July 16, 2021

Ms. Renee Romero
New Mexico Environment Department
Petroleum Storage Tank Bureau
1914 West Second Street
Roswell, New Mexico 88201-1712

Re: Final Remediation Plan
Former Y Station, 721 Commerce Way, Clovis, New Mexico
Facility #53742, Release ID #4746, WPID #4134

Dear Ms. Romero:

Daniel B. Stephens & Associates, Inc. (DBS&A) is pleased to submit the enclosed Final Remediation Plan (FRP) for the above-referenced site. The plan has been prepared in accordance with applicable sections of the Petroleum Storage Tank Regulations and DBS&A standard operating procedures. Pending approval of the FRP and potential responses to comments, DBS&A intends to invoice the full amount budgeted for Deliverable ID 4134-1.

Please contact us at (505) 822-9400 if you have any questions or require additional information.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Thomas Golden, P.E. Project Engineer	Jason J. Raucci, P.G. Project Geologist

TG/rpf
Enclosure
cc: Katherine MacNeil, NMED PSTB
Lorena Goerger, NMED PSTB

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Responses to Petroleum Storage Tank Bureau Comments
Received July 30, 2021
Regarding Former Y Final Remediation Plan

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared the following responses to questions posed by the New Mexico Environment Department (NMED) Petroleum Storage Tank Bureau (PSTB) regarding the Final Remediation Plan (FRP) for the Former Y Station site. DBS&A submitted the original FRP on July 16, 2021. Comments were discussed in a conference call on July 30, 2021 and submitted via email on August 5, 2021. The PSTB's complete comment is provided in *italics*, followed by DBS&A's response in regular text. The FRP has been updated to include these responses.

Comments

1. *Please include verbiage about pressure testing conveyance lines before backfilling as mentioned in the PVC piping specification 22 05 03 02.*

The following was added to the FRP:

Section 4.5.2. "All PVC conveyance piping shall be pressure tested per specification Section 22 05 03 02 prior to backfilling."

2. *Appendix C - Engineering Drawings & Appendix E – Cut Sheets*

Spelling mistakes and other minor errors have been corrected on the drawings, as was discussed during the conference call. The following items will be captured in the as-built report in order to provide the most accurate information on those specific items:

- Labels and tank gauging chart for the 300-gallon product storage tank
- Labels on the SVE treatment unit and the Thermal Oxidizer
- A separate P&ID legend

3. *Calculation DB18.1157-001: SVE Headloss*

    a. *Narrative:*

        i. *Please fix Reynold's Formula and call out dynamic viscosity instead of kinematic viscosity in the denominator of this formula as per our MS Teams discussion on Friday July 30th, 2021.*

        Corrected from "kinematic" to "dynamic".

        ii. *Please correct the air density value to be consistent in the H_{maj} and H_{min} calculation as per our MS Teams discussion on Friday July 30th, 2021.*

Air density was corrected for the H_{min} calculation.

    b. *Summary Table 2:SVE Headloss by Line*

   i. *SVE Line 1 shows 23.2 in H2O head loss yet when you tally up the line segments that make up SVE Line 1 – you get 17.39 in of H2O and if you include the BW-5 (RW-3) to tie-in and RW-4 to tie in, you get a total of 20.69 in of H2O. How do you arrive at 23.2 in of H2O for SVE Line 1.*

The total for SVE Line 1 also includes the losses from the Blower to the SVE Manifold (4.16 inches water), and the Intermediate Well head (1.70 inches water). These are provided in Table 3 of the spreadsheet.

   c. *Summary Table 3: Total Head losses – the total sum of head loss for the lines (Maximum head loss) shows 9.3 in of H2O, please revise as appropriate.*

The total sum in that table has been deleted. It does not apply to this site.

   d. *Third graph: depicting pressure (bs/sq ft) versus altitude needs the y and x axes labeled.*

Added axis labels.

4. *Calculation DB18.1157-002:*

   a. *Please elaborate on your professional judgment in the assumption of wellhead minor losses (pitless adaptor, valve, fittings etc) as per our MS Teams discussion on Friday July 30th, 2021.*

During design, it can be difficult to accurately predict minor losses for small submersible pump systems. Choosing one value for minor losses simplifies calculations and provides the ability to include an additional factor of safety for the overall TDH for each pump. For this site, a value of approximately 10 percent of the static head (rounded up), or 40 feet, was conservatively chosen for minor losses. Total friction loss was only 13 feet, so the value of 40 feet used in the calculation will be very conservative.

5. *Additional Calculations:*

   a. *As per our MS Teams Discussion on Friday July 30th, 2021, DBS was to provide the hydrocarbon emissions and rates from the DPE system to demonstrate compliance with Air Quality Standards for TPH and COCs in lbs/hr, tons/yr.*

A calculation has been added showing hypothetical emissions from the proposed remediation system. No pilot testing was performed on the proposed remediation wells, so actual influent concentrations are not available and had to be estimated from sample collection performed by the previous consultant on other nearby wells. The calculation does show convincingly that soil vapor treatment is required at this site, and that emissions should be below regulatory triggers for a Notice of Intent. Emissions calculations will need to be performed during regular system operation to ensure compliance with NMED air permitting regulations.

Final Remediation Plan

Former Y Station State Lead Site
721 Commerce Way, Clovis, New Mexico
Facility ID #53742, Release ID #4746
WPID #4134

Prepared for

New Mexico Environment Department
Petroleum Storage Tank Bureau
Roswell, New Mexico

Prepared by

DBS&A
Daniel B. Stephens & Associates, Inc.
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DB18.1157

THOMAS A. GOLDEN
22750
7/16/21

July 16, 2021
(Revised August 12, 2021)

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1. Introduction

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this Final Remediation Plan (FRP) for the Former Y Station State Lead site in Clovis, New Mexico (the site). This FRP was prepared in accordance with applicable sections of Part 119 of the New Mexico Petroleum Storage Tank Regulations (PSTR) and the work plan dated December 20, 2019 (DBS&A, 2019d), which was approved by the New Mexico Environment Department (NMED) Petroleum Storage Tank Bureau (PSTB) on February 19, 2020 (NMED, 2020). The associated work plan identification (WPID) number is #4134.

1.1 Site Summary

Located at 721 Commerce Way in Clovis, New Mexico (Figure 1), the site is currently occupied by an optical retail center and the intersection of Prince Street and Commerce Way. It is surrounded by a variety of other commercial land uses, such as big box retail stores, fast food restaurants, and gasoline service stations. Residential neighborhoods are adjacent to the west and east of the Prince Street commercial corridor.

Initial site investigation activities conducted by the previous consultant in 2011 were driven by the discovery of a release during a tank pull at the Allsup’s No. 320 (Allsup’s) site, located at the corner of Prince and 21st Streets (Figure 2). Subsequent investigations from 2012 to 2016 revealed a large dissolved-phase hydrocarbon plume south of the Allsup’s site, centered near the intersection of Prince Street and Commerce Way.

1.2 Site History

Interviews with local residents and inspection of public records by the previous consultant revealed that a fueling station was formerly present on the southwest corner of Prince Street and Commerce Street, locally referred to as “the Y.” The Former Y Station was reportedly active from the late 1950s through approximately 1981. The intersection has been reconfigured since that time, and the site is now occupied by active traffic lanes and the adjacent Optical Source retail outlet.

The previous consultant oversaw installation of 10 groundwater monitor wells (BW-1 through BW-10) in the vicinity of the Former Y Station, including 3 wells on the Allsup’s property (Figure 2), and conducted limited soil vapor extraction (SVE) feasibility testing at the Allsup’s site

(BEI, 2012). Benzene was the constituent detected at the highest concentrations and across the greatest areal extent. Concentrations of other contaminants of concern (COCs) above applicable regulatory standards were typically localized near the center of the benzene plume. As of July 2016, the extent of groundwater contamination remained undefined to the south and east.

DBS&A responded to a request for proposals (RFP) for State Lead remediation services for the site with a proposal submitted to the PSTB on October 24, 2017. DBS&A was selected as the most responsive bidder and entered into a contract with NMED that was executed on May 15, 2018. On May 30, 2019, DBS&A initiated an additional investigation program, which included installation of 9 monitor and/or remediation wells at the site (RW-1 through RW-4, BW-7R, and MW-11 through MW-14). The primary goals of the initial investigation were to (1) characterize soil and groundwater conditions directly under the site of the Former Y station, which is presumed to be the site of the release and (2) attempt to delineate the downgradient extent of the dissolved-phase contaminant plume.

Data collected during installation of remediation wells RW-1 through RW-4 confirmed the conceptual site model (CSM) presented in DBS&A's proposal for State Lead remediation services. Significant contamination is present in the vadose zone adjacent to the release point; however, contamination in the downgradient smear zone appeared to be less than previously thought (DBS&A, 2019c). Initial investigation activities also included step and constant-rate aquifer pumping tests at newly installed monitor well MW-11, analysis of the physical properties of aquifer materials, groundwater modeling to assess the feasibility of the proposed remediation approach, and baseline monitoring of new and existing site wells (DBS&A, 2019b and 2019c). In June 2020, 3 additional monitor wells (MW-15, MW-16, and MW-17) were installed to better define the extent of contamination cross-gradient to the east (DBS&A, 2020).

Based on findings from the additional investigations, DBS&A recommended that corrective action proceed using a dual-phase extraction (DPE) system as detailed in the DBS&A proposal for State Lead remediation services. The proposed remediation system prioritizes removal of source area mass near the point of release using multi-zone DPE remediation wells to remove light nonaqueous-phase liquid (LNAPL) and residual hydrocarbons in the vadose zone, and is coupled with a pump-and-treat approach to speed remediation of the downgradient dissolved-phase contaminant plume in groundwater.

1.3 Geology and Hydrogeology

The site is located in the Llano Estacado section of the Great Plains physiographic province, at an elevation of approximately 4,280 feet above mean sea level (feet msl). Surface drainage in the area around the site is generally to the south. The City of Clovis (the City) is located within the Curry County underground water basin (UWB), as defined by the New Mexico Office of the State Engineer (OSE).

The geology underlying the City consists of layered sedimentary formations dipping gently to the southeast—principally the Ogallala Formation and underlying Triassic-age sedimentary rocks. The Ogallala Formation (Pliocene) consists of fine- to coarse-grained sand, silt, and clay; ledges of weathering-resistant, calcium carbonate-cemented caprock are present near the top of the formation (Galloway, 1972). The caprock unit of the Ogalalla Formation is up to 60 feet thick and variably cemented by caliche, and has been observed in boreholes completed at the site. The caprock is underlain by a thick sequence of fine-grained, loosely consolidated sands and silty sands. A slight increase in cementation is noted below about 250 to 300 feet below ground surface (bgs) in boring logs from the site (DBS&A, 2019c and 2020). Sonic cores retrieved during drilling of new wells installed in 2019 indicated the widespread presence of a poorly sorted, clay- and gravel-rich interval below about 350 feet bgs (Figure 3), consistent with the basal beds described by Galloway (1972).

Based on data from the U.S. Geological Survey (USGS), the Ogallala Formation likely extends to a depth of approximately 380 feet bgs in the site vicinity (Hart and McAda, 1985). The Ogallala Formation is underlain by fine-grained sedimentary rocks of the Triassic-age Dockum Group. Rocks of the Dockum Group are considered hydrologic bedrock, and constitute the lower bound of the Ogallala Aquifer (Hart and McAda, 1985; Galloway, 1972).

At the site, groundwater is present within the Ogallala aquifer under unconfined conditions, and is encountered at depths of approximately 325 to 330 feet bgs. Figure 4 presents a potentiometric surface map constructed from data collected during the most recent monitoring event in March 2021. The groundwater flow direction is generally to the south-southeast with an overall average gradient of approximately 0.003 foot per foot (ft/ft). The flow direction and gradient have been consistent since the initiation of groundwater monitoring at the site.

The current saturated thickness of the Ogallala aquifer in the site vicinity is estimated to be approximately 50 to 55 feet. The City currently relies entirely on groundwater from the Ogallala aquifer for its municipal water supply. Significant and ongoing water level declines in the

Ogallala aquifer are well documented in the Clovis area. Water levels have decreased in the Clovis vicinity by over 50 feet since 1950, and recent estimates indicate that water levels have been decreasing at locally variable rates, by up to 1 foot per year.

The results of aquifer testing conducted by DBS&A at Former Y Station monitor well MW-11 indicate aquifer parameters that are consistent with literature ranges for fine-grained silty sand aquifers under unconfined conditions (e.g., Freeze and Cherry, 1979). Based on observed drawdown at MW-11, the estimated aquifer transmissivity is approximately 58 square feet per day (ft^2/d), with a specific yield of 0.20. The transmissivity estimate is equivalent to a hydraulic conductivity of 1.16 feet per day (ft/d) for an aquifer of 50-foot thickness. These findings are close to the lower range of laboratory hydraulic conductivity measurements for sediment samples collected during well drilling. The laboratory samples did not include the clay-rich basal sediments (DBS&A, 2019b).

Modeling of the Curry County UWB by the OSE estimated that the hydraulic conductivity of the Ogallala aquifer in the vicinity of Clovis is approximately 70 ft/d, with a specific yield of approximately 23 percent (NMISC, 2016). The regional hydraulic conductivity in the Ogallala Aquifer is thus significantly greater than that observed at the site. This difference may be due to the lower part of the aquifer at the site being locally composed of finer-grained sediments and/or well losses during pumping, which would contribute to a lower estimate of the formation hydraulic conductivity.

1.4 Distribution of Contamination

1.4.1 Contaminants of Concern

Field observations and laboratory analytical results indicate that soil and groundwater at the site have been impacted by contamination from petroleum storage facilities. Contamination is characteristic of gasoline range organics (GRO) fuels. COCs at the site include LNAPL and dissolved-phase petroleum hydrocarbons including benzene, toluene, ethylbenzene, and total xylenes (BTEX), methyl tertiary-butyl ether (MTBE), and naphthalenes, as well as the fuel additives 1,2-dichloroethane (EDC) and 1,2-dibromoethane (EDB).

1.4.2 Distribution of Contaminants in Soil

Historical aerial photographs show an aboveground tank farm and convenience store north of the current Optical Source building, within what is currently right-of-way (ROW) for Commerce Way (Figure 2). Soil screening data gathered during drilling of remediation wells near the site helped confirm the release point as the Former Y Station, with high soil vapor field screening concentrations present in RW-2 below a depth of 135 feet bgs. Elevated soil vapor field screening concentrations were present in RW-1 starting at approximately 273 feet bgs, which corresponds to the approximate water table near the time of the release. In RW-3, high soil vapor field screening concentrations were noted starting at approximately 294 feet bgs (Appendix A). These data are consistent with the proposed CSM, with decreasing water levels over time as contaminants migrated off-site, resulting in a significant thickness of impacted smear zone above the water table downgradient of the release area, decreasing in thickness farther from the release. However, vadose zone contamination in the smear zone near downgradient wells appears to be less than that expected based on wellhead vapor analysis by the previous site consultant. A relatively high SVE radius of influence (ROI) may have allowed movement of soil vapor from highly impacted areas toward more distal sampling points.

1.4.3 Light Nonaqueous-Phase Liquid Contamination

LNAPL has been consistently present in monitor well BW-5 since at least February 2019 at thicknesses ranging up to 1.77 feet, and recently appeared in well RW-2 at a thickness of 0.35 foot. Based on the presence of LNAPL in these two wells, a significant volume of LNAPL is likely present under North Prince Street and Commerce Way. The limited number of wells intersecting the LNAPL plume precludes a quantitative assessment of the free LNAPL volume, but a rough estimate—assuming an LNAPL formation thickness of 0.15 foot, impacted area of approximately 0.5 acre, and porosity of 0.25—yields a residual volume of approximately 6,100 gallons.

The laboratory report from the May 2019 monitoring event includes results for individual hydrocarbon constituents, as well as a series of diagnostic ratios and parameters used to characterize the LNAPL recovered from well BW-5. Diagnostic ratios are used to assess a variety of factors, such as the type of release, environmental weathering, refining characteristics, and regulatory compliance. Evaporation ratios from the BW-5 LNAPL sample are below established ranges for fresh gasoline, suggesting that the LNAPL is more evaporated, consistent with a source from an aboveground tank. LNAPL analytical results were consistent with slightly weathered, leaded gasoline, with little or no indication of a diesel fuel component (DBS&A, 2019a).

Oxygen exchange with the surface at this depth is likely to be minimal without the aid of a corrective action system. Therefore, it is reasonable to assume that anaerobic conditions currently exist in the vicinity of the LNAPL plume, and that natural biodegradation of the petroleum hydrocarbon constituents is minimal.

1.4.4 Dissolved-Phase Contamination

DBS&A conducted six monitoring events between 2019 and 2021. Based on data collected during these monitoring events, concentrations of dissolved-phase COCs in groundwater above the applicable New Mexico Water Quality Control Commission (NMWQCC) standards extend approximately 1,000 feet downgradient from the presumed release. Figure 5 provides analytical results for dissolved-phase COCs in groundwater samples from site wells collected during the most recent monitoring event in March 2021. Figures 6 through 8 provide isoconcentration maps showing the extent of elevated benzene, EDC, and EDB concentrations in groundwater. The elongate plume structure is consistent with a stable groundwater flow direction in a relatively permeable aquifer. Monitor wells MW-14, MW-15, and MW-17 largely define the extent of dissolved-phase contamination downgradient to the east and south. The plume extent remains less well constrained east of well MW-16 (DBS&A, 2021).

2. Contractor Qualifications

DBS&A is a licensed contractor in the state of New Mexico and holds a GS-29 license (License #89947). EnviroWorks of Edgewood, New Mexico has been selected to serve as the general contractor at the site, and will coordinate conveyance line trenching and backfill, as well as installation of the remediation system. The equipment manufacturers will be Intellishare Environmental (Intellishare) of Menomonie, Wisconsin and H2K Technologies, Inc. (H2K) of Corcoran, Minnesota. All work will be performed under the supervision of a professional engineer licensed in the state of New Mexico.

3. Remediation Goals/Cleanup Standards

3.1 Exposure Pathways

Potential exposure pathways at the site include soil vapor, soil, and groundwater. Shallow soil has been impacted near former bulk dispensers at the Former Y Station site, located north of the intersection of Commerce Way and Prince Streets in Clovis, New Mexico. Findings of the site investigations confirmed a CSM of water levels decreasing with time as contaminants migrated off-site, resulting in a significant but decreasing thickness of smear zone above the water table downgradient of the release area. However, vadose zone contamination in the smear zone at downgradient well locations appears to be less than expected. Based on historical information, the primary release point was likely located under the current intersection of Prince Street and Commerce Way. The Optical Source is the only occupied commercial structure located in proximity to the release. Soil impacts were noted during drilling of well RW-2 (adjacent to the Optical Source) below a depth of about 135 feet bgs, and the depth to contamination in the smear zone farther from the release is greater than 250 feet bgs. Based on current U.S. Environmental Protection Agency (EPA) guidance, petroleum hydrocarbons in soil at this depth are not considered a risk via the vapor intrusion pathway.

The vapor intrusion pathway is therefore not considered complete for petroleum hydrocarbons at the site due to the depth of groundwater and LNAPL, as well as the lack of shallow soil impacts under existing structures. However, concentrations of the halogenated organic compounds EDB and EDC in groundwater under commercial and residential structures in the plume area may exceed the March 2017 New Mexico vapor intrusion screening levels (VISLs) for these compounds. The VISLs corresponding to the vapor intrusion pathway from groundwater for EDC and EDB are 22.3 micrograms per liter (µg/L) and 1.76 µg/L, respectively. These compounds are comparatively stable in the vadose zone, and may diffuse upward in the vapor phase from the water table to shallow soil. Given the depth to the water table in this area, it is not known whether this pathway is complete for these constituents.

Groundwater impacts to municipal production or domestic wells constitute a potential exposure pathway. Based on data obtained from the OSE online database, the nearest well to the site is a domestic well located approximately 1,000 feet cross-gradient to the east; the nearest downgradient well is a domestic well located approximately 2,000 feet to the southeast. It is not known if these wells remain in use. The closest active EPCOR Water production well is located approximately 2.5 miles northeast of the site. Based on the distances to these wells and the apparent stability of the plume, the risk to water production wells is minimal. In addition, EPCOR has stated that they are actively sampling downgradient municipal supply wells, and that no detections of hydrocarbon constituents have been reported.

3.2 Remediation Goals/Performance Standards

The proposed remedial approach entails using DPE to simultaneously remove vapor-phase and dissolved-phase hydrocarbons from the soil column and groundwater, respectively. Treated groundwater will be discharged to a sanitary sewer manhole located near the equipment compound. Primary remedial objectives are as follows:

1. Remove residual source area hydrocarbon mass in order to mitigate the impact of released petroleum hydrocarbons on groundwater resources and potential receptors. DBS&A has observed that during previous remedial actions, dissolved-phase hydrocarbon concentrations in groundwater decreased significantly following removal of the source area contaminant mass.
2. Accelerate achievement of performance standards for the dissolved-phase hydrocarbon plume by extracting and treating impacted groundwater. Dissolved-phase contamination will be monitored on a quarterly basis to assess plume stability and response to mitigation actions.

The following performance standards will be met to document the success of the remediation work performed:

- Maintain minimum runtime of 90 percent for major remediation equipment, which is achievable through proper preventive maintenance on equipment and use of telemetry to provide instant notification of system shutdowns through text message and/or e-mail.
- Document, through laboratory testing, that extracted groundwater discharged to the sanitary sewer system contains volatile organic compound (VOC) concentrations that are below NMWQCC standards and/or comply with City discharge requirements.
- Document efficacy of the vapor treatment system by collecting system influent and effluent air samples at a minimum frequency of twice per month to demonstrate optimization of mass removal and destruction of contaminants prior to discharge to the atmosphere.
- Within two years of system operation, document that measurable LNAPL is no longer present within the monitor well network, and within three years reduce extracted soil vapor concentrations to less than 100 parts per million by volume (ppmv) of VOCs as measured by a photoionization detector (PID).
- Conduct remediation of groundwater to meet NMWQCC standards for BTEX, MTBE, EDB, EDC, and total naphthalenes within 5 to 7 years of system operation.

These performance standards for remediation of LNAPL and vadose zone contaminants are based on DBS&A's experience with LNAPL plumes of similar areal extent. SVE feasibility testing showed the subsurface to be highly conducive to SVE, with a relatively high ROI—approaching

100 feet (BEI, 2012). DBS&A aggressively designed the extraction well network using a more conservative ROI of 80 feet and removal of approximately 800 standard cubic feet per minute (scfm) of impacted soil vapor from source area wells BW-8 and RW-1 through RW-4 (Table 1).

The DBS&A groundwater modeling report provided an assessment of a range of groundwater extraction scenarios for 5- and 10-year time frames (Appendix B). The minimum pumping scenario evaluates the minimal threshold for attaining containment of the benzene plume within 5 years of operation. The maximum pumping scenario evaluated the pumping conditions that could be applied to maximize capture of the plume through 10 years of operation without extraction wells going dry. A combined pumping rate of 20 gallons per minute (gpm), similar to the maximum pumping scenario, will produce approximately 10 million gallons per year, which is approximately half of a contaminated pore volume per year based on the current plume extent. Under this scenario, and combined with aggressive source area vapor-phase extraction, DBS&A anticipates that COC concentrations in groundwater across a significant majority of the impacted area can be reduced to below applicable standards within 5 to 7 years.

Although it may not be possible to remove all COCs from the subsurface, the selected method of remediation will provide the most cost-effective means of mitigating hydrocarbon contamination in soil and groundwater at the site, while protecting potential receptors and groundwater resources.

4. Description of Proposed Remediation System

4.1 Overview

The remediation system designed for the site is a DPE system, including SVE and whole-fluids extraction. The proposed remediation system is detailed in the engineering drawings (Appendix C), supporting calculations (Appendix D), product cut sheets (Appendix E), and technical specifications (Appendix F).

A total of 5 multi-zone nested wells (BW-8 and RW-1 through RW-4) have been clustered around the current extent of LNAPL to address source area contamination. A total of 4 single-zone remediation wells (BW-7R, MW-11, MW-12, and MW-16) will address downgradient contamination (Figure 9). Table 1 summarizes extracted air and groundwater flow rates for the DPE system. MW-13 will also be connected to the DPE system for contingency purposes; a submersible pump could be installed at a later date if site conditions warrant its use.

SVE pilot testing showed observable vacuum response up to 94 feet from the extraction wells (BEI, 2012). Due to the large areal plume extent and high cost of well installation at this site, it has not been practical to establish a well network conducive to additional pilot testing. Therefore, DBS&A conservatively designed the remediation well network for an ROI of 80 feet, as shown on Figure 9.

Applied well vacuum during feasibility testing ranged from 27 to 57 inches of water column (inches H_2O), which produced extracted air flow rates of 85 to 99 scfm (BEI, 2012). The vacuum and flow data were used to estimate design parameters for the proposed SVE wells based on calculated unit flow rates per length of exposed screen (scfm per foot [scfm/ft]). Because individual zones produced air flow on the order of 1.5 scfm/ft, DBS&A assumed that flow in a full-scale, multi-zone extraction scenario with some overlap with adjacent zones will be approximately 1.0 scfm/ft. In addition, DBS&A conservatively assumed an applied well vacuum at the wellhead of 60 inches H_2O (Appendix D).

Based on evaluation of the pumping scenarios presented in the groundwater modeling report for the site (Appendix B), DBS&A plans to implement a groundwater extraction strategy that will produce a combined volume of approximately 20 gpm from 8 existing wells (Table 1). This approach will maximize capture of the dissolved-phase contaminant plume and expedite achievement of the applicable cleanup standards, while not dewatering the well network during sustained system operation.

The remediation wells will be plumbed to an equipment compound located on the northeast corner of North Prince Street and York Drive (Figure 10). The compound will be enclosed by an 8-foot-tall, gated chain link fence with vertical privacy slats to reduce visibility of the remediation equipment. Treated groundwater will be discharged to the sanitary sewer.

DBS&A received written approval in January 2021 from both the property owner and the tenant, Albertson's, to locate major remediation equipment at this location. DBS&A helped negotiate access for conveyance piping with most of the other affected property owners in 2019, and NMED counsel negotiated access for conveyance piping with Clovis Shopping Center, LLC in June 2021.

The remediation system is designed to achieve the goals outlined in Section 3 through the following primary processes:

- Recovery of contaminant mass from the release area and vicinity using SVE

- Reduction of groundwater impacts by diffusing hydrocarbon mass from a liquid to a vapor phase that can be removed using the SVE system
- Treatment of contaminated groundwater using an oil/water separator, a diffused aerator, and an inclined plate clarifier

4.2 Equipment Enclosures

Treatment equipment will be provided within two modified shipping containers to reduce noise and mitigate theft and vandalism. Both containers are expected to be 20 feet in length. The modular approach at this site will be advantageous if site conditions require operation of only one component of the DPE system.

The SVE blower, vapor/liquid separator, and associated equipment and controls will be located within one modified shipping container. The second container will contain the oil/water separator, diffused aerator, and clarifier. The enclosures will be provided with an insulated floor, walls, ceiling, and steel access doors; the floor will be sealed with a non-skid bed liner. Heating and cooling will be provided via a wall-mounted heater and vent fan with sound-insulated inlet/outlet louvers and a thermostat. A floor sump and high level sensor will be included in the event of a water leak from tanks or process piping. Noise will be reduced to a reasonable level. The site is zoned as commercial and located adjacent to Prince Street, but the closest residence is located approximately 200 feet to the southeast.

4.3 Soil Vapor Extraction Treatment Equipment

The SVE system treatment equipment will include the following:

- *Conveyance piping:* SVE wells will be piped to three primary conveyance lines that will connect to a common manifold using individual Schedule (SCH) 40 polyvinyl chloride (PVC) conveyance lines (Appendix C). The primary trunk lines for SVE from source area wells (SVE line 1) and downgradient wells (SVE line 2) will be 8-inch-diameter and 4-inch-diameter, respectively. A 2-inch-diameter pipe will convey flow from contingency well MW-13 (SVE line 3).
- *Inlet piping manifold:* The manifold will be constructed using an 8-inch SCH 40 PVC header, with SCH 40 PVC risers and fittings to match the three primary trunk lines. Each riser will include a vacuum gauge, isolation valve, sample port, and ¼-inch threaded plug for a manometer-type insertion flow meter.

- *Moisture separator:* The piping manifold will connect to a 220-gallon vapor/liquid separator, including a 55-gallon liquid-holding capacity, with at least 99 percent moisture removal capability. The vapor/liquid separator will include a liquid-coalescing media internal to the separator, and a demister element with acquiescence plate to isolate condensate water from turbulent flow. External devices will include a 6-inch sediment clean-out port, sight tube and 3-point level switch, vacuum relief valve, and bottom drain valve that will be connected to the oil/water separator using a condensate transfer pump.
- *SVE blower:* The SVE blower will be a rotary lobe blower Sutorbuilt Legend 7L or equivalent, capable of maintaining an extraction flow rate of 1,000 scfm at 85 inches H_2O vacuum at an elevation of 4,295 feet msl. A 40-horsepower (hp), 480-volt, 3-phase completely enclosed fan-cooling variable speed motor will be provided, equipped with a variable frequency drive (VFD) located at the main control panel. The blower will be mounted on a steel discharge silencer with adjustable motor base for belt tensioning. The blower inlet will include a particulate filter; the discharge piping from the blower will be galvanized steel, and will include a sample port, pressure gauge, and temperature gauge.
- *Thermal oxidizer:* The oxidizer used for treatment of extracted soil vapor will be an Intellishare thermal oxidizer designed to operate at concentrations up to 50 percent of the lower explosive limit (LEL) and rated at a maximum of 1,000 scfm. The base and reactor will be composed of A-36 carbon steel, with a 300-series stainless steel stack. The treatment unit will discharge through a stack that will vent at a height of approximately 15 feet above the ground surface.
- *Control panel:* The control panel will consist of a NEMA 4 enclosure or equivalent enclosure rated for outdoor use, with an interior swing door. A fused main disconnect will be located in a separate enclosure mounted next to the control panel. The panel will have circuit breakers for protection of all motors. Each motor will have a Hand-Off-Auto switch with green run light indicators. Red lights will be labeled for all alarms. The panel will include intrinsically safe barriers for all switches, and surge and lightning protection for the controls and telephone line. The system will be controlled with an Allen Bradley programmable logic control (PLC) that has datalogging capability and a touch-screen graphical user interface. The PLC will be sized with two additional inputs and outputs beyond the number required to run the system and an uninterruptible power supply. The panel will include a control transformer, emergency stop switch, and ground fault interrupter outlet. The control panel will be labeled with an Underwriters Laboratory certification sticker.

4.4 Groundwater Treatment Equipment

The proposed groundwater treatment equipment, as shown in the mechanical series of the drawings (Appendix C), will include the following:

- *Well pumps:* Submersible pumps will be used to extract groundwater from the wells. Wells RW-1 through RW-4 will each have a Grundfos model 5SQ05-320 ¾-hp pump with a 220-volt, single-phase motor, and integral soft start. This pump will operate at 2 gpm. All other groundwater extraction wells will use a Grundfos model SP 5S10-22 1-hp pump with 480-volt, 3-phase motor equipped with a VFD. These pumps will operate between 2 and 4 gpm based on the design pumping rates provided in Table 1.
- *Conveyance piping:* Extracted groundwater from the remediation wells will be conveyed to a single trunk line. Groundwater conveyance piping will be 1.5-inch-diameter SCH 40 PVC.
- *Oil/water separator:* Within the shipping container will be an H2K Technologies oil/water separator, which will provide 100 percent removal of 20-micron or larger droplets at 25 gpm.
- *Diffused aeration tank:* VOC removal will be accomplished using an H2K Technologies model DTA-3 Diffused Aeration Tank capable of 94 percent removal of lighter hydrocarbons, such as BTEX and MTBE, and 50 percent removal of heavier hydrocarbons, such as naphthalenes, at 20 gpm. The diffused aerator allows the system to operate in heavy fouling conditions, which should minimize maintenance from precipitation of total dissolved solids (TDS). The tank will be constructed of 304 stainless steel, including three aeration chambers, 15 aeration diffusers, and a cover. The DTA-3 includes a 90 scfm blower that passes through the aeration chambers (270 scfm equivalent flow). It will be stand-mounted so that fluids will gravity drain from the oil/water separator, through the diffused aeration tank, and into the clarifier.
- *Inclined plate clarifier:* Solids, including inorganic constituents, will be removed using an H2K model IPC-80 inclined plate clarifier constructed of 304 stainless steel. The clarifier is designed for 90 percent removal of 20-micron and larger solids at a flow rate of 20 gpm, and includes an adjustable skimming weir and a solids collection sump.
- *Treated water discharge pump:* A discharge pump will be included to pump treated water to the municipal sanitary sewer manhole connection (AMT model 489, ¾-hp, 3-phase).
- *Product storage tank:* Free product extracted from the treatment process will be stored in a steel 300-gallon capacity, double-walled storage tank located outside of the enclosure, but within the fenced area.

- *Control panel:* All remediation equipment will be integrated to the control panel to provide automatic system operation. The control panel will have a C-More 7-inch color touch screen HMI interface. An Allen Bradley Micrologix 1400 PLC will be installed inside the control panel with input and output as required for system operation. The submersible pump control panel will also be integrated, so as to shut off submersible pump operation with any remediation equipment alarms.
- *Instrumentation and monitoring:* Pressure gauges and sample ports will be present on each vessel's inlet and outlet.
- *Process valves and piping:* Each vessel will have a manual isolation valve at the inlet. Connection piping within the enclosure will consist of SCH 80 PVC and fittings.

The exact remediation equipment components and configuration within the enclosure will be determined during implementation of the FRP, and a detailed description will be provided in an as-built report, including drawings of the interior enclosure. These equipment drawings will be available during the final PSTB walkthrough prior to system startup.

4.5 Remediation Wells, Trenching, and Pipe Installation

4.5.1 Extraction Wells

The proposed remediation system will require connection of 10 existing wells and associated conveyance piping and trenching. Due to the use of nested wells, a total of 20 screened intervals will be used for remediation (Table 1). The areal extent of the remediation well network precludes running dedicated conveyance lines back to the equipment compound. Therefore, isolation valves, instrumentation, and controls for each well and zone will be located within a combination of wellhead and/or valve vaults as shown on the drawings (Appendix C). Valves at each wellhead will be used to optimize soil vapor and groundwater flow for specific zones. Hinged vaults will be flush-mounted, spring-assisted, H-20 traffic-rated, and surrounded by a 6-inch-thick concrete pad (Appendix C).

4.5.2 Conveyance Line Trenching and Pipe Installation

Details of conveyance piping trenches are shown on Drawing C-2 (Appendix C). The SVE and groundwater conveyance piping will be placed below ground in trenches at a minimum burial depth of 3 feet, supported by plastic spacers. In addition, two sections of road borings will be required to connect wells on the west side of Prince Street to the remediation system (Figure 10 and Appendix C). Conveyance piping below roadways will have a minimum burial depth of

4 feet. All PVC conveyance piping shall be pressure tested per specification Section 22 05 03 02 prior to backfilling.

In order to minimize accumulation of condensate, SVE conveyance lines will be installed to slope toward sumps that have been strategically located throughout the project area based on topography. For valves to be comfortably accessed from the surface, piping cannot feasibly slope back to the wellhead. Sumps (conveyance line cleanouts) will be provided at each end of the roadway borings, at the SVE manifold, and between wells BW-8 and RW-2 (Appendix C).

Piping circuits will be backfilled in accordance with the specifications (Appendix F) either with on-site soils (followed by compaction) or flowable fill. Paved surfaces will be machine-cut and replaced with material and thickness similar to existing conditions. The only non-paved area planned for conveyance pipe installation is the landscape median where RW-1 is located and where the entry pit will be located for the roadway borings. Gravel and vegetation in this area will need to be replaced when system installation is complete.

Due to the shallow depth of the trenching and piping, it is not anticipated that contaminated media will be encountered during installation of the remediation system. All of the wells are located on private land, but some piping is located under public roadways. A traffic control plan will be required when working near public roadways, and will be provided by a third-party contractor. Utility service lines (electric and natural gas) will be extended from existing services located near York Drive. Potential roadwork for these services, if needed, will be handled by the utility companies.

When the system is completed, each SVE zone will have an isolation valve, a sample port, a vacuum gauge, and a threaded plug for an insertion type flow meter, as shown in the drawings (Appendix C). The sample port will be used for collecting air samples and as a secondary measuring point for applied well vacuum.

4.6 Utility Requirements/Utility Clearances

Both Xcel Energy and Farmers Electric Co-op provide electrical service in Clovis. DBS&A will specify which provider will be used for this project in the FRP implementation work plan. A new three-phase, 200-amp electrical service connection will be required for the remediation system; this connection will be supplied by the power pole located on the north side of York Drive through 3-inch-diameter conduit. This connection will likely require an 150-kVA pad-mounted transformer with a bushing mount utility meter. Power for individual well pumps and controls will be routed from this single service to the wellheads. One shared 2-inch-diameter PVC conduit will be used for the source area wells, and a separate shared 2-inch-diameter PVC conduit will be used for the downgradient wells.

NM Gas Company (NM Gas) is the provider for natural gas service at the site. NM Gas will tie into an existing service line located in the Albertson's Market parking lot, and will install a new gas meter south of the proposed equipment compound. Based on system requirements, initial approval has been received from NM Gas.

DBS&A contracted with Lydick Engineering & Surveyors (Lydick) in Clovis, New Mexico to obtain subsurface utilities shown in the drawings (Appendix C). New Mexico One Call will also be contacted prior to subsurface excavation activities. The locations of utilities uncovered during installation of the remediation system will be shown on the record drawings following implementation of the FRP.

4.7 As-Built Report Preparation and Submittal

Following implementation of the FRP, record drawings signed and sealed by DBS&A's Engineer of Record will be prepared and submitted to the NMED PSTB project manager as part of an as-built report. The report will conform to the requirements of 20.5.119.1925.D NMAC and will include, but not be limited to, the following:

- Area/vicinity map
- Detailed site diagram with locations of underground utilities and other subsurface structures on or adjacent to the site's property boundaries, buildings, monitor wells, storage tanks and lines, sumps, impoundments, pit areas, water lines, and other relevant structures
- Summary of site conditions
- Any deviations from the drawings and specifications included in the FRP
- Tabulation of pertinent data including, but not limited to, flow rates, pressures, temperatures, contaminant concentrations, and groundwater elevations at startup
- Boring logs and well completion diagrams
- Inventory of purchased equipment
- Discussion of the data collection methods

- Laboratory results with chain of custody records and laboratory quality assurance/quality control (QA/QC) reports
- Photographic documentation of critical construction junctures
- Characterization of wastes, including handling and disposal
- Elevation survey results
- Detailed description of remedial system and as-built drawings
- Discussion of system startup and shakedown
- Identification and explanation of operational adjustments made for optimum system performance
- Discussion of the remedial system's performance criteria
- Summary and recommendations
- Familiarity statement by the DBS&A qualified representative

4.8 Operations

Operation of the remediation system will include initial startup activities and regular maintenance. Safety controls will be installed to automatically shut down the system under certain circumstances, including malfunction or failure of any integral system component or loss of power. System monitoring objectives include tracking the progress of mass removal, maximizing treatment efficiency, and documenting compliance with permits issued for this project. Controls will also be implemented to protect equipment from weather and vandalism.

Progress of the source area abatement will be evaluated by monitoring the concentration of VOCs in the extracted air—from both the system as a whole and from individual remediation wells. The total mass of VOCs and chemical composition of extracted vapors will be quantified and tracked. To document hydrocarbon recovery efficiency, influent and effluent vapor will be tested daily for the first week of operations, weekly for the remainder of the first month, and biweekly thereafter. Extracted vapor concentrations are expected to be at their highest levels during the first month of system operation.

To ensure that the project objectives are achieved, an authorized representative of DBS&A will have direct supervisory control over all aspects of the project. All drilling, construction, and equipment setup activities conducted during the project will be performed under the direction of a New Mexico licensed professional engineer. All activities proposed in this FRP will be conducted in accordance with DBS&A standard operating procedures (SOPs), applicable federal and state regulations, and frequent communication with the PSTB project manager and other stakeholders.

4.9 Contingency Plan

If there is a change in site conditions that threatens public health, safety, or the environment, DBS&A will reevaluate the extraction well network. The most likely change in conditions would be a substantial change in groundwater elevation or flow direction due to demand from municipal supply and overall regional groundwater mining. Additional wells could be installed to maintain control of both the LNAPL and dissolved-phase plumes, and to protect regional drinking water sources. Conveyance piping has been sized to allow future flow from additional wells, if needed.

5. Remediation System Operation and Maintenance

5.1 Overview

Operation and maintenance (O&M) of the remediation system and monitoring of subsurface conditions is required at regular intervals to accomplish the following tasks:

- Collect data on system operation
- Maximize the system’s mechanical performance
- Optimize operating configurations
- Document mass removal and compliance with air emissions standards
- Document groundwater quality in response to system operation
- Perform general equipment preventive maintenance
- Demonstrate that the remediation system is complying with City requirements for industrial discharge.

5.2 Extracted Soil Vapor

Hydrocarbon concentrations in extracted soil vapor and treated vapor discharge will be measured to document system effectiveness, regulatory compliance, and hydrocarbon recovery rates. Total ionizable VOC concentrations will be measured using a PID during each O&M event. DBS&A proposes that influent and effluent air samples from the system be collected and analyzed for total petroleum hydrocarbons (TPH) and BTEX using EPA methods 8015B and 8021, respectively, on the following schedule:

- *Startup and shakedown:* Collect system influent/effluent samples within 4 hours of startup and again approximately 48 hours after startup.
- *Second week to end of first month:* Collect system influent/effluent samples weekly until the end of the first month of operation.
- *Remainder of first quarter and subsequent quarters of O&M:* Collect one influent and one effluent sample every two weeks.

Field and laboratory analytical data will be used to optimize system operation and to calculate system efficiency, extraction rates, emission rates, and quantities of recovered hydrocarbons.

5.3 Extracted Groundwater

Hydrocarbon concentrations for raw and treated water will be measured to document system effectiveness, regulatory compliance, and hydrocarbon recovery rates. DBS&A will also provide information necessary to document compliance with the approved discharge of treated groundwater. Specific requirements will be provided in the FRP implementation work plan, but may include the following:

- Periodic (monthly) flow discharge readings
- Laboratory testing of treated groundwater discharge to be performed weekly during the first month and biweekly thereafter, similar to the vapor sampling schedule
- Notification of any system changes or faults

To meet City discharge requirements, raw and treated water samples will be collected and analyzed for the site COCs. In addition, diffused aeration tank effluent vapor samples will be collected on the same sampling schedule and analyzed for VOCs and TPH using EPA methods 8021 and 8015, respectively. Samples will be analyzed at Hall Environmental Analysis Laboratory (HEAL) in Albuquerque, New Mexico. Field and laboratory analytical data will be used to optimize system operation, demonstrate compliance with discharge requirements, and calculate system efficiency, extraction rates, emission rates, and quantities of recovered hydrocarbons.

5.4 DPE Treatment System Operation and Maintenance

DPE system startup will require daily site visits for the first five days of operation to document system performance and hydrocarbon recovery rates. During this initial startup period, the system will be adjusted to obtain optimum performance and maximize hydrocarbon removal from the site. Applied vacuum and resultant flow rates and vapor concentrations in each individual SVE well will be recorded using a form similar to the example provided in Appendix G. Vacuum from and fluid levels in surrounding wells will be observed to determine the ROI for each treatment well, if possible (the existing well network may limit data collection).

Because the actual subsurface conditions at the site are difficult to precisely predict, specific SVE well flow rates, operating configurations, and vacuum can only be estimated from data collected during the SVE pilot test (BEI, 2012) and from extraction well design (Appendix D). Actual remediation system performance will be documented in the quarterly O&M reports submitted for the site.

After the startup period, the system will be operated and maintained for optimal efficiency. O&M and evaluation of the DPE system will be performed on a monthly, quarterly, and annual basis. Informal electronic reports on system performance will be provided to the PSTB project manager on a monthly basis. Quarterly reports will be provided both electronically (as a compiled PDF) and in hard copy, unless otherwise requested.

In case of a change in site conditions that threatens public health, safety, and welfare or the environment, the system will be shut down immediately. The change in conditions will be evaluated and, if necessary, modifications will be made to the system and its operations to remedy the risk to the public or the environment.

5.4.1 Biweekly Activities

DBS&A proposes to perform the following activities on a biweekly basis:

- Measure DPE well flow rates and vacuum
- Adjust and maintain vapor flow rates at design specifications
- Adjust flow rates and applied well vacuum to maximize mass removal rates
- Empty knockout tank and dispose of condensate as required
- Collect, recycle, and dispose of LNAPL (if applicable); check and clean filters

- Respond to system shutdowns
- Conduct other miscellaneous activities necessary to ensure efficient and effective system performance
- Perform routine preventive maintenance on all equipment and motors
- Collect influent and effluent vapor samples for laboratory analysis of TPH and BTEX in accordance with EPA methods 8015B and 8021, respectively
- Collect raw and treated water samples and diffused aeration tank effluent vapor samples for laboratory analysis of VOCs and any other parameters specified for industrial discharge
- Record periodic field measurements of temperature, pH, dissolved oxygen (DO), electrical conductivity (EC), and oxidation/reduction potential (ORP)
- Calculate system extraction and emission rates and destruction efficiency

5.4.2 Quarterly Activities

On a quarterly basis, DBS&A will evaluate the efficacy of coalescing media and filters, and will replace those materials that exhibit a decrease in performance. DBS&A will also prepare and submit a report to the PSTB documenting all O&M activities and groundwater monitoring results for the previous quarter. Reports will include the following:

- Identification and explanation of any operational adjustments made for system optimization
- Discussion of actual system operation and effectiveness compared to expected parameters used for the remedial design
- Evaluation of contaminant reduction
- Familiarity statement by the DBS&A project manager
- Description of actions taken or future plans for the recovery of contaminant mass
- Summary and recommendations

5.5 One Year of Quarterly Monitoring and Reporting

Subsequent to system installation, DBS&A will initiate quarterly groundwater monitoring in accordance with DBS&A SOPs. Up to 22 wells associated with the site will be gauged during each monitoring event. All wells that do not contain LNAPL will be sampled. In the event that remedial activities cause a decrease in site concentrations, the sampling program may be adjusted in future years. For example, contaminant concentrations in upgradient wells BW-1 through BW-3 and cross-gradient wells BW-9 and BW-10 have consistently been below laboratory reporting limits, and those wells could be eliminated from the regular sampling program.

Fluid levels will be gauged using an electronic interface probe to determine if LNAPL is present and to determine the depth to water. If detected by the interface probe, the LNAPL thickness will be measured to within 0.01 foot. The interface probe will be decontaminated before each measurement using a solution of deionized water and soap.

Groundwater monitor wells are sampled using HydraSleeve no-purge groundwater sampling systems. HydraSleeve samplers remain closed due to water pressure until they are retrieved. The upward motion of retrieval opens the HydraSleeve’s check valve, and the bag fills from the top. When the HydraSleeve sample bag is full, the check valve closes, allowing the sample to be collected from a discrete depth, reducing turbidity of the sample, and preventing water above (or below) the desired sample zone from entering the sample bag. The sample bag is pierced with a straw to transfer the sample to laboratory-provided sample bottles. Groundwater field parameters (DO, ORP, EC, pH, and temperature) will be measured using a YSI Professional or equivalent device after sample collection is complete.

Bottled groundwater samples will be labeled and preserved on ice in an insulated cooler for delivery to HEAL for analysis. Groundwater samples will be analyzed for VOCs using EPA method 8260B (full list) and EDB using EPA method 504.1. Groundwater samples will be accompanied by full chain of custody documentation at all times.

Following completion of each quarter of sampling and O&M and upon receipt of laboratory analytical reports, DBS&A will prepare and submit to the NMED PSTB project manager a quarterly monitoring report conforming to 20.5.119.1926 NMAC. The report will include, but not be limited to, the following:

- Area/vicinity map
- Detailed site diagram with locations of buildings, monitor wells, storage tanks and lines, sumps, impoundments, pit areas, water lines, and other relevant structures
- Summary of site conditions
- Discussion of the sampling collection procedures
- Laboratory results with chain of custody records and quality assurance information

- Tabulation and graphs of recent and historical (including baseline) groundwater elevations, LNAPL levels (if applicable), and contaminant concentrations in each well, such as the following tables and graphs:
    - Groundwater analytical chemistry
    - Soil vapor analytical chemistry
    - Fluid level measurements and groundwater elevations
    - Summary of LNAPL recovery
    - System operations data
    - Cumulative mass removal
    - Well circuit soil vapor field screening data
    - Groundwater elevation and LNAPL thickness over time for each well containing LNAPL
    - Groundwater elevations and COC concentrations for key wells
- Groundwater elevation map
- Groundwater contaminant and isoconcentration maps with contaminant concentrations for each well (baseline data will be included as a separate appendix in each report)
- Identification and explanation of any operational adjustments made for system optimization
- Discussion of actual system operation and effectiveness compared to expected parameters used for the remedial design
- Evaluation of contaminant reduction
- Familiarity statement by the DBS&A project manager
- Description of actions taken or future plans for the recovery of contaminant mass
- Summary and recommendations

5.6 Health and Safety Requirements

DBS&A has updated the current site-specific health and safety plan (HASP) for the proposed field activities at the site related to the remediation system installation and operation pursuant to the requirements of CFR 1910.120. The current HASP is provided as Appendix H. A copy of the HASP will be kept on-site during all field activities.

6. Permits

6.1 Temporary Water Right Use Agreement

Treated water will be discharged to the sanitary sewer in Clovis, which is ultimately routed to a direct potable reuse system. Therefore, extracted groundwater will be put to beneficial use. This will require an application to the OSE to change place and purpose of use. DBS&A worked with the City and has already received OSE approval to borrow required water rights at no additional cost, other than required utility costs associated with the industrial discharge. Drafts of OSE Form WR-06 and a potential water right use agreement were provided to PSTB in June 2020, and are included in Appendix I.

6.2 Air Quality Bureau Notice of Intent

DBS&A reviewed current guidance from the NMED Air Quality Bureau (AQB) regarding air permitting, which states that "facilities that emit less than 10 tons per year of any criteria pollutant do not need an air quality permit nor do they need a Notice of Intent (NOI)." After the system is implemented, DBS&A will monitor remediation system emissions, which are typically multiple orders of magnitude below regulatory standards, and will submit the relevant paperwork if required. However, a draft NOI permit application has not been included in this FRP.

6.3 Office of the State Engineer Well Permits

Permits from the OSE may be required in the future if additional wells are constructed at the site. Permit applications will be submitted upon approval of the work plan for well installation, and permit approvals will be provided with subsequent reports.

7. Notifications

DBS&A has provided public notice in accordance with 20.5.119.1923.D.10 NMAC, as follows:

- Legal notice of the submission of the FRP will be published twice in the *Eastern New Mexico News*, a newspaper of general circulation in Curry County, on July 14 and 21, 2021. The format for the legal notice follows the guidelines dictated in 20.5.119.1923.D.10.b NMAC. The legal notices were submitted to PSTB for prior approval and translation. The certified affidavit of publication for each legal notice will be provided to the PSTB project manager following the second date of publication and issuance of the affidavit.

- A notice containing the specified information listed in the regulation will be posted at the Former Y Station site at 721 Commerce Way in Clovis, New Mexico, at the current location of the Optical Source retail outlet. Additional signage will be posted on the prominent “Shopping Center” sign on the east side of Prince Street across from the Optical Source and on the recycling dumpsters at the Albertson’s grocery store, near the proposed location of the treatment equipment. Signs will be posted the week of July 19, 2021; photographs of sign placement will be emailed to the PSTB project manager.
- In accordance with the above-cited regulation, DBS&A provided notice of submission of the FRP by certified mail to adjacent property owners. DBS&A mailed a total of 25 certified letters on July 9, 2021. The list was compiled from Curry County Assessor data. DBS&A will update the PSTB project manager when return receipts from the certified letters are received.

A copy of the text of the legal notices (English and Spanish), a list of certified addresses, and a map indicating which residences and businesses received certified letters are provided in Appendix J.

8. Implementation Schedule

A schedule for implementing this FRP is provided in Appendix K. Implementation milestones include the following:

- Approval of the FRP
- Procurement of major remediation equipment
- Installation of conveyance piping
- Installation of remediation equipment
- System startup
- Submittal of the final as-built report and record drawings
- Quarterly O&M and reporting

9. Evaluation of Remedial Actions

Remediation system performance will be evaluated annually in accordance with 20.5.119.127 NMAC. The system evaluation will be incorporated into the fourth quarter monitoring report and submitted to the NMED PSTB project manager. This evaluation will provide NMED with the information necessary to determine whether the remedial approach undertaken is successful in achieving the remedial action objectives. Key elements of the report include the following:

- Contaminant plume maps with contaminant levels from each well
- Evaluation of DPE system performance based on mass of fuel compounds removed and volume of groundwater treated and discharged
- Summary and recommendations

In the event that the data collected during the first six months of operation suggest that the system as installed has not been effective at removing or reducing contaminant mass, DBS&A may propose an alternative approach or change to the existing remediation plan. A variety of technologies could augment the removal. DBS&A believes that the remedial approach documented in this FRP is a prudent and cost-effective approach to achieve removal of contaminant mass in the most expeditious time frame and to ultimately bring the site to closure.

10. Statement of Familiarity

This FRP was prepared by DBS&A under contract number 18-667-3200-0022 for the Former Y Station site under the PSTB State Lead remediation program. Preparation of all engineering drawings and specifications was conducted under the direction and supervision of Thomas Golden, a New Mexico Licensed Professional Engineer (License #22750).

______________________	July 16, 2021
Thomas Golden, P.E. Project Engineer	Date

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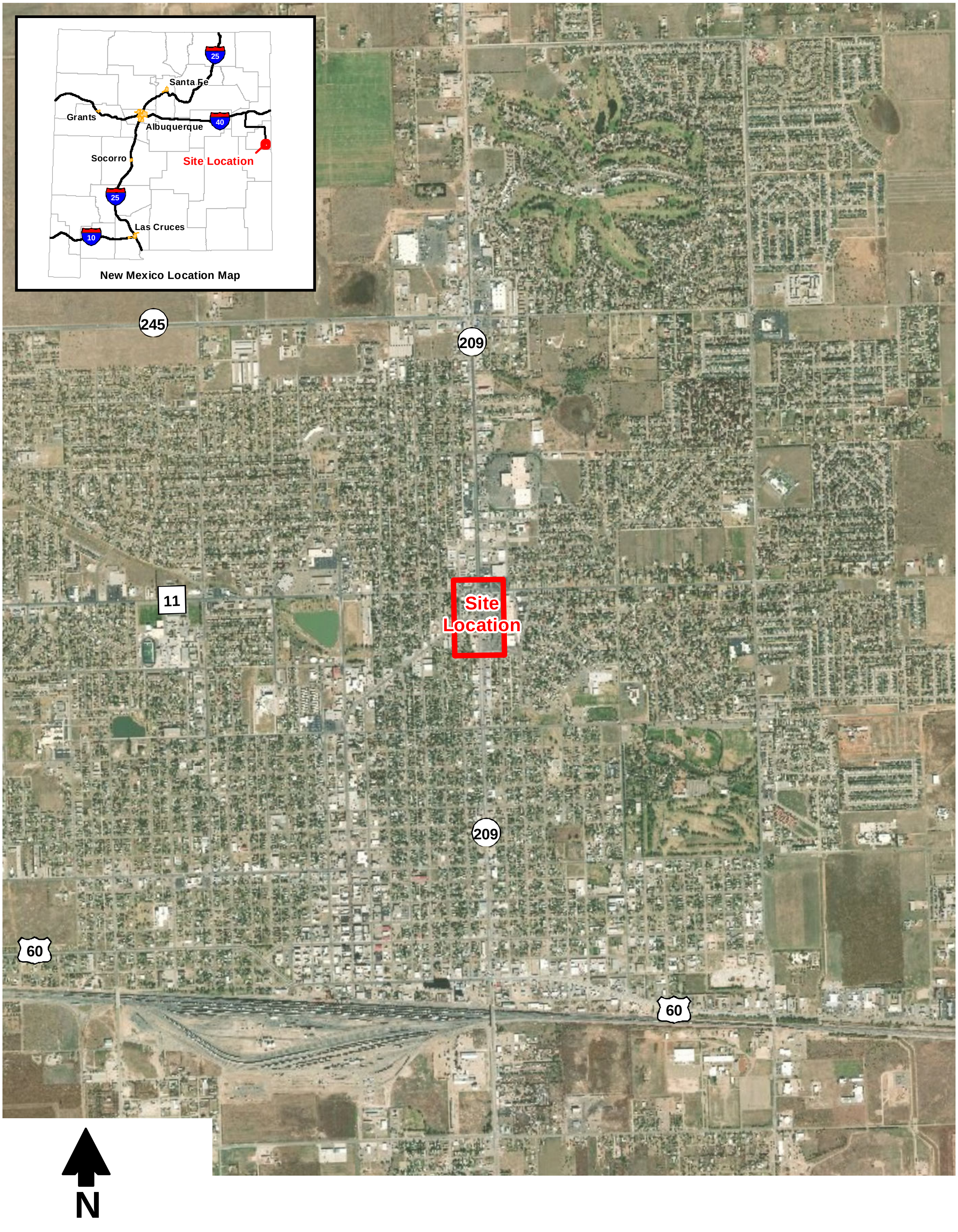
Figures



FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Area Map

Daniel B. Stephens & Associates, Inc.
6/3/2019
JN DB18.1157.00

Figure 1

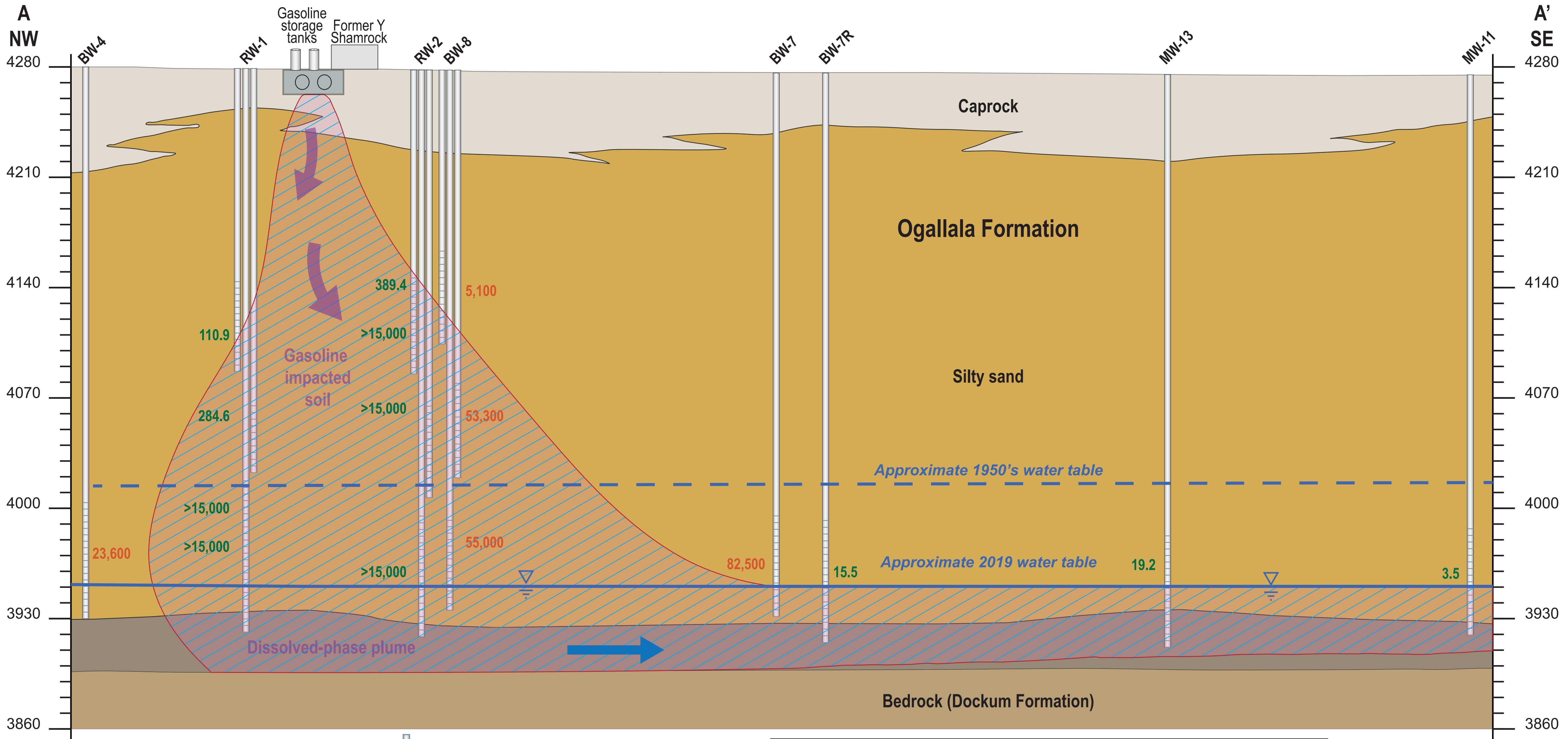
S:\PROJECTS\DB18.1157_FORMER_Y_STATION\GIS\MXDS\F01_AREA_MAP.MXD

V:\Marketing\Proposals in Progress\DB17.1228.PR_NMED_Former_Y_Station_RA\GIS\MXD

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO
Site Map

Figure 2

Daniel B. Stephens & Associates, Inc.
6/16/2020
JN DB18.1157.00



Explanation

Single completion monitor well

Nested monitor well

Cross section A - A'

389.4 Field vapor concentration (ppmv)

23,600 TPH vapor concentration (µg/L)

Approximate historical water table

Approximate 2019 water table

Hydrocarbon impacted area

Contaminant flow direction

Groundwater flow direction

Monitor well

Well screen

Former gasoline storage tank

Underground storage tank (UST)

Building

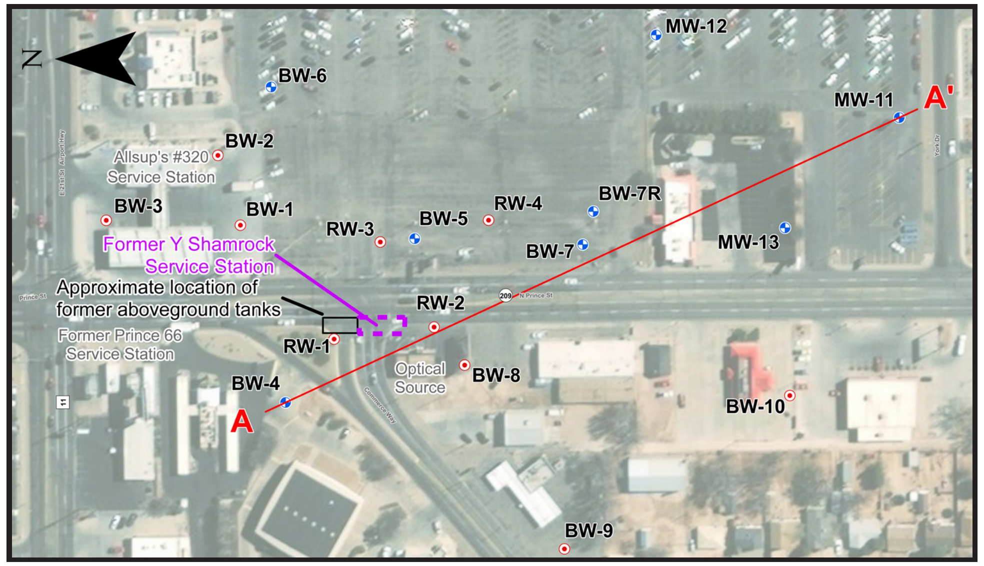
Geology

Caprock (Ogallala Formation)

Ogallala Formation

Clayey sand and gravel

Bedrock (Dockum Formation)



0' 70'

FORMER Y STATION
STATE LEAD SITE
CLOVIS, NEW MEXICO
Geologic Cross Secton

Figure 3

Daniel B. Stephens & Associates, Inc.
11/14/2019
DB18.1157

S:\Projects\DB18.1157_Former_Y_Station\VR_Drawings\AI\Cross_Section_20191113\Former Y Station 20191113.ai

V:\Marketing\Proposals in Progress\DB17.1228.PR_NMED_Former_Y_Station_RA\GIS\MXD

Explanation

MW-14 Monitor well designation

3945.91 Potentiometric surface elevation (ft msl)

● Single completion monitor well

⊙ Nested monitor well

— Potentiometric surface elevation contour (ft msl)

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Potentiometric Surface Elevations
March 19, 2021

Figure 4

Daniel B. Stephens & Associates, Inc.
4/15/2021
JN DB18.1157.00

S:\Projects\DB18.1157_Former_Y_Station\GIS\MXDs\Chemistry\DPC_2021-03.mxd

BW-4			3/20/2021
<1.0	<1.0	<1.0	<1.5
<4.5	<0.0095	1.6	<10
<1.0			

RW-1			3/21/2021
3,000	750	230	590
4,570	**7.5**	**57**	**123**
<2.0			

RW-3			3/21/2021
2,900	980	160	**930**
4,970	**22**	**110**	**44**
<20			

BW-8			3/21/2021
14,000	**23,000**	**1,600**	**6,600**
45,200	**0.86**	**94**	**300**
<50			

RW-4			3/20/2021
3,000	**1,100**	200	**640**
4,940	**7.4**	**41**	**35**
<5.0			

BW-7			3/20/2021
1,000	<2.0	13	3.3
1,016.3	<0.0094	**110**	<20
<2.0			

BW-9			3/20/2021
<1.0	<1.0	<1.0	<1.5
<4.5	<0.0094	<1.0	<10
<1.0			

BW-7R			3/20/2021
920	2.2	43	20
985.2	0.012	**120**	11
<2.0			

MW-17			3/20/2021
<1.0	<1.0	<1.0	<1.5
<4.5	<0.0094	<1.0	<10
<1.0			

MW-12			3/21/2021
98	<5.0	<5.0	<7.5
98	**0.11**	**44**	<50 ^{a}
<5.0			

BW-10			3/20/2021
<1.0	<1.0	<1.0	<1.5
<4.5	<0.0094	<1.0	<10
<1.0			

MW-13			3/20/2021
64	<1.0	2.8	1.8
68.6	**0.090**	**26**	2.0
<1.0			

MW-11			3/20/2021
3,800	<20	250	38
4,088	**0.14**	**200**	**42**
<20			

MW-16			3/20/2021
10	<1.0	<1.0	2.6
12.6	**0.30**	**27**	<10
<1.0			

MW-15			3/20/2021
<1.0	<1.0	<1.0	<1.5
<4.5	<0.0093	<1.0	<10
<1.0			

MW-14			3/20/2021
<1.0	<1.0	<1.0	<1.5
<4.5	<0.0093	<1.0	<10
<1.0			

Explanation

- 🔵 Single completion monitor well
- 🔴 Nested monitor well

Location designation			Sample Date
Benzene	Toluene	Ethylbenzene	Total Xylenes
BTEX	EDB	EDC	Total Naphthalenes
MTBE			

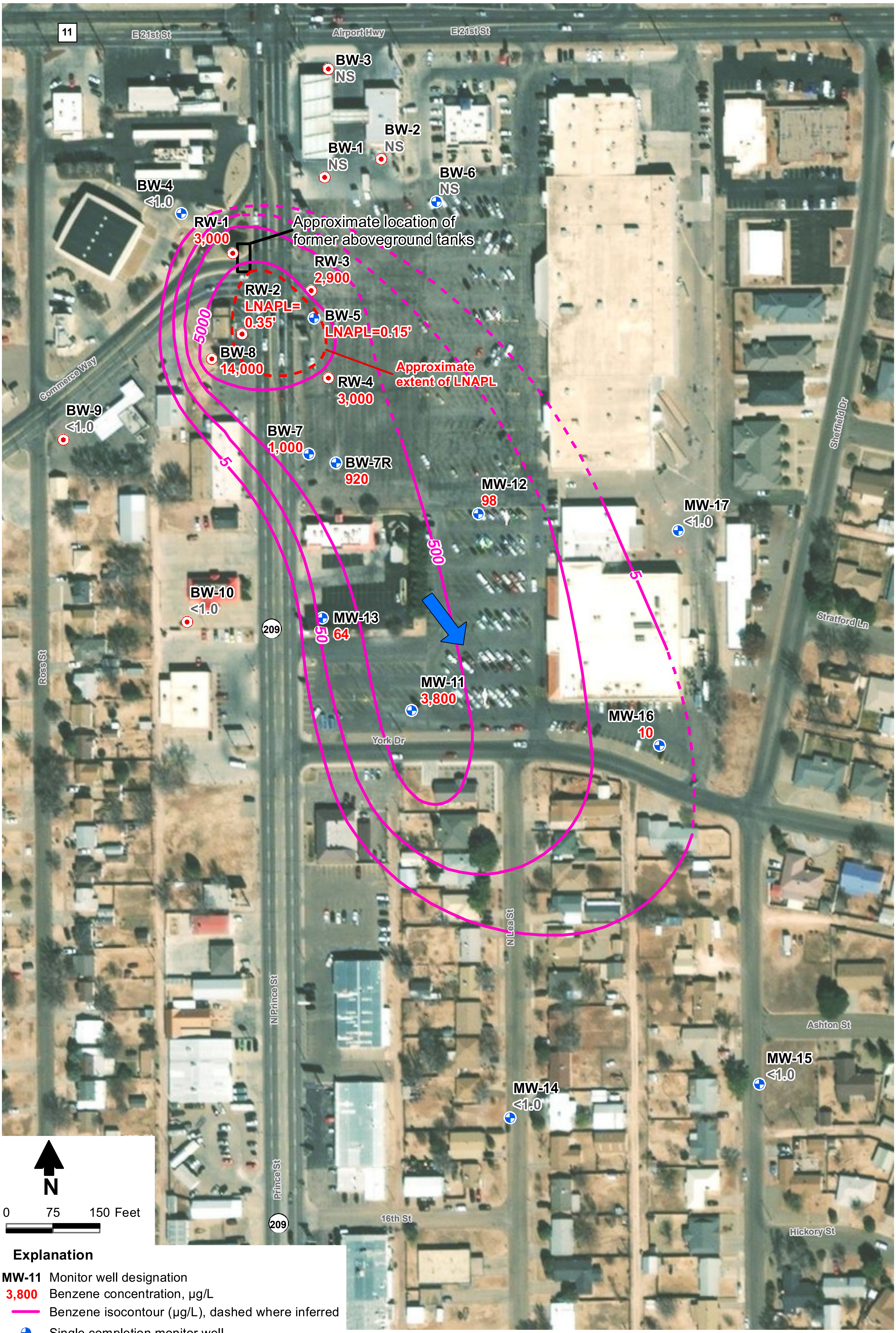
Notes: 1. All concentrations reported in micrograms per liter (µg/L).
2. **RED** indicates concentration that exceeds NMWQCC standard.
3. ^{a} Laboratory reporting limit is equal to or greater than the applicable standard.
4. Samples presented on this figure were collected using HydraSleeve sampling devices.

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Distribution of Dissolved-Phase Contaminants, March 2021

Figure 5

Daniel B. Stephens & Associates, Inc.
4/15/2021
JN DB18.1157.00



Explanation

MW-11	Monitor well designation
3,800	Benzene concentration, µg/L
—	Benzene isocontour (µg/L), dashed where inferred
◐	Single completion monitor well
⊙	Nested monitor well

Notes:
1. All concentrations reported in micrograms per liter (µg/L).
2. RED indicates concentration that exceeds NMWQCC standard.
3. Samples collected on this figure were collected using HydraSleeve sampling devices.

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Benzene Isoconcentration Map
March 2021

Figure 6

Daniel B. Stephens & Associates, Inc.
4/15/2021
JN DB18.1157.00

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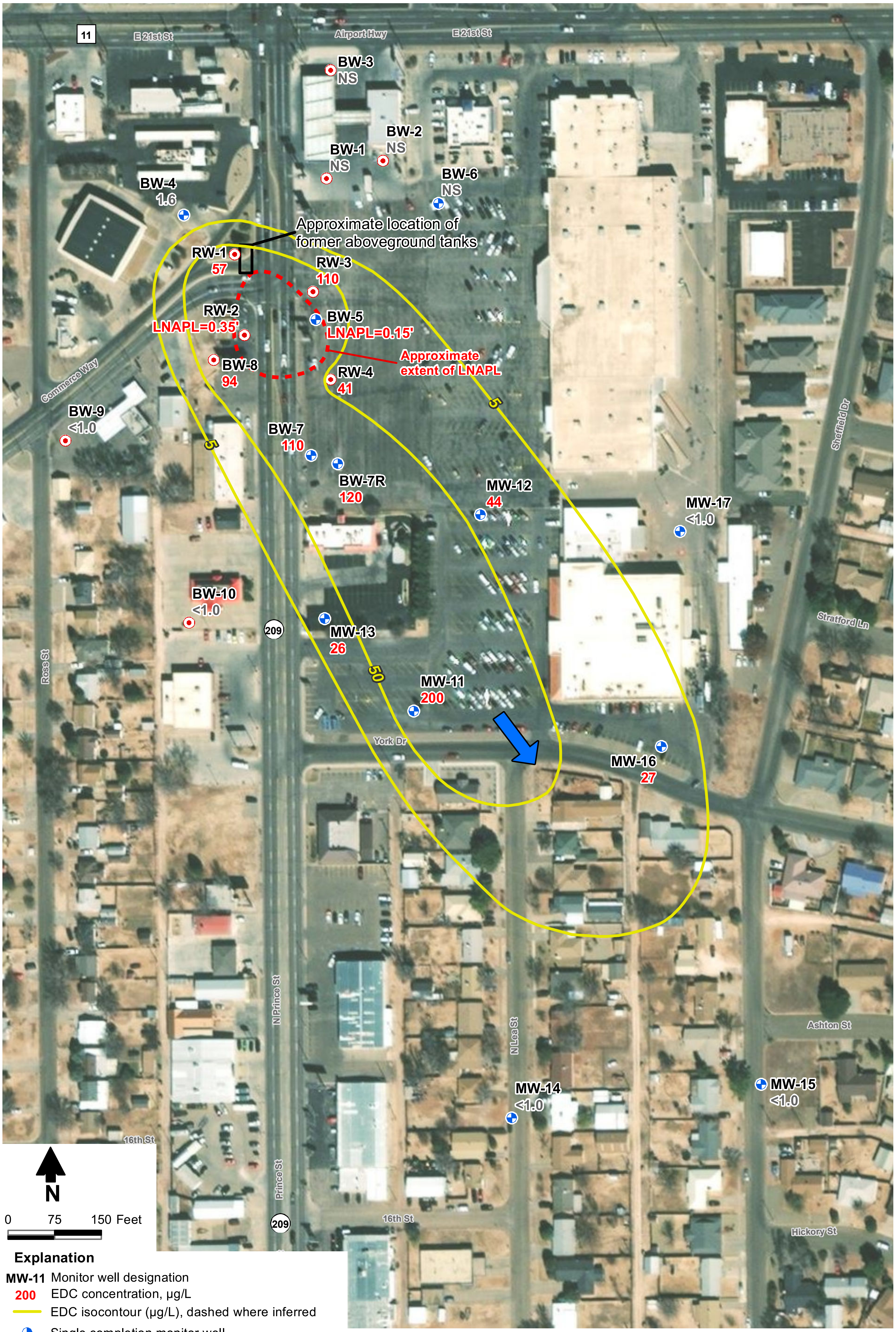

Explanation

MW-11	Monitor well designation
200	EDC concentration, µg/L
—	EDC isocontour (µg/L), dashed where inferred
◐	Single completion monitor well
⊙	Nested monitor well

Notes: 1. All concentrations reported in micrograms per liter (µg/L).
2. RED indicates concentration that exceeds NMWQCC standard.
3. Samples collected on this figure were collected using HydraSleeve sampling devices.

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

EDC Isoconcentration Map
March 2021

Figure 7

Daniel B. Stephens & Associates, Inc.
4/15/2021
JN DB18.1157.00

S:\Projects\DB18.1157_Former_Y_Station\GIS\MXDs\Chemistry\EDB\EDB_2021-03.mxd

Explanation

MW-11	Monitor well designation
0.14	EDB concentration, µg/L
—	EDB isocontour (µg/L), dashed where inferred
◐	Single completion monitor well
⊙	Nested monitor well

Notes: 1. All concentrations reported in micrograms per liter (µg/L).
2. RED indicates concentration that exceeds NMWQCC standard.
3. Samples collected on this figure were collected using HydraSleeve sampling devices.

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

EDB Isoconcentration Map
March 2021

Daniel B. Stephens & Associates, Inc.
4/15/2021
JN DB18.1157.00

Figure 8

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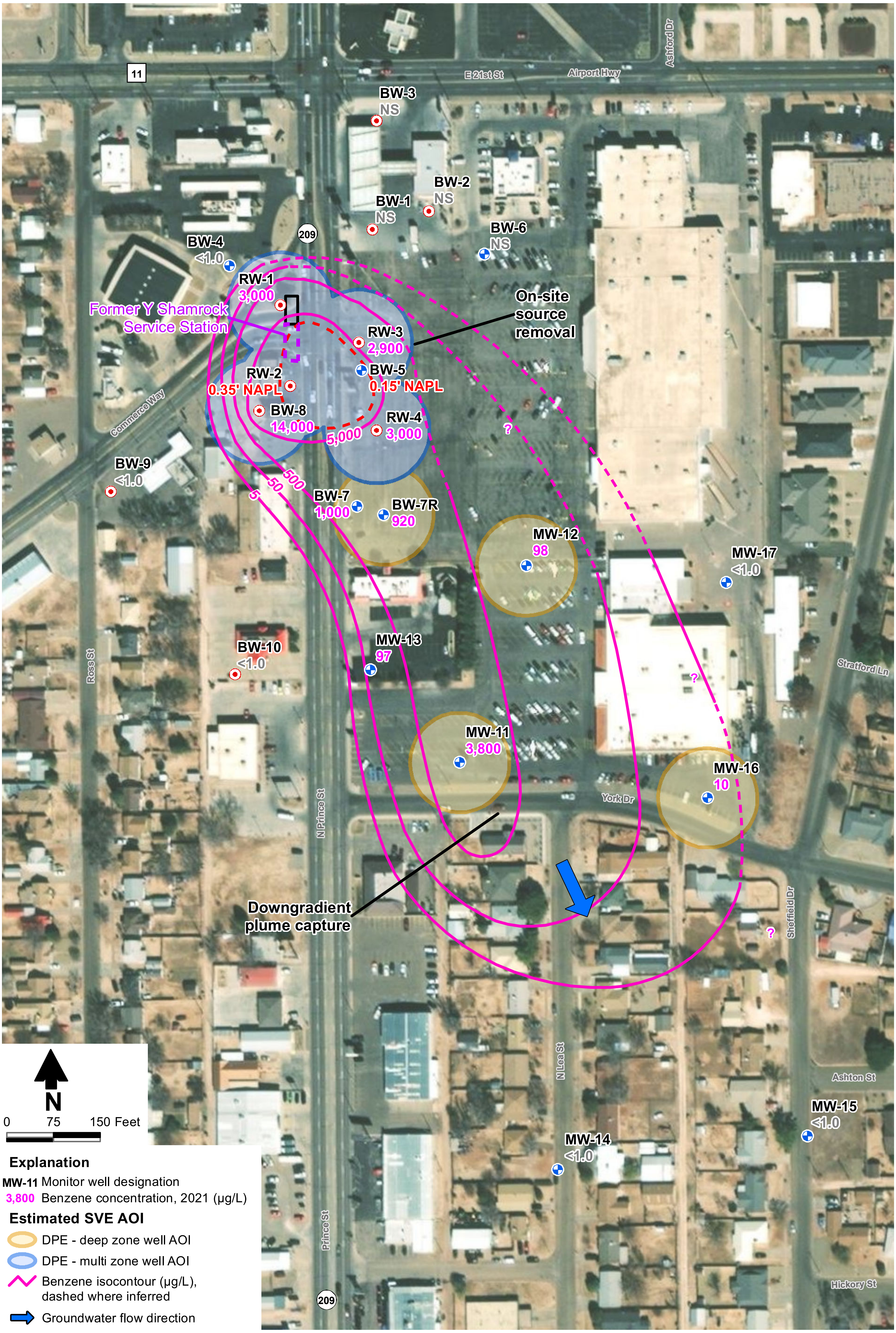

Figure 9

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO
Proposed Technical Approach

Daniel B. Stephens & Associates, Inc.
5/13/2021
JN DB18.1157.00

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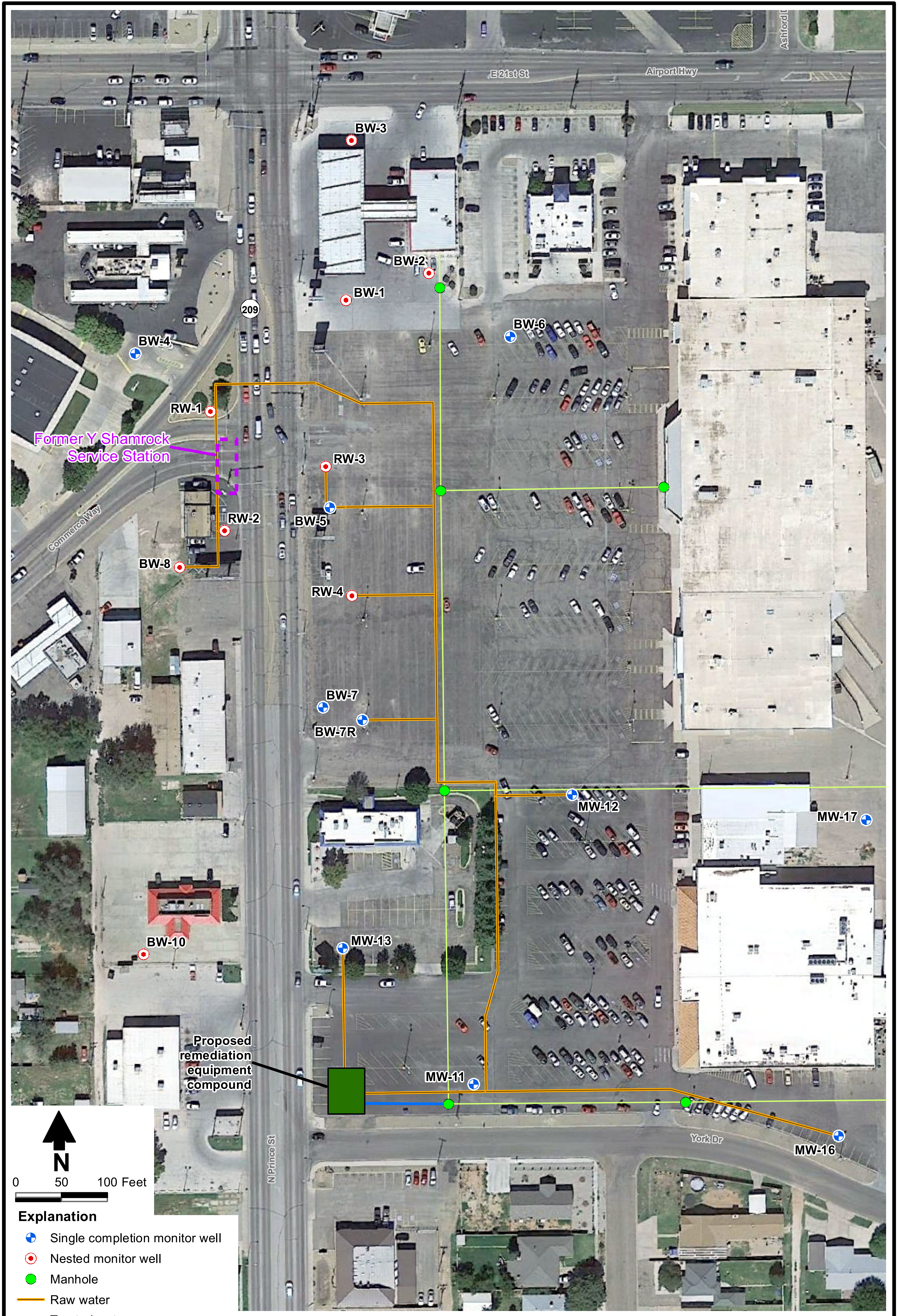


Figure 10

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Proposed Remediation System Layout

Daniel B. Stephens & Associates, Inc.
5/13/2021
JN DB17.1228.PR

Table

Table 1. Proposed Remediation Wells

Well	Well Diameter (inches)	Well Screen (feet bgs)	Depth to Water (feet btoc)	Open Well Screen (feet)	Extracted Air Flow (scfm)	Available Drawdown (feet)	Design Pumping Rate (gpm)
Source Area Wells							
RW-1	2	135.0–195.0	NA	60	60		
	2	215.0–255.0	NA	40	40		
	4	264.9–355.3	330	65	65	25	2.0
RW-2	2	135.0–195.0	NA	60	60		
	2	215.0–275.0	NA	60	60		
	4	289.8–360.1	330	40	40	30	2.0
RW-3	2	135.4–195.4	NA	60	60		
	2	215.0–275.0	NA	60	60		
	4	289.3–359.5	329	40	40	30	2.0
RW-4	2	134.9–194.9	NA	60	60		
	2	214.9–274.9	NA	60	60		
	4	291.2–361.5	330	39	39	31	2.0
BW-8	2	115–175	NA	60	60		
	2	200–260	NA	60	60		
	4	287–347	329	42	42	18	0.0
Downgradient Wells							
BW-7R	5	286.8–357.1	329	42	42	28	2.0
MW-11	5	285.5–355.5	327	42	42	28	4.0
MW-12	5	286.5–356.7	330	44	44	26	2.0
MW-16	5	289.0–359.3	330	42	42	28	4.0
				Total	976		20.0
Contingency Well							
MW-13	5	287.0–357.0	328	41	41	29	2.0

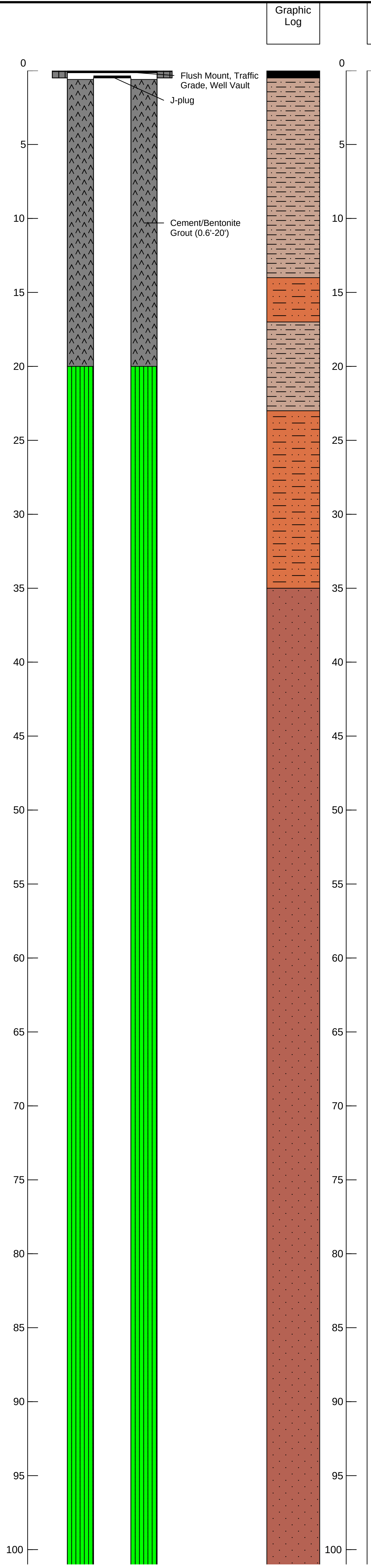
Note: Depth to water based on March 2021 data and rounded up to the nearest foot.
bgs = Below ground surface
btoc = Below top of the well casing
scfm = Standard cubic feet per minute
gpm = Gallons per minute
NA = Not applicable

Appendix A

Boring Logs

DBS&A

Daniel B. Stephens & Associates, Inc.



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
0.5	100	0-15	NA	0-0.5	Asphalt.
			CL	0.5-14	Sandy clay - yellowish red (5YR 5/6), fine grained, well sorted, subrounded, moderate to high plasticity, medium dense, slightly moist, odorless.
			CL		Sandy clay - as above.
			CL		Sancy clay - as above with calcium carbonate.
			SC	14-17	Clayey sand - dry, otherwise as above.
0.0	100	15-25	SC		Clayey sand - as above with less calcium carbonate.
			CL	17-23	Sandy clay - yellowish red (5YR 5/6), fine grained, well sorted, subrounded, moderate plasticity, medium dense, dry, odorless, trace calcium carbonate.
			SC	23-35	Clayey sand - increased calcium carbonate concentrations, otherwise as above.
0.0	100	25-35	SC		Clayey sand - reddish yellow (5YR 6/6), loose to partially cemented, otherwise as above.
0.3	100	35-45	SP	35-137	Sand - reddish yellow (5YR 6/6), fine grained, well sorted, subrounded, non-plastic, loose, dry, odorless, trace silt, calcium carbonate concretions.
0.0	100	45-55	SP		Sand - as above.
			SP		Sand - as above with high amounts of calcium carbonate.
1.3	100	55-65	SP		Sand - as above.
			SP		Caliche.
0.6	100	65-75	SP		Sand - as above.
			SP		Sand - as above with lower amounts of calcium carbonate.
0.0	100	75-85	SP		Clayey sand - reddish brown (7.5YR 6/6), fine grained, well sorted, subrounded to subangular, low plasticity, loose, dry, odorless, trace calcium carbonate.
			SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless.
4.8	100	85-95	SP		Sand - as above.
			SP		Sand - light gray (10YR 7/2), fine grained, well sorted, subrounded, non-plastic, loose, dry, pulverized, odorless, trace silt.
			SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless.
0.3	100	95-105	SP		Sand - as above.
			SP		Sand - light gray (10YR 7/2), fine grained, well sorted, subrounded, non-plastic, loose, dry, pulverized, odorless, trace silt.
			SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless.

Geologist: H. Barnes
Driller: Yellow Jacket Drilling
Date completed: 8/4/19

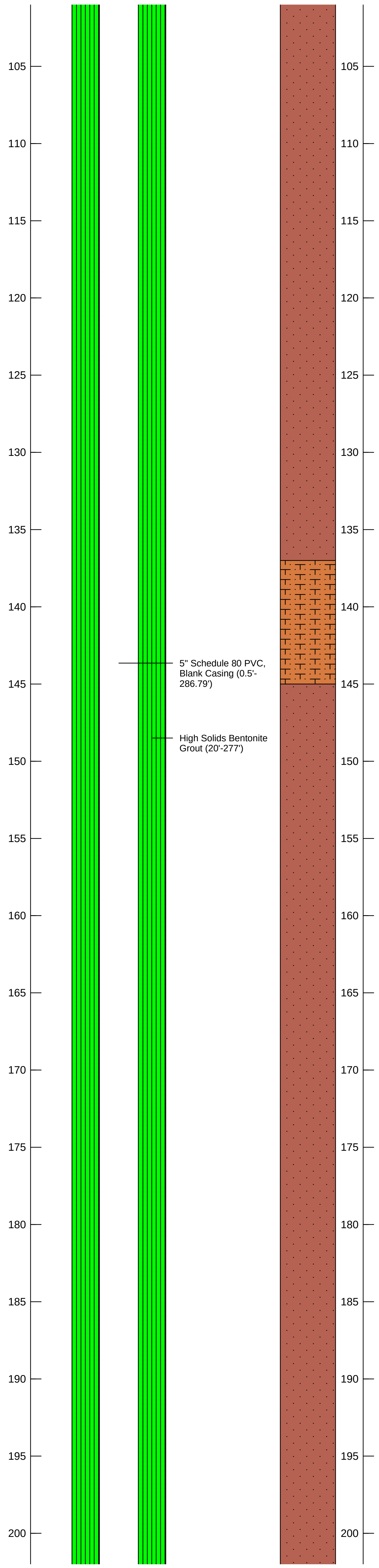
Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 124529 Elevation: 4277.44
Easting: 884291.12

FORMER Y STATION
CLOVIS, NEW MEXICO
BW-7R

Daniel B. Stephens & Associates, Inc.
9/5/2019 JN DB18.1157.00

Graphic Log



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
			SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless.
			SP		Sand - as above with increased calcium carbonate concentrations.
0.0	100	105-115	SP		Sand - as above without calcium carbonate.
			SP		Sand - as above with calcium carbonate, loose to partially cemented.
			SP		Sand - as above, pinkish gray (7.5YR 7/2), calcium carbonate.
			SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless.
0.0	100	115-125	SP		Sand - as above, no calcium carbonate, light reddish brown (5YR 6/4), 2" layer light grey sand layer at 117' bgs.
0.0	100	125-135	SP		Sand - as above.
0.2	100	135-145	SP		Sand - as above.
			SM	137-145	Silty sand - pinkish white (5YR 8/2), fine grained, well sorted, rounded, loose, dry, calcium carbonate rich, pulvurized.
0.0	100	145-155	SP	145-354	Sand - reddish yellow (5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless, little to no calcium carbonate.
0.0	100	155-165	SP		Sand - as above.
			SP		Sand - as above with increased calcium carbonate content.
0.0	100	165-175	SP		Sand - as above with little to no calcium carbonate content.
			SP		Sand - as above mottled with light gray (10YR 7/2).
			SP		Sand - as above with little to no calcium carbonate content.
0.0	100	175-185	SP		Sand - as above.
			SP		Sand - light gray (10YR 7/2), fine grained, well sorted, subrounded, non-plastic, loose, dry, pulverized, odorless, trace silt.
			SP		Sand - reddish yellow (5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless, little to no calcium carbonate.
			SP		Sand - light gray (10YR 7/2), fine grained, well sorted, subrounded, non-plastic, loose, dry, pulverized, odorless, trace silt.
			SP		Sand - reddish yellow (5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless, little to no calcium carbonate.
0.0	100	185-195	SP		Sand - as above.
			SP		Sand - light gray (10YR 7/2), fine grained, well sorted, subrounded, non-plastic, loose, dry, pulverized, odorless, trace silt.
			SP		Sand - reddish yellow (5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless, little to no calcium carbonate.
0.0	100	195-205	SP		Sand - as above.

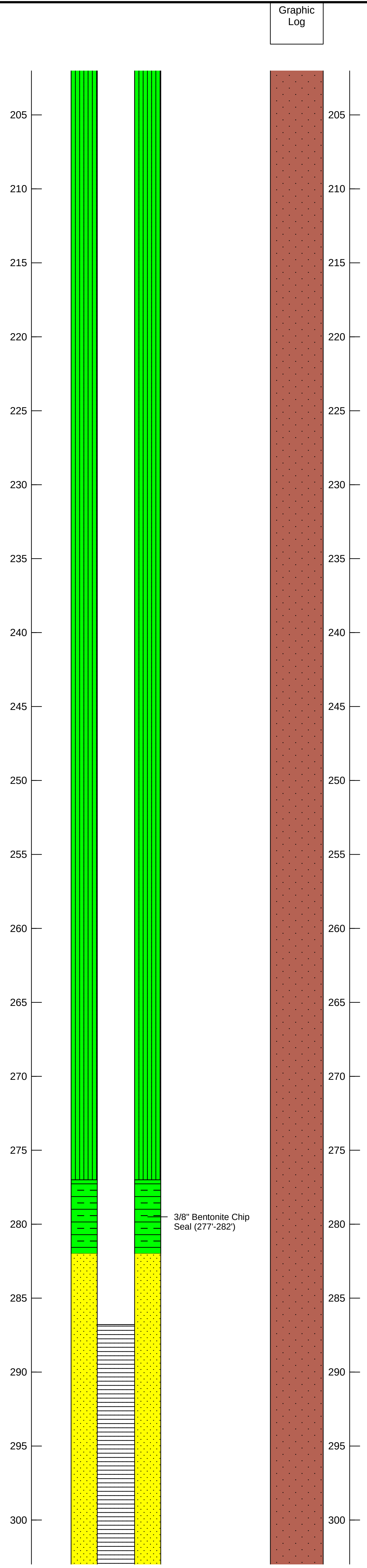
Geologist: H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 7/20/19
Well completion date: 8/4/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245210.02 Elevation: 4277.44
Easting: 884291.06

FORMER Y STATION
CLOVIS, NEW MEXICO
BW-7R

Daniel B. Stephens & Associates, Inc.
9/5/2019 JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
4.4	100	205-215	SP		Sand - as above.
			SP		Sand - as above, pinkish gray, calcium carbonate rich.
			SP		Sand - as above, reddish yellow (5YR 6/6), no calcium carbonate.
			SP		Sand - as above, pinkish gray, calcium carbonate rich.
			SP		Sand - as above, reddish yellow (5YR 6/6), no calcium carbonate.
2.1	100	215-225	SP		Sand - as above.
1.0	100	225-235	SP		Sand - as above.
			SP		Sand - as above.
0.7	100	235-245	SP		Sand - as above with calcium carbonate.
1.1	100	245-255	SP		Sand - as above with little to no calcium carbonate.
0.7	100	255-265	SP		Sand - as above.
6.3	100	265-275	SP		Sand - as above.
4.7	100	275-285	SP		Sand - as above with increased calcium carbonate.
5.3	100	285-295	SP		Sand - as above.
5.8	100	295-305	SP		Sand - as above but slightly moist.

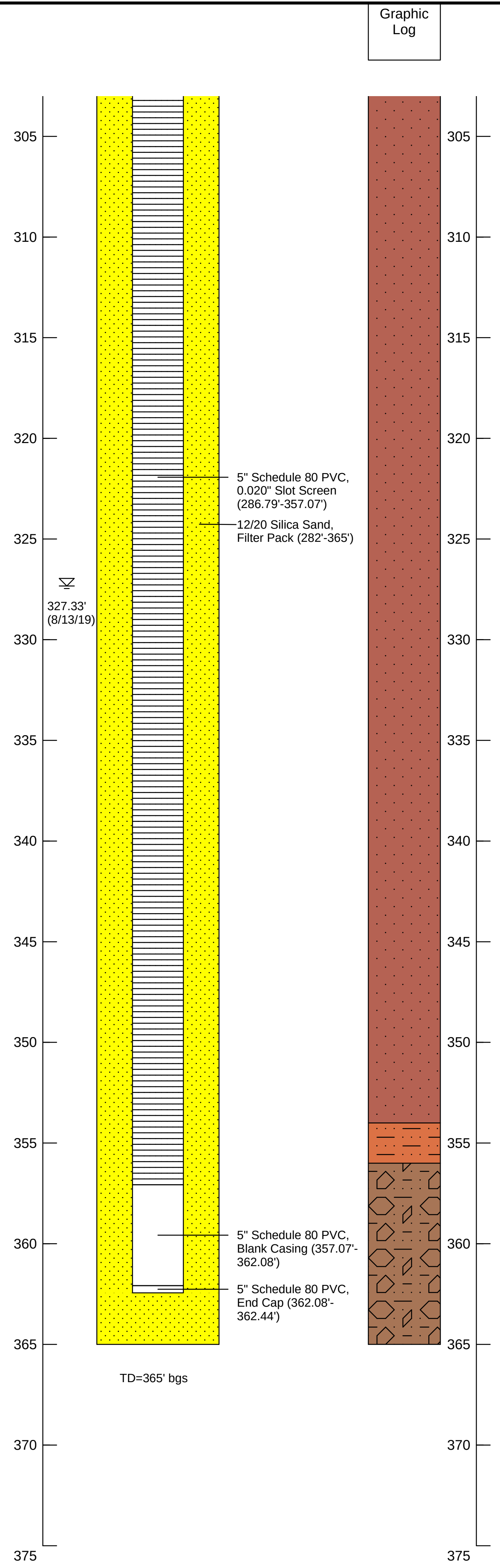
Geologist: H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 7/20/19
Well completion date: 8/4/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245210.02 Elevation: 4277.44
Easting: 884291.06

FORMER Y STATION
CLOVIS, NEW MEXICO
BW-7R

Daniel B. Stephens & Associates, Inc.
9/5/2019 JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
1.7	100	305-315	SP		Sand - as above, dry.
2.2	100	315-325	SP		Sand - as above but slightly moist and trace silt.
15.5	100	325-335	SP		Sand - as above. Saturated at 330'.
NA	100	335-345	SP		Sand - as above, saturated.
			SP		Sand - as above with trace low plasticity clay.
NA	100	345-355	SP		Sand - as above.
			SP		Sand - as above, loose to partially cemented with calcium carbonate, dry.
			SC	354-356	Clayey sand - yellowish red (5YR 4/6), fine grained, well sorted, rounded, low plasticity, medium dense, slightly moist, no odor.
NA	100	355-365	SC		Clayey sand - as above.
			SW-SC	356-356.5	Wackestone.
			SW	356.5-365	Gravelly sand with clay - light reddish brown (5YR 6/3), fine grained, poorly sorted, subrounded, fine gravels, low plasticity, loose, dry, no odor, calcium carbonate rich.

Geologist: H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 7/20/19
Well completion date: 8/4/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245210.02 Elevation: 4277.44
Easting: 884291.06

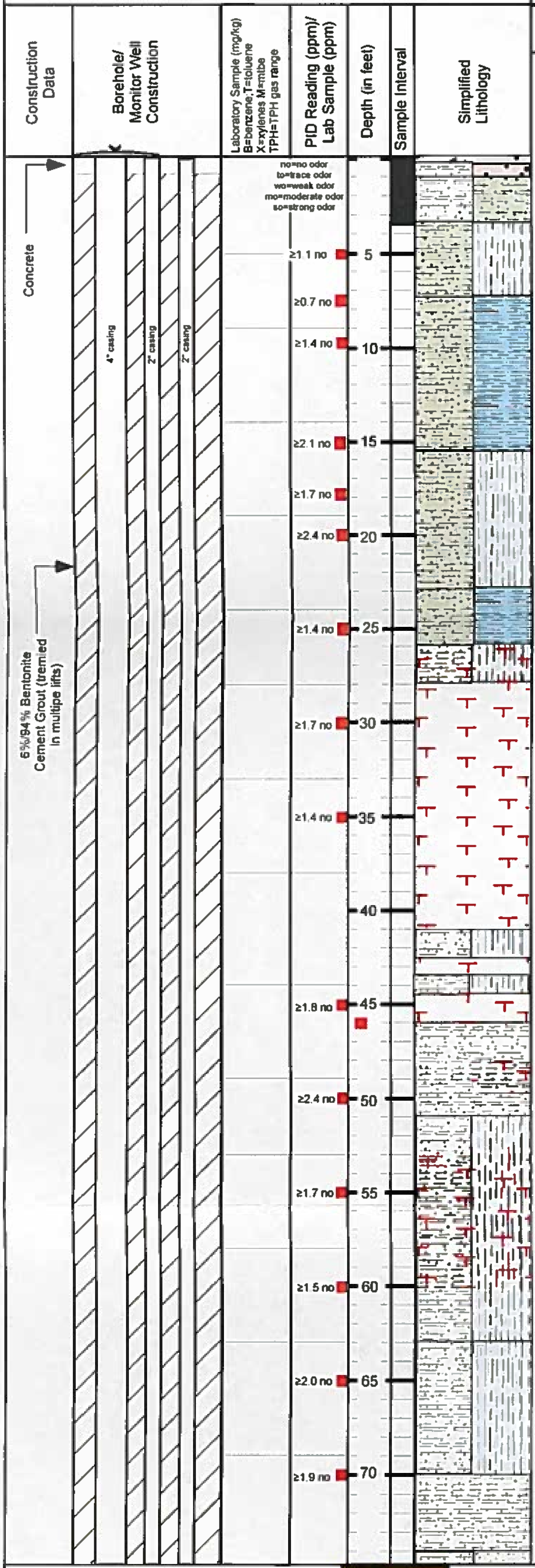
FORMER Y STATION
CLOVIS, NEW MEXICO
BW-7R

Daniel B. Stephens & Associates, Inc.
9/5/2019
JN DB18.1157.00

ALLSUPS #320

CLIENT: Allsups Petroleum, Inc.
Borehole ID: BW-8

DATE OF DRILLING: 11/10-14/15
LOGGED BY: WJB
DRILLER: John Chavez/Yellowjacket
BOREHOLE DIAMETER: 11 3/4"
DRILLING METHOD: ARCH
SAMPLING METHOD: Cuttings/Split Spoon
TOP OF CASING ELEV: na
DEPTH TO WATER: ~327'
TOTAL DEPTH: 356'
SHALLOW WELL: 2" Sched 80 PVC; Screen 115'-175'
INTERMEDIATE WELL: 2" Sched 80 PVC; Screen 200'-260'
DEEP WELL: 4" Sched 80 PVC; Screen 287'-347'
SURFACE COMPLETION: 18"X18" Manway w/Concrete Pad



USCS - LITHOLOGIC DESCRIPTION

Surface Conditions: 0-0.3' Saw cut concrete.

0.3'-3.5' Cuttings/Posthole 0.3'-1.0' **(SM/SW)** with **(SC)** Silty fine to medium sand with minor gravel and clay/silt. 1.0'-3.5' **(SM/SC)** Clayey silty very fine sand, weakly plastic, brown **(10YR)**, soft, slightly moist, no apparent hydrocarbon odor.

3.5'-7.5 Cuttings **(SC/ML)** Light tan-brown silty clayey very fine sand, plastic, soft, slightly moist, calcium carbonate, no apparent hydrocarbon odor.

7.5'-15.5' Cuttings **(SC/CL)** Light brown **(10YR)** silty sandy clay, plastic, slightly moist, no apparent hydrocarbon odor.

15.5'-23.0' Cuttings **(SC/ML)** Weakly cemented with calcium carbonate, slightly moist, no apparent hydrocarbon odor.

23.0'-26.0' Cuttings **(SC/CL)** Light brown **(10YR)** soft, plastic, silty very fine sand-clay mixture, slightly moist, no apparent hydrocarbon odor.

26.0'-28.0' Cuttings **(SM/ML)** silt-very fine sand with Stage 3 caliche, hard drilling, light tan-white, no apparent hydrocarbon odor.

28.0'-41.0' Cuttings **(Caliche)**, Stage 3+ to 4, dense, massive, hard drilling. light tan-white.

<11/10/15 19:50 Stopped Drilling at 40'.>
<11/11/15 7:20 Blowdown - 1.1 ppm/v, no apparent hydrocarbon odor.>

41.0'-46.0' Cuttings **(SM/ML)** silt-very fine sand Stage 3+ calcium carbonate with interbeds of Stage 4, slightly moist.

46.0'-51.0' Cuttings **(SM)** **(5YR 6/4)** Light red brown, silty very fine sand, unconsolidated at top with localized calcium carbonate nodules, no apparent hydrocarbon odor, slightly moist.

51.0'-63.0' Cuttings **(SM/ML)** with Stage 2 to Stage 3 -3+ calcium carbonate zones, light tan-white pink, **(5YR)** slightly moist, no apparent hydrocarbon odor.

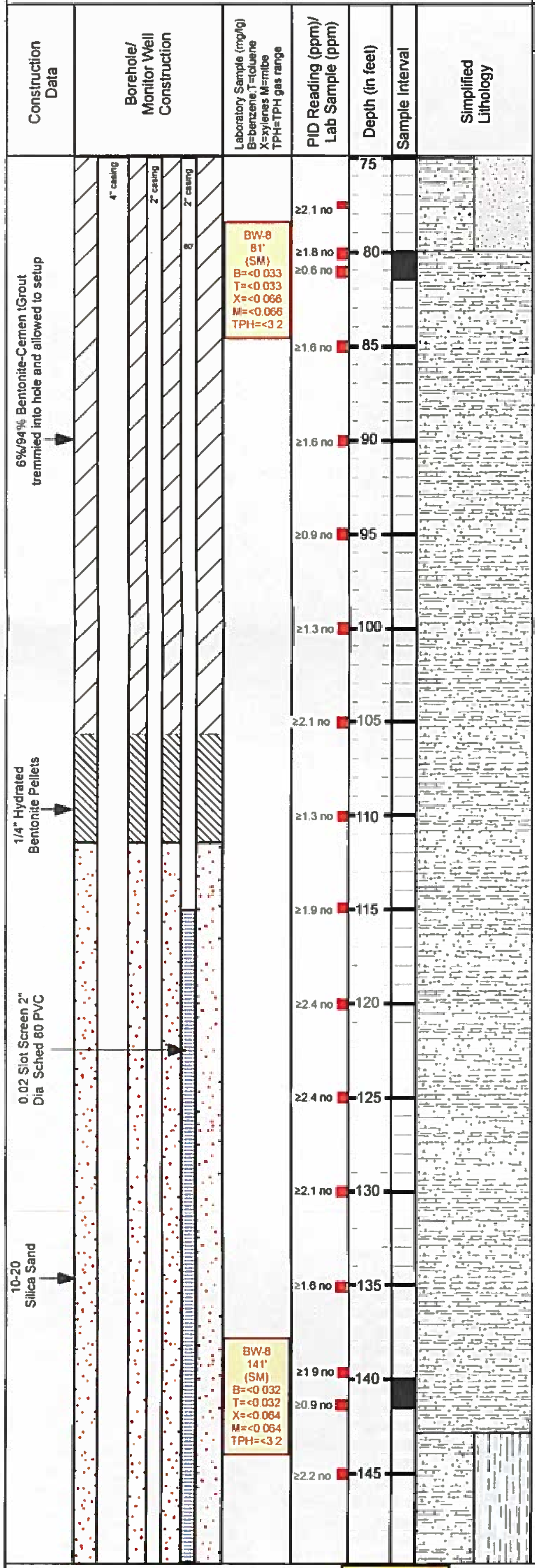
63.0'-70.0' Cuttings **(SM/ML)** Silt-very fine sand, light tan-brown **(10YR)** localized minor calcium carbonate, slightly moist, no apparent hydrocarbon odor.

70.0'-74.0' Cuttings **(SM)** silty very fine sand, light brown **(7.5YR)**, unconsolidated, slightly moist.

ALLSUPS #320

CLIENT: Allsups Petroleum, Inc.
Borehole ID: BW-8

DATE OF DRILLING: 11/10-14/15
LOGGED BY: WJB
DRILLER: John Chavez/Yellowjacket
BOREHOLE DIAMETER: 11 3/4"
DRILLING METHOD: ARCH
SAMPLING METHOD: Cuttings/Split Spoon
TOP OF CASING ELEV: na
DEPTH TO WATER: ~327'
TOTAL DEPTH: 356'
SHALLOW WELL: 2" Sched 80 PVC; Screen 115'-175'
INTERMEDIATE WELL: 2" Sched 80 PVC; Screen 200'-260'
DEEP WELL: 4" Sched 80 PVC; Screen 287'-347'
SURFACE COMPLETION: 18"X18" Manway w/Concrete Pad



USCS - LITHOLOGIC DESCRIPTION

74.0'-80.0' Cuttings (SM/SP) Fine to medium sand with trace silt - well sorted, slightly moist, unconsolidated no apparent hydrocarbon odor.

<**10:32 @ 80'** Let hole sit until 11:40 and collected split spoon drive sample for PID and lab analysis.>

80.0'-81.5' Split Spoon 1.5' sample. 0.0'-1.5' (SM) Silty very fine to fine sand, unconsolidated, slightly moist, no apparent hydrocarbon odor.

<Blowdown on hole at 11:45 = 1.2 ppm/v, no apparent hydrocarbon odor.>

81.5'-143' Cuttings (SM) Silty-very fine sand. Light reddish-brown (7.5YR) unconsolidated, slightly moist, well sorted, no apparent hydrocarbon odor.

<13:39 Let hole equilibrate at 140' - collected split spoon at 15:10.>

140.0'-141.5' Split Spoon 1.5' sample. (SM) (7.5YR) Very fine to fine sand with minor silt, unconsolidated to weakly disseminated calcium carbonate cemented, slightly moist, no apparent hydrocarbon odor.

143'-152' Cuttings (SM/ML) Silt content higher than surrounding with very fine sand, unconsolidated, no apparent hydrocarbon odor, slightly moist.

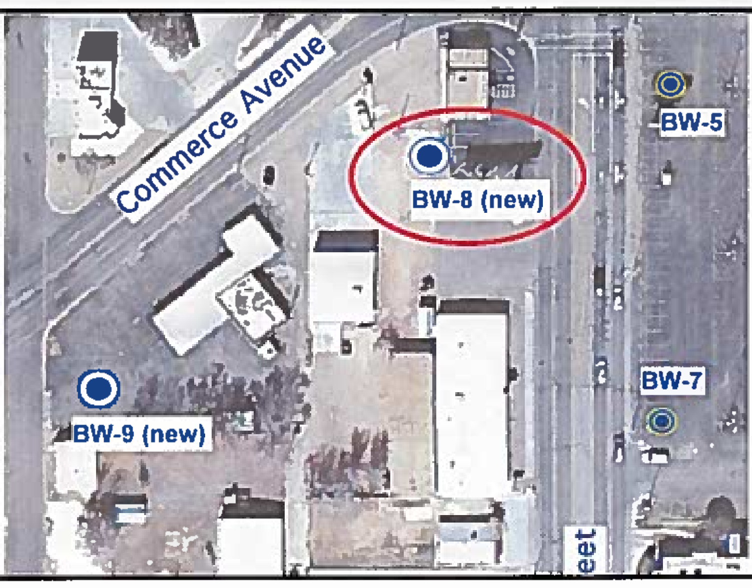
<15:30-16:45 Rig shutdown @ 150' for 75 minutes. Blowdown - 2.9 ppm/v).

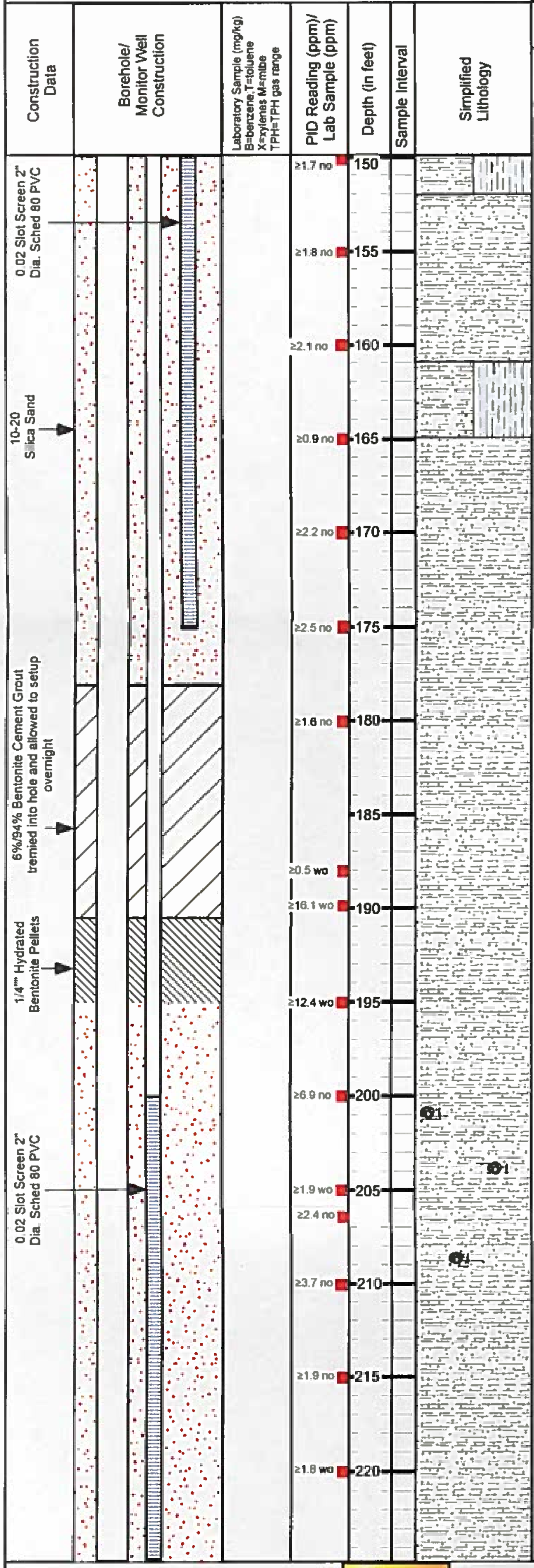
ALLSUPS #320

CLIENT: Allsups Petroleum, Inc.

Borehole ID: BW-8

DATE OF DRILLING: 11/10-14/15
LOGGED BY: WJB
DRILLER: John Chavez/Yellowjacket
BOREHOLE DIAMETER: 11 3/4"
DRILLING METHOD: ARCH - Stratex / Air Rotary
SAMPLING METHOD: Cuttings/Split Spoon
TOP OF CASING ELEV: na
DEPTH TO WATER: ~327'
TOTAL DEPTH: 356'
SHALLOW WELL: 2" Sched 80 PVC; Screen 115'-175'
INTERMEDIATE WELL: 2" Sched 80 PVC; Screen 200'-260'
DEEP WELL: 4" Sched 80 PVC; Screen 287'-347'
SURFACE COMPLETION: 18"X18" Manway w/Concrete Pad





USCS - LITHOLOGIC DESCRIPTION

152'-161' Cuttings (SM) Silty very fine to fine sand, (7.5YR) brown, slightly moist, unconsolidated, no apparent hydrocarbon odor.

161'-165' Cuttings (SM/ML) As above, silt - very fine sand (7.5YR).

165'-238' Cuttings (SM) (7.5YR) Silty very fine to fine sand, unconsolidated, slightly moist, no apparent hydrocarbon odor.

<188' Rig breakdown, hole sat overnight, blowdown at 10:50 = 0.5 ppm/v, no apparent hydrocarbon odor.>

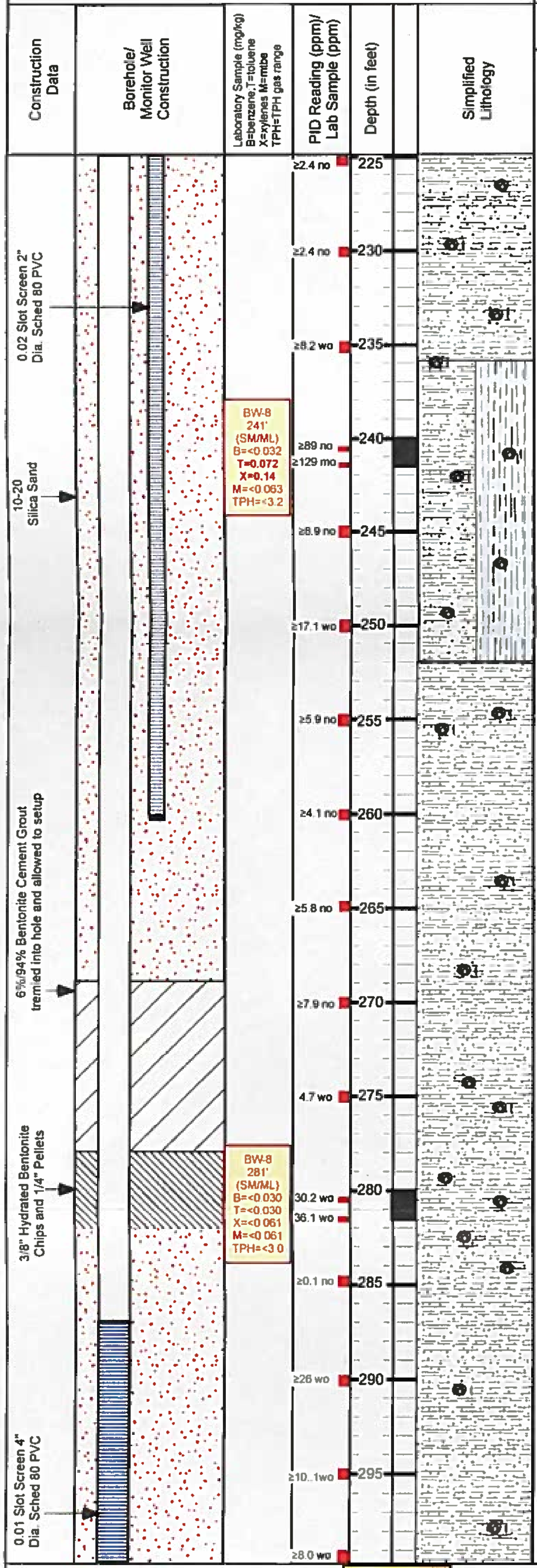
~200 to 210', minor calcium carbonate cemented, small sandstone nodules.

210'-240' Occasional weathered turpene-like hydrocarbon odor in off gas from hole/cyclone 2-10 ppm/v.

ALLSUPS #320

CLIENT: Allsups Petroleum, Inc.
Borehole ID: BW-8

DATE OF DRILLING: 11/10-14/15
LOGGED BY: WJB
DRILLER: John Chavez/Yellowjacket
BOREHOLE DIAMETER: 11 3/4"
DRILLING METHOD: ARCH
SAMPLING METHOD: Cuttings/Split Spoon
TOP OF CASING ELEV: na
DEPTH TO WATER: ~327'
TOTAL DEPTH: 356'
SHALLOW WELL: 2" Sched 80 PVC; Screen 115'-175'
INTERMEDIATE WELL: 2" Sched 80 PVC; Screen 200'-260'
DEEP WELL: 4" Sched 80 PVC; Screen 287'-347'
SURFACE COMPLETION: 18"X18" Manway w/Concrete Pad



USCS - LITHOLOGIC DESCRIPTION

236'-252' (SM/ML) (7.5YR) silt-very fine sand, well sorted, slightly moist with minor calcium carbonate cemented sandstone (SAS) nodules.

<12:30 Hole at 240', stop for lunch and to let hole equilibrate. 14:00 Collected split spoon at 240'-241.5', weathered hydrocarbon odor.>

240.0'-241.5' Split Spoon 1.4' sample. (SM/ML) (7.5YR) Light brown silt to very fine sand, well sorted, slightly moist with ~2-3% calcium carbonate cemented (SAS) nodules, degraded hydrocarbon odor.

<245' Rig down for 25 minutes, blowdown = 68 ppm/v, moderate weathered hydrocarbon odor.>

252'-309' Cuttings (SM) Silty very fine to fine sand (5YR to 7.5 YR) Reddish-light brown, occasional (SAS) concretions, slightly moist.

<270' measured vapor levels in adjacent deep wells BW-4d and BW-5d= 0.01 and 0.07 ppm/v, respectively. Wells under negative pressure.>

280.0' -281.5' Split Spoon 1.4' sample. (SM) (7.5YR) Light brown, silty very fine to fine sand with several prominent concretions, slightly moist, weak hydrocarbon odor, localized (SM/ML) finer grained silt-very fine sand intervals.

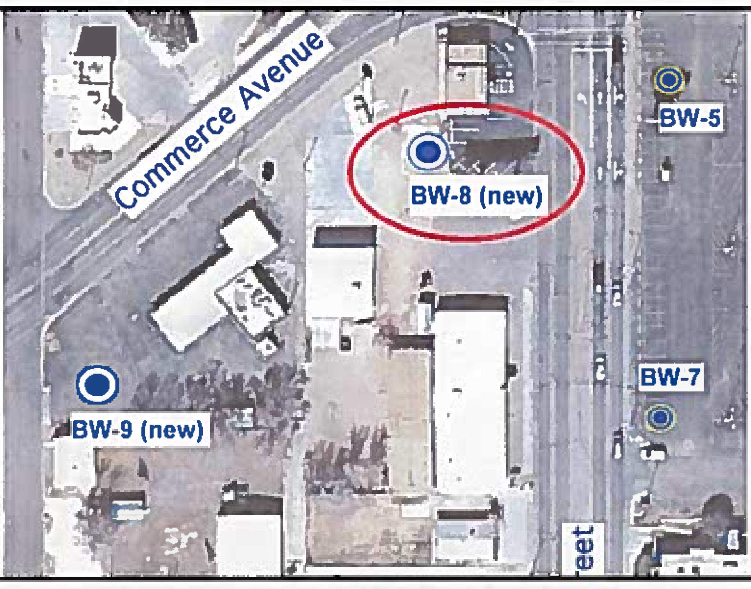
(5YR) Light reddish brown below ~300' depth.

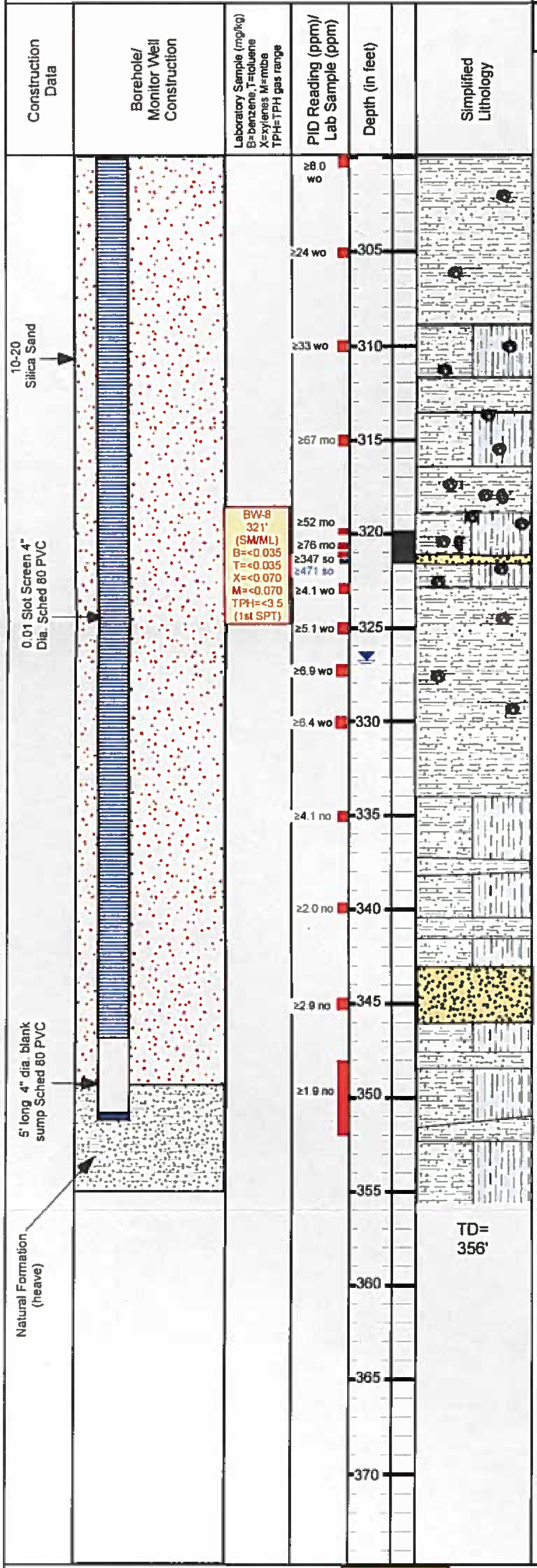
ALLSUPS #320

CLIENT: Allsups Petroleum, Inc.
Borehole ID: BW-8

page 5 of 5

DATE OF DRILLING: 11/10-14/15
LOGGED BY: WJB
DRILLER: John Chavez/Yellowjacket
BOREHOLE DIAMETER: 11 3/4"
DRILLING METHOD: ARCH - Stratex / Air Rotary
SAMPLING METHOD: Cuttings/Split Spoon
TOP OF CASING ELEV: na
DEPTH TO WATER: ~327'
TOTAL DEPTH: 356'
SHALLOW WELL: 2" Sched 80 PVC; Screen 115'-175'
INTERMEDIATE WELL: 2" Sched 80 PVC; Screen 200'-260'
DEEP WELL: 4" Sched 80 PVC; Screen 287'-347'
SURFACE COMPLETION: 18"X18" Manway w/Concrete Pad





USCS - LITHOLOGIC DESCRIPTION

309'-323' Cuttings (**SM**) silty fine sand with (**SM/ML**)silt-very fine sand intebeds, gradational contacts, (**5YR**) reddish brown, slightly moist, degraded hydrocarbon odor, concretions common-especially in lower 5', possible thin laminar calcium carbonate cemented (**SAS**) sandstone zones.

320.0'-321.5' Split Spoon 1st sample collected 11/12/15 at 19:02 1.5' sample. 0.0'-1.5' (**ML/SM**) Silt-very fine sand (**7.5YR**) light reddish brown, unconsolidated, slightly moist with moderate highly weathered hydrocarbon odor (more volatile compounds partially stripped out from drilling procedure). Several 1-2" calcium carbonate cemented (**SAS**) nodules.

Stopped drilling at 320' 11/12/15 at 19:02, let hole sit overnight-collected 2nd split spoon from same depth and continued drilling to total depth.

320.0'-321.5' Split Spoon 2nd sample collected 11/13/15 at 8:35 - refusal 2 times - calcium carbonate zone, dense, hard, not enough sample for lab - PID =471 ppm/v, moderate to strong hydrocarbon odor, ~1" (**SM/ML**) in spoon. Note: borehole under vacuum - atmospheric air going into borehole.

323'-334' Cuttings (**SM**) (**5YR**) Reddish-brown silty very fine to fine sand with some concretions but less than above, moist below ~325', degraded hydrocarbon odor, present.

334'-343' Cuttings (**SM/ML**) Very fine to fine sand-silt, moist, **5YR**) red-brown, weathered hydrocarbon odor at top with localized (**SM**) silty very fine to fine sand intervals (borehole not making much water - having to add water to retrieve cuttings).

343'-346' Cuttings Very hard zone, very fine to fine grained sandstone (**SAS**) light tan-brown (**7.5YR**) calcium carbonate cemented.

346'-356' Cuttings Poor cuttings return - soupy, (**ML/SM**) silt-very fine sand, (**7.5**) light brown, no apparent hydrocarbon odor, water saturated; likely interbedded (**SM**), coarse grained zones as above.

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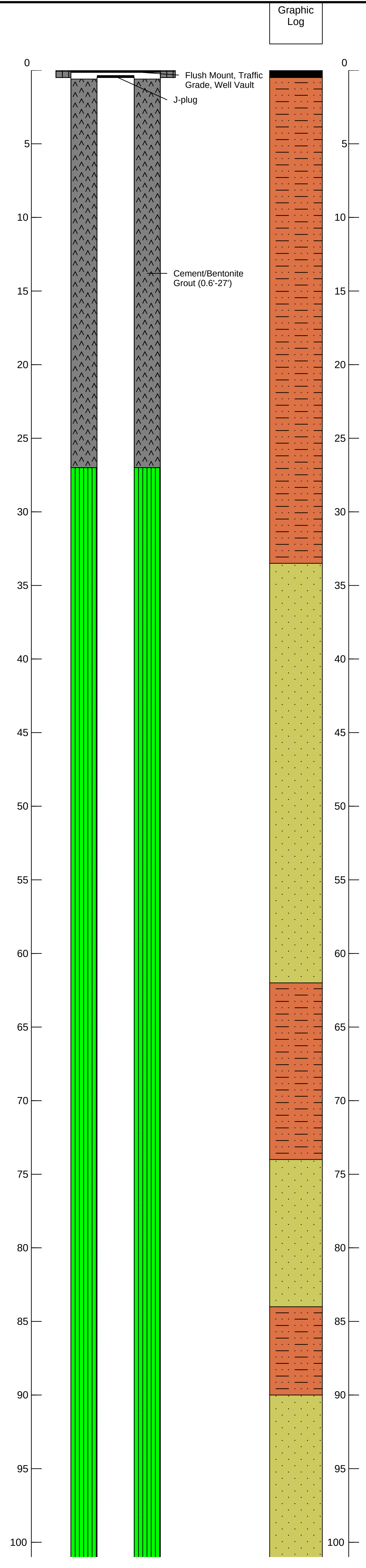


PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	0-15	NA	0-0.5	Asphalt
0.0			SC	0.5-33.5	Clayey sand - dark brown (7.5YR 3/3), fine grained, well sorted, subrounded to subangular, moderate to high plasticity, soft, slightly moist, odorless.
			SC		Clayey sand - as above.
			SC		Clayey sand - strong brown (7.5YR 5/6), fine grained, well sorted, subrounded to subangular, moderate plasticity, stiff, dry, mottled with Caliche - pink (7.5YR 8/3), fine to medium grained, moderately well sorted, rounded to subrounded, hard, moderately
0.0			SC		Clayey sand - same as above.
	100	15-25	SC		Clayey sand - same as above.
0.3			SC		Clayey sand - increased caliche, otherwise as above.
	100	25-35	SC		Caliche - pink (5YR 7/4), fine grained, well sorted, subangular, low plasticity, loose to somewhat consolidated, dry, odorless.
0.0			SC		Caliche - as above.
			SP	33.5-62	Sand - yellowish red (5YR 5/8), fine grained, well sorted, rounded to subrounded, non-plastic, loose, dry, odorless.
	100	35-45	SP		Sand - caliche stringers - otherwise as above.
0.0			SP		Sand - as above.
			SP		Sand - yellowish red (5YR 5/6), fine grained, well sorted, subrounded, non-plastic, loose, dry, calcium carbonate , odorless.
	100	45-55	SP		Sand - as above.
0.0			SP		Sand - pink (7.5YR 7/4), fine grained, well sorted, subangular, non-plastic, loose, dry, increased calcium carbonate, odorless.
			SP		Sand - reddish yellow (5YR 6/6), fine grained, well sorted, subrounded, non-plastic, loose, dry, calcium carbonate.
	100	55-65	SP		Sand - as above.
0.0			SP		Sand - as above.
			SC	62-74	Caliche - Sandstone - pinkish gray (7.5YR 7/2), fine grained, well sorted, subangular, calcium carbonate cemented, dry, odorless. (Very hard drilling).
	100	65-75	SC		Caliche - as above.
0.0			SC		Caliche - as above (less difficult drilling).
			SP	74-84	Sand - pink (7.5YR 7/4), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless.
	10	75-85			No recovery.
0.0					No recovery.
			SC	84-90	Caliche - sandstone - pinkish gray (7.5YR 7/2), fine grained, well sorted, subangular, calcium carbonate cement, dry, odorless. (very hard drilling - core pulverized).
	50	85-95			No recovery.
1.7			SP	90-173	Sand - light brown (7.5YR 6/4), fine grained, well sorted, subangular to angular, non-plastic, loose, dry, odorless, minor calcium carbonate.
	100	95-105	SP		Sand - no calcium carbonate, otherwise as above.
0.1			SP		Sand - as above.

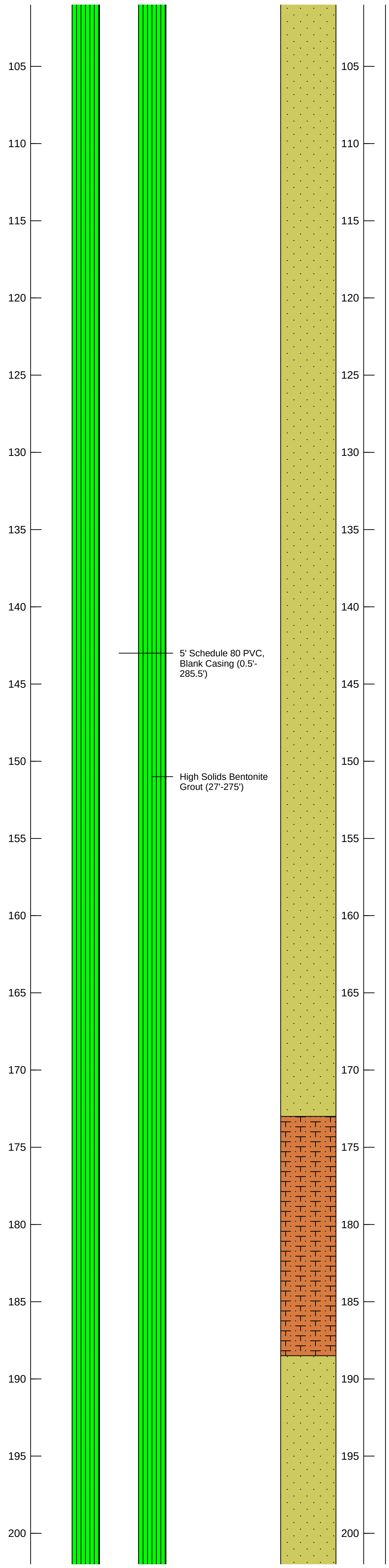
Geologist: P. Feltman and J. Fisher
Driller: Yellow Jacket Drilling
Drilling start date: 5/29/19
Well completion date: 6/8/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244812.45
Easting: 884412.98
Elevation: 4274.64

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-11

Daniel B. Stephens & Associates, Inc.
8/25/2019
JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	105-115	SP		Sand with clay - pink (7.5YR 7/4), fine grained, well sorted, subangular to angular, low plasticity, loose, dry, odorless. (water added for drilling).
6.0			SP		Sand - as above.
	100	115-125	SP		Sand - light brown (7.5YR 6/3), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry.
0.8			SP		Sand - as above.
	100	125-135	SP		Sand - as above.
0.4			SP		Sand - as above.
	100	135-145	SP		Sand - as above.
1.0			SP		Sand - calcium carbonate, otherwise as above. (Driller reports hard drilling)
	100	145-155	SP		Sand - light brown (7.5YR 6/3), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry.
0.4			SP		Sand - as above.
	100	155-165	SP		Sand - as above.
3.3			SP		Sand - as above.
	100	165-175	SP		Sand with clay - brown (7.5YR 5/4), fine grained, well sorted, subangular to angular, low to moderate plasticity, loose, dry, odorless.
0.1			SP		Sand - as above.
			SM	173-188.5	Silty sand - pink (7.5YR 7/4), fine grained, well sorted, subrounded, non-plastic, loose, slightly moist, odorless.
	100	175-185	SM		Silty sand - subrounded to angular, otherwise as above.
0.5			SM		Silty sand - as above.
	100	185-195	SM		Silty sand - as above.
			SM		Silty sand - very dark grayish brown (10YR 3/2), fine grained, well sorted, subrounded to subangular, low plasticity, possibly cemented (pulverized), slightly moist, odorless, no calcium carbonate.
			SP	188.5-360	Sand - light brown (7.5YR 6/4), fine grained, well sorted, subangular, non--plastic, loose, slightly moist, odorless.
0.0			SP		Sand - as above.
	100	195-205	SP		Sand - as above.
0.3			SP		Sand - as above.

Geologist: P. Feltman and J. Fisher
Driller: Yellow Jacket Drilling
Drilling start date: 5/29/19
Well completion date: 6/8/19

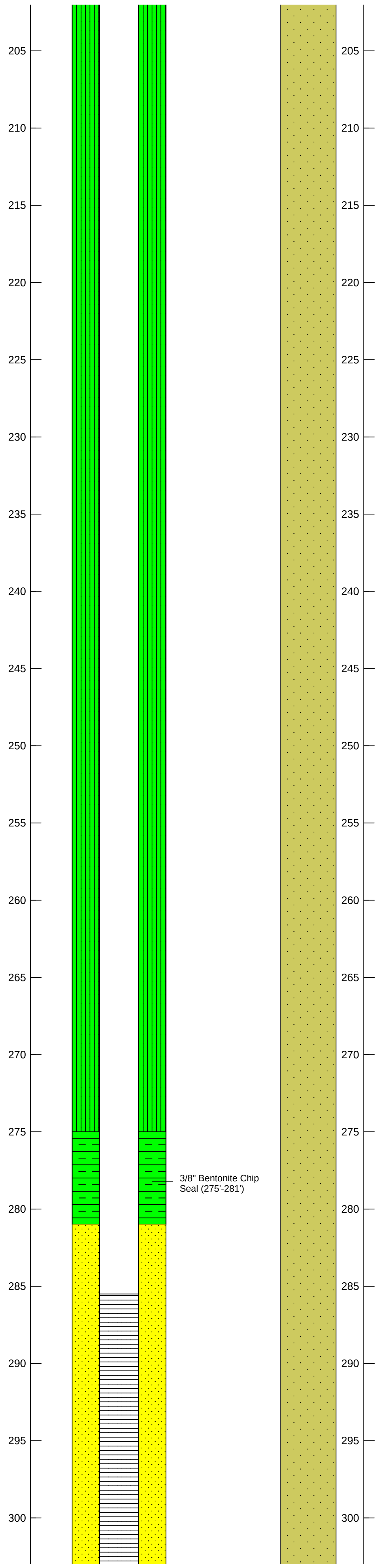
Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244812.45 Elevation: 4274.64
Easting: 884412.98

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-11

Daniel B. Stephens & Associates, Inc.
8/25/2019 JN DB18.1157.00

Graphic Log



	PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
205		100	205-215	SP		Sand - as above.
210	0.5			SP		Sand - as above.
215		100	215-225	SP		Sand - as above.
220	0.7			SP		Sand - as above.
				SP		Sand with clay - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, low plasticity, loose, lightly moist, odorless.
				SP		Sand - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, non-plastic, loose, slightly moist, odorless.
225		100	225-235	SP		Sand - as above.
230	1.2			SP		Sand - with CaCO3 concretions, otherwise as above.
235		100	235-245	SP		Sand - with CaCO3 concretions as above.
240	1.3			SP		Sand - with CaCO3 concretions as above.
				SP		Sand - with CaCO3 concretions - pinkish gray (5YR 7/2), fine grained, well sorted, rounded, dry, odorless.
245		100	245-255	SP		Sand with CaCO3 concretions - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, non-plastic, slightly moist, odorless.
				SP		Sand with clay - pinkish white (5YR 8/2), fine grained, well sorted, rounded, low plasticity, CaCO3 (caliche), dry, odorless.
				SP		Sand with CaCO3 concretions - light brown (7.5YR 6/4), fine grained, well sorted, subroundd to subangular, non-plastic, slightly moist, odorless.
250	0.1			SP		Sand with CaCO3 concretions - as above.
255		100	255-265	SP		Sand with CaCO3 concretions - as above.
260	0.0			SP		Sand - light brown (7.5YR 6/4), fine rained, well sorted, subrounded to subangular, non-plastic, loose, slghtly moist, odorless.
				SP		Sand with CaCO3 concretions - otherwise as above.
265		100	265-275	SP		Sand with CaCO3 concretions - as above.
270	0.3			SP		Sand with CaCO3 concretions - as above.
275		100	275-285	SP		Sand with CaCO3 concretions - as above.
280	1.7			SP		Sand with CaCO3 concretions - as above.
285		100	285-295	SP		Sand with CaCO3 concretions - as above.
290	0.0			SP		Sand with CaCO3 concretions - as above.
295		100	295-305	SP		Sand with CaCO3 concretions - as above.
300	0.0			SP		Sand with CaCO3 concretions - as above.

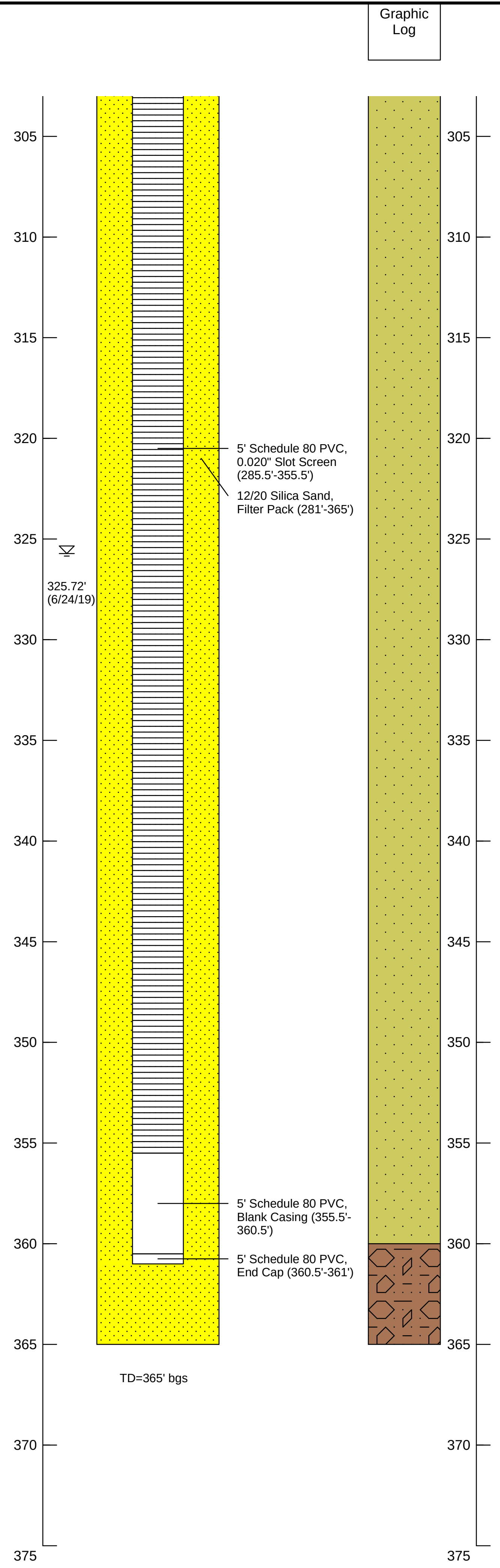
Geologist: P. Feltman and J. Fisher
Driller: Yellow Jacket Drilling
Drilling start date: 5/29/19
Well completion date: 6/8/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244812.45 Elevation: 4274.64
Easting: 884412.98

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-11

Daniel B. Stephens & Associates, Inc.
8/25/2019 JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	305-315	SP		Sand with CaCO3 concretions - as above.
0.3			SP		Sand with CaCO3 concretions - as above.
	100	315-325	SP		Sand with CaCO3 concretions - as above, damp to moist, no HC odor.
3.5			SP		Sand with CaCO3 concretions - as above, moist, no HC odor.
	100	325-335	SP		Sand with CaCO3 concretions - as above, moist, no HC odor.
257.6			SP		Sand with CaCO3 concretions - as above, wet, no HC odor.
	100	335-345	SP		Sand with CaCO3 concretions - as above, wet, no HC odor.
5.6			SP		Sand with CaCO3 concretions - as above, wet, no HC odor.
	100	345-355	SP		Sand with CaCO3 concretions - as above, wet, no HC odor.
3.3			SP		Sand with CaCO3 concretions - as above, wet, no HC odor.
	100	355-365	SP		Sand with CaCO3 concretions - as above, wet, no HC odor.
			SW-SC	360-365	Gravelly sand with clay and cobbles - light brown (7.5YR 6/4), fine to medium grained, moderately well sorted, loose, granitic gravels and cobbles up to 2.5", wet, no HC odor.

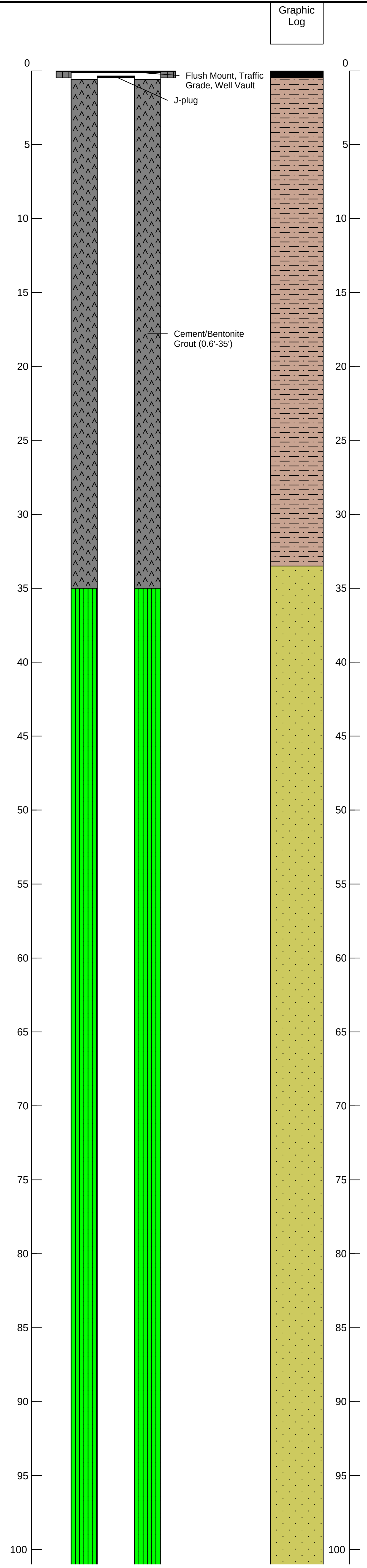
Geologist: P. Feltman and J. Fisher
Driller: Yellow Jacket Drilling
Drilling start date: 5/29/19
Well completion date: 6/8/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244812.45 Elevation: 4274.64
Easting: 884412.98

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-11

Daniel B. Stephens & Associates, Inc.
8/25/2019 JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	0-15	NA	0-0.5	Asphalt.
0.0			CL	0.5-33.5	Sandy clay - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded, moderate to high plasticity, stiff, dry, odorless, calcium carbonate reaction.
			CL		Sandy clay - same as above.
0.0	100	15-25	CL		Sandy clay - same as above.
0.0			CL		Sandy clay - same as above.
	100	25-35	CL		Sandy clay - same as above.
0.2			CL		Sandy clay - same as above.
			CL		Sandy clay (caliche) - pinkish white (7.5YR 8/2), fine grained, well sorted, subrounded to subangular, moderate plasticity, stiff, sry, odorless.
			SP	33.5-167	Sand - strong brown (7.5YR 5/6), fine grained,well sorted, subrounded to subangular, non-plastic, loose, dry, odorless, partially cemented with calcium carbonate.
	100	35-45	SP		Sand - as above.
0.0			SP		Sand - as above.
	100	45-55	SP		Sand - as above.
0.7			SP		Sand - light reddish brown (5YR 6/4), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, odorless, calcium carbonate cement and concretions.
	100	55-65	SP		Sand - as above.
0.1			SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded to subangular,non-plastic, loose, dry, odorless, calcium carbonate concretions.
	100	65-75	SP		Sand - as above.
0.3			SP		Sand - as above.
	100	75-85	SP		Sand - as above.
4.9			SP		Sand - as above.
			SP		Sand - light gray (10YR 7/2), fine grained, well sorted, subrounded to subangular, non-plastic, possibly cemented (hard drilling), pulverized, dry, odorless.
	100	85-95	SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded to subangular,non-plastic, loose, dry, odorless, calcium carbonate concretions.
2.4			SP		Sand - as above.
	100	95-105	SP		Sand - as above.
2.8			SP		Sand - as above.

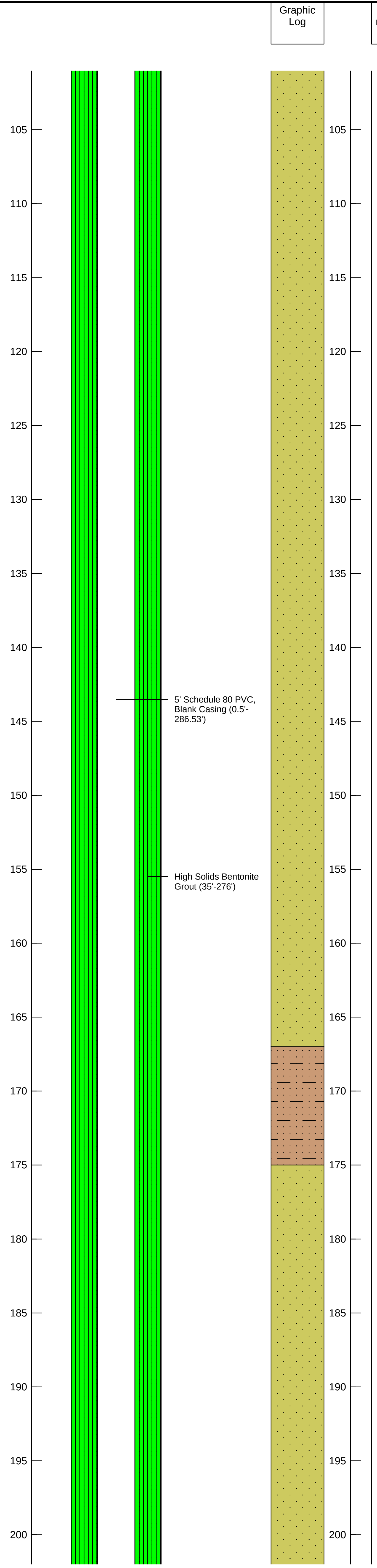
Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 7/9/19 Well completion date: 7/20/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245128.28 Elevation: 4277.60
Easting: 884520.19

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-12

Daniel B. Stephens & Associates, Inc.
9/5/2019 JN DB18.1157.00



	PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
105		100	105-115	SP		Sand - as above.
110	2.0			SP		Sand - as above interbedded with caliche - pinkish white (7.5YR 8/2), fine grained, well sorted, subrounded to subangular, calcium carbonate cement, dry, odorless.
115		100	115-125	SP		Sand - as above.
120	2.8			SP		Sand - as above.
125		100	125-135	SP		Sand - as above.
130	1.6			SP		Sand - as above.
135		100	135-145	SP		Sand - as above.
140	2.8			SP		Sand - as above.
145		100	145-155	SP		Sand - as above.
150	0.4			SP		Sand - as above.
155		100	155-165	SP		Sand - as above.
160	6.6			SP		Sand - as above.
165		100	165-175	SP		Sand - as above.
				SP-SC	167-175	Sand with clay - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, low plasticity, loose, dry, odorless.
170	1.8			SP-SC		Sand with clay - as above.
175		100	175-185	SP	175-355	Sand - yellowish red (7.5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, calcium carbonate concentrations, dry, odorless.
180	1.6			SP		Sand - as above.
185		100	185-195	SP		Sand - as above.
190	2.6			SP		Sand - as above.
195		100	195-205	SP		Sand - as above.
200	3.5			SP		Sand - as above.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 7/9/19 Well completion date: 7/20/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245128.28 Elevation: 4277.60
Easting: 884520.19

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-12

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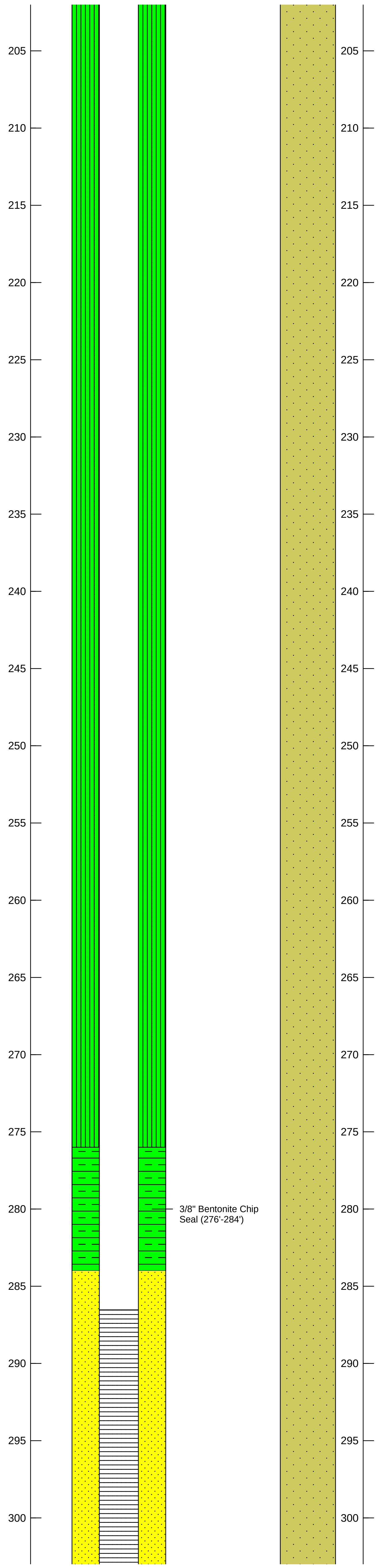

Depth	PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
205		100	205-215	SP		Sand - as above.
210	1.3			SP		Sand - as above.
215		100	215-225	SP		Sand - no calcium carbonate concretions, otherwise as above.
220	1.1			SP		Sand - as above.
225		100	225-235	SP		Sand - as above.
230	0.4			SP		Sand - as above.
235		100	235-245	SP		Sand - as above.
240	0.3			SP		Sand - as above.
245		100	245-255	SP		Sand - as above.
250	2.1			SP		Sand - as above.
255		100	255-265	SP		Sand - as above.
260	6.6			SP		Sand - as above.
265		100	265-275	SP		Sand - as above.
270	1.0			SP		Sand - as above.
275		100	275-285	SP		Sand - as above.
280	0.4			SP		Sand - as above.
285		100	285-295	SP		Sand - solvent odor - otherwise as above.
290	0.2			SP		Sand - as above, solvent odor.
295		100	295-305	SP		Sand - as above.
300	2.4			SP		Sand - as above.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 7/9/19 Well completion date: 7/20/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245128.28 Elevation: 4277.60
Easting: 884520.19

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-12

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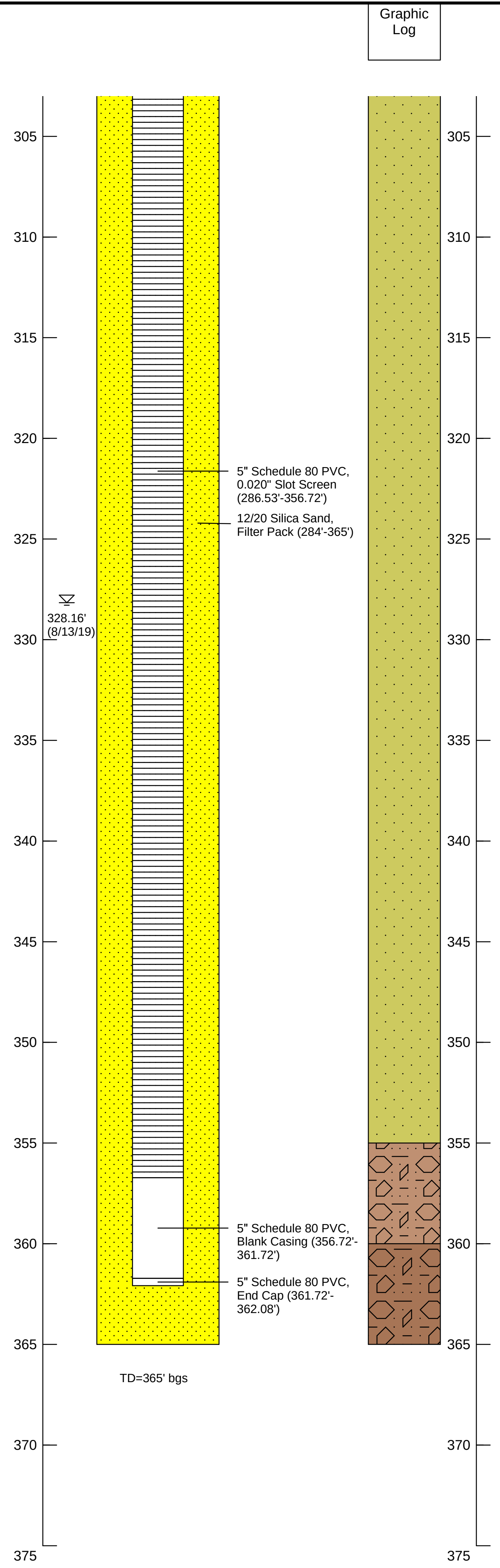

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	305-315	SP		Sand - as above.
20.6			SP		Sand - as above.
	100	315-325	SP		Sand - as above.
12.6			SP		Sand - as above with slight HC odor.
3.5	100	325-335	SP		Sand - as above.
			SP		Sand - as above but moist and yellowish red (5YR 5/6).
NA	100	335-345	SP		Sand - as above but wet.
			SP		Sand - as above.
	100	345-355	SP		Sand - as above.
			SP		Sand - as above with trace low plasticity clay.
	100	355-365	SW	355-360	Gravelly sand - reddish brown (5YR 5/4), fine grained, fine gravels, well graded, subrounded, low plasticity (trace clay), medium dense, wet, odorless. Increasing gravel and clay content down section.
			SW-SC	360-365	Wackestone - (calcium carbonate cemented gravels and sand), very pale brown (10YR 7/3), fine grained sand, fine gravels to cobbles, well graded, subrounded, dry, odorless.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 7/9/19 Well completion date: 7/20/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245128.28 Elevation: 4277.60
Easting: 884520.19

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-12

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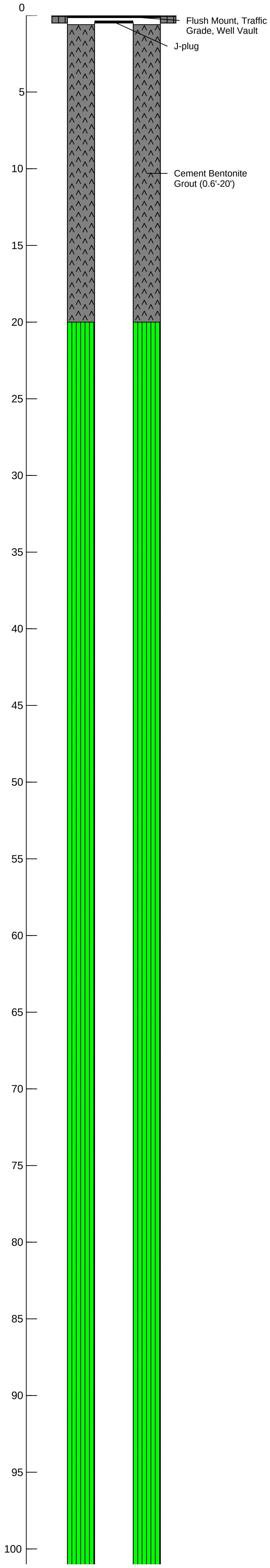

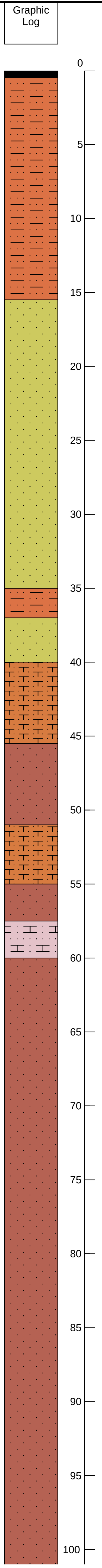

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	0-15	NA	0-0.5	Asphalt.
				0.5-15.5	
11.2			SC		Clayey sand - yellowish red (5YR 5/6), fine grained, well sorted, subrounded, low plasticity, loose to medium dense, slightly moist, no odor, calcium carbonate rich.
			SC		Clayey sand - light brown (7.5YR 6/4), less clay content, dry, otherwise as above.
13.1	100	15-25	SC		Clayey sand - as above.
			SP	15.5-35	Sand - yellowish red (5YR 5/8), fine grained, well sorted, subrounded, non-plastic, loose to partially cemented with cacium carbonate, dry, no odor.
			SP		Sand - pink (5YR 7/3), increased calcium carbonate, otherwise as above.
			SP		Sand - yellowish red (5YR 5/8), trace silt, otherwise as above.
19.2	100	25-30	SP		Sand - less calcium carbonate, loose, otherwise as above.
			SP		Sand - pink (5YR 7/3), calcium carbonate rich, partially cemented, otherwise as above.
	100	30-35	SP		Sand - as above.
18.1	100	35-45	SC	35-37	Clayey sand - yellowish red (5YR 5/6), fine grained, well sorted, subrounded, low plasticity, loose, dry, no odor.
			SP	37-40	Sand - yellowish red (5YR 5/6), very fine to fine grained, well sorted, subrounded, non-plastic, loose to partially cemented, calcium carbonate rich, dry, no odor.
			SM	40-45.5	Silty sand - little calcium carbonate and silty, loose, otherwise as above.
11.1	100	45-55	SM		Silty sand - as above.
			SP	45.5-51	Sand - yellowish red (5YR 5/6), fine, well sorted, subrounded, non-plastic, loose, dry, no odor.
			SM	51-55	Silty sand - light brown (7.5YR 6/4), very fine, well sorted, subrounded, non-plastic, loose, dry, no odor, claicum carbonate rich.
			SM		Silty sand - little calcium carbonate, otherwise as above.
20.7	100	55-60	SP	55-57.5	Sand - light brown (75.YR 6/4), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, no odor, calcium carbonate nodules..
			NA	57.5-60	Caliche.
	100	60-65	SP	60-345	Sand - pinkish gray (5YR 7/2), fine grained, well sorted, subrounded to subangular, non-plastic, loose to partially cemented, calcium carbonate rich, dry, no odor.
30.5	100	65-75	SP		Sand - as above.
			SP		Sand - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, non-plastic, loose to partially cemented, calcium carbaonate rich, dry, no odor.
			SP		Sand - reddish yellow (7.5 YR 6/6), trace silt, little calcium carbonate, otherwise as above.
20.1	100	75-85	SP		Sand - as above.
12.1	100	85-95	SP		Sand - no calcium carbonate, no trace silt, otherwise as above.
0.4	100	95-105	SP		Sand - as above.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 8/4/19
Well completion date: 8/13/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244960.74
Easting: 884269.96
Elevation: 4275.82

FORMER Y STATION
CLOVIS, NEW MEXICO
MW-13

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9/5/2019
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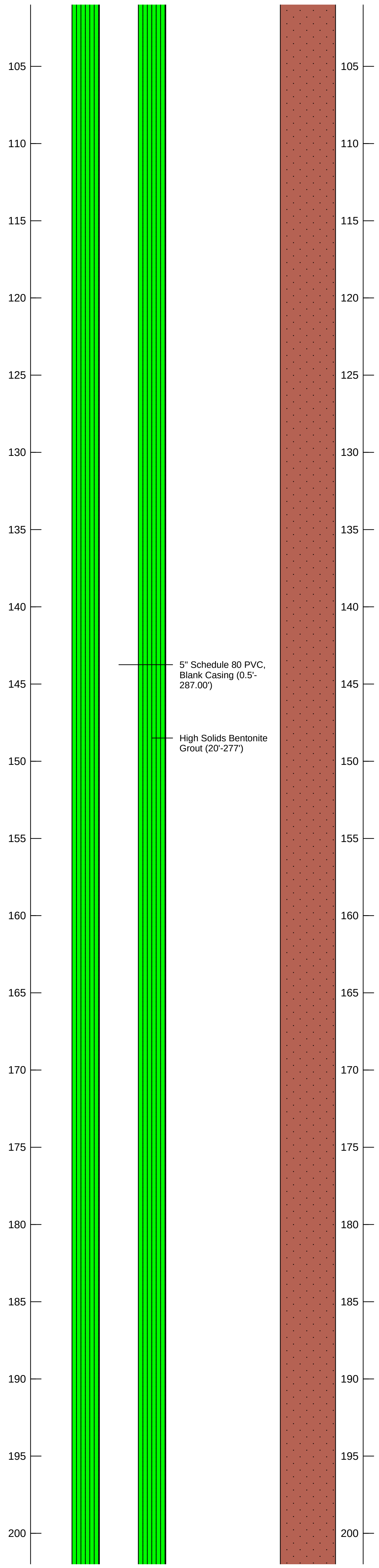

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
19.6	100	105-115	SP		Sand - claiche stringers from 106'-108', otherwise as above.
6.1	100	115-125	SP		Sand - as above.
14.1	100	125-135	SP		Sand - as above.
8.7	100	135-145	SP		Sand - as above.
12.1	100	145-155	SP		Sand - as above.
4.7	100	155-165	SP		Sand - as above.
4.1	100	165-175	SP		Sand - as above.
6.7	100	175-185	SP		Sand - as above.
4.1	100	185-195	SP		Sand - calcium carbonate cemented at 186', calcium carbonate cemented gravels and cobbles up to 3" at 189', otherwise as above.
3.3	100	195-205	SP		Sand - as above.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 8/4/19
Well completion date: 8/13/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
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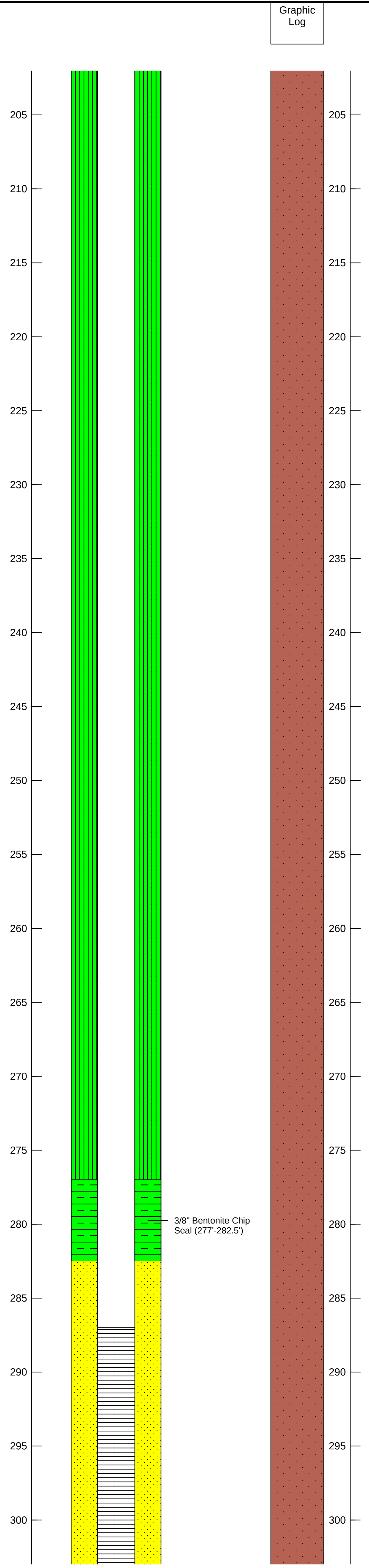

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
4.2	100	205-215	SP		Sand - as above.
3.4	100	215-225	SP		Sand - as above.
1.9	100	225-235	SP		Sand - cemented cobbles at 230'-235', otherwise as above.
1.6	100	235-245	SP		Sand - as above.
3.3	100	245-255	SP		Sand - with cemented cobbles and gravels at 245' and 250', otherwise as above.
1.1	100	255-265	SP		Sand - as above.
5	100	265-275	SP		Sand - cemented gravels and cobbles up to 3", otherwise as above.
5.9	100	275-285	SP		Sand with cemented gravels and cobbles as above.
1.1	100	285-295	SP		Sand - as above.
1.5	100	295-305	SP		Sand - red (2.5YR 5/8), fine to medium grained, with calcarius cementations, some well cemented cobbles present, non-plastic, no odor, dry.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 8/4/19
Well completion date: 8/13/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244960.74 Elevation: 4275.82
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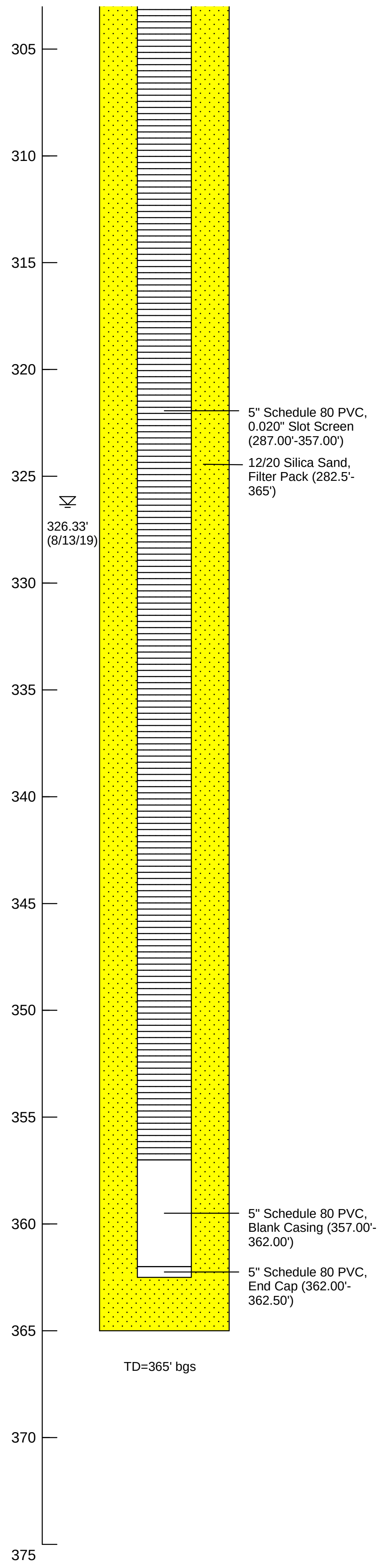
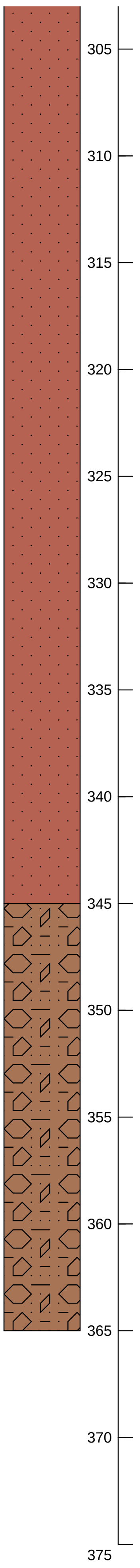


Graphic Log



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
9.7	100	305-315	SP		Sand - moist, increasing indurated sandstone, fine to medium grained, quartz, subrounded to rounded.
19.2	100	315-325	SP		Sand - reddish brown (2.5YR 4/4), fine to medium grained, quartz sand, rounded, trace silt, poorly compacted, weakly plastic, wet, no odor.
3.5	100	325-335	SP		Sand - yellowish red (5YR 5/6), fine to medium grained, well sorted, rounded, wet, no odor.
2	100	335-345	SP		Sand - as above.
NA	100	345-355	SC	345-365	Clayey sand - reddish brown (5YR 5/4), fine grained, well sorted, rounded, minor clay, wet, moderately plastic, no odor.
NA	100	355-365	SC		Clayey sand with gravel and cobbles - fine to coarse, subrounded, firm, slightly plastic, fine gravels to small cobbles, wet, no odor.

Geologist: P. Feltman and J. Fisher
Driller: Yellow Jacket Drilling
Drilling start date: 8/4/19
Well completion date: 8/13/19

Drilling method: Sonic
Borehole diameter: 9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244960.74 Elevation: 4275.82
Easting: 884269.96

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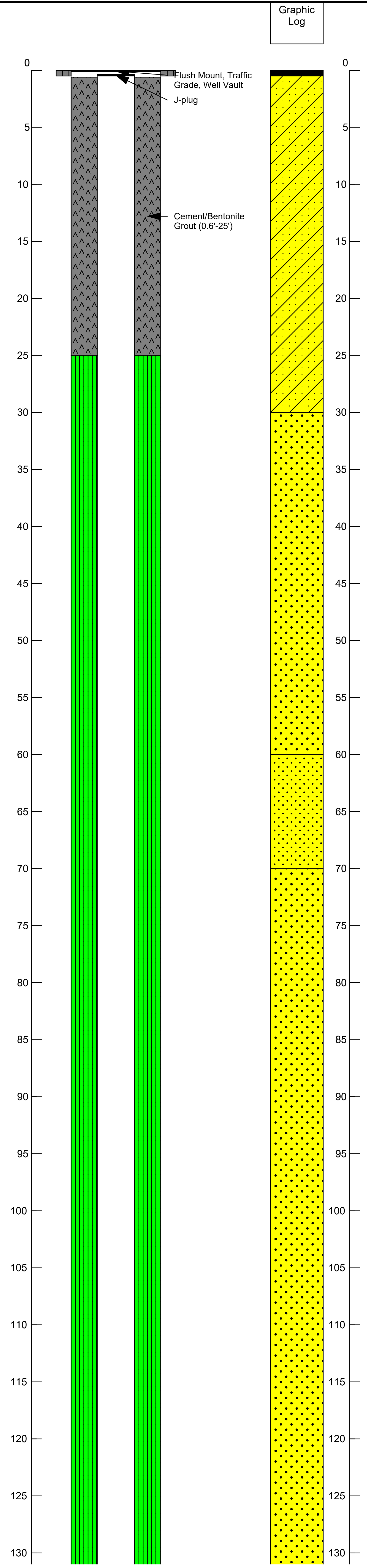

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
0.0	100	0-10	NA SC	0-0.5 0.5-30	Asphalt. Clayey sand - reddish yellow (5YR7/6), fine grained, poorly sorted, subrounded to subangular, moderate plasticity, soft, moist, no odor
0.0	100	10-20	SC		Clayey sand - as above
0.0	100	20-30	SC		Clayey sand - as above
0.0	100	30-40	SP	30-60	Sand - reddish yellow (5YR5/6), fine grained, well sorted, subrounded to subangular, well cemented, trace silt and clay, dry, no odor
0.0	100	40-50	SP		Sand - as above
0.0	100	50-60	SP		Sand - as above
1.9	100	60-70	SW	60-70	Sand - light reddish brown (5YR6/4), fine to coarse grained, poorly sorted, subrounded to subangular, partially cemented, trace silt, dry, no odor
1.3	100	70-80	SP	70-350	Sand - pink (5YR7/3), fine to medium grained, well sorted, subrounded to subangular, partially cemented, increased CaCO3, dry, no odor
0.8	100	80-90	SP		Sand - as above, light reddish brown (5YR6/4)
1.6	100	90-100	SP		Sand - pink (7.5YR7/4), fine grained, well sorted, subrounded to subangular, loose, little to no CaCO3, dry, no odor
1.4	100	100-110	SP		Sand - as above
2.1	100	110-120	SP		Sand - as above, some medium grained sand
0.7	100	120-130	SP		Sand - light brown (7.5YR6/4), very fine, well sorted, subrounded, loose, trace silt, dry, no odor
0.7	100	130-140	SP		Sand - as above, fine grained, decreased silt

Geologist: J. Fisher and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 5/29/2020
Well completion date: 5/29/2020

Drilling method: ARCH
Borehole diameter: 8.5"
Sampling method: Cuttings

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244755.74
Easting: 884811.25
Elevation: 4276.23

FORMER Y STATION
STATE LEAD SITE
CLOVIS, NEW MEXICO
MW-16

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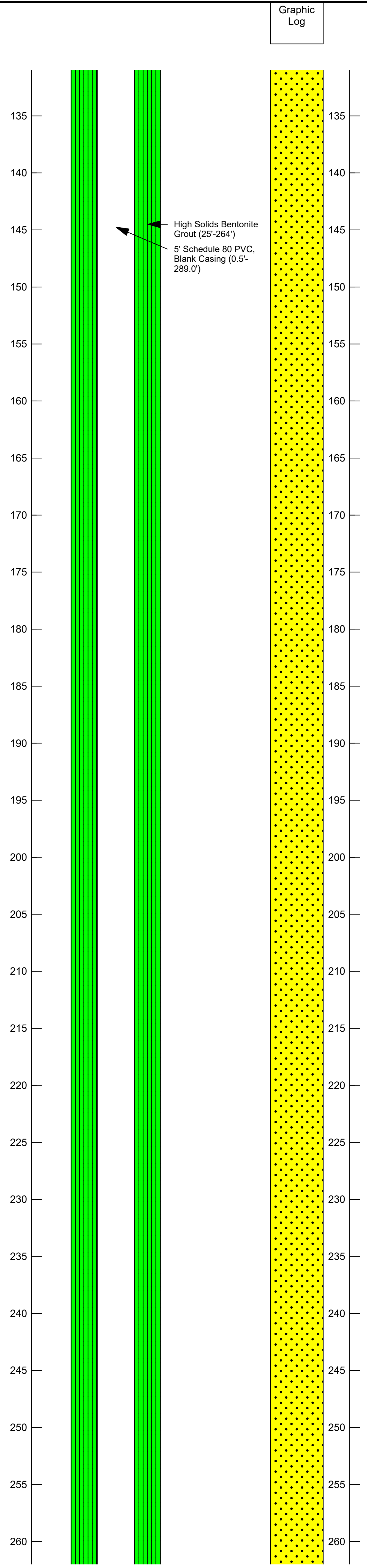

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
1.4	100	140-150	SP		Sand - as above, increased silt
1.8	100	150-160	SP		Sand - as above, decreased silt
1.4	100	160-170	SP		Sand - as above
2.7	100	170-180	SP		Sand - as above, increased silt
2.4	100	180-190	SP		Sand - as above
2.0	100	190-200	SP		Sand - as above
2.9	100	200-210	SP		Sand - as above
1.7	100	210-220	SP		Sand - as above
2.3	100	220-230	SP		Sand - as above
1.1	100	230-240	SP		Sand - as above
0.9	100	240-250	SP		Sand - as above
1.3	100	250-260	SP		Sand - as above
0.0	100	260-270	SP		Sand - as above, pink (7.5YR7/4), increased silt, trace CaCO3

Geologist: J. Fisher and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 5/29/2020
Well completion date: 5/29/2020

Drilling method: ARCH
Borehole diameter: 8.5"
Sampling method: Cuttings

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244755.74 Elevation: 4276.23
Easting: 884811.25

FORMER Y STATION
STATE LEAD SITE
CLOVIS, NEW MEXICO
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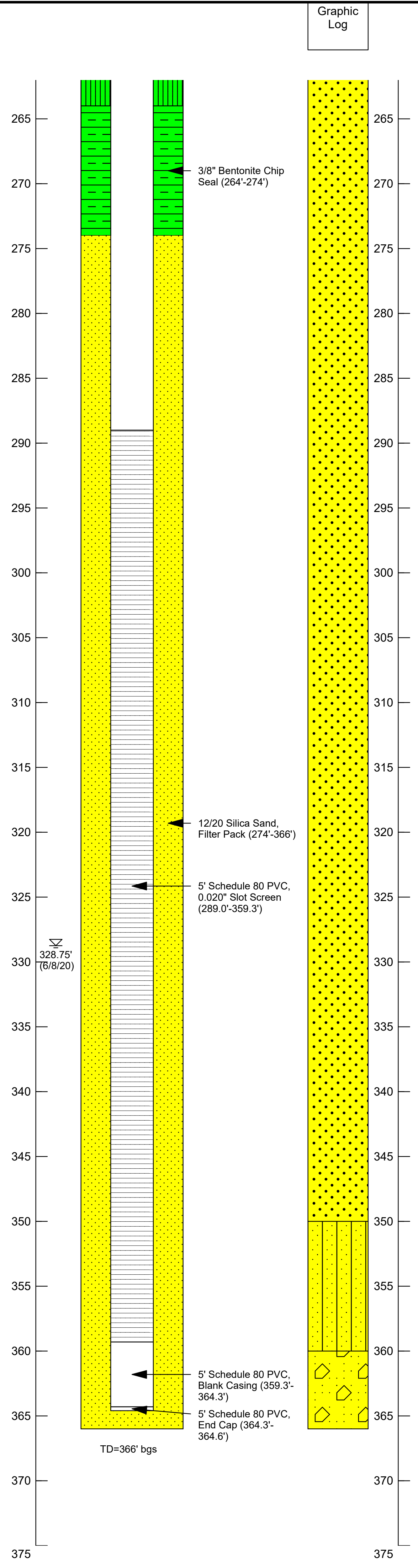
5/17/2021 JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
2.2	100	270-280	SP		Sand - as above, no CaCO3
5.1	100	280-290	SP		Sand - as above
1.6	100	290-300	SP		Sand - as above, reddish yellow (7.5YR6/6), trace CaCO3
0.6	100	300-310	SP		Sand - as above
1.1	100	310-320	SP		Sand - as above
0.4	100	320-330	SP		Sand - as above, moist
1.8	100	330-340	SP		Sand - as above, very moist, no CaCO3
NA	100	340-350	SP		Sand - as above, wet, trace gravel
NA	100	350-360	SM	350-360	Silty sand with gravel - reddish yellow (7.5YR6/6), fine to medium grained, poorly sorted, subrounded, gravels of CaCO3 cemented sand, trace clay,saturated, no odor
NA	100	360-366	GW	360-366	Sandy gravel - light brown (7.5YR6/4), gravels up to 2.5", subrounded, fine sand, silt, poorly sorted, saturated, no odor

Geologist: J. Fisher and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 5/29/2020
Well completion date: 5/29/2020

Drilling method: ARCH
Borehole diameter: 8.5"
Sampling method: Cuttings

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1244755.74 Elevation: 4276.23
Easting: 884811.25

FORMER Y STATION
STATE LEAD SITE
CLOVIS, NEW MEXICO
MW-16

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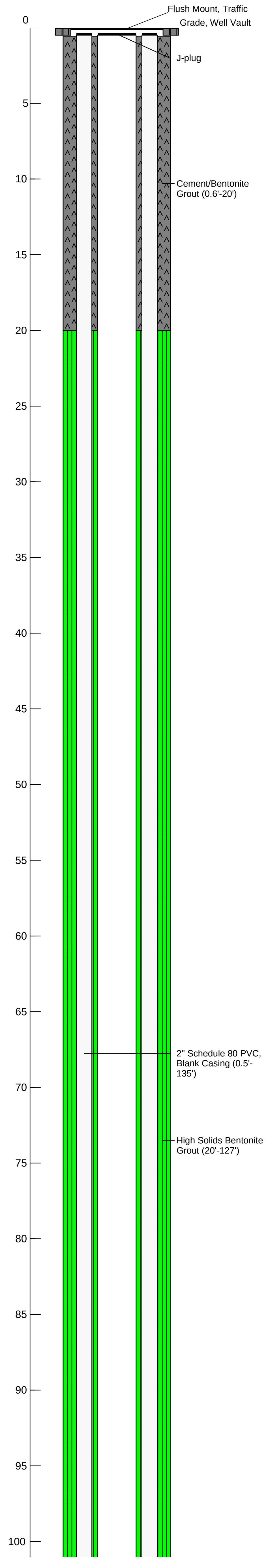
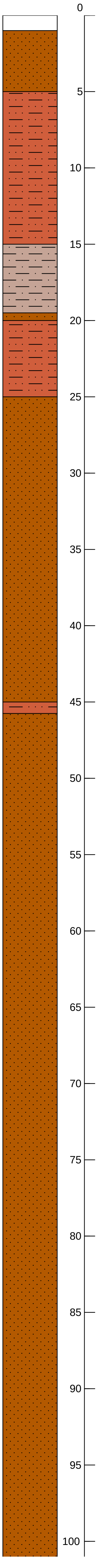


Graphic Log



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
9.6			NA	0-1	Landscaping rocks and soil/plants
			SP	1-5	Sand - light brown (5YR 7/4), well graded, loose, dry to moist, subrounded, very fine, trace silt, no odor, some caliche nodules.
	100	5-15	SC	5-15	Clayey sand - (7.5YR 6/3), fine sand, subrounded, low plasticity, claiche nodules, and stringers (10%), dry, loose-medium dense, no odor.
2.8					
			SC		Clayey sand - as above but loose, (7.5YR 8/4).
	100	15-25	CL	15-19.5	Sandy clay - yellowish red (5YR 5/8), trace silt, low to medium plasticity, moist, fine sand, caliche nodules.
			CL		Sandy clay - as above.
			SC	19.5-20	Sand - calcium carbonate cemented, light gray (5YR 7/4).
0.3			SC	20-25	Clayey sand - (5YR 5/8), well sorted, low to medium plasticity, slightly moist, fine, subrounded, loose, caliche nodules (<10%), no odor.
	100	25-35	SP	25-45	Sand - yellowish red (5YR 5/8), very fine, subrounded, loose, dry, no odor, low caliche content, well sorted.
3.0			SP		Sand - as above but calcium carbonate cemented, medium dense.
			SP		Sand - as above with <15% caliche, loose (see 25'-30').
	100	35-45	SP		Sand - (7.5YR 9/2), well sorted, very fine, subrounded, partially cemented, dry, no odor.
0.0					
			SP		Sand - (5YR 5/8), well sorted, very fine to fine, subrounded, loose to partially cemented, slightly moist, no odor.
	100	45-55	SC	45-45.75	Clayey sand - (5YR 5/6), fine, subrounded, low plasticity, moist, no odor.
			SP	45.75-114	Sand - (5YR 5/6), well sorted, fine, subrounded, loose, dry, no odor, CaCO3.
7.6					
	100	55-63	SP		Sand - pink (7.5YR 7/4), fine, well sorted, subangular, loose to partially cemented (CaCO3), dry, odorless.
			SP		Sand - reddish yellow (5YR 6/6), fine, well sorted, subrounded, loose, odorless, dry, calcium carbonate (10%).
			SP		Sand - see 55'. Hard drilling.
0.0					
	100	63-73	SP		Sand (5YR 8/4), fine, well sorted, subrounded, loose to partially cemented (fragments up to 2"), dry, no odor, trace silt. Very hard caliche layer at 68' bgs.
6.6					
	100	73-85	SP		Sand - (7.5YR 8/4), fine to medium, well sorted, loose, litle to no caliche, subrounded to subangular, dry, slight HC odor, some mottling of green and gray staining.
0.5					
	100	85-95	SP		Sand - light brown (7.5YR 6/4), fine grained, well sorted, loose, subrounded to subangular, dry, HC odor (possibly diesel).
0.4			SP		Sand - as above.
			SP		Sand - white (10YR 8/1), caliche cement, otherwise as above.
	100	95-105	SP		Sand - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, slightly moist, HC odor.
0.5			SP		Sand - as above.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 6/20/19
Well completion date: 6/29/19

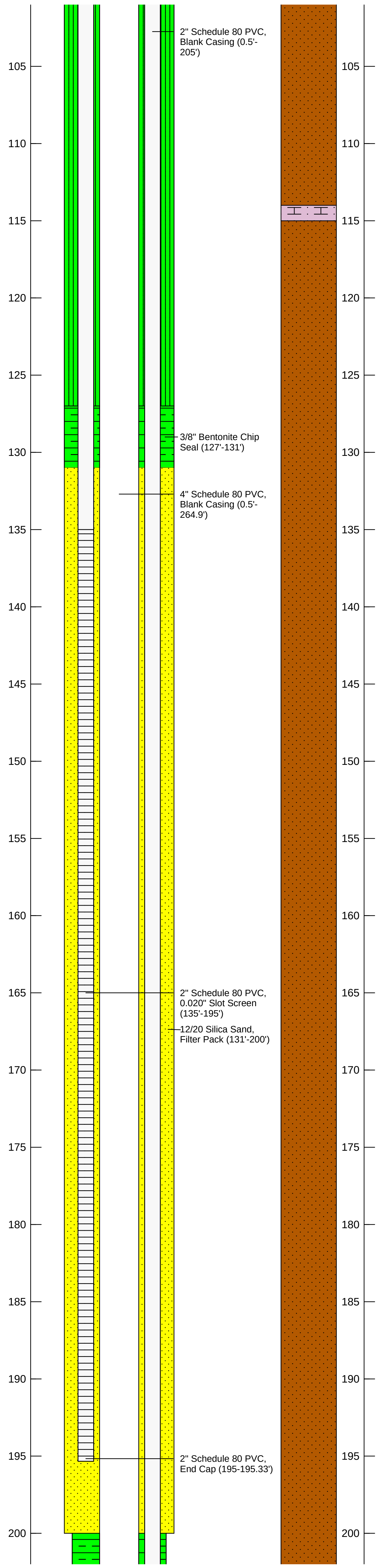
Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245546.71 Elevation: 4280.00
Easting: 884125.47

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-1

Daniel B. Stephens & Associates, Inc.
5/17/2021 JN DB18.1157.00

Graphic Log



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	105-115	SP		Sand - as above.
1.3			SP		Sand - as above.
			NA	114-115	Caliche - pinkish white (7.5YR 8/2), fine grained, well sorted, subrounded, calcium carbonate cemented, dry, odorless.
	100	115-125	SP	115-281	Sand - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, slightly moist, HC odor, minor staining.
73.2			SP		Sand - as above.
	100	125-135	SP		Sand - as above.
4.1			SP		Sand - as above.
	100	135-145	SP		Sand - as above.
22.7			SP		Sand - as above.
	100	145-155	SP		Sand - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, non-plastic, minor clay, loose, slightly moist, HC odor.
3.6			SP		Sand - as above.
	100	155-165	SP		Sand - as above.
2.8			SP		Sand - with calcium carbonate concretions, otherwise as above.
	100	165-175	SP		Sand - as above.
17.3			SP		Sand - as above.
			SP		Sand - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, non-plastic, loose, slightly moist, HC odor.
	100	175-185	SP		Sand - as above.
14.5			SP		Sand - as above.
	100	185-195	SP		Sand - as above.
6.1			SP		Sand - as above.
	100	195-205	SP		Sand - calcium carbonate concretions, otherwise as above.
13.2			SP		Sand - as above.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 6/20/19
Well completion date: 6/29/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245546.71 Elevation: 4280.00
Easting: 884125.47

FORMER Y STATION
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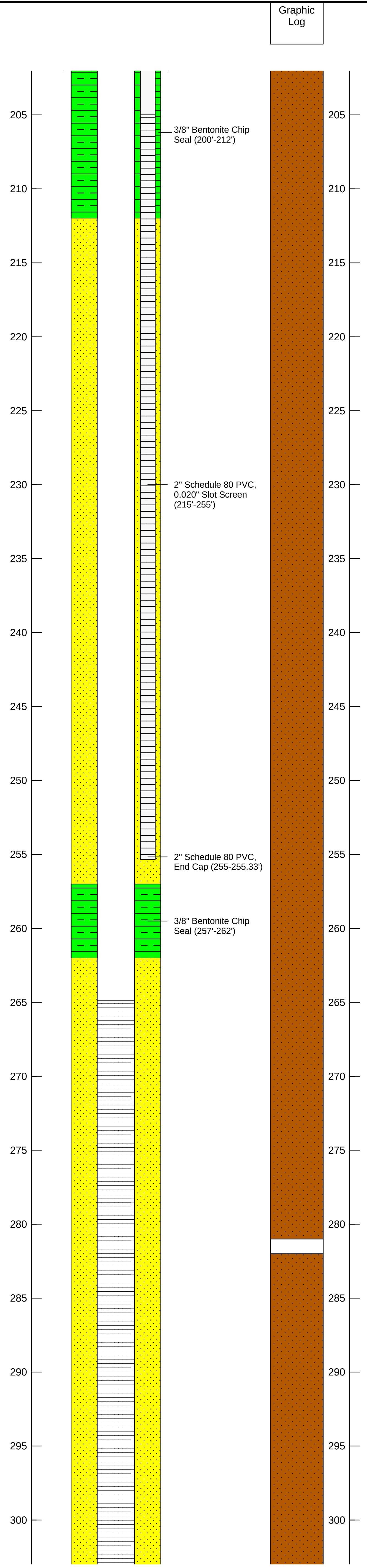
5/17/2021 JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	205-215	SP		Sand - as above.
16.9			SP		Sand - as above.
	100	215-225	SP		Sand - as above.
53.4			SP		Sand - with calcium carbonate concretions, otherwise as above.
	100	225-235	SP		Sand - as above.
17.4			SP		Sand - as above.
	100	235-245	SP		Sand - as above.
30.6			SP		Sand with minor clay - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, low plasticity, loose, slightly moist, HC odor.
			SP		Sand with minor clay - as above.
	100	245-255	SP		Sand with minor clay - as above.
26.8			SP		Sand with minor clay - as above.
	100	255-265	SP		Sand with minor clay - as above.
6.3			SP		Sand with calcium carbonate concretions - light brown (7.5YR 6/4), fine grained well sorted, subrounded to subangular, non-plastic. loose, slightly moist, HC odor.
	50	265-273	SP		Sand with calcium carbonate concretions - as above.
			NA		No recovery.
32.2	100	273-280	SP		Sand with calcium carbonate concretions - as above.
21.1	100	280-285	SP		Sand with calcium carbonate concretions - as above.
			SP	281-282	Sandstone - pinkish gray (7.5YR 7/2), fine grained, well sorted, subrounded to subangular, calcium carbonate cement, dry, odorless.
			SP	282-348	Sand with calcium carbonate concretions and stringers - light brown (7.5YR 6/4), fine grained, well sorted, surounded to subangular, non-plastic, loose, slightly moist, slight HC odor.
	100	285-295	SP		Sand - staining brown (7.5YR 5/3), otherwise as above.
			SP		Sand - continued staining and HC odor, as above.
>15,000	100	295-305	SP		Sand - continued staining and HC odor, as above.
>15,000			SP		Sand with calcium carbonate concretions - light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, non-plastic, loose, moist, HC odor.

Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 6/20/19
Well completion date: 6/29/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245546.71 Elevation: 4280.00
Easting: 884125.47

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-1

Daniel B. Stephens & Associates, Inc.
5/17/2021 JN DB18.1157.00

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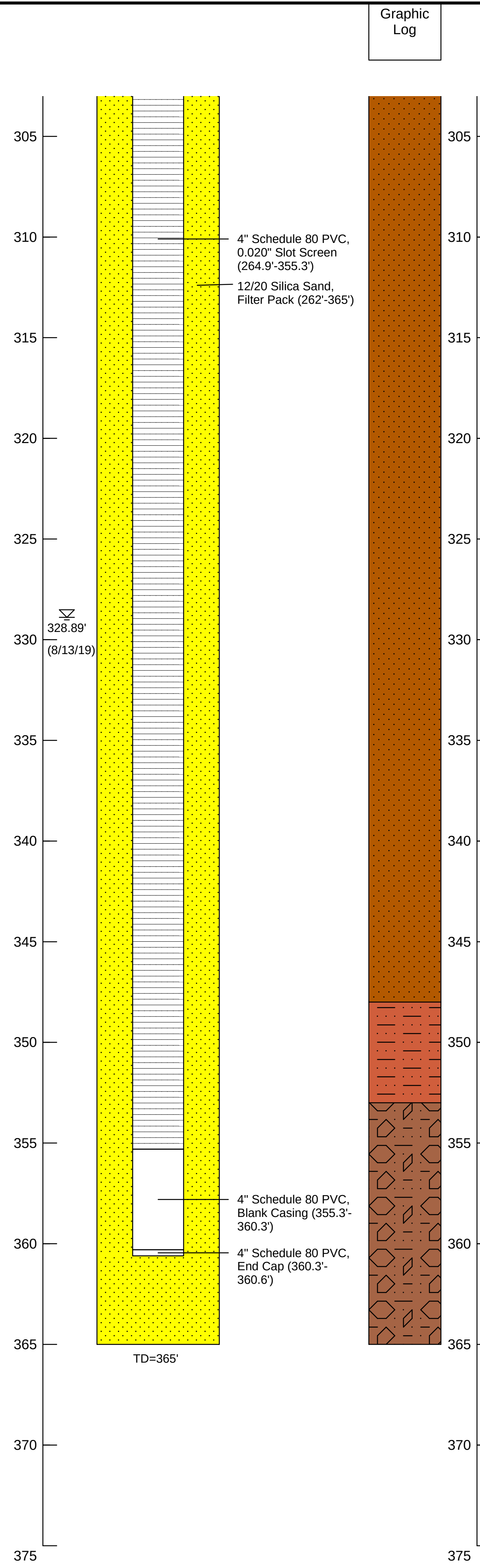
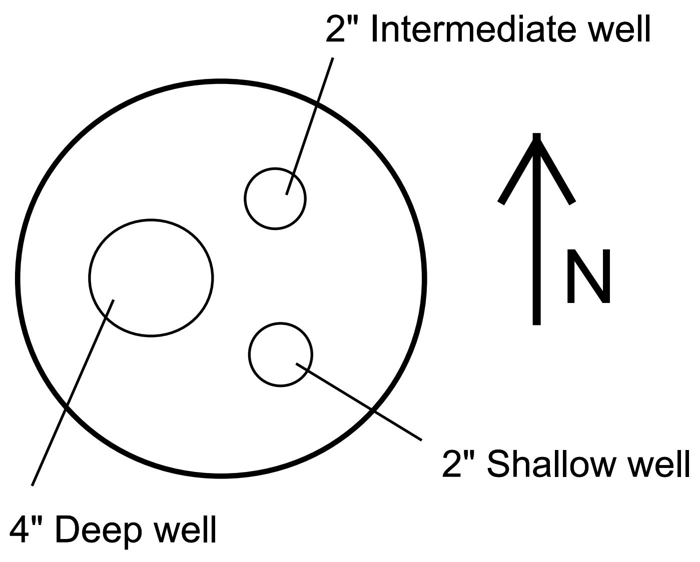


PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	305-315	SP		Sand with calcium carbonate concretions, HC odor, as above.
>15,000			SP		Sand with calcium carbonate concretions, HC odor, as above.
	100	315-325	SP		Sand with calcium carbonate concretions, HC odor, as above.
27.9			SP		Sand with calcium carbonate concretions, HC odor, as above.
	100	325-335	SP		Sand with calcium carbonate concretions, saturated, odorless, as above.
NA			SP		Sand with calcium carbonate concretions, saturated, odorless, as above.
	100	335-345	SP		Sand with calcium carbonate concretions, as above.
NA			SP		Sand with calcium carbonate concretions, as above.
	100	345-355	SP		Sand with calcium carbonate concretions, as above.
			SC	348-353	Clayey sand with calcium carbonate concretions, light brown (7.5YR 6/4), fine grained, well sorted, subrounded to subangular, moderate plasticity, loose, wet, odorless.
NA			SC		Clayey sand - as above.
			SC	353-365	Clayey sand with gravel - light brown (7.5YR 6/4), fine to coarse grained, poorly sorted, rounded to subangular, low plasticity, wet, gravel up to 2", odorless.
	100	355-365	SC		Clayey sand with gravel - as above.
NA			SC		Clayey sand with gravel - as above.



Geologist: P. Feltman and H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 6/20/19
Well completion date: 6/29/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245546.71 Elevation: 4280.00
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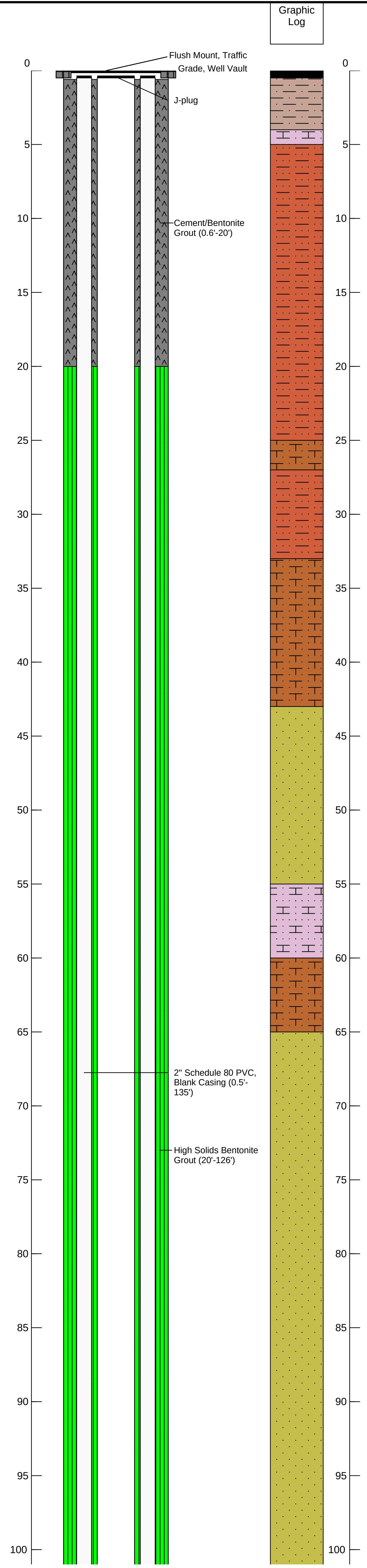


PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	0-5	NA	0-0.5	Asphalt.
0.0			CL	0.5-4	Sandy clay - dark brown (7.5YR 3/3), medium stiff, slight to moderate plasticity, slightly moist, odorless.
			CH	4-5	Clay with silt - pink (7.5YR 7/4), soft, moderate to high plasticity.
0.0	100	5-15	SC	5-25	Clayey sand - strong brown (7.5YR 5/6), fine grained, well sorted, subrounded, stiff, brittle to slightly plastic, odorless. Carbonate cementation (caliche) present in stringers and ribbons becoming more pervasive with depth.
0	30	15-25	SC		Clayey sand - as above.
			SC		Clayey sand - yellowish red (5YR 5/6), fine grained, well sorted, variably cemented with caliche. Sands are loose to moderately cohesive, slightly moist, odorless.
0	100	25-35	SM	25-27	Silty sand - strong brown (7.5YR 5/6), very fine grained sand and silt, loose to slightly cohesive, dry to slightly moist, ordorless.
			SC	27-33	Clayey sand - strong brown (7.5YR 5/6), fine grained sand with appreciable clay content, variably cemented with caliche, increasing with depth, moderately stiff to well cemented, odorless.
			SM	33-43	Silty sand - light brown (7.5YR 6/4), fine to medium grained, moderately sorted, variably cemented with caliche, loose where not cemented, dry, odorless.
0	100	35-45	SM		Silty sand - similar to above, grading downward to fine sand (SP). Caliche stringers and nodules abundant, loose where not cemented, dry, odorless.
			SP	43-50	Sand - reddish yellow (7.5YR 6/6), fine to very fine grained, well sorted, rounded, loose to weakly cemented.
0	100	45-55	SP		Sand - as above.
0.0			SP/SM	50-55	Sand - strong brown (7.5YR 5/6), very fine to fine grained, generally loose to weakly cemented, with variable degrees of calcium carbonate cement in stringers and nodules, dry, ordorless.
0.0	100	55-65	NA	55-60	Caliche - white to pinkish gray (7.5YR 7/2), masssive, very hard, weakly cemented sand and silt stringers present.
			SM	60-65	Silty sand - pink (7.5YR 7/3), fine grained, significant caliche development, otherwise loose, dry, odorless.
0.0	100	65-75	SP	65-243	Sand with silt - reddish yellow (7.5YR 6/6), very fine to fine grained, well sorted, rounded, approximately 15% silt, generally loose with sparse caliche nodules.
83.2	100	75-85	SP		Sand with silt - as above.
			SP		Sand - reddish yellow (7.5YR 6/6), fine to medium grained, moderately well sorted, little to no caliche development, loose, slightly moist, slight hydrocarbon odor.
0.0	100	85-95	SP		Sand - as above, some carbonate development (~10%).
			SP		Sand - greater cementation, otherwise as above.
			SP		Sand - little to no caliche developement, otherwise as above.
0.4	100	95-105	SP		Sand - no HC odor, otherwise as above.

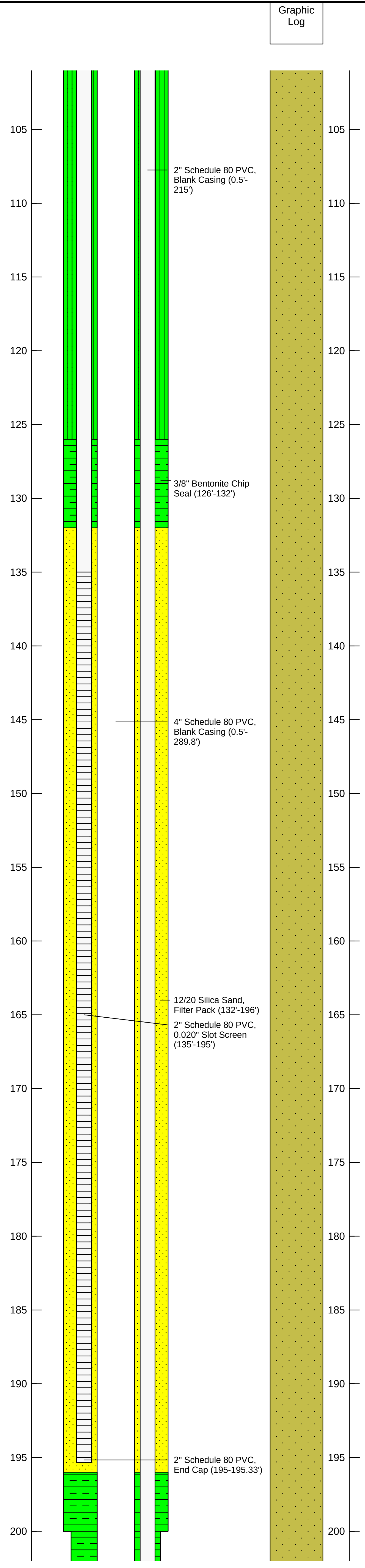
Geologist: H. Barnes and J. Raucci
Driller: Yellow Jacket Drilling
Drilling start date: 6/15/19
Well completion date: 6/19/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 124516.84 Elevation: 4279.70
Easting: 884140.97

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-2

Daniel B. Stephens & Associates, Inc.
5/17/2021 JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
19.1	100	105-110	SP		Sand - similar to above but mottled with light gray (7.5YR 7/1), variable but generally greater developement of carbonate cementation (10-20%) in nodules and lenses.
1.8	100	110-115	SP		Sand - as above.
58	100	115-125	SP		Sand - as above.
6.9	100	125-135	SP		Sand - as above.
			SP		Sand - light brown (7.5YR 6/4), fine grained, well sorted, loose with sparse carbonate cemmented nodules, slightly moist, slight HC odor.
389.4	100	135-145	SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, loose with little to no carbonate development, slightly moist, slight HC odor.
			SP		Sand - similar to above but with large (up to 2") carbonate cemented nodules, strong HC odor.
295.6	100	145-155	SP		Sand - as above, HC odor.
603.3	100	155-165	SP		Sand - as above, HC odor.
			SP		Sand - general increase in carbonate cementation, abundant hard carbonate cemented nodules and lenses, mododerate HC odor.
>15,000	100	165-175	SP		Sand - reddish yellow (7.5YR 6/6), fine grained, very well sorted, loose with little to no carbonate development, slightly moist, HC odor.
2338	100	175-185	SP		Sand - as above, HC odor.
>15,000	100	185-195	SP		Sand - as above, HC odor.
3553	100	195-200	SP		Sand - similar to above but slightly finer grained (very fine sand).
5133	100	200-210	SP		Sand - as above, very fine sand with trace silt.

Geologist: H. Barnes and J. Raucci
Driller: Yellow Jacket Drilling
Drilling start date: 6/15/19
Well completion date: 6/19/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 124516.84 Elevation: 4279.70
Easting: 884140.97

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-2

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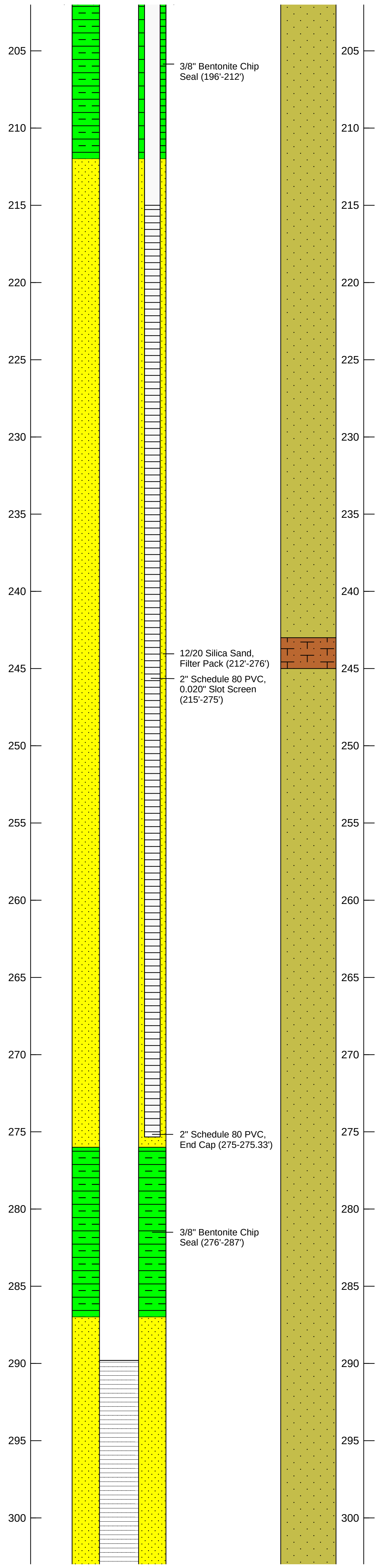
Graphic Log



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
2994	100	210-217	SP		Sand - as above.
>15,000	100	217-227	SP		Sand - similar to above but with lenses of darker sand, olive yellow (10YR 5/6), fine grained, well sorted, loose to very weakly cemented.
>15,000	100	227-235	SP		Sand - reddish yellow (7.5YR 6/6), very fine grained, well sorted, loose with sparse carbonate nodules 1-5 cm diameter, slightly moist, HC odor.
861.1	100	235-245	SP		Sand - as above.
			SM	243-245	Silty sand - reddish yellow (7.5YR 6/6), very fine grained, greater cementation than above.
3129	100	245-255	SP	245-354	Sand - reddish yellow (7.5YR 6/6), very fine to fine grained, well sorted, loose with sparse carbonate nodules, occurance increasing with depth, slightly moist, HC odor.
1661	100	255-265	SP		Sand - as above with some olive yellow color mottling (10YR 6/6), HC odor.
>15,000	100	265-275	SP		Sand - similar to above, variable but generally greater cementation through this interval.
1661	100	275-277	SP		Sand - as above.
>15,000	100	277-284	SP		Sand - continue as above, but sparsely interbedded with thin sandstone beds (<2"). Sandstone is light brown (7.5Y/R 6/4), fine grained, structureless, moderately indurated.
>15,000	100	284-295	SP		Sand - as above.
>15,000	100	295-300	SP		Sand - as above.
>15,000	100	300-315	SP		Sand - as above.

Geologist: H. Barnes and J. Raucci
Driller: Yellow Jacket Drilling
Drilling start date: 6/15/19
Well completion date: 6/19/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 124516.84 Elevation: 4279.70
Easting: 884140.97

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-2

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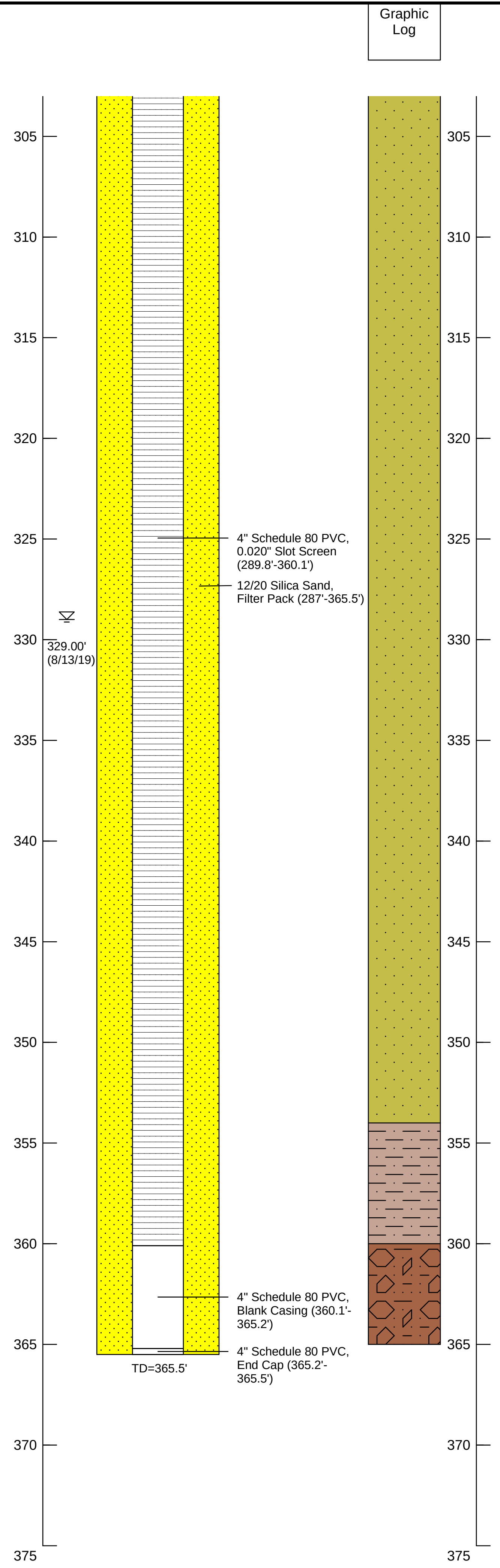
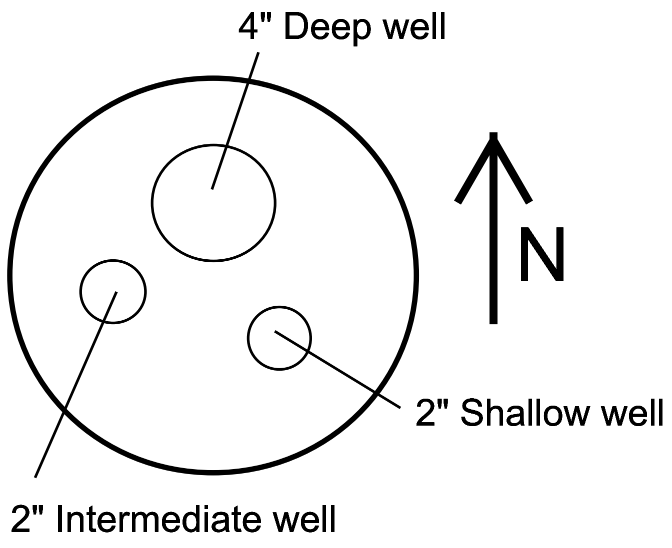


PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
>15,000	100	315-325	SP		Sand - generally as above but with a thin, well-indurated bed at 320'.
>15,000	100	325-335	SP		Sand - as above, trace silt, encounter water table at approximately 329'.
516.9	100	335-345	SP		Sand - with silt, otherwise as above.
48.1	100	345-352	SP		Sand - as above with trace clay (<10%), wet.
	100	352-360	SP		Sand - strong brown (7.5YR 5/6), fine grained, loose to slightly cohesive, minor rounded to subrounded gravels up to 0.5", wet.
			CL	354-360	Sandy clay - reddish brown (2.5YR 5/4), fine grained, slightly to moderately plastic, minor rounded to subrounded gravels up to 0.5", wet.
	100	360-365	SC	360-365	Clayey sand with gravel - light brown (7.5YR 6/4), fine grained, poorly sorted, slightly to moderately plastic, moderately dense, abundant subrounded gravels up to 2" diameter, wet.



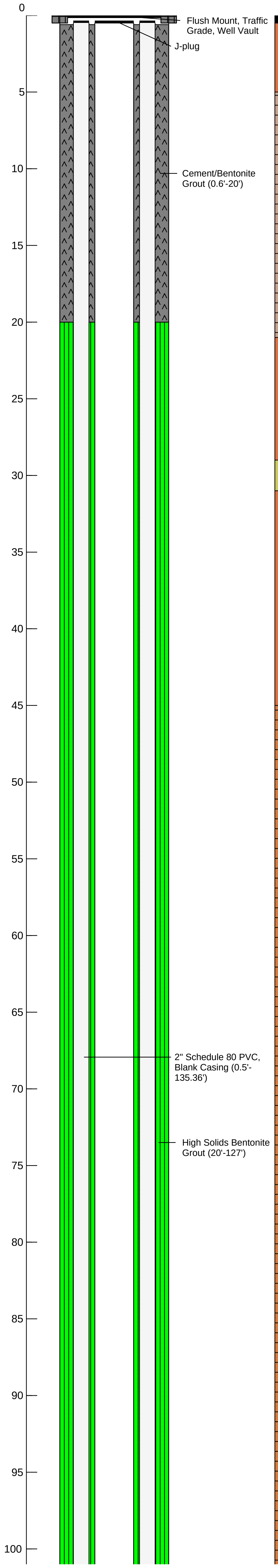
Geologist: H. Barnes and J. Raucci
Driller: Yellow Jacket Drilling
Drilling start date: 6/15/19
Well completion date: 6/19/19

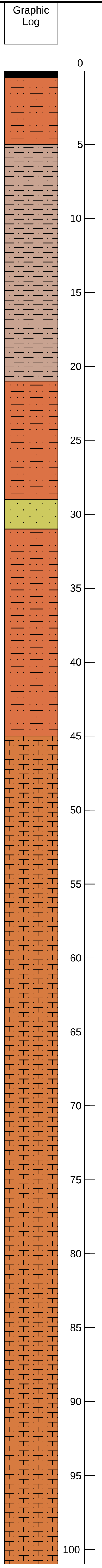
Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 124516.84 Elevation: 4279.70
Easting: 884140.97

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-2

Daniel B. Stephens & Associates, Inc.
5/17/2021 JN DB18.1157.00





	PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
0	9.6		0-5	NA	0-0.5	Asphalt
				SC	0.5-5	Clayey sand - dark brown (7.5YR 3/4), fine grained, well sorted, subangular, high plasticity, loose, slightly moist, odorless.
5		100	5-15	CH	5-21	Sandy clay with caliche - yellowish red (5YR 5/6), fine grained, well sorted, subangular, high plasticity, stiff, dry, odorless.
10	2.8			CH		Sandy clay - as above.
15		100	15-25	CH		Sandy clay - as above.
20	0.3			CH		Sandy clay - as above.
				SC	21-29	Clayey sand - yellowish red (5YR 5/8), and pinkish white (7.5YR 8/2), fine grained, well sorted, subrounded, to angular, low plasticity, loose to semi-consolidated, dry, odorless.
25		100	25-35	SC		Clayey sand - decreased caliche, otherwise as above.
				SP	29-31	Sand - yellowish red (5YR 5/8), fine grained, well sorted, subrounded to subangular, non-plastic, minor clay, loose, dry, odorless.
30	3.0			SP		Sand - as above.
				SC	31-45	Clayey sand - reddish yellow (5YR 5/6), minor silt, fine grained, well sorted, subrounded to subangular, with caliche - pinkish white (7.5YR 8/2), semi consolidated, dry, odorless.
35		100	35-45	SC		Clayey sand - as above.
40	0.0			SC		Clayey sand - reduced claiche, otherwise as above.
45		100	45-55	SP	45-335	Sand with silt and clay - yellowish red (5YR 5/6), fine grained, well sorted, subrounded to angular, low plasticity, loose, dry, odorless.
50	7.6			SP		Sand with slilt and clay - as above.
55		100	55-63	SP		Sand with silt - pink (7.5YR 7/3), fine grained, well sorted, subrounded minor clay, low plasticity, loose, dry, odorless, calcium carbonate reaction with HCl; some consolidated areas.
60	0.0			SP		Sand with silt - as above.
		100	63-73			
65				SP		Sand with silt - as above.
70	6.6			SP		Sand with silt - as above.
		100	73-85			
75				SP		Sand with silt - as above.
80	0.5			SP		Sand with silt and calcium carbonate concretions - otherwise as above.
85		100	85-95	SP		Sand with silt and calcium carbonate concretions - as above.
90	0.4			SP		Sand with silt and calcium carbonate concretions - as above.
95		100	95-105	SP		Sand with silt and calcium carbonate concretions - as above.
100	0.5			SP		Sand with silt and calcium carbonate concretions - as above.

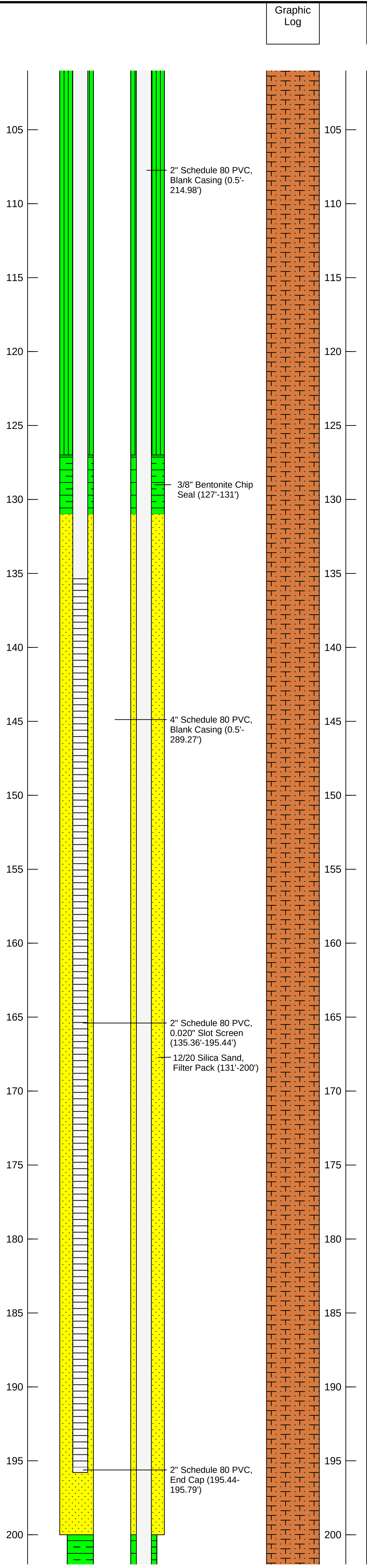
Geologist: P. Feltman
Driller: Yellow Jacket Drilling
Drilling start date: 8/19/19
Well completion date: 8/30/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245486.71 Elevation: 4278.78
Easting: 884251.49

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-3

Daniel B. Stephens & Associates, Inc.
9/26/2019 JN DB18.1157.00



	PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
105		100	105-115	SP		Sand with silt and calcium carbonate concretions - as above.
110	1.3			SP		Sand with silt and calcium carbonate concretions - as above.
115				SP		Sand with silt and calcium carbonate concretions - as above.
		100	115-125			
120	73.2			SP		Sand with silt - no calcium carbonate concretions, black staining, otherwise as above.
				SP		Sand with silt - no staining, otherwise as above.
125		100	125-135	SP		Sand with silt - as above.
130	4.1			SP		Sand with silt - as above.
135		100	135-145	SP		Sand with silt - as above.
140	22.7			SP		Sand with silt - as above.
145		100	145-155	SP		Sand with silt - as above.
150	3.6			SP		Sand with silt - as above.
155		100	155-165	SP		Sand with silt - as above.
160	2.8			SP		Sand with silt - as above.
165		100	165-175	SP		Sand with silt - as above.
170	17.3			SP		Sand with silt - with minor gray staining, odorless, otherwise as above.
				SP		Sand with silt andcalcium carbonate concretions - no staining, otherwise as above.
175		100	175-185	SP		Sand with silt and calcium carbonate concretions - no staining, otherwise as above.
180	14.5			SP		Sand with silt - odorless, otherwise as above.
185		100	185-195	SP		Sand with silt - minor gray staining, otherwise as above.
				SP		Sand with silt - no staining, otherwise as above.
190	6.1			SP		Sand with silt - slight HC odor, as above.
195		100	195-205	SP		Sand with silt - slight HC odor, as above.
200	13.2			SP		Sand with silt - slight HC odor, as above.

Geologist: P. Feltman
Driller: Yellow Jacket Drilling
Drilling start date: 8/19/19
Well completion date: 8/30/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245486.71 Elevation: 4278.78
Easting: 884251.49

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-3

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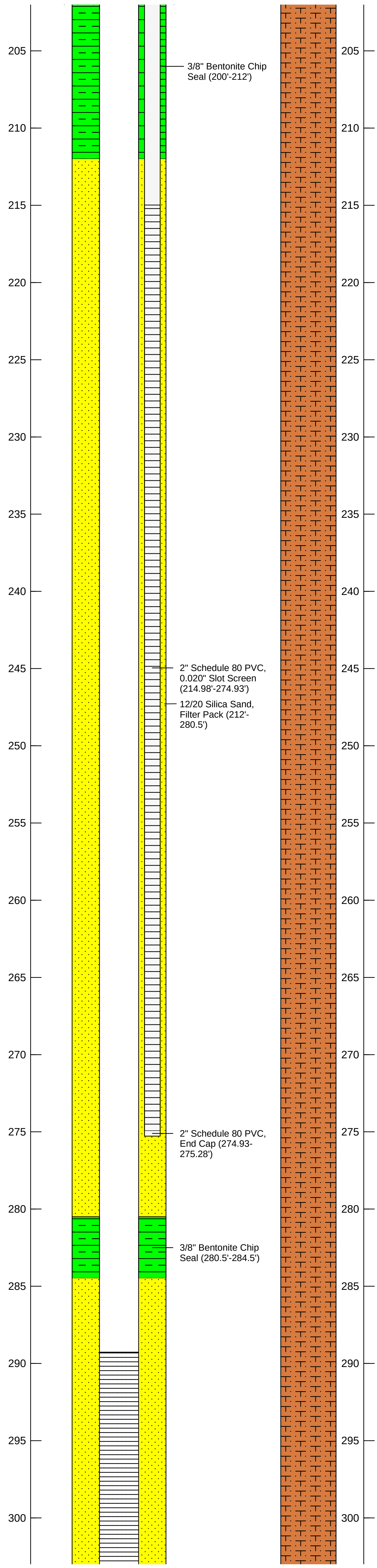
9/26/2019 JN DB18.1157.00



PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	205-215	SP		Sand with silt and calcium carbonate concretions - slight HC odor, otherwise as above.
16.9			SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
	100	215-225	SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
53.4			SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
	100	225-235	SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
17.4			SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
	100	235-245	SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
30.6			SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
	100	245-255	SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
26.8			SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
	100	255-265	SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
6.3			SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
	100	265-272	SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
			SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
	100	272-284	SP		Sand with silt and calcium carbonate concretions - slight HC odor, as above.
32.2					
21.1			SP		Sand with silt - no calcium carbonate concretions, slight HC odor, otherwise as above.
	0	284-294	SP		No Recovery.
>15,000	100	294-305	SP		Sand with silt - slight HC odor, as above.
>15,000			SP		Sand with silt - very strong HC odor, otherwise as above.

Geologist: P. Feltman
Driller: Yellow Jacket Drilling
Drilling start date: 8/19/19
Well completion date: 8/30/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245486.71 Elevation: 4278.78
Easting: 884251.49

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CLOVIS, NEW MEXICO
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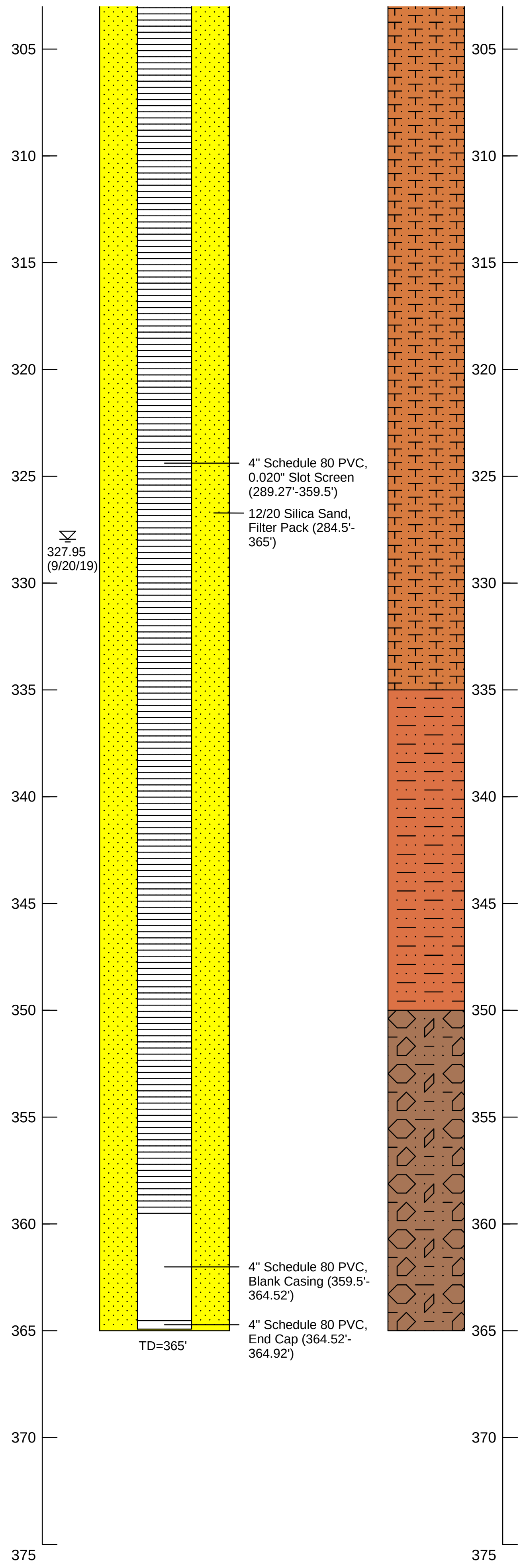
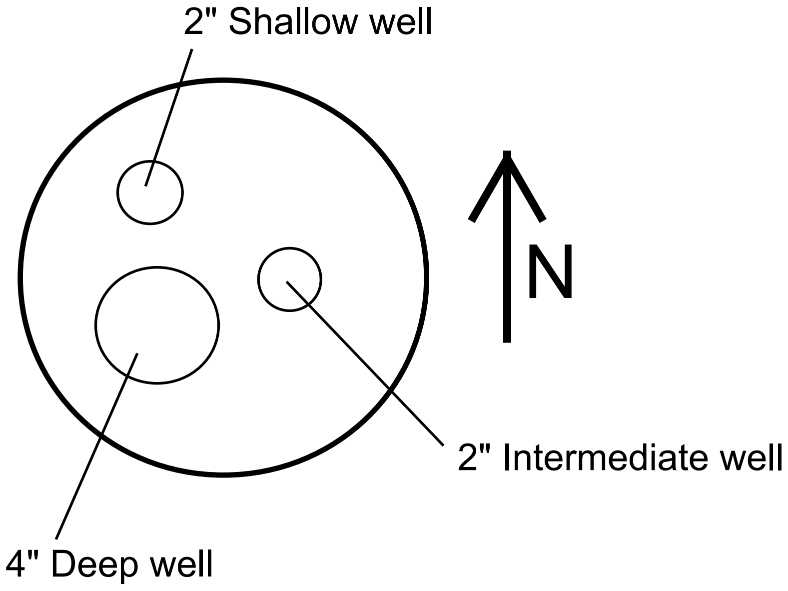
Graphic Log



	PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
305		100	305-315	SP		Sand with silt - very strong HC odor, as above.
310	>15,000			SP		Sand with silt - very strong HC odor, as above.
315		100	315-325	SP		Sand with silt - very strong HC odor, as above.
320	27.9			SP		Sand with silt - very strong HC odor, as above.
325		100	325-335	SP		Sand with silt - very strong HC odor, as above.
330	NA			SP		Sand with silt - very strong HC odor, as above.
335		100	335-345	SC	335-365	Clayey sand - yellowish red (5YR 4/6), fine grained, well sorted, rounded, low plasticity, medium dense, slightly moist, no odor.
340	NA			SC		Clayey sand - as above.
345		100	345-355	SC		Clayey sand - as above.
350	NA			SC		Clayey sand with gravel - light brown (7.5YR 6/4), fine to coarse grained, poorly sorted, rounded to subangular, low plasticity, wet, gravel up to 3", odorless.
355		100	355-365	SC		Clayey sand with gravel - as above.
360	NA			SC		Clayey sand with gravel - as above.
365						
370						
375						



Geologist: P. Feltman
Driller: Yellow Jacket Drilling
Drilling start date: 8/19/19
Well completion date: 8/30/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245486.71 Elevation: 4278.78
Easting: 884251.49

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-3

Daniel B. Stephens & Associates, Inc.
9/26/2019 JN DB18.1157.00

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
	100	0-5	NA	0-0.5	Asphalt.
7.2			CL	0.5-22	Sand clay - brown (7.5YR 4/4), fine grained, well sorted, subrounded, moderate plasticity, loose to medium dense, slightly moist, no odor, calcium carbonate.
0.2	100	6-16	CL		Sandy clay - yellowish red (5YR 5/6), otherwise as above.
2.7	100	16-26	CL		Sandy clay - as above.
			SC	22-26	Clayey sand - yellowish red (5YR 5/6), fine grained, well sorted, subrounded, low plasticity, partially cemented (calcium carbonate rich), dry, no odor.
			SC		Clayey sand - reddish yellow (5YR 6/6), with less calcium carbonate, loose, otherwise as above.
0.0	100	26-36	SP	26-347	Sand - pink (5YR 7/4), fine grained, well sorted, subrounded, non-plastic, loose to partially cemented, no odor, trace silt, calcium carbonate rich.
	100	34-46	SP		Sand - reddish yellow (5YR 6/6), fine grained, well sorted, subrounded, low plasticity (trace clay), loose, dry, no odor.
0.0			SP		Sand - no clay (non-plastic), trace calcium carbonate nodules, otherwise as above.
0.0	100	46-56	SP		Sand - as above.
			SP		Sand - pink (5YR 7/4), very high calcium carbonate concentrations, partially cemented, otherwise as above.
4.6	100	56-66	SP		Sand - light reddish brown (5YR 6/4), fine grained, well sorted, subrounded, non-plastic, partially cemented, dry, no odor, calcium carbonate rich, trace silt.
5.0	100	66-76	SP		Sand - loose, lower calcium carbonate concentration, otherwise as above.
0.8	100	76-86	SP		Sand - as above.
			SP		Sand - reddish yellow (7.5YR 6/6), fine grained, well sorted, subrounded to subangular, non-plastic, loose, dry, little to no calcium carbonate.
3.6	100	86-96	SP		Sand - as above.
0.0	100	96-104	SP		Sand - as above.

Geologist: H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 9/9/19
Well completion date: 9/9/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245346.00 Elevation: 4278.84
Easting: 884279.77

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-4

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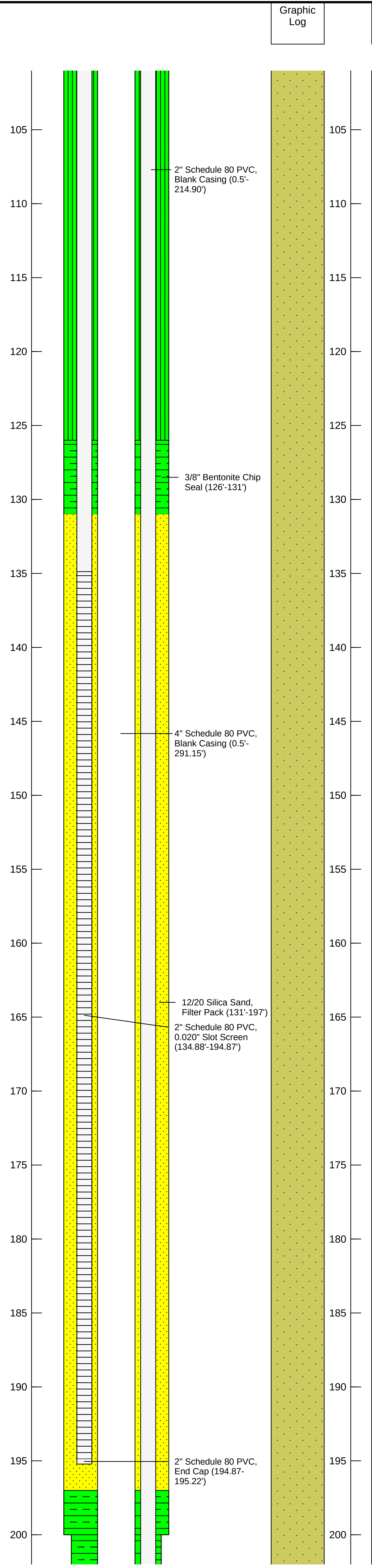

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
0.6	100	104-108	SP		Sand - as above.
0.0	100	108-116	SP		Sand - increased calcium carbonate concentrations (~15%) at 110', otherwise as above.
2.9	100	116-126	SP		Sand - <10% calcium carbonate, otherwise as above.
3.0	100	126-136	SP		Sand - as above.
0.4	100	136-146	SP		Sand - as above.
23.7	100	146-156	SP		Sand - as above.
16.4	100	156-166	SP		Sand - as above.
13.7	100	166-176	SP		Sand - less calcium carbonate, otherwise as above.
19.5	100	176-182	SP		Sand - as above.
92.4	100	182-192	SP		Sand - higher concentrations of calcium carbonate at 186'-187', otherwise as above.
66.6	100	192-202	SP		Sand - as above.

Geologist: H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 9/9/19
Well completion date: 9/9/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245346.00 Elevation: 4278.84
Easting: 884279.77

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-4

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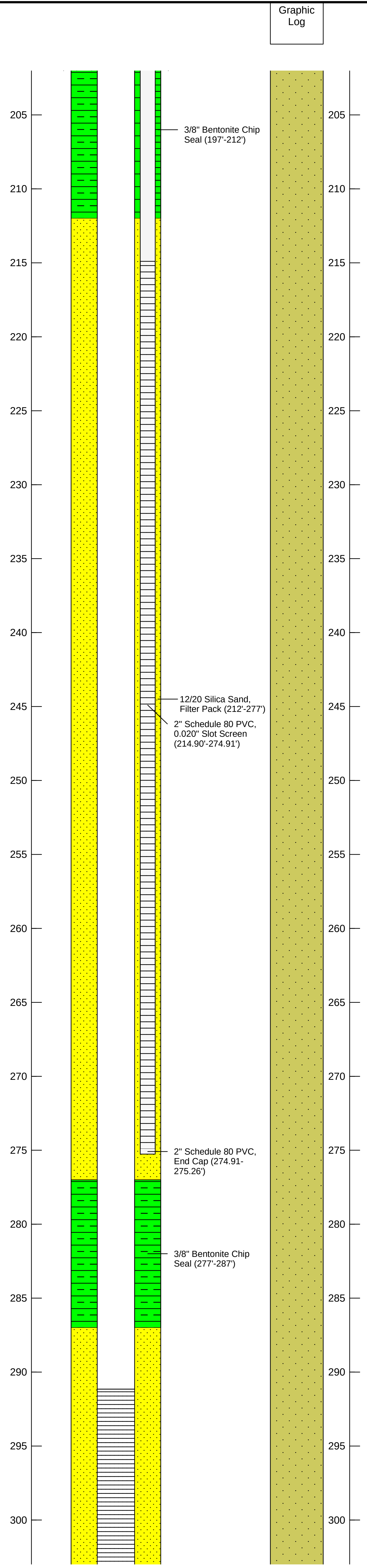

PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
26.7	10	208-216	SP		Sand - as above.
27.8	100	216-226	SP		Sand - as above.
2.8	100	226-236	SP		Sand - increased calcium carbonate at 228'-229', otherwise as above.
2.0	100	236-246	SP		Sand - as above.
234.6	100	246-256	SP		Sand - as above.
31.3	100	256-266	SP		Sand - increased calcium carbonate at 262'-264', otherwise as above.
119.6	100	266-276	SP		Sand - as above.
270.9	100	276-286	SP		Sand - increased calcium carbonate concentration, otherwise as above.
815	100	286-292	SP		Sand - less calcium carbonate, HC odor, otherwise as above.
474.5	100	292-302	SP		Sand - strong HC odor, higher calcium carbonate concentration at 300'-301', otherwise as above.
435.1	100	302-310	SP		Sand - HC odor, increased calcium carbonate at 308.5'-310', otherwise as above.

Geologist: H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 9/9/19
Well completion date: 9/9/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
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RW-4

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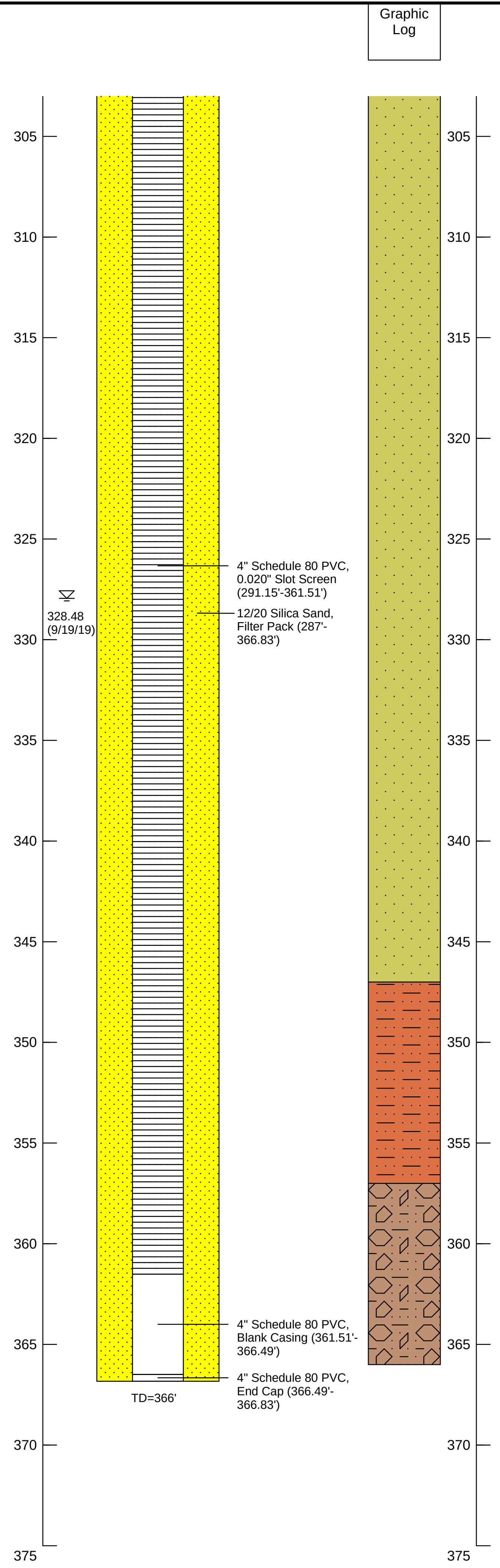
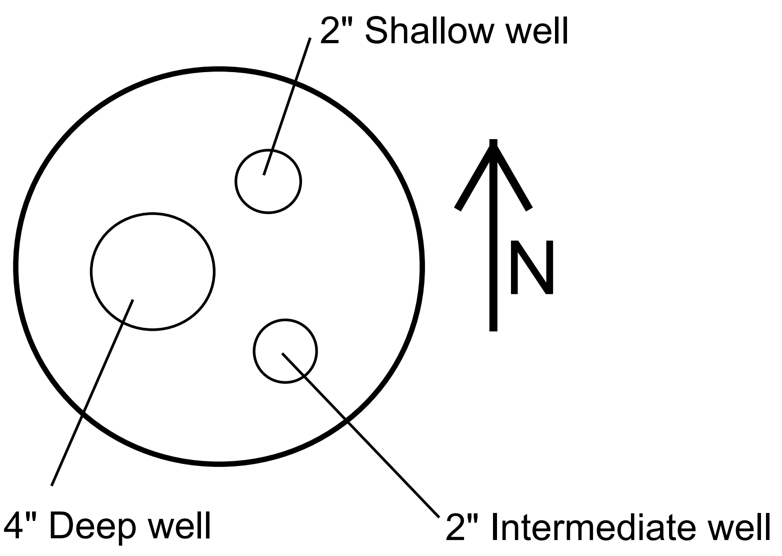


PID reading (ppm)	Sample Recovery (%)	Sample Interval (ft bgs)	USCS Symbol	Lithology Interval	Comments and Lithology
448.6	100	310-316	SP		Sand - increased calcium carbonate, strong odor, moist, trace silt, otherwise as above.
345.6	100	316-326	SP		Sand - as above.
598.7	100	326-336	SP		Sand - as above, wet at 331'.
NA	100	336-346	SP		Sand - with trace low plasticity clay, otherwise as above.
NA	100	346-350	SP		Sand - as above.
			SC	347-357	Clayey sand - light reddish brown (5YR 6/4), fine grained, well sorted, subrounded, low plasticity, loose, saturated, HC odor.
NA	100	350-360	SC		Clayey sand - as above.
			SW	357-366	Gravelly sand with clay - light reddish brown (5YR 6/3), fine grained, poorly sorted, subrounded, fine gravels, low plasticity, loose, calcium carbonate, damp to wet, HC odor.
NA	100	360-366	SC		Gravelly sand with clay - as above.



Geologist: H. Barnes
Driller: Yellow Jacket Drilling
Drilling start date: 9/9/19
Well completion date: 9/9/19

Drilling method: Sonic
Borehole diameter: 10.25"/9.5"
Sampling method: Sonic core

DTW= Depth to water measured below top of casing (feet)
New Mexico State Plane East NAD83
Northing: 1245346.00
Easting: 884279.77
Elevation: 4278.84

FORMER Y STATION
CLOVIS, NEW MEXICO
RW-4

Daniel B. Stephens & Associates, Inc.
9/26/2019
JN DB18.1157.00

Appendix B

DBS&A Groundwater Modeling Report

Groundwater Model Simulations for Evaluation of the Proposed Remediation Plan in Clovis, New Mexico

Prepared for	**New Mexico Environment Department** **Petroleum Storage Tank Bureau**

September 14, 2020

Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100 • Albuquerque, New Mexico 87109

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Groundwater Model Simulations for Evaluation of the Proposed Remediation Plan in Clovis, New Mexico

1. Introduction

This report summarizes groundwater model simulations and particle tracking runs completed to assist with decision making regarding proposed remediation activities at the Former Y Station site in Clovis, New Mexico (the site). Investigations completed since 2011 indicate that this former Shamrock-brand fueling station, centered near the intersection of Prince Street and Commerce Way, is the primary source of a 1,000-foot-long hydrocarbon plume. DBS&A is in the process of designing a remediation system that will include groundwater extraction to reduce the magnitude and areal extent of the dissolved-phase plume. The proposed extraction well network was evaluated relative to the benzene plume delineated from June 2020 sampling activities at the site. The goals of the groundwater modeling effort are to (1) evaluate whether the proposed pumping plan will capture the benzene plume, and (2) to determine the minimum pumping rate at each well necessary for plume capture.

2. Model Setup

A three-dimensional groundwater flow model was developed for the area of the proposed extraction network using the MODFLOW-2005 code (Harbaugh, 2005). The groundwater model simulates a steady-state condition with no extraction. The steady-state model was calibrated using water levels collected on June 8, 2020. Table 1 illustrates the agreement between the model and the observed groundwater elevations. The calibrated steady-state hydraulic head field served as the initial condition for a series of predictive simulations. The modeled simulations assess the effects of drawdown and movement of the benzene plume from the proposed extraction network. Simulations were modeled for 1, 3, 5, 7, and 10 years of groundwater extraction beyond the steady-state base model (Table 1).

2.1 Model Grid and Layers

The model was discretized with grid cells and a representative aquifer layer. The grid is oriented such that model columns are approximately parallel to groundwater flow (Figure 1). The model has 504 rows and 367 columns with squares of 20 feet by 20 feet cells. The small model cell size allows for better resolution of the extraction network.

The model was built with one layer that represents the alluvium of the Ogallala aquifer. The top of this layer represents the land surface and was determined from the 10-meter digital elevation model (DEM) of the area. The bottom of the layer was assumed to be 380 feet below the surface elevation. This construct is consistent with the conceptual site model and the geologic conditions indicated by nearby borings and wells.

2.2 Model Boundary Conditions

The northern and southern ends of the model are simulated as constant hydraulic head boundaries with groundwater elevations set to 3964.90 and 3934.86 feet above mean sea level, respectively (Figure 2). These boundaries produce a hydraulic gradient of 0.003 which is consistent with the 2019 and 2020 groundwater elevation data. The boundaries were set far from the extraction network, and therefore should not have much effect on model results. The bottom of the model (bottom of layer 1) and the western and eastern boundaries of the model in both layers are simulated as no-flow boundaries.

2.3 Hydraulic Properties

The thickness of the Ogallala aquifer in this area is approximated at 50 feet and is assumed to be underlain by comparatively impermeable bedrock materials. At the site, groundwater is present within the Ogallala aquifer under unconfined conditions and is encountered at a depth of approximately 330 feet below ground surface (bgs) (DBS&A, 2020). This data justifies the assumption to model the bottom boundary layer at a depth of 380 feet bgs.

A 60-hour constant rate test was conducted at monitor well MW-11 in July 2019 to determine well efficiency, aquifer hydraulic properties, and the theoretical capture zone of the pumped well. Based on the AQTESOLV solutions, drawdown data were consistent with an aquifer transmissivity of approximately 58 square feet per day and a specific yield of 0.20. The transmissivity estimate is equivalent to a hydraulic conductivity of 1.16 feet per day (ft/d) for an aquifer with a 50-foot thickness (DBS&A, 2019).

The results of aquifer testing conducted at monitor well MW-11 indicate aquifer parameters that are consistent with literature ranges for fine-grained silty sand aquifers under unconfined conditions (e.g., Freeze and Cherry, 1979). Although consistent with the site geology, the results of the aquifer test indicate an aquifer that is more than an order of magnitude less transmissive than regional literature estimates for the Ogallala aquifer, which suggested hydraulic conductivities of approximately 70 ft/d (NMISC, 2016).

Laboratory estimates of hydraulic conductivity from remolded sonic core materials range from 1.59 to 11.3 ft/d; the aquifer test results are close to the low end of laboratory estimates. The sample collected from the borehole for monitor well MW-11 yielded a result of 4.54 ft/d, but did not incorporate the clayey sand and gravel interval at the base of the aquifer. DBS&A believes the physical properties analysis and the aquifer testing results to be broadly consistent, as (1) well losses under pumping drawdown conditions may result in a slight underestimate of hydraulic conductivity based on aquifer testing and (2) target remold parameters for the laboratory sample may result in a slight overestimate of hydraulic conductivity from physical properties analysis (DBS&A, 2019).

The groundwater model was used to assess the effects of the proposed extraction network using the horizontal hydraulic conductivity of 1.16 ft/d determined from the hydraulic testing at MW-11. The specific yield and effective porosity were set at 0.20, consistent with literature values for unconfined conditions with sandy, fine-grained aquifer materials (e.g., Freeze and Cherry, 1979; NMISC, 2016).

3. Predictive Simulation Results

Two scenarios were simulated: (1) a minimum pumping scenario to determine the minimum pumping rates required to contain the benzene plume delineated by the June 2020 5-micrograms per liter (ug/L) benzene contour (i.e., to stop from spreading downgradient), and

(2) a maximum pumping scenario to determine the highest pumping rates achievable at each well location to maximize capture of the benzene plume. Modeled pumping rates, groundwater elevation, drawdown, and remaining water column height are provided in Table 1 for both scenarios. Pumping rates ranged from 0.5 gallons per minute (gpm) to 4.0 gpm based on July 2019 aquifer test results. Simulated groundwater elevations and associated drawdown were analyzed at each well after 1, 3, 5, 7, and 10 years of constant pumping. The maximum drawdown at the extraction wells following each predictive simulation period is provided in Table 1. Maximum pumping rates were limited by the depth of the screen bottom at each well. A minimum water column of 2 feet was used as the limiting factor for possible pump rates at each well. As would be expected, drawdown beneath the proposed extraction network increases with the maximum pumping scenario (Table 1).

The 5 and 10 year simulation results are provided for both scenarios. Figures 3 and 4 show groundwater elevation contours under the minimum pumping scenario after 5 and 10 years, respectively. Between the 5 and 10 year simulations, drawdown increased at each extraction well (Table 1). The simulated drawdown ranges from 5 feet at RW-1 to 19 feet at MW-12 following the 5-year simulation, and 6 feet at RW-1 to 21 feet at MW-12 following the 10-year simulation.

Groundwater elevation contours under the maximum pumping scenario are provided in Figures 5 and 6. The figures illustrate groundwater flow toward each extraction well. Groundwater flows into the extraction wells faster in the maximum pumping scenario leading to more pronounced cones of depression. Simulated drawdown ranges from 13 feet at BW-8 to 26 feet at RW-3 following the 5-year simulation, and 17 feet at BW-8 to 32 feet at RW-3 following the 10-year simulation.

Particle tracking simulations (Pollock, 1994) were also performed to evaluate the potential time of travel from the previously delineated June 2020 5-ug/L benzene plume contour. Particles were released from the model cells used to represent the 5-ug/L benzene contour line, and were forward tracked until the end of each simulation time period. Figures 7 and 8 show particle traces after 5 and 10 years of continuous pumping for the minimum pumping scenario, and Figures 9 and 10 show particle traces after 5 and 10 years of continuous pumping for the maximum pumping scenario.

Particle tracking results are presented with groundwater contours for a more complete conceptual picture of containment movement. Particle tracking provides a prediction for the leading edge of the benzene plume, and the groundwater contours illustrate interior plume movement. Figures 7 and 9 illustrate the advantage of the maximum scenario compared to the minimum pumping scenario. Under the minimum pumping scenario after 5 years of pumping, particle tracking illustrates containment of the June 2020 5-ug/L benzene isocontour; however, the groundwater contours illustrate that interior plume groundwater has not been captured (Figure 7). The maximum pumping scenario after 5 years of pumping predicts containment and capture of the benzene plume (Figure 9).

Based on the results provided in Table 1, and assuming a horizontal hydraulic conductivity of 1.16 ft/d, extraction network pump rates must be within the range of the minimum and maximum pumping scenarios to capture the extent of the June 2020 benzene plume. Applying rates below those listed in Table 1 will result in a smaller capture zone that will not reach the full extent of the target area, while applying rates above those listed in Table 1 will result in water levels dropping below the pump.

4. Conclusions

The constructed groundwater model evaluated a series of parameters in an effort to assess the feasibility of the proposed extraction network. Field and laboratory data provided the estimated range of site hydraulic conductivity of 1.16 to 11.3 ft/d. The value of 1.16 ft/d was used in the analysis as determined from hydraulic testing at MW-11. Modeled pumping rates ranged from 0.5 to 4.0 gpm distributed through the extraction network, with a total of 8 gpm in the minimum pumping scenario and almost 20 gpm in the maximum pumping scenario.

Particle tracking simulations were performed using the model parameters detailed in sections 2 and 3. Figures 7 through 10 illustrate the particle movement from the leading edge of the plume (June 2020 5-ug/L benzene isocontour line) toward the extraction network wells. While both the minimum and maximum scenarios simulate leading edge plume movement, the maximum pumping scenario contains the heart of the plume at a much faster rate than the minimum scenario.

The model simulations predict plume containment under both scenarios. Particle tracking and simulated groundwater contours illustrate plume containment and capture under the maximum pumping scenario with 5 years of pumping, whereas the minimum pumping scenario primarily contains the leading edge and minimizes further downgradient contaminant movement. Based on this modeling effort, the maximum pumping scenario is recommended. This analysis does not account for system down time, declining groundwater trends, declining well yields from screen fouling, and/or geologic heterogeneities that may affect hydraulic conductivity or storage. However, model inputs can be refined as additional field data becomes available. Once the extraction system is installed, the extraction network should be monitored to ensure water levels are maintained and do not fall below the pump. The monitoring well network should be sampled regularly to evaluate concentration trends and to allow for necessary modifications to the extraction system.

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Figures

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Figure 1

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO
MODFLOW Model Grid

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FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

MODFLOW Model Boundary

Figure 2

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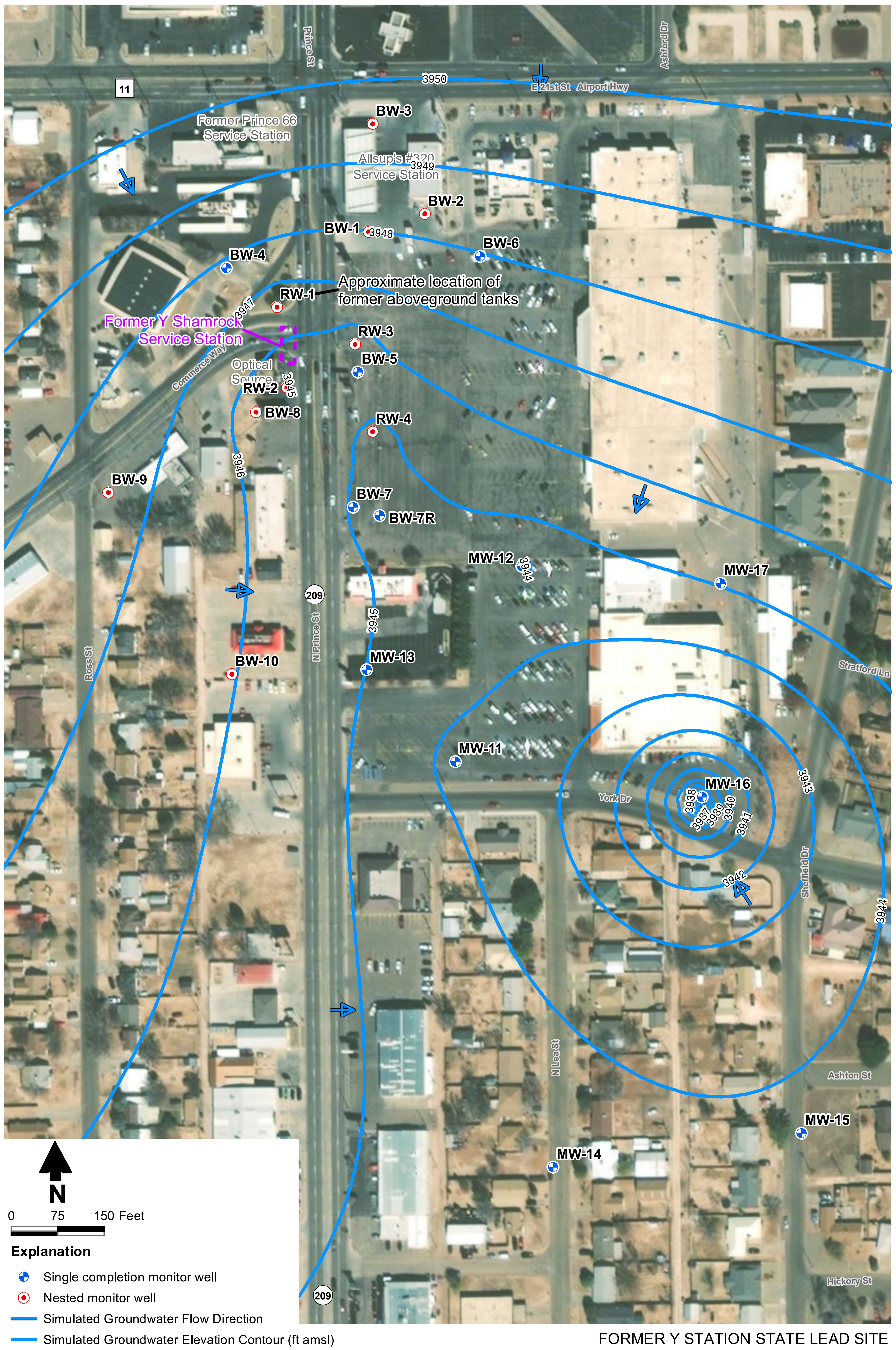

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Minimum Pumping Scenario Groundwater Elevation Contour Map: 5 Year Simulation

Figure 3

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FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Minimum Pumping Scenario Groundwater Elevation Contour Map: 10 Year Simulation

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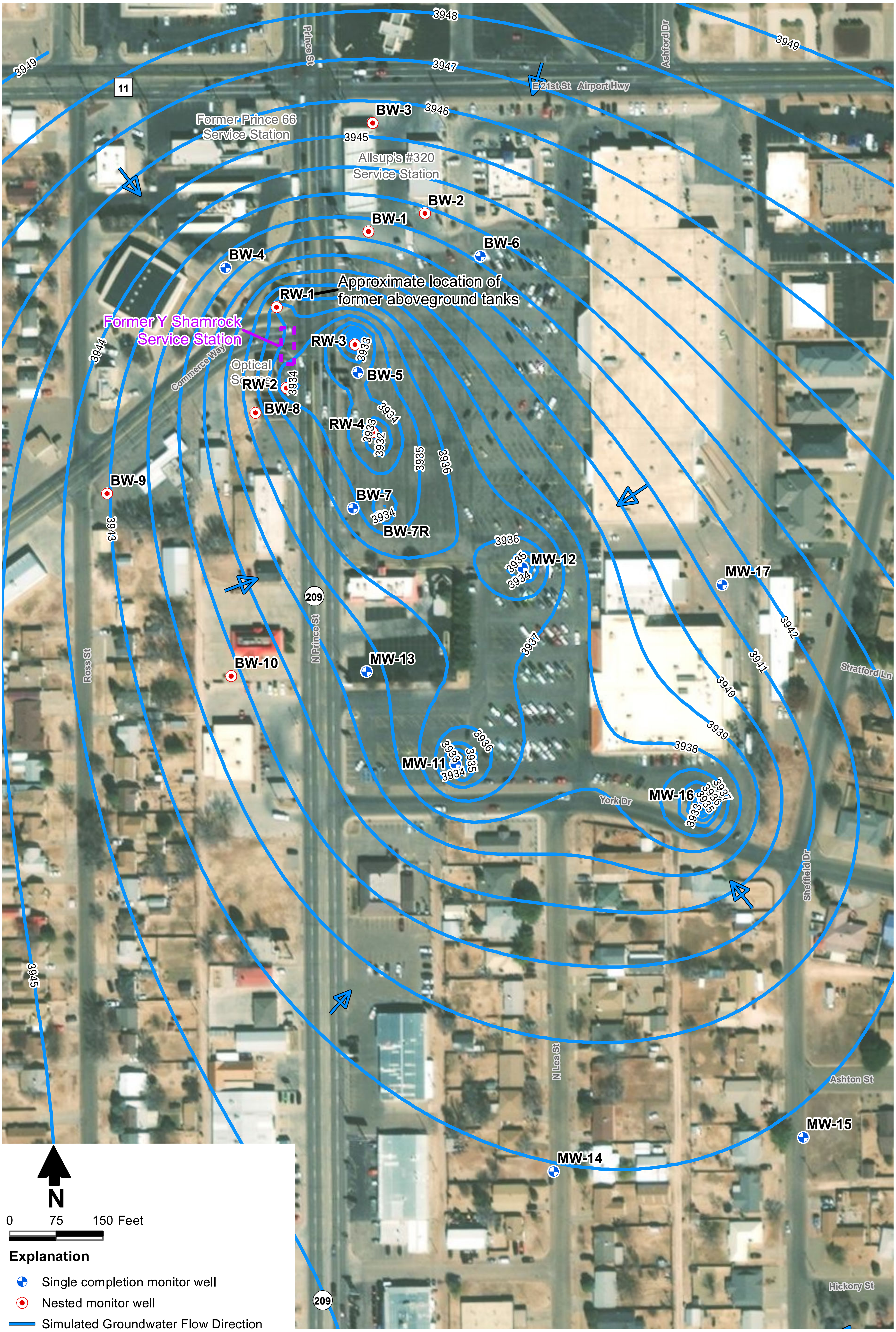
1/25/2021
JN DB18.1157.00

Figure 4



Explanation

- Single completion monitor well
- Nested monitor well
- Simulated Groundwater Flow Direction
- Simulated Groundwater Elevation Contour (ft amsl)

Figure 5

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Maximum Pumping Scenario Groundwater Elevation Contour Map: 5 Year Simulation

Daniel B. Stephens & Associates, Inc.
9/11/2020
JN DB18.1157.00

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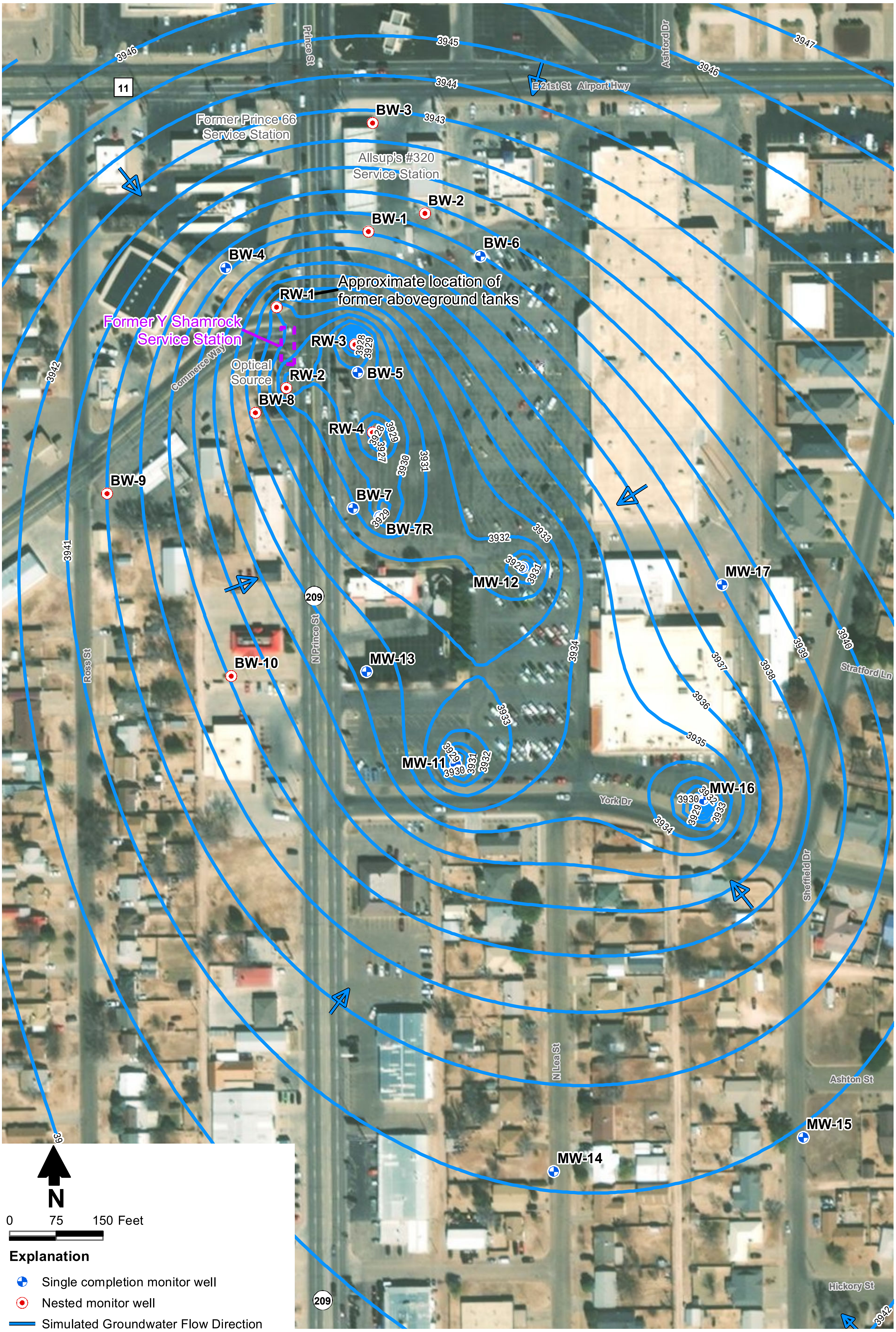

N

0 75 150 Feet

Explanation

- Single completion monitor well
- Nested monitor well
- Simulated Groundwater Flow Direction
- Simulated Groundwater Elevation Contour (ft amsl)

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Maximum Pumping Scenario Groundwater Elevation Contour Map: 10 Year Simulation

Daniel B. Stephens & Associates, Inc.
9/11/2020
JN DB18.1157.00

Figure 6

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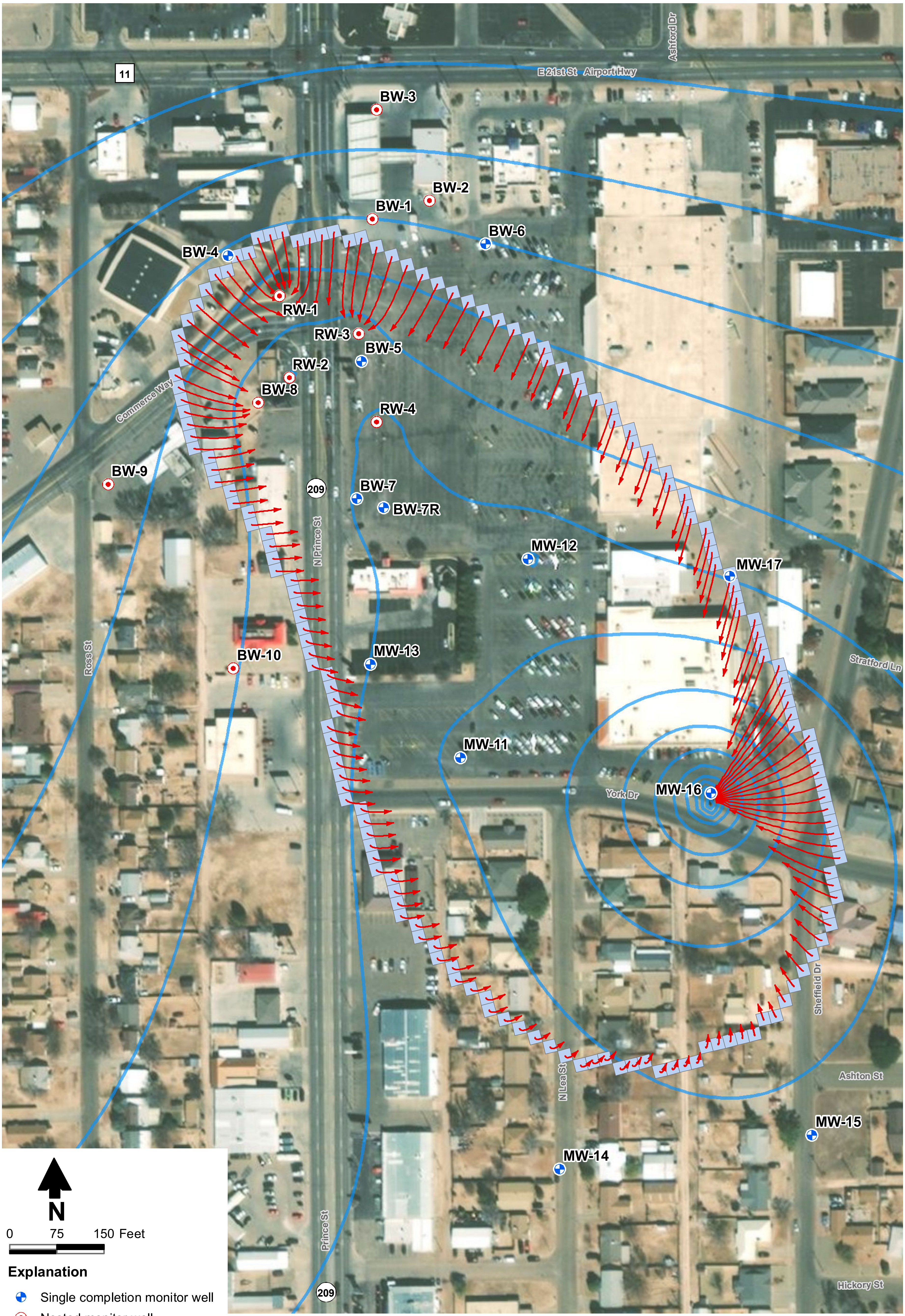


Explanation

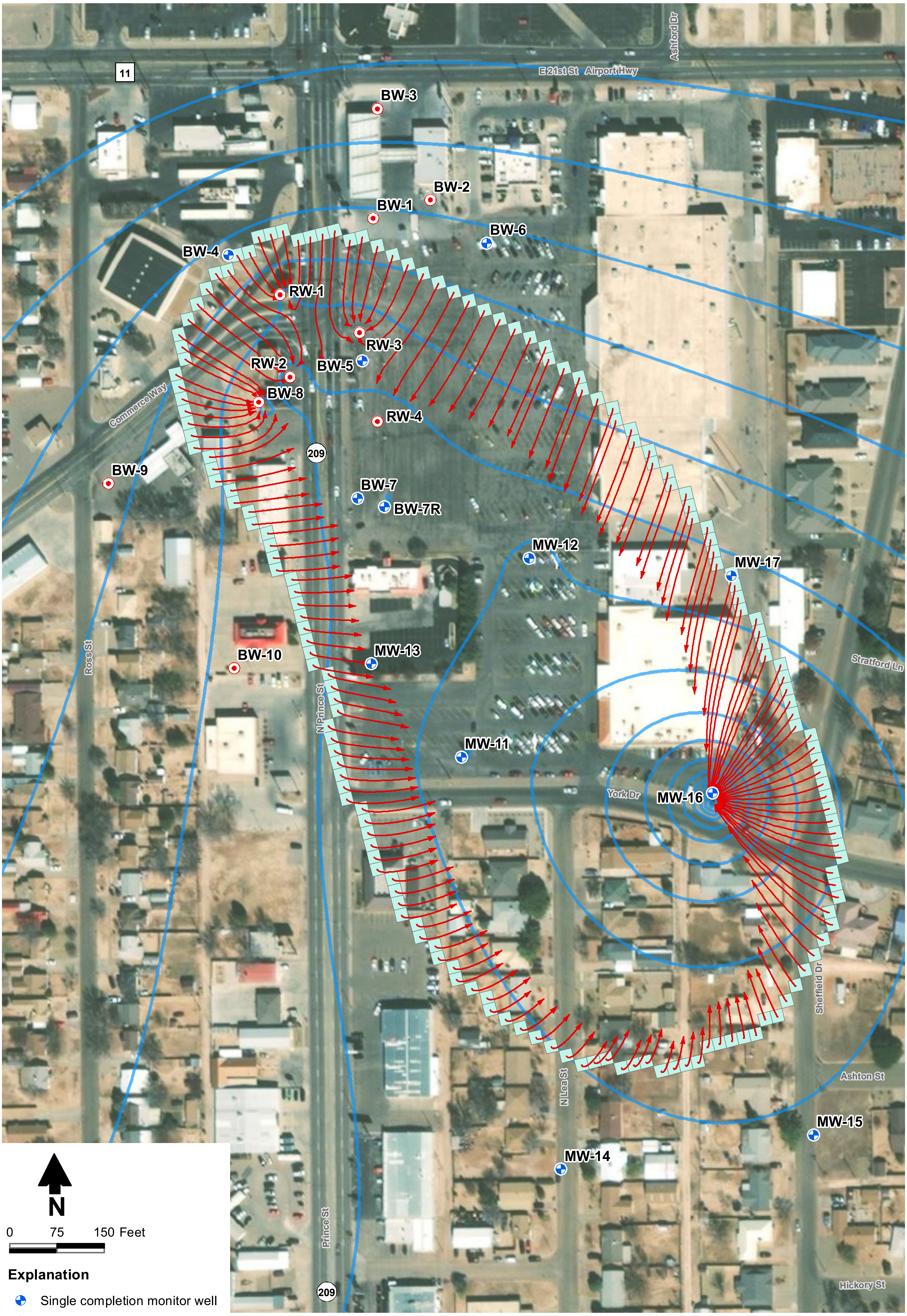
- ● Single completion monitor well
- ● Nested monitor well
- → Particle trace
- ▭ Particle starting cell
- — Simulated Groundwater Elevation Contour

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Minimum Pumping Scenario Particle Trace and Ground Water Elevation Map: 5 Year Simulation

Figure 7

Daniel B. Stephens & Associates, Inc.
9/14/2020
JN DB18.1157.00



Explanation

- ● Single completion monitor well
- ◉ Nested monitor well
- → Particle trace
- 🟩 Particle starting cell
- — Simulated Groundwater Elevation Contour (ft amsl)

FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Minimum Pumping Scenario Particle Trace and Ground Water Elevation Map: 10 Year Simulation

Figure 8

Daniel B. Stephens & Associates, Inc.
9/14/2020
JN DB18.1157.00

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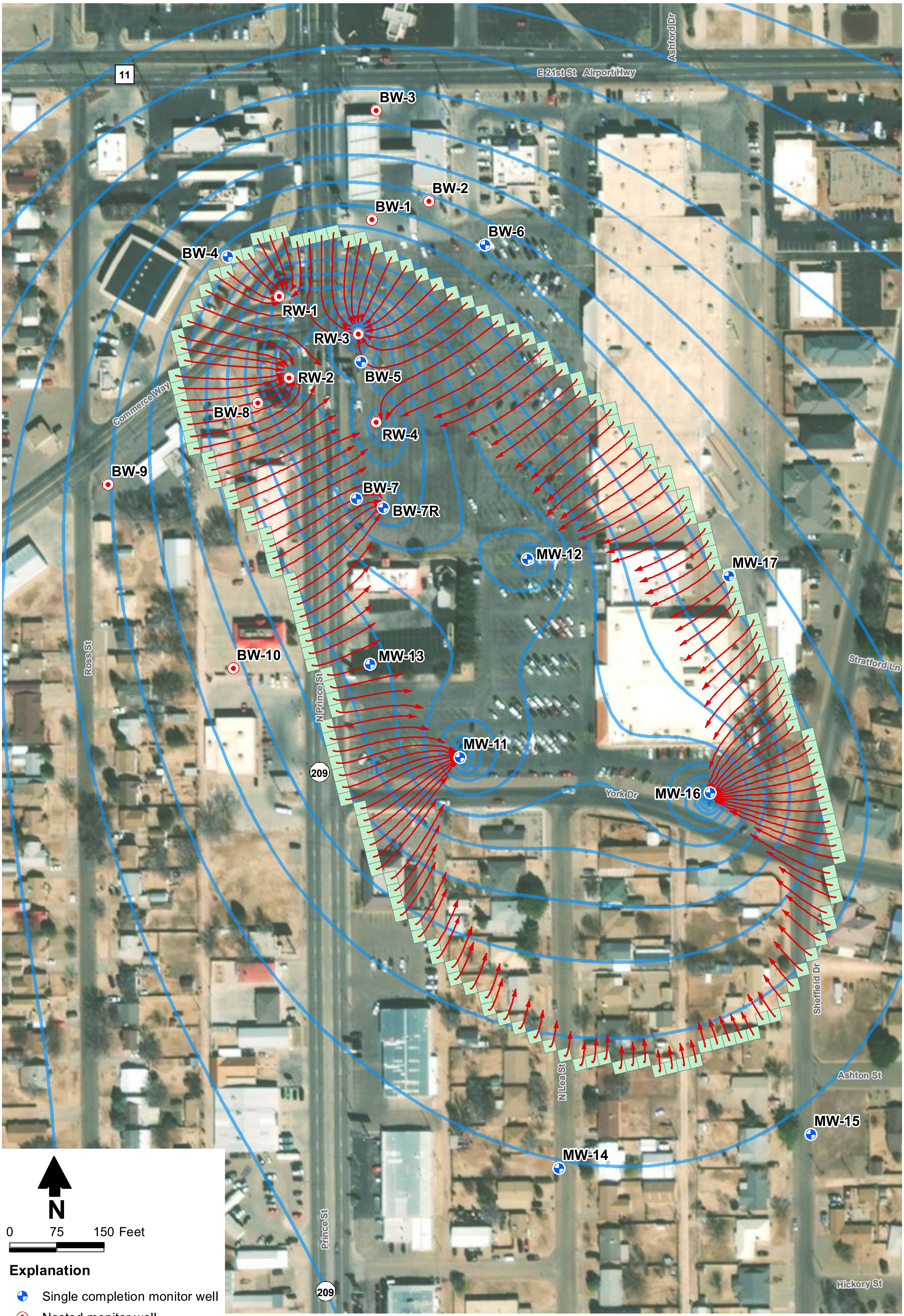


Explanation

⊕ Single completion monitor well

◉ Nested monitor well

→ Particle trace

🟩 Particle starting cell

— Simulated Groundwater Elevation Contour

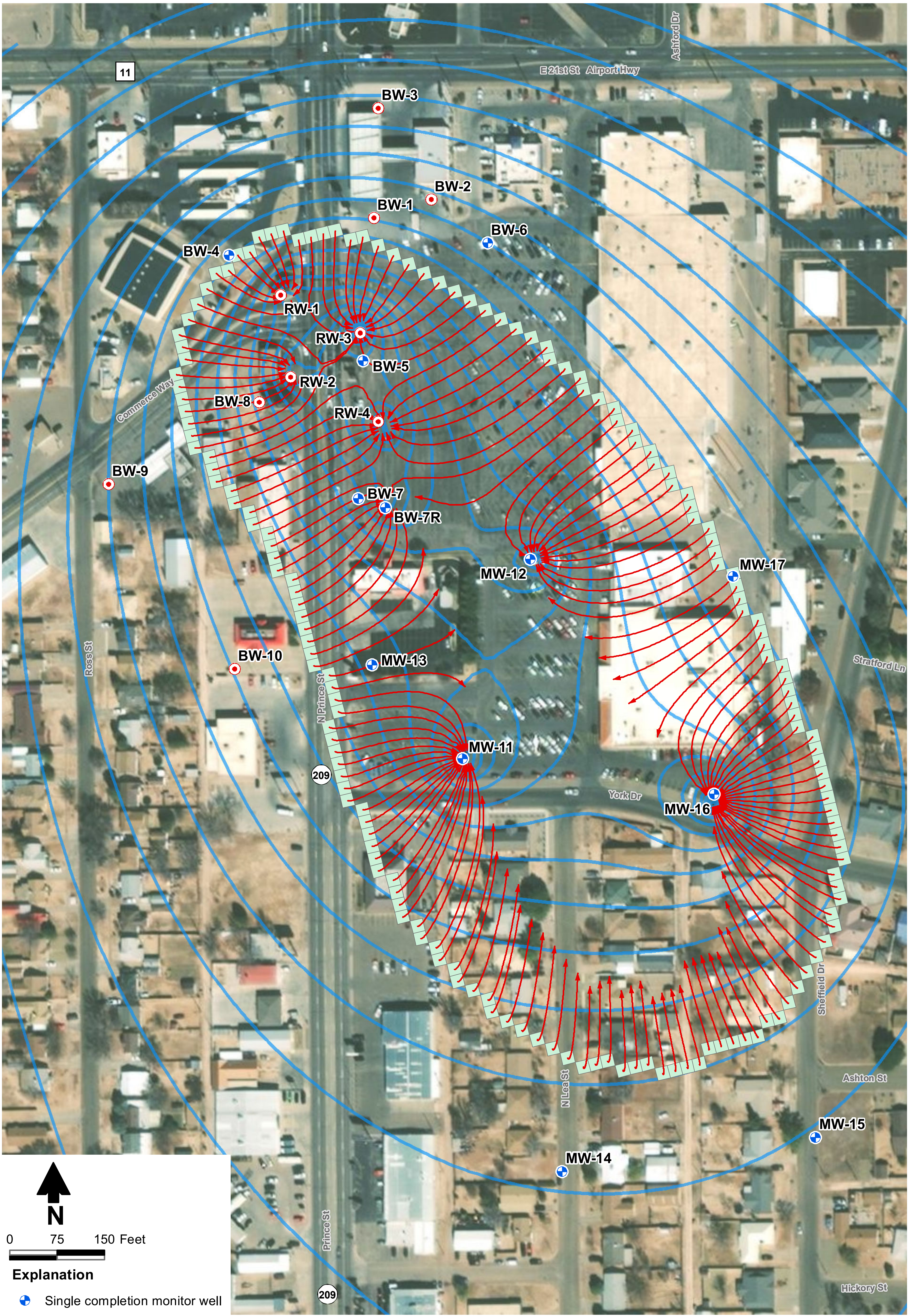
FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Maximum Pumping Scenario Particle Trace and Groundwater Elevation Map: 5 Year Simulation

Daniel B. Stephens & Associates, Inc.
9/14/2020
JN DB18.1157.00

Figure 9

S:\Projects\DB18.1157_Former_Y_Station\Modeling\03_Modflow\GIS



FORMER Y STATION STATE LEAD SITE
CLOVIS, NEW MEXICO

Maximum Pumping Scenario Particle Trace and Groundwater Elevation Map: 10 Year Simulation

Figure 10

Daniel B. Stephens & Associates, Inc.
9/14/2020
JN DB18.1157.00

Table

Table 1. Extraction Network Proposed Pumping and Drawdown

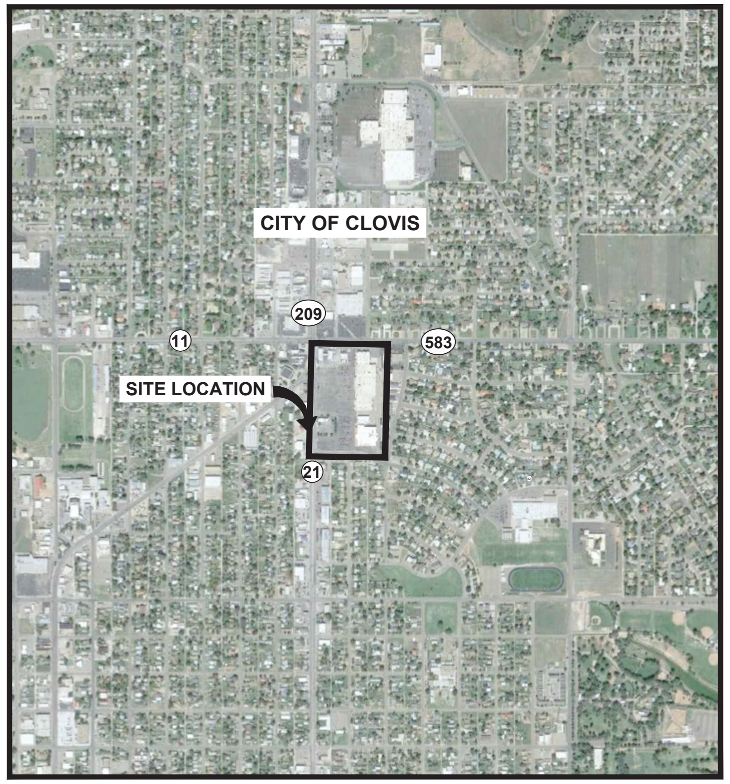
Well ID	Pump Rate (gpm)	Observed Static Water Level [a] (feet amsl)	Modeled Static Water Level (feet amsl)	Well Screen Bottom Elevation (feet amsl)	Available Drawdown [b] (feet)	Simulated Groundwater Elevation at Well (feet amsl)					Modeled Drawdown at Well (ft amsl)					Feet of Water Above Bottom of Well Screen after 10 Years
						1 Year	3 Years	5 Years	7 Years	10 Years	1 Year	3 Years	5 Years	7 Years	10 Years	
Minimum Pumping Scenario																
BW-7R	0.5	3949.61	3950	3921	29	3946.4	3944.7	3943.7	3943.0	3942.3	3	5	6	6	7	21
BW-8	0.5	3950.40	3950	3932	18	3946.8	3945.4	3944.6	3943.9	3943.2	3	5	6	6	7	11
RW-1	0.5	3950.78	3951	3925	26	3947.6	3946.3	3945.5	3944.9	3944.3	3	4	5	6	6	19
RW-2	0.5	3950.42	3950	3920	30	3946.7	3945.3	3944.4	3943.8	3943.1	4	5	6	6	7	23
RW-3	0.5	3950.53	3950	3915	35	3947.2	3945.7	3944.9	3944.3	3943.6	3	5	6	6	7	29
RW-4	0.5	3949.99	3950	3918	32	3946.5	3944.9	3944.0	3943.3	3942.6	3	5	6	7	7	25
MW-11	0.5	3948.40	3948	3919	29	3945.5	3943.7	3942.8	3942.1	3941.4	3	4	5	6	7	22
MW-12	0.5	3949.00	3949	3921	28	3946.2	3944.4	3943.4	3942.7	3941.9	3	5	6	6	7	21
MW-16	4.0	3947.48	3948	3917	31	3932.7	3930.3	3929.0	3928.1	3927.1	15	17	19	20	21	10
Maximum Pumping Scenario																
BW-7R	1.5	3949.61	3950	3921	29	3939.1	3933.6	3930.5	3928.3	3925.6	10	16	19	21	24	5
BW-8	0	3950.40	3950	3932	18	3944.2	3939.9	3937.4	3935.6	3933.6	6	10	13	15	17	2
RW-1	2.0	3950.78	3951	3925	26	3940.4	3935.9	3933.3	3931.3	3929.0	10	15	17	19	22	4
RW-2	2.0	3950.42	3950	3920	30	3939.0	3934.0	3931.0	3928.8	3926.3	11	16	19	21	24	6
RW-3	2.5	3950.53	3950	3915	35	3934.2	3928.4	3924.8	3922.0	3918.6	16	22	26	28	32	4
RW-4	2.0	3949.99	3950	3918	32	3936.8	3931.0	3927.6	3925.1	3922.1	13	19	22	25	28	4
MW-11	3.5	3948.40	3948	3919	29	3935.7	3930.9	3928.0	3925.8	3923.2	12	17	20	22	25	4
MW-12	2.0	3949.00	3949	3921	28	3938.6	3933.4	3930.3	3928.0	3925.4	10	16	19	21	24	4
MW-16	4.0	3947.48	3948	3917	31	3933.8	3929.6	3926.9	3924.8	3922.3	14	18	21	23	25	5

[a] Observed June 8, 2020
[b] Available drawdown based on modeled static water level
gpm = Gallons per minute
amsl = Above mean sea level

Appendix C

Engineering Drawings

VICINITY MAP
NTS
NORTH



SITE MAP
NTS
NORTH

STATE LEAD REMEDIATION
FORMER Y STATION

CLOVIS, NEW MEXICO

PREPARED FOR NEW MEXICO ENVIRONMENT DEPARTMENT
PETROLEUM STORAGE TANK BUREAU

INDEX OF DRAWINGS

REV. NO.	DATE	DESCRIPTION	APPROVED BY

DATE OF ISSUE: 07/16/2021
DESIGNED BY: T. GOLDEN
DRAWN BY: J. ARELLANO
CHECKED BY: G. HALL
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STATE LEAD REMEDIATION
FORMER Y STATION
CLOVIS, NEW MEXICO

COVER SHEET AND INDEX

SHEET 1 OF 11
DWG NO. G-0

JOB NO.
DB18.1157.00

GENERAL CONSTRUCTION NOTES:

A. ALL WORK ON THIS PROJECT SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL LAWS, ORDINANCES, AND REGULATIONS CONCERNING CONSTRUCTION SAFETY AND HEALTH.

B. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL REQUIRED CONSTRUCTION PERMITS AND APPROVALS OF LIKE KIND PRIOR TO START OF CONSTRUCTION.

C. PROJECT DOCUMENTS CONSIST OF THESE DRAWINGS, PROJECT SPECIFICATIONS, PROJECT CONTRACTS, AND ANY AND ALL SUBSEQUENT EXECUTED PROJECT DOCUMENTATION ISSUED AS, OR WITH, CHANGE ORDERS, AND RFI'S (REQUEST FOR INFORMATION.) THE CONTRACTOR SHALL REVIEW ALL PROJECT DOCUMENTS AND VERIFY ALL DIMENSIONS, QUANTITIES, AND FIELD CONDITIONS. ANY CONFLICTS OR OMISSIONS WITH THE DOCUMENTS SHALL BE REPORTED TO THE ENGINEER/PROJECT MANAGER FOR CLARIFICATION PRIOR TO PERFORMANCE OF ANY WORK IN QUESTION. IN THE EVENT THE CONTRACTOR DOES NOT NOTIFY THE ENGINEER/PROJECT MANAGER, THE CONTRACTOR ASSUMES FULL RESPONSIBILITY AND ANY AND ALL EXPENSE FOR ANY REVISIONS NECESSARY OR CORRECTIONAL WORK REQUIRED.

D. THE LOCATION OF BURIED UTILITIES ARE BASED UPON INFORMATION PROVIDED TO THE ENGINEER BY OTHERS AND MAY NOT REFLECT ACTUAL FIELD CONDITIONS. EXISTING BURIED UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL USE ANY MEANS APPROVED BY THE ENGINEER/PROJECT MANAGER TO LOCATE UNDERGROUND UTILITIES INCLUDING, BUT NOT LIMITED TO, ELECTRONIC LOCATING EQUIPMENT AND/OR POT HOLING. ANY DAMAGE TO ANY OTHER UTILITIES AND/OR COLLATERAL DAMAGE CAUSED BY THE CONTRACTOR SHALL BE THE FULL RESPONSIBILITY OF THE CONTRACTOR.

E. EXISTING FENCING THAT IS NOT DESIGNATED FOR REMOVAL SHALL NOT BE DISTURBED. ANY FENCING THAT IS DISTURBED OR ALTERED BY THE CONTRACTOR SHALL BE RESTORED TO ITS ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE. IF THE CONTRACTOR DESIRES TO REMOVE FENCING TO ACCOMMODATE CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL OBTAIN THE OWNER'S WRITTEN PERMISSION BEFORE FENCE IS REMOVED. CONTRACTOR SHALL RESTORE THE FENCE TO ITS ORIGINAL CONDITION AT THE EARLIEST OPPORTUNITY TO THE SATISFACTION OF THE OWNER. WHILE ANY FENCING IS REMOVED, THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR SECURITY OF THE SITE UNTIL THE FENCE IS RESTORED.

F. AT THE END OF EACH WORK DAY, THE CONTRACTOR SHALL CLEAN AND PICK UP THE WORK AREA TO THE SATISFACTION OF THE ENGINEER/PROJECT MANAGER. AT NO TIME SHALL THE WORK BE LEFT IN A MANNER THAT COULD ENDANGER THE WORKERS OR THE PUBLIC.

G. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO PROJECT SPECIFICATIONS AND PLANS, AS AMENDED AND REVISED BY THE ENGINEER. ALL INSTALLATION DETAILS ARE TYPICAL AND MAY BE CHANGED TO BETTER FIT EXISTING LOCAL CONDITIONS UPON APPROVAL BY THE ENGINEER.

H. ONLY THE CONTRACTOR SHALL BE RESPONSIBLE FOR SAFETY OF ALL WORK. ALL WORK, INCLUDING WORK WITHIN TRENCHES, SHALL BE IN ACCORDANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA).

I. REFERENCES MADE TO STANDARD SPECIFICATIONS AND STANDARD DRAWINGS REFER TO THE NEW MEXICO CHAPTER OF THE AMERICAN PUBLIC WORKS ASSOCIATION (APWA–NM) STANDARDS FOR PUBLIC WORKS CONSTRUCTION, OR CITY OF CLOVIS STANDARD DWGS.

J. THE CONTRACTOR SHALL NOT INSTALL ITEMS AS SHOWN ON THESE PLANS WHEN IT IS OBVIOUS THAT FIELD CONDITIONS ARE DIFFERENT THAN SHOWN IN THE PLANS. SUCH CONDITIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER IN A TIMELY MANNER. IN THE EVENT THE CONTRACTOR DOES NOT NOTIFY THE ENGINEER IN A TIMELY MANNER, THE CONTRACTOR ASSUMES FULL RESPONSIBILITY AND EXPENSE FOR ANY REVISIONS NECESSARY, INCLUDING ENGINEERING DESIGN FEES.

K. EXISTING SITE IMPROVEMENTS WHICH ARE DAMAGED OR DISPLACED BY THE CONTRACTOR SHALL BE REMOVED AND REPLACED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE. REPAIRS SHALL BE APPROVED BY THE OWNER PRIOR TO CONSTRUCTION OF THE REPAIRS. REPAIRS SHALL BE ACCEPTED BY THE OWNER PRIOR TO FINAL PAYMENT.

WORK WITHIN ADJACENT RIGHT–OF–WAY

L. PRIOR TO BEGINNING ANY CONSTRUCTION ACTIVITIES WITHIN ADJACENT RIGHT–OF–WAYS OR WITHIN PROPERTY NOT OWNED BY THE OWNER OF THE PROJECT SITE, THE CONTRACTOR SHALL ASSURE THAT ALL PERMITS AND PERMISSIONS REQUIRED HAVE BEEN OBTAINED IN WRITING.

SURVEY MONUMENTS, PROPERTY CORNERS, BENCHMARKS

M. THE CONTRACTOR SHALL NOTIFY THE OWNER AT LEAST SEVEN (7) DAYS BEFORE BEGINNING ANY CONSTRUCTION ACTIVITY THAT COULD DAMAGE OR DISPLACE SURVEY MONUMENTS, PROPERTY CORNERS, OR PROJECT BENCHMARKS SO THESE ITEMS MAY BE RELOCATED.

N. ANY SURVEY MONUMENTS, PROPERTY CORNERS, OR BENCHMARKS THAT ARE NOT IDENTIFIED FOR RELOCATION ARE THE RESPONSIBILITY OF THE CONTRACTOR TO PRESERVE AND PROTECT, RELOCATION OR REPLACEMENT OF THESE ITEMS SHALL BE DONE BY THE OWNER'S SURVEYOR AT THE EXPENSE OF THE CONTRACTOR.

DESIGN SURVEY

O. DESIGN SURVEY PERFORMED JUNE 2020 BY LYDICK ENGINEERS AND SURVEYORS, INC. ANY DISCREPANCIES BETWEEN THE ENGINEER'S DESIGN AND SITE SURFACE CONDITIONS SHALL BE BROUGHT TO THE ENGINEER'S ATTENTION IMMEDIATELY.

PAVEMENT

P. WHEN ABUTTING NEW PAVEMENT TO EXISTING PAVEMENT, CUT EXISTING PAVEMENT EDGE TO A NEAT, STRAIGHT LINE AS NECESSARY TO REMOVE ANY BROKEN OR CRACKED PAVEMENT AND MATCH NEW PAVEMENT ELEVATION TO EXISTING.

Q. ALL UTILITIES AND UTILITY SERVICE LINES SHALL BE INSTALLED AND APPROVED PRIOR TO PAVING.

CONSTRUCTION LIMITS

R. SHALL BE AS SHOWN ON PLANS.

UTILITIES

S. UTILITY LINES, PIPELINES, OR UNDERGROUND UTILITY LINES SHOWN ON THESE DRAWINGS ARE SHOWN IN AN APPROXIMATE LOCATION ONLY BASED ON THE INFORMATION PROVIDED TO THE ENGINEER BY OTHERS. THIS INFORMATION MAY BE INACCURATE OR INCOMPLETE. ADDITIONALLY, UNDERGROUND LINES MAY EXIST THAT ARE NOT SHOWN. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ANY UTILITY LINE, PIPELINE, OR UNDERGROUND UTILITY LINE IN OR NEAR THE AREA OF THE WORK IN ACCORDANCE WITH CHAPTER 62, ARTICLE 14–1, THROUGH 14–8, NMSA 1978.

T. THE CONTRACTOR SHALL CONTACT THE STATEWIDE UTILITY LOCATOR SERVICE AT 811 AT LEAST FIVE WORKING DAYS BEFORE BEGINNING CONSTRUCTION. AFTER THE UTILITIES ARE SPOTTED, THE CONTRACTOR SHALL EXPOSE ALL PERTINENT UTILITIES TO VERIFY THEIR VERTICAL AND HORIZONTAL LOCATION. IF A CONFLICT EXISTS BETWEEN EXISTING UTILITIES AND PROPOSED CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE ENGINEER SO THAT THE CONFLICT CAN BE RESOLVED WITH MINIMAL DELAY.

U. THE CONTRACTOR SHALL EXERCISE DUE CARE TO AVOID DISTURBING ANY EXISTING UTILITIES, ABOVE OR BELOW GROUND. UTILITIES THAT ARE DAMAGED BY CARELESS CONSTRUCTION SHALL BE REPAIRED OR REPLACED AT THE CONTRACTOR'S EXPENSE.

V. THE CONTRACTOR SHALL COORDINATE ANY REQUIRED UTILITY INTERRUPTIONS WITH THE OWNER AND AFFECTED UTILITY COMPANY A MINIMUM OF FIVE (5) WORKING DAYS BEFORE THE INTERRUPTION.

W. THE CONTRACTOR SHALL MAINTAIN A RECORD DRAWING SET OF PLANS AND PROMPTLY LOCATE ALL UTILITIES, EXITING OR NEW, IN THEIR CORRECT LOCATION, HORIZONTAL AND VERTICAL. THIS RECORD SET OF DRAWINGS SHALL BE MAINTAINED ON THE PROJECT SITE AND SHALL BE AVAILABLE TO THE OWNER AND ENGINEER AT ANY TIME DURING CONSTRUCTION. RECORD INFORMATION SHALL INCLUDE HORIZONTAL AND VERTICAL COORDINATE CALLOUTS, LINE SIZES, LINE TYPES, BURIAL DEPTHS, AND ALL OTHER PERTINENT INSTALLATION INFORMATION. IN ADDITION ALL ITEMS THAT ARE INSTALLED EXACTLY AS DESIGNED SHALL BE NOTED AS SUCH.

EROSION CONTROL, ENVIRONMENTAL PROTECTION, AND STORM WATER POLLUTION PREVENTION PLAN

X. THE CONTRACTOR SHALL CONFORM TO ALL CURRY COUNTY, STATE OF NEW MEXICO, AND FEDERAL DUST AND EROSION CONTROL REGULATIONS. THE CONTRACTOR SHALL PREPARE AND OBTAIN ANY DUST CONTROL OR EROSION CONTROL PERMITS FROM THE APPROPRIATE REGULATORY AGENCIES.

Y. THE CONTRACTOR SHALL PROMPTLY REMOVE OR STABILIZE ANY MATERIAL EXCAVATED WITHIN THE RIGHT–OF–WAY OR ADJACENT PROPERTY TO KEEP IT FROM WASHING OFF THE PROJECT SITE.

Z. THE CONTRACTOR SHALL ENSURE THAT NO SOIL ERODES FROM THE SITE ONTO ADJACENT PROPERTY BY CONSTRUCTION OF TEMPORARY EROSION CONTROL BERMS OR INSTALLING SILT FENCES AT THE PROPERTY LINES (OR LIMITS OF CONSTRUCTION WHERE DESIGNATED) AND WETTING SOIL TO PREVENT IT FROM BLOWING.

AA. WATERING, AS REQUIRED FOR CONSTRUCTION DUST CONTROL, SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION AND NO MEASUREMENT OR PAYMENT SHALL BE MADE. CONSTRUCTION AREAS SHALL BE WATERED FOR DUST CONTROL IN COMPLIANCE WITH CITY, COUNTY AND STATE ORDINANCES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING WITH THE CITY OF CLOVIS, FOR AVAILABILITY AND USE OF WATER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING ALL EQUIPMENT AND MATERIALS NECESSARY FOR OBTAINING, METERING, AND PAYING FOR WATER.

AB. THE CONTRACTOR SHALL PROPERLY HANDLE AND DISPOSE OF ALL ASPHALT AND CONCRETE REMOVED ON THE PROJECT BY HAULING TO AN APPROVED DISPOSAL SITE IN ACCORDANCE WITH THE REQUIREMENTS OF MORA COUNTY.

AC. ALL WASTE PRODUCTS FROM THE CONSTRUCTION SITE, INCLUDING ITEMS DESIGNED FOR REMOVAL, CONSTRUCTION WASTE, CONSTRUCTION EQUIPMENT WASTE PRODUCTS (OIL, GAS, TIRES, ETC.), DRILLING MUD AND WATER, GARBAGE, GRUBBING, EXCESS CUT MATERIAL, VEGETATIVE DEBRIS, ETC. SHALL BE APPROPRIATELY DISPOSED OF OFFSITE AT NO ADDITIONAL COST TO THE OWNER. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN ANY PERMITS REQUIRED FOR HAUL OR DISPOSAL OF WASTE PRODUCTS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT THE WASTE DISPOSAL SITE COMPLIES WITH APPROPRIATE REGULATIONS REGARDING THE ENVIRONMENT, ENDANGERED SPECIES, AND ARCHAEOLOGICAL RESOURCES.

AD. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CLEANUP AND REPORTING OF SPILLS OF HAZARDOUS MATERIALS ASSOCIATED WITH THE CONSTRUCTION SITE. HAZARDOUS MATERIALS INCLUDES GASOLINE, DIESEL FUEL, MOTOR OIL, SOLVENTS, CHEMICALS, PAINT, ETC. WHICH MAY BE A THREAT TO THE ENVIRONMENT. THE CONTRACTOR SHALL REPORT THE DISCOVERY OF PAST OR PRESENT SPILLS TO THE NEW MEXICO HAZARDOUS WASTE BUREAU AT 1–505–476–6000 AND THE ENGINEER.

AE. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS CONCERNING SURFACE AND UNDERGROUND WATER. CONTACT WITH SURFACE WATER BY CONSTRUCTION EQUIPMENT AND PERSONNEL SHALL BE MINIMIZED. EQUIPMENT MAINTENANCE AND REFUELING OPERATIONS SHALL BE PERFORMED IN AN ENVIRONMENTALLY SAFE MANNER IN COMPLIANCE WITH CITY, COUNTY, STATE, AND EPA REGULATIONS.

AF. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS CONCERNING CONSTRUCTION NOISE AND HOURS OF OPERATION AS STATED IN THE SPECIFICATIONS OR IMPOSED BY THE OWNER, CITY OR COUNTY AUTHORITIES.

TRAFFIC CONTROL

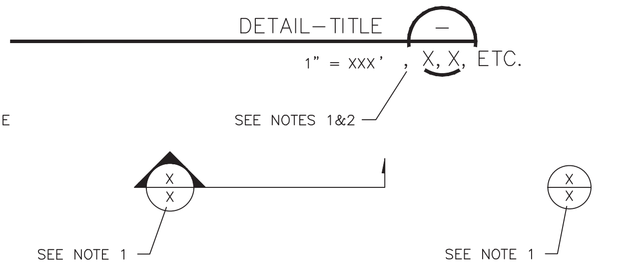
AG. THE CONTRACTOR SHALL PROVIDE ALL REQUIRED TRAFFIC CONTROL PLANS AND TRAFFIC CONTROL EQUIPMENT. ALL SIGNS, BARRICADES, CHANNELIZATION DEVICES, SIGN FRAMES AND ERECTION OF SUCH DEVICES SHALL CONFORM TO THE REQUIREMENTS OF "MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS" LATEST EDITION. TRAFFIC CONTROL PLANS SHALL BE APPROVED BY THE COUNTY AND NMDOT PRIOR TO CONSTRUCTION.

MISCELLANEOUS SYMBOLS:

NOTE: SYMBOLS ARE NOT SHOWN TO SCALE ON PLAN OR PROFILE DRAWINGS, AND INDICATE APPROXIMATE LOCATION ONLY.

—— — ——	CENTERLINE
— OHP — OHP —	EXISTING OVERHEAD ELECTRICAL LINE
—— UE ——	EXISTING UNDERGROUND ELECTRICAL LINE
—— GAS ——	EXISTING GAS LINE
— SS — SS — SS —	EXISTING SEWER LINE
— T — T —	EXISTING COMMUNICATION LINE
— W — W — W —	EXISTING WATER LINE
━ C ━ C ━ C ━	CONVEYANCE LINE
⛆	CONCRETE
▨	EXISTING STRUCTURE
▦	NATIVE MATERIAL
░	TRENCH ZONE MATERIAL COMPPACT TO 85% (D698)
▩	TRENCH ZONE MATERIAL COMPACT TO 95% (D698)
▧	TRENCH ZONE MATERIAL COMPACT TO 90% (D1557)
∼ 3910 ∼	EXISTING MAJOR CONTOUR LINE AND ELEVATION DESIGNATION
∼ 3909 ∼	EXISTING MINOR CONTOUR LINE AND ELEVATION DESIGNATION
⚙	EXISTING POWER/LIGHT POLE
Ⓢ	EXISTING SEWER MANHOLE
●	EXISTING HYDRANT
⋈	EXISTING WATER VALVE
⊢	EXISTING GUY WIRE
⊕	EXISTING SINGLE COMPLETION MONITOR WELL
◉	EXISTING NESTED MONITOR WELL

LEGEND:



NOTES:

1. IF SECTION, DETAIL, SCHEMATIC, OR DIAGRAM IS DRAWN ON THE SAME SHEET THAT IT IS TAKEN FROM, THE SHEET NUMBER SHALL BE REPLACED WITH A HYPHEN.

2. IF THE SECTION, DETAIL, SCHEMATIC, OR DIAGRAM IS REFERENCED ON MULTIPLE SHEETS, ALL SHEETS SHOULD BE LISTED TO THE OUTSIDE RIGHT OF THE DETAIL–TITLE BUBBLE, AND SEPARATED WITH A COMMA.

ABBREVIATIONS:

AI	AIR INJECTION
ARV	AIR RELIEF VALVE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
BMP	BEST MANAGEMENT PRACTICE
C–C	CENTER TO CENTER
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CS	CARBON STEEL
DI	DUCTILE IRON
DIA	DIAMETER
DPE	DUAL–PHASE EXTRACTION
DTA	DIFFUSED AERATION TANK
DW	DRIVEWAY
EL	ELBOW
EOP	EDGE OF PAVEMENT
EXIST	EXISTING
FH	FLUSH HYDRANT
FM	FLOW METER
FQI	FLOW QUANTITY INDICATOR
FT	FEET
FT MSL	FEET ABOVE MEAN SEA LEVEL
GW	GROUND WATER
H	HEIGHT
HDPE	HIGH DENSITY POLYETHYLENE
HOA	HANDS OFF AUTO
HOR	HORIZONTAL
INV	INVERT ELEVATION
LB	POUND
LF	LINEAR FEET
MDWCA	MUTUAL DOMESTIC WATER CONSUMER ASSOCIATION
MIN	MINIMUM
MSL	MEAN SEA LEVEL
N/A	NOT APPLICABLE
NMDOT	NEW MEXICO DEPARTMENT OF TRANSPORTATION
NMED	NEW MEXICO ENVIRONMENT DEPARTMENT
NTS	NOT TO SCALE
OC	ON CENTER
OW	OIL/WATER
P/L	PROPERTY LINE
POT	POTABLE WATER
PS	PRESSURE SENSOR
PSI	POUNDS PER SQUARE INCH
PVC	POLY VINYL CHLORIDE
RED	REDUCER
ROW	RIGHT OF WAY
SCH	SCHEDULE
STA	STATION
STD	STANDARD
SVE	SOIL VAPOR EXTRACTION
TBD	TO BE DETERMINED
THR	THREADED
UE	UNDERGROUND ELECTRIC
VERT	VERTICAL
VI	VACUUM INDICATOR
W	WIDTH
W/	WITH
WL	WATER LINE

REV. NO.	DATE	DESCRIPTION	APPROVED BY

DATE OF ISSUE: 07/16/2021
DESIGNED BY: T. GOLDEN
DRAWN BY: J. ARELLANO
CHECKED BY: G. HALL
APPROVED BY: T. GOLDEN

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STATE LEAD REMEDIATION
FORMER Y STATION
CLOVIS, NEW MEXICO

GENERAL NOTES AND LEGEND

SHEET 2 OF 11
DWG NO. G-1

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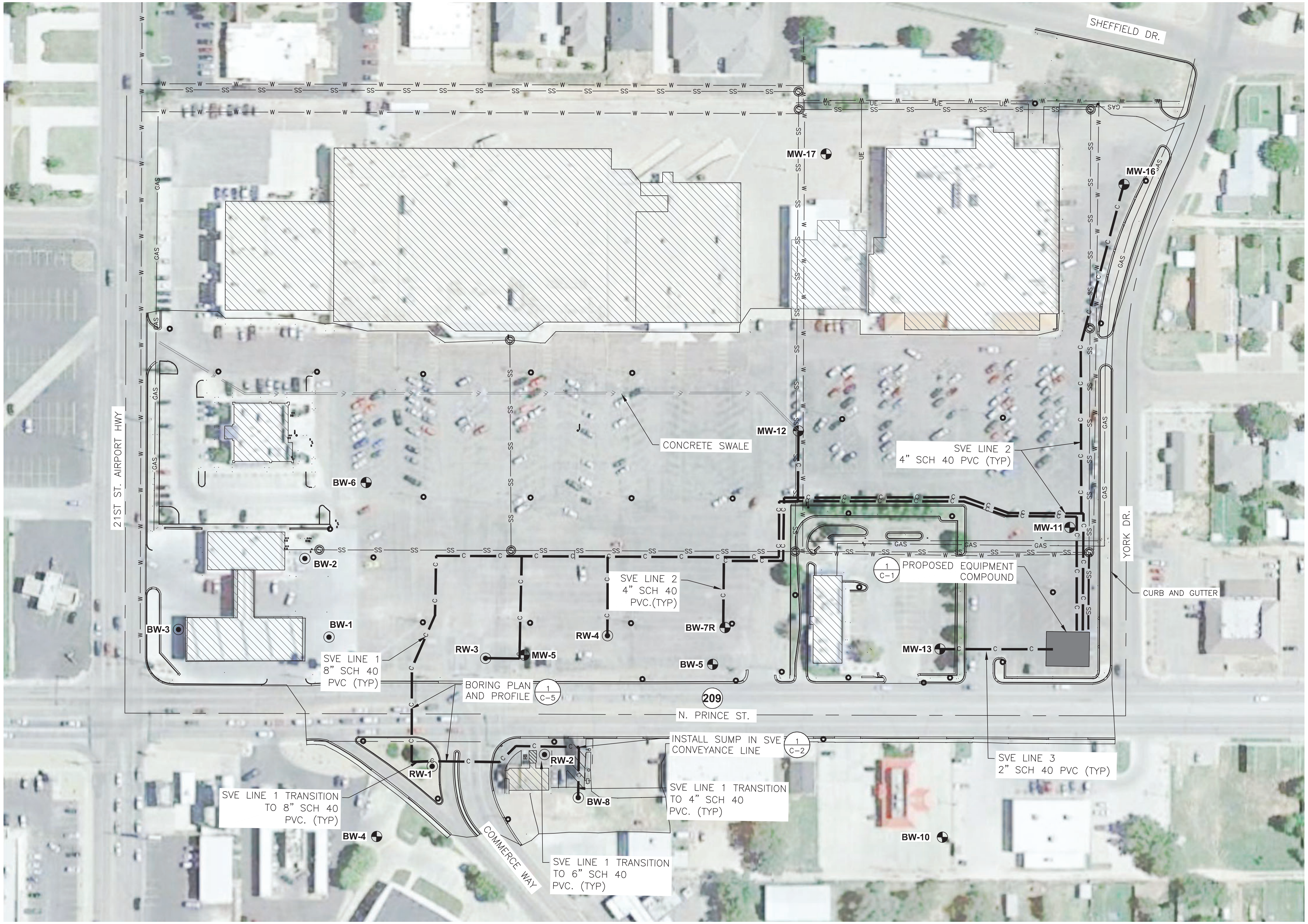
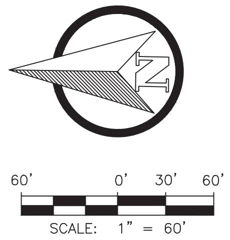


GENERAL NOTES:

1. DESIGN SURVEY, SUBSURFACE UTILITIES, AND TOPOGRAPHY DATED JUNE 16, 2020 PROVIDED BY LYDICK ENGINEERS AND SURVEYORS.
2. AERIAL PHOTOGRAPH DATED OCTOBER 2016 OBTAINED THROUGH GOOGLE EARTH.
3. GROUNDWATER CONVEYANCE LINE IS 1.5" SCH 40 PVC, EXCEPT AT WELLHEAD, AND EXTENDS TO ALL WELLS SHOWN, EXCEPT BW–8.
4. SVE CONVEYANCE LINES SIZE AND MATERIALS AS INDICATED ON THIS SHEET.
5. ELECTRICAL LINES CONSISTS OF 2" CONDUIT FOR 3PHASE WELLS 2.5" CONDUIT FOR SINGLE PHASE WELLS AND 2"CONDUIT FOR COMMUNICATION LINES
6. GROUNDWATER CONVEYANCE LINES ARE CO–LOCATED IN THE SAME TRENCH AS THE SVE LINES AND ELECTRICAL LINES ARE A 2" CONDUIT FOR 3–PHASE WELL PUMPS, AND 2" CONDUIT FOR COMMUNICATION LINES.
7. CONTRACTOR TO SLOPE SVE CONVEYANCE PIPING TO SUMPS AS SHOWN IN THE DRAWINGS.



S:\PROJECTS\DB18.1157_FORMER_Y_STATION\CAD\PRODUCTION\SITE PLAN.DWG July 15, 2021 – 2:14 PM BY: ARELLANO, JEFFREY

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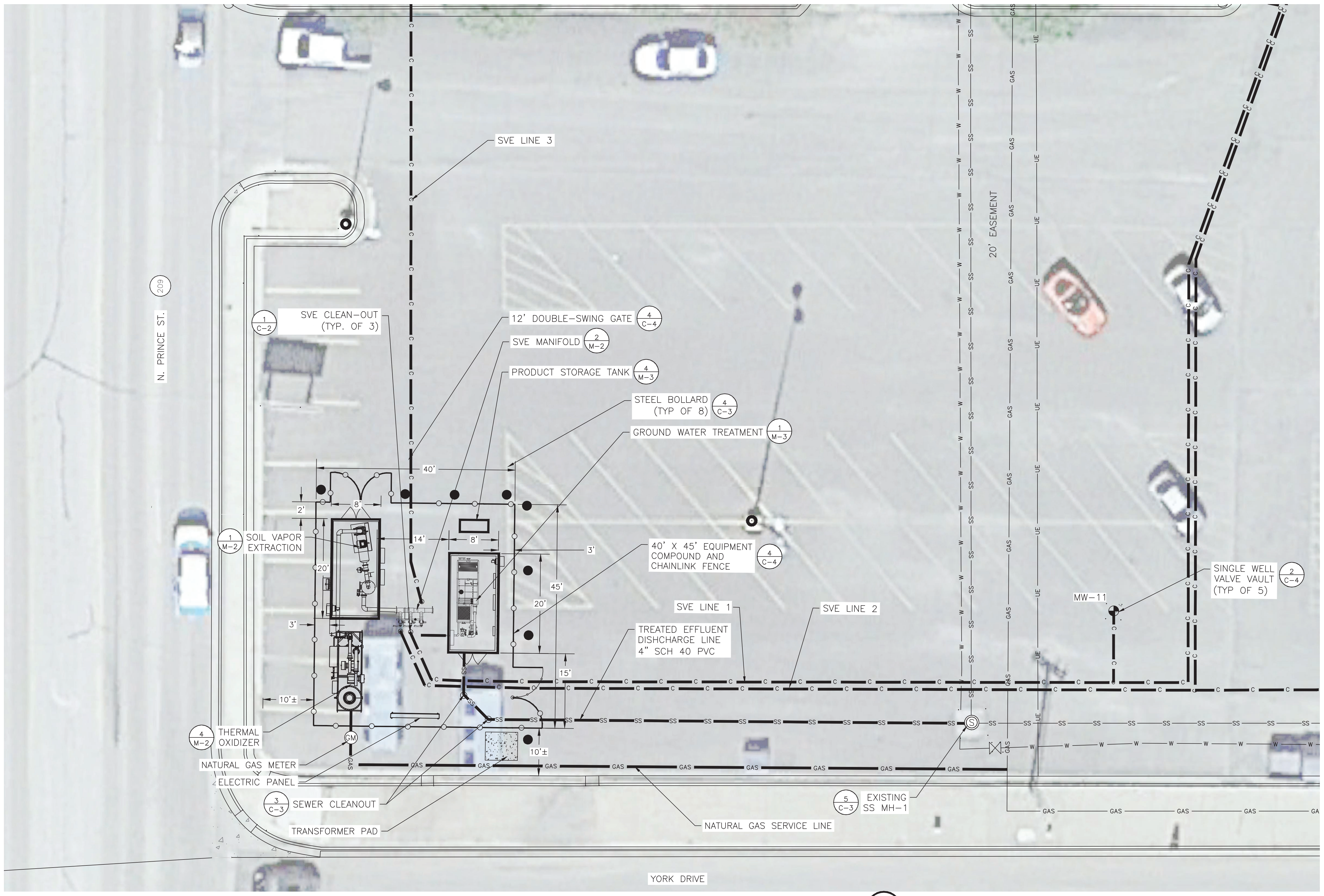
STATE LEAD REMEDIATION
FORMER Y STATION
CLOVIS, NEW MEXICO

GENERAL SITE PLAN

SHEET 3 OF 11
DWG NO. G-2

JOB NO.
DB18.1157.00



GENERAL NOTES:

1. DESIGN SURVEY, SUBSURFACE UTILITIES, AND TOPOGRAPHY DATED JUNE 16, 2020 PROVIDED BY LYDICK ENGINEERS AND SURVEYORS.
2. AERIAL PHOTOGRAPH DATED OCTOBER 2016 OBTAINED THROUGH GOOGLE EARTH.
3. ENGINEER TO COORDINATE WITH THE CITY OF CLOVIS REGARDING RELOCATION OF RECYCLING DUMPSTERS.
4. YARD PIPING AND CONNECTIONS TO REMEDIATION EQUIPMENT TO BE DETERMINED IN THE FIELD AND APPROVED BY ENGINEER.
5. GROUNDWATER CONVEYANCE IS CO-LOCATED WITH SVE LINES UNTIL DAYLIGHTED AND CONNECTED TO THE GW TREATMENT SYSTEM INLET.
6. GW AND SVE CONVEYANCE, SANITARY SEWER CONVEYANCE, GAS, AND ELECTRICAL LINES SHALL BE CO-LOCATED IN A SINGLE TRENCH WHENEVER POSSIBLE.

SITE PLAN 1 / G-2

NTS

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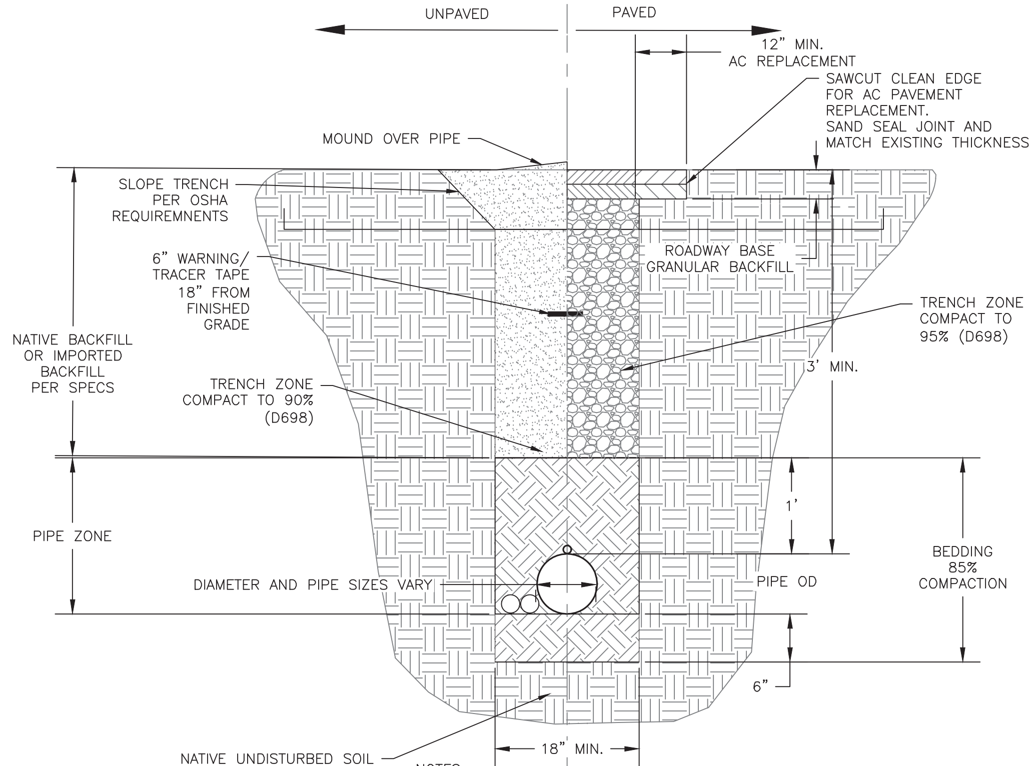
REMEDIATION COMPOUND SITE PLAN

SHEET 4 OF 11
DWG NO. C-1

JOB NO.
DB18.1157.00

S:\PROJECTS\DB18.1157_FORMER_Y_STATION\CAD\PRODUCTION\MECHANICAL SITE PLAN.DWG August 5, 2021 - 2:14 PM BY: ARELLANO, JEFFREY

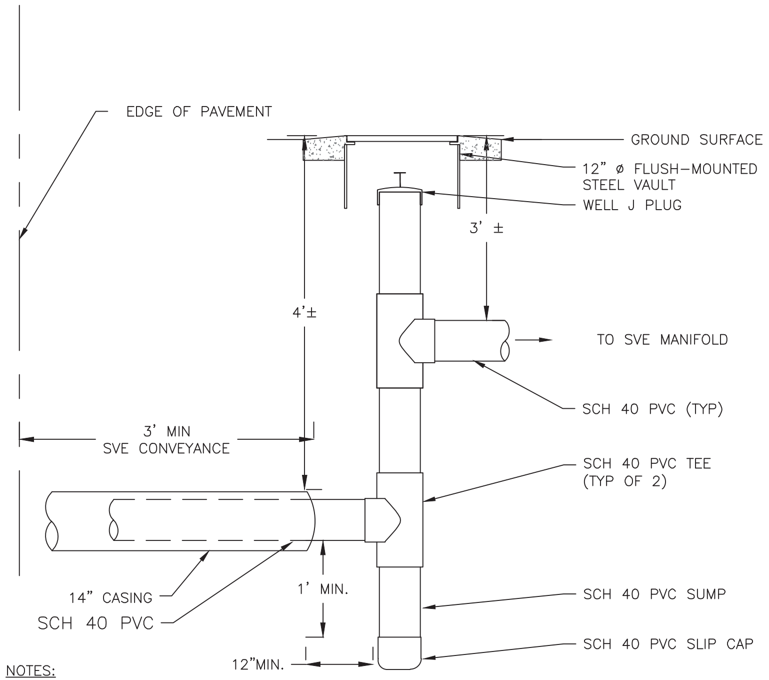


NOTES:

1. ALL FILL TO BE NATIVE GRANULAR OR SANDY MATERIAL FREE OF STUMPS, ROOTS, AND ROCKS GREATER THAN 3" AND NO STONES LARGER THAN 1" WITHIN PIPE EMBEDMENT COMPACTED TO 90% OF ASTM D698.
2. CONTRACTOR MAY CHOOSE TO BACKFILL WITH FLOWABLE FILL.
3. PIPE LOCATED IN NMDOT RIGHT-OF-WAY TO BE BURIED TO A MIN. DEPTH OF 4 FEET.

TYPICAL TRENCH DETAIL A-A' / C-5

NTS

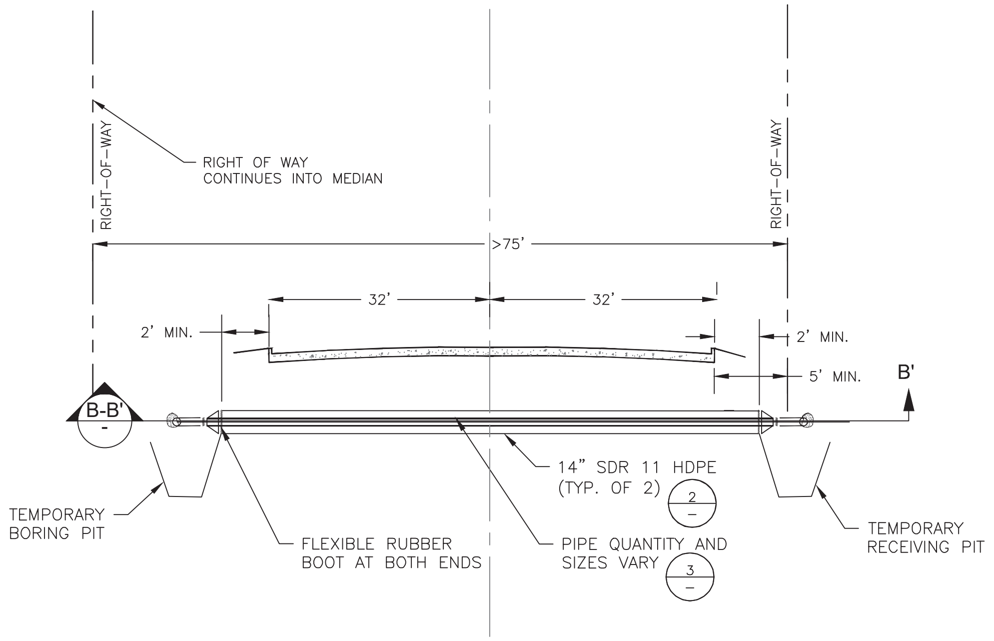


NOTES:

1. SUMP AND FITTINGS TO MATCH PIPE DIAMETER FOR CONVEYANCE LINE.
2. CO-LOCATE 1.5" GROUNDWATER AND SVE CONVEYANCE LINES.
3. SUMPS OUTSIDE OF ROADWAY BORINGS WILL NOT HAVE A 14" CASING.

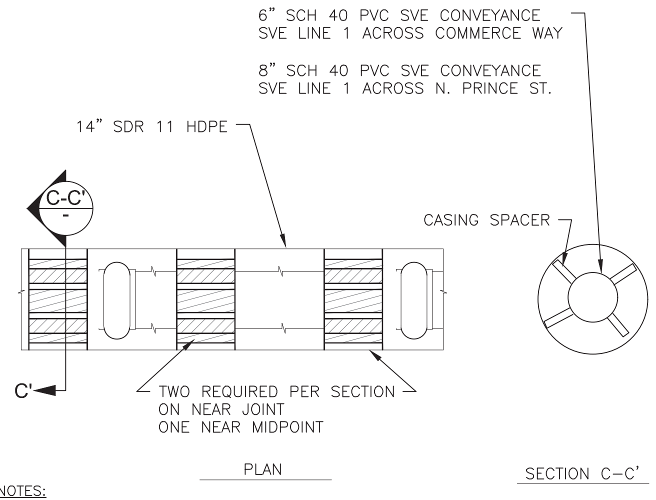
TYPICAL SVE CONVEYANCE LINE CLEAN-OUT 1 / C-1,C-5

NTS



ROADWAY CROSSING (TYP. OF 2) B-B' / C-5

NTS

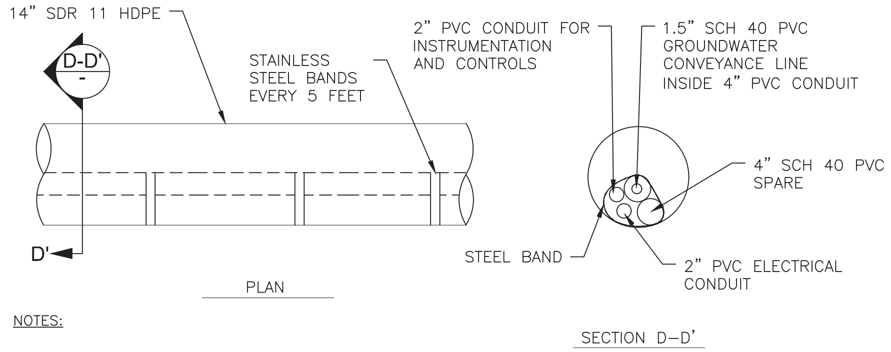


NOTES:

1. UNDERGROUND UTILITY MARKER POSTS TO BE INSTALLED AT EACH END OF ROADWAY CROSSING. MARKER POSTS WILL BE PROVIDED BT THE ENGINEER.

SVE PIPE CASING DETAIL 2 / -

NTS



NOTES:

1. UNDERGROUND UTILITY MARKER POSTS TO BE INSTALLED AT EACH END OF ROADWAY CROSSING. MARKER POSTS WILL BE PROVIDED BT THE ENGINEER.

GROUNDWATER PIPE CASING DETAIL 3 / -

NTS

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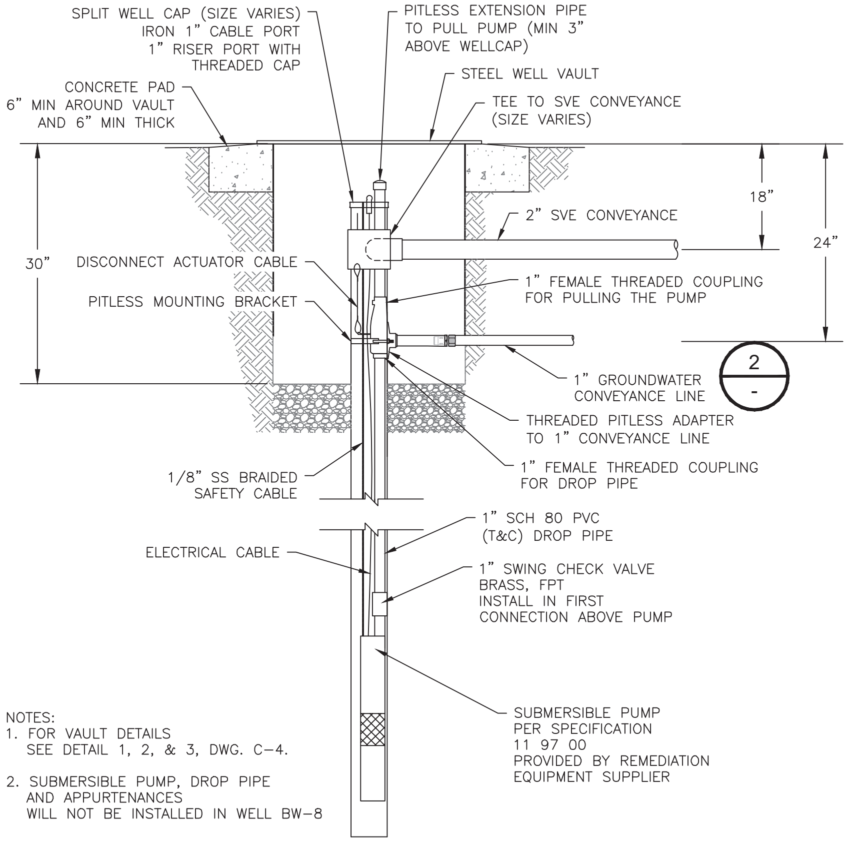
CIVIL DETAILS 1

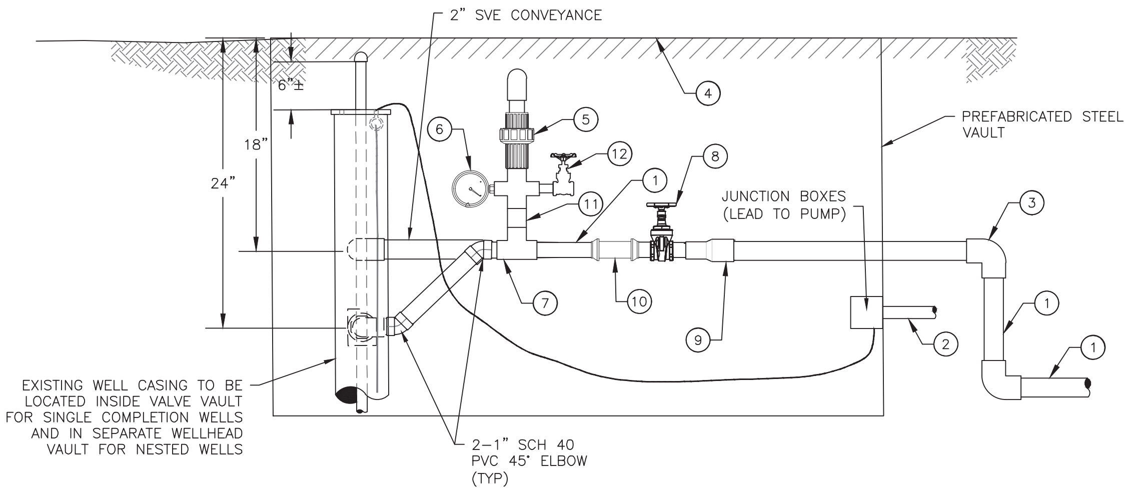
SHEET 5 OF 11
DWG NO. C-2

JOB NO.
DB18.1157.00



NOTES:
1. FOR VAULT DETAILS SEE DETAIL 1, 2, & 3, DWG. C-4.
2. SUBMERSIBLE PUMP, DROP PIPE AND APPURTENANCES WILL NOT BE INSTALLED IN WELL BW-8

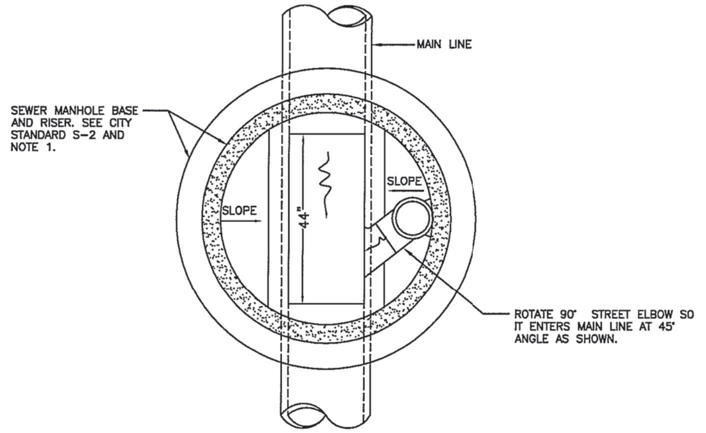
EXTRACTION WELL COMPLETION (TYP. OF 9) 1
NTS C-1



KEY NOTES:

① 1-1/2" SCH 40 PVC.
② 2" SCH 40 PVC, ELECTRIC CONDUIT TO NEAR WELL HEAD AND 2" SCH 40 PVC CONDUIT FOR CONTROLS
③ 1-1/2" SCH 40 PVC 90° ELBOW (TYP)
④ H-20 STEEL TRAFFIC RATED COVER WITH TORSION SPRING ASSISTED HATCH ASSEMBLY.
⑤ 1/2" PLAST-O-MATIC ARV WITH VENT
⑥ PRESSURE GAUGE (0-150 PSI)
⑦ 1"X1"X1/2" SCH 40 PVC TEE
⑧ 1" SS GATE VALVE
⑨ 1"X1.5" SCH 40 PVC REDUCING BUSHING
⑩ 1" FLOW METER TO BE INSTALLED WITH TRUE UNION CONNECTIONS PROVIDED BY REMEDIATION EQUIPMENT SUPPLIER
⑪ 1/2" PIPE NIPPLE
⑫ 1/2" HOSE BIB

WATER CONVEYANCE LINE ELEVATION (TYP. OF 9) 2
NTS C-1, C-4

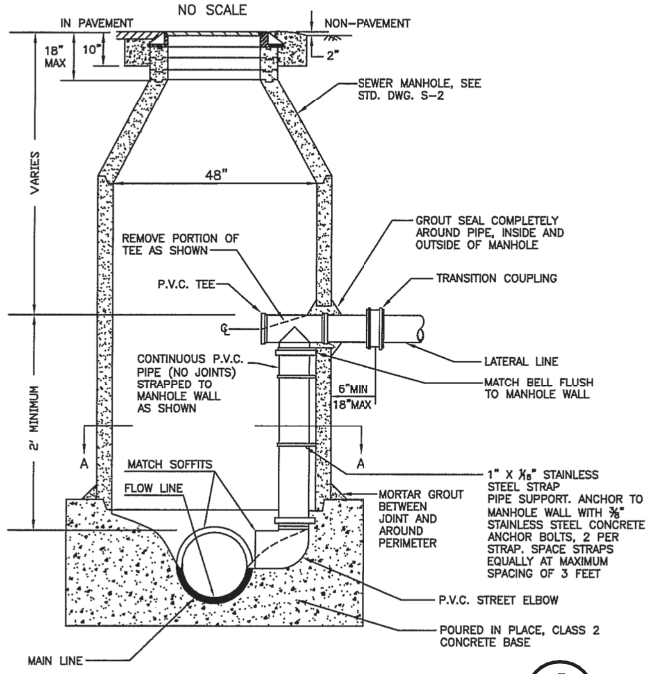


SECTION A-A

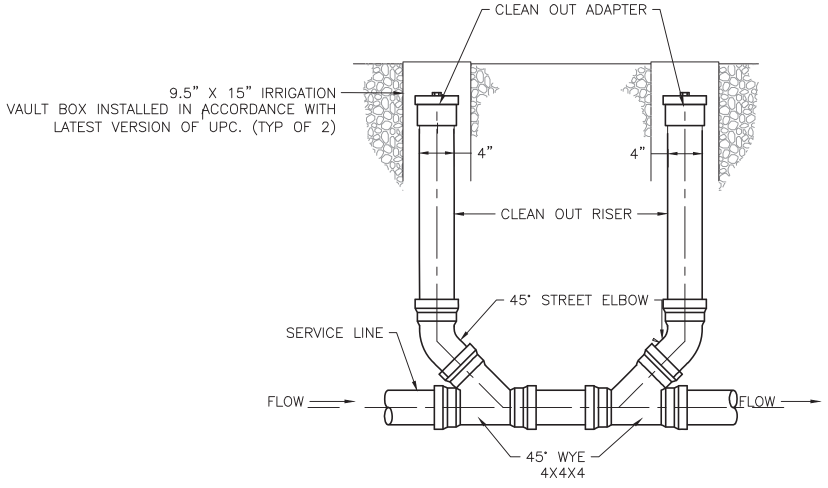
NO SCALE

NOTES

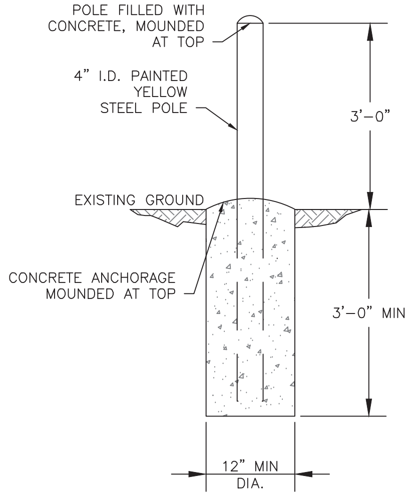
1. MANHOLE SHALL BE CONSTRUCTED IN ACCORDANCE WITH CITY STANDARD DRAWING S-2.
2. A DROP MANHOLE SHALL BE USED WHENEVER THE DIFFERENCE BETWEEN THE SOFFIT OF THE MAIN LINE AND THE SOFFIT OF THE LATERAL LINE IS TWO FEET OR GREATER.
3. ALL DROP PIPE MATERIALS SHALL BE A MINIMUM OF 8" PVC ASTM D3034-73 PSIG, SDR-35 OR LARGER TO MATCH LATERAL SIZE.
4. DROP MANHOLES ARE TO BE ALLOWED ONLY UPON SPECIAL AUTHORIZATION OF THE CITY ENGINEER.



SANITARY SEWER MANHOLE DROP CONNECTION
CITY CLOVIS STANDARD DRAWING S-4 5
NTS C-1



SEWER CLEAN-OUT DETAIL 3
NTS C-1



TYPICAL BOLLARD DETAIL 4
NTS C-1

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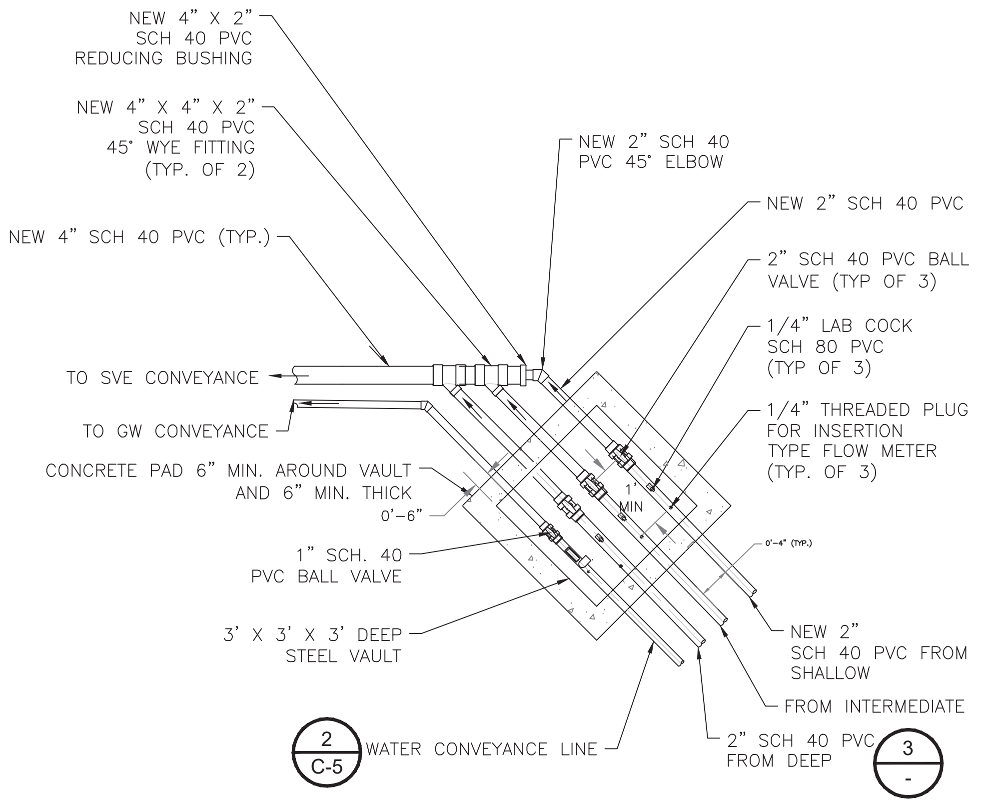
STATE LEAD REMEDIATION
FORMER Y STATION
CLOVIS, NEW MEXICO

CIVIL DETAILS 2

SHEET 6 OF 11
DWG NO. C-3

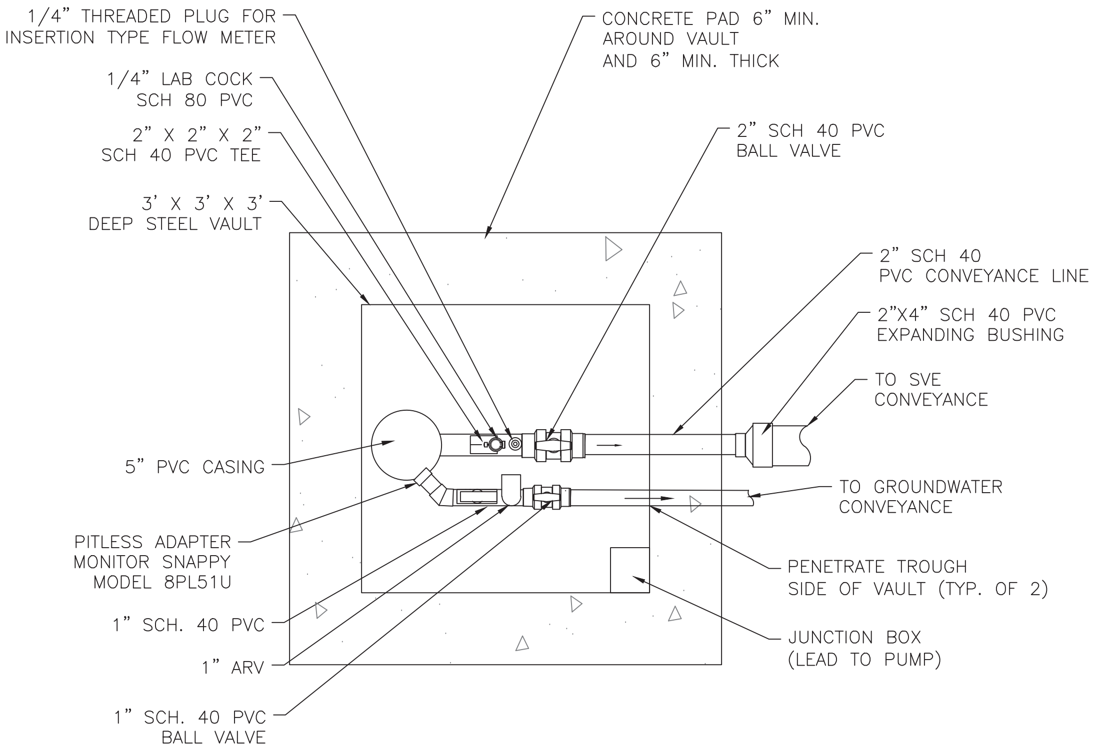
JOB NO.
DB18.1157.00



TYPICAL NESTED WELL VALVE VAULT DETAIL

1
C-5

RW–1, RW–2, RW–3, RW–4, BW–8 NTS



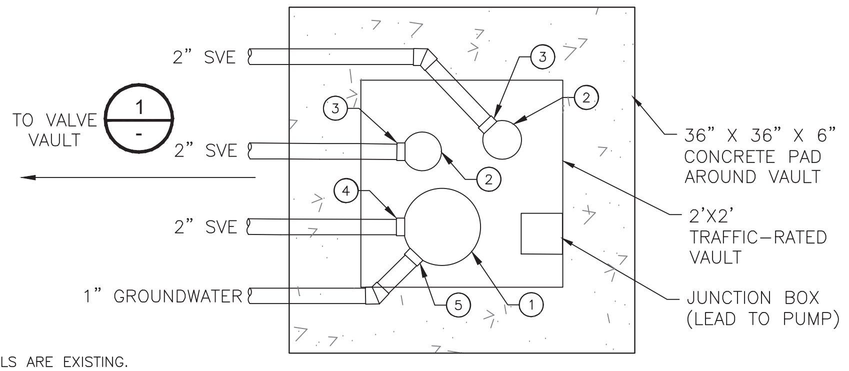
TYPICAL SINGLE WELL VALVE VAULT DETAIL

2
C-1

BW–7R, MW–11, MW–12, MW–16, MW–13 (CONTINGENCY) NTS

GENERAL NOTES:

1. 2" WELL CASING TO RETAIN EXISTING WELL J–PLUG 4" AND 5" WELL CASING TO HAVE NEW SPLIT WELL CAPS
2. PLACE 3" MINIMUM GRAVEL LAYER IN ALL VAULTS.
3. ALL VAULTS TO BE TRAFFIC RATED AND HINGE ASSISTED.



NOTES:

1. ALL WELLS ARE EXISTING.
2. CONTRACTOR TO REMOVE EXISTING 12" VAULT AND SURFACE COMPLETION TO FACILITATE CONVEYANCE PIPE INSTALLATION.
3. BW–8 DOES INTO HAVE GROUND WATER EXTRACTION, INCLUDING PUMP, ELECTRICAL, AND PITLESS ADAPTER.

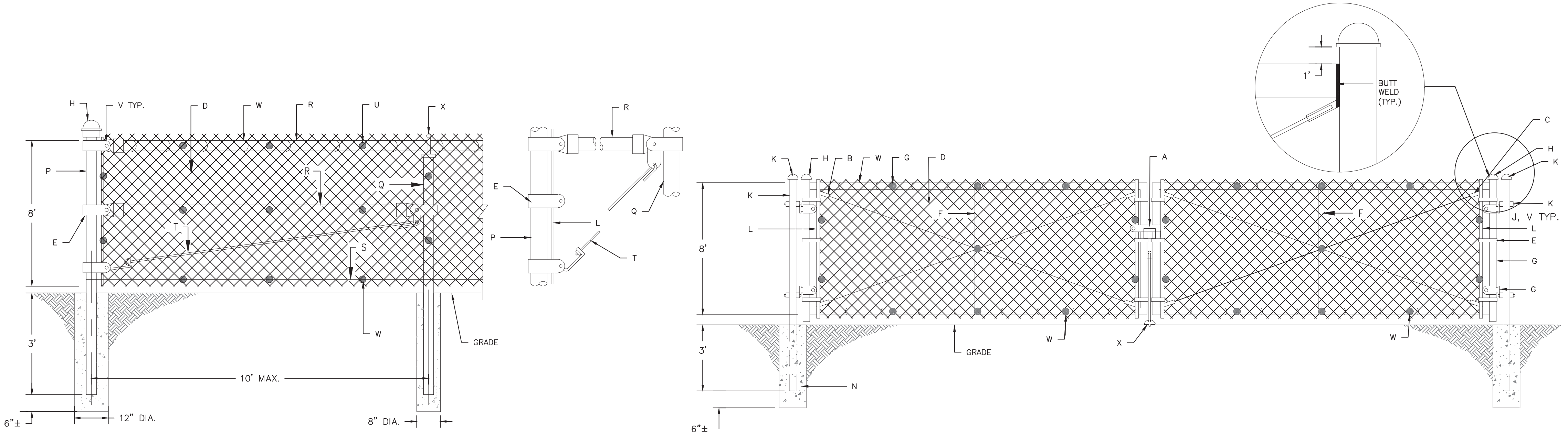
KEY NOTES:

① EXISTING 4" SCH 80 PVC WELL CASING
② EXISTING 2" SCH 80 PVC WELL CASING (TYP OF 2)
③ NEW 2"X2"X2" SCH 40 PVC TEE (TYP OF 2)
④ NEW 4"X4"X2" SCH 40 PVC TEE
⑤ NEW PITLESS ADAPTER MONITOR SNAPPY MODEL 8PL41U

NESTED WELLHEAD VAULT DETAIL (TYP OF 5)

3
C-5

NTS



SECURITY FENCE DETAILS

4
C-1

NTS

NOTES:

1. CONTRACTOR TO PROVIDE TWO 12' GATES AT THE LOCATIONS SHOWN ON THE REMEDIATION COMPOUND SITE PLAN, C–1.
2. SINGLE LEAF GATES SHALL BE USED ON OPENINGS LESS THAN 12'. FOR GATES 12' OR MORE, DOUBLE LEAF GATES SHALL BE USED, WITH A CENTER LOCK POST INSERTED IN A CENTER STOP.
3. MESH IS FLUSH WITH GRADE LEVEL.
4. ALL METAL ITEMS, INCLUDING PIPE, SHALL BE GAL STEEL.
5. ALL PIPE SHALL BE NOMINAL SIZE, SCH. 40.
6. FENCE MESH TO BE PROVIDED WITH SLATS. ENGINEER TO SPECIFY COLOR.

CONSTRUCTION NOTES:

A. GATE LATCH WITH VANDAL PROOF SHIELD & PADLOCK (PADLOCK TO BE FURNISHED BY THE OWNER).
B. 2– 3/8" TRUSS RODS, WELDED AT CORNERS.
C. 2– 3/8" THREADED TRUSS RODS AND BRACKET ATTACHMENT.
D. 2" NO. 9 GAUGE CHAIN LINK GAL WIRE FABRIC.
E. STEEL TENSION BANDS AT 18" OR LESS O.C.
F. BRACE, 1 1/4" DIA., WELDED TO FRAME.
G. GATE FRAME, 2" DIA. (2.375" O.D.) WELDED.
H. MALLEABLE ACORN CAP.
J. 4" J–BOLT, THREADED.
K. 3 1/2" GATE POST (4" O.D.) WITH WELDED STEEL CAP.
L. TENSION BAR 1/4" X 3/4".
M. GATE CLAMP.
N. 12" DIA. HOLES, FILLED WITH PORTLAND CEMENT CONC.
P. CORNER POST 2 1/2" DIA. (2.875" O.D.).
Q. LINE POST 2" DIA. (2.375" O.D.).
R. TOP AND BRACE RAILS 1 1/4" DIA. (1.660" O.D.).
S. WIRE REINFORCEMENT, 9 GAUGE, INSTALL 3" ABOVE BOTTOM OF FABRIC.
T. TRUSS ROD 3/8" DIA.
U. FABRIC SHALL BE TACK WELDED TWO PLACES TO EACH TENSION BAR AND THREE PLACES TO ALL TOP AND BRACE RAILS BETWEEN POSTS.
V. ALL NUTS, BOLTS, AND OTHER CONNECTIONS SHALL BE TACK WELDED.
W. WIRE TIES, 9 GA. GAL STEEL AT 18" O.C.
X. MUSHROOM–TYPE CENTER STOP.

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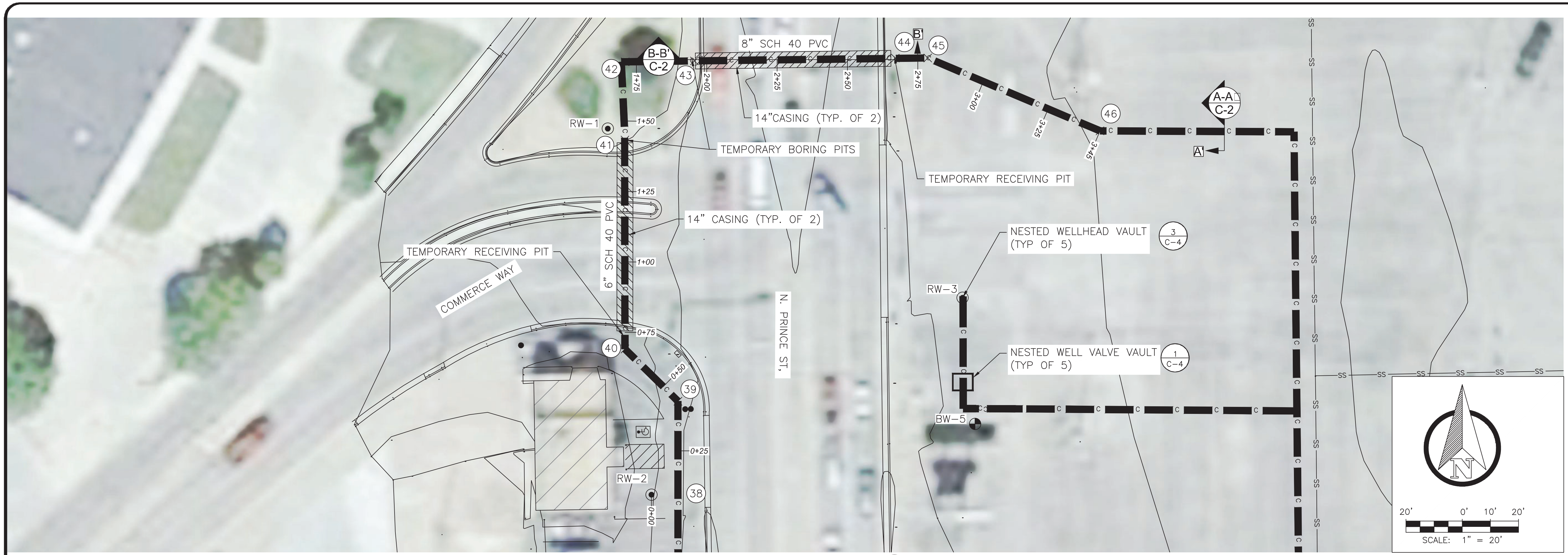
CIVIL DETAILS 3

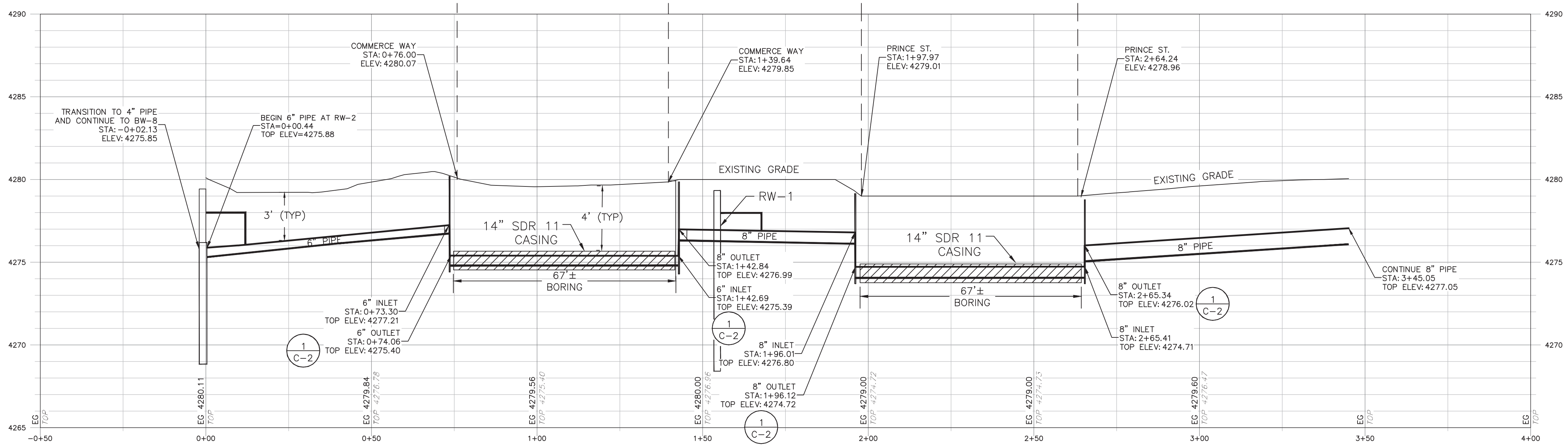
SHEET 7 OF 11
DWG NO. C-4

JOB NO.
DB18.1157.00



PLAN 1/-

Point Table			
Point #	Northing	Easting	Description
(38)	1245416.83	884150.39	90 DEG. BEND
(39)	1245450.05	884150.39	45 DEG. BEND
(40)	1245468.56	884131.55	RECEIVING PIT
(41)	1245542.77	884131.55	BORING PIT
(42)	1245570.53	884131.63	90 DEG. BEND
(43)	1245570.84	884156.21	BORING PIT
(44)	1245571.86	884227.62	RECEIVING PIT
(45)	1245571.89	884239.15	22.5 DEG. BEND
(46)	1245546.01	884300.36	22.5 DEG. BEND



SECTION 1/G-2

HORIZONTAL SCALE = 1" = 20'
VERTICAL SCALE = 1" = 4'

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BORINGS PLAN AND PROFILE

SHEET 8 OF 11
DWG NO. C-5

JOB NO.
DB18.1157.00

MS–1
MOISTURE SEPARATOR
H2K MODEL VLS–220
30" DIA X 72" VERTICAL HEIGHT
55 GALLON LIQUID HOLDING CAPACITY

P–1
MOISTURE SEPARATOR TRANSFER PUMP
MOYNO 356–01 PROGRESSIVE CAVITY
PUMP 2 HP, 208/240/460 VAC, 30
TEFC MOTOR
20 GPM AT 25 PSI DIFFERENTIAL
PRESSURE

P–2
ROTARY LOBE BLOWER
SUTORBILT LEGEND 7L 40 HP,
230 VAC, 30, TEFC MOTOR
1,000 SCFM AT 85" H2O
VACUUM

P–3
SINGLE STAGE REGENERATIVE BLOWER
FPZ MODEL K005–MS
4HP/230/460 VAC/3 PH/TEFC MOTOR
90 CFM AT 80" H2O COLUMN

P–4
TRANSFER PUMP
AMT MODEL 489
¾ HP/230/460 VAC/3 PH/TEFC MOTOR
20 GPM @ 54' TDH

P–5
COMBUSTION AIR BLOWER
PROVIDED BY INTELLISHARE
2HP/460 VAC/3 PH/60 HZ

GENERAL NOTES:

1. PRELIMINARY P&ID ONLY. FINAL P&ID AND EXPLANATION OF SYMBOLS TO BE PROVIDED IN THE AS–BUILT REPORT.

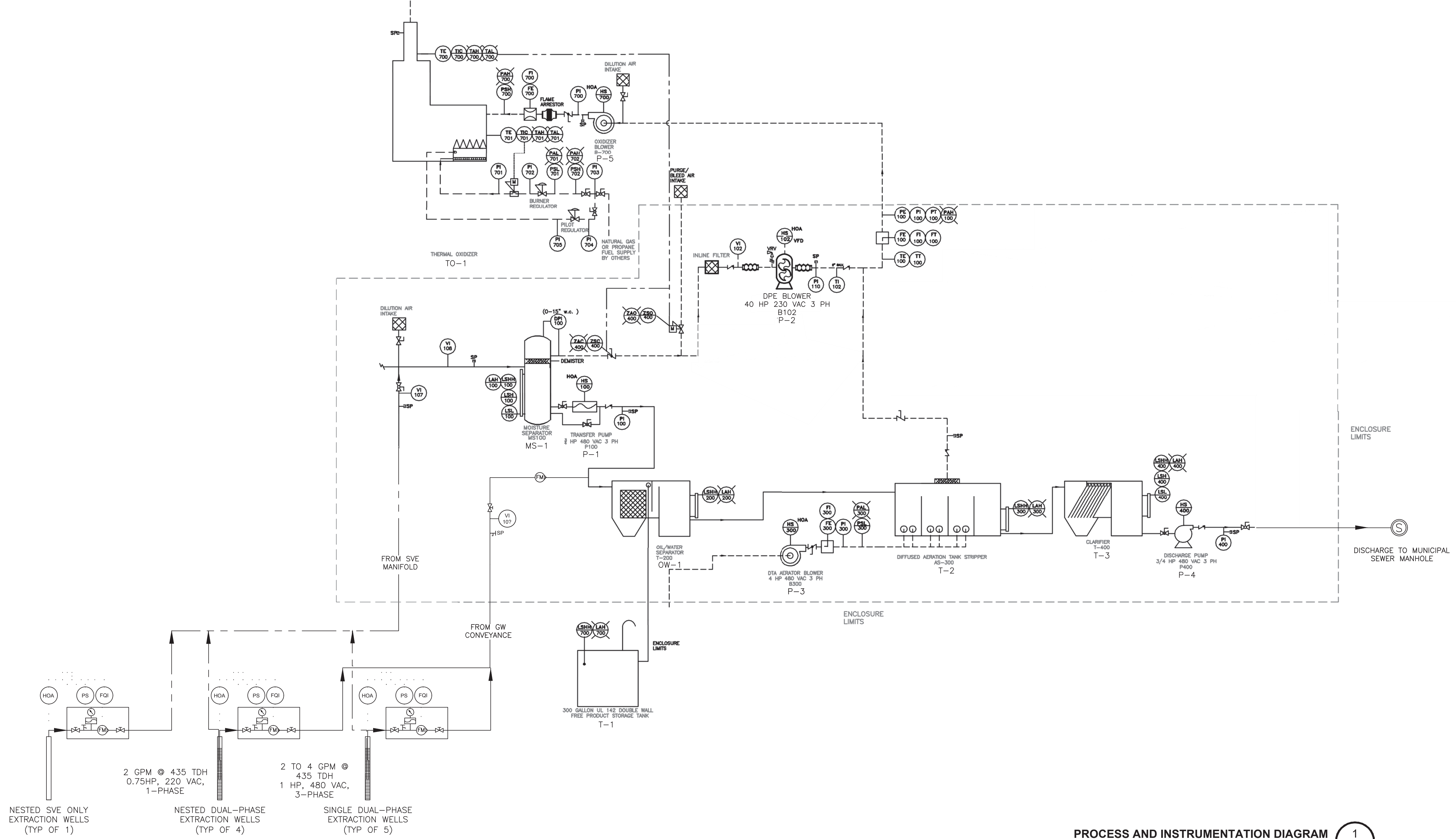
TO–1
THERMAL OXIDIZER
W/ CATALYTIC OPTION
PROVIDED BY INTELLISHARE
1,000 SCFM
650–1,800 DEGREES F
MAX 50% LEL

OW–1
H2K MODEL LLS8 OIL/WATER SEPARATOR
304 SS CONSTRUCTION
100% REMOVAL OF 20 MICRON AND
LARGER DROPLETS AT 25 GPM W SG= 0.75
SIGHT GLASS WITH SS LEVEL SWITCHES

T–1
PRODUCT STORAGE TANK
300 GALLON UL 142 DOUBLE WALL TANK
38.5" DIA X 68" LENGTH HORIZONTAL TANK
1" POLYURETHANE INSULATION

T–2
DIFFUSED AERATION TANK
H2K MODEL DTA–3
THREE AERATION CHAMBERS
FIFTEEN NON–FOULING SS DIFFUSERS
SIGHT GLASS WITH SS LEVEL SWITCHES

T–3
INCLINED PLATE CLARIFIER
H2K MODEL IPC–80
90% REMOVAL OF 20 MICRON AND LARGER
SOLIDS AT 23.5 GPM
SIGHT GLASS WITH SS LEVEL SWITCHES



PROCESS AND INSTRUMENTATION DIAGRAM 1
NTS -

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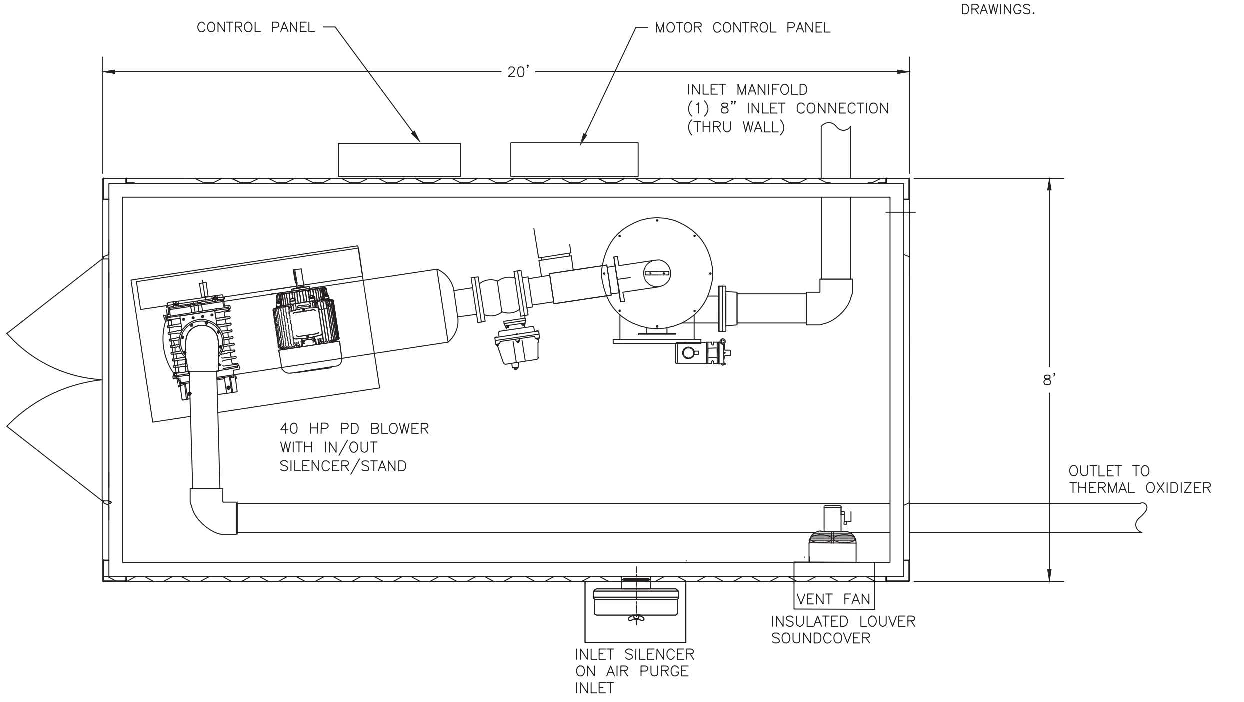
PROCESS AND INSTRUMENTATION DIAGRAM

SHEET 9 OF 11
DWG NO. M-1

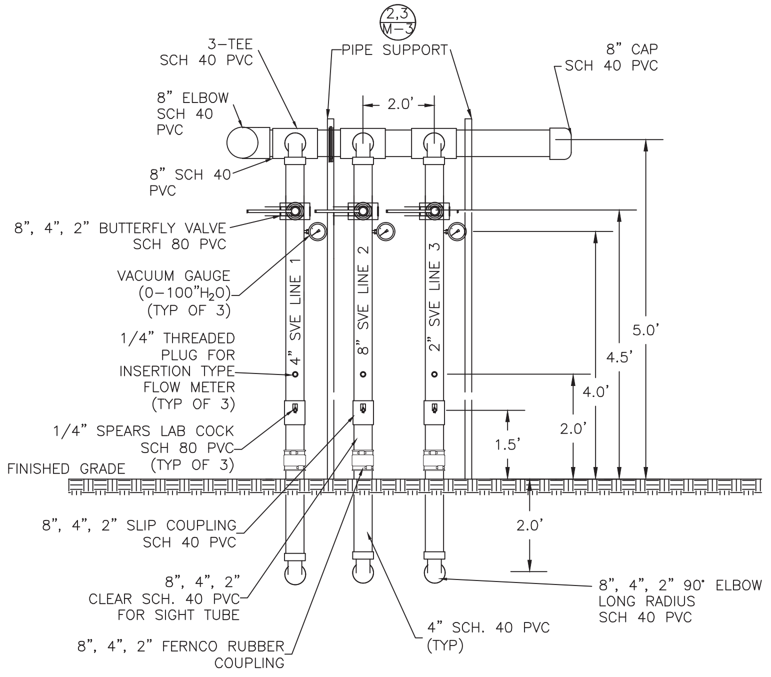
JOB NO.
DB18.1157.00

GENERAL NOTES:

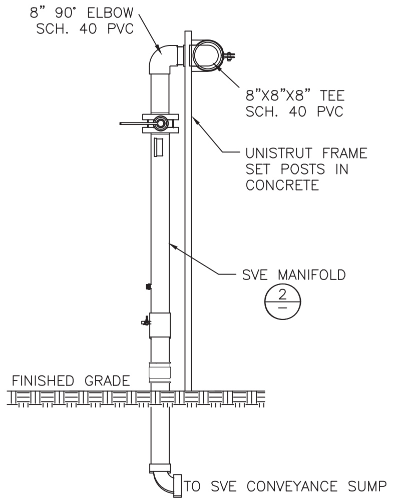
1. EQUIPMENT LAYOUT WITHIN CONTAINER IS CONCEPTUAL. FINAL EQUIPMENT LAYOUT WILL BE SHOWN ON THE AS-BUILT DRAWINGS.



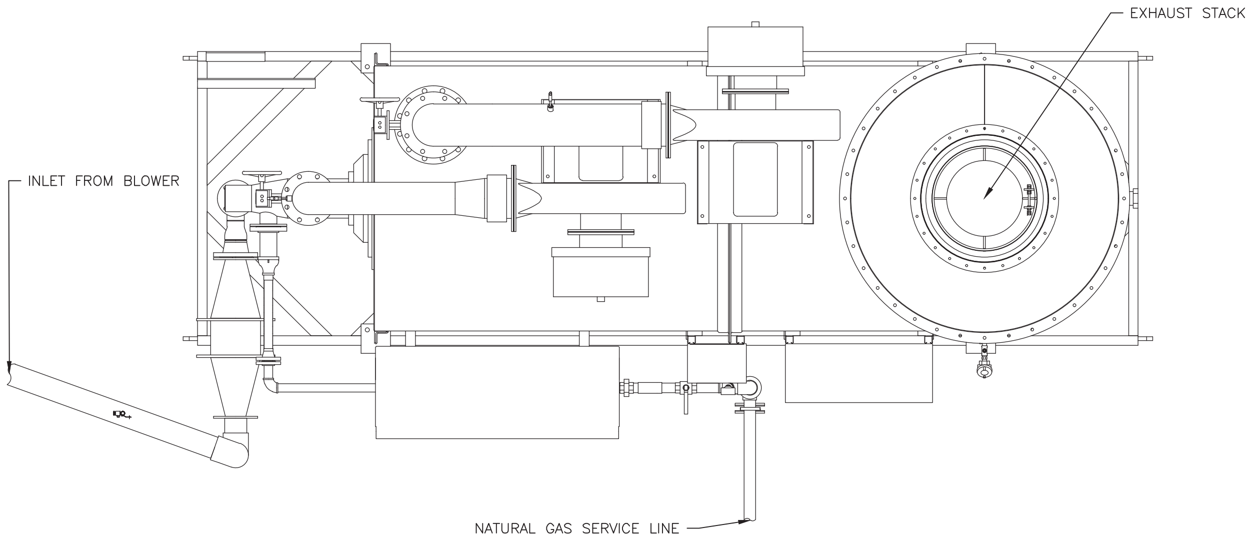
SVE TREATMENT UNIT 1 / C-1
NTS



SVE MANIFOLD ELEVATION 2 / C-1
NTS



SVE MANIFOLD ELEVATION 3 / C-1
NTS



THERMAL OXIDIZER 4 / C-1
NTS

S:\PROJECTS\DB18.1157_FORMER_Y_STATION\CAD\PRODUCTION\MECHANICAL DETAILS 1.DWG August 6, 2021 – 2:14 PM BY: ARELLANO, JEFFREY

REV. NO.	DATE	DESCRIPTION	APPROVED BY

DATE OF ISSUE: 07/16/2021
DESIGNED BY: T. GOLDEN
DRAWN BY: J. ARELLANO
CHECKED BY: G. HALL
APPROVED BY: T. GOLDEN

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Daniel B. Stephens & Associates, Inc.
6020 Academy Rd. NE, Suite 100
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THOMAS A. GOLDEN
22750
7/16/21

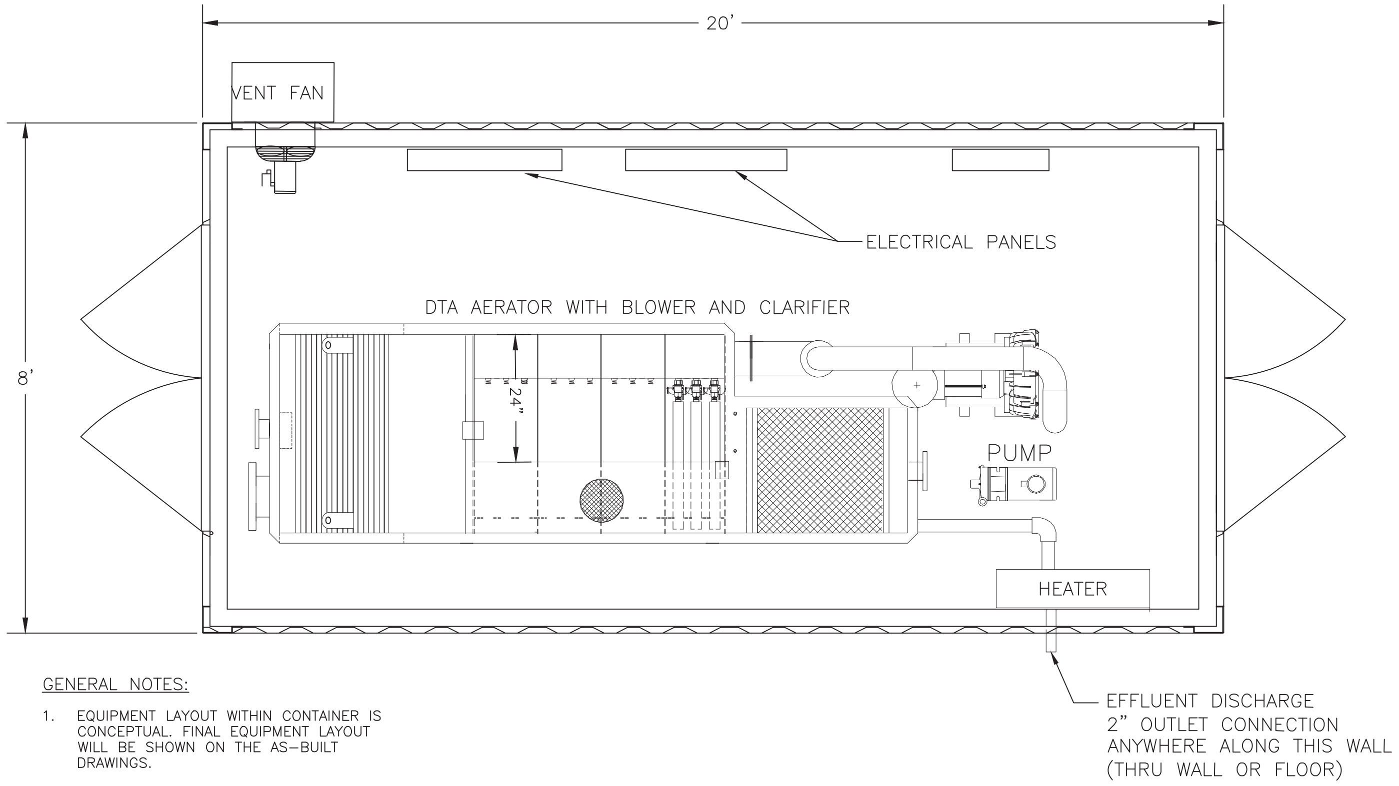
721 COMMERCE WAY
CLOVIS, NM 88101

STATE LEAD REMEDIATION
FORMER Y STATION
CLOVIS, NEW MEXICO

MECHANICAL DETAILS 1

SHEET 10 OF 11
DWG NO. M-2

JOB NO.
DB18.1157.00

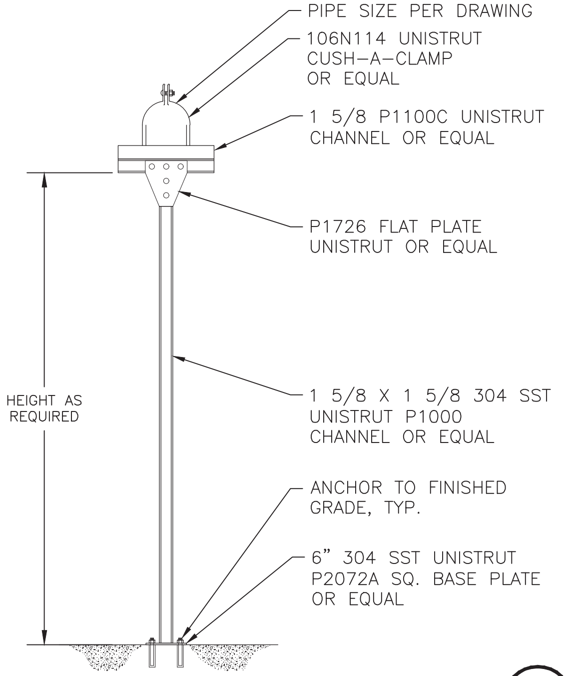


GENERAL NOTES:

1. EQUIPMENT LAYOUT WITHIN CONTAINER IS CONCEPTUAL. FINAL EQUIPMENT LAYOUT WILL BE SHOWN ON THE AS-BUILT DRAWINGS.

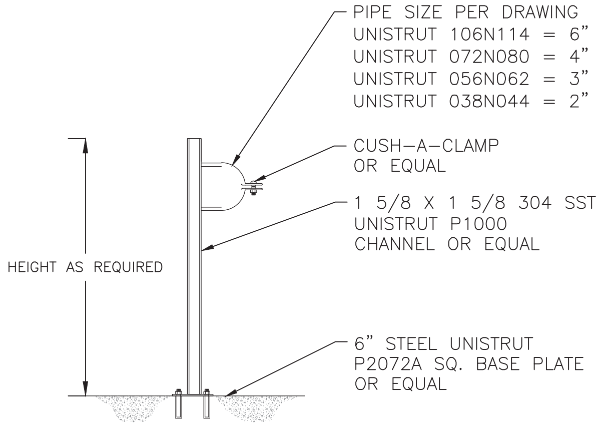
GROUNDWATER TREATMENT 1 C-1

NTS



PIPE SUPPORT DETAIL 2 M-2

NTS

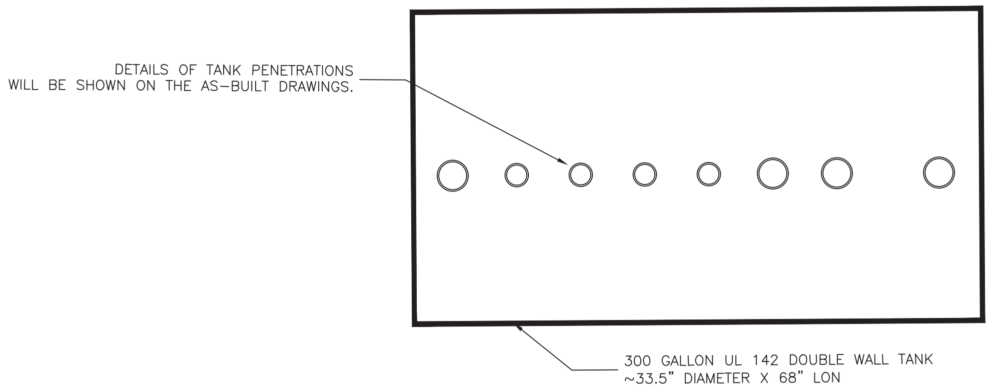


NOTES

1. 1 5/8" P1001C UNISTRUT OR EQUAL SHALL BE USED IN PLACE OF P1000 OR EQUAL TO SUPPORT PIPES LESS THAN 3" FROM FINISHED GRADE.

PIPE SUPPORT DETAIL 3 M-2

NTS



PRODUCT STORAGE CONTAINER 4 C-1

NTS

S:\PROJECTS\DB18.1157_FORMER_Y_STATION\CAD\PRODUCTION\MECHANICAL DETAILS 1.DWG July 16, 2021 - 2:14 PM BY: ARELLANO, JEFFREY

REV. NO.	DATE	DESCRIPTION	APPROVED BY

DATE OF ISSUE: 07/16/2021
DESIGNED BY: T. GOLDEN
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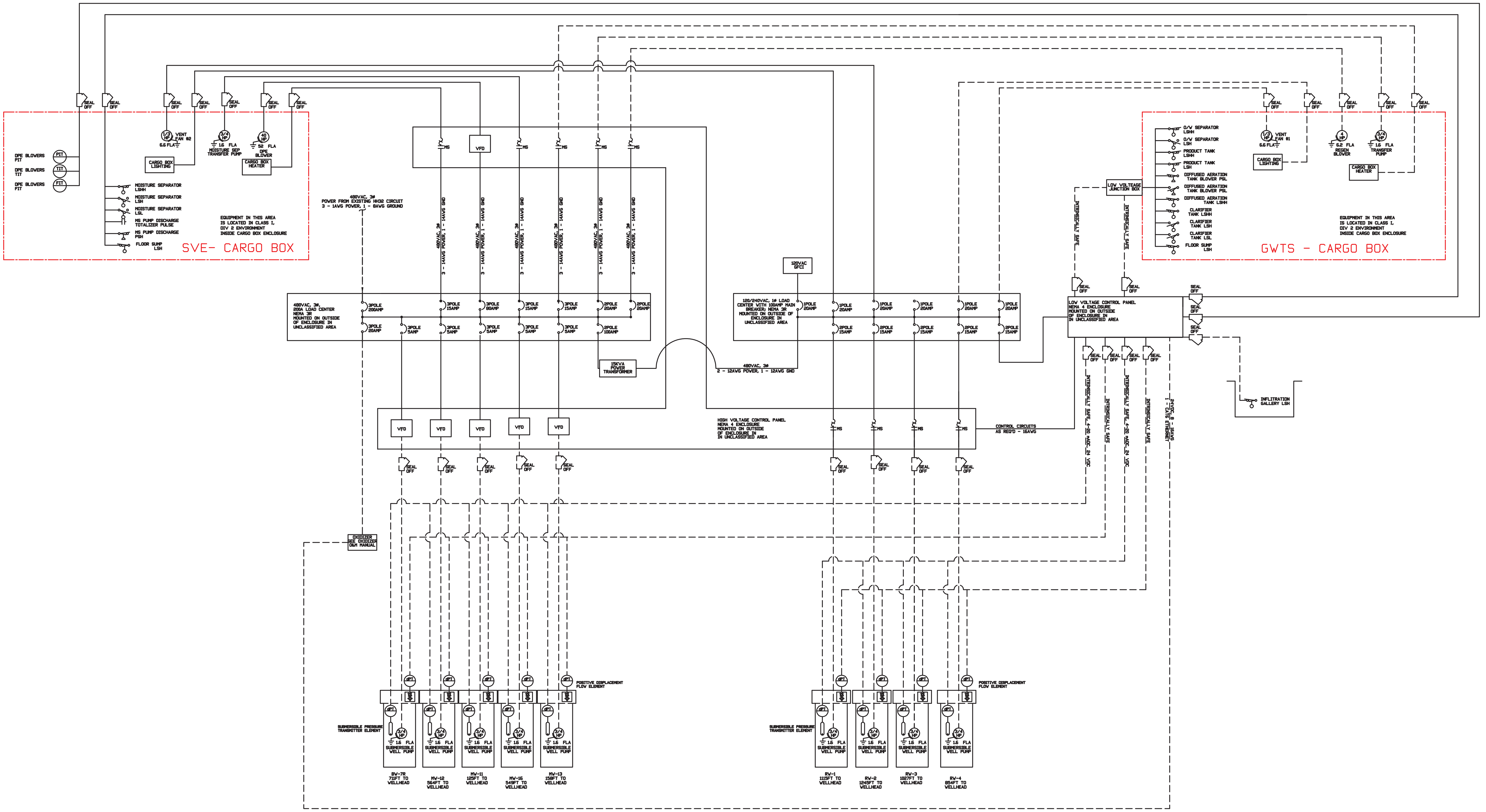
FORMER Y STATION
CLOVIS, NEW MEXICO

MECHANICAL DETAILS 2

SHEET 11 OF 11
DWG NO. M-3

JOB NO.
DB18.1157.00



NOTE: DASHED LINES REPRESENT FIELD WIRING TO BE TERMINATED INSIDE OF PANELS OR JUNCTION BOXES IF SHOWN WITH SEALOFFS AS REQUIRED BY CODE BY ELECTRICAL CONTRACTOR.

REVISIONS

REV	DESCRIPTION	DATE	DWN
A	SPLIT INTO TWO CARGO BOXES	7/7/21	GH

UNLESS SPECIFIED OTHERWISE
* DIMENSIONS ARE IN INCHES
* DO NOT SCALE DRAWING
DRAWN BY: RC
DESIGNED BY: RC
PROJECT MANAGER: TP
DATE: 05/02/19
PROJECT NO.: 5293

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PROJECT TITLE:
D. B. STEPHENS
FORMER Y STATION
SVE/GWTS SYSTEM
CLOVIS, NM

DRAWING TITLE:
ELECTRICAL ONE LINE

SHEET 1 OF 1
DRAWING NO.:
5913-03

Appendix D

Calculations

Calculation Cover Sheet

Daniel B. Stephens & Associates, Inc.

Project Name Former Y Station

Project Number DB18.1157

Calculation Number DB18.1157-001

Discipline Engineering

No. of Sheets 5

PROJECT: Former Y Station

SITE: Former Y Station State Lead Site, Clovis, New Mexico

THOMAS A. GOLDEN
22750
7/16/21

SUBJECT: Determine pressure losses and size blowers for the SVE remediation system.

SOURCES OF DATA:

A. Computer Applications in Hydraulic Engineering, 6th edition, Haestad Methods, Inc., 2004, Table 1-2:Typical Roughness Coefficients

B. Fundamentals of Fluid Mechanics, 2nd edition, Bruce Munson, Donald Young and Theodore Okiishi, John Wiley & Sons, Inc., 1994

C. PVC pipe size & fittings dimensions from Commericial Industrial Supply

D. Fundamentals of Fluid Mechanics, 2nd edition, Bruce Munson, Donald Young and Theodore Okiishi, John Wiley & Sons, Inc, 2006

E. Water Resources Engineering, Ralph Wurbs and Wesley James, Prentice Hall, 2002.

F. Survey Reports, performed by Lydick Engineers & Surveyors, Clovis, NM, 2019, 2020.

G. Minimum Site Assessment and Feasibility Testing Report: Allsups #320 Facility, Brown Environmental, Inc., 2012.

SOURCES OF FORMULAE & REFERENCES:

1. Computer Applications in Hydraulic Engineering, 6th edition, Haestad Methods, Inc, 2004.
2. Water Resources Engineering, Ralph Wurbs and Wesley James, Prentice Hall, 2002.
3. Figure 10 - Proposed Remediation System Layout

☒ Preliminary Calculation ☐ Final Calculation Supersedes Calculation No. ____________

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date
0	Final Remediation Plan	GMH	5/26/21	GH	6/2/2021	TG	7/9/2021

Calculation Sheet

Daniel B. Stephens & Associates, Inc.

Project No. DB18.1157
Date 05/26/2021
Subject Determine pressure losses and size blowers for SVE remediation system
Sheet 1 of 5
By GMH
Checked By GH
Calculation No. DB18.1157-001

1.0 OBJECTIVE

Calculate the amount of pressure loss within the SVE pipe network, and use this information to size a system blower.

2.0 GIVEN

SVE conveyance pipe consisting of 2-inch, 4-inch, 6-inch, and 8-inch schedule 40 polyvinyl chloride (PVC), and equipment compound piping consisting of 8-inch SCH 40 PVC[C]; minor loss coefficients, K, for fittings within the system[B]; individual SVE well air flowrates[C]; and Darcy Weisbach roughness coefficients of 0.000005 for plastic pipe[A].

3.0 METHOD

Use the Darcy-Weisbach equation[2] to determine the amount of pressure loss within a given system. This equation is dependent on fluid properties (density and dynamic viscosity of the fluid), pipe material properties (expressed through the Darcy-Weisbach friction factor), pipe length, and pipe diameter. The Darcy-Weisbach friction factor[1] is dependent on the Darcy-Weisbach roughness coefficient[A], pipe diameter, and the Reynolds number[1].

The first step in determining the major and minor pressure losses within a given system is to determine the Reynolds number for the system. This unitless number describes the type of flow within the system. Reynolds numbers above 4,000 describe fully-developed turbulent flow[1]. In order to determine the Reynolds number, three variables are needed: the dynamic viscosity of the fluid, the characteristic length/diameter of the pipe, and the average fluid velocity.

$$\mathrm{Re} = \frac{\rho V D}{\mu} \qquad \text{eqn. 1}$$

Where Re = Reynolds number
ρ = Fluid density
V = Fluid velocity
D = Pipe diameter
μ = Dynamic viscosity

Calculate the Darcy-Weisbach friction factor[1].

$$f = \frac{1.325}{\left[\ln\left(\frac{k}{3.7D} + \frac{5.74}{\text{Re}^{0.9}}\right)\right]^2}$$ eqn. 2

Where f = Darcy-Weisbach friction factor
k = Darcy-Weisbach roughness coefficient
Re = Reynolds number
D = Pipe diameter

Calculate major pressure losses within the system[2].

$$H_{maj} = \frac{flV^2}{D2g}$$ eqn. 3

Where H_{maj} = Major headlosses
f = Darcy-Weisbach friction factor
l = pipe length
D = Hydraulic diameter
V = Fluid velocity
g = Gravitational acceleration

Minor pressure losses are dependent on the type of fitting and the velocity head of the fluid flowing through the pipe network.

Calculate minor pressure losses within the system. The values of K are additive.

$$H_{\min} = K_m \frac{V^2}{2g}$$ eqn. 4

Where H_{min} = Minor head losses
K_m = Minor loss coefficient for fittings

Use the major and minor pressure losses, together with the expected applied extraction well vacuum, to determine the expected blower operating vacuum.

4.0 SOLUTION

The Former Y Station State Lead site will consist of a single SVE system connected to 5 multi-zone nested extraction wells, and 4 downgradient single-completion vertical wells. In 2012, a pilot test was conducted to assess feasibility for SVE and collect site specific data for future remediation system design. Applied well vacuum during the test ranged from 27 to 57 inches water column (in H_2O), which produced extracted air flow rates of 85 to 99 standard cubic feet per minute (scfm)[G]. The vacuum and flow data were used to estimate design parameters for the proposed SVE wells based on calculated unit flowrates per length of exposed screen (scfm/ft). Since individual zones were on the order of 1.5 scfm/ft, DBS&A assumed that flow in a multi-zone extraction scenario will be 1.0 scfm/ft. In addition, DBS&A is conservatively assuming an applied well vacuum at the wellhead of 60 in H_2O.

There will be three main SVE conveyance lines with combined flow from the wells. Flow from multi-zone extraction wells BW-8, RW-2, RW-1, RW-3, and RW-4 is combined and conveyed through SCH 40 PVC pipe with varying diameters to the manifold. Flow from extraction wells BW-7R, MW-12, MW-11, and MW-16 is combined and conveyed to the manifold through 4-inch SCH 40 PVC pipe. MW-13 is a contingency well, with flow conveyed through 2-inch SCH 40 PVC pipe directly to the manifold at the compound.

Example calculations are provided below for the section of SVE Line 1 between RW-2 and RW-1. Calculations for all SVE lines and extraction wells are provided in the attached spreadsheet. The following equations in this example use the solutions as given in the spreadsheet and may differ slightly due to differences in rounding and significant digits shown.

First, determine the linear flow velocity and Reynold's number for the section of pipe at the anticipated flow rate assuming full pipe flow. Average inside diameter is 6.031 inches for 6-inch SCH 40 PVC pipe[C]. Assuming extracted air flow of 1.0 scfm/ft, combined air flow from wells BW-8 and RW-2 is 322 scfm. The dynamic viscosity and air density of 3.63 E-7 $lbf*sec/ft^2$ and 2.101 E-3 $slug/ft^3$, respectively, were calculated based on a linear regression equation corresponding to an elevation of 4,280 feet above mean sea level[F].

$$V_{6PVC} = Q / A = (322\ ft^3/min) * (min / 60\ sec) / (\pi / 4 * (6.031\ in / 12\ in./ft)^2) = 27.1\ ft/sec$$

$$Re_{6PVC} = \rho * V * D / \mu = (2.101\ E\text{-}3\ slug/ft^3) * (27.1\ ft/sec) * (6.031\ in / 12\ in./ft) / (3.63\ E\text{-}7\ lbf*sec/ft^2) = 78{,}650$$

The Reynold's numbers calculated above are indicative of turbulent flow. Use the calculated Reynolds numbers and a Darcy-Weisbach roughness coefficient of 0.000005[A] to calculate the Darcy-Weisbach friction factor following eqn. 2:

$$f_{6PVC} = \frac{1.325}{\left[ln\left(\frac{0.000005}{3.7 \times \left(\frac{6.031}{12}\right)} + \frac{5.74}{78650^{0.9}}\right)\right]^2} = 0.0188$$

The schedule of pipe and fittings for SVE Line 1 (From the manifold to the well head) is presented in Table 1 below.

Project No. DB18.1157 Date 05/26/2021

Subject Determine pressure losses and size blowers for SVE remediation system Sheet 4 of 5

By GMH Checked By GH Calculation No. DB18.1157-001

Table 1: Pipe and fitting schedule for the conveyance line segment of RW-2 to RW-1

Pipe Section	Section Length, L	Actual Pipe Diameter, D	Flowrate	90° Elbow		45° Elbow		Slip Tees (Branch Flow)	
	ft	in	scfm	#	K	#	K	#	K
RW-2 to RW-1	130	6.031	322	2	1.5	2	0.4	5	2

Calculate major pressure losses for RW-2 to RW-1 using equation 3 together with the circuit length and flow rate from Table 1, the specific weight of air, and the Darcy friction factor calculated above.

$$H_{maj} = \frac{0.0188 \times 130\,ft \times 27.1^2\,\frac{ft^2}{sec^2}}{\frac{6.031\ in.}{12\,{}^{in.}/_{ft}} \times 2 \times 32.2\,\frac{ft}{sec^2}} = 55.4\,ft\ air$$

Convert this head loss from units of feet of air to units of inches of water.

$$55.4\,ft\ air \times \frac{0.06774 lbm/ft^3\ air}{62.37 lbm/ft^3\ water} \times \frac{12\ in.}{ft} = 0.72\ in.H_2O$$

Calculate minor pressure losses using equation 4 for fittings on the RW-2 to RW-1 segment and data from Table 1.

K_m = (2 * 1.5) + (2 * 0.4) + (5 * 2) = 13.8

$$H_{min} = \frac{13.8 \times 27.1^2\,\frac{ft^2}{sec^2}}{2 \times 32.2\,\frac{ft}{sec^2}} \times \frac{0.06774\ lbm/ft^3\ air}{\frac{62.37\ lbm}{ft^3} water} \times \frac{12\ in.}{ft} = 2.04\ in\ H_2O$$

The total design pressure loss for the RW-2 to RW-1 segment is the sum of the major and minor losses:

H_T = 0.72 + 2.04 = **2.77 in H_2O**

The attached spreadsheet performs similar calculations for each SVE line segment in the proposed system and provides a full summary of how each segment combines in each line. Table 2 below summarizes the line length, flow, vacuum, and maximum head loss for each SVE line. The color coding key is provided on Proposed Remediation System Layout[3].

Project No. DB18.1157

Date 05/26/2021

Subject Determine pressure losses and size blowers for SVE remediation system

Sheet 5 of 5

By GMH

Checked By GH

Calculation No. DB18.1157-001

Table 2: SVE Line and manifold pressure losses for the exisiting system

	Total line length	Flow at Manifold	Max Head Loss
SVE Line #	(ft)	(scfm)	(in H_2O)
1	1470	806	23.2
2A	475	-	1.6
2B	395	-	0.5
2	630	170	4.2
3	160	41	4.9
Manifold	20	1017	4.2

To provide at least 60 in H_2O vacuum at each SVE well head, the blower will need to be sized for the SVE line with the largest pressure loss through the branched SVE system. Therefore, the greatest calculated pressure loss would be for SVE Line 1 (23.2 in H_2O), which combines flow from BW-8 and RW-1 through RW-4, and conveys to the manifold[3].

Calculate the expected SVE blower total operating vacuum using the design pressure losses calculated above and the expected extraction well vacuum of 60 in H_2O^G:

$$H_{sys} = 23.2 \text{ in } H_2O + 60 \text{ in } H_2O = 83.2 \text{ in } H_2O$$

The blower at this site will be designed for 1,000 scfm at an applied vacuum of 85 in H_2O. The blower will include a variable frequency drive (VFD), which can be adjusted to match specific air flow operating requirements for the vapor treatment equipment based on actual flow conditions and a variety of operating well configurations.

Total Headloss Summary - FORMER Y

Summary TABLE 1 - Total Design Headlosses

Existing System	**Total System Flow Rate [a]**	**Maximum Calculated Headloss**	**Applied Well Vacuum [b]**	**Design Vacuum at Blower**
	(scfm)	(in H2O)	(in H2O)	(in H2O)
SVE	1017	23.2	60	83.2

Summary TABLE 2 - SVE Headloss by Line

SVE Line #	Total line length (ft)	Flow at Manifold (scfm)	Max Head Loss (in H2O)
1	1470	806	23.2
2A	475	-	1.6
2B	395	-	0.5
2	630	170	4.2
3	160	41	4.9
Manifold	20	1017	4.2

Notes:

Color coding key is provided on Proposed Remediation System Layout figure

[a] Flow includes contingency well (MW-13)

[b] Based on pilot test data collected 2012

Major Headloss Calculations

SVE Compound Piping (Existing)

CONSTANTS

Pipe Roughness	smooth			
e/d	smooth		Altitude (ft)	4280
Dynamic Viscosity, u	3.632E-07	lbf-sec/ft^2		
k, Roughness Height, ft	5.00E-06			
Air Density	0.06774	lbm/ft^3 =	2.101E-03	slugs/ft^3
Water Density	62.37	lbm/ft^3		
Gravitational Acceleration,g	32.2	ft/s^2		

Major Headlosses

$$\boxed{h_L = f\left(\frac{L}{D}\right)v^2 / 2g}$$

conveyance pipe, dia =	2.047	in (2" SCH 40 PVC)
conveyance pipe, dia =	3.998	in (4" SCH 40 PVC)
conveyance pipe, dia =	6.031	in (6" SCH 40 PVC)
conveyance pipe, dia =	7.942	in (8" SCH 40 PVC)

Table 1. Major Headlosses

Piping Run[a]	Run Length,L (ft)	Flow Rate Q (cfm)	Actual Pipe Diameter, D (in)	Actual Pipe Diameter, D (ft)	X-Sectional Area, A (ft^2)	Velocity V (ft/min)	Velocity V (ft/s)	Reynolds #	Friction Factor, f	L/D	hL (ft air)	hL (ft water)	hL (in water)
Blower to SVE Manifold	20	1017	7.942	0.662	0.344	2956	49.3	188,626	0.0158	30.2	18.0	0.02	0.23
Intermediate Well Head	5	60	2.047	0.171	0.023	2625	43.8	43,176	0.0216	29.3	18.8	0.02	0.24
Deep Well Head	5	40	2.047	0.171	0.023	1750	29.2	28,784	0.0237	29.3	9.2	0.01	0.12
BW-8 to RW-2	80	162	3.998	0.333	0.087	1858	31.0	59,688	0.0200	240.1	71.6	0.08	0.93
RW-2 to RW-1	130	322	6.031	0.503	0.198	1623	27.1	78,646	0.0188	258.7	55.4	0.06	0.72
RW-1 to RW-3 tie-in	390	487	7.942	0.662	0.344	1416	23.6	90,325	0.0183	589.3	93.1	0.10	1.21
RW-3 tie-in to RW-4 tie-in	100	647	7.942	0.662	0.344	1881	31.3	120,001	0.0172	151.1	39.8	0.04	0.52
RW-4 tie-in to compound	770	806	7.942	0.662	0.344	2343	39.0	149,491	0.0165	1163.4	454.6	0.49	5.92
BW-7R tie-in to MW-12 tie-in	150	42	3.998	0.333	0.087	482	8.0	15,475	0.0276	450.2	12.4	0.01	0.16
MW-12 tie-in to MW-16 tie-in	325	86	3.998	0.333	0.087	986	16.4	31,686	0.0231	975.5	94.6	0.10	1.23
MW-16 tie-in to compound	155	170	3.998	0.333	0.087	1950	32.5	62,635	0.0198	465.2	151.2	0.16	1.97
MW-16 to tie-in	395	42	3.998	0.333	0.087	482	8.0	15,475	0.0276	1185.6	32.7	0.04	0.43
MW-13 to compound	160	41	2.047	0.171	0.023	1794	29.9	29,504	0.0235	938.0	306.6	0.33	4.00
MW-12 to tie-in	90	44	3.998	0.333	0.087	505	8.4	16,211	0.0273	270.1	8.1	0.01	0.11
BW-7R to tie-in	76	42	3.998	0.333	0.087	482	8.0	15,475	0.0276	228.1	6.3	0.01	0.08
RW-4 to tie-in	100	160	3.998	0.333	0.087	1835	30.6	58,951	0.0201	300.2	87.5	0.10	1.14
BW-5 (RW-3) to tie-in	117	160	3.998	0.333	0.087	1835	30.6	58,951	0.0201	351.2	102.4	0.11	1.33

Minor Headloss Calculations

SVE Compound Piping

Appurtenance	Minor Loss Coeff. (Kl)
90° elbow	1.5
45° elbow	0.4
Branch Flow (BF) Tees	2
Ball Valve (Fully Open)	0.05
Butterfly Valve (Fully Open)	1.2
Transitions (Expansions)	0.4
Entrance	0.5
Exit	1

Minor Headlosses

$$h_L = k_L v^2 / 2g$$

Table 2. Minor Headlosses

	Quantinty of Appurtenances												
Piping Run[a]	90°	45°	Slip Tees (Branch Flow)	Ball Valve	Butterfly Valve	Transitions (Expansions)	Entrance	Exit	Kl Sum	Velocity,v (ft/S)	hL (ft air)	hL (ft water)	hL (in water)
Blower to SVE Manifold	2	4	1	0	0	1	0	1	8.0	49.3	301.6	0.33	3.93
Intermediate Well Head	0	2	1	1	0	1	1	0	3.8	43.8	111.5	0.12	1.45
Deep Well Head	0	2	1	1	0	1	1	0	3.8	29.2	49.5	0.05	0.65
BW-8 to RW-2	1	0	1	0	0	0	0	0	3.5	31.0	52.1	0.06	0.68
RW-2 to RW-1	2	2	5	0	0	0	0	0	13.8	27.1	156.8	0.17	2.04
RW-1 to RW-3 tie-in	2	2	5	0	0	0	0	0	13.8	23.6	119.3	0.13	1.55
RW-3 tie-in to RW-4 tie-in	0	0	1	0	0	0	0	0	2.0	31.3	30.5	0.03	0.40
RW-4 tie-in to compound	4	2	1	0	1	0	0	1	11.0	39.0	260.4	0.28	3.39
BW-7R tie-in to MW-12 tie-in	3	0	1	0	0	0	0	0	6.5	8.0	6.5	0.01	0.08
MW-12 tie-in to MW-16 tie-in	0	2	1	0	0	0	0	0	2.8	16.4	11.8	0.01	0.15
MW-16 tie-in to compound	0	2	0	0	1	0	0	1	3.0	32.5	49.2	0.05	0.64
MW-16 to tie-in	0	1	1	0	0	1	0	0	2.8	8.0	2.8	0.00	0.04
MW-13 to compound	0	2	1	0	1	0	0	1	5.0	29.9	69.4	0.08	0.90
MW-12 to tie-in	0	0	0	1	0	1	0	0	0.5	8.4	0.5	0.00	0.01
BW-7R to tie-in	0	0	0	1	0	1	0	0	0.5	8.0	0.5	0.00	0.01
RW-4 to tie-in	0	0	1	1	0	1	0	0	2.5	30.6	35.6	0.04	0.46
BW-5 (RW-3) to tie-in	1	0	0	1	0	1	0	0	2.0	30.6	28.3	0.03	0.37

Total Design Headloss

SVE Compound Piping (Existing)

Table 3. Total Headlosses

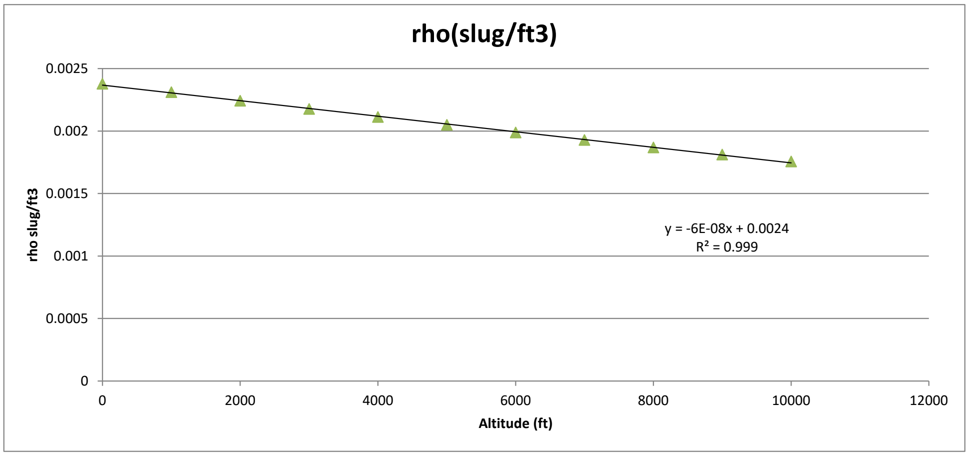
Piping Run	hL (ft air)	hL (ft water)	hL (in water)
Blower to SVE Manifold	319.5	0.35	4.16
Intermediate Well Head	130.3	0.14	1.70
Deep Well Head	58.7	0.06	0.77
BW-8 to RW-2	123.7	0.13	1.61
RW-2 to RW-1	212.2	0.23	2.77
RW-1 to RW-3 tie-in	212.4	0.23	2.77
RW-3 tie-in to RW-4 tie-in	70.3	0.08	0.92
RW-4 tie-in to compound	715.1	0.78	9.32
BW-7R tie-in to MW-12 tie-in	18.9	0.02	0.25
MW-12 tie-in to MW-16 tie-in	106.4	0.12	1.39
MW-16 tie-in to compound	200.4	0.22	2.61
MW-16 to tie-in	35.5	0.04	0.46
MW-13 to compound	376.0	0.41	4.90
MW-12 to tie-in	8.6	0.01	0.11
BW-7R to tie-in	6.7	0.01	0.09
RW-4 to tie-in	123.1	0.13	1.60
BW-5 (RW-3) to tie-in	130.7	0.14	1.70

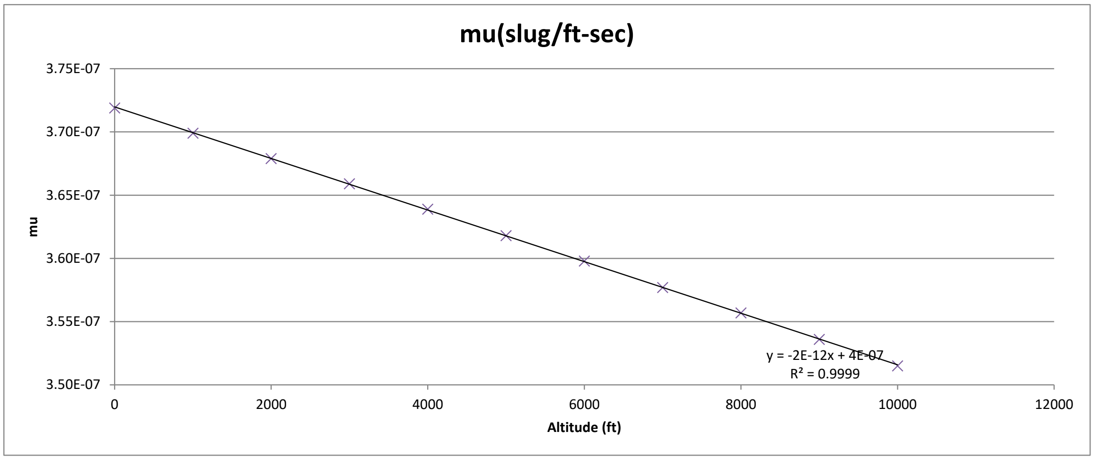
Density of air calculation

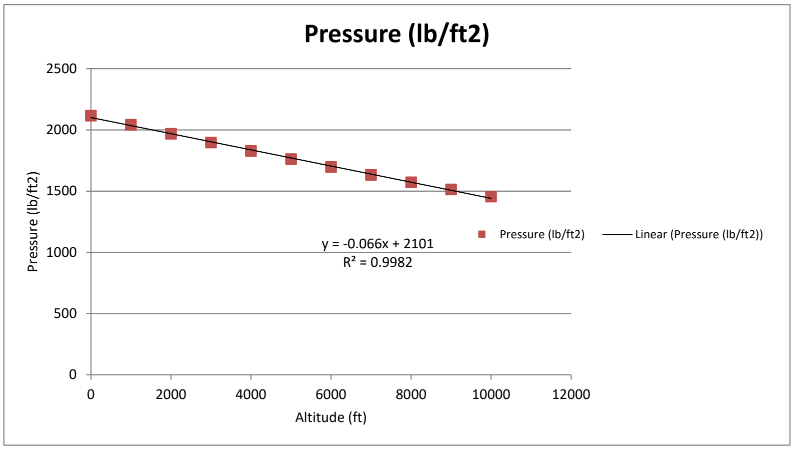
Altitude = 4280 ft
Rho = 2.101E-03 slug/ft3
mu = 3.63E-07 slug/ft-sec
Temp = 44.0 F 503.6504 R
Patm = 1818.4 lb/ft2
Patm = 12.6 lb/in2

Fundamentals of Momentum, Heat, and Mass Transfer

h(ft)	Temp (F)	Pressure (lb/ft2)	rho(slug/ft3)	mu(slug/ft-sec)
0	59	2116.2	0.002378	3.72E-07
1000	57.44	2040.9	0.00231	3.70E-07
2000	51.87	1967.7	0.002242	3.68E-07
3000	48.31	1896.7	0.002177	3.66E-07
4000	44.74	1827.7	0.002112	3.64E-07
5000	41.18	1760.8	0.002049	3.62E-07
6000	37.62	1696	0.001988	3.60E-07
7000	34.05	1633	0.001928	3.58E-07
8000	30.49	1571.9	0.001869	3.56E-07
9000	26.92	1512.8	0.001812	3.54E-07
10000	23.36	1455.4	0.001756	3.52E-07







SUMMARY OUTPUT for rho

Regression Statistics	
Multiple R	0.999488387
R Square	0.998977037
Adjusted R Square	0.998863374
Standard Error	6.95955E-06
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4.25697E-07	4.26E-07	8788.96876	9.06425E-15
Residual	9	4.35918E-10	4.84E-11		
Total	10	4.26133E-07			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.0023675	3.92572E-06	603.0746	4.82489E-22	0.002358619	0.002376381	0.002358619	0.002376381
X Variable 1	-6.22091E-08	6.63567E-10	-93.7495	9.06425E-15	-6.371E-08	-6.0708E-08	-6.37102E-08	-6.0708E-08

SUMMARY OUTPUT for mu

Regression Statistics	
Multiple R	0.999969093
R Square	0.999938188
Adjusted R Square	0.99993132
Standard Error	5.60483E-11
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	4.57368E-16	4.57E-16	145593.0579	2.96912E-20
Residual	9	2.82727E-20	3.14E-21		
Total	10	4.57396E-16			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.71977E-07	3.16155E-11	11765.66	1.17849E-33	3.71906E-07	3.72049E-07	3.71906E-07	3.72049E-07
X Variable 1	-2.03909E-12	5.344E-15	-381.567	2.96912E-20	-2.0512E-12	-2.027E-12	-2.05118E-12	-2.027E-12

SUMMARY OUTPUT for pressure

Regression Statistics	
Multiple R	0.999108089
R Square	0.998216973
Adjusted R Square	0.998018858
Standard Error	9.755712649
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	479542.8765	479542.9	5038.594918	1.10486E-13
Residual	9	856.5653636	95.17393		
Total	10	480399.4418			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2100.959091	5.502964098	381.7868	2.95374E-20	2088.510521	2113.407661	2088.510521	2113.407661
X Variable 1	-0.066026364	0.000930171	-70.9831	1.10486E-13	-0.06813056	-0.063922171	-0.068130556	-0.063922171

SUMMARY OUTPUT for temperature

Regression Statistics	
Multiple R	0.998947454
R Square	0.997896016
Adjusted R Square	0.99766224
Standard Error	0.583829572
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1454.981851	1454.982	4268.599384	2.32726E-13
Residual	9	3.067712727	0.340857		
Total	10	1458.049564			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	59.54636364	0.329324294	180.8138	2.46206E-17	58.80138033	60.29134695	58.80138033	60.29134695
X Variable 1	-0.003636909	5.5666E-05	-65.3345	2.32726E-13	-0.00376283	-0.003510984	-0.003762834	-0.003510984

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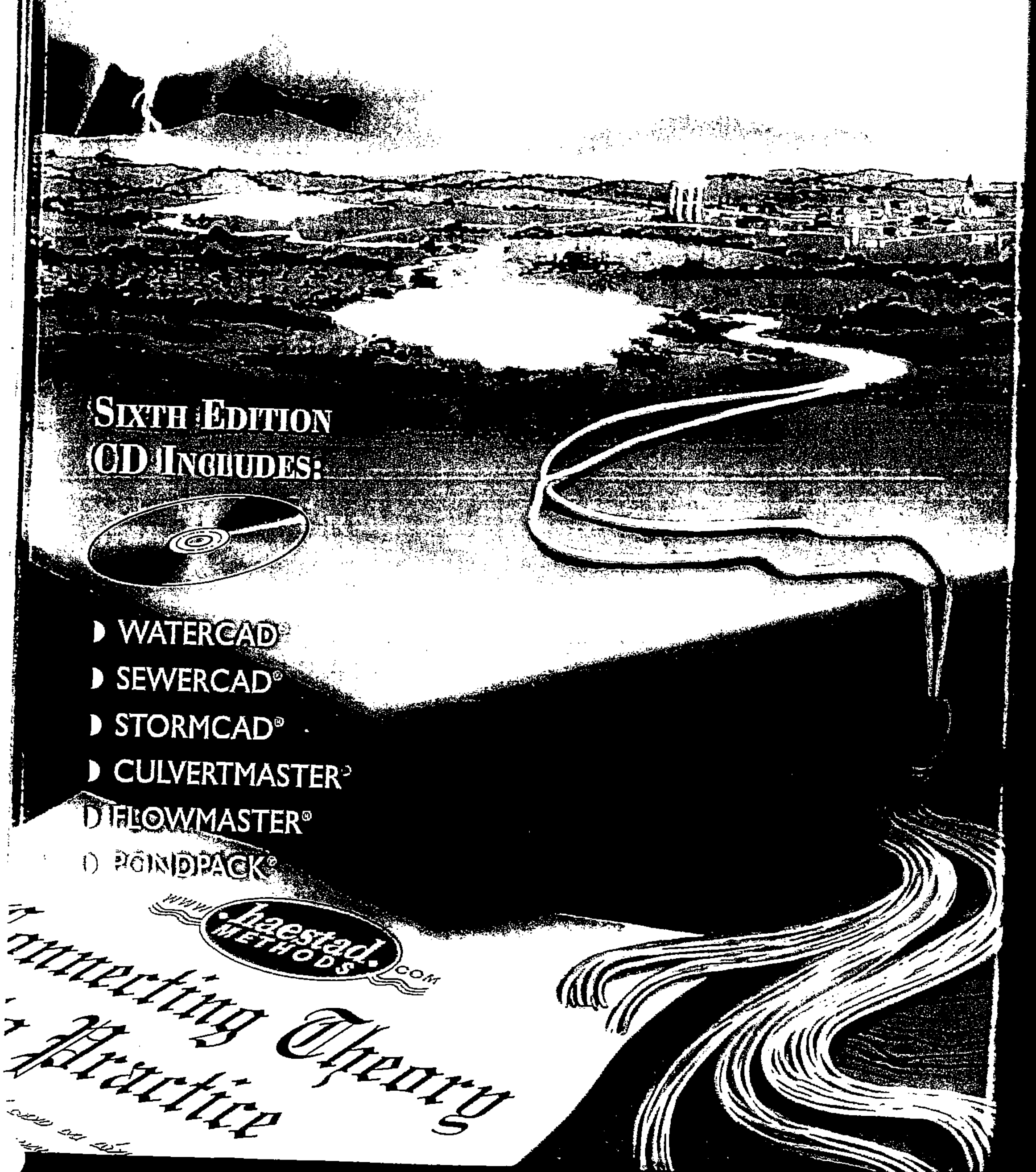

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given particle in the direction of flow, and at other times detract from it. The result is that velocity distributions captured at different times will be quite different from one another, and will be far more chaotic than the velocity distribution of a laminar flow section.

By strict interpretation, the changing velocities in turbulent flow would cause it to be classified as unsteady flow. Over time, however, the average velocity at any given point within the section is essentially constant, so the flow is assumed to be steady.

The velocity at any given point within the turbulent section will be closer to the mean velocity of the entire section than with laminar flow conditions. Turbulent flow velocities are closer to the mean velocity because of the continuous mixing of flow, particularly the mixing of low-velocity flow near the channel walls with the higher-velocity flow toward the center.

To classify flow as either turbulent or laminar, an index called the ***Reynolds number*** is used. It is computed as follows:

$$Re = \frac{4VR}{\nu}$$

where Re = Reynolds number (unitless)
V = average velocity (m/s, ft/s)
R = hydraulic radius (m, ft)
ν = kinematic viscosity (m^2/s, ft^2/s)

If the Reynolds number is below 2,000, the flow is generally laminar. For flow in closed conduits, **if the Reynolds number is above 4,000, the flow is generally turbulent.** Between 2,000 and 4,000, the flow may be either laminar or turbulent, depending on how insulated the flow is from outside disturbances. In open channels, laminar flow occurs when the Reynolds number is less than 500 and turbulent flow occurs when it is above 2,000. Between 500 and 2,000, the flow is transitional.

Example 1-1: Flow Characteristics

A rectangular concrete channel is 3 m wide and 2 m high. The water in the channel is 1.5 m deep and is flowing at a rate of 30 m^3/s. Determine the flow area, wetted perimeter, and hydraulic radius. Is the flow laminar or turbulent?

Solution

From the section's shape (rectangular), we can easily calculate the area as the rectangle's width multiplied by its depth. Note that the depth used should be the actual depth of flow, not the total height of the cross-section. The wetted perimeter can also be found easily through simple geometry.

$$A = 3.0 \text{ m} \times 1.5 \text{ m} = 4.5 \text{ m}^2$$

$$P_w = 3.0 \text{ m} + 2 \times 1.5 \text{ m} = 6.0 \text{ m}$$

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Table 1-2: Typical Roughness Coefficients

Material	Manning's Coefficient	Hazen-Williams	Darcy-Weisbach Roughness Height	
	n	*C*	*k* (mm)	*k* (ft)
Asbestos cement	0.011	140	0.0015	0.000005
Brass	0.011	135	0.0015	0.000005
Brick	0.015	100	0.6	0.002
Cast-iron, new	0.012	130	0.26	0.00085
Concrete:				
Steel forms	0.011	140	0.18	0.006
Wooden forms	0.015	120	0.6	0.002
Centrifugally spun	0.013	135	0.36	0.0012
Copper	0.011	135	0.0015	0.000005
Corrugated metal	0.022	–	45	0.15
Galvanized iron	0.016	120	0.15	0.0005
Glass	0.011	140	0.0015	0.000005
Lead	0.011	135	0.0015	0.000005
Plastic	**0.009**	**150**	**0.0015**	**0.000005**
Steel:				
Coal-tar enamel	0.010	148	0.0048	0.000016
New unlined	0.011	145	0.045	0.00015
Riveted	0.019	110	0.9	0.003
Wood stave	0.012	120	0.18	0.0006

1.5 Pressure Flow

For pipes flowing full, many of the friction loss calculations are greatly simplified because the flow area, wetted perimeter, and hydraulic radius are all functions of pipe radius (or diameter). Table 1-3 presents the three pipe friction loss equations that are commonly used to design pressure pipe systems.

There is much more information presented about pressure piping systems in Chapter 6, including further discussion on pumping systems, minor losses, and network analysis.

Table 1-3: Three Pipe Friction Loss Equations

Equation	Q (m^3/s); D (m)	Q (cfs); D (ft)	Q (gpm); D (in.)
Darcy-Weisbach	$S_f = \frac{0.083 f Q^2}{D^5}$	$S_f = \frac{0.025 f Q^2}{D^5}$	$S_f = \frac{0.031 f Q^2}{D^5}$
Hazen-Williams	$S_f = \frac{10.7}{D^{4.87}}\left(\frac{Q}{C}\right)^{1.852}$	$S_f = \frac{4.73}{D^{4.87}}\left(\frac{Q}{C}\right)^{1.852}$	$S_f = \frac{10.5}{D^{4.87}}\left(\frac{Q}{C}\right)^{1.852}$
Manning	$S_f = \frac{10.3(nQ)^2}{D^{5.33}}$	$S_f = \frac{4.66(nQ)^2}{D^{5.33}}$	$S_f = \frac{13.2(nQ)^2}{D^{5.33}}$

FUNDAMENTALS OF FLUID MECHANICS

Bruce R. Munson
Donald F. Young
Theodore H. Okiishi

B

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■ TABLE B.3

Physical Properties of Air at Standard Atmospheric Pressure (BG Units)[a]

Temperature (°F)	Density, ρ (slugs/ft^3)	Specific Weight[b], γ (lb/ft^3)	Dynamic Viscosity, μ (lb·s/ft^2)	Kinematic Viscosity, ν (ft^2/s)	Specific Heat Ratio, k (—)	Speed of Sound, c (ft/s)
−40	2.939 E − 3	9.456 E − 2	3.29 E − 7	1.12 E − 4	1.401	1004
−20	2.805 E − 3	9.026 E − 2	3.34 E − 7	1.19 E − 4	1.401	1028
0	2.683 E − 3	8.633 E − 2	3.38 E − 7	1.26 E − 4	1.401	1051
10	2.626 E − 3	8.449 E − 2	3.44 E − 7	1.31 E − 4	1.401	1062
20	2.571 E − 3	8.273 E − 2	3.50 E − 7	1.36 E − 4	1.401	1074
30	2.519 E − 3	8.104 E − 2	3.58 E − 7	1.42 E − 4	1.401	1085
40	2.469 E − 3	7.942 E − 2	3.60 E − 7	1.46 E − 4	1.401	1096
50	2.420 E − 3	7.786 E − 2	3.68 E − 7	1.52 E − 4	1.401	1106
60	2.373 E − 3	7.636 E − 2	3.75 E − 7	1.58 E − 4	1.401	1117
70	2.329 E − 3	7.492 E − 2	3.82 E − 7	1.64 E − 4	1.401	1128
80	2.286 E − 3	7.353 E − 2	3.86 E − 7	1.69 E − 4	1.400	1138
90	2.244 E − 3	7.219 E − 2	3.90 E − 7	1.74 E − 4	1.400	1149
100	2.204 E − 3	7.090 E − 2	3.94 E − 7	1.79 E − 4	1.400	1159
120	2.128 E − 3	6.846 E − 2	4.02 E − 7	1.89 E − 4	1.400	1180
140	2.057 E − 3	6.617 E − 2	4.13 E − 7	2.01 E − 4	1.399	1200
160	1.990 E − 3	6.404 E − 2	4.22 E − 7	2.12 E − 4	1.399	1220
180	1.928 E − 3	6.204 E − 2	4.34 E − 7	2.25 E − 4	1.399	1239
200	1.870 E − 3	6.016 E − 2	4.49 E − 7	2.40 E − 4	1.398	1258
300	1.624 E − 3	5.224 E − 2	4.97 E − 7	3.06 E − 4	1.394	1348
400	1.435 E − 3	4.616 E − 2	5.24 E − 7	3.65 E − 4	1.389	1431
500	1.285 E − 3	4.135 E − 2	5.80 E − 7	4.51 E − 4	1.383	1509
750	1.020 E − 3	3.280 E − 2	6.81 E − 7	6.68 E − 4	1.367	1685
1000	8.445 E − 4	2.717 E − 2	7.85 E − 7	9.30 E − 4	1.351	1839
1500	6.291 E − 4	2.024 E − 2	9.50 E − 7	1.51 E − 3	1.329	2114

[a] Based on data from R. D. Blevins, *Applied Fluid Dynamics Handbook*, Van Nostrand Reinhold Co., Inc., New York, 1984.

[b] Density and specific weight are related through the equation $\gamma = \rho g$. For this table g = 32.174 ft/s^2.

PVC Pipe & Fittings Dimensions (Sch 40 / Sch 80)

This entry was posted on May 20, 2018 by admin.

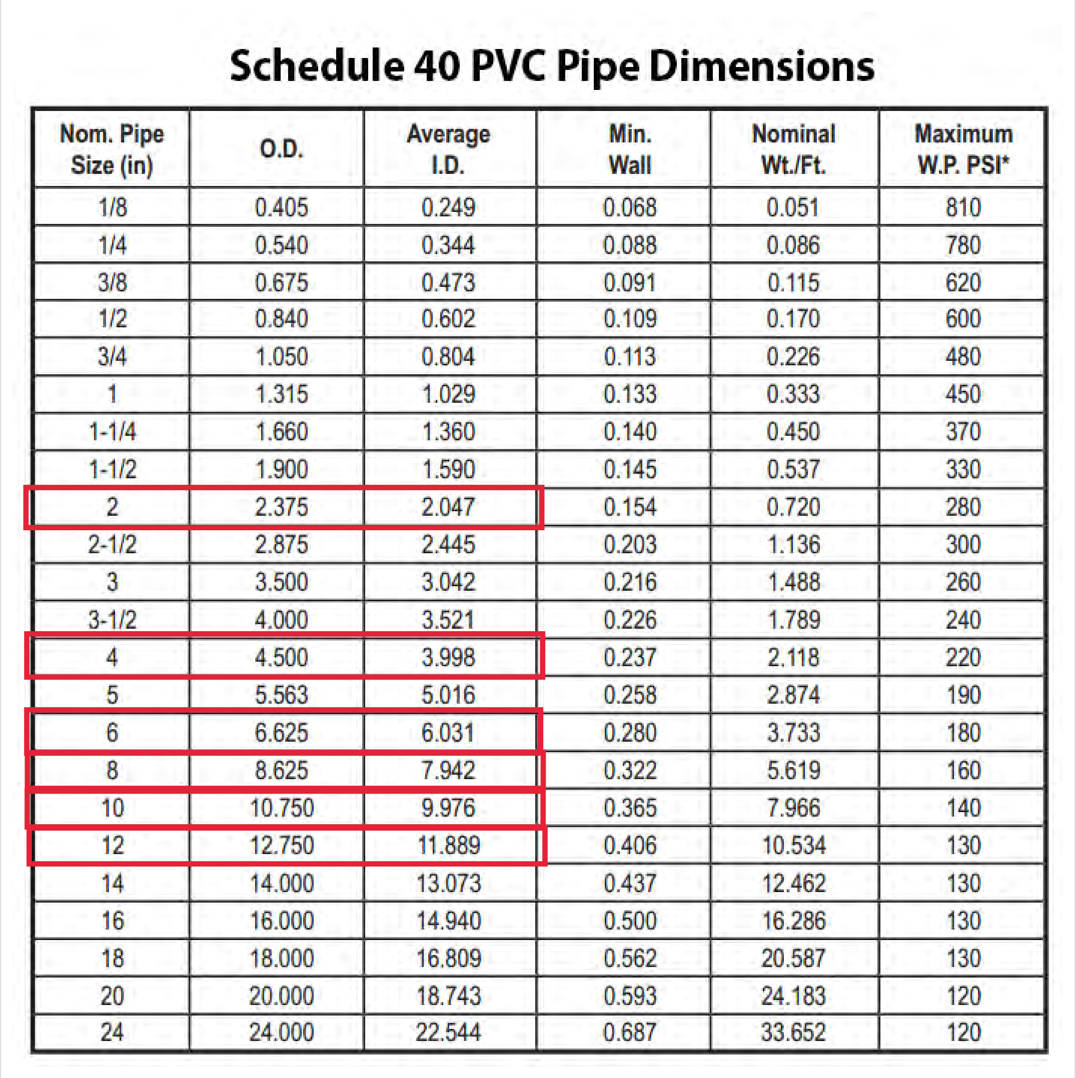
Looking for PVC dimensions? Check out this post for PVC pipe and fittings information for both schedule 40 and schedule 80 PVC. Click through to the Lasco Tech Docs for detailed fittings dimensions and see our PVC pipe sizing chart below for pipe OD, IS, wall thickness and more.

PVC Fittings Dimensions:

Lasco Technical Fittings Dimensions Information - Sch 40, Sch 80, 80 CPVC

PVC Pipe Dimensions:

Sch 40 PVC Pipe Dimensions



Schedule 40 PVC Pipe Dimensions

Nom. Pipe Size (in)	O.D.	Average I.D.	Min. Wall	Nominal Wt./Ft.	Maximum W.P. PSI*
1/8	0.405	0.249	0.068	0.051	810
1/4	0.540	0.344	0.088	0.086	780
3/8	0.675	0.473	0.091	0.115	620
1/2	0.840	0.602	0.109	0.170	600
3/4	1.050	0.804	0.113	0.226	480
1	1.315	1.029	0.133	0.333	450
1-1/4	1.660	1.360	0.140	0.450	370
1-1/2	1.900	1.590	0.145	0.537	330
2	2.375	2.047	0.154	0.720	280
2-1/2	2.875	2.445	0.203	1.136	300
3	3.500	3.042	0.216	1.488	260
3-1/2	4.000	3.521	0.226	1.789	240
4	4.500	3.998	0.237	2.118	220
5	5.563	5.016	0.258	2.874	190
6	6.625	6.031	0.280	3.733	180
8	8.625	7.942	0.322	5.619	160
10	10.750	9.976	0.365	7.966	140
12	12.750	11.889	0.406	10.534	130
14	14.000	13.073	0.437	12.462	130
16	16.000	14.940	0.500	16.286	130
18	18.000	16.809	0.562	20.587	130
20	20.000	18.743	0.593	24.183	120
24	24.000	22.544	0.687	33.652	120

Sch 80 PVC Pipe Dimensions

Schedule 80 PVC Pipe Dimensions

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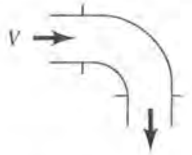
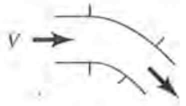
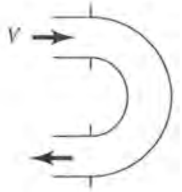
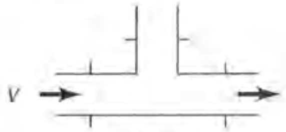
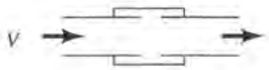
conventional globe valve) are designed for general use, providing convenient control between the extremes of fully closed and fully open. Others (such as a needle valve) are designed to provide very fine control of the flowrate. The check valve provides a diode type operation that allows fluid to flow in one direction only.

Loss coefficients for typical valves are given in Table 8.2. As with many system components, the head loss in valves is mainly a result of the dissipation of kinetic energy of a high-speed portion of the flow. This is illustrated in Fig. 8.33.

TABLE 8.2

Loss Coefficients for Pipe Components $\left(h_L = K_L \frac{V^2}{2g}\right)$ **(Data from Refs. 5, 10, 27)**

Component	K_L	
a. Elbows		
Regular 90°, flanged	0.3	
Regular 90°, threaded	1.5	
Long radius 90°, flanged	0.2	
Long radius 90°, threaded	0.7	
Long radius 45°, flanged	0.2	
Regular 45°, threaded	0.4	
b. 180° return bends		
180° return bend, flanged	0.2	
180° return bend, threaded	1.5	
c. Tees		
Line flow, flanged	0.2	
Line flow, threaded	0.9	
Branch flow, flanged	1.0	
Branch flow, threaded	2.0	
d. Union, threaded	0.08	
***e. Valves**		
Globe, fully open	10	
Angle, fully open	2	
Gate, fully open	0.15	
Gate, $\frac{1}{4}$ closed	0.26	
Gate, $\frac{1}{2}$ closed	2.1	
Gate, $\frac{3}{4}$ closed	17	
Swing check, forward flow	2	
Swing check, backward flow	∞	
Ball valve, fully open	0.05	
Ball valve, $\frac{1}{3}$ closed	5.5	
Ball valve, $\frac{2}{3}$ closed	210	

*See Fig. 8.32 for typical valve geometry.

Water Resources Engineering

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$$300.0 - 250.0 = \frac{0.017 \times 4500}{10/12}\frac{V^2}{2g} = 91.8\frac{V^2}{2g}$$

$$\frac{V^2}{2g} = 0.545 \text{ ft}$$

$$V = (2g \times 0.545)^{1/2} = 5.90 \text{ fps}$$

$$R_e = \frac{DV}{\nu} = \frac{0.833 \times 5.9}{10^{-5}} = 4.9 \times 10^5$$

From the Moody diagram $f = 0.018$

$$H_L = 97.2\frac{V^2}{2g}$$

$$\frac{V^2}{2g} = 0.514 \text{ ft}$$

$$V = 5.75 \text{ fps}$$

$$R_e = 4.8 \times 10^5$$

$$Q = AV = 0.545 \times 5.75 = 3.14 \text{ cfs}$$

4.1.3.2 Minor losses. Minor losses are caused by additional turbulence generated by a change in flow geometry. They represent the headloss that is in excess of the normal pipe friction at transitions, bends, valves, and other fittings. The coefficient (K) is used to give the minor headloss (H_M) as a function of the velocity head

$$H_M = K\frac{V^2}{2g} \tag{4.11}$$

At transitions V is the velocity in the smaller pipe. Minor loss coefficients are listed in Table 4.2.

TABLE 4.2 MINOR LOSS COEFFICIENTS (K)

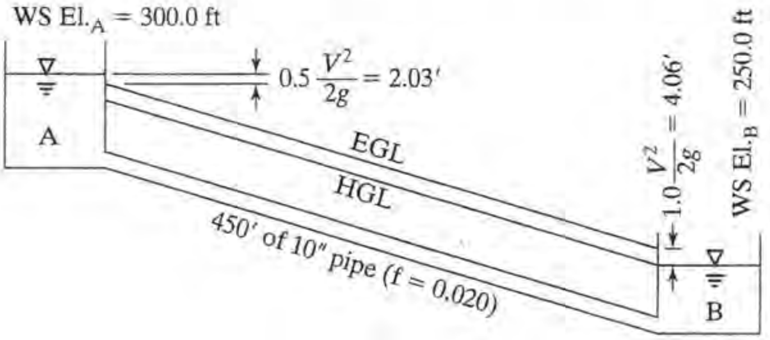
Transitions		
Diameter ratio	Expansion	Contraction
0	1.0	0.5
0.2	0.92	0.45
0.4	0.70	0.38
0.6	0.40	0.29
0.8	0.12	0.12
1.0	0.0	0.0
Entrance		
Pipe projection	0.8	
Square edge	0.5	
Rounded	0.1	
Exit	1.0	

TABLE 4.2 *(Continued)*

Bends		
Radius/diameter	90°	45°
1	0.5	0.37
2	0.3	0.22
4	0.25	0.19
6	0.15	0.11
Valves		
Globe (open)	10	
Swing check	2.0	
Gates (open)	0.2	
Gate (1/2 open)	5.6	
Butterfly (open)	1.2	
Ball (open)	0.05	

Example 4.3 Short Pipe Problem

The two reservoirs are connected with 450 ft of 10-in. diameter pipe ($f = 0.020$). The entrance loss coefficient is 0.5 at the upper reservoir, and the exit loss coefficient is 1.0 at the lower reservoir. Determine the discharge rate in the pipe. Draw the *EGL* and *HGL* on the sketch



$$H_L = 0.5\frac{V^2}{2g} + \frac{fL}{D}\frac{V^2}{2g} + \frac{V^2}{2g}$$

$$300.0 - 250.0 = \left(1.5 + \frac{0.02 \times 450}{0.833}\right)\frac{V^2}{2g}$$

$$50.0 = 12.3\frac{V^2}{2g}$$

$$\frac{V^2}{2g} = 4.06 \text{ ft}$$

$$V = 16.2 \text{ fps}$$

$$Q = AV = 0.545 \times 16.2 = 8.83 \text{ cfs}$$

Example 4.4 Minor Losses

A pipeline consisting of three pipes in series ($f = 0.02$) extends from an upper reservoir (Elevation 200.0 m) to a lower reservoir (Elevation 180.0 m). Compute the discharge rate in the pipeline using minor loss coefficients of 0.5 for entrance, 0.15 for contraction

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MINIMUM SITE ASSESSMENT AND FEASIBILITY TESTING REPORT

ALLSUPS #320 FACILITY
CLOVIS, NEW MEXICO

Submitted To:

Ms. Renee Romero
NMED-PSTB
1914 West 2nd Street
Roswell, New Mexico 88201

Mr. Jeff Scarbrough
Allsups Petroleum, Inc
2112 Thornton Ave.
Clovis, New Mexico 88102

December 2012

STATE ENGINEER OFFICE
ROSWELL
2012 DEC 31 P 1: 2

Minimum Site Assessment and Feasibility Testing Report

Allsups #320 Facility
Clovis, New Mexico

BEI Job No. 1070
WPID #s16460/16553
DID#16460-2, 16553-1 and 16553-2
Facility #31013
RID #4623

Submitted to:

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STATE ENGINEER OFFICE
ROSWELL, NEW MEXICO
2012 DEC 31 P 1:20

5.0 SVE FEASIBILITY STUDY

5.1 OVERVIEW

The primary goal of the SVE feasibility study at the Site was two-fold:

- Characterize hydrocarbon vapor concentrations and composition within the vadose zone
- Evaluate SVE technology as a potential remedial alternative

On behalf of Allsups, BEI conducted nine short-term SVE FS tests at the Site between October 15 and 18, 2012. During the FS, each of the nested wells (BW-1s, BW-1i, BW-1d, BW-2s, BW-2i, BW-2d, BW-3s, BW-3i, and BW-3d) was tested for periods ranging from 1.13 to 17.0 hours in length. Summaries of major SVE testing parameters for wells in the shallow, intermediate, and deep vadose zones are presented in Figures 6a, 6b, and 6c, respectively. BEI has also included detailed FS field test sheets and analyses of each SVE test in Appendix D.

In an effort to evaluate the effects of lithologic heterogeneity across the soil hydrocarbon plume, the existing vadose zone monitoring well clusters were used to measure vacuum responses in a three dimensional nature during the FS testing. Applied vacuums during the SVE tests ranged between approximately 27 and 57 inches of water ("H_2O). Associated subsurface airflows generated during the testing events ranged between approximately 85 and 99 standard cubic feet/minute (scfm). Table 4 summarizes laboratory analytical data for vapor samples collected during the FS. Laboratory reports including chain-of-custody documentation are presented in Appendix C.

In summary, effective subsurface airflow was generated during the testing of all nine wells. Elevated PID/FID measurements were obtained throughout the testing, especially in wells screened in the intermediate and deep vadose zone. Extracted vapor samples collected for laboratory analysis yielded TPH levels up to 56,000 micrograms/liter (ug/l). Total BTEX concentrations were measured at concentrations up to 3,970 ug/l. Elevated levels of carbon dioxide and depleted levels of oxygen were documented on select samples. Vapor discharge levels remained below air quality emission levels throughout the testing period. No groundwater or LNAPLs were recovered during the testing of the above wells. All four GAC vessels were utilized at the Site to control off-gas emissions.

Based on a review of the FS test data, which is presented below, SVE should be an effective remediation strategy for removal of subsurface TPH and BTEX at the Site.

The roughness component in the Darcy-Weisbach equation is a function of both the channel material and the Reynolds number, which varies with velocity and hydraulic radius.

$$V = \sqrt{\frac{8g}{f} RS}$$

where V = flow velocity (m/s, ft/s)
g = gravitational acceleration (m/s^2, ft/s^2)
f = Darcy-Weisbach friction factor (unitless)
R = hydraulic radius (m, ft)
S = friction slope (m/m, ft/ft)

The Darcy-Weisbach friction factor, *f*, can be found using the Colebrook-White equation for fully developed turbulent flow, as follows:

Free Surface

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{k}{12R} + \frac{2.51}{Re\sqrt{f}}\right)$$

Full Flow (Closed Conduit)

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{k}{14.8R} + \frac{2.51}{Re\sqrt{f}}\right)$$

where k = roughness height (m, ft)
R = hydraulic radius (m, ft)
Re = Reynolds number (unitless)

This iterative search for the correct value of *f* can become quite time-consuming for hand computations and computerized solutions of many pipes. Another method, developed by Swamee and Jain, solves directly for *f* in full-flowing circular pipes. This equation is:

$$f = \frac{1.325}{\left[\log_e\left(\frac{k}{3.7D} + \frac{5.74}{Re^{0.9}}\right)\right]^2}$$

where f = friction factor (unitless)
k = roughness height (m, ft)
D = pipe diameter (m, ft)
Re = Reynolds number (unitless)

Typical Roughness Factors

Typical pipe roughness values for each of these methods are shown in Table 1-2. These values will vary depending on the manufacturer, workmanship, age, and other factors. For this reason, the following table should be used only as a guideline.

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①

Table 1-

Asbesto
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WATER RESOURCES ENGINEERING

Ralph A. Wurbs ▪ Wesley P. James

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Replacing the dependent variable with the nonrepeating independent variable μ gives

$$\pi_2 = \mu V^a D^b \rho^c$$

$$F^0L^0T^0 = FL^{-2}T(LT^{-1})^a(L)^b(FL^{-4}T^2)^c$$

$$\begin{array}{lll} F: & 0 = 1 + c & c = -1 \\ T: & 0 = 1 - a - 2 & a = -1 \\ L: & 0 = -2 - 1 + b + 4 & b = -1 \end{array}$$

$$\pi_2 = \frac{\mu}{VD\rho} = \frac{1}{\text{Re}} \tag{3.24}$$

where Re is the Reynolds number. Selecting ℓ as the next nonrepeating variable gives

$$\pi_3 = \ell V^a D^b \rho^c$$

$$F^0L^0T^0 = L(LT^{-1})^a L^b(FL^{-4}T^2)^c$$

$$\begin{array}{lll} F: & 0 = c & c = 0 \\ T: & 0 = -a & a = 0 \\ L: & 0 = 1 + b & b = -1 \end{array}$$

$$\pi_3 = \frac{L}{D} \tag{3.25}$$

The remaining nonrepeating variable is ε, so that

$$\pi_4 = \varepsilon V^a D^b \rho^c$$

solving for exponents gives

$$\pi_4 = \frac{\varepsilon}{D} \tag{3.26}$$

where π_4 is the relative roughness of the pipe.

The equation for the pressure drop in a pipe (Eq. 3.22) can be written in terms of

$$\frac{\Delta P}{\rho V^2} = \phi\left(\frac{1}{\text{Re}}, \frac{L}{D}, \frac{\varepsilon}{D}\right) \tag{3.27}$$

Equation 3.27 forms the basis for the Darcy–Weisbach equation for headloss ($h_f = \Delta P/\gamma$) in a pipe

$$h_L = f\frac{L}{D}\frac{V^2}{2g} \tag{3.28}$$

where the friction factor (f) is a function of Re and ε/D and is given in the Moody chart presented in Chapter 4.

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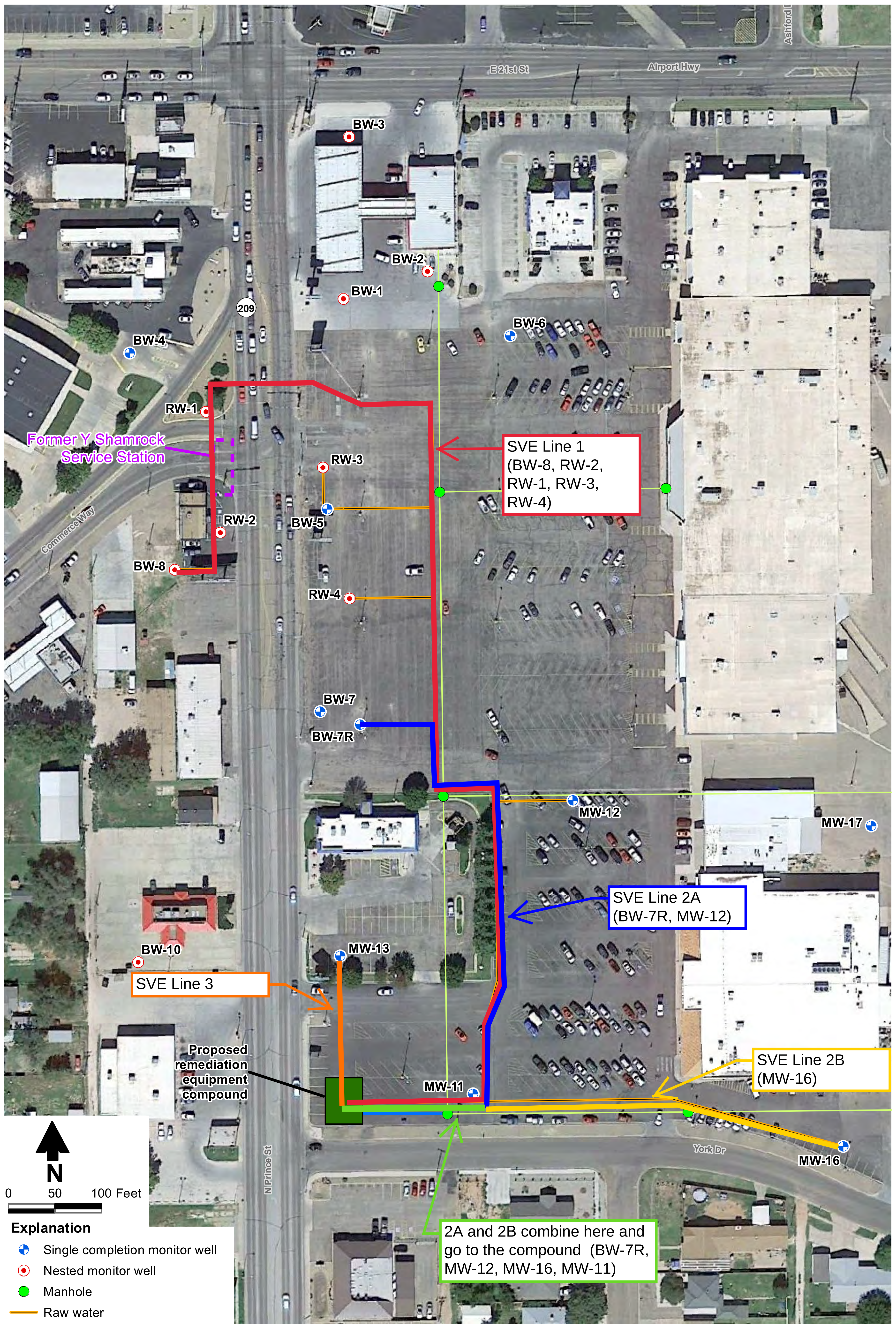


FORMER Y STATION STATE LEAD SITE
721 COMMERCE WAY
CLOVIS, NEW MEXICO

Proposed Remediation System Layout

Daniel B. Stephens & Associates, Inc.
5/13/2021
JN DB17.1228.PR

Figure 10

Calculation Cover Sheet

Daniel B. Stephens & Associates, Inc.

Project Name Former Y Station

Project Number DB18.1157

Calculation Number DB18.1157-002

Discipline Engineering

No. of Sheets 3

PROJECT: Former Y Station

SITE: Former Y Station State Lead Site, Clovis, New Mexico

THOMAS A. GOLDEN
22750
7/16/21

SUBJECT: Determine total dynamic head (TDH) from the treatment compound to the distribution lines and size the pumps

SOURCES OF DATA:

A. Groundwater Model Simulations for Evaluation of the Proposed Remediation Plan in Clovis, New Mexico. DBS&A, September 14, 2020.
B. Figure 10 - Proposed Remediation System Layout
C. Survey Reports, performed by Lydick Engineers & Surveyors, Clovis, NM, 2019, 2020.
D. Fourth Quarter Groundwater Monitoring Report, Former Y Station. DBS&A, May 5, 2021.
E. Grundfos Pump Curve Chart

SOURCES OF FORMULAE & REFERENCES:

1. Hydraulic Engineering. Roberson, Cassidy, and Chaudhry, 1998
2. FlowMaster by Bentley
3. Pumping Station Design, Second Edition. Sanks, 1998
4. Groundwater and Wells 2nd Edition, Driscoll, 1987.

☐ Preliminary Calculation ☒ Final Calculation Supersedes Calculation No. ____________

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date
0	Final Remediation Plan	GMH	6/7/2020	GH	7/1/2021	TG	7/9/2021

Project No. DB18.1157 Date 06/07/2021

Subject Determine pressure losses and size blowers for SVE remediation system Sheet 1 of 3

By GMH Checked by ______ Calculation No. DB18.1157-002

1.0 OBJECTIVE

Determine the Total Dynamic Head (TDH) at each groundwater extraction well to appropriately size the pumps at each well.

2.0 GIVEN

The well pump rates were determined based on the maximum pumping scenario assessed in the modeling report for the site[A]. The number and length of distribution pipes were determined from the Proposed Remediation System Layout[B].

3.0 METHOD

The TDH is the sum of the static head, friction head, minor losses, and the velocity head and is given by the equation[1] (all terms in feet):

$$TDH = h_{stat} + h_f + h_m + h_v + h_{lp}$$

where: h_{stat} = static head
h_f = friction head
h_m = minor losses
h_v = velocity head
h_{lp} = minimum line pressure

The static head is assumed to be equal to the elevation difference between the groundwater table at each well and the surface elevation at the groundwater treatment compound. All ground surface elevations have been approximated using the data from the survey reports[C]. The friction head from friction losses in the pipes and fittings is calculated using FlowMaster[2] (Bentley) and the Hazen-Williams equation. Material roughness coefficients are taken from definitions in the FlowMaster software. The minor losses are from elbows, valves, and fittings. The energy loss coefficients for the minor losses are taken from literature[3]. The velocity head is calculated as $h_v = V^2/2g$, and will be taken from FlowMaster[2].

TDH will be calculated for each pump. TDH and discharge (Q) will be used to size the required pumps, assuming pump and motor efficiencies. The water horsepower is calculated by the equation:[4]

$$WHP = Q * TDH / 3960 \qquad \text{Eqn. 2}$$

Q = gpm

TDH = feet

Project No. DB18.1157 Date 06/07/2021

Subject Determine pressure losses and size blowers for SVE remediation system Sheet 2 of 3

By GMH Checked by Calculation No. DB18.1157-002

The brake horsepower that must be applied to the shaft by the motor assumes a pump efficiency (E_p): [4]

$HP_b = WHP / E_p$ Eqn. 3

The motor horsepower that must be used to operate the shaft assumes a motor efficiency (E_m): [4]

$HP_m = HP_b / E_m$ Eqn. 4

4.0 SOLUTION

Example calculations are provided below for the pipe section MW-11 to the compound. Calculations for all extraction wells are provided in the attached spreadsheet. The following equations in this example use the solutions as given in the spreadsheet and may differ slightly due to differences in rounding and significant digits shown. Friction losses for each reach of the flow path were found using FlowMaster (Bentley) to determine friction head and velocity head for anticipated pipe materials, pipe diameters, and the volumetric flow rate[2]. The assumed pipeline segment lengths and diameters are shown on the Proposed System Layout[B]. The Hazen-Williams roughness coefficients used by Bentley Flowmaster are approximated as follows; PVC pipes = 150[2] . Table 1 summarizes these results:

Table 1. FlowMaster results for friction losses (h_f) and velocity head (h_v):

Pipe Section	Pipe Material	Nominal Pipe Dia. (in)	Pipe Length (ft)	Flow Rate (gpm)	h_f (ft)	h_v (ft)
MW-11 to Compound	PVC	1.5	155	20	5.39	0.20

The pumping drawdown over a 5 to 7 year period was based on the maximum pumping scenario from the modeling report[A]. Depth to water for MW-11 is provided in the monitoring report[D]. The drop pipe friction head is calculated using FlowMaster[2].

h_{stat} = 327 ft depth to water + 25 ft pumping drawdown + 4.48 ft drop pipe head loss = 356.5 ft

Based on professional judgment, assume the wellhead minor losses (pitless adaptor, valves, fittings, etc.) and assume that the velocity head is small enough to include in this assumption.

$$\Sigma h_m = 40 \text{ ft}$$

A minimum line pressure is assumed based on preliminary system requirements.

$$h_{lp} = 25 \text{ ft}$$

Project No. DB18.1157 Date 06/07/2021

Subject Determine pressure losses and size blowers for SVE remediation system Sheet 3 of 3

By GMH Checked by ________ Calculation No. DB18.1157-002

Use data shown above to calculate the TDH at the pump:

TDH = $h_{stat} + \Sigma h_f + \Sigma h_m + h_{lp}$ = 356.5 ft + 5.39 ft + 40 ft + 25 ft **= 426.9 feet** Eqn. 1

Calculate the water horsepower using the calculated TDH:

WHP = Q * TDH / 3960 = 4 * 426.9 / 3960 = 0.43 HP Eqn. 2

Calculate the brake horsepower, assuming a motor efficiency of 80%:

HP_b = WHP / 0.80 = 0.43/ 0.80 = 0.54 HP Eqn. 3

Calculate the motor horsepower, assuming a motor efficiency of 80%:

$HP_m = HP_b$ / 0.80 = 0.54 / 0.80= **0.68 HP** Eqn. 4

FS = 1.2

HP =1.2*.68 = 0.81

Therefore, to provide a nominal factor of safety of 20% and sizing up to the next available pump, a 1.0 HP pump is appropriate.

Based on the Grundfos Pump Curve^{E}, the SP 5S10-22 pump will be used for MW-11.

Daniel B. Stephens & Associates, Inc.

Total Dynamic Head (TDH) and Pump Power

Extraction well	RW-2	RW-1	RW-3	RW-4	BW-7R	MW-12	MW-16	MW-11
Flow rate (gpm)	2	2	2	2	2	2	4	4
Flow rate (ft^3/s)	0.004	0.004	0.004	0.004	0.004	0.004	0.009	0.009
Surface elevation (ft msl)	4,280	4,280	4,279	4,279	4,278	4,278	4,277	4,275
Depth to water (ft btoc)	330	330	329	330	329	330	330	327
Pumping elevation (ft msl)	3,925	3,925	3,925	3,924	3,924	3,923	3,922	3,923
Static head (ft)	356.3	356.3	355.3	356.3	355.3	356.3	359.5	356
TDH (ft)	**434.5**	**434.4**	**432.7**	**433.4**	**431.5**	**431.0**	**430.6**	**426.9**
Water horsepower (HP)	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.43**	**0.43**
Brake horsepower (HP)	**0.27**	**0.27**	**0.27**	**0.27**	**0.27**	**0.27**	**0.54**	**0.54**
Motor horsepower (HP)	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**	**0.81**	**0.81**
Selected horsepower (HP)	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**1.00**	**1.00**
Well head pressure (psi)	**34**	**34**	**34**	**33**	**33**	**32**	**31**	**31**
	5SQE-320	5SQE-320	5SQE-320	5SQE-320	SP 5S10-22	SP 5S10-22	SP 5S10-22	SP 5S10-22

Conversion factors:

32.17	ft/s^2, acceleration due to gravity
7.48	gallons in a cubic foot
60	seconds in a minute
62.3	specific weight of water (lb/ft^3)
80%	pump and motor efficiency
33.91	ft water per atm
14.7	psi per atm

Assumptions

4,275	ft, elevation at ground water treatment compound
25	ft, pumping drawdown (5 to 7 years)
40	ft, wellhead minor losses (pitless, valve, fittings)
25	ft, minimum line pressure
1.2	factor of safety
1.25	ft, drop pipe friction headloss, 2 gpm
4.48	ft, drop pipe friction headloss, 4 gpm

Calculation Cover Sheet

Daniel B. Stephens & Associates, Inc.

Project Name Former Y Station

Project Number DB18.1157

Calculation Number DB18.1157-003

Discipline Engineering

No. of Sheets 3

PROJECT: Former Y Station

SITE: Former Y Station State Lead Site, Clovis, New Mexico

THOMAS A. GOLDEN
22750
8/11/21

SUBJECT: Estimated hydrocarbon emissions from SVE treatment equipment

SOURCES OF DATA:

A. Minimum Site Assessment and Feasibility Testing Report: Allsups #320 Facility, Brown Environmental, Inc. (BEI), 2012.

B. Extended Off-Site Investigation and Groundwater Sampling Report. BEI, 2016

C. Model 1000 CFM Thermal Oxidizer specifications, Intellishare Environmental, June 2021.

D. Table 1. Proposed Remediation Wells

SOURCES OF FORMULAE & REFERENCES:

1. Figure 10. Proposed Remediation System Layout

☒ Preliminary Calculation ☐ Final Calculation Supersedes Calculation No. ____

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date
0	Final Remediation Plan	GMH	08/06/2021	JS	08/09/2021	TG	08/10/2021

Project No. DB18.1157 Date 8/6/2021

Subject Emissions calculation Sheet 1 of 4

By GMH Checked by JS Calculation No. DB18.1157-003

1.0 OBJECTIVE

Calculate the estimated hydrocarbon emission rates for a future dual phase extraction system, including a natural gas thermal oxidizer. The results will be compared to the limits of 10 pounds per hour and 10 tons per year, under which the New Mexico Environment Department (NMED) Air Quality Bureau does not require an air quality permit or a Notice of Intent to Discharge.

2.0 GIVEN

1. Laboratory results for influent soil vapor samples from the soil vapor extraction (SVE) pilot test data[A] and the Extended Off-site investigation data[B].
2. The estimated destruction efficiency for the multi-phase treatment equipment is greater than 99%[C], with similar systems proven to have a destruction efficiency of at least 99.5%.
3. The combined standard inlet design flow is 1,017 standard cubic feet per minute (scfm) [D] when including the MW-13 contingency well.

3.0 METHOD

Influent vapor concentrations are not available at this site as pilot testing was not performed on the proposed remediation wells. Instead, vapor concentrations have been assigned to each well and screen interval based on vapor concentration data collected by a previous consultant during a feasibility study and extended off-site investigation for other nearby wells [B]. Proximity to those wells and the estimated nonaqueous-phase liquid (NAPL) plume were taken into consideration. For example, the benzene concentration for the deep zone of remediation well RW-1 is estimated to be 1,000 micrograms per liter (µg/L) based on comparison of data for BW-4 and BW-5 (240 and 2,400 µg/L, respectively). Similarly, the total petroleum hydrocarbon gasoline range organics (TPH GRO) concentration for RW-1d is assumed to be 75,000 µg/L.

The combined benzene and TPH GRO concentrations for each nested source area well (RW-1 through RW-4 and BW-8), C_{well}, were calculated based on a weighted average of the assumed concentration, C, for each individual well screen interval (shallow, intermediate, and deep) and the expected air flow rate, Q, in that screen interval using equation 1.

$$C_{well} = [(C_{shallow}*Q_{shallow}) + (C_{int}*Q_{int}) + (C_{deep}*Q_{deep})] \;/\; [Q_{shallow} + Q_{int} + Q_{deep}] \qquad \text{eqn. 1}$$

The estimated total combined influent concentrations from the 10 proposed remediation wells (including contingency well MW-13) was calculated in a similar fashion using a weighted average of the concentrations and estimated flows from each well [D].

Estimated effluent concentrations were calculated using a range of assumed thermal oxidizer destruction efficiencies, DE, provided by the manufacturer using equation 2.

$$C_{eff} = C_{\inf} \cdot (1 - DE) \qquad \text{eqn. 2}$$

Where C_{eff} = effluent concentration
C_{inf} = influent concentration
DE = destruction efficiency of the thermal oxidizer

The effluent concentration is converted to a volume of air under standard conditions using equation 3.

$$C_{std} = C_{eff} \cdot \left(\frac{P_{std}}{P_{lab}} \cdot \frac{T_{lab}}{T_{std}} \right) \qquad \text{eqn. 3}$$

Where C_{std} = effluent concentration under standard temperature and pressure
C_{eff} = effluent concentration
P_{std} = standard pressure
T_{std} = standard temperature
P_{lab} = laboratory pressure
T_{lab} = laboratory temperature

4.0 SOLUTION

Laboratory results for samples collected during previous site investigation activities are provided on attached spreadsheets. These samples were collected from wells BW-1, BW-4, BW-5, BW-7, BW-8, and BW-9. DBS&A used this data to approximate influent concentrations for the 10 proposed remediation wells (RW-1 through RW-4, BW-7R, BW-8, MW-11, MW-12, MW-13, and MW-16). Weighted averages were used to calculation individual well concentrations and then the combined system influent concentration. A sample calculation for the TPH GRO concentration at RW-1 is provided below using equation 1. Calculations for all wells are attached.

$$C_{RW\text{-}1} = [(60\ \text{scfm} * 2{,}000\ \mu\text{g/l}) + (40\ * 40{,}000) + (65 * 75{,}000)]\ /\ (60\ \text{scfm} + 40\ \text{scfm} + 65\ \text{scfm})$$

$$C_{RW\text{-}1} = 39{,}970\ \mu\text{g/l}$$

Using a similar methodology, the combined influent benzene concentration is assumed to be approximately 590 µg/l and the combined influent TPH GRO concentration is just over 50,000 µg/l.

Project No. DB18.1157
Date 8/6/2021
Subject Emissions calculation
Sheet 3 of 4
By GMH
Checked by JS
Calculation No. DB18.1157-003

A sample calculation for estimating emission rates of TPH GRO is provided below. Assuming that effluent concentrations, C_{eff}, would be reduced by 99.5 percent following vapor treatment (the minimum destruction efficiency reported by the oxidizer manufacturer). Calculate an approximate treated TPH (GRO) concentration using equation 2:

$$C_{eff} = C_{inf} * (1 - 0.995) = 50{,}044\ \mu\frac{g}{L} * 0.005 = 250\ \mu g/L$$

Calculate the TPH (GRO) concentration under standard conditions for the raw influent, $C_{inf(std),}$ and treated vapor effluent, $C_{eff(std)}$, using equation 3 and assuming the absolute pressure and temperature at the laboratory (5,200 feet above mean sea level) are 12.4 pounds per square inch (psi) and 70 degrees Fahrenheit (°F), respectively, using the TPH (GRO) effluent concentration calculated above:

Raw Influent:

$$C_{\mathrm{inf}(std)} \ = \ C_{inf} \ \times \ \left(\frac{P_{std}}{P_{lab}} \times \frac{T_{lab}}{T_{std}}\right) = 50{,}044 \ \ \mathrm{\mu g}/L \ \times \ \left(\frac{14.7\, psi}{12.4\, psi} \times \frac{530\ R}{530\ R}\right) = 59{,}327 \ \ \mathrm{\mu g}/L$$

Treated Vapor Effluent:

$$C_{eff(std)} \ = \ C_{eff} \ \times \ \left(\frac{P_{std}}{P_{lab}} \times \frac{T_{lab}}{T_{std}}\right) = 250\, \mathrm{\mu g}/L \ \times \ \left(\frac{14.7\, psi}{12.4\, psi} \times \frac{530\ R}{530\ R}\right) = 297 \ \ \mathrm{\mu g}/L$$

Calculate emissions rates with (treated) and without (raw) oxidizer vapor treatment in pounds per hour (lb/hr) and tons per year (ton/yr) assuming a discharge air flow rate, Q_{out}, of 1,017 scfm:

Emissions(raw) = Q_{out} * $C_{inf(std)}$ = 1,017 scfm * 59,327 µg/L * (28.317 L/ft^3) * (60 min/hr) *

(pound/ 454 grams) * (gram / 10^6 µg) = 226 lb/hr

Emissions(raw) = 226 lb/hr * 8760 hr/yr * ton/2000 lb = 989 ton/yr

Emissions(treated) = Q_{out} * $C_{eff(std)}$ = 1,017 scfm * 297 µg/L * (28.317 L/ft^3) * (60 min/hr) *

(pound/ 454 grams) * (gram / 10^6 µg) = 1.1 lb/hr

Emissions(treated) = 1.1 lb/hr * 8760 hr/yr * ton/2000 lb = 4.9 ton/yr

Project No. DB18.1157

Date 8/6/2021

Subject Emissions calculation

Sheet 4 of 4

By GMH

Checked by JS

Calculation No. DB18.1157-003

The above calculation assumes the system will be run continuously (24-hours per day). The hypothetical individual well concentrations also represent what would be taken in by the system during initial operations. Over time with consistent system operation, influent concentrations typically drop significantly.

The values above represent hypothetical emissions at startup; actual emissions will ultimately decrease over time as the system operates. If the process air stream is treated with an oxidizer, this calculation shows that treated soil vapor will be below the New Mexico Environment Department's air permitting standards of 10 lb/hr and 10 ton/yr, while the untreated raw vapor TPH (GRO) exceeds these values by almost two orders of magnitude. Hypothetical emissions for other monitored VOCs, including benzene, toluene, ethylbenzene, and total xylenes, are presented in the attached table and are below the regulatory limits with and without oxidizer treatment.

Hypothetical Emissions Analysis
Based onSVE Pilot Test Analytical Organic Chemistry Data for Soil Vapor
Former Y, Clovis, New Mexico

Estimated Influent Concentrations	**Benzene**	**TPH (GRO)**
Average Raw Influent from SVE Pilot Test (µg/L)	590	50044
Average Raw Influent from SVE Pilot Test at STP (µg/L)	699	59327
Hypothetical Emissions		
Assumed Vapor Treatment Equipment Destruction Efficiency:	0.0%	
Raw Effluent (µg/L)	590	50044
Raw Effluent at STP (µg/L)	699	59327
Average Raw Effluent (lb/hr)	2.7	226
Average Raw Effluent (ton/yr)	11.7	990
Hypothetical Emissions		
Assumed Vapor Treatment Equipment Destruction Efficiency:	99.0%	
Treated Effluent (µg/L)	5.9	500
Treated Effluent at STP (µg/L)	7.0	593
Average Treated Effluent (lb/hr)	0.03	2.3
Average Treated Effluent (ton/yr)	0.12	9.9
Hypothetical Emissions		
Assumed Vapor Treatment Equipment Destruction Efficiency:	99.5%	
Treated Effluent (µg/L)	2.9	250
Treated Effluent at STP (µg/L)	3.5	297
Average Treated Effluent (lb/hr)	0.01	1.1
Average Treated Effluent (ton/yr)	0.06	4.9

TPH (GRO) = Total Petroleum Hydrocarbons gasoline range organics

Estimated Flow (SCFM)
1017

Estimated Flow (ACFM)
1206

Conversions

453.59	gram / lb
1000000	ug / gram
60	min / hr
28.3	liter / cubic foot
8760	hr/yr
2000	lb/ton

Flow Conversions

12.4	absolute air pressure at 5200 ft msl (Lab in Albuquerque)
14.7	absolute air pressure at 0 ft msl
70	°F, standard temperature
70	°F, assumed lab temperature
460	°R

Vapor Concentration Calculations:

Pilot Test Well	Benzene µg/l	TPH GRO µg/l
BW-1s	2.4	1020
BW-1i	480	27800
BW-1d	790	40500
BW-4d	240	23600
BW-5d	2400	191000
BW-7d	840	82500
BW-8s	72	5100
BW-8i	610	69500
BW-8d	830	85000
BW-9s	7.7	485
BW-9i	7.4	591
BW-9d	1.6	150
Extended Investigation, 2016		
Pilot Test, 2012, higher values		

NOTE:
Site investgation vapor concentrations for the above wells are used to infer expected influent concentrations in the remediation wells. Assumptions are made based on well proximity and professional judgment.

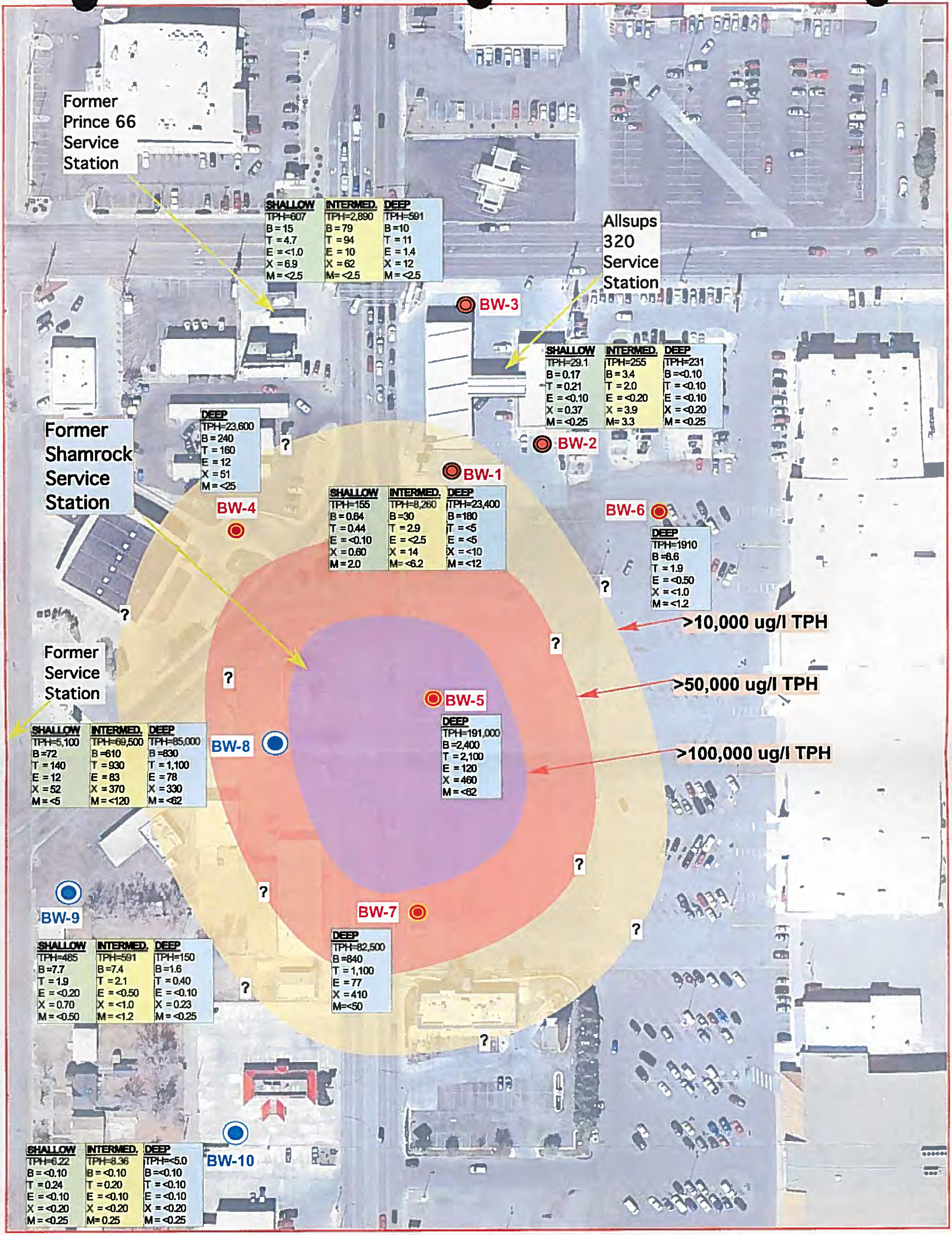
Well	Well Diameter (inches)	Extracted Air Flow (scfm)	Benzene µg/l	TPH GRO µg/l
Source Area Wells				
RW-1	2	60	25	2,000
	2	40	500	40,000
	4	65	1000	75,000
RW-2	2	60	75	5,000
	2	60	650	70,000
	4	40	1000	100,000
RW-3	2	60	60	4,000
	2	60	900	60,000
	4	40	2500	175,000
RW-4	2	60	50	3,000
	2	60	750	50,000
	4	39	2000	150,000
BW-8	2	60	70	5,000
	2	60	600	70,000
	4	42	800	85,000
Downgradient Wells				
BW-7R	5	42	850	85,000
MW-11	5	42	200	20,000
MW-12	5	44	400	50,000
MW-16	5	42	200	20,000
Total flow		976		
Contingency Well				
MW-13	5	41	50	10,000

		Weighted Avg Concentration	
Well	Total Extracted Air Flow (scfm)	Benzene µg/l	TPH GRO µg/l
RW-1	165	524	39,970
RW-2	160	522	53,125
RW-3	160	985	67,750
RW-4	159	792	56,792
BW-8	162	456	49,815
BW-7R	42	850	85,000
MW-11	42	200	20,000
MW-12	44	400	50,000
MW-16	42	200	20,000
MW-13	41	50	10,000
total flow:	1017	590	50,044

TABLE 4
SUMMARY OF SVE LABORATORY ANALYTICAL DATA
ALLSUPS #320 FACILITY CLOVIS, NEW MEXICO

SAMPLE ID		BTEX/TPH						FIXED GASES		
PILOT TEST WELL (SAMPLE I.D.)	DATE	BENZENE ug/l	TOLUENE ug/l	ETHYL BENZENE ug/l	TOTAL XYLENES ug/l	BTEX (total) ug/l	TPH GRO C5-C14 ug/l	OXYGEN MOL%	NITROGEN MOL%	CARBON DIOXIDE MOL%
BW-1s @18:00	10/15/12	2.4	2.8	9.3	6.6	21.1	1,020	5.41	85.89	8.70
BW-1i @ 9:00	10/16/12	480	770	90.0	710	2,050	27,800	3.62	88.03	7.92
BW-1i @ 13:30	10/16/12	1,000	1,500	170	1,300	3,970	56,000	---	---	---
BW-1d @ 15:30	10/16/12	800	320	53.0	240	1,413	40,900	1.73	88.92	8.28
BW-1d @ 22:40	10/16/12	790	400	54.0	230	1,474	40,500	3.22	88.28	7.63
BW-2s @10:40	10/17/12	1.7	4.7	0.72	7.1	14.2	311	---	---	---
BW-2i @ 13:30	10/17/12	22.0	33.0	4.1	45.0	104.1	1,270	---	---	---
BW-2d @ 15:25	10/17/12	140	26	<10	<10	166	10,700	---	---	---
BW-2d @ 22:25	10/17/12	180	39	8.6	37	265	13,300	1.75	89.19	8.83
BW-2d @ 7:25	10/18/12	190	43	8.9	37	279	14,000	---	---	---
BW-3s @ 16:20	10/18/12	42	63	9.2	47	161.2	2,330	---	---	---
BW-3i @ 14:00	10/18/12	230	570	84	440	1,324.0	15,900	---	---	---
BW-3d @ 12:05	10/18/12	80	180	26.0	130	416.0	7,270	---	---	---

SVE pilot test lab data



SHALLOW	INTERMED.	DEEP
TPH=607	TPH=2,890	TPH=591
B = 15	B = 79	B = 10
T = 4.7	T = 94	T = 11
E = <1.0	E = 10	E = 1.4
X = 6.9	X = 62	X = 12
M = <2.5	M= <2.5	M = <2.5

SHALLOW	INTERMED.	DEEP
TPH=29.1	TPH=255	TPH=231
B = 0.17	B = 3.4	B =<0.10
T = 0.21	T = 2.0	T = <0.10
E = <0.10	E = <0.20	E = <0.10
X = 0.37	X = 3.9	X = <0.20
M = <0.25	M= 3.3	M = <0.25

DEEP
TPH=23,600
B = 240
T = 160
E = 12
X = 51
M = <25

SHALLOW	INTERMED.	DEEP
TPH=155	TPH=8,260	TPH=23,400
B = 0.64	B =30	B =180
T = 0.44	T = 2.9	T = <5
E = <0.10	E = <2.5	E = <5
X = 0.60	X = 14	X = <10
M = 2.0	M= <6.2	M = <12

DEEP
TPH=1910
B =8.6
T = 1.9
E = <0.50
X = <1.0
M = <1.2

SHALLOW	INTERMED.	DEEP
TPH=5,100	TPH=69,500	TPH=85,000
B =72	B =610	B =830
T = 140	T = 930	T = 1,100
E = 12	E = 83	E = 78
X = 52	X = 370	X = 330
M = <5	M = <120	M = <62

DEEP
TPH=191,000
B =2,400
T = 2,100
E = 120
X = 460
M = <62

SHALLOW	INTERMED.	DEEP
TPH=485	TPH=591	TPH=150
B =7.7	B =7.4	B =1.6
T = 1.9	T = 2.1	T = 0.40
E = <0.20	E = <0.50	E = <0.10
X = 0.70	X = <1.0	X = 0.23
M = <0.50	M = <1.2	M = <0.25

DEEP
TPH=82,500
B =840
T = 1,100
E = 77
X = 410
M=<50

SHALLOW	INTERMED.	DEEP
TPH=6.22	TPH=8.36	TPH=<5.0
B = <0.10	B = <0.10	B =<0.10
T = 0.24	T = 0.20	T = <0.10
E = <0.10	E = <0.10	E = <0.10
X = <0.20	X = <0.20	X = <0.20
M = <0.25	M= 0.25	M = <0.25

EXPLANATION

BW-6 ◎ Single Completion Monitor Well Location

BW-3 ◎ Nested Monitor Well Location

BW-10 ● NEWLY INSTALLED MULTIPLE COMPLETION WELL

10,000 Total Petroleum Hydrocarbon (TPH) Vapor Isoncontour (in micrograms/liter (ug/l)

Laboratory Vapor Results (in micrograms/liter (ug/l)

DEEP	WELL SCREEN LOCATION
TPH=85,000	TPH=total petroleum hydrocarbons
B =830	B =benzene
T = 1,100	T = toluene
E = 76	E = ethyl benzene
X = 330	X = total xylenes
M = <62	M = MTBE

0 100 ft
Scale

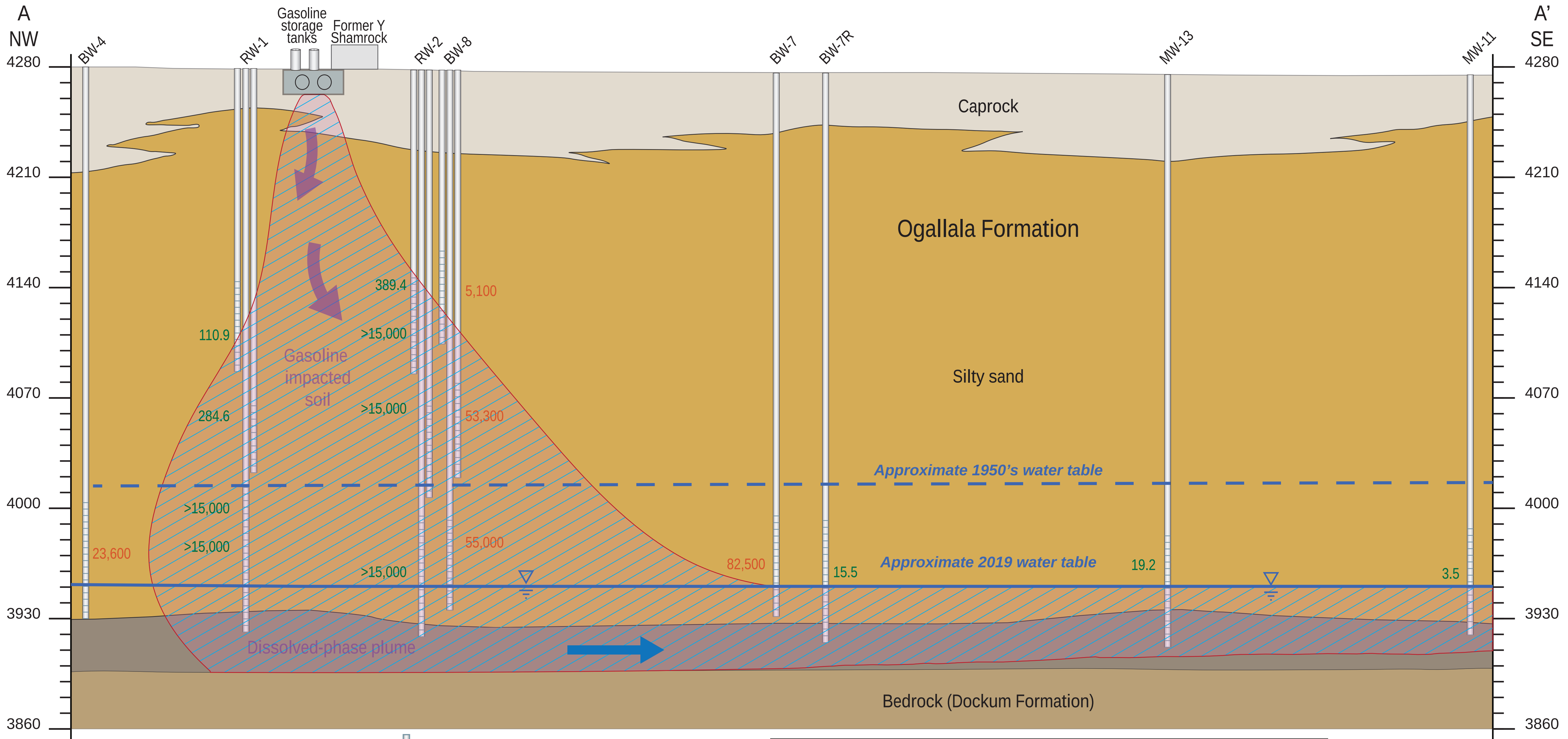
NORTH

DEEP ZONE TPH VAPOR CONCENTRATIONS IN MONITOR WELLS 1/14/16

Prince and Commerce Site - Clovis, New Mexico

BROWN ENVIRONMENTAL, INC.
P.O. Box 886 Placitas, NM 87043

Drawn by:	WJB	5/16	Client: Allsups/NMED
Drafted by:	EMB	5/16	Job #1070
Reviewed by:	WJB	5/16	FIGURE 5



0' 70'

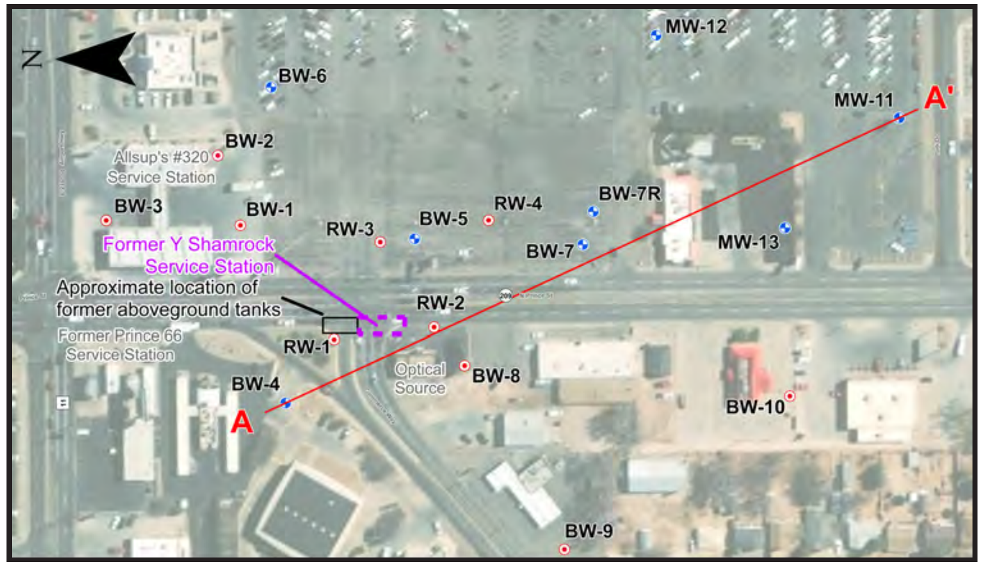
Explanation

- 🔵 Single completion monitor well
- ⦿ Nested monitor well
- ╲ Cross section A - A'
- 389.4 Field vapor concentration (ppmv)
- 23,600 TPH vapor concentration (µg/L)
- - - Approximate historical water table
- — Approximate 2019 water table
- ▨ Hydrocarbon impacted area
- ➜ Contaminant flow direction
- ➜ Groundwater flow direction

- Monitor well
- Well screen
- Former gasoline storage tank
- ○○ Underground storage tank (UST)
- ☐ Building

Geology

- Caprock (Ogallala Formation)
- Ogallala Formation
- Clayey sand and gravel
- Bedrock (Dockum Formation)



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Daniel B. Stephens & Associates, Inc.
11/14/2019 DB18.1157

FORMER Y STATION
STATE LEAD SITE
CLOVIS, NEW MEXICO
Geologic Cross Secton

Figure 3

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

1422 Indianhead Drive E
Menomonie, WI 54751 USA
Phone: 715-233-6115
Fax: 715-232-0669
E-Mail: jstrey@intellishare-env.com
Website: www.intellishare-env.com

Date: 6/10/21

ISE Proposal No: N-21-2318
Client Project ID: Clovis, NM

Proposal For: Tom Golden
DB Stephens

Phone:
Fax:
E-Mail:

Proposed Solution: Model 1000 CFM Thermal Oxidizer

Intellishare Environmental specializes in the engineering and manufacturing of clean air solutions for the environmental remediation industry. We offer new, used, rental and lease programs to fit any budget or application.

Thank you for the opportunity to provide the following proposal for your project. At Intellishare Environmental, every client is important. Please contact me with any additional questions you may have regarding this information.

Kind Regards,

John Strey
Principal

Oxidizer Process Information

Process Air Flow:	1000 SCFM
Maximum Air Flow Capacity:	1000 SCFM
Minimum Air Flow:	250 SCFM
Max Gas Pre-Heater Input:	2,500,000 @ 1000 CFM
Recommended NG Gas Supply	3000 CFH @ 5 psig, Max 7 psig
Min Thermal/Cat Operating Temperature:	1400/650 degrees F.
Avg Thermal/Cat Operating Temperature:	1450/750 degrees F.
Max Therma/Catl Operating Temperature:	1800/1100 degrees F.
Estimated Destruction Efficiency:	>99%
Estimated Catalyst Destruction Efficiency:	>98%
Catalyst Volume:	1.4 cubic feet
Catalyst Type:	400 cell Metal Monolith
Time to Reach Operating Temperature:	15 minutes from cold start
Inlet Connection:	8” 150# Flanged
Foot Print:	W=7’, L=15’, H=8’
Stack Height:	15’ AGL
Weight:	6000 lbs
Electrical Voltage:	460/3/60
Electrical Amperage:	20
Site Elevation	4700’ msl

Equipment Specification

Reactor: The reactor housing will be constructed of 7 gauge rolled steel. The Inlet and outlet connections are flanged. . The exterior is painted standard ISE gray.

High Temperature Refractory: All internal reactor surfaces are completely insulated with a ceramic insulation media rated for 2200 deg F. A coating is applied to the insulation to increase the mechanical integrity and extend the life of the insulation.

Gas Pre-Heater: The unit will come equipped as standard with a direct gas fired primary air burner with 3 HP combustion air blower.

Fuel Gas Piping Assembly: The fuel gas piping assembly is pre-piped. The gas train will meet all code requirements and is suitable for FM approval. All components are rated for outdoor operation and continuous use.

Main Control Panel: The main control panel shall be NEMA 4 construction and shall be pre-wired to all components. The PLC based control panel features alarm detection and an hour meter to record run time. Temperature control will be provided with approved temperature control devices and limit switches. The control panel shall be UL labeled and listed as an assembly.

Flame Arrestor: A flame arrestor will be supplied and mounted to the inlet of the oxidizer and utilized to prevent flame propagation to the source. A spiral crimped aluminum element shall be removable for inspection and cleaning.

Purge/Automatic Dilution Control: A purge and dilution valve control assembly with C1, D2, GD actuator will be mounted between the VLS and MPE blower. Once the fresh air purge is complete the dilution control will be enabled. The oxidizer outlet temperature controller, included in the control cabinet, is wired to automatically modulate the electric actuator and control the dilution air valve when VOC concentrations exceed the temperature set-point.

Process Isolation Valve: A control valve assembly with C1, D2, GD actuator will be mounted between the VLS and MPE blower. Once the fresh air purge is complete the process control will be enabled. The oxidizer outlet temperature controller, included in the control cabinet, is wired to automatically modulate the electric actuator and control the process air valve when VOC concentrations exceed the temperature set-point.

Exhaust Stack: A stainless steel exhaust stack will be supplied and shall terminate at 15’ above grade level (AGL). The exhaust stack will be equipped with sample ports for field testing.

Table 1. Proposed Remediation Wells
Former Y Station State Lead Site, Clovis, New Mexico

Well	Well Diameter (inches)	Well Screen (feet bgs)	Depth to Water (feet btoc)	Open Well Screen (feet)	Extracted Air Flow (scfm)	Available Drawdown (feet)	Design Pumping Rate (gpm)
Source area wells							
RW-1	2	135.0–195.0	NA	60	60		
	2	215.0–255.0	NA	40	40		
	4	264.9–355.3	330	65	65	25	2.0
RW-2	2	135.0–195.0	NA	60	60		
	2	215.0–275.0	NA	60	60		
	4	289.8–360.1	330	40	40	30	2.0
RW-3	2	135.4–195.4	NA	60	60		
	2	215.0–275.0	NA	60	60		
	4	289.3–359.5	329	40	40	30	2.0
RW-4	2	134.9–194.9	NA	60	60		
	2	214.9–274.9	NA	60	60		
	4	291.2–361.5	330	39	39	31	2.0
BW-8	2	115–175	NA	60	60		
	2	200–260	NA	60	60		
	4	287–347	329	42	42	18	0.0
Downgradient wells							
BW-7R	5	286.8–357.1	329	42	42	28	2.0
MW-11	5	285.5–355.5	327	42	42	28	4.0
MW-12	5	286.5–356.7	330	44	44	26	2.0
MW-16	5	289.0–359.3	330	42	42	28	4.0
				Total	976		20.0
Contingency well							
MW-13	5	287.0–357.0	328	41	41	29	2.0

Note: Depth to water is based on March 2021 data and rounded up to the nearest foot.

bgs = Below ground surface
btoc = Below top of the well casing
scfm = Standard cubic feet per minute
gpml = Gallons per minute
NA = Not applicable

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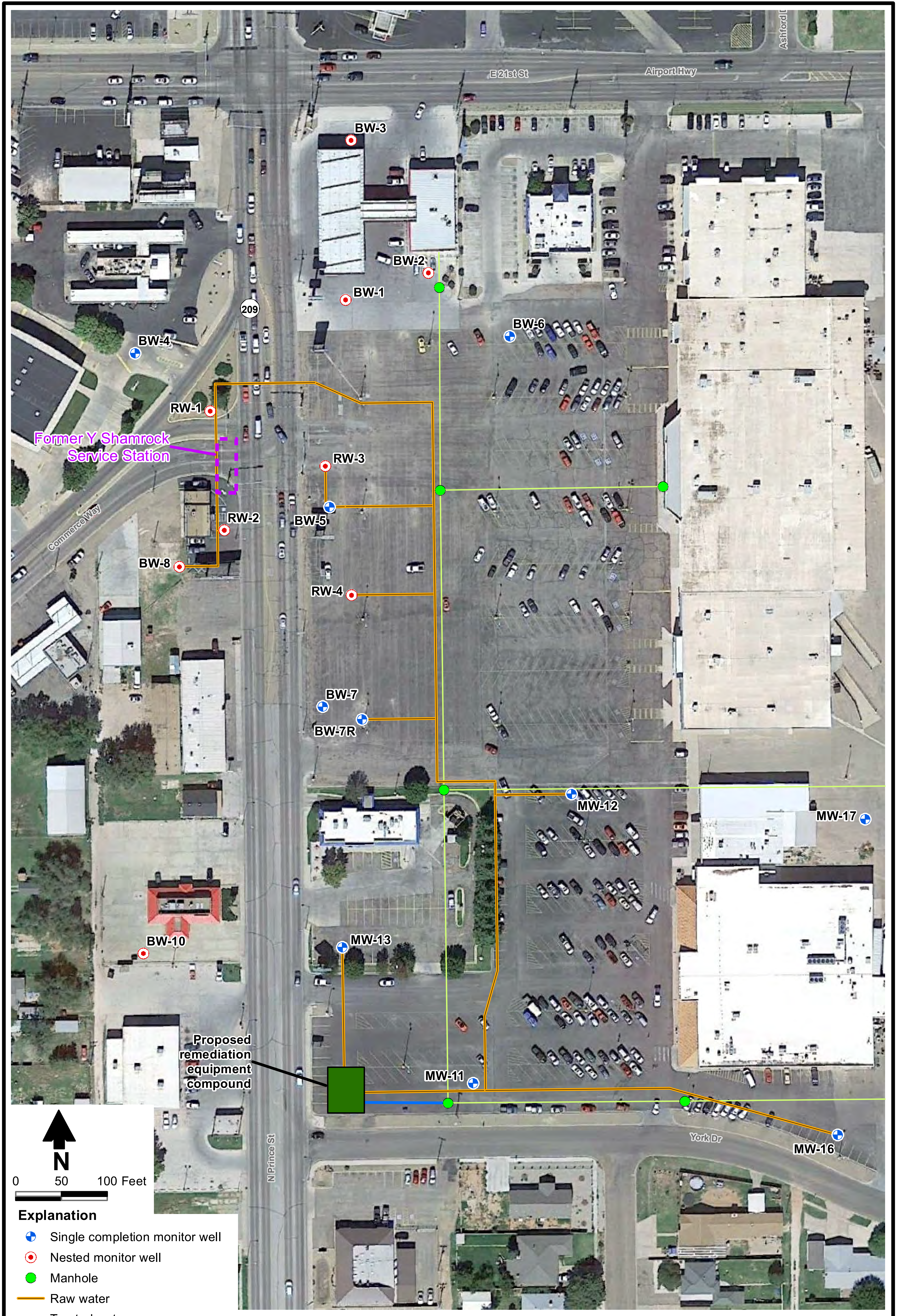


Figure 10

FORMER Y STATION STATE LEAD SITE
721 COMMERCE WAY
CLOVIS, NEW MEXICO

Proposed Remediation System Layout

Daniel B. Stephens & Associates, Inc.
5/13/2021
JN DB17.1228.PR

Appendix E

Product Cut Sheets

H2K Technologies, Inc.

7550 Commerce St.
Corcoran, MN 55340
Office: 763-746-9900
Fax: 763-746-9903
www.H2KTech.com

July 7, 2021

To: Thomas Golden, P.E.
Daniel B. Stephens & Associates, Inc.
12303 Technology Blvd., Suite 930D
Austin, TX 78727
(512) 821-2765
Email: tgolden@geo-logic.com

Project Name:	Former Y station – SVE/GWTS system
Project Location:	Clovis, NM
Quote Number:	5513B

Dear Tom,
Below is a quote you requested for the above referenced project. Quote is per the specifications with exceptions as noted. We appreciate the opportunity to bid on this project, please call or email with any questions.

Treatment Description

Flow	20 gpm avg

VOC's (ug/l)

Benzene	17,000 ug/l max
Naphthalene	570 ug/l max

Treatment Methodology
A combined treatment unit which combines an oil/water separator, with a diffused aerator and inclined plate clarifier. First an oil/water separator/ grit chamber will remove any free product and/or TSS solids that may settle. Then a diffused aerator will provide 98.4% removal of all BTEX compounds and 85% removal of Naphthalene at 20 gpm, while also providing oxygen to oxidize the Ferric to Ferrous iron and allow it to precipitate in the clarifier. The diffused aerator allows the system to run in heavy fouling conditions from the precipitation of TDS, including hardness and Fe while maintaining operation and not losing removal efficiency.

The non-fouling aerator will also strip the CO2 thereby raising the pH and lowering the hardness/alkalinity to allow it to precipitate out in the clarifier before reaching the discharge piping to sanitary sewer.

Description/Pricing

SVE

(1) Air dilution intake line
- 4" PVC butterfly valve
- 4" Filter/silencer, Solberg FS-365P-400

(1) Moisture separator, H2K model VLS-220
- Welded steel construction with external enamel finish
- Tangential inlet and demister for 99%+ moisture removal
- 30" Dia x 72" high vertical tank
- 220 gallon total capacity, 55 gallon liquid holding capacity
- Full vacuum design rating
- Epoxy lined, enamel exterior finish
- PVC site glass with ss low/high/high-high level switch assembly and union for easy removal

Polypropylene demister element
Acquiescence plate to isolate condensate water from turbulent airflow
1” Brass drain valve
6” plate flange inlet and outlet connections
6” Plate flanged cleanout port
Sloped bottom for solids removal
Vacuum gage on separator inlet & outlet, 0-100 “wc vacuum
Sample port on separator intake
Integral filter element inside of moisture separator with access manway for easy replacement

(1) Isolation and Purge/Bleed vapor control valves, mounted on vacuum side of blowers, controlled by oxidizer
Supplied by others

(1) Condensate pump, Moyno 356-01 progressive cavity pump
2 hp, 208-240/460 VAC, 3Ø, TEFC motor
20 gpm at 25 psi differential pressure
Carbon steel housing and rotor, NBR rubber stator
(1) 1” Ball valve on pump inlet
(1) 1” Check valve on pump discharge
(1) 1” Gate valve on pump discharge
Pressure gage on pump discharge
Pump re-circulation with 1” gate valve
Sample port on pump discharge

(1) Vacuum transmitter prior to SVE blower, Foxboro Series IDP10

(1) Rotary Lobe Blower, Sutorbilt Legend 7L
1,000 scfm at 85” wc vacuum, at 4295 ft elevation (1,495 icfm at blower inlet)
Flexible couplings for vibration isolation on blower inlet and outlet
40 HP, 208-240/460 VAC, 3Ø, TEFC motor
Motor mounted on adjustable sliding base
V belt drive with OSHA belt guard - Brass belt guard cage
Discharge silencer/stand
Inlet silencer combined reactive/absorbtive premium
Vacuum relief valve on blower intake
8” CI butterfly valve on intake and discharge
Pressure gauge on blower discharge
Pressure relief valve on blower discharge. Kunkle
Sample port on discharge

(1) Flow transmitter on SVE blower discharge, Foxboro Series IDP10 transmitter with averaging pitot tube

Water Treatment Equipment

(5) 5” Wells - Submersible well pumps Grundfos model SP 5S10-22 w/ 480VAC 3 phase motor
1 hp 480VAC, 3Ø oil sealed motor
304 stainless steel case and impellers
4” pump, 18 stages, 1" NPT outlet
2 gpm to 4 gpm at 435' TDH
(400’) three wire neoprene insulated downwell cable with motor gland

(4) 4" Wells - Submersible well pumps Grundfos model 5SQ05- 320 with 220VAC 1 phase motor
Integral soft start with protection from low voltage, lightening, and dry-run,
¾ hp 220VAC, 1Ø oil sealed motor
304 stainless steel case and impellers
3” pump, 18 stages, 1" NPT outlet

2 gpm at 435' TDH
(400') two wire neoprene insulated downwell cable with motor gland

(9) Submersible level transmitters, KPSI or equal with 400' vented cable
316 stainless steel, 4-20 mADC output

(9) water flow totalizers with pulse output for total volume
Brass turbine or nutating disk meter

(1) H2K Technologies model LLS8, oil/water separator
304 stainless steel construction
100% removal of 20 micron & larger droplets at 25 gpm w/ SG=0.75
PVC slant rib coalescing media
Adjustable skimming weir
Gravity drain from skimmer into product holding tank
Solids collection sump
Clearwell for pumping directly from separator
PVC site glass with ss low, high & high-high pump out level switch assembly, union mounted
Vapor tight gasketed cover, Buna-N Gasket
1" PVC vent line, plumbed to exterior
2" Brass ball valve, clearwell drain
Sample port on inlet
2" PVC ball valve on discharge

(1) Product storage tank, 300 gallon, UL 142 double wall tank (OUTSIDE OF ENCLOSURE)
Welded steel horizontal tank with enamel external finish
38.5" dia. x 68" long horizontal tank
High/high and high level switches
Normal vent with riser pipe
Emergency vent
Check valve and isolation valve on product inlet
120 VAC heat trace for class I, Div 1 hazardous location
1" polyurethane insulation, UV resistant, R-7 on tank

(1) H2K Technologies model DTA-3 Diffused Aeration Tank, each including:
304 Stainless steel welded construction
(3) Aeration chambers
(15) Non-fouling 304 Stainless Steel aeration diffusers
Quick connections for easy lateral removal
Counter current water and air flow to provide maximum flow path across each aeration chamber
Hinged 304 Stainless steel cover
Provides easy access to aeration chambers and diffusers
Off gas nozzle with polypropylene demister element
(1) Pump out clearwell
Site glass with ss high/high-high-low pump out level switches
Unit will be stand mounted to allow gravity drain from oil/water separator thru DTA into clarifier
Welded steel stand with enamel finish, walking platform for access into DTA for cleaning

Note: Unit will remove 94% BTEX compounds and 50% of Napthalene at 20 gpm.

(1) FPZ model K05-MS single stage regenerative blower
90 cfm @ 80" wc
4 hp, 230/460VAC 3 ph, TEFC motor
Aluminum wheel and housing
Interconnecting ducting to diffused air inlet
High & Low blower pressure switches

(1) H2K Technologies model IPC-80, inclined plate clarifier
    304 stainless steel construction
    90% removal of 20 micron & larger solids 20 gpm
    PVC slant tube coalescing media
    Adjustable skimming weir
    Solids collection sump
    Clearwell for pumping directly from clarifier
    PVC site glass with ss low, high & high-high pump out level switch assembly, union mounted
    Vapor tight gasketed cover, Buna-N Gasket
    1" PVC vent line, plumbed to exterior
    2" Brass ball valve, clearwell drain
    Sample port on inlet
    2" PVC ball valve on discharge

(1) Access platform and steps to allow easy access into OWS, DTA, IPC
    Welded steel with bar grating, urethane finish

(1) Discharge pump, AMT model 489
    20 gpm @ 54' TDH
    Cast iron bronze fitted
    3/4 HP, 208-230/460VAC, 3Ø, TEFC motor
    2" PVC Isolation ball valve on inlet
    1" Brass ball valve on discharge
    1" Brass Check valve on pump discharge
    Sample port on pump discharge
    Pressure gage on pump discharge, ss, liquid filled

(1) Flow totalizer, total gallons, with pulse output

(1) Pressure switch on discharge, Barksdale model D1T

(1) Siphon break on discharge of vessels

(1) Pressure transmitter on discharge, Foxboro IDP-10 DP transmitter,
    4-20 mADC output, loop powered, local LCD display, NEMA 4X, Class I, Div 2 rated

Controls

(1) Control Panel
For operation on 480 VAC, 3Ø, 100 Amp incoming electrical service. To control (1) 40 hp SVE blower, (1) 5 HP air stripper blower, (2) pumps. To be mounted and wired on the enclosure exterior wall. To include:

QTY	DESCRIPTION
1	Enclosure, NEMA 4, 36"h, 36"w, 12"d with inner door mounted switches and indicators
1	Enclosure vent fan with thermostat and inlet/outlet louvers
1	Allen Bradley Micrologix 1400 PLC, with input & output as required for system operation
1	8" Color operator interface terminal, with embedded web browser for local & remote viewing of system status & alarms
1	Industrial cell modem for remote access and alarm callout Ethernet switch for tie in to Intellishare panel by ethernet cable to allow communications by cellular modem
12	Switch; three position; Hand-Off-Auto
1	Light (red/LED); alarms, individual alarms called out on interface
1	Pushbutton (red/NO); alarm Reset flow totalizing transmit
5	Motor run time meters
2	Emergency stop button on panel door and in treatment room

1 VFD, 40 hp 480 VAC with remote keypad for SVE blower
5 VFD, 1 hp 480 VAC with remote pad for well pumps
1 Motor starter: Contactor 11A FLA/Overload relay 6-11A, 3Ø; AS Blower
6 Motor starter: Contactor 6A FLA/Overload relay 3-6A, 3Ø; pumps
2 Motor starter: Contactor 23A FLA3Ø; heaters
Engraved laminated legends for all door mounted devices
Terminal blocks for external connections and fusing as required
Color-coded wiring with wire markers at all terminations
Fully documented, assembled, wired, programmed and pre-shipment test
1 UL 508 serialized label
Relay logic and timers as required
Engraved laminated legends for all door mounted devices
Terminal blocks for external connections and fusing as required
Color-coded wiring with wire markers at all terminations
Fully documented, assembled, wired, programmed and pre-shipment test
1 UL 698A serialized label

1 480 VAC panelboard with 100 A main breaker, to include:
  1 Circuit breaker 480V 3P100A 10K; main breaker
  1 Circuit breaker 480V 3P30A 10K; SVE blower
  1 Circuit breaker 480V 3P10A 10K; AS Blower
  2 Circuit breaker 480V 3P10A 10K; pumps
  1 Circuit breaker 480V 2P15A 10K; Heater
  1 Circuit breaker 480V 2P40A 10K; single phase /control power transformer

1 120/240 VAC panelboard with 100 A main breaker, to include:
  1 Circuit breaker 240V 3P100A 10K; main breaker
  9 Circuit breaker 240V 3P10A 10K; pumps
  1 Circuit breaker 120V 1P10A 10K; control power
  2 Circuit breaker 120V 1P10A 10K; Vent fan, lights

Enclosure

(2) Modified Cargo box enclosure system, 8' wide x 20' long x 9'6" high (high cube) outside dimension
Includes equipment installation and wiring
Welded steel Sea container with 2" fir decking
Floor sealed with non-skid bed liner
Exterior painted as required to match existing color
R-13 Insulation walls and ceiling with 2x4 furring and plywood interior
Floor box or wall penetrations for incoming and outgoing lines as needed
Anchor lugs and lifting eyes
Double rear doors with cam lock
(2) 48" x 8' double insulated steel access door on other end
Sound insulated louver covers for vent air intake and exhaust louvers
Mounting of all equipment
Spray urethane insulation under cargo box
2" Containment lip around interior of building (approx. 280 gallons total volume)
(1) Floor sump w/ high level switch
(2) Wall mounted electric convection heater with thermostat, 3600 Watt
(4) Ceiling mounted lights with vapor globe and wall switch
(1) 12" vent fan with inlet & outlet louvers, wall-mount cabinet, and thermostat

GWTS and SVE will be installed, piped and wired in separate enclosures, control panel will be mounted and wired on outside or inside of SVE enclosure. Piping will be schedule Schedule 80 PVC for water. Wiring will be per NEC for non-classified area inside and outside of enclosure.

Note:
H2K Technologies will provide (3) submittals with all equipment including plot & elevation drawings, wiring schematics, manufacturers cut sheets, modeling data, & O&M manuals as required.

Notes:

1. Sales tax is not included in this quote, but will be added to the invoice if a tax exempt certificate is not provided.

2. An NRTL system inspection of equipment installation and wiring was not requested and is not included with this quote. If this is deemed necessary by local inspectors, add $3,900.00 to this quote.

3. Panel starter/interrupt components will be rated for 10K AIC minimum, if higher rating is needed there may be an additional charge.

General Conditions

1. Terms of payment to be 35% upon order, balance not exceed 90 days from invoice date.

2. Proposal and pricing valid for 30 days from the date of this proposal.

3. This proposal and pricing are based on our interpretation of the specifications & P&ID's provided at the time of bid only. We reserve the right to review any and all written specifications and drawings that may apply to this equipment before accepting or stating that the equipment meets specifications at time of order, otherwise equipment is bid as quoted only.

4. H2K Technologies will not initiate work without a fully executed contract or purchase order. Fabrication will not be initiated until complete submittal approvals have been received.

5. Submittals will be provided within two weeks of receipt of a fully executed contract or P.O.

6. Equipment can generally be shipped within 9-12 weeks after receipt of completely approved submittals. Lead time will be updated at the time of order execution.

7. Shipping charges are not included in the prices quoted unless explicitly stated in the proposal. Actual freight costs will be pre-paid and added to the invoice.

8. The price quoted does not include sales tax. State and local sales and use tax will be added to the invoice, unless a valid sales/use tax exemption certificate is supplied with the contract or purchase order for this project. Exemption certificates must be supplied at the time of order.

If you have any questions or comments concerning this information, please feel free to give me a call at 763-746-9900. Thank you for the opportunity to bid on this project.

Sincerely,

Garth Hoffelt

INTELLISHARE ENVIRONMENTAL
CLEAN AIR SOLUTIONS

1422 Indianhead Drive E
Menomonie, WI 54751 USA
Phone: 715-233-6115
Fax: 715-232-0669
E-Mail: jstrey@intellishare-env.com
Website: www.intellishare-env.com

Date: 6/10/21

ISE Proposal No: N-21-2318
Client Project ID: Clovis, NM

Proposal For: Tom Golden
DB Stephens

Phone:
Fax:
E-Mail:

Proposed Solution: Model 1000 CFM Thermal Oxidizer

Intellishare Environmental specializes in the engineering and manufacturing of clean air solutions for the environmental remediation industry. We offer new, used, rental and lease programs to fit any budget or application.

Thank you for the opportunity to provide the following proposal for your project. At Intellishare Environmental, every client is important. Please contact me with any additional questions you may have regarding this information.

Kind Regards,

John Strey
Principal

Oxidizer Process Information

- Process Air Flow: 1000 SCFM
- Maximum Air Flow Capacity: 1000 SCFM
- Minimum Air Flow: 250 SCFM
- Max Gas Pre-Heater Input: 2,500,000 @ 1000 CFM
- Recommended NG Gas Supply 3000 CFH @ 5 psig, Max 7 psig
- Min Thermal/Cat Operating Temperature: 1400/650 degrees F.
- Avg Thermal/Cat Operating Temperature: 1450/750 degrees F.
- Max Therma/Catl Operating Temperature: 1800/1100 degrees F.
- Estimated Destruction Efficiency: >99%
- Estimated Catalyst Destruction Efficiency: >98%
- Catalyst Volume: 1.4 cubic feet
- Catalyst Type: 400 cell Metal Monolith
- Time to Reach Operating Temperature: 15 minutes from cold start
- Inlet Connection: 8” 150# Flanged
- Foot Print: W=7’, L=15’, H=8’
- Stack Height: 15’ AGL
- Weight: 6000 lbs
- Electrical Voltage: 460/3/60
- Electrical Amperage: 20
- Site Elevation 4700’ msl

Equipment Specification

Reactor: The reactor housing will be constructed of 7 gauge rolled steel. The Inlet and outlet connections are flanged. . The exterior is painted standard ISE gray.

High Temperature Refractory: All internal reactor surfaces are completely insulated with a ceramic insulation media rated for 2200 deg F. A coating is applied to the insulation to increase the mechanical integrity and extend the life of the insulation.

Gas Pre-Heater: The unit will come equipped as standard with a direct gas fired primary air burner with 3 HP combustion air blower.

Fuel Gas Piping Assembly: The fuel gas piping assembly is pre-piped. The gas train will meet all code requirements and is suitable for FM approval. All components are rated for outdoor operation and continuous use.

Main Control Panel: The main control panel shall be NEMA 4 construction and shall be pre-wired to all components. The PLC based control panel features alarm detection and an hour meter to record run time. Temperature control will be provided with approved temperature control devices and limit switches. The control panel shall be UL labeled and listed as an assembly.

Flame Arrestor: A flame arrestor will be supplied and mounted to the inlet of the oxidizer and utilized to prevent flame propagation to the source. A spiral crimped aluminum element shall be removable for inspection and cleaning.

Purge/Automatic Dilution Control: A purge and dilution valve control assembly with C1, D2, GD actuator will be mounted between the VLS and MPE blower. Once the fresh air purge is complete the dilution control will be enabled. The oxidizer outlet temperature controller, included in the control cabinet, is wired to automatically modulate the electric actuator and control the dilution air valve when VOC concentrations exceed the temperature set-point.

Process Isolation Valve: A control valve assembly with C1, D2, GD actuator will be mounted between the VLS and MPE blower. Once the fresh air purge is complete the process control will be enabled. The oxidizer outlet temperature controller, included in the control cabinet, is wired to automatically modulate the electric actuator and control the process air valve when VOC concentrations exceed the temperature set-point.

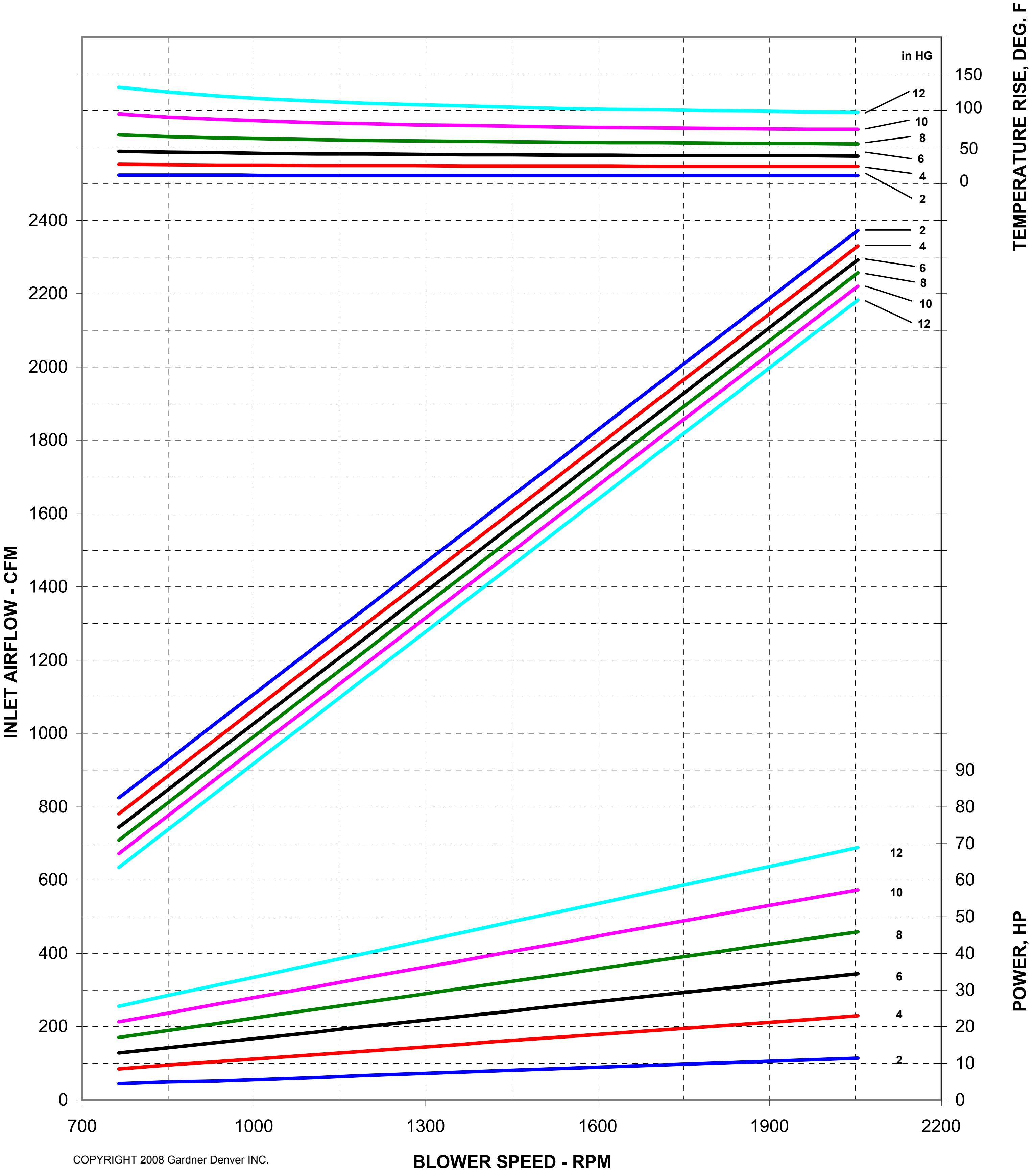
Exhaust Stack: A stainless steel exhaust stack will be supplied and shall terminate at 15’ above grade level (AGL). The exhaust stack will be equipped with sample ports for field testing.

SUTORBILT® LEGEND®
MODEL 7L
P-VERSION GREASE

VACUUM PERFORMANCE CURVE

INLET AIR AT 68 DEG. F, AMBIENT PRESSURE 14.7 PSIA, 36% RH

DISPLACEMENT 1.200 FT^3/REV



Legend® Series

Positive Displacement Blowers & Vacuum Pumps

GARDNER
DENVER

1859 2009

SESQUICENTENNIAL

GARDNER DENVER™

Experience Proven Results™

Sutorbilt Legend Series

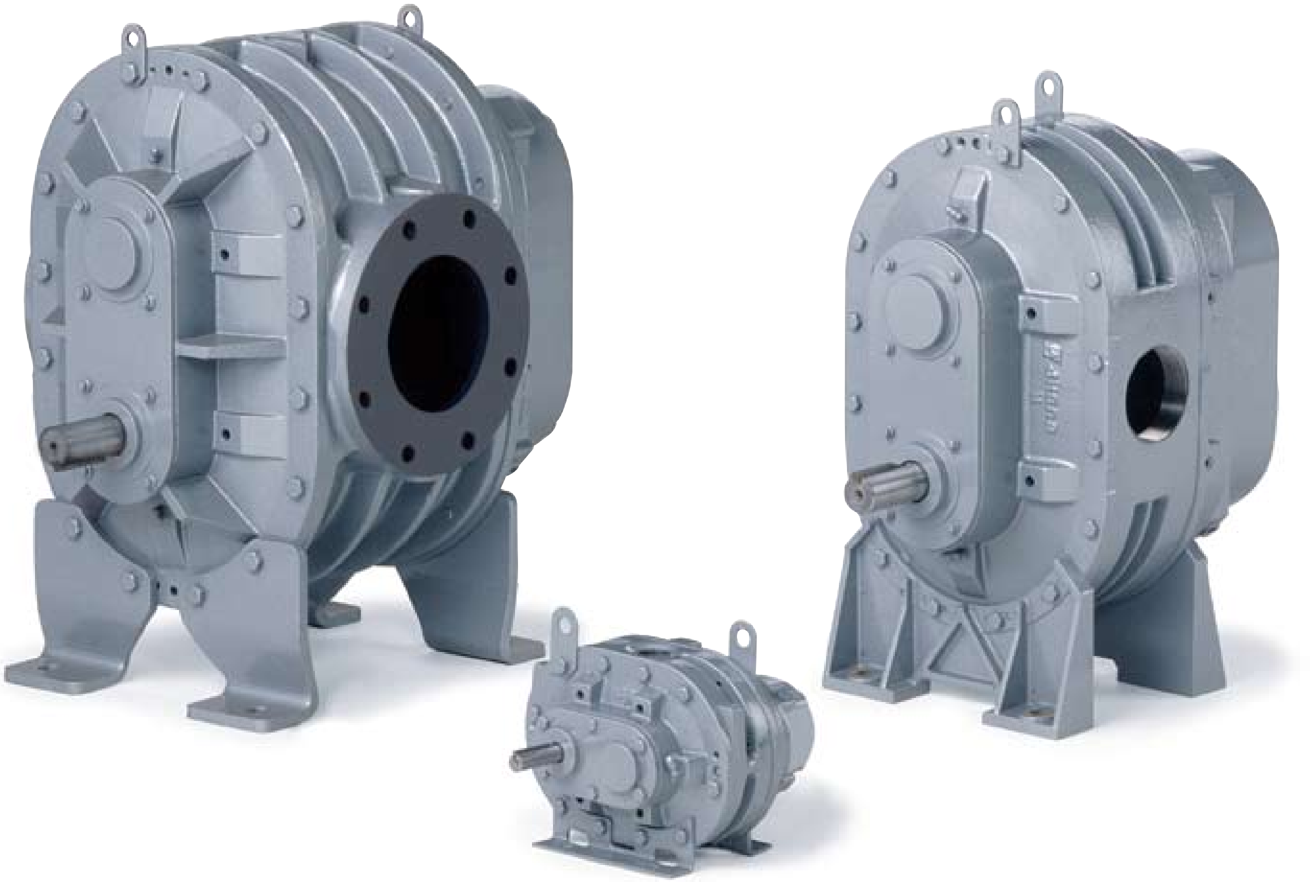
Setting the Industry Standard

The Gardner Denver Sutorbilt® Legend® line of rotary positive displacement lobe blowers and vacuum pumps are the result of more than 150 years experience in the design, manufacture and support of superior industrial equipment.

- Available in 20 sizes with 4 different configurations
- The Legend Series delivers
  - – Pressure to 15 psig
  - – Vacuum to 16" Hg
  - – Flows to 3,015 cfm

Why the Sutorbilt line of blowers and vacuum pumps earned the name "Legend"

- Backed by the most experienced and trusted distributor network in the industry
- Every Sutorbilt Legend blower/vacuum pump is built under rigid ISO 9001:2000 quality standards
- Each Legend is individually tested to meet rigorous performance specifications
- Requested by leading Original Equipment Manufacturers (OEMs) worldwide for a wide range of applications, due to the ability to customize the Legend to their specifications while meeting strict performance requirements
- A Legend is at the heart of an ever-expanding variety of air solutions working every minute of every day around the globe
- Dual Splash Lubricated and Quiet Series (for up to 5 dBA reduction) are available

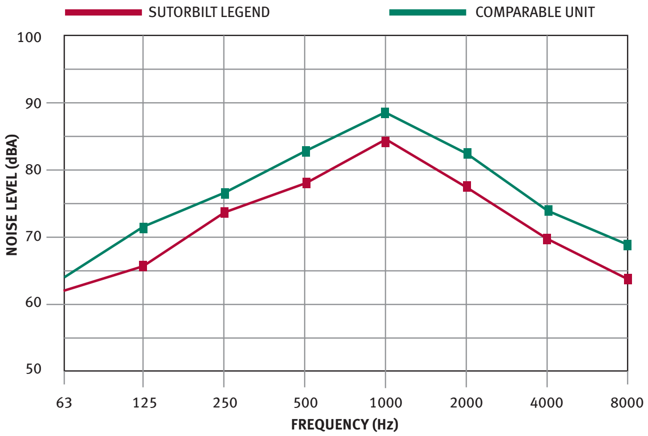


Proven Performance. Global Applications. Local Support.

QUIET OPERATION

The sound data shown below compares the Legend (red) and a comparably sized blower (green) operating at 3,275 rpm and 12 psig.

- Improved blower design reduces the sound pressure output of the Legend blower
- Typical reduction is 3 dBA which represents 50% less noise than the competition



SUPERIOR LOCAL SALES AND SERVICE

- Extensive network of authorized Gardner Denver/ Sutorbilt distributors
- Offers the most convenient local sales and service support in the industry
- Factory trained professionals are experts in blower/ vacuum pump technology
- Providing system installation guidance, troubleshooting and optimization recommendations for new or existing applications

EVEN A "LEGENDARY" WARRANTY

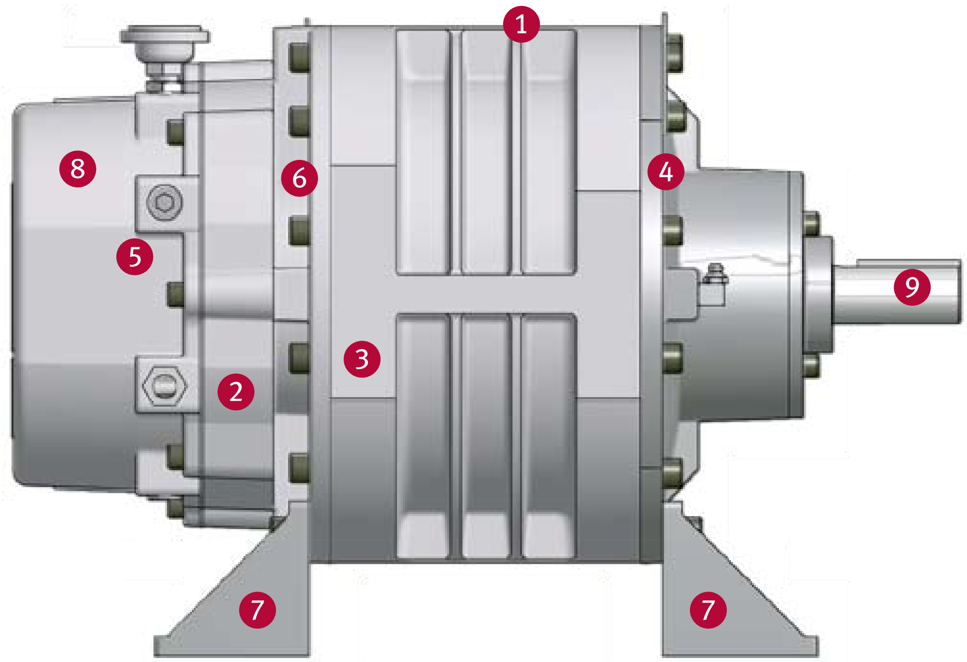
Every Sutorbilt Legend Series blower/vacuum pump is covered by a "Legendary" warranty:

- **24 months** from the date of shipment or
- **18 months** from the date of installation, whichever occurs first

INDUSTRY	APPLICATION
Aquaculture	Aeration
Cement & Lime	Fluidization & Conveying
Chemical	Vacuum Processing & Conveying
Coal Bed/Landfill	Methane Gas Recovery
Dairy	Automated Milking
Dry Bulk Hauling	Trailer Unloading & Aeration
Environmental Services	Sewer Cleaning & Portable Restroom Services
Industrial	Material Vacuuming
Milling & Baking	Blending & Conveying
Oil & Gas	Gas Collection & Sparging
Power Generation	Fly Ash Conveying & Aeration
Process Gas	Gas Boosting
Pulp & Paper	Chip Conveying & Process Vacuum
Resin & Plastic	Processing & Conveying
Soil Remediation	Vacuum Extraction & Sparging
Vacuum Excavation	Potholing & Slurry Recovery
Wastewater	Aeration & Backwashing

The above table illustrates industries which depend upon the Sutorbilt® Legend® to deliver clean, oil-free air to a wide range of global applications.

Legendary Design Features



1 High-strength impeller case is heavily ribbed and machined from a single piece of cast iron and features oversized dowel pins for precise mounting and alignment of head plates

- *Results in reduced noise and more stable, vibration-free operation*

2 Head plates, machined from cast iron, are ground on the interior surface to precise operating tolerances. Bearing fits are machined into head plates to assure exact bearing positioning

- *Ensures accurate, fixed-dimension clearances through all blower operating conditions and temperature ranges*

3 Impellers are machined from cast iron to an exact profile and are permanently fastened to steel shafts. They are dynamically balanced for smooth operation in any assembled position

- *Provides extra strength and rigidity to handle continuous maximum loads without fatigue or deflection*

4 Anti-friction bearings are used exclusively (table at right)

- *Optimum bearing selection provides longer blower life and added overhung shaft load capacity*

Gear diameter	Single row ball	Double row ball	Cylindrical roller	Spherical roller
2"	•			
3–4"	•		•	
5"		•	•	
6–8"		•		•


2MP LHC


3MR RHC


4LVR BHC


5MR RHC

5 3–6" R versions feature improved timing and ease of teardown/rebuild through grip rings, which expand against the bore and compress on the shaft for a secure, mechanical shrink fit

2, 7 and 8" P versions feature precision machines alloy steel timing gears, permanently pinned to the shafts

- *Assures non-slip timing even under the most strenuous loading conditions*

6 High temperature Viton® oil seals

- *Maximizes the seal life in continuous, severe-duty applications to provide leak-free operation*

7 Flex-Mount™ design on 2, 7 and 8" blowers is adaptable to either vertical or horizontal installation, while 3–6" R-version blowers have universal feet

- *The feet are precisely machined and match the footprints of many competitive units*

8 Timing gears and gear end bearings are splash lubricated utilizing an abundant oil reservoir. A non-asbestos graphite gasketed, oil-tight housing encloses the timing gears. Drive end bearings are grease lubricated through fittings. Lip-type seals prevent oil and grease from entering the impeller chamber

- *Superior gear and bearing lubrication is assured at all operating conditions with minimal maintenance*

9 High strength steel drive shaft is extended for V-belt drive or direct connection

- *Provides greater blower durability and installation flexibility*

Available with Mechanical Gas Seals

The Legend design accommodates mechanical gas seals for critical gas applications with proven results based on a large installed base

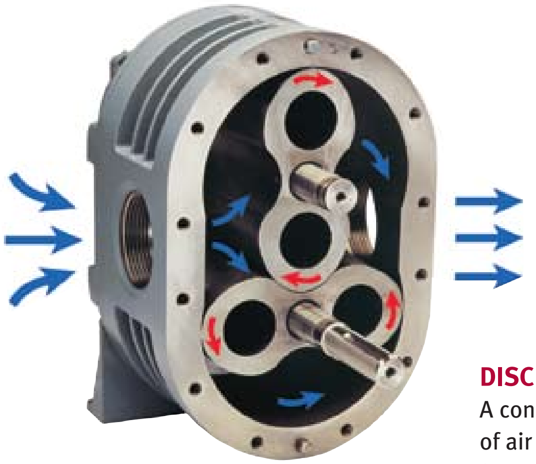
- *This field proven seal design allows trouble-free operation in critical gas applications*

6HVR BHC

7MVP BHC

8HVP BHC

The Sutorbilt Legend Design



DISCHARGE
A constant volume of air or gas is forced out through the discharge port.

INTAKE
A constant volume of air or gas is drawn into the cylinder by the action of the turning impellers.

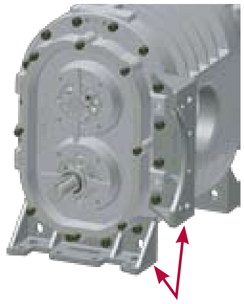
TRANSFER
A constant volume of trapped air or gas is transferred around the cylinder to the discharge port.

The Sutorbilt PD Cycle

- Two figure-eight impellers turn in opposite directions within a machined housing
- Transferring a constant volume of air or gas from inlet to discharge with every rotation of the blower drive shaft
- No lubrication within the cylinder is required
- Rotating components are held in close tolerance do not contact each other
- Impeller positioning is maintained by precision timing gears affixed to each impeller shaft
- Gear and bearing lubrication occurs externally to the cylinder assuring clean, oil-free gas delivery under all operating conditions

Universal Foot & Flex-Mount™ Design Provides Maximum Installation Versatility

- 3–6" R versions feature the "universal" mounting feet which allow them to be mounted in vertical and horizontal configurations
- 2", 7" & 8" P versions feature Flex-Mount™ design creating interchangeability on existing and new applications



Universal Foot

Horizontal Configuration, Right Hand Drive

Vertical Configuration, Bottom Hand Drive

Horizontal Configuration, Left Hand Drive

Vertical Configuration, Top Hand Drive

State-of-the-Art Quality

The Gardner Denver line of Sutorbilt Legend blowers and vacuum pumps are engineered and manufactured under strict ISO 9001:2000 quality standards in our 330,000 square feet state-of-the-art facility in Sedalia, MO (photo below)

- Gardner Denver makes it a priority to invest in highly skilled people who take pride in producing quality products
- Our Flexible Machining System (FMS) assures consistent production of the highest quality Legend components
- Attention to detail is found throughout the manufacturing process such as utilizing advanced coordinate measuring equipment (photo A)
- Legend components are subjected to quality inspections before assembly
- Prior to shipment, every Legend is tested against rigid standards using our computer automated testing stations (photo B)

Photo A

Photo B

Sutorbilt Legend Pressure Performance Data

	SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	2 PSIG		3 PSIG		4 PSIG		5 PSIG		6 PSIG		7 PSIG	
					CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
LOW PRESSURE UNITS	2LP 2LVP	2"-S	0.035	2,800	76	1.1	71	1.6	67	2.1	63	2.5	59	3.0	56	3.5
				3,250	91	1.3	86	1.8	82	2.4	79	2.9	75	3.4	72	4.0
				3,560	102	1.4	97	2.0	93	2.6	89	3.2	86	3.7	83	4.3
				5,275	162	2.0	157	2.8	153	3.7	149	4.6	146	5.3	143	6.1
	3LR 3LVR	2½"-S	0.104	1,760	149	1.9	142	2.8	135	3.7	130	4.5	124	5.2	120	6.1
				2,265	202	2.4	194	3.5	188	4.7	182	5.6	177	6.7	172	7.8
				2,770	254	2.9	247	4.3	240	5.5	235	6.8	230	8.2	225	9.6
				3,600	341	3.7	333	5.3	327	7.1	321	8.9	316	10.6	311	12.4
	4LR 4LVR	3"-S	0.170	1,760	253	3.0	243	4.5	234	5.7	227	7.1	220	8.5	213	9.9
				2,190	326	3.7	316	5.3	307	7.1	300	8.8	293	10.6	286	12.4
				2,620	400	4.4	389	6.3	381	8.4	373	10.6	366	12.7	360	14.8
				3,600	566	5.8	556	8.7	547	11.6	539	14.5	533	17.4	526	20.3
	5LR 5LVR	4"-S	0.350	1,500	463	5.2	449	7.5	438	10.0	427	12.4	418	14.9	409	17.4
				1,760	554	5.8	540	8.8	529	11.7	518	14.6	509	17.5	500	20.4
				2,100	673	7.0	659	10.5	648	13.9	637	17.4	628	20.9	619	24.4
				2,850	936	9.5	922	14.2	910	18.9	900	23.6	890	28.4	882	33.1
	6LR 6LVR	6"-F	0.718	1,170	739	8.0	716	11.9	697	15.9	680	19.9	664	23.9	650	27.9
				1,760	1,162	12.0	1,139	18.0	1,120	24.0	1,103	29.9	1,088	35.9	1,074	41.9
				1,930	1,284	13.1	1,261	19.7	1,242	26.3	1,225	32.8	1,210	39.4	1,196	46.0
				2,350	1,586	16.0	1,563	24.0	1,544	32.0	1,527	40.0	1,512	48.0	1,497	56.0
	7LP 7LVP	8"-F	1.200	1,170	1,277	13.3	1,248	20.0	1,224	16.6	1,203	33.3	1,184	39.9		
				1,465	1,631	16.7	1,602	25.0	1,578	33.3	1,557	41.7	1,538	50.0		
				1,760	1,985	20.0	1,956	30.0	1,932	40.0	1,911	50.1	1,892	60.1		
				2,050	2,333	23.3	2,304	35.0	2,280	46.6	2,259	58.3	2,240	70.0		
	8LP 8LVP	10"-F	1.740	880	1,366	14.5	1,329	21.8	1,298	29.0	1,271	36.3	1,246	43.5		
				1,170	1,871	19.3	1,834	28.9	1,803	38.6	1,775	48.2	1,750	57.9		
				1,375	2,228	22.7	2,191	34.0	2,159	45.4	2,132	56.7	2,107	68.0		
				1,800	2,967	29.7	2,930	44.5	2,899	59.4	2,871	74.2	2,847	89.1		

	SIZE	DIA.INLET & OUTLET	DISPL.CU. FT./REV.	RPM	7 PSIG		9 PSIG		10 PSIG		12 PSIG		13 PSIG		14 PSIG	
					CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
MEDIUM PRESSURE UNITS	2MP 2MVP	1"-S	0.017	2,800	25	1.7	22	2.1								
				3,250	33	1.9	30	2.5	28	2.7						
				3,560	38	2.1	35	2.7	34	3.0						
				5,275	67	3.1	64	3.9	63	4.4	60	5.1				
	3MR 3MVR	2"-S	0.060	1,760	64	3.6	59	4.6								
				2,265	95	4.6	89	5.8	87	6.4						
				2,770	125	5.5	119	7.1	117	7.9	112	9.5				
				3,600	175	7.2	169	9.2	167	10.2	162	12.3				
	4MR 4MVR	2½"-S	0.117	1,760	144	6.8	136	8.8	132	9.8						
				2,190	194	8.5	186	10.9	182	12.1						
				2,620	245	10.2	236	13.1	233	14.5						
				3,600	359	14.0	351	18.0	347	20.0						
	5MR 5MVR	4"-S	0.210	1,500	237	10.5	227	13.4	222	14.9	213	17.9	209	19.4		
				1,760	292	12.3	281	15.8	277	17.5	268	21.0	263	22.8		
				2,100	363	14.6	353	18.8	348	20.9	339	25.1	335	27.2		
				2,850	521	19.9	510	25.5	506	28.4	497	34.0	493	36.9		
	6MR 6MVR	5"-S	0.383	1,170	332	14.9	316	19.1	309	21.2	296	25.5	289	27.6	283	29.7
				1,760	558	22.4	542	28.8	535	32.0	522	38.3	515	41.5	509	44.7
				1,930	622	24.5	607	31.5	600	35.0	587	42.0	580	45.5	574	49.1
				2,350	784	29.9	768	38.4	761	42.7	748	51.2	741	55.5	735	59.7
	7MP 7MVP	6"-F	0.733	1,170	693	28.5	671	36.6	661	40.7						
				1,465	909	35.6	887	45.8	877	50.9						
				1,760	1,125	42.8	1,103	55.0	1,093	61.1						
				2,050	1,338	49.9	1,316	64.1	1,306	71.2						
	8MP 8MVP	8"-F	1.040	880	709	30.4	681	39.0	669	43.4						
				1,170	1,011	40.4	983	51.9	970	57.7						
				1,375	1,224	47.4	1,196	61.0	1,183	67.8						
				1,800	1,666	62.1	1,638	79.9	1,625	88.7						

	SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	7 PSIG		8 PSIG		9 PSIG		11 PSIG		13 PSIG		15 PSIG	
					CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
HIGH PRESSURE UNITS	3HR 3HVR	1¼"-S	0.045	1,760	46	2.6	44	3.0	41	3.4						
				2,265	69	3.4	66	3.9	64	4.3	60	5.3				
				2,770	91	4.1	89	4.7	87	5.3	83	6.5				
				3,600	129	5.4	126	6.1	124	6.9	120	8.4	117	10.0	113	11.5
	4HR 4HVR	1½"-S	0.069	1,760	80	4.0	77	4.6	74	5.2						
				2,190	110	5.0	107	5.7	104	6.4	99	7.9				
				2,620	139	6.0	137	6.9	134	7.7	129	9.4	124	11.1		
				3,600	207	8.2	204	9.4	201	10.6	196	13.0	192	15.3	188	17.7
	5HR 5HVR	2½"-S	0.140	1,500	154	7.0	151	8.0	147	9.0	140	10.9				
				1,760	191	8.2	187	9.3	183	10.5	177	12.8	171	15.2	165	17.5
				2,100	238	9.8	235	11.1	231	12.5	224	15.3	218	18.1	213	20.9
				2,850	343	13.2	340	15.1	336	17.0	329	20.8	323	24.6	318	28.4
	6HR 6HVR	3"-S	0.227	1,170	188	8.8	182	10.1	177	11.3	168	13.8	159	16.4		
				1,760	321	13.3	316	15.1	311	17.0	302	20.8	293	24.6	285	28.4
				1,930	360	14.5	355	16.6	350	18.7	340	22.8	332	27.0	324	31.1
				2,350	455	17.7	450	20.2	445	22.8	436	27.8	427	32.9	419	37.9
	7HP 7HVP	4"-S	0.367	1,170	332	14.2	326	16.3	319	18.3	308	22.4	297	26.5	287	30.5
				1,465	441	17.8	434	20.4	428	22.9	416	28.0	405	33.1	396	38.2
				1,760	549	21.4	542	24.5	536	27.6	524	33.7	514	39.8	504	45.9
				2,050	655	25.0	649	28.5	642	32.1	631	39.2	620	46.4	610	53.5
	8HP 8HVP	4"-S	0.566	880	363	16.5	354	18.9	345	21.2	329	26.0	315	30.7	301	35.4
				1,170	528	22.0	518	25.1	509	28.3	493	34.5	479	40.8	465	47.1
				1,375	644	25.8	634	29.5	626	33.2	609	40.6	595	48.0	581	55.3
				1,800	884	33.8	875	38.6	866	43.5	850	53.1	835	62.8	822	72.4

Performance based on inlet air at standard temperature of 68˚F, an ambient pressure of 14.7 psia and 36% relative humidity. For performance at non-standard conditions, contact your authorized Gardner Denver representative. S=Screwed connections std. NPT. F=flange connections. Intake and outlet pipe connections are same type and size.

Sutorbilt Legend Vacuum Performance Data

	SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	2 "Hg		4 "Hg		8 "Hg		10 "Hg		12 "Hg		14 "Hg	
					CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
LOW VACUUM UNITS	2LP 2LVP	2"-S	0.035	2,800	82	0.7	74	1.1	61	2.0	55	2.5				
				3,250	98	0.7	90	1.3	77	2.3	71	2.8	64	3.4		
				3,560	108	0.8	101	1.4	88	2.5	82	3.1	75	3.7		
				4,165	130	0.9	122	1.6	109	2.9	103	3.6	96	4.3		
				5,275	168	1.1	161	1.9	148	3.6	142	4.5	135	5.2	128	6.0
	3LR 3LVR	2½"-S	0.104	1,760	158	1.1	147	1.9	128	3.6	118	4.5	108	5.1		
				2,265	211	1.3	200	2.4	180	4.6	171	5.5	160	6.6		
				2,770	264	1.5	252	2.9	233	5.4	223	6.7	213	8.1		
				3,600	350	1.9	338	3.7	319	7.0	309	8.7	299	10.5	288	12.2
	4LR 4LVR	3"-S	0.170	1,760	266	1.6	250	3.0	224	5.6	211	7.0	197	8.4		
				2,190	339	1.9	323	3.7	297	6.9	284	8.7	270	10.4		
				2,620	412	2.3	396	4.3	370	8.3	357	10.4	343	12.4	329	14.5
				3,600	579	3.1	563	5.7	537	11.4	524	14.3	510	17.1	495	20.0
	5LR 5LVR	4"-S	0.350	1,500	480	2.6	459	5.1	424	9.8	406	12.2	388	14.7		
				1,760	571	3.1	550	5.7	515	11.5	497	14.3	479	17.2	459	20.1
				2,100	690	3.6	669	6.8	634	13.7	616	17.1	598	20.5	578	24.0
				2,850	953	4.8	932	9.3	896	18.6	879	23.2	860	27.9	840	32.5
	6LR 6LVR	6"-F	0.718	1,170	766	4.1	732	7.8	674	15.7	645	19.6	615	23.5		
				1,760	1,190	5.9	1,115	11.8	1,097	23.5	1,068	29.4	1,038	35.3	1,005	41.2
				1,930	1,312	6.5	1,278	12.9	1,219	25.8	1,191	32.3	1,160	38.7	1,127	45.2
				2,350	1,614	7.9	1,579	15.7	1,521	31.4	1,492	39.3	1,462	47.2	1,429	55.0
	7LP 7LVP	8"-F	1.200	1,170	1,312	6.5	1,268	13.1	1,195	26.2	1,159	32.7	1,121	39.2		
				1,465	1,666	8.2	1,622	16.4	1,549	32.8	1,513	40.9	1,475	49.1		
				1,760	2,020	9.8	1,976	19.7	1,903	39.3	1,867	49.2	1,829	59.0		
				2,050	2,368	11.5	2,324	22.9	2,251	45.8	2,215	57.3	2,177	68.7		
	8LP 8LVP	10"-F	1.740	880	1,411	7.1	1,355	14.3	1,261	28.5	1,214	35.7	1,165	42.8		
				1,170	1,916	9.5	1,860	19.0	1,766	37.9	1,719	47.4	1,670	56.9		
				1,375	2,273	11.1	2,217	22.3	2,122	44.6	2,076	55.7	2,026	66.9		
				1,800	3,012	14.6	2,953	29.2	2,862	58.4	2,815	72.9	2,765	87.6		

	SIZE	DIA. INLET &OUTLET	DISPL. CU. FT./REV.	RPM	6 "Hg		10 "Hg		12 "Hg		14 "Hg		15 "Hg		16 "Hg	
					CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
MEDIUM VACUUM UNITS	2MP 2MVP	1"-S	0.017	2,800	31	0.8	24	1.2								
				3,250	39	0.9	32	1.4								
				3,560	44	0.9	37	1.5	34	1.8						
				4,165	54	1.1	48	1.7	44	2.1	40	2.4				
				5,275	73	1.4	67	2.2	63	2.6	59	3.0	57	3.2		
	3MR 3MVR	2"-S	0.060	1,760	76	1.6	63	2.6	57	3.1						
				2,265	106	2.0	93	3.3	87	3.9						
				2,770	136	2.4	124	4.0	117	4.7	110	5.4				
				3,600	186	3.1	174	5.0	167	6.0	160	7.0	156	7.5		
	4MR 4MVR	2½"-S	0.117	1,760	161	3.0	142	4.9	132	5.8						
				2,190	211	3.7	193	6.0	183	7.2						
				2,620	262	4.4	243	7.1	233	8.6	222	10.0				
				3,600	376	5.9	358	9.8	348	11.8	337	13.7	331	14.7	325	15.7
	5MR 5MVR	4"-S	0.210	1,500	258	4.5	235	7.3	223	8.8	209	10.3				
				1,760	313	5.2	290	8.6	277	10.3	264	12.1				
				2,100	384	6.2	361	10.3	349	12.3	335	14.4	328	15.4		
				2,850	542	8.4	519	13.9	506	16.7	493	19.5	485	20.9	477	22.3
	6MR 6MVR	5"-S	0.383	1,170	363	6.3	328	10.4	310	12.5	290	14.6	279	15.7	267	16.7
				1,760	589	9.4	554	15.7	536	18.8	516	22.0	505	23.5	493	25.1
				1,930	655	10.3	619	17.2	601	20.7	581	24.1	570	25.8	558	27.5
				2,350	815	12.6	780	21.0	762	25.2	741	29.3	731	31.4	719	33.5
	7MP 7MVP	6"-F	0.733	1,170	738	12.0	688	20.0	662	24.0	633	28.0	618	30.0	601	32.0
				1,465	954	15.0	904	25.0	878	30.0	850	35.0	834	37.5	817	40.0
				1,760	1,170	18.0	1,121	30.0	1,094	36.1	1,065	42.1	1,050	45.1	1,034	48.1
				2,050	1,383	21.0	1,333	35.0	1,307	42.0	1,278	49.0	1,263	52.5	1,246	56.0
	8MP 8MVP	8"-F	1.040	880	765	12.8	703	21.3	670	25.6	634	29.8	615	32.0	594	34.1
				1,170	1,067	17.0	1,005	28.3	972	34.0	936	39.7	917	42.5	896	45.3
				1,375	1,280	20.0	1,218	33.3	1,185	40.0	1,149	46.6	1,130	50.0	1,109	53.3
				1,800	1,722	26.2	1,660	43.6	1,627	52.3	1,591	61.0	1,572	65.4	1,551	69.7

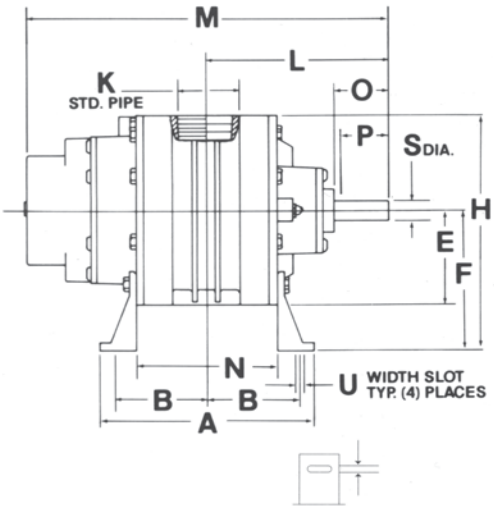
	SIZE	DIA. INLET & OUTLET	DISPL. CU. FT./REV.	RPM	6 "Hg		8 "Hg		12 "Hg		14 "Hg		15 "Hg		16 "Hg	
					CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
HIGH VACUUM UNITS	3HR 3HVR	1¼"-S	0.045	1,760	55	1.1	50	1.5	40	2.2						
				2,265	78	1.4	73	1.9	62	2.8						
				2,770	100	1.7	95	2.3	85	3.5	79	4.1	76	4.4		
				3,600	138	2.3	133	3.0	122	4.5	117	5.3	113	5.7	110	6.0
	4HR 4HVR	1½"-S	0.069	1,760	91	1.7	85	2.3	72	3.4						
				2,190	121	2.1	115	2.8	102	4.2	95	4.9	91	5.3		
				2,620	151	2.5	144	3.4	132	5.1	124	5.9	120	6.3		
				3,600	218	3.5	212	4.6	199	6.9	192	8.1	188	8.7	184	9.3
	5HR 5HVR	2½"-S	0.140	1,500	170	2.9	161	3.9	144	5.9	134	6.8				
				1,760	206	3.4	198	4.6	180	6.9	171	8.0	165	8.6		
				2,100	254	4.1	245	5.5	228	8.2	218	9.6	213	10.3		
				2,850	359	5.6	350	7.4	333	11.2	323	13.0	318	14.0	312	14.9
	6HR 6HVR	3"-S	0.227	1,170	209	3.7	197	4.8	173	7.4	159	8.7	152	9.3		
				1,760	343	5.6	331	7.4	307	11.2	293	13.0	286	14.0	278	14.9
				1,930	381	6.1	370	8.2	345	12.2	332	14.3	325	15.3	317	16.3
				2,350	477	7.5	165	9.9	441	14.9	427	17.4	420	18.6	412	19.9
	7HP 7HVP	4"-S	0.367	1,170	359	6.0	344	8.0	314	12.0	297	14.0	288	15.0	278	16.0
				1,465	467	7.5	453	10.0	422	15.0	406	17.5	396	18.8	387	20.0
				1,760	575	9.0	561	12.0	531	18.1	514	21.1	505	22.6	495	24.1
				2,050	682	10.5	667	14.0	637	21.0	620	24.5	611	26.3	601	28.0
	8HP 8HVP	4"-S	0.566	880	400	7.0	380	9.3	338	13.9	315	16.2	302	17.4		
				1,170	564	9.3	544	12.3	502	18.5	479	21.6	466	23.1	453	24.7
				1,375	680	10.9	660	14.5	618	21.7	595	25.4	582	27.2	569	29.0
				1,800	921	14.2	901	19.0	859	28.5	835	33.2	823	35.6	809	38.0

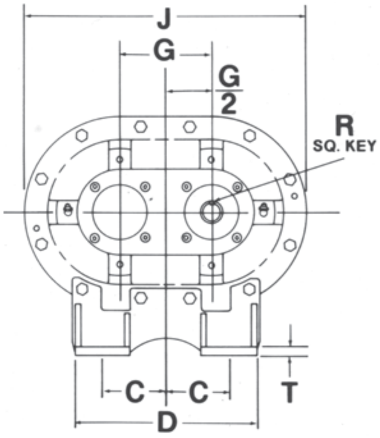
Sutorbilt Legend Dimensional Data

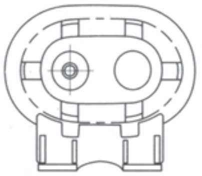
Horizontal Configurations

SIZE	WT.	CONN.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	U
2M	72	S	5.00	2.00	2.00	6.36	3.25	3.75	2.75	7.00	9.25	1.00	5.16	10.00	2.76	1.97	1.62	0.19	0.620	0.13	0.44
2L	86	S	7.00	3.00	2.00	6.36	3.25	3.75	2.75	7.00	9.25	2.00	6.16	12.00	4.76	1.97	1.62	0.19	0.620	0.13	0.44
3H	88	S	6.75	2.69	2.68	7.75	3.88	5.00	3.50	8.88	11.26	1.25	5.86	12.05	3.50	2.05	1.62	0.19	0.750	0.25	0.62 x 1.12
3M	110	S	7.62	3.13	2.68	7.75	3.88	5.00	3.50	8.88	11.26	2.00	6.30	12.92	4.38	2.05	1.62	0.19	0.750	0.25	0.62 x 1.12
3L	132	S	10.25	4.44	2.68	7.75	3.88	5.00	3.50	8.88	11.26	2.50	7.61	15.55	7.00	2.05	1.62	0.19	0.750	0.25	0.62 x 1.13
4H	138	S	7.24	3.00	3.00	8.25	4.19	6.25	4.00	10.44	12.38	1.50	6.91	13.74	4.00	2.39	1.62	0.19	0.875	0.38	0.5 x 0.75
4M	160	S	9.49	4.13	3.00	8.25	4.19	6.25	4.00	10.44	12.38	2.50	8.04	15.99	6.26	2.39	1.62	0.19	0.875	0.38	0.5 x 0.75
4L	182	S	11.99	5.38	3.00	8.25	4.19	6.25	4.00	10.44	12.38	3.00	9.29	18.49	8.76	2.39	1.62	0.19	0.875	0.38	0.5 x 0.75
5H	210	S	10.85	3.50	3.50	9.00	5.19	7.00	5.00	12.19	15.38	2.50	8.19	16.38	4.86	2.50	2.00	0.25	1.125	0.38	0.56 x 0.75
5M	232	S	12.85	4.50	3.50	9.00	5.19	7.00	5.00	12.19	15.38	4.00	9.19	18.38	6.86	2.50	2.00	0.25	1.125	0.38	0.56 x 0.75
5L	306	S	16.85	6.50	3.50	9.00	5.19	7.00	5.00	12.19	15.38	4.00	11.19	22.38	10.86	2.50	2.00	0.25	1.125	0.38	0.56 x 0.75
6H	318	S	9.76	3.94	4.00	16.50	6.00	8.75	6.00	14.75	18.00	3.00	9.18	18.57	5.76	2.94	2.00	0.31	1.375	0.50	0.75 x 1
6M	366	S	13.00	5.56	4.00	16.50	6.19	8.75	6.00	14.94	18.00	5.00	10.80	21.81	9.00	2.94	2.00	0.31	1.375	0.50	0.75 x 1
6L	538	F	20.00	9.06	4.00	16.50	7.50	8.75	6.00	16.25	18.00	6.00	14.31	28.82	16.00	2.94	2.00	0.31	1.375	0.50	0.75 x 1
7H	482	S	12.00	4.63	5.50	15.00	9.69	11.00	7.00	20.69	22.00	4.00	10.00	21.03	5.74	3.21	2.50	0.38	1.562	0.50	0.75 x 1
7M	638	F	17.50	7.38	5.50	15.00	8.50	11.00	7.00	19.50	22.00	6.00	12.75	26.53	11.24	3.21	2.50	0.38	1.562	0.50	0.75 x 1
7L	770	F	24.50	10.88	5.50	15.00	8.50	11.00	7.00	19.50	22.00	8.00	16.25	33.53	18.24	3.21	2.50	0.38	1.562	0.50	0.75 x 1
8H	736	S	13.50	5.75	6.00	16.00	10.00	12.50	8.00	22.50	25.25	4.00	11.69	23.85	7.76	3.86	2.50	0.38	1.750	0.50	0.75 x 1
8M	938	F	19.00	8.50	6.00	16.00	10.00	12.50	8.00	22.50	25.25	8.00	14.44	29.35	13.26	3.86	2.50	0.38	1.750	0.50	0.75 x 1
8L	1,170	F	27.00	12.50	6.00	16.00	10.00	12.50	8.00	22.50	25.25	10.00	18.44	37.35	21.26	3.86	2.50	0.38	1.750	0.50	0.75 x 1

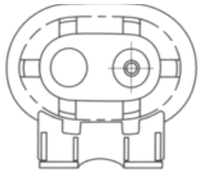
S=Threaded connections standard NPT. F=flange connections. Inlet and outlet connections are the same type and size.
Dimensions are in inches. Weights are in pounds and include shipping cartons or pallets and are approximate.







LHC
LEFT HAND CENTRAL
(OPTIONAL ASSEMBLY)



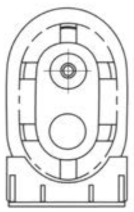
RHC
RIGHT HAND CENTRAL
(STANDARD ASSEMBLY)

CENTER TIMED FOR ROTATION
IN EITHER DIRECTION

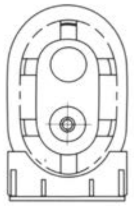
Vertical Configurations

SIZE	WT.	CONN.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	U
2MV	72	S	5.00	2.00	1.50	5.60	3.50	4.88	6.25	9.50	6.50	1.00	5.16	10.00	2.76	1.97	1.62	0.19	0.6200	0.13	0.44
2LV	86	S	7.00	3.00	1.50	5.60	3.50	4.88	6.25	9.50	6.50	2.00	6.16	12.00	4.76	1.97	1.62	0.19	0.6200	0.13	0.44
3HV	88	S	6.75	2.69	2.68	7.75	4.50	6.25	8.00	11.88	7.76	1.25	5.86	12.05	3.50	2.05	1.62	0.19	0.7500	0.25	0.62 x 1.12
3MV	110	S	7.62	3.13	2.68	7.75	4.50	6.25	8.00	11.88	7.76	2.00	6.30	12.92	4.36	2.05	1.62	0.19	0.7500	0.25	0.62 x 1.12
3LV	132	S	10.25	4.44	2.68	7.75	4.50	6.25	8.00	11.88	7.76	2.50	7.61	15.55	7.00	2.05	1.62	0.19	0.7500	0.25	0.62 x 1.12
4HV	138	S	7.24	3.00	3.00	8.25	4.50	6.50	8.50	12.69	8.40	1.50	6.91	13.74	4.00	2.39	1.62	0.19	0.8750	0.38	0.5 x 0.75
4MV	160	S	9.49	4.13	3.00	8.25	4.50	6.50	8.50	12.69	8.40	2.50	8.04	15.99	6.26	2.39	1.62	0.19	0.8750	0.38	0.5 x 0.75
4LV	182	S	11.99	5.38	3.00	8.25	4.50	6.50	8.50	12.69	8.40	3.00	9.29	18.49	8.76	2.39	1.62	0.19	0.8750	0.38	0.5 x 0.75
5HV	210	S	10.85	3.50	3.50	9.00	5.50	8.00	10.50	15.85	10.38	2.50	8.19	16.38	4.86	2.50	2.00	0.25	1.1250	0.38	0.56 x 0.75
5MV	232	S	12.85	4.50	3.50	9.00	5.50	8.00	10.50	15.85	10.38	4.00	9.19	18.38	6.86	2.50	2.00	0.25	1.1250	0.38	0.56 x 0.75
5LV	306	S	16.85	6.50	3.50	9.00	5.50	8.00	10.50	15.85	10.38	4.00	11.19	22.38	10.86	2.50	2.00	0.25	1.1250	0.38	0.56 x 0.75
6HV	318	S	9.76	3.94	4.00	10.50	8.75	11.75	14.75	20.75	12.00	3.00	9.18	18.57	5.76	2.94	2.00	0.31	1.3750	0.50	0.75 x 1
6MV	366	S	13.00	5.56	4.00	10.50	8.75	11.75	14.75	20.80	12.38	5.00	10.80	21.81	9.00	2.94	2.00	0.31	1.3750	0.50	0.75 x 1
6LV	538	F	20.00	9.06	4.00	10.50	8.75	11.75	14.75	20.75	15.00	6.00	14.31	28.81	9.00	2.93	2.00	0.31	1.3750	0.50	0.75 x 1
7HV	482	S	12.00	4.62	5.50	14.04	11.00	14.50	18.00	25.50	19.38	4.00	10.00	21.03	5.74	3.21	2.50	0.38	1.5620	0.50	0.75 x 1
7MV	638	F	17.50	7.37	5.50	14.04	11.00	14.50	18.00	25.50	17.00	6.00	12.75	26.53	11.24	3.21	2.50	0.38	1.5620	0.50	0.75 x 1
7LV	770	F	24.50	10.87	5.50	14.04	11.00	14.50	18.00	25.50	17.00	8.00	16.25	33.53	18.24	3.21	2.50	0.38	1.5620	0.50	0.75 x 1
8HV	736	S	13.50	5.75	6.00	16.00	12.50	16.50	20.50	29.12	20.00	4.00	11.69	23.85	7.76	3.86	2.50	0.38	1.7500	0.50	0.75 x 1
8MV	938	F	19.00	8.50	6.00	16.00	12.50	16.50	20.50	29.12	20.00	8.00	14.44	29.35	13.26	3.86	2.50	0.38	1.7500	0.50	0.75 x 1
8LV	1,170	F	27.00	12.50	6.00	16.00	12.50	16.50	20.50	29.12	20.00	10.00	18.44	37.35	21.26	3.86	2.50	0.38	1.7500	0.50	0.75 x 1

S=Threaded connections standard NPT. F=flange connections. Inlet and outlet connections are the same type and size.
Dimensions are in inches. Weights are in pounds and include shipping cartons or pallets and are approximate.

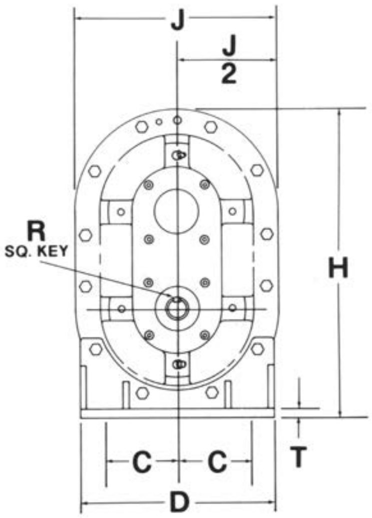


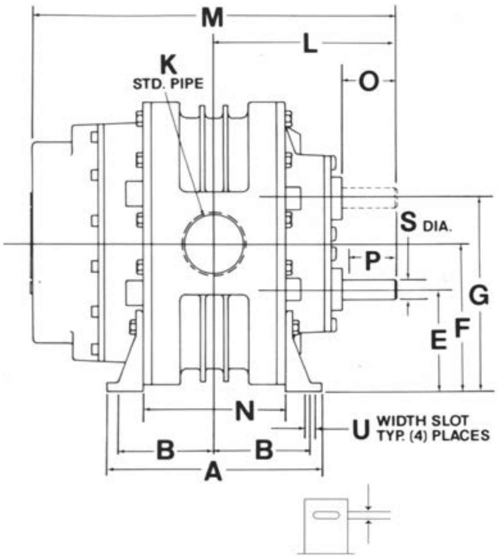
THC
TOP HAND CENTRAL
(OPTIONAL ASSEMBLY)



BHC
BOTTOM HAND CENTRAL
(STANDARD ASSEMBLY)

CENTER TIMED FOR ROTATION
IN EITHER DIRECTION





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Please recycle after use.

VLS Series
Vapor/Liquid Separators

Features & Specifications

- All Welded Steel construction, ASTM A-36 sheet steel
- 17” Hg vacuum design rating (optional full vacuum design available)
- Polypropylene demister element covering entire separator cross section to minimizes vapor velocity & maximize water coalescing
- Tangential inlet utilizing centrifugal force for gross water/air separation (95%+ By Volume)
- 2” PVC site glass with unions for easy removal
- Steel baffle cover over water holding volume to prevent re-entrainment of water into air stream
- Stainless steel hermetically sealed float rod assembly (single or multiple floats)
- All zinc plated steel hardware
- Enamel external finish (optional internal & external finishes available)
- 99% + moisture removal of 10 micron and larger droplets (due to coalescing)
- Optional air filter with polyester element sized for specific blower, housed in separator (polyester element standard)
- 2” NPT half coupling for pump out or gravity drain, ¼” NPT gage port on inlet
- Neoprene full face top cover gasket

H2K
Technologies, Inc.

Applications

- Soil vapor extraction
- Dual phase extraction
- Liquid ring pump
- Vacuum or pressure
- Blowers-Side Channel/regenerative,

multi-stage regenerative, positive displacement, and centrifugal

- Industrial industry
- Remediation industry
- Vapor GAC
- Bio venting systems
- Excavation venting

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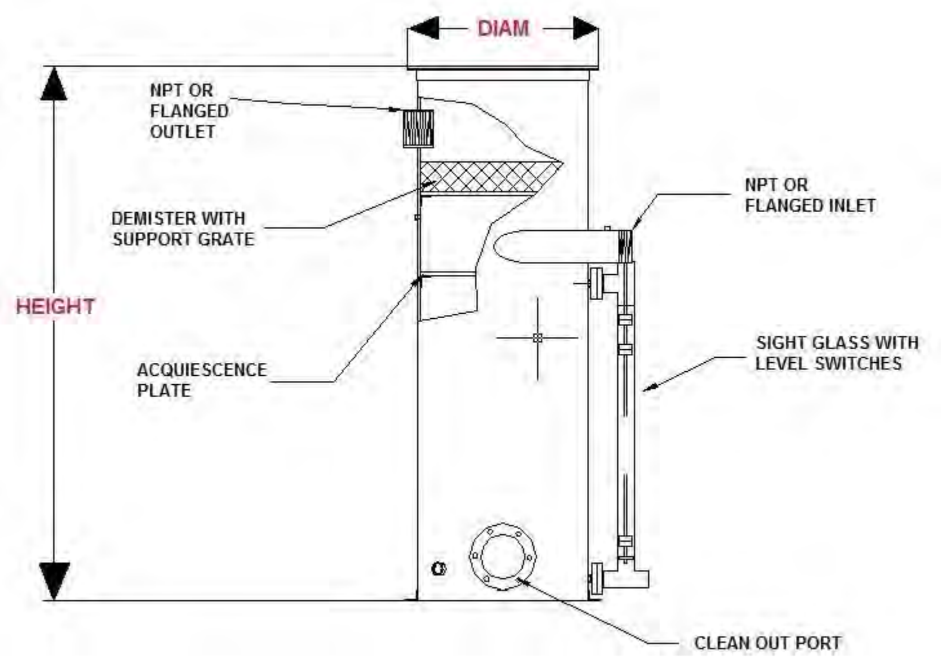
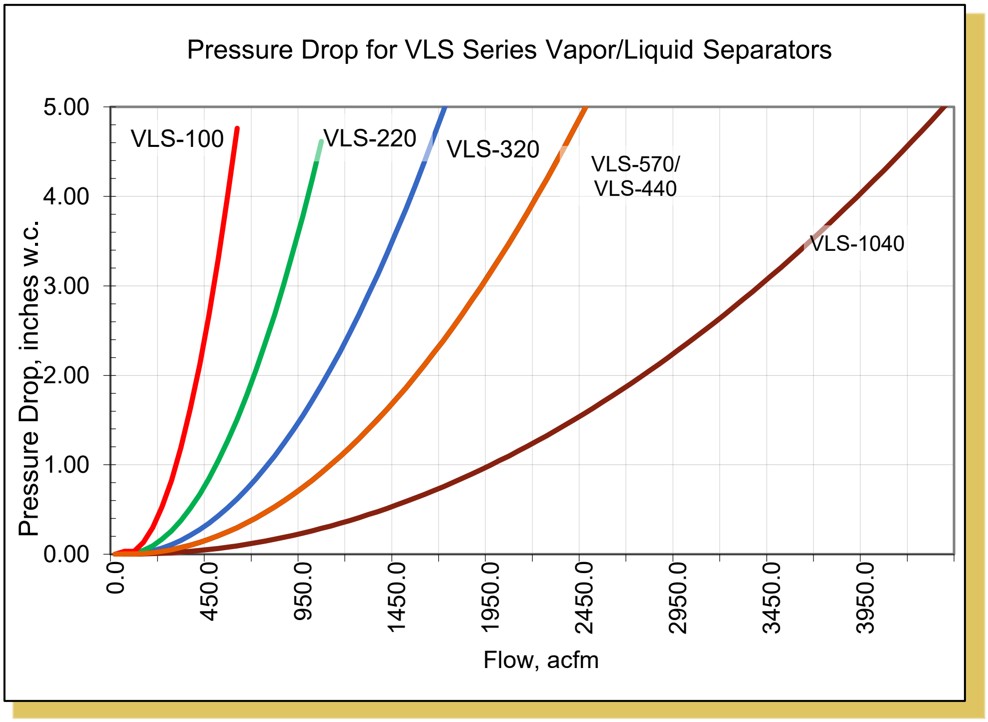
Model Number	Inlet/Outlet Connection	Height In.	Diam. In.	Rated Flow SCFM	Separator Total Volume Gallons	Liquid Holding Volume Gallons	Shipping Weight Lbs.	Operating Weight Lbs.	Vacuum/ Rating, "Hg/PSI
VLS-033	3” FPT	30	18	500	33	10	50	160	17”Hg/9psi
VLS-082	4” FPT	44	24	500	82	30	90	325	17”Hg/9psi
VLS-100	4”/6” FPT	50	22	650	100	40	140	480	30”Hg/9psi
VLS-220	8”/10” 150 lb flange	72	30	1440	220	75	350	1,020	30”Hg/9psi
VLS-320	10”/12” 150lb flange	72	36	2600	320	110	450	1,356	30”Hg/9psi
VLS-440	12” 150lb flange	74	42	2600	440	150	625	1,860	17”Hg/9psi
VLS-570	12” 150 lb flange	74	48	2600	570	195	860	2,465	17”Hg/9psi
VLS-1040	16” Duct flange	84	60	4500	1,040	200	1,250	2,978	10”Hg/5psi
VLS-1500	20” Duct flange	85	72	7000	1,500	440	1,525	5,325	10”Hg/5psi
VLS-3055	32” Duct flange	96	96	11,000	3,055	780	1,820	8,532	10”Hg/5psi

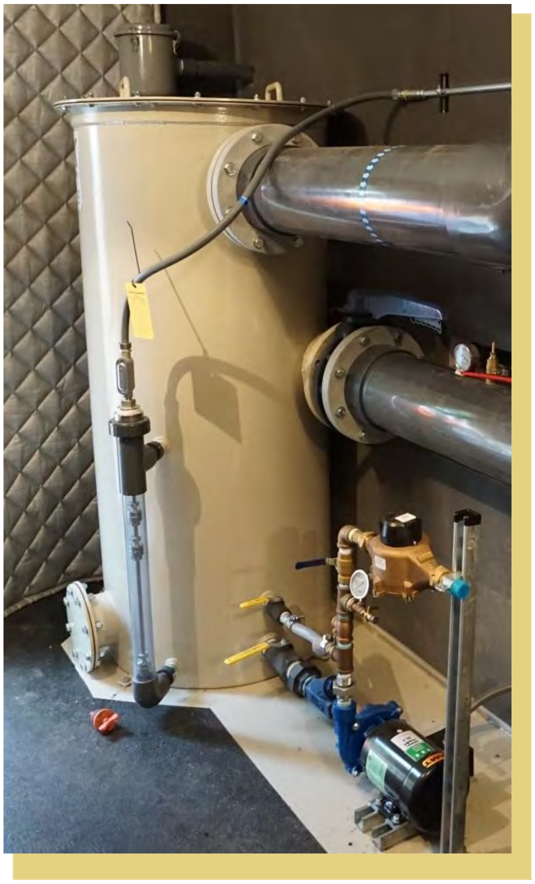




Options

- Stainless steel or Fiberglass re-enforced plastic construction (low pressure)
- Stainless steel coalescer media
- ASME designed & stamped for vacuum or pressure
- Full vacuum design
- Immersion heaters, NEMA 4 or NEMA 7 for freeze protection
- 1” recirculation port for pumping under high vacuum
- Air filter material and sizes
- Enamel internal finish, epoxy coatings or hot dipped galvanized finish
- Flanged or NPT inlet and outlet connections
- Flow, pressure, level & temperature gages or transmitters
- Heat trace for classified or non-classified electrical areas for freeze protection
- Clean out Ports
- Internal aeration diffuser for low level stripping or iron oxidation
- DP gage across filter, demister or both
- R-5 insulation with jacket, (steel or aluminum jacket)
- Vacuum relief valve

Additional Photos



LLS Series
Oil/Water Separators

H2K
Technologies, Inc.

Applications

- Oil/Water separation
- Wastewater treatment
- Light non-aqueous phase product removal
- Free Phase product separation
- Oil & Grease separation
- Dense non-aqueous phase product removal
- Groundwater treatment
- Solid settling
- Mixed oil grease, product & solids

Features & Specifications

- Removal of free phase gasoline (0.75 SG) product to less than 10 ppm or less typical
- Solids collection sump with sludge drain
- Set up standard for pump out or gravity drain
- PVC coalescing media with ¾" spacing for resistance to plugging from solids or oil & grease (optional 1/4" spacing media available for higher removal efficiencies)
- Full removable top cover with quick release latches for easy access to entire separator for cleaning
- PVC adjustable height skimmer with gravity drain outlet
- PVC site glass
- 2" PVC site glass with flange connections for easy removal
- Epoxy coating inside & out on all steel units with urethane top coat on exterior
- Clear-well for pumping directly from unit
- Stainless steel hermitically sealed float rod assembly (single or multiple floats for gravity or pump operation)
- All zinc plated steel hardware
- Neoprene D gasket on cover for vapor tight seal
- All Welded Steel construction, ASTM A-36 sheet steel, or Fiberglass re-enforced plastic (FRP) construction on some models
- Removable media packs for cleaning and access to solids collection sump

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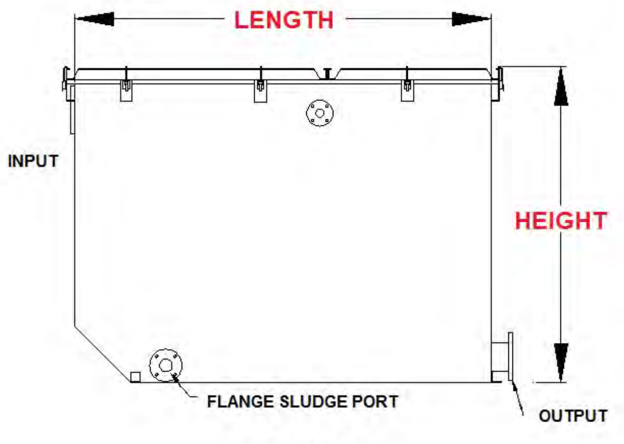
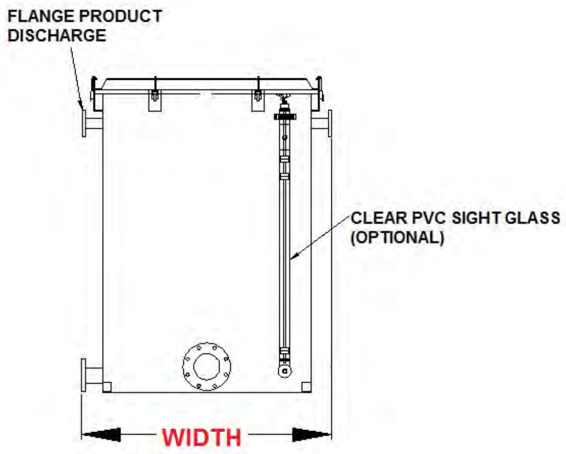
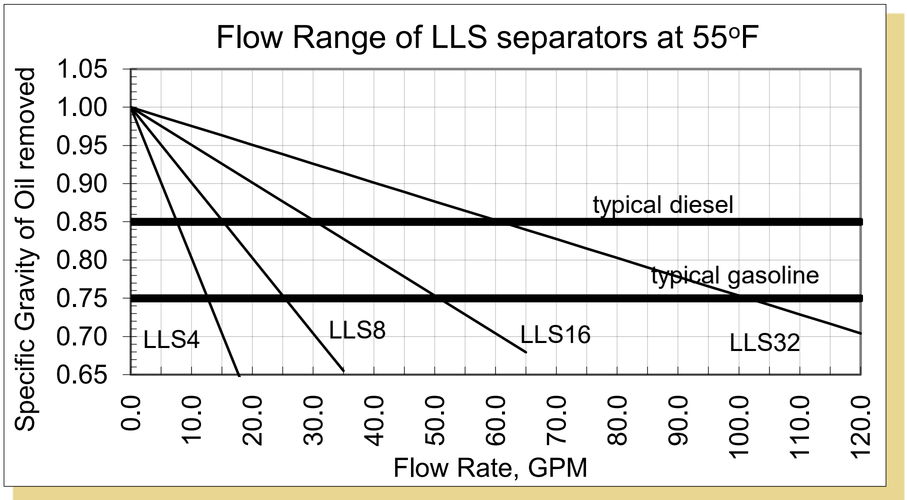
Model Number	Inlet/Outlet Connection	Height In.	Length In.	Dim Width In.	Skimmer Outlet Dia. In.	Media Horizontal Surface Area Ft^2	GPM at 0.75 S.G. oil, 55°F (typical gasoline)	Shipping Weight Lbs.	Operating Weight Lbs.	Clearwell Volume Gallons	Standard Material
LLS4	2” FPT	34	60	28	2”	192	13	95	976	45	FRP
LLS8	2” FPT	47	60	28	2”	384	25	170	1,635	65	FRP
LLS16	3” FPT	47	64	52	2”	768	50	325	3,432	162	FRP
LLS32	4” FPT	47	92	52	2”	1536	100	445	5,292	195	FRP
LLS48	6” 150 lb flng	72	100	52	2”	2304	150	2,100	9,193	271	Steel
LLS80	6” 150 lb flng	72	124	52	2”	3840	250	2,650	12,134	271	Steel
LLS144	8” 150 lb flng	100	133	100	4”	6912	450	7,582	42,966	1,716	Steel
LLS240	10” 150 lb flng	100	166	100	4”	11520	760	9,100	52,125	1,716	Steel
LLS384	10” 150 lb flng	100	202	100	4”	18432	1200	9,627	57,172	1,716	Steel
LLS480	10” 150 lb flng	100	256	100	4”	23040	1500	13,057	82,356	2,145	Steel
LLS576	12” 150 lb flng	100	292	100	6”	27648	1800	14,260	90,000	2,544	Steel

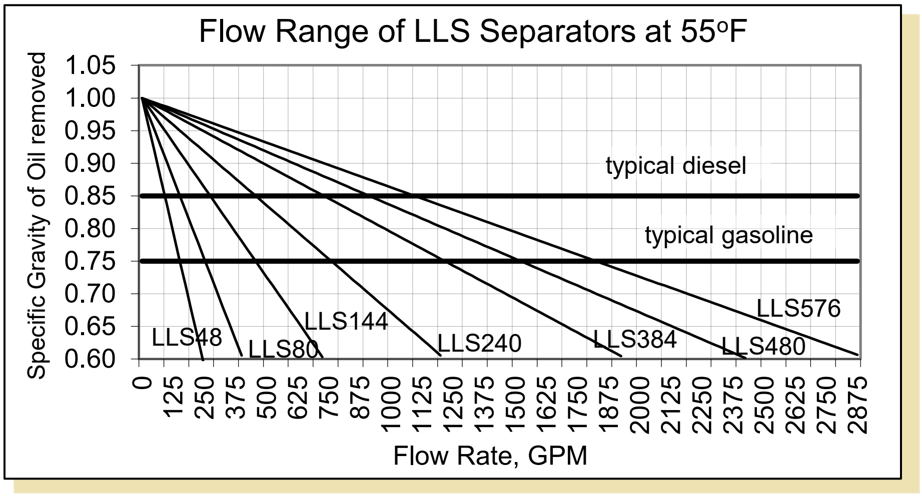


SIDE VIEW



END VIEW





Options

- Stainless steel construction
- Integral product storage sump with level switches
- Elevation stand for gravity drain
- Sludge pumps
- Flow, pressure, level & temperature gages or transmitters
- Immersion heaters, NEMA 4 or NEMA 7 for freeze protection
- ¼” spaced PVC media for higher removal efficiencies
- Media racks to ease removal of media for cleaning
- ¾” Polypropylene media in lieu of PVC
- R-5 insulation with jacket, (steel or aluminum jacket)
- Product storage drums and tanks, single or double wall, typical UL 142
- Oil reservoir trough for pumping product directly from skimmer with level switch(es)

Additional Photos

DTA Series
Diffused Aeration Tank Stripper

H2K
Technologies, Inc.

Features & Specifications *(Patent pending)*

- 304 Stainless steel welded tank construction
- Clearwell for pump out or gravity drain discharge
- (2) 304 Stainless steel fouling-resistant coarse bubble diffusers per chamber with PVC risers and unions above the water line for easy removal
- Centrifugal pressure blower operating under forced or induced draft, welded steel volute and stand, aluminum wheel, special coatings available
- Full removable top cover for easy access to entire cross section, D-ring buna-N cover gasket
- Over and under weirs and baffles to distribute water across each chamber for maximum residence time, aeration and removal efficiency
- Stainless steel hermetically sealed float rod assembly (single or multiple floats for pump control)
- 6” High steel skid125 lb flanged influent & effluent connections with conical gussets
- Flanged air inlet with diffuser for distribution
- Steel skid with C6x8.2 joists and frame members continuously welded at the ends, 3/16” steel deck with 1” fillet welds every 12” on center, fork pockets
- PVC air inlet transition piping with flexible coupling for vibration isolation
- Polypropylene demister on vapor discharge to remove 99% 0f 10 micron and larger droplets
- ¾” Drain valves for sump and aeration chambers
- Internal PVC air distributor header
- Clearwell for pumping directly from unit
- 2” PVC Sump level site glass with flange connections for easy removal

Applications

- Groundwater /wastewater treatment
- Radon removal
- Removal of dissolved chlorinated organic compounds from water (TCE, PCE, TCA, DCA…)
- Removal of gasoline range organics (BTEX compounds), DRO & other hydrocarbons from water (including MTBE)
- Iron oxidation for subsequent filtration
- H2S Removal
- Carbon dioxide removal
- Methane removal
- THM’s

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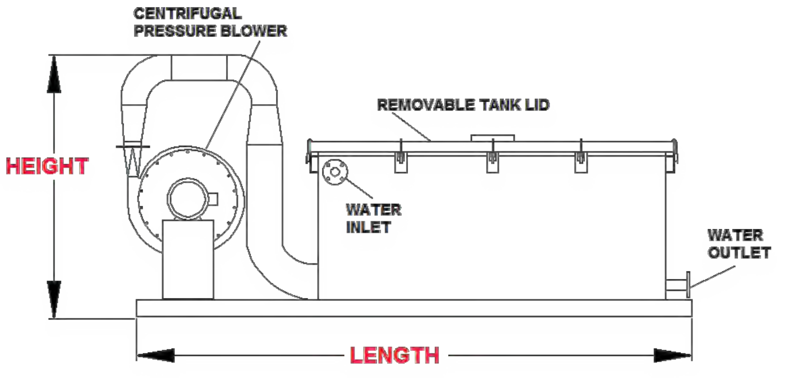
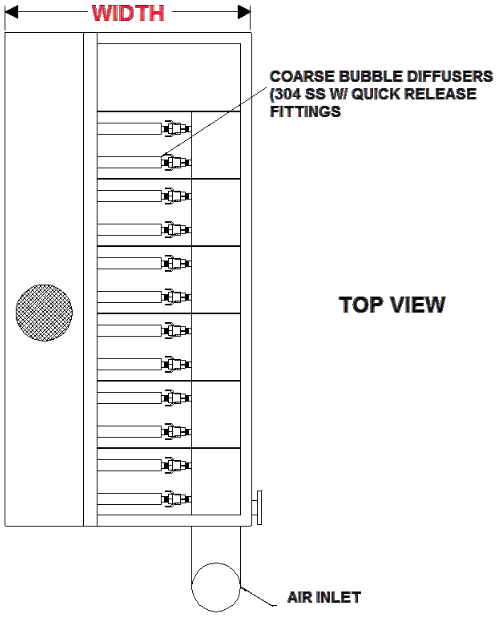
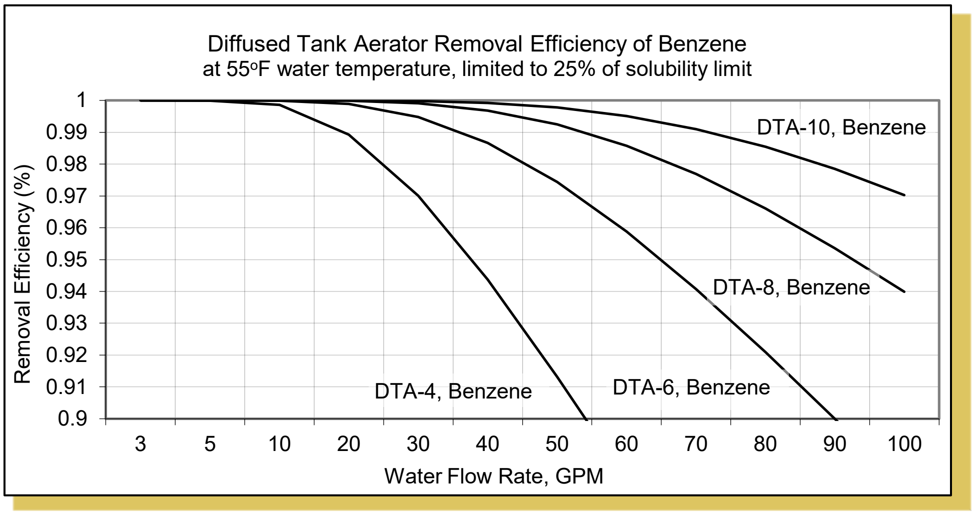
Model Number	Number of aeration chambers	Liquid Flow Range, GPM	Air flow SCFM	Length Feet	Height Feet	Width Feet	Inlet/Outlet connection, Standard	Vapor discharge connection, inches	Standard sump holding capacity Gallons	Shipping Weight Lbs.	Operating Weight Lbs.
DTA-4	4	1-225	320	10.5	5.5	3.5	2” FPT	(2) 4”	35	1,790	3,200
DTA-6	6	1-225	480	12.5	6	4	2” FPT	(2) 8”	40	2,665	6,240
DTA-8	8	1-225	640	14.5	6	4	2” FPT	(2) 8”	40	2,980	7,820
DTA-10	10	1-450	800	11.5	6	8	2” FPT	(2) 10”	80	3,570	9,250
DTA-12	12	1-450	960	12.5	6	8	4” 150lb flng	(2) 10”	80	3,990	10,100
DTA-16	16	1-450	1,280	15.5	6	8	4” 150 lb flng	(2) 10”	80	4,690	11,230

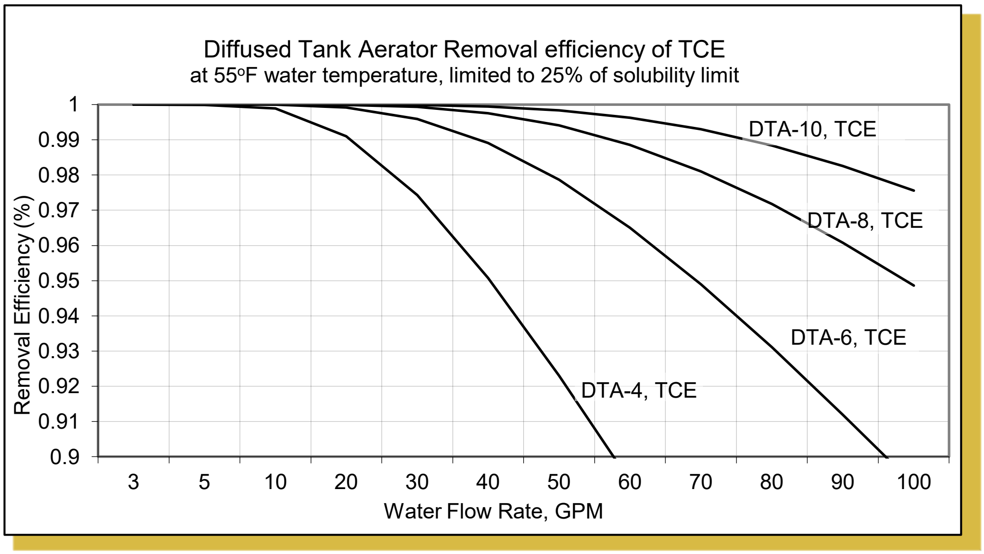


SIDE VIEW





Diffused Tank Aerator Removal Efficiency of Benzene
at 55ºF water temperature, limited to 25% of solubility limit



Diffused Tank Aerator Removal efficiency of TCE
at 55ºF water temperature, limited to 25% of solubility limit

Options

- Epoxy painted steel, fiberglass reinforced plastic construction or welded polypropylene construction
- Larger clearwell for more pump down volume
- High flow units up to 300 gpm
- Sound enclosure with urethane sound insulation to reduce sound level 10-15 dBA at 3
- Centrifugal discharge pump & level controls
- Heat trace or immersion heaters for classified or non-classified electrical areas for freeze protection
- Induced draft blower configuration for humidity
- R-5 insulation with jacket, (FRP or aluminum jacket)
- Custom control panel to control blower, pump and other equipment if required
- Process duct heater to lower humidity in off gas vapor before vapor GAC treatment
- Off gas ducting, FRP, PVC, coated or hot dipped galvanized steel construction
- Enclosures or trailer for freeze protection or mobility
- Flow, pressure, level & temperature gages or transmitters

Additional Photos

IPC Series
DAF & Inclined Plate Clarifiers

H2K
Technologies, Inc.

Features and Specifications

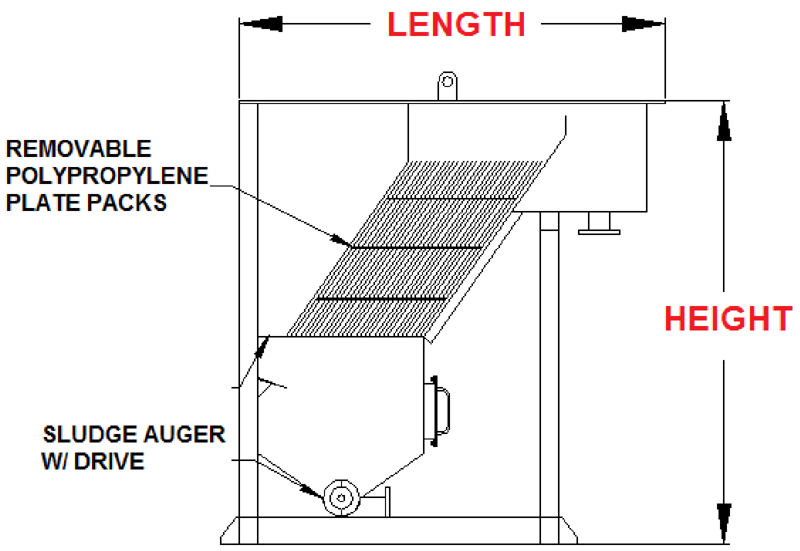
- Suspended solids removal down to 2 ppm possible
- Parallel Plate Packs to increase effective settling area in a small footprint, polypropylene with SS rods, removable with lifting lugs, other materials available
- Counter-flow of settled solids and process flow minimizing solid re-entrainment
- Welded steel construction with sand blasted with epoxy lining and epoxy/urethane external finish, 304 stainless steel construction optional
- Inlet chamber with non-clog diffusers and baffle to distribute flow evenly across packing plates
- Sludge auger to thicken sludge and move it toward sludge outlet for efficient removal, access hatches to solids collection sump
- Clean Water Chamber with Adjustable Effluent Weir to further ensure even distribution across packing plates

Applications

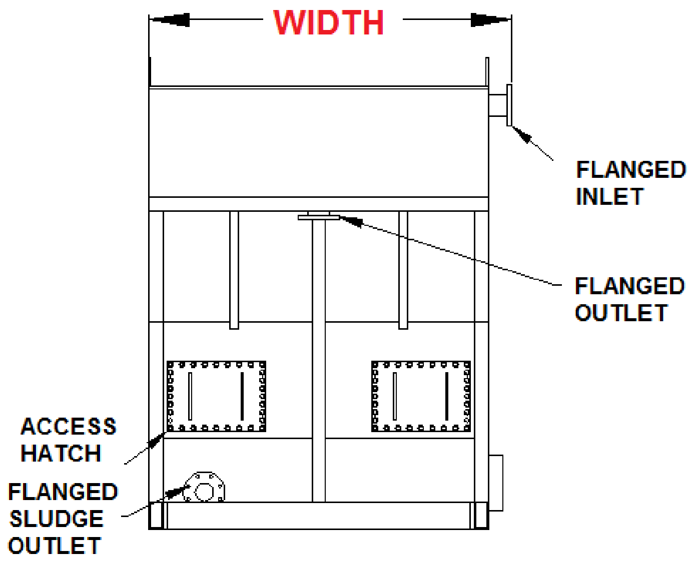
- Removal of Suspended Solids
- Industrial Waste Metals and Sludge Separation
- Precipitated Iron Removal
- Fabricated Metal Plants
- Pulp and Paper Mills
- Railroad Yards

H2K Technologies, Inc.
7550 Commerce St
Corcoran, MN 55340
Phone: 763.746.9900
Fax: 763.746.9903
www.H2KTECH.com
Sales@H2KTech.com

Model Number	Length	Height	Width	Effective Settling Area (Ft^2)	Nominal Flow Rate (gpm) at 0.25 gpm/ft^2	Empty Weight (Lbs)	Operating Weight (Lbs)
IPC-220	7'-4"	8'	4'	220	55	2,580	11,200
IPC-330	7'-4"	8'	6'	330	82.5	3,280	16,000
IPC-440	7'-4"	8'	8'	440	110	4,200	20,800
IPC-550	7'-4"	8'	10'	550	137.5	5,100	25,700
IPC-660	7'-4"	8'	12'	660	165	6,200	30,500
IPC-770	7'-4"	8'	14'	770	192.5	7,000	35,300
IPC-880	7'-4"	8'	16'	880	220	7,800	40,200
IPC-990	7'-4"	8'	18'	990	247.5	8,300	45,000
IPC-1100	7'-4"	8'	20'	1,100	275	9,100	49,800



SECTION SIDE VIEW



END VIEW

Options

- Flash/Floculation Tanks with mixers
- Access catwalk with ladder for maintenance
- Chemical metering for pH, floc agents, and oxidizing agents
- 304 Stainless steel construction

Reference Photos

KPSI 700

- Submersible level transducer
- ±1.00% FS static accuracy
- Custom built in two days
- Two year warranty

The KPSI 700 is a submersible hydrostatic level transducer specifically designed to meet the rigorous environments encountered in liquid level measurement and control. It can be configured to perform to specifications under most adverse, reactive conditions.

Every KPSI Transducer utilizes a highly accurate pressure sensor assembly specifically designed for hostile fluids and gases. The assembly is integrated with supporting electronics in a durable waterproof housing constructed of 316 stainless steel or titanium. The attached electrical cable is custom manufactured and includes para-aramid synthetic fiber members to prevent errors due to cable elongation, and a unique water block feature that self-seals in the event of accidental cuts to the cable. Each vented reference transducer is shipped with a SuperDry Vent Filter that prevents moisture from entering the vent tube for at least one year without maintenance, even in the most humid environments.

Features

- Custom polyurethane or ETFE cable lengths
- Welded 316SS or titanium body
- Custom level ranges up to 700 ft. (210 m) H_2O
- Multiple analog output
- Multiple nose piece styles
- Optional lifetime lightning protection
- Long life vent filter or aneroid bellows
- Available molded cable seal

Applications

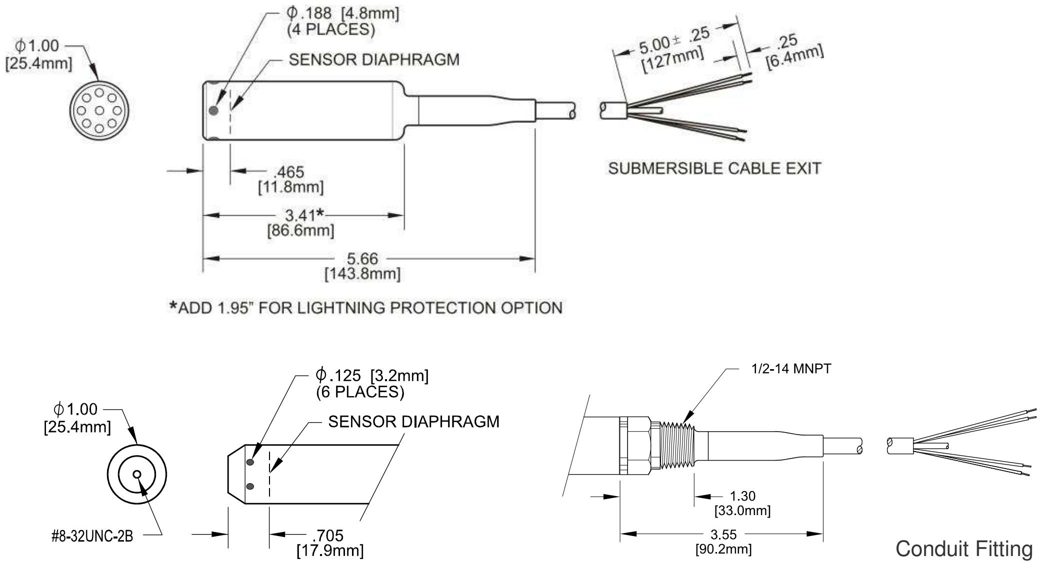
- Lift stations
- Pump control
- Level control
- Surface water monitoring
- Landfill leachate
- Well monitoring
- Groundwater monitoring

Specifications

PARAMETER		**COMMENT**
LEVEL RANGES		
Full Scale Level Ranges (Intermediate level ranges are available)	2.3 thru 700 ft. H_2O (0.70 thru 210 m H_2O)	Vented Gage Reference
	10 thru 700 ft. H_2O (3 thru 210 m H_2O)	Sealed Gage Reference
	35 thru 700 ft. H_2O (10 thru 210 m H_2O)	Absolute Gage Reference
Proof Pressure	1.5 x FS	
Burst Pressure	2.0 x FS	

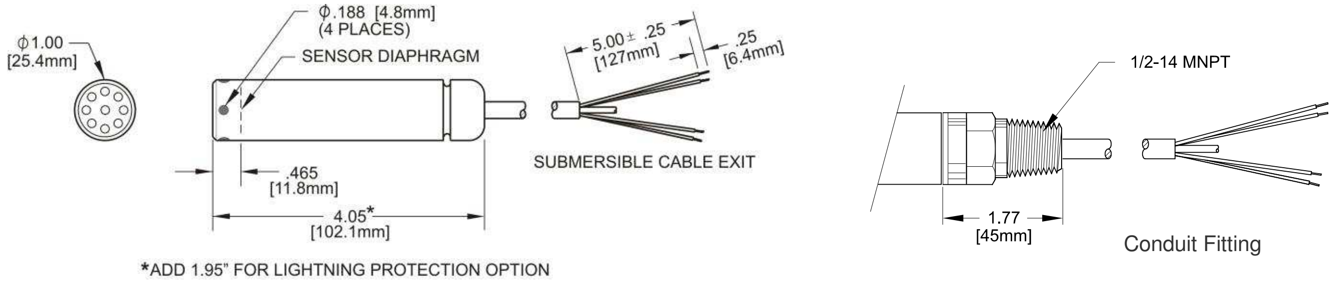
STATIC PERFORMANCE		
Static Accuracy (combined effects of non-linearity, hysteresis and repeatability, best fit straight line method)	±1.00% FSO	BFSL method
Resolution	+0.0001% FS	
ENVIRONMENTAL		
Wetted Materials	316 SS or Titanium; POM; FKM; Polyurethane or ETFE	
Compensated Temp Range	0 to 50ºC	
Thermal Error (maximum allowable deviation from the Best Fit Straight Line due to a change in temperature)	±0.05% FSO/ºC ±0.1% FSO/ºC	Worse case over compensated temperature range for ranges < 12 ft. (4 m) H_2O
Operating Temp Range	-20 to 60 ºC	When attached to polyurethane cable
Protection Rating	IP 68, NEMA 6P	
ELECTRICAL		
Excitation	9-28V – VDC output 9-28V – mA output 15-28V – VDC output 10-28V – VDC output	0-5 V, 0-2.5 V, 0-4 V 4-20 0-10 V 1.5-7.5 V
Input Current	20 mA max., 3.5 mA max.	For mA output, for VDC output
Output	4-20 mA, 0-5 VDC, 0-2.5 VDC, 0-4 VDC, 0-10 VDC, 1.5-7.5 VDC	For ranges < 5 ft. (1.5m) H_2O, only 4-20mA output is available
Zero Offset	±0.25 mA for mA output < 0.25 VDC for VDC output	
Output Impedance	See loop diagram for mA output 20 ohm for VDC output	
Insulation Resistance	100 mega ohm at 50 VDC	
Circuit Protection	Polarity, surge/shorted output	
CERTIFICATIONS		
	CE compliant	EN 61326-1:2013 and 61326-2-3:2013
	UL, CUL and FM	Class I, II, III, Div. 1, Groups A,B,C,D,E,F&G
	WEEE/RoHS	Waste from Electrical and Electronic Equipment (WEEE) and Restrictions on the use of Hazardous Substances (RoHS)
PHYSICAL		
Approximate Weight	0.44 lbs. (198 g) transducer 0.05 lbs./ft. (79 g/m) cable	
Cable Jacket Material	Polyurethane (Standard), ETFE (Optional)	
Cable Pull Strength	200 lbs (90 kg)	Polyurethane
Cable Number of Conductors	4 max.	
Cable Conductor Size	22 AWG	
Cable Seal	Molded Polyurethane FKM Gland	For polyurethane cable For ETFE cable
TEMPERATURE OUTPUT OPTION (Not Intrinsically safety approved)		
Temperature Range	-20 to 60ºC	Available for 4-20 mA output versions only
Output Signal	4-20 mA	
Temperature Measurement Accuracy	±4ºC	±1ºC with single point calibration
LIGHTNING PROTECTION (Power supply needs to be limited to 150mA to avoid lock up of the gas tube after a suppression event)		
Life Expectancy	>1,000 Operations	
Peak Clamping Voltage	36 Volts	
Response Time	<10 nsecs	
Shunts	20,000 Amperes	

Dimensions



*ADD 1.95" FOR LIGHTNING PROTECTION OPTION

Molded Cable Seal Configuration for Polyurethane Cable

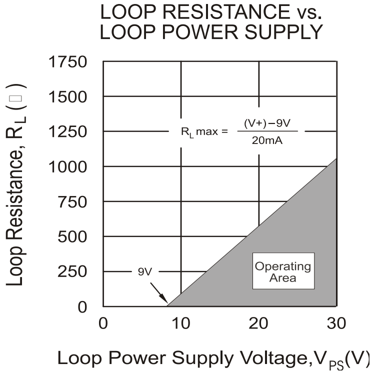


*ADD 1.95" FOR LIGHTNING PROTECTION OPTION

Gland Cable Seal Configuration for ETFE Cable

Electrical Termination / Loop Resistance

ELECTRICAL TERMINATION		
22AWG CONDUCTORS IN A SHIELDED CABLE WITH VENT TUBE		
4-20 mA	RED BLACK	+ EXCITATION - EXCITATION
0-5 VDC	RED BLACK WHITE	+ EXCITATION - EXCITATION + SIGNAL
ALL	DRAIN WIRE	SHIELD



Ordering Information

MODEL | **SUBMERSIBLE LEVEL TRANSDUCER**

7 0 0 ±1.00% FSO Static Accuracy

MATERIAL

S	Stainless Steel
T	Titanium

REFERENCE FORMAT

1	Vented gage
3	Sealed gage
4	Absolute

OUTPUT

3	0-5 VDC
F	0-2.5 V
G	0-4 V
H	0-10 V
J	1.5-7.5V
4	4-20mA
6	4-20mA temperature measurement option

PRESSURE CONNECTION

A	Open-face nose cap
B	Ported nose cap
E	Piezometer nose cap
2	1/4" - 18 NPT male fitting
7	1/2" - 14 NPT male fitting

ELECTRICAL CONNECTION

0	Molded cable seal
4	1/2" - 14 NPT male conduit fitting with molded cable seal
A	Gland cable seal
B	1/2" - 14 NPT male conduit fitting with gland cable seal

LIGHTNING PROTECTION

A	None
B	Full Lightning Protection

LEVEL RANGE (at MAX output)[1]

\# # # . # # #

LEVEL RANGE (at MIN output) [1]

\# # # . # # #

MOISTURE PROTECTION

A	None (sealed/absolute only)
B	Vent Filter
C	Aneroid Bellows
D	Stainless Steel Vent Filter

CABLE TYPE

1	Polyurethane
2	ETFE (Electrical Connection "A" or "B" Only)

CABLE LENGTH

\# # # # (in feet)

LABEL[2]

A	psi
B	ft H_2O
C	m H_2O

7	0	0																										

Notes:

1 The part number requires two level range limits, corresponding to the maximum and minimum analog outputs of the transducer, to be specified in **pounds per square inch (psi)** to three decimal places. The lower level range is typically 000.000 unless otherwise required. For reverse output requirements, enter the lower level range for the maximum output signal and the upper range for the minimum output. Use the following conversion factors: **Ft. H_2O / 2.3073 = psi // m H_2O / 0.703265 = psi**
Examples: 10 ft. H_2O / 2.3073 = 4.334 psi (Enter 004.334 in the part number), 10 m H_2O / 0.703265 = 14.219 psi (Enter 014.219 in the part number)
For sealed gage reference add local atmosphere when converting to psi. Contact PSI for assistance.
Example:10 ft. H_2O / 2.3073 +14.7 = 19.034 psi (Enter 019.034 in the part number)

2 Units of measure on standard MEAS label. Contact Measurement Specialties if private labeling is required.

NORTH AMERICA

Measurement Specialties, Inc.,
a TE Connectivity company
Tel : 1-800-522-6752
Email: customercare.hmpt@te.com

EUROPE

Measurement Specialties (Europe), Ltd.,
a TE Connectivity company
Tel : +33 (0) 800-440-5100
Email: customercare.dtmd@te.com

ASIA

Measurement Specialties (China), Ltd.,
a TE Connectivity company
Tel : +86 755 3330 5088
Email: customercare.shzn@te.com

te.com/sensorsolutions

Measurement Specialties Inc., a TE Connectivity company.

SP

Submersible pumps, motors, and accessories
North America, 60 Hz

be
think
innovate

GRUNDFOS

1. Product data

Introduction

The Grundfos SP range of submersible pumps is renowned for high efficiency and reliability. SP pumps are ideal for a wide variety of applications and are made entirely of corrosion resistant stainless steel.

Grundfos SP pumps represent state-of-the-art hydraulic design. SP pumps are built to deliver optimum efficiency during periods of high demand, and they provide low long-term costs and high operating reliability regardless of the application.

The SP range offers high efficiency, high resistance to sand and other abrasives, motor burnout protection, and easy maintenance. A complete monitoring and control system is available for constant optimization of the pumping system.

TM06 4950 3315

Fig. 1 Grundfos SP pumps

Pump Energy Index

Pump Energy Index (PEI) was established by the U.S. Department of Energy (DOE) and adopted by Canada as the standard metric used to evaluate pump efficiency. The value is the ratio of the pump efficiency rating (PER) divided by the calculated minimally compliant PER (PER_{STD}) for the pump type. This provides a representation of a pump's actual performance compared to the minimal standard performance required by regulation. The lower the PEI value, the more efficient a pump is at the tested operating points.

PER is determined by defined testing parameters required by the DOE. This includes testing a particular pump model at its best efficiency point (BEP).

For PEI values there are two different versions:

- PEI_{CL} (constant load): Applies to a bare-shaft pump, and a pump sold with a motor
- PEI_{VL} (variable load): Applies to pumps sold with a motor and controller (such as VFD, VSD)

The DOE has set the maximum PEI value as 1.00. Any pump, pump and motor, or pump, motor and controller that exceeds a PEI value of 1.00 can no longer be manufactured after January 26, 2020.

PEI is a generalized efficiency value. PEI cannot be used to determine the efficiency of a pump in a specific application.

Pump type	Pole	PEI_{CL} bare-shaft pump	PEI_{CL} pump with motor	PEI_{VL} pump with motor plus controller*	Impeller diameter [in (mm)]
25S	2	0.93	0.93	0.59	2.87 (72)
35S		0.85	0.87	0.54	2.88 (73)
45S		0.84	0.84	0.54	2.87 (72)
62S		0.88	0.88	0.54	2.78 (71)
77S		0.89	0.91	0.54	2.78 (71)
85S		0.82	0.85	0.52	3.49 (89)
150S		0.91	0.91	0.56	3.52 (89)
230S		0.92	0.92	0.54	3.87 (98)
300S		0.92	0.92	0.53	3.90 (99)

*Grundfos CUE continuous controls.

Applications

Grundfos large SP submersible pumps are suitable for:

- Groundwater supply to waterworks
- irrigation in horticulture and agriculture
- groundwater lowering (dewatering)
- pressure boosting
- industrial applications
- domestic water supply.

Pumped liquids

Grundfos SP pumps are suitable for pumping clean, thin, non-aggressive liquids without solid particles or fibers.

SP offers stainless steel construction which ensures good wear resistance and a reduced risk of corrosion where the water has minor chloride content.

Optional, upgraded stainless steel construction is available for pumping more aggressive liquids:

- A complete range of zinc anodes for cathodic protection is available. See page 142 for applications, for example, sea water applications.
- For slightly polluted liquids, such as containing oil, Grundfos offers a complete range of stainless steel SP NE pumps with all rubber parts made of FKM.

Features and benefits

Grundfos SP submersible pumps offer these features and benefits:

- State-of-the-art hydraulics provide high efficiency and low operating costs
- 100 % stainless steel components inside and outside for long service life
- sand resistant
- resistant to aggressive water
- dry-running protection
- monitoring, protection and communication via
  - – protection unit MP 204
  - – Grundfos GO.

A wide pump range

Grundfos offers energy-efficient SP submersible pumps with a performance range of up to 1,400 gpm (318 m^3/h) and 2,100 ft (640 m) of head.

The pump range consists of many pump sizes, and each pump size is available with an optional number of stages to match any duty point.

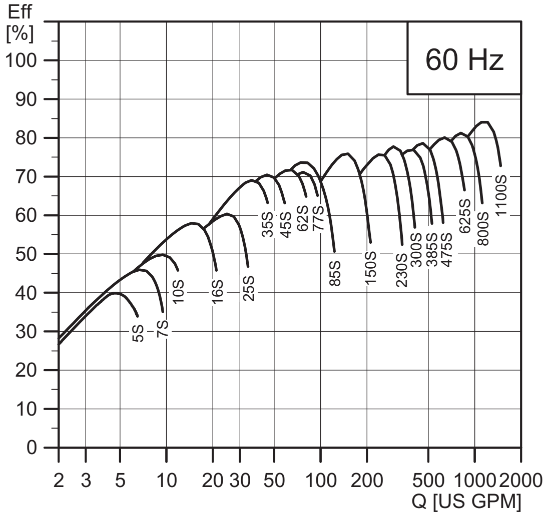
High pump efficiency

Often pump efficiency is given less consideration than the price of a pump; however, owners who choose efficiency will find substantial savings in energy costs over time. See fig. 2 for an illustration of SP efficiencies in relation to flow rate.

Example

For example, a pump and motor with a 10 % higher efficiency than a cheaper, less efficient pump, can save its owner more than $80,000 over 10 years*.

* If producing 880 gpm at 325 ft of head for 10 years at 13.8 cents per kWh. U.S. kWh costs range from 6 cents to more than 20 cents, depending on region.



TM05 0057 3215

Fig. 2 SP pump and motor efficiencies in relation to flow rate

Pump design

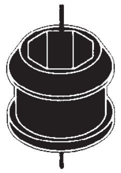
Grundfos SP submersible pumps feature components that contribute to the superior performance and durability of the range.

Lower installation costs

Stainless steel means low weight for ease in the handling of pumps, resulting in lower equipment costs and reduced installation and service time.

Bearings with sand channels

All bearings are water-lubricated and have a squared shape enabling sand particles, if any, to leave the pump together with the pumped liquid.

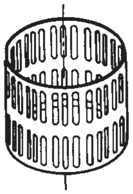


TM00 7301 1096

Fig. 3 Bearing

Inlet strainer

The inlet strainer prevents particles over a certain size from entering the pump.



TM00 7302 1096

Fig. 4 Inlet strainer

Check valve

All pumps are equipped with a reliable check valve in the valve casing preventing back flow in connection with pump stoppage.

Furthermore, the short closing time of the check valve means that the risk of destructive water hammer is reduced to a minimum.

The valve casing is designed for optimum hydraulic properties to minimize the pressure loss across the valve and thus to contribute to the high efficiency of the pump.

Note: As shown in fig. 5 the check valve is spring-assisted intended for vertical pump applications. When installing pump at an angle, installation requires an additional check valve installed in the outlet piping. This prevents misalignment or failure to seat the pump check valve at an angle. Additional check valves in outlet piping are sold separately.

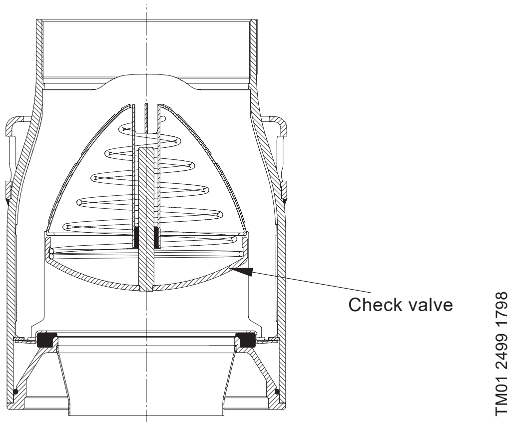


Fig. 5 Check valve

Priming screw

All Grundfos 4" pumps with radial impellers are fitted with a priming screw. Consequently, dry running is prevented because the priming screw will make sure that pump bearings are always lubricated.

Due to the semi-axial impellers of large SP pumps, this priming is provided automatically.

However, it applies to all pump types that if the water table is lowered to a level below the pump inlet, neither pump nor motor will be protected against dry running.

Fig. 6 Priming screw

Stop ring

The stop ring prevents damage to the pump during transport and in case of up-thrust in connection with startup.

The stop ring, which is designed as a thrust bearing, limits axial movements of the pump shaft.

Example: SP 385S

The stationary part of the stop ring (A) is secured in the upper intermediate chamber.

The rotating part (B) is fitted above the split cone (C).

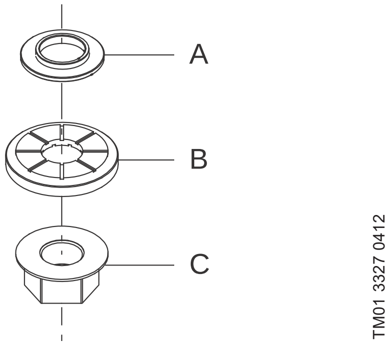


Fig. 7 Stop ring (rotating and stationary part) and the split cone

Grundfos submersible motors

A complete motor range

Grundfos offers a complete submersible motor range in different voltages. For an overview of motor types, sizes and voltages, see page 106.

- MS 402 is designed for the domestic ground water market and covers outputs.
- The MS 4000 and MS 6000C series are designed for use in a variety of applications in water supply. When equipped with features like oversized motor, temperature measurement, cooling jacket, and SiC/SiC mechanical shaft seals, these motors are suitable for heavy-duty industrial applications, such as dewatering operations.

As a standard, all external surfaces of Grundfos MS motors in contact with water are made of AISI 304 stainless steel. For aggressive water, such as seawater or brackish water, R versions made of AISI 904L are available.

Grundfos rewindable MMS motor range

Grundfos MMS motors are suitable for any submersible installation, including heavy-duty industrial applications and dewatering operations (when equipped with temperature control, oversized motor, cooling jacket, and SiC/SiC mechanical shaft seals).

As standard MMS motors are supplied with black cast-iron end-bells. Optionally, the range is available in all-stainless steel AISI 316 or AISI 904L versions.

The 2-pole Grundfos MMS submersible motors are all easy to rewind. The windings of the stator are made of a special waterproof wire of pure electrolytic copper sheathed with special non-hydroscopic thermoplastic material. The fine dielectric properties of this material allow direct contact between the windings and the liquid for efficient cooling of the windings.

TM00 7305 1096 - GrA4011 - GrA4013

Fig. 8 Grundfos MS motors

TM03 3478 0406

Fig. 9 Grundfos MMS motors

Industrial submersible motors and MS 6000C T60 versions

For heavy-duty applications Grundfos offers a complete motor range of industrial motors with up to 5 % higher efficiency than that of Grundfos' standard motors.

The cooling of the motor is very efficient due to the large motor surface. The efficient cooling makes it possible to increase the liquid temperature on T60 motors to 140 °F (60 °C) at a minimum flow rate of 3.3 fps (1.0 m/s) past the motor.

The industrial motors are for customers who value low operating costs and long life higher than price.

Grundfos industrial motors are developed for difficult operating conditions. These motors will stand a higher thermal load than standard motors and thus have a longer life when subjected to high load. This applies whether the high load is caused by bad power supply, hot water, bad cooling conditions, high pump load etc.

Please note that heavy duty motors are longer than motors for standard conditions.

Overtemperature protection

Accessories for protection against overtemperature are available for both Grundfos MS and MMS submersible motors. When the temperature becomes too high, the protection device will cut out so damage to the pump and motor can be avoided.

Restart of the motor after cut-out can be achieved in two ways:

- manual restart
- automatic restart.

Automatic restart means that MP 204 attempts to restart the motor after 15 minutes. If the first attempt is not successful, restarting will be reattempted at 30-minute intervals.

MS: The Grundfos MS submersible motors (with the exception of MS 402) are available with a built-in Tempcon temperature transmitter for protection against overtemperature. By means of the transmitter, it is possible to read out and/or monitor the motor temperature via an MP 204.

The Grundfos MS 402, MS 4000, and MS 6000C submersible motors can be fitted with a Pt100/Pt1000. Pt100/Pt1000 is fitted in the motor and connected directly to MP 204 or monitored by the PR 5714 relay.

MMS: For the protection of the Grundfos MMS submersible motors against overtemperature, Grundfos offers the Pt100/Pt1000 temperature sensor as an optional extra.

Pt100/Pt1000 is fitted in the motor and connected directly to MP 204 or monitored by the PR 5714 relay.

Protection against upthrust

In case of a very low counter pressure in connection with startup, there is a risk that the entire chamber stack may rise. This is called upthrust. Upthrust may damage both pump and motor. Grundfos pumps and motors are protected against upthrust as standard, preventing upthrust from occurring during the critical startup phase. The protection consists of either a built-in stop ring or hydraulic balancing.

Built-in cooling chambers

In all Grundfos MS submersible motors, efficient cooling is ensured by cooling chambers at the top and at the bottom of the motor, and by an internal circulation of motor liquid. See fig. 10.

As long as the required flow velocity past the motor is maintained, cooling of the motor will be efficient.

Lightning protection

The smallest Grundfos submersible motors, such as MS 402, are all insulated in order to minimize the risk of motor burnout caused by lightning strike.

Reduced risk of short-circuit

The embedded stator winding in the Grundfos MS submersible motor is hermetically enclosed in stainless steel. The result is high mechanical stability and optimum cooling. Also, this eliminates the risk of short-circuit of the windings caused by water condensation.

Shaft seal

MS 402

The shaft seal is of the lip seal type characterized by low friction against the rotor shaft.

The rubber material offers good wear resistance, good elasticity and resistance to particles, and it is approved for use in drinking water.

MS 4000

Ceramic/carbon materials provide the MS shaft seals with optimum sealing, optimum wear resistance and long life.

MS 6000C

The MS 6000C shaft seal material is SiC/SiC. The spring loaded shaft seal is designed with a large surface and a sand shield. The result is a minimum exchange of pumped and motor liquids and no penetration of particles.

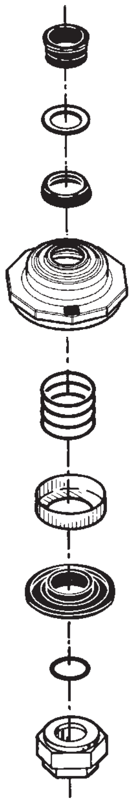
Motors, version R, are supplied with a SiC/SiC shaft seal. Other combinations are available on request. See figs 10 and 11 for an illustration of shaft seal components and configuration.

MMS rewindable motors

The standard shaft seal is a SiC/SiC mechanical shaft seal. The shaft seal is replaceable.

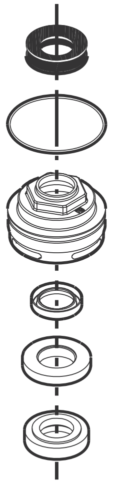
The material features good wear resistance and resistance to particles.

Together with the shaft seal housing, the sand shield forms a labyrinth seal, which during normal operating conditions prevents penetration of sand particles into the shaft seal.



TM00 7306 0412

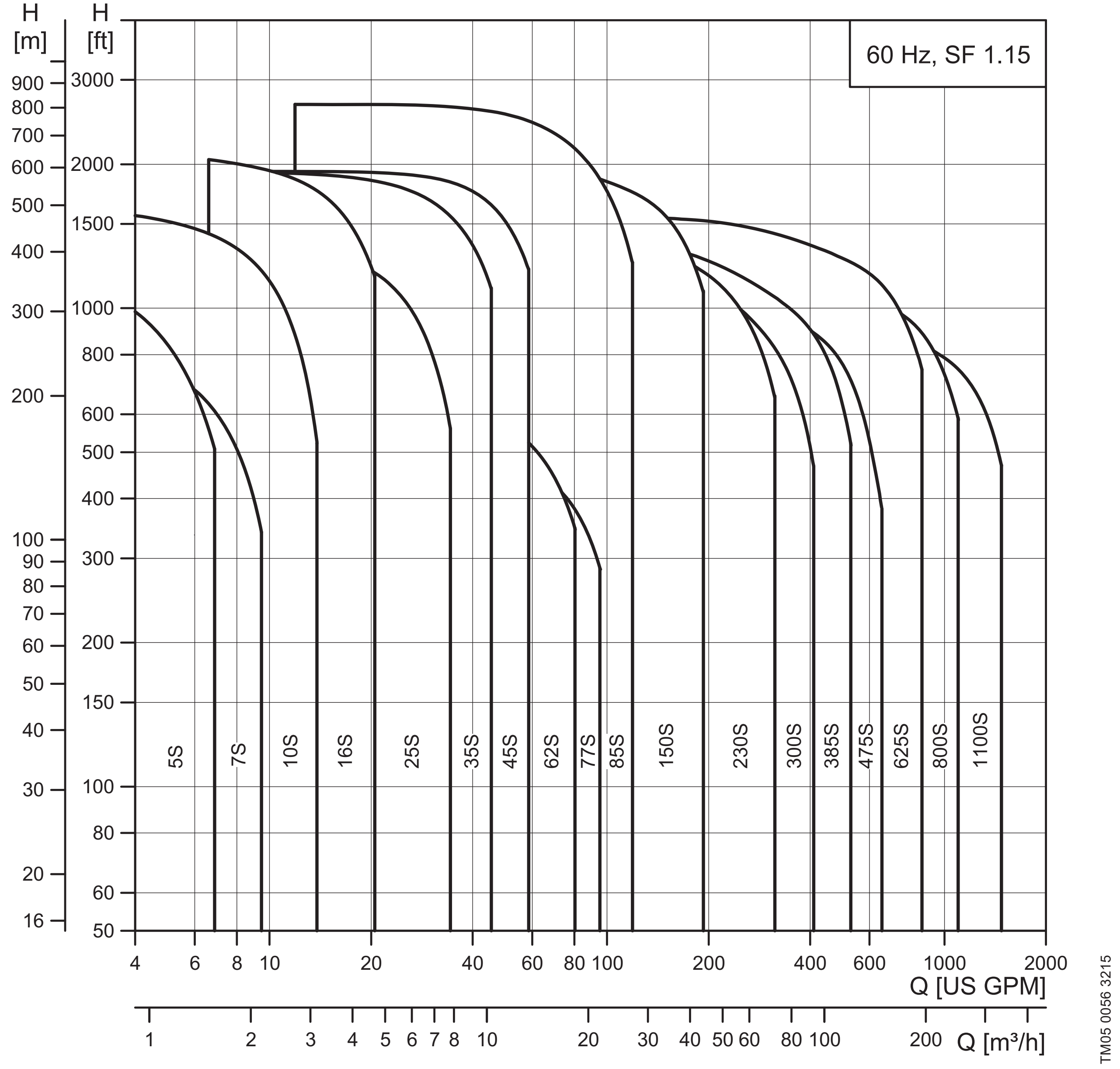
Fig. 10 Shaft seal, MS 4000



TM03 9225 3607

Fig. 11 Shaft seal, MS 6000C

Performance range 60 Hz



Pump range

Type		5S	10S	16S	25S	35S	45S	62S	77S	85S	150S	230S	300S	385S	475S	625S	800S	1100S
AISI 304 (EN 1.4301) stainless steel		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
AISI 316 (EN 1.4401) stainless steel				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
AISI 904L (EN 1.4539) stainless steel					●	●	●	●	●	●	●	●	●	●	●	●	●	●
Connection ★	NPT	1"	1.25"	1.25"	1.5"	1.5" (2")	2" (2")	2"	2"	(3")	(3")	3" (4")	3" 4"	4"	6"	6"	6"	6"
Flange connection: Grundfos flange														4"	6"	6"	6"	6"

★ Figures in brackets ( ) indicate connection for pumps including sleeve and male thread.

Motor protection and controllers range

Motor output [Hp]	0.5	0.75	1.0	1.5	1.5	3.0	5.0	7.5	10.0	15	20	25	30	40	50	60	75	100	125	150	175	200	250
MP 204	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pt100							●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pt1000	●	●	●	●	●	●	●	●															
Zinc anode				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Vertical flow sleeve	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Horizontal flow sleeve	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SA-SPM6	●	●	●	●	●	●	●																
GO remote	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
RS-485 communication module	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Motor protection of single-phase motors, see page 106.

Identification

Type key, SP pumps

Example	475	S	500 -	5 -	A	B

Rated flow rate in gpm

Type range
Stainless steel parts of material
S = AISI 304 (EN 1.4301) SS
N = AISI 316 (EN 1.4401) SS
R = AISI 904L (EN 1.4539) SS

Hp of motor

Number of impellers

First reduced-diameter impeller (A, B or C)

Second reduced-diameter impeller (A, B or C)

Type key, MS 402 motors

Example	MS	4	02

Motor submersible

Minimum well casing diameter in inches

Generation

= AISI 304 (EN 1.4301) stainless steel

Type key, MS 4000 motors

Example	MS	4	000	R

Motor submersible

Minimum well casing diameter in inches

Generation

= AISI 304 (EN 1.4301) stainless steel
R = AISI 904L (EN 1.4539) stainless steel
I = AISI 304 (EN 1.4301) + Derated
RE = AISI 904L (EN 1.4539) + FKM
EI = AISI 304 (EN 1.4301) + Derated + FKM

Type key, MS 6000C

Example pump: MS 6000CQFT40 3 x 460/60 25 Hp

Description	MS 6000C	Q	F	T40	3 x 460/60	25 Hp

Motor type

Material type
= AISI 304 stainless steel (EN 1.4301)
R = AISI 904L stainless steel (EN 1.4539)

Rubber
= NBR
E = FKM

Shaft seal

	=	Ceramic/carbon	BXPFF/NBR
S	=	SiC/SiC	Q1Q1VFF/FKM
Q	=	SiC/SiC	Q1Q1PFF/NBR

Radial bearings
= Ceramic/hard metal
W = SIC/Tungsten carbide

Motor liquid
= SML-3
D = Demineralized water
H = Glycol 60 vol % HTF

Flange extension
= Without
F = With

Tempcon
= With
X = Without

Maximum liquid temperature
T40 = 104 °F (40 °C)
T60 = 140 °F (60 °C)

Voltage
3 x 460/60 = 3 x 440-460-480 V, 60 Hz
3 x 208-230/60 = 3 x 208-220-230 V, 60 Hz
3 x 575/60 = 3 x 575 V, 60 Hz

Method of starting
= DOL
SD = SD

Motor power

5 Hp	3.7 kW	6"
7.5 Hp	5.5 kW	6"
10 Hp	7.5 kW	6"
15 Hp	11 kW	6"
20 Hp	15 kW	6"
25 Hp	18.5 kW	6"
30 Hp	22 kW	6"
40 Hp	30 kW	6"

Type key, MMS motors

Example pump: MMS 3 x 460/60 75 Hp

Example	**MMS**	**6**	**000**	**N**	**3 x 460/60**	**75 Hp**

Motor type

Minimum well casing diameter in inches

Generation

Material type

= Cast iron EN-JL1040
N = AISI 316 (EN 1.4401) SS

Voltage

3 x 460/60 = 3 x 440-460-480 V, 60 Hz

Method of starting

= DOL
SD = SD

Motor power

40 Hp	30 kW	8"
50 Hp	37 kW	6"
50 Hp	37 kW	8"
60 Hp	45 kW	6"
60 Hp	45 kW	8"
75 Hp	55 kW	8"
100 Hp	75 kW	8"
125 Hp	92 kW	8"
150 Hp	110 kW	8"
175 Hp	132 kW	10"
200 Hp	147 kW	10"
250 Hp	190 kW	10"

2. Construction

Sectional drawing, SP pump 4" spline shaft (SP 5S - 25S)

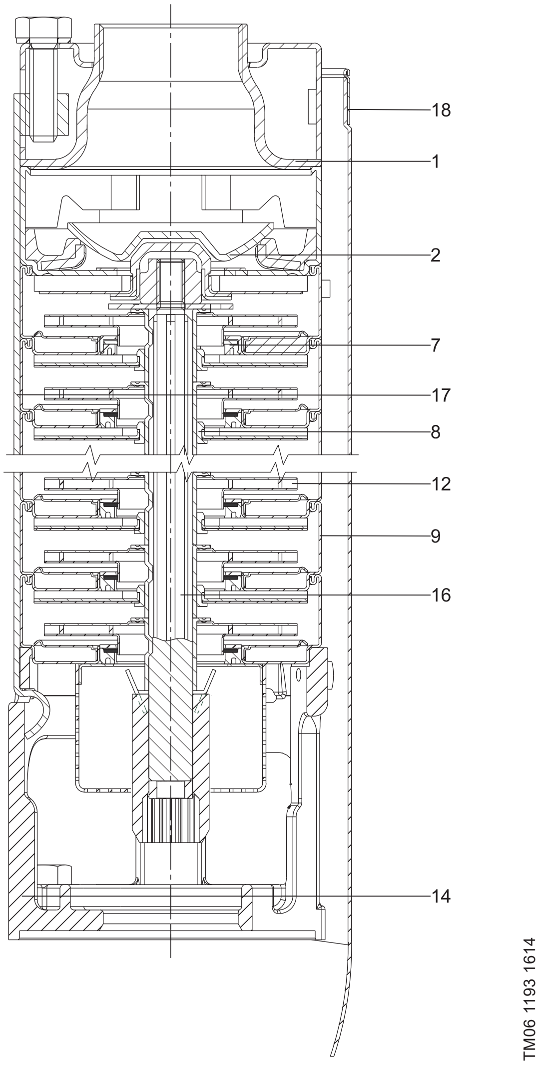


Fig. 12 SP pump, 4" spline shaft (SP 5S - 25S)

Material specification

Pos.	Component	Material	Standard	N-version	R-version
			[AISI (EN)]		
1	Valve casing	Stainless steel	304 (1.4308)	316 (1.4408)	904L (1.4517)
2	Valve cup	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
7	Neck ring	Elastomer	NBR/TPU	NBR/TPU	NBR/TPU
8	Bearing	Elastomer	NBR	NBR	NBR
9	Chamber	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
12	Impeller	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
14	Suction interconnector	Cast stainless steel	304 (1.4308)	316 (1.4408)	904L (1.4517)
16	Shaft complete	Stainless steel	431 (1.4057)	329 (1.4460)	904L (1.4462)
17	Strap	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
18	Cable guard	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
	Washer for stop ring	Carbon/graphite	HY22 in PTFE mass	HY22 in PTFE mass	HY22 in PTFE mass
	Strainer	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
	Valve seat	Elastomer	NBR	NBR-FKM	NBR-FKM

Sectional drawing, SP pump 4" smooth shaft (SP 35S - 77S)

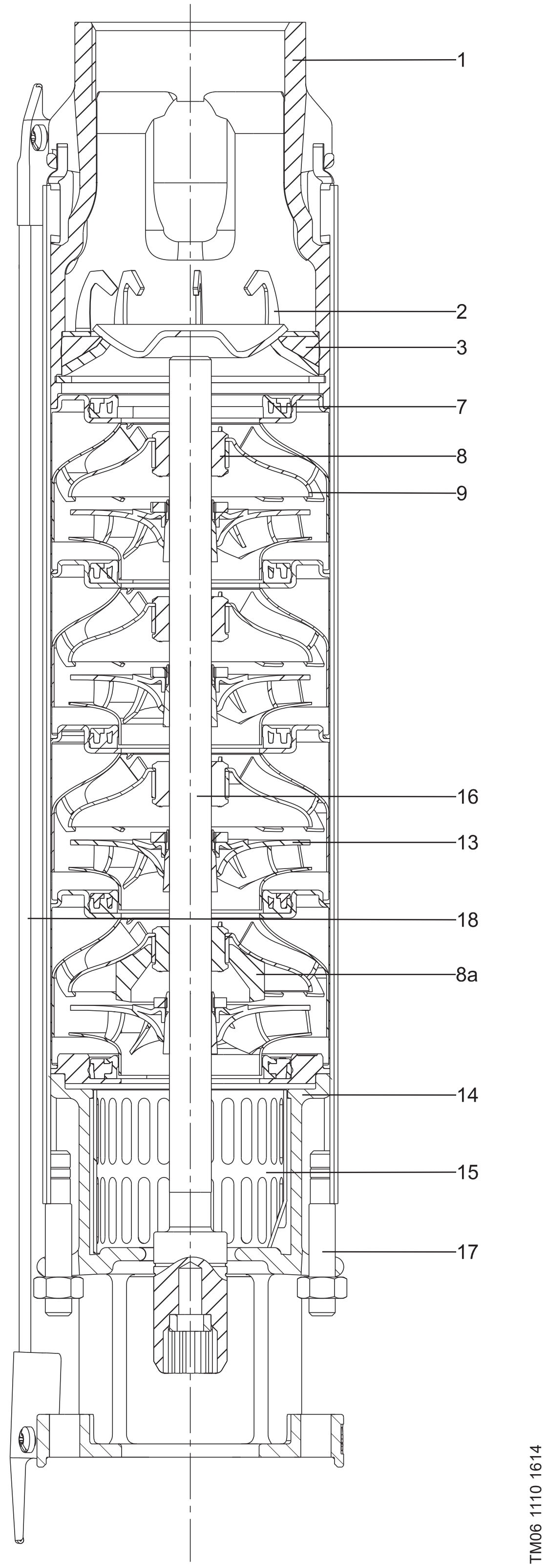


Fig. 13 SP pump, 4" smooth shaft (SP 35S - 77S)

Material specification

Pos.	Component	Material	Standard	N-version	R-version
			[AISI (EN)]		
1	Valve casing	Cast stainless steel	304 (1.4308)	316 (1.4408)	904L (1.4517)
2	Valve cup	Cast stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
3	Valve seat	NBR-FKM	NBR-FKM	NBR-FKM	NBR-FKM
7	Neck ring	TPU/PPS-FKM	TPU/ PPS-FKM	TPU/ PPS-FKM	TPU/ PPS-FKM
8	Bearing	LSR-FKM	LSR/FKM	LSR/FKM	LSR/FKM
8a	Washer for stop ring	Carbon/graphite	HY22 in PTFE mass	HY22 in PTFE mass	HY22 in PTFE mass
9	Chamber	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
13	Impeller	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
14	Suction interconnector	Cast stainless steel	304 (1.4308)	316 (1.4408)	904L (1.4517)
15	Strainer	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
16	Shaft complete	Stainless steel	1.4057	1.4460	1.4462
17	Strap	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
18	Cable guard	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)

Sectional drawing, SP pump 6" (SP 85S - 300S)

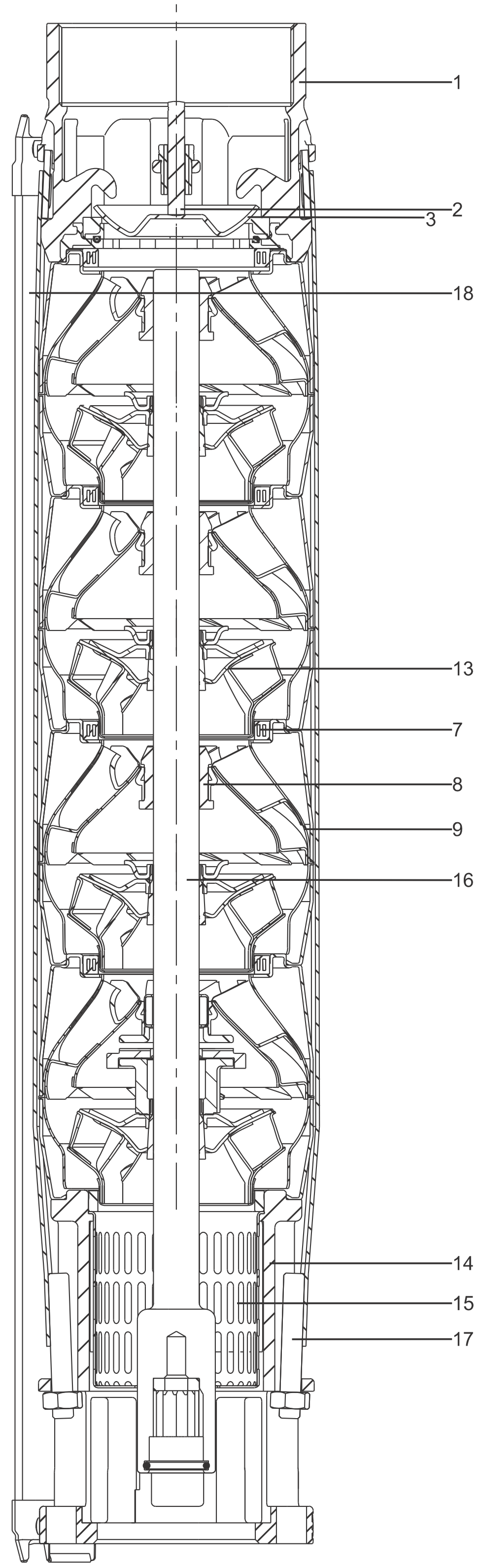
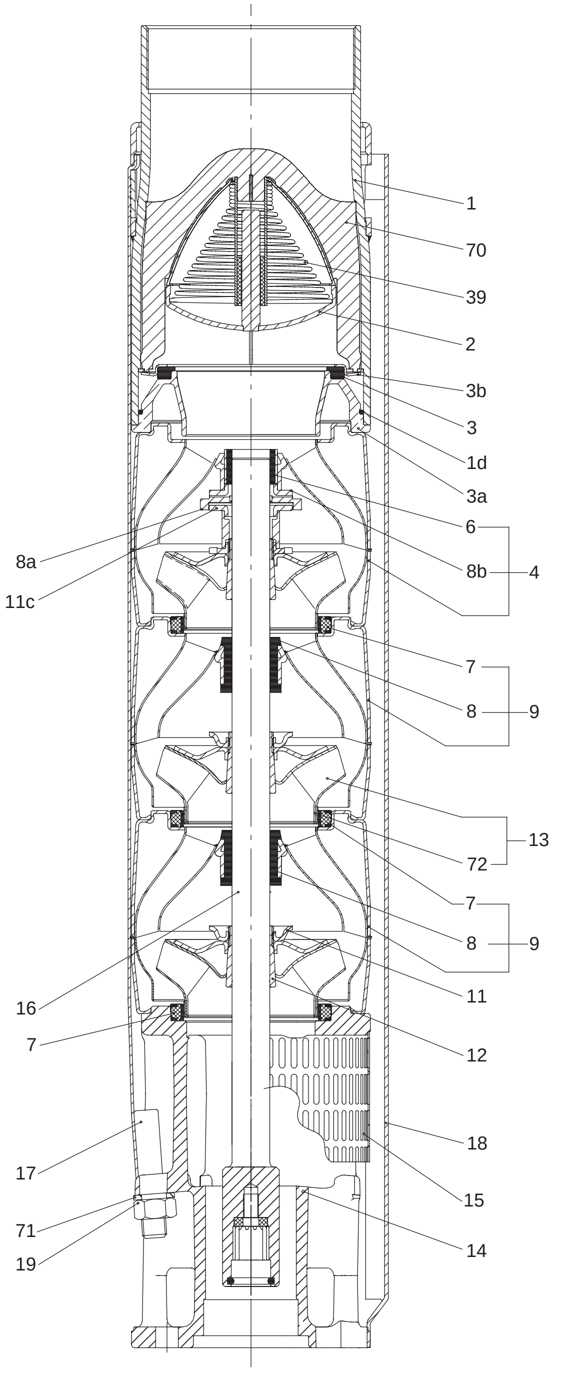


Fig. 14 Example, SP pump, 6" (SP 85S - 300S)

Material specification

Pos.	Component	Material	Standard	N-version	R-version
			[AISI (EN)]		
1	Valve casing	Stainless steel	304 (1.4308)	316 (1.4408)	904L (1.4517)
2	Valve cup	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
3	Valve seat	Elastomer	NBR-FKM	NBR-FKM	NBR-FKM
7	Neck ring	Elastomer	NBR-FKM	NBR-FKM	NBR-FKM
8	Bearing	NBR-FKM-LSR	NBR-FKM-LSR	NBR-FKM-LSR	NBR-FKM-LSR
9	Chamber	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
13	Impeller	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
14	Suction interconnector	Cast stainless steel	304 (1.4308)	316 (1.4408)	904L (1.4517)
15	Strainer	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
16	Shaft complete	Stainless steel	431 (1.4057)	329 (1.4460)	904L (1.4462)
17	Strap	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
18	Cable guard	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)

Sectional drawing, SP pump 8" (SP 385S - 475S)



TM01 2359 2301

Fig. 15 SP pump, 8" (SP 385S - 475S)

Material specification

Pos.	Component	Materials	Standard	N version	R version
			[AISI (EN)]		
1	Valve casing	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
1d	O-ring	Elastomer	NBR	NBR	NBR
2	Valve cup	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
3	Valve seat	Elastomer	NBR	NBR	FKM
3a	Lower valve seat retainer	Stainless steel	316 (1.4401)	316 (1.4401)	904L (1.4517)
3b	Upper valve seat retainer	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
4	Top chamber	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
6	Upper bearing	Stainless steel/NBR	304 (1.4301)	316 (1.4401)	904L (1.4539)
7	Neck ring	Elastomer (optional FKM)	NBR/PPS	NBR/PPS	NBR/PPS
8	Bearing	Elastomer (optional FKM)	NBR	NBR	NBR
8a	Washer for stop ring	Carbon	graphite HY22 in PTFE mass	graphite HY22 in PTFE mass	graphite HY22 in PTFE mass
8b	Stop ring	Stainless steel	316 (1.4401)	316 (1.4401)	904L (1.4539)
9	Chamber	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
11	Split cone nut	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
11c	Nut for stop ring	Stainless steel	316 (1.4401)	316 (1.4401)	904L (1.4539)
12	Split cone	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
13	Impeller	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
14	Suction interconnector	Stainless steel	304 (1.4308)	316 (1.4408)	904L (1.4517)
15	Strainer	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
16	Shaft complete	Stainless steel	431 (1.4057)	329 (1.4460)	329 (1.4460)
17	Strap	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
18	Cable guard	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
19	Nut for strap	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
39	Spring for valve cup	Stainless steel	304 (1.4301)	316 (1.4401)	SAF 2205
70	Valve guide	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)
71	Washer	Stainless steel	316 (1.4401)	316 (1.4401)	904L (1.4539)
72	Wear ring	Stainless steel	304 (1.4301)	316 (1.4401)	904L (1.4539)

Sectional drawing, SP pump 10" (SP 625S - 1100S)

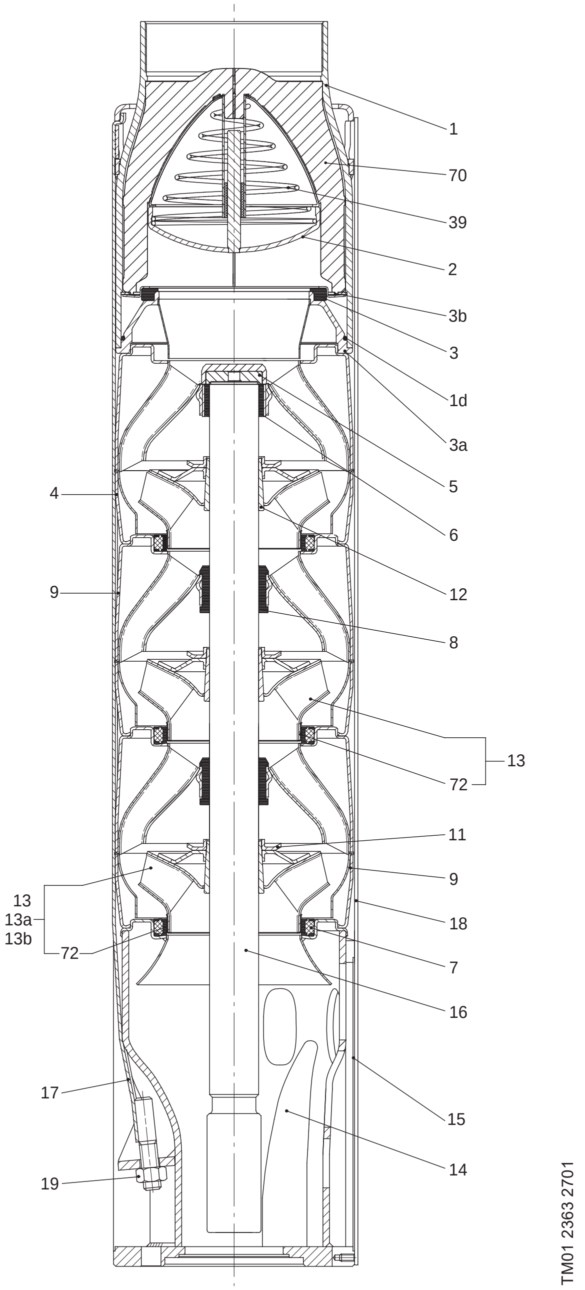
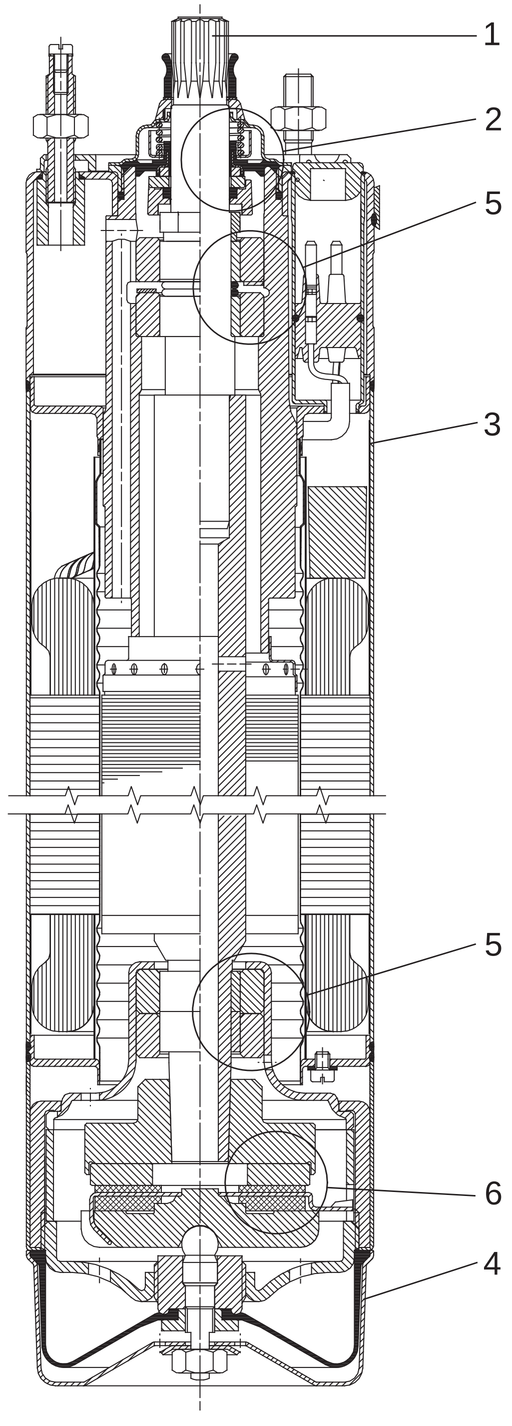


Fig. 16 SP pump, 10" (SP 625S - 1100S)

Material specification

Pos.	Description	Material	Standard	N version
			[AISI (EN)]	
		Valve casing		
1	Valve casing	Stainless steel	304 (1.4301)	316 (1.4401)
1d	O-ring	Elastomer	NBR	NBR
2	Valve cup	Stainless steel	304 (1.4301)	316 (1.4401)
3	Valve seat	Stainless steel	304 (1.4301)	316 (1.4401)
3a	Lower valve seat retainer	Stainless steel	304 (1.4301)	316 (1.4401)
3b	Upper valve seat retainer	Stainless steel	304 (1.4301)	316 (1.4401)
39	Spring for valve cup	Stainless steel	301 (1.4310)	316 (1.4401)
70	Valve guide	Stainless steel	304 (1.4301)	316 (1.4401)
78	Nameplate	Stainless steel	304 (1.4301)	316 (1.4401)
79	Rivet	Stainless steel	304 (1.4301)	316 (1.4401)
63	Connecting piece	Stainless steel	304 (1.4301)	316 (1.4401)
		Chamber stack		
4	Top chamber	Stainless steel	304 (1.4301)	316 (1.4401)
5	Upthrust disc	Carbon/graphite HY22 in PTFE mass		
6	Top bearing	Stainless steel/ NBR	304 (1.4301)	316 (1.4401)
7	Neck ring	Elastomer	NBR/PPS	NBR/PPS
8	Bearing	Elastomer	NBR	NBR
9	Chamber	Stainless steel	304 (1.4301)	316 (1.4401)
11	Nut for split cone	Stainless steel	304 (1.4301)	316 (1.4401)
12	Split cone	Stainless steel	304 (1.4301)	316 (1.4401)
13	Impeller	Stainless steel	304 (1.4301)	316 (1.4401)
16	Shaft with coupling	Stainless steel	431 (1.4057)	329 (1.4460)
18	Cable guard	Stainless steel	304 (1.4301)	316 (1.4401)
18a, 18b	Screw for cable guard	Stainless steel	304 (1.4301)	316 (1.4401)
23	Rubber guard	Elastomer	NBR	NBR
72	Wear ring	Stainless steel	304 (1.4301)	316 (1.4401)
		Suction interconnector		
14	Suction interconnector	Stainless steel	304 (1.4308)	316 (1.4408)
15	Strainer	Stainless steel	304 (1.4301)	316 (1.4401)
17	Strap	Stainless steel	304 (1.4301)	316 (1.4401)
19	Nut for strap	Stainless steel	304 (1.4301)	316 (1.4401)
19a	Nut	Stainless steel	316 (1.4401)	316 (1.4401)
22	Bolts	Stainless steel	316 (1.4401)	316 (1.4401)
28, 28a	Lock for strainer	Stainless steel	329 (1.4460)	329 (1.4460)

Sectional drawing, MS motors



TM00 7865 2196

Fig. 17 MS 4000 motor

Material specification, MS 402, MS 4000, and MS 6000C motors

Pos.	Part	MS 402	MS 4000 MS 6000C
		[AISI (EN)]	
1	Shaft	431	431
2	Shaft seal	NBR	NBR/SiC/SiC
3	Motor sleeve	304 (1.4301)	304 (1.4301)
4	Motor end shield	304 (1.4301)	304 (1.4301)
5	Radial bearing	Ceramic	Ceramic/ tungsten carbide
6	Axial bearing	Ceramic/carbon	Ceramic/carbon
	Rubber parts	NBR	NBR

R-version motor

Pos.	Part	MS 4000 MS 6000C
1	Shaft	318 LN
2	Shaft seal	SiC/SiC
3	Motor sleeve	904L (1.4539)
4	Motor end shield	904L (1.4539)
5	Radial bearing	Ceramic/tungsten carbide
6	Thrust bearing	Ceramic/carbon
	Rubber parts	NBR

Sectional drawing, MMS motors

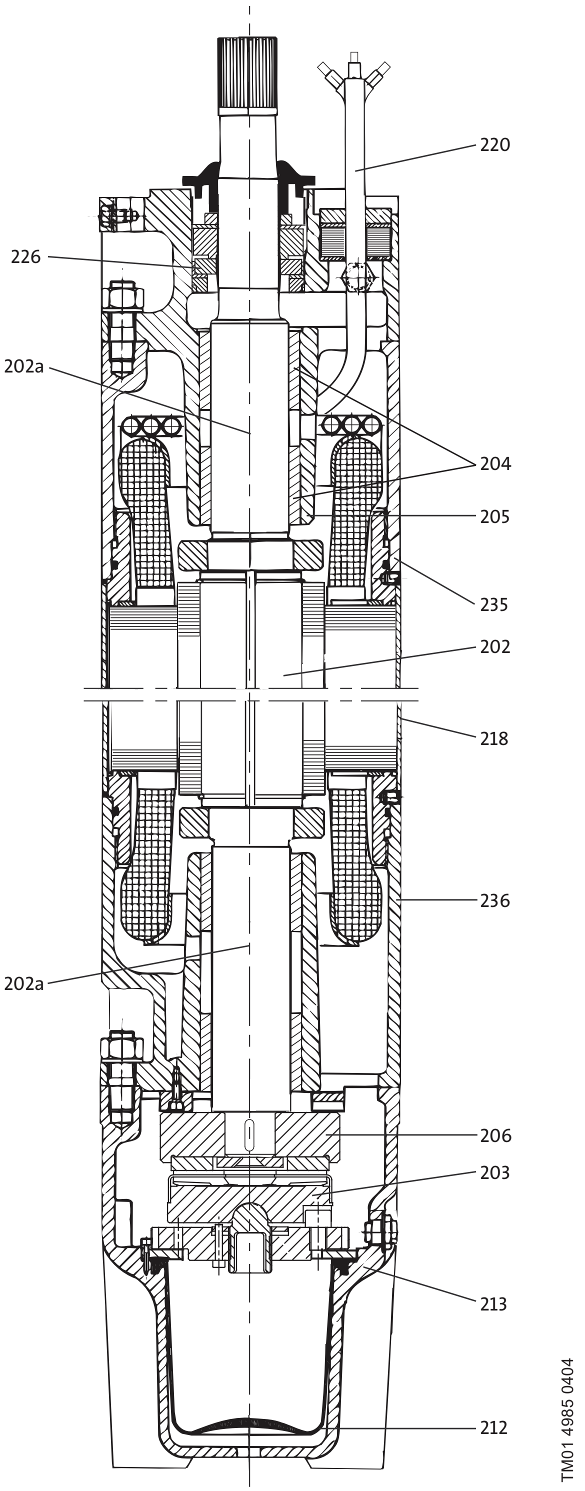


Fig. 18 MMS 10000 motor

Material specification

MMS motors, submersible rewindable versions

Pos.	Component		Material	[AISI (EN)]
202	Shaft		Steel	(1.0533)
202a	Shaft ends		Stainless steel	316/329 (1.4401/1.4460)
203/ 206	Thrust bearing Stationary/ rotating part	6", 0.5 - 20 Hp	Hardened steel/EPDM	
		6", 25-50 Hp	Ceramic/ carbon	
		8" - 10"		
204	Bearing bush	6" - 10"	Carbon	
205	Bearing housing, upper		Cast iron	A126 Class B
212	Diaphragm		CR	
213	Motor end shield		Cast iron	A126 Class B
218	Motor sleeve		Stainless steel	304 (1.4301)
220	Motor cable		EPR	
226	Shaft seal		SiC/SiC	
235	Intermediate housing		Cast iron	A126 Class B
236	Bearing housing, lower		Cast iron	A126 Class B

MMS motors, N and R versions

Pos.	Component		Material	Version	
				N	R
				[AISI (EN)]	
202	Shaft		Steel	(1.0533)	
202a	Shaft ends		Stainless steel	316/329 (1.4401/1.4460)	318LN (1.4462)
203/ 206	Thrust bearing Stationary/ rotating part	6", 0.5 - 20 Hp	Hardened steel/EPDM		
		6", 25-50 Hp	Ceramic/ carbon		
		8" - 10"			
204	Bearing bush	6" - 10"	Carbon		
205	Bearing housing, upper		Stainless steel	316 (1.4401)	904L (1.4539)
212	Diaphragm		CR		
213	Motor end shield		Stainless steel	316 (1.4401)	904L (1.4539)
218	Motor sleeve		Stainless steel	316 (1.4401)	904L (1.4539)
220	Motor cable		EPR		
226	Shaft seal		SiC/SiC		
235	Intermediate housing		Stainless steel	316 (1.4401)	904L (1.4539)
236	Bearing housing, lower		Stainless steel	316 (1.4401)	904L (1.4539)

3. Operating conditions

Operating conditions

Flow rate, Q: 0.44 - 1475 gpm (0.1 - 335 m^3/h).

Head, H: Maximum 2657 ft (810 m).

Maximum liquid temperature

Motor cooling requirements*: Maximum liquid temperature / minimum velocity / flow past the motor

Motor type	Min. well casing or sleeve diameter	Minimum velocity	Minimum flow	Maximum temperature of pumped liquid	
				Vertical installation	Horizontal installation
	in. (mm)	fps (m/s)	gpm (m^3/h)	° F (° C)	° F (° C)
MS402, MS4000	4 (102)	If at 0.0	If at 0.0	86 (30)	Flow sleeve recommended
MS402, MS4000	4 (102)	0.25 (0.08)	1.2 (0.27)	104 (40)	104 (40)
MS6000C (T40) (Standard)	6 (152)	0.50 (0.15)	9 (2)	104 (40)	104 (40)
MS6000C (T60) (High temperature)	6 (152)	3.3 (1.0)	30 (6.8)	140 (60)	140 (60)
MMS6	6 (152)	0.15 (0.05)	13 (3)	86 (30)	86 (30)
MMS8000	8 (203)	0.50 (0.15)	25 (5.7)	86 (30)	86 (30)
MMS10000 (175, 200 HP)	10 (254)	0.50 (0.15)	55 (12.5)	86 (30)	86 (30)
MMS10000 (250 HP)	10 (254)	0.50 (0.15)	41 (9.3)	86 (30)	86 (30)

Note: For MMS 6, 50 Hp; MMS 8000, 150 Hp; the maximum liquid temperature is 9 °F (5 °C) lower than the values stated in the table.
For MMS 10000, 250 Hp, the temperature is 18 °F (10 °C) lower.

Operating pressure

Motor	Maximum operating pressure
MS 402, 4"	217 psi (1.5 Mpa) (15 bar)
MS4000, 4" MS6000C, 6"	870 psi (6 Mpa) (60 bar)
MMS 6" to 10" rewindable	

4. Selection

5S - 25S easy selection charts

5 gpm easy selection chart

Flow range 1.2 to 7 gpm

Pump outlet 1" NPT

Ratings in gallons per minute (gpm)

Pump model	Hp	psi	Depth to pumping water level (lift) in ft																								
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
5S03-9	0.33	0				7.1	6.7	6.2	5.8	5.3	4.8	4.3	3.2	2.1													
		20		7.0	6.6	6.1	5.7	5.2	4.6	4.0	2.8	1.6															
		30		6.5	6.0	5.6	5.1	4.6	3.8	2.9	1.5																
		40	6.7	6.0	5.5	5.1	4.4	3.8	2.4																		
		50	6.2	5.5	4.9	4.4	3.4	2.5	1.3																		
		60	4.6	4.9	4.2	3.5	1.9																				
Shut-off psi			102	94	85	76	68	59	50	42	33	24	16	7													
5S05-13	0.5	0						7.1	6.8	6.4	6.1	5.8	5.5	5.2	4.8	4.5	3.9	2.3									
		20			7.3	7.0	6.7	6.3	6.0	5.7	5.4	5.1	4.7	4.3	3.7	3.1	2.0										
		30		7.2	6.9	6.6	6.3	6.0	5.7	5.4	5.0	4.7	4.2	3.7	2.8	2.0											
		40	7.2	6.9	6.6	6.3	5.9	5.6	5.3	5.0	4.6	4.2	3.5	2.8	1.6												
		50	6.8	6.5	6.2	5.9	5.6	5.3	4.9	4.6	4.0	3.5	2.6	1.6													
		60	6.5	6.2	5.8	5.5	5.2	4.9	4.5	4.0	3.3	2.6	1.3														
Shut-off psi			152	143	134	126	117	108	100	91	82	74	65	56	48	39	30	13									
5S07-18	0.75	0								7.1	6.9	6.7	6.4	6.2	6.0	5.8	5.6	5.1	4.2	2.7							
		20						7.1	6.8	6.6	6.4	6.2	5.9	5.7	5.5	5.3	5.0	4.5	3.2								
		30					7.0	6.8	6.6	6.3	6.1	5.9	5.7	5.5	5.2	5.0	4.7	4.0	2.5								
		40			7.2	7.0	6.8	6.5	6.3	6.1	5.9	5.6	5.4	5.2	4.9	4.7	4.4	3.5	1.5								
		50		7.2	7.0	6.7	6.5	6.3	6.1	5.8	5.6	5.4	5.1	4.9	4.6	4.3	3.9	2.9									
		60	7.1	6.9	6.7	6.5	6.2	6.0	5.8	5.6	5.3	5.1	4.9	4.6	4.3	3.9	3.4	2.1									
Shut-off psi			213	204	195	187	178	169	161	152	143	135	126	117	109	100	91	74	48	22							
5S10-22	1.0	0										7.1	6.9	6.7	6.6	6.4	6.2	5.8	5.3	4.7	3.8	1.7					
		20								7.1	6.9	6.7	6.5	6.3	6.1	6.0	5.8	5.4	4.8	4.0	2.8						
		30							7.0	6.8	6.7	6.5	6.3	6.1	5.9	5.7	5.6	5.2	4.6	3.6	2.1						
		40						7.0	6.8	6.6	6.5	6.3	6.1	5.9	5.7	5.5	5.4	5.0	4.3	3.1	1.3						
		50				7.2	7.0	6.8	6.6	6.4	6.2	6.1	5.9	5.7	5.5	5.3	5.1	4.7	3.9	2.5							
		60			7.1	6.9	6.8	6.6	6.4	6.2	6.0	6.0	5.7	5.5	5.3	5.1	4.9	4.4	3.5	1.7							
Shut-off psi					245	237	228	219	211	202	194	185	176	168	159	150	142	124	98	72	46	12					
5S15-26	1.5	0												7.1	7.0	6.8	6.7	6.4	5.9	5.4	4.9	4.1	2.1				
		20										7.1	6.9	6.8	6.6	6.5	6.3	6.0	5.5	5.1	4.5	3.4					
		30									7.1	6.9	6.7	6.6	6.4	6.3	6.1	5.8	5.4	4.8	4.2	2.9					
		40								7.0	6.9	6.7	6.6	6.4	6.3	6.1	6.0	5.6	5.2	4.6	5.6	2.4					
		50							7.0	6.9	6.7	6.5	6.4	6.2	6.1	5.9	5.8	5.5	5.0	4.4	3.6	1.7					
		60						7.0	6.8	6.7	6.5	6.4	6.2	6.1	5.9	5.8	5.6	5.3	4.8	4.1	3.1						
Shut-off psi								269	260	252	243	234	226	217	208	200	191	174	148	122	96	61	18				
5S15-31	1.5	0														7.1	7.0	6.7	6.3	5.9	5.5	6.7	4.1	2.6			
		20												7.1	6.9	6.8	6.7	6.4	6.0	5.6	5.2	4.6	3.5	1.6			
		30											7.0	6.9	6.8	6.6	6.5	6.2	5.9	5.5	5.1	4.4	3.2	0.9			
		40										7.0	6.9	6.8	6.6	6.5	6.4	6.1	5.7	5.3	4.9	4.2	2.8				
		50								7.1	7.0	6.9	6.7	6.6	6.5	6.3	6.2	6.0	5.6	5.2	4.7	4.0	2.3				
		60							7.1	7.0	6.8	6.7	6.6	6.5	6.3	6.2	6.1	5.8	5.4	5.0	4.5	3.7	1.7				
Shut-off psi									320	311	303	294	285	277	268	259	251	233	207	181	155	121	77	34			

See 5S performance curves for higher head models.
Specifications are subject to change without notice.
These values are approximate. For more precise values, see the performance curves in section *6. Curve charts and technical data*.

7 gpm easy selection chart

Flow range 3 to 10 gpm

Pump outlet 1" NPT

Ratings in gallons per minute (gpm)

Pump model	Hp	psi	Depth to pumping water level (lift) in ft																								
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
7S03-8	0.33	20	10.0	9.5	8.7	8.0	7.2	6.4	5.0	3.7	1.8																
		30	9.3	8.7	7.9	7.1	6.1	5.1	2.6																		
		40	8.5	7.8	7.0	6.1	4.5	2.9	1.5																		
		50	7.6	6.9	5.8	4.7	2.3																				
		60	6.7	5.8	3.9	2.0																					
Shut-off psi			86	77	69	60	52	43	34	26	17	8															
7S05-11	0.5	0					9.9	9.5	8.9	8.4	7.8	7.3	6.7	6.0	5.0	4.0											
		20			9.8	9.3	8.8	8.2	7.7	7.1	6.5	5.8	4.7	3.5	1.8												
		30	10.1	9.7	9.2	8.7	8.1	7.6	7.0	6.4	5.6	4.7	2.9														
		40	9.6	9.2	8.6	8.1	7.5	6.9	6.2	5.6	4.3	3.0	1.5														
		50	9.1	8.5	8.0	7.4	6.8	6.2	5.3	4.3	2.2																
		60	8.4	7.9	7.3	6.8	6.0	5.3	3.8	2.3																	
Shut-off psi			122	113	105	96	87	79	70	61	53	44	35	27	18	10											
7S07-15	0.75	0						10.2	9.9	9.5	9.2	8.8	8.4	8.0	7.6	7.1	6.7	5.6	2.9								
		20				10.1	9.8	9.4	9.0	8.6	8.2	7.8	7.4	7.0	6.5	6.1	5.4	3.6									
		30			10.0	9.7	9.4	9.0	8.6	8.2	7.8	7.4	6.9	6.5	5.9	5.4	4.5	1.8									
		40		10.0	9.7	9.3	8.9	8.5	8.1	7.7	7.3	6.9	6.4	5.9	5.2	4.5	3.2	1.0									
		50	9.9	9.6	9.2	8.9	8.5	8.1	7.6	7.2	6.8	6.4	5.8	5.2	4.2	3.2	1.6										
		60	9.5	9.2	8.8	8.4	8.0	7.6	7.2	6.7	6.2	5.7	4.9	4.2	2.8	1.4											
Shut-off psi			170	101	153	144	135	127	118	110	101	92	84	75	66	58	49	32	6								
7S10-19	1.0	0								10.1	9.8	9.6	9.3	9.0	8.7	8.4	8.0	7.4	6.4	4.8							
		20						10.0	9.8	9.5	9.2	8.9	8.6	8.3	7.9	7.6	7.3	6.6	5.3	2.8							
		30					10.0	9.7	9.5	9.2	8.9	8.5	8.2	7.9	7.6	7.3	6.9	6.2	4.6	1.4							
		40				10.0	9.7	9.4	9.1	8.8	8.5	8.2	7.8	7.5	7.2	6.9	6.5	5.6	3.7								
		50		10.2	9.9	9.7	9.4	9.1	8.8	8.4	8.1	7.8	7.5	7.2	6.8	6.5	6.0	5.0	2.4								
		60	10.1	9.9	9.6	9.3	9.0	8.7	8.4	8.1	7.8	7.4	7.1	6.8	6.4	6.0	5.5	4.2									
Shut-off psi			218	209	200	192	183	174	166	157	148	140	131	123	114	105	97	79	53	27							
7S15-26	1.5	0											10.1	9.9	9.7	9.5	9.3	8.8	8.1	7.4	6.7	5.5					
		20									10.0	9.8	9.6	9.4	9.2	9.0	8.8	8.3	7.6	6.9	6.1	4.4					
		30								10.0	9.8	9.6	9.4	9.2	9.0	8.7	8.5	8.0	7.3	6.6	5.7	3.7					
		40						10.1	10.0	9.8	9.6	9.4	9.1	8.9	8.7	8.5	8.2	7.8	7.1	6.3	5.2	2.9					
		50					10.1	9.9	9.7	9.6	9.3	9.1	8.9	8.7	8.4	8.2	8.0	7.5	6.8	5.9	4.7	1.9					
		60				10.1	9.9	9.7	9.5	9.3	9.1	8.9	8.6	8.4	8.2	7.9	7.7	7.2	6.5	5.5	4.1						
Shut-off psi						274	265	257	248	239	231	222	213	205	196	187	179	161	135	110	84	49					
7S20-32	2.0	0											10.6	10.5	10.4	10.4	10.3	10.1	9.6	9.1	8.4	7.3	5.7				
		20									10.5	10.5	10.4	10.3	10.3	10.2	10.0	9.8	9.2	8.6	7.8	6.6	4.8				
		30								10.5	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.6	9.0	8.3	7.5	6.2	4.3				
		40							10.5	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.7	9.4	8.8	8.0	7.2	5.8	3.9				
		50							10.5	10.4	10.3	10.2	10.1	10.0	9.8	9.7	9.5	9.1	8.5	7.7	6.8	5.4	3.3				
		60						10.5	10.4	10.3	10.2	10.1	10.0	9.8	9.7	9.5	9.3	8.9	8.2	7.4	6.4	5.0					
Shut-off psi							343	334	326	317	308	300	291	282	274	265	256	239	213	187	161	126	83				

See 7S performance curves for higher head models.
Specifications are subject to change without notice.
These values are approximate. For more precise values, see the performance curves in section *6. Curve charts and technical data*.

10 gpm easy selection chart

Flow range 5 to 14 gpm

Pump outlet 1.25" NPT

Ratings in gallons per minute (gpm)

Pump model	Hp	psi	Depth to pumping water level (lift) in ft																								
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
10S03-6	**0.33**	**20**	14.0	13.2	12.4	10.6	8.9	5.3																			
		30	13.2	11.8	10.4	8.4																					
		40	11.9	10.1	8.3																						
		50	9.8	7.5																							
		60	7.7	3.9																							
Shut-off psi			64	55	47	38	29	21	12	3																	
10S05-9	**0.5**	**0**				14.1	13.4	12.4	11.4	10.4	9.5	8.3	6.6	3.5													
		20		13.9	13.1	12.1	11.1	10.1	9.2	7.9	5.8	2.0															
		30	13.8	13.0	12.0	11.0	10.0	9.0	7.6	5.3	1.2																
		40	12.8	11.8	10.8	9.8	8.8	7.3	4.8																		
		50	11.7	10.7	9.7	8.6	7.0	4.3																			
		60	10.5	9.5	8.4	6.7	3.7																				
Shut-off psi			100	92	83	74	66	57	48	40	31	23	14	5													
10S07-12	**.75**	**0**					14.3	13.8	13.2	12.5	11.7	11.0	10.2	9.5	8.7	7.6	6.0										
		20			14.2	13.6	12.9	12.2	11.5	10.7	10.0	9.3	8.4	7.2	5.4	2.6											
		30		14.1	13.5	12.9	12.1	11.4	10.6	9.9	9.2	8.2	7.0	5.0	2.0												
		40	14.0	13.4	12.8	12.0	11.3	10.5	9.8	9.0	8.1	6.7	4.7	1.4													
		50	13.3	12.6	11.9	11.1	10.4	9.7	8.9	7.9	6.5	4.2															
		60	12.5	11.8	11.0	10.3	9.6	8.8	7.7	6.2	3.8																
Shut-off psi			137	129	120	111	103	94	85	77	68	59	51	42	33	25	16										
10S10-15	**1.0**	**0**							14.1	13.6	13.1	12.5	11.9	11.3	10.7	10.1	9.6	8.2	3.8								
		20					13.9	13.5	12.9	12.3	11.7	11.1	10.5	10.0	9.4	8.7	7.9	5.2									
		30				13.9	13.4	12.8	12.2	11.6	11.0	10.5	9.9	9.3	8.6	7.7	6.6	2.6									
		40		14.2	13.8	13.3	12.7	12.1	11.5	10.9	10.4	9.8	9.2	8.5	7.6	6.3	4.6										
		50	14.1	13.7	13.2	12.6	12.1	11.4	10.9	10.3	9.7	9.1	8.3	7.4	6.1	4.3	1.7										
		60	13.6	13.1	12.6	12.0	11.4	10.8	10.2	9.6	9.0	8.2	7.2	5.9	3.9												
Shut-off psi			174	165	157	148	139	131	122	113	105	96	87	79	70	61	53	35	10								
10S15-21	**1.5**	**0**									14.2	13.9	13.6	13.3	12.9	12.5	12.0	11.2	9.9	8.5	6.3						
		20							14.1	13.9	13.5	13.1	12.7	12.3	11.9	11.5	11.0	10.2	8.9	6.9	2.9						
		30						14.1	13.8	13.5	13.1	12.7	12.3	11.8	11.4	11.0	10.5	9.7	8.3	5.7							
		40					14.1	13.8	13.4	13.0	12.6	12.2	11.8	11.3	10.9	10.5	10.1	9.2	7.5	4.1							
		50				14.0	13.7	13.3	13.0	12.5	12.1	11.7	11.3	10.8	10.4	10.0	9.6	8.7	6.5	2.0							
		60		14.2	14.0	13.6	13.3	12.9	12.5	12.1	11.6	11.2	10.8	10.4	9.9	9.5	9.1	8.0	5.1								
Shut-off psi				237	229	220	211	203	194	185	177	168	159	151	142	133	125	107	81	55	29						
10S30-27	**2.0**	**0**												14.1	13.9	13.7	13.4	12.8	11.8	10.8	9.8	8.3	4.7				
		20										14.1	13.8	13.6	13.3	13.0	12.7	12.0	11.0	10.0	9.0	7.1	1.5				
		30									14.0	13.8	13.5	13.3	12.9	12.6	12.3	11.6	10.6	9.7	8.6	6.2					
		40							14.2	14.0	13.8	13.5	13.2	12.9	12.6	12.2	11.9	11.2	10.3	9.3	8.1	5.2					
		50						14.2	14.0	13.7	13.5	13.2	12.8	12.5	12.2	11.9	11.5	10.9	9.9	8.9	7.4	3.8					
		60					14.1	13.9	13.7	13.4	13.1	12.8	12.5	12.1	11.8	11.5	11.1	10.5	9.5	8.4	6.6	2.1					
Shut-off psi							285	276	268	259	250	242	233	224	216	207	198	181	155	129	103	68	25				
10S30-34	**3.0**	**0**																13.8	13.2	12.5	11.9	10.9	9.6	7.9	4.8		
		20														13.9	13.7	13.3	12.7	12.0	11.3	10.3	8.9	6.7	2.7		
		30													13.9	13.7	13.5	13.1	12.4	11.7	11.0	10.0	8.5	6.0	1.3		
		40											14.0	13.8	13.7	13.5	13.3	12.8	12.2	11.5	10.8	9.7	8.0	5.1			
		50										14.0	13.8	13.6	13.4	13.2	13.0	12.6	11.9	11.2	10.5	9.4	7.5	4.2			
		60										13.8	13.6	13.4	13.2	13.0	12.8	12.3	11.6	10.9	10.2	9.0	6.9	3.1			
Shut-off psi												332	324	315	306	298	289	272	246	220	194	159	116	73	29		

See 10S performance curves for higher head models.
Specifications are subject to change without notice.
These values are approximate. For more precise values, see the performance curves in section *6. Curve charts and technical data*.

16 gpm easy selection chart

Flow range 10 to 20 gpm

Pump outlet 1.25" NPT

Ratings in gallons per minute (gpm)

Pump model	Hp	psi	Depth to pumping water level (lift) in ft																								
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
16205-5	.5	20	20.3	18.2	14.1	10.0	5.0																				
		30	17.3	14.4	8.0	1.6																					
		40	12.7	8.0	4.0																						
		50	6.5																								
		60	2.9																								
Shut-off psi			58	49	40	32	23	14																			
16S07-8	.75	0					20.5	19.2	17.5	15.8	12.8	9.8	5.2														
		20			20.1	18.8	16.9	15.2	11.8	8.5	4.3																
		30	21.2	19.9	18.4	16.9	14.3	11.8	7.5	3.2	1.6																
		40	19.7	18.3	16.3	14.3	10.8	7.2	3.6																		
		50	17.9	16.3	13.5	10.7	6.2	1.7																			
		60	15.7	13.5	9.6	5.8	2.9																				
Shut-off psi			97	88	80	71	62	54	45	36	28	19	10														
16S10-10	1.0	0						20.8	19.8	18.8	17.3	15.9	13.7	11.4	8.0	4.7											
		20				20.5	19.4	18.3	16.8	15.3	12.9	10.5	7.0	3.5	1.8												
		30			20.3	19.3	18.1	16.8	14.8	12.8	9.8	6.7	3.3														
		40		20.2	19.1	18.0	16.4	14.8	12.2	9.6	5.9	2.3															
		50	20.0	19.0	17.7	16.3	14.2	12.0	8.8	5.6	2.8																
		60	18.8	17.6	15.8	14.1	11.3	8.6	4.8																		
Shut-off psi			123	115	106	97	89	80	71	63	54	45	37	28	19	11											
16S15-14	1.5	0								21.0	20.3	19.6	18.8	18.0	16.9	15.8	14.3	10.7	3.3								
		20							20.1	19.3	18.5	17.7	16.6	15.4	13.8	12.2	10.0	5.1									
		30					20.7	20.0	19.2	18.4	17.4	16.5	15.1	13.7	11.8	9.8	7.3	2.4									
		40				20.6	19.8	19.1	18.3	17.4	16.0	15.0	13.3	11.6	9.3	7.0	4.3										
		50			20.4	19.8	18.9	18.2	17.2	16.1	14.7	13.2	11.2	9.1	6.5	3.9	2.0										
		60		20.3	19.6	18.8	18.0	17.1	15.8	14.5	12.8	11.0	8.6	6.3	3.4												
Shut-off psi				167	158	149	141	132	123	115	106	97	89	80	71	63	54	37	28								
16S20-18	2.0	0										21.2	20.6	20.0	19.5	18.9	18.2	16.7	13.5	8.8	2.7						
		20									20.4	19.8	19.3	18.7	18.0	17.3	16.4	14.3	10.0	4.2							
		30								20.3	19.8	19.2	18.6	17.9	17.2	16.3	15.3	12.8	7.9	1.9							
		40							20.3	19.7	19.1	18.5	17.8	17.1	16.1	15.2	13.9	11.1	5.7								
		50						20.2	19.6	19.0	18.3	17.7	16.8	16.0	14.9	13.8	12.3	9.2	3.2								
		60					20.1	19.5	18.9	18.3	17.5	16.8	15.8	14.8	13.5	12.3	10.6	7.0									
Shut-off psi							194	186	177	168	160	151	142	134	125	116	108	90	65	39	13						
16S30-24	3.0	0																19.6	18.3	16.5	14.2	9.8	2.1				
		20													20.3	19.9	19.5	18.6	17.0	14.8	11.8	6.5					
		30												20.3	19.8	19.4	19.0	18.0	16.3	13.7	10.4	4.7					
		40											20.2	19.8	19.3	18.9	18.4	17.3	15.3	12.5	8.9	2.8					
		50										20.2	19.8	19.3	18.8	18.3	17.8	16.7	14.3	11.3	7.3						
		60									20.1	19.7	19.2	18.8	18.3	17.8	17.2	15.8	13.3	9.8	5.5						
Shut-off psi											239	230	221	213	204	195	187	169	143	117	91	57	13				
16S50-38	5.0	0																			21.5	20.4	18.7	16.5	13.4	8.9	2.1
		20																			20.9	19.6	17.7	15.2	11.5	6.1	
		30																		21.4	20.5	19.2	17.2	14.5	10.5	4.5	
		40																		21.1	20.2	18.8	16.7	13.7	9.3	2.7	
		50																	21.6	20.7	19.8	18.4	16.1	12.8	8.0	0.8	
		60																	21.3	20.4	19.4	17.9	15.4	11.9	6.6		
Shut-off psi																			314	288	262	227	184	141	98	54	11

See 16S performance curves for higher head models.
Specifications are subject to change without notice.
These values are approximate. For more precise values, see the performance curves in section *6. Curve charts and technical data*.

25 gpm easy selection chart

Flow range 18 to 32 gpm

Pump outlet 1.5" NPT

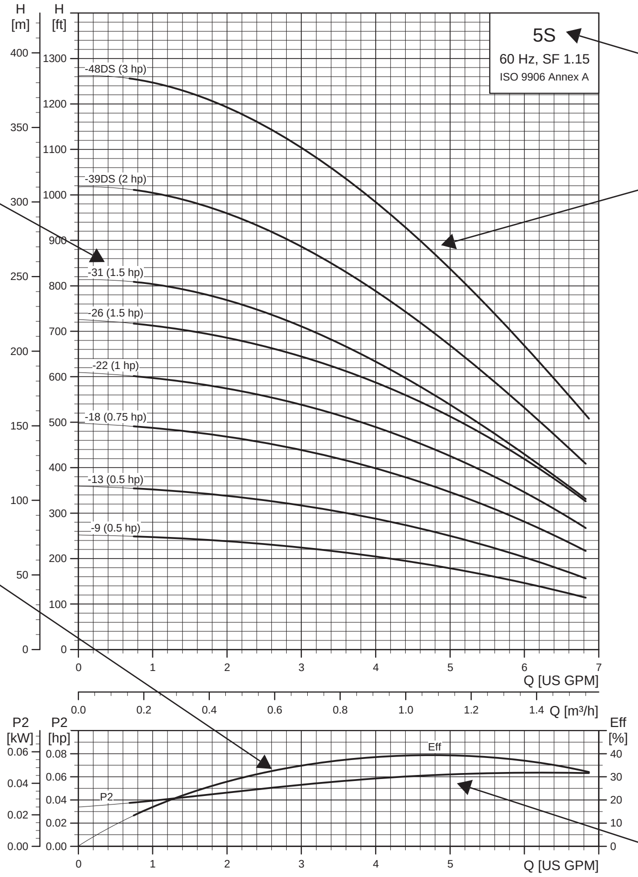
Ratings in gallons per minute (gpm)

Pump model	Hp	psi	Depth to pumping water level (lift) in ft																								
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	400	460	520	600	700	800	900	1000	1100
25S05-3	.5	20	18.6	6.5	3.3																						
		30	10.5																								
		40																									
		50																									
		60																									
Shut-off psi			31	22	13	5																					
25S07-5	.75	0			34.5	29.8	23.9	18.1																			
		20	32.9	28.6	21.8	15.1	7.5																				
		30	27.1	22.5	12.3	2.0																					
		40	19.5	11.8	5.8																						
		50	10.1																								
		60	4.1																								
Shut-off psi			57	48	39	31	22	13																			
25S10-7	1.0	0					31.3	28.5	24.3	20.2	12.7	5.1															
		20		33.2	30.3	27.6	22.9	18.3	10.4	2.5	1.3																
		30	33.0	29.9	26.5	23.1	13.0	9.6	4.8																		
		40	29.4	26.6	21.3	16.2	8.2																				
		50	25.3	21.5	14.3	7.0	3.5																				
		60	19.7	13.9	7.0																						
Shut-off psi			83	74	65	57	48	39	31	22	13	5															
25S15-9	1.5	0						32.2	30.0	27.9	24.8	21.6	16.3	10.8													
		20				31.5	29.3	27.2	23.7	20.3	14.5	8.8	4.4														
		30			31.3	29.1	26.4	23.7	18.9	14.2	7.8	1.5															
		40		30.8	28.6	26.3	22.6	18.8	12.8	6.8	3.4																
		50	30.6	28.4	25.5	22.5	17.4	12.3	6.2																		
		60	27.8	25.5	21.3	17.2	11.0	4.8	2.4																		
Shut-off psi			109	100	91	83	74	65	57	48	39	31	22	13													
25S20-11	2.0	0						33.1	31.1	29.3	27.6	25.1	22.5	18.5	14.5	9.3											
		20					32.5	30.6	28.8	27.0	24.3	21.5	17.3	13.0	7.8	2.5											
		30				32.0	30.3	28.7	26.4	24.2	20.6	16.9	12.0	7.0	3.5												
		40			31.8	30.1	28.2	26.3	23.3	20.4	15.9	11.4	6.3														
		50		31.5	29.8	28.1	25.7	23.3	19.4	15.6	10.4	5.3	2.7														
		60	31.3	29.6	27.6	25.6	22.4	19.3	14.5	9.8	4.9																
Shut-off psi			135	126	118	109	100	92	83	74	66	57	48	40	31	23											
25S30-15	3.0	0										32.3	31.0	29.8	28.4	27.1	25.2	20.7									
		20								31.8	30.6	29.3	28.0	26.6	24.6	22.7	19.8	13.5									
		30						33.0	31.7	30.4	29.2	27.8	26.2	24.5	22.1	19.7	16.4	9.3									
		40					32.8	31.5	30.3	29.0	27.5	26.0	24.0	21.9	19.0	16.1	12.4	4.9									
		50				32.6	31.3	30.0	28.7	27.4	25.7	23.8	21.3	18.8	15.3	12.0	8.2	2.2									
		60			32.4	31.1	29.8	28.6	27.0	25.5	23.3	21.2	18.1	15.0	11.3	7.6	3.8										
Shut-off psi					170	161	152	144	135	126	118	109	100	92	83	74	66	48									
25S50-26	5.0	0																32.5	30.3	28.0	25.3	19.9	10.2				
		20															32.3	30.8	28.6	25.9	22.5	15.8	5.0				
		30														32.1	31.3	29.9	27.7	24.7	20.8	13.5	2.5				
		40													32.0	31.3	30.5	29.1	26.7	23.3	18.9	11.0					
		50											32.7	31.8	31.2	30.4	29.7	28.2	25.5	21.8	16.8	8.5					
		60										32.5	31.8	31.0	30.3	29.6	28.8	27.3	24.3	20.0	14.6	5.8					
Shut-off psi												253	245	236	227	219	210	193	167	141	115	80	37				

See 25S performance curves for higher head models.
Specifications are subject to change without notice.
These values are approximate. For more precise values, see the performance curves in section *6. Curve charts and technical data*.

5. Performance curves and technical data

How to read the curve charts



Pump type, frequency, and service factor.

Number of stages. First figure: number of stages; second figure: impeller trim(s).

QH curve for the individual pump. The **bold** curves indicate the **recommended** performance range for best efficiency.

The efficiency curve (Eff) shows the efficiency of the pump. The efficiency curve is an average curve of all the pump types shown in the chart. The efficiency of pumps with reduced-diameter impellers is approximately 2 % lower than the efficiency curve shown in the chart.

The power curves (P2) indicate pump input power **per stage**. Curves are shown for complete (1/1) and for reduced-diameter (2/3) impellers.

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Curve conditions

The conditions below apply to the curves shown in section *6. Curve charts and technical data* on pages 29-105:

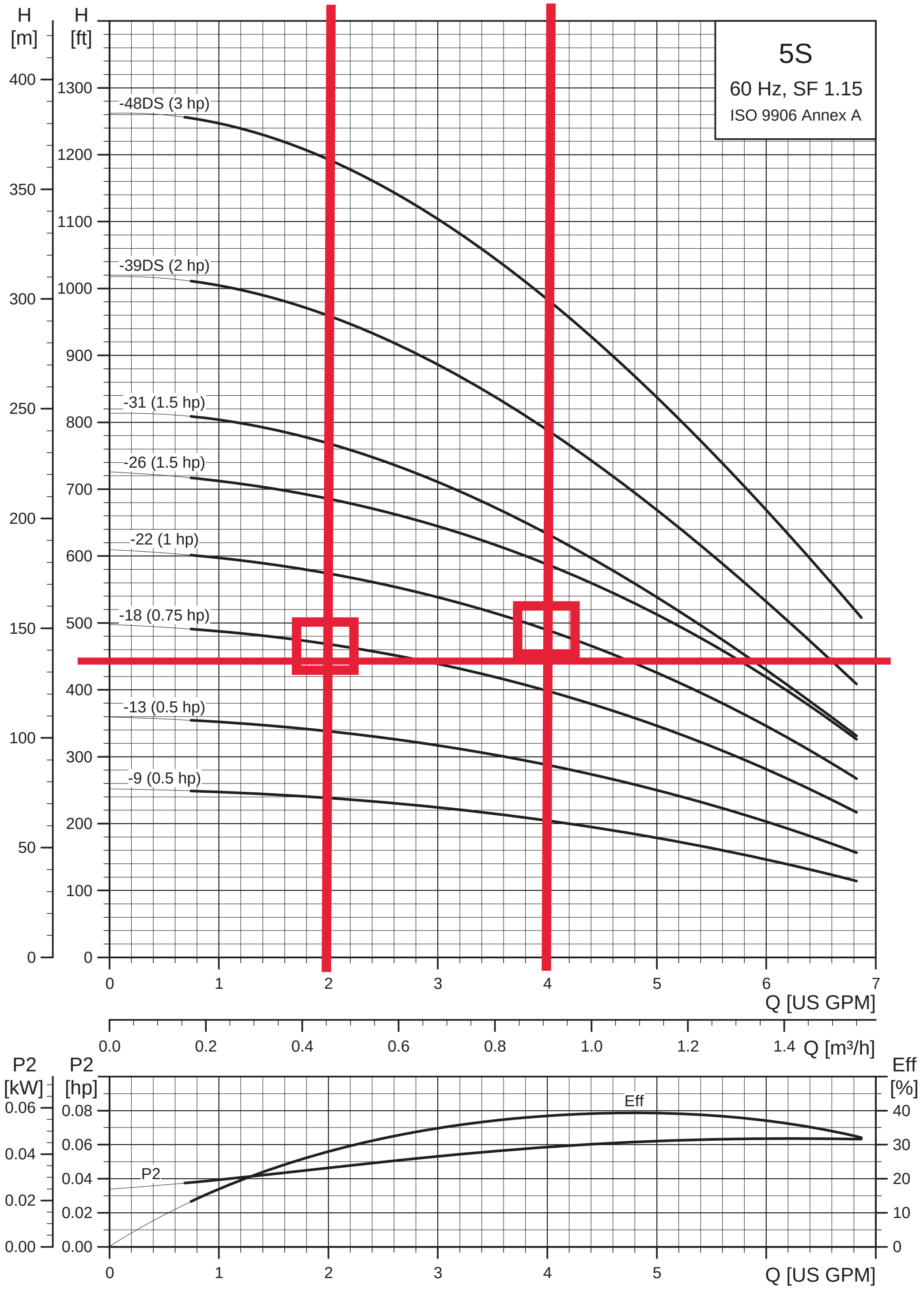
General

- Curve tolerances according to ISO 9906, Annex A.
- The performance curves show pump performance at actual speed, cf. standard motor range.
  The motor speeds are listed in the data tables in section *6. Curve charts and technical data*.
- The measurements were made with airless water at a temperature of 68 °F (20 °C). The curves apply to a kinematic viscosity of 1 mm^2/s (1 cSt). When pumping liquids with a density higher than that of water, use motors with correspondingly higher outputs.
- The **bold** curves indicate the recommended performance range.
- The performance curves are inclusive of possible losses such as check valve loss.
- **Pump rpm:** The curves include the actual motor rpm. The actual motor rpm is listed in the data charts in section *6. Curve charts and technical data*.
- **Q/H:** The curves are inclusive of valve and inlet losses at the actual speed.
  Operation without check valve will increase the actual head at rated performance by 1.6 to 3.3 ft (0.5 to 1.0 m).
- **NPSH:** The curve is inclusive of pressure loss in the suction interconnector and shows required inlet pressure.
- **Power curve:** P_2 shows pump power input [Hp] at the actual speed of each individual pump size.
- **Efficiency curve:** Eta shows pump stage efficiency. If Eta for the actual pump size is needed, please consult Grundfos Product Center.

6. Curve charts and technical data

4" and larger wells

SP 5S (5 gpm)



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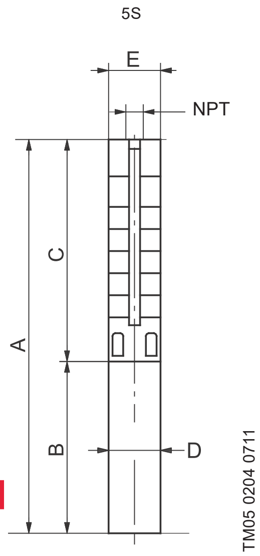
4" and larger wells - continued

SP 5S (5 gpm) pump with 4" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
5S, motor diameter 4-inch, 2-wire motor, 60 Hz - rated flow rate 5 gpm (1" NPT)												
5S05-9	184	1	230	0.5	■	3517	24.57 (624)	11.03 (280)	13.55 (344)	3.74 (95)	3.98 (101)	21.6
5S05-13	258	1	115	0.5	■	3360	27.88 (708)	11.03 (280)	16.86 (428)	3.74 (95)	3.98 (101)	26.9
			230	0.5	■	3474	27.88 (708)	11.03 (280)	16.86 (428)	3.74 (95)	3.98 (101)	26.1
5S07-18	357	1	230	0.75	■	3465	32.60 (828)	11.62 (295)	20.99 (533)	3.74 (95)	3.98 (101)	29.7
5S10-22	439	1	230	1	■	3400	36.50 (927)	12.21 (310)	24.30 (617)	3.74 (95)	3.98 (101)	32.4
5S15-26	529	1	230	1.5	■	3439	41.30 (1049)	13.71 (348)	27.60 (701)	3.74 (95)	3.98 (101)	41.4
5S15-31	585	1	230	1.5	■	3410	47.21 (1199)	13.71 (348)	33.51 (851)	3.74 (95)	3.98 (101)	47.7
5S, motor diameter 4-inch, 3-wire motor, 60 Hz - rated flow rate 5 gpm (1" NPT)												
5S05-9	184	1	230	0.5	■	3450	24.57 (624)	11.03 (280)	13.55 (344)	3.74 (95)	3.98 (101)	22.5
5S05-13	258	1	115	0.5	■	3382	27.88 (708)	11.03 (280)	16.86 (428)	3.74 (95)	3.98 (101)	26.9
			230	0.5	■	3352	27.88 (708)	11.03 (280)	16.86 (428)	3.74 (95)	3.98 (101)	25.2
5S07-18	357	1	230	0.75	■	3346	32.60 (828)	11.62 (295)	20.99 (533)	3.74 (95)	3.98 (101)	28.8
5S10-22	439	1	230	1	■	3379	36.50 (927)	12.21 (310)	24.30 (617)	3.74 (95)	3.98 (101)	32.4
5S15-26	529	1	230	1.5	■	3459	41.30 (1049)	13.71 (348)	27.60 (701)	3.74 (95)	3.98 (101)	37.8
		3	230	1.5	■	3465	39.81 (1011)	12.21 (310)	27.60 (701)	3.74 (95)	3.98 (101)	38.7
			460	1.5	■	3465	39.81 (1011)	12.21 (310)	27.60 (701)	3.74 (95)	3.98 (101)	38.7
5S15-31	585	1	230	1.5	■	3423	47.21 (1199)	13.71 (348)	33.51 (851)	3.74 (95)	3.98 (101)	47.7
		3	230	1.5	■	3437	45.71 (1161)	12.21 (310)	33.51 (851)	3.74 (95)	3.98 (101)	45.0
			460	1.5	■	3437	45.71 (1161)	12.21 (310)	33.51 (851)	3.74 (95)	3.98 (101)	45.0
5S20-39DS	730	1	230	2	●	3428	59.61 (1514)	19.49 (495)	40.12 (1019)	3.74 (95)	4.25 (108)	57.6
		3	230	2	■	3426	53.82 (1367)	13.71 (348)	40.12 (1019)	3.74 (95)	4.25 (108)	54.0
			460	2	■	3426	53.82 (1367)	13.71 (348)	40.12 (1019)	3.74 (95)	4.25 (108)	54.0
5S30-48DS	909	1	230	3	●	3450	70.16 (1782)	22.60 (574)	47.56 (1208)	3.74 (95)	4.25 (108)	77.4
		3	208	3	●	3485	65.56 (1665)	18.00 (457)	47.56 (1208)	3.74 (95)	4.25 (108)	77.4
			230	3	●	3485	65.56 (1665)	18.00 (457)	47.56 (1208)	3.74 (95)	4.25 (108)	77.4
			460	3	●	3485	65.56 (1665)	18.00 (457)	47.56 (1208)	3.74 (95)	4.25 (108)	77.4



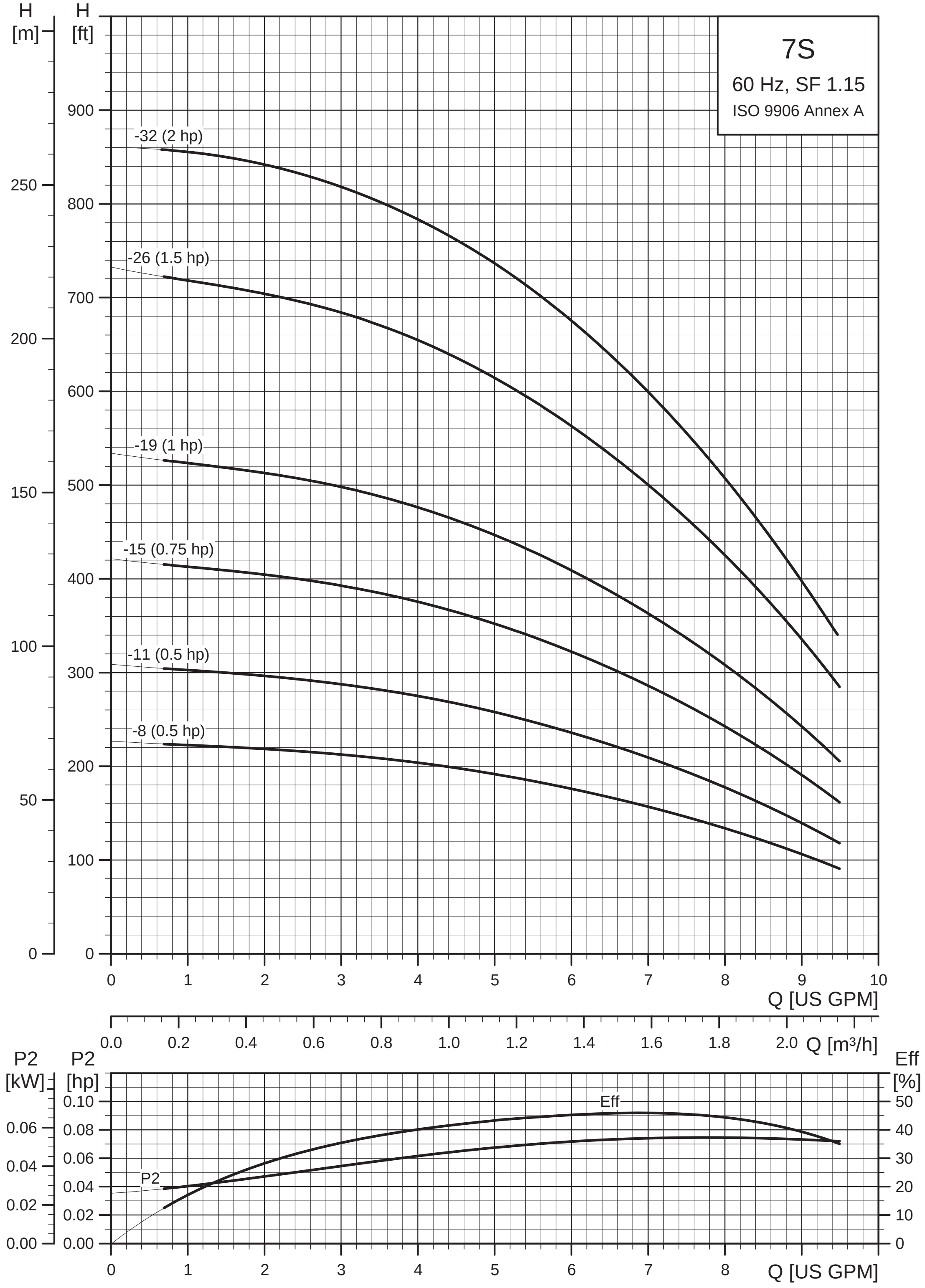
E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
DS designation = Built into sleeve, 1 - 1/2" NPT, 6" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 2 ft (0.6 m).

- ■ MS 402 motor.
- ● MS 4000 motor.

4" and larger wells - continued

SP 7S (7 gpm)



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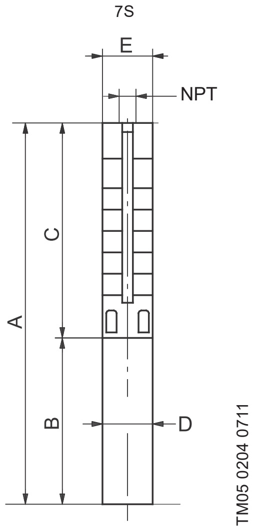
4" and larger wells - continued

SP 7S (7 gpm) pump with 4" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
7S, motor diameter 4-inch, 2-wire motor, 60 Hz - rated flow rate 7 gpm (1" NPT)												
7S05-8	164	1	230	.5	■	3512	23.75 (603)	11.03 (280)	12.72 (323)	3.74 (95)	3.98 (101)	21.6
7S05-11	222	1	115	.5	■	3359	26.23 (666)	11.03 (280)	15.20 (386)	3.74 (95)	3.98 (101)	29.7
			230	.5	■	3472	26.23 (666)	11.03 (280)	15.20 (386)	3.74 (95)	3.98 (101)	24.3
7S07-15	303	1	230	.75	■	3467	30.12 (765)	11.62 (295)	18.51 (470)	3.74 (95)	3.98 (101)	29.7
7S10-19	385	1	230	1	■	3394	34.02 (864)	12.21 (310)	21.82 (554)	3.74 (95)	3.98 (101)	32.4
7S15-26	525	1	230	1.5	■	3408	41.3 (1049)	13.71 (348)	27.60 (701)	3.74 (95)	3.98 (101)	41.4
7S, motor diameter 4-inch, 3-wire motor, 60 Hz - rated flow rate 7 gpm (1" NPT)												
7S05-8	164	1	230	.5	■	3438	23.75 (603)	11.03 (280)	12.72 (323)	3.74 (95)	3.98 (101)	21.6
7S05-11	222	1	115	.5	■	3380	26.23 (666)	11.03 (280)	15.20 (386)	3.74 (95)	3.98 (101)	21.6
			230	.5	■	3349	26.23 (666)	11.03 (280)	15.20 (386)	3.74 (95)	3.98 (101)	30.6
7S07-15	303	1	230	.75	■	3349	30.12 (765)	11.62 (295)	18.51 (470)	3.74 (95)	3.98 (101)	27.9
7S10-19	385	1	230	1	■	3369	34.02 (864)	12.21 (310)	21.82 (554)	3.74 (95)	3.98 (101)	39.6
7S15-26	525	1	230	1.5	■	3419	41.30 (1049)	13.71 (348)	27.60 (701)	3.74 (95)	3.98 (101)	38.7
		3	230	1.5	■	3435	39.81 (1011)	12.21 (310)	27.60 (701)	3.74 (95)	3.98 (101)	38.7
			460	1.5	■	3435	39.81 (1011)	12.21 (310)	27.60 (701)	3.74 (95)	3.98 (101)	38.7
7S20-32	630	1	230	2	●	3590	52.05 (1322)	19.49 (495)	32.56 (827)	3.74 (95)	3.98 (101)	48.5
		3	230	2	■	3596	46.26 (1175)	13.71 (348)	32.56 (827)	3.74 (95)	3.98 (101)	48.5
			460	2	■	3596	46.26 (1175)	13.71 (348)	32.56 (827)	3.74 (95)	3.98 (101)	48.5



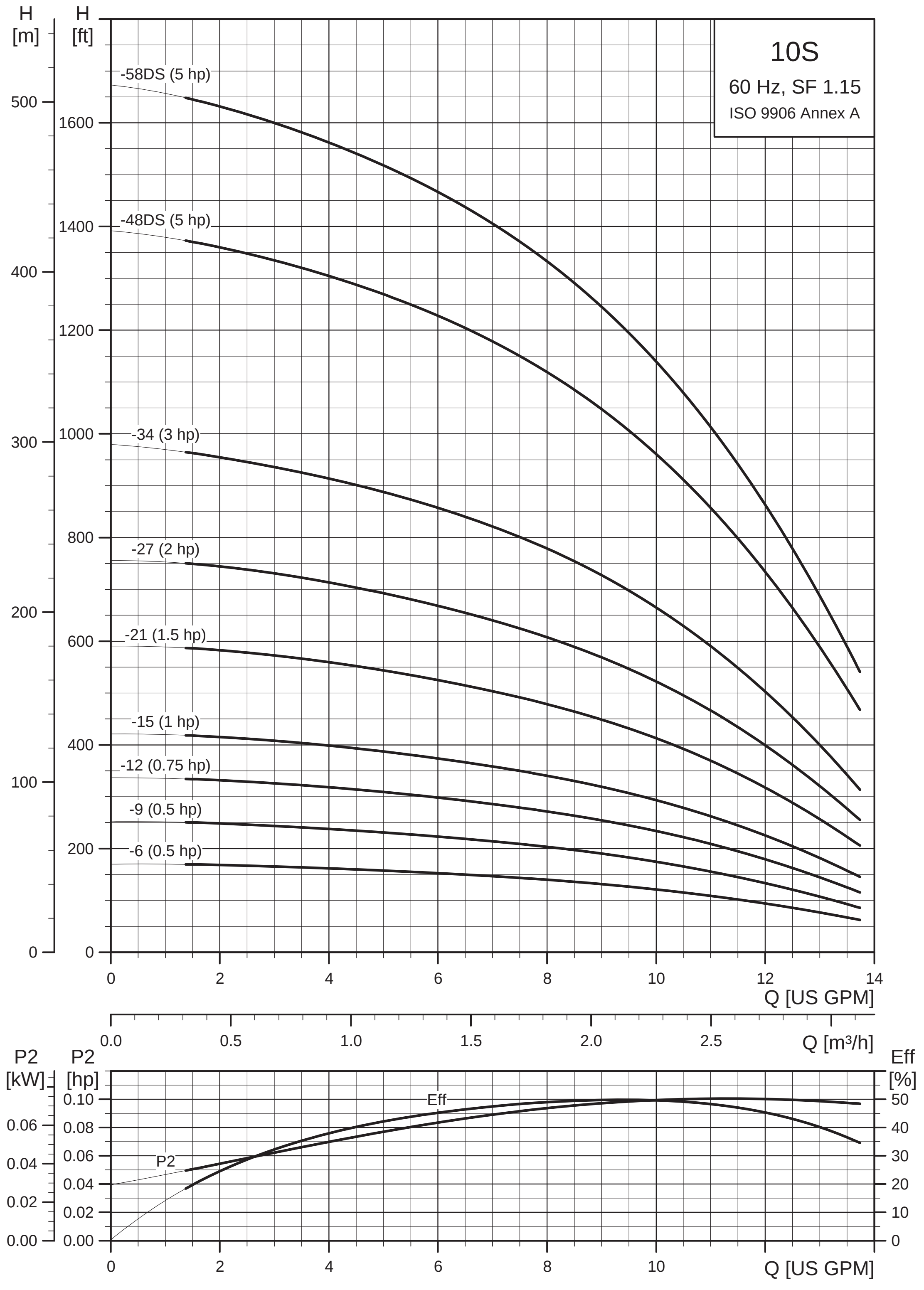
E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
DS designation = Built into sleeve, 1 - 1/2" NPT, 6" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 2 ft (0.6 m).

- ■ MS 402 motor.
- ● MS 4000 motor.

4" and larger wells - continued

SP 10S (10 gpm)



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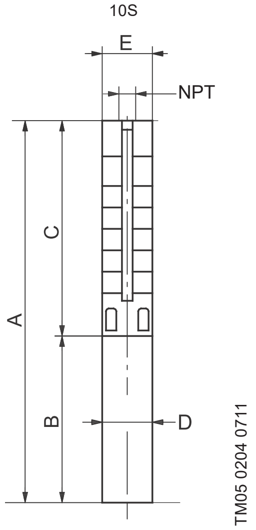
4" and larger wells - continued

SP 10S (10 gpm) pump with 4" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
10S, motor diameter 4-inch, 2-wire motor, 60 Hz - rated flow rate 10 gpm (1.25" NPT)												
10S05-6	126	1	230	.5	■	3454	22.05 (560)	10.99 (279)	11.07 (281)	3.74 (95)	3.98 (101)	20.7
10S05-9	185	1	115	.5	■	3336	24.53 (623)	10.99 (279)	13.55 (344)	3.74 (95)	3.98 (101)	24.3
			230	.5	■	3457	24.53 (623)	10.99 (279)	13.55 (344)	3.74 (95)	3.98 (101)	23.4
10S07-12	246	1	230	.75	■	3453	27.60 (701)	11.58 (294)	16.03 (407)	3.74 (95)	3.98 (101)	24.3
10S10-15	309	1	230	1	■	3382	30.67 (779)	12.17 (309)	18.51 (470)	3.74 (95)	3.98 (101)	29.7
10S15-21	433	1	230	1.5	■	3392	37.17 (944)	13.71 (348)	23.47 (596)	3.74 (95)	3.98 (101)	35.1
10S, motor diameter 4-inch, 3-wire motor, 60 Hz - rated flow rate 10 gpm (1.25" NPT)												
10S05-6	126	1	230	.5	■	3279	24.77 (629)	13.71 (348)	11.07 (281)	3.74 (95)	3.98 (101)	21.6
10S05-9	185	1	115	.5	■	3350	24.53 (623)	10.99 (279)	13.55 (344)	3.74 (95)	3.98 (101)	25.4
			230	.5	■	3313	24.53 (623)	10.99 (279)	13.55 (344)	3.74 (95)	3.98 (101)	24.3
10S07-12	246	1	230	.75	■	3320	27.60 (701)	11.58 (294)	16.03 (407)	3.74 (95)	3.98 (101)	28.8
10S10-15	309	1	230	1	■	3348	30.67 (779)	12.17 (309)	18.51 (470)	3.74 (95)	3.98 (101)	29.7
10S15-21	433	1	230	1.5	■	3398	37.17 (944)	13.71 (348)	23.47 (596)	3.74 (95)	3.98 (101)	35.1
		3	230	1.5	■	3419	35.63 (905)	12.17 (309)	23.47 (596)	3.74 (95)	3.98 (101)	32.4
			460	1.5	■	3419	35.63 (905)	12.17 (309)	23.47 (596)	3.74 (95)	3.98 (101)	36.0
10S20-27	554	1	230	2	●	3400	47.92 (1217)	19.49 (495)	28.43 (722)	3.74 (95)	3.98 (101)	45.9
		3	230	2	■	3399	42.13 (1070)	13.71 (348)	28.43 (722)	3.74 (95)	3.98 (101)	44.1
			460	2	■	3399	42.13 (1070)	13.71 (348)	28.43 (722)	3.74 (95)	3.98 (101)	44.1
10S30-34	716	1	230	3	●	3418	58.59 (1488)	22.6 (574)	35.99 (914)	3.74 (95)	3.98 (101)	81.9
		3	208	3	●	3465	53.98 (1371)	18.00 (457)	35.99 (914)	3.74 (95)	3.98 (101)	74.7
			230	3	●	3465	53.98 (1371)	18.00 (457)	35.99 (914)	3.74 (95)	3.98 (101)	74.7
			460	3	●	3465	53.98 (1371)	18.00 (457)	35.99 (914)	3.74 (95)	3.98 (101)	74.7
10S50-48DS	1020	1	230	5	●	3476	74.18 (1884)	26.62 (676)	47.56 (1208)	3.74 (95)	4.25 (108)	103.5
		3	208	5	●	3499	70.16 (1782)	22.60 (574)	47.56 (1208)	3.74 (95)	4.25 (108)	103.5
			230	5	●	3499	70.16 (1782)	22.60 (574)	47.56 (1208)	3.74 (95)	4.25 (108)	103.5
			460	5	●	3497	70.16 (1782)	22.60 (574)	47.56 (1208)	3.74 (95)	4.25 (108)	103.5
10S50-58DS	1225	1	230	5	●	3441	89.49 (2272)	26.62 (676)	62.88 (1597)	3.74 (95)	4.25 (108)	132.3
		3	208	5	●	3473	85.48 (2171)	22.60 (574)	62.88 (1597)	3.74 (95)	4.25 (108)	132.3
			230	5	●	3473	85.48 (2171)	22.60 (574)	62.88 (1597)	3.74 (95)	4.25 (108)	132.3
			460	5	●	3470	85.48 (2171)	22.60 (574)	62.88 (1597)	3.74 (95)	4.25 (108)	132.3



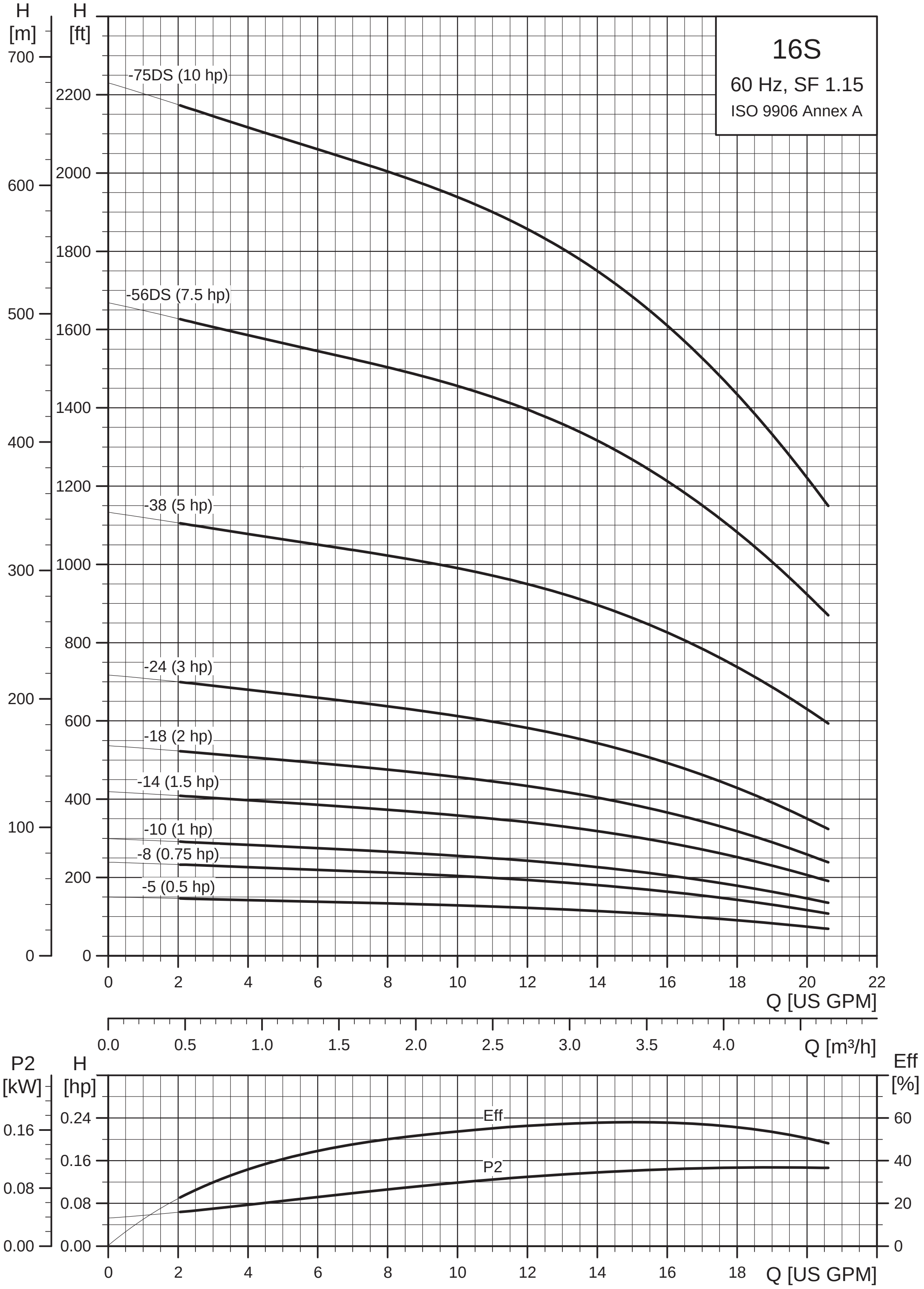
E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
DS designation = Built into sleeve, 1 - 1/2" NPT, 6" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 2 ft (0.6 m).

- ■ MS 402 motor.
- ● MS 4000 motor.

4" and larger wells - continued

SP 16S (16 gpm)



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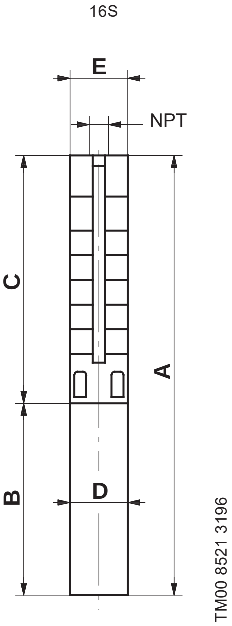
4" and larger wells - continued

SP 16S (16 gpm) pump with 4", 6" motors

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
16S, motor diameter 4-inch, 2-wire motor, 60 Hz - rated flow rate 16 gpm (1.25" NPT)												
16S05-5	112	1	115	.5	■	3391	21.26 (540)	11.03 (280)	10.24 (260)	3.74 (95)	3.98 (101)	21.6
			230	.5	■	3393	21.26 (540)	11.03 (280)	10.24 (260)	3.74 (95)	3.98 (101)	23.4
16S07-8	177	1	230	.75	■	3464	24.34 (618)	11.62 (295)	12.72 (323)	3.74 (95)	3.98 (101)	24.3
16S10-10	223	1	230	1	■	3394	26.58 (675)	12.21 (310)	14.38 (365)	3.74 (95)	3.98 (101)	27.9
16S15-14	313	1	230	1.5	■	3403	31.38 (797)	13.71 (348)	17.68 (449)	3.74 (95)	3.98 (101)	36.0
16S, motor diameter 4-inch, 3-wire motor, 60 Hz - rated flow rate 16 gpm (1.25" NPT)												
16S05-5	112	1	115	.5	■	3419	21.26 (540)	11.03 (280)	10.24 (260)	3.74 (95)	3.98 (101)	21.6
			230	.5	■	3396	21.26 (540)	11.03 (280)	10.24 (260)	3.74 (95)	3.98 (101)	21.6
16S07-8	177	1	230	.75	■	3343	24.34 (618)	11.62 (295)	12.72 (323)	3.74 (95)	3.98 (101)	27.0
16S10-10	223	1	230	1	■	3369	26.58 (675)	12.21 (310)	14.38 (365)	3.74 (95)	3.98 (101)	27.9
16S15-14	313	1	230	1.5	■	3414	31.38 (797)	13.71 (348)	17.68 (449)	3.74 (95)	3.98 (101)	32.4
		3	230	1.5	■	3430	29.89 (759)	12.21 (310)	17.68 (449)	3.74 (95)	3.98 (101)	28.8
			460	1.5	■	3430	29.89 (759)	12.21 (310)	17.68 (449)	3.74 (95)	3.98 (101)	28.8
16S20-18	397	1	230	2	●	3414	40.48 (1028)	19.49 (495)	20.99 (533)	3.74 (95)	3.98 (101)	36.0
		3	230	2	■	3413	34.69 (881)	13.71 (348)	20.99 (533)	3.74 (95)	3.98 (101)	36.0
			460	2	■	3413	34.69 (881)	13.71 (348)	20.99 (533)	3.74 (95)	3.98 (101)	36.0
16S30-24	533	1	230	3	●	3416	48.55 (1233)	22.60 (574)	25.95 (659)	3.74 (95)	3.98 (101)	62.1
		3	208	3	●	3464	43.94 (1116)	18.00 (457)	25.95 (659)	3.74 (95)	3.98 (101)	57.6
			230	3	●	3464	43.94 (1116)	18.00 (457)	25.95 (659)	3.74 (95)	3.98 (101)	57.6
			460	3	●	3464	43.94 (1116)	18.00 (457)	25.95 (659)	3.74 (95)	3.98 (101)	57.6
16S50-38	832	1	230	5	●	3449	65.91 (1674)	26.62 (676)	39.30 (998)	3.74 (95)	3.98 (101)	97.2
		3	208	5	●	3479	62.01 (1575)	22.72 (577)	39.30 (998)	3.74 (95)	3.98 (101)	90.0
			230	5	●	3479	62.01 (1575)	22.72 (577)	39.30 (998)	3.74 (95)	3.98 (101)	90.0
			460	5	●	3476	62.01 (1575)	22.72 (577)	39.30 (998)	3.74 (95)	3.98 (101)	90.0
SP 16S, motor diameter 6 inch, 60 Hz - rated flow rate 16 gpm (1.25" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
16S75-56DS	1224	3	208	7.5	▲	3478	92.28 (2344)	23.51 (597)	68.78 (1747)	5.63 (143)	5.51 (140)	165.1
			230	7.5	▲	3478	92.28 (2344)	23.51 (597)	68.78 (1747)	5.63 (143)	5.51 (140)	165.1
			460	7.5	▲	3491	92.28 (2344)	23.51 (597)	68.78 (1747)	5.63 (143)	5.51 (140)	165.1
16S100-75DS	1636	3	460	10	▲	3482	109.18 (2773)	24.69 (627)	84.49 (2146)	5.63 (143)	5.51 (140)	190.0



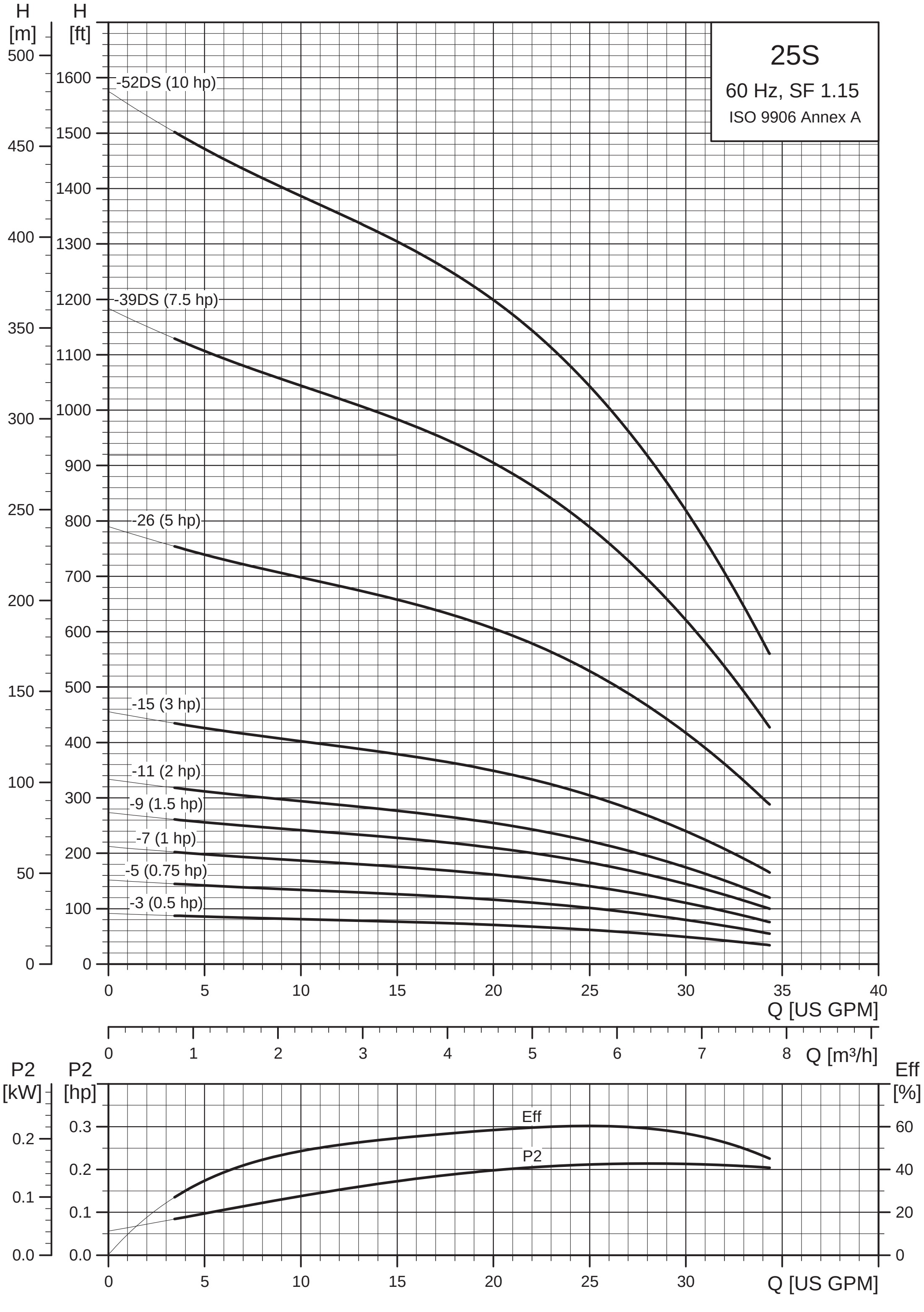
E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
DS designation = Built into sleeve, 1 - 1/2" NPT, 6" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 2 ft (0.6 ft).

- ■ MS 402 motor.
- ● MS 4000 motor.
- ▲ MS 6000C motor.

4" and larger wells - continued

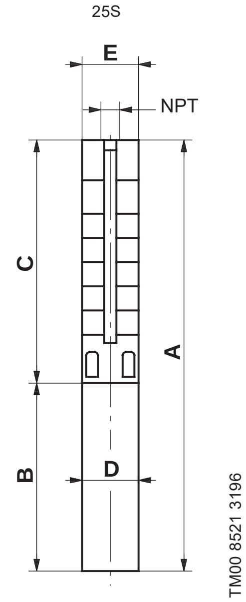
SP 25S (25 gpm)



4" and larger wells - continued

SP 25S (25 gpm) pump with 4", 6" inch motors

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
25S, motor diameter 4-inch, 2-wire motor, 60 Hz - rated flow rate 25 gpm (1.5" NPT)												
25S05-3	64	1	115	.5	■	3411	19.61 (498)	11.03 (280)	8.59 (218)	3.74 (95)	3.98 (101)	21.6
			230	.5	■	3505	19.61 (498)	11.03 (280)	8.59 (218)	3.74 (95)	3.98 (101)	21.6
25S07-5	105	1	230	.75	■	3474	21.86 (555)	11.62 (295)	10.24 (260)	3.74 (95)	3.98 (101)	23.4
25S10-7	146	1	230	1	■	3383	24.10 (612)	12.21 (310)	11.89 (302)	3.74 (95)	3.98 (101)	25.2
25S15-9	189	1	230	1.5	■	3410	27.25 (692)	13.71 (348)	13.55 (344)	3.74 (95)	3.98 (101)	28.8
25S, motor diameter 4-inch, 3-wire motor, 60 Hz - rated flow rate 25 gpm (1.5" NPT)												
25S05-3	64	1	115	.5	■	3441	19.61 (498)	11.03 (280)	8.59 (218)	3.74 (95)	3.98 (101)	21.6
			230	.5	■	3423	19.61 (498)	11.03 (280)	8.59 (218)	3.74 (95)	3.98 (101)	21.6
25S07-5	105	1	230	.75	■	3365	21.86 (555)	11.62 (295)	10.24 (260)	3.74 (95)	3.98 (101)	23.4
25S10-7	146	1	230	1	■	3349	24.10 (612)	12.21 (310)	11.89 (302)	3.74 (95)	3.98 (101)	25.2
25S15-9	189	1	230	1.5	■	3422	27.25 (692)	13.71 (348)	13.55 (344)	3.74 (95)	3.98 (101)	29.7
		3	230	1.5	■	3437	25.75 (654)	12.21 (310)	13.55 (344)	3.74 (95)	3.98 (101)	27.0
			460	1.5	■	3437	25.75 (654)	12.21 (310)	13.55 (344)	3.74 (95)	3.98 (101)	28.8
25S20-11	229	1	230	2	●	3434	34.69 (881)	19.49 (495)	15.20 (386)	3.74 (95)	3.98 (101)	33.1
		3	230	2	■	3431	28.90 (734)	13.71 (348)	15.20 (386)	3.74 (95)	3.98 (101)	37.0
			460	2	■	3431	28.90 (734)	13.71 (348)	15.20 (386)	3.74 (95)	3.98 (101)	33.3
25S30-15	314	1	230	3	●	3432	41.11 (1044)	22.60 (574)	18.51 (470)	3.74 (95)	3.98 (101)	61.2
		3	208	3	●	3474	36.50 (927)	18.00 (457)	18.51 (470)	3.74 (95)	3.98 (101)	53.1
			230	3	●	3474	36.50 (927)	18.00 (457)	18.51 (470)	3.74 (95)	3.98 (101)	53.1
			460	3	●	3474	36.50 (927)	18.00 (457)	18.51 (470)	3.74 (95)	3.98 (101)	53.1
25S50-26	546	1	230	5	●	3449	54.22 (1377)	26.62 (676)	27.60 (701)	3.74 (95)	3.98 (101)	72.9
		3	208	5	●	3479	50.32 (1278)	22.72 (577)	27.60 (701)	3.74 (95)	3.98 (101)	72.9
			230	5	●	3479	50.32 (1278)	22.72 (577)	27.60 (701)	3.74 (95)	3.98 (101)	72.9
			460	5	●	3476	50.32 (1278)	22.72 (577)	27.60 (701)	3.74 (95)	3.98 (101)	72.9
SP 25S, motor diameter 6 inch, 60 Hz - rated flow rate 25 gpm (1.5" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
25S75-39DS	815	3	208	7.5	▲	3475	66.06 (1678)	23.51 (597)	42.56 (1081)	5.63 (143)	5.43 (138)	122.1
			230	7.5	▲	3475	66.06 (1678)	23.51 (597)	42.56 (1081)	5.63 (143)	5.43 (138)	122.1
			460	7.5	▲	3488	66.06 (1678)	23.51 (597)	42.56 (1081)	5.63 (143)	5.43 (138)	122.1
25S100-52DS	1082	3	460	10	▲	3480	90.17 (2290)	24.69 (627)	65.48 (1663)	5.63 (143)	5.51 (140)	163.1



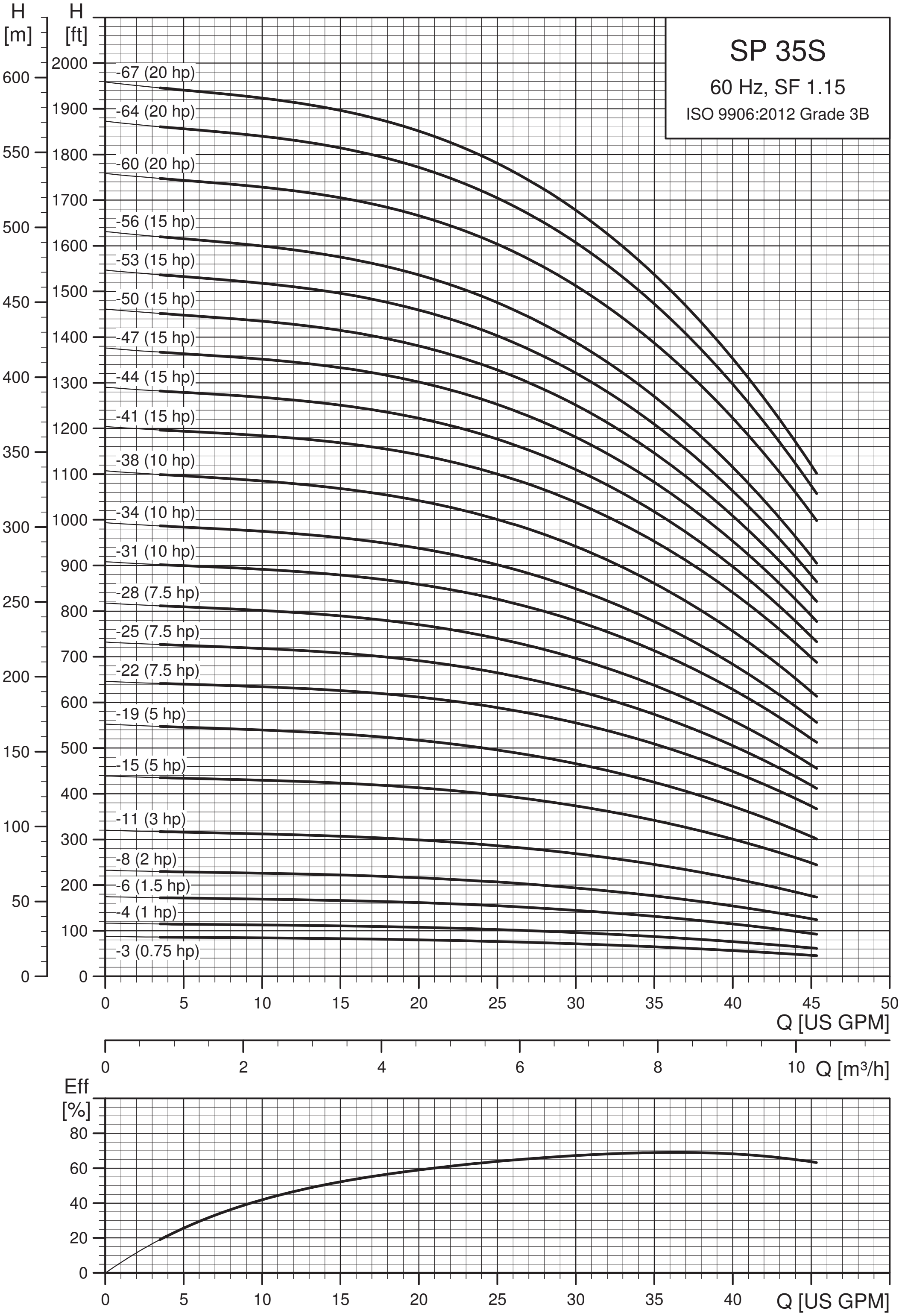
E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
DS designation = Built into sleeve, 1 - 1/2" NPT, 6" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 2 ft (0.6 m).

- ■ MS 402 motor.
- ● MS 4000 motor.
- ▲ MS 6000C motor.

4" and larger wells - continued

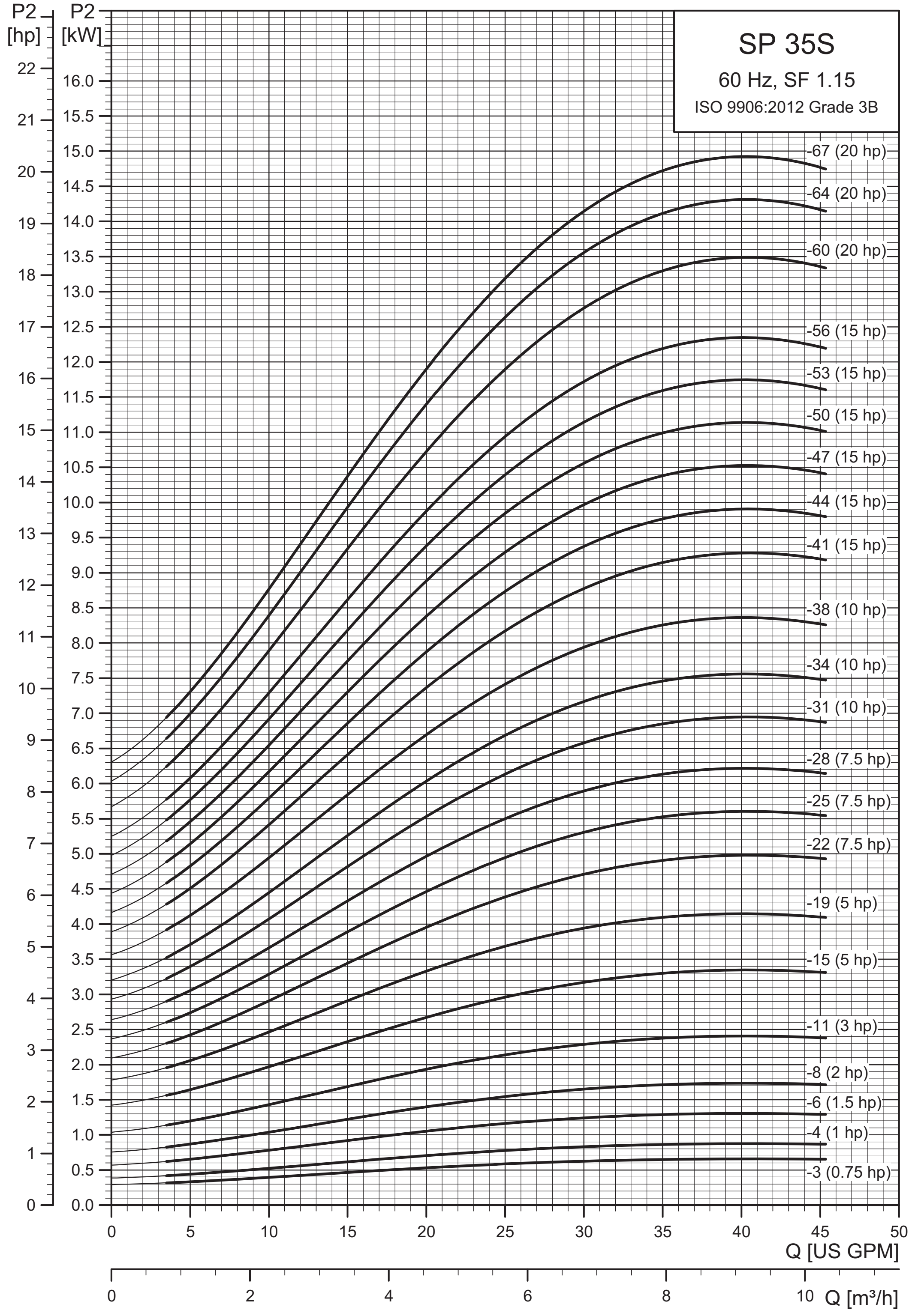
SP 35S (35 gpm)



TM06 4614 3215

4" and larger wells - continued

SP 35S (35 gpm) pump power requirement (P2)

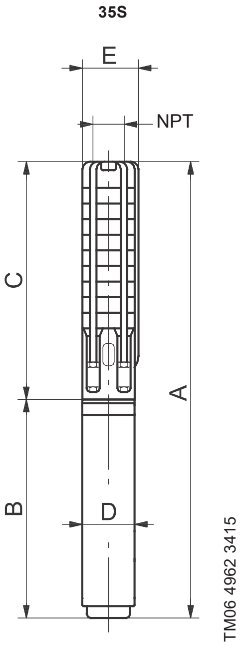


TM06 4615 3215

4" and larger wells - continued

SP 35S (35 gpm) pump with 4" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
35S - Motor diameter 4-inch, 3-wire motor, 60 Hz, rated flow rate 35 gpm (1 1/2" NPT)												
35S07-3	61	1	230	.75	■	3427	28.35 (720)	13.08 (332)	15.28 (388)	3.75 (95)	3.98 (101)	29.9
		3	230	.75	■	3439	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.9
		3	460	.75	■	3439	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.9
		3	575	.75	■	3428	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.9
35S10-4	82	1	230	1	■	3429	30.91 (785)	13.67 (347)	17.25 (438)	3.75 (95)	3.98 (101)	32.8
	83	3	230	1	■	3445	29.73 (755)	12.49 (317)	17.25 (438)	3.75 (95)	3.98 (101)	30.1
	83	3	460	1	■	3445	29.73 (755)	12.49 (317)	17.25 (438)	3.75 (95)	3.98 (101)	29.9
	82	3	575	1	■	3431	29.73 (755)	12.49 (317)	17.25 (438)	3.75 (95)	3.98 (101)	29.9
35S15-6	126	1	230	1.5	■	3442	36.42 (925)	15.24 (387)	21.19 (538)	3.75 (95)	3.98 (101)	39.1
	126	3	230	1.5	■	3451	34.85 (885)	13.67 (347)	21.19 (538)	3.75 (95)	3.98 (101)	35.5
	126	3	460	1.5	■	3451	34.85 (885)	13.67 (347)	21.19 (538)	3.75 (95)	3.98 (101)	35.5
	125	3	575	1.5	■	3427	34.85 (885)	13.67 (347)	21.19 (538)	3.75 (95)	3.98 (101)	35.3
35S20-8	168	1	230	2	●	3434	44.69 (1135)	19.57 (497)	25.12 (638)	3.75 (95)	3.98 (101)	57.3
		3	230	2	■	3432	40.36 (1025)	15.24 (387)	25.12 (638)	3.75 (95)	3.98 (101)	41.9
		3	460	2	■	3432	40.36 (1025)	15.24 (387)	25.12 (638)	3.75 (95)	3.98 (101)	42.1
		3	575	2	■	3430	40.36 (1025)	15.24 (387)	25.12 (638)	3.75 (95)	3.98 (101)	41.9
35S30-11	232	1	230	3	●	3431	53.75 (1365)	22.72 (577)	31.03 (788)	3.75 (95)	3.98 (101)	69.9
	233	3	208	3	●	3440	49.02 (1245)	18.00 (457)	31.03 (788)	3.75 (95)	3.98 (101)	56.7
	233	3	230	3	●	3440	49.02 (1245)	18.00 (457)	31.03 (788)	3.75 (95)	3.98 (101)	56.7
	237	3	460	3	●	3468	49.02 (1245)	18.00 (457)	31.03 (788)	3.75 (95)	3.98 (101)	56.7
35S50-15	327	1	230	5	●	3483	65.56 (1665)	26.66 (677)	38.90 (988)	3.75 (95)	3.98 (101)	86.1
	331	3	208	5	●	3502	61.62 (1565)	22.72 (577)	38.90 (988)	3.75 (95)	3.98 (101)	75.1
	331	3	230	5	●	3502	61.62 (1565)	22.72 (577)	38.90 (988)	3.75 (95)	3.98 (101)	75.1
	331	3	460	5	●	3501	61.62 (1565)	22.72 (577)	38.90 (988)	3.75 (95)	3.98 (101)	75.1
35S50-19	407	1	230	5	●	3446	73.43 (1865)	26.66 (677)	46.78 (1188)	3.75 (95)	3.98 (101)	91.2
	413	3	208	5	●	3473	69.49 (1765)	22.72 (577)	46.78 (1188)	3.75 (95)	3.98 (101)	80.2
	413	3	230	5	●	3473	69.49 (1765)	22.72 (577)	46.78 (1188)	3.75 (95)	3.98 (101)	80.2
	413	3	460	5	●	3471	69.49 (1765)	22.72 (577)	46.78 (1188)	3.75 (95)	3.98 (101)	80.2
35S75-22	485	3	208	7.5	●	3495	79.34 (2015)	26.66 (677)	52.68 (1338)	3.75 (95)	3.98 (101)	95.0
		3	230	7.5	●	3495	79.34 (2015)	26.66 (677)	52.68 (1338)	3.75 (95)	3.98 (101)	95.0
		3	460	7.5	●	3495	79.34 (2015)	26.66 (677)	52.68 (1338)	3.75 (95)	3.98 (101)	95.0
		3	575	7.5	●	3495	79.34 (2015)	26.66 (677)	52.68 (1338)	3.75 (95)	3.98 (101)	95.0
35S75-25	547	3	208	7.5	●	3479	85.24 (2165)	26.66 (677)	58.59 (1488)	3.75 (95)	3.98 (101)	98.9
		3	230	7.5	●	3479	85.24 (2165)	26.66 (677)	58.59 (1488)	3.75 (95)	3.98 (101)	98.9
		3	460	7.5	●	3479	85.24 (2165)	26.66 (677)	58.59 (1488)	3.75 (95)	3.98 (101)	98.9
		3	575	7.5	●	3479	85.24 (2165)	26.66 (677)	58.59 (1488)	3.75 (95)	3.98 (101)	98.9
35S75-28	607	3	208	7.5	●	3463	91.15 (2315)	26.66 (677)	64.49 (1638)	3.75 (95)	3.98 (101)	102.7
		3	230	7.5	●	3463	91.15 (2315)	26.66 (677)	64.49 (1638)	3.75 (95)	3.98 (101)	102.7
		3	460	7.5	●	3463	91.15 (2315)	26.66 (677)	64.49 (1638)	3.75 (95)	3.98 (101)	102.7
		3	575	7.5	●	3463	91.15 (2315)	26.66 (677)	64.49 (1638)	3.75 (95)	3.98 (101)	102.7
35S100-31	682	3	460	10	●	3487	100.99 (2565)	30.60 (777)	70.40 (1788)	3.75 (95)	3.98 (101)	115.4
		3	575	10	●	3487	100.99 (2565)	30.60 (777)	70.40 (1788)	3.75 (95)	3.98 (101)	115.4
35S100-34	743	3	460	10	●	3475	106.89 (2715)	30.60 (777)	76.30 (1938)	3.75 (95)	3.98 (101)	119.2
		3	575	10	●	3475	106.89 (2715)	30.60 (777)	76.30 (1938)	3.75 (95)	3.98 (101)	119.2
35S100-38	823	3	460	10	●	3459	114.77 (2915)	30.60 (777)	84.18 (2138)	3.75 (95)	3.98 (101)	124.3
		3	575	10	●	3459	114.77 (2915)	30.60 (777)	84.18 (2138)	3.75 (95)	3.98 (101)	124.3



E = Maximum diameter of pump including cable guard and motor.

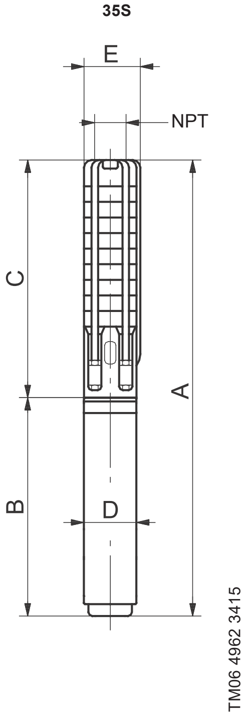
Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

- ■ MS 402 motor.
- ● MS 4000 motor.

4" and larger wells - continued

SP 35S (35 gpm) pump with 6" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
35S - Motor diameter 6 inch, 60 Hz, rated flow rate 35 gpm (1 1/2" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
35S75-22	487	3	208	7.5	▲	3502	78.67 (1998)	23.51 (597)	55.16 (1401)	5.50 (140)	5.50 (140)	123.6
	487	3	230	7.5	▲	3502	78.67 (1998)	23.51 (597)	55.16 (1401)	5.50 (140)	5.50 (140)	123.6
	490	3	460	7.5	▲	3510	78.67 (1998)	23.51 (597)	55.16 (1401)	5.50 (140)	5.50 (140)	123.6
	489	3	575	7.5	▲	3509	78.67 (1998)	23.51 (597)	55.16 (1401)	5.50 (140)	5.50 (140)	123.6
35S75-25	549	3	208	7.5	▲	3487	84.57 (2148)	23.51 (597)	61.07 (1551)	5.50 (140)	5.50 (140)	127.5
	549	3	230	7.5	▲	3487	84.57 (2148)	23.51 (597)	61.07 (1551)	5.50 (140)	5.50 (140)	127.5
	553	3	460	7.5	▲	3498	84.57 (2148)	23.51 (597)	61.07 (1551)	5.50 (140)	5.50 (140)	127.5
	552	3	575	7.5	▲	3496	84.57 (2148)	23.51 (597)	61.07 (1551)	5.50 (140)	5.50 (140)	127.5
35S75-28	611	3	208	7.5	▲	3472	90.48 (2298)	23.51 (597)	66.97 (1701)	5.50 (140)	5.50 (140)	131.4
	611	3	230	7.5	▲	3472	90.48 (2298)	23.51 (597)	66.97 (1701)	5.50 (140)	5.50 (140)	131.4
	615	3	460	7.5	▲	3484	90.48 (2298)	23.51 (597)	66.97 (1701)	5.50 (140)	5.50 (140)	131.4
	614	3	575	7.5	▲	3483	90.48 (2298)	23.51 (597)	66.97 (1701)	5.50 (140)	5.50 (140)	131.4
35S100-31	688	3	208	10	▲	3489	97.56 (2478)	24.69 (627)	72.88 (1851)	5.50 (140)	5.50 (140)	142.0
	687	3	230	10	▲	3489	97.56 (2478)	24.69 (627)	72.88 (1851)	5.50 (140)	5.50 (140)	142.0
	687	3	460	10	▲	3499	97.56 (2478)	24.69 (627)	72.88 (1851)	5.50 (140)	5.50 (140)	142.0
	687	3	575	10	▲	3498	97.56 (2478)	24.69 (627)	72.88 (1851)	5.50 (140)	5.50 (140)	142.0
35S100-34	744	3	208	10	▲	3476	103.47 (2628)	24.69 (627)	78.78 (2001)	5.50 (140)	5.50 (140)	145.9
	744	3	230	10	▲	3476	103.47 (2628)	24.69 (627)	78.78 (2001)	5.50 (140)	5.50 (140)	145.9
	749	3	460	10	▲	3488	103.47 (2628)	24.69 (627)	78.78 (2001)	5.50 (140)	5.50 (140)	145.9
	749	3	575	10	▲	3488	103.47 (2628)	24.69 (627)	78.78 (2001)	5.50 (140)	5.50 (140)	145.9
35S100-38	824	3	208	10	▲	3459	111.34 (2828)	24.69 (627)	86.66 (2201)	5.50 (140)	5.50 (140)	151.1
	824	3	230	10	▲	3459	111.34 (2828)	24.69 (627)	86.66 (2201)	5.50 (140)	5.50 (140)	151.1
	830	3	460	10	▲	3474	111.34 (2828)	24.69 (627)	86.66 (2201)	5.50 (140)	5.50 (140)	151.1
	830	3	575	10	▲	3473	111.34 (2828)	24.69 (627)	86.66 (2201)	5.50 (140)	5.50 (140)	151.1



E = Maximum diameter of pump including cable guard and motor.

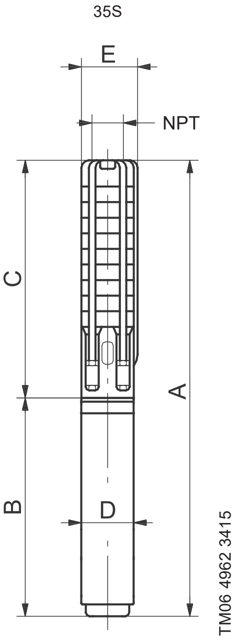
Notes: Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

▲ MS 6000C motor.

4" and larger wells - continued

SP 35S (35 gpm) pump with 6" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
35S - Motor diameter 6 inch, 60 Hz, rated flow rate 35 gpm (2" NPT)												
35S150-41DS	912	3	208	15	▲	3503	131.23 (3333)	27.05 (687)	104.18 (2646)	5.50 (140)	5.50 (140)	217.3
	912	3	230	15	▲	3503	131.23 (3333)	27.05 (687)	104.18 (2646)	5.50 (140)	5.50 (140)	217.3
	914	3	460	15	▲	3507	131.23 (3333)	27.05 (687)	104.18 (2646)	5.50 (140)	5.50 (140)	217.3
	913	3	575	15	▲	3506	131.23 (3333)	27.05 (687)	104.18 (2646)	5.50 (140)	5.50 (140)	217.3
35S150-44DS	975	3	208	15	▲	3496	137.13 (3483)	27.05 (687)	110.08 (2796)	5.50 (140)	5.50 (140)	223.1
	975	3	230	15	▲	3496	137.13 (3483)	27.05 (687)	110.08 (2796)	5.50 (140)	5.50 (140)	223.1
	977	3	460	15	▲	3500	137.13 (3483)	27.05 (687)	110.08 (2796)	5.50 (140)	5.50 (140)	223.1
	976	3	575	15	▲	3499	137.13 (3483)	27.05 (687)	110.08 (2796)	5.50 (140)	5.50 (140)	223.1
35S150-47DS	1037	3	208	15	▲	3488	143.04 (3633)	27.05 (687)	115.99 (2946)	5.50 (140)	5.50 (140)	228.8
	1037	3	230	15	▲	3488	143.04 (3633)	27.05 (687)	115.99 (2946)	5.50 (140)	5.50 (140)	228.8
	1040	3	460	15	▲	3493	143.04 (3633)	27.05 (687)	115.99 (2946)	5.50 (140)	5.50 (140)	228.8
	1039	3	575	15	▲	3491	143.04 (3633)	27.05 (687)	115.99 (2946)	5.50 (140)	5.50 (140)	228.8
35S150-50DS	1098	3	208	15	▲	3480	148.94 (3783)	27.05 (687)	121.89 (3096)	5.50 (140)	5.50 (140)	234.6
	1098	3	230	15	▲	3480	148.94 (3783)	27.05 (687)	121.89 (3096)	5.50 (140)	5.50 (140)	234.6
	1101	3	460	15	▲	3485	148.94 (3783)	27.05 (687)	121.89 (3096)	5.50 (140)	5.50 (140)	234.6
	1100	3	575	15	▲	3484	148.94 (3783)	27.05 (687)	121.89 (3096)	5.50 (140)	5.50 (140)	234.6
35S150-53DS	1159	3	208	15	▲	3472	154.85 (3933)	27.05 (687)	127.80 (3246)	5.50 (140)	5.50 (140)	240.3
	1159	3	230	15	▲	3472	154.85 (3933)	27.05 (687)	127.80 (3246)	5.50 (140)	5.50 (140)	240.3
	1163	3	460	15	▲	3478	154.85 (3933)	27.05 (687)	127.80 (3246)	5.50 (140)	5.50 (140)	240.3
	1161	3	575	15	▲	3476	154.85 (3933)	27.05 (687)	127.80 (3246)	5.50 (140)	5.50 (140)	240.3
35S150-56DS	1218	3	208	15	▲	3464	160.75 (4083)	27.05 (687)	133.71 (3396)	5.50 (140)	5.50 (140)	246.1
	1218	3	230	15	▲	3464	160.75 (4083)	27.05 (687)	133.71 (3396)	5.50 (140)	5.50 (140)	246.1
	1223	3	460	15	▲	3470	160.75 (4083)	27.05 (687)	133.71 (3396)	5.50 (140)	5.50 (140)	246.1
	1222	3	575	15	▲	3468	160.75 (4083)	27.05 (687)	133.71 (3396)	5.50 (140)	5.50 (140)	246.1
35S200-60DS	1329	3	208	20	▲	3494	171.19 (4348)	29.61 (752)	141.58 (3596)	5.50 (140)	5.50 (140)	269.2
	1329	3	230	20	▲	3494	171.19 (4348)	29.61 (752)	141.58 (3596)	5.50 (140)	5.50 (140)	269.2
	1337	3	460	20	▲	3503	171.19 (4348)	29.61 (752)	141.58 (3596)	5.50 (140)	5.50 (140)	269.2
	1338	3	575	20	▲	3506	171.19 (4348)	29.61 (752)	141.58 (3596)	5.50 (140)	5.50 (140)	269.2
35S200-64DS	1412	3	208	20	▲	3486	179.06 (4548)	29.61 (752)	149.45 (3796)	5.50 (140)	5.50 (140)	276.9
	1412	3	230	20	▲	3486	179.06 (4548)	29.61 (752)	149.45 (3796)	5.50 (140)	5.50 (140)	276.9
	1420	3	460	20	▲	3497	179.06 (4548)	29.61 (752)	149.45 (3796)	5.50 (140)	5.50 (140)	276.9
	1422	3	575	20	▲	3499	179.06 (4548)	29.61 (752)	149.45 (3796)	5.50 (140)	5.50 (140)	276.9
35S200-67DS	1473	3	208	20	▲	3491	184.97 (4698)	29.61 (752)	155.36 (3946)	5.50 (140)	5.50 (140)	282.7
	1473	3	230	20	▲	3491	184.97 (4698)	29.61 (752)	155.36 (3946)	5.50 (140)	5.50 (140)	282.7
	1482	3	460	20	▲	3480	184.97 (4698)	29.61 (752)	155.36 (3946)	5.50 (140)	5.50 (140)	282.7
	1485	3	575	20	▲	3494	184.97 (4698)	29.61 (752)	155.36 (3946)	5.50 (140)	5.50 (140)	282.7



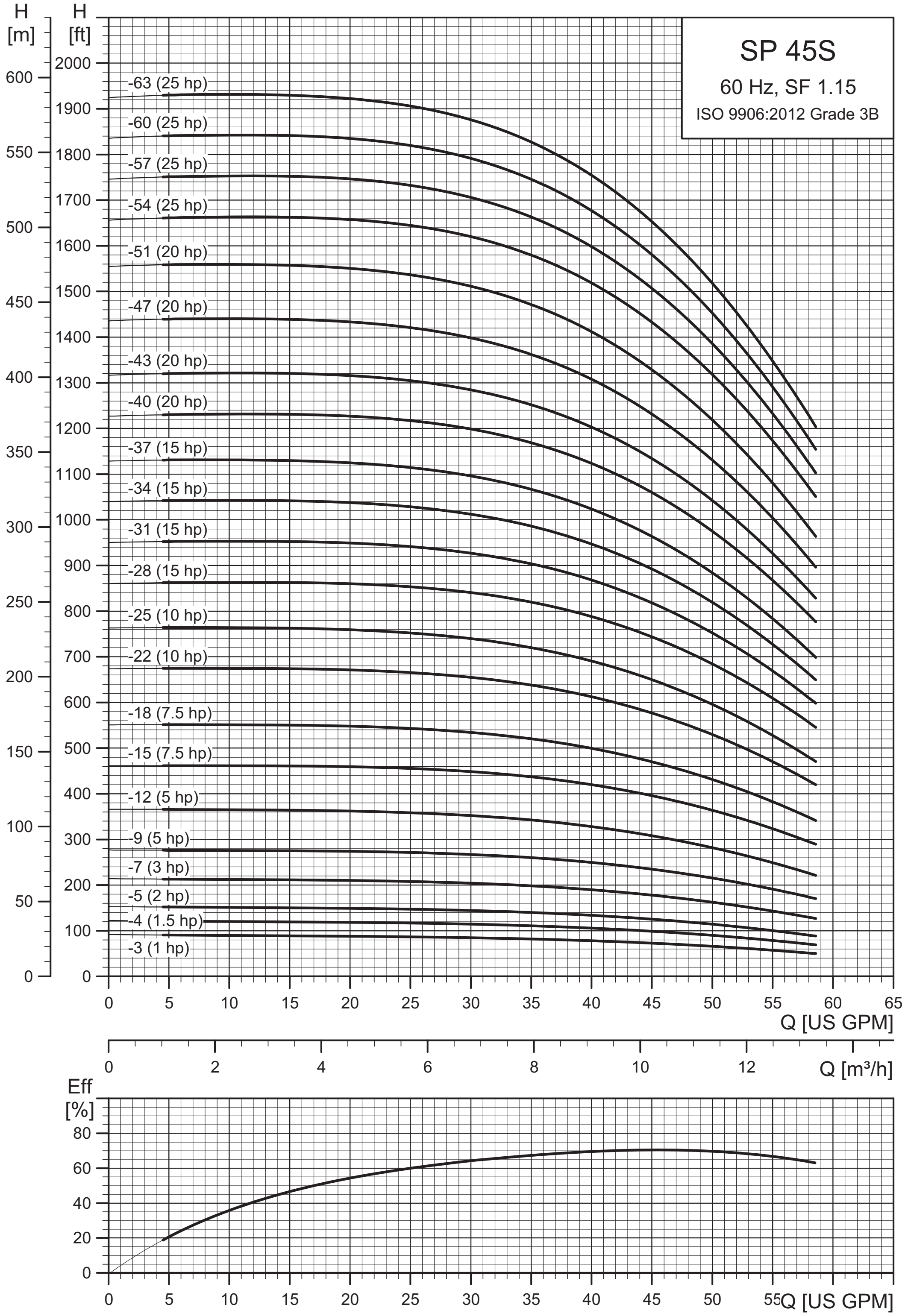
E = Maximum diameter of pump including cable guard and motor.

Notes:
DS designation = Built into sleeve, 2" NPT, 6" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

▲ MS 6000C motor.

4" and larger wells - continued

SP 45S (45 gpm)



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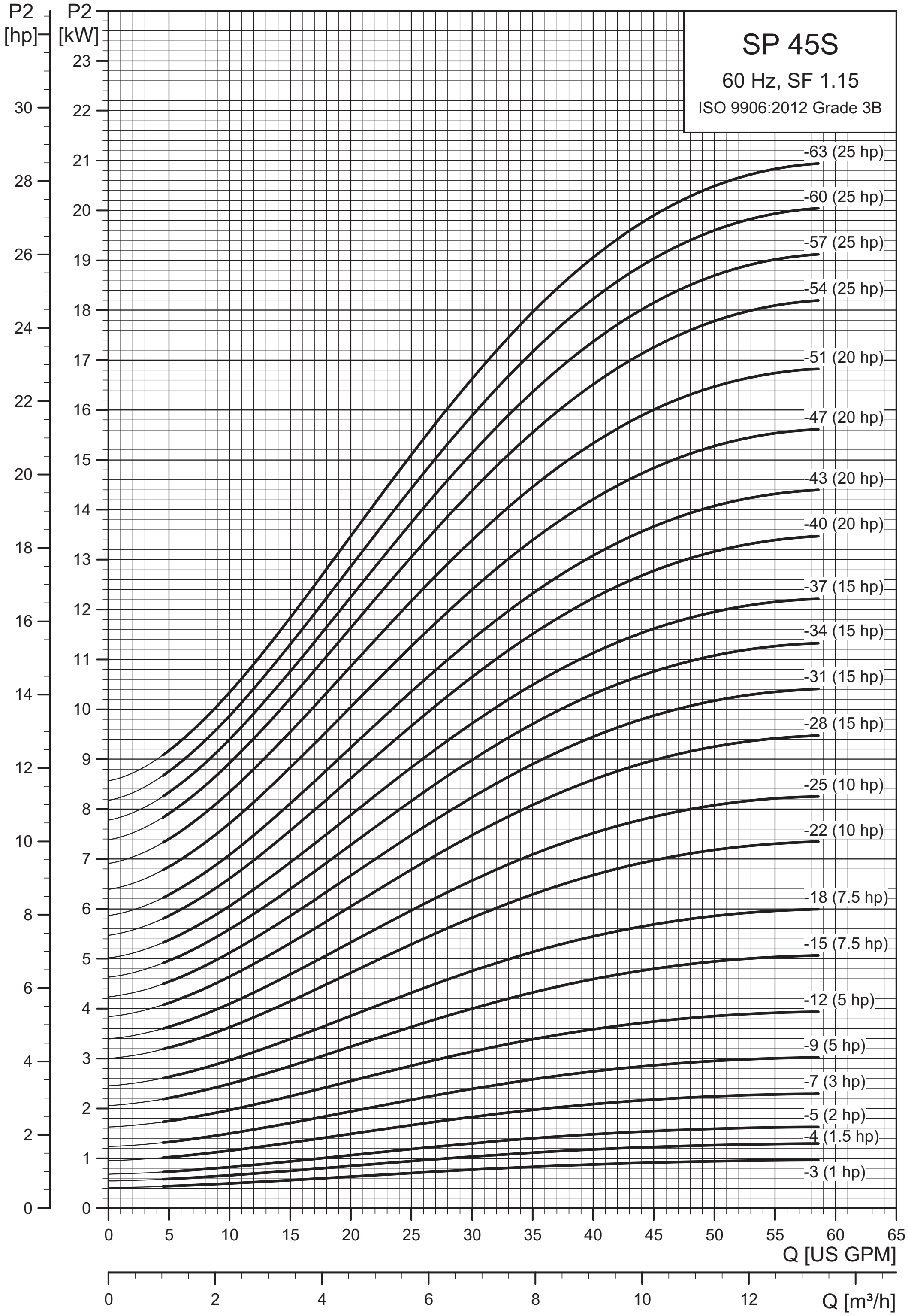
4" and larger wells - continued

SP 45S (45 gpm) pump power requirement (P2)



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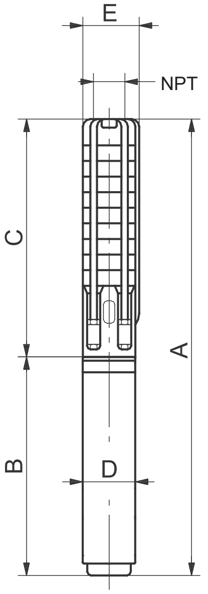
4" and larger wells - continued

SP 45S (45 gpm) pump with 4" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
45S - Motor diameter 4-inch, 3-wire motor, 60 Hz, rated flow rate 45 gpm (2" NPT)												
45S10-3	72	1	230	1	■	3416	28.94 (735)	13.67 (347)	15.28 (388)	3.75 (95)	3.98 (101)	31.5
	73	3	230	1	■	3435	27.76 (705)	12.49 (317)	15.28 (388)	3.75 (95)	3.98 (101)	28.8
	73	3	460	1	■	3435	27.76 (705)	12.49 (317)	15.28 (388)	3.75 (95)	3.98 (101)	28.6
	72	3	575	1	■	3422	27.76 (705)	12.49 (317)	15.28 (388)	3.75 (95)	3.98 (101)	28.6
45S15-4	98	1	230	1.5	■	3451	32.49 (825)	15.24 (387)	17.25 (438)	3.75 (95)	3.98 (101)	36.5
	99	3	230	1.5	■	3458	30.91 (785)	13.67 (347)	17.25 (438)	3.75 (95)	3.98 (101)	33.0
	99	3	460	1.5	■	3458	30.91 (785)	13.67 (347)	17.25 (438)	3.75 (95)	3.98 (101)	33.0
	97	3	575	1.5	■	3435	30.91 (785)	13.67 (347)	17.25 (438)	3.75 (95)	3.98 (101)	32.8
45S20-5	124	1	230	2	●	3454	38.78 (985)	19.57 (497)	19.22 (488)	3.75 (95)	3.98 (101)	53.4
	124	3	230	2	■	3451	34.45 (875)	15.24 (387)	19.22 (488)	3.75 (95)	3.98 (101)	38.0
	124	3	460	2	■	3451	34.45 (875)	15.24 (387)	19.22 (488)	3.75 (95)	3.98 (101)	38.2
	123	3	575	2	■	3446	34.45 (875)	15.24 (387)	19.22 (488)	3.75 (95)	3.98 (101)	38.0
45S30-7	174	1	230	3	●	3448	45.87 (1165)	22.72 (577)	23.15 (588)	3.75 (95)	3.98 (101)	64.8
	174	3	208	3	●	3452	41.15 (1045)	18.00 (457)	23.15 (588)	3.75 (95)	3.98 (101)	51.6
	174	3	230	3	●	3452	41.15 (1045)	18.00 (457)	23.15 (588)	3.75 (95)	3.98 (101)	51.6
	178	3	460	3	●	3481	41.15 (1045)	18.00 (457)	23.15 (588)	3.75 (95)	3.98 (101)	51.6
	185	3	575	3	●	**3530**	41.15 (1045)	18.00 (457)	23.15 (588)	3.75 (95)	3.98 (101)	51.4
45S50-9	232	1	230	5	●	3502	53.75 (1365)	26.66 (677)	27.09 (688)	3.75 (95)	3.98 (101)	78.4
	234	3	208	5	●	3517	49.81 (1265)	22.72 (577)	27.09 (688)	3.75 (95)	3.98 (101)	67.4
	234	3	230	5	●	3517	49.81 (1265)	22.72 (577)	27.09 (688)	3.75 (95)	3.98 (101)	67.4
	234	3	460	5	●	3516	49.81 (1265)	22.72 (577)	27.09 (688)	3.75 (95)	3.98 (101)	67.4
	237	3	575	5	●	**3515**	49.81 (1265)	22.72 (577)	27.09 (688)	3.75 (95)	3.98 (101)	67.2
45S50-12	301	1	230	5	●	3462	59.65 (1515)	26.66 (677)	33.00 (838)	3.75 (95)	3.98 (101)	82.2
	306	3	208	5	●	3486	55.71 (1415)	22.72 (577)	33.00 (838)	3.75 (95)	3.98 (101)	71.2
	306	3	230	5	●	3486	55.71 (1415)	22.72 (577)	33.00 (838)	3.75 (95)	3.98 (101)	71.2
	306	3	460	5	●	3483	55.71 (1415)	22.72 (577)	33.00 (838)	3.75 (95)	3.98 (101)	71.2
	308	3	575	5	●	**3485**	55.71 (1415)	22.72 (577)	33.00 (838)	3.75 (95)	3.98 (101)	71.0
45S75-15	386	3	208	7.5	●	3497	65.56 (1665)	26.66 (677)	38.90 (988)	3.75 (95)	3.98 (101)	86.1
	386	3	230	7.5	●	3497	65.56 (1665)	26.66 (677)	38.90 (988)	3.75 (95)	3.98 (101)	86.1
	386	3	460	7.5	●	3497	65.56 (1665)	26.66 (677)	38.90 (988)	3.75 (95)	3.98 (101)	86.1
	386	3	575	7.5	●	3497	65.56 (1665)	26.66 (677)	38.90 (988)	3.75 (95)	3.98 (101)	86.1
45S75-18	458	3	208	7.5	●	3474	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	89.9
	458	3	230	7.5	●	3474	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	89.9
	458	3	460	7.5	●	3474	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	89.9
	458	3	575	7.5	●	3474	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	89.9
45S100-22	564	3	460	10	●	3484	83.27 (2115)	30.60 (777)	52.68 (1338)	3.75 (95)	3.98 (101)	103.8
	564	3	575	10	●	3484	83.27 (2115)	30.60 (777)	52.68 (1338)	3.75 (95)	3.98 (101)	103.8
45S100-25	632	3	460	10	●	3466	89.18 (2265)	30.60 (777)	58.59 (1488)	3.75 (95)	3.98 (101)	107.7
	632	3	575	10	●	3466	89.18 (2265)	30.60 (777)	58.59 (1488)	3.75 (95)	3.98 (101)	107.7

45S



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E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

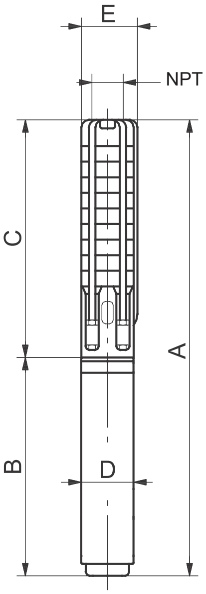
- ■ MS 402 motor.
- ● MS 4000 motor.

4" and larger wells - continued

SP 45S (45 gpm) pump with 6" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
45S - Motor diameter 6 inch, 60 Hz, rated flow rate 45 gpm (2" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
45S75-15	388	3	208	7.5	▲	3504	64.89 (1648)	23.51 (597)	41.38 (1051)	5.50 (140)	5.50 (140)	114.4
	388	3	230	7.5	▲	3504	64.89 (1648)	23.51 (597)	41.38 (1051)	5.50 (140)	5.50 (140)	114.4
	390	3	460	7.5	▲	3512	64.89 (1648)	23.51 (597)	41.38 (1051)	5.50 (140)	5.50 (140)	114.4
	390	3	575	7.5	▲	3511	64.89 (1648)	23.51 (597)	41.38 (1051)	5.50 (140)	5.50 (140)	114.4
45S75-18	460	3	208	7.5	▲	3482	70.79 (1798)	23.51 (597)	47.29 (1201)	5.50 (140)	5.50 (140)	118.3
	460	3	230	7.5	▲	3482	70.79 (1798)	23.51 (597)	47.29 (1201)	5.50 (140)	5.50 (140)	118.3
	463	3	460	7.5	▲	3493	70.79 (1798)	23.51 (597)	47.29 (1201)	5.50 (140)	5.50 (140)	118.3
	462	3	575	7.5	▲	3492	70.79 (1798)	23.51 (597)	47.29 (1201)	5.50 (140)	5.50 (140)	118.3
45S100-22	564	3	208	10	▲	3485	79.85 (2028)	24.69 (627)	55.16 (1401)	5.50 (140)	5.50 (140)	130.2
	564	3	230	10	▲	3485	79.85 (2028)	24.69 (627)	55.16 (1401)	5.50 (140)	5.50 (140)	130.2
	568	3	460	10	▲	3496	79.85 (2028)	24.69 (627)	55.16 (1401)	5.50 (140)	5.50 (140)	130.2
	568	3	575	10	▲	3496	79.85 (2028)	24.69 (627)	55.16 (1401)	5.50 (140)	5.50 (140)	130.2
45S100-25	632	3	208	10	▲	3467	85.75 (2178)	24.69 (627)	61.07 (1551)	5.50 (140)	5.50 (140)	134.1
	632	3	230	10	▲	3467	85.75 (2178)	24.69 (627)	61.07 (1551)	5.50 (140)	5.50 (140)	134.1
	640	3	460	10	▲	3481	85.75 (2178)	24.69 (627)	61.07 (1551)	5.50 (140)	5.50 (140)	134.1
	640	3	575	10	▲	3480	85.75 (2178)	24.69 (627)	61.07 (1551)	5.50 (140)	5.50 (140)	134.1
45S150-28	727	3	208	15	▲	3505	94.02 (2388)	27.05 (687)	66.97 (1701)	5.50 (140)	5.50 (140)	160.6
	727	3	230	15	▲	3505	94.02 (2388)	27.05 (687)	66.97 (1701)	5.50 (140)	5.50 (140)	160.6
	729	3	460	15	▲	3508	94.02 (2388)	27.05 (687)	66.97 (1701)	5.50 (140)	5.50 (140)	160.6
	728	3	575	15	▲	3507	94.02 (2388)	27.05 (687)	66.97 (1701)	5.50 (140)	5.50 (140)	160.6
45S150-31	801	3	208	15	▲	3494	99.93 (2538)	27.05 (687)	72.88 (1851)	5.50 (140)	5.50 (140)	164.7
	801	3	230	15	▲	3494	99.93 (2538)	27.05 (687)	72.88 (1851)	5.50 (140)	5.50 (140)	164.7
	803	3	460	15	▲	3498	99.93 (2538)	27.05 (687)	72.88 (1851)	5.50 (140)	5.50 (140)	164.7
	802	3	575	15	▲	3497	99.93 (2538)	27.05 (687)	72.88 (1851)	5.50 (140)	5.50 (140)	164.7
45S150-34	869	3	208	15	▲	3482	105.83 (2688)	27.05 (687)	78.78 (2001)	5.50 (140)	5.50 (140)	168.8
	869	3	230	15	▲	3482	105.83 (2688)	27.05 (687)	78.78 (2001)	5.50 (140)	5.50 (140)	168.8
	876	3	460	15	▲	3487	105.83 (2688)	27.05 (687)	78.78 (2001)	5.50 (140)	5.50 (140)	168.8
	875	3	575	15	▲	3486	105.83 (2688)	27.05 (687)	78.78 (2001)	5.50 (140)	5.50 (140)	168.8
45S150-37	939	3	208	15	▲	3470	111.74 (2838)	27.05 (687)	84.69 (2151)	5.50 (140)	5.50 (140)	172.9
	939	3	230	15	▲	3470	111.74 (2838)	27.05 (687)	84.69 (2151)	5.50 (140)	5.50 (140)	172.9
	942	3	460	15	▲	3476	111.74 (2838)	27.05 (687)	84.69 (2151)	5.50 (140)	5.50 (140)	172.9
	941	3	575	15	▲	3474	111.74 (2838)	27.05 (687)	84.69 (2151)	5.50 (140)	5.50 (140)	172.9
45S200-40DS	1037	3	208	20	▲	3498	131.82 (3348)	29.61 (752)	102.21 (2596)	5.50 (140)	5.50 (140)	230.8
	1037	3	230	20	▲	3498	131.82 (3348)	29.61 (752)	102.21 (2596)	5.50 (140)	5.50 (140)	230.8
	1043	3	460	20	▲	3507	131.82 (3348)	29.61 (752)	102.21 (2596)	5.50 (140)	5.50 (140)	230.8
	1044	3	575	20	▲	3509	131.82 (3348)	29.61 (752)	102.21 (2596)	5.50 (140)	5.50 (140)	230.8
45S200-43DS	1105	3	208	20	▲	3489	137.72 (3498)	29.61 (752)	108.12 (2746)	5.50 (140)	5.50 (140)	236.6
	1105	3	230	20	▲	3489	137.72 (3498)	29.61 (752)	108.12 (2746)	5.50 (140)	5.50 (140)	236.6
	1117	3	460	20	▲	3500	137.72 (3498)	29.61 (752)	108.12 (2746)	5.50 (140)	5.50 (140)	236.6
	1118	3	575	20	▲	3502	137.72 (3498)	29.61 (752)	108.12 (2746)	5.50 (140)	5.50 (140)	236.6
45S200-47DS	1199	3	208	20	▲	3478	145.60 (3698)	29.61 (752)	115.99 (2946)	5.50 (140)	5.50 (140)	244.2
	1208	3	230	20	▲	3489	145.60 (3698)	29.61 (752)	115.99 (2946)	5.50 (140)	5.50 (140)	244.2
	1208	3	460	20	▲	3489	145.60 (3698)	29.61 (752)	115.99 (2946)	5.50 (140)	5.50 (140)	244.2
	1216	3	575	20	▲	3492	145.60 (3698)	29.61 (752)	115.99 (2946)	5.50 (140)	5.50 (140)	244.2
45S200-51DS	1291	3	208	20	▲	3466	153.47 (3898)	29.61 (752)	123.86 (3146)	5.50 (140)	5.50 (140)	251.9
	1291	3	230	20	▲	3466	153.47 (3898)	29.61 (752)	123.86 (3146)	5.50 (140)	5.50 (140)	251.9
	1392	3	460	20	▲	3479	153.47 (3898)	29.61 (752)	123.86 (3146)	5.50 (140)	5.50 (140)	251.9
	1302	3	575	20	▲	3482	153.47 (3898)	29.61 (752)	123.86 (3146)	5.50 (140)	5.50 (140)	251.9

45S



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E = Maximum diameter of pump including cable guard and motor.

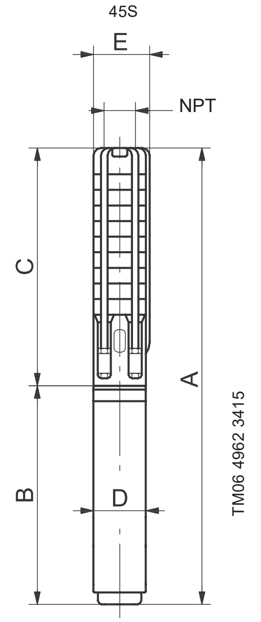
Notes: DS designation = Built into sleeve, 2" NPT, 6" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

▲ MS 6000C motor.

4" and larger wells - continued

SP 45S (45 gpm) pump with 6" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
45S - Motor diameter 6 inch, 60 Hz, rated flow rate 45 gpm (2" NPT)												
45S250-54DS	1389	3	208	25	▲	3490	161.54 (4103)	31.78 (807)	129.77 (3296)	5.50 (140)	5.50 (140)	267.6
	1389	3	230	25	▲	3490	161.54 (4103)	31.78 (807)	129.77 (3296)	5.50 (140)	5.50 (140)	267.6
	1404	3	460	25	▲	3501	161.54 (4103)	31.78 (807)	129.77 (3296)	5.50 (140)	5.50 (140)	267.6
	1405	3	575	25	▲	3501	161.54 (4103)	31.78 (807)	129.77 (3296)	5.50 (140)	5.50 (140)	267.6
45S250-57DS	1460	3	208	25	▲	3484	167.45 (4253)	31.78 (807)	135.67 (3446)	5.50 (140)	5.50 (140)	273.4
	1460	3	230	25	▲	3484	167.45 (4253)	31.78 (807)	135.67 (3446)	5.50 (140)	5.50 (140)	273.4
	1471	3	460	25	▲	3494	167.45 (4253)	31.78 (807)	135.67 (3446)	5.50 (140)	5.50 (140)	273.4
	1471	3	575	25	▲	3495	167.45 (4253)	31.78 (807)	135.67 (3446)	5.50 (140)	5.50 (140)	273.4
45S250-60DS	1530	3	208	25	▲	3477	173.35 (4403)	31.78 (807)	141.58 (3596)	5.50 (140)	5.50 (140)	279.1
	1530	3	230	25	▲	3477	173.35 (4403)	31.78 (807)	141.58 (3596)	5.50 (140)	5.50 (140)	279.1
	1542	3	460	25	▲	3488	173.35 (4403)	31.78 (807)	141.58 (3596)	5.50 (140)	5.50 (140)	279.1
	1543	3	575	25	▲	3489	173.35 (4403)	31.78 (807)	141.58 (3596)	5.50 (140)	5.50 (140)	279.1
45S250-63DS	1599	3	208	25	▲	3470	167.64 (4258)	31.78 (807)	135.87 (3451)	5.50 (140)	5.50 (140)	233.7
	1599	3	230	25	▲	3470	167.64 (4258)	31.78 (807)	135.87 (3451)	5.50 (140)	5.50 (140)	233.7
	1612	3	460	25	▲	3482	167.64 (4258)	31.78 (807)	135.87 (3451)	5.50 (140)	5.50 (140)	233.7
	1613	3	575	25	▲	3483	167.64 (4258)	31.78 (807)	135.87 (3451)	5.50 (140)	5.50 (140)	233.7



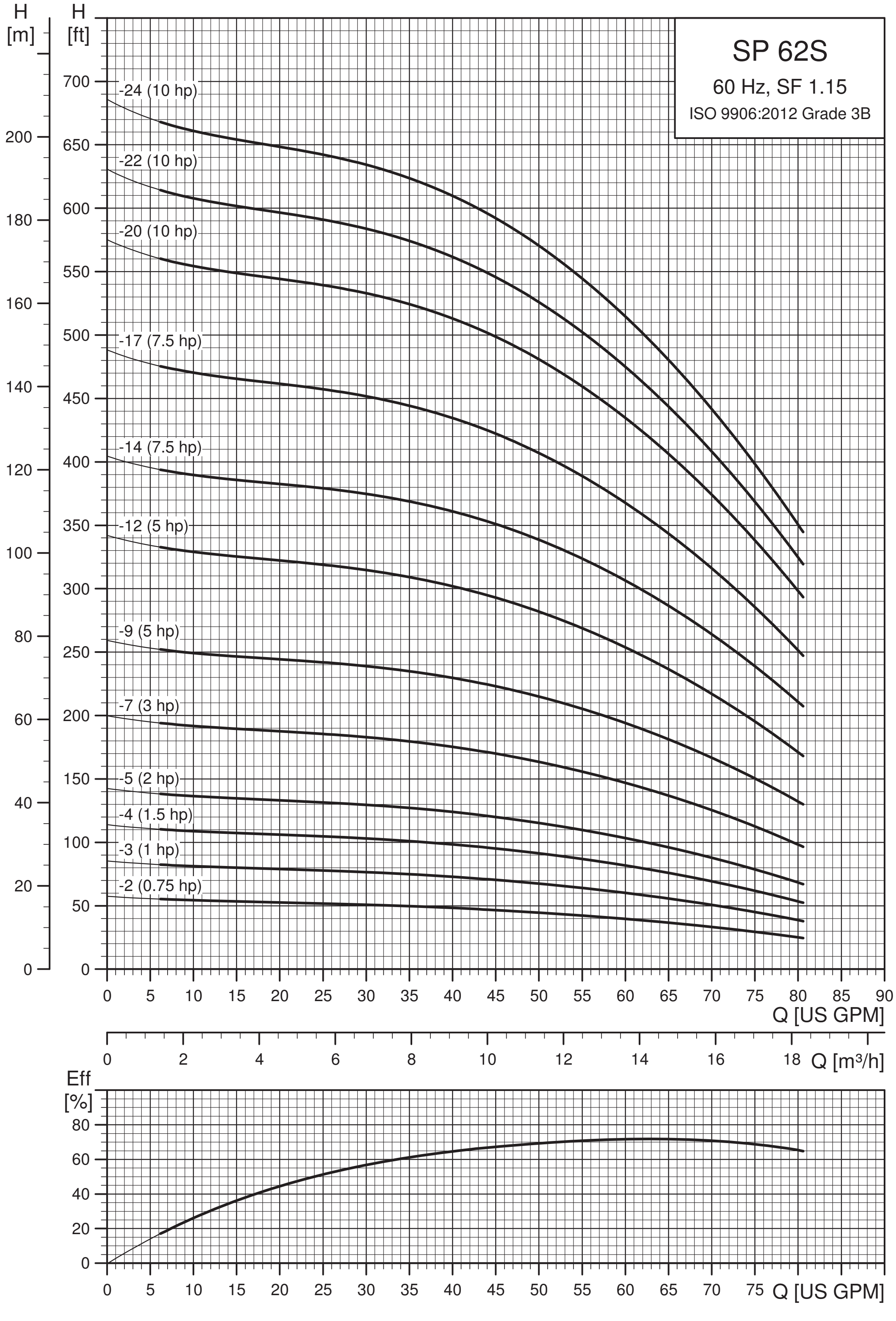
E = Maximum diameter of pump
including cable guard and motor.

Notes:
DS designation = Built into sleeve, 2" NPT, 6" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

▲ MS 6000C motor.

4" and larger wells - continued

SP 62S (62 gpm)



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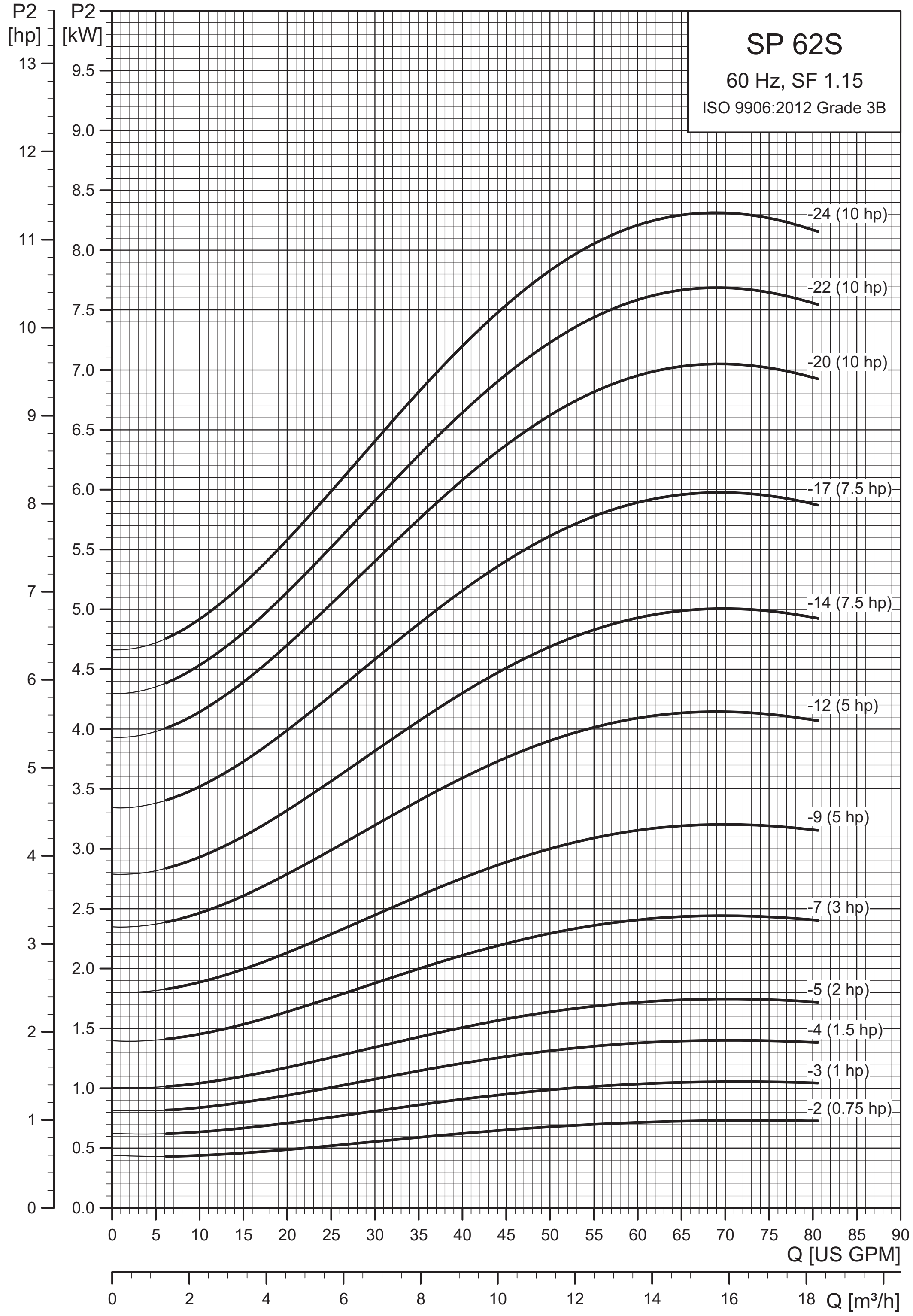
4" and larger wells - continued

SP 62S (62 gpm) pump power requirement (P2)



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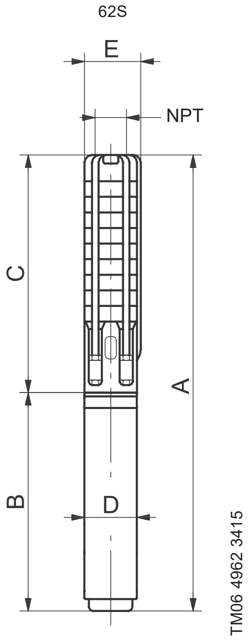
4" and larger wells - continued

SP 62S (62 gpm) pump with 4" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
62S - Motor diameter 4-inch, 3-wire motor, 60 Hz, rated flow rate 62 gpm (2" NPT)												
62S07-2	40	1	230	.75	■	3407	28.35 (720)	13.08 (332)	15.28 (388)	3.75 (95)	3.98 (101)	29.7
	40	3	230	.75	■	3423	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.7
	40	3	460	.75	■	3423	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.7
	40	3	575	.75	■	3414	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.7
62S10-3	57	1	230	1	■	3381	31.89 (810)	13.67 (347)	18.23 (463)	3.75 (95)	3.98 (101)	33.0
	58	3	230	1	■	3407	30.71 (780)	12.49 (317)	18.23 (463)	3.75 (95)	3.98 (101)	30.4
	58	3	460	1	■	3407	30.71 (780)	12.49 (317)	18.23 (463)	3.75 (95)	3.98 (101)	30.2
	57	3	575	1	■	3398	30.71 (780)	12.49 (317)	18.23 (463)	3.75 (95)	3.98 (101)	30.2
62S15-4	78	1	230	1.5	■	3427	36.42 (925)	15.24 (387)	21.19 (538)	3.75 (95)	3.98 (101)	38.5
	79	3	230	1.5	■	3439	34.85 (885)	13.67 (347)	21.19 (538)	3.75 (95)	3.98 (101)	35.0
	79	3	460	1.5	■	3439	34.85 (885)	13.67 (347)	21.19 (538)	3.75 (95)	3.98 (101)	35.0
	78	3	575	1.5	■	3415	34.85 (885)	13.67 (347)	21.19 (538)	3.75 (95)	3.98 (101)	34.8
62S20-5	98	1	230	2	•	3433	43.71 (1110)	19.57 (497)	24.14 (613)	3.75 (95)	3.98 (101)	56.0
	98	3	230	2	■	3431	39.38 (1000)	15.24 (387)	24.14 (613)	3.75 (95)	3.98 (101)	40.5
	98	3	460	2	■	3431	39.38 (1000)	15.24 (387)	24.14 (613)	3.75 (95)	3.98 (101)	40.7
	98	3	575	2	■	3430	39.38 (1000)	15.24 (387)	24.14 (613)	3.75 (95)	3.98 (101)	40.5
62S30-7	136	1	230	3	•	3427	52.76 (1340)	22.72 (577)	30.04 (763)	3.75 (95)	3.98 (101)	68.3
	138	3	208	3	•	3437	48.04 (1220)	18.00 (457)	30.04 (763)	3.75 (95)	3.98 (101)	55.1
	138	3	230	3	•	3437	48.04 (1220)	18.00 (457)	30.04 (763)	3.75 (95)	3.98 (101)	55.1
	141	3	460	3	•	3466	48.04 (1220)	18.00 (457)	30.04 (763)	3.75 (95)	3.98 (101)	55.1
	141	3	575	3	•	3470	48.04 (1220)	18.00 (457)	30.04 (763)	3.75 (95)	3.98 (101)	54.9
62S50-9	184	1	230	5	•	3490	62.60 (1590)	26.66 (677)	35.95 (913)	3.75 (95)	3.98 (101)	82.8
	186	3	208	5	•	3507	58.67 (1490)	22.72 (577)	35.95 (913)	3.75 (95)	3.98 (101)	71.8
	186	3	230	5	•	3507	58.67 (1490)	22.72 (577)	35.95 (913)	3.75 (95)	3.98 (101)	71.8
	186	3	460	5	•	3506	58.67 (1490)	22.72 (577)	35.95 (913)	3.75 (95)	3.98 (101)	71.8
	182	3	575	5	•	3470	58.67 (1490)	22.72 (577)	35.95 (913)	3.75 (95)	3.98 (101)	71.6
62S50-12	237	1	230	5	•	3446	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	88.1
	242	3	208	5	•	3473	67.52 (1715)	22.72 (577)	44.81 (1138)	3.75 (95)	3.98 (101)	77.1
	242	3	230	5	•	3473	67.52 (1715)	22.72 (577)	44.81 (1138)	3.75 (95)	3.98 (101)	77.1
	242	3	460	5	•	3471	67.52 (1715)	22.72 (577)	44.81 (1138)	3.75 (95)	3.98 (101)	77.1
	244	3	575	5	•	3470	67.52 (1715)	22.72 (577)	44.81 (1138)	3.75 (95)	3.98 (101)	76.9
62S75-14	287	3	208	7.5	•	3494	77.37 (1965)	26.66 (677)	50.71 (1288)	3.75 (95)	3.98 (101)	91.6
	287	3	230	7.5	•	3494	77.37 (1965)	26.66 (677)	50.71 (1288)	3.75 (95)	3.98 (101)	91.6
	287	3	460	7.5	•	3494	77.37 (1965)	26.66 (677)	50.71 (1288)	3.75 (95)	3.98 (101)	91.6
	287	3	575	7.5	•	3494	77.37 (1965)	26.66 (677)	50.71 (1288)	3.75 (95)	3.98 (101)	91.6
62S75-17	342	3	208	7.5	•	3469	86.23 (2190)	26.66 (677)	59.57 (1513)	3.75 (95)	3.98 (101)	96.9
	342	3	230	7.5	•	3469	86.23 (2190)	26.66 (677)	59.57 (1513)	3.75 (95)	3.98 (101)	96.9
	342	3	460	7.5	•	3469	86.23 (2190)	26.66 (677)	59.57 (1513)	3.75 (95)	3.98 (101)	96.9
	342	3	575	7.5	•	3469	86.23 (2190)	26.66 (677)	59.57 (1513)	3.75 (95)	3.98 (101)	96.9
62S100-20	407	3	460	10	•	3485	99.02 (2515)	30.60 (777)	68.43 (1738)	3.75 (95)	3.98 (101)	111.0
	407	3	575	10	•	3485	99.02 (2515)	30.60 (777)	68.43 (1738)	3.75 (95)	3.98 (101)	111.0
62S100-22	445	3	460	10	•	3472	104.93 (2665)	30.60 (777)	74.34 (1888)	3.75 (95)	3.98 (101)	114.5
	445	3	575	10	•	3472	104.93 (2665)	30.60 (777)	74.34 (1888)	3.75 (95)	3.98 (101)	114.5
62S100-24	478	3	460	10	•	3460	110.83 (2815)	30.60 (777)	80.24 (2038)	3.75 (95)	3.98 (101)	118.0
	478	3	575	10	•	3460	110.83 (2815)	30.60 (777)	80.24 (2038)	3.75 (95)	3.98 (101)	118.0



E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

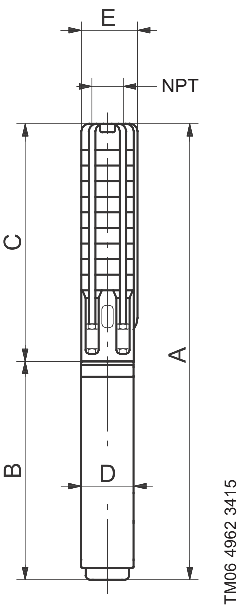
- ■ MS 402 motor.
- • MS 4000 motor.

4" and larger wells - continued

SP 62S (62 gpm) pump with 6" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
62S - Motor diameter 6 inch, 60 Hz, rated flow rate 62 gpm (2" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
62S75-14	288	3	208	7.5	▲	3501	76.70 (1948)	23.51 (597)	53.19 (1351)	5.50 (140)	5.50 (140)	119.3
	288	3	230	7.5	▲	3501	76.70 (1948)	23.51 (597)	53.19 (1351)	5.50 (140)	5.50 (140)	119.3
	292	3	460	7.5	▲	3510	76.70 (1948)	23.51 (597)	53.19 (1351)	5.50 (140)	5.50 (140)	119.3
	291	3	575	7.5	▲	3509	76.70 (1948)	23.51 (597)	53.19 (1351)	5.50 (140)	5.50 (140)	119.3
62S75-17	344	3	208	7.5	▲	3478	85.56 (2173)	23.51 (597)	62.05 (1576)	5.50 (140)	5.50 (140)	124.6
	344	3	230	7.5	▲	3478	85.56 (2173)	23.51 (597)	62.05 (1576)	5.50 (140)	5.50 (140)	124.6
	347	3	460	7.5	▲	3489	85.56 (2173)	23.51 (597)	62.05 (1576)	5.50 (140)	5.50 (140)	124.6
	347	3	575	7.5	▲	3488	85.56 (2173)	23.51 (597)	62.05 (1576)	5.50 (140)	5.50 (140)	124.6
62S100-20	408	3	208	10	▲	3486	95.60 (2428)	24.69 (627)	70.91 (1801)	5.50 (140)	5.50 (140)	136.4
	408	3	230	10	▲	3486	95.60 (2428)	24.69 (627)	70.91 (1801)	5.50 (140)	5.50 (140)	136.4
	411	3	460	10	▲	3497	95.60 (2428)	24.69 (627)	70.91 (1801)	5.50 (140)	5.50 (140)	136.4
	410	3	575	10	▲	3496	95.60 (2428)	24.69 (627)	70.91 (1801)	5.50 (140)	5.50 (140)	136.4
62S100-22	445	3	208	10	▲	3474	101.50 (2578)	24.69 (627)	76.82 (1951)	5.50 (140)	5.50 (140)	139.9
	445	3	230	10	▲	3474	101.50 (2578)	24.69 (627)	76.82 (1951)	5.50 (140)	5.50 (140)	139.9
	449	3	460	10	▲	3486	101.50 (2578)	24.69 (627)	76.82 (1951)	5.50 (140)	5.50 (140)	139.9
	448	3	575	10	▲	3485	101.50 (2578)	24.69 (627)	76.82 (1951)	5.50 (140)	5.50 (140)	139.9
62S100-24	478	3	208	10	▲	3460	107.41 (2728)	24.69 (627)	82.72 (2101)	5.50 (140)	5.50 (140)	143.4
	478	3	230	10	▲	3460	107.41 (2728)	24.69 (627)	82.72 (2101)	5.50 (140)	5.50 (140)	143.4
	486	3	460	10	▲	3474	107.41 (2728)	24.69 (627)	82.72 (2101)	5.50 (140)	5.50 (140)	143.4
	486	3	575	10	▲	3473	107.41 (2728)	24.69 (627)	82.72 (2101)	5.50 (140)	5.50 (140)	143.4

62S



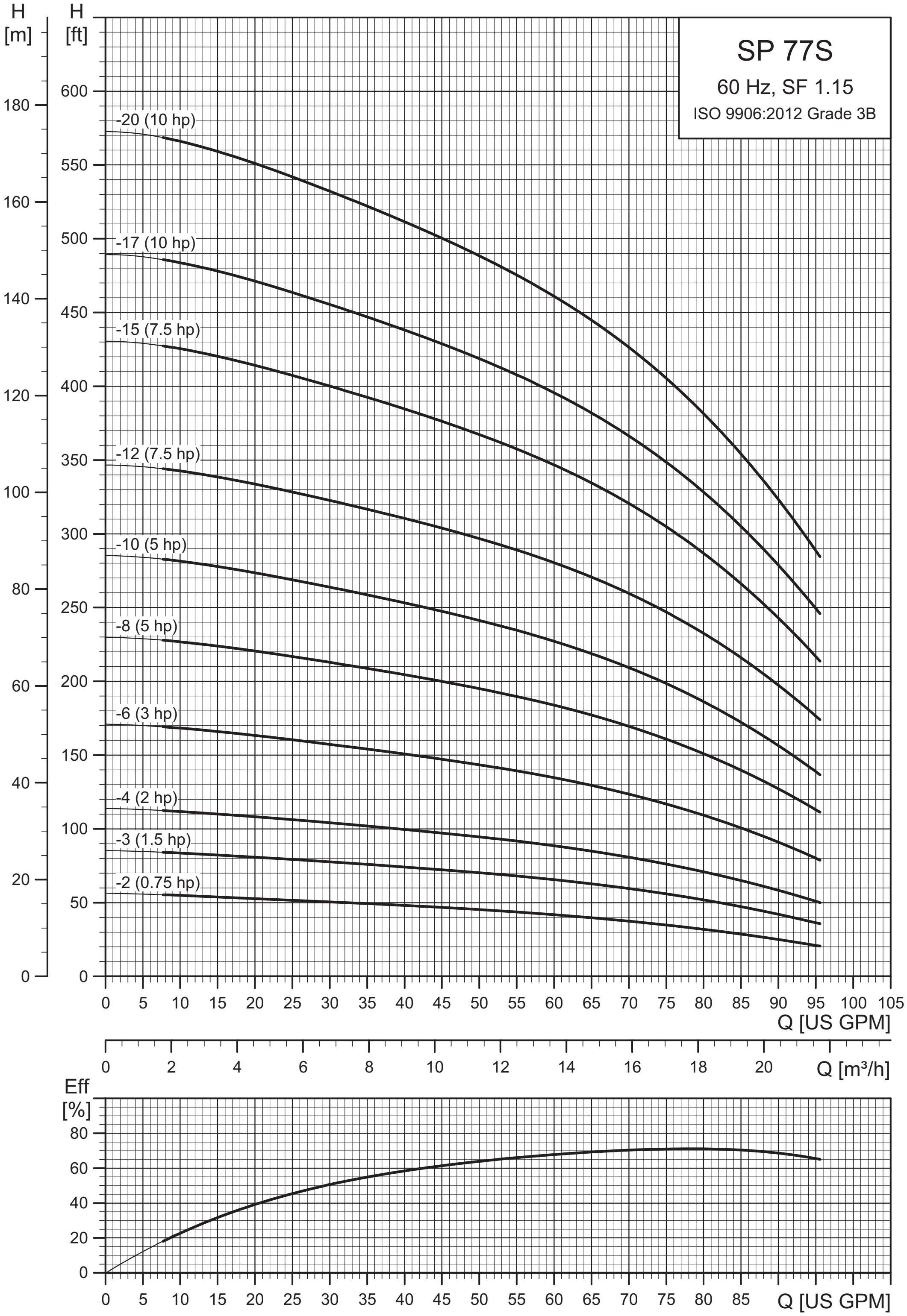
E = Maximum diameter of pump including cable guard and motor.

Notes:
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

▲ MS 6000C motor.

4" and larger wells - continued

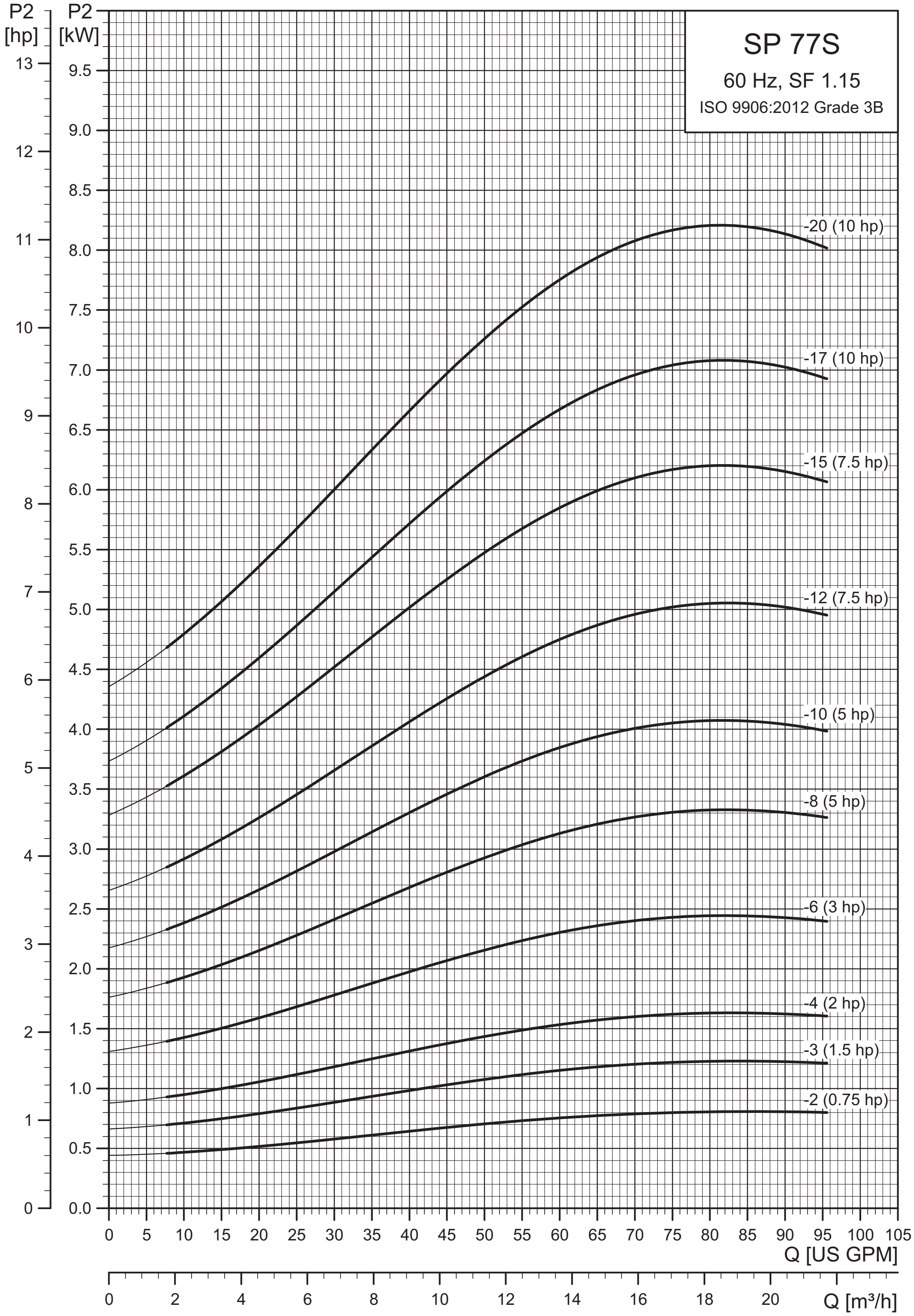
SP 77S (77 gpm)



TM06 4620 3215

4" and larger pumps - continued

SP 77S (77 gpm) pump power requirement (P2)



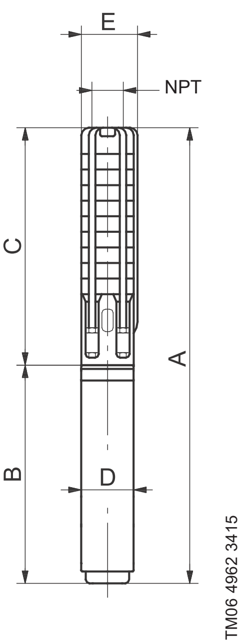
TM06 4621 3215

4" and larger wells - continued

SP 77S (77 gpm) pump with 4" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
77S - Motor diameter 4-inch, 3-wire motor, 60 Hz, rated flow rate 77 gpm (2" NPT)												
77S07-2	37	1	230	.75	■	3380	28.35 (720)	13.08 (332)	15.28 (388)	3.75 (95)	3.98 (101)	29.7
	38	3	230	.75	■	3401	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.7
	38	3	460	.75	■	3401	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.7
	37	3	575	.75	■	3393	26.97 (685)	11.70 (297)	15.28 (388)	3.75 (95)	3.98 (101)	26.7
77S15-3	61	1	230	1	■	3457	33.47 (850)	15.24 (387)	18.23 (463)	3.75 (95)	3.98 (101)	36.8
	61	3	230	1.5	■	3463	31.89 (810)	13.67 (347)	18.23 (463)	3.75 (95)	3.98 (101)	33.3
	61	3	460	1.5	■	3463	31.89 (810)	13.67 (347)	18.23 (463)	3.75 (95)	3.98 (101)	33.3
	60	3	575	1.5	■	3440	31.89 (810)	13.67 (347)	18.23 (463)	3.75 (95)	3.98 (101)	33.0
77S20-4	77	1	230	2	●	3447	40.75 (1035)	19.57 (497)	21.19 (538)	3.75 (95)	3.98 (101)	54.2
	77	3	230	2	■	3445	36.42 (925)	15.24 (387)	21.19 (538)	3.75 (95)	3.98 (101)	38.8
	77	3	460	2	■	3445	36.42 (925)	15.24 (387)	21.19 (538)	3.75 (95)	3.98 (101)	39.0
	77	3	575	2	■	3441	36.42 (925)	15.24 (387)	21.19 (538)	3.75 (95)	3.98 (101)	38.8
77S30-6	113	1	230	3	●	3427	49.81 (1265)	22.72 (577)	27.09 (688)	3.75 (95)	3.98 (101)	66.5
	114	3	208	3	●	3437	45.08 (1145)	18.00 (457)	27.09 (688)	3.75 (95)	3.98 (101)	53.3
	114	3	230	3	●	3437	45.08 (1145)	18.00 (457)	27.09 (688)	3.75 (95)	3.98 (101)	53.3
	117	3	460	3	●	3466	45.08 (1145)	18.00 (457)	27.09 (688)	3.75 (95)	3.98 (101)	53.3
77S50-8	157	1	230	5	●	3484	59.65 (1515)	26.66 (677)	33.00 (838)	3.75 (95)	3.98 (101)	81.1
	159	3	208	5	●	3503	55.71 (1415)	22.72 (577)	33.00 (838)	3.75 (95)	3.98 (101)	70.1
	159	3	230	5	●	3503	55.71 (1415)	22.72 (577)	33.00 (838)	3.75 (95)	3.98 (101)	70.1
	159	3	460	5	●	3501	55.71 (1415)	22.72 (577)	33.00 (838)	3.75 (95)	3.98 (101)	70.1
77S50-10	192	1	230	5	●	3449	65.56 (1665)	26.66 (677)	38.90 (988)	3.75 (95)	3.98 (101)	84.6
	195	3	208	5	●	3476	61.62 (1565)	22.72 (577)	38.90 (988)	3.75 (95)	3.98 (101)	73.6
	195	3	230	5	●	3476	61.62 (1565)	22.72 (577)	38.90 (988)	3.75 (95)	3.98 (101)	73.6
	195	3	460	5	●	3473	61.62 (1565)	22.72 (577)	38.90 (988)	3.75 (95)	3.98 (101)	73.6
77S75-12	237	3	208	7.5	●	3493	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	88.1
	237	3	230	7.5	●	3493	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	88.1
	237	3	460	7.5	●	3493	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	88.1
	237	3	575	7.5	●	3493	71.46 (1815)	26.66 (677)	44.81 (1138)	3.75 (95)	3.98 (101)	88.1
77S75-15	293	3	208	7.5	●	3463	80.32 (2040)	26.66 (677)	53.67 (1363)	3.75 (95)	3.98 (101)	93.4
	293	3	230	7.5	●	3463	80.32 (2040)	26.66 (677)	53.67 (1363)	3.75 (95)	3.98 (101)	93.4
	293	3	460	7.5	●	3463	80.32 (2040)	26.66 (677)	53.67 (1363)	3.75 (95)	3.98 (101)	93.4
	293	3	575	7.5	●	3463	80.32 (2040)	26.66 (677)	53.67 (1363)	3.75 (95)	3.98 (101)	93.4
77S100-17	337	3	460	10	●	3484	90.16 (2290)	30.60 (777)	59.57 (1513)	3.75 (95)	3.98 (101)	105.7
	337	3	575	10	●	3484	90.16 (2290)	30.60 (777)	59.57 (1513)	3.75 (95)	3.98 (101)	105.7
77S100-20	392	3	460	10	●	3462	99.02 (2515)	30.60 (777)	68.43 (1738)	3.75 (95)	3.98 (101)	111.0
	392	3	575	10	●	3462	99.02 (2515)	30.60 (777)	68.43 (1738)	3.75 (95)	3.98 (101)	111.0

77S



E = Maximum diameter of pump including cable guard and motor.

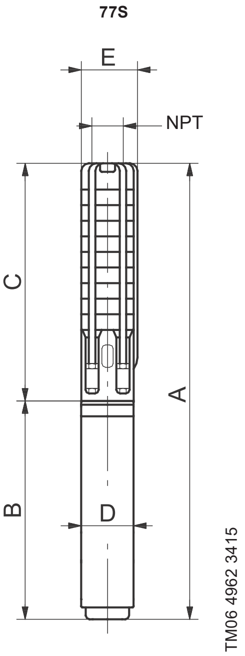
Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

- ■ MS 402 motor.
- ● MS 4000 motor.

4" and larger wells - continued

SP 77S (77 gpm) pump with 6" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
77S - Motor diameter 6 inch, 60 Hz, rated flow rate 77 gpm (2" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
77S75-12	239	3	208	7.5	▲	3500	70.79 (1798)	23.51 (597)	47.29 (1201)	5.50 (140)	5.50 (140)	115.8
	239	3	230	7.5	▲	3500	70.79 (1798)	23.51 (597)	47.29 (1201)	5.50 (140)	5.50 (140)	115.8
	240	3	460	7.5	▲	3509	70.79 (1798)	23.51 (597)	47.29 (1201)	5.50 (140)	5.50 (140)	115.8
	240	3	575	7.5	▲	3508	70.79 (1798)	23.51 (597)	47.29 (1201)	5.50 (140)	5.50 (140)	115.8
77S75-15	295	3	208	7.5	▲	3472	79.65 (2023)	23.51 (597)	56.15 (1426)	5.50 (140)	5.50 (140)	121.1
	295	3	230	7.5	▲	3472	79.65 (2023)	23.51 (597)	56.15 (1426)	5.50 (140)	5.50 (140)	121.1
	297	3	460	7.5	▲	3484	79.65 (2023)	23.51 (597)	56.15 (1426)	5.50 (140)	5.50 (140)	121.1
	297	3	575	7.5	▲	3483	79.65 (2023)	23.51 (597)	56.15 (1426)	5.50 (140)	5.50 (140)	121.1
77S100-17	337	3	208	10	▲	3486	86.74 (2203)	24.69 (627)	62.05 (1576)	5.50 (140)	5.50 (140)	131.2
	337	3	230	10	▲	3486	86.74 (2203)	24.69 (627)	62.05 (1576)	5.50 (140)	5.50 (140)	131.2
	340	3	460	10	▲	3496	86.74 (2203)	24.69 (627)	62.05 (1576)	5.50 (140)	5.50 (140)	131.2
	340	3	575	10	▲	3496	86.74 (2203)	24.69 (627)	62.05 (1576)	5.50 (140)	5.50 (140)	131.2
77S100-20	393	3	208	10	▲	3462	95.60 (2428)	24.69 (627)	70.91 (1801)	5.50 (140)	5.50 (140)	136.4
	393	3	230	10	▲	3476	95.60 (2428)	24.69 (627)	70.91 (1801)	5.50 (140)	5.50 (140)	136.4
	396	3	460	10	▲	3476	95.60 (2428)	24.69 (627)	70.91 (1801)	5.50 (140)	5.50 (140)	136.4
	396	3	575	10	▲	3475	95.60 (2428)	24.69 (627)	70.91 (1801)	5.50 (140)	5.50 (140)	136.4



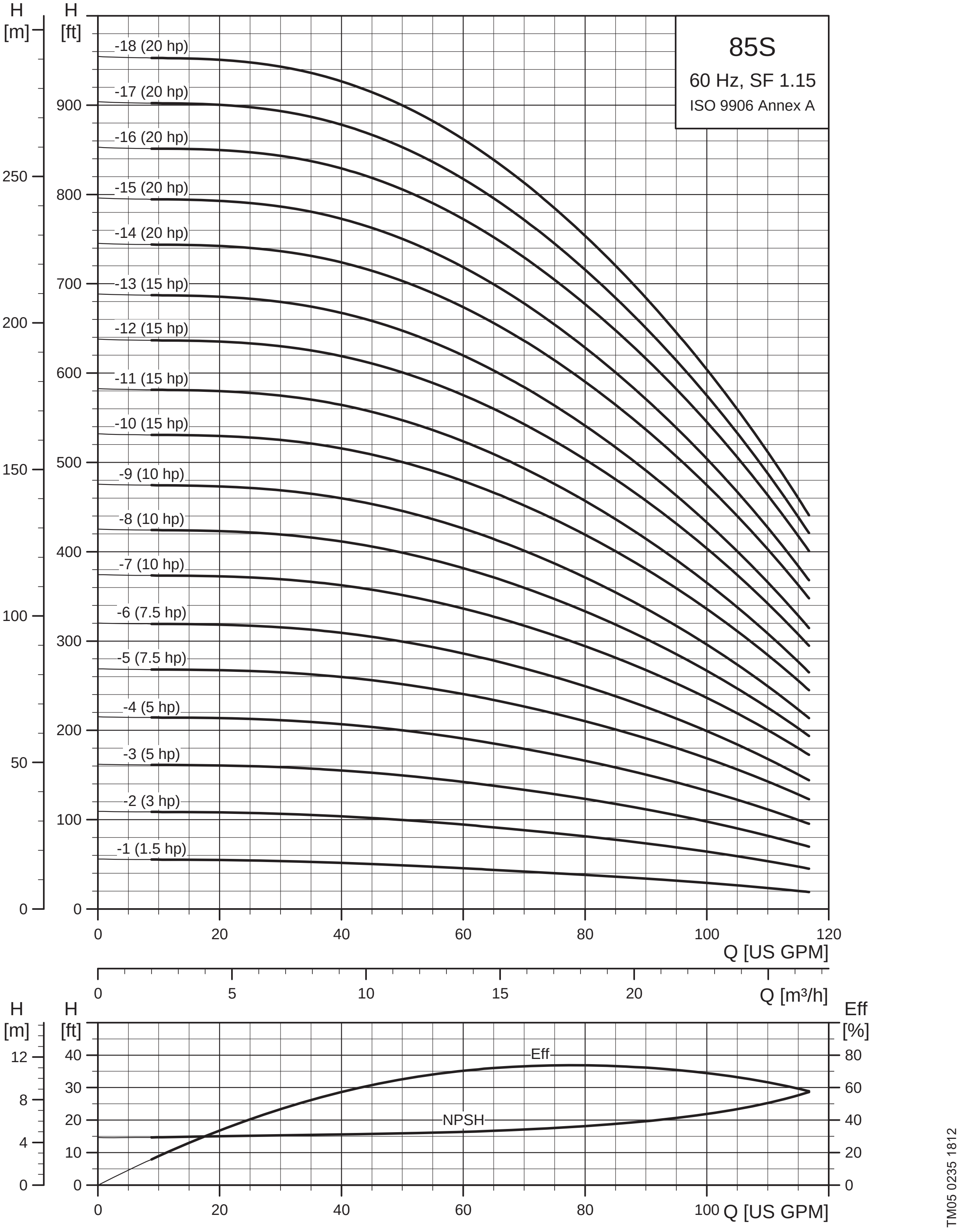
E = Maximum diameter of pump including cable guard and motor.

Notes:
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

▲ MS 6000C motor.

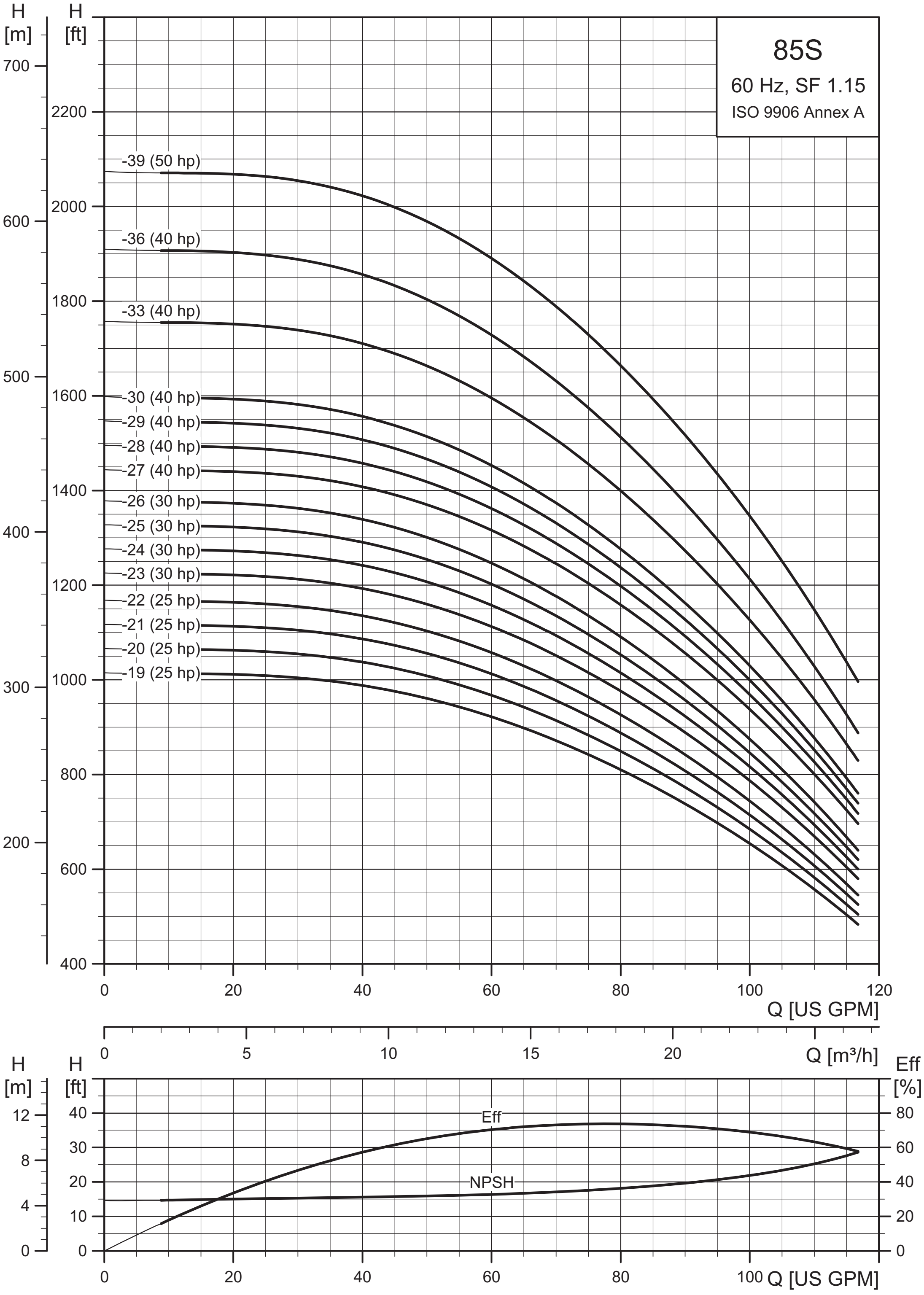
6" and larger wells

SP 85S (85 gpm)



6" and larger wells - continued

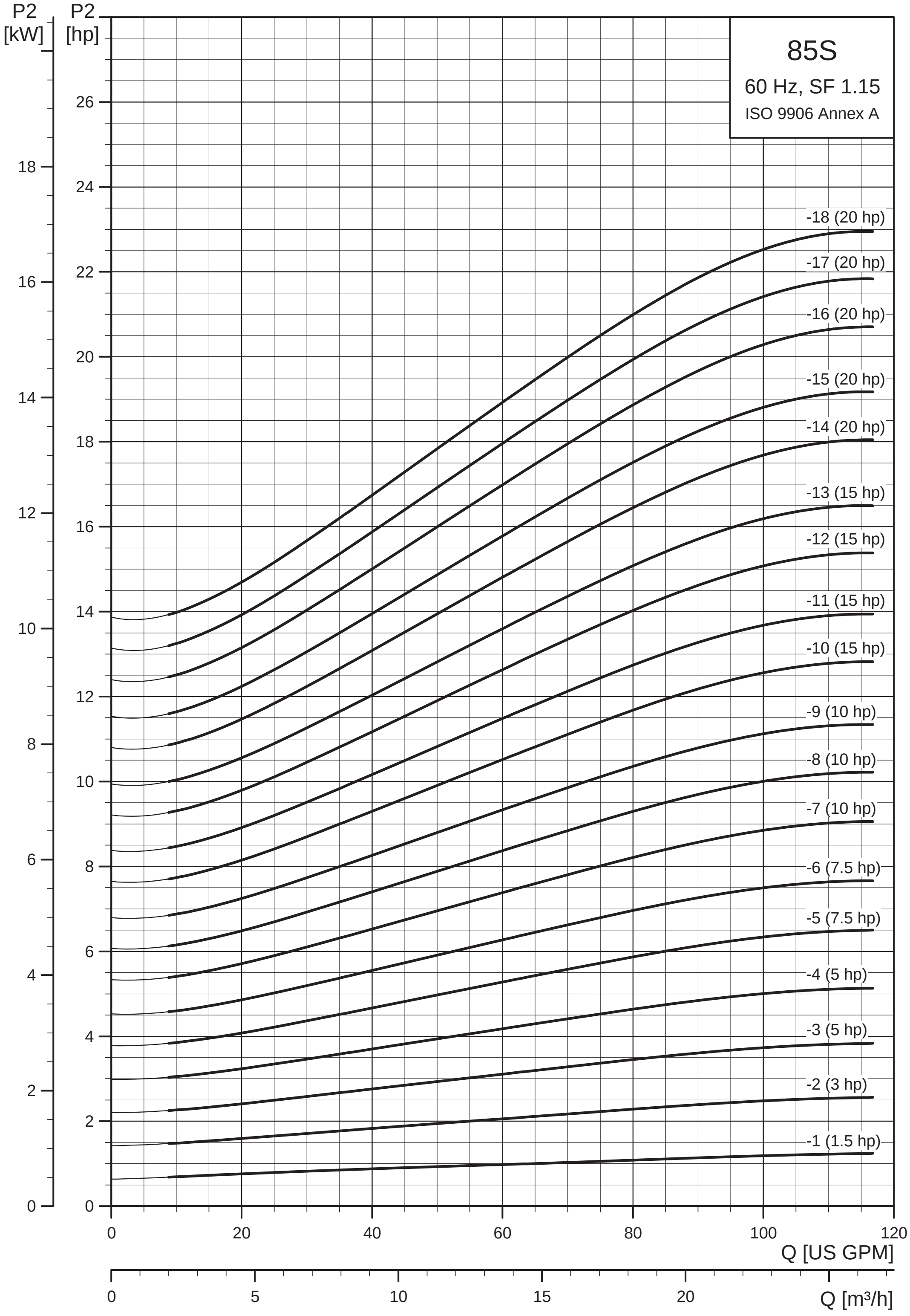
SP 85S (85 gpm)



TM05 0236 3815

6" and larger wells - continued

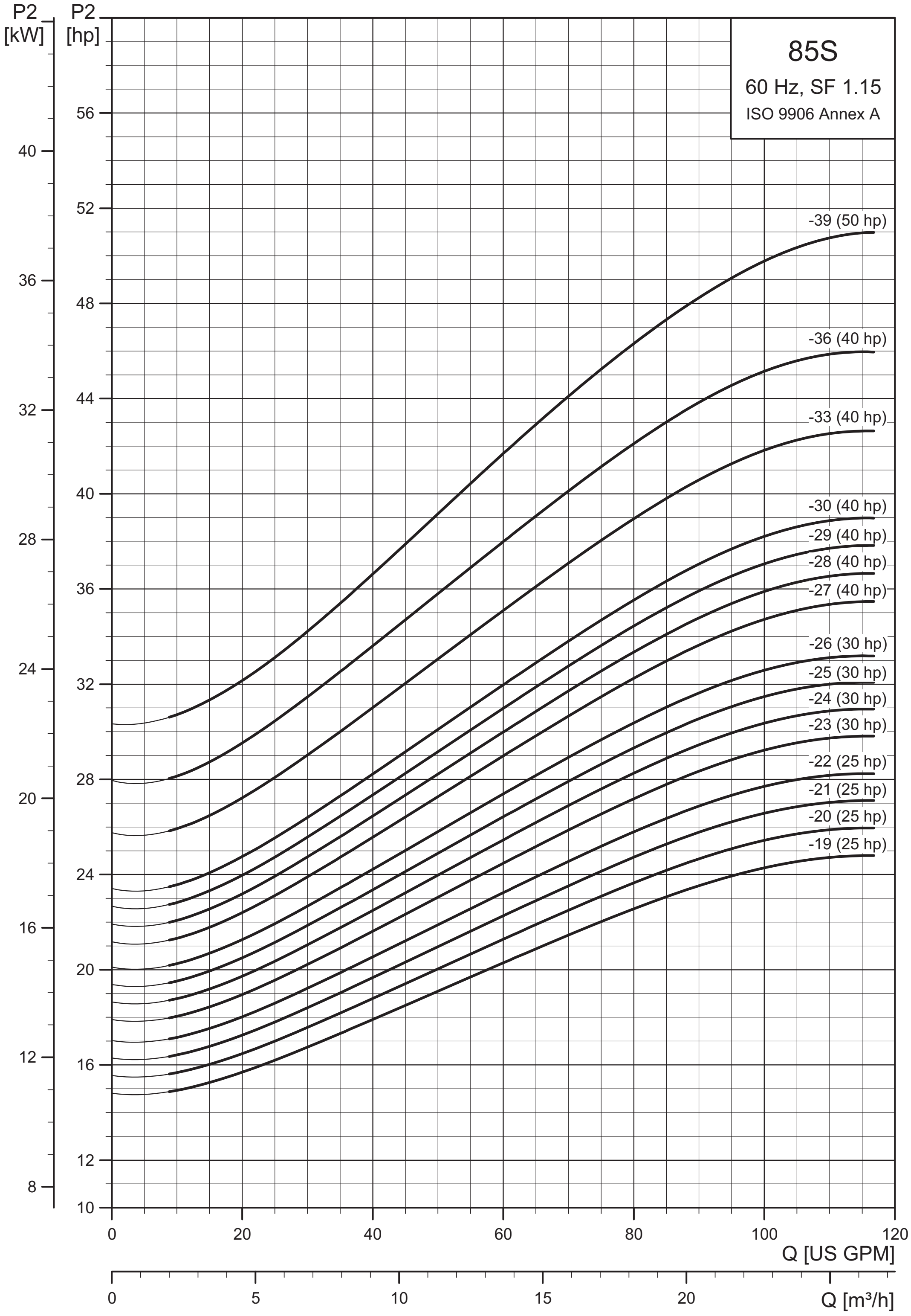
SP 85S (85 gpm) pump power requirement (P2)



TM05 0237 1812

6" and larger wells - continued

SP 85S (85 gpm) pump power requirement (P2)

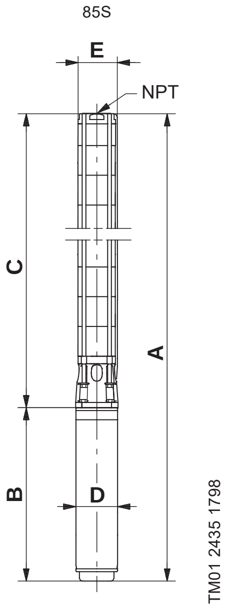


TM05 0238 3815

6" and larger wells - continued

SP 85S (85 gpm) pump with 4", 6" motors

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
85S - Motor diameter 4-inch, 3-wire motor, 60 Hz, rated flow rate 85 gpm (3" NPT)												
85S15-1	42	1	230	1.5	■	3519	28.04 (712)	15.24 (387)	12.80 (325)	3.75 (95)	5.28 (134)	29.7
		3	230	1.5	■	3516	26.46 (672)	13.67 (347)	12.80 (325)	3.75 (95)	5.28 (134)	29.7
		3	460	1.5	■	3516	26.46 (672)	13.67 (347)	12.80 (325)	3.75 (95)	5.28 (134)	29.7
85S30-2	87	1	230	3	●	3500	37.88 (962)	22.72 (577)	15.16 (385)	3.75 (95)	5.28 (134)	55.8
	87	3	230	3	●	3491	33.12 (841)	17.96 (456)	15.16 (385)	3.75 (95)	5.28 (134)	47.7
	88	3	460	3	●	3517	33.12 (841)	17.96 (456)	15.16 (385)	3.75 (95)	5.28 (134)	47.7
85S50-3	135	1	230	5	●	3520	44.22 (1123)	26.66 (677)	17.56 (446)	3.75 (95)	5.28 (134)	67.5
	134	3	230	5	●	3531	40.24 (1022)	22.68 (576)	17.56 (446)	3.75 (95)	5.28 (134)	51.3
	135	3	460	5	●	3530	40.24 (1022)	22.68 (576)	17.56 (446)	3.75 (95)	5.28 (134)	51.3
85S50-4	170	1	230	5	●	3482	46.58 (1183)	26.66 (677)	19.93 (506)	3.75 (95)	5.28 (134)	69.3
	171	3	230	5	●	3502	42.60 (1082)	22.68 (576)	19.93 (506)	3.75 (95)	5.28 (134)	61.2
	171	3	460	5	●	3500	42.60 (1082)	22.68 (576)	19.93 (506)	3.75 (95)	5.28 (134)	61.2
85S75-5	215	3	230	7.5	●	3510	48.94 (1243)	26.62 (676)	22.33 (567)	3.75 (95)	5.28 (134)	73.8
	215	3	460	7.5	●	3510	48.94 (1243)	26.62 (676)	22.33 (567)	3.75 (95)	5.28 (134)	73.8
85S75-6	256	3	230	7.5	●	3490	51.30 (1303)	26.62 (676)	24.69 (627)	3.75 (95)	5.28 (134)	85.5
	256	3	460	7.5	●	3490	51.30 (1303)	26.62 (676)	24.69 (627)	3.75 (95)	5.28 (134)	76.5
85S100-7	301	3	460	10	●	3503	57.64 (1464)	30.56 (776)	27.09 (688)	3.75 (95)	5.28 (134)	136.8
85S100-8	342	3	460	10	●	3488	60.00 (1524)	30.56 (776)	29.45 (748)	3.75 (95)	5.28 (134)	138.6
85S100-9	382	3	460	10	●	3472	62.41 (1585)	30.56 (776)	31.86 (809)	3.75 (95)	5.28 (134)	140.4
85S - Motor diameter 6-inch, 3-wire motor, 60 Hz, rated flow rate 85 gpm (3" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
85S75-5	216	3	230	7.5	▲	3516	46.58 (1183)	23.51 (597)	23.08 (586)	5.52 (140)	5.52 (140)	98.1
	217	3	460	7.5	▲	3523	46.58 (1183)	23.51 (597)	23.08 (586)	5.52 (140)	5.52 (140)	98.1
85S75-6	257	3	230	7.5	▲	3498	48.94 (1243)	23.51 (597)	25.44 (646)	5.52 (140)	5.52 (140)	99.9
	258	3	460	7.5	▲	3507	48.94 (1243)	23.51 (597)	25.44 (646)	5.52 (140)	5.52 (140)	99.9
85S100-7	301	3	230	10	▲	3505	52.52 (1334)	24.69 (627)	27.84 (707)	5.52 (140)	5.52 (140)	103.5
	303	3	460	10	▲	3513	52.52 (1334)	24.69 (627)	27.84 (707)	5.52 (140)	5.52 (140)	103.5
85S100-8	342	3	230	10	▲	3490	54.89 (1394)	24.69 (627)	30.20 (767)	5.52 (140)	5.52 (140)	105.3
	344	3	460	10	▲	3500	54.89 (1394)	24.69 (627)	30.20 (767)	5.52 (140)	5.52 (140)	105.3
85S100-9	383	3	230	10	▲	3474	57.29 (1455)	24.69 (627)	32.60 (828)	5.52 (140)	5.52 (140)	108.0
	385	3	460	10	▲	3486	57.29 (1455)	24.69 (627)	32.60 (828)	5.52 (140)	5.52 (140)	108.0
85S150-10	432	3	230	15	▲	3509	62.01 (1575)	27.05 (687)	34.97 (888)	5.52 (140)	5.52 (140)	122.4
	433	3	460	15	▲	3513	62.01 (1575)	27.05 (687)	34.97 (888)	5.52 (140)	5.52 (140)	122.4
85S150-11	473	3	230	15	▲	3499	64.41 (1636)	27.05 (687)	37.37 (949)	5.52 (140)	5.52 (140)	126.0
	474	3	460	15	▲	3503	64.41 (1636)	27.05 (687)	37.37 (949)	5.52 (140)	5.52 (140)	126.0
85S150-12	513	3	230	15	▲	3489	66.78 (1696)	27.05 (687)	39.73 (1009)	5.52 (140)	5.52 (140)	133.2
	514	3	460	15	▲	3494	66.78 (1696)	27.05 (687)	39.73 (1009)	5.52 (140)	5.52 (140)	133.2
85S150-13	553	3	230	15	▲	3479	69.18 (1757)	27.05 (687)	42.13 (1070)	5.52 (140)	5.52 (140)	135.0
	554	3	460	15	▲	3484	69.18 (1757)	27.05 (687)	42.13 (1070)	5.52 (140)	5.52 (140)	135.0



E = Maximum diameter of pump including cable guard and motor.

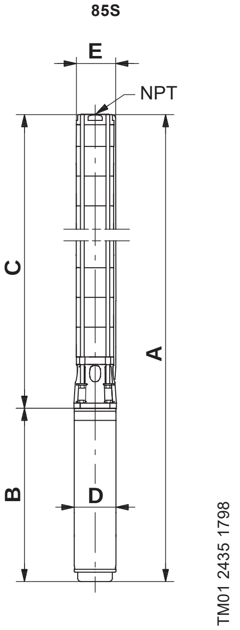
Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m)

- ■ MS 402 motor.
- ● MS 4000 motor.
- ▲ MS 6000C motor.

6" and larger wells - continued

SP 85S (85 gpm) pump with 6", 8" motors

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
85S - Motor diameter 6 inch, 60 Hz, rated flow rate 85 gpm (3" NPT)												
85S200-14	604	3	230	20	▲	3505	74.10 (1882)	29.61 (752)	44.49 (1130)	5.52 (140)	5.52 (140)	143.1
	607	3	460	20	▲	3513	74.10 (1882)	29.61 (752)	44.49 (1130)	5.52 (140)	5.52 (140)	143.1
85S200-15	644	3	230	20	▲	3497	76.50 (1943)	29.61 (752)	46.89 (1191)	5.52 (140)	5.52 (140)	147.6
	648	3	460	20	▲	3507	76.50 (1943)	29.61 (752)	46.89 (1191)	5.52 (140)	5.52 (140)	147.6
85S200-16	685	3	230	20	▲	3490	78.86 (2003)	29.61 (752)	49.26 (1251)	5.52 (140)	5.52 (140)	157.5
	689	3	460	20	▲	3500	78.86 (2003)	29.61 (752)	49.26 (1251)	5.52 (140)	5.52 (140)	157.5
85S200-17	724	3	230	20	▲	3482	81.26 (2064)	29.61 (752)	51.66 (1312)	5.52 (140)	5.52 (140)	160.2
	729	3	460	20	▲	3493	81.26 (2064)	29.61 (752)	51.66 (1312)	5.52 (140)	5.52 (140)	160.2
85S200-18	764	3	230	20	▲	3474	83.63 (2124)	29.61 (752)	54.02 (1372)	5.52 (140)	5.52 (140)	161.1
	769	3	460	20	▲	3486	83.63 (2124)	29.61 (752)	54.02 (1372)	5.52 (140)	5.52 (140)	179.0
85S250-19	817	3	230	25	▲	3497	88.19 (2240)	31.78 (807)	56.42 (1433)	5.52 (140)	5.52 (140)	191.7
	821	3	460	25	▲	3506	88.19 (2240)	31.78 (807)	56.42 (1433)	5.52 (140)	5.52 (140)	191.7
85S250-20	857	3	230	25	▲	3491	90.56 (2300)	31.78 (807)	58.78 (1493)	5.52 (140)	5.52 (140)	195.3
	862	3	460	25	▲	3501	90.56 (2300)	31.78 (807)	58.78 (1493)	5.52 (140)	5.52 (140)	195.3
85S250-21	897	3	230	25	▲	3485	92.96 (2361)	31.78 (807)	61.19 (1554)	5.52 (140)	5.52 (140)	198.0
	902	3	460	25	▲	3496	92.96 (2361)	31.78 (807)	61.19 (1554)	5.52 (140)	5.52 (140)	198.0
85S250-22	936	3	230	25	▲	3479	95.32 (2421)	31.78 (807)	63.55 (1614)	5.52 (140)	5.52 (140)	199.8
	942	3	460	25	▲	3490	95.32 (2421)	31.78 (807)	63.55 (1614)	5.52 (140)	5.52 (140)	199.8
85S300-23	984	3	230	30	▲	3487	100.08 (2542)	34.14 (867)	65.95 (1675)	5.52 (140)	5.52 (140)	199.8
	989	3	460	30	▲	3498	100.08 (2542)	34.14 (867)	65.95 (1675)	5.52 (140)	5.52 (140)	199.8
85S300-24	1023	3	230	30	▲	3482	102.45 (2602)	34.14 (867)	68.31 (1735)	5.52 (140)	5.52 (140)	216.0
	1030	3	460	30	▲	3493	102.45 (2602)	34.14 (867)	68.31 (1735)	5.52 (140)	5.52 (140)	216.0
85S300-25	1063	3	230	30	▲	3476	104.85 (2663)	34.14 (867)	70.71 (1796)	5.52 (140)	5.52 (140)	219.6
	1070	3	460	30	▲	3488	104.85 (2663)	34.14 (867)	70.71 (1796)	5.52 (140)	5.52 (140)	219.6
85S300-26	1102	3	230	30	▲	3471	107.21 (2723)	34.14 (867)	73.08 (1856)	5.52 (140)	5.52 (140)	221.4
	1110	3	460	30	▲	3483	107.21 (2723)	34.14 (867)	73.08 (1856)	5.52 (140)	5.52 (140)	221.4
85S400-27	1171	3	460	40	▲	3512	109.61 (2784)	34.14 (867)	75.48 (1917)	5.52 (140)	5.52 (140)	234.9
85S400-28	1212	3	460	40	▲	3508	117.09 (2974)	39.26 (997)	77.84 (1977)	5.52 (140)	5.52 (140)	246.6
85S400-29	1253	3	460	40	▲	3505	119.49 (3035)	39.26 (997)	80.24 (2038)	5.52 (140)	5.52 (140)	248.4
85S400-30	1294	3	460	40	▲	3501	121.86 (3095)	39.26 (997)	82.60 (2098)	5.52 (140)	5.52 (140)	270.0
85S400-33DS	1416	3	460	40	▲	3490	142.88 (3629)	39.26 (997)	103.63 (2632)	5.52 (140)	6.89 (175)	515.5
85S400-36DS	1535	3	460	40	▲	3479	150.00 (3810)	39.26 (997)	110.75 (2813)	5.52 (140)	6.89 (175)	454.8
85S500-39DS	1670	3	460	50	☼	3487	173.94 (4418)	56.03 (1423)	117.92 (2995)	5.63 (143)	6.89 (175)	469.0
85S - Motor diameter 8 inch, 60 Hz, rated flow rate 85 gpm (3" NPT)												
85S400-33DS	1427	3	460	40	*	3505	145.12 (3686)	43.71 (1110)	101.42 (2576)	7.56 (192)	7.56 (192)	652.7
85S400-36DS	1549	3	460	40	*	3496	152.25 (3867)	43.71 (1110)	108.55 (2757)	7.56 (192)	7.56 (192)	592.0
85S400-39DS	1690	3	460	50	*	3508	159.41 (4049)	43.71 (1110)	115.71 (2939)	7.56 (192)	7.56 (192)	537.2



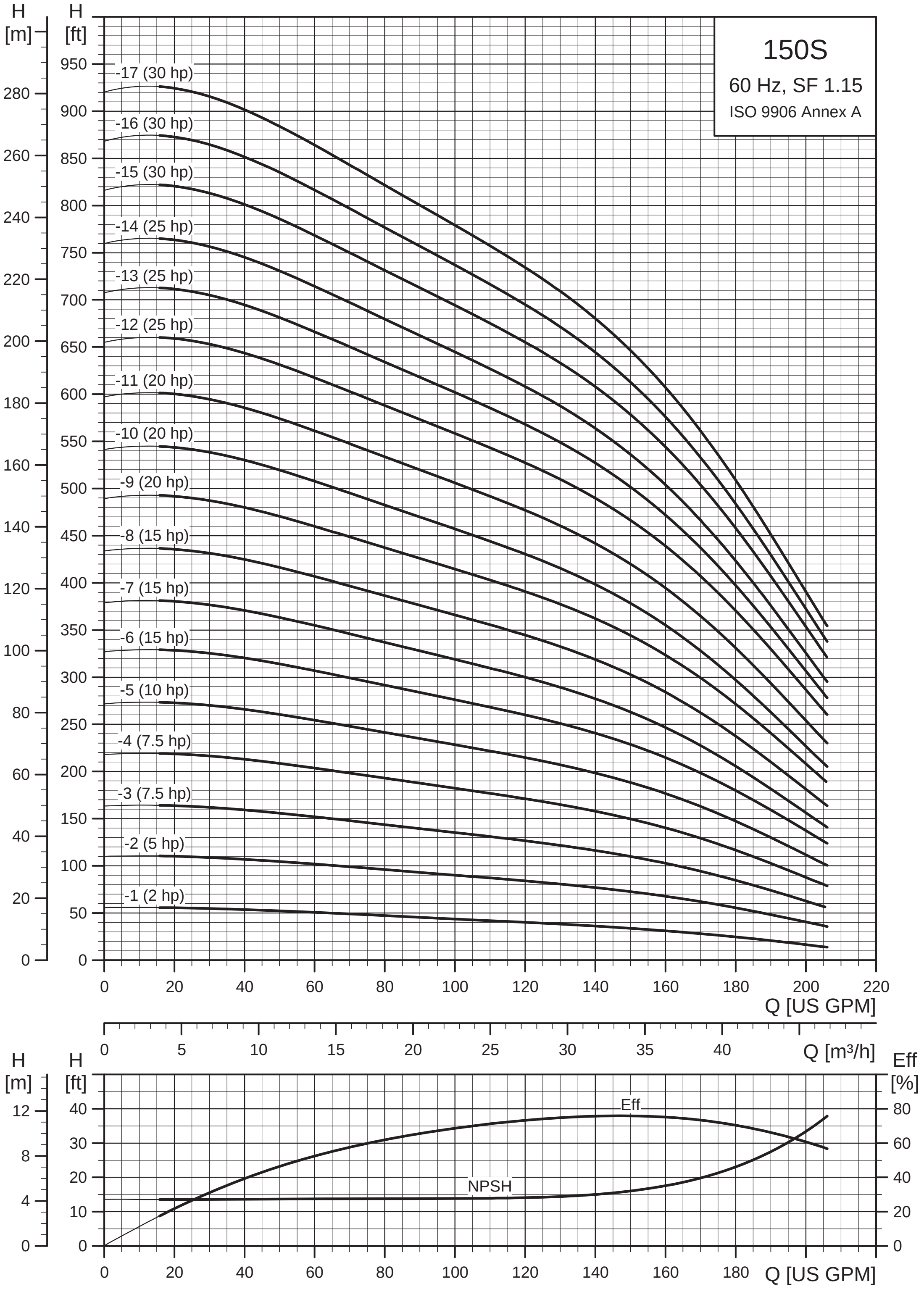
E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
DS designation = Built into sleeve, 3" NPT, 8" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

▲	MS 6000C motor.
☼	Takes MMS 6 motor; not available as complete.
*	Takes MMS 8000 motor; not available as complete.

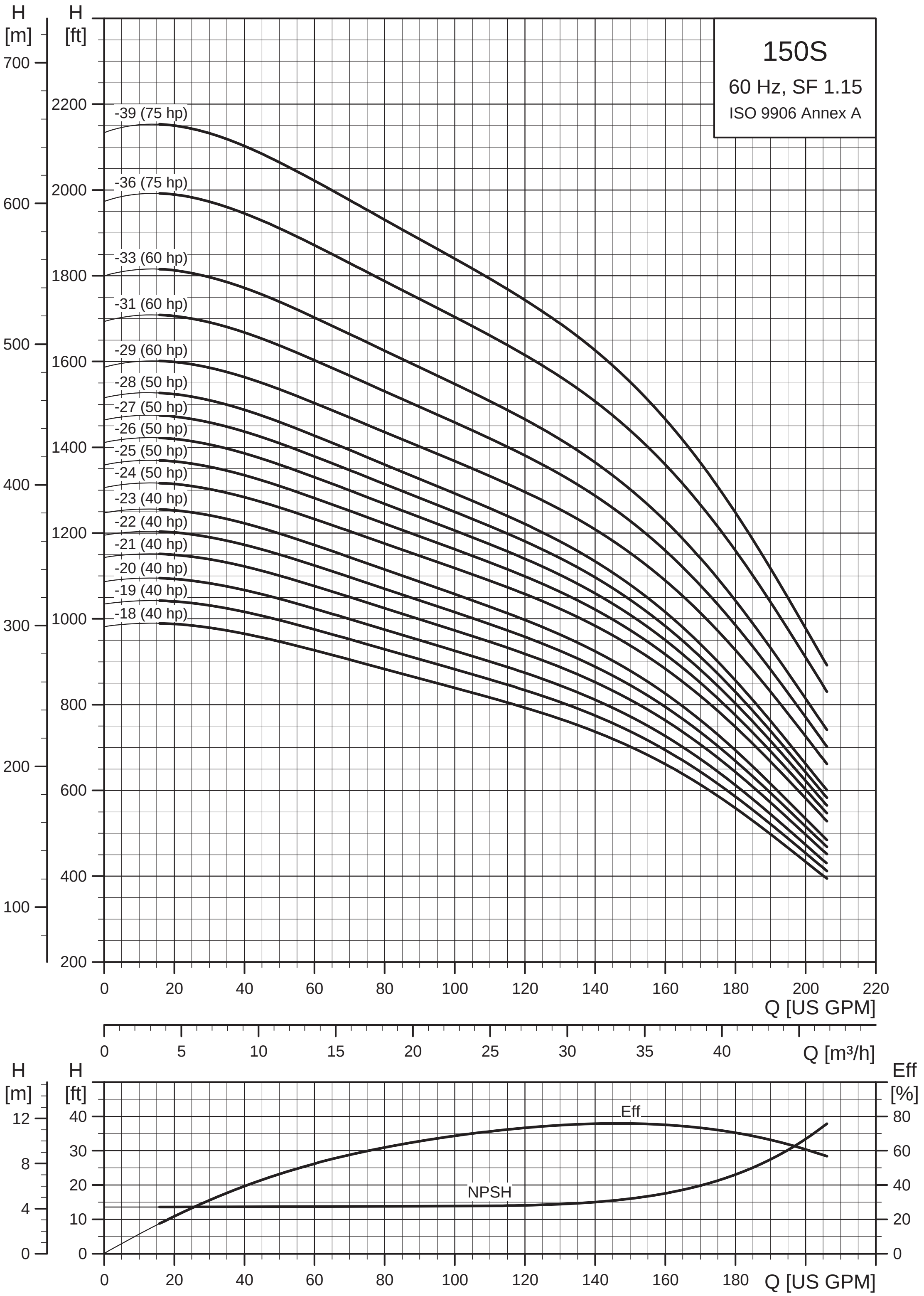
6" and larger wells - continued

SP 150S (150 gpm)



6" and larger wells - continued

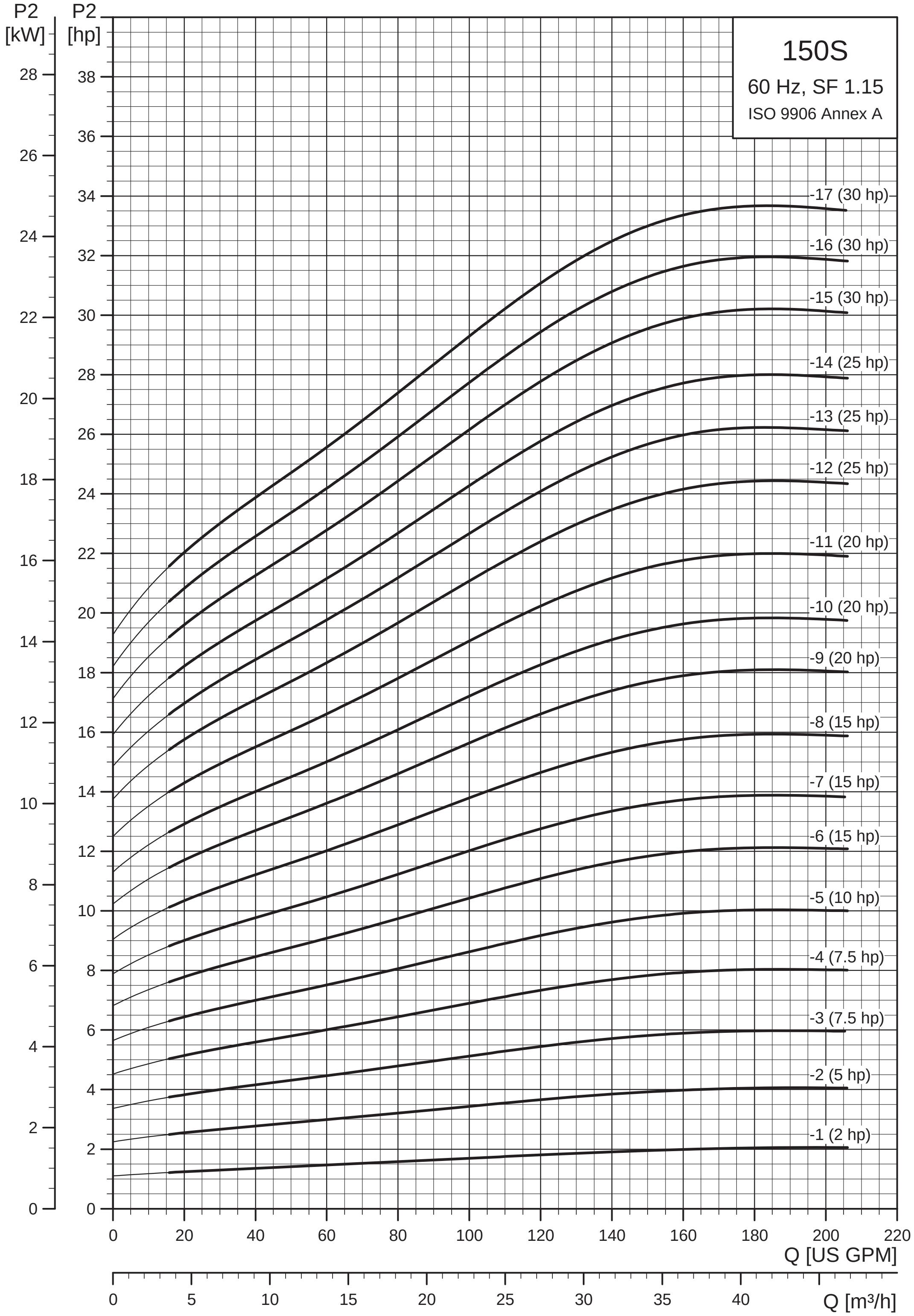
SP 150S (150 gpm)



TM05 0240 1812

6" and larger wells - continued

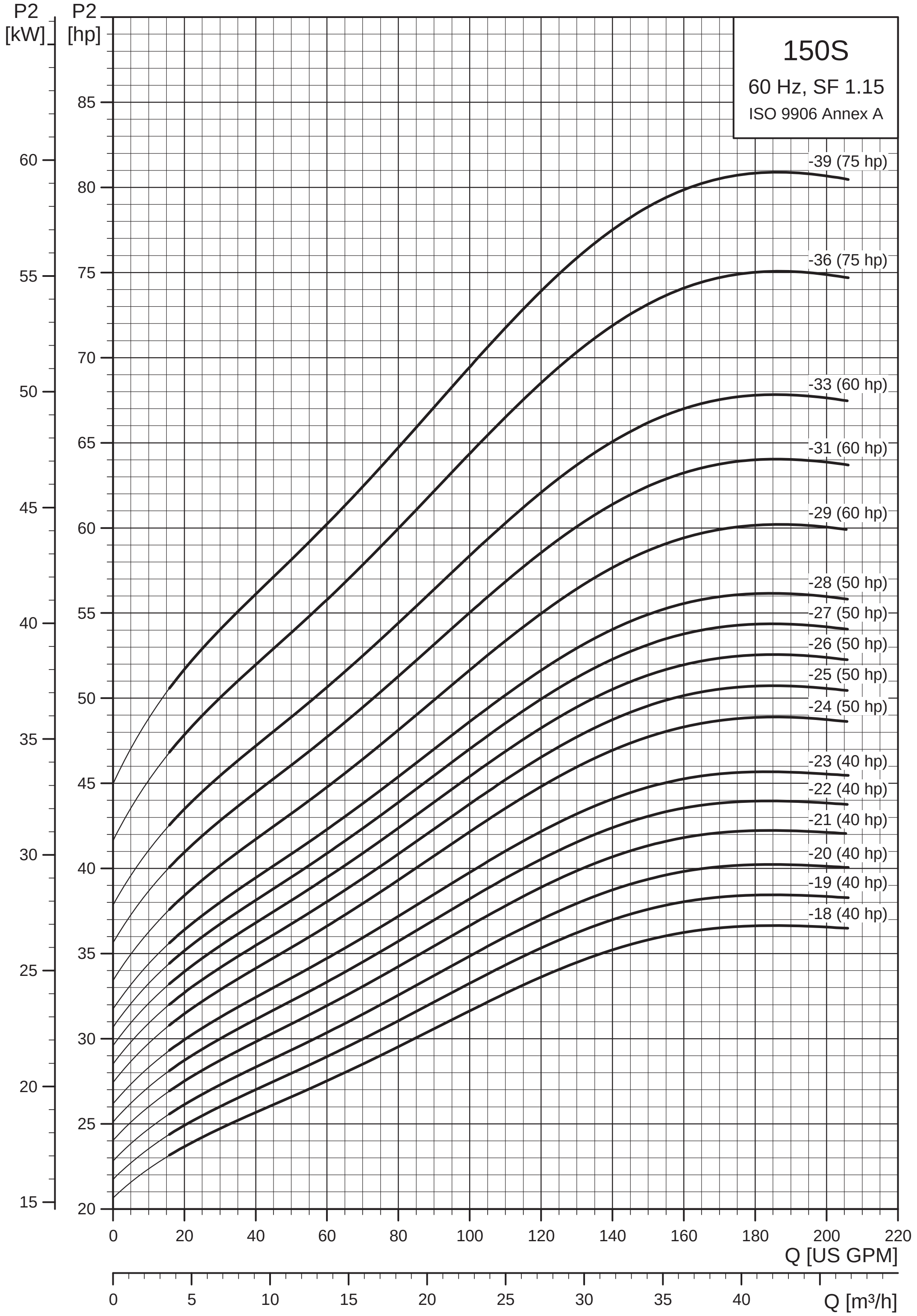
SP 150S (150 gpm) pump power requirement (P2)



TM05 0241 1812

6" and larger wells - continued

SP 150S (150 gpm) pump power requirement (P2)

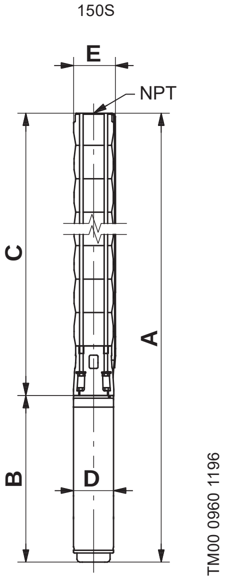


TM05 0242 1812

6" and larger wells - continued

SP 150S (150 gpm) pump with 4" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
150S - Motor diameter 4-inch, 3-wire motor, 60 Hz, rated flow rate 150 gpm (3" NPT)												
150S20-1	39	1	230	2	●	3477	33.67 (855)	19.57 (497)	14.10 (358)	3.75 (95)	5.28 (134)	49.5
	39	3	230	2	■	3474	29.34 (745)	15.24 (387)	14.10 (358)	3.75 (95)	5.28 (134)	45.0
	39	3	460	2	■	3474	29.34 (745)	15.24 (387)	14.10 (358)	3.75 (95)	5.28 (134)	45.0
150S50-2	78	1	230	5	●	3502	44.53 (1131)	26.66 (677)	17.88 (454)	3.75 (95)	5.28 (134)	67.5
	79	3	230	5	●	3517	40.56 (1030)	22.68 (576)	17.88 (454)	3.75 (95)	5.28 (134)	42.3
	79	3	460	5	●	3516	40.56 (1030)	22.68 (576)	17.88 (454)	3.75 (95)	5.28 (134)	42.3
150S75-3	118	3	230	7.5	●	3508	48.27 (1226)	26.62 (676)	21.66 (550)	3.75 (95)	5.28 (134)	51.3
	118	3	460	7.5	●	3508	48.27 (1226)	26.62 (676)	21.66 (550)	3.75 (95)	5.28 (134)	82.8
150S75-4	154	3	230	7.5	●	3473	52.05 (1322)	26.62 (676)	25.44 (646)	3.75 (95)	5.28 (134)	85.5
	154	3	460	7.5	●	3473	52.05 (1322)	26.62 (676)	25.44 (646)	3.75 (95)	5.28 (134)	85.5
150S100-5	195	3	460	10	●	3481	59.77 (1518)	30.56 (776)	29.22 (742)	3.75 (95)	5.28 (134)	135.9
150S - Motor diameter 6 inch, 60 Hz, rated flow rate 150 gpm (3" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
150S75-4	155	3	230	7.5	▲	3482	49.69 (1262)	23.51 (597)	26.19 (665)	5.52 (140)	5.52 (140)	99.9
	156	3	460	7.5	▲	3493	49.69 (1262)	23.51 (597)	26.19 (665)	5.52 (140)	5.52 (140)	99.9
150S100-5	195	3	230	10	▲	3482	54.65 (1388)	24.69 (627)	29.97 (761)	5.52 (140)	5.52 (140)	73.8
	196	3	460	10	▲	3493	54.65 (1388)	24.69 (627)	29.97 (761)	5.52 (140)	5.52 (140)	73.8
150S150-6	238	3	230	15	▲	3508	60.79 (1544)	27.05 (687)	33.75 (857)	5.52 (140)	5.52 (140)	119.7
	239	3	460	15	▲	3511	60.79 (1544)	27.05 (687)	33.75 (857)	5.52 (140)	5.52 (140)	119.7
150S150-7	276	3	230	15	▲	3492	64.57 (1640)	27.05 (687)	37.52 (953)	5.52 (140)	5.52 (140)	127.8
	277	3	460	15	▲	3496	64.57 (1640)	27.05 (687)	37.52 (953)	5.52 (140)	5.52 (140)	127.8
150S150-8	313	3	230	15	▲	3474	68.35 (1736)	27.05 (687)	41.30 (1049)	5.52 (140)	5.52 (140)	137.7
	314	3	460	15	▲	3480	68.35 (1736)	27.05 (687)	41.30 (1049)	5.52 (140)	5.52 (140)	137.7
150S200-9	357	3	230	20	▲	3496	74.69 (1897)	29.61 (752)	45.08 (1145)	5.52 (140)	5.52 (140)	141.3
	359	3	460	20	▲	3506	74.69 (1897)	29.61 (752)	45.08 (1145)	5.52 (140)	5.52 (140)	141.3
150S200-10	395	3	230	20	▲	3484	78.47 (1993)	29.61 (752)	48.86 (1241)	5.52 (140)	5.52 (140)	151.2
	397	3	460	20	▲	3495	78.47 (1993)	29.61 (752)	48.86 (1241)	5.52 (140)	5.52 (140)	151.2
150S200-11	431	3	230	20	▲	3471	82.25 (2089)	29.61 (752)	52.64 (1337)	5.52 (140)	5.52 (140)	166.5
	435	3	460	20	▲	3483	82.25 (2089)	29.61 (752)	52.64 (1337)	5.52 (140)	5.52 (140)	166.5
150S250-12	477	3	230	25	▲	3490	88.19 (2240)	31.78 (807)	56.42 (1433)	5.52 (140)	5.52 (140)	188.1
	479	3	460	25	▲	3500	88.19 (2240)	31.78 (807)	56.42 (1433)	5.52 (140)	5.52 (140)	188.1
150S250-13	514	3	230	25	▲	3480	91.97 (2336)	31.78 (807)	60.20 (1529)	5.52 (140)	5.52 (140)	201.6
	517	3	460	25	▲	3492	91.97 (2336)	31.78 (807)	60.20 (1529)	5.52 (140)	5.52 (140)	201.6
150S250-14	550	3	230	25	▲	3470	95.75 (2432)	31.78 (807)	63.98 (1625)	5.52 (140)	5.52 (140)	206.1
	554	3	460	25	▲	3482	95.75 (2432)	31.78 (807)	63.98 (1625)	5.52 (140)	5.52 (140)	206.1



E = Maximum diameter of pump including cable guard and motor.

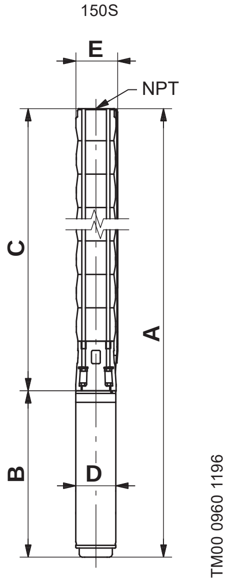
Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

- ■ MS 402 motor.
- ● MS 4000 motor.
- ▲ MS 6000C motor.

6" and larger wells - continued

SP 150S (150 gpm) pump with 6", 8" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
150S - Motor diameter 6 inch, 60 Hz, rated flow rate 150 gpm (3" NPT)												
150S300-15	592	3	230	30	▲	3476	101.89 (2588)	34.14 (867)	67.76 (1721)	5.52 (140)	5.52 (140)	209.7
	596	3	460	30	▲	3488	101.89 (2588)	34.14 (867)	67.76 (1721)	5.52 (140)	5.52 (140)	209.7
150S300-16	628	3	230	30	▲	3466	105.67 (2684)	34.14 (867)	71.54 (1817)	5.52 (140)	5.52 (140)	211.5
	633	3	460	30	▲	3479	105.67 (2684)	34.14 (867)	71.54 (1817)	5.52 (140)	5.52 (140)	211.5
150S300-17	664	3	230	30	▲	3456	109.45 (2780)	34.14 (867)	75.32 (1913)	5.52 (140)	5.52 (140)	216.0
	670	3	460	30	▲	3471	109.45 (2780)	34.14 (867)	75.32 (1913)	5.52 (140)	5.52 (140)	246.6
150S400-18	721	3	460	40	▲	3501	118.35 (3006)	39.26 (997)	79.10 (2009)	5.52 (140)	5.52 (140)	246.6
150S400-19	759	3	460	40	▲	3495	122.13 (3102)	39.26 (997)	82.88 (2105)	5.52 (140)	5.52 (140)	248.4
150S400-20	797	3	460	40	▲	3489	125.91 (3198)	39.26 (997)	86.66 (2201)	5.52 (140)	5.52 (140)	291.0
150S400-21	834	3	460	40	▲	3483	129.69 (3294)	39.26 (997)	90.44 (2297)	5.52 (140)	5.52 (140)	271.8
150S400-22	871	3	460	40	▲	3476	133.47 (3390)	39.26 (997)	94.22 (2393)	5.52 (140)	5.52 (140)	305.9
150S400-23	907	3	460	40	▲	3470	137.25 (3486)	39.26 (997)	98.00 (2489)	5.52 (140)	5.52 (140)	277.2
150S500-24	954	3	460	50	☼	3483	157.88 (4010)	56.11 (1425)	101.78 (2585)	5.67 (144)	5.67 (144)	411.8
150S500-25	991	3	460	50	☼	3478	161.66 (4106)	56.11 (1425)	105.56 (2681)	5.67 (144)	5.67 (144)	419.0
150S500-26	1028	3	460	50	☼	3473	165.44 (4202)	56.11 (1425)	109.34 (2777)	5.67 (144)	5.67 (144)	426.2
150S500-27	1064	3	460	50	☼	3467	169.22 (4298)	56.11 (1425)	113.12 (2873)	5.67 (144)	5.67 (144)	433.4
150S500-28	1100	3	460	50	☼	3462	173.00 (4394)	56.11 (1425)	116.89 (2969)	5.67 (144)	5.67 (144)	440.6
150S600-29DS	1131	3	460	60	☼	3465	190.64 (4842)	56.11 (1425)	134.53 (3417)	5.67 (144)	6.89 (175)	605.0
150S600-31DS	1209	3	460	60	☼	3455	198.20 (5034)	56.11 (1425)	142.09 (3609)	5.67 (144)	6.89 (175)	617.0
150S600-33DS	1288	3	460	60	☼	3446	205.76 (5226)	56.11 (1425)	149.65 (3801)	5.67 (144)	6.89 (175)	629.0
150S - Motor diameter 8 inch, 60 Hz, rated flow rate 150 gpm (3" NPT)												
150S500-24	966	3	460	50	*	3505	162.45 (4126)	45.67 (1160)	116.78 (2966)	7.56 (192)	7.56 (192)	484.5
150S500-25	1004	3	460	50	*	3501	166.23 (4222)	45.67 (1160)	120.56 (3062)	7.56 (192)	7.56 (192)	491.7
150S500-26	1042	3	460	50	*	3497	170.00 (4318)	45.67 (1160)	124.34 (3158)	7.56 (192)	7.56 (192)	498.9
150S500-27	1080	3	460	50	*	3493	173.78 (4414)	45.67 (1160)	128.12 (3254)	7.56 (192)	7.56 (192)	506.1
150S500-28	1117	3	460	50	*	3489	177.56 (4510)	45.67 (1160)	131.89 (3350)	7.56 (192)	7.56 (192)	513.3
150S600-29DS	1177	3	460	60	*	3519	182.33 (4631)	50.00 (1270)	132.33 (3361)	7.56 (192)	7.56 (192)	612.7
150S600-31DS	1255	3	460	60	*	3513	189.89 (4823)	50.00 (1270)	139.89 (3553)	7.56 (192)	7.56 (192)	623.7
150S600-33DS	1332	3	460	60	*	3508	197.45 (5015)	50.00 (1270)	147.45 (3745)	7.56 (192)	7.56 (192)	639.1
150S750-36DS	1467	3	460	75	*	3524	211.93 (5383)	53.15 (1350)	158.78 (4033)	7.56 (192)	7.56 (192)	689.2
150S750-39DS	1584	3	460	75	*	3518	223.27 (5671)	53.15 (1350)	170.12 (4321)	7.56 (192)	7.56 (192)	704.6



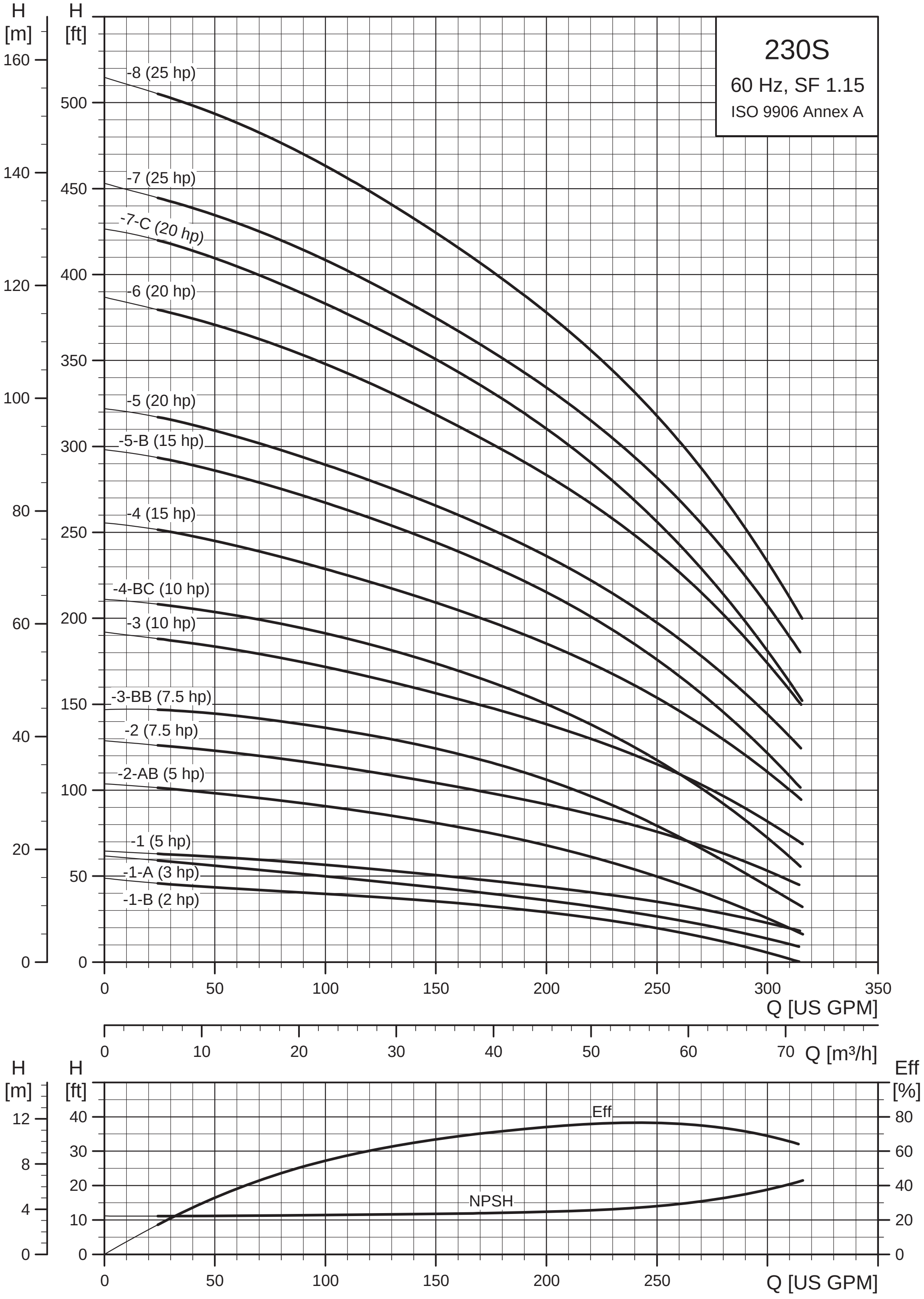
E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
DS designation = Built into sleeve, 3" NPT, 8" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 ft (1.5 m).

▲	MS 6000C motor.
☼	Takes MMS 6 motor; not available as complete.
*	Takes MMS 8000 motor; not available as complete.

6" and larger wells - continued

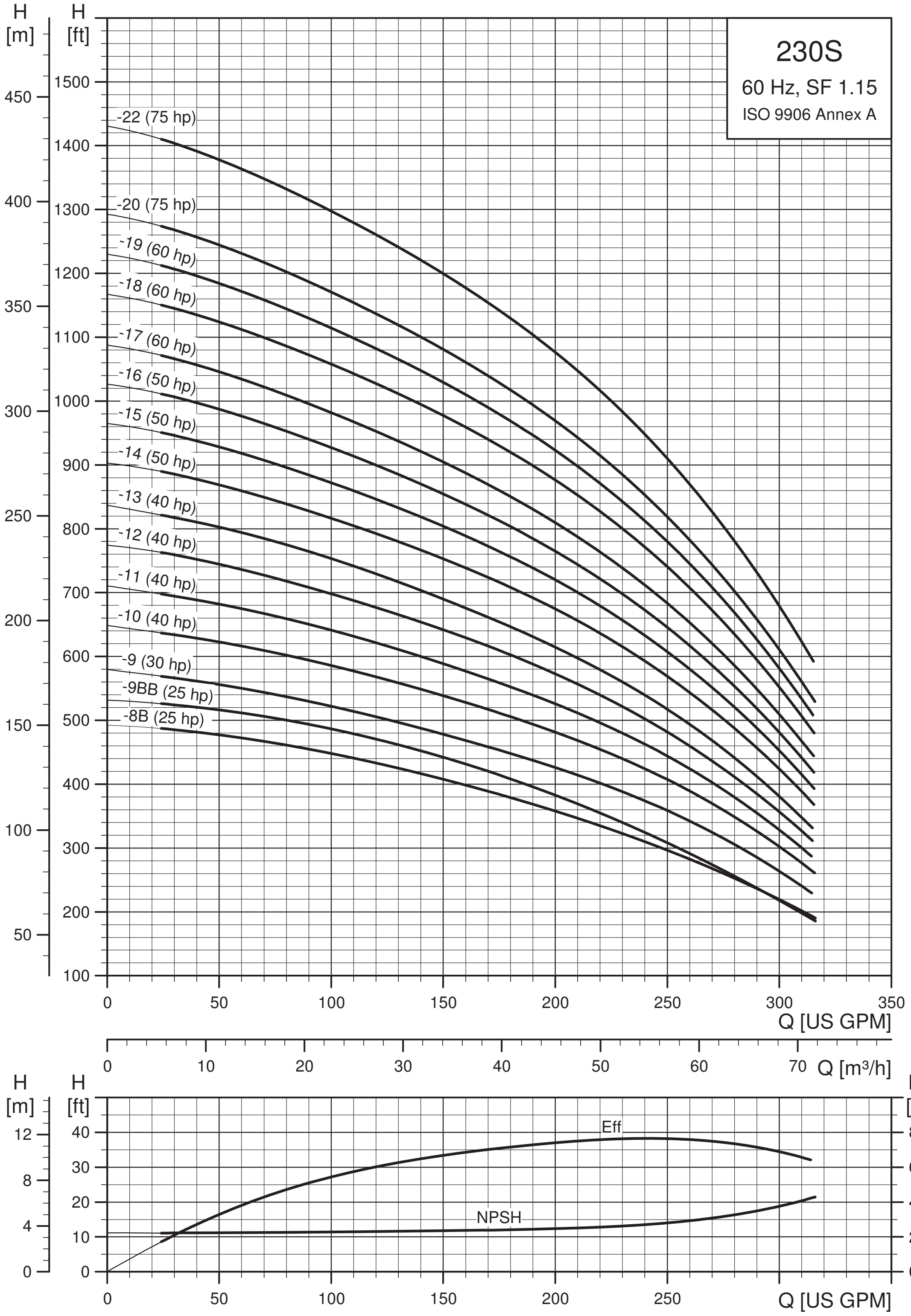
SP 230S (230 gpm)



TM05 0243 1812

6" and larger wells - continued

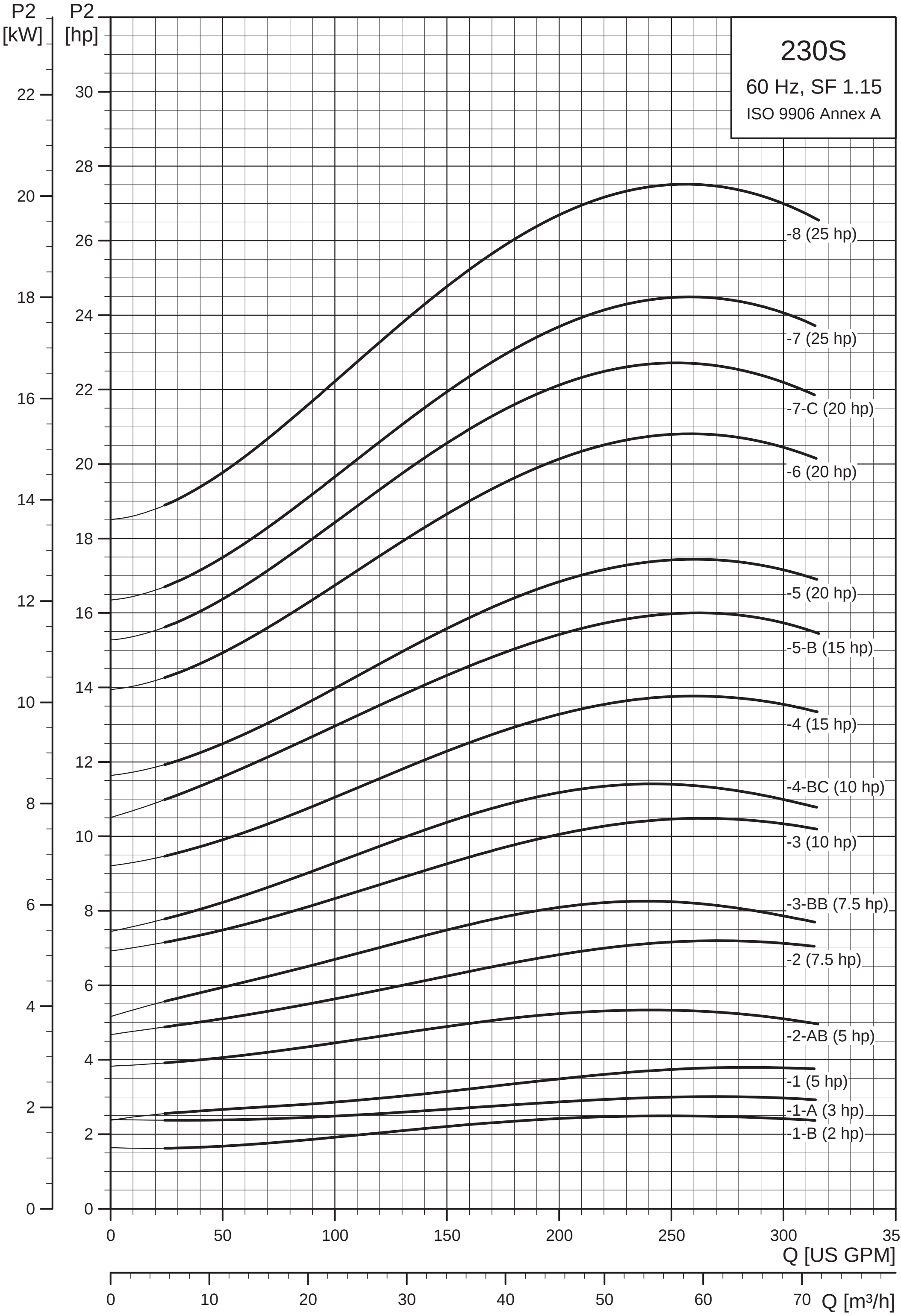
SP 230S (230 gpm)



TM05 0244 5014

6" and larger wells - continued

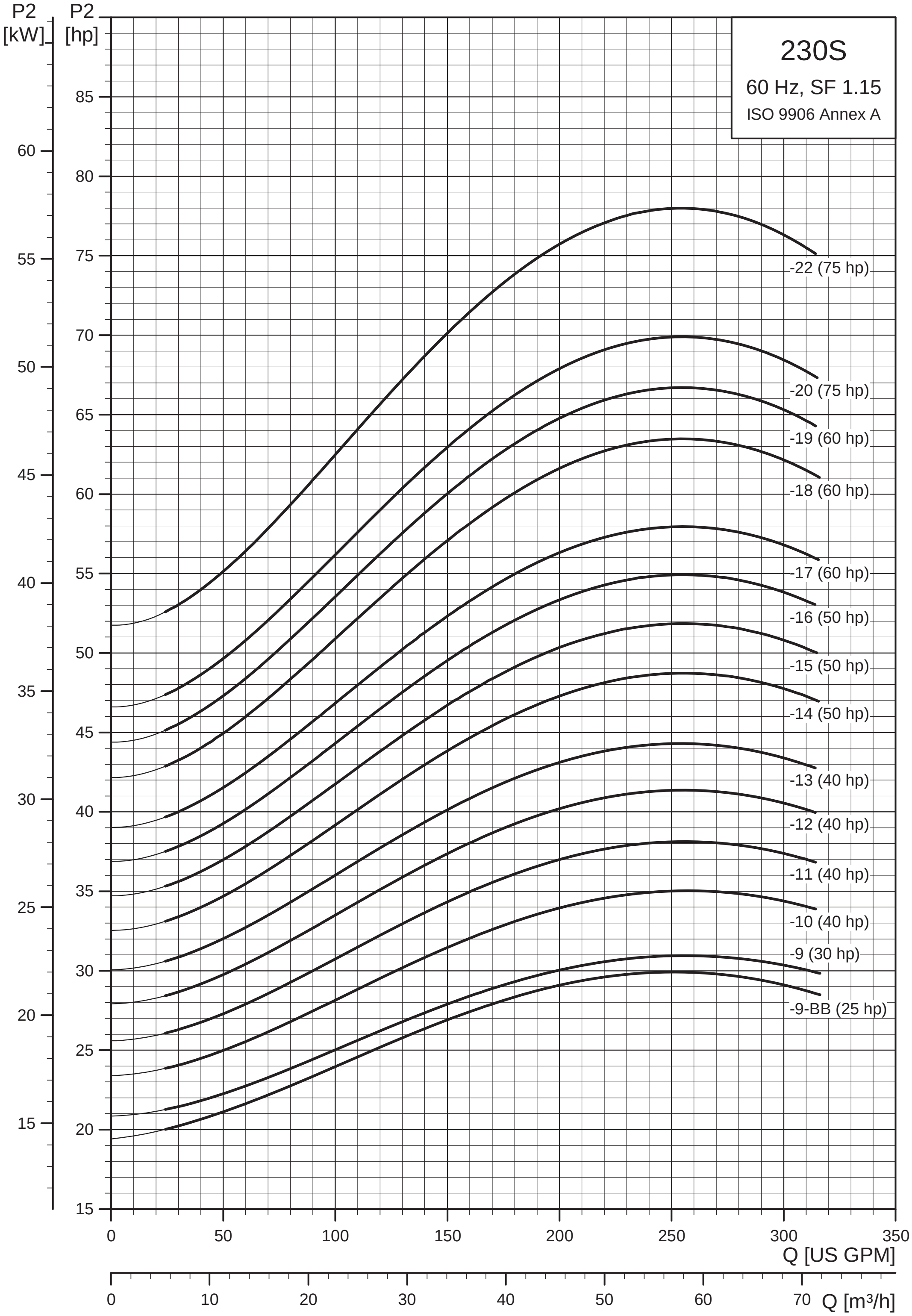
SP 230S (230 gpm) pump power requirement (P2)



TM05 0245 1812

6" and larger wells - continued

SP 230S (230 gpm) pump power requirement (P2)

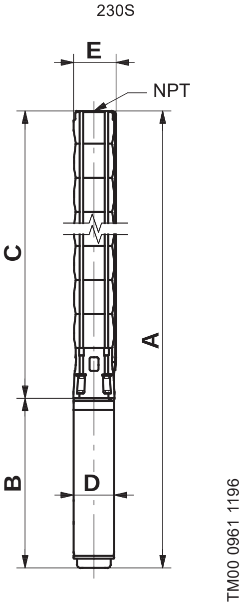


TM05 0246 5014

6" and larger wells - continued

SP 230S (230 gpm) pump with 4", 6" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
230S - Motor diameter 4-inch, 3-wire motor, 60 Hz, rated flow rate 230 gpm (3" NPT)												
230S20-1B	32	1	230	2	●	3434	34.45 (875)	19.57 (497)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
	32	3	230	2	■	3432	30.12 (765)	15.24 (387)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
	32	3	460	2	■	3432	30.12 (765)	15.24 (387)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
230S30-1A	38	1	230	3	●	3459	37.60 (955)	22.72 (577)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
	38	3	230	3	●	3460	32.84 (834)	17.96 (456)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
	39	3	460	3	●	3489	32.84 (834)	17.96 (456)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
230S50-1	46	1	230	5	●	3516	41.54 (1055)	26.66 (677)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
	46	3	230	5	●	3528	37.56 (954)	22.68 (576)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
	46	3	460	5	●	3527	37.56 (954)	22.68 (576)	14.89 (378)	3.75 (95)	5.75 (146)	49.5
230S50-2AB	71	1	230	5	●	3459	45.99 (1168)	26.66 (677)	19.34 (491)	3.75 (95)	5.75 (146)	49.5
	71	3	230	5	●	3487	42.01 (1067)	22.68 (576)	19.34 (491)	3.75 (95)	5.75 (146)	79.2
	71	3	460	5	●	3484	42.01 (1067)	22.68 (576)	19.34 (491)	3.75 (95)	5.75 (146)	79.2
230S75-2	86	3	230	7.5	●	3488	45.95 (1167)	26.62 (676)	19.34 (491)	3.75 (95)	5.75 (146)	79.2
	86	3	460	7.5	●	3488	45.95 (1167)	26.62 (676)	19.34 (491)	3.75 (95)	5.75 (146)	79.2
230S75-3BB	110	3	230	7.5	●	3468	50.40 (1280)	26.62 (676)	23.78 (604)	3.75 (95)	5.75 (146)	126.0
	110	3	460	7.5	●	3468	50.40 (1280)	26.62 (676)	23.78 (604)	3.75 (95)	5.75 (146)	126.0
230S100-3	129	3	460	10	●	3472	54.34 (1380)	30.56 (776)	23.78 (604)	3.75 (95)	5.75 (146)	126.0
230S100-4BC	141	3	460	10	●	3456	58.78 (1493)	30.56 (776)	28.23 (717)	3.75 (95)	5.75 (146)	144.9
230S - Motor diameter 6 inch, 60 Hz, rated flow rate 230 gpm (3" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
230S75-2	87	3	230	7.5	▲	3496	43.47 (1104)	23.51 (597)	19.97 (507)	5.52 (140)	5.79 (147)	111.6
	87	3	460	7.5	▲	3505	43.47 (1104)	23.51 (597)	19.97 (507)	5.52 (140)	5.79 (147)	111.6
230S75-3BB	111	3	230	7.5	▲	3477	47.92 (1217)	23.51 (597)	24.41 (620)	5.52 (140)	5.79 (147)	131.4
	111	3	460	7.5	▲	3488	47.92 (1217)	23.51 (597)	24.41 (620)	5.52 (140)	5.79 (147)	131.4
230S100-3	129	3	230	10	▲	3474	49.10 (1247)	24.69 (627)	24.41 (620)	5.52 (140)	5.79 (147)	126.0
	130	3	460	10	▲	3486	49.10 (1247)	24.69 (627)	24.41 (620)	5.52 (140)	5.79 (147)	126.0
230S100-4BC	141	3	230	10	▲	3457	53.55 (1360)	24.69 (627)	28.86 (733)	5.52 (140)	5.79 (147)	144.9
	143	3	460	10	▲	3472	53.55 (1360)	24.69 (627)	28.86 (733)	5.52 (140)	5.79 (147)	144.9
230S150-4	176	3	230	15	▲	3491	55.91 (1420)	27.05 (687)	28.86 (733)	5.52 (140)	5.79 (147)	144.9
	176	3	460	15	▲	3495	55.91 (1420)	27.05 (687)	28.86 (733)	5.52 (140)	5.79 (147)	144.9
230S150-5B	202	3	230	15	▲	3470	60.36 (1533)	27.05 (687)	33.31 (846)	5.52 (140)	5.79 (147)	161.1
	202	3	460	15	▲	3476	60.36 (1533)	27.05 (687)	33.31 (846)	5.52 (140)	5.79 (147)	161.1
230S200-5	222	3	230	20	▲	3499	62.92 (1598)	29.61 (752)	33.31 (846)	5.52 (140)	5.79 (147)	161.1
	224	3	460	20	▲	3508	62.92 (1598)	29.61 (752)	33.31 (846)	5.52 (140)	5.79 (147)	161.1
230S200-6	248	3	230	20	▲	3476	67.37 (1711)	29.61 (752)	37.76 (959)	5.52 (140)	5.79 (147)	167.4
	252	3	460	20	▲	3488	67.37 (1711)	29.61 (752)	37.76 (959)	5.52 (140)	5.79 (147)	167.4
230S200-7C	288	3	230	20	▲	3462	71.82 (1824)	29.61 (752)	42.21 (1072)	5.52 (140)	5.79 (147)	181.8
	291	3	460	20	▲	3475	71.82 (1824)	29.61 (752)	42.21 (1072)	5.52 (140)	5.79 (147)	181.8



E = Maximum diameter of pump including cable guard and motor.

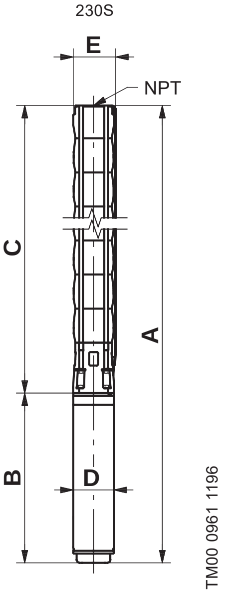
Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 8 ft (2.4 m).

- ■ MS 402 motor.
- ● MS 4000 motor.
- ▲ MS 6000C motor.

6" and larger wells - continued

SP 230S (230 gpm) pump with 6", 8" motor

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
230S - Motor diameter 6 inch, 60 Hz, rated flow rate 230 gpm (3" NPT)												
230S250-7	291	3	230	25	▲	3487	73.98 (1879)	31.78 (807)	42.21 (1072)	5.52 (140)	5.79 (147)	149.9
	294	3	460	25	▲	3497	73.98 (1879)	31.78 (807)	42.21 (1072)	5.52 (140)	5.79 (147)	181.8
230S250-8B	315	3	230	25	▲	3476	78.43 (1992)	31.78 (807)	46.66 (1185)	5.52 (140)	5.79 (147)	188.1
	316	3	460	25	▲	3487	78.43 (1992)	31.78 (807)	46.66 (1185)	5.52 (140)	5.79 (147)	188.1
230S250-8	329	3	230	25	▲	3469	78.43 (1992)	31.78 (807)	46.66 (1185)	5.52 (140)	5.79 (147)	188.1
	332	3	460	25	▲	3482	78.43 (1992)	31.78 (807)	46.66 (1185)	5.52 (140)	5.79 (147)	188.1
230S250-9BB	363	3	230	25	▲	3463	82.88 (2105)	31.78 (807)	51.11 (1298)	5.52 (140)	5.79 (147)	205.2
	366	3	460	25	▲	3476	82.88 (2105)	31.78 (807)	51.11 (1298)	5.52 (140)	5.79 (147)	205.2
230S300-9	368	3	230	30	▲	3468	85.24 (2165)	34.14 (867)	51.11 (1298)	5.52 (140)	5.79 (147)	205.2
	374	3	460	30	▲	3481	85.24 (2165)	34.14 (867)	51.11 (1298)	5.52 (140)	5.79 (147)	205.2
230S400-10	414	3	460	40	▲	3476	94.81 (2408)	39.26 (997)	55.56 (1411)	5.52 (140)	5.79 (147)	241.2
230S400-11	457	3	460	40	▲	3493	99.26 (2521)	39.26 (997)	60.00 (1524)	5.52 (140)	5.79 (147)	245.7
230S400-12	495	3	460	40	▲	3482	103.71 (2634)	39.26 (997)	64.45 (1637)	5.52 (140)	5.79 (147)	251.1
230S400-13	533	3	460	40	▲	3472	108.15 (2747)	39.26 (997)	68.90 (1750)	5.52 (140)	5.79 (147)	255.6
230S500-14	577	3	460	50	☼	3481	129.45 (3288)	56.11 (1425)	73.35 (1863)	5.67 (144)	5.79 (147)	356.0
230S500-15	615	3	460	50	☼	3471	133.90 (3401)	56.11 (1425)	77.80 (1976)	5.67 (144)	5.79 (147)	360.5
230S500-16	653	3	460	50	☼	3462	138.35 (3514)	56.11 (1425)	82.25 (2089)	5.67 (144)	5.79 (147)	365.0
230S600-17	700	3	460	60	☼	3460	142.81 (1447)	56.11 (1425)	86.70 (2202)	5.67 (144)	5.79 (147)	381.0
230S600-18	742	3	460	60	☼	3452	147.26 (3740)	56.11 (1425)	91.15 (2315)	5.67 (144)	5.79 (147)	386.0
230S600-19	783	3	460	60	☼	3444	151.71 (38.53)	56.11 (1425)	95.60 (2428)	5.67 (144)	5.79 (147)	391.0
230S - Motor diameter 8 inch, 60 Hz, rated flow rate 230 gpm (3" NPT)												
230S600-17	700	3	460	60	*	3460	138.47 (3517)	50.00 (1270)	88.47 (2247)	7.56 (192)	7.56 (192)	546.0
230S600-18	741	3	460	60	*	3452	142.92 (3630)	50.00 (1270)	92.92 (2360)	7.56 (192)	7.56 (192)	568.5
230S600-19	783	3	460	60	*	3444	147.37 (3743)	50.00 (1270)	97.37 (2473)	7.56 (192)	7.56 (192)	591.0
230S750-20DS	850	3	460	75	*	3526	164.69 (4183)	53.15 (1350)	111.54 (2833)	7.56 (192)	7.56 (192)	549.9
230S750-22DS	931	3	460	75	*	3519	173.59 (4409)	53.15 (1350)	120.44 (3059)	7.56 (192)	7.56 (192)	620.4



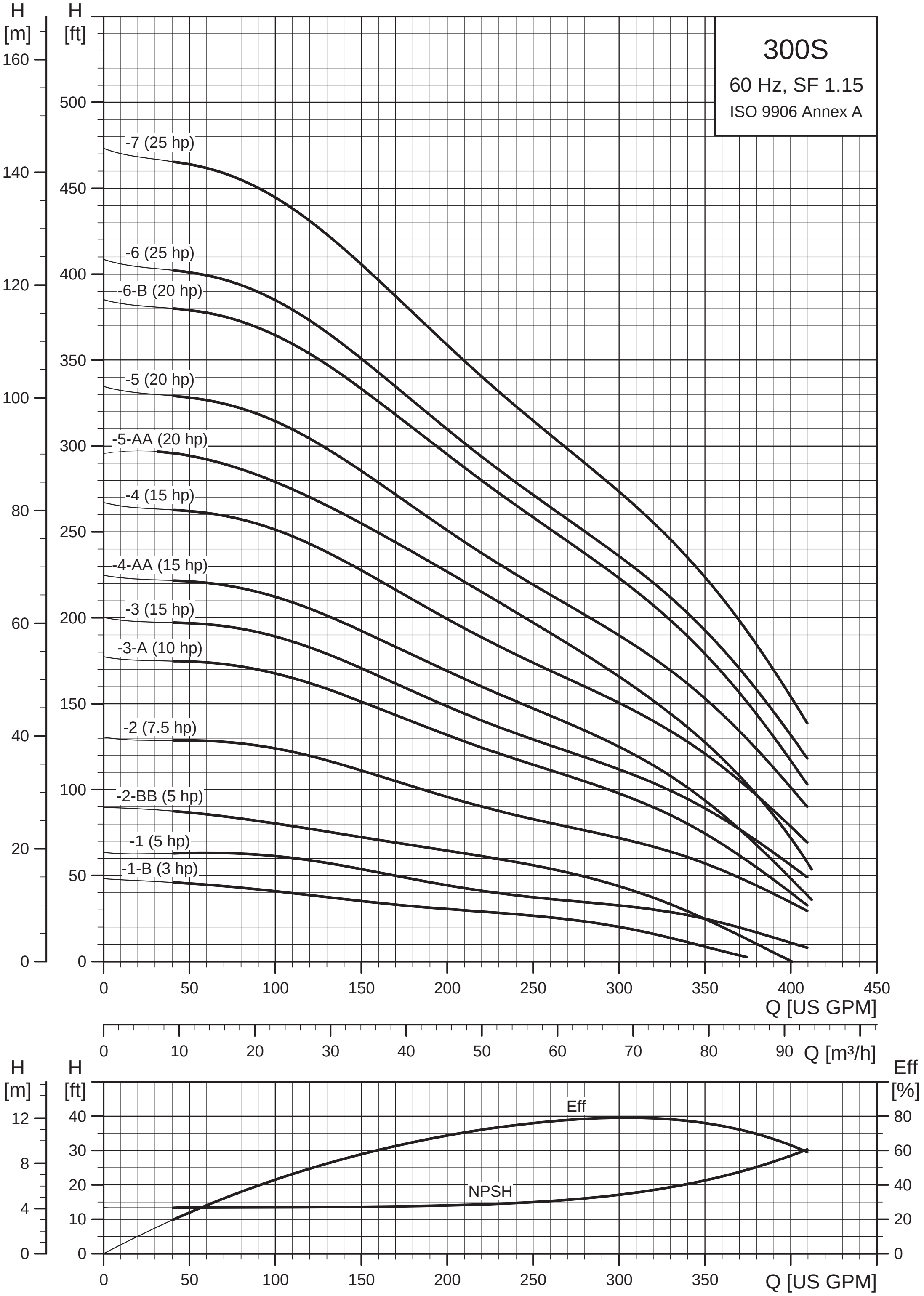
E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
DS designation = Built into sleeve, 3" NPT, 8" minimum well diameter.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 8 ft (2.4 m).

▲	MS 6000C motor.
☼	Takes MMS 6 motor; not available as complete.
*	Takes MMS 8000 motor; not available as complete.

6" and larger wells - continued

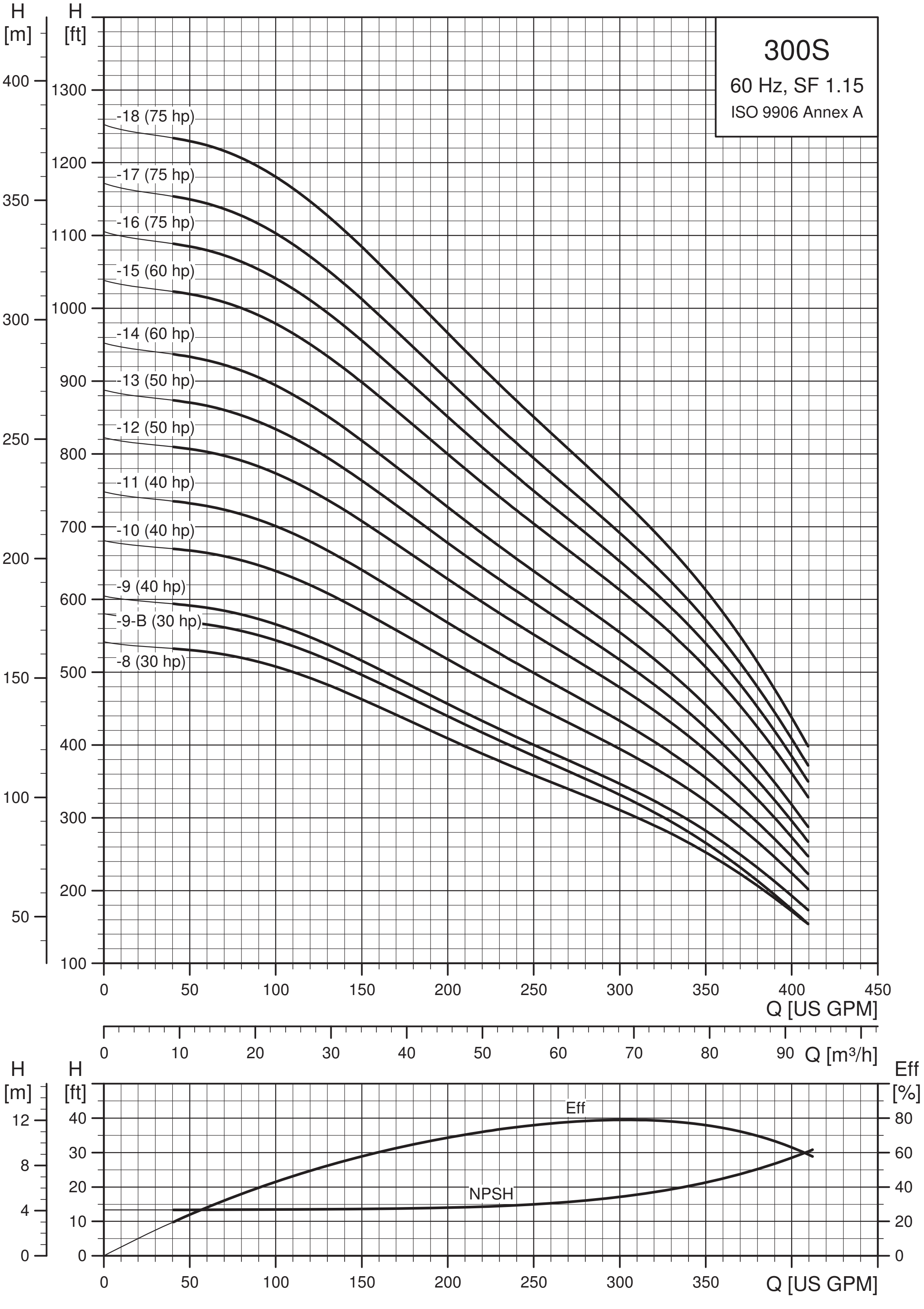
SP 300S (300 gpm)



TM05 0247 1812

6" and larger wells - continued

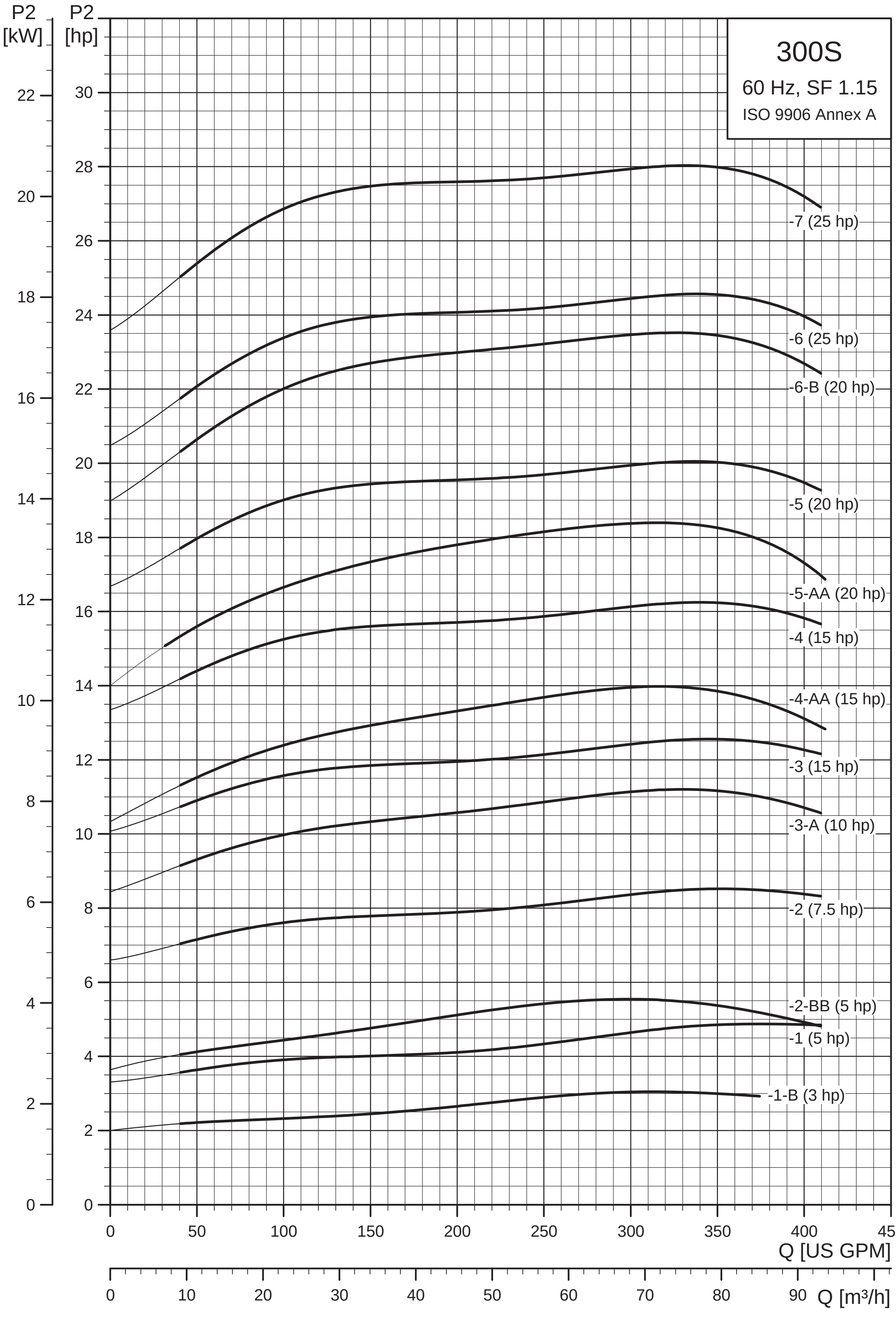
SP 300S (300 gpm)



TM05 0248 5014

6" and larger wells - continued

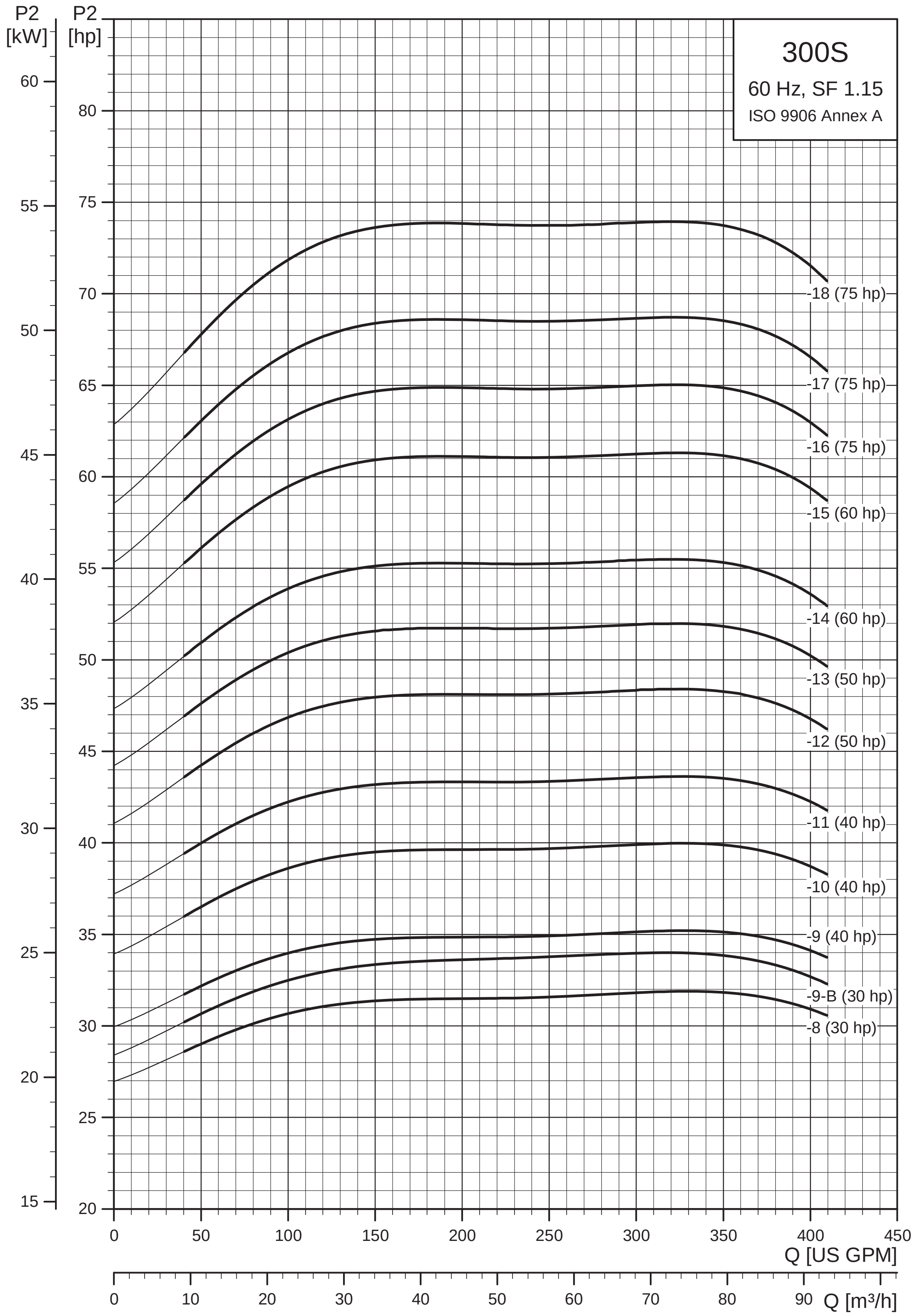
SP 300S (300 gpm) pump power requirement (P2)



TM05 0249 1812

6" and larger wells - continued

SP 300S (300 gpm) pump power requirement (P2)

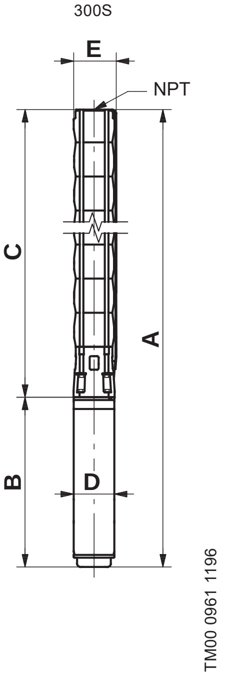


TM05 0250 5014

6" and larger wells - continued

SP 300S (300 gpm) pump with 4", 6" motor

Pump model	Nom. head [ft]	Ph	Motor				Dimensions [in (mm)]					Net weight (complete) [lb]
			Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
300S - Motor diameter 4-inch, 3-wire motor, 60 Hz, rated flow rate 300 gpm (3" NPT)												
300S30-1B	29	1	230	3	●	3470	37.60 (955)	22.72 (577)	14.89 (378)	3.75 (95)	5.75 (146)	72.0
	30	3	230	3	●	3466	32.84 (834)	17.96 (456)	14.89 (378)	3.75 (95)	5.75 (146)	72.0
	30	3	460	3	●	3494	32.84 (834)	17.96 (456)	14.89 (378)	3.75 (95)	5.75 (146)	72.0
300S50-1	38	1	230	5	●	3490	41.54 (1055)	26.66 (677)	14.89 (378)	3.75 (95)	5.75 (146)	74.7
	38	3	230	5	●	3508	37.56 (954)	22.68 (576)	14.89 (378)	3.75 (95)	5.75 (146)	74.7
	38	3	460	5	●	3506	37.56 (954)	22.68 (576)	14.89 (378)	3.75 (95)	5.75 (146)	74.7
300S50-2BB	57	1	230	5	●	3443	45.99 (1168)	26.66 (677)	19.34 (491)	3.75 (95)	5.75 (146)	135.0
	57	3	230	5	●	3480	42.01 (1067)	22.68 (576)	19.34 (491)	3.75 (95)	5.75 (146)	135.0
	57	3	460	5	●	3477	42.01 (1067)	22.68 (576)	19.34 (491)	3.75 (95)	5.75 (146)	135.0
300S75-2	77	3	230	7.5	●	3463	45.95 (1167)	26.62 (676)	19.34 (491)	3.75 (95)	5.75 (146)	101.7
	77	3	460	7.5	●	3463	45.95 (1167)	26.62 (676)	19.34 (491)	3.75 (95)	5.75 (146)	101.7
300S100-3A	107	3	460	10	●	3461	54.34 (1380)	30.56 (776)	23.78 (604)	3.75 (95)	5.75 (146)	145.8
300S - Motor diameter 6 inch, 60 Hz, rated flow rate 300 gpm (3" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
300S75-2	77	3	230	7.5	▲	3472	43.47 (1104)	23.51 (597)	19.97 (507)	5.52 (140)	5.79 (147)	167.4
	78	3	460	7.5	▲	3484	43.47 (1104)	23.51 (597)	19.97 (507)	5.52 (140)	5.79 (147)	167.4
300S100-3A	107	3	230	10	▲	3461	49.10 (1247)	24.69 (627)	24.41 (620)	5.52 (140)	5.79 (147)	216.0
	107	3	460	10	▲	3475	49.10 (1247)	24.69 (627)	24.41 (620)	5.52 (140)	5.79 (147)	216.0
300S150-3	119	3	230	15	▲	3503	51.46 (1307)	27.05 (687)	24.41 (620)	5.52 (140)	5.79 (147)	216.0
	119	3	460	15	▲	3506	51.46 (1307)	27.05 (687)	24.41 (620)	5.52 (140)	5.79 (147)	216.0
300S150-4AA	138	3	230	15	▲	3488	55.91 (1420)	27.05 (687)	28.86 (733)	5.52 (140)	5.79 (147)	222.3
	139	3	460	15	▲	3492	55.91 (1420)	27.05 (687)	28.86 (733)	5.52 (140)	5.79 (147)	222.3
300S150-4	157	3	230	15	▲	3469	55.91 (1420)	27.05 (687)	28.86 (733)	5.52 (140)	5.79 (147)	222.3
	158	3	460	15	▲	3474	55.91 (1420)	27.05 (687)	28.86 (733)	5.52 (140)	5.79 (147)	222.3
300S200-5AA	179	3	230	20	▲	3493	62.92 (1598)	29.61 (752)	33.31 (846)	5.52 (140)	5.79 (147)	194.4
	180	3	460	20	▲	3503	62.92 (1598)	29.61 (752)	33.31 (846)	5.52 (140)	5.79 (147)	194.4
300S200-5	200	3	230	20	▲	3479	62.92 (1598)	29.61 (752)	33.31 (846)	5.52 (140)	5.79 (147)	194.4
	201	3	460	20	▲	3491	62.92 (1598)	29.61 (752)	33.31 (846)	5.52 (140)	5.79 (147)	194.4
300S200-6B	222	3	230	20	▲	3462	67.37 (1711)	29.61 (752)	37.76 (959)	5.52 (140)	5.79 (147)	198.0
	224	3	460	20	▲	3476	67.37 (1711)	29.61 (752)	37.76 (959)	5.52 (140)	5.79 (147)	198.0
300S250-6	243	3	230	25	▲	3487	69.53 (1766)	31.78 (807)	37.76 (959)	5.52 (140)	5.79 (147)	198.0
	244	3	460	25	▲	3497	69.53 (1766)	31.78 (807)	37.76 (959)	5.52 (140)	5.79 (147)	198.0



E = Maximum diameter of pump including cable guard and motor.

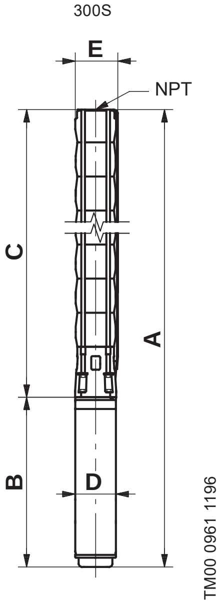
Notes:
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 8 ft (2.4 m).

- ● MS 4000 motor.
- ▲ MS 6000C motor.

6" and larger wells - continued

SP 300S (300 gpm) pump with 6", 8" motor

Pump model	Nom. head [ft]	Ph	Motor				Dimensions [in (mm)]					Net weight (complete) [lb]
			Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
300S - Motor diameter 6 inch, 60 Hz, rated flow rate 300 gpm (4" NPT)												
300S250-7AA	260	3	230	25	▲	3478	73.98 (1879)	31.78 (807)	42.21 (1072)	5.52 (140)	5.79 (147)	217.8
	262	3	460	25	▲	3489	73.98 (1879)	31.78 (807)	42.21 (1072)	5.52 (140)	5.79 (147)	217.8
300S300-7	283	3	230	30	▲	3482	76.34 (1939)	34.14 (867)	42.21 (1072)	5.52 (140)	5.79 (147)	217.8
	285	3	460	30	▲	3493	76.34 (1939)	34.14 (867)	42.21 (1072)	5.52 (140)	5.79 (147)	217.8
300S300-8	321	3	230	30	▲	3463	80.79 (2052)	34.14 (867)	46.66 (1185)	5.52 (140)	5.79 (147)	224.1
	324	3	460	30	▲	3477	80.79 (2052)	34.14 (867)	46.66 (1185)	5.52 (140)	5.79 (147)	224.1
300S300-9B	343	3	230	30	▲	3450	85.24 (2165)	34.14 (867)	51.11 (1298)	5.52 (140)	5.79 (147)	261.0
	346	3	460	30	▲	3466	85.24 (2165)	34.14 (867)	51.11 (1298)	5.52 (140)	5.79 (147)	261.0
300S400-9	370	3	460	40	▲	3499	90.36 (2295)	39.26 (997)	51.11 (1298)	5.52 (140)	5.79 (147)	296.0
300S400-10	409	3	460	40	▲	3487	94.81 (2408)	39.26 (997)	55.56 (1411)	5.52 (140)	5.79 (147)	300.5
300S400-11	442	3	460	40	☼	3443	99.26 (2521)	39.26 (997)	60.00 (1524)	5.52 (140)	5.79 (147)	352.0
300S500-12	491	3	460	50	☼	3482	120.56 (3062)	56.11 (1425)	64.45 (1637)	5.67 (144)	5.79 (147)	348.8
300S500-13	529	3	460	50	☼	3471	125.00 (3175)	56.11 (1425)	68.90 (1750)	5.67 (144)	5.79 (147)	355.1
300S600-14	594	3	460	60	☼	3456	129.46 (3288)	56.11 (1425)	73.35 (1863)	5.67 (144)	5.79 (147)	371.0
300S600-15	606	3	460	60	☼	3458	133.91 (3401)	56.11 (1425)	77.80 (1976)	5.67 (144)	5.79 (147)	378.0
SP 300S - Motor diameter 8 inch, 60 Hz, rated flow rate 230 gpm (4" NPT)												
300S600-14	594	3	460	60	*	3456	125.12 (3178)	50.00 (1270)	75.12 (1908)	7.56 (192)	7.56 (192)	479.4
300S600-15	629	3	460	60	*	3515	129.57 (3291)	50.00 (1270)	79.57 (2021)	7.56 (192)	7.56 (192)	519.4
300S750-16	678	3	460	75	*	3532	137.17 (3484)	53.15 (1350)	84.02 (2134)	7.56 (192)	7.56 (192)	569.1
300S750-17	719	3	460	75	*	3528	141.62 (3597)	53.15 (1350)	88.47 (2247)	7.56 (192)	7.56 (192)	575.4
300S750-18	760	3	460	75	*	3523	146.07 (3710)	53.15 (1350)	92.92 (2360)	7.56 (192)	7.56 (192)	581.7



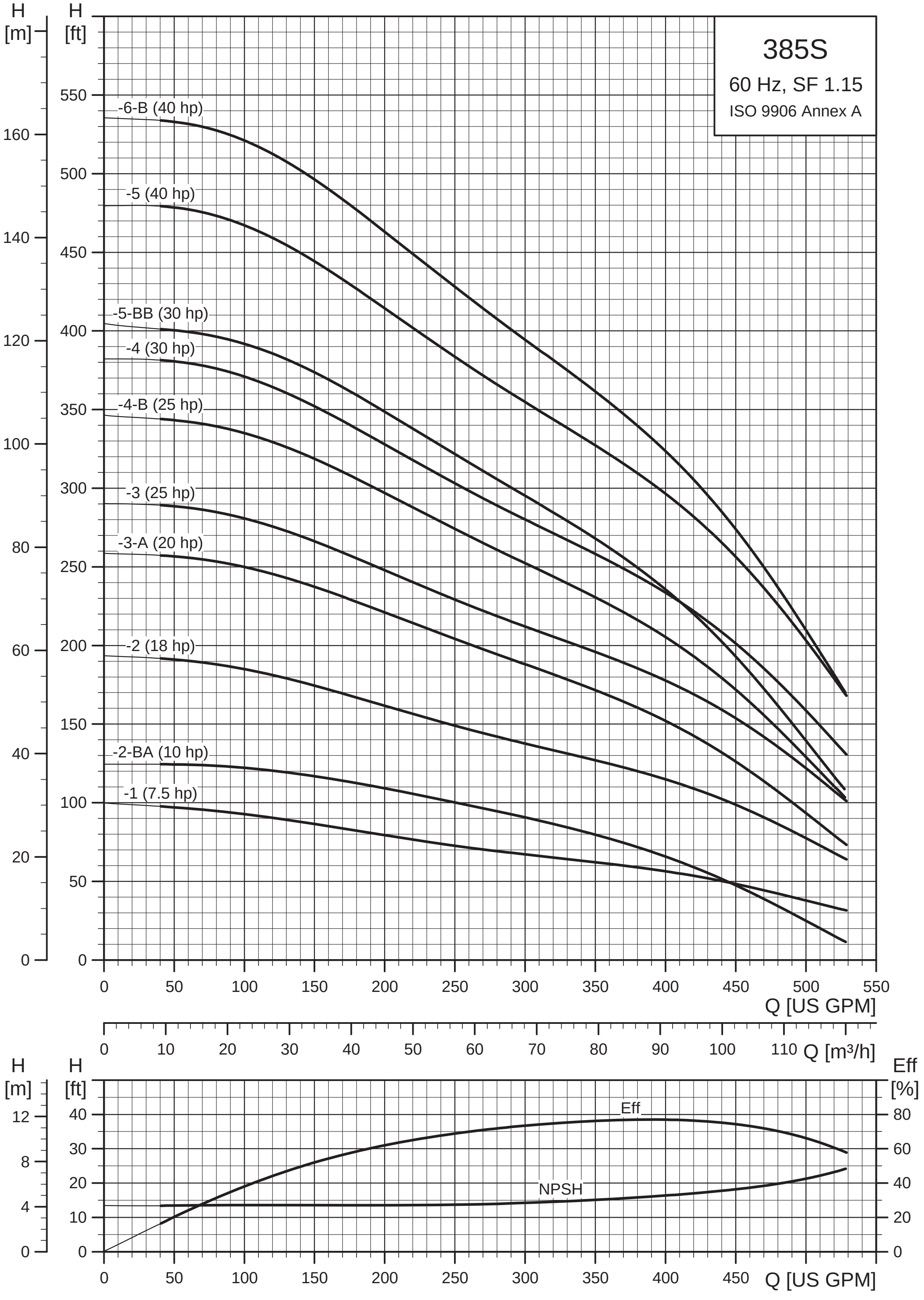
E = Maximum diameter of pump including cable guard and motor.

Notes:
Performance conforms to ISO 9906 Annex A. Minimum submergence is 8 ft (2.4 m).

- ▲ MS 6000C motor.
- ☼ Takes MMS 6 motor; not available as complete.
- * Takes MMS 8000 motor; not available as complete.

8" and larger wells

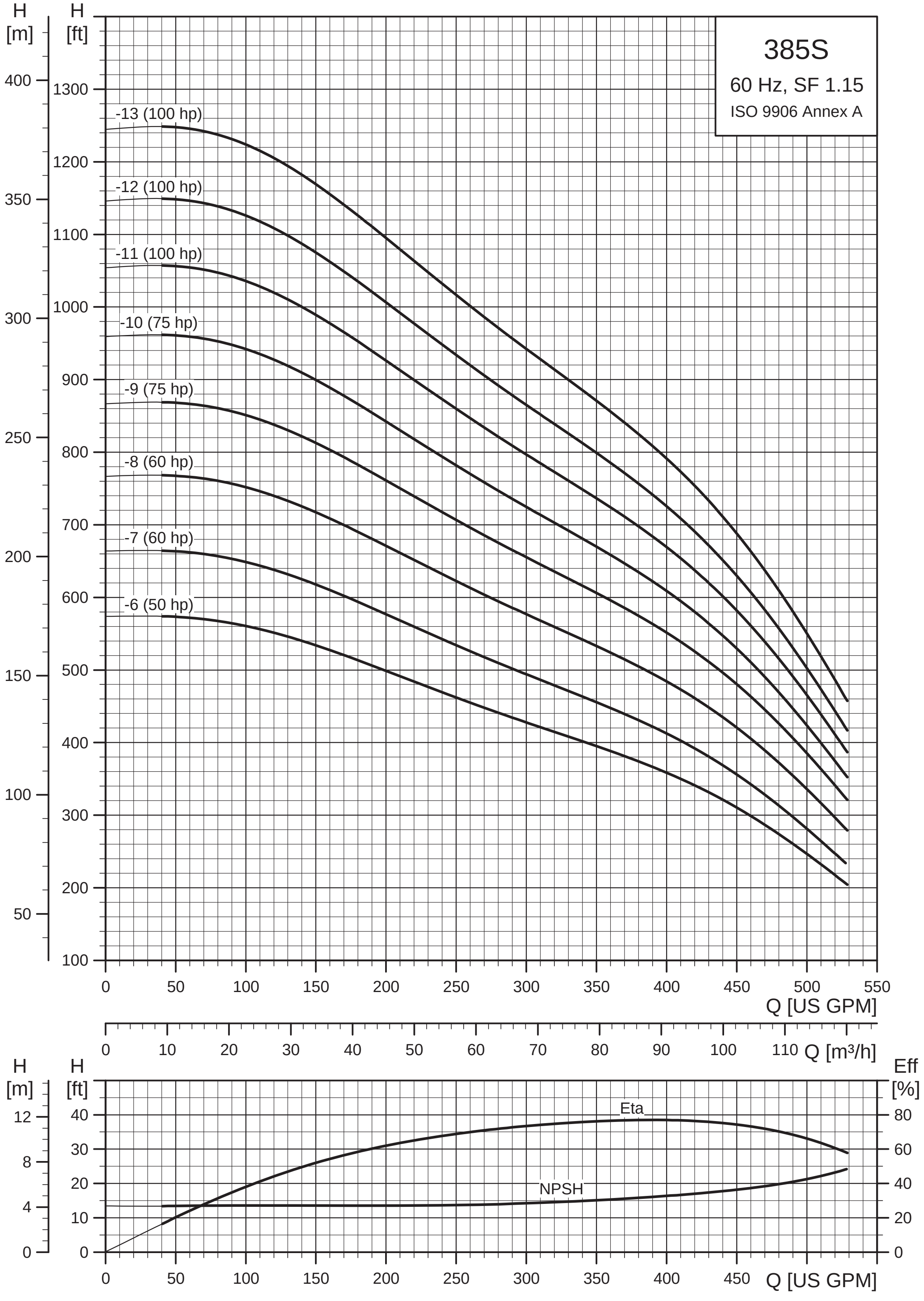
SP 385S (385 gpm)



TM05 0251 1812

8" and larger wells - continued

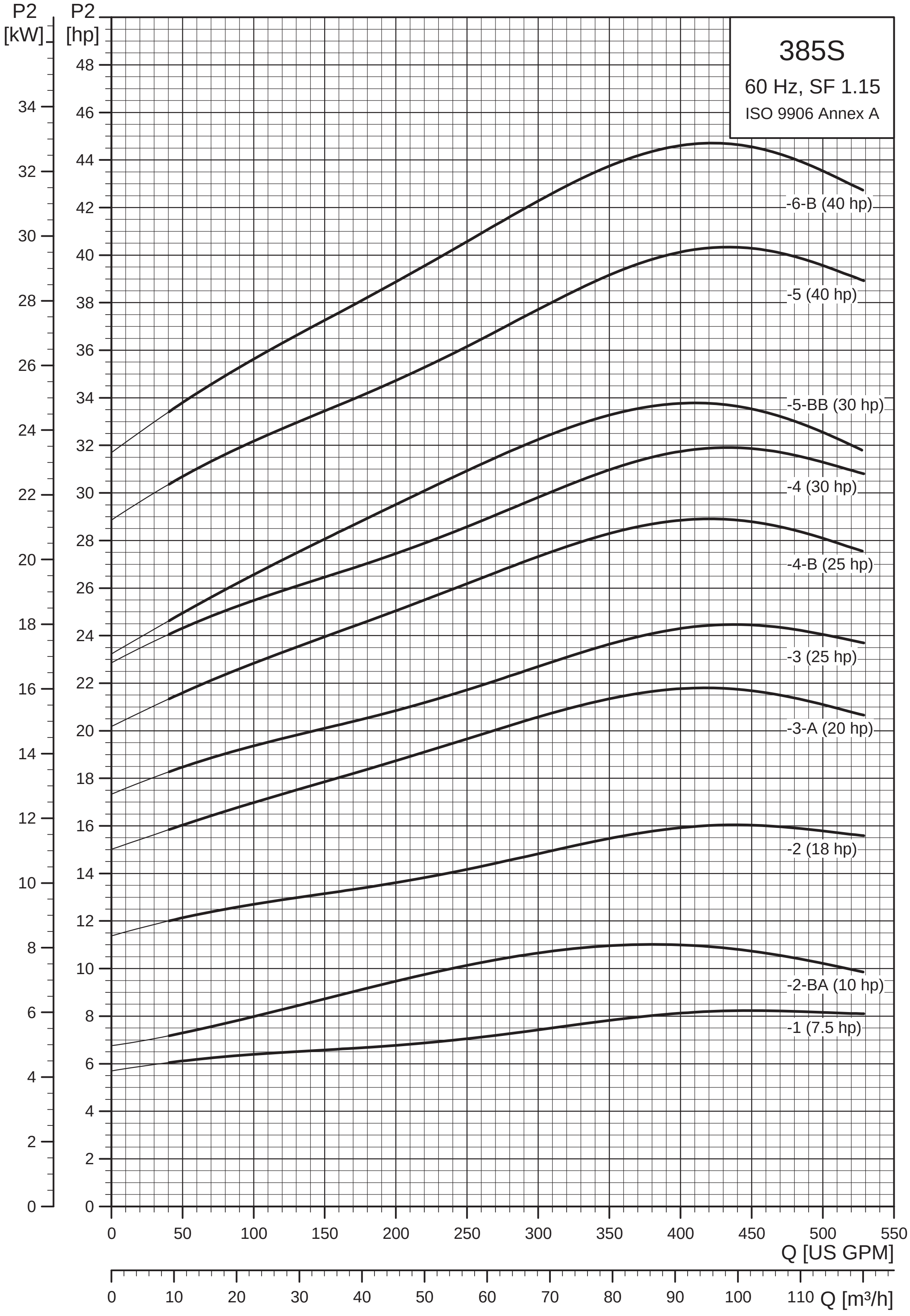
SP 385S (385 gpm)



TM05 0252 1812

8" and larger wells - continued

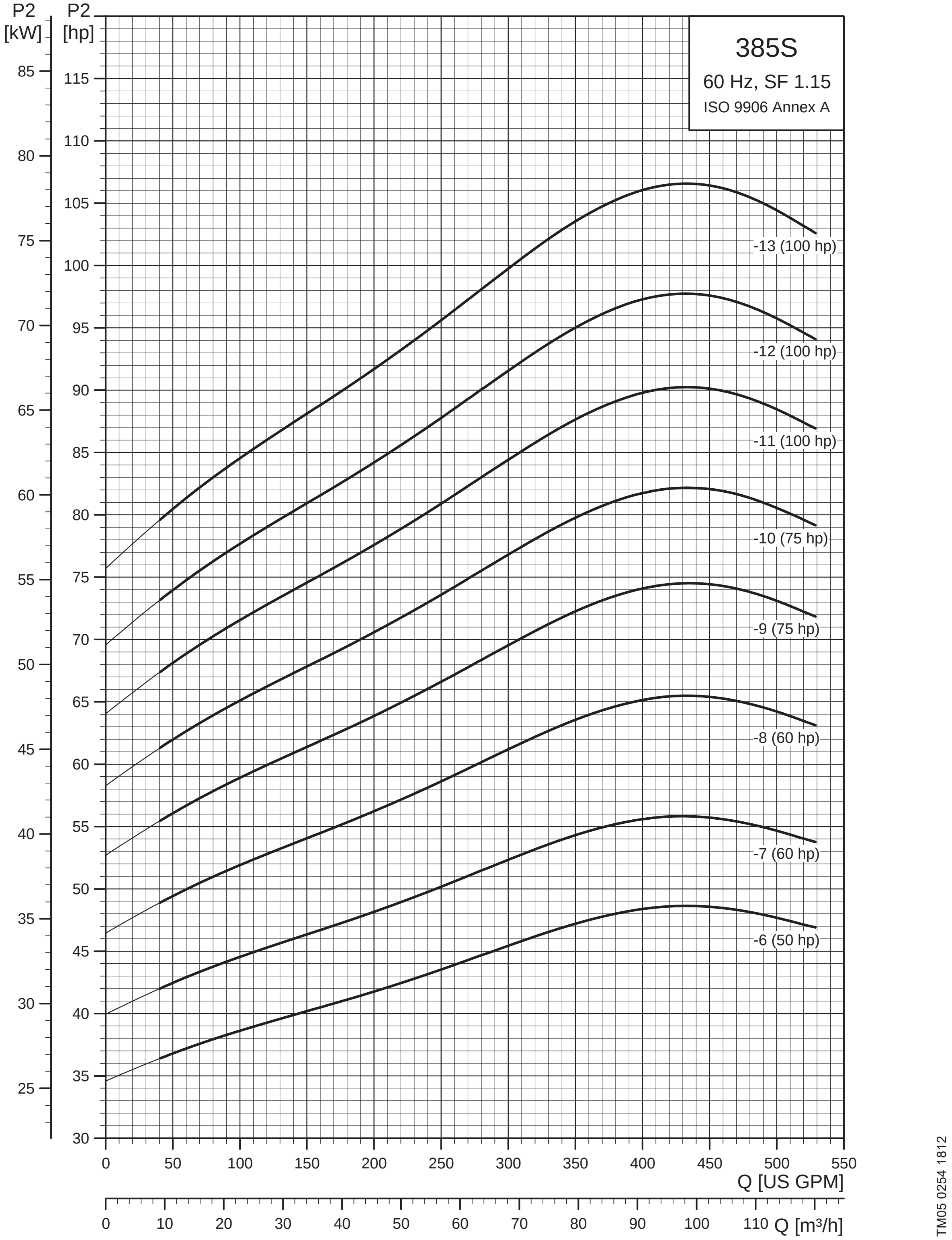
SP 385S (385 gpm) pump power requirement (P2)



TM05 0253 1812

8" and larger wells - continued

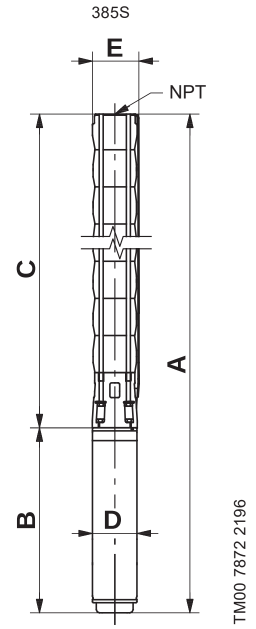
SP 385S (385 gpm) pump power requirement (P2)



8" and larger wells - continued

SP 385S (385 gpm) pump with 6", 8", 10" motor

Pump model	Nom. head [ft]	Ph	Motor				Dimensions [in (mm)]					Net weight (complete) [lb]
			Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
385S - Motor diameter 6 inch, 60 Hz, rated flow rate 385 gpm (4" NPT)												
-	-	3	208	5	▲	3480	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	3510	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	3500	-	23.51 (597)	-	5.50 (139.5)	-	80.0
385S75-1	60	3	230	7.5	▲	3478	46.58 (1183)	22.25 (565)	24.34 (618)	5.63 (143)	7.01 (178)	135.9
	61	3	460	7.5	▲	3489	46.58 (1183)	22.25 (565)	24.34 (618)	5.63 (143)	7.01 (178)	135.9
385S100-2AB	87	3	230	10	▲	3467	52.6 (1336)	23.23 (590)	29.38 (746)	5.63 (143)	7.01 (178)	169.2
	87	3	460	10	▲	3482	52.6 (1336)	23.23 (590)	29.38 (746)	5.63 (143)	7.01 (178)	169.2
385S150-2	123	3	230	15	▲	3472	57.25 (1454)	27.88 (708)	29.38 (746)	5.63 (143)	7.01 (178)	169.2
	123	3	460	15	▲	3477	57.25 (1454)	27.88 (708)	29.38 (746)	5.63 (143)	7.01 (178)	169.2
385S200-3A	163	3	230	20	▲	3469	65.24 (1657)	30.83 (783)	34.41 (874)	5.63 (143)	7.01 (178)	188.1
	165	3	460	20	▲	3482	65.24 (1657)	30.83 (783)	34.41 (874)	5.63 (143)	7.01 (178)	188.1
385S250-3	187	3	230	25	▲	3489	67.41 (1712)	33.00 (838)	34.41 (874)	5.63 (143)	7.01 (178)	188.1
	189	3	460	25	▲	3499	67.41 (1712)	33.00 (838)	34.41 (874)	5.63 (143)	7.01 (178)	188.1
385S250-4B	220	3	230	25	▲	3461	72.45 (1840)	33.00 (838)	39.45 (1002)	5.63 (143)	7.01 (178)	239.4
	222	3	460	25	▲	3475	72.45 (1840)	33.00 (838)	39.45 (1002)	5.63 (143)	7.01 (178)	239.4
385S300-4	234	3	230	30	▲	3463	75.00 (1905)	35.56 (903)	39.45 (1002)	5.63 (143)	7.01 (178)	239.4
	249	3	460	30	▲	3478	75.00 (1905)	35.56 (903)	39.45 (1002)	5.63 (143)	7.01 (178)	239.4
385S300-5BB	254	3	230	30	▲	3452	80.04 (2033)	35.56 (903)	44.49 (1130)	5.63 (143)	7.01 (178)	247.5
	257	3	460	30	▲	3467	80.04 (2033)	35.56 (903)	44.49 (1130)	5.63 (143)	7.01 (178)	247.5
385S400-5	314	3	460	40	▲	3488	84.77 (2153)	40.28 (1023)	44.49 (1130)	5.63 (143)	7.01 (178)	247.5
385S400-6B	347	3	460	40	▲	3471	89.81 (2281)	40.28 (1023)	49.53 (1258)	5.63 (143)	7.01 (178)	252.0
385S500-6	375	3	460	50	☼	3447	110.99 (2825)	56.11 (1425)	54.88 (1394)	5.67 (144)	7.88 (200)	376.0
385S500-7A	414	3	460	50	☼	3467	110.99 (2825)	56.11 (1425)	54.88 (1394)	5.67 (144)	7.88 (200)	407.0
385S600-7	449	3	460	60	☼	3414	111.23 (2825)	56.11 (1425)	55.12 (1400)	5.67 (144)	7.88 (200)	385.0
385S600-8	494	3	460	60	☼	3449	111.23 (2825)	56.11 (1425)	55.12 (1400)	5.67 (144)	7.88 (200)	385.0
385S - Motor diameter 8 inch, 60 Hz, rated flow rate 385 gpm (4" NPT)												
385S400-6B	351	3	460	40	*	3490	93.78 (2382)	43.71 (1110)	50.08 (1272)	7.56 (192)	7.88 (200)	428.3
385S500-6	375	3	460	50	*	3481	95.75 (2432)	45.67 (1160)	50.08 (1272)	7.56 (192)	7.88 (200)	451.2
385S500-7A	420	3	460	50	*	3492	100.79 (2560)	45.67 (1160)	55.12 (1400)	7.56 (192)	7.88 (200)	461.1
385S600-7	449	3	460	60	*	3459	105.12 (2670)	50.00 (1270)	55.12 (1400)	7.56 (192)	7.88 (200)	507.3
385S600-8	511	3	460	60	*	3510	110.16 (2798)	50.00 (1270)	60.16 (1528)	7.56 (192)	7.88 (200)	517.2
385S750-9	582	3	460	75	*	3508	118.35 (3006)	53.15 (1350)	65.2 (1656)	7.56 (192)	7.88 (200)	558.7
385S750-10	643	3	460	75	*	3498	123.39 (3134)	53.15 (1350)	70.24 (1784)	7.56 (192)	7.88 (200)	568.6
385S1000-11	711	3	460	100	*	3512	137.88 (3502)	62.60 (1590)	75.28 (1912)	7.56 (192)	7.88 (200)	677.5
385S1000-12	771	3	460	100	*	3505	142.92 (3630)	62.60 (1590)	80.32 (2040)	7.56 (192)	7.88 (200)	687.4
385S1000-13	831	3	460	100	*	3497	147.96 (3758)	62.60 (1590)	85.36 (2168)	7.56 (192)	7.88 (200)	697.3



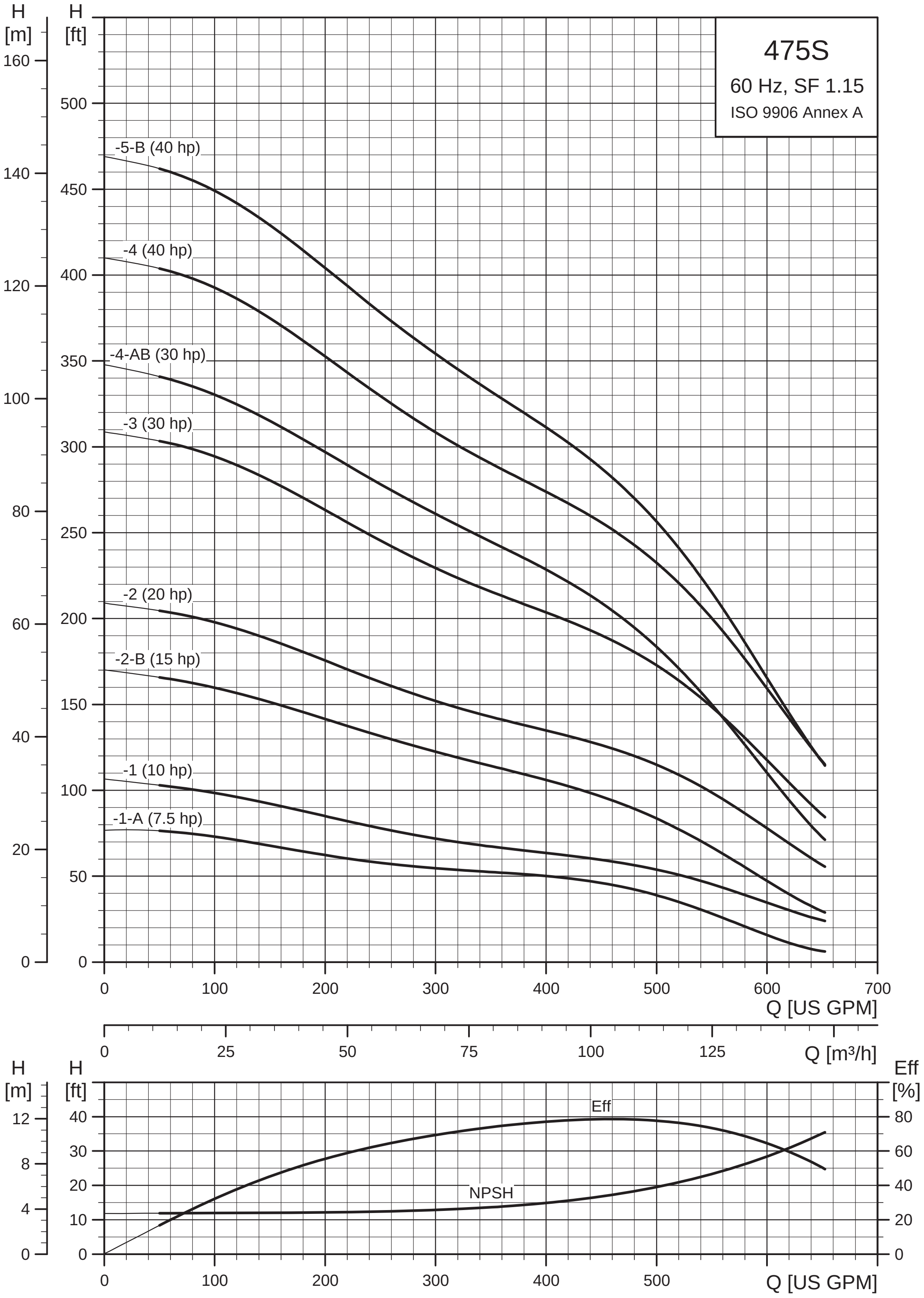
E = Maximum diameter of pump including cable guard and motor.

Notes:
Performance conforms to ISO 9906 Annex A. Minimum submergence is 8 ft (2.4 m).

- ▲ MS 6000C motor.
- ☼ Takes MMS 6 motor; not available as complete.
- * Takes MMS 8000 motor; not available as complete.

8" and larger wells - continued

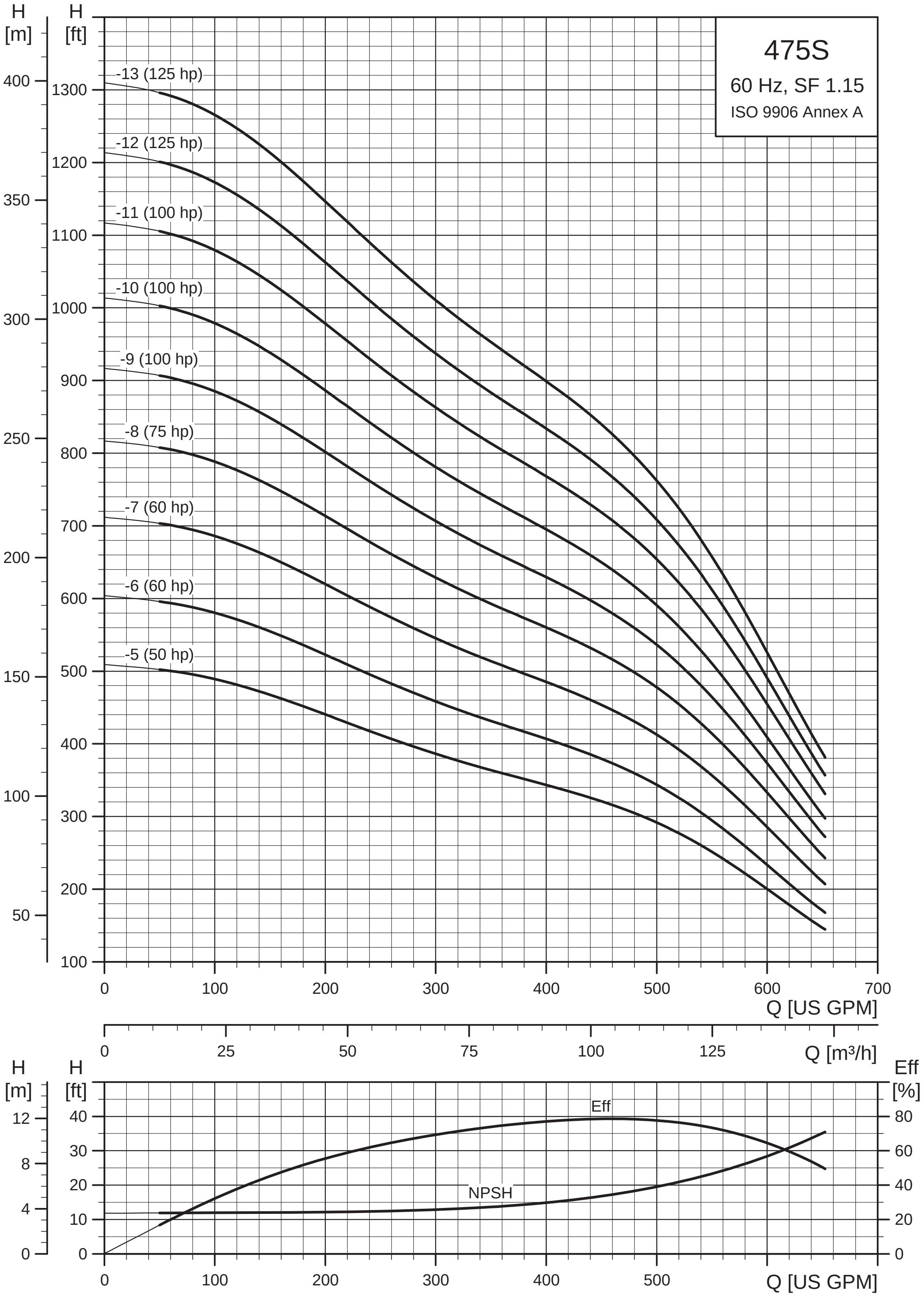
SP 475S (475 gpm)



TM05 0255 2112

8" and larger wells - continued

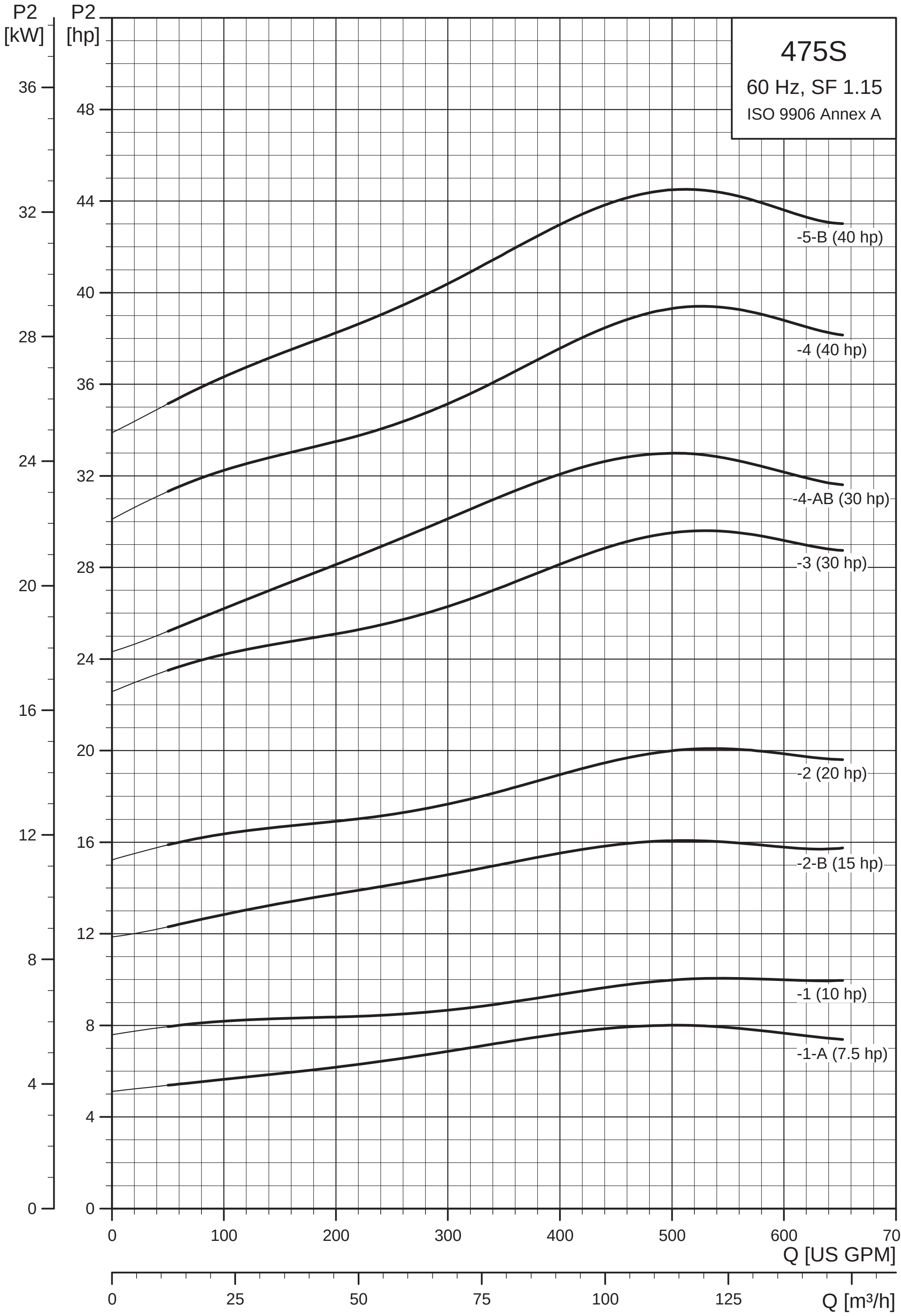
SP 475S (475 gpm)



TM05 0256 2112

8" and larger wells - continued

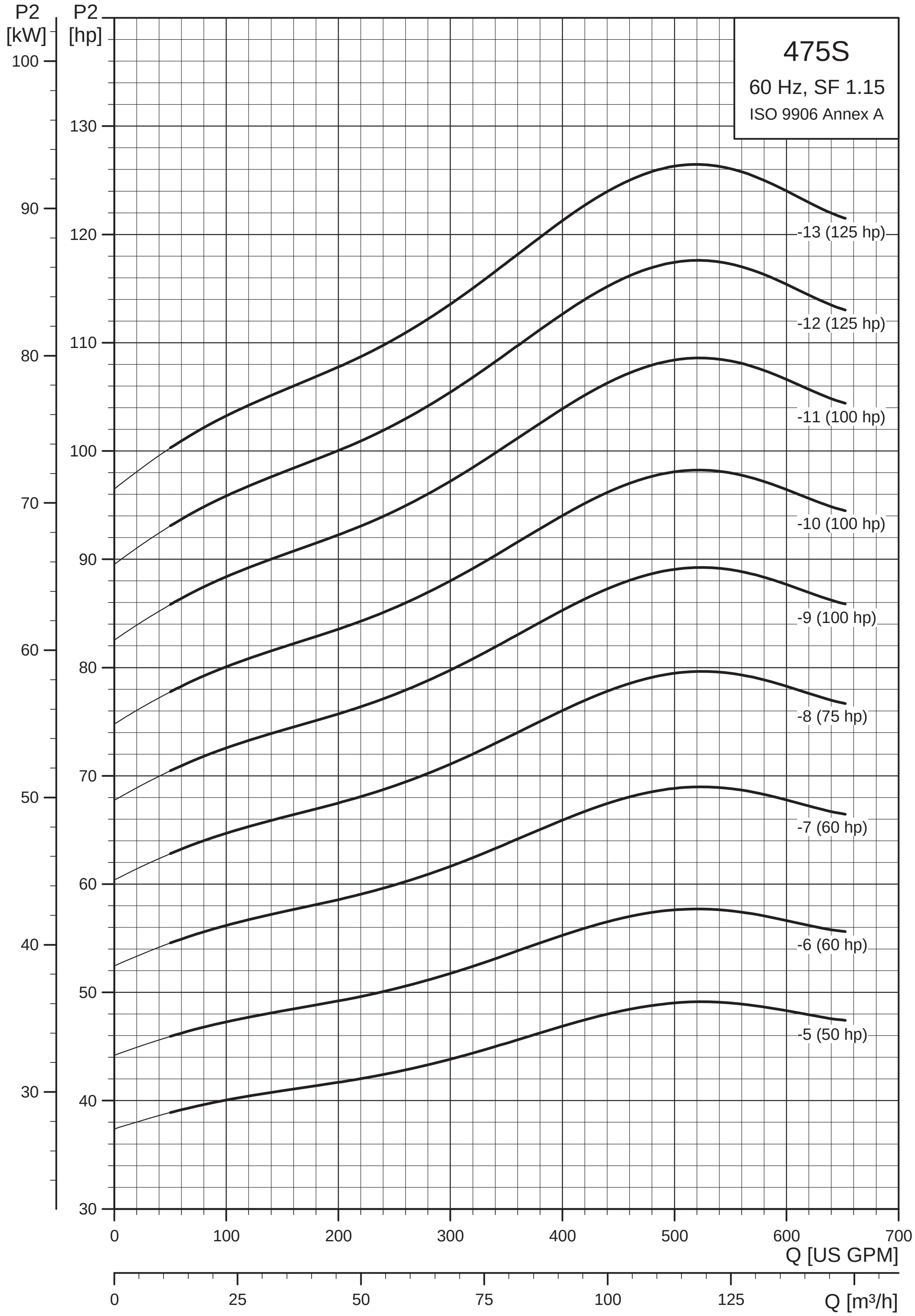
SP 475S (475 gpm) pump power requirement (P2)



TM05 0257 1812

8" and larger wells - continued

SP 475S (475 gpm) pump power requirement (P2)



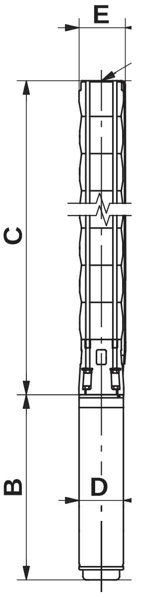
TM05 0258 1812

8" and larger wells - continued

SP 475S (475 gpm) pump with 6", 8" motors

Pump model	Nom. head [ft]	Ph	Motor				Dimensions [in (mm)]					Net weight (complete) [lb]
			Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
475S - Motor diameter 6 inch, 60 Hz, rated flow rate 475 gpm (6" NPT)												
-	-	3	208	5	▲	-	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			230	5	▲	-	-	23.51 (597)	-	5.50 (139.5)	-	80.0
			460	5	▲	-	-	23.51 (597)	-	5.50 (139.5)	-	80.0
475S75-1A	51	3	230	7.5	▲	3484	46.58 (1183)	22.25 (565)	24.34 (618)	5.63 (143)	7.05 (179)	132.3
	51	3	460	7.5	▲	3495	46.58 (1183)	22.25 (565)	24.34 (618)	5.63 (143)	7.05 (179)	132.3
475S100-1	61	3	230	10	▲	3478	47.56 (1208)	23.23 (590)	24.34 (618)	5.63 (143)	7.05 (179)	132.3
	61	3	460	10	▲	3490	47.56 (1208)	23.23 (590)	24.34 (618)	5.63 (143)	7.05 (179)	132.3
475S150-2B	108	3	230	15	▲	3474	57.25 (1454)	27.88 (708)	29.38 (746)	5.63 (143)	7.05 (179)	170.1
	108	3	460	15	▲	3480	57.25 (1454)	27.88 (708)	29.38 (746)	5.63 (143)	7.05 (179)	170.1
475S200-2	124	3	230	20	▲	3484	60.20 (1529)	30.83 (783)	29.38 (746)	5.63 (143)	7.05 (179)	198.7
	124	3	460	20	▲	3494	60.20 (1529)	30.83 (783)	29.38 (746)	5.63 (143)	7.05 (179)	198.7
475S250-3A	172	3	230	25	▲	3471	67.41 (1712)	33.00 (838)	34.41 (874)	5.63 (143)	7.05 (179)	218.2
	173	3	460	25	▲	3484	67.41 (1712)	33.00 (838)	34.41 (874)	5.63 (143)	7.05 (179)	218.2
475S300-3	186	3	230	30	▲	3477	69.97 (1777)	35.56 (903)	34.41 (874)	5.63 (143)	7.05 (179)	233.6
	187	3	460	30	▲	3489	69.97 (1777)	35.56 (903)	34.41 (874)	5.63 (143)	7.05 (179)	233.6
475S300-4AB	210	3	230	30	▲	3457	75.00 (1905)	35.56 (903)	39.45 (1002)	5.63 (143)	7.05 (179)	239.9
	212	3	460	30	▲	3472	75.00 (1905)	35.56 (903)	39.45 (1002)	5.63 (143)	7.05 (179)	239.9
475S400-4	251	3	460	40	▲	3491	79.73 (2025)	40.28 (1023)	39.45 (1002)	5.63 (143)	7.05 (179)	268.5
475S400-5B	284	3	460	40	▲	3460	84.77 (2153)	40.28 (1023)	44.49 (1130)	5.63 (143)	7.05 (179)	356.0
475S500-5	313	3	460	50	☼	3460	100.6 (2555)	56.11 (1425)	44.49 (1130)	5.67 (144)	7.05 (179)	384.0
475S500-6A	357	3	460	50	☼	3460	105.63 (2683)	56.11 (1425)	49.53 (1258)	5.67 (144)	7.05 (179)	385.0
475S600-6	375	3	460	60	☼	3456	106.19 (2697)	56.11 (1425)	50.08 (1272)	5.67 (144)	7.05 (179)	436.0
475S600-7	449	3	460	60	☼	3433	111.23 (2825)	56.11 (1425)	55.12 (1400)	5.67 (144)	7.05 (179)	446.0
475S - Motor diameter 8 inch, 60 Hz, rated flow rate 475 gpm (6" NPT)												
475S400-4	245	3	460	40	*	3462	83.71 (2126)	43.71 (1110)	40.00 (1016)	7.56 (192)	8.08 (205)	406.5
475S400-5B	284	3	460	40	*	3441	88.75 (2254)	43.71 (1110)	45.04 (1144)	7.56 (192)	8.08 (205)	444.0
475S500-5	317	3	460	50	*	3480	90.71 (2304)	45.67 (1160)	45.04 (1144)	7.56 (192)	8.08 (205)	420.4
475S500-6A	363	3	460	50	*	3480	95.75 (2432)	45.67 (1160)	50.08 (1272)	7.56 (192)	8.08 (205)	422.0
475S600-6	375	3	460	60	*	3519	100.08 (2542)	50.00 (1270)	50.08 (1272)	7.56 (192)	8.08 (205)	476.0
475S600-7	449	3	460	60	*	3505	105.12 (2670)	50.00 (1270)	55.12 (1400)	7.56 (192)	8.08 (205)	482.6
475S750-8	513	3	460	75	*	3518	113.31 (2878)	53.15 (1350)	60.16 (1528)	7.56 (192)	8.08 (205)	524.4
475S1000-9	582	3	460	100	*	3529	127.8 (3246)	62.60 (1590)	65.20 (1656)	7.56 (192)	8.08 (205)	631.0
475S1000-10	643	3	460	100	*	3512	132.84 (3374)	62.60 (1590)	70.24 (1784)	7.56 (192)	8.08 (205)	637.6
475S1000-11	711	3	460	100	*	3512	137.88 (3502)	62.60 (1590)	75.28 (1912)	7.56 (192)	8.08 (205)	644.3
475S1250-12	771	3	460	125	*	3505	152.37 (3870)	72.05 (1830)	80.32 (2040)	7.56 (192)	8.08 (205)	754.1
475S1250-13	831	3	460	125	*	3497	157.41 (3998)	72.05 (1830)	85.36 (2168)	7.56 (192)	8.08 (205)	760.7

475S



TM00 7872 2196

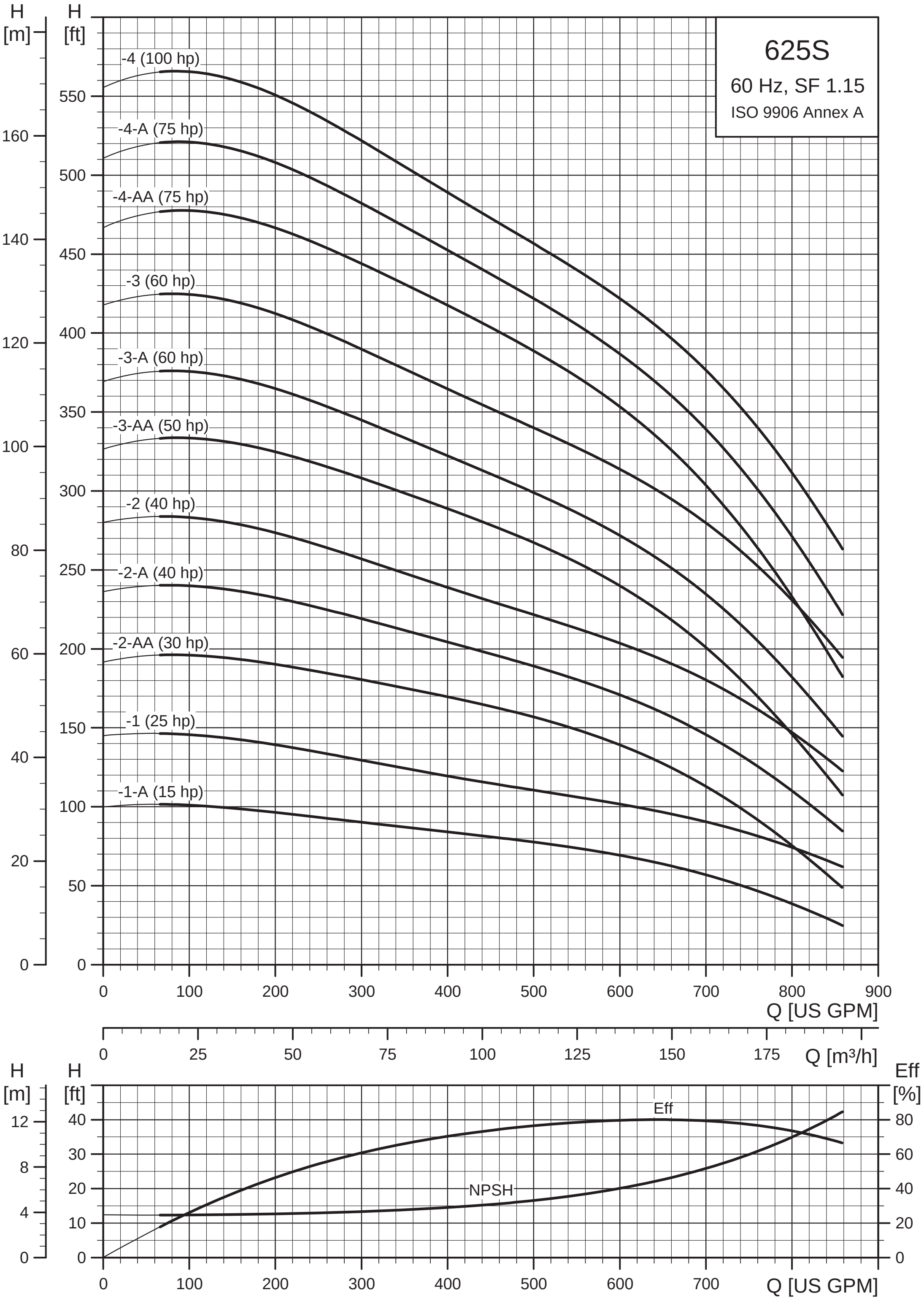
E = Maximum diameter of pump including cable guard and motor.

Notes:
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 8 ft (2.4 m).

▲	MS 6000C motor.
☼	Takes MMS 6 motor; not available as complete.
*	Takes MMS 8000 motor; not available as complete.

10" and larger wells

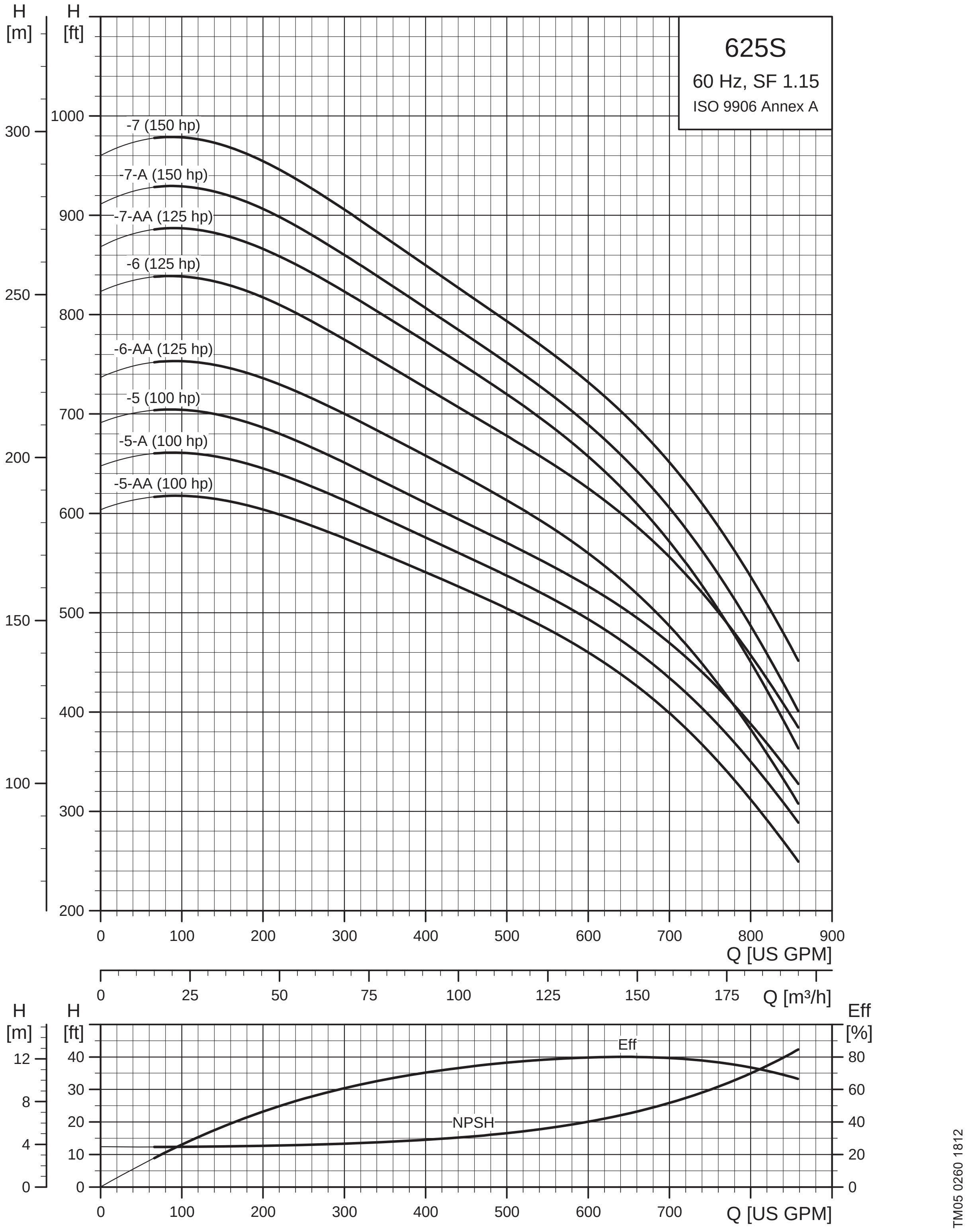
SP 625S (625 gpm)



TM05 0259 1812

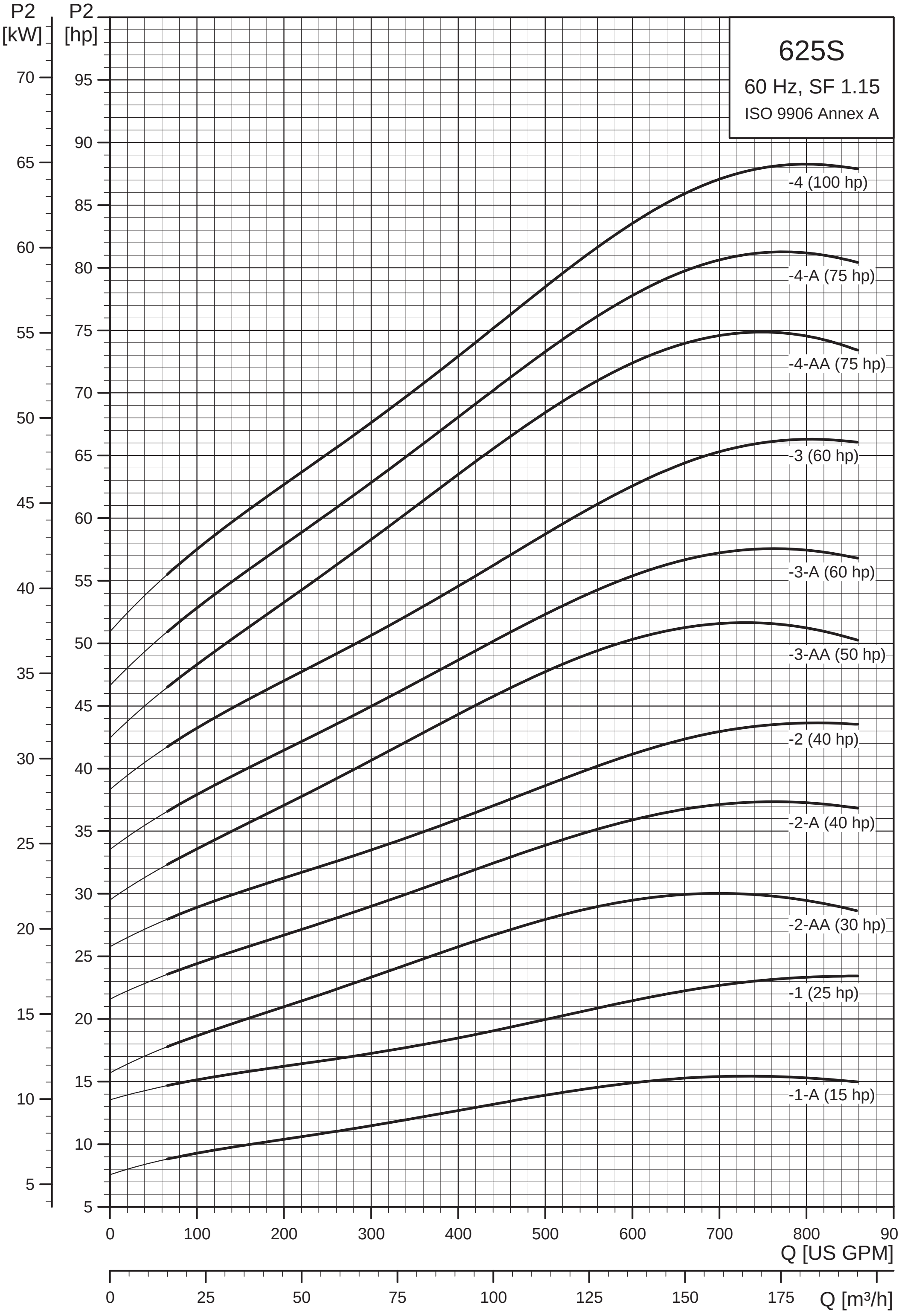
10" and larger wells - continued

SP 625S (625 gpm)



10" and larger wells - continued

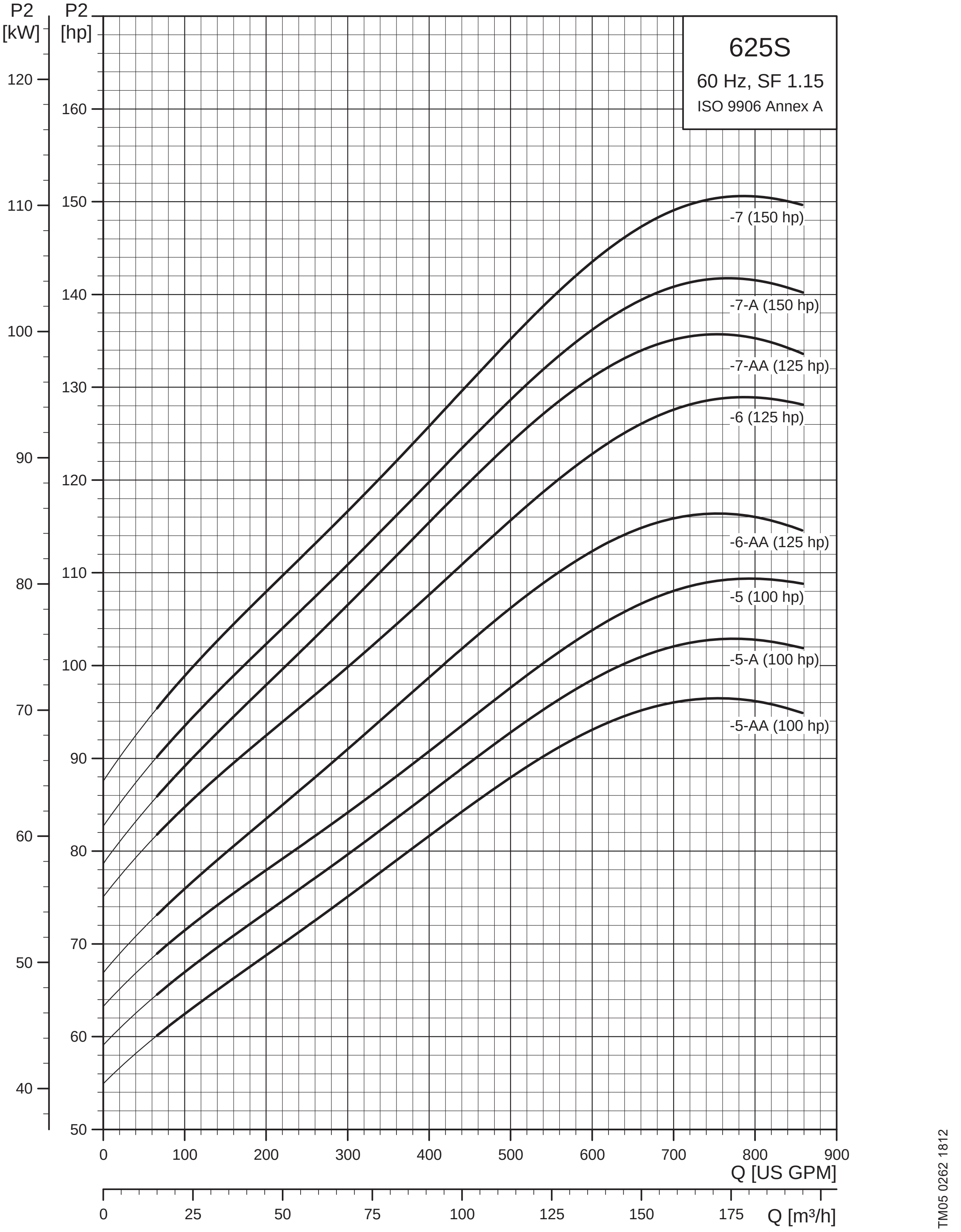
SP 625S (625 gpm) pump power requirement (P2)



TM05 0261 1812

10" and larger wells - continued

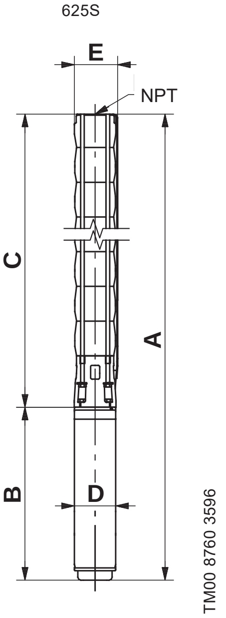
SP 625S (625 gpm) pump power requirement (P2)



10" and larger wells - continued

SP 625S (625 gpm) pump with 6", 8" motors

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
625S - Motor diameter 6 inch, 60 Hz, rated flow rate 625 gpm (6" NPT)												
625S150-1A	76	3	230	15	▲	3486	53.51 (1359)	27.88 (708)	25.63 (651)	5.63 (143)	8.31 (211)	193.0
		3	460	15	▲	3491	53.51 (1359)	27.88 (708)	25.63 (651)	5.63 (143)	8.31 (211)	193.0
625S250-1	101	3	230	25	▲	3502	58.63 (1489)	33.00 (838)	25.63 (651)	5.63 (143)	8.31 (211)	189.9
		3	460	25	▲	3511	58.63 (1489)	33.00 (838)	25.63 (651)	5.63 (143)	8.31 (211)	198.9
625S300-2AA	143	3	230	30	▲	3476	67.33 (1710)	35.56 (903)	31.78 (807)	5.63 (143)	8.31 (211)	213.0
	144	3	460	30	▲	3488	67.33 (1710)	35.56 (903)	31.78 (807)	5.63 (143)	8.31 (211)	222.3
625S400-2A	171	3	460	40	▲	3499	72.05 (1830)	40.28 (1023)	31.78 (807)	5.63 (143)	8.31 (211)	333.8
625S400-2	203	3	460	40	▲	3482	72.05 (1830)	40.28 (1023)	31.78 (807)	5.63 (143)	8.31 (211)	333.8
625S500-3AA	240	3	460	50	☼	3475	94.02 (2388)	56.11 (1425)	37.94 (963)	5.63 (143)	8.31 (211)	376.4
625S600-3A	267	3	460	60	☼	3467	94.03 (2388)	56.11 (1425)	37.92 (963)	5.63 (143)	8.31 (211)	382.0
625S600-3	301	3	460	60	☼	3453	94.03 (2388)	56.11 (1425)	37.92 (963)	5.63 (143)	8.31 (211)	382.0
625S - Motor diameter 8 inch, 60 Hz, rated flow rate 625 gpm (6" NPT)												
625S400-2	205	3	460	40	*	3498	76.03 (1931)	43.71 (1110)	32.33 (821)	7.56 (192)	8.39 (213)	409.4
625S500-3AA	243	3	460	50	*	3498	83.59 (2123)	45.67 (1160)	37.92 (963)	7.56 (192)	8.39 (213)	444.6
625S600-3A	278	3	460	60	*	3520	87.92 (2233)	50.00 (1270)	37.92 (963)	7.56 (192)	8.39 (213)	490.8
625S600-3	299	3	460	60	*	3510	87.92 (2233)	50.00 (1270)	37.92 (963)	7.56 (192)	8.39 (213)	490.8
625S750-4AA	350	3	460	75	*	3524	97.21 (2469)	53.15 (1350)	44.06 (1119)	7.56 (192)	8.39 (213)	534.8
625S750-4A	384	3	460	75	*	3518	97.21 (2469)	53.15 (1350)	44.06 (1119)	7.56 (192)	8.39 (213)	534.8
625S1000-4	402	3	460	100	*	3529	106.66 (2709)	62.60 (1590)	44.06 (1119)	7.56 (192)	8.39 (213)	633.8
625S1000-5AA	460	3	460	100	*	3524	112.76 (2864)	62.60 (1590)	50.16 (1274)	7.56 (192)	8.39 (213)	649.3
625S1000-5A	490	3	460	100	*	3519	112.76 (2864)	62.60 (1590)	50.16 (1274)	7.56 (192)	8.39 (213)	649.3
625S1000-5	500	3	460	100	*	3513	112.76 (2864)	62.60 (1590)	50.16 (1274)	7.56 (192)	8.39 (213)	649.3
625S1250-6AA	557	3	460	125	*	3507	128.31 (3259)	72.05 (1830)	56.26 (1429)	7.56 (192)	8.39 (213)	761.5
625S1250-6	590	3	460	125	*	3495	128.31 (3259)	72.05 (1830)	56.26 (1429)	7.56 (192)	8.39 (213)	761.5
625S1250-7AA	655	3	460	125	*	3490	134.45 (3415)	72.05 (1830)	62.41 (1585)	7.56 (192)	8.39 (213)	774.7
625S1500-7A	696	3	460	150	*	3505	143.51 (3645)	81.11 (2060)	62.41 (1585)	7.56 (192)	8.39 (213)	884.7
625S1500-7	690	3	460	150	*	3499	143.51 (3645)	81.11 (2060)	62.41 (1585)	7.56 (192)	8.39 (213)	884.7



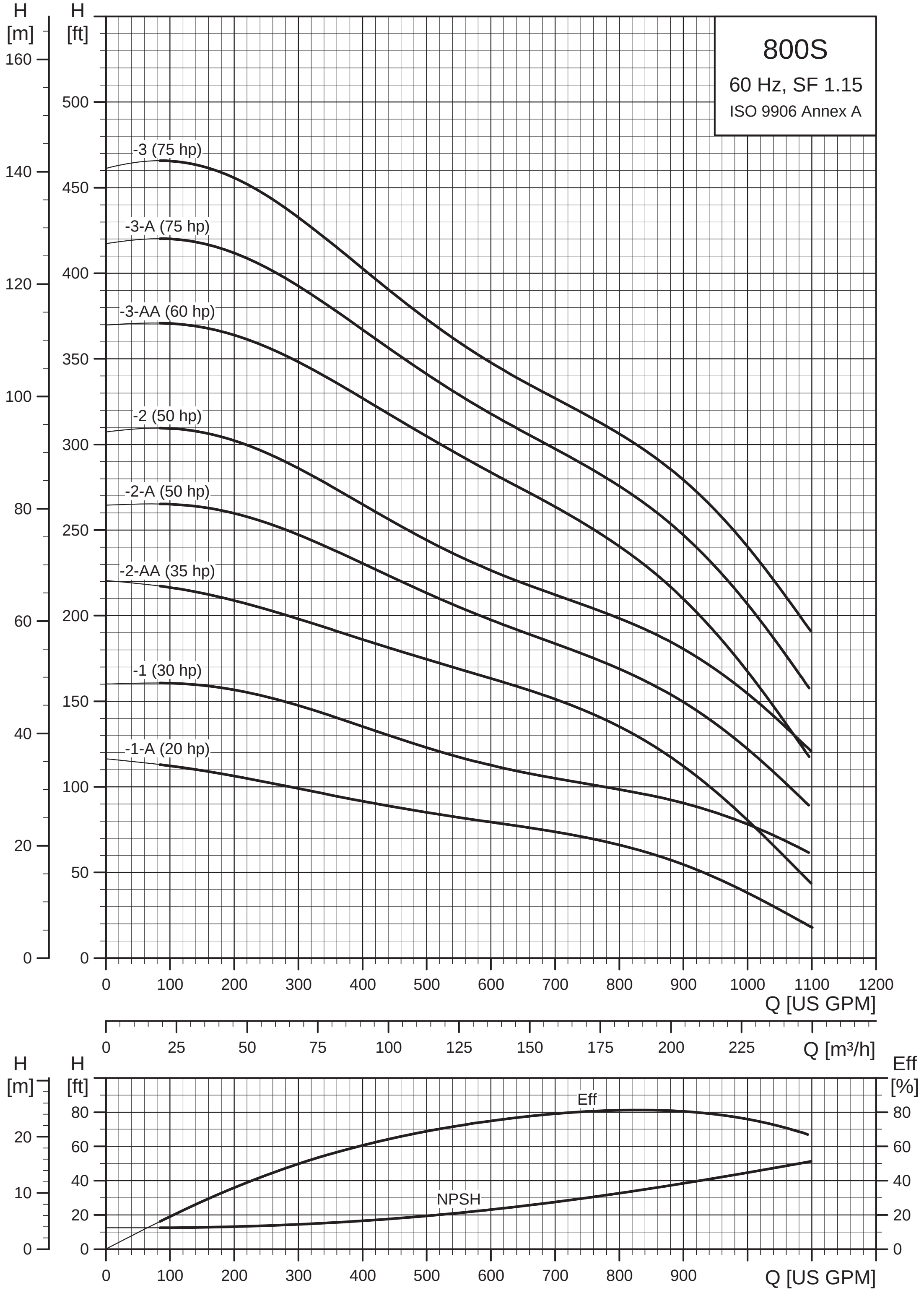
E = Maximum diameter of pump including cable guard and motor.

Notes:
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 10 ft (3 m).

▲	MS 6000C motor.
☼	Takes MMS 6 motor; not available as complete.
*	Takes MMS 8000 motor; not available as complete.

10" and larger wells - continued

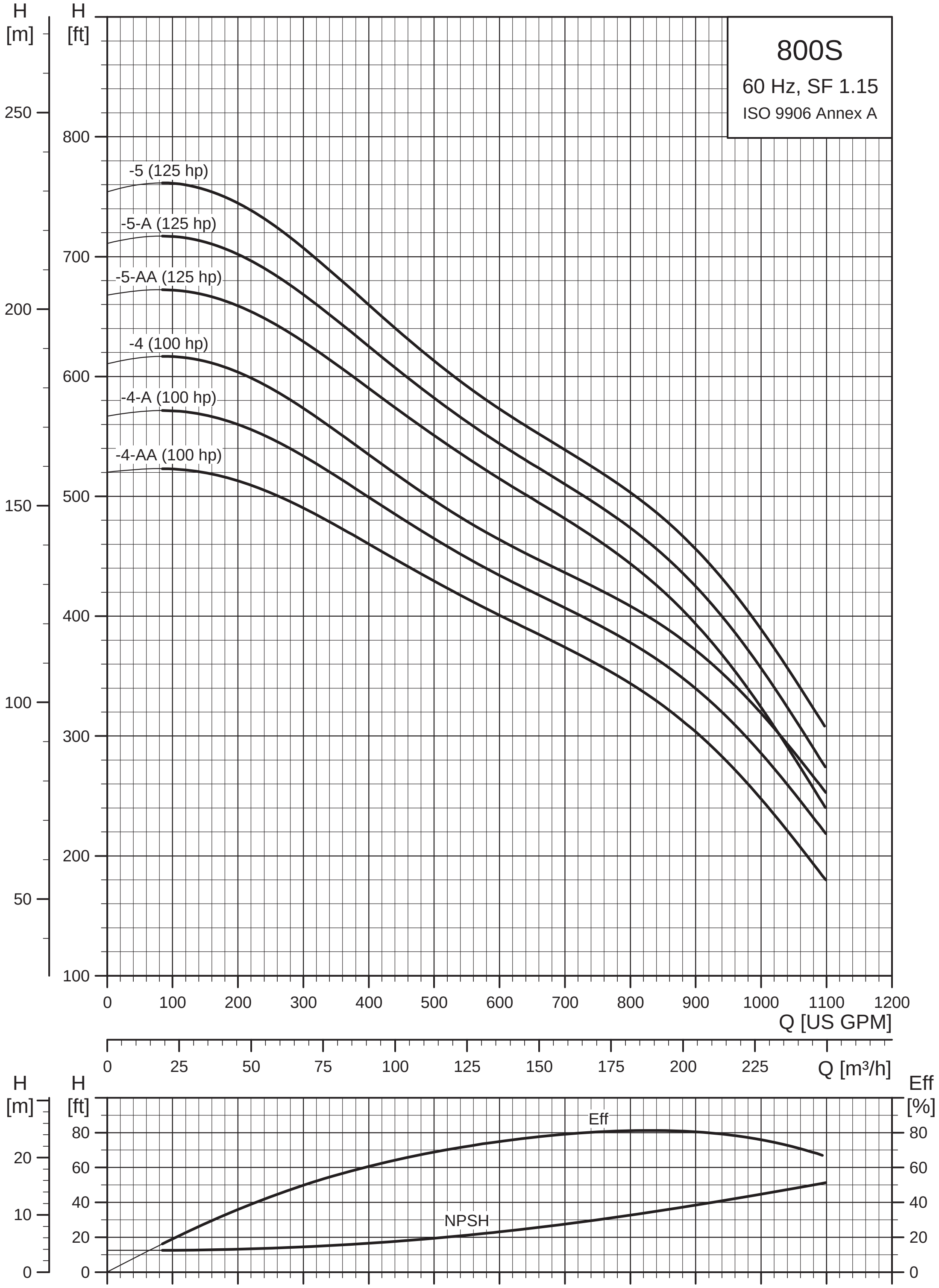
SP 800S (800 gpm)



TM05 0263 1812

10" and larger wells - continued

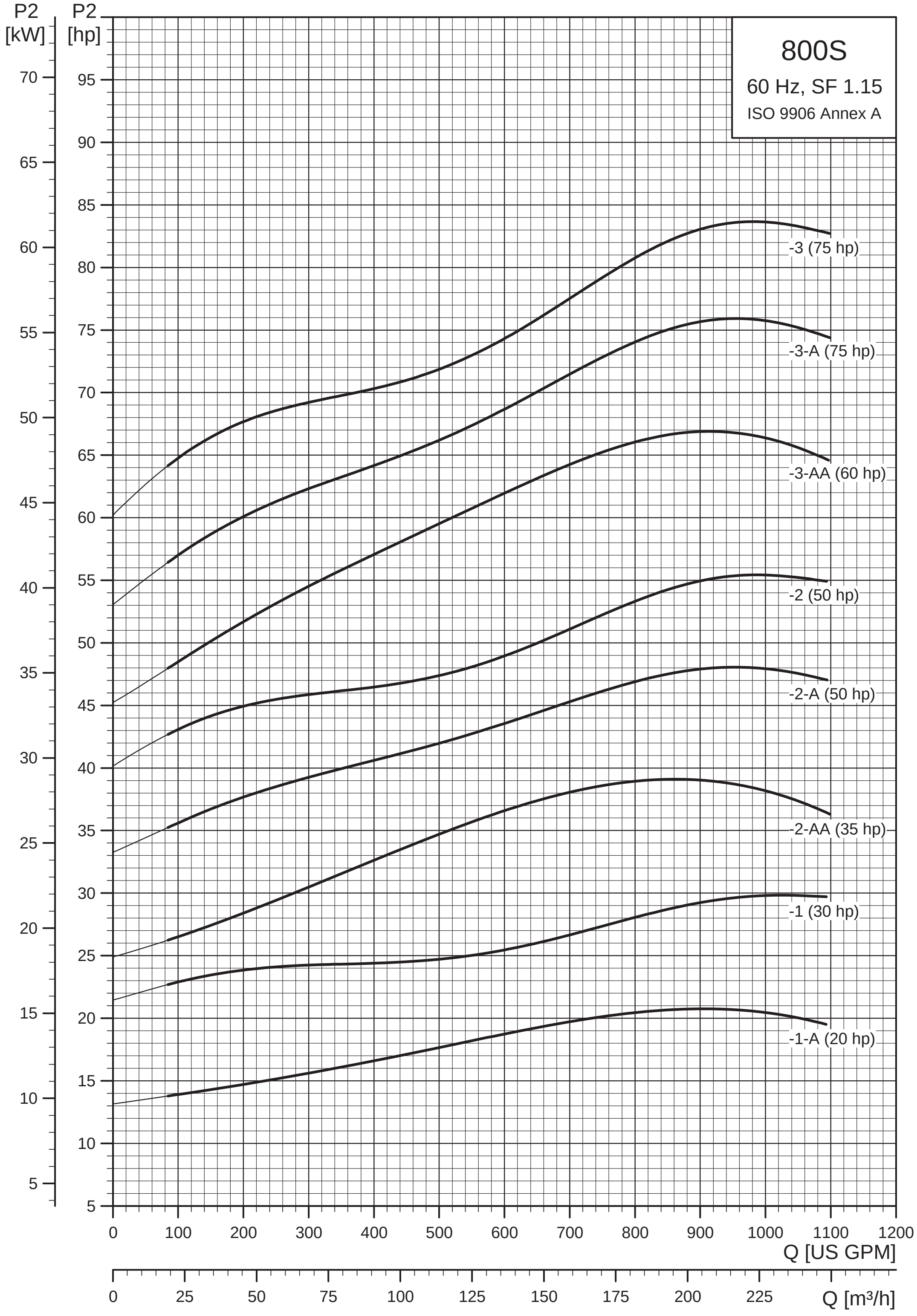
SP 800S (800 gpm)



TM05 0264 1812

10" and larger wells - continued

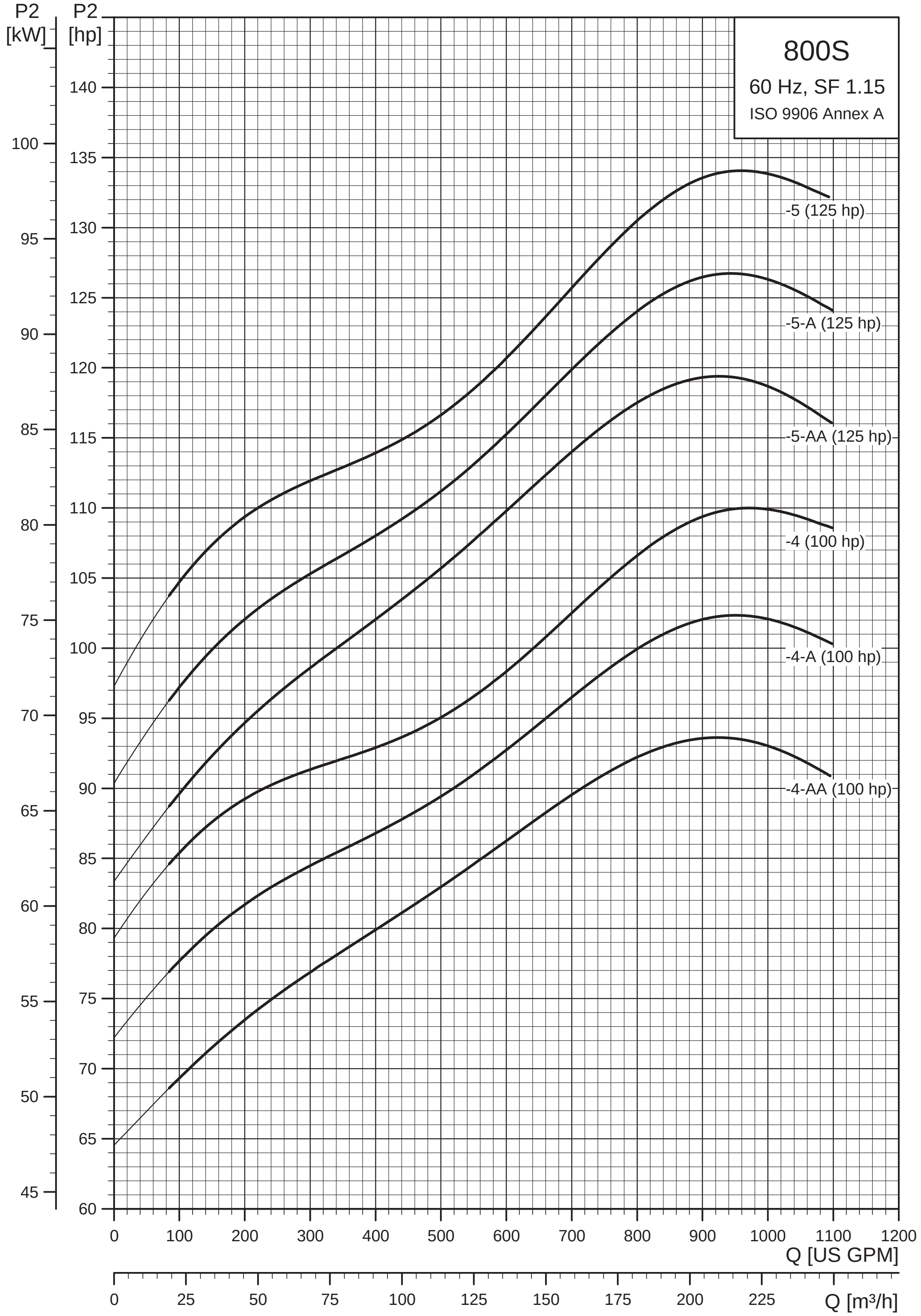
SP 800S (800 gpm) pump power requirement (P2)



TM05 0265 1812

10" and larger wells - continued

SP 800S (800 gpm) pump power requirement (P2)

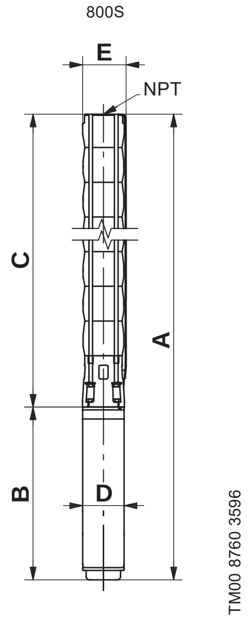


TM05 0266 1812

10" and larger wells - continued

SP 800S (800 gpm) pump with 6", 8" motors

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
800S - Motor diameter 6 inch, 60 Hz, rated flow rate 800 gpm (6" NPT)												
800S200-1A	72	3	230	20	▲	3481	56.50 (1435)	30.83 (783)	25.67 (652)	5.63 (143)	8.31 (211)	180.0
	72	3	460	20	▲	3492	56.50 (1435)	30.83 (783)	25.67 (652)	5.63 (143)	8.31 (211)	180.0
800S300-1	95	3	230	30	▲	3479	61.23 (1555)	35.56 (903)	25.67 (652)	5.63 (143)	8.31 (211)	202.5
	96	3	460	30	▲	3491	61.23 (1555)	35.56 (903)	25.67 (652)	5.63 (143)	8.31 (211)	202.5
800S400-2AA	143	3	460	40	▲	3490	72.05 (1830)	40.28 (1023)	31.78 (807)	5.63 (143)	8.31 (211)	257.4
800S500-2A	172	3	460	50	☼	3486	88.00 (2235)	56.11 (1425)	31.87 (810)	5.63 (143)	8.39 (213)	363.2
800S500-2	189	3	460	50	☼	3463	88.00 (2235)	56.11 (1425)	31.87 (810)	5.63 (143)	8.39 (213)	363.2
800S600-3AA	239	3	460	60	☼	3446	94.03 (2388)	56.11 (1425)	37.92 (963)	5.63 (143)	8.39 (213)	381.4
800S - Motor diameter 8 inch, 60 Hz, rated flow rate 800 gpm (6" NPT)												
800S400-2AA	141	3	460	40	*	3462	75.48 (1917)	43.71 (1110)	31.78 (807)	7.56 (192)	8.39 (213)	409.4
800S500-2A	174	3	460	50	*	3507	77.45 (1967)	45.67 (1160)	31.78 (807)	7.56 (192)	8.39 (213)	431.4
800S500-2	192	3	460	50	*	3489	77.45 (1967)	45.67 (1160)	31.78 (807)	7.56 (192)	8.39 (213)	438.0
800S600-3AA	247	3	460	60	*	3508	87.92 (2233)	50.00 (1270)	37.92 (963)	7.56 (192)	8.39 (213)	490.8
800S750-3A	281	3	460	75	*	3523	91.07 (2313)	53.15 (1350)	37.92 (963)	7.56 (192)	8.39 (213)	523.8
800S750-3	293	3	460	75	*	3514	91.07 (2313)	53.15 (1350)	37.92 (963)	7.56 (192)	8.39 (213)	523.8
800S1000-4AA	354	3	460	100	*	3524	106.62 (2708)	62.60 (1590)	44.02 (1118)	7.56 (192)	8.39 (213)	633.8
800S1000-4A	385	3	460	100	*	3519	106.62 (2708)	62.60 (1590)	44.02 (1118)	7.56 (192)	8.39 (213)	633.8
800S1000-4	390	3	460	100	*	3511	106.62 (2708)	62.60 (1590)	44.02 (1118)	7.56 (192)	8.39 (213)	633.8
800S1250-5AA	454	3	460	125	*	3503	122.21 (3104)	72.05 (1830)	50.16 (1274)	7.56 (192)	8.39 (213)	748.3
800S1250-5A	457	3	460	125	*	3496	122.21 (3104)	72.05 (1830)	50.16 (1274)	7.56 (192)	8.39 (213)	748.3
800S1250-5	479	3	460	125	*	3489	122.21 (3104)	72.05 (1830)	50.16 (1274)	7.56 (192)	8.39 (213)	746.6



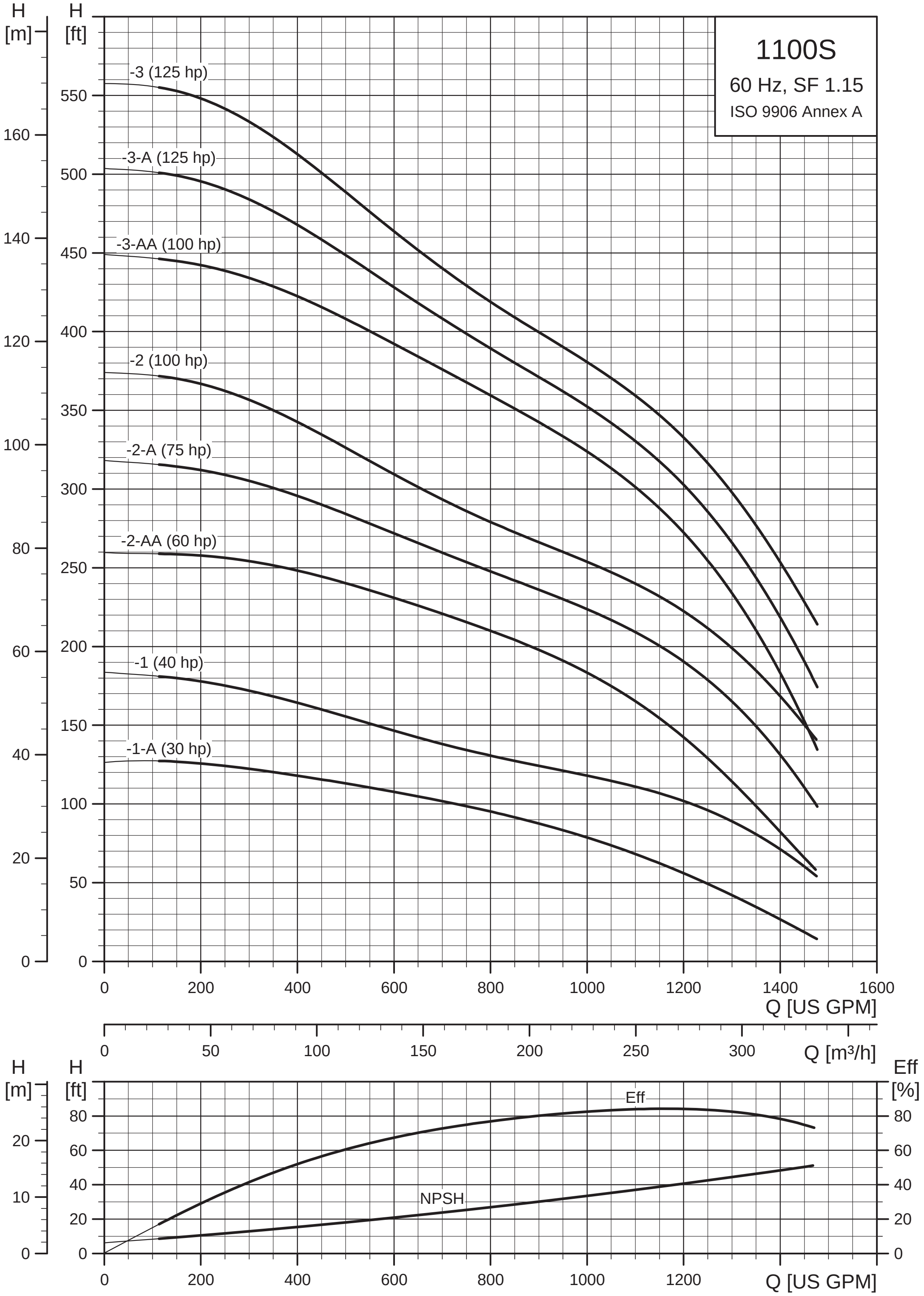
E = Maximum diameter of pump including cable guard and motor.

Notes:
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 25 ft (7.6 m).

- ▲ MS 6000C motor.
- ☼ Takes MMS 6 motor; not available as complete.
- * Takes MMS 8000 motor; not available as complete.

10" and larger wells - continued

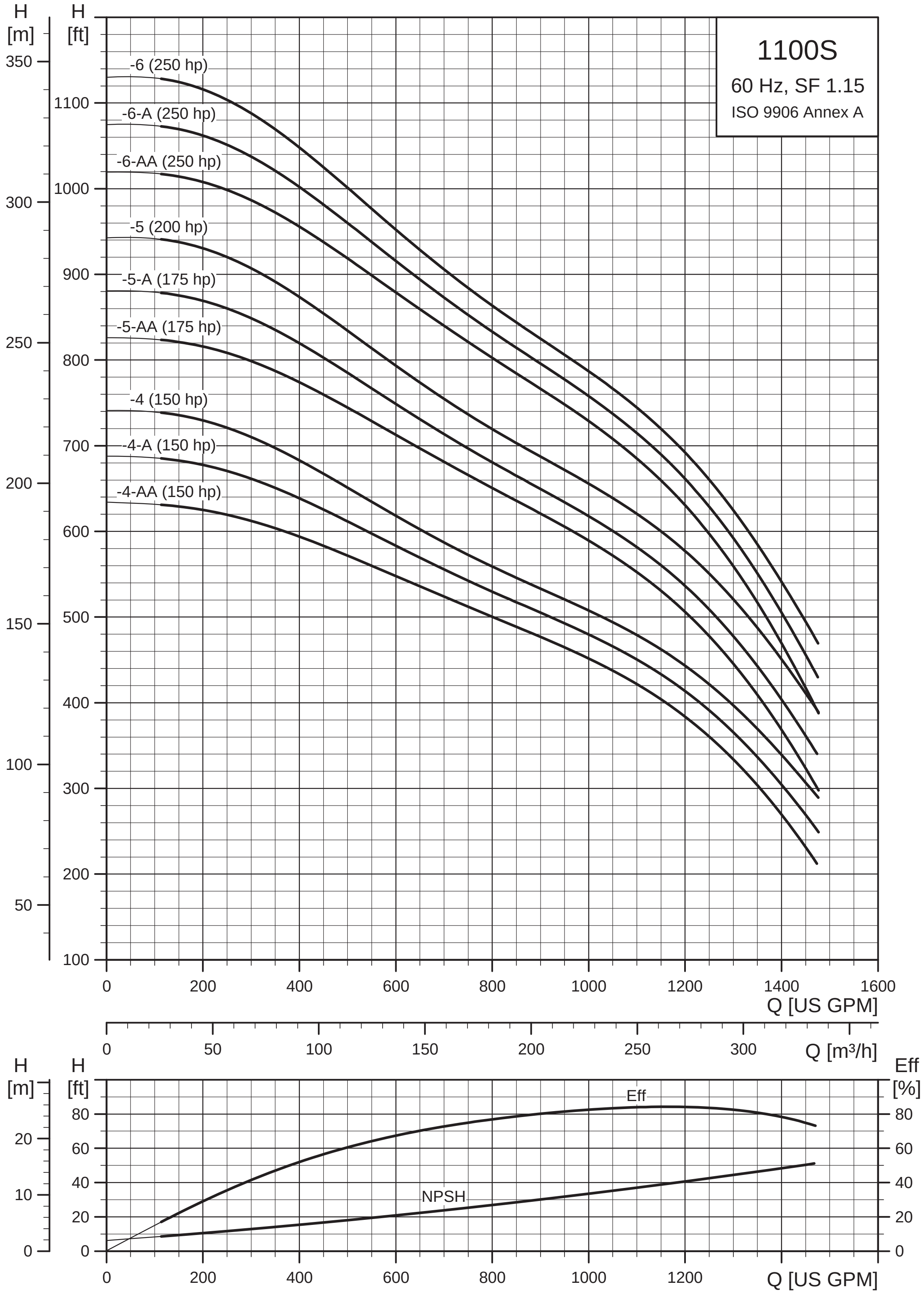
SP 1100S (1100 gpm)



TM05 0267 1812

10" and larger wells - continued

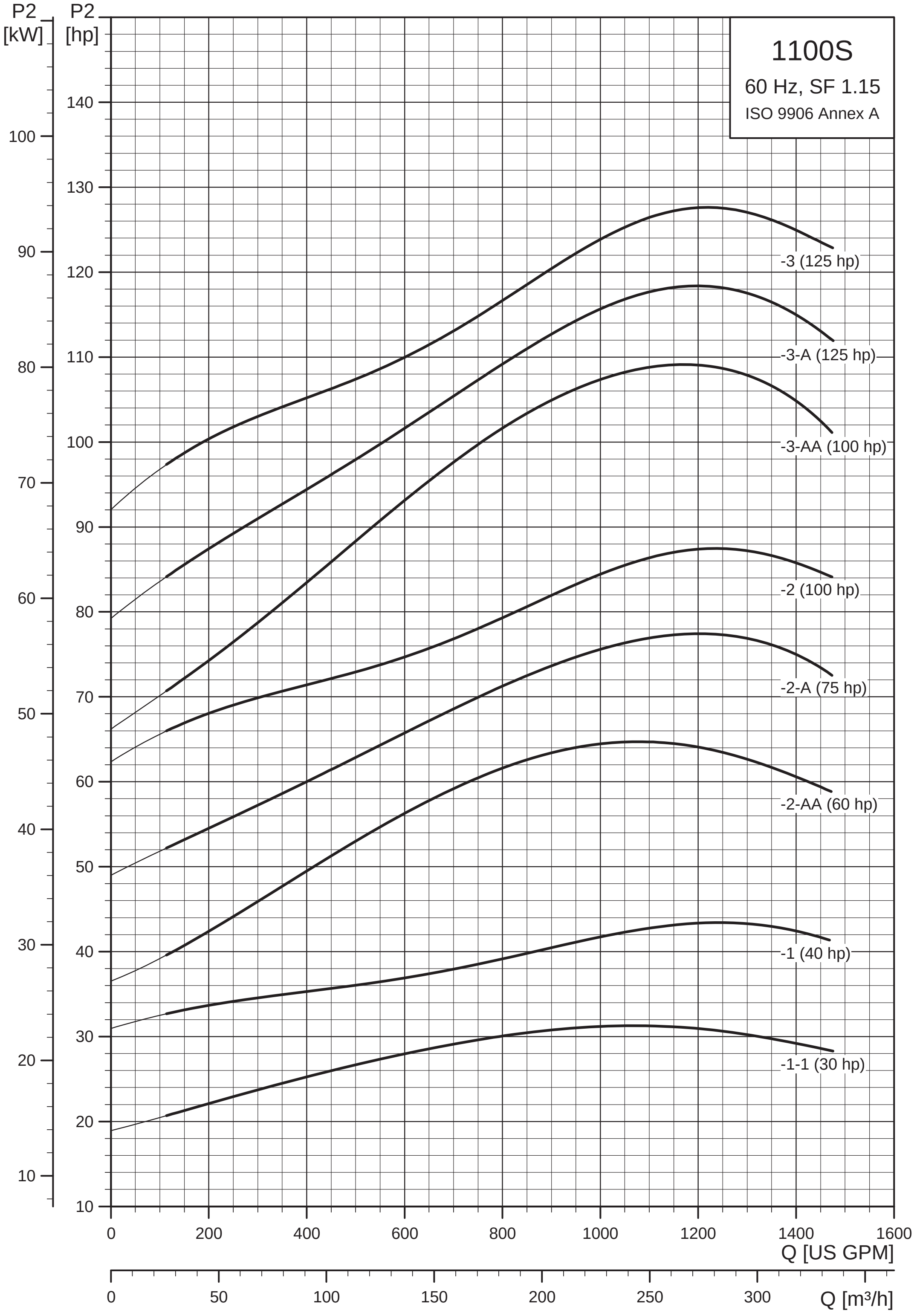
SP 1100S (1100 gpm)



TM05 0268 1812

10" and larger wells - continued

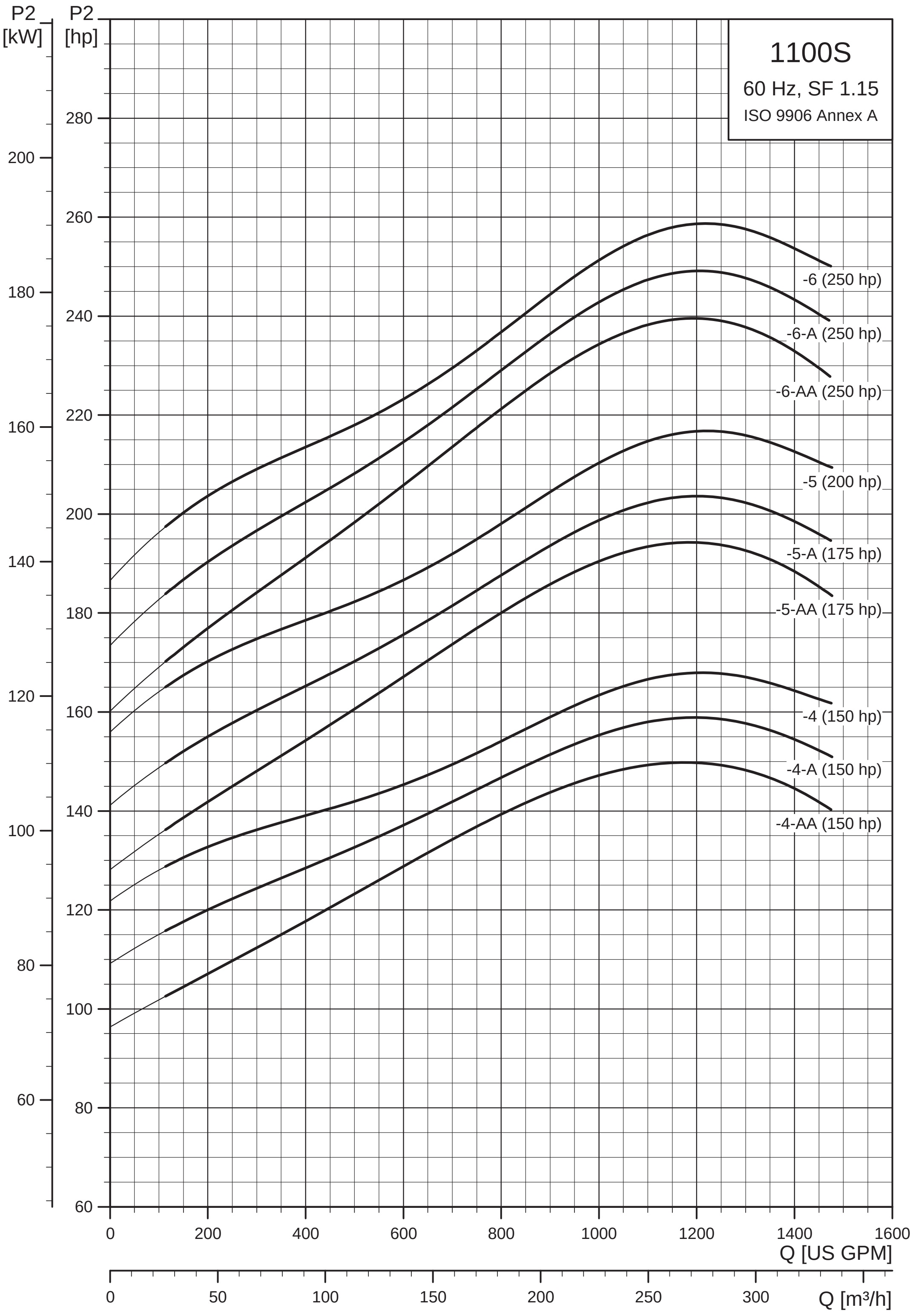
SP 1100S (1100 gpm) pump power requirement (P2)



TM05 0269 1812

10" and larger wells - continued

SP 1100S (1100 gpm) pump power requirement (P2)

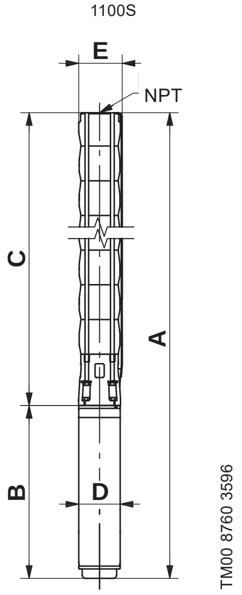


TM05 0270 1812

10" and larger wells - continued

SP 1100S (1100 gpm) pump with 6", 8", 10" motors

Pump model	Nom. head [ft]	Motor					Dimensions [in (mm)]					Net weight (complete) [lb]
		Ph	Volts [V]	[Hp]		[rpm]	A	B	C	D	E	
1100S - Motor diameter 6 inch, 60 Hz, rated flow rate 1100 gpm (6" NPT)												
1100S300-1A	77	3	230	30	▲	3449	66.66 (1693)	35.56 (903)	31.11 (790)	5.63 (143)	9.30 (236)	261.0
	89	3	460	30	▲	3481	66.66 (1693)	35.56 (903)	31.11 (790)	5.63 (143)	9.30 (236)	261.0
1100S400-1	109	3	460	40	▲	3476	71.38 (1813)	40.28 (1023)	31.11 (790)	5.63 (143)	9.30 (236)	290.6
1100S600-2AA	178	3	460	60	☼	3455	94.15 (2391)	56.11 (1425)	38.04 (966)	5.63 (143)	9.30 (236)	389.8
1100S - Motor diameter 8 inch, 60 Hz, rated flow rate 1100 gpm (6" NPT)												
1100S400-1	110	3	460	40	*	3493	74.81 (1900)	43.71 (1110)	31.11 (790)	7.56 (192)	9.41 (239)	407.2
1100S600-2AA	180	3	460	60	*	3510	88.04 (2236)	50.00 (1270)	38.04 (966)	7.56 (192)	9.41 (239)	501.8
1100S750-2A	217	3	460	75	*	3521	91.19 (2316)	53.15 (1350)	38.04 (966)	7.56 (192)	9.41 (239)	534.8
1100S1000-2	230	3	460	100	*	3529	100.63 (2556)	62.60 (1590)	38.04 (966)	7.56 (192)	9.41 (239)	633.8
1100S1000-3AA	314	3	460	100	*	3511	107.56 (2732)	62.60 (1590)	44.97 (1142)	7.56 (192)	9.41 (239)	655.9
1100S1250-3A	319	3	460	125	*	3503	117.01 (2972)	72.05 (1830)	44.97 (1142)	7.56 (192)	9.41 (239)	757.1
1100S1250-3	340	3	460	125	*	3495	117.01 (2972)	72.05 (1830)	44.97 (1142)	7.56 (192)	9.41 (239)	757.1
1100S1500-4AA	411	3	460	150	*	3498	133.00 (3378)	81.11 (2060)	51.89 (1318)	7.56 (192)	9.41 (239)	889.1
1100S1500-4A	431	3	460	150	*	3485	133.00 (3378)	81.11 (2060)	51.89 (1318)	7.56 (192)	9.41 (239)	889.1
1100S1500-4	450	3	460	150	*	3491	133.00 (3378)	81.11 (2060)	51.89 (1318)	7.56 (192)	9.41 (239)	889.1
1100S - Motor diameter 10 inch, 60 Hz, rated flow rate 1100 gpm (6" NPT)												
1100S1750-5AA	524	3	460	175	†	3510	132.45 (3364)	73.63 (1870)	58.82 (1494)	9.34 (237)	9.85 (250)	1142.2
1100S1750-5A	559	3	460	175	†	3446	132.45 (3364)	73.63 (1870)	58.82 (1494)	9.34 (237)	9.85 (250)	1137.0
1100S2000-5	577	3	460	200	†	3522	140.32 (3564)	81.5 (2070)	58.82 (1494)	9.34 (237)	9.85 (250)	1285.2
1100S2600-6AA	658	3	460	250	†	3520	160.24 (4070)	94.49 (2400)	65.75 (1670)	9.34 (237)	9.85 (250)	1478.0
1100S2600-6A	673	3	460	250	†	3520	160.24 (4070)	94.49 (2400)	65.75 (1670)	9.34 (237)	9.85 (250)	1483.2
1100S2600-6	703	3	460	250	†	3520	160.24 (4070)	94.49 (2400)	65.75 (1670)	9.34 (237)	9.85 (250)	1483.2



E = Maximum diameter of pump including cable guard and motor.

Notes:
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 30 ft (9.1 m).

- ▲ MS 6000C motor.
- ☼ Takes MMS 6 motor; not available as complete.
- * Takes MMS 8000 motor; not available as complete.
- † Takes MMS 10000 motor; not available as complete.

7. Electrical data

Motor type	Hp	kW	Volt [V]	Service factor	Full load				Service factor (max. load)				Locked rotor	KVA code	Max. thrust	RPM
					[A]	[W]*	Power factor	Eff. [%]	[A]	[W]*	Power factor	Eff. [%]	[A]**			
4" 2-wire single phase motors - control box not required																
MS402	.5	0.37	115	1.60	9.5	675	0.67	55.0	12.0	1076	0.78	62	82.8	R	900	3450
	.5	0.37	230	1.60	4.5	646	0.63	57.7	6.0	1049	0.76	62	37.2	R	900	3450
	.75	0.55	230	1.50	6.9	994	0.63	56.3	8.4	1449	0.75	62	51.2	N	900	3450
	1	0.75	230	1.40	8.8	1260	0.67	59.7	9.8	1848	0.82	63	55.9	M	900	3450
	1.5	1.10	230	1.30	11.6	1760	0.70	62.7	13.1	2561	0.85	64	81.2	L	900	3450
4" 3-wire single phase motors - control box required																
MS402	.5	0.37	115	1.60	10.0	992	0.74	37.6	12.0	1049	0.73	61	44.4	L	900	3450
	.5	0.37	230	1.60	5.6	968	0.75	38.2	6.0	1049	0.76	62	24.6	L	900	3450
	.75	0.55	230	1.50	8.4	1410	0.76	39.7	8.4	1449	0.75	62	34.4	L	900	3450
	1	0.75	230	1.40	9.0	1662	0.81	44.9	9.8	1848	0.82	63	42.1	K	900	3450
	1.5	1.10	230	1.30	10.7	2169	0.89	51.6	11.6	2375	0.89	69	58.0	H	900	3450
MS4000	2	1.50	230	1.25	13.1	2582	0.86	57.8	13.2	2611	0.86	72	55.4	G	1500	3450
	3	2.20	230	1.15	16.8	3601	0.93	62.1	17.0	3636	0.93	74	103.7	F	1500	3450
	5	3.70	230	1.15	25.7	5645	0.96	66.0	27.5	5819	0.92	77	110.0	F	1500	3450
4" three phase 60 Hz motors																
MS402	.5	0.37	208	1.60	3.3	623	0.53	59.4	3.5	908	0.72	67	16.1	N	900	3450
			230	1.60	3.0	625	0.53	59.2	3.2	904	0.72	67	14.5	N	900	3450
			460	1.60	1.5	625	0.53	59.2	1.6	918	0.72	67	7.4	N	900	3450
			575	1.60	1.2	618	0.53	59.5	1.3	896	0.72	67	5.8	N	900	3450
	.75	0.55	208	1.50	4.6	878	0.53	62.7	5.1	1286	0.70	69	23.5	N	900	3450
			230	1.50	4.2	883	0.53	62.3	4.6	1283	0.70	69	21.2	N	900	3450
			460	1.50	2.1	878	0.53	62.6	2.3	1283	0.70	69	10.6	N	900	3450
			575	1.50	1.7	881	0.53	62.4	1.9	1290	0.70	69	8.5	N	900	3450
	1	0.75	208	1.40	4.9	1105	0.63	67.4	6.0	1578	0.73	70	28.8	M	900	3450
			230	1.40	4.6	1129	0.62	66.3	5.4	1570	0.73	70	25.9	M	900	3450
			460	1.40	2.3	1131	0.62	66.3	2.7	1570	0.73	70	13.0	M	900	3450
			575	1.40	1.8	1130	0.62	66.3	2.2	1563	0.73	70	10.3	M	900	3450
	1.5	1.10	208	1.30	6.6	1581	0.67	70.1	8.1	2101	0.72	75	40.5	M	900	3450
			230	1.30	5.8	1571	0.68	70.8	7.3	2094	0.72	75	37.2	M	900	3450
			460	1.30	2.9	1559	0.67	71.0	3.7	2094	0.72	75	18.6	M	900	3450
			575	1.30	2.3	1560	0.69	70.7	2.9	2080	0.72	75	14.5	M	900	3450
	2	1.50	208	1.25	8.1	2043	0.70	73.2	9.6	2594	0.75	76	51.8	L	900	3450
			230	1.25	7.5	2062	0.69	72.8	8.7	2599	0.75	76	47.0	L	900	3450
			460	1.25	3.7	2056	0.69	72.7	4.4	2599	0.75	76	23.5	L	900	3450
			575	1.25	3.1	2071	0.68	72.7	3.5	2614	0.75	76	19.3	L	900	3450
MS4000	3	2.20	208	1.15	9.9	2996	0.84	72.6	11.9	3644	0.85	73	61.9	J	1500	3415
			230	1.15	10.4	3054	0.74	71.6	11.6	3466	0.75	73	60.3	J	1500	3460
			440	1.15	5.0	3010	0.79	73.6	5.7	3531	0.82	73	28.8	J	1500	3440
			460	1.15	5.2	3042	0.74	72.7	5.8	3604	0.78	73	30.7	J	1500	3460
			575	1.15	3.9	3014	0.77	73.5	4.7	3520	0.76	73	24.2	J	1500	3470
	5	3.70	208	1.15	15.7	4864	0.86	76.0	18.6	5830	0.87	77	106.0	K	1500	3425
			230	1.15	15.0	4840	0.81	76.7	17.4	5407	0.78	77	102.7	K	1500	3470
			440	1.15	7.5	4820	0.84	76.5	8.7	5472	0.83	77	47.6	J	1500	3460
			460	1.15	7.5	4814	0.81	76.6	8.7	5513	0.80	77	51.0	J	1500	3470
			575	1.15	6.1	4617	0.76	80.5	6.9	5498	0.80	77	40.7	J	1500	3470
	7.5	5.50	208	1.15	22.8	7146	0.87	76.8	27.0	8657	0.89	81	137.7	I	1500	3415
			230	1.15	21.5	7023	0.82	78.0	25.0	8167	0.82	81	155.0	I	1500	3460
			440	1.15	10.8	6996	0.85	78.0	12.8	8487	0.87	81	73.0	I	1500	3440
			460	1.15	10.6	6925	0.82	78.3	12.6	8232	0.82	81	78.1	I	1500	3460
			575	1.15	8.7	6876	0.79	81.4	10.0	8167	0.82	81	62.0	I	1500	3460
	10	7.50	440	1.15	15.1	9667	0.84	78.0	18.0	11386	0.83	81	108.0	J	1500	3420
			460	1.15	15.0	9561	0.80	78.0	18.6	11856	0.80	81	119.0	J	1500	3460
			575	1.15	12.5	9212	0.74	81.0	14.4	11330	0.79	81	90.7	J	1500	3440

Motor type	Hp	kW	Volt [V]	Service factor	Full load				Service factor (max. load)				Locked rotor	KVA code	Max. thrust	RPM
					[A]	[W]*	Power factor	Eff. [%]	[A]	[W]*	Power factor	Eff. [%]	[A]**			
6" three phase 60 Hz motors																
MS 6000C	5	3.70	208	1.15	16.9	4932	0.81	79.3	19.0	5681	0.83	79.3	95.0	H	6070	3480
			230	1.15	16.2	4969	0.77	79.2	17.8	5673	0.80	79.9	105.0	H	6070	3510
			460	1.15	8.0	4908	0.77	79.4	8.8	5609	0.80	80.2	51.3	H	6070	3500
	7.5	5.50	208	1.15	24.2	7149	0.82	80.2	27.5	8223	0.83	79.4	114.0	H	6070	3450
			230	1.15	23.4	7178	0.77	80.6	26.0	8286	0.80	80.8	130.0	H	6070	3480
			440	1.15	11.6	7161	0.81	80.6	13.2	8249	0.82	80.4	61.0	J	6070	3470
			460	1.15	11.6	7117	0.77	80.6	13.0	8286	0.80	80.8	64.5	J	6070	3480
			480	1.15	12.0	7283	0.73	80.2	13.0	8322	0.77	80.7	68.0	J	6070	3490
			575	1.15	9.3	7186	0.78	80.6	10.2	8228	0.81	80.8	51.0	H	6070	3480
	10	7.50	208	1.15	32.0	9684	0.84	80.5	37.5	11483	0.85	79.2	126.0	G	6070	3420
			230	1.15	30.0	9680	0.81	81.7	33.5	11077	0.83	81.5	142.0	G	6070	3470
			440	1.15	15.2	9615	0.83	81.5	17.4	11139	0.84	0.81	67.5	G	6070	3450
			460	1.15	15.0	9680	0.81	81.8	16.8	11110	0.83	81.7	71.0	G	6070	3470
			480	1.15	15.0	9602	0.77	81.8	16.6	11041	0.80	82.0	75.0	G	6070	3480
			575	1.15	12.0	9680	0.81	81.4	13.4	11077	0.83	81.2	56.5	G	6070	3470
	15	11.00	208	1.15	46.5	14072	0.84	82.1	53.5	16383	0.85	81.1	198.0	G	6070	3430
			230	1.15	44.5	14005	0.79	83.0	49.5	16170	0.82	82.9	224.0	G	6070	3470
			440	1.15	22.0	13916	0.83	82.8	25.0	16004	0.84	82.1	100.0	H	6070	3450
			460	1.15	21.6	13940	0.81	83.1	24.4	16136	0.83	82.8	106.0	H	6070	3470
			480	1.15	21.6	13828	0.77	83.1	24.0	15963	0.80	83.2	112.0	H	6070	3480
			575	1.15	17.2	13875	0.81	83.0	19.4	16036	0.83	82.7	84.0	G	6070	3460
	20	15.00	208	1.15	61.5	19054	0.86	82.7	71.5	22153	0.86	81.5	310.0	H	6070	3430
			230	1.15	57.5	18783	0.82	84.0	65.0	21751	0.84	83.7	350.0	H	6070	3470
			440	1.15	29.0	18565	0.84	83.7	33.5	21701	0.85	82.9	166.0	J	6070	3450
			460	1.15	29.0	18947	0.82	84.0	32.5	21751	0.84	83.7	176.0	J	6070	3470
			480	1.15	29.0	18806	0.78	83.9	32.0	21549	0.81	83.9	186.0	J	6070	3480
			575	1.15	23.4	18877	0.81	83.8	26.0	21492	0.83	83.5	144.0	J	6070	3480
	25	18.50	208	1.15	75.0	23237	0.86	83.4	87.0	26955	0.86	82.3	395.0	J	6070	3430
			230	1.15	71.0	22910	0.81	84.6	80.0	26452	0.83	84.3	445.0	J	6070	3480
			440	1.15	36.0	23046	0.84	84.3	41.0	26559	0.85	83.6	212.0	J	6070	3460
			460	1.15	35.5	22910	0.81	84.6	40.0	26452	0.83	84.3	224.0	J	6070	3480
			480	1.15	36.0	23046	0.77	84.3	39.5	26272	0.80	84.4	236.0	J	6070	3490
			575	1.15	28.5	23275	0.82	84.0	32.0	26452	0.83	83.7	180.0	J	6070	3480
	30	22.00	208	1.15	88.0	27582	0.87	83.3	104.0	32597	0.87	81.8	445.0	H	6070	3420
			230	1.15	81.0	27105	0.84	85.1	92.0	31153	0.85	84.4	500.0	H	6070	3470
			440	1.15	41.5	27199	0.86	84.5	48.0	31825	0.87	83.5	238.0	J	6070	3450
			460	1.15	40.5	27105	0.84	85.1	46.0	31153	0.85	84.4	250.0	J	6070	3470
			480	1.15	40.0	26937	0.81	85.2	45.0	31052	0.83	85.0	265.0	J	6070	3480
			575	1.15	32.0	27089	0.85	84.8	37.0	31690	0.86	84.0	194.0	H	6070	3460
	40	30.00	440	1.15	56.0	37130	0.87	84.7	65.0	43592	0.88	83.6	290.0	H	6070	3440
			460	1.15	54.5	36909	0.85	85.2	62.0	42482	0.86	84.7	310.0	H	6070	3460
			480	1.15	54.5	37155	0.82	85.3	61.0	42600	0.84	85.1	330.0	H	6070	3480
			575	1.15	43.5	36824	0.85	85.2	49.5	42890	0.87	84.7	250.0	G	6070	3470
6" three phase 60 Hz motors																
MMS 6	50	37.00	460	1.15	73.0	47111	0.81	83.2	82.0	54226	0.83	82.6	405	H	6000	3450
MMS 6	60	45.00	460	1.15	86.3	57070	0.83	85.0	97.0	66464	0.86	86.0	525	G	6000	3455
8" three phase 60 Hz motors																
MMS 8000	40	30.00	460	1.15	53.3	36096	0.85	82.5	64.0	43853	0.86	83.0	371	K	13000	3490
	50	37.00	460	1.15	65.6	44426	0.85	83.7	78.0	53446	0.86	84.0	429	J	13000	3480
	60	45.00	460	1.15	77.5	52485	0.85	85.4	92.5	64118	0.87	86.0	592	K	13000	3500
	75	55.00	460	1.15	101.0	65182	0.81	85.8	112.0	77635	0.87	86.0	650	J	13000	3500
	100	75.00	460	1.15	126.0	86335	0.86	86.6	150.0	105170	0.88	87.0	855	J	13000	3500
	125	92.00	460	1.15	155.5	107787	0.87	86.9	184.0	129009	0.88	87.0	1104	J	13000	3480
	150	110.00	460	1.15	186.2	129068	0.87	86.6	220.0	154250	0.88	86.0	1276	J	13000	3480
	40	30.0	575	1.15	43.3	37086	0.86	81.0	49.0	42456	0.87	85.0	202	J	13000	3500
	50	37.0	575	1.15	55.5	46983	0.85	79.0	62.2	53274	0.86	84.0	257	G	13000	3500
	60	45.0	575	1.15	62.0	53720	0.87	84.0	71.0	62226	0.88	85.0	465	J	13000	3500
	75	55.0	575	1.15	79.1	67749	0.86	81.0	89.4	78352	0.88	85.0	586	L	13000	3485
	100	75.0	575	1.15	104.0	91147	0.88	82.0	118.0	104592	0.89	86.0	786	N	13000	3470
	125	92.0	575	1.15	118.4	104947	0.89	88.0	144.0	127638	0.89	86.0	1007	R	13000	3470
	150	110.0	575	1.15	156.0	127399	0.82	86.0	176.0	147238	0.84	89.0	1230	H	13000	3470
10" three phase 60 Hz motors																
MMS 10000	175	132.00	460	1.15	226.2	151388	0.84	86.5	265.0	181578	0.86	88.0	1511	J	13000	3510
	200	147.00	460	1.15	266.4	171924	0.81	86.6	305.0	204126	0.84	87.0	1891	K	13000	3520
	250	190.00	460	1.15	339.8	213879	0.79	86.7	405.0	264598	0.82	87.0	2471	K	13000	3520

* Calculated value (voltage x current x Cos F)

** Calculated value (full load current x locked rotor current %)

8. Approvals

Product	Approval		
SP 4"	CSA®	C CSA® US	UL®
SP 4" pump end (5S - 77S)		CLASSIFIED C UL® US WATER QUALITY Drinking Water System Component NSF/ANSI 61 MH26400 NSF/ANSI 372	
MS 6000C motor	CSA®	CLASSIFIED C UL® US Submersible Motor NSF/ANSI 372 MH26400	
MS 4000 motor	CSA®	IAPMO File 6591 0.25 % lead	
MS 402 motor	CSA®	RU ®	IAPMO File 6591 0.25 % lead

Grundfos SP pumps are certified when driven by a certified motor provided with suitable overheating protection.

9. Accessories

Grundfos RSI (Renewable Solar Inverter)

Grundfos RSI is an off-grid solar inverter that converts the DC power output from a solar panel to AC power supply for pump operation.

RSI is designed for continuous as well as intermittent operation. The system is suitable for various water supply systems including irrigation.

The RSI can be used in existing systems with submersible pumps or dry-installed pumps, thus providing a very wide range of applications allowing you to leverage renewable energy sources with the ability to back up the system with grid or generator power.

RSI features:

- Weatherproof (enclosure class IP66).
- Setup wizard.
- Can operate without the detachable, magnetic control panel.
- AC/DC* compatibility for connecting to the grid or use as a generator as back-up power during solar panel disruptions.
- Maximum power point tracking (MPPT) optimizes available solar irradiation and environmental conditions.
- Overvoltage and undervoltage protection.
- Overload protection.
- Overcurrent protection.
- Overtemperature protection**.
- No-load protection.
- Operating history memory.

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Fig. 19 Grundfos RSI

System components

An RSI system consists of a three-phase Grundfos motor, an RSI solar inverter, and other components such as:

- circuit breaker, AC (optional)
- circuit breaker, DC
- surge protection, DC
- solar panel
- dry-running switch
- level switch (optional)
- sine-wave filter (optional)
- combiner box (junction box).

Pump requirements:

- 50 or 60 Hz
- 3 x 380-440 VAC or 3 x 220 VAC.

As standard, Grundfos three-phase pumps can only be operated via an AC voltage supply. Therefore, the solar panels must not be connected directly to the pump but must be connected via an RSI.

***** Solar power (DC) and AC power must never under any circumstances be connected at the same time.

****** The inverter does not detect motor temperature or protect the motor against overtemperature.

Technical data

Voltage			**3 x 208-240 V**	**3 x 380-440 V**
Installation environment	Minimum ambient temperature	[°F (°C)]	14 (-10)	14 (-10)
	Maximum ambient temperature	[°F (°C)]	140 (60)	140 (60)
	Maximum relative humidity	[%]	100	100
Electrical data	DC minimum MPP voltage	[VDC]	230	400
	DC recommended MPP voltage	[VDC]	290-336	530-615
	DC maximum input voltage	[VDC]	380	800
	AC input voltage	[VAC]	208-240	380-460
	AC rated output voltage	[VAC]	220	380-440
	Minimum frequency	[Hz]	5	5
	Maximum frequency	[Hz]	60	60
	Phases		3	3
	Enclosure class		IP66	IP66

Low voltage range (3 x 208-240 V)

Power [kW]	Product number	Electrical data			Frame size
		Max. P2 [Hp]	Max. P2 [kW]	Rated output current [Amps]	
1.5	99090622	2	1.5	8	A
2.2	99090633	3	2.2	11	A
3	99090634	4	3.0	12.5	A
4	99090635	5	4.0	18	B
5.5	99090636	7.5	5.5	24.2	B
7.5	99090637	10	7.5	31	B
11	99090638	15	11	48	C
15	99090639	20	15	62	C

High voltage range (3 x 380-440 V)

Power [kW]	Product number	Electrical data			Frame size
		Max. P2 [Hp]	Max. P2 [kW]	Rated output current [Amps]	
2.2	99044348	3	2.2	5.6	A
3.0	99044349	4	3.0	8	A
4.0	99044350	5	4.0	9.6	A
5.5	99044351	7.5	5.5	12	A
7.5	99044352	10	7.5	16	B
11	99044363	15	11	23	B
15	99044364	20	15	31	B
18.5	99044365	25	18.5	38	C
22	99044366	30	22	46	C
30	99044367	40	30	61	C
37	99044368	50	37	72	C

Optional

CU331SP variable frequency drive

Description	Product number
Combiner box (junction box) components kit, DC	98298572
Circuit breaker, DC	98341686
Surge protection, DC	98341687

CU331SP constant pressure drive kits (with sensor)

Enclosure type	NEMA	Hp	Input Ph	Input volts	Product number	Approximate ship wt. [lb]
Indoor	Type 12	2	1	200 - 240	98370277	60
		3	1	200 - 240	98370280	60
		5	1	200 - 240	98370304	60
Outdoor	Type 4X	2	1	200 - 240	98370279	60
		3	1	200 - 240	98370301	60
		5	1	200 - 240	98370305	60

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Fig. 20 CU331SP variable frequency drive and sensor

Features

User interface

The user interface offers these possibilities:

- Local operation via a operating panel with graphic display where the menu structure is based on the well-known system from Grundfos E-pumps.
- Monitoring of operating status via indicator lights and signal relays.
- Display of alarm or warning and logging of the last five alarms and warnings.

Functions

Control mode: Constant pressure

CU331SP has only one control mode, Constant pressure. The pressure is kept constant, independently of the flow rate.

Startup guide

CU331SP has a startup guide, which is launched at the first power up. Parameters are set manually on the basis of the installation. The startup guide can be repeated, if necessary.

Thanks to the startup guide, the installer can quickly set a few parameters and put CU331SP into operation.

Direction of rotation test

During startup, CU331SP automatically tests and sets the correct direction of rotation without changing the cable connections. The direction of rotation test can be performed manually if it fails for any reason.

Dry-running protection

To protect the pump, CU331SP will automatically set up dry-running protection so that water shortage can be detected. The dry-running alarm will automatically reset 30 minutes after the alarm is declared.

Low-flow stop function

The low-flow stop function is used for changing between on/off operation at low flow rate and continuous operation at high flow rate.

The low-flow stop function protects the pump and saves energy.

Applications

For 4" or larger wells. Main applications:

- Domestic and light commercial water supply
- irrigation
- livestock watering
- water transfer.

System components

- Compact, efficient, and reliable variable frequency drive
- rugged stainless steel pump end and proven, reliable, three-phase motor
- pressure sensor
- diaphragm tank (sold separately).

CU331SP identification

Nameplate

CU331SP can be identified by means of the nameplate. An example is shown below.

GRUNDFOS

Prod. no: 98370280 S/N:000201H462

T/C: CU-331P3K0S2E55H2XGXXSXSXXXXAXBXCXXXXDX

3 HP

IN: 1x200-240V 50/60Hz 24A

OUT: 3x0-Vin 0-200Hz 12.5A

Type 12 / IP55 Tamb. 45°C/113F

134G9466000201H462

ASSEMBLED IN USA

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Fig. 21 Example of nameplate

Key	
Text	**Description**
T/C:	CU-331 (product name)
Prod. no:	Product number (98370280)
S/N:	Serial number (000201H462) The last four digits indicate the production date. In this case, 46 is the week, and 2 is the year 2012.
3.0 hp	Typical shaft power on the motor
IN:	Supply voltage, frequency and maximum input current.
OUT:	Motor voltage, frequency and maximum output current. The maximum output frequency usually depends on the pump type.
Type 12 / IP55	Enclosure class
Tamb.	Maximum ambient temperature

CU331SP sizing

Step 1

Calculate maximum head requirements at rated flow rate conditions:

H_{max}=dynamic head + system psi (in feet) + friction loss + above grade elevation.

Step 2

Select pump from performance curves as follows:

Select a model in which the calculated value of H_{max} is within the maximum performance curve of the pump. Refer to section *CU331SP curve charts* on page 126.

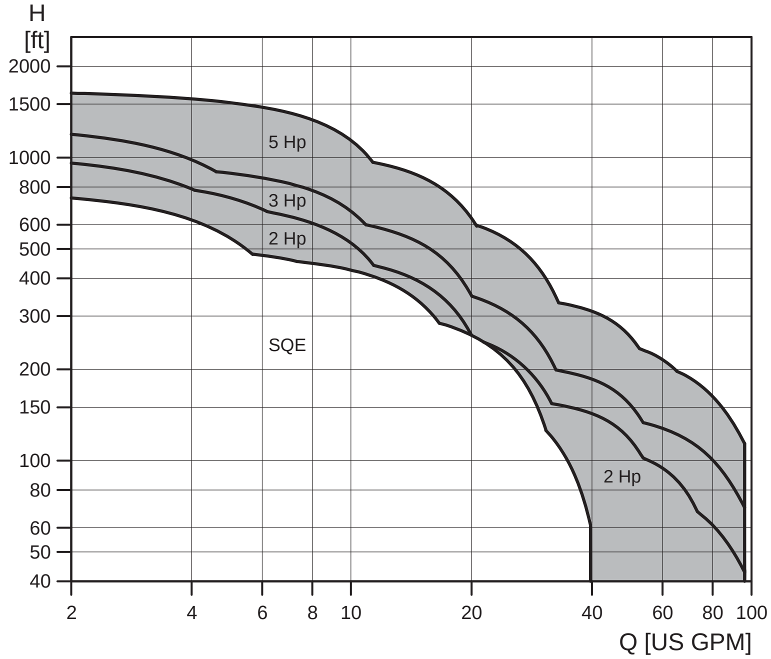
Step 3

Select the CU331SP that corresponds to the correct motor Hp and enclosure type.

CU331SP product range

Enclosure type	NEMA	Hp	Input Ph	Input volts
Indoor	Type 12	2	1	200 - 240
		3	1	200 - 240
		5	1	200 - 240
Outdoor	Type 4X	2	1	200 - 240
		3	1	200 - 240
		5	1	200 - 240

CU331SP performance range



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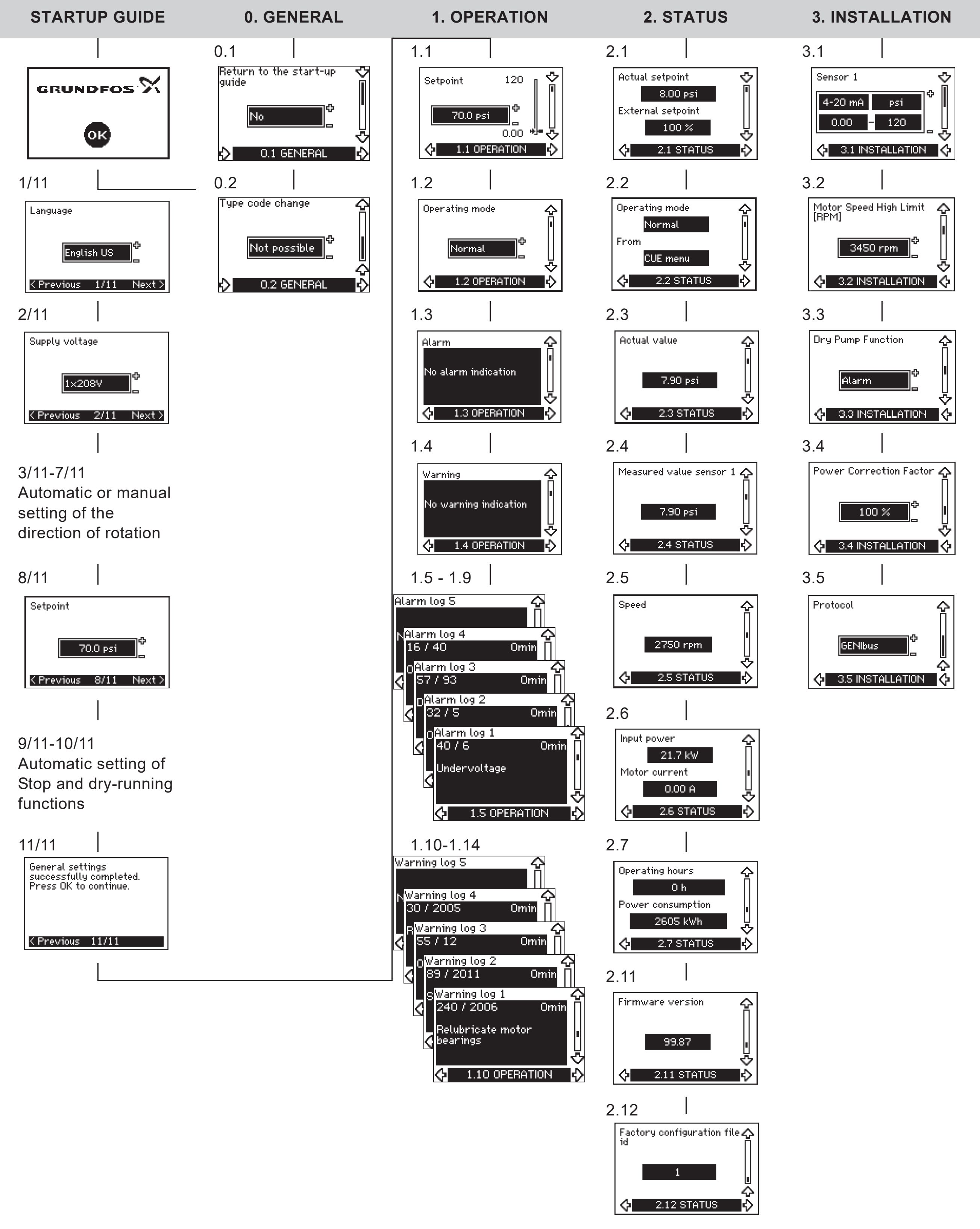
CU331SP operation

Menu structure

CU331SP has a startup guide, which is launched at the first power up. After the startup guide, CU331SP has a menu structure divided into four main menus:

0. **GENERAL** gives access to the startup guide for the general setting of CU331SP.
1. **OPERATION** enables the setting of setpoint and resetting of alarms. It is also possible to see the latest five warnings and alarms.
2. **STATUS** shows the status of CU331SP and the pump. It is not possible to change or set values.
3. **INSTALLATION** gives access to available parameters.

CU331SP menu overview



STARTUP GUIDE

GRUNDFOS OK

1/11
Language
English US
< Previous 1/11 Next >

2/11
Supply voltage
1x208V
< Previous 2/11 Next >

3/11-7/11
Automatic or manual setting of the direction of rotation

8/11
Setpoint
70.0 psi
< Previous 8/11 Next >

9/11-10/11
Automatic setting of Stop and dry-running functions

11/11
General settings successfully completed. Press OK to continue.
< Previous 11/11

0. GENERAL

0.1
Return to the start-up guide
No
0.1 GENERAL

0.2
Type code change
Not possible
0.2 GENERAL

1. OPERATION

1.1
Setpoint 120
70.0 psi
0.00
1.1 OPERATION

1.2
Operating mode
Normal
1.2 OPERATION

1.3
Alarm
No alarm indication
1.3 OPERATION

1.4
Warning
No warning indication
1.4 OPERATION

1.5 - 1.9
Alarm log 5
Alarm log 4 16 / 40 0min
Alarm log 3 57 / 93 0min
Alarm log 2 32 / 5 0min
Alarm log 1 40 / 6 0min
Undervoltage
1.5 OPERATION

1.10-1.14
Warning log 5
Warning log 4 30 / 2005 0min
Warning log 3 55 / 12 0min
Warning log 2 89 / 2011 0min
Warning log 1 240 / 2006 0min
Relubricate motor bearings
1.10 OPERATION

2. STATUS

2.1
Actual setpoint 8.00 psi
External setpoint 100 %
2.1 STATUS

2.2
Operating mode Normal
From CUE menu
2.2 STATUS

2.3
Actual value 7.90 psi
2.3 STATUS

2.4
Measured value sensor 1 7.90 psi
2.4 STATUS

2.5
Speed 2750 rpm
2.5 STATUS

2.6
Input power 21.7 kW
Motor current 0.00 A
2.6 STATUS

2.7
Operating hours 0 h
Power consumption 2605 kWh
2.7 STATUS

2.11
Firmware version 99.87
2.11 STATUS

2.12
Factory configuration file id 1
2.12 STATUS

3. INSTALLATION

3.1
Sensor 1
4-20 mA psi
0.00 - 120
3.1 INSTALLATION

3.2
Motor Speed High Limit [RPM]
3450 rpm
3.2 INSTALLATION

3.3
Dry Pump Function
Alarm
3.3 INSTALLATION

3.4
Power Correction Factor
100 %
3.4 INSTALLATION

3.5
Protocol
GENIbus
3.5 INSTALLATION

Fig. 22 Menu overview

Operating modes

These operating modes can be selected with CU331SP:

- Normal
- Stop
- Minimum
- Maximum

You can set the operating modes without changing the setpoint setting.

Normal

The pump operates in constant pressure mode.

Stop

The pump has been stopped by user.

Minimum curve

The pump is running at a set minimum speed value. See fig. 23.

For instance, this operating mode can be used during periods with a very small flow requirement.

Maximum curve

The pump is running at a set maximum speed value.

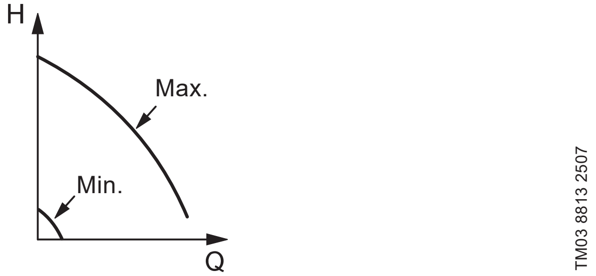


Fig. 23 Minimum and maximum curves

Control mode

CU331SP has been developed specifically to operate submersible pumps in constant pressure mode. This closed-loop control mode uses an analog pressure transducer to provide pressure feedback to the drive.

Constant pressure with stop function

The outlet pressure is kept constant at high flow rate (Q > Qmin). On/off operation at low flow rate. See fig. 24.

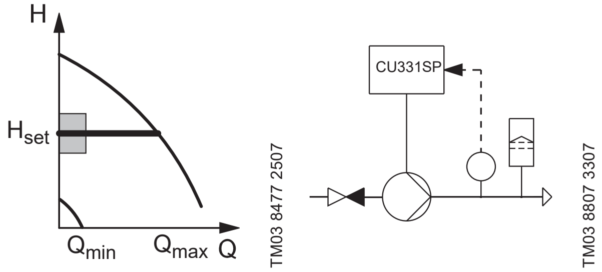


Fig. 24 Constant pressure with stop function

The pump is controlled according to a constant pressure measured after the pump. This means that the pump offers a constant pressure in the Q-range of Q_{min} to Q_{max}, represented by the horizontal line in the QH diagram.

Setting the setpoint by means of the "OPERATION" menu

The setpoint can be set or changed during operation using the setpoint display in the "OPERATION" menu shown below. It is not necessary to run the startup guide to change the setpoint.

Low flow and stop functions

The pump will check the flow regularly by reducing the speed for a short time. If there is no or only a small change in pressure, this means that there is low flow.

The speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached and the pump will stop after a few moments. The pump will restart at the latest when the pressure has fallen to the start pressure (actual setpoint - 0.5 x ΔH).

Operating conditions for the stop function

It is only possible to use the stop function if the system incorporates a pressure sensor, a check valve and a diaphragm tank.

The check valve must always be installed before the pressure sensor.

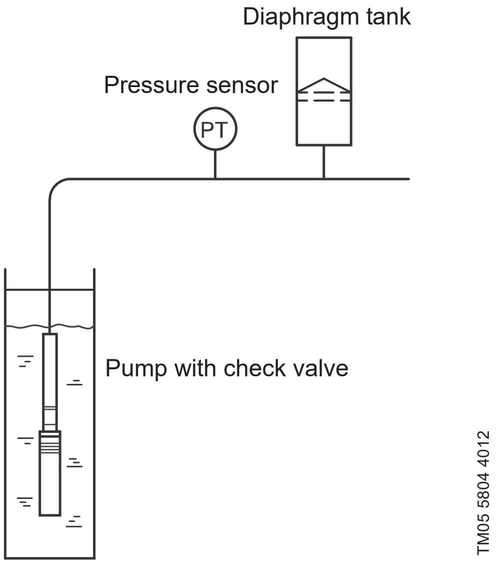


Fig. 25 Position of the pressure sensor and diaphragm tank

Diaphragm tank

The stop function requires a diaphragm tank of a certain minimum size. The tank must be installed as close as possible after the pump and the precharge pressure must be 0.7 x actual setpoint.

Recommended diaphragm tank size:

Rated flow rate of pump [gpm (m^3/h)]	Minimum diaphragm tank size [gal (l)]
0-26 (0-6)	2 (8)
27-105 (7-24)	4.4 (18)
106-176 (25-40)	14 (50)
177-308 (41-70)	34 (120)
309-440 (71-100)	62 (180)

If a diaphragm tank of the above size is installed in the system, the factory setting of ΔH is the correct setting.

If the tank installed is too small, the pump will start and stop too often.

Setting the direction of rotation

The startup guide is started the first time CU331SP is connected to supply voltage. Then while going through the startup guide, CU331SP tests and sets the correct direction of rotation without changing the cable connections to the motor.

The correct direction of rotation can be set in these ways:

- automatic setting.
- manual setting when the direction of rotation is not visible.

Automatic setting

CU331SP automatically tests and sets the correct direction of rotation without changing the cable connections.

Automatic setting requires a sensor.

This test is not suitable for all pump types and will in certain cases not be able to determine for certainty the correct direction of rotation. In these cases, CU331SP changes over to manual setting where the direction of rotation is determined on the basis of the installer's observations.

Manual setting when the direction of rotation is not visible

The correct direction of rotation is set manually without changing the cable connections. This requires that it is possible to observe the head or flow rate.

Status functions

CU331SP shows the following data:

- power consumption
- operating hours
- measured value
- speed
- input power
- motor current.

The status information can be shown in the display.

Power consumption

The value of the power consumption is an accumulated value calculated from the pump's startup date and cannot be reset. No additional sensor is required.

Operating hours

The value of operating hours is an accumulated value calculated from the pump's startup date and cannot be reset. No additional sensor is required.

Measured value

The sensor display will show the actual pressure as received from the pressure transducer.

Speed

The display will show the motor speed in RPM's (calculated).

Input power

The display will show the power consumption in kW.

Motor current

The display will show the actual motor current being used.

Logging functions

Alarm and warning log

The latest five alarms and five warnings are logged with a timestamp corresponding to the power-on time after the fault has occurred. The alarm and warning log can be shown directly on the display.

See section *Warning and alarm list*.

Signal relays

The table shows the function of the signal relays.

Type	Function
Relay 1	• *Pump running*
Relay 2	• *Alarm*

See also fig. 26.

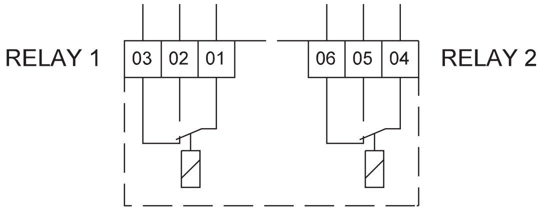


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Fig. 26 Terminals for signal relays (normal state, not activated)

Terminal		Function
C1	C2	Common
NO 1	NO 2	Normally open contact
NC1	NC2	Normally closed contact

CU331SP installation

Mechanical installation

The individual CU331SP cabinet sizes are characterized by their enclosures. The table in section *CU331SP technical data* shows the relationship of enclosure class and enclosure type.

Reception and storage

Check on receipt that the packaging is intact, and the unit is complete. In case of damage during transport, contact the transport company to file a claim.

Note that CU331SP is delivered in a packaging which is not suitable for outdoor storage.

Transportation and unpacking

CU331SP must only be unpacked at the installation site to prevent damage during the transport to the site.

The packaging contains accessory bag(s), documentation and the unit itself. See fig. 27.

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Fig. 27 CU331SP packaging

Space requirements and air circulation

CU331SP units can be mounted side by side, but as a sufficient air circulation is required for cooling these requirements must be met:

- Sufficient free space above and below CU331SP
- Ambient temperature up to 122°F (50 °C)
- Hang CU331SP directly on the wall, or fit it with a back plate. See fig. 28.

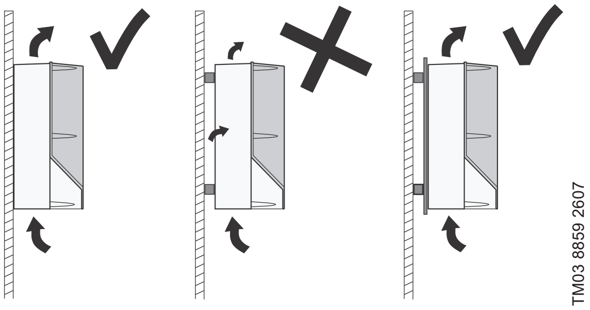

Fig. 28 CU331SP hung directly on the wall or fitted with a back plate

Required free space above and below CU331SP:

Enclosure	Space [in (mm)]
B1	7.9 (200)

For information about enclosure, see section *Enclosure*.

Mounting

CU331SP must be mounted securely on a firm surface. Ensure that screws are sized appropriately for the weight of CU331SP (approximately 60 lbs) and anchored securely to the mounting surface.

1. Mark and drill holes. See fig. 29; also see section *Main dimensions and weight*.
2. Fit the screws, but leave loose. Mount CU331SP, and tighten the four screws.

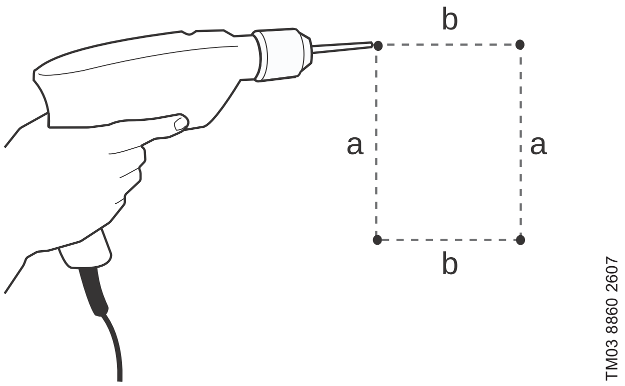

Fig. 29 Drilling holes for mounting

CU331SP electrical connection

Ensure the correct grounding and protection procedures are used for the installation. Before the electrical installation, ensure that the power supply and other voltage inputs are switched off.

Electrical protection

Protection against electric shock, indirect contact

The leakage current to ground exceeds 3.5 mA, and a reinforced ground connection is required.

Protective conductors must always have a yellow and green (PE) or yellow and green and blue (PEN) color marking.

Instructions according to EN IEC 61800-5-1:

- CU331SP must be stationary, installed permanently and connected permanently to the mains supply.
- The ground connection must be carried out with duplicate protective conductors or with a single reinforced protective conductor with a cross-section of minimum AWG 7 (10 mm^2).

Protection against short-circuit, fuses

CU331SP and the supply system must be protected against short-circuit.

Grundfos requires that the backup fuses are used for protection against short-circuit.

CU331SP offers complete short-circuit protection in case of a short-circuit on the motor output.

Additional protection

The leakage current to ground exceeds 3.5 mA.

We recommend to connect CU331SP to an electrical installation where a Ground Fault Circuit Interrupter (GFCI) type B is used as additional protection. The total leakage current of all the electrical equipment in the installation must be taken into account.

During startup and in asymmetrical supply systems, the leakage current can be higher than normal and may cause the GFCI to trip.

Motor protection

The motor requires no external motor protection. CU331SP protects the motor against thermal overloading and blocking.

Protection against overcurrent

CU331SP has an internal overcurrent protection for overload protection on the motor output.

Protection against mains voltage transients

CU331SP is protected against mains voltage transients.

Mains and motor connection

The supply voltage and frequency are marked on the CU331SP nameplate. Make sure that CU331SP is suitable for the power supply of the installation site.

The maximum output voltage of CU331SP is equal to the input.

Example: if the supply voltage is rated at 208V choose a 208V motor for operation.

Main switch

A main switch can be installed before CU331SP according to local regulations. See fig. 30.

Wiring diagram

The wires in the terminal box must be as short as possible. Excepted from this is the ground wire, which must be so long that it is the last one to be disconnected in case the cable is inadvertently pulled out of the cable entry.

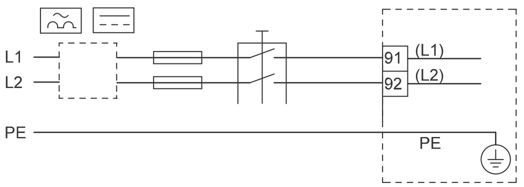

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Fig. 30 CU331SP wiring diagram

Terminal		Function
91	(L1)	Single-phase supply
92	(L2)	
95/99	(PE)	Ground connection

For single-phase connection, use L1 and L2.

Mains connection

Check that mains voltage and frequency correspond to the values on the nameplate of CU331SP and the motor.

1. Connect the ground wire to terminal 95 (PE). See fig. 31.
2. Connect the power leads to the terminals 91 (L1), 92 (L2).
3. Fix the mains cable with a cable clamp.

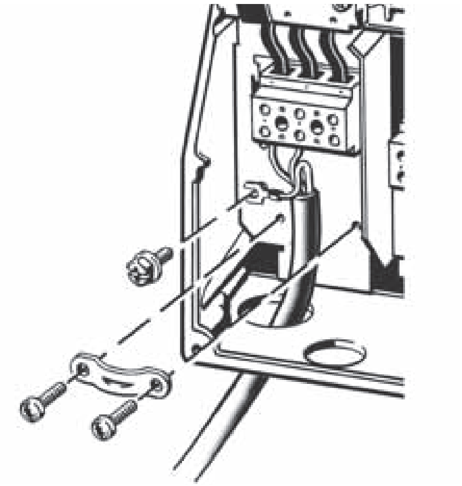

Fig. 31 Mains connection

CU331SP drive is usable with three-phase input power by connecting leads to 91 (L1), 92 (L2), and 93 (L3).

Motor connection

The motor cable must be screened for CU331SP to meet EMC requirements.

1. Connect the ground wire to terminal 99 (PE). See fig. 32.
2. Connect the motor leads to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.

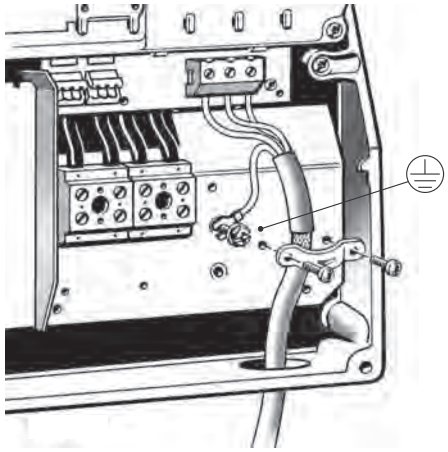

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Fig. 32 Motor connection

The cable screen must be exposed and in physical contact with the mounting plate and clamp

9.1 Connecting the signal terminals

As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.

If no external on/off switch is connected, short-circuit terminals 18 and 20 using a short wire.

Connect the signal cables according to the guidelines for good practice to ensure EMC-correct installation. See section *EMC-correct installation*.

- Use screened signal cables with a conductor cross-section of minimum AWG 20 (0.5 mm^2) and maximum AWG 16 (1.5 mm^2).
- Use a 3-conductor screened bus cable in new systems.

Minimum connection, signal terminal

Operation is only possible when the terminals 18 and 20 are connected, for instance by means of an external on/off switch or a short wire.

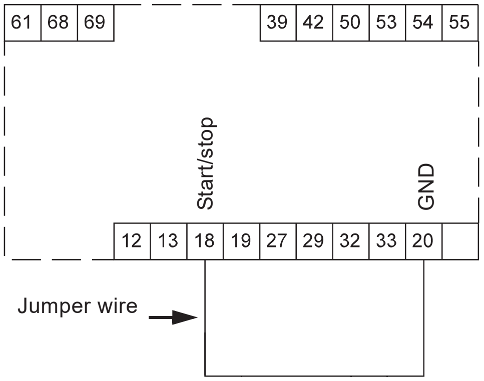

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Fig. 33 Required minimum connection, signal terminal

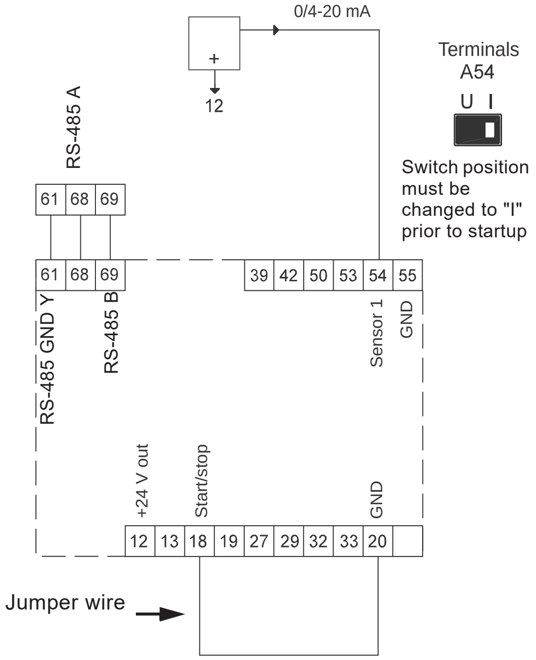

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Fig. 34 Wiring diagram for CU331SP

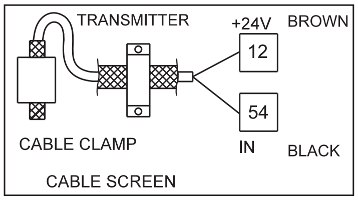

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Fig. 35 Sensor wiring diagram

Setting the analog input 54

The contact A54 is positioned behind the control panel and is used for setting the signal type of the analog input.

The factory setting of the inputs is voltage signal "U". This setting must be changed to "I" prior to starting CU331SP. Be sure the power supply is switched off.

Remove the control panel to set the contact. See fig. 36.

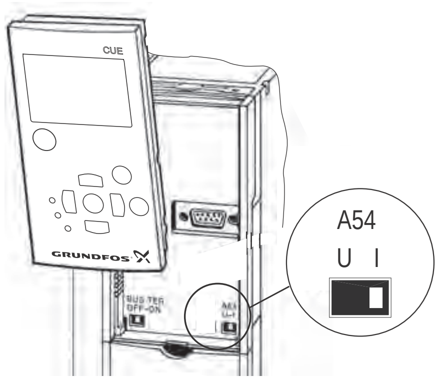

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Fig. 36 Setting contact A54 to current signal "I"

Terminal key

Terminal	Type	Function
12	+24 V out	Supply to sensor
18	DI 1	Digital input, start/stop
20	GND	Common frame for digital inputs
55	GND	Common frame for analog inputs
54	AI 2	Sensor input, sensor 1, 0/4-20 mA
61	RS-485 GND Y	GENIbus, frame
68	RS-485 A	GENIbus, signal A (+)
69	RS-485 B	GENIbus, signal B (-)

The RS-485 screen must be connected to frame.

Access to signal terminals

All signal terminals are behind the terminal cover of CU331SP front. Remove the terminal cover as shown in fig. 37.

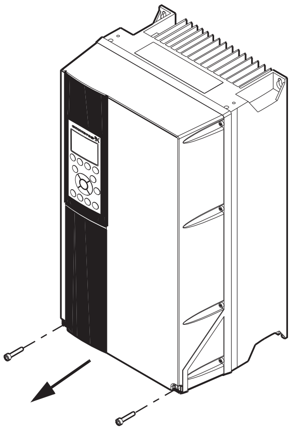

Fig. 37 Access to signal terminals

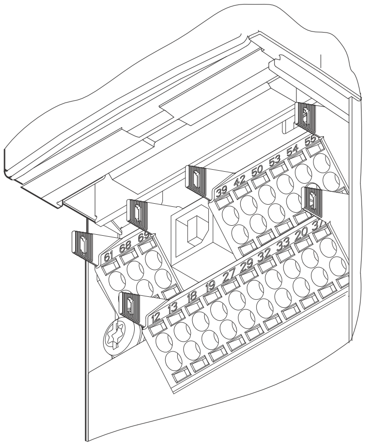

Fig. 38 Signal terminals

Fitting the conductor

1. Remove the insulation at a length of 0.35 to 0.40 inches (9 to 10 mm).
2. Insert a screwdriver with a tip of maximum 0.015 X 0.1 in (0.4 X 2.5 mm) into the square hole.
3. Insert the conductor into the corresponding round hole. Remove the screwdriver. The conductor is now fixed in the terminal.

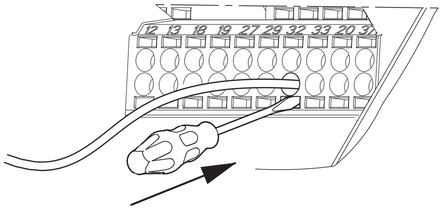

Fig. 39 Fitting the conductor into the signal terminal

Connecting the signal relays

As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.

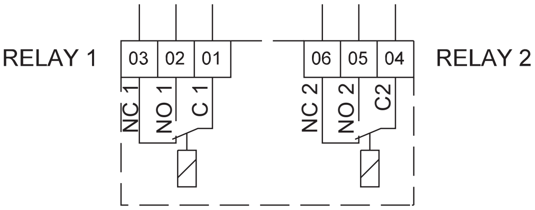

Fig. 40 Terminals for signal relays (normal state, not activated)

Terminal		Function
C 1	C 2	Common
NO 1	NO 2	Normally open contact
NC 1	NC 2	Normally closed contact

Signal relay

The signal relays on CU331SP are predefined as follows:

Relay 1: Pump running

Relay 2: Alarm

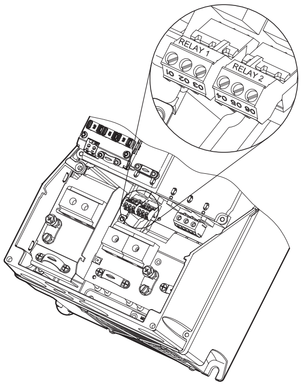

Fig. 41 Terminals for relay connection

EMC-correct installation

This section gives guidelines for good practice when installing CU331SP. Follow these guidelines to meet EN 61800-3, first environment.

- Use only motor and signal cables with a braided metal screen in applications without output filter.
- There are no special requirements to supply cables, apart from local requirements.
- Leave the screen as close to the connecting terminals as possible. See fig. 42.
- Avoid terminating the screen by twisting the ends. See fig. 43. Use cable clamps or EMC screwed cable entries instead.
- Connect the screen to frame at both ends for both motor and signal cables. If the controller has no cable clamps, connect only the screen to CU331SP.
- Avoid unscreened motor and signal cables in electrical cabinets with variable frequency drives.
- Make the motor cable as short as possible in applications without output filter to limit the noise level and minimize leakage currents.
- Screws for frame connections must always be tightened whether a cable is connected or not.
- Keep main cables, motor cables and signal cables separated in the installation, if possible.

Other installation methods may give similar EMC results if the above guidelines for good practice are followed.

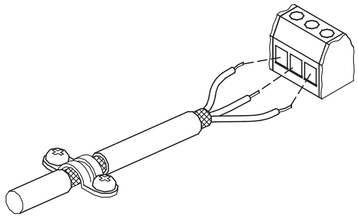

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Fig. 42 Example of stripped cable with screen

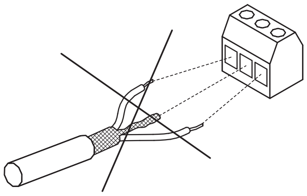

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Fig. 43 Do not twist the screen ends

Line disturbance and transient protection

To protect itself from AC line voltage disturbances, CU331SP monitors the input power supply and interrupts drive operation in the event of phase loss or imbalance. Transients on the AC line are suppressed by MOVs as well as zener diodes for extreme transients. CU331SP meets VDE 0160 (European standard - 2.3 x line voltage for 1.3 msec) for transient protection.

RFI filters

To meet the EMC requirements, CU331SP comes with the following types of built-in radio frequency interference filter (RFI).

Voltage	Typical shaft power P2	RFI filter type
1 x 200-240 V *	1.5 - 10 hp	C1

* Single-phase input - three-phase output.

Description of RFI filter types

C1:	For use in domestic areas.

RFI filter types are according to EN61800-3.

Control panel

The on/off button on the control panel does not disconnect CU331SP from the power supply and must therefore not be used as a safety switch.

On/Off The On/Off button has the highest priority. In "Off" condition, pump operation is not possible.

The control panel is used for local setting of CU331SP. The functions available are preset in CU331SP.

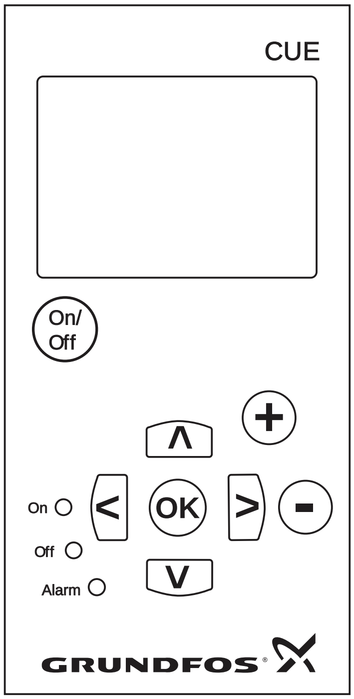

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Fig. 44 Control panel of CU331SP

Editing buttons

Button	Function
On/Off	With this button you can start and stop the pump and ake it ready for operation.
OK	With this button you can save changed values, resets alarms and expands the value field.
+ -	These buttons change values in the value field.

Navigating buttons

Button	Function
< >	With these buttons you can navigate from one menu to another. When the menu is changed, the display shown will always be the top display of the new menu.
Λ V	With these buttons you can navigate up and down in the individual menu.

Adjusting the display contrast

Press OK and + for darker display.

Press OK and - for brighter display.

Button lock

To lock the buttons on the panel press and hold the up and down arrows simultaneously.

Indicator lights

The operating condition of the pump is indicated by the indicator lights on the front of the control panel. See fig. 44.

The table shows the function of the indicator lights.

Indicator light	Function
On (green)	The pump is running or has been stopped by a stop function.
	If flashing, the pump has been stopped by the user (CU331SP menu), external start/stop or bus.
Off (orange)	The pump has been stopped with the on/off button.
Alarm (red)	Indicates an alarm or a warning.

Displays, general terms

Figures 45 and 46 show the general terms of the display.

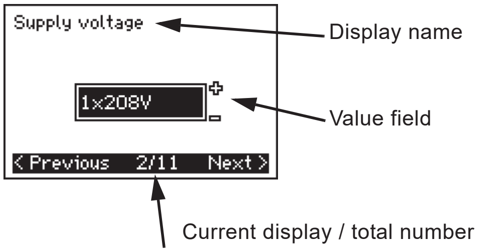

Fig. 45 Example of display in the startup guide

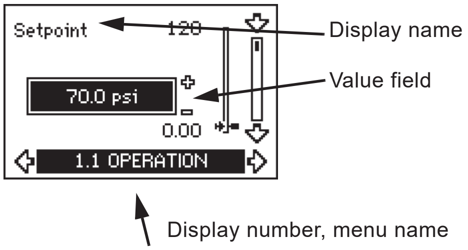

Fig. 46 Example of display in the user menu

Warning and alarm list

Code and display text		Status			Operating mode	Resetting
		Warning	Alarm	Locked alarm		
1	Too high leakage current			●	Stop	Man.
2	Mains phase failure		●		Stop	Aut.
3	External fault		●		Stop	Man.
16	Other fault		●		Stop	Aut.
				●	Stop	Man.
32	Overvoltage	●			-	Aut.
			●		Stop	Aut.
40	Undervoltage	●			-	Aut.
			●		Stop	Aut.
48	Overload		●		Stop	Aut.
				●	Stop	Man.
49	Overload		●		Stop	Aut.
55	Overload	●			-	Aut.
			●		Stop	Aut.
57	Dry running		●		Stop	Aut.
64	Too high CU331SP temperature		●		Stop	Aut.
89	Sensor 1 outside range		●		[1]	Aut.
96	Setpoint signal outside range		●		[1]	Aut.
155	Inrush fault		●		Stop	Aut.
241	Motor phase failure	●			-	Aut.
			●		Stop	Aut.

[1] In case of an alarm, CU331SP will change the operating mode depending on the pump type. Warning is reset in display 3.20.

CU331SP technical data

Enclosure

All CU331SP enclosures are size B1.

The enclosure rating can be either IP 55 / TYPE 12 or IP 66 / TYPE 4X.

Main dimensions and weight

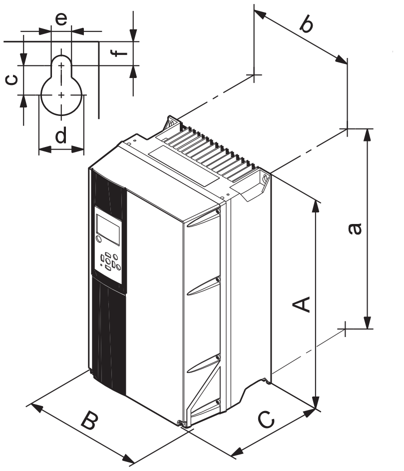

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Fig. 47 Enclosure B1

Note: The dimensions shown for CU331SP enclosures are maximum height, width and depth.

Enclosure	Height [in]		Width [in]		Depth [in]
	A	**a**	**B**	**b**	**C**
B1	18.9	17.9	9.5	8.3	10.2
	Screw holes [in]				**Weight [lbs]**
	c	**d**	**e**	**f**	
	0.47	0.75	0.35	0.35	50.7

Surroundings

Relative humidity	5-95 % RH
Ambient temperature	Max. 122 °F (50 °C)
Average ambient temperature over 24 hours	Max. 113 °F (45 °C)
Minimum ambient temperature at full operation	32 °F (0 °C)
Minimum ambient temperature at reduced operation	14 °F (-10 °C)
Temperature during storage and transportation	-13 to 150 °F (-25 to 65 °C)
Storage duration	Max. 6 months
Maximum altitude above sea level without performance reduction	3280 ft (1000 m)
Maximum altitude above sea level with performance reduction	9840 ft (3000 m)

CU331SP comes in a packaging which is not suitable for outdoor storage.

Terminal tightening torques

Enclosure	Tightening torque [ft-lb]			
	Mains	Motor	Earth	Relay
B1	1.3	1.3	2.2	0.4

Cable length

Maximum length, screened motor cable	500 ft (152 m)
Maximum length, unscreened motor cable	1000 ft (305 m)
Maximum length, signal cable	1000 ft (305 m)

Fuses and cable cross-section

Always comply with national and local regulations as to cable cross-sections.

Cable cross-section to signal terminals

Maximum cable cross-section to signal terminals, rigid conductor	AWG 14
Maximum cable cross-section to signal terminals, flexible conductor	AWG 18
Minimum cable cross-section to signal terminals	AWG 20

Non-UL fuses and conductor cross-section to mains and motor

Typical shaft power P2 [Hp]	Maximum fuse size [A]	Fuse type	Maximum conductor cross section[1]	
			[AWG]	[mm^2]
2	40	gG	7	10
3	40	gG	7	10
5	80	gG	7	10

[1] Screened motor cable, unscreened supply cable.

UL fuses and conductor cross-section to mains and motor

Typical shaft power P2 [Hp]	Maximum fuse size [A]	Bussmann RK1	Maximum conductor cross section[1] [AWG}
2	40	KTN-R40	7
3	40	KTN-R40	7
5	80	KTN-R80	7

[1] Screened motor cable, unscreened supply cable.

Inputs and outputs

Mains supply (L1, L2)

Supply voltage	200-240 V ± 10 %
Supply frequency	60 Hz
Maximum temporary imbalance between phases	3 % of rated value
Leakage current to earth	> 3.5 mA
Number of cut-ins	Max. 1 time/min.

Do not use the power supply for switching CU331SP on and off.

Motor output (U, V, W)

Output voltage	0-100 % [1]
Output frequency	0-60 Hz
Switching on output	Not recommended

[1] Output voltage in % of supply voltage.

RS-485 GENIbus connection

Terminal number	68 (A), 69 (B), 61 GND (Y)

The RS-485 circuit is functionally separated from other central circuits and galvanically separated from the supply voltage (PELV).

Digital inputs

Terminal number	18
Voltage level	0-24 VDC
Voltage level, open contact	> 19 VDC
Voltage level, closed contact	< 14 VDC
Maximum voltage on input	28 VDC
Input resistance, R_i	Approx. 4 kΩ

All digital inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

Signal relays

Relay 01, terminal number	1 (C), 2 (NO), 3 (NC)
Relay 02, terminal number	4 (C), 5 (NO), 6 (NC)
Maximum terminal load (AC-1) [1]	240 VAC, 2 A
Maximum terminal load (AC-15) [1]	240 VAC, 0.2 A
Maximum terminal load (DC-1) [1]	50 VDC, 1 A
Minimum terminal load	24 V DC 10 mA 24 V AC 20 mA

[1] IEC 60947, parts 4 and 5.

C	Common
NO	Normally open
NC	Normally closed

The relay contacts are galvanically separated from other circuits by reinforced insulation (PELV).

Analog input

Terminal number	54
Current signal	A54 = "I" [1]
Current range	0-20, 4-20 mA
Input resistance, R_i	Approx. 200 Ω
Maximum current	30 mA
Maximum fault, terminals 53, 54	0.5 % of full scale

[1] The factory setting is voltage signal "U".

All analog inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

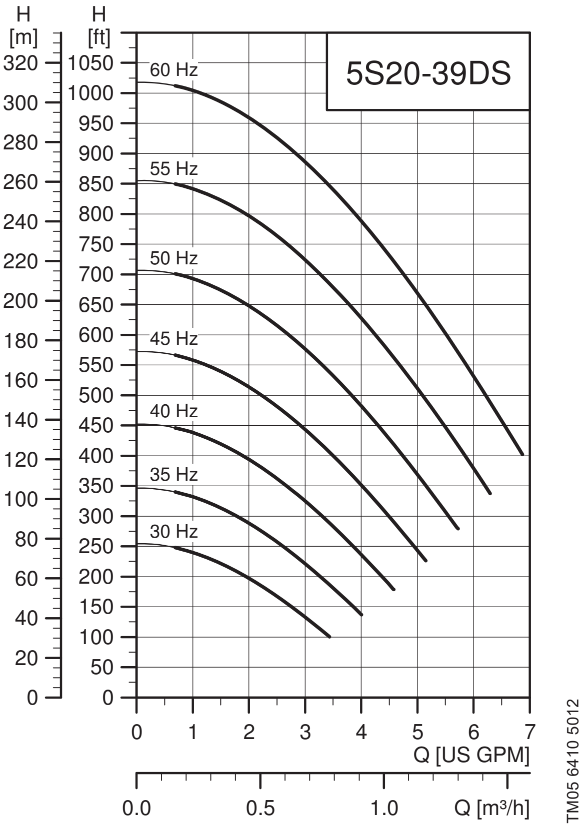
Sound pressure level

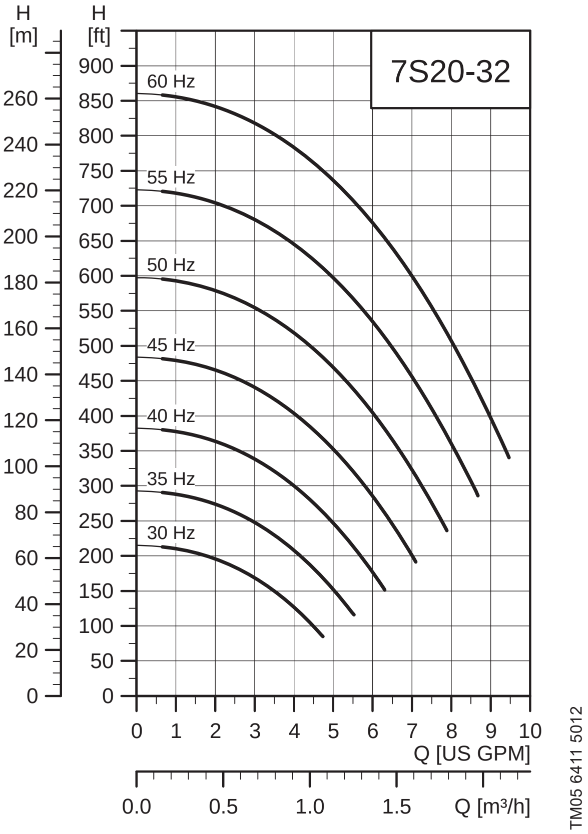
The sound pressure of CU331SP is maximum 70 dB(A).

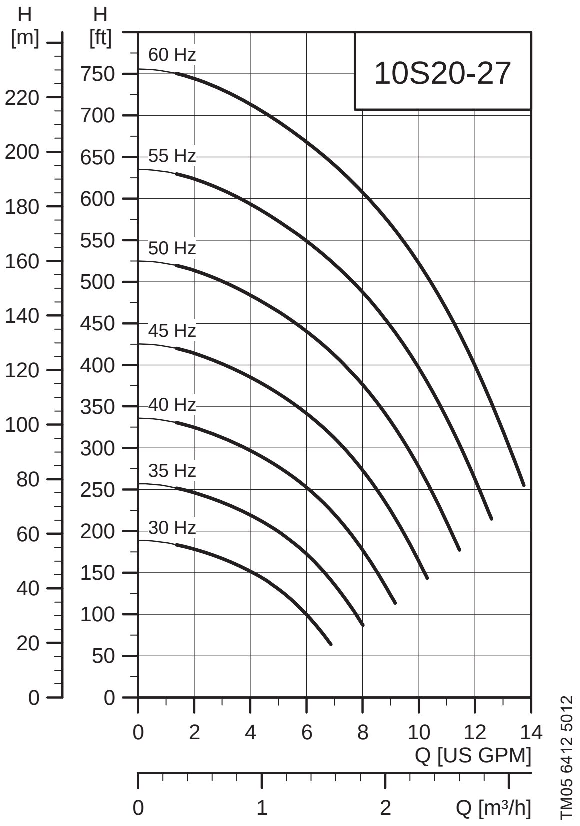
The sound pressure level of a motor controlled by a variable frequency drive may be higher than that of a corresponding motor which is not controlled by a variable frequency drive.

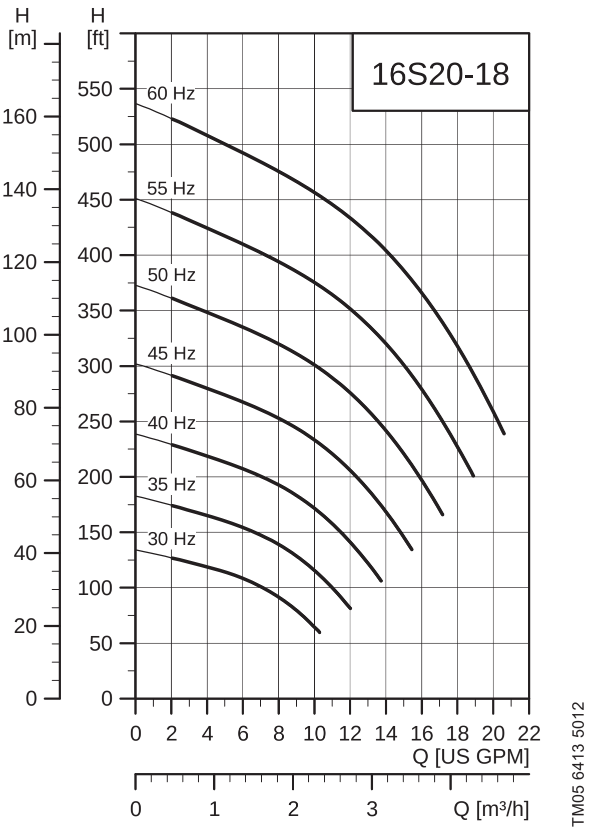
CU331SP curve charts

CU331SP, 2 Hp

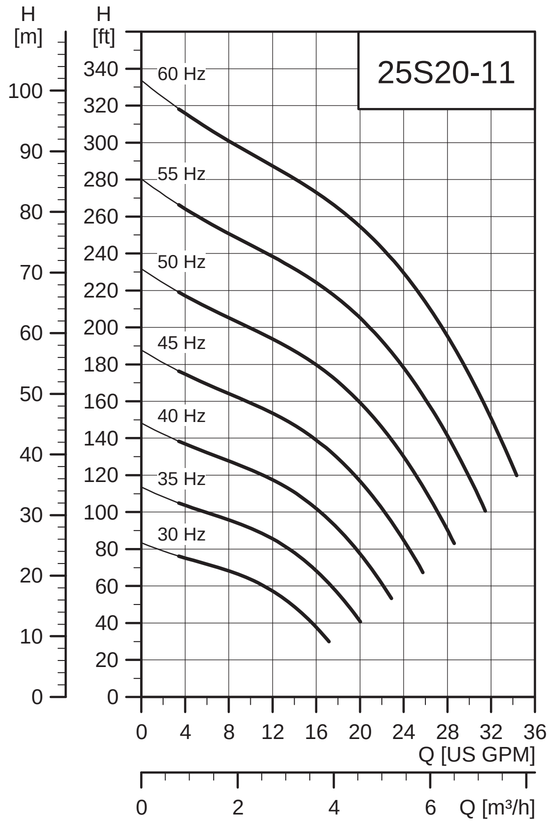




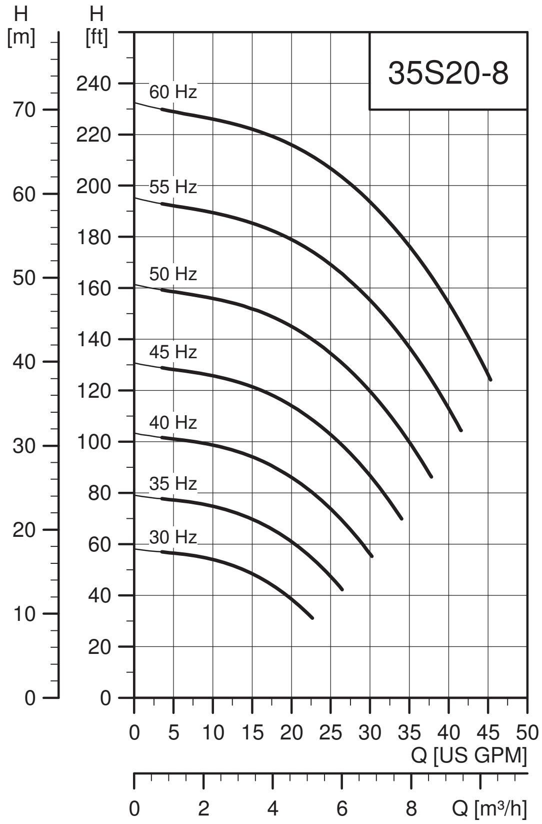




CU331SP, 2 Hp, continued



TM05 6414 5012



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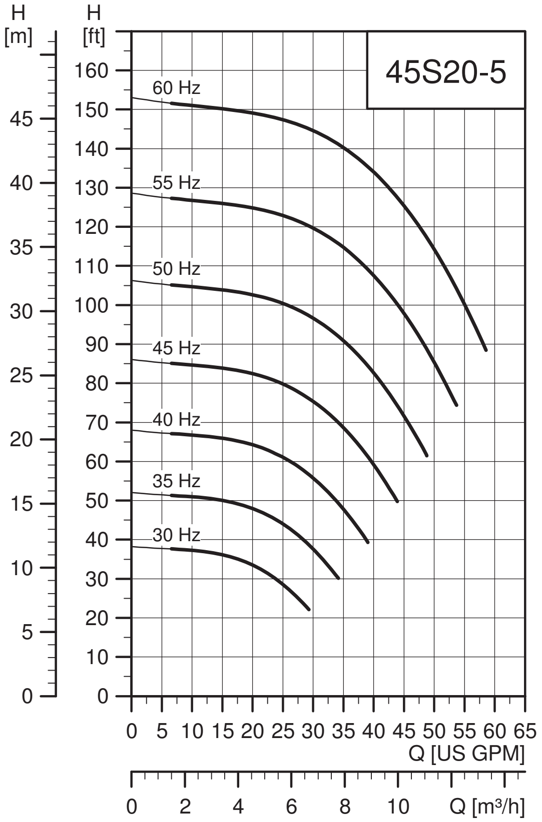

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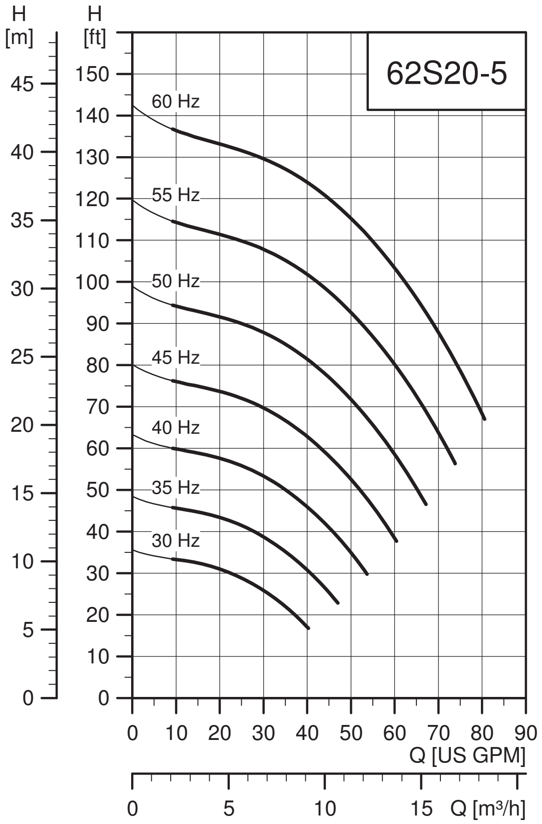

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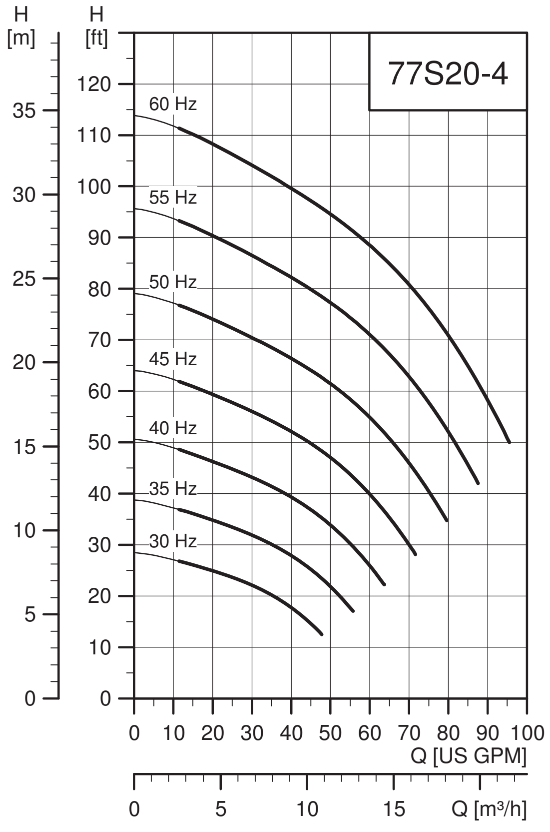

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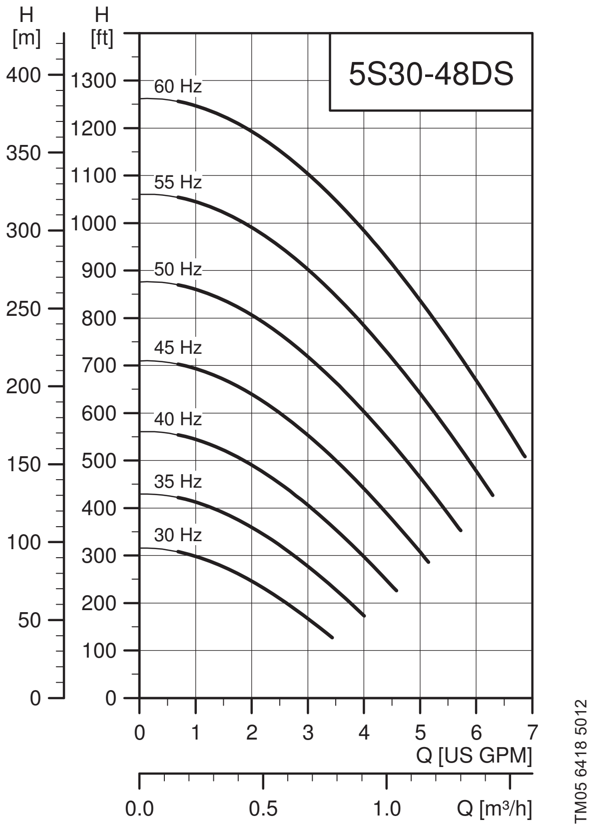
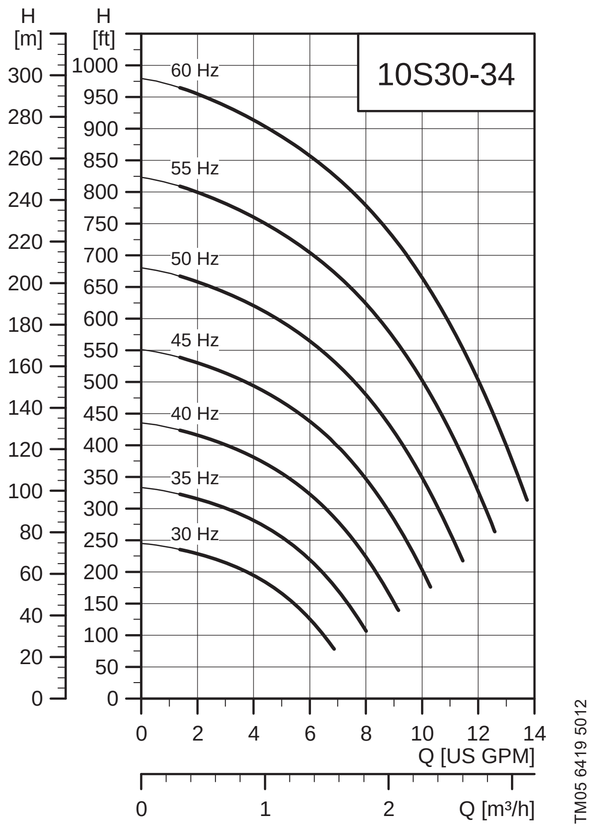
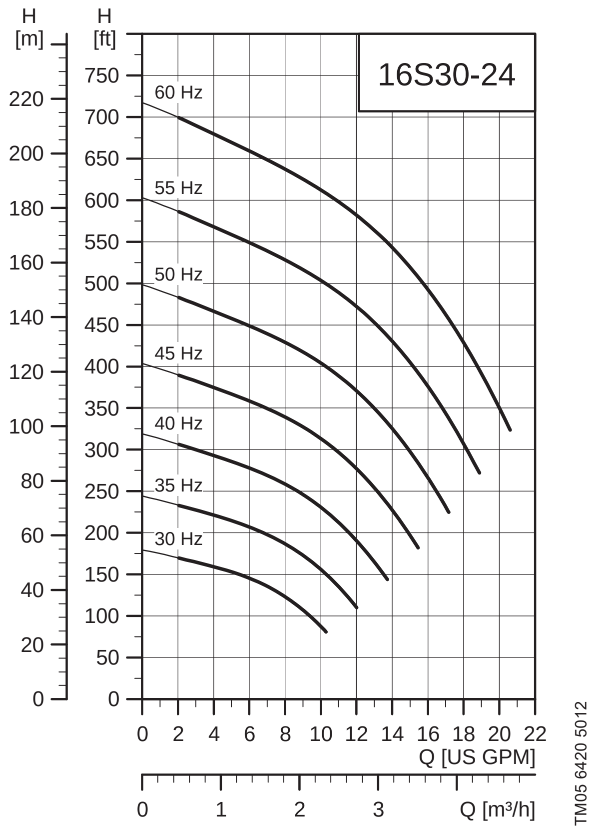
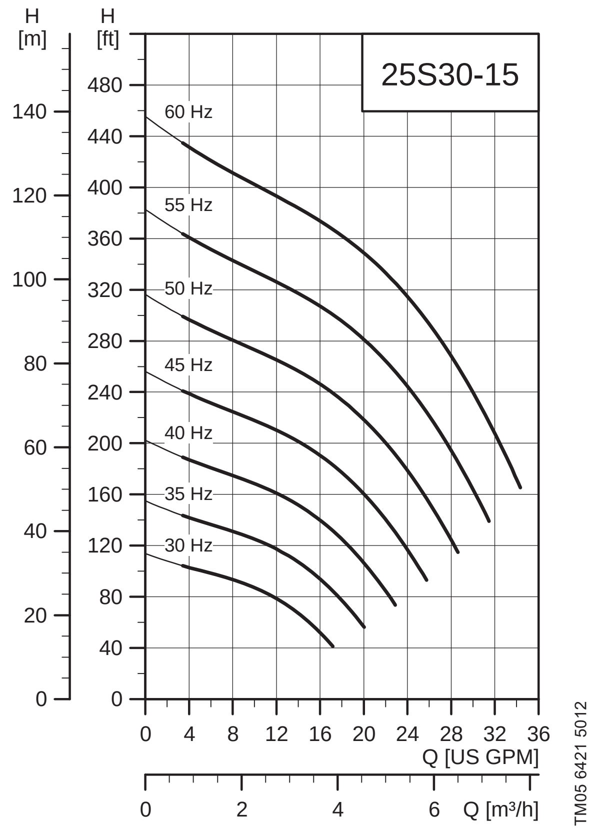
CU331SP, 3 Hp

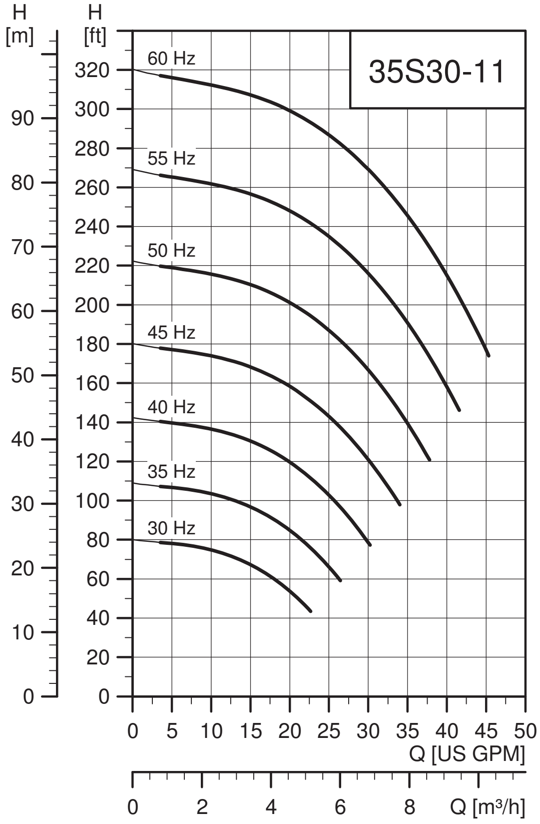

5S30-48DS
H [m]
H [ft]
0
50
100
150
200
250
300
350
400
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
0 1 2 3 4 5 6 7
Q [US GPM]
0.0 0.5 1.0
Q [m³/h]
TM05 6418 5012


10S30-34
H [m]
H [ft]
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
0 2 4 6 8 10 12 14
Q [US GPM]
0 1 2
Q [m³/h]
TM05 6419 5012


16S30-24
H [m]
H [ft]
0
20
40
60
80
100
120
140
160
180
200
220
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
0 2 4 6 8 10 12 14 16 18 20 22
Q [US GPM]
0 1 2 3
Q [m³/h]
TM05 6420 5012


25S30-15
H [m]
H [ft]
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
320
360
400
440
480
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
0 4 8 12 16 20 24 28 32 36
Q [US GPM]
0 2 4 6
Q [m³/h]
TM05 6421 5012

CU331SP, 3 Hp, continued



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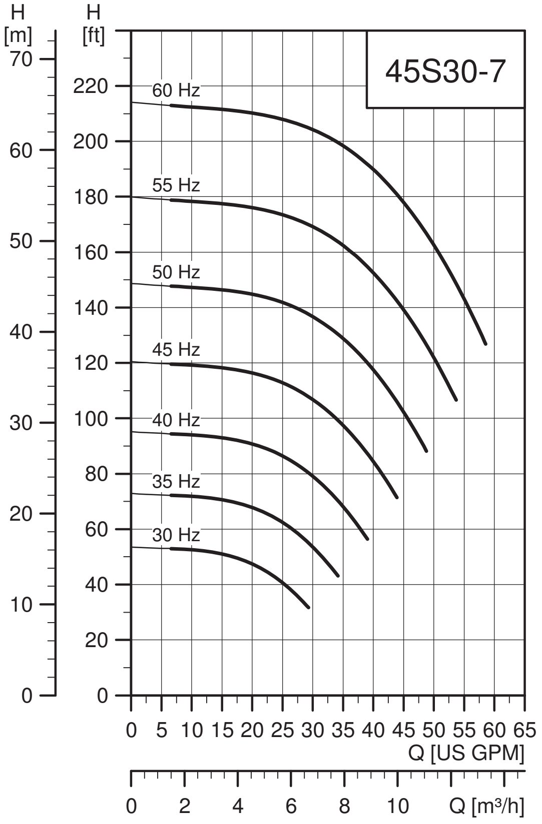

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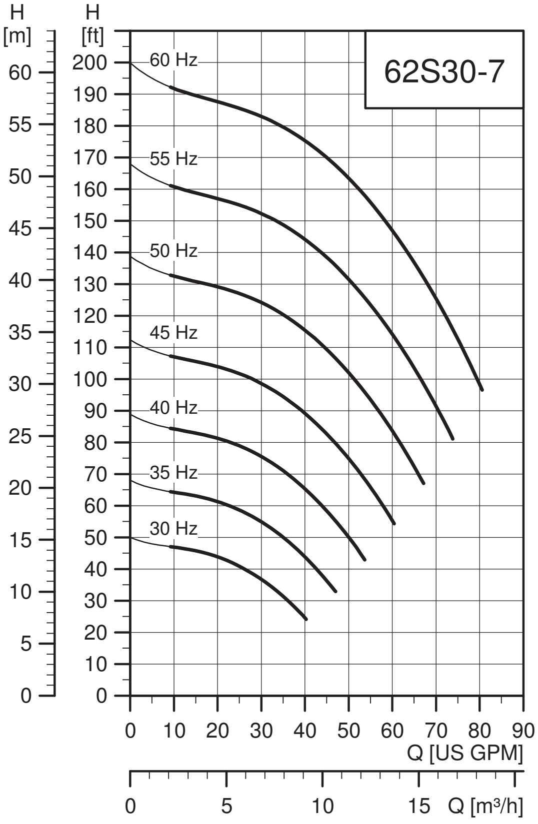

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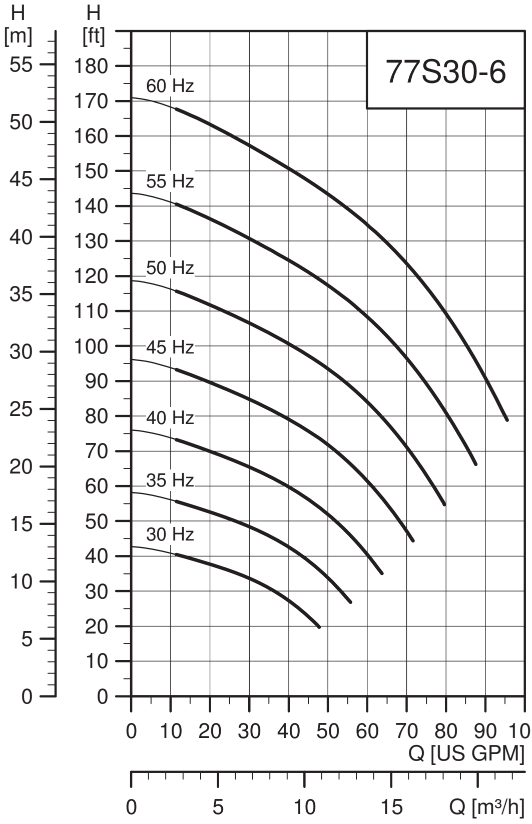

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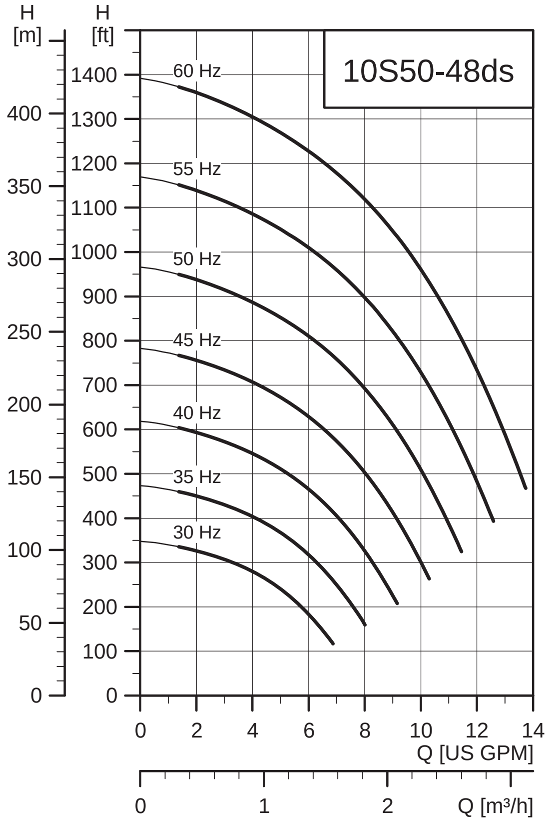
CU331SP, 5 Hp



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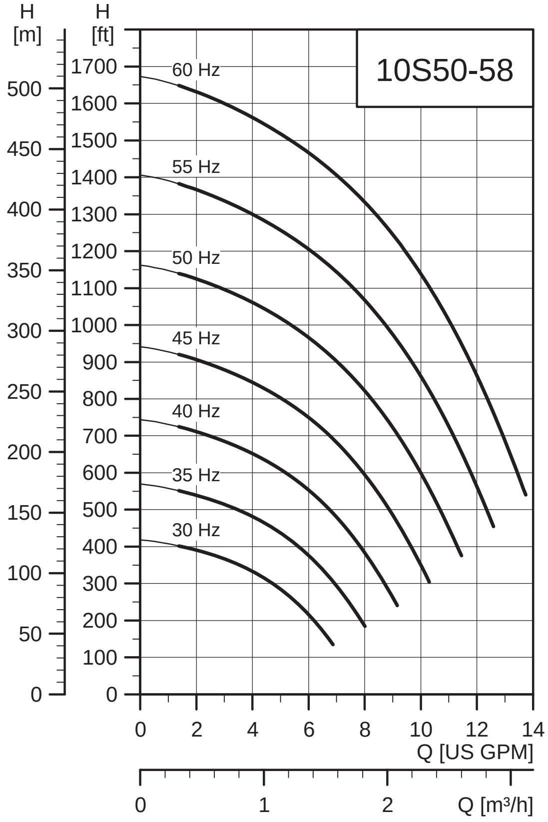

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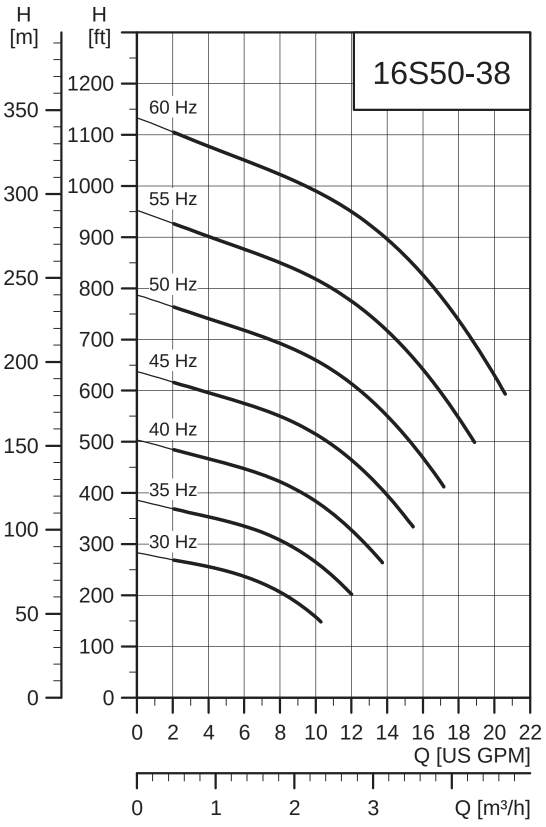

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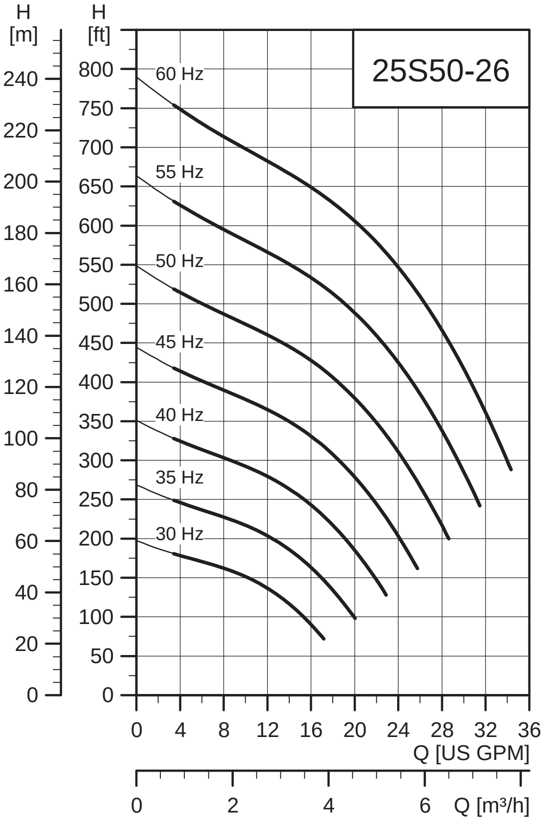
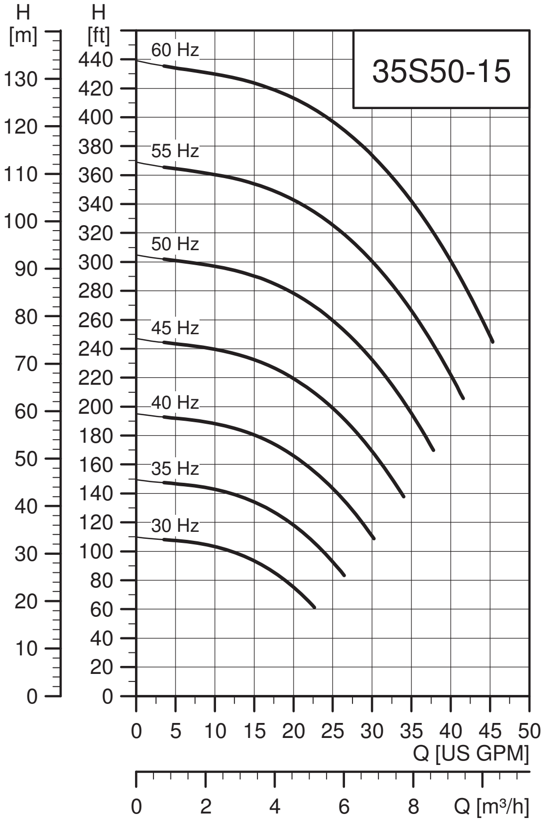


TM05 6428 5012

CU331SP, 5 Hp, continued



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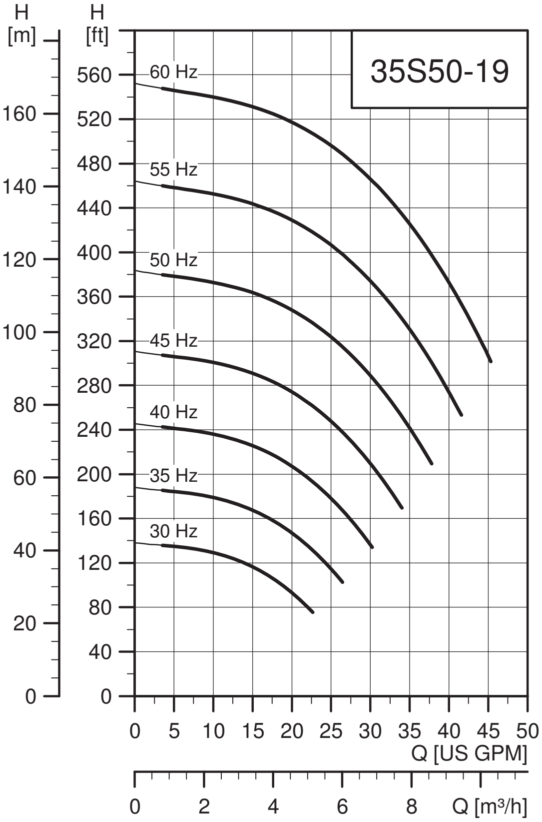

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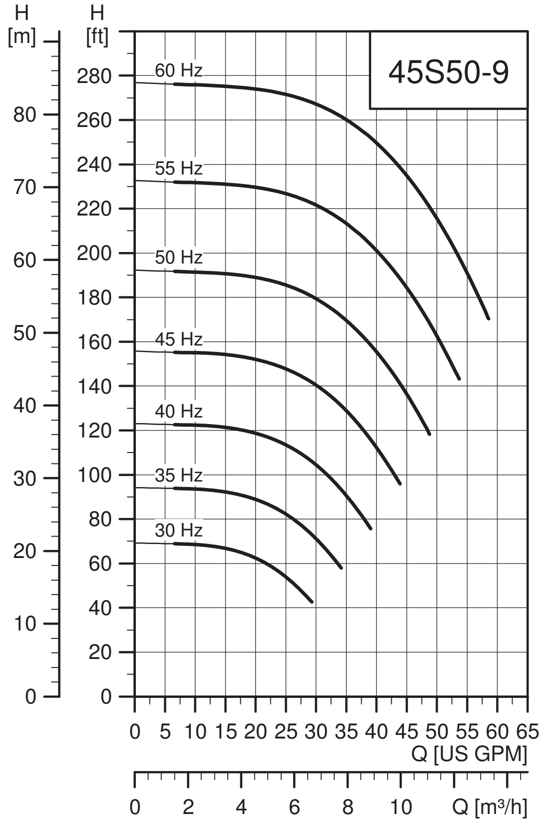

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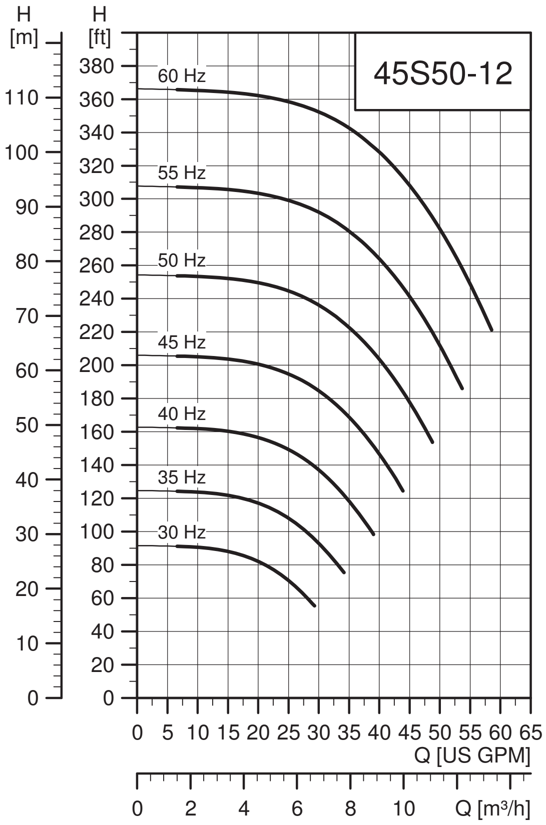

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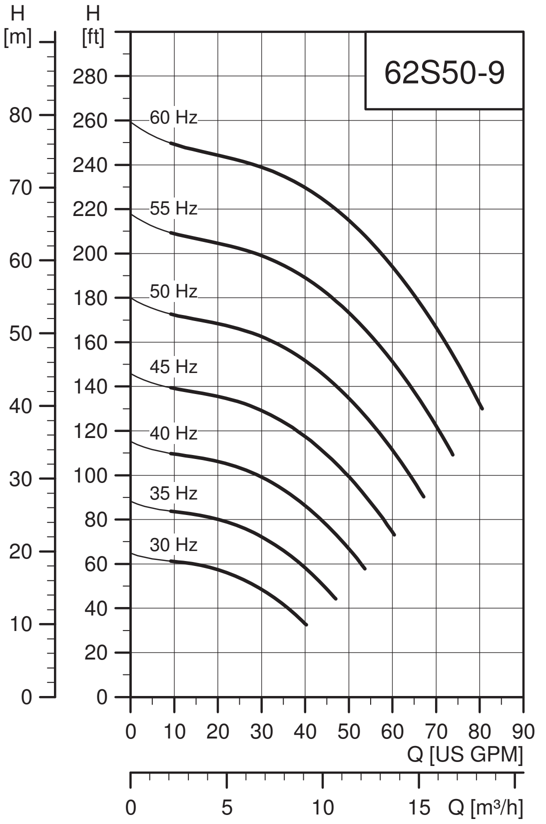
CU331SP, 5 Hp, continued



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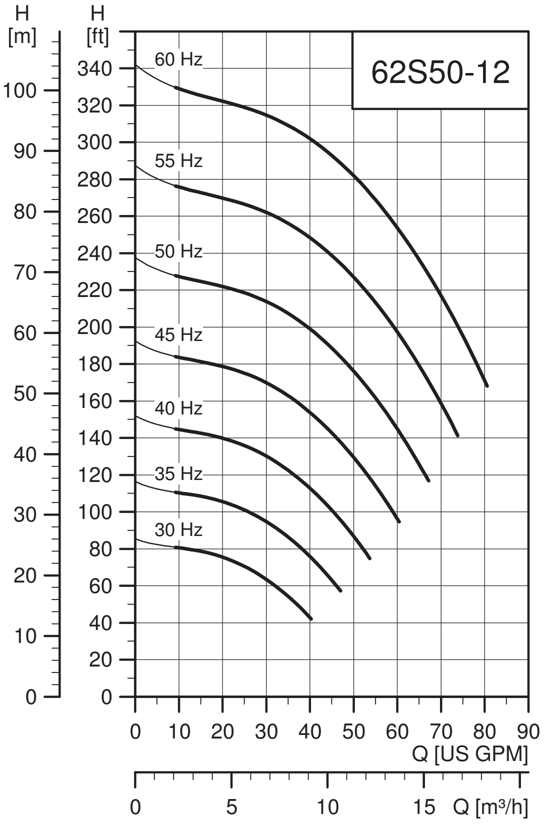

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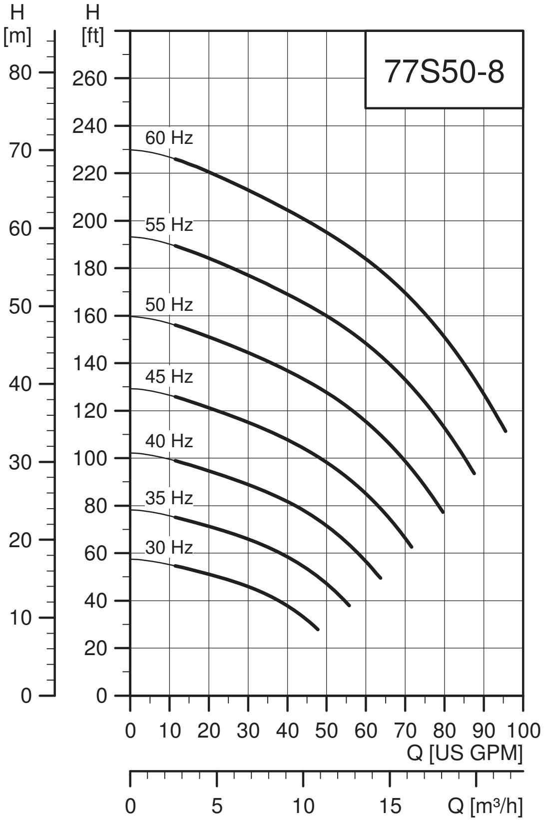
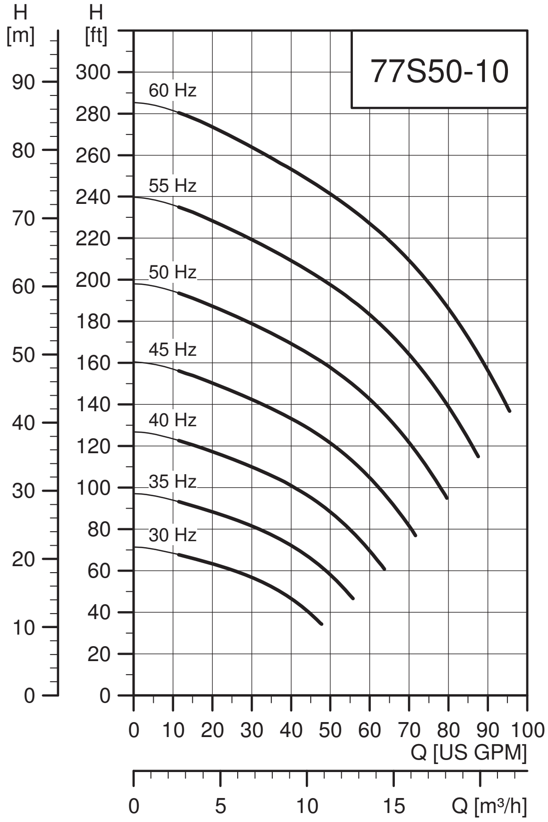


TM06 9757 3217



TM06 9758 3217

CUE variable frequency drive

Fig. 48 The CUE range

Grundfos CUE is a series of external variable frequency drive designed for speed control of a wide range of Grundfos pumps.

CUE offers quick and easy setup and commissioning compared to a standard variable frequency drive because of the startup guide. Simply key in application-specific variables such as motor data, pump family, control function (for example constant pressure), sensor type and setpoint, and CUE will automatically set all necessary parameters.

CUE enables gentle pumping and thereby protects the water reservoir and the rest of the distribution system, as water hammer can be avoided by adjusting ramp times up and down.

When a CUE is installed, the motor requires no further overload protection. Pt100/1000 together with the MCB 114 provides overheat protection of the motor windings, if needed.

Note: If the motor has a built-in Tempcon sensor, this sensor will be disconnected when it is exposed to the variable frequency drive. An internal fuse in the motor blows and it cannot be replaced. The motor will work without the sensor, but it is not possible to restore the functionality of the Tempcon sensor.

CUE is available in two enclosure classes:

- Nema 1 (IP20/21)
- Nema 12 (IP54/55).

RFI filters

To meet the EMC requirements, CUE comes with the following types of built-in radio frequency interference filter (RFI).

Functions

CUE has a wide range of pump-specific functions, such as:

- constant pressure
- constant level
- constant flow rate
- constant temperature
- constant curve.

Features

- Startup guide
  CUE incorporates an innovative startup guide for the general setting of CUE including the setting of the correct direction of rotation.
  The startup guide is started the first time CUE is connected to the power supply.
- Check of direction of rotation.
- Duty/standby operation.
- Dry-running protection.
- Low-flow stop function.

Accessories

Grundfos offers various accessories for CUE.

MCB 114 sensor input module

MCB 114 offers additional analog inputs for CUE:

- 1 analog input, 0/4-20 mA
- 2 inputs for Pt100/Pt1000 temperature sensors.

Output filters

Output filters are used primarily to protect the motor against overvoltage and increased operating temperature. However, output filters can also be used to reduce acoustic noise from the motor.

Grundfos offers sine-wave filters as an CUE accessory.

Sensors

The following sensors can be used in connection with CUE. All sensors are with 4-20 mA output signal.

- pressure sensors, up to 362 psi (25 bar)
- temperature sensors
- differential-pressure sensors
- differential-temperature sensors
- flowmeters
- potentiometer box for external setpoint setting.

Installation

Use of output filters

The table below shows in which cases an output filter is required and which type to use.

The selection depends on these factors:

- pump type
- motor cable length
- the required reduction of acoustic noise from the motor.

Pump type	Typical shaft power, P2	Sine-wave filter
SP with 380 V motor and up	All sizes	0-984 ft (0-300 m)

The lengths stated apply to the motor cable.

Cables used in CUE installations

Note: When CUE is installed in connection with SP pumps, we distinguish between two types of installation:

- installation in EMC-insensitive sites. See fig. 49.
- installation in EMC-sensitive sites. See fig. 50.

The two types of installation are different when it comes to the use of screened cable.

Note: Drop cables are always unscreened.

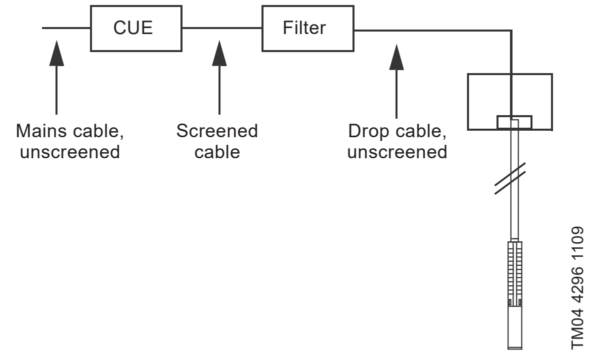


Fig. 49 Example of installation in EMC-insensitive sites

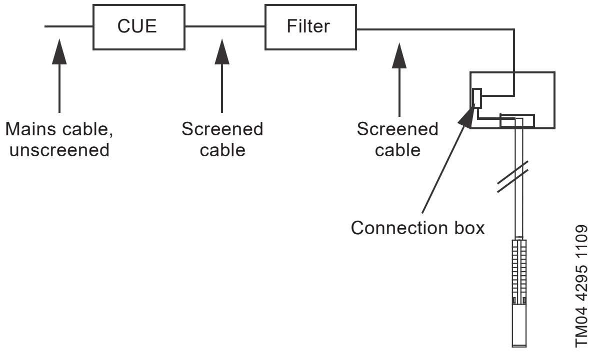


Fig. 50 Example of installation in EMC-sensitive sites

Screened cables are required in those parts of the installation where the surroundings must be protected against EMC.

CUE is the right choice of variable frequency drive in SP installations as it meets all basic issues.

CUE has a pre-installed startup guide which takes the installer through all the necessary settings.

For more information about the CUE variable frequency drive, see the CUE Data booklet, part number 9886424 or visit Grundfos Product Center at www.grundfos.us.

MP 204

MP 204 is an electronic motor protector, designed for the protection of an asynchronous motor or a pump.

The motor protector consists of:

- a cabinet incorporating transformers and electronics
- a control panel with operating buttons and display for reading of data.

MP 204 operates with two sets of limits:

- a set of warning limits and
- a set of trip limits.

If one or more of the warning limits are exceeded, the motor continues to run, but the warnings will appear in the MP 204 display.

Some values only have a warning limit.

The warning can also be read out by means of Grundfos GO.

If one of the trip limits is exceeded, the trip relay will stop the motor. At the same time, the signal relay is operating to indicate that the limit has been exceeded.

Applications

MP 204 can be used as a stand-alone motor protector.

MP 204 can be monitored via a Grundfos GENIbus.

The power supply to MP 204 is in parallel with the supply to the motor. Motor currents up to 120 A are passed directly through MP 204. MP 204 protects the motor primarily by measuring the motor current by means of a true RMS measurement. MP 204 disconnects the contactor if, for example, the current exceeds the preset value.

Secondarily, the motor is protected via temperature measuring by a Tempcon sensor, a Pt100/Pt1000 sensor and a PTC sensor/thermal switch.

MP 204 is designed for single- and three-phase motors. In single-phase motors, the starting and run capacitors are also measured. Cos φ is measured in both single- and three-phase systems.

Benefits

MP 204 offers these benefits:

- Suitable for both single- and three-phase motors
- Dry-running protection
- Overload protection
- Very high accuracy
- Made for submersible pumps.

Many monitoring options

MP 204 monitors the following parameters:

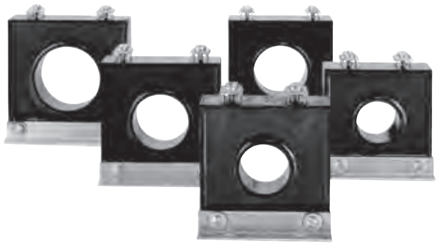
- Insulation resistance before startup
- Temperature (Tempcon, Pt sensor and PTC/thermal switch)
- Overload and underload
- Overvoltage and undervoltage
- Phase sequence
- Phase failure
- Power factor
- Power consumption
- Harmonic distortion
- Operating hours and number of starts.

TM03 1471 2205

Fig. 51 MP 204

Five sizes of single-turn transformers, 120-999 A.

Note: Monitoring of motor temperature with Tempcon sensor is not possible when single-turn transformers are used.



TM03 2033 3505

Fig. 52 Single-turn transformers

Product numbers

Product	Product number
MP 204	96079927
Single-turn transformers	
Current transformer ratio: 200:5, $I_{max.}$ = 120 A	96095274
Current transformer ratio: 300:5, $I_{max.}$ = 300 A	96095275
Current transformer ratio: 500:5, $I_{max.}$ = 500 A	96095276
Current transformer ratio: 750:5, $I_{max.}$ = 750 A	96095277
Current transformer ratio: 1000:5, $I_{max.}$ = 1000 A	96095278

Functions

- Phase-sequence monitoring
- Indication of current or temperature (user selection)
- Indication of temperature in °F or °C (user selection)
- 4-digit, 7-segment display
- Setting and status reading with Grundfos GO.
- Setting and status reading via GENIbus.

Tripping conditions

- Overload
- Underload (dry running)
- Temperature (Tempcon sensor, PTC/thermal switch and Pt sensor)
- Phase failure
- Phase sequence
- Overvoltage
- Undervoltage
- Power factor (cos φ)
- Current unbalance.

Warnings

- Overload
- Underload
- Temperature (Tempcon and Pt sensor)
- Overvoltage
- Undervoltage
- Power factor (cos φ)
  Note: In connection with single- and three-phase connection.
- Run capacitor (single-phase operation)
- Starting capacitor (single-phase operation)
- Loss of communication in network
- Harmonic distortion.

Learning function

- Phase sequence (three-phase operation)
- Run capacitor (single-phase operation)
- Starting capacitor (single-phase operation)
- Identification and measurement of Pt100/Pt1000 sensor circuit.

External current transformers

When fitted with external current transformers, the MP 204 unit can handle currents from 120 to 999 A. Grundfos can supply approved current transformers from stock (200/5A, 300/5A, 500/5A, 750/5A, 1000/5A).

Grundfos GO

Grundfos GO allows for wireless infrared remote control of your MP 204 unit.

With Grundfos GO, you get access to a full range of options such as factory setting adjustment, service and fault finding.

Ready for bus communication

MP 204 allows for monitoring and communication via GENIbus, a Grundfos-designed bus for exchange of pump data, alarms, status information, and setpoints. This enables users to connect MP 204 to, for instance, SCADA systems.

Technical data - MP 204

Enclosure class	IP20
Ambient temperature	-4 °F to +140 °F (-20 °C to +60 °C)
Relative humidity	99 %
Voltage range	100-480 VAC
Current range	3-999 A
Frequency	50 to 60 Hz
IEC trip class	1-45
Special Grundfos trip class	0.1 to 30 s
Voltage variation	- 25 %/+ 15 % of nominal voltage
Approvals	EN 60947, EN 60335, UL/CSA 508
Marking	CE, cUL, C-tick
Consumption	Maximum 5 W
Plastic type	Black PC / ABS

	Measuring range	Accuracy	Resolution
Current without external current transformers	3-120 A	± 1 %	0.1 A
Current with external current transformers	120-999 A	± 1 %	1 A
Phase-to-phase voltage	80-610 VAC	± 1 %	1 V
Frequency	47-63 Hz	± 1 %	0.5 Hz
Power	0-1 MW	± 2 %	1 W
Power factor	0 - 0.99	± 2 %	0.01
Energy consumption	0-4 x 10^9 kWh	± 5 %	1 kWh

Control functions

This table describes the protection provided by MP 204.

Control parameters	Function	Problem	Advantages
Temperature	**MS** The motor temperature is measured by means of the built-in Tempcon temperature transmitter and a signal is sent to MP 204 via the phase leads. In MP 204 the measured temperature is compared with the factory-set value of 167 °F (75 °C). **MMS** The motor temperature is measured by means of Pt100/Pt1000. The signal is sent to MP 204 where the measured temperature is compared with the factory-set value. Temperature protection requires a submersible motor with a Pt100/Pt1000. The motor temperature must be monitored during variable frequency drive operation.	Overload, frequent starts/stops, operation against blocked outlet pipe, insufficient flow velocity past the motor.	Longer motor life, safe operating conditions, service indication.
Overvoltage/undervoltage	If the set trip value is exceeded, the motor will stop.	The installation is close to a transformer. The mains do not absorb load variations.	Important installation parameter, possibility of improving operating conditions.
Overload	The motor power input is measured on each of the three phases. The registered power input is an average of these three values. If the factory-set value is exceeded, the motor will stop.	Incorrect sizing of pump/motor, voltage supply failure, defective cable, blocking, wear or corrosion.	Longer pump life, safe operating conditions, service indication.
Underload (dry running)	The motor power input is measured on each of the three phases. The registered power input is an average of these three values. If the average value is lower than the factory-set value, the motor will stop.	Pump exposed to dry running or underload, for example caused by wear.	Traditional dry-running protection is no longer necessary, no extra cables.
Current unbalance	The power input of the motor is measured on each of the three phases.	Mains load is uneven, incipient motor defect, phase voltages diverging.	Motor protection against overload, service indication.
Phase sequence	MP 204 and motor are installed so that the phase sequence corresponds to correct direction of rotation. MP 204 monitors changes in the phase sequence.	Two phases are wrongly connected.	Ensures correct pump performance.
Phase failure	MP 204 checks the phases connected, phase failure will cause an alarm.	Phase failure.	Indication of phase failure, and alarm.

Grundfos GO remote app and Grundfos GO CAPS

Grundfos GO is the mobile tool box for professional users on the go. The Grundfos GO app can be used to establish wireless connection to Grundfos products. Grundfos GO gives you intuitive handheld pump control, and full access to all the Grundfos Online tools on the go. Grundfos GO consists of two Apps: GO Remote and GO CAPS. It is available from Apple App Store and Google Play.

The Grundfos GO app must be used in conjunction with one of the following mobile interface devices:

Product	Description	Product number
MI 202	Dongle for iPhone 4/4s, iPad, or iPod touch (30 pin connector compatible)	98046376
MI 204	Dongle for iPhone, iPad, or iPod touch with Lightning connector	98424092
MI 301	Universal Bluetooth dongle for Android, iPhone or other iOS device	98046408
MI 204	MI204 Kit with MI204 dongle, Apple iPod, sleeve and cover	98612711

•

The mobile interfaces are modules with built-in IR and radio communication.

The Grundfos product must support either IR communication or radio communication.

Grundfos GO Remote

Grundfos GO Remote works with all our E-pumps and communicates both using both radio and infrared technology. It provides easy-to-follow tips and guidance as well as live pump data feeds.

To communicate with the pumps, special hardware (Mobile Interfaces) from Grundfos is required. The Grundfos GO Remote app can be downloaded for free for both Apple iOS and Android devices.

While connected to a Grundfos product, the following features are available:

- Product dashboard which gives the user a quick overview of the connected product
- Status data which monitor status data from the Grundfos product
- Alarms and warnings where you can see detailed alarm information with timestamps
- Configuration and commissioning
- Create installation report in pdf format
- Read and write profiles,and copy configuration from one product to another
- Available in 28 languages.

Grundfos GO CAPS

GO CAPS works online and supports all the basic CAPS functionalities. It is available for Apple iOS devices only, and is free to download. Features:

- Search product by: Number, Name or QR code
- Size a product (Heating, Air-conditioning, Pressure boosting & Wastewater)
- Catalog
- Replace product
- Compare products
- Product view
- Projects
- Favorites
- Supports 11 languages

MI 202 and MI 204

MI 202 and MI 204 are add-on modules for Apple devices. For Apple iPod touch 4 and iPhone 4 and 4S, use MI 202. For Apple products with Lightning connector, use MI 204.
Note: "Made for iPod, iPhone" means that an electronic accessory has been designed to connect specifically to iPod or iPhone and has been certified by the developer to meet Apple performance standards. Apple is not responsible for the operation of this device or its compliance with safety and regulatory standards. Please note that the use of this accessory with iPod may affect wireless performance.

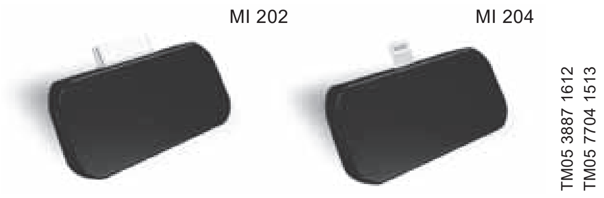


Fig. 53 MI 202 and MI 204

MI 301

MI 301 is a module that connects to an Android or iOS-based smart device via Bluetooth. MI 301 has a rechargeable Li-ion battery and must be charged separately.

Fig. 54 MI 301

Supported devices

The smart devices listed below have been tested and are supported by Grundfos GO.

Make	Model	MI 202	MI 204	MI 301
Apple	iPod touch 4G	●		●
	iPod touch 5G		●	●
	iPhone 4, 4S	●		●
	iPhone with Lightning connector		●	●
	iPad, iPad Mini		●	●
Asus	Nexus 7			●
	Transformer TF101, TF300			●
Google	Galaxy Nexus, Nexus 4, Nexus 10			●
HTC	Desire S, One S, Sensation			●
Motorola	Xoom2, Moto X (XT1053)			●
Samsung	Galaxy S II, Galaxy S III			●
	Galaxy tab 2 7.0			●
Sony	Xperia Arc, Arc S, Xperia Tipo, Xperia V			●

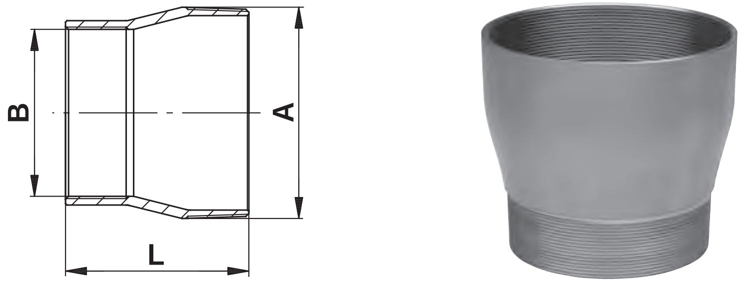
Note: Similar Android and iOS-based devices may work as well, but have not been tested by Grundfos.

For further details, features and screens, see Grundfos GO instructions part number 98133717 that are included with GO Remote product.

Connecting pieces

The tables below show the range of connecting pieces for connection of thread-to-flange and thread-to-thread.

Thread-to- thread



TM01 2397 1698 - GrA2555

Fig. 55 Dimensional sketch and photo of connecting piece thread-to-thread

Type	Connecting piece	Dimensions			Product number	
		Thread-to-thread		L [in (mm)]		
		A	B		304 stainless steel	316 stainless steel
385S **475S**	NPT 5→ NPT 4	NPT 5	NPT 4	4.76 (121)	190064	190586
	NPT 5→ NPT 6	NPT 5	NPT 6	5.91 (150)	190070	190592
625S **800S** **1100S**	NPT 6→ NPT 5	NPT 6	NPT 5	5.91 (150)	200135	200645

Zinc anodes

Application

Cathodic protection by means of zinc can be used for corrosion protection of SP pumps in chloride-containing liquids such as brackish water and seawater.

Sacrificial anodes are placed on the outside of the pump and motor as protection against corrosion.

The number of anodes required depends on the pump and motor in question.

Please contact Grundfos for further details.

Liquid temperatures

- Seawater:
  Up to 95 °F (35 °C).
- Brackish water (minimum 1500 ppm (g/m^3) chloride):
  Up to 95 °F (35 °C).

Anode life

The zinc anodes have a life of one to four years, depending on operating conditions (temperature, flow rate and chloride content).

Product numbers of zinc anodes

Zinc anodes for pumps

Product number	Used for pump type									
	SP 5S to 77S	85S	150S	230S	300S	385S	475S	625S	800S	1100S
99326959	●	-	-	-	-	-	-	-	-	-
97645875	-	●	●	●	●	-	-	-	-	-
97645914	-	-	-	-	-	●	●	-	-	-
97646116	-	-	-	-	-	-	-	●	●	-
97646118	-	-	-	-	-	-	-	-	-	●

Zinc anodes for motors

4" motors	6" motors	8" motors	10" motors	12" motors
96856060	97645910	97646116	97646118	97646138

SA-SPM 6 control boxes

Application

SA-SPM 6 control boxes are used as starting units for single-phase, 3-wire motors ranging from 0.5 Hp to 5 Hp (.37 kW to 3.7 kW).

SA-SPM 6 from 1.5 Hp to 5 Hp (1.1 kW to 3.7 kW) is available in two versions, Standard (STD) and Deluxe (DLX).

The standard version incorporates a motor-protective circuit breaker and thus protects the motor against overload.

The deluxe version is identical to the standard version with the addition of a motor contactor for connection and disconnection of the power supply.

Technical data

Enclosure class:	IP42.
Ambient temperature:	-4 °F to +140 °F (-20 °C to +60 °C).
Relative humidity:	Maximum 95 %, normal non-aggressive atmosphere.

TM03 8150 0607

Fig. 56 SA-SPM 6 control box

SA-SPM 6 control box part numbers

Control box for 4-inch, 3-wire, single phase motors						
			Approximate ship wt	Product number	Product number	Reference product number only**
Type	Hp	Volts	(lb)	(Order in multiples of 1)	(Order in multiples of 10)	
STD	1/2*	115	2	-	98821580	98315240
STD	1/2*	230	2	-	98821631	98315251
STD	3/4*	230	2	-	98821632	98315252
STD	1*	230	2	-	98821633	98315253
STD	1-1/2	230	2	98315254	-	-
DLX	1-1/2	230	3	98315255	-	-
STD	2	230	6	98315256	-	-
DLX	2	230	6	98315257	-	-
STD	3	230	6	98315258	-	-
DLX	3	230	7	98315259	-	-
STD	5	230	7	98315260	-	-
DLX	5	230	8	98315261	-	-

* The 1/2 hp, 3/4 hp and 1 hp control boxes are now sold by Grundfos in multiple quantities (10-pack) only.
** Old control box material numbers that Grundfos sold in single units.
DLX (Deluxe Control Box,): Includes magnetic starter in addition to Standard Control Box (STD).

Pt100/Pt1000

The Pt100/Pt1000 sensor offers these features:

- Continuous monitoring of the motor temperature
- Protection against too high motor temperature.

Protecting the motor against too high motor temperature is the simplest and cheapest way of avoiding that motor lifetime is reduced. Pt100/Pt1000 ensures that the operating conditions are not exceeded and indicates when it is time for service of the motor.

Monitoring and protection by means of Pt100/Pt1000 require the following parts:

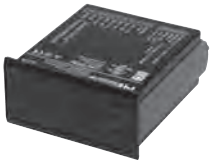
- Pt100/Pt1000 sensor
- Relay, type PR 5714
- Cable.

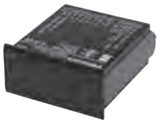
The PR 5714 relay is fitted with a Pt100/Pt1000 module. For both relays the following temperature limits are preset on delivery:

- 140 °F (60 °C) warning limit
- 167 °F (75 °C) stop limit.

Technical data

	Relay type
	PR 5714
Enclosure class	IP65 (mounted in a control panel)
Ambient temperature	-4 °F to +140 °F (-20 °C to +60 °C)
Relative humidity	95 % (condensating)
Voltage variation	• 1 x 24-230 VAC ± 10 %, 50-60 Hz. • 24-250 VDC ± 20 %.
Approvals	UL, DNV
Mark	CE

PR 5714 relay	Voltage	Product number
	24-230 VAC, 50/60 Hz / 24-250 VDC	96621274

PR 5714 relay	Voltage	Product number
 GrA3186 0407	24-230 VAC, 50/60 Hz / 24-250 VDC	96913234

Pt100 sensor, including cable for standard-, N- and R-versions	Cable length [ft (m])	
 GrA3190 0407	65.6 (20)	For product number, see Grundfos Price Book or call Grundfos.
	131.2 (40)	
	196.9 (60)	
	262.5 (80)	
	100 (328.1)	

Staybolt kits for Pt100 in MS 6000	Description	
 GrA3191 0407	Staybolt kit for Pt100/Pt1000. Material: AISI 316 (EN 1.4401).	For product number, see Grundfos Price Book or call Grundfos.
	Staybolt kit for Pt100. Material: AISI 904L (EN 1.4539).	

Insertion probe for MMS 10000	Description	
 TM04 3560 4508	Insertion probe for Pt100/Pt1000 in MMS 10000. Material: 316 (EN 1.4401) (N-version).	For product number, see Grundfos Price Book or call Grundfos.
	Insertion probe for Pt100/Pt1000 in MMS 10000. Material: AISI 904L (EN 1.4539) (R-version).	

Pt1000 sensor, including cable	Cable length [ft (m)]	
 TM04 3563 4508	65.6 (20)	For product number, see Grundfos Price Book or call Grundfos.
	131.2 (40)	
	196.9 (60)	
	262.5 (80)	
	100 (328.1)	

Staybolt kits for Pt1000 in MS 402 and MS 4000	Description	
 TM05 3694 1612	Staybolt kit for Pt1000. Material: AISI 316 (EN 1.4401).	For product number, see Grundfos Price Book or call Grundfos.
	Staybolt kit for Pt1000. Material: AISI 904 (EN 1.4539).	

10. Energy consumption

Energy consumption of submersible pumps

The percentage distribution of service life costs of a submersible pump for water supply is:

- 5 % initial costs (pump)
- 85 % operating energy costs
- 10 % maintenance costs.

It is obvious that the highest savings can be achieved within energy consumption!

The annual energy consumption, E, of a submersible pump can be calculated as follows:

E = c x h x P_1 (USD)
c = specific energy price (USD/kWh)
h = operating hours/year (hours)
P_1 = power input of the submersible pump (Hp).

Example: Calculation of the annual energy consumption of the submersible pump, type 625S-3.
625S-3 with MMS 8000, 60 Hp, 3 x 460 V, 60 Hz.

Duty point:

Flow rate:	Q = 528 gpm
Total head:	H = 335 ft
Specific energy price:	c = USD 0.15/kWh (consisting of day and night rate)
Operating hours/year:	h = 3200.

$$P_1 = \frac{Q \times H \times \rho}{367 \times \eta_{pump} \times \eta_{motor}} \text{ in kW}$$

Q = gpm
H = ft
Density ρ = lb/ft^3 (assumed 1)
367 = conversion factor
η_{motor} = (example 84.5 %, in equation 0.845)
η_{pump} = (not to be confused with the stage efficiency curve).

By showing the P_2/Q curve we make it easier for you to calculate the energy consumption.

$$P_1 = \frac{P_2}{\eta_{motor}}$$

P_2 = 35 Hp (power requirement of 625S-3 pump at 88 gpm, from curve P_2/Q).

Calculation of motor efficiency at duty point

As standard the SP 625S-3 is equipped with a 60 Hp (45 kW for P1) MS 6000C motor.

At duty point (Q = 528 gpm) the pump requires 59 Hp (44 kW for P1), thus:

a motor load of 87 % (44 kw / 45 kw) and a power reserve of 2 %.

From the table on page 94 the motor efficiency can be read as:

84.6 % at a load of 75 %. ($\eta_{75\ \%}$)

85.6 % at a load of 100 %. ($\eta_{100\ \%}$)

The interpolated value in this example is

η_{motor} = 85.1 %, η_{motor} = 0.851.

$$P_1 = \frac{44}{0.851} = 51.7 \text{ kW}$$

E = 0.15 USD/kWh x 3200 h x 51.7 kW.

The annual energy costs amount to USD 24816.

The pay-off time, A, (months) is calculated as follows:

$$A = \frac{\text{Purchase price of energy - efficiency pump}}{\text{Energy savings / year}} \times 12$$

Cable sizing

In order to obtain an economical duty of the pump the voltage drop must be low.

Today large water works already size cables for a maximum voltage drop of 1 %.

The hydraulic resistance in the outlet pipe must be as low as possible.

11. Cables

Cable sizing charts

115 V and 230 V, 1 ph 60 Hz

Maximum submersible power cable length (maximum cable length in feet - starter to motor)

Motor rating	[Hp]	AWG copper wire size [ft (m)]													MCM copper wire size		
		14	**12**	**10**	**8**	**6**	**4**	**3**	**2**	**1**	**0**	**00**	**000**	**0000**	**250**	**300**	**350**
115 V 1 ph 60 Hz	0.33	130 (40)	210 (64)	340 (104)	540 (165)	840 (256)	1300 (396)	1610 (491)	1960 (597)	2390 (728)	2910 (887)	3540 (1079)	4210 (1283)	5060 (1542)	5680 (1731)	6390 (1948)	7110 (2167)
	0.5	100 (30)	160 (49)	250 (76)	390 (119)	620 (189)	960 (293)	1190 (363)	1460 (445)	1780 (543)	2160 (658)	2630 (802)	3140 (957)	3770 (1149)	4240 (1292)	4770 (1454)	5320 (1622)
230 V 1 ph 60 Hz	0.33	550 (168)	880 (268)	1390 (424)	2190 (668)	3400 (1036)	5250 (1600)	6520 (1987)	7960 (2426)	9690 (2954)	11770 (3587)	14320 (4365)	17050 (5197)	20460 (6236)	22980 (7004)	25850 (7879)	28750 (8763)
	0.5	400 (122)	650 (198)	1020 (311)	1610 (491)	2510 (765)	3880 (1183)	4810 (1466)	5880 (1792)	7170 (2185)	8720 (2658)	10620 3237)	12660 (3859)	15210 (4636)	17100 (5212)	19260 (5870)	21440 (6535)
	0.75	300 (91)	480 (146)	760 (232)	1200 (366)	1870 (570)	2890 (881)	3580 (1091)	4370 (1332)	5330 (1625)	6470 (1972)	7870 (2399)	9380 (2859)	11250 (3429)	12640 (3853)	14220 (4334)	15810 (4819)
	1	250 (76)	400 (122)	630 (192)	990 (302)	1540 (469)	2380 (725)	2960 (902)	3610 (1100)	4410 (1344)	5360 (1634)	6520 (1987)	7780 (2371)	9350 (2850)	10510 (3203)	11840 (3609)	13180 (4017)
	1.5	190 (58)	310 (94)	480 (146)	770 (235)	1200 (366)	1870 (570)	2320 (707)	2850 (869)	3500 (1067)	4280 (1305)	5240 (1597)	6300 (1920)	7620 (2323)	8630 (2630)	9810 (2990)	10980 (3347)
	2	150 (46)	250 (76)	390 (119)	620 (189)	970 (296)	1530 (466)	1910 (582)	2360 (719)	2930 (893)	3620 (1103)	4480 (1366)	5470 (1667)	6700 (2042)	770 (235)	8890 (2710)	10080 (3072)
	3	120 (37)	190 (58)	300 (91)	470 (143)	750 (229)	1190 (363)	1490 (454)	1850 (564)	2320 (707)	2890 (881)	3610 (1100)	4470 (1362)	5550 (1692)	6450 (1966)	7580 (2310)	8690 (2649)
	5	-	110* (34*)	180 (55)	280 (85)	450 (137)	710 (216)	890 (271)	1110 (338)	1390 (424)	1740 (530)	2170 (661)	2680 (817)	3330 (1015)	3870 (1180)	4550 (1387)	5210 (1588)
	7.5	-	-	120* (37*)	200 (61)	310 (94)	490 (149)	610 (186)	750 (229)	930 (283)	1140 (347)	1410 (430)	1720 (524)	2100 (640)	2400 (732)	2790 (850)	3120 (951)
	10	-	-	-	160* (49*)	250 (76)	390 (119)	490 (149)	600 (183)	750 (229)	930 (283)	1160 (354)	1430 (436)	1760 (536)	2030 (619)	2370 (723)	2700 (823)
	15	-	-	-	-	170* (52*)	270 (82)	340 (104)	430 (131)	530 (162)	660 (201)	820 (250)	1020 (311)	1260 (384)	1460 (445)	1700 (518)	1940 (591)

NOTE:

* Indicates single conductor only (not jacketed).

No asterisk indicates both jacketed cable and single conductor cables.

1. The table is based on copper wire. If aluminum wire is used, multiply lengths by 0.5.
   The maximum permissible length of aluminum is considerably shorter than copper wire of same size.
2. Make sure that the portion of the total cable which is between the service entrance and a motor starter/controller does not exceed 25 % of the total maximum length to ensure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. The table is based on a maintaining motor terminal voltage at 95 % of service entrance voltage, running at maximum nameplate amperes. In general, a voltage drop must be maintained at 3 V / 100 ft or less.
4. 1 foot = 0.305 meter (1 meter = 3.28 feet).

200-208 V, 3 Ph 60 Hz

Maximum submersible power cable length (maximum cable length in feet - starter to motor)																	
Motor rating	[Hp]	AWG copper wire size [ft (m)]													MCM copper wire size		
		14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350
200-208 V 3 ph 60 Hz	.5	710 (216)	1140 (347)	1800 (549)	2840 (866)	4420 (1347)	-	-	-	-	-	-	-	-	-	-	-
	.75	510 (155)	810 (245)	1280 (390)	2030 (619)	3160 (963)	-	-	-	-	-	-	-	-	-	-	-
	1	430 (131)	690 (210)	1080 (329)	1710 (521)	2670 (814)	4140 (1262)	5140 (1567)	-	-	-	-	-	-	-	-	-
	1.5	310 (94)	500 (152)	790 (241)	1260 (384)	1960 (597)	3050 (930)	3780 (1152)	-	-	-	-	-	-	-	-	-
	2	240 (73)	390 (119)	610 (186)	970 (296)	1520 (463)	2360 (719)	2940 (896)	3610 (1100)	4430 (1350)	5420 (1652)	-	-	-	-	-	-
	3	180 (55)	290 (88)	470 (143)	740 (226)	1160 (354)	1810 (552)	2250 (686)	2760 (841)	3390 (1033)	4130 (1259)	-	-	-	-	-	-
	5	110* (34*)	170 (52)	280 (85)	440 (134)	690 (210)	1080 (329)	1350 (411)	1660 (506)	2040 (622)	2490 (759)	3050 (930)	3670 (1119)	4440 (1353)	5030 (1533)	-	-
	7.5	-	-	200 (61)	310 (94)	490 (149)	770 (235)	960 (293)	1180 (360)	1450 (442)	1770 (539)	2170 (661)	2600 (792)	3150 (960)	3560 (1085)	-	-
	10	-	-	-	230* (70*)	370 (113)	570 (174)	720 (219)	880 (268)	1090 (332)	1330 (405)	1640 (500)	1970 (600)	2390 (728)	2720 (829)	3100 (945)	3480 (1061)
	15	-	-	-	160* (49*)	250* (76*)	390 (119)	490 (149)	600 (183)	740 (226)	910 (277)	1110 (338)	1340 (408)	1630 (497)	1850 (564)	2100 (640)	2350 (716)
	20	-	-	-	-	190* (58*)	300* (91*)	380 (116)	460 (140)	570 (174)	700 (213)	860 (262)	1050 (320)	1270 (387)	1440 (439)	1650 (503)	1850 (564)
	25	-	-	-	-	-	240* (73*)	300* (91*)	370* (113*)	460 (140)	570 (174)	700 (213)	840 (256)	1030 (314)	1170 (357)	1330 (405)	1500 (457)
	30	-	-	-	-	-	-	250* (76*)	310* (94*)	380* (116*)	470 (143)	580 (177)	700 (213)	850 (259)	970 (296)	1110 (338)	1250 (381)

NOTE:

* Indicates single conductor only (not jacketed).

No asterisk indicates both jacketed cable and single conductor cables.

1. The table is based on copper wire. If aluminum wire is used, multiply lengths by 0.5.
   The maximum permissible length of aluminum is considerably shorter than copper wire of same size.
2. Make sure that the portion of the total cable which is between the service entrance and a motor starter/controller does not exceed 25 % of the total maximum length to ensure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. The table is based on a maintaining motor terminal voltage at 95 % of service entrance voltage, running at maximum nameplate amperes. In general, a voltage drop must be maintained at 3 V / 100 ft or less.
4. 1 foot = 0.305 meter (1 meter = 3.28 feet).

230 V, three-phase, 60 Hz

Motor rating	[Hp]	Maximum submersible power cable length (maximum cable length in feet, starter to motor)																
		AWG copper wire size [ft (m)]													MCM copper wire size			
		14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400
230 V 3-ph 60 Hz	.5	930 (283)	1490 (454)	2350 (716)	3700 (1128)	5760 (1756)	8910 (2716)	-	-	-	-	-	-	-				
	.75	670 (204)	1080 (329)	1700 (518)	2580 (786)	4190 (1277)	6490 (1978)	8060 (2457)	9860 (3005)	-	-	-	-	-				
	1	560 (171)	910 (277)	1430 (436)	2260 (689)	3520 (1073)	5460 (1664)	6780 (2067)	8290 (2527)	-	-	-	-	-				
	1.5	420 (128)	670 (204)	1060 (323)	1670 (509)	2610 (796)	4050 (1234)	5030 (1533)	6160 (1878)	7530 (2295)	9170 (2795)	-	-	-				
	2	320 (98)	510 (155)	810 (247)	1280 (390)	2010 (613)	3130 (954)	3890 (1186)	4770 (1454)	5860 (1786)	7170 (2185)	8780 (2676)	-	-				
	3	240 (73)	390 (119)	620 (189)	990 (302)	1540 (469)	2400 (732)	2980 (908)	3660 (1116)	4480 (1366)	5470 (1667)	6690 (2039)	8020 (2444)	9680 (2950)				
	5	140* (43*)	230 (70)	370 (113)	590 (180)	920 (280)	1430 (436)	1790 (546)	2190 (668)	2690 (820)	3290 (1003)	4030 (1228)	4850 (1478)	5870 (1789)	6650 (2027)	7560 (2304)	8460 2579)	9220 (2810)
	7.5	-	160* (49*)	260 (79)	420 (128)	650 (198)	1020 (311)	1270 (387)	1560 (475)	1920 (585)	2340 (713)	2870 (875)	3440 (1049)	4160 (1268)	4710 (1436)	5340 (1628)	5970 (1820)	6500 (1981)
	10	-	-	190* (58*)	310 (94)	490 (149)	760 (232)	950 (290)	1170 (357)	1440 (439)	1760 (536)	2160 (658)	2610 (796)	3160 (963)	3590 (1094)	4100 (1250)	4600 (1402)	5020 (1530)
	15	-	-	-	210* (64*)	330 (101)	520 (158)	650 (198)	800 (244)	980 (299)	1200 (366)	1470 (448)	1780 (543)	2150 (655)	2440 (744)	2780 (847)	3110 (948)	3400 (1036)
	20	-	-	-	-	250* (76*)	400 (122)	500 (152)	610 (186)	760 (232)	930 (283)	1140 (347)	1380 (421)	1680 (512)	1910 (582)	2180 (664)	2450 (747)	2680 (817)
	25	-	-	-	-	-	320* (98*)	400 (122)	500 (152)	610 (186)	750 (229)	920 (280)	1120 (341)	1360 (415)	1540 (469)	1760 (536)	1980 (604)	2160 (658)
	30	-	-	-	-	-	260* (79*)	330* (101*)	410* (125*)	510 (155)	620 (189)	760 (232)	930 (283)	1130 (344)	1280 (390)	1470 (448)	1650 (503)	1800 (549)

Note:

* Indicates single conductor only (not jacketed).
No asterisk indicates both jacketed cable and single-conductor cables.

1. The table is based on copper wire. If aluminum wire is used, multiply lengths by 0.5. The maximum permissible length of aluminum is considerably shorter than copper wire of same size.
2. Make sure that the portion of the total cable which is between the service entrance and a motor starter/controller does not exceed 25 % of the total maximum length to ensure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. The table is based on maintaining motor terminal voltage at 95 % of service entrance voltage, running at maximum nameplate amperes. In general, a voltage drop must be maintained at 3 V / 100 ft or less.
4. 1 foot = 0.305 meter (1 meter = 3.28 feet).

460 V, 3 ph 60 Hz

Maximum submersible power cable length (maximum cable length in feet - starter to motor)																	
Motor rating	[Hp]	AWG copper wire size [ft (m)]													MCM copper wire size		
		14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350
460 V 3 ph 60 Hz	.5	3770 (1149)	6020 (1835)	9460 (2883)	-	-	-	-	-	-	-	-	-	-	-	-	-
	.75	2730 (832)	4350 (1326)	6850 (2088)	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	2300 (701)	3670 (1119)	5770 (1759)	9070 (2765)	-	-	-	-	-	-	-	-	-	-	-	-
	1.5	1700 (518)	2710 (826)	4270 (1301)	6730 (2051)	-	-	-	-	-	-	-	-	-	-	-	-
	2	1300 (396)	2070 (631)	3270 (997)	5150 (1570)	8050 (2454)	-	-	-	-	-	-	-	-	-	-	-
	3	1000 (305)	1600 (488)	2520 (768)	3970 (1210)	6200 (1890)	-	-	-	-	-	-	-	-	-	-	-
	5	590 (180)	950 (290)	1500 (457)	2360 (719)	3700 (1128)	5750 (1753)	-	-	-	-	-	-	-	-	-	-
	7.5	420 (128)	680 (207)	1070 (326)	1690 (515)	2640 (805)	4100 (1250)	5100 (1554)	6260 (1908)	7680 (2341)	-	-	-	-	-	-	-
	10	310 (94)	500 (152)	790 (241)	1250 (381)	1960 (597)	3050 (930)	3800 (1158)	4680 (1426)	5750 (1753)	7050 (2149)	-	-	-	-	-	-
	15	-	340* (104*)	540 (165)	850 (259)	1340 (408)	2090 (637)	2600 (792)	3200 (975)	3930 (1198)	4810 (1466)	5900 (1798)	7110 (2167)	-	-	-	-
	20	-	-	410 (125)	650 (198)	1030 (314)	1610 (491)	2000 (610)	2470 (753)	3040 (927)	3730 (1137)	4580 (1396)	5530 (1686)	-	-	-	-
	25	-	-	330* (101*)	530 (162)	830 (253)	1300 (396)	1620 (494)	1990 (607)	2450 (747)	3010 (917)	3700 (1128)	4470 (1362)	5430 (1655)	-	-	-
	30	-	-	270* (82*)	430 (131)	680 (207)	1070 (326)	1330 (405)	1640 (500)	2030 (619)	2490 (759)	3060 (933)	3700 (1128)	4500 (1372)	5130 (1564)	5860 (1786)	-
	40	-	-	-	320* (98*)	500* (152*)	790 (241)	980 (299)	1210 (369)	1490 (454)	1830 (558)	2250 (686)	2710 (826)	3290 (1003)	3730 (1137)	4250 (1295)	-
	50	-	-	-	-	410* (125*)	640 (195)	800 (244)	980 (299)	1210 (369)	1480 (451)	1810 (552)	2190 (668)	2650 (808)	3010 (917)	3420 (1042)	3830 (1167)
	60	-	-	-	-	-	540* (165*)	670* (204*)	830 (253)	1020 (311)	1250 (381)	1540 (469)	1850 (564)	2240 (683)	2540 (774)	2890 (881)	3240 (988)
	75	-	-	-	-	-	440* (134*)	550* (168*)	680* (207*)	840 (256)	1030 (314)	1260 (384)	1520 (463)	1850 (564)	2100 (640)	2400 (732)	2700 (823)
	100	-	-	-	-	-	-	-	500* (152*)	620 (189*)	760* (232*)	940 (287)	1130 (344)	1380 (421)	1560 (475)	1790 (546)	2010 (613)
	125	-	-	-	-	-	-	-	-	-	600* (183*)	740* (226*)	890* (271*)	1000 (305)	1220 (372)	1390 (424)	1560 (475)
	150	-	-	-	-	-	-	-	-	-	-	630* (192*)	760* (232*)	920* (280*)	1050 (320)	1190 (363)	1340 (408)
	175	-	-	-	-	-	-	-	-	-	-	-	670* (204*)	810* (247*)	930* (283*)	1060 (323)	1190 (363)
	200	-	-	-	-	-	-	-	-	-	-	-	590* (180*)	710* (216*)	810* (247*)	920* (280*)	1030 (314)

NOTE:

* Indicates single conductor only (not jacketed).

No asterisk indicates both jacketed cable and single-conductor cables.

1. The table is based on copper wire. If aluminum wire is used, multiply lengths by 0.5.
   The maximum permissible length of aluminum is considerably shorter than copper wire of same size.
2. Make sure that the portion of the total cable which is between the service entrance and a motor starter/controller does not exceed 25 % of the total maximum length to ensure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. The table is based on a maintaining motor terminal voltage at 95 % of service entrance voltage, running at maximum nameplate amperes. In general, a voltage drop must be maintained at 3 V / 100 ft or less.
4. 1 foot = 0.305 meter (1 meter = 3.28 feet).

575 V, 3 ph 60 Hz

Maximum submersible power cable length (maximum cable length in feet - starter to motor)																	
Motor rating [Hp]		AWG copper wire size [ft (m)]													MCM copper wire size		
		14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350
575 V 3 ph 60 Hz	5	5900 (1798)	9410 (2868)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	.75	4270 (1301)	6810 (2076)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	3630 (1106)	5800 (1768)	9120 (2780)	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.5	2620 (799)	4180 (1274)	6580 (2006)	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	2030 (619)	3250 (991)	5110 (1558)	8060 (2457)	-	-	-	-	-	-	-	-	-	-	-	-
	3	1580 (482)	2530 (771)	3980 (1213)	6270 (1911)	-	-	-	-	-	-	-	-	-	-	-	-
	5	920 (280)	1480 (451)	2330 (710)	3680 (1122)	5750 (1753)	-	-	-	-	-	-	-	-	-	-	-
	7.5	660 (201)	1060 (323)	1680 (512)	2650 (808)	4150 (1265)	-	-	-	-	-	-	-	-	-	-	-
	10	490 (149)	780 (238)	1240 (378)	1950 (594)	3060 (933)	4770 (1454)	5940 (1811)	-	-	-	-	-	-	-	-	-
	15	330* (101*)	530 (162)	850 (259)	1340 (408)	2090 (637)	3260 (994)	4060 (1237)	-	-	-	-	-	-	-	-	-
	20	-	410* (125*)	650 (198)	1030 (314)	1610 (491)	2520 (768)	3140 (957)	3860 (1177)	4760 (1451)	5830 (1777)	-	-	-	-	-	-
	25	-	-	520 (158)	830 (253)	1300 (396)	2030 (619)	2530 (771)	3110 (948)	3840 (1170)	4710 (1436)	-	-	-	-	-	-
	30	-	-	430* (131*)	680 (207)	1070 (326)	1670 (509)	2080 (634)	2560 (780)	3160 (963)	3880 (1183)	4770 (1454)	5780 (1762)	7030 (2143)	8000 (2438)	-	-
	40	-	-	-	500* (152*)	790 (241)	1240 (378)	1540 (469)	1900 (579)	2330 (710)	2860 (872)	3510 (1070)	4230 (1289)	5140 (1567)	5830 (1777)	-	-
	50	-	-	-	410* (125*)	640* (195*)	1000 (305)	1250 (381)	1540 (469)	1890 (576)	2310 (704)	2840 (866)	3420 (1042)	4140 (1262)	4700 (1433)	5340 (1628)	5990 (1826)
	60	-	-	-	-	540* (165*)	850 (259)	1060 (323)	1300 (396)	1600 (488)	1960 (597)	2400 (732)	2890 (881)	3500 (1067)	3970 (1210)	4520 (1378)	5070 (1545)
	75	-	-	-	-	-	690* (210*)	860 (262)	1060 (323)	1310 (399)	1600 (488)	1970 (600)	2380 (725)	2890 (881)	3290 (1003)	3750 (1143)	4220 (1286)
	100	-	-	-	-	-	-	640* (195*)	790* (241*)	970 (296)	1190 (363)	1460 (445)	1770 (539)	2150 (655)	2440 (744)	2790 (850)	3140 (957)
	125	-	-	-	-	-	-	-	630* (192*)	770* (235*)	950 (290)	1160 (354)	1400 (427)	1690 (515)	1920 (585)	2180 (664)	2440 (744)
	150	-	-	-	-	-	-	-		660* (202*)	800* (244*)	990* (302*)	1190 (363)	1440 (439)	1630 (497)	1860 (567)	2080 (634)
	175	-	-	-	-	-	-	-	-	-	700* (214*)	870* (265*)	1050* (320*)	1270 (387)	1450 (442)	1650 (503)	1860 (567)
	200	-	-	-	-	-	-	-	-	-	-	760* (232*)	920* (280*)	1110* (338*)	1260 (384)	1440 (439)	1620 (494)

NOTE:

* Indicates single conductor only (not jacketed).

No asterisk indicates both jacketed cable and single conductor cables.

1. The table is based on copper wire. If aluminum wire is used, multiply lengths by 0.5.
   The maximum permissible length of aluminum is considerably shorter than copper wire of same size.
2. Make sure that the portion of the total cable which is between the service entrance and a motor starter/controller does not exceed 25 % of the total maximum length to ensure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. The table is based on a maintaining motor terminal voltage at 95 % of service entrance voltage, running at maximum nameplate amperes. In general, a voltage drop must be maintained at 3 V / 100 ft or less.
4. 1 foot = 0.305 meter (1 meter = 3.28 feet).

12. Friction loss tables

Friction loss table - SCH 40 steel pipe										
		.5"	.75"	1"	1.25"	1.5"	2"	2.5"	3"	4"
[US gpm]	[US gph]	ID 0.622"	ID 0.824"	ID 1.049"	ID 1.380"	ID 1.610"	ID 2.067"	ID 2.469"	ID 3.068"	ID 4.026"
		Friction loss in feet of head per 100 feet of pipe								
2	120	4.8								
3	180	10.0	2.5							
4	240	17.1	4.2							
5	300	25.8	6.3	1.9						
6	360	36.5	8.9	2.7						
7	420	48.7	11.8	3.6						
8	480	62.7	15.0	4.5						
9	540	78.3	18.8	5.7						
10	600	95.9	23.0	6.9						
12	720		32.6	9.6	2.5	1.2				
14	840		43.5	12.8	3.3	1.5				
16	960		56.3	16.5	4.2	2.0				
20	1,200		86.1	25.1	6.3	2.9				
25	1,500			38.7	9.6	4.5	1.3			
30	1,800			54.6	13.6	6.3	1.8			
35	2,100			73.3	18.2	8.4	2.4			
40	2,400			95.0	23.5	10.8	3.1	1.3		
45	2,700				29.4	13.5	3.9	1.6		
50	3,000				36.0	16.4	4.7	1.9		
60	3,600				51.0	23.2	6.6	2.7		
70	4,200				68.8	31.3	8.9	3.6	1.2	
80	4,800				89.2	40.5	11.4	4.6	1.6	
90	5,400					51.0	14.2	5.8	2.0	
100	6,000					62.2	17.4	7.1	2.4	
120	7,200						24.7	10.1	3.4	
140	8,400						33.2	13.5	4.5	1.2
160	9,600						43.0	17.5	5.8	1.5
200	12,000						66.3	27.0	8.9	2.3
260	15,600							45.0	14.8	3.7
300	18,000							59.6	19.5	4.9

Friction loss table - SCH 40 PVC pipe

		.5"	.75"	1"	1.25"	1.5"	2"	2.5"	3"	4"
[US gpm]	[US gph]	ID 0.622"	ID 0.824"	ID 1.049"	ID 1.380"	ID 1.610"	ID 2.067"	ID 2.469"	ID 3.068"	ID 4.026"
		Friction loss in feet of head per 100 feet of pipe								
2	120	4.1								
3	180	8.7	2.2							
4	240	14.8	3.7							
5	300	22.2	5.7	1.8						
6	360	31.2	8.0	2.5						
7	420	41.5	10.6	3.3						
8	480	53.0	13.5	4.2						
9	540	66.0	16.8	5.2						
10	600	80.5	20.4	6.3	1.7					
12	720		28.6	8.9	2.3	1.1				
14	840		38.0	11.8	3.1	1.4				
16	960		48.6	15.1	4.0	1.9				
20	1,200		60.5	22.8	6.0	2.8				
25	1,500			38.7	9.1	4.3	1.3			
30	1,800				12.7	6.0	1.8			
35	2,100				16.9	8.0	2.4			
40	2,400				21.6	10.2	3.0	1.1		
45	2,700				28.0	12.5	3.8	1.4		
50	3,000					15.4	4.6	1.7		
60	3,600					21.6	6.4	2.3		
70	4,200					28.7	8.5	3.0	1.2	
80	4,800					36.8	10.9	3.8	1.4	
90	5,400					45.7	13.6	4.8	1.8	
100	6,000					56.6	16.5	5.7	2.2	
120	7,200						23.1	8.0	3.0	
140	8,400						30.6	10.5	4.0	1.1
160	9,600						39.3	13.4	5.0	1.4
200	12,000						66.3	20.1	7.6	2.1
260	15,600							32.4	12.2	3.4
300	18,000							42.1	15.8	4.4

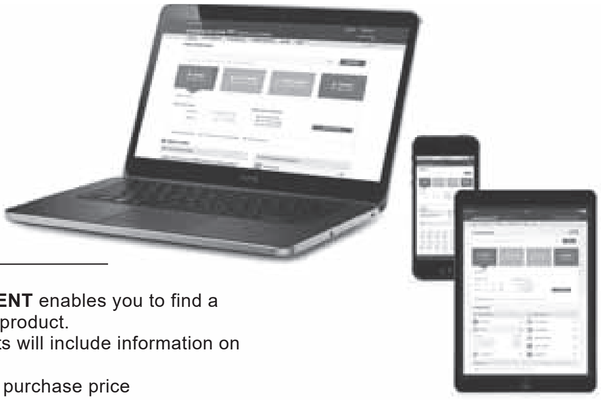
Type of fitting and application	Pipe and fitting	Nominal size of fitting and pipe						
		1/2"	3/4"	1"	1.25"	1.5"	2"	2.5"
		Friction loss in equivalent length of straight pipe in feet						
Insert coupling	Plastic	3	3	3	3	3	3	3
Threaded adapter (plastic to thread)	Plastic	3	3	3	3	3	3	3
90 ° standard elbow	Steel	2	2	3	4	4	5	6
	Plastic	2	2	3	4	4	5	6
Standard tee (flow through run)	Steel	1	2	2	3	3	4	4
	Plastic	1	2	2	3	3	4	4
Standard tee (flow through side)	Steel	4	5	6	7	8	11	13
	Plastic	4	5	6	7	8	11	13
Gate valve[1]	Steel	1	1	1	1	2	2	2
Swing check valve[1]	Steel	5	7	9	12	13	17	21

Notes:
Based on Schedule 40 steel and plastic fittings.
Friction loss figures are for screwed valves and are based on equivalent lengths of steel pipe.

13. Grundfos Product Center

Grundfos Product Center is an online search and sizing tool to help you make the right choice.

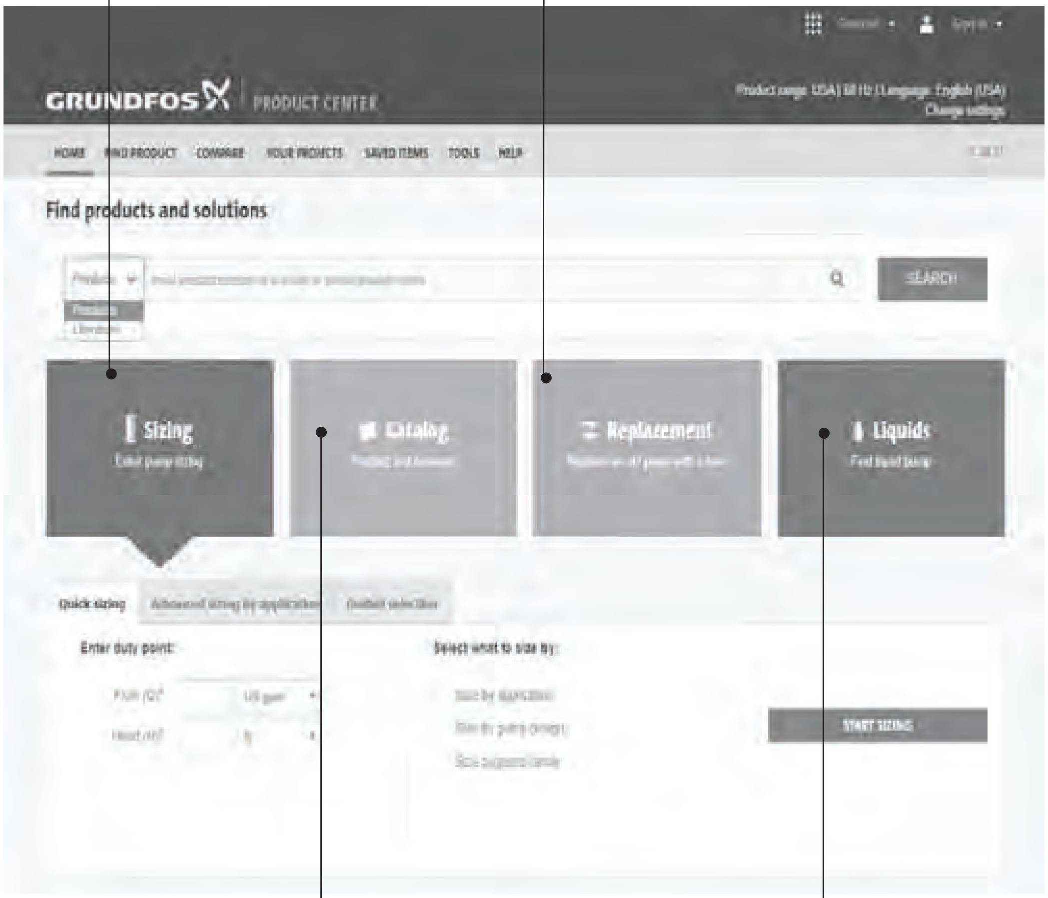
http://product-selection.grundfos.com



SIZING enables you to size a pump based on entered data and selection choices.

REPLACEMENT enables you to find a replacement product.
Search results will include information on

- the lowest purchase price
- the lowest energy consumption
- the lowest total life cycle cost.



CATALOG gives you access to the Grundfos product catalog.

LIQUIDS enables you to find pumps designed for aggressive, flammable or other special liquids.

All the information you need in one place

Performance curves, technical specifications, pictures, dimensional drawings, motor curves, wiring diagrams, spare parts, service kits, 3D drawings, documents, system parts. The Product Center displays any recent and saved items - including complete projects - right on the main page.

Downloads

On the product pages, you can download installation and Operating Instructions, data booklets, service instructions, etc. in PDF format.

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GRUNDFOS **DATA BOOKLET**

SQ, SQE, SQE-NE, CU331SP

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1. Product introduction

3-inch SQ, SQE submersible well pumps for 3-inch and larger wells

SQ, SQE pumps are suitable for both continuous and intermittent operation for a variety of applications:

- Domestic water supply
- light commercial
- irrigation
- tank applications.

Features and benefits

SQ, SQE pumps offer these features:

- Dry-run protection
- high efficiency pump and motor
- protection against up-thrust
- soft-start
- over-voltage and under-voltage protection
- over-temperature protection
- high starting torque.

Additionally, SQE pumps offer these advantages:

- Constant pressure control
- variable speed
- electronic control and communication.

SQ, SQE innovative motor technology

SQ, SQE pumps feature an innovative motor design incorporating permanent-magnet technology. By combining permanent-magnet motors and a Grundfos micro-frequency converter, we are able to deliver unmatched performance and the ability to control and communicate with the pump in ways never before possible. A few of the features that result from this combined technology are Constant Pressure Control, Soft-Start, and Integrated Dry-Run Protection, but these are just a few of the features these pumps offer.

SQ pump models operate at a constant speed much like today’s conventional pumps. The difference is that SQ delivers the benefits of an electronically controlled permanent-magnet motor that cannot be achieved with a conventional induction motor.

SQ pumps are available for single-phase power; a simple 2-wire design makes installation easy.

SQE pumps are equipped with a Grundfos "Smart Motor." Like the SQ models, SQ pumps have a high efficiency permanent-magnet motor — but we add the ability to communicate.

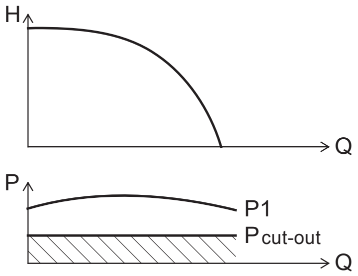
The "Smart Motor" communicates via the CU301 status box through the power leads.

It is not necessary to run any additional wires down the well. Communication with the pump provides Constant Pressure Control and the highly useful ability to change the pump performance while the pump is installed in the well. Like the SQ motor, this is also a 2-wire motor designed for single-phase operation.

Dry-running protection

The pumps are protected against dry running. A value of $P_{cut-out}$ ensures cut-out of the pump in case of lack of water in the borehole thus preventing a burnout of the motor.

$P_{cut-out}$ is factory-set both for the SQ and SQE, SQE-NE pumps.



TM01 2751 2298

Fig. 1 $P_{cut-out}$ curve

High pump efficiency

The hydraulic pump components are polyamide reinforced with 30 % glass fiber. The hydraulic design provides for high pump efficiency resulting in low energy consumption and therefore low energy costs.

High motor efficiency

The motors are based on a permanent magnet rotor (PM motor) featuring high efficiency within a wide load range.

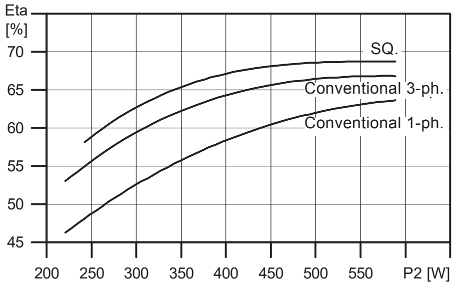


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Fig. 2 Efficiency curves of Grundfos SQ motor versus conventional motors

Wear resistance

The pump design features "floating" impellers (not fastened to the shaft). Each impeller has its own tungsten carbide/ceramic bearing. The construction and materials ensure high wear resistance to sand for long product life.


TM01 3141 3498

Fig. 3 Example of Grundfos floating impeller

Protection against upthrust

Starting up a pump with a very low counter pressure involves the risk of the entire impeller stack being lifted, also called upthrust. Upthrust may cause breakdown of both pump and motor.

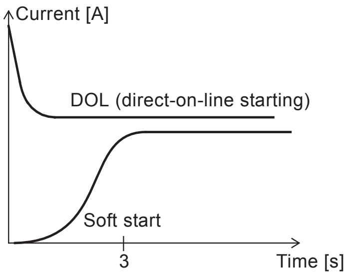
SQ, SQE, SQE-NE motors are fitted with a top bearing protecting both pump and motor against upthrust, thus preventing breakdown during the critical start-up phase.

Excellent starting capabilities

The integrated electronic unit of the motor features soft starting. Soft start reduces the starting current and thus gives the pump a smooth and steady acceleration.

The soft starter minimizes the risk of wear on the pump and prevents overloading of the mains during start-up.

The excellent starting capabilities are a result of the high locked-rotor torque of the permanent magnet motor together with the few pump stages. The high starting reliability also applies in case of low voltage supply.



TM01 3479 4198

Fig. 4 Soft-start feature

Overvoltage and undervoltage protection

Overvoltage and undervoltage may occur in case of unstable voltage supply.

The integrated protection of all motors prevents damage to the motor in case the voltage moves outside the permissible voltage range.

The pump will cut out if the voltage falls below 150 V or rises above 315 V. The motor is automatically cut in again when the voltage again falls within the permissible voltage range. Therefore no extra protection relay is needed.

Overload protection

Exposure of the pump to heavy load causes the current consumption to rise. The motor will automatically compensate for this by reducing the speed to 3000 rpm. Further overload will lead to stop.

If the rotor is being prevented from rotating, this will automatically be detected and the power supply will be cut out. Consequently, no extra motor protection is needed.

Overtemperature protection

A permanent magnet motor gives off very little heat to its surroundings. In combination with an efficient internal circulation system leading the heat away from the rotor, stator and bearings, this ensures optimum operating conditions for the motor.

As an extra protection, the electronic unit has a built-in temperature sensor. When the temperature rises too high, the motor is cut out; when the temperature has dropped, the motor is automatically cut in again.

Reliability

The motors are built for high reliability and feature:

- Tungsten carbide / ceramic bearings
- thrust bearings protecting against downthrust
- product life time equal to conventional AC motors.

Variable speed

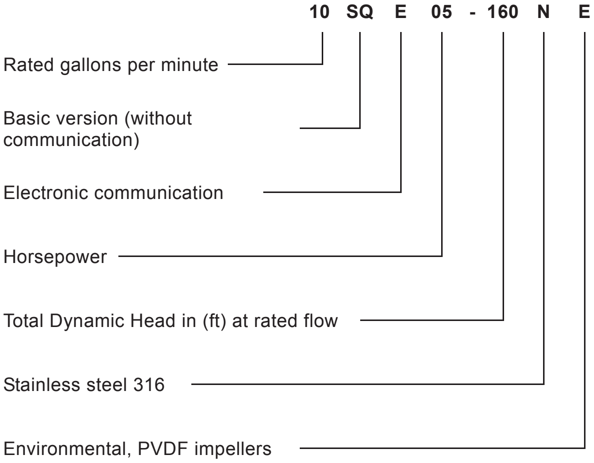
The SQE motor enables continuously variable speed control from 3,000 to 10,700 rpm. The pump can be set to operate in any duty point in the range between the 3,000 and 10,700 rpm performance curves of the pump. Consequently, the pump performance can be adapted to any specific requirement.

The variable speed control facility requires the use of the CU 300 or CU 301 control unit.

For the calculation of pump speed, the program "SQE Speed Calculation" is available on CD-ROM as an accessory.

Identification

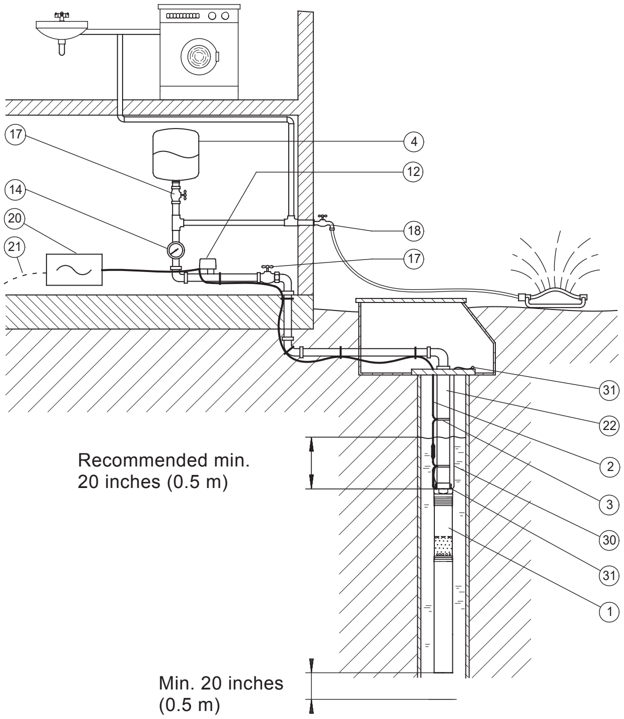
Type key example SQ, SQE, SQE-NE



2. Applications

SQ with pressure switch and pressure tank

SQ is ideally suited for domestic water supply in single- family dwellings or summer homes which are not connected to municipal waterworks. SQ is easy to install and operate.



1	Pump, SQ
2	Cable
3	Cable clips
4	Pressure tank
12	Pressure switch
14	Pressure gauge
17	Isolating valve
18	Tap
20	Mains switch
21	Mains connection
22	Riser pipe
30	Safety cable
31	Wire clamp

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Fig. 5 Application example: SQ with pressure switch and pressure tank

Pos.	Part	Type	No. of units	Product number	Unit price	Total price
1	Pump	SQ				
2	Cable					
3	Cable clips					
4	Pressure tank					
12	Pressure switch					
14	Pressure gauge					
20	Mains switch					
30	Safety cable					
31	Wire clamp					

Constant-pressure control with CU 301 - residential water supply

The system maintains a constant pressure within the maximum pump performance in spite of a varying water consumption.

The pressure is registered by the pressure sensor and transmitted to the CU 301. The CU 301 adjusts the pump performance accordingly.

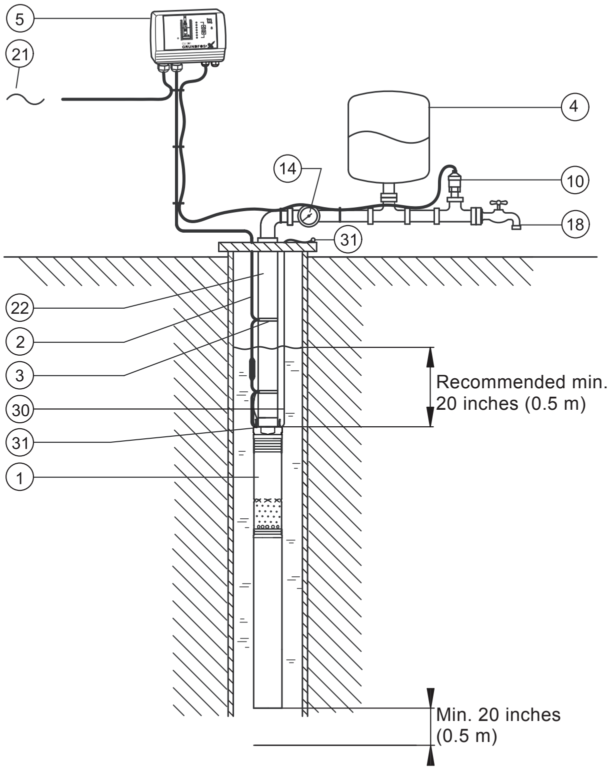
Function

When a tap is opened the pressure in the tank will start to drop. At a flow lower than approximately 1 gpm (0.18 m^3/h), the pressure will drop slowly.

When the pressure in the tank is 7 psi (0.5 bar) below setpoint, the pump will start. The pump will run until the pressure is 7 psi (0.5 bar) above setpoint. This way of operation is called on/off operation.

At a flow higher than approximately 1 gpm (0.18 m^3/h), the pressure will drop quickly and the pump will start immediately and maintain a constant pressure.

During operation, the CU 301 will regulate the pump speed to maintain a constant pressure. If there is no consumption, the pump will boost the pressure to 7 psi (0.5 bar) above setpoint and stop after a few seconds.



1	Pump, SQE
2	Cable
3	Cable clips
4	Pressure tank, 2 gal (8 liters)
5	Control unit, CU 301
10	Pressure sensor, 0 - 120 psi (0 - 6 bar)
14	Pressure gauge
18	Tap
21	Mains connection
22	Riser pipe
30	Safety cable
31	Wire clamp

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Fig. 6 Application example: Constant-pressure control with CU 301 - residential water supply

Pos.	Part	Type	No. of units	Product number	Unit price	Total price
1	Pump	SQE				
2	Cable					
3	Cable clips					
4	Pressure tank	2 gal (8 liters)				
5	Control unit	CU 301				
10	Pressure sensor	0 - 120 psi (0 - 6 bar)				
14	Pressure gauge					
30	Safety cable					
31	Wire clamp					

Constant-pressure control with CU 301 - irrigation

The system maintains a constant pressure within the maximum pump performance in spite of a varying water consumption.

The pressure is registered by means of the pressure sensor and transmitted to the CU 301. The CU 301 adjusts the pump performance accordingly.

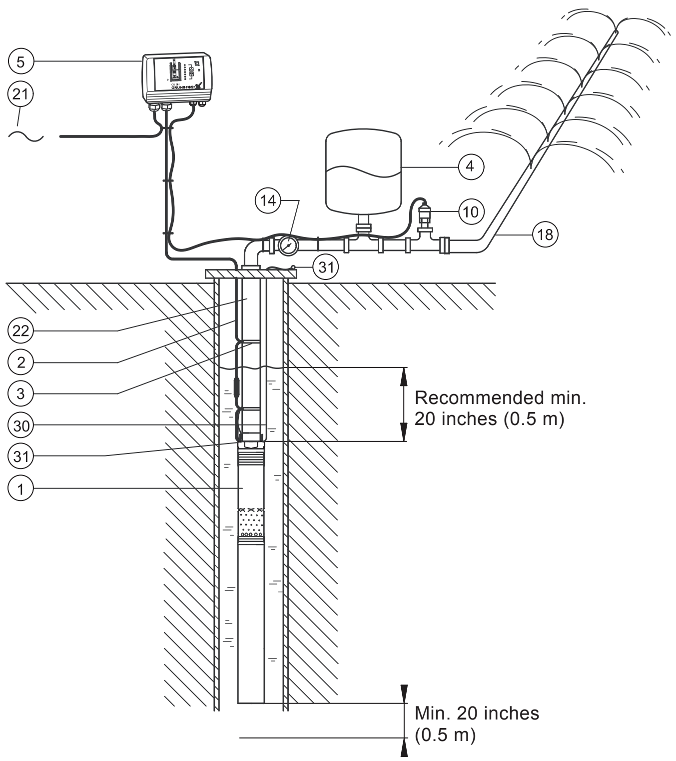
Function

When the sprinkler system is started, the pressure in the tank will start to drop.

At a flow lower than approximately 1 gpm (0.18 m^3/h), the pressure will drop slowly. When the pressure in the tank is 7 psi (0.5 bar) below setpoint, the pump will start. The pump will run until the pressure is 7 psi (0.5 bar) above setpoint. This way of operation is called on/off operation.

At a flow higher than approximately 1 gpm (0.18 m^3/h), the pressure will drop quickly and the pump will start immediately and maintain a constant pressure.

During operation, the CU 301 will regulate the pump speed to maintain a constant pressure. If there is no consumption, the pump will boost the pressure to 7 psi (0.5 bar) above setpoint and stop after a few seconds.



1	Pump, SQE
2	Cable
3	Cable clips
4	Pressure tank 2 gal (8 liter)
5	Control unit, CU 301
10	Pressure sensor, 0 - 120 psi (0-6 bar)
14	Pressure gauge
18	Sprinkler system
21	Mains connection
22	Riser pipe
30	Safety cable
31	Wire clamp

Fig. 7 Application example: Constant-pressure control with CU 301 - irrigation

Pos.	Part	Type	No. of units	Product number	Unit price	Total price
1	Pump	SQE				
2	Cable					
3	Cable clips					
4	Pressure tank	2 gal (8 liter)				
5	Control unit	CU 301				
10	Pressure sensor	0 - 120 psi (0 - 6 bar)				
14	Pressure gauge					
30	Safety cable					
31	Wire clamp					

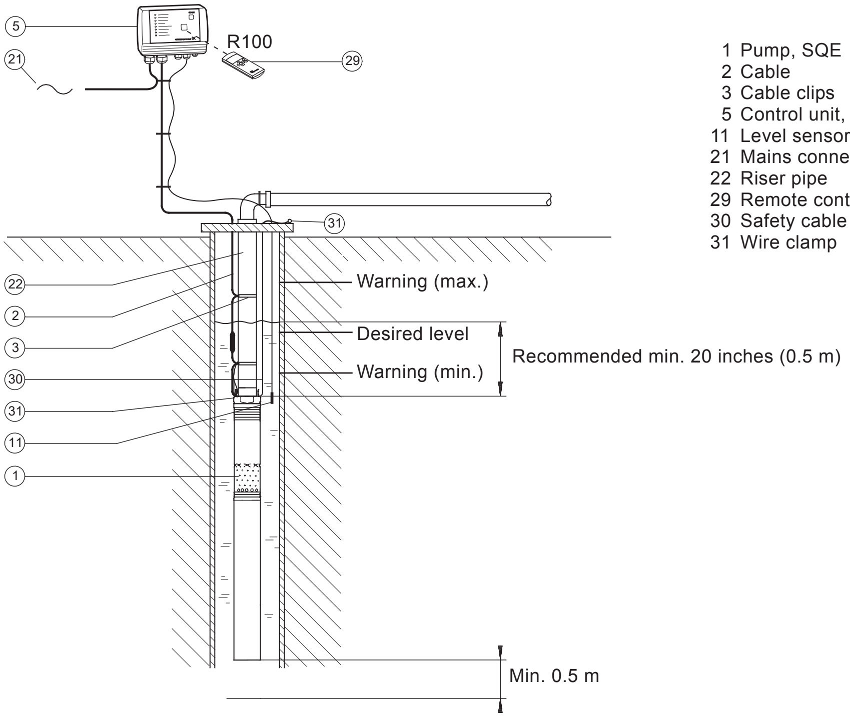
Maintaining a constant water table

A constant water table can be maintained by adjusting pump performance. It may be important to maintain a constant water table, e.g. in connection with keeping out the groundwater on a building site or water remediation projects.

The example shows how to maintain a constant water table by adjusting pump performance.

Sensors

Level	Description	Reaction
Level sensor (pos. 11)		
Warning (max.)	Too high water level. Possible cause: Insufficient pump capacity.	Alarm relay operates.
Desired level	The water level which should be maintained.	
Warning (min.)	Too low water level. Possible cause: Too high pump capacity.	Alarm relay operates.



1	Pump, SQE
2	Cable
3	Cable clips
5	Control unit, CU 300
11	Level sensor
21	Mains connection
22	Riser pipe
29	Remote control, R100
30	Safety cable
31	Wire clamp

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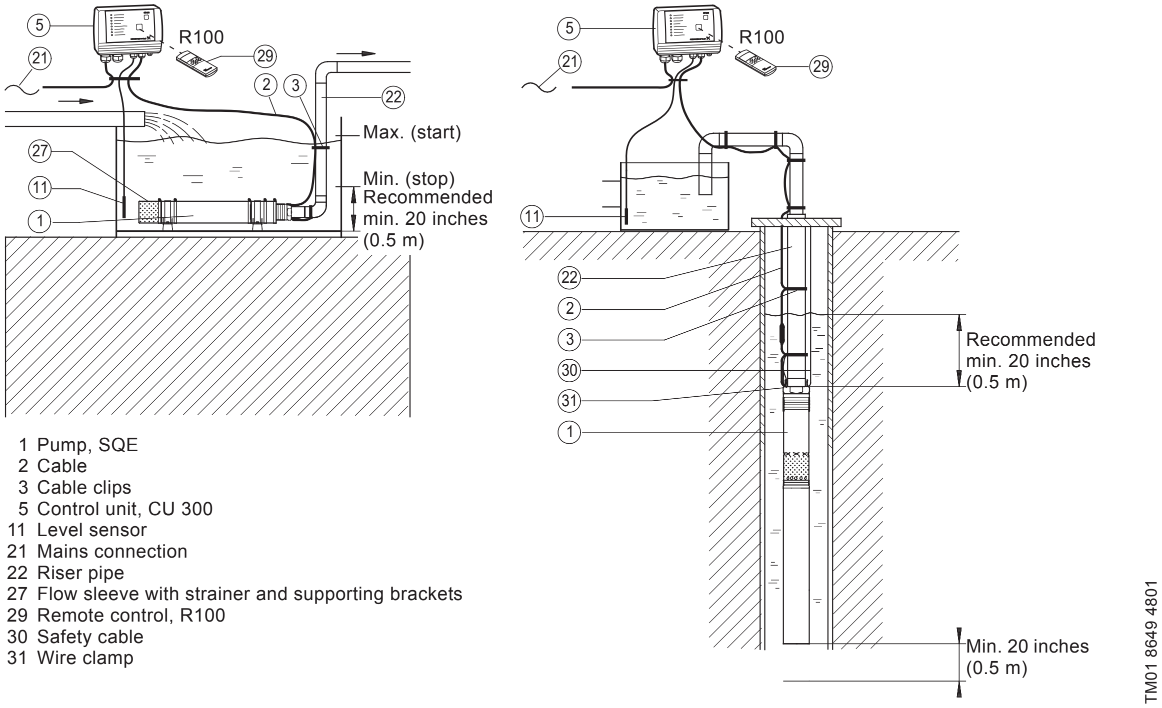
Fig. 8 Application example: Maintaining a constant water table

Pos.	Part	Type	No. of units	Product number	Unit price	Total price
1	Pump	SQE				
2	Cable					
3	Cable clips					
5	Control unit	CU 300				
11	Level sensor					
29	Remote control	R100				
30	Safety cable					
31	Wire clamp					

Emptying or filling a tank

The SQE pump with CU 300 is ideal for emptying or filling a tank.



1 Pump, SQE
2 Cable
3 Cable clips
5 Control unit, CU 300
11 Level sensor
21 Mains connection
22 Riser pipe
27 Flow sleeve with strainer and supporting brackets
29 Remote control, R100
30 Safety cable
31 Wire clamp

Fig. 9 Application example: Emptying or filling a tank

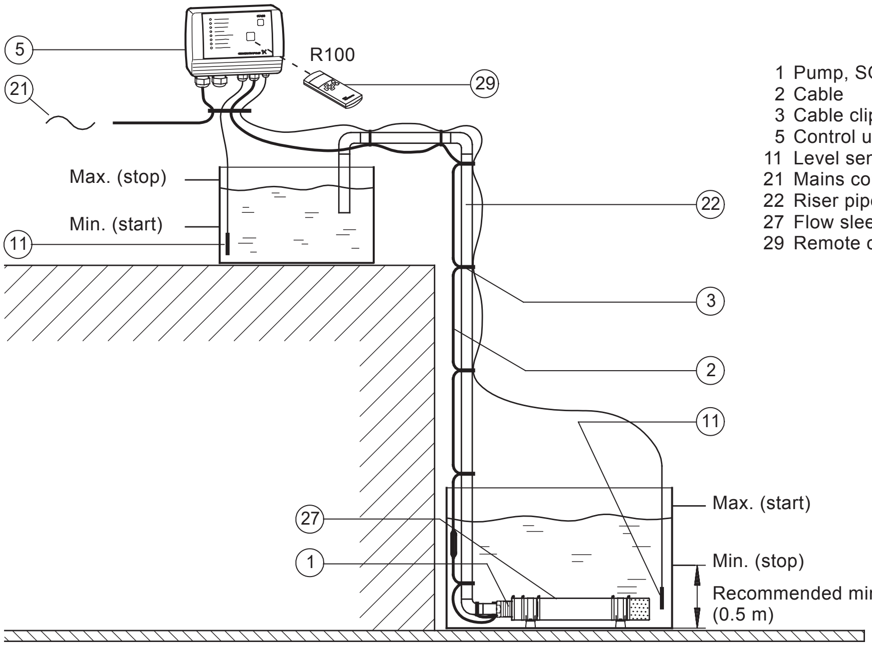
Pos.	Part	Type	No. of units	Product number	Unit price	Total price
1	Pump	SQE				
2	Cable					
3	Cable clips					
5	Control unit	CU 300				
11	Level sensor					
22	Riser pipe					
27	Flow sleeve with strainer and supporting brackets					
29	Remote control	R100				
30	Safety cable					
31	Wire clamp					

Pumping from one tank to another

The SQE pump is ideal for pumping water from one tank to another.

Sensors

Level	Description	Light indication on CU 300
Level sensor (pos. 11, tank at top)		
Max. (stop)	When the water has reached this level, the pump stops.	Green indicator light in on/off button is flashing.
Min. (start)	When the water has dropped to this level, the pump starts.	Green indicator light in on/off button is permanently on.
Level sensor (pos. 11, tank at bottom)		
Max. (start)	When the water has reached this level, the pump starts.	Green indicator light in on/off button is on.
Min. (stop)	When the water has dropped to this level, the pump stops.	Green indicator light in on/off button is flashing.



1 Pump, SQE
2 Cable
3 Cable clips
5 Control unit, CU 300
11 Level sensor
21 Mains connection
22 Riser pipe
27 Flow sleeve with strainer and supporting brackets
29 Remote control, R100

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Fig. 10 Application example: Pumping from one tank to another

Pos.	Part	Type	No. of units	Product number	Unit price	Total price
1	Pump	SQE				
2	Cable					
3	Cable clips					
5	Control unit	CU 300				
11	Level sensor					
27	Flow sleeve with strainer and supporting brackets					
29	Remote control	R100				

Setting of operating parameters

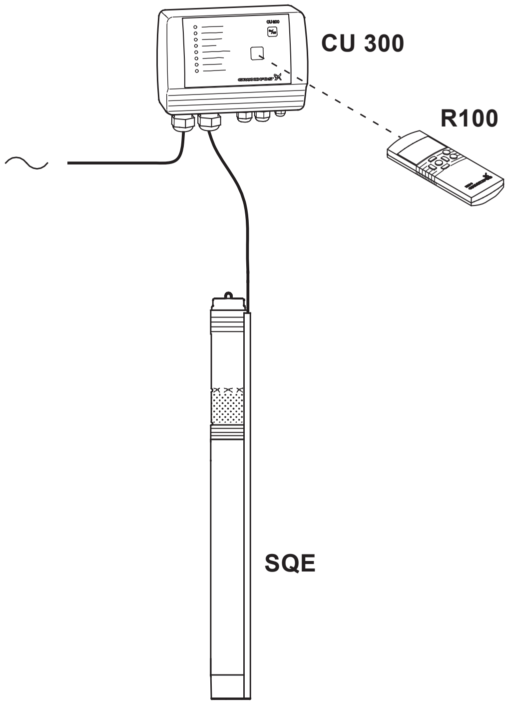
Using the R100 and the CU 300 enables change of the motor speed and thereby setting of the pump to a specific performance.

The software program "SQE Speed Calculation" has been developed for the calculation of the speed in order to obtain the required flow rate and head.

Dry-running protection

The value $P_{cut\text{-}out,}$ ensuring dry-running protection, is factory-set for the SQE pump.

If the speed of the SQE pump is reduced by more than 1000 rpm, the $P_{cut\text{-}out}$ value must be readjusted by means of the CU 300 and R100.



Note: The SQE pump must not be started until the pump has been completely submerged below the water table. However, the change of the motor speed can be made even if the pump is not submerged.

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Fig. 11 Application example: Workshop setting of operating parameters

Part	Type	No. of units	Product number	Unit price	Total price
Pump	SQE				
Remote control	R100				
Control unit	CU 300				
SQE Speed Calculation program					

SQE with manual speed control

Functioning and benefits

Manual speed control of the SQE pumps is possible by means of R100 and an SPP 1 potentiometer.

This application is especially suitable for sampling from groundwater monitoring wells. The monitoring well is purged at high speed and the sample is taken at a low speed (quiet flow). For contaminated groundwater the SQE-NE type range is recommended.

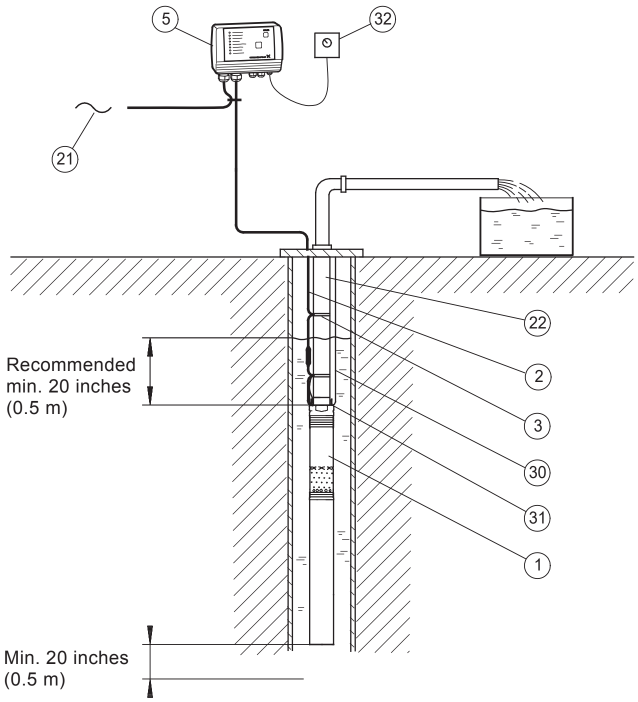
In case frequent sampling is required, dedicated installation of the pump is recommended, thus eliminating wear caused by frequent assembly and dismantling the installation.

Furthermore, dedicated installations saves the costs of assembling and dismantling the installation.

Important: Through dedicated installation the transfer of contamination from one monitoring well to another is avoided.

Dry-running protection

The value $P_{\text{cut out}}$, ensuring dry-running protection, is factory-set for the SQE pump. If the speed of the pump is reduced more than 1,000 rpm, the value of $P_{\text{cut out}}$ must be readjusted by means of CU 300 and R100.



1	SQE pump
2	Cable
3	Cable clips
5	Control unit, CU 300
21	Mains connection
22	Riser pipe
30	Stainless-steel safety cable
31	Stainless-steel wire clamps, 2 per lifting eye
32	Potentiometer, SPP 1

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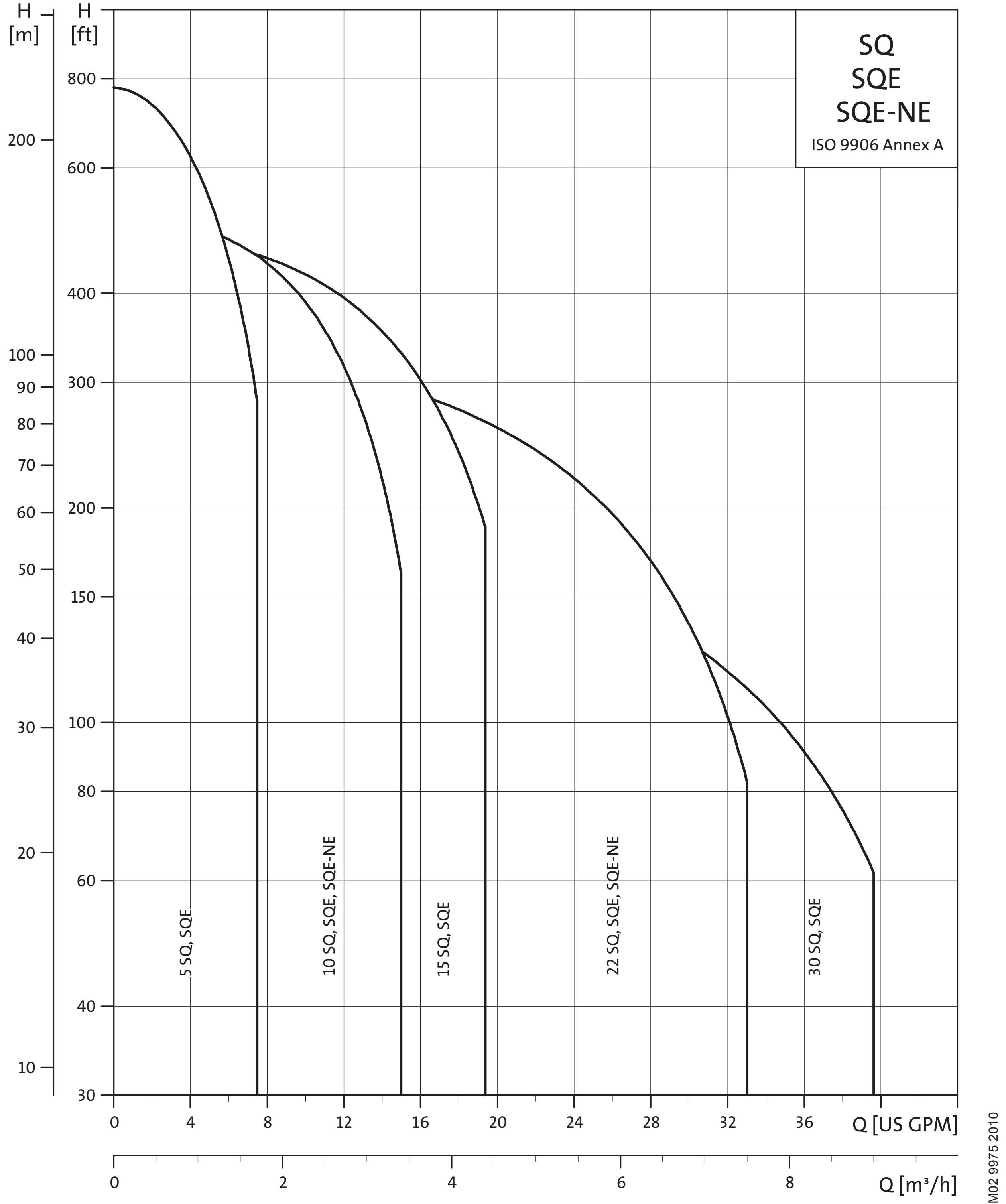
Fig. 12 Application example: Sampling/manual speed control of SQE

Pos.	Part	Type	No. of units	Product number	Unit price	Total price
1	Pump	SQE				
2	Cable					
3	Cable clips					
5	Control unit	CU 300				
22	Riser pipe					
30	Stainless-steel safety cable					
31	Wire clamps	2 per lifting eye				
32	Potentiometer	SPP 1				

3. Performance range



4. Installation

The SQ and SQE, SQE-NE may be installed vertically, horizontally or in any position in between.

Note: The pump must not fall below the horizontal level in relation to the motor.

The following features ensure simple installation of the pump:

- Built-in check valve with spring
- low weight ensuring user-friendly handling
- installation in 3" or larger boreholes
- only on/off switch is needed, which means that no extra motor starter / starter box is necessary.

For horizontal installation a flow sleeve is recommended in order to:

- ensure sufficient flow velocity past the motor and thus provide sufficient cooling
- prevent motor and electronic unit from being buried in sand or mud.

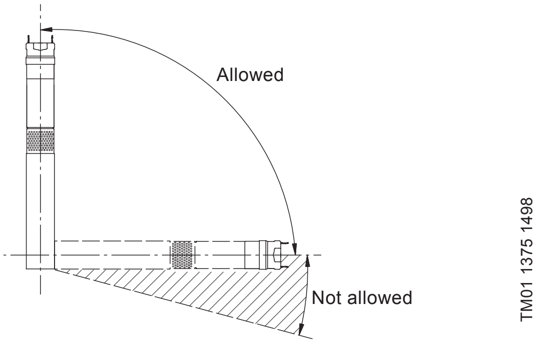


Fig. 13 SQE installation

5. Sizing and selection

System sizing guide

Step 1

Calculate minimum head requirements at no flow conditions:

H_{max} (required) = dynamic head + system pressure (in feet) + above grade elevation + friction loss

Step 2

Select pump from chart as follows:

- Choose model family based on the desired flow rate (i.e. 15SQE for a flow rate of 15 gpm)
- Select the first model with a value in Column 2 greater than the H_{max} calculated in Step 1 (For example: the choice for a 22 gpm model with an H_{max} of 140 ft would be the 22SQE-160).
- Double check your selection in the performance curves; see *7. SQ curve charts* on p. 18.

System sizing matrix

	Column 1	Column 2
Pump type Model B	**Shutoff head (0 gpm) @ 3000 rpm min. speed**	**Head @ rated gpm @ 10700 rpm max. speed**
	TDH [feet]	**TDH [feet]**
5SQE-90	11	86
5SQE-140	17	131
5SQE-180	22	177
5SQE-230	28	222
5SQE-270	34	270
5SQE-320	39	315
5SQE-360	45	360
5SQE-410	51	405
5SQE-450	56	450
10SQE-110	12	105
10SQE-160	17	164
10SQE-200	23	215
10SQE-240	29	267
10SQE-290	34	328
10SQE-330	40	390
15SQE-70	10	75
15SQE-110	14	123
15SQE-150	19	164
15SQE-180	24	205
15SQE-220	29	246
15SQE-250	33	287
15SQE-290	38	328
22SQE-40	5	36
22SQE-80	9	77
22SQE-120	14	117
22SQE-160	18	159
22SQE-190	23	200
22SQE-220	27	240
30SQE-40	5	33
30SQE-90	11	82
30SQE-130	16	126

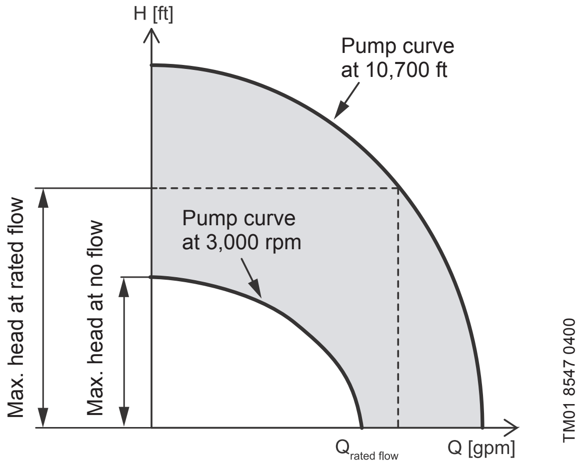


Fig. 14 Recommended sizing

Note: All calculated head requirements must lie between the selected pump models minimum and maximum speed curves.

6. Cable sizing

Cable sizing chart

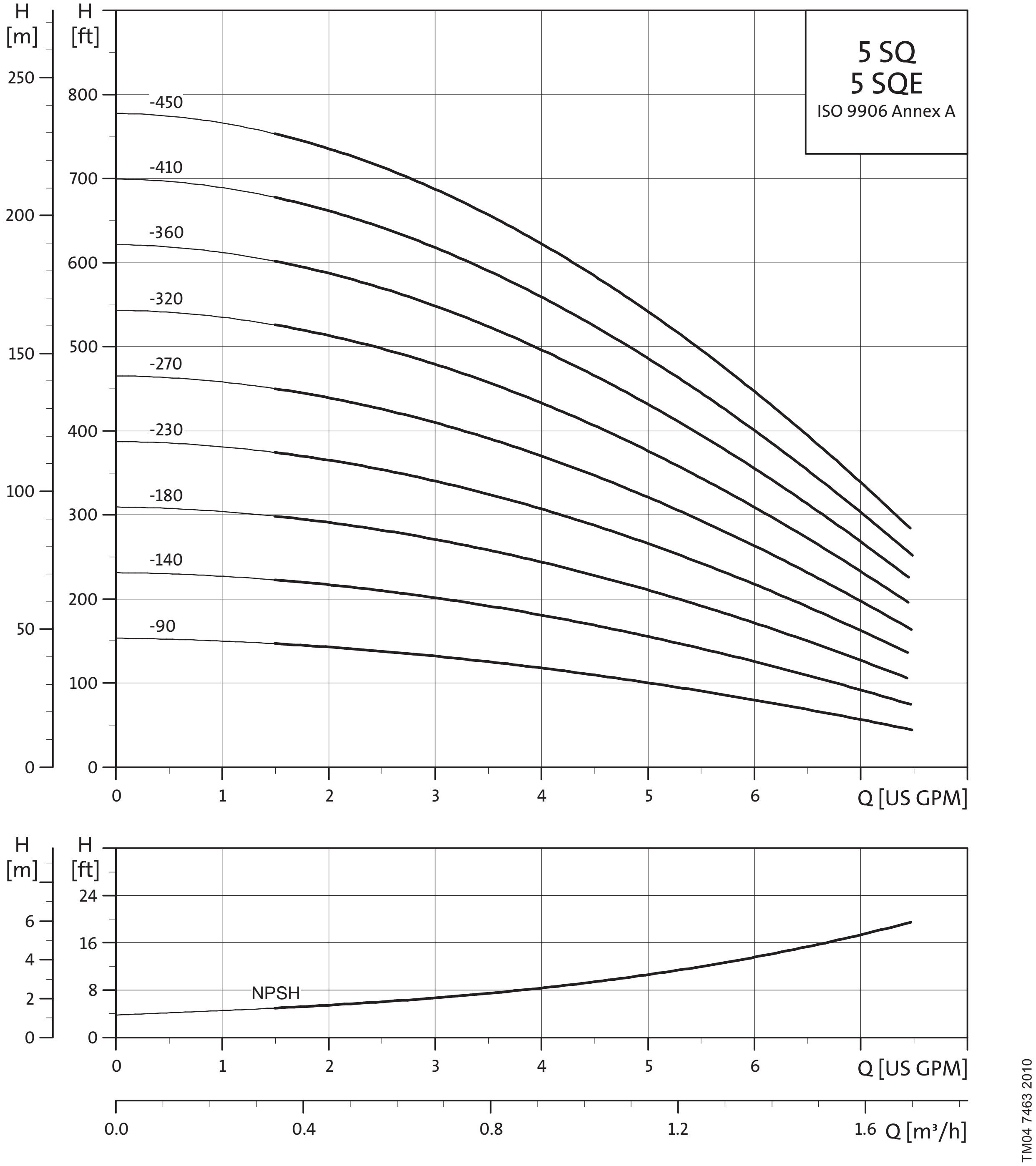
Motor rating			Copper wire size (AWG)						
Volts	**Hp**	**Amps**	**14**	**12**	**10**	**8**	**6**	**4**	**2**
115	0.5	12	140	220	360	550	880	1390	2260
230	0.5	5.2	640	1000	1660	2250	4060	—	—
230	0.75	8.4	400	620	1030	1580	2510	3970	—
230	1	11.2	300	460	770	1190	1890	2980	4850
230	1.5	12	280	430	720	1110	1760	2780	4530

Cable length in feet.

Note: shaded values do not apply when using a CU 301 as its max. recommended cable length is 650 ft.

7. SQ curve charts

5 SQ, SQE



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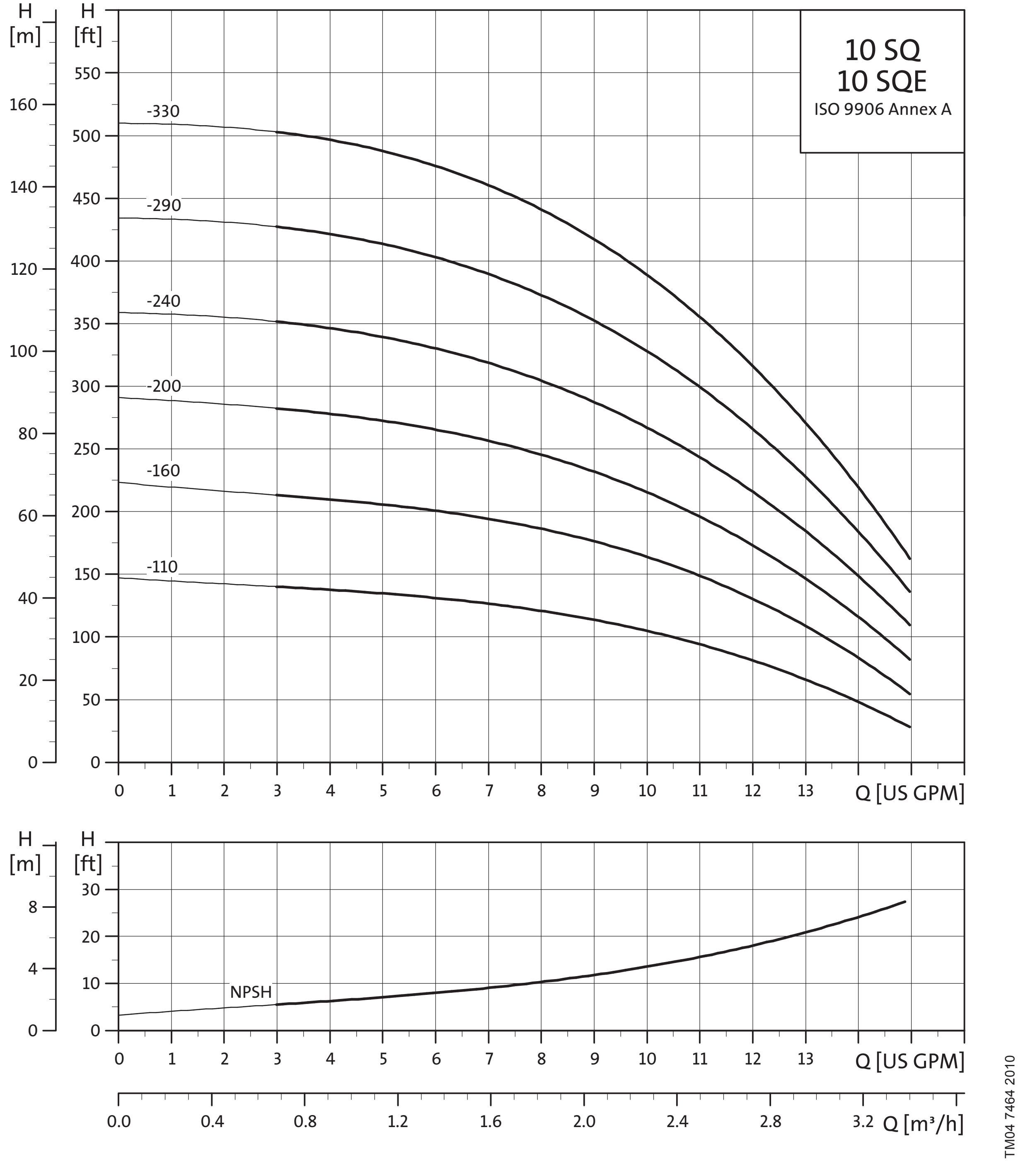
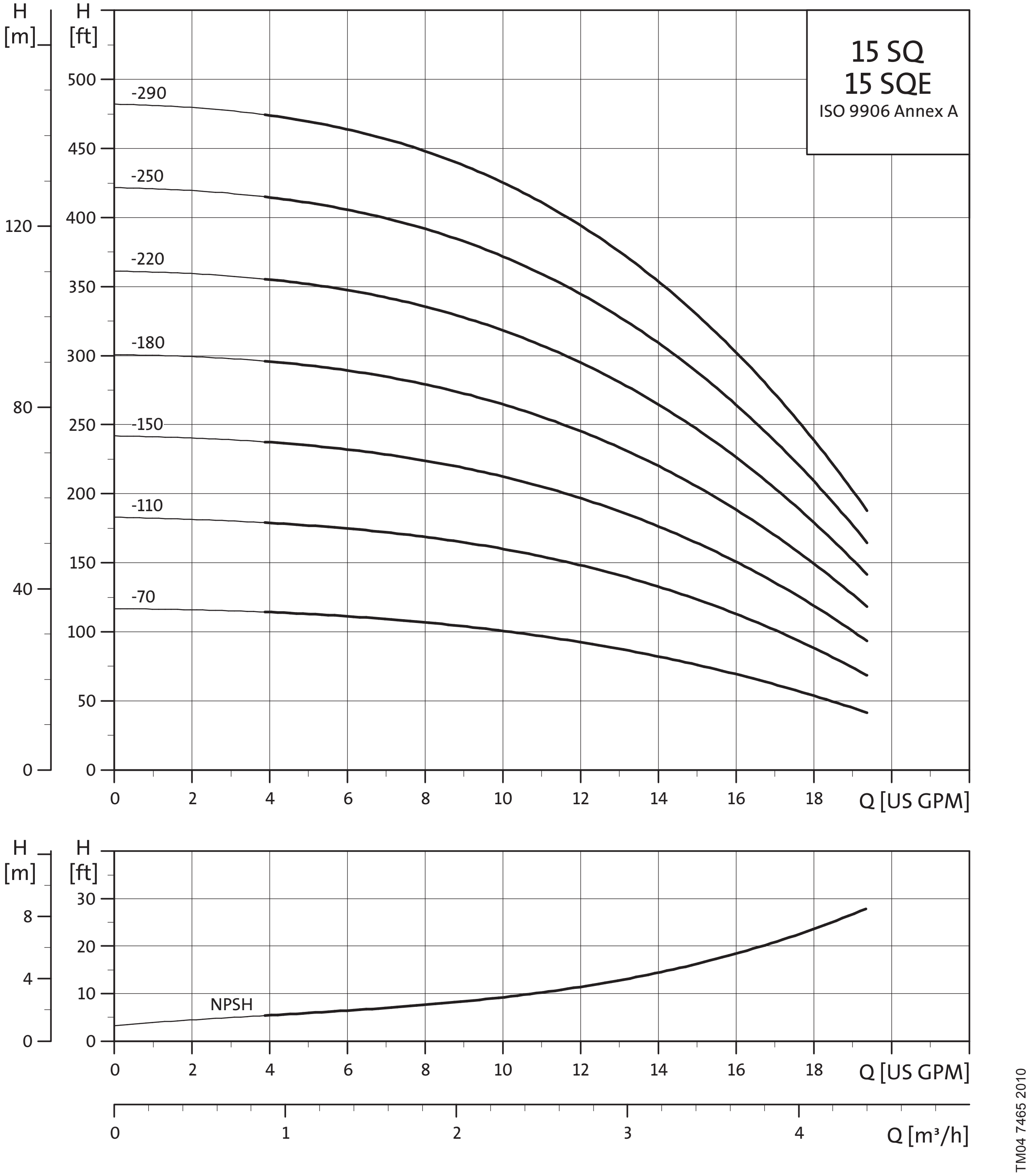
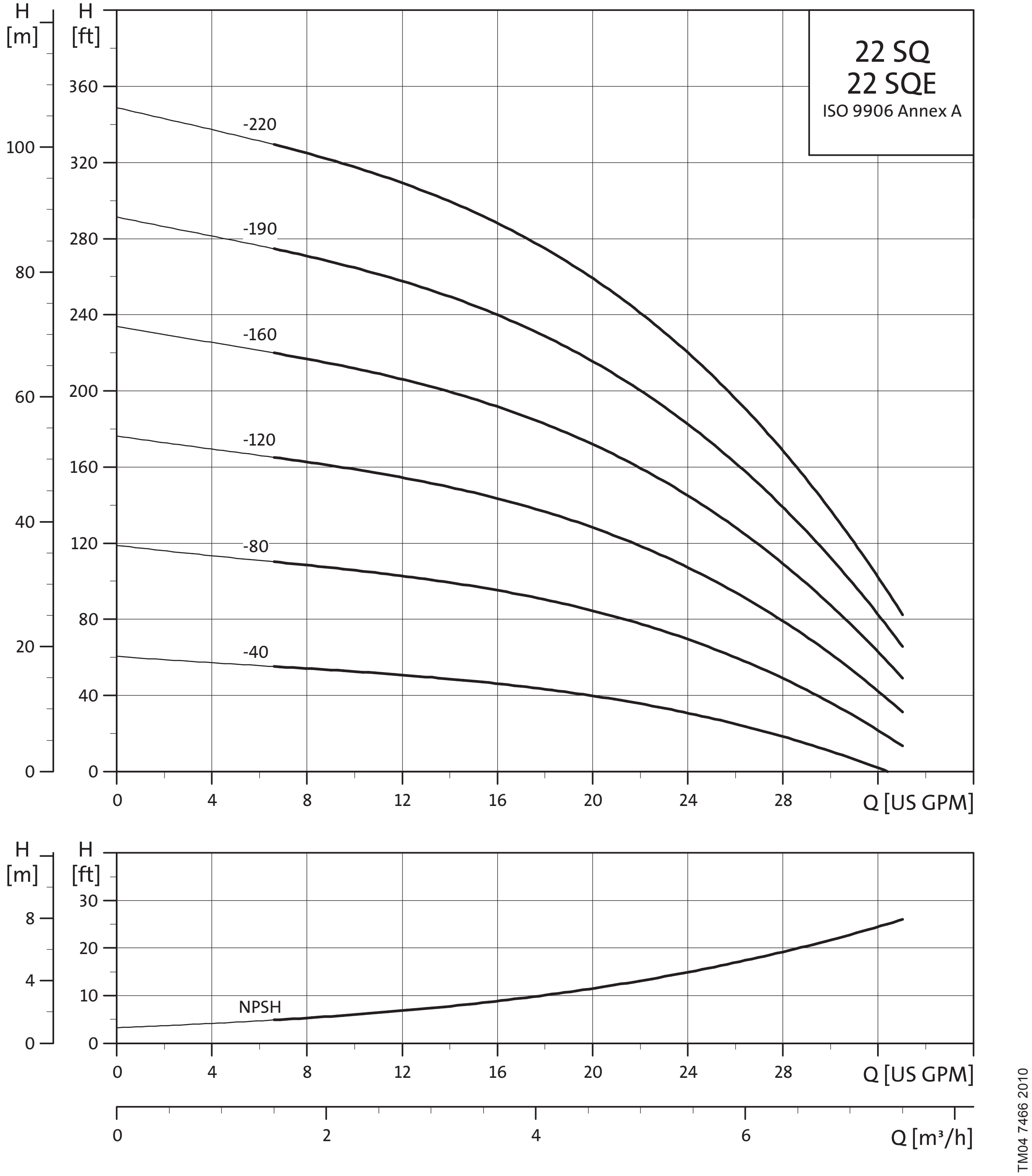
10 SQ, SQE


10 SQ
10 SQE
ISO 9906 Annex A
H [m]
H [ft]
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250
300
350
400
450
500
550
-330
-290
-240
-200
-160
-110
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Q [US GPM]
H [m]
H [ft]
0
4
8
0
10
20
30
NPSH
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Q [US GPM]
0.0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
Q [m³/h]
TM04 7464 2010

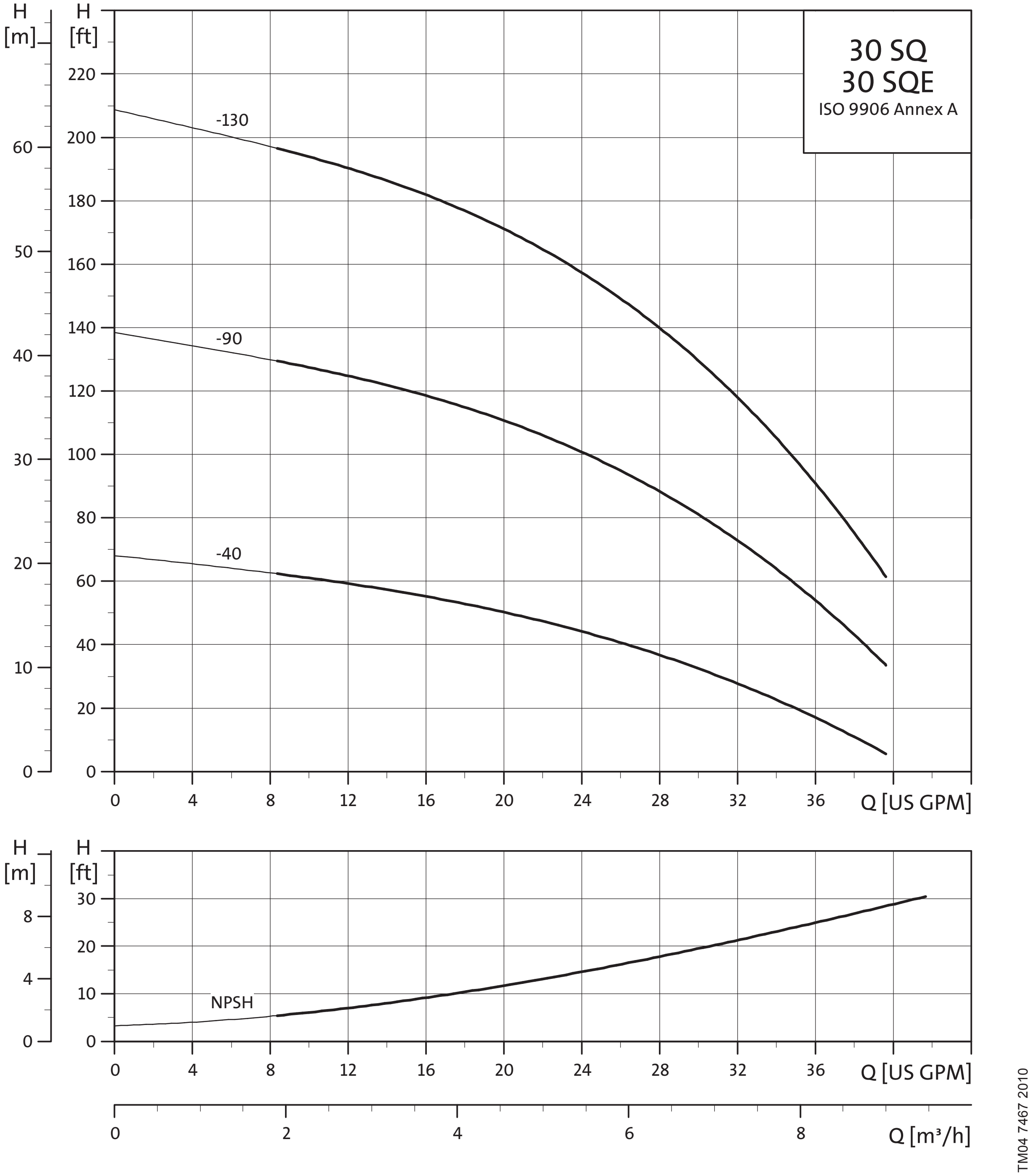
15 SQ, SQE


H [m]
H [ft]
15 SQ
15 SQE
ISO 9906 Annex A
-290
-250
-220
-180
-150
-110
-70
0
40
80
120
0
50
100
150
200
250
300
350
400
450
500
0
2
4
6
8
10
12
14
16
18
Q [US GPM]
H [m]
H [ft]
0
4
8
0
10
20
30
NPSH
Q [US GPM]
0
1
2
3
4
Q [m³/h]
TM04 7465 2010

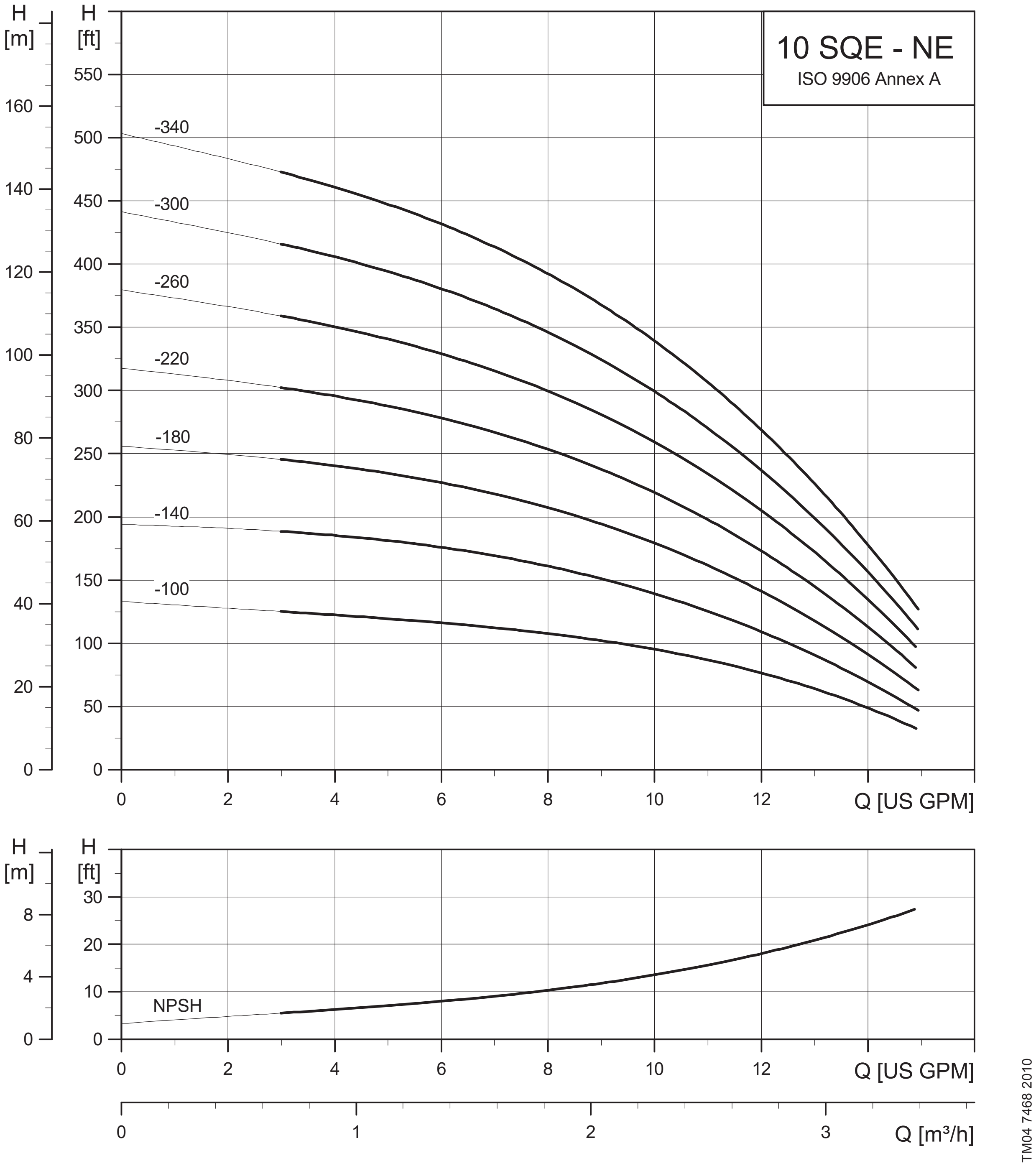
22 SQ, SQE


22 SQ
22 SQE
ISO 9906 Annex A
H [m]
H [ft]
-220
-190
-160
-120
-80
-40
NPSH
0
20
40
60
80
100
0
40
80
120
160
200
240
280
320
360
0
4
8
12
16
20
24
28
Q [US GPM]
H [m]
H [ft]
0
4
8
0
10
20
30
0
2
4
6
Q [m³/h]
TM04 7466 2010

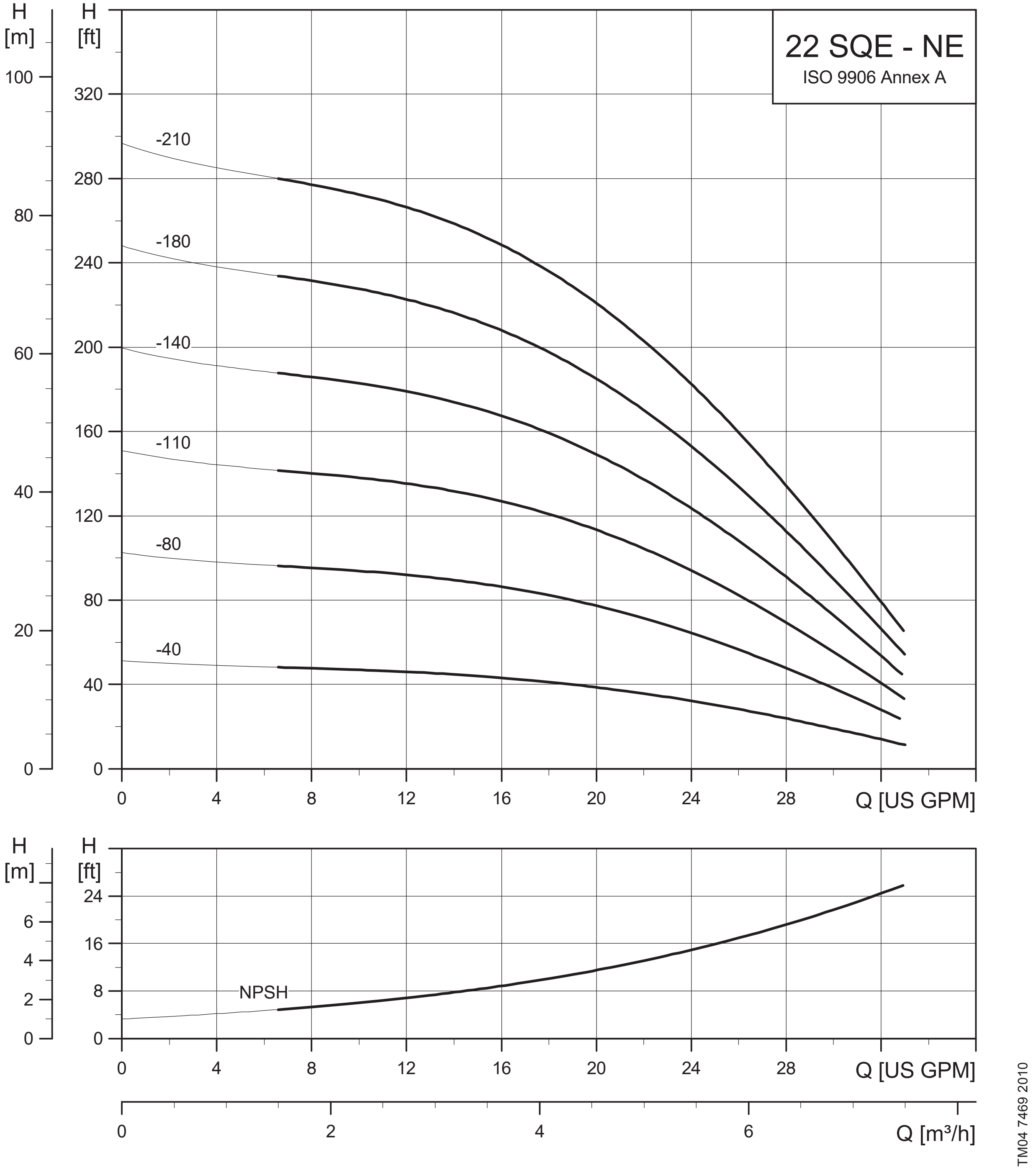
30 SQ, SQE


30 SQ
30 SQE
ISO 9906 Annex A
H [m]
H [ft]
0
10
20
30
40
50
60
0
20
40
60
80
100
120
140
160
180
200
220
-130
-90
-40
0
4
8
12
16
20
24
28
32
36
Q [US GPM]
H [m]
H [ft]
0
4
8
0
10
20
30
NPSH
Q [US GPM]
0
2
4
6
8
Q [m³/h]
TM04 7467 2010

10 SQE-NE


10 SQE - NE
ISO 9906 Annex A
H [m]
H [ft]
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250
300
350
400
450
500
550
-340
-300
-260
-220
-180
-140
-100
0
2
4
6
8
10
12
Q [US GPM]
H [m]
H [ft]
0
4
8
0
10
20
30
NPSH
0
2
4
6
8
10
12
Q [US GPM]
0
1
2
3
Q [m³/h]
TM04 7468 2010

22 SQE-NE


22 SQE - NE
ISO 9906 Annex A
H [m]
H [ft]
100
80
60
40
20
0
320
280
240
200
160
120
80
40
0
-210
-180
-140
-110
-80
-40
0
4
8
12
16
20
24
28
Q [US GPM]
H [m]
H [ft]
6
4
2
0
24
16
8
0
NPSH
0
4
8
12
16
20
24
28
Q [US GPM]
0
2
4
6
Q [m³/h]
TM04 7469 2010

8. Technical data

Electrical data

Supply voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE 1x100-115V +6%/-10%, 50/60 Hz, PE
Operation via generator:	As a minimum, the generator output must be equal to the motor P1[kw] + 10%
Starting current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft Start
Run-up time:	Maximum: 2 seconds
Motor protection:	Motor is protected against: – Dry running – overvoltage – undervoltage – overload – overtemperature.
Power factor:	PF=1
Motor cable:	3 wire, 14AWG XLPE, 5 ft
Motor liquid:	Type SML 2
pH Values:	SQ and SQE: 5 to 9 SQE-NE: 2 to 13
Liquid temperature:	The temperature of the pumped liquid must not exceed 86 °F (30 °C)

Note: If liquids with a viscosity higher than that of water are to be pumped, please contact Grundfos.

Control units CU 300 and CU 301

Voltage:	1 x 100-240 V – 10 %/+ 6 %, 50/60 Hz, PE
Power consumption:	5 W
Current consumption:	Maximum 130 mA
Enclosure class:	IP 55
Ambient temperature:	During operation: –22 °F to +122 °F (–30 °C to +50 °C) During storage: –22 °F to 140 °F (–30 °C to +60 °C)
Relative air humidity:	95 %.
Pump cable:	Maximum length between CU 300 or CU 301 and pump: 650 ft (198 m)
Back-up fuse:	Maximum: 16 A
Radio noise:	CU 300 and CU 301 comply with EMC Directive 89/336/EEC. Approved according to the standards EN 55014 and EN 55014-2
Marking:	CE, cUL (CU 301)
Load:	Max. 100 mA

Operating conditions

Minimum ambient fluid temperature:	+34 °F (+1 °C)
Maximum ambient fluid temperature:	+86 °F (+30 °C)
Well diameter:	3-inch or larger
Installation depth (maximum):	500 feet below static water level

Storage conditions

Minimum ambient temperature:	–4 °F (–20 °C)
Maximum ambient temperature:	+140 °F (+60 °F)
Frost protection:	If the pump has to be stored after use, it must be stored at a frost-free location, or it must be ensured that the motor liquid is frost-proof.

Motor data

Pump type	Hp	Voltage	Full load amps		Overload amps		Min. well diameter	Discharge
			230V	115V	230V	115V		
5SQE05-90	1/2	230V / 115V	2.1	4.2	5	11	3"	1" NPT
5SQE05-140	1/2	230V / 115V	2.9	6.0	5	11	3"	1" NPT
5SQE05-180	1/2	230V / 115V	3.7	7.7	5	11	3"	1" NPT
5SQE07-230	3/4	230V	4.6	-	8	-	3"	1" NPT
5SQE07-270	3/4	230V	5.3	-	8	-	3"	1" NPT
5SQE07-320	3/4	230V	6.2	-	8	-	3"	1" NPT
5SQE10-360	1	230V	7.2	-	11	-	3"	1" NPT
5SQE10-410	1	230V	8.1	-	11	-	3"	1" NPT
5SQE15-450	1 1/2	230V	9.2	-	12	-	3"	1" NPT
10SQE05-110	1/2	230V / 115V	2.9	6.1	5	11	3"	1 1/4" NPT
10SQE05-160	1/2	230V / 115V	4.1	8.6	8	11	3"	1 1/4" NPT
10SQE07-200	3/4	230V	5.3	-	8	-	3"	1 1/4" NPT
10SQE7-240	3/4	230V	6.0	-	8	-	3"	1 1/4" NPT
10SQE10-290	1	230V	7.7	-	11	-	3"	1 1/4" NPT
10SQE15-330	1 1/2	230V	8.9	-	12		3"	1 1/4" NPT
15SQE05-70	1/2	230V / 115V	2.9	6.0	5	11	3"	1 1/4" NPT
15SQE05-110	1/2	230V / 115V	4.0	8.3	5	11	3"	1 1/4" NPT
15SQE07-150	3/4	230V	5.1	-	8	-	3"	1 1/4" NPT
15SQE07-180	3/4	230V	6.2	-	8	-	3"	1 1/4" NPT
15SQE10-220	1	230V	7.4	-	11	-	3"	1 1/4" NPT
15SQE10-250	1	230V	8.4	-	11	-	3"	1 1/4" NPT
15SQE15-290	1 1/2	230V	9.7	-	12	-	3"	1 1/4" NPT
22SQE05-40	1/2	230V / 115V	1.9	3.9	5	-	3"	1 1/2" NPT
22SQE05-80	1/2	230V / 115V	3.4	7.2	5	-	3"	1 1/2" NPT
22SQE07-120	3/4	230V	4.9	-	8	-	3"	1 1/2" NPT
22SQE10-160	1	230V	6.4	-	8	-	3"	1 1/2" NPT
22SQE10-190	1	230V	7.9	-	11	-	3"	1 1/2" NPT
22SQE15-220	1 1/2	230V	9.5	-	12	-	3"	1 1/2" NPT
30SQE05-40	1/2	230V / 115V	2.8	5.7	5	-	3"	1 1/2" NPT
30SQE07-90	3/4	230V	5.2	-	8	-	3"	1 1/2" NPT
30SQE10-130	1	230V	7.6	-	11	-	3"	1 1/2" NPT

Dimensions and weights

SQ, SQE

Model	Hp	Motor size	Discharge size	Dimensions in inches					Approx. ship. wt.
				A	B	C	D	E	
5SQ/SQE05-90	1/2	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5SQ/SQE05-140	1/2	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5SQ/SQE05-180	1/2	3"	1" NPT	31.5	19.8	11.6	2.6	2.9	12
5SQ/SQE07-230	3/4	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5SQ/SQE07-270	3/4	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5SQ/SQE07-320	3/4	3"	1" NPT	34.6	19.8	14.8	2.6	2.9	13
5SQ/SQE10-360	1	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5SQ/SQE10-410	1	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5SQ/SQE15-450	1 1/2	3"	1" NPT	39.3	21.3	18.0	2.6	2.9	16
10SQ/SQE05-110	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10SQ/SQE05-160	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10SQ/SQE07-200	3/4	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
10SQ/SQE07-260	3/4	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
10SQ/SQE10-290	1	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
10SQ/SQE15-330	1 1/2	3"	1 1/4" NPT	36.14	21.3	14.8	2.6	2.9	16
15SQ/SQE05-70	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
15SQ/SQE05-110	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
15SQ/SQE07-150	3/4	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
15SQ/SQE07-180	3/4	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
15SQ/SQE10-220	1	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
15SQ/SQE10-250	1	3"	1 1/4" NPT	36.1	21.3	14.8	2.6	2.9	16
15SQ/SQE10-290	1 1/2	3"	1 1/4" NPT	38.2	21.3	16.9	2.6	2.9	16
22SQ/SQE05-40	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22SQ/SQE05-80	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22SQ/SQE07-120	3/4	3"	1 1/2" NPT	31.5	19.8	11.6	2.6	2.9	13
22SQ/SQE10-160	1	3"	1 1/2" NPT	33.6	19.8	13.7	2.6	2.9	13
22SQ/SQE10-190	1	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16
22SQ/SQE15-220	1 1/2	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16
30SQ/SQE05-40	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
30SQ/SQE07-90	3/4	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	13
30SQ/SQE10-130	1	3"	1 1/2" NPT	35.0	21.3	13.7	2.6	2.9	13

SQE-NE

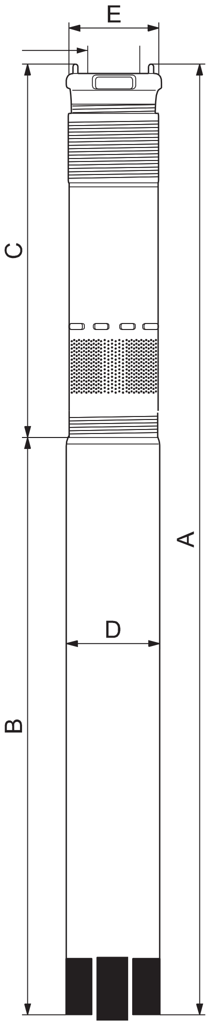
10SQE-05-100NE	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10SQE-05-140NE	1/2	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10SQE-05-180NE	3/4	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
10SQE-07-220NE	3/4	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
10SQE-10-260NE	1	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
10SQE-10-300NE	1	3"	1 1/4" NPT	36.1	21.3	14.8	2.6	2.9	16
10SQE-10-340NE	1	3"	1 1/4" NPT	38.2	21.3	16.9	2.6	2.9	16
22SQE05-40NE	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22SQE05-80NE	1/2	3"	1 1/2" NPT	30.4	19.8	10.6	2.6	2.9	12
22SQE07-110NE	3/4	3"	1 1/2" NPT	31.5	19.8	11.6	2.6	2.9	13
22SQE07-140NE	3/4	3"	1 1/2" NPT	33.6	19.8	13.7	2.6	2.9	13
22SQE10-180NE	1	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16
22SQE10-210NE	1	3"	1 1/2" NPT	38.2	21.3	16.9	2.6	2.9	16

9. Construction

Materials of construction

SQ, SQE	
Component	**Splined shaft**
Valve casing	Polyamide
Discharge chamber	304 stainless steel
Valve guide	Polyamide
Valve spring	316LN stainless steel
Valve cone	Polyamide
Valve seat	NBR rubber
O-ring	NBR rubber
Lock ring	310 stainless steel
Top bearing	NBR rubber
Top chamber	Polyamide
Guide vanes	Polyamide
Impeller	Polyamide w/ tungsten carbide bearings
Bottom chamber	Polyamide
Neck ring	TPU / PBT
Bearing	Aluminum oxide
Suction interconnector	Polyamide
Ring	304 stainless steel
Pump sleeve	304 stainless steel
Pressure equalization cone	Polyamide
Spacer	Polyamide
Sand trap	316 stainless steel
Shaft w/coupling	304 stainless steel
Cable guard	304 stainless steel

SQE-NE	
Component	**Splined shaft**
Valve casing	PVDF
Discharge chamber	316 stainless steel
O-ring	FPM rubber
Valve cone	PVDF
Valve seat	FPM rubber
Top chamber	PVDF
Empty chamber	PVDF
Top bearing	FPM rubber
Neck ring	PVDF
Lock ring	316 stainless steel
Guide vanes	PVDF
Bottom chamber	PVDF
Impeller w/ tungsten carbide bearing	PVDF
Suction interconnector	PVDF
Ring	316 stainless steel
Shaft w/coupling	Sintered steel
	316 stainless steel
Cable guard	316 stainless steel
Cable guard screws	316 stainless steel
Pressure equalization cone	PVDF
Valve spring	316 stainless steel
Pump sleeve	316 stainless steel
Valve guide	PVDF
Spacer	316 stainless steel



Discharge sizes:

1" NPT	5 SQ/SQE
1 1/4" NPT	10 - 15 SQ/SQE
1 1/2" NPT	22-30 SQ/SQE

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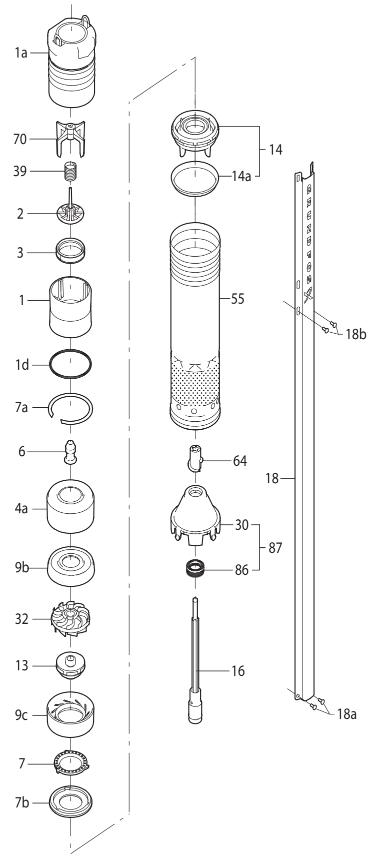
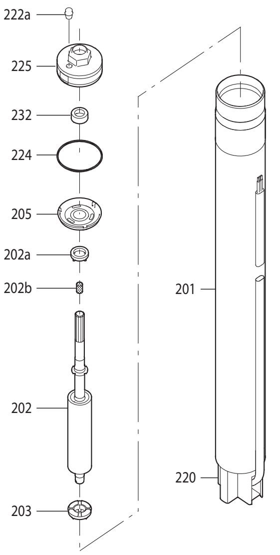
Material specification

Pump						
Pos.	**Component**	**Material**	**DIN W-Nr. SQ/SQE**	**AISI**	**DIN W-Nr. SQ/-NE**	**AISI**
1	Valve casing	Polyamide	1.4301	304	1.4401	316
1a	Discharge chamber	Stainless steel				
1d	O-ring	NBR rubber				
2	Valve cup	Polyamide				
3	Valve seat	NBR rubber				
4a	Empty chamber	Polyamide				
6	Top bearing	NBR rubber				
7	Neck ring	TPU / PBT				
7a	Lock ring	Stainless spring steel	1.4301	310	1.4401	316
7b	Neck ring retainer	Polyamide				
9b	Chamber top	Polyamide				
9c	Chamber bottom	Polyamide				
13	Impeller with tungsten carbide bearing	Polyamide				
14	Suction inter-connector	Polyamide				
14a	Ring	Stainless steel	1.4301	304	1.4401	316
16	Shaft with coupling	Stainless steel	1.4301	304	1.4401	316
		Sintered steel				
18	Cable guard	Stainless steel	1.4301	304	1.4401	316
18a 18b	Screws for cable guard	Stainless steel	1.4301	316	1.4401	316
30	Cone for pressure equalization	Polyamide				
32	Guide vanes	Polyamide				
39	Spring	Stainless spring steel	1.4406	316LN	1.4406	316LN
55	Pump sleeve	Stainless steel	1.4301	304	1.4401	316
64	Priming screw	Polyamide				
70	Valve guide	Polyamide				
86	Lip seal ring	NBR rubber				
87	Cone for pressure equalization complete	Polyamide / NBR rubber				



Motor						
Pos.	**Component**	**Material**	**DIN W-Nr. SQ-SQE**	**AISI**	**DIN W-Nr. SQE-NE**	**AISI**
201	Stator	Stainless steel	1.4301	304	1.4401	316
202	Rotor	Stainless steel	1.4301	304	1.4401	316
202a	Stop ring	PP				
202b	Filter	Polyester				
203	Thrust bearing	Carbon				
205	Radial bearing	Ceramic tungsten carbine				
220	Motor cable with plug	EPR				
222a	Filling plug	MS 3: NBR MSE 3: FKM				
224	O-ring	FKM				
225	Top cover	PPS				
232	Shaft seal	MS 3: NBR MSE 3: FKM				
	Motor liquid	SML-2				



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10. Control units

CU 301

The CU 301 is a control and communication unit developed especially for the SQE submersible pumps in constant-pressure applications.

The CU 301 control unit provides:

- Full control of the SQE pumps
- two-way communication with the SQE pumps
- possibility of adjusting the pressure
- alarm indication (LED) when service is needed
- possibility of starting, stopping and resetting the pump simply by means of a push-button
- configuration with R100 remote control.

The CU 301 communicates with the pump via mains borne signalling (Power Line Communication), meaning that no extra cables are required between the CU 301 and the pump.

The CU 301 features the following indications (see drawing in right column):

1. Pump running indicator
2. System pressure setting
3. System ON/OFF
4. Button lock indicator
5. Dry-running indicator
6. Service needed in case of:
    – – no contact to pump
    – overvoltage
    – undervoltage
    – speed reduction
    – overtemperature
    – overload
    – sensor defective.

The CU 301 incorporates:

- External signal input for pressure sensor
- connection to an operating relay for indication of pump operation.

Optional R100 remote control

Wireless infrared remote control of the CU 301 is possible by means of the R100.

Using the R100, it is possible to monitor and change the operating parameters, see the R100 menu structure on page 31.

The R100 is a valuable tool in case fault finding is required.

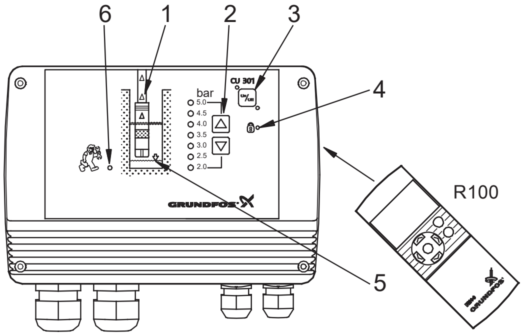

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Fig. 15 CU 301 control unit

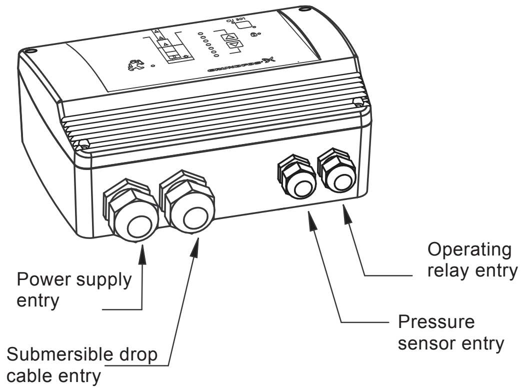

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Fig. 16 CU 301 entry ports

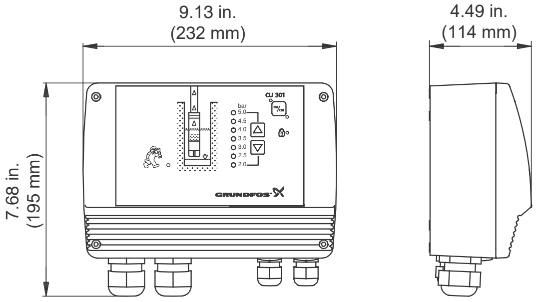

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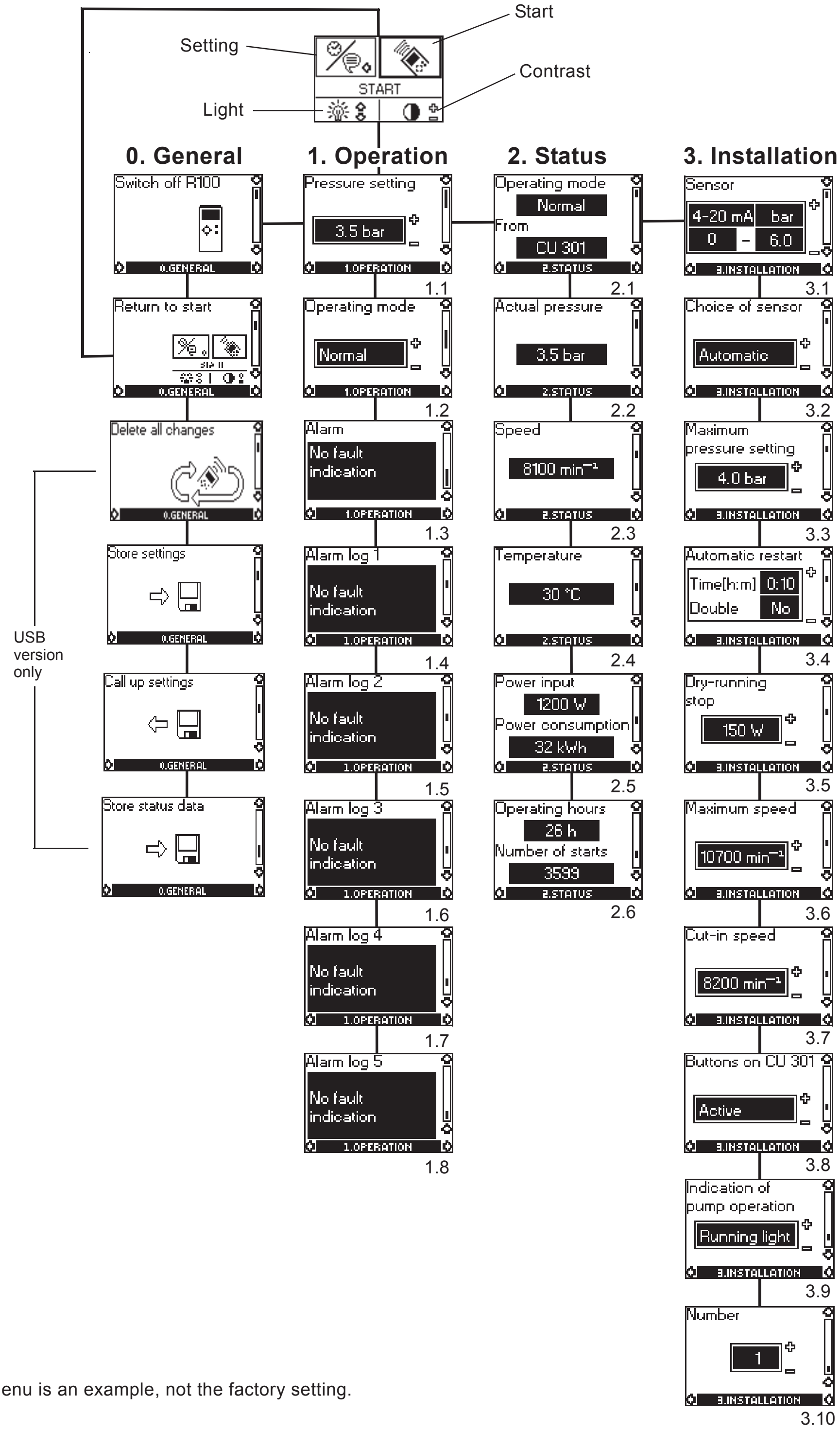
Fig. 17 CU 301 dimensions

R100 menu structure for CU 301 control unit



Note: This menu is an example, not the factory setting.

R100 menus for CU 301

0. General

1. Operation

1.1 Setpoint setting

1.2 Selection of operating mode

1.3 Alarm indication.

2. Status

The indication of:

2.1 Actual operating mode

2.2 Actual pressure

2.3 Actual motor speed

2.4 Actual motor temperature

2.5 Actual power input and accumulated motor power consumption

2.6 Accumulated number of operating hours and accumulated number of starts.

3.Installation

3.1 Sensor parameters

3.2 Choice of sensor

3.3 Setting of maximum pressure setpoint

3.4 Setting of automatic restart time

3.5 Setting of the dry-running stop limit

3.6 Setting of the maximum motor speed

3.7 Setting of the cut-in motor speed

3.8 Activating or deactivating the on/off-button and the buttons for system pressure setting on the CU 301

3.9 Indication of pump operation

3.10 Allocation of identification number.

CU 300

The CU 300 is a control and communication unit developed especially for the SQE submersible pumps for control applications other than constant pressure.

The CU 300 control unit provides:

- Flexible pump control based on various sensor inputs
- two-way communication with the SQE pumps
- alarm indication of pump operation by LED's on the front
- possibility of starting, stopping and resetting the pump simply by means of a push-button
- communication with R100 remote control.

The CU 300 communicates with the pump via mains borne signalling (Power Line Communication), meaning that no extra cables are required between the CU 300 and the pump.

The following alarms can be indicated by the CU 300:

- No contact
- overvoltage
- undervoltage
- dry running
- speed reduction
- overtemperature
- overload
- sensor alarm.

The CU 300 incorporates:

- External signal input for two analog sensors and one digital sensor
- relay output for external alarm indication
- control according to the signals received, e.g. of flow, pressure, water level and conductivity.

R100 remote control

Wireless infrared remote control of the CU 300 is possible by means of the R100.

Using the R100, it is possible to monitor and change the operating parameters, see the R100 menu structure on page 34.

The R100 is a valuable tool in case fault finding is required.

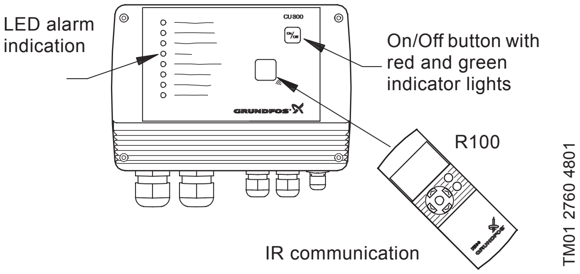


Fig. 18 CU 300 control unit with R100

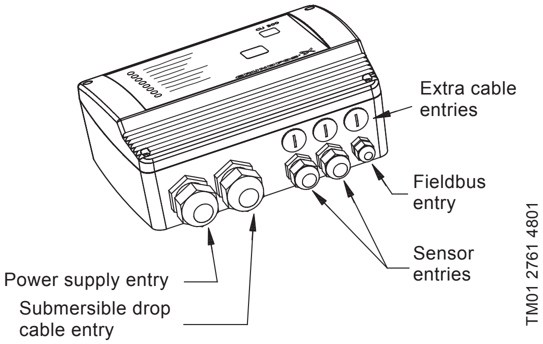


Fig. 19 CU 300 control unit, external entry ports

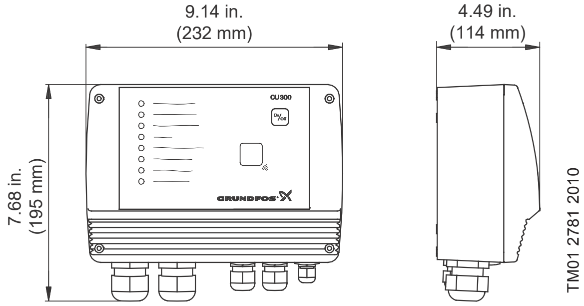
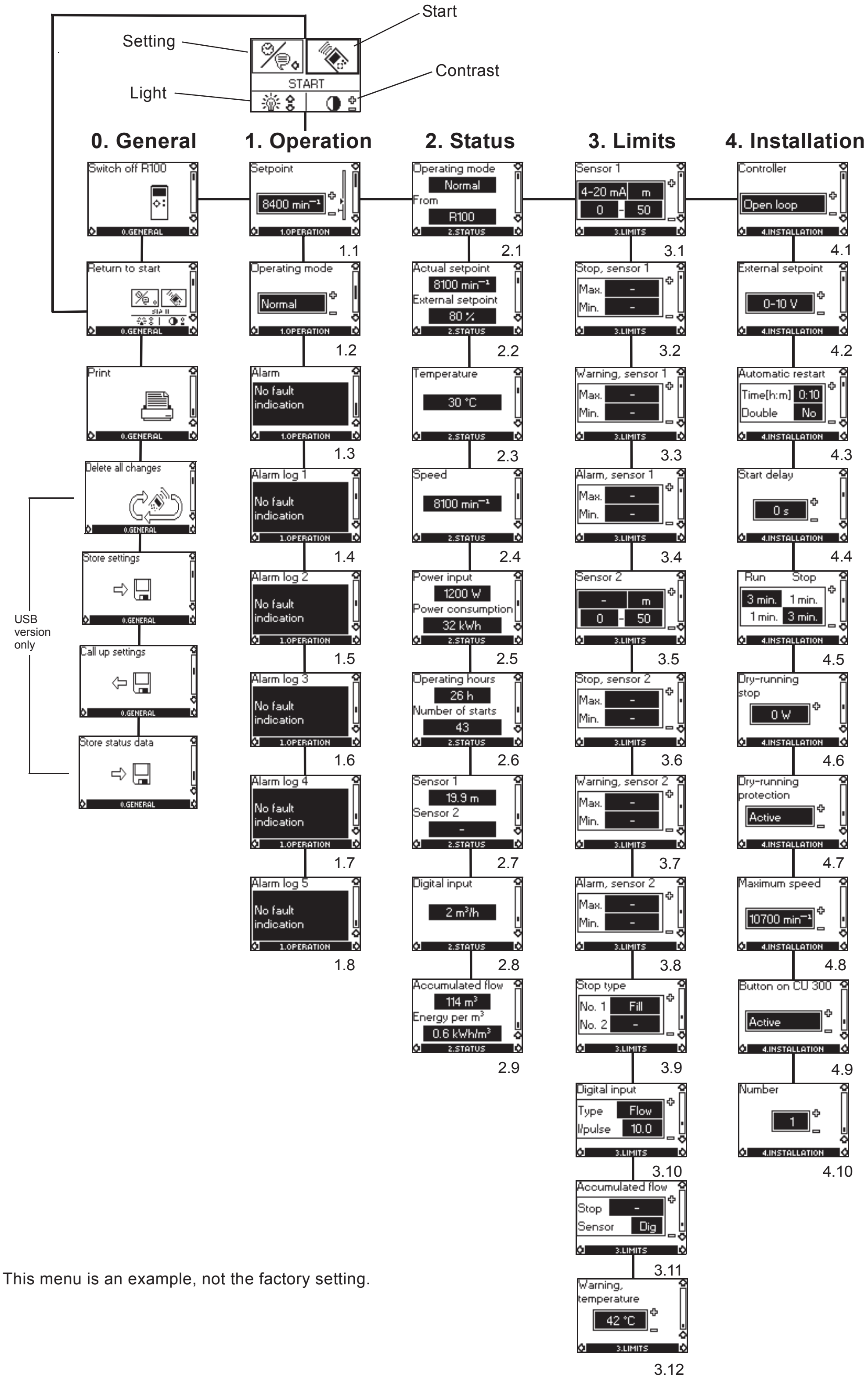


Fig. 20 CU 300 dimensions

R100 menu structure for the CU 300



Note: This menu is an example, not the factory setting.

R100 menus for CU 300

0. General

1. Operation

1.1 Setpoint setting

1.2 Selection of operating mode

1.3 Alarm indication.

2. Status

The indication of:

2.1 Actual operating mode

2.2 Actual and external setpoint

2.3 Actual motor temperature

2.4 Actual motor speed

2.5 Actual power input and accumulated motor power consumption

2.6 Accumulated number of operating hours and accumulated number of starts

2.7 Actual values of sensors 1 and 2, respectively

2.8 Actual values of the digital input

2.9 Accumulated flow, and the power used to pump.

R100 offers the possibility of making a number of settings.

3. Limits

The setting of:

3.1 Sensor 1 parameters

3.2 Min. and max. stop limits of sensor 1

3.3 Min. and max. warning limits of sensor 1

3.4 Min. and max. alarm limits of sensor 1

3.5 Sensor 2 parameters

3.6 Min. and max. stop limits of sensor 2

3.7 Min. and max. warning limits of sensor 2

3.8 Min. and max. alarm limits of sensor 2

3.9 Filling or emptying

3.10 Setting of the function of the digital sensor connected to the digital input

3.11 The setting of the water quantity stop limit and the setting of the sensor to detect water quantity

3.12 The setting of the temperature warning limits of the motor electronics.

4. Installation

4.1 Selection of controller — open loop, closed loop

4.2 Setting of external setpoint

4.3 Setting of automatic restart time

4.4 Allocation of individual start delays

4.5 Setting of the stop and run times for the dewatering function

4.6 Setting of the dry-running stop limit

4.7 Activating or deactivating the dry-running protection

4.8 Setting of the maximum motor speed

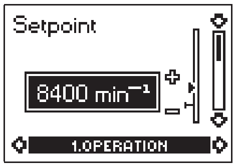
4.9 Activating or deactivating the on/off-button on the CU 300

4.10 Allocation of ID number where more than one CU 300 is installed.

Examples of R100 displays

Menu OPERATION

Setpoint setting



Setpoint

8400 min^{-1}

1.1

From factory, the pump is set to maximum speed, 10,700 rpm. R100 makes it possible to reduce the pump speed by changing the setpoint. The speed can be set to 3,000 - 10,700 rpm, at 100 rpm intervals.

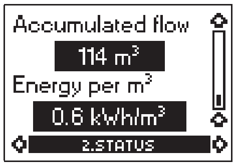
The unit of the setpoint is automatically changed according to the unit of the sensor connected to sensor input 1.

Example: Sensor input 1 is connected to a pressure sensor using the unit feet (ft) and the range 0-60. Consequently, the setpoint of display 1.1 can be set to between 0-60 ft.

Menu STATUS

The displays appearing in this menu are status displays only. It is not possible to change settings in this menu.

Accumulated flow



Accumulated flow

114 m^3

Energy per m^3

0.6 kWh/m^3

2.9

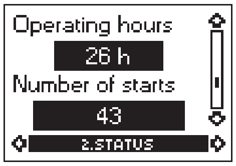
In display 2.9, the water quantity (m^3)* pumped is shown. The value shown is the accumulated flow registered by the sensor selected in display 3.11.

The power used to pump 1 m^3 is shown in the display as energy per m^3 (kWh/m^3).

It is possible to read the status of the accumulated flow and energy per m^3 at any time.

*Water quantity in units of gpm can be chosen.

Accumulated number of operating hours and number of starts



Operating hours

26 h

Number of starts

43

2.6

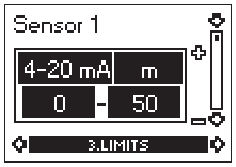
The number of operating hours and the number of starts are values accumulated from the time of installation and they cannot be reset.

Both values are stored in the motor electronics, and they are kept even if the CU 300 is replaced.

The number of operating hours is registered every two hours of continuous operation.

Menu LIMITS

Sensor 1



Sensor 1

4-20 mA m

0 - 50

3.1

The setting of sensor 1.

Depending on the type of sensor, the following settings can be made:

- Sensor outputs:
  – (not active), 0-10 V, 2-10 V, 0-20 mA, 4-20 mA
- setting range unit: m^3/h, m, %, gpm, ft
- sensor minimum value: 0-249 (0, 1, 2, 3.....249)
- sensor maximum value: 1-250 (1, 2, 3, 4.....250).

11. CU331SP variable frequency drive

Features

User interface

The user interface offers these possibilities:

- Local operation via a control panel with graphic display where the menu structure is based on the well-known system from Grundfos E-pumps.
- Monitoring of operating status via indicator lights and signal relays.
- Display of alarm or warning and logging of the last five alarms and warnings.

Functions

Control mode: Constant pressure

The CU331SP has only one control mode, Constant pressure. The pressure is kept constant, independently of the flow rate.

Start-up guide

The CU331SP has a start-up guide, which is launched at the first power up. Parameters are set manually on the basis of the installation. The start-up guide can be repeated, if necessary.

Thanks to the start-up guide, the installer can quickly set a few parameters and put the CU331SP into operation.

Direction of rotation test

During start-up, the CU331SP automatically tests and sets the correct direction of rotation without changing the cable connections. The direction of rotation test can be performed manually if it fails for any reason.

Dry-running protection

To protect the pump, the CU331SP will automatically set up dry-run protection so that water shortage can be detected. The dry-run alarm will automatically reset 30 minutes after the alarm is declared.

Low-flow stop function

The low-flow stop function is used for changing between on/off operation at low flow rate and continuous operation at high flow rate.

The low-flow stop function protects the pump and saves energy.

Applications

For 4" or larger wells. Main applications:

- Domestic and light commercial water supply
- irrigation
- livestock watering
- water transfer.

System components

- Compact, efficient, and reliable variable frequency drive
- rugged stainless steel pump end and proven, reliable, 3-phase motor
- pressure sensor
- diaphragm tank (sold separately).

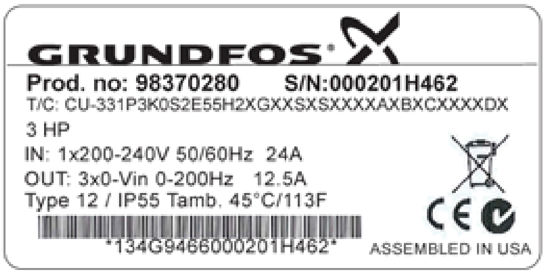
TM05 5801 4012

Fig. 21 CU331SP variable frequency drive and sensor

Identification

Nameplate

The CU331SP can be identified by means of the nameplate. An example is shown below.



GRUNDFOS

Prod. no: 98370280 S/N:000201H462

T/C: CU-331P3K0S2E55H2XGXXSXSXXXXAXBXCXXXXDX

3 HP

IN: 1x200-240V 50/60Hz 24A

OUT: 3x0-Vin 0-200Hz 12.5A

Type 12 / IP55 Tamb. 45°C/113F

134G9466000201H462

ASSEMBLED IN USA

TM05 6001 4012

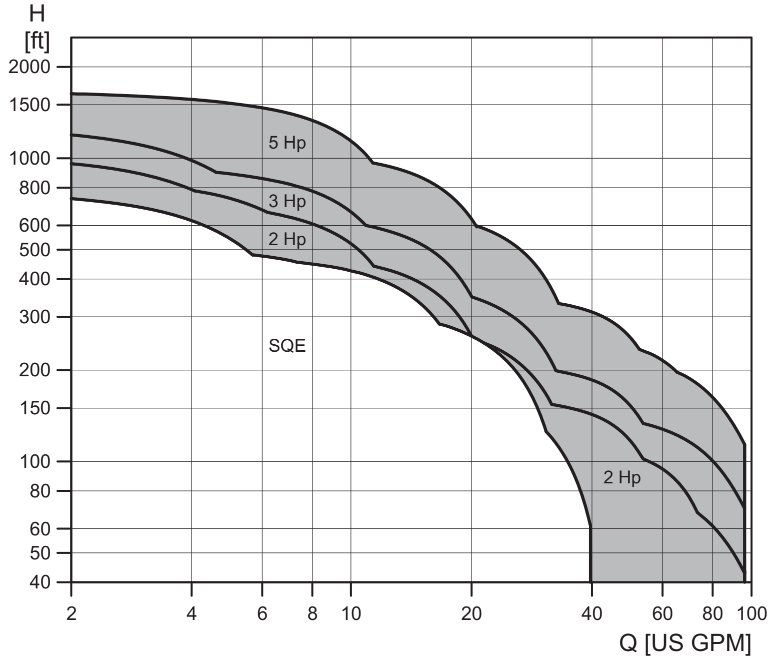
Fig. 22 Example of nameplate

Key	
Text	**Description**
T/C:	CU-331 (product name)
Prod.no:	Product number (98370280)
S/N:	Serial number (000201H462) The last four digits indicate the production date. In this case, 46 is the week, and 2 is the year 2012.
3.0 hp	Typical shaft power on the motor
IN:	Supply voltage, frequency and maximum input current.
OUT:	Motor voltage, frequency and maximum output current. The maximum output frequency usually depends on the pump type.
Type 12 / IP55	Enclosure class
Tamb.	Maximum ambient temperature

CU331SP product range

Enclosure type	NEMA	Hp	Input Ph	Input volts
Indoor	Type 12	2	1	200 - 240
		3	1	200 - 240
		5	1	200 - 240
Outdoor	Type 4X	2	1	200 - 240
		3	1	200 - 240
		5	1	200 - 240

CU331SP performance range



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CU331SP sizing

Step 1

Calculate maximum head requirements at rated flow conditions:

H_{max}=dynamic head + system psi (in feet) + friction loss + above grade elevation.

Step 2

Select pump from performance curves as follows:

Select a model in which the calculated value of H_{max} is within the maximum performance curve of the pump. Refer to section *CU331SP curve charts* on page 53.

Step 3

Select the CU331SP that corresponds to the correct motor Hp and enclosure type.

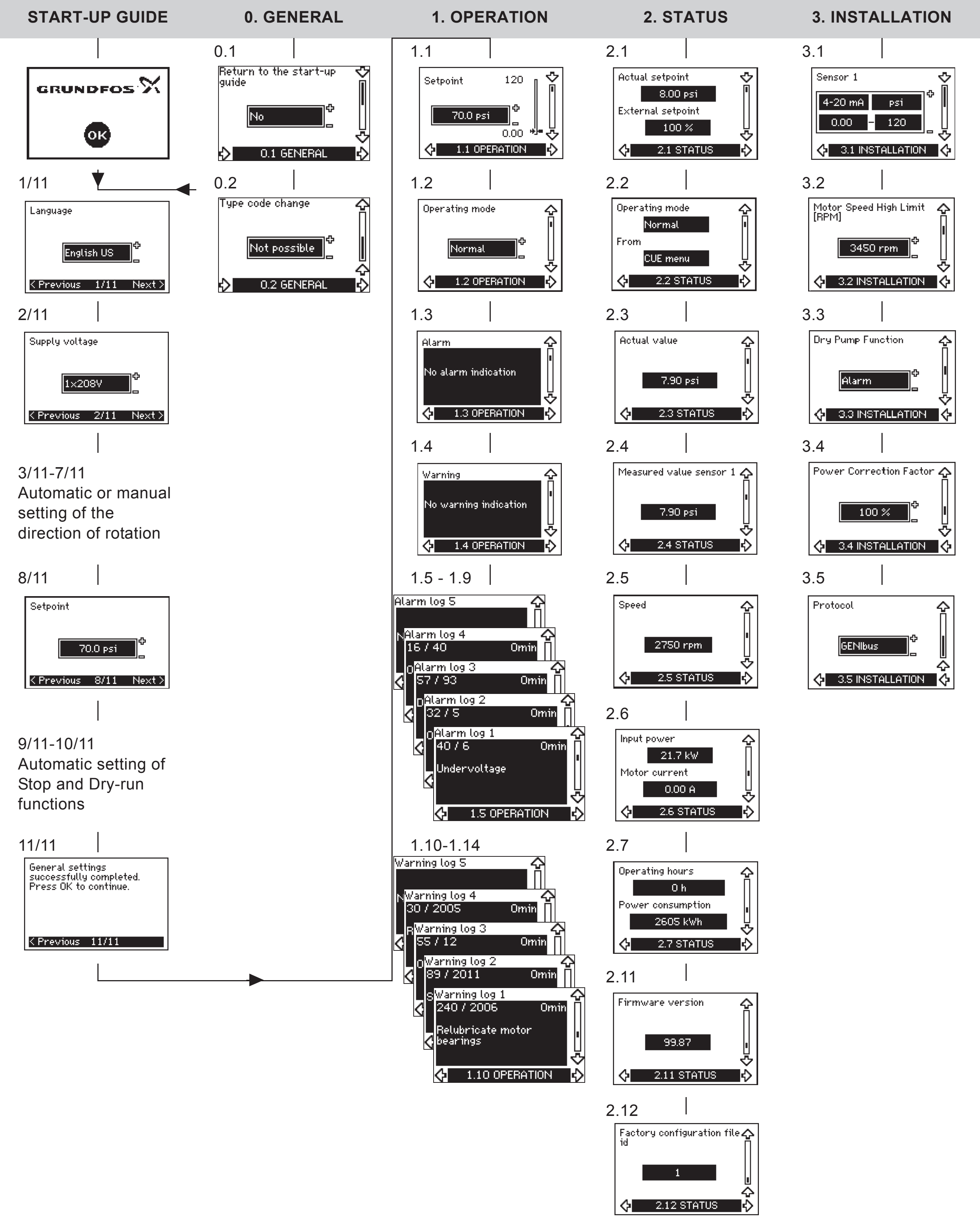
CU331SP operation

Menu structure

The CU331SP has a start-up guide, which is launched at the first power up. After the start-up guide, the CU331SP has a menu structure divided into four main menus:

0. **GENERAL** gives access to the start-up guide for the general setting of the CU331SP.
1. **OPERATION** enables the setting of setpoint and resetting of alarms. It is also possible to see the latest five warnings and alarms.
2. **STATUS** shows the status of the CU331SP and the pump. It is not possible to change or set values.
3. **INSTALLATION** gives access to available parameters.

CU331SP menu overview



Language: English US (1/11)

Supply voltage: 1x208V (2/11)

Setpoint: 70.0 psi (8/11)

General settings successfully completed. Press OK to continue. (11/11)

Return to the start-up guide: No

Type code change: Not possible

Setpoint: 70.0 psi (120, 0.00)

Operating mode: Normal

Alarm: No alarm indication

Warning: No warning indication

Alarm log 5

Alarm log 4: 16 / 40 0min

Alarm log 3: 57 / 93 0min

Alarm log 2: 32 / 5 0min

Alarm log 1: 40 / 6 0min Undervoltage

Warning log 5

Warning log 4: 30 / 2005 0min

Warning log 3: 55 / 12 0min

Warning log 2: 89 / 2011 0min

Warning log 1: 240 / 2006 0min Relubricate motor bearings

Actual setpoint: 8.00 psi

External setpoint: 100 %

Operating mode: Normal

From: CUE menu

Actual value: 7.90 psi

Measured value sensor 1: 7.90 psi

Speed: 2750 rpm

Input power: 21.7 kW

Motor current: 0.00 A

Operating hours: 0 h

Power consumption: 2605 kWh

Firmware version: 99.87

Factory configuration file id: 1

Sensor 1: 4-20 mA psi 0.00 - 120

Motor Speed High Limit [RPM]: 3450 rpm

Dry Pump Function: Alarm

Power Correction Factor: 100 %

Protocol: GENIbus

Fig. 23 Menu overview

Operating modes

These operating modes can be selected with the CU331SP:

- Normal
- Stop
- Min.
- Max.

The operating modes can be set without changing the setpoint setting.

Normal

The pump operates in constant pressure mode.

Stop

The pump has been stopped by user.

Min. curve

The pump is running at a set minimum speed value. See fig. 24.

For instance, this operating mode can be used during periods with a very small flow requirement.

Max. curve

The pump is running at a set maximum speed value.

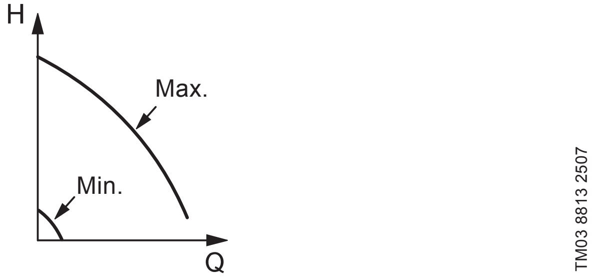


Fig. 24 Min. and max. curves

Control mode

The CU331SP has been developed specifically to operate submersible pumps in Constant Pressure mode. This Closed-Loop control mode uses an analog pressure transducer to provide pressure feedback to the drive.

Constant pressure with stop function

The outlet pressure is kept constant at high flow rate (Q > Qmin). On/off operation at low flow rate. See fig. 25.

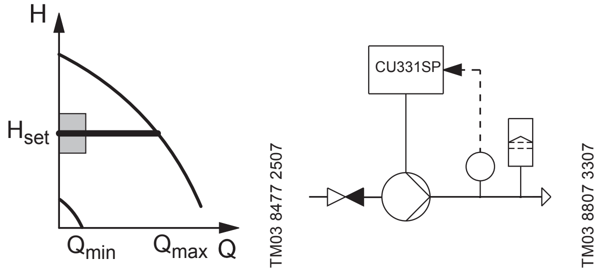


Fig. 25 Constant pressure with stop function

The pump is controlled according to a constant pressure measured after the pump.This means that the pump offers a constant pressure in the Q-range of Q_{min} to Q_{max}, represented by the horizontal line in the QH diagram.

Setting the setpoint by means of the OPERATION menu

The setpoint can be set or changed during operation using the setpoint display in the "OPERATION" menu shown below. It is not necessary to run the start guide to change the setpoint.

Low flow and stop functions

The pump will check the flow regularly by reducing the speed for a short time. If there is no or only a small change in pressure, this means that there is low flow.

The speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached and the pump will stop after a few moments. The pump will restart at the latest when the pressure has fallen to the start pressure (actual setpoint - 0.5 x ΔH).

Operating conditions for the stop function

It is only possible to use the stop function if the system incorporates a pressure sensor, a non-return valve and a diaphragm tank.

The non-return valve must always be installed before the pressure sensor.

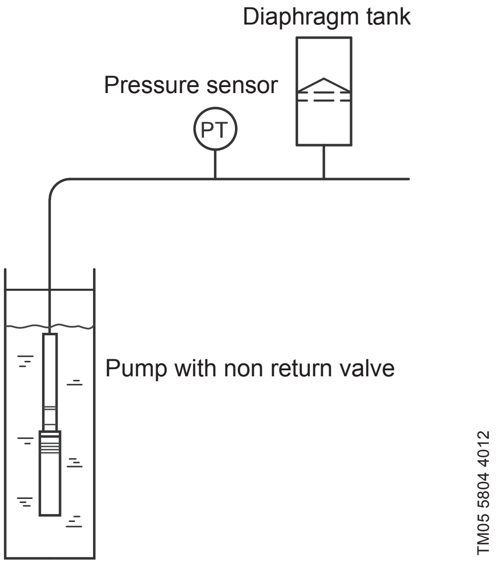


Fig. 26 Position of the pressure sensor and diaphragm tank

Diaphragm tank

The stop function requires a diaphragm tank of a certain minimum size. The tank must be installed as close as possible after the pump and the precharge pressure must be 0.7 x actual setpoint.

Recommended diaphragm tank size:

Rated flow of pump [gpm (m^3/h)]	Typical diaphragm tank size [gal (l)]
0-26 (0-6)	2 (7.5)
27-105 (7-24)	4 (15.1)

If a diaphragm tank of the above size is installed in the system, the factory setting of ΔH is the correct setting.

If the tank installed is too small, the pump will start and stop too often.

Setting the direction of rotation

The start-up guide is started the first time the CU331SP is connected to supply voltage. Then while going through the start-up guide, the CU331SP tests and sets the correct direction of rotation without changing the cable connections to the motor.

The correct direction of rotation can be set in these ways:

- automatic setting.
- manual setting when the direction of rotation is not visible.

Automatic setting

The CU331SP automatically tests and sets the correct direction of rotation without changing the cable connections.

Automatic setting requires a sensor.

This test is not suitable for all pump types and will in certain cases not be able to determine for certainty the correct direction of rotation. In these cases, the CU331SP changes over to manual setting where the direction of rotation is determined on the basis of the installer’s observations.

Manual setting when the direction of rotation is not visible

The correct direction of rotation is set manually without changing the cable connections. This requires that it is possible to observe the head or flow rate.

Status functions

The CU331SP shows the following data:

- power consumption
- operating hours
- measured value
- speed
- input power
- motor current.

The status information can be shown in the display.

Power consumption

The value of the power consumption is an accumulated value calculated from the pump’s startup date and cannot be reset. No additional sensor is required.

Operating hours

The value of operating hours is an accumulated value calculated from the pump’s startup date and cannot be reset. No additional sensor is required.

Measured value

Sensor display will show the actual pressure as received from the pressure transducer.

Speed

Display will show the motor speed in RPM's (calculated).

Input power

Display will show the power consumption in kW.

Motor current

Display will show the actual motor current being used.

Logging functions

Alarm and warning log

The latest five alarms and five warnings are logged with a timestamp corresponding to the power-on time after the fault has occurred. The alarm and warning log can be shown directly on the display.

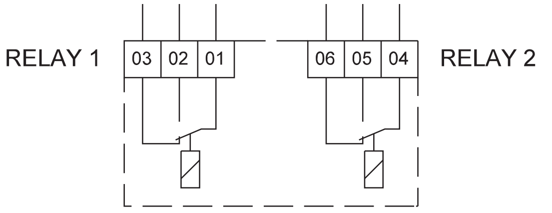
See section *Warning and alarm list*.

Signal relays

The table shows the function of the signal relays.

Type	Function
Relay 1	• *Pump running*
Relay 2	• *Alarm*

See also fig. 27.



TM03 8801 3407

Fig. 27 Terminals for signal relays (normal state, not activated)

Terminal		Function
C1	C2	Common
NO 1	NO 2	Normally open contact
NC1	NC2	Normally closed contact

CU331SP installation

Mechanical installation

The individual CU331SP cabinet sizes are characterized by their enclosures. The table in section *CU331SP technical data* shows the relationship of enclosure class and enclosure type.

Reception and storage

Check on receipt that the packaging is intact, and the unit is complete. In case of damage during transport, contact the transport company to file a claim.

Note that the CU331SP is delivered in a packaging which is not suitable for outdoor storage.

Transportation and unpacking

The CU331SP must only be unpacked at the installation site to prevent damage during the transport to the site.

The packaging contains accessory bag(s), documentation and the unit itself. See fig. 28.

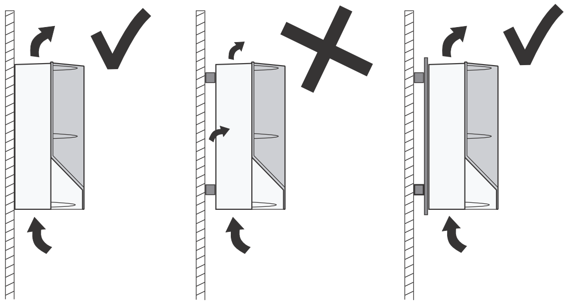
TM05 5990 4012

Fig. 28 CU331SP packaging

Space requirements and air circulation

CU331SP units can be mounted side by side, but as a sufficient air circulation is required for cooling these requirements must be met:

- Sufficient free space above and below the CU331SP
- Ambient temperature up to 122°F (50 °C)
- Hang the CU331SP directly on the wall, or fit it with a back plate. See fig. 29.



TM03 8859 2607

Fig. 29 CU331SP hung directly on the wall or fitted with a back plate

Required free space above and below the CU331SP:

Enclosure	Space [in (mm)]
B1	7.9 (200)

For information about enclosure, see section *Enclosure*.

Mounting

The CU331SP must be mounted securely on a firm surface. Ensure that screws are sized appropriately for the weight of the CU331SP (approximately 60 lbs) and anchored securely to the mounting surface.

1. Mark and drill holes. See fig. 30; also see section *Main dimensions and weight*.
2. Fit the screws, but leave loose. Mount the CU331SP, and tighten the four screws.

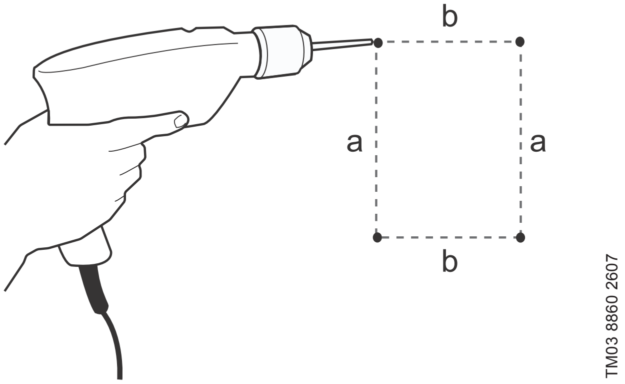


Fig. 30 Drilling holes for mounting

CU331SP electrical connection

Ensure the correct grounding and protection procedures are used for the installation. Before the electrical installation, ensure that the power supply and other voltage inputs are switched off.

Electrical protection

Protection against electric shock, indirect contact

The leakage current to ground exceeds 3.5 mA, and a reinforced ground connection is required.

Protective conductors must always have a yellow/green (PE) or yellow/green/blue (PEN) color marking.

Instructions according to EN IEC 61800-5-1:

- The CU331SP must be stationary, installed permanently and connected permanently to the mains supply.
- The ground connection must be carried out with duplicate protective conductors or with a single reinforced protective conductor with a cross-section of minimum AWG 7 (10 mm^2).

Protection against short-circuit, fuses

The CU331SP and the supply system must be protected against short-circuit.

Grundfos requires that the back-up fuses are used for protection against short-circuit.

The CU331SP offers complete short-circuit protection in case of a short-circuit on the motor output.

Additional protection

The leakage current to ground exceeds 3.5 mA.

If the CU331SP is connected to an electrical installation where an earth leakage circuit breaker (ELCB) is used as additional protection, the circuit breaker must be of a type marked with the following symbols:

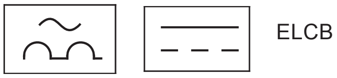


Fig. 31 Circuit breaker **type B**

The total leakage current of all the electrical equipment in the installation must be taken into account.

During start and in asymmetrical supply systems, the leakage current can be higher than normal and may cause the ELCB to trip.

Motor protection

The motor requires no external motor protection. The CU331SP protects the motor against thermal overloading and blocking.

Protection against overcurrent

The CU331SP has an internal overcurrent protection for overload protection on the motor output.

Protection against mains voltage transients

The CU331SP is protected against mains voltage transients according to EN 61800-3, second environment.

Mains and motor connection

The supply voltage and frequency are marked on the CU331SP nameplate. Make sure that the CU331SP is suitable for the power supply of the installation site.

The maximum output voltage of the CU331SP is equal to the input.

Example: if the supply voltage is rated at 208V choose a 208V motor for operation.

Mains switch

A mains switch can be installed before the CU331SP according to local regulations. See fig. 32.

Wiring diagram

The wires in the terminal box must be as short as possible. Excepted from this is the ground wire, which must be so long that it is the last one to be disconnected in case the cable is inadvertently pulled out of the cable entry.

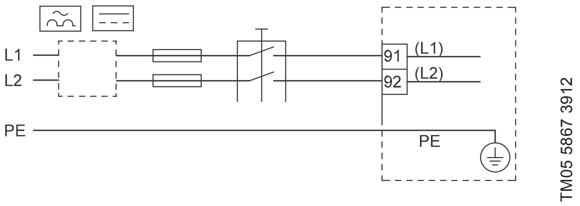


Fig. 32 CU331SP wiring diagram

Terminal		Function
91	(L1)	Single-phase supply
92	(L2)	
95/99	(PE)	Ground connection

For single-phase connection, use L1 and L2.

Mains connection

Check that mains voltage and frequency correspond to the values on the nameplate of the CU331SP and the motor.

1. Connect the ground wire to terminal 95 (PE). See fig. 33.
2. Connect the power leads to the terminals 91 (L1), 92 (L2).
3. Fix the mains cable with a cable clamp.

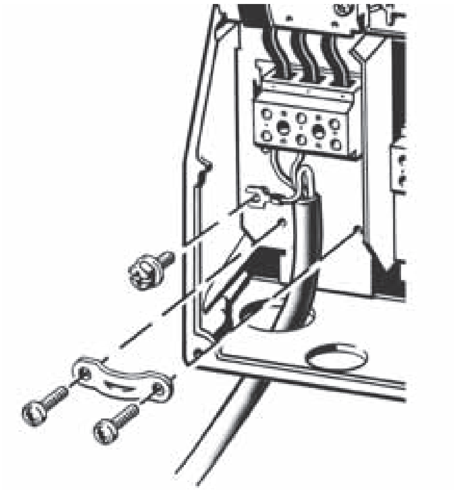


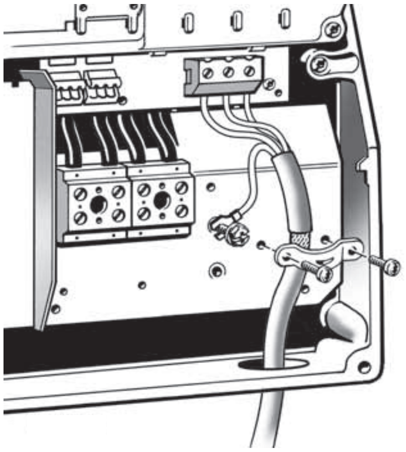
Fig. 33 Mains connection

CU331SP drive is usable with 3-phase input power by connecting leads to 91 (L1), 92 (L2), and 93 (L3).

Motor connection

The motor cable must be screened for the CU331SP to meet EMC requirements.

1. Connect the ground wire to terminal 99 (PE). See fig. 34.
2. Connect the motor leads to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9020 2807

Fig. 34 Motor connection

The cable screen must be exposed and in physical contact with the mounting plate and clamp

11.1 Connecting the signal terminals

As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.

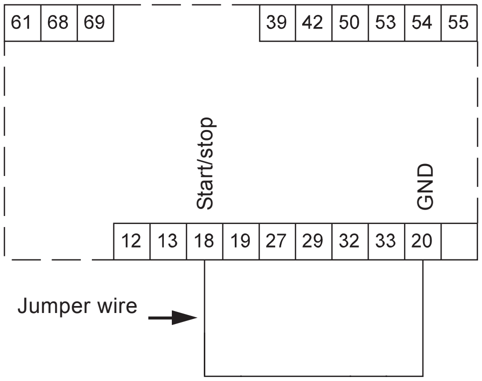
If no external on/off switch is connected, short-circuit terminals 18 and 20 using a short wire.

Connect the signal cables according to the guidelines for good practice to ensure EMC-correct installation. See section *EMC-correct installation*.

- Use screened signal cables with a conductor cross-section of min. AWG 20 (0.5 mm^2) and max. AWG 16 (1.5 mm^2).
- Use a 3-conductor screened bus cable in new systems.

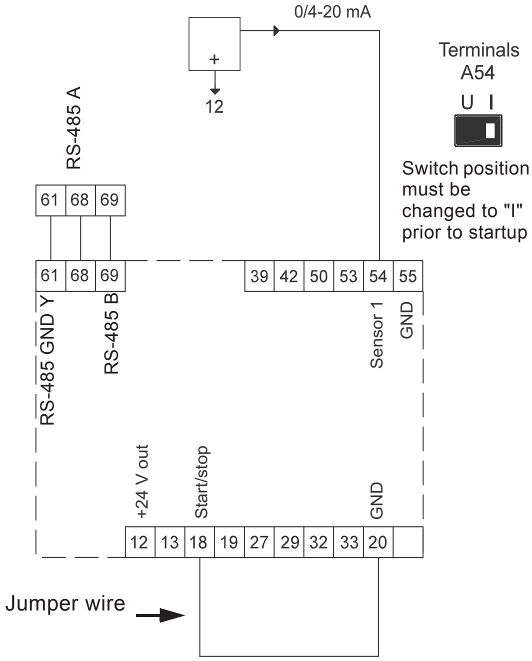
Minimum connection, signal terminal

Operation is only possible when the terminals 18 and 20 are connected, for instance by means of an external on/off switch or a short wire.



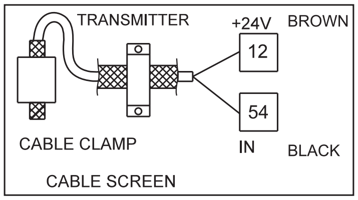
TM03 9057 3207

Fig. 35 Required minimum connection, signal terminal



TM05 5802 3913

Fig. 36 Wiring diagram for CU331SP



TM05 6776 5112

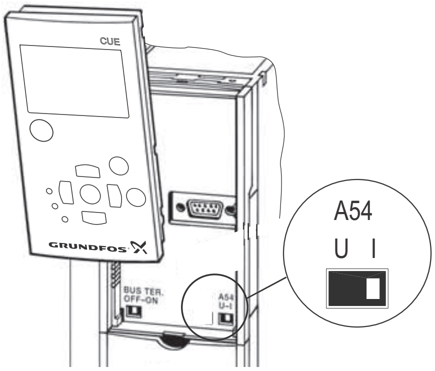
Fig. 37 Sensor wiring diagram

Setting the analog input 54

The contact A54 is positioned behind the control panel and is used for setting the signal type of the analog input.

The factory setting of the inputs is voltage signal "U". This setting must be changed to "I" prior to starting the CU331SP. Be sure the power supply is switched off.

Remove the control panel to set the contact. See fig. 38.



TM05 5803 3912

Fig. 38 Setting contact A54 to current signal "I"

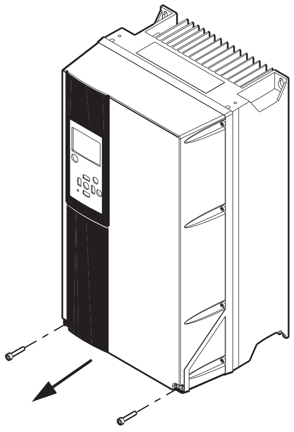
Terminal key

Terminal	Type	Function
12	+24 V out	Supply to sensor
18	DI 1	Digital input, start/stop
20	GND	Common frame for digital inputs
55	GND	Common frame for analog inputs
54	AI 2	Sensor input, sensor 1, 0/4-20 mA
61	RS-485 GND Y	GENIbus, frame
68	RS-485 A	GENIbus, signal A (+)
69	RS-485 B	GENIbus, signal B (-)

The RS-485 screen must be connected to frame.

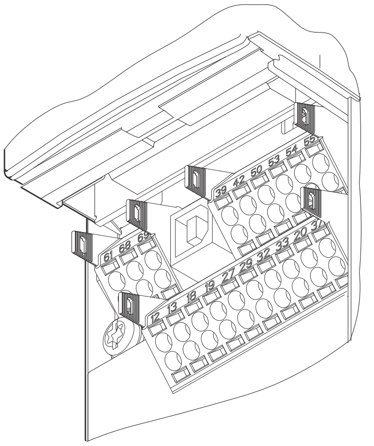
Access to signal terminals

All signal terminals are behind the terminal cover of the CU331SP front. Remove the terminal cover as shown in fig. 39.



TM03 9004 2807

Fig. 39 Access to signal terminals

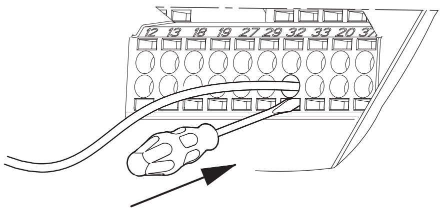


TM03 9025 2807

Fig. 40 Signal terminals

Fitting the conductor

1. Remove the insulation at a length of 0.35 to 0.40 inches (9 to 10 mm).
2. Insert a screwdriver with a tip of maximum 0.015 X 0.1 in (0.4 X 2.5 mm) into the square hole.
3. Insert the conductor into the corresponding round hole. Remove the screwdriver. The conductor is now fixed in the terminal.

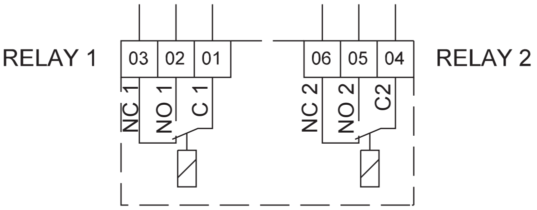


TM03 9026 2807

Fig. 41 Fitting the conductor into the signal terminal

Connecting the signal relays

As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.



TM03 8801 2507

Fig. 42 Terminals for signal relays (normal state, not activated)

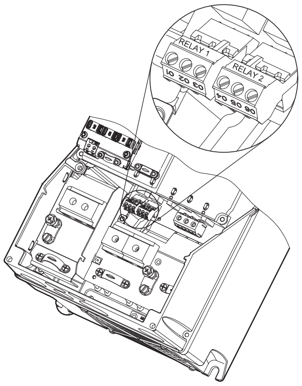
Terminal		Function
C 1	C 2	Common
NO 1	NO 2	Normally open contact
NC 1	NC 2	Normally closed contact

Signal relay

The signal relays on the CU331SP are predefined as follows:

Relay 1: Pump running

Relay 2: Alarm



TM03 9008 2807

Fig. 43 Terminals for relay connection

EMC-correct installation

This section gives guidelines for good practice when installing the CU331SP. Follow these guidelines to meet EN 61800-3, first environment.

- Use only motor and signal cables with a braided metal screen in applications without output filter.
- There are no special requirements to supply cables, apart from local requirements.
- Leave the screen as close to the connecting terminals as possible. See fig. 44.
- Avoid terminating the screen by twisting the ends. See fig. 45. Use cable clamps or EMC screwed cable entries instead.
- Connect the screen to frame at both ends for both motor and signal cables. If the controller has no cable clamps, connect only the screen to the CU331SP.
- Avoid unscreened motor and signal cables in electrical cabinets with variable frequency drives.
- Make the motor cable as short as possible in applications without output filter to limit the noise level and minimize leakage currents.
- Screws for frame connections must always be tightened whether a cable is connected or not.
- Keep main cables, motor cables and signal cables separated in the installation, if possible.

Other installation methods may give similar EMC results if the above guidelines for good practice are followed.

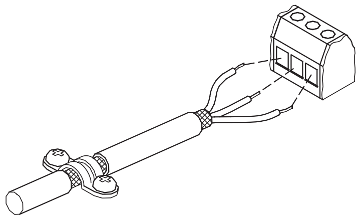


Fig. 44 Example of stripped cable with screen

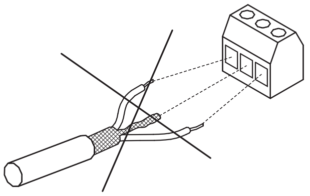


Fig. 45 Do not twist the screen ends

Line disturbance and transient protection

To protect itself from AC line voltage disturbances, the CU331SP monitors the input power supply and interrupts drive operation in the event of phase loss or imbalance. Transients on the AC line are suppressed by MOVs as well as zener diodes for extreme transients. The CU331SP meets VDE 0160 (European standard - 2.3 x line voltage for 1.3 msec) for transient protection.

RFI filters

To meet the EMC requirements, the CU331SP comes with the following types of built-in radio frequency interference filter (RFI).

Voltage	Typical shaft power P2	RFI filter type
1 x 200-240 V *	1.5 - 10 hp	C1

*Single-phase input - three-phase output.

Description of RFI filter types

C1:	For use in domestic areas.

RFI filter types are according to EN61800-3

Control panel

The on/off button on the control panel does not disconnect the CU331SP from the power supply and must therefore not be used as a safety switch.

On/Off The On/Off button has the highest priority. In "Off" condition, pump operation is not possible.

The control panel is used for local setting of the CU331SP. The functions available are preset in the CU331SP.

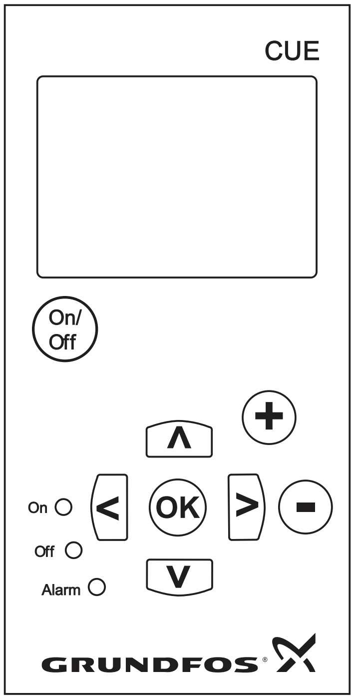


Fig. 46 Control panel of the CU331SP

Editing buttons

Button	Function
On/Off	Makes the pump ready for operation/starts and stops the pump.
OK	Saves changed values, resets alarms and expands the value field.
+ -	Changes values in the value field.

Navigating buttons

Button	Function
< >	Navigates from one menu to another. When the menu is changed, the display shown will always be the top display of the new menu.
Λ V	Navigates up and down in the individual menu.

Adjusting the display contrast

Press OK and + for darker display.

Press OK and - for brighter display.

Button lock

To lock the buttons on the panel press and hold the up and down arrows simultaneously.

Indicator lights

The operating condition of the pump is indicated by the indicator lights on the front of the control panel. See fig. 46.

The table shows the function of the indicator lights.

Indicator light	Function
On (green)	The pump is running or has been stopped by a stop function.
	If flashing, the pump has been stopped by the user (CU331SP menu), external start/stop or bus.
Off (orange)	The pump has been stopped with the on/off button.
Alarm (red)	Indicates an alarm or a warning.

Displays, general terms

Figures 47 and 48 show the general terms of the display.

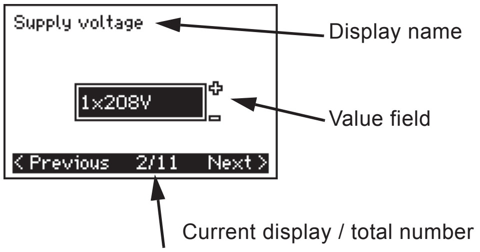


Fig. 47 Example of display in the start-up guide

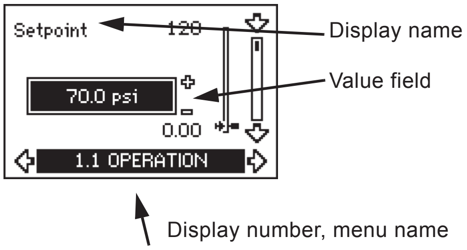


Fig. 48 Example of display in the user menu

Warning and alarm list

Code and display text		Status			Operating mode	Resetting
		Warning	Alarm	Locked alarm		
1	Too high leakage current			●	Stop	Man.
2	Mains phase failure		●		Stop	Aut.
3	External fault		●		Stop	Man.
16	Other fault		●		Stop	Aut.
				●	Stop	Man.
32	Overvoltage	●			-	Aut.
			●		Stop	Aut.
40	Undervoltage	●			-	Aut.
			●		Stop	Aut.
48	Overload		●		Stop	Aut.
				●	Stop	Man.
49	Overload		●		Stop	Aut.
55	Overload	●			-	Aut.
			●		Stop	Aut.
57	Dry running		●		Stop	Aut.
64	Too high CU331SP temperature		●		Stop	Aut.
89	Sensor 1 outside range		●		1)	Aut.
96	Setpoint signal outside range		●		1)	Aut.
155	Inrush fault		●		Stop	Aut.
241	Motor phase failure	●			-	Aut.
			●		Stop	Aut.

1) In case of an alarm, the CU331SP will change the operating mode depending on the pump type.

2) Warning is reset in display 3.20.

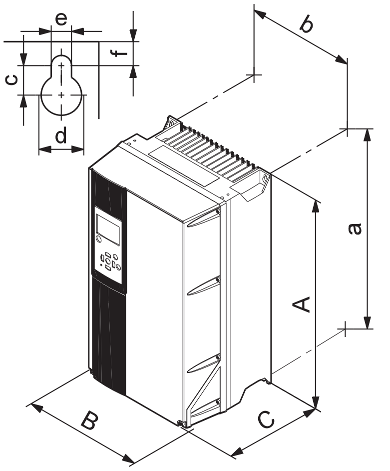
CU331SP technical data

Enclosure

All CU331SP enclosures are size B1.

The enclosure rating can be either IP 55 / TYPE 12 or IP 66 / TYPE 4X.

Main dimensions and weight



TM03 9002 2807

Fig. 49 Enclosure B1

[1] The dimensions are maximum height, width and depth.

Enclo-sure	Height [in]		Width [in]		Depth [in]
	A	a	B	b	C
B1	18.9	17.9	9.5	8.3	10.2
	Screw holes [in]				Weight [lbs]
	c	d	e	f	
	0.47	0.75	0.35	0.35	50.7

Surroundings

Relative humidity	5-95 % RH
Ambient temperature	Max. 122 °F (50 °C)
Average ambient temperature over 24 hours	Max. 113 °F (45 °C)
Minimum ambient temperature at full operation	32 °F (0 °C)
Minimum ambient temperature at reduced operation	14 °F (-10 °C)
Temperature during storage and transportation	-13 to 150 °F (-25 to 65 °C)
Storage duration	Max. 6 months
Maximum altitude above sea level without performance reduction	3280 ft (1000 m)
Maximum altitude above sea level with performance reduction	9840 ft (3000 m)

The CU331SP comes in a packaging which is not suitable for outdoor storage.

Terminal tightening torques

Enclosure	Tightening torque [ft-lb]			
	Mains	Motor	Earth	Relay
B1	1.3	1.3	2.2	0.4

Cable length

Maximum length, screened motor cable	500 ft (152 m)
Maximum length, unscreened motor cable	1000 ft (305 m)
Maximum length, signal cable	1000 ft (305 m)

Fuses and cable cross-section

Always comply with national and local regulations as to cable cross-sections.

Cable cross-section to signal terminals

Maximum cable cross-section to signal terminals, rigid conductor	AWG 14
Maximum cable cross-section to signal terminals, flexible conductor	AWG 18
Minimum cable cross-section to signal terminals	AWG 20

Non-UL fuses and conductor cross-section to mains and motor

Typical shaft power P2 [Hp]	Maximum fuse size [A]	Fuse type	Maximum conductor cross section[1]	
			[AWG]	[mm²]
2	40	gG	7	10
3	40	gG	7	10
5	80	gG	7	10

[1] Screened motor cable, unscreened supply cable.

UL fuses and conductor cross-section to mains and motor

Typical shaft power P2 [Hp]	Maximum fuse size [A]	Bussmann RK1	Maximum conductor cross section[1] [AWG}
2	40	KTN-R40	7
3	40	KTN-R40	7
5	80	KTN-R80	7

[1] Screened motor cable, unscreened supply cable.

Inputs and outputs

Mains supply (L1, L2)

Supply voltage	200-240 V ± 10 %
Supply frequency	60 Hz
Maximum temporary imbalance between phases	3 % of rated value
Leakage current to earth	> 3.5 mA
Number of cut-ins	Max. 1 time/min.

Do not use the power supply for switching the CU331SP on and off.

Motor output (U, V, W)

Output voltage	0-100 % [1]
Output frequency	0-60 Hz
Switching on output	Not recommended

[1] Output voltage in % of supply voltage.

RS-485 GENIbus connection

Terminal number	68 (A), 69 (B), 61 GND (Y)

The RS-485 circuit is functionally separated from other central circuits and galvanically separated from the supply voltage (PELV).

Digital inputs

Terminal number	18
Voltage level	0-24 VDC
Voltage level, open contact	> 19 VDC
Voltage level, closed contact	< 14 VDC
Maximum voltage on input	28 VDC
Input resistance, R_i	Approx. 4 kΩ

All digital inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

Signal relays

Relay 01, terminal number	1 (C), 2 (NO), 3 (NC)
Relay 02, terminal number	4 (C), 5 (NO), 6 (NC)
Maximum terminal load (AC-1) [1]	240 VAC, 2 A
Maximum terminal load (AC-15) [1]	240 VAC, 0.2 A
Maximum terminal load (DC-1) [1]	50 VDC, 1 A
Minimum terminal load	24 V DC 10 mA 24 V AC 20 mA

[1] IEC 60947, parts 4 and 5.

C	Common
NO	Normally open
NC	Normally closed

The relay contacts are galvanically separated from other circuits by reinforced insulation (PELV).

Analog input

Terminal number	54
Current signal	A54 = "I" [1]
Current range	0-20, 4-20 mA
Input resistance, R_i	Approx. 200 Ω
Maximum current	30 mA
Maximum fault, terminals 53, 54	0.5 % of full scale

[1] The factory setting is voltage signal "U".

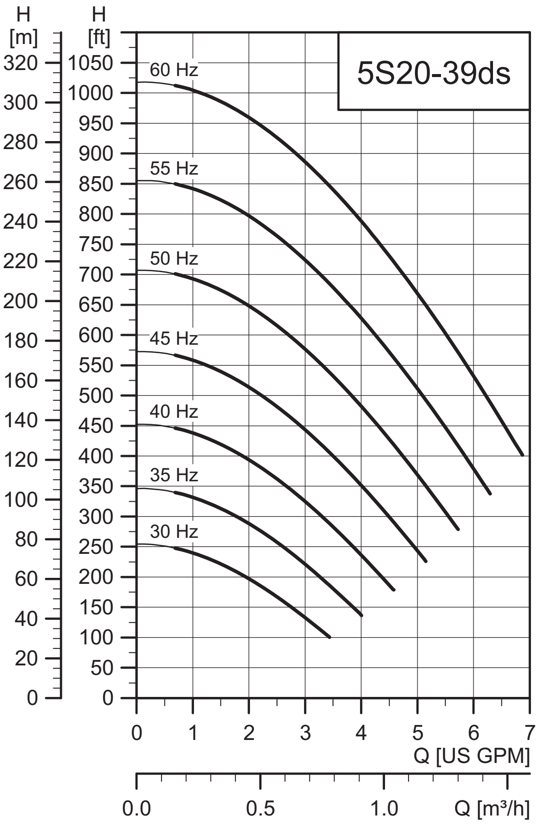
All analog inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

Sound pressure level

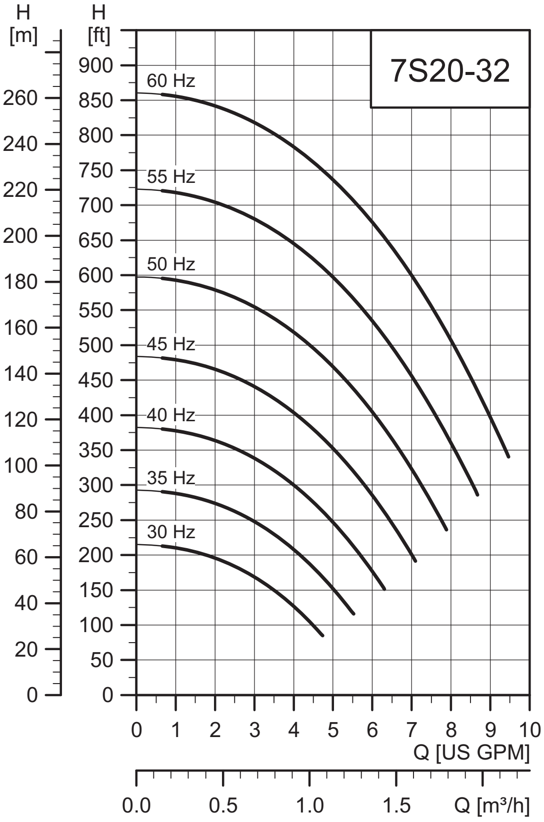
The sound pressure of the CU331SP is maximum 70 dB(A).

The sound pressure level of a motor controlled by a Variable frequency drive may be higher than that of a corresponding motor which is not controlled by a variable frequency drive.

CU331SP curve charts



TM05 6410 5012



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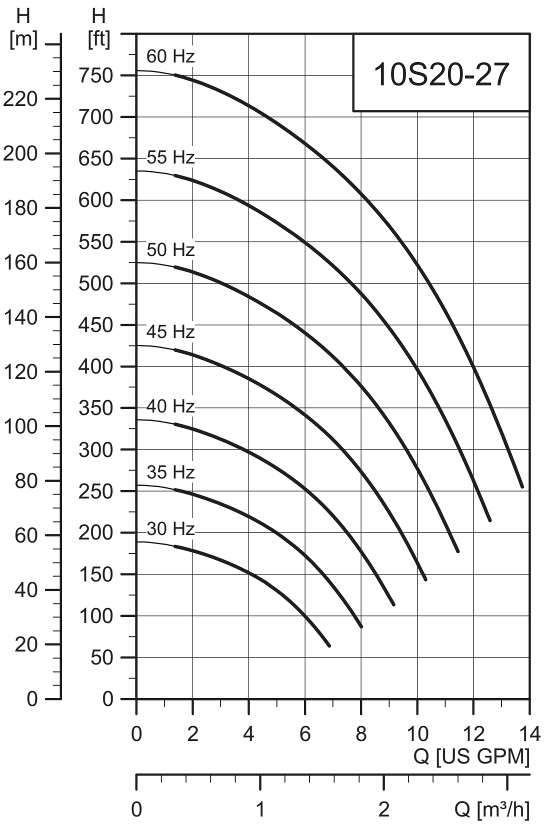

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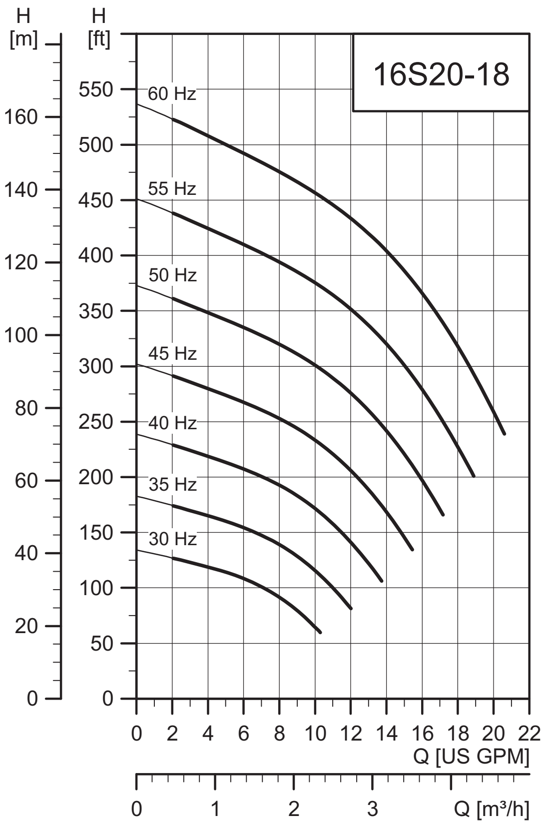

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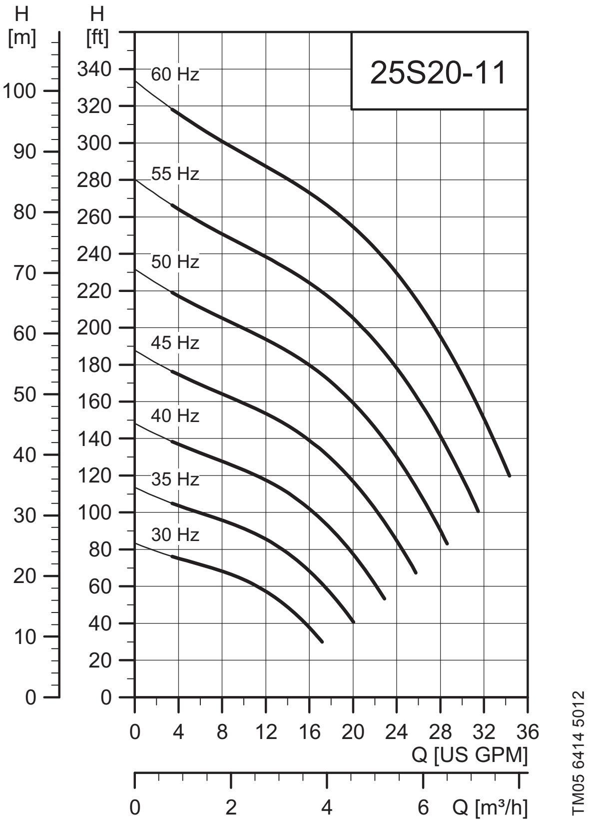
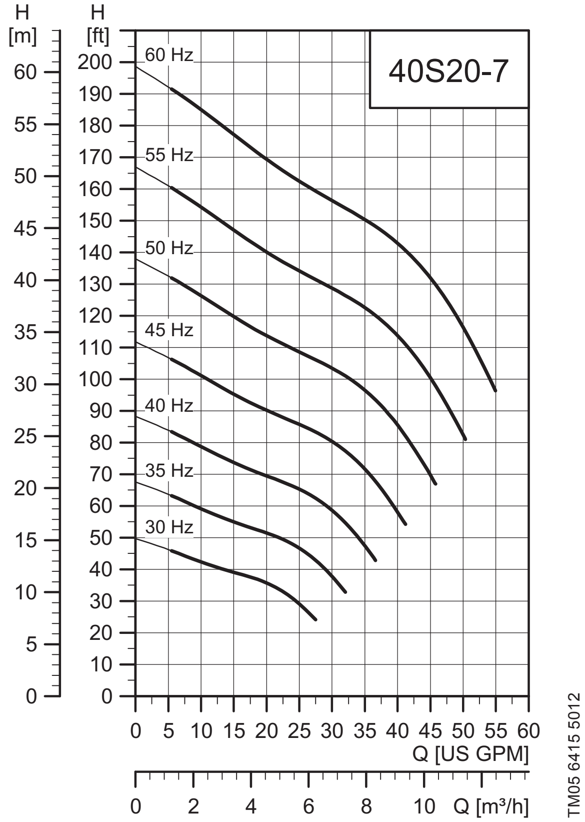
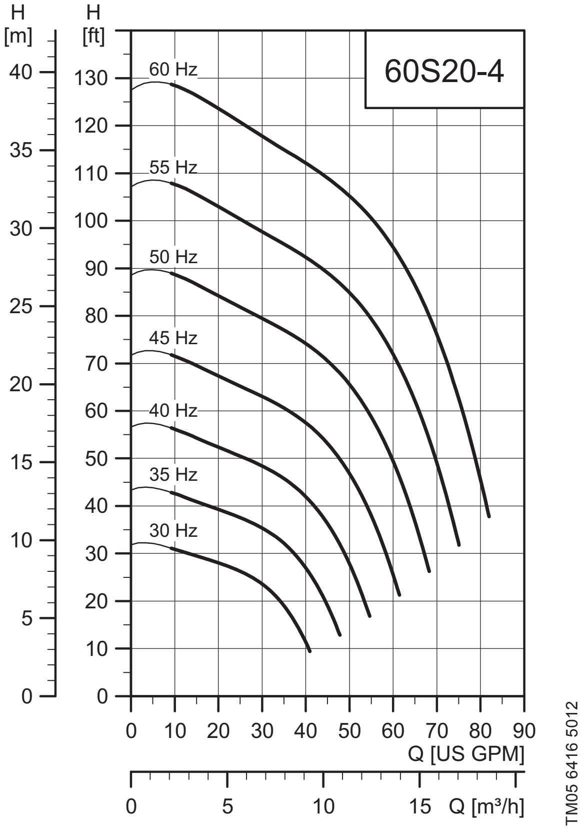
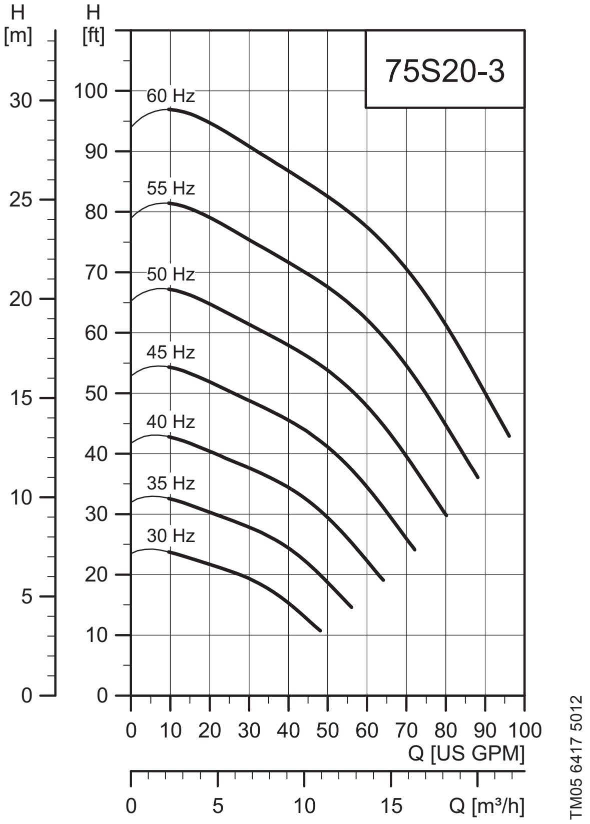
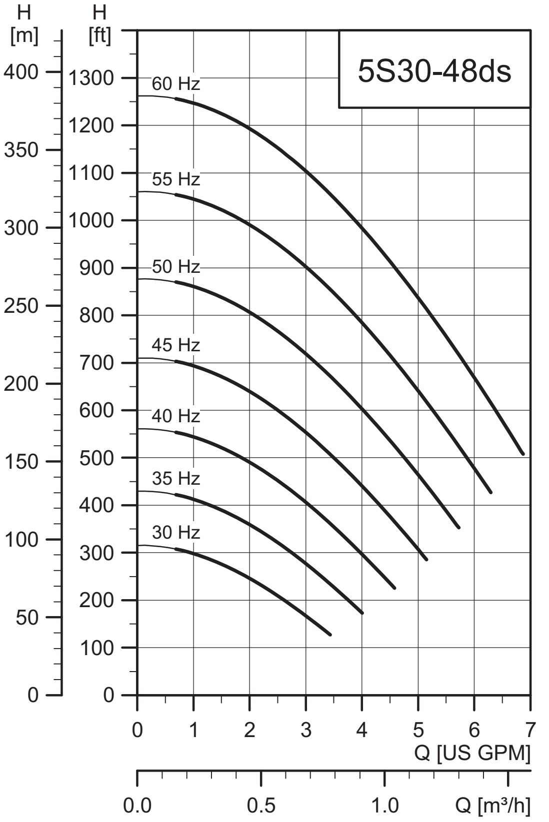

25S20-11
H [m]
H [ft]
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
0 4 8 12 16 20 24 28 32 36
Q [US GPM]
0 2 4 6 Q [m³/h]
TM05 6414 5012


40S20-7
H [m]
H [ft]
0
5
10
15
20
25
30
35
40
45
50
55
60
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
0 5 10 15 20 25 30 35 40 45 50 55 60
Q [US GPM]
0 2 4 6 8 10 Q [m³/h]
TM05 6415 5012


60S20-4
H [m]
H [ft]
0
5
10
15
20
25
30
35
40
0
10
20
30
40
50
60
70
80
90
100
110
120
130
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
0 10 20 30 40 50 60 70 80 90
Q [US GPM]
0 5 10 15 Q [m³/h]
TM05 6416 5012


75S20-3
H [m]
H [ft]
0
5
10
15
20
25
30
0
10
20
30
40
50
60
70
80
90
100
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
0 10 20 30 40 50 60 70 80 90 100
Q [US GPM]
0 5 10 15 Q [m³/h]
TM05 6417 5012



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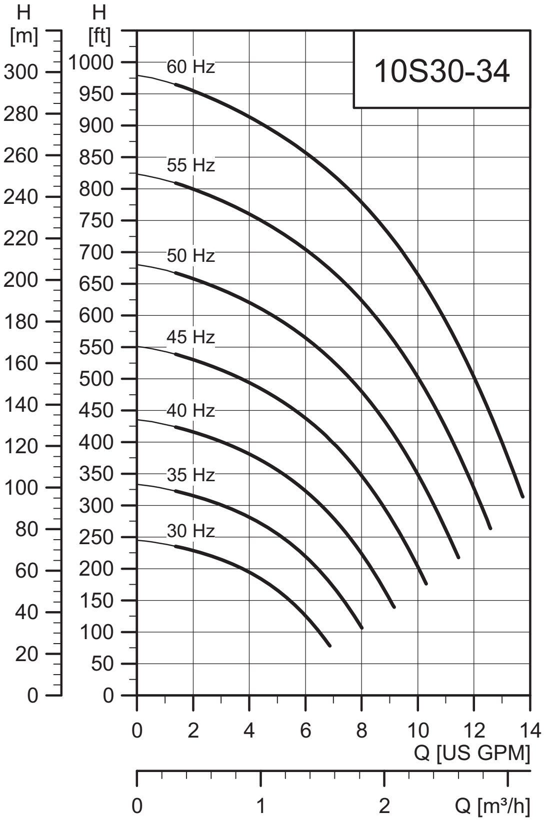

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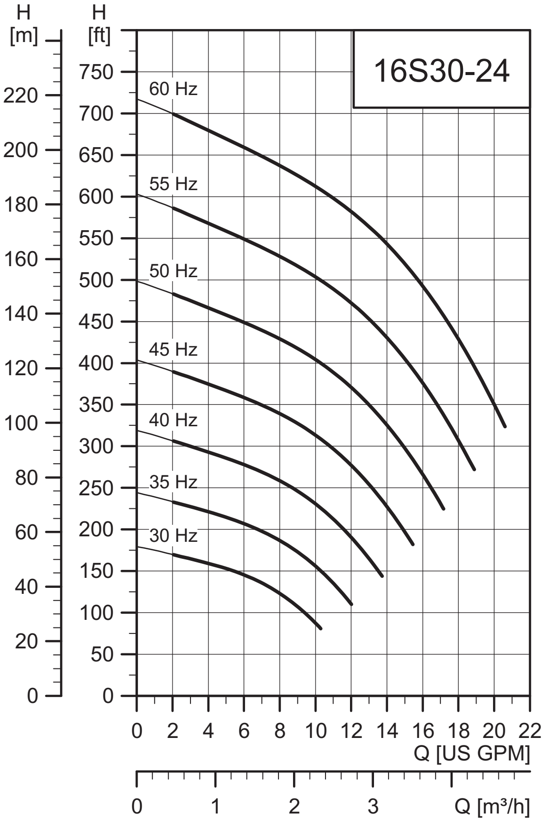

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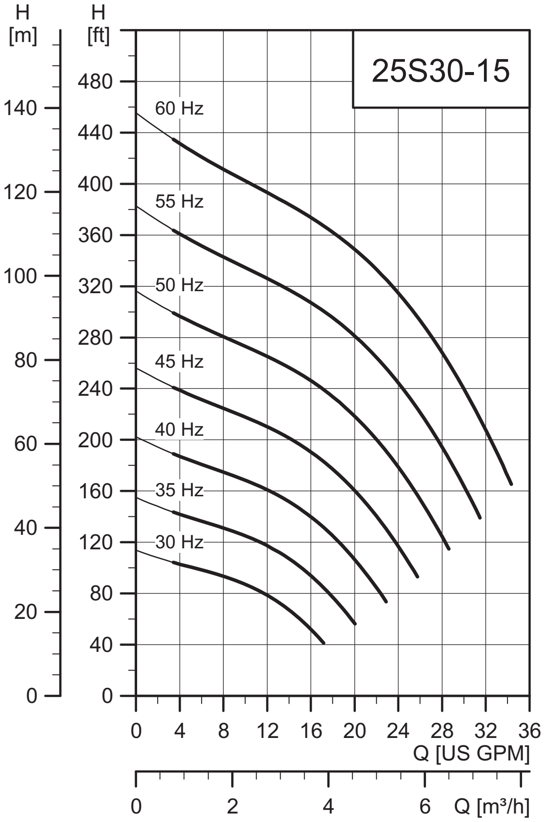

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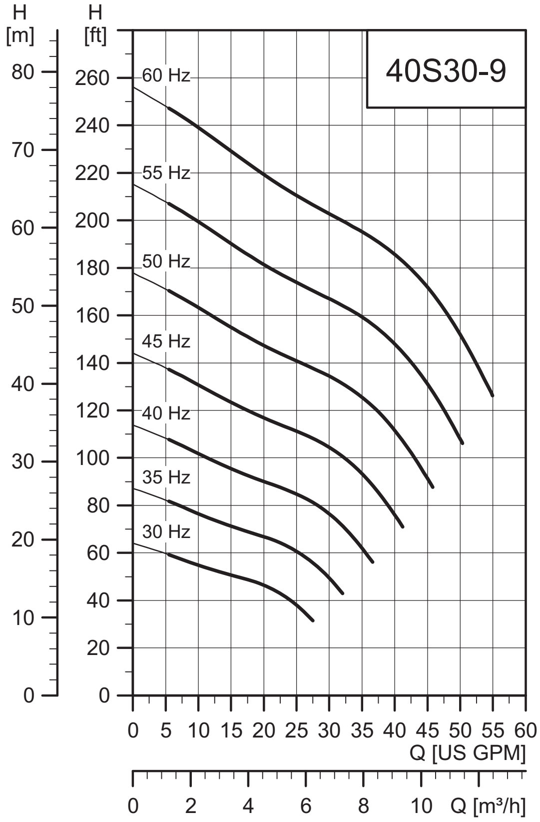

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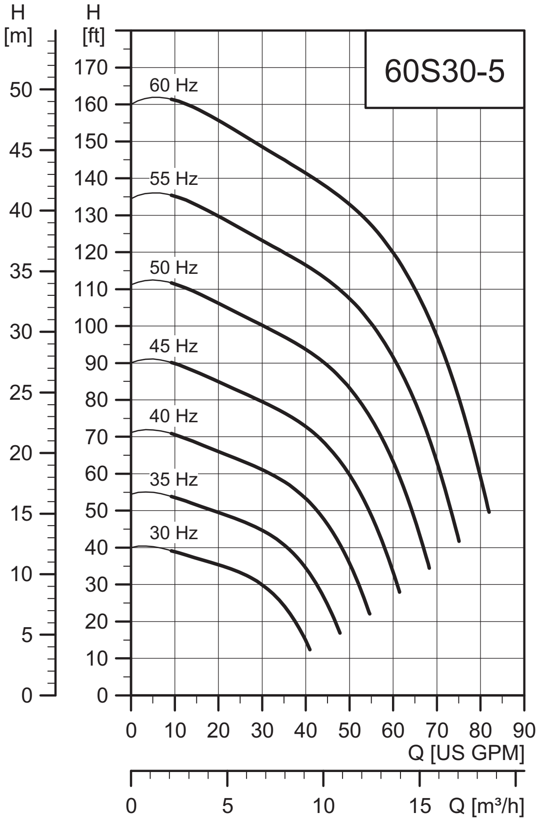

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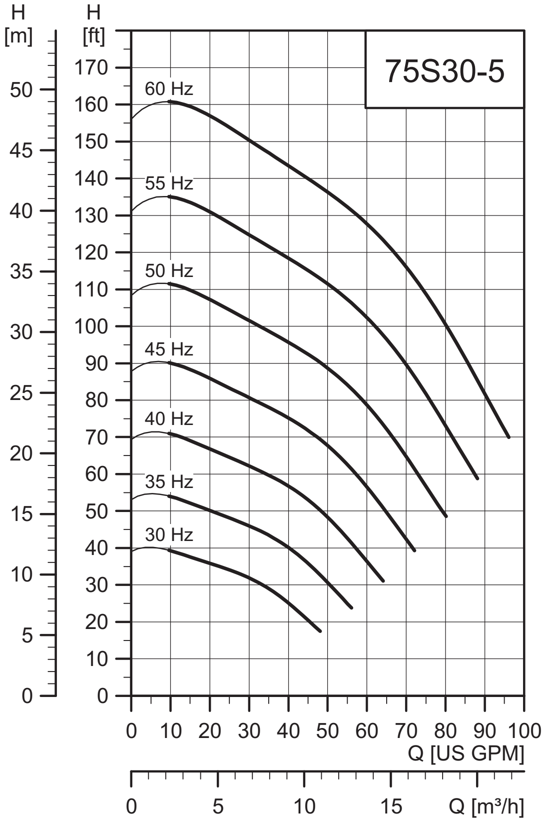

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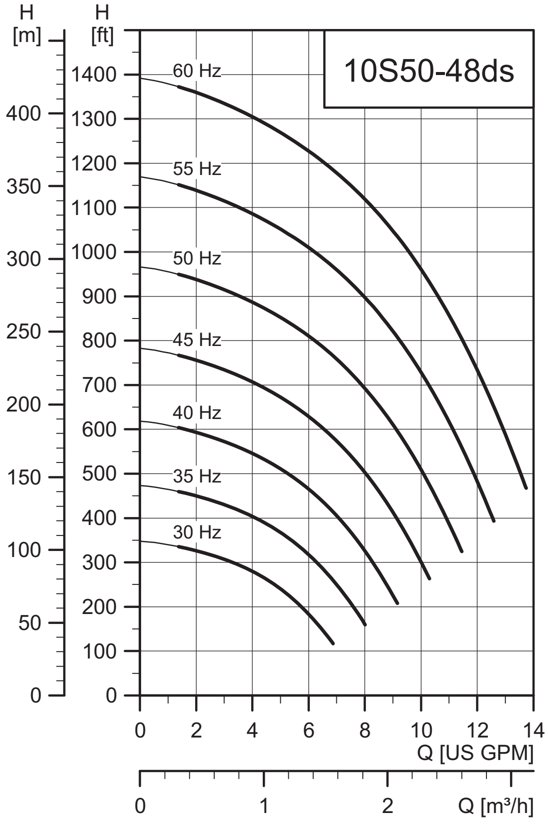

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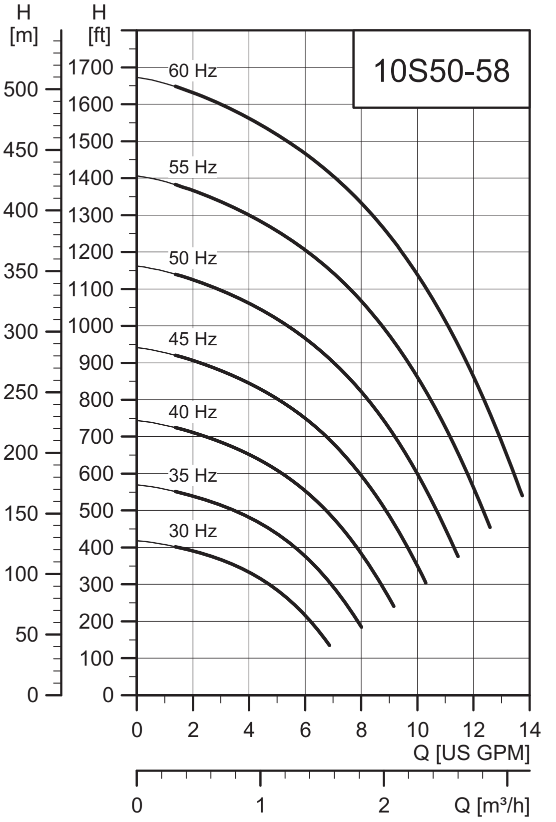
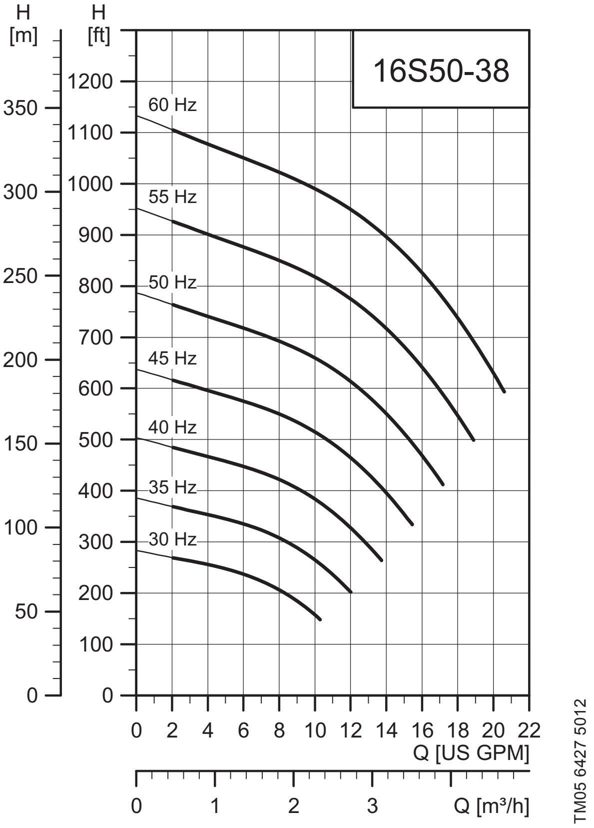
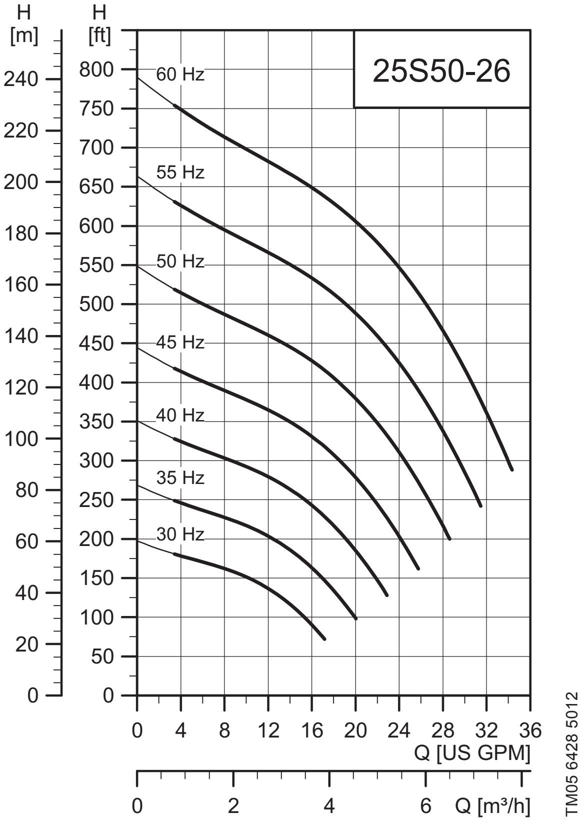
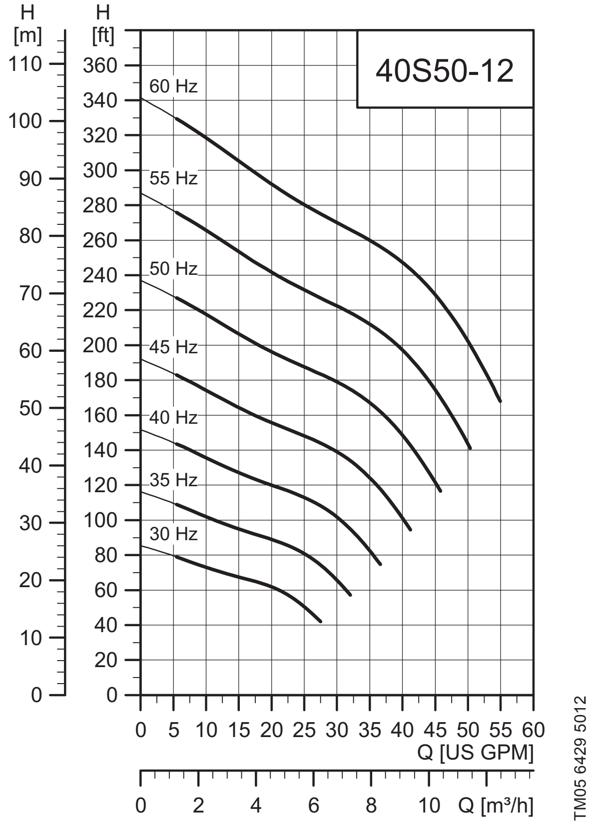
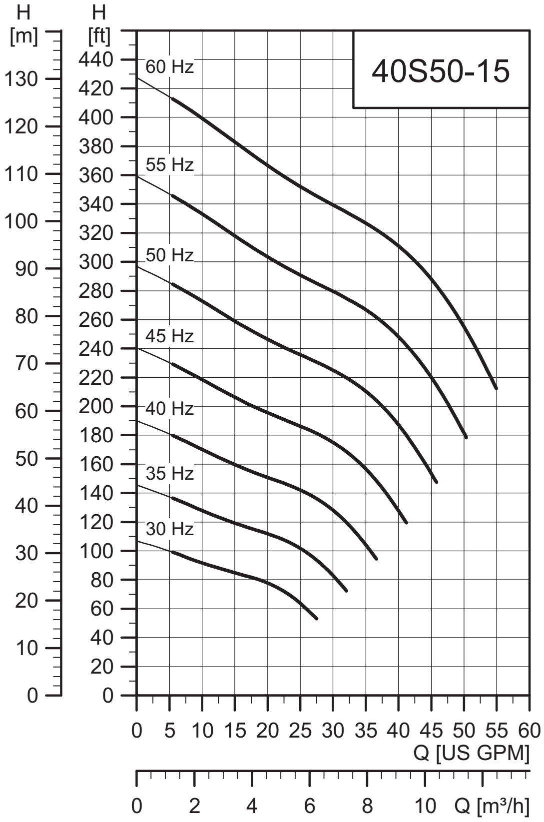

H [m]
H [ft]
10S50-58
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
Q [US GPM]
Q [m³/h]
TM05 6426 5012


H [m]
H [ft]
16S50-38
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
Q [US GPM]
Q [m³/h]
TM05 6427 5012


H [m]
H [ft]
25S50-26
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
Q [US GPM]
Q [m³/h]
TM05 6428 5012


H [m]
H [ft]
40S50-12
60 Hz
55 Hz
50 Hz
45 Hz
40 Hz
35 Hz
30 Hz
Q [US GPM]
Q [m³/h]
TM05 6429 5012



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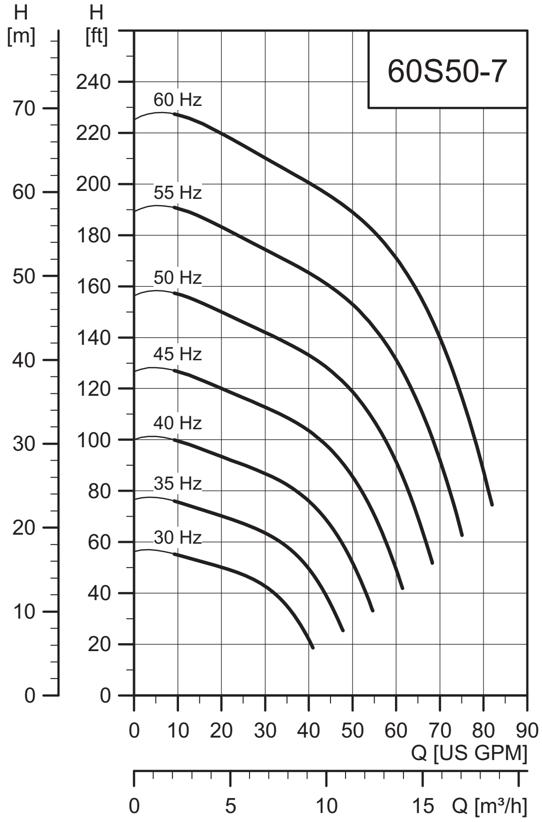

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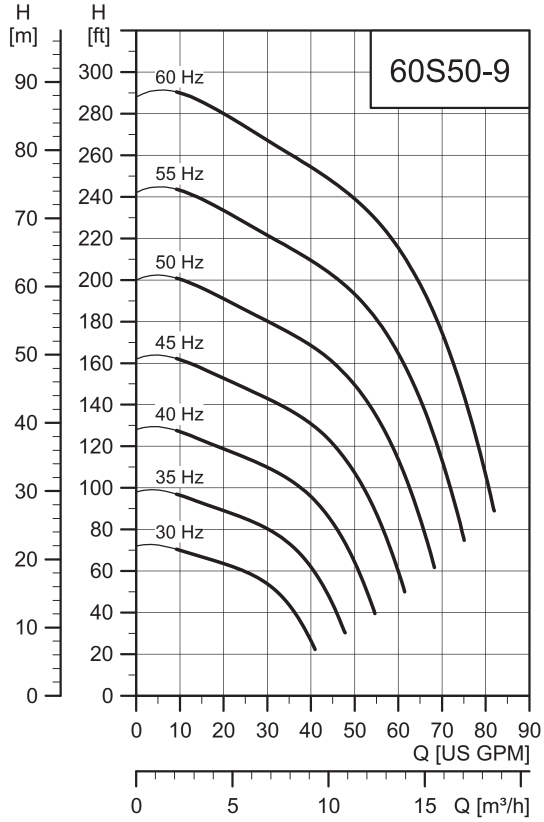

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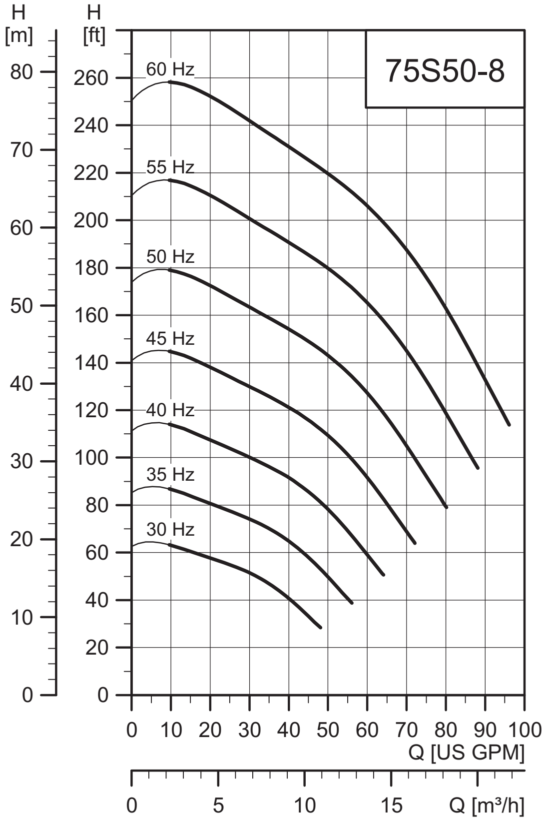


TM05 6433 5012

12. Accessories

CU331SP Constant Pressure Drive Kits (with sensor)

TM05 5801 4012

Enclosure type	NEMA	Hp	Input Ph	Input volts	Product number	Approx. ship wt. [lbs]
Indoor	Type 12	2	1	200 - 240	98370277	60
		3	1	200 - 240	98370280	60
		5	1	200 - 240	98370304	60
Outdoor	Type 4X	2	1	200 - 240	98370279	60
		3	1	200 - 240	98370301	60
		5	1	200 - 240	98370305	60

CU 301 Constant Pressure System

TM04 7509 2110

Description	Product number
Constant Pressure Kit (CU 301 and Transducer)	96438895

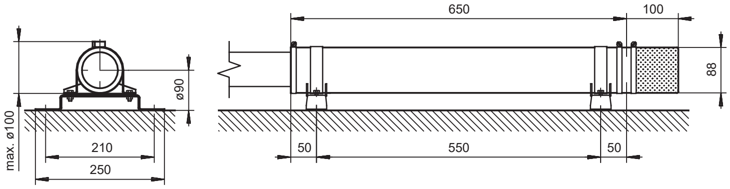
CU 300 Status Box & R100

TM04 7508 2110

Description	Product number
CU300 Status Box	96422776

Description	Product number
R100 (for wireless infrared communication with the CU 301 / CU 300)	96615297

SQ, SQE flow sleeves

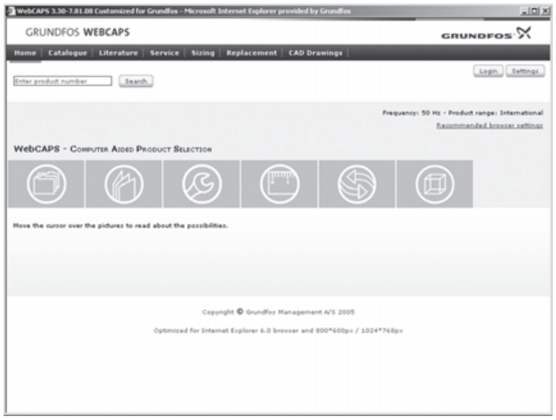


TM01 3292 3798

Description	Product number
SQ, SQE flow sleeve, complete	98148594

13. Further product documentation

WebCAPS



Frequency: 50 Hz - Product range: International

WebCAPS - Computer Aided Product Selection

Move the cursor over the pictures to read about the possibilities.

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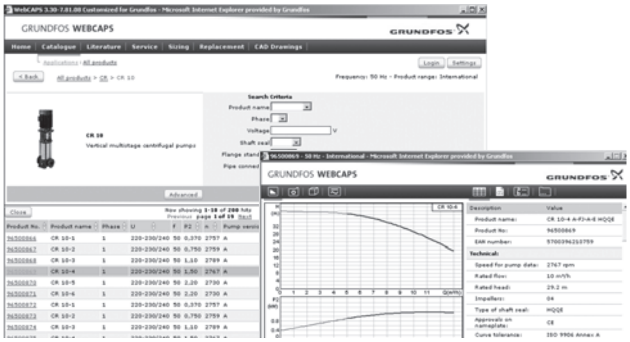
Optimized for Internet Explorer 6.0 browser and 800*600px / 1024*768px

WebCAPS is a **Web**-based **C**omputer **A**ided **P**roduct **S**election program available on www.grundfos.com.

WebCAPS contains detailed information on more than 185,000 Grundfos products in more than 20 languages.

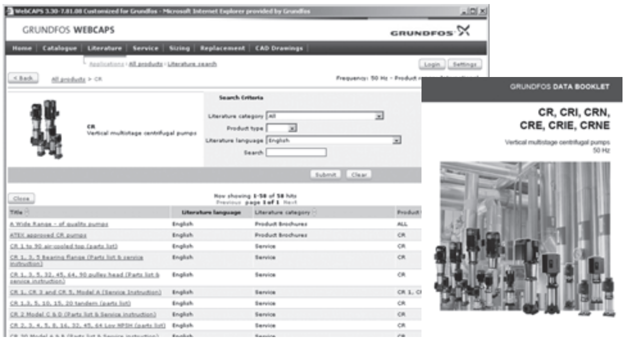
In WebCAPS, all information is divided into 6 sections:

- Catalog
- Literature
- Service
- Sizing
- Replacement
- CAD drawings.



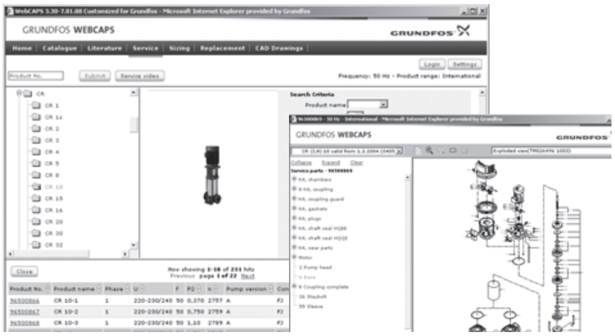
Catalog

This section is based on fields of application and pump types, and contains
- technical data
- curves (QH, Eta, P1, P2, etc) which can be adapted to the density and viscosity of the pumped liquid and show the number of pumps in operation
- product photos
- dimensional drawings
- wiring diagrams
- quotation texts, etc.



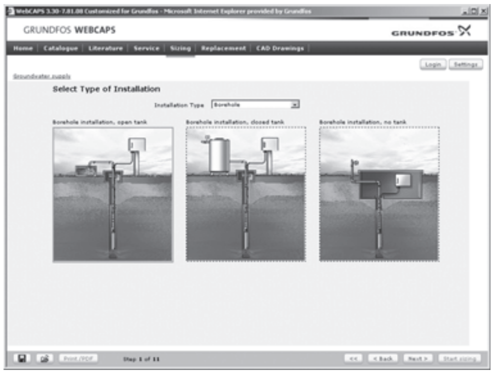
Literature

In this section you can access all the latest documents of a given pump, such as
- product guides
- installation and operating instructions
- service documentation, such as Service kit catalog and Service kit instructions
- quick guides
- product brochures, etc.



Service

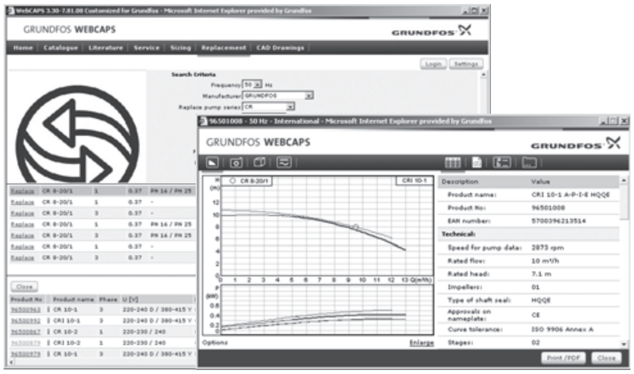
This section contains an easy-to-use interactive service catalog. Here you can find and identify service parts of both existing and discontinued Grundfos pumps.
Furthermore, this section contains service videos showing you how to replace service parts.



Sizing

This section is based on different fields of application and installation examples, and gives easy step-by-step instructions in how to

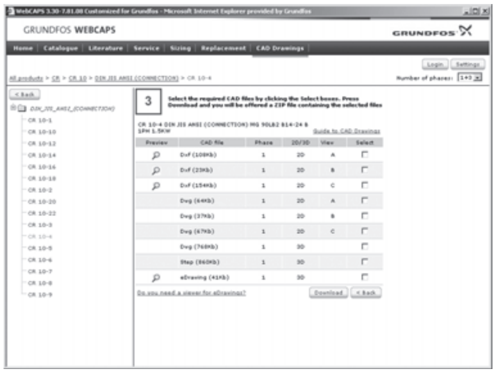
- select the most suitable and efficient pump for your installation
- carry out advanced calculations based on energy consumption, payback periods, load profiles, life cycle costs, etc.
- analyse your selected pump via the built-in life cycle cost tool
- determine the flow velocity in wastewater applications, etc.

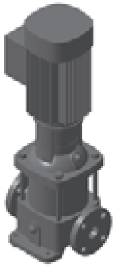


Replacement

In this section you find a guide to selecting and comparing replacement data of an installed pump in order to replace the pump with a more efficient Grundfos pump.
The section contains replacement data of a wide range of pumps produced by other manufacturers than Grundfos.

Based on an easy step-by-step guide, you can compare Grundfos pumps with the one you have installed on your site. When you have specified the installed pump, the guide will suggest a number of Grundfos pumps which can improve both comfort and efficiency.





CAD drawings

In this section it is possible to download 2-dimensional (2D) and 3-dimensional (3D) CAD drawings of most Grundfos pumps.

These formats are available in WebCAPS:

2-dimensional drawings:

- .dxf, wireframe drawings
- .dwg, wireframe drawings.

3-dimensional drawings:

- .dwg, wireframe drawings (without surfaces)
- .stp, solid drawings (with surfaces)
- .eprt, E-drawings.

WinCAPS

Fig. 50 WinCAPS CD-ROM

WinCAPS is a **Win**dows-based **C**omputer **A**ided **P**roduct **S**election program containing detailed information on more than 185,000 Grundfos products in more than 20 languages.

The program contains the same features and functions as WebCAPS, but is an ideal solution if no Internet connection is available.

WinCAPS is available on CD-ROM and updated once a year.

be think innovate

L-SQ-PG-001

98440904 0313

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GRUNDFOS

PRODUCT CATALOG

MOTORS & CONTROL BOXES

franklinwater.com

Franklin Electric

Franklin Electric

SUBMERSIBLE MOTORS & CONTROL BOXES

For the most up-to-date product information, visit **franklinwater.com**.

4" SUBMERSIBLE MOTORS

These motors are built for dependable operation in 4" diameter or larger water wells.

BASIC FEATURES

- Corrosion-resistant stainless steel exterior
- Stainless steel splined shaft
- Hermetically-sealed windings
- StatorShield™ resin system
- Filter check valve
- Water lubrication
- Kingsbury-type thrust bearing
- Pressure-equalizing diaphragm
- Built-in lightning arrestors (all single-phase; 200 & 300 V three-phase)
- Removable Water-Bloc™ lead
- Franklin-manufactured control boxes available for single-phase motors
- UL 778 recognized (North American voltages)
- CSA certified
- ANSI/NSF 61 certified
- Industry standard NEMA mounting dimensions

SPECIAL FEATURES

- Flow inducer sleeve not required in water up to 86 °F (30 °C) for motors through 2 hp
- Two-wire motors are split-phase designs with integral starting components and do not require a control box; features Franklin's patented 2-wire BIAC starting switch, which provides reverse impact torque to aid starting in adverse environments and prevents extreme fast cycling (e.g. water-logged tank)
- Three-wire motors through 1 hp use Franklin's exclusive three-wire QD (Quick Disconnect) Control Box with the patented QD Relay. This relay provides the ultimate in operational life
- Single-phase motors can be used with Pumptec products to protect against dry-run and other installation conditions that can damage motors and/or pumps; see single-phase protection devices for details

POLLUTION RECOVERY OPTION

- Pollution Recovery motors are equipped for use in monitoring and recovery wells in which hydrocarbons and other chemicals may be present
- Features nitrile rubber parts and other chemical-resistant materials as listed in the construction materials chart

4" SUBMERSIBLE MOTORS - SPECIFICATIONS AND MATERIALS

MOTOR SPECIFICATIONS

Hz	Model	Phase	HP Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
50	Super Stainless	1	0.5 - 1.5	0.37 - 1.1	2	2875	86 °F / 30 °C	Continuous
		1	0.3 - 3	0.25 - 2.2				Continuous*
		3	0.5 - 3	0.37 - 2.2				Continuous*
	Pollution Recovery	1	0.5 - 1.5	0.37 - 1.1				Continuous
		1	0.3 - 2	0.25 - 1.5				Continuous*
		3	0.5 - 2	0.37 - 1.5				Continuous*
	High Thrust	1	1.5 - 5	1.1 - 3.7				Continuous*
		3	1.5 - 10	1.1 - 7.5				Continuous*
60	Super Stainless	1	0.3 - 1.5	0.25 - 1.1		3450		Continuous
		1	0.3 - 3	0.25 - 2.2				Continuous*
		3	0.5 - 3	0.37 - 2.2				Continuous*
	Pollution Recovery	1	0.3 - 1.5	0.25 - 1.1				Continuous
		1	0.3 - 2	0.25 - 1.5				Continuous*
		3	0.5 - 2	0.37 - 1.5				Continuous*
	High Thrust	1	1.5 - 5	1.1 - 3.7				Continuous*
		3	1.5 - 10	1.1 - 7.5				Continuous*

** 3 hp motors require 0.25 ft/sec flow past motor*

CONSTRUCTION MATERIALS

Model No.	-	-	-8602G	-8802G	-3529G (not including 15HP)	-0630G	-8502G	-8702G	-8801G
Model Type	Super Stainless	Super Stainless	High Thrust	High Thrust	High Thrust	High Thrust	High Thrust	High Thrust	High Thrust
Component	Watwer Well	Pollution Recovery	Water Well	Sand Fighter®	CBM+	SERIES 600M	316 SS	Oil Stripper	ES
Top Castings	304 SS over Iron	304 SS over Iron	303 SS	303 SS	316 SS	303 SS	316 SS	316 SS	316 SS
Bottom Castings	Cast iron	Cast iron	304 SS over cast iron	304 SS over cast iron	316 SS	304 SS over cast iron	316 SS	316 SS	304 SS over cast iron
Stator Shell	301 SS	301SS	304 SS	304 SS	316 SS	316 SS	316 SS	316 SS	304 SS
Stator Ends	Low-carbon steel	Low-carbon steel	Low-carbon steel	Low-carbon steel	316 SS	Low-carbon steel	316 SS	316 SS	Low-carbon steel
Shaft Extension	17-4 SS	17-4 SS	17-4 SS	17-4 SS	17-4 SS	17-4 SS	17-4 SS	17-4 SS	17-4 SS
Fasteners	300 Series SS	316 SS	300 Series SS	300 Series SS	316 SS	300 Series SS	316 SS	316 SS	300 Series SS
Seal Cover	Acetal	Tefzel	Acetal	Sintered bronze	316 SS	Sintered bronze	316 SS	316 SS	Sintered bronze
Seal	Lip-Nitrile	Lip-FKM	Lip-Nitrile	Mech-Nitrile, SiC face	Mech-FKM, SiC face	Mech-FKM, SiC face	Mech-Nitrile, SiC face	Mech-FKM, SiC face	Mech-FKM, SiC face
Diaphragm	Nitrile	FKM	Nitrile	Nitrile	FKM	Nitrile	Nitrile	FKM	FKM
Diaphragm Cup	N/A	N/A	316 SS	316 SS	316 SS	316 SS	316 SS	316 SS	316 SS
Diaphragm Spring	N/A	N/A	316 SS	316 SS	316 SS	316 SS	316 SS	316 SS	316 SS
Diaphragm Cover	304 SS	304 SS	304 SS	304 SS	316 SS	316 SS	316 SS	316 SS	304 SS
Slinger	Nitrile	FKM	Nitrile	Nitrile	FKM	Nitrile	Nitrile	FKM	FKM
Lead Wire/Cable	XLPE or EPCV	sold separately	XLPE or EPCV	XLPE or EPCV	sold separately	XLPE or EPCV	XLPE or EPCV	Nitrile	Sold separately
Lead Potting	Epoxy	N/A	Epoxy	Epoxy	N/A	Epoxy	Epoxy	Epoxy	N/A
Lead Type	303 SS jam nut	304 SS jam nut	316 SS screws/clamp	316 SS screws/clamp	316 SS screw/clamp	316 SS screws/clamp	316 SS screws/clamp	316 SS screws/clamp	316 SS screw/clamp
Filter	Polyester	Polyester	Acetal/polyester	Acetal/polyester	316 SS plug	Acetal/polyester	316 SS plug	316 SS plug	316 SS plug
Max Temp Range	30C	30C	30C (1/4 ft/sec)	30C (1/4 ft/sec)	50C (1/4 ft/sec)	30C (1/4 ft/sec)	30C (1/4 ft/sec)	80C (1 ft/sec)	30C (1/4 ft/sec)
Thrust Rating	300 to 900	300 to 900	1500	1500	1500	300 to 1500	1500	1500	1500

4" SUBMERSIBLE MOTORS - ORDERING INFORMATION

2-WIRE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (Lbs)
1/3	Water Well	115	60	1.75	-	2445020117GS	300	16
		115	60	1.75	Yes	2445029004GS	300	16
		230	60	1.75	-	2445030117GS	300	16
		230	60	1.75	Yes	2445039004GS	300	16
	Pollution Recovery	115	60	1.75	-	2445020917GS	300	16
		230	60	1.75	-	2445030917GS	300	16
1/2	Water Well	115	60	1.6	-	2445040117GS	300	18
		115	60	1.6	Yes	2445049004GS	300	18
		220	50	1.0	-	2445550117GS	300	18
		230	60	1.6	-	2445050117GS	300	18
		230	60	1.6	Yes	2445059004GS	300	18
	Pollution Recovery	115	60	1.6	-	2445040917GS	300	18
		230	60	1.6	-	2445050917GS	300	18
3/4	Water Well	220	50	1.0	-	2445570117GS	300	21
		230	60	1.5	-	2445070117GS	300	21
		230	60	1.5	Yes	2445079004GS	300	21
	Pollution Recovery	230	60	1.5	-	2445070917GS	300	21
1	Water Well	220	50	1.0	-	2445581203GS	650	24
		230	60	1.4	-	2445081203GS	650	24
		230	60	1.4	Yes	2445089003GS	650	24
	Pollution Recovery	230	60	1.4	-	2445082303GS	650	24
1.5	Water Well	220	50	1.0	-	2443591217GS	650	31
		230	60	1.3	-	2443091217GS	650	31
		230	60	1.3	Yes	2443099004GS	650	31
	Pollution Recovery	230	60	1.3	-	2443092317GS	650	31

NOTE: All 3 hp motors are single-packed; pallet packs available but not shown; contact customer service for availability

4" SUBMERSIBLE MOTORS - ORDERING INFORMATION

3-WIRE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (Lbs)
1/3	Water Well	115	60	1.75	Yes	2145029004GS	300	17
		220	50	1.0	-	2145534116GS	300	17
		230	60	1.75	-	2145034416GS	300	17
		230	60	1.75	Yes	2145039004GS	300	17
	Pollution Recovery	115	60	1.75	-	2145024916GS	300	17
		230	60	1.75	-	2145034916GS	300	17
1/2	Water Well	115	60	1.6	-	2145044416GS	300	19
		115	60	1.6	Yes	2145049004GS	300	19
		220	50	1.0	-	2145554116GS	300	19
		220	50	1.0	Yes	2145559204GS	300	19
		230	60	1.6	-	2145054416GS	300	19
		230	60	1.6	Yes	2145059004GS	300	19
	Pollution Recovery	115	60	1.6	-	2145044916GS	300	19
		230	60	1.6	-	2145054916GS	300	19
3/4	Water Well	220	50	1.0	-	2145574116GS	300	21
		220	50	1.0	Yes	2145579204GS	300	21
		230	60	1.5	-	2145074416GS	300	21
		230	60	1.5	Yes	2145079004GS	300	21
	Pollution Recovery	230	60	1.5	-	2145074916GS	300	21
	Series 600M	230	60	1.5	Yes	2145070600GS	300	22
1	Water Well	220	50	1.0	-	2145581903GS	650	24
		220	50	1.0	Yes	2145589203GS	650	24
		230	60	1.4	-	2145081203GS	650	24
		230	60	1.4	Yes	2145089003GS	650	24
	Pollution Recovery	230	60	1.4	-	2145082303GS	650	24
	Series 600M	230	60	1.4	Yes	2145080610GS	650	25
1.5	Water Well	220	50	1.0	-	2243501903GS	650	28
		220	50	1.0	Yes	2243509203GS	650	28
		230	60	1.3	-	2243001903GS	650	28
		230	60	1.3	Yes	2243009203GS	650	28
		230	60	1.3	-	2243008600G	1500	38
	Pollution Recovery	230	60	1.3	-	2243002303GS	650	28
	Series 600M	230	60	1.3	Yes	2243000610GS	650	25
	316 SS	230	60	1.3	Yes	2243008502G	1500	40
2	Water Well	220	50	1.0	-	2243511916GS	650	33
		220	50	1.0	Yes	2243519204GS	650	33
		220	50	1.0	Yes	2243518602G	1500	43
		230	60	1.25	-	2243011916GS	650	33
		230	60	1.25	Yes	2243019204GS	650	33
		230	60	1.25	-	2243018600G	1500	43
		230	60	1.25	Yes	2243018602G	1500	43
	Pollution Recovery	230	60	1.25	-	2243012316GS	650	33
	Series 600M	230	60	1.25	Yes	2243010610GS	650	29
	Sand Fighter®	230	60	1.15	Yes	2243018802G	1500	43
	Oil Stripper	230	60	1.25	Yes	2243018702G	1500	46
	316 SS	230	60	1.25	Yes	2243018502G	1500	45
3	Water Well	220	50	1.0	-	2243522504G	900	41
		220	50	1.0	-	2247528600G	1500	56
		230	60	1.15	-	2247022504G	900	41
		230	60	1.15	Yes	2247022604G	900	41
		230	60	1.15	-	2247028600G	1500	56
		230	60	1.15	Yes	2243028602G	1500	56
	Series 600M	230	60	1.15	Yes	2247020620G	900	35
		230	60	1.15	Yes	2247020630G	1500	44
	Sand Fighter®	230	60	1.15	Yes	2247028802G	1500	56
	Oil Stripper	230	60	1.15	Yes	2247028702G	1500	56
	316 SS	230	60	1.15	Yes	2247028502G	1500	56
5	Water Well	220	50	1.0	-	2243538600G	1500	71
		230	60	1.15	-	2247038600G	1500	71
		230	60	1.15	Yes	2247038602G	1500	71
	Series 600M	230	60	1.15	Yes	2243030630G	1500	56
	Sand Fighter®	230	60	1.15	Yes	2247038802G	1500	71
	Oil Stripper	230	60	1.15	Yes	2247038702G	1500	71
	316 SS	230	60	1.15	Yes	2247038502G	1500	71

NOTE: All 3 hp motors are single-packed; pallet packs available but not shown; contact customer service for availability

4" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust	Wt. (Lbs)
1/2	Water Well	48	60	1.5	Yes	2349049204GS	300	18
		200	60	1.6	-	2345014116GS	300	18
		200	60	1.6	Yes	2345019204GS	300	19
		220	50	1.0	-	2345514116GS	300	18
		230	60	1.6	-	2345114116GS	300	18
		230	60	1.6	Yes	2345119204GS	300	19
		380-415	50	1.0	-	2345613116GS	300	18
		460	60	1.6	-	2345213116GS	300	18
		460	60	1.6	Yes	2345219404GS	300	19
		575	60	1.6	Yes	2345319404GS	300	19
	Pollution Recovery	200	60	1.6	-	2345014916GS	300	18
		230	60	1.6	-	2345114916GS	300	18
		460	60	1.6	-	2345214916GS	300	18
3/4	Water Well	100	60	1.5	Yes	2349029204GS	300	21
		200	60	1.5	-	2345024116GS	300	21
		200	60	1.5	Yes	2345029204GS	300	22
		220	50	1.0	-	2345524116GS	300	21
		230	60	1.5	-	2345124116GS	300	21
		230	60	1.5	Yes	2345129204GS	300	22
		380-415	50	1.0	-	2345623116GS	300	21
		460	60	1.5	-	2345223116GS	300	21
		460	60	1.5	Yes	2345229404GS	300	22
		575	60	1.5	Yes	2345329404GS	300	22
	Pollution Recovery	200	60	1.5	-	2345024916GS	300	21
		230	60	1.5	-	2345124916GS	300	21
		460	60	1.5	-	2345224916GS	300	21
	Series 600M	230	60	1.5	Yes	2345120600GS	300	22
		460	60	1.5	Yes	2345220600GS	300	22
1	Water Well	200	60	1.4	-	2345031903GS	650	24
		200	60	1.4	Yes	2345039203GS	650	25
		220	50	1.0	-	2345534116GS	650	24
		230	60	1.4	-	2345131903GS	650	24
		230	60	1.4	Yes	2345139203GS	650	25
		380-415	50	1.0	-	2345633116GS	650	24
		460	60	1.4	-	2345231603GS	650	24
		460	60	1.4	Yes	2345239403GS	650	25
		575	60	1.4	Yes	2345339403GS	650	25
	Pollution Recovery	200	60	1.4	-	2345032303GS	650	24
		230	60	1.4	-	2345132303GS	650	24
		460	60	1.4	-	2345232303GS	650	24
	Series 600M	230	60	1.4	Yes	2345130610GS	650	25
		460	60	1.4	Yes	2345230610GS	650	25
1.5	Water Well	200	60	1.3	-	2345041903GS	650	28
		200	60	1.3	Yes	2345049203GS	650	29
		200	60	1.3	-	2345048600	1500	33
		220	50	1.3	Yes	2345549003GS	650	28
		230	60	1.3	-	2345141903GS	650	28
		230	60	1.3	Yes	2345149203GS	650	29
		230	60	1.3	-	2345148600G	1500	33
		460/380	60/50	1.3/1.0	-	2345241603GS	650	28
		460/380	60/50	1.3/1.0	Yes	2345249403GS	650	28
		460/380	60/50	1.3/1.0	-	2345248600G	1500	28
		575	60	1.3	-	2345341603GS	650	28
		575	60	1.3	Yes	2345349403GS	650	29
		575	60	1.3	-	2345348600G	1500	33
	Pollution Recovery	200	60	1.3	-	2345042303GS	650	28
		230	60	1.3	-	2345142303GS	650	28
		460/380	60/50	1.3/1.0	-	2345242303GS	650	28
	Series 600M	230	60	1.3	Yes	2345140610GS	650	25
		460/380	60/50	1.3/1.0	Yes	2345240610GS	650	25
	316 SS	200	60	1.3	Yes	2345048502G	1500	40
		230	60	1.3	Yes	2345148502G	1500	40
		460/380	60/50	1.3/1.0	Yes	2345248502G	1500	40
		575	60	1.3	Yes	2345348502G	1500	40

4" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust	Wt. (Lbs)
2	Water Well	200	60	1.25	-	2343051618GS	650	33
		200	60	1.25	Yes	2343059204GS	650	34
		200	60	1.25	-	2343058600G	1500	44
		220	50	1.0	-	2343551916GS	650	33
		230	60	1.25	-	2343151618GS	650	33
		230	60	1.25	Yes	2343159204GS	650	34
		230	60	1.25	-	2343158600G	1500	44
		460/380	60/50	1.25/1.0	-	2343251618GS	650	33
		460/380	60/50	1.25/1.0	Yes	2343259404GS	650	34
		460/380	60/50	1.25/1.0	-	2343258600G	1500	44
		460/380	60/50	1.25/1.0	Yes	2343258602G	1500	44
		575	60	1.25	-	2343351618GS	650	33
		575	60	1.25	Yes	2343359404GS	650	34
		575	60	1.25	-	2343358600G	1500	44
	Pollution Recovery	200	60	1.25	-	2343052318GS	650	33
		230	60	1.25	-	2343152318GS	650	33
		460/380	60/50	1.25/1.0	-	2343252318GS	650	33
	Series 600M	230	60	1.25	Yes	2343150610GS	650	29
		460/380	60/50	1.25/1.0	Yes	2343250610GS	650	29
	316 SS	200	60	1.25	Yes	2343058502G	1500	44
		230	60	1.25	Yes	2343158502G	1500	44
		460/380	60/50	1.25/1.0	Yes	2343258502G	1500	44
		575	60	1.25	Yes	2343358502G	1500	44
	Oil Stripper	230	60	1.25	Yes	2343158702G	1500	44
		460/380	60/50	1.25/1.0	Yes	2343258702G	1500	44
3	Water Well	200	60	1.15	-	2343062504G	900	41
		200	60	1.15	Yes	2343062604G	900	41
		200	60	1.15	-	2343068600G	1500	43
		200	60	1.15	Yes	2343068602G	1500	44
		220	50	1.0	-	2343562504G	900	41
		220	50	1.0	-	2343568600G	1500	43
		230	60	1.15	-	2343162504G	900	41
		230	60	1.15	Yes	2343162604G	900	41
		230	60	1.15	-	2343168600G	1500	43
		230	60	1.15	Yes	2343168602G	1500	44
		380	60	1.15	-	2343462504G	900	41
		380	60	1.15	Yes	2343462604G	900	41
		380	60	1.15	-	2343468600G	1500	43
		380	60	1.15	Yes	2343468602G	1500	44
		460/380	60/50	1.15/1.0	-	2343262504G	900	41
		460/380	60/50	1.15/1.0	Yes	2343262604G	900	41
		460/380	60/50	1.15/1.0	-	2343268600G	1500	43
		460/380	60/50	1.15/1.0	Yes	2343268602G	1500	44
		575	60	1.15	-	2343362504G	900	41
		575	60	1.15	Yes	2343362604G	900	41
		575	60	1.15	-	2343368600G	1500	43
		575	60	1.15	Yes	2343368602G	1500	44
	Series 600M	230	60	1.15	Yes	2343160620G	900	35
		230	60	1.15	Yes	2343160630G	1500	44
		460/380	60/50	1.15	Yes	2343260620G	900	35
		460/380	60/50	1.15	Yes	2343260630G	1500	44
	Sand Fighter®	200	60	1.15	Yes	2343068802G	1500	44
		230	60	1.15	Yes	2343168802G	1500	44
		380	60	1.15	Yes	2343468802G	1500	44
		460/380	60/50	1.15/1.0	Yes	2343268802G	1500	44
		575	60	1.15	Yes	2343368802G	1500	44
	316 SS	200	60	1.15	Yes	2343068502G	1500	44
		230	60	1.15	Yes	2343168502G	1500	44
		460/380	60/50	1.15/1.0	Yes	2343268502G	1500	44
		575	60	1.15	Yes	2343368502G	1500	44
	Oil Stripper	230	60	1.15	Yes	2343168702G	1500	44
		460/380	60/50	1.15/1.0	Yes	2343268702G	1500	44

4" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust	Wt. (Lbs)
4	Water Well	380	50	1.0	-	2343958600G	1500	49
		380	50	1.0	Yes	2348068602G	1500	50
5	Water Well	200	60	1.15	-	2343078600G	1500	55
		200	60	1.15	Yes	2343078602G	1500	56
		220	50	1.0	-	2347578600G	1500	55
		230	60	1.15	-	2347178600G	1500	55
		230	60	1.15	Yes	2347178602G	1500	56
		380	60	1.15	-	2343478600G	1500	55
		380	60	1.15	Yes	2347478602G	1500	56
		460/380	60/50	1.15/1.0	-	2343278600G	1500	55
		460/380	60/50	1.15/1.0	Yes	2347278602G	1500	56
		575	60	1.15	-	2343378600G	1500	55
		575	60	1.15	Yes	2347378602G	1500	56
	Series 600M	230	60	1.15	Yes	2347170630G	1500	56
		460/380	60/50	1.15	Yes	2347270630G	1500	56
	Sand Fighter®	200	60	1.15	Yes	2343078802G	1500	56
		230	60	1.15	Yes	2347178802G	1500	56
		380	60	1.15	Yes	2343478802G	1500	56
		460/380	60/50	1.15/1.0	Yes	2347278802G	1500	56
		575	60	1.15	Yes	2347378802G	1500	56
	316 SS	200	60	1.15	Yes	2343078502G	1500	56
		230	60	1.15	Yes	2347178502G	1500	56
		460/380	60/50	1.15/1.0	Yes	2347278502G	1500	56
		575	60	1.15	Yes	2347378502G	1500	56
	Oil Stripper	230	60	1.15	Yes	2347178702G	1500	58
		460/380	60/50	1.15/1.0	Yes	2347278702G	1500	58
	ES	460/380	60/50	1.15/1.0	-	2347278801G	1500	56
	CBM+	460/380	60/50	1.15/1.0	-	2347273529G	1500	59
5.5	Water Well	460/380	60/50	1.0	-	2343978600G	1500	60
		460/380	60/50	1.0	Yes	2347658602G	1500	61
7.5	Water Well	200	60	1.15	-	2343088600G	1500	70
		200	60	1.15	Yes	2343088602G	1500	71
		220	50	1	-	2343588600G	1500	70
		230	60	1.15	-	2343188600G	1500	70
		230	60	1.15	Yes	2347188602G	1500	71
		380	60	1.15	-	2343488600G	1500	70
		380	60	1.15	Yes	2347488602G	1500	71
		460/380	60/50	1.15/1.0	-	2343288600G	1500	70
		460/380	60/50	1.15/1.0	Yes	2347288602G	1500	71
		575	60	1.15	-	2343388600G	1500	70
		575	60	1.15	Yes	2347388602G	1500	71
	Sand Fighter®	200	60	1.15	Yes	2343088802G	1500	71
		230	60	1.15	Yes	2347188802G	1500	71
		380	60	1.15	Yes	2347488802G	1500	71
		460/380	60/50	1.15/1.0	Yes	2347288802G	1500	71
		575	60	1.15	Yes	2347388802G	1500	71
	316 SS	200	60	1.15	Yes	2343088502G	1500	71
		230	60	1.15	Yes	2347188502G	1500	71
		460/380	60/50	1.15/1.0	Yes	2343288502G	1500	71
		575	60	1.15	Yes	2343388502G	1500	71
	Oil Stripper	230	60	1.15	Yes	2347188702G	1500	71
		460/380	60/50	1.15/1.0	Yes	2343288702G	1500	71
	ES	460/380	60/50	1.15/1.0	-	2347288801G	1500	71
	CBM+	460/380	60/50	1.15/1.0	-	2347283529G	1500	74
10	Water Well	380	60	1.15	Yes	2347498602G	1500	77
		460/380	60/50	1.15/1.0	Yes	2347298602G	1500	77
		575	60	1.15	Yes	2347398602G	1500	77
	Sand Fighter®	380	60	1.15	Yes	2347498802G	1500	77
		460/380	60/50	1.15/1.0	Yes	2347298802G	1500	77
		575	60	1.15	Yes	2347398802G	1500	77
	316 SS	460/380	60/50	1.15	Yes	2347298502G	1500	77
	Oil Stripper	460/380	60/50	1.15	Yes	2347298702G	1500	77
	ES	460/380	60/50	1.15/1.0	-	2347298801G	1500	77
	CBM+	460/380	60/50	1.15/1.0	-	2347293529G	1500	80
15	CBM+	460/380	60/50	1.15/1.0	-	2346268996	3500	115

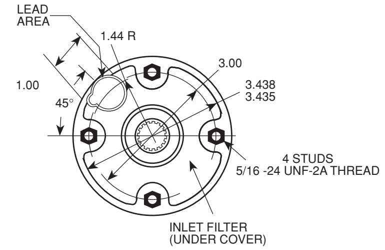
NOTE: All 3 hp motors are single-packed; pallet packs available but not shown; contact customer service for availability

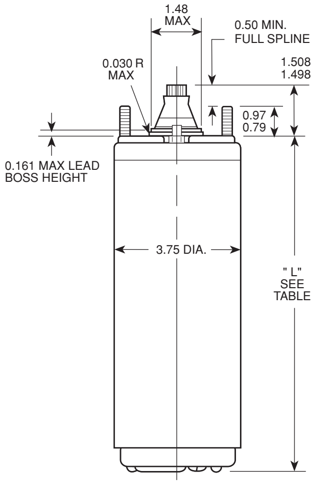
4" SUBMERSIBLE MOTORS - DIMENSIONS AND WEIGHTS

SUPER STAINLESS

HP / kW	Phase	L (in)	Motor Carton Size (in)			Shipping Wt.	
			W	H	L	lbs	kg
0.333 / 0.25	1	8.76	4.25	4.38	16.00	16	7.3
	1	8.76	4.25	4.38	16.00	17	7.7
0.5 / 0.37	1	9.51	4.25	4.38	16.00	18	8.2
	1	9.51	4.25	4.38	16.00	19	8.6
	3	9.51	4.25	4.38	16.00	18	8.2
0.75 / 0.55	1	10.64	4.25	4.38	19.00	21	9.5
	1	10.64	4.25	4.38	19.00	21	9.5
	3	10.64	4.25	4.38	16.00	21	9.5
1 / 0.75	1	11.73	4.25	4.38	19.00	24	10.9
	1	11.73	4.25	4.38	19.00	24	10.9
	3	11.73	4.25	4.38	19.00	24	10.9
1.5 / 1.1	1	15.1	4.25	4.38	21.25	31	14.1
	1	13.6	4.25	4.38	21.25	28	12.7
	3	11.73	4.25	4.38	19.00	24	10.9
2 / 1.5	1	15.1	4.25	4.38	21.25	33	15
	3	13.6	4.25	4.38	21.25	28	12.7
3 / 2.2	1	19.04	4.25	4.38	21.25	41	18.6
	3	16.04	4.25	4.38	21.25	35	15.9

NOTE: All dimensions listed above are for models supplied with lead; consult factory for other models

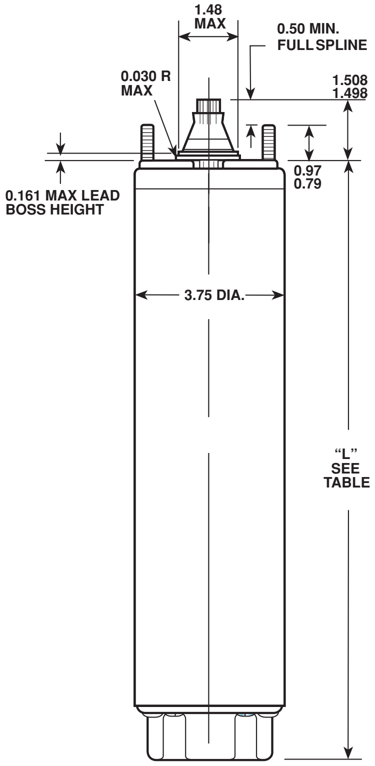




HIGH THRUST

HP / kW	Model	Phase	L (in)	Motor Carton Size (in)			Shipping Wt.	
				W	H	L	lbs	kg
1.5 / 1.1	Standard, Sand Fighter®	1	19.1	6.50	6.25	21.50	35	15.9
	Standard, Sand Fighter®	3	17.98	6.50	6.25	21.50	37	16.8
2 / 1.5	Standard, Sand Fighter®	1	20.6	6.50	6.25	24.25	43	19.5
	Oil Stripper	1	22.85	6.50	6.25	25.75	46	20.9
	Standard, Sand Fighter®	3	19.1	6.50	6.25	24.25	44	20
	Oil Stripper	3	21.35	6.50	6.25	25.75	42	19.1
3 / 2.2	Standard, Sand Fighter®	1	22.49	6.50	6.25	27.75	47	21
	Oil Stripper	1	22.98	6.50	6.25	27.75	48	22
	Standard, Sand Fighter®	3	19.44	6.50	6.25	24.75	41	19
	Oil Stripper	3	19.93	6.50	6.25	26.25	42	19
5 / 3.7	Standard, Sand Fighter®	1	27.41	6.50	6.25	33.75	64	29
	Oil Stripper	1	27.90	6.50	6.25	33.75	65	30
	Standard, Sand Fighter®	3	22.49	6.50	6.25	27.75	50	23
	Oil Stripper	3	22.98	6.50	6.25	27.75	51	23
	CBM+	3	23.45	6.50	6.25	27.75	52	24
5.5 / 4	Standard, Sand Fighter®	3	23.39	6.50	6.25	27.75	52	24
7.5 / 5.5	Standard, Sand Fighter®	3	27.41	6.50	6.25	33.75	64	29
	Oil Stripper	3	27.90	6.50	6.25	33.75	65	30
	CBM+	3	28.37	6.50	6.25	33.75	66	30
10 / 7.5	Standard, Sand Fighter®	3	30.48	6.50	6.25	35.25	72	33
	Oil Stripper	3	30.97	6.50	6.25	35.25	73	33
	CBM+	3	31.44	8.88	8	39.5	74	34
15 / 11	CBM+	3	47.50	6.50	6.25	50.00	115	52

NOTE: Consult factory for 316 SS weights and dimensions

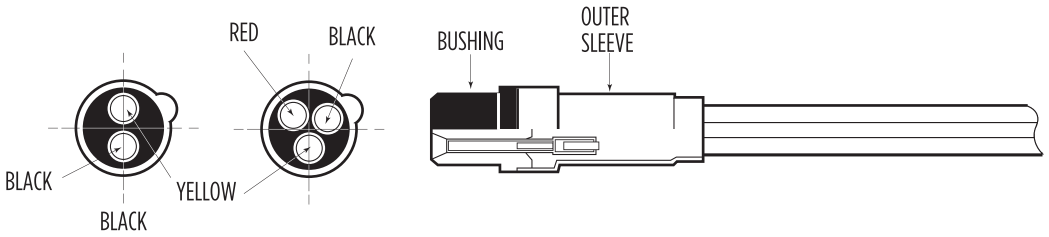


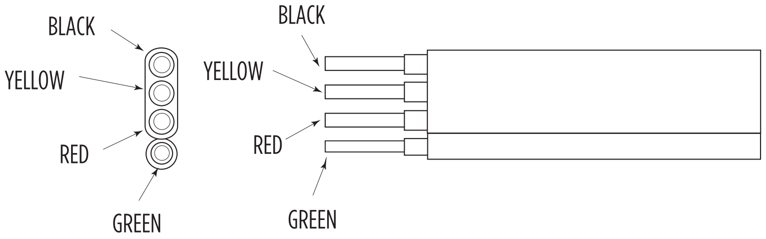
4" SUBMERSIBLE MOTORS - LEADS AND ACCESSORIES

MOTOR LEADS AND CABLES

HP	Wire	Description	Wire AWG	Model No.	Wt. (lbs)
All	2	Lead, Individual XLPE, 303 SS, 48 in, Ground	14	152552905	1
		Lead, Individual XLPE, 303 SS, 100 in, Ground		152552906	1
		Lead, Individual Nitrile, 316 SS, 48 in, No Ground		152328905*	1
		Lead, Individual Nitrile, 316 SS, 100 in, No Ground		152328906*	1
	3 (Jam-Nut Style)	Lead, Individual XLPE, 303 SS, 48 in, Ground		152553905	< 1
		Lead, Individual XLPE, 303 SS, 100 in, Ground		152553906	< 1
		Lead, Individual Nitrile, 316 SS, 48 in, No Ground *		152255901	< 1
		Lead, Individual Nitrile, 316 SS, 100 in, No Ground *		152255902	< 1
		Lead, Individual Nitrile, 316 SS, 160 in, No Ground *		152255904	< 1
		Lead, Individual Nitrile, 316 SS, 30 ft, No Ground *		152255906	5
		Lead, Individual Nitrile, 316 SS, 50 ft, No Ground *		152255907	5
		Lead, Individual Nitrile, 316 SS, 100 ft, No Ground *		152255910	9
		Lead, Individual Nitrile, 316 SS, 150 ft, No Ground *		152255912	14
	3 (Clamp Style)	Lead, Individual XLPE, 316 SS, 48 in, Ground		152735911	< 1
		Lead, Individual XLPE, 316 SS, 100 in, Ground		152735941	1
		Lead, Individual Nitrile, 316 SS, 100 in, No Ground *		152744902	< 1
		Lead, Individual Nitrile, 316 SS, 160 in, No Ground *		152744904	< 1
		Lead, Individual Nitrile, 316 SS, 50 ft, No Ground *		152744907	5
		Lead, Individual Nitrile, 316 SS, 100 ft, No Ground *		152744910	9

NOTE: Refer to Franklin Application Installation Maintenance (AIM) Manual for accurate cable sizing; MOTOR WARRANTY IS VOID if Franklin-supplied leads are not used
** Nitrile not for use in potable water*





MOTOR ACCESSORIES

HP	Description	Model No.	Wt. (lbs)
All	Coupling, 4-inch, #416 SS, 3/16 x 1/8 x 1 3/8 Key	151551911	1

6" SUBMERSIBLE MOTORS

These motors are built for dependable operation in 6" diameter or larger water wells.

BASIC FEATURES

- Double flanged NEMA mounting design
- Stainless steel splined shaft
- StatorShield™, Franklin's six-feature encapsulation system
- High-capacity, Kingsbury-type, water-lubricated thrust bearing
- Factory-filled with Franklin's non-toxic water soluble fill solution
- Field replaceable lead using Franklin's exclusive Water-Bloc™ technology
- Full 3,450 rpm 60 Hz design point
- External sand slinger on shaft
- Mechanical face seal at shaft exit
- Copper bar rotor
- All models variable frequency drive (VFD) compatible
- Single-phase models must be used with a Franklin Electric control box

SPECIAL FEATURES

- **316 Stainless Steel:** Special construction option for acid, low pH, and seawater applications. All 316 SS motors include a Subtrol™ heat sensor.
- **Sand Fighter**® models include SubTrol™ heat sensor on 40, 50, and 60 hp models.
- Consult factory for other voltage, hertz, and horsepower ratings not listed in this catalog
- Specifications are subject to change without notice; contact Franklin Electric if current materials are required for bid specifications
- Overmolded motor leads on all 10 GA leads

6" SUBMERSIBLE MOTORS - SPECIFICATIONS AND MATERIALS

MOTOR SPECIFICATIONS

Hz	Model	Phase	HP Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
50	Sand Fighter®*	3	5 - 40	3.7 -45	2	2875	86° F / 30° C	Continuous
50		3	50 - 60	37 - 45			86° F / 30° C	
50	High-Temp 90° C**	3	5 - 40	3.7 - 30			195° F / 90° C	
60	Sand Fighter®*	3	5 - 40	3.7 - 30		3450	86° F / 30° C	
60		3	50 - 60	37 - 45			86° F / 30° C	
60	High-Temp 90° C**	3	5 - 40	3.7 - 30			195° F / 90° C	

**At 0.5 ft/sec flow past motor, motors are rated for continuous duty up to 86 °F (30 °C) water temperature.*

***At 0.5 ft/sec flow past motor, motors are rated for continuous duty up to 195 °F (90 °C) water temperature and up to 86 °F (30 °C) water temperature with NO FLOW in lakes or in wells 12 inches or larger in diameter.*

CONSTRUCTION MATERIALS

Component	Construction Type			
	Sand Fighter®	Corrosion Resistant (316 SS)	Hi-Temp 90 °C (300 SS Shell)	Hi-Temp 90 °C (316 SS)
UL Insulation Class Rating	Class F	Class F	Class F	Class F
Motor Ambient Temp. Rating	86 °F / 30 °C	86 °F / 30 °C	194 °F / 90 °C (5-40 hp)	194 °F / 90 °C (5-40 hp)
Stator Resin Type	Standard (5-40 hp) / Hi-Temp (50-60 hp)	Standard (5-40 hp) / Hi-Temp (50-60 hp)	FE Hi-Temp	FE Hi-Temp
Motor Fill Solution (Water Soluble/Non-Toxic)	FES91	FES91	FES92	FES92
Top End Bell & Thrust Housing	Epoxy-coated gray iron	316 SS	Epoxy-coated gray iron	316 SS
On Winding SubTrol™ heat sensor	No (5-30 hp) / Yes (40-60 hp)	Yes	Not Available	Not Available
Stator Shell	300 series SS	316 SS	300 series SS	316 SS
Stator Ends	Carbon steel		Carbon steel	316 SS
Shaft Extension	300 Series SS (5-30 hp) / 17-4 SS (40-60 hp)	17-4 SS	300 SS (5-20 hp), 17-4 SS (25-40 hp)	17-4 SS
Bushing	316 SS	316 SS	316 SS	316 SS
Bushing Retainer	300 series SS		300 series SS	316 SS
Shaft Mechanical Seal	Sand Fighter™ Seal System	Sand Fighter™ Seal System	Sand Fighter™ Seal System	Sand Fighter™ Seal System
Mechanical Seal / Rubber Components	Nitrile (5-40 hp) / FKM (50-60 hp)	Nitrile (5-40 hp) / FKM (50-60 hp)	FKM	FKM
Diaphragm Material	Nitrile (5-40 hp) / FKM (50-60 hp)	Nitrile (5-40 hp) / FKM (50-60 hp)	FKM	FKM
Diaphragm Plate	300 series SS	316 SS	300 series SS	316 SS
Diaphragm Spring	300 series SS	25-6 MO SS	300 series SS	25-6 MO SS
Shaft Slinger	Nitrile (5-40 hp) / FKM (50-60 hp)	Nitrile	FKM	FKM
Lead Wire	Jacketed (10 AWG) Individual (8 AWG)	Jacketed (10 AWG) Individual (8 AWG)	Individual Hi-Temp XLPO	Individual Hi-Temp XLPO
Lead Construction	Overmolded (10 AWG) Potted (8 AWG)	Overmolded (10 AWG) Potted (8 AWG)	Potted	Potted
Lead Jam Nut	Brass	316 SS	Brass	316 SS
Thrust Bearing Rating (86 °F / 30 °C)	3500 lbs (5-30 hp) 6000 lbs (40-60 hp)	3500 lbs (5-30 hp) 6000 lbs (40-60 hp)	Standard 5-20 hp • 4,500 lbs Standard 25-40 hp • 7,500 lbs	Standard 5-20 hp • 4,500 lbs Standard 25-40 hp • 7,500 lbs
Method Of Connecting System Ground To Motor	Ground wire in power lead connector	Ground wire in power lead connector	Ground wire in power lead connector	Ground wire in power lead connector

NOTE: Specifications subject to change without notice; contact Franklin Electric if current material types are required for bid specifications

6" SUBMERSIBLE MOTORS - ORDERING INFORMATION

SINGLE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
5	Sand Fighter®	230	60	1.15	DOL (3)	2261108020	3500	110
	316 SS	230	60	1.15	DOL (3)	2261103920	3500	110
7.5	Sand Fighter®	230	60	1.15	DOL (3)	2261118020	3500	123
	316 SS	230	60	1.15	DOL (3)	2261113920	3500	123
10	Sand Fighter®	230	60	1.15	DOL (3)	2261128020	3500	141
	316 SS	230	60	1.15	DOL (3)	2261123920	3500	141
15	Sand Fighter®	230	60	1.15	DOL (3)	2261138020	3500	154
	316 SS	230	60	1.15	DOL (3)	2261133920	3500	154

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
5	Sand Fighter®	200	60	1.15	DOL (3)	2366508120	3500	101
		220	50	1.0	DOL (3)	2366808120	3500	101
		230	60	1.15	DOL (3)	2366008120	3500	101
		380	60	1.15	DOL (3)	2366608120	3500	101
		460/380	60/50	1.15/1.0	DOL (3)	2366108120	3500	101
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367108120	3500	106
		575	60	1.15	DOL (3)	2366208120	3500	101
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366504020	3500	101
		230	60	1.15	DOL (3)	2366004020	3500	101
		380	60	1.15	DOL (3)	2366604020	3500	101
		460/380	60/50	1.15/1.0	DOL (3)	2366104020	3500	101
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367104020	3500	106
		575	60	1.15	DOL (3)	2366204020	3500	101
	Hi-Temp 90 °C	200	60	1.15	DOL (3)	2766500003	4500	116
		230	60	1.15	DOL (3)	2766000003	4500	116
		380	60	1.15	DOL (3)	2766600003	4500	116
		460/380	60/50	1.15/1.0	DOL (3)	2766100003	4500	116
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767100003	4500	121
		575	60	1.15	DOL (3)	2766200003	4500	116
	Hi-Temp 90 °C - 316 SS	200	60	1.15	DOL (3)	2766503003	4500	116
		230	60	1.15	DOL (3)	2766003003	4500	116
		380	60	1.15	DOL (3)	2766603003	4500	116
		460/380	60/50	1.15/1.0	DOL (3)	2766103003	4500	116
		575	60	1.15	DOL (3)	2766203003	4500	116

6" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
7.5	Sand Fighter®	200	60	1.15	DOL (3)	2366518120	3500	108
		220	50	1.0	DOL (3)	2366818120	3500	108
		230	60	1.15	DOL (3)	2366018120	3500	108
		380	60	1.15	DOL (3)	2366618120	3500	108
		415	50	1.0	DOL (3)	2366918120	3500	108
		460/380	60/50	1.15/1.0	DOL (3)	2366118120	3500	108
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367118120	3500	113
		575	60	1.15	DOL (3)	2366218120	3500	108
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366514020	3500	108
		230	60	1.15	DOL (3)	2366014020	3500	108
		380	60	1.15	DOL (3)	2366614020	3500	108
		460/380	60/50	1.15/1.0	DOL (3)	2366114020	3500	108
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367114020	3500	113
		575	60	1.15	DOL (3)	2366214020	3500	108
	Hi-Temp 90 °C	200	60	1.15	DOL (3)	2766510003	4500	129
		230	60	1.15	DOL (3)	2766010003	4500	129
		380	60	1.15	DOL (3)	2766610003	4500	129
		460/380	60/50	1.15/1.0	DOL (3)	2766110003	4500	129
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767110003	4500	134
		575	60	1.15	DOL (3)	2766210003	4500	129
	Hi-Temp 90 °C - 316 SS	200	60	1.15	DOL (3)	2766513003	4500	129
		230	60	1.15	DOL (3)	2766013003	4500	129
		380	60	1.15	DOL (3)	2766613003	4500	129
		460/380	60/50	1.15/1.0	DOL (3)	2766113003	4500	129
		575	60	1.15	DOL (3)	2766213003	4500	129
10	Sand Fighter®	200	60	1.15	DOL (3)	2366528120	3500	116
		220	50	1.0	DOL (3)	2366828120	3500	116
		230	60	1.15	DOL (3)	2366028120	3500	116
		380	60	1.15	DOL (3)	2366628120	3500	116
		415	50	1.0	DOL (3)	2366928120	3500	116
		460/380	60/50	1.15/1.0	DOL (3)	2366128120	3500	116
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367128120	3500	121
		575	60	1.15	DOL (3)	2366228120	3500	116
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366524020	3500	116
		230	60	1.15	DOL (3)	2366024020	3500	116
		380	60	1.15	DOL (3)	2366624020	3500	116
		460/380	60/50	1.15/1.0	DOL (3)	2366124020	3500	116
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367124020	3500	121
		575	60	1.15	DOL (3)	2366224020	3500	116
	Hi-Temp 90 °C	200	60	1.15	DOL (3)	2766520003	4500	145
		230	60	1.15	DOL (3)	2766020003	4500	145
		380	60	1.15	DOL (3)	2766620003	4500	145
		460/380	60/50	1.15/1.0	DOL (3)	2766120003	4500	145
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767120003	4500	150
		575	60	1.15	DOL (3)	2766220003	4500	145
	Hi-Temp 90 °C - 316 SS	200	60	1.15	DOL (3)	2766523003	4500	145
		230	60	1.15	DOL (3)	2766023003	4500	145
		380	60	1.15	DOL (3)	2766623003	4500	145
		460/380	60/50	1.15/1.0	DOL (3)	2766123003	4500	145
		575	60	1.15	DOL (3)	2766223003	4500	145

6" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
15	Sand Fighter®	200	60	1.15	DOL (3)	2366538120	3500	129
		220	50	1.0	DOL (3)	2366838120	3500	129
		230	60	1.15	DOL (3)	2366038120	3500	129
		380	60	1.15	DOL (3)	2366638120	3500	129
		415	50	1.0	DOL (3)	2366938120	3500	129
		460/380	60/50	1.15/1.0	DOL (3)	2366138120	3500	129
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367138120	3500	134
		575	60	1.15	DOL (3)	2366238120	3500	129
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366534020	3500	129
		230	60	1.15	DOL (3)	2366034020	3500	129
		380	60	1.15	DOL (3)	2366634020	3500	129
		460/380	60/50	1.15/1.0	DOL (3)	2366134020	3500	129
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367134020	3500	134
		575	60	1.15	DOL (3)	2366234020	3500	129
	Hi-Temp 90 °C	200	60	1.15	DOL (3)	2766530003	4500	156
		230	60	1.15	DOL (3)	2766030003	4500	156
		380	60	1.15	DOL (3)	2766630003	4500	156
		460/380	60/50	1.15/1.0	DOL (3)	2766130003	4500	156
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767130003	4500	161
		575	60	1.15	DOL (3)	2766230003	4500	156
	Hi-Temp 90 °C - 316 SS	200	60	1.15	DOL (3)	2766533003	4500	156
		230	60	1.15	DOL (3)	2766033003	4500	156
		380	60	1.15	DOL (3)	2766633003	4500	156
		460/380	60/50	1.15/1.0	DOL (3)	2766133003	4500	156
		575	60	1.15	DOL (3)	2766233003	4500	156
20	Sand Fighter®	200	60	1.15	DOL (3)	2366548120	3500	145
		220	50	1.0	DOL (3)	2366848120	3500	145
		230	60	1.15	DOL (3)	2366048120	3500	145
		380	60	1.15	DOL (3)	2366648120	3500	145
		415	50	1.0	DOL (3)	2366948120	3500	145
		460/380	60/50	1.15/1.0	DOL (3)	2366148120	3500	145
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367148120	3500	150
		575	60	1.15	DOL (3)	2366248120	3500	145
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366544020	3500	145
		230	60	1.15	DOL (3)	2366044020	3500	145
		380	60	1.15	DOL (3)	2366644020	3500	145
		460/380	60/50	1.15/1.0	DOL (3)	2366144020	3500	145
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367144020	3500	150
		575	60	1.15	DOL (3)	2366244020	3500	145
	Hi-Temp 90 °C	200	60	1.15	DOL (3)	2766540003	4500	174
		230	60	1.15	DOL (3)	2766040003	4500	174
		380	60	1.15	DOL (3)	2766640003	4500	174
		460/380	60/50	1.15/1.0	DOL (3)	2766140003	4500	174
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767140003	4500	179
		575	60	1.15	DOL (3)	2766240003	4500	174
	Hi-Temp 90 °C - 316 SS	200	60	1.15	DOL (3)	2766543003	4500	174
		230	60	1.15	DOL (3)	2766043003	4500	174
		380	60	1.15	DOL (3)	2766643003	4500	174
		460/380	60/50	1.15/1.0	DOL (3)	2766143003	4500	174
		575	60	1.15	DOL (3)	2766243003	4500	174

6" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
25	Sand Fighter®	200	60	1.15	DOL (3)	2366558120	3500	156
		220	50	1.0	DOL (3)	2366858120	3500	156
		230	60	1.15	DOL (3)	2366058120	3500	156
		380	60	1.15	DOL (3)	2366658120	3500	156
		415	50	1.0	DOL (3)	2366958120	3500	156
		460/380	60/50	1.15/1.0	DOL (3)	2366158120	3500	156
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367158120	3500	161
		575	60	1.15	DOL (3)	2366258120	3500	156
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366554020	3500	156
		230	60	1.15	DOL (3)	2366054020	3500	156
		380	60	1.15	DOL (3)	2366654020	3500	156
		460/380	60/50	1.15/1.0	DOL (3)	2366154020	3500	156
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367154020	3500	161
		575	60	1.15	DOL (3)	2366254020	3500	156
	Hi-Temp 90 °C	200	60	1.15	DOL (3)	2766550103	7500	202
		230	60	1.15	DOL (3)	2766050103	7500	202
		380	60	1.15	DOL (3)	2766650103	7500	202
		460/380	60/50	1.15/1.0	DOL (3)	2766150103	7500	202
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767150103	7500	207
		575	60	1.15	DOL (3)	2766250103	7500	202
	Hi-Temp 90 °C - 316 SS	200	60	1.15	DOL (3)	2766553103	7500	202
		230	60	1.15	DOL (3)	2766053103	7500	202
		380	60	1.15	DOL (3)	2766653103	7500	202
		460/380	60/50	1.15/1.0	DOL (3)	2766153103	7500	202
		575	60	1.15	DOL (3)	2766253103	7500	202
30	Sand Fighter®	200	60	1.15	DOL (3)	2366568120	3500	174
		220	50	1.0	DOL (3)	2366868120	3500	174
		230	60	1.15	DOL (3)	2366068120	3500	174
		380	60	1.15	DOL (3)	2366668120	3500	174
		415	50	1.0	DOL (3)	2366968120	3500	174
		460/380	60/50	1.15/1.0	DOL (3)	2366168120	3500	174
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367168120	3500	179
		575	60	1.15	DOL (3)	2366268120	3500	174
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366564020	3500	174
		230	60	1.15	DOL (3)	2366064020	3500	174
		380	60	1.15	DOL (3)	2366664020	3500	174
		460/380	60/50	1.15/1.0	DOL (3)	2366164020	3500	174
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367164020	3500	179
		575	60	1.15	DOL (3)	2366264020	3500	174
	Hi-Temp 90 °C	200	60	1.15	DOL (3)	2766560103	7500	300
		230	60	1.15	DOL (3)	2766060103	7500	300
		380	60	1.15	DOL (3)	2766660103	7500	300
		460/380	60/50	1.15/1.0	DOL (3)	2766160103	7500	300
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767160103	7500	305
		575	60	1.15	DOL (3)	2766260103	7500	300
	Hi-Temp 90 °C - 316 SS	200	60	1.15	DOL (3)	2766563103	7500	300
		230	60	1.15	DOL (3)	2766063103	7500	300
		380	60	1.15	DOL (3)	2766663103	7500	300
		460/380	60/50	1.15/1.0	DOL (3)	2766163103	7500	300
		575	60	1.15	DOL (3)	2766263103	7500	300

6" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
40	Sand Fighter® w/SubTrol™	380	60	1.15	DOL (3)	2366678125	6000	202
		415	50	1.0	DOL (3)	2366978125	6000	202
		460/380	60/50	1.15/1.0	DOL (3)	2366178125	6000	202
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367178125	6000	207
		575	60	1.15	DOL (3)	2366278125	6000	202
	316 SS w/SubTrol™	380	60	1.15	DOL (3)	2366674025	6000	202
		460/380	60/50	1.15/1.0	DOL (3)	2366174025	6000	202
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367174025	6000	207
		575	60	1.15	DOL (3)	2366274025	6000	202
	Hi-Temp 90 °C	380	60	1.15	DOL (3)	2766670103	10000	330
		460/380	60/50	1.15/1.0	DOL (3)	2766170103	10000	330
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767170103	10000	335
		575	60	1.15	DOL (3)	2766270103	10000	330
	Hi-Temp 90 °C - 316 SS	380	60	1.15	DOL (3)	2766673103	10000	330
		460/380	60/50	1.15/1.0	DOL (3)	2766173103	10000	330
		575	60	1.15	DOL (3)	2766273103	10000	330
50	Sand Fighter® w/SubTrol™	380	60	1.15	DOL (3)	2366688125	6000	300
		460/380	60/50	1.15/1.0	DOL (3)	2366188125	6000	300
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367188125	6000	305
		575	60	1.15	DOL (3)	2366288125	6000	300
	316 SS	380	60	1.15	DOL (3)	2366684025	6000	300
		460/380	60/50	1.15/1.0	DOL (3)	2366184025	6000	300
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367184025	6000	305
		575	60	1.15	DOL (3)	2366284025	6000	300
60	Sand Fighter® w/SubTrol™	380	60	1.15	DOL (3)	2366698125	6000	330
		460/380	60/50	1.15/1.0	DOL (3)	2366198125	6000	330
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367198125	6000	335
		575	60	1.15	DOL (3)	2366298125	6000	330
	316 SS	380	60	1.15	DOL (3)	2366694025	6000	330
		460/380	60/50	1.15/1.0	DOL (3)	2366194025	6000	330
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367194025	6000	335
		575	60	1.15	DOL (3)	2366294025	6000	330

NOTE: Models designated above as Sand Fighter® are water well construction; all 316 SS and Ni-Resist models are equipped with Sand Fighter® sealing system; all models listed above include factory-installed leads (13 ft)

6" SUBMERSIBLE MOTORS - DIMENSIONS AND WEIGHTS

STANDARD

HP / kW	Construction	"L" (in)	Motor Carton Size (in)			Shipping Wt.	
			W	H	L	lbs	kg
5 / 3.7	304 SS 3-Lead	22.9	7.50	10.75	34.50	101	46
	316 SS 3-Lead	22.5	7.50	10.75	34.50	101	46
7.5 / 5.5	304 SS 3-Lead	24.2	7.50	10.75	34.50	108	49
	316 SS 3-Lead	23.8	7.50	10.75	34.50	108	49
10 / 7.5	304 SS 3-Lead	25.4	7.50	10.75	34.50	116	53
	316 SS 3-Lead	25.0	7.50	10.75	34.50	116	53
15 / 11	304 SS 3-Lead	28.0	7.50	10.75	34.50	129	59
	316 SS 3-Lead	27.6	7.50	10.75	34.50	129	59
20 / 15	304 SS 3-Lead	30.6	7.50	10.75	37.00	145	66
	316 SS 3-Lead	30.2	7.50	10.75	37.00	145	66
25 / 18.5	304 SS 3-Lead	33.1	7.50	10.75	42.25	156	71
	316 SS 3-Lead	32.7	7.50	10.75	42.25	156	71
30 / 22	304 SS 3-Lead	35.7	7.50	10.75	42.25	174	79
	316 SS 3-Lead	35.3	7.50	10.75	42.25	174	79
40 / 30	304 SS 3-Lead	40.8	7.50	10.75	47.25	202	92
	316 SS 3-Lead	40.4	7.50	10.75	47.25	202	92
50 / 37	304 SS 3-Lead	55.3	8.75	10.50	71.75	300	136
	316 SS 3-Lead	54.9	8.75	10.50	71.75	300	136
60 - 45	304 SS 3-Lead	61.3	8.75	10.50	71.75	330	150
	316 SS 3-Lead	60.9	8.75	10.50	71.75	330	150

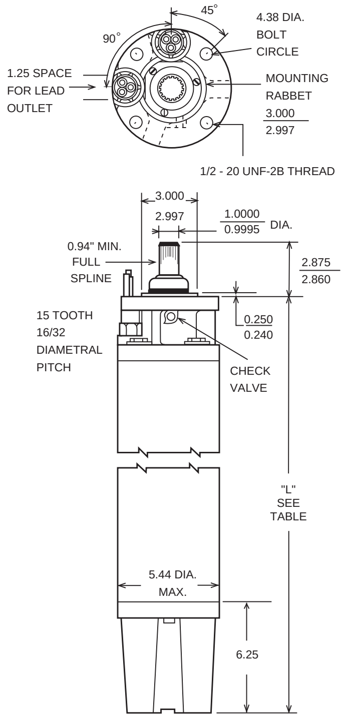
NOTE: 6-Lead Y-Δ models available (add 5 lbs to shipping weight)

HIGH-TEMP 90

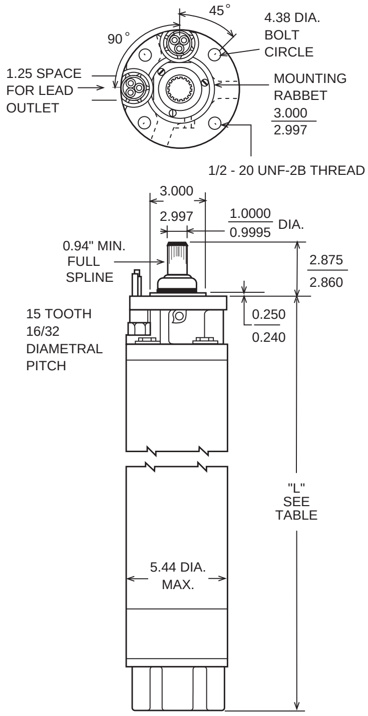
HP / kW	Construction	L (in)	Motor Carton Size (in)			Shipping Wt.	
			W	H	L	lbs	kg
5 / 3.7	304 SS 3-Lead	26.4	9	11	35	116	53
	316 SS 3-Lead	26.4	9	11	35	116	53
7.5 / 5.5	304 SS 3-Lead	28.96	9	11	37	129	59
	316 SS 3-Lead	28.96	9	11	37	129	59
10 / 7.5	304 SS 3-Lead	31.52	9	11	42	145	66
	316 SS 3-Lead	31.52	9	11	42	145	66
15 / 11	304 SS 3-Lead	34.09	9	11	42	156	71
	316 SS 3-Lead	34.09	9	11	42	156	71
20 / 15	304 SS 3-Lead	36.65	9	11	51	174	79
	316 SS 3-Lead	36.65	9	11	51	174	79
25 / 18.5	304 SS 3-Lead	41.77	9	11	51	202	92
	316 SS 3-Lead	41.77	9	11	51	202	92
30 / 22	304 SS 3-Lead	58.14	9	11	72	300	136
	316 SS 3-Lead	58.14	9	11	72	300	136
40 / 30	304 SS 3-Lead	64.14	9	11	72	330	150
	316 SS 3-Lead	64.14	9	11	72	330	150

NOTE: 6-Lead Y-Δ models available (add 5 lbs to shipping weight)

Standard Water Well



316 Stainless



6" SUBMERSIBLE MOTORS - LEADS AND ACCESSORIES

MOTOR LEADS AND CABLES

HP	Model	Description	Wire AWG	Model No.	Wt. (lbs)
All	Standard	Lead, XLPE, Brass, 13 ft, w/Ground	8	305517901	4
		Lead, XLPE, Brass, 26 ft, w/Ground	8	305517902	9
		Lead, XLPE, 316 SS, 13 ft, w/Ground	8	305517951	4
		Lead, XLPE, 316 SS, 26 ft, w/Ground	10	305518952	9
		Lead, XLPE, 316 SS, 26 ft, w/Ground	8	305517952	9
5-30		Lead, XLPE, 316 SS, 50 ft, w/Ground	10	305518955	11
		Lead, XLPE, 316 SS, 50 ft, w/Ground	8	305517955	16
		Lead, XLPE, 316 SS, 75 ft, w/Ground	10	305518957	16
		Lead, XLPE, 316 SS, 75 ft, w/Ground	8	305517957	24
		Lead, XLPE, 316 SS, 100 ft, w/Ground	10	305518960	21
		Lead, XLPE, 316 SS, 100 ft, w/Ground	8	305517960	32
		Lead, XLPE, 316 SS, 125 ft, w/Ground	10	305518962	27
		Lead, XLPE, 316 SS, 125 ft, w/Ground	8	305517962	40
		Lead, XLPE, 316 SS, 150 ft, w/Ground	10	305518965	32
		Lead, XLPE, 316 SS, 150 ft, w/Ground	8	305517965	48
All	Hi-Temp	Lead, XLPO, 316 SS, 13 ft, w/Ground	8	305519951	4
		Lead, XLPO, 316 SS, 26 ft, w/Ground	8	305519952	9
5-30		Lead, XLPO, 316 SS, 50 ft, w/Ground	8	305519955	16
		Lead, XLPO, 316 SS, 75 ft, w/Ground	8	305519957	24
		Lead, XLPO, 316 SS, 100 ft, w/Ground	8	305519960	32
		Lead, XLPO, 316 SS, 125 ft, w/Ground	8	305519962	40
		Lead, XLPO, 316 SS, 150 ft, w/Ground	8	305519965	48

NOTE: Refer to Franklin Application Installation Maintenance (AIM) Manual for accurate cable sizing; MOTOR WARRANTY IS VOID if Franklin-supplied leads are not used

MOTOR ACCESSORIES

HP	Description	Model No.	Wt. (lbs)
All	Coupling, 6-inch, #416 SS, 3/4" Pump Shaft, 3/16 x 1/8 x 1-3/4 Key	151935902	2
	Coupling, 6-inch, #416 SS, 7/8" Pump Shaft, 1/4 x 3/16 x 1-3/4 Key	151935901	2
	Coupling, 6-inch, #416 SS, 1" Pump Shaft, 1/4 x 3/16 x 1-3/4 Key	151935909	2
	Coupling, 6-inch, #316 SS, 3/4" Pump Shaft, 3/16 x 1/8 x 1-3/4 Key	151935922	2
	Coupling, 6-inch, #316 SS, 7/8" Pump Shaft, 1/4 x 3/16 x 1-3/4 Key	151935921	2
	Coupling, 6-inch, #316 SS, 1" Pump Shaft, 1/4 x 3/16 x 1-3/4 Key	151935929	2
	Surge Arrestor - Three-Phase - Up to 650 V to Ground	155440902	2
	PT 100 Sensor - 6-inch (1/2-13 Threads)	305327903	< 2

8" SUBMERSIBLE MOTORS

These motors are built for dependable operation in vertical 8" diameter or larger water wells.

BASIC FEATURES

- Double flanged NEMA mounting design
- Stainless steel splined shaft
- StatorShield™ six feature encapsulation system
- High-capacity, Kingsbury-type, water lubricated thrust bearing
- Factory filled with Franklin's non-toxic water soluble fill solution
- Field replaceable lead using Franklin's exclusive Water-Bloc™ technology
- Full 3,525 rpm 60 Hz design point
- External sand slinger on shaft
- Mechanical face seal at shaft exit
- Copper bar rotor
- All models are variable frequency drive (VFD) compatible
- Franklin's Exclusive on-winding SubTrol™ heat sensor for use with SubMonitor Connect™

SPECIAL FEATURES

- Sand Fighter® and 316 stainless steel models are equipped with Franklin's exclusive Sand Fighter® sealing system for sand or other abrasives

Consult factory for other voltage, hertz and horsepower ratings not listed in this catalog; specifications are subject to change without notice; contact Franklin Electric if current materials are required for bid specifications

8" SUBMERSIBLE MOTORS - SPECIFICATIONS AND MATERIALS

THREE-PHASE MOTOR SPECIFICATIONS

Hz	Model	Phase	HP Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
50	Standard	3	40 - 200	30 - 150	2	2900	86 °F / 30 °C	Continuous*
	Hi-Temp 75		40 - 150	30 - 110			167 °F / 75 °C	
60	Standard		40 - 200	30 - 150		3525	86 °F / 30 °C	
	Hi-Temp 75		40 - 150	30 - 110			167 °F / 75 °C	

** At 0.5 ft/sec flow past motor; Motors are also rated for continuous duty up to 86 °F (30 °C) water temperature with NO FLOW in lakes or in wells 12 inches or larger in diameter; Higher temperature ambient motors are available in the 8" Hi-Temp motor line*

CONSTRUCTION MATERIALS

Component	Sand Fighter® (300 SS Shell)	Corrosion Resistant (316 SS)	Hi-Temp 75 (300 SS Shell)	Hi-Temp 75 (316 SS)
UL Insulation Class Rating	Class F	Class F	Class F	Class F
Motor Ambient Temp. Rating	86 °F / 30 °C	86 °F / 30 °C	167 °F / 75 °C	167 °F / 75 °C
Stator Resin Type	FE Standard	FE Standard	FE Hi-Temp	FE Hi-Temp
Motor Fill Solution (Water Soluble/Non-Toxic)	FES91	FES91	FES92	FES92
Top End Bell & Thrust Housing	Epoxy-coated gray iron	316 SS	Epoxy-coated gray iron	316 SS
SubTrol™ heat sensor (Mounted On Winding)	Yes	Yes	No	No
Stator Shell	300 series SS	316 SS	300 series SS	316 SS
Stator Ends	Carbon Steel	316 SS	Carbon Steel	316 SS
Shaft Extension	17-4 SS	Per standard water well	17-4 SS	17-4 SS
Bushing	Bronze	316 SS	Bronze	316 SS
Bushing Retainer	300 series SS	316 SS	300 series SS	316 SS
Shaft Mechanical Seal	Sand Fighter® Seal System	Sand Fighter® Seal System	Sand Fighter® Seal System	Sand Fighter® Seal System
Mechanical Seal / Rubber Components	Nitrile	Nitrile	FKM	FKM
Diaphragm Material	Nitrile	Nitrile	FKM	FKM
Diaphragm Plate	300 SS	316 SS	316 SS	316 SS
Diaphragm Spring	300 SS	316 SS	316 SS	316 SS
Shaft Slinger	Nitrile	Nitrile	FKM	FKM
Lead Wire	XLPE (#8 AWG) / EPCV (#4 & #2 AWG)	XLPE (#8 AWG) / EPCV (#4 & #2 AWG)	XLPO	XLPO
Lead Potting	Epoxy	Epoxy	Epoxy	Epoxy
Lead Jam Nut or Compression Plate	Brass jam nut (40-125 hp) 316 SS plate (150-200 hp)	316 SS jam nut (40-125 hp) 316 SS plate (150-200 hp)	316 SS plate (150-200 hp)	316 SS plate (150-200 hp)
Thrust Bearing Rating (86 °F / 30 °C)	10,000 lbs	10,000 lbs	12,500 lbs (86 °F / 30 °C) 10,000 lbs (167 °F / 75 °C)	12,500 lbs (86 °F / 30 °C) 10,000 lbs (167 °F / 75 °C)
Method Of Connecting System Ground To Motor	Ground lug on top end bell	Ground lug on top end bell	Ground lug on top end bell	Ground lug on top end bell

NOTE: Specifications subject to change without notice; Contact Franklin Electric if current material types are required for bid specifications

8" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
40	Sand Fighter®	380	60	1.15	DOL (3)	2396608521	10000	320
		460/380	60/50	1.15/1.0	DOL (3)	2396008521	10000	320
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396208621	10000	325
		575	60	1.15	DOL (3)	2396108521	10000	320
	316 SS	380	60	1.15	DOL (3)	2396606221	10000	320
		460/380	60/50	1.15/1.0	DOL (3)	2396006221	10000	320
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396202221	10000	325
		575	60	1.15	DOL (3)	2396106221	10000	320
	Hi-Temp 75 °C	380	60	1.15	DOL (3)	2791609004	12500	400
		380	60	1.15	Y-Δ (6)	2791809004	12500	405
		460/380	60/50	1.15/1.0	DOL (3)	2791009004	12500	400
		460/380	60/50	1.15/1.0	Y-Δ (6)	2791209004	12500	405
		575	60	1.15	DOL (3)	2791109004	12500	400
		575	60	1.15	Y-Δ (6)	2791909004	12500	405
	Hi-Temp 75 °C - 316 SS	460/380	60/50	1.15/1.0	DOL (3)	2791009204	12500	400
50	Sand Fighter®	380	60	1.15	DOL (3)	2396618521	10000	345
		460/380	60/50	1.15/1.0	DOL (3)	2396018521	10000	345
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396218621	10000	350
		575	60	1.15	DOL (3)	2396118521	10000	345
	316 SS	380	60	1.15	DOL (3)	2396616221	10000	345
		460/380	60/50	1.15/1.0	DOL (3)	2396016221	10000	345
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396212221	10000	350
		575	60	1.15	DOL (3)	2396116221	10000	345
	Hi-Temp 75 °C	380	60	1.15	DOL (3)	2791619004	12500	455
		380	60	1.15	Y-Δ (6)	2791819004	12500	450
		460/380	60/50	1.15/1.0	DOL (3)	2791019004	12500	455
		460/380	60/50	1.15/1.0	Y-Δ (6)	2791219004	12500	450
		575	60	1.15	DOL (3)	2791119004	12500	455
		575	60	1.15	Y-Δ (6)	2791919004	12500	450
	Hi-Temp 75 °C - 316 SS	460/380	60/50	1.15/1.0	DOL (3)	2791019204	12500	455
60	Sand Fighter®	380	60	1.15	DOL (3)	2396628521	10000	375
		460/380	60/50	1.15/1.0	DOL (3)	2396028521	10000	375
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396228621	10000	380
		575	60	1.15	DOL (3)	2396128521	10000	375
	316 SS	380	60	1.15	DOL (3)	2396626221	10000	375
		460/380	60/50	1.15/1.0	DOL (3)	2396026221	10000	375
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396222221	10000	380
		575	60	1.15	DOL (3)	2396126221	10000	375
	Hi-Temp 75 °C	380	60	1.15	DOL (3)	2791629004	12500	555
		380	60	1.15	Y-Δ (6)	2791829004	12500	560
		460/380	60/50	1.15/1.0	DOL (3)	2791029004	12500	555
		460/380	60/50	1.15/1.0	Y-Δ (6)	2791229004	12500	560
		575	60	1.15	DOL (3)	2791129004	12500	555
		575	60	1.15	Y-Δ (6)	2791929004	12500	560
	Hi-Temp 75 °C - 316 SS	460/380	60/50	1.15/1.0	DOL (3)	2791029204	12500	455

8" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
75	Sand Fighter®	380	60	1.15	DOL (3)	2396638541	10000	430
		460/380	60/50	1.15/1.0	DOL (3)	2396038541	10000	430
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396238641	10000	435
		575	60	1.15	DOL (3)	2396138541	10000	430
	316 SS	380	60	1.15	DOL (3)	2396636241	10000	430
		460/380	60/50	1.15/1.0	DOL (3)	2396036241	10000	430
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396232241	10000	435
		575	60	1.15	DOL (3)	2396136241	10000	430
	Hi-Temp 75 °C	380	60	1.15	DOL (3)	2791639004	12500	700
		380	60	1.15	Y-Δ (6)	2791839004	12500	705
		460/380	60/50	1.15/1.0	DOL (3)	2791039004	12500	700
		460/380	60/50	1.15/1.0	Y-Δ (6)	2791239004	12500	705
		575	60	1.15	DOL (3)	2791139004	12500	700
		575	60	1.15	Y-Δ (6)	2791939004	12500	705
	Hi-Temp 75 °C - 316 SS	460/380	60/50	1.15/1.0	DOL (3)	2791039204	12500	700
100	Sand Fighter®	380	60	1.15	DOL (3)	2396648541	10000	530
		460/380	60/50	1.15/1.0	DOL (3)	2396048541	10000	530
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396248641	10000	535
		575	60	1.15	DOL (3)	2396148541	10000	530
	316 SS	380	60	1.15	DOL (3)	2396646241	10000	530
		460/380	60/50	1.15/1.0	DOL (3)	2396046241	10000	530
		460/380	60/50	1.15/1.0	Y-Δ (6)	2396242241	10000	535
		575	60	1.15	DOL (3)	2396146241	10000	530
	Hi-Temp 75 °C	380	60	1.15	DOL (3)	2791649004	12500	840
		380	60	1.15	Y-Δ (6)	2791849004	12500	845
		460/380	60/50	1.15/1.0	DOL (3)	2791049004	12500	840
		460/380	60/50	1.15/1.0	Y-Δ (6)	2791249004	12500	845
		575	60	1.15	DOL (3)	2791149004	12500	840
		575	60	1.15	Y-Δ (6)	2791949004	12500	845
	Hi-Temp 75 °C - 316 SS	460/380	60/50	1.15/1.0	DOL (3)	2791049204	12500	840
125	Sand Fighter®	380	60	1.15	DOL (3)	2391658504	10000	700
		460/380	60/50	1.15/1.0	DOL (3)	2391058504	10000	700
		460/380	60/50	1.15/1.0	Y-Δ (6)	2391258604	10000	705
		575	60	1.15	DOL (3)	2391158504	10000	700
	316 SS	380	60	1.15	DOL (3)	2391656204	10000	700
		460/380	60/50	1.15/1.0	DOL (3)	2391056204	10000	700
		460/380	60/50	1.15/1.0	Y-Δ (6)	2391252204	10000	705
		575	60	1.15	DOL (3)	2391156204	10000	700
	Hi-Temp 75 °C	380	60	1.15	DOL (3)	2791659004	12500	945
		380	60	1.15	Y-Δ (6)	2791859004	12500	950
		460/380	60/50	1.15/1.0	DOL (3)	2791059004	12500	945
		460/380	60/50	1.15/1.0	Y-Δ (6)	2791259004	12500	950
		575	60	1.15	DOL (3)	2791159004	12500	945
		575	60	1.15	Y-Δ (6)	2791959004	12500	950
	Hi-Temp 75 °C - 316 SS	460/380	60/50	1.15/1.0	DOL (3)	2791059204	12500	945

8" SUBMERSIBLE MOTORS - ORDERING INFORMATION

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	Thrust Rating	Wt. (lbs)
150	Sand Fighter®	380	60	1.15	DOL (3)	2391668504	10000	840
		380	60	1.15	Y-Δ (6)	2391868604	10000	845
		460/380	60/50	1.15/1.0	DOL (3)	2391068504	10000	840
		460/380	60/50	1.15/1.0	Y-Δ (6)	2391268604	10000	845
		575	60	1.15	DOL (3)	2391168504	10000	840
	316 SS	380	60	1.15	DOL (3)	2391666204	10000	840
		460/380	60/50	1.15/1.0	DOL (3)	2391066204	10000	840
		460/380	60/50	1.15/1.0	Y-Δ (6)	2391262204	10000	845
		575	60	1.15	DOL (3)	2391166204	10000	840
	Hi-Temp 75 °C	380	60	1.15	DOL (3)	2791669004	12500	1040
		380	60	1.15	Y-Δ (6)	2791869004	12500	1045
		460/380	60/50	1.15/1.0	DOL (3)	2791069004	12500	1040
		460/380	60/50	1.15/1.0	Y-Δ (6)	2791269004	12500	1045
		575	60	1.15	DOL (3)	2791169004	12500	1040
		575	60	1.15	Y-Δ (6)	2791969004	12500	1045
	Hi-Temp 75 °C - 316 SS	460/380	60/50	1.15/1.0	DOL (3)	2791069204	12500	1040
175	Sand Fighter®	380	60	1.15	DOL (3)	2391678504	10000	945
		380	60	1.15	Y-Δ (6)	2391878604	10000	950
		460/380	60/50	1.15/1.0	DOL (3)	2391078504	10000	945
		460/380	60/50	1.15/1.0	Y-Δ (6)	2391278604	10000	950
		575	60	1.15	DOL (3)	2391178504	10000	945
	316 SS	380	60	1.15	DOL (3)	2391676204	10000	945
		460/380	60/50	1.15/1.0	DOL (3)	2391076204	10000	945
		460/380	60/50	1.15/1.0	Y-Δ (6)	2391272204	10000	950
		575	60	1.15	DOL (3)	2391176204	10000	945
200	Sand Fighter®	380	60	1.15	DOL (3)	2391688504	10000	1040
		380	60	1.15	Y-Δ (6)	2391888604	10000	1045
		460/380	60/50	1.15/1.0	DOL (3)	2391088504	10000	1040
		460/380	60/50	1.15/1.0	Y-Δ (6)	2391288604	10000	1045
		575	60	1.15	DOL (3)	2391188504	10000	1040
	316 SS	380	60	1.15	DOL (3)	2391686204	10000	1040
		460/380	60/50	1.15/1.0	DOL (3)	2391086204	10000	1040
		460/380	60/50	1.15/1.0	Y-Δ (6)	2391282204	10000	1045
		575	60	1.15	DOL (3)	2391186204	10000	1040

NOTE: Models designated above as Sand Fighter® are water well construction; all 316 SS models are equipped with Sand Fighter® sealing system; all models listed above include factory installed leads (13 ft); motor leads do not include ground

8" SUBMERSIBLE MOTORS - DIMENSIONS AND WEIGHTS

STANDARD

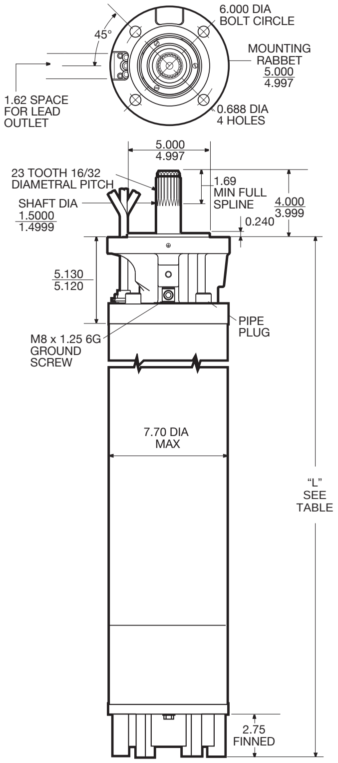
HP / kW	Phase	L (in)	Motor Carton Size (in)			Shipping Wt.	
			W	H	L	lbs	kg
40 / 30	3 (3-Lead)	36.4	9	17	51	320	146
50 / 37		39.4	9	17	51	345	157
60 / 45		42.4	9	17	51	375	171
75 / 55		47.4	9	17	64	430	196
100 / 75		54.9	9	17	64	530	241
125 / 93		68.8	9	17	79	700	318
150 - 110		77.8	9	17	96	840	382
175 - 130		85.8	9	17	96	945	430
200 / 150		94.8	9	17	108	1040	473

NOTE: 6-Lead Y-Δ models available (add 5 lbs to shipping weight)

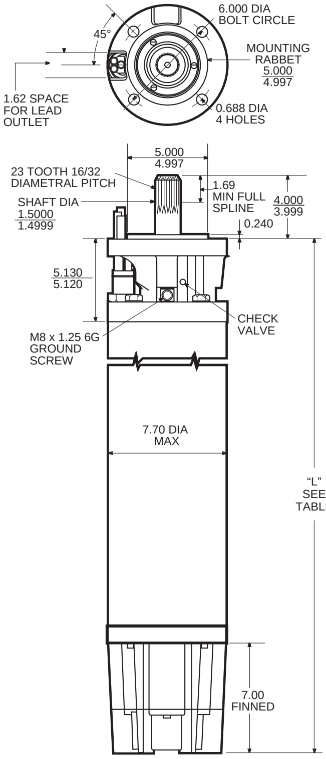
HI-TEMP 75

HP / kW	Phase	L (in)	Motor Carton Size (in)			Shipping Wt.	
			W	H	L	lbs	kg
40 / 30	3	44.8	9	17	64	400	181
50 / 37		49.8	9	17	64	455	206
60 / 45		57.3	9	17	79	555	252
75 / 55		68.8	9	17	79	700	318
100 / 75		77.8	9	17	96	840	382
125 / 93		85.8	9	17	96	945	430
150 - 110		94.8	9	17	108	1040	473

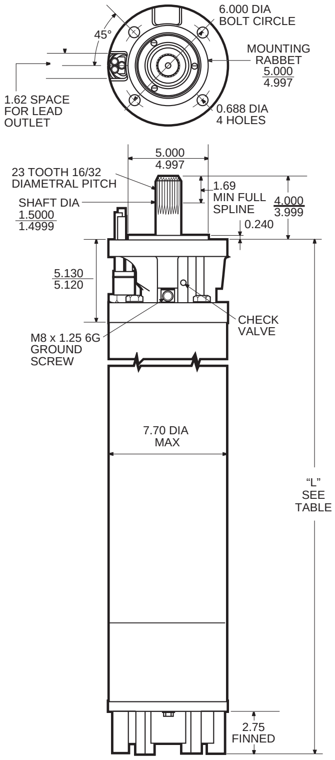
Type 1.0 (40-150 hp)



Type 2.1 (40-100 hp)



Type 1.0 (125-200 hp)



8" SUBMERSIBLE MOTORS - LEADS AND ACCESSORIES

MOTOR LEADS AND CABLES

HP	Model	Description	Wire AWG	Model No.	Wt. (lbs)
40 - 60	Standard	Lead, Brass, 13 ft, No Ground	8	305516901	4
		Lead, Brass, 26 ft, No Ground	8	305516902	9
		Lead, 316 SS, 13 ft, No Ground	8	305516950	4
		Lead, 316 SS, 26 ft, No Ground	8	305516951	9
75-125 DOL / 75-200 Y-D		Lead, Brass, 26 ft, No Ground	6	305310903	9
		Lead, Brass, 13 ft, No Ground	6	305310901	17
		Lead, 316 SS, 26 ft, No Ground	6	305310953	9
75-200 Y-D Only		Lead, 316 SS, 13 ft, No Ground	6	305310951	17
150-200 DOL Only	All Hi-Temp	Lead, XLPO, 316 SS, 13 ft, No Ground	2	305315901	12
		Lead, XLPO, 316 SS, 26 ft, No Ground	2	305315902	23

NOTE: Refer to Franklin Application Installation Maintenance (AIM) Manual for accurate cable sizing; MOTOR WARRANTY IS VOID if Franklin-supplied leads are not used

MOTOR ACCESSORIES

HP	Description	Model No.	Wt. (lbs)
All	Coupling, 8-inch, #416 SS, 1" Pump Shaft, 1/4 x 1/4 x 2 Key	156563901	5
	Coupling, 8-inch, #416 SS, 1-3/16" Pump Shaft, 1/4 x 1/4 x 2 Key	156563906	5
	Coupling, 8-inch, #416 SS, 1-3/16" Pump Shaft, 5/16 x 5/16 x 2 Key	156563902	5
	Coupling, 8-inch, #416 SS, 1-1/4" Pump Shaft, 5/16 x 5/16 x 2 Key	156563903	5
	Coupling, 8-inch, #416 SS, 1-1/2’ Pump Shaft, 3/8 x 3/8 x 2 Key	156563904	5
	Surge Arrestor - Three-Phase - Up to 650 V to Ground	155440902	2
	PT 100 Sensor, 8-inch 40 - 60 HP	305326902	< 1
	PT 100 Sensor, 8-inch 75 - 200 HP	305326901	< 1

10" REWINDABLE MOTORS - SPECIFICATIONS AND MATERIALS

These 10" rewindable motors, manufactured in ISO 9001 certified facilities, are built for dependable operation in 10" diameter or larger water wells. It is fitted with water lubricated radial and thrust bearings for maintenance-free operation. The motor is filled with a special FES93 fluid, providing frost protection down to -15 °C storage temperature. A special diaphragm ensures pressure compensation inside the motor. The Sand Fighter® SiC seal system is standard. For applications in aggressive media, motors made of 316 SS and 904 L are available.

FEATURES & BENEFITS

- Easy to assemble with double flange
- Cable material according to drinking water regulations (VDE/ACS/KTW approved)
- Sand Fighter® SiC seal system for high performance in sand
- High efficiency electrical design for low operation cost
- All motors prefilled and 100% tested
- Maximum storage temperature 5 °F (-15 °C) to 140 °F (60 °C)
- Design for retrofitable PT100 sensor
- Non contaminating FES 93 filled design

OPTIONS

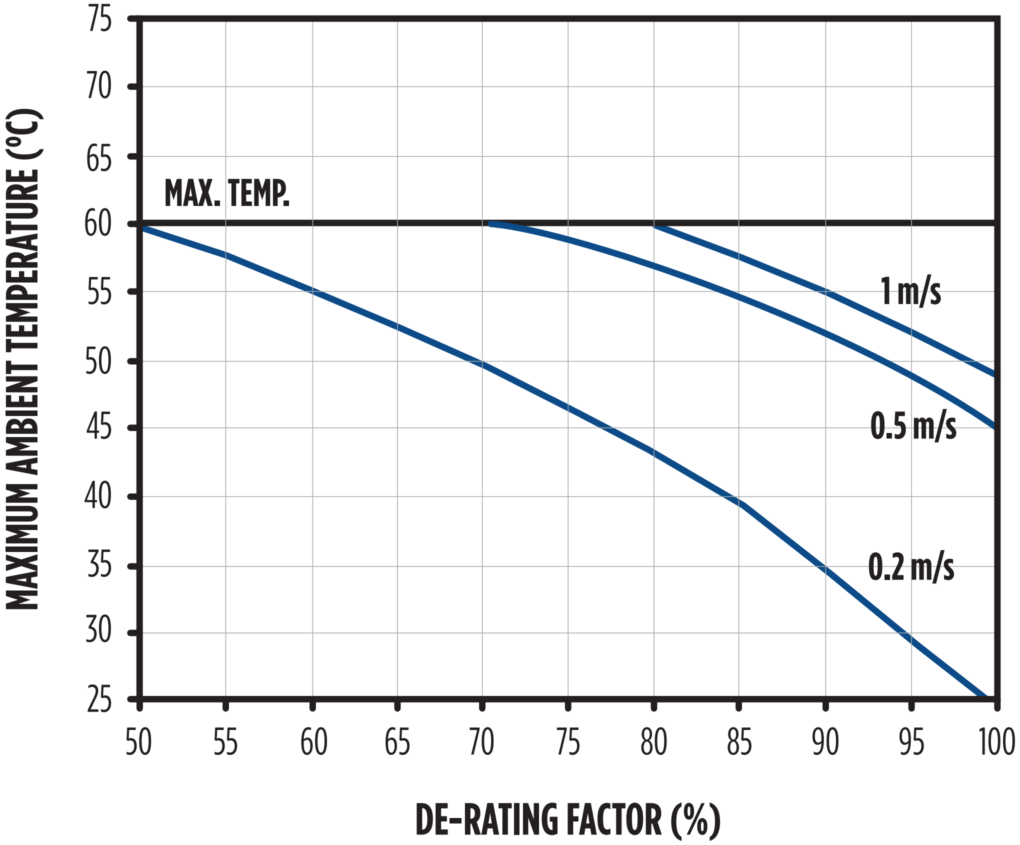
- Other voltages
- YΔ - start (pos. of cables 90°)
- Motors in complete 316 SS and 904 L
- PT 100 temperature sensor (sold separately)
- Lead in different lengths up to 165 ft. (50 m)

TECHNICAL SPECIFICATIONS

- 10" three-phase motors, 2-pole, 3600 RPM
- 130-185 kW / 175-250 hp
- 10" flange
- IP 68 protection
- 10 maximum starts per hour
- Vertical and horizontal installation (excluding 185 kW / 250 hp motors)
- Motor Lead in 20 ft. (6 m) length
- 380-415 V/50 Hz, 460 V/60 Hz, and 575 V/60 Hz standard voltages
- Voltage tolerance (50 Hz): -10% / +6% U_N [380-415 V = (380-10%) – (415+6%)]
- Voltage tolerance (60 Hz): ±10% U_N
- PE2/PA winding insulation for maximum ambient temperature of 113 °F (45 °C) at the same cooling conditions as standard

10" REWINDABLE MOTORS - SPECIFICATIONS AND MATERIALS

DE-RATING CURVE (PE2/PA)



10" REWINDABLE MOTORS - SPECIFICATIONS AND MATERIALS

TECHNICAL DATA

Stator and Rotor (50/60 Hz)							
P_N (kW/HP)	Stator (incl. winding and 6 m motor lead)						Rotor
	U_N / f		304/316	904 L	304/316	904 L	
	V	Hz	DOL PE2/PA	DOL PE2/PA	YΔ PE2/PA	YΔ PE2/PA	
130/175	460/380	60/50	326314931	326314921	326314981	326314971	176 379 803K
	575	60	326317931	326317921	326317981	326317971	
150/200	460/380	60/50	326325931	326325921	326325981	326325971	176 379 804K
	575	60	326327931	326327921	326327981	326327971	
185/250	460/380	60/50	326448931	326448921	326448981	326448971	176 379 805K
	575	60	327534931	327534921	327534981	327534971	

PE2/PA Insulation Standard Windings (575 V / 60 Hz)									
P_N (kW/HP)	Model No. Winding Kits	Turns Per Coil	Wire Dia. (mm)	Isolation Type	Group Connection	Total Wire Length (m)	Resistance Coil (Ω)	Resistance YΔ (U1-U2) (Ω)	Resistance DOL (U1-V1) (Ω)
130/175	326317999	9+10+9+10	1.8/2.8 DR.II	PE2/PA	Parallel	1067	0.2987	0.1494	0.0996
150/200	326327999	8+8+8+8	2.7/4.1			495	0.2454	0.1227	0.0818
185/250	327534999	6+7+6+7	2.1/3.3 2DR.II			904	0.1834	0.0917	0.0611

PE2/PA Insulation Standard Windings (380-415 V/50 Hz / 460 V/60 Hz)									
P_N (kW/HP)	Model No. Winding Kits	Turns Per Coil	Wire Dia. (mm)	Isolation Type	Group Connection	Total Wire Length (m)	Resistance Coil (Ω)	Resistance YΔ (U1-U2) (Ω)	Resistance DOL (U1-V1) (Ω)
130/175	326314999	7+8+7+8	2.0/3.1 2DR.II	PE2/PA	Parallel	850	0.1910	0.0955	0.0636
150/200	326325999	6+7+6+7	2.1/3.3 2DR.II			810	0.1647	0.0823	0.0549
185/250	326448999	5+5+6+5	2.3/3.5 2DR.II			735	0.1240	0.0620	0.0413

Insulation resistant (20 °C / 500 VDC)		
New Motor w/o Drop Cable	400 >	MΩ
Used Motor w/o Drop Cable	20 >	
New Motor w/ Drop Cable	4 >	
Used Motor w/ Drop Cable	1	

10" REWINDABLE MOTORS - ORDERING INFORMATION

ORDERING INFORMATION

P_N (kW/HP)	U_N / f		Model No. Digit 1 – 6		Model No. Digit 7 – 10		
					PE2/PA21		
	V	Hz	DOL	YΔ	304	316 SS	904 L
130/175	460/380	60/50	264 134	264 234	5321	6321	7321
	575	60	264 564	264 864			
150/200	460/380	60/50	264 135	264 235			
	575	60	264 565	264 865			
185/250	460/380	60/50	264 136	264 236			
	575	60	264 566	264 866			
	380-415	50	264 136	264 236			
	460/380	60/50	264 136	264 236			
	380	60	-	264 766			

PERFORMANCE (60 HZ)

P_N (kW/HP)	P_{max} (kW/HP)	Thrust Rating (N/lbf)	U_N (V)	n_N (min-1)	I_{max} (A)	I_A (A)	η (Eff.) % at % load			cos ϕ PF at % load			T_{max} (Nm)	T_A (Nm)
							50	75	100	50	75	100		
130/175	149/200	60000/13500	460	3510	254	1308	86	87	87	0.77	0.84	0,87	408	437
150/200	173/232				294	1557	85	87	87	0.77	0.84	0,87	469	508
185/250	213/285				377	2130	85	87	87	0.70	0.79	0,84	585	858
130/175	149/200		575		204	1047	86	87	87	0.77	0.84	0.87	408	437
150/200	173/232				236	1246	85	87	87	0.77	0.84	0.87	469	508
185/250	213/285				302	1704	85	87	87	0.70	0.79	0.84	585	858

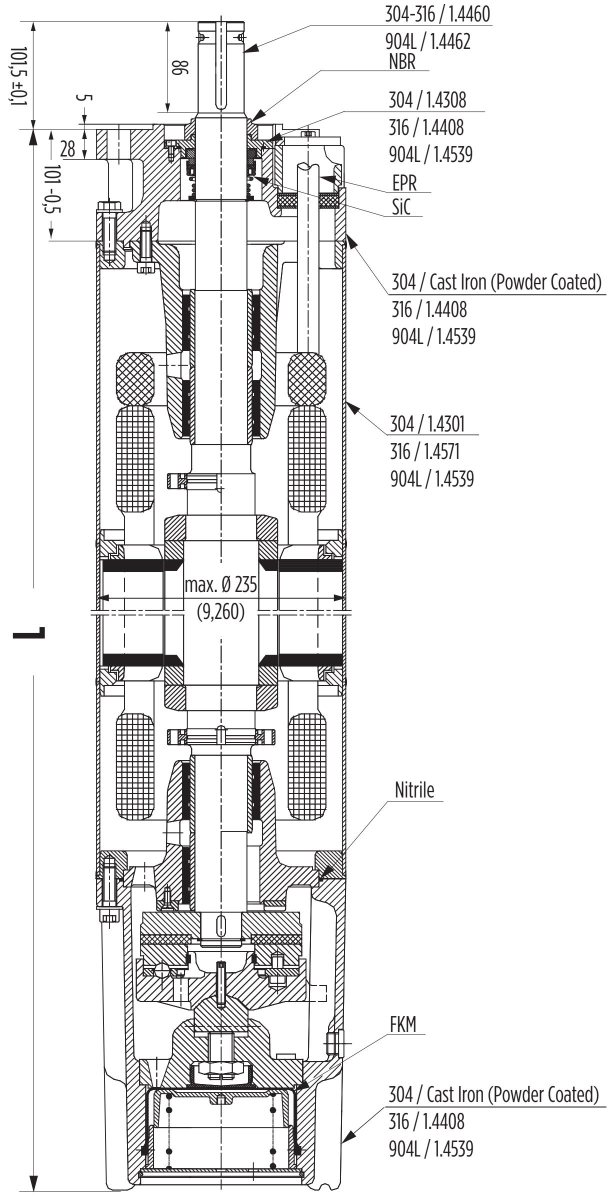
PERFORMANCE (50 HZ)

P_N (kW/HP)	Thrust Rating (N/lbf)	U_N (V)	n_N (min-1)	I_N (A)	I_A (A)	η (Eff.) % at % load			cos ϕ PF at % load			T_N (Nm)	T_A (Nm)
						50	75	100	50	75	100		
130/175	60000/13500	380	2900	266	1271	88	88	87	0.79	0.85	0.87	428	487
		400	2920	256	1344	87	88	88	0.74	0.82	0.86	425	546
		415	2920	255	1400	87	88	87	0.69	0.78	0.83	425	592
150/200		380	2910	307	1502	87	87	86	0.79	0.85	0.88	492	568
		400	2920	298	1590	86	88	87	0.73	0.81	0.85	491	635
		415	2930	296	1655	86	87	87	0.67	0.77	0.83	489	689
		500	2910	233	1142	87	87	86	0.79	0.85	0.88	492	568
		525	2920	227	1211	86	87	87	0.73	0.81	0.85	491	635
		1000	2920	117	636	86	88	87	0.73	0.81	0.85	491	635
185/250		380	2900	390	2030	87	88	87	0.72	0.81	0.85	609	913
		400	2920	384	2148	86	88	88	0.64	0.75	0.81	605	1022
		415	2920	389	2237	84	86	86	0.57	0.70	0.79	605	1109
		500	2900	294	1500	87	88	87	0.72	0.81	0.85	610	888
		525	2910	289	1580	86	87	87	0.65	0.76	0.82	607	988
		1000	2900	148	859	87	88	87	0.72	0.81	0.85	609	913

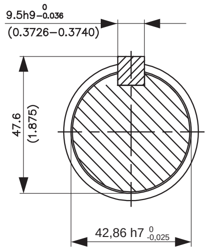
10" REWINDABLE MOTORS - DIMENSIONS AND WEIGHTS

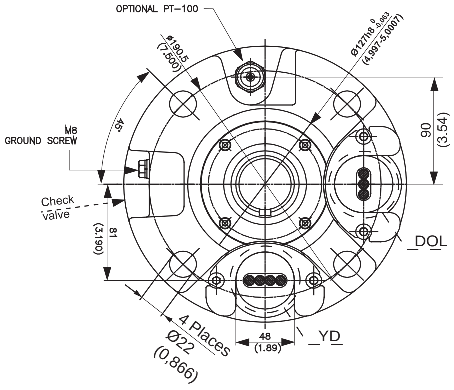
MOTOR DESIGN

Motor - 304/316SS/904L

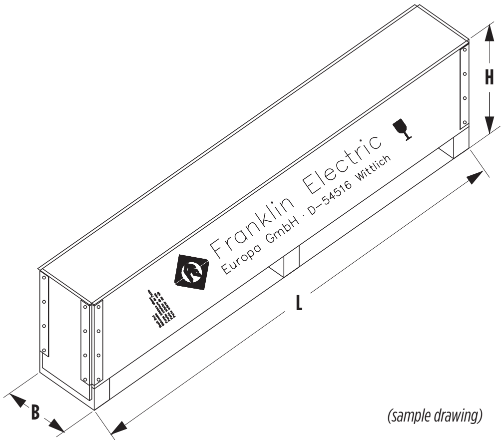


End Bell





Motor Box



(sample drawing)

PN (kW/HP)	Motor Lengths (in/mm)	Motor Weights (lb/kg)		Motor Shipping Size (in/mm)		
		Motor	Incl. Pack	B	H	L
130/175	65.3/1659	798/362	908/412	13.4/341	27.1/562	90.4/2296
150/200	69.6/1769	910/413	1021/463			
185/250	75.5/1919	990/449	1100/499			

10" REWINDABLE MOTORS - LEADS AND ACCESSORIES

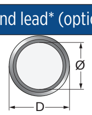
MOTOR LEADS

DOL								
P_N (kW/HP)	Ø (mm²)	B / H (mm/in)		Lengths (m/ft)	Qyt.	Lead Mod.- Nr.	Lead seal Kit 304/316 Mod.- Nr.	Lead seal Kit 904 L Mod.- Nr.
130/175	4G35	B	48.5/1.91	6/20	1	308 710 117	308 660 721	308 660 725
		H	16.5/.65					
110-150/150-200 (PE2/PA)	3X50	B	46.5/1.83	6/20	1	308 710 113	308 660 712	308 660 726
		H	19.5/0.77					
185/250**	1X70	D	20.7/0.82	6/20	3	308 711 000	308 660 732	308 660 733

For PE2/PA engines additionally the special Tape 700 541 688 is absolutely necessary

YΔ								
P_N (kW/HP)	Ø (mm²)	B / H (mm/in)		Lengths (m/ft)	Qyt.	Lead Mod.- Nr.	Lead seal Kit 304/316 Mod.- Nr.	Lead seal Kit 904 L Mod.- Nr.
10-150/150-200	3X25	B	37.5/1.48	6/20	1	308 710 114	308 660 713	308 660 728
		H	6/0.63					
	4G25	B	44.3/1.74		1			
		H	14.5/0.57					
185/250	4G35	B	48.5/1.91	6/20	1	308 710 121	308 660 723	308 660 729
		H	6.5/0.65					
	3X35	B	38.5/1.52		1			
		H	16.5/0.65					

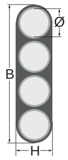
For PE2/PA engines additionally the special Tape 700 541 688 is absolutely necessary

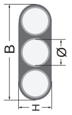
Ground lead* (optional)	Ø (mm²)	D Ø (mm/in)	Lengths (m/ft)	St.	Mod.-Nr.
	1G25	13.0/0.5	8/26	1	308 053 080
	1G35	15.3/0.60	6/20	1	308 056 060

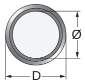
** Only for 304SS and 316SS*

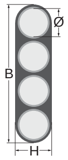
Lead Opening Seal Kit		
85 – 185 kW DOL / YΔ	304 / 316	308 660 715
	904L	308 660 730

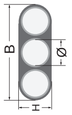
NOTE: Cables are designed for submerged operation; For air operation please consult Franklin Electric



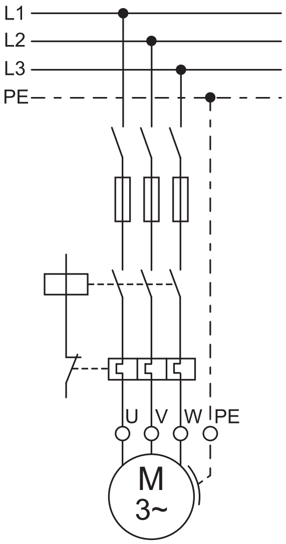
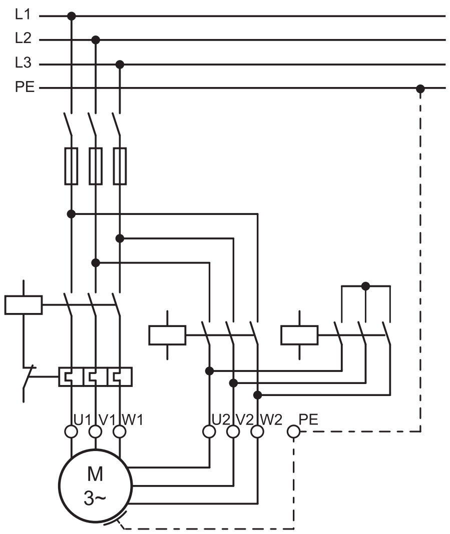








ELECTRICAL CONNECTION

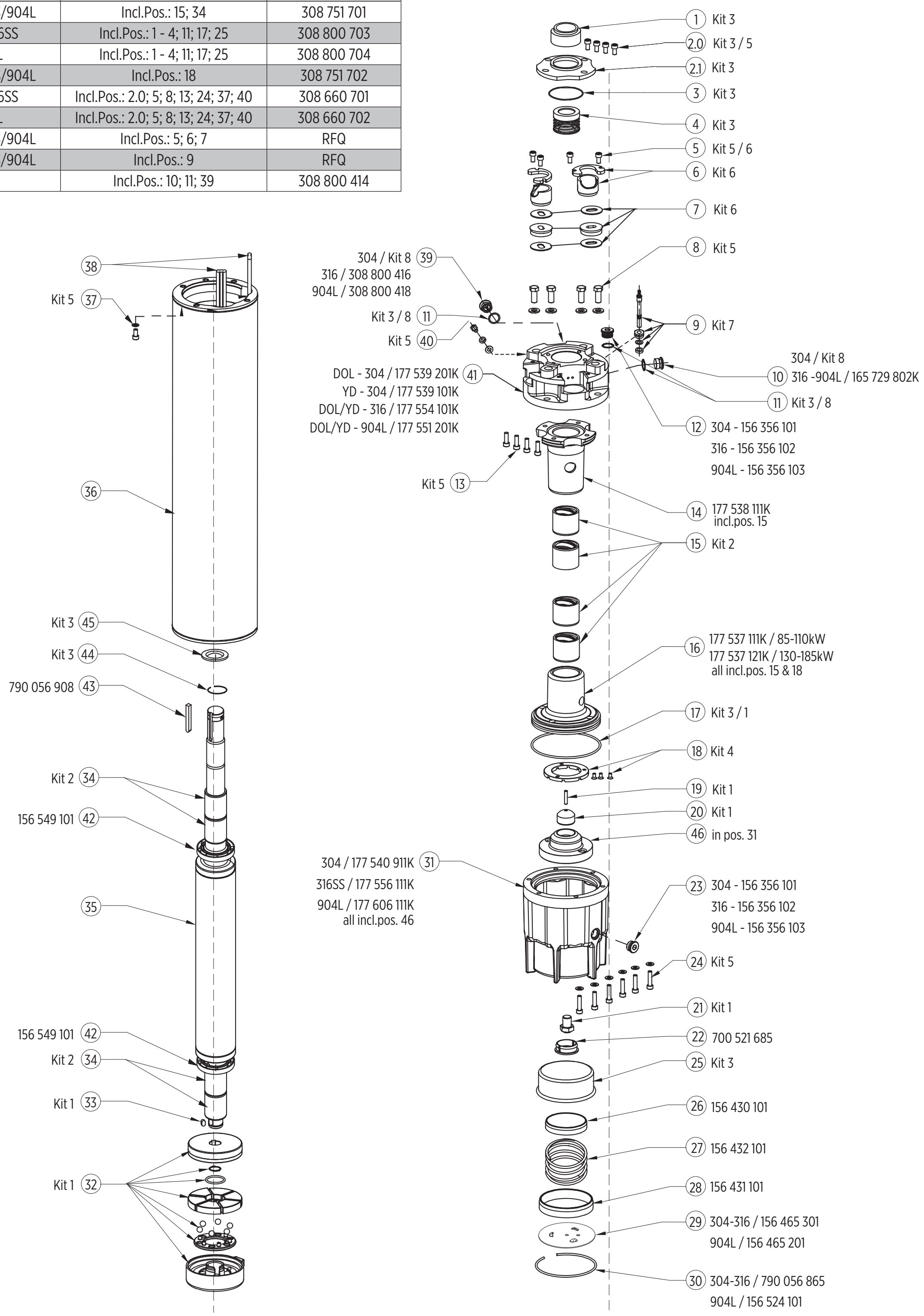
DOL	YΔ
	

U	V	W	PE
Brown	Grey	Black	Yellow/Green

10" REWINDABLE MOTORS - LEADS AND ACCESSORIES

SPARE PARTS

Description	Material	Fig. No.	Order No.
Kit 1 Thrust Bearing Kit	304/316SS/904L	Incl.Pos.: 17; 19; 20; 21; 32; 33	308 750 701
Kit 2 Radial Bearing Kit	304/316SS/904L	Incl.Pos.: 15; 34	308 751 701
Kit 3 Seal Kit	304/316SS	Incl.Pos.: 1 - 4; 11; 17; 25	308 800 703
	904L	Incl.Pos.: 1 - 4; 11; 17; 25	308 800 704
Kit 4 Up-Thrust Kit	304/316SS/904L	Incl.Pos.: 18	308 751 702
Kit 5 Screw Kit	304/316SS	Incl.Pos.: 2.0; 5; 8; 13; 24; 37; 40	308 660 701
	904L	Incl.Pos.: 2.0; 5; 8; 13; 24; 37; 40	308 660 702
Kit 6 Lead Seal Kit	304/316SS/904L	Incl.Pos.: 5; 6; 7	RFQ
Kit 7 PT100 Kit	304/316SS/904L	Incl.Pos.: 9	RFQ
Kit 8 Valve Kit	304	Incl.Pos.: 10; 11; 39	308 800 414



12" REWINDABLE MOTORS - SPECIFICATIONS AND MATERIALS

These 12" rewindable motors, manufactured in ISO 9001 certified facilities, are built for dependable operation in 12" diameter or larger water wells. It is fitted with water lubricated radial and thrust bearings for maintenance-free operation. The motor is filled with a special FES93 fluid, providing frost protection down to -15 °C storage temperature. A special diaphragm ensures pressure compensation inside the motor.

FEATURES & BENEFITS

- Easy to assemble with double flange
- Cable material according to drinking water regulations (VDE/ACS/KTW approved)
- Sand Fighter® SiC seal system for high performance in sand
- High efficiency electrical design for low operation cost
- All motors pre-filled and 100% tested
- Max. storage temperature 5 °F (-15 °C) to 140 °F (60 °C)
- Design for retrofitable PT100 sensor
- Non contaminating FES 93 filled design

OPTIONS

- 80 kN thrust load
- Other voltages
- YΔ - start (pos. of cables 90°)
- PT 100 temperature sensor (sold separately)
- Special lead lengths available upon request
- 316 SS construction

TECHNICAL SPECIFICATIONS

- 12" three-phase motors, 2-Pole (3600 RPM) & 4-Pole (1800 RPM)
- 185-400 kW / 150-250 hp
- 12" flange
- IP 68 protection
- 5 maximum starts per hour
- Vertical and horizontal installation
- Motor Lead in 20 ft. (6 m) length
- 460 V/60 Hz, 575 V/60 Hz, and 380 V/50 Hz standard voltages
- Voltage tolerance (50 Hz): -10% / +6% UN [380-415 V = (380-10%) – (415+6%)]
- Voltage tolerance (60 Hz): ±10% UN
- 30 °C ambient temperature with a minimum cooling flow: v = 0.5 m/s

12" REWINDABLE MOTORS - SPECIFICATIONS AND ACCESSORIES

TECHNICAL DATA

304/316 SS Stator and Rotor								
Pole	P_N (kW/HP)	Stator (incl. winding and 6 m motor lead)						
		U_N / f		DOL PVC	DOL PE2/PA	YΔ PVC	YΔ PE2/PA	Rotor
		V	Hz					
2-Pole	185/250	380-415	50	-	327 013 902K	-	326 013 952K	176 381 500K
		460/380	60/50					
	220/300	380-415	50		326 639 902K		326 639 952K	176 381 501K
		460/380	60/50					
	250/340	380-415	50		326 639 902K		326 639 952K	176 381 501K
		460/380	60/50					
	300/400	380-415	50		326 640 902K		326 640 952K	176 381 502K
		460/380	60/50					
	350/470	380-415	50		-		326 696 952K	176 381 504K
		460/380	60/50					
	400/536	380-415	50				326 641 952K	176 381 503K
		460/380	60/50					

304 SS Stator and Rotor					
Pole	P_N (kW/HP)	Stator (incl. winding and 6 m motor lead)			
		U_N / f		DOL PVC	Rotor
		V	Hz		
4-Pole	110/150	400	50	327633902K	176381701K
		460	60		
	132/175	400	50	327406902K	176381702K
		460	60		
	160/200	400	50	327471902K	176381704K
		460	60		
	200/250	400	50	327407902K	176381703K
		460	60		

Insulation Standard Windings (460 V/60 Hz)										
Pole	P_N (kW/HP)	Model No. Winding Kits	Turns Per Coil	Wire Dia. (mm)	Isolation Type	Group Connection	Total Wire Length (m)	Resistance Coil (Ω)	Resistance YΔ (U1-U2) (Ω)	Resistance DOL (U1-V1) (Ω)
2-Pole	185/250	327013999	6+6+6+6	2.6/3.9 (2GrII)	PE2/PA	Parallel Delta	794	0.1061	-	-
	220/300	326639999	5+6+5+6	2.7/4.1 (2GrII)			770	0.0901		
	250/340	326639999	5+6+5+6	2.7/4.1 (2GrII)			770	0.0901		
	300/400	326640999	4+5+4+5	3.0/4.5 (2GrII)			720	0.0677		
	350/470	326696999	4+4+4+5	3.0/4.5 (2GrII)			706	0.0664		
	400/536	326641999	4+4+4+4	3.3/4.8 (2GrII)			700	0.0536		

Insulation Standard Windings (460 V/60 Hz)										
Pole	P_N (kW/HP)	Model No. Winding Kits	Turns Per Coil	Wire Dia. (mm)	Isolation Type	Group Connection	Total Wire Length (m)	Resistance Coil (Ω)	Resistance YΔ (U1-U2) (Ω)	Resistance DOL (U1-V1) (Ω)
4-Pole	110/150	327633999	17-17	2.9/4.0/4.3	PE2PA	Parallel Delta	618	0.1109	0.1109	0.0739
	132/175	327406999	15-15	3.0/4.2/4.5			600	0.1005	0.1005	0.0670
	160/200	327471999	14-14	3.2/4.4/4.7			590	0.0888	0.0888	0.0592
	200/250	327407999	12-12	3.4/4.7/5.0			530	0.0705	0.0705	0.0470

Insulation Standard Windings (575 V / 60 Hz)										
Pole	P_N (kW/HP)	Model No. Winding Kits	Turns Per Coil	Wire Dia. (mm)	Isolation Type	Group Connection	Total Wire Length (m)	Resistance Coil (Ω)	Resistance YΔ (U1-U2) (Ω)	Resistance DOL (U1-V1) (Ω)
2-Pole	185/250	327535999	7+8+7+8	2.3/3.5 (2GrII)	PE2/PA	Parallel Delta	1075	0.1694	-	-
	220/300	326701999	7+7+7+7	2.5/3.8 (2GrII)			1000	0.1338		
	250/340	326702999	6+7+7+7	2.5/3.8 (2GrII)			924	0.1290		
	300/400	326703999	5+6+5+6	2.7/4.1 (2GrII)			861	0.1021		
	350/470	326697999	5+5+5+6	2.7/4.1 (2GrII)			856	0.1012		
	400/536	326704999	5+5+5+5	2.9/4.3 (2GrII)			848	0.0867		

Insulation resistant (20 °C/500 VDC)		
New Motor w/o Drop Cable	400 >	MΩ
Used Motor w/o Drop Cable	20 >	
New Motor w/ Drop Cable	4 >	
Used Motor w/ Drop Cable	1	

12" REWINDABLE MOTORS - ORDERING INFORMATION

ORDERING INFORMATION

Pole	P_N (kW/HP)	U_N / f		Model No. Digit 1 – 6		Model No. Digit 7 – 10		
						PE2/PA21		
		V	Hz	DOL	YΔ	304	316 SS	904 L
2-Pole	185/250	460/380	60/50	265 610	265 710	5021	6021	-
		575	60	265 690	265 760			
	220/300	460/380	60/50	265 611	265 711			
		575	60	265 691	265 761			
	250/340	460/380	60/50	265 612	265 712			
		575	60	265 692	265 762			
	300/400	460/380	60/50	265 614	265 714			
		575	60	265 694	265 764			
	350/470	460/380	60/50	-	265 716			
		575	60	265 696	265 766			
	400/536	460/380	60/50	-	265 717			
		575	60	265 697	265 767			

Pole	P_N (kW/HP)	U_N / f		Model No. Digit 1 – 6		Model No. Digit 7 – 10		
						PE2/PA21		
		V	Hz	DOL	YΔ	304	316 SS	904 L
4-Pole	110/150	400	50	265 682	-	5021	-	-
		460	60					
	132/175	400	50	265 684				
		460	60					
	160/200	400	50	265 686				
		460	60					
	200/250	400	50	265 687				
		460	60					

PERFORMANCE (60 HZ)

Pole	P_N (kW/HP)	P_{max} (kW/HP)	Thrust Rating ((N/lbf)	U (V)	n_N (min-1)	I_{max} (A)	I_A / I_N (A)	η_{max} (Eff.) % at % load			cos ϕ (PF) at % load			T_{max} (Nm)	T_A / T_N (Nm)
								50	75	100	50	75	100		
2-Pole	185/250	212/284	60000/13500	460	3540	339	5.59	83	86	86	0.84	0.87	0.87	723	0.83
				575	3540	272	5.59	83	86	86	0.84	0.87	0.87	723	0.83
	220/300	252/338		460	3530	425	5.44	90	91	91	0.81	0.84	0.86	776	0.95
				575	3530	340	5.44	90	91	91	0.81	0.84	0.86	776	0.95
	250/340	287/385		460	3530	462	5.44	90	91	91	0.81	0.84	0.84	776	0.95
				575	3530	370	5.44	90	91	91	0.81	0.84	0.84	776	0.95
	300/400	345/463		460	3530	533	5.85	90	91	91	0.85	0.89	0.89	928	0.94
				575	3530	427	5.85	90	91	91	0.85	0.89	0.89	928	0.94
	350/470	402/539		460	3530	647	5.13	89	90	90	0.83	0.87	0.88	1085	0.90
				575	3530	518	5.13	89	90	90	0.83	0.87	0.88	1085	0.90
	400/536	460/617		460	3520	745	4.79	89	90	90	0.84	0.87	0.87	1243	0.84
				575	3520	596	4.79	89	90	90	0.84	0.87	0.87	1243	0.84

Pole	P_N (kW/HP)	P_{max} (kW/HP)	Thrust Rating ((N/lbf)	U (V)	n_N (min-1)	I_{max} (A)	I_A / I_N (A)	η_{max} (Eff.) % at % load			cos ϕ (PF) at % load			T_{max} (Nm)	T_A / T_N (Nm)
								50	75	100	50	75	100		
4-Pole	110/150	-	60000/13500	460	1760	195	5.30	85	87	87.5	0.75	0.79	0.80	594	0.90
	132/175					225		86	87.5	88	0.78	0.82	0.83	713	
	160/200					270		86.5	88	88.5	0.81	0.84	0.84	865	
	200/250					340		86.5	88	88.5	0.76	0.82	0.84	1081	

12" REWINDABLE MOTORS - ORDERING INFORMATION

PERFORMANCE (50 HZ)

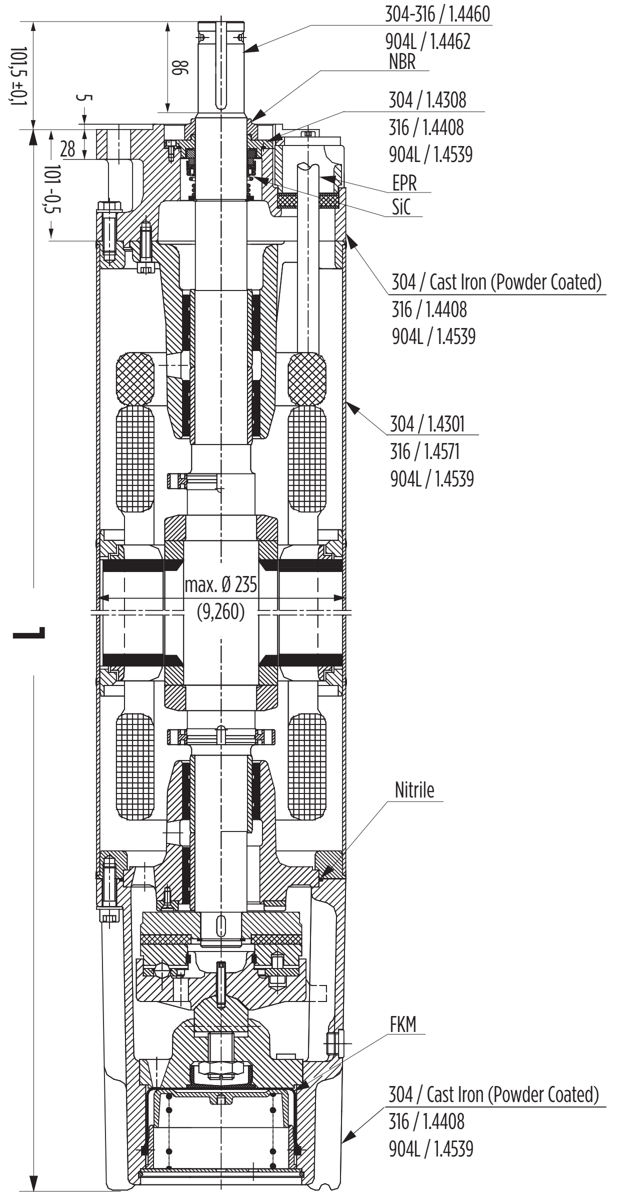
Pole	P_N (kW/HP)	Thrust Rating (N/lbf)	U_N (V)	n_N (min-1)	I_N (A)	I_A / I_N (A)	η_{max} (Eff.) % at % load			cos φ (PF) at % load			T_N (Nm)	T_A / T_N (Nm)
							50	75	100	50	75	100		
2-Pole	185/250	60000/13500	380	2940	368	4.70	88	88	87	0.82	0.87	0.88	602	0.81
			400	2945	351	5.30	87	88	87	0.79	0.85	0.86	600	0.90
	220/300		415	2950	344	5.76	87	88	88	0.76	0.84	0.84	599	0.97
			380	2930	448	4.79	88	88	87	0.83	0.87	0.88	716	0.77
	250/340		400	2935	430	5.40	88	89	88	0.80	0.86	0.87	714	0.84
			415	2940	427	5.85	88	89	88	0.77	0.85	0.84	712	0.94
	300/400		380	2930	507	4.7	87	87	86	0.85	0.88	0.85	815	0.85
			400	2935	481	5.2	88	89	88	0.80	0.85	0.80	812	0.95
	350/470		415	2940	471	5.6	88	89	88	0.76	0.83	0.76	812	1.02
			380	2940	586	4.9	88	89	87	0.87	0.90	0.88	974	0.83
	400/536		400	2945	551	5.6	88	89	88	0.85	0.89	0.88	971	0.94
			415	2950	532	6.0	88	89	88	0.83	0.88	0.89	970	1.03
	350		380	2920	720	4.7	88	88	86	0.85	0.88	0.87	1140	0.80
			400	2930	676	5.2	88	88	87	0.82	0.87	0.88	1137	0.90
			415	2935	652	5.4	87	88	87	0.79	0.86	0.87	1135	0.95
	400		380	2920	795	4.2	90	90	89	0.85	0.88	0.87	1306	0.73
			400	2930	750	4.8	90	90	90	0.82	0.87	0.87	1301	0.84
			415	2940	719	5.2	89	90	90	0.80	0.85	0.87	1299	0.92

Pole	P_N (kW/HP)	Thrust Rating (N/lbf)	U_N (V)	n_N (min-1)	I_N (A)	I_A / I_N (A)	η_{max} (Eff.) % at % load			cos φ (PF) at % load			T_N (Nm)	T_A / T_N (Nm)
							50	75	100	50	75	100		
4-Pole	110/150	60000/13500	400	1460	230	5.30	86	87	87.5	0.76	0.80	0.81	720	0.90
	132/175				259		88	88.5	88	0.77	0.82	0.84	864	
	160/200				316		87	88	87	0.78	0.83	0.84	1050	
	200/250				399		88.5	89	88.5	0.78	0.83	0.84	1309	

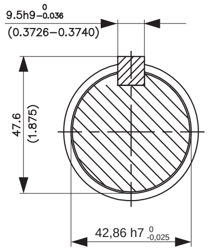
12" REWINDABLE MOTORS - DIMENSIONS AND WEIGHTS

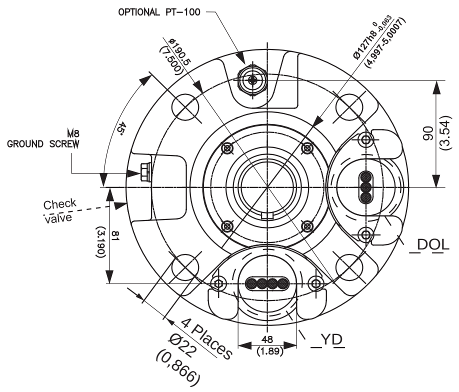
MOTOR DESIGN - 2-POLE

Motor - 304/316SS/904L

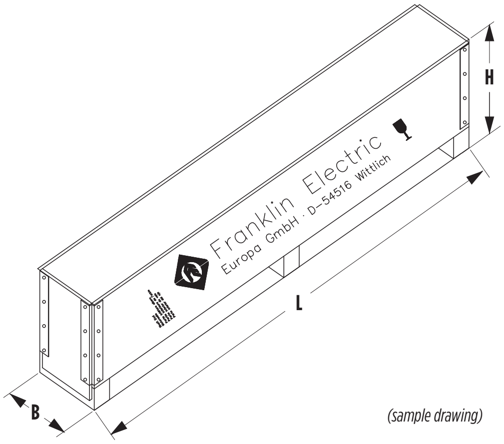


End Bell





Motor Box



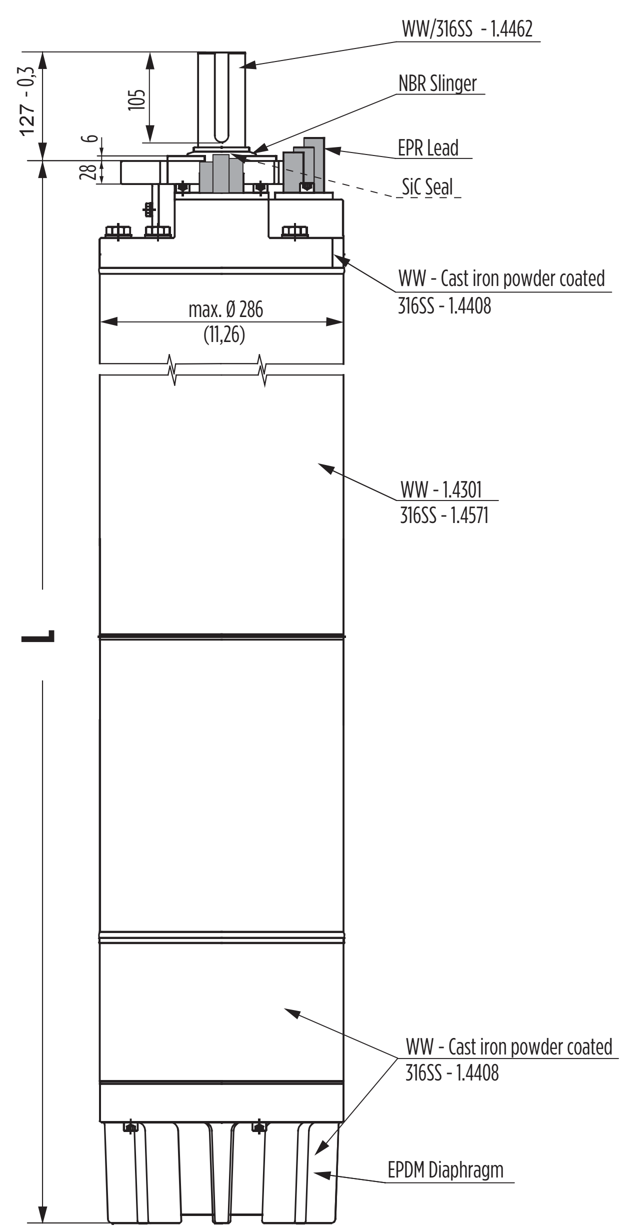
(sample drawing)

PN (kW/HP)	Motor Lengths (in/mm)	Motor Weights (lb/kg)		Motor Shipping Size (in/mm)		
		Motor	Incl. Pack	B	H	L
220/300	74.5/1893	1461/663	1638/743	15.6/396	22.5/572	90.4/2296
250/340	74.5/1893	1461/663	1638/743			
300/400	80.4/2043	1600/726	1776/806			
350/470	84.4/2143	1695/769	1871/849	15.6/396	22.5/572	90.4/2596
400/536	86.3/2193	1750/794	1926/874			

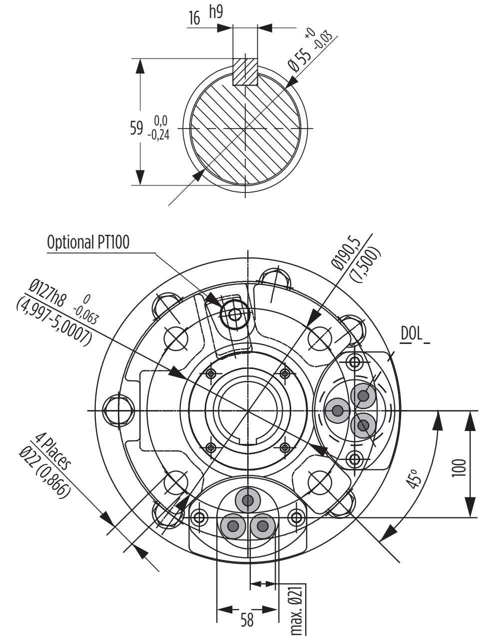
12" REWINDABLE MOTORS - DIMENSIONS AND WEIGHTS

MOTOR DESIGN - 4-POLE

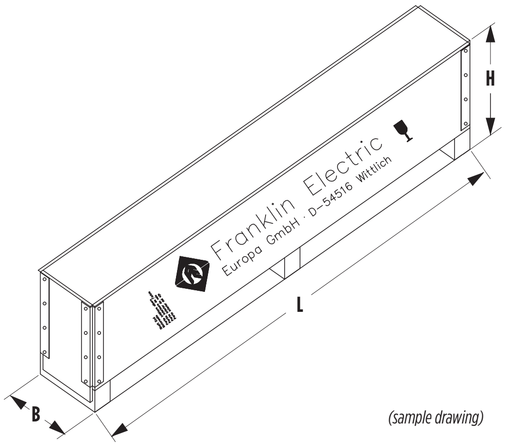
Motor - 304/316SS/904L



End Bell



Motor Box

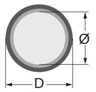


(sample drawing)

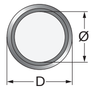
P_N (kW/HP)	Motor Lengths (in/mm)	Motor Weights (lb/kg)		Motor Shipping Size (in/mm)		
		Motor	Incl. Pack	B	H	L
110/150	74.5/1893	1461/663	1638/743	15.6/396	22.5/572	90.4/2296
132/175	80.4/2043	1600/726	1776/806			
160/200	84.4/2143	1695/769	1871/849			102.2/2596
200/250	86.3/2193	1750/794	1926/874			

12" REWINDABLE MOTORS - LEADS AND ACCESSORIES

MOTOR LEADS - 2-POLE

Lead	Ø (mm^2)	D (mm/in)	Lengths (m/ft)	Motor (kW/HP)			Qyt.	Lead Kit (3 Single Leads)	Lead Seal Kit.
				380-415 V / 50 Hz 460 V / 60 Hz	500 V / 50 Hz	1000 V / 50 Hz			
	1X70	20.7/0.82	6/20	185-300/250-400 DOL 300-400/400-536 YΔ**	185-400/250-536 DOL	-	DOL 1 YΔ 2	308 711 100	308 661 120
	1X35	15.3/0.60	6/20	185-250/250-340 YΔ**	185-400/250-536 YΔ**	185-400/250-536 DOL	DOL 1 YΔ 2	308 711 101	308 661 121

NOTE: For this standard PE2/PA motors must additionally ordered the special Tape 700 541 688, is absolutely necessary.
*** For YΔ motors please order two Lead (sealing) kits*

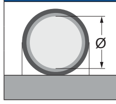
Ground Lead* (opt.)	Ø (mm^2)	D Ø (mm/in)	Lengths (m/ft)	St.	Mod.-Nr.
	1G25	13.0/0.51	8/26	1	308 053 080
	1G35	15.3/0.60	6/20		308 056 060

** Only for 304 SS and 316 SS*

Lead Opening Seal Kit	
Motor (kW/HP)	Part No.
250-400/340-536 DOL/YΔ	308 661 122

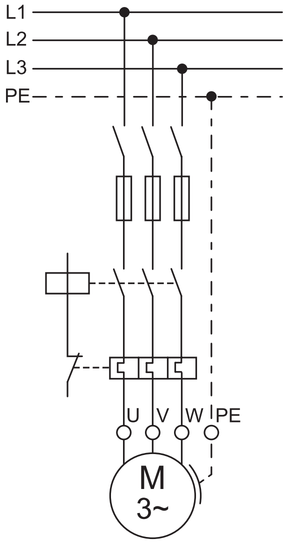
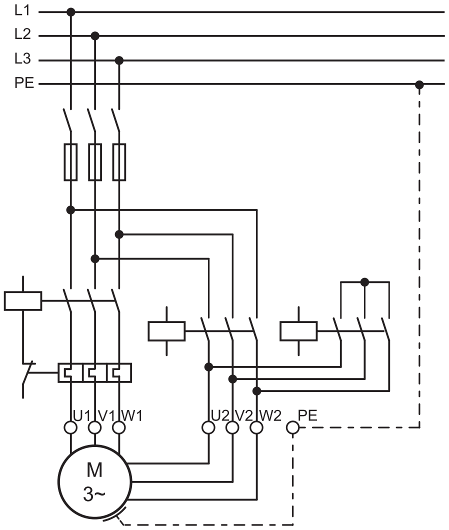
NOTE: Cables are designed for submerged operation; for air operation please consult Franklin Electric

MOTOR LEADS - 4-POLE

Lead	Ø (mm^2)	D (mm/in)	Lengths (m/ft)	Motor (kW/HP)	Qyt.	Lead Kit (3 Single Leads)	Lead Seal Kit.
				400 V / 50 Hz			
	1X70	20.7/0.82	6/20	110/150, 132/175, 160/200, 200/250	DOL 1	308 711 100	308 661 120
	Groundlead						
	1G35	15.3/0.60	6/20	110/150, 132/175, 160/200, 200/250	DOL 1	308 056 060	
Lead Opeing Seal Kit				All Ratings	DOL 1	308 661 122	

NOTE: For this standard PE2/PA motors must additionally ordered the special Tape 700 541 688, is absolutely necessary; cables are designed for submerged operation; for air operation, please consult Franklin Electric

ELECTRICAL CONNECTION

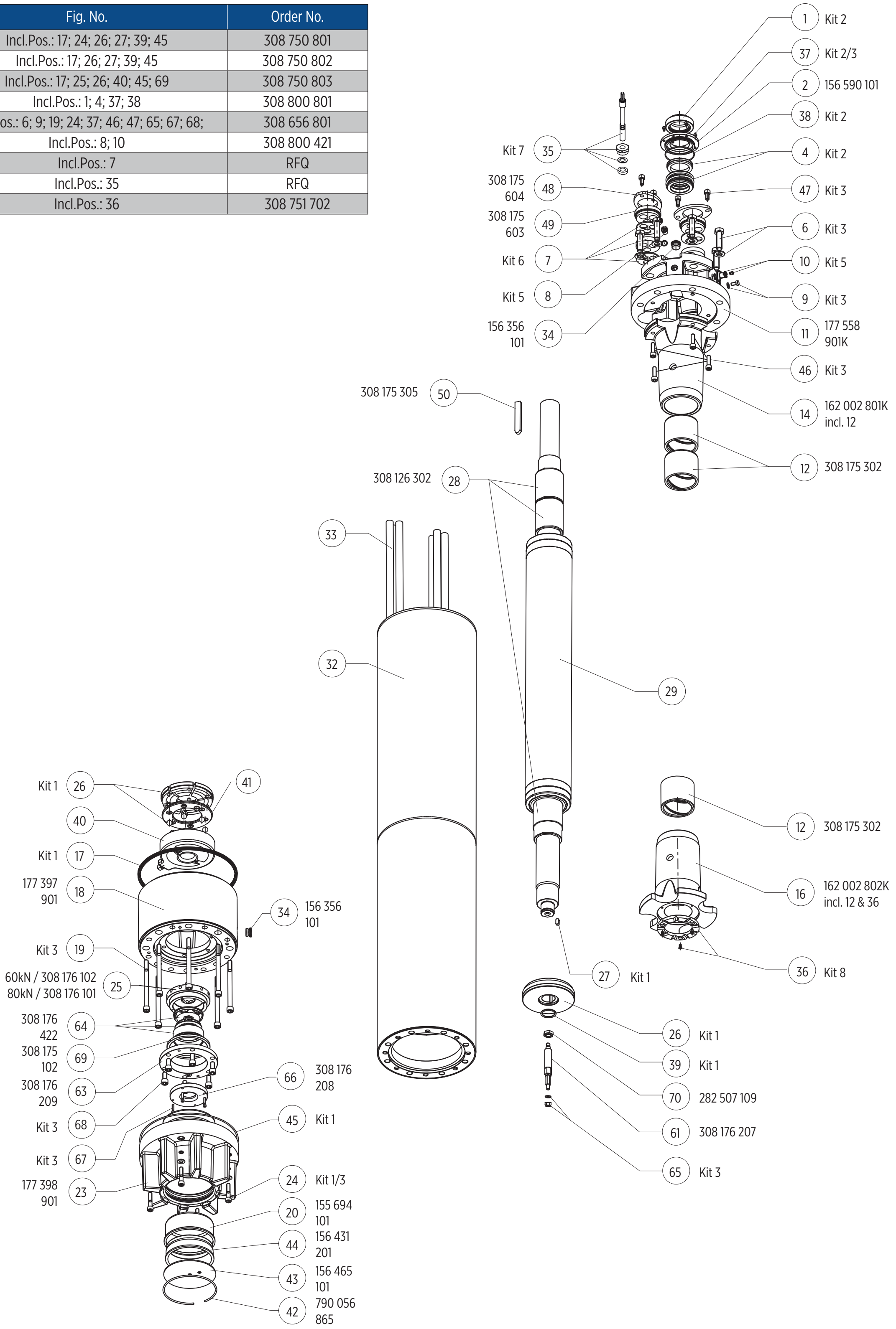
DOL	YΔ
	

U	V	W	PE
Brown	Grey	Black	Yellow/Green

12" REWINDABLE MOTORS - LEADS AND ACCESSORIES

SPARE PARTS

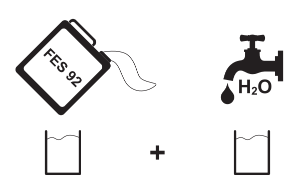
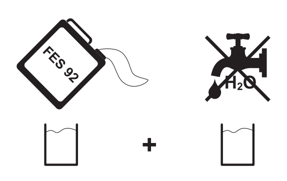
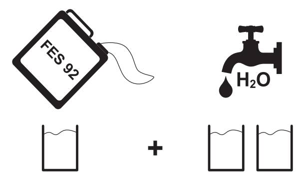
Description	Fig. No.	Order No.
Kit 1 Thrust Bearing Kit 60kN	Incl.Pos.: 17; 24; 26; 27; 39; 45	308 750 801
Kit 1 Thrust Bearing Kit 80kN	Incl.Pos.: 17; 26; 27; 39; 45	308 750 802
Motor Conversion Kit 80KN	Incl.Pos.: 17; 25; 26; 40; 45; 69	308 750 803
Kit 2 Seal Kit - Top	Incl.Pos.: 1; 4; 37; 38	308 800 801
Kit 3 Screw Kit	Incl.Pos.: 6; 9; 19; 24; 37; 46; 47; 65; 67; 68;	308 656 801
Kit 5 Valve Kit	Incl.Pos.: 8; 10	308 800 421
Kit 6 Lead Seal Kit	Incl.Pos.: 7	RFQ
Kit 7 PT 100 Kit	Incl.Pos.: 35	RFQ
Kit 8 Up-Thrust Bearing Kit	Incl.Pos.: 36	308 751 702



MOTOR ACCESSORIES

MOTOR FILLING LIQUID

Filling Liquid (5 L FES92)		
Description	Liquid	Part No.
4" Encapsulated	FES93	308353941
6" Encapsulated Standard	FES91	
6" Encapsulated HighTemp 90	FES92	
8" Encapsulated Standard	FES91	
8" Encapsulated HighTemp 75	FES92	
6" / 8" / 10" / 12" Rewindable Motors 6" / 8" Rewindable PM Motors	FES93	

FES91	FES92	FES93
		

MOTOR FILLING KIT

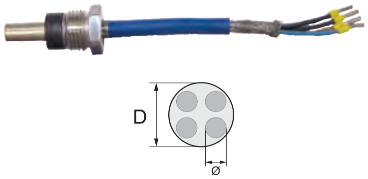
Motor Filling Kit	
Description	Part No.
This kit contains all necessary tools to check and replenish Franklin Electric submersible motors with FES 91, 92 or 93 filling liquid (fill solution/concentrate must be ordered separately)	308726103

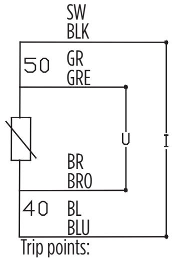
PT100 REWINDABLE MOTORS

- Fitted into the upper end bell flange, all end bells 6" ,8", 10" and 12" rewindable are prepare for installation PT100
- Measures the temperature of the filling liquid
- Conductor with a resistance proportional to the temperature
- Allows monitoring the temperature continuously

The above-ground equipment is not available from Franklin Electric and is typically part of a custom panel or data acquisition system. PT100 sensor retrofit kits from Franklin Electric come with complete instructions and allow for easy field installation.

Dimensions			6" Rew Redesign starting 08.2012		6" (Cast Iron/304SS) / 8" / 10" / 12"	
Ø (mm2)	D (mm)	Lead L (m)	304/316	904L	304/316	904L
4x0.5	8	10	308016501	308016522	308016401	308016422
		20	308016502	-	308016402	-
		30	308016503	-	308016403	-
		50	308016505	308016526	308016405	308016426





Trip points:
PVC = 55°C
PE2/PA = 75°C

CONTROL BOXES

The Quick Disconnect (QD) and Capacitor Run Control (CRC) control boxes are designed for use with Franklin 3-wire, single-phase submersible motors through 1 hp. The Standard and Deluxe control boxes are designed for use with Franklin 3-wire, single-phase submersible motors from 1 through 15 hp, and are recommended for water systems that use pressure switches, level switches, or other pilot devices. Deluxe boxes contain magnetic line contactors carefully matched to the motor rating, eliminating the need for external line connectors.

FEATURES: ALL

- Suitable for outdoor mounting
- Capacitor start/run design (except QD boxes)
- UL Listed for US and Canada (60 Hz models)

FEATURES: STANDARD & DELUXE

- Heavy-duty, box-type terminals accept up to AWG #2 wire
- External access to overload resets
- Multiple-size knockouts
- User-friendly connection diagrams
- Easy access to grounding lugs

SINGLE-PHASE SPECIFICATIONS

Box Type	Hz	HP Range	kW Range	Enclosure	Terminal Block		Mag Contactor	Agency Approvals
					Terminals	Max Wire		
Quick Disconnect (QD)	60	1/3 - 1	0.25 - 0.75	NEMA 3R, IP23	5	AWG 10	No	UL listed for US and Canada
Quick Disconnect (QD)	50	1/3 - 1	0.25 - 0.75	NEMA 3R, IP23	5	AWG 10	No	CSA Certified
Capacitor Run Control (CRC)	60	1/2 - 1	0.37 - 0.75	NEMA 3R, IP23	5	AWG 10	No	UL listed for US and Canada
Standard (S)	60	1 - 10	0.75 - 7.5	NEMA 3R, IP23	5	AWG 2	No	UL listed for US and Canada
Standard (S)	50	1.5 - 5	1.1 - 3.7	NEMA 3R, IP23	5	AWG 2	No	CSA Certified
Deluxe (D)	60	1 - 15	0.75 - 11	NEMA 3R, IP23	6	AWG 2	Yes	UL listed for US and Canada
Extra Large Deluxe (D-XL)	60	15	11	NEMA 3R, IP23	5	AWG 00	Yes	UL listed for US and Canada

CONTROL BOXES

ORDERING INFORMATION

HP (kW)	Description				Model No.
	Phase	Volts	Hz	Type	
⅓ / 0.25	1	115	60	Q	2801024915
		220	50	Q	2803532115
		230	60	Q	2801034915
1/2 / 0.37		115	60	Q	2801044915
		220	50	Q	2803552115
		230	60	Q	2801054915
		230	60	CRC	2824055015
¾ / 0.55		220	50	Q	2803572115
		230	60	Q	2801074915
		230	60	CRC	2824075015
1 / 0.75		220	50	Q	2803582115
		230	60	Q	2801084915
		230	60	CRC	2824085015
		230	60	S	2823008110
		230	60	D	2823008310
1.5 / 1.1		220	50	S	2823508110
		230	60	S	2823008110
		230	60	D	2823008310
2 / 1.5		220	50	S	2823518110
		230	60	S	2823018110
		230	60	D	2823018310
3 / 2.2		220	50	S	2823528110
		230	60	S	2823028110
		230	60	D	2823028310
5 / 3.7		220	50	S	2822539010
		230	60	S	2821138110
		230	60	D	2821139310
7.5 / 5.5		230	60	S	2822019210
		230	60	D	2822019310
10 / 7.5		230	60	S	2822029230
		230	60	D	2822029330
15 / 11		230	60	D	2822039330
		230	60	D-XL	2822039621

NOTE: Q = Quick Disconnect Control Box; CRC = Capacitor Run Control Box; S = Standard Control Box; D = Deluxe Control Box; D-XL = Extra Large Deluxe Control Box

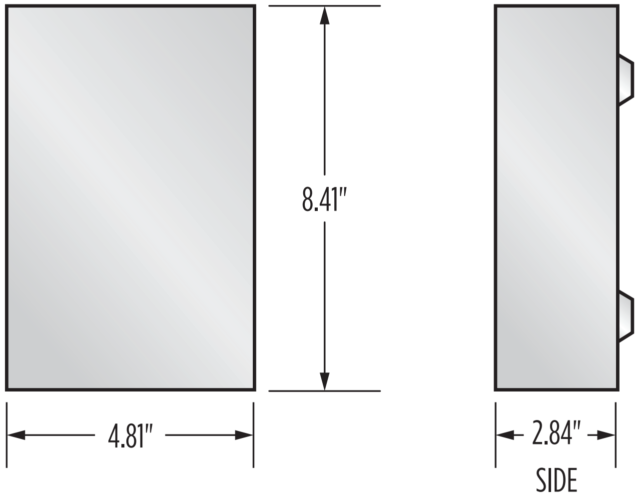
CONTROL BOXES - QUICK DISCONNECT (QD) & CAPACITOR RUN CONTROL (CRC)

SPECIFICATIONS

- Bottom Knockout: Two 0.88" knockouts and one 1.31" knockout
- Side Knockout: One 0.88" knockout and one 1.31" knockout on each side
- Terminal Block: Five terminals provided for wiring up to AWG #10 wire

DIMENSIONS

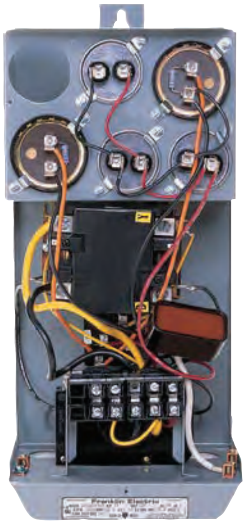
Box Type	HP / kW	Enclosure Size	Motor Carton Size (in)			Shipping Wt.	
			W	H	L	lbs	kg
Quick Disconnect (QD)	1/3 / 0.25	QD	5.5	3.25	9	4	1.8
	1/2 / 0.37						
	3/4 / 0.55						
	1 / 0.75						
Capacitor Run Control (CRC)	1/2 / 0.37					5	2.3
	3/4 / 0.55						
	1 / 0.75						



CONTROL BOXES - STANDARD & DELUXE

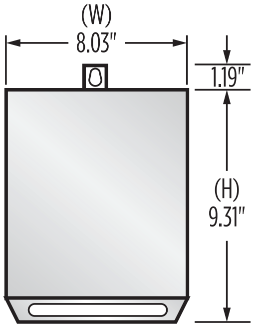
SPECIFICATIONS

- Knockouts: Two 1.31" diameter holes for 1" conduit connection; One 1.75" knockout for 1.25" conduit; One 0.88" knockout for 0.5" conduit connection
- Terminal Block: Six terminals provided for wiring up to AWG 2 wire



DIMENSIONS

Box Type	HP / kW	Enclosure Size	Motor Carton Size (in)			Shipping Wt.	
			W	H	L	lbs	kg
Standard	1 / 0.75	A	8.125	6.25	11.25	7	3.2
	1.5 / 1.1	A	8.125	6.25	11.25	7	3.2
	2 / 1.5	A	8.125	6.25	11.25	7	3.2
	3 / 2.2	A	8.125	6.25	11.25	7	3.2
	5 (60 Hz) / 3.7	A	8.125	6.25	11.25	8	3.6
	5 (50 Hz) / 3.7	B	8.125	6.25	18	8	3.6
	7.5 / 5.5	B	8.125	6.25	18	12	5.5
	10 / 7.5	B	8.125	6.25	18	14	6.4
Deluxe	1 / 0.75	A	8.125	6.25	11.25	7	3.2
	1.5 / 1.1	A	8.125	6.25	11.25	7	3.2
	2 / 1.5	A	8.125	6.25	11.25	7.0	3.2
	3 / 2.2	A	8.125	6.25	11.25	7.3	3.3
	5 / 3.7	B	8.125	6.25	18	11.2	5.1
	7.5 / 5.5	B	8.125	6.25	18	13.1	6.0
	10 / 7.5	B	8.125	6.25	18	14.7	6.7
	15 / 11	B	8.125	6.25	18	16.5	7.5
	15 (XL) / 11	C	16	7.125	19	28.0	12.7



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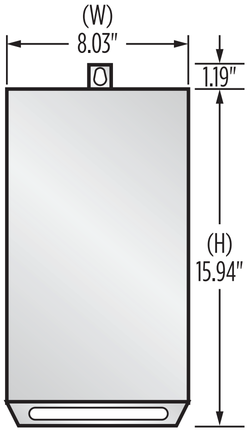


SIZE 'B'

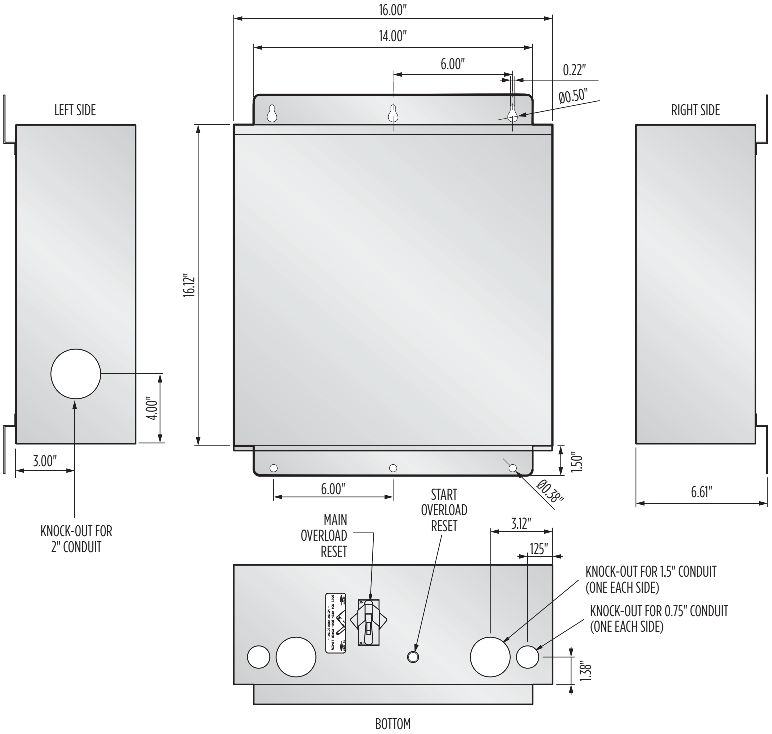
SIDES

CONTROL BOXES - EXTRA LARGE DELUXE (D-XL)

SPECIFICATIONS

- Bottom Knockouts: Two knockouts for 0.75" conduit, and two for 1.5" conduit
- Side Knockouts: One knockout for 2" conduit
- Terminal Block: Two terminals provided for incoming power and three terminals provided for drop cable for conductors from AWG 14 to 00
- Control Switch Terminal Block: Accepts conductors from AWG 20 to 6

DIMENSIONS



CONTROL BOXES - PARTS

QD 60 HZ

HP / Voltage	Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1/3 / 115	280 102 4915	Start Capacitor 159-191 MFD, 110 V	1	275 464 125	305 207 925
		QD Relay		223 415 905	305 101 905
1/3 / 230	280 103 4915	Start Capacitor 43-53 MFD, 220 V		275 464 126	305 207 926
		QD Relay		223 415 901	305 101 901
1/2 / 115	280 104 4915	Start Capacitor 250-300 MFD, 125 V		275 464 201	305 207 951
		QD Relay		223 415 906	305 101 906
1/2 / 230	280 105 4915	Start Capacitor 59-71 MFD, 220 V		275 464 105	305 207 905
		QD Relay		223 415 902	305 101 902
3/4 / 230	280 107 4915	Start Capacitor 86-103 MFD, 220 V		275 464 118	305 207 918
		QD Relay		223 415 903	305 101 903
1 / 230	280 108 4915	Start Capacitor 105-126 MFD, 220 V		275 464 113	305 207 913
		QD Relay		223 415 904	305 101 904
1/2 / 230	CRC 282 405 5015	Start Capacitor 43-53 MFD, 220 V		275 464 126	305 207 926
		Run Capacitor 15 MFD, 370 V		156 362 101	305 203 907
		QD Relay		223 415 912	305 105 901
3/4 / 230	CRC 282 407 5015	Start Capacitor 59-71 MFD, 220 V		275 464 105	305 207 905
		Run Capacitor 23 MFD, 370 V		156 362 102	305 203 908
		QD Relay		223 415 913	305 105 902
1 / 230	CRC 282 408 5015	Start Capacitor 86-103 MFD, 220 V		275 464 118	305 207 918
		Run Capacitor 23 MFD, 370 V		156 362 102	305 203 908
		QD Relay		223 415 914	305 105 903

QD 50 HZ

HP / Voltage	Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1/2 / 220	280 355 2115	Start Capacitor 43-53 MFD, 220 V		275 461 123	305 205 923
		Capacitor Overload Assembly		151 033 990	305 218 990
		QD Relay		223 415 915	305 105 904
3/4 / 220	280 357 2115	Start Capacitor 59-71 MFD, 220 V		275 461 108	305 205 908
		Capacitor Overload Assembly		151 033 989	305 218 989
		QD Relay		223 415 916	305 105 905
1 / 220	280 358 2115	Start Capacitor 86-103 MFD, 220 V		275 461 106	305 205 906
		Capacitor Overload Assembly		151 033 988	305 218 988
		QD Relay		233 451 917	305 105 906

QD OLD STYLE

Description	Rating	No. Req.	Component Part No.	Kit Order No.
Voltage Relay Kit	115 V w/ Bracket and Screws	1	155 031 901	305 102 901
	230 V w/ Bracket and Screws		155 031 902	305 102 902
	208 V w/ Bracket and Screws		155 031 903	305 102 903
Overload Kit	1/3 hp, 115 V		N/A	305 100 901
	1/3 hp, 230 V		N/A	305 100 902
	1/2 hp, 115 V		N/A	305 100 903
	1/2 hp, 230 V		N/A	305 100 904
	3/4 hp, 230 V		N/A	305 100 905
	1 hp, 230 V		N/A	305 100 906

NOTE: Some Franklin motors, controls, and parts are non-stock items and may need to be special ordered

CONTROL BOXES - PARTS

STANDARD 60 HZ

HP	Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1/1.5 - 4"	282 300 8110	Start Capacitor 105-126 MFD, 220 V	1	275 464 113	305 207 913
		Run Capacitor 15 MFD, 370 V		155 328 101	305 204 901
		Start Overload		275 411 114	305 215 914
		Run Overload		275 411 113	305 215 913
		Relay - 230 V*		155 031 102	305 213 902
2 - 4"	282 301 8110	Start Capacitor 105-126 MFD, 220 V		275 464 113	305 207 913
		Run Capacitor 20 MFD, 370 V		155 328 103	305 204 903
		Start Overload		275 411 117	305 215 917
		Run Overload		275 411 113	305 215 913
		Relay - 230 V*		155 031 102	305 213 902
3 - 4"	2823028110	Start Capacitor 208-250 MFD, 220 V		275 463 123	305 206 923
		Run Capacitor 45 MFD, 370 V		155 327 109	305 203 909
		Start Overload		275 411 118	305 215 918
		Run Overload		275 411 115	305 215 915
		Relay - 230 V*		155 031 102	305 213 902
5 - 4" & 6"	282 113 8110	Start Capacitor 216-259 MFD, 330 V		275 468 118	305 208 918
		Run Capacitor 40 MFD, 370 V	2	155 327 114	305 203 914
		Start Overload	1	275 411 119	305 215 919
		Run Overload		275 406 102	305 214 902
		Relay - 230 V*		155 031 601	305 213 961
7.5 - 6"	282 201 9210	Start Capacitor 270-324 MFD, 330 V		275 468 119	305 208 919
		Start Capacitor 130-154 MFD, 330 V		275 468 117	305 208 917
		Run Capacitor 45 MFD, 370 V		155 327 109	305 203 909
		Start Overload		275 411 102	305 215 902
		Run Overload		275 406 122	305 214 922
		Relay - 230 V*		155 031 601	305 213 961
10 - 6"	282 202 9230	Start Capacitor 270-324 MFD, 330 V	2	275 468 119	305 208 919
		Run Capacitor 35 MFD, 370 V		155 327 102	305 203 902
		Start Overload	1	275 406 103	305 214 903
		Run Overload		155 409 101	155 409 101
		Relay - 230 V*		155 031 601	305 213 961
All	All	Lightning Arrestor		150 814 902	150 814 902
208 V Relay *	208 V Relay *	Relay 1.5-3 hp (replaces 155031102)		155 031 103	305 213 903
		Relay 5-15 hp (replaces 155031601)		155 031 602	305 213 962

STANDARD 50 HZ

HP / Voltage	Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1.5 / 220	282 350 8110	Start Capacitor 105-126 MFD, 220 V	1	275 464 113	305 207 913
		Run Capacitor 10 MFD, 370 V		155 328 102	305 204 902
		Overload Assembly - Run		275 411 114	305 215 914
		Relay 220 V		155 031 112	305 213 912
2 / 220	282 351 8110	Start Capacitor 189-227 MFD, 220 V		275 468 115	305 208 915
		Run Capacitor 20 MFD, 370 V		155 328 103	305 204 903
		Overload Assembly - Run		275 411 102	305 215 902
		Overload Assembly - Start		275 411 106	305 215 906
		Relay 220 V		155 031 112	305 213 912
3 / 220	282 352 8110	Start Capacitor 270-324 MFD, 220 V		275 468 119	305 208 919
		Run Capacitor 35 MFD, 370 V		155 327 102	305 203 902
		Overload Assembly - Run		275 406 107	305 214 907
		Overload Assembly - Start		275 411 117	305 215 907
		Relay 220 V		155 031 112	305 213 912
5 / 220	282 253 9010	Start Capacitor 189-227 MFD, 220 V	2	275 468 115	305 208 915
		Run Capacitor 30 MFD, 220 V	1	155 327 101	305 203 901
		Run Capacitor 45 MFD, 220 V		155 327 109	305 203 909
		Overload Assembly - Run		275 406 102	305 214 902
		Overload Assembly - Start		275 411 102	305 215 902
		Relay 220 V		155 031 112	305 213 912

NOTE: Some Franklin motors, controls, and parts are not stock items and may need to be special ordered

** For 208 V systems or where line voltage is between 200 V and 210 V, a low voltage relay and larger cable are required: Use relay part number 305 213 903 in place of 305 213 902 on 1.5 through 3 hp applications; Use relay 305213962 for 5-15 hp applications; use the next size larger cable than is specified in the 230 V table; boost transformers are an alternative to special relay and cable.*

CONTROL BOXES - PARTS

DELUXE

HP Size / Model No.	Model No.	Rating	No. Req.	Component Part No.	Kit Order No.
1/1.5 - 4"	282 300 8310	Start Capacitor 105-126 MFD, 220 V	1	275 464 113	305 207 913
		Run Capacitor 15 MFD, 370 V		155 328 101	305 204 901
		Start Overload		275 411 114	305 215 914
		Run Overload		275 411 113	305 215 913
		Contactor		155 325 102	305 226 902
		Relay - 230 V*		155 031 102	305 213 902
2 - 4"	282 301 8310	Start Capacitor 105-126 MFD, 220 V		275 464 113	305 207 913
		Run Capacitor 20 MFD, 370 V		155 328 103	305 204 903
		Start Overload		275 411 117	305 215 917
		Run Overload		275 411 113	305 215 913
		Contactor		155 325 102	305 226 902
		Relay - 230 V*		155 031 102	305 213 923
3 - 4"	282 302 8310	Start Capacitor 208-250 MFD, 220 V		275 463 123	305 206 911
		Run Capacitor 45 MFD, 370 V		155 327 109	305 203 909
		Start Overload		275 411 118	305 215 918
		Run Overload		275 411 115	305 215 915
		Contactor		155 325 102	305 226 902
		Relay - 230 V*		155 031 102	305 213 902
5 - 4" & 6"	282 113 9310	Start Capacitor 216-259 MFD, 330 V		275 468 118	305 208 918
		Run Capacitor 40 MFD, 370 V	2	155 327 114	305 203 914
		Start Overload	1	275 411 119	305 215 919
		Run Overload		275 406 102	305 214 902
		Contactor		155 326 101	305 347 903
		Relay - 230 V*		155 031 601	305 213 961
7.5 - 6"	282 201 9310	Start Capacitor 130-154 MFD, 330 V		275 468 117	305 208 917
		Start Capacitor 270-324 MFD, 330 V		275 468 119	305 208 919
		Run Capacitor 45 MFD, 370 V		155 327 109	305 203 909
		Start Overload		275 411 102	305 215 902
		Run Overload		275 406 121	305 214 921
		Contactor		155 326 102	305 347 902
		Relay - 230 V*		155 031 601	305 213 961
10 - 6"	282 202 9330	Start Capacitor 270-324 MFD, 330 V	2	275 468 119	305 208 919
		Run Capacitor 35 MFD, 370 V		155 327 102	305 203 902
		Start Overload	1	275 406 103	305 214 903
		Run Overload		155 409 101	-
		Contactor		155 326 102	305 347 902
		Relay - 230 V*		155 031 601	305 213 961
15 - 6"	282 203 9330	Start Capacitor 270-324 MFD, 330 V	2	275 468 119	305 208 919
		Run Capacitor 45 MFD, 370 V	3	155 327 109	305 203 909
		Start Overload	1	275 406 103	305 214 903
		Run Overload		155 409 102	-
		Contactor		155 429 101	305 347 901
		Relay - 230 V*		155 031 601	305 213 961
15 - 6"	282 203 9621 (X-Large Enclosure)	Start Capacitor 270-324 MFD, 330 V	2	275 468 119	305 208 919
		Run Capacitor 45 MFD, 370 V	3	155 327 109	305 203 909
		Start Overload	1	275 406 103	305 214 903
		Run Overload		155 409 102	-
		Contactor		155 429 101	305 347 901
		Relay - 230 V*	2	155 031 601	305 213 961
All	All	Lightning Arrestor	1	150 814 902	150 814 902
208 V Relay*	208 V Relay*	Relay 1.5-3 hp (replaces 155 031 102)		155 031 103	305 213 903
		Relay 5-15 hp (replaces 155 031 601)		155 031 602	305 213 962

NOTE: Some Franklin motors, controls & parts are not stock items and may need to be special ordered

** For 208 V systems or where line voltage is between 200 V and 210 V, a low voltage relay and larger cable are required: Use relay part number 305 213 903 in place of 305 213 902 on 1.5 through 3 hp applications; Use relay 305213962 for 5-15 hp applications; use the next size larger cable than is specified in the 230 V table; boost transformers are an alternative to special relay and cable.*

ACCESSORIES & SERVICES - COUPLINGS

Franklin Electric offers this line of motor-to-pump couplings for maximum customer convenience in matching the Franklin motor to a variety of pump shafts. Couplings are designed to transmit the pump thrust to the motor in order to provide maximum benefits from Franklin's internal thrust bearing construction.

Hardened stainless steel spacer discs in the 4" and 6" couplings assure positive bearing between motor and pump shafts, and assure full support for downward thrust created by the pump.

8" couplings DO NOT contain hardened spacer discs since the motor shaft itself is hardened.

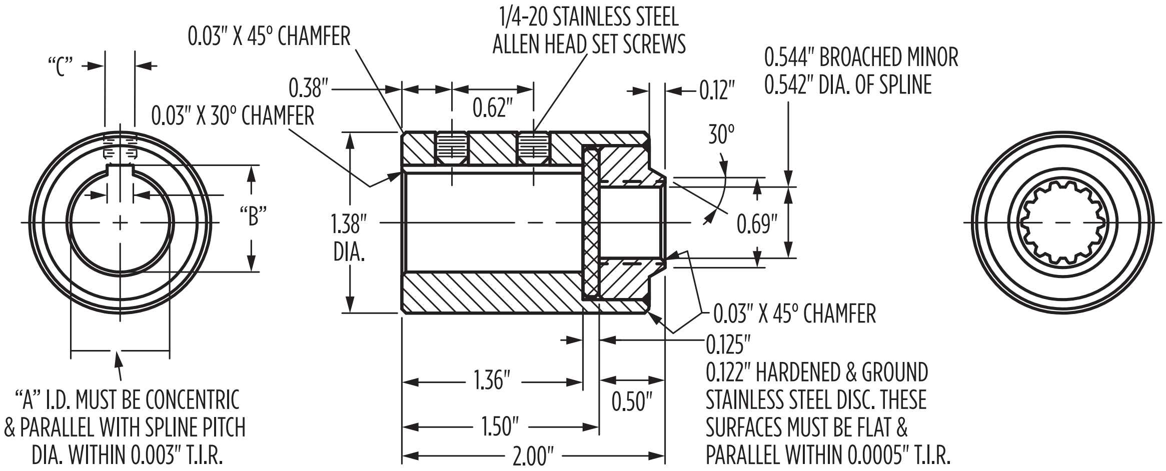
All couplings include Allen head 300 series stainless steel set screws with key included.

SPECIFICATIONS

Motor Size (in)	Construction	Pump Shaft Dia.	Dimensions (in)			Part No.
			W	D	L	
4	416 SS	3/4	3/16	1/8	1 3/8	151 551 911
	316 SS	3/4	3/16	1/8	1 3/8	151 551 931
6	416 SS	3/4	3/16	1/8	1 3/4	151 935 902
		7/8	1/4	3/16	1 3/4	151 935 901
		1	1/4	3/16	1 3/4	151 935 909
	316 SS	3/4	3/16	1/8	1 3/4	151 935 922
		7/8	1/4	3/16	1 3/4	151 935 921
		1	1/4	3/16	1 3/4	151 935 929
8	416 SS	1	1/4	1/4	2	151 922 901
		1 3/16	1/4	1/4	2	151 922 906
		1 3/16	5/16	5/16	2	151 922 902
		1 1/4	5/16	5/16	2	151 922 903
		1 1/2	3/8	3/8	2	151 922 904
	316 SS	1 3/16	1/4	1/4	2	151 922 926
		1 1/4	5/16	5/16	2	151 922 923
		1 1/2	3/8	3/8	2	151 922 924
		1 11/16	3/8	3/8	2	151 922 929

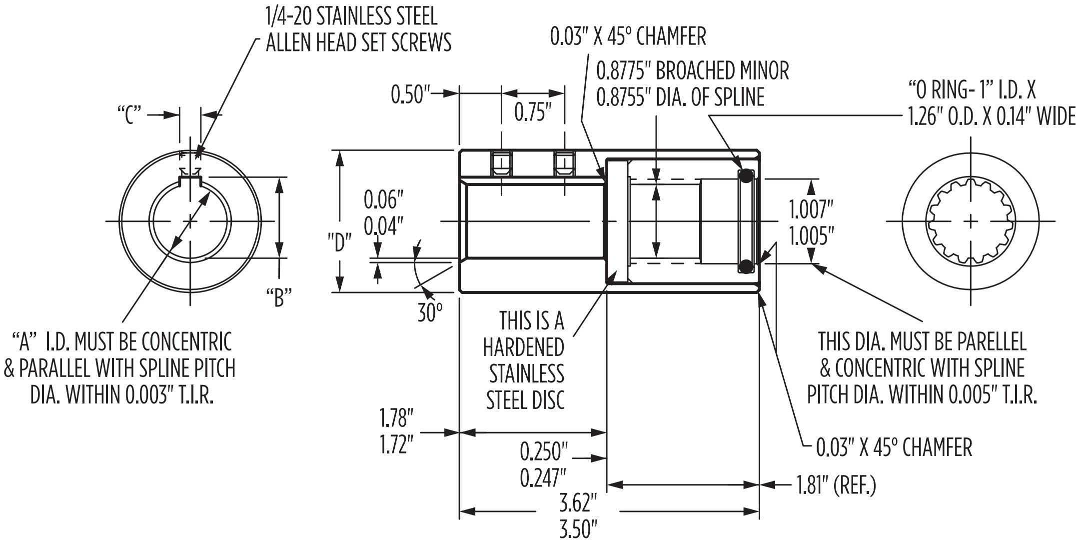
NOTE: 316 SS couplings are normally used with corrosion-resistant motors

4" DIMENSIONS

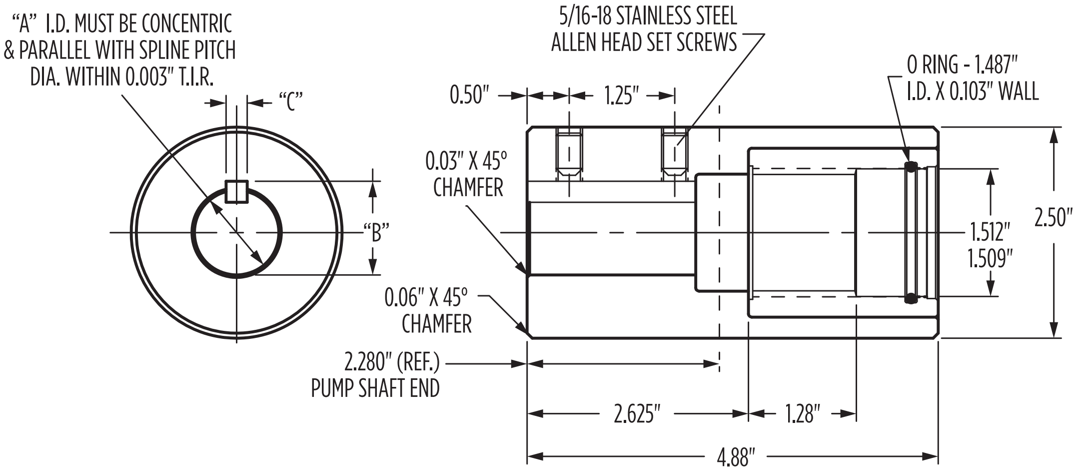


ACCESSORIES & SERVICES - COUPLINGS

6" DIMENSIONS



8" DIMENSIONS



ACCESSORIES & SERVICES - QD SERVICE BOX & SPECIAL SERVICES

QD SERVICE BOX

- Franklin Electric's QD service box is a service tool that provides capability to measure motor amps and line voltage with the motor running
- Fits between the base and cover of an installed QD control box
- Compatible with any Franklin Electric QD or CRC control box
- Meter jacks for measuring voltage while the motor is running
- Clamp-on ammeter access to all three motor leads for installations with jacketed cable or conduit
- Easy to use

Compatible With	Part No.
All QD & CRC Control Box Ratings	305 510 901

SPECIAL SERVICES

Special testing services are available for motors purchased from Franklin Electric. These services must be specified at the time of order and will result in additional lead time.

Calibrated Motor Performance Test	
HP	Motor Diameter
1/3-3	4"
5-10	4"
5-60	6"
40-200	8"

Submergence Performance Test	
HP	Motor Diameter
1/3-2	4" @ 1000 psi (2W = 500 psi)
3-10	4" @ 1000 psi
5-30	6" @ 1000 psi
40-60	6" @ 1000 psi
	8" @ 1000 psi

NOTES

NOTES

NOTES

Franklin Electric

FEATURES of SNAPPY® AND BULLDOG® PITLESS ADAPTERS

To install a Snappy or Bulldog pitless adapter, you must first excavate, per OSHA regulations, around the well casing and cut a hole in the casing below the frost-line. The Snappy or Bulldog casing fitting is then attached to the casing around the hole to provide a sanitary water service connection. The submersible pump and drop pipe are suspended from the Snappy or Bulldog drop pipe fitting. As the pump, drop pipe, and drop fitting are lowered into the well the drop fitting discharge is pointed toward the hole in the casing. When the drop fitting discharge reaches the open hole in the casing, the drop fitting actuator forces the discharge port into the inner machined surface of the casing fitting and locks it in place. Once the discharge port is properly seated within the machined surface of the casing fitting, and the actuator is fully engaged, the submersible pump and drop pipe are fully supported and secured. To remove the submersible pump, the drop fitting must first be supported by a pump hoist. This is accomplished by threading a pull pipe into the threaded pull pipe port located on the top side of the drop fitting and properly supporting the pull pipe with a pump hoist. Mark the pull pipe and top of well casing toward the direction of the water service connection. This will help locate the casing fitting during replacement. The Snappy or Bulldog drop fitting can then be disengaged from the casing fitting by pulling up on the stainless steel release cable. The motion of pulling up on the release cable will remove the drop fitting discharge port from within the casing fitting machine surface. Once the drop fitting is disengaged, the drop fitting, drop pipe, and submersible pump can be removed from the well.

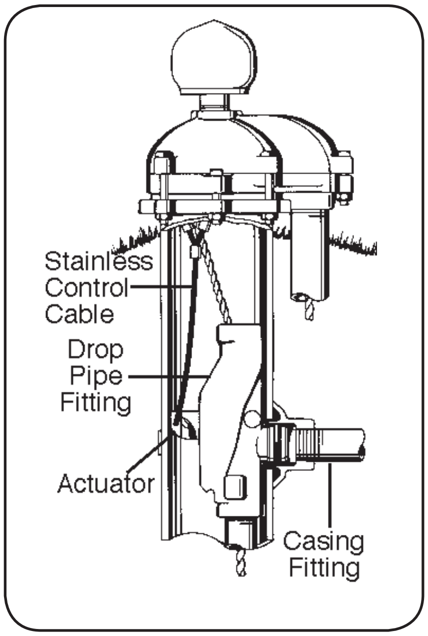
The Snappy is manufactured from lead-free galvanized cast iron and the Bulldog from brass. Snappy and Bulldog pitless adapters are certified under the standards of the Pitless Adapter Division of the Water Systems Council (PAS-l). Snappy pitless adapters are available for well sizes from 4 to 6-1/4 inches I.D. Bulldog pitless adapters are available for well sizes 4", 5" and 6" I.D. Both are for drop and discharge pipe sizes of 1 and 1-1/4 inches. **Conforms to Water System Council PAS-97(04) Standards.**

ECONOMICAL . . . Regular well casing is used all the way. Extra cost of larger upper well casing used with spool-type units and expensive pit or well house construction are eliminated.

FROSTPROOF . . . No heating required. All water passages are buried below the frostline.

SANITARY . . . No heated pump house or well pit is needed.

PUMP IS EASILY SET . . . by simply lowering pump into well suspended from drop pipe fitting with neck of the latter pointed in the casing fitting direction.



PUMP IS EASILY PULLED . . . by first supporting drop pipe with hoist, and then pulling control cable to free pump.

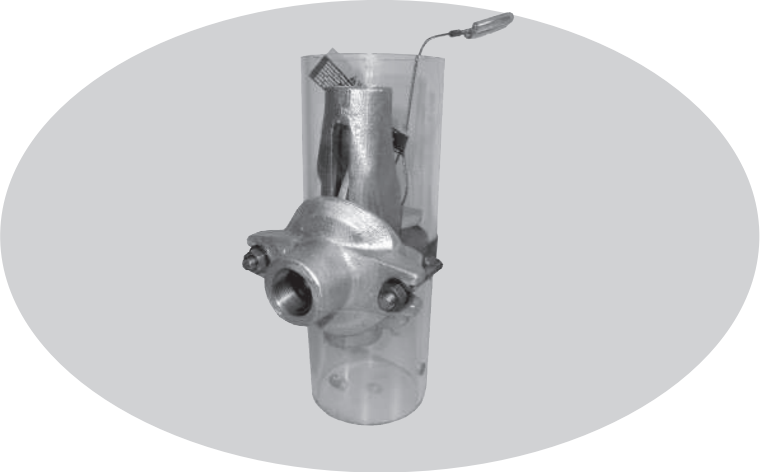
CORROSION PROTECTION . . . The Snappy Clamp-on casing fittings are lead-free galvanized gray iron. All parts within the well casing are either hot-dipped galvanized or constructed of corrosion resistant materials. All cast parts of the Bulldog pitless adapter are of high quality cast brass and conform to ASTM B584 specifications. Remaining parts are of 304 stainless steel or other corrosion resistant material. Springs are of phosphor bronze, O-rings are neoprene.

FULL CASING OPENING . . . provided by Snappy and Bulldog when pump is removed facilitates well and pump service, is often required by well codes and ordinarily necessary where a well screen is used.

MONITOR® AT-THE-WELL PITLESS ACCESSORIES. . . Allows for the pressure switch to be located in the well casing. For a description of the Monitor At-The-Well Control and ordering information, check the At-the-Well section of this catalog.

NOTE: Improper chlorination can lead to corrosion problem.
SNAPPY AND BULLDOG ADAPTERS WILL SUPPORT 1,000 LBS. PRESSURE RATED AT 250 PSI.

SNAPPY® PITLESS ADAPTER



The Snappy is manufactured from lead-free galvanized cast iron. Snappy pitless adapters are certified under the standards of the Pitless Adapter Division of the Water Systems Council (PAS-I). Snappy pitless adapters are available for well sizes from 4” to 6 1/4” I.D. and is for drop and discharge pipe sizes of 1” and 1-1/4”. **Snappy adapters conform to Water System Council PAS-97(04) Standards.**

SNAPPY® PITLESS ADAPTER

Well Size I.D.	Min.-Max. I.D.	1” DROP PIPE & DISCHARGE Order No.	Wt.	1-1/4” DROP PIPE & DISCHARGE Order No.	Wt.
4”	3.981-4.130”	**8PL41U**	10	**8PL41.2U**	11
4”	3.981-4.130”	****8PL41U/3**	30	****8PL41.2U/3**	33
4-1/2”	4.444-4.607”	**8PL4.31U**	11	**8PL4.31.2U**	12
5”	4.991-5.166”	**8PL51U**	12	**8PL51.2U**	12
5-3/16”	5.137-5.286”	**8PL5.21U**	12		
5-3/16”	5.137-5.286”	**8PL5.25.61U**	10		
6”	5.906-6.201”	**8PL61U**	14	**8PL61.2U**	14
6-1/4”	6.189-6.367”	**8PL6.21U**	14	**8PL6.21.2U**	14

** 3 - Pack.

Note: To order Snappy Units with TAPPING for AT-THE-WELL controls INSERT the letter “P” after the number indicating the well size. Example: 8PL4P1U.

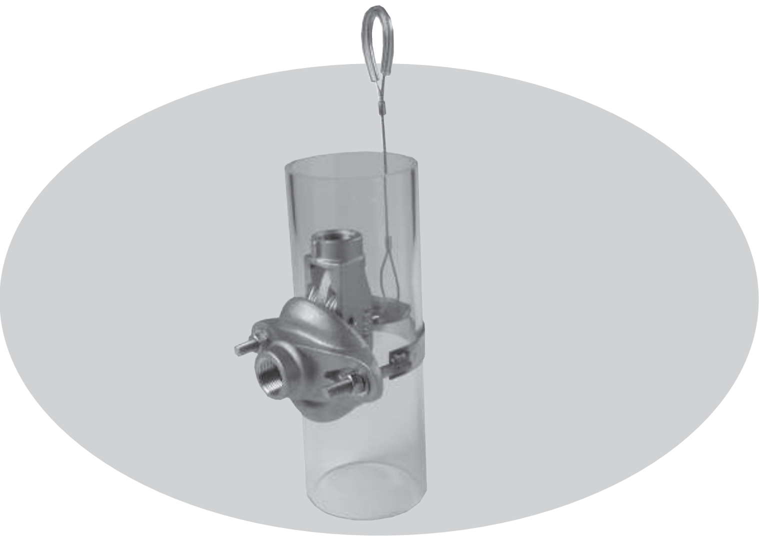
ILLINOIS & MICHIGAN SNAPPY PITLESS ADAPTERS (PRESSURIZED)

The Pressurized Snappy is equipped with dual o-rings on the casing fitting to insure a watertight seal at the well and to meet Illinois and Michigan code requirements.

Well Size I.D.	Min-Max. I.D.	Order No.	Drop Pipe & Discharge Size	Weight
4”	3.981-4.130”	**8PL04P1**	1”	12
5”	4.991-5.166”	**8PL05P1.2**	1-1/4”	13
6”	5.906-6.201”	**8PL06P1.2**	1-1/4”	15

Note: To order Snappy Pitless adapters with tapping for at-the-well controls, replace the “0” with “T” in the ordering number. Example: 8PLT4P1.

BULLDOG® PITLESS ADAPTER



The Bulldog is manufactured from brass. Bulldog pitless adapters are certified under the standards of the Pitless Adapter Division of the Water Systems Council (PAS-I). Bulldog pitless adapters are available for well sizes 4”, 5” and 6” I.D. and is for drop and discharge pipe sizes of 1 and 1-1/4 inches. **Bulldog adapters conform to Water System Council PAS-97(04) Standards.**

BULLDOG® PITLESS ADAPTER

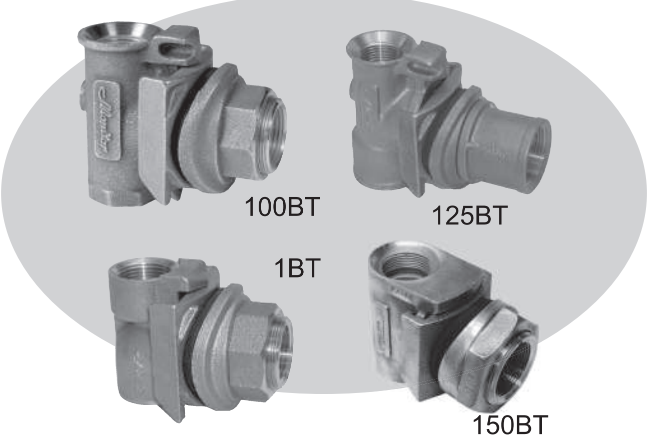
Well Size I.D.	Min.-Max. I.D.	1” DROP PIPE & DISCHARGE Order No.	Wt.	1-1/4” DROP PIPE & DISCHARGE Order No.	
4”	3.981-4.130”	**4A0**	7	**4B0**	8
5”	4.991-5.166”	**5A0**	7	**5B0**	8
6”	5.906-6.201”	**6A0**	7	**6B0**	8

SNAPPY® AND BULLDOG® PITLESS ADAPTERS O-RING SELECTION GUIDE

Description	O-Ring Part No.	O.D. Diameter
1” drop fitting, Std. or Pressurized	PL3	1-5/8”
1-1/4” drop fitting, Std. or Pressurized	PL40	1-7/8”
Std. Discharge fitting, all sizes	PL34	3-5/8”
Pressurized Discharge Fitting,		
4” well size, inner O-ring	PL86	2-7/8”
4” Well size outer O-ring	PL85	4-5/8”
5” & 6 well size, inner O-ring	PL84	3-3/8”
5” & 6” well size, outer O-ring	PL83	5-1/4”

BRASS SLIDE PITLESS ADAPTERS

Monitor® “Slide Type” brass pitless adapters are designed for greater strength and constructed of precision machined valve brass, with many features that provide for easier installation, more convenient servicing and improved sanitation. All conform to Water System Council PAS-97 (04)Standards.



FEATURES

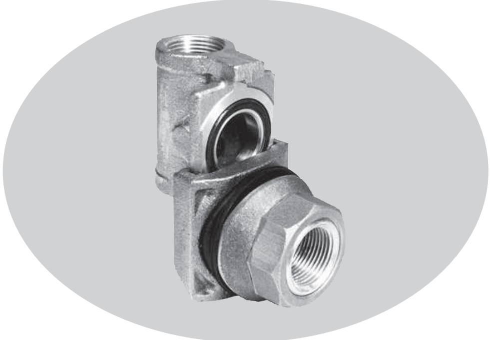
- All models (including 1 1/4” NPT sizes) are installed with a 1 3/4” diameter hole in the well casing, eliminating the need for several size of holesaws.
- Nipple and nut have fine pitch threads for secure seal.
- Vertical indicators.
- Generous molded gaskets for a sanitary, secure seal on the well casing.
- Large bevels on the edges of the male slides make it easier to insert the mating parts.
- Pressurized models have a small port in the nipple which allows the sealed area between the gaskets to fill with water under system pressure. The design prevents the entry of contamination as required by the State of Illinois.

BRASS PITLESS ADAPTERS

Well Size I.D.	Drop Pipe Size	Lift Out Pipe Size	Discharge Size	Order No.	Pressurized	Safe Load Limit	WT.
5-8”	1”	1”	1”	1BT	No	1500 lbs	3.5
5-8”	1”	**1”**	**1”**	**1BTB (boxed)**	No	1500 lbs.	3.5
5-8”	1”	1”	**1”**	**100BT**	No	2500 lbs.	3.75
5-8”	1 1/4”	1”	1 1/4”	**125BT**	No	2500 lbs.	4.5
5-7”	1”	1”	**1”**	**1BPT**	Yes	1500 lbs.	3.5
5-7”	1”	1”	**1”**	**100BPT**	Yes	2500 lbs.	3.75
5-7”	1 1/4”	1”	1 1/4”	**125BPT**	Yes	2500 lbs.	4.5
5-7”	1 1/4”	1”	**1”**	**1251BT**	No	2500 lbs.	3.8
6-8”	1 1/2”	1 1/4”	1 1/2”	**150BT**	No	6000 lbs.	8.2
6-8”	1 1/2”	1 1/4”	1 1/2”	**150BPT**	Yes	6000 lbs.	8.2
6-8”	1 1/2”	**1 1/4”**	1 1/2”	**150BTC**	No	6000 lbs.	8.2
6-8”	1 1/2”	1 1/4”	**1 1/2”**	**150BPTC**	Yes	6000 lbs.	8.2

NOTE: (C) = Tapped for At-The-Well Control Kits

BRASS PITLESS ADAPTER



BRASS PITLESS ADAPTERS - conform to Water System Council PAS-97(04)Standards.

FEATURES

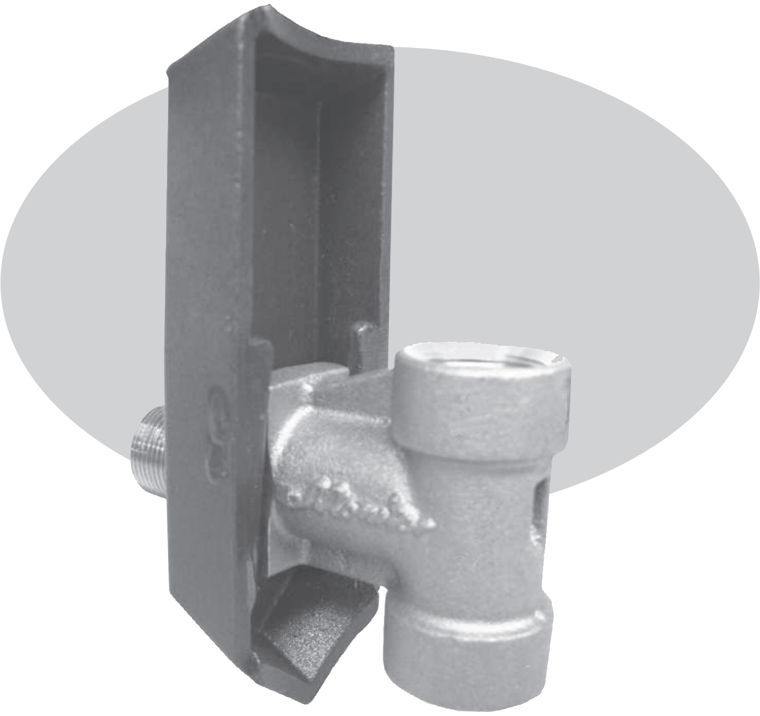
- All brass construction, reliable O-Ring seal, easy installation & servicing.
- Either a Monitor ventilated, Turtle or watertight cap may be used.
- Unit will support up to a 600’ length of Sch. 40 Steel pipe.

BRASS PITLESS ADAPTER

Well Size I.D.	Order No.	Drop Pipe Size	Discharge Size	Weight
8”	**130BA**	2”	2”	10.5 lbs.

Monitor®

6123BEZ WELD ON PITLESS ADAPTERS



WELD ON PITLESS ADAPTER
FOR 4", 5" & 6" I.D. & 7" O.D. WELLS

FEATURES

- 304 Stainless Steel 1" Male NPT Nipple
- 304 Stainless Steel locating support pins
- Steel housing has taper at the bottom to allow for easy bottom side welding
- Positive stop feature on interior of housing assures proper o-ring seal
- C84400 Red Brass 1" drop fitting with female NPT connection
- Maximum safe load rating: 1600 lbs.
- Chamfered 1" pull pipe port
- Large drainage hole in backside of drop fitting to prevent chlorine build-up
- Drop fitting has long sweep 90 degree turn
- Pump is more centrally located within well
- Large neoprene o-ring seal
- Factory pressure test to 100 lbs.

WELD ON PITLESS ADAPTER

Order No.	Well Size	Drop Pipe Size	Discharge Size	Weight (lbs)
6123BEZ	4", 5" & 6" I.D. & 7" O.D.	1" Female NPT	1" Male NPT	5.4

CERTIFIED LEAD FREE
500 SB Series

NSF/ANSI 372

CERTIFIED LEAD FREE
Check Valve

- Silicon bronze cast body.
- Silicon bronze cast poppet.
- Female threads.

Part No.	Size	Weight Each lbs.	Carton Quantity
501SB	1/2	.6	1
502SB	3/4	.8	1
503SB	1	1.1	1
513SB*	1	1.2	1
504SB	1 1/4	1.6	1
514SB**	1 1/4	1.7	1
505SB	1 1/2	2.1	1
506SB	2	3.7	1
507SB	2 1/2	9.8	1
508SB	3	10.8	1
509SB	4	23.6	1
510SB***	5	25.1	1
511SB	6	41.5	1

513SB* has longer threads.
514SB** has longer threads.
510SB*** has 5" male threads both ends.

CERTIFIED LEAD FREE
2500 SB Series

NSF/ANSI 372

CERTIFIED LEAD FREE
Stemless Check Valve

- Silicon bronze cast body.
- Silicon bronze stemless poppet.
- Female threads.

Part No.	Size	Weight Each lbs.	Carton Quantity
2503SB	1	1.3	1
2504SB	1 1/4	1.8	1
2505SB	1 1/2	2.1	1
2506SB	2	3.7	1

CERTIFIED LEAD FREE
Submersible Check Valve

NSF/ANSI 372

- Silicon bronze cast body.
- Silicon bronze cast poppet.
- Female-Male threads.

Part No.	Size FxM	Weight Each lbs.	Carton Quantity
610SB**	1 x 1 Long	1.4	1
611SB**	1 1/4 x 1 1/4 Long	2.0	1
616SB	1 x 1	1.4	1
617SB	1 x 1 1/4	1.4	1
618SB	1 1/4 x 1 1/4	1.8	1
622SB	2 x 2	3.9	1
623SB	3 x 3	10.4	1
624SB	4 x 4	22.6	1
625SB	6 x 6	41.4	1

* * Extended male and female threads

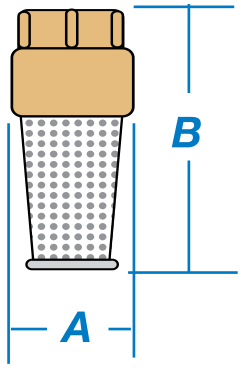
*Silicon bronze components contain less than .05% (1/20 of 1%) Lead.

Check Valves furnished with Buna-N O-Ring, stainless steel spring, stainless steel washer, and stainless steel locknut.
All valves 1/2” through 1-1/2” have a working pressure of 400 psi. All valves 2” and larger have a working pressure of 600 psi.
190° Maximum Temperature Rating

MADE IN U.S.A.

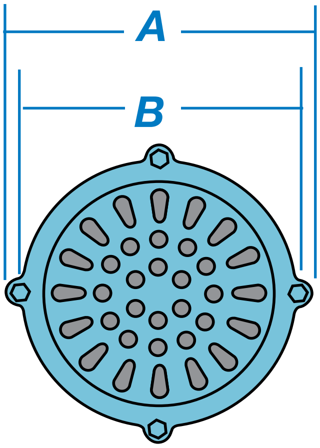
Dimensions

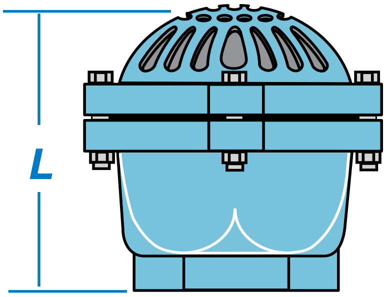
Foot Valves



Part No.	A Diameter Inches	B Length Inches
404SB	1 15/16	5
452SB	1 3/8	3 3/4
453SB	1 3/4	4 3/4
454SB	2 1/16	5
455SB	2 5/16	5 1/4
456SB	2 5/8	6 5/16
457SB	3 1/2	7 3/16
458SB	4	9 3/8
459SB	4 5/8	9 1/2
460SB	6	13 7/8
461SB	7 1/2	15 3/4
465SB	1 5/16	3 3/4
466SB	1 5/8	5
467SB	1 15/16	5
IMPORT VALVES		
7402	1 1/2	3 1/2
7403	1 7/8	4 1/2
7405	2 1/16	4 7/8
7406	2 3/8	6
7407	3 1/16	6 3/8

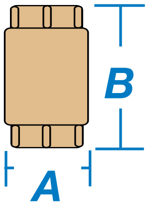
Cast Iron Foot Valves





Part No.	Size	A	B	L	Hex Size
471	1 1/4 NPT	3 3/8”	4 5/8”	4 1/8”	2 5/8”
472	1 1/2 NPT	3 3/8”	4 5/8”	4 1/8”	2 5/8”
473	2 NPT	5 1/4”	5 3/4”	5 1/4”	3 5/16”
475	3 NPT	6 1/4”	7 5/8”	7 3/16”	4 9/16”
476	4 NPT	7 11/16”	9 1/16”	8 7/8”	5 9/16”
478	6 NPT	10 1/16”	11 7/16”	12”	7 3/4”
479	8 NPT	13 3/4”	15 1/8”	15 1/2”	10 1/8”

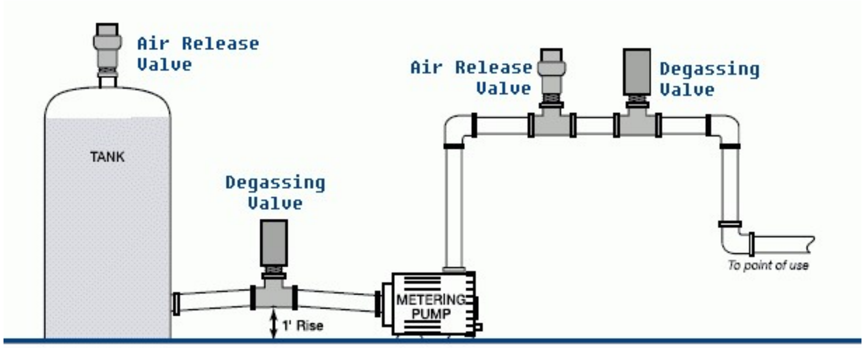
Check Valves



Part No.	Part No.	A Diameter	B Length
501SB		1 7/16	2 5/8
502SB		1 5/8	3 3/8
503SB		1 7/8	3 5/8
504SB		2 1/4	3 3/4
505SB	2505SB	2 5/8	4 1/8
506SB	2506SB	3 1/4	5 1/8
507SB		4	7 3/8
508SB		4 1/16	7 1/4
509SB		5 1/2	10 1/2
510SB		5 5/8	10 5/8
511SB		7 5/8	10 5/8
513SB	2503SB	1 7/8	3 7/8
514SB	2504SB	2 1/4	4 1/8
601SB		2 3/16	3 5/8
602SB		2 1/4	4 1/4
603SB		2 9/16	4 1/16
604SB		3 3/16	5 1/16
610SB		1 15/16	4 3/4
611SB		2 1/4	4 15/16
613SB		1 15/16	4 5/8
616SB		2	3 7/8
617SB		1 7/8	3 3/4
618SB		2 1/4	4 3/8
622SB		3 1/4	5
623SB		4 1/8	7 3/8
624SB		5 9/16	10 1/2
625SB		7 3/4	11
630SB		4 1/16	8 3/4
641SB		1 3/4	4 3/4
653SB	2653SB	1 7/8	3 7/8
654SB	2654SB	2 1/4	4 1/8
655SB	2655SB	2 5/8	4 3/8
658SB		3 1/4	5
660SB		4 1/8	7 3/8
661SB		5 9/16	10 1/2
662SB		7 3/4	11
669SB		4 1/16	8 3/4
670SB	675SB	4 1/16	8 7/8
671SB	2671SB	5 5/8	11 1/2
676SB	2676SB	5 5/8	11 1/2
672SB	677SB	7 5/8	11 1/2
673SB	678SB	9 5/8	12
674SB	2674SB	6 3/4	11 3/4
679SB	2679SB	6 3/4	11
680SB	2680SB	3 3/16	5 1/16
681SB	2681SB	4 7/8	8
685SB	2685SB	4 7/8	8
683SB	2683SB	9 1/4	12
687SB	2687SB	9 1/4	12
689SB	690SB	12 1/8	14
IMPORT VALVES			
7501		1 1/4	2 3/8
7502		1 5/8	2 3/4
7503		1 7/8	3 1/8
7504		2 1/8	3 5/8
7505		2 3/8	4 1/16
7506		3 1/16	5

Plast-O-Matic Valves, Inc.
1384 Pompton Avenue
Cedar Grove, NJ 07009 USA
Email: info@plastomatic.com

Call Us: (973) 256-3000



ARV QUICK LINKS

ARV Cut Sheet
ARV DWG file
ARV Installation Instructions

Degassing Valve Info

Series ARV Thermoplastic Air Release Valves...

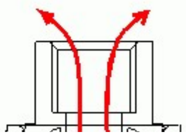
Self-Guided Poppet Assures Dependable, Repetitive Operation

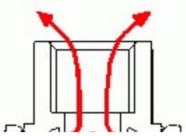
Features/Benefits:

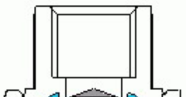
- **Safety:** Allows safe expulsion of unwanted air in piping systems.
- **Dependability:** Unique self-guided poppet assures minimal emission of system liquid prior to sealing.
- **Convenience:** True-union simplifies valve inspection/removal with minimum piping breakdown. Optional dust cap available for appropriate installations.
- **Minimal Closing Pressure:** Closes at 0 PSI, as long as liquid is present. Valve closes as liquid rises, after virtually all unwanted air is forced out. Seals bubble tight at system pressures as low as 10 psi (EPDM seals).
- **Cost Efficient:** Designed to improve system performance and competitively priced.
- **Superior Design:** Poppet seals more reliably than ball designs; does not deform under pressure like a hollow ball.
- **Corrosion Resistant:** Top quality thermoplastics and elastomers resist chemical attack and protect system purity. No metal components in Series ARV.

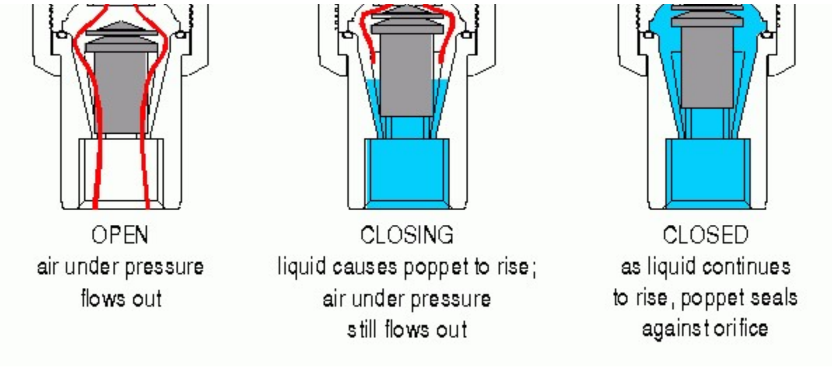
How it Works:

Series ARV is a normally-open valve. Until your system is pressurized, the valve is simply open, and air is present. As pressure builds within the system, unwanted air is forced to the highest point in the system, i.e., the normally-open Air Release Valve. When pressure within the system exceeds atmospheric pressure, air is expelled. As liquid rises, the poppet becomes buoyant and eventually closes. (Note minimum specific gravity of liquid must be .9 or higher). It is possible that trace amounts of air will remain in the system, depending on the rapidity with which the valve closes. It is also likely that some trace amounts of process liquid will be emitted. At system pressure of 10 psi (with EPDM elastomer), the poppet will seal bubble tight against the orifice. When pressure and liquid level drop, the valve will automatically re-open.[1]





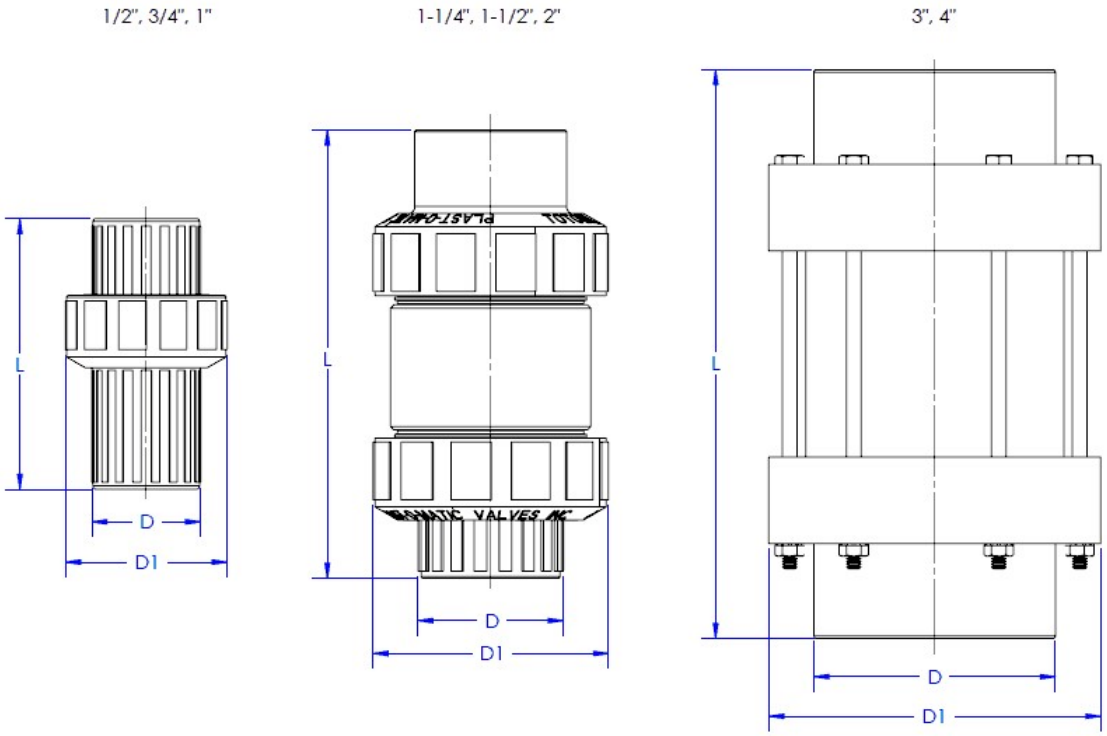




The poppet is guided by a series of thermoplastic ribs within the valve. The poppet is a unique design by Plast-O-Matic Valves, Inc. that is engineered to provide a balance of buoyancy and sealability. This balanced poppet is the key to the superior performance of this valve: It is dense enough to permit maximum emission of unwanted system air, yet buoyant enough to affect a quick seal and minimize emission of the process liquid. Historically, competitive air release valves have used ball-type sealing mechanisms that either seal too rapidly or allow excessive liquid to escape.

[1] Note that although Series ARV is a normally open valve, it should not be used in lieu of a vacuum breaker due to safety considerations. Under certain conditions, a normally-open air release valve will not perform properly as a vacuum breaker.

Dimensions, Specifications & Ordering Information:



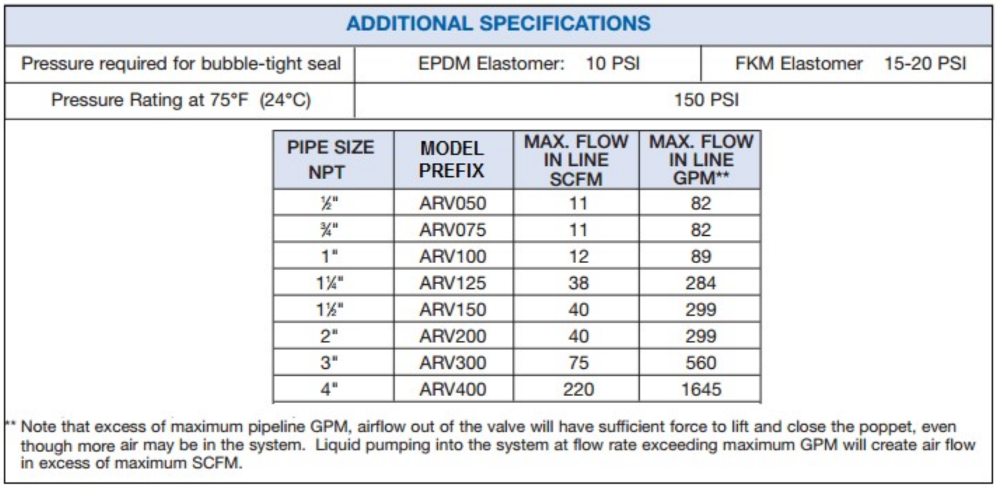
Available in Geon® PVC & Corzan® CPVC

Series ARV Pipe Size (NPT)	L		D		D1		Model Number
	IN.	mm	IN.	mm	IN.	mm	
1/2"	5.3	130	1.9	48	2.8	72	ARV050EPT-PV
3/4"	5.3	130	1.9	48	2.8	72	ARV075EPT-PV
1"	4.7	120	1.9	48	2.8	72	ARV100EPT-PV
1 1/4"	7.8	197	2.5	64	4.1	103	ARV125EPT-PV

1 1/2"	7.8	197	2.5	64	4.1	103	**ARV150EPT-PV**
2"	8.4	214	3.0	76	4.1	103	**ARV200EPT-PV**
3"	9.8	250	4.2	106	5.8	146	**ARV300EPT-PV**
4"	11.7	298	5.8	146	7.9	200	**ARV400EPT-PV**

ARV(series) **050**(size) **EP**(seal material) **T**(threaded) - **PV**(body material)
Part numbers shown are EPDM seals with PVC bodies.
Note that 1/2" and 3/4" are based on the 1" valve; the 1/2" and 3/4" sizes use reducing bushings.

- For Viton seals, change "EP" to "V" (ARV050VT-PV)
- For Corzan CPVC body, change "-PV" to "-CP" (ARV050VT-CP)
- Standard connections are threaded. For socket connection, change "T" to "S" after seal material (ARV050EPS-PV)
- For spigot or other connection types, consult factory.
- For optional dust cap, consult factory.



ADDITIONAL SPECIFICATIONS

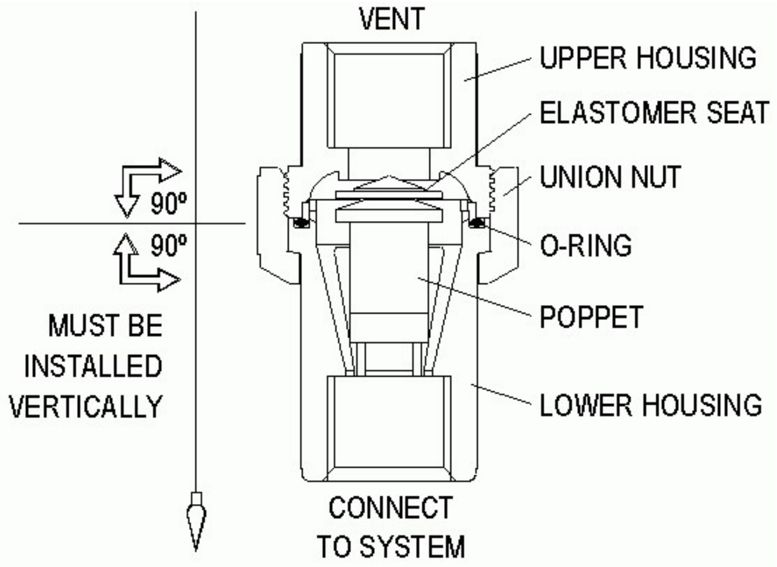
Pressure required for bubble-tight seal	EPDM Elastomer: 10 PSI	FKM Elastomer 15-20 PSI
Pressure Rating at 75°F (24°C)	150 PSI	

PIPE SIZE NPT	MODEL PREFIX	MAX. FLOW IN LINE SCFM	MAX. FLOW IN LINE GPM**
½"	ARV050	11	82
¾"	ARV075	11	82
1"	ARV100	12	89
1¼"	ARV125	38	284
1½"	ARV150	40	299
2"	ARV200	40	299
3"	ARV300	75	560
4"	ARV400	220	1645

** Note that excess of maximum pipeline GPM, airflow out of the valve will have sufficient force to lift and close the poppet, even though more air may be in the system. Liquid pumping into the system at flow rate exceeding maximum GPM will create air flow in excess of maximum SCFM.

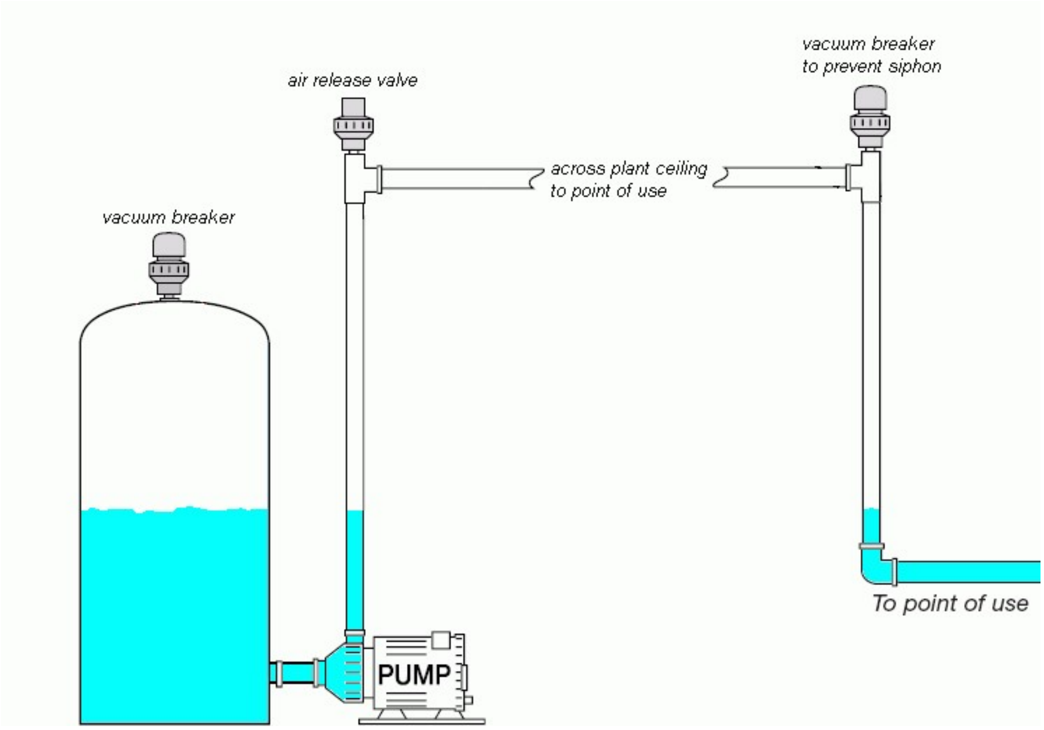
Installation Notes

Series ARV should be installed at the highest possible point in a piping system or vessel, and it **must** be oriented upright. In most cases, residual liquid and/or vapor in the valve may be expelled from the outlet port just prior to valve shut-off. Therefore, it is recommended to pipe the outlet port to a safe area for hazardous liquids, or use a standpipe for non-hazardous liquids.



For detailed installation instructions, please click here.

Use of Air Release Valve with Vacuum Breakers to Prevent Siphon



Air release valves are used mostly to expel pockets of air at system start-up, but as shown in the diagram above, they are also used in conjunction with vacuum breakers to eliminate siphon in piping systems. First, a vacuum breaker is positioned on top of the supply tank to prevent implosion when the tank is drained. A second vacuum breaker is shown on a tee to prevent siphon in a vertical drop. This creates a pocket of air in the riser, lateral line, and drop to "break" the suction that would otherwise be created in the drop when the pump is turned off. The blue color indicates liquid in the system when the pump is turned off. When the system is re-started, an air release valve positioned along the high point of the pipeline is necessary to expel the air pocket for safe and efficient operation. Additional air release valves may be necessary at other points, depending upon the size and complexity of the pipeline. Placement of degassing valves (not shown) varies from system to system.

Helpful Links:

CAD DRAWING -- ARV (1") 2D CAD drawing in .dwg format.

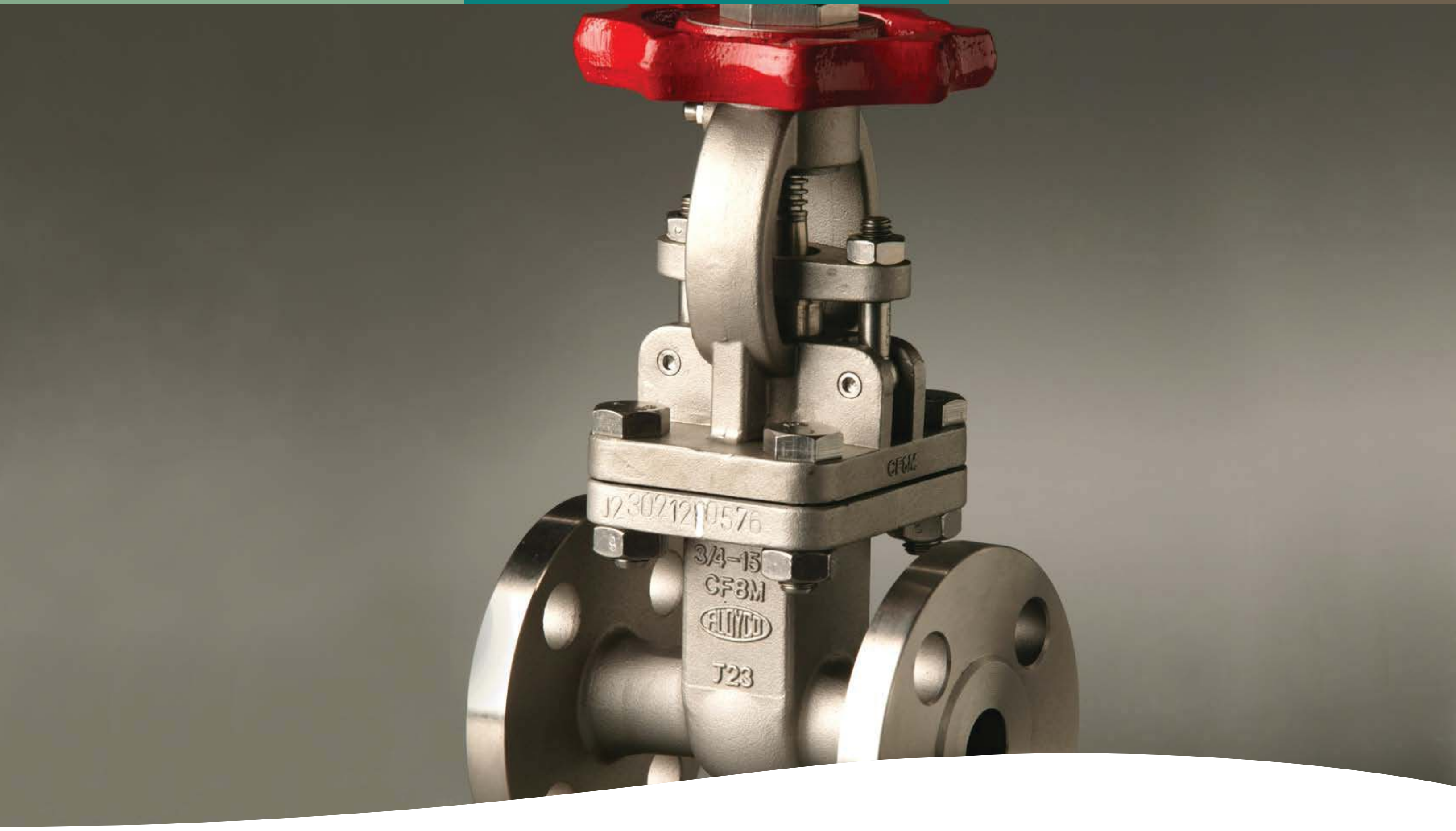
Catalog Sheet: For specifications and catalog page in .PDF format, please click here.

Self-Training Powerpoint: Specific to Series ARV; please click here.

Degassing Valve: Remember that an Air Release Valve is used to expel a large volume of air at system start up. A Degassing Valve sounds similar, but is different from an Air Release Valve...If your application requires continuous expulsion of trace amounts of outgassing throughout the day, please click here for degassing valve information.

For complete information request Catalog ARV.

brands you trust.



ALOYCO® Corrosion Resistant Stainless Steel Valves

Crane ChemPharma & Energy

www.cranecpe.com

Dimensions Class 150 • OS&Y • Solid or Flexible Wedge Disc

Figure 110

Gate Valve, Raised Face, Threaded Ends,
Solid Wedge Disc (½ - 1")
Flexible Wedge Disc (1½ - 2")

Figure 114

Gate Valve, Raised Face, Socket Weld Ends,
Solid Wedge Disc (½ - 1")
Flexible Wedge Disc (1½ - 2")

Size Range:

½ through 2 inches

Design Features:

- Bolted Bonnet
- Rising Stem
- Integral Seat
- MSS SP-42
- API 603 (except for end connections)
- ASME B16.34

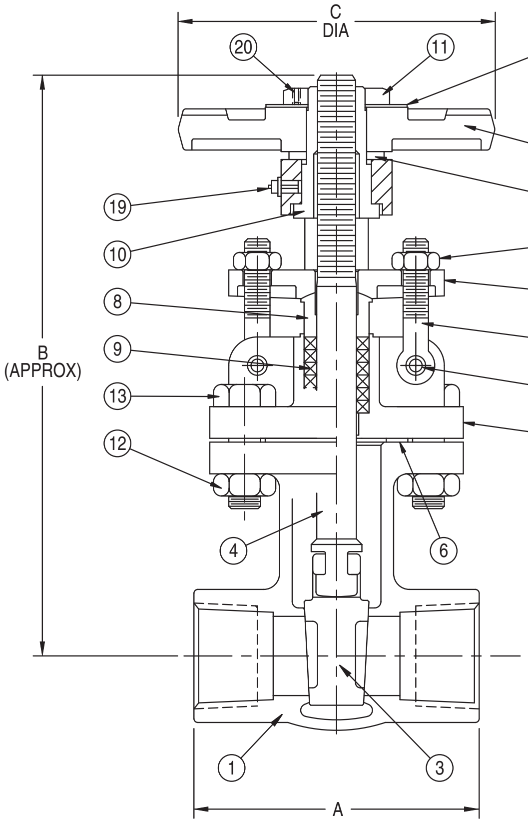


Fig. 110

Dimensions and Weights

Valve Size	Weight (lbs)	Dimensions (inches)		
		A	B (open)	C
½	6.8	2.76	8.1	3.9
¾	7.2	3.15	8.5	3.9
1	9.8	3.54	9.1	3.9
1 ½	14.9	4.13	11.0	5.5
2	20.1	4.72	12.6	6.3

Please refer to page 28 for Pressure-Temperature Ratings.

Industry Standards

Pipe Threads	ASME B1.20.1
Wall Section	ASME B16.34
Socket Weld Ends	ASME B16.11
End-to-End	Manufacturer's Standard
Pressure-Temp Rating	ASME B16.34
Testing	API 598

Materials of Construction

1	Body	ASTM A351 CF3M
2	Bonnet	ASTM A351 CF8M
3	Disc	ASTM A351 CF8M
4	Stem	ASTM A276 T316
5	Handwheel	ASTM A536
6	Gasket	PTFE
7	Gland Flange	ASTM A351 CF8
8	Gland	ASTM A276 T316
9	Packing	PTFE
10	Stem Nut	ASTM A439, D2
11	Handwheel Nut	ASTM A276 T316
12	Bonnet Bolt Nut	ASTM A194 GR 8
13	Bonnet Bolt	ASTM A193 GR B8
14	Eyebolt Pin	ASTM A276 T304
15	Eyebolt	ASTM A193 GR B8
16	Eyebolt Nut	ASTM A194 GR 8
17	ID Tag	304 Stainless
18	Washer	ASTM A536
19	Grease Fitting	Nickel-plated Copper
20	Set Screw	Steel

GATE VALVES

Bronze Gate Valves - Class 125

Nonrising Stem

Pipe Size (In.)	Screw-in Bonnet					
	Threaded			Solder		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
¼	T113-¼	81452708	**$53.57**			
⅜	T113-⅜	81452757	**53.57**	S113-⅜	80017361	**$43.83**
½	T113-½	81452690	**38.28**	S113-½	80017312	**38.28**
¾	T113-¾	81452740	**46.13**	S113-¾	80017353	**43.83**
1	T113-1	81452666	**59.11**	S113-1	80017288	**63.16**

Pipe Size (In.)	Screw-in Bonnet					
	Threaded			Solder		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
1¼	S113-1¼	81452682	**$89.07**	S113-1¼	80017304	**$95.27**
1½	S113-1½	81452674	**130.93**	S113-1½	80017296	**106.86**
2	T113-2	81452716	**157.39**	S113-2	80017320	**149.63**
2½	S113-2½	81452724	**356.21**	S113-2½	80017338	**375.81**
3	T113-3	81452732	**495.83**	S113-3	80017346	**491.56**

- WOG: 200 psi
- WSP rating: 125 psi
- Solid wedge
- Drain option available on some styles, contact Sales


Screw-in Bonnet Nonrising Stem


Screw-in Bonnet Rising Stem


Union Bonnet Rising Stem

Rising Stem

Pipe Size (In.)	Screw-in Bonnet						Union Bonnet		
	Threaded			Solder			Threaded		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
¼	T111- ¼	81451130	**$46.13**						
⅜	T111- ⅜	81451189	**69.43**				T124- ⅜	81453177	**$57.01**
½	T111- ½	81451122	**41.49**	S111- ½	76616432	**$41.85**	T124- ½	81453110	**52.90**
¾	T111- ¾	81451171	**51.46**				T124- ¾	81453169	**62.80**
1	T111-1	81451098	**85.95**	S111-1	76616440	**69.26**	T124-1	81453086	**79.96**

Pipe Size (In.)	Screw-in Bonnet						Union Bonnet		
	Threaded			Solder			Threaded		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
1¼	T111-1¼	81451114	**$100.72**				T124-1¼	81453102	**$113.30**
1½	T111-1½	81451106	**117.56**	S111-1½	76616416	**$125.94**	T124-1½	81453094	**138.91**
2	T111-2	81451148	**166.51**	S111-2	76616457	**172.74**	T124-2	81453136	**185.23**
2½	T111-2½	81451155	**444.56**	S111-2½	76616465	**422.70**			
3	T111-3	81451163	**546.75**						

Bronze Gate Valves - Class 150

Rising Stem

Pipe Size (In.)	Union Bonnet						Screw-in Bonnet		
	Solder			Threaded			Threaded		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
¼				T134-¼	81928798	**$58.97**			
⅜				T134-⅜	81928848	**58.97**	T131-⅜	81928640	**$56.45**
½	S134-½	80017486	**$64.98**	T134-½	81928780	**74.07**	T131-½	81453219	**52.72**
¾	S134-¾	80017528	**75.16**	T134-¾	81928830	**85.95**	T131-¾	81928632	**62.32**

Pipe Size (In.)	Union Bonnet						Screw-in Bonnet		
	Solder			Threaded			Threaded		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
1	S134-1	80017452	**$103.29**	T134-1	81928756	**$107.78**	T131-1	81453185	**$83.01**
1¼	S134-1¼	80017478	**143.87**	T134-1¼	81928772	**166.63**	T131-1¼	81453201	**112.18**
1½	S134-1½	80017460	**174.47**	T134-1½	81928764	**144.26**	T131-1½	81453193	**140.67**
2				T134-2	81928806	**199.45**	T131-2	81453235	**190.56**

Nonrising Stem

Pipe Size (In.)	Union Bonnet Threaded			Screw-in Bonnet Threaded		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
¼	T136-¼	81929093	**$80.49**			
⅜	T136-⅜	81929143	**81.29**	T133-⅜	81928749	**$79.35**
½	T136-½	81929085	**77.47**	T133-½	81928681	**59.49**
¾	T136-¾	81929135	**90.83**	T133-¾	81928731	**85.95**

Pipe Size (In.)	Union Bonnet Threaded			Screw-in Bonnet Threaded		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
1	T136-1	81929051	**$110.42**	T133-1	81928657	**$86.01**
1¼	T136-1¼	81929077	**220.21**	T133-1¼	81928673	**115.75**
1½	T136-1½	81929069	**192.34**	T133-1½	81928665	**146.04**
2	T136-2	81929101	**267.15**	T133-2	81928707	**199.45**

- WOG: 300 psi
- Steam: 150 psi (to 366°F)
- Block pattern
- Solid wedge


Union Bonnet Rising Stem


Union Bonnet Nonrising Stem


Screw-in Bonnet

Bronze Gate Valves - Class 300

Pipe Size (In.)	Rising Stem		Nonrising Stem	
	Order #	Price Ea.	Order #	Price Ea.
Bronze Seat				
	Series T174A		**Series T176A**	
¼	82029398	**$100.97**	82029539	**$128.43**
⅜	82029422	**113.99**	82029562	**125.94**
½	82029380	**92.04**	82029521	**174.58**
¾	82029414	**110.56**	82029554	**149.63**
1	82029356	**151.47**	82029497	**208.39**
1¼	82029372	**220.85**	82029513	**277.85**
1½	82029364	**233.76**	82029505	**354.04**

- Threaded end connections
- WOG: 600 psi
- Steam: 300 psi
- Union bonnet
- Block pattern
- Alloy solid wedge


Rising Stem

Iron Body Gate Valves - Bronze Mounted - Class 250

Pipe Sz. (In.)	Mfr's #	Order #	Price Ea.
2½	F6670-2½	75962134	**$1184.73**
3	F6670-3	75962142	**1296.16**
4	F6670-4	75962159	**1786.30**
5	F6670-5	75962167	**3335.67**
6	F6670-6	75962175	**3313.55**

- Outside screw and yoke
- End connections: flanged
- WOG: 500 psi; WSP: 250 psi
- Solid wedge
- Bolted bonnet

Stainless Steel Gate Valves - Class 125

2	82029406	**347.30**	82029547	**537.86**
Stainless Steel Seat				
	Series T174SS		**Series T176SS**	
½	82029463	**115.25**	82029604	**131.32**
¾	82029489	**132.65**	82029620	**159.85**
1	82029430	**176.26**	82029570	**221.65**
1¼	82029455	**231.53**	82029596	**297.91**
1½	82029448	**273.42**	82029588	**372.38**
2	82029471	**395.40**	82029612	**588.19**


Nonrising Stem

Flanged Cast Iron Gate Valves - Class 125

LEGEND VALVE

T-303/T301

IBBM gate valves are made of ASTM A-126, Class B cast iron with bronze trim. Designed with bolted bonnets.

- Pressure Rating: 200 WOG
- Pressure Rating: 125 WSP to 450°F

Size (In.)	Outside Screw & Yoke			Non-Rising Stem		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
2	116-121	03492311	**$379.59**	116-101	03492386	**$359.90**
2½	116-122	03492329	**443.34**	116-102	03492394	**446.30**
3	116-123	03492337	**410.32**	116-103	03492402	**498.19**
4	116-124	03492345	**621.24**	116-104	03492410	**531.53**
5	116-125	03492352	**713.51**	116-105	03492428	**672.34**
6	116-126	03492360	**941.00**	116-106	03492436	**817.09**
8	116-127	03492378	**1604.56**	116-107	03492444	**1361.78**

- Replaceable seat rings
- Solid wedge
- Flanged ends
- Meets MSS-SP-70

Mfr's #	Thread Size	Order #	Price Ea.
113-403	½	03492451	**$131.53**
113-404	¾	03492469	**150.04**
113-405	1	03492477	**194.98**
113-406	1¼	03492485	**256.13**
113-407	1½	03492493	**361.86**
113-408	2	67309039	**433.92**

- Pressure rating: 600 WOG/125 WSP
- Solid wedge
- Stainless steel seats
- PTFE packing

Iron Body Gate Valves - Class 125

NIBCO® AHEAD OF THE FLOW™

- End connections: flanged
- WOG: 200 psi
- Bolted bonnet
- Solid wedge
- Conform to MSS SP-70
- Additional sizes available, contact Sales


Rising Stem


Nonrising Stem

Pipe Size (In.)	Rising Stem - Outside Screw & Yoke			Nonrising Stem - Inside Screw		
	Mfr's #	Order #	Price Ea.	Mfr's #	Order #	Price Ea.
2	F617ON-2	75512533	**$611.68**	F619N-2	75951830	**$614.59**
2½	F617ON-2½	75512541	**668.61**	F619N-2½	75951848	**668.61**
3	F617ON-3	75512574	**705.85**	F619N-3	75951855	**717.31**
4	F617ON-4	75512582	**982.16**			
6	F617ON-6	75512608	**1613.17**			
8	F617ON-8	75512616	**2967.03**			

Figure 15B-200
STAINLESS STEEL GATE VALVES

200 WOG NON-RISING STEM GATE VALVE

Features:

- 200 WOG
- Non-Rising Stem
- Inside Screw
- Temperature: -4°F to 356°F
- Investment Cast Components
- Stainless Steel Body and Trim
- Solid Wedge Disc
- Threaded NPT Ends
- Adjustable Packing

Standards:

- Pressure Test: API 598
- Material: ASTM/ASME B16.34
- Connections: ANSI B1.20.1 (NPT)

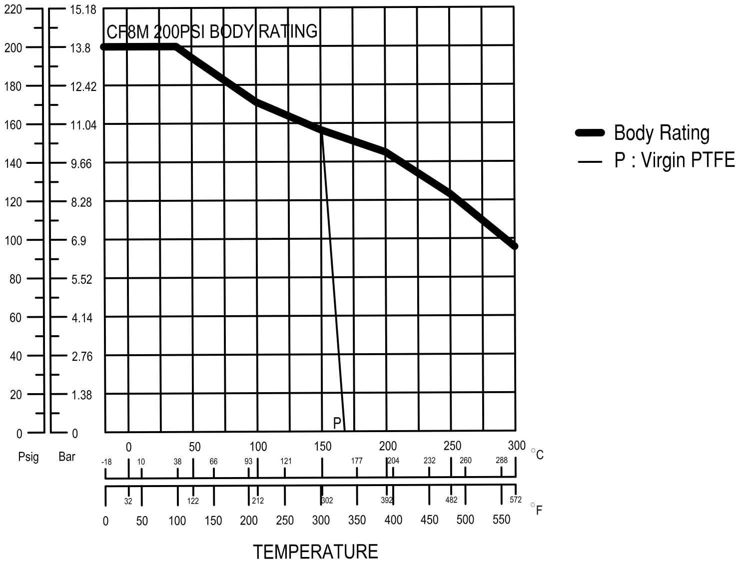
Figure Number Matrix

FNW 15B 200 Size

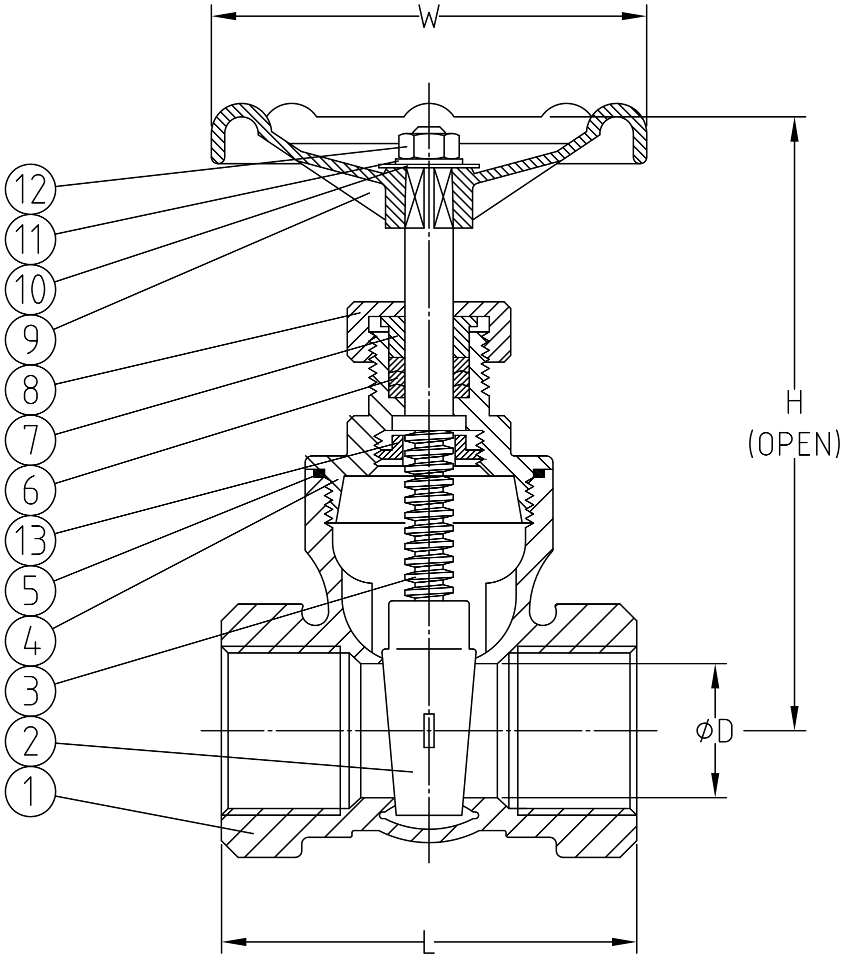
SIZE CODE
1/2 = D 1-1/4 = H
3/4 = F 1-1/2 = J
1 = G 2 = K

Cv & Weights

Size	Cv	Wt. (lbs.)
1/2	22.4	1.0
3/4	41.5	1.2
1	67.5	1.5
1-1/4	113.1	2.1
1-1/2	180.9	3.2
2	297.2	4.5



200 WOG NON-RISING STEM GATE VALVE



Dimensions (inches)

Size	ØD	L	H	W
1/2	0.59	2.17	3.62	2.76
3/4	0.79	2.38	3.82	2.76
1	0.98	2.58	4.27	3.15
1-1/4	1.26	3.01	4.86	3.15
1-1/2	1.57	3.37	5.75	3.54
2	1.98	3.76	6.38	3.94

Standard Materials

Ref. No.	Description	Material	Qty
1	Body	ASTM A351 Gr. CF8M	1
2	Disc	ASTM A351 Gr. CF8M	1
3	Stem	316SS	1
4	Bonnet	ASTM A351 Gr. CF8M	1
5	Body Seal	PTFE	1
6	Stem Packing	PTFE	1 Set
7	Gland	304SS	1
8	Gland Nut	ASTM A351 Gr. CF8M	1
9	Hand Wheel	DIE CAST ZINC ALLOY	1
10	Name Plate	ALUMINUM	1
11	Hand Wheel Washer	304SS	1
12	Hand Wheel Nut	304SS	1
13	Stop Ring	304SS	1

DOC: FNW15B06 Ver. 03/2017

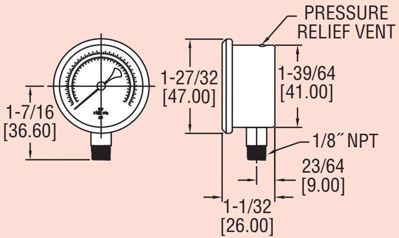
Series SG1

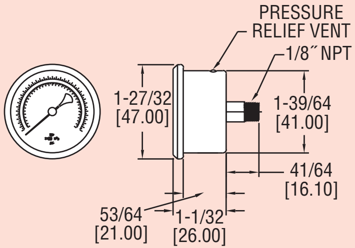
1.5″ Stainless Steel Industrial Pressure Gage

2.5% FS Accuracy, Brass Wetted Parts, Dual PSI/Bar x100 kPa Scales

SG1 Bottom

SG1 Back





The Series SG1 Gages are perfect for applications where resistance to corrosion is necessary. The stainless steel case and ring offer excellent protection from harsh processes. The SG1 gages are an economical choice where ambient corrosion and vibration are a concern. Gages are suitable for all fluids that are compatible with brass and bronze, and are available with bottom or back connections.

Model	Range
SG1-B10121N	0 to 30″ Hg
SG1-B10321N	0 to 30 psi
SG1-B10421N	0 to 60 psi
SG1-B10521N	0 to 100 psi
SG1-B10621N	0 to 160 psi
SG1-B10721N	0 to 200 psi
SG1-B11021N	0 to 300 psi

Note: Change ending 21N to 41N for back connection

SPECIFICATIONS

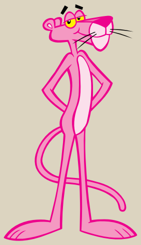
Service: Compatible gases and liquids.
Wetted Materials: Brass connector, bronze tube.
Housing: 304 SS.
Lens: Polycarbonate.
Accuracy: ±2.5% FS.
Pressure Limit: FS range.
Temperature Limits: -4 to 140°F (-20 to 60°C).
Size: 1.5″ (40 mm).
Process Connections: 1/8″ NPT.
Weight: 2.2 oz (63 g) bottom, 2.3 oz (65 g) back.

OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

ACCESSORY

A-445B, U-Bracket Mounting Kit for 1.5″ Gage



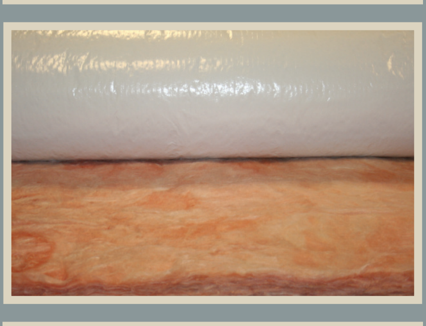
OWENS CORNING®

INNOVATIONS FOR LIVING®

SoftR® Duct Wrap White PSK

Enhanced Product Now Available

The SoftR® Duct Wrap product line is providing consistent enhancements that will further meet your needs. Read below for details on SoftR® Duct Wrap with white PSK facing:



Features/Benefits:

- Light reflectance
- Professional appearance with white vinyl facing
- Excellent water vapor permanence
- Extremely resistant to water and inorganic chemical environments
- Easy to clean surface
- Highly resistant to deterioration by exposure to UV light
- Tough and highly resistant to damage such as punctures
- Dimensional stability helps resist wrinkling and sagging
- Durable to help resist environmental stress-cracking or yellowing

Uses:

- External insulation on heating and air conditioning ducts
- Surfaces where temperature or condensation needs to be controlled.
- Professional appearance makes it suited for exposed applications, boiler and equipment rooms, and high humidity applications.
- Offered in R4.2, R6 and R8 in either 4' or 5' wide rolls.

This isn't all. We will continue bringing you new and innovative products.

Look what's coming Next!

To learn more about Owens Corning™ SoftR® Duct Wrap go to www.owenscorningcommercial.com or call 1-800-GET-PINK®

Dwyer

SERIES SBLT2 & SBLTX | MERCOID® BY DWYER

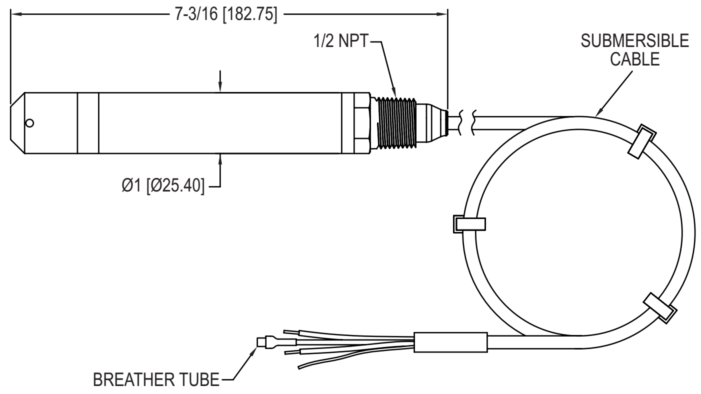
SUBMERSIBLE LEVEL TRANSMITTERS

Perfect for Ground Water and Wells, Lightning Protected, Standard 72 Hour Lead Time

SBLT2

SBLTX
(ATEX option available)

NOW WITH 72 HOUR
OUT OF STOCK LEAD TIME!



The **Series SBLT2 & SBLTX Submersible Level Transmitters** are manufactured for years of trouble free service. These series measure the height of liquid above the position in the tank referenced to atmospheric pressure. The transmitter consists of a piezoresistive sensing element, encased in a 316 SS housing.

BENEFITS/FEATURES

- Slim design for tight applications with bullet nose design which protects the diaphragm from damage
- Incorporates lightning and surge protection utilizing dual arrestor technology, grounded to case, eliminating both power supply surges and lightning ground strike transients (surge protection is not guaranteed and is not covered by warranty) on SBLT2 models
- Maintenance free filter eliminates particulate or water droplets from entering the transducer
- UL approved intrinsically safe on SBLTX models for use in hazardous locations when used with proper barrier
- 270 lb tensile strength shielded and vented cable
- Excellent chemical compatibility
- NPT connection allows the unit to be rigidly installed in a pipe/conduit, or the addition of a A-625 hanging loop for attaching a chain for pulling out of the installation
- Standard 72 hour lead time ensures minimal downtime

APPLICATIONS

- Well monitoring
- Ground water monitoring
- Environmental remediation
- Surface water monitoring
- Down hole
- Water tanks

SPECIFICATIONS

Service: Compatible liquids.
Wetted Materials: Body: 316 SS, 316L SS; Bullet nose: PVC; Cable: Polyether polyurethane or ETFE; Seals: Fluoroelastomer.
Accuracy: ±0.25% FS.
Temperature Limit: SBLT2: Polyurethane: 0 to 150°F (-18 to 66°C); ETFE: 0 to 200°F (-18 to 93°C); SBLTX -4 to 176°F (-20 to 80°C); Polyurethane: -4 to 149°F (-20 to 65°C).
Compensated Temperature Range: SBLT2: 0 to 140°F (-18 to 60°C); SBLTX: 0 to 176°F (-18 to 80°C).
Thermal Effect: ±0.02% FS/°F.
Pressure Limit: 2X FS.
Power Requirement: SBLT2: 10-30 VDC (≤ 1000 ft (305 m) of cable); SBLTX: 10-28 VDC.
Output Signal: 4-20 mA DC, 2-wire.
Response Time: 50 ms.
Max. Loop Resistance: 900 Ω at 30 VDC.
Electrical Connections: Wire pigtail.
Mounting Orientation: Suspended in tank below level being measured.
Electrical Protection: SBLT2: Lightning and surge protection; SBLTX: None.
Weight: 2.2 lb (1.0 kg).
Agency Approvals: SBLT2: CE; SBLTX: CE, cULus intrinsically safe for Class I, Div. 1, Groups A, B, C, D; Class II, Div. 1, Groups E, F, G; Class III Div. 1; ATEX: II 1 G Ex ia IIC T4 Ga and II 1 D Ex ia IIIC T135C Da (according to control drawing 001833-43)**.

**Up to 275´ (83.8 m) for ETFE cable; Up to 470´ (143.3 m) for polyurethane cable.

MODEL CHART

Model	Range psi* (ft w.c.) [m w.c.]	Cable Length ft (m)	Cable Type
SBLT2-5-40-ETFE	5 (11.54) [3.52]	40 (12.2)	ETFE
SBLT2-10-40-ETFE	10 (23.09) [7.04]	40 (12.2)	ETFE
SBLT2-15-60-ETFE	15 (34.63) [10.56]	60 (18.3)	ETFE
SBLT2-20-60-ETFE	20 (46.18) [14.08]	60 (18.3)	ETFE
SBLT2-5-40	5 (11.54) [3.52]	40 (12.2)	Polyurethane
SBLT2-10-40	10 (23.09) [7.04]	40 (12.2)	Polyurethane
SBLT2-15-60	15 (34.63) [10.56]	60 (18.3)	Polyurethane
SBLT2-20-60	20 (46.18) [14.08]	60 (18.3)	Polyurethane
SBLT2-3.5M-5M	4.97 (11.48) [3.5]	16.40 (5)	Polyurethane
SBLT2-5M-10M	14.21 (32.81) [10]	32.81 (10)	Polyurethane
SBLT2-10M-18M	25.58 (59.06) [18]	59.06 (18)	Polyurethane

*Configured ranges below 5 psi (11.54´ w.c.) (3.52 m w.c.) ±1% FS accuracy.

Note: For intrinsically safe approval, change model number from SBLT2 to SBLTX. For custom ranges or cable lengths, contact factory.

OPTIONS

Model	Description
-ATEX	ATEX intrinsically safe
-P1	1/4˝ NPT male
-P2	1/4˝ NPT female
-P3	1/4˝ BSPT male ISO 228 R
-P4	1/4˝ BSPT female ISO 228 RC
-P11	3/4˝ clean-out type

-P11 option

ACCESSORIES

Model	Description
A-297	Dessicant filter for vent tube. Removes humidity for protection of the sensor. Changes color to show saturation
A-625	316 SS cable hanger use with NPT option for attaching chain for easy pulling out of application
MTL5541	Galvanic barrier
MTL7706	Intrinsically safe zener barrier

A-297

A-625

Multi-Jet Pulse Water Meters

- **Works well in low-quality water applications**
- **Dry top multi-jet design for enhanced reliability**
- **Dry contact output meters interface with external data loggers or chemical feed equipment**

Multi-jet flowmeters offer a wide flow range, simplicity and accuracy, even in low-quality water applications. Use them for a variety of applications including industrial water treatment, cooling tower chemical control and general water metering.

Choose from three body materials: traditional bronze for non-potable industrial applications, NSF 61 lead-free eco-brass suitable for potable water applications, or economical NSF 61 lightweight plastic. All models feature a register that totalizes in gallons.

Includes: two straight meter installation couplings and gaskets.

Lead-free plastic body models available!

Dry Contact Output Bronze Meter

Direct-Read Plastic Meter

Dry Contact Output Eco-Brass Meter

Certified to NSF/ANSI 61

Eco-Brass & Plastic Meters only

Accuracy:	98.5 to 101.5%
Max operating pressure:	150 psi
Max operating temp:	105°F
Materials	
Body:	cast bronze or eco-brass alloy* or engineered plastic*
Internals:	thermoplastic with alnico magnet
Dry contact output models	
Cable length:	12'L standard (2000'L maximum run; can be extended in field)
Maximum voltage:	24 VAC or VDC
Maximum current:	20 mA

***NSF/ANSI 61 certified for potable water use.**

Direct-Read Meters (Gallons)

SIZE	BRONZE STOCK #	EACH	PLASTIC (NSF 61) STOCK #	EACH	ECO-BRASS (NSF 61) STOCK #	EACH
1/2"	53151	$ 117.95	21561	$ 90.95	53156	$ 127.95
3/4"	53152	127.95	21562	106.95	53157	151.95
1"	53153	211.95	21671	184.95	53158	263.95
1 1/2"	53154	409.95	21672	394.95	53159	524.95
2"	53155	599.95	—	—	53160	799.95

Meters with Dry Contact Output (Gallons)

SIZE	GALLONS/ CONTACT CLOSURE	BRONZE STOCK #	EACH	PLASTIC (NSF 61) STOCK #	EACH	ECO-BRASS (NSF 61) STOCK #	EACH
1/2"	1	53161	$ 125.95	21722	$ 103.95	53166	$ 145.95
3/4"	1	53162	147.95	21723	136.95	53167	158.95
1"	1	53163	240.95	22098	213.95	53168	278.95
1 1/2"	100	53164	434.95	22099**	419.95	53169	539.95
2"	100	53165	614.95	—	—	53170	804.95

****Gallons/Contact (GPC) Closure=1**

Accessories

DESCRIPTION	STOCK #	EACH
Replacement Dry Contact Reed Switch	68497	$ 57.00
LCD Flow Totalizer/Display for Dry Contact Models	78009	165.95
External Pulse Splitter	51274	283.00

Flow Ranges for Multi-Jet Pulse Water Meters

Size	Flow Range (gpm) Min-Max	Connection	Lay Length (Meter Only)	Lay Length (w/ Incl. Couplings)
Bronze & Plastic Meters				
1/2"	1/4 to 13	Threaded	6 1/2"	10 1/4"
3/4"	1/4 to 20	Threaded	7 1/2"	11 5/8"
1"	3/4 to 50	Threaded	10 1/4"	15"
1 1/2"	1 1/2 to 100	Threaded	11 3/4"	17"
2"	2 to 160	Threaded	11 3/4"	17 5/8"
Eco-Brass Meters				
1/2"	1/4 to 13	Threaded	6 1/2"	10 1/4"
3/4"	1/4 to 20	Threaded	7 1/2"	11 5/8"
1"	3/4 to 50	Threaded	10 3/4"	15 1/2"
1 1/2"	1 1/2 to 100	Threaded	12 5/8"	17 3/4"
2"	2 to 160	Threaded	15 1/4"	21"

operator notes

Models with Dry Contact Output Features

Select models feature a dry contact pulse output reed switch for interfacing with PLCs, counters or data loggers, or to pace chemical feed pumps. This externally-mounted switch fastens to the register lens with a single screw.

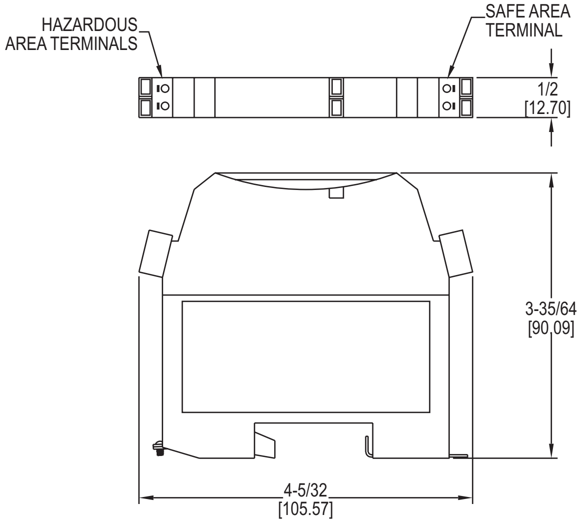
Pulse output rates come factory configured, but you can change them in the field with no special tools. Simply remove the lens and top ring to access the magnetic dial pointer, and reposition it to change gallons per contact (GPC) output. Refer to manual for GPC rates versus dial pointer positions for your meter.

SERIES MTL7706/7787

ZENER BARRIERS

Intrinsically Safe Barriers for Hazardous Locations

MTL7787



The **Series MTL7706/7787 Zener Barriers** are an intrinsically safe shunt-diode barrier that can be used to communicate with and provide isolations for certain Dwyer® transmitters approved for use in hazardous areas. These barriers limit the amount of energy allowed to pass into the hazardous area, which inhibit ignition in flammable atmospheres.

FEATURES/BENEFITS

- Approved for use in hazardous areas

APPLICATIONS

- Electrically isolates pressure and level transmitters from unregulated circuits for intrinsically safe applications

SPECIFICATIONS

Transmitter Voltage: 16.2 V at 20 mA with 250 Ω load (negative w.r.t. earth); 11.0 V at 20 mA with 500 Ω load (negative w.r.t. earth).
Safe Area Output: 4-20 mA.
Load Resistance: 0 to 500 Ω.
Power Requirement: 20-35 VDC w.r.t. earth.
Accuracy: ±2 μA under all conditions.
LED Indicator: Green: Power indication.
Temperature Limits: Operating: -4 to 140°F (-20 to 60°C); Storage: -40 to 176°F (-40 to 80°C).
Humidity: 5 to 95% RH.
Terminals: Accommodate up to 2.5 mm² stranded or single-core.
Safety Description: 28 μV, 300 Ω, 93 mA.
Weight: 4.9 oz (140 g).
Agency Approvals: See table.

COMPATIBLE MODELS: 637, 608, SBLTX, PBLTX, IS626

Model	Approval	Dwyer Series
MTL7706	UL for class I; div. 1 groups A, B, C, D CL II; div. 1 groups E, F, G; CL III div. 1	IS626, SBLTX, PBLTX
MTL7706	FM for class I, II, III; div. 1 groups B, C, D, E, F, G	637
MTL7706	FM for class I, II, III; div. 1 groups A, B, C, D, E, F, G	608
Note: Compatible models: 637, 608, SBLTX, PBLTX, IS626		

MODEL CHART

Model	Description
MTL7706	Zener barrier
MTL7787	Zener barrier

ACCESSORIES

Model	Description
A-360	Aluminum DIN rail 1 m

MODEL CHART

	FM			BASEEFA (ATEX)		
Model	**Group**	**μF**	**mH**	**Group**	**μF**	**mH**
MTL7706	A & B	0.083	4.2	IIC	0.083	4.2
MTL7787	A & B	0.083	3.05	IIC	0.083	3.05

Region (Authority)	Standard	Approved For	Certificate/File no.
USA (FM) (UL)	3600, 3610 entity 3611, 3810 UL698, UL913 UL1604	AIS/I,II,III/1/Entity ABCDEFG-SCI-942; NI/I/@/ABCD/T4 [I/0] AEx[ia]IIC-SCI-942 Entity; NI/1/2/IIC/T4; Ta=140°F (60°C)	3010737
Canada (CSA)	CAN/CSA E60070, IEC60079, C22.2	Class I, Div.2, Gps A, B, C, D; Ex nA [iA] IIC T4 Class I, Xone 2, Aex nA IIC T4	1345550
UK (BASEEFA)	EN 50014, EN 50020	EEx ia IIC	BAS01ATEX7217
UK (BASEEFA) Systems	EN 50039	EEx ia IIC	Ex01E2219

60 MM INTRINSICALLY SAFE BARRIER RELAYS

ISD SERIES

The ISD Series of Intrinsically Safe Barrier Relays provide a safe and reliable method to control up to four loads (motor starters, relays, etc.) with up to four input devices (switches, sensors, etc.) located in a hazardous area.

The ISD Series relays utilize a compact 60mm wide enclosure that can be both mounted on 35mm DIN rail or panel-mounted with two screws. Terminals for the input devices from the hazardous area are on the bottom of the unit for easy access in the enclosure to incoming field wiring from the hazardous area. Pluggable terminal blocks on both the input and output sides allow for easy initial wiring of the unit as well as replacement without having to remove any wires.

Each input has two terminals supporting direct connection of 2-wire input devices eliminating the need to mount a separate terminal block. Each output relay is isolated with two wiring terminals providing a true normally-open contact. This allows the output contacts to be used in complex control circuits and allows for each output to switch different voltages with respect to other outputs and the input voltage. A universal input voltage of 102-132V AC & 10-125V DC covers a variety of applications with one device.

Operation

Each ISD Series product consists of 4 intrinsically safe inputs and four corresponding normally-open relay outputs. With input voltage applied, the V LED will be ON (GREEN) to indicate power is applied. When the input device is closed, the input LED is ON (GREEN). When the output relay is closed, the output LED is ON (ORANGE). The ISD series offers four user-selectable configurations built in.

ISDUR4 has a two-position DIP-switch that selects a single configuration for all channels.

ISDUM4 has an eight-position DIP-switch that selects a configuration for each channel, independently.

Configurations

Standard Logic (DIP Switch set to “STD”):

When the input device is closed, the corresponding output contact is closed. When the input device is open, the corresponding output contact is open.

Inverse Logic (DIP Switch set to “INV”):

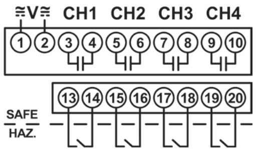
When the input device is open, the corresponding output contact is closed. When the input device is closed, the corresponding output contact is open.

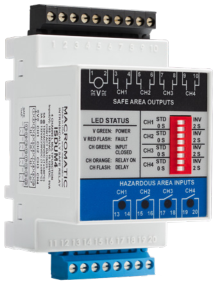
No Time Delay (DIP Switch set to “0 S”):

The output contact changes state immediately in response to a change in input device state.

2 Second Delay (DIP Switch set to “2 S”):

The output contact will delay 2 seconds before changing state in response to a change in input device state.

INPUT VOLTAGE	NUMBER OF CHANNELS	CONFIGURATION	CATALOG NUMBER	WIRING
102-132V AC (50/60Hz) and 10-125V DC	4	SELECTED FOR ALL CHANNELS	ISDUR4	 **DIAGRAM 814**
		SELECTED FOR EACH CHANNEL	ISDUM4	



ISDUM4

ISDUR4

- ◆ Approved for use in these Hazardous Locations:

  Class I, Div 1 (Zones 0 and 1 Canada), Groups A, B, C, D

  Class II, Div 1 (Zones 20 and 21 Canada), Group E, F, G

  Class III, Div 1
- ◆ 4-Channel
- ◆ Terminals support 2-wire inputs
- ◆ Isolated 5A relay outputs
- ◆ Pluggable terminals offer easy installation & replacement
- ◆ Universal input voltage of 102-132V AC & 10-125V DC
- ◆ Compact 60mm wide enclosure for both DIN-rail or panel-mount
- ◆ Standard & inverse logic
- ◆ Instantaneous & delayed response times
- ◆ LED status indicator

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60 MM INTRINSICALLY SAFE BARRIER RELAYS

ISD SERIES

APPLICATION DATA

Input Voltage: 102-132V AC (50/60Hz.) & 10-125V DC

Load (Burden): 5VA Maximum

Input Switch Open Circuit Voltage: 10V DC

Output Contacts:

SPST-NO (Form A) 3A Resistive @ 125V AC @60°C & 30V DC Resistive, Pilot Duty Rating D300

SPST-NO (Form A) 5A Resistive @ 125V AC @40°C & 30V DC Resistive, Pilot Duty Rating D300

Life:

Electrical: 50,000 Closures @ Full Load AC
Mechanical: 5 Million Closures @ No Load

Response Times:

Standard (DIP Switch set to “0S”): < 50ms
Delay (DIP Switch set to “2S”): Fixed 2 Seconds

Temperature:

Operating: -28° to + 60° C (-18° F to +140° F)
Storage: -55° to +85° C (-67° to 185° F)

LED Indication:

V: ON (Green); Inputs: ON (Green); Outputs: ON (Orange)

Insulation Voltage:

1500 V AC between coil & contacts
750 V AC between open contacts
1500 V AC between contacts of different output channels
1500 V AC between hazardous and safe circuits

Wire Sizes:

One #14-24 AWG Conductor or
Two #16 or 18 AWG Conductors

Mounting:

Mounts on 35mm DIN-rail or panel-mounted with two #8 screws when DIN-rail clips are fully extended from under the enclosure.

Control Drawing:

See Instruction Sheet 901-0000-328, which includes Control Drawing ISD1A04.

Approvals:

E318075

ACCESSORIES

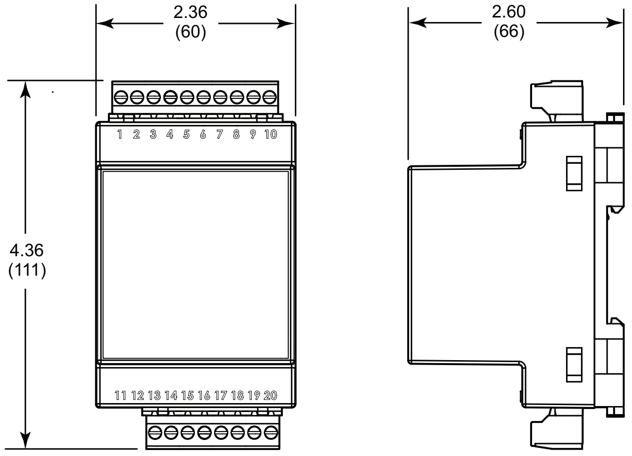
Terminal Kit Part # 70700: Replacement kit for Intrinsically Safe Barrier Relay plugable terminals, includes 1 black and 1 blue block.

Input Voltage: 102-132V AC and 10-125V DC

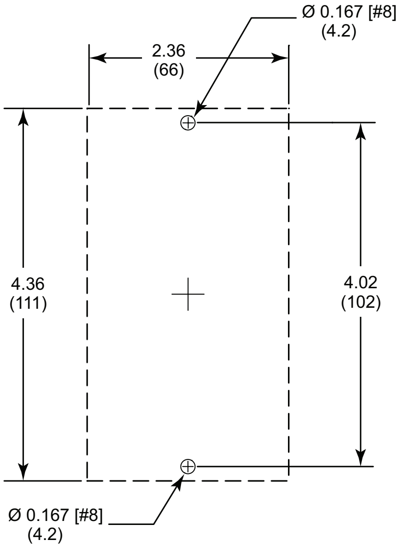
Output: 5A

Kit Part # 70700

DIMENSIONS



All Dimensions in Inches (Millimeters)



Panel Mount Template

FLEXIBILITY The flexibility of polyethylene pipe allows it to be curved over, under, and around obstacles as well as make elevation and directional changes. In some instances, the pipe's flexibility can eliminate the need for fittings and reduce installation costs.

Driscopipe HDPE pipe can be bent to a minimum radius between 20 to 40 times the pipe diameter.

TABLE 2: MINIMUM ALLOWABLE BEND RADIUS @ 73.4°F

SDR	Minimum Allowable Bend Radius, R_a
32.5	> 40 times outside diameter
26	> 35 times outside diameter
21	> 28 times outside diameter
19	> 27 times outside diameter
17	> 27 times outside diameter
15.5	> 27 times outside diameter
13.5	> 25 times outside diameter
11	> 25 times outside diameter
9	> 20 times outside diameter
7	> 20 times outside diameter

Example: Assume a 24" diameter DR 21 pipe was to be bent. The minimum bend radius can be calculated as follows:

$$R_a > 28 \times D \qquad R_a > 28 \times 24" \qquad R_a > 672"$$

Where: R_a is the radius of curvature of the bend in the pipe, in.
D is the outside diameter of the pipe, in.

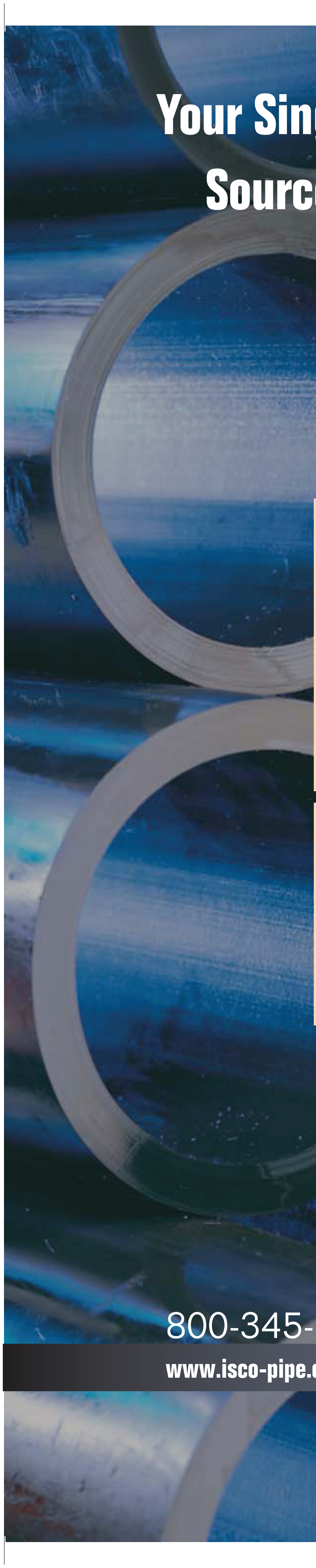
The radius of the circular sector (bend) must be greater than 672" (56 ft).

FLOW FACTORS Driscopipe polyethylene pipe has a smooth inside surface. A "C" factor of 150 is recommended in the Hazen-Williams Formula. Polyethylene pipe has a recommended Manning's "n" value of 0.009. The smoothness factor, ε, is equal to $7x10^{-5}$ ft. Smooth walls and the non-wetting characteristic of polyethylene allow higher flow capacity and reduced friction loss with polyethylene pipe.

LIFE EXPECTANCY The hydrostatic design basis for Driscopipe pipe is based on extensive hydrostatic testing data evaluated by standardized industry methods. Based on ASTM D2837, regression curves project a life expectancy of approximately 50 years when transporting water at 73.4°F. Internal and external environmental conditions may alter the expected life or change the recommended design basis for a given application.

LIGHTWEIGHT Polyethylene pipe is much lighter than concrete, cast iron, or steel pipe. It is easier to handle and install. Reduced manpower and equipment requirements may result in installation savings.

PRESSURE RATINGS Phillips Driscopipe manufactures polyethylene pipe for gravity flow and pressure service through 267 psi at 73.4° F. Some applications or design codes require that the pipe be derated, resulting in lower design pressure ratings. The formulas used to design polyethylene piping systems include a 2:1 safety factor in hydrostatic stress and a greater than 2:1 safety factor in surge fatigue.



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- > Fittings
- > Fusion Equipment
- > Electrofusion
- > Mechanical Connections
- > Accessories

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Version 2.2 2007

High-Density Polyethylene Pipe

Introduction

ISCO Industries, LLC is the largest high-density polyethylene pipe distributor in North America. ISCO can serve your needs anywhere in the USA and internationally. ISCO offers a complete package of HDPE piping products. Butt fusion machines are offered for sale or rental. Fusion technicians are available to provide on-site training or assistance to your project. Please call 1-800-345-ISCO for all your HDPE piping needs.

Some of The Characteristics of HDPE Pipe are:

Economical

Corrosion Resistant

Zero Leak-Rate

Hydraulically Smooth

Fatigue and Surge Resistant

Long Design Life

Tappable

Chemically Resistant

Easily Installed

Small to Large Diameters

Non-Toxic, Non-Tasting

Lightweight

Reliable

Flexible and Coilable

Heat Fused

Mechanically Joined (As Needed)

Strong and Ductile

Weather Resistant

Impact Resistant

Freeze Resistant

Durable

Abrasion Resistant

Inert

Self Restrained Pipe (Monolithic)

Listed and Approved

Important Standards for High Density Polyethylene (HDPE) Pipe

Standards important for HDPE pipe relate to the resin the pipe is made from and the standards related to manufacturing sizes and tolerances. The American Society of Testing Materials (ASTM) standard for resin from which the pipe is made is **ASTM D 3350-05**, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials. This standard defines the physical properties of the resin that the pipe is made from.

Pipe dimensions and manufacturing requirements:

ASTM F 714-05 Standard Specification for Polyethylene (PE) Pipe (SDR-PR) Based on Outside Diameter. This standard is used for most large diameter HDPE pipe (4" to 63") applications other than gas pipe.

ASTM D 2513-05 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings. Polyethylene pipe and other plastic for natural gas distribution are described in great detail in this standard.

ASTM D 3035-03a Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter. Most HDPE water tubing (1/2 inch to 3") is made to the dimensions in this standard. While pipe sizes up to 24" are provided, very little large diameter pipe is made to this standard.

Intallation Standards:

ASTM D 2321-05 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications

ASTM D 2774-04 Standard Practice for Underground Installation of Thermoplastic Pressure Piping

ASTM F 1962 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings

ASTM F 585-94 Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers

American Water Works Association Standards

ANSI/AWWA C 901-2005 Polyethylene Pressure Pipe and Tubing, .5 in (13 mm) Through 3 in. (76 mm) for Water Services

ANSI/AWWA C 906-2006 Polyethylene Pipe and Fittings, 4 in (100 mm) Through 63 In (1,575 mm) for Water Distribution

Pipe Joining Standards:

ASTM F 2620 – Standard Practice for Heat Fusion of Polyethylene Pipe and Fittings

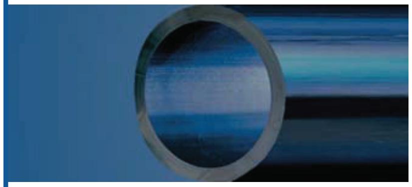
ASTM D 2657 – Standard Practice of Heat Fusion Joining of Polyolefin Pipe and Fittings

ASTM F 1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings

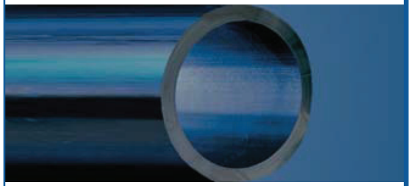
Fitting Standards

ASTM D 3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM F 1055 Standard Specification for Electrofusion Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing



HDPE Pipe



Specifications for HDPE Pipe

The physical properties of high-density polyethylene pipe are described using ASTM D 3350-05, “Standard Specification for Polyethylene Plastic Pipe and Fittings Materials”. Recently this standard was changed. The two key areas changed are, density and slow crack growth. In the 05 version, the cell classifications for density were increased from four cells to seven cells defining the density ranges for various resins.

New high performance bimodal resins, PE 4710 resins, have higher PENT test values. Slow crack grow properties can now be defined using eight cells.

As of December 2006, most HDPE pipe is made from resin with a cell classification of PE 345464C. The pipe is labeled as PE3408/3608. The physical properties for PE 345464C are:

PROPERTY VALUE		SPECIFICATION	UNIT	NOMINAL VALUE
Material Designation		PPI / ASTM		PE3408
Material Designation		PPI / ASTM		PE 3408/3608
Cell Classification		ASTM D 3350		345464C
Density	(3)	ASTM D 1505	g/cm3	0.941-943
Melt Index	(4)	ASTM D 1238	gm/ 10 min	0.05 -.11
Flexural Modulus	(5)	ASTM D 790	psi	110,000 to 140,000
Tensile Strength	(4)	ASTM D 638	psi	3,200
Slow Crack Growth				
ESCR		ASTM D 1693	hours in 100% igepal	>5,000
PENT	(6)	ASTM F 1473	hours	>100
HDB @ 73 deg F	(4)	ASTM D 2837	psi	1,600
UV Stabilizer	(C)	ASTM D 1603	%C	2 to 2.5%

The density provided is without carbon black. Typical HDPE pipe has a density of .955 to .957 with carbon black.

Types of Polyethylene Pipe

All polyethylene (PE) is not the same. In ASTM D 3350-05, low density PE is defined as having a density range of 0.919 to 0.925 g/cc; medium density has a range of 0.926 to 0.940 g/cc and high density is defined with a range from 0.941 to 0.955. All densities are without carbon black.

Density influences key properties in polyethylene materials. As the density increases, the tensile strength increases; also chemical resistance increases.

Medium density PE resins have been used for gas distribution. This original selection was made based on superior slow crack growth properties of medium density resins. Medium density pipe is designated as PE 2406 and PE 2708.

Today new bimodal resins are being used in gas distribution because of higher pressure ratings plus superior slow crack growth. These resins are designated PE 3408, PE 3608, PE 3708, PE 3710 and PE 4710.

Slow Crack Growth
The Pent test is used to determine stress crack resistance for PE resins. The PENT test is conducted in accordance with ASTM F 1473, “Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins”. This test uses a solid sample of material which is notched and tested.

The PENT test is a good test of slow crack growth. Scratches and gouges can cause crack propagation. Materials with high PENT numbers are less likely to fail because of slow crack growth.

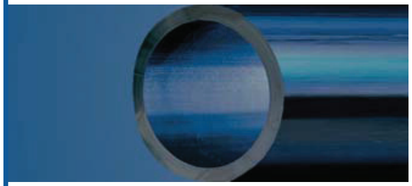
Traditional PE 3408/3608 resins have PENT test values of about 100 hours. New bimodal resins used to make PE 3710 and PE 4710 pipes have values ranging from 600 hours to several thousand hours.

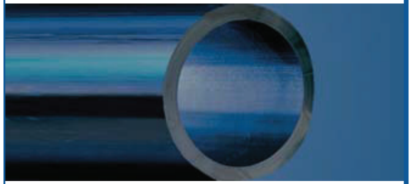
Physical Properties of PE 4710
HDPE pipe with a designation of PE 4710 is made from resin with a cell classification of PE 445474C or PE 445574C. We suggest using a specification calling for a minimum cell classification of PE 445474 C or higher. Both cell classifications can be used if specified in this way. The pipe is labeled as PE 4710. The physical properties for PE 445474C are provided below:

PROPERTY VALUE		SPECIFICATION	UNIT	NOMINAL VALUE
Material Designation		PPI / ASTM		PE 4710
Cell Classification		ASTM D 3350		445474 C
Density	(4)	ASTM D 1505	g/cm3	0.947-955
Melt Index	(4)	ASTM D 1238	gm/ 10 min	<.15
Flexural Modulus	(5)	ASTM D 790	psi	110,000 to 160,000
Tensile Strength	(5)	ASTM D 638	psi	3500-4000
Slow Crack Growth				
ESCR		ASTM D 1693	hours in 100% igepal	>5,000
PENT	(7)	ASTM F 1473	hours	>500
HDB @ 73 deg F	(4)	ASTM D 2837	psi	1,600
UV Stabilizer	(C)	ASTM D 1603	%C	2 to 2.5 %

The density provided is without carbon black. Typical PE 4710 HDPE pipe has a density of 0.956 to 0.964 with carbon black.

To be called a PE 4710, the pipe and resin has substantiation at 50 years.





HDPE Pipe

- **Items highlighted in Blue indicates standard stocking items that are more readily available.**
- **Pressures are based on using water at 23°C (73°F).**
- **Average inside diameter calculated using nominal OD and minimum wall plus 6% for use in estimating fluid flows. Actual ID will vary.**
- **Other piping sizes or DR's may be available upon request.**
- **Standard Lengths:**
  40' for 2"-24"
  50' for 26" and larger
  Coils available for 3/4"-6"(8" by special order)

PE 3608/3408 IPS HDPE Pipe Sizes

Pressure Rating	Nominal Size	3/4"	1"	1 1/4"	1 1/2"	2"	3"	4"	5"	5"	6"	7"	8"	10"	12"	14"	16"	18"
	Actual O.D.	1.05"	1.315"	1.66"	1.90"	2.375"	3.50"	4.50"	5.375"	5.563"	6.625"	7.125"	8.625"	10.75"	12.75"	14.00"	16.00"	18.00"
DR 7 (267psi)	Min. wall	0.150"	0.188"	0.237"	0.271"	0.339"	0.500"	0.643"	0.768"	0.795"	0.946"	1.018"	1.232"	1.536"	1.821"	2.000"	2.286"	2.571"
	Average I.D.	0.732"	0.917"	1.157"	1.325"	1.656"	2.440"	3.137"	3.747"	3.878"	4.619"	4.967"	6.013"	7.494"	8.889"	9.760"	11.154"	12.549"
	Weight lb/lf	0.184	0.289	0.460	0.603	0.943	2.047	3.384	4.830	5.172	7.336	8.195	12.433	19.314	27.170	32.758	42.786	54.151
DR 7.3 (254psi)	Min. wall	0.144"	0.180"	0.227"	0.260"	0.325"	0.479"	0.616"	0.736"	0.762"	0.908"	0.976"	1.182"	1.473"	1.747"	1.918"	2.192"	2.466"
	Average I.D.	0.745"	0.933"	1.178"	1.348"	1.685"	2.484"	3.193"	3.814"	3.947"	4.701"	5.056"	6.120"	7.628"	9.047"	9.934"	11.353"	12.773"
	Weight lb/lf	0.178	0.279	0.444	0.582	0.762	1.656	2.737	4.663	4.182	5.932	8.200	10.054	15.618	21.970	26.489	34.598	43.788
DR 9 (200psi)	Min. wall	0.117"	0.146"	0.184"	0.211"	0.264"	0.389"	0.500"	0.597"	0.618"	0.736"	0.792"	0.958"	1.194"	1.417"	1.556"	1.778"	2.000"
	Average I.D.	0.803"	1.005"	1.269"	1.452"	1.816"	2.676"	3.440"	4.109"	4.253"	5.064"	5.447"	6.593"	8.218"	9.747"	10.702"	12.231"	13.760"
	Weight lb/lf	0.150	0.234	0.372	0.488	0.762	1.656	2.737	3.903	4.182	5.932	6.863	10.054	15.618	21.970	26.489	34.598	43.788
DR 11 (160psi)	Min. wall	0.095"	0.120"	0.151"	0.173"	0.216"	0.318"	0.409"	0.489"	0.506"	0.602"	0.648"	0.784"	0.977"	1.159"	1.273"	1.455"	1.636"
	Average I.D.	0.848"	1.062"	1.340"	1.534"	1.917"	2.825"	3.633"	4.339"	4.491"	5.348"	5.752"	6.963"	8.678"	10.293"	11.302"	12.916"	14.531"
	Weight lb/lf	0.125	0.197	0.312	0.409	0.639	1.387	2.294	3.272	3.505	4.971	5.750	8.425	13.089	18.412	22.199	28.994	36.696
DR 13.5 (128psi)	Min. wall	---	---	---	---	0.176"	0.259"	0.333"	0.398"	0.412"	0.491"	0.528"	0.639"	0.796"	0.944"	1.037"	1.185"	1.333"
	Average I.D.	---	---	---	---	2.002"	2.950"	3.793"	4.531"	4.689"	5.585"	6.006"	7.271"	9.062"	10.748"	11.801"	13.487"	15.173"
	Weight lb/lf	---	---	---	---	0.531	1.153	1.906	2.718	2.912	4.130	4.779	7.001	10.875	15.298	18.445	24.092	30.491
DR 15.5 (110psi)	Min. wall	---	---	---	---	0.153"	0.226"	0.290"	0.347"	0.359"	0.427"	0.460"	0.556"	0.694"	0.823"	0.903"	1.032"	1.161"
	Average I.D.	---	---	---	---	2.050"	3.021"	3.885"	4.640"	4.802"	5.719"	6.150"	7.445"	9.280"	11.006"	12.085"	13.812"	15.538"
	Weight lb/lf	---	---	---	---	0.467	1.015	1.678	2.396	2.564	3.637	3.985	6.164	9.576	13.471	16.242	21.214	26.849
DR 17 (100psi)	Min. wall	---	---	---	---	0.140"	0.206"	0.265"	0.316"	0.327"	0.390"	0.419"	0.507"	0.632"	0.750"	0.824"	0.941"	1.059"
	Average I.D.	---	---	---	---	2.079"	3.064"	3.939"	4.705"	4.869"	5.799"	6.236"	7.549"	9.409"	11.160"	12.254"	14.005"	15.755"
	Weight lb/lf	---	---	---	---	0.429	0.932	1.540	2.197	2.353	3.338	3.860	5.657	8.788	12.362	14.905	19.467	24.638
DR 19 (89psi)	Min. wall	---	---	---	---	---	---	0.237"	0.283"	0.293"	0.349"	0.375"	0.454"	0.566"	0.671"	0.737"	0.842"	0.947"
	Average I.D.	---	---	---	---	---	---	3.998"	4.775"	4.942"	5.886"	6.330"	7.663"	9.551"	11.327"	12.438"	14.215"	15.992"
	Weight lb/lf	---	---	---	---	---	---	1.387	1.980	2.120	3.007	3.478	5.097	7.918	11.138	13.429	17.540	22.199
DR 21 (80psi)	Min. wall	---	---	---	---	---	---	0.214"	0.256"	0.265"	0.315"	0.339"	0.411"	0.512"	0.607"	0.667"	0.762"	0.857"
	Average I.D.	---	---	---	---	---	---	4.046"	4.832"	5.001"	5.956"	6.406"	7.754"	9.665"	11.463"	12.587"	14.385"	16.183"
	Weight lb/lf	---	---	---	---	---	---	1.262	1.801	1.929	2.736	3.165	4.637	7.204	10.134	12.218	15.959	20.198
DR 26 (64 psi)	Min. wall	---	---	---	---	---	---	0.173"	0.207"	0.214"	0.255"	0.274"	0.332"	0.413"	0.490"	0.538"	0.615"	0.692"
	Average I.D.	---	---	---	---	---	---	4.133"	4.937"	5.109"	6.085"	6.544"	7.922"	9.873"	11.710"	12.858"	14.695"	16.532"
	Weight lb/lf	---	---	---	---	---	---	1.030	1.470	1.574	2.233	2.582	3.784	5.878	8.269	9.970	13.022	16.480
DR 32.5 (51 psi)	Min. wall	---	---	---	---	---	---	0.138"	0.165"	0.171"	0.204"	0.219"	0.265"	0.331"	0.392"	0.431"	0.492"	0.554"
	Average I.D.	---	---	---	---	---	---	4.206"	5.024"	5.200"	6.193"	6.660"	8.062"	10.049"	11.918"	13.087"	14.956"	16.826"
	Weight lb/lf	---	---	---	---	---	---	0.831	1.186	1.270	1.801	2.083	3.053	4.742	6.671	8.044	10.506	13.296

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HDPE Fabricated and Molded Fittings

Pressure Ratings for Molded and Fabricated Fittings

Fittings serve the purpose of creating a change in direction in a short distance. There are two basic types of fittings, molded and fabricated. Molded fittings are made by injection molding. These fittings are fully pressure rated. The body of a molded fitting is thicker (greater OD except at ends) than pipe to maintain the pressure rating.

Fabricated fittings have reduced pressure rating because miter cuts create a change in the diameter of the fitting at this point. Stress is increased because of changes in flow direction. The larger the angle of the miter cut, the greater the stress and the greater the need to decrease the pressure rating to maintain a 2 to 1 safety factor.

In this Fitting Section, mitered fittings are shown with traditional three-piece 45 degree and five-piece 90 degree ells. Newly added are two-piece 45 degree ells and three-piece 90 degree ells. To maintain a 2 to 1 safety factor, the two-piece 45 degree ells and the three-piece 90 degree ells have a lower pressure rating for the same wall thickness (DR) than do the three-piece 45 degree and five-piece 90 degree ells.

The pressure ratings are based on standards for design established by the American Society of Mechanical Engineers (ASME). These standards are in ASME B31.3 paragraph number 304.2. Equations 4a and 4b are used to determine pressure ratings.

For five-piece mitered 90 degree and three-piece 45 degree ells based on 22.5 degree miter joints, the derating factor is 25% of the pressure rating of the pipe. A DR 11 wall thickness has a pressure rating of 160 psi. Fittings made from DR 11 pipe have a pressure rating of 120 psi. The 25% derating factor is based on a 2 to 1 safety factor.

For three-piece mitered 90 degree and two-piece 45 degree ells based 45 degree miter cuts, the derating factor is 38%. Fittings made from DR 11 pipe have a pressure rating of 100 psi. The 38% derating factor is based on a 2 to 1 safety factor.

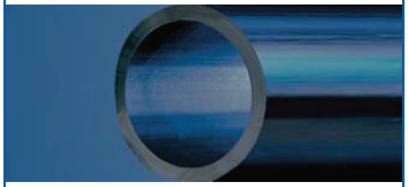
Derating factors for fittings are provided in Table 1, Derating Factors for HDPE Fittings. This table can assist in the selection of the correct fitting for a given application based on pressure rating requirements. Derating factor is the percentage that the pressure rating is lowered.

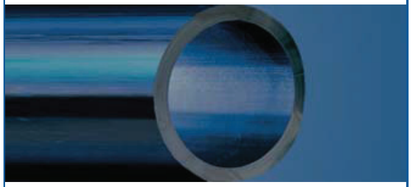
Table 1: Derating Factors For HDPE Fittings

Description	**Industry Practice**	**Derating ASME B31.3**
Fabricated 90 degree Ell - Five Segment	25%	25%
Fabricated 90 degree Ell Three	25%	38%
Fabricated 45 degree Ell Three	25%	25%
Fabricated 45 degree Ell Two	25%	38%
Fabricated 22.5 degree Ell Two	25%	25%
Fabricated Tees, Three Piece	25%	25%
Fabricated Tees, Two Piece	50%	25%
Fabricated Cross	50%	50%
Fabricated Wye, Three piece	40%	40%
Fabricated Wye, Two piece	50%	50%
Reducing Tee	none	none
Fabricated Cleanouts	***see note**	***see note**
Concentric Reducers	none	none
Transition Fittings	none	none
MJ Adapters	none	none
Bell MJ Adapters	none	none
Flange Adapters	none	none
Stub Ends	none	none
Molded Caps	none	none
Wall Anchors	none	none
Blind Flanges	***see note**	***see note**

Molded fittings such as 90 degree ells, 45 degree ells, tees, reducers, and end caps are normally not derated. These fittings have been designed and made with the needed radius and material in critical areas to handle the pressure for the thickness of the fitting. These fittings do not require derating when used at 73 degrees F with water or approved chemical service.

***NOTE: Plastic blind flanges are normally used for gravity or low pressure applications. Fabricated caps are typically designed to handle the required pressure. Blind Flanges and fabricated caps pressure ratings vary with size, type of material and thickness. Please indicate pressure requirements when ordering.**





HDPE Fabricated and Molded Fittings

ASME B 31.3 provides calculations to estimate derating factors for metal fittings. These values are applied to HDPE fittings in the table (refer to table 1). These ratings result in a 2 to 1 safety factor.

New three-piece miter 90 degree ells and two-piece 45 degree ells have been derated differently than ASME calculations by some HDPE fabricators. Using the BSME 31.3 method, its appears that the safety factor is less than 2 to 1.

ISCO Industries recognizes that these fittings are satisfactory for many applications using a lower derating factor and lower safety factor. This note has been provided to make you aware that critical applications may be better handled with five-piece mitered 90 degree ells. Critical applications are those that have high flow velocity (above 5 fps), higher temperature and those that may endanger people or the environment. Use good engineering judgment in the selection of fittings for your application.

Please call ISCO at 1-800-345-ISCO or go to our web site (www.isco-pipe.com) and use “Ask an Engineer” to answer your questions and get additional information.

TRANSITION FITTINGS

Transition fittings are mechanical connections between metal pipe and HDPE pipe. These fittings are used in a large number of applications. A common use is in natural gas systems to change from HDPE pipe to steel pipe where the pipe goes above ground.

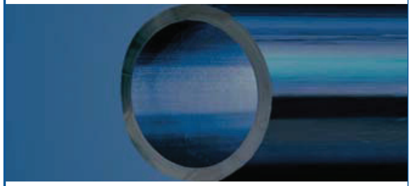
Transition fittings for natural gas service are required to meet the requirements of ASTM D 2513, “Standard Specifications for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings”. Within this specification there are provisions for mechanical joints. The specification indicates that the mechanical connection must: 1) provide a seal plus resistance to force on the pipe which will cause permanent deformation of the pipe, 2) provide a seal only, and 3) provide a seal plus a pipe restraint.

Not all transition fittings will meet the requirements of ASTM 2513. If you need transitions that meet ASTM 2513, ask for this requirement.

Central Plastics test their products using ASTM D 638 tensile test. This testing qualifies their fittings as providing a seal plus resistance to force which will cause permanent deformation.

Quick burst test per ASTM D1599 are used to proof that the transition fittings provide a seal and resist axial pullout forces.

Transition fittings are made from different metals. Carbon steel is the standard. If you need greater corrosion resistance, please request stainless steel transition fittings.



Carbon Steel Transition Fittings

Features:

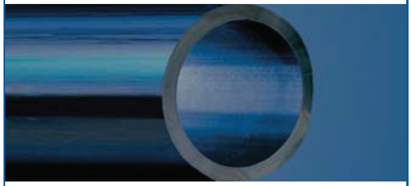
Compression design effectively resists creep and pullout
Carbon steel per ASTM A-53, Sch. 40 steel pipe
O-Ring design for added protection
Meets ASTM 2513
No Weld Design
Size range 3/4” through 12”
No shear points
Available with AWWA pipe

Stainless Steel Transition Fittings

Features:

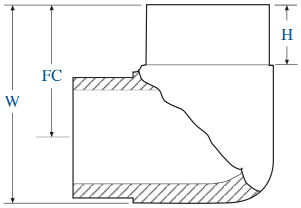
Compression design effectively resists creep and pullout
Stainless Steel 304 Body (316 Available)
O-Ring design for added protection
Meets ASTM 2513
No Weld Design
Size range 3/4” through 2”
No shear points
Available with AWWA pipe

Threads per ANSI B1.20.1



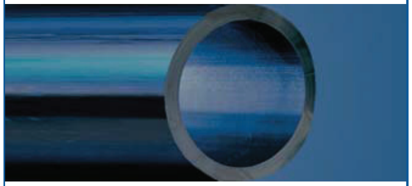
IPS
HDPE
Fittings

IPS Fittings Molded 90° Ell

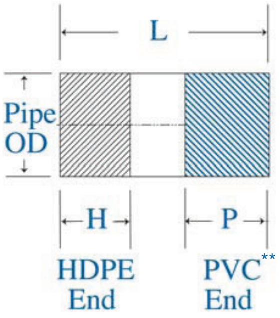


IPS Fittings Molded 90° Ell

Nominal Size(in)	Pipe OD(in)	DR	Pressure Rating	Part #	Dimensions H (in)	FC (in)	W (in)	Weight Lbs.	Shipping Method
3/4	1.05	11	160	ISMF9007511IPS	2.05	2.68	3.2	0.05	UPS
1	1.315	11	160	ISMF900111IPS	2.17	2.91	3.57	0.1	UPS
1-1/4	1.66	11	160	ISMF9012511IPS	2.44	3.35	4.18	0.15	UPS
1-1/2	1.9	11	160	ISMF901511IPS	2.64	3.7	4.65	0.22	UPS
2	2.375	09	200	ISMF900209IPS	2.5	4.25	5.815	0.5	UPS
		11	160	ISMF900211IPS	“	“	“	0.43	“
3	3.5	09	200	ISMF900309IPS	3	5.25	7.4	1.5	UPS
		11	160	ISMF900311IPS	“	“	“	1.2	“
		17	100	ISMF900317IPS	“	“	“	0.8	“
4	4.5	09	200	ISMF900409IPS	3	5.875	8.25	3	UPS
		11	160	ISMF900411IPS	“	“	“	2.4	“
		17	100	ISMF900417IPS	“	“	“	1.6	“
6	6.625	09	200	ISMF900609IPS	4.125	8	12.5	7	UPS
		11	160	ISMF900611IPS	“	“	“	6.7	“
		17	100	ISMF900617IPS	“	“	“	4.8	“
8	8.625	11	160	ISMF900811IPS	6	12	16.5	15	UPS
		17	100	ISMF900817IPS	“	“	“	10	“
10	10.75	11	160	ISMF901011IPS	6	13.25	18.875	27	UPS
		17	100	ISMF901017IPS	“	“	“	18	“
12	12.75	11	160	ISMF901211IPS	7.5	15.88	22.555	41	UPS
		17	100	ISMF901217IPS	“	“	“	27	“



IPS HDPE to PVC Transition Fitting



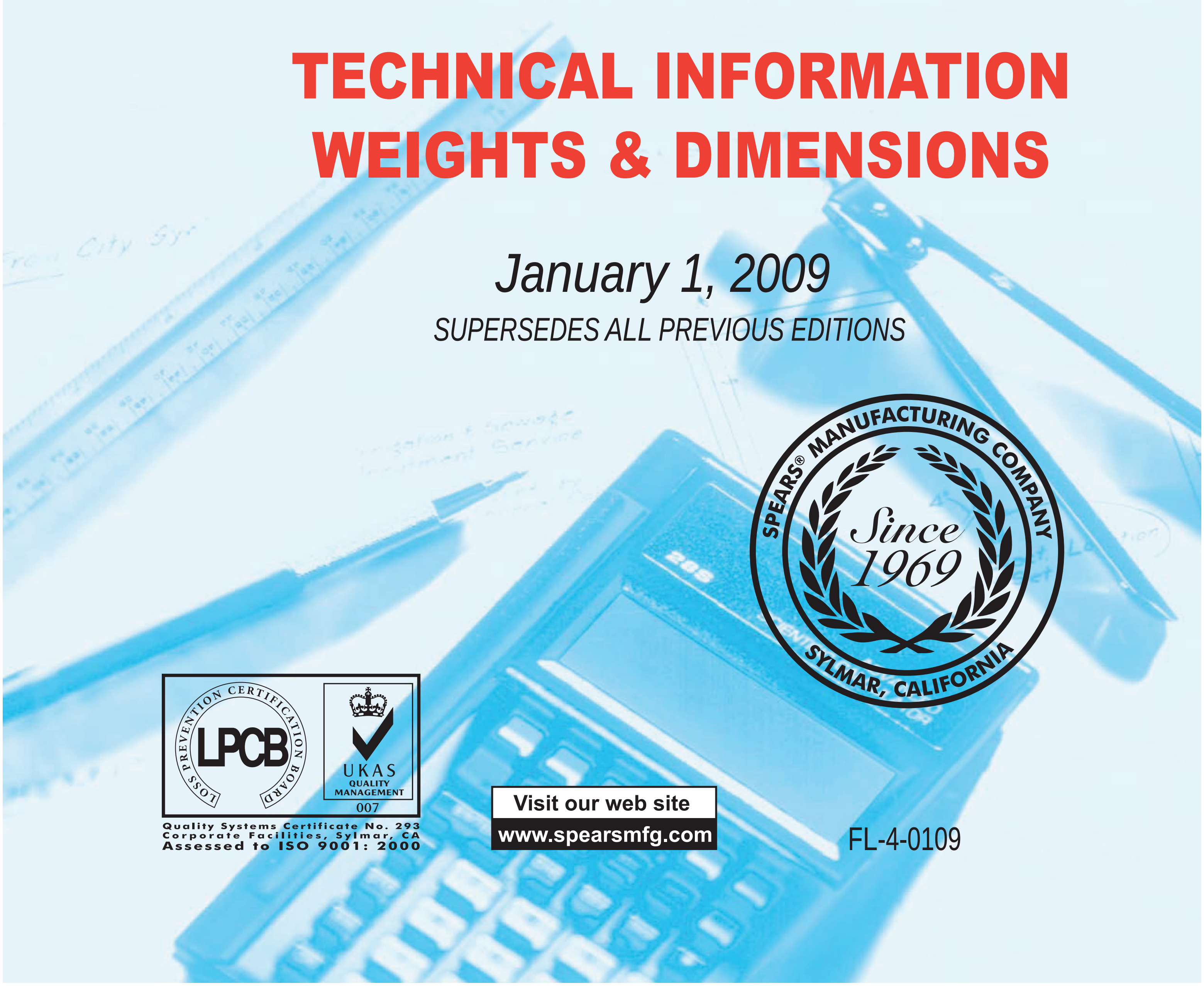
IPS HDPE To PVC Transition Fitting

Nominal Size (in)	Pipe OD (in)	Material	Part #	Dimensions			Weight Lbs.	Shipping Method
				H (in)	L (in)	P (in)		
3/4	1.05	Steel	ISFFTF003/4PVC	3	8	3	0.7	UPS
		Stainless Steel	ISFFTF003/4PVCS		“	“	“	“
1	1.315	Steel	SFFTF0111PVC	3	8.5	3	0.8	UPS
		Stainless Steel	ISFFTF0111PVCSS		“	“	“	“
1 1/4	1.66	Steel	ISFFTF01.25PVC	4	11.5	4	1	UPS
		Stainless Steel	ISFFTF01.25PVCS		“	“	“	“
1 1/2	1.9	Steel	ISFFTF01.5PVC	4	12	4	1.25	UPS
		Stainless Steel	ISFFTF01.50PVCS		“	“	“	“
2	2.375	Steel	ISFFTF0211PVC	4	12.5	4	1.5	UPS
		Stainless Steel	ISFFTF0211PVCSS		“	“	“	“
3	3.5	Steel	ISFFTF0311PVC	4.5	14	4.5	3	UPS
		Stainless Steel	ISFFTF0311PVCSS		“	“	“	“
4	4.5	Steel	ISFFTF0411PVC	4.5	15	4.5	5	UPS
		Stainless Steel	ISFFTF0411PVCSS		“	“	“	“

**** PVC available as SCH 40 or SCH 80.**

THERMOPLASTIC FLANGES

TECHNICAL INFORMATION
WEIGHTS & DIMENSIONS



January 1, 2009

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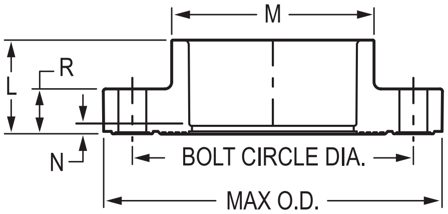
PVC & CPVC INJECTION MOLDED CLASS 150 FLANGES

F O P

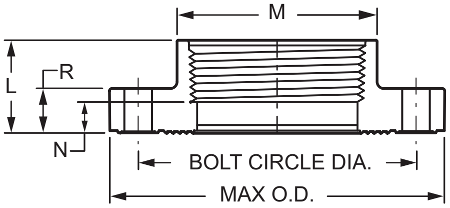
Socket



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
851-005	851-005C	1/2	1-1/16	1-9/32	1/8	9/16	2-3/8	4	1/2	2	3-1/2	.22	.24
851-007	851-007C	3/4	1-3/16	1-1/2	1/8	5/8	2-3/4	4	1/2	2	3-7/8	.31	.31
851-010	851-010C	1	1-5/16	1-13/16	3/16	3/4	3-1/8	4	1/2	2-1/4	4-1/4	.44	.47
851-012	851-012C	1-1/4	1-7/16	2-7/32	3/16	23/32	3-1/2	4	1/2	2-1/4	4-5/8	.41	.42
851-015	851-015C	1-1/2	1-23/32	2-1/2	1/4	3/4	3-7/8	4	1/2	2-1/2	5	.61	.64
851-020	851-020C	2	1-27/32	3	3/8	13/16	4-3/4	4	5/8	3	6	.82	.95
851-025	851-025C	2-1/2	2-1/4	3-1/2	1/2	1	5-1/2	4	5/8	3-1/4	7	1.63	1.67
851-030	851-030C	3	2-5/16	4-9/32	15/32	1-1/16	6	4	5/8	3-1/4	7-1/2	1.73	1.83
851-040	851-040C	4	2-5/8	5-7/16	1/4	1-1/4	7-1/2	8	5/8	3-1/2	9	2.88	3.00
851-050	851-050C	5	3-1/4	6-3/8	1/4	1	8-1/2	8	3/4	3-3/4	10-1/8	3.00	3.17
851-060	851-060C	6	3-1/4	7-9/16	1/4	1-3/8	9-1/2	8	3/4	4	11	4.06	4.34
851-080	851-080C	8	4-9/16	9-3/4	9/16	1-7/16	11-3/4	8	3/4	4-1/2	13-1/2	7.63	7.36

F O P

Fipt



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P C	CP C											P C	CP C
852-005	852-005C	1/2	1-1/16	1-5/16	9/32	9/16	2-3/8	4	1/2	2	3-1/2	.21	.22
852-007	852-007C	3/4	1-3/16	1-17/32	15/32	5/8	2-3/4	4	1/2	2	3-7/8	.30	.32
852-010	852-010C	1	1-5/16	1-13/16	7/16	3/4	3-1/8	4	1/2	2-1/4	4-1/4	.41	.48
852-012	852-012C	1-1/4	1-3/8	2-7/32	17/32	23/32	3-1/2	4	1/2	2-1/4	4-5/8	.44	.46
852-015	852-015C	1-1/2	1-3/4	2-1/2	19/32	3/4	3-7/8	4	1/2	2-1/2	5	.64	.74

PVC & CPVC INJECTION MOLDED CLASS 150 FLANGES

F O P **(continued)**

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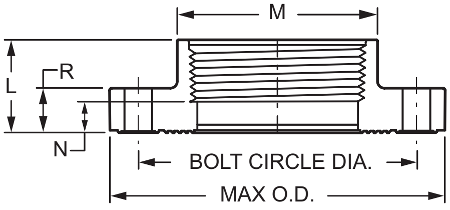
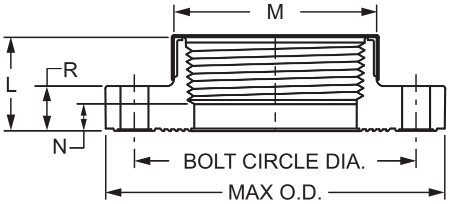


P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
852-020	852-020C	2	1-27/32	3	7/8	7/8	4-3/4	4	5/8	3	6	.96	1.00
852-025	852-025C	2-1/2	2-1/4	3-1/2	15/16	1	5-1/2	4	5/8	3-1/4	7	1.65	1.41
852-030	852-030C	3	2-5/16	4-9/32	29/32	1-1/16	6	4	5/8	3-1/4	7-1/2	1.83	1.86
852-040	852-040C	4	2-1/16	5-7/16	5/16	1-1/4	7-1/2	8	5/8	3-1/2	9	2.79	2.86
852-060F	852-060CF	6	7	7-1/4	5-1/2	1-1/4	9-1/2	8	3/4	4	11	7.16	7.69
852-080F	852-080CF	8	8-15/16	9-11/16	7-3/16	1-3/8	11-3/4	8	3/4	4-1/2	13-1/2	13.41	13.92
852-100F	852-100CF	10	10-1/2	11-9/16	8-9/16	1-11/16	14-1/4	12	7/8	5	16	20.65	20.72

S R
F O P

SR Fipt



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
852-005SR	852-005CSR	1/2	1-3/32	1-7/32	11/32	9/16	2-3/8	4	1/2	2	3-1/2	.20	.22
852-007SR	852-007CSR	3/4	1-3/16	1-3/8	7/16	5/8	2-3/4	4	1/2	2	3-7/8	.27	.30
852-010SR	852-010CSR	1	1-7/16	1-23/32	17/32	21/32	3-1/8	4	1/2	2-1/4	4-1/4	.37	.39
852-012SR	852-012CSR	1-1/4	1-9/16	2-1/16	19/32	21/32	3-1/2	4	1/2	2-1/4	4-5/8	.49	.52
852-015SR	852-015CSR	1-1/2	1-3/4	2-7/16	3/4	3/4	3-7/8	4	1/2	2-1/2	5	.63	.67
852-020SR	852-020CSR	2	1-7/8	3-1/32	7/8	11/16	4-3/4	4	5/8	3	6	.99	1.06
852-025SR	852-025CSR	2-1/2	2-1/8	3-19/32	3/8	1	5-1/2	4	5/8	3-1/4	7	1.58	1.69
852-030SR	852-030CSR	3	2-5/16	4-9/32	15/16	1-1/16	6	4	5/8	3-1/4	7-1/2	1.79	1.94
852-040SR	852-040CSR	4	2-1/2	5-1/4	1	1-5/32	7-1/2	8	5/8	3-1/2	9	2.74	2.89

PVC & CPVC INJECTION MOLDED CLASS 150 FLANGES

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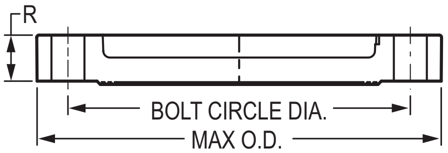
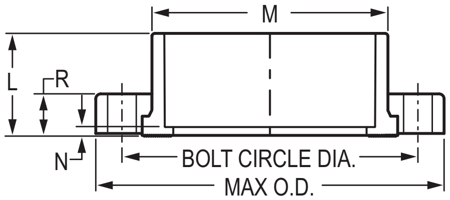


P N		S	R	C	N	S	M	M O	A	
P C	CP C								P C	CP C
853-005	853-005C	1/2	9/16	2-3/8	4	1/2	2	3-1/2	.21	.21
853-007	853-007C	3/4	5/8	2-3/4	4	1/2	2	3-7/8	.28	.30
853-010	853-010C	1	3/4	3-1/8	4	1/2	2-1/4	4-1/4	.41	.47
853-012	853-012C	1-1/4	23/32	3-1/2	4	1/2	2-1/4	4-5/8	.37	.40
853-015	853-015C	1-1/2	3/4	3-7/8	4	1/2	2-1/2	5	.62	.64
853-020	853-020C	2	13/16	4-3/4	4	5/8	3	5-15/16	.83	.88
853-025	853-025C	2-1/2	1	5-1/2	4	5/8	3-1/4	7	1.61	1.63
853-030	853-030C	3	1-1/16	6	4	5/8	3-1/4	7-5/8	1.56	1.64
853-040	853-040C	4	1-1/4	7-1/2	8	5/8	3-1/2	9	2.84	2.98
853-060	853-060C	6	1-3/8	9-1/2	8	3/4	4	11	4.36	4.45
853-080	853-080C	8	1-7/16	11-3/4	8	3/4	4-1/2	13-1/2	6.83	7.20
853-100	853-100C	10	1-11/16	14-1/4	12	7/8	5	16	11.32	11.80
853-120	853-120C	12	1-11/16	17	12	7/8	5	19	15.49	17.58

F S S

(Two Piece)
Socket

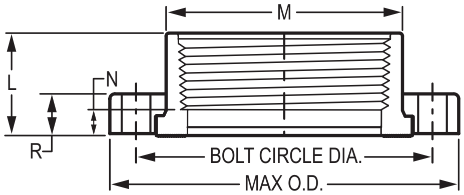


P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
854-005	854-005C	1/2	1-1/32	1-7/32	5/32	17/32	2-3/8	4	1/2	2	3-1/2	.19	.20
854-007	854-007C	3/4	1-1/8	1-7/16	5/32	9/16	2-3/4	4	1/2	2	3-7/8	.26	.27
854-010	854-010C	1	1-9/32	1-3/4	5/32	5/8	3-1/8	4	1/2	2-1/4	4-1/4	.36	.37
854-012	854-012C	1-1/4	1-13/32	2-5/32	5/32	11/16	3-1/2	4	1/2	2-1/4	4-5/8	.46	.45
854-015	854-015C	1-1/2	1-17/32	2-7/16	3/16	3/4	3-7/8	4	1/2	2-1/2	5	.56	.60
854-020	854-020C	2	1-11/16	2-15/16	3/16	13/16	4-3/4	4	5/8	3	6	.85	.91

PVC & CPVC INJECTION MOLDED CLASS 150 FLANGES

F S S

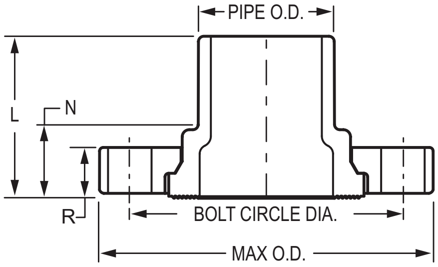
(Two Piece)
Fipt



P N		S		M	N	R	C	N	S	M	M O	A	
P C	CP C											P C	CP C
855-005	855-005C	1/2	1-1/32	1-7/32	9/32	17/32	2-3/8	4	1/2	2	3-1/2	.19	.20
855-007	855-007C	3/4	1-5/32	1-3/8	13/32	9/16	2-3/4	4	1/2	2	3-7/8	.27	.28
855-010	855-010C	1	1-1/4	1-3/4	5/16	5/8	3-1/8	4	1/2	2-1/4	4-1/4	.36	.39
855-012	855-012C	1-1/4	1-3/8	2-1/8	13/32	11/16	3-1/2	4	1/2	2-1/4	4-5/8	.46	.47
855-015	855-015C	1-1/2	1-15/32	2-7/16	13/32	3/4	3-7/8	4	1/2	2-1/2	5	.55	.61
855-020	855-020C	2	1-9/16	2-31/32	1/2	13/16	4-3/4	4	5/8	3	6	.87	.94
855-025	855-025C	2-1/2	2	3-9/16	7/16	1	5-1/2	4	5/8	3-1/4	7	1.22	1.50
855-030	855-030C	3	2-1/8	4-1/4	1/2	1-1/16	6	4	5/8	3-1/4	7-1/2	1.73	1.79
855-040	855-040C	4	2-1/16	5-1/4	3/8	1-1/4	7-1/2	8	5/8	3-1/2	9	2.61	2.78
855-060F	855-060CF	6	7	7-1/4	5-1/2	1-1/4	9-1/2	8	3/4	4	11	7.62	7.69
855-080F	855-080CF	8	8-15/16	9-11/16	7-3/16	1-3/8	11-3/4	8	3/4	4-1/2	13-1/2	12.84	13.92
855-100F	855-100CF	10	10-1/2	11-9/16	8-9/16	1-11/16	14-1/4	12	7/8	5	16	20.65	20.72

F S S

(Two Piece)
Spigot

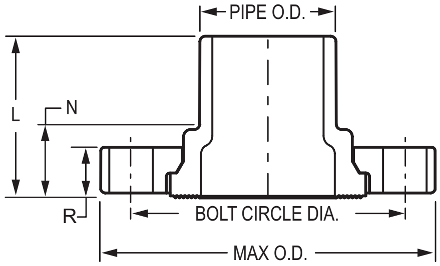


P N		S		N	R	C	N	S	M	M O	A	
P C	CP C										P C	CP C
856-005	856-005C	1/2	1-3/4	29/32	17/32	2-3/8	4	1/2	2	3-1/2	.20	.21
856-007	856-007C	3/4	1-15/16	31/32	9/16	2-3/4	4	1/2	2	3-7/8	.29	.30
856-010	856-010C	1	2-3/16	1-1/32	5/8	3-1/8	4	1/2	2-1/4	4-1/4	.39	.41
856-012	856-012C	1-1/4	2-11/32	1-3/32	11/16	3-1/2	4	1/2	2-1/4	4-5/8	.50	.50

PVC & CPVC INJECTION MOLDED CLASS 150 FLANGES

F S S **(continued)**

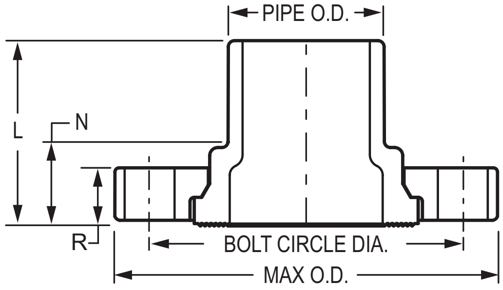
(Two Piece)
Spigot



P N		S		N	R	C	N	S	M	M O	A	
P C	CP C										P C	CP C
856-015	856-015C	1-1/2	2-5/8	1-9/32	3/4	3-7/8	4	1/2	2-1/2	5	.60	.65
856-020	856-020C	2	2-7/8	1-11/32	13/16	4-3/4	4	5/8	3	6	.94	1.00
856-025	856-025C	2-1/2	3-1/16	1-9/32	1	5-1/2	4	5/8	3-1/4	7	1.29	1.54
856-030	856-030C	3	3-3/8	1-7/16	1-1/16	6	4	5/8	3-1/4	7-1/2	1.82	1.88
856-040	856-040C	4	3-7/8	1-5/8	1-1/4	7-1/2	8	5/8	3-1/2	9	2.93	3.12
856-060	856-060C	6	4-3/4	1-25/32	1-9/32	9-1/2	8	3/4	4	11	4.62	4.79
856-080	856-080C	8	5-7/8	1-15/16	1-3/8	11-3/4	8	3/4	4-1/2	13-1/2	7.95	8.17
856-100	856-100C	10	8	2-1/4	1-5/8	14-1/4	12	7/8	5	16	15.61	16.09
856-120	856-120C	12	8-1/2	2-3/16	1-5/8	17	12	7/8	5	19	21.31	22.70

F S S

with Multi-Bolt Pattern Ring
(Two Piece)
Spigot



P N		S		N	R	C		N	S	M O	A	
P C	CP C					M	M				P C	CP C
M856-020	M856-020C	2	2-7/8	1-11/32	13/16	4-1/2	4-15/16	4	5/8	6	.94	1.00
M856-030	M856-030C	3	3-3/8	1-7/16	1-1/16	5-13/16	6-11/32	8	5/8	7-1/2	1.82	1.96
M856-040	M856-040C	4	3-7/8	1-5/8	1-1/4	7-3/32	7-1/2	8	5/8	9	2.98	3.24
M856-060	M856-060C	6	4-3/4	1-25/32	1-9/32	9-7/32	9-1/2	8	3/4	11	4.77	5.21
M856-080	M856-080C	8	5-7/8	1-15/16	1-3/8	11-1/2	11-3/4	8	3/4	13-1/2	7.95	8.32

SPEARS®

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May 1, 2009

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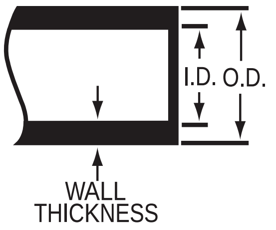
PVC WHITE SCHEDULE 40 FITTINGS UNIONS & SADDLES

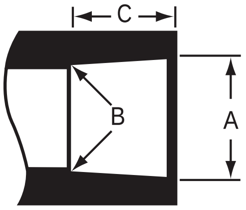
ASTM STANDARD DIMENSIONS

SCHEDULE 40 PIPE DIMENSIONS ASTM D 1785



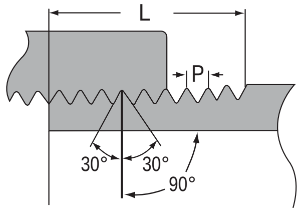
Nominal Pipe Size In.	Mean Outside Diameter In.	O. D. Tolerance In.	Minimum Wall Thickness In.
1/8	0.405	± 0.004	0.068
1/4	0.540	± 0.004	0.088
3/8	0.675	± 0.004	0.091
1/2	0.840	± 0.004	0.109
3/4	1.050	± 0.004	0.113
1	1.315	± 0.005	0.133
1-1/4	1.660	± 0.005	0.140
1-1/2	1.900	± 0.006	0.145
2	2.375	± 0.006	0.154
2-1/2	2.875	± 0.007	0.203
3	3.500	± 0.008	0.216
4	4.500	± 0.009	0.237
5	5.563	± 0.010	0.258
6	6.625	± 0.011	0.280
8	8.625	± 0.015	0.322
10	10.750	± 0.015	0.365
12	12.750	± 0.015	0.408

SCHEDULE 40 SOCKET DIMENSIONS ASTM D 2466



Nominal Size In.	Diameter			Socket Length Minimum C
	Entrance A	Bottom B	Tolerance A	
1/8	0.417	0.401	± 0.004	0.500
1/4	0.552	0.536	± 0.004	0.500
3/8	0.687	0.671	± 0.004	0.594
1/2	0.848	0.836	± 0.004	0.688
3/4	1.058	1.046	± 0.004	0.719
1	1.325	1.310	± 0.005	0.875
1-1/4	1.670	1.655	± 0.005	0.938
1-1/2	1.912	1.894	± 0.006	1.094
2	2.387	2.369	± 0.006	1.156
2-1/2	2.889	2.868	± 0.007	1.750
3	3.516	3.492	± 0.008	1.875
4	4.518	4.491	± 0.009	2.000
5	5.583	5.553	± 0.010	3.000
6	6.647	6.614	± 0.011	3.000
8	8.655	8.610	± 0.015	4.000
10	10.780	10.735	± 0.015	5.000
12	12.780	12.735	± 0.015	6.000

AMERICAN NATIONAL STANDARD TAPER PIPE THREADS (NPT) ANSI B1.20.1,ASTM F 1498



Nominal Size In.	Threads Per Inch.	Effective Thread Length L	Pitch Of Thread P
1/8	27	0.2639	0.03704
1/4	18	0.4018	0.05556
3/8	18	0.4078	0.05556
1/2	14	0.5337	0.07143
3/4	14	0.5457	0.07143
1	11-1/2	0.6828	0.08696
1-1/4	11-1/2	0.7068	0.08696
1-1/2	11-1/2	0.7235	0.08696
2	11-1/2	0.7565	0.08696
2-1/2	8	1.1375	0.12500
3	8	1.2000	0.12500
4	8	1.3000	0.12500
5	8	1.4063	0.12500
6	8	1.5125	0.12500
8	8	1.7125	0.12500

Molded Schedule 40 products are manufactured to ASTMD 2466 for use with pipe manufactured to ASTM D1785. Certain products carry reduced pressure handling capability and have maximum internal pressure ratings at 73° F noted.

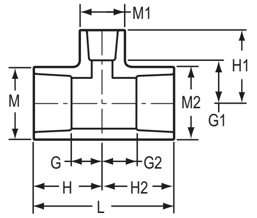
Fabricated Schedule 40 pressure fittings (part numbers ending with “F”) are manufactured to Spears® specifications for use with pipe manufactured to ASTM D1785. See publication FAB-7, General Specifications for Standard Fabricated Fittings for additional information.

All specified Schedule 40 products are manufactured from materials certified by NSF for use in potable water service.

PVC WHITE SCHEDULE 40 FITTINGS UNIONS & SADDLES

REDUCING TEE **(continued)**

Socket x Socket x Socket



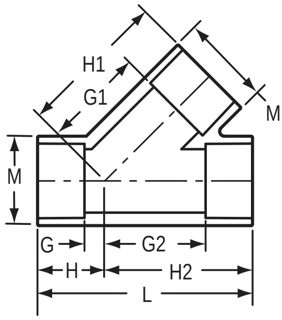
Part Number	Size	G	G1	G2	H	H1	H2	L	M	M1	M2	Approx. Wt. (Lbs.)
401-527[1]	6x6x1-1/2	1-3/8	3-7/8	1-3/8	4-27/32	5-3/16	4-27/32	9-11/16	7-1/4	2-11/16	7-1/4	3.60
401-528	6x6x2	1-3/8	3-19/32	1-3/8	4-27/32	4-31/32	4-27/32	9-11/16	7-3/16	2-11/16	7-3/16	3.39
401-529	6x6x2-1/2	2	3-15/16	2	5-1/2	5-15/16	5-1/2	10-15/16	7-3/16	3-15/16	7-3/16	4.29
401-530	6x6x3	2	3-23/32	2	5	5-19/32	5	10	7-1/4	4	7-1/4	3.89
401-532	6x6x4	2-17/32	3-5/8	2-17/32	6	5-5/8	6	12-1/16	7-3/16	5	7-3/16	4.54
401-533[1]	6x6x5	3-1/2	4-1/2	3-1/2	7	7-1/2	7	14	7-3/16	7-3/16	7-3/8	8.46
401-535[1]	6x6x8	5-3/8	5-1/2	5-3/8	8-7/8	9-1/2	8-7/8	17-3/4	9-1/2	9-3/4	9-1/2	19.21
401-537[1]	6x6x10	8	5-13/16	8	11-3/8	10-13/16	11-3/8	22-3/4	11-1/2	11-9/16	11-1/2	38.30
401-578[1]	8x8x2	2	5-7/8	2	6	7	6	12	9-1/4	4	9-1/4	11.71
401-579[1]	8x8x2-1/2	2	5-5/16	2	6	7-5/16	6	12	9-5/16	4	9-5/16	6.62
401-580	8x8x3	1-31/32	4-3/4	1-31/32	6-1/32	6-3/4	6-1/32	12-1/16	9-11/32	4	9-11/32	6.44
401-582	8x8x4	2-17/32	4-11/16	2-17/32	6-17/32	6-11/16	6-17/32	13-1/16	9-9/32	4-31/32	9-9/32	7.02
401-583[1]	8x8x5	3-21/32	5-1/4	3-21/32	7-21/32	8-1/4	7-21/32	15-5/16	9-5/16	7-1/4	9-5/16	10.60
401-585	8x8x6	3-5/8	4-3/4	3-5/8	7-21/32	7-25/32	7-21/32	15-11/32	9-11/32	7-1/4	9-11/32	8.90
401-589[1]	8x8x10	6-23/32	5-11/16	6-23/32	11-7/32	10-1/2	11-7/32	22-7/16	11-9/16	11-9/16	11-9/16	34.76
401-621F	10x10x2	4-7/8	7-1/4	4-7/8	10-1/8	9	10-1/8	20-1/4	11-1/2	2-11/16	11-1/2	19.60
401-623[1]	10x10x3	3-13/16	7	3-13/16	9-3/8	9	9-3/8	18-3/4	12	7-1/2	12	25.54
401-624[1]	10x10x4	3-27/32	7-3/8	3-27/32	9-11/32	9-3/8	9-11/32	18-11/16	12	7-1/2	12	25.63
401-628[1]	10x10x8	5-3/4	7-3/16	5-3/4	10-7/8	11-1/4	10-7/8	21-11/16	11-11/16	11-11/16	11-1/2	29.85
401-661F	12x12x2	5-1/4	8-1/4	5-1/4	11-1/2	10	11-1/2	23	13-1/2	2-11/16	13-1/2	25.00
401-663F	12x12x3	5-3/4	9	5-3/4	12	11-1/4	12	23	13-1/2	3-15/16	13-1/2	31.41
401-664F	12x12x4	7	9-5/16	7	13-1/4	11-9/16	13-1/4	26-1/2	13-9/16	5	13-9/16	32.40
401-666[1]	12x12x6	4-7/8	8-5/16	4-7/8	11-7/16	11-3/4	11-7/16	22-13/16	14-1/4	9-3/4	14-1/4	44.02
401-668	12x12x8	4-27/32	7-1/8	4-27/32	11-13/32	11-1/8	11-13/32	22-13/16	14-1/4	9-3/4	14-1/4	40.00
401-670	12x12x10	6-13/16	7-3/8	6-13/16	12-13/16	13-1/4	12-13/16	25-5/8	13-3/4	13-3/4	13-3/4	50.00
401-670F	12x12x10	10-1/4	10-3/8	10-1/4	16-1/2	15-5/8	16-1/2	33	13-9/16	11-1/2	13-9/16	50.00
401-676F	12x12x16	18-1/2	12-3/4	18-1/2	30-1/4	20-3/4	30-1/4	60-1/2	14-1/8	17	14-1/8	144.87
401-678F	12x12x18	14-1/4	13	17-7/8	23-1/4	22	23-7/8	47-3/4	19-1/8	19-1/8	19-1/8	252.00
401-691F	14x14x2	6	9-1/4	6	13	11	13	26	14-7/8	2-3/4	14-7/8	35.53
401-693F	14x14x3	6-1/2	9-9/16	6-1/2	13-1/2	11-13/16	13-1/2	27	14-7/8	3-15/16	14-7/8	38.35
401-694F	14x14x4	7-1/2	10	7-1/2	14-1/2	12-1/4	14-1/2	29	14-7/8	5	14-7/8	38.58
401-696F	14x14x6	8	10-1/4	8	15	13-1/2	15	30	14-7/8	7-1/8	14-7/8	45.70
401-698F	14x14x8	9-1/8	10-1/2	9-3/32	16-1/8	14-3/4	16-3/32	32-3/16	14-7/8	9-3/8	14-7/8	51.99

[1] Oultet sized with bushing

WYE

Socket x Socket x Socket

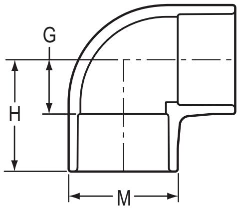
Pressure Rating
1/2" - 2" 235 psi @ 73°F
2-1/2" - 6" 200 psi @ 73°F
8" & Up 100 psi @ 73°F



Part Number	Size	G	G1	G2	H	H1	H2	L	M	M1	Approx. Wt. (Lbs.)
475-005	1/2	1/4	1-3/16	1-3/16	1-1/8	2-1/16	2-1/16	3-3/16	1-5/32	1-5/32	.12
475-007	3/4	1/8	1-9/16	1-9/16	1-1/8	2-9/16	2-9/16	3-11/16	1-3/8	1-3/8	.18
475-010	1	9/32	1-13/16	1-13/16	1-13/32	2-15/16	2-15/16	4-11/32	1-23/32	1-23/32	.31
475-012	1-1/4	3/8	2-1/4	2-1/4	1-5/8	3-1/2	3-1/2	5-1/8	2-1/16	2-1/16	.50
475-015	1-1/2	1/2	2-19/32	2-9/16	1-7/8	3-31/32	3-15/16	5-13/16	2-11/32	2-11/32	.69
475-020	2	19/32	3-7/32	3-7/32	2-1/8	4-3/4	4-3/4	6-7/8	2-7/8	2-7/8	1.20
475-025	2-1/2	1	5-1/4	4-3/4	3	7-1/4	6-3/4	9-3/4	4-1/8	4-1/8	2.59
475-030	3	11/16	4-5/8	4-3/16	2-19/32	6-17/32	6-3/32	8-11/16	4-5/32	4-5/32	2.68
475-040	4	7/8	6	5-3/8	3-1/8	8-1/4	7-5/8	10-3/4	5-9/32	5-9/32	4.76
475-050F	5	3-3/4	10-1/8	9-5/16	6-3/4	13-1/8	12-5/16	19-1/8	6-1/16	6-1/16	13.26
475-060	6	1-5/16	8-21/32	8-1/16	4-5/16	11-21/32	11-1/16	15-3/8	7-9/16	7-9/16	12.09
475-080	8	1-3/4	11-1/2	11-9/16	5-3/4	15-17/32	15-19/32	21-5/16	9-3/4	9-3/4	25.76
475-080F	8	5-1/2	13-1/2	13-1/2	9-3/4	17-3/4	17-3/4	27-1/2	9-1/4	9-1/4	25.46
475-100	10	2-1/2	16-7/8	13-31/32	7-1/2	22-1/8	18-31/32	26-15/32	11-9/16	11-9/16	26.92
475-100F	10	6-7/8	16-7/8	16-7/8	12-1/8	22-1/8	22-1/8	34-1/4	11-1/2	11-1/2	45.11
475-120	12	2-11/16	16-1/8	16-7/32	8-3/4	22-7/32	22-9/32	31-1/32	13-21/32	13-21/32	41.85
475-120F	12	6-3/4	19-3/4	19-3/4	13	26	26	39	13-9/16	13-9/16	63.02
475-140F	14	6-7/8	21-1/8	21-1/8	13-7/8	28-1/8	28-1/8	42	14-7/8	14-7/8	90.24
475-160F	16	8-1/2	26-1/4	24-1/2	16-1/2	34-1/4	32-1/2	49	17	17	93.06
475-180F	18	9	28	27-3/4	18	37	36-3/4	54-3/4	19-1/8	19-1/8	151.20
475-200F	20	11-7/16	30-5/16	30-5/16	21-7/16	40-5/16	40-5/16	61-3/4	21-3/16	21-3/16	191.78
475-240F	24	11-3/4	34-3/4	34-3/4	25-3/4	46-3/4	46-3/4	70-1/2	25-3/8	25-3/8	420.00

PVC WHITE SCHEDULE 40 FITTINGS
UNIONS & SADDLES

90° ELBOW
Socket x Socket

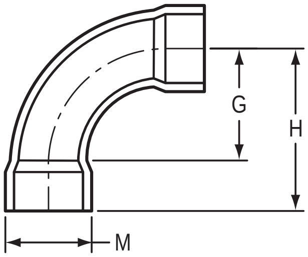


Part Number	Size	G	H	M	Approx. Wt. (Lbs.)
406-003	3/8	3/8	1-1/8	7/8	.03
406-005	1/2	1/2	1-1/4	1-1/16	.05
406-007	3/4	9/16	1-1/2	1-5/16	.07
406-010	1	11/16	1-13/16	1-5/8	.12
406-012	1-1/4	31/32	2-5/32	2	.20
406-015	1-1/2	1-1/16	2-3/8	2-7/32	.25
406-020	2	1-9/32	2-21/32	2-3/4	.37
406-025	2-1/2	1-15/16	3-7/32	3-5/16	.71
406-030	3	1-7/8	3-25/32	3-31/32	1.04
406-040	4	2-1/2	4-1/2	5	1.71
406-045F	4-1/2	7-1/8	9-5/8	5-1/2	3.13
406-050	5	3-1/16	6-1/8	6-5/32	3.58
406-060	6	3-1/2	6-29/32	7-9/32	5.03
406-080	8	4-7/16	8-15/32	9-5/16	8.75
406-100	10	5-29/32	10-7/8	11-5/8	17.82
406-100F	10	9-1/2	14-3/4	11-1/2	17.40
406-120	12	7-1/16	13-9/16	14-1/4	27.98
406-120F	12	10-1/2	16-3/4	13-9/16	25.94
406-140F	14	12-1/4	19-1/4	14-7/8	47.26
406-160F	16	14-1/8	22-1/8	17	69.70
406-180F	18	17-1/4	26-1/4	19-1/8	104.20
406-200F	20	18-3/4	28-3/4	21-3/16	131.93
406-240F	24	22-1/4	34-1/4	25-3/8	216.00

PVC WHITE SCHEDULE 40 FITTINGS
UNIONS & SADDLES

LONG SWEEP ELBOW

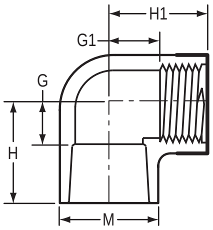
Socket x Socket



Part Number	Size	G	H	M	Approx. Wt. (Lbs.)
406-025LSF	2-1/2	5-7/16	7-7/16	3-1/4	1.26
406-030LSF	3	6-5/8	8-5/8	3-15/16	1.87
406-040LSF	4	8-3/8	10-5/8	5	2.69
406-060LSF	6	12-5/8	15-7/8	7-3/16	6.92
406-080LSF	8	22-9/16	26-13/16	9-1/4	19.43

90° ELBOW

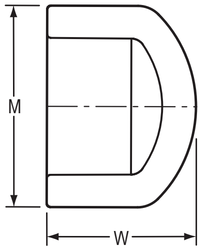
Socket x SR Fipt



Part Number		Size	G	G1	H	H1	M	Approx. Wt. (Lbs.)
407-005	407-005SR	1/2	1/2	9/16	1-1/4	1-1/4	1-1/16	.06
407-007	407-007SR	3/4	9/16	17/32	1-9/16	1-9/32	1-5/16	.08
407-010	---	1	11/16	21/32	1-13/16	1-9/16	1-5/8	.14
407-012	---	1-1/4	15/16	1-1/4	2-1/4	2-1/4	2	.25
407-015	---	1-1/2	1	1-1/16	2-5/16	2	2-1/4	.25
407-020	---	2	1-3/16	1-5/16	2-3/8	2-3/8	2-23/32	.46
407-025	---	2-1/2	1-1/2	1-1/2	3-1/2	3-1/16	3-5/16	.94
407-030	---	3	1-13/16	1-31/32	3-11/16	3-21/32	4	1.14
407-040	---	4	2-5/16	2-15/32	4-5/16	3-15/16	5-1/16	1.85

CAP

Socket

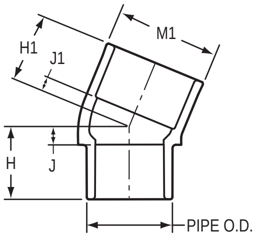


Part Number	Size	M	W	Approx. Wt. (Lbs.)
447-003	3/8	7/8	1	.01
447-005	1/2	1-3/32	1-1/32	.02
447-007	3/4	1-5/16	1-5/16	.04
447-010	1	1-9/16	1-9/16	.06
447-012	1-1/4	1-31/32	1-3/4	.09
447-015	1-1/2	2-1/4	1-7/8	.11
447-020	2	2-23/32	2-1/32	.17
447-025	2-1/2	3-5/16	2-9/16	.33
447-030	3	4	2-29/32	.49
447-040	4	5-1/16	3-1/8	.85
447-045F	4-1/2	5-1/4	3-1/4	.31
447-050	5	6-5/32	4-1/2	1.43
447-060	6	7-1/4	5	2.36
447-080	8	9-5/16	6-3/8	4.35
447-100F	10	11-13/16	5-1/4	5.22
447-120F	12	13-7/8	6-3/4	8.22
447-140F	14	15	7-3/8	8.75
447-160F	16	17	9	12.15
447-180F	18	19-1/16	9	17.58
447-200F	20	21-3/16	12-1/4	26.48
447-240F	24	25-1/2	13-1/2	40.26

PVC WHITE SCHEDULE 40 FITTINGS
UNIONS & SADDLES

22-1/2° STREET ELBOW

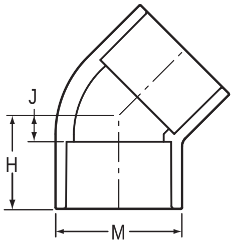
Spigot x Socket



Part Number	Size	H	H1	J	J1	M1	Approx. Wt. (Lbs.)
442-005	1/2	1-1/16	1	1/4	1/4	1-5/32	.05
442-010	1	1-15/32	1-3/8	11/32	9/32	1-11/16	.13
442-012	1-1/4	1-1/2	1-3/8	3/16	1-11/16	2-1/16	.20
442-015	1-1/2	1-7/8	1-11/16	15/32	11/32	2-5/16	.26
442-020	2	1-15/16	1-19/32	9/16	1/4	2-7/8	.39
442-025F	2-1/2	4-1/8	2-3/4	1-3/4	3/4	3-1/4	.81
442-030	3	2-1/2	2-5/16	21/32	7/16	4-5/32	.95
442-040	4	4-3/8	2-7/8	1-7/8	5/8	5-1/4	2.14
442-060	6	5-11/16	3-15/16	2-3/8	7/8	7-5/8	5.87
442-080	8	7-3/8	5-1/8	3-1/8	1-1/8	9-3/4	11.34

45° ELBOW

Socket x Socket

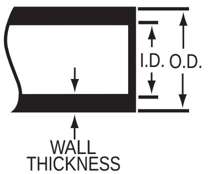


Part Number	Size	H	J	M	Approx. Wt. (Lbs.)
417-005	1/2	1	7/32	1-1/8	.04
417-007	3/4	1-1/4	5/16	1-5/16	.06
417-010	1	1-3/8	5/16	1-5/8	.10
417-012	1-1/4	1-5/8	3/8	1-31/32	.14
417-015	1-1/2	1-3/4	7/16	2-7/32	.19
417-020	2	2	5/8	2-3/4	.30
417-025	2-1/2	2-7/16	11/16	3-11/32	.56
417-030	3	2-27/32	27/32	4	.80
417-040	4	3-3/32	1-3/32	5-1/32	1.22
417-045F	4-1/2	4-3/8	1-7/8	5-1/2	1.59
417-050	5	4-3/8	1-3/8	6-1/16	2.41
417-060	6	5-7/8	1-13/16	7-5/16	3.45
417-080	8	6-7/16	2	9-9/32	6.56
417-100	10	8-1/8	3-1/8	11-1/2	20.72

PVC & CPVC SCHEDULE 80 FITTINGS, UNIONS, TANK ADAPTERS, EXPANSION JOINTS & SADDLES

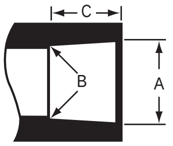
ASTM STANDARD DIMENSIONS

SCHEDULE 80 PIPE DIMENSIONS
ASTM D 1785



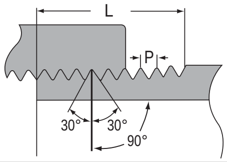
Nominal Pipe Size In.	Mean Outside Diameter In.	O. D. Tolerance In.	Minimum Wall Thickness In.
1/8	0.405	± 0.004	0.095
1/4	0.540	± 0.004	0.119
3/8	0.675	± 0.004	0.126
1/2	0.840	± 0.004	0.147
3/4	1.050	± 0.004	0.154
1	1.315	± 0.005	0.179
1-1/4	1.660	± 0.005	0.191
1-1/2	1.900	± 0.006	0.200
2	2.375	± 0.006	0.218
2-1/2	2.875	± 0.007	0.276
3	3.500	± 0.008	0.300
4	4.500	± 0.009	0.337
5	5.563	± 0.010	0.375
6	6.625	± 0.011	0.432
8	8.625	± 0.015	0.500
10	10.750	± 0.015	0.593
12	12.750	± 0.015	0.687

SCHEDULE 80 SOCKET DIMENSIONS
ASTM D 2467



Nominal Size In.	Diameter			Socket Length Minimum C
	Entrance A	Bottom B	Tolerance A	
1/8	0.417	0.401	± 0.004	0.500
1/4	0.552	0.536	± 0.004	0.625
3/8	0.687	0.671	± 0.004	0.750
1/2	0.848	0.836	± 0.004	0.875
3/4	1.058	1.046	± 0.004	1.000
1	1.325	1.310	± 0.005	1.125
1-1/4	1.670	1.655	± 0.005	1.250
1-1/2	1.912	1.894	± 0.006	1.375
2	2.387	2.369	± 0.006	1.500
2-1/2	2.889	2.868	± 0.007	1.750
3	3.516	3.492	± 0.008	1.875
4	4.518	4.491	± 0.009	2.250
5	5.583	5.553	± 0.010	2.625
6	6.647	6.614	± 0.011	3.000
8	8.655	8.610	± 0.015	4.000
10	10.780	10.735	± 0.015	5.000
12	12.780	12.735	± 0.015	6.000

AMERICAN NATIONAL STANDARD TAPER PIPE THREADS (NPT) ANSI B1 .20.1 ASTM F 1498



Nominal Size In.	Threads Per Inch	Effective Thread Length L	Pitch Of Thread P
1/8	27	0.2639	0.03704
1/4	18	0.4018	0.05556
3/8	18	0.4078	0.05556
1/2	14	0.5337	0.07143
3/4	14	0.5457	0.07143
1	11-1/2	0.6828	0.08696
1-1/4	11-1/2	0.7068	0.08696
1-1/2	11-1/2	0.7235	0.08696
2	11-1/2	0.7565	0.08696
2-1/2	8	1.1375	0.12500
3	8	1.2000	0.12500
4	8	1.3000	0.12500
5	8	1.4063	0.12500
6	8	1.5125	0.12500
8	8	1.7125	0.12500

STANDARD COMPARISONS

SPEARS® IPS-to-Metric transition unions are listed by nominal size. The chart below compares nominal and actual* pipe O.D. for each size according to the designated standard.

JIS K6741 (mm)		DIN 8062 (mm)		ASTM D1785 (in.)		NPT—ANSI B1.20.1** Tapered Thread		BSP—BS21,DIN 2999,ISO 7/1 Thread	
Nominal	Actual*	O.D.	Actual*	Nominal	Actual*	Designation	Threads/in.	Designation	Threads/ 25.4mm
16	22	20	20	1/2	.840	1/2	14	1/2	14
20	26	25	25	3/4	1.050	3/4	14	3/4	14
25	32	32	32	1	1.315	1	11.5	1	11
30	38	40	40	1-1/4	1.660	1-1/4	11.5	1-1/4	11
40	48	50	50	1-1/2	1.900	1-1/2	11.5	1-1/2	11
50	60	63	63	2	2.375	2	11.5	2	11
75	89	90	90	3	3.500	3	8	3	11
100	114	110	110	4	4.500	4	8	4	11

*Specified dimension, certain tolerances apply

**NPT and BSP have different thread angles and not compatible.

VELOCICALC®
Air Velocity Meters

Models 9535, 9535-A, 9545 and 9545-A

The Models 9535 and 9545 air velocity meters are like having multiple meters—for the price of just one. These meters simultaneously measure and data log several ventilation parameters using a single probe with multiple sensors. Both models measure velocity, temperature and calculate flow. The Model 9545 also measures relative humidity, and calculates dew point, and wet bulb temperature. Models 9535 and 9545 have telescopic straight probes; Models 9535-A and 9545-A have telescopic articulated probes.

Model 9545

Features and Benefits

- Simple to operate
- Accurate air velocity measurement
- Simultaneously measure temperature and velocity
- Displays up to three measurements simultaneously
- Measures humidity (Model 9545 and 9545-A)
- Calculates volumetric flow and actual/standard velocity
- Data log 12,700+ samples and 100 test IDs
- LogDat2™ downloading software included
- Articulated probe versions available (9535-A and 9545-A)

Applications

- HVAC system performance
- Commissioning
- Plant maintenance
- Critical environment certification
- Duct traverses

TRUST. SCIENCE. INNOVATION.

ENERGY AND COMFORT

Ventilation Test Instruments

Specifications

VelociCalc Models 9535 and 9545

Velocity

Range 0 to 6,000 ft/min (0 to 30 m/s)

Accuracy[1&2] ±3% of reading or ±3 ft/min (±0.015 m/s), whichever is greater

Resolution 1 ft/min (0.01 m/s)

Duct Size

Dimensions 1 to 250 inches in increments of 0.1 in.
(1 to 635 cm in increments of 0.1 cm)

Volumetric Flow Rate

Range Actual range is a function of velocity and duct size

Temperature

Range (9535 and 9535-A)
0 to 200 °F (-18 to 93°C)

Range (9545 and 9545-A)
14 to 140°F (-10 to 60°C)

Accuracy[3] ±0.5°F (±0.3°C)

Resolution 0.1°F (0.1°C)

Relative Humidity (9545 only)

Range 0 to 95% RH

Accuracy[4] ±3% RH

Range 0.1% RH

Instrument Temperature Range

Operating (Electronics)
40 to 113°F (5 to 45°C)

Model 9535 Operating (Probe)
0 to 200°F (-18 to 93°C)

Model 9545 Operating (Probe)
14 to 140°F (-10 to 60°C)

Storage -4 to 140°F (-20 to 60°C)

Data Storage Capabilities

Range 12,700+ samples and 100 test IDs

Logging Interval

1 second to 1 hour

Time Constant

User selectable

External Meter Dimensions

3.3 in. x 7.0 in. x 1.8 in. (8.4 cm x 17.8 cm x 4.4 cm)

Meter Weight with Batteries

0.6 lbs. (0.27 kg)

Meter Probe Dimensions

Probe Length 40 in. (101.6 cm)

Probe Diameter of Tip
0.28 in. (7.0 mm)

Probe Diameter of Base
0.51 in. (13.0 mm)

Articulating Probe Dimensions

Articulating Section Length
7.8 in. (19.7 cm)

Diameter of Articulating Knuckle
0.38 in. (9.5 mm)

Power Requirements

Four AA-size batteries or AC adapter

	9535, 9535-A	9545, 9545-A
Velocity	●	●
Temperature	●	●
Flow	●	●
Humidity, wet bulb, dew point		●
Probe	Straight or -A articulated	Straight or -A articulated
Variable time constant	●	●
Manual data logging	●	●
Auto save data logging		●
Statistics	●	●
Review data	●	●
LogDat2 downloading software	●	●
Certificate of Calibration	●	●

---

[1] Temperature compensated over an air temperature range of 40 to 150°F (5 to 65°C).

[2] The accuracy statement begins at 30 ft/min through 6,000 ft/min (0.15 m/s through 30 m/s).

[3] Accuracy with instrument case at 77°F (25°C), add uncertainty of 0.05°F/°F (0.03°C/°C) for change in instrument temperature.

[4] Accuracy with probe at 77°F (25°C). Add uncertainty of 0.1% RH/°F (0.2% RH/°C) for change in probe temperature. Includes 1% hysteresis.

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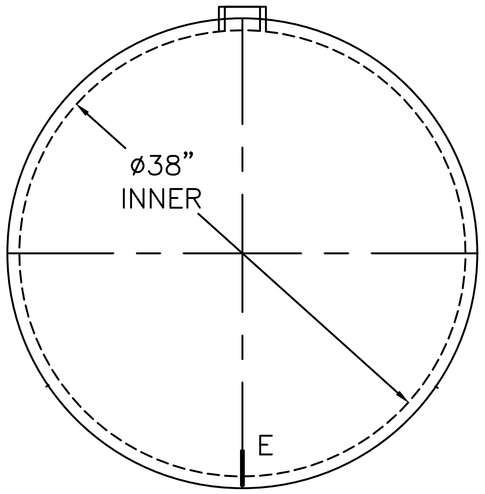
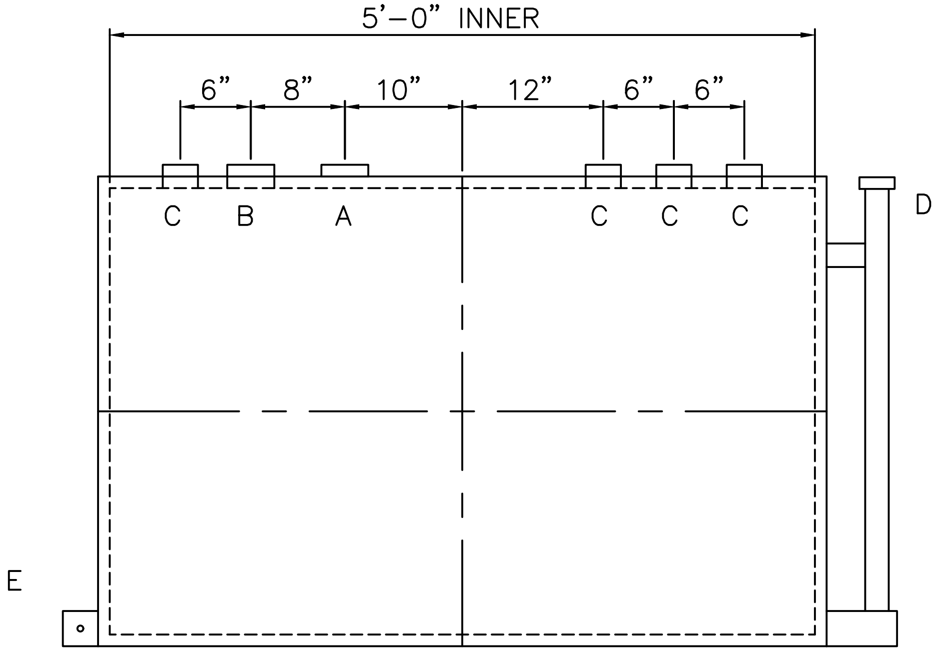
TOUCH UP OF FINISHED PAINT IS REQUIRED BY INSTALLATION CONTRACTOR. TOUCH UP PAINT SHIPPED WITH TANK.





DESIGN DATA

CAPACITY – 300 GALLONS
TYPE – DOUBLE WALL – TYPE I
NO. REQ. – –
OPERATING PRESSURE – ATMOSPHERIC
SPECIFIC GRAVITY = 1.0
TANK MATERIAL – MILD CARBON STEEL
THICKNESS – INNER– HEADS: 12 GA SHELL: 12 GA THICKNESS – OUTER– HEADS: 10 GA SHELL:10 GA
CONSTRUCTION – INNER – LAP WELD OUTSIDE ONLY OUTER – LAP WELD OUTSIDE ONLY
TANK TEST – INNER – 5 PSIG OUTER – +3 PSIG OR 13"hg VACUUM
INT. FINISH – NONE –
EXT. FINISH – SHOP PRIMER –
LABEL – UL 142

LEGEND

A	3" FITTING THROUGH OUTER SHELL ONLY – MARK WITH LABEL – SECONDARY EMERGENCY VENT USE ONLY
B	3" FITTING – PRIMARY EMERGENCY VENT USE
C	2" FITTING
D	2" INTERSTITIAL MONITOR PIPE
E	3" FLAT BAR GROUNDING LUG WITH 1/2"⌀ HOLE ON CL
F	–

△ –

Highland Tank

UNLESS NOTED, TOLERANCES ARE +/- 1"

300 GAL 38"⌀ AG DW HORIZONTAL

CUSTOMER:

PROJECT:

QUOTE NO:

CHK'D BY:

SCALE: 3/4"=1'-0"

DATE:

DWG. BY:

DWG. NO: 00300AHDW38

Appendix F

Technical Specifications

Table of Contents

THOMAS A. GOLDEN
NEW MEXICO
22750
PROFESSIONAL ENGINEER
7/16/21

SECTION 11 54 00.01

SOIL VAPOR EXTRACTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the equipment and installation of a Soil Vapor Extraction (SVE) System.

B. Related Sections:

1. Section 22 05 23 - General Duty Valves
2. Section 22 05 03.02 - PVC Piping
3. Section 22 30 10 - High Density Polyethylene Tanks

1.2 Acronym Definitions

A. scfm - standard cubic feet per minute

B. ppmv - parts per million by volume

C. VOC - volatile organic compound

D. TPH - total petroleum hydrocarbons

E. in. - inch

F. HP - horsepower

G. SVE - soil vapor extraction

H. VFD - variable frequency drive

1.3 PERFORMANCE REQUIREMENTS

A. The system shall remove 1,000 scfm of soil vapor using a positive displacement blower. A thermal oxidizer shall be used for vapor treatment, with an option for operation using a catalyst. The oxidizer uses natural gas to supplement destruction of hydrocarbons. The system shall have a minimum of 98% destruction efficiency of incoming vapor concentrations. TPH vapor concentrations from SVE pilot testing in 2012 were as high as 56,000 micrograms per liter. Under no circumstances shall the discharge to the atmosphere, from all vapor streams, exceed the New Mexico Environment Department limits of 10 lbs/hr and 10 tons/year of a regulated air contaminant, using average hourly flow rates and data from laboratory samples collected by the OWNER, analyzed using standard EPA methods. Based on these discharge limits and the expected vapor stream concentrations, the system shall also have a direct discharge option.

1.4 SUBMITTALS

A. The Manufacturer shall submit the following:

   1. Shop Drawings: Provide equipment dimensions, process connections, electrical diagrams, piping and instrumentation diagram, and all information necessary to relate the equipment to the specifications.
   2. Product Data: Submit system performance, noise data, and removal rates for benzene and gasoline range organics.
   3. Design Data: Provide basis of design to include flow rates and removal rates. Include calculations for removal rates.
   4. Test Reports: Indicate flow rates, power consumption, and removal rate.
   5. Manufacturer's Installation Instructions and Operation Manuals: Submit 1 copy of each equipment's installation instruction and operation manual
   6. Manufacturer's Field Reports: Provide data from installed systems with removal rates, operating costs, and length of operation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The Contractor will be responsible for safe and timely transportation of all necessary equipment and appurtenances to the site. The Contractor’s representative on site will inspect for damage and assumes the responsibility for any issues which may arise from equipment transportation.

B. The Contractor will be responsible for providing any equipment required for system unloading and temporary storage.

1.6 ENVIRONMENTAL REQUIREMENTS

A. All equipment supplied should be manufactured to perform in the anticipated weather conditions at the site, which may include low temperatures of -10°F and high temperatures of 110°F.

B. The equipment should be designed to operate at an elevation of 4,280 feet without adverse effect to performance and operation.

1.7 SCHEDULING

A. Schedule for construction, delivery, and startup to be coordinated with the Engineer. The Manufacturer is to provide the initial schedule and any changes.

1.8 COORDINATION

A. Coordinate work with the Engineer and other Contractors as required.

PART 2 PRODUCTS

2.1 VAPOR EXTRACTION EQUIPMENT

A. Suppliers:
  1. Intellishare Environmental, Inc.
     E4803 395th Avenue
     Menomonie, WI 54751 USA
     Contact: John Strey
     Phone: 1.715.233.6115
     Fax: 1.715.232.0669
     Email: jstrey@intellishare-env.com

2.2 COMPONENTS

A. SVE System
  1. Equipment assemblies:
     a. SVE treatment equipment in an equipment enclosure
     b. Moisture separator with 55 gallon holding capacity and condensate pump
     c. Skid-mounted thermal oxidizer with option to run in catalytic mode
  2. Skids: constructed of a welded steel frame covered by a welded steel plate.
  3. Control panels and local instrumentation and controls with the ability to be remotely accessed
  4. Interconnected process piping
  5. Electrical power connections
  6. Natural gas feed connections

B. Equipment Enclosure
  1. SVE blower, vapor-liquid separator, and associated equipment and controls will be located within a modified shipping container. This enclosure will be used to reduce noise and mitigate vandalism and theft of remediation equipment.
  2. Noise restriction: Manufacturer to coat walls, ceiling, and floor with noise-reducing materials to minimize noise from equipment such as blowers and motors.
     a. Equipment to be located in the parking lot of a grocery store, within a primary commercial corridor, adjacent to a highly-trafficked roadway. Closest residence is approximately 200 feet to the southeast from the equipment compound.
  3. Interior
     a. Floor sealed with non-skid bed liner
     b. Insulated floor, walls, ceiling, and steel access door
     c. Overhead lighting
     d. Wall-mounted electric heater

C. Vent fan, sound-insulated inlet/outlet louvers, and thermostat

D. SVE Blowers
  1. Blowers:

   a. The SVE blower shall be a Sutorbilt Legend 7L rotary positive displacement blower driven by a 40-hp TEFC variable speed motor and a VFD located at the main control panel. The blower will be rated for 1,000 scfm at an applied vacuum of 85 inches water column.

2. Filter, Discharge Silencer, Gauges and Sampling Port: A particulate filter shall be located on the inlet of the blower and the discharge of the blower will include a premium chamber discharge silencer, pressure gauge, temperature gauge, and sample port.
3. Moisture Separator: A moisture separator shall be located on the inlet of the system and provide sufficient storage for 55 gallons of accumulated condensate. The vapor liquid separator shall include a polypropylene demister element and acquiescence plate to isolate condensate water from turbulent flow internal to the separator and external devices will include three-point liquid level switches mounted inside a clear PVC site glass. The separator shall have a condensate pump and bottom drain.

E. Thermal Oxidizer w/ Optional Catalytic Mode

1. Oxidizer Reactor: The reactor housing will be constructed of 7 gauge rolled steel. The Inlet and outlet connections are flanged. The reactor will be painted ISE standard grey two component paint.
2. Gas Pre-Heater: The unit will come equipped as standard with a direct gas fired air burner with combustion air blower and 2-hp TEFC motor.
3. Flame Arrestor: A flame arrestor will be supplied and mounted to the inlet of the oxidizer and utilized to prevent flame propagation to the source. A spiral crimped aluminum element shall be removable for inspection and cleaning.
4. Exhaust Stack: The stack for the discharge of cleaned gases shall be self-supporting and made of stainless steel. The stack shall terminate at approximately 15’ AGL and is supplied with sampling ports that can be accessed from ground surface without a ladder.

F. Control System

1. Main Control System: A NEMA 4 control panel shall be completely assembled, wired and mounted at eye level. Control panel components shall include, power distribution circuit with solid state PID temperature controller, flame safety programmer with built in purge timer, Allen Bradley programmable logic controller with Ethernet card, operator and alarm lights and an hour meter to record system run time. The control panel shall be UL 508 approved as an assembly. All wiring shall be consistent with standards set forth in the NEC.
2. Automatic Purge Control: The oxidizer shall be purged with fresh air prior to the introduction of contaminated vapors per NFPA 86. To accomplish this, the combustion air blower will be enabled for a specified time. Once complete, the system shall enable the pre-heat mode.
3. Temperature Control: Combustion chamber temperature shall be continuously monitored via thermocouple. The thermocouple and digital indicating temperature controller enable a 4-20ma PID loop with the variable frequency tertiary air fan to maintain the combustion chamber set-point temperature.
4. The control panel shall contain an illuminated selector switch indicating power Hand/Off/Auto, status/alarm lights, motor starter, control relays, and terminal

blocks factory assembled and tested. The enclosure shall be rated NEMA 4 and constructed of steel.

G. Telemetry

1. A cellular modem will be provided to allow remote access to system controls. The telemetry system will provide data access, remote-start capability, and the ability to be notified of alarm conditions via text or email.

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with the components described above, including all motors and controls.

B. Disconnect Switch: Factory mounted disconnect switches on all individual pieces of equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

3.2 INSTALLATION

A. Contractor to install in accordance with the approved project plans, including all piping and ancillary equipment, and manufacturer's instructions. Contractor shall be responsible for unloading all equipment delivered to the site prior to installation.

3.3 FIELD QUALITY CONTROL

A. All field inspecting, testing, adjusting, and balancing shall be performed by the Supplier for the equipment to function as designed.

3.4 SUPPLIER'S FIELD SERVICES

A. Supplier to coordinate delivery of all vapor extraction and treatment equipment.

B. Start-up training to include a minimum of 3 days on-site, including inspection of system installation, verification of safety controls, and staff training to optimize the system operation.

END OF SECTION

SECTION 11 54 00

GROUNDWATER TREATMENT SYSTEM

PART 1 GENERAL

1.1 Summary

A. Section includes:
   1. Containerized treatment equipment
   2. Control system
   3. Telemetry

B. Related Sections

1.	11 97 00	Well Pumps
2.	22 05 03.02	PVC Pipe
3.	22 05 23	General Duty Valves
4.	22 07 00	Plumbing Insulation
5.	33 70 00	High Density Polyethylene Pipe

1.2 References

A. Air Movement and Control Association, Inc. (AMCA):
   1. AMCA Publication 211 - Product Rating Manual for Fan Air Performance

B. American National Standards Institute (ANSI):
   1. ANSI/NFPA 70 - National Electric Code (NEC)
   2. ANSI Z358.1 - Emergency Eyewash and Shower Equipment

C. American Society of Mechanical Engineers (ASME)
   1. ASME B31.3 - Process Piping Design

D. American Society for Testing and Materials
   1. ASTM D 1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

1.3 Performance Requirements

A. The system shall be a fully automatic, integrated, and containerized treatment system capable of meeting the discharge standards designated in Table 1 for the effluent water. For design purposes, the flow rate through the system shall be 20 gpm of groundwater with approximate concentrations of contaminants in raw water as defined in Table 1. This represents average contaminant concentrations from the proposed extraction wells using laboratory data from March 2021. Approximate depth to water is 330 feet bgs. Four existing wells were constructed with 4-inch-diameter SCH 80 PVC, and five existing wells were constructed with 5-inch-diameter SCH 80 PVC. Treated water will be discharged to the sanitary sewer through an existing manhole as shown on the Drawings.

B. In addition to all tanks, pumps, and controls needed for a completely integrated package, the containerized treatment system shall have three treatment processes, at a minimum, to meet the target concentrations listed in Table 1:
1. Oil-water separation to remove nonaqueous-phase liquid.
2. Diffused aeration for removal of volatile organics.
3. Clarification to remove solid particulates or suspended solids that are generated during aeration of extracted groundwater.

C. The system shall meet or be below the effluent concentrations given in Table 1 given the following operational parameters:
1. The altitude of the site is 4,280 feet above mean sea level.
2. The average groundwater temperature is 68°F.
3. The ambient air temperature at the site varies from approximately –10°F to 110°F.
4. Engineer will provide additional data upon request, if it is available.

Table 1. Discharge Groundwater Standard and Assumed Groundwater Concentration

Parameter	Concentration (µg/L)	
	Expected Influent	Discharge Standard
Benzene	2,000	5
Toluene	1,000	1,000
Ethylbenzene	200	700
Total Xylenes	400	620
Ethylene dibromide (EDB)	5	0.05
1,2-dichloroethane (EDC)	100	5
Total Naphthalenes	60	30

µg/L = Micrograms per liter
BTEX = Benzene + toluene + ethylbenzene + total xylenes

1.4 Submittals

A. The following Manufacturer information shall be submitted with the Bid to evaluate conformance with the Contract Documents prior to award of the Contract:
1. Product data for the selected diffused aeration tank, including manufacturer and model, rated flow capacity, dimensions, weights (dry and operating), accessories, and warranty coverage.
2. Product data for selected diffused aeration blower, including manufacturer and model, rated output capacity, electrical requirements, and warranty coverage.
3. Shop drawings and/or product data containing all information necessary to correlate the equipment to the specifications.

4. List of all instrumentation to be provided, with descriptive information for each component and an overall controls strategy. Include a process and instrumentation diagram for the containerized treatment system.

1.5 Closeout Submittals

A. Project Record Documents: Record actual location of process, power, and electrical connections on the Record Drawings.

B. Operation and Maintenance Manual to include:
1. Operating instructions for all treatment system components.
2. Three copies of the operation and maintenance manual for each piece of equipment.
3. Summary of system components.
4. Summary of system operation principles.
5. Summary of operation controls and fail safes.
6. Summary of maintenance requirements for each piece of equipment.

1.6 Qualifications

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum 10 years documented experience, including design, fabrication, and assembly of containerized treatment equipment. Installation contractor shall have at least five (5) treatment system installations in New Mexico.

B. Installer: Company specializing in performing work of this section and approved by Engineer.

1.7 Warranty

A. Furnish a minimum 1-year Manufacturer's warranty for the containerized treatment system, including process equipment, vessels, blowers, pumps, and all other ancillary equipment. Warranty period shall begin upon completion and acceptance of the Functional Demonstration Test during startup. Warranty shall cover materials, shipping, and appurtenances required to remove and replace defective equipment.

PART 2 PRODUCTS

2.1 Containerized Treatment Equipment

B. Manufacturer:
1. H2K Technologies, Inc.
2. Substitutions: Substitutions permitted with Engineer's Approval.

C. Containerized treatment system: Self-contained and fully constructed and functional prior to delivery at the site, including installation of all plumbing, valves, treatment equipment, tanks, flow meters, and other ancillary equipment.
   1. Manufacturer to provide all labor, materials, equipment, tools, shipping, startup services, testing, training, superintendence, and incidental items necessary for a complete installation.
   2. Contractor to install containerized treatment system in accordance with Manufacturer's written instructions.

D. Treatment processes are specified below based on performance characteristics.
   1. Major treatment components will include at a minimum:
      a. Oil-water separator.
      b. Diffused aeration tank.
      c. Clarifier.
      d. Water storage tanks.
      e. Chemical feed modules.
      f. Monitoring devices.
      g. Tanks, pumps, and controls.

E. Additional components:
   1. Provide all appurtenances required to facilitate an automatically controlled, fully functioning treatment system, including actuated control valves, flow meters, pressure gauges, and transfer and chemical feed pumps appropriately sized for the prescribed flow rate and contaminants listed in Table 1.
   2. Manual isolation valves shall be provided on the upstream and downstream side of all process pumps and equipment to facilitate easy isolation for maintenance and repair.
   3. Appropriately sized pressure gauges shall be installed on the upstream and downstream side of each process pump to monitor performance of the major process components.
   4. Engineering controls shall be provided to minimize scaling and improve performance period intervals between maintenance/replacement, including but not limited to, the use of chemicals and cartridge filters. Any such chemicals or cartridge filters shall be readily available.
   5. Sample ports shall be provided at key locations in the treatment system. At a minimum: raw water influent, post-diffused aeration, and treated water effluent. A sample port shall be provided on the diffused aeration discharge stack for collection of effluent air samples. Final locations shall be as directed by Engineer.
   6. Chemical storage tanks: Compatible for long-term use with the chemicals they are storing. Each tank must have appropriate venting. Minimum chemical storage for 30 days of normal operation shall be provided, unless a shorter duration is approved in writing by the Engineer. Containers shall have secondary containment.
   7. Manufacturer's plumbers working with PVC/CPVC shall be certified to applicable ASTM and ASME training requirements for PVC and CPVC materials.

8. The effluent flow rate and totalizer volume in gallons shall be displayed on the control panel.

F. Equipment Design Requirements.
  1. Oil/Water Separator
    a. 304 stainless steel construction
    b. Capable of 100% removal of 20 micro or larger droplets at 25 gpm
    c. PVC site glass with ss low, high, and high-high pump out level switch assembly
  2. Diffused Aeration Tank
    a. Unit shall remove 94% BTEX compounds and 50% of Napthalene at 20 gpm
    b. (3) Aeration chambers
    c. (15) Non-fouling 304 Stainless Steel aeration diffusers
    d. 304 welded stainless-steel construction
    e. 90 cfm blower at 80-in. WC
    f. Unit shall be stand mounted to allow gravity drain from oil/water separator thru DTA into clarifier
  3. Inclined Plate Clarifier
    a. 304 stainless steel construction
    b. 90% removal of 20 micron & larger solids 20 gpm
    c. PVC slant tube coalescing media
    d. Adjustable skimming weir
    e. Solids collection sump
    f. Clearwell for pumping directly from clarifier
    g. PVC site glass with ss low, high & high-high pump out level switch assembly, union mounted
    h. Vapor tight gasketed cover, Buna-N Gasket
  4. Storage tanks
    a. An anti-siphoning loop shall be provided prior to discharging from the treatment system to mitigate potential for siphoning.
    b. Provide level controls using ultrasonic level meters, float switches, or a pressure-type transducer.
    c. Product Storage Tank:
      1) 300-gallon capacity, UL 142 double wall tank (OUTSIDE OF ENCLOSURE)
      2) Welded steel horizontal tank with enamel external finish
      3) High/high- and high-level switches
      4) Normal vent with riser pipe
      5) Emergency vent
      6) Check valve and isolation valve on product inlet
      7) 120 VAC heat trace for class I, Div 1 hazardous location
      8) 1” polyurethane insulation, UV resistant, R-7 on tank

G. Instrumentation and Controls: The containerized treatment equipment Manufacturer shall provide an equipment control strategy that will allow for a fully automated treatment system. All hardware, software, and programming required for the control system shall be the responsibility of the Manufacturer. The control strategy shall include the containerized treatment equipment and the individual well pumps. The control strategy shall be provided for Engineer approval as outlined in this specification.

H. Telemetry: The containerized treatment equipment Manufacturer shall provide a cellular-based telemetry system to provide remote access to system data. The telemetry system shall provide the ability to monitor system data through a secure web-based interface. Additionally, alarm conditions shall be sent electronically via e-mail and/or phone-based text messaging. At a minimum, the following parameters shall be able to be monitored remotely:
   1. Operating status for the system and each major process component.
   2. Alarm conditions for any major process component.
   3. Water flow rates and pressure transducer water level for each well.
   4. Water flow rates from the effluent equalization tank.
   5. Air flow rate for the diffused aeration tank.
   6. Water levels in the influent and effluent equalization tanks.
   7. Critical water pressures for the major process components.

2.2 Equipment Enclosure Modules

A. Equipment enclosure module: lined and coated container with a steel frame, corrugated steel walls, and treated wood floor with steel overlay.
   1. The Work is based on provision of one 20-foot-long equipment enclosure module for groundwater treatment equipment.

B. The equipment enclosure module shall be insulated and rated for the expected ambient air temperatures for the site specified in this section.

C. The module shall come equipped with fluorescent lighting, receptacles, emergency lighting, and a heating, ventilating, and air conditioning (HVAC) system appropriately sized for the expected ambient air temperatures specified in this section.

D. The container shall be ready for connection to the water conveyance piping system with flanged connections outside the equipment enclosure module for connection to 1.5-inch PVC piping.

E. A single electrical service shall be provided to the module. All interior wiring shall be NEC compliant and complete prior to delivery at the site.

F. The container shall have at least one set of double swing-out doors on one end of the container. The doors shall be lockable with either a deadbolt (installed by Manufacturer) or configured for a padlock.

G. Each module shall have all visible exterior surfaces coated with marine-grade industrial enamel. Custom colors to be as specified by Engineer.

PART 3 EXECUTION

3.1 Shipping

A. Upon arrival at the destination, the Contractor and/or his agent shall be responsible for inspection for damage in transit. If damage has occurred, a claim should be filed with the carrier by the Contractor, and the Manufacturer should be notified prior to the system being put into service.

3.2 Installation

A. The containerized equipment shall be installed in accordance with the Contract Drawings and specifications.

B. Mechanical service connections:
   1. Contractor to furnish materials and labor to connect conveyance line from the influent tank located in the remediation equipment compound to the equipment enclosure module.

C. Electric service connections:
   1. Installed by a licensed electrician. The NEC and all applicable state and local codes shall be followed when installing this equipment. This includes but is not limited to any provisions for intrinsically safe or explosion-proof wiring. The installation shall be executed in a neat and workmanlike manner.
   2. At no time shall any individual tamper with or change any of the wiring in the control panel without the knowledge and consent of the vendor’s personnel. The Contractor shall only land wires on the field terminals provided and install or remove any jumpers as shown and indicated on the control schematics to achieve proper operation. Any changes made to the panel wiring other than those just mentioned or those approved by the Manufacturer, in writing, will result in the voiding of any warranty associated with the control panel or any of the connected equipment.

D. The Contractor shall ensure that all Manufacturer checklist items are completed prior to requesting startup assistance.

3.3 Startup and Training

A. Services of a factory trained representative shall be supplied by the Manufacturer to start up and provide operator training for the remediation system.

B. Inspection and startup:
   1. Five (5) days startup instruction and operator training. This startup period may coincide with the operational readiness test.

3.4 Factory Testing

A. Factory Testing: Manufacturer-certified factory tests of each module and the overall treatment system will be required. The factory test of the module shall include at a minimum the following information:

1. The factory test shall be conducted on the actual unit(s) to be installed in the field. Each module shall be tested to ensure that all treatment equipment, transfer and chemical feed pumps, flow meters, actuated control valves, pressure transducers, and appurtenances operate properly, cycle as directed by the system controls, open and close as directed, and correctly meter flow as required.
2. Factory testing shall confirm that connections and piping inside each module are leak-free. Any leaks encountered shall be repaired at the factory.
3. All controls within the modules shall be tested to ensure proper operation to the extent practicable.
4. All alarms on and between equipment within the module shall be triggered to ensure proper system response to all alarms.
5. Factory testing is intended to test system hydraulic performance and not to confirm treatment objectives. No water quality samples are expected to be analyzed.

B. The factory test shall be conducted on the actual units to be installed in the field; including transfer and chemical feed pumps, treatment equipment, and control systems. The factory test shall be conducted after the containerized treatment equipment to be shipped to the field has been fully assembled. A copy of the certified factory test results shall be furnished to the Engineer within three days after completion (and included in the operation and maintenance manuals).

3.5 Operational Readiness Tests

A. All required on-site testing is the responsibility of the Contractor and shall be performed by persons with a minimum of 24-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) training.

B. Prior to startup and the Functional Demonstration Test, the entire system shall be tested in the field by the Contractor to certify that it is ready for operation in the form of an Operational Readiness Test (ORT). The entire system shall be checked for proper installation. The entire system shall be calibrated and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications. This testing shall include all well pumps, treatment equipment, transfer and chemical feed pumps, flow meters, actuated control valves, pressure transducers, instrumentation and controls, telemetry, and appurtenances. Recycling of water will be permitted during this testing period. Alarms shall be triggered to ensure proper system response to all alarms. Proper communication between the extraction wells, the influent equalization tank, and the treatment equipment shall be verified.

1. The Contractor shall be required to maintain all documentation and reports generated during the ORT at the job site and make them available to the Engineer/Owner at any time.
2. These inspections and tests do not require witnessing. However, the Engineer shall review documentation generated during testing and spot-check their entries periodically and upon completion of the ORT. Any deficiencies found shall be corrected.
3. The Contractor shall coordinate and allocate time to assist the Owner personnel on all telemetry system integration prior to completion of the ORT.

C. ORT shall confirm that connections and piping inside each module are leak-free. Any leaks encountered shall be repaired prior to the functional demonstration test.

D. All chemical feed systems shall be calibrated during the ORT. Documentation of successful calibration shall be furnished as part of the documentation of the ORT.

E. Costs for as many field visits as are necessary for proper system operations by Manufacturer representatives to perform and/or assist with ORT shall be considered incidental to the Work and no separate payment will be made.

3.6 Functional Demonstration Tests

A. Prior to startup, the entire installed instrument and control system shall be inspected by the manufacturer/supplier and contractor and certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the ORT.

B. Once the facility has been started up and is operating, a witnessed Functional Demonstration Test (FDT) shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. This testing will require active participation by the Contractor, Owner, and the Engineer. This testing shall be performed by persons with a minimum of 24-hour OSHA HAZWOPER training.

C. Updated versions of the documentation specified to be provided during the ORT shall be made available to the Engineer at the job site both before and during the tests. In addition, one (l) copy of all O&M Manuals shall be made available to the Engineer at the job-site both before and during testing.

D. The daily schedule specified to be followed during the Factory Tests shall also be followed during the Functional Demonstration Testing.

E. After startup, the system shall operate for a continuous 100 hours without failure before the FDT will be considered successful. The system must operate without interference for 100 continuous hours and appropriately cycle all pumps, chemical feeds, treatment equipment, and extraction wells. Normal system downtime while the well refills the influent equalization tank shall be included in the 100-hour test, as needed. The performance test shall be performed at the system design flow rate of 20 gpm, or whatever flow rate is sustainable from the extraction wells, unless otherwise directed by the Engineer.

F. Water sampling: Performed during the FDT to ensure the system meets effluent water quality standards. Sample collection and laboratory analysis shall be coordinated by the Engineer. During the 100-hour test, samples shall be collected as detailed below.
  1. All samples collected during the FDT shall have laboratory results reported within 24 hours of collection. Preliminary results from the laboratory are acceptable.
  2. Official laboratory reports shall be provided to the Engineer.
  3. Samples may only be collected by persons with a minimum of 24-hour OSHA HAZWOPER training
  4. Sample locations and schedule are defined in Table 2 below.

Table 2. FDT Sample Schedule

Matrix	Sample Point	Type	Sampling Frequency	Total Number of Samples
Process water	Raw water influent (after influent tank)	Grab	Sample after four hours of operation, every day for rest of FDT	5
Process water	Treated effluent (after effluent tank)	Grab	Sample after four hours of operation, every day for rest of FDT	5
Air	Diffused aeration effluent	Grab	Sample after four hours of operation, every day for rest of FDT	5

  5. Analytes
    a. Raw and treated water samples
      1) VOCs: EPA Method 8260B (full list)
      2) TDS: Standard Method 2540C
      3) Field parameters
        a) pH
        b) Temperature
        c) Conductivity
        d) Dissolved oxygen
        e) Oxidation reduction potential
    b. Treated water samples only
      1) Total suspended solids (TSS): EPA Method SM2540D
      2) pH: EPA Method SM4500/9040C
    c. Air samples
      1) BTEX and MTBE: EPA Methods 8021B
      2) TPH: EPA method 8015D

G. Upon successful completion of the FDT and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete and the warranty period and operations and maintenance period shall commence.

END OF SECTION

SECTION 11 97 00

WELL PUMPS

PART 1 GENERAL

1.1 Summary

A. Section Includes:
   1. Well Pumps

B. Related Sections:
   1. Section 11 54 00.02 Groundwater Treatment Equipment
   2. Section 22 05 03.02 PVC Piping

1.2 References

A. National Electric Code
   1. NEC Section 250 43
   2. NEC Section 250 95
   3. NEC Section 310 11

1.3 Scope of Work

A. Installation of submersible pump, drop pipe, electrical wire, well cap, pitless adapter and appurtenances at eight (8) proposed extraction wells. Contractor to provide all labor, materials, equipment, tools, shipping, startup services, testing, training, superintendence, and incidental items necessary for a complete installation.

B. The Contractor shall familiarize himself with local conditions at the project site. Failure to do so shall in no way relieve Contractor of the responsibility for performing any of the Work or operations required as a part of this contract.

1.4 Submittals

A. As directed by the Engineer, Contractor or groundwater treatment equipment Supplier shall submit the following upon award of the Contract:
   1. Product Data:
      a. Pump
      b. Drop pipe
      c. Motor
      d. Submersible pump cable
      e. Controller
      f. Pitless adapter
   2. Manufacturer’s Installation Instructions.

1.5 Closeout Submittals

A. Pump Installation Report and O&M Manuals.

1.6 Qualifications

A. Installer: Company specializing in performing work of this section with minimum three (3) years experience.

1.7 Warranty

A. Contractor shall warrant against defects for all materials provided and work performed under this contract for a period of one (1) year from the date of Substantial Completion. The Contractor shall replace promptly, at the Contractor's own expense, any materials and workmanship that fail during this warranty period as determined by the Owner or Engineer.

PART 2 PRODUCTS

2.1 Submersible Pumping Units

A. Manufacturer:
   1. Grundfos:
   2. Model: 5SQE-320, 1-phase motors (Wells RW-1, RW-2, RW-3, RW-4)
   3. Model: SP 5S10-22, 3-phase motors, VFDs (Wells BW-7R, MW-11, MW-12, and MW-16). Well MW-13 will be set up for pumping as a contingency well, but a pump will not be installed.
   4. Substitutions: Substitutions permitted with Engineer’s Approval

B. Submersible pumping unit:
   1. Groundwater Treatment Equipment Supplier: Furnish pump, motor, cable, and appurtenances. Materials of construction shall be suitable for the influent water quality parameters shown in Table 1, Specification Section 11 54 00.
   2. Contractor: Furnish drop pipe and install equipment listed in this section.
   3. The pump shall be selected for best efficiency at a water flow rate of 2 and 4 gpm and total dynamic head (TDH) of 427-435 feet.
   4. Pump and motor to be powered using a variable frequency drive (VFD), if possible for the specified pump model.
   5. Additional electrical design resulting from selection of substitute equipment will be at the Contractor’s expense.

C. The motor shall be sized so that its nameplate horsepower is not exceeded throughout the entire range of the pump.
   1. Model 5SQE-320 shall be designed for continuous underwater operation on 208/240-volt, 1-phase, and 60-Hz current.
   2. Model: SP 5S10-22 shall be designed for continuous underwater operation on 480-volt, 3-phase, and 60-Hz current

2.2 Submersible Pump Cable

A. Use manufacturer recommended materials of construction for insulation and jacketing of the submersible pump cable. Unless otherwise indicated, the conductors shall be sized based upon the motor nameplate full-load amps, the capacity of the conductor, and the allowable voltage drop. In general, the allowable voltage drop shall be less than the difference between the service voltage and the nameplate voltage.

2.3 Pitless Adapter

A. Manufacturer:
   1. Baker Manufacturing Company - Monitor
   2. Model #8PL41U for the 4-inch wells or Engineer-approved equal.
   3. Model #8PL51U for the 5-inch wells or Engineer-approved equal.
   4. The unit shall be factory assembled, before shipping to the site.

2.4 Drop Pipe

A. Drop pipe: 1-inch Schedule 80 flush-threaded polyvinyl chloride (PVC).

2.5 Check Valves

A. Drop Pipe Check Valves:
   1. Manufacturers:
      a. Simmons, Series 600 SB Submersible Check Valve
      b. Substitutions: Permitted with Engineer’s Approval.
   2. Silicon bronze body, 400 psi WOG, PTFE, Viton, or approved equal O-ring, stainless steel spring, stainless steel washer and stainless steel locknut.

2.6 Pump Installation Report and O&M Manuals

A. The Contractor shall prepare a well pump installation report. All applicable information shall be included, and "NA" will be shown for those items that are not applicable.

B. Upon completion of the project, the Contractor shall furnish four (4) sets of operations and maintenance (O&M) manuals to the Owner. The manuals shall include:
   1. Operations manuals for all pumps, valves, and controls installed.
   2. Piping diagrams of all installed plumbing, valves, and controls.
   3. Safety data sheets for all chemical substances and solvents used in installation and construction.
   4. Electrical circuit diagrams of all controls, power supplies, transformers, and any other electrical equipment installed.

PART 3 EXECUTION

3.1 Installation

A. The well head completion shall be according to the drawings.

B. Install the submersible pump and appurtenances complete in place, to provide for a fully functioning extraction well. Install pump and motor in accordance with manufacturer's written instructions.

C. Pump Installation:
  1. Contractor shall verify that the well casing and screen are free of sediment. If sediment has accumulated, clean by bailing or other Engineer-approved method.
  2. Prior to installation of pumping equipment, Contractor to ensure pump outside diameter is at least 1 inch less than the inside diameter of the well casing to the pump installation depth.

D. Submersible pump cable:
  1. Padded to prevent abrasion and fastened to the drop pipe at approximate 10-foot intervals with stainless steel clamps or other fastening system approved by the Engineer.

E. Pitless adapter: install at the location indicated on the Drawings and in conformance with manufacturer installation instructions.

F. Column check valves: install at the location indicated on the Drawings and in conformance with manufacturer installation instructions.

G. Submersible pumping unit: install to the depth shown on the Drawings and in conformance with manufacturer installation instructions.

3.2 Field Test of Pump Performance

A. Initial Testing of Submersible Pumps
  1. Untreated discharge from pump testing must be containerized or recirculated back to the same extraction well. Discharge to surface or sewer will not be permitted.
    a. If untreated water is containerized, it is the Contractor’s responsibility to properly dispose of the containerized water and all associated costs will be considered incidental to the Work.
    b. Temporary plumbing may be installed to allow recirculation of water back to the same extraction well.
    c. If water is to be containerized, ensure the temporary storage vessel has a working level indicator.
  2. Start motor and verify immediately correct shaft rotation.
  3. Check and record motor running volts and amps.
  4. Verify correct operation of all interlocking and protective devices.

B. Field testing of submersible pumps shall be included as part of the Operation Readiness Testing (ORT) performed for the containerized treatment equipment as specified under Section 11 54 00.02 Groundwater Treatment Equipment.

3.3 Cleanup

A. After the work is completed, the Contractor shall remove all debris, tools, equipment, supplies, and excess material from the site and shall restore the site to its original condition, as approved by the Owner/Engineer.

END OF SECTION

SECTION 22 05 03.01

HIGH DENSITY POLYETHYLENE PIPE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Casing pipe under Commerce Way and N Prince Street.
   2. HDPE pipe.
   3. HDPE fittings.
   4. HDPE burial.
   5. HDPE joining.
   6. HDPE testing.

B. Related Sections:
   1. Section 31 23 17 – Trenching, Backfill, and Compaction
   2. Section 31 70 00 – Boring and Tunneling Conduits

1.2 REFERENCES

A. ASTM International
   1. ASTM D1248 - Standard Specification for Polyethylene Molding and Extrusion Materials.
   2. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameters.
   3. ASTM D2122 - Determining Dimensions of Thermoplastic Pipe and Fittings.
   4. ASTM D2241 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
   5. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
   6. ASTM D2513 - Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
   7. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
   8. ASTM D2657 - Standard Practice for Heat-Joining Polyolefin Pipe and Fittings.
   9. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
   10. ASTM D2774 - Underground Installation of Thermoplastic Pressure Piping.
   11. ASTM D2837 - Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pressure Piping.
   12. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
   13. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.

14. ASTM F412 - Standard Terminology Relating to Plastic Piping System.
15. ASTM F1248 - Standard Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.

B. American Water Works Association (AWWA):
  1. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, ½ in. through 3 in., for Water Service.

C. Plastic Pipe Institute (PPI):
  1. Handbook of Polyethylene Pipe.
  2. TR-33, Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.

1.3 SUBMITTALS

A. Product Data: Submit data on pipe sizes, materials and fittings. Submit manufacturers catalog information.

1.4 QUALITY ASSURANCE

A. Manufacturer Quality Assurance:
  1. Manufacturer shall maintain a continuous quality control program.
  2. Material certification shall be included verifying that the materials have been tested for conformance with ASTM D3350 and that the pipe material has exceeded 5,000 hours without failure when tested under F1248.

B. HDPE pipe and fittings shall be provided from one approved manufacturer.

C. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing work of this section with minimum five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All necessary precautions shall be taken to prevent damage or contamination to pipe and other materials during shipment and delivery.

B. All materials shall be securely fastened to truck or rail car to prevent movement or damage during shipment.

C. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

E. All pipe materials shall be handled in such a manner as to prevent damage. HDPE pipe shall not be dropped, rolled or pushed off from any height during delivery, storage or installation.

F. All pipe materials shall be stored off the ground in a dry location.

G. All pipe materials shall be stored in such a manner as to prevent sagging or bending.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 POLYETHYLENE PRODUCTS

A. Manufacturers:
  1. ISCO Industries.
  2. Polypipe, Inc.
  3. Performance Pipe, Inc.
  4. Substitutions: Permitted with the Engineer's approval.

B. Polyethylene Pipe: Pipe shall be provided in diameters, pressure classes, and dimension ratios (DR) as shown on the plans and in accordance with ASTM D3035. Also:
  1. HDPE pipe shall be manufactured from extra high molecular weight polyethylene pipe materials meeting the requirements of cell classification PE345464C Standard PE Code Designation PE3408 as defined by ASTM D3350.
  2. Fittings: AWWA C901, molded.
  3. Joints: Butt fusion by a qualified technician, trained by an approved manufacturer's representative, and in accordance with the manufacturer's recommended procedures.

C. Typical Material Physical Properties: All pipe and fitting materials shall meet these typical physical properties:

D. HDPE Fittings:
  1. The fittings shall be manufactured from the same cell class resin and fully pressure rated to the same pressure rating as the designed piping system.
  2. Shall have a controlled outside diameter and produced to the SDR/DR rating for the pressure specified by the Engineer.

3. Shall be specifically manufactured to the standardized dimensions noted on the Drawings.
4. Where applicable, fittings shall meet the requirement of AWWA C901 or AWWA C906.
5. Butt fusion fittings shall be manufactured from the same material as the extruded pipe, shall be rated for the pressure service at least equal to that of the system pipe, and shall have outlets manufactured to the same DR as that of system pipe.
6. Molded fittings shall be manufactured in accordance with ASTM D3261.
7. Socket fittings shall be manufactured in accordance with ASTM D2683.

2.2 UNDERGROUND PIPE MARKERS

A. Underground pipe marker shall be metallic detectable brightly colored plastic tape.

2.3 BEDDING AND COVER MATERIALS

A. Bedding, cover, and backfill shall be as specified in Sections 31 23 17 and as indicated on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Contractor shall inspect all piping to assure that the piping is free from defects in material and workmanship.

B. Compatibility of all pipe and fittings shall be verified.

C. Pipe, fittings and accessories that are cracked, damaged, not identified or in poor condition shall be rejected.

D. The Engineer shall have free access to all joints and test joints for determining the suitability of the joining process.

E. Where construction restrictions limit inspection of joints, the Engineer may have the person joining the pipe and or fittings perform a test joint in the presence of the Engineer.

F. The Engineer shall determine the method of testing either by visual examination or bent strap testing.

G. Verify excavations are to required grade, dry, and not over-excavated.

H. Verify trenches are ready to receive piping.

3.2 PREPARATION

A. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection size, location, and inverts are as indicated on Drawings.

B. Joining
   1. The pipe and fittings shall be heat fused creating a homogeneous joint.
   2. Joining shall be in accordance with the manufacturer's heat fusion recommendations.
   3. Joints shall not be of the solvent welded type.
   4. Each person making heat fusion joints shall demonstrate proficiency by making joints and test the trial fusion by bent strap testing in accordance with ASTM D2657.
   5. Trial joints shall be allowed to cool completely prior to testing and shall not fail at the joint.
   6. During construction, at the Engineer’s discretion, a trial fusion shall be made which shall then be allowed to cool and destructively bent strap tested.
   7. If the trial fusion should fail, additional trial fusions shall be made and tested until successful fusions are completed.
   8. The procedure used to join the trial fusion shall be used for the balance of the day's work, proved the procedure is within the limitations recommended by the manufacturer.
   9. The Engineer shall have the authority to disallow any installer's from completing heat fusion of polyethylene pipe if that technician has consecutively failed trial joints.
   10. Any person deemed unqualified by the Engineer will require training per Manufacturer’s guidelines at the expense of the Contractor and training shall be documented and submitted to the Engineer.
   11. The equipment used to make the heat fusion joint shall be capable of recording the heating and fusion pressures used to join the pipe, recording heater temperature, and storing this information for retrieval.
   12. Each field fusion shall be recorded by such equipment and this information shall be made available to the Engineer's representative.

C. Excavate pipe trench in accordance with Section 31 23 17.

D. Install pipe as indicated on Drawings.

E. Install pipe to allow for expansion and contraction without stressing pipe or joints.

F. Install detectable plastic ribbon tape continuously 12 inches above pipeline; coordinate with Section 31 23 17.

3.4 BURIAL

A. All polyethylene pipe must be installed to minimize shear and tensile stresses.

B. Pipe shall be installed in a trench as specified in the construction drawings.

C. Minimum burial depth is specified in the Drawings.

D. The Contractor shall take care to insure haunching material is well placed as to not disturb the pipeline.

E. Final backfill material may consist of the excavated material as specified in the Drawings provided it is free of unsuitable matter, such as clumps of clay, stones, construction debris, and frozen clods of dirt, unless final backfill is under a roadway.

F. Final backfill material shall be compacted as shown on the Drawings. Proctor density shall be determined by ASTM D698 for compaction and density of soils.

G. All polyethylene pipe shall use warning tape for future location.

END OF SECTION

SECTION 22 05 03.02

PVC PIPE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
  1. Pipe and pipe fittings for the following systems:
    a. SVE conveyance system
    b. Groundwater conveyance system
    c. Extraction well drop pipe
  2. Pipeline Test Report Form

B. Related Sections:
  1. Section 22 05 23 - General Duty Valves.
  2. Section 31 23 17 - Trenching, Backfilling, and Compaction
  3. Section 31 70 00 - Boring and Jacking.

C. ASTM International:
  1. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  2. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  3. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  4. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  5. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

1.2 SUBMITTALS

A. Product Data: Submit data on pipe sizes, materials and fittings. Submit manufacturers catalog information.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 COORDINATION

A. Coordinate installation of buried piping with trenching.

PART 2 PRODUCTS

2.1 PVC PRODUCTS

A. PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material.
   1. Fittings: ASTM D2466, Schedule 40, PVC.
   2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

B. PVC Pipe: ASTM D1785, Schedule 80, PVC material
   1. Fittings: ASTM D2467, Schedule 80, PVC.
   2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.2 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, detectable metallic, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.3 BEDDING AND COVER MATERIALS

A. Bedding, cover, and backfill shall be as specified in Section 31 23 17 and as indicated on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

B. Verify trenches are ready to receive piping.

3.2 PREPARATION

A. Remove burrs.

B. Remove dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection sizes, locations, and inverts are as indicated on Drawings.

B. Excavate pipe trench in accordance with Section 31 23 17.

C. Install pipe to elevation as indicated on Drawings.

D. Install pipe on prepared bedding.

E. Install valves at locations indicated on Drawings in accordance with this Section.

F. Install plastic ribbon tape continuously buried 12 inches, above pipe line; coordinate with Section 31 23 17.

G. Pipe Cover and Backfilling:
   1. Backfill trench in accordance with Section 31 23 17 and as indicated on the Drawings.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain appropriate gradients. Route parallel and perpendicular to fences and equipment.

B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

F. Install piping penetrating roofed areas to maintain integrity of roof assembly.

G. Install valves in accordance with the manufacturer's instructions.

H. Insulate piping as shown in the Drawings.

3.5 FIELD QUALITY CONTROL

A. The Contractor shall test each SVE line by applying a pressure of 10 psig and holding it for a minimum of 15 minutes. Measured pressure shall be at least 90% of the applied pressure (9 psig) at the end of the test period. Contractor and Engineer to document results using forms found in this specification.

B. The Contractor shall test the groundwater conveyance line by applying a pressure of 150 psig and holding it for a minimum of two hours. During the test, the test pressure should not lose more than 10 psig without being pumped back up to test pressure. Contractor and Engineer to document results using forms found in this specification.

Leakage Allowed (L_{ALL}):

$$L_{ALL} = SD(\sqrt{P})/133{,}200 \text{ (gal/hr)}$$

S = Length (ft)

D = size (in)

P = Pressure (psi – gauge)
(average test pressure during the hydrostatic test)

END OF SECTION

PIPELINE TEST REPORT

Operating Company: ____

Testing Company: ____

This form must be completed for each section of newly installed section of pipe or service line and on each service line that is disconnected from the main for any reason.

Test Data

Type of Pipe/Line: ____

Size of Pipe: ___________________ inches Length of Line: ______________________

Location of Line: ____

Tested with: Air ( ) Water ( )

Time Started: ______________a.m./p.m. Time Ended: ________________a.m./p.m.

Test Pressure Start: _________________psig Test Pressure Stop: __________________psig

Line Loss: Yes _________ No __________ Amount Lost: ________________________

Allowable Loss per Specification: _______________ Pass _________ Fail _________

Reason for Line Loss: ____

____

____

Corrective Measures Taken: ____

____

____

Remarks: ____

____

DBS&A Representative: ____

Signature: _________________________________ Date: ____________________________

Contractor Representative: ____

Signature: _________________________________ Date: ____________________________

SECTION 22 05 19

GAUGES AND SENSORS

PART 1 GENERAL

1.1 Summary

A. Section Includes:
  1. Analog dial-type vacuum gauges for SVE system lines.
  2. Analog dial-type pressure gauges for groundwater extraction wells.
  3. Groundwater extraction well flow meters per drawings.

B. Accessories to be furnished and installed at the locations indicated on Drawings.

C. Allowances:
  1. Gauges, meters, and sensors shall be considered incidental.

1.2 References

A. Except as modified or supplemented herein, all gauges shall conform to the requirements of:
  1. ANSI/ASME B40.100
  2. ANSI Grade 2A or better

1.3 Submittals

A. Shop Drawings: Required.

B. Product Data: Required.

C. Manufacturer's Installation Instructions: Required.

1.4 Closeout Submittals

A. Project Record Documents: Required.

B. Operation and Maintenance Data: Required.

1.5 Warranty

A. Furnish manufacturer’s warranty.

PART 2 PRODUCTS

2.1 Vacuum Gauges

A. Manufacturers:
  1. Dwyer Series LPG3 Low Pressure Gauge.
  2. Substitutions: Permitted with the Engineer’s approval.

2.2 Pressure Gauges

A. Manufacturers:
  1. Dwyer Series SG1 Industrial Pressure Gauge.
  2. Substitutions: Permitted with the Engineer's approval.

2.3 Flow Meters

  1. Per the Drawings. Substitutions permitted with the Engineer's approval.

2.4 Gauge and Sensor Construction

A. Dwyer Series LPG3
  1. Unless otherwise specified, gauges shall be indicating dial type with:
    a. Drawn steel housing.
    b. Polycarbonate lens.

B. Dwyer Series SG1
  1. Unless otherwise specified, gauges shall be indicating dial type with:
    a. 304 stainless steel housing.
    b. Shatter-proof safety glass lens.

2.5 Operation

A. The dial shall be 3 inches diameter or less with a white background and black markings.

B. The units of measurement shall be indicated on the dial face.

C. Subdivisions of scale shall conform to the requirements of the governing standard.

D. Point travel shall be not less than 200 degrees or more than 270 degrees.

E. Connection shall be ¼-inch male NPT.

2.6 Mounting

A. The mounting configuration of each gauge shall be as indicated on the Drawings.

B. Connections
  1. As necessary, depending on the thickness class and size of the gauged pipe, a tap or saddle shall be located on the pipe, fitting, or appurtenance to be gauged.

2. The attachment shall be made by an appropriately sized NPT nipple in the tap or saddle.
3. Nipples or elbows or combination thereof shall be long enough such that the edge of the gauge case does not contact the pipe; however, in no case shall the distance from the edge of the pipe to the centerline of the gauge exceed 6 inches without prior approval of the Engineer.

PART 3 EXECUTION

3.1 Installation

A. Gauges and meters shall be installed at the locations indicated on the Drawings.

B. Gauges and meters shall be installed per the manufacturer's guidelines and directions.

C. All gauges shall be installed in the vertical upright position, unless indicated otherwise in the Drawings.

D. Threaded connections shall be assembled using Teflon thread tap or Teflon thread sealer, as specified in the miscellaneous piping section.

3.2 Field Quality Control

A. Test: Verify all gauge and sensor installations are free from leaks.

3.3 Schedule

ID	Range	Manufacturer	Model	Count
VG-301	–100 to 0” w.c	Dwyer	LPG3	3
PG-201	0-150 psi	Dwyer	SG1	9
FM-101	0-10 gpm			9

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES

PART 1 GENERAL

1.1 Summary

A. Furnish all labor, materials, equipment, and incidentals required to install all valves necessary for the soil vapor extraction, treatment, and groundwater treatment systems including but not limited to wells, piping, and equipment.

B. Section Includes:
  1. Ball valves
  2. Butterfly valves
  3. Gate valves
  4. Check valves

1.2 References

A. ASTM International:
  1. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  2. ASTM D4101 - Standard Specification for Polypropylene Injection and Extrusion Materials
  3. ASTM/ASME B16.34 - Valves-Flanged, Threaded, and Welding End
  4. ASTM B61-15 - Standard Specification for Steam or Valve Bronze Castings

B. Manufacturers Standardization Society of the Valve and Fittings Industry:
  1. MSS SP 67 - Butterfly Valves
  2. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
  3. MSS SP 80 - Bronze Gate, Globe, Angle, and Check Valves

1.3 Submittals

A. Product Data: Submit manufacturer’s catalog information with valve data and ratings for each service.

B. Manufacturer’s Installation Instructions: Submit hanging and support methods, joining procedures.

C. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

1.4 Closeout Submittals

A. Project Record Documents: Record actual locations of valves.

B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 Quality Assurance

A. Maintain one copy of each document at the site.

1.6 Delivery, Storage, and Handling

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.7 Environmental Requirements

A. Do not install valves underground when bedding is wet or frozen.

1.8 Warranty

A. Furnish one-year manufacturer warranty for valves excluding packing.

1.9 Extra Materials

PART 2 PRODUCTS

2.1 Butterfly Valves

A. Manufacturers:
  1. Asahi/America, Inc, Model Type 57.
  2. Substitutions: Permitted with the Engineer’s approval.

B. 8-inch (BFV-801): 150 psi at 73°F water temperature, maximum service temperature: 140°F, one-piece body, ASTM D1785 PVC, lug type flange facing, disc encapsulated with EPDM, stainless steel shaft, locking lever handle.

2.2 Ball Valves

A. Manufacturers:
  1. American Valve Company, Model p200S.
  2. Substitutions: Permitted with the Engineer’s approval.

B. 2-inch (BV-201): SCH 40 PVC, pressure class 150 psi at 73°F, max temperature 140°F, in compliance with ASTM F1970, female solvent-weld socket dimensions ASTM D2467.

2.3 Gate Valves

A. Manufacturers:
  1. Sharpe, Series 30276

2. FNW, Model 200 WOG
3. NIBCO, Class 125, 200 WOG
4. Substitutions: Permitted with the Engineer’s approval.

B. 1-inch (GV-101): Stainless steel or bronze body, threaded, non-rising stem, pressure test API 598.

2.4 Check Valves

A. Manufacturers:
  1. Simmons, Series 600 SB Submersible Check Valve
  2. Substitutions: Permitted with the Engineer’s approval.

B. Silicon bronze body, 400 psi WOG, PTFE, Viton, or approved equal O-ring, stainless steel spring, stainless steel washer and stainless steel locknut.

PART 3 EXECUTION

3.1 Examination

A. Verify piping system is ready for valve installation.

3.2 Installation

A. Install valves with stems upright or horizontal, not inverted, unless indicated otherwise on the Drawings.

B. Install valves with clearance for installation of insulation and allowing access.

C. Provide access where valves and fittings are not accessible.

D. Install butterfly valves with appropriate length handles to allow for ease of operation.

3.3 Valve Applications

A. Install valves at locations indicated on the Drawings in accordance with this Section.

B. Install ball or butterfly valves to isolate equipment, part of systems, or vertical risers.

C. Install ball or butterfly valves for throttling, bypass, or manual flow control services.

D. Install gate valves for throttling, bypass, or manual flow control services.

3.4 Schedules

Valve ID	Valve Type	Material	Size, inches	Number of Valves
BFV-801	Butterfly	PVC		3
BV-201	Ball Valve	PVC		20
GV-101	Gate Valve	SS		9
CV-101	Check Valve	Bronze	1	8

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 GENERAL

1.1 Summary

A. Section Includes:
   1. Plumbing, insulation, jackets, and accessories for exterior, aboveground piping.

B. Related Sections
   1. Section 22 05 23 General Duty Valves
   2. Section 22 05 03.02 PVC Pipe

1.2 References

A. ASTM International:
   1. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
   2. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
   3. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
   4. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
   5. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
   6. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
   7. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
   8. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
   9. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 Submittals

A. Product Data: Submit product descriptions, thermal characteristics, and material thickness for each service, and location.

B. Samples: Submit two samples of representative size illustrating each insulation type.

C. Manufacturer's Installation Instructions: Submit manufacturer's published literature indicating proper installation procedures.

D. Manufacturer's Certificate: Certify that products meet or exceed the specified requirements.

1.4 Quality Assurance

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index not exceeding 450, in accordance with ASTM E84.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Maintain 2 copies of each document on-site.

1.5 Qualifications

A. Manufacturer: A company specializing in manufacturing products specified in this section, with a minimum of three (3) years of experience.

B. Applicator: A company specializing in performing the Work described in this section, with a minimum of three (3) years of experience.

1.6 Delivery, Storage, and Handling

A. Accept materials on-site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect materials from weather and construction traffic, dirt, water, chemicals, and damage, by storing in original wrapping and in a dry storage area.

1.7 Environmental Requirements

A. Install insulation only when ambient temperature and humidity conditions are within the range recommended by the manufacturer.

B. Maintain the temperature before, during, and after installation, for a minimum period of 24 hours.

1.8 Field Measurements

A. Verify field measurements prior to fabrication.

1.9 Warranty

A. Furnish 1-year manufacturer warranty for insulation and jacketing.

PART 2 PRODUCTS

2.1 Manufacturers

A. Manufacturers for Insulation and Jacketing Products:
   1. CertainTeed.
   2. Knauf.
   3. Johns Manville.
   4. Substitutions: Permitted with Engineer’s Approval

2.2 Pipe Insulation

A. Product Description: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.
   1. Thermal Conductivity: 0.23 at 75°F.
   2. Operating Temperature Range: 0 to 450°F.
   3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
   4. Jacket Temperature Limit: –20 to 150°F.
   5. Minimum thickness: 2 inches.

2.3 Pipe Insulation Jackets

A. PVC Plastic Pipe Jacket:
   1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
   2. Thickness: 30 mil.
   3. Connections: Brush on welding adhesive.

B. Field Applied Glass Fiber Fabric Jacket System:
   1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
   2. Glass Fiber Fabric:
      a. Cloth: Untreated; 9 oz/sq yd weight.
      b. Blanket: 1.0 lb/cu ft density.
      c. Weave: 10 x 10.
   3. Indoor Vapor Retarder Finish:
      a. Cloth: Untreated; 9 oz/sq yd weight.
      b. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.4 Pipe Insulation Accessories

A. Adhesives: Compatible with insulation.

B. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

PART 3 EXECUTION

3.1 Examination

A. Verify piping has been tested before applying insulation materials per Section 22 10 00 Plumbing and Piping.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 Installation: Piping Systems

A. Exterior Piping: Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with jacket with seams located at 3 or 9 o’clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

END OF SECTION

SECTION 22 30 10

HIGH DENSITY POLYETHYLENE TANKS

PART 1 GENERAL

1.1 SUMMARY

A. This specification covers upright, single-walled, flat bottom SVE condensate storage tank assemblies. The tank is designed for aboveground, vertical installation, and is capable of containing fluids at atmospheric pressure. Tank capacity shall be per the drawings.

B. This specification also covers groundwater storage tank assemblies. The tank is designed for aboveground, vertical installation, and is capable of containing fluids at atmospheric pressure. Tank capacity shall be per the drawings.

1.2 MATERIALS

A. The material used shall be virgin polyethylene resin.

1.3 DIMENSIONS AND TOLERANCES

A. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.

1.4 SUBMITTALS

A. Product Data: Submit complete information concerning materials of construction, fabrication, and fitting installation locations.

1.5 SCHEDULING

A. Schedule prior to connecting piping work.

1.6 COORDINATION

A. Coordinate work with location and placement of utilities.

PART 2 PRODUCTS

2.1 TANKS

A. Manufacturers:
   1. Snyder Industries, Inc
   2. Substitutions: Permitted with approval of Engineer.

B. Product Description:
  1. 300 gallon single-walled tanks
  2. 600 gallon single-walled tanks

2.2 WORKMANSHIP

A. The finished tanks wall shall be free, as practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminating that will impair the serviceability of the vessel.

B. All edges where openings are cut into the tanks shall be trimmed smooth.

2.3 THREADED BULKHEAD FITTINGS

A. Furnish threaded bulkhead fittings as required to connect tank to piping as indicated on the Drawings.

B. The bulkhead fittings shall be constructed of polyvinyl chloride (PVC), polypropylene (PP), or other specified material. Gaskets shall be a minimum of ¼ in. thickness and constructed of EPDM.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Inspect tanks for damage.

B. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

3.2 EXAMINATION

A. Verify layout and orientation of tank accessories and piping connections prior to placement.

3.3 INSTALLATION

A. Install storage tanks as indicated on the Drawings and in accordance with manufacturer’s instructions.

B. Connect piping to tank.

C. Install tank accessories not factory-mounted to complete installation.

3.4 FIELD QUALITY CONTROL

A. Field Testing:
1. Hydrostatically test the storage tank by filling with water to the overflow pipe level.
2. Conduct test minimum of 24 hours.
3. No leakage is permitted.
4. Adjust, repair, modify, or replace components of system failing to perform as specified and rerun tests.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Removing surface debris.
   2. Removing designated paving, curbs, and sidewalks.
   3. Removing designated trees, shrubs, and other plant life.
   4. Removing abandoned utilities.
   5. Excavating topsoil.

B. Related Sections:
   1. Section 31 23 17 - Trenching, Backfilling, and Compaction

1.2 DEFINITIONS

A. Clearing: Clearing is the removal from the ground surface and disposal of trees, brush, shrubs, down timber, decayed wood, other vegetation, concrete, rubbish, and debris, as well as the removal of fences, stockpiled materials, and incidental structures such as recycle bins.

B. Grubbing: Grubbing is the removal and disposal of all stumps, buried logs, roots, matted roots, and organic materials.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with applicable State of New Mexico Standard Specifications.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 DISPOSITION OF TREES AND SHRUBS

A. General
   1. Trees and shrubs within the limits of work shall be removed only where shown on the Drawings. Do not cut or damage trees unless so indicated or unless written permission has been obtained from the affected property owner. Three

copies of such permission shall be furnished to the ENGINEER before removal operations commence.

B. Trees and Shrubs to be Removed
  1. Trees and shrubs felled within the limits of work shall have their stumps grubbed and removed to a licensed disposal site. Depressions created by such removal shall be filled with suitable backfill and compacted to match properties of existing terrain.

3.2 CLEARING AND GRUBBING

A. Clear all items specified herein to the limits indicated or as directed by the ENGINEER and stockpile cleared and grubbed material onsite. Do not start earthwork operations in areas where clearing and grubbing is not complete, with the exception that stumps and large roots may be removed concurrent with excavation. Comply with erosion and sediment control and storm water management measures.

B. Clear and grub areas to be excavated, areas to receive fill, and areas upon which structures are to be constructed, as directed by the ENGINEER. Remove all trees, stumps, and root mats in these areas and dispose of them offsite at no cost to the property owner. Depressions made by the removal of stumps or roots shall be filled with suitable backfill.

C. The CONTRACTOR shall clear, grub, and strip the site area to the limits of disturbance shown on the Contract Drawings. Clearing and grubbing shall not be performed more than 60 days before excavation is to begin.

END OF SECTION

SECTION 31 23 17

TRENCHING, BACKFILLING, AND COMPACTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. This Section shall be supplemental to 701 of the New Mexico Standard Specifications for Public Works Construction. Section 701 shall apply except as modified in this Section.

B. Related Sections:
   1. Section 31 10 00 - Site Clearing
   2. Section 22 05 03.01 - High Density Polyethylene Pipe
   3. Section 22 05 03.02 - PVC Pipe

1.2 REFERENCES

A. New Mexico Standard Specifications for Public Works Construction:
   1. Section 701 - Trenching, Excavation and Backfill

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

B. Trench Zone: The trench zone includes the portion of the trench from the top of the pipe zone to the existing surface in unpaved areas.

C. Pipe Zone: The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12 inches above the top of the pipe. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level 12 inches above the top of the highest or topmost pipe.

D. Pipe Bedding: The pipe bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe bedding shall be as shown on the drawings or as described in these specifications.

E. Excess Excavated Material
   1. The Contractor shall make the necessary arrangements for and shall remove and dispose of all excess excavated material.
   2. No excavated material shall be deposited on private property unless written permission from the Engineer is secured by the Contractor.

1.4 TRENCH SAFETY

A. All excavations shall be performed, protected, and supported as required for safety. In all cases, Contractor shall ensure that all excavation and trenching methods meet or exceed safety requirements as set forth by local, state and federal agencies.

B. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all traffic of such excavations.

C. No trench or excavation shall remain open and exposed to vehicular or foot traffic during non-working hours. The trench or excavation shall be fenced off, or covered with steel plates, spiked in place, or backfilled.

D. The Contractor shall notify the Engineer of all work-related accidents which may occur to persons or property at or near the project site, and shall provide the Engineer with a copy of all accident reports. All accident reports shall be signed by the Contractor or its authorized representative and submitted to the Engineer within twenty-four (24) hours of the accident's occurrence.

1.5 ACCESS

A. Unobstructed access must be provided to all driveways or other property or facilities that require routine use. Temporary closures of driveways require written approval of the property owner and confirmation from the Engineer.

1.6 PERMITS

A. The Contractor shall keep a copy of all the required permits in the job site and comply with all the terms and conditions of said permits.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with applicable State of New Mexico Standard Specifications for Public Works Construction.

B. Perform hydrostatic testing on installed pipe per Section 22 05 03.02 prior to covering pipe.

1.8 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Native Earth Backfill: Native earth backfill, acceptable for use, shall be fine-grained material free from roots, debris, and rocks with a maximum dimension not larger than 3 inches.

B. Imported Backfill Material: Whenever the excavated material is not suitable for backfill, the Contractor shall arrange for and furnish suitable imported backfill material that is capable of attaining the required relative density.

C. The Contractor shall dispose of the excess trench excavation material as specified in the preceding section. Backfilling with imported material shall be done in accordance with the methods described herein.

PART 3 EXECUTION

3.1 COMPACTION REQUIREMENTS

A. Determine laboratory moisture-density relations of existing soils by ASTM D698.

B. Determine the relative density of cohesionless soils by ASTM D2049.

C. Sample backfill materials by ASTM D75.

D. Express "relative compaction" as the ratio, expressed as a percentage; of the in place dry density to the laboratory maximum dry density.

E. Compaction shall be deemed to comply with the specifications when no test falls below the specified relative compaction.

F. The Contractor will secure the services of a soils tester and pay the costs of all compaction testing. The Contractor will be responsible for the cost of all retests in failed areas. Test results will be furnished to the Engineer immediately upon conclusion of the test.

G. If the backfill fails to meet the specified relative compaction requirements, the Contractor shall rework the backfill until the requirements are met. The Contractor shall make all necessary excavations for density tests as directed by the Engineer. The Contractor will be responsible for the cost of all additional compaction tests in the reworked areas.

H. Compaction tests shall be performed at 2 foot depths and at 200-foot intervals or as per section A-1 of Standard Specification 701.

I. Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as described below:
  1. Pipe zone and pipe base: 85% relative compaction.
  2. Trench zone not beneath paving: 90% relative compaction.
  3. Trench zone beneath paving: 95% relative compaction.

4. Work performed in roadways shall be done in accordance with section A-1 of Standard Specification 701 and approval of the roadway Owner.

3.2 MATERIAL REPLACEMENT

A. Removal and replacement of any trench and backfill material which does not meet the specifications shall be the Contractor's responsibility.

3.3 TRENCHING

A. Excavation for pipe, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the facilities as shown on the plans.

B. Trench banks shall be kept as near to vertical as possible and shall be properly braced and sheeted.

3.4 BRACING

A. The Contractor's design and installation of bracing and shoring shall be consistent with OSHA rules, orders, and regulations.

B. Excavations shall be so braced, sheeted, and supported that they will be safe such that the walls of the excavation will not slide or settle and all existing improvements of any kind, either on public or private property, will be fully protected from damage.

C. The sheeting, shoring, and bracing shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

D. Care shall be exercised in the drawing or removal of sheeting, shoring, bracing, and timbering to prevent the caving or collapse of the excavation faces being supported.

3.5 TRENCH WIDTHS

A. Excavation and trenching shall be true to line with a minimum width of the largest outside diameter of the pipe + 12 inches and a maximum width of the largest outside diameter of the pipe + 24 inches. Width of trenches for multiple pipes will keep a distance of 12 inches between pipes.

3.6 LENGTH OF OPEN TRENCH

A. The maximum allowable length of open trench shall be the distance necessary to accommodate the amount of pipe installed in a single day.

3.7 GRADE

A. Excavate the trench to the lines and grades shown on the Drawings with allowance for pipe thickness and for pipe base or special bedding.

B. The trench bottom shall be graded to provide a smooth, firm, and stable foundation that is free from rocks and other obstructions and shall be at a reasonably uniform grade.

3.8 CORRECTION OF OVER EXCAVATION

A. Where excavation is inadvertently carried below the design trench depth, suitable provision shall be made by the Contractor to adjust the excavation, as directed by the Engineer, to meet requirements incurred by the deeper excavation.

B. Over excavations shall be corrected by backfilling with approved graded crushed rock or gravel and shall be compacted to provide a firm and unyielding subgrade or foundation, as directed by the Engineer.

3.9 FOUNDATION STABILIZATION

A. Whenever the trench bottom does not afford a sufficiently solid and stable base to support the pipe or appurtenances, the Contractor shall excavate to a depth below the design trench bottom, as directed by the Engineer, and the trench bottom shall be backfilled with 3/4-inch rock and compacted to provide uniform support and a firm foundation.

B. Where rock is encountered, (see Section 3.10 C) it shall be removed to a depth at least 6 inches below grade and the trench shall be backfilled with 3/4-inch crushed rock to provide uniform support and a firm foundation.

C. If excessively wet, soft, spongy, unstable, or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall removed to a depth as determined in the field by the Engineer and replaced by crushed rock to provide uniform support and a firm foundation.

3.10 EXCAVATED MATERIAL

A. All excavated material shall not be stockpiled in a manner that will create an unsafe work area or obstruct sidewalks or driveways.

B. In confined work areas, the Contractor may be required to stockpile the excavated material off-site, as determined by the Engineer.

C. Rock excavation is defined as boulders, sedimentary, or igneous rock that cannot be removed without continuous use of pneumatic tools or blasting.

3.11 PLACING OF PIPE BEDDING

A. Place the thickness of pipe bedding material over the full width of trench necessary to produce the required bedding thickness when the material is compacted to the specified relative density. Grade the top of the pipe bedding ahead of the pipe to provide firm, uniform support along the full length of pipe. Pipe bedding should not be composed of rocks or deleterious materials which may come in contact with the pipe.

3.12 BACKFILLING WITHIN PIPE ZONE

A. After pipe has been installed in the trench, place pipe zone material simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

3.13 BACKFILLING WITHIN TRENCH ZONE

A. Push the backfill material carefully onto the backfill previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

B. The remaining portion of the trench to the street zone or ground surface, as the case may be, shall be backfilled, compacted and/or consolidated by approved methods to obtain the specified relative compaction.

   1. Compaction using vibratory equipment, tamping rollers, pneumatic tire rollers, or other mechanical tampers shall be done with the type and size of equipment necessary to accomplish the work. The backfill shall be placed in horizontal layers of not greater than 12-inches depth. Each layer shall be evenly spread, properly moistened, and compacted to the specified relative density as given on the drawings. The Contractor shall repair or replace any utility, pipe, fittings, manholes, or structures as directed by the Engineer damaged by the Contractor's operations.

END OF SECTION

SECTION 31 70 00

BORING AND TUNNELING CONDUITS

PART 1 GENERAL

1.1 Summary

A. This Section covers road crossings under all paved roads including:
  1. Excavation for approach trenches and pits
  2. Casing pipe
  3. Carrier pipe

B. Related Sections:
  1. Section 22 05 03.01- High Density Polyethylene Pipe
  2. Section 31 23 17 - Trenching, Backfilling, and Compaction

1.2 References

A. New Mexico Standard Specifications for Public Words Construction.
  1. NM APWA Section 710 - Boring, Drilling, and Jacking

1.3 Design Requirements

A. Design bracing, backstops, and use jacks of sufficient rating for continuous jacking without stoppage, except for adding pipe sections and, as conditions permit, to minimize tendency of ground material to “freeze” around casing pipe.

1.4 Submittals

A. Installation Plan: Submit description of proposed construction plan, dewatering plan, and plan to establish and maintain vertical and horizontal alignment.

B. Submit emergency response procedures to handle situations when conduit is compromised and jeopardizes integrity of installation or safety.

C. Project Record Documents: Record actual locations of casing, carrier pipe, and invert elevations.

D. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 Quality Assurance

A. CONTRACTOR shall have a copy of the NMDOT permit and its attachments on the job at all times. Deviations from the approved permit must have prior approval of NMDOT.

1.6 Qualifications

A. Installer: Company specializing in performing work of this section with a minimum of three (3) years documented experience.
   1. Work Experience: Include projects of similar magnitude and conditions.
   2. Furnish list of references upon request.

1.7 Delivery, Storage, and Handling

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Accept system components on site in Manufacturer’s original containers or configuration. Inspect for damage.

C. Support casing and carrier pipes with nylon slings during handling.

D. All construction equipment and materials stored on highway right of way shall be stored in such a manner and at such locations (a minimum of 30 feet from nearest traffic lane) as not to interfere with the safe passage of traffic.

1.8 Environmental Requirements

A. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.9 Field Measurements

A. Verify invert elevations of existing work prior to excavation and installation of casing.

PART 2 PRODUCTS

2.1 Casing Materials

A. Per Specification Section 22 05 03.01

2.2 Carrier Pipe Materials

A. Per NM APWA Specification Section 710 and as shown on the drawings.

2.3 Grout and Cover Materials

A. Soil Backfill for Trench Approaches and Pits to Finish Grade as specified in Section 31 23 17.

B. Pressure Grout Mix: One part Portland cement, and 6 parts mortar sand, mixed with water to a consistency applicable for pressure grouting.

2.4 End Caps

A. Pull-on end seals shall be minimum ⅛-inch-thick synthetic rubber. Banding clamps shall be 304 stainless steel with worm screws. End seal shall have locating ribs on the outside for banding clamps and ribs in the inside to prevent leakage. End Seals shall be Pipeline Seal & Insulator, Inc. Model S or Model C Pull-on or approved equal.

1. Materials: EPDM 60
2. Thickness: ⅛-inch minimum
3. Color: Black
4. Temperature Rating: 250°F.
5. Hardware: 304 stainless steel bands with worm screws

2.5 Accessories

A. Supports and Insulators:

1. Casing Spacers:
    a. Casing Spacers shall be Cascade stainless steel casing spacers or equivalent. Casing spacers shall support and restrain carrier pipe throughout casing.
    b. Other supports per drawings.
    c. Substitutions: Permitted with the Engineer's approval.

PART 3 EXECUTION

3.1 Examination

A. Locate existing underground utilities per NM APWA Specification Section 710.

B. Verify connection to new piping system size, location, and bury depths are in accordance with drawings.

C. Provide information pertaining to boring pit bracing and casing boring head per NM APWA Specification Section 710.

3.2 Preparation

A. Identify required lines, levels, contours, and datum locations.

B. Warning and protective devices, including flagmen, shall be used to prevent creation of a traffic hazard and to ensure the safety of the public in accordance with the Manual of Uniform Traffic Control Devices.

C. Protect plant life, lawns and other features remaining as portion of final landscaping.

D. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Establish elevations of casing per drawings.

3.3 Dewatering

A. Intercept and divert surface flow and groundwater flow away from the excavation through the use of dikes, curb walls, ditches, pipes, sumps, or other means.

B. Develop substantially dry subgrade for prosecution of subsequent operations.

C. Comply with State of New Mexico requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.4 Existing Work

A. Maintain access to existing facilities and other remaining active installations requiring access. Modify installation as necessary to maintain access.

3.5 Pits or Approach Trenches

A. Excavate approach trenches or pits in accordance with the installation plan. Bore pits shall be located at least 30 feet from all roadways. If 30-foot separation is not attainable, use guard fence, concrete barriers, or other protective devices in accordance with NMDOT “Special Provisions.”

3.6 Casing Pipe Installation

A. General:
   1. No more than three (3) pilot bores will be permitted. Abandoned pilot bores shall be pressure grout filled.

B. Boring:
   1. The boring and installation of the HDPE casing shall be performed with equipment capable of simultaneous operation per NM APWA Specification Section 710.
   2. When voids develop greater than outside diameter of pipe by 1 inch, grout to fill voids.
   3. When boring is obstructed, relocate, jack, or tunnel as directed by ENGINEER.

3.7 Pressure Grouting

A. Pressure grout annular space between casing pipe and surrounding earth if annular space is greater than 1 inch.

3.8 Carrier Pipe Installation

A. Clean, inspect, and handle pipe in accordance manufacturer recommendations.

B. Prior to installing carrier pipes into casing, slide end seal loosely onto the active carrier pipe (insertion side) making sure to have large size of end seal facing toward casing pipe. Two spare carrier pipes will be installed and capped inside the casing. Slide far enough back onto the active carrier pipe so that the end seal will be near the casing opening after the insertion of the carrier pipe is completed.

C. Place carrier pipes and casing spacers in accordance with casing spacer manufacturer installation guidelines. Casing spacers shall support and restrain carrier pipe(s). Casing spacers shall be installed along the carrier pipe per manufacturer guidelines and within 2 feet of the end of the casing.

D. Prepare outside surfaces by removing dirt from casing and carrier pipes. After the carrier pipes are inserted into casing, slide small end of end seal over the active carrier pipe with stainless steel banding clamp. Large end should face casing. Position large end of end seal over the casing pipe. Position banding clamp approximately 1 inch from the end of the casing pipe (in between the external ribs on the end seal) and then tighten. Maintain "S" shape so it will extend into the casing. Position banding clamp in between the external ribs on the end seal on the carrier pipe then tighten. (Make sure the end seal is folded into the casing to relieve stress during backfilling and allow for expansion and contraction movement.)

3.9 Markers and Vents

A. Place a readily identifiable and suitable marker at each right of way line crossed (6 feet maximum height). Marker shall also serve as a vent for annular space between carrier and casing.

END OF SECTION

SECTION 33 56 13

ABOVEGROUND HYDROCARBON STORAGE TANK

PART 1 GENERAL

1.1 SUMMARY

A. This specification covers a horizontal, double-walled, cylindrical tank. The tank is designed for aboveground, horizontal installation, and is capable of containing nonaqueous-phase liquid (NAPL) at atmospheric pressure. Extracted fluids (gasoline and diesel fuel) will be transferred to this tank from an oil-water separator

1.2 MATERIALS

A. The material used shall be welded steel.

1.3 DIMENSIONS AND TOLERANCES

A. All dimensions will be taken with the tank in the horizontal position, unfilled. Tank dimensions will represent the exterior measurements.

1.4 SUBMITTALS

A. Product Data: Submit complete information concerning materials of construction, fabrication, and fitting installation locations.

1.5 SCHEDULING

A. Schedule prior to connecting piping work.

1.6 COORDINATION

A. Coordinate work with location and placement of utilities.

PART 2 PRODUCTS

2.1 TANKS

A. Manufacturers:

1. Kohlhaas Corporation
2. Hughes Tank Company
3. Willborn Tank and Fuel Systems
4. Mills Equipment Company
5. Substitutions: Permitted with approval of Engineer.

B. Product Description:
   1. Welded steel tank 300-gallon double-walled tank.
   2. Tank shall conform to the UL 142, Standard for Safety for Steel Aboveground Tanks for Flammable and Combustible Liquids
   3. Tank shall have an enamel external finish
   4. Check valve and isolation valve on product inlet
   5. High/high and high level switches
   6. Normal vent with riser pipe
   7. Emergency vent

2.2 WORKMANSHIP

A. The finished tank wall shall be free, as practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminating that will impair the serviceability of the vessel.

B. All edges where openings are cut into the tanks shall be trimmed smooth.

2.3 THREADED BULKHEAD FITTINGS

A. Furnish threaded bulkhead fittings as required to connect tank to piping as indicated on the Drawings.

B. Openings are female national pipe thread (FPNT)

PART 3 EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Inspect tanks for damage.

B. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

3.2 EXAMINATION

A. Verify layout and orientation of tank accessories and piping connections prior to placement.

3.3 INSTALLATION

A. Install NAPL storage tank as indicated on the Drawings and in accordance with manufacturer's instructions.

B. Connect piping to tank.

C. Install tank accessories not factory-mounted to complete installation.

3.4 Schedules

A. Storage Tank Schedule:

Stored Material	Tank Type & Number	Tank Dimensions (Nominal)	Tank Size (Capacity)
NAPL	T-1	38” dia. & 68” long	300 gallons

END OF SECTION

Appendix G

O&M Data Collection

Site: Former Y Station State Lead Site **Project No:** DB18.1157

Staff: ____________________

Date/Time on site: ____________________ **off site:** ____________________

(use value of no reading (NR) or not active (NA) if applicable for each entry)

SERVICE GAS METER READING: ____________________ cubic feet

SERVICE ELECTRIC METER READING: ____________________ kWh

DPE System Data

Main Menu Time captured: __________

OX OUTLET TEMP (°F): __________

OX INLET TEMP (°F): __________

OX Natural Gas Valve (%) __________

OX Dilution Air (%) __________

LEL (%) __________

Statistics Menu

DPE Vacuum Blower	HOURS: __________	CYCLES: __________
DTA Blower	HOURS: __________	CYCLES: __________
MS Transfer Pump	HOURS: __________	CYCLES: __________
LNAPL Transfer Pump	HOURS: __________	CYCLES: __________
DTA Transfer Pump	HOURS: __________	CYCLES: __________
Treated Water Totalizer	Gallons: __________	

DPE System Control Panel Main Menu

Sample point	Vacuum (in Hg)	Pressure (in H_2O/psi)	Temp. (°F)	Flow (scfm)	Motor (amps)
SVE combined influent		NA			
DTA blower	NA				

Knockout Tank: __________ inches Product Storage Tank: __________ ft. below measuring point

SVE Lines

Well	Vacuum (in Hg)	HC Conc (ppm-v)	VelociCalc (cfm)	Velocity (ft/min)	Remarks
Ox Effluent	NA		NA	NA	
SVE Line 1					
SVE Line 2					
SVE Line 3					
SVE combined					

LABORATORY SAMPLES COLLECTED (list times):

__________ Oxidizer Effluent (vapor)

__________ GW System Influent (water)

__________ SVE Combined Influent (vapor)

__________ GW Treated Effluent (water)

NOTES (leaks? corrosion? potential concerns? sampling problems?):

Site: Former Y Station State Lead Site **Project No:** DB18.1157

Staff:

System Component Data

1 Temperature Inside Container (°F)

2 Knockout Tank vacuum (in. Hg)

3 Vacuum Relief valve on blower (open or closed)

4 Vacuum filter #1 differential pressure Gauge

5 DPE Blower Inlet Vacuum (in. Hg)

6 DPE Blower Outlet Pressure (in. H20)

7 DPE Blower Outlet Temperature (°F)

8 Level Oil/Water Separator Tank (In.)

9 DA Tank Level (In.)

10 Clarifier Tank Level (In.)

11 Level of Solids in Clarifier Sump (In.)

12 Clarifier Transfer Pump Operating Hours

Individual Well Data

Well	Vacuum (in Hg)	HC Conc (ppm-v)	VelociCalc (cfm)	Velocity (ft/min)	GW Flow (gpm)	Ducer (psi)	Remarks
BW-8s							
BW-8i							
BW-8d							
RW-1s							
RW-1i							
RW-1d							
RW-2s							
RW-2i							
RW-2d							
RW-3s							
RW-3i							
RW-3d							
RW-4s							
RW-4i							
RW-4d							
BW-7R							
MW-11							
MW-12							
MW-16							
MW-13							

Appendix H

Health and Safety Plan

DBS&A

Daniel B. Stephens & Associates, Inc.

Health and Safety Plan for FRP Implementation

Former Y Station State Lead Site
721 Commerce Way, Clovis, New Mexico

Prepared for

New Mexico Environment Department
Petroleum Storage Tank Bureau

Prepared by

DBS&A
Daniel B. Stephens & Associates, Inc.
a Geo-Logic Company

6020 Academy NE, Suite 100
Albuquerque, New Mexico 87109
www.dbstephens.com
DB18.1157

July 6, 2021

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List of Tables

List of Appendices

Site Health and Safety Plan Summary

This summary provides critical, site-specific health and safety information that all site workers should be familiar with. This summary is an integral part of the site-specific health and safety plan (HASP) and must be attached to the complete plan.

Site Name and Location

Former Y Station State Lead Site, 721 Commerce Way Clovis, New Mexico

Project Personnel (refer to Section 3 for description of duties)

Project Manager (PM): Tom Golden

Site Safety Officer (SSO): Grace Herrmann

Site Supervisor: Grace Herrmann

Emergency Response

Table S-1 lists the emergency contacts that might be needed in the event of a site emergency. The complete emergency response plan is provided as Appendix B of this plan.

Site Activities and Hazard Assessment

Table S-2 identifies each of the tasks that will be performed during the field program and the hazards associated with each task. Table S-3 identifies the appropriate personal protective equipment (PPE) to be used for each task, including respiratory protection, and the air monitoring equipment that will be used. Air monitoring is further discussed in Section 7.1 of this plan. In the event that new tasks become necessary or new hazards are encountered, the SSO will update Tables S-2 and S-3 accordingly, and will notify all site workers of the changes.

Contaminants of Concern

Tables S-4 and S-5 identify the contaminants of concern that might reasonably be encountered during site activities and provide summaries of the chemical properties and worker exposure/ health information, respectively. This information is typically summarized from safety data sheets (SDSs) and other sources.

Hospital Route

Figure S-1 depicts the route and provides written instructions from the site to the hospital.

Medical Monitoring (refer to GLA Policy)

All site workers must be currently participating in a medical monitoring program that includes baseline and annual medical evaluation and testing.

Site Control Plan (refer to Section 9 of this plan)

Site control measures will be implemented during any activity that presents a hazard to workers outside the immediate work area or to unauthorized personnel in the vicinity. These measures can range from erecting barricades or barriers to prevent unauthorized entry, to establishing and enforcing work zones to mitigate the spread of contaminants beyond the work area.

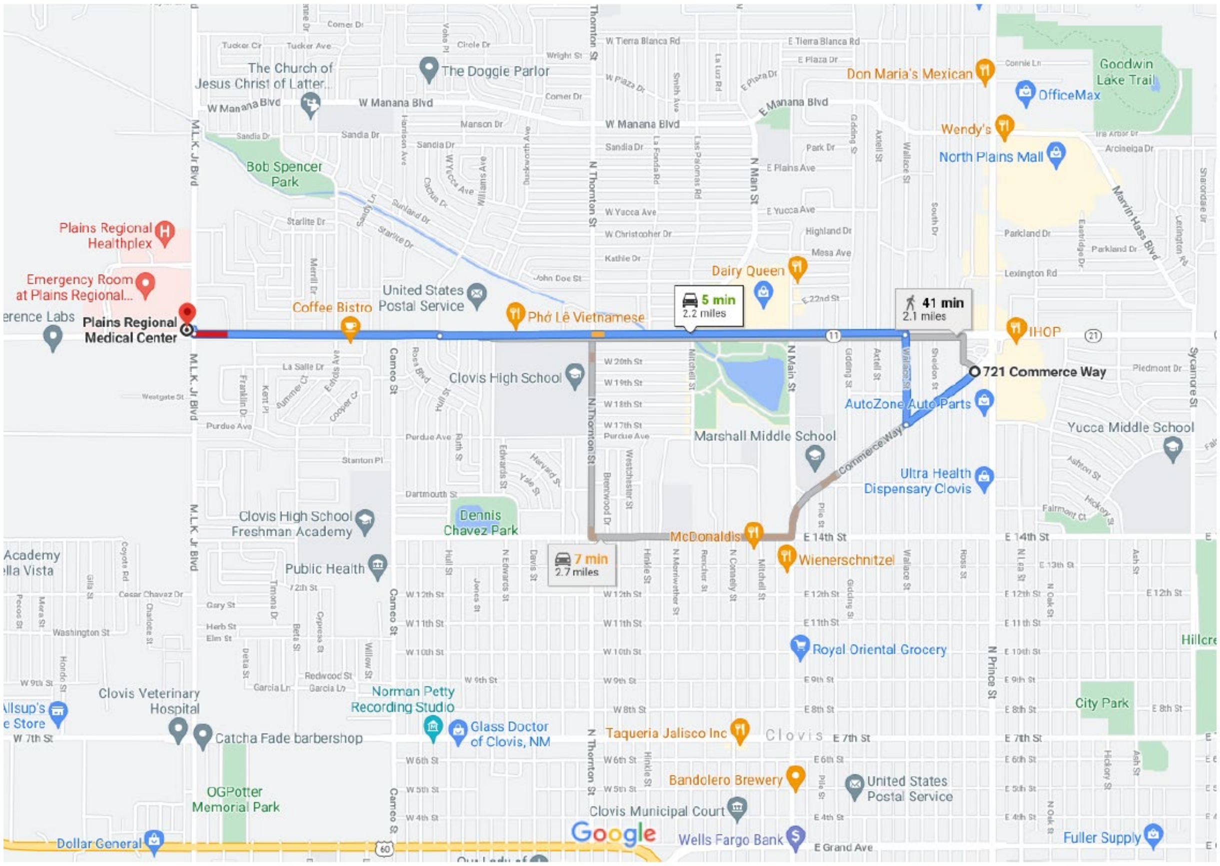
As all work is occurring on private property with minimal truck traffic anticipated, a traffic control plan is not required for this site.

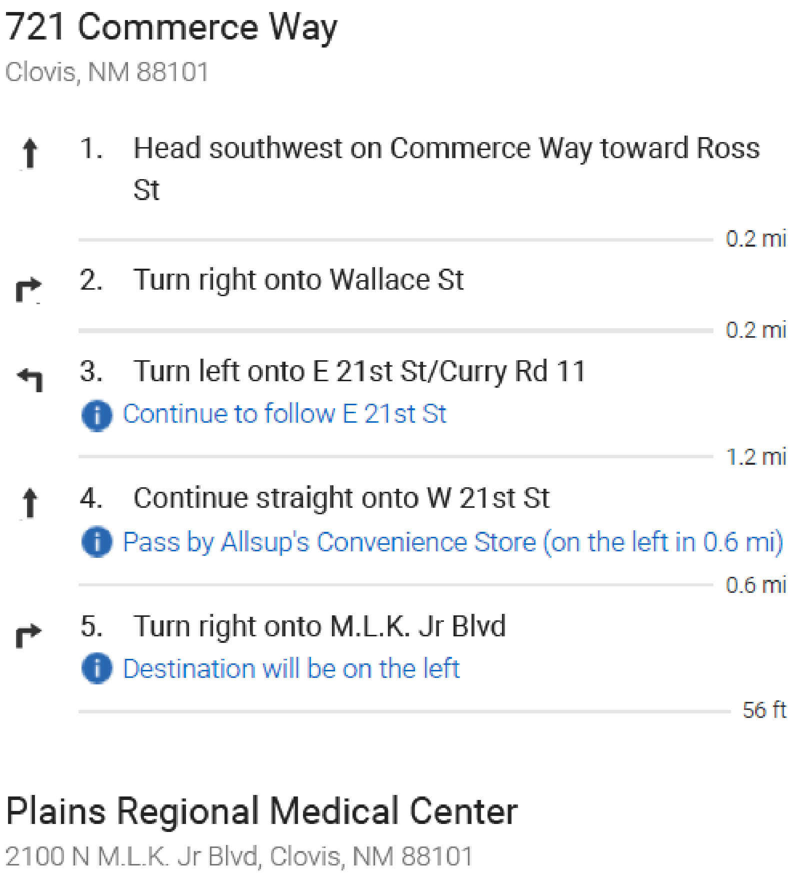
Confined Spaces (refer to Section 10 of this plan)

No confined space entries will be performed during this investigation. In the event that confined space entries become necessary, this site-specific HASP will be amended. Confined space entries can only be performed by trained personnel in accordance with the GLA Confined Space Entry Program.

Figure S-1. Hospital Route

The nearest hospital with emergency services is Plains Regional Medical Center, located at 2100 N M.L.K Jr Blvd, Clovis NM 88101. The map to the hospital is shown on this page, written directions are located on the following page.





721 Commerce Way

Clovis, NM 88101

↑ 1. Head southwest on Commerce Way toward Ross St

0.2 mi

↱ 2. Turn right onto Wallace St

0.2 mi

↰ 3. Turn left onto E 21st St/Curry Rd 11

ⓘ Continue to follow E 21st St

1.2 mi

↑ 4. Continue straight onto W 21st St

ⓘ Pass by Allsup's Convenience Store (on the left in 0.6 mi)

0.6 mi

↱ 5. Turn right onto M.L.K. Jr Blvd

ⓘ Destination will be on the left

56 ft

Plains Regional Medical Center

2100 N M.L.K. Jr Blvd, Clovis, NM 88101

Table S-1. Emergency Resources

Location of Nearest Telephone:	DBS&A and Contractor Vehicles
In Case of Fire or Explosion:	
Fire Department:	911
Police/Sheriff	911
In Case of Personal Injury or Exposure:	
Hospital:	Plains Regional Medical Center: 575-769-2141
Poison Control Center:	800-222-1222
Ambulance:	911
Air Ambulance:	911
GLA and Other Contacts:	
DBS&A Albuquerque Office:	505-822-9400
DBS&A Project Manager:	Tom Golden, 505-249-9402
GLA H&S Committee Member:	Chad Johannesen, 505-250-4630
GLA Corporate Program Administrator:	Russell Granfors (cell) 602-659-7131
Human Resources Manager:	Maria Robles, Ontario: 909-626-2281
Medical Contact:	WorkCare, Dr. Peter Greaney, Anaheim, CA, 800-455-6155
Regulatory Contact (if appropriate):	Renee Romero, 575-291-2109
Emergency Response:	
Local Chemical Emergency Response Team:	911
National Response Center, Oil & Toxic Chemical Spills	800-424-8802
CHEMTREC (24-hour)	800-424-9300

Other Contacts: ____

____

Table S-2. Proposed Tasks and Hazard Assessment

	Proposed Tasks		
Potential Hazards	Groundwater Sampling	DPE System Installation and Operation	Trenching and Excavations
Heavy equipment		X	X
Hazardous energy		X	X
Pinch points		X	X
Unstable ground			X
Noise hazards (>85 dbA)		X	X
Eye hazards	X	X	X
Head hazards		X	X
Dermal contact	X	X	X
Slips, trips, and/or falls	X	X	X
Heavy lifting	X	X	X
Vehicle traffic	X	X	X
Unauthorized site entry		X	X
Buried utilities		X	X
Overhead utilities		X	X
Respiratory Concerns			
Particulates			X
Vapors and/or gases	X	X	X
Oxygen depletion			
Asbestos			
Contaminated soil or liquids	X	X	X
Explosive atmospheres			
Heat/cold stress	X	X	X
Sunburn	X	X	X
Electrical hazards		X	
Compressed air or gases	X	X	
Fire hazards (hot work)		X	
Chemical hazards (other than COCs)	X	X	

Potential Hazards	Proposed Tasks		
	Groundwater Sampling	DPE System Installation and Operation	Trenching and Excavations
Insects and vermin	X	X	X
Confined spaces			
Ionizing radiation			
Unexploded ordnance/munitions			
HAZARD RANKING (Low, Medium, High)	Low	Low-Medium	Medium

dBA = A-weighted decibels
COCs = Contaminants of concern

Table S-3. Requirements for Personal Protective Equipment and Air Monitoring

Personal Protective Equipment	Proposed Tasks		
	Groundwater Sampling	DPE System Installation and Operation	Trenching and Excavations
Level D (Long pants, shirt, steel-toed boots, and safety glasses)	Minimum required for all site activities		
Hard hat		X	X
Hearing protection		X	X
Faceshield			
Respiratory Protection	(Selection matrix and cartridge change schedule in Project Files)		
Half-mask with organic vapor/HEPA cartridge			
Full-face with organic vapor/HEPA cartridge			
Cartridge change schedule			Breakthrough, 8 hours, or end of shift
Air Monitoring Equipment			
Particulate monitor			X
Photoionization detector		X	X
Flame-ionization detector			
Combustible gas indicator			
O_2 monitor			
Colorimetric tubes			
H_2S detector			
Methane gas monitor			
Other _________________			

HEPA = High-efficiency particulate air
O_2 = Oxygen
H_2S = Hydrogen sulfide

Table S-4. Chemical and Physical Properties for Primary Contaminants of Concern

Compound	Vapor Pressure (mm Hg)	Vapor Density [a] (air=1)	Specific Gravity	Odor Threshold [b] (ppm)	LEL-UEL (%)	Ionization Potential (eV)	Physical Description
Silica, crystalline as respirable dust **[Ca]**	NA	NA	2.66	NA	Unknown	NA	Colorless, odorless solid - a component of many mineral dusts.
Benzene **[Ca]**	75	2.7	0.88	24–119 (P)	1.2–7.8	9.24	Colorless to light yellow liquid with aromatic odor
Toluene	21	3.18	0.87	1.6 (G)	1.1–7.1	8.82	Colorless liquid with a sweet, pungent, benzene-like odor
Ethylbenzene	7	3.66	0.87	0.092–0.6 (G)	0.8–6.7	8.76	Colorless liquid with an aromatic odor
Xylene (o-, m-, p-isomers)	7–9	3.66	0.86–0.88	0.62–20 (G)	0.9–1.1	8.44–8.56	Colorless liquid with an aromatic odor (p-xylene is a solid below 56°F)
Methyl tertiary butyl ether (MTBE) **[Ca]**	8.5–10	3.1	0.74	0.053 (G)	NA	NA	Clear, colorless, low viscosity liquid with a terpene-like odor
Tertiary butyl alcohol (TBA)	40-42	2.55	0.79	21.5	2.4-8		
Gasoline **[Ca]**	38–300	NA	0.72–0.76	0.3 (G)	1.4–7.6	NA	Clear liquid with a characteristic odor
Diesel fuel	NA	<1	0.81	NA	0.7 [a]	NA	Clear white liquid with kerosene odor

Sources: NIOSH *Pocket Guide to Chemical Hazards* (2013 - accessed online).

[a] Vapor density data from *Groundwater Chemicals Desk Reference* (Montgomery, 2000) and product material safety data sheets.

[b] Odor threshold data from (1) MSA *RESPONSE® Guide*, on-line at http://webapps.msanet.com/responseguide/ChemicalDatabase.aspx, and (2) 3M *Respirator Selection Guide* (2012).

mm Hg = Millimeters of mercury
ppm = Parts per million
LEL/UEL = Lower explosive limit/Upper explosive limit
eV = Electron volts
NA = Not available or unknown
[Ca] = Known or suspected carcinogen

Table S-5. Exposure Limit, Hazard, and First Aid Information for Primary Contaminants of Concern

Compound	Applicable Exposure Limit	IDLH	Primary Acute Symptoms from Inhalation and Dermal Exposures	Target Organs	First Aid
Silica, crystalline as respirable dust **[Ca]**	0.05 mg/m^{3} [a]	50 mg/m^{3}	Cough, dyspnea (breathing difficulty), wheezing; decreased pulmonary function, progressive respiratory symptoms (silicosis); irritation eyes	Eyes, respiratory system	*Eyes:* irrigate immediately; *Skin:* no recommendation; *Breathing:* remove to fresh air; *Ingestion:* no recommendation
Benzene **[Ca]**	0.1 ppm [a] 1.0 ppm [b]	500 ppm	Irritates eyes, skin, and nose; causes headache, nausea, giddiness, staggered gait, weakness, exhaustion; dermatitis	Eyes, skin, respiratory system, blood, CNS, bone marrow	*Eyes:* irrigate immediately; *Skin:* soap wash immediately; *Breathing:* remove to fresh air, provide respiratory support; *Ingestion:* medical attention immediately
Toluene	100 ppm [a] 150 ppm [b]	500 ppm	Irritates eyes and nose; causes headache, weakness, fatigue	Eyes, skin, respiratory system, CNS, liver, kidneys	As above
Ethylbenzene	100 ppm [a,c] 125 ppm [b]	800 ppm	Irritates eyes, skin and mucous membranes	Eyes, skin, respiratory system, CNS	As above
Xylene, o-, m-, p-	100 ppm [a,c] 150 ppm [b]	900	Irritates eyes, skin, nose and throat; causes dizziness, excitement	Eyes, skin, respiratory system, CNS, GI tract, blood, liver, kidneys (o-, m- and p-Xylene)	As above
Methyl tertiary butyl ether (MTBE) **[Ca]**	50 ppm [d]	NE	Irritates eyes, skin, and respiratory tract	Eyes, skin, respiratory system, CNS	As above

Compound	Applicable Exposure Limit	IDLH	Primary Acute Symptoms from Inhalation and Dermal Exposures	Target Organs	First Aid
Gasoline **[Ca]**	300 ppm [a]	NE.	Irritates eyes, skin, mucous membrane; causes dermatitis, headache, weakness, exhaustion, blurred vision, dizziness, slurred speech, confusion, convulsions; possible liver, kidney damage	Eyes, skin, respiratory system, CNS, liver, kidneys	As above
Diesel fuel	10 ppm [a,c,e] 15 ppm [b,e]	NE	Irritates eyes, skin, and upper respiratory tract; CNS depression	Eyes, skin, respiratory system	As above

Sources: NIOSH *Pocket Guide to Chemical Hazards* (2013- accessed on-line) and manufacturer's safety data sheets (SDS); MSA *Response®* Guide (2013 - accessed on-line)

[a] National Institute of Safety and Health recommended exposure limit (NIOSH REL) - 10-hour time-weighted average (TWA)

[b] NIOSH short-term exposure limit (STEL) - 15 minute TWA - not to be exceeded

[c] Occupational Safety and Health Administration permissible exposure limit (OSHA PEL) - 8-hour TWA

[d] American Conference for Governmental Industrial Hygienists (ACGIH) - 8-hr TWA

[e] No exposure limit established; limits for naphthalene presented as a guide only

mg/m^3 = Milligrams per cubic meter
ppm = Parts per million
[Ca] = Known or suspected carcinogen
CNS = Central nervous system
CVS = Cardiovascular system
NE = None established

Site-Specific Health and Safety Plan

Project Name: Former Y Station State Lead Site, FRP Implementation

Project Location: 721 Commerce Way, Clovis, New Mexico

DBS&A Project Manager: Tom Golden

1. Introduction

This health and safety plan (HASP) establishes the responsibilities, requirements, and procedures for personnel of Daniel B. Stephens & Associates, Inc. (DBS&A), a wholly owned subsidiary of Geo-Logic Associates (GLA), while performing work at the above-named site. The HASP summary is an integral part of this HASP and must be attached for the plan to be considered complete.

The objective of this HASP is to establish a safe work environment for all site personnel, provide a uniform and concise plan of action in an emergency, and furnish the necessary guidance to adhere to these policies. This HASP meets the requirements set forth by the Occupational Safety and Health Administration (OSHA) in Title 29 of the Code of Federal Regulations (CFR), Part 1910.120 (Hazardous Waste Operations and Emergency Response) and 29 CFR, Part 1926 (Safety and Health Regulations for Construction). This HASP is designed to augment the health and safety policies and procedures established in the GLA Health and Safety Program Manual (H&S Manual).

Safety is considered a priority during all field activities. Field personnel will not perform any task for which they have not received adequate training, or which they personally feel is unsafe.

2. Description of Site Activities

The project will include DBS&A observation of the following activities: trenching and installation of buried and aboveground conveyance pipelines, installation of treatment equipment, and DBS&A performance of groundwater sampling and remediation system sampling.

Table S-2 in the HASP summary identifies the tasks that will be performed during the field program and the hazards associated with those tasks. The measures that will be employed to protect worker safety are described in Table S-3 and Sections 4 and 5 of this plan. Assuming that the site tasks do not change and that data from follow-up testing do not change the hazard assessment, this HASP will also apply to any subsequent field events. This HASP must be revised to address activities beyond those described above and listed in Tables S-2 and S-3.

The specific field activities are described in detail in the scope of work and the related sampling and analysis plan. The site-specific field methods and procedures are based on standard procedures established by DBS&A/GLA and applicable regulatory agency guidance.

The site is considered an uncontrolled hazardous waste site. All workers and visitors are subject to the OSHA requirements for hazardous waste workers in 29 CFR 1910.120.

The site is an active gas station. Workers must be aware of traffic and pedestrians entering and exiting the site.

Nearest telephone:	DBS&A and contractor personnel
Nearest water:	Potable water will be supplied
Nearest bathroom facilities:	Albertson's Market grocery store, Allsup's Convenience Store, or on-site port-a-potty
Nearest fire extinguisher:	DBS&A and contractor vehicles
Nearest first aid kit:	DBS&A and contractor vehicles
Warning/method signal for site evacuation:	Verbal

3. Project Personnel

The H&S manual establishes the roles and responsibilities for health and safety at various levels within the company. The DBS&A personnel responsible for the activities at the site are listed in the HASP summary. Their roles are described in the following subsections.

Project Manager

The Project Manager (PM) is responsible for implementing the GLA H&S Program at the site and designating the Site Safety Officer (SSO). The PM will oversee the preparation of this site-specific HASP, ensuring that the hazards associated with each task have been identified and that appropriate protective measures have been established. The PM will approve the final HASP.

Site Safety Officer

The SSO will be responsible for ensuring that all personnel entering an active work area comply with this HASP, meet appropriate OSHA medical and safety training requirements, and use the required level of personal protective equipment (PPE). The SSO will conduct site safety meetings prior to the start of work and before the start of each new activity. Workers will acknowledge their attendance by signing the tailgate safety meeting form (Appendix A). Accidents or incidents at the job site that affect or could potentially affect worker safety will be documented using the GLA Illnesses, Injury, and Unusual Occurrence Report.

In accordance with the Hazard Communication standard (29 CFR 1910.1200), the SSO will coordinate with contractor representatives to identify hazardous materials being used on the site and to ensure that safety data sheets (SDSs [formerly referred to as material safety data sheets, or MSDSs]) are available for each material. Site workers will be briefed on hazardous materials at the job site. The SSO will maintain SDSs for the hazardous chemicals routinely used at the site; the contractor will maintain SDSs for the hazardous chemicals they bring to the site.

To maintain a safe job site, all potentially dangerous conditions or practices must be corrected before proceeding with field work. The SSO will notify contractors and the PM of any unsafe work practices, and will stop all work on DBS&A projects if contractors do not abide by this plan.

The SSO will establish the initial level of PPE and respiratory protection and will upgrade or downgrade levels of protection in response to changes in field conditions. Information and guidance concerning the PPE Program and the Respiratory Protection Program are found in the H&S manual.

The SSO will establish the physical limits of the work areas at the site and will instruct all personnel and visitors on the boundaries of the exclusion zones. Only authorized personnel will be allowed in active work areas. It is also the responsibility of the SSO to ensure that all personnel enter and leave active work areas through the decontamination station, if necessary. Specific site control measures are addressed in Section 9 of this plan.

Site Supervisor

The Site Supervisor is responsible for directing all field activities at the site and ensuring that the scope of work is completed. The Site Supervisor will serve as the SSO in his/her absence.

Site Workers and Visitors

Additional workers and visitors may be authorized to enter the site under the direction of the PM or the SSO. All workers must be properly trained in their assigned duties, including standard safety procedures. All workers and visitors entering the work zone will be familiar with the contents of this site-specific HASP and will sign the plan acceptance form (Appendix A). Constructive comments regarding the HASP should be directed to the PM, the SSO, or the GLA H&S Program Coordinator.

Contractors

Contractors to DBS&A are obligated to comply with OSHA regulations and standard industry safety practices for their profession. If a contractor proposes changes in the HASP, the SSO will obtain permission from the H&S Program Coordinator and the PM, and this authorization will be documented in the project site log. A modification to the HASP will be issued reflecting the changes. Additional contractor responsibilities are described in Section 14 of the H&S manual.

4. General Hazard Review and Assessment

The hazard review for the site is based on DBS&A's experience conducting similar field operations at similar sites. Table S-2 in the HASP summary identifies the hazards associated with each task and provides a hazard ranking (from low to high) for each task. The controls (elimination, substitution, engineering, administrative, or PPE) that will be employed to protect worker safety are described in Sections 4 and 5 of this plan. Table S-3 in the HASP summary lists the PPE required to protect workers during each task and identifies the air monitoring equipment that will be used on-site.

Tables S-4 and S-5 in the site HASP summary provide information on the physical and chemical characteristics, symptoms of exposure, and first aid procedures for each of the contaminants known or suspected to be present at the site. The OSHA permissible exposure limits (PELs) or the National Institute of Occupational Safety and Health (NIOSH) recommended exposure limits (RELs) for each contaminant of concern are also presented in Table S-5. The PEL and REL are levels to which one may be exposed for 8 hours per day, 5 days per week for one's working lifetime without resulting in adverse health effects.

4.1 Sunburn and Temperature Hazards

Sunburn is perhaps the most common hazard for field site workers. Sunburn is caused by overexposure to ultraviolet (UV) radiation from the sun. Chronic overexposure to sunlight, especially the UV-B component, accelerates skin aging and increases the risk of skin cancer. The following guidelines can be used to avoid overexposure to UV rays from the sun:

- Wear protective clothing (long sleeves, hats with protective brims, and long pants) that provides the most coverage and is consistent with the job to be performed.
- Protect eyes with UV-absorbing tinted safety glasses.
- Use a commercial sunscreen with a skin protection factor (SPF) of at least 30 and protection against both UV-A and UV-B rays. Sunscreen should be applied 15 to 30 minutes before exposure and reapplied at 60- to 90-minute intervals. If possible, avoid exposure to the sun between 10:00 a.m. and 2:00 p.m., as rays are the most powerful during this period.

Heat stress is often the most critical hazard for field site workers. The effects can range from transient heat fatigue to serious illness and even death. Heat stress is caused by a number of interacting factors including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is fairly common during the summer and fall, preventive measures and alertness are especially important during these seasons.

Protective clothing and equipment affect the way the body controls its temperature. A previous heat injury (including sunburn) can also increase an individual’s susceptibility to further heat injury. Workers who have suffered a previous heat injury or who have sunburn must be especially vigilant in preventing heat stress and injury.

In order to ensure against heat stress-related problems, personnel should take frequent breaks in shaded areas. Workers should wear loose-fitting clothing (except around rotating equipment) and will unzip or remove coveralls during breaks. Cool drinking water with added electrolytes will be made available and sufficient amounts of fluids should be consumed to avoid dehydration.

During hot weather, heat stress monitoring will be part of the daily regimen. DBS&A personnel will count their pulse rate for 30 seconds as early as possible in the rest period. If the pulse rate exceeds 110 beats per minute (bpm), the length of the next work period will be reduced by 20 minutes and the heat stress parameters will be observed again at that time. If the pulse rate at the beginning of the next test period exceeds 100 bpm and the last reading was over 110 bpm, the work cycle will be reduced by one-third. Whenever the pulse rate is elevated, work should not be resumed until the pulse rate is below 100 bpm. These heat stress indicators shall be observed at least once every hour.

During cold weather, DBS&A personnel should wear multilayer, wind-resistant outfits and drink warm fluids. Warm shelter will be available during breaks.

4.2 Weather Hazards

In addition to the hazards of UV radiation from the sun and extreme ambient temperatures, general weather conditions may present a hazard to field workers. Rain and snow may result in muddy, slippery conditions that make foot and vehicle travel hazardous. Lightning and tornadoes, common summertime phenomena, can be extremely hazardous. In the event of adverse weather (e.g., high wind and airborne dust, lightning, extreme cold or heat, or rain) that could compromise worker's health and safety during outdoor activities, the SSHO will shut down operations. Additional safety measures for weather-related hazards are described in the IIPP.

If lightning is visible and the sound of thunder is heard less than 60 seconds after lightning is observed (10 miles), stop field operations and move to a sturdy, completely enclosed building. There are many apps for cell phones that will show immediate radar and tell you how many miles away lightning is from your location (e.g., Weather Bug). If a sturdy shelter is not available, get inside a hardtop automobile and keep the windows up. Automobiles offer excellent lightning protection.

In the event of a tornado, move to a pre-designated shelter. If an underground shelter is not available, move to an interior room or hallway on the lowest floor and get under a sturdy piece of furniture. Stay away from windows. If caught outside or in a vehicle, do not try to outrun a tornado in your car; instead, lie flat in a nearby ditch or depression. Remember that flying debris from tornadoes causes most deaths and injuries.

4.3 Biological Hazards

Venomous snakes and arthropods (e.g., insects, spiders, ticks, scorpions, and centipedes) create a hazard when their habitats are disturbed. Awareness and avoidance are the best defenses. Fieldwork shall be performed in a manner that minimizes disturbances of these creatures.

Should a bite or sting occur, first aid shall be immediately applied and medical treatment sought as soon as possible.

The feces and urine of some desert rodents may be carriers of the hantavirus, and fleas on living or dead animals may carry bubonic plague. Both hantavirus and bubonic plague occur in the southwestern U.S. Field workers should avoid all contact with rodent nests, droppings, or bodies. Professional medical treatment should be sought immediately if a worker suffers an animal bite of any kind.

Important Note: Any individual with a known allergy to wasps and bees must notify the SSHO and/or PM/task leader prior to working at the project site. If an individual has a history of allergic reactions to insect bites or is subject to attacks of hay fever or asthma, or if they are not promptly relieved of symptoms after first aid is administered, a physician will be called or immediate emergency medical treatment will be sought. In a highly sensitive person, do not wait for symptoms to appear, as delay can be fatal.

4.4 Emergency Response

Table S-1 in the HASP summary lists the names and telephone numbers of people and agencies that might be contacted in the event of an emergency. The emergency response (ER) plan is included as Appendix B. The ER plan includes instructions and procedures for emergency vehicular access, evacuation procedures for personnel, methods of containing a fire, and instructions on how to handle a variety of specific medical emergencies.

5. Task-Specific Safety Guidelines

Table S-2 in the HASP summary identifies each of the tasks that will be performed during the field investigation and the physical and chemical hazards associated with each task. Table S-3 in the site HASP summary identifies the requirements for PPE, as well as the air monitoring that will be performed. This section identifies the measures that will be taken to eliminate or minimize potential exposures to site workers for each task listed in Tables S-2 and S-3.

5.1 Groundwater Sampling

Groundwater samples will be collected from groundwater monitor wells. Prior to sampling, water level measurements will be collected using a water level indicator. Physical hazards may include any of those identified in Table S-2. Chemical hazards associated with groundwater sampling include potential skin and eye contact with contaminated groundwater and sample preservatives. Attention to site conditions, good housekeeping, and use of standard safety procedures will help to control or minimize the physical and chemical hazards. Appropriate PPE for groundwater sampling is described in Table S-3.

5.2 Installation and Operation of DPE System

Site activities will include installation and operation of a dual-phase extraction (DPE) system. Chemical hazards associated with this work include inhalation of organic vapors. Physical hazards may include typical construction hazards due to work with and around heavy equipment, heat stress, trips, falls, and slips, and electrical hazards when working in and around open electrical panels. Use caution when working around blower discharge piping; it is insulated but may be hot. Blowers have sound attenuating enclosures, but ear protection may be needed when working around equipment. Remediation well vaults are located in an active gas station parking lot and in the shoulder of adjacent roadways, so use reflective safety vests and traffic cones when working in well vaults.

Appropriate PPE will include safety glasses or goggles, steel-toed boots, and long-legged pants. Air monitoring will be conducted using a PID to monitor organic vapors in the breathing zones of workers and around piping joints. Diligent air monitoring and the use of appropriate PPE and standard safety procedures will minimize the risk of exposure and physical injury. Work in and around electrical panels shall be conducted by qualified professionals and shall include locking and tagging of affected equipment.

5.3 Excavating and Trenching Activities

Excavating and trenching operations will be conducted using a backhoe or a larger excavator (trackhoe). The hazards associated with excavating operations at this site will be primarily physical (e.g., slips, trips, falls, etc.), as identified in Table S-2. Chemical hazards associated with excavating and trenching activities include potential skin and eye contact with airborne particulates and contaminated soil. Attention to site conditions, good housekeeping, and use of standard safety procedures will help to control or minimize the physical and chemical hazards. Appropriate PPE for groundwater sampling will include that described in Table S-3.

Any excavation/trenching operations will be performed in accordance with OSHA regulations in 29 CFR 1926, Subpart P (Excavations). Properly trained contractor personnel will operate excavating equipment; at no time will an employee of DBS&A operate excavating equipment. Personnel should be sure they have eye contact with equipment operators before approaching heavy equipment. Never approach equipment from or work within an operator's blind spots. DBS&A employees will be familiar with and avoid hazards associated with work near or in trenches.

A “competent person” trained to interpret soil conditions and to identify the proper safety protection devices or procedures needed for each particular situation shall be in charge of all excavation and trenching activities at the job site. “Competent person” means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. The DBS&A competent person shall be designated by the PM and will be familiar with their role and responsibilities (refer to the H&S manual). All site workers should be familiar with basic soil mechanics related to excavations (refer to the H&S manual) and pay particular attention to identify evidences of distress in the excavation.

The following safety guidelines and practices can be used to mitigate some of the hazards associated with excavation activities:

- Contact the local utility locator to identify and mark the locations of any underground cables, pipes, or utility installations in the area of the proposed excavation. Discuss the locations of utilities with the property owner to identify private utilities.
- Take additional precautions when excavating a backfilled trench, or when working near railroads, highways, or other sources of vibrations.
- Provide appropriate and adequate barricades and warning lights to prevent accidental entry by workers and unauthorized persons, animals, or vehicles.
- Do not leave a hazard unguarded. Secure the site or surround the excavation with plastic high-visibility fencing to prevent accidental entry.
- If personnel are required to enter a trench or excavation that is greater than 5 feet in depth or excavated in soft or unstable materials, the sides of the excavation will be shored or sloped in accordance with OSHA regulations in 29 CFR Part 1926.652.
- If the excavation cannot be sloped adequately (usually at 1.5 horizontal to 1 vertical), trench boxes, shoring, sheeting, bracing, or other equivalent methods are required to keep the trench wall from collapsing.

- When workers are required to enter trenches that are 4 feet or greater in depth, an adequate means of exit, such as ladders or steps, shall be provided. Exit points shall be spaced no more than 50 feet apart.
- If the trench is 4 feet or more in depth and hazardous atmospheres exist or could reasonably be expected to exist, the trench shall be considered a confined space. Workers entering the trench shall be properly trained in confined space entries, and atmospheric testing for oxygen content, flammability, and organic or other vapors shall be performed before entering the trench. For additional information on the GLA Confined Space Program, refer to the H&S manual or contact the H&S Program Coordinator.

6. Standard Safe Work Practices

The following guidelines are meant to cover operations by DBS&A field staff and DBS&A contractors during field activities at the site. DBS&A contractors may choose to establish and enforce more stringent safety guidelines for personnel under their employ. Health and safety issues for other personnel working or visiting at the site and not involved in the site activities are the responsibility of the client and their respective contractors, not DBS&A.

Prior to the initiation of any on-site activities, the SSO will conduct a safety meeting to discuss the contents of this site-specific HASP, describe the field activities, identify any high-risk activities, and familiarize personnel with emergency procedures, including the route to the hospital. The DBS&A field supervisor will establish that all equipment is in good condition. The DBS&A supervisor should properly and thoroughly instruct the contractor on exactly what results are to be accomplished and point out all known safety hazards.

During the field activities, all participants will be expected to follow standard safe work practices as outlined below:

- Do not eat, drink, smoke, or chew tobacco in the work area.
- Avoid contact with potentially contaminated substances.
- Report any unsafe conditions to the SSO.
- Be aware of the physical characteristics of investigations, including:
  - ◇ Wind direction in relation to the contaminated area
  - ◇ Accessibility to associates, equipment, vehicles, etc.
  - ◇ Communication

  - Areas of known or suspected contamination
  - Site access
  - Nearest water sources
- Dispose of all wastes generated during field activities in accordance with applicable regulatory guidelines.

7. Air and Noise Monitoring

This section describes the measures that will be taken to protect workers from exposures to hazardous atmospheres and noise during the site activities.

7.1 Air Monitoring

This site is contaminated with fuel-related petroleum hydrocarbons (gasoline, diesel), and the potential exists for the development of toxic or explosive atmospheres in or near excavation. Excavation activities also have the potential to create hazardous levels of dust and airborne particulates. Respiratory protection will be used if air monitoring shows the presence of a hazardous atmosphere at concentrations above occupational exposure limits.

Respiratory protection will be used in accordance with OSHA regulations in 29 CFR 1910.134 and the GLA Respiratory Protection Program Plan. All persons using respiratory protection must be medically cleared to do so and should be aware of the following important definitions:

- Assigned protection factor (APF) is the level of protection that a respirator or class of respirators is expected to provide to employees and is used to select the appropriate class of respirators. Level C PPE includes an air-purifying respirator (APR). A half-face APR has an APF of 10; a full-facepiece APR has an APF of 50.
- Maximum use concentration (MUC) is the maximum atmospheric concentration of a hazardous substance from which an employee can expect to be protected when wearing a respirator. The MUC is calculated by multiplying the occupational exposure limit by the APF. For example, in the case of benzene, OSHA has established a permissible exposure level (PEL) of 1 part per million (ppm) (for an 8-hour time-weighted average [TWA]), and a short-term exposure limit (STEL) of 5 ppm. Therefore, the MUC for benzene is 10 ppm for a half-face APR and 50 ppm for a full-facepiece APR. The half-face and full-facepiece APRs may be

used for short periods of time (up to 15 minutes) in benzene concentrations up to 50 and 250 ppm, respectively (STEL x APF).

Table S-3 in the HASP summary identifies each of the tasks to be performed at the site and the air monitoring requirements for each task. Targets of such monitoring may include organic vapors, particulates, combustible gases, and oxygen. Table S-4 lists each of the contaminants of concern for the site. Table 1 lists the types of hazardous atmospheres that could be present at a site, the air monitoring equipment used for each, and the action levels to be used at this site. When in use, all meters will be calibrated daily in accordance with manufacturer's instructions.

The SSO or his/her designee will obtain PID readings of organic vapor concentrations in the breathing zone of the workers. Readings will be made at the working face of the excavation as the excavation progresses. The person making the PID measurements will determine the extent of the affected area, record the readings, and advise workers of the results.

7.1.1 Organic Vapors

The need for respiratory protection from toxic vapors is based on the most hazardous constituent that is likely to be present or known to be present, based on soil, soil gas, and/or groundwater sampling. Table S-4 lists each of the volatile contaminants of concern for the site.

A release of gasoline has occurred at this site. Gasoline is a complex mixture of petroleum hydrocarbons, additives, and blending agents, whose composition varies widely. The most hazardous constituent is benzene, a known human carcinogen. A PID will be used to monitor organic vapor concentrations; in the absence of other data, the PID readings are assumed to be due to benzene. If testing shows that benzene is not present or does not occur at significant concentrations, toluene, the next most volatile aromatic hydrocarbon in gasoline would be considered the most hazardous constituent. The OSHA PEL and STEL for benzene are 1 ppm and 5 ppm, respectively. The OSHA PEL for toluene is 200 ppm.

Assuming the presence of benzene, work will stop and workers in the affected area will upgrade to Level C respiratory protection if PID readings exceed 1 meter unit (usually parts per million by volume or ppmv) above background in the breathing zone for 5 minutes, or if unusual or unpleasant odors are detected. Workers will leave the work zone when PID readings exceed the MUC for the respiratory protection being used (10 ppm for a half-face APR; 50 ppm for a full-face APR). All personnel within the work zone will continue to wear respiratory protection until vapor levels dissipate below 1 meter unit. APRs will be equipped with organic vapor cartridges that will be changed at the end of each 8-hour shift.

Table 1. Air Monitoring Equipment, Action Levels, and Protective Measures

Hazard	Equipment	Action Levels in BZ	Action Response
Organic vapors	PID, FID	Background	Level D PPE
		OEL of most toxic contaminant sustained for 5 minutes	Use Level C respiratory protection; evaluate specific compounds.
		MUC for respiratory protection in use.	Stop work; upgrade to Level B
	Colorimetric (Drager) Tubes	Chemical specific: >1 ppm for benzene >1 ppm for vinyl chloride >1 ppm for 1,1-DCE	Use Level C respiratory protection if compounds exceed OELs.
Particulates	Dust Monitor	Visible dust	Suppress with water
		<5 mg/m^3	Level D PPE
		>5 mg/m^3	Use Level C respiratory protection
Flammable/explosive atmosphere	Explosimeter	<10% scale reading	Proceed with work
		10 – 15% scale reading	Stop work
		>15% scale reading	Evacuate site
Oxygen-deficient atmosphere	Oxygen Meter	19.5 – 23.5%	Normal - continue work
		<19.5%	Evacuate - oxygen deficient
		>23.5%	Evacuate - fire hazard
Ionizing radiation	Gamma radiation meter	>0.1 millirem/hr	Radiation sources may be present
		>1 millirem/hr	Evacuate - radiation hazard

BZ = Breathing zone
PID = Photoionization detector
FID = Flame ionization detector
PPE = Personal protective equipment
OEL = Occupational exposure limit
MUC = Maximum use concentration
ppm = Parts per million
mg/m^3 = Milligrams per cubic meter
1,1-DCE = 1,1-Dichloroethene

A benzene-specific colorimetric tube (e.g., Draeger) can be used to determine whether benzene is present and at what concentration. If the colorimetric tube indicates that benzene concentration exceeds 1 ppm, all personnel within the affected area must use respiratory protection. If the colorimetric tube indicates that benzene is not present, exposure levels for toluene will be used to determine the need for respiratory protection. The SSO will periodically check for the presence of benzene using a colorimetric tube.

All personnel should be aware that the detection capabilities of PIDs may be enhanced or dampened by high humidity or by the presence of certain gases, such as methane. Direct evidence of contamination, such as visible staining of soils or strong odors, should be used to further evaluate these quantitative instrument readings.

7.1.2 Combustible and Oxygen-Deficient Atmospheres

An instrument or instruments capable of detecting combustible gases and oxygen levels will be used during excavation activities. The instrument(s) shall be placed as close to the working face of the excavation, as possible. The lower explosive limit (LEL) and the upper explosive limit (UEL) for benzene are 1.2 percent and 7.8 percent, respectively. Similar values are published for gasoline (NIOSH Pocket Guide). Excavation operations will be suspended when combustible gas measurements are at or between the LEL and the UEL.

Normal atmosphere contains between 20.8 and 21 percent oxygen. The atmosphere is oxygen-deficient if it contains less than 19.5 percent oxygen, and oxygen-enriched if it contains more than 22 percent oxygen. Oxygen-deficient atmospheres may be created when oxygen is displaced by other gases, or consumed by bacterial activities. Oxygen-enriched atmospheres can be created by certain chemical reactions and present a significant fire and explosion risk. Excavating operations will be suspended when readings indicate oxygen levels at or below 19.5 percent and at or above 22 percent.

7.1.3 Particulates

When respirable dust is considered a potential hazard (e.g., drilling or excavating operations), direct-reading personal dust monitors (e.g., Thermo Scientific pDR-1500 personal DataRAM) should be used to identify and quantify airborne dust concentrations that a worker is exposed to while working. NIOSH has established a recommended exposure limit (REL) for crystalline silica as respirable dust of 0.05 milligrams per cubic meter (mg/m^3). This value is 10-hour TWA concentration for a 40-hour workweek. NIOSH recommends the use of N95 or more efficient filters for protection against respirable dust. The MUC for crystalline silica as respirable dust is 0.5 mg/m^3 for a half-face APR and 2.5 mg/m^3 for a full-face APR. Supplied air respirators must be used if airborne concentrations of crystalline silica exceed 2.5 mg/m^3 (NIOSH Pocket Guide, 2013). Respirator cartridges and filters will be changed each day.

7.2 Noise Monitoring

All site personnel who are exposed to average noise levels of 85 A-weighted decibels (dBA) or greater during an 8-hour workday must participate in their company's Hearing Protection Program. Workers must use appropriate hearing protection whenever noise levels exceed 90 dBA. The GLA H&S Program Coordinator has used a noise meter to survey a variety of equipment that may be used during the site activities and found that work around heavy equipment is most likely to require hearing protection. Noise levels are highest near the engines and compressors, but generally do not exceed 85 dBA in the typical operator locations (e.g., behind the drill rig). However, impact noise, such as the tripping of a pneumatic or hydraulic hammer on a direct-push rig or driving casing on a dual-tube drill rig, can be considerably higher. When a noise meter is not available, the following rule of thumb should be used: if it seems loud or you cannot carry on a normal conversation, hearing protection should be worn.

8. Protective Equipment

PPE requirements for each task are described in Table S-3. At a minimum, the following PPE shall be used by personnel while working at the site:

- Steel-toed/steel-shanked work boots
- Long pants
- Protective eyewear
- Hard hat (when needed)
- Chemical-resistant gloves (when needed)
- Hearing protection (when needed)

Level C PPE will include Level D equipment plus a full- or half-face air-purifying respirator with appropriate cartridges and prefilters. Workers using respiratory protection should be familiar with guidelines to determine that the equipment being used for respiratory protection is providing adequate protection, as discussed in Section 7.1. Chemical-resistant coveralls and/or gloves will be worn whenever conditions require DBS&A field personnel to come in direct contact with potentially contaminated materials.

DBS&A will supply employees with PPE that meets requirements established by NIOSH or the American National Standards Institute (ANSI), and that meet current OSHA criteria. Employees will be trained in the selection, care, and use of PPE, as described in the H&S manual.

8.1 Disposal of Contaminated Clothing or Equipment

All potentially contaminated clothing, Tyvek coveralls, gloves, paper towels, and other expendable items will be placed in garbage bags for disposal. Fresh Tyvek coveralls and work gloves should be donned at the start of each workday or when otherwise required.

8.2 Decontamination Procedures

Specific personnel decontamination procedures are based on the personal level of protection. When using Level D protection, a personnel decontamination system (PDS) is not required. However, because project personnel wearing Level D protection may need to upgrade to Level C if site conditions change, a PDS may be established based on specific site characteristics.

The decontamination stations for Level C decontamination may include (1) a segregated equipment drop for hand tools and monitoring equipment, (2) a wash and rinse for gloves and disposable booties (if worn), (3) a removal station for gloves and disposable booties (if worn), (4) a removal station for respiratory protection, hard hat, safety glasses, and Tyvek suits, and (5) a station to wash and rinse hands and face. Specific procedures and the sequence of events will be determined based on the potential hazards identified at the site. The stations listed are a guide to the selection of adequate decontamination procedures.

When a PDS is set up, the SSO or his/her designee has the responsibility for operating the decontamination station. This person will make sure that all personnel enter and leave active work areas through the PDS, that all personnel decontaminate properly, and that disposable items are bagged. The SSO will assist on-site workers in changing cartridges, masks, gloves, or other pieces of safety equipment, and monitor the length of work periods. Disposable items will be placed in plastic bags and properly disposed of. Non-disposable items will be properly cleaned and dried according to manufacturer's specifications and stored for future use.

Decontamination procedures, which are based on guidelines appropriate for low-level contamination, will be required for all reusable equipment used for sampling, personal protection, and field monitoring. Sampling equipment will be decontaminated between each sample. High-pressure steam cleaners, Alconox detergent solution, and deionized water rinses may be used. If necessary, personnel will decontaminate equipment at a specified decontamination area before leaving the site. Field monitoring equipment will be cleaned daily; additional cleaning and recalibration will be performed if contamination affects operation.

9. Site Control

Barricades, caution tape, or other necessary means shall be used when necessary to prevent unauthorized access into the work area. The SSO will establish the physical limits of the work areas at the site and instruct all personnel and visitors concerning the boundaries of the exclusion zones.

At a minimum, a 15-foot-wide primary exclusion area will be established around the perimeter of active machinery. DBS&A personnel will enter the primary exclusion zone only when absolutely necessary for the performance of the task at hand. A secondary exclusion zone will be established around the general work area. If necessary, the work area will be marked off with temporary barriers and caution tape. Only authorized personnel will be allowed in active work areas.

Traffic control plans may be required for all sites where work activities may impact traffic flow on adjacent roadways. These plans must be submitted to and approved by the local traffic control authority. The PM or their designee will be responsible for ensuring that the necessary site control measures and plans are prepared and implemented.

10. Confined Space Entry

No confined spaces have been identified at the site and no confined space entries are anticipated during the field activities. However, any confined spaces identified as the work progresses shall be properly marked and managed accordingly. GLA has developed and implemented a Confined Space Entry Program Plan that provides policies and procedures to be followed for confined space entries, including air monitoring, participant training and duties, and authorizing and permitting confined space entries.

If confined space entries become necessary, the SSO will contact the PM and this site-specific HASP will be amended accordingly. The SSO will ensure that entries are performed in accordance with the GLA Confined Space Entry Program Plan. If necessary, the SSO will contact the local fire department to coordinate the entry and rescue requirements.

11. Spill Prevention

Minor spills of potentially contaminated soil, residual free product, or groundwater may occur during site work. If a spill occurs, site personnel will use best judgment and available materials to contain and prevent it from spreading. All contained soil and liquids will be disposed of in compliance with federal, state, and local requirements.

12. Safety Meetings

A site safety or "tailgate" safety meeting will be held every day before the start of work for the project and before the start of each new activity. All personnel directly involved in the work are required to attend. This HASP and all pertinent health and safety issues will be discussed during the initial briefing or meetings. The tailgate meeting will also address specific issues regarding on-site health and safety, such as the proposed work and associated hazards, recent problems, and any accidents or incidents. All personnel will acknowledge their attendance by signing the safety meeting form (Appendix A).

13. Training Requirements

Before entering the site, workers will have received the necessary training required by OSHA for workers at potentially hazardous waste sites [29 CFR 1910.120(e)], including 40 hours of formal instruction and a minimum of 3 days of field experience under the supervision of a trained and experienced worker. Additionally, site supervisors will have completed an 8-hour health and safety supervisor training course. Before starting work, each worker will receive site-specific hazard recognition and emergency response training.

In the event that organic vapor concentrations in the work zone require an upgrade to Level C PPE, only workers who are trained and medically cleared to wear a respirator will be allowed in the work zone.

DBS&A's contractors will certify, by name, that each of their employees who will perform field work at a hazardous waste project site has received the applicable health and safety training listed above.

14. Medical Monitoring Requirements

All medical monitoring will be performed in accordance with 29 CFR 1910.120(f), 29 CFR 1910.134 (Respiratory Protection), and 29 CFR 1910.95 (Occupational Noise Exposure). The PM must identify any chemicals of concern that might require monitoring (e.g., lead or PCBs) before and after the site activities.

The GLA medical monitoring program is directed by WorkCare in Anaheim, California. In the event of a chemical exposure resulting in symptoms or illness, the SSO may contact Dr. Peter Greaney at WorkCare (800-455-6155) to obtain guidance for recommended testing protocols.

15. Hospital and Evacuation Route

If a medical emergency occurs during work at the site, the Lincoln County Medical Center in Alto, NM is the closest emergency room facility. Figure S-1 in the HASP summary provides a computer-generated route map from the site to the hospital, with driving directions. All workers should be familiar with the location of this facility. The SSO will perform a pre-activity physical route check to determine any planning modifications required. If the evacuation route needs to be modified, this HASP will be corrected, and all workers will be notified of the changes. All workers should be familiar with the location of this facility.

Appendix A

Health and Safety Forms

Geo-Logic
ASSOCIATES

Health and Safety Plan Acceptance Form

Instructions: This form is to be completed by each person prior to beginning work at the subject hazardous waste site. THIS FORM IS TO BE MAINTAINED IN THE PROJECT FILES.

Project ______________________________

Job No. ______________________________

Location ______________________________

By my signature below, I acknowledge that I have read and understand the contents of the Health & Safety Plan for this project. I agree to perform my work in accordance with the plan.

Signature	Print Name	Company	Date

Geo-Logic
ASSOCIATES

Tailgate Safety Meeting

Project ID:______________________________ Day: ______________________________

Location:______________________________ Date: ______________________________

Project Manager:________________________ Team Leader: ____________________________

Health & Safety Officer:____________________ No. of Personnel Present: ______________________

Check Topics Discussed

Scheduled Activities:____

Chemical/Physical Hazards

___ Contaminants of Concern
___ Safety Data Sheets
___ Overhead & Underground Utilities
___ Extraordinary Site Conditions
___ Lifting/Slips/Trips/Falls
___ Heat/Cold Stress (Inc. Sunburn)
___ Other:______________________________

First Aid

___ Facilities/Kits/Eyewashes

Personal Protective Equipment - Level D

___ Hard Hats/Hearing Protection
___ Steel-Toed Boots
___ Glasses/Goggles/Shields
___ Gloves
___ Contingency:_ Level C____________________
___ Respirators & Tyvek/Saranex

Emergency Procedures/Site Safety

___ "Buddy System"
___ Communication
___ Facility-Specific Regulations
___ Rally Point

Vehicle/Heavy Equipment

___ Operation and Inspection
___ Preventive Maintenance
___ Fusion Welding
___ Other

Sanitation & Hygiene

___ Drinking Water/Fluids
___ Restrooms
___ Personal Cleanliness

Housekeeping

___ Waste Containers
___ Waste Materials
___ Other

Fire Prevention

___ Locations of Extinguishers
___ Smoking
___ Hot Work
___ Explosive & Flammable Liquids
___ Other:______________________________

Emergency Facilities

Name:____
Address:____
Tel. No.:____

Safety Meeting Attendees:

Name	Signature	Name	Signature

Geo-Logic
ASSOCIATES

Illnesses, Injury, and Unusual Occurrence Report

Date of Event: ______________________________ Report Number: __________

1. Name of the Site: ______________________________

2. Name of individual(s) injured, ill, or exposed:

____

____

3. Provide a brief, but concise description of the event:

____

____

4. Damaged Property:

____

____

5. Damage to equipment and the type of equipment:

____

____

6. Did this accident involve a motor vehicle? ☐ Yes ☐ No

Any motor vehicle accident, regardless of fault, which involves a company vehicle, rental vehicle, or personal vehicle, while the employee is acting in the course of employment must be accompanied by a police report, unless the police refuse to respond to the scene of the accident. In addition, draw a simple illustration of the scene on the reverse side of this form.

7. Action taken/additional employee training:

____

8. Name and Signature: ______________________________Name (print)

______________________________ Signature

______________________________ Date completed

Diagram 1:

Diagram 2:

Geo-Logic
ASSOCIATES

Daily Site Safety Checklist

Job Name and Number: ____

Person Completing Form: ________________________ **Date(s):** ______________

Instructions: Use form for up to five consecutive days. Write in date, place checkmark to indicate item has been completed. Deficiencies must be corrected. Completed form to be maintained with the Project files with copy to H&S Program Coordinator.

Checklist Item	Date				
The HASP (including emergency phone numbers) has been reviewed and signed by GLA staff, subcontractors, & visitors and is available on site					
Hazardous chemicals have been discussed and SDSs are available for each hazardous chemical on site.					
Tailgate Safety Meeting has been conducted for all site workers and visitors (and updated as necessary)					
Copies of Hospital Route map and emergency phone numbers are available in all vehicles					
DBS&A personnel and subcontractors have discussed hazards associated with Site-specific work					
Potential slips, trips, or fall hazards have been identified and mitigated where possible					
Site control measures have been established for present conditions (e.g., safety cones or caution tape)					
Proper PPE has been identified and is being used for present conditions					
Personnel monitoring is being conducted for present conditions					
An operating, fully-charged cell phone is available on site					
A fully-stocked first aid kit and eye wash bottle are readily available					
Fully-charged fire extinguishers are available for use.					
All workers and visitors have training appropriate for assigned tasks					
Equipment on-site has been inspected and is in safe working order					
Electrical power operated tools are properly grounded and used with a GFCI					
Excavated soils are properly stored and labeled					
Excavations are properly shored/sloped and barricaded					
Used disposable PPE and garbage are bagged for proper disposal					
All Health and Safety concerns have been communicated to the Site H&S Officer and the Project Manager					

Geo-Logic
ASSOCIATES

Project Health and Safety Checklist

The Project Manager and their designated site supervisors and safety officers are responsible for the implementation of the company health and safety program. This form has been designed to help the Project Manager meet the health and safety guidelines established by the company in accordance with OSHA regulations and accepted protocols. If you have any questions, contact the H&S Program Coordinator.

Project Planning

_ Do all of the workers at the site have the required or appropriate level of safety training for the site and the assigned tasks (e.g., current 40-hour training, 8-hour Supervisor training, 3-day supervised training)?
_ Has an OSHA-trained Supervisor been designated for the site?
_ Has a Safety Officer been designated for the site?
_ Has a Competent Person been designated for the site (required at construction/excavation sites)?
_ Do field personnel have current first aid/CPR training?
_ Are there any health hazards at the site that require workers to be medically monitored (e.g., excessive noise, possible respirator use, or potential for exposure to hazardous contaminants)?
_ Are there any special health hazards at the site that require baseline testing before and follow-up testing after field activities (e.g., cadmium or PCBs)?

Site H&S Plans

_ Has a site-specific H&S Plan been prepared? *[Required for all Hazwoper sites; Company policy requires completion of the H&S Plan Summary at a minimum.]*
_ Has the site H&S Plan been reviewed and approved by the PM?
_ Have all site workers been briefed on the contents of the site H&S Plan and signed-off on the Plan?
_ Have Tailgate Safety Meetings been held as necessary (e.g., prior to the start of activities, when activities or conditions change, or when new workers come on site) and have those present signed the attendance sheet?
_ Do site workers understand the site hazards and know the route to the hospital?
_ Have clearances been obtained for underground utilities?

Documentation

The following documentation should be available at the field site or in the office for inspection:

_ Site-specific H&S Plan signed by site workers **(must be available at the field site)**
_ Utility Clearance Form **(must be available at the field site)**
_ MSDSs for hazardous chemicals used on-site **(must be available at the field site)**
_ Tailgate Safety Meeting forms signed by site workers (current one in the field and completed forms in the project file)
_ Records of excavation inspections by Competent Person (current one in the field and completed forms in the project file)
_ Copies of Accident/Incident or Chemical Exposure reports (submitted to H&S Program)
_ Results of any safety inspections (project and/or program files)

Appendix B

Emergency Response Plan

DBS&A

Daniel B. Stephens & Associates, Inc.

Emergency Response Plan

Purpose and Scope

The following emergency response plan (ER plan) has been developed to include instruction and procedures for emergency vehicular access, evacuation procedures for personnel, methods of containing a fire, and medical emergencies. All extraordinary conditions that require concise and timely action must be dealt with in a manner that minimizes the health and safety risks to the immediate site personnel and the general public.

General Response Considerations

All on-site personnel shall be familiar with the ER plan described herein. This section will be maintained in the field office.

Due to the nature of the site, the emergencies or extraordinary conditions that may arise are more than likely limited to personnel accidents requiring first aid, exposure to contaminated sediments, and potential fire near mechanical equipment. The following procedures shall be implemented in the event of an emergency:

- First aid or other appropriate initial action will be administered by those closest to the accident/event. This assistance will be coordinated by the Site Safety Officer (SSO) and will be conducted in a manner so that those rendering assistance are not placed in a situation of unacceptable risk. The primary concern is to avoid placing a greater number of workers in jeopardy.
- Personnel shall report all accidents and unusual events to the SSO, the subcontractor Health and Safety representative, and the Project Manager (PM).

The SSO and other on-site personnel are responsible for conducting the emergency response in an efficient, rapid, and safe manner. The SSO will decide if off-site assistance and/or medical treatment is required and shall be responsible for alerting off-site authorities and arranging for their assistance. The SSO, in coordination with the contractor Health and Safety representative, will provide an Accident/Incident Report to the PM that includes the following:

- A description of the emergency (including date, time and duration)

- Date, time and names of all persons/agencies notified and their response
- A description of corrective actions implemented or other resolution of the incident

All workers at the site are responsible for conducting themselves in a mature, calm manner in the event of an accident/unusual event. All personnel must conduct themselves in a manner to avoid spreading the danger to themselves and to surrounding workers.

Responsibilities

The SSO shall have responsibility for directing response activities in the event of an emergency. He/she will:

- Assess the situation
- Determine required response measures
- Notify appropriate response teams
- Determine and direct on-site personnel during the emergency

The SSO shall coordinate the response activities of on-site personnel with those of public agencies.

Public Response Agencies

The site-specific HASP includes a list of public response agencies to be contacted and who may, depending on the nature of the situation, assume authority for emergency response. The HASP presents local emergency numbers, including local hospitals (which include the poison control center), ambulance service, fire and police departments, and others. In addition, nationwide hotline numbers for emergency assistance are listed. These phone lists should be retained by all field personnel and posted by the phone in all field trailers.

The hospital location is outlined in the HASP. The SSO will provide directions and/or maps to these facilities to all field personnel.

Prior to the initiation of all on-site work, the local police and fire department will be notified, if deemed necessary. This notification will take the form of a letter describing both on-site and off-site activities. If requested, a briefing will be held to further explain the type of activities and equipment that are associated with each project. Emergency procedures also will be discussed.

Accidents and Non-Routine Events

Several types of emergencies are outlined in the following subsections. These are not intended to cover all potential situations, and the corresponding response procedures should be followed using common sense. Every accident is a unique event that must be dealt with by trained personnel working in a calm, controlled manner. In the event of an accident/unusual event, the prime consideration is to provide the appropriate initial response to assist those in jeopardy without placing additional personnel at an unnecessary risk. Employees shall be instructed to report all injuries and illnesses to the SSO.

Worker Injury

If a person working on the site is physically injured, appropriate first aid procedures shall be followed. Depending on the severity of the injury, emergency medical response may be sought. If the employee can be moved, he/she will be taken to the edge of the work area where contaminated clothing (if any) will be removed, and emergency first aid administered. If necessary, transportation to local emergency medical facility will be provided as soon as possible.

If a worker can only be moved by emergency medical personnel, the SSO will decide what protective equipment, if any, is required to be worn by emergency personnel. Each work area will have extra equipment available for emergencies.

- *Eye Exposure:* If contaminated solid or liquid gets into the eyes, wash eyes immediately at the emergency eyewash station using water and lifting the lower and upper lids occasionally. Obtain medical attention immediately if symptoms warrant.
- *Skin Exposure:* If contaminated solid or liquid gets on the skin, wash skin immediately at the decontamination station using soap and water. Obtain medical attention immediately if symptoms warrant.
- *Inhalation:* If a person inhales large amounts of organic vapor, move him/her to fresh air at once. If breathing has stopped, perform cardiopulmonary resuscitation (CPR) per American Red Cross standard first aid instruction. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.
- *Ingestion:* If contaminated solid or liquid is swallowed, medical attention shall be obtained immediately by consulting the Poison Control Center as outlined in the site-specific HASP.

Temperature-Related Problems

Adverse weather conditions are important considerations in planning and conducting site operations. Hot or cold weather can cause physical discomfort, loss of efficiency, and personal injury. One or more of the following control measures shall be employed to help control heat stress:

- Provide adequate non-alcoholic liquids to replace lost body fluids. Employees must replace water and salt lost through perspiration. Employees will be encouraged to drink more than the amount required to satisfy thirst, as thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.
- Replacement fluids can be a 0.1 percent salt solution, commercial mixes such as Gatorade™ or Quick Kick™, or a combination of these with fresh water.
- Establish a work regimen that will provide adequate rest periods for cooling down.
- Take rest breaks in a cool, shaded area during hot periods.
- Employees shall not be assigned other tasks during rest periods.
- Inform all employees of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

Adverse Weather

In addition to the hazards of UV radiation from the sun and extreme ambient temperatures, general weather conditions may present a hazard to field workers. Rain may result in muddy, slippery conditions that make foot and vehicle travel hazardous. Lightning and tornadoes, common summertime phenomena, can be extremely hazardous. In the event of adverse weather (e.g., high wind and airborne dust, lightning, extreme cold or heat, or rain) that could compromise worker's health and safety during outdoor activities, the SSO will shut down operations. Safety precautions for lightning and tornadoes can be found in the health and safety manual.

Fires

The potential for fires involving hazardous chemicals must be addressed during the preliminary site-specific evaluation of all hazards. Personnel in each work group will be knowledgeable in fire extinguishing techniques. They shall be instructed in proper use and maintenance of the appropriate fire extinguishers supplied at the work site.

Vehicle Accidents

Posted speed limits will be observed. All vehicles will be required to meet applicable state inspection standards. All drivers will be required to have a good driving record and must have all necessary licenses to operate their vehicle.

The phone numbers of the SSO, the field office, and subcontractor health and safety representative will be carried in each vehicle at the site. These numbers may also be provided to all police, fire, rescue, and emergency agencies in the area.

Upon notification of an accident, the PM will make available any personnel and equipment at his or her disposal to aid in the cleanup. For example, the following equipment may be supplied:

- Sorbent materials to contain/control liquids
- Front-end loaders to pick up solids
- Dust-suppression materials to control dust
- Trucks to haul collected material
- Appropriate protective gear for cleanup workers

The supervision and operation of all emergency response personnel and equipment will be coordinated through the authorities at the scene of the accident.

Appendix I

Permits

File No.

NEW MEXICO OFFICE OF THE STATE ENGINEER

APPLICATION FOR PERMIT TO CHANGE AN EXISTING WATER RIGHT
(Non 72-12-1)

(check applicable boxes):

For fees, see State Engineer website: http://www.ose.state.nm.us/

☒ Change Purpose of Use ☒ Ground water ☐ Surface Water ☒ Change Place of Use ☒ Groundwater ☐ Surface Water	☒ Change Point of Diversion (POD): From: ☒ Groundwater ☐ Surface Water To: ☒ Groundwater ☐ Surface Water	☒ Additional Groundwater Point of Diversion (POD) ☐ Additional Surface Water Point of Diversion (POD)

☐ Temporary Change, NMSA 1978, § 72-12-7(B) Requested Start Date: Requested End Date:
(Not to Exceed 3 ac-ft in One Year)
☐ Water Use Lease, NMSA 1978, §§ 72-6-1 to-7 Requested Start Date: Requested End Date:
☒ Temporary Change (other) Requested Start Date: Agreement date Requested End Date: 12/31/2030
☐ Accounting Period Start Date: WY 2021

1. APPLICANT(S) (Required) Note: water-right owner must be listed as an applicant.

Name: City of Clovis	Name: New Mexico Environment Department - PSTB
Contact or Agent: check here if Agent ☐ Justin Howalt, P.E., Clovis City Manager	Contact or Agent: check here if Agent ☒ Thomas Golden, P.E. (DBS&A)
Mailing Address: 321 N. Connelly St.	Mailing Address: 6020 Academy Rd. NE, Suite 100
City: Clovis	City: Albuquerque
State: NM Zip Code: 88101	State: NM Zip Code: 87109
Phone: ☐ Home ☐ Cell Phone (Work): 575-763-9654	Phone: ☐ Home ☐ Cell Phone (Work): 505-822-9400
E-mail (optional): jhowalt@cityofclovis.org	E-mail (optional): tgolden@geo-logic.com

2. CURRENT OSE FILE INFORMATION (Required)

OSE File No(s):	Priority Date (if known):	Subfile/Cause No. (if applicable):
CC-01090	12/31/1934	n/a

3. CURRENT PURPOSE OF USE AND AMOUNT OF WATER (Required)

☐ Domestic ☐ Livestock ☒ Irrigation
☐ Municipal ☐ Industrial ☐ Commercial
☐ Other Use (specify): ____________

Describe a specific use If applicable (i.e. sand & gravel washing, dairy etc): City zoo, irrigation of golf course, parks, & ball fields

Amount of Water (acre-feet per annum): If more details are needed, type "See Comments" in "Other" field below, and explain in Additional Statements Section.

Diversion: 1,162.16 (total WR)
Consumptive Use: ____________
Other (include units): See Comments

FOR OSE INTERNAL USE

File No.:	Trn. No.:	Receipt No.:
Trans Description (optional):		Sub-Basin:
Well Tag ID No. (if applicable):	PCW/LOG Due Date:	PBU Due Date:

4. COUNTY WHERE WATER RIGHT IS CURRENTLY USED (Required)

Curry

5. ADDITIONAL STATEMENTS CONCERNING THE CURRENT WATER RIGHT

The diversion right under file number CC-01090 is 1,162.16 acre-feet/year. This application seeks to temporarily change the point of diversion and place and purpose of use for up to 50.0 acre-feet/year under this file number.

6. CURRENT or MOVE-FROM POINT(S) OF DIVERSION (POD) (Required)

☐ **Surface POD** **OR** ☒ **Ground Water POD (Well)**

Name of ditch, acequia, or spring:

Stream or water course: Tributary of:

If application proposes a new point of diversion involving a diversion dam, storage dam, main canal, and/or pipeline, complete Attachment 2. ☐ Check here if Attachment 2 is included in this application packet.

POD Location Required: Coordinate location must be reported in NM State Plane (NAD 83), UTM (NAD 83), or Latitude/Longitude (Lat/Long - WGS84).
District II (Roswell) & District VII (Cimarron) customers, provide a PLSS location in addition to above.

☐ NM State Plane (NAD83) (Feet)
  ☐ NM West Zone
  ☐ NM East Zone
  ☐ NM Central Zone

☐ UTM (NAD83) (Meters)
  ☐ Zone 12N
  ☐ Zone 13N

☒ Lat/Long (WGS84) (to the nearest 1/10th of second)

POD Number (if known):	X or Easting or Longitude:	Y or Northing or Latitude:	Provide if known: -Public Land Survey System (PLSS) (*Quarters or Halves , Section, Township, Range*) OR - Hydrographic Survey Map & Tract; OR - Lot, Block & Subdivision; OR - Land Grant Name
CC-01090	103°11'13.3"W	34°24'27.1"N	Hillcrest Park well: T02N, R36E, Section 8, NW¼ SW¼ SE¼
CC-01090-S	103°10'55.8"W	34°24'29.3"N	Municipal golf course well: T02N, R36E, S 8, NW¼ SE¼ SE¼
CC-01090-S2	103°10'44.6"W	34°24'42.3"N	Guy Leeder well: T02N, R36E, Section 8, SE¼

NOTE: If more PODS need to be described, complete form WR-08 (Attachment 1 – POD Descriptions)
Additional point of diversion descriptions are attached: ☐ **Yes** ☒ **No** **If yes, how many________**

Point of Diversion is on Land Owned by: City of Clovis

Other description relating point of diversion to common landmarks, streets, or other:

FOR OSE INTERNAL USE

File Number:

Trn Number:

7. CURRENT or MOVE-FROM PLACE(S) OF USE (Required)

The land is legally described by (check all that apply):

☒ Public Land Survey System (PLSS) (quarters, section, township, range)
☐ Irrigation or Conservation District Map
☐ Hydrographic Survey Report or Map
☐ Subdivision
☐ Grant

Complete the blocks below for all tracts of land (more than one description can be provided for a tract if available):

PLSS Quarters or Halves, **and/or** Name of Hydrographic Survey, **and/or** Name of Irrigation or Conservation District, **and/or** Name and County of Subdivision **and/or** Grant	PLSS Section **and/or** Map No. **and/or** Lot No.	PLSS Township **and/or** Tract No. (Please list each tract individually) **and/or** Block No.	PLSS Range	Acres	Priority
SE¼	8	T02N	R36E	0	12/31/1934

Total Acres: 0

Other description relating place of use to common landmarks, streets, or other:

Place of use is on land owned by (required):
City of Clovis

Are there other sources of water for these lands? No ☒ Yes ☐ describe by OSE file number:

Note: If on Federal or State Land, please provide copy of lease.

8. MOVE-TO PURPOSE OF USE AND AMOUNT OF WATER

Check all that apply:

☐ Domestic ☐ Livestock ☐ Irrigation
☐ Municipal ☐ Industrial ☐ Commercial
☒ Other Use (specify): Pollution Recovery

Describe a specific use If applicable (i.e. sand & gravel washing, dairy etc): Remediation

Amount of Water (acre-feet per annum): If more details are needed, type "See Comments" in "Other" field below, and explain in Additional Statements Section.

Diversion: 50.0
Consumptive Use:
Other (include units):

9. MOVE-TO POINT(S) OF DIVERSION (POD) (Complete this section ONLY if adding or replacing a POD)

☐ **Surface POD** **OR** ☒ **Ground Water POD (Well)**

Name of ditch, acequia, or spring:

Stream or water course:

Tributary of:

If application proposes a new point of diversion involving a diversion dam, storage dam, main canal, and/or pipeline, complete Attachment 2. ☐ Check here if Attachment 2 is included in this application packet.

POD Location Required: Coordinate location must be reported in NM State Plane (NAD 83), UTM (NAD 83), or Latitude/Longitude (Lat/Long - WGS84).
District II (Roswell) & District VII (Cimarron) customers, provide a PLSS location in addition to above.

☒ NM State Plane (NAD83) (Feet)
  ☐ NM West Zone
  ☒ NM East Zone
  ☐ NM Central Zone

☐ UTM (NAD83) (Meters)
  ☐ Zone 12N
  ☐ Zone 13N

☐ Lat/Long (WGS84) (to the nearest 1/10th of second)

POD Number (if known):	**X or Easting or Longitude:**	**Y or Northing or Latitude:**	**Provide if known:** **-Public Land Survey System (PLSS)** **(*Quarters or Halves , Section, Township, Range*) OR** **- Hydrographic Survey Map & Tract; OR** **- Lot, Block & Subdivision; OR** **- Land Grant Name**
CC-02536 POD6 (MW-11)	884412.98	1244812.45	SW SW NW NW, S8, T2N, R36E
CC-02536 POD7 (MW-12)	884520.19	1245128.28	NW SW NW NW, S8, T2N, R36E
CC-02536 POD5 (BW-7R)	884291.06	1245210.02	NW SW NW NW, S8, T2N, R36E
CC-02536 POD1 (RW-1)	884125.45	1245546.79	NE NE NE NE, S7, T2N, R36E

NOTE: If more PODS need to be described, complete form WR-08 (Attachment 1 – POD Descriptions)
Additional POD descriptions are attached: ☑ **Yes** ☐ **No** **If yes, how many** 6

Other description relating point(s) of diversion to common landmarks, streets, or other: ~21st & Commerce Street intersection, Clovis

Point of Diversion is on Land Owned by: Various (access agreements are in place with each landowner)

Note: The following information is for wells only. If more than one (1) well needs to be described, provide attachment.

Approximate depth of well (feet): Attachment 1

Outside diameter of well casing (inches):

Driller Name:

Driller License Number:

If replacing the current well, is the current well to be plugged? ☐ Yes ☐ No ☒ Not Applicable
If No, state for what use it is retained:

10. MOVE-TO PLACE(S) OF USE (Complete this section ONLY if adding or changing a place of use)

List each individually

The land is legally described by (check all that apply):

☒ Public Land Survey System (PLSS) (quarters, section, township, range)

☐ Irrigation or Conservation District Map

☐ Hydrographic Survey Report or Map

☐ Subdivision

☐ Grant

Complete the blocks below for all tracts of land (more than one description can be provided for a tract if available):

PLSS Quarters or Halves, **and/or** Name of Hydrographic Survey, **and/or** Name of Irrigation or Conservation District, **and/or** Name and County of Subdivision **and/or** Grant	PLSS Section **and/or** Map No. **and/or** Lot No.	PLSS Township **and/or** Tract No. (Please list each tract individually) **and/or** Block No.	PLSS Range	Acres	Priority
Former Y Station State Lead Site					
NE¼	7	T02N	R36E	NA	NA

Total Acres: 0

Other description relating place of use to common landmarks, streets, or other:

Place of use is on land owned by (required): Various (site address is 721 Commerce Way, Clovis, NM)

Are there other sources of water for these lands? No ☒ Yes ☐ describe by OSE file number:

Note: If on Federal or State Land, please provide copy of lease.

FOR OSE INTERNAL USE

File Number:	Trn Number:

11. ACEQUIA OR COMMUNITY DITCH REQUIREMENTS

☒ A. The water right is not within a Community Ditch or Acequia

☐ B. The water right is within a Community Ditch or Acequia. **If you checked box B you must:**

1) Attach documentary evidence provided by commissioners of the Community Ditch or Acequia confirming applicant's compliance with any applicable requirement for the change adopted by the Community Ditch or Acequia **or**

2) Attach an affidavit from the commissioners of the Community Ditch or Acequia stating that no such requirement has been adopted by the relevant association bylaws.

This documentation is required pursuant to NMSA 1978 § 72-5-24.1.

12. ADDITIONAL STATEMENTS OR EXPLANATIONS

Purpose of the application is to make up to 50.0 acre-feet of City of Clovis water rights available for pollution recovery purposes at the Former Y Station, NMED-PSTB State Lead Site. See attached Water Use Agreement.

Move-to points of diversion will be limited to a combined diversion of 50.0 acre-feet/year, metered and reported separately. The approximate pumping rates by well are included on the attached table (Attachment 2).

The water will be pumped, treated, and then discharged to the City of Clovis sanitary sewer.

FOR OSE INTERNAL USE

File Number:	Trn Number:

ACKNOWLEDGEMENT

I, We (name of applicant(s)), City of Clovis and New Mexico Environment Department
Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

Applicant Signature

Applicant Signature

ACTION OF THE STATE ENGINEER

This application is:

☐ approved ☐ partially approved ☐ denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval.

Witness my hand and seal this ________ day of ____________________ 20 ______ , for

____, New Mexico State Engineer

By:
Signature

Print

Title:
Print

☐ Check here if a new well is to be drilled under this permit.

FOR OSE INTERNAL USE

Well Tag ID Issued? ☐ Yes ☐ No

File No.:	Trn No.:	Well ID Tag No.:

NEW MEXICO OFFICE OF THE STATE ENGINEER

ATTACHMENT 1
POINT OF DIVERSION DESCRIPTIONS

This Attachment is to be completed if more than one (1) point of diversion is described on an Application or Declaration.

a. Is this a:

☐ Move-From Point of Diversion(s)
☒ Move-To Point of Diversion(s)

b. Information on Attachment(s):

Number of points of diversion involved in the application: 10
Total number of pages attached to the application: 1

☐ **Surface Point of Diversion** **OR** ☒ **Well**

Name of ditch, acequia, or spring:	
Stream or water course:	
Tributary of:	

c. Location (Required):
Required: Move to POD location coordinate must be either New Mexico State Plane (NAD 83), UTM (NAD 83), **or** Lat/Long (WGS84)

NM State Plane (NAD83) (feet) NM West Zone ☐ NM Central Zone ☐ NM East Zone ☒	UTM (NAD83) (meters) Zone 13N ☐ Zone 12N ☐	☐ Lat/Long– (WGS84) 1/10th of second	OTHER (allowable only for move-from descriptions - see application form for format) ☒ PLSS (quarters, section, township, range) ☐ Hydrographic Survey, Map & Tract ☐ Lot, Block & Subdivision ☐ Grant

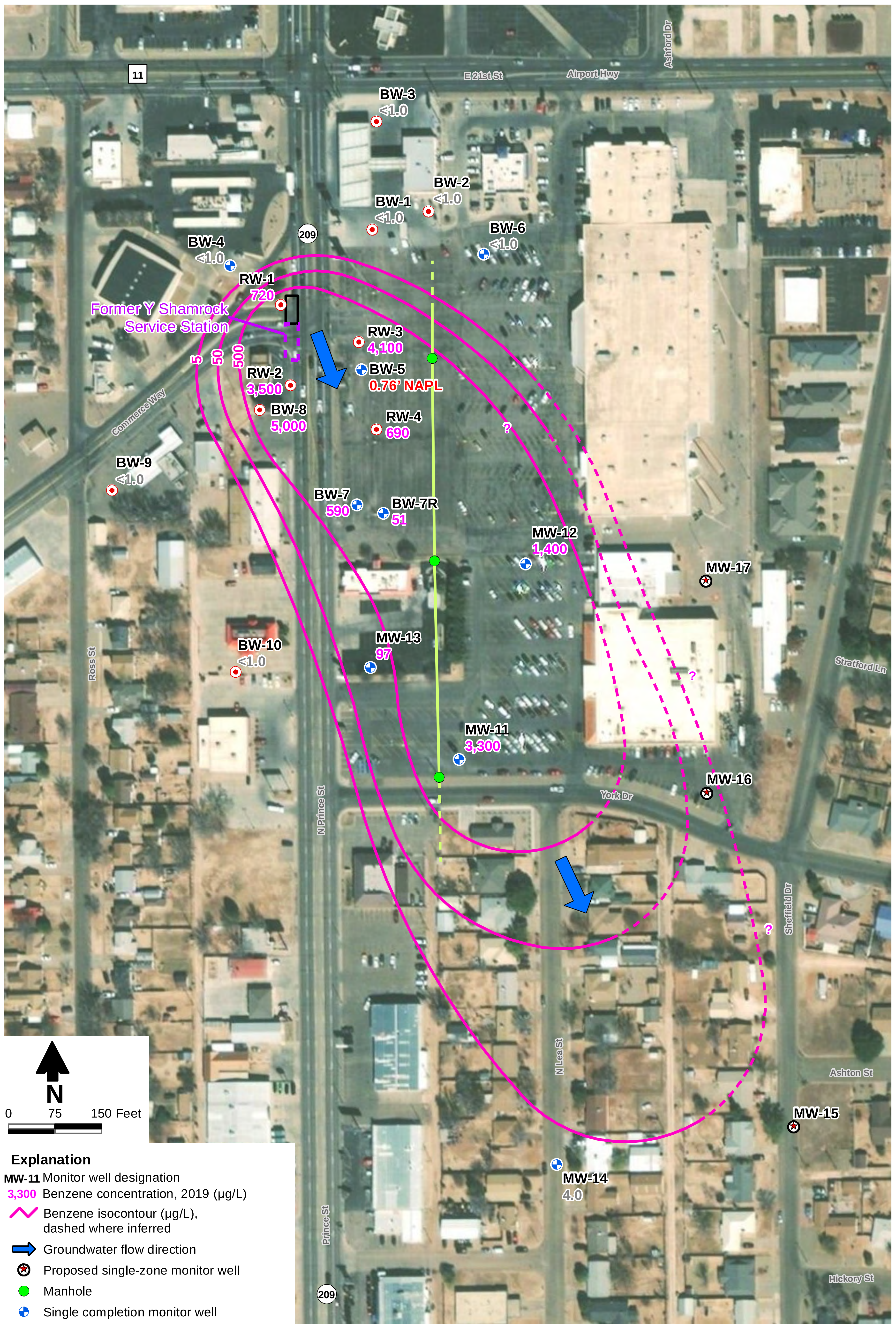
POD Number:	X or Longitude	Y or Latitude	Other Location Description:
CC-02536 POD2 (RW-2)	884140.96	1245416.83	SE NE NE NE, S7, T2N, R36E
CC-02536 POD3 (RW-3)	884251.49	1245486.71	SW NW NW NW, S8, T2N, R36E
CC-02536 POD4 (RW-4)	884279.77	1245346.00	SW NW NW NW, S8, T2N, R36E
CC-02536 POD8 (MW-13)	884269.96	1244960.74	NW SW NW NW, S8, T2N, R36E
CC-02548 POD3 (MW-16)	not surveyed yet		SW NW NW, S8, T2N, R36E
CC-02244 POD8 (BW-8)	884091.68	1245377.10	NE NE NE, S7, T2N, R36E

FOR OSE INTERNAL USE

Form wr-08
POD DESCRIPTIONS - ATTACHMENT 1

File Number:	Trn Number:
Trans Description (optional):	

S:\Projects\DB18.1157_Former_Y_Station\GIS\MXDs\Proposed_wells_2019-12.mxd



FORMER Y STATION STATE LEAD SITE
721 COMMERCE WAY
CLOVIS, NEW MEXICO
Proposed Monitor Wells

Figure 2

Daniel B. Stephens & Associates, Inc.
12/19/2019
JN DB18.1157.00

Attachment 2. Additional Move To Well Information

City of Clovis-NMED CC-01090 Permit Application to Change POD, Purpose, and Place of Use

OSE POD Number	Monitor well ID	Depth (feet)	Well casing diameter (inches)	Driller name	Driller's license number	Install date (Month/Year)	Proposed extraction rate (gpm)	Comments
CC-02536 POD6	MW-11	361	5	Richard LeBlanc/YJD	WD-1458	6/2019	4	---
CC-02536 POD7	MW-12	362	5	Richard LeBlanc/YJD	WD-1458	7/2019	4	---
CC-02536 POD5	BW-7R	362	5	Richard LeBlanc/YJD	WD-1458	8/2019	4	---
CC-02536 POD1	RW-1	359	4	Richard LeBlanc/YJD	WD-1458	6/2019	2	Nested completion (other two are 2-inch diameter)
CC-02536 POD2	RW-2	360.5	4	Richard LeBlanc/YJD	WD-1458	6/2019	2	Nested completion (other two are 2-inch diameter)
CC-02536 POD3	RW-3	364.5	4	Richard LeBlanc/YJD	WD-1458	8/2019	2	Nested completion (other two are 2-inch diameter)
CC-02536 POD4	RW-4	366	4	Richard LeBlanc/YJD	WD-1458	9/2019	2	Nested completion (other two are 2-inch diameter)
CC-02536 POD8	MW-13	362	5	Richard LeBlanc/YJD	WD-1458	8/2019	4	Contingency extraction well
CC-02548 POD3	MW-16	364	5	Richard LeBlanc/YJD	WD-1458	5/2020	4	Contingency extraction well
CC-02244 POD8	BW-8	352	4	Richard LeBlanc/YJD	WD-1458	11/2015	2	Nested completion (other two are 2-inch diameter)

gpm = gallons per minute
ID = identification
POD = point of diversion
YJD = Yellow Jacket Drilling

TEMPORARY WATER RIGHT USE AGREEMENT

THIS AGREEMENT is made this ___ day of Month, 2020 by and between the City of Clovis, whose address is 321 N. Connelly St., Clovis, NM 88101, hereinafter referred to as "Water Right Owner ", and the New Mexico Environment Department, Petroleum Storage Tank Bureau, whose address is 2905 Rodeo Park Drive East, Building 1, Santa Fe, NM 87505, hereinafter referred to as “Water Right User”.

WHEREAS, the Water Right Owner holds perpetual water rights ("water rights”) with consumptive duty diversionary rights totaling 1,162.16 acre-feet per year under New Mexico Office of the State Engineer (OSE) file number CC-01090, as more particularly set forth in Exhibit "A" attached hereto and incorporated herein by reference as though fully set forth;

and

WHEREAS, the parties desire to set forth the terms and conditions of their agreement.

NOW, THEREFORE, IT IS MUTUALLY AGREED AS FOLLOWS:

1. PROPERTY: Water Right Owner, upon the terms, provisions and conditions hereinafter contained, shall make available to the Water Right User up to 50.0 acre-feet per year of consumptive water rights in supplemental pollution recovery wells associated with the New Mexico Environment Department-Petroleum Storage Tank Bureau Former Y Station State Lead Site, located at 721 Commerce Way in Clovis, New Mexico (Site).

The transfer to the new points of diversion and place and purpose of use, and all fees associated therewith shall be the responsibility of the Water Right User and its designated agents. If additional extraction wells are needed in the future, additional permitting will be coordinated and paid for by the Water Right User or its designated agents.

2. PRICE: The total price for use of the Water Right Owner’s water right shall be the sum of $0.00 dollars, but the Water Right User or its designated agents will pay City of Clovis’ current industrial discharge rate for discharge of treated water to the City sewer, with the total cost based on the metered discharge. Fees will be assessed and paid monthly.

3. STATE ENGINEER APPROVAL: Water Right Owner and Water Right User shall promptly apply to the OSE for approval of a temporary change in point of diversion, and purpose and place of use of water rights to the site extraction wells. The parties shall diligently and in good faith

cooperate to obtain final approval of the application by the OSE. All expenses related to the temporary water right use agreement, including any legal fees in the case of a protest, shall be borne by the Water Right User. At the end of the project, the Water Right User will be responsible for all plugging, permitting, and associated costs.

4. ATTORNEY FEES AND COSTS: In the event an action is brought to enforce any of the terms and conditions of this Agreement, the prevailing party shall be entitled to recover from the other party as part of the prevailing party's costs, reasonable attorney fees and costs, the amount of which shall be fixed by the court and shall be made a part of any Judgment or Decree rendered.

5. ENTIRE AGREEMENT: This Agreement constitutes the entire agreement between the parties and replaces any existing agreement. No representations, warranties or promises pertaining to the Agreement or any other property affected by this Agreement have been made or shall be binding upon either of the parties except as expressly stated herein. This Agreement may not in any way be changed orally and cannot be reassigned to other parties except by an agreement in writing, signed by both parties

IN WITNESS WHEREOF, the parties have executed this Agreement as of the date and year first above written.

________________________________,"Water Right Owner" Date: ____________

By: __________________________________

Title:_________________________________

________________________________,"Water Right User" Date: ____________

By: __________________________________

Title:_________________________________

Exhibit A. Former Y Station Site Remediation Project
Additional Information

The New Mexico Environment Department (NMED) Petroleum Storage Tank Bureau (PSTB), and their consultant Daniel B. Stephens & Associates, Inc. (DBS&A), are preparing the final remediation plan for corrective action at the Former Y Station State Lead Site. The site is located at 721 Commerce Way in Clovis, and a large dissolved-phase hydrocarbon plume is located south of the Allsup's, near the intersection of Prince Street and Commerce Way. Water rights in the Curry County Underground Water Basin are needed for the corrective action at this site.

The treatment system will be run for 5 to 7 years. Pending access, regulatory approvals, and funding, the treatment system will be installed in the first quarter of 2021. Operation could begin as early as third quarter of 2021. The treatment system is being designed for a groundwater extraction rate of 30 gallons per minute (gpm), which is equivalent to approximately 50 acre-feet per year (ac-ft/yr). The temporary water use agreement is for a volume of up to 50 ac-ft/yr under New Mexico Office of the State Engineer (OSE) file number CC-01090, for a term of not to exceed ten years (e.g., July 1, 2021 through December 31, 2030).

Through its consultant, NMED PSTB intends to pay the City of Clovis (the City) for discharge of the treated water, at the City's current industrial discharge rate of $1.12 per thousand gallons (kgal). A flow rate of 30 gpm is equivalent to 43.2 kgal per day. Assuming that the treatment system is run 365 days per year, at the industrial discharge fee of $1.12/kgal, NMED PSTB will pay up to $17,660.16 per year in discharge fees, plus New Mexico Gross Receipts Tax, under the temporary water use agreement. There will be no additional charge for using the City's water rights.

An application to change the point of diversion and place and purpose of use for up to 50 ac-ft/yr of water rights under OSE file number CC-01090 will be filed with the OSE. Public notice of this application will be required. NMED PSTB's consultant will complete the public notice tasks, which will be paid for by NMED PSTB. The application will be filed as soon as the temporary water use agreement has been signed, to ensure that water can be pumped once the treatment system is ready for operation.

New Mexico Office of the State Engineer

Water Right Summary

get image list

WR File Number: CC 01090 **Subbasin:** CU **Cross Reference:** -

Primary Purpose: IRR IRRIGATION

Primary Status: PMT PERMIT

Total Acres: 0 **Subfile:** - **Header:** -

Total Diversion: 1162.16 **Cause/Case:** -

Owner: CITY OF CLOVIS

Contact: JOE THOMAS

Documents on File

	Trn #	Doc	File/Act	Status 1	Status 2	Transaction Desc.	From/ To	Acres	Diversion	Consumptive
get images	440686	SUPPL	1997-10-03	PMT	ET	CC 01090 S-2	T	0	1162.16	1162.16
get images	314716	DCL	1996-11-25	DCL	PRC	CC 01090	T	0	1162.16	1162.16

Current Points of Diversion

(NAD83 UTM in meters)

POD Number	Well Tag	Source	Q 64	Q 16	Q 4	Sec	Tws	Rng	X	Y	Other Location Desc
CC 01090		Shallow	1	3	4	08	02N	36E	666669	3808823*	
CC 01090 S		Shallow	1	4	4	08	02N	36E	667072	3808830*	
CC 01090 S2		Shallow			4	08	02N	36E	666971	3808925*	N1/2

***An (*) after northing value indicates UTM location was derived from PLSS - see Help**

Priority Summary

Priority	Status	Acres	Diversion	Pod Number	Source
12/31/1934	DCL	0	1162.16	CC 01090	Shallow
				CC 01090 S	Shallow
				CC 01090 S2	Shallow

Place of Use

Q 256	Q 64	Q 16	Q 4	Sec	Tws	Rng	Acres	Diversion	CU	Use	Priority	Status	Other Location Desc
			4	08	02N	36E	0	1162.16	1162.16	IRR	12/31/1934	DCL	

Source

Acres	Diversion	CU	Use	Priority	Source	Description
0	1162.16	1162.16	IRR	12/31/1934	GW	

Appendix J

Legal Notice of Publication

NOTICE OF SUBMISSION OF FINAL REMEDIATION PLAN

Date of Notice: July 14 and 21, 2021

Notice is hereby given by the Petroleum Storage Tank Bureau (PSTB) of the New Mexico Environment Department (NMED) of the submission of a Final Remediation Plan (Plan) on July 16, 2021, as follows:

1. The Plan proposes actions to remediate a release of petroleum or petroleum products into the environment.

2. The release occurred at the Former Y Station site, located at the northwest corner of Prince Street and Commerce Way in Clovis, New Mexico. Impacts associated with the release extend under the intersection and adjacent property to the southeast. With permission, remediation equipment will be located in the parking lot of the Albertson's grocery store located at 1905 N. Prince Street, at the northeast corner of Prince Street and York Drive.

3. The Plan proposes to remove gasoline contamination through the use of dual-phase extraction technology from existing on-site and downgradient wells. Extracted hydrocarbon vapors will be treated using thermal and/or catalytic oxidation technology and discharged to the atmosphere. Extracted groundwater will be treated with diffused aeration and discharged to the sanitary sewer, pending required regulatory approval.

4. Copies of the Final Remediation Plan can be viewed by interested parties at the NMED PSTB offices at 1) 2905 Rodeo Park Drive East, Building 1, Santa Fe, New Mexico, 87505; and 2) 1914 W. Second Street, Roswell, New Mexico, 88201. Due to policies in place in response to the COVID-19 pandemic, arrangements must be made 48 hours in advance for an in-person viewing of the Plan. Please contact the NMED PSTB project manager, Ms. Renee Romero, by telephone at 505-372-8332 or email at d.renee.romero @state.nm.us to arrange a viewing.

   In addition, the Final Remediation Plan and all applicable data may be viewed at the following website: http://dbsa-client-access.com/PSTB/file_access.htm. Services may be arranged for translation of documents, for interpreters, and for obtaining services for persons with disabilities by contacting the PSTB Project Manager. TDD or TTY users, please access phone numbers using the New Mexico Relay Network, 1-800-659-1779 (voice) and 1-800-659-8331 (TTY users).

5. Comments on the Plan may be sent to the PSTB Project Manager: by mail at New Mexico Environment Department Petroleum Storage Tank Bureau, Attn: Renee Romero, 1914 W Second St., Roswell, New Mexico, 88201; by telephone at 505-372-8332; or e-mailed to: d.renee.romero@state.nm.us. Comments sent to the PSTB Project Manager must also be mailed to the NMED Secretary at New Mexico Environment Department, Attn: Secretary Kenney, PO Box 5469, Santa Fe, NM 87502-5469. Comments must be delivered by August 12, 2021. Please include the name of the site "Former Y Station, 721 Commerce Way, Clovis, New Mexico" to ensure comments are correctly assigned to the site.

AVISO DE PRESENTACIÓN DEL PLAN FINAL DE REMEDIACIÓN

Fecha del aviso: 14 y 21 de julio de 2021

Por el presente aviso, la Oficina de Tanques de Almacenamiento de Petróleo (PSTB, por sus siglas en inglés) del Departamento de Medio Ambiente de Nuevo México (NMED, por sus siglas en inglés) notifica la presentación de un Plan Final de Remediación (Plan) el 16 de julio de 2021, como sigue:

1. El Plan propone acciones para remediar una liberación de petróleo o productos petrolíferos en el medio ambiente.

2. La liberación ocurrió en el sitio de la Antigua Estación Y, ubicada en la esquina noroeste de Prince Street y Commerce Way en Clovis, Nuevo México. Los impactos asociados con la liberación se extienden bajo la intersección y la propiedad adyacente al sureste. Con permiso, el equipo de remediación se ubicará en el estacionamiento de la tienda de comestibles Albertson's ubicada en 1905 N. Prince Street, en la esquina noreste de Prince Street y York Drive.

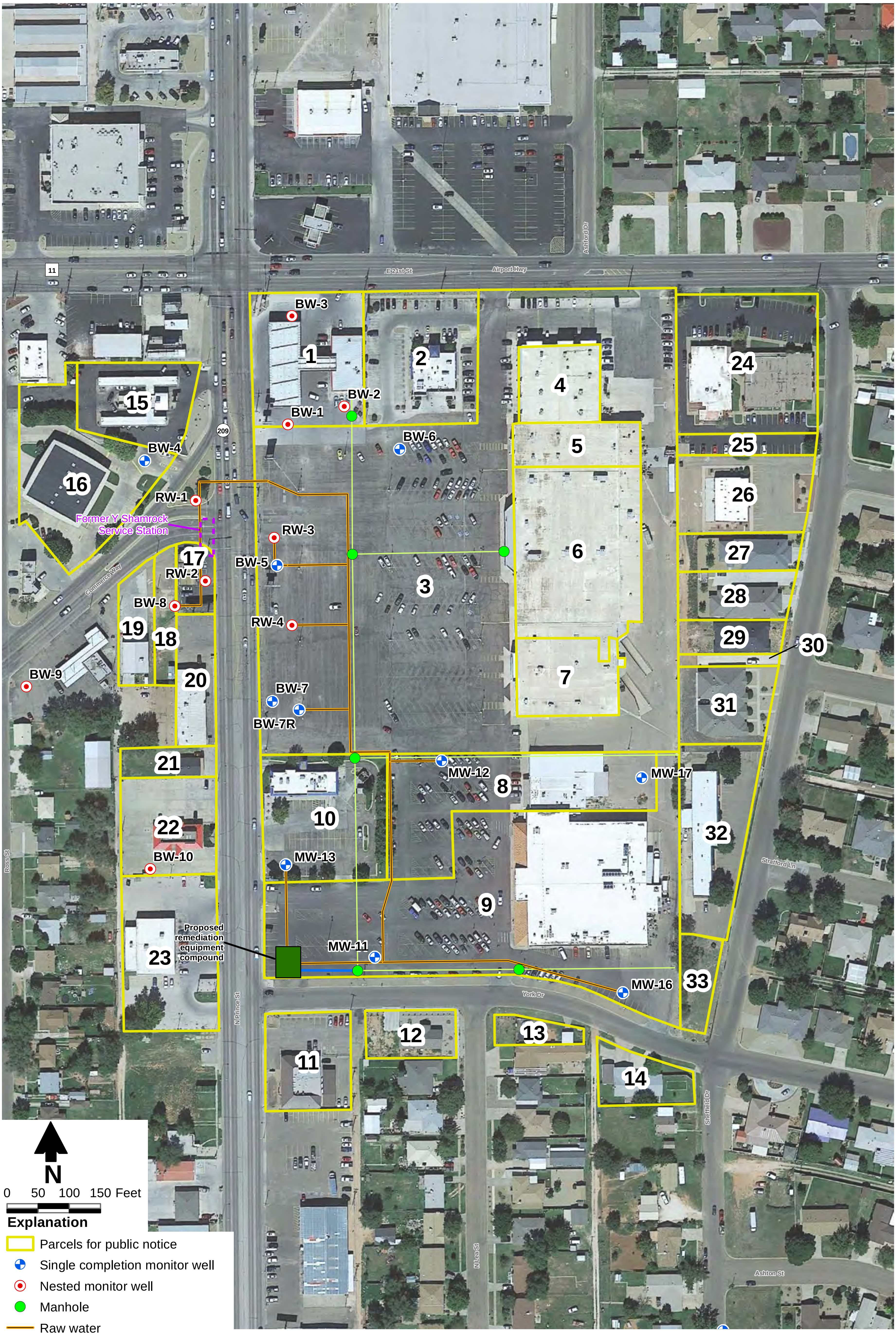
3. El plan propone eliminar la contaminación por gasolina mediante el uso de tecnología de extracción de doble fase en los pozos existentes en el lugar y en los pozos descendentes. Los vapores de hidrocarburos extraídos se tratarán mediante tecnología de oxidación térmica y/o catalítica y se descargarán a la atmósfera. Las aguas subterráneas extraídas se tratarán con aireación difusa y se verterán al alcantarillado sanitario, pendiente de la aprobación regulatoria requerida.

4. Las partes interesadas pueden ver copias del Plan Final de Remediación en las oficinas de la PSTB del NMED en 1) 2905 Rodeo Park Drive East, Edificio 1, Santa Fe, NM, 87505; y 2) 1914 W. Second Street, Roswell, NM, 88201. Debido a las políticas establecidas en respuesta a la pandemia por COVID-19, se deben hacer acomodaciones con 48 horas de anticipación para ver el Plan en persona. Comuníquese con la gerente del proyecto de la PSTB del NMED, la Sra. Renee Romero, por teléfono llamando al 505-372-8332 o por correo electrónico a d.renee.romero @state.nm.us para concertar una visita.

   Además, el Plan Final de Remediación y todos los datos aplicables pueden verse en el siguiente sitio web: http://dbsa-client-access.com/PSTB/file_access.htm. Se pueden concertar servicios de traducción de documentos, de intérpretes y de obtención de servicios para personas con discapacidades comunicándose con la gerente del proyecto de la PSTB. Los usuarios de TDD o TTY, pueden acceder a los números de teléfono usando la Red de Retransmisión de Nuevo México, 1-800-659-1779 (voz) y 1-800-659-8331 (usuarios de TTY).

5. Los comentarios sobre el Plan pueden enviarse a la gerente del proyecto de la PSTB: por correo postal a New Mexico Environment Department Petroleum Storage Tank Bureau, Attn: Renee Romero, 1914 W Second St., Roswell, NM, 88201; por teléfono llamando al 505-372-8332; o por correo electrónico a: d.renee.romero@state.nm.us. Los comentarios enviados a la gerente del proyecto de la PSTB también deben enviarse por correo postal al secretario del NMED de Nuevo México, Environment Department, Attn: Secretary Kenney, PO Box 5469, Santa Fe, NM 87502-5469. Los comentarios deben ser entregados a más tardar hasta el 12 de agosto de 2021. Incluya el nombre del sitio "Former Y Station, 721 Commerce Way, Clovis, New Mexico" para asegurar que los comentarios sean asignados correctamente al sitio.

S:\Projects\DB18.1157_Former_Y_Station\GIS\MXDs\Public Notice\Public_Notice_Parcels.mxd



FORMER Y STATION STATE LEAD SITE
721 COMMERCE WAY
CLOVIS, NEW MEXICO

Proposed Remediation System Layout

Figure 10

Daniel B. Stephens & Associates, Inc.
6/15/2021
JN DB17.1228.PR

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

12741 LLC
5435 Lemon Gulch Road
Castle Rock, Co 80108

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

Dear Addressee:

Enclosed please find a copy of the announcement of the submission of the proposed Final Remediation Plan for the Former Y Station site, located at the northwest corner of Prince Street and Commerce Way in Clovis, New Mexico.

If you have any questions or comments, please contact the project manager at the New Mexico Environment Department Petroleum Storage Tank Bureau office in Roswell, New Mexico.

Adjunto encontrará aviso de la presentación de un Plan de Remediación Final por Bell Gas #1186 (TR's Market) Site, 101 Sun Valley Road, Alto, Nuevo Mexico.

Los comentarios sobre el plan pueden enviarse a la gerente de proyectos de la Oficina de Tanques de Almacenamiento de Petróleo (PSTB, por sus siglas en inglés) del Departamento de Medio Ambiente de Nuevo México (NMED, por sus siglas en inglés) de Roswell, Nuevo Mexico.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Thomas Golden, P.E.
Project Engineer/ Ingeniero

TG/djs
Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

<u>CERTIFIED MAIL</u>
<u>RETURN RECEIPT REQUESTED</u>

Darrell & Andrea Armstrong
221 York Drive
Clovis, NM 88101

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Thomas Golden, P.E.
Project Engineer/ Ingeniero

TG/djs
Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Autozone #2514
PO Box 2198, Dept. 8088
Memphis, TN 38101

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Thomas Golden, P.E.
Project Engineer/ Ingeniero

TG/djs
Enclosure

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

B & B Merritt Real Estate LLC
750 North 17th Street
Las Cruces, NM 88005

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
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Thomas Golden, P.E.
Project Engineer/ Ingeniero

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Brian Bailey
7200 A Windsor Drive
Allentown, PA 18106

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
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Project Engineer/ Ingeniero

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

John Bourne and William L. Erwin
321 Remuda
Clovis, NM 88101

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Sincerely,

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Thomas Golden, P.E.
Project Engineer/ Ingeniero

TG/djs
Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Joline Chaparro
1717 North Lea Street
Clovis, NM 88101

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Clovis Grocery Owners LLC
c/o Paradigm Tax Group
PO Box 800729
Dallas, TX 75380

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
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Thomas Golden, P.E.
Project Engineer/ Ingeniero

TG/djs
Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Clovis Shopping Center LLC
5435 Lemon Gulch Road
Castle Rock, CO 80108

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
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Thomas Golden, P.E.
Project Engineer/ Ingeniero

TG/djs
Enclosure

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Clovis Shopping Center LLC
Pace Properties Inc.
1401 S Brentwood Boulevard, Suite 900
Brentwood, MO 63144

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Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Thomas Golden, P.E.
Project Engineer/ Ingeniero

TG/djs
Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Gerald V. Cryer
PO Box 7730
Ruidoso, NM 88355

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Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Thomas Golden, P.E.
Project Engineer/ Ingeniero

TG/djs
Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Lawrence & Anna Kolek
15 North Village Drive
Clovis, NM 88101

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

Dear Addressee:

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Thomas Golden, P.E.
Project Engineer/ Ingeniero

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Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

<u>CERTIFIED MAIL</u>
<u>RETURN RECEIPT REQUESTED</u>

Legacy Capital LLC
2020 Sheffield Drive
Clovis, NM 88101

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Thomas Golden, P.E.
Project Engineer/ Ingeniero

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Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Lotharlo LLC
437 Audraine Drive
Glendale, CA 91202

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Thomas Golden, P.E.
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Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Jazmin Loya
619 Dixie Drive
Clovis, NM 88101

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Dennis Matsui Trustee
Dennis Matsui Living Trust
89 Old Agua Fria Road West
Santa Fe, NM 87508

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Thomas Golden, P.E.
Project Engineer/ Ingeniero

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Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Raymond J. Montoya
1908 North Prince Street
Clovis, NM 88101

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Thomas Golden, P.E.
Project Engineer/ Ingeniero

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Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

<u>CERTIFIED MAIL</u>
<u>RETURN RECEIPT REQUESTED</u>

National Retail Properties LP
450 South Orange Avenue, Suite 900
Orlando, Fl 32801

Re: Proposed Final Remediation Plan / Plan de Remediación Final por
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Project Engineer/ Ingeniero

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Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

<u>CERTIFIED MAIL</u>
<u>RETURN RECEIPT REQUESTED</u>

New Mexico Bank & Trust
P O Box 730
Clovis, NM 88102

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Former Y Station Site
Northwest Corner of Prince Street and Commerce Way, Clovis, NM

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Project Engineer/ Ingeniero

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Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Paradise Rentals LLC
PO Box 683
Clovis, NM 88102

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Former Y Station Site
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Thomas Golden, P.E.
Project Engineer/ Ingeniero

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Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Realty Income Properties 17 LLC
Attn:Pm Dept #4796
c/o Hobby Lobby
11995 El Camino Real
San Diego, CA 92130

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Jeffrey D. Rosenbury
400 East 19th
Clovis, NM 88101

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Project Engineer/ Ingeniero

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Sam & Julie Snell
Sam & Julie Snell Trust
c/o Mark Sweetman, Esq
PO Box 397
Clovis, NM 88102

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Jeff E. and Mati Tharp
553 State Road 523
Clovis, NM 88101

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Project Engineer/ Ingeniero

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

July 8, 2021

CERTIFIED MAIL
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Tierra Blanca Galleria LLC
3220 Axtell
Clovis, NM 88101

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Thomas Golden, P.E.
Project Engineer/ Ingeniero

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6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

S:\Projects\DB18.1157_Former_Y_Station\GIS\MXDs\Public Notice\Public_Notice_System_Layout.mxd

Figure 10

FORMER Y STATION STATE LEAD SITE
721 COMMERCE WAY
CLOVIS, NEW MEXICO

Proposed Remediation System Layout

Daniel B. Stephens & Associates, Inc.

7/8/2021

JN DB17.1228.PR

Appendix K

Schedule for Implementation of Final Remediation Plan

Former Y Station FRP Implementation

Task	Calendar Days	Start Date	End Date
Final FRP Submittal			7/16/2021
Address PSTB and Public Comments	45	7/16/2021	8/30/2021
FRP Approval	7	8/30/2021	9/6/2021
Work Plan for FRP Implementation	30	9/6/2021	10/6/2021
Work Plan Approval	60	10/6/2021	12/5/2021
Equipment Procurement	84	12/5/2021	2/27/2022
Trenching/Piping	90	12/19/2021	3/19/2022
Equipment Installation	21	3/19/2022	4/9/2022
Startup	7	4/9/2022	4/16/2022
First Year System Operations	365	4/16/2022	4/16/2023