ROMTEC UTILITIES OPERATION & MAINTENANCE MANUAL

FOR:

ANIMAL HEALTH PRODUCT FACILITY

(DE SOTO, KANSAS)

DATE: March 3, 2014

REVISION: 0

ENGINEER CONTACT INFORMATION:

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

ROMTEC UTILITIES

18240 North Bank Road ~ Roseburg ~ OR ~ 97470
541.496.9678(ph) / 541.496.0804(fx)
romtec3@romtecutilities.com

INDEX

INDEX

1. INTRODUCTION

This section contains the necessary information and procedures for the understanding and use of this document by the client and other parties of interest.

This section is structured as follows:

1.01 ABOUT THIS DOCUMENT

1.02 CONTACT INFORMATION

1.03 SCOPE OF SUPPLY

1.01 ABOUT THIS DOCUMENT

1. Document Identification

The information in this document is the Operation & Maintenance Manual (O&M) provided by Romtec Utilities, Inc., herein referred to as Romtec Utilities for the project listed below:

Name (herein referred to as “the project”): Animal Health Product Facility

Location (herein referred to as “the site”): De Soto, Kansas

Document Date: 3/3/14 Revision #: 0

2. Document Description

This document contains all the as-built drawings and operation, maintenance manuals & manufacturers warranties for the associated mechanical and electrical components of this project.

3. Document Delivery

One (1) hard copy (upon request) and one (1) CD Rom of the Romtec Utilities Operation & Maintenance Manual will be provided to the customer at start-up of the system.

Any request for additional copies will result in additional fees and a change order.

1.02 CONTACT INFORMATION

Engineer:

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

Pump Station Supplier:

Romtec Utilities, Inc.
18240 North Bank Rd.
Roseburg, OR 97470
541-496-3541; Fax: 541-496-0803
romtec3@romtec.com; www.romtecutilities.com

Wet Well & Related Equipment:

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

1.02 CONTACT INFORMATION

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

Pumps & Related Equipment:

Customer Name
Company Name
(555) 555-5555
customername@companyname.co
m

Liquid Level Sensors:

Customer Name
Company Name
(555) 555-5555
customername@companyname.com

Electrical:

Control Panel Supplier:
Romtec Utilities, Inc.
18240 North Bank Rd.
Roseburg, OR 97470
541-496-3541; Fax: 541-496-0803
romtec3@romtec.com; www.romtecutilities.com

1.03 SCOPE OF SUPPLY PRODUCTS (SUPPLIED BY ROMTEC UTILITIES)

COMPLETE PUMP STATION INCLUDES:

WET WELL & RELATED EQUIPMENT

QTY	ITEM
1	WET WELL - FIBERGLASS -6FT DIA X 12FT TALL - DOUBLE WALL - WITH LEAK DETEC
1	4 in CAP WITH CORD GRIP
1	LEVEL SENSOR FOR FIBER GLASS WET WELL (40 FT CABLE)
1	PIPE SUPPORT ANGLE - FPR
1	HATCH - WW - 6FT ID FULL COVER FOR ROUND TANK - PED 33 X 46 - 75932-R2
2	DISCHARGE CLAMP - UBOLT - 2in 316SS
1	VENT - MUSHROOM CAP
2	BOLT & NUT KIT - UPPER GUIDE BAR BRACKET - 3-8in
4	CABLE HANGER ASSEMBLY
2	DISCHARGE CLAMP BOLT - 1-2 X 1 SS BOLT, WASHER, FIBER LOCK NUT
2	BRACKET - UPPER GUIDE BAR - 1.00 - TSURUMI
1	VALVE KEY - EXT GATE WRENCH CUSTOM
2	TSURUMI - TOK80PU21.5 - 2HP - SS WITH LEAK DETECTION
2	ANCHOR KIT - DISCHARGE ELBOW
2	3in ELBOW - TSURUMI - MODEL PU
1	PUMP LIFTING EYE
2	BOW SHACKLE - 3-8in - SS W-SCREW PIN
2	BOW SHACKLE - 1-2in - SS W-SCREW PIN
2	CORD GRIP - .41 - .50
2	LIFTING SLING - .125in SS CABLE 2 @ 14FT
4	CHAIN - S5 9-32in 316SS 2@2FT
4	NIPPLE - 316SS - 2in SCH40 X 12in
2	NIPPLE - 316SS - 2in SCH40 X 36in
44	PIPE - 304SS - 1in SCH40 4@11.5FT
1	NIPPLE - ALUM - 4in X 36in (HATCH)
2	NIPPLE - 316 SS - 2in SCH40 X 30in
2	NIPPLE - 316SS - 2in X CLOSE
2	VALVE - BALL - 2in 316SS - 1-4 TURN
2	VALVE - SWING CHECK - 2in - 316SS - VELAN
2	VALVE BOX - TOP - #910 X 18in TALL
2	EXTENDED VALVE BOX - BASE - #931 5X60
2	VALVE BOX - LID - #910
2	BUSHING - 316SS - 3inX2in
4	UNION - 316SS - 2in
3	PRESS SEAL - 8in CORE -1.70 THRU 4.80 PIPE - NITRILE
1	PRESS-SEAL - 12in CORE - 6in PIPE NITRILE
1	PRESS SEAL - 12in CORE - 8in PIPE NITRILE
4	FLANGE - 316SS - 2in - COMPANION X 2in NPT

1.03 SCOPE OF SUPPLY PRODUCTS (SUPPLIED BY ROMTEC UTILITIES)

2	ELBOW - 316SS - 2in - 90 DEG - SCH40 - THD
4	GASKET - FLANGE - 2in X 1/8in - TEFLON
1	NEVER SIEZE - TUBE
4	FLOAT - NOLTA - MS1 C - 20m
7	BOLT - NC3-8 X 2 SS (FOR HATCH)
2	CONDUIT UNIONS - 1in NPT (FOR HATCH)
2	CONDUIT UNIONS - 3_4in NPT (FOR HATCH)
1	CORD GRIP - LEAK SENSOR CABLE - 1-2in NPT
7	NUT - NC3-8 NYLOCK SS (FOR HATCH)
14	WASHER - FLAT - 3-8 SS (FOR HATCH)
12	WASHER - FLAT - 3-8 316 SS (FOR U BOLT CLAMPS SPACERS)

ELECTRICAL EQUIPMENT

QTY	ITEM
1	NEMA 4X FIBERGLASS - 480V/3P - DUPLEX ALTENATOR CONTROL PANEL
1	LEAK DETECTION FOR FIBERGLASS TANK

END

OF

SECTION

2. GENERAL REQUIREMENTS

This section includes all general requirements including warranties, permits, and reports for this project.

This section is structured as follows:

2.01 WARRANTY

- 2.01.1 ROMTEC UTILITIES WARRANTY
- 2.01.2 PUMP WARRANTY

2.02 PERMITS

(Engineer/Contractor to insert permits related to this pump station when received)

2.03 START-UP REPORTS

(The Romtec Utilities Start-up Reports will be sent after the start-up is complete. Please insert in this section when received.)

2.04 ENGINEER/AGENCY INSPECTION REPORTS

(Engineer/Contractor to insert inspection reports related to this pump station when received)

2.01 WARRANTY

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2.01.1 ROMTEC UTILITIES LIMITED WARRANTY

Romtec Utilities Limited Warranty

Romtec Utilities, Inc. (herein referred to as "Romtec") warrants that the equipment supplied will be free from defects in material and workmanship under normal use and service, when used in accordance with Romtec's procedures as set forth below for a period of two years from date of acceptance (acceptance is defined as the date Romtec's "Start-Up" report is completed) or two years and six months from installation of the wet well (or delivery of the wet well or the date that the wet well was ready to deliver), whichever comes first. The obligation of Romtec under this warranty is limited to replacing or repairing any defective part (failure of other manufacturer supplied components will be addressed according to the individual manufacturer's warranty, the periods of which, and the manufacturer's obligations therein may differ from Romtec Utilities' Warranty). This warranty extends only to Romtec's direct customer (as named in the Romtec Purchase Order), herein called "CUSTOMER", and not to any person or entity with whom CUSTOMER has business relationships, or any party other than CUSTOMER.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PURPOSE, WHICH IMPLIED WARRANTIES ARE EXCLUDED. ROMTEC SHALL NOT BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES.

Components Resold or Supplied with Romtec Materials. Certain components are warrantable directly by the original manufacturer for periods between 90 days and 5 years. Specific details of such warranties are included with the Romtec Scope of Supply and Design Submittal document. Replacement for, repair or refund of defective workmanship or material under normal use shall be remunerated directly with the manufacturer of the component. Examples of components would be generators, manual cranes, pumps, pump controls, valves, etc.

Warranty Voidable. Start-up that is performed without the presence of Romtec's representative shall void all warranties.

Claims of Defective Manufacture. Claims that the merchandise was incorrectly manufactured or that is defective in any way must be made directly to Romtec on a product-by-product basis. All claims must be made within 72 hours of the defective condition, or the time when the defect should have been discovered, whichever is earlier. All claims must include the following:

1. A detailed description of the specific problem, failure, or other event giving rise to the claim; and
2. Supporting photographs or videos; and
3. Specific location; and
4. Names and phone numbers of individuals who can substantiate the claim, but who do not work for Contractor.

Failure of Pump Station.
Romtec Utilities pump stations pump all types of water containing all kinds of materials. Sometimes pumps may clog or power may be lost and the pump station will fail to operate. If your station fails to operate, Romtec Utilities will suggest a local service company to evaluate the problem. If it is a warranty issue, Romtec Utilities will repair and/or replace

2.01.1 ROMTEC UTILITIES LIMITED WARRANTY

per the terms of this warranty. If however, the pumps are simply "clogged" or the power is simply lost Romtec Utilities will advise you that it is not a warranty issue and you will simply pay for the service call and the associated services.

Action in Event of Established Claim. In the event it is determined that goods have been incorrectly manufactured or are defective, the liability of Romtec shall be limited to, at its option, repair or replacement of the goods. Romtec also reserves the right to establish reasonable time limits for completion of any specific installation tasks resulting from the replacement of defective merchandise.

No Third Party Claims. Under no circumstances shall Romtec be responsible for any damage claims by any party other than claims by Romtec direct customers.

Release and Hold Harmless. Contractor releases and agrees to defend, indemnify, and hold Romtec harmless from and against any and all claims, demands, actions, and causes of action for any matters arising out of or connected with the Materials whereby the Contractor is responsible for errors or omissions.

FURTHER LIMITATIONS ON ROMTEC LIABILITY

1. Specific Limitations.

Romtec's liability under the foregoing warranty and under the transaction of which this document is a part is limited as follows:

a. Romtec has designed the lift station supplied under this project to meet a specific design standard and specific set of parameters as dictated to Romtec by its CUSTOMER as set forth in the "Lift Station Design Form" located Tab 4 of the Romtec Utilities Scope of Supply and Design Submittal.

b. Romtec's Scope of Supply & Design Submittal is a part of and limited by CUSTOMER'S site civil and electrical plans.

c. Romtec makes no guarantees that any of its supply will fit on CUSTOMER'S site and/or building. However, at CUSTOMER'S request, Romtec will provide suggested layouts for the CUSTOMER'S project. Ultimately, the CUSTOMER decides to accept or reject any given layout.

d. Romtec cannot make final layout or equipment placement judgments at the site (i.e. generator or control panel "fit" in or out of a building). It is the responsibility of CUSTOMER'S site engineer and contractor to check dimensions, etc. If CUSTOMER has not accepted (or received) final dimensions, etc., please request further definition before approval. Romtec is not responsible for items that do not fit on the site.

e. It is Romtec's CUSTOMER'S responsibility and obligation to review Romtec's Scope of Supply & Design Submittal to insure it meets with CUSTOMER approval relative to any CUSTOMER third party agreements.

f. Romtec Utilities is not responsible for any aspect of the construction/installation of the Romtec Utilities lift station. The Contractor bears sole responsibility for installation of products manufactured by Romtec Utilities. The Romtec Utilities Scope of Supply and Design Submittal defines Romtec Utilities scope of supply relative to equipment, documentation, start-up services and warranty.

2.01.1 ROMTEC UTILITIES LIMITED WARRANTY

g. If Romtec Utilities is on site during the construction/installation of the Romtec Utilities lift station it is only as an advisor. Romtec Utilities is never on site to perform any construction and/or installation tasks.

Romtec Utilities designs and prefabricates its lift station system to enable contractors to install the Romtec Utilities system quickly and completely. However, Romtec Utilities has made no representation and/or claims as to "how long" it will take to construct/install the Romtec Utilities system.

Note: If any Romtec Utilities-supplied part is found to be defective and/or has been manufactured in error relative to this document, Romtec Utilities will repair and/or replace that part at Romtec Utilities' expense. Romtec Utilities does not offer, nor will Romtec Utilities accept, any charges and/or claims by anyone relative to the time it takes to install/construct the Romtec Utilities system and or claims for delays relative to a part that has to be repaired and/or replaced by Romtec Utilities.

h. Romtec Utilities' responsibility is to its direct customer. We want to help all parties, but we are ultimately responsible only to our direct customer.

If Romtec Utilities' direct customer has hired a sub-contractor Romtec Utilities will communicate with that sub-contractor through a representative of Romtec Utilities' direct customer. In other words, Romtec Utilities will not direct and/or advise any sub-contractor. Instead, Romtec Utilities will communicate directly with its "direct customer" and they will communicate with their sub-contractors, engineers, and/or owners.

i. The Romtec Utilities design reflects all elevations and/or orientations to an accuracy of and/or minus .10'. Romtec Utilities does not claim to manufacture any aspect of its lift station systems to absolute elevations. It is simply not possible in the general underground construction world to meet absolutes. Therefore, any owner and/or installer of a Romtec Utilities system is accepting the Romtec Utilities system proposed herein to the plus or minus .10' offered by Romtec Utilities.

2. Performance Characteristics and Start-Up.

a. The lift station is a sophisticated device that can be operated in many different ways. The Romtec Scope of Supply & Design Submittal defines Romtec's approach to the operation of the lift station.

Note: While there are many ways to vary and/or adjust "operational parameters" within the overall lift station, Romtec is only prepared to start-up per its own parameters (as specified in the CUSTOMER'S design criteria, see attached).

b. Romtec's obligation is to show that the station can run as designed to meet specific design criteria as shown in its Scope of Supply & Design Submittal. It is understood that the regulating agency may want to test many other scenarios. This will not be part of the standard Romtec's start-up procedures and training. At start-up, Romtec will only prove that the station can run at the pre-specified design parameters.

c. Romtec is not an operator, installer or an electrical interconnector for the lift stations and equipment it supplies.

d. During start-up, Romtec is completely in charge. Romtec's start-up technician will start-up and "prove" the station per the approved Romtec Scope of Supply & Design

2.01.1 ROMTEC UTILITIES LIMITED WARRANTY

Submittal. After the lift station is accepted other parties may choose to adjust and/or vary the operational parameters to suit their specific preference. However, Romtec will not be involved with these issues either during or after start-up, and is not responsible for problems arising from any adjustments or variations by such other parties.

3. Training.

a. Romtec will perform start-up and training at no additional cost as part of its scope of supply if the training is scheduled for the day after start-up and CUSTOMER wants training at no additional cost. If training is scheduled for any other time other than the day after start-up, Romtec will require prepayment of the additional costs incurred as a result of the need to reschedule

Limited Warranty

TSURUMI MANUFACTURING CO., LTD. ("TSURUMI") warrants to the original end purchaser during the warranty period, every new TSURUMI pump or product to be free from defects in material and workmanship under normal use and service, when properly installed, used, and maintained, (in accordance with Tsurumi's instruction manual), for a period of two years from the date the unit was first installed or twenty six months from the date of shipment by TSURUMI to wholesaler, whichever comes first.
TSURUMI will not warranty any product that does not have Serial Numbers.

TSURUMI's sole obligation under this warranty is to repair or replace at TSURUMI's option, with new or re-manufactured parts, any part(s) that fail or that are found to be defective during the warranty period. No allowance will be made for shipping charges, damages, labor, or other charges due to failure, repair or replacement.

This warranty does not apply to any TSURUMI product that has been disassembled without prior approval of TSURUMI nor does it apply to product that has been subjected to misuse, neglect, alteration, misapplication, accident or act of God.

TSURUMI assumes no responsibility for compliance with any regulations, codes, standards, or ordinances applicable to the installation, location, operation or maintenance of its products.

No other warranty, expressed or implied, is authorized by, or applicable to, the seller, No person, agent or dealer is authorized to enlarge upon this warranty.

TSURUMI expressly disclaims liability for consequential or incidental damages or breach of expressed or implied warranty; and any implied warranty of fitness for a particular purpose and merchantability shall be limited to the duration of the expressed warranty.

Some states do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which very from state to state.

Tsurumi Manufacturing Co., Ltd.

2.02 PERMITS

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(INSERT ALL PERMITS IN THIS SECTION)

2.03 START-UP REPORTS

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(INSERT START-UP REPORTS IN THIS SECTION)

2.04 ENGINEER/AGENCY INSPECTION REPORTS

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(INSERT INSPECTION REPORTS IN THIS SECTION)

END

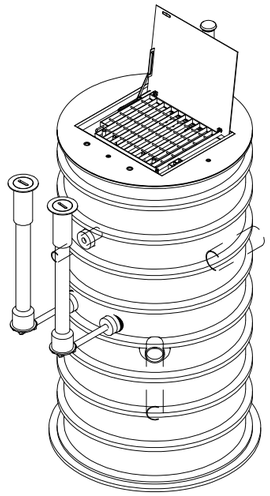
OF

SECTION

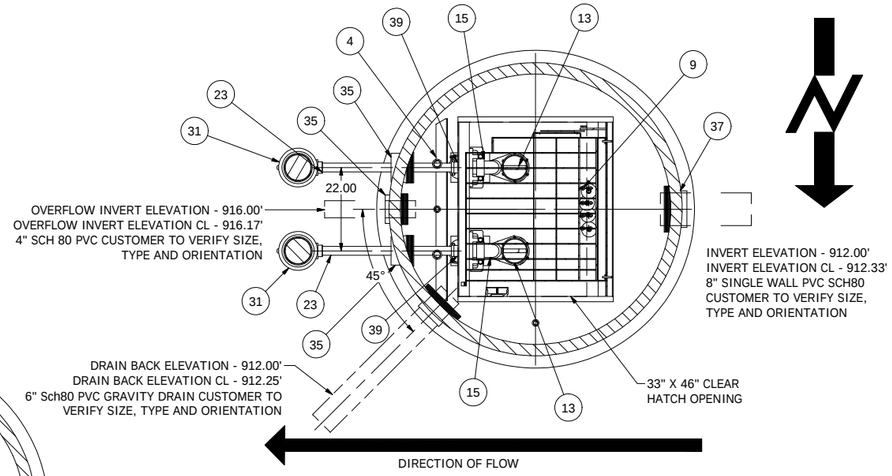
3. WET WELL & RELATED EQUIPMENT

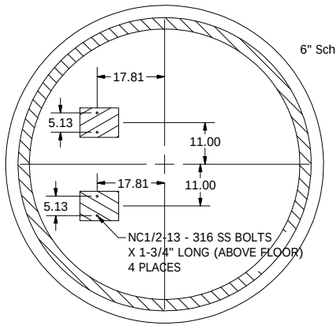
This section contains information pertaining to the wet well. There is both technical information and related drawings necessary for the wet well construction.

This section is structured as follows:



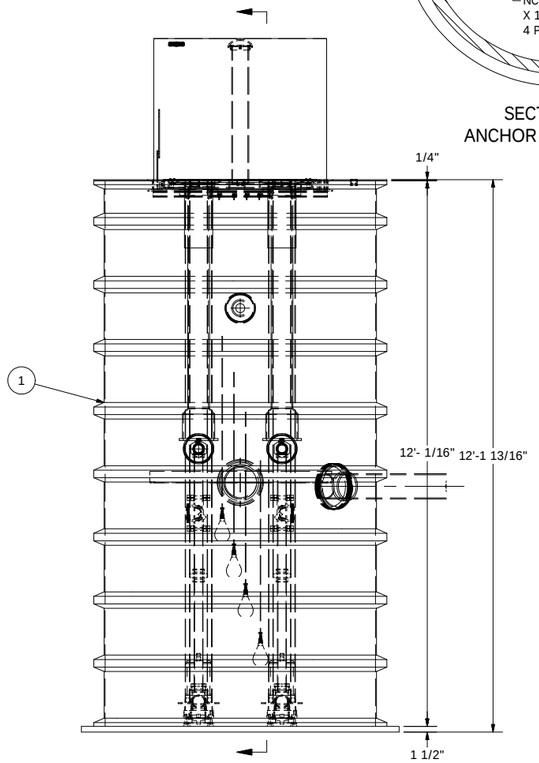
SENSOR AND ELEVATION TABLE		
LEVEL ELEVATION	DISTANCE BETWEEN POINTS	SET POINT DESCRIPTION
912.00		SEWER INVERT IN
909.80		HIGH LEVEL ALARM
	0.5	SENSOR SPACING
909.30		LAG PUMP START
	0.5	SENSOR SPACING
908.80		LEAD PUMP START
	1.0	SENSOR SPACING
907.80		PUMP STOP
	0.83	DISTANCE TO FLOOR
906.97		FLOOR ELEVATION
919.00		TOP OF WET WELL
912.00		6" SEWER INVERT
916.00		4" SEWER INVERT
913.00		3" DIS. INVERT



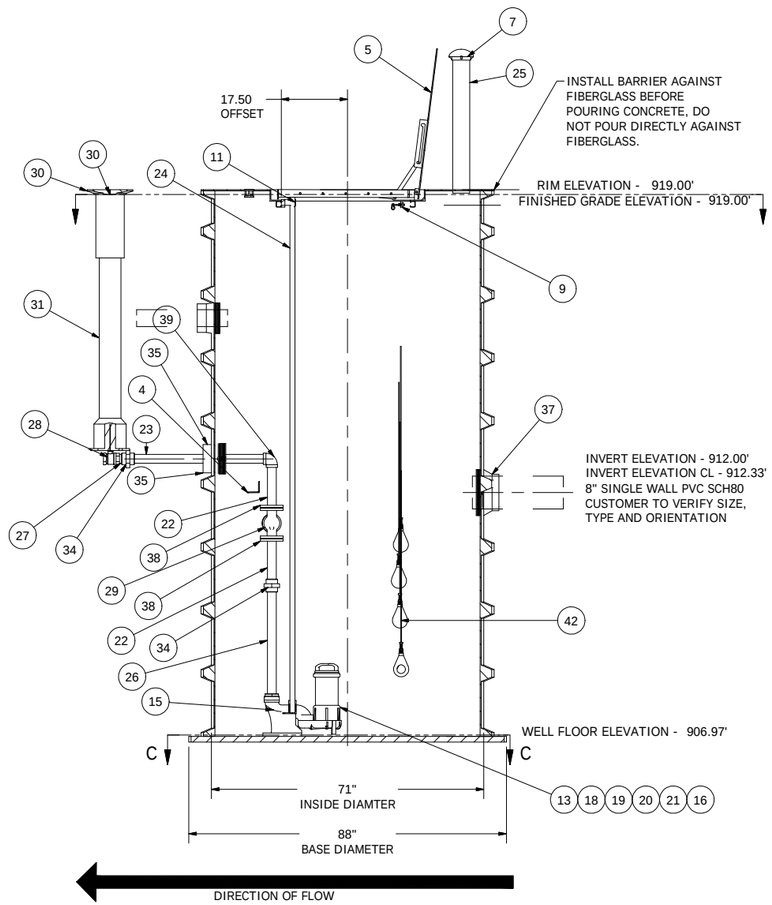


SECTION C-C
ANCHOR BOLT LAYOUT

NOTE: WET WELL TOP SLAB IS PEDESTRIAN RATED



DISCHARGE ELEVATION - 913.00'
DISCHARGE ELEVATION CL: 913.08'



Parts List			
ITEM	QTY	STOCK NUMBER	DESCRIPTION
1	1	10-XXXX	WET WELL - FIBERGLASS -6FT DIA X 12FT TALL - DOUBLE WALL - WITH LEAK DETECTION
2	1	10-XXXX	4 in CAP WITH CORD GRIP
3	1	10-XXXX	LEVEL SENSOR FOR FIBER GLASS WET WELL (40 FT CABLE)
4	1	11-REF	PIPE SUPPORT ANGLE - FPR
5	1	13-XXXX	HATCH - WW - 6FT ID FULL COVER FOR ROUND TANK - PED 33 X 46 - 75932-R2
6	2	18-XXXX	DISCHARGE CLAMP - UBOLT - 2in 316SS
7	1	18-5427	VENT - MUSHROOM CAP
8	2	18-6031	BOLT & NUT KIT - UPPER GUIDE BAR BRACKET - 3-8in
9	4	18-6115	CABLE HANGER ASSEMBLY
10	2	18-FAST	DISCHARGE CLAMP BOLT - 1-2 X 1 SS BOLT, WASHER, FIBER LOCK NUT
11	2	18-XXXX	BRACKET - UPPER GUIDE BAR - 1.00 - TSURUMI
12	1	25-XXXX	VALVE KEY - EXT GATE WRENCH CUSTOM
13	2	30-XXXX	TSURUMI - TOK80PU21.5 - 2HP - SS
14	2	31-6040	ANCHOR KIT - DISCHARGE ELBOW
15	2	31-4907	3in ELBOW - TSURUMI - MODEL PU
16	1	32-4673	PUMP LIFTING EYE
17	2	32-5942	BOW SHACKLE - 3-8in - SS W-SCREW PIN
18	2	32-5943	BOW SHACKLE - 1-2in - SS W-SCREW PIN
19	2	32-4642	CORD GRIP - .41in - .50 DIA SS
20	2	32-6354	LIFTING SLING - .125in SS CABLE 2 @ 14FT
21	4	32-6600	CHAIN - S5 9-32in 316SS 2@2FT
22	4	40-4113	NIPPLE - 316SS - 2in SCH40 X 12in
23	2	40-4114	NIPPLE - 316SS - 2in SCH40 X 36in
24	44	40-4127	PIPE - 304SS - 1in SCH40 4@11.5FT
25	1	40-4679	NIPPLE - ALUM - 4in X 36in (HATCH)
26	2	40-4908	NIPPLE - 316 SS - 2in SCH40 X 30in
27	2	40-XXXX	NIPPLE - 316SS - 2in X CLOSE
28	2	41-XXXX	VALVE - BALL - 2in 316SS - 1-4 TURN
29	2	41-4655	VALVE - SWING CHECK - 2in - SS - VELAN
30	2	41-5139	VALVE BOX - 10in TOP - #910
31	2	41-5142	EXTENDED VALVE BOX - BASE - #931 5X60
32	2	41-5143	VALVE BOX - LID - #910
33	2	42-4895	BUSHING - 316SS - 3inX2in
34	4	42-6323	UNION - 316SS - 2in
35	3	43-XXXX	PRESS SEAL - 8in CORE -1.70 THRU 4.80 PIPE - NITRILE
36	1	43-XXXX	PRESS SEAL- 12in CORE - 6in PIPE NITRILE
37	1	43-XXXX	PRESS SEAL - 12in CORE - 8in PIPE NITRILE
38	4	44-XXXX	FLANGE - 316SS - 2in - COMPANION X 2in NPT
39	2	46-6163	ELBOW - 316SS - 2in - 90 DEG - SCH40 - THD
40	4	47-XXXX	GASKET - FLANGE - 2in X 1/8in - TEFLON
41	1	51-ROM	NEVER SIEZE - TUBE
42	4	60-4574	FLOAT - NOLTA - MS1 C - 20m
43	7	62-4857	BOLT - NC3-8 X 2 SS (FOR HATCH)
44	2	62-4858	CONDUIT UNIONS - 1in NPT (FOR HATCH)
45	2	62-4859	CONDUIT UNIONS - 3_4in NPT (FOR HATCH)
46	1	62-4860	CORD GRIP - LEAK SENSOR CABLE - 1-2in NPT
47	7	62-4862	NUT - NC3-8 NYLOCK SS (FOR HATCH)
48	14	62-4864	WASHER - FLAT - 3-8 SS (FOR HATCH)

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROV
1	PER COMMENTS 5/17/13	5-28-13	NG
2	PIPE ELEVATION REVISIONS	9-27-13	AD
3	REVISIONS PER PRODUCTION LAUNCH	10-21-13	AD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY

DSN - NG
DRN - NG
CKD - AD
DATE - 4/1/2013

COMPONENT DRAWING

ROMTEC UTILITIES
18240 NORTH BANK ROAD
ROSEBURG, OREGON 97470
(541) 496-9678
FAX (541) 496-0804

NOTE: ALL DIMENSIONS AND ELEVATIONS SHOWN ARE NOMINAL DIMENSIONS. IT IS THE RESPONSIBILITY OF THE ON-SITE CONTRACTOR OR ROMTEC UTILITIES CUSTOMER (NOT ROMTEC UTILITIES) TO VERIFY THE ACCURACY OF ANY CRITICAL DIMENSIONS OR ELEVATIONS PRIOR TO SETTING OR INSTALLING ANY EQUIPMENT.

6' DIAMETER WET WELL
2" DISCHARGE PIPING
80PU21.5 TSURUMI PUMPS

ALL MATERIALS SHOWN ON THIS SHEET WILL BE SUPPLIED BY ROMTEC UTILITIES AND DELIVERED TO THE SITE AFTER THE HOLE HAS BEEN EXCAVATED AND SHORED. THE CONTRACTOR SHALL SUPPLY A CRANE OF SUFFICIENT SIZE TO LOWER ALL THE CONCRETE PIECES INTO THE HOLE SAFELY. THE THE CONTRACTOR SHALL INSTALL THE WET WELL (AND VALVE VAULT AND METERING VAULT IF APPLICABLE). ROMTEC UTILITIES WILL PROVIDE A REPRESENTATIVE FOR TECHNICAL ASSISTANCE ON THE DAY OF INSTALLATION TO ANSWER ANY QUESTIONS THAT MAY ARISE. THE CONTRACTOR IS RESPONSIBLE FOR ALL PLUMBING AND ELECTRICAL CONNECTIONS AND INSTALLATION. ITEMS NOTED AS "BY OTHERS" WILL BE PROVIDED AND INSTALLED BY THE CONTRACTOR. ROMTEC UTILITIES WILL NOT INSTALL ANY OF THE COMPONENTS SHOWN ON THIS PAGE.

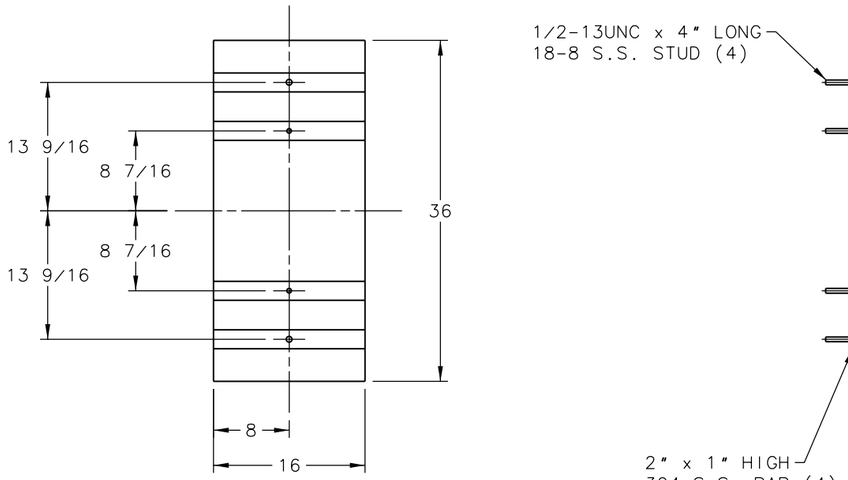
ANIMAL HEALTH PRODUCT FACILITY
2" - 6' DIA WET WELL

SHEET
1 OF 1

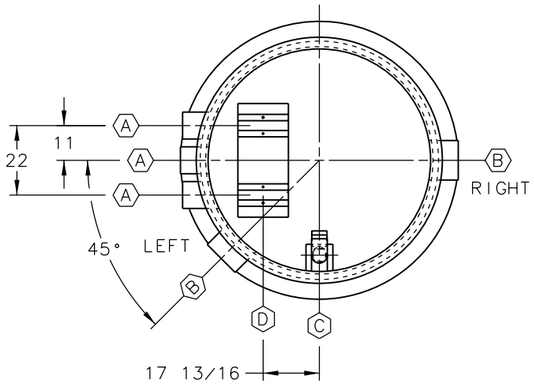
JOB NUMBER
RMTC
0000

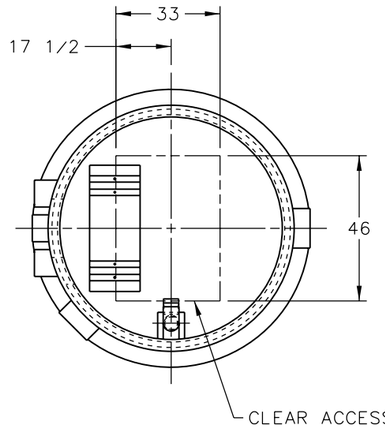
NOTE:

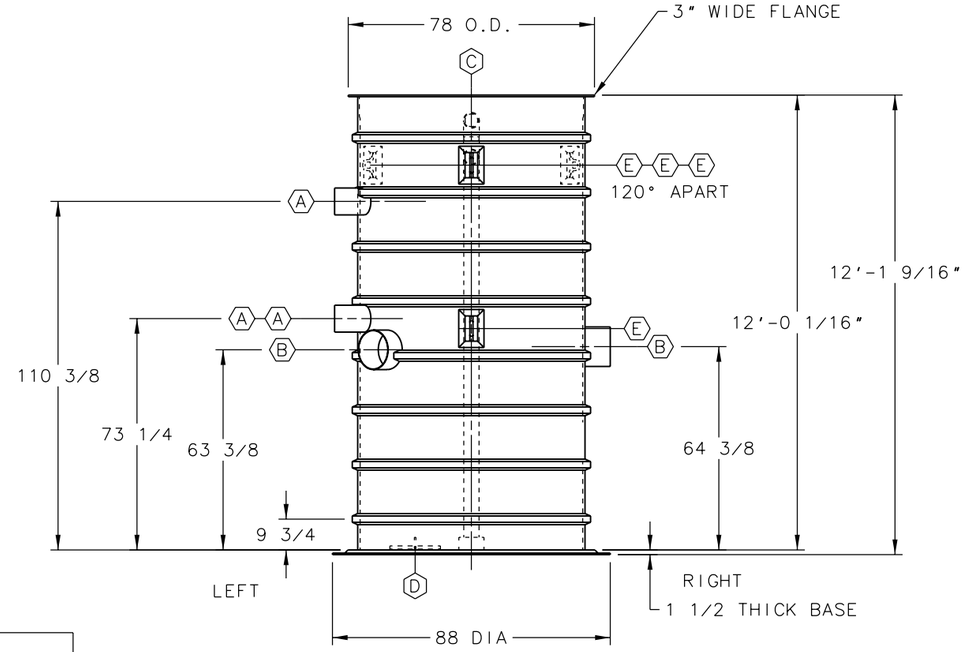
1 - DRAFT ONLY- NOT FOR PRODUCTION.
2 - ALL CHEMICAL TANKS REQUIRE CUSTOMER SUBMITTAL OF "UNDERGROUND CHEMICAL TANK LIMITED WARRANTY EXHIBIT A".
3 - RESIN SYSTEM FOR FRP COMPONENTS TO BE DETERMINED.



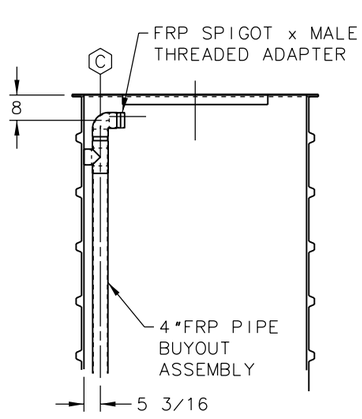
BOLTING PLATE DETAIL
SCALE: 1/8







FRONT VIEW



ITEM	QTY	DESCRIPTION
A	3	8"DIA V.E. FRP PIPE SLEEVE
B	2	12"DIA V.E. FRP PIPE SLEEVE
C	1	4"DIA V.E. FRP MONITOR PIPE WITH ELBOW & MALE THREADED ADAPTER
D	1	16" x 36" S.S. BOLTING PLATE WITH (4) 1/2-13UNC STUDS
E	4	LIFTING LUG

2	MOVE PIPES "A" LEFT SIDE DOWN 1/16" "B" RIGHT SIDE UP 1/6", MOVE BOLTING PLATE					
DRN DAG	DATE 10-11-13	CHK'D -	DATE -	APPR'D JB	DATE 9-14-13	
1	RELOCATE TOP NOZZLE 'A'. RELOCATE LEFT NOZZLE 'B'.					
DRN PRM	DATE 7-12-13	CHK'D -	DATE -	APPR'D JWL	DATE 7-12-13	

XERXES®
a ZCL company

DRN DAG	DATE 6-11-13	TITLE	6'DIA x 12'HIGH DW VERTICAL WET WELL ANIMAL HEALTH
CHK'D	DATE		
APPR'D JWL	DATE 6-12-13	DR. SIZE D	DR. NUMBER 643-661 REV 02
SALES MANAGER Bruce Coe		SCALE: 1/2"=1'-0"	SHT 1 OF 1
INDUSTRY TYPE: M401 UNDERGROUND CHEMICAL			

XERXES®
a ZCL company

October 25, 2013

Natalie Mc Farland
E-mail: romtec14@romtecutilities.com

CC: Bruce Coe, Xerxes

Re: Xerxes 6-foot-diameter x 12-foot-tall Double-Wall Wet Well
Buoyancy Calc – Animal Health - 3500 W. 91st St., De Soto KS 66018

Dear Natalie:

We have summarized the buoyancy data you requested. All of the calculations are based on the site data you have provided to us and on nominal engineering values for the physical parameters.

All of the calculations are based on standard engineering practice. Xerxes uses approaches in a manner similar to the protocols presented in the Petroleum Equipment Institute's Recommended Practices manual (PEI/RP 100-05) to calculate the underground tank Buoyancy Safety Factors. Note that for wet wells, Xerxes assumes a soil friction angle of 30 degrees.

It is the tank owner's responsibility to determine the suitability and applicability of installation. Our sole responsibility in any installation is as stated in our Limited Warranty.

Our calculations show that, given the installation parameters that you have provided to us (calculated with water table at finished grade and no secondary anchorage), Xerxes has found the following:

Wet Well	Buoyancy Safety Factor
6-foot-diameter x 12-foot-tall	4.26:1

Xerxes recommends a minimum Buoyancy Safety Factor of 1.20:1. I have included a copy of the worksheet for your files.

If we can be of additional assistance, please feel free to contact us.

Sincerely,

Jeffrey Lexvold
Sales Engineer

Attachment

XERXES® a ZCL company

WET WELL BUOYANCY CALCULATIONS NO SECONDARY ANCHORS

Animal Health - 3500 W. 91st St., De Soto KS 66018

JWL | **10/25/13**

WET WELL DATA				INSTALLATION DATA		
NOMINAL SHELL DIAMETER (FT)	=	6	*CALCULATED WITH WATER TABLE AT FINISHED GRADE*	HEIGHT BELOW GRADE (FT)	=	12.13
DIAMETER OF BOTTOM (FT)	=	6		DEPTH TO WATER TABLE FROM FINSHED GRADE (FT)	=	0.00
ANTI-FLOTATION FLANGE (IN)	=	6		VOLUME, BALLAST (GAL)	=	0.00
NUMBER OF RIBS	=	8				
WEIGHT OF WET WELL (LBS)	=	1200				

RESULTS

SAFETY FACTOR = **DOWN FORCE / UP FORCE** = **92602 LBS / 21717 LBS** = **SAFETY FACTOR 4.26:1**

WORKSHEET SUMMARY

DOWN FORCES:

BACKFILL, TOTAL WEIGHT (LBS)	=	*91401.52*
+ WET WELL, WEIGHT (LBS)	=	*1200.00*
+ BALLAST, WEIGHT (LBS)	=	*0.00*
= TOTAL DOWN FORCE (LBS)	=	*92601.52*

UP FORCES:

TOTAL DISPLACEMENT (GAL)	=	*2603.99*
x UNIT WEIGHT, WATER (LB/GAL)	=	*8.34*
= TOTAL UP FORCE (LBS)	=	*21717.23*

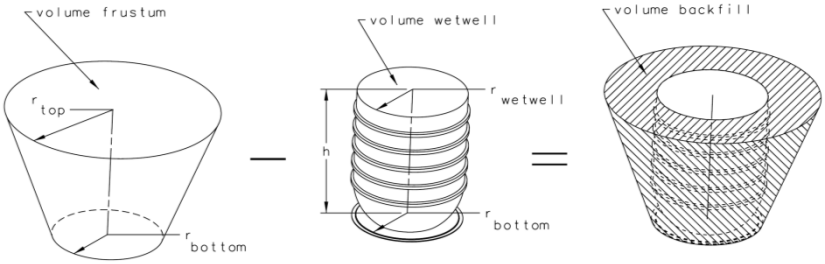
WORKSHEET

EQUATIONS:

$$Volume_{frustrum} = \frac{1}{3}\pi h(r_{top}^2 + r_{top}r_{bottom} + r_{bottom}^2)$$

$$Volume_{wetwell} = \pi r_{wetwell}^2 h_{cylinder} + Volume_{bottom}$$

$$Volume_{backfill} = Volume_{frustrum} - Volume_{wetwell}$$



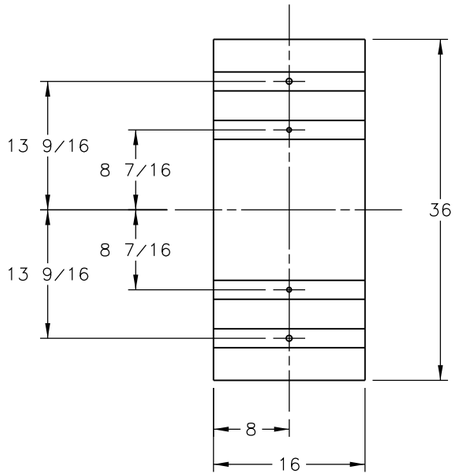
ASSUMPTIONS:

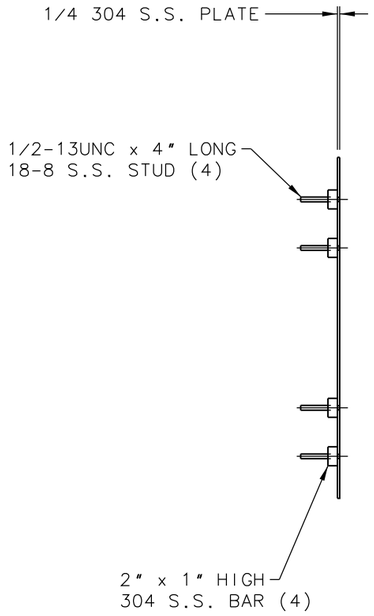
SOIL FRICTION ANGLE (DEG)	=	*30.00*	*UNIT WEIGHT, WET SOIL (LB/FT^3)*	=	*60.00*
WATER, UNIT WEIGHT (LB/GAL)	=	*8.34*	*UNIT WEIGHT, DRY SOIL (LB/FT^3)*	=	*100.00*

CALCULATIONS:

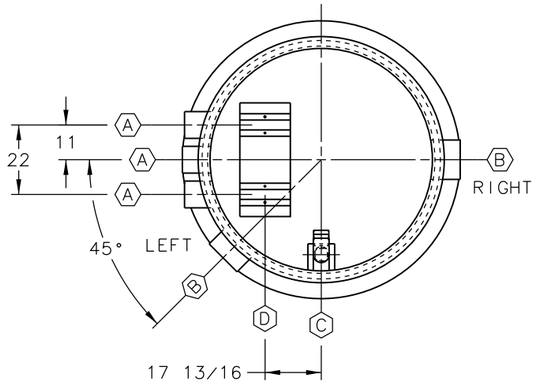
TOP RADIUS (AT GRADE) (FT)	=	*10.00*	*FRUSTUM, PORTION BELOW WATER TABLE (FT^3)*	=	*1871.49*
RADIUS (AT WATER TABLE) (FT)	=	*10.00*	*FRUSTUM, PORTION ABOVE WATER TABLE (FT^3)*	=	*0.00*
RADIUS AT BOTTOM (FT)	=	*3.50*	*FRUSTUM, TOTAL VOLUME (FT^3)*	=	*1871.49*
CYLINDRICAL PORTION, HEIGHT (FT)	=	*12.13*	*CYLINDER, PORTION BELOW WATER TABLE (FT^3)*	=	*342.97*
			CYLINDER, PORTION ABOVE WATER TABLE (FT^3)	=	*0.00*
BOTTOM PORTION, HEIGHT (FT)	=	*0.00*	*BOTTOM PORTION, VOLUME (FT^3)*	=	*0.00*
			RIBS, VOLUME (FT^3)	=	*5.15*
WET WELL, TOTAL VOLUME (GAL)	=	*2603.99*	*WET WELL, TOTAL VOLUME (FT^3)*	=	*348.13*
WET BACKFILL, WEIGHT (LBS)	=	*91401.52*	*WET BACKFILL, VOLUME (FT^3)*	=	*1523.36*
DRY BACKFILL, WEIGHT (LBS)	=	*0.00*	*DRY BACKFILL, VOLUME (FT^3)*	=	*0.00*
BACKFILL, TOTAL WEIGHT (LBS)	=	*91401.52*			

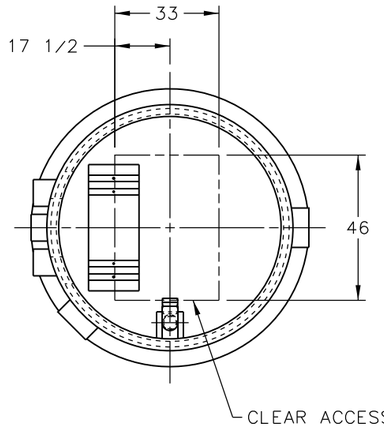
NOTE:
1 - SEE UCT# 571.13 FOR CONSTRUCTION DETAILS.

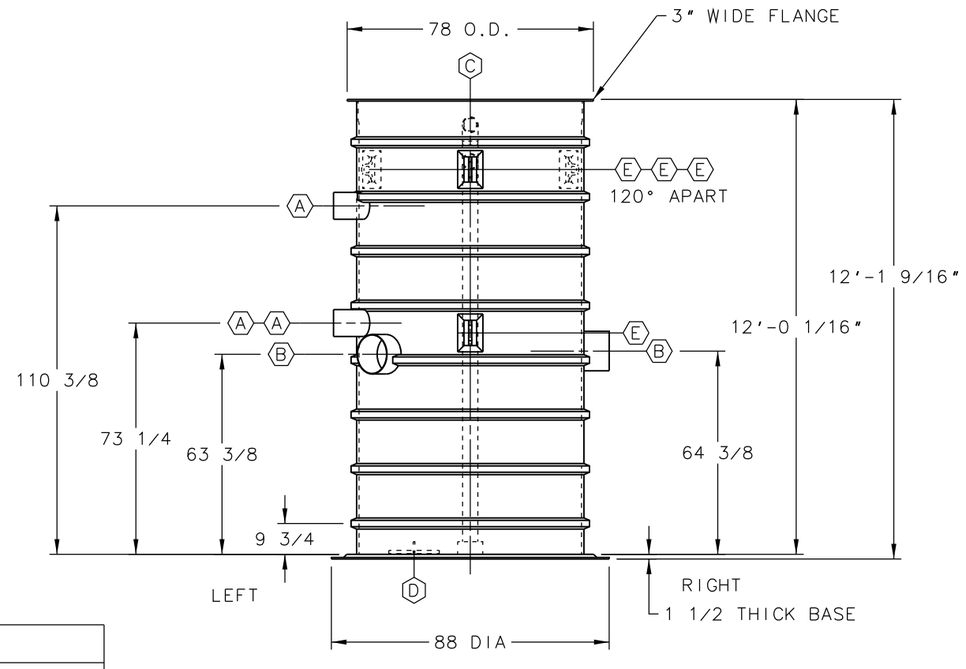




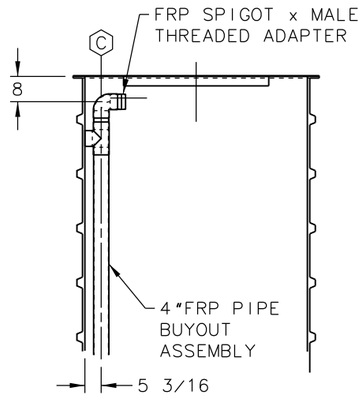
BOLTING PLATE DETAIL
SCALE: 1/8







FRONT VIEW



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D	1	16" x 36" S.S. BOLTING PLATE WITH (4) 1/2-13UNC STUDS
E	4	LIFTING LUG

3	DELETE "DRAFT ONLY" NOTATIONS. ADD UCT #.				
DRN PRM	DATE 10-25-13	CHK'D	DATE	APPR'D JWL	DATE 10-25-13
2	MOVE PIPES "A" LEFT SIDE DOWN 1/16" "B" RIGHT SIDE UP 1/6", MOVE BOLTING PLATE				
DRN DAG	DATE 10-11-13	CHK'D -	DATE -	APPR'D JB	DATE 9-14-13
1	RELOCATE TOP NOZZLE 'A'. RELOCATE LEFT NOZZLE 'B'.				
DRN PRM	DATE 7-12-13	CHK'D -	DATE -	APPR'D JWL	DATE 7-12-13

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a ZCL company

DRN DAG	DATE 6-11-13	TITLE	6'DIA x 12'HIGH DW VERTICAL WET WELL ANIMAL HEALTH
CHK'D	DATE		
APPR'D JWL	DATE 6-12-13	DR. SIZE D	DR. NUMBER 643-661 REV 03
SALES MANAGER Bruce Coe		SCALE: 1/2"=1'-0"	SHT 1 OF 1
INDUSTRY TYPE: M401 UNDERGROUND CHEMICAL			

XERXES®
CORPORATION

Nicole Gifford
Romtec Utilities
18240 North Bank Rd.
Roseburg, OR 97470

June 11, 2013

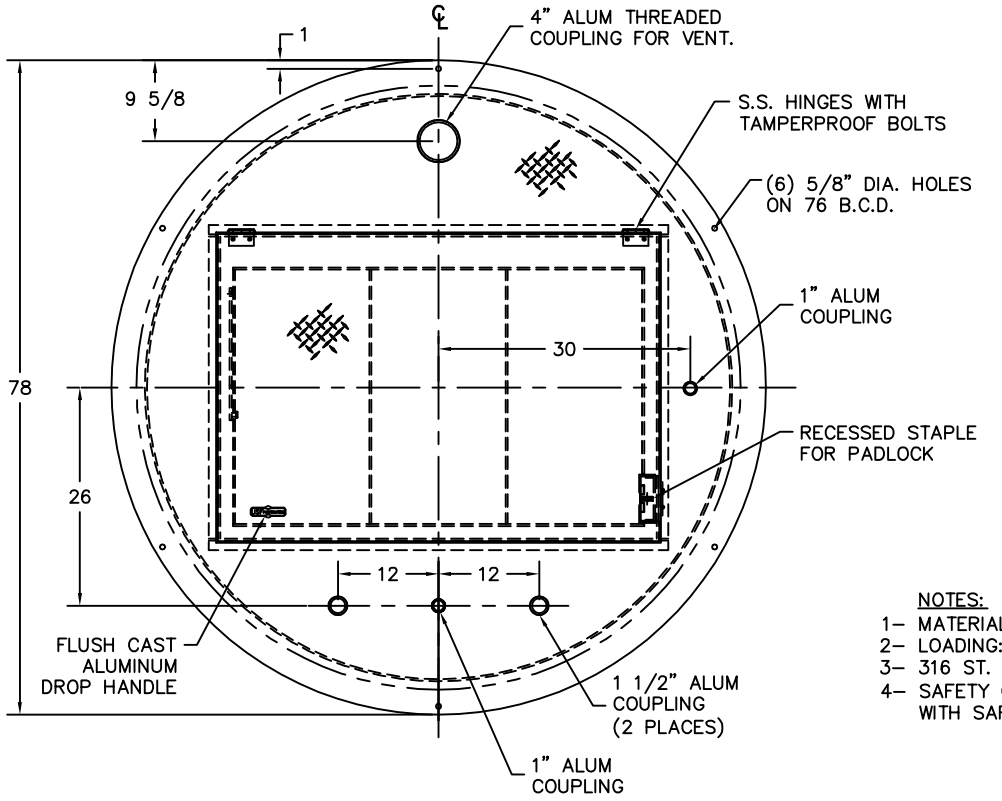
Subject: Animal Health

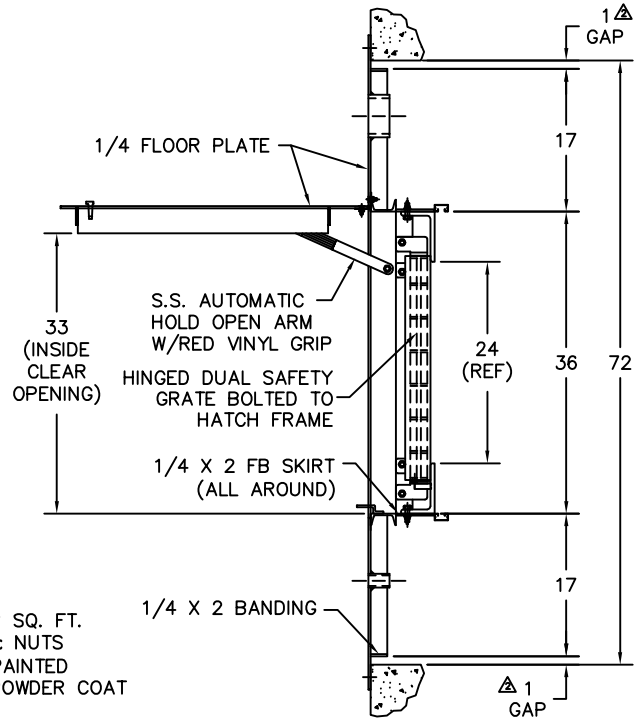
Dear Andy,

Xerxes standard practice is to pull a vacuum test on the interstial space of all double wall tanks or lift stations. Your tank will have vacuum of 15 inches of mercury put on the interstial space and held for 48 hours prior to shipment. Xerxes will verify this test with a written statement of completion of this test for your file.

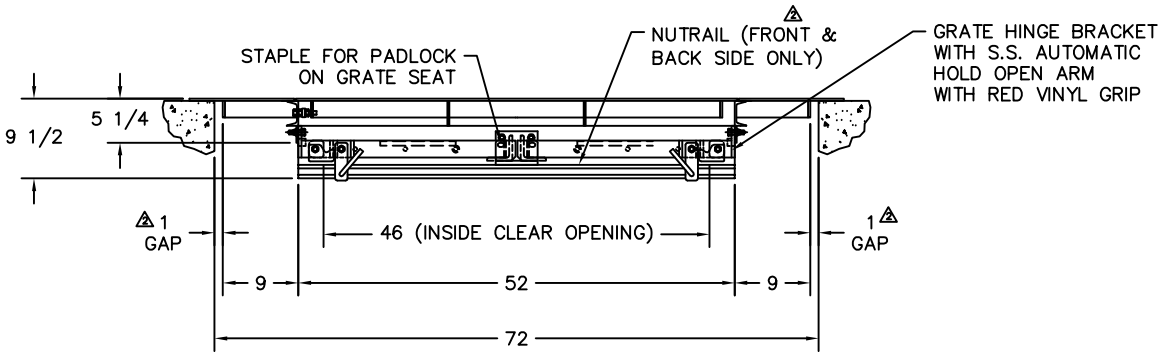
Sincerely,

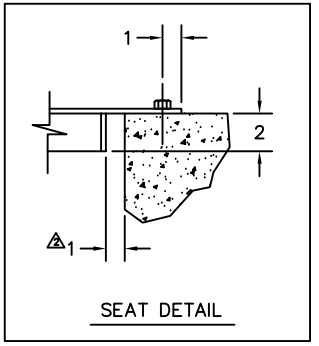
Bruce Coe
Western Regional Sales Manager
Water Products Division
Xerxes Corporation
16452 SE Keystone Drive
Milwaukie, OR 97267
503-653-1604
612-963-7561 (mobile)
bruce.coe@xerxes.com
www.xerxes.com





NOTES:
1- MATERIAL: ALUMINUM
2- LOADING: 300 LBS. PER SQ. FT.
3- 316 ST. STEEL BOLTS & NUTS
4- SAFETY GRATE TO BE PAINTED WITH SAFETY ORANGE POWDER COAT





REV.	DATE	BY	CHK.	DESCRIPTION
2	12/6/12	C.S.	A.Q.	ADDED NUTRAIL / 1" GAP WAS 1/4"
1	12/5/12	C.S.	A.Q.	ALUMINUM HATCH WAS STEEL / ADDED COUPLINGS

INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

TOLERANCES UNLESS OTHERWISE SPECIFIED
SURFACE FINISH: Mill
FRACTIONAL
± 1/16

U.S.F. FABRICATION INC.
HIALEAH, FLORIDA

HATCH BPS 72 ID X 78 OD – ALUMINUM 36 X 52 ACCESS DOOR W/RECESSED PADLOCK, NUTRAIL & DUAL SAFETY GRATE

DWN. BY:	SCALE:	QUOTE#	DATE:
C.S.	1=12	70076	10/12/12
CHK. BY:	DWG.#	SHEET SIZE:	SHEET NO:
DAV	75932-R2	C	1 OF 1

REV: 2

3.04 WET WELL RELATED DATA SHEETS

PAGE IS INTENTIONALLY LEFT BLANK

Specialty Switches – Continued

Portable Level Switch — Integral Mounting Magnet

Precisely monitors liquid level and is ideal for controlling filling operations and preventing overflows. Permanent magnet attaches unit securely to steel tank wall at exact level required.

LS-750 Series — Weighted for Suspension Cable

With a compact-sized float, slosh shield and weighted collar, the LS-750 provides liquid level detection for a wide variety of applications. Suspend in stand pipes or sumps for leak detection duty, or drop into wells for ground-water monitoring. Supplied with 25 feet of waperproof cable.

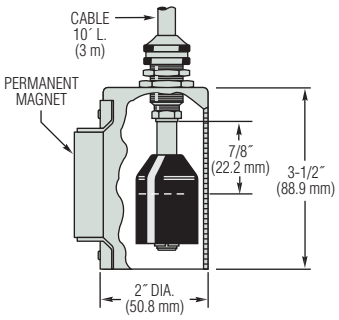
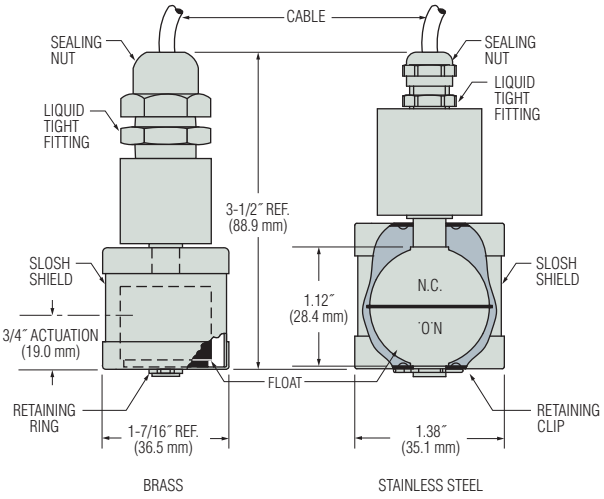
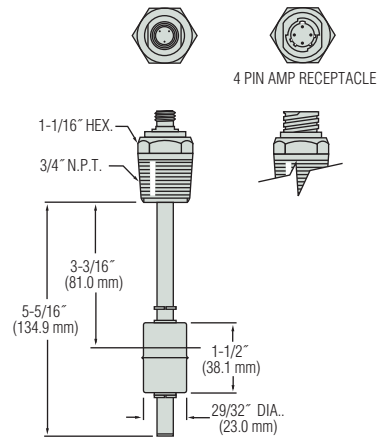
U.L. Recognized— File No. E-45168. CSA Listed-File No. LR-30200.

LS-700F Series

Overfill Protection for Refrigerant Tanks.The LS-700F enables safe compliance with EPA directives to recover refrigerants. These units are designed to fit standard 30# and 50# D.O.T. approved refrigerant tanks. They provide 80% full shutoff capability when used as an integral part of a recovery system.

U.L. Recognized— File No. SA8857. CSA Listed-File No. LR-30200-31.

Dimensions

Portable Level Switch	LS-750	LS-700F
		
SJO, 18/2 10´L., Neoprene	22 AWG, 2-Wire Cable	3- or 4-Pin, Quick-Connect Receptacle

†L_1 = Switch actuation level. In liquid with specific gravity of 1.0, switch actuation is approximately half the distance from end of stem to mounting, or at the halfway point of float travel.

How To Order — Select Part Number based on specifications required.

Series	Material			Min. Liquid Sp. Gr.	Operating Temperature	Pressure PSI, Max.	Switch*	Electrical Termination Option	Part Number
	Stem and Mounting	Float	Other Wetted						
Portable	Brass	Buna N	Aluminum, 316 S.S.	.85	Oil: -40°F to +230°F (-40°C to +110°C) Water: to 180°F (82°C)	10	SPST, 20 VA N.O., Dry	—	**15208** ⚡
LS-750	Brass	Buna N	Nylon, PVC, Beryllium Copper	.45		150	SPST, 20 VA N.O., Dry	PVC Cable Jacket	**149350** ⚡
	316 S.S.**	316 S.S.	PVDF, Viton®	.65	-40°F to 212°F (-40°C to +100°C)	375	SPST, 10 VA N.C., Dry	Teflon® Cable Jacket	**197433**
LS-700F	Brass	304 S.S.	—	.98	-40°F to +221°F (-40°C to +105°C)	400	SPST, 20 VA N.C., Dry	3-Pin	**128500** ⚡
								4-Pin	**144900** ⚡

*See "Electrical Data" on Page X-5 for more information.

⚡ – Stock Items.

** Stainless steel is generally recognized as safe (GRAS) with FDA for food contact regulations.

VELAN

CAST STEEL
Gate, Globe and Check Valves

API 600 & 603 • ASME Class 150–1500 • 2 – 60" (50 – 1500 mm)

VELAN COMPANY PROFILE

Velan is one of the world's leading manufacturers of industrial valves, supplying forged and cast steel gate, globe, check, ball, butterfly and knife gate valves for critical applications in the chemical, petrochemical, oil and gas, fossil and nuclear power, cogeneration, pulp and paper and cryogenic industries.

Founded in 1950, Velan earned a reputation for excellence as a major supplier of forged valves for nuclear power plants and the U.S. Navy. Velan Inc., pioneered many designs which became industry standards, including bellows seal valves, all stainless steel knife gate valves and forged valves up to 24".

Velan valves are manufactured in 12 specialized manufacturing plants, including five in Canada, two in Korea, and one each in the U.S., France, U.K., Portugal and Taiwan. We have a total of 1,126 employees in North America and 374 overseas.

CONTENTS

The **Velan Corporate Philosophy** is to bring to the market new and innovative valve designs with special emphasis on quality, safety, ease of operation, simple in-line maintenance and most of all, long service life. All this combined with the use of high quality materials, advanced manufacturing technology and automation in all stages of manufacturing ensures the highest possible quality at a competitive price. Velan is strongly committed to defending its market position and aggressively competing in all countries around the world.

MONTREAL, CANADA 115,000 sq. ft. (10,683 m²)
3–24" (80–600 mm) butterfly, ⅜–4" (10–100 mm) metal & resilient seated ball valves

MANUFACTURING LOCATIONS

CANADA

VELAN INC.
HEAD OFFICE & PLANT 5
7007 Côte de Liesse
Montreal, QC H4T 1G2
Tel: (514) 748-7743
Fax: (514) 748-8635

PLANT 1
2125 Ward Avenue
Montreal, QC H4M 1T6
Tel: (514) 748-7743
Fax: (514) 748-8635

PLANT 2/7
550 McArthur Ave.
Montreal, QC H4T 1X8
Tel: (514) 748-7743
Fax: (514) 341-3032

PLANT 4/6
1010 Cowie Street
Granby, QC J2J 1E7
Tel: (450) 378-2305
Fax: (450) 378-6865

PROQUIP
835 Fourth Line
Oakville, ON L6L 5B8
Tel: (905) 842-1721
Fax: (905) 849-0923

U.S.A.

VELAN VALVE CORPORATION
PLANT 3
94 Avenue C
Williston, VT
05495-9732
Tel: (802) 863-2562
Fax: (802) 862-4014

ENGLAND

VELAN VALVES LTD.
Cambridge Rd.,
Whetstone
Leicester LE8 6LH
Tel: 44-116-275-0206
Fax: 44-116-275-0224

FRANCE

VELAN S.A.S
90, rue Challemel Lacour
F 69 367 Lyon Cedex 7
Tel: (33) 4 78 61 67 00
Fax: (33) 4 78 72 12 18

PORTUGAL

VELAN VÁLVULAS INDUSTRIAIS, LDA.
Av. Ary dos Santos
1679-018 Famoes
Tel: (351-21) 934-7800
Fax: (351-21) 934-7809

TAIWAN

VELAN-VALVAC
P.O. Box 2020
Taichung, Taiwan, R.O.C.
Tel: (04) 2792649
Fax: (886) 42750855

KOREA

VELAN LTD.
1060-4 Shingil-Dong
Ansan City,
Kyunggi-do
425-833
Tel: (82) 31-491-2811
Fax: (82) 31-491-2813

DISTRIBUTION CENTERS

U.S.A.

VELCAL
537 Stone Road, Unit "A"
Benicia, CA 94510
Tel: (707) 745-4507
Fax: (707) 745-4708

VELEAST
605 Commerce Park Drive SE
Marietta, GA 30060
Tel: (770) 420-2010
Fax: (707) 420-7063

GERMANY

VELAN GmbH
Daimlerstrasse 8
D-47877 Willich
Tel: (49) 2154/4938-00
Fax: (49) 2154/4938-99

Velan has sales offices and distributors located worldwide.

GENERAL INFORMATION

Tel: (514) 748-7743 Fax: (514) 748-8635

Visit the Velan website at **www.velan.com** for an updated contact list.

NOTE: *The material in this catalog is for general information. For specific performance data and proper material selection, consult your Velan representative. Although every attempt has been made to ensure that the information contained in this catalog is correct, Velan reserves the right to change designs, materials or specifications without notice.*

MANUFACTURING PLANTS AROUND THE WORLD

MONTREAL, CANADA 109,000 sq. ft. (10,126 m²) ¼–4" (8–100 mm) forged gate, globe & check valves, ASME 'N' stamp, ISO 9001

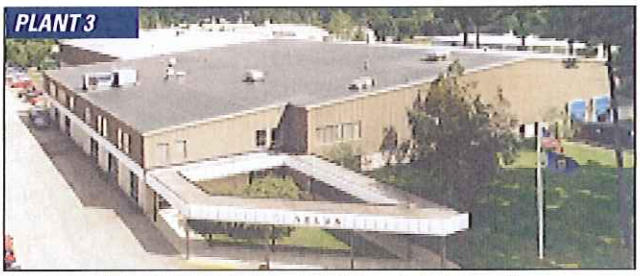
MONTREAL, CANADA 170,000 sq. ft. (15,800 m²)
2–60" (50–1500 mm) forged and cast steel gate, globe, check, ball, knife and butterfly valves 3–36" (80–700 mm) ASME 'N' stamp, ISO 9001

GRANBY, CANADA 186,500 sq. ft. (17,325 m²)
2–12" (50–300 mm) cast steel gate and check valves,
¼–12" (8–300 mm) ball valves, ISO 9001

TORONTO, CANADA *Velan-Proquip* 41,000 sq. ft. (3,800 m²)
2–48" (50–1200 mm) wafer check valves
½–24" (15–600 mm) clamp joint connectors, ISO 9001

WILLICH, GERMANY 12,000 sq. ft. (1,115 m²) ISO 9002

LEICESTER, ENGLAND 14,000 sq. ft. (1,300 m²), ISO 9002



WILLISTON, VERMONT, U.S.A. 155,000 sq. ft. (14,400 m²)
2–24" (50–600 mm) forged and cast steel gate, globe and check valves, ASME 'N' stamp, ISO 9001

LYON, FRANCE 160,000 sq. ft. (14,900 m²) ¼–40" (8–1,000 mm) forged and cast steel gate, globe and butterfly valves, ISO 9001

LISBON, PORTUGAL 60,000 sq. ft. (5,600 m²) ISO 9002
2–12" (50–300 mm) cast steel gate, globe and check valves

ANSAN CITY, SOUTH KOREA *Plant 1* 30,000 sq. ft. (2,800 m²)
components and 2-4" (50–100 mm) cast steel valves, ISO 9002

ANSAN CITY, SOUTH KOREA *Plant 2* 65,000 sq. ft. (5,800 m²)
2–12" (50–300 mm) cast steel gate, globe, check, ball and knife gate valves

TAICHUNG, TAIWAN *Velan-Valvac* 20,000 sq. ft. (1,840 m²)
¼–2" (8–50 mm) ball valves, ISO 9002

VELAN API 600 & 603 CAST STEEL VALVES

FOR THE OIL, GAS, PETROCHEMICAL, CHEMICAL AND PULP & PAPER INDUSTRIES

LOW FUGITIVE EMISSIONS

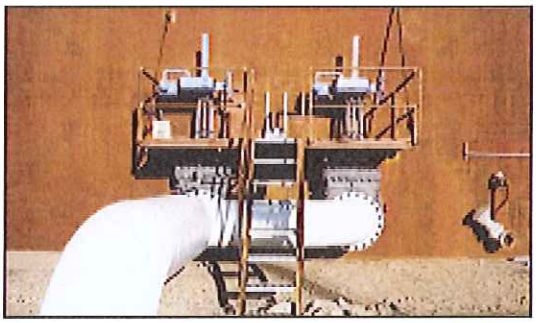
Velan's comprehensive line of cast steel gate globe and check valves features leading edge design, engineering and manufacturing technology. Our valves meet the most stringent national and international standards for fugitive emissions.

Our gate globe and check valves are widely used in many industries including:

- **Process Industries** – Oil, Chemical, Petrochemical, Refining, Pulp & Paper, Pharmaceutical and Food Processing.
- **Power Industries** – Nuclear, Fossil Fuel, Combined Cycle, Cogeneration and District Heating.

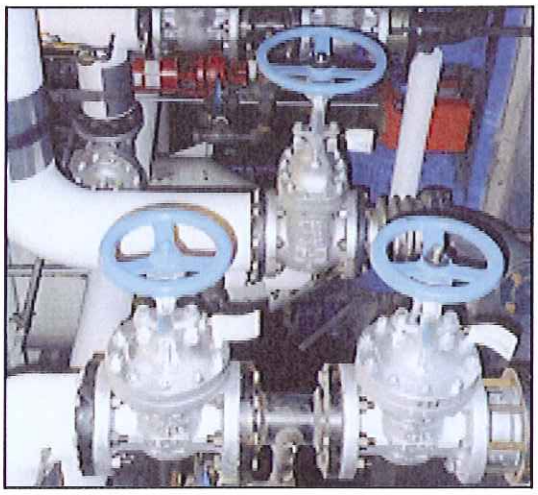
In addition, our valves are used for Shipbuilding, LNG Tanker Carriers, Offshore Platforms, Water Treatment, Mining and more.

Carbon steel gate valve (ASME Class 600), used for boiler feed water installation at a Hydrogen Plant in Texas.



Cast steel valve installation at an oil refinery.

A geothermal power plant valve installation for sour gas service.



API 600 gate valves in service for a boiler feed installation.

CAST STEEL VALVES MANUFACTURING PROGRAM

API 600 CAST STEEL GATE, GLOBE & CHECK VALVES

VALVE TYPE & CLASS		SIZE (in, mm)																					
		2 50	2½ 65	3 80	4 100	6 150	8 200	10 250	12 300	14 350	16 400	18 450	20 500	24 600	28 700	30 750	32 800	36 900	40 1000	42 1100	48 1200	54 1350	60 1500
GATE	150	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	600	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	900	✓	✓	✓	✓	✓	✓	✓															
	1500	✓	✓	✓	✓	✓	✓	✓															
GLOBE	150	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓											
	300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓											
	600	✓	✓	✓	✓	✓	✓	✓															
	900	✓		✓	✓																		
	1500	✓		✓	✓																		
CHECK	150	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓					
	300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
	600	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓									
	900	✓	✓	✓	✓	✓	✓																
	1500	✓	✓	✓	✓	✓	✓																

API 603 CAST STAINLESS STEEL GATE, GLOBE & CHECK VALVES

VALVE TYPE & CLASS		SIZE (in, mm)																
		½ 15[1]	¾ 20[1]	1 25[1]	1½ 40[1]	2 50	2½ 65	3 80	4 100	6 150	8 200	10 250	12 300	14 350	16 400	18 450	20 500	24 600
GATE	150	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
GLOBE	150	✓	✓	✓	✓	✓	✓	✓	✓	✓								
	300	✓	✓	✓	✓	✓	✓	✓	✓	✓								
CHECK	150	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					

(1) Refer to API 603 catalog.

API 600 BONNET GASKET MATERIALS

VALVE TYPE	MATERIAL
GATE	Class 150: corrugated steel/graphite (except 2–2½" (50–65 mm) spiral wound)
	Class 300–1500: spiral wound stainless steel and graphite
GLOBE	Spiral wound stainless steel and graphite
CHECK	Spiral wound stainless steel and graphite

API 603 BONNET GASKET MATERIALS

VALVE TYPE	MATERIAL	
	Trim SX or SY	Trim GX, GY or GS
GATE, GLOBE and CHECK	PTFE with stainless wire mesh	graphite with stainless steel foil

OPTIONAL BODY MATERIALS

ASTM SPEC. GRADE	NOMINAL DESIGNATION	MIN. TEMP °F	MIN. TEMP °C	MAX. TEMP. °F	MAX. TEMP. °C	VELAN CODE
A216-WCB	Carbon steel	-20	-29	800	427	02
A217-WC6	1¼ CR–½ Mo	-20	-29	1100*	593	05
A217-WC9	2¼ CR–1 Mo	-20	-29	1100*	593	06
A217-C5	5 CR–½ Mo	-20	-29	1200*	649	04
A217-C12	9 CR–1 Mo	-20	-29	1200*	649	09
A352-LCB	Carbon steel	-50	-46	650	343	25
A352-LCC	Carbon steel	-50	-46	700	371	31
A352-LC2	2½ Ni	-100	-73	650	343	26
A351-CF8M	18 CR-9 Ni-2 Mo	-425	-254	1500*	816*	13
A351-CF3M	18 CR-9 Ni-2 Mo	-425	-254	850	454	14

*Note: *Flanged end ratings terminate at 1000°F (538°C) for Class 150.*

VELAN

Mission Statement

Our aim is to offer products and services which not only meet, but clearly exceed, the expectations of our customers.

Through training, teamwork and performance, our employees strive to achieve continuous improvement of all processes.

Our goals are:
Total Quality and On-time Delivery.
Our method is Total Commitment.

A.K. Velan,
President and C.E.O.

ON-LINE NETWORKED SPC

Velan has installed on-line networked SPC computers operated by machinists themselves.

Each unit can handle four gageports and provide instant feedback on tool wear and lubrication to a control manager station.

6 SYSTEMS ENSURE THE FINAL QUALITY GOALS

1. DESIGN

All valves are designed to comply with the requirements of ASME B16.34, the ASME code and special customer requirements, as applicable.

2. QUALITY ASSURANCE

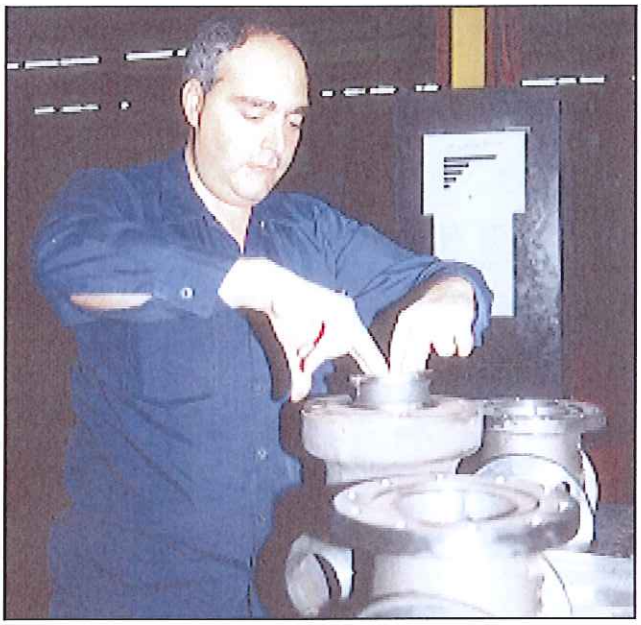
Every step from procurement through production, welding, assembly, testing and packaging is in accordance with written quality programs and procedures. (An ASME Section III manual for code valve production and an ISO 9001 QA manual for all other production.) Velan's six North American plants are certified to IS0 9001 and Plants 1 and 2 have ASME "N" type Certificates of Authorization, Plant 3 has a Certificate of Accreditation Furthermore, Velan has been fully approved to supply CE marked valves in accordance with the PED (European Pressure Equipment Directive). Orders are reviewed by Engineering and QA Departments and all special customer requirements are incorporated into QCI (Quality Control Instructions) issued for each project. The QA Department also maintains calibration and gauge control systems, and trains and qualifies skilled welders and NDT inspectors.

3. QUALITY CONTROL

The QC Department is responsible for all aspects of quality, from receiving of material to control of machining processes, welding, nondestructive examination, assembly, pressure testing, cleaning, painting and packaging. When required, a permanent record of all completed quality goals is prepared and sent to customers in the form of a "Valve Data Package".

4. PRESSURE TESTING

Each valve is pressure tested in accordance with ASME B16.34, the ASME Code, or special customer requirements as applicable. In all plants test status is integrated into production control/inventory management software.



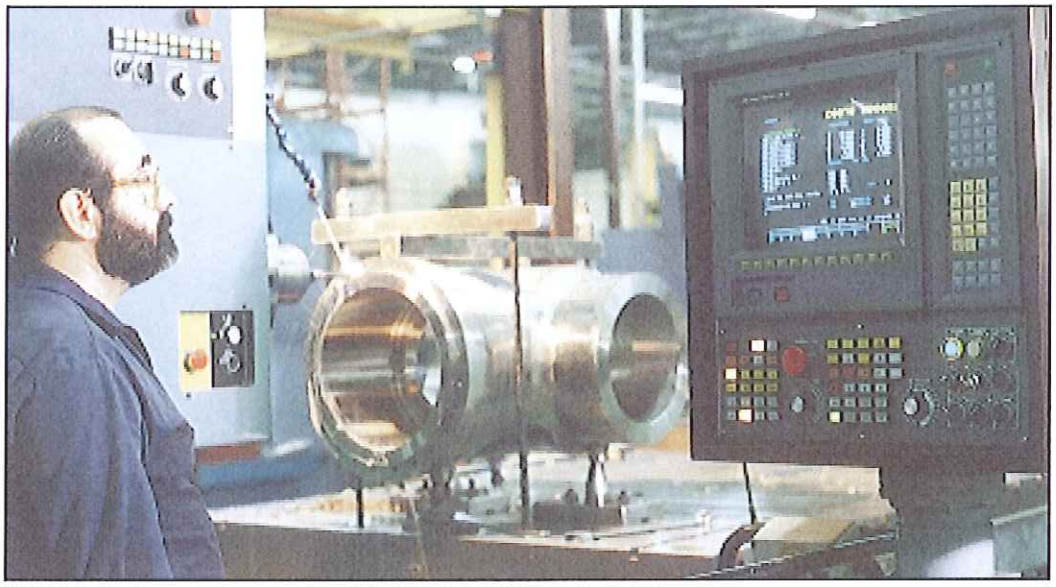
TQM innovations at Plant 2 include "snag lists" of any problems encountered in daily engineering and manufacturing processes. The lists are compiled on a weekly basis and automatically become the first items on the agenda for TQM team meetings.

5. IMPROVEMENT TEAMS

Continuous Improvement Teams at point of manufacturing ensure quality at source, process control, higher quality workmanship and operator ownership.

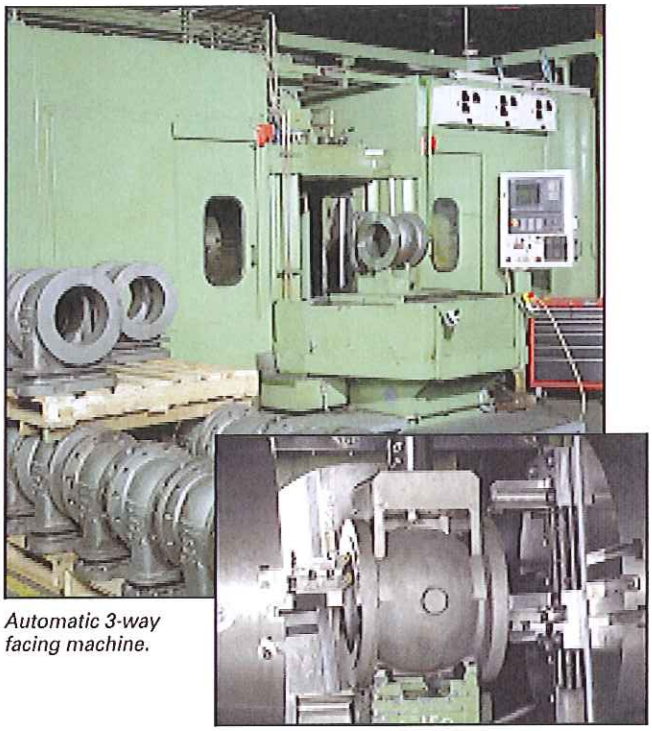
6. QUALIFICATION TESTING

A key to reliability is the performance of functional qualification tests. These tests are performed on all valves to determine reliability and service life. 1000 cold and 1000 thermal cycles with 1000°F superheated steam and five blowdowns with "0" leakage.



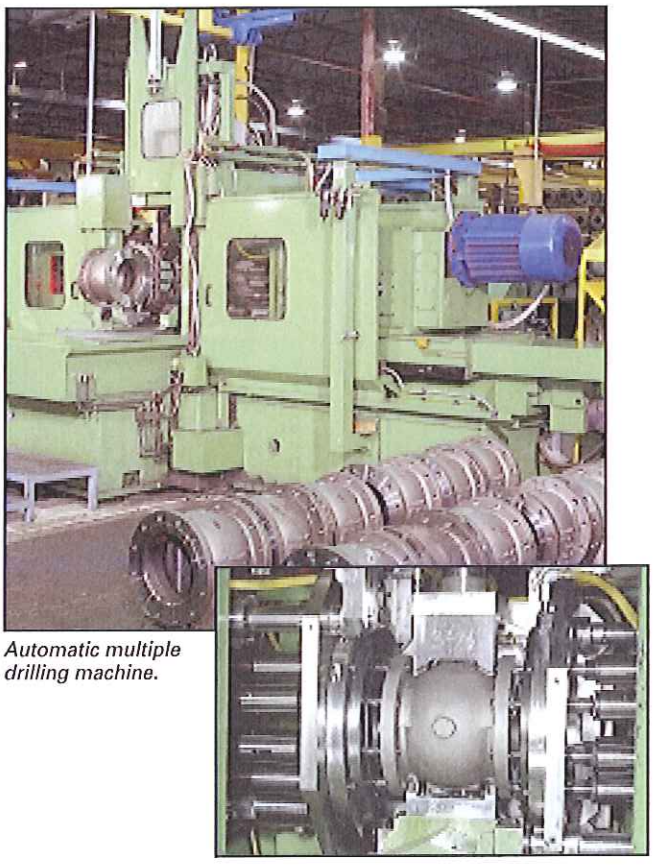
Operator on CNC horizontal boring mill monitors his own quality.

WORLD'S LARGEST MASS PRODUCTION
OF API 600 CAST STEEL VALVES

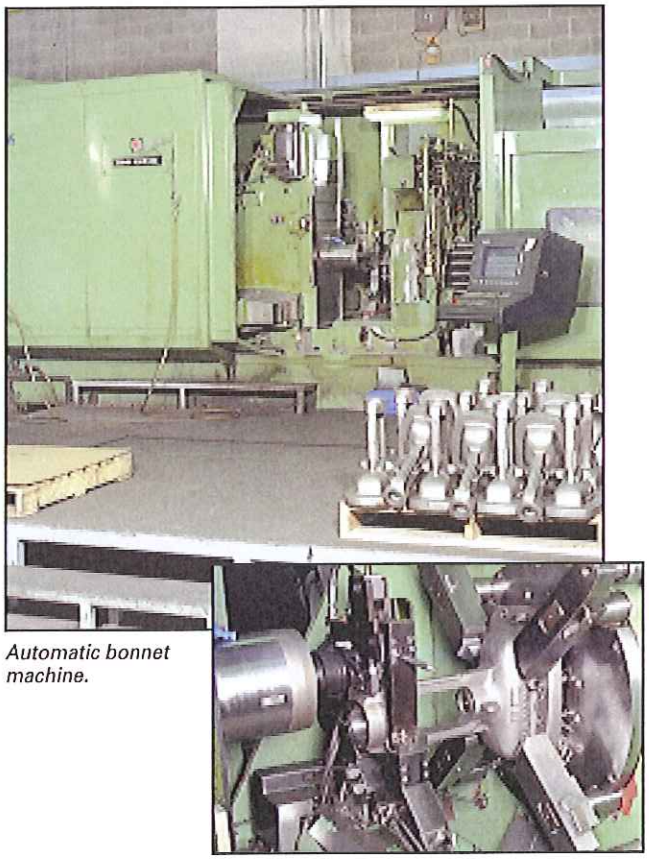


Automatic 3-way facing machine.

For smaller runs, complete automatic machining and drilling in one set-up.



Automatic multiple drilling machine.

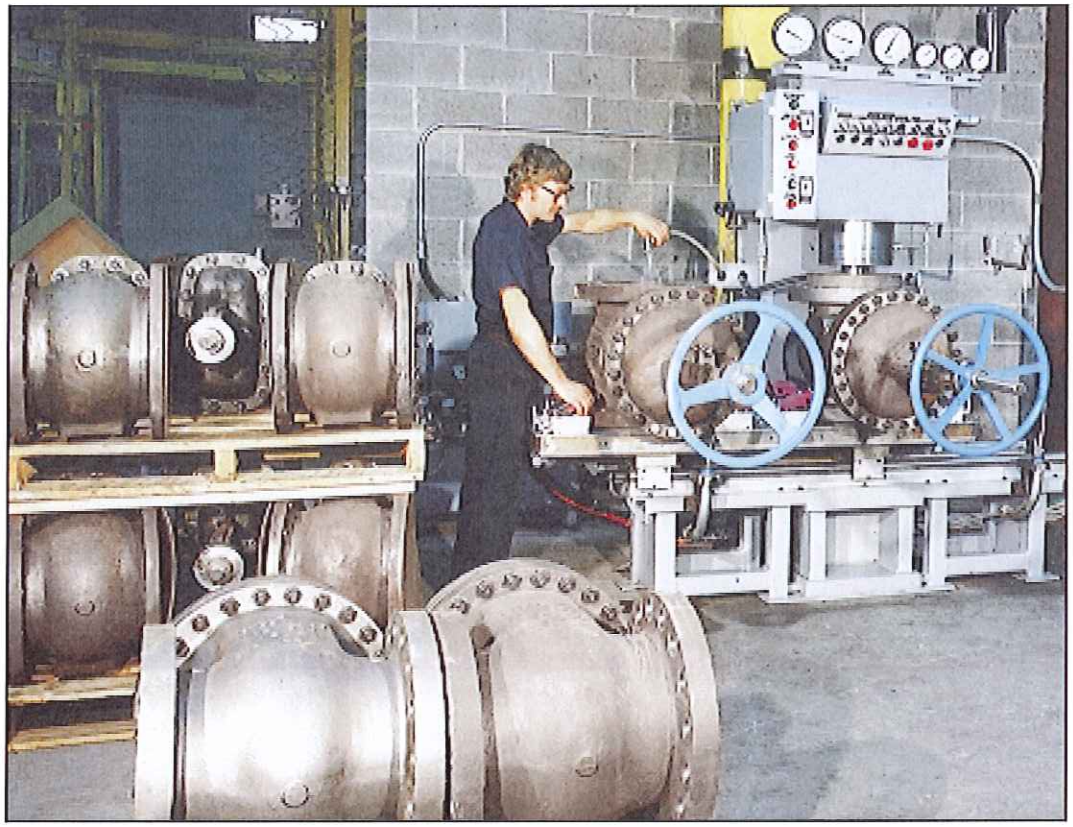


Automatic bonnet machine.

AUTOMATIC PLASMA ARC HARDFACING
FOR SEATS AND DISCS

High quality deposits of Stellite 6 and other hardfacing alloys are assured by the use of the following state of the art technology: controlled preheating, automatic Plasma Arc hardfacing equipment and a controlled cooling process. Shown below is the hardfacing of a gate valve wedge and to the right a cast steel seat.

RELIABILITY THROUGH TESTING

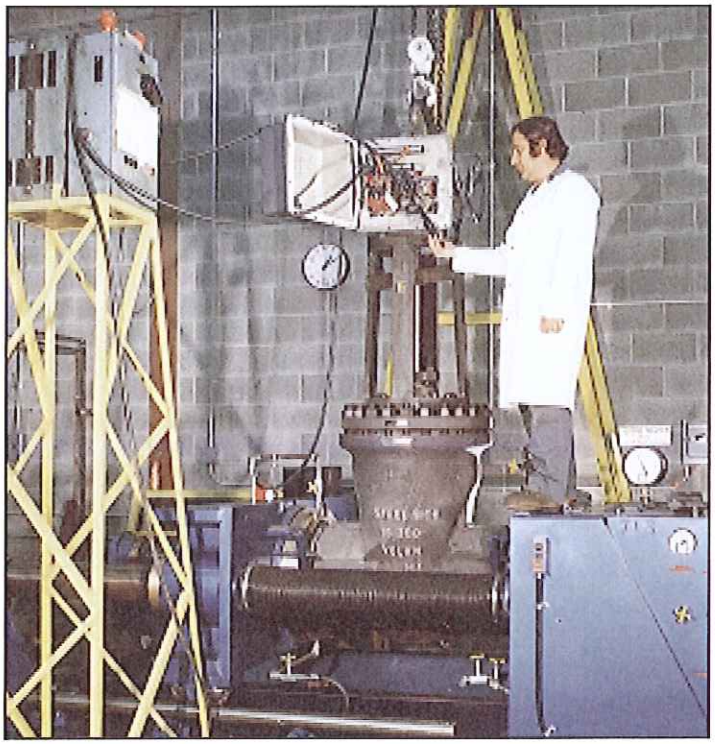


Top:
Semi-automatic stations for testing 2–12" (50–300 mm) valves to API 598.

Bottom Right:
Operational test for electric actuators.

Bottom Left:
TA-LUFT qualification test on a 4" Class 600 gate valve with live-loading. The test medium is helium at 1500 psi (100 bar).

All valves are tested during production for reliability with pressurized air and hydrotested for bubble-free tightness in accordance with API 598 specifications.



CONTINUOUS CASTING QUALITY IMPROVEMENT
AND COMPUTERIZED CASTING PROCESS SIMULATION

VELAN'S VEL-QCI-955 PROGRAM (API 600/ISO 10434)

The **Velan VEL-QCI-955 Program** was implemented to set the quality control standards for pressure boundary castings, and to ensure a consistent supply of quality castings to Velan.

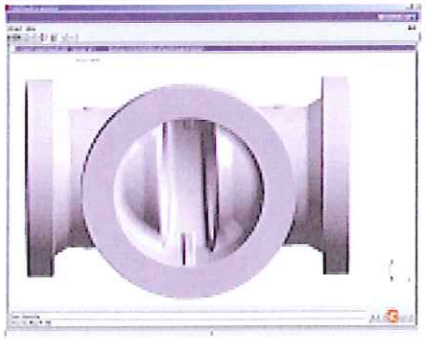
1. X-Ray Sample (pattern) Approval Process;
2. X-Ray Monitoring Program;
3. Casting Monitoring Program.

SAMPLE CASTINGS

Before castings are released for production, the Velan NDE Inspector Level III, evaluates and approves the submitted x-ray films (100% coverage) as per B16.34 acceptance standard.

X-RAY MONITORING:

Random x-ray monitoring requires that castings taken every six months from each vendor, randomly by size and quantity sets and x-rayed per B16.34 requirement.

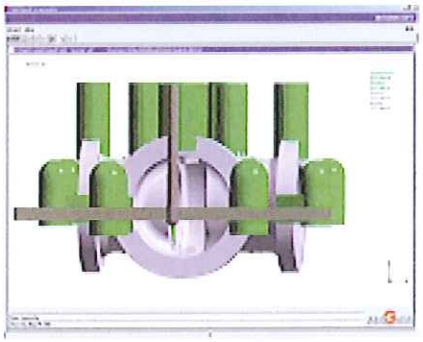


Pro-Engineering model imported into Magmasoft® casting simulation program.

If casting fails to meet the x-ray requirements of B16.34, Velan's Senior Metallurgist will issue a corrective action request to the vendor, including recommendations for detailed methoding change and re-x-ray.

CASTING MONITORING:

Rejected castings due to defects such as hydro-test leakage, porosity, inclusions, shrinkage indication discovered by x-ray or machining, are entered into the computer, as part of the statistical control of each vendor.

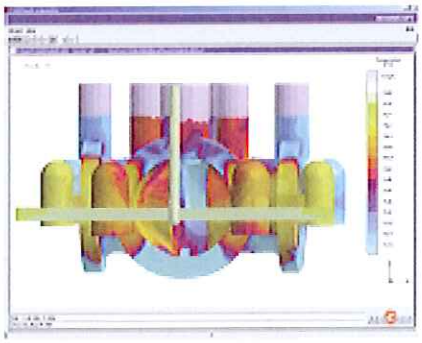


Risering and gating simulation on a 30" Class 600 gate body.

3-D SOLIDIFICATION SIMULATION:

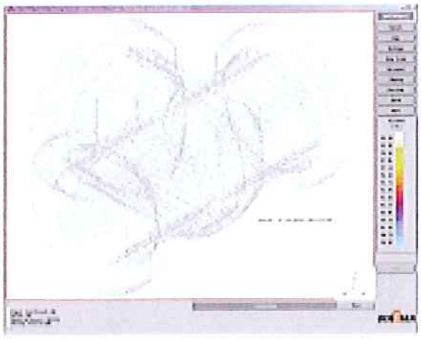
Velan is one of the first valve manufacturers in the world to have the MAGMASOFT® computer casting simulation program at its design facilities.

Working together with foundry engineers and our designers, we continue improving the internal integrity of castings, to X-Ray Level II or better as a general standard.



90% filling simulation on a 30" Class 600 gate body.

One example of the successful cooperation of Engineering, our Metallurgist and the foundry, using the MAGMASOFT® simulation, is shown for 30" Class 600 Gate body on this page.



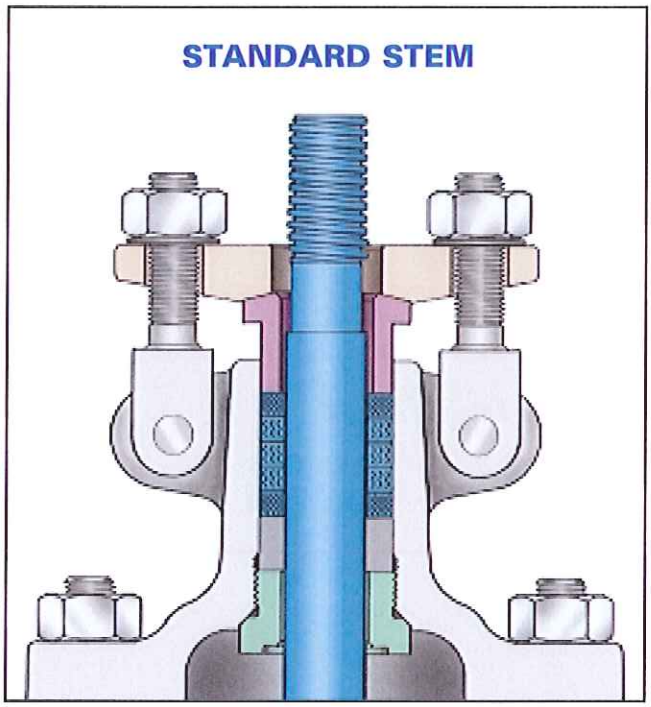
No shrinkage on a 30" Class 600 gate body simulation.

Benefits to Velan's customers and to the foundries:

- **Shorter delivery time,**
- **Higher quality of commercial castings,**
- **Optimum methoding system,**
- **Elimination of trial at sample approval,**
- **Improves the internal integrity of castings (RT level 2 or better) at pattern approval,**
- **Optimizes the metal flow and solidification pattern,**
- **Predicts internal defects,**
- **Reduces scrap,**
- **Optimizes the design of the castings,**
- **Solves problems such as shrinkage and porosity, without test castings,**
- **Reduces NDE (x-ray) upgrading.**

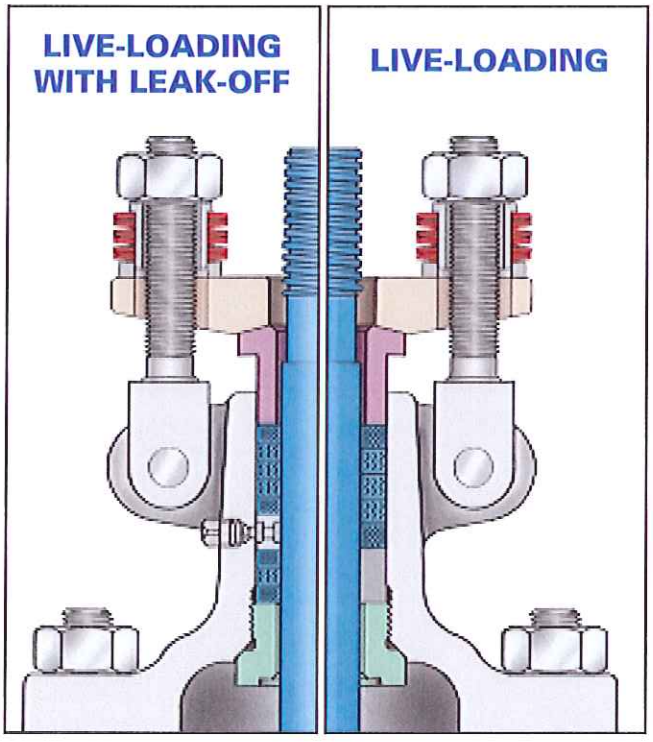
DESIGN OF STEM SEALS

Velan now offers standard cast steel bolted bonnet gate and globe valves qualification tested for compliance with EPA fugitive emissions regulations



The Velan stem seal evolved from these test findings:

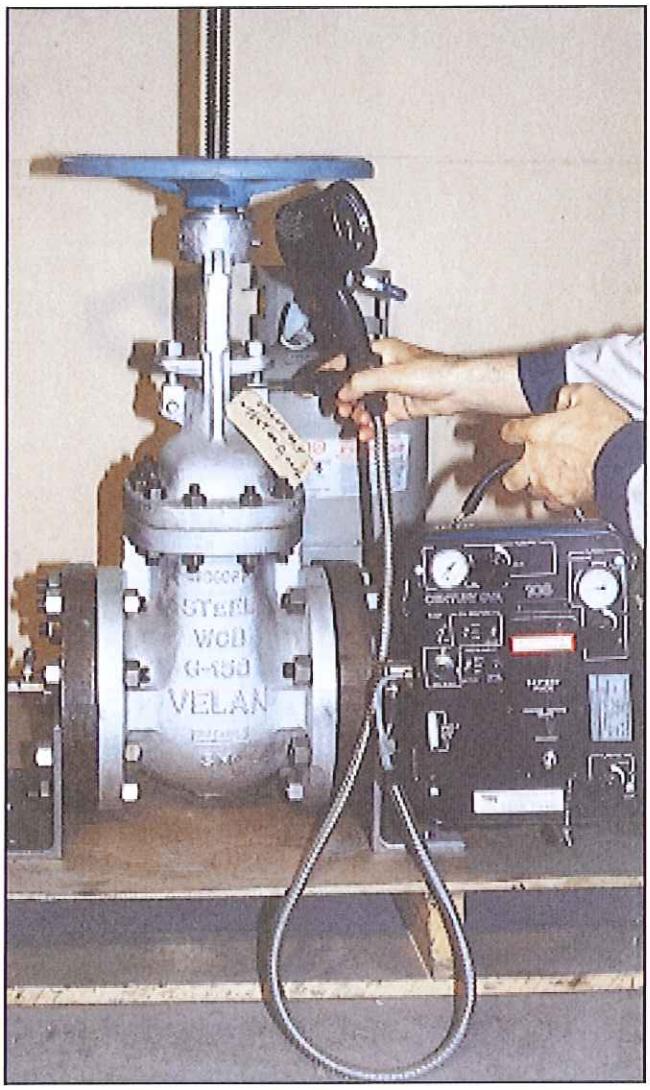
- **Ensures leakage of less than 100 ppm** as demonstrated through extensive laboratory testing.
- **Large loads.** Sealing is achieved when compression load is high and packing forms a mass of low porosity and permeability (4,000 psi for graphite).
- **Small clearances between vital parts.**
- **Precision stem and packing chambers.** Straightness, roundness and fine finish of stem and packing chamber wall are essential.
- **Short and narrow packing chambers improve sealing.** Maximum six rings in a single set chamber and wherever possible, only ¼" wide.
- **Stem and packing chamber walls.** Close roundness, straightness and superior surface finish of 6 RMS or better for the stem and 63 RMS for the packing chamber.



LIVE-LOADING OPTIONS

- **Live-loading.** Two sets of Belleville springs maintain a permanent packing stress of 3500–4000 psi. Live-loading extends low emission service life especially in service with large pressure/ temperature transients or frequent cycling.
- **Leak-off.** For critical service a lantern ring and double packing can be provided with a leak-off connection. The leak-off is provided to allow collection of leakage from the lower packing set.
- **Rings individually compressed in packing chamber** to 3500 –4000 psi for graphite and 2,000 psi PTFE to ensure equal stress distribution and effectiveness of all rings.
- Velan has extensive experience in valve live-loading. The original live-loading concept was developed by Velan in 1972 in a research project for AECL to eliminate leakage in Nuclear service. Velan has been supplying live loaded valves for Nuclear and non-Nuclear service for more than 30 years.

API 600 CAST STEEL VALVES
TYPICAL TEST REPORT



TEST CONDITIONS

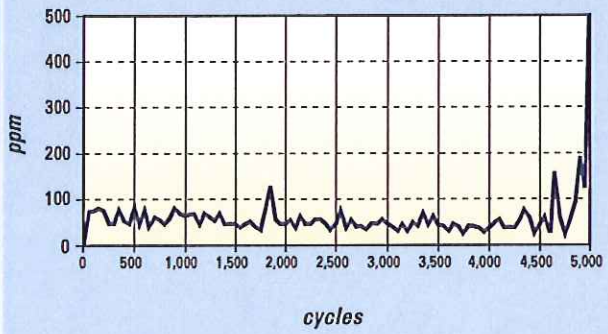
Test Medium:	Propane at 115 psi, ambient temperature
Instrument:	Organic vapor analyzer OVA-108, range 1–10,000 ppm
Valve Type:	Gate, Class 150, API 600
Sizes:	3", 6", 12" (80, 150, 300 mm)
Packing:	Graphite
Gasket:	Corrugated steel with graphite filler
Trim:	Wedge: 13 CR Seat: Stellite
Quantity:	3" (80 mm) – one valve 6" (150 mm) – four valves 12" (300 mm) – one valve

TEST COMPARISON TO API 598 TEST

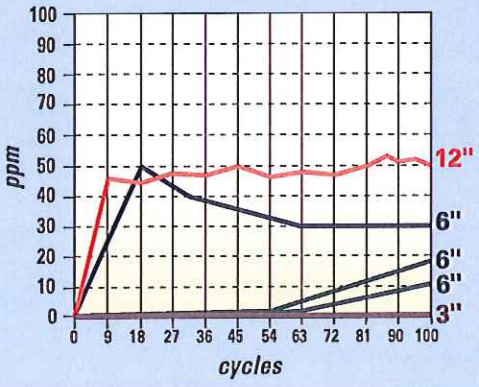
- API 598 test standard requires no visible external leakage (gasket, packing chamber and casting). The organic vapor analyzer measures leakage in parts per million (ppm). "Visible leakage" in API 598 is one drop of liquid per minute which we estimate is equivalent to about 2,400 ppm of gas. The API 598 test does not invoke cycling while we have cycled valves between 100 and 5000 cycles in our research testing.

- Critical factors in low emission service life include severity of pressure-temperature transients, number of cycles and cleanliness. During extensive cycling tests it was found that after leak paths developed, leakage could be reduced or eliminated by retightening gland bolts. For example a 150 ppm leak that developed after 350 cycles could be reduced to zero after retightening gland bolts.

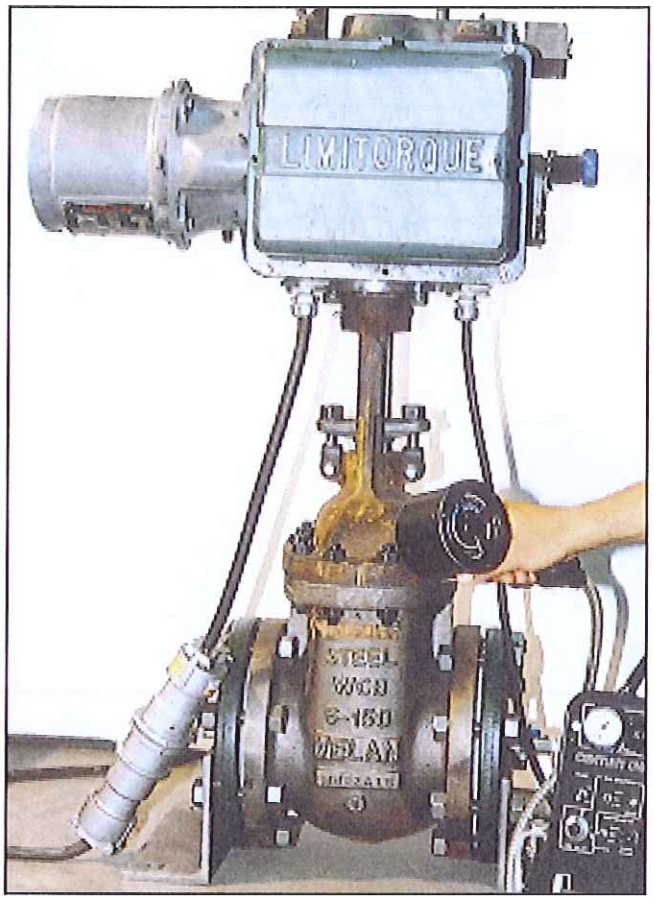
6" GATE VALVE 5,000 CYCLE TEST

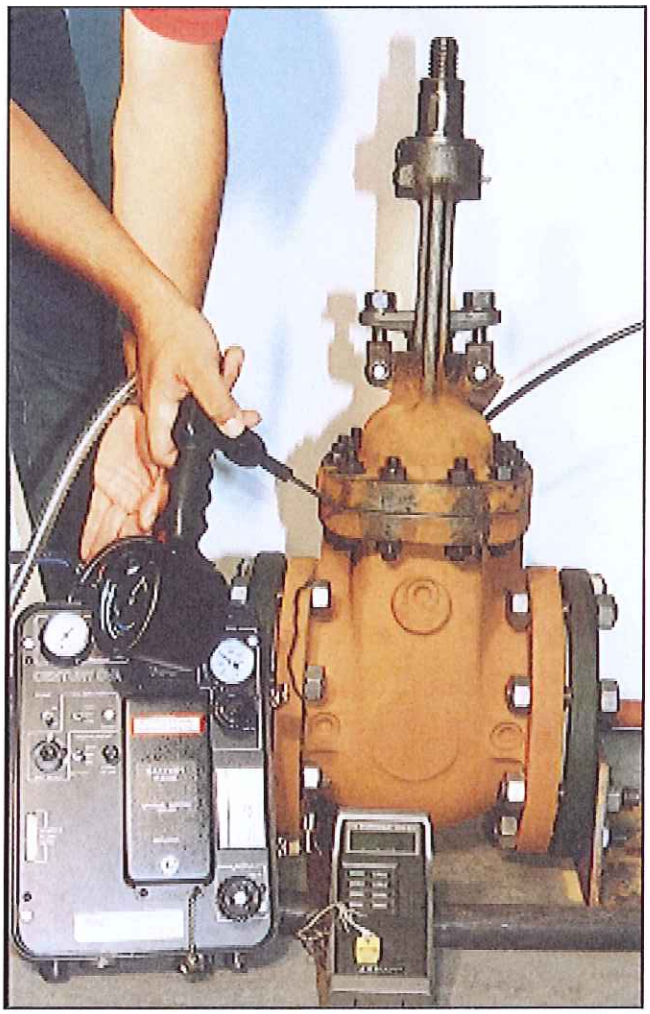


3", 6" & 12" GATE VALVES 100 CYCLE TEST

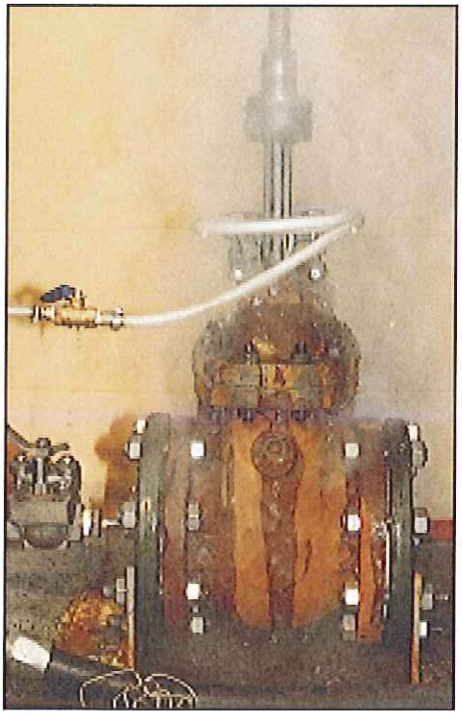


TESTING GASKET PERFORMANCE





Upper right: *50 cycles with steam at 400°F (204°C)*
Leakage: zero ppm.

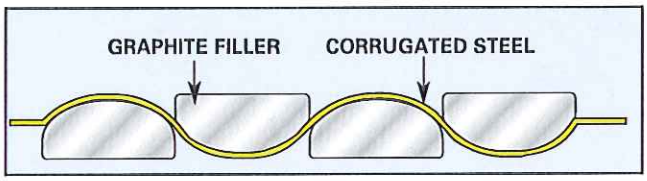


Upper left:
3000 cycles with propane at 125 psi
Leakage: zero ppm.

Left:
Thermal shock with water at 60°F (15°C)
Leakage: zero ppm.

Valve type:	**Class 150 gate valve**
Size:	**6" (150 mm)**
Gasket:	**Corrugated steel with graphite filler**
Instrument:	**OVA-108 vapor analyzer Range: 1–10,000 ppm**

BODY-BONNET GASKET DESIGN
GATE VALVES WITH OVAL FLANGES



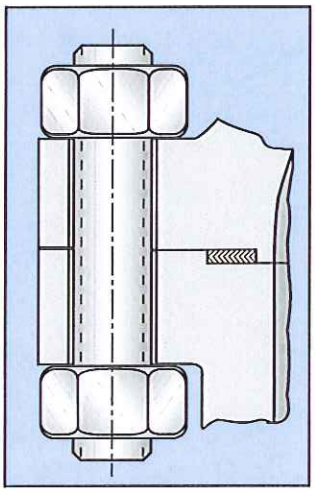
Standard corrugated steel gaskets without graphite as specified in API 600 were found to be an unacceptable choice for low emission service, even under ideal laboratory test conditions, and regardless of flange finish and gasket load. After testing several alternative gaskets, we selected the best performing gasket in our tests - a corrugated steel gasket with graphite filled channels.

TYPICAL TEST RESULT:
3700 cycles with zero ppm for 6" Class 150.

DESIGN FEATURES:

- **Ensures leakage of no more than 20 ppm** as demonstrated through extensive laboratory testing.
- **Requires no retorquing** after long cycling.
- **Effective under wide fluctuations** of temperature and pressure.
- **Insensitive to flange finish.**
- **Steel walls of graphite channels** provide additional protection from oxidation, corrosion and blow-out.
- **Seal offers the advantage of flexible graphite** (0–14pH, -328°F to +2000°F).
- **Lower bolt torques.**
- **Modern torquing methods.**

API 600 CAST STEEL VALVES WITH ROUND BODY-BONNET FLANGES



FULLY-ENCASED SPIRAL WOUND
316 or 347 SS/GRAPHITE BODY-BONNET GASKET

Gate	Class 150: 2–2½" (50–65 mm) Class 300–1500: 2–36" (50–900 mm)
Globe	Class 150–600: 2–16" (50–400 mm)
Check	Class 150–1500: 2–36" (50–900 mm)

DESIGN FEATURES:

- **Full enclosure** to allow gasket to retain positive radial support during loading.
- **Ensures leakage of no more than 20 ppm** as demonstrated through extensive laboratory testing.
- **Accurate control of compression** through close tolerance of gasket groove and allowance for radial expansion.
- **No radial machine marks.**
- **Minimum of three inner wraps** to prevent buckling.
- **Minimum of three tack welds.**
- **Minimum of three filler wraps.**
- **Close tolerance** (± 0.005" or 0.13 mm) for gasket thickness.
- **Regular testing of gasket resiliency** and inspection at Receiving due to sensitivity to inconsistent quality.
- **Modern torquing methods.**

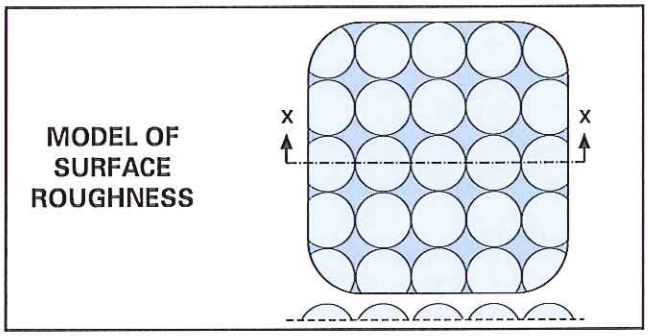
TYPICAL TEST RESULT:
3100 cycles with zero ppm for 10" Class 300.

TECHNOLOGY OF SEAT-DISC TIGHTNESS

The initial seat tightness of valves which can be proven by hydro-testing has little effect on extended long-term tightness.

SEAT-DISC CONTACT MECHANICS

- When magnified, even a ground, lapped surface appears irregular and rough.
- The rate of leakage is a function of the smoothness and finish of the surfaces.
- The seat-disc (wedge) contacts are between the peaks.
- For absolutely leak-tight joints, the peaks must be deformed with torque until a large portion of mating surfaces is in microscopic contact.
- The compression stress is approximately 3 times the yield (for 70,000 psi–210,000 psi).
- Sufficient contact pressure generated by the torque is essential. A small increase in contact pressure produces a rapid decrease in leakage.
- The valve seat should be either very narrow or very wide, depending on the valve type.



Globe Valves	Conical seat-line contact
Gate Valves and Swing Check Valves	Large, flat-faced seats

VELAN API 600 GATE VALVE SEAT TIGHTNESS

GATE VALVE SEAT TIGHTNESS

- Welded-in Stellite 6 faced seats and a flexible wedge in 13 CR, SS 316, Monel or hardfaced with Stellite 6.
- Seating faces ground and lapped to 2 RMS.

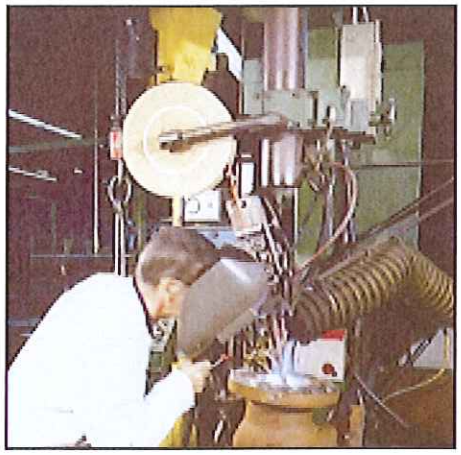
Factory Acceptance Standard for Gate Valve Seat Leakage

Size in	Velan Standard (VEL-NDT-571)	Seat Leakage Rate (1) (API 598–October 1996)	
		Low Pressure Test	High Pressure Test
2	0	0	0
2½–6	0	24	12
8–12	0	40	20
14+	28	56	28

(1) Leakage rates are in bubbles per minute for low pressure test and drops per minute for high pressure test

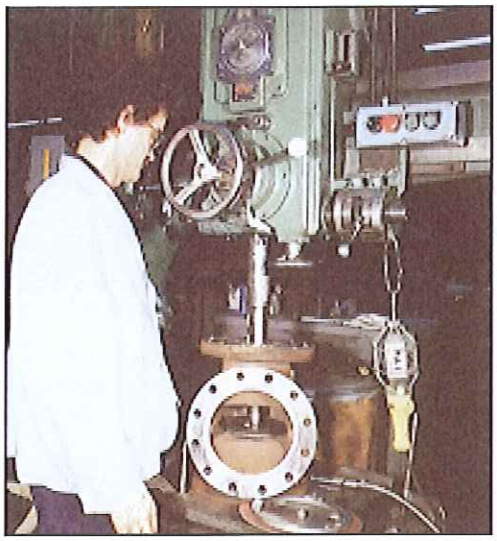
EIGHT IMPORTANT STEPS IN ASSEMBLY & TESTING

Make the Difference in Seat Tightness and Performance

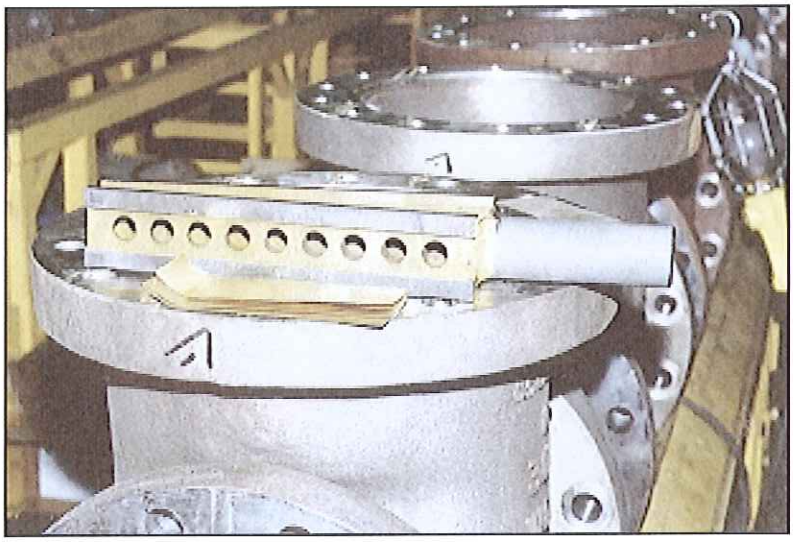


1 Automatic seal welding of Stellite 6 hardfaced seats.

2 Air-under-water test of the seat's welds.



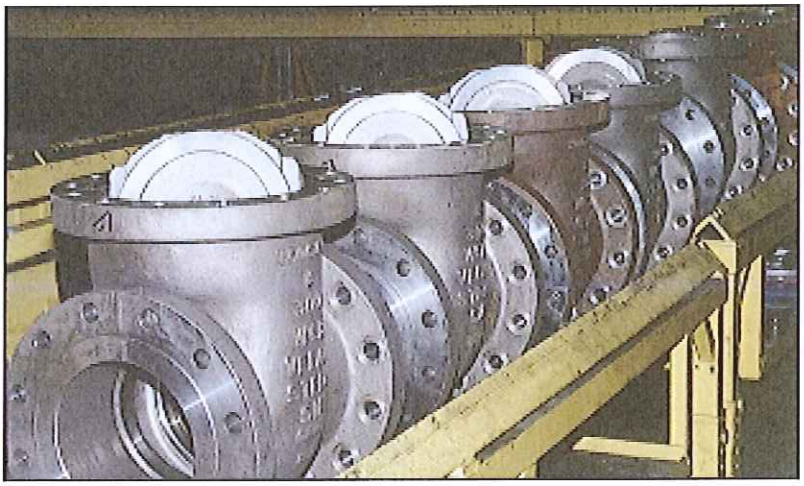
3 Relapping of seating faces after seal welding.



4 Determination of final seat/seat angle with gauge and shims to determine ideal wedge angle (6–60").

5 Precision grinding of individually fit wedge seating surfaces.

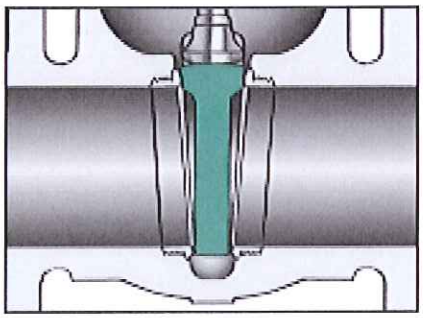
6 Lapping of wedge seating surfaces.



7 Assigning the ideally fitted wedge, ground and lapped, to proper valve body.

8 After assembly, pressure testing of shell, seats, packing and backseat to API 598.

VELAN API 600 GATE VALVES
FLEXIBLE WEDGE VERSUS SOLID WEDGE



FLEXIBLE ROUND WEDGE PIONEERED BY VELAN

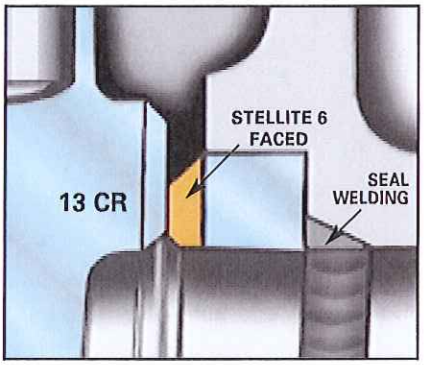
- Universal use for temperatures up to 1000°F (538°C).
- Flexibility compensates for seat face distortion.
- Compensates for deformation of body due to pipe stresses.
- Long cycle life.
- Ideal for processes with large temperature fluctuations.
- Assures valve tightness on both seats over wide range of pressures.
- Stem to wedge connection is inside the seating faces supporting the wedge ears during opening.

  More robust with less mass.

CLASSICAL SOLID WEDGE ON COMPETITIVE DESIGNS

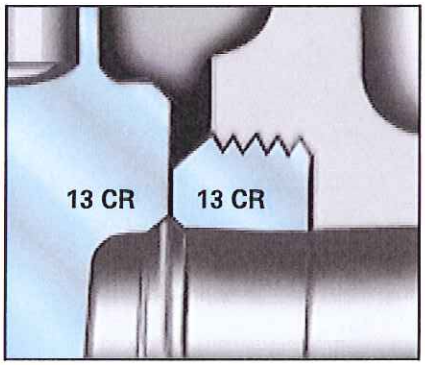
- Wedge may cause severe jamming at temperatures over 200°F (93°C).
- Suitable for small valves (½–2", 15–50 mm).
- Wedge will stick when valve is closed hot and allowed to cool.
- No compensation for deformation of body due to pressure-temperature or pipe stresses.
- Difficult to make valve tight on both seats due to seat face distortion.

SEAL WELDED SEATS VS SCREWED-IN SEATS



VELAN STANDARD GROUND AND LAPPED SEAL WELDED SEAT RINGS FACED WITH STELLITE 6

- Pioneered by Velan and considered state-of-the-art technology.
- Welded-in leakproof.
- Weld quality 100% tested.
- Stellite 6 seating faces for long service life.
- Ground and lapped to 2 RMS finish after weld-in.
- Standardized use for steam up to 1000°F (538°C), oil and gas.
- Stellite face will wear less than the 13 CR wedge, which can easily be repaired or replaced.

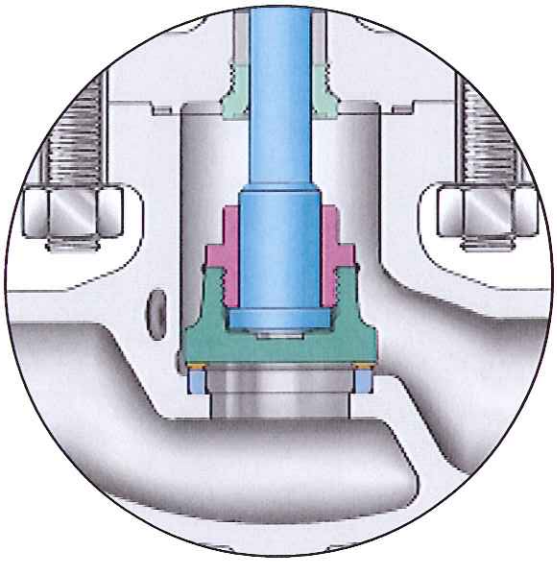


COMPETING SCREWED-IN SEATS IN 13 CR

- Can loosen up due to corrosion and cause substantial leakage.
- Replacement is difficult if not impossible.
- Threads can corrode and cause leakage.
- Seat is unsecured from unscrewing.
- Seat can become loose due to temperature fluctuations, corrosion or vibration, and can leak.
- Not suitable for steam service. Steam and other fluids will wire draw body threads of loose seats beyond repair.
- 13 CR seat suitable only for certain fluids.

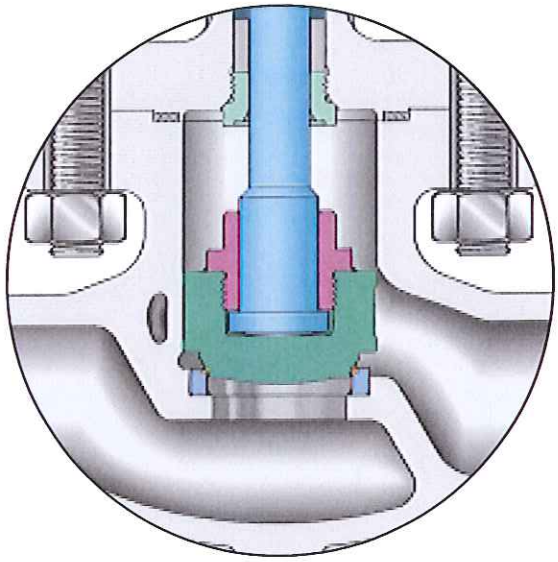
VELAN API 600 GLOBE VALVES
FLAT AND CONICAL SEATS

FLAT SEAT



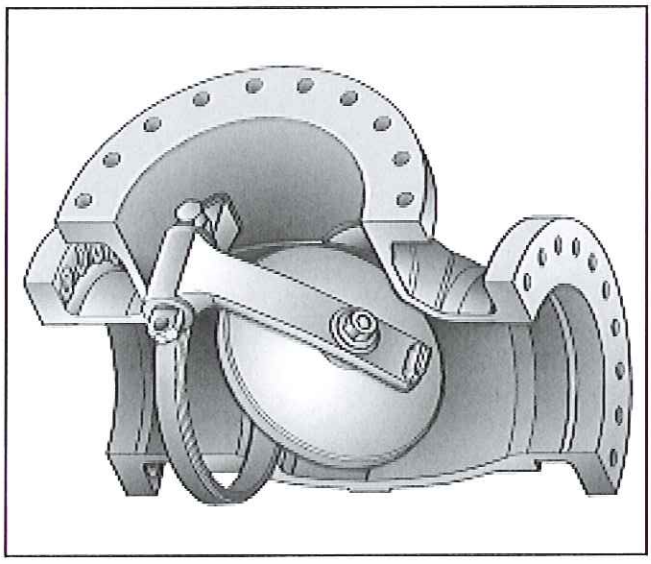
- Machining, lapping to close tolerances is easy.
- Flatness tolerance easy to control.
- Area contact wide seat.
- Disc is guided by the mating surface of the seat.
- Hard thrust pad prevents galling.
- Faster maintenance in-line. Flat seating faces can be lapped and checked for flatness easier.

CONICAL SEAT



- Line contact seal.
- Contact pressure increase by 1.5–5 with same stems and yokes.
- Seat has greater elasticity.
- Lower closing torques.
- Recommended for high pressure-temperature.

VELAN API 600 SWING CHECK VALVES

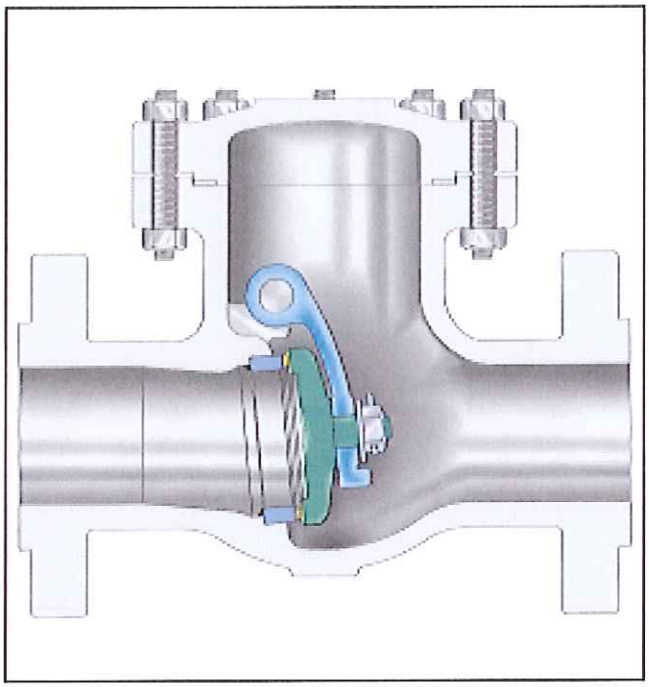


- Cage unit design with no penetration of body prevents:
  - *a)* Possibility of leakage with gasketed or packed hinge pin.
  - *b)* Possibility of pin ejection.
- All parts are accessible from the top for easy servicing.
- Welded-in seat is Stellite 6 faced.
- Disc is free to rotate to prevent localized wear.
- Ground and lapped seating surfaces.

VELAN

CAST CARBON, STAINLESS OR ALLOY STEEL API 600 SWING CHECK VALVES, 2–36" (50–900 mm)

ASME CLASSES 150, 300, 600, 900 AND 1500



CLASS	FIGURE NUMBER	CLASS	FIGURE NUMBER
150	0114C	900	7114C
300	1114C	1500	3114C
600	2114C		

STANDARD MATERIALS

PART	MATERIALS			
Body[1]	WCB	WC6	WC9	CF8M
Seat[1][2]	Stellite 6 faced CS	Stellite 6 faced F11	Stellite 6 faced F22	Stellite 6 faced F316
Hinge pin[1][3]	SS 410			SS 630 or 660
Gasket[1]	Spiral wound stainless steel/graphite			
Cover stud	Gr. B7	B16		B8M or 630
Cover nut	Gr. 2H	Gr. 4		Gr. 8M
Cover[1]	WCB	WC6	WC9	CF8M
Washer	Commercial			
Disc[1]	CA 15 or 13 CR faced WCB	CA 15 or 13 CR faced WC6	CA 15 or 13 CR faced WC9	CF8M
Disc hanger	WCB	WC6	WC9	CF8M
Disc nut	Gr. 2H	Gr. 4		Gr. 8M

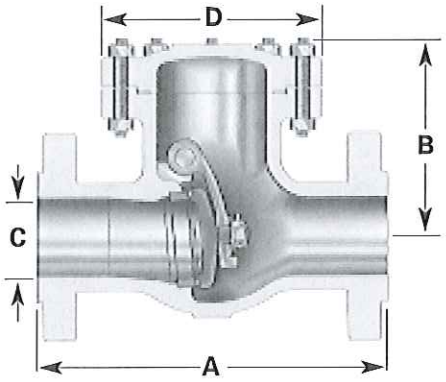
(1) Other materials available. (2) Stellited. (3) Hardened.

DESIGN FEATURES:

- **Body and cover.** Precision machined castings. ***Exclusive:*** Disc shaft does not penetrate body.
- **Body and cover joint.** Accurately machined, fully-enclosed gasket (gasket materials on page 3).
- **Disc.** Robust one-piece construction to withstand the severe shock of check valve service. Hardfaced with 13 CR, Stellite 6, SS 316, or Monel, ground and lapped to mirror finish. Sizes 2–6" (50–150 mm) may have solid CA15 (13 CR) disc. SS 316 disc with Stellite 6 facing also available.
- **Disc assembly.** Disc is fastened securely to disc hanger with a lock nut and cotter pin. Disc is free to rotate to avoid localized wear. Disc hanger is supported on a sturdy disc carrier hinge pin of excellent bearing qualities. All parts are accessible from top for easy servicing.
- **Flanges.**
  Class 150/300: 1/16" raised face.
  Class 600: 1/4" raised face.
  Finish: 125–250 AARH for all valves.

DESIGN SPECIFICATIONS

ITEM	APPLICABLE SPECIFICATION
Wall thickness and general valve design	API 600, BS1868
Pressure–temperature rating	ASME B16.34
Face-to-face dimensions for butt weld and flanged valves	ASME B16.10
Flange design	ASME B16.5
Butt welding design	ASME B16.25
Materials	ASTM



See page 32 & 33 for valve weights and CVs.

CHECK VALVE DIMENSIONS

SIZE	ASME 150 (PN 20)				ASME 300 (PN 50)				ASME 600 (PN 100)				ASME 900 (PN 150)				ASME 1500 (PN 250)			
in mm	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
2 50	8.00 203	5.75 146	2.00 51	6.75 171	10.50 267	6.00 152	2.00 51	6.75 171	11.50 292	6.25 159	2.00 51	6.75 171	14.50 368	9.50 241	1.88 48	8.63 219	14.50 368	9.50 241	1.88 48	8.63 219
2½ 65	8.50 216	6.25 159	2.50 64	6.75 171	11.50 292	6.25 159	2.50 64	6.75 171	13.00 330	6.50 165	2.50 64	7.50 191	16.50 419	10.00 254	2.25 57	9.25 235	16.50 419	10.00 254	2.25 57	9.25 235
3 80	9.50 241	7.75 197	3.00 76	8.50 216	12.50 318	7.75 197	3.00 76	8.50 216	14.00 356	8.75 222	3.00 76	9.75 248	15.00 381	10.50 267	2.88 73	10.50 267	18.50 470	11.50 292	2.75 70	10.50 267
4 100	11.50 292	8.75 222	4.00 102	10.25 260	14.00 356	8.75 222	4.00 102	10.25 260	17.00 432	9.25 235	4.00 102	12.00 305	18.00 457	11.75 299	3.88 99	12.25 311	21.50 546	12.00 305	3.63 92	12.25 311
6 150	14.00 356	10.75 273	6.00 152	12.50 318	17.50 445	10.75 273	6.00 152	12.50 318	22.00 559	11.50 292	6.00 152	15.75 400	24.00 610	15.00 381	5.75 146	15.25 387	27.75 705	16.50 419	5.38 137	16.00 406
8 200	19.50 495	12.75 324	8.00 203	15.75 400	21.00 533	12.75 324	8.00 203	15.75 400	26.00 660	13.50 343	7.88 200	15.75 400	29.00 737	19.25 489	7.50 191	18.38 467	32.75 832	21.00 533	7.00 178	20.75 527
10 250	24.50 622	15.50 394	10.00 254	18.50 470	24.50 622	16.25 413	10.00 254	18.50 470	31.00 787	16.75 425	9.75 248	19.50 495	– –	– –	– –	– –	– –	– –	– –	– –
12 300	27.50 699	17.00 432	12.00 305	20.50 521	28.00 711	17.00 432	12.00 305	20.50 521	33.00 838	18.50 470	11.75 298	22.50 572	– –	– –	– –	– –	– –	– –	– –	– –
14 350	31.00 787	19.63 499	13.25 337	23.00 584	33.00 838	19.63 499	13.25 337	23.00 584	35.00 889	20.93 532	12.88 327	26.25 667	– –	– –	– –	– –	– –	– –	– –	– –
16 400	34.00 864	22.00 559	15.25 387	26.50 673	34.00 864	22.50 572	15.25 387	26.50 673	39.00 991	23.38 594	14.75 375	28.25 718	– –	– –	– –	– –	– –	– –	– –	– –
18 450	38.50 978	25.00 635	17.13 435	28.50 724	38.50 978	25.00 635	17.13 435	28.50 724	43.00 1092	28.67 728	16.50 419	31.50 800	– –	– –	– –	– –	– –	– –	– –	– –
20 500	38.50 978	26.50 673	19.00 483	31.50 800	40.00 1016	26.50 673	19.00 483	31.50 800	47.00 1194	27.12 689	18.25 464	35.25 895	– –	Other sizes on application.						– –
24 600	51.00 1295	31.25 794	23.25 591	37.00 940	53.00 1346	31.25 794	23.25 591	37.00 940	55.00 1397	35.69 907	22.00 559	40.25 1022	– –							– –
26 650	51.00 1295	32.63 829	25.00 635	37.25 946	53.00 1346	32.63 829	25.00 635	37.25 946	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
28 700	57.00 1448	36.55 928	27.00 686	42.00 1067	59.00 1499	36.55 928	27.00 686	42.00 1067	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
30 750	60.00 1524	36.89 937	29.25 743	44.50 1130	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
36 900	77.00 1956	41.78 1061	35.25 895	53.00 1346	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –

See catalog VEL-PS for Classes 900 and 1500 FORGED STEEL CHECK VALVES.

ACCESSORIES

GEAR ACTUATORS

Gearing is generally applied to valves to make operation easier. The gearing may be of the spur, bevel or worm type–any of which may be applied to Velan valves.

The gears and gear brackets may be either cast iron or cast steel and may have cast or cut teeth, depending on the loads and the application. Gearing is too often neglected when valve operation is considered, resulting in unsatisfactory operation requiring expensive changes.

	CLASS	OPTIONAL	STANDARD
GATE	150	6–24" (150–600 mm)	30–60" (750–1500 mm)
	300	6–16" (150–400 mm)	18–36" (450–900 mm)
	600	4–12" (100–400 mm)	14–36" (350–900 mm)
	900	3–6" (80–150 mm)	8–10" (200–250 mm)
	1500	3–4" (80–100 mm)	6–10" (150–250 mm)
GLOBE	150	6–12" (150–300 mm)	14–16" (350–400 mm)
	300	6–12" (150–300 mm)	14–16" (350–400 mm)
	600	4–10" (100–250 mm)	—
	900	2–4" (50–100 mm)	—
	1500	2–4" (50–100 mm)	—

ELECTRIC ACTUATORS

Motorized controls may be applied to valves of almost any size for operation in practically any position or location.

All units, whether installed directly on a valve or on a floor stand, can be manually operated in case of power failure. The units are available for either alternating or direct current.

Motor units supplied by Velan are the high torque type with windings impregnated to resist both oil and moisture. They are completely weather-proof, explosion-proof (optional) and dust and steam tight. Various sizes and styles are available for different applications, and systems and can be varied to fit special requirements.

CYLINDER ACTUATORS

The most commonly-used cylinders are actuated by air, but oil and water types are also available if required. In all designs, the valve stem normally serves as a piston rod with disc fastened directly to them. Tail rods are also supplied as standard equipment to serve as position indicators and for emergency opening. Handwheels and gear heads can be mounted on top of cylinders for operation in an emergency which may arise due to the loss of operating medium in the cylinder.

Velan cylinders can be furnished with mounting pads for one of the commercial cylinders or valve positioners which provide throttling control. High pressure cylinders are also available for specific applications.

VALVE ACTUATOR SIZING

The Velan philosophy for selecting an actuator is to calculate the required thrust and torque to operate the valve at the required service conditions. A reasonable margin of excess actuator capability over that required is always allowed for in the final actuator selection, but grossly oversized actuators are avoided.

Because of the wide variations in system operating conditions, actuator sizing is based on the following:

ACTUATOR TYPE	LINE PRESSURE	DIFFERENTIAL PRESSURE (CLOSED)	POWER SUPPLY
ELECTRIC	Specified by customer	Specified by customer	Voltage, type, phase and frequency specified by customer
PNEUMATIC	Specified by customer	Specified by customer	Air pressure specified by customer
HYDRAULIC	Specified by customer	Specified by customer	Hydraulic pressure specified by customer
HANDWHEEL/ GEAR ACTUATED	70% of CWP(1) unless otherwise advised by customer	70% of CWP(1) unless otherwise advised by customer	200 lb. rimpull(2) unless otherwise advised by customer

(1) CWP = cold working pressure per ASME B16.34 at 100°F (e.g., Class 150, CWP = 285 psig, 70% of CWP = 200 psig).

(2) Rimpull is defined as the total tangential force acting on the handwheel (e.g., 200 lb. rimpull requires 100 lb force per hand). This rimpull figure is given for closing/opening conditions. For running conditions (travel from open to closed or vice versa), the rimpull is considerably less. For details, contact the company.

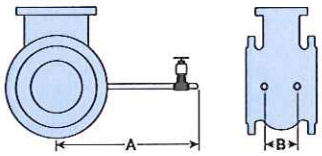
CHAIN WHEELS

Chain wheels are available for all types of Velan cast steel valves. They may be substituted for a plain handwheel or may be used in addition to the existing handwheel.

FLOOR STANDS

Floor stands are available in a number of sizes, and the size to be used depends on the stem size and stem load of the valve.

BYPASSES



AVAILABLE FOR ALL VELAN CAST STEEL VALVES IN ACCORDANCE WITH MSS-SP45 - SERIES A

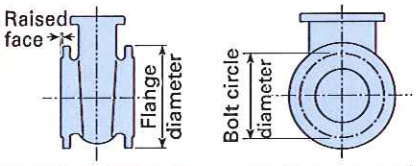
API 600 GLOBE *(Note: Dimensions are in inches)*

SIZE	CLASS 150				CLASS 300				CLASS 600			
in	BYPASS	A	ELBOW	B	BYPASS	A	ELBOW	B	BYPASS	A	ELBOW	B
3	1/2	13.00	1/2	6.38	1/2	11.50	1/2	6.13	1/2	13.00	1/2	8.25
4	1/2	13.00	1/2	7.50	1/2	16.50	1/2	7.00	1/2	15.00	1/2	9.50
6	3/4	11.13	3/4	11.00	3/4	14.75	3/4	11.00	3/4	13.00	3/4	11.00
8	3/4	11.50	3/4	14.00	3/4	13.00	3/4	14.00	3/4	13.00	3/4	11.25
10	1	18.00	1	14.88	1	18	1	15.00	—	—	—	—
12	1	18.00	1	19.00	1	18	1	18.00	—	—	—	—
14	1	18.00	1	19.50	1	18	1	19.50	—	—	—	—
16	1	18.00	1	24.00	1	18	1	24.00	—	—	—	—

API 600 GATE *(Note: Dimensions are in inches)*

SIZE	CLASS 150				CLASS 300				CLASS 600			
in	BYPASS	A	ELBOW	B	BYPASS	A	ELBOW	B	BYPASS	A	ELBOW	B
3	1/2	10.50	1/2	4.75	1/2	12.25	1/2	6.25	1/2	12.31	1/2	6.25
4	1/2	13.00	1/2	5.63	1/2	13.00	1/2	6.50	1/2	14.00	1/2	6.50
6	3/4	14.00	3/4	6.13	3/4	14.00	3/4	9.00	3/4	15.00	3/4	9.00
8	3/4	17.00	3/4	6.81	3/4	17.00	3/4	10.00	3/4	17.38	3/4	10.00
10	1	18.00	1	7.69	1	18.00	1	11.00	1	18.50	1	11.00
12	1	18.00	1	8.13	1	18.00	1	12.50	1	18.50	1	12.50
14	1	23.00	1	9.00	1	18.50	1	16.00	1	18.50	1	19.13
16	1	24.00	1	10.00	1	18.50	1	15.50	1	20.50	1	20.00
18	1	26.63	1	12.00	1	19.50	1	14.00	1	20.50	1	24.00
20	1	26.63	1	12.00	1	19.50	1	16.00	1	20.50	1	24.00
24	1	28.75	1	12.25	1	22.50	1	18.25	1	22.50	1	32.00
30	1	33.63	1	14.00	1	26	1	24.00	1	27	1	36.00
36	1	34.00	1	15.25	1	28	1	50.00	1	30	1	35.00
42	1	32.00	1	18.00	—	—	—	—	—	—	—	—
48	1	38.00	1	22.00	—	—	—	—	—	—	—	—
60	1	44.00	1	24.00	—	—	—	—	—	—	—	—

FLANGES, WEIGHTS & CV FLOW COFFICIENTS



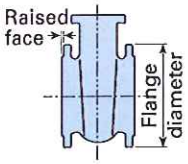
API 600 CAST STEEL VALVES CLASS 150

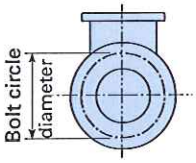
DRILLED AND FACED AS FOLLOWS: 2–24" ASME B16.5[1]

ASME CLASS	DIMENSIONS IN INCHES						WEIGHT IN LBS.						CV FLOW FLOW COEFFICIENTS		
							GATE		GLOBE		SWING				
	SIZE in	FLANGE DIAM.	BOLT CIRCLE DIAM.	HOLE DIAM.	QTY. HOLES	DIAM. BOLTS	BW	FL	BW	FL	BW	FL	GATE	GLOBE	CHECK
150 1/16 RAISED FACE	2	6.00	4.75	0.75	4	5/8	42	48	48	55	31	40	260	35	95
	2½	7.00	5.50	0.75	4	5/8	50	59	54	58	35	44	420	60	150
	3	7.50	6.00	0.75	4	5/8	67	78	82	102	59	78	625	92	220
	4	9.00	7.50	0.75	8	5/8	97	117	120	152	98	121	1150	180	410
	6	11.00	9.50	0.88	8	3/4	180	198	240	280	179	212	2650	430	950
	8	13.50	11.75	0.88	8	3/4	278	319	405	435	314	360	4850	810	1750
	10	16.00	14.25	1.00	12	7/8	456	515	500	550	513	586	7750	1400	2800
	12	19.00	17.00	1.00	12	7/8	646	738	1050	1200	602	823	11,500	1950	4100
	14	21.00	18.75	1.13	12	1	875	954	1700	1850	765	960	14,000	2500	6200
	16	23.50	21.25	1.13	16	1	1120	1200	2300	2500	1120	1300	19,000	3400	8400
	18	25.00	22.75	1.25	16	1⅛	1485	1570	2640	2850	1450	1660	24,000	4500	11,000
	20	27.50	25.00	1.25	20	1⅛	1825	1910	—	—	1700	2050	31,000	—	13,500
	24	32.00	29.50	1.38	20	1¼	2870	2960	—	—	2900	3300	45,000	—	20,000
	26[1]	34.25	31.75	1.38	24	1¼	3600	3700	—	—	3600	4000	53,000	—	23,500
	28[1]	36.50	34.00	1.38	28	1¼	4400	4500	—	—	4300	5000	62,000	—	28,000
	30[1]	38.75	36.00	1.37	28	1¼	4705	4750	—	—	6300	7000	73,000	—	33,000
	32[1]	41.75	38.50	1.62	28	1½	5800	6000	—	—	—	—	81,000	—	—
	36[1]	46.00	42.75	1.63	32	1½	6500	6850	—	—	8500	9500	108,000	—	48,000
	40[1]	50.75	47.25	1.62	36	1½	8400	9000	—	—	—	—	130,000	—	—
	42[1]	53.00	49.50	1.63	36	1½	10,000	11,000	—	—	—	—	142,000	—	—
	48[1]	59.50	56.00	1.63	44	1½	14,000	15,000	—	—	—	—	190,000	—	—
	54[1]	66.25	62.75	1.88	44	1¾	21,000	23,000	—	—	—	—	238,000	—	—
	60[1]	73.00	69.25	1.88	52	1¼	22,600	26,600	—	—	—	—	300,000	—	—

(1) 30"and up: ASME B16.47 Series A (MSS-SP–44), for Series B (API 605) contact the factory.

FLANGES, WEIGHTS & CV FLOW COFFICIENTS





API 600 CAST STEEL VALVES CLASS 300, 600, 900 & 1500

DRILLED AND FACED AS FOLLOWS: 2–24" ASME B16.5

ASME CLASS	DIMENSIONS IN INCHES						WEIGHT IN LBS.						CV FLOW FLOW COEFFICIENTS		
							GATE		GLOBE		SWING				
	SIZE in	FLANGE DIAM.	BOLT CIRCLE DIAM.	HOLE DIAM.	QTY. HOLES	DIAM. BOLTS	BW	FL	BW	FL	BW	FL	GATE	GLOBE	CHECK
300 1/16 RAISED FACE	2	6.50	5.00	0.75	8	⅝	46	60	45	60	37	45	260	35	95
	2½	7.50	5.88	0.88	8	¾	55	76	63	72	49	57	420	60	150
	3	8.25	6.62	0.88	8	¾	90	115	88	114	70	96	625	92	220
	4	10.00	7.88	0.88	8	¾	136	166	130	171	110	150	1150	180	410
	6	12.50	10.62	0.88	12	¾	245	314	261	337	204	265	2650	430	950
	8	15.00	13.00	1.00	12	¾	415	506	447	565	360	455	4850	810	1750
	10	17.50	15.25	1.13	16	1	646	762	1000	1150	582	650	7750	1325	2800
	12	20.50	17.75	1.25	16	1⅛	900	1100	1300	1550	825	945	11,500	1950	4100
	14	23.00	20.25	1.25	20	1⅛	1392	1720	1800	2100	1200	1350	14,000	2500	6200
	16	25.50	22.50	1.38	20	1¼	1870	2220	2300	2700	1500	1800	19,000	3400	8400
	18	28.00	24.75	1.38	24	1¼	2405	2960	2640	3200	2000	2400	23,500	4500	11,000
	20	30.50	27.00	1.38	24	1¼	3260	3700	—	—	2600	3000	30,000	—	13,500
	24	36.00	32.00	1.63	24	1½	4250	5100	—	—	3000	4050	44,000	—	20,000
	26[1]	38.25	34.50	1.75	28	1⅝	5000	5500	—	—	4000	5000	53,000	—	23,500
	28[1]	40.75	37.00	1.75	28	1⅝	7000	7500	—	—	5000	6000	62,000	—	28,000
	30[1]	43.00	39.25	1.88	28	1¾	8550	9000	—	—	—	—	73,000	—	—
	32[1]	45.25	41.50	2.00	28	1⅞	8200	8800	—	—	—	—	81,000	—	—
	36[1]	50.00	46.00	2.13	32	2	13,500	15,500	—	—	—	—	108,000	—	—
600 1/4 RAISED FACE	2	6.50	5.00	0.75	8	⅝	60	72	60	72	48	52	260	35	95
	2½	7.50	5.88	0.88	8	¾	89	102	89	100	59	87	420	60	150
	3	8.25	6.62	0.88	8	¾	130	157	130	150	96	130	625	92	220
	4	10.75	8.50	1.00	8	⅞	224	275	213	285	167	225	1150	180	410
	6	14.00	11.50	1.13	12	1	394	540	415	515	332	476	2650	430	950
	8	16.50	13.75	1.25	12	1⅛	726	884	1050	1220	525	715	4850	800	1750
	10	20.00	17.00	1.38	16	1⅛	1125	1405	1550	1830	1000	1250	7750	1250	2800
	12	22.00	19.25	1.38	20	1¼	1490	1812	—	—	1500	1750	11,500	—	4100
	14	23.75	20.75	1.50	20	1⅜	2200	2500	—	—	1750	2050	13,000	—	5900
	16	27.00	23.75	1.62	20	1½	3000	3700	—	—	2400	3100	18,000	—	7800
	18	29.25	25.75	1.75	20	1⅝	4000	4800	—	—	3200	4000	22,000	—	9900
	20	32.00	28.50	1.75	24	1⅝	5600	6800	—	—	4500	6100	27,000	—	12,000
	24	37.00	33.00	2.00	24	1⅞	8000	9800	—	—	6400	7600	40,000	—	18,000
	30[1]	44.50	40.25	2.12	28	2	12,000	14,000	—	—	—	—	52,000	—	—
	36[1]	51.75	47.00	2.62	28	2½	17,000	19,500	—	—	—	—	72,000	—	—
900 1/4 RAISED FACE	2	8.50	6.50	1.00	8	⅞	150	185	—	—	135	165	230	—	80
	2½	9.63	7.50	1.12	8	1	235	270	—	—	175	210	560	—	200
	3	9.50	7.50	1.00	8	⅞	235	270	—	—	175	210	560	—	200
	4	11.50	9.25	1.25	8	1⅛	270	355	—	—	245	330	1050	—	380
	6	15.00	12.50	1.25	12	1⅛	830	980	—	—	485	635	2400	—	875
	8	18.50	15.50	1.50	12	1⅜	1220	1500	—	—	700	900	4200	—	1325
	10	21.50	18.50	1.50	16	1⅜	2000	2400	—	—	—	—	6750	—	1525
	12	24.00	21.00	1.50	20	1⅜	3170	3670	—	—	—	—	9700	—	—
	14	25.25	22.00	1.62	20	1½	3900	4460	—	—	—	—	12,000	—	—
	16	27.75	24.25	1.75	20	1⅝	5570	6250	—	—	—	—	16,000	—	—
1500 1/4 RAISED FACE	2	8.50	6.50	1.00	8	⅞	150	185	—	—	135	165	230	—	80
	2½	9.63	7.50	1.12	8	1	255	325	—	—	205	275	510	—	185
	3	10.50	8.00	1.25	8	1⅛	255	325	—	—	205	275	510	—	185
	4	12.25	9.50	1.37	8	1¼	430	520	—	—	340	430	925	—	330
	6	15.50	12.50	1.50	12	1⅜	1045	1205	—	—	805	965	2100	—	750
	8	19.00	15.50	1.75	12	1⅝	1850	2550	—	—	1350	2050	3650	—	1325
	10	23.00	19.00	2.00	12	1⅞	2600	3300	—	—	—	—	5850	—	—

(1) 30"and up: ASME B16.47 Series A (MSS-SP–44), for Series B (API 605) contact the factory.

ENGINEERING DATA

PRESSURE-TEMPERATURE RATINGS
STANDARD CLASS VALVES, FLANGED AND BUTT WELD END

NOTE: FOR SPECIAL CLASS VALVES, WHICH HAVE HIGHER RATINGS CONTACT THE COMPANY.

CAST

ASTM MATERIAL STANDARD–TO ASME B16.34
ASME Boiler and Pressure Vessel Code Section II materials that also meet the requirements of the listed ASTM specifications.
psig/°F (bar/°C) CLASSES 150–4500

A216 Gr. WCB

TEMP.	WORKING PRESSURE by classes, psig						
°F	150	300	600	900	1500	2500	4500
100	285	740	1480	2220	3705	6170	11110
200	260	675	1350	2025	3375	5625	10120
300	230	655	1315	1970	3280	5470	9845
400	200	635	1270	1900	3170	5280	9505
500	170	600	1200	1795	2995	4990	8980
600	140	550	1095	1640	2735	4560	8210
650	125	535	1075	1610	2685	4475	8055
700	110	535	1065	1600	2665	4440	7990
750	95	505	1010	1510	2520	4200	7560
800	80	410	825	1235	2060	3430	6170
850[1]	65	270	535	805	1340	2230	4010
900[1]	50	170	345	515	860	1430	2570
950[1]	35	105	205	310	515	860	1545
1000[1]	20	50	105	155	260	430	770

(1) Permissible, but not recommended for prolonged usage above 800°F (427°C).

TEMP.	GAGE WORKING PRESSURE BY RATING NUMBER, bar						
°C	PN 20	PN 50	PN 100	PN 150	PN 250	PN 420	PN 760
38	19.6	51.1	102.1	153.2	255.3	425.5	765.8
50	19.2	50.1	100.2	150.2	250.4	417.3	751.1
100	17.7	46.4	92.8	139.1	231.9	386.5	695.7
150	15.8	45.2	90.5	135.7	226.1	376.9	678.4
200	14.0	43.8	87.6	131.5	219.1	365.2	657.3
250	12.1	41.7	83.4	125.2	208.6	347.7	625.8
300	10.2	38.7	77.5	116.2	193.7	322.8	581.0
350	8.4	37.0	73.9	110.9	184.8	308.0	554.4
375	7.4	36.5	72.9	109.4	182.3	303.9	547.0
400	6.5	34.5	69.0	103.5	172.5	287.5	517.5
425	5.6	28.8	57.5	86.3	143.8	239.6	431.4
450[1]	4.7	20.0	40.1	60.1	100.2	166.9	300.5
475[1]	3.7	13.5	27.1	40.6	67.7	112.9	203.2
500[1]	2.8	8.8	17.6	26.4	44.0	73.3	131.9
525[1]	1.9	5.2	10.4	15.5	25.9	43.2	77.7
540[1]	1.3	3.3	6.5	9.8	16.3	27.2	48.9

A217 Gr. WC6

TEMP.	WORKING PRESSURE by classes, psig						
°F	150	300	600	900	1500	2500	4500
100	290	750	1500	2250	3750	6250	11250
200	260	750	1500	2250	3750	6250	11250
300	230	720	1445	2165	3610	6015	10830
400	200	695	1385	2080	3465	5775	10400
500	170	665	1330	1995	3325	5540	9965
600	140	605	1210	1815	3025	5040	9070
650	125	590	1175	1765	2940	4905	8825
700	110	570	1135	1705	2840	4730	8515
750	95	530	1065	1595	2660	4430	7970
800	80	510	1015	1525	2540	4230	7610
850	65	485	975	1460	2435	4060	7305
900	50	450	900	1350	2245	3745	6740
950	35	320	640	955	1595	2655	4785
1000	20	215	430	650	1080	1800	3240
1050	20[1]	145	290	430	720	1200	2160
1100	20[1]	95	190	290	480	800	1440

(1) For welding end valves only. Flanged end ratings terminate at 1000°F (538°C).

TEMP.	GAGE WORKING PRESSURE BY RATING NUMBER, bar						
°C	PN 20	PN 50	PN 100	PN 150	PN 250	PN 420	PN 760
38	20.0	51.7	103.4	155.2	258.6	431.0	775.9
50	19.5	51.7	103.4	155.2	258.6	431.0	775.9
100	17.7	51.4	103.0	154.5	257.4	429.1	772.4
150	15.8	49.6	99.6	149.2	248.8	414.5	746.3
200	13.9	48.1	95.9	143.9	239.8	399.6	719.6
250	12.1	46.2	92.4	138.6	231.0	385.0	692.6
300	10.2	42.9	85.8	128.6	214.4	357.2	642.8
350	8.3	40.3	80.3	120.8	201.1	335.4	603.5
375	7.4	38.9	77.6	116.6	194.1	323.3	582.0
400	6.5	36.5	73.3	109.8	183.1	305.0	548.7
425	5.6	35.2	70.2	105.4	175.7	292.6	526.3
450	4.6	33.7	67.7	101.4	169.1	281.9	507.2
475	3.7	31.7	63.4	95.1	158.2	263.9	475.0
500	2.8	25.3	50.6	75.7	126.1	210.1	378.6
525	1.9	18.1	36.3	54.5	90.8	151.2	272.5
550	1.4[1]	12.7	25.4	38.1	63.6	105.9	190.7
575	1.4[1]	8.8	17.7	26.3	44.0	73.4	132.1
600[2]	1.4[1]	6.0	12.0	18.3	30.3	50.5	90.8

(2) Not to be used over 593°C.

A217 Gr. WC9

TEMP.	WORKING PRESSURE by classes, psig						
°F	150	300	600	900	1500	2500	4500
100	290	750	1500	2250	3750	6250	11250
200	260	750	1500	2250	3750	6250	11250
300	230	730	1455	2185	3640	6070	10925
400	200	705	1410	2115	3530	5880	10585
500	170	665	1330	1995	3325	5540	9965
600	140	605	1210	1815	3025	5040	9070
650	125	590	1175	1765	2940	4905	8825
700	110	570	1135	1705	2840	4730	8515
750	95	530	1065	1595	2660	4430	7970
800	80	510	1015	1525	2540	4230	7610
850	65	485	975	1460	2435	4060	7305
900	50	450	900	1350	2245	3745	6740
950	35	375	755	1130	1885	3145	5665
1000	20	260	520	780	1305	2170	3910
1050	20[1]	175	350	525	875	1455	2625
1100	20[1]	110	220	330	550	915	1645

(1) For welding end valves only. Flanged end ratings terminate at 1000°F (538°C).

TEMP.	GAGE WORKING PRESSURE BY RATING NUMBER, bar						
°C	PN 20	PN 50	PN 100	PN 150	PN 250	PN 420	PN 760
38	20.0	51.7	103.4	155.2	258.6	431.0	775.9
50	19.5	51.7	103.4	155.2	258.6	431.0	775.9
100	17.7	51.6	103.1	154.6	257.7	429.5	773.2
150	15.8	50.3	100.3	150.6	250.9	418.3	753.0
200	13.9	48.8	97.5	146.3	244.1	406.6	731.9
250	12.1	46.3	92.7	139.1	231.9	386.3	695.0
300	10.2	42.9	85.8	128.6	214.4	357.2	642.8
350	8.3	40.3	80.3	120.8	201.1	335.4	603.5
375	7.4	38.9	77.6	116.6	194.1	323.3	582.0
400	6.5	36.5	73.3	109.8	183.1	305.0	548.7
425	5.6	35.2	70.2	105.4	175.7	292.6	526.3
450	4.6	33.7	67.7	101.4	169.1	281.9	507.2
475	3.7	31.7	63.4	95.1	158.2	263.9	475.0
500	2.8	27.7	55.7	83.4	139.0	231.8	417.4
525	1.9	21.6	43.3	64.9	108.4	180.6	325.3
550	1.4[1]	15.4	30.7	46.1	77.0	127.9	230.7
575	1.4[1]	10.6	21.1	31.7	52.7	87.7	158.1
600[2]	1.4[1]	6.9	13.8	20.7	34.6	57.4	103.2

(2) Not to be used over 593°C.

ENGINEERING DATA

A217 Gr. C5

TEMP.	WORKING PRESSURE by classes, psig						
°F	150	300	600	900	1500	2500	4500
100	290	750	1500	2250	3750	6250	11250
200	260	745	1490	2235	3725	6205	11170
300	230	715	1430	2150	3580	5965	10740
400	200	705	1410	2115	3530	5880	10585
500	170	665	1330	1995	3325	5540	9965
600	140	605	1210	1815	3025	5040	9070
650	125	590	1175	1765	2940	4905	8825
700	110	570	1135	1705	2840	4730	8515
750	95	530	1055	1585	2640	4400	7920
800	80	510	1015	1525	2540	4230	7610
850	65	485	965	1450	2415	4030	7250
900	50	370	740	1110	1850	3085	5555
950	35	275	550	825	1370	2285	4115
1000	20	200	400	595	995	1655	2985
1050	20[1]	145	290	430	720	1200	2160
1100	20[1]	100	200	300	495	830	1490
1150	20[1]	60	125	185	310	515	925
1200	15[1]	35	70	105	170	285	515

TEMP.	GAGE WORKING PRESSURE BY RATING NUMBER, bar						
°C	PN 20	PN 50	PN 100	PN 150	PN 250	PN 420	PN 760
38	20.0	51.7	103.4	155.2	258.6	431.0	775.9
50	19.5	51.7	103.3	155.0	258.6	430.3	774.6
100	17.7	51.1	102.3	153.4	257.2	425.9	766.8
150	15.8	49.3	98.6	148.2	246.8	411.2	740.5
200	13.9	48.7	97.4	146.1	243.7	406.0	730.8
250	12.1	46.3	92.7	139.1	231.9	386.3	695.0
300	10.2	42.9	85.8	128.6	214.4	357.2	642.8
350	8.3	40.3	80.3	120.8	201.1	335.4	603.5
375	7.4	38.9	77.5	116.4	193.9	323.0	581.5
400	6.5	36.5	72.6	109.2	181.8	303.0	545.4
425	5.6	35.2	70.1	105.4	175.6	292.4	526.1
450	4.6	33.7	67.1	100.8	167.9	280.1	504.0
475	3.7	27.6	55.0	82.6	137.7	229.7	413.5
500	2.8	21.3	42.6	64.0	106.4	177.4	319.5
525	1.9	16.1	32.3	48.3	80.5	134.1	241.7
550	1.4[1]	12.1	24.3	36.0	60.3	100.3	180.8
575	1.4[1]	9.0	17.9	26.6	44.3	74.1	133.2
600	1.4[1]	6.2	12.6	18.8	31.1	52.0	93.4
625	1.3[1]	3.9	8.1	12.0	20.0	33.3	59.9
650	1.0[1]	2.4	4.8	7.2	11.7	19.7	35.5

(1) For welding end valves only. Flanged end ratings terminate at 1000°F (538°C).

A217 Gr. C12

TEMP.	WORKING PRESSURE by classes, psig						
°F	150	300	600	900	1500	2500	4500
100	290	750	1500	2250	3750	6250	11250
200	260	750	1500	2250	3750	6250	11250
300	230	730	1455	2185	3640	6070	10925
400	200	705	1410	2115	3530	5880	10585
500	170	665	1330	1995	3325	5540	9965
600	140	605	1210	1815	3025	5040	9070
650	125	590	1175	1765	2940	4905	8825
700	110	570	1135	1705	2840	4730	8515
750	95	530	1065	1595	2660	4430	7970
800	80	510	1015	1525	2540	4230	7610
850	65	485	975	1460	2435	4060	7305
900	50	450	900	1350	2245	3745	6740
950	35	375	755	1130	1855	3145	5655
1000	20	255	505	760	1270	2115	3805
1050	20[1]	170	345	515	855	1430	2570
1100	20[1]	115	225	340	565	945	1695
1150	20[1]	75	150	225	375	630	1130
1200	20[1]	50	105	155	255	430	770

TEMP.	GAGE WORKING PRESSURE BY RATING NUMBER, bar						
°C	PN 20	PN 50	PN 100	PN 150	PN 250	PN 420	PN 760
38	20.0	51.7	103.4	155.2	258.6	431.0	775.9
50	19.5	51.7	103.4	155.2	258.6	431.0	775.9
100	17.7	51.6	103.1	154.6	257.7	429.5	773.2
150	15.8	50.3	100.3	150.6	250.9	418.3	753.0
200	13.9	48.8	97.5	146.3	244.1	406.6	731.9
250	12.1	46.3	92.7	139.1	231.9	386.3	695.0
300	10.2	42.9	85.8	128.6	214.4	357.2	642.8
350	8.3	40.3	80.3	120.8	201.1	335.4	603.5
375	7.4	38.9	77.6	116.6	194.1	323.3	582.0
400	6.5	36.5	73.3	109.8	183.1	305.0	548.7
425	5.6	35.2	70.2	105.4	175.7	292.6	526.3
450	4.6	33.7	67.7	101.4	169.1	281.9	507.2
475	3.7	31.7	63.4	95.1	158.2	263.9	475.0
500	2.8	27.7	55.7	83.4	139.0	231.8	417.0
525	1.9	21.4	42.8	64.1	107.1	178.6	321.1
550	1.4[1]	15.0	30.0	45.0	75.0	125.1	225.0
575	1.4[1]	0.4	21.0	31.4	52.1	87.2	156.7
600	1.4[1]	7.2	14.3	21.5	35.8	59.9	107.5
625	1.4[1]	4.9	9.9	14.8	24.7	41.5	74.5
650	1.4[1]	3.4	7.2	10.7	17.6	29.7	53.1

(1) For welding end valves only. Flanged end ratings terminate at 1000°F (538°C).

A351 Gr. CF8M[3], A351 Gr. CF3M[2]

TEMP.	WORKING PRESSURE BY CLASSES, psig						
°F	150	300	600	900	1500	2500	4500
100	275	720	1440	2160	3600	6000	10800
200	235	620	1240	1860	3095	5160	9280
300	215	560	1120	1680	2795	4660	8390
400	195	515	1025	1540	2570	4280	7705
500	170	480	955	1435	2390	3980	7165
600	140	450	900	1355	2255	3760	6770
650	125	445	890	1330	2220	3700	6660
700	110	430	870	1305	2170	3620	6515
750	95	425	855	1280	2135	3560	6410
800	80	420	845	1265	2110	3520	6335
850	65	420	835	1255	2090	3480	6265
900	50	415	830	1245	2075	3460	6230
950	35	385	775	1160	1930	3220	5795
1000	20	350	700	1050	1750	2915	5245
1050[3]	20[1]	345	685	1030	1720	2865	5155
1100[3]	20[1]	305	610	915	1525	2545	4575
1150[3]	20[1]	235	475	710	1185	1970	3550
1200[3]	20[1]	185	370	555	925	1545	2775
1250[3]	20[1]	145	295	440	735	1230	2210
1300[3]	20[1]	115	235	350	585	970	1750
1350[3]	20[1]	95	190	290	480	800	1440
1400[3]	20[1]	75	150	225	380	630	1130
1450[3]	20[1]	60	115	175	290	485	875
1500[3]	20[1]	40	85	125	205	345	620

TEMP.	GAGE WORKING PRESSURE BY RATING NUMBER, bar						
°C	PN 20	PN 50	PN 100	PN 150	PN 250	PN 420	PN 760
38	19.0	49.7	99.3	149.0	248.3	413.8	744.8
50	18.3	48.1	96.3	144.4	240.6	401.0	721.9
100	16.1	42.3	84.6	126.8	211.0	351.7	633.2
150	14.8	38.6	77.1	115.7	192.4	320.8	577.7
200	13.6	35.8	71.2	107.0	178.5	297.2	535.2
250	12.0	33.5	66.8	100.3	167.0	278.2	500.8
300	10.2	31.6	63.1	95.0	158.1	263.6	474.6
350	8.3	30.4	61.0	91.3	152.3	253.9	456.9
375	7.4	29.6	59.9	89.7	149.3	249.1	448.3
400	6.5	29.3	59.0	88.2	147.2	245.4	441.9
425	5.6	29.0	58.3	87.3	145.6	242.9	437.2
450	4.6	29.0	57.7	86.7	144.3	240.4	432.8
475	3.7	28.7	57.3	86.1	143.4	239.0	430.3
500	2.8	27.3	54.8	82.1	136.7	228.0	410.5
525	1.9	25.2	50.6	75.9	126.4	210.7	379.2
550[3]	1.4[1]	24.0	47.8	71.8	119.8	199.5	359.0
575[3]	1.4[1]	22.8	45.4	68.3	114.1	190.1	341.9
600[3]	1.4[1]	19.9	39.9	59.7	99.5	166.0	298.6
625[3]	1.4[1]	15.7	31.7	47.4	79.2	131.7	237.3
650[3]	1.4[1]	12.6	25.3	37.9	63.2	105.7	189.8
675[3]	1.4[1]	10.1	20.6	30.8	51.4	86.1	154.8
700[3]	1.4[1]	8.3	16.9	25.1	42.0	69.8	125.8
725[3]	1.4[1]	6.9	13.9	21.1	35.0	58.2	104.9
750[3]	1.4[1]	5.7	11.3	17.1	28.7	47.7	85.7
775[3]	1.4[1]	4.6	9.0	13.7	22.8	38.1	68.4
800[3]	1.4[1]	3.5	7.0	10.6	17.4	29.2	52.6

(1) For welding end valves only. Flanged end ratings terminate at 1000°F (538°C).
(2) CF3M: Not to be used over 850°F (454°C).
(3) At temperatures over 1000°F (538°C), use only when the carbon content is 0.04% or higher.

SPECIFICATION OF CAST VALVE MATERIALS

BODY AND BONNET, WEDGE–DISC–PACKING FLANGE

DESCRIPTION		CARBON STEEL			ALLOY STEEL				STAINLESS STEEL				
					1¼ CR ½ Mo	2¼ CR-1 Mo	5 CR	9 CR-1Mo	13 CR		316	316L	304
	ASTM DESIGNATION	A216 WCB	A352 LCB	A352 LCC	A217 WC6	A217 WC9	A217 C5	A217 C12	A217 CA15	A296 CA40	A351 CF8M	A351 CF3M	A351 CF8
COMPOSITION %	Carbon	0.25(1)	0.25(1)	0.25	0.20	0.18	0.20	0.20	0.15	0.10-0.40	0.08	0.03	0.08
	Manganese	1.00	1.00	1.20	0.50-0.80	0.40-0.70	0.40-0.70	0.35-0.65	1.00	1.00	1.50	1.50	1.50
	Phosphorus	0.04	0.04	0.04	0.04	0.40	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	Sulphur	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.040	0.040	0.040	0.040	0.040
	Silicon	0.60	0.60	0.60	0.60	0.60	0.75	1.00	1.50	1.50	1.50	1.50	2.00
	Nickel	0.50	—	0.50	0.50	0.50	0.50	0.50	1.00	1.00	9.00-12.00	9.00-13.00	8.00-11.00
	Chromium	0.50	—	0.50	1.00-1.50	2.00-2.75	4.00-6.50	8.00-10.00	11.5-14.0	11.5-14.0	18.00-21.00	17.00-21.00	18.00-21.00
	Molybdenum	0.20	—	0.20	0.45-0.65	0.90-1.20	0.45-0.65	0.90-1.20	0.50	0.50	2.0-3.00	2.0-3.00	0.50
	Copper	0.30	0.30	0.30	0.50	—	0.50	0.50	—	—	—	—	—
Heat Treat.		Anneal	Quench and Temper		Temper	Temper	Temper	Temper	Solution anneal				
Tensile psi min.		70,000	65,000-90,000	70,000-95,000	70,000-90,000	70,000-90,000	90,000-115,000	90,000-115,000	90,000-115,000	100,000	70,000	70,000	70,000
Yield psi min.		36,000	35,000	40,000	40,000	40,000	60,000	60,000	65,000	70,000	30,000	30,000	30,000
Elong. % Min.		22	24	22	20	20	18	18	18	15	30	30	35
R. Area % Min.		35	35	35	35	35	35	35	30	25	—	—	—
Hardness HB		187 max.	197 max.	200 max.	207 max.	207 max.	241 max.	241 max.	327-381	475 min.	—	187 max.	—
Parts		BODIES–BONNETS–LARGE DISCS							DISC MATERIALS		BODIES–BONNETS–DISCS		

(1) Velan standard: 0.25 or less.

TRIM SPECIFICATION

		BAR STOCK								CAST		
		CR 13		Stainless Steels			Monel		Hastelloy	Monel	Stellite 6	Austenitic Ductile
	ASTM DESIGNATION	A 479 410*	A 582 416*	A 479 316 St. Hard.	A 479 316	A 564 630	B 164 Monel	AMS 4676A K-Monel	B574 N 10276	A 494 M-25S	AMS 5387 A	A 439 D-2C
COMPOSITION %	Carbon	0.15	0.15	0.08	0.08	0.07	0.3	0.25	0.010	0.25	0.9–1.4	2.90
	Manganese	1.00	1.25	2.00	2.00	1.00	2.0	1.50	1.0	1.50	1.0	1.80–2.40
	Phosphorus	0.040	0.06	0.045	0.045	0.040	–	0.02	0.04	0.03	0.04	0.08
	Sulphur	0.030	0.15 min.	0.030	0.030	0.030	0.024	0.010	0.03	0.03	0.04	–
	Silicon	1.00	1.00	1.00	1.00	1.00	0.5	1.00	0.08	3.5-4.5	1.5	1.00–3.00
	Nickel	–	–	10.00–14.00	10.00–14.00	3.00–5.00	63.0	63.00–70.00	Balance	Balance	3.0	21.00–24.00
	Chromium	11.50–13.50	12.00–14.00	16.00–18.00	16.00–18.00	15.00–17.50	–	–	14.5–16.5	–	27.0–31.0	0.50
	Molybdenum	–	–	2.00–3.00	2.00–3.00	–	–	–	15.0–17.0	–	1.5	–
	Copper	–	–	–	–	3.00–5.00	28.0–34.0	Balance	–	27.0-33.0	–	–
	Aluminum	–	–	–	–	–	3.00	–	3.00	–	–	–
	Cobalt	–	–	–	–	–	–	–	–	–	Balance	–
	Tungsten	–	–	–	–	–	–	–	–	–	3.5-5.5	–
	Iron	–	–	–	–	–	–	–	–	3.50	3.0	–
Special Condition		Temper	Hard	Level 2	–	–	Hot worked	Hot Fin.	–	Age Hard.	–	–
Heat Treat.		Class 2	Hard Temper	Sol. Ann.	Sol. Ann.	H 1100	–	–	–	–	–	–
Tensile psi min.		110,000	–	95,000	75,000	140,000	80,000	140,000	100,000	–	130,000	58,000
Yield psi min.		85,000	–	75,000	30,000	115,000	40,000	100,000	41,000	–	–	28,000
Elong. % min.		15	–	25	30	14	30	20	40	–	1	20
R. Area % min.		45	–	40	40	45	–	–	–	–	–	–
Hardness HB		269 max.	293–352	–	–	302 min.	–	326 min.	–	300 min.	344 min.	121–171

** 13 CR or Monel trim also available in soft form (less than 237 HB). Non-cobalt hardfacing also available.*

SOUR SERVICE VALVES

To meet **NACE STANDARD MR0175** Velan manufactures the complete range of valves shown in this catalog in compliance with NACE standard MR0175. Trim materials must be selected by customers from table based on experience in corrosion resistance against sulphides (sour gas) found in processing crude oil.

For trim material (wedge/disc surface, seat surface, stem) see page 37.

TRIM	
NA, ND, NE, NF:	B7M / 2HM RC. 22 MAX.
NB, NC, NN:	B7M / 2HM OR B8M / 8

CAST STEEL GATE, GLOBE & CHECK VALVES

Type of Connection	Size of Connection		Pressure Rating	Type		Body/Bonnet Style		Body Material		Trim Material	
A	B		C	D		E		F		G	
F	0	8	0	1	1	4	C	1	3	S	X
e.g.: F	1	0	0	0	6	4	C	0	2	T	Y

Example: *Flanged 3" class 150 cast carbon steel full bore gate valve with TY trim.*

The figure numbers shown on this key are designed to cover essential features of Velan valves.
Please use figure numbers to ensure prompt and accurate processing of your order.
A detailed description must accompany any special orders.

A TYPE OF CONNECTION

- A - Special
- B - Butt weld
- C - Combination
- D - DIN flanged
- E - Welded stubs
- F - Flanged B16.5 (B16.47 series A)
- P - Flanged B16.47 series B (API 605)
- R - Flanged ring joint
- U - Undrilled flanges
- X - Butt weld (intermediate class)

B SIZE OF CONNECTION

Customers have the choice of specifying valve size as part of the valve figure number (B) using the numbers below, or indicating valve size separately.

EXAMPLES:
F10-0064C-02TY (valve size is part of figure number)
3"F-0064C-02TY (valve size is shown separately)

08 - 2" (50 mm)	16 - 10" (250 mm)	26 - 26" (650 mm)	44 - 44" (1100mm)
09 - 2½" (65 mm)	18 - 12" (300 mm)	28 - 28" (700 mm)	46 - 46" (1150 mm)
10 - 3" (80 mm)	19 - 14" (350 mm)	30 - 30" (750 mm)	48 - 48" (1200 mm)
11 - 3½" (90 mm)	20 - 16" (400 mm)	32 - 32" (800 mm)	54 - 54" (1350 mm)
12 - 4" (100 mm)	21 - 18" (450 mm)	34 - 34" (850 mm)	60 - 60" (1500 mm)
13 - 5" (125 mm)	22 - 20" (500 mm)	36 - 36" (900 mm)	99 - Special
14 - 6" (150 mm)	23 - 22" (550 mm)	40 - 40" (1000 mm)	
15 - 8" (200 mm)	24 - 24" (600 mm)	42 - 42" (1050 mm)	

C PRESSURE RATING

0 - 150 | 1 - 300 | 2 - 600 | 3 - 1500 | 7 - 900

D VALVE TYPE

- 01 - Flow control
- 06 - Full port gate
- 07 - Stop globe
- 08 - Stop check
- 09 - Needle
- 11 - Swing check
- 99 - Special

E BODY / BONNET STYLE

4 - Vertical

- A - Special
- C - Bolted bonnet (cast)
- E - Extended bonnet (cryogenic)
- V - Cast bolted bonnet bellows seal

F BODY MATERIAL

01 - Special	09 - C12	19 - Monel M35	31 - LCC
02 - WCB	11 - CF8	23 - Alloy 20	34 - C12A (F91)
03 - WC1	12 - CF3	25 - LCB	38 - LC1
04 - C5	13 - CF8M	27 - LC3	39 - LC2
05 - WC6	14 - CF3M	28 - CG8M	46 - GS-C25N
06 - WC9	15 - CF8C	29 - CG3M	

G TRIM

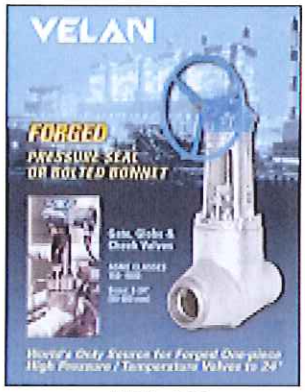
CODE		WEDGE/DISC SURFACE[1]	SEAT SURFACE[1]	STEM	API Number	If applicable BELLOWS[2]
MS	STANDARD	Stellite 6[3]	Stellite 6[3]	316		321
MY	STANDARD	CF8M or 316	Stellite 6[3]	316	12	321
TS	STANDARD	Stellite 6[3]	Stellite 6[3]	13 CR (410)[4]	5	321
TY	STANDARD	13 CR (410 or CA15)	Stellite 6[3]	13 CR (410)	8	
NA	NACE SERVICE[6]	13 CR (410 or CA15) HRC 22 max	Stellite 6[3]	13 CR (410) HRC 22 max.	8[6]	
NB	NACE SERVICE[6]	CF8M	Stellite 6[3]	316	12[6]	321
NC	NACE SERVICE[6]	Monel	Stellite 6[3]	Monel	11[6]	Hastelloy C
ND	NACE SERVICE[6]	Stellite 6[3]	Stellite 6[3]	630 (H1150M)		
NE	NACE SERVICE[6]	Stellite 6[3]	Stellite 6[3]	13 CR (410) HRC 22 max.	5[6]	
NF	NACE SERVICE[6]	Stellite 6[3]	Stellite 6[3]	Same as Body		
NG	NACE SERVICE[6]	Stellite 6[3]	Stellite 6[3]	316		321
NN	NACE SERVICE[6]	CF8M	Stellite 6[3]	316		IN 625
NX	NACE SERVICE[6]	Monel	Monel	Monel		
AS		Stellite 6[3]	Stellite 6[3]	321		321
AY		CF8C/F321	Stellite 6[3]	321		321
CC		Alloy 20	Alloy 20	Alloy 20	13	
ES		Stellite 6[3]	Stellite 6[3]	347		
EY		CF8C/F347	Stellite 6[3]	347		
HC		Hastelloy C	Stellite 6[3]	Hastelloy C		Hastelloy C
MF		CF8M or 316 w/ Teflon insert[5]	Stellite 6[3]	316		
MH		Stellite 6[3]	Stellite 6[3]	316		Hastelloy C
MN		Stellite 6[3]	Stellite 6[3]	316		IN 625
MX		CF8M	316	316	10	
TF		13 CR (410 or CA15) w/ Teflon insert[5]	Stellite 6[3]	13 CR (410)		
TH		Stellite 6[3]	Stellite 6[3]	13 CR (410)[4]		Hastelloy C
TN		Stellite 6[3]	Stellite 6[3]	13 CR (410)[4]		IN 625
XS		Stellite 6[3]	Stellite 6[3]	Monel		
XX		Monel	Monel	Monel	9	
XY		Monel	Stellite 6[3]	Monel	11	
SX[7]	API 603	Same as body	Integral	Same as body	10	
GX[7]	API 603	Same as body	Integral	Same as body	10	
SY[7]	API 603	Same as body	Stellite 6[3]	316	12	
GY[7]	API 603	Same as body	Stellite 6[3]	316	12	
GS	API 603	Stellite 6[3]	Integral	316		
SB[7]	API 603	Bronze	Integral	316		

(1) Base material is either the same as the body or solid trim at manufacturer's option.
(2) Bellows material shown as standard, Inconel can be used in lieu of 321 and Hastelloy C in lieu of Inconel, where design and/or pressure class applicable.
(3) Stellite 6 or Stellite 21 based on material or application at manufacturer's option.
(4) 616HT Manufacturer's Std. (F91 and C12A only).
(5) Inserts may be in seat or wedge at manufacturer's option.
(6) NACE service valves are supplied with all materials conforming to NACE MR0175. (Including bolting with max. hardness of RC22).
(7) SB, SX, SY PTFE gasket and packing GS, GX, GY Graphite gasket and packing.

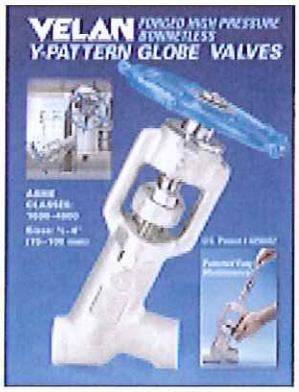
Note: *For a more detailed list of available trims, contact the factory or visit our web site at www.velan.com*

THE MOST COMPREHENSIVE LINE OF INDUSTRIAL FORGED AND CAST STEEL, GATE, GLOBE, CHECK, BALL, KNIFE GATE AND BUTTERFLY VALVES

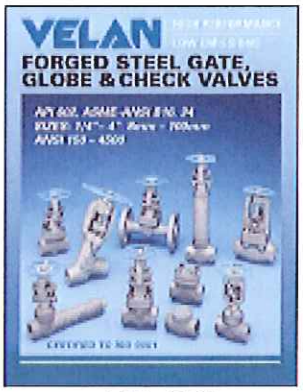
ASME Pressure Classes 150–4500 in Carbon, Alloy and Stainless Steel



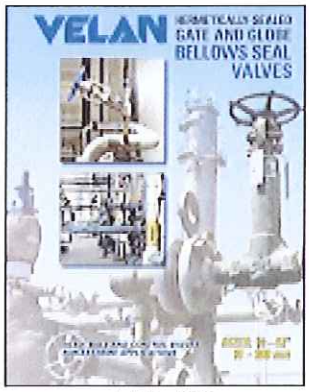
VEL-PS



VEL-BG



VEL-SFV

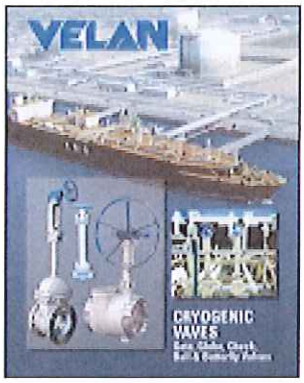


VEL-BS

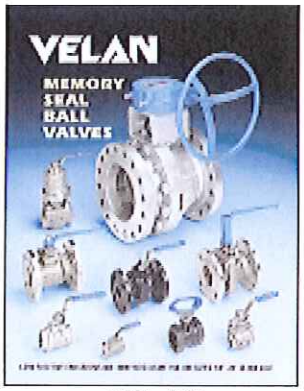
VEL-PRO-CV

VEL-API-603

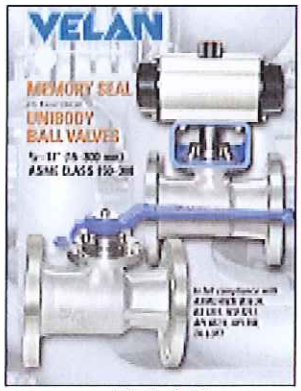
VEL-KGV



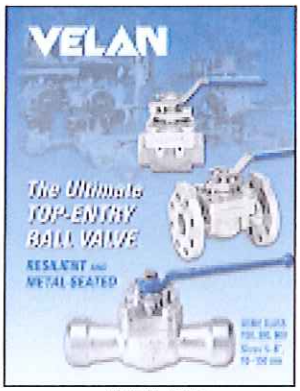
VEL-CRYO



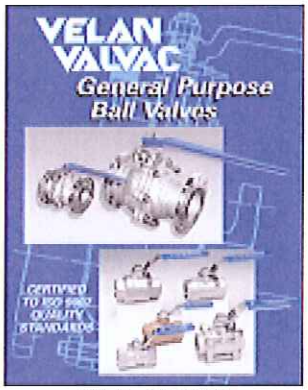
VEL-BV



VEL-UB

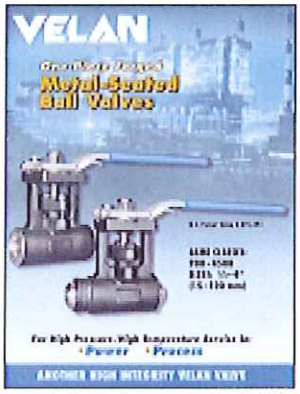


VEL-TE

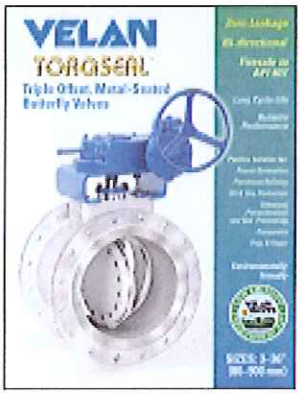


VEL-GP2BV

VEL-MS



VEL-PBV



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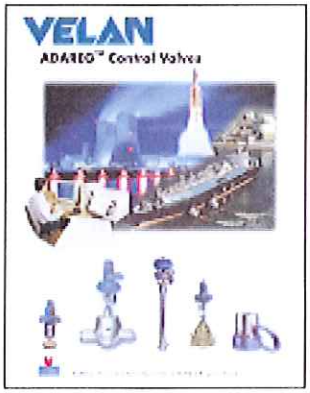

VEL-ADCV

Printed in Canada

VEL-CSV-2002

PSX:DIRECT DRIVE

NITRILE

OIL-RESISTANT PIPE-TO-MANHOLE CONNECTOR

What It Is

PSX:Direct Drive - Nitrile is a high-performance flexible pipe- to-manhole connector that combines easy installation and proven watertight performance with the ability to resist common underground contaminants, including most hydrocarbons and many mixed chemistries

How It Works

PSX:Direct Drive - Nitrile
has superior materials and technology

- Specially developed synthetic nitrile rubber is continuously tested and lab-certified
- Power Sleeve made from tempered Series 304 stainless steel
- Installation Mechanism made from Series 300 stainless steel
- Installation Mechanism is infinitely adjustable
- Installation tools are calibrated and certified
- Take-up clamps made from Series 304 stainless steel with quick-adjusting screws

How It Performs

PSX:Direct Drive - Nitrile *meets or exceeds all requirements of the following Specifications and/or Test Methods:*

ASTM C 923
ASTM C 443 (Oil Resistance)
ASTM C 1244
ASTM C 1478
ASTM F 2510

TYPICAL TEST RESULTS for PSX:Direct Drive - Nitrile (as in ASTM C 923, C 1478, and C 443)

Test	ASTM Test Method	Test Requirements	Typical Result
CHEMICAL RESISTANCE; 1N SULFURIC ACID and 1N HYDROCHLORIC ACID	D 534, AT 22ºC FOR 48 HRS	NO WEIGHT LOSS NO WEIGHT LOSS	NO WEIGHT LOSS NO WEIGHT LOSS
TENSILE STRENGTH	D 412	1200 PSI, MIN.	1403 PSI
ELONGATION AT BREAK	D 412	350%, MIN.	563%
HARDNESS	D 2240 (SHORE A DUROMETER)	±5 FROM THE MANUFACTURER'S SPECIFIED HARDNESS	<2
ACCELERATED OVEN-AGING	D 573, 70± 1ºC FOR 7 DAYS	DECREASE OF 15%, MAX. OF ORIGINAL TENSILE STRENGTH, DECREASE OF 20%, MAX. OF ELONGATION	-3% TENSILE CHANGE, -10% ELONGATION CHANGE
COMPRESSION TEST	D 395, METHOD B, AT 70ºC FOR 22 HRS	DECREASE OF 25%, MAX. OF ORIGINAL DEFLECTION	10%
WATER ABSORPTION	D 471 IMMERSE 0.75 BY 2-IN.SPECIMEN IN DISTILLED WATER AT 70ºC FOR 48 hrs	INCREASE OF 10%, MAX. OR ORIGINAL BY WEIGHT	2.70%
OZONE RESISTANCE	D 1171	RATING 0	PASS
LOW-TEMP, BRITTLE POINT	D 746	NO FRACTURE AT -40ºC	PASS
TEAR RESISTANCE	D624, METHOD B	200 LBF/IN (MIN.)	255 LBF/IN.
OIL RESISTANCE	D 471; ASTM IRM 903 AT 100ºC FOR 70HRS	80% MAX VOL. CHANGE	-1.9%

Protected by one or more of the following patents: 6805359, 7146689, 7263746

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web: www.press-seal.com

Made in USA

PSX:DIRECT DRIVE NITRILE

OIL-RESISTANT PIPE-TO-MANHOLE CONNECTOR *SELECTION GUIDE*

How It Performs

PSX:Direct Drive - Nitrile *meets or exceeds all requirements of the following Specifications and/or Test Methods:*

ASTM C 923
ASTM C 443 (Oil Resistance)
ASTM C 1244
ASTM C 1478
ASTM F 2510

NOMINAL HOLE SIZE	PSX: DD NITRILE SIZE and DESCRIPTION	GASKET I.D. (INCHES)	PIPE O.D. ACCOMMODATION RANGE (INCHES)	TAKE-UP CLAMP QTY	TAKE-UP CLAMP PART #	MINIMUM SIZE ROUND STRUCTURE (INCHES)	MINIMUM SPAN/RISE STRAIGHT WALL (INCHES)
REQUIRES BLACK SHORT 7/16" TORQUE WRENCH PRESET TO 12 FT/LBS PART # 850.605							
8	8 QRS STEP "S" PSX: DD NITRILE 8 QRS STEP "R" PSX: DD NITRILE 8 QRS STEP "Q" PSX: DD NITRILE 8 QRS PSX: DD NITRILE	2.20 3.50 4.60 N/A	1.70 TO 2.50 2.75 TO 3.75 3.75 TO 4.80 1.70 TO 4.80	1 1 1 1	600-088 600-088 600-088 600-088	36	16
12	12Y PSX: DD NITRILE 12 M PSX: DD NITRILE	6.50 8.63	5.70 TO 6.90 8.00 TO 9.10	1 1	600-128 600-152	36	20
14	14 M PSX: DD NITRILE	10.35	9.75 TO 11.10	1	600-188	36	22
REQUIRES BLUE 1/2" TORQUE WRENCH PRESET TO 20 FT/LBS PART # 850.610							
16	16 M PSX: DD NITRILE	12.75	12.05 TO 13.30	1	600-232	36	24
18	18 M PSX: DD-2 NITRILE	15.35	14.60 TO 15.50	2	600-296	36	26

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Made in USA

Figure 310A
STAINLESS STEEL BALL VALVES

FNW™

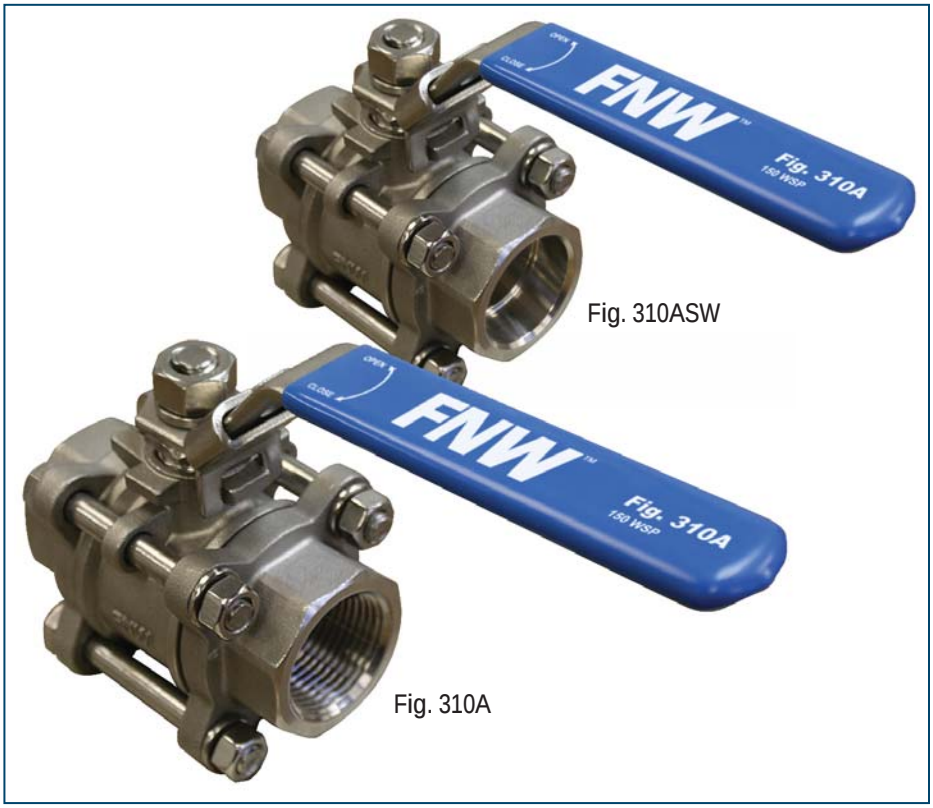
3 PC FULL PORT 1000 CWP

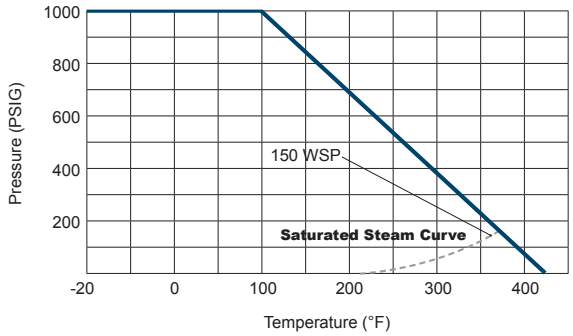
Features:

- 1000 PSI CWP Non-Shock
- 150 PSI WSP
- Full Port
- Blow-out Proof Stem
- Adjustable Packing
- Investment Cast Body
- End Connections
  - Threaded
  - Socket Weld
- Stainless Steel Handle
- Locking Lever
- RTFE Seats
- Vented Ball
- Manufactured Silicone Free

Standards:

- Design: ASME B16.34, MSS SP-110
- End Connections:
  - NPT - ASME B1.20.1
  - SW - ASME B16.11
- Seat/Shell Test: MSS SP-110





Cv, Torque & Weight

Size	Cv	Torque (in-lbs)	Wt (lbs)	
			NPT	SW
1/4	15	60	1.01	0.93
3/8	15	60	1.01	0.98
1/2	18	66	1.12	1.10
3/4	36	80	1.81	1.76
1	48	146	2.69	2.60
1-1/4	58	252	4.28	4.19
1-1/2	120	344	5.73	5.60
2	190	503	9.04	8.95
2-1/2	450	631	18.25	18.08
3	600	1337	25.57	25.88

Figure Number Matrix

FNW 310A Ends Size

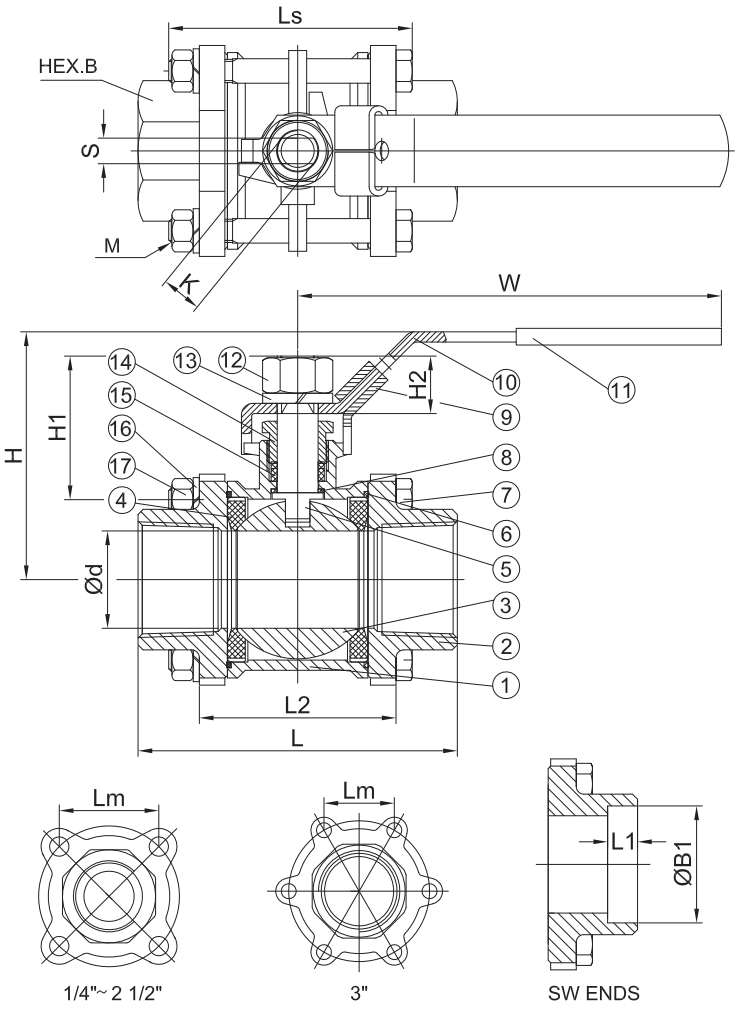
END CODE	SIZE CODE	
Blank = Threaded NPT	1/4 = B	1-1/4 = H
SW = Socket Weld	3/8 = C	1-1/2 = J
	1/2 = D	2 = K
	3/4 = F	2-1/2 = L
	1 = G	3 = M

(For 4" valves, use FNW Figure number 310AM)

FNW™

Figure 310A
STAINLESS STEEL BALL VALVES

3 PC FULL PORT 1000 CWP



Standard Materials

Ref. No.	Description		Material	Qty
1	Body		ASTM A351 Gr. CF8M Stainless	1
2	End Cap	NPT	ASTM A351 Gr. CF8M Stainless	2
		SW	ASTM A351 Gr. CF3M Stainless	
3	Ball		316SS Stainless	1
4	Seat		RTFE	2
5	Stem		316SS Stainless	1
6	Body Gasket		PTFE	2
7	Body Bolt	1/4"~2-1/2"	ASTM A193-B8 Stainless	4
		3"		6
8	Thrust Washer		PTFE	1
9	Locking Device		304SS Stainless	1
10	Handle		304SS Stainless	1
11	Handle Sleeve		Vinyl Plastic	1
12	Stem Nut		ASTM A194-8 Stainless	1
13	Stem Washer		304SS Stainless	1
14	Gland Nut		304SS Stainless	1
15	V-Ring Packing		PTFE	1 Set
16	Bolt Washer	1/4"~2"	SUS304 Stainless	4
		2-1/2"		8
		3"		12
17	Bolt Nut	1/4"~2"	ASTM A194-8 Stainless	4
		2-1/2"		8
		3"		12

Dimensions (inches)

SIZE	Ød	L	Lm	H1	H2	H	W	S	K (UNC)	Ls	L2	M (UNC)	B	L1	ØB1
1/4	0.42	2.57	1.14	1.20	0.43	2.26	3.94	0.197	5/16-18	1.98	1.46	1/4-20	0.93	0.39	0.56
3/8	0.50	2.57	1.14	1.20	0.43	2.26	3.94	0.197	5/16-18	1.98	1.46	1/4-20	0.93	0.39	0.69
1/2	0.59	2.74	1.21	1.11	0.38	2.26	3.94	0.197	5/16-18	2.13	1.63	1/4-20	1.10	0.39	0.86
3/4	0.79	3.15	1.52	1.30	0.49	2.50	5.08	0.256	3/8-16	2.44	1.82	5/16-18	1.36	0.51	1.07
1	0.98	3.54	1.76	1.61	0.62	2.97	6.14	0.314	7/16-14	2.79	2.10	5/16-18	1.65	0.51	1.34
1-1/4	1.26	4.33	2.13	1.61	0.55	3.19	6.14	0.314	7/16-14	3.37	2.68	3/8-16	2.05	0.63	1.69
1-1/2	1.50	4.72	2.42	2.12	0.89	3.70	7.19	0.394	5/8-11	3.81	3.05	3/8-16	2.30	0.63	1.93
2	1.97	5.51	2.95	2.19	0.89	4.11	7.19	0.394	5/8-11	4.36	3.59	3/8-16	2.81	0.67	2.42
2-1/2	2.50	7.28	3.62	2.69	0.93	5.16	9.92	0.472	3/4-10	5.75	4.36	9/16-12	3.41	0.67	2.91
3	2.99	8.07	2.93	2.75	0.93	5.47	9.92	0.472	3/4-10	6.34	4.93	9/16-12	3.98	0.67	3.54

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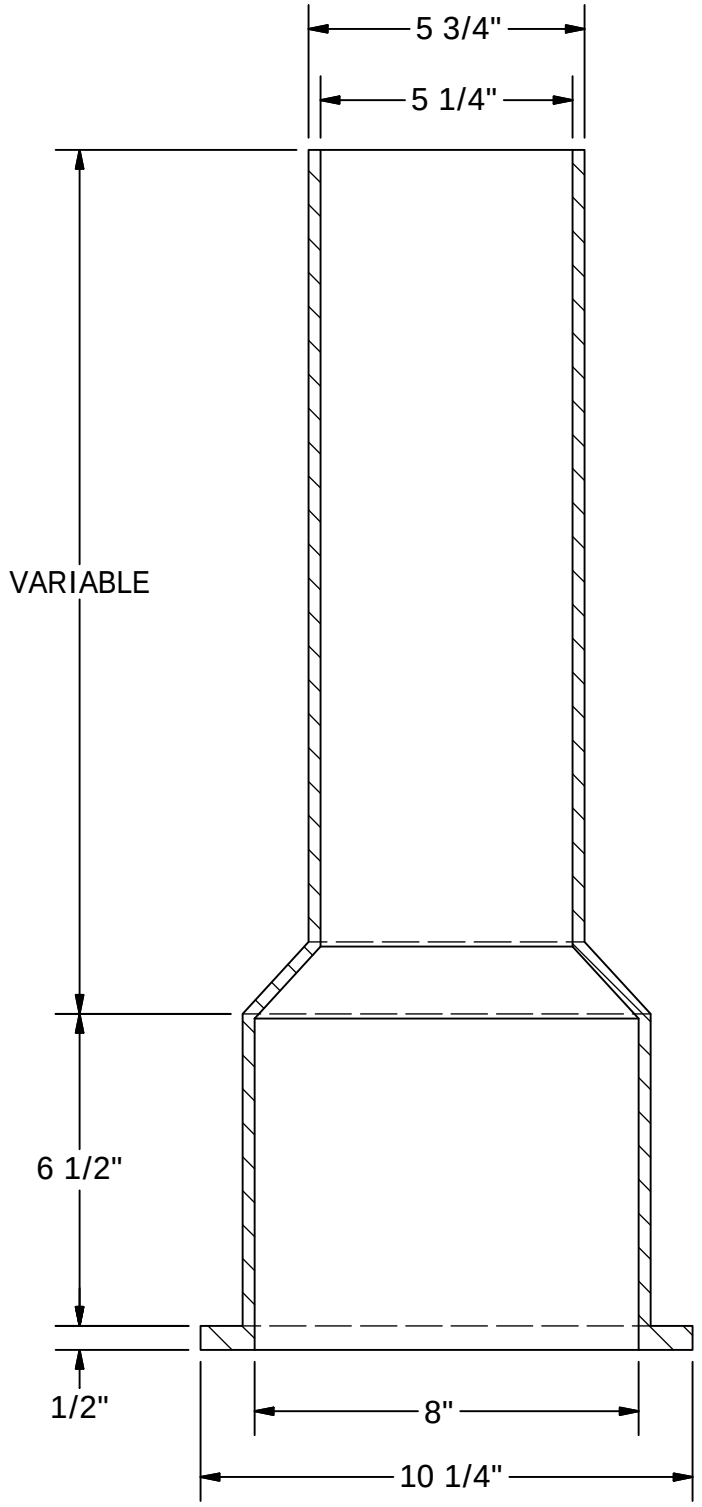
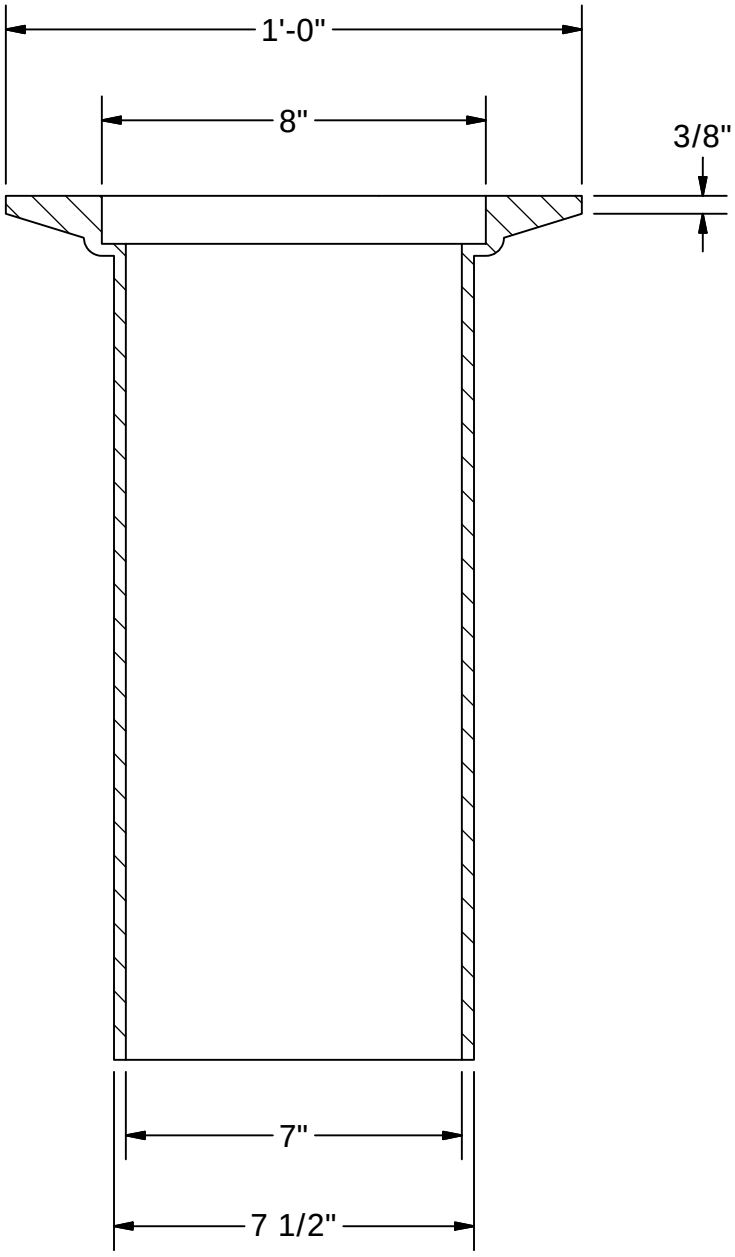


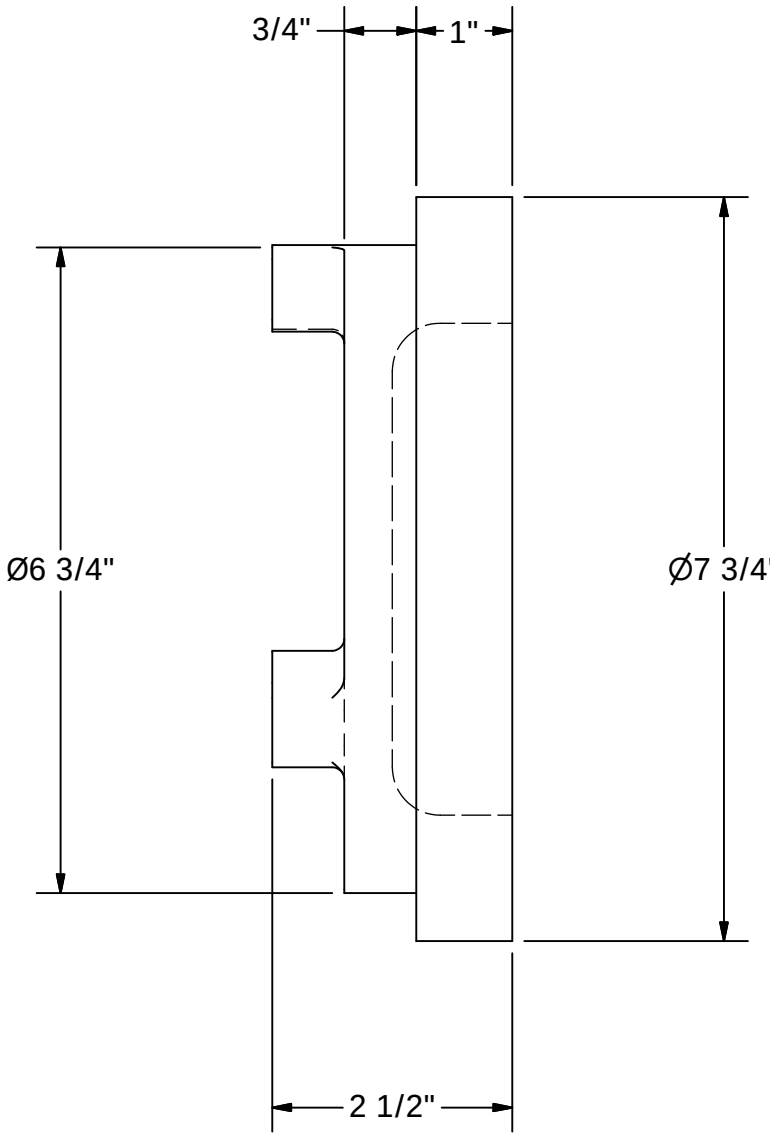
MATERIAL: CAST IRON ASTM A48, CL30
OR DUCTILE IRON ASTM A536 CL80-55-06
RATING - H-20

DRN BY AM	DATE 03/10/11	ROMTEC UTILITIES	18240 NORTH BANK ROAD ROSEBURG, OREGON 97470 541-496-3541
CHK BY	DATE		
APR BY	DATE	DESCRIPTION	
		VALVE BOX BOTTOM	
		DWG NO NO. 931	REV



MATERIAL: CAST IRON ASTM A48, CL30
RATING - H-20

DRN BY AM	DATE 03/10/11	ROMTEC UTILITIES	18240 NORTH BANK ROAD ROSEBURG, OREGON 97470 541-496-3541
CHK BY	DATE		
APR BY	DATE	DESCRIPTION	
		18" FLANGE UP VALVE BOX	
		DWG NO NO. 910	REV



DRN BY AM	DATE 03/10/11	ROMTEC UTILITIES	18240 NORTH BANK ROAD ROSEBURG, OREGON 97470 541-496-3541
CHK BY	DATE		
APR BY	DATE	DESCRIPTION	
		VALVE BOX LID	
		DWG NO NO. 910	REV

END

OF

SECTION

4. PUMPS

This section provides the information pertaining to the pumps for this project.

This section is structured as follows:

TSURUMI PUMP

BUILT FOR WORK

SEWAGE AND WASTEWATER PUMPS

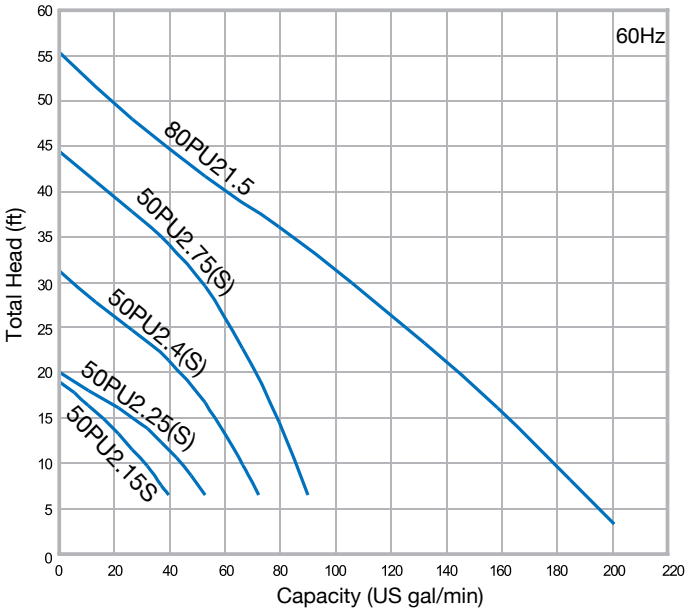
CORROSION RESISTANT PUMPS
VANCS SERIES

PU • PN • PSF • TM

Electric Submersible Pumps • Engine Powered Pumps • Accessories

PU Series

Performance Curves

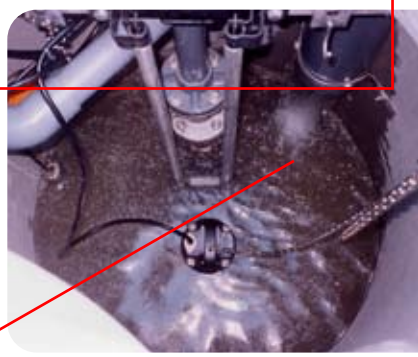


Feature

- 304 Stainless Steel
- FRP Resin Molded Parts
- Semi-Vortex Impeller Design

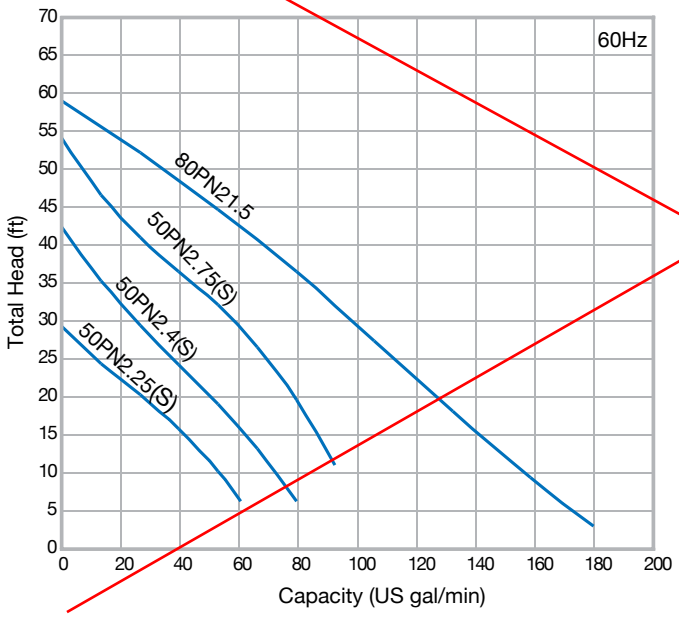
Applications

- Residential, commercial, industrial sewage, effluent, wastewater and site drainage.
- Chemical spill containment
- Decorative waterfalls, fountains and fish ponds.
- Raw water supply from rivers or lakes.
- Anywhere your sump pump is subject to rust or corrosion, VANCS is the answer.



PN Series

Performance Curves



Feature

- 304 Stainless Steel
- FRP Resin Molded Parts
- Semi-Open impeller Design

Applications

- Residential, commercial, industrial, effluent, wastewater and site drainage.
- Chemical spill containment
- Raw water supply from rivers or lakes.
- Anywhere your sump pump is subject to rust or corrosion, VANCS is the answer.

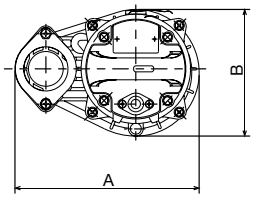
TSURUMI PUMP

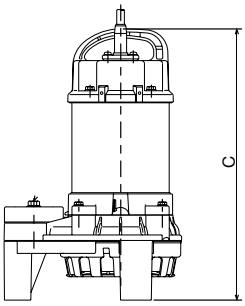
VANCS Series Specification

Model		Discharge Size (inch)	Phase	Voltages	Motor Output (HP)	Dimensions (inch)						Cable length (ft)	Free Standing Weight (lbs.)	※Guide Rail Fitting (lbs.)
						Free Standing Models			TOK Guide Rail Models					
						A	B	C	D	E	F			
PU	50PU2.15S	2	1Ø	115/230	1/5	8 7/8	6 1/16	14 13/16	16	6 1/16	16 1/8	20	13	15
	50PU2.25S	2	1Ø	115/230	1/3	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16	32	16	17
	50PU2.25	2	3Ø	230/460	1/3	9 5/16	6 3/8	13 3/4	16 3/4	6 11/16	16	32	13	16
	50PU2.4S	2	1Ø	115/230	1/2	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16 5/16	32	16	19
	50PU2.4	2	3Ø	230/460	1/2	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16 5/16	32	15	17
	50PU2.75S	2	1Ø	115/230	1	9 5/16	6 3/8	14 15/16	16 3/4	6 11/16	16 8/9	32	20	24
	50PU2.75	2	3Ø	230/460	1	9 5/16	6 3/8	14 3/4	16 3/4	6 11/16	16 7/8	32	18	21
	80PU21.5	3	3Ø	230/460	2	11 5/8	7 11/16	18 11/16	20 7/16	7 11/16	19 1/4	32	35	35
PN	50PN2.25S	2	1Ø	115/230	1/3	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16	32	16	17
	50PN2.25	2	3Ø	230/460	1/3	9 5/16	6 3/8	13 3/4	16 3/4	6 11/16	16	32	13	16
	50PN2.4S	2	1Ø	115/230	1/2	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16 5/16	32	16	19
	50PN2.4	2	3Ø	230/460	1/2	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16 5/16	32	15	18
	50PN2.75S	2	1Ø	115/230	1	9 5/16	6 3/8	14 15/16	16 3/4	6 11/16	16 7/8	32	20	24
	50PN2.75	2	3Ø	230/460	1	9 5/16	6 3/8	14 3/4	16 3/4	6 11/16	16 7/8	32	18	21
	80PN21.5	3	3Ø	230/460	2	11 5/8	7 11/16	17 1/8	20 7/16	7 11/16	19 1/4	32	35	35
PSF	50PSF2.25S	2	1Ø	115/230	1/3	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16	32	16	17
	50PSF2.25	2	3Ø	230/460	1/3	9 5/16	6 3/8	13 3/4	16 3/4	6 11/16	16	32	14	16
	50PSF2.4S	2	1Ø	115/230	1/2	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16 5/16	32	16	19
	50PSF2.4	2	3Ø	230/460	1/2	9 5/16	6 3/8	14 3/16	16 3/4	6 11/16	16 15/16	32	16	18
	50PSF2.75S	2	1Ø	115/230	1	9 5/16	6 3/8	14 15/16	16 3/4	6 11/16	16 7/8	32	20	24
	50PSF2.75	2	3Ø	230/460	1	9 5/16	6 3/8	14 3/4	16 3/4	6 11/16	16 7/8	32	19	21
	80PSF21.5	3	3Ø	230/460	2	11 5/8	7 11/16	17 1/8	20 7/16	7 11/16	19 1/4	32	35	35
TM	50TM2.4S	2	1Ø	115/230	1/2	9 5/16	6 3/8	14 3/16	N/A	N/A	N/A	32	15	N/A
	50TM2.4	2	3Ø	230/460	1/2	9 5/16	6 3/8	14 3/16	N/A	N/A	N/A	32	15	N/A
	50TM2.75S	2	1Ø	115/230	1	9 5/16	6 3/8	14 3/4	N/A	N/A	N/A	32	17	N/A
	50TM2 75	2	3Ø	230/460	1	9 5/16	6 3/8	14 3/4	N/A	N/A	N/A	32	17	N/A

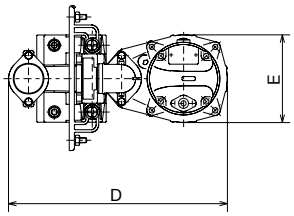
※ Pump weight only

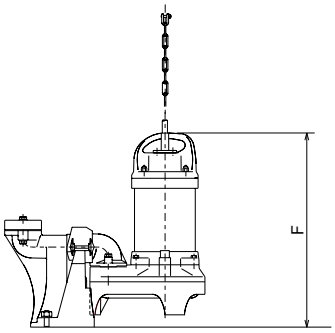
Dimension: Free Standing





Dimension: Guide Rail Fitting (TOK)





TSURUMI PUMP

The Pump Technology That The World Trusts.

Tsurumi introduced its international strategy in the 1960s. Our technical capabilities gained recognition first in Asia in the 1970s and then in the United States and Europe in the 1980s.

Following the initial steps, our international division successfully penetrated many worldwide markets including: construction, civil engineering, mining, industrial, wastewater, sewage treatment, and flood control.

Today Tsurumi has expanded its base of operations and is active in 45 countries and regions. In addition to supporting a variety of work sites, our high-performance pump products are widely used in large-scale national projects where they surpass expectations. Reliable performance is our first priority.

TSURUMI PUMP

TSURUMI (AMERICA), INC.
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Glendale Heights, IL 60139
Tel: 1-888-878-7864 (Toll-Free)
1-630-793-0127
Fax: 1-630-793-0146

TSURUMI (AMERICA), INC. WEST
6216 West 9790 South
West Jordan, UT 84081
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1-801-563-5910
Fax: 1-801-563-5911

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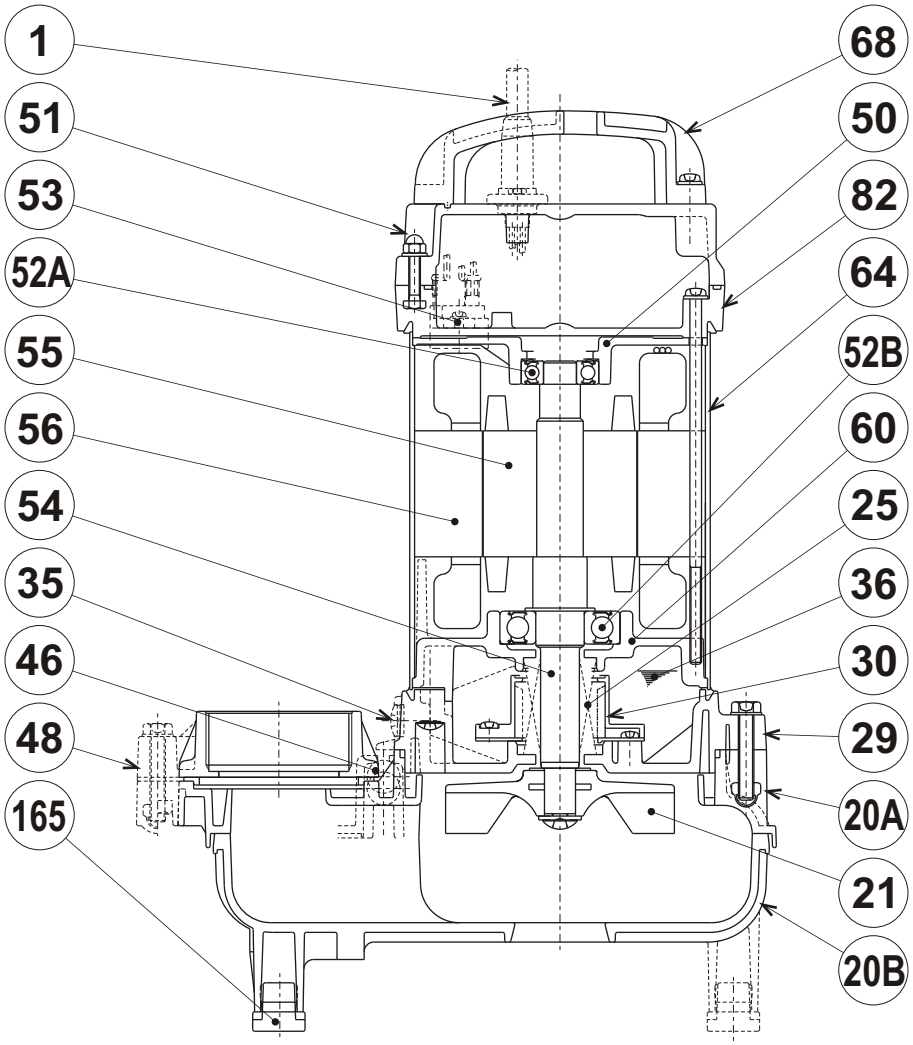
TSURUMI PUMP

VANCS - SERIES - PU
(FRP) SEMI-VORTEX - SEWAGE & WASTEWATER PUMPS

SECTIONAL VIEW

80PU21.5-62



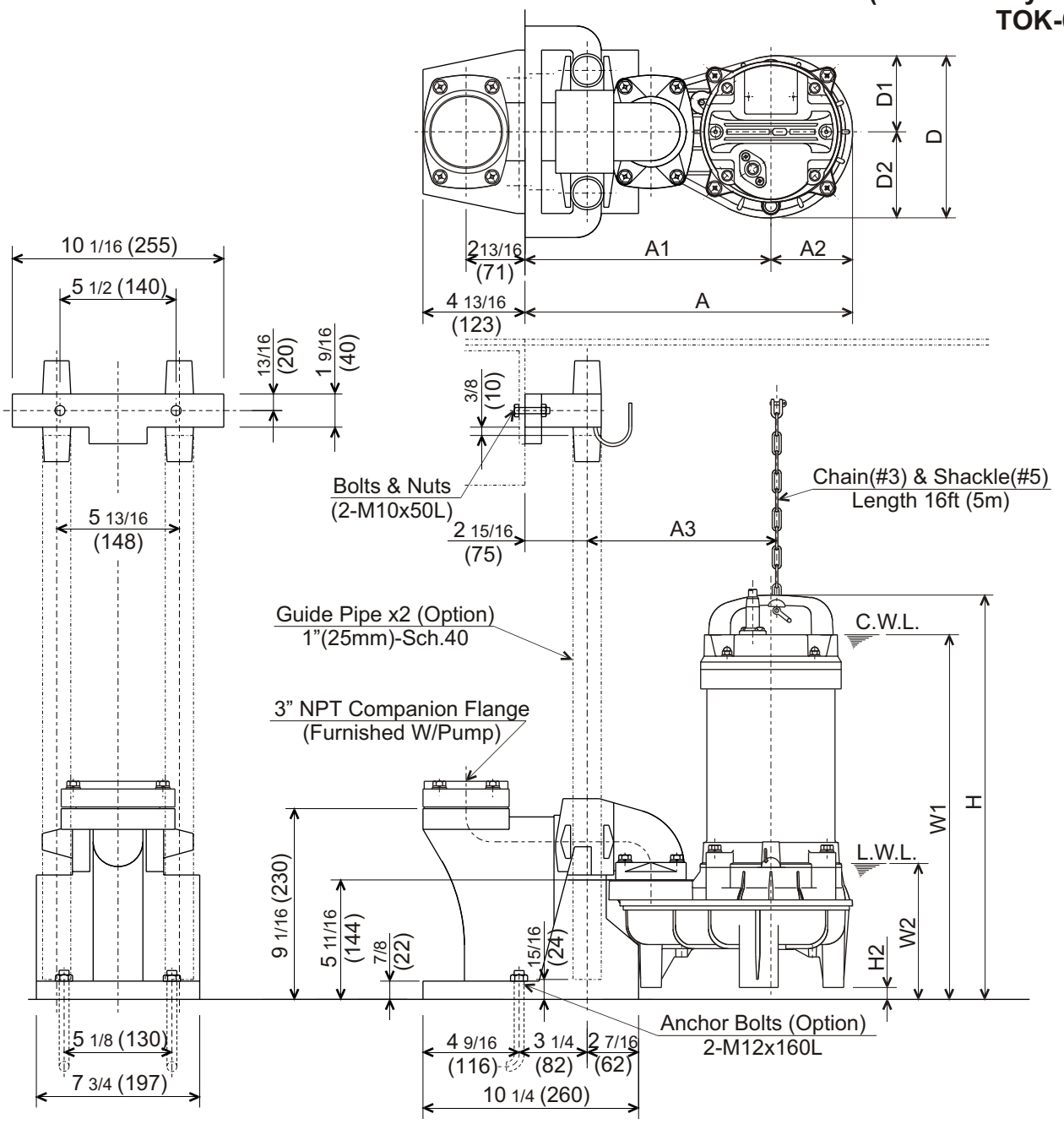
PART#	DESCRIPTION	MAIN MATERIAL / NOTE	RELATED ASTM, AISI CODE	RELATED EN CODE	QTY
1	Power Cable	PVC Sheath AWG16/4-32ft			1
20A	Upper Pump Casing	PA+ABS Plastic w/GF30			1
20B	Lower Pump Casing	PA+ABS Plastic w/GF30			1
21	Impeller	PPO Plastic w/GF20			1
25	Mechanical Seal	Silicon Carbide / H-20A			1
29	Oil Casing	PPS Plastic w/(GF+MD)50			1
30	Oil Lifter	PBT Plastic W/(GF+MD)40			1
35	Oil Plug	Stainless Steel	S 30400	1.4301	1
36	Lubricant	White Mineral Oil ISO VG32			
46	Air Valve	Glass Ball			1
48	Companion Flange	PVC / NPT 3"			1
50	Motor Bracket	Aluminum Alloy Die Casting	B85 383.0	EN 1706 AC-46100	1
51	Motor Head Cover	PPS Plastic w/GF40			1
52A	Upper Bearing	#6203ZZC3			1
52B	Lower Bearing	#6305ZZC3			1
53	Motor Protector				1
54	Shaft	Stainless Steel	S 30400	1.4301	1
55	Rotor				1
56	Stator				1
60	Bearing Housing	Aluminum Alloy Die Casting	B85 383.0	EN 1706 AC-46100	1
64	Motor Housing	Stainless Steel	S 30400	1.4301	1
68	Handle	ABS Plastic			1
82	Motor Head Cover Spacer	PPS Plastic w/GF40			1
165	Rubber Cusion	Nitrile Butadiene Rubber			5

TSURUMI PUMP

VANCS-SERIES - PU
(FRP) SEMI-VORTEX - SEWAGE & WASTEWATER PUMPS

DIMENSIONS

TOK80PU21.5
(Slide Rail System
TOK-65)



C.W.L. : Continuous running Water Level
L.W.L. : Lowest running Wtaer Level

DIMENSIONS:USCS (Inch)

Model	HP	NOM.	Pump & Motor									C.W.L.	L.W.L.	Wt.
		SIZE	A	A1	A2	A3	D	D1	D2	H	H2	W1	W2	(lbs.)
TOK80PU21.5	2	3"	15 9/16	11 11/16	3 7/8	9 1/16	7 11/16	3 5/8	4 1/8	19 1/4	9/16	17 3/8	6 1/2	34.8

DIMENSIONS:METRIC (mm)

Model	kW	NOM.	Pump & Motor									C.W.L.	L.W.L.	Wt.
		SIZE	A	A1	A2	A3	D	D1	D2	H	H2	W1	W2	(kg)
TOK80PU21.5	1.5	80	396	297	99	231	196	92	104	489	14	441	164	15.8

TSURUMI PUMP

VANCS - SERIES - PU
(FRP) SEMI-VORTEX - SEWAGE & WASTEWATER PUMPS

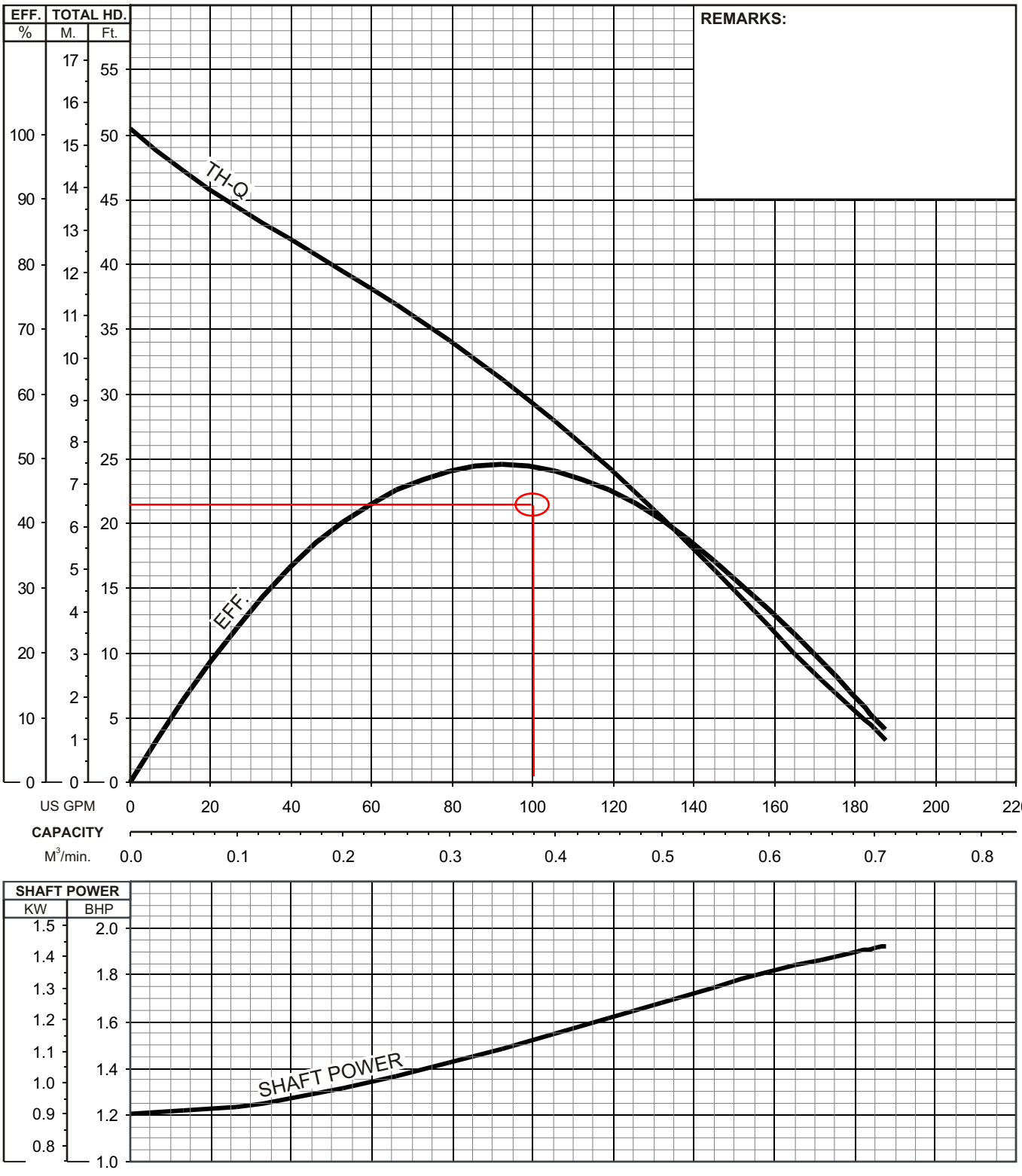
PERFORMANCE CURVE

MODEL	BORE	HP	KW	RPM	SOLIDS DIA	LIQUID	SG.	VISCOSITY	TEMP.
80PU(A/W)21.5 -62	3"/80mm	2	1.5	3455	1.81"/46mm	Water	1.0	1.123 CST	60°F

PUMP TYPE	PHASE	VOLTAGE	AMPERAGE	HZ	STARTING METHOD	INS. CLASS
Semi-Vortex - Sewage & Wastewater	3	208 - 220 / 440	6.9 - 6.6 / 3.6	60	Direct On Line	E

CURVE No.	DATE	PHASE	VOLTAGE	AMPERAGE	HZ	STARTING METHOD	INS. CLASS
-	-	-	-	-	-	-	-

REMARKS:



TSURUMI PUMP

17200159/B-10095-3

PU Submersible Vortex Sewage Pump

PN Submersible Vortex Wastewater Drainage Pump

PSF Submersible Centrifugal Effluent Drainage Pump

TM Submersible Titanium Pump

OPERATION MANUAL

INTRODUCTION

Thank you for selecting the Tsurumi PU submersible vortex sewage pump, PN submersible vortex wastewater drainage pump, PSF submersible centrifugal effluent drainage pump, or TM submersible titanium pump for your application.

This equipment should not be used for applications other than those listed in this manual. Failure to observe this precaution may lead to a malfunction or an accident. In the event of a malfunction or an accident, the manufacturer will not assume any liability. After reading this Operation Manual, keep it in a location that is easily accessible, so that it can be referred to whenever information is needed while operating the equipment.

CONTENTS

TSURUMI MANUFACTURING CO., LTD.

SAFETY INFORMATION :

This manual contains WARNING, CAUTION and ATTENTION, callouts which must be followed to reduce the possibility of personal injury, damage to the equipment, or improper service.

WARNING

To reduce risk of electric shock, see installation instruction manual for proper installation.

To Reduce Risk of Electric Shock, connect only to the properly grounded, grounded-type receptacle.

Reduce Risk of Electric Shock – This pump has not been investigated for use in Swimming Pool, Deep Wells, Fountains or Marine areas.

An acceptable motor-control switch shall be provided at the time of installation according to local codes and regulations.

To Reduce Risk of Electric Shock – Install only on a circuit protected by a Ground-Fault Circuit Interrupter (GFCI).

The pump must not be used when people are in the water.

Leakage of pump lubricants may cause pollution of water.

Proper plug must be provided according to local codes and standards. Refer to wiring diagram.

Never operate pump while it is suspended in air. The recoil may result in injury or other major accident.

Do not use in the vicinity of explosive or flammable materials.

CAUTION

Risk of Electric Shock – Service and Installation to be Conducted by Qualified Persons Only.

This pump may automatically restart. Disconnect all supply circuits before working on the pump or control panel.

Risk of Electric Shock – Do not remove cord and strain relief or connect conduit to the pump motor.

This pump has been evaluated for use in water only.

ATTENTION

If used in permanent installation where the pump is not readily accessible after the installation, please contact Tsurumi for duplicate nameplate to be installed at the wellhead or on the control box so that it will be readily visible.

1 BE SURE TO READ FOR YOUR SAFETY

Be sure to thoroughly read and understand the SAFETY PRECAUTIONS given in this section before using the equipment in order to operate the equipment correctly.
The precautionary measures described in this section are intended to prevent danger or damage to you or to others. The contents of this manual that could possibly be performed improperly are classified into two categories: ⚠**WARNING**, and ⚠**CAUTION**. The categories indicate the extent of possible damage or the urgency of the precaution. Note however, that what is included under ⚠**CAUTION** may at times lead to a more serious problem. In either case, the categories pertain to safety-related items, and as such, must be observed carefully.

- ⚠**WARNING** : Operating the equipment improperly by failing to observe this precaution may possibly lead to death or injury to humans.
- ⚠**CAUTION** : Operating the equipment improperly by failing to observe this precaution may possibly cause injury to humans and other physical damage.
- **NOTE** : Gives information that does not fall in the WARNING or CAUTION categories.
- Explanation of Symbols:


: The △ mark indicates a WARNING or CAUTION item. The symbol inside the mark describes the precaution in more detail ("electrical shock", in the case of the example on the left).

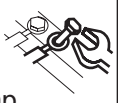
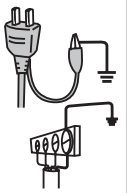
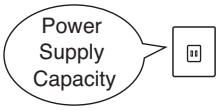

: The ⃠ mark indicates a prohibited action. The symbol inside the mark, or a notation in the vicinity of the mark describes the precaution in more detail ("disassembly prohibited", in the case of the example on the left).


: The ● mark indicates an action that must be taken, or instructs how to perform a task. The symbol inside the mark describes the precaution in more detail ("provide ground work", in the case of the example on the left).

PRECAUTIONS TO THE PRODUCT SPECIFICATIONS

⚠ CAUTION	
	●Do not operate the product under any conditions other than those for which it is specified. **Failure to observe the precaution can lead to electrical leakage, electrical shock, fire, or water leakage, etc.** 

PRECAUTIONS DURING TRANSPORT AND INSTALLATION

⚠ WARNING			
	●When transporting the product, pay close attention to its center of gravity and mass. Use an appropriate lifting equipment to lift the unit. **Improper lifting may result in the product damage, injury, or death.** 		●Install the product properly in accordance with this instruction manual. **Improper installation may result in electrical leakage, electrical shock, fire, water leakage, or injury.** 
	●Electrical wiring should be performed in accordance with all applicable regulations in your country. Provide a dedicated earth leakage circuit breaker and a thermal overload relay for the pump. **Imperfect wiring or neglecting the installation of proper equipment will cause electrical leakage, fire, or explosion at worst.** 		●Provide a secure grounding dedicated for the product. Never fail to provide an earth leakage circuit breaker and a thermal overload relay in your starter or control panel (Both available on the market). **If an electrical leakage occurs by due to a product failure, it may cause electrical shock.** 
	●Use a power outlet that has a sufficient rating and has been exclusively provided for the pump. **If the power outlet is shared with other equipment, it can lead to an abnormal heat of the outlet and can cause fire as a result.** 		

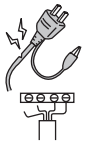
⚠ CAUTION

- ●Be sure to provide a ground wire securely. Do not connect the ground wire to a gas pipe, water pipe, lightening rod, or telephone ground wire. **Improper grounding could cause electrical shock.**

- ●Prevent a metallic object or dust from sticking to the power plug. **Adhesion of foreign object to the plug could cause electrical shock, short-circuit, or fire.**

- ●Do not scratch, fold, twist, make alterations, or bundle the cable, or use it as a lifting device. **The cable may be damaged, which may cause electrical leakage, short-circuit, electrical shock, or fire.**

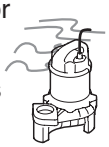
- ●Do not use the cabtyre cable, power plug, or power outlet if it is damaged or it is not closely fitted. Connect every conductor of the cabtyre cable securely to the terminals. **Failure to observe this can lead to electrical shock, short-circuit, or fire.**



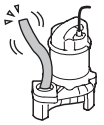
- ●Install the discharge pipe securely so that no water leakage may occur. In addition, It is suggested to provide a stand-by pump in case of flooding. **Failure to do so may result in damage to nearby walls, floors, and other equipment.**

- ●When the product will be carried by hand, decide the number of persons considering the mass of the product. **When lifting up the product, do not attempt to do it by simply bowing from the waist. Use the knees, too, to protect your waist.**

- ●This pump is neither dust-proof nor explosion-proof. Do not use it at a dusty place or at a place where toxic, corrosive or explosive gas is present. **Use in such places could cause fire or explosion.**



- ●If a hose is used for the discharge line, take a measure to prevent the hose from shaking. **If the hose shakes, you may be wet or injured.**



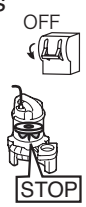
PRECAUTIONS DURING TEST OPERATION AND OPERATION

⚠ WARNING

- ●Never try to operate the pump if somebody is present in the pump sump. **If an electrical leakage occurs, it can cause electrical shock.**

- ●Never start the pump while it is suspended, as **the unit may jerk and could lead to injury.**

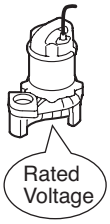
- ●When changing power connection is needed to correct the direction of rotation, be sure to turn off the power supply (earth leakage circuit breaker, etc.), and perform the work after making sure that the impeller has stopped completely. **Failure to do so may lead to electrical shock, short-circuit, or injury.**



- ●When inspecting the pump, be sure to turn off the power supply (earth leakage circuit breaker, etc.) so that the pump may not start accidentally. **Failure to do so may lead to a serious accident.**

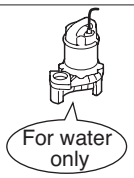
⚠ CAUTION

- ●Do not operate the product under any voltage other than described on the nameplate with the voltage variation limit within ±10%. If it is operated with a generator, it is strongly suggested not to operate other equipment with the same generator. **Failure to observe this caution may cause malfunction and breakdown of the product, which may lead to electrical leakage or electrical shock.**



- ●Do not touch the product with bare hands during or immediate after the operation, as the product may become very hot during operation. **Failure to observe this caution may lead to be burned.**

- ●Do not use the product in a liquid other than water. **Use in oil, salt water or organic solvents will damage it, which may lead to electrical leakage or electrical shock.**

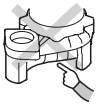


- ●Do not run the product dry or operate it with its valve (sluice or gate valve) closed, as **doing so will damage the product, which may lead to electrical leakage or electrical shock.**

⚠ CAUTION

- ●Do not use the product for hot or warm liquid over 40°C, as **doing so will damage the product, which may lead to electrical leakage or electrical shock.**

- ●Do not allow foreign objects (metal objects such as pins or wires) to enter the suction inlet of the pump. **Failure to observe this caution could cause it to malfunction or to operate abnormally, which may lead to electrical leakage or electrical shock.**

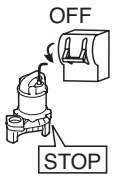


- ●When the product will not be used for an extended period, be sure to turn off the power supply (earth leakage circuit breaker, etc.). **Deterioration of the insulation may lead to electrical leakage, electrical shock, or fire.**

PRECAUTIONS DURING MAINTENANCE AND INSPECTION

⚠ WARNING

- ●Absolutely turn off the power supply or disconnect the plug before starting maintenance or inspection. Do not work with wet hands. **Failure to observe these cautions may lead to electrical shock or injury.**



- ●In case any abnormality (excessive vibration, unusual noise or odor) is found in the operation, turn the power off immediately and consult with the dealer where it was purchased or Tsurumi representative. **Continuing to operate the product under abnormal conditions may result in electrical shock, fire, or water leakage.**

- ●Do not disassemble or repair any parts other than those designated in the operation manual. If repairs are necessary in any other than the designated parts, consult with the dealer where it was purchased or Tsurumi representative. **Improper repairs can result in electrical leakage, electrical shock, fire, or water leakage.**

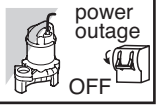
⚠ CAUTION

- ●After reassembly, always perform a test operation before resuming use of the product. **Improper assembly can result in electrical leakage, electrical shock, fire, or water leakage .**

PRECAUTION TO POWER OUTAGE

⚠ WARNING

- ●In case of power outage, turn off the power supply. **The product will resume operation when the power is restored, which presents serious danger to people in the vicinity.**



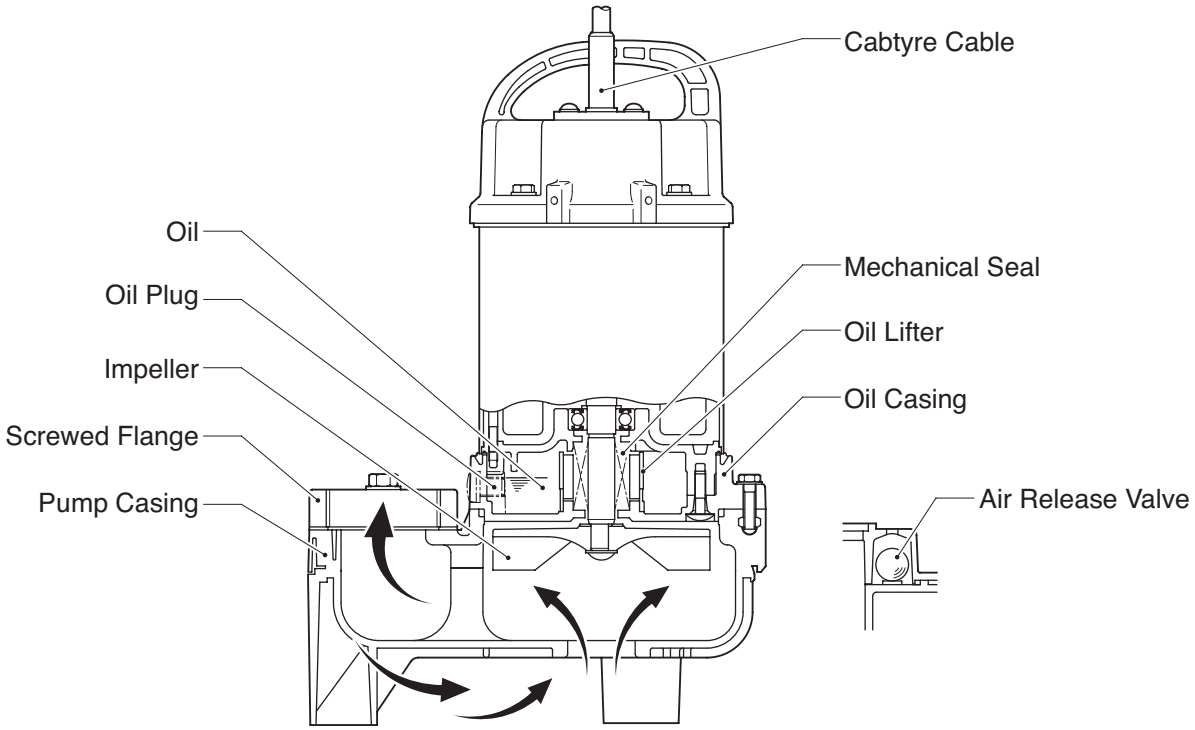
OTHER PRECAUTION

⚠ CAUTION

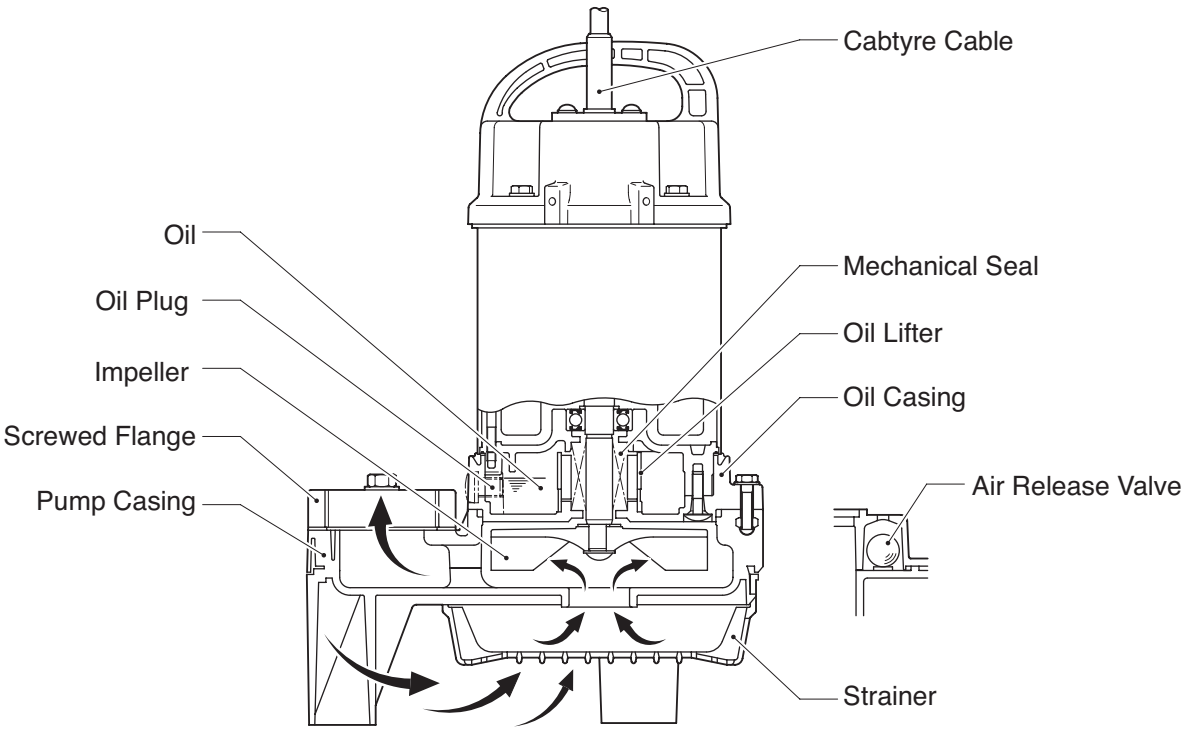
- ●Never use the product for potable water. **It may present a danger to human health.**

2 PART NAMES

■ Example: PU Series



■ Example: PN Series



3 PRIOR TO OPERATION

When the unit is delivered, first perform the following checks.

Inspection

While unpacking, inspect the product for damage during, shipment, and make sure all bolts and nuts are tightened properly.

Specification Check

Check the nameplate of the unit to verify that it is the product that you have ordered. Pay particular attention to its voltage and frequency specifications.

Accessory Check

Verify that all accessory items are included in the package.

Operation Manual..... 1

Note: *If you discover any damage or discrepancy in the product, please contact the dealer where this equipment was purchased or the Tsurumi sales office in your area.*

Product Specifications

⚠CAUTION **Do not operate this product under any conditions other than those that have been specified.**

■ Major Standard Specifications

Applicable Liquids	Consistency and Temperature	PU Series: Water, waste water, sewage, and liquid carrying waste and solid matters; 0 ~ 40°C PN Series: Water, waste water and effluent; 0 ~ 40°C PSF Series: Water, waste water, treated effluent, and standing water; 0 ~ 40°C TM Series: Water, waste water, effluent and sea water; 0 ~ 40°C
	Working Atmosphere	The chlorine gas concentration should be below 0.1 ppm. (PU/PN/PSF Series) **Note:** The concentration over 0.1 ppm may cause the pump to corrode.
Pump	Impeller	PU, PN, TM Series: Vortex type PSF Series: Closed type
	Shaft Seal	Double Mechanical Seal
	Bearing	Shielded Ball Bearing
Motor	Specifications	Dry Submersible Induction Motor, 2-Pole
	Insulation	Class E
	Protection System (built-in)	Miniature Protector (0.15 to 0.4 kW Single-Phase) Circle Thermal Protector (0.75kW Single-Phase, all Three-Phase models)
	Lubricant	Liquid Paraffin VG32
Connection		Screwed Flange

4 INSTALLATION

⚠CAUTION

- **Do not use the pump for pumping liquids other than water, such as oil, salt water (TM Series excepted), or organic solvents.**
- **Use with a power supply voltage variation within ±10% of the rated voltage.**
- **The water temperature for operating the pump should be between 0 ~ 40°C.**

Failure to observe the precautions given above could cause the pump to malfunction, which may lead to current leakage or electrical shock.

Note: *To use the pump for a special solution, contact the dealer where it was purchased, or the Tsurumi sales office in your area.*

■ Maximum Allowable Pressure

⚠CAUTION **Do not operate the pump in an area that is exposed to a water pressure that exceeds the values given below.**

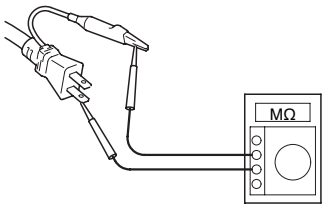
Applicable Pump	Maximum Allowable Pressure
Models with output of 0.75kW or under	0.2MPa (2kgf/cm^2) — discharge pressure during use
Models with output of 1.5kW	0.3MPa (3kgf/cm^2) — discharge pressure during use
Models with output of 2.2 ~ 3.7kW	0.5MPa (5kgf/cm^2) — discharge pressure during use

Preparation for Installation

■ Single-phase power supply:

Use a megger to measure the resistance between the tip of the cabtyre cable plug and the ground terminal to verify the insulation resistance of the motor.
Measure twice the resistance between each of the two tips of the plug and ground.
(This drawing shows a 2-pin plug type.)

Single-Phase

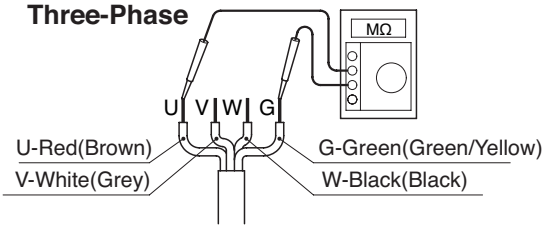


⚠CAUTION **Beware that the power plug varies by country or region.**

■ Three-phase power supply:

Use a megger to measure the resistance between each core of the cabtyre cable and the (green) ground wire to verify the insulation resistance of the motor.

Three-Phase



Insulation resistance reference value
= 20M Ω minimum

Note: *The insulation resistance reference value of 20M Ω minimum is based on a new or repaired pump. For reference values of a pump that has already been put into operation, refer to "7. Maintenance and Inspection" of this manual.*

Precautions During Installation

⚠WARNING **When installing the pump, be mindful of the pump's center of gravity and weight. If the pump is not suspended properly, the pump may fall and break, which may lead to injury.**

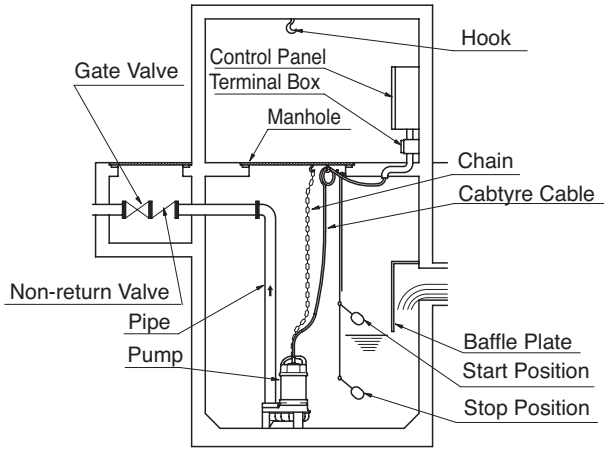
⚠CAUTION **When installing or moving the pump, never suspend the pump by the cabtyre cable. Doing so will damage the cable, which may cause a current leakage, electrical shock, or fire.**

Refer to the installation examples illustrated below and pay attention to the points described below to install the pump.

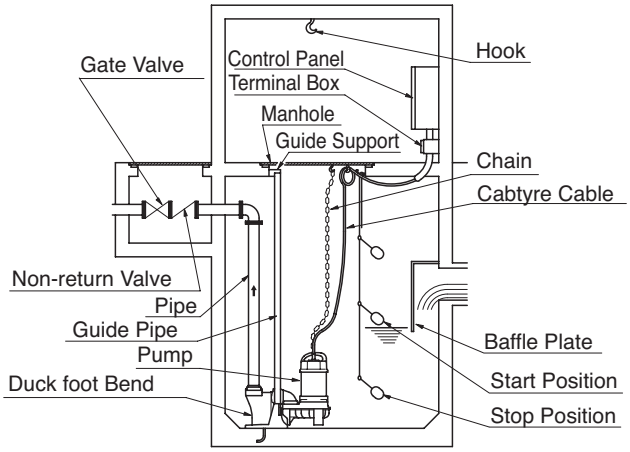
⚠CAUTION **During piping work if the welding sparks, paint, or concrete come in contact with the pump, they could cause the pump to malfunction, which may lead to current leakage or electrical shock.**

⚠CAUTION **The starting reaction of the pump may let the pump rotate to the direction of screwing the discharge pipe, which could cause damage to the screw flange of the pump. If frequent starts are expected in your installation, prevent the pump from rotating by fixing it to the pipe or other method.**

■ Free Standing Specification



■ Guide-Rail Specification



(1) When transporting or installing the pump, do not kink the cabtyre cable or use it in place of a rope.

(2) With the cabtyre cable lifted slightly, secure it to the hook (a hook must be prepared in advance by placing it on the frame of a manhole or the like).

⚠CAUTION **Do not operate the pump with the cabtyre cable dangling. Failure to observe this precaution may cause the cabtyre cable to become wrapped around the impeller, which could cut the cable, break the impeller, or cause flooding, which may lead to current leakage or electrical shock.**

(3) Install the pump on a horizontal and rigid surface such as concrete, in an area that is free from turbulence and does not cause the pump to take air in.

(4) The area near the inlet of a water tank is susceptible to turbulence or allows the pump to take air in; therefore, place the pump and the float switch away from the inlet or install a baffle plate.

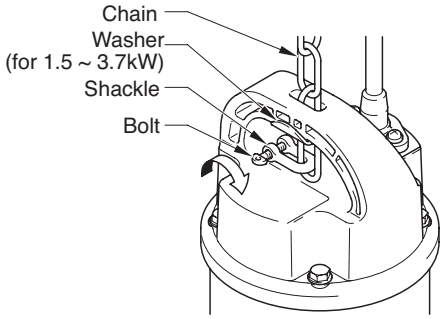
(5) Properly perform piping work so as not to create any air pockets in the middle of piping.

⚠CAUTION **With automatic control, the sewage water in the pipe could flow backwards, causing the water surface control to react immediately. As a result, the pump will operate ON/OFF repeatedly, which could cause the pump to malfunction.**

(6) Install a non-return valve if the pump tank is deep, or if the vertical head or the lateral distance is long.

Attaching a Chain to Suspend the Pump

Refer to the illustration on the right in order to suspend the pump by a chain. (On the 1.5 ~3.7kW models, use a washer.)



⚠CAUTION **Make sure that the chain does not become twisted during installation. Failure to observe this precaution could cause the chain to break and the pump to fall and break, which could lead to injury.**

Note: *To use the pump with the guide rail, refer to the separate operation manual entitled "Guide Rail".*

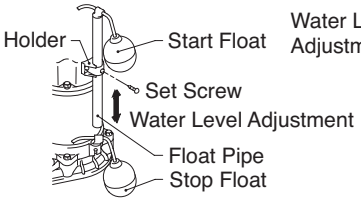
Installing the Float

Insert the float pipe into the holder, and use a Phillips screwdriver to tighten the set screw. Although the float level is preset, follow the procedures given below to change the level.

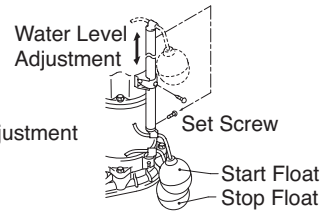
(1) Loosen the screw and adjust the height at the top and the bottom of the float pipe to set the starting and stopping water levels.
(2) After completing the setting, tighten the screws to secure both the top and the bottom of the float pipe.

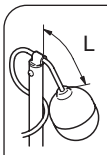
* The start float must always be set to a position higher than the level that makes the motor completely submerged. Also, be sure that the running time must not be longer than 15 minutes and that the frequency of start must be less than 10 times per hour.

Adjusting the start float to set the starting water level as desired:



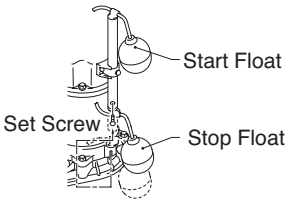
Setting the start float water level low:





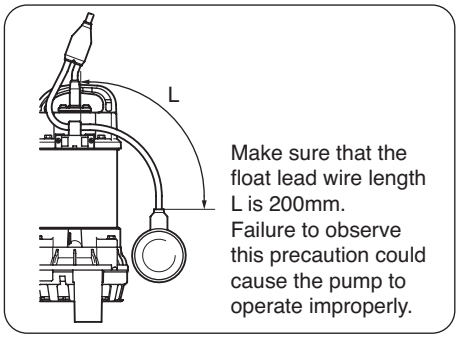
Make sure that the float lead wire length L is 40mm. Failure to observe this precaution could cause the pump to operate improperly.

Setting the stop float water level high:



Note: *If the float is set to a lower position than described above, the motor protection device may operate, or the motor may become damaged by due to inadequate motor cooling.*

* In the case of an automatic alternating model, apply the same procedures to set the parallel operating water level. Then, remove the alternating start float by loosening its screw, set the alternating starting water level as desired, and secure the alternating start float in place by tightening the screw.
* To prevent unintended operation, face the floats outward.

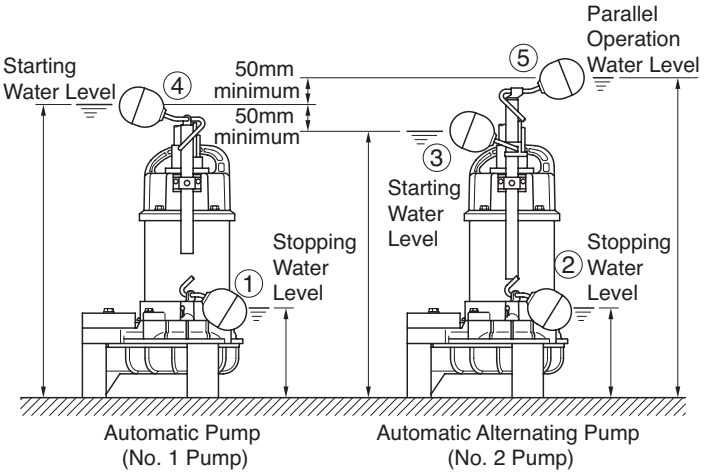


Make sure that the float lead wire length L is 200mm. Failure to observe this precaution could cause the pump to operate improperly.

To change the operating water level on an automatic alternating model, perform the setting by referring to the diagram on the right. There is no need to change its stopping water level.

* After changing the water level on an automatic alternating model, make sure to adjust its automatic side.
* Pay attention to the positional relationship between floats 3, 4, and 5 to perform the settings.

Number	Name	Color
1	No. 1 Pump Stop Float	Red
2	No. 2 Pump Stop Float	Red
3	No. 2 Pump Alternating Start Float	Yellow
4	No. 1 Pump Start Float	Yellow
5	No. 1 Pump / No. 2 Pump Parallel Operation Float	Green



5 ELECTRICAL WIRING

Electrical Wiring Work

⚠WARNING

- **All electrical work must be performed by an authorized electrician, in compliance with local electrical equipment standards and internal wiring codes. Never allow an unauthorized person to perform electrical work because it is not only against the law, but it can also be extremely dangerous.**
- **Improper wiring can lead to current leakage, electrical shock, or fire.**
- **Absolutely provide a dedicated earth leakage circut breaker and a thermal overload relay suitable for the pump (available on the market). Failure to follow this warning can cause electrical shock or explosion when the product fails or an electrical leakage occurs.**

Operate well within the capacity of the power supply and wiring.

Grounding

⚠WARNING **Be sure to install the ground wire securely. Failure to observe this precaution could damage the pump and cause current leakage, which may lead to electrical shock.**

⚠CAUTION **Do not connect the ground wire to a gas pipe, water pipe, lightning rod, or telephone ground wire. Improper grounding could cause electrical shock.**

Connecting the Power Plug

⚠WARNING **Before inserting the power plug or connecting the wires to the terminal board, make sure that the power supply (i.e. circuit breaker) is properly disconnected. Failure to do so may lead to electrical shock, short, or injury caused by the unintended starting of the pump.**

⚠CAUTION **Do not use damaged cabtyre cables, power plugs, or loose power outlets. Failure to observe this precaution could lead to electrical shock, short circuit, or fire.**

Follow the diagram on the right to connect the power.

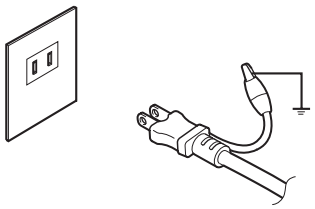
When using a three-prong grounded plug,connect as shown in the drawing.

⚠CAUTION **Be sure to use a dedicated power supply with a ground leakage circuit breaker.**

(This drawing shows a 2-pin plug type.)

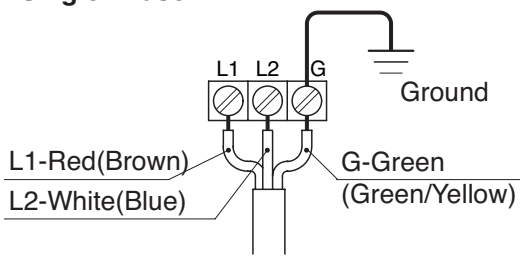
⚠CAUTION **Beware that the power plug varies by country or region.**

Note: *The shape of the plug may differ from that shown in the illustration.*



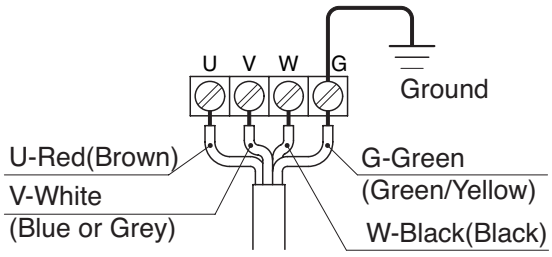
When a single-phase power source is used, connect the leads to the control panel terminals as shown in the diagram, making sure they do not become twisted together.

Single Phase



When a three-phase power source is used, connect the leads to the control panel terminals as shown in the diagram, making sure they do not become twisted together.

Three Phase



Note: *The cabtyre cable, if it is unused, is terminally processed. If there is a need to peel off the cable again, have the terminal processed.*

⚠CAUTION

- **If it is necessary to extend the cabtyre cable, use a core size equal to or larger than the original. This is necessary not only for avoiding a performance drop, but to prevent cable overheating which can result in fire, electrical leakage or electrical shock.**
- **If a cable with cut insulation or other damage is submerged in the water, there is a danger of water seeping into the motor causing a short. This may result in damage to the product, electrical leakage, electrical shock, or fire.**
- **Be careful not to let the cabtyre cable be cut or become twisted. This may result in damage to the product, electrical leakage, electrical shock, or fire.**
- **If it is necessary to submerse the connection leads of the cabtyre cable in water, first seal the leads completely in a molded protective sleeve, to prevent electrical leakage, electrical shock, or fire.**

Do not allow the cabtyre cable leads to become wet.
Make sure the cable does not become excessively bent or twisted, and does not rub against a structure in a way that might damage it.

Motor Protector

The pump is equipped with a built-in motor protector.

If a current overload or overheating occurs under the symptoms given below, the pump will stop automatically to protect the motor regardless of the water level at the time of operation.

- Extreme fluctuation of power supply voltage
- Pump operated under overload condition
- Pump operated at open phase or binding condition

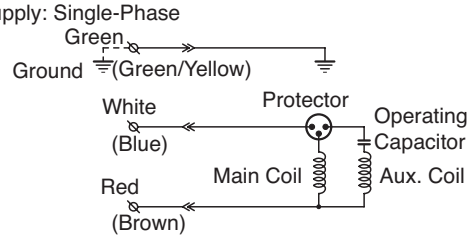
Note: *After the motor protector has tripped, the motor automatically resumes its operation. Therefore, make sure to disconnect the cabtyre cable from the terminal board or the power outlet, and eliminate the cause of the problem.*

Do not operate the pump at unusually low head, or with the impeller clogged with debris. Doing so will not only prevent the pump from attaining its full potential, but may also generate abnormal noise and vibration and damage the pump.

Electrical Circuit Diagrams

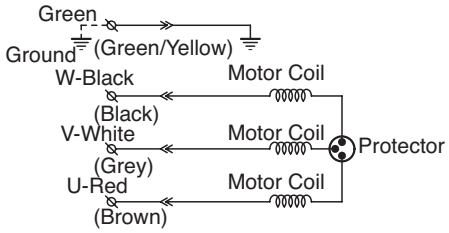
■ PU/PN/PSF/TM Series Non-Automatic Circuit (Output 0.75kW maximum)

Power Supply: Single-Phase



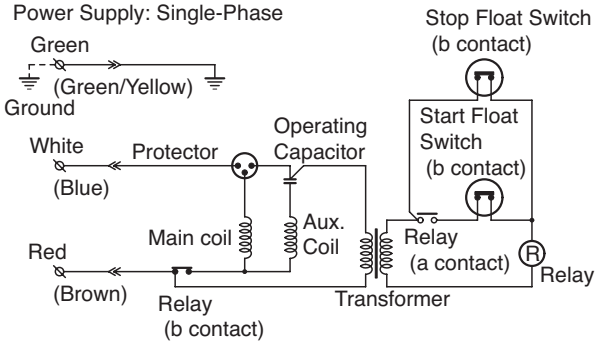
■ PU/PN/PSF/TM Series Non-Automatic Circuit

Power Supply: Three-Phase



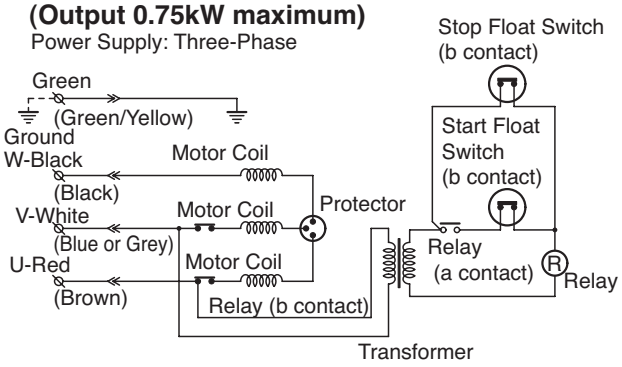
■ PUA/PNA/PSFA/TMA Series Automatic Circuit (Output 0.75kW maximum)

Power Supply: Single-Phase



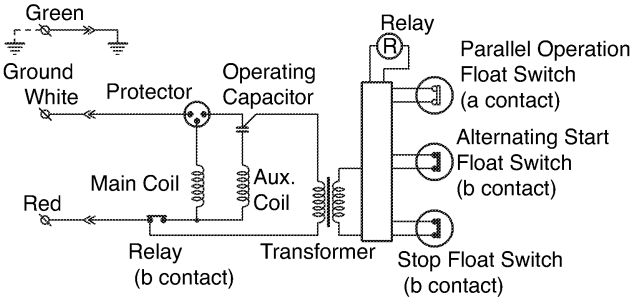
■ PUA/PNA/PSFA/TMA Series Automatic Circuit (Output 0.75kW maximum)

Power Supply: Three-Phase



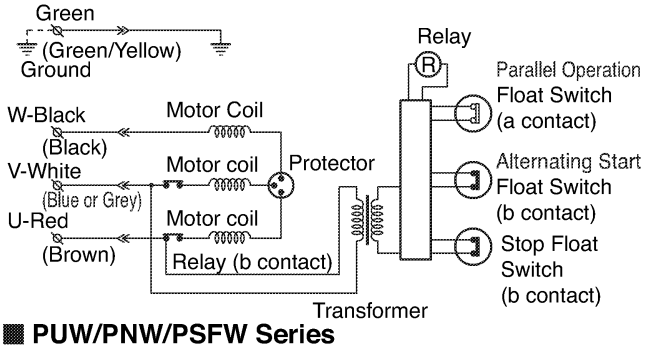
■PUW/PNW/PSFW Series
Automatic Alternating Circuit (Output 0.75kW maximum)

Power Supply: Single-Phase



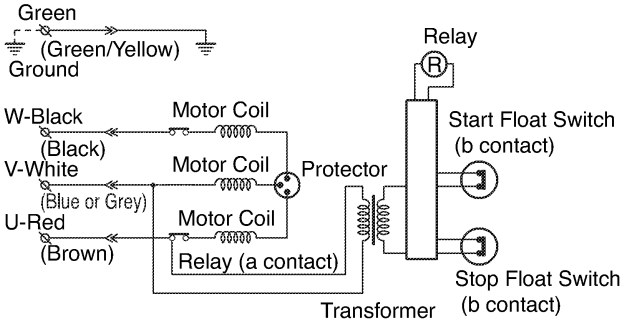
■ PUW/PNW/PSFW Series
Automatic Alternating Circuit (Output 0.75kW maximum)

Power Supply: Three-Phase



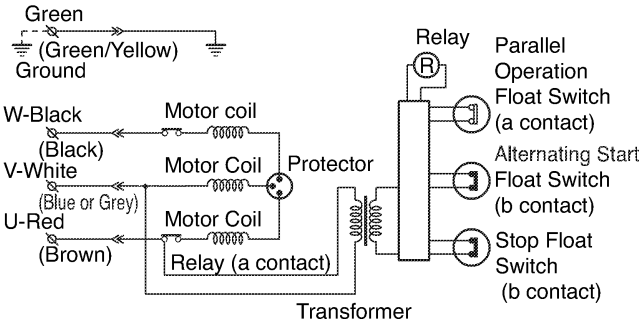
■ PUA/PNA/PSFA Series
Automatic Operation Circuit (Output 1.5kW)

Power Supply: Three-Phase



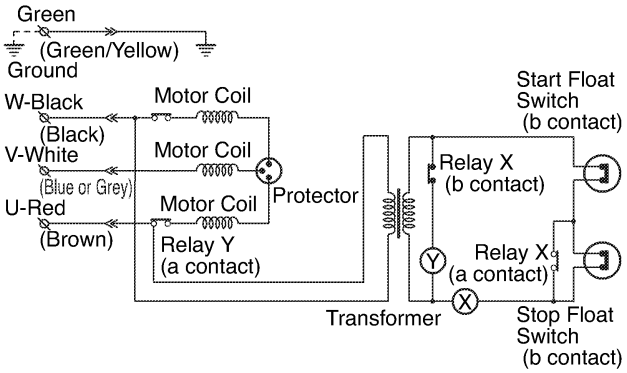
■ PUW/PNW/PSFW Series
Automatic Alternating Operation Circuit (Output 1.5kW)

Power Supply: Three-Phase



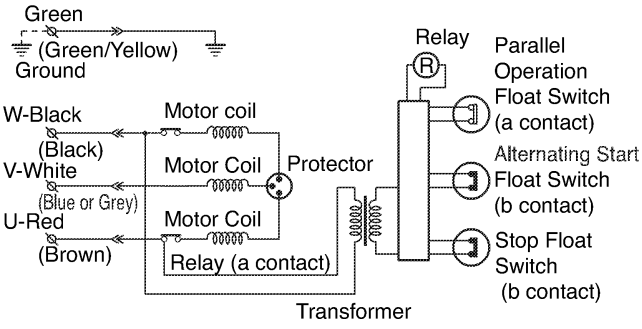
■ PUA/PNA/PSFA/TMA Series
Automatic Circuit (Output 2.2kW)

Power Supply: Three-Phase



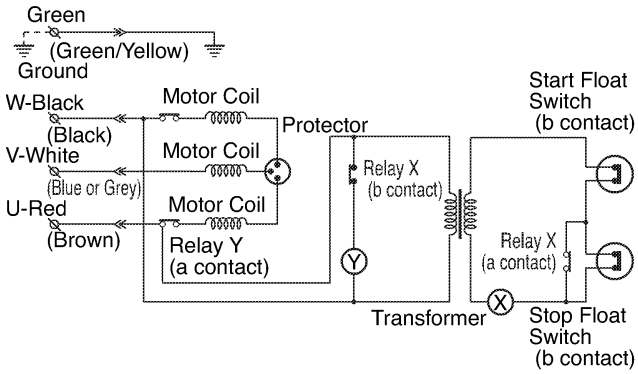
■ PUW/PNW/PSFW Series
Automatic Alternating Operation Circuit (Output 2.2~3.7kW)

Power Supply: Three-Phase

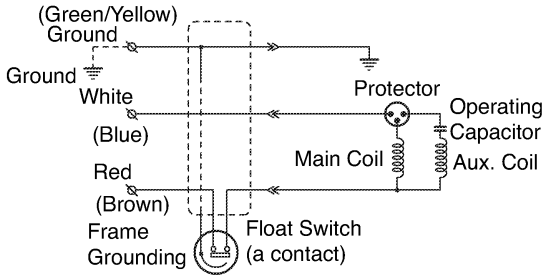


■ PUA/PNA/PSFA/TMA Series
Automatic Circuit (Output 3.7kW)

Power Supply: Three-Phase



■ PUZ/PNZ/PSFZ Series



Note: *a contact = normally-open contact*
b contact = normally-closed contact

6 OPERATION

Prior to Operation

(1) Once again, check the nameplate of the pump to verify that its voltage and frequency are correct.

⚠CAUTION **Improper voltage and frequency of the power supply will prevent the pump from attaining its full potential, and may also damage the pump.**

Note: *Verify the specs on the pump's nameplate.*

(2) Check the wiring, power supply voltage, the capacity of the ground leakage circuit breaker, and the insulation resistance of the motor.

■ Insulation resistance reference value = 20MΩ minimum

Note: *The insulation resistance reference value of 20MΩ minimum is based on a new or repaired pump. For reference values of a pump that has already been put into operation, refer to "Maintenance and Inspection".*

(3) Adjust the setting of the thermal relay (i.e. 3E relay) to the pump's rated current.

Note: *Verify the rated current on the pump's nameplate.*

6-1 NON-AUTOMATIC OPERATION

Trial Operation

⚠WARNING **Never start the pump while it is suspended, as the pump may jerk and cause a serious accident involving injury.**

(1) Operate the pump for a short time (1 to 2 seconds) and verify the direction of the rotation of the impeller. Observe the pump unit from above, and if its recoil is in the counterclockwise direction, the direction of its rotation is correct.

⚠CAUTION **Make sure to check the pump's direction of rotation with the pump exposed to the atmosphere. Operating the pump in reverse while it is submerged in water will damage the pump, which may lead to current leakage and electrical shock.**

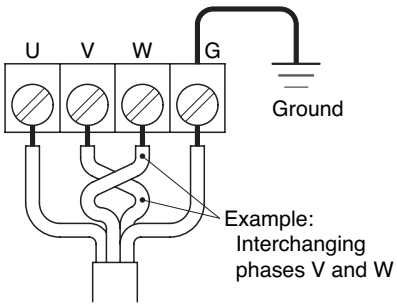
(2) To reverse the rotation, the following countermeasures must be taken.

⚠WARNING **Before changing the connections for reverse rotation, make sure that the power supply (i.e. circuit breaker) is properly disconnected and that the impeller has stopped completely. Failure to observe this may lead to electrical shock, short, or injury.**

COUNTERMEASURE

Direct-on-line starting

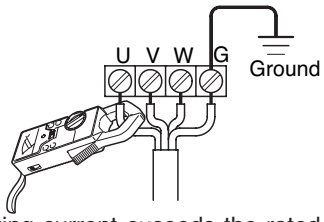
Interchange any two of the three wires designated U, V, and W, respectively.



(3) Connect the pump to the pipe and submerge it in water.

(4) Operate the pump for a short time (3 to 10 minutes) and perform the following checks:

Using an AC ammeter (clamp), measure the operating current at the phases U, V, and W that are connected to the terminal board.

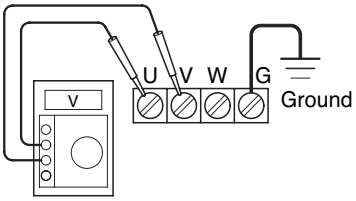


COUNTERMEASURE

Because an overload condition may be present at the pump motor if the operating current exceeds the rated current, follow the instructions in section "4. Installation" to operate the pump in the correct manner.

Using an AC voltmeter (tester), measure the voltage at the terminal board.

■ Power supply voltage variation
= within ±10 % of the rated voltage



COUNTERMEASURE

If the power supply voltage deviates from the variation value, the cause of the deviation may be the capacity of the power supply or the extension cable that is used. Refer to section "5. Electrical Wiring" to operate the pump in the correct manner.

⚠CAUTION **In case the pump exhibits an abnormal condition (such as a considerable amount of vibration, noise, or smell), disconnect the power supply immediately and contact the dealer where you purchased the equipment, or Tsurumi's sales office in your area. If the pump continues to be used in the abnormal state, it may cause current leakage, electrical shock, or fire.**

(5) Proceed with the normal operation if no abnormal conditions are found during the trial operation.

Operation

⚠WARNING **The pump unit may be extremely hot during operation. To prevent burns, do not touch the pump unit with bare hands during or after the operation.**

Pay attention to the water level during the pump operation. The pump will become damaged if it is allowed to operate dry.
Due to an overload operation or a pump malfunction, if the motor protector trips to stop the pump, make sure to eliminate the cause of the problem before restarting.

A frequent ON/OFF will shorten the lifetime of the pump.
To operate a submersible pump (including automatic operation), set the water level so that the pump will operate about 10 times per hour.

However, set the operating condition of the pump so that it may run for less than 12 hours per day and 4000 hours per year.

Note: *A large amount of amperage flows when a submergible pump is started, causing the temperature of its windings to rise rapidly. Beware that a frequent stop-and-go operation of the pump will accelerate the deterioration of the insulation of the motor windings and thus affect the use life of the motor.*

Operating Water Level

⚠CAUTION **The maximum continuous running time at the L.W.L. (=Lowest Water Level) shall be 10 minutes. When the water level changes between the C.W.L. (=Continuous running Water Level) and the L.W.L., it shall be 30 minutes. If the pump runs longer than the prescribed periods, the motor protection device may stop its operation to protect the motor from burning out. Refer the dimension drawing of each model for the water levels.**

6-2 Automatic Operation

Trial Operation

■ A Type

Equipped with floats to detect the water level and an internal control circuit, the automatic type (PUA, PNA, PSFA, TMA) pump can perform an automatic drainage operation alone by merely connecting its cable to a power supply.
Connect the power and perform a trial operation as follows:

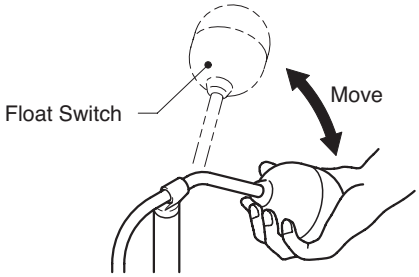
(1) Direct all the floats downward.

(2) First raise the (red) stop float, then the (yellow) start float. This will cause the pump to start.

(3) Next, return the (yellow) start float, and then the (red) stop float to their original positions. This will cause the pump to stop.

(4) Perform steps (2) and (3) consecutively two or more times to verify the operation.

Check float switch operation



Note: *Allow the pump to operate a minimum of 2 seconds for each trial operation. The trial operation must be completed within 1 minute.*

⚠CAUTION **In case the pump exhibits an abnormal condition (such as a considerable amount of vibration, noise, or smell), disconnect the power supply immediately and contact the dealer where you purchased the equipment, or Tsurumi's sales office in your area. If the pump continues to be used in the abnormal state, it may cause current leakage, electrical shock, or fire.**

■ B Type

Equipped with floats to detect the water level the automatic type (PUZ, PNZ, PSFZ) pump can perform an automatic drainage operation alone by merely connecting its cable to a power supply.
Connect the power and perform a trial operation as follows:

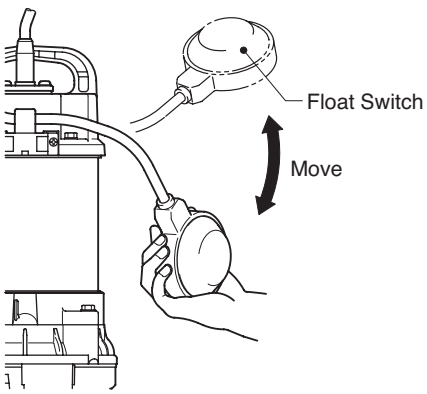
(1) Direct all the floats downward.

(2) Raise the (yellow) float. This will cause the pump to start.

(3) Next, return the (yellow) float to their original positions. This will cause the pump to stop.

(4) Perform steps (2) and (3) consecutively two or more times to verify the operation.

Check float switch operation



Note: *The trial operation must be completed within 1 minute.*

⚠CAUTION **In case the pump exhibits an abnormal condition (such as a considerable amount of vibration, noise, or smell), disconnect the power supply immediately and contact the dealer where you purchased the equipment, or Tsurumi's sales office in your area. If the pump continues to be used in the abnormal state, it may cause current leakage, electrical shock, or fire.**

6-3 Automatic Alternating Operation

Trial Operation

The (PUW, PNW, or PSFW) automatic alternating type pump is used in conjunction with the (PUA , PNA, or PSFA) automatic type. Equipped with floats to detect the water level and an internal control circuit, it can perform an automatic alternating drainage operation by merely connecting its cable to a power supply. Connect the power and perform a trial operation as follows:

(1) Direct all the floats downward.

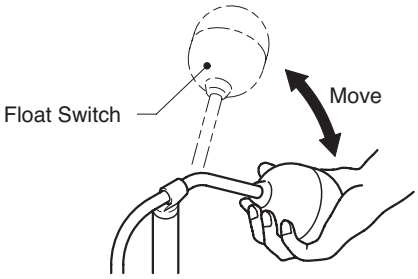
(2) First raise the (red) stop float, then the (yellow) alternating start float.

(3) Next, return the (yellow) start float, and then the (red) stop float to their original positions. This will cause the pump to stop.

(4) Perform steps (2) and (3) consecutively three or more times to verify the operation. The pump will start and stop every other time.

(5) Again, direct all the floats downward.

Check float switch operation



(6) Raise the (red) stop float, then the (green) parallel operation float. This will cause the pump to start.

(7) Next, return the (green) parallel operation float, and then the (red) stop float to their original positions. This will cause the pump to stop.

(8) Perform steps (6) and (7) consecutively two or more times to verify the operation.

Note: *It takes approximately 1 second for the pump to start after the float is moved. Allow the pump to operate a minimum of 2 seconds for each trial operation. The trial operation must be completed within 1 minute.*

⚠CAUTION **In case the pump exhibits an abnormal condition (such as a considerable amount of vibration, noise, or smell), disconnect the power supply immediately and contact the dealer where you purchased the equipment, or Tsurumi's sales office in your area. If the pump continues to be used in the abnormal state, it may cause current leakage, electrical shock, or fire.**

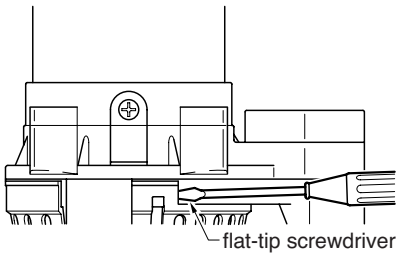
7 MAINTENANCE AND INSPECTION

Regular maintenance and inspection are indispensable to maintaining the pump's performance. If the pump behaves differently from its normal operating condition, refer to section "9. Troubleshooting" and take appropriate measures at an early stage. We also recommend that you have a spare pump on hand for an emergency.

Prior to Inspection

⚠WARNING **Make sure that the power supply (i.e. circuit breaker) is disconnected and disconnect the cabtyre cable from the power outlet or remove it from the terminal board. Failure to do so may cause electrical shock or unintended starting of the pump, which may lead to serious accidents.**

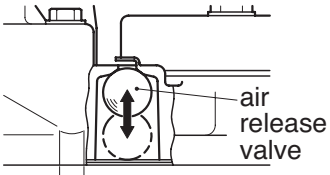
(1) Washing the Pump
Remove any debris attached to the pump's outer surface, and wash the pump with tap water. Pay particular attention to the impeller area, and completely remove any debris from the impeller. To remove the strainer, use a flat-tip screwdriver to pry on the three areas of the strainer as illustrated on the right (PN, PSF, and TM models). To reinstall, simply install the strainer in place.



(2) Inspecting the Pump Exterior
Verify that there is no damage, and that the bolts and nuts have not loosened.

Note: *If the pump must be disassembled for repair due to damage or loose bolts or nuts, contact the dealer where it was purchased, or the Tsurumi sales office in your area.*

Daily and Periodic Inspection

Interval	Inspection Item
Daily	Measuring the operating current ■ To be within the rated current Measuring the power voltage ■ Power supply voltage variation = within ±10% of the rated voltage
Monthly	Measuring the insulation resistance ■ Insulation resistance reference value = 1MΩ minimum **Note:** The motor must be inspected if the insulation resistance is considerably lower than the last inspection. Inspecting the pump ■ A noticeable drop in performance may indicate wear on the impeller or other parts, or else clogging of the strainer. Replace any worn parts, or remove the clogged debris. Inspecting the operation of air release valve ■ Check to confirm that the air release valve (air-lock prevention device) works normally when you start the pump. Section of a pump casing  Inspection of the operation of air release valve
Semi-yearly	Inspection of lifting chain or rope ■ Replace if damage, corrosion, or wear has occurred to the chain or rope. Remove if foreign object is attaching to it.
Yearly	Inspecting oil (models with 0.15~0.75kW power output) ■ 3,000 hours or 12 months, whichever comes first Inspecting oil (models with 1.5~3.7kW power output) ■ 6,000 hours or 12 months, whichever comes first
Once every 2 years	Changing oil (models with 0.15~0.75kW power output) ■ 4,500 hours or 24 months, whichever comes first Changing oil (models with 1.5~3.7kW power output) ■ 9,000 hours or 24 months, whichever comes first Changing the mechanical seal (models with 0.15~3.7kW power output) **Note:** The inspection and replacement of the mechanical seal requires specialized equipment. To have this operation performed, contact the dealer where this equipment was purchased, or the Tsurumi sales office in your area.
Once every 2 to 5 years	Overhaul ■ The pump must be overhauled even if the pump appears normal during operation. Especially, the pump may need to be overhauled earlier if it is used continuously. **Note:** To overhaul the pump, contact the dealer where it was purchased, or the Tsurumi sales office in your area.

Note: *Refer to section "Oil Inspection and Change Procedures" below for further detail.*

Storage

If the pump will not be operated for a long period of time, pull the pump up, wash the pump, allow it to dry, and store it indoors.

Note: *For reinstallation, be sure to perform a trial operation before putting the pump into operation.*

If the pump remains immersed in water, operate it on a regular basis (i.e. once a week).

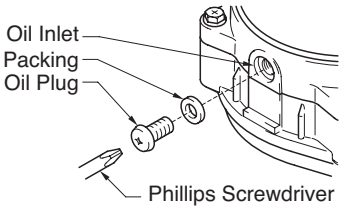
Oil Inspection and Changing Procedures

Inspecting Oil

Remove the oil plug and take out a small amount of oil. The oil can be extracted easily by tilting the pump so that the oil filler plug faces downward. If the oil appears milky or intermixed with water, a likely cause is a defective shaft sealing device (i.e. mechanical seal), which requires that the pump be disassembled and repaired.

Changing Oil

Remove the oil plug and drain the oil completely. Pour a specified volume of oil into the oil filler inlet.



Specified Oil:
Liquid Paraffin VG32

Unit : ml

Applicable Model	Specified Volume
Model with 0.15kW power output	150
Model with 0.25 ~ 0.75kW power output	240
Model with 1.5kW power output	500
Model with 2.2 ~ 3.7kW power output	680

Note: *The drained oil must be disposed of properly to prevent it from being released into the sewer or rivers. The packing or the O-ring for the oil plug must be replaced with a new part at each oil inspection and change.*

8 DISASSEMBLY AND REASSEMBLY PROCEDURE

Prior to Disassembly and Reassembly

⚠WARNING **Before disassembling and reassembling the pump, be sure that the power supply (i.e. circuit breaker) is disconnected, and remove the cabtyre cable from the outlet or the terminal board. Do not connect or disconnect the power plug with a wet hand, in order to prevent electrical shock. Do not perform an activation test (to check the rotation of the impeller) during disassembly and reassembly. Failure to observe this precaution could lead to a serious accident, including injury.**

This section explains the disassembly and reassembly processes that are involved up to the replacement of the impeller itself. Operations involving the disassembly and reassembly of the sealing portion (i.e. mechanical seal) and of the motor require a specialized facility including vacuum and electrical test equipment. For these operations, contact the dealer where this equipment was purchased, or the Tsurumi sales office in your area.

PU Series

Disassembly Procedure

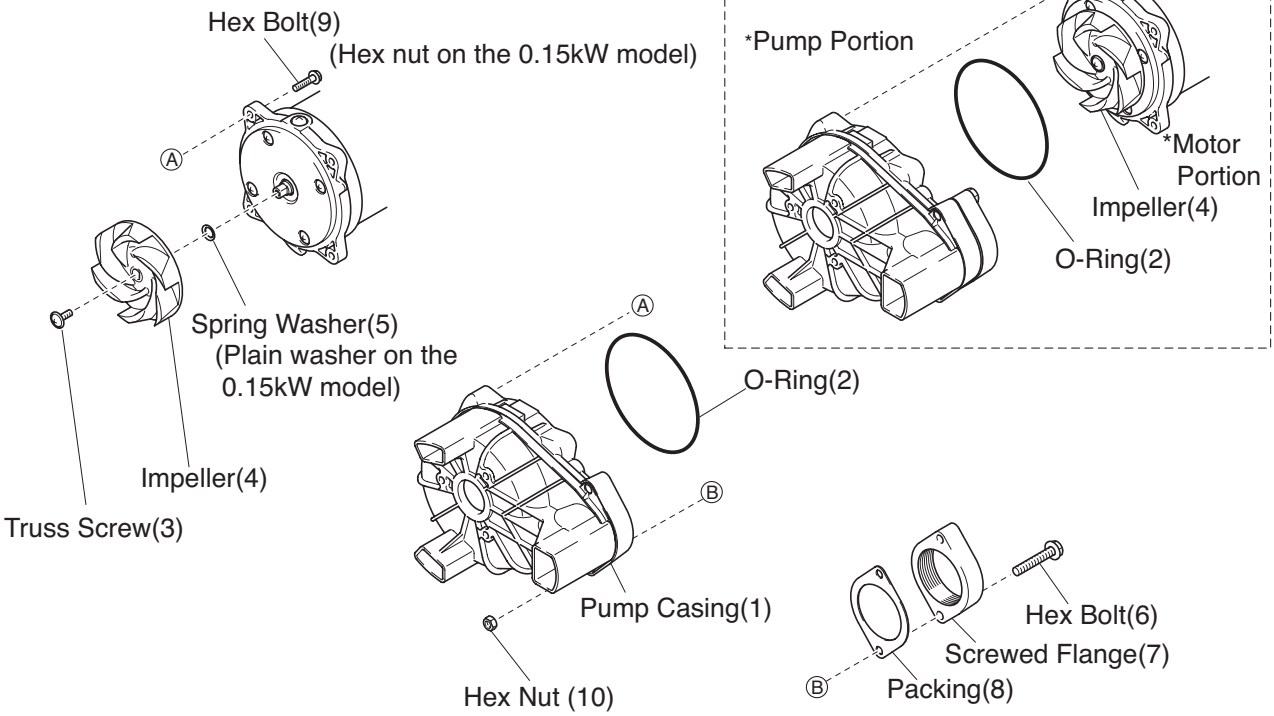
Note: *Before disassembling, be sure to drain the oil from the pump.*

(1) This pump has adopted a back-pullout construction. Therefore, by removing the four cross-recessed hex bolts(9)(or hex nuts on the 0.15kW model), the pump can be inspected while the impeller(4) remains attached to the motor mainshaft.
(2) Remove the two cross-recessed hex bolts(6) (or the four cross-recessed hex bolts on the 1.5 ~ 3.7kW models), and remove the screwed flange(7) , packing(8), and two hex nuts(10) , in that order.
(3) Remove the truss screw(3) , and remove the impeller(4) and the spring washer(5) (or the plain washer on the 0.15kW model) , in that order.
(4) Wash and inspect all parts to make sure that they are not worn or damaged.

Note: *If any part is worn or damaged, make sure to replace it with a new part. Replace the packing and the O-ring each time the pump is disassembled.*

Disassembly Diagram

[Pump Disassembly Diagram]

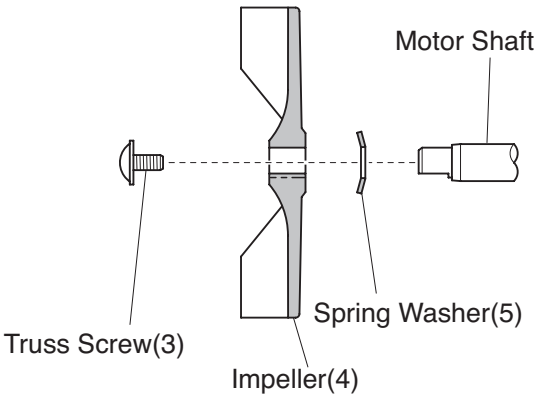


Note: *The description of the disassembly diagram above may differ slightly in shape and construction depending on the model.*

Reassembly Procedure

Observe the precautions given below and reassemble the unit in the reverse order of disassembly.

(1) Thoroughly wash all parts before reassembly.
(2) Make sure that the packing is securely fitted.
(3) Pay attention to the proper installation direction of the following part:
Spring Washer(5) (for 0.25 ~ 1.5kW)



[Assembly direction of spring washer]

Disassembly Procedure

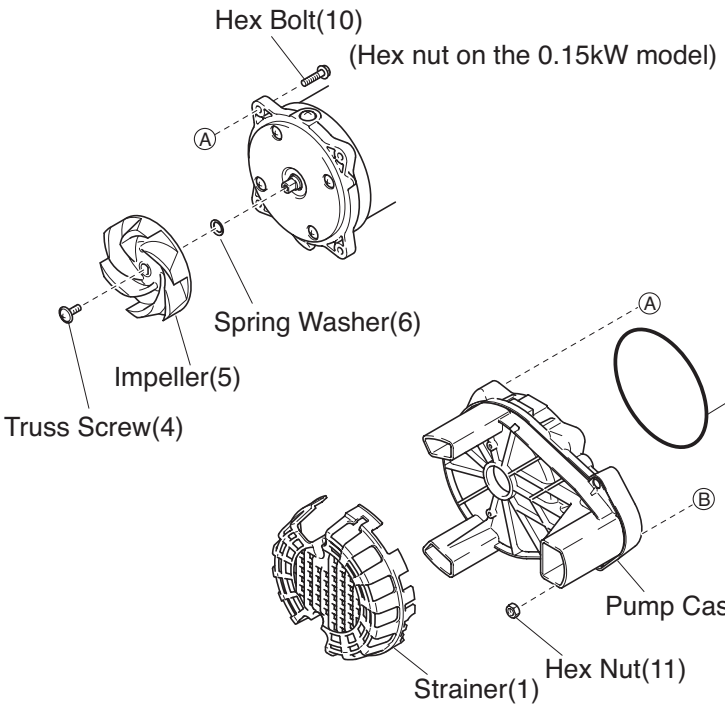
Note: *Before disassembling, be sure to drain the oil from the pump.*

(1) This pump has adopted a back-pullout construction. Therefore, by removing the four cross-recessed hex bolts(10)(or hex nuts on the 0.15kW model), the pump can be inspected while the impeller(5) remains attached to the motor mainshaft.
(2) Remove the two cross-recessed hex bolts(7) (or the four cross-recessed hex bolts on the 1.5 ~ 3.7kW models), and remove the screwed flange(8) , packing (9), and two hex nuts(11) , in that order.
(3) Remove the truss screw(4) , and remove the impeller(5) and the spring washer(6) , in that order.
(4) Wash and inspect all parts to make sure that they are not worn or damaged.

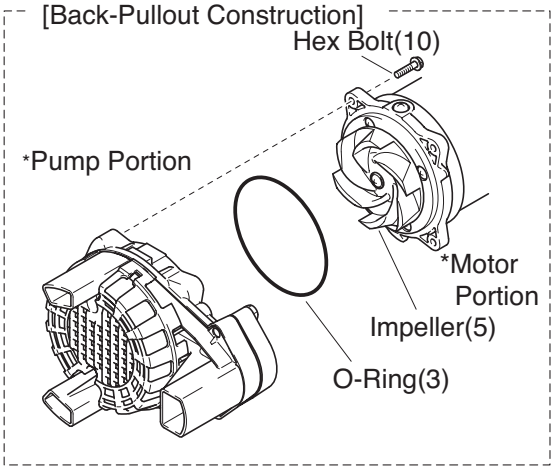
Note: *If any part is worn or damaged, make sure to replace it with a new part. Replace the packing and the O-ring each time the pump is disassembled.*

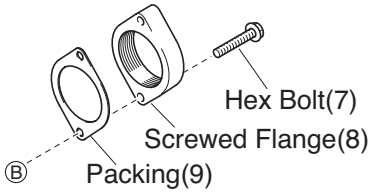
Disassembly Diagram

[Pump Disassembly Diagram]



[Back-Pullout Construction]

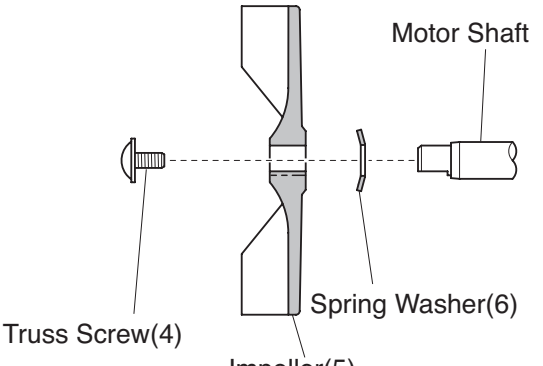




Note: *The description of the disassembly diagram above may differ slightly in shape and construction depending on the model.*

Reassembly Procedure

Observe the precautions given below and reassemble the unit in the reverse order of disassembly.
(1) Thoroughly wash all parts before reassembly.
(2) Make sure that the packing is securely fitted.
(3) Pay attention to the proper installation direction of the following parts:
Spring Washer(6) (for 0.15 ~ 1.5kW)



[Assembly direction of spring washer]

Disassembly Procedure

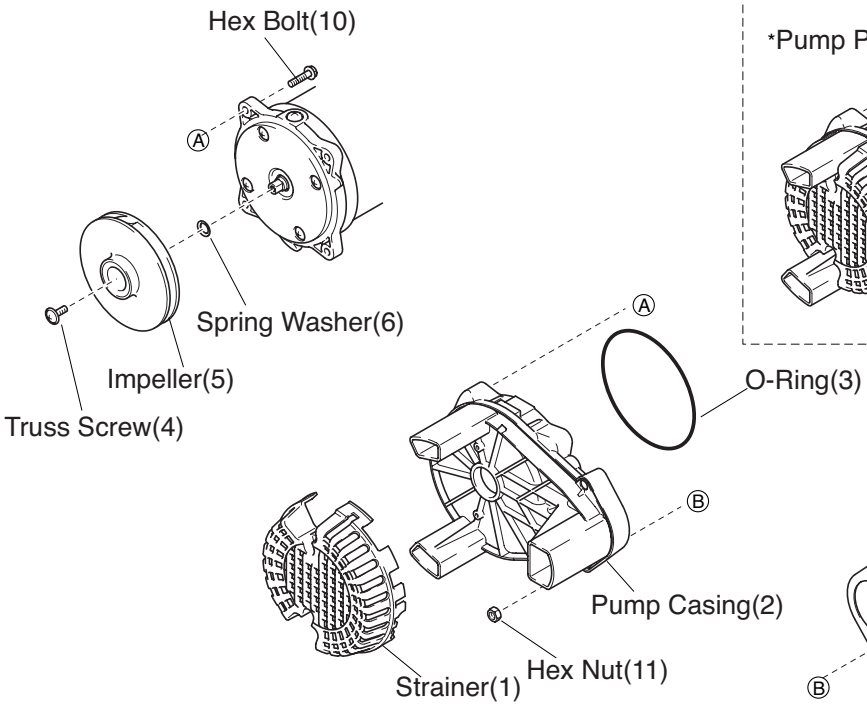
Note: *Before disassembling, be sure to drain the oil from the pump.*

(1) This pump has adopted a back-pullout construction. Therefore, by removing the four cross-recessed hex bolts(10) , the pump can be inspected while the impeller(5) remains attached to the motor mainshaft.
(2) Remove the two cross-recessed hex bolts(7) (or the four cross-recessed hex bolts on the 1.5 ~ 3.7kW models) , and remove the screwed flange(8), packing(9), and two hex nuts(11) , in that order.
(3) Remove the truss screw(4), and remove the impeller(5) and the spring washer(6), in that order.
(4) Wash and inspect all parts to make sure that they are not worn or damaged.

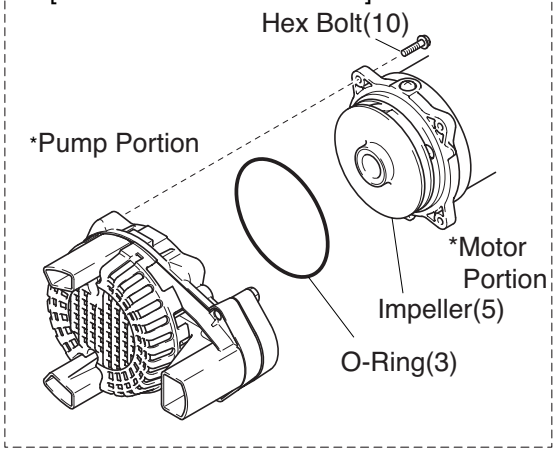
Note: *If any part is worn or damaged, make sure to replace it with a new part. Replace the packing and the O-ring each time the pump is disassembled.*

Disassembly Diagram

[Pump Disassembly Diagram]



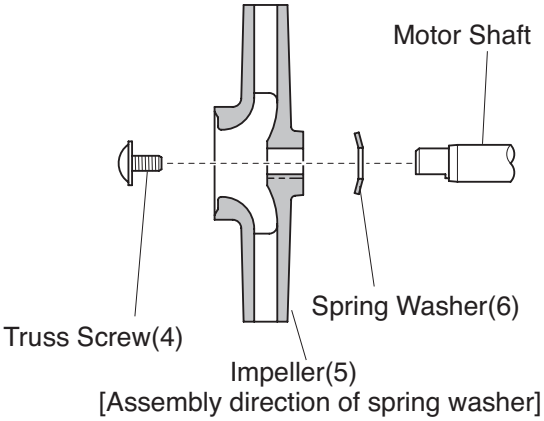
[Back-Pullout Construction]



Note: *The description of the diagram may differ slightly in shape and construction depending on the model.*

Reassembly Procedure

Observe the precautions given below and reassemble the unit in the reverse order of disassembly.
(1) Thoroughly wash all parts before reassembly.
(2) Make sure that the packing is securely fitted.
(3) Pay attention to the proper installation direction of the following parts:
Spring Washer(6) (for 0.25 ~ 1.5kW)



[Assembly direction of spring washer]

Disassembly Procedure

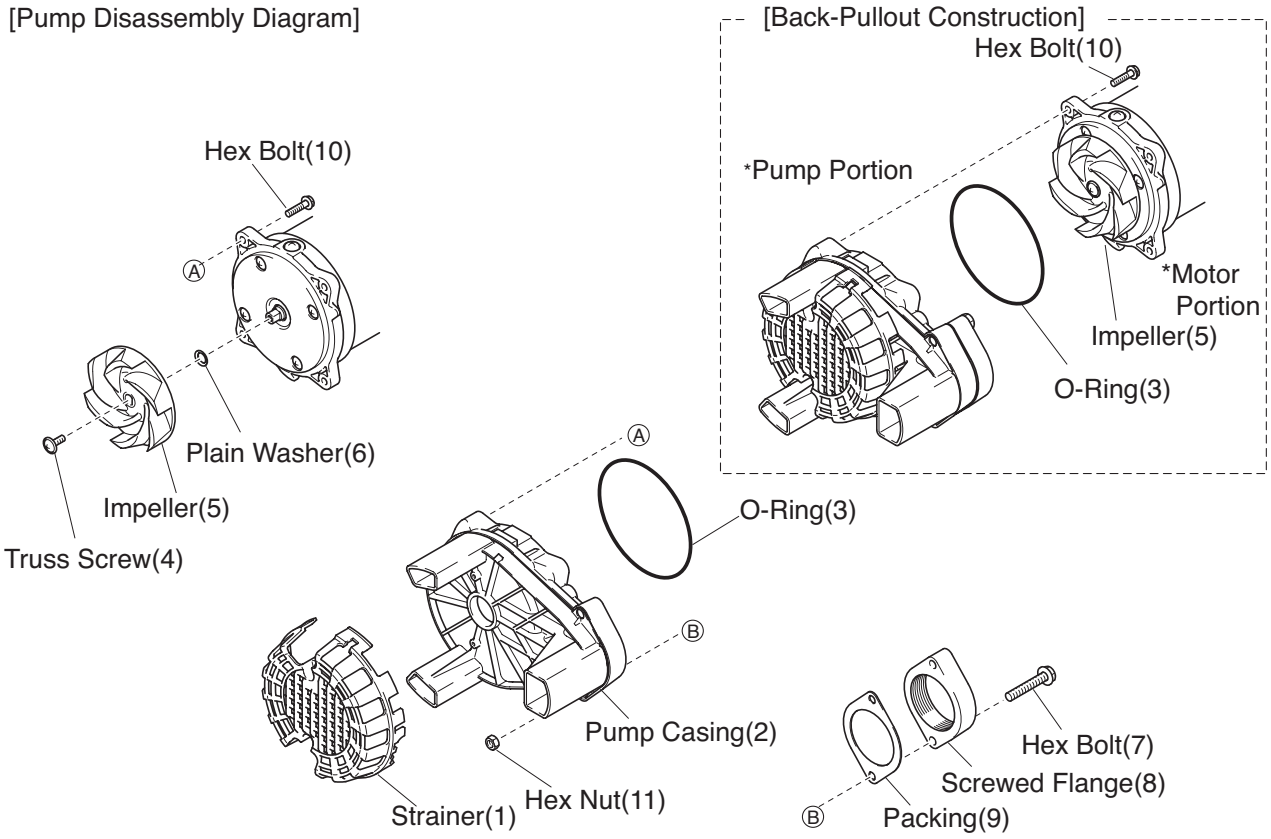
Note: *Before disassembling, be sure to drain the oil from the pump.*

(1) This pump has adopted a back-pullout construction. Therefore, by removing the four cross-recessed hex bolts(10) , the pump can be inspected while the impeller(5) remains attached to the motor mainshaft.
(2) Remove the two cross-recessed hex bolts(7) (or the four cross-recessed hex bolts on the 1.5 ~ 3.7kW models), and remove the screwed flange(8), packing(9), and two hex nuts(11), in that order.
(3) Remove the truss screw(4), and remove the impeller(5) and the plain washer(6), in that order.
(4) Wash and inspect all parts to make sure that they are not worn or damaged.

Note: *If any part is worn or damaged, make sure to replace it with a new part. Replace the packing and the O-ring each time the pump is disassembled.*

Disassembly Diagram

[Pump Disassembly Diagram]



Note: *The description of the diagram may differ slightly in shape and construction depending on the model.*

Reassembly Procedure

Observe the precautions given below and reassemble the unit in the reverse order of disassembly.
(1) Thoroughly wash all parts before reassembly.
(2) Make sure that the packing is securely fitted.

9 TROUBLESHOOTING

⚠WARNING **To prevent serious accidents, disconnect the power supply before inspecting the pump.**

Read this Operation Manual carefully before requesting repair. After re-inspecting the pump, if it does not operate normally, contact the dealer where this equipment was purchased, or the Tsurumi sales office in your area.

Problem	Possible cause	Countermeasure
Pump fails to start; or, starts but stops immediately.	(1)No proper power is supplied (i.e. power outage). (2)Malfunction in automatic control (control panel) (3)Foreign matter is wedged in the impeller, causing the motor protector to trip. (4)Malfunction in float.	(1)Contact the electric power company or an electrical repair shop. (2)Have the cause investigated and repaired by a specialist. (3)Inspect the pump and remove the debris. (4)Remove obstacles and check the operation of the float.
Pump starts but stops after a certain length of time.	(1)The pump has been operating for a long time while being exposed to air, causing the motor protector to trip. (2)The movement of the stop float is obstructed, causing the start float alone to perform the start and stop operations.	(1)After resuming operation, switch to operation of approximately once every 15 minutes. (2)Remove obstacles and check the operation of the stop float.
The power supply circuit breaker trips.	(1)The equipment is not matched to the pump specifications or the equipment rating is improperly set. (2)Malfunction of motor (seizure or water leakage). (3)A 50Hz unit is used at 60Hz.	(1)Replace the equipment with the correct specification or set it to the correct setting. (2)Repair or replace. (3)Check the nameplate and replace the pump or the impeller.
Pump operates but does not pump water.	(1)An air lock occurred in the pump. (2)The pump or the piping is blocked. (3)The piping is partially blocked or the valve is operating improperly. (4)The motor rotates in reverse.	(1)Stop momentarily and then restart; or, clean the air release valve. (2)Remove the blockage. (3)Remove the blockage, or repair or replace the valve. (4)Change the power supply connection.
The pumping volume is low.	(1)The impeller or the pump casing is significantly worn. (2)There is a great piping loss. (3)A 60Hz pump is used at 50Hz. (4)The motor rotates in reverse.	(1)Repair or replace the affected part. (2)Re-examine the work plan. (3)Check the nameplate and replace the pump or the impeller. (4)Change the power supply connection.
Pump generates vibration or noise.	(1)The pipe support is loose. (2)Motor bearings are damaged. (3)Valve is tightly closed.	(1)Secure the pipe support. (2)Replace the bearings. (3)Adjust the valve to the proper opening.
The pump does not stop automatically.	(1)The movement of the floats is obstructed. The switch in a float is faulty. (2)The water level of the (stop) float is set lower than the pump's minimum possible operating water level.	(1)Remove the blockage. Or, replace the part. (2)Set the water level of the (stop) float higher than the pump's minimum possible operating water level.
The pumps do not perform proper alternating operation.	(1)The float switch is not set to the proper water level. (2)One of the pumps is malfunctioning.	(1)Set it to the proper water level. (2)Repair or replace the pump.

The following information is required when ordering repairs or making other inquiries.

Product model	
Manufacturing number	
Purchase date	
Remarks	

Disposal of Product

Properly dispose of the product by disassembling it, presorting the contents, and sending them to the waste material treatment site.

4.05 PUMP RELATED DATA SHEETS

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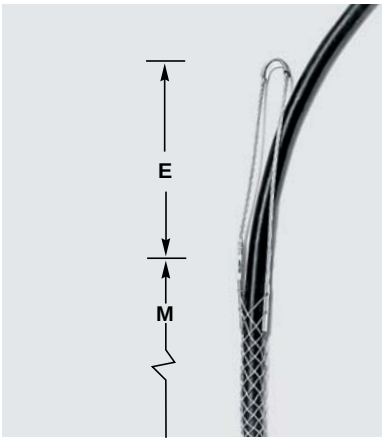
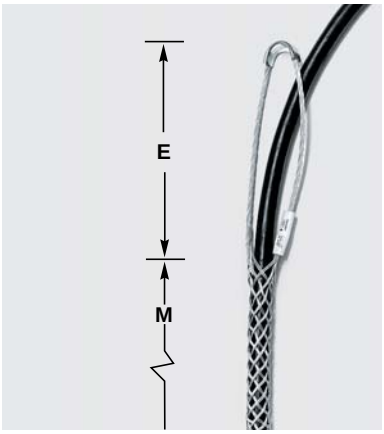
Support Grips
Service Drop
Single Eye, Tin-Coated Bronze

IMPORTANT!
It is important that you read all breaking strength, safety and technical data relating to this product on pages T-43 through T-48.



Light Duty, Single Eye, Closed Mesh



Heavy Duty, Single Eye, Closed Mesh

Light Duty, Single Eye, Closed Mesh Single Weave
For permanent support when cable end is available to be installed.

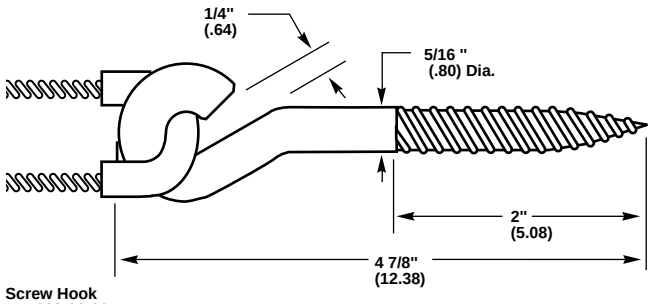
Cable Diameter Range Inches (cm)	Approx. Breaking Strength Lbs. (N)	E Inches (cm)	M Inches (cm)	Catalog Numbers
.23"-.31" (.58-.79)	290 (1,290)	3" (7.62)	3 3/4" (9.52)	**02216001**
.29"-.37" (.74-.94)	290 (1,290)	5" (12.70)	4 1/4" (10.79)	**02216002**
.35"-.44" (.89-1.12)	500 (2,224)	5 1/2" (13.97)	4 3/4" (12.06)	**02216003**
.41"-.50" (1.04-1.27)	500 (2,224)	5 1/2" (13.97)	5" (12.70)	**02216004**
.46"-.56" (1.17-1.42)	660 (2,936)	6" (15.24)	5 1/4" (13.33)	**02216005**
.52"-.62" (1.32-1.57)	790 (3,514)	7" (17.78)	6 1/4" (15.87)	**02216006**
.58"-.68" (1.47-1.73)	790 (3,514)	7" (17.78)	6 1/2" (16.51)	**02216007**
.64"-.75" (1.63-1.90)	790 (3,514)	7" (17.78)	6 3/4" (17.14)	**02216008**
.70"-.81" (1.78-2.06)	790 (3,514)	7" (17.78)	7 1/4" (18.41)	**02216009**
.75"-.87" (1.90-2.21)	1,020 (4,537)	8" (20.32)	8" (20.32)	**02216010**
.81"-.94" (2.06-2.39)	1,020 (4,537)	8" (20.32)	8 1/4" (20.95)	**02216011**
.87"-1.00" (2.21-2.54)	1,020 (4,537)	8" (20.32)	8 3/4" (22.22)	**02216012**
.94"-1.06" (2.39-2.69)	1,020 (4,537)	9" (22.86)	9" (22.86)	**02216013**
1.00"-1.18" (2.54-3.00)	1,020 (4,537)	9" (22.86)	9 1/2" (24.13)	**02216014**
1.06"-1.25" (2.69-3.17)	1,020 (4,537)	9" (22.86)	9 1/2" (24.13)	**02216015**

2416004

Heavy Duty, Single Eye, Closed Mesh Multi-Weave
For permanent support when cable end is available to be installed.

Cable Diameter Range Inches (cm)	Approx. Breaking Strength Lbs. (N)	E Inches (cm)	M Inches (cm)	Catalog Numbers
.23"-.31" (.58-.79)	500 (2,224)	5" (12.70)	4 1/2" (11.43)	**02217001**
.29"-.37" (.74-.94)	500 (2,224)	5" (12.70)	5 1/2" (13.97)	**02217002**
.35"-.44" (.89-1.12)	870 (3,870)	6" (15.24)	6 1/2" (16.51)	**02217003**
.41"-.50" (1.04-1.27)	870 (3,870)	6" (15.24)	7 1/2" (19.05)	**02217004**
.46"-.56" (1.17-1.42)	1,050 (4,670)	6" (15.24)	8" (20.32)	**02217005**
.52"-.62" (1.32-1.57)	1,050 (4,670)	7" (17.78)	8 1/2" (21.59)	**02217006**
.58"-.68" (1.47-1.73)	1,050 (4,670)	7" (17.78)	9 1/2" (24.13)	**02217007**
.64"-.75" (1.63-1.90)	1,390 (6,183)	7" (17.78)	9 1/2" (24.13)	**02217008**
.70"-.81" (1.78-2.06)	1,390 (6,183)	8" (20.32)	10 1/2" (26.67)	**02217009**
.75"-.87" (1.90-2.21)	1,390 (6,183)	8" (20.32)	10 1/2" (26.67)	**02217010**
.81"-.94" (2.06-2.39)	1,390 (6,183)	8" (20.32)	10 1/2" (26.67)	**02217011**
.87"-1.00" (2.21-2.54)	1,790 (7,962)	8" (20.32)	11 1/2" (29.21)	**02217012**
.94"-1.06" (2.39-2.69)	1,790 (7,962)	9" (22.86)	12 1/2" (31.75)	**02217013**
1.00"-1.18" (2.54-3.00)	1,790 (7,962)	9" (22.86)	13 1/2" (34.29)	**02217014**
1.06"-1.25" (2.69-3.17)	1,790 (7,962)	9" (22.86)	14 1/2" (36.83)	**02217015**

E-Eye length *M-Mesh length at nominal diameter*



Screw Hook
No. 203-03-001
Yield Strength 900 lbs (4003)

END

OF

SECTION

5. LIQUID LEVEL SENSORS

This section provides the information pertaining to the level sensing for this project.

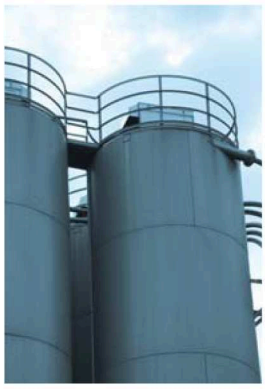
This section is structured as follows:

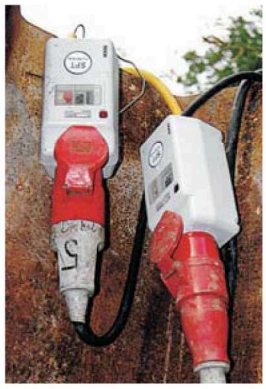
5.01 PRIMARY LEVEL SENSOR DATA SHEETS

Level Controller MS 1 C

The NIVA level controller MS 1 C
is the ideal solution to control liquids with limited switching space. For example in:

- Chemical plants
- Electro plating shops
- Purifying Plants





Level Controller MS 1 C

The NIVA level controller MS 1 C was designed for an extremely high resistance to chemical liquids and for use at high temperatures up to 100 °C (212 °F).

Available versions:

Type	Cable	Lenght (m)	Order-no.
W	Teflon/FEP 4 x 0.5	5	40 000705
W	Teflon/FEP 4 x 0.5	10	40 000710
W	Teflon/FEP 4 x 0.5	20	40 000720

W = Changeover (SPDT)

Other cable types and lengths are available upon request

Application:

For use in chemically loaded liquids at temperatures up to 100 °C (212 °F).

Electronic connection

Connection of level controllers	Wire grey	black	brown	⏚
For emptying a tank	insulate	X	X	X
For filling a tank	X	insulate	X	X
Alarm high level	insulate	X	X	X
Alarm low level	X	insulate	X	X

Technical data subject to change

⏚ Potential equalization wire

Technical data:

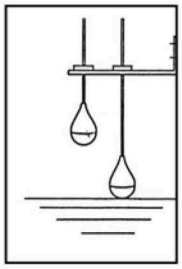
Specific weight:	0.95–1.05 or according to specification
Max. temperature:	100 °C (212 °F)
Breaking capacity:	1 mA / 4 V - 5 A / 250 V *
Switch point:	10 °
Protective system:	IP 68 / 2 bar
Protection class:	II
Cable cross section:	4 x 0.5 mm²
Height / diameter:	180 / 100 mm (7 in / 3.9 in)
Housing quality:	Polypropylene (PP)
Housing Colour:	Grey
Cable quality:	Teflon (FEP)
Cable colour:	Black
Cable seal:	Viton

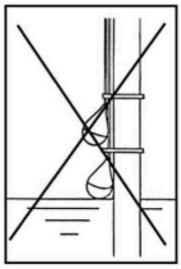
* Micro-switch with gold-plated contacts especially for low currents in electronic circuits

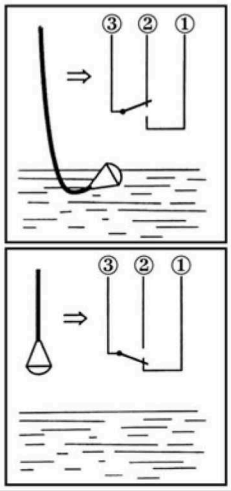
MS 1

CE
73/23/EEC
RoHS 2002/05/EC

1mA/4V-5A/250V
μ T80
γ 0,95 - 1,05





			①	②	③
GB	Connection of Level Regulators		grey	black	brown
D	Anschluss der Niveauregler		grau	schwarz	braun
F	Branchement des régulateurs de niveau		gris	noir	brun
I	Collegamento regolatori di livello		grigio	nero	marrone
E	Conexión de los reguladores de nivel		gris	negro	marrón
P	Conexão dos reguladores de nível		cinzento	preto	castanho
NL	Aansluiting van de niveauregelaar		grijs	zwart	bruin
DK	Tilslutning af niveauregulator		grå	sort	brun
S	Anslutning av nivåregulatorn		grå	svart	brun
N	Forbindelse til nivåregulatoren		grå	svart	brun
FIN	Pinnansäätimen liitäntä		harmaa	musta	ruskea
RUS	подсоединение регулятора уровня		серый	чёрный	коричневый
PL	Przyłącze regulatorów poziomu		kolor szary	kolor czarny	kolor brązowy
H	A szintszabályozók csatlakoztatása		szürke	fekete	barna
CZ	Přípoj regulátorů hladiny		šedý	černý	hnědý
SK	Prípoj regulátorov hladiny		sivý	čierný	hnedý
SLO	Priključitev regulatorjev nivoja		siv	črno	rjavo
HR	Cijev za regulator razine		sivo	crni	smeđi
SCG	Cev za spravu za regulisanje nivoa		sivo	crni	smeđi
GR	Σύνδεση ρυθμιστή στάθμης		γκρίζο	μαύρο	καφέ
TR	Seviye regülatörlerinin bağlantısı		gri	siyah	kahverengi

GB	For emptying a tank	Alarm high level	insulate		
D	Zum Entleeren eines Behälters	Alarm bei hohem Flüssigkeitsstand	isolieren		
F	Pour vider un réservoir	Alarme au niveau supérieur	isoler		
I	Per lo svuotamento	Allarme di massimo livello	isolare		
E	Para vaciar un recipiente	Alarma con alto nivel de líquido	aislar		
P	Para esvaziar um reservatório	Alarme de nível máximo	isolar		
NL	Om een reservoir te legen	Alarm bij een hoog vloeistofpeil	isoleren		
DK	Til tømning af en beholder	Alarm ved høj væskeniveau	isoler		
S	För tömning av en behållare	Larm vid hög vätskenivå	isolera		
N	For å tømme en beholder	Alarm ved høyt væskenivå	isolere		
FIN	Säiliön tyhjennykseen	Ylärajahälytys	eristä	X	X
RUS	для опорожнения резервуара	сигнал тревоги при высоком уровне жидкости	изолировать		
PL	Opróżnienie pojemnika	Alarm w przypadku wysokiego poziomu cieczy	zaizolować		
H	Egy tartály ürítéséhez	Riasztás túl magas töltésszint esetén	szigeteljük		
CZ	K vyprázdnění nádrže	Poplach při vysokém stavu kapaliny	izolovat		
SK	K vyprázdneniu nádrže	Poplach pri vysokom stave kvapaliny	izolovat'		
SLO	Za praznjenje posode	Alarm pri visokem nivoju tekočine	izolirati		
HR	Za pražnjenje nekog spremnika	Alarm kod visokog stanja tekućine	izolirati		
SCG	Za pražnjenje nekog rezervoara	Alarm kod visokog stanja tećnosti	izolovati		
GR	Γ ια την εκκένωση τον περιέκτη	Αλάρμ οε πολύ νψηλή στάθμη υγρού	μόνωση		
TR	Bir hazneyi/kabı boşaltmak için	Yüksek sıvı seviyesinde alarm	İzole etmek		

GB	For filling a tank	Alarm low level		insulate	
D	Zum Füllen eines Behälters	Alarm bei niedrigem Flüssigkeitsstand		isolieren	
F	Pour remplir un réservoir	Alarme au niveau inférieur		isoler	
I	Per il riempimento	Allarme di minimo livello		isolare	
E	Para llenar un recipiente	Alarma con bajo nivel de líquido		aislar	
P	Para encher um reservatório	Alarme de nível mínimo		isolar	
NL	Om een reservoir te vullen	Alarm bij een laag vloeistofpeil		isoleren	
DK	Til fyldning af en beholder	Alarm ved lav væskeniveau		isoler	
S	För fyllning av en behållare	Larm vid låg vätskenivå		isolera	
N	For å fylle en beholder	Alarm ved lavt væskenivå		isolere	
FIN	Säiliön täyttämiseen	Alarajahälytys	X	eristä	X
RUS	для наполнения резервуара	сигнал тревоги при низком уровне жидкости		изолировать	
PL	Napełnienie pojemnika	Alarm w przypadku niskiego poziomu cieczy		zaizolować	
H	Egy tartály töltéséhez	Riasztás túl alacsony töltésszint esetén		szigeteljük	
CZ	K naplnění nádrže	Poplach při nízkém stavu kapaliny		izolovat	
SK	K naplneniu nádrže	Poplach pri nízkom stave kvapaliny		izolovat'	
SLO	Za polnjenje posode	Alarm pri nizkem nivoju tekočine		izolirati	
HR	Za punjenje nekog spremnika	Alarm kod niskog stanja tekućine		izolirati	
SCG	Za punjenje nekog rezervoara	Alarm kod niskog stanja tećnosti		izolovati	
GR	Γ ια την πλήρωση τον περιέκτη	Αλάρμ οε πολύ χαμηλή στάθμη υγρού		μόνωση	
TR	Bir hayneyi/kabı doldurmak için	Düşük sıvı seviyesinde alarm		İzole etmek	

11 2126

NOLTANIVA

CE

EC Declaration of Conformity

according to

EC Directive 2006 /95 / EC
EC Directiv RoHS 2002 / 95 / EC

We

NOLTA GmbH
35091 Cölbe

hereby declare, that the products we manufacture conform in conception, design and circulated model to the relevant basic health and safety requirements of EC directives. If any changes are made to the level – controllers without our prior consent, this declaration loses its validity.

Products:	**Level – Controllers**
Type:	**MS 1 C**
Applied harmonized standards:	• **DIN EN 60730-1 (VDE 0631-1):2005-12+Ber.1:2007-11 +/A2:2008-04+/A15:2007-08+/A16:2008-02** • **DIN EN 60730-2-16 (VDE 0631-2-16):200208+/A11:2005 11** • **DIN IEC 60730-1 (VDE 0631-1):2008-10+/A3:2005-01**

Cölbe, 14.04.2009

…….
Dr.-Ing. Jochen Knake / Geschäftsführer

…….
Wolfgang Seip / Quality Manager

NOLTA GmbH – 35091 Cölbe / Germany
Telefon Fon +49 64 21 / 98 59 14 - Fax +49 64 21 / 98 59 28 - Email: info@nolta.de – www.nolta.de

END

OF

SECTION

6. ELECTRICAL

This section includes drawings and data sheets related to the control panel and electrical components.

This section is structured as follows:

6.01 CONTROL PANEL DRAWING(S)

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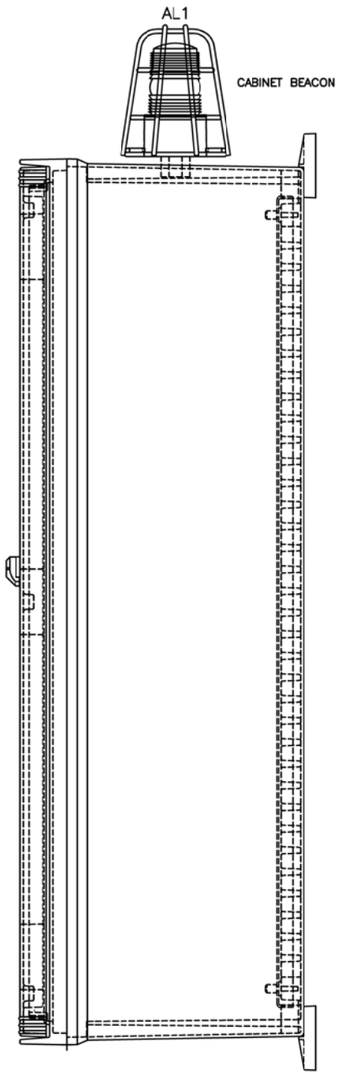
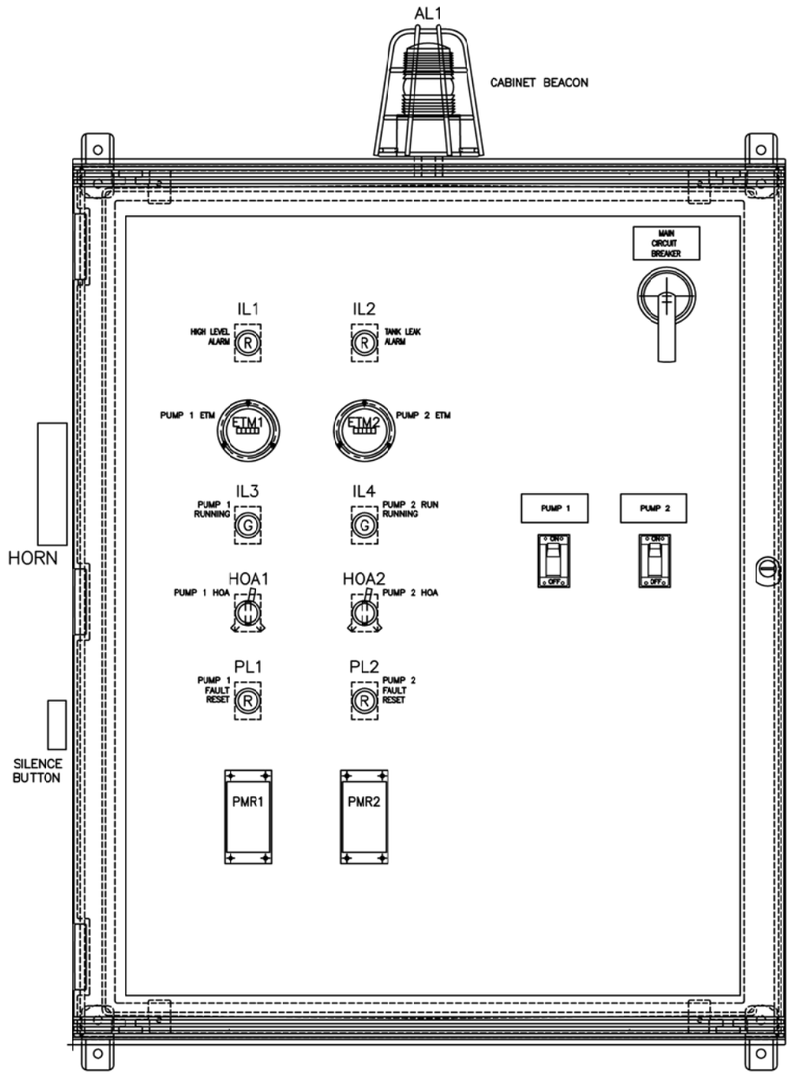
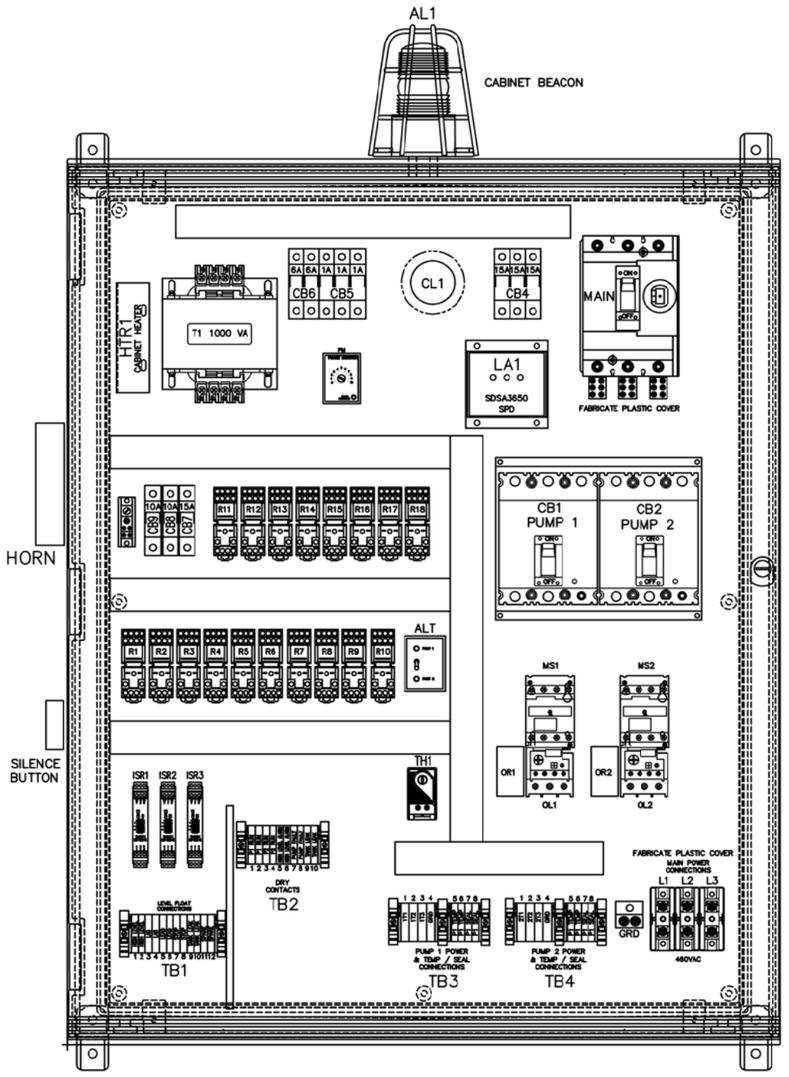
40.35" HIGH X 32.58" WIDE X 13" DEEP NEMA 4X FIBERGLASS ENCLOSURE WITH INNER DOOR AND PADLOCKABLE LATCH





FRONT VIEW
INNER DOOR



FRONT VIEW
SUBPANEL

REV	DATE	BY
1	8/28/12	DSN/KAS
		DRN/KAS
		CKD/KAS

ROMTEC UTILITIES
18240 NORTH BANK ROAD
ROSEBURG, OR 97470
(541)-496-9678
FAX (541)-496-0804
WWW.romtecutilities.com

ANIMAL HEALTH

LAYOUT DIAGRAM 1

SHEET
1 OF 1

JOB NUMBER
P4657

6.02 ELECTRICAL SCHEMATICS

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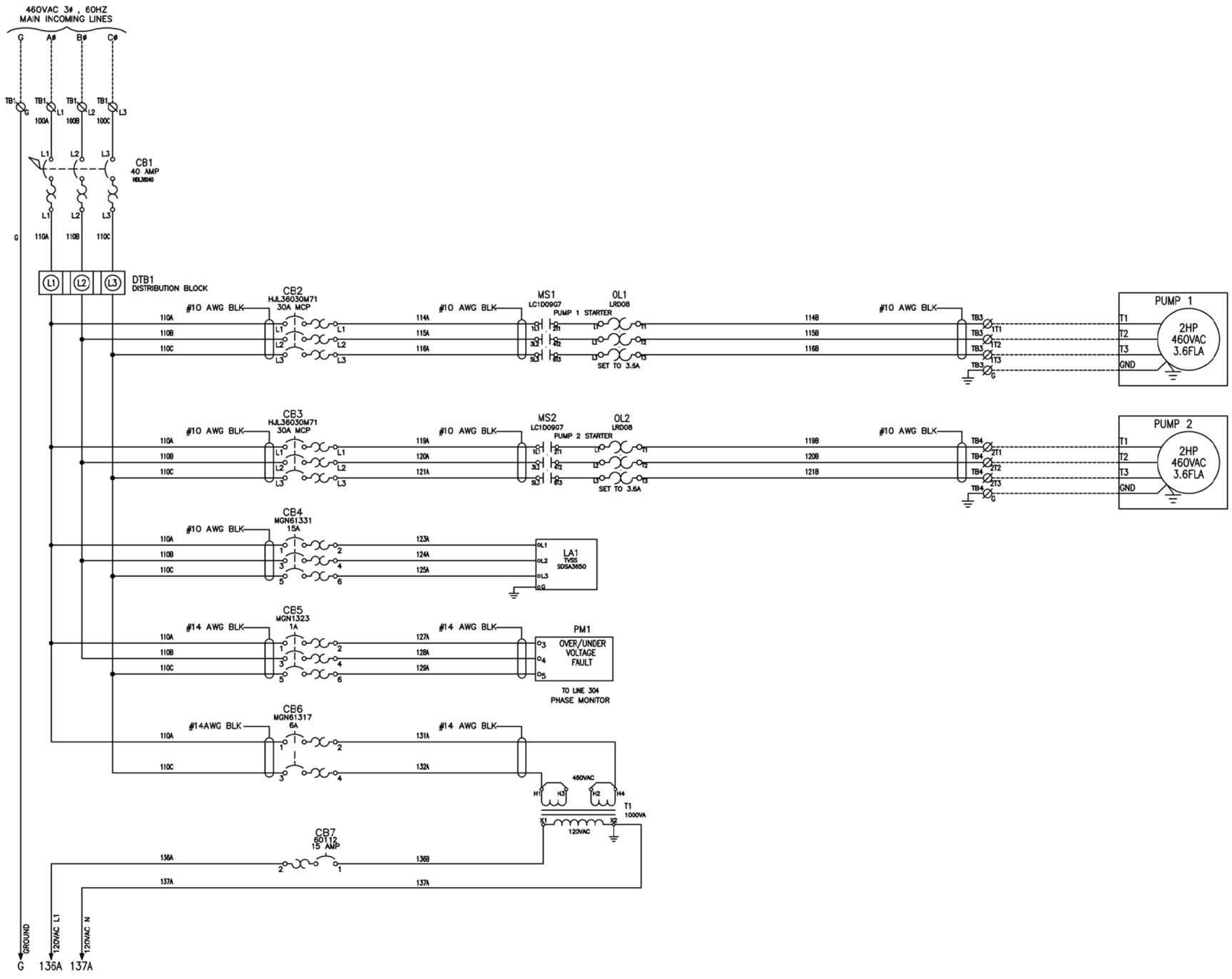
SCHEMATIC DIAGRAM



BY	DESCRIPTION REVISIONS	REV	DATE
		1	

DSN.JSP
DRN.JSP
CKD.KAS 12/2/13

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ROSEBURG, OR 97470
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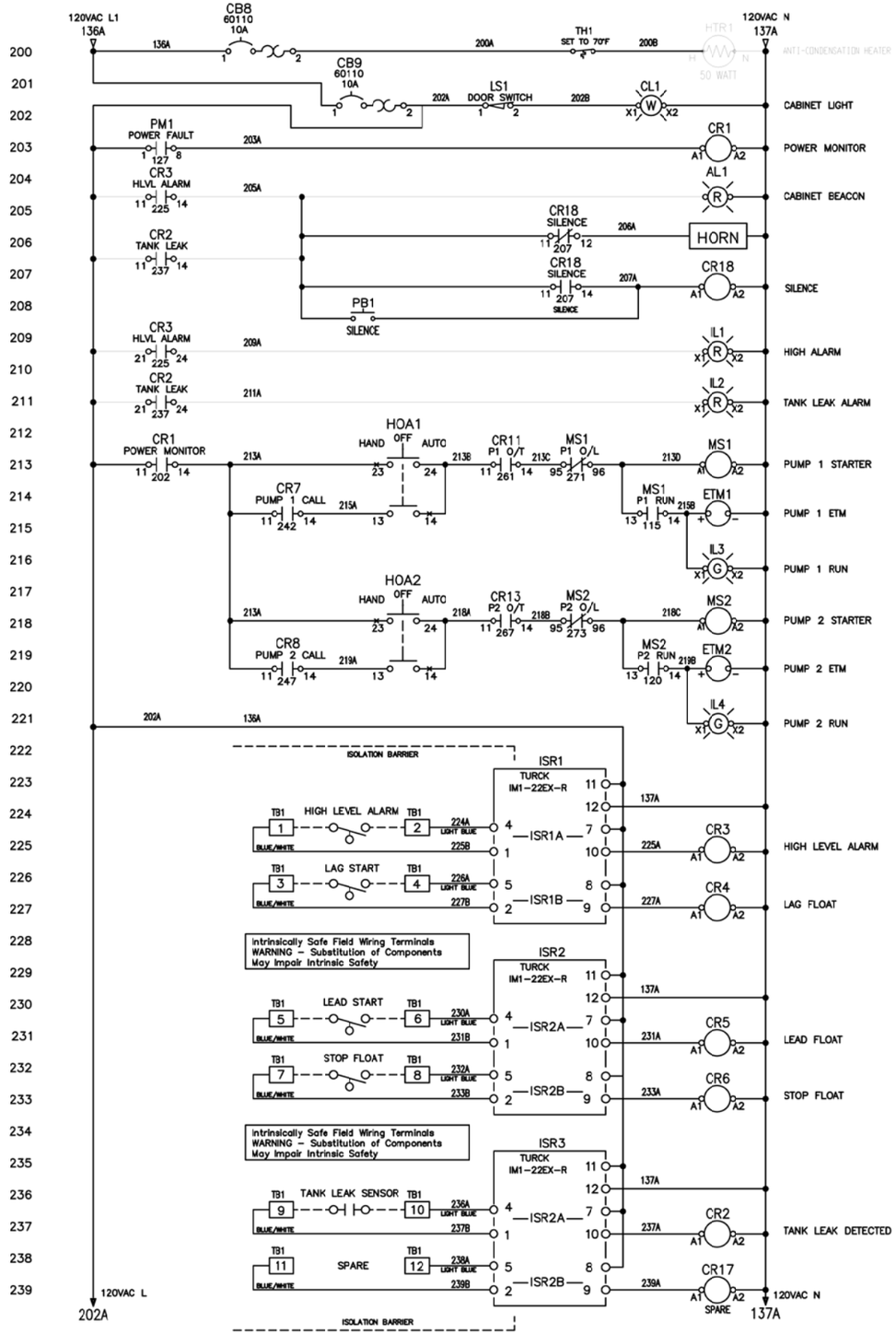
ANIMAL HEALTH, KANSAS

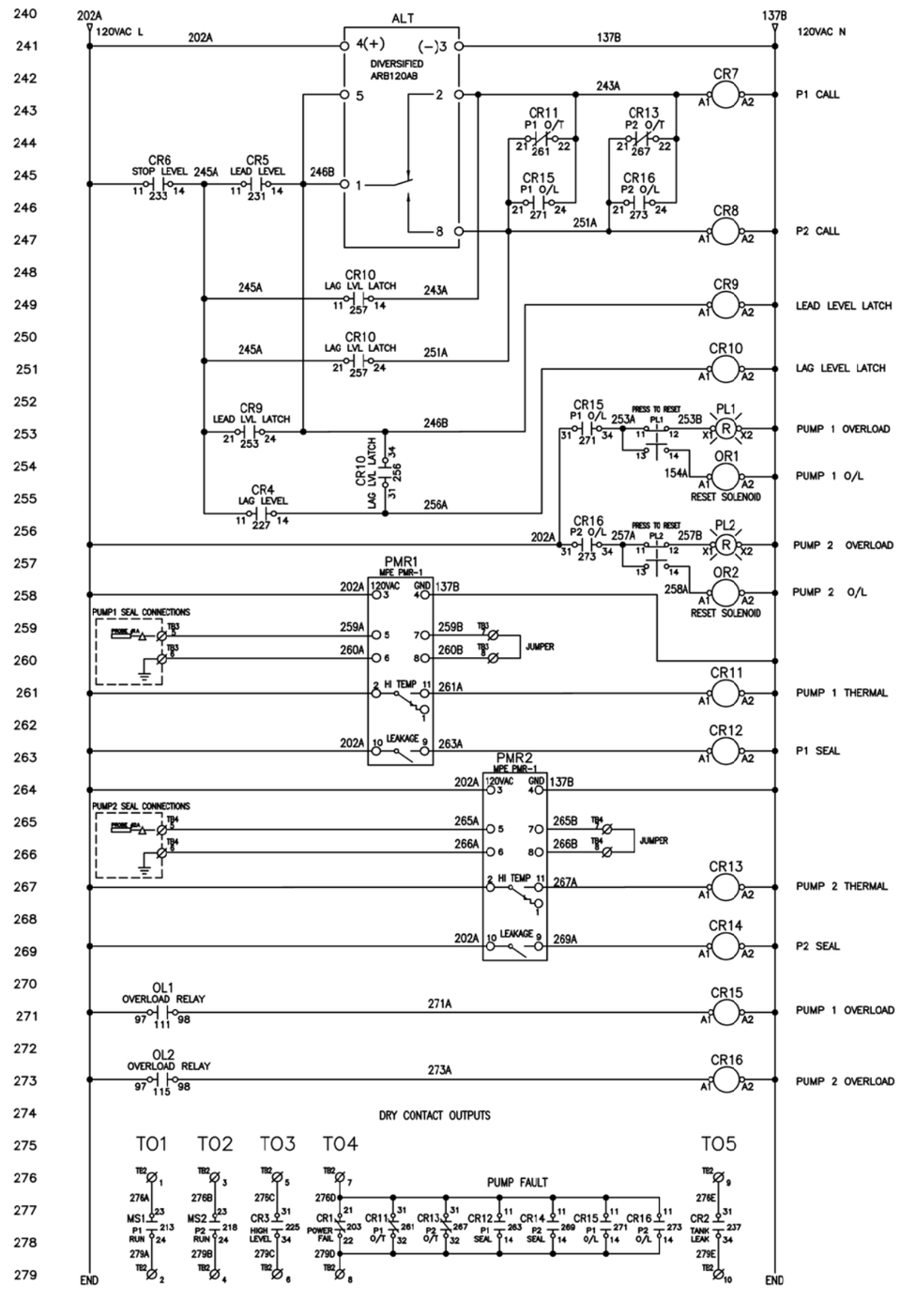
ANAIMAL HEALTH
CONTROL PANEL
ELECTRICAL DIAGRAM 1

SHEET
1 OF 3

JOB NUMBER
P4657

SCHEMATIC DIAGRAM





BY	DESCRIPTION REVISIONS	REV	DATE
		1	

DSN:JSP
DRN:JSP
CKD:KAS
12/2/13

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ANIMAL HEALT, KANSAS

ANIMAL HEALT
CONTORL PANEL
ELECTRICAL DIAGRAM 2

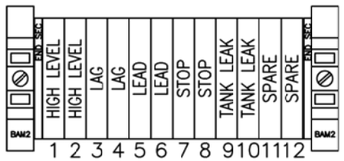
SHEET
2 OF 3

JOB NUMBER
P4657

FIELD CONNECTIONS DIAGRAM

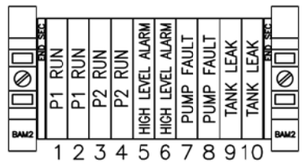
MAIN PANEL TERMINAL BLOCK CONNECTIONS

LEVEL FLOAT CONNECTIONS



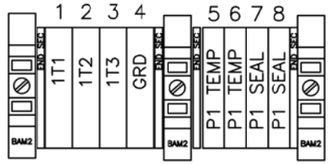
Intrinsically Safe Field Wiring Terminals
WARNING – Substitution of Components
May Impair Intrinsic Safety

DRY CONTACTS



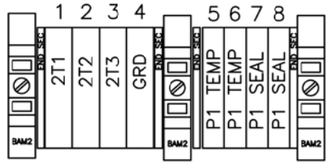
TB2

PUMP 1 POWER & TEMP / SEAL CONNECTIONS



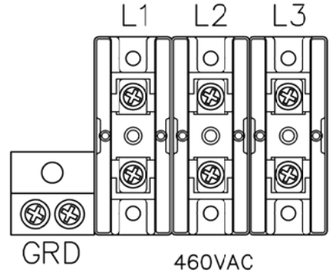
TB3

PUMP 2 POWER & TEMP / SEAL CONNECTIONS



TB4

MAIN POWER CONNECTIONS



BY	DESCRIPTION REVISIONS	REV	DATE
		1	

DSN.JSP
DRN.JSP
CKD.KAS
12/2/13

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ANIMAL HEALTH, KANSAS

ANIMAL HEALTH
CONTROL PANEL
ELECTRICAL DIAGRAM 3

SHEET
3 OF 3

JOB NUMBER
P4657

6.03 CONTROL PANEL DATA SHEETS

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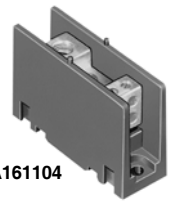
LBC165212

LBA365212

LBA361104



LBA161104

Standard Power Distribution Blocks

Lug WireRange▲		Aluminum■						Dim. Type
Main	Branch	One Pole		Two Pole		Three Pole		
		Type ★	Price	Type ★	Price	Type ★	Price	
(1) #14–2/0	(1) #14–2/0	LBA162101	$ 6.90	LBA262101	$ 14.70	LBA362101	$ 17.10	2
(1) #6–350 kcmil	(1) #6–350 kcmil	LBA163101	35.60	LBA263101	54.00	LBA363101	71.00	3
(1) #4–600 kcmil	(1) #4–600 kcmil	LBA164101	63.00	N/A	. . .	LBA364101	122.00	4
(2) #4–350 kcmil	(2) #4–350 kcmil	LBA165202	65.00	LBA265202	98.00	LBA365202	126.00	5
(2) #4–500 kcmil	(2) #4–500 kcmil	LBA1652021	60.00	LBA2652021	137.00	LBA3652021	162.00	5
(1) #14–2/0	(4) #14–4	LBA162104	20.30	LBA262104	30.50	LBA362104	45.60	2
(1) #14–2/0	(6) #14–4	N/A	. . .	N/A	. . .	LBA362106	87.00	...▼
(1) #6–400 kcmil	(4) #14–2	LBA163104	37.20	LBA263104	56.00	LBA363104	75.00	3
(1) #6–400 kcmil	(6) #14–2	LBA163106	39.30	LBA263106	59.00	LBA363106	81.00	3
(1) #6–400 kcmil	(8) #14–2	LBA164108	51.00	LBA264108	77.00	LBA364108	107.00	4
(1) #4–500 kcmil	(6) #14–2/0	LBA165106	84.00	LBA265106	126.00	LBA365106	155.00	5
(1) #4–500 kcmil	(12) #14–2	LBA165112	89.00	LBA265112	134.00	LBA365112	174.00	5
(2) #14–2/0	(6) #14–4	LBA163206	39.80	LBA263206	60.00	LBA363206	81.00	3
(2) #4–500 kcmil	(8) #14–2/0	LBA165208	84.00	LBA265208	126.00	LBA365208	167.00	5
(2) #4–500 kcmil	(12) #14–4	LBA165212	90.00	LBA265212	137.00	LBA365212	174.00	5

Miniature Power Distribution Blocks

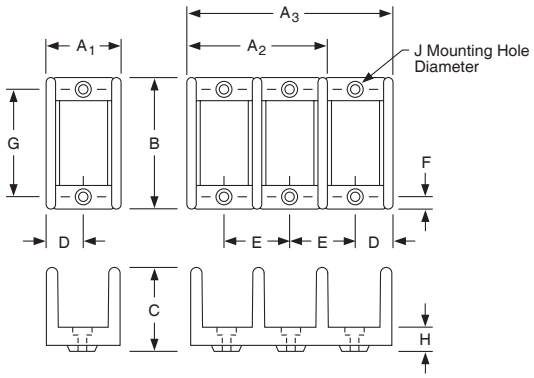
Lug Wire Range▲		Aluminum■						Dim. Type
Main	Branch	One Pole		Two Pole		Three Pole		
		Type ★	Price	Type ★	Price	Type ★	Price	
(1) #14–2	(1) #14–2	LBA161101	$ 8.90	N/A	. . .	LBA361101	$ 16.60	1
(1) #14–2	(4) #18–10	LBA161104	17.60	LBA261104	$20.40	LBA361104	38.70	1

Copper Power Distribution Blocks

Lug Wire Range▲		Copper						Dim. Type
Main	Branch	One Pole		Two Pole		Three Pole		
		Type ★	Price	Type ★	Price	Type ★	Price	
(1) #18–1/0	(1) #18–1/0	LBC162101	$ 66.00	N/A	. . .	LBC362101	$134.00	2
(1) #6–250 kcmil	(1) #6–250 kcmil	LBC163101	83.00	N/A	. . .	LBC363101	155.00	3
(1) #14–2/0	(4) #14–4	LBC162104	66.00	LBC262104	$ 98.00	LBC362104	165.00	2
(1) #4–500 kcmil	(6) #14–2	LBC163106	102.00	LBC263106	156.00	LBC363106	236.00	3
(2) #14–2/0	(6) #14–4	LBC163206	89.00	LBC263206	134.00	LBC363206	179.00	3
(2) #4–500 kcmil	(8) #14–2/0	LBC165208	181.00	N/A	. . .	LBC365208	395.00	5
(2) #4–500 kcmil	(12) #14–2	LBC165212	189.00	N/A	. . .	LBC365212	378.00	5

▲ Lugs suitable for use with 75°C conductors. (#) indicates number of conductors.
■ Aluminum blocks will accept either Al or Cu conductors.
♦ Cu blocks will accept copper conductors only.
★ CE Marked.
▼ Refer to catalog for dimensions.

Dimensions



Dimensions (Inches)

Type	A1	A2	A3	B	C	D	E	F	G	H	J
1	.76	1.40	2.03	2.29	1.62	.38	.64	.19	1.93	.32	.201
2	1.13	1.94	2.75	2.88	1.78	.56	.81	.31	2.25	.24	.205
3	1.94	3.47	5.00	4.00	2.61	.97	1.53	.31	3.38	.40	.203
4	2.28	4.16	6.04	4.75	2.92	1.14	1.88	.31	4.13	.51	.20
5	3.17	5.88	8.54	5.50	3.12	1.58	2.69	.38	4.75	.50	.265

Clear Plastic Covers (0.045 in. thick)

Note: There are no covers for miniature blocks.

For LBA Type	Type	Price △	Dim. A	Dim. B
LBA162..., LBC162	LB21	$ 7.50	1.062	2.750
LBA262..., LBC262	LB22	9.00	1.875	2.750
LBA362..., LBC362 □	LB23	10.50	2.688	2.750
LBA163..., LBC163	LB31	8.30	1.782	3.813
LBA263..., LBC263	LB32	9.80	3.313	3.813
LBA363..., LBC363	LB33	11.30	4.844	3.813
LBA164...	LB41	9.00	2.125	4.563
LBA264...	LB42	10.50	4.000	4.563
LBA364...	LB43	12.00	5.875	4.563
LBA165..., LBC165	LB51	9.80	2.719	5.313
LBA265..., LBC265	LB52	11.30	5.656	5.313
LBA365..., LBC365	LB53	12.80	8.375	5.313

△ Above covers must be ordered in multiples of 5 covers.
Above covers are supplied with two self tapping screws per cover.
□ Will not work on a 9080LBA362106 block.

Application Data

UL component recognized (File E60616 CCN XCFR2).
CSA certified (File LR70361).
Voltage Rating—Class B & C—600 V
Blocks are rated based on NEC Table 310-16 using 75°C wire.
Aluminum blocks are tin plated high conductive aluminum.
Copper blocks are tin plated high conductive copper.
Housing material:

- Miniature Blocks are made from high impact thermoplastic rated at 125°C. max. & -40°C. min.
- Full Size Blocks are made from general purpose phenolic rated at 150°C. max. & -40°C. min.

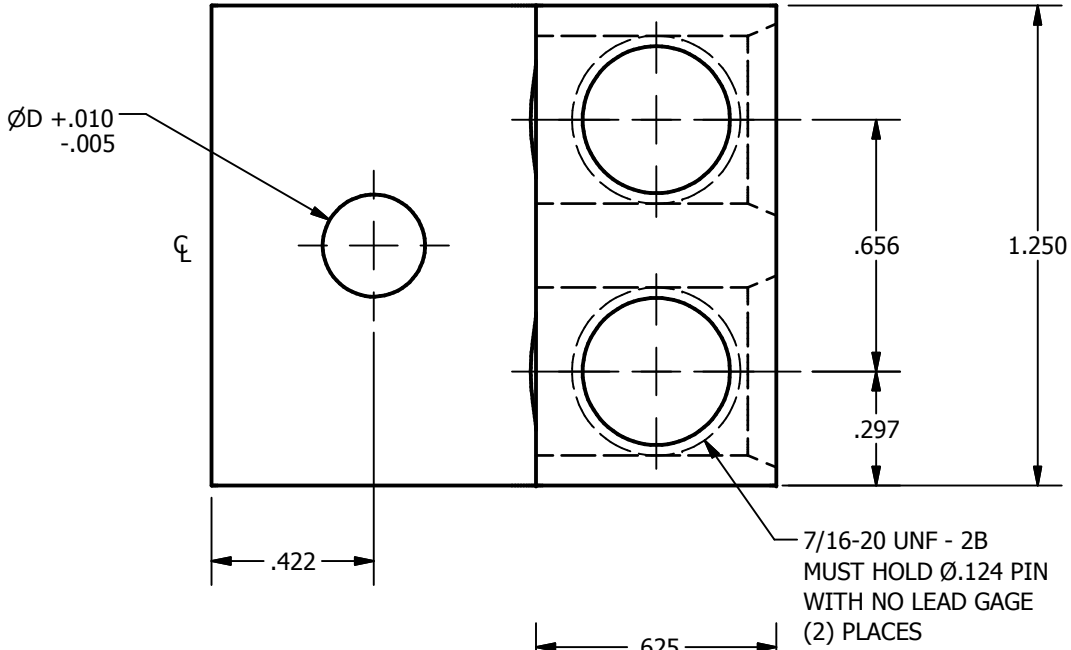
All blocks have a flammability rating of UL 94V-0.

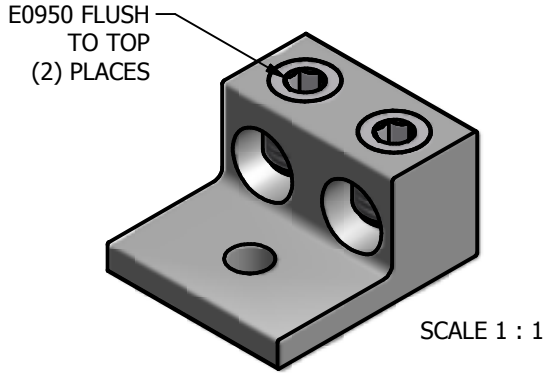
For additional information, reference Catalog # 9080CT9603.

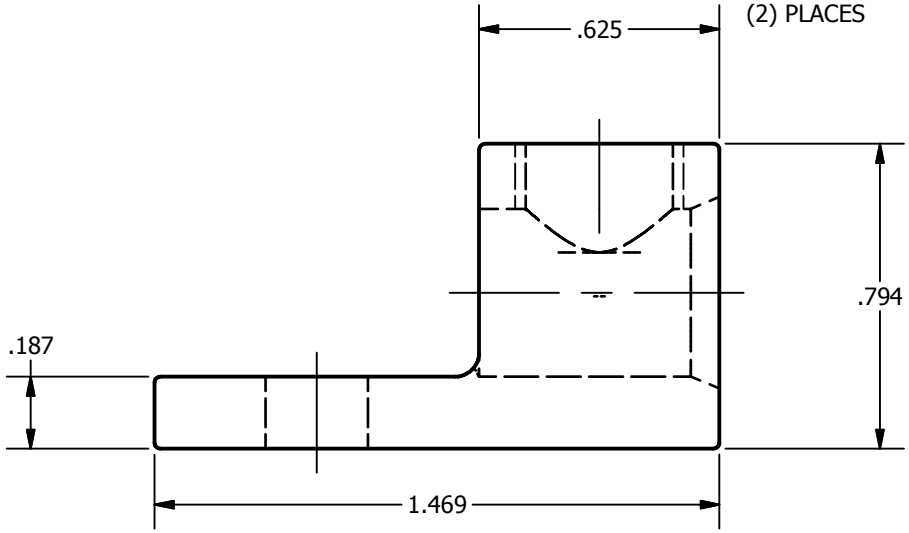
SCREW: E0950	MATERIAL:ALUMINUM, X0031	TOLERANCES-UNLESS OTHERWISE SPECIFIED 2 PL. DEC. ±.015 TRUE C.L. ±.015 3 PL. DEC. ±.015 ANGLES ±1		DWG. NO. D2057 SHEET 1 OF 1
CAT. NO.:	PLATING: EL-TIN			
MASS:SEE CHART	MARKING: SEE CHART	DRAWN BY: CLH	SCALE: 2:1	
SURFACE AREA: SEE CHART²		DATE: 1/16/2008	SIZE: A	
STUFFER SHT: FORM 1	CELL:AMP			

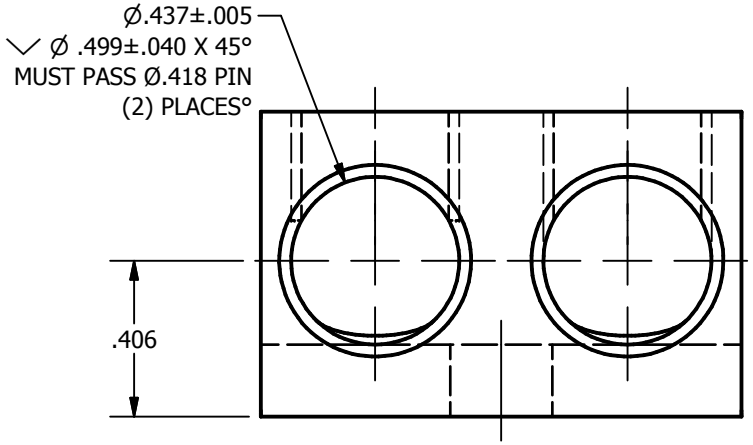
REV.	DESCRIPTION
E	

Cat #: AU-2/0
AU-2/0-B2









DEV	D	MASS LBS.	SURFACE AREA IN²	MARKING
-22	.272	.0555	8.0048	ILSCO, D2057, AU-2/0, 2/0-14, AL9CU

Power Distribution Connectors for Circuit Breakers and Switches
Conectores de distribución de alimentación para los desconectadores e interruptores automáticos
Connecteurs de distribution d'alimentation pour interrupteurs et disjoncteurs

Retain for future use. / Conservar para uso futuro. / À conserver pour usage ultérieur.

GENERAL INFORMATION

Special Purpose

- Only for use on the OFF (O) end of circuit breaker and only when the OFF (O) end is the load end.
- Only for use in UL 508 Industrial Control Equipment Standard Applications.
- Only for use in UL 1995/CSA C22.2 No. 236 Heating and Cooling Equipment Standard Applications.
- For copper wire only.

KIT CONTENTS

- Power Distribution Connector(s)—See **Table 1**
- Lug Mounting Screw(s)
- Special Purpose Label
- Lug Data Label

INFORMACIÓN GENERAL

Para uso especial

- Utilice sólo en el extremo abierto (O) del interruptor automático y sólo si el extremo abierto es el extremo de carga.
- Para su uso en aplicaciones normales de equipo de control industrial que cumple con la norma UL 508 solamente.
- Para su uso en aplicaciones normales de equipo de calefacción y enfriamiento que cumple con la norma UL 1995 / CSA-C22.2 no. 236 solamente.
- Para conductores de cobre solamente.

CONTENIDO DEL ACCESORIO

- Conector(es) de distribución de alimentación-**consulte la tabla 1**
- Tornillo(s) de montaje de la zapata
- Etiqueta para uso especial
- Etiqueta de datos de la zapata

GÉNÉRALITÉS

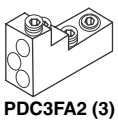
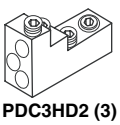
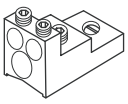
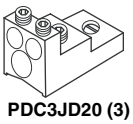
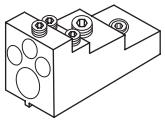
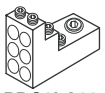
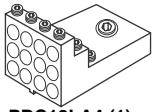
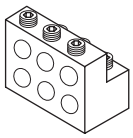
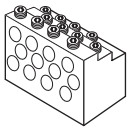
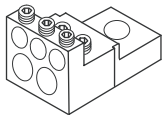
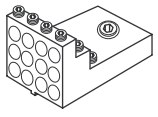
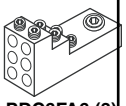
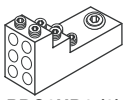
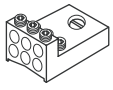
Pour un usage particulier

- Utiliser seulement sur l'extrémité d'arrêt (O) du disjoncteur et seulement si elle est l'extrémité de charge.
- Pour un usage dans des applications industrielles standard de matériel de contrôle selon la norme UL 508 uniquement.
- Pour un usage dans des applications standard de matériel de chauffage et de refroidissement selon la norme UL 1995/CSA-C22.2 Nº 236 uniquement.
- Pour fils en cuivre seulement.

CONTENU DU KIT

- Connecteur(s) de distribution d'alimentation-**voir le tableau 1**
- Vis de montage de cosse
- Étiquette pour usage particulier
- Étiquette de données de cosses

Table / Tabla / Tableau 1 : Power Distribution Connectors / Conectores de distribución / Connecteurs de distribution

Circuit Breaker / Interruptor aut. / Disjoncteur	FAL, FHL, FCL	H-frame / Marco H / Châssis H	KAL, KHL	J-frame / Marco J / Châssis J	LAL, LHL, Q4L	MAL, MHL, MEL, MXL	D-frame / Marco D / Châssis D	NSJ
Catalog No. (Qty. per kit) / No. de catálogo / Nº de catalogue (cant. por accesorio)	 **PDC3FA2 (3)**	 **PDC3HD2 (3)**	 **PDC3KA20 (3)**	 **PDC3JD20 (3)**	 **PDC4LA250 (1)**  **PDC6LA20 (1)**  **PDC12LA4 (1)**	 **PDC6MA20 (1)**  **PDC12MA4 (1)**	 **PDC5DG20 (3)**  **PDC12DG4 (3)**	
	 **PDC6FA6 (3)**	 **PDC6HD6 (3)**	 **PDC6KA4 (3)**	 **PDC6JD4 (3)**				

New!

HD and HG 2P

H-frame

J-frame

Table 7.37: H-frame 150 A and J-frame 250 A Thermal-magnetic Circuit Breakers (600 Vac, 250 Vdc) With Factory Sealed Trip Unit Suitable for Reverse Connection▲

Current Rating @ 40°C	Fixed AC Magnetic Trip		Cat. No.■♦	Interrupting Rating (2nd Letter of Catalog Number)								Terminal Wire Range
				D		G		J		L		
				$ Price								
	Hold	Trip		80% Rated	100% Rated	80% Rated	100% Rated	80% Rated	100% Rated	80% Rated	100% Rated	
H-frame, 150A 2P, 600 Vac 50/60 Hz, 250 Vdc												
15 A	350 A	750 A	H( )L26015(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	AL150HD 14–3/0 AWG Al or Cu
20 A	350 A	750 A	H( )L26020(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	
25 A	350 A	750 A	H( )L26025(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	
30 A	350 A	750 A	H( )L26030(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	
35 A	400 A	850 A	H( )L26035(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	
40 A	400 A	850 A	H( )L26040(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	
45 A	400 A	850 A	H( )L26045(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	
50 A	400 A	850 A	H( )L26050(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	
60 A	800 A	1450 A	H( )L26060(C)	580.00	696.00	846.00	1015.00	1039.00	1247.00	1576.00	1891.00	
70 A	800 A	1450 A	H( )L26070(C)	708.00	849.00	998.00	1198.00	1147.00	1377.00	1742.00	2091.00	
80 A	800 A	1450 A	H( )L26080(C)	708.00	849.00	998.00	1198.00	1147.00	1377.00	1742.00	2091.00	
90 A	800 A	1450 A	H( )L26090(C)	708.00	849.00	998.00	1198.00	1147.00	1377.00	1742.00	2091.00	
100 A	900 A	1700 A	H( )L26100(C)	708.00	849.00	998.00	1198.00	1147.00	1377.00	1742.00	2091.00	
110 A	900 A	1700 A	H( )L26110(C)	1381.00	1657.00	2039.00	2447.00	2966.00	3559.00	3689.00	4427.00	
125 A	900 A	1700 A	H( )L26125(C)	1381.00	1657.00	2039.00	2447.00	2966.00	3559.00	3689.00	4427.00	
150 A	900 A	1700 A	H( )L26150(C)	1381.00	1657.00	2039.00	2447.00	2966.00	3559.00	3689.00	4427.00	
H-frame 150A 3P, 600 Vac 50/60 Hz, 250 Vdc												
15 A	350 A	750 A	H( )L36015(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	AL150HD 14–3/0 AWG Al or Cu
20 A	350 A	750 A	H( )L36020(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	
25 A	350 A	750 A	H( )L36025(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	
30 A	350 A	750 A	H( )L36030(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	
35 A	400 A	850 A	H( )L36035(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	
40 A	400 A	850 A	H( )L36040(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	
45 A	400 A	850 A	H( )L36045(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	
50 A	400 A	850 A	H( )L36050(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	
60 A	800 A	1450 A	H( )L36060(C)	725.00	870.00	995.00	1194.00	1299.00	1559.00	1899.00	2279.00	
70 A	800 A	1450 A	H( )L36070(C)	885.00	1061.00	1134.00	1361.00	1399.00	1679.00	2099.00	2519.00	
80 A	800 A	1450 A	H( )L36080(C)	885.00	1061.00	1134.00	1361.00	1399.00	1679.00	2099.00	2519.00	
90 A	800 A	1450 A	H( )L36090(C)	885.00	1061.00	1134.00	1361.00	1399.00	1679.00	2099.00	2519.00	
100 A	900 A	1700 A	H( )L36100(C)	885.00	1061.00	1134.00	1361.00	1399.00	1679.00	2099.00	2519.00	
110 A	900 A	1700 A	H( )L36110(C)	1733.00	2080.00	2399.00	2879.00	3449.00	4139.00	4499.00	5399.00	
125 A	900 A	1700 A	H( )L36125(C)	1733.00	2080.00	2399.00	2879.00	3449.00	4139.00	4499.00	5399.00	
150 A	900 A	1700 A	H( )L36150(C)	1733.00	2080.00	2399.00	2879.00	3449.00	4139.00	4499.00	5399.00	

Current Rating @ 40°C	Adjustable AC Magnetic Trip		Cat. No.■♦	Interrupting Rating (2nd Letter of Catalog Number)								Terminal Wire Range
				D		G		J		L		
				$ Price								
	Low	High		80% Rated	100% Rated	80% Rated	100% Rated	80% Rated	100% Rated	80% Rated	100% Rated	
J-frame 250A 2P, 600 Vac 50/60 Hz, 250 Vdc												
150 A	750 A	1500 A	J( )L26150(C)	1450.00	1740.00	2141.00	2569.00	3114.00	3737.00	3874.00	4648.00	AL175JD 4–4/0 AWG Al or Cu
175 A	875 A	1750 A	J( )L26175(C)	1450.00	1740.00	2141.00	2569.00	3114.00	3737.00	3874.00	4648.00	
200 A	1000 A	2000 A	J( )L26200(C)	1450.00	1740.00	2141.00	2569.00	3114.00	3737.00	3874.00	4648.00	AL250JD 3/0 AWG–350 kcmil Al or Cu
225 A	1125 A	2250 A	J( )L26225(C)	1450.00	1740.00	2141.00	2569.00	3114.00	3737.00	3874.00	4648.00	
250 A	1250 A	2500 A	J( )L26250(C)	1992.00	2390.00	2834.00	3401.00	4150.00	4979.00	4796.00	5755.00	
J-frame 250A 3P, 600 Vac 50/60 Hz, 250 Vdc												
150 A	750 A	1500 A	J( )L36150(C)	1820.00	2184.00	2519.00	3023.00	3621.00	4346.00	4724.00	5669.00	AL175JD 4–4/0 AWG Al or Cu
175 A	875 A	1750 A	J( )L36175(C)	1820.00	2184.00	2519.00	3023.00	3621.00	4346.00	4724.00	5669.00	
200 A	1000 A	2000 A	J( )L36200(C)	1820.00	2184.00	2519.00	3023.00	3621.00	4346.00	4724.00	5669.00	AL250JD 3/0 AWG–350 kcmil Al or Cu
225 A	1125 A	2250 A	J( )L36225(C)	1820.00	2184.00	2519.00	3023.00	3621.00	4346.00	4724.00	5669.00	
250 A	1250 A	2500 A	J( )L36250(C)	2499.00	2999.00	3334.00	4001.00	4825.00	5790.00	5995.00	7194.00	

▲ See page 7-23 for circuit breakers with field interchangeable trip units.
■ To complete catalog number, replace the blank with the appropriate rating (D, G, J, L).
♦ For 100% rated circuit breakers add a "C" in the 9th character place (for example, HDL26015**C** or JDL26150**C**).

Table 7.38: H- and J-frame Termination Options

Termination Letter
A - I-Line (See Section 9)
F = No Lugs (includes terminal nut kit on both ends)★
L = Lugs both ends
M = Lugs ON end Terminal Nut Kit OFF end
P = Lugs OFF end Terminal Nut Kit ON end
N = Plug-in ▼
D = Drawout ▼
S = Rear Connected ▼

For factory-installed termination, place termination letter in the third block of the circuit breaker catalog number.

H G L 3 6 1 0 0
└ Termination Letter

Plug-in

Drawout

Rear Connected

★ Add TS suffix for circuit breaker without terminal nut kit.
▼ For N and D pricing, add termination pricing on page 7-41 to price. For S pricing, add termination pricing on page 7-37 to price.

Table 7.39: H- and J-frame Interrupting Ratings

Voltage	Interrupting Rating			
	D	G	J	L
240 Vac	25 kA	65 kA	100 kA	125 kA
480 Vac	18 kA	35 kA	65 kA	100 kA
600 Vac	14 kA	18 kA	25 kA	50 kA

PowerPact® Electronic Motor Circuit Protectors

Turn It On: motor circuit protection solutions that offer reliability and flexibility

Delivering more reliable start-ups, better protection for equipment and a wide range of adjustments to meet users' motor starting needs, the Square D® PowerPact® electronic motor circuit protectors (MCP) are available for the PowerPact H- and J-Frame molded case circuit breakers.

To adjust to users' needs, the new PowerPact MCP has a unique design that includes one dial that allows for a wide range of full load amperes (FLA) adjustment and a second dial for motor selection. These adjustments ensure motor circuits are set to the in-rush characteristics of the motor, while achieving National Electrical Code® (NEC®) compliance.

What can PowerPact electronic motor circuit protectors do for you?

- **Reliable equipment start-ups**
  - Instantaneous trip points align with the motor and NEC requirements to ensure compliant installation
  - Two dials allow quick and precise adjustment of settings to ensure proper protection
- **Simple installation**
  - Wide adjustments range means no need to change devices to cover the starter's horsepower range
  - 30 A MCP has an FLA adjustment range of 1.5 A to 27 A, covering the entire range of a NEMA Size 1 starter
  - Settings align directly with the information published on the motor nameplate for quick and easy installation
- **Improved equipment protection and safety**
  - Improved longevity of equipment from quick and decisive tripping when motor limitations are exceeded
  - Ensures that breaker contacts correspond to the ON, OFF or tripped indication
- **Lower life cycle costs**
  - Due to the PowerPact MCPs flexibility, it eliminates the need to stock a wide variety of unique fuses and non-electronic MCPs

Where do you use PowerPact electronic motor circuit protectors?

- **Industrial Control Panels**
  - Branch Motor Circuits
- **HVAC Equipment**
  - Branch Motor Circuits

a brand of Schneider Electric

SQUARE D

PowerPact® Electronic Motor Circuit Protectors

Product Specifications

Product Feature	Benefit
SCCR Ratings for UL 508A	Up to 100 kA at 480 V SCCR rating with Square D® NEMA and Telemecanique® TeSys® contactors and starters
NEC Code Compliance	Adjustment for standard and energy efficient motors make code compliance simple
Motor In-rush	Trip unit setting to allow dampening for in-rush current from an electric motor
Voltage Ratings	Rated for both wye and delta voltage systems Allowing use on 480 Y/277 V, 480 V delta, 600 Y/347 V and 600 V delta voltages
Certifications	UL, IEC, CSA, NOM and CE

Product Selection

Frame/Current		Full-Load Amperes Range (A)		J Interrupting (see SCCR table)	L Interrupting (see SCCR table)
				Catalog Number	Catalog Number
H-Frame	30A	1.5 – 25	9 – 325	HJL36030M71	HJL36030M71
	50A	14 – 42	84 – 546	HJL36050M72	HJL36050M72
	100A	30 – 80	180 – 1040	HJL36100M73	HJL36100M73
	150A	58 – 130	348 – 1690	HJL36150M74	HJL36150M74
J-Frame	250A	114 – 217	684 – 2500	JJL36250M75	JJL36250M75

For more information

Visit our Web site at www.squared.com/powerpact for more information on the PowerPact MCP.
The following literature is available from your authorized Square D® distributor or Schneider Electric sales office:

- Brochure, New Motor Circuit Protectors Improve Start-ups, document number 0106HO0601
- Catalog, PowerPact H- and J-Frame Circuit Breakers, document number 0611CT0401
- Brochure, UL 508A tested SCCR Combinations 0101BR0601
- Application Guide, PowerPact H- and J-Frame Circuit Breakers, document number 0611BR0401
- Brochure, PowerPact MCCB, document number 0611BR0402
- Application Guide, MCP Based Starters, document number 0600DB0701

For technical support, please call 888-SQUARED.

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Raleigh, NC 27616
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www.us.squared.com

document number 8000HO0706

02-07 jb

Class **9421** / Refer to Catalog **9420CT9701**

Type L Circuit Breaker Mechanisms

Operating Mechanism

Type L door mounted, variable depth operating mechanisms feature heavy duty, all metal construction with trip indication. All can be padlocked in the "OFF" position when the enclosure door is open. Further, the handle assemblies can be locked "OFF" with up to three padlocks, which also locks the door closed. (The 3" handle accepts one padlock.)

Complete kits are rated for NEMA Type 1, 3R and 12 enclosures, and a door-drilling template is supplied to ease installation. They include a handle assembly, operating mechanism, and shaft assembly

Table 8.45: Complete Kits

Complete Kit Does Not Include Circuit Breaker — Use With			Includes: Operating Mechanism Standard 6" Handle Standard Shaft Kit			Includes: Operating Mechanism Standard 6" Handle Long Shaft Kit			Includes: Operating Mechanism Short 3" Handle Long Shaft Kit		
Circuit Breaker or Interrupter Type	Number of Poles	Frame Size (A)	Type	$ Price	Mounting Depth▲ Min.-Max.	Type	$ Price	Mounting Depth▲ Min.-Max.	Type	$ Price	Mounting Depth▲ Min.-Max.
GJL	3	75, 100	LG1	**93.**	5-1/2—10-1/4	LG4	**105.**	5-1/2—20-7/8	LG3	**132.**	5-1/2—20-7/8
FAL, FCL, FHL	2–3	100	LN1	**93.**	5-1/2—10-7/16	LN4	**105.**	5-1/2—21	LN3	**132.**	5-1/2—21
KAL, KCL, KHL	2–3	250	LP1	**114.**	6-1/4—11-3/16	LP4	**126.**	6-1/4—21-3/4	LP3	**153.**	6-1/4—21-3/4
New! NSF, Powerpact H and J	2–3	250	LJ1	**114.**	5-1/2—10-3/4	LJ4	**126.**	5-1/2—21-3/8	—	—	—
LAL♦, LHL♦, Q4L	2–3	400	LR1	**161.**	6-5/16—10-7/8	LR4	**170.**	6-5/16—21-1/2	3" handles are not recommended for use with these circuit breakers.		
MEL, MXL	2–3	800	LT1■	**161.**	7-3/16—11-5/8	LT4■	**170.**	7-3/16—22-1/4			
MAL, MHL	2–3	1200	LT1■	**161.**	7-3/16—11-5/8	LT4■	**170.**	7-3/16—22-1/4			
NAL, NCL, NEL, NXL	2–3	1200	LX1■	**161.**	8-1/4—12-3/4	LX4■	**170.**	8-1/4—23-3/8			
Powerpact M and P ▼	3	1200	LW1★	**161.**	7-3/16—11-5/8	LW4★	**170**	7-3/16—22-1/4			

Component parts kits are rated for NEMA Type 1, 3, 3R, 4, 4X, and 12 enclosures. All handle assemblies are painted (the handle is flat black and the base ring is silver.)

Table 8.46: Component Parts

Use With			3" Handle Assemblies Type 1, 3R, 12		Standard Handle Assemblies Type 1, 3R, 12		Operating Mechanism Includes Lockout		Standard Shaft (Support Bracket Not Required)			Long Shaft (Support Bracket Included)		
Circuit Breaker or Interrupter Type	No. of Poles	Frame Size (A)	Type	$ Price	Type	$ Price	Type	$ Price	Mounting Depth▲ Min. - Max.	Type	$ Price	Mounting Depth▲ Min. - Max.	Type	$ Price
GJL	3	75, 100	LH3	**60.**	LH6	**33.30**	LG7	**45.00**	5-1/2—10-7/16	LS8	**14.30**	5-1/2—21	LS13	**23.70**
FAL, FCL, FHL	2–3	100	LH3	**60.**	LH6	**33.30**	LF1	**47.60**	5-1/2—10-7/16	LS8	**14.30**	5-1/2—21	LS12	**23.70**
KAL, KCL, KHL	2–3	250	LH3	**60.**	LH6	**33.30**	LK1	**70.00**	6-1/4—11-3/16	LS8	**14.30**	6-1/4—21-3/4	LS12	**23.70**
New! NSF, Powerpact H and J	2–3	250	LH3	**60.**	LH6	**33.30**	LJ7	**70.00**	5-1/2—10-1/4	LS8	**14.30**	5-1/2—21-3/8	LS13	**23.70**
LAL♦, LHL♦, Q4L	2–3	400	3" handles are not recommended for use with these circuit breakers.		LH6	**33.30**	LL1	**113.00**	6-5/16—10-7/8	LS8	**14.30**	6-5/16—21-1/2	LS10	**23.70**
MEL, MXL	2–3	800			LH8	**33.30**	LM1	**113.00**	7-3/16—11-5/8	LS8	**14.30**	7-3/16—22-1/4	LS10	**23.70**
MAL, MHL	2–3	1200			LH8	**33.30**	LM1	**113.00**	7-3/16—11-5/8	LS8	**14.30**	7-3/16—22-1/4	LS10	**23.70**
NAL, NCL, NEL, NXL	2–3	1200			LH8	**33.30**	LX7	**113.00**	8-1/4—12-3/4	LS8	**14.30**	8-1/4—23-3/8	LS10	**23.70**
New! Powerpact M and P▼	3	1200			LHP8	**33.3**	LW7	**113.00**	7-3/16—11-5/8	LS8	**14.30**	7-3/16—22-1/4	LS10	**23.70**

▲ Mounting depth measured from circuit breaker mounting surface (control panel) to outside of enclosure door in inches.
■ Types LT1, LT4, LX1, and LX4 include an 8" handle rather than a 6" handle.
♦ **Warning:** These operating mechanisms cannot be used with any LA/LH circuit breaker with an MB or MT suffix.
★ Type LW1 and LW4 include an 8 in. handle (9421LHP8) rather than a 6 in. handle.
▼ These breakers must use the 9421LHP** or LCP** handles only

3" Handle Assembly

Table 8.47: NEMA Type 3 and 4 Handle Assemblies△

Use With			Standard Handle Assemblies				Special 3" Version			
Circuit Breaker or Interrupter Type	No. of Poles	Frame Size (A)	NEMA Type 3, 4 (Painted)		NEMA Type 3, 4, 4X (Chrome Plated)		NEMA Type 3, 4 (Painted)		NEMA Type 3, 4, 4X (Chrome Plated)	
			Type	$ Price	Type	$ Price	Type	$ Price	Type	$ Price
GJL	3	75	LH46	**60.**	LC46	**99.**	LH43	**110.**	LC43	**155.**
FAL, FCL, FHL	2–3	100	LH46	**60.**	LC46	**99.**	LH43	**110.**	LC43	**155.**
KAL, KCL, KHL	2–3	250	LH46	**60.**	LC46	**99.**	LH43	**110.**	LC43	**155.**
NSF, Powerpact H and J	2–3	250	LH46	**60.**	LC46	**99.**	LH43	**110.**	LC43	**155.**
LAL, LHL, Q4L	2–3	400	LH46	**60.**	LC46	**99.**	3" handles are not recommended for use with these circuit breakers.			
MEL, MXL	2–3	800	LH48	**60.**	LC48	**99.**				
MAL, MHL	2–3	1000	LH48	**60.**	LC48	**99.**				
NAL, NCL, NEL, NXL	2–3	1200	LH48	**60.**	LC48	**99.**				
New! Powerpact M and P	3	1200	LHP48	**60.**	LCP48	**99.**				

△ Due to gasketing, NEMA Type 3 & 4 handle assemblies are NOT trip indicating.

Standard Handle Assembly

Table 8.48: IEC Style Operating Mechanisms

Circuit Breaker or Interrupter Type	Type 1, 4, 4X, 12			Operating Mechanism includes lockout		Extension Shafts			
						Mounting Depth		Type	$ Price
	Color	Type	$ Price	Type	$ Price	Min.	Max.		
GJL	Red/Yellow	NW3	**60.**	LG8	**$47.60**	6-1/8	10-3/4	NS16	**19.10**
	Black	NW3B	**60.**			6-1/8	17-7/8	NS336□	**23.70**

□ Contains support bracket.

Note: Not used with GJL, NAL, NCL, NEL, NXL, NSF, NSJ, Powerpact C, D, H, and J circuit breakers; use field-installed circuit breaker interlocks instead.

Table 8.49: Electrical Interlock Kits—Class 9999 ◊

Description	Class	Type	$ Price
Single Pole Double Throw	9999	R47	**87.**
Double Pole Double Throw	9999	R48	**147.**

◊ (optional accessory for use with 9421L operating mechanisms)

UL 489 Listed 240 Vac C60 Circuit Breakers (AC)

A selected range of Multi-9 circuit breakers rated 240 V are UL 489 Listed. Unlike UL 1077 Supplementary Protectors, these UL 489 circuit breakers can be used for branch circuit protection as required by the National Electrical Code.

As shown in tables Table 5 and Table 6, the UL 489 Listed products are available in C and D curves. They include devices ranging from 0.5 to 35 A.

UL 489 Listed Multi 9 C60 Circuit Breakers

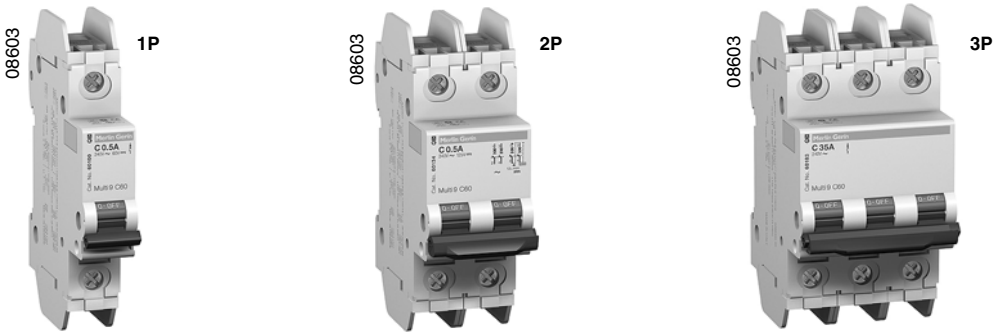


Table 4: Specifications for UL 489 240 V Listed C60N Circuit Breakers

High Voltage Withstand	6 kV	
Connector: Box Lug	Rating	UL 486A File No. E216919 (Use with Copper Wire Only)
	Connection	0.5–25 A: 14–4 AWG (2–25 mm^2) Cables Torque to 22 lb-in. (2.48 N•m) 30–35 A: 14–2 AWG (1–35 mm^2) Cables Torque to 31 lb-in. (3.52 N•m)
Connector: Ring Tongue	Use Single UL Listed or CSA Certified Insulated Ring Tongue Only	Screw dia. 0.2 in. (5 mm) Torque to 18 lb-in. (2.03 N•m)
	Max Ring Terminal Width	0.54 in. (14 mm)
Mounting	35 mm DIN rail	
Degree of Protection	Case	IP40 as per IEC 529
	Terminals	IP20
Temperatures	Calibration	25°C (77°F)
	Storage	-40 to 80°C (-40 to 176°F)
	Operating	-30 to 70°C (-22 to 158°F)
Plug-On Auxiliary Modules with Mechanical Linkage:	MN Undervoltage Trip	
	MX + OF Shunt Trip/Auxiliary Switch	
	OF Auxiliary Switch	
	SD Alarm Switch	
Tropicalization	Treatment 2	Relative Humidity: 95% at 131°F (55°C)
Number of Operating Cycles	Electrical (O-C)	6,000 load, 4,000 no-load
See specifications Table 2 for dimensions, weights and interrupting ratings		

Standard Features

- Fast closing: Allows increased withstand to the high inrush currents of some loads.
- Trip-free mechanism: Contacts cannot be held in the I-ON position when the C60 circuit breaker is tripped automatically.
- Positive indication of contact disconnect. Green mechanical indication on front face of circuit breaker shows that all poles are open.
- C curve: Overcurrent protection for all application types. Magnetic release operates from 7 to 10 times ampere rating (7 to 14 for DC applications).

- D curve: Overcurrent protection for loads with high inrush currents (motors, transformers). Magnetic release operates between 10 and 14 times ampere rating (no dc rating for D curve).
- Suitable for reverse feeding.
- Allows locking in O-OFF position using padlock attachment.

Connections

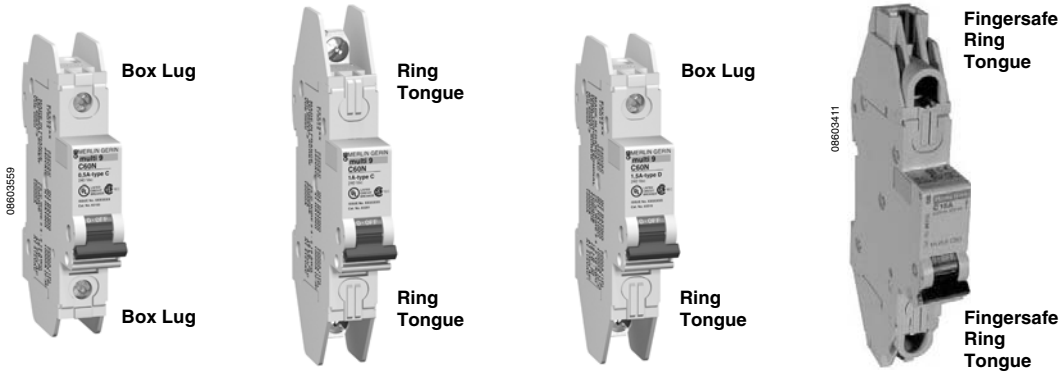
Three versions of field wiring connectors are available for the 240 Vac UL 489 Listed devices:

- Box lug, meeting UL 486A requirements
- Ring tongue terminal with 5 mm screw
- Ring Tongue terminals with Fingersafe (IP20) shrouds

The circuit breakers can be ordered with the following combinations of connectors:

- Line terminal box lug/load terminal box lug
- Line terminal ring tongue/load terminal ring tongue (for fingersafe version, add -F suffix to catalog number)
- Line terminal box lug/load terminal ring tongue

Figure 5: Connection Options for 240 Vac UL 489 Listed Devices



Standards

- UL 489 Circuit Breaker: File No. E215117
- Single pole 15–20 A is UL Listed as SWD (switching duty).
- 1-, 2-, and 3-pole 15–35 A are HID (high intensity discharge) rated.
- CSA C22.2 No. 5.1 Circuit Breakers: File No. 179014
- IEC 60947-2
- CE Marked

Catalog Numbers

Table 5: Catalog Numbers for C Curve, UL 489 Listed 240 Vac C60 Miniature Circuit Breakers (Box Lug and Ring Tongue Terminal Combinations)

Rating	1P			2P			3P		
	Box/Box	Ring/Ring[1]	Box/Ring	Box/Box	Ring/Ring[1]	Box/Ring	Box/Box	Ring/Ring[1]	Box/Ring
0.5 A	60100	60200	60300	60134	60234	60334	—	—	—
1 A	60101	60201	60301	60135	60235	60335	60168	60268	60368
1.5 A	60102	60202	60302	60136	60236	60336	60169	60269	60369
2 A	60103	60203	60303	60137	60237	60337	60170	60270	60370
3 A	60104	60204	60304	60138	60238	60338	60171	60271	60371
4 A	60105	60205	60305	60139	60239	60339	60172	60272	60372
5 A	60106	60206	60306	60140	60240	60340	60173	60273	60373
6 A	60107	60207	60307	60141	60241	60341	60174	60274	60374
7 A	60108	60208	60308	60142	60242	60342	60175	60275	60375
8 A	60109	60209	60309	60143	60243	60343	60176	60276	60376
10 A	60110	60210	60310	60144	60244	60344	60177	60277	60377
13 A	60111	60211	60311	60145	60245	60345	60178	60278	60378
15 A	60112	60212	60312	60146	60246	60346	60179	60279	60379
20 A	60113	60213	60313	60147	60247	60347	60180	60280	60380
25 A	60114	60214	60314	60148	60248	60348	60181	60281	60381
30 A	60115	60215	60315	60149	60249	60349	60182	60282	60382
35 A	60116	60216	60316	60150	60250	60350	60183	60283	60383

[1] IP-20 Fingersafe ring tongue terminals may be ordered with an F suffix (example: 60210F)

Table 6: Catalog Numbers for D Curve, UL 489 Listed 240 Vac C60 Miniature Circuit Breakers (Line/Load as Box Lug or Ring Tongue Terminals)

Rating	1P			2P			3P		
	Box/Box	Ring/Ring[1]	Box/Ring	Box/Box	Ring/Ring[1]	Box/Ring	Box/Box	Ring/Ring[1]	Box/Ring
0.5 A	60117	60217	60317	60151	60251	60351	—	—	—
1 A	60118	60218	60318	60152	60252	60352	60184	60284	60384
1.5 A	60119	60219	60319	60153	60253	60353	60185	60285	60385
2 A	60120	60220	60320	60154	60254	60354	60186	60286	60386
3 A	60121	60221	60321	60155	60255	60355	60187	60287	60387
4 A	60122	60222	60322	60156	60256	60356	60188	60288	60388
5 A	60123	60223	60323	60157	60257	60357	60189	60289	60389
6 A	60124	60224	60324	60158	60258	60358	60190	60290	60390
7 A	60125	60225	60325	60159	60259	60359	60191	60291	60391
8 A	60126	60226	60326	60160	60260	60360	60192	60292	60392
10 A	60127	60227	60327	60161	60261	60361	60193	60293	60393
13 A	60128	60228	60328	60162	60262	60362	60194	60294	60394
15 A	60129	60229	60329	60163	60263	60363	60195	60295	60395
20 A	60130	60230	60330	60164	60264	60364	60196	60296	60396
25 A	60131	60231	60331	60165	60265	60365	60197	60297	60397
30 A	60132	60232	60332	60166	60266	60366	60198	60298	60398
35 A	60133	60233	60333	60167	60267	60367	60199	60299	60399

[1] IP-20 Fingersafe ring tongue terminals may be ordered with an F suffix (example: 60210F)

NOTE: UL 489 Listed Multi 9 circuit breakers are calibrated at 25°C (77°F). Please refer to the rating tables (page 80) for applications at temperatures greater than 25°C (77°F).

NOTE: The NEC requires that the continuous load applied to the circuit breaker shall not exceed 80% of the circuit breaker ampere rating.

UL 489 Listed 480Y/277 Vac C60 Circuit Breakers (AC)

The UL 489 Listed 480Y/277 Vac Multi 9 C60 miniature circuit breakers can be used in 480Y/277 Vac systems. With amperages from 0.5 A to 20 A, they are ideal for fuse replacement, yet carry the UL 489 Listing that is required for branch circuit applications. See specifications on Table 2 for dimensions, weights, and interrupting ratings.

Table 7: Specifications for UL 489 Listed 480Y/277 Vac C60 Circuit Breakers

Interruption Rating	2P and 3P 1P	480Y/277 V @ 10kA 277 Vac @ 10kA
Amperage	0.5 A through 20 A	
Construction	1P, 2P and 3P	
Magnetic Trip Curves	C-curve D-curve	7 to 10 Times Ampere Rating 10 to 14 Times Ampere Rating
UL 486E Listed 2-Barrel Lug	18–16 AWG (1–1.5 mm^2), Cu Only Stranded Wire: 14–10 AWG (2–5 mm^2), Cu Only Solid or Stranded Wire	Torque to 7 lb-in (0.68 N•m) Torque to 14 lb-in (1.6 N•m)
Ring Tongue Screw	5 mm	Torque to 18 lb-in (2 N•m)
Plug-On Auxiliary Modules With Mechanical Linkage:	MN Undervoltage Trip MX + OF Shunt Trip/Auxiliary Switch OF Auxiliary Switch SD Alarm Switch	
Mounting	35 mm DIN Rail	
See selection Table 2 for dimensions, weights, and interrupting ratings.		

Benefits

- Satisfies customer's preferences to use circuit breakers instead of fuses.
- Eliminates costs of spare fuses, blown fuse indicators, additional wiring, etc.
- Reduces concerns and uncertainty of misapplying a UL 1077 supplementary protector where a UL 489 branch circuit breaker is required.
- Facilitates one common design for UL 489, CSA and IEC applications.
- Simplifies installation with a compact, DIN-mounted circuit breaker that accepts a wide range of accessories.
- Offers alternative terminations for ring terminals or cable.

Standard Features

- Fast closing: Allows increased withstand to the high inrush currents of some loads.
- Trip-free mechanism: Contacts cannot be held in the I-ON position when the circuit breaker is tripped automatically.
- Positive indication of contact disconnect. Green mechanical indication on front face of device shows that all poles are open.
- C curve: Overcurrent protection for all application types. Magnetic release operates from 7 to 10 times ampere rating. (7 to 14 for dc)
- D curve: Overcurrent protection for loads with high inrush currents (motors, transformers). Magnetic release operates between 10 and 14 times ampere rating (no dc rating for D curve).
- Suitable for reverse feeding
- Allows locking in O-OFF position using padlock attachment.

Connections

Two versions of field wiring connectors are available:

- Two-barrel lug with binding screws for two 18–10 AWG wires.
- Crimp-type ring tongue terminal for up to 8 AWG wire

Both of these terminals provide fingersafe ingress protection per IP20 of IEC EN60529. This feature reduces the potential of incidental contact with live circuit breaker components.

Standards

- UL 489 Listed
- CSA C22.2 No. 5.1
- IEC 60947-2
- CE Marked

Catalog Numbers

Table 8: Catalog Numbers for UL 489 Listed 480Y/277 V C60 Miniature Circuit Breakers (AC)

Rating	2-Barrel Wire Lug			Ring-Tongue Terminal		
	1P	2P	3P	1P	2P	3P
C-curve, 7–10 Times Ampere Rating						
0.5 A	MGN61300	—	—	MGN61366	—	—
1 A	MGN61301	MGN61312	MGN61323	MGN61367	MGN61378	MGN61389
2 A	MGN61302	MGN61313	MGN61324	MGN61368	MGN61379	MGN61390
3 A	MGN61303	MGN61314	MGN61325	MGN61369	MGN61380	MGN61391
4 A	MGN61304	MGN61315	MGN61326	MGN61370	MGN61381	MGN61392
5 A	MGN61305	MGN61316	MGN61327	MGN61371	MGN61382	MGN61393
6 A	MGN61306	MGN61317	MGN61328	MGN61372	MGN61383	MGN61394
8 A	MGN61307	MGN61318	MGN61329	MGN61373	MGN61384	MGN61395
10 A	MGN61308	MGN61319	MGN61330	MGN61374	MGN61385	MGN61396
15 A	MGN61309	MGN61320	MGN61331	MGN61375	MGN61386	MGN61397
20 A	MGN61310	MGN61321	MGN61332	MGN61376	MGN61387	MGN61398
D-curve, 10–14 Times Ampere Rating						
0.5 A	MGN61333	—	—	MGN61399	—	—
1 A	MGN61334	MGN61345	MGN61356	MGN61400	MGN61411	MGN61422
2 A	MGN61335	MGN61346	MGN61357	MGN61401	MGN61412	MGN61423
3 A	MGN61336	MGN61347	MGN61358	MGN61402	MGN61413	MGN61424
4 A	MGN61337	MGN61348	MGN61359	MGN61403	MGN61414	MGN61425
5 A	MGN61338	MGN61349	MGN61360	MGN61404	MGN61415	MGN61426
6 A	MGN61339	MGN61350	MGN61361	MGN61405	MGN61416	MGN61427
8 A	MGN61340	MGN61351	MGN61362	MGN61406	MGN61417	MGN61428
10 A	MGN61341	MGN61352	MGN61363	MGN61407	MGN61418	MGN61429
15 A	MGN61342	MGN61353	MGN61364	MGN61408	MGN61419	MGN61430
20 A	MGN61343	MGN61354	MGN61365	MGN61409	MGN61420	MGN61431

LC1D09

LC1D093

LC1D115

LC1DT20

3-Pole Contactors with AC and DC Operating Coils

Maximum Horsepower Ratings						Maximum Current		Auxiliary Contacts Built In		Catalog Number ▲■	AC Control Price	DC Control Price
Single Phase		Three Phase				Inductive AC3 Amperes	Resistive AC1 Amperes	N.O.	N.C.			
115 V hp	230 V hp	200 V hp	230 V hp	460 V hp	575 V hp							
0.5	1	2	2	5	7.5	9	20	1	1	LC1D09	$ 94.	$119.
1	2	3	3	7.5	10	12	25	1	1	LC1D12	119.	149.
1	3	5	5	10	15	18	32	1	1	LC1D18	136.	160.
2	3 5	7.5 10	7.5 10	15 20	20 30	25 32	40 50	1 1	1 1	LC1D25 LC1D32	151. 172.	181. 213.
3	5 7.5	10 15	10 15	30 40	30 40	40 50	60 70	1 1	1 1	LC1D40 LC1D50	218. 234.	275. 291.
5	10	20	20	50	50	65	80	1	1	LC1D65	322.	379.
7.5	15	30	30	60	60	80	110	1	1	LC1D80	363.	420.
. . .	. . .	30	40	75	100	115	175	1	1	LC1D115	479.	479.
. . .	. . .	40	50	100	125	150	200	1	1	LC1D150	696.	696.

4-pole Contactors with AC and DC Operating Coils

Maximum Current Utilization Categories	Number of Poles		Instantaneous Auxiliary Contacts		Catalog Number ▲■	AC Control Price	DC Control Price
AC-1	N.O.	N.C.	N.O.	N.C.			
20	4	0	1	1	LC1DT20	$ 94.	$119.
	2	2	1	1	LC1D098	94.	119.
25	4	0	1	1	LC1DT25	119.	149.
	2	2	1	1	LC1D128	119.	149.
32	4	0	1	1	LC1DT32	149.	183.
	2	2	1	1	LC1D188	149.	183.
40	4	0	1	1	LC1DT40	193.	240.
	2	2	1	1	LC1D258	193.	240.
60	4	0	1	1	LC1D40004	296.	. . .
	4	0	1	1	LP1D40004	. . .	353.
	2	2	1	1	LC1D40008	296.	. . .
	2	2	1	1	LP1D40008	. . .	353.
80	4	0	0	0	LC1D65004	446.	. . .
	4	0	0	0	LP1D65004	. . .	503.
	2	2	0	0	LC1D65008	446.	. . .
	2	2	0	0	LP1D65008	. . .	503.
125	4	0	0	0	LC1D80004	489.	. . .
	4	0	0	0	LP1D80004	. . .	524.
	2	2	0	0	LC1D80008	489.	. . .
	2	2	0	0	LP1D80008	. . .	524.
200	4	0	0	0	LC1D115004	630.	630.

▲ Use voltage codes from the "Voltage Codes" table below to complete the catalog number.
■ Contactor supplied with touch safe cable clamps. For ring terminal configuration on LC.D09–D32 and LC.DT20–DT40 contactors only, add "6" before coil voltage suffix. For spring terminal configuration add "3" before coil voltage suffix. No price adder for these modifications.

Voltage Codes (D-Line Only)▾

Contactor	Hz	24 V	48 V	110 V	120 V	125 V	208 V	220 V	240 V	250 V	440 V	480 V	600 V
AC													
LC1D40–LC1D150 only (see notes)	50	B5	E5	F5	. . .	. . .	. . .	M5★	U5	. . .	. . .	. . .	. . .
	60	B6	E6	F6	G6	. . .	L6	M6	U6	. . .	. . .	T6	X6♦
All (see notes)	50/60	B7	E7	F7	G7	. . .	LE7	M7	U7	. . .	. . .	T7★	X7★
DC (D09–D32, D115 and D150 coils with integral suppression device are fitted as standard)													
D09–D32 Low Consumption	. . .	BL	EL	FL	. . .	. . .	. . .	ML	. . .	UL	. . .	. . .	. . .
All	. . .	BD	ED	FD	. . .	GD	. . .	MD	. . .	UD	RD	. . .	. . .

♦ Not available for LC1D115 and LC1D150.
★ Not available for LC1D40–LC1D150.
▼ Other voltages available. See page 16-17.

Dimensions . . . . . pages 16-24–16-32
Overload Relays . . . . . pages 16-19–16-20
Accessories . . . . . pages 16-6–16-13
Replacement Coils . . . . . pages 16-15–16-18

For additional information on D-Line contactors, reference Catalog #8502CT9901R5/03.

LRD22

Ambient Compensated bi-metallic overload relays

LRD overload relays are designed for direct mounting to D-line contactors. To mount these overloads separately, select separate mount kits from the table below.

D-Line overload relays

Current Setting Range Amperes	For direct mounting to LC1●●●	Class 10 with Single Phase Sensitivity	Class 10 without Single Phase Sensitivity	Class 20 with Single Phase Sensitivity	Class 20 without Single Phase Sensitivity	Price
.10–.16	D09–D32	LRD01	LR3D01	. . .	. . .	
.16–.25	D09–D32	LRD02	LR3D02	. . .	. . .	
.25–.40	D09–D32	LRD03	LR3D03	. . .	. . .	
.40–.63	D09–D32	LRD04	LR3D04	. . .	. . .	
.63–1	D09–D32	LRD05	LR3D05	. . .	. . .	$ 60.00
1–1.6	D09–D32	LRD06	LR3D06	. . .	. . .	
1.6–2.5	D09–D32	LRD07	LR3D07	. . .	. . .	
2.5–4	D09–D32	LRD08	LR3D08	LRD1508	LR3D1508A1	
4–6	D09–D32	LRD10	LR3D10	LRD1510	LR3D1510A1	
5.5–8	D09–D32	LRD12	LR3D12	LRD1512	LR3D1512A1	
7–10	D09–D32	LRD14	LR3D14	LRD1514	LR3D1514A1	
9–13	D12–D32	LRD16	LR3D16	LRD1516	LR3D1516A1	
12–18	D18–D32	LRD21	LR3D21	LRD1521	LR3D1521A1	62.00
16–24	D25–D32	LRD22	LR3D22	. . .	. . .	
17–25	D25–D32	. . .	. . .	LRD1522	LR3D1522A1	
23–32	D25–D32	LRD32	LR3D32	. . .	. . .	
23–28	D25–D32	. . .	. . .	LRD1530	LR3D1530A1	
25–32	D25–D32	. . .	. . .	LRD1532	LR3D1532A1	73.00
30–38	D32	LRD35	LR3D35	. . .	. . .	
17–25	D40–D80	LRD3322	LR3D3322	LR2D3522	LR3D3522	
23–32	D40–D80	LRD3353	LR3D3353	LR2D3553	LR3D3553	
30–40	D40–D80	LRD3355	LR3D3355	LR2D3555	LR3D3555	107.00
37–50	D50–D80	LRD3357	LR3D3357	LR2D3557	LR3D3557	
48–65	D50–D80	LRD3359	LR3D3359	LR2D3559	LR3D3559	
55–70	D65–D80	LRD3361	LR3D3361	LR2D3561	LR3D3561	
63–80	D65–D80	LRD3363	LR3D3363	LR2D3563	LR3D3563	127.00
80–104	D80	LRD3365	. . .	. . .	. . .	
80–104	D115–D150	LRD4365	. . .	. . .	. . .	
95–120	D115–D150	LRD4367	. . .	. . .	. . .	362.00
110–140	D150	LRD4369	. . .	. . .	. . .	

Mounting Kits and Plates

Description	For use with overload relays:	Catalog Number	Price
Separate mounting kits for mounting to 35 mm omega rail or for panel mounting with screws	LRD01–35 and LR3D01–35	LAD7B10	$ 8.70
	LRD15●●	LAD7B105	10.40
	LR2D15●●	LA7D1064	8.70
	LR2D25●●	LA7D2064	13.10
	LRD3●●●, LR3D3●●●, LR2D35●●	LA7D3064	17.50
Mounting plates for screw mounting at 110 mm (4.3") centers	LRD01–35, LR3D01–35, LR2D15●●	DX1AP25	11.00
	LR2D25●●	DX1AP26	12.00
	LRD3●●●, LR3D3●●●, LR2D35●●	LA7D902	16.40

LA7D901

Accessories

Description	For use with	Standard Packaging	Catalog Number	Price
Pre wiring kit allows direct connection of the N.C. contact of relay LRD01–D32 or LR3D01–D32 to the contactor	LC1D09 through D18	10	LAD7C1	$ 8.70
	LC1D25, D32	10	LAD7C2	8.70
Stop button locking device	All relays except LRD01–D32, LR3D01–D32 and LR9D	10	LA7D901	2.20
Remote stop/tripping or electrical reset♦	LRD01–D32, LR3D01–32	1	LAD703■	43.70
	All relays except LRD01–D32, LR3D01–D31	1	LA7D03■	43.70
Reset by flexible cable 500 mm (19.6 in.)	LRD01–D32	1	LAD7305	100.00

■ Part number to be completed by adding coil voltage code.

LA7D03

Control Circuit Voltages for LA7D03 and LAD703

Volts	12	24	48	110	220/230	380/400	415/440
AC 50/60 Hz	J★	B	E	F	M	Q	N
DC	J	B	E	F	M	. . .	. . .

♦ The time that the LA7D03 can remain energized depends on its rest time; 1 s pulse wth 9 s rest time; 5 s pulse with 30 s rest time; 10 s pulse with 90 s rest time; maximum pulse duration of 20 s with rest time of 300 s. Consumption on inrush and sealed : < 100 VA
★ Not available for LRD01-D32, LR3D01-D32.

Dimensions . . . . . page 16-30

For additional information, reference Catalog #8502CT9901R5/03.

The Type T units are designed for the global market and are the best choice when size and cost are of concern. This is our most popular and complete offering of industrial control transformers, and includes the following features:

- 50/60 Hz rated
  Customer installed accessories (finger-safe covers, fuse blocks, fuse clips)
- Type T transformers are designed with the various temperature classes:
  50–150 VA with a 55° C temperature rise, 105° C insulation
  200–350 VA with a 80° C temperature rise, 130° C insulation
  500–5000 VA with a 115° C temperature rise, 180° C insulation

Square D manufactures a wide variety of voltage combinations for control transformers. The voltage combinations are expressed as "Voltage Codes" and these codes are embedded within the catalog number of the transformer. Standard codes are listed, if the voltage combination you require is not listed, call your Square D Distributor for assistance.

Key to Price Column Headings

Voltage Code
Primary Voltages
Secondary Voltages
Key for Dimensions & Accessory

Type T

UL/CSA/ NOM VA	CE VA	Type	D1 240 x 480 120 I	D31 240 x 480 120/240 I	D5 600 120 I	D37 600 120/240 I	D24 120 120 I	D55 120 x 240 120/240 I	D3 208 120 I	D4 277 120 I	D51 208/277 120 I	D60 277 120/240 I
25	25	T25	$ 34.70	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
50	50	T50	36.50	$ 59.00	$ 42.40	$147.00	$147.00	$147.00	$ 42.40	$ 42.40	$147.00	$147.00
75	75	T75	43.30	62.00	51.00	153.00	153.00	153.00	51.00	51.00	153.00	153.00
100	100	T100	48.50	65.00	57.00	154.00	154.00	154.00	57.00	57.00	154.00	154.00
150	150	T150	52.00	86.00	72.00	164.00	164.00	164.00	72.00	72.00	164.00	164.00
200	200	T200	64.00	111.00	92.00	224.00	224.00	224.00	92.00	92.00	224.00	224.00
250	160	T250	75.00	117.00	114.00	225.00	225.00	225.00	114.00	114.00	225.00	225.00
300	200	T300	83.00	137.00	117.00	227.00	227.00	227.00	117.00	117.00	227.00	227.00
350	250	T350	88.00	143.00	136.00	228.00	228.00	228.00	136.00	136.00	228.00	228.00
500	300	T500	110.00	160.00	148.00	235.00	235.00	235.00	148.00	148.00	235.00	235.00
750	500	T750	152.00	223.00	209.00	264.00	264.00	264.00	209.00	209.00	264.00	264.00
1000	630	T1000	184.00	263.00	263.00	280.00	280.00	280.00	263.00	263.00	280.00	280.00
1500	1000	T1500	263.00	385.00	368.00	404.00	404.00	404.00	368.00	368.00	404.00	404.00
2000	1500	T2000	320.00	427.00	427.00	438.00	438.00	438.00	427.00	427.00	438.00	438.00
3000	2000	T3000	444.00	701.00	602.00	749.00	749.00	749.00	602.00	602.00	749.00	749.00
5000	3000	T5000	746.00	948.00	948.00	948.00	948.00	948.00	948.00	948.00	948.00	948.00

Type T

UL/CSA/ NOM VA	CE VA	Type	D2 240 x 480 24 I	D59 240 x 480 12/24 I	D13 120 12/24 I	D23 120/240 24 I	D54 120/240 12/24 I	D14 208 24 I	D25 277 24 I	D36 600 12/24 I
50	50	T50	$ 42.40	$147.00	$ 42.40	$ 42.40	$147.00	$ 42.40	$147.00	$147.00
75	75	T75	51.00	153.00	51.00	51.00	153.00	51.00	153.00	153.00
100	100	T100	57.00	154.00	57.00	57.00	154.00	57.00	154.00	154.00
150	150	T150	72.00	164.00	72.00	72.00	164.00	72.00	164.00	164.00
200	200	T200	92.00	224.00	92.00	92.00	224.00	92.00	224.00	224.00
250	160	T250	114.00	225.00	114.00	114.00	225.00	114.00	225.00	225.00
300	200	T300	117.00	227.00	117.00	117.00	227.00	117.00	227.00	227.00
350	250	T350	136.00	228.00	136.00	136.00	228.00	136.00	228.00	228.00
500	300	T500	148.00	235.00	148.00	148.00	235.00	148.00	235.00	235.00
750	500	T750▲	209.00	264.00	209.00	209.00	264.00	209.00	264.00	264.00
1000	630	T1000▲	263.00	280.00	263.00	263.00	280.00	263.00	280.00	280.00

Type T

UL/CSA/NOM VA	CE VA	Type	D15 240 x 480 24/120 I	D12 480 240 I	D22 480 277 I	D62 600 240 I
50	50	T50	$ 42.40	$ 42.40	$147.00	$147.00
75	75	T75	51.00	153.00	153.00	153.00
100	100	T100	65.00	57.00	154.00	154.00
150	150	T150	72.00	72.00	164.00	164.00
200	200	T200	92.00	92.00	224.00	224.00
250	160	T250	117.00	114.00	225.00	225.00
300	200	T300	137.00	117.00	227.00	227.00
350	250	T350	143.00	136.00	228.00	228.00
500	300	T500	160.00	148.00	235.00	235.00
750	500	T750	223.00	209.00	264.00	264.00
1000	630	T1000	263.00	263.00	280.00	280.00
1500	1000	T1500	385.00	368.00	404.00	404.00
2000	1500	T2000	427.00	427.00	438.00	438.00
3000	2000	T3000	701.00	602.00	749.00	749.00
5000	3000	T5000	948.00	948.00	948.00	948.00

Listing	File	Type
UL	E61239	T25–T1000
CSA	LR37055, Guide 184-N-90, C22.2	T25–T1000
cULus	E61239	T1500–T5000
EN (CE)	947923, EN-61558-1 (TUV ref: 00941-RAG/sg E9371495E01)	T25–T200
	9579078, EN-61558-1 (TUV ref: 00941-RAG/sg E9471921.02E01)	T250–T1000
	9579078, EN-61558-1 (TUV ref: 00941-RAG/sg E9471921.02E01)	T1500–T5000

▲ See Control Transformer Catalog: 9070CT9901 for dimensions different than Digest.

XB4BT845

XB4BS9445

XB4BS542

Non-Illuminated Emergency Stop Mushroom Head Push Buttons, Ø 40 mm (Red) (screw clamp terminal connections)

Shape of Head	Type of Push	Type of Contact N.O.	Type of Contact N.C.			Catalog Number (Components)	Price
	Trigger action push-pull▲	1	1			XB4BT845 (ZB4BZ105 + ZB4BT84)	**$46.00**
	Trigger action turn-to-release▲	1	1			XB4BS8445 (ZB4BZ105 + ZB4BS844)	**75.00**
	Trigger action Key release ▲ (No. 455)	1	1			XB4BS9445 (ZB4BZ105 + ZB4BS944)	**75.00**
	Push-pull	. . .	1			XB4BT42 (ZB4BZ102 + ZB4BT4)	**31.20**
	Turn-to-release	. . .	1			XB4BS542 (ZB4BZ102 + ZB4BS54)	**50.00**
	Key release (No. 455)	. . .	1			XB4BS142 (ZB4BZ102 + ZB4BS14)	**67.00**

▲ Trigger action mushroom heads are tamper proof in that a change of contact state is not possible by teasing or floating the operator.

XB4BD33

XB4BJ33

XB4BG33

Non-Illuminated Selector Switches and Key Switches (screw clamp terminal connections)

Shape of Head	Type of Operator	Type of Contact N.O.	Type of Contact N.C.	Number and Type of Positions		Catalog Number (Components)	Price
	Standard lever, black	1	. . .	2-maintained		XB4BD21 (ZB4BZ101 + ZB4BD2)	**$23.00**
		1	1	2-maintained		XB4BD25 (ZB4BZ105 + ZB4BD2)	**31.10**
		2	. . .	3-maintained		XB4BD33 (ZB4BZ103 + ZB4BD3)	**31.10**
				3-momentary to center		XB4BD53 (ZB4BZ103 + ZB4BD5)	**33.80**
	Extended lever, black	1	. . .	2-maintained		XB4BJ21 (ZB4BZ101 + ZB4BJ2)	**23.00**
		2	. . .	3-maintained		XB4BJ33 (ZB4BZ103 + ZB4BJ3)	**31.10**
				3-momentary to center		XB4BJ53 (ZB4BZ103 + ZB4BJ5)	**33.80**
	Key (No. 455)	1	. . .	2-maintained		XB4BG21 (ZB4BZ101 + ZB4BG2)	**55.80**
						XB4BG41 (ZB4BZ101 + ZB4BG4)	**55.80**
				2-momentary to left		XB4BG61 (ZB4BZ101 + ZB4BG6)	**55.80**
		2	. . .	3-maintained		XB4BG03 (ZB4BZ103 + ZB4BG0)	**63.90**
						XB4BG33 (ZB4BZ103 + ZB4BG3)	**63.90**

The symbol ⚷ indicates key withdrawal position(s)

For additional information, reference Catalog #9001CT0301.


XB4BA31


XB4BA4322


XB4BP51


XB4BL42


XB4BC21


XB4BL845

Non-Illuminated Push Buttons, Momentary (screw clamp terminal connections)

Shape of Head	Type of Push	Type of Contact N.O.	Type of Contact N.C.	Marking	Color of Cap	Catalog Number (Components)	Price
	Flush	1	. . .	. . .	Black	XB4BA21 (ZB4BZ101 + ZB4BA2)	$17.50
					Green	XB4BA31 (ZB4BZ101 + ZB4BA3)	
					Yellow	XB4BA51 (ZB4BZ101 + ZB4BA5)	
					Blue	XB4BA61 (ZB4BZ101 + ZB4BA6)	
		. . .	1	. . .	Red	XB4BA42 (ZB4BZ102 + ZB4BA4)	17.50
		1	1	. . .	Black	XB4BA25 (ZB4BZ105 + ZB4BA2)	25.60
					Green	XB4BA35 (ZB4BZ105 + ZB4BA3)	
					Red	XB4BA45 (ZB4BZ105 + ZB4BA4)	
					Yellow	XB4BA55 (ZB4BZ105 + ZB4BA5)	
					Blue	XB4BA65 (ZB4BZ105 + ZB4BA6)	
	Flush	1	. . .	"I" (white)	Green	XB4BA3311 (ZB4BZ101 + ZB4BA331)	20.30
	Flush	. . .	1	"O" (white)	Red	XB4BA4322 (ZB4BZ102 + ZB4BA432)	20.30
	Flush with clear silicone boot (color of pusher unobscured)	1	. . .	. . .	Black	XB4BP21 (ZB4BZ101 + ZB4BP2)	23.90
					Green	XB4BP31 (ZB4BZ101 + ZB4BP3)	
					Yellow	XB4BP51 (ZB4BZ101 + ZB4BP5)	
					Blue	XB4BP61 (ZB4BZ101 + ZB4BP6)	
		. . .	1	. . .	Red	XB4BP42 (ZB4BZ102 + ZB4BP4)	23.90
	Extended	. . .	1	. . .	Red	XB4BL42 (ZB4BZ102 + ZB4BL4)	17.50
		1	1	. . .	Red	XB4BL45 (ZB4BZ105 + ZB4BL4)	25.60
	Mushroom head Ø 40 mm	1	. . .	. . .	Black	XB4BC21 (ZB4BZ101 + ZB4BC2)	25.70

Two Button Push Buttons, Momentary (screw clamp terminal connections)

Shape of Head	Type of Push	Type of Contact N.O.	Type of Contact N.C.	Degree of Protection	Catalog Number (Components)	Price
	One flush green push (marked "I") One extended red push (marked "O")	1	1	IP40	XB4BL845 (ZB4BZ105 + ZB4BL8434)	$31.50

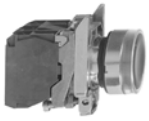
For additional information, reference Catalog #9001CT0301.

XB4BVB5

XB4BV64

XB4BV33

XB4BW33B5



XB4BW3465

XB4BW3545

Pilot Lights with PROTECTED LED® (screw clamp terminal connections)

Shape of Head	Supply Voltage	Color	Catalog Number (Components)	Price
	24 Vac/dc	White	XB4BVB1 (ZB4BVB1 + ZB4BV013)	**$32.40**
		Green	XB4BVB3 (ZB4BVB3 + ZB4BV033)	
		Red	XB4BVB4 (ZB4BVB4 + ZB4BV043)	
		Yellow	XB4BVB5 (ZB4BVB5 + ZB4BV053)	
		Blue	XB4BVB6 (ZB4BVB6 + ZB4BV063)	
	110–120 Vac	White	XB4BVG1 (ZB4BVG1 + ZB4BV013)	**32.40**
		Green	XB4BVG3 (ZB4BVG3 + ZB4BV033)	
		Red	XB4BVG4 (ZB4BVG4 + ZB4BV043)	
		Yellow	XB4BVG5 (ZB4BVG5 + ZB4BV053)	
		Blue	XB4BVG6 (ZB4BVG6 + ZB4BV063)	

Pilot Lights for BA9s Bulb (screw clamp terminal connections)

Shape of Head	Supply Voltage	Color	Catalog Number (Components)	Price
Direct supply, for BA9s (incandescent, LED, neon) V ≤ 250 V, 2.4 W bulb (bulb not included)				
	≤ 250 Vac/dc	White	XB4BV61 (ZB4BV6 + ZB4BV01)	**$23.10**
		Green	XB4BV63 (ZB4BV6 + ZB4BV03)	
		Red	XB4BV64 (ZB4BV6 + ZB4BV04)	
		Yellow	XB4BV65 (ZB4BV6 + ZB4BV05)	
Transformer type with 1.2 VA, 6 V secondary. BA9s incandescent bulb included				
	110–120 Vac 50/60 Hz	White	XB4BV31 (ZB4BV3 + ZB4BV01)	**53.00**
		Green	XB4BV33 (ZB4BV3 + ZB4BV03)	
		Red	XB4BV34 (ZB4BV3 + ZB4BV04)	
		Yellow	XB4BV35 (ZB4BV3 + ZB4BV05)	

Illuminated Push Buttons, Momentary (screw clamp terminal connections)

Shape of Head	Description	Type of Contact N.O.	Type of Contact N.C.	Supply Voltage	Color of Push	Catalog Number (Components)	Price
Flush							
	Protected LED	1	1	24 Vac/dc	White	XB4BW31B5 (ZB4BW0B15 + ZB4BW313)	**$54.00**
					Green	XB4BW33B5 (ZB4BW0B35 + ZB4BW333)	
					Red	XB4BW34B5 (ZB4BW0B45 + ZB4BW343)	
					Yellow	XB4BW35B5 (ZB4BW0B55 + ZB4BW353)	
					Blue	XB4BW36B5 (ZB4BW0B65 + ZB4BW363)	
				110–120 Vac	White	XB4BW31G5 (ZB4BW0G15 + ZB4BW313)	**54.00**
					Green	XB4BW33G5 (ZB4BW0G35 + ZB4BW333)	
					Red	XB4BW34G5 (ZB4BW0G45 + ZB4BW343)	
					Yellow	XB4BW35G5 (ZB4BW0G55 + ZB4BW353)	
					Blue	XB4BW36G5 (ZB4BW0G65 + ZB4BW363)	
	Direct supply for BA9s 2.4 W max. bulb not included	1	1	≤ 250 Vac/dc	White	XB4BW3165 (ZB4BW065 + ZB4BW31)	**44.90**
					Green	XB4BW3365 (ZB4BW065 + ZB4BW33)	
					Red	XB4BW3465 (ZB4BW065 + ZB4BW34)	
					Yellow	XB4BW3565 (ZB4BW065 + ZB4BW35)	
	Transformer type 1.2 VA, 6 V secondary. BA9s incandescent bulb included	1	1	110–120 Vac 50/60 Hz	White	XB4BW3135 (ZB4BW035 + ZB4BW31)	**74.00**
					Green	XB4BW3335 (ZB4BW035 + ZB4BW33)	
					Red	XB4BW3435 (ZB4BW035 + ZB4BW34)	
					Yellow	XB4BW3535 (ZB4BW035 + ZB4BW35)	
				230–240 Vac 50/60 Hz	White	XB4BW3145 (ZB4BW045 + ZB4BW31)	**74.00**
					Green	XB4BW3345 (ZB4BW045 + ZB4BW33)	
					Red	XB4BW3445 (ZB4BW045 + ZB4BW34)	
					Yellow	XB4BW3545 (ZB4BW045 + ZB4BW35)	
Extended							
	Protected LED	1	1	24 Vac/dc	White	XB4BW11B5 (ZB4BW0B15 + ZB4BW113)	**51.40**
					Green	XB4BW13B5 (ZB4BW0B35 + ZB4BW133)	
					Red	XB4BW14B5 (ZB4BW0B45 + ZB4BW143)	
					Yellow	XB4BW15B5 (ZB4BW0B55 + ZB4BW153)	
					Blue	XB4BW16B5 (ZB4BW0B65 + ZB4BW163)	
				110–120 Vac	White	XB4BW11G5 (ZB4BW0G15 + ZB4BW113)	**51.40**
					Green	XB4BW13G5 (ZB4BW0G35 + ZB4BW133)	
					Red	XB4BW14G5 (ZB4BW0G45 + ZB4BW143)	
					Yellow	XB4BW15G5 (ZB4BW0G55 + ZB4BW153)	
					Blue	XB4BW16G5 (ZB4BW0G65 + ZB4BW163)	

For additional information, reference Catalog #9001CT0001.

XB4BV85

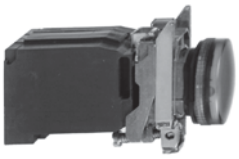
Pilot Lights with Protected LED (screw clamp terminal connections)

Shape of Head	Supply Voltage	Color	Catalog Number
 	24 Vac/Vdc	White	**XB4BVB1** (ZB4BVB1 + ZB4BV013)
		Green	**XB4BVB3** (ZB4BVB3 + ZB4BV033)
		Red	**XB4BVB4** (ZB4BVB4 + ZB4BV043)
		Yellow	**XB4BVB5** (ZB4BVB5 + ZB4BV053)
		Blue	**XB4BVB6** (ZB4BVB6 + ZB4BV063)
	110-120 Vac	White	**XB4BVG1** (ZB4BVG1 + ZB4BV013)
		Green	**XB4BVG3** (ZB4BVG3 + ZB4BV033)
		Red	**XB4BVG4** (ZB4BVG4 + ZB4BV043)
		Yellow	**XB4BVG5** (ZB4BVG5 + ZB4BV053)
		Blue	**XB4BVG6** (ZB4BVG6 + ZB4BV063)

XB4BV64

Pilot lights for BA 9s Bulb (screw clamp terminal connections)

Shape of Head	Supply Voltage	Color	Catalog Number
Direct supply, for BA 9s (incandescent, LED, neon) V ≤ 250 V, 2.4 W bulb (bulb not included)			
	≤ 250 Vac/Vdc	White	**XB4BV61** (ZB4BV6 + ZB4BV01)
		Green	**XB4BV63** (ZB4BV6 + ZB4BV03)
		Red	**XB4BV64** (ZB4BV6 + ZB4BV04)
		Yellow	**XB4BV65** (ZB4BV6 + ZB4BV05)
Transformer type with 1.2 VA, 6 V secondary. BA 9s incandescent bulb included			
	110-120 Vac 50/60 Hz	White	**XB4BV31** (ZB4BV3 + ZB4BV01)
		Green	**XB4BV33** (ZB4BV3 + ZB4BV03)
		Red	**XB4BV34** (ZB4BV3 + ZB4BV04)
		Yellow	**XB4BV35** (ZB4BV3 + ZB4BV05)

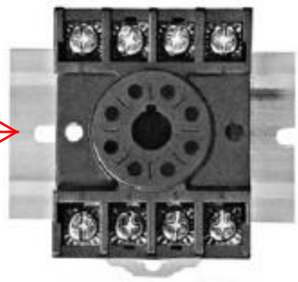


XB4BV33

OT SERIES

RELAY SOCKETS

socketTRAC™



CUSTOM CONNECTOR

DESCRIPTION	8 and 11 Pin Octal Sockets, DIN Rail Mountable
ELECTRICAL RATING	• OT08, OT08-PC - 600 Volts, 10 Amps *****NEW UPGRADED RATING - OT08-PC**** • OT11, OT11-PC - 300 Volts, 10 Amps
CONSTRUCTION	**Contacts** • Brass, Nickel Plated **Screws** • Binder Head, 6 - 32 x 1/4" Steel, Zinc Plated • Pressure Clamp, 6 - 32 x 5/16" Steel, Zinc Plated, Wire Range #12 - #22 Solid or Stranded **Molding** • Break Resistant Thermoplastic Black Standard, Grey Available
AGENCY APPROVALS	• UL recognized, File No. E60008 • CSA certified, File No. LR29513 • CE

ORDERING CODE

PART NO.	DESCRIPTION	TERMINAL TYPE
OT08	DPDT, 8 Pin Octal (Fig. 1)	Binder Head Screws
OT08-PC	DPDT, 8 Pin Octal (Fig. 1)	Pressure Clamp Screws
OT11	3PDT, 11 Pin Octal Style (Fig. 2)	Binder Head Screws
OT11-PC	3PDT, 11 Pin Octal Style (Fig. 2)	Pressure Clamp Screws

ACCESSORIES

PART NO.	DESCRIPTION (Refer to the accessories pages 25-27)
C-103-PM	Prepunched Aluminum DIN Rail (1 Meter Lengths)
C-104-PM	Prepunched Steel DIN Rail (1 Meter Lengths)
C-105-PM	Prepunched Steel DIN Rail (1 Meter Lengths)
C-106-2PM	Prepunched Steel DIN Rail (2 Meter Lengths)
C-108-PM	Prepunched Raised Aluminum DIN Rail (1 Meter Lengths)
C-108-2PM	Prepunched Raised Aluminum DIN Rail (2 Meter Lengths)

Fig. 1

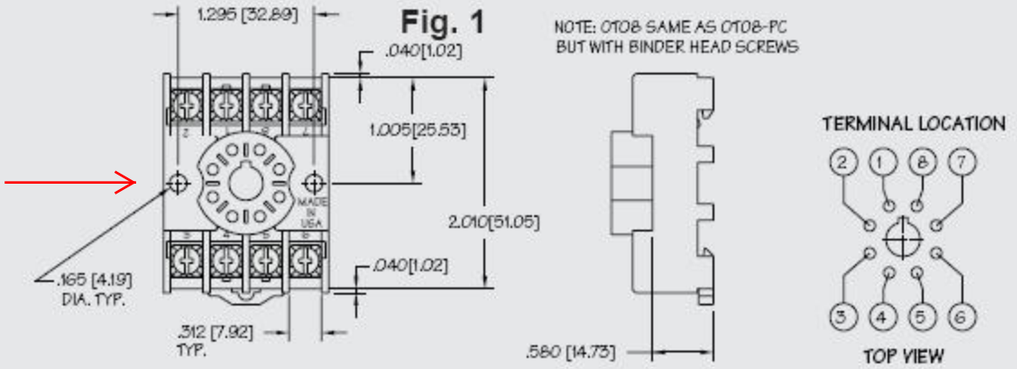
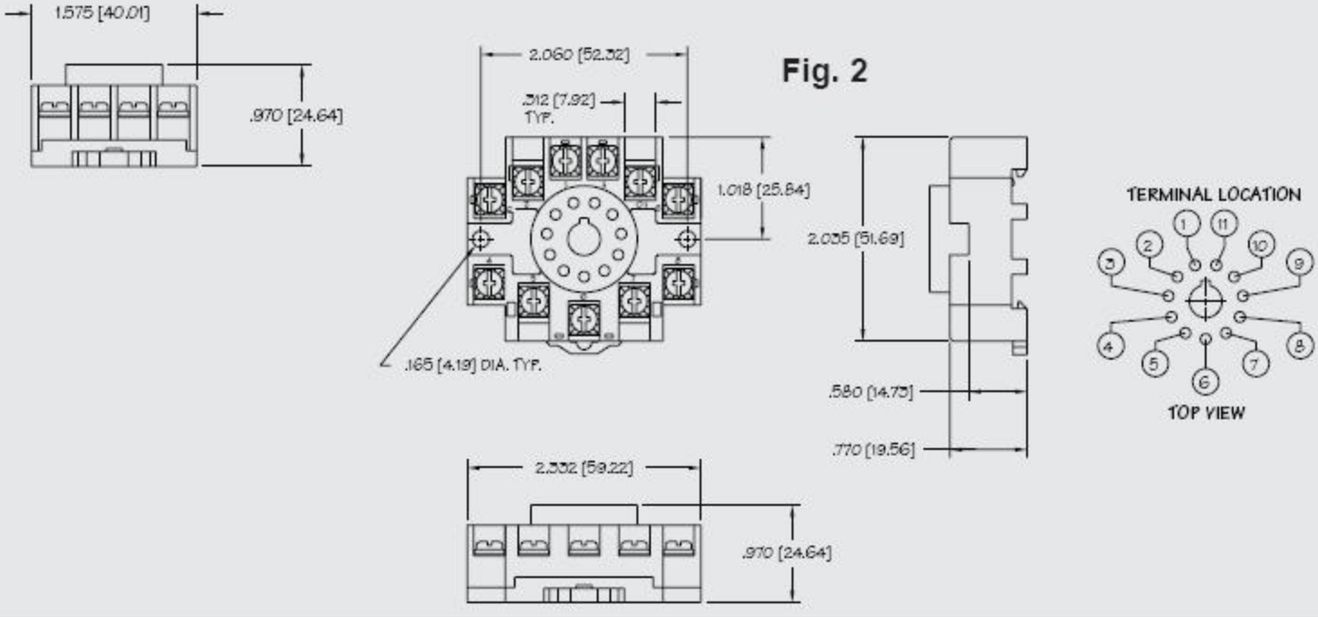


Fig. 2



Custom Connector Corporation • 1738 E. 30th, Cleveland, OH 44114 • 216/241-1679 • Fax 216/241-5529
E-mail: sales@customconnector.com • Web: www.customconnector.com

Table 23.22: Miniature relays (sold in lots of 100)

	Number and type of contacts - Thermal current (Ith)			
	2 C/O - 12 A Res.		4 C/O - 6 A Res.	
Coil Voltage	**Catalog Number**	**$ Price ea.**	**Catalog Number**	**$ Price ea.**
Without LED				
12 Vdc	—	—	RXM4AB1JDTQ	**4.70**
24 Vdc	RXM2AB1BDTQ	**4.20**	RXM4AB1BDTQ	**4.70**
48 Vdc	—	—	RXM4AB1EDTQ	**4.70**
110 Vdc	—	—	RXM4AB1FDTQ	**4.70**
220 Vdc	—	—	RXM4AB1MDTQ	**5.00**
24 Vac	RXM2AB1B7TQ	**4.20**	RXM4AB1B7TQ	**4.70**
48 Vac	—	—	RXM4AB1E7TQ	**4.70**
120 Vac	RXM2AB1F7TQ	**4.20**	RXM4AB1F7TQ	**4.70**
230 Vac	RXM2AB1P7TQ	**4.20**	RXM4AB1P7TQ	**4.70**
With LED				
24 Vdc	—	—	RXM4AB2BDTQ	**5.40**
24 Vac	RXM2AB2B7TQ	**4.90**	RXM4AB2B7TQ	**5.40**
230 Vac	RXM2AB2P7TQ	**4.90**	RXM4AB2P7TQ	**5.40**

RXZE2M114M with Relay RXM4AB2P7TQ

Table 23.23: Sockets (sold in lots of 10)

Contact terminal arrangement	Connection	Relay type	Catalog Number	$ Price ea.
Mixed	Screw clamp terminals	RXM2●●●●●▲ RXM4●●●●●▲	RXZE2M114■	**3.90**
	Box lug connector	RXM2●●●●● RXM4●●●●●	RXZE2M114M■	**3.90**
Separate	Box lug connector	RXM2●●●●●	RXZE2S108M♦	**3.90**
		RXM3●●●●●	RXZE2S111M■	**3.90**
		RXM4●●●●●	RXZE2S114M■	**3.90**

▲ When mounting relay RXM2●●●●● on socket RXZE2M●●●●, the thermal current must not exceed 10 A.
■ Thermal current Ith: 10 A
♦ Thermal current Ith: 12 A

RXZE2S114M with relay RXM4AB2F7TQ

Table 23.24: Protection modules (sold in lots of 20)

Description	Voltage	For use with	Catalog Number	$ Price ea.
Diode	6–250 Vdc	All sockets	RXM040W	**1.50**
RC circuit	24–60 Vac	All sockets	RXM041BN7	**1.50**
	110–240 Vac	All sockets	RXM041FU7	**1.70**
Varistor	6–24 Vac/Vdc	All sockets	RXM021RB	**1.50**
	24–60 Vac/Vdc	All sockets	RXM021BN	**1.50**
	110–240 Vac/Vdc	All sockets	RXM021FP	**1.50**

Table 23.25: Accessories (sold in lots of 10)

Description	For use with	Catalog Number	$ Price ea.
Metal hold-down clip	All sockets	RXZ400	**.38**
Plastic hold-down clip	All sockets	RXZR335	**.38**
Bus jumper, 2-pole (Ith: 5 A)	All sockets with separate contacts	RXZS2	**.56**
Mounting adapter for DIN rail	All relays	RXZE2DA	**.56**
Mounting adapter for mounting directly to a panel	All relays	RXZE2FA	**.38**
Clip-in markers	All relays (sheet of 108 markers)	RXZL520	**.03**
	All sockets except RXZE2M114	RXZL420	**.03**

RXM041●●7

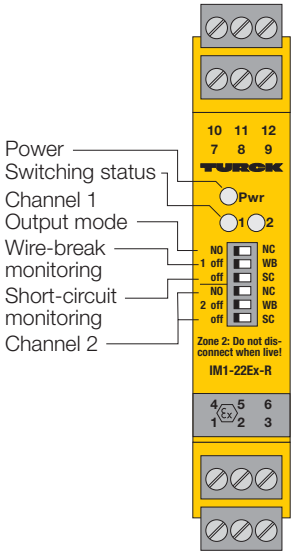
RXZ400

Approvals for Sockets:

File CCN E172326 SWIV2, SWIV8

File 230765 Class 3211 07

RoHS Compliant



Isolating Switching Amplifier IM1-22Ex-R 2-channel

- **2-channel isolating switching amplifier with removable terminal blocks**
- **Intrinsically safe input circuits EEx ia**
- **Area of application according to ATEX: II (1) GD, II 3 G**
- **Approved for installation in zone 2, however the device must be installed in a housing which complies with the requirements of EN 60079-15 with a minimum protection degree of IP54**
- **Functional safety up to SIL 2 (acc. to EN 61508)**
- **Galvanic isolation between input circuits, output circuits and supply voltage**
- **Input circuit monitoring for wire-break and short-circuit (can be disabled)**
- **2 relay outputs, each with one NO contact**
- **Selectable NO/NC output function**
- **Universal supply voltage (20...250 VAC/20...125 VDC)**

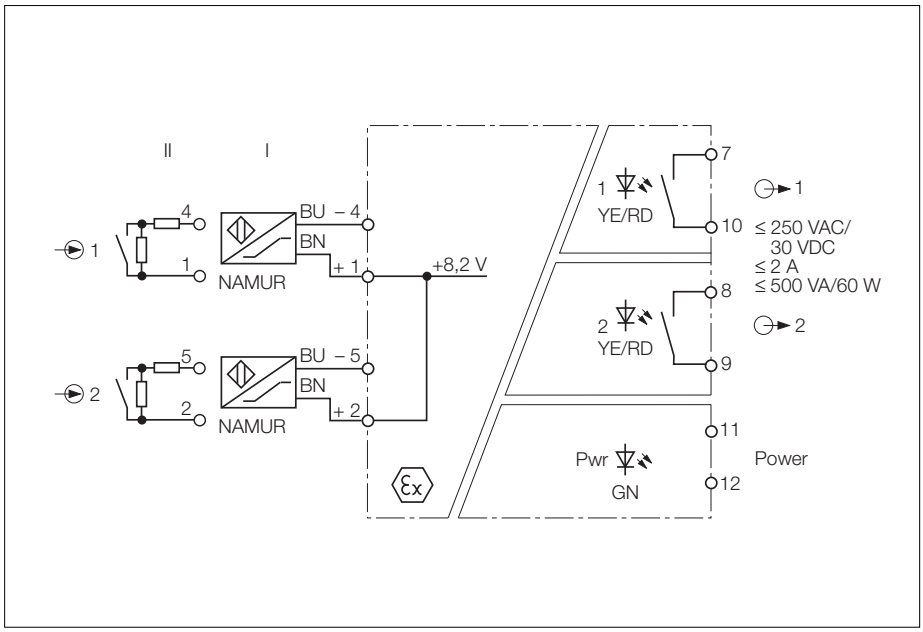
The isolating switching amplifier type IM1-22Ex-R is a dual channel device featuring intrinsically safe input circuits. It can be connected to sensors according to EN 60947-5-6 (NAMUR), variable resistors or potential-free contacts.

The output circuits feature one relay with one NO contact each.

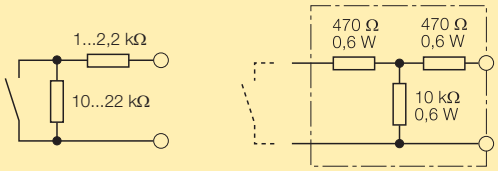
Six front panel programming switches select the output function of each channel (normally open mode = NO/or normally closed mode = NC) and enable separate activation and de-activation of wire-break (WB) and short-circuit (SC) monitoring of each channel.

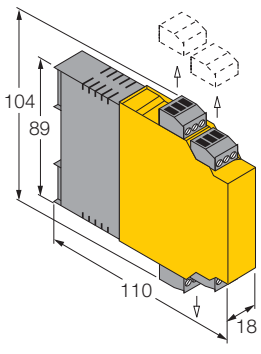
When using mechanical contacts as the input device, wire-break and short-circuit monitoring must be disabled or shunt resistors must be connected to the contacts (II). (See next page for contact configuration).

The green LED on the front cover indicates that the device is powered. The two dual colour LEDs indicate the switching status (yellow) as well as fault conditions (red). When the input circuit monitoring feature is activated, red illuminates to indicate a fault in the input circuit and the respective output relay is de-energised.



Isolating switching amplifier IM1-22Ex-R

Type	IM1-22Ex-R
Ident-no.	7541231
Supply voltage U_B	20...250 VAC/20...125 VDC
Line frequency (AC)	40...70 Hz
Power/current consumption	≤ 3 W
Galvanic isolation	between input circuit, output circuits and supply voltage for 250 V_{rms} test voltage 2.5 kV_{rms}
Input circuits	according to EN 60947-5-6 (NAMUR), intrinsically safe according to EN 50020
Operating characteristics	
– Voltage	8,2 V
– Current	8,2 mA
Switching threshold	1.55 mA
Hysteresis	typ. 0.2 mA
Wire-break threshold	≤ 0.1 mA
Short-circuit threshold	≥ 6 mA
Contact configuration Of mechanical switches with active input circuit monitoring function	 resistor module WM1, ident-no. 0912101
Output circuits	2 relay outputs with 1 NO contact each
Switching voltage	≤ 250 VAC/120 VDC
Switching current per output	≤ 2 A
Switching capacity per output	≤ 500 VA/60 W
Switching frequency	≤ 10 Hz
Contact material	silver-alloy + 3 µm Au
Ex-Approval acc. to certificate of conformity	TÜV 04 ATEX 2553 / TÜV 06 ATEX 552968 X
Maximum nominal values	
– No load voltage U_0	≤ 9.6 V
– Short-circuit current I_0	≤ 11 mA
– Power P_0	≤ 26 mW
Maximum external inductances/capacitances	
– [EEx ia] IIC	1 mH/1.1 µF / 5 mH/0.83 µF / 10 mH/0.74 µF
– [EEx ia] IIB	2 mH/5,2 µF / 10 mH/3,8 µF / 20 mH/3,4 µF
– Ex nL IIC	1 mH/1,9 µF / 5 mH/1,4 µF / 10 mH/1,2 µF
– Ex nL IIB	1 mH/11 µF / 5 mH/7,5 µF / 10 mH/6,6 µF
Marking of devices	⟨Ex⟩ II (1) GD [EEx ia] IIC II 3 G Ex nA nC [nL] IIC/IIB T4
LED indications	
– Power	green
– Switching status/Fault indication	2 x yellow/red (dual colour LED)
Terminal housing	12-pole, 18 mm wide, Polycarbonate/ABS, flammability class V-0 per UL 94
Mounting	snap-on clamps for top-hat rail (DIN 50022) or screw terminals for panel mounting
Connection	removeable terminal blocks, reverse-polarity protected, screw connection, self-lifting
Connection profile	≤ 1 x 2.5 mm^2, 2 x 1.5 mm^2 or 2 x 1.0 mm^2 with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25…+70 °C



Hans Turck GmbH & Co.KG • D–45466 Mülheim/Ruhr • Tel. 0208/4952-0 • Fax 0208/4952-264 • E-Mail: more@turck.com • www.turck.com

PHASE MONITOR RELAYS

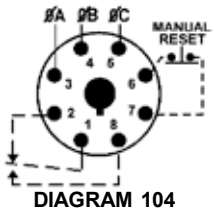
Phase Loss, Phase Reversal, Phase Unbalance, and Under/Over Voltage PMP Series Plug-in

- Universal voltage range of 208-480V on PMPU provides the flexibility to cover a variety of applications with one unit
- Protects against phase loss, phase reversal, phase unbalance, undervoltage and overvoltage
- Variety of user-selectable and adjustable settings for the ultimate in three-phase protection
- Automatic or Manual Reset
- Multi-Color LED indicates normal condition and provides fault indication to simplify troubleshooting
- Compact plug-in case utilizing industry-standard 8 pin octal socket
- 10A SPDT output contacts
- c UL us CE UL LISTED (with appropriate socket)

The PMP Series Phase Monitor Relays utilize a microprocessor-based design to provide protection against phase loss, phase reversal, phase unbalance, undervoltage and overvoltage. The PMPU is a universal voltage product that works on any three-phase system voltage from 208-480V (a separate 120V version is available). These devices are designed to be compatible with most Wye or Delta systems. In Wye systems, a connection to a neutral is not required. PMP Series products protect against unbalanced voltages or single phasing regardless of any regenerative voltages.

The relay is energized when the phase sequence and all voltages are correct. Any one of five fault conditions will de-energize the relay. As standard, re-energization is automatic upon correction of the fault condition. Manual reset is available if a momentary N.C. switch is wired to the appropriate terminals. A multi-color LED indicates normal condition and also provides specific fault indication to simplify troubleshooting.

The PMP Series offers a variety of user-adjustable settings. The percent phase unbalance is adjustable from 2-10%, and also has a “Disable” setting for those applications where poor voltage conditions could cause nuisance tripping. The undervoltage drop-out can be set at 80-95% of operating voltage (overvoltage setting is fixed at 110% of nominal). The adjustable time delay drop-out on undervoltage (0.1-20 seconds) eliminates nuisance tripping caused by momentary voltage fluctuations. There is also an adjustable time delay (1-300 seconds) on both power up and restart after a fault has been cleared.

MOUNTING STYLE	OPERATING VOLTAGE 50/60 Hz	PRODUCT NUMBER	WIRING/SOCKET ■
Plug-in	120V	PMP120	8 Pin Octal **70169-D**
	208-480V	PMPU *	 **DIAGRAM 104**

* Requires a 600V-rated socket when used on system voltages greater than 300V.

■ See Pages 81 & 82 for **Sockets & Accessories**.

MACROMATIC

800-238-7474

www.macromatic.com

sales@macromatic.com

PHASE MONITOR RELAYS

Phase Loss, Phase Reversal, Phase Unbalance, and Under/Over Voltage

PMP Series Plug-in

Application Data & Dimensions

Application Data

Phase Loss:
Unit trips on loss of any Phase A, B or C.

Phase Reversal:
Unit trips if rotation (sequence) of the three phases is anything other than A-B-C.

Undervoltage:
Adjustable from 80-95% of nominal voltage. Unit trips when the average of all three lines is less than the adjusted set point for a period longer than the adjustable time delay drop-out.

Overvoltage:
Fixed at 110% of nominal voltage. Unit trips when the average of all three lines is greater than the fixed set point for a period longer than the time delay drop-out.

Phase Unbalance:
Adjustable from 2 - 10% unbalance. Unit trips when any one of the three lines deviates from the average of all three lines by more than the adjusted set point. There is also a "Disable" setting adjustment that will turn off the Phase Unbalance Protection if nuisance tripping is a problem.

Output Contacts:
SPDT: 10A @ 240V AC/30V DC, 1/2HP @ 240V AC

Life:
Mechanical: 10,000,000 operations
Full Load: 100,000 operations

Response Times:

Power Up & Restart After Fault:	1 - 300 seconds adjustable
Drop-out Due to Fault:	
Phase Loss & Reversal	100ms fixed
Phase Unbalance	2 seconds fixed
Undervoltage	0.1 - 20 seconds adjustable
Overvoltage	Fixed Time Based on Inverse Time Curve

Hysteresis: 2 - 3%

Load (Burden): Less than 3VA

Temperature: -28° to 65°C (-20° to 150°F)

Mounting:
Uses an 8 pin octal socket. Requires a 600V-rated socket when used on system voltages greater than 300V (Macromatic Product Number 70169-D--see Page 81).

Indicator LED:

LED Status	Indicator
Green Steady	Normal / Relay ON
Green Flashing	Power Up / Restart Delay
Red Steady	Unbalance
Red Flashing	Undervoltage / Overvoltage
Amber Steady	Reversal
Amber Flashing	Loss
Green / Red Alternating	Undervoltage / Overvoltage Trip Pending
Red / Amber Alternating *	Nominal Voltage Set Error

* Applies to 208-480V units only.

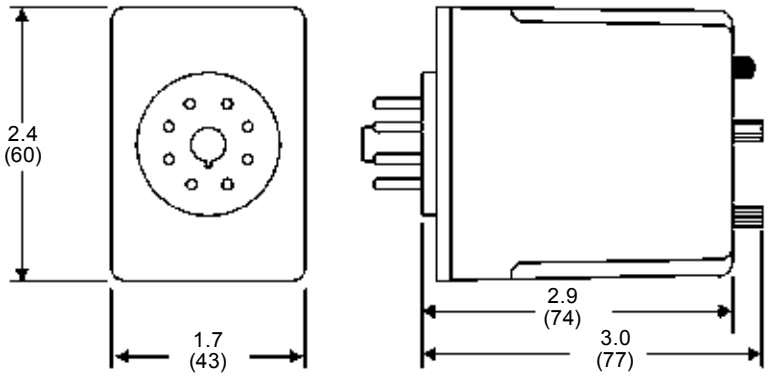
Reset:
As standard, reset is automatic upon correction of fault. When a momentary-contact N.C. switch is wired across the Manual Reset terminals (6 & 7), the unit switches to manual reset mode and remote manual reset is available.

Approvals:
c UL us
File #E109466

CE
Low Voltage & EMC Directives
EN60947-1, EN60947-5-1

UL LISTED (NO. CONT. EQUIP. 5007)
with appropriate socket
File #E109466

Dimensions



All Dimensions in Inches (Millimeters)

SDSA3650 SPDs

Square D Type 1 Surge Protective Devices

Square D™ brand Surgelogic™ SDSA3650 products are compact and affordable Surge Protective Devices (SPDs). SDSA3650 SPDs offer a simple means to bring down initial surges to manageable levels and can offer addtional value in a cascaded SPD system. Their compact design allows surge suppression to be installed adjacent to power panels or directly on sensitive equipment.

SQUARE D™

by Schneider Electric

SDSA3650 SPDs
Features

Superior Performance

Square D brand Surgelogic SDSA3650 SPDs utilize high-energy suppression circuitry that can be located at any point in the electrical system. As a Type 1 rated device, they have the flexibility to be used with or without an Overcurrent Protection Device (OCPD).

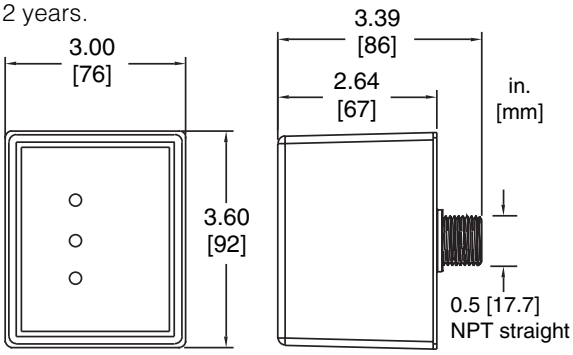
SDSA3650 SPDs provide surge suppression for equipment from severe transient activity. Each metal oxide varistor (MOV) is individually fused and the products carry a NEMA Type 4X rating suitable for installing indoors, outdoors, or in other harsh environments.

Easy Installation

Surgelogic SDSA3650 SPDs are some of the most versatile, yet compact devices available on the market today. This compact package can be mounted on an electrical panel, meter socket, or inside electrical control cabinets.

Warranty

The SDSA3650 and SDSA3650D warranty is 2 years.



SDSA3650 SPDs

Performance

Surge Current Rating per Phase	40kA
Short Circuit Current Rating	200kA
Modes of Protection	6
Fusing	Individually fused MOVs
Thermal Fusing	Yes
Overcurrent Fusing	Yes
Operating Frequency	50/60 Hz

Mechanical Description

Enclosure	Plastic
NEMA Rating	NEMA Type 4X
Connection Method	#12 AWG
Weight	1.8 lbs
Mounting Method	Close Nippled, Back Mounted
Operating Altitude	Sea Level-12,000' (3,658 m)
Storage Temperature	-40˚ F to +149˚ F (-40˚ C to +65˚ C)
Operating Temperature	-40˚ F to +149˚ F (-40˚ C to +65˚ C)

Diagnostics

Green status LED

Listings and Performance

cULus Listed per UL 1449 3rd edition Type 1 SPD, UL 1283, CSA C22.2 No. 8-M1986, C233.1-87
CE marked (IEC 61643-11)

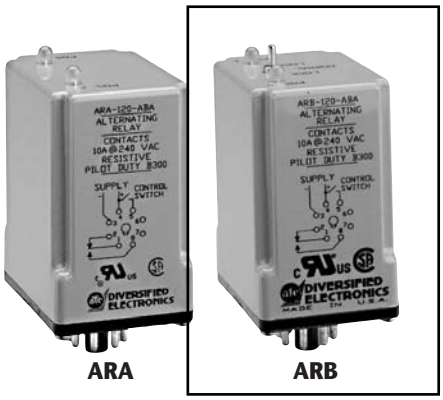
The SDSA3650 is a four-wire surge suppressor designed for use on all solidly grounded systems up to 600Y/347 Vac. The SDSA3650D is a three-wire surge suppressor designed for delta applications up to 600 Vac.

Voltage	Surge Current per Phase	Modes of Protection	Configuration	Model Number	MCOV	SCCR	I_n	VPR L-N	VPR L-G	VPR L-L	VPR N-G
600Y/347V[1]	40kA	6	3 Ø, 4-wire	SDSA3650	750V L-N 1500V L-L	200kA	10kA	2500V	N/A	4000V	N/A
600V Delta[2]	40kA	3	3 Ø, 3-wire	SDSA3650D	1500V L-L	200kA	10kA	N/A	N/A	4000V	N/A

1 Applicable voltages: 120/240V, 208Y/120V, 380Y/220V, 400Y/230V, 480Y/277V, 600Y/347V
2 Applicable voltages: 240V Delta, 480V Delta, 600V Delta

Schneider Electric USA, Inc. 1751 S. 4800 W., Salt Lake City, UT 84104, USA Telephone: (801)-977-9009 Fax: (801)-977-0200 www.surgelogic.com

Document Number 9990-0120B March 2011 bw



The **Duplexor** is used in control panels where **two loads** are required to alternate to provide equal run time on the loads. The alternating action is initiated by a control switch, which is common with one side of the control voltage. The output contacts will change states each time the control switch is opened, thus alternating the two loads. The LED indicators show the position of the output relay.

The ARA series is the standard Duplexor providing automatic alternating sequence. The ARB has the automatic sequencing feature plus the option of locking it into one sequence. A three position switch permits the field selection of normal duplexing action, locking in the A-B sequence, or B-A sequence.

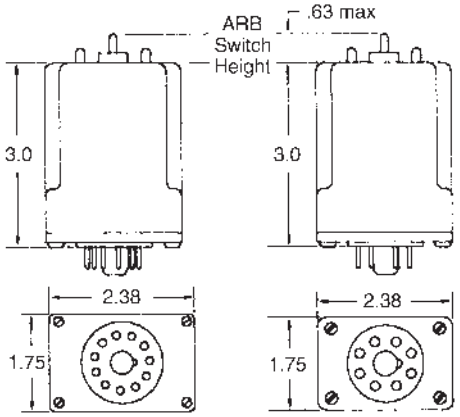
Duplexor

SPECIFICATIONS

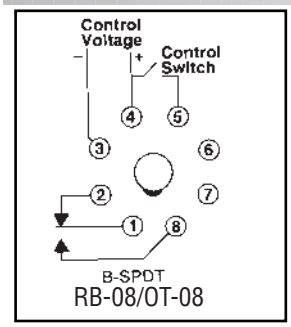
CONTROL VOLTAGE	24, 120 VAC/DC, 208, 240, 480 VAC, 50/60Hz, 48 VDC, ±10%	
CONTROL SWITCH CURRENT	1 mA	
POWER REQUIRED	3 VA (Approximately)	
DUTY CYCLE	Continuous	
LIFE EXPECTANCY	Mechanical	10,000,000 Operations (Minimum)
	Electrical	100,000 Operations @ Rated Load
INDICATORS	LED Shows Output Position	
TEMPERATURES RATING	Operate	-4° to 131°F (-20° to +55°C)
	Storage	-40° to 185°F (-40° to +85°C)
CONTACT RATING	10 Amps @ 240 VAC, Resistive 1/8 hp @ 120 VAC 1/4 hp @ 240 VAC Inductive 360 VA @ 240 VAC, Inductive	
ENCLOSURE	"A" Lexan® Dust Cover	
TERMINATIONS	Industrial Plug-in	
WEIGHT	4.5 oz.	

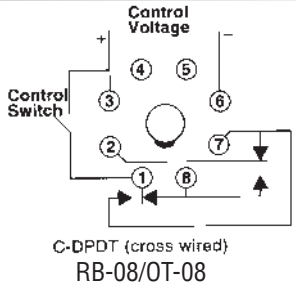
NOTE: For Analog signal inputs, ATC offers a duplexing pump control — the ATC-Digitec 3800 Panel Meter
480 VAC is not available in the D-DPDT 11-Pin configuration

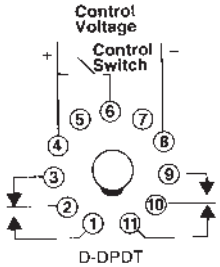
DIMENSIONS (INCHES)

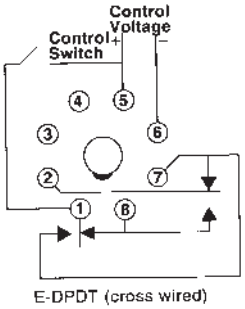


WIRING









MODEL NUMBER >>>>>>	AR					A
Type of Alternating Relay						
Standard Duplexor	A					
Special Function Duplexor	B					
Control Voltage						
24 VAC/DC		24				
48 VDC		48				
120 VAC/DC		120				
208 VAC		208				
240 VAC		240				
380-408 VAC (Consult Factory)		480				
Type of Voltage						
VAC or VAC/DC			A			
48 VDC only			D			
Contact Configuration						
SPDT				B		
DPDT (Cross Wired)				C		
DPDT				D		
DPDT (Cross Wired)				E		
Enclosure Style						A

Description

These 7 figure, AC or DC hour meters with running indicators, offer crisp, distinctive styling for many panel applications. Available in square and round bezel, flush mount, or three-hole round panel mount. Each is light-weight, low power, and carry UL, CSA and CE approvals.

Features

- 7 Figure, 99999.99
- Various voltage inputs
- Distinctive styling

Options

- Terminations
- Din Rail
- Voltages

Specifications

Figures: 7 figures, 0.14" high [3.6mm], 99,999.99 hours
Reset: Non-reset
Voltages: 24, 115, or 230VAC (+/-10%), 50 or 60Hz., 10-80 VDC
Power: 3 watts (AC), 1.2 watt maximum (DC)
Terminations: 1/4" [6.3mm] spade terminals, with removable screws, or 8" [203mm] wire leads

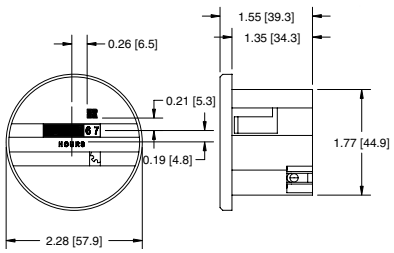
Mounting: Panel (mounting hardware included)
Temp. Range: -22°F to +158°F [-30°C to +70°C]
Approvals: UL Recognized and CSA Certified (AC only), CE Approved
Weight: 2 oz. [57g]

Models	Description
711-0150	115VAC/60Hz., 2.28" Dia., Flush mount, screw termination
711-0152	230VAC/60Hz., 2.28" Dia., Flush mount, screw termination
711-0160	115VAC/60Hz., 2.93" Dia., 3-hole round, screw termination
711-0161	115VAC/50Hz., 2.93" Dia., 3-hole round, screw termination
711-0162	230VAC/60Hz., 2.93" Dia., 3-hole round, screw termination
711-0163	230VAC/50Hz., 2.93" Dia., 3-hole round, screw termination
711-0164	24VAC/60Hz., 2.93" Dia., 3-hole round, screw termination
711-0170	230VAC/60Hz., 2.93" Dia., 3-hole round, 8" wire leads
711-0171	115VAC/60Hz., 2.93" Dia., 3-hole round, 8" wire leads
711-0180	115VAC/60Hz., 1.89" Sq., Flush mount, screw termination

Models	Description
711-0182	24VAC/60Hz., 1.89" Sq., Flush mount, screw termination
711-0190	115VAC/60Hz., 2.05" Sq., Flush mount, screw termination
711-0191	230VAC/60Hz., 2.05" Sq., Flush mount, screw termination
711-0192	24VAC/60Hz., 2.05" Sq., Flush mount, screw termination
711-0193	115VAC/50Hz., 2.05" Sq., Flush mount, screw termination
711-0194	230VAC/50Hz., 2.05" Sq., Flush mount, screw termination
711-0195	24VAC/50Hz., 2.05" Sq., Flush mount, screw termination
711-0200	115VAC/60Hz., 2.20" Sq., Flush mount, screw termination
711-0201	115VAC/50Hz., 2.20" Sq., Flush mount, screw termination
731-0046	10-80VDC, 2.93" Dia., 3-hole round, screw termination

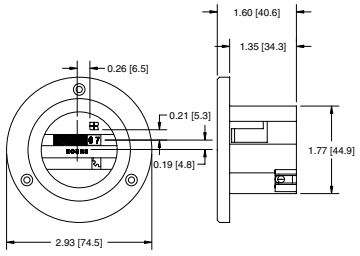
Dimensions

2.28" Dia. Flush



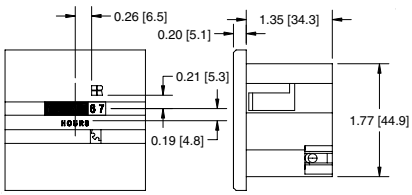
Panel cutout: 1.99" [50] Dia. or 1.81" [46] Sq.

3 - Hole Round



Panel cutout: 1.99" [50] Dia. or 1.81" [46] Sq.
Screws provided: 4-40 x 5/8" [16]
Bolt hole circle: 2.44" [62]

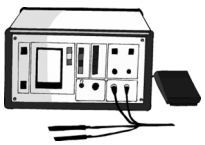
1.89", 2.05" or 2.20" Sq. Flush



Panel cutout: 1.99" [50] Dia. or 1.81" [46] Sq.
(for 1.89" Sq. use 1.81" [46] Sq. cutout only)

Applications

Medical equipment



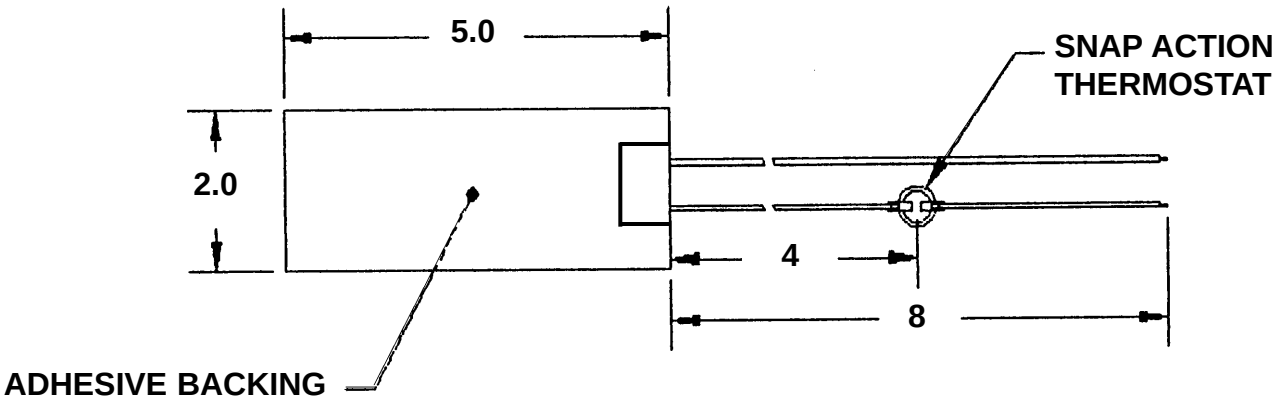
Test equipment

Office equipment

HI-HEAT INDUSTRIES, INC.

256 Hanover Road, Lewistown, MT 59437
406-538-7411 • Info@hiheat.com

E020050A2 - Heater Assembly



CLOSE @ 32°F ± 10 (22-42°F)
OPEN @ 50°F ± 5 (55-45°F)

NOTES:
HEATING ELEMENT: SILICONE RUBBER W/ ETCHED STAINLESS STEEL ELEMENT
120 VOLT, 50 WATTS
U/L FILE # E95403
CATEGORY # KS0T2

Thermostat Serie FLZ

Pfannenberg
ELECTRO-TECHNOLOGY FOR INDUSTRY

Mechanical bi-metallic thermostat for temperature in enclosures. Suitable for Pfannenberg Filterfans® and heaters and also for monitoring temperature.

Different models available fitted with either change-over contact with neutral position, NCC or NOC. Function at increasing temperature. AS-i slave module also available.

IP 20 — Level of protection

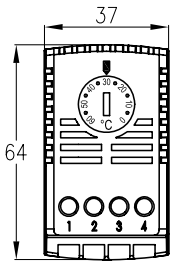
50 Hz / 60 Hz — suitable for both 50 Hz and 60 Hz

AC

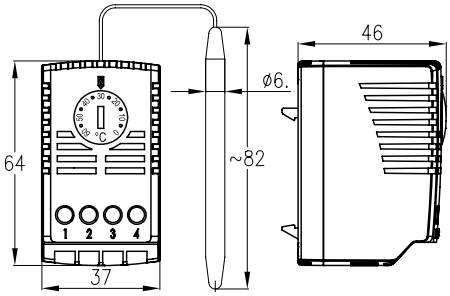
DC

Technical data:	FLZ 510	FLZ 520	FLZ 530	FLZ 550 AS-i
Type of contact	change over switch with spring contact	NCC with spring contact	NOC with spring contact	integrated AS-i bus slave
Available setting ranges	- 20 °C (- 4 °F) ... + 40 °C (+ 104 °F) 0 °C (+32 °F) ... + 60 °C (+ 140 °F) + 20 °C (+ 68 °F) ... + 80 °C (+ 176 °F)			-10°C (+14°F) ... +60°C (+140°F)
Max. breaking capacity, value in brackets inductive load at cos(phi) = 0,6	NCC: 100-250V AC/10(2)A NOC: 100-250V AC/5(2)A DC: max. 30W	240V AC / 10(2) A 120V AC / 15(2) A DC: max. 30W		< 20 mA 26,5 V ... 31,6 V AS-i profile: S-BA
Breaking temperature difference	1K: thermal return 3K: without thermal return 7K: capillary sensor	< 7K		1 - 4K
Tolerance for switching point	+/- 3K	+/- 4K		+/- 2K
Sensor	bimetal or remote sensor with 1,5 m capillary	bimetal		NTC
Connection	0,5 - 2,5 mm² screw clamps			1,3 mm DC Jack
Colour	RAL 7035 - light grey			
Weight	75 g	50 g	50 g	55 g
System of protection	IP20			
Working / storage temperature range	– 20 °C (- 4 °F) ... + 80 °C (+ 176 °F)			-25°C (-13°F) ... +80°C (+176°F)
Mounting method	snap fastening for 35 mm profile bars in accordance with EN 60715 (FLZ 520/530: for Pfannenberg Exhaust Filter PFA 3000 too) FLZ 550 AS-i not for headfirst mounting			
Approvals	UL approval applied for	UL approval		AS-i

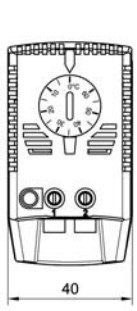
FLZ 510

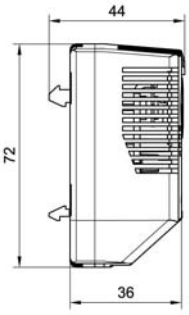


FLZ 510
capillary sensor

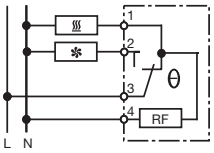


FLZ 520 / FLZ 530 / FLZ 550-AS-i

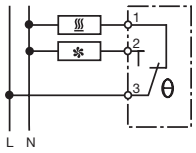




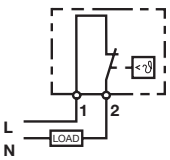
FLZ 510 1K



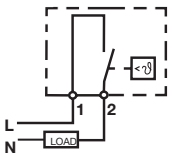
FLZ 510 3K / 7K



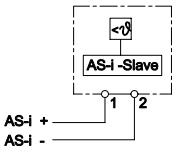
FLZ 520
NCC



FLZ 530
NOC



FLZ 550 AS-i



FEDERAL SIGNAL CORPORATION

Streamline® Low Profile Strobe Light

Models LP3S, LP3E, LP3M

PERFECT SIZE MEETS SUPERIOR PERFORMANCE

- LP3S and LP3M are available in 12-48VDC, 120VAC and 240VAC; LP3E in 120VAC
- Surface mount, Edison mount, or integrated 1/2-inch NPT pipe mount
- Five dome colors
- Screw-on lens provides easy access
- Low profile — Model LP3S is only 5" high
- Type 4X, IP66 enclosure
- PLC and triac compatible
- UL and cUL Listed, CSA Certified and CE Approved*

* CE Approval for S and M models only.

Federal Signal introduces the Model LP3 low profile strobe light. This Type 4X strobe is available in five colors: Amber, Blue, Clear, Green and Red.

The LP3 is offered in three mounting configurations: the LP3S features a three-hole surface mount — ideal for control panels and other flat or flush surfaces; the LP3E features a standard A-19 medium Edison screw-in base; the LP3M features a 1/2" NPT male pipe mount and 18' wire leads.

Both the LP3S and LP3M include a surface gasket to completethe Type 4X installation. An optional dome guard is available for use with the LP3M when installed flush with a panel. All LP3 units feature a unique threaded screw-on lens to provide for tool free wiring and strobe tube replacement. The strobe tube is rated for 7,000 hours.

LP3 comes in three voltage variations: 12-48VDC, 120VAC and 240VAC. The state-of-the-art strobe mechanism produces 2.2 joules of energy, while drawing relatively low amperage.

StreamLine® strobes feature high-quality, long-life strobe tubes which are designed to reduce tungsten build-up for longer lamp maintenance cycles. Careful consideration is given to the relationship between tube shape and lens design for maximum light output. StreamLine products make use of surface mount technology, which provides a more powerful light in a much smaller package. The high-quality dry-electrolyte capacitor used in StreamLine products runs cooler than those used in many competitive strobes, resulting in a more reliable product that won't fail due to overheating.

Model	Voltage	Operating Current	Flash Rate/ Minute	Joule Output	Candela Peak[1]	Candela ECP[2]
LP3 __-012/048_*__**	12-48VDC	0.44-0.10 amps	65-95	2.2	175,000	51.5
LP3 __-120_*__**	120VAC	0.10 amps	65-95	2.2	175,000	51.5
LP3 __-240_*__**	240VAC	0.07 amps	65-95	2.2	175,000	51.5

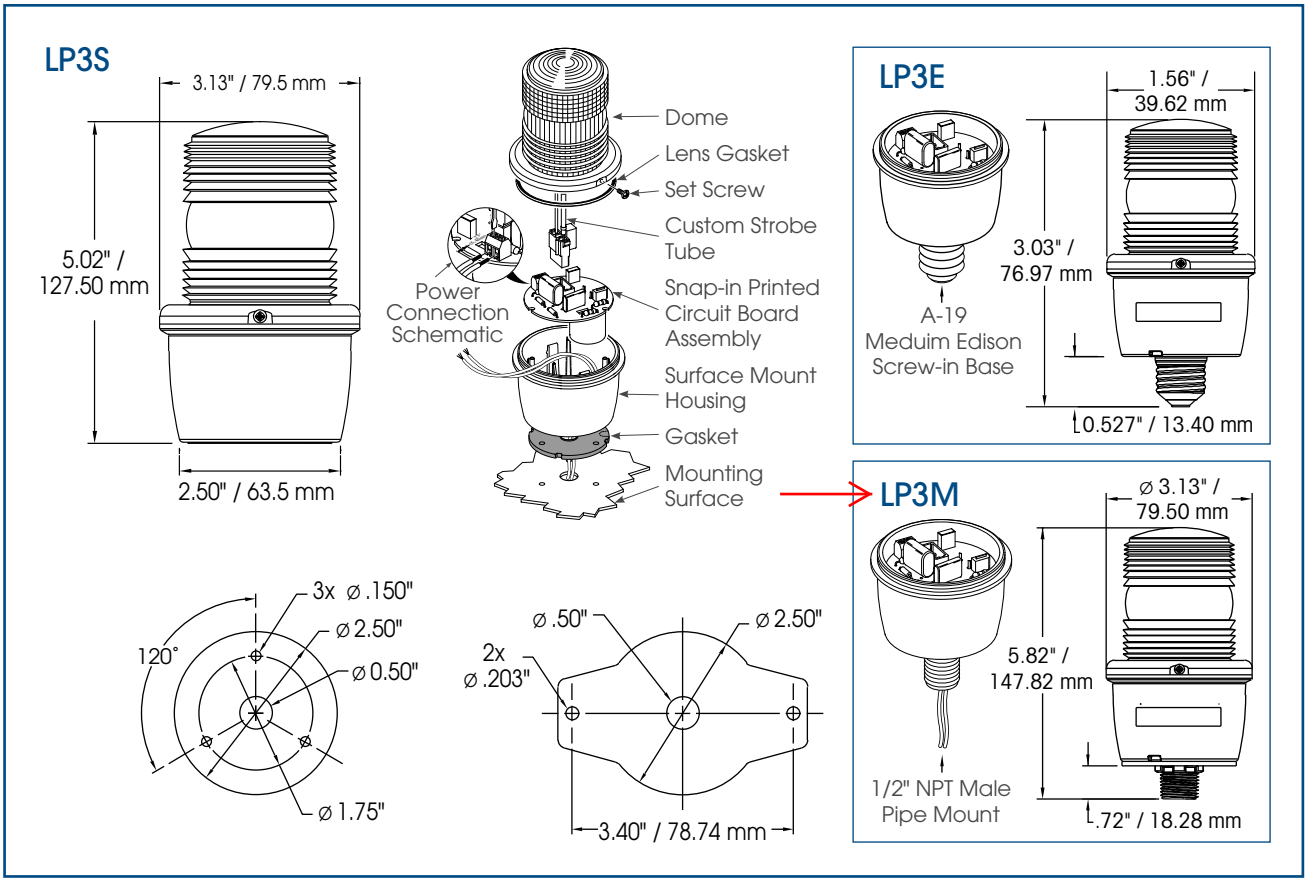
*** Indicates Mounting Style: (S) Surface Mount, (E) Edison A-19 Screw-in Base or (M) Male Pipe Mount*

** Indicates color: (A) Amber, (B) Blue, (C) Clear, (G) Green or (R) Red*

5 yr FEDERAL SIGNAL WARRANTY

[1] Peak candela is the maximum light intensity generated by a flashing light during its light pulse
[2] ECP (Effective Candela) is the intensity that would appear to an observer if the light were burning steadily

STREAMLINE® LOW PROFILE STROBE LIGHT (LP3S/LP3E/LP3M)



SPECIFICATIONS

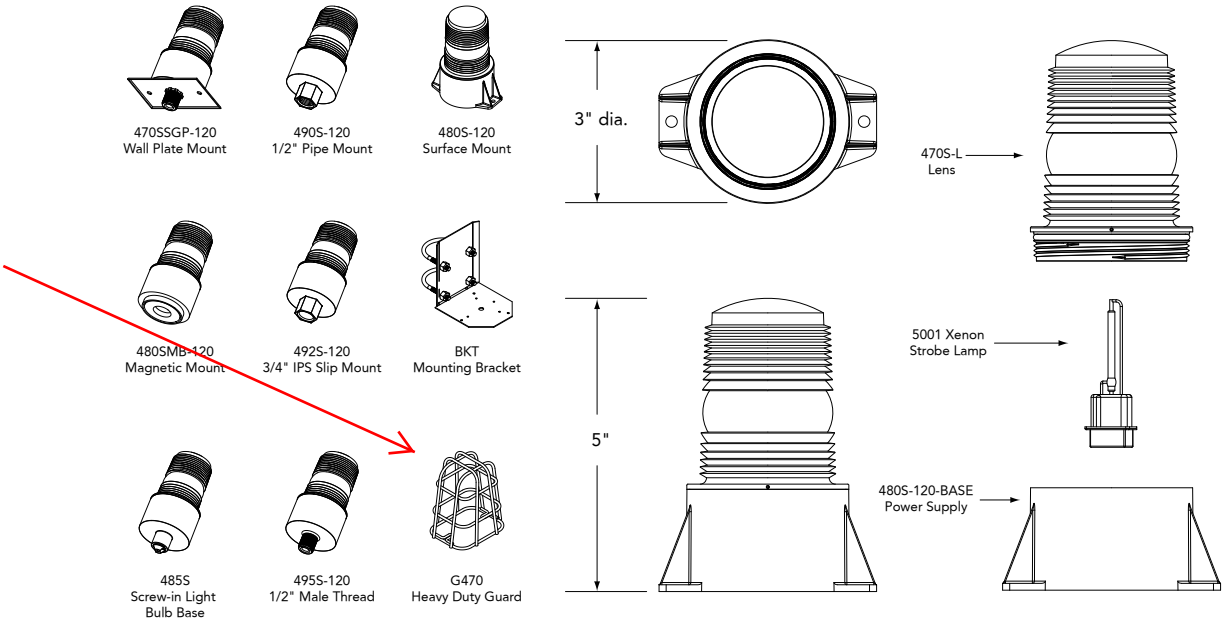
Lamp Life:	7,000 Hours	7,000 Hours
Light Source:	Strobe tube	Strobe tube
Operating Temperature:	-31°F to 150°F	-35°C to 66°C
Net Weight:	7.3 oz.	206.96 g
Shipping Weight:	8.5 oz.	240.98 g
Diameter:	3.125"	7.94 cm
Height (from bottom):		
LP3S	5.0"	12.7 cm
LP3E	6.1"	15.5 cm
LP3M	5.8"	14.7 cm

HOW TO ORDER

- Specify model, voltage and color
- Optional Accessories:
  Wire/Dome Guard (LP3G)
  for LP3S and LP3M
- Please refer to Model Number Index
  LP3 (E.M) beginning on page 371

REPLACEMENT PARTS

Description	***Part Number***	***Description***	***Part Number***
Dome, Amber	K8589063A	PC Assembly, 12-48VDC	K2001316B
Dome, Blue	K8589063A-01	PC Assembly, 120VAC	K2001317B
Dome, Clear	K8589063A-02	PC Assembly, 240VAC	K2001317B-01
Dome, Green	K8589063A-03	Gasket, Lens	K8589013A
Dome, Red	K8589063A-04	Gasket, Base LP3S	K8589011A
Strobe Tube	K149130A		



Specifications

Item	Description
Voltage and Amperage	120VAC and 240VAC draw 0.07A average
Power Supply Output 2.7 Watts	2.3 joules per flash
Flash Rate	60 to 80 flashes per minute
Size and Weight	5" tall x 3" dia. x 0.5 lbs (127mm x 76mm x 0.23kg)

Available Options

NOTE: All "/" options are factory installed only.

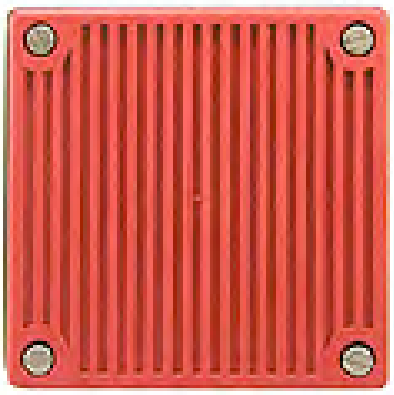
Model No.	Description
G470	Heavy duty guard
BKT	Mounting bracket
LBO–MINI	Lens blackout segment 180°
MICROSHIELD	Vinyl, 180° lens blackout
/TRIAC–SW	Solid state relay option

Replacement Parts

Model No.	Description
5001	Xenon strobe lamp
470S–L	Colored lens (please specify color)
480S–120–PSA	120VAC power supply, surface mount
480SMB–120–PSA	120VAC power supply, magnetic mount
485S–120–PSA	120VAC power supply, screw-in light bulb base
485S–240–PSA	240VAC power supply, screw-in light bulb base
490S–120–PSA	120VAC power supply, 1/2" female pipe mount
490S–240–PSA	240VAC power supply, 1/2" female pipe mount
492S–120–PSA	120VAC power supply, 3/4" IPS slip mount
495S–120–PSA	120VAC power supply, 1/2" male thread mount
495S–240–PSA	240VAC power supply, 1/2" male thread mount

The Sounder 120 VAC Alarm

Part No. AH115A8R & AH115A8G



Designed for use with Ingram's Silence Module

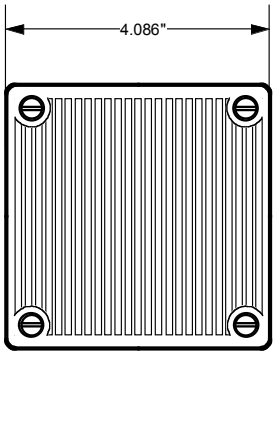
The Ingram 120 VAC Sounder is NEMA and UL Type 4X alarm horn suitable for heavy duty applications inside and outdoors. This horn features 8 user selectable alert sounds. Add quality to your control panel with the Ingram Sounder.

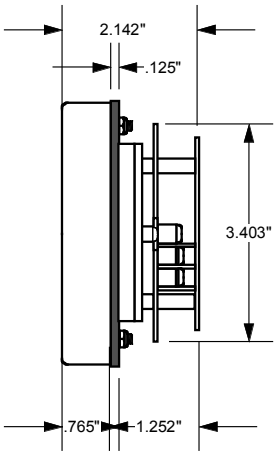
Features

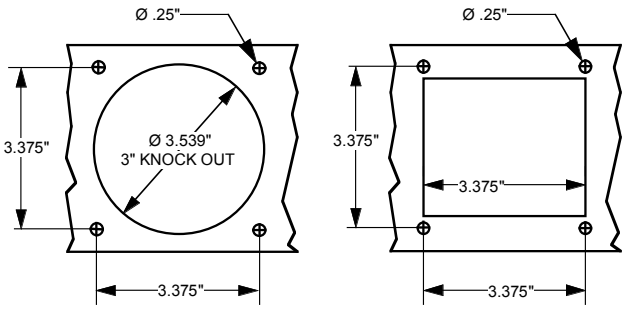
- UL listed (E175530) for use in NEMA and UL Type 3, 3R, 4, 4X, 12 and 13
- Loud: 110+ decibels at 5 feet
- 8 user selectable alert sounds
- 2 user selectable sound output levels
- Low profile protrudes less than 1" from mounting surface
- Does not generate electrical noise due to piezo electronic sound element
- Self locking stainless steel hex nuts makes it tamper resistant
- Highly reliable solid state circuitry

Technical Specifications

- Voltage: AH115A8R, AH115A8G - 115 VAC
- Average current draw: 50 mA @ 120 VAC
- Ambient operating temperature: -40°F - 151°F
- Maximum humidity of 98% RH±2%
- Each wire screw clamp terminal will accept two #18AWG - #12AWG wires.
- 3 year warranty
- Available in red or gray







Hole Pattern for Mounting

⚠ **WARNING:** Do not operate this device within 15 inches of a person's ear. Exposure to such high sound level can result in permanent damage to a persons hearing.

8725 Youngerman Court Suite 206 Jacksonville, FL 32257 ■ 888-875-2221 ph (904)778-1010 fax ■ Website:www.ingramproducts.com ■ e-mail: info@ingramproducts.com

NEMA Type Terminal Blocks
Box Lug Termination

CLASS 9080		TYPE GM6	TYPE GR6	TYPE GR6T
		 High Density Block	 Without Test Probe Adapter	 With Test Probe Adapter
Maximum Voltage Rating		600	600	600
Maximum Amperage Ratingv ✯	UL	30	60	60
	CSA	30	60	60
Wire Range		#22 to #10 AWG	#22 to #8 AWG	#22 to #8 AWG
Maximum Wire Combination		1 - #10 1 - #12 1 - #14 1 or 2 - #16 1 or 2 - #18 1 to 5 - #20 1 to 8 - #22	1 - #8 1 - #10 1 to 3 - #12 1 to 4 - #14 1 to 4 - #16 1 to 5 - #18 1 to 8 - #20 1 to 10 - #22	1 - #8 1 - #10 1 to 3 - #12 1 to 4 - #14 1 to 4 - #16 1 to 5 - #18 1 to 8 - #20 1 to 10 - #22
Wire Type		Solid or Stranded Copper Wire	Solid or Stranded Copper Wire	Solid or Stranded Copper Wire
Density - Sections per foot		51	34	34
Approx. Dimensions (D)x(H)x(W)		1.72 x 1.82 x .235 inches 44 x 46 x 6 mm	1.72 x 1.82 x .35 inches 44 x 46 x 9 mm	1.72 x 1.82 x .35 inches 44 x 46 x 9 mm
Block Material		Nylon		
Busbar Material		Tin Plated Brass	N/A	N/A
Screw Material		Steel with Zinc Plating and Chromate Film		
Box Lug Material		Zinc Plated Steel	Copper	
Temperature Rating		-40 to 257° F -40 to 125° C	-40 to 257° F -40 to 125° C	-40 to 257° F -40 to 125° C
Flammability Rating		UL94V2	UL94V2	UL94V2
Recommended Screw Tightening Torque		7-8 lbf-in 0.8-0.9 N-m	18-20 lbf-in 2.1-2.3 N-m	18-20 lbf-in 2.1-2.3 N-m
Listings		File E60616 Guide XCFR2	File LR62144 Class 6228 01	
FINGERSAFE® per DIN 57470		YES	YES	YES
Block: Natural (White)		GM6	GR6	GR6T
Black		GMB6	GRB6	
Blue		GML6	GRL6	
Green		GMG6	GRG6	
Grey		GME6	GRE6	
Orange		GMS6	GRS6	
Red		GMR6	GRR6	
Yellow		GMY6	GRY6	
End Barrier		GM6B	GM6B	GM6B
6 Foot Assembly		GM6296BC	GR6204BC	
Mounting Track: ▲				
DIN 3 :	0.5 meter long	MH320	MH320	MH320
	1.0 meter long	MH339	MH339	MH339
	2.0 meter long	MH379	MH379	MH379
Standard:	3 Foot Long	GH136	GH136	GH136
Snap-Off:	3 Foot Long	GH236	GH236	GH236
High Rise:	3 Foot Long	GH336	GH336	GH336
End Clamps:	Screw-in	GH10	GH10	GH10
	Slip-in	GH11	GH11	GH11
	DIN 3 End Clamp	MHA10	MHA10	MHA10
Jumpers: 2 pole		GH700	GH72	GH72
6 pole		GH710	GH73	GH73
Fanning Strip			GH52	GH52
Cover			GH62	GH62
Vinyl Marking Strip		GH220	GH220	GH220
Sheets of Blank Marking Tabs			GH200	GH200
Sheets of Marked Tabs			GH210	GH210
Marking Strip End Plug		GH60	GH60	GH60

▲ For additional mounting track, see page 8.

✯ These maximum current values assume the use of insulated copper conductors with 75° C temperature rating, and are calculated based on NEC Article 310, Table 310-16. In most cases this value is the maximum ampacity of that wire or combination of wires (as listed in the above table) which has the greatest current carrying capacity. The actual allowable current for a particular application is dependent upon the number, size, insulation class and other characteristics of the wires used.

Pump Monitor Relay

MADE IN THE U.S.A.

UL FILE #E101681

OPERATION

The Pump Monitor Relay provides Motor Over Temperature and Seal Leakage alarms for Submersible Pumps.

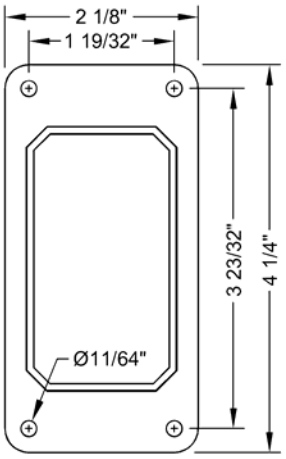
Motor Over Temperature Alarm - The Pump Monitor Relay applies a low voltage DC signal to the Motor Thermal Sensor to check its status. If the Pump Monitor Relay detects that the Motor Thermal Sensor contacts are closed (normal condition), the Overtemp indicator remains off, and the Overtemp Relay is energized, closing the contacts between terminals 2 and 11.

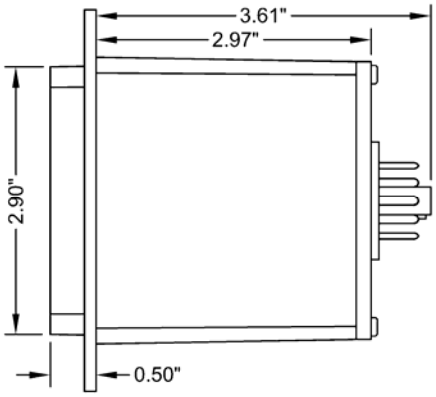
When the Motor Thermal Sensor contacts open (Over Temperature condition), the Overtemp Indicator is turned on and the Overtemp Alarm Relay is de-energized, opening the contacts between terminals 2 and 11, and closing the contacts between terminals 2 and 1.

When the Over Temperature condition has cleared, the Pump Monitor Relay will reset based upon the position of Alarm Reset Mode Select Switch (Auto or Manual). When in the Auto position, the Overtemp Alarm resets automatically. When the switch is in the Manual position, the Overtemp Reset Push-button must be pushed for approximately 1.5 seconds to clear the alarm.

Seal Leakage Alarm - The Pump Monitor Relay detects moisture inside a pump motor by using a low voltage AC signal to measure the resistance across Leakage Probes #1 and #2, or between the Leakage Probe(s) and the grounded motor housing. A Seal Leakage condition is considered present when the amount of moisture in the motor causes the resistance between terminals 6 and 5 to drop below the setting of the potentiometer. When this occurs, the Pump Monitor Relay turns on the Leakage Indicator and energizes the Leakage Alarm Relay, closing the contacts between terminals 9 and 10.

The alarm trip point may be set by the following procedure: Isolate the Leakage Probe from terminal 6. Connect a resistor with the desired trip value across terminals 5 and 6. Slowly adjust the potentiometer to the point where the alarm turns on. Remove the resistor and reconnect the Leakage Probe(s) to terminal 6.





SPECIFICATIONS

Input Power:	120 VAC ±10%, 7.0 VA max
Output Rating:	8A Resistive @ 120VAC
Operating Temp:	-20°C to +65 °C
Storage Temp:	-45°C to +85 °C
Temp Sensor Voltage:	6.6 VDC ±10%
Leak Sensor Voltage:	4.7 VAC ±10%
Enclosure:	White Lexan
Base:	Phenolic

ORDERING INFORMATION

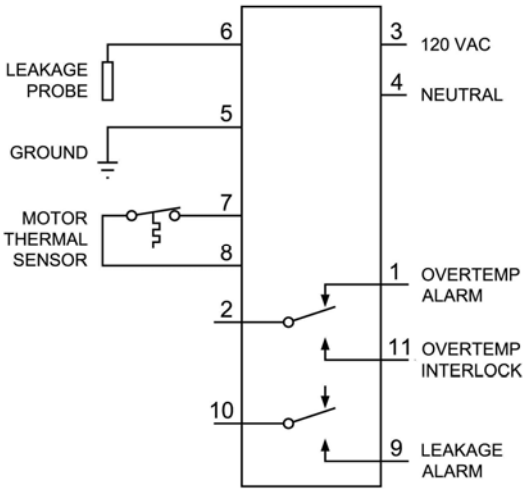
Part Number: PMR1

2464 Vulcan Road, Apopka, Florida 32703 (407) 299-3825 • Fax (407) 294-9435

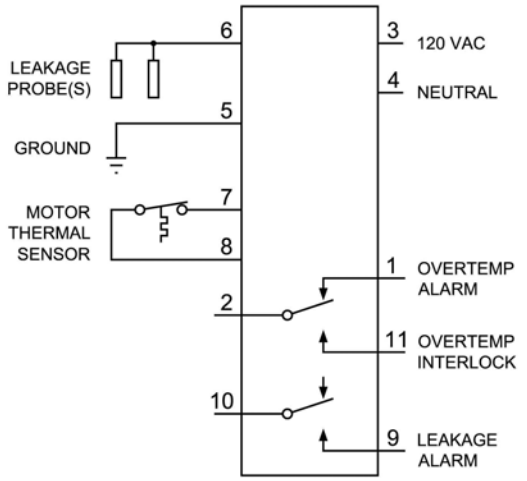
Pump Monitor Relay

CONNECTION DIAGRAMS

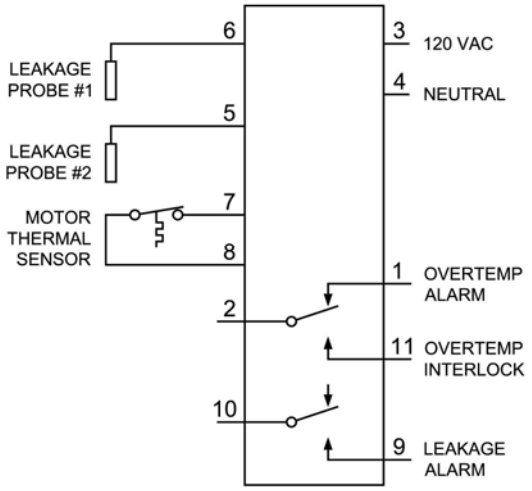
CHECKS RESISTANCE BETWEEN ONE PROBE AND MOTOR HOUSING



CHECKS RESISTANCE BETWEEN TWO PROBES AND MOTOR HOUSING



CHECKS RESISTANCE BETWEEN TWO PROBES



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ULTRX®, Type 4X

ULTRX®, Type 4X

Industry Standards

Mounting brackets required to meet UL/CSA external mounting requirements.

UL 508A Listed; Type 3, 3R, 4, 4X, 12, 13; File No. E61997
cUL Listed per CSA C22.2 No 94; Type 3, 3R, 4, 4X, 12, 13; File No. E619977
Enclosure flammability evaluated per UL 508A
Window flammability evaluated per UL 508A

NEMA/EEMAC Type 3, 3R, 4, 4X, 12, 13
CSA File No. 42186: Type 3, 3R, 4, 4X, 12, 13
IEC 60529, IP66
Meets NEMA Type 3RX requirements

Application

Providing outstanding protection against corrosion and the elements, the clean lines and molded, embossed design of ULTRX® fiberglass enclosures make them the most stylish and aesthetically pleasing of their class. These enclosures feature hidden hinges, a padlocking capability for security, and flexible internal mounting options.

Specifications

- Compression-molded fiberglass material has excellent temperature and chemical resistance qualities and exhibits outstanding physical properties, including high-impact resistance
- Fiberglass is easily punched, drilled, filed or sawed
- Seamless foam-in-place gasket assures water-tight and dust-tight seal
- Enclosure may be rotated 180 degrees for left and right hinging
- Molded-in drip shields are standard with each enclosure
- Impact-resistant polycarbonate window is permanently bonded in place
- Fiberglass mounting brackets and stainless steel attachment screws are provided with each enclosure
- Unique hinge design allows for standard 180 degree door opening with a maximum opening of 270 degrees
- Door hinges are replaceable
- Patented Type 316 stainless steel quarter-turn latch. Optional keylocking or padlocking handle available.
- Molded-in DIN bosses
- Molded bosses on door provide additional mounting provisions
- Integral mounting rails provide infinite panel adjustment front to back
- Optional data pocket is high-impact thermoplastic

Finish

Exterior surface painted light-gray acrylic enamel for enhanced UV protection. Optional steel panels are painted white. Optional stainless steel, aluminum, conductive and composite panels are unpainted.

Patents

This product is covered by the following patent:
US 5,481,889

Accessories

See also Accessories.
H2OMIT® Vent Drains, Type 4X
H2OMIT® Thermoelectric Dehumidifier
HOL-SEALERS™ Non-Metallic Hole Seals
Panels for Type 3R, 4, 4X, 12 and 13 Enclosures
Rack Angles (Type RA)

Modification and Customization

Hoffman excels at modifying and customizing products to your specifications. Contact your local Hoffman sales office or distributor for complete information.

Bulletin: UX1

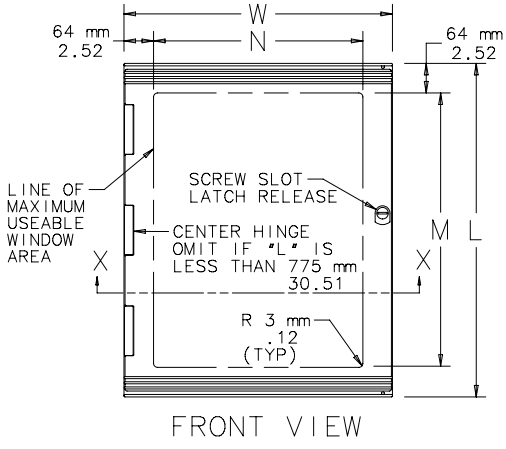
Standard Product

Catalog Number	Door Style	External Dimensions L x W mm/in.	Internal Dimensions A x B x C mm/in.	Panel	Conductive Panel	Panel Size D x E mm/in.	Mounting G x H mm/in.	Window Size M x N mm/in.	F mm/in.	J mm/in.	K mm/in.	S mm/in.	T mm/in.
UU504020	Solid	513 x 413	496 x 396 x 220	A20P16	A20P16G	432 x 330	359 x 459	—	186	297	19	286	387
		20.20 x 16.26	19.53 x 15.59 x 8.66			17.00 x 12.99	14.13 x 18.07	—	7.32	11.69	0.75	11.26	15.24
UU504020W	Window	513 x 413	496 x 396 x 220	A20P16	A20P16G	439 x 330	359 x 459	386 x 286	186	297	19	286	387
		20.20 x 16.26	19.53 x 15.59 x 8.66			17.00 x 12.99	14.13 x 18.07	15.20 x 11.26	7.32	11.69	0.75	11.26	15.24
UU606020	Solid	625 x 612	608 x 595 x 220	A24P24	A24P24G	533 x 533	559 x 572	—	186	500	21	489	489
		24.61 x 24.09	23.94 x 23.43 x 8.66			20.98 x 20.98	22.01 x 22.52	—	7.32	19.68	0.83	19.25	19.25
UU606020W	Window	625 x 612	608 x 595 x 220	A24P24	A24P24G	533 x 533	559 x 572	498 x 486	186	500	21	489	489
		24.61 x 24.09	23.94 x 23.43 x 8.66			20.98 x 20.98	22.01 x 22.52	19.61 x 19.13	7.32	19.68	0.83	19.25	19.25
UU605025	Solid	625 x 513	608 x 496 x 270	A24P20	A24P20G	533 x 432	457 x 570	—	239	400	21	387	489
		24.61 x 20.20	23.94 x 19.53 x 10.63			20.98 x 17.00	17.99 x 22.44	—	9.41	15.75	0.83	15.24	19.25
UU605025W	Window	625 x 513	608 x 496 x 270	A24P20	A24P20G	533 x 432	457 x 570	498 x 386	239	400	21	387	489
		24.61 x 20.20	23.94 x 19.53 x 10.63			20.98 x 17.00	17.99 x 22.44	19.61 x 15.20	9.41	15.75	0.83	15.24	19.25
UU504030	Solid	513 x 412	496 x 395 x 321	A20P16	A20P16G	432 x 330	355 x 455	—	287	300	19	286	387
		20.20 x 16.22	19.53 x 15.55 x 12.64			17.00 x 12.99	13.98 x 17.91	—	11.30	11.81	0.75	11.26	15.24
UU504030W	Window	513 x 412	496 x 395 x 321	A20P16	A20P16G	432 x 330	355 x 455	386 x 286	287	300	19	286	387
		20.20 x 16.22	19.53 x 15.55 x 12.64			17.00 x 12.99	13.98 x 17.91	15.20 x 11.26	11.30	11.81	0.75	11.26	15.24
UU606030	Solid	625 x 612	608 x 595 x 321	A24P24	A24P24G	533 x 533	555 x 568	—	287	500	21	489	489
		24.61 x 24.09	23.94 x 23.43 x 12.64			20.98 x 20.98	21.85 x 22.36	—	11.30	19.68	0.83	19.25	19.25

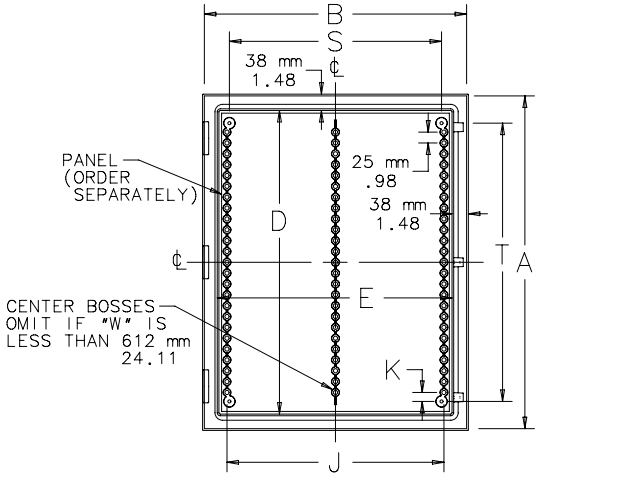
ULTRX®, Type 4X

Catalog Number	Door Style	External Dimensions L x W mm/in.	Internal Dimensions A x B x C mm/in.	Panel	Conductive Panel	Panel Size D x E mm/in.	Mounting G x H mm/in.	Window Size M x N mm/in.	F mm/in.	J mm/in.	K mm/in.	S mm/in.	T mm/in.
UU606030W	Window	625 x 612	608 x 595 x 321	A24P24	A24P24G	533 x 533	555 x 568	498 x 486	287	500	21	489	489
		24.61 x 24.09	23.94 x 23.43 x 12.64			20.98 x 20.98	21.85 x 22.36	19.61 x 19.13	11.30	19.68	0.83	19.25	19.25
UU756030	Solid	775 x 612	758 x 595 x 321	A30P24	A30P24G	686 x 533	555 x 718	—	287	500	21	489	641
		30.51 x 24.09	29.84 x 23.43 x 12.64			27.01 x 20.98	21.85 x 28.27	—	11.30	19.68	0.83	19.25	25.24
UU756030W	Window	775 x 612	758 x 595 x 321	A30P24	A30P24G	686 x 533	555 x 718	648 x 486	287	500	21	489	641
		30.51 x 24.09	29.84 x 23.43 x 12.64			27.01 x 20.98	21.85 x 28.27	25.51 x 19.13	11.30	19.68	0.83	19.25	25.24
UU1008030	Solid	1025 x 825	1008 x 808 x 321	A40P30	A40P30G	940 x 737	768 x 968	—	287	700	23	692	895
		40.35 x 32.48	39.68 x 31.81 x 12.64			37.01 x 29.02	30.24 x 38.11	—	11.30	27.56	0.91	27.24	35.24
UU1008030W	Window	1025 x 825	1008 x 808 x 321	A40P30	A40P30G	940 x 737	768 x 968	898 x 698	287	700	23	692	895
		40.35 x 32.48	39.68 x 31.81 x 12.64			37.01 x 29.02	30.24 x 38.11	35.35 x 27.48	11.30	27.56	0.91	27.24	35.24
UU606040	Solid	625 x 612	608 x 595 x 421	A24P24	A24P24G	533 x 533	555 x 568	—	387	500	21	489	489
		24.61 x 24.09	23.94 x 23.43 x 16.57			20.98 x 20.98	21.85 x 22.36	—	15.24	19.68	0.83	19.25	19.25
UU606040W	Window	625 x 612	608 x 595 x 421	A24P24	A24P24G	533 x 533	555 x 568	498 x 486	387	500	21	489	489
		24.61 x 24.09	23.94 x 23.43 x 16.57			20.98 x 20.98	21.85 x 22.36	19.61 x 19.13	15.24	19.68	0.83	19.25	19.25
UU756040	Solid	775 x 612	758 x 595 x 421	A30P24	A30P24G	686 x 533	555 x 718	—	387	500	21	489	641
		30.51 x 24.09	29.84 x 23.43 x 16.57			27.01 x 20.98	21.85 x 28.27	—	15.24	19.68	0.83	19.25	25.24
UU756040W	Window	775 x 612	758 x 595 x 421	A30P24	A30P24G	686 x 533	555 x 718	648 x 486	387	500	21	489	641
		30.51 x 24.09	29.84 x 23.43 x 16.57			27.01 x 20.98	21.85 x 28.27	25.51 x 19.13	15.24	19.68	0.83	19.25	25.24

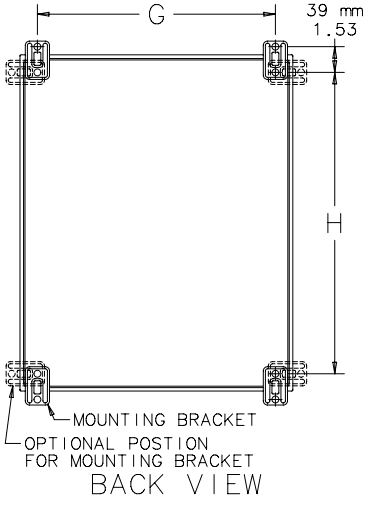
Purchase panels separately.



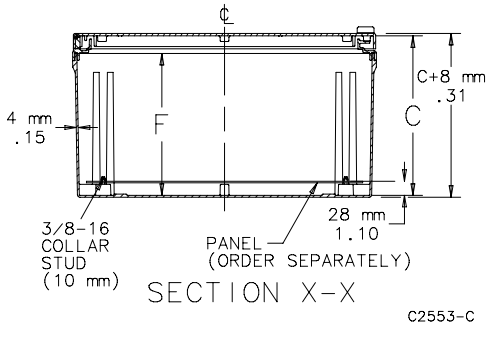
FRONT VIEW



FRONT VIEW WITH DOOR REMOVED



BACK VIEW

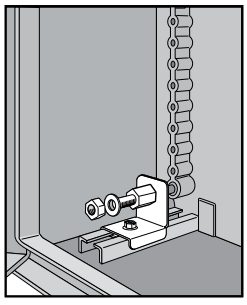


SECTION X-X

C2553-C

ULTRX®, Type 4X

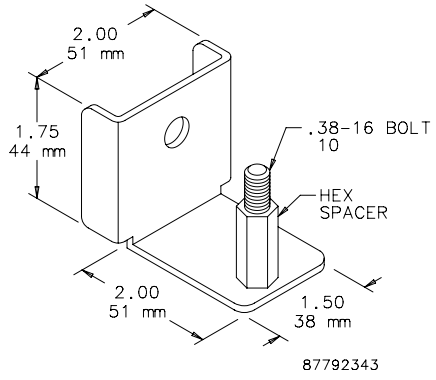
Panel Bracket Kit



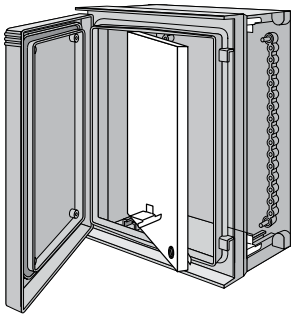
Panel Bracket Kit is used with steel panels and permits panel adjustment from front to rear. Fits all ULTRX sizes. Mounts on integrally molded body rail. Brackets are plated steel. All mounting hardware is included.

Bulletin: UX1Y

Catalog Number	Description	Pkg. Qty.
UUPB	ULTRX Panel Bracket Kit	4



Swing-Out Panel

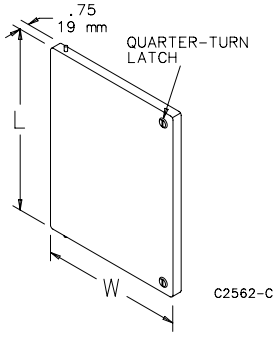


Installs front-mounted panels in ULTRX fiberglass enclosures. The front-mounted swing panel complements window-door units and is suited for any application requiring a display of gauges, dials or any type of control equipment monitor. Made of 14 gauge plated steel. Easy installation; no drilling required. Fully adjustable front to rear. Panel and mounting hardware included.

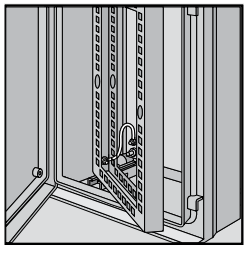
Bulletin: UX1Y

Catalog Number	Fits A x B mm/in.	L mm/in.	W mm/in.
UU5040SP	513 x 413	432	330
	20.20 x 16.26	17.00	12.99
UU6050SP	625 x 513	536	432
	24.61 x 20.20	21.10	17.00
UU6060SP	625 x 612	540	535
	24.61 x 24.09	21.25	21.08
UU7560SP	775 x 612	687	535
	30.51 x 24.09	27.05	21.08
UU10080SP	1025 x 825	935	737
	40.35 x 32.48	36.80	29.00

Use UU6060SP with DATACOM ULTRX Fiberglass Type 4X WiFi Cabinet.



Grounding Device



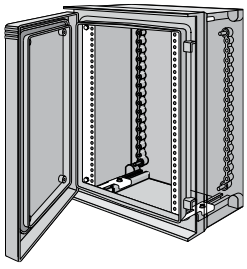
Grounding Device provides a means to attach a grounding conductor to an ULTRX Swing-Out Panel or Swing-Out Frame. Includes all installation hardware and instructions.

Bulletin: UX1Y

Catalog Number	Description
UUGK	ULTRX Grounding Device

ULTRX®, Type 4X

Rack Angles (Type RA)

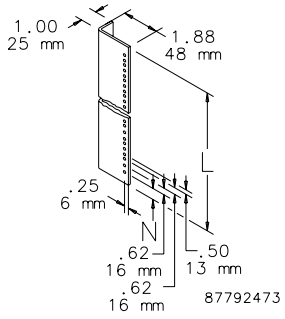


Pairs of full-length rack-mounting angles are available for mounting 19-in. (483-mm) rack-mounted equipment. Type RA angles are 14 gauge steel with mounting holes .281-in. (7-mm) in diameter and spaced per EIA standard RS-310-D (universal spacing). Use Clip Nut Package (AN1032) to provide tapped holes at desired locations. Angles and mounting hardware are plated steel. Mounting hardware is furnished.

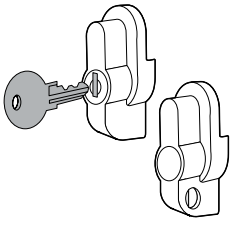
Bulletin: UX1Y

Catalog Number	Fits A x B mm/in.	L mm/in.	N mm/in.	Rack Units	Pkg. Qty.
UURA6060	610 x 610	552	10	12	2
	24.00 x 24.00	21.75	.38		
UURA7560	762 x 610	705	19	15	2
	30.00 x 24.00	27.75	.75		

Use UURA6060 with DATACOM ULTRX Fiberglass Type 4X WiFi Cabinet.



Keylock Kit and Padlock Kit



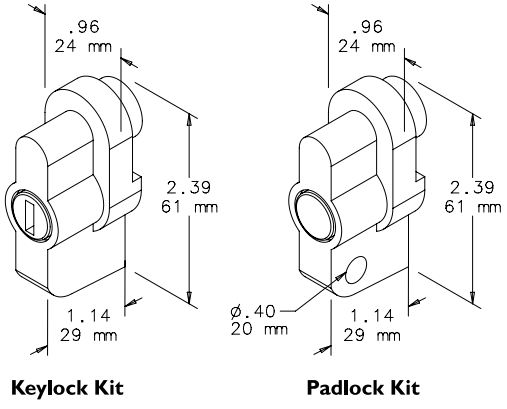
Keylock Kit or pushbutton-style Padlock Kit is easily inserted in latch hole to prevent unauthorized personnel from gaining access to enclosure contents. Each kit is fully assembled for easy installation in the field. Type 316 stainless steel construction.

Bulletin: UX1Y

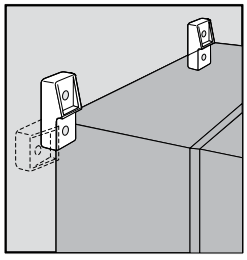
Catalog Number	Description
UUHKL	Keylock Kit
UUHPL	Padlock Kit

UUHKL: Internal key components are not stainless steel.

UUHPL: Handles maintain UL 508A, Type 3, 4, 4X and 12 when properly installed on a Hoffman enclosure. Set up for 1/4-in. or 3/8-in. padlock.



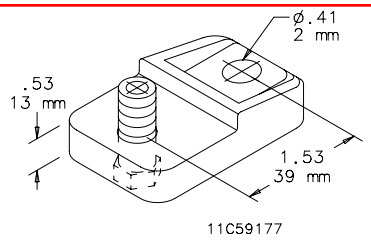
ULTRX® Mounting Bracket Kit



Kit is field-installable. Corrosion-resistant fiberglass material. Type 316 stainless steel mounting hardware is included. Four mounting brackets per kit.

Bulletin: UX1Y

Catalog Number	Description	Kit Qty.
UUMF	Mounting Bracket Kit	4



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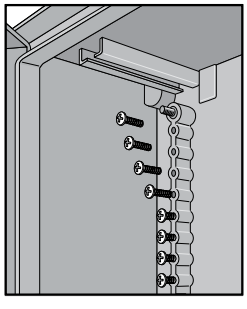
Screw Insert Kit

Brass threaded inserts (10-32) with plated screws. Used on door bosses and DIN bosses.

Bulletin: UX1Y

Catalog Number	Description	Kit Qty.
UUMH2	Screw Insert Kit	4 inserts and 4 screws

Self-Tapping Screws



Plated screws (1/4-15 x .88) mount panels and accessories to DIN bosses on back of enclosure.

Bulletin: UX1Y

Catalog Number	Description	Pkg. Qty.
UUMH1	Self-Tapping Screws	10

Lighting

Fluorescent Lighting Package

These low-profile light packages are available with either a manual or a door-activated switch. On door-activated switches, the circuit is closed (activates the light) when the enclosure door is opened. Each light comes with a pre-wired terminal block for easy connection to electric supply, in either 115 volt or 230 volt models. An easy to remove, non-yellowing white plastic lens cover provides protection against bulb breakage (fluorescent bulb not included). All 115 volt models come standard with a 9 amp convenience outlet. Standard mounting hardware and brackets included. Body finish is light gray RAL 7035 polyester powder paint.

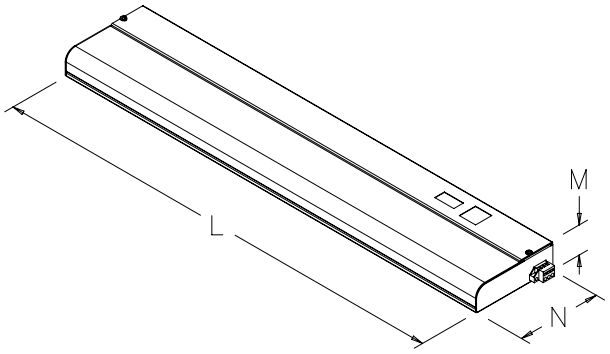
Underwriters' Laboratories Inc. listed:

UL 508 Component Recognized File No. E229434

cUL Component Recognized C22.2 No. 14 File No. E229434

Maintains Type 4 and Type 12 when properly installed in a Hoffman enclosure.

Optional accessories include a mounting bracket kit designed specifically for Hoffman PROLINE® disconnect enclosure applications and easy to mount "remote" manual and door-activated switches with mounting bracket. Accept the following standard bulbs, which are not included with light package: F8T5, F15T8, F18T8, or F40T12.



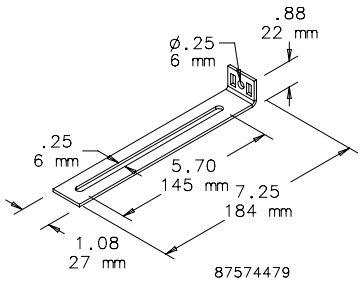
Catalog Number	Description	VAC	Hz	Amps	Convenience Outlet	L (in.)	L (mm)	M (in.)	M (mm)	N (in.)	N (mm)
ALF16D12R	Door switch	115	60	0.16	Yes	12.30	312	1.38	42	4.59	140
ALF16M12R	Manual switch	115	60	0.16	Yes	12.30	312	1.38	42	4.59	140
ALF16D18R	Door switch	115	60	0.35	Yes	18.10	460	1.38	42	4.59	140
ALF16M18R	Manual switch	115	60	0.35	Yes	18.10	460	1.38	42	4.59	140
	Manual switch, 6 ft. power cord[a]	115	60	0.35	Yes	18.10	460	1.38	42	4.59	140
ALF25D18R	Door switch	230	50	0.30	No	18.10	460	1.84	56	5.25	160
ALF25M18R	Manual switch	230	50	0.30	No	18.10	460	1.84	56	5.25	160
ALF16D24R	Door switch	115	60	0.35	Yes	24.10	612	1.38	42	4.59	140
ALF16M24R	Manual switch	115	60	0.35	Yes	24.10	612	1.38	42	4.59	140
ALF16M48R	Manual switch	115	60	0.65	Yes	48.00	1219	1.84	56	5.25	160

[a] Corded light is listed to UL/cUL 153 standard.

Mounting Bracket Kit for Fluorescent Light Package

Kit simplifies mounting light package in Hoffman PROLINE® disconnect enclosures. Includes brackets, all mounting hardware, and complete instructions.

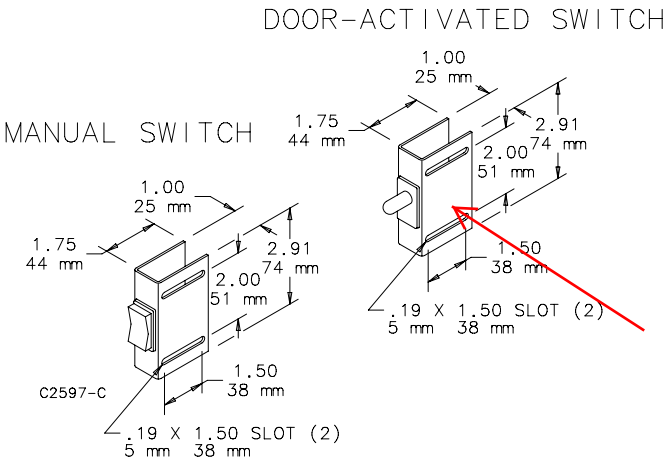
Catalog Number	Description
PDLFBRKT	Mounting Bracket Kit



Switches

Remote switches for these light packages.

Catalog Number	Description
ALFSWM	Manual switch
ALFSWD	Door-activated switch



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6.04 INSTRUCTIONS FOR CONDUIT ENTRY INTO ROMTEC UTILITIES SUPPLIED CONTROL PANEL ENCLOSURES

A. Conduit Top of Enclosure Entry:

1. Use only U.L. listed rain tight or liquid tight conduit hubs.
2. Install hubs and conduit according to the hub manufacturer's instructions.
3. Punch or drill the correct hole for the size of hub to be used.
4. Capture all drilling fines to prevent interior component damage.

B. Conduit Bottom of Enclosure Entry:

1. Punch or drill correct hole for the size of the conduit to be used.
2. Use only U.L. listed rain tight or liquid tight conduit hubs or sealing locknuts on the onside entry point.
3. Install conduit, hubs or sealing locknuts as per the manufacturer's instructions.
4. Secure conduits on the inside with locknuts.
5. Use plastic bushing or grounding bushing where applicable.

CONDUIT SIZE	HOLE SIZE
1/2"	7/8"
3/4"	1-1/8"
1"	1-3/8"
1-1/4"	1-3/4"
1-1/2"	2"
2"	2-3/8"
2-1/2"	3"
3"	3-5/8"
3-1/2"	4-1/4"
4"	4-5/8"

C. Conduit hole sealing:

1. Seal all unused holes with hole seals that are recognized for use with the enclosure NEMA rating.
2. Install seals according to the seal manufacturer's instructions.