GREAT BASIN ENGINEERING INC

RIVERSBEND SECONDARY WATER MODEL
APPROX 900 SOUTH 3500 WEST
WEBER COUNTY, UTAH 84401
SECONDARY WATER MODEL
Project No. 21N724
6-16-2021
Updated 6-17-2021
Updated 6-30-2021

General Site Information:

The proposed residential subdivision is located approximately at 900 South 3500 West along the Weber River on the west of the Interstate 15 Freeway in Weber County, Utah. Construction will consist of a 98-Lot residential subdivision along with site grading, parking lots, sidewalks, curb and gutter, underground utilities (including a secondary water system, herein after referred to as the "System"), a secondary water reservoir, and similar related improvements when completed. Secondary water will be piped through the System via water pumps, 4-inch and 6-inch main diameter lines, 2-inch residential laterals, and 1.0-inch individual lot connections, where individual meters may be required.

Secondary water will be supplied by diverting from an existing irrigation ditch and be stored in a new off-site irrigation pond. Water rights are available or will be purchased for this use. This water will be supplemented by any storm water which falls on the site. The water will be stored in the afore-mentioned reservoir until used. Pumps will be provided which will deliver water from the new pond through new secondary water piping to each residential lot of this subdivision, as well as common areas for use with landscaping in these lots and common areas.

Design Requirements:

This development lies within Zone 4 of the Irrigated Crop Consumptive Use Zones and Normal Annual Effective Precipitation, Utah map in R39-510-7(3). The State requires developers within this Zone to design for an irrigation water rights of 1.87-acre feet per irrigated acre per year (ac-ft/irr-ac-yr) with a unit peak day demand of 3.96 gpm/irr-ac which is delivered from the well to the proposed irrigation pond. However, alternate local data suggests a depth of 25.57 inches (2.13 ft/year) using a thirty-year average for period 1961 – 1990. The required storage will need to be provided even in the month with the highest demand. This is July with a demand of 5.21 inches, which in july is equivalent to about 1.3 inches each turn (7.5-day duration).

In the experience of this office, many watering guidelines are not always followed or closely regulated for secondary water systems. Therefore, a safety factor of 2 is chosen to act as a buffer for the PID, resulting in a design rate of 15.84 gpm/irr-ac. This 15.84 gpm/irr-ac is divided through the development in a pro-rated fashion to each lot or area based upon required landscaping area within the Water Model. It is understood that not every lot, common area, or agricultural area will be watering at

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the same time, and that at any given time, a single lot or area may be utilizing more or less than 15.84 gpm/irr-ac, as this PID is an average throughout the development.

Watering days/times will be split or assigned to decrease the irrigated acreage being watered at any given time during the watering season.

The requirements provided by the State of Utah and Hooper Irrigation company are supplemented, by reasonable requirements from nearby Marriott-Slaterville Public Works Standards. For service saddle connections, the Hooper Irrigation Company Standards require "All service saddles for connections to C900 PVC pipe sizes 4-inch to 10-inch diameter shall be Mueller Model H-13490 Series or Ford S-90". Diameters of 4" and 6" were selected for all main lines in this model. The Marriott-Slaterville standards require that pressures be designed between 60 psi and 100 psi for individual connections.

Copies of the State of Utah, Hooper Irrigation Company and Marriott-Slaterville Standards are attached to this report.

Currently, each share is allowed up to 2.8 ac-ft. This site will be required to have 12.2 shares in order to provide the required 34.3 ac-ft of storage. However, water shares are only sold in 0.5 share increments. Therefore, 12.5 shares will be needed.

Model Software and Input:

The software used for this analysis is EPANET 2.2, which is a free service that is available on the epa.gov website. Naming conventions for junctions (nodes) and pipes (links) are as follows:

- Connection nodes for individual lots, common area, and agricultural areas (requiring demand) are labeled by a "C" followed by a whole number, beginning at the most upstream connection. The numbering continues proceeding incrementally (to C51) in the directions indicated by the attached LCM. For example, the node serving as connection for Lots 228/229 is labeled as "C30".
- The relatively short laterals that lead to the connection nodes are labeled with an "L" followed by the corresponding connection number. For example, the short lateral serving Lots 228/229 is labeled as "L30".
- The nodes on the upstream ends of each lateral are labeled with "J." followed by the corresponding connection number(s) (separated by "." if necessary) attached to the connected laterals. For example, the node on the upstream end of L29 is also the node on the upstream end of L28 (which serves Lots 236/237) and is labeled as "J.28.29".
- The remaining nodes are along the main lines, are not at the ends of connection laterals, and do not have associated demands. These are labeled "J1" through "J15" likewise in the directions indicated by the attached LCM. For example, the junction in the intersection nearest Lot 202 is labeled as "J5".
- The remaining irrigation lines are all mainlines and are designated as 1,2,3…62 in the directions

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indicated by the attached LCM. For example, the pipe connecting nodes J5 and J.27 is labeled as "52".

To model the System, head vs. flow curves were needed to incorporate the water pumps. The Design Peak Instantaneous Demand calculates to about 254.89 gpm. It is reasonable to consider using 130 gpm constant flow and a 130 gpm VFD to provide a conservative total 260 gpm for the System. A reputable manufacturer, Grundfos, was contacted to provide guidance on selecting a possible pump combination to meet these criteria. The manufacturer's website was consulted to locate suitable choices. For the pumps, a GRUNDFOS CR 20-4 A-GJ-A-E-HQQE was selected. Corresponding headloss/head (ft) vs. flow (gpm) curves and O&M manuals are attached to this report.

The water pumps were modeled as "pumps" in EPANET. They are labeled as "Pump-1" and "Pump-2" on the attached exhibits. For analyses, either both or one of the pumps are assumed functioning, as explained on the next section. This is for considering the event where one of the pumps may be shut down at any one time for servicing, etc.

Modeled Scenarios:

Two scenarios are analyzed using the EPANET model, conservatively assuming the full PID for the site under the first scenario. The VFD pump will provide more or less head, as needed, during times when there is an increase or decrease in flow from what the constant head pump is able to provide. First, both pumps are considered functioning properly. Next it is assumed that one of the pumps (Pump 2) is not functioning during times of required maintenance. The two scenarios are:

1. Both pumps functioning with full PID utilized throughout the subdivision.
2. Pump-2 off with half of PID utilized throughout the subdivision.

Data showing specifics for the pipe and node properties can be found in the attached exhibits (Appendix A) and calculations/results (Appendix D) as well.

The results are sorted by base demand for nodes, and length for pipes to make it easier to analyze/critique the data.

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Results:

In Scenario 1, when considering both pumps to be functioning, pressures between 60 through 80 psi are obtained for all 51 connection points, as required.

In Scenario 2, where one pump is considered off for maintenance etc., the pressures at connection points were still at least 60 psi or greater. It is assumed that when one of the two pumps that are down for maintenance will be serviced promptly so that these occasional decreased flow rates will be temporary and short-lived for the water users.

Velocities in each pipe were less than 10 fps under both scenarios. Moreover, most of the velocities are under 3 fps as per the case study, which is reasonable for secondary water systems.

Great Basin Engineering, Inc.

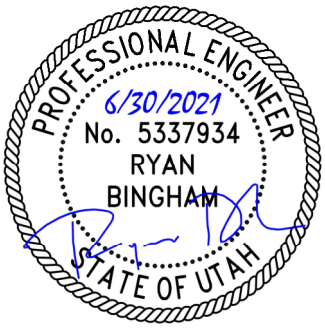
Prepared by

Abhishek Amalaraj, E.I.T.

Abhishek Amalaraj

Reviewed by

Ryan Bingham, P.E.



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APPENDICES

Appendix A – Maps

Appendix B – Design Parameters and Details

Appendix C – Pump Curves

Appendix D – Model Calculations/Results

Appendix E – Pump O&M Manuals

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APPENDIX A

Maps

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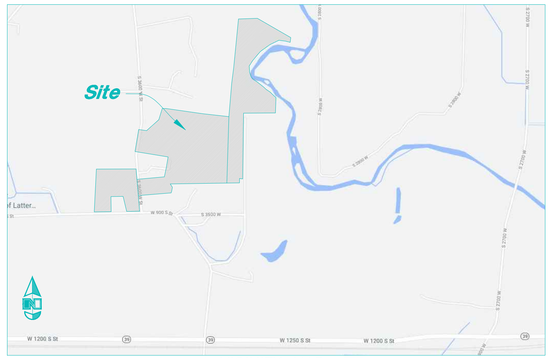
Riverbend



VICINITY MAP
Not to Scale

Scale: 1" = 80'

Graphic Scale

Phase 1 = 49 Lots – 50 %
Phase 2 = 49 Lots – 50 %

NOTES:

1. 10' Wide Public Utility Easements as indicated by dashed lines.
2. All lots with a "–R" designation to be "Restricted". All lots are restricted to homes without restrictions.
3. Secondary Water – See Attached Calcs

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REV | DATE | DESCRIPTION

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Secondary Water Model Exhibit

Riverbend

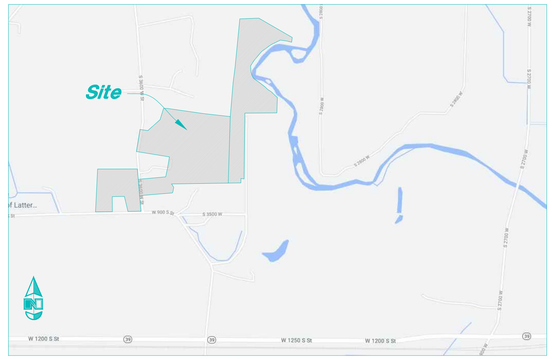
A part of Section Southeast Quarter of 16 and the West Half of Section 15, T6N. R2W, SLB&M, U.S. Survey

June, 2021

SHEET NO.
SWME1

21N724

Riverbend



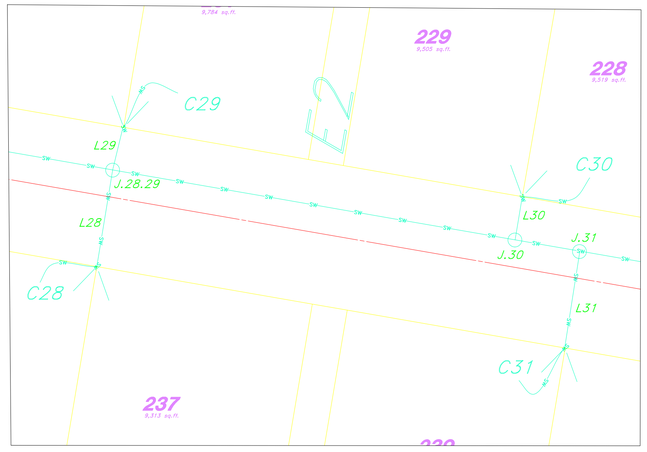
VICINITY MAP
Not to Scale

Scale: 1" = 80'

80 0 20 40 80 100 120 140 160

Graphic Scale

Phase 1 = 49 Lots – 50 %
Phase 2 = 49 Lots – 50 %



NOTES:

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3. Secondary Water – See Attached Calcs

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Secondary Water - Labeling Convention

Riverbend

A part of Section Southeast Quarter of 16 and the West Half of Section 15, T6N. R2W, SLB&M, U.S. Survey

June, 2021

SHEET NO.
SWME2

21N724

APPENDIX B

Design Parameters and Details

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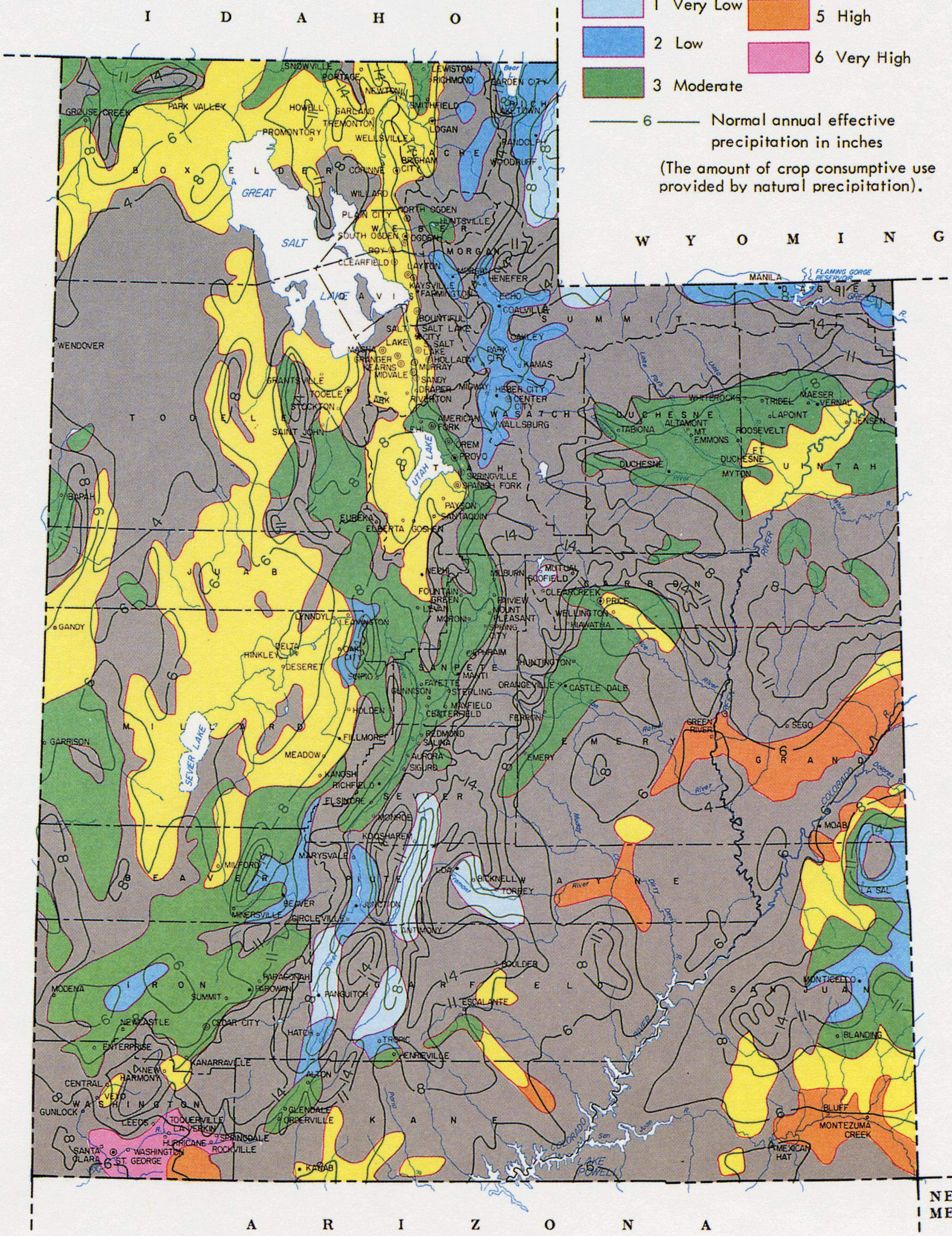


IRRIGATED CROP CONSUMPTIVE USE ZONES AND NORMAL ANNUAL EFFECTIVE PRECIPITATION

UTAH

NOVEMBER 1978

10 0 10 20 30 40 50 60 MILES

SCALE 1:3,000,000

M7-0L-23893

Source:
Base map prepared by SCS, WTSC Carto Staff from USGS 1:1,000,000 National Atlas.
Thematic detail compiled by state staff.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS-FORT WORTH, TEXAS 1983

Note 4. Or Peak Day Demand = 20 x [Water Area (ft^2)/30] + Deck Area (ft^2)

(3) Irrigation Use.

If a water system provides water for irrigation, Table 510-3 shall be used to determine the peak day demand and average yearly demand for irrigation water use. The following procedure shall be used:

(a) Determine the location of the water system on the map entitled *Irrigated Crop Consumptive Use Zones and Normal Annual Effective Precipitation, Utah* as prepared by the Soil Conservation Service (available from the Division). Find the numbered zone, one through six, in which the water system is located (if located in an area described "non-arable" find nearest numbered zone).

Guidance: The irrigation zone map is provided below. This map is available on the Division of Drinking Water's website.

(b) Determine the net number of acres which may be irrigated.

Guidance: To determine the net number of acres to be irrigated, start with the gross acreage, then subtract any area of roadway, driveway, sidewalk, or patio pavement along with housing foundation footprints that can be reasonably expected for lots within a new subdivision or which is representative of existing lots. Before any other land area which may be considered "non-irrigated" (e.g., steep slopes, wooded acres, etc.) is subtracted from the gross area, the Director should be consulted and agree that the land in question will not be irrigated. For instance, in the case of a heavily wooded mountain home subdivision, it may be claimed that large lawns will not be put in by the lot owners. The division should review and concur with this judgment.

(c) Refer to Table 510-3, which assumes direct application of water to vegetation, to determine peak day demand and average yearly demand for irrigation use.

(d) Consider water losses due to factors such as evaporation, irrigation delivery method, overwatering, pipe leaks, etc. Apply a safety factor to the irrigation demand in the design accordingly.

Table 510-3 Source Demand for Irrigation		
Map Zone	Peak Day Demand (gpm/irrigated acre)	Average Yearly Demand (AF/ irrigated acre) (Note 1)

1	2.26	1.17
2	2.80	1.23
3	3.39	1.66
4	3.96	1.87
5	4.52	2.69
6	4.90	3.26

NOTE FOR TABLE 510-3:

Note 1. The average yearly demand for irrigation water use (in acre-feet per irrigated acre) is based on 213 days of irrigation, e.g., April 1 to October 31.

Guidance: If the irrigation season differs from the assumed 213 days, the average yearly demand numbers may need to adjusted.

(4) Variations in Source Yield.

(a) Water systems shall consider that flow from sources may vary seasonally and yearly. Where flow varies, the number of service connections supported by a source shall be based on the minimum seasonal flow rate compared to the corresponding seasonal demand.

(b) Where source capacity is limited by the capacity of treatment facilities, the maximum number of service connections shall be determined using the treatment plant design capacity instead of the source capacity.

Guidance: Some water sources, such as deep wells, yield consistent quantities of water while others, such as springs, yield inconsistent quantities that vary seasonally and annually. Sources that yield inconsistent quantities of water should be studied and understood prior to the commitment of those sources for future uses, such as providing will-serve letters or approving proposed developments.

60 to 239	$Q= 80+ 20N^{0.5}$
240 or greater	Q= 1.6N

NOTES FOR TABLE 510-6:

Q is total peak instantaneous demand (gpm). N is the maximum number of connections. However, if the only water use is via service buildings, the peak instantaneous demand shall be calculated for the number of plumbing fixture units as presented in the state-adopted plumbing code.

(d) For small non-community water systems, the peak instantaneous demand for indoor water use shall be calculated on a per-building basis for the number of plumbing fixture units as presented in the state-adopted plumbing code.

(3) Peak Instantaneous Demand for Irrigation Use.

Peak instantaneous demand for irrigation use is given in Table 510-7. The procedure for determining the map zone and irrigated acreage for using Table 510-7 is outlined in R309-510-7(3).

Table 510-7 Peak Instantaneous Demand for Irrigation Use	
Map Zone	Peak Instantaneous Demand (gpm/irrigated acre)
1	4.52
2	5.60
3	6.78
4	7.92
5	9.04
6	9.80

(4) Fire Flow.

(a) Distribution systems shall be designed to deliver needed fire flow if fire flow is required by the local fire code official or if fire hydrants intended for fire flow are provided. The distribution system shall be sized to provide minimum pressures as required by R309-105-9 to all points in the distribution system when needed fire flows are imposed during peak day demand in the distribution system.

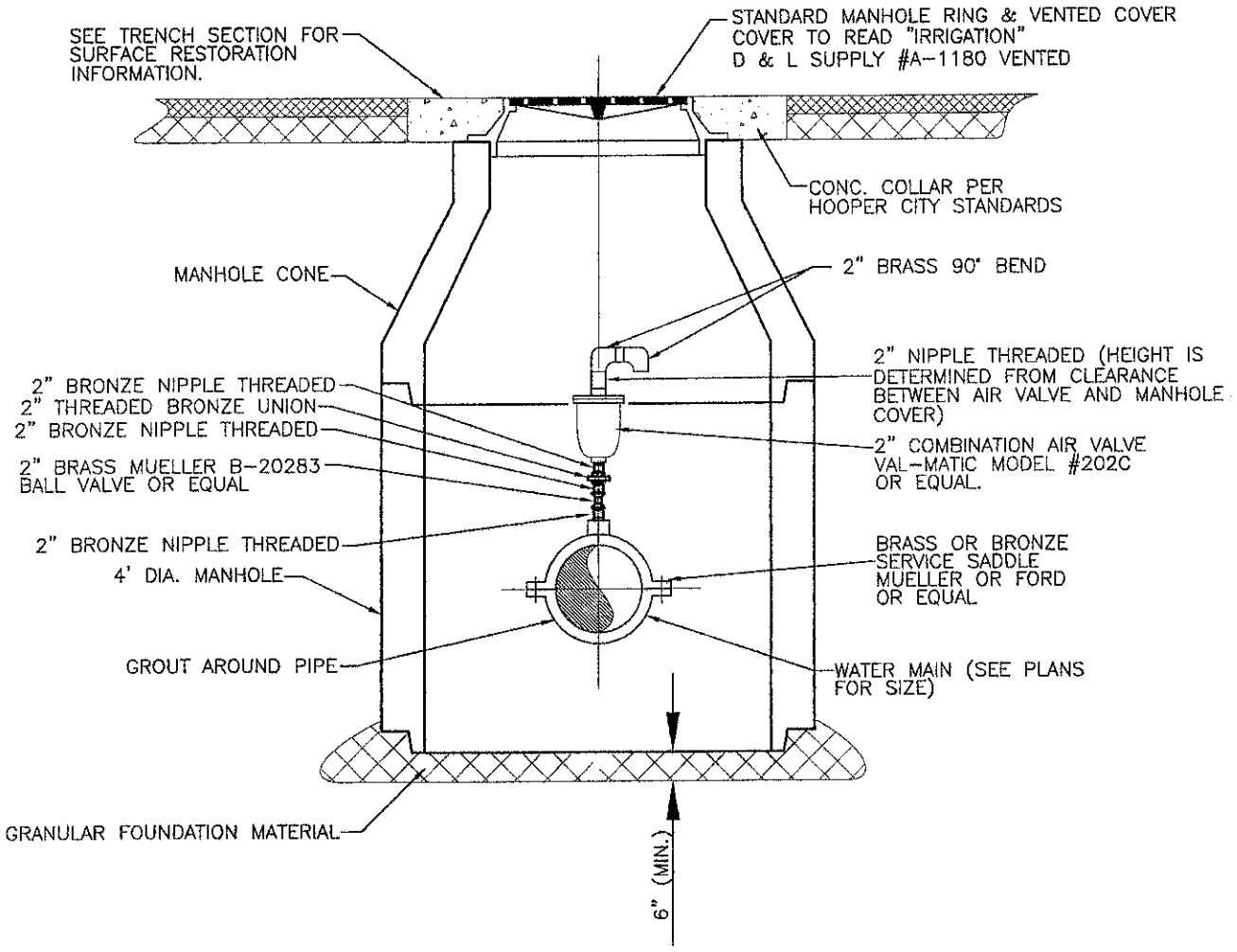
(b) The water system shall consult with the local fire code official regarding needed fire flow in the area under consideration. The fire flow information shall be provided to the Division during the plan review process.

HOOPER IRRIGATION COMPANY

PRESSURE IRRIGATION STANDARDS AND SPECIFICATIONS

JULY 2003

J-U-B
Engineers • Surveyors • Planners



COMBINATION AIR-VAC DETAIL

N.T.S.

NO.	REVISION DESCRIPTION	BY	APR.	DATE
1				
2				
3				

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Hooper Irrigation Company
Pressure Irrigation Standards

COMBINATION AIR-VAC DETAIL

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PLOT SCALE:	N/A
DATE:	MAY 2003
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DESIGN BY:	D.STEELE
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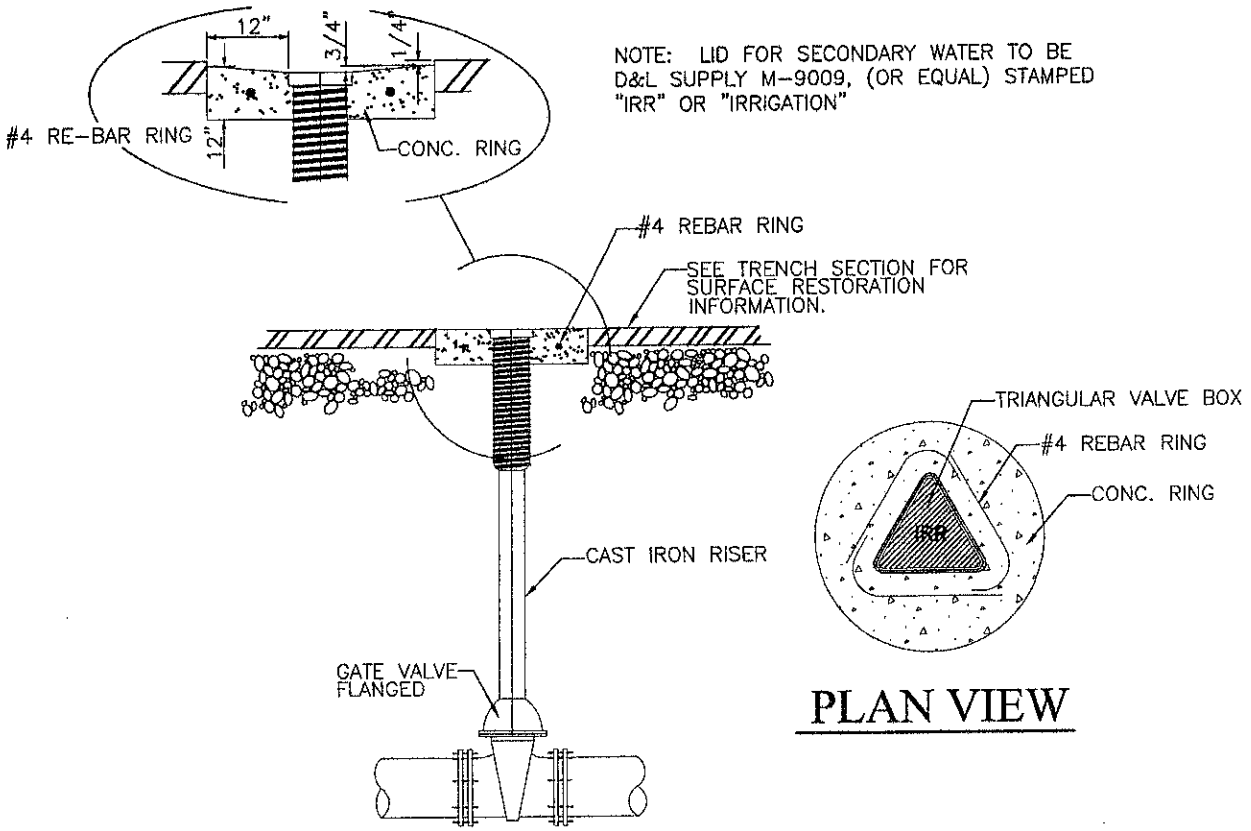

VALVE BOX CONCRETE COLLAR DETAIL

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1				
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4				

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Hooper Irrigation Company
Pressure Irrigation Standards

VALVE BOX CONCRETE COLLAR

SHEET PI-2

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DESIGN BY:	D.STEELE
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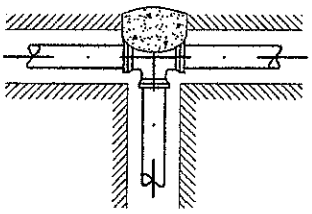

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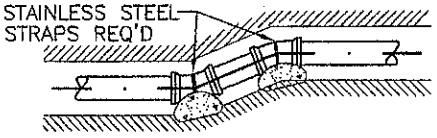
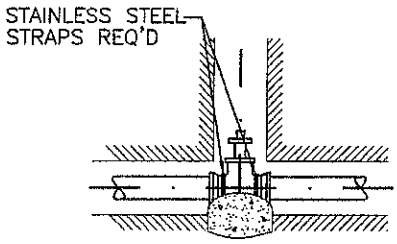
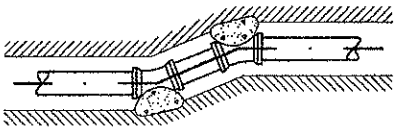


VERTICAL APPLICATION

45°, 22 1/2°, OR
11 1/4° BEND

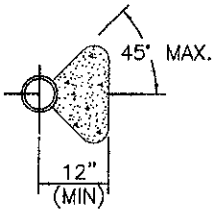


VALVE ANCHORS REQ'D
FOR VALVES 12" OR LARGER

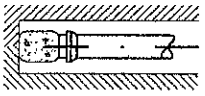


HORIZONTAL APPLICATION

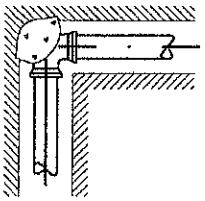
45°, 22 1/2°, OR
11 1/4° BEND



TYPICAL SECTION
THRU THRUST BLOCK



DEAD END



90° BEND

DIMENSION TABLE

THRUST BLOCK BEARING AREA IN SQ. FT. (SEE CONDITIONS BELOW)			
	CONDITION		
PIPE SIZE	90° BEND	OTHER BENDS	VALVES, TEES, DEAD ENDS
4	1.8	1.0	1.3
6	4.0	2.2	2.8
8	7.1	3.8	5.0
10	11.1	6.0	7.9
12	16.0	8.7	11.3
14	21.8	11.8	15.4
16	28.4	15.4	20.1
18	36.0	19.5	25.4
20	44.4	24.0	31.4
24	64.0	34.6	45.2
27	81.0	43.8	57.3
30	100.0	54.1	70.7
42	195.9	106.0	138.5
48	255.9	138.5	181.0

CONDITIONS:

LINE PRESSURE – 120 PSI
SOIL BEARING CAPACITY – 1500 PSF

NOTE: ALL FITTINGS SHALL BE WRAPPED WITH 12 MIL POLYETHYLENE PRIOR TO POURING THE CONCRETE THRUST BLOCK.

THRUST BLOCKING

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APR.	DATE

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Hooper Irrigation Company
Pressure Irrigation Standards

THRUST BLOCKING DETAILS

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DESIGN BY:	D.STEELE
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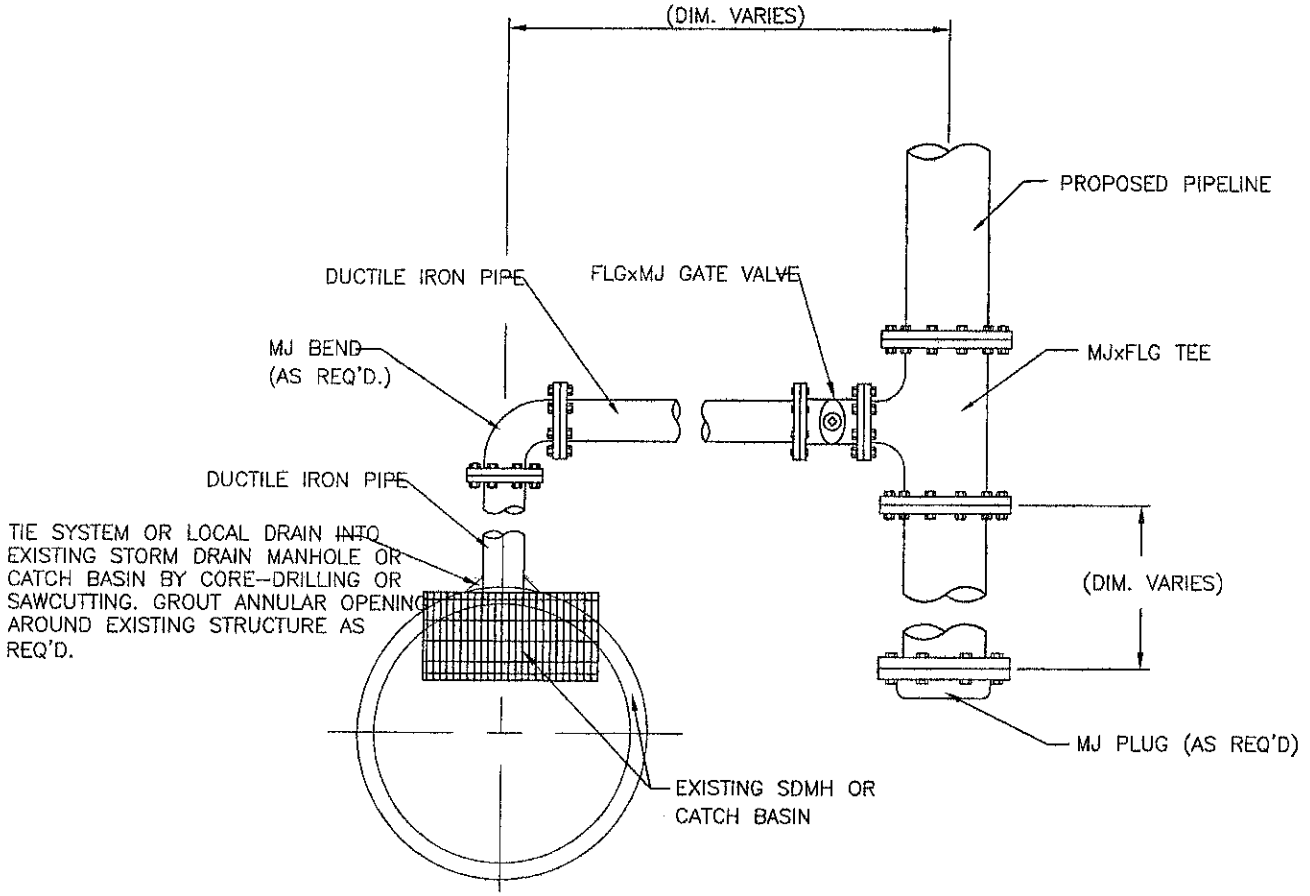

NOTE:
DRAIN SIZE TO BE APPROVED
BY COMPANY ENGINEER.

LOCAL / SYSTEM DRAIN DETAIL

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1				
2				
3				

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Hooper Irrigation Company
Pressure Irrigation Standards

LOCAL/SYSTEM DRAIN DETAIL

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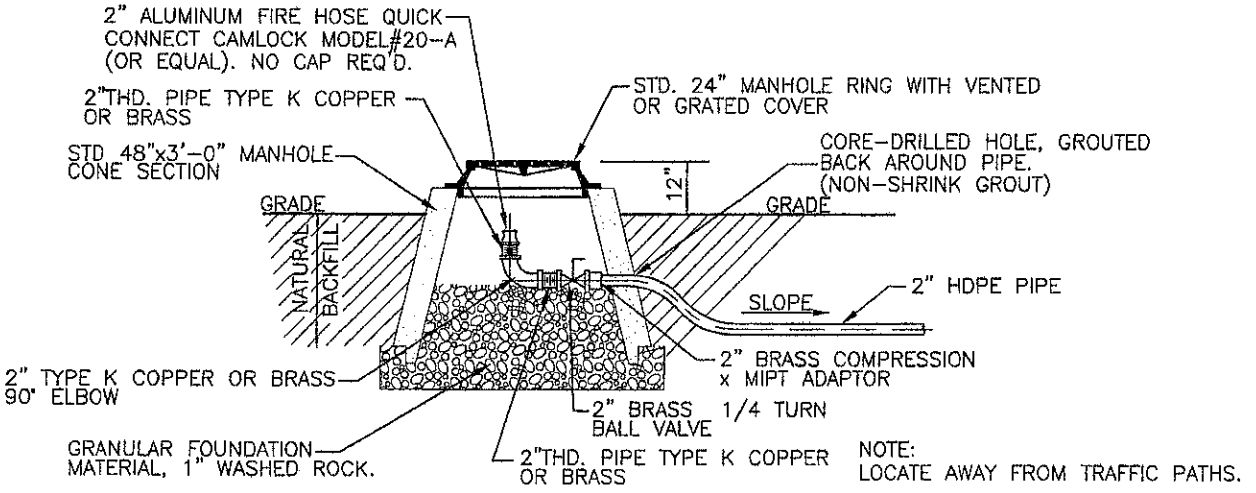
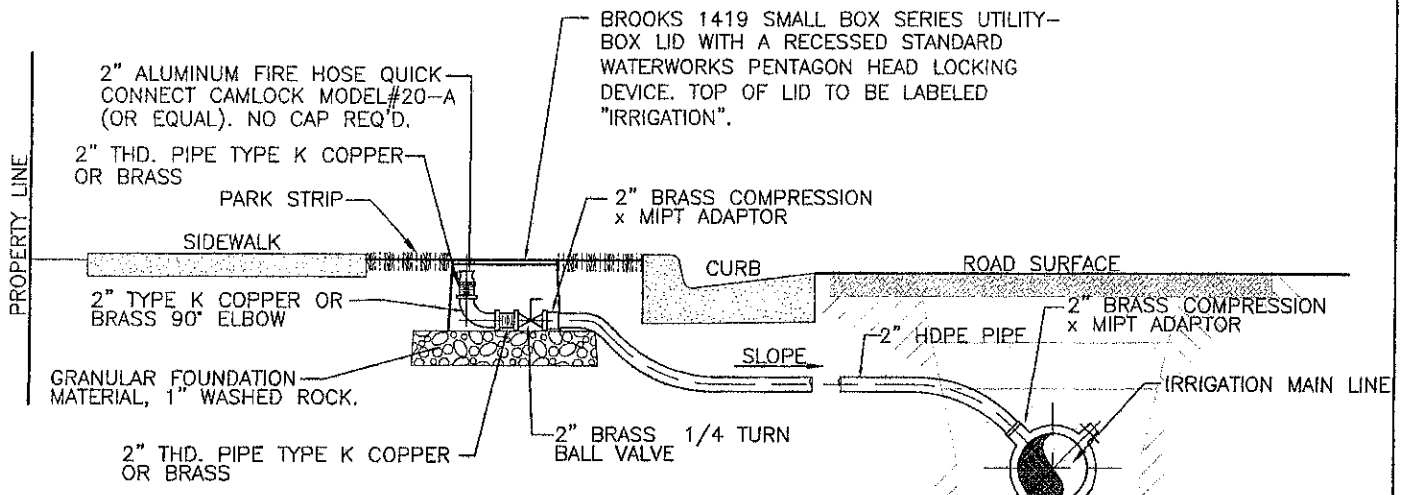


NO CURB & GUTTER



SIDEWALK, CURB & GUTTER

CONNECTION TO C900 PVC MAIN (4" THRU 10")
- 2" SERVICE SADDLE, MUELLER BOLTED 2 PC. BRONZE SERIES #H-13490 OR FORD BOLTED #S-90

2" CONNECTION TO DUCTILE IRON MAIN (12" & LARGER)
- 2" SERVICE SADDLE REQ'D., DOUBLE STRAP BRONZE MUELLER SERIES #BR2B OR BRASS FORD #202B

NOTE:
STAINLESS STEEL PIPE STIFFENERS ARE REQUIRED TO BE USED ON ALL CONNECTIONS ON POLY PIPE.

AIR INLET & REMOVAL FACILITY

N.T.S.

REVISION

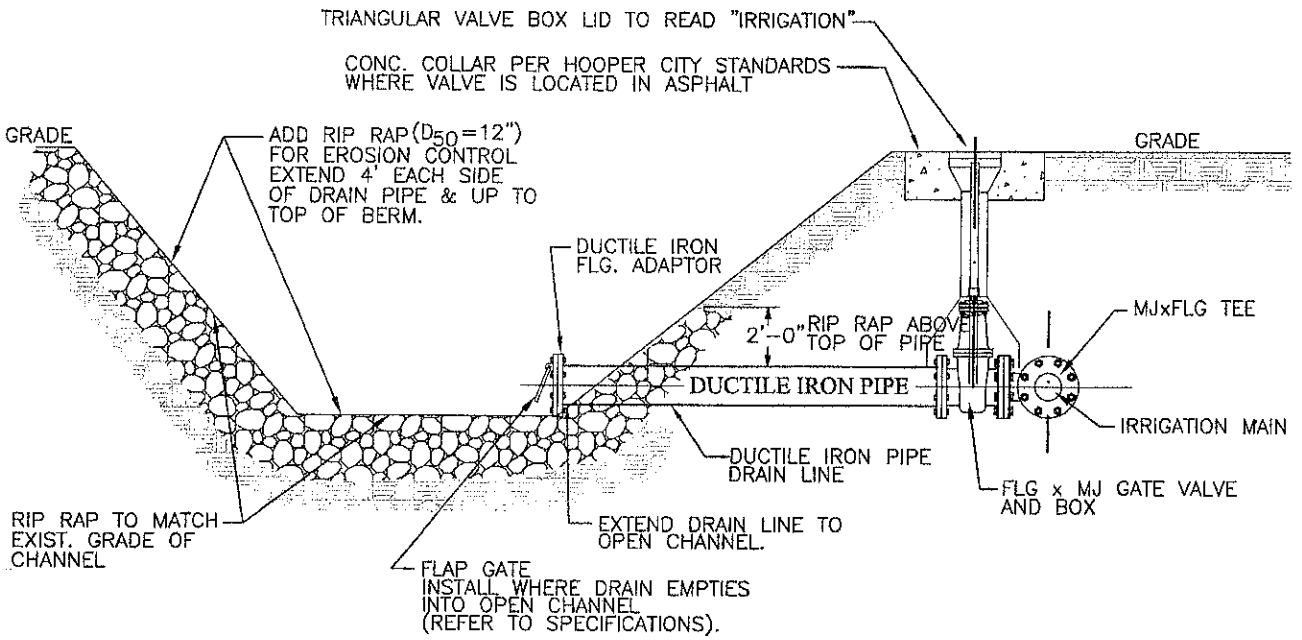
NO.	DESCRIPTION	BY	APR.	DATE
1				
2				
3				

J-U-B Engineers • Surveyors • Planners

Hooper Irrigation Company
Pressure Irrigation Standards

AIR INLET & REMOVAL FACILITY

SHEET	PI-5
CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	MAY 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	—



NOTE:
DRAIN SIZE TO BE APPROVED BY COMPANY ENGINEER.

OPEN CHANNEL DRAIN

N.T.S.

REVISION

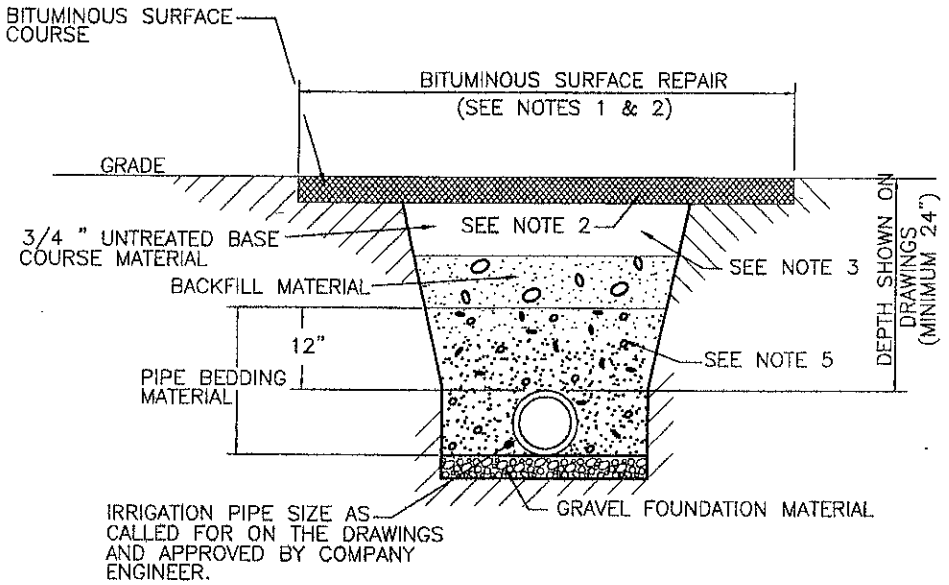
NO.	DESCRIPTION	BY	APR.	DATE
1				
2				
3				
4				

J-U-B Engineers • Surveyors • Planners

Hooper Irrigation Company
Pressure Irrigation Standards

OPEN CHANNEL DRAIN

SHEET	PI-6
CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	MAY 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	-



NOTES:

1. SAW CUT BITUMINOUS ASPHALT SURFACE 0.5' WIDER THAN TRENCH ON EACH SIDE FOR FINAL TRENCH REPAIR WHERE BITUMINOUS SURFACE EXISTS.
2. BITUMINOUS SURFACE IS TO BE 6" OR TO MATCH EXISTING THICKNESS, WHICHEVER IS GREATER FOR STATE ROADS & 4" FOR ALL OTHER ROADS.
3. 3/4 " UNTREATED BASE COURSE MATERIAL IS TO BE 12" OR TO MATCH EXISTING THICKNESS, WHICHEVER IS GREATER.
4. SLOPE TRENCH SIDES TO MEET OSHA SAFETY REQUIREMENTS, (LATEST REV.)
5. SEE SPECIFICATIONS FOR GRADATION & COMPACTION REQUIREMENTS.
6. REFER TO U.D.O.T. STANDARDS FOR TRENCH SECTION DETAIL.

BITUMINOUS SURFACE TRENCH SECTION

N.T.S.

NO.	DESCRIPTION	BY	APR.	DATE
	REVISION			

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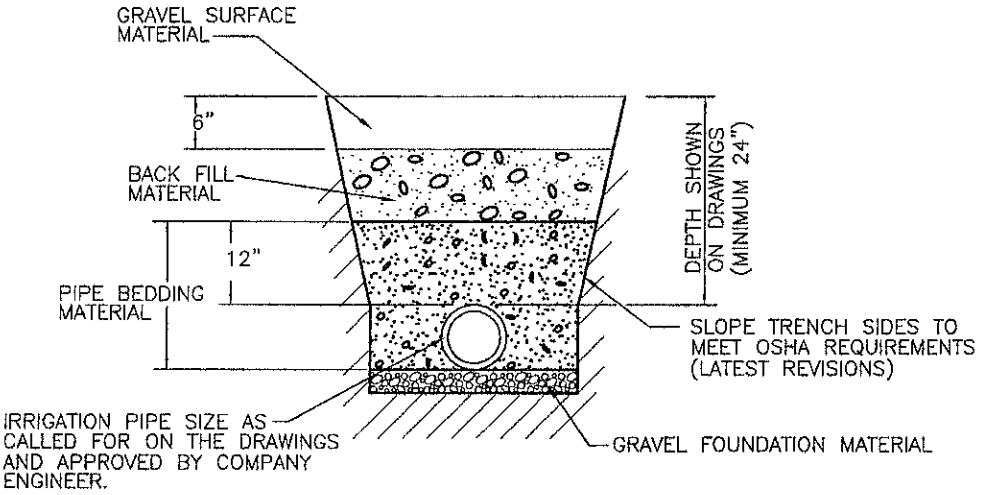
Pressure Irrigation Standards

BITUMINOUS SURFACE
TRENCH SECTION

SHEET	PI-7
CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	MAY 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	–



NOTES:

SEE SPECIFICATIONS FOR GRADATION & COMPACTION REQUIREMENTS.

GRAVEL SURFACE TRENCH SECTION

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APR.	DATE

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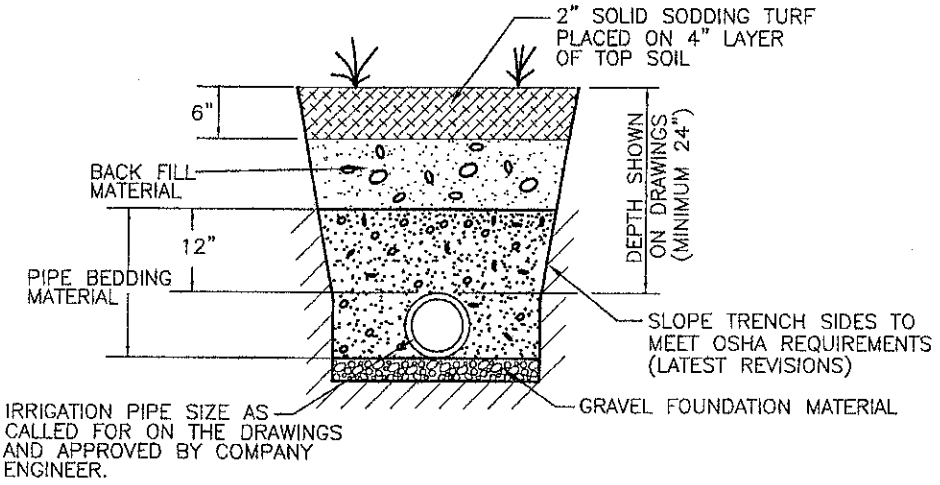
Pressure Irrigation Standards

GRAVEL SURFACE
TRENCH SECTION

SHEET	PI-8
CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	MAY 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	–



NOTES:

SEE SPECIFICATIONS FOR GRADATION & COMPACTION REQUIREMENTS.

TURF SURFACE
TRENCH SECTION

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1				
2				
3				
4				

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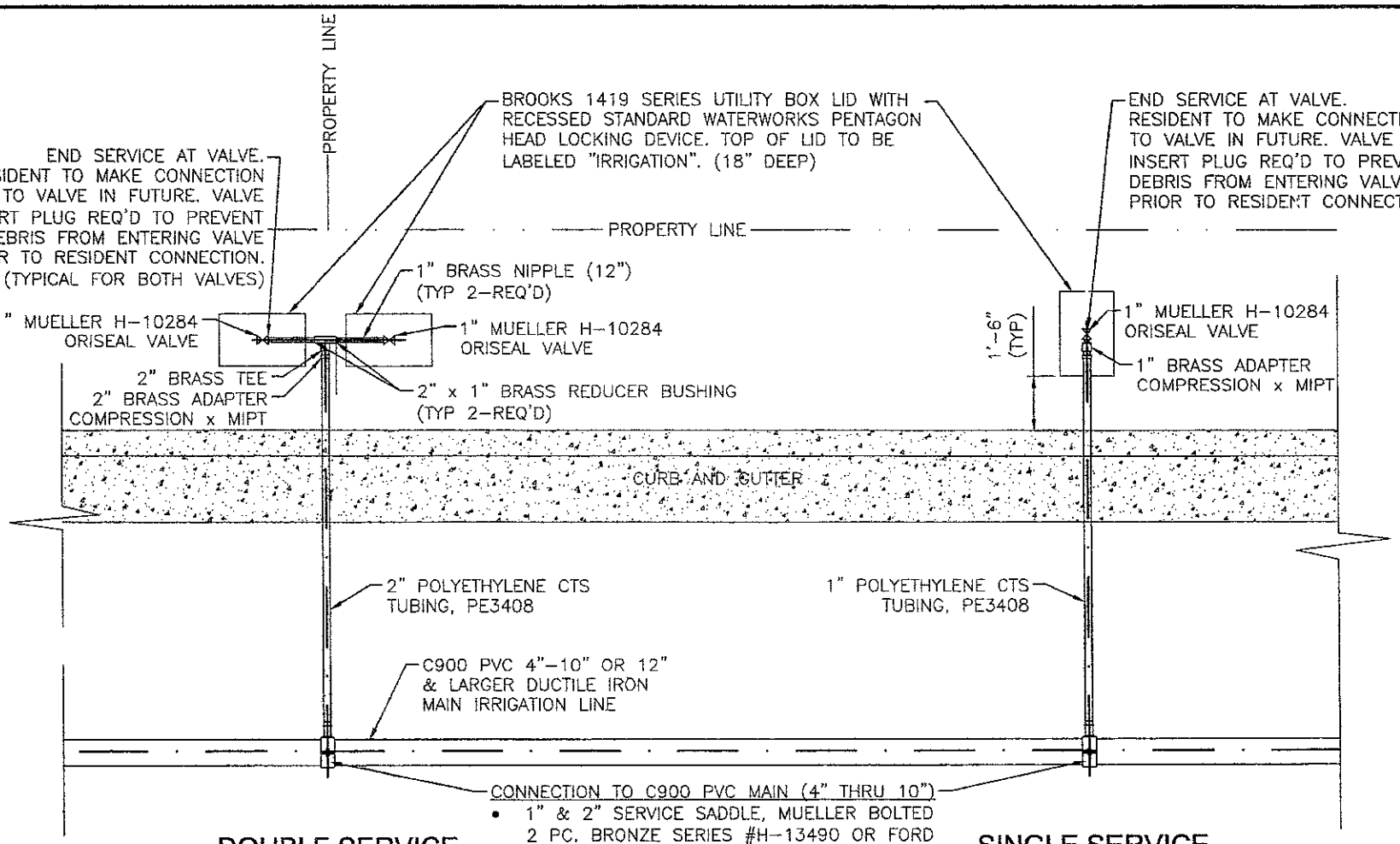
Pressure Irrigation Standards

TURF SURFACE
TRENCH SECTION

SHEET	PI-9
CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	MAY 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	–



NOTE:
STAINLESS STEEL PIPE STIFFENERS ARE REQUIRED TO BE USED ON ALL CONNECTIONS ON POLY PIPE.

TYPICAL SERVICE CONNECTIONS

N.T.S.

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NO.	DESCRIPTION	BY	APR.	DATE
A	REV. DRAWING TO ADD CURB & GUTTER & CALLOUTS	DBS	TLA	12-15-04
B	REV. DRAWING TO ADD TWO BOXES ON DOUBLE SERVICE	JDW	GLS	5-15-14

REVISION

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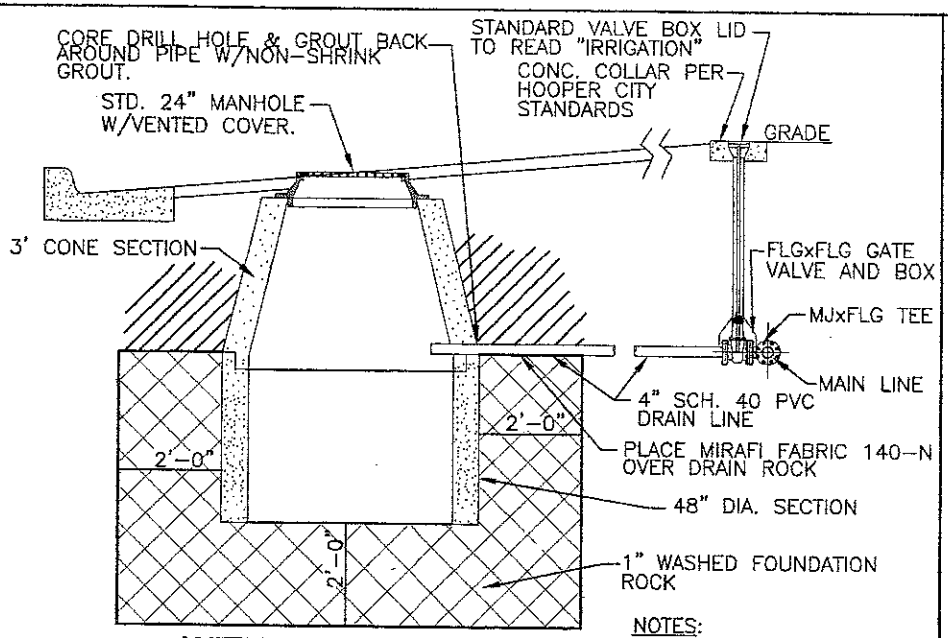
Hooper Irrigation Company
Pressure Irrigation Standards

TYPICAL SERVICE CONNECTION DETAIL

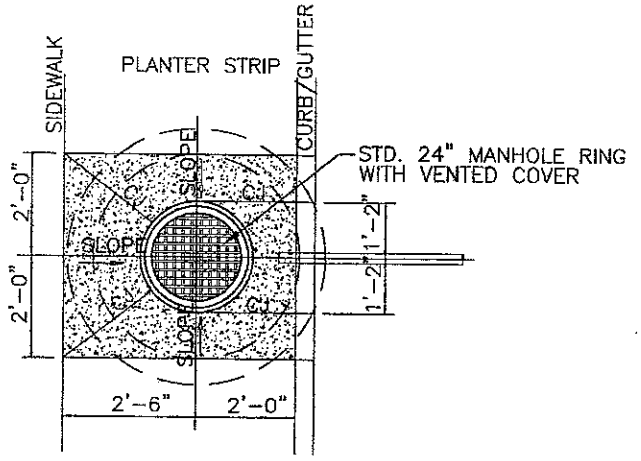
SHEET PI-10

CAD DWG: detail01.dwg
PLOT SCALE: N/A
DATE: DECEMBER 2004
DRAWN BY: D.STEELE
DESIGN BY: D.STEELE
CHECKED BY: TLA
SCALE: -

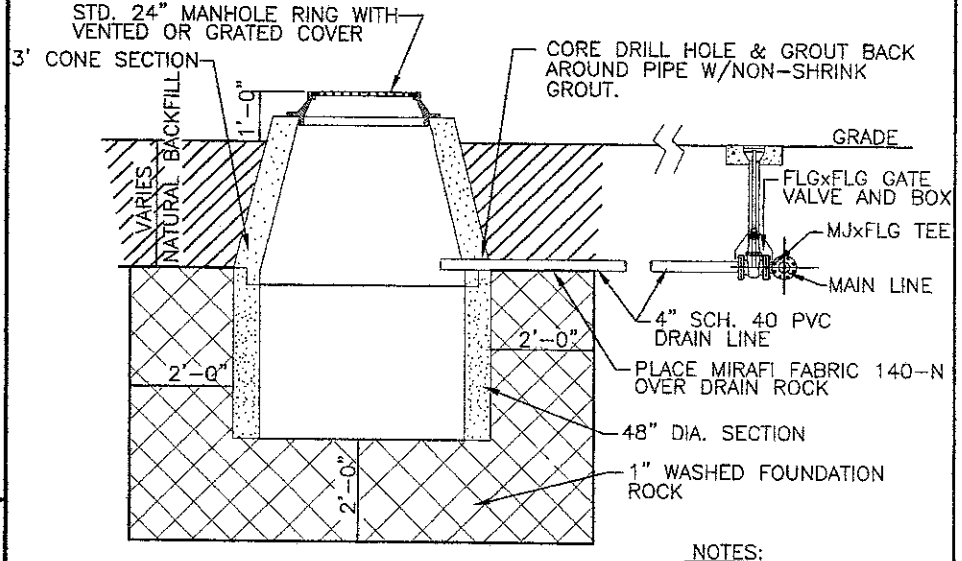


NOTES:
- REFER TO DRAWINGS FOR PIPE SIZES.

WITH CURB/GUTTER (IN STREET) N.T.S.

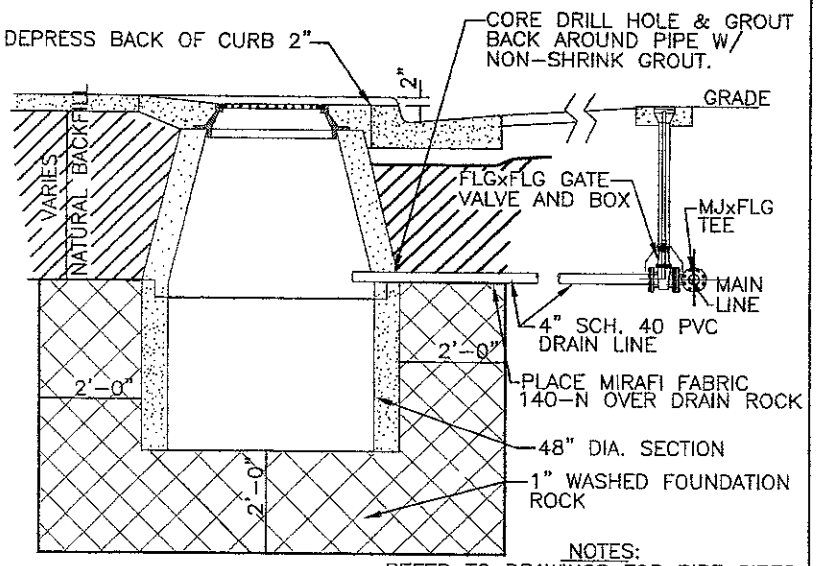


PLAN VIEW N.T.S.



NOTES:
- REFER TO DRAWINGS FOR PIPE SIZES.

WITHOUT CURB/GUTTER N.T.S.



NOTES:
- REFER TO DRAWINGS FOR PIPE SIZES.

WITH CURB/GUTTER (BEHIND CURB) N.T.S.

NO. | DESCRIPTION | BY | APR. | DATE

REVISION

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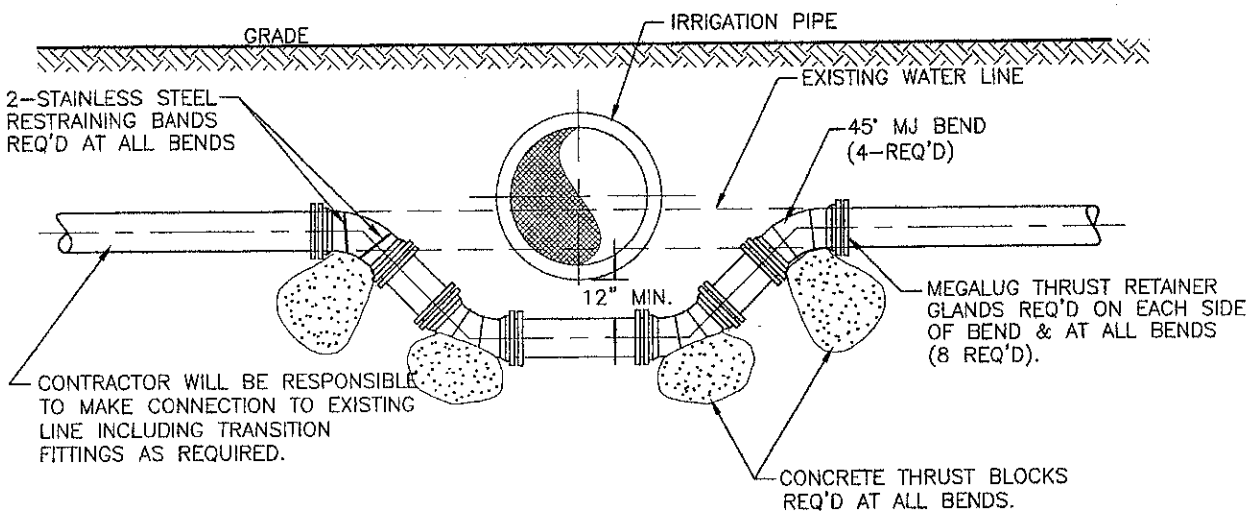
Pressure Irrigation Standards
TYPICAL LOCAL DRAIN W/SUMP DETAILS

SHEET PI-11

CAD DWG: detail01.dwg
PLOT SCALE: N/A
DATE: MAY 2003
DRAWN BY: D.STEELE
DESIGN BY: DETAILS
CHECKED BY: TLA
SCALE: -



NOTES:

BEFORE RELOCATING AN EXISTING WATERLINE THE CONTRACTOR SHALL NOTIFY ALL AFFECTED BUSINESSES AND RESIDENTS 24 HOURS BEFORE CONSTRUCTION. THE CONTRACTOR MUST DEMONSTRATE TO THE CITY THAT ALL OF THE MATERIALS ARE ON HAND THAT MAY BE NEEDED BEFORE RELOCATING ANY WATERLINES. RELOCATION OF WATERLINES WILL NOT BE STARTED AFTER 10:00 A.M. THE CITY SHALL OPERATE ALL MAINLINE WATER VALVES AND THE CONTRACTOR MUST CONTACT THE CITY IF SERVICE IS REQUIRED.

WATER LINE RELOCATION DETAIL

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1				
2				
3				
4				

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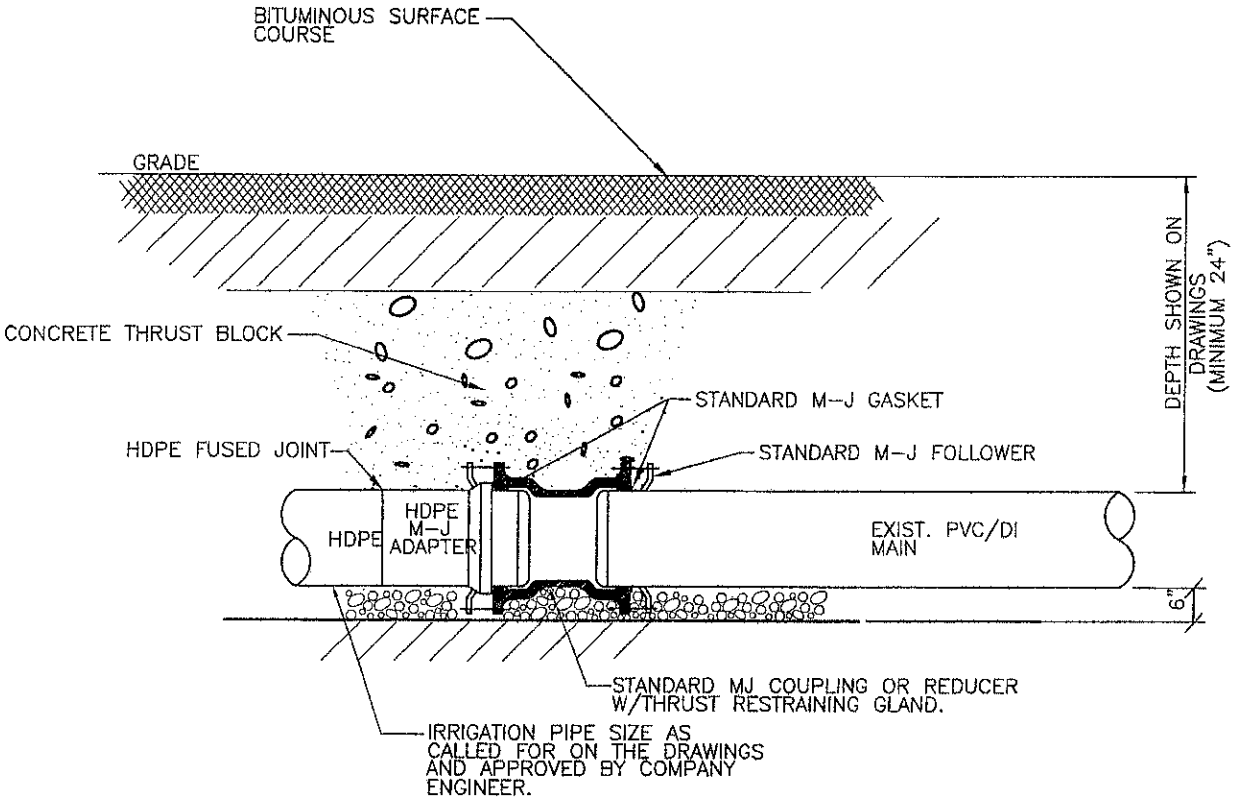
Hooper Irrigation Company
Pressure Irrigation Standards

WATERLINE
RELOCATION DETAIL

SHEET PI-12

CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	MAY 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	–



NOTE:

1. REFER TO SHEET # PI-7, 8 & 9 TRENCH DETAILS FOR BEDDING MATERIAL ETC...

2. ALL FITTINGS SHALL BE WRAPPED WITH 12 MIL POLYETHYLENE PRIOR TO POURING THE CONCRETE THRUST BLOCK.

HDPE CONNECTION DETAIL

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APP.	DATE

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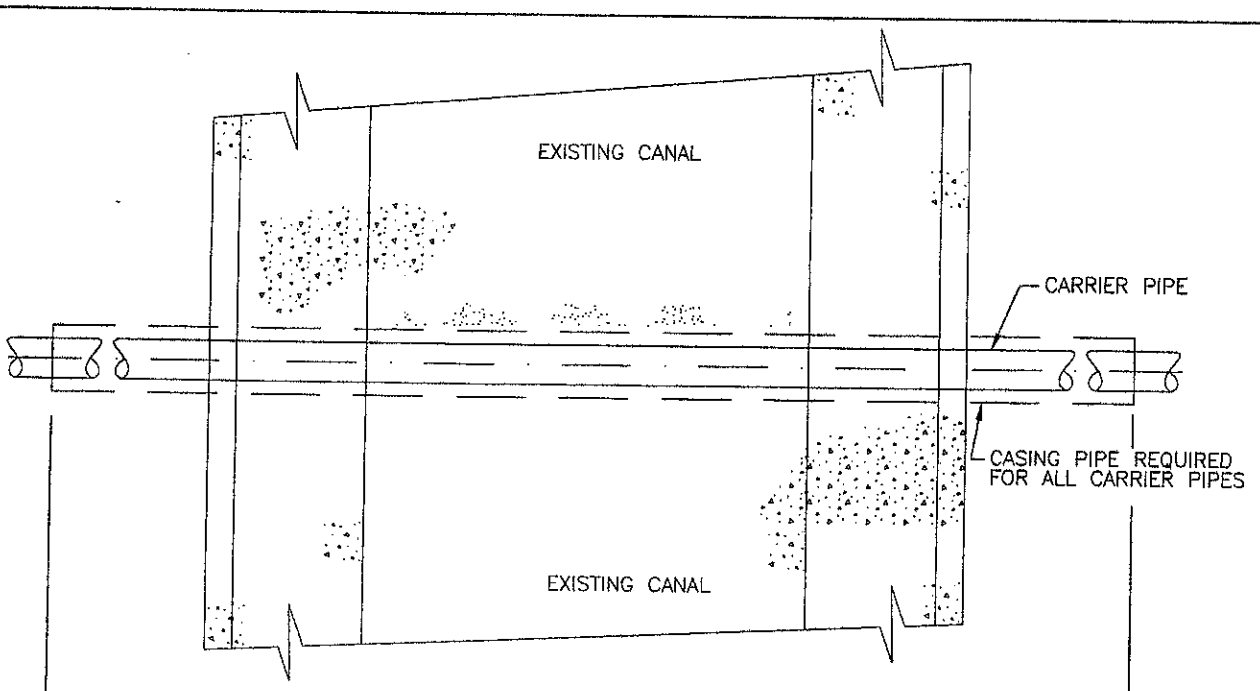
Hooper Irrigation Company
Pressure Irrigation Standards

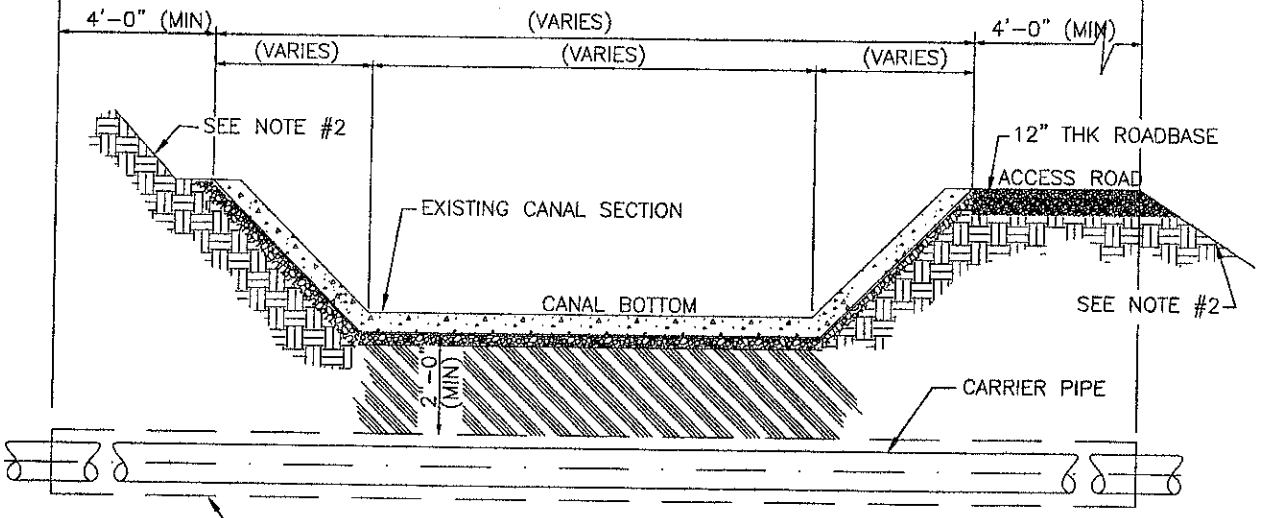
HDPE
CONNECTION DETAIL

SHEET PI-13

CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	MAY 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	–



PLAN VIEW



CASING PIPE: SIZE IS TO BE DETERMINED BASED ON CARRIER PIPE.
MAT'L. TYPE:
STEEL WELDED
PIPE CASING (SEE DETAIL PI-17)

OPEN CONCRETE-LINED CHANNEL
ELEVATION VIEW

NOTES:

1) BEFORE CROSSING THE CANAL WITH A UTILITY THE CONTRACTOR SHALL OBTAIN WRITTEN AUTHORIZATION FROM HOOPER IRRIGATION COMPANY. THE CONTRACTOR MUST DEMONSTRATE TO HOOPER IRRIGATION COMPANY THAT ALL OF THE MATERIALS ARE ON HAND THAT MAY BE NEEDED BEFORE STARTING CONSTRUCTION ON IRRIGATION COMPANY PROPERTY OR EASEMENTS.

2) CONTRACTOR SHALL BE RESPONSIBLE FOR TOTAL RESTORATION OF THE CONSTRUCTION AREA, INCLUDING REVEGETATION & RESTORATION OF ACCESS ROADWAY

TYPICAL CANAL CROSSING

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APR.	DATE

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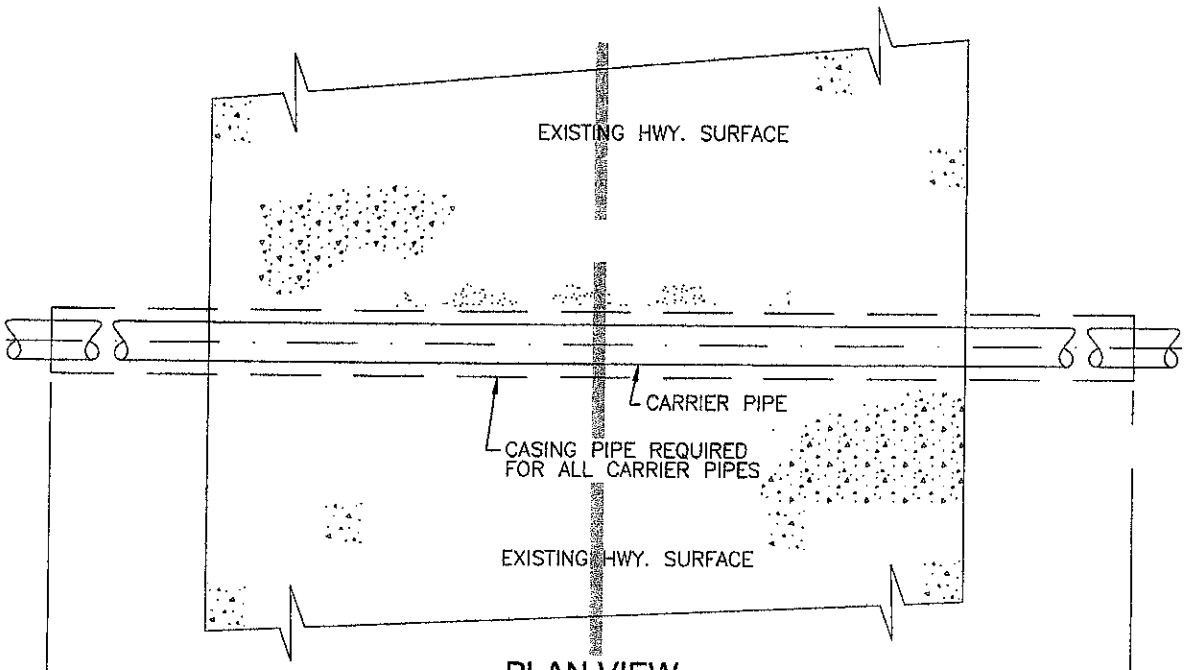
Hooper Irrigation Company
Pressure Irrigation Standards

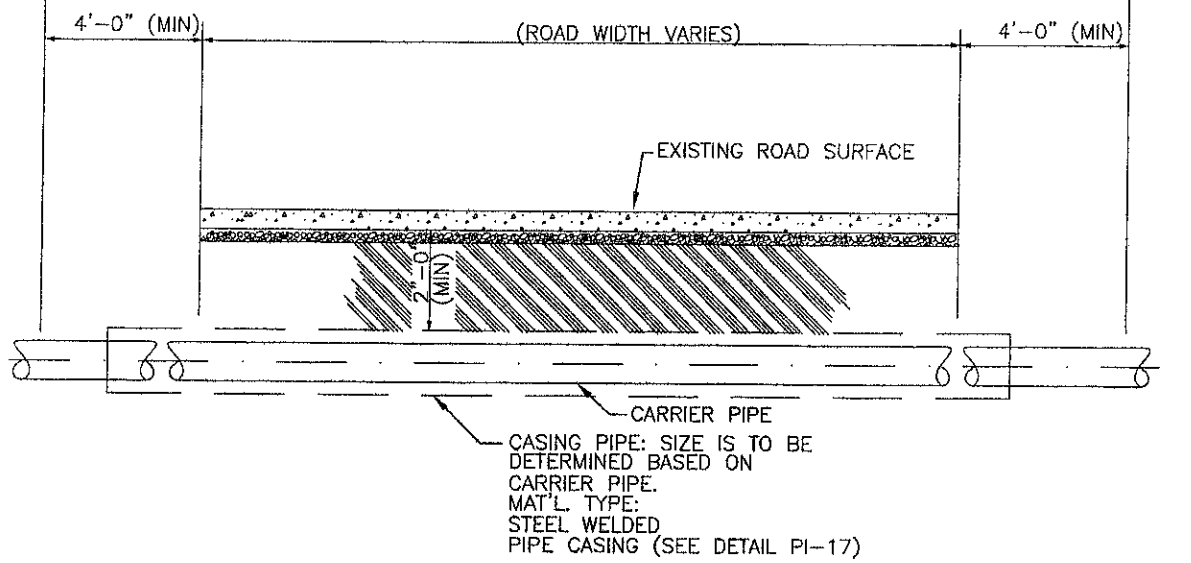
TYPICAL CANAL
CROSSING DETAIL

SHEET PI-14

CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	JUNE 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	–



PLAN VIEW
N.T.S.



ELEVATION VIEW

NOTES:

1) WORK TO BE PERFORMED WITHIN UDOT RIGHT-OF-WAYS SHALL BE DONE IN ACCORDANCE WITH DIVISION 19 OF SPECIFICATIONS.
2) CONTRACTOR SHALL BE RESPONSIBLE FOR TOTAL RESTORATION OF THE CONSTRUCTION AREA, INCLUDING REVEGETATION & RESTORATION OF ACCESS ROADWAY

TYPICAL UDOT HWY. CROSSING

N.T.S.

REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1				
2				
3				
4				

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Hooper Irrigation Company
Pressure Irrigation Standards

TYPICAL UDOT HWY.
CROSSING DETAIL

SHEET PI-15

CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	JUNE 2003
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	-

NO.	DESCRIPTION	BY	APR.	DATE
1	REVISION			

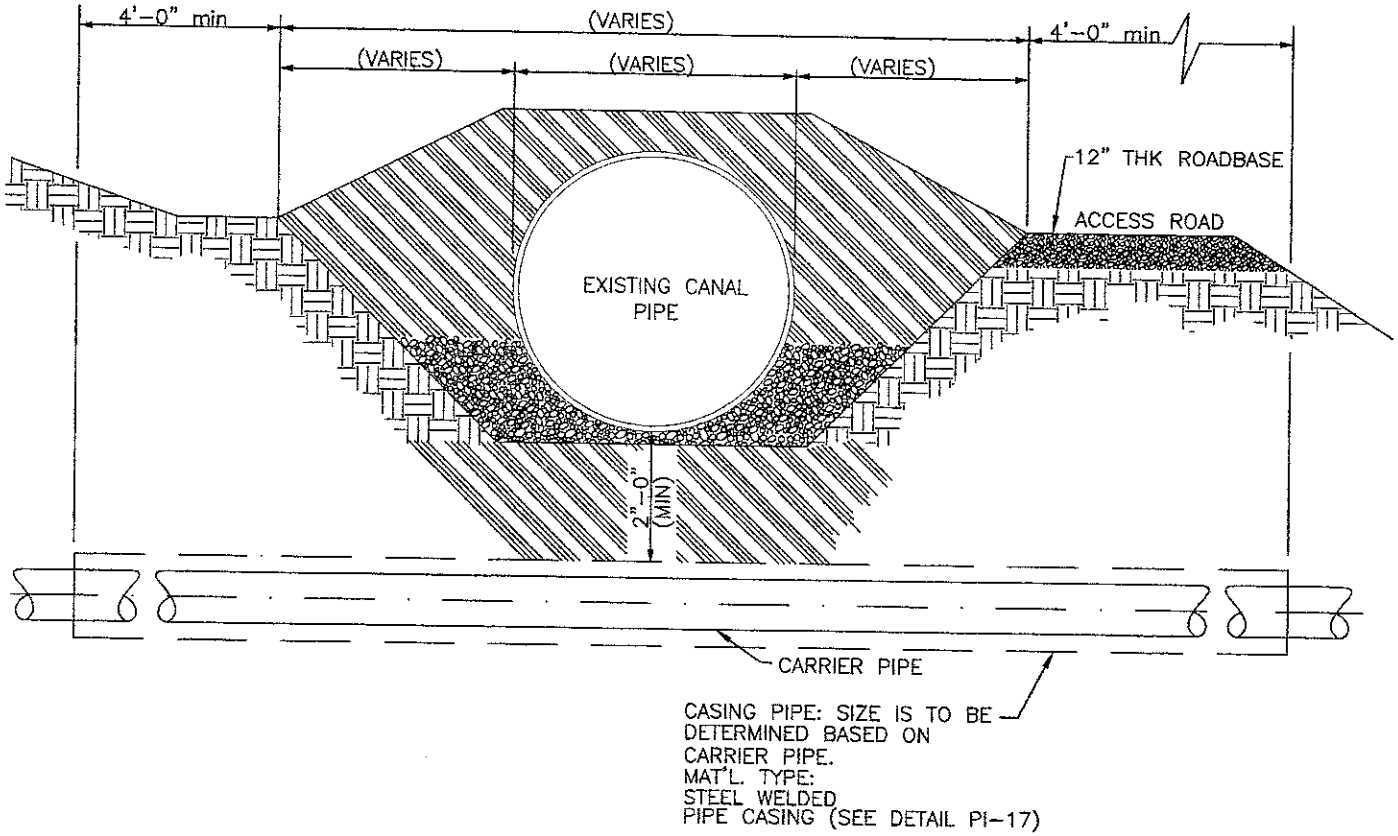
J-U-B Engineers • Surveyors • Planners

Hooper Irrigation Company
Pressure Irrigation Standards

TYPICAL PIPED CANAL CROSSING DETAIL

SHEET PI-16

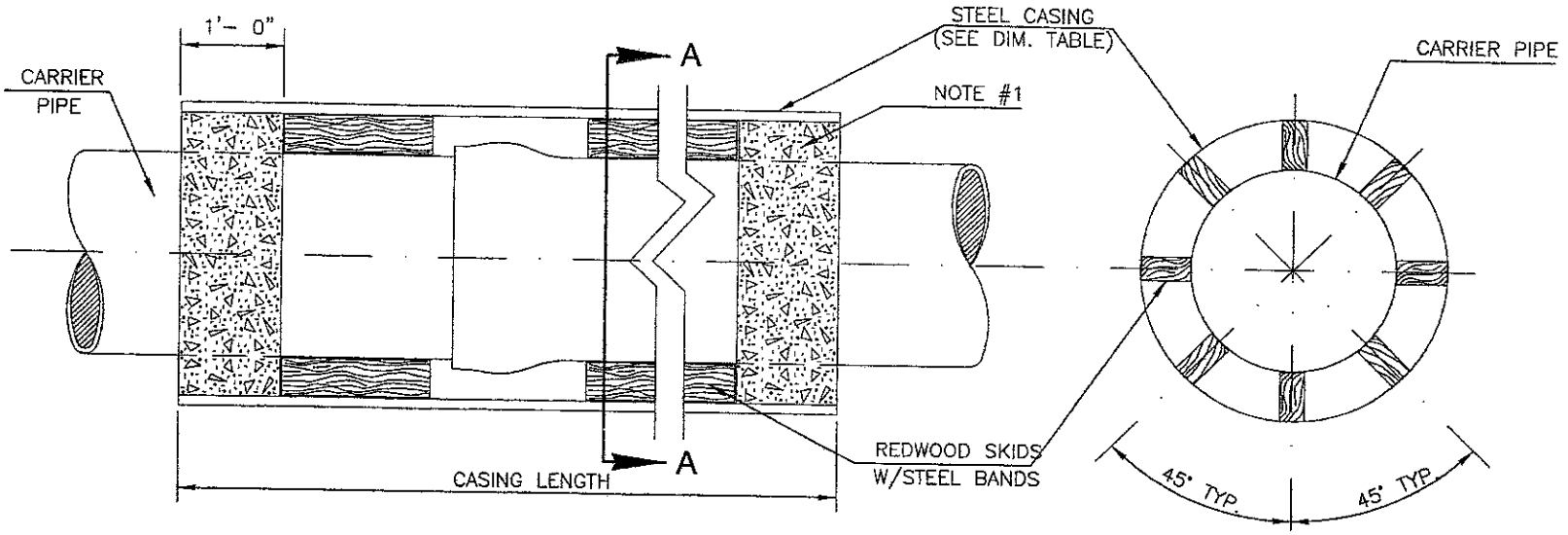
CAD DWG: detail01.dwg
PLOT SCALE: N/A
DATE: JUNE 2003
DRAWN BY: D.STEELE
DESIGN BY: DETAILS
CHECKED BY: TLA
SCALE: -



ELEVATION VIEW

TYPICAL PIPED CANAL CROSSING

N.T.S.



SECTION A-A

N.T.S.

NOTES:

1. ANNULAR SPACE AT ENDS OF STEEL CASING SHALL BE CONCRETE GROUTED.
2. STEEL PIPE TO HAVE A MINIMUM YIELD STRENGTH OF 42,000 PSI.

DIMENSION TABLE

CARRIER PIPE	CASING STEEL PIPE		
DIAMETER (INCHES)	DIAMETER (INCHES)	MIN. WALL THK. W/PROTECTIVE COATING	MIN. WALL THK. W/OUT PROTECTIVE COATING
4" & UNDER	12" & UNDER	0.188"	0.188"
6" & 8"	14" & 16"	0.219"	0.312"
10"	18"	0.250"	0.312"
12"	20"	0.281"	0.375"
14"	22"	0.312"	0.375"
16"	24"	0.344"	0.438"
18"	26"	0.375"	0.438"
20" & 21"	28" & 30"	0.406"	0.500"
24"	32"	0.438"	0.500"
27"	34" & 36"	0.469"	0.562"
30"	38",40",42"	0.500"	0.562"

PIPE CASING DETAIL

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NO.	DESCRIPTION	BY	APP.	DATE
	REVISION			

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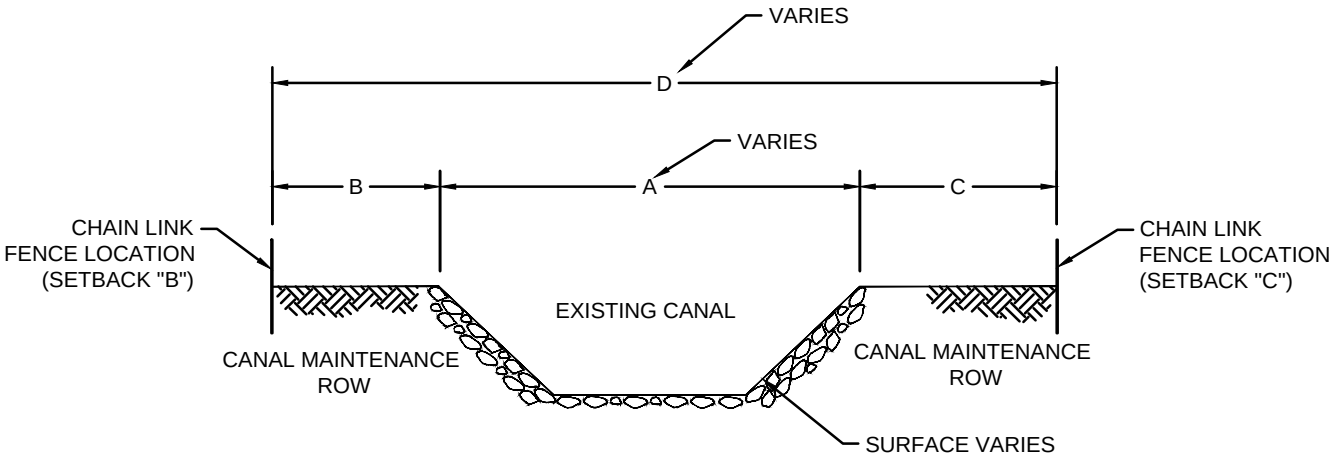
Hooper Irrigation Company
Pressure Irrigation Standards
TYPICAL PIPE CASING DETAIL

SHEET PI-17

CAD DWG: detail01.dwg
PLOT SCALE: N/A
DATE: JUNE 2003
DRAWN BY: D.STEELE
DESIGN BY: DETAILS
CHECKED BY: TLA
SCALE: -

HOOPER IRRIGATION COMPANY (H.I.C.)
CANAL R.O.W. DETAIL



CANAL	A	B	C	D
DIMENSIONS	VARIES	12'	22'	VARIES

NOTE:

1. RIGHT OF WAY (R.O.W.) ESTABLISHED BY HISTORIC PRESCRIPTIVE USE.
2. ANY IMPROVEMENTS TO PROPERTIES LOCATED WITHIN H.I.C. R.O.W. SHALL CONFORM TO CURRENT STANDARD .
3. FENCES SHALL BE BUILT AT THE SETBACKS FOR "C" AND "B".

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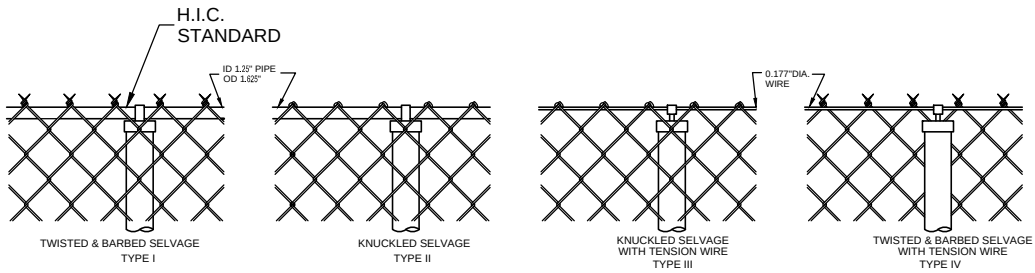
NOTES

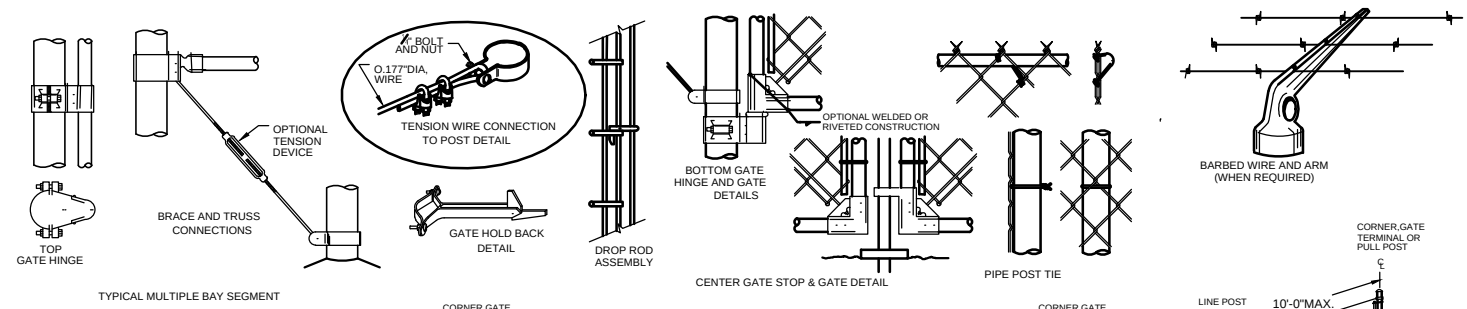
SUMMARY

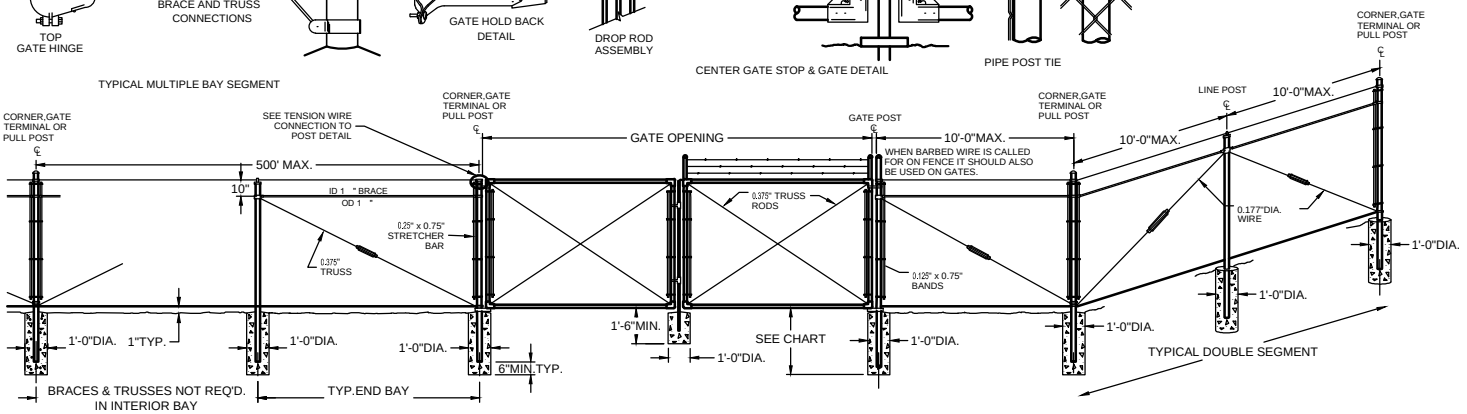
HOOPER IRRIGATION COMPANY (H.I.C.)
FENCE DETAIL



NOTES:

1. POSTS: SCHEDULE 40 PIPE.
   TRIPLE COATED HIGH TENSILE STEEL PIPE OR ROLL-FORMED C-SECTION OF THE SIZE SHOWN IN THE CHART AND AS DEFINED IN THE STANDARD SPECIFICATION. WEIGHT IN lb/ft WITH TOLERANCE OF 5 PERCENT. OTHER TYPES OF POSTS WITH EQUAL OR GREATER SECTION MODULUS MAY BE USED IF APPROVED, IN ADVANCE, BY THE ENGINEER.
2. FABRIC HEIGHTS LESS THAN 5':
   TRUSS RODS AND BRACES NOT REQUIRED.





H.I.C. STANDARD

HEIGHT OF FABRIC	DEPTH OF POSTS	LENGTH OF END CORNER OR PULL POSTS	LENGTH OF LINE POSTS	SIZE OF POSTS									
				END, CORNER & PULL POSTS				LINE POST MIN.SIZE					
				NOM. SIZE	OUTSIDE DIA.	PIPE WEIGHT		NOM. SIZE	OUTSIDE DIA.	PIPE WEIGHT		OUTSIDE DIMENSIONS C-SECTION	WT/FT
						ASTM A 120	TRIPLE COAT			ASTM A 120	TRIPLE COAT		
7'	3'	10'	9'-8"	2"	2.875"	5.79	4.64	2"	2.375"	3.65	3.11	1.875 x 1.625	2.28
6'	3'	9'	8'-8"	2"	2.375"	3.65	3.11	1"	1.900"	2.72	2.23	1.875 x 1.625	1.85
5'	3'	8'	7'-8"	2"	2.375"	3.65	3.11	1"	1.900"	2.72	2.23	1.875 x 1.625	1.85
4'	2'	6'	5'-8"	2"	2.375"	3.65	3.11	1"	1.900"	2.72	2.23	1.875 x 1.625	1.85
3'	2'	5'	4'-8"	2"	2.375"	3.65	3.11	1"	1.900"	2.72	2.23	1.875 x 1.625	1.85

H.I.C. STANDARD

HEIGHT	GATE OPENING	GATE POST	GATE FRAME
UNDER 6'	SINGLE TO 6' OR DOUBLE TO 12'	2"	1"
	SINGLE OVER 6' TO 8' OR DOUBLE OVER 12' TO 16'	2"	
	SINGLE OVER 8' TO 12' OR DOUBLE 16' TO 24'	3"	
6' AND OVER *	SINGLE TO 6' OR DOUBLE TO 12'	2"	1"
	SINGLE OVER 6' TO 13' OR DOUBLE OVER 12' TO 24'	3"	
	SINGLE OVER 13' TO 18' OR DOUBLE OVER 24' TO 36'	6"	
	SINGLE OVER 18' OR DOUBLE OVER 36'	8"	

* GATES OVER 6' IN HEIGHT AND WIDER THAN 12' WILL REQUIRE 3 INDUSTRIAL PRESSED STEEL HINGES.

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NOTES

SUMMARY

DIVISION 15

SERVICE CONNECTION

15.01 GENERAL:

This section covers the installation of service connection and components to homeowner's property line.

15.02 SERVICE SADDLE SPECIFICATIONS:

For service connections to C900 PVC main, all service saddles shall be of a "Full encirclement design," and shall be O.D. controlled, which design will eliminate the possibility of pipe crushing due to the over torquing of the nuts upon installation. All service saddles for connections to C900 PVC pipe sizes 4 inch to 10 inch diameter shall be Mueller Model H-13490 Series or Ford S-90.

15.03 CORPORATION STOP:

For service connections to Ductile Iron main on pipe sizes that are 12 inch diameter and larger, corporation stops shall be used to connect to the main. Corporation stops shall be manufactured and tested to ANSI/AWWA C800. The body is to be cast from 85-5-5-5 ASTM B62 brass alloy and be of a straight through design. All corporation stops shall be Mueller 1500 series (or approved equal), with CTS 110 compression outlet. Stainless steel pipe stiffeners are required to be used to eliminate cold flow of plastic pipe and compression fittings.

15.04 POLYETHYLENE TUBING:

Pipe for the transmission of irrigation water from main to utility box and from the utility box at property line shall be Polyethylene CTS tube. Polyethylene CTS tube shall be manufactured in accordance with the standard specification for Polyethylene (PEP plastic tubing as issued by the American Standard for Testing and Materials under ASTM D 2737 and AWWA C-901.

Material designation code:	Polyethylene PE 3408
Plastic Extrusion Compound:	Type III, class C, grade 34, as defined

in ASTM D 1248

The standard pipe dimension ratio is CTS (SDR) 9, which has a 200 psi pressure rating. All tubing for service lines shall be cut and installed in a neat and workmanlike manner by a method recommended by the manufacturer. No joints will be allowed between the main and the service valve. Tubing shall be WESTFLEX PE 3408 Gold Label or equivalent.

15.05 COMPRESSION CONNECTION:

MUELLER 110 COMPRESSION COUPLINGS AND FITTINGS OR FORD C84-44Q (1-INCH) OR FORD C84-77Q (2-INCH) COMPRESSION COUPLINGS ARE TO BE USED ON ALL P.E. PLASTIC PIPE INSTALLATIONS.

(a) The interior surface of the coupling nut, including threads, shall have a baked on, fluorocarbon coating to reduce assembly friction and prevent the gasket from turning and twisting during tightening. The nut shall bottom on a cast or machined shoulder on the body when properly assembled. This design will provide a visual check to assure connection is properly assembled.

(b) The sealing gasket shall be of molded synthetic rubber (ASTM D-2000) with molded in place bronze spring (ASTM A-134 Alloy #6) to eliminate the possible cold flow of the gasket between the pipe and fitting. A gripper band of hardened stainless steel (ANSI Type 401) shall be fitted into the gasket. When the gasket is compressed it will cause the gripper ring to distort the pipe giving the fitting a high resistance to pull out. The gripper band shall overlap itself to prevent cold flow of the gasket into the cavity under the band.

(c) When compression fittings are used with P.E. Pipe, Stainless Steel pipe stiffeners are required to be used to eliminate cold flow of plastic pipe.

(d) All fittings are to be for CTS Polyethylene pipe.

(e) The Minimum pull out load for the fitting when used with PE plastic pipe shall be as follows for each given size:

SIZE	MINIMUM PULL OUT (FT.LBS.)
1"	400
1½"	500
2"	500

15.06 SERVICE FITTINGS:

All service fittings such as brass tees, and brass ells shall be Mueller 110 Compression Connections or Ford Q Fittings.

15.07 MARK II ORI-SEAL VALVE:

These valves shall be closed bottom design and sealed against external leakage at the top by means of a non-adjustable resilient pressure actuated seal, and shall be provided with a secondary resilient seal disposed above the pressure seal for added protection of the bearing surfaces against ground water infiltration. Shutoff shall be affected by a resilient pressure actuated seal so disposed in the key (or plug) as to completely enclose the inlet body port (flow way), in the closed position. All Curb valves shall be quarter turn valves and the fully open and closed positions shall be controlled by check lugs which are integral parts of the key and body. The maximum pressure rating shall be 175 PSI water at a maximum temperature of 180 degrees Fahrenheit.

All fittings are to be CTS Size, used on CTS (Copper Tube Size) Polyethylene pipe. No IPS polyethylene pipe or fittings are to be used.

Curb stops valves shall be MUELLER H-15172, 110 COMPRESSION by FIP, STOP AND WASTE CONFIGURATION. (no substitution is allowed)

A protective insert plug shall be placed on the open side of the valve (the side where the resident will connect into in the future) in order to prevent dirt and debris from entering the valve.

15.08 SERVICE BOX:

Service box shall be an 11 3/4-inch by 17-inch standard green fiberglass irrigation box with cover. Service Box shall be installed over the Ori-Seal valve. A sign shall be attached or embossed to or on the cover indicating as follows: "IRRIGATION" Box shall be Brooks 1419 series utility box with lid recessed and shall be provided with Waterworks Pentagon Head locking device or equivalent.

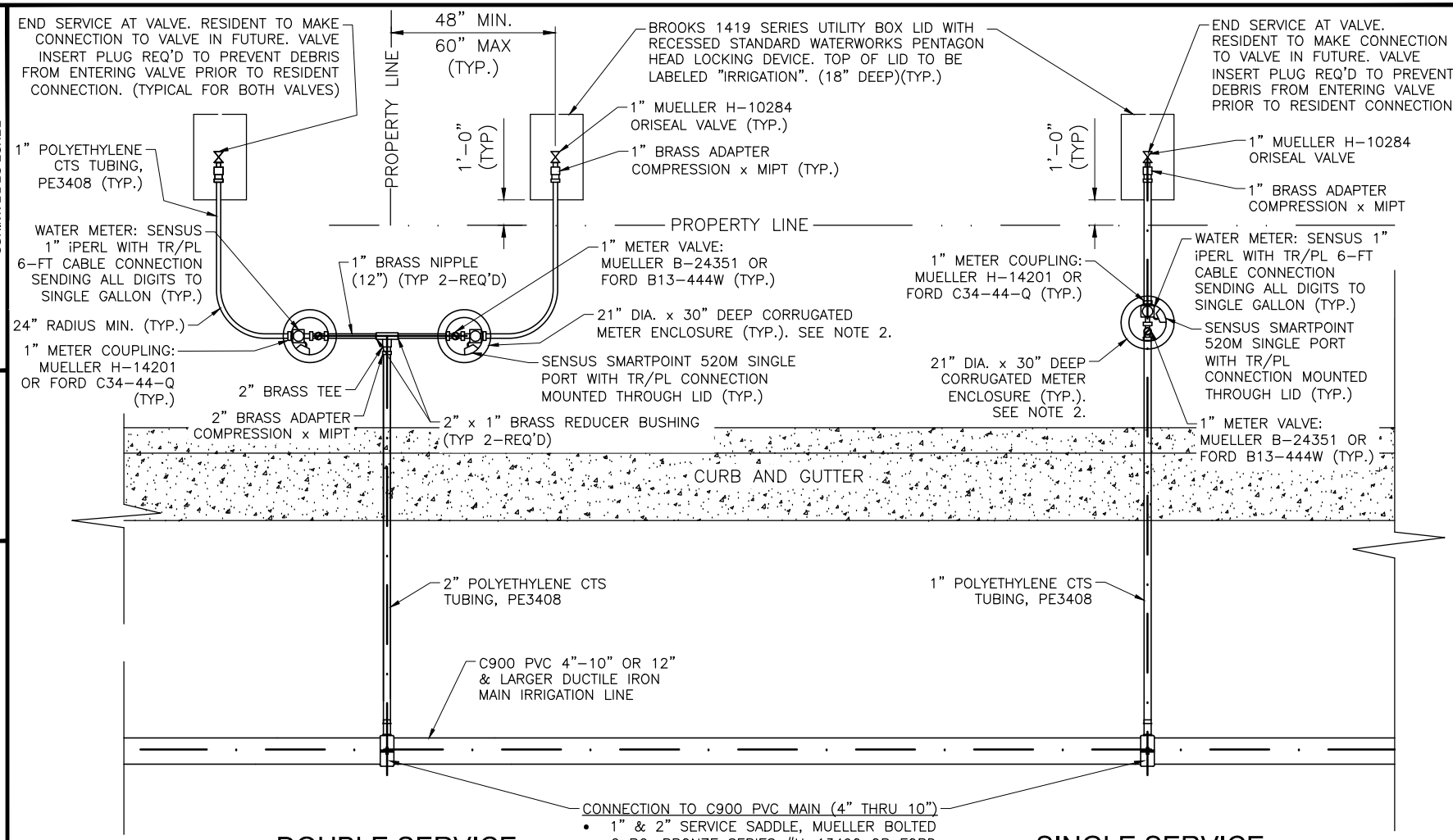
The location of the service box should be coordinated with each property owner. A double service near a shared property corner is encouraged in order to reduce construction and maintenance costs. Determination of service location shall be provided by Hooper Irrigation Company (Owner) and coordinated with the resident and the Contractor. The location shall be near the property line and away from traffic impact areas. The location shall be marked on the ground with a flag, stake, paint, or other methods chosen by the Owner. The Contractor must coordinate with the Owner and the resident when a service box location may provide conflicts with existing infrastructure or difficulties in construction. Note: Service box must be a minimum of 5’-0” away, either side of culinary water meter. Field notes of the actual installed location of the service box must be shown on the as-built drawings by the Contractor. Contractor shall be required to write in permanent ink Marker on the lid of the service box footage from service box to main. This will serve as another means of locating the main in the roadway and for dewatering pay quantities.

15.09 SERVICE BORE:

All services on the opposite side of the street from the main will be bored under the asphalt. No open trenching for services will be permitted unless approved by engineer. All approved open trenching for service installation will require a minimum of 1’-0” (one Foot) trench width in order to achieve the necessary compaction and asphalt replacement. Boring will also be required in areas where construction will cross existing sidewalk, and/or curb and gutter. Sidewalk and/or curb and gutter that is damaged or removed on this project shall be replaced in same or better condition (than before the damage or removal) at no additional cost to the Owner.

15.10 FLOW METERS:

As of March 12, 2018, flow meters shall be installed on all new secondary services per the Hooper Irrigation Company "Typical Service Connections" detail in the standard drawings. Meters shall be of type Sensus iPerl for all services 1" in size and smaller. For services larger than 1", the Hooper Irrigation Company engineer should be consulted for information about meter type and model. Meters shall be located behind the curb and gutter in the park strip area per the standard detail.



NOTE:
1. STAINLESS STEEL PIPE STIFFENERS ARE REQUIRED TO BE USED ON ALL CONNECTIONS ON POLY PIPE.
2. INSURE VALVE CONTROL NUT CAN BE SERVICED BY WRENCH WHEN POSITIONING UNDER ENCLOSURE LID

TYPICAL SERVICE CONNECTIONS

N.T.S.

NO.	DESCRIPTION	BY	APR.	DATE
1	REV. DRAWING TO ADD CURB & GUTTER & GALLOUTS	DBS	TLA	12-15-0
2	REV. DRAWING TO ADD TWO BOXES ON DOUBLE SERVICE	JDM	GLS	5-15-14
3	REV. DRAWING TO ADD FLOW METERS ON ALL SERVICES	JRH	GLS	3-15-18

REVISION

J-U-B Engineers • Surveyors • Planners

Hooper Irrigation Company
Pressure Irrigation Standards

TYPICAL SERVICE CONNECTION DETAIL

SHEET PI-10

CAD DWG:	detail01.dwg
PLOT SCALE:	N/A
DATE:	DECEMBER 2004
DRAWN BY:	D.STEELE
DESIGN BY:	D.STEELE
CHECKED BY:	TLA
SCALE:	-

demand. The storage amount given herein correlates with Pine View Water System requirements. This is done so that if a transfer ever takes place, the system will comply.

1. **Fencing**: Reservoirs should be fenced around the perimeter with room between the fence and the perimeter for maintenance vehicles (min 20'). Fencing shall be 6 feet tall chain link in accordance with these Public Works Standards and conform to City Zoning requirements.
2. **Lining**: Reservoirs shall be clay lined to inhibit percolation or infiltration. The corners should rounded to avoid stress concentrations in the event of future concrete lining.
3. **Side Slope**: Due to the fact that most of these basins will be in residential areas, the maximum side slope of the basis shall be two (2) feet horizontal to one (1) feet vertical.
4. **Depth**: Irrigation basins shall not exceed 12 feet deep and, in the presence of ground water, consideration for draining the basin must be given.
5. **Grates, Pipes and Screens**: All grates and screens shall be hot dip galvanized to avoid corrosion. Pipes shall be in accordance with the pipe specification given herein.
6. **Freeboard**: The top of the embankment in all areas shall be one (1) foot above the highest water elevation.
7. **Ground Covers:** The surface area around the basin shall be covered with weed barrier fabric and gravel. Gravel shall 2" minus and be 4" thick over the top of the weed barrier.
8. **Embankment (Fill) Construction:** If a raised embankment is constructed for the reservoir (constructed with granular materials), it shall be provided with a minimum of 6" of clay cover on the inside of the berm to prevent water passage through the soil as well as the clay lining.
9. **Excavation (Cut) Construction:** If the basin is constructed primarily by excavation, then it may be necessary to provide an impermeable liner and land drain system when constructed in the proximity of basements or other below grade structures as determined by a geotechnical evaluation.

G. PRESSURIZATION

Gravity systems are always desirable, however pumps may need to be used. Pumps, which shall directly pressurize the system, shall be Variable Frequency Drive (VFD) pumps with redundancy designed for meeting the peak instantaneous flows.

The hydraulics of the system should be set for a peak instantaneous flow equal to the following formula:

$$Q = U*180*N^{0.55}$$

Where: Q is the instantaneous flow rate in g.p.m.
U is the usage factor (no less than 60% or 0.6)
N is the total number of Irrigable acres

In no case shall the Peak Instantaneous Flow Rate per irrigable acre be less than 8gpm. Pressures should be designed between 60 psi (139' TDH) and 100 psi (230' TDH). Pump

APPENDIX C

Head / Headloss Curves

TEL (801) 394-4515 • FAX (801) 392-7544 • 5746 South 1475 East • Ogden, Utah 84403 • www.greatbasinengineering.com

GRUNDFOS

Company name: Great Basin Engineering
Created by: Abhishek Amalaraj
Phone: 801-689-8419
Email: abhisheka@greatbasineng.com
Date: 6/16/2021

Count	Description
1	**CR 20-4 K-GJ-A-E-HQQE** Product No.: 99968313 Vertical, multistage centrifugal pump with inlet and outlet ports on same the level (inline). The pump head and base are in cast iron – all other wetted parts are in stainless steel. A special "Low NPSH" first-stage design reduces the pump's NPSHr value. A cartridge shaft seal ensures high reliability, safe handling, and easy access and service. Power transmission is via a rigid split coupling. Pipe connection is via combined ANSI-JIS flanges. The pump is fitted with a 3-phase, fan-cooled asynchronous motor. Liquid: Pumped liquid: Water Liquid temperature range: -4 .. 248 °F Selected liquid temperature: 68 °F Density: 62.29 lb/ft³ Technical: Rated pump speed: 3444 rpm Actual calculated flow: 145 US gpm Resulting head of the pump: 81.12 psi Actual impeller diameter: 4.13 in Pump orientation: Vertical Shaft seal arrangement: Single Code for shaft seal: HQQE Approvals on nameplate: CURUS Curve tolerance: ISO9906:2012 3B Materials: Base: Cast iron EN 1561 EN-GJL-200 ASTM A48-25B Impeller: Stainless steel EN 1.4301 AISI 304 Bearing: SIC Installation: Maximum ambient temperature: 104 °F Maximum operating pressure: 232.06 psi Max pressure at stated temperature: 232 psi / 250 °F 232 psi / -4 °F Type of connection: ANSI / JIS Size of inlet connection: DN 50 Size of outlet connection: DN 50 Pressure rating for connection: PN 25 Flange rating inlet: 250 lb Flange size for motor: 254TC Electrical data: Motor standard: NEMA Motor type: WEG IE Efficiency class: IE3 / NEMA Premium Rated power - P2: 15 HP Power (P2) required by pump: 15 HP Main frequency: 60 Hz Rated voltage: 3 x 208-230/460 V Service factor: 1.15 Rated current: 38,5-34,8/17,4 A Starting current: 680-680 % Cos phi - power factor: 0.87 Rated speed: 3525 rpm IE efficiency: IE3 91% Motor efficiency at full load: 91 %

GRUNDFOS

Company name: Great Basin Engineering
Created by: Abhishek Amalaraj
Phone: 801-689-8419
Email: abhisheka@greatbasineng.com
Date: 6/16/2021

Count	Description	
	Motor efficiency at 3/4 load:	91 %
	Motor efficiency at 1/2 load:	89.5 %
	Number of poles:	2
	Enclosure class (IEC 34-5):	IP55
	Insulation class (IEC 85):	F
	Motor Number:	99883247
	Controls:	
	Frequency converter:	NONE
	Others:	
	DOE Pump Energy Index CL:	0.96
	Net weight:	295 lb
	Gross weight:	381 lb
	Shipping volume:	13.1 ft^3
	Country of origin:	US
	Custom tariff no.:	8413.70.9090

Company name: Great Basin Engineering
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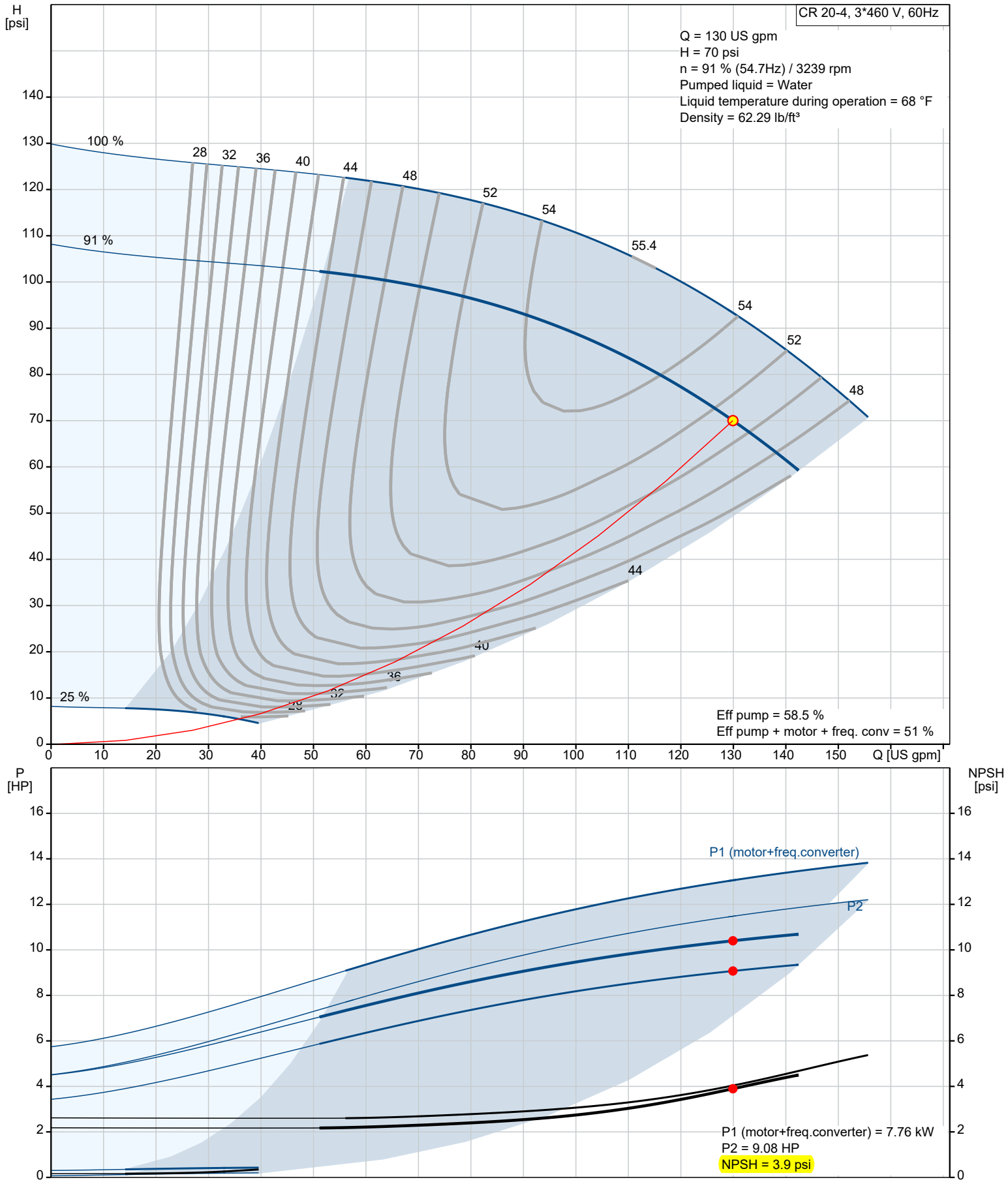
Email: abhisheka@greatbasineng.com
Date: 6/16/2021

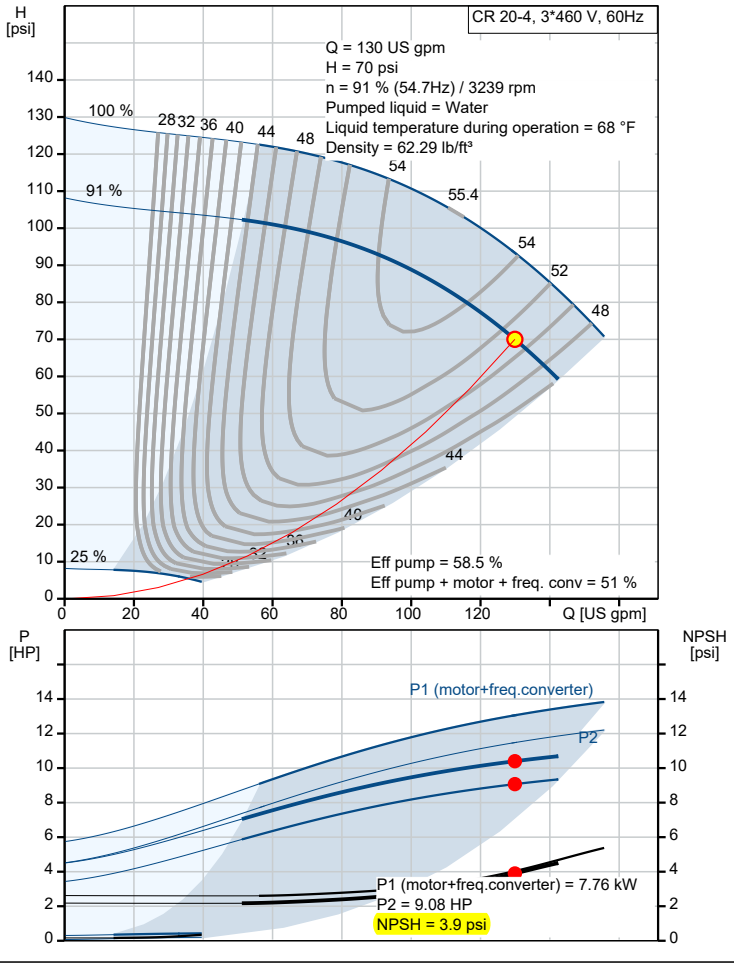
99968313 CR 20-4 K-GJ-A-E-HQQE 60 Hz

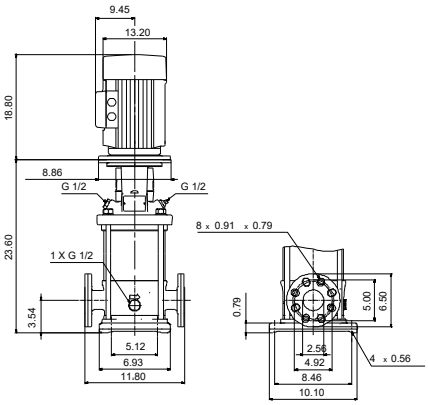


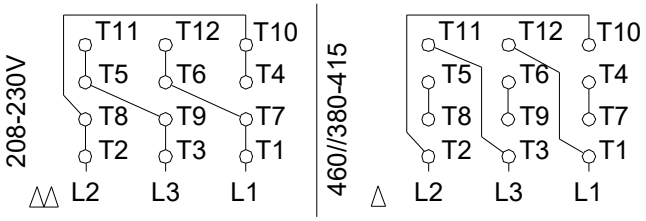
GRUNDFOS

Company name: Great Basin Engineering
Created by: Abhishek Amalaraj
Phone: 801-689-8419
Email: abhisheka@greatbasineng.com
Date: 6/16/2021

Description	Value
General information:	
Product name:	CR 20-4 K-GJ-A-E-HQQE
Product No.:	99968313
EAN:	5715114889100
Price:	
Technical:	
Rated pump speed:	3444 rpm
Actual calculated flow:	130 US gpm
Resulting head of the pump:	70 psi
Maximum head:	128.8 psi
Actual impeller diameter:	4.13 in
Stages:	4
Impellers:	4
Number of reduced-diameter impellers:	0
Low NPSH:	Y
Pump orientation:	Vertical
Shaft seal arrangement:	Single
Code for shaft seal:	HQQE
Approvals on nameplate:	CURUS
Curve tolerance:	ISO9906:2012 3B
Pump version:	K
Model:	A
Cooling:	IC 411
Materials:	
Base:	Cast iron
Base:	EN 1561 EN-GJL-200
Base:	ASTM A48-25B
Impeller:	Stainless steel
Impeller:	EN 1.4301
Impeller:	AISI 304
Material code:	A
Code for rubber:	E
Bearing:	SIC
Installation:	
Maximum ambient temperature:	104 °F
Maximum operating pressure:	232.06 psi
Max pressure at stated temperature:	232 psi / 250 °F
Max pressure at stated temperature:	232 psi / -4 °F
Type of connection:	ANSI / JIS
Size of inlet connection:	DN 50
Size of outlet connection:	DN 50
Pressure rating for connection:	PN 25
Flange rating inlet:	250 lb
Flange size for motor:	254TC
Connect code:	GJ
Liquid:	
Pumped liquid:	Water
Liquid temperature range:	-4 .. 248 °F
Selected liquid temperature:	68 °F
Density:	62.29 lb/ft³
Electrical data:	
Motor standard:	NEMA
Motor type:	WEG
IE Efficiency class:	IE3 / NEMA Premium
Rated power - P2:	15 HP
Power (P2) required by pump:	15 HP
Main frequency:	60 Hz
Rated voltage:	3 x 208-230/460 V
Service factor:	1.15
Rated current:	38,5-34,8/17,4 A
Starting current:	680-680 %







GRUNDFOS

Company name: Great Basin Engineering
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Phone: 801-689-8419
Email: abhisheka@greatbasineng.com
Date: 6/16/2021

Description	Value
Full load SF current:	40/20 A
Cos phi - power factor:	0.87
Rated speed:	3525 rpm
IE efficiency:	IE3 91%
Motor efficiency at full load:	91 %
Motor efficiency at 3/4 load:	91 %
Motor efficiency at 1/2 load:	89.5 %
Number of poles:	2
Enclosure class (IEC 34-5):	IP55
Insulation class (IEC 85):	F
Motor protection:	NONE
Motor Number:	99883247
Controls:	
Frequency converter:	NONE
Others:	
DOE Pump Energy Index CL:	0.96
Net weight:	295 lb
Gross weight:	381 lb
Shipping volume:	13.1 ft³
Country of origin:	US
Custom tariff no.:	8413.70.9090

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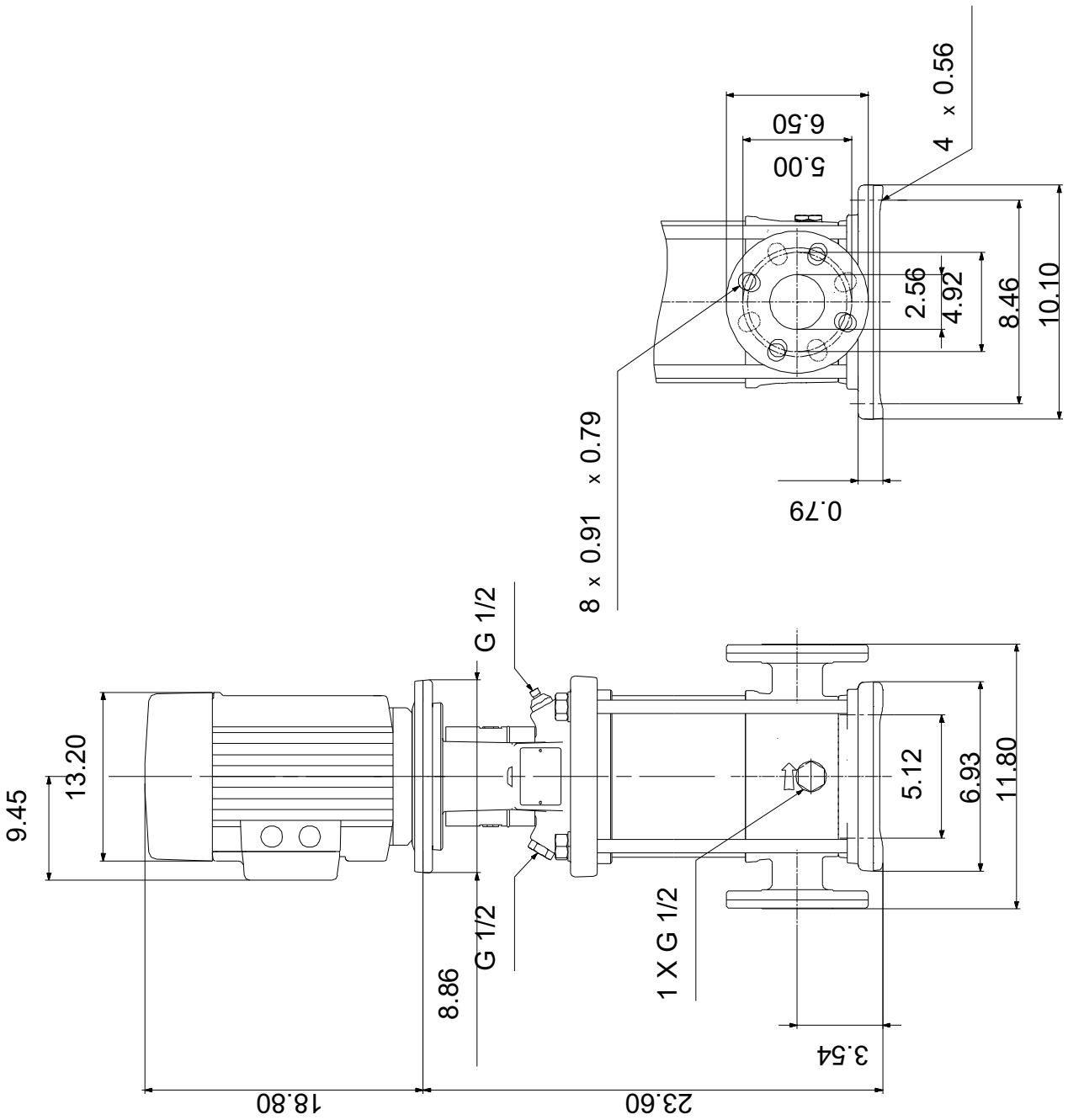
Date: 6/16/2021

99968313 CR 20-4 K-GJ-A-E-HQQE 60 Hz

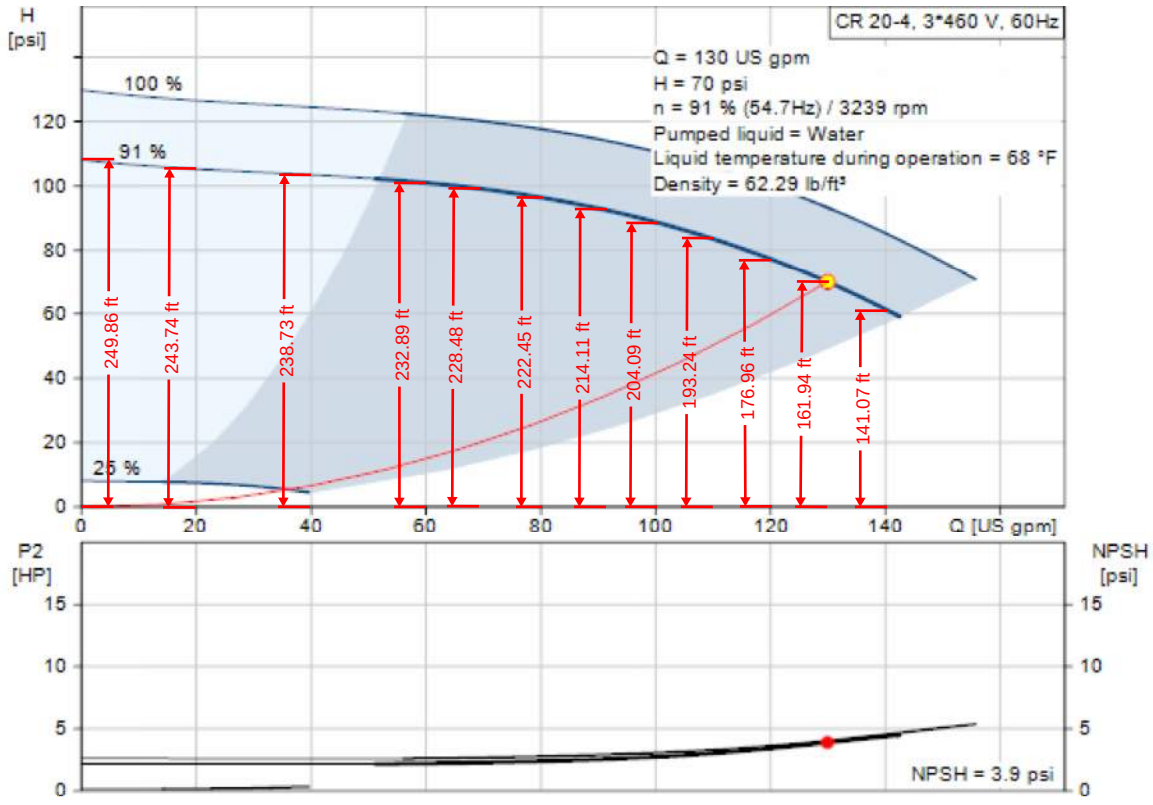


Note! All units are in [in] unless otherwise stated.
Disclaimer: This simplified dimensional drawing does not show all details.

The pump curve for CR 20-4 A-GJ-A-E-HQQE

Flow : 130 gpm
Pressure: 70 psi

Note: 1psi = 2.31' head



APPENDIX D

Model Calculations/Results

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Design Unit Peak Instantaneous Demand = 15.84 gpm/irr-ac

RiversBend Ph1

Parcel	Size (sf)	Irrigable area (sf)
Lot 100	11886	6886
Lot 101	11043	6043
Lot 102	11157	6157
Lot 103	11764	6764
Lot 104	11389	6389
Lot 105	9899	5899
Lot 106	9014	5014
Lot 107	9014	5014
Lot 108	11792	6792
Lot 109	10794	5794
Lot 110	9093	5093
Lot 111	9150	5150
Lot 112	9913	5913
Lot 113	10136	6136
Lot 114	10155	6155
Lot 115	10173	6173
Lot 117	9067	5067
Lot 118	9900	5900
Lot 119	12095	7095
Lot 120	12331	7331
Lot 121	12517	7517
Lot 122	11479	6479
Lot 123	9326	5326
Lot 124	10508	5508
Lot 125	9290	5290
Lot 126	9290	5290
Lot 127	9290	5290
Lot 128	9935	5935
Lot 129	10277	6277
Lot 130	9046	5046
Lot 131	9046	5046
Lot 132	9046	5046
Lot 133	10052	6052
Lot 134	12414	7414
Lot 135	11351	6351
Lot 136	9599	5599
Lot 137	9577	5577
Lot 138	9556	5556
Lot 140	9378	5378
Lot 141	9333	5333
Lot 142	9329	5329
Lot 143	9325	5325
Lot 144	9321	5321
Lot 145	10180	6180
Lot 146	9027	5027
Lot 147	9034	5034
Lot 148	9011	5011
Lot 149	9041	5041
Lot 150	9064	5064
Parcel A	4128	3922
Parcel B	8929	8483
Parcel C	6473	6149
Parcel D	58234	55322
Parcel E1	1827	1736
ROWs	224310	40376
Totals	**797308**	**399394**

RiversBend Ph2

Parcel	Size (sf)	Irrigable area (sf)
Lot 200	10135	6135
Lot 201	9135	5135
Lot 202	9135	5135
Lot 203	9135	5135
Lot 204	10002	6002
Lot 205	9499	5499
Lot 206	9807	5807
Lot 207	9511	5511
Lot 208	9511	5511
Lot 209	9511	5511
Lot 211	9014	5014
Lot 212	9004	5004
Lot 213	9004	5004
Lot 214	9004	5004
Lot 215	9004	5004
Lot 216	9004	5004
Lot 217	9004	5004
Lot 218	9004	5004
Lot 219	9768	5768
Lot 220	9101	5101
Lot 221	9023	5023
Lot 222	9006	5006
Lot 223	9017	5017
Lot 224	10881	5881
Lot 225	9427	5427
Lot 226	9458	5458
Lot 227	9489	5489
Lot 228	9519	5519
Lot 229	9505	5505
Lot 231	9784	5784
Lot 232	9799	5799
Lot 233	9820	5820
Lot 234	10814	5814
Lot 235	11752	6752
Lot 236	9313	5313
Lot 237	9313	5313
Lot 239	9419	5419
Lot 240	9419	5419
Lot 241	9419	5419
Lot 242	9419	5419
Lot 243	9841	5841
Lot 244	9690	5690
Lot 245	9006	5006
Lot 246	9057	5057
Lot 247	9108	5108
Lot 248	9158	5158
Lot 249	9114	5114
Lot 250	9163	5163
Lot 251	9320	5320
Parcel E2	1827	1736
Parcel F	2982	2833
Parcel G	1687	1603
ROWs	172451	31041
Totals	**642292**	**301557**

	Irrigable Area					
Phase	Residential Lots*	Common Area**	Rights-of-Way***	Units	Totals	Units
RiversBend 1	283407	75611	40376	SF	700952	SF
RiversBend 2	264345	6171	31041			
RiversBend 1	6.506	1.736	0.927	Acres	16.09	Acres
RiversBend 2	6.069	0.142	0.713			

*Assumes 4000 sf non-irrig per lot for Lots < 10,500 sf and 5000 sf for Lots larger than 10,500 sf.

**Assumes 5% non-irrig areas for gravel paths, small structures, etc.

***Use 82.0% non-irrig areas for ROWs since 49' out of 60' ROW has asph or conc paving. This assumption is conservative for 66' ROWs

Source Requirements:

Table Taken from page 6 of "Sprinklers, Crop Water Use, and Irrigation Time Weber County"
(Website : https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1158&context=extension_histall)

1) Calculation for number of shares required

Table taken from page 6 of "Sprinklers, Crop Water Use, and Irrigation Time Weber County" which shows the Monthly Crop Evapotranspiration at Ogden and Huntsville. Thirty year average for period 1961-1990

Table 3. Monthly Crop Evapotranspiration at Ogden and Huntsville. Thirty year average for period 1961-1990.

Site		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Season Total
Alfalfa Water Use, Inches										
Huntsville			1.74	5.57	5.73	8.55	5.26	3.87		30.72
Ogden	0.24	3.42	5.72	7.44	6.95	5.75	3.66	2.47	35.66	
Pasture Water Use, Inches										
Huntsville			1.53	3.65	5.10	5.62	4.75	2.84	0.40	23.89
Ogden		0.48	2.37	4.18	5.55	6.05	5.14	3.18	1.91	28.86
Sp Grain Water Use, Inches										
Huntsville			0.46	3.16	7.74	8.08	1.76			21.20
Ogden			1.23	5.42	8.54	5.89				21.07
Corn Water Use, Inches										
Huntsville			0.82	2.37	6.19	6.93	3.73			20.05
Ogden		0.11	1.29	3.23	7.25	7.49	4.10			23.47
Orchard Water Use, Inches										
Ogden			0.84	4.18	8.29	10.09	8.60	5.05	1.28	38.33
Turf Water Use, Inches										
Huntsville			1.81	3.20	4.39	4.84	4.09	2.44	1.06	21.84
Ogden		0.64	2.23	3.61	4.78	5.21	4.43	2.74	1.93	25.57
Garden Water Use, Inches										
Huntsville			0.83	2.89	6.01	5.01	1.11			15.89
Ogden		0.44	1.87	4.40	7.33	4.19	1.02	0.38		19.63

Adapted from: Consumptive Use of Irrigated Crops in Utah, Utah Agricultural Experiment Station Research Report No. 145. Oct. 1994.

Total water use needed per year (inches)	=	25.57	inches/ year
Total irrigated areas (acres)	=	16.09	acres
One share	=	2.8	ac-ft

The shares needed for the secondary water line are calculated using the equation shown below,

$$\left(25\ {}^{in}/_{yr}\right) * (\ 16.09\ acre) * (\ 1\ feet/12\ inch\ ) * \left({}^{1\ share}/_{2.8\ ac-ft}\right) \approx 12.2 \text{ shares}$$

Since shares are available in no less than 0.5 share increments, there are 12.5 shares needed.

2) Water turn availability

A 3 CFS flow rate is sanctioned for 649 minutes, once every 7.5 days (turn)

$$\left(3\ {}^{ft^3}/_{\sec}\right) * (649\ {}^{min}/_{turn}) * (60\ {}^{sec}/_{min}) * \left(1\ {}^{acre}/_{43650 ft^2}\right) = 2.68 \text{ ac-ft per turn}$$

Storage Requirements:

Although the required storage during the highest demand month is only 1.75 ac-ft/turn, almost 3 ac-ft are available each turn. The owner would like the ability to store all available water, assuming loss and or over use yield, an empty pond between cycles. A 3 ac-ft pond is selected which provides a safety factor of 1.71.

$$\left(5.21\ in/30\ days\right) * \left(7.5\ days/turn\right) * \left(1\ ft/12\ inch\right) * (16.09\ acre) = 1.75\ ac-ft/turn$$

Distribution Requirements:

Flow Rate: (See Table 510-7 in Utah Rule R309-510-9(3))

Provided Unit Peak Inst. Demand =	7.92	gpm/irr-acre
Safety Factor =	2	
Design Unit Peak Inst. Demand =	15.84	gpm/irr-acre
Design Peak Inst. Demand =	**254.866**	gpm (peak delivered from pond to irrigation main)

Design Unit Peak Instantaneous Demand = 15.84 gpm/irr-ac
Total Peak Instantaneous Demand = 254.89 gpm

Residential Lots

Lot	Size (sf)	Initial Irrigable area (sf)	Adjusted* Irrigable area (sf)	Des. Peak Instant. (gpm)
100	11886	6886	9680	3.52
101	11043	6043	8639	3.14
102	11157	6157	8780	3.19
103	11764	6764	9529	3.47
104	11389	6389	9066	3.30
105	9899	5899	8226	2.99
106	9014	5014	7133	2.59
107	9014	5014	7133	2.59
108	11792	6792	9564	3.48
109	10794	5794	8331	3.03
110	9093	5093	7231	2.63
111	9150	5150	7301	2.65
112	9913	5913	8243	3.00
113	10136	6136	8519	3.10
114	10155	6155	8542	3.11
115	10173	6173	8564	3.11
117	9067	5067	7198	2.62
118	9900	5900	8227	2.99
119	12095	7095	9938	3.61
120	12331	7331	10230	3.72
121	12517	7517	10459	3.80
122	11479	6479	9177	3.34
123	9326	5326	7518	2.73
124	10508	5508	7978	2.90
125	9290	5290	7474	2.72
126	9290	5290	7474	2.72
127	9290	5290	7474	2.72
128	9935	5935	8270	3.01
129	10277	6277	8693	3.16
130	9046	5046	7172	2.61
131	9046	5046	7172	2.61
132	9046	5046	7172	2.61
133	10052	6052	8415	3.06
134	12414	7414	10332	3.76
135	11351	6351	9019	3.28
136	9599	5599	7855	2.86
137	9577	5577	7828	2.85
138	9556	5556	7802	2.84
140	9378	5378	7583	2.76
141	9333	5333	7527	2.74
142	9329	5329	7522	2.74
143	9325	5325	7517	2.73
144	9321	5321	7512	2.73
145	10180	6180	8573	3.12
146	9027	5027	7149	2.60
147	9034	5034	7158	2.60
148	9011	5011	7129	2.59
149	9041	5041	7166	2.61
150	9064	5064	7195	2.62
200	10135	6135	6949	2.53
201	9135	5135	5869	2.13
202	9135	5135	5869	2.13
203	9135	5135	5869	2.13
204	10002	6002	6805	2.47
205	9499	5499	6262	2.28
206	9807	5807	6595	2.40
207	9511	5511	6275	2.28
208	9511	5511	6275	2.28
209	9511	5511	6275	2.28
211	9014	5014	5738	2.09
212	9004	5004	5727	2.08
213	9004	5004	5727	2.08
214	9004	5004	5727	2.08
215	9004	5004	5727	2.08
216	9004	5004	5727	2.08
217	9004	5004	5727	2.08
218	9004	5004	5727	2.08
219	9768	5768	6552	2.38
220	9101	5101	5832	2.12
221	9023	5023	5748	2.09
222	9006	5006	5729	2.08
223	9017	5017	5741	2.09
224	10881	5881	6755	2.46
225	9427	5427	6184	2.25
226	9458	5458	6218	2.26
227	9489	5489	6251	2.27
228	9519	5519	6283	2.28
229	9505	5505	6268	2.28
231	9784	5784	6570	2.39
232	9799	5799	6586	2.39
233	9820	5820	6609	2.40
234	10814	5814	6682	2.43
235	11752	6752	7696	2.80
236	9313	5313	6061	2.20
237	9313	5313	6061	2.20
239	9419	5419	6175	2.25
240	9419	5419	6175	2.25
241	9419	5419	6175	2.25
242	9419	5419	6175	2.25
243	9841	5841	6631	2.41
244	9690	5690	6468	2.35
245	9006	5006	5729	2.08
246	9057	5057	5784	2.10
247	9108	5108	5839	2.12
248	9158	5158	5894	2.14
249	9114	5114	5846	2.13
250	9163	5163	5899	2.15
251	9320	5320	6069	2.21

*These include a pro-rated value (by total lot areas in applicable phase) of the irrigable area in the ROWs and Common Areas.

Non-Res Lot Areas

Parcel	Res. Size (sf)	Irrigable area (sf)	**Des. Peak Instant. (gpm)
Ph1	493407	115987	0.00
Ph2	463345	37212	0.00

** These flows are accounted for by pro-rating and adding to the Initial Lot Irrigable areas to become Adjusted Irrigable areas.

Connection	Serves Lot	and Lot	Full	Half
1	105	106	5.59	2.795
2	100		3.52	1.760
3	101	102	6.33	3.165
4	107	108	6.07	3.035
5	103	104	6.76	3.380
6	109		3.03	1.515
7	134	200	6.28	3.140
8	201	202	4.27	2.135
9	203	204	4.61	2.305
10	235	251	5.01	2.505
11	117	118	5.61	2.805
12	114	115	6.22	3.110
13	112	113	6.10	3.050
14	119	120	7.33	3.665
15	121	122	7.14	3.570
16	123		2.73	1.365
17	124	125	5.62	2.810
18	126	127	5.44	2.720
19	135	136	6.14	3.070
20	110	111	5.28	2.640
21	137	138	5.68	2.840
22	140	141	5.49	2.745
23	132	133	5.67	2.835
24	142	143	5.47	2.735
25	130	131	5.22	2.610
26	144	145	5.85	2.925
27	233	234	4.83	2.415
28	236	237	4.41	2.205
29	231	232	4.78	2.390
30	228	229	4.56	2.280
31	239	240	4.49	2.245
32	226	227	4.53	2.265
33	241	242	4.49	2.245
34	224	225	4.71	2.355
35	205		2.28	1.140
36	206	207	4.68	2.340
37	249	250	4.27	2.135
38	208	209	4.56	2.280
39	211	212	4.17	2.085
40	247	248	4.27	2.135
41	213	214	4.17	2.085
42	245	246	4.19	2.095
43	215	216	4.17	2.085
44	217	218	4.17	2.085
45	149	150	5.22	2.610
46	128	129	6.17	3.085
47	147	148	5.20	2.600
48	146	223	4.69	2.345
49	221	222	4.17	2.085
50	243	244	4.76	2.380
51	219	220	4.50	2.250
Totals			254.90	127.45

Net Positive Suction Head Calculation

NPSHA = Ha +/- Hz - Hf + Hv - Hvp

Where:

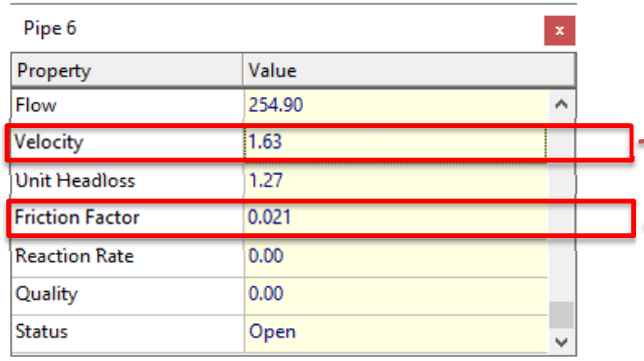
Ha is the atmospheric or absolute pressure

Hz is the vertical distance from the surface of the water to the pump centerline

Hf is the friction formed in the suction piping

Hv is the velocity head at the pump's suction

Hvp is the vapor pressure of the water at its ambient temperature



Pipe 6

Property	Value
Flow	254.90
Velocity	1.63
Unit Headloss	1.27
Friction Factor	0.021
Reaction Rate	0.00
Quality	0.00
Status	Open

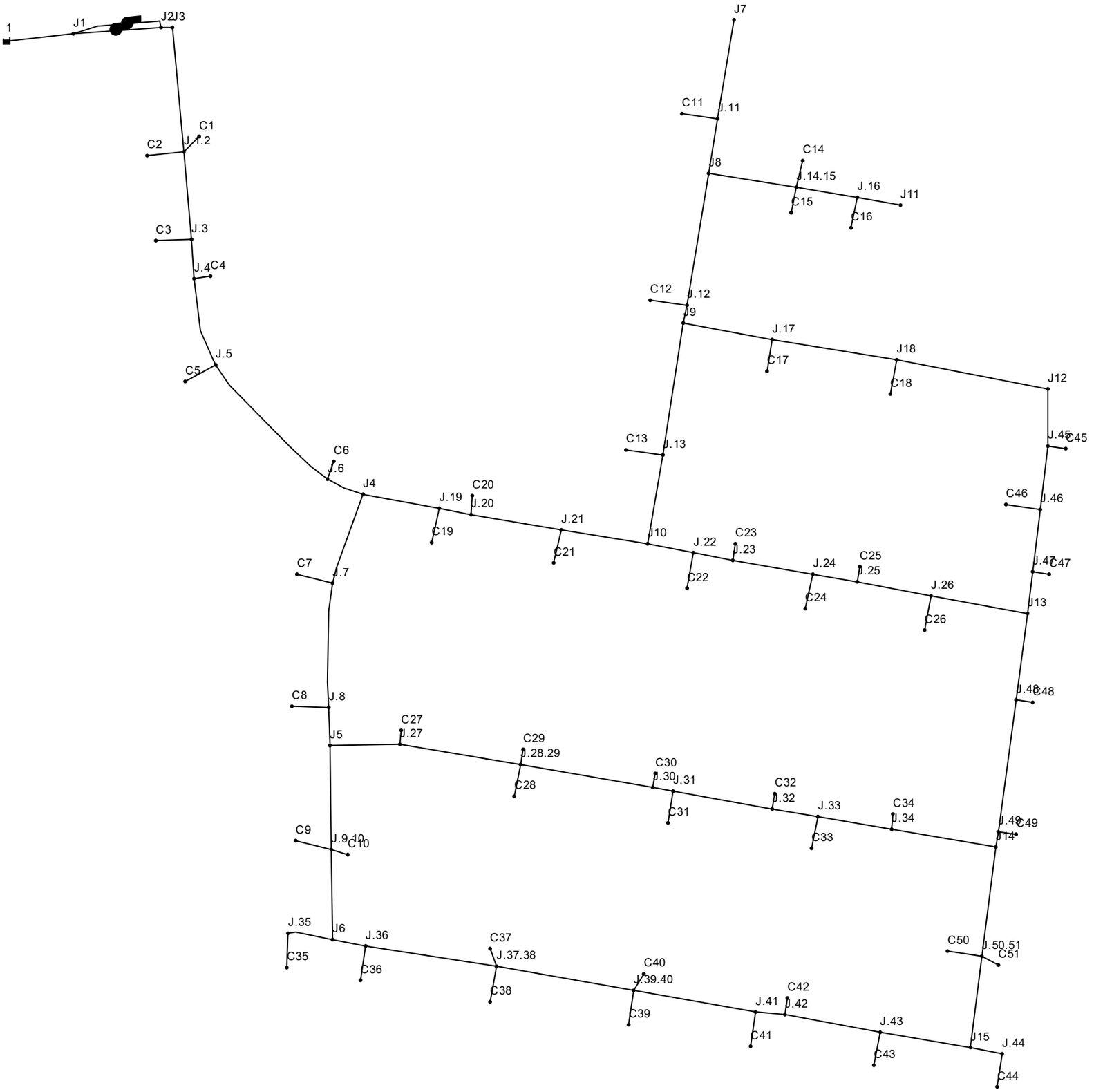
Elevation of the pump	4243	ft
Elevation of the reservoir	4235	ft
Temperature	50	◦F
Velocity of water	1.63	ft/s
Pipe diameter (inches)	8	
Length of pipe (feet)	20	
Friction factor (from EPANET)	0.021	
Atmospheric Absolute pressure	**12.69**	psi
Vapor pressure	**0.18**	psi
Specific weight of water	**62.41**	lb/cft
Gravity	**32.2**	ft/s^2

Ha (head from absolute pressure)	**29.27992**	ft
Hz (elevation difference)	**8**	ft
Hvp (head from vapor pressure)	**0.415318**	ft
Hf (friction head)	**0.025991**	ft
Hv (velocity head)	**0.041256**	ft

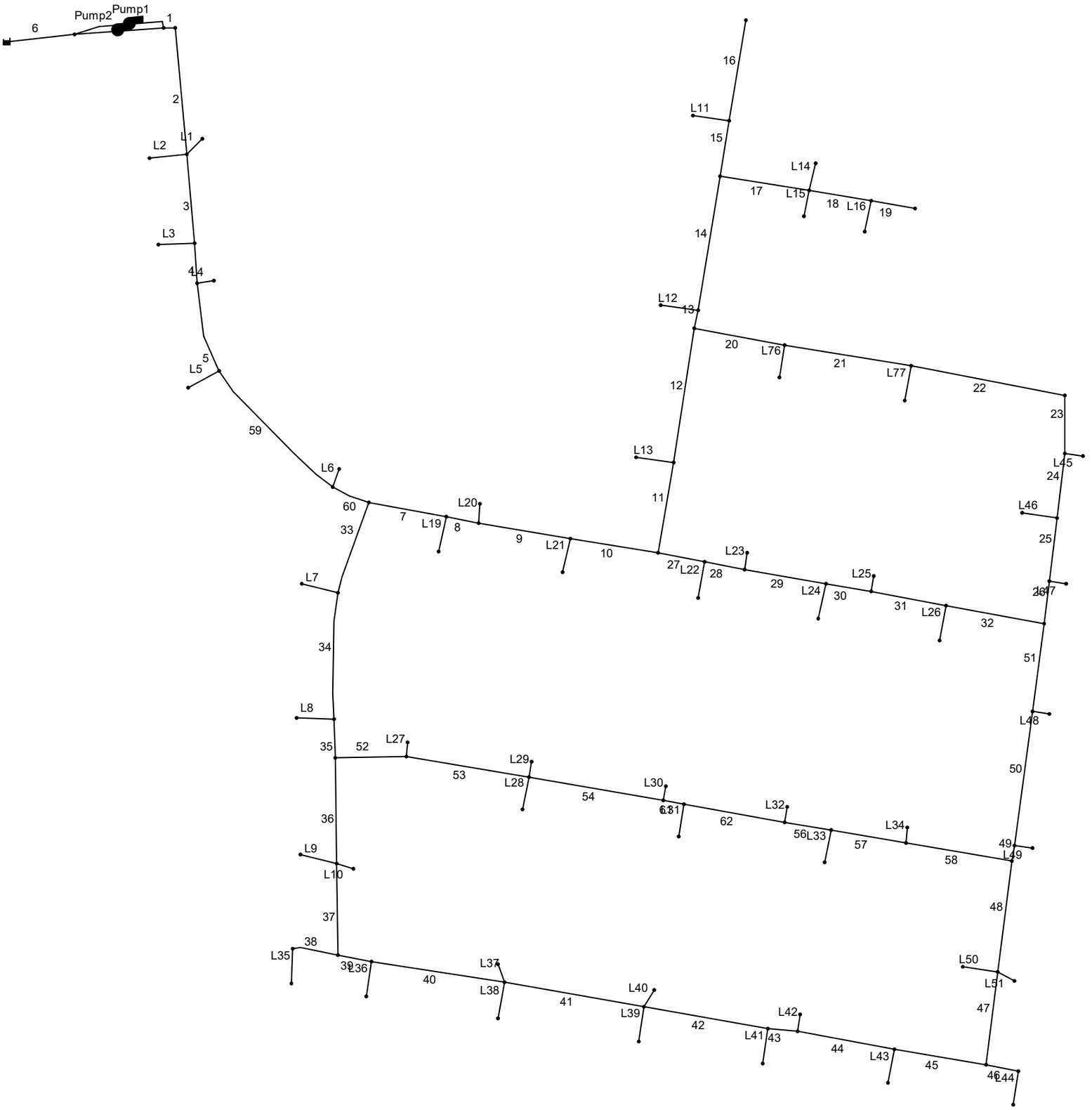
NPSHa	**36.79736**
NPSHr for selected pump (required)	**3.91**

NPSHa formula Net Positive Suction Head: NPSHR and NPSHA | Pumps & Systems (pumpsandsystems.com)
Atmosp. Pressure https://www.mide.com/air-pressure-at-altitude-calculator
Vapor Pressure https://www.accessengineeringlibrary.com/content/book/9780070471788/back-matter/appendix4

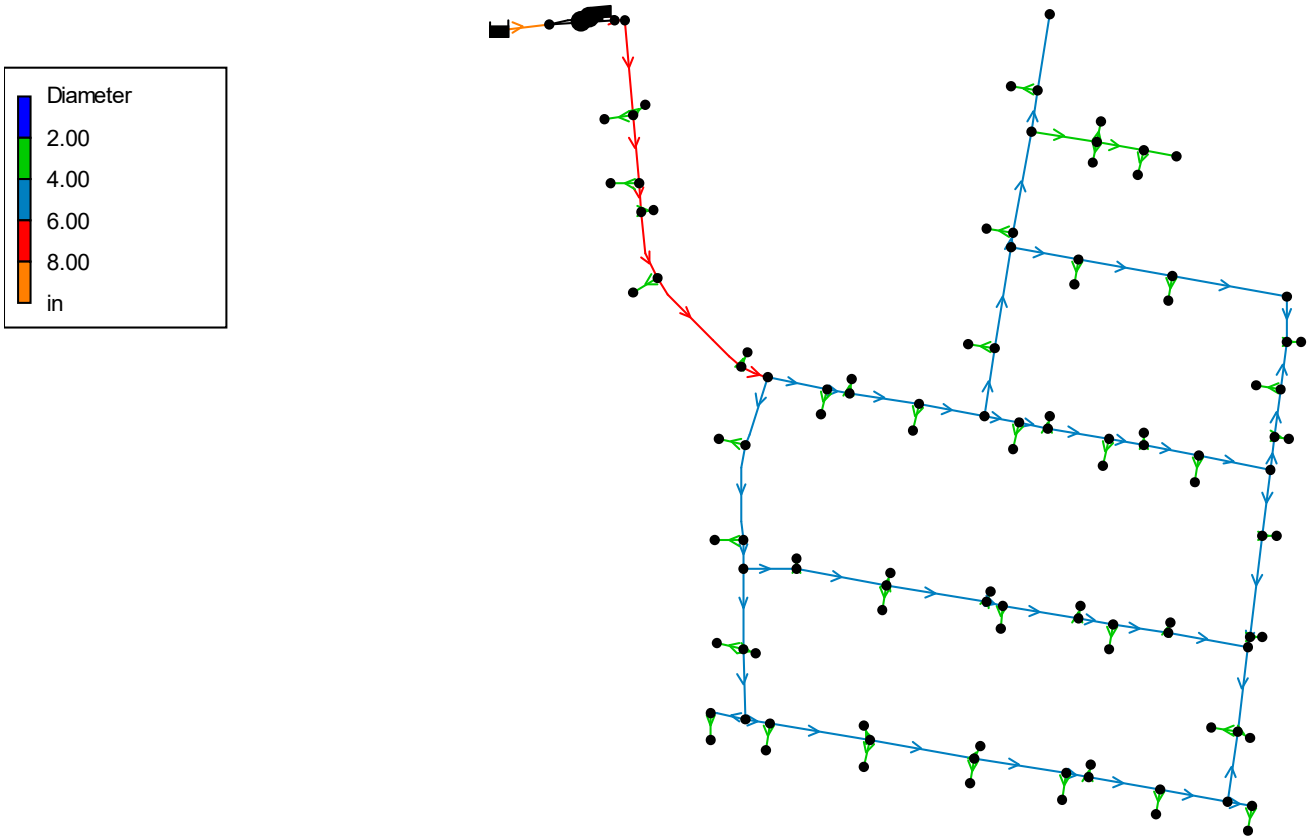
Nodes in the network - EPANET



Links in the network - EPANET

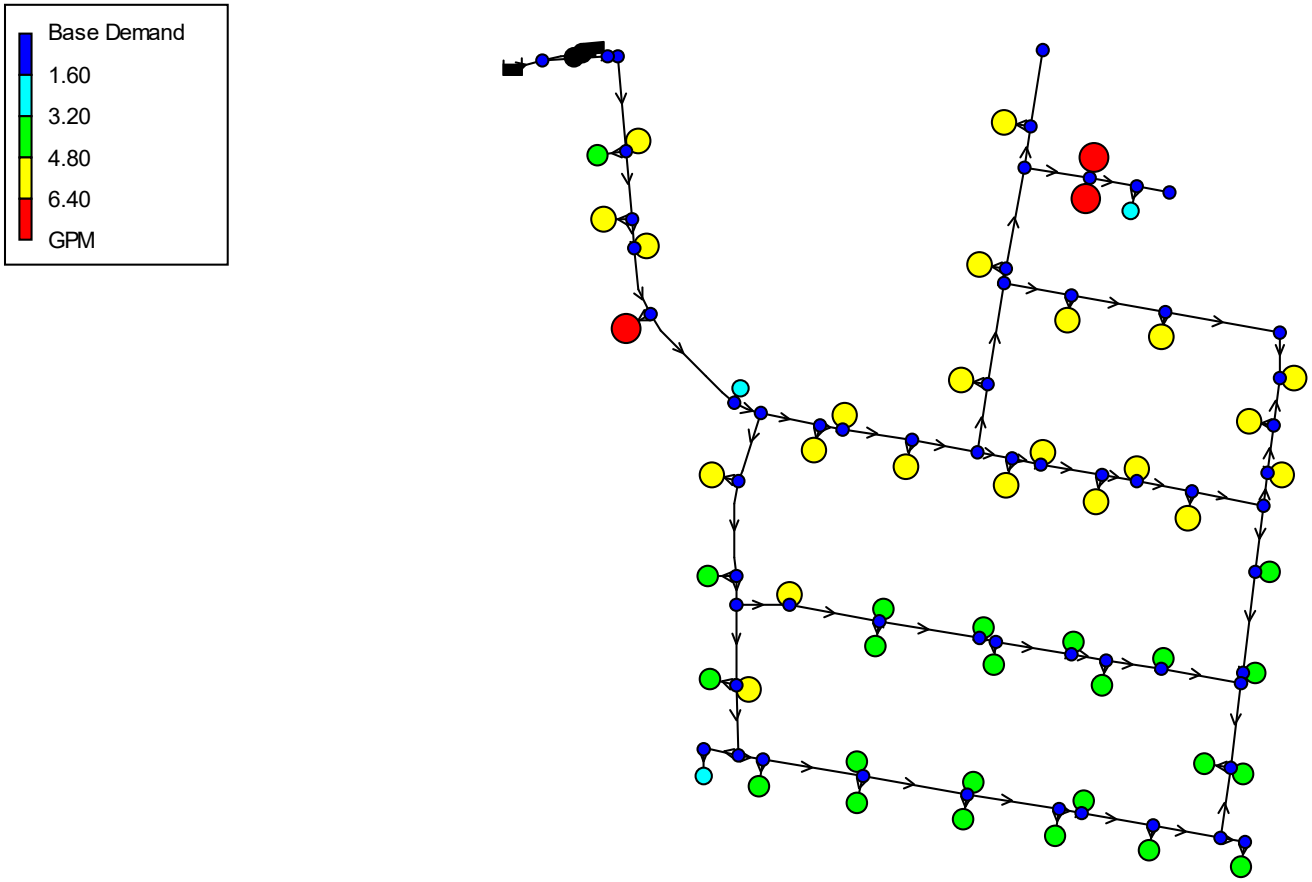


Pipe diameter



Both pumps on - Base demand at nodes

Day 1, 12



Both pumps on - Nodes

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc J.45	35	0	192.03	68.04
Junc J.46	35	0	192.03	68.04
Junc J8	35	0	191.97	68.01
Junc J.17	35	0	192.04	68.04
Junc J18	35	0	192.03	68.04
Junc J12	35	0	192.03	68.04
Junc J.11	35	0	191.96	68.01
Junc J.47	35	0	192.04	68.04
Junc J13	35	0	192.05	68.05
Junc J.48	35	0	192.04	68.05
Junc J.14.15	35	0	191.13	67.65
Junc J.16	35	0	191.11	67.64
Junc J11	35	0	191.11	67.64
Junc J.12	35	0	192.04	68.05
Junc J.20	35	0	193.97	68.88
Junc J.21	35	0	193.17	68.53
Junc J10	35	0	192.48	68.23
Junc J.6	36	0	195.31	69.03
Junc J4	35	0	195.11	69.38
Junc J.19	35	0	194.28	69.02
Junc J.13	35	0	192.28	68.15
Junc J.25	35	0	192.15	68.09
Junc J.26	35	0	192.09	68.07
Junc J9	35	0	192.05	68.05
Junc J.22	35	0	192.37	68.19
Junc J.23	35	0	192.30	68.16
Junc J.24	35	0	192.19	68.11
Junc J.49	35	0	192.04	68.05

Both pumps on - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc J.41	35	0	192.04	68.05
Junc J.42	35	0	192.04	68.04
Junc J.43	35	0	192.03	68.04
Junc J6	36	0	192.36	67.75
Junc J.37.38	35	0	192.17	68.10
Junc J.39.40	35	0	192.08	68.06
Junc J.50.51	35	0	192.03	68.04
Junc J7	35	0	191.96	68.01
Junc J2	43	0	199.81	67.94
Junc J1	43	0	34.98	-3.47
Junc J.44	35	0	192.03	68.04
Junc J15	35	0	192.03	68.04
Junc J3	40	0	198.26	68.58
Junc J.36	36	0	192.31	67.73
Junc J.32	35	0	192.11	68.07
Junc J.31	35	0	192.18	68.10
Junc J.30	35	0	192.20	68.11
Junc J14	35	0	192.04	68.05
Junc J.34	35	0	192.06	68.05
Junc J.33	35	0	192.08	68.06
Junc J.28.29	35	0	192.36	68.18
Junc J.7	35	0	194.18	68.97
Junc J.8	35	0	193.06	68.49
Junc J.35	36	0	192.36	67.75
Junc J.27	35	0	192.59	68.28
Junc J5	35	0	192.75	68.35
Junc J.9.10	35	0	192.50	68.25
Junc J.1.2	39	0	197.44	68.65
Junc J.3	38	0	196.90	68.85

Both pumps on - Nodes

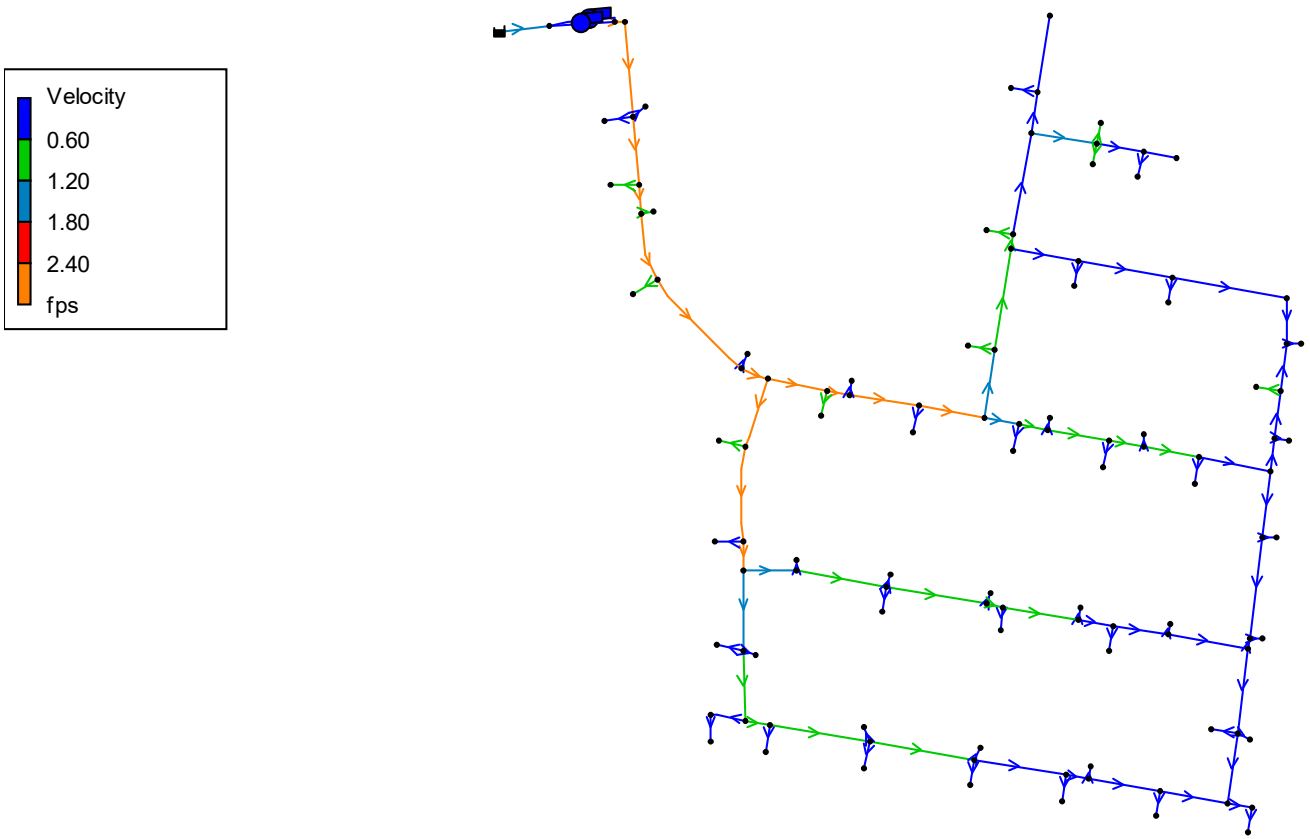
Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc J.5	37	0	196.16	68.96
Junc J.4	38	0	196.66	68.75
Junc C35	36	2.28	192.35	67.75
Junc C16	35	2.73	191.10	67.64
Junc C6	36	3.03	195.31	69.03
Junc C2	39	3.52	197.42	68.64
Junc C43	35	4.17	192.01	68.03
Junc C39	35	4.17	192.05	68.05
Junc C41	35	4.17	192.02	68.04
Junc C44	35	4.17	192.01	68.03
Junc C49	35	4.17	192.03	68.04
Junc C42	35	4.19	192.03	68.04
Junc C37	35	4.27	192.15	68.09
Junc C40	35	4.27	192.06	68.06
Junc C8	35	4.27	193.03	68.48
Junc C28	35	4.41	192.33	68.17
Junc C31	35	4.49	192.15	68.09
Junc C33	35	4.49	192.06	68.05
Junc C51	35	4.50	192.01	68.03
Junc C32	35	4.53	192.09	68.07
Junc C30	35	4.56	192.18	68.11
Junc C38	35	4.56	192.14	68.09
Junc C9	35	4.61	192.47	68.23
Junc C36	36	4.68	192.28	67.72
Junc C48	35	4.69	192.03	68.04
Junc C34	35	4.71	192.05	68.05
Junc C50	35	4.76	192.00	68.03
Junc C29	35	4.78	192.35	68.18
Junc C27	35	4.83	192.57	68.28

Both pumps on - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc C10	35	5.01	192.49	68.24
Junc C47	35	5.2	192.02	68.04
Junc C45	35	5.22	192.01	68.03
Junc C25	35	5.22	192.13	68.08
Junc C20	35	5.28	193.95	68.87
Junc C18	35	5.44	191.99	68.02
Junc C24	35	5.47	192.15	68.09
Junc C22	35	5.49	192.33	68.17
Junc C1	39	5.59	197.41	68.64
Junc C11	35	5.61	191.92	67.99
Junc C17	35	5.62	192.00	68.03
Junc C23	35	5.67	192.28	68.15
Junc C21	35	5.68	193.13	68.52
Junc C26	35	5.85	192.05	68.05
Junc C4	38	6.07	196.64	68.74
Junc C13	35	6.10	192.23	68.13
Junc C19	35	6.14	194.23	68.99
Junc C46	35	6.17	191.98	68.02
Junc C12	35	6.22	191.99	68.02
Junc C7	35	6.28	194.12	68.95
Junc C3	38	6.33	196.84	68.83
Junc C5	37	6.76	196.10	68.94
Junc C15	35	7.14	191.09	67.63
Junc C14	35	7.33	191.08	67.63
Resvr 1	35	#N/A	35.00	0.00

Both pumps on - Flow through pipes

Day 1, 12:



Both pumps on - Flow through pipes

Network Table - Links

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe 6	15	8	254.90	1.63
Pipe L34	18.66	2	4.71	0.48
Pipe L27	18.66	2	4.83	0.49
Pipe L30	19.39	2	4.56	0.47
Pipe L29	19.48	2	4.78	0.49
Pipe L32	19.69	2	4.53	0.46
Pipe L4	20.33	2	6.07	0.62
Pipe L25	20.77	2	5.22	0.53
Pipe 49	20.81	4	2.67	0.07
Pipe L23	21.23	2	5.67	0.58
Pipe L10	21.42	2	5.01	0.51
Pipe L42	21.54	2	4.19	0.43
Pipe L48	21.94	2	4.69	0.48
Pipe L49	22.04	2	4.17	0.43
Pipe 13	22.18	4	29.03	0.74
Pipe L47	22.41	2	5.20	0.53
Pipe L45	22.85	2	5.22	0.53
Pipe L20	23.13	2	5.28	0.54
Pipe L6	23.47	2	3.03	0.31
Pipe L51	23.64	2	4.50	0.46
Pipe L40	24.37	2	4.27	0.44
Pipe L37	25.56	2	4.27	0.44
Pipe L1	27.59	2	5.59	0.57
Pipe 61	27.92	4	30.65	0.78
Pipe L15	32.74	2	7.14	0.73
Pipe L14	35.38	2	7.33	0.75
Pipe 43	37.51	4	12.03	0.31
Pipe L16	40.12	2	2.73	0.28

Both pumps on - Flow through pipes

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe L31	41.04	2	4.49	0.46
Pipe L33	41.57	2	4.49	0.46
Pipe 8	41.61	4	107.63	2.75
Pipe 46	41.79	4	4.17	0.11
Pipe L76	41.97	2	5.62	0.57
Pipe L44	42.03	2	4.17	0.43
Pipe L28	42.11	2	4.41	0.45
Pipe 39	43.53	4	38.15	0.97
Pipe L43	43.57	2	4.17	0.43
Pipe L77	43.97	2	5.44	0.56
Pipe L21	44.01	2	5.68	0.58
Pipe L35	44.08	2	2.28	0.23
Pipe L41	44.26	2	4.17	0.43
Pipe L46	44.33	2	6.17	0.63
Pipe L39	44.33	2	4.17	0.43
Pipe L26	44.34	2	5.85	0.60
Pipe L36	44.40	2	4.68	0.48
Pipe L19	44.46	2	6.14	0.63
Pipe L24	44.52	2	5.47	0.56
Pipe L22	44.88	2	5.49	0.56
Pipe L5	45.19	2	6.76	0.69
Pipe L50	45.53	2	4.76	0.49
Pipe L3	45.70	2	6.33	0.65
Pipe L38	45.86	2	4.56	0.47
Pipe L2	46.20	2	3.52	0.36
Pipe L12	46.52	2	6.22	0.64
Pipe L11	46.53	2	5.61	0.57
Pipe L13	46.59	2	6.10	0.62
Pipe L8	46.87	2	4.27	0.44

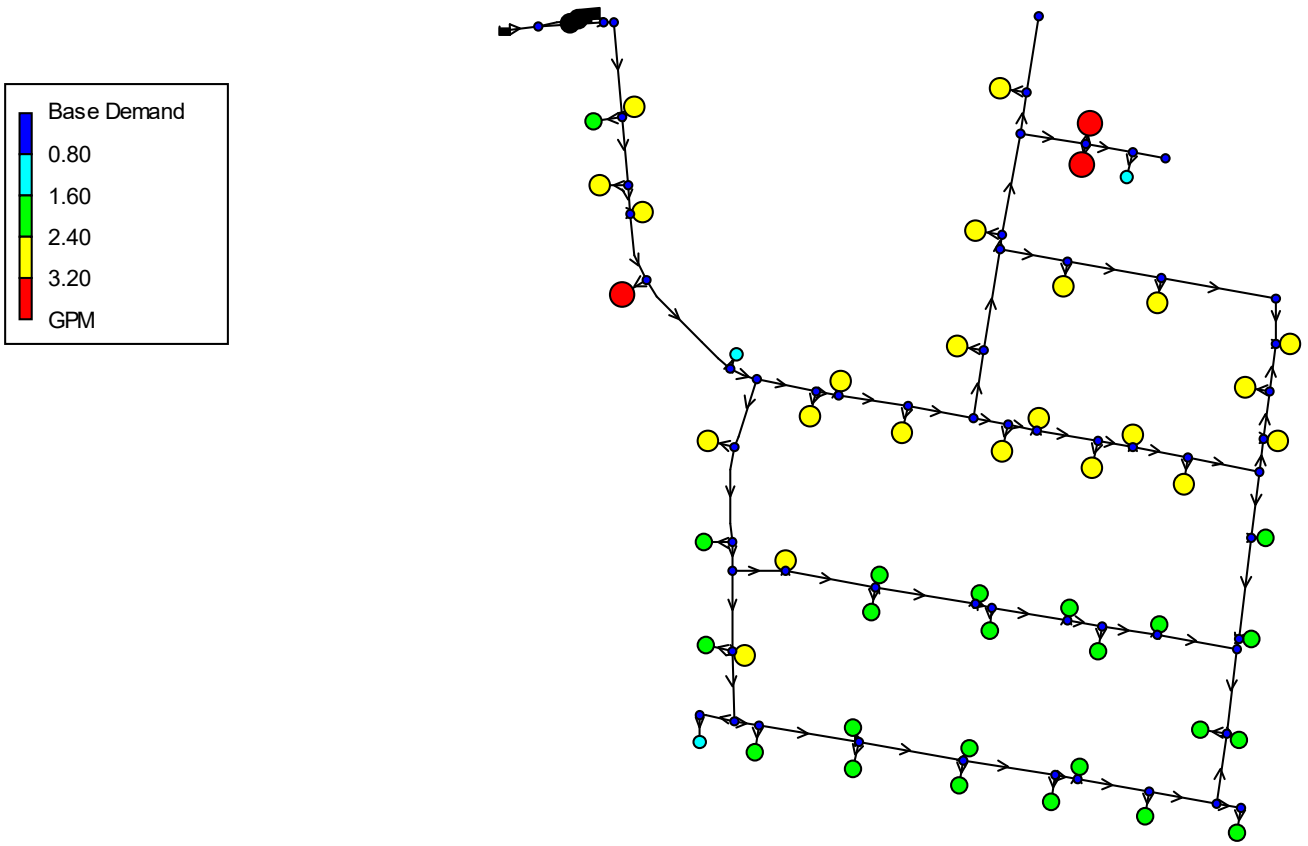
Both pumps on - Flow through pipes

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe L7	46.89	2	6.28	0.64
Pipe L9	47.33	2	4.61	0.47
Pipe 35	48.39	4	99.28	2.53
Pipe 60	49.93	6	223.60	2.54
Pipe 4	50.46	6	239.46	2.72
Pipe 28	50.94	4	43.11	1.10
Pipe 26	52.97	4	-14.71	0.38
Pipe 19	56.14	2	0.00	0.00
Pipe 30	58.05	4	31.97	0.82
Pipe 38	58.54	4	2.28	0.06
Pipe 56	59.13	4	21.63	0.55
Pipe 27	59.85	4	48.60	1.24
Pipe 15	69.75	4	5.61	0.14
Pipe 23	73.51	4	1.88	0.05
Pipe 18	79.24	2	2.73	0.28
Pipe 25	80.98	4	-9.51	0.24
Pipe 24	82.12	4	-3.34	0.09
Pipe 52	89.79	4	49.23	1.26
Pipe 57	95.68	4	17.14	0.44
Pipe 31	96.08	4	26.75	0.68
Pipe 7	100.28	4	113.77	2.90
Pipe 29	104.11	4	37.44	0.96
Pipe 51	112.58	4	-6.19	0.16
Pipe 10	112.74	4	96.67	2.47
Pipe 3	113.01	6	245.79	2.79
Pipe 17	113.20	2	17.20	1.76
Pipe 5	115.22	6	233.39	2.65
Pipe 11	115.49	4	48.07	1.23
Pipe 20	115.52	4	12.94	0.33

Both pumps on - Flow through pipes

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe 37	116.32	4	40.43	1.03
Pipe 9	116.56	4	102.35	2.61
Pipe 45	117.48	4	3.67	0.09
Pipe 47	118.70	4	-0.50	0.01
Pipe 33	120.10	4	109.83	2.80
Pipe 44	123.38	4	7.84	0.20
Pipe 32	124.71	4	20.90	0.53
Pipe 62	127.88	4	26.16	0.67
Pipe 16	129.16	4	0.00	0.00
Pipe 36	134.00	4	50.05	1.28
Pipe 58	136.15	4	12.43	0.32
Pipe 48	139.70	4	-9.76	0.25
Pipe 53	156.18	4	44.40	1.13
Pipe 42	159.01	4	16.20	0.41
Pipe 34	160.04	4	103.55	2.64
Pipe 2	160.32	6	254.90	2.89
Pipe 21	161.38	4	7.32	0.19
Pipe 40	168.65	4	33.47	0.85
Pipe 50	169.83	4	-1.50	0.04
Pipe 54	171.94	4	35.21	0.90
Pipe 12	172.01	4	41.97	1.07
Pipe 14	172.70	4	22.81	0.58
Pipe 41	178.98	4	24.64	0.63
Pipe 22	197.45	4	1.88	0.05
Pipe 59	204.63	6	226.63	2.57
Pipe 1	300	6	254.90	2.89
Pump Pump2	#N/A	#N/A	127.45	0.00
Pump Pump1	#N/A	#N/A	127.45	0.00

Pump 2 off - Base demand at nodes



Pump 2 off - Nodes

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc J.45	35	0	197.66	70.48
Junc J.46	35	0	197.66	70.48
Junc J8	35	0	197.65	70.47
Junc J.17	35	0	197.67	70.48
Junc J18	35	0	197.66	70.48
Junc J12	35	0	197.66	70.48
Junc J.11	35	0	197.65	70.47
Junc J.47	35	0	197.67	70.48
Junc J13	35	0	197.67	70.48
Junc J.48	35	0	197.67	70.48
Junc J.14.15	35	0	197.42	70.37
Junc J.16	35	0	197.41	70.37
Junc J11	35	0	197.41	70.37
Junc J.12	35	0	197.67	70.48
Junc J.20	35	0	198.20	70.71
Junc J.21	35	0	197.98	70.62
Junc J10	35	0	197.79	70.54
Junc J.6	36	0	198.57	70.44
Junc J4	35	0	198.52	70.85
Junc J.19	35	0	198.29	70.75
Junc J.13	35	0	197.73	70.51
Junc J.25	35	0	197.70	70.50
Junc J.26	35	0	197.68	70.49
Junc J9	35	0	197.67	70.49
Junc J.22	35	0	197.76	70.52
Junc J.23	35	0	197.74	70.52
Junc J.24	35	0	197.71	70.50
Junc J.49	35	0	197.67	70.48

Pump 2 off - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc J.41	35	0	197.67	70.48
Junc J.42	35	0	197.67	70.48
Junc J.43	35	0	197.66	70.48
Junc J6	36	0	197.76	70.09
Junc J.37.38	35	0	197.70	70.50
Junc J.39.40	35	0	197.68	70.49
Junc J.50.51	35	0	197.66	70.48
Junc J7	35	0	197.65	70.47
Junc J2	43	0	199.82	67.95
Junc J1	43	0	34.99	-3.47
Junc J.44	35	0	197.66	70.48
Junc J15	35	0	197.66	70.48
Junc J3	40	0	199.39	69.06
Junc J.36	36	0	197.74	70.08
Junc J.32	35	0	197.69	70.49
Junc J.31	35	0	197.71	70.50
Junc J.30	35	0	197.71	70.50
Junc J14	35	0	197.67	70.48
Junc J.34	35	0	197.67	70.49
Junc J.33	35	0	197.68	70.49
Junc J.28.29	35	0	197.76	70.52
Junc J.7	35	0	198.26	70.74
Junc J.8	35	0	197.95	70.61
Junc J.35	36	0	197.76	70.09
Junc J.27	35	0	197.82	70.55
Junc J5	35	0	197.86	70.57
Junc J.9.10	35	0	197.80	70.54
Junc J.1.2	39	0	199.16	69.40
Junc J.3	38	0	199.01	69.77

Pump 2 off - Nodes

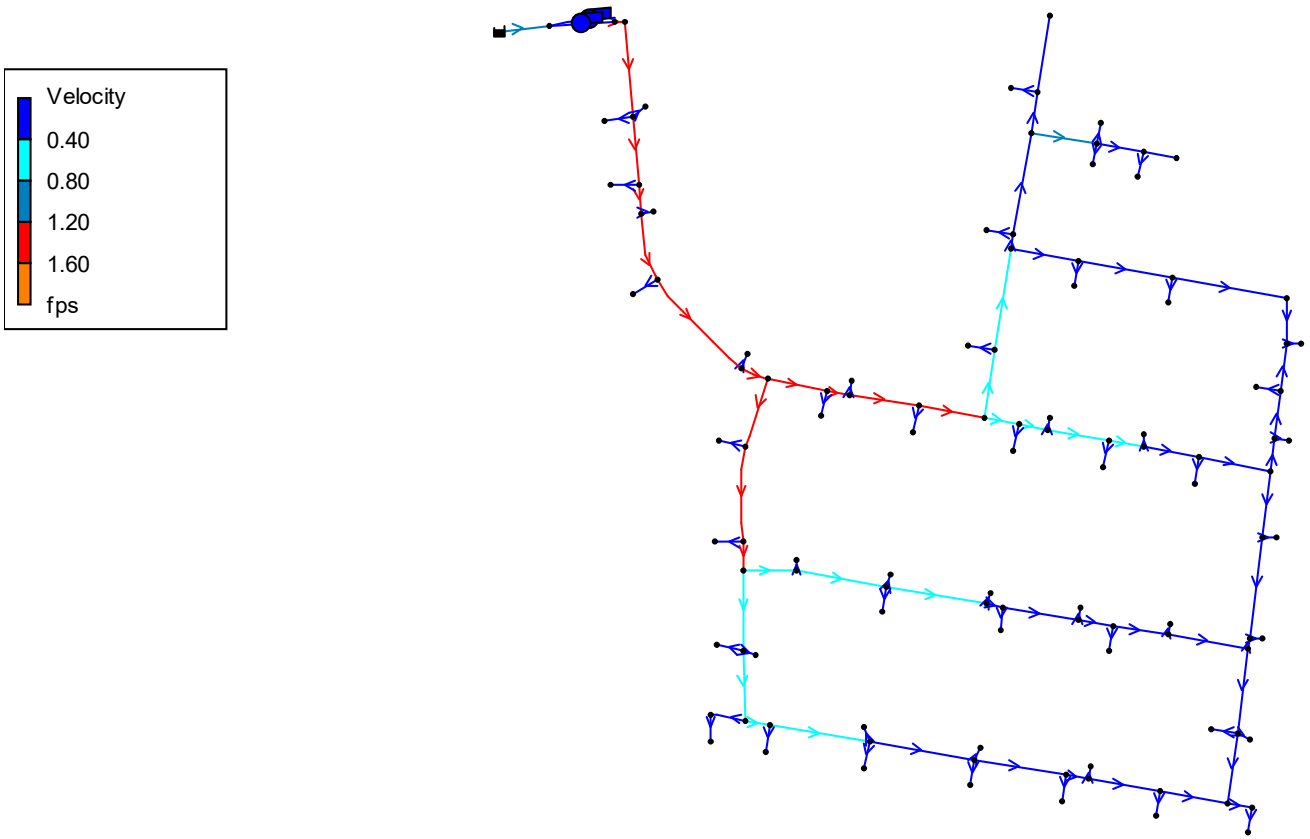
Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc J.5	37	0	198.81	70.11
Junc J.4	38	0	198.95	69.74
Junc C35	36	1.14	197.75	70.09
Junc C16	35	1.365	197.41	70.37
Junc C6	36	1.515	198.57	70.44
Junc C2	39	1.76	199.16	69.40
Junc C43	35	2.085	197.66	70.48
Junc C39	35	2.085	197.67	70.49
Junc C41	35	2.085	197.66	70.48
Junc C44	35	2.085	197.66	70.48
Junc C49	35	2.085	197.66	70.48
Junc C42	35	2.095	197.66	70.48
Junc C37	35	2.135	197.70	70.50
Junc C40	35	2.135	197.67	70.49
Junc C8	35	2.135	197.94	70.60
Junc C28	35	2.205	197.75	70.52
Junc C31	35	2.245	197.70	70.50
Junc C33	35	2.245	197.67	70.49
Junc C51	35	2.25	197.66	70.48
Junc C32	35	2.265	197.68	70.49
Junc C30	35	2.28	197.71	70.50
Junc C38	35	2.28	197.69	70.50
Junc C9	35	2.305	197.79	70.54
Junc C36	36	2.34	197.73	70.08
Junc C48	35	2.345	197.66	70.48
Junc C34	35	2.355	197.67	70.48
Junc C50	35	2.38	197.66	70.48
Junc C29	35	2.39	197.75	70.52
Junc C27	35	2.415	197.82	70.55

Pump 2 off - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc C10	35	2.505	197.79	70.54
Junc C47	35	2.6	197.66	70.48
Junc C45	35	2.61	197.66	70.48
Junc C25	35	2.61	197.69	70.49
Junc C20	35	2.64	198.20	70.71
Junc C18	35	2.72	197.65	70.48
Junc C24	35	2.735	197.70	70.50
Junc C22	35	2.745	197.75	70.52
Junc C1	39	2.795	199.16	69.40
Junc C11	35	2.805	197.63	70.47
Junc C17	35	2.81	197.66	70.48
Junc C23	35	2.835	197.73	70.51
Junc C21	35	2.84	197.97	70.61
Junc C26	35	2.925	197.67	70.48
Junc C4	38	3.035	198.94	69.74
Junc C13	35	3.05	197.72	70.51
Junc C19	35	3.07	198.27	70.75
Junc C46	35	3.085	197.65	70.48
Junc C12	35	3.11	197.65	70.48
Junc C7	35	3.14	198.24	70.73
Junc C3	38	3.165	199.00	69.76
Junc C5	37	3.38	198.79	70.10
Junc C15	35	3.57	197.40	70.37
Junc C14	35	3.665	197.40	70.37
Resvr 1	35	#N/A	35.00	0.00

Pump 2 off - Flow through pipes

Day 1, 12:



Pump 2 off - Flow through pipes

Network Table - Links

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe 6	15	8	127.45	0.81
Pipe L34	18.66	2	2.36	0.24
Pipe L27	18.66	2	2.41	0.25
Pipe L30	19.39	2	2.28	0.23
Pipe L29	19.48	2	2.39	0.24
Pipe L32	19.69	2	2.27	0.23
Pipe L4	20.33	2	3.03	0.31
Pipe L25	20.77	2	2.61	0.27
Pipe 49	20.81	4	1.33	0.03
Pipe L23	21.23	2	2.84	0.29
Pipe L10	21.42	2	2.50	0.26
Pipe L42	21.54	2	2.10	0.21
Pipe L48	21.94	2	2.35	0.24
Pipe L49	22.04	2	2.09	0.21
Pipe 13	22.18	4	14.52	0.37
Pipe L47	22.41	2	2.60	0.27
Pipe L45	22.85	2	2.61	0.27
Pipe L20	23.13	2	2.64	0.27
Pipe L6	23.47	2	1.51	0.15
Pipe L51	23.64	2	2.25	0.23
Pipe L40	24.37	2	2.13	0.22
Pipe L37	25.56	2	2.13	0.22
Pipe L1	27.59	2	2.80	0.29
Pipe 61	27.92	4	15.32	0.39
Pipe L15	32.74	2	3.57	0.36
Pipe L14	35.38	2	3.66	0.37
Pipe 43	37.51	4	6.02	0.15
Pipe L16	40.12	2	1.37	0.14

Pump 2 off - Flow through pipes

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe L31	41.04	2	2.24	0.23
Pipe L33	41.57	2	2.24	0.23
Pipe 8	41.61	4	53.82	1.37
Pipe 46	41.79	4	2.09	0.05
Pipe L76	41.97	2	2.81	0.29
Pipe L44	42.03	2	2.09	0.21
Pipe L28	42.11	2	2.21	0.23
Pipe 39	43.53	4	19.08	0.49
Pipe L43	43.57	2	2.09	0.21
Pipe L77	43.97	2	2.72	0.28
Pipe L21	44.01	2	2.84	0.29
Pipe L35	44.08	2	1.14	0.12
Pipe L41	44.26	2	2.09	0.21
Pipe L46	44.33	2	3.09	0.32
Pipe L39	44.33	2	2.09	0.21
Pipe L26	44.34	2	2.93	0.30
Pipe L36	44.40	2	2.34	0.24
Pipe L19	44.46	2	3.07	0.31
Pipe L24	44.52	2	2.74	0.28
Pipe L22	44.88	2	2.75	0.28
Pipe L5	45.19	2	3.38	0.35
Pipe L50	45.53	2	2.38	0.24
Pipe L3	45.70	2	3.16	0.32
Pipe L38	45.86	2	2.28	0.23
Pipe L2	46.20	2	1.76	0.18
Pipe L12	46.52	2	3.11	0.32
Pipe L11	46.53	2	2.81	0.29
Pipe L13	46.59	2	3.05	0.31
Pipe L8	46.87	2	2.13	0.22

Pump 2 off - Flow through pipes

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe L7	46.89	2	3.14	0.32
Pipe L9	47.33	2	2.31	0.24
Pipe 35	48.39	4	49.64	1.27
Pipe 60	49.93	6	111.80	1.27
Pipe 4	50.46	6	119.73	1.36
Pipe 28	50.94	4	21.55	0.55
Pipe 26	52.97	4	-7.35	0.19
Pipe 19	56.14	2	0.00	0.00
Pipe 30	58.05	4	15.98	0.41
Pipe 38	58.54	4	1.14	0.03
Pipe 56	59.13	4	10.81	0.28
Pipe 27	59.85	4	24.30	0.62
Pipe 15	69.75	4	2.81	0.07
Pipe 23	73.51	4	0.94	0.02
Pipe 18	79.24	2	1.37	0.14
Pipe 25	80.98	4	-4.75	0.12
Pipe 24	82.12	4	-1.67	0.04
Pipe 52	89.79	4	24.61	0.63
Pipe 57	95.68	4	8.57	0.22
Pipe 31	96.08	4	13.37	0.34
Pipe 7	100.28	4	56.89	1.45
Pipe 29	104.11	4	18.72	0.48
Pipe 51	112.58	4	-3.10	0.08
Pipe 10	112.74	4	48.34	1.23
Pipe 3	113.01	6	122.90	1.39
Pipe 17	113.20	2	8.60	0.88
Pipe 5	115.22	6	116.70	1.32
Pipe 11	115.49	4	24.04	0.61
Pipe 20	115.52	4	6.47	0.17

Pump 2 off - Flow through pipes

Link ID	Length ft	Diameter in	Flow GPM	Velocity fps
Pipe 37	116.32	4	20.22	0.52
Pipe 9	116.56	4	51.18	1.31
Pipe 45	117.48	4	1.84	0.05
Pipe 47	118.70	4	-0.25	0.01
Pipe 33	120.10	4	54.91	1.40
Pipe 44	123.38	4	3.92	0.10
Pipe 32	124.71	4	10.45	0.27
Pipe 62	127.88	4	13.08	0.33
Pipe 16	129.16	4	0.00	0.00
Pipe 36	134.00	4	25.03	0.64
Pipe 58	136.15	4	6.21	0.16
Pipe 48	139.70	4	-4.88	0.12
Pipe 53	156.18	4	22.20	0.57
Pipe 42	159.01	4	8.10	0.21
Pipe 34	160.04	4	51.77	1.32
Pipe 2	160.32	6	127.45	1.45
Pipe 21	161.38	4	3.66	0.09
Pipe 40	168.65	4	16.74	0.43
Pipe 50	169.83	4	-0.75	0.02
Pipe 54	171.94	4	17.60	0.45
Pipe 12	172.01	4	20.99	0.54
Pipe 14	172.70	4	11.41	0.29
Pipe 41	178.98	4	12.32	0.31
Pipe 22	197.45	4	0.94	0.02
Pipe 59	204.63	6	113.32	1.29
Pipe 1	300	6	127.45	1.45
Pump Pump2	#N/A	#N/A	0.00	0.00
Pump Pump1	#N/A	#N/A	127.45	0.00

APPENDIX E

Pump and Meter O&M Manuals

TEL (801) 394-4515 • FAX (801) 392-7544 • 5746 South 1475 East • Ogden, Utah 84403 • www.greatbasinengineering.com

CR, CRI, CRN, CRT

Installation and operating instructions

be
think
innovate

GRUNDFOS

Table of contents

Original installation and operating instructions

CONTENTS

Read this document before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Limited warranty

Products manufactured by Grundfos Pumps Corporation (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges that may arise in connection with a warranty claim.

Products which are sold, but not manufactured by Grundfos, are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty.

Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions and accepted codes of good practice. The warranty does not cover normal wear and tear.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

Grundfos will not be liable for any incidental or consequential damages, losses, or expenses arising from installation, use, or any other causes. There are no express or implied warranties, including merchantability or fitness for a particular purpose, which extend beyond those warranties described or referred to above. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

Products which are repaired or replaced by Grundfos or authorized service center under the provisions of these limited warranty terms will continue to be covered by Grundfos warranty only through the remainder of the original warranty period set forth by the original purchase date.

2. General information

2.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

2.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

3. Introduction

The CR range is based on the inline multistage centrifugal pump first pioneered by Grundfos. CR is available in four basic materials and over one million configurations. CR is suitable for pumping water and water-like liquids in industry, petrochemical plants, water treatment plants, commercial buildings, and many other applications. Some of the outstanding characteristics of CR are:

- superior efficiency
- reliability
- easy maintenance
- compact size and small footprint
- quiet operation.

4. Receiving the product

4.1 Transporting the product

WARNING

Falling objects

Death or serious personal injury
- Keep the product in a stable and fixed position during transportation.
- Wear personal protective equipment.

4.2 Receiving the product

WARNING

Falling objects

Death or serious personal injury
- Keep the product in a stable and fixed position during unpacking.
- Wear personal protective equipment.

4.3 Lifting instructions

WARNING

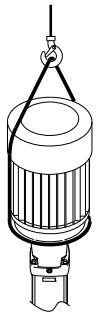
Falling objects

Death or serious personal injury
- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

Do not use the lifting eyes of the motor for lifting the entire pump and motor assembly.

Note that typically the centre of gravity of the pump is close to the motor.

Lift pump assembly with lifting straps that pass through the motor stool. Ensure that the load is not applied to the pump shaft.



TM04 0339 0608

Fig. 1 Correct lifting of a CR pump

4.4 Inspecting the product

Before you install the product, do the following:
- Check that the product is as ordered.
- Check that no visible parts have been damaged during shipment.
- Ensure that the pump is NOT dropped or mishandled.

If parts are damaged or missing, contact your local Grundfos sales company.

The packing in which your pump arrived is specially designed for your pump to prevent damage during shipment. As a precaution, leave the pump in the packing until you are ready to install it.
Installing the product

4.5 Ensure you have the right pump

Check the pump nameplate to make sure that it is the one you ordered.
- **CR:** Centrifugal pump; all parts in contact with the pumped liquid are made of standard cast iron and AISI 304 stainless steel
- **CRI:** Centrifugal pump; all parts in contact with the pumped liquid are made of AISI 304 stainless steel
- **CRN:** Centrifugal pump; all parts in contact with the pumped liquid are made of AISI 316 stainless steel
- **CRT:** Centrifugal pump; all parts in contact with the pumped liquid are made of titanium
- **CRE:** Centrifugal pump with a Grundfos MLE variable frequency drive motor.

4.6 Pump end without motor

If the shipment consists of a complete unit (motor attached to pump end), the position of the coupling connecting the pump shaft to the motor shaft is set to factory specifications. No adjustment is required.

If the shipment is a pump end without motor, follow the adjustment procedures in section *15. Replacing the motor*.

Pump without motor (CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20 only)

If you purchased a pump end without motor, the shaft seal has been set from factory. Do not loosen the three set screws on the shaft seal when attaching the motor.

Pump without motor (CR, CRN 32, 45 and 64 only)

If you purchased a pump end without motor, you must install the shaft seal. The shaft seal is protected in its own box inside the pump packing crate. To protect the shaft and bearings during shipment, a transport protector is used. Remove the transport protector prior to installation of the shaft seal. Read the seal installation instructions which are included in the pump packing.

4.7 Drive-end motor bearing

Make sure to use the correct type of drive-end (DE) motor bearing for the bare-shaft pump. Please check the specific pump range and pump version stated on the nameplate and select the corresponding DE bearing.

DE bearing CR 1-64 pump range

Pump version[1]		Deep-groove ball bearing (62/63xx)	Angular contact bearing (73xx)
A	Standard pump	0.33 - 10 HP	15 - 60 HP
T	Pump with thrust handling device (THD)[2]	-	-
Z	Pump with bearing flange[2]	0.33 - 60 HP	Not allowed

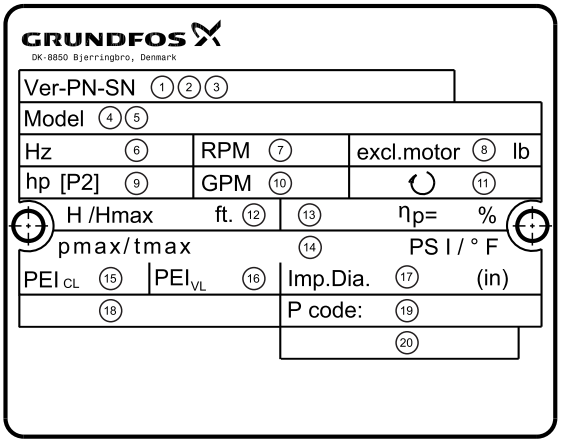
[1] Refer to the codes for pump version in section *5.2 Type keys*.

[2] Factory product variants (FPV).

5. Identification

5.1 Nameplate data

The information on the pump nameplate is described below.



TM07 5722 5019

Fig. 2 Nameplate example

Pos.	Description
1	Version
2	Product number
3	Serial number
4	Model
5	Type designation
6	Frequency
7	Rated speed
8	Weight excluding motor
9	Motor-rated power output
10	Rated flow rate
11	Direction of rotation CCW: Counterclockwise CW: Clockwise
12	Head at rated flow rate / Maximum head
13	Hydraulic efficiency at rated flow rate
14	Maximum system pressure / Maximum liquid temperature. Note: This field may have two sets of data.
15	Pump Energy Index, constant load
16	Pump Energy Index, variable load
17	Impeller diameter
18	External reference (Other Equipment Manufacturer number)
19	Production code
20	Country of origin
21	Approval marks

5.2 Type keys

5.2.1 CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20

Example	CR	3-	10	A	FG	A	E	HQQE
Type range: CR, CRI, CRN								
Rated flow rate in [m^3/h] (x 5 gpm)								
Number of impellers								
Code for pump version								
Code for pipe connection								
Code for materials								
Code for rubber parts								
Code for shaft seal								

5.2.2 CR, CRN 32, 45 and 64

Example	CR	32-	2-	1	A	G	A	E	KUBE
Pump range: CR, CRN									
Rated flow rate in [m^3/h] (x 5 gpm)									
Number of impellers									
Number of reduced-diameter impellers									
Code for pump version									
Code for pipe connection									
Code for materials									
Code for rubber parts									
Code for shaft seal									

5.2.3 CRT 2, 4, 8, and 16

Example	CRT	16-	30	/2	A	G	A	AUUE
Pump range: CRT								
Rated flow rate in [m^3/h] (x 5gpm)								
Number of stages x 10								
Code for impellers (used only if the pump has fewer impellers than stages)								
Code for pump version								
Code for pipe connection								
Code for materials								
Code for shaft seal and rubber parts								

5.2.4 Codes

Example		A	-G	-A	-E	-H	QQ	E
Pump version								
A	Basic version[1)]							
B	Oversize motor							
E	Certificate/approval							
F	CR pump for high temperatures (air-cooled top assembly)							
H	Horizontal version							
HS	High-pressure pump with high-speed MLE motor							
I	Different pressure rating							
J	Pump with different max. speed							
K	Pump with low NPSH							
M	Magnetic drive							
N	Fitted with sensor							
P	Undersize motor							
R	Horizontal version with bearing bracket							
SF	High-pressure pump							
T	Oversize motor (two flange sizes bigger)							
U	NEMA version[1)]							
X	Special version[2)]							
Pipe connection								
A	Oval flange, Rp thread							
B	Oval flange, NPT thread							
CA	FlexiClamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)							
CX	Triclamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)							
F	DIN flange							
G	ANSI flange							
J	JIS flange							
N	Changed diameter of ports							
P	PJE coupling							
X	Special version							
Materials								
A	Basic version							
D	Carbon-graphite filled PTFE (bearings)							
G	Wetted parts, AISI 316							
GI	All parts stainless steel, wetted parts, AISI 316							
I	Wetted parts, AISI 304							
II	All parts stainless steel, wetted parts, AISI 304							
K	Bronze (bearings)							
S	SiC bearings + PTFE neck rings							
X	Special version							
Code for rubber parts								
E	EPDM							
F	FXM							
K	FFKM							
V	FKM							

Example		A	-G	-A	-E	-H	QQ	E
Shaft seal								
A	O-ring seal with fixed driver							
B	Rubber bellows seal							
E	Cartridge seal with O-ring							
H	Balanced cartridge seal with O-ring							
K	Metal bellows cartridge seal							
O	Double seal, back-to-back							
P	Double seal, tandem							
X	Special version							
B	Carbon, synthetic resin-impregnated							
H	Cemented tungsten carbide, embedded (hybrid)							
Q	Silicon carbide							
U	Cemented tungsten carbide							
X	Other ceramics							
E	EPDM							
F	FXM							
K	FFKM							
V	FKM							

[1] In August 2003 the NEMA version pump code was discontinued for all material numbers created by Grundfos manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or a U as the pump version code depending on the date the material number was created.

[2] If a pump incorporates more than two pump versions, the code for the pump version is X. X also indicates special pump versions not listed above.

6. Applications

Compare the pump's nameplate data or its performance curve with the application in which you plan to install it. Make sure the application falls within the following limits.

Type	Application/liquid
CR	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal liquids.
CRI/CRN	Deionized, demineralized and distilled water. Brackish water and other liquids unsuitable for contact with iron or copper alloys. (Consult manufacturer for specific liquid compatibilities.)
CRN-SF	High-pressure washdown, reverse osmosis or other high-pressure applications.
CRT	Salt water, chloride based liquids and liquids approved for titanium.

7. Operating conditions

7.1 Ambient temperature and altitude

If the ambient temperature exceeds the maximum temperature limits of the pump or the pump is installed at an altitude exceeding the altitude values in the chart below, the motor must not be fully loaded due to the risk of overheating.

Overheating may result from excessive ambient temperatures or the low density and consequently low cooling effect of the air at high altitudes. In such cases, it may be necessary to use a motor with a higher rated output (P_2).

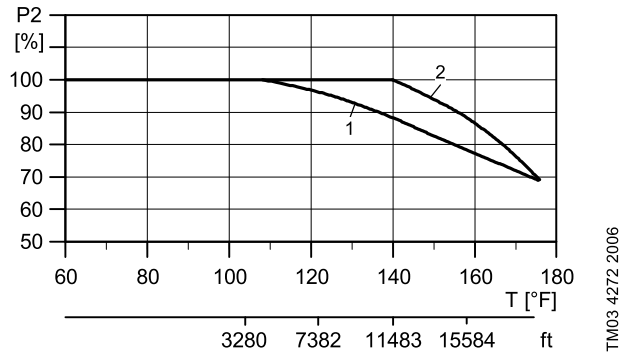


Fig. 3 Relationship between motor output (P_2) and ambient temperature/altitude

Legend

Pos.	Description
1	NEMA standard-efficiency motors
2	NEMA premium-efficiency motors

Example: From fig. 3 it appears that P_2 must be reduced to 88 % when a pump with a NEMA premium-efficiency ML motor is installed 15,584 feet above sea level. At an ambient temperature of 167 °F, P_2 of a standard-efficiency motor must be reduced to 74 % of rated output.

In cases where both the maximum temperature and the maximum altitude are exceeded, the derating factors must be multiplied. Example: 0.89 x 0.89 = 0.79.

7.2 Liquid temperatures

Pump	Liquid temperature
CR, CRI, CRN 1s, 3, 5, 10, 15, and 20	-4 to +248 °F (-20 to +120 °C)
CR, CRN 32, 45 and 64*	-22 to +248 °F (-30 to +120 °C)
CRT 2, 4, 8, 16	-4 to +248 °F (-20 to +120 °C)
CRN-SF	-4 to +221 °F (-15 to +105 °C)
Pumps with Cool-Top™	up to 356 °F (180 °C)

All motors are designed for continuous duty in 104 °F (40 °C) ambient air conditions. For higher ambient temperature conditions, consult Grundfos.

* We recommend xUBE shaft seals for temperatures above 200 °F. Pumps with KUHE hybrid shaft seals can only operate up to 200 °F (90 °C). Pumps with xUUE shaft seals can be operated down to -40 °F (-40 °C). ("x" is the seal type).

Maximum water temperature for NSF 61 drinking water applications is limited to 73 °F (23 °C).

7.3 Minimum inlet pressures

All CR, CRI, CRN	NPSHR + 2 feet
CRN-SF	29 psi (2 bar)

7.4 Maximum inlet pressures

Pump type	Stages		Max. [psi (bar)]
	60 Hz	50 Hz	
CR, CRI, CRN 1s	2-27	2-36	145 (10)
CR, CRI, CRN 1	2-25	2-36	145 (10)
	27		217 (15)
CR, CRI, CRN 3	2-17	2-29	145 (10)
	19-25	31-36	217 (15)
CR, CRI, CRN 5	2-9	3-16	145 (10)
	10-24	18-36	217 (15)
CR, CRI, CRN 10	1-5	1-6	116 (8)
	6-17	7-22	145 (10)
CR, CRI, CRN 15	1-2	1-3	116 (8)
	3-12	4-17	145 (10)
CR, CRI, CRN 20	1	1-3	116 (8)
	2-10	4-17	145 (10)
CR, CRN 32	1-1 - 2	1-1 - 4	58 (4)
	3-2 - 6	5-2 - 10	145 (10)
	7-2 - 11-2	11-14	217 (15)
CR, CRN 45	1-1 - 1	1-1 - 2	58 (4)
	2-2 - 3	3-2 - 5	145 (10)
	4-2 - 8-1	6-2 - 13-2	217 (15)
CR, CRN 64	1-1	1-1 - 2-2	58 (4)
	1 - 2-1	2-1 - 4-2	145 (10)
	2 - 5-2	4-1 - 8-1	217 (15)
CRT 2	2-6	2-11	145 (10)
	7-18	13-26	217 (15)
CRT 4	1-7	1-12	145 (10)
	8-16	14-22	217 (15)
CRT 8	1-16	1-20	145 (10)
CRT 16	2-10	2-16	145 (10)
CRN-SF	all	all	72 (5)* 362 (25)**

* While pump is off or during start-up.

** During operation.

7.5 Maximum operating pressures

250 °F (194 °F for CRN-SF)

Pump type/ connection	Stages		Max. [psi (bar)]
	60 Hz	50 Hz	
CR, CRI, CRN 1s			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 1			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 3			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 5			
Oval flange	1-16	1-22	232 (16)
FGJ, PJE	1-24	1-36	362 (25)
CR, CRI 10			
Oval flange CR	1-6		145 (10)
Oval flange, CRI	1-10	1-16	232 (16)
FGJ, GJ, PJE	1-10	1-16	232 (16)
FGJ, GJ, PJE	12-17	17-22	362 (25)
CRN 10			
All	1-17	1-22	362 (25)
CR, CRI 15			
Oval flange	1-5	1-7	145 (10)
FGJ, GJ, PJE	1-8	1-10	232 (16)
FGJ, GJ, PJE	9-12	12-17	362 (25)
CRN 15			
All	1-12	1-17	362 (25)
CR, CRI 20			
Oval flange	1-5	1-7	145 (10)
FGJ, GJ, PJE	1-7	1-10	232 (16)
FGJ, GJ, PJE	8-10	12-17	362 (25)
CRN 20			
All	1-10	1-17	362 (25)
CR, CRN 32			
	1-1 - 5	1-1 - 7	232 (16)
	6-2 - 11-2	8-2 - 14	435 (30)
CR, CRN 45			
	1-1 - 4-2	1-1 - 5	232 (16)
	4-2 - 8-1	6-2 - 13-2	435 (30)
CR, CRN 64			
	1-1 - 3	1-1 - 5	232 (16)
	4-2 - 5-2	6-2 - 8-1	435 (30)
CRT 2	2-18	2-26	305 (21)
CRT 4	1-16	1-22	305 (21)
CRT 8			
	1-8	1-12	232 (16)
	10-16	14-20	362 (25)
CRT 16			
	1-8	1-8	232 (16)
	10-12	10-16	362 (25)

Consult Grundfos in case of other operating conditions.

8. Mechanical installation

WARNING

Contamination when pumping drinking water

Death or serious personal injury

- Before the pump is used for supplying drinking water, flush the pump thoroughly with clean water.
- Do not use the pump for drinking water if the internal parts have been in contact with particles or substances not suitable for water intended for human consumption.

The pump must be installed according to national water regulations and standards.

8.1 Lifting the product

WARNING

Falling objects

Death or serious personal injury

- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

For lifting instructions, see section *4.3 Lifting instructions*.

8.2 Pump location

Locate the pump in a dry, well-ventilated, frost-free area which is not subject to extreme variation in temperature.

Make sure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces.

The motor requires an adequate air supply to prevent overheating and adequate vertical space to remove the motor for repair.

In open systems requiring suction lift, locate the pump as close to the liquid source as possible to reduce friction loss in pipes.

8.3 Outside installation

Grundfos recommends that pumps installed outside have rain cover for the motor and remove, at a minimum, one of the motor drain plugs. Failure to remove a motor drain plug will result in condensation in the motor and cause motor damage or failure. Grundfos recommends that you consult the motor manufacturer's installation and operation instructions.

8.4 Foundation

Use concrete or similar foundation material to provide a secure, stable mounting base for the pump.

See table below for bolt hole center line dimensions for the various pump types.

Secure the pump to the foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported (uneven surfaces can result in pump base breakage when mounting bolts are tightened).

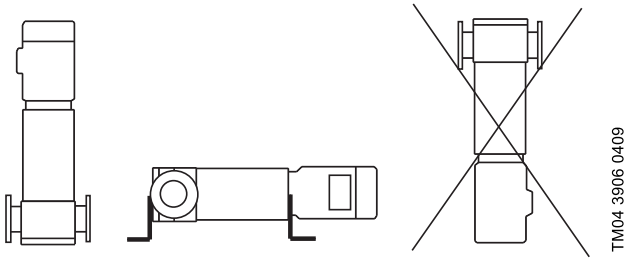


Fig. 4 Pump position

The pump can be installed vertically or horizontally. See fig. 4.

Ensure that an adequate supply of cool air reaches the motor cooling fan. The motor must never fall below the horizontal plane.

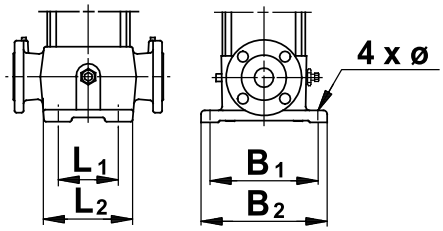
Arrows on the pump base show the direction of flow of liquid through the pump.

To minimize possible noise from the pump, it is advisable to fit expansion joints on either side of the pump and anti-vibration mountings between the foundation and the pump.

Make sure the vent plug is located in the uppermost position.

Fit isolating valves on either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.

Base and bolt hole center line dimensions



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Pump type	L1		L2		B1		B2		ø	
	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]
CR 1s, 1, 3, 5	3 15/16	100	5 11/16	145	7 1/16	180	8 11/16	220	1/2	13
CRI, CRN 1s 1, 3, 5 CRT 2, 4	3 15/16	100	5 7/8	150	7 1/16	180	8 11/16	220	1/2	13
CR 10, 15, 20	5 1/8	130	6 15/16	176	8 7/16	215	10 1/16	256	9/16	13.5
CRN 10, 15, 20 CRT 8, 16	5 1/8	130	7 7/8	200	8 7/16	215	9 3/4	248	1/2	13
CR 32	6 11/16	170	8 3/4	223	9 7/16	240	11 3/4	298	9/16	14
CRN 32	6 11/16	170	8 7/8	226	9 7/16	240	11 3/4	298	9/16	14
CR 45, 64	7 1/2	190	9 3/4	248	10 1/2	266	13 1/16	331	9/16	14
CRN 45, 64	7 1/2	190	9 7/8	251	10 1/2	266	13 1/16	331	9/16	14

8.5 Pump mounting

WARNING

Pressurised system

Death or serious personal injury

- The pumps are shipped with covered inlet and outlet ports. Remove the covers before the pipes are connected to the pump.

8.5.1 Recommended installation torques

Pump type	Recommended foundation torque [ft-lbs]	Recommended flange torque [ft-lbs]
CR, CRI, CRN 1s/1/3/5 CRT 2/4	30	37-44
CR, CRI, CRN 10/15/20 CRT 8/16	37	44-52
CR, CRN 32/45/64	52	52-59

8.6 Inlet pipe

The inlet pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum (minimum of four pipe diameters straight run prior to the inlet flange). Avoid using unnecessary fittings, valves or accessory items. Use butterfly valves in the inlet line only when it is necessary to isolate a pump because of a flooded inlet condition. This would occur if the water source is above the pump. See fig. 5 and fig. 6. Flush piping prior to pump installation to remove loose debris.

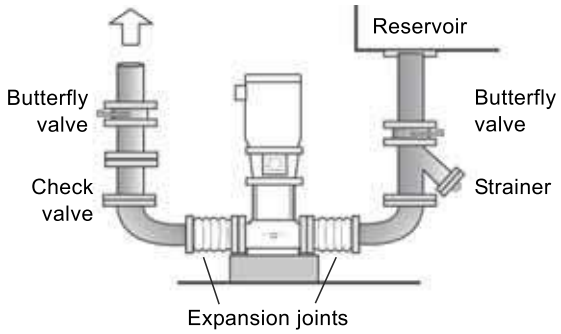


Fig. 5 Flooded inlet

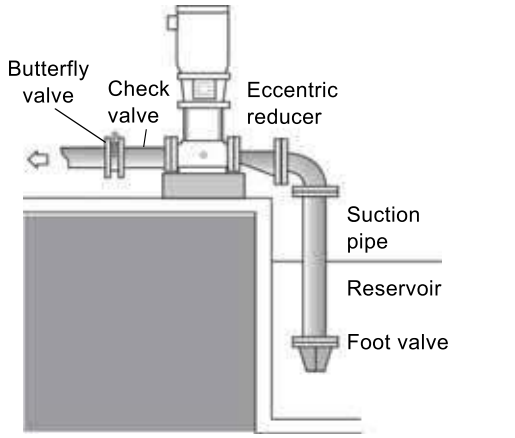


Fig. 6 Inlet lift*

* The inlet pipe should have a fitting on it for priming. CRN-SF pumps cannot be used for inlet lift.

8.6.1 Inlet pipe sizes

The following recommended inlet pipe sizes are the smallest sizes which should be used with any specific CR pump type.

Verify the inlet pipe size in each installation to ensure that good pipe practices are being observed and excess friction losses are not encountered.

High temperatures may require larger diameter pipes to reduce friction and improve NPHSA.

Pump type		Min. inlet pipe size
CR, CRI, CRN 1s, 1, 3 CRT 2	1"	Nominal diameter acc. to ANSI schedule 40
CR, CRI, CRN 5 CRT 4	1 - 1/4"	Nominal diameter acc. to ANSI schedule 40
CR, CRI, CRN 10, 15, 20 CRT 8, 16	2"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 32	2 - 1/2"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 45	3"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 64	4"	Nominal diameter acc. to ANSI schedule 40

8.7 Outlet pipe

We suggest to install a check valve and a isolating valve in the outlet pipe.

Pipe, valves and fittings should be at least the same diameter as the outlet pipe or sized in accordance with good piping practices to reduce excessive flow velocities and friction losses in pipes.

The pressure rating of pipes, valves and fittings must be equal to or greater than the maximum system pressure.

Before installing the pump, pressure check the outlet piping to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure-loss fittings, such as elbows or branch tees directly on either side of the pump. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump.

According to good installation practices, clean the system thoroughly and flush it of all foreign materials and sediment prior to pump installation. Furthermore, never install the pump at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles, we recommend that a strainer or filter is used. Grundfos recommends that pressure gauges are installed on inlet and outlet flanges or in pipes to monitor pump and system performance.

To avoid problems with water hammer, do not use quick-closing valves in CRN-SF applications.

8.8 Bypass

Install a bypass in the outlet pipe if there is any risk that the pump may operate against a closed valve in the outlet line. Flow through the pump is required to ensure that adequate cooling and lubrication of the pump is maintained. See *7.3 Minimum inlet pressures* for minimum flow rates.

Elbows should be at least 12" from the bypass opening to prevent erosion.

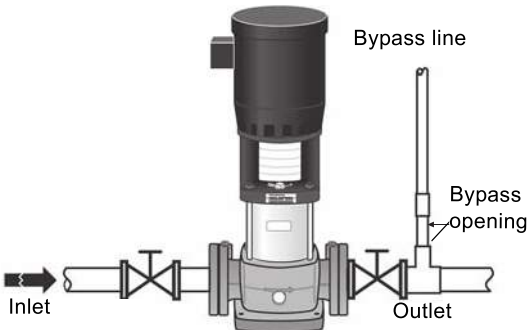


Fig. 7 Recommended bypass arrangement

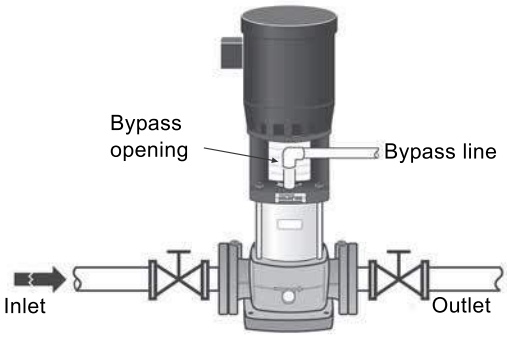


Fig. 8 Optional bypass arrangement

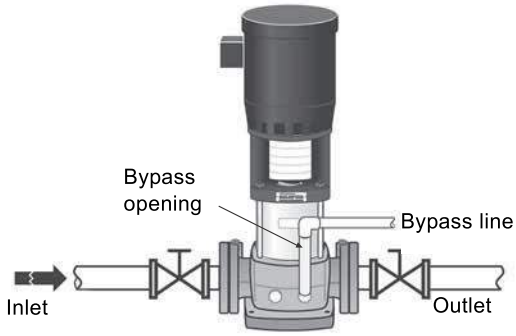
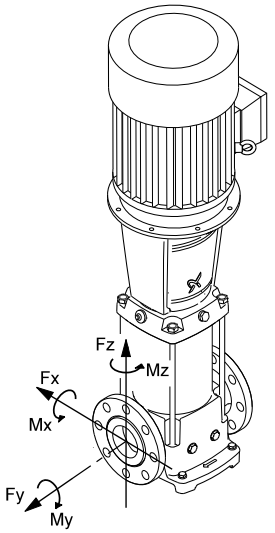


Fig. 9 Optional bypass arrangement for CR, CRN 32, 45 and 64

8.9 Flange forces and torques

If not all loads reach the maximum permissible value stated in the tables after fig. 10, one of these values may exceed the normal limit. Contact Grundfos for further information.



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Y-direction: Inlet/outlet

Z-direction: Direction of chamber stack

X-direction: 90 ° from inlet/outlet

Fig. 10 Flange forces [F] and torques [M]

Force limits

Flange		Pump	CR - Cast iron pump housing			CRI, CRN - Stainless steel pump housing		
ANSI [in]	DN [mm]	Type	Force, Y-direction [lb]	Force, Z-direction [lb]	Force, X-direction [lb]	Force, Y-direction [lb]	Force, Z-direction [lb]	Force, X-direction [lb]
1/ 1 1/4	25/32	1s-5	76	89	72	152	177	143
1 1/2	40	10	93	105	84	185	211	169
2	50	15, 20	127	131	114	253	261	228
2 1/2	65	32	156	177	143	312	354	287
3	80	45	211	173	190	421	346	379
4	100	64	282	228	253	565	455	506

Torque limits

Flange		Pump	CR - Cast iron pump housing			CRI, CRN - Stainless steel pump housing		
ANSI [in]	DN [mm]	Type	Torque, Y-direction [ft-lb]	Torque, Z-direction [ft-lb]	Torque, X-direction [ft-lb]	Torque, Y-direction [ft-lb]	Torque, Z-direction [ft-lb]	Torque, X-direction [ft-lb]
1/ 1 1/4	25/32	1s-5	221	129	92	443	258	184
1 1/2	40	10	295	203	148	590	406	295
2	50	15, 20	332	240	184	664	479	369
2 1/2	65	32	369	258	221	738	516	443
3	80	45	240	295	406	479	590	811
4	100	64	277	350	461	553	701	922

8.10 Minimum continuous duty flow rates [gpm]

Pump type	min. °F to 176 °F (min. °C to 80 °C)	at 210 °F (at 99 °C)	at 248 °F (at 120 °C)	at 356 °F (at 180 °C)
CR, CRI, CRN 1s	0.5	0.7	1.2	1.2*
CR, CRI, CRN 1	0.9	1.3	2.3	2.3*
CR, CRI, CRN 3	1.6	2.4	4.0	4.0*
CR, CRI, CRN 5	3.0	4.5	7.5	7.5*
CR, CRI, CRN 10	5.5	8.3	14	14*
CR, CRI, CRN 15	9.5	14	24	24*
CR, CRI, CRN 20	11	17	28	28*
CR, CRN 32	14	21	35	35*
CR, CRN 45	22	33	55	55*
CR, CRN 64	34	51	85	85*
CRT 2	1.3	2.0	3.3	N/A
CRT 4	3.0	4.5	7.5	N/A
CRT 8	4.0	6.0	10	N/A
CRT 16	8.0	12	20	N/A

* Grundfos Cool-Top® is only available in the following pump types:

Pump type	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20	CR 32	CR 45	CR 64
Standard (CR)								●	●	●
I version (CRI)	●	●	●	●	●	●	●			
N version (CRN)	●	●	●	●	●	●	●	●	●	●

8.11 Check valves

A check valve may be required on the outlet side of the pump to prevent the pump inlet pressure from being exceeded.

When a pump with no check valve is stopped because there is no demand on the system (all valves are closed), the high system pressure on the outlet side of the pump will "find" its way back to the inlet of the pump.

This is especially critical for CRN-SF applications because of the very high outlet pressures involved. As a result, most CRN-SF installations require a check valve on the outlet piping.

8.12 Temperature rise

It may sometimes be necessary to stop the flow through a pump during operation.

When the flow is stopped, the power to the pump is transferred to the pumped liquid as heat, causing a temperature rise in the liquid.

The result is risk of overheating and consequent damage to the pump. The risk depends on the temperature of the pumped liquid and for how long the pump is operating without flow. See the following temperature rise table.

Pump type	Time for temperature rise of 18 °F (10 °C)	
	Seconds	Minutes
CR 1s, 1, 3	210	3.5
CR 5	240	4.0
CR 10	210	3.5
CR 15	150	2.5
CR 20	120	2.0
CR 32, 45, 64	-	-

Conditions/reservations

The listed times are subject to the following conditions/ reservations:

- No exchange of heat with the surroundings.
- The pumped liquid is water with a specific heat capacity of 1.0 $^{Btu}/_{lb.}$ °F (4.18 $^{kJ}/_{kg}$ °C).
- Pump parts (chambers, impellers and shaft) have the same heat capacity as water.
- The water in the base and the pump head is not included.

These reservations should give sufficient safety margin against excessive temperature rise.

The maximum temperature must not exceed the pump maximum temperature rating.

9. Electrical connection

All electrical work must be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code and local codes and regulations.

Follow the instructions for the motor when carrying out the electrical connections.

WARNING

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.
- Connect the pump to an external main switch close to the pump and to a motor-protective circuit breaker or a CUE frequency converter. Make sure you can lock the main switch in OFF position (isolated). Type and requirements as specified in EN 60204-1, 5.3.2.

WARNING

Electric shock

Death or serious personal injury

- The safe operation of this pump requires that it is grounded in accordance with the National Electrical Code and local codes and regulations.
- A faulty motor or faulty wiring can cause electric shock that could be fatal, whether the motor is touched directly or the current is conducted through standing water. For this reason, safe installation and operation require proper grounding of the pump to the power supply ground (earth) terminal.
- Connect the ground conductor to the grounding screw in the terminal box and then to the ACCEPTABLE grounding point.
- In all installations, connect the above-ground metal plumbing to the power supply ground terminal as described in Article 250-80 of the National Electrical Code.

WARNING

Electric shock

Death or serious personal injury

- Connect the pump to the same protective-earth (PE) potential as the motor if both motor bearings are of the insulated type such as ceramic bearings..

Verify the power supply to make sure that the voltage, phases and frequency match those of the pump. The proper operating voltage and other electrical information appear on the motor nameplate. These motors are designed to run on - 10 %/+ 10 % of the rated nameplate voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10 % rating, i.e., a 208 V motor should be wired according to the 208 V wiring diagram. The wiring diagram can be found on either a plate attached to the motor or on a label inside the terminal box cover.

Do not operate the pump if voltage variations are greater than - 10 %/+ 10 %.

9.1 Motors

Grundfos CR pumps are supplied with heavy-duty, 2-pole (3600 rpm), ODP (open drip-proof) or TEFC (totally enclosed fan cooled), NEMA C frame motors selected to our rigid specifications.

Motors with other enclosure types and for other voltages and frequencies are available on a special-order basis.

CRN-SF pumps are supplied with an IEC (metric) type motor with a reverse thrust bearing.

If you replace the pump, but keep a motor previously used on another CR pump, be sure to read section *14. Maintaining the motor* for proper adjustment of the coupling height.

If you install the pump outside, read section *8.3 Outside installation*.

9.2 Position of terminal box

The motor terminal box can be turned to any of four positions in steps of 90 °.

To rotate the terminal box, remove the four bolts securing the motor to the pump but do not remove the coupling. Turn the motor to the desired position; replace and securely tighten the four bolts. See fig. 11.

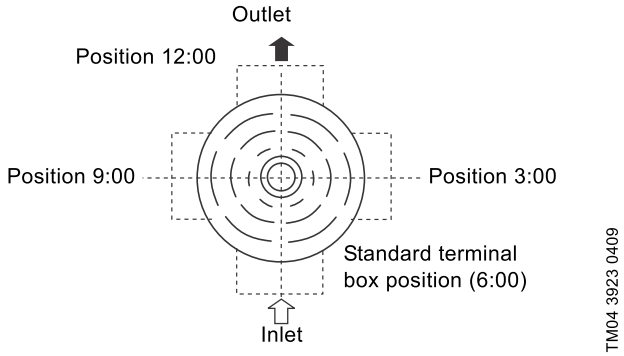

Fig. 11 Motor terminal box positions (top view)

9.3 Field wiring

Lead sizes should be based on the current carrying properties of conductors required by the latest edition of the National Electrical Code or local regulations. Direct-on-line (DOL) starting is approved due to the extremely short run-up time of the motor and the low moment of inertia of the pump and motor. If DOL starting is not acceptable and reduced starting current is required, use an auto transformer, resistance starter or soft starter. We suggest to use a fused disconnect for each pump in case standby pumps are installed.

9.4 Motor protection

9.4.1 Single-phase motors

All CR pumps with single phase motors, except 10 HP, are equipped with multi-voltage, squirrel cage induction motors which include built-in thermal protection.

9.4.2 Three-phase motors

CR pumps with three-phase motors must be used with the proper size and type of motor-protective circuit breaker to ensure the motor is protected against damage from low voltage, phase failure, current unbalance and overloads.

Use a properly sized circuit breaker with manual reset and ambient-temperature compensated extra-quick trip in all three phases. The overload protection should be set and adjusted to the full-load current rating of the motor. Under no circumstances should the overload protection be set to a higher value than the full-load current shown on the motor nameplate. This will void the warranty.

Set overload protection for auto transformers and resistance starters in accordance with the recommendations of the manufacturer.

Three-phase MLE motors (CRE-pumps) require only fuses as circuit breaker. They do not require a motor-protective circuit breaker. Check for phase unbalance (worksheet is provided. See section *20. Worksheet for three-phase motors*).

Standard allowable phase unbalance is 5 %.

9.4.3 CRN-SF

The CRN-SF is typically operated in series with a feed pump. Because the maximum allowable inlet pressure of the CRN-SF increases from 73 psi (when pump is off and during start-up) to 365 psi (during operation), use a control device to start the CRN-SF pump one second before the feed pump starts. Similarly, the CRN-SF must stop one second after the feed pump stops. See CRN-SF start-up timeline below.

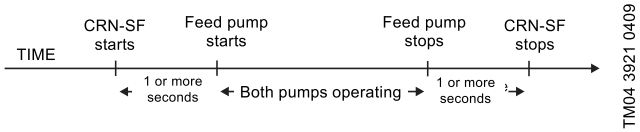

Fig. 12 CRN-SF start-up

10. Starting up the product

WARNING

Corrosive liquids

Death or serious personal injury
- Wear personal protective equipment.

WARNING

Toxic liquids

Death or serious personal injury
- Wear personal protective equipment.

CAUTION

Hot or cold liquid

Minor or moderate personal injury
- Wear personal protective equipment.
- Pay attention to the direction of the vent hole when you fill the pump with liquid and vent it.
- Make sure that no persons are hurt by the escaping liquid.

Fill the pump with liquid and vent it before you start the pump.

Pay attention to the direction of the vent hole during liquid filling and venting. Make sure that the escaping liquid does not cause damage to the motor or other components

If the pump runs dry, the pump bearings and the shaft seal may be damaged.

10.1 Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolating valve(s) and open the priming plug on the pump head. See fig. 13, fig. 14, and fig. 15.

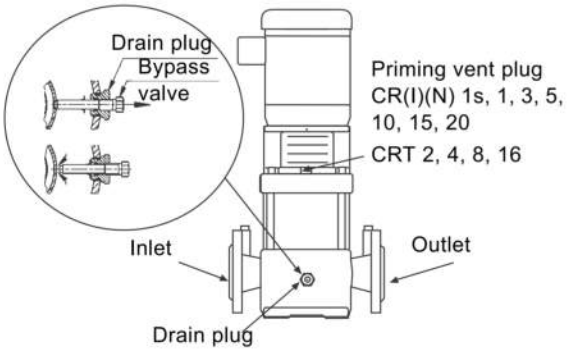

Fig. 13 Position of plugs and bypass valve

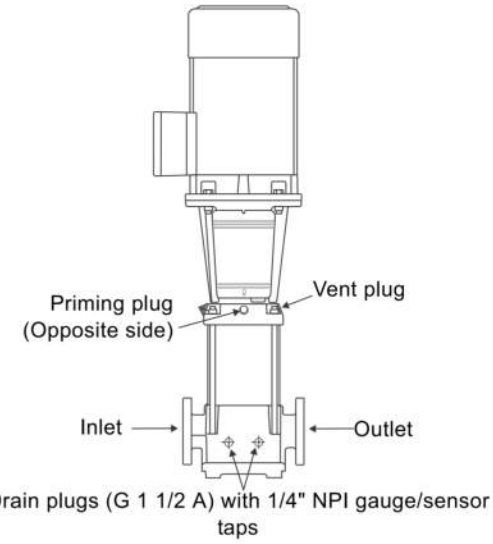

Fig. 14 Position of plugs CR, CRN 32, 45, 64

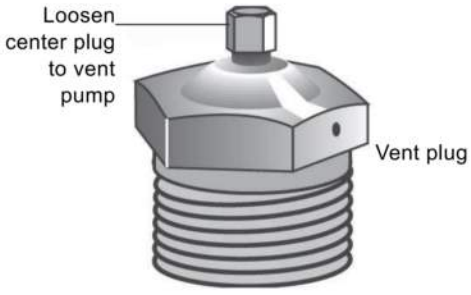

Fig. 15 Vent plug

In open systems where the water level is below the pump inlet, the inlet pipe and pump must be filled with liquid and vented before starting the pump.

1. Close the outlet isolating valve and remove the priming plug.
2. Pour water through the priming hole until the inlet pipe and pump are completely filled with liquid. If the inlet pipe does not slope downwards away from the pump, the air must be purged while priming the pump.
3. Replace the priming plug and tighten securely.

10.2 Startup instructions

1. Gradually open the isolating valve in the inlet line until a steady stream of airless water runs out of the priming hole.
2. Close the plug and tighten securely.
3. Completely open the isolating valves.

For pumps with Cool-Top®, see section *18. Startup of pump with air-cooled top (Cool-Top®)*.

Follow these steps:

1. Switch off the power supply.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to make sure it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch on the power and observe the direction of rotation. When viewed from above, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch off the power supply.
7. On three-phase motors, interchange any two phases of the power supply.
   On single-phase motors, see wiring diagram on the nameplate. Change wiring as required.
8. Switch on the power again and check for proper direction of rotation. Once direction of rotation has been verified, switch off the power again. Do not attempt to reinstall the coupling guards while the motor is on. Replace the coupling guard if the direction of rotation is correct. When the guards are in place, the power can be switched on again.

Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.

Do not start the pump before priming or venting the pump. See fig. 15. Never let the pump run dry.

For CR, CRI, CRN 1s to 5 it is advisable to open the bypass valve during start-up. See fig. 13. The bypass valve connects the inlet and outlet sides of the pump, thus making the filling procedure easier. Close the bypass valve when operation is stable.

11. Operating the product

WARNING

Contamination when pumping drinking water

Death or serious personal injury

- Do not use the pump for drinking water if the internal parts have been in contact with particles or substances not suitable for water intended for human consumption

WARNING

Airborne noise

Death or serious personal injury

- Wear personal protective equipment.

WARNING

Too high pressure and leakage

Death or serious personal injury

- Do not run the pump against a closed outlet valve.

CAUTION

Hot or cold surface

Minor or moderate personal injury

- Make sure that no one can accidentally come into contact with hot or cold surfaces.

CAUTION

Hot or cold liquid

Minor or moderate personal injury

- Wear personal protective equipment.

11.1 Operating parameters

CR multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors may require periodic lubrication as described in section *14. Maintaining the motor*.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient liquid to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

11.2 Pump cycling

Pump cycling should be checked to ensure the pump is not starting more often than the following max. starts per hour:

WEG motors:

- 100 times per hour on 1/3 to 1 HP models
- 20 times per hour on 1 1/2 to 20 HP models
- 10 times per hour on 20 to 150 HP models
- 5 times per hour on 200 to 300 HP models.

Grundfos ML motors:

- 200 times per hour on 1/3 to 5 HP models
- 100 times per hour on 7 1/2 to 15 HP models
- 40 times per hour on 20 to 30 HP models.

Rapid cycling is a major cause of premature motor failure due to overheating of the motor. If necessary, adjust controller to reduce the frequency of starts and stops.

11.3 Boiler feed installations

If the pump is used as a boiler feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication. See section *7.3 Minimum inlet pressures*.

11.4 Frost protection

If the pump is installed in an area where frost could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolating valves, remove the priming plug and drain plug at the base of the pump. Do not refit the plugs until the pump is to be used again. Always replace the drain plug with the original or an exact replacement. Do not replace with a standard plug. Internal recirculation will occur, reducing the output pressure and flow.

12. Servicing the product

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

WARNING

Falling objects

Death or serious personal injury

- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

For lifting instructions, see section *4.3 Lifting instructions*.

WARNING

Falling objects

Death or serious personal injury

- Keep the product in a stable and fixed position when working on it..

WARNING

Corrosive liquids

Death or serious personal injury

- Wear personal protective equipment.

WARNING

Toxic liquids

Death or serious personal injury

- Wear personal protective equipment.

WARNING

Contamination when pumping drinking water

Death or serious personal injury

- Before the pump is used for supplying drinking water, flush the pump thoroughly with clean water.
- Do not use the pump for drinking water if the internal parts have been in contact with particles or substances not suitable for water intended for human consumption.
- Always use original spare parts suitable for drinking water.

CAUTION

Hot or cold liquid

Minor or moderate personal injury

- Wear personal protective equipment.

CAUTION

Hot or cold surface

Minor or moderate personal injury

- Make sure that no one can accidentally come into contact with hot or cold surfaces.

12.1 Contaminated products

CAUTION

Biological hazard

Minor or moderate personal injury

- Flush the product thoroughly with water and rinse the product parts in water after dismantling.

The product will be classified as contaminated if it has been used for a liquid which is injurious to health or toxic.

If you request Grundfos to service the product, contact Grundfos with details about the liquid before returning the product for service. Otherwise, Grundfos can refuse to accept the product for service.

Any application for service must include details about the liquid.

Clean the product in the best possible way before you return it.

Costs of returning the product are to be paid by the customer.

13. Maintaining the pump

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

WARNING

Falling objects

Death or serious personal injury

- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

For lifting instructions, see section *4.3 Lifting instructions*.

Depending on the conditions and operating time, make the following checks at regular intervals:

- Check that the pump meets the required performance and is operating smoothly and quietly.
- Check that there are no leaks, particularly at the shaft seal.
- Check that the motor is not overheating.
- Remove and clean all strainers or filters in the system.
- Check that the tripping function of the motor overload protection works.
- Check the operation of all controls.
- If the pump is not operated for unusually long periods, maintain the pump in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
- In severe-duty applications, pump life may be extended by performing one of the following actions:
  - Drain the pump after each use.
  - Flush the pump with water or other liquid that is compatible with the pump materials and process liquid.
  - Disassemble the pump and thoroughly rinse or wash components in contact with the pumped liquid with water or other liquid that is compatible with the pump materials and process liquid.

If the pump fails to operate or there is a loss of performance, see *section 19. Diagnosing specific problems*.

14. Maintaining the motor

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

WARNING

Falling objects

Death or serious personal injury

- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

For lifting instructions, see section *4.3 Lifting instructions*.

Only qualified personnel should attempt installation, operation, and maintenance of this equipment.

14.1 Motor inspection

Inspect the motor approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear.

Go through the following steps during each inspection:

1. Check that the motor is clean. Check that the interior and exterior of the motor are free of dirt, oil, grease, water, etc. Oily residue, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an ohmmeter periodically to ensure that the winding insulation is OK. Record the ohmmeter readings, and immediately investigate any significant drop in insulation resistance.
3. Check all electrical connections to be sure that they are tightened securely.

14.2 Motor lubrication

Electric motors are pre-lubricated from factory and do not require additional lubrication at start-up. Motors without external grease zerks have sealed bearings that cannot be re-lubricated. Motors with grease zerks should only be lubricated with approved types of grease. Do not over-grease the bearings. Over-greasing will cause increased bearing heat and can result in bearing or motor failure. Do not mix oil-based grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time. The lubricating ability of a grease depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions.

Good results can be obtained if the following recommendations are used in your maintenance program. It should also be noted that multistage pumps, pumps running to the left of the performance curve, and certain pump ranges may have higher thrust loads. Pumps with high thrust loads should be greased according to the next service interval level.

Remove the grease outlet plug before adding new grease.

14.2.1 Recommended lubricant

Severity of duty	Ambient temperature (max.)	Environment	Approved types of grease
Standard	104 °F (40 °C)	Clean, little corrosion	Grundfos ML motors are greased for life, or the grease type will be stated on the nameplate. WEG motors are greased with Polyrex EM (Exxon Mobile).
Severe	122 °F (50 °C)	Moderate dirt, corrosion	
Extreme	> 122 °F (50 °C) or class H insulation	Severe dirt, abrasive dust, corrosion	

14.2.2 Lubricating chart (for motors with grease zerks)

New motors that have been stored for a year or more should be regreased according to the following table:

NEMA (IEC) frame size	Service intervals [hours]			Weight of grease [oz (grams)]	Volume of grease [in^3 (teaspoons)]
	Standard duty	Severe duty	Extreme duty		
Up to and incl. 210 (132)	5500	2750	550	0.30 (8.4)	0.6 (2)
Over 210 up to and incl. 280 (180)	3600	1800	360	0.61 (17.4)	1.2 (3.9)
Over 280 up to and incl. 360 (225)	2200	1100	220	0.81 (23.1)	1.5 (5.2)
Over 360 (225)	2200	1100	220	2.12 (60.0)	4.1 (13.4)

14.2.3 Lubricating procedure

Keep grease free from dirt to avoid damage to motor bearings. If the environment is extremely dirty, contact Grundfos, the motor manufacturer, or an authorized service center for additional information.

Do not mix dissimilar types of grease.

1. Clean all grease zerks. If the motor does not have grease zerks, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease. If the motor is stopped, add the recommended amount of grease. If the motor is to be lubricated while running, add a slightly greater quantity of grease.
3. Add grease SLOWLY taking approximately one minute until new grease appears at the shaft hole in the flange or grease outlet plug. Never add more than 1 1/2 times the amount of grease shown in the lubricating chart.

If new grease does not appear at the shaft hole or grease outlet, the outlet passage may be blocked. Contact Grundfos service center or certified motor shop.

4. Let motors equipped with a grease outlet plug run for 20 minutes before replacing the plug.

15. Replacing the motor

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

WARNING

Falling objects

Death or serious personal injury

- Follow the lifting instructions.
- Use lifting equipment which is approved for the weight of the product.
- Persons must keep a safe distance to the product during lifting operations.
- Wear personal protective equipment.

For lifting instructions, see section *4.3 Lifting instructions*.

Motors used on CR pumps are specifically selected to our rigid specifications. Replacement motors must be of the same frame size, should be equipped with the same or better bearings and have the same service factor. Failure to follow these recommendations may result in premature motor failure.

If the motor is damaged due to bearing failure, burning or electrical failure, observe the following instructions as to how to remove the motor and how to mount the replacement motor.

15.1 Disassembly

Proceed as follows:

1. Disconnect the power supply leads from the motor. Remove the coupling guards.

   For CR 1s, 1, 3, 5, 10, 15, and 20: Do not loosen the three hexagon socket head cap screws securing the shaft seal.

2. Use the proper metric hexagon key to loosen the four cap screws in the coupling. Remove coupling halves completely. On CR 1s-CR 20, the shaft pin can be left in the pump shaft. CR, CRN 32, 45 and 64 do not have a shaft pin.
3. Use the correct size spanner to loosen and remove the four mounting bolts joining motor and pump.
4. Lift the motor straight up until the shaft has cleared the motor stool.

15.2 Assembly

Proceed as follows:

1. Remove key from motor shaft, if present, and discard.
2. Thoroughly clean the surfaces of the motor and pump mounting flanges. The motor and shaft must be clean of all oil or grease and other contaminants where the coupling attaches. Place the motor on top of the pump.
3. Turn the terminal box to the desired position by rotating the motor.
4. Insert the four mounting bolts, then tighten diagonally and evenly:
   – For 3/8" bolts (1/2 - 2 HP), torque = 17 ft-lb.
   – For 1/2" bolts (3 - 40 HP), torque = 30 ft-lb.
   – For 5/8" bolts (50 - 100 HP), torque = 59 ft-lb.
   – Follow instructions for particular pump model in sections *15.2.2 CR 1s, 1, 3, and 5* to *15.2.5 CR, CRN 32, 45 and 64*.

15.2.1 Torque specifications

Torque specifications for CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20 CRT 2, 4, 8, and 16

Coupling screw size	Minimum torque
M6	10 ft-lb
M8	23 ft-lb
M10	46 ft-lb

15.2.2 CR 1s, 1, 3, and 5

1. Insert shaft pin into shaft hole.
2. Mount the coupling halves onto shaft and shaft pin.
3. Fit the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft keyway is centered in the coupling half as shown in fig. 16.
4. Tighten the screws to the correct torque. See section *15.2.1 Torque specifications*.

15.2.3 CR 10, 15 and 20

1. Insert shaft pin into shaft hole.
2. Insert plastic shaft seal spacer beneath shaft seal collar.
3. Mount the coupling halves onto shaft and shaft pin.
4. Fit the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft keyway is centered in the coupling half as shown in fig. 16.
5. Tighten the screws to the correct torque. See section *15.2.1 Torque specifications*.
6. Remove plastic shaft seal spacer and hang it on inside of coupling guard.

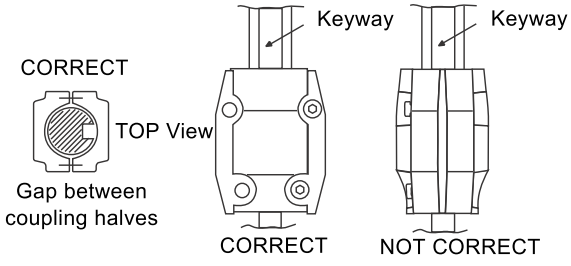

Fig. 16 Coupling adjustment all CR, CRI, CRN, CRT

15.2.4 CRT 2, 4, 8 and 16

1. Mount coupling halves. Make sure the shaft pin is located in the pump shaft.
2. Put the cap screws loosely back into the coupling halves.
3. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully raising the coupling to its highest point. See fig. 17.

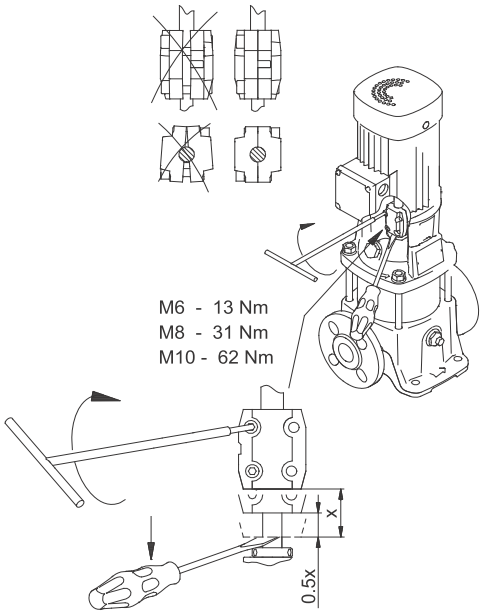

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Fig. 17 Coupling adjustment CRT 2, 4, 8, and 16

The shaft can only be raised approximately 0.20 inches (5 mm).

4. Now lower the shaft halfway back the distance you just raised it and tighten the coupling screws (finger tight) while keeping the coupling gap equal on both sides. When the screws are tight enough to keep the coupling in place, then cross-tighten the screws.
   – Note the clearance below the coupling.
   – Raise the coupling as far as it will go.
   – Lower it halfway back down (1/2 the distance you just raised it).
   – Tighten screws (see torque specifications).

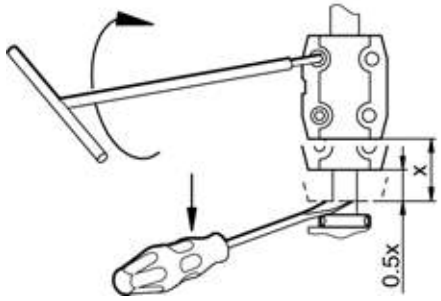

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Fig. 18 Coupling adjustment clearance CRT 2, 4, 8, and 16

15.2.5 CR, CRN 32, 45 and 64

1. Make sure pump shaft is all the way down. Tighten the set screws on the mechanical shaft seal.
2. Place the plastic adjusting fork under the cartridge seal collar. See fig. 19.

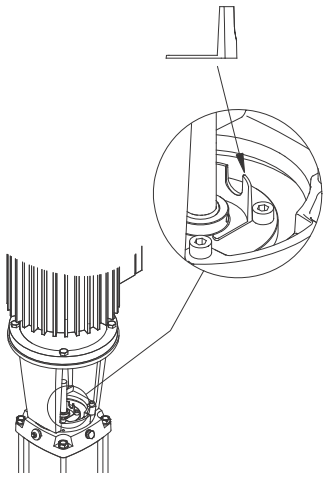

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Fig. 19 Coupling adjustment CR, CRN 32, 45 and 64

3. Fit the coupling on the shaft so that the top of the pump shaft is flush with the bottom of the coupling chamber. See fig. 20.

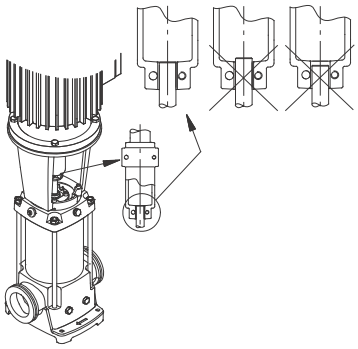

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Fig. 20 Coupling adjustment, CR, CRN 32, 45 and 64

To avoid damaging the coupling halves, ensure that the motor shaft keyway is centered in the coupling half as shown in fig. 16.

4. Lubricate the coupling screws with an anti-seize, lubricating compound. Tighten the coupling screws (finger tight) while keeping the coupling gap equal on both sides and the motor shaft keyway centered in the coupling half as shown in fig. 16. When the screws are tight enough to keep the coupling in place, then cross-tighten the screws.

5. Tighten coupling screws to 62 ft-lbs (75 and 100 HP motors to 74 ft-lbs). Remove the adjusting fork from under the cartridge seal collar and replace it to the storage location. See fig. 21.

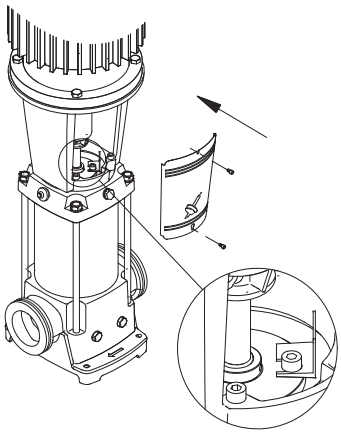

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Fig. 21 Adjusting fork storage CR, CRN 32, 45 and 64

6. Check to see that the gaps between the coupling halves are equal. Loosen and readjust, if necessary.
7. Make sure the pump shaft can be rotated by hand. If the shaft cannot be rotated or it jams, disassemble and check for misalignment.
8. Prime the pump.
9. Follow the wiring diagram on the motor label for the correct motor wiring combination which matches your supply voltage. Once this has been confirmed, reconnect the power supply leads to the motor.
10. Check the direction of rotation by bump-starting the motor. Direction of rotation must be left to right (counter-clockwise) when looking directly at the coupling.
11. Switch off the power, then mount the coupling guards. When the coupling guards have been mounted, the power can be switched on again.

16. Parts list

Grundfos offers an extensive parts list for each CR pump model. A parts list typically covers the following items:

- a diagram of pump parts which we recommend to have on hand for future maintenance
- a list of prepacked service kits covering the pump components most likely to be exposed to wear over time
- complete chamber stacks needed to replace the rotating assembly of each model.

These parts lists are available separately from the Grundfos literature warehouse or as a set with extensive service instructions in the Grundfos CR Service Manuals.

TM05 9272 3613

Fig. 22 Prepacked chamber stack kits

TM04 3916 1609

Fig. 23 Prepacked flange kits

16.1 Spare parts

Grundfos offers an extensive list of spare parts for CR pumps. For a current list of these parts, see Grundfos All Product Spare Parts/Service Kits Price List, part number L-SK-SL-002.

17. Preliminary electrical tests

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.
- We recommend to wear rubber gloves and boots, and to make sure that metal terminal boxes and motors are grounded before any work is done.

17.1 Supply voltage

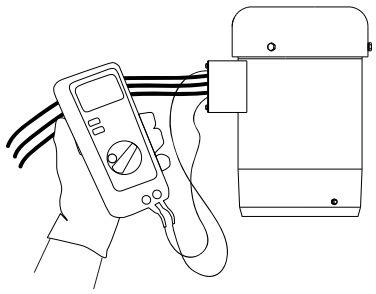
17.1.1 How to measure the supply voltage

Use a voltmeter (set to the proper scale) to measure the voltage at the pump terminal box or starter. On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

– Power leads L1 and L2

– Power leads L2 and L3

– Power leads L3 and L1.



TM04 3911 2609

Fig. 24 Measuring supply voltage

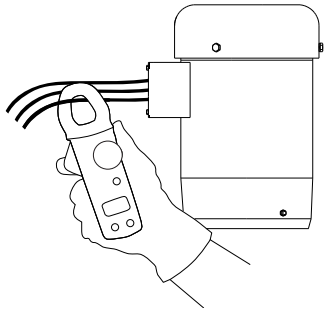
17.1.2 Meaning of supply voltage measurement

When the motor is under load, the voltage should be within + 10 %/- 10 % of the nameplate voltage. Larger voltage variation may cause winding damage. Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected. If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

17.2 Current

17.2.1 How to measure the current

Use an ammeter (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information. Current should be measured when the pump is operating at constant outlet pressure.



TM04 3908 2609

Fig. 25 Measuring current

17.2.2 Meaning of current measurement

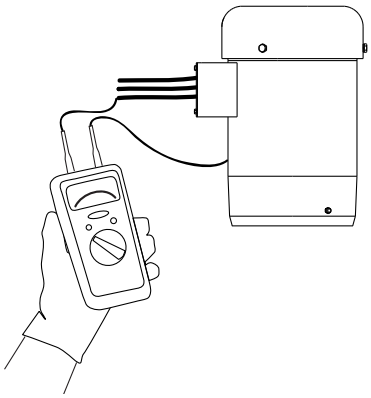
If the amp draw exceeds the listed service factor amps (SFA) or if the current unbalance is greater than 5 % between each leg on three-phase units, check for the following faults:

Fault	Remedy
Burned contacts in the motor-protective circuit breaker.	Replace contacts.
Loose terminals in motor-protective circuit breaker or terminal box or possibly defective lead.	Tighten terminals or replace lead.
Too high or too low supply voltage.	Reestablish correct supply voltage.
Motor windings are short-circuited or grounded. (Check winding and insulation resistances).	Remove cause of short circuit or grounding.
Pump is damaged causing motor overload.	Replace defective pump parts.

17.3 Insulation resistance

17.3.1 How to measure the insulation resistance

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohmmeter or megohmmeter, set the scale selector to R x 100K and zero-adjust the meter. Measure and record the resistance between each of the terminals and ground.



TM04 3907 2609

Fig. 26 Measuring insulation resistance

17.3.2 Meaning of insulation resistance measurement

Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, the motor should be repaired or replaced.

18. Startup of pump with air-cooled top (Cool-Top®)

Do not start the pump until it has been filled with liquid and vented.

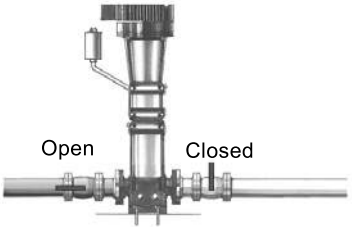
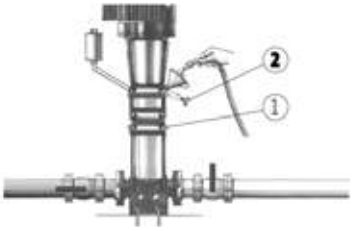
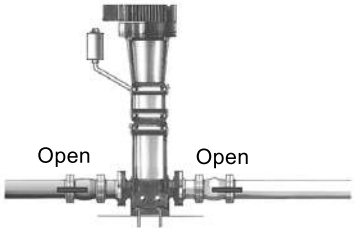
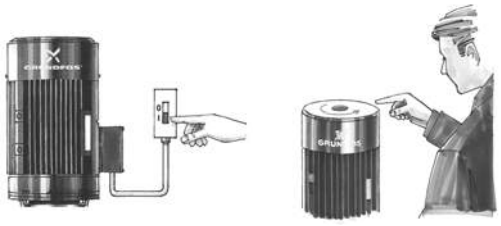
CAUTION

Hot or cold liquid

Minor or moderate personal injury

- Wear personal protective equipment.
- Pay attention to the direction of the vent hole when you fill the pump with liquid and vent it.
- Make sure that no persons are hurt by the escaping liquid.

We recommend to connect a drain pipe to the 1/2" air vent in order to lead the hot water or steam to a safe place.

Step		Action
1	 TM02 4151 5001	The air-cooled top should only be started up with cold liquid. Close the isolating valve on the outlet side and open the isolating valve on the inlet side of the pump.
2	 TM02 4153 1503	Remove the priming plug from the air-cooled chamber (pos. 2) and slowly fill the chamber with liquid. When the chamber is completely filled with liquid, replace the priming plug and tighten securely.
3	 TM02 5907 1503	Open the isolating valve on the outlet side of the pump. The valve may have to be partially closed when the pump is started if there is no counter pressure (i.e. boiler not up to pressure).
4	 TM01 1406 3702 - TM01 1405 4497	Start the pump and check the direction of rotation. See the correct direction of rotation of the pump on the motor fan cover. If the direction of rotation is wrong, interchange any two of the incoming power supply leads. After 3 to 5 minutes, the air vent has been filled with liquid. **Note** During start-up of a cold pump with hot liquid, it is normal that a few drops of liquid are leaking from the sleeve.

19. Diagnosing specific problems

DANGER

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

Problem	Possible cause	Remedy
1. The pump does not run.	a) No power to motor.	Check voltage to motor terminal box. If no voltage to motor, check starter panel for tripped circuits and reset circuits.
	b) Fuses blown or circuit breaker tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	c) Motor starter overload protection burned or tripped out.	Check for voltage on line and load side of starter. Replace or reset burned motor protection. Inspect starter for other damage. If protection trips again, check the supply voltage and starter holding coil.
	d) Starter does not energize.	Energize control circuit and check for voltage to the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for short circuits. Replace bad coil.
	e) Defective control devices.	Check that all safety and pressure switches function correctly. Inspect contacts in control devices. Replace worn or defective parts or control devices.
	f) Motor is defective.	Turn off power and disconnect wiring. Measure the lead-to-lead resistances with ohmmeter (RX-1). Measure lead-to-ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace it.
	g) Defective capacitor (single-phase motors).	Turn off power and outlet capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (h). Replace capacitor if defective.
	h) Pump is blocked or seized.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair the pump.

Problem	Possible cause	Remedy
2. The pump runs but at reduced performance or does not deliver water.	a) Wrong direction of rotation.	Check wiring for proper connections. Correct wiring.
	b) Pump is not primed or is air-bound.	Turn pump off, close isolation valve(s) and remove priming plug. Check liquid level. Refill the pump, replace plug and start the pump. Long inlet lines must be filled before starting the pump.
	c) Strainers, check or foot valves are clogged.	Remove strainer, screen or check valve and inspect. Clean and replace. Reprime pump.
	d) Suction lift too large.	Install compound pressure gauge at the inlet side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase inlet line size or removing high friction loss devices.
	e) Inlet and/or outlet pipes leaking. (Pump spins backwards when turned off)	Air in inlet pipe. Inlet pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	f) Pump worn.	Install pressure gauge, start pump, gradually close the outlet valve and read pressure at shutoff. Convert measured pressure (in psi) to head (in feet): (Measured psi x 2.31 ft/psi = ___ ft). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	g) Pump impeller or guide vane is clogged.	Disassemble and inspect pump passageways. Remove any foreign materials found.
	h) Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
	i) Improper coupling setting.	Check/reset the coupling. See page 18.
3. Pump cycles too much	a) Pressure switch is not properly adjusted or is defective.	Check that pressure switch is set and functions correctly. Check voltage across closed contacts. Readjust switch or replace if defective.
	b) Level control is not properly adjusted or is defective.	Check that level control is set and functions correctly. Readjust setting (refer to level control manufacturer's data). Replace if defective.
	c) Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leaks. Check tank and piping for leaks with soap and water solution. Check air-to-water volume. Repair as necessary.
	d) Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump performance. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	e) Pump is oversized.	Install pressure gauges on or near pump inlet and outlet ports. Start and run pump under normal conditions, record gauge readings. Convert psi to feet (Measured psi x 2.31 ft/psi = ____ ft) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump outlet flow if necessary.

Problem	Possible cause	Remedy
4. Fuses blow or circuit breakers or overload relays trip	a) Tank is too small.	Check voltage at starter panel and motor. If voltage varies more than - 10 %/+ 10 %, contact power company. Check wire sizing.
	b) Motor overload protection set too low.	Cycle pump and measure amperage. Increase size of overload protection or adjust trip setting to maximum motor nameplate (full load) current.
	c) Three-phased current is imbalanced.	Check current draw on each lead to the motor. Must be within - 5 %/+ 5 %. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	d) Motor short-circuited or grounded.	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohmmeter. Record values. If an open or grounded winding is found, remove the motor, repair and/or replace.
	e) Wiring or connections are faulty.	Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wires.
	f) Pump is blocked or seized.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair the pump.
	g) Defective capacitor (single-phase motors).	Turn off power and outlet capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace capacitor if defective.
	h) Motor overload protection devices at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near overload protection devices and motor. Record these values. If ambient temperature at motor is lower than at overload protection devices, especially where temperature at overload protection devices is above 104 °F (40 °C), replace standard protection devices with ambient-compensated protection devices.

20. Worksheet for three-phase motors

Below is a worksheet for calculating current unbalance on a three-phase hookup. Use the calculations below as a guide.

Current unbalance should not exceed 5 % at service factor load or 10 % at rated input load. If the unbalance cannot be corrected by rolling the leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source. However, if the reading farthest from the averages moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider if the cause can be a damaged cable, an untight cable splice, a poor connection, or a faulty motor winding.

Explanation and examples	
Here is an example of current readings at maximum pump loads on each leg of a three-wire hookup. You must make calculations for all three hookups. To begin, add up all three readings for hookup numbers 1, 2, and 3.	**Hookup 1** T1 = 51 amps T2 = 46 amps T3 = 53 amps TOTAL = 150 amps
Divide the total by three to obtain the average.	**Hookup 1** 50 amps 3 | 150 amps
Calculate the greatest current difference from the average.	**Hookup 1** 50 amps - 46 amps 4 amps
Divide this difference by the average to obtain the percentage of the unbalance. In this case, the current unbalance for **Hookup 1** is 8 %.	**Hookup 1** .08 or 8 % 50 | 4.00 amps

Blank worksheet		
Hookup 1	**Hookup 2**	**Hookup 3**
L_1 to T_1 = ___ amps	L_1 to T_3 = ___ amps	L_1 to T_2 = ___ amps
L_2 to T_2 = ___ amps	L_2 to T_1 = ___ amps	L_2 to T_3 = ___ amps
L_3 to T_3 = ___ amps	L_3 to T_2 = ___ amps	L_3 to T_1 = ___ amps
TOTAL = ___ amps	TOTAL = ___ amps	TOTAL = ___ amps
Hookup 1	**Hookup 2**	**Hookup 3**
___ amps	___ amps	___ amps
3 | ___ amps	3 | ___ amps	3 | ___ amps
Hookup 1	**Hookup 2**	**Hookup 3**
___ amps	___ amps	___ amps
___ amps	___ amps	___ amps
___ amps	___ amps	___ amps
Hookup 1	**Hookup 2**	**Hookup 3**
___ or ___ %	___ or ___ %	___ or ___ %
___ | ___ amps	___ | ___ amps	___ | ___ amps

21. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

The crossed-out wheelie bin symbol on a product means that it must be disposed of separately from household waste. When a product marked with this symbol reaches its end of life, take it to a collection point designated by the local waste disposal authorities. The separate collection and recycling of such products will help protect the environment and human health.

See also end-of-life information at www.grundfos.com/product-recycling.

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