Appendix B

Proposed Secondary Containment Storage Tank Information (Snyder)

EnSol, Inc.

Tank Product Data

(Snyder)

EnSol, Inc.

Captor™ Containment

DOUBLE WALL TANK SYSTEMS

www.snydernet.com

Captor Containment System

Protects Bulk Storage Profits

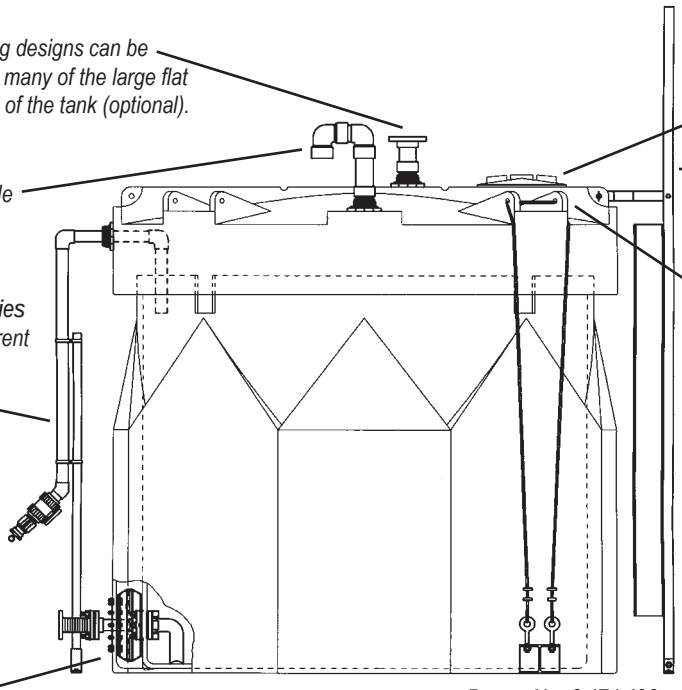
Without Jeopardizing Safety or the Environment

Flanged Outlets and other fitting designs can be securely fastened and sealed to many of the large flat areas located on the top section of the tank (optional).

U-Vent Assemblies are available in a variety of sizes to relieve vacuum pressures.

Fill and/or Draw Pipe Assemblies can be installed to facilitate different material loading or un-loading requirements. (optional).

U.F.O. (Unified Fitting Outlet) is uniquely designed to mechanically seal fitting outlet through both the inner and outer tank walls. Material unloading is easier and more cost effective than pumping contents from the top of the tank (optional).



Patent No. 6,474,496

Bolted and Threaded Manways are available in sizes up to 24". Standard size is an 18" threaded manway.

OSHA Approved Ladders are available with and without cages in fiberglass and steel construction.

Molded in Tie-Down Lugs interface with optional cable restraint system to meet seismic and 150 mph wind load requirements.

Outer Containment Tank provides 115-120% of inner tanks capacity for added safety factor. Complies with 40 CFR-264.193.

Double Wall Tank Construction encloses and interlocks outer and inner tank to prevent rain, snow, and debris from entering outer containment tank.

Mini-Captor Containments

Double Wall Tank System

Ideal for Mini-Bulk Chemical Delivery Programs

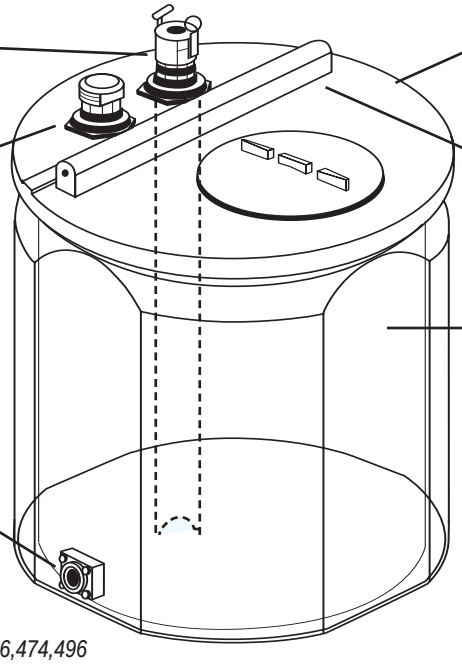
Top Draw-Tube Assembly enables material contents to be safely dispensed from the top of the tank. (optional)

2" Vent provides pressure vacuum relief for interior tank. (optional)

Available in XLPE and HDLPE resin packages.

Transition Fitting allows sidewall safe installation and long-term sealing power through both walls of tank. (optional)

Forklift Channels are available on 275, 360 and 500 gallon sizes.



Patent No. 6,474,496

Large Flat Surface Area provides ample space for a variety of fitting sizes and styles.

Two Tanks within one design provide double-wall protection.

Rib Reinforced Flat Top Design provides ample surface space for chemical feed pump mounting and multiple fitting and accessories installation.

Narrow Diameter provides location versatility in that it can fit through most any doorway on sizes up to 150 gallons.

Secondary Containment Tank provides 120% of inner tank's capacity. Complies with 40 CFR-264.193.

All Other Snyder Industrial Product Fittings and accessories are available wherever applicable.

Captor Options/Accessories

Leak Detection Sensor
Capacitive proximity sensor detects and communicates the smallest of leaks with an easy to understand warning signal.

Level Indicator
Ultrasonic level indicator with digital display measures the inner tank's slightest liquid level changes.

Fill Pipe Assembly
Modified to accommodate double wall construction and take advantage of our outer containment capability.

Other Options
Bolted and sealed manways, heat trace and insulation, and most other Snyder tank fittings and accessories.

Transition Fitting
U.F.O. (Unified Fitting Outlet) design allows side wall fittings to be installed and safely sealed through both walls of the Captor Containment System.

Seismic Restraints and Ladders
Molded-in tie-down lugs and cable tie-down system meet seismic and 150 mph wind load requirements. OSHA-approved ladders are also available.

Tank Material Options
High Density linear polyethylene (HDLPE) or cross-linked polyethylene (XLPE).

SPECIFICATIONS

Captor Containment System			
Part No.	**Gallons**	**Diameter**	**Height**
504/503	550	76”	65”
547/545	1,100	76”	104”
549/546	1,550	76”	136”
557/550	2,000	102”	103”
558/551	2,500	102”	122”
559/552	3,000	102”	142”
560/553	3,500	102”	158”
561/554	4,000	102”	178”
562/555	4,500	102”	197”
563/556	5,000	102”	216”
566/564	5,500	120”	172”
567/565	6,500	120”	199”
10064/10065	8,700	142”	197”
10066/10067	10,000	142”	226”

All Snyder specific gravity ratings meet or exceed ASTM D-1998. Consult your Snyder representatives on material construction recommendations for your company's particular application.

Mini-Captor Options/Accessories

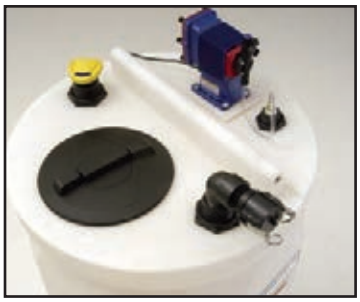
Leak Detection Sensor
Capacitive proximity sensor detects and communicates the smallest of leaks with an easy to understand warning signal.

Forklift and Pallet Jack Accessible Design
Larger 275, 360 and 500 gallon sizes are equipped with forklift channels designed to help move the containers when full and empty.

Transition Fitting
Allows safe sidewall installation and long-term sealing power through both walls of tank.

Level Indicator
Ultrasonic level indicator with digital display measures the inner tank's slightest liquid level changes.

Stands
Mini-Captor tank systems (35-275 gals.) can be mounted on elevation stands, creating more room for plumbing and other system requirements without utilizing additional floor space. Patent No. 7,059,575



Other Fittings and Accessories
All applicable Snyder Industries fittings and accessories can be integrated to complete tank system.

Tank Material Options
High-density linear polyethylene (HDLPE) or cross-linked polyethylene (XLPE).

SPECIFICATIONS

Mini-Captor Tank Systems				
Part No.	**Gallons**	**Diameter**	**Height**	**Lid**
1010100N--	15	23”	23”	8”
1010300N--	30	23”	35”	8”
1000200N---	35	22”	36”	6”
1010500N--	55	28”	36”	8”
1000300N---	60	26”	41”	14”
1010700N--	100	33”	44”	8”
5980000N---	120	34”	49”	14”
1010900N--	140	32” X 32”	48”	8”
1000400N---	150	34”	60”	14”
1000500N---	275	47”	60”	14”
1000600N---	360	53”	60”	14”
1000800N---	500	53”	79”	14”

Double Strength Protection

Protect Your Liquid Assets!

Regulation is becoming increasingly stringent in the formulation and enforcement of chemical containment legislation. Berm and tank-in-a-basin containment systems, thought to be modern, are now found to be inadequate and not compliant.

There is an answer. Snyder's polyethylene tanks with secondary containment systems can safely store a wide range of hazardous chemicals. Our double wall (tank-in-a-tank) designs are being increasingly utilized as a supplement or alternative to secondary containment requirements. The design features built into Snyder's Captor and Mini-Captor Tank Systems increase safety and protect the environment without jeopardizing your profits.

Consider the Benefits…

- Tank-in-a-tank design provides TOTAL containment protection in one space-saving unit.
- The system consists of a primary tank with a secondary outer containment tank with a capacity of 115%-120% of the inner tank's capacity, exceeding EPA standards.
- Double-wall construction is completely enclosed so that external matter such as rainwater, snow and debris is prevented from collecting in the outer containment tank making it ideal for outdoor chemical storage.
- Shipped fully-assembled on either a standard or wide-load flatbed trailer which reduces field assembly costs.
- Available in sizes ranging from 15 to 10,000 gallons.
- Available in High Density Linear Polyethylene (HDLPE) or Cross Link Polyethylene (XLPE) construction. Having a choice provides ultimate chemical compatibility and performance.
- Tanks designed with wall thickness equal to or greater than ASTM D-1998 standards.

Your Snyder Double Wall Tank can be customized with these options…

- Seismic restraint system (for 35-10,000 gallon sizes).
- 150 MPH wind load restraint system (for 35-10,000 gallon sizes).
- Ultrasonic level indicators.
- Leak detection sensors.
- Heat tracing and insulation.
- OSHA compliant ladders (for 550 -10,000 gallon sizes).
- Variety of manway sizes and styles.
- Bottom sidewall outlets.
- Top inlet connections and vents.

SOLUTIONS IN BULK HANDLING

Transportation containers hold from 60 to 550 gallons.

UN/DOT-APPROVED IBCs

Snyder intermediate bulk containers (IBCs) are durable, corrosion-resistant and economical. These long-term, reusable containers are ideal for the transportation of both hazardous and non-hazardous liquid materials.

Stationary tanks store from 8 to 16,500 gallons.

BULK STORAGE & PROCESSING TANKS

For larger stationary applications, Snyder offers the industry's broadest range of tanks – from 8 to 16,500 gallons – in shapes that meet your specific needs. To match your special function requirements, we also market a complete line of accessories, such as stands, seismic tie-downs, ladders, fittings, gaskets, sight gauges, heat tracing and insulation.

Customized mini-bulk containers

CUSTOM CONTAINER DESIGNS

In addition to Snyder's extensive standard product offering, some of our greatest success stories stem from custom container designs to meet specific customer requirements. Snyder's engineering team is a recognized leader in design innovation, and is driven to work with customers to develop the best performing container at the lowest possible cost.

ONE SOURCE DOES IT ALL

Whether you are a manufacturer or distributor, Snyder Industries can help you improve the function, economics and performance of your company's bulk handling systems.

SNYDER INDUSTRIES, INC.

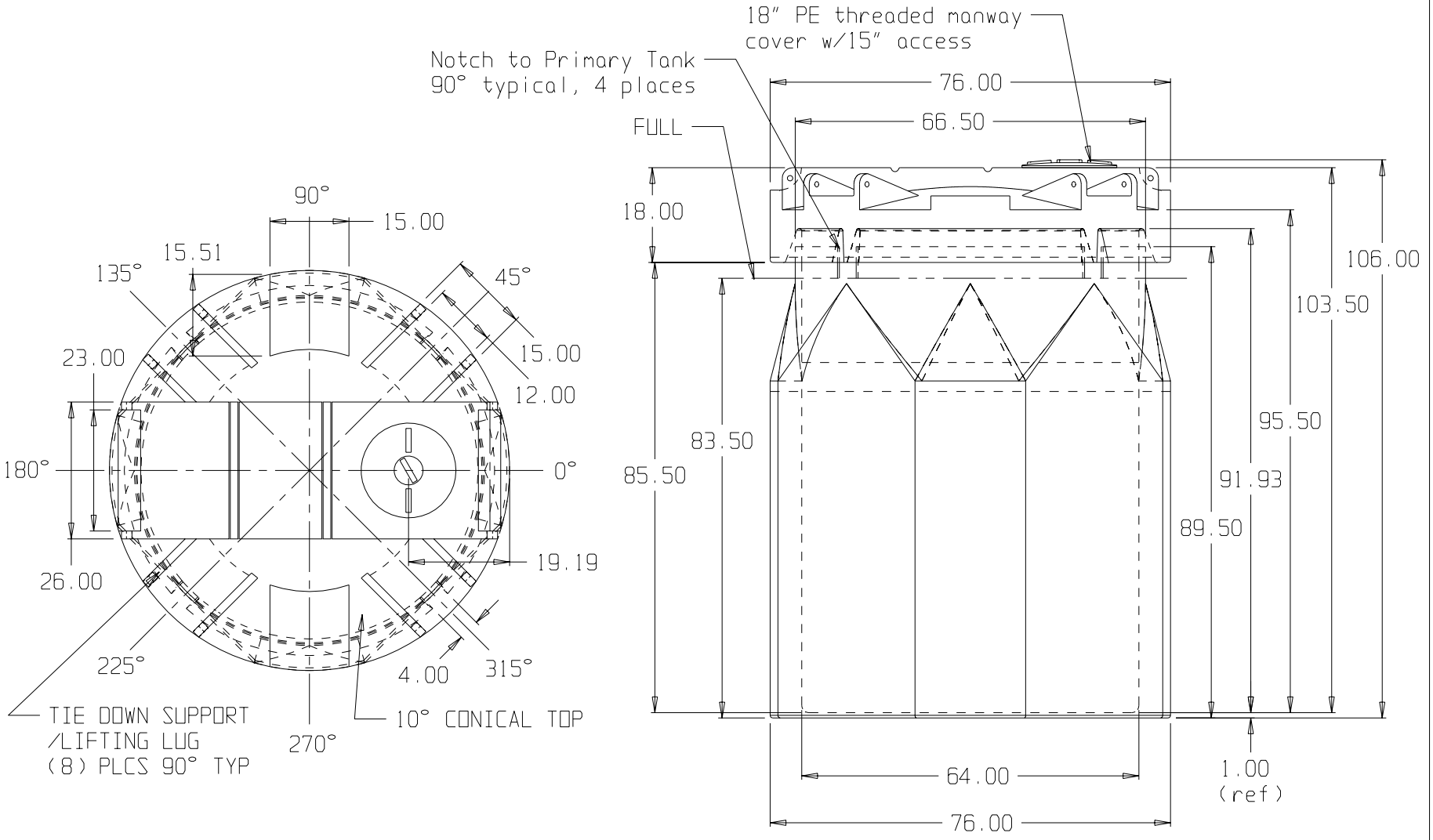
SOLUTIONS IN BULK HANDLING

P.O. Box 4583 • Lincoln, Nebraska 68504 • 402-467-5221 • FAX: 402-465-1220 • ***www.snydernet.com • email: sales@snydernet.com***

Other manufacturing facilities: Marked Tree, Arkansas • Chowchilla, California • Philippi, West Virginia • Mancelona, Michigan

www.snydernet.com

Printed 09/2011



SNYDER INDUSTRIES INC.

(all dimensions in inches)

BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER Sii PROCEDURE

1,100 GALLON CAPTOR CONTAINMENT SYSTEM

PART #	PRIMARY:	5470--
	CONTAINMENT:	5450--
REF#:	0000	06/24/02

ExxonMobil Chemical

ExxonMobil™ HDPE HD 8660 Series
High Density Polyethylene Resin

Product Description

HD 8660 Series are high density hexene copolymers designed to offer superior toughness and stiffness. They are ideally suited for applications that require the optimum balance of low temperature toughness, creep resistance, stiffness, ESCR, and tear properties.

General

Availability [1]	• Latin America	• North America	• South America
Additive	• HD 8660.29: Long Term UV-15 Stabilizer: Yes	• HDP8660.29: Long Term UV-15 Stabilizer: Yes	
Applications	• Industrial Products	• Intermediate Bulk Containers	• Large Agricultural Tanks
Revision Date	• July 2011		

Resin Properties	Typical Value (English)	Typical Value (SI)	Test Based On
Density	0.942 g/cm³	0.942 g/cm³	ASTM D4883
Melt Index (190°C/2.16 kg)	2.0 g/10 min	2.0 g/10 min	ASTM D1238

Thermal	Typical Value (English)	Typical Value (SI)	Test Based On
Deflection Temperature Under Load (DTUL) at 66psi - Unannealed			ASTM D648
--	153 °F	67 °C	
Deflection Temperature Under Load (DTUL) at 264psi - Unannealed			ASTM D648
--	106 °F	41 °C	
Melting Temperature	264 °F	129 °C	ASTM D3418

Molded Properties	Typical Value (English)	Typical Value (SI)	Test Based On
Tensile Strength at Yield			ASTM D638
2.0 in/min (51 mm/min)	3000 psi	20 MPa	
Elongation at Yield	20 %	20 %	ASTM D638
Flexural Modulus - 1% Secant	130000 psi	890 MPa	ASTM D790B
Environmental Stress-Crack Resistance			ASTM D1693A
10% Igepal, F50	50 hr	50 hr	
100% Igepal, F50	550 hr	550 hr	

Impact	Typical Value (English)	Typical Value (SI)	Test Based On
Impact Strength			ARM
-40°F (-40°C), 0.125 in (3.18 mm)	80 ft·lb	108 J	
0.250 in (6.35 mm)	180 ft·lb	244 J	

Additional Information

All physical properties were measured on 3 mm. rotomolded samples unless a different value is shown, except for ESCR, which was measured on compression molded samples.

- Tensile testing was conducted at a crosshead speed of 50 mm/min. The tensile strength reported refers to the maximum stress reached during the test.
- Test procedures may be modified to accommodate operating conditions or facility limitations.

Typical properties: these are not to be construed as specifications.

Legal Statement

Contact your ExxonMobil Chemical Customer Service Representative for potential food contact application compliance (e.g. FDA, EU, HPFB).

This product is not intended for use in medical applications and should not be used in any such applications.

Notes

[1] Product may not be available in one or more countries in the identified Availability regions. Please contact your Sales Representative for complete Country Availability.

For additional technical, sales and order assistance:

Worldwide and the Americas
ExxonMobil Chemical Company
13501 Katy Freeway
Houston, TX 77079-1398
USA
1-281-870-6050

Asia Pacific
ExxonMobil Chemical Singapore Pte. Ltd.
1 HarbourFront Place
#06-00 HarbourFront Tower One
Singapore 098633
86 21 240-75380

Europe, Middle East and Africa
ExxonMobil Chemical Europe
Hermeslaan 2
1831 Machelen, Belgium
420-239-016-274

Typical properties: these are not to be construed as specifications.

Snyder Specification #199901

EnSol, Inc.

Snyder Industries, Inc.
Specification #199901 For
Polyethylene Upright Double Wall Storage Tanks
(10-19-2012)

1. Scope

1.1 This specification covers upright, double wall, flat bottom storage tank assemblies. The assembly consists of one cylindrical inner primary tank and one blended form octagonal outer secondary tank. Each tank is molded in one-piece seamless construction by rotational molding (laminated or fabricated tanks will not be accepted). The tanks are designed for above-ground, vertical installation and are capable of containing chemicals at atmospheric pressure. The assembly shall be designed to prevent rainwater from entering the containment tank. The design shall allow direct primary tank base retention for up to seismic conditions per IBC code requirements. The containment tank shall be designed to hold a minimum of 115% of the normal fill capacity of the primary tank. Included in this specification are requirements for material properties, design, construction, dimensions, tolerances, workmanship, and appearance. Tank capacities are from 550 gallons (2082 L) up to 10,000 gallons (37,851 L).

1.2 This specification does not cover the design of vessels intended for use at pressures above or below atmospheric conditions. It is also not for vessels intended for use with liquids heated above their flash points, temperatures above 140 degrees Fahrenheit for Type I materials, or temperatures above 130 degrees Fahrenheit for Type II materials (see section 6.1 for material classifications).

2. Applicable Documents

2.1 ASTM (American Society for Testing and Materials) Standards:

D618 Conditioning Plastics and Electrical Insulating Materials for Testing
D638 Tensile Properties of Plastics
D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
D883 Definitions of Terms Relating to Plastics
D1505 Density of Plastics by the Density-Gradient Technique
D1525 Test Method for Vicat Softening Temperature of Plastics
D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
D1998 Standard Specification for Polyethylene Upright Storage Tanks
D2765 Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction
D2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
D3892 Practice for Packaging/Packing of Plastics
F412 Definitions of Terms Relating to Plastic Piping Systems

2.2 ARM (Association of Rotational Molders) Standards: Low Temperature Impact Resistance (Falling Dart Test Procedure)

2.3 ANSI Standards: B-16.5 Pipe Flanges and Flanged Fittings

2.4 OSHA Standards: 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids

2.5 UBC CODE: Uniform Building Code 2006 Edition

2.6 IBC CODE: International Building Code 2009 Edition

2.7 CBC Code: California Building Code 2010 Edition

2.8 NSF/ANSI Standard 61 – Drinking Water System Components (Type II resin)

2.9 40 CFR-264.193

3. Submittals

3.1 Drawings and Data: The manufacturer's shop drawings shall be approved by the engineer or contractor prior to the manufacturing of the tank(s). Data and specifications for the equipment shall include, but shall not be limited to the following.

3.2 Contractor shall submit for review sufficient literature, detailed specifications, and drawings to show dimensions, materials used, design features, internal construction, weights and any other information required by the ENGINEER for review of storage tanks and accessories.

3.3 Information to be included with submittals are specified below:

3.3.1 Shop drawings for the tanks shall include as a minimum the following:

a) Service Conditions: Chemical environment and temperature.

b) Statement that fabrication shall be in accordance with ASTM D 1998, where applicable.

c) Sizing and description of the fittings and accessories for each tank that are to be supplied by the tank manufacturer.

d) Layouts and assembly schedules for each tank identifying the location and elevation from the bottom of the tank for all connections and appurtenances supplied by the tank manufacturer.

3.3.2 Resin - A copy of the resin data sheet from the resin manufacturer for the tank is to be supplied and the tank manufacturer is to certify that it will be the resin used in the manufacture of the tank. Verification may be required if the resin is to be FDA or NSF 61 listed.

3.3.3 Wall thickness - Prior to the manufacture of the tank the designed wall thickness audit is to be supplied based upon 600 psi hoop stress (ASTM D 1998) @ 100 degrees F. (Note: See 7.1.2 for chemicals being stored above 100 degrees F)

3.3.4 Tank restraint – If supplied, the drawings and calculations for the system are to be provided. Note: Wet stamped or site specific drawings and calculations may be required.

3.3.5 Supporting information on fittings and accessories to be supplied; heat system, insulation, mastic coating, etc.

3.4 Technical Manuals: The tank manufacturer's "Guideline for Use & Installation" is to be submitted for review.

3.5 Installation certificate: Once installed the installer is to certify that the tank system has been installed according to the tank manufacturer's Guidelines for Use & Installation.

3.6 Manufacturer's warranty

3.7 Manufacturer Qualifications: The manufacturer is to have rotationally molded polyethylene tanks based upon ASTM D 1998 utilizing Type I and Type II resins for the last 10 years.

3.8 Factory Test Report: Upon completion of the tank the manufacturer's inspection report is to be supplied for each tank.

a. Verification of wall thickness (See 8.5)
b. Impact test (See 8.3.1)
c. Gel test – (Type I resin only) (See 8.4)
d. Hydrostatic test (See 8.6)
e. Verification of fitting placement (See 8.2.4)
f. Visual inspection (See 8.7)
g. Verification of materials

4. Service Conditions

Note: The tank color will be based upon the chemical application and UV exposure of the installation. Tank color is to be natural, black or opaque white.

Table I – Service Conditions

Tank #	Chemical Stored	Concentration / Specific Gravity	Tank Location Inside / Outside	Operating Temperature *(Temperature of chemical)*	Fitting Material	Gasket Material	Bolt Material

5. Chemical Compatibility

5.1 Chemical compatibility shall be according to the following chemical resistance guides:

Compass Publications -

Pruett, Kenneth M., "Chemical Resistance Guide for Plastics"

Pruett, Kenneth M., "Chemical Resistance Guide for Metals and Alloys"

Pruett, Kenneth M., "Chemical Resistance Guide for Elastomers III"

5.2 These references shall be considered as general guidelines only. In many cases, combinations of these chemicals are used in such a way that only the customer (by testing molded product samples) can make a determination in regards to acceptability.

Note: Contact the manufacturer for applications that are not listed below.

Chemical	Concentration	Resin	Design Info	Fitting Material	Gasket Material	Bolt Material
Acetic Acid	60	HDLPE & XLPE	1.5/600	PP/PVC	EPDM	316SS/Hastelloy/Titan.
Acetic Acid	80	HDLPE	1.9/600	PP	EPDM	316SS/Hastelloy/Titan.
Acrylic Emulsions	50	XLPE	1.9/600	PVC	EPDM	316SS
Aluminum Sulfate	50	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Ammonium Sulfate	40	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Calcium Carbonate	Saturated	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS

Calcium Chloride	40	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
DEF (Diesel Exhaust Fluid)	32.5	HDLPE & XLPE	1.35/600	PP/PVC	EPDM	316SS
Deionized Water <5 Megohm		HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Deionized Water >5 Megohm		HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Ethyl Alcohol	100	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Ethylene Glycol	100	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Ferric Chloride	50	HDLPE & XLPE	1.9/600	PVC	EPDM	Hastelloy/Titan.
Ferric Sulfate	60	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Ferrous Chloride	Saturated	HDLPE & XLPE	1.9/600	PVC	EPDM	Hastelloy/Titan.
Ferrous Sulfate	20	HDLPE & XLPE	1.5/600	PVC	EPDM	Hastelloy
Hydrochloric Acid	37	HDLPE	1.9/600	PVC	Viton	Hastelloy
Hydrofluoric Acid	48	HDLPE	1.9/600	PP/PVC	Viton	Hastelloy
Hydrofluosilicic Acid	26	HDLPE/XLPE*	1.9/600	PP/PVC	Viton	Hastelloy
Hydrogen Peroxide	50	HDLPE	1.9/600	PVC	Viton	316SS/Hastelloy/Titan.
Isopropyl Alcohol	100	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Magnesium Chloride	30	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Methyl Alcohol	100	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Motor Oil	100	HDLPE & XLPE	1.9/600	316SS	Viton	316SS
Phosphoric Acid	85	HDLPE	1.9/600	PVC	Viton	316SS
Phosphoric Acid	50	HDLPE	1.9/600	PVC	Viton	316SS
Polymers (Deposition)		XLPE	1.5/600	PVC	EPDM	316SS
Potable Water		HDLPE	1.5/600	PVC	EPDM	316SS
Potassium Carbonate	50	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Potassium Hydroxide	Saturated	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Sodium Carbonate	30	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Sodium Carbonate	Saturated	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Sodium Hydroxide	50	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Sodium Hypochlorite-in(Non-UV)	<16.5	HDLPE	1.9/600	PVC	Viton	Titanium
Sodium Hypochlorite-out (UV)	<16.5	HDLPE #880059	1.9/600	PVC	Viton	Titanium
Sodium Hypochlorite-out (UV)	<16.5	HDLPE Insulated	1.9/600	PVC	Viton	Titanium
Sodium Thiosulfate	40	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Sulfuric Acid	98	HDLPE #880046*	1.9/600	CPVC	Viton	Hastelloy
Sulfuric Acid	93	HDLPE #880046*	1.9/600	CPVC	Viton	Hastelloy
Surfactants		XLPE	1.5/600	PVC	EPDM	316SS
Urea Solution	50	HDLPE & XLPE	1.35/600	PP/PVC	EPDM	316SS
Water w/Ozone up to 10 PPM		HDLPE & XLPE	1.5/600	PVC	EPDM	316SS

Note: Ambient Temperature / atmospheric pressure.
Chart applies to Industrial ASTM designed tanks.
*Chemical may cause tank material to discolor.
** 316SS may pit upon drying. Not recommended for SUMOs.
High purity chemical applications are limited to natural tank color or special hot compounded resins.
For chemicals or chemical blends not listed on the above chart, please contact Snyder Industries.

6. Materials – Resin Classification

6.1 Tanks are classified according to type as follows and it is the responsibility of the purchaser to specify Type I or Type II.

6.1.1 Type I – Tanks molded from cross-linkable polyethylene resin.

6.1.2 Type II - Tanks molded from linear polyethylene resin (not cross-linkable resin).

6.2 The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Type I tanks shall be made from crosslinked polyethylene (XLPE) resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties. Type II tanks shall be made from high density linear polyethylene (HDLPE) resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.

6.3 All polyethylene resin material shall contain a minimum of a U.V. 8 stabilizer as compounded by the resin manufacturer. Pigments may be added at the purchaser's request, but shall not exceed 0.25% (dry blended) of the total weight.

6.4 Mechanical Properties of Type I tank material: Cross-linked (XLPE)

PROPERTY	ASTM	VALUE
Density (Resin)	D1505	0.938-0.946 g/cc
Tensile (Yield Stress 2"/min)	D638	2830 - 3000 PSI
Elongation at Break (2"/min.)	D638	700 - 800%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1000 hours
Vicat Softening Degrees F. Temperature	D1525	250
Flexural Modulus	D790	87,000 – 110,000 PSI

6.5 Mechanical Properties of Type II tank material: High density Linear (HDLPE)

PROPERTY	ASTM	VALUE
Density (Resin)	D1505	0.941-0.948 g/cc
Tensile (Yield Stress 2"/min)	D638	3000 PSI
Elongation at Break (2"/min.)	D638	>1000%
ESCR (100% Igepal, Cond. A, F50)	D1693	550 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	50 hours
Vicat Softening Degrees F. Temperature	D1525	235
Flexural Modulus	D790	130,000 PSI

7. Design Requirements

7.1 The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in. thick.

T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD

T = wall thickness
SD = hydrostatic design stress, PSI
P = pressure (.433 x S.G. x H), PSI
H = fluid head, ft.
S.G. = specific gravity, g/cm^3
O.D. = outside diameter, in.

7.1.1 The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees

Fahrenheit for Type I and Type II materials. In accordance with the formula in 7.1, the tank shall have a stratiform (tapered wall thickness) wall.

7.1.2 The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

7.1.3 The standard design specific gravity shall be 1.5 or 1.9.

7.1 The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Secondary containment tanks shall be designed per SII standard containment thickness requirements. The secondary containment shall be configured to allow shipment of the primary tank inside of the secondary tank. The shipment shall be done without the aid of additional spacer blocks which can be lost during shipment causing tank damage.

7.2 The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The primary tank top shall be configured to prevent rain water from entering the secondary containment tank. The top head of tanks with 550 or more gallons of capacity shall be designed to provide a minimum of 1300 square inches of flat area for fitting locations. The primary tank shall be keyed to the secondary tank preventing primary tank rotation. The secondary containment shall have 115% of the normal fill capacity of the primary tank.

7.3 Tanks with 550 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of empty primary and secondary tanks. Tanks shall be capable of being lifted into position as a unit (primary and secondary tanks).

7.4 The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention in wind and seismic loading situations without tank damage. The primary/secondary tank unit shall be configured to allow direct primary tank base retention for seismic load conditions. The base retention unit shall be anchor bolted to an appropriate structure and not require additional spacer blocks. Refer to section 12.0 for tank tie-down accessories.

Table II – Tank Schedule

Tank Reference #				
Quantity				
Capacity - Side Wall				
Specific Gravity– designed				
Primary Tank				
Secondary Tank				
Diameter (nominal)				
Height (feet) maximum				
Tank Resin (primary/secondary)				
Type I XLPE				
Type II HDLPE				
Color				
Manway Type				

Fitting Material				
Gasket Material				
Bolt Material				

8. Test Methods

Quality Assurance & Testing

8.1 The tanks of the same material furnished under this Section shall be supplied by a manufacturer who has been regularly engaged in the design and manufacturing of rotationally molded polyethylene chemical storage tanks using cross-linked and high density linear polyethylene tanks for over ten years.

8.2 Dimensions and Tolerances

8.2.1 All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.

8.2.3 The tolerance for the outside diameter, including out of roundness, shall be per ASTM D1998.

8.2.4 The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.

8.3 Test Methods

Test specimens shall be taken from fitting location areas.

8.3.1 Low Temperature Impact Test

8.3.2 Test specimens shall be conditioned at (- 40) degrees Fahrenheit for a minimum of 2 hours.

8.3.3 The test specimens shall be impacted in accordance with the standard testing methods as found in ASTM D1998. Test specimens < ½" thickness shall be tested at 100 ft. lb. Test specimens > ½" thickness shall be tested at 200 ft. lb.

8.4 Degree of Crosslinking Test (% Gel – Type I Resin Only)

8.4.1 The test method used is to be the o-xylene insoluble fraction (gel test) per ASTM D2765 Method C. This test method is for determination of the ortho-xlene insoluble fraction (gel) of crosslinked polyethylene.

8.4.2 The percent gel level for Type I tanks on the inside 1/8 in. of the wall shall be a minimum of 65%.

8.5 Ultrasonic Tank Thickness Test

8.5.1 All tanks 2000 gallons or larger shall be measured for tank wall thickness at 6", 1ft., 2ft. and 3ft. on the tank sidewall height at 0° and 180° around the tank circumference with 0° being the tank manway and going counter-clockwise per ANSI standard drafting specifications. A copy of this test report can be ordered when placing the original tank order. All tanks shall meet design thickness requirements and tolerances.

8.5.2 Tanks smaller than 2000 gallons are only periodically measured at the start of a production run or after any design changes. Customers can place an order for tank wall

thickness measurements on smaller tank sizes when placing the original order. A copy of the test report will be provided if ordered.

8.6 Hydrostatic Water Test

8.6.1 The hydrostatic water test shall consist of filling the primary tank to brim full capacity for a minimum of four hours and conducting a visual inspection for leaks. A hydrostatic water test will be conducted if ordered by the customer.

8.7 Workmanship

8.7.1 The finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel. Fine bubbles are acceptable with Type II tanks to the degree in which they do not interfere with proper fusion of the resin melt.

8.7.2 All cut edges where openings are cut into the tanks shall be trimmed smooth.

Table III – Fitting and Accessory Schedule

Tank Number	TNK -	TNK -	TNK -	TNK -
Description	**Quantity / Size**	**Quantity / Size**	**Quantity / Size**	**Quantity / Size**
Inlet nozzle				
Top draw outlet nozzle				
Drain (transition fitting)				
Overflow				
Vent				
Surge Protection Lid				
Fill				
External fill pipe				
Internal fill pipe				
Manway				
Threaded/ vented				
Threaded				
Hinged				
Bolted / Sealed				
Ladder FRP / Galvanized Steel				
Lifting Lugs				
Tie-down Lugs				
Seismic/Wind Tie-down				
Galvanized Steel				
304 SS				
316 SS				
Level Indicator				
Ultrasonic				
Flexible tube				
Mechanical Reverse Float				

Leak Detection System				
Heat System				
Maintenance Temperature				
Min. Ambient Temperature				
Insulation w/mastic coating (gray in color)				

9. Tank Fittings (Nozzles)

9.1 Fittings – Threaded Bulkhead

9.1.1 Threaded bulkhead fittings are available for above liquid installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult SII for placement questions. The maximum allowable size for bulkhead fittings placed on a curved cylindrical section of tanks 48 in. to 142 in. in diameter is 2 inch. Tank wall thickness must be considered for bulkhead fitting placement. The maximum wall thickness for each fitting size is shown below.

Fitting Size	Maximum Wall Thickness
1/2 in.	2 in.
3/4 in.	2 in.
1 in.	2 in.
1 1/4 in.	2 in.
1 1/2 in.	2 in.
2 in.	2 in.
3 in.	2.125 in. (Flat Surface Only)

9.1.2 The bulkhead fittings shall be constructed of PVC, PP, or other specified material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton◆, or other specified material.

9.2 Fittings - Bolted Double 150 lb. Flange Fittings

9.2.1 Bolted double flange fittings are available for below liquid level installation for sizes 2 in. through 4 in. depending on the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult SII for placement questions. Bolted double flange fittings provide the best strength and sealing characteristics of any tank fitting available. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

Tank Diameter	Maximum Bolted Fitting Size Allowable
48 in. - 86 in.	3 in.
90 in. - 102 in.	6 in.
120 in. - 142 in.	8 in.

The bolted double flange fittings shall allow tank wall thickness up to 2 1/2 in.

9.2.2 The bolted double flange fitting shall be constructed with 2 ea. 150 lb. flanges, 2 ea. 150 lb. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. The flanges shall be constructed of PVC Type I, Grade I, or other specified material. Gaskets shall be a minimum of 1/4" thickness and

constructed of 40-50 durometer EPDM, 60-70 durometer Viton◆ or other specified material. There shall be a minimum of 4 ea. full thread bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4" of the threads closest to the bolt head. The polyethylene shall be color coded to distinguish bolt material (white - 316 S.S., yellow - Hastelloy C276, red - Monel, green - Titanium). Each encapsulated bolt shall have a gasket to provide a sealing surface against the inner flange.

9.2.3 Standard orientation of bolted double flange fittings shall have bolt holes straddling the principal centerline of the tank in accordance with ANSI/ASME B-16.5 unless otherwise specified.

9.3 Fittings - Bolted Stainless Steel Fittings

9.3.1 Bolted stainless steel fittings are available for below liquid level installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult SII for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

Tank Diameter	Maximum Bolted Fitting Size Allowable
48 in.	3 in.
64 in. - 142 in.	4 in.

The bolted stainless steel fittings shall allow tank wall thickness up to 2 1/2 in.

9.3.2 The bolted stainless steel fittings shall be constructed with a minimum of 4 fully threaded 3/8 in. studs. Each fitting shall have two gaskets and two flanges. One gasket shall be compressed between the inside of the tank wall surface and the inside flange of the fitting. The other gasket shall be compressed between the outside tank wall surface and the outside flange of the fitting. The stainless steel fittings come standard with female pipe threads on both the inner and outer flanges. Other threading arrangements may be specified. The fittings shall be constructed of Type 316 stainless steel. Gaskets shall be a minimum of ¼" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton◆ or other specified material.

9.4 Fittings – Unified Fitting Outlet (UFO™)

9.4.1 The UFO shall provide a flexible containment seal between the inner primary tank and the outer secondary containment tank. This fitting outlet when used in combination with fittings as per sections 9.2 and 9.3 provides access for connecting piping to the inner primary tank while maintaining containment integrity between the inner primary tank and the outer secondary containment tank. This fitting outlet may be used for 2, 3, and 4 in. fitting sizes.

9.4.2 The fitting outlet shall consist of 1 ea. flexible polyethylene containment boot, 1 ea. appropriate fitting gasket, 1 ea. UFO gasket, 1 ea. solid 304 stainless steel UFO flange, 1 ea. split 304 stainless steel UFO flange, and 12 ea. 3/8 in. 304 stainless steel bolt assemblies. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton◆ or other specified material.

9.5 Fittings - Siphon Tube Fittings

9.5.1 Siphon tubes may be added to the fittings specified in sections 9.2 and 9.3. A siphon tube will allow these fittings, when used as drainage fittings, to provide better tank drainage.

9.6 Vents

9.6.1 Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106 (f) (2) (iii) or other accepted standard. All tanks

must be vented for atmospheric pressure as well as any pressure created by filling and emptying the tank. Some applications may require a sealed tank with a vent line going to a scrubber system for proper chemical safety. Venting equipment should be sized to limit pressure or vacuum in the tank to a maximum of 1/2" of water column (0.02 psi). U-Vents are offered in sizes from 1 in. to 6 in. with or without mesh insect screening. U-Vents with mesh screening may require additional sizing due to reduced air-flow rates. Consult the manufacturer for necessary venting and placement information.

9.6.2 All u-vents shall be constructed of PVC or other specified materials.

9.6.3. When a tank is being filled from a pressurized tanker truck or rail car steps need to be taken to avoid pressurizing the tank. The tank may require a secondary surge protection lid to avoid any pressure build up. The surge protection lid is to be a 14” or 18” hinged and be design that it is self-closing.

9.7 Flange Adapters

9.7.1 Flange adapters may be purchased as optional equipment to adapt threaded or socket fitting outlets to 150 lb. flange connections for connection to piping system components. Flange adapters are available in PVC, CPVC or other specified materials. Flange adapter construction shall utilize schedule 80 components in sizes ranging from ¾” to 8” depending on material required.

9.8 Fittings - Self-Aligning Threaded Bulkhead

9.8.1 Self-Aligning fittings are available for installation in vapor phase applications on curved surfaces depending on the spherical dome radius and the placement of the fitting on the tank dome. Fittings must be placed away from tank radius’. Consult SII for placement questions. The maximum allowable size for self-aligning fittings placed on a spherical section of the tank is shown below.

Tank Diameter	Maximum Fitting Size Allowable
45 in. – 48 in.	2 in.
64 in. – 142 in.	3 in.

Tank thickness and fitting angle may need to be considered for self-aligning fitting placement. The maximum thickness and installation angles for each fitting size are shown below.

Fitting Size	Maximum Angle	Maximum Thickness
1 in.	27 degrees	1.000 in.
2 in.	25 degrees	0.750 in.
3 in.	20 degrees	1.000 in.

9.8.2 The self-aligning fittings shall be constructed of PVC or CPVC. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton◆, or other specified material.

9.9 Flexible Connections

9.9.1 All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer. The tank will deflect based upon tank loading, chemical temperature and storage time duration. Tank piping flexible couplers shall be designed to allow 4% design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.

9.1.2 The flexible connection is to be manufactured of the same material as the tank or a compatible material approved by the project engineer. If an elastomer flexible connection is used control bolts are required if recommended by the manufacturer. The flexible

connection is to be designed for a minimum of 4% movement. The flexible connection is to be designed with 150# flange connections to allow for attachment to the tank and the piping system. The flexible connection is to be attached as close as possible to the tank to reduce stress.

10. Tank Attachments

10.1 Tank Attachments – Ultrasonic Level Indicator

10.1.1a. The ultrasonic enclosure is to be an all plastic design with a NEMA 4X rating. The ultrasonic transducer is to have a 12" dead band and beam with a 20 ft range. The supply voltage can be 110, 220 VAC or 24 VDC. The connection to the tank is to be 2" NPT.

The ultrasonic level indicator shall provide a visual display of liquid level in the tank showing gallonage in measurement of hundreds of gallons along with 4-20 mA output for other alarm or control systems as well as four independent contacts capable of handling 10 amps each. Each contact can be programmed to operate in different opening and closing methods (7 modes). Contacts can be used to control pumps, valves, alarms, etc.

10.2 Tank Attachments – Leak Detector Unit

10.2.1 The leak detector unit shall consist of a proximity sensor, a welded 2 in. fpt connection, a 2 in. bung plug with a ¾ in strain relief, and an indicator box. The sensor is placed in the interstitial space between the primary and secondary tanks approximately 1 in. above the tank bottom. The indicator box shall be Nema 4 rated and factory pre-wired for 110 VAC power. All connections shall be labeled to prevent errors in field installation. The indicator box will show a green light when power is on and the sensor is not detecting a liquid. The light is a push to test light allowing the operator to test for power outage or malfunction. If the green light goes out there are two possibilities. The green light does not come on when the button is pushed. This would indicate a lack of power to the unit or the light bulb is burned out. If the green light comes on when pushed, then a possible leak condition is indicated.

10.3 Level Indication

10.3.1 Sight Level Gage

a. The sight level gage shall be constructed of flexible PE or PVC tubing to allow for tank contraction and expansion due to loading and temperature changes. The level gage shall be connected to the tank at the top of the tank with 1ea. appropriate 3/4" fitting as described in section 9.1 or 9.2. and to a tee off of the drain / transition fitting. Each fitting can have valves installed for isolation or drainage purposes.

10.3.2 Manway and Fill Cap (Non-sealed)

10.3.1 Fill caps are available in a 10 in. vented-threaded style on various tank sizes with a minimum opening diameter of 7.125 in. Cap attachment shall be provided with all standard 10 in. cap placements with a polyurethane cap tie. Check the manufacturer's specification drawing for availability and position.

10.3.2 Manways are available in an 18 in. vented or non-vented threaded design or hinged style (minimum opening diameter of 15 in.) and a 24 in. vented or non-vented threaded or hinged style (minimum opening diameter of 22 in.) on various tank sizes. Check the manufacture's specification drawing for availability and position.

10.3.3 All caps and manways shall be constructed of polyethylene material.

10.4 Bolted Sealed Top Manway

10.4.1 Sealed manways are available in 14, 18, 20 and 24 in. sizes on certain tanks in selected positions. Consult the manufacturer for placement positions.

10.4.2 The sealed manway shall be constructed of polyethylene material. The bolts shall be polypropylene or other specified material. The gaskets shall be closed cell, crosslinked polyethylene foam and Viton◆ o-rings to seal the bolts.

10.5 Surge Protection Lid

10.5.1 The hinged lid is to be manufactured of polyethylene. The lid will be a 14 in. size with 11 in. access opening or 18" with 15" access. The opening of the lid is to be restricted by a tether. The lid is to be designed so that is will close when the pressure has been released. Check SII specification drawing for availability and position.

10.6 Tank Attachments – External Fill Pipes

10.6.1 External fill pipes shall be prepared per the customer approved drawings and specifications. All external fill pipes shall be supported at 3 ft. maximum intervals with a support structure independent of the tank (ground supported). All designs shall be done according to the specific needs of the customer.

10.6.2 All external fill pipes shall be constructed of PVC or other specified materials.

10.7 Tank Attachments – Internal Down Pipes

10.7.1 Internal down pipes shall be prepared per the customer approved drawings and specifications. All internal down pipes shall be supported at 5 ft. maximum intervals with a support structure welded to the inside of the primary tank (only available in tanks constructed with Type II resin). The support design may utilize a PVC clamp or other specified materials for support. All designs shall be done according to the specific needs of the customer.

10.7.2. All internal down pipes shall be constructed of PVC or other specified materials.

11. Tank Accessories

11. Ladders

11.1 Ladders shall be constructed of galvanized mild steel or FRP.

11.2 Safety cages shall be provided with ladders as optional equipment unless required by OSHA standards.

11.3 All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.

11.4 Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded in attachment lugs that allow for tank movement due to temperature and loading changes.

11.5 Mild steel parts shall be deburred and galvanized.

12.0 Tie Down Systems

12.1 The tie down system shall be designed to withstand 150 MPH wind loads. Tie down systems must meet seismic requirements per IBC 2009 / CBC 2010 code with seismic loads ≤ .445g (Seismic Design Category "D" - Fa=1.0, Fv=1.5, Ss=1.4, S1=0.5). Anchor bolts shall be provided by the contractor per the calculations and the base plates for the system. A registered engineer's wet stamped calculations and or drawings may be required.

12.2 The tie down system shall be offered galvanized, 304 or 316 stainless steel.

12.3 Mild steel parts shall be deburred and galvanized.

13.0 Tank Accessories - Tank Heating Systems

13.1 Heating systems for use with polyethylene tanks shall be designed to meet specific requirements such as tank material type, tank size, low ambient temperature, and desired maintenance temperature.

13.2 All control components of the heating system shall be mounted in water tight, high impact plastic box(es) with a gasketed cover.

13.3 All heating system components shall be Nema 4 rated and factory pre-wired for 110 VAC. All connections shall be labeled to prevent errors in field installation.

13.4 Each control box shall carry a decal attached to the inside surface of the cover, on which an electrical wiring diagram will be printed.

13.5 Each control box shall contain two temperature controls. One control shall regulate the maintenance temperature setting and the other control shall regulate the high temperature setting. The maintenance temperature setting should be set at the desired maintenance temperature. The high temperature setting shall be adjusted to 10 degrees above the desired maintenance temperature to a maximum of 130 degrees Fahrenheit. All control systems must be designed with a power off failure mode.

13.6 The heating panels shall be designed to wrap around and lie flat against the surface of the secondary containment tank. The heating panels shall have a maximum heating density of 0.022 watts per square centimeter. All heating panels and sensor bulbs shall be attached to the tank with 2" wide duct tape. The high temperature sensor shall directly sense the temperature of the heating panels on the secondary containment tank. The maintenance temperature sensor shall directly sense the temperature of the inner primary tank. Under no circumstances shall cable type heaters be used with polyethylene tanks.

13.7 Insulation used shall be polyurethane foam with a density of 2.0 - 3.0 lb./ft ^3 with a "R" value of 8.33/in. The foam shall be applied with a nominal thickness of 2" to all external tank surfaces except the tank bottom shell.

13.8 Upon completion of application and curing of the insulation, two full coverage coats of latex mastic coating shall be applied to the surface of the insulation in such manner as to seal the insulation from the outside environment.

14. Warranty

14.1 The tank shall be warranted for three years in regards to defects in materials and workmanship. The warranty on fittings and accessories that are supplied by the tank manufacturer will be for one year. The warranty will begin at time of shipment.

15. Marking, Packing and Packaging

15.1 The tanks shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. The tank shall be shipped with a 3 of 9, HRI bar code label containing tank description, manufacturing order number, part number, serial number, manufacturer, and date.

15.2 The proper caution or warning signs as prescribed by OSHA standard 29 CFR 1910.106 shall be customer determined and supplied.

15.3 All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard.

15.4 Customer specified labeling is available.

15.5 Tank shrink wrapping and bagging is available upon customer request.

15.6 All fittings that do not interfere with tank shipment shall be installed unless otherwise specified. Fittings and accessories that interfere with tank shipment or could be broken during shipment are shipped separately.

16. Shipping

16.1 Since there are variations in methods of shipping, SII's instructions shall be followed in all cases.

16.2 Consult the SII “Guidelines for Use and Installation” booklet included with your tank for unloading instructions on specific tanks. This booklet can be found attached to the cap or manway area on the inside of the tank. Tanks with capacities of 2000 gallons or more have molded-in lifting lugs provided to assist with tank handling. All tank units are shipped with shipping cables allowing the two tanks to be handled as a unit during shipping and tank handling. Once the tank is put into position the shipping cables are to be removed to allow the tank to fully contact the tank pad/support area.

16.3 Upon arrival at the destination, the purchaser and/or his agent shall be responsible for inspection for damage in transit. If damage has occurred, a claim should be filed with the carrier by the purchaser, and the manufacturer should be notified prior to the tank being put into service.

17. Delivery & Storage

17.1 Installation

17.1.1 Transportation, handling, storage of the tanks, and installation shall be in accordance with the manufacturer's printed instructions.

17.1.2. Repair any damage to tank components or the insulation due to transportation or installation.

17.1.3. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer. The tank will deflect based upon tank loading, chemical temperature and storage time duration. Tank piping flexible couplers shall be designed to allow 4 percent design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.

17.1.4. The installer is to certify in writing that the tank system has been installed according to the tank manufacturer’s Guidelines for Use & Installation.

Tank Chemical Resistance Chart

(Snyder)

EnSol, Inc.

SNYDER INDUSTRIES, INC.
THE ENGINEERED DIFFERENCE IN TANKS

April 2012

CHEMICAL RESISTANCE RECOMMENDATIONS

Chemical	Concentration	Resin	Design Info	Fitting Material	Gasket Material	Bolt Material
Acetic Acid	60	HDLPE & XLPE	1.5/600	PP/PVC	EPDM	316SS/Hastelloy/Titan.
Acetic Acid	80	HDLPE	1.9/600	PP	EPDM	316SS/Hastelloy/Titan.
Acrylic Emulsions	50	XLPE	1.9/600	PVC	EPDM	316SS
Aluminum Sulfate	50	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Ammonium Sulfate	40	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Calcium Carbonate	Saturated	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Calcium Chloride	40	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
DEF (Diesel Exhaust Fluid)	32.5	HDLPE & XLPE	1.35/600	316SS	EPDM	316SS
Deionized Water <5 Megohm		HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Deionized Water >5 Megohm		HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Ethyl Alcohol	100	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Ethylene Glycol	100	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Ferric Chloride	50	HDLPE & XLPE	1.9/600	PVC	EPDM	Hastelloy/Titan.
Ferric Sulfate	60	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Ferrous Chloride	Saturated	HDLPE & XLPE	1.9/600	PVC	EPDM	Hastelloy/Titan.
Ferrous Sulfate	20	HDLPE & XLPE	1.5/600	PVC	EPDM	Hastelloy
Hydrochloric Acid	37	HDLPE	1.9/600	PVC	Viton	Hastelloy
Hydrofluoric Acid	48	HDLPE	1.9/600	PP/PVC	Viton	Hastelloy
Hydrofluosilicic Acid	26	HDLPE/XLPE*	1.9/600	PP/PVC	Viton	Hastelloy
Hydrogen Peroxide	50	HDLPE	1.9/600	PVC	Viton	316SS/Hastelloy/Titan.
Isopropyl Alcohol	100	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Magnesium Chloride	30	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Methyl Alcohol	100	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS
Motor Oil	100	HDLPE & XLPE	1.9/600	316SS	Viton	316SS
Phosphoric Acid	85	HDLPE	1.9/600	PVC	Viton	316SS
Phosphoric Acid	50	HDLPE	1.9/600	PVC	Viton	316SS
Polymers (Deposition)		XLPE	1.5/600	PVC	EPDM	316SS
Potable Water		HDLPE	1.5/600	PVC	EPDM	316SS
Potassium Carbonate	50	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Potassium Hydroxide	Saturated	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Sodium Carbonate	30	HDLPE & XLPE	1.5/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Sodium Carbonate	Saturated	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS**/Hastelloy/Titan.
Sodium Hydroxide	50	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Sodium Hypochlorite-in(Non-UV)	<16.5	HDLPE	1.9/600	PVC	Viton	Titanium
Sodium Hypochlorite-out (UV)	<16.5	HDLPE #880059	1.9/600	PVC	Viton	Titanium
Sodium Hypochlorite-out (UV)	<16.5	HDLPE Insulated	1.9/600	PVC	Viton	Titanium
Sodium Thiosulfate	40	HDLPE & XLPE	1.9/600	PVC	EPDM	316SS
Sulfuric Acid	98	HDLPE #880046*	1.9/600	CPVC	Viton	Hastelloy
Sulfuric Acid	93	HDLPE #880046*	1.9/600	CPVC	Viton	Hastelloy
Surfactants		XLPE	1.5/600	PVC	EPDM	316SS
Urea Solution	50	HDLPE & XLPE	1.35/600	PP/PVC	EPDM	316SS
Water w/Ozone up to 10 PPM		HDLPE & XLPE	1.5/600	PVC	EPDM	316SS

Note: Ambient Temperature.
Chart applies to Industrial ASTM designed tanks.
*Chemical may cause tank material to discolor.
** 316SS may pit upon drying. Not recommended for SUMOs.
High purity chemical applications are limited to natural tank color or special hot compounded resins.
For chemicals or chemical blends not listed on the above chart, please contact Snyder Industries.

Fac Pond Water Physical / Chemical Analysis

(CWM)

EnSol, Inc.

2012 PHYSICAL / CHEMICAL ANALYSES
FACULATIVE POND # 3

EFFLUENT PARAMETER	DISCHARGE LIMIT	FACULTATIVE POND #3 CONCENTRATION	PRACTICAL QUANTITATION LIMIT	UNITS
pH (RANGE)	(6.5 to 8.5)	7.6	0.01	SU
SPECIFIC CONDUCTANCE	Monitor	10,567	1	µmhos/cm
ALKALINITY, TOTAL (as CaCO3)	Monitor	123.3	1	mg/l
HARDNESS, TOTAL (as CaCO3)	Monitor	715	5	mg/l
TEMPERATURE	90	62	0.1	^{o} F
SOLIDS, TOTAL SUSPENDED	60	12	1.0	mg/l
SOLIDS, TOTAL DISSOLVED	13,000	6,420	10	mg/l
SOLIDS, VOLATILE DISSOLVED	Monitor	583	10.0	mg/l
SOLIDS, SETTLEABLE	0.2	<0.1	0.1	ml/l/hr
BOD, 5-DAY	45	4.3	6	mg/l
DISSOLVED OXYGEN	2.0 (min)	6.6	0.01	mg/l
CARBON, TOTAL ORGANIC	Monitor	21	10	mg/l
NITROGEN, TOTAL ORGANIC (as N)	Monitor	4.3	1.00	mg/l
AMMONIA (as N)	20	2.8	0.5	mg/l
NITRITE, TOTAL (as N)	1.5	1.05	0.10	mg/l
NITRITE + NITRATE, TOTAL (N)	10	4.4	0.01	mg/l
OIL & GREASE	15	<1.0	1.0	mg/l
SURFACTANTS (MBAS)	1.0	0.04	0.02	mg/l
ALUMINUM, TOTAL	4,000	<100	100	µg/l
ANTIMONY, TOTAL	90	<60	60	µg/l
ARSENIC, TOTAL	80	22	5	µg/l
BARIUM, TOTAL	1,000	77	10	µg/l
BERYLLIUM, TOTAL	20	<5	5	µg/l
CADMIUM, TOTAL	50	<5	5	µg/l
CHLORIDE, TOTAL	Monitor	3,210,000	100,000	µg/l
CHLORINE, RESIDUAL	1,000	<324	324	µg/l
CHROMIUM, TOTAL	370	<5	5	µg/l
COBALT, TOTAL	75	<50	50	µg/l
COPPER, TOTAL	300	14	5	µg/l
CYANIDE, TOTAL	400	<10	10	µg/l
FLUORIDE, TOTAL	12,000	1,850	100	µg/l
IRON, TOTAL	3,100	318	50	µg/l
LEAD, TOTAL	100	<5	5	µg/l
MANGANESE, TOTAL	1,100	182	20	µg/l
MERCURY, TOTAL	2,000	<200	200	ng/l
MERCURY, TOTAL LOW LEVEL	Monitor	36	25	ng/l
MOLYBDENUM, TOTAL	410	135	10	µg/l

2012 PHYSICAL / CHEMICAL ANALYSES
FACULATIVE POND # 3

EFFLUENT PARAMETER	DISCHARGE LIMIT	FACULTATIVE POND #3 CONCENTRATION	PRACTICAL QUANTITATION LIMIT	UNITS
NICKEL, TOTAL	550	57	20	µg/l
PHOSPHOROUS, TOTAL	5,000	133	20	µg/l
SELENIUM, TOTAL	40	<5	5	µg/l
SILVER, TOTAL	60	<10	10	µg/l
STRONTIUM, TOTAL	4000	1600	50	µg/l
SULFATE, TOTAL	Monitor	1,300,000	200000	µg/l
SULFIDE, TOTAL	2000	<100	100	µg/l
THALLIUM, TOTAL	50	<10	10	µg/l
TIN, TOTAL	10	<10	10	µg/l
TITANIUM, TOTAL	1000	<10	10	µg/l
VANADIUM, TOTAL	42	<20	20	µg/l
ZINC, TOTAL	500	<10	10	µg/l
AROCLOR 1016	Nondetect	<65	65	ng/l
AROCLOR 1221	Nondetect	<65	65	ng/l
AROCLOR 1232	Nondetect	<65	65	ng/l
AROCLOR 1242	Nondetect	<65	65	ng/l
AROCLOR 1248	Nondetect	<65	65	ng/l
AROCLOR 1254	Nondetect	<65	65	ng/l
AROCLOR 1260	Nondetect	<65	65	ng/l
ACENAPHTHLYENE	20	<5	5	µg/l
BENZIDINE	200	<25	25	µg/l
BENZO[A]ANTHRACENE	40	<5	5	µg/l
BENZO[B]FLUORATHENE	20	<5	5	µg/l
BENZOTHIAZOLE	10	<10	10	µg/l
BENZO[GHI]PERYLENE	5.5	<5	5	µg/l
BIS(2-CHLOROETHOXY)METHANE	30	<5	5	µg/l
BIS(2-CHLOROETHYL)ETHER	30	<5	5	µg/l
BIS(2-CHLOROISOPROPYL)ETHER	30	<5	5	µg/l
BIS(2-ETHYL HEXYL)PHTHALATE	50	<5	5	µg/l
4-CHLORO-3-METHYLPHENOL	20	<5	5	µg/l
2-CHLOROPHENOL	20	<5	5	µg/l
4-CHLOROPHENYL PHENYL ETHER	20	<5	5	µg/l
1,4-DICHLOROBENZENE	20	<5	5	µg/l
3,3'-DICHLOROBENZIDINE	70	<10	10	µg/l
2,4-DICHLOROPHENOL	20	<5	5	µg/l
DIETHYLPHTHALATE	40	<5	5	µg/l
2,4-DIMETHYPHENOL	20	<5	5	µg/l

2012 PHYSICAL / CHEMICAL ANALYSES
FACULATIVE POND # 3

EFFLUENT PARAMETER	DISCHARGE LIMIT	FACULTATIVE POND #3 CONCENTRATION	PRACTICAL QUANTITATION LIMIT	UNITS
2,4-DINITROPHENOL	120	<25	25	µg/l
2,4-DINITROTOLUENE	30	<5	5	µg/l
HEXAMETHYLBENZENE	8	<5	5	µg/l
INDENO[1,2,3-C,D]PYRENE	5.5	<5	5.0	µg/l
2-METHYL-4,6-DINITROPHENOL	100	<25	25	µg/l
2-NITROPHENOL	20	<5	5.0	µg/l
PENTACHLOROPHENOL	20	<20	20.0	µg/l
PHENANTHRENE	30	<5	5.0	µg/l
2,4,6-TRICHLOROPHENOL	20	<5	5.0	µg/l
SEMI-VOLATILE ORGANICS (1)	10	<10	(10)	µg/l
PHENOLICS, TOTAL RECOVERABLE	220	<4	2	µg/l
2-CHLOROETHYLVINYL ETHER	20	<10	10	µg/l
DICHLORODIFLUOROMETHANE	10	<1	1	µg/l
METHYLENE CHLORIDE	20	<5.0	5.0	µg/l
VOLATILE ORGANICS (2)	10	<10	(10)	µg/l

NOTES:

(1) Parenthetical reporting limit represents the highest reporting limit for USEPA Method 625 for those compounds not listed individually.

(2) Parenthetical reporting limit represents the highest reporting limit for USEPA Method 624 for those compounds not listed individually. Value excludes Acrolein and Acrylonitrile which are analyzed by approved screen methodology per USEPA Method 624.

Appendix C

Proposed Pump, Piping, And Equipment Information

EnSol, Inc.

Secondary Containment Submersible Pump Data

(Goulds)

EnSol, Inc.

TECHNICAL BROCHURE
B3885

FEATURES

Impeller: Cast iron, semi-open, non-clog with pump-out vanes for mechanical seal protection. Balanced for smooth operation. Silicon bronze impeller available as an option.

Casing: Cast iron volute type for maximum efficiency. 2" NPT discharge.

Mechanical Seal: Silicon Carbide vs. Silicon Carbide sealing faces. Stainless steel metal parts, BUNA-N elastomers.

Shaft: Corrosion-resistant, stainless steel. Threaded design. Locknut on all models to guard against component damage on accidental reverse rotation.

Fasteners: 300 series stainless steel.

Capable of running dry without damage to components.

Designed for continuous operation when fully submerged.

EXTENDED WARRANTY AVAILABLE FOR RESIDENTIAL APPLICATIONS.

WE Series

Model 3885

SUBMERSIBLE EFFLUENT PUMPS

GOULDS WATER TECHNOLOGY
a xylem brand

APPLICATIONS

Specifically designed for the following uses:

- Homes, Farms, Trailer Courts, Motels, Schools, Hospitals, Industry, Effluent Systems

SPECIFICATIONS

Pump

- Solids handling capabilities: ¾" maximum.
- Discharge size: 2" NPT.
- Capacities: up to 140 GPM.
- Total heads: up to 128 feet TDH.
- Temperature: 104°F (40°C) continuous, 140°F (60°C) intermittent.
- See order numbers on reverse side for specific HP, voltage, phase and RPM's available.

MOTORS

- Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.
- Class B insulation on ⅓ – 1½ HP models.
- Class F insulation on 2 HP models.

Single phase (60 Hz):

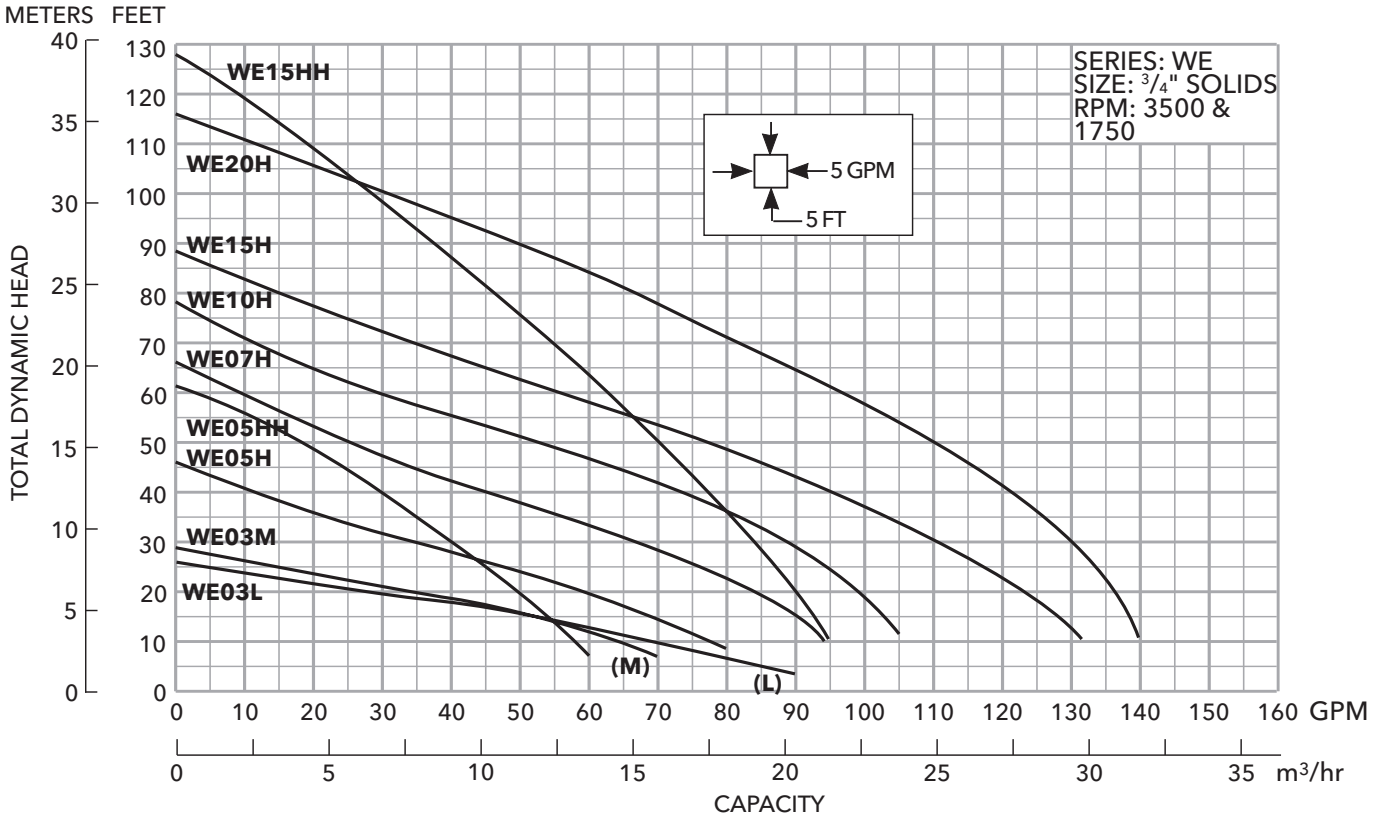
- Capacitor start motors for maximum starting torque.
- Built-in overload with automatic reset.
- SJTOW or STOW severe duty oil and water resistant power cords.
- ⅓ – 1 HP models have NEMA three prong grounding plugs.
- 1½ HP and larger units have bare lead cord ends.

Three phase (60 Hz):

- Class 10 overload protection must be provided in separately ordered starter unit.
- STOW power cords all have bare lead cord ends.
- Designed for Continuous Operation: Pump ratings are within the motor manufacturer's recommended working limits, can be operated continuously without damage when fully submerged.
- Bearings: Upper and lower heavy duty ball bearing construction.
- Power Cable: Severe duty rated, oil and water resistant. Epoxy seal on motor end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking. Standard cord is 20'. Optional lengths are available.
- O-ring: Assures positive sealing against contaminants and oil leakage.

AGENCY LISTINGS

Tested to UL 778 and CSA 22.2 108 Standards
By Canadian Standards Association File #LR38549



MODELS

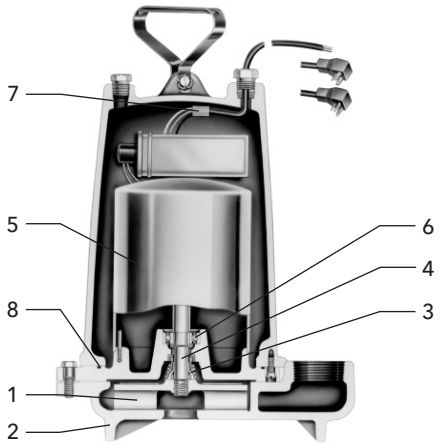
Order Number	HP	Phase	Volts	RPM	Impeller Diameter (in.)	Maximum Amps	Locked Rotor Amps	KVA Code	Full Load Efficiency %	Resistance		Power Cable Size	Weight (lbs.)
										Start	Line-Line		
WE0311L	0.33	1	115	1750	5.38	10.7	30.0	M	54	11.9	1.7	16/3	56
WE0318L			208			6.8	19.5	K	51	9.1	4.2		
WE0312L			230			4.9	14.1	L	53	14.5	8.0		
WE0311M			115			10.7	30.0	M	54	11.9	1.7		
WE0318M			208			6.8	19.5	K	51	9.1	4.2		
WE0312M			230			4.9	14.1	L	53	14.5	8.0		
WE0511H	0.5	1	115	3450	3.56	14.5	46.0	M	54	7.5	1.0	14/3	60
WE0518H			208			8.1	31.0	K	68	9.7	2.4	16/3	60
WE0512H			230			7.3	34.5	M	53	9.6	4.0		
WE0538H		3	200			4.9	22.6	R	68	NA	3.8	14/4	60
WE0532H			230			3.3	18.8	R	70	NA	5.8		
WE0534H			460			1.7	9.4	R	70	NA	23.2		
WE0537H			575			1.4	7.5	R	62	NA	35.3		
WE0511HH		1	115		3.88	14.5	46.0	M	54	7.5	1.0	14/3	60
WE0518HH			208			8.1	31.0	K	68	9.7	2.4	16/3	60
WE0512HH			230			7.3	34.5	M	53	9.6	4.0		
WE0538HH		3	200			4.9	22.6	R	68	NA	3.8	14/4	60
WE0532HH			230			3.6	18.8	R	70	NA	5.8		
WE0534HH			460			1.8	9.4	R	70	NA	23.2		
WE0537HH			575			1.5	7.5	R	62	NA	35.3		
WE0718H	0.75	1	208		4.06	11.0	31.0	K	68	9.7	2.4	14/3	70
WE0712H			230			10.0	27.5	J	65	12.2	2.7		
WE0738H		3	200			6.2	20.6	L	64	NA	5.7	14/4	70
WE0732H			230			5.4	15.7	K	68	NA	8.6		
WE0734H			460			2.7	7.9	K	68	NA	34.2		
WE0737H			575			2.2	9.9	L	78	NA	26.5		
WE1018H	1	1	208		4.44	14.0	59.0	K	68	9.3	1.1	14/3	70
WE1012H			230			12.5	36.2	J	69	10.3	2.1		
WE1038H		3	200			8.1	37.6	M	77	NA	2.7	14/4	70
WE1032H			230			7.0	24.1	L	79	NA	4.1		
WE1034H			460			3.5	12.1	L	79	NA	16.2		
WE1037H			575			2.8	9.9	L	78	NA	26.5		
WE1518H	1.5	1	208		4.56	17.5	59.0	K	68	9.3	1.1	14/3	80
WE1512H			230			15.7	50.0	H	68	11.3	1.6		
WE1538H		3	200			10.6	40.6	K	79	NA	1.9	14/4	80
WE1532H			230			9.2	31.7	K	78	NA	2.9		
WE1534H			460			4.6	15.9	K	78	NA	11.4		
WE1537H			575			3.7	13.1	K	75	NA	16.9		
WE1518HH		1	208		5.50	17.5	59.0	K	68	9.3	1.1	14/3	80
WE1512HH			230			15.7	50.0	H	68	11.3	1.6		
WE1538HH		3	200			10.6	40.6	K	79	NA	1.9	14/4	80
WE1532HH			230			9.2	31.7	K	78	NA	2.9		
WE1534HH			460			4.6	15.9	K	78	NA	11.4		
WE1537HH			575			3.7	13.1	K	75	NA	16.9		
WE2012H	2	1	230		5.38	18.0	49.6	F	78	3.2	1.2	14/3	83
WE2038H		3	200			12.0	42.4	K	78	NA	1.7	14/4	83
WE2032H			230			11.6	42.4	K	78	NA	1.7		
WE2034H			460			5.8	21.2	K	78	NA	6.6		
WE2037H			575			4.7	16.3	L	78	NA	10.5		

PERFORMANCE RATINGS (gallons per minute)

Order No.		WE-03L	WE-03M	WE-05H	WE-07H	WE-10H	WE-15H	WE-05HH	WE-15HH	WE-20H
Total Head Feet of Water	HP	⅓	⅓	½	¾	1	1½	½	1½	2
	RPM	1750	1750	3500	3500	3500	3500	3500	3500	3500
	5	86	–	–	–	–	–	–	–	–
	10	70	63	78	94	–	–	58	95	–
	15	52	52	70	90	103	128	53	93	138
	20	27	35	60	83	98	123	49	90	136
	25	5	15	48	76	94	117	45	87	133
	30	–	–	35	67	88	110	40	83	130
	35	–	–	22	57	82	103	35	80	126
	40	–	–	–	45	74	95	30	77	121
	45	–	–	–	35	64	86	25	74	116
	50	–	–	–	25	53	77	–	70	110
	55	–	–	–	–	40	67	–	66	103
	60	–	–	–	–	30	56	–	63	96
	65	–	–	–	–	20	45	–	58	89
	70	–	–	–	–	–	35	–	55	81
	75	–	–	–	–	–	25	–	51	74
	80	–	–	–	–	–	–	–	47	66
	90	–	–	–	–	–	–	–	37	49
	100	–	–	–	–	–	–	–	28	30

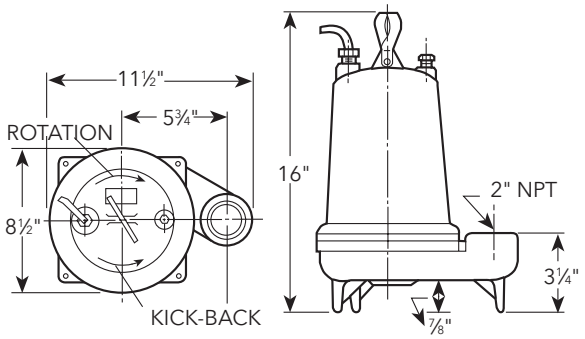
COMPONENTS

Item No.	Description
1	Impeller
2	Casing
3	Mechanical Seal
4	Motor Shaft
5	Motor
6	Ball Bearings
7	Power Cable
8	Casing O-Ring



DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)



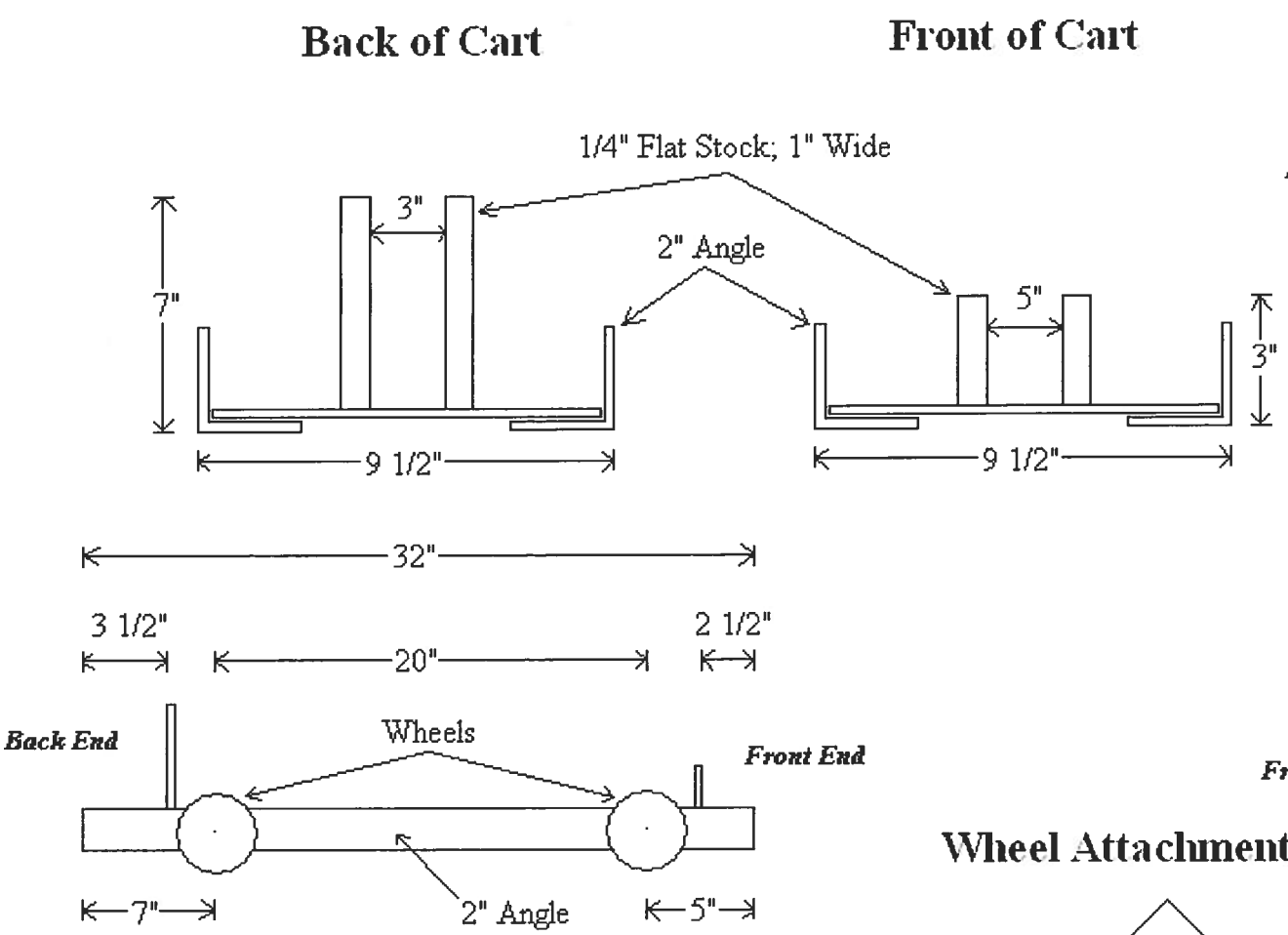
xylem
Let's Solve Water

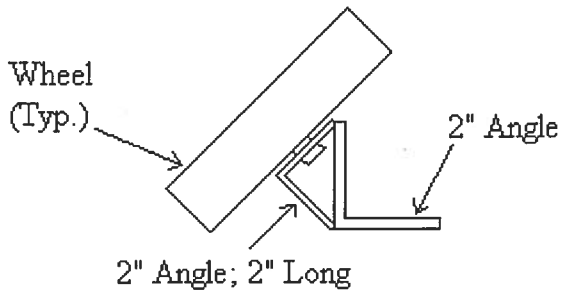
Xylem, Inc.
2881 East Bayard Street Ext., Suite A
Seneca Falls, NY 13148
Phone: (866) 325-4210
Fax: (888) 322-5877
www.xyleminc.com/brands/goulds watertechnology

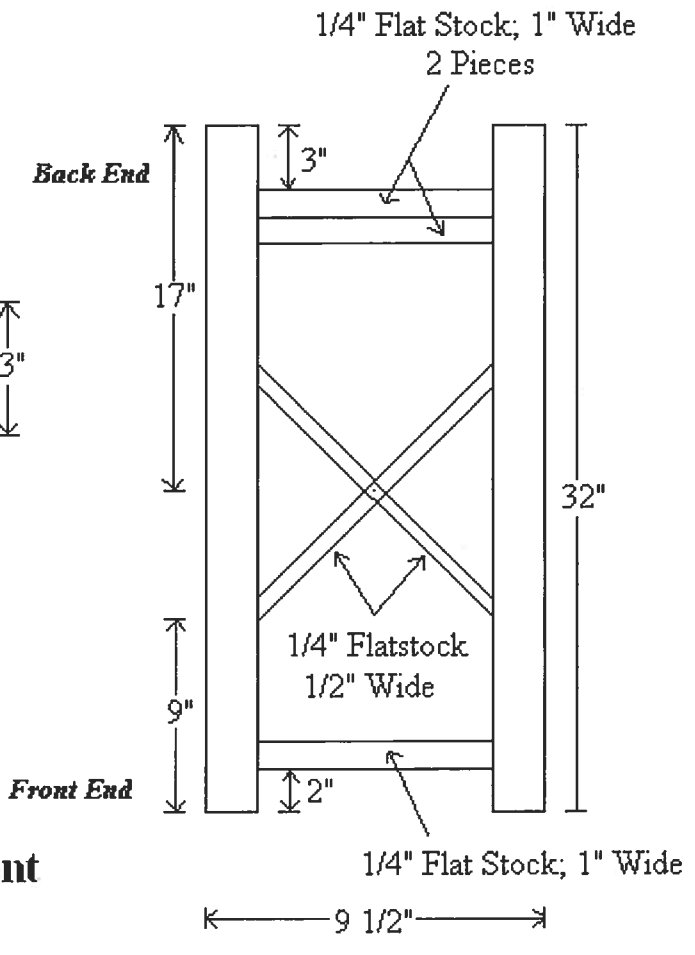
Pump Cart Shop Drawing

(CWM)

EnSol, Inc.







Goulds Pump Cart

Flex Hose Cut Sheet

(Goodyear)

EnSol, Inc.

GOODYEAR ENGINEERED PRODUCTS

VEYANCE TECHNOLOGIES

Plicord® Extremeflex™ BROWN

APPLICATION: A high-tech, flexible and versatile chemical hose capable of handling a wide variety of acids, alcohols, salt solutions and petroleum-based products.

CONSTRUCTION

TUBE: Black Chemrin® (CPE) synthetic rubber

COVER: Corrugated Brown Versigard® (EPDM) synthetic rubber with white spiral stripe

REINFORCEMENT: Spiral plied synthetic fabric with double wire helix

TEMPERATURE: -30°F to 275°F (-34°C to 135°C)

PACKAGING: 100' exact cut length, coiled, polywrapped

BRANDING: Example: Goodyear® Plicord® ExtremeFlex™ Brown w/ Chemrin® 150 PSI. Made In Canada.

COUPLINGS: Use Goodyear® Engineered Products Insta-Lock™ Cam & Groove fittings with the product. See the Coupling Systems information pages at the back of the catalog.

NON-STOCK/SIZES: 400' min if not stocked.

ORDER CODES: 546-723

ID		NOM. OD		MAX. WP		BEND RADIUS		VACUUM HG		WEIGHT	
in.	mm.	in.	mm.	psi	Mpa	in.	mm.	in.	mm.	lb./ft.	kg./m.
1	25.30	1.42	36.00	150	1.03	1.50	38.10	29	737	0.50	0.75
1-1/4	32.00	1.63	41.50	150	1.03	2.00	50.80	29	737	0.57	0.85
1-1/2	38.00	1.92	48.70	150	1.03	2.25	57.20	29	737	0.74	1.10
2	51.20	2.44	61.90	150	1.03	3.00	76.00	29	737	0.97	1.45
3	76.20	3.54	89.80	150	1.03	4.50	114.00	29	737	1.80	2.68
4	102.10	4.57	116.10	150	1.03	6.00	152.00	29	737	2.47	3.68

Level Transmitter

(Viatran)

EnSol, Inc.

Viatran
A Dynisco Company

LEVEL TRANSMITTER

Model 517

FEATURES

- **Submersible**
- **Less than 7/8" diameter**
- **Corrosion resistant construction**
- **Ranges from 30" WC to 1,200 ft WC/500 PSI (34 bar)**
- **Intrinsically Safe design available**
- **All stainless steel construction**

TYPICAL APPLICATIONS

- **Methane gas wells**
- **Down hole water wells**
- **Inground and underground tanks**
- **Water and sewage treatment plants**
- **Reservoirs / Dams**
- **Marine / Shipboard**
- **Chemical waste ponds**

HYDROSTATIC HEAD PRESSURE TO ACCURATELY MEASURE LEVEL

If you choose to measure level through hydrostatic head pressure, then you can't do better than the Model 517 from Viatran. The Model 517 promises an accuracy to 0.1%.

And it's submersible. Meaning you can throw it in the tank and not worry about some of the things that Process Engineers have to worry about - like the fog rolling in. The Model 517 will send you a reliable 4 to 20 mA output.

WHAT DOES RUGGED REALLY MEAN?

The Model 517 has been engineered to survive in hostile media. We're confident you can depend on the 517. Internal circuitry provides lightning protection, while a 4 to 20 mA output signal minimizes potential outside interference and signal degradation. All of this is critical if the signal needs to travel over long cable lengths (as in groundwater studies).

RUGGED FEATURES

The unique Viatran cable seal ensures watertight integrity up to 500 PSI (34 bar). Other potential leak paths are avoided by Viatran's all-welded sensor design. This design eliminates the O-ring seal.

OPTIONAL 1/4" NPT PRESSURE PORT

A removable end cap comes standard on the Model 517. However, if weight is needed, heavier end caps are available. The optional 1/4" NPT pressure port is critical for checking unit calibration against a known pressure source.

For more information, contact Viatran.

Viatran
3829 Forest Parkway
Suite 500
Wheatfield, NY 14120

Hotline: 1-800-688-0030
Phone: 1-716-629-3800
Fax: 1-716-693-9162
Email: solutions@viatran.com

Viatran
A Dynisco Company

PERFORMANCE	Full Scale Pressure Range (FSPR)	0-3, 5, 10, 15, 30, 50, 100, 300, 500 PSI
		0-80, 140, 275, 415, 555, 690, 830 inches water column
	Accuracy Combined	Linearity, Hysteresis & Repeatability ≤±0.1% FSO typical (±0.25% FSO max)
		Hysteresis & Repeatability ≤±0.05% FSO
		Full Scale Output (FSO) 16 mA
		Resolution Infinite
		Zero Balance 4 mA ±0.25% FSO
		Long Term Stability ≤±0.20% FSO per year
		Response time ≤1 mSec
		Temperature Effect on Zero ≤±1.0% 100°F (37°C)
		Temperature Effect on Span ≤±1.0% 100°F (37°C)
		Compensated Temperature Range 32°F to 185°F (0°C to 85°C)
		Operating Temperature -40°F to 185°F (-40°C to 85°C)
		Storage Temperature Range -65°F to 250°F (-53°C to 121°C)
ELECTRICAL	Supply Voltage	9 to 30 Vdc
	Power Supply Regulation	≤±0.0001% FSO per Volt
	Output Signal	4 to 20 mA
	Span	<0.25% FSO
	Circuit Protection	Output may be short-circuited indefinitely. Input polarity may be reversed. Over-voltage protected to 1000 volts. ≤1 mSec duration
	Electrical Connection	3 wire, 22 AWG
	Red	+Power/Signal
	Black	-Power/Signal
	Bare	Case ground
MECHANICAL	Pressure Connection	5/8" - 18 UN female thread with protective end cap installed
	Proof Pressure	3 times rated range
	Burst Pressure	5 times rated range
	Diameter	0.875 inches
	Weight	Pressure capsule 10 oz.
	Cable Weight	11.3 lbs per 1000 feet (Polyurethane)
MATERIALS OF CONSTRUCTION	Housing	316L stainless steel
	Pressure Connection Sensor	316L stainless steel
	Cable Options	316L stainless steel
	Mounting	Polyurethane, Tefzel
	Identification	Laser etched onto body
	Cable Strength	Poly Wire - 30 lbs; Support Line - 100 lbs

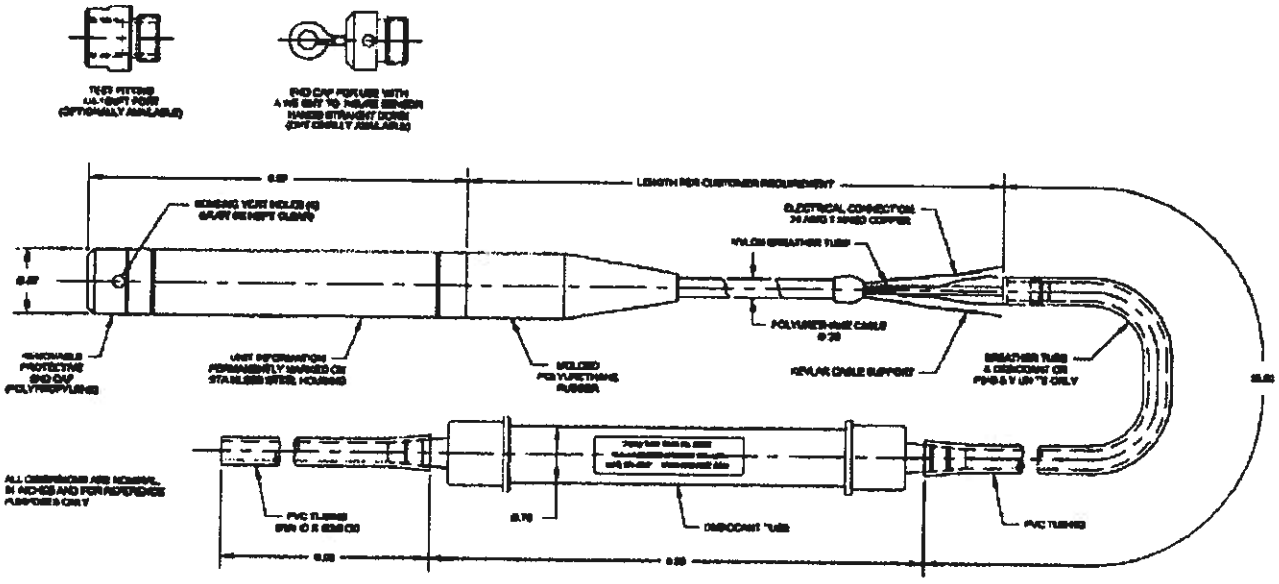
CERTIFICATIONS (Consult Factory for Available Options)

FM	Intrinsic Safety Class I, II, III, Div. 1 Groups A thru G and AEx ia IIC T4, Indoor and Outdoor NEMA 4X Hazardous Locations
CSA	Intrinsic Safety Class I, Div.1, Ex ia IIC T4 Type 4 Enclosure

OPTIONS	Codes	DH.....Special range
		DN.....Improved accuracy
		EA.....Special calibration run
		NH.....Customer specified identification
		NR.....Alternate protection baffle plate with weight hook (max weight 2 lbs)
		TG.....CSA and FM Intrinsically Safe design (consult factory)

Note: Application of some available options may affect standard performance. Consult your Viatran Representative for details.

ACCESSORIES	Breather tube filer
	Panel mount digital display
	Pressure test fitting (1/4" NPT (F) screws into end cap threads)
	Desiccant tube kit



Viatran
A Dynisco Company

Programmable Limit Alarm

(Moore)

EnSol, Inc.

MOORE INDUSTRIES WORLDWIDE

SPA²

Programmable Current/Voltage and RTD/Thermocouple Limit Alarm Trips

May 2010

Description

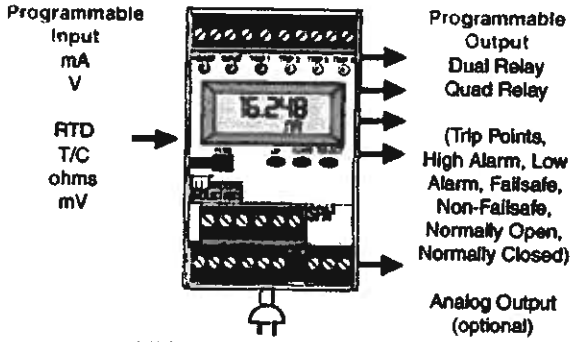
The universal SPA² Programmable Limit Alarm Trips provide on/off control, warn of unwanted process conditions, alarm on rate-of-change and provide emergency shutdown. Very versatile, they accept a signal input from transmitters, temperature sensors and a wide array of other monitoring and control instruments:

- Current and Voltage Signals
- 23 RTD Types
- 9 Thermocouple Types
- Resistance and Potentiometer Devices
- Direct Millivolt Sources

Dual and Quad Alarm Trip Outputs

The 4-wire (line/mains-powered) SPA² provides two or four independent and individually-configurable alarm relay outputs when a monitored process variable falls outside of user-set high and/or low limits. This is typically used to activate a warning light, annunciator, bell, pump, motor or shutdown system.

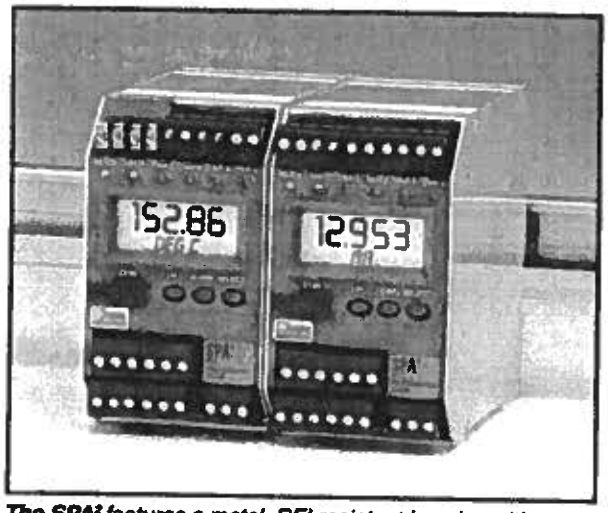
Figure 1. Available SPA² models deliver versatile and programmable input and output choices.



Certifications

Factory Mutual – FM Approvals – cFMus (US/Canada), Non-Incendive – Class I, Division 2, Groups A, B, C, D Suitable for use in General Locations and Hazardous 'Classified' Locations when mounted in suitable protective enclosures
NOTE: Models with the -DPDT option are not FM approved)

CE Conformant – EMC Directive 89/336/EEC EN 61326; Low Voltage Directive 73/23/EEC EN 61010



The SPA² features a metal, RFI resistant housing with display that snaps onto standard DIN-style rails.

Features

- **Universal plant standard.** There's no need to stock dozens of different fixed range alarm trips.
- **20-bit input resolution.** Delivers industry-best digital accuracy for both sensor (RTD and thermocouple) and analog (current/voltage) inputs.
- **Site- and PC-Programmable.** Featuring security password protection, the SPA² offers the choice of using front panel pushbuttons or our Windows®-based Intelligent PC Configuration Software for fast and simple set up.
- **Long-term stability.** Provides up to 5 years between scheduled calibrations.
- **Large 5-digit process and status readout.** A display shows menu prompts during pushbutton configuration and, when the SPA² is in operation, shows the process variable, the output or toggles between the two in selectable engineering units.
- **Combined alarm trip and transmitter.** The analog output (-AO) option reduces costs and installation time when both alarm and transmitter functions are needed at the same location.
- **Isolated and RFI/EMI protection.** Delivers superior protection against the effects of ground loops, and plant noise, radio frequency and electromagnetic interference.

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Site- and PC-Programmable

Operating parameters configure quickly and easily using front panel pushbuttons or our Intelligent PC Configuration Software. Programmable functions include:

- Security password protection on/off and password
- Input type and measurement range (zero and full scale values)
- Input and output trimming
- High or low alarm(s) with trip points
- Failsafe or non-failsafe, and normally open or normally closed alarm relays
- Alarm deadband (0-100%) and alarm time delay
- T/C reference junction compensation (on/off)
- Display parameters (scale, engineering units, and set number of digits after the decimal point)
- Differential or averaging of RTD inputs
- Standard and custom linearization curves (up to 128 points)*
- Analog output range**
- On input failure, upscale or downscale drive, fail to last value or fail to selected value**
- Analog signal output damping (0-30 seconds)**

*Programmable via the PC Configuration Software only.

**Models with Analog Output (-AO) option.

Powers a 2-Wire Transmitter

The SPA² (HLPRG: current/voltage input model) comes standard with 2-wire transmitter excitation that provides 24Vdc to power the loop. This saves the cost of specifying and installing an additional instrument power supply to power a 2-wire transmitter on the input loop.

Figure 2. The SPA² provides transmitter excitation to power a 2-wiretransmitter.

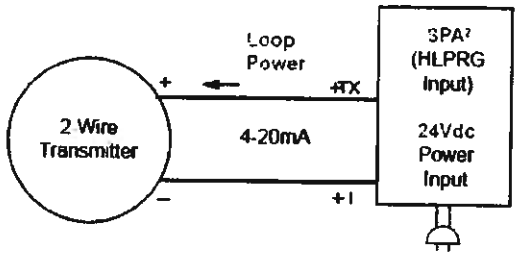
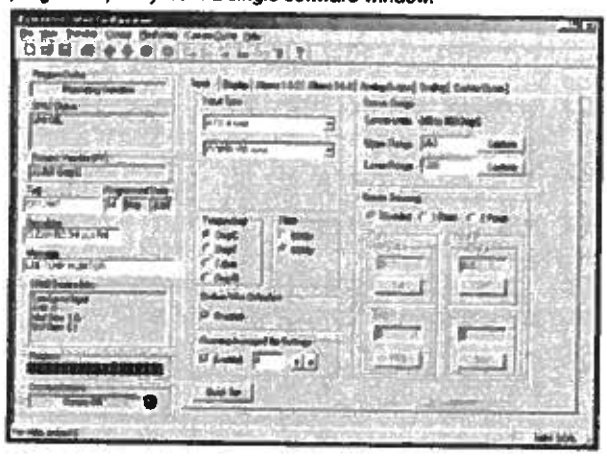


Figure 3. In addition to pushbutton configuration, the SPA² programs quickly from a single software window.



Versatile Alarm Options

Each individually-configurable SPA² alarm trip relay programs via the PC software as a:

High or Low Limit Process Alarm—Monitor a temperature, pressure, level, flow, position or status variable, and use to warn of unwanted process conditions (Figure 4), provide emergency shutdown or provide on/off control (Figure 5).

Rate-of-Change Alarm—Monitor an input for a change in value with respect to time (Figure 6). The alarm trips when the input rate-of-change exceeds a user-selected rate (Delta) over a user selected time period (Delta Time).

Input Fault Alarm—Setting one of the alarm's relays to trip on input or self-diagnostic failure (without affecting the other relay being used to monitor the process) is typically implemented to warn of a failure, such as a broken sensor, without tripping more critical process alarms or shutting down the process.

Out of Range Alarm—Monitor your process variable (PV). If the value strays past user-set limits, the SPA² will go into an alarm state indicating that the PV has gone out of the allowed range.

Self-Diagnostic Alarm—The SPA² checks its own operation and configuration upon start up, and then continuously monitors its status during operation. One of the SPA²'s relays can be configured to trip if it senses that it is not operating properly.

Quick Ranging Calibration

Using the front panel pushbuttons or the PC Configuration Software (instead of potentiometers which can drift), precise zero and span settings can be made in seconds. Just select the zero and span values, and the push of a button locks the values into the alarm trip's memory.

Figure 4. High and/or low limit alarms, with a selectable deadband to reduce false alarms, can be used to warn of unwanted process conditions or to provide emergency shutdown.

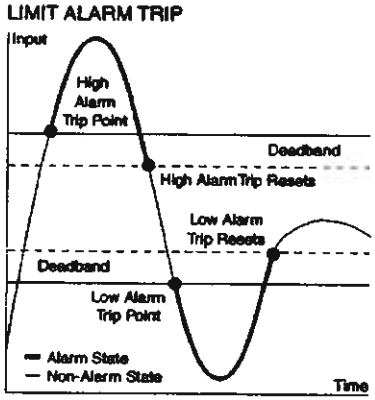


Figure 5. The SPA² can be used as a simple on/off controller such as those required in level applications (pump/valve control) when filling or emptying a container or tank.

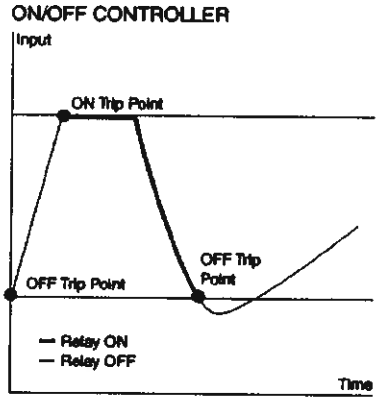
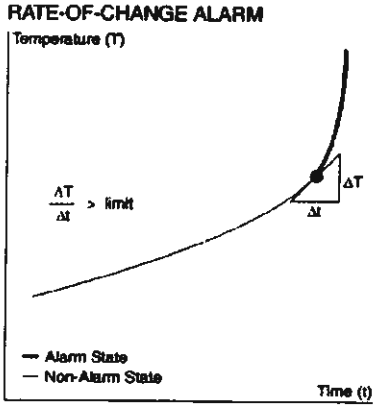


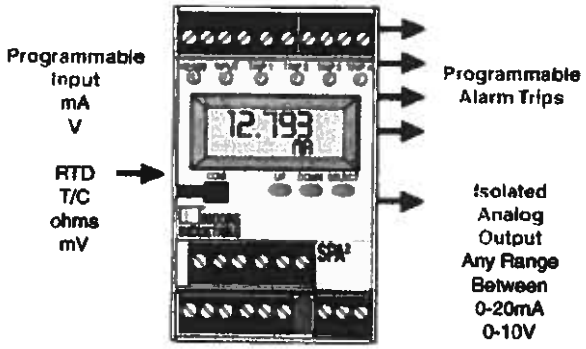
Figure 6. The SPA² can be set to trip when the input rate-of-change exceeds a user-selected rate (Delta) over a user-selected time period (Delta Time).



Combination Alarm and Isolated Transmitter

When ordered with the Analog Output (-AO) option, the SPA² provides a proportional and isolated analog retransmission of the input signal that can be sent to remote monitoring/control devices like a DCS, PLC, PC, indicator or data recorder (Figure 7). All analog parameters can be selected using the SPA² pushbuttons or the Intelligent PC Configuration Software. Upon input failure, the analog output can be user-set for upscale or downscale drive or fail to last value.

Figure 7. When ordered with the Analog Output (-AO) option, the SPA² is a combination alarm trip and signal transmitter.



Superior Reference Junction Compensation

Uncompensated plastic terminals are very susceptible to ambient temperature changes that may result in readings that are "off" by several degrees. SPA² models that accept temperature inputs (TPRG input) feature metal terminals and advanced electronic compensation techniques that provide a stable measurement in fluctuating ambient temperature conditions.

Continuous Self-Diagnostics

Incorporating advanced self-diagnostics, the SPA² checks its own operation and configuration upon start up and then continuously monitors its status during operation. If it senses that it is not operating properly, it displays an error message on its display indicating what condition has occurred. In addition, one or more of the alarm trip outputs can be set as a fault alarm which will trip when an unwanted diagnostic condition occurs.

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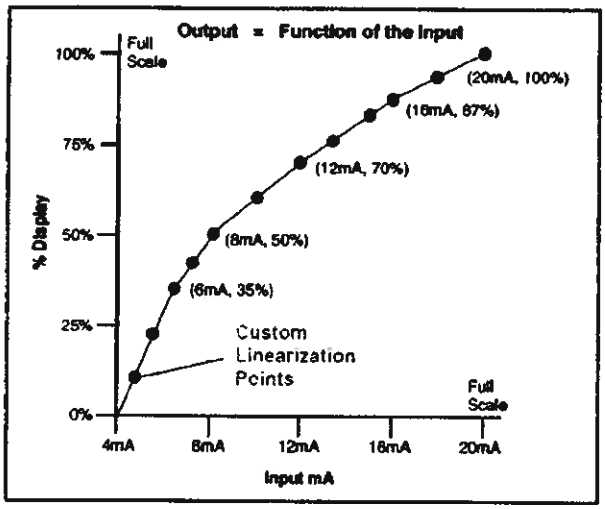
Custom 128-Point Linearization Curves

The ability to plot a custom linearization curve is beneficial when non-linear input signals must be converted to linear output representations (Figure 8). Typical applications include monitoring a non-linear transducer, the level of odd-shaped tanks and flow meter linearization.

Figure 8. *Using the Intelligent PC Configuration Software, up to 128 custom linearization points can be selected and saved in the SPA²'s memory to compensate for non-linear input signals.*



Total Sensor Diagnostics for RTD Inputs

Our SPA² Programmable Limit Alarm Trip (TPRG input model) performs continuous sensor diagnostics (Figure 10). This industry-first and patented Moore Industries feature saves you time and money by letting you know when a problem occurs, and its type and location. If the RTD input breaks, the user can decide whether or not to trip one or more alarms to indicate trouble. A plain-English error message on the display, as well as on the PC Configuration Software, indicates exactly which RTD wire has broken. Specific error messages eliminate the work of removing the sensor or checking all lead wires to diagnose a problem. If equipped with the Analog Output (-AO) option, the user has the option of driving the analog output either upscale or downscale on sensor failure.

Trim to Specific Curve Segments

The SPA² can be trimmed with two data points within the selected zero and span measurement range (Figure 9). This allows a complete process range to be monitored while placing measurement emphasis on a critical segment of the range. This provides incredible precision over a limited portion of the span while measuring the remainder of the span with outstanding accuracy.

Figure 9. *The SPA² can be set to measure the segment most critical to the process.*

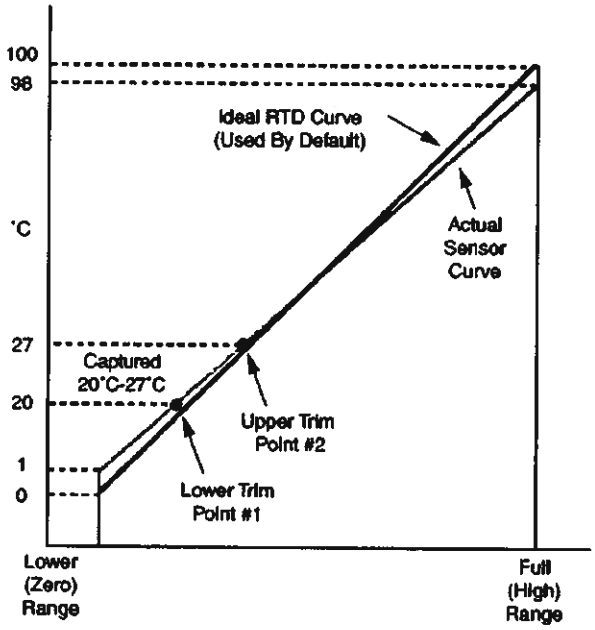
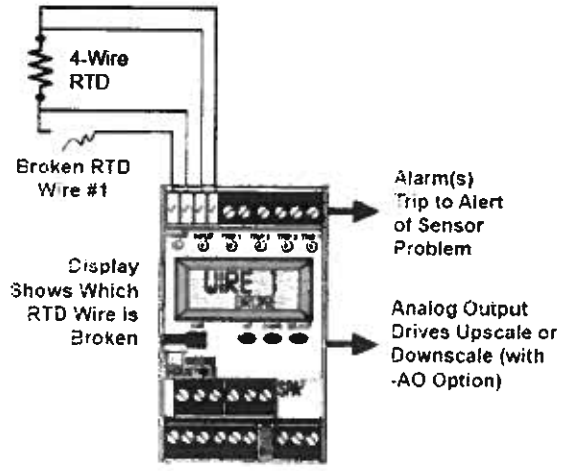


Figure 10. *Patented "Total Sensor Diagnostics" saves troubleshooting time by identifying which sensor wire has broken.*



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Programmable Current/Voltage
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Specifications (HLPRG: mA and V Input Model)

Performance

Alarm Trip Repeatability: Current inputs, ±2 microamps (0.01% of 20mA span); Voltage inputs, ±1mV (0.01% of maximum span)
Display Accuracy: ±1 digit; when scaling the display (or in Custom Mode), high input-to-display span ratios decrease display accuracy
Input Accuracy: Current inputs, ±2 microamps (0.01% of 20mA span); Voltage inputs, ±1mV (0.01% of maximum span)
Stability: Refer to Table 1
Dead Band: 11.5V or 50mA, maximum in Linear Mode; equivalent of maximum input range in user-set engineering units in Scaling/Custom Mode
Response Time: 256msec maximum (Defined as the time from step change on input to alarm state change when alarm is set to trip mid-point)
Alarm Trip Delay: Programmable from 0-120 seconds
Line Voltage Effect: ±0.002% of span for a 1% change in line voltage (AC or DC)
Isolation: 1000Vrms between case, input, output (units with -AO option) and power, continuous. Will withstand a 1200Vac dielectric strength test for one minute (with no breakdown)
WITH -RF OPTION: 500Vrms between case, input, output and power
Power Supply: 24DC range, 18-30Vdc; UAC range, 90-260Vac; 110DC range, 75-150Vdc
Power Consumption: 3.5W maximum (24DC supply); 4W maximum (UAC supply); 6W maximum (110DC supply)
Input Impedance: Current inputs, 20 ohms; Voltage inputs, 1 Mohm
Input Over-Range Protection: Voltage inputs, ±30Vdc; Current inputs, ±100mA
TX Power Supply: 24Vdc, ±10%@24mA (regulated)

Performance with Analog Output (-AO Option)

WITH ANALOG OUTPUT
Output Accuracy: Current, ±0.01% of maximum span (±2 microamps); Voltage, ±0.01% of maximum span (±1mV)
Response Time: 256msec maximum (128msec typical) for the output to change from 10% to 90% of its scale for an input step change of 0 to 100%
Ripple (up to 120Hz): Current output, 10mVp-p when measured across a 250 ohm resistor; Voltage output, 50mVp-p maximum
Output Limiting: Current outputs,

Output	Failure Limits
0-20mA	0, 23.6mA
4-20mA	3.6, 23.6mA
X-20mA	(90% of X), 23.6mA

Voltage output, -0.5-11V
Load Effect (current outputs): ±0.01% of span from 0 to 1000 ohms resistance on current output

Ambient Conditions

Operating Range: -40°C to +85°C (-40°F to +185°F)
Relay Range: -25°C to +70°C (-13°F to +158°F)
Storage Range: -40°C to +85°C (-40°F to +185°F)
Ambient Temperature Effect: Current, 2 microamps/°C; Voltage, 1mV/°C; Output, ±0.009% of maximum span/°C
Relative Humidity: 0-95%, non-condensing
RFI/EMI Protection: 10V/m@80-1000MHz, 1kHz AM, when tested to IEC61326 with 0.5% of span or less error
WITH -RF OPTION: 20V/m@80-1000MHz, 1kHz AM, when tested to IEC61326 with 0.5% of span or less error
Noise Rejection: Common Mode, 100dB@50/60Hz
Normal Mode, Current Input, 70dB typical@50mAp-p@50/60Hz; Voltage Input, 70dB typical@1Vp-p@50/60Hz

Adjustments Front panel pushbuttons control settings for zero, span, alarm trip points, high/low alarms, etc.; Internal jumper and menu password protect parameter settings

Indicators

LCD: 2x5 14-segment characters, backlit, alphanumeric readout accurate to the nearest digit.
Range: -99999 to 99999; Decimal point can be user-set
LED Type: INPUT LED: Dual color LED indicates input failure
READY LED: Green LED indicates unit is operating properly
ALARM 1, 2, 3 and 4 LED: Dual color LED per relay indicates alarm status

Weight 544 g to 601 g (19.2 oz to 21.2 oz)

Table 1. Long-Term Stability

Stability (% of Maximum Span)	Input-to-Output (Years)			Input-to-Relay (Years)		
	1	3	5	1	3	5
Current Inputs	0.081	0.14	0.18	0.047	0.081	0.105
Voltage Inputs	0.093	0.16	0.21	0.066	0.114	0.147

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Specifications (TPRG: RTD, T/C, Ohm, mV and Potentiometer Input Model)

Performance

Alarm Trip Repeatability: Refer to Table 2
Display Accuracy: ±1 digit; when scaling the display (or in custom mode), high input-to-display span ratios decrease display accuracy
Input Accuracy: Refer to Table 2
Reference Junction Compensation Accuracy (T/C inputs only): ±0.45°C
Stability: Refer to Table 3
Dead Band: User set within selected input range; fully scaleable and set in user-selected engineering units
Response Time: 256msec maximum (Defined as the time from step change on input to alarm state change when alarm is set to trip mid-point)
Alarm Trip Delay: Programmable from 0-120 seconds
Line Voltage Effect: ±0.002% of span for a 1% change in line voltage (AC or DC)
Isolation: 1000Vrms between case, input, output (units with -AO option) and power, continuous. Will withstand a 1200Vac dielectric strength test for one minute (with no breakdown)
WITH -RF OPTION: 500Vrms between case, input, output and power
Power Supply: 24DC range, 18-30Vdc; UAC range, 90-260Vac; 110DC range, 75-150Vdc
Power Consumption: 3.5W maximum (24DC supply); 4W maximum (UAC supply); 6W maximum (110DC supply)
Input Over-Range Protection: ±5Vdc
Input Impedance: T/C inputs, 40 Mohms, nominal
Input Over-Range Protection: ±5Vdc
Excitation Current: (RTD and Ohms) 250 microamps, ±10%

Performance with Analog Output (-AO Option)

WITH ANALOG OUTPUT
Output Accuracy: Current, ±0.01% of maximum span (±2 microamps); Voltage, ±0.01% of maximum span (±1mV)
Response Time: 256msec maximum (128msec typical) for the output to change from 10% to 90% of its scale for an input step change of 0 to 100%
Ripple (up to 120Hz): Current output, 10mVp-p when measured across a 250ohm resistor; Voltage output, 50mVp-p maximum
Output Limiting: Current outputs,

Output	Failure Limits
0-20mA	0, 23.6mA
4-20mA	3.6, 23.6mA
X-20mA	(90% of X), 23.6mA

Voltage output, -0.5-11V
Load Effect (current outputs): ±0.01% of span from 0 to 1000 ohms resistance on current output

Ambient Conditions

Operating Range: -40°C to +85°C (-40°F to +185°F)
Relay Range: -25°C to +70°C (-13°F to +158°F)
Storage Range: -40°C to +85°C (-40°F to +185°F)
Ambient Temperature Effect: Refer to Table 4
Effect of Ambient Temperature on Reference Junction Compensation (T/C inputs only): ±0.005% per °C change of ambient temperature
Relative Humidity: 0-95%, non-condensing
RFI/EMI Protection: 10V/m @ 80-1000MHz, 1kHz AM, when tested to IEC61326 with 0.5% of span or less error
WITH -RF OPTION: 20V/m @ 80-1000MHz, 1kHz AM, when tested to IEC61326 with 0.5% of span or less error
Noise Rejection: Common Mode, 100dB @ 50/60Hz
Normal Mode, refer to Table 5

Adjustments

Front panel pushbuttons control settings for zero, span, alarm trip points, high/low alarms, etc.; Internal jumper and menu password protect parameter settings

Indicators

LCD: 2x5 14-segment characters, backlit, alphanumeric readout accurate to the nearest digit.
Range: -99999 to 99999; Decimal point can be user-set
LED Type: INPUT LED: Dual color LED indicates input failure
READY LED: Green LED indicates unit is operating properly
ALARM 1, 2, 3 and 4 LED: Dual color LED per relay indicates alarm status

Weight

544 g to 601 g (19.2 oz to 21.2 oz)

Table 2. Accuracy with RTD, Thermocouple, Ohms, and Millivolt Inputs (Models with TPRG Input)

Input	Type	Ω	Ohms	Conformance Range	Minimum Span	Input Accuracy/ Repeatability	Maximum Range
RTD (2-, 3-, 4-Wire) Dual (2-Wire, One 2-Wire and One 3-Wire)	Platinum	0.003850	100	-200 to 850°C (-328 to 1562°F)	10°C (18°F)	±0.1°C (±0.18°F)	-240 to 960°C (-400 to 1760°F)
			200				
			300				
			400				
			500				
			1000				
			Dual 500				
Triple (2-Wire)			Dual 1000	-200 to 260°C (-328 to 500°F)			-200 to 260°C (-328 to 500°F)
			Triple 500	-200 to 440°C (-326 to 824°F)			-200 to 440°C (-328 to 824°F)
			Triple 1000	-200 to 80°C (-328 to 176°F)			-200 to 80°C (-328 to 176°F)
		0.003902	100	-100 to 650°C (-148 to 1202°F)			-150 to 720°C (-238 to 1328°F)
			200				
			400				
			500				
			1000				
			Dual 500				
			Dual 1000	-100 to 260°C (-148 to 500°F)			-100 to 260°C (-148 to 500°F)
			Triple 500	-100 to 440°C (-148 to 824°F)			-100 to 440°C (-148 to 824°F)
			Triple 1000	-100 to 80°C (-148 to 176°F)			-100 to 80°C (-148 to 176°F)
		0.003916	100	-200 to 510°C (-328 to 950°F)			-240 to 580°C (-400 to 1076°F)
	Nickel	0.00672	120	-80 to 320°C (-112 to 608°F)			-100 to 360°C (-148 to 680°F)
	Copper	0.00427	9.035	-50 to 250°C (-58 to 482°F)		±0.85°C (±1.53°F)	-65 to 280°C (-85 to 536°F)
Ohms	Direct Resistance	n/a	0-4000	0-4000 ohms	10 ohms	±0.4 ohms	0-4095 ohms
			Dual 0-2000 ohms	0-2000 ohms			0-2000 ohms
			Triple 0-1300 ohms	0-1300 ohms			0-1300 ohms
	Potentiometer		4000 maximum	0-100%	10%	±0.1%	0-100%
T/C	J	n/a	n/a	-180 to 760°C (-292 to 1400°F)	35°C (63°F)	±0.25°C (±0.45°F)	-210 to 770°C (-346 to 1418°F)
	K	n/a	n/a	-150 to 1370°C (-238 to 2498°F)	40°C (72°F)	±0.3°C (±0.54°F)	-270 to 1390°C (-454 to 2534°F)
	E	n/a	n/a	-170 to 1000°C (-274 to 1832°F)	35°C (63°F)	±0.2°C (±0.36°F)	-270 to 1013°C (-454 to 1855.4°F)
	T	n/a	n/a	-170 to 400°C (-274 to 752°F)	35°C (63°F)	±0.25°C (±0.45°F)	-270 to 407°C (-454 to 764.6°F)
	R	n/a	n/a	0 to 1760°C (32 to 3200°F)	50°C (90°F)	±0.55°C (±0.99°F)	-50 to 1786°C (-58 to 3246.8°F)
	S	n/a	n/a	0 to 1760°C (32 to 3200°F)	50°C (90°F)	±0.55°C (±0.99°F)	-50 to 1786°C (-58 to 3246.8°F)
	B	n/a	n/a	400 to 1820°C (752 to 3308°F)	75°C (135°F)	±0.75°C (±1.35°F)	200 to 1836°C (392 to 3336.8°F)
	N	n/a	n/a	-130 to 1300°C (-202 to 2372°F)	45°C (81°F)	±0.4°C (±0.72°F)	-270 to 1316°C (-454 to 2400.8°F)
	C	n/a	n/a	0 to 2300°C (32 to 4172°F)	100°C (180°F)	±0.8°C (±1.44°F)	0 to 2338°C (32 to 4240.4°F)
mV	DC	n/a	n/a	n/a	4mV	±30 microvolts	-50 to 1000mV

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Ordering Information

Unit	Input	Output	Power	Options	Housing
SPA2 Programmable Limit Alarm Trip	**HLPRG** Programs to accept: Current: Any range between 0-50mA including: 0-20mA 4-20mA 10-50mA Voltage: Any range between 0-10Vdc including: 0-5Vdc 1-5Vdc 0-10Vdc **TPRG** Programs to accept (see Table 2 for details): RTD: 2-, 3- and 4-wire; platinum, copper, and nickel Thermocouple: J, K, E, T, R, S, N, C, B Ohms: 0-4000ohms (Potentiometer, 4000ohms maximum) Millivolts: –50 to +1000mV	**2PRG** Dual Relays (Relays are single-pole/double-throw (SPDT, 1 form C, rated 5A @250Vac, 50/60Hz or 24Vdc, non-inductive) **4PRG** Quad Relays (Relays are single-pole/double-throw (SPDT), 1 form C, rated 5A @250Vac, 50/60Hz or 24Vdc, non-inductive) Each relay individually configures for: High or Low Trip Normally Open or Normally Closed Failsafe or Non-Failsafe	**24DC ±10%** **110DC** **75-150DC** **UAC** Accepts any power input range between 90-260Vac	**-AO** Analog output (Isolated and linearized) scaleable for any range between 0-20mA into 1000 ohms or 0-10V into 10 kohms (see "Specifications" for additional information) NOTE: Current output can be user-set for internal or external power (source or sink) **-DPDT** Relays are double-pole/double-throw (DPDT), 2 form C, rated 5A@250Vac, 50/60Hz or 24Vdc, non-inductive (2PRG output model only) **NOTE: Models with the -DPDT option are not FM approved)** **-RF** Enhanced RFI/EMI protection (see "Specifications" for details) **-FMEDA** Unit comes with Failure Modes, Effects and Diagnostic Analysis (FMEDA) data for evaluating the instrument for suitability of use in a safety-related application	**DIN** Universal DIN-style housing mounts on 32mm (EN50035) G-type and 35mm (EN50022) Top Hat DIN-rails **FLD** Externally-mounted flange provides a secure mount

When ordering, specify: Unit / Input / Output / Power / Options [Housing]
Model number example: SPA2 / TPRG / 2PRG / 24DC / - AO -RF [DIN]

Table 3. Long-Term Stability

Stability (% of Maximum Span)	Input-to-Output (Years)			Input-to-Relay (Years)		
	1	3	5	1	3	5
RTD, Ohm & Pot Inputs	0.09	0.16	0.21	0.047	0.081	0.104
T/C & mV Inputs	0.08	0.14	0.18	0.008	0.014	0.019

Table 4. Ambient Temperature Effect

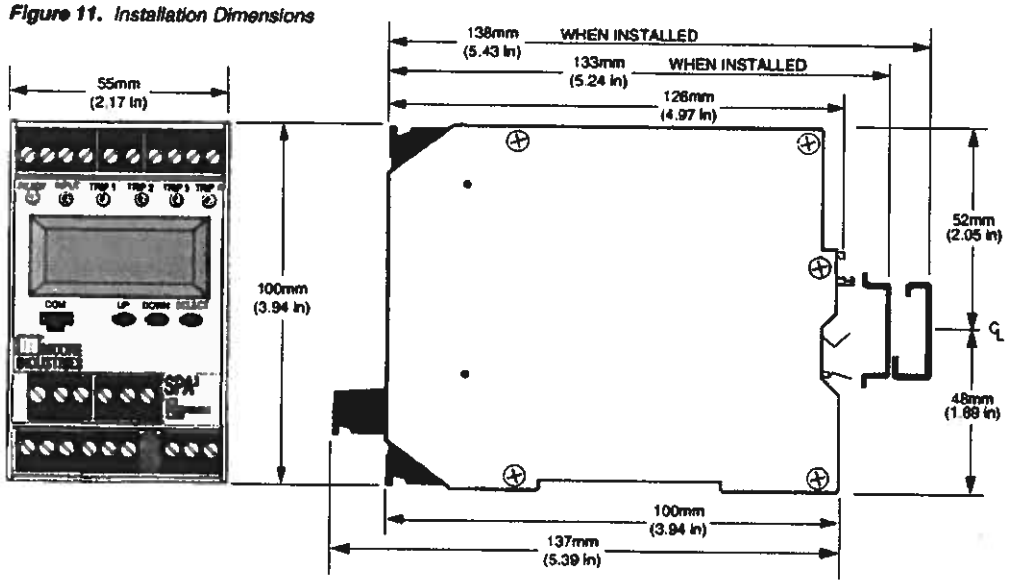
	Accuracy per 1°C (1.8°F) Change in Ambient
RTD*	0.0035°C
Millivolt	0.5 microvolts + 0.005% of reading
Ohm	0.002 ohms +0.005% of reading
Thermocouple	
	Accuracy per 1°C (1.8°F) Change in Ambient
J	0.00016°C + 0.005% of reading
K	0.0002°C + 0.005% of reading
E	0.00026°C + 0.005% of reading
T	0.0001°C + 0.005% of reading
R, S	0.00075°C + 0.005% of reading
B	0.0038°C + 0.005% of reading
N	0.003°C + 0.005% of reading
C	0.00043°C + 0.005% of reading
mV	0.5 microvolts + 0.005% of reading

*Accuracy of Ni672 is 0.002°C

Table 5. Normal Mode Rejection Ratio

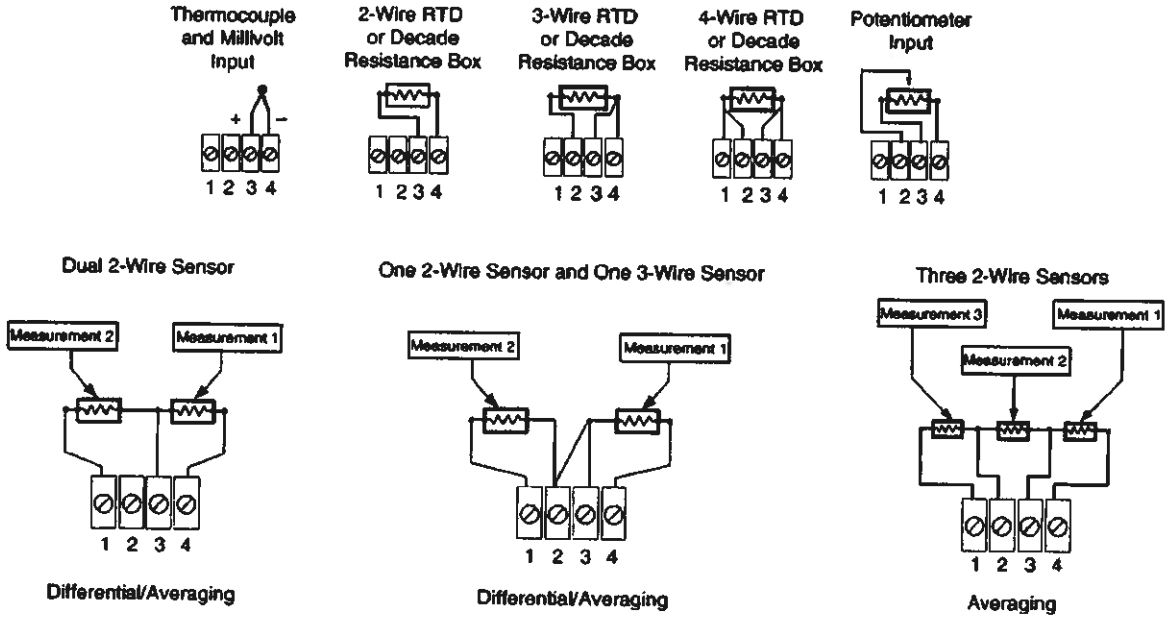
Sensor Type		Max. p-p Voltage Injection for 100dB at 50/60Hz
T/C: J, K, N, C, E		150mV
T/C: T, R, S, B		80mV
Pt RTD: 100, 200, 300 ohms		250mV
Pt RTD: 400, 500, 1000 ohms		1V
Ni: 120 ohms		500mV
Cu: 9.03 ohms		100mV
Resistance	**mV**	
1-4 kohms	250-1000	1V
0.25-1 kohms	62.5-250	250mV
0.125-0.25 kohms	31.25-62.5	100mV

Figure 11. *Installation Dimensions*



NOTE: While all SPA² models (model with HLPRG input shown) are dimensionally identical, the SPA² that accepts temperature inputs (TPRG input) features metal terminal blocks for enhanced reference junction compensation.

Figure 12. *Temperature Sensor Hook-Up Guide (Models with TPRG Input)*



SPA²

Programmable Current/Voltage
and RTD/Thermocouple Limit Alarm Trips

Table 6. Terminal Designations (Models with TPRG Input)

Input Type	Top Terminals (Left to Right)									
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
RTD, Ohm, Potentiometer, T/C & mV Inputs	See Figure 12				MR	MR	+Io Source	-Io Source +Io Sink	+Vo	-Vo -Io Sink

Output Type	Middle Terminals (Left to Right)					
	11	12	13	14	15	16
2PRG (SPDT Relays)	N/A	N/A	N/A	N/A	N/A	N/A
4PRG (SPDT Relays)	NO3	CM3	NC3	NO4	CM4	NC4
2 DPDT Relays	Relay 2 NO1	Relay 2 CM1	Relay 2 NC1	Relay 2 NO2	Relay 2 CM2	Relay 2 NC2

Output/Power Type	Bottom Terminals (Left to Right)									
	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
2PRG (SPDT Relays)	NO1	CM1	NC1	NO2	CM2	NC2	Not Used	AC or DC	ACC or DCC	GND
4PRG (SPDT Relays)	NO1	CM1	NC1	NO2	CM2	NC2	Not Used	AC or DC	ACC or DCC	GND
2 DPDT Relays	Relay 1 NO1	Relay 1 CM1	Relay 1 NC1	Relay 1 NO2	Relay 1 CM2	Relay 1 NC2	Not Used	AC or DC	ACC or DCC	GND

NOTES:
1. Terminal blocks can accommodate 14-22 AWG solid wiring, tighten to four inch-pounds (maximum).
2. ±Io/±Vo labeling is present only when the unit is equipped with the Analog Output (-AO) option.
3. Your input power requirement (AC or DC / ACC or DCC) will depend upon your unit's power need.

KEY:
AC or DC = Power Input
ACC or DCC = Power Input
CM = Relay Common
DPDT = Double-Pole/Double-Throw
GND = Ground (case)
Io = Current Output
MR = Manual Reset
NO = Normally Open
NC = Normally Closed
Sink = Current Sink
Source = Current Source
SPDT = Single-Pole/Double-Throw
Vo = Voltage Output

Accessories

Each SPA² order comes with one copy of our Intelligent PC Configuration Software and a configuration cable. Use the chart below to order additional parts.

Part Number **750-75E05-01**	**Intelligent PC Configuration Software** (One copy provided free with each order)
Part Number **803-053-26**	**Configuration Cable** for use in connecting the SPA² to a PC (one cable provided free with each order)
Part Number **208-836-00**	**USB Communication Cable**

Table 7. Terminal Designations (Models with HLPRG Input)

Input Type	Top Terminals (Left to Right)									
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Current Input	Tx	+I	COM	Not Used	MR	MR	+Io Source	-Io Source +Io Sink	+Vo	-Vo -Io Sink
Voltage Input	Tx	Not Used	COM	+V	MR	MR	+Io Source	-Io Source +Io Sink	+Vo	-Vo -Io Sink

Output Type	Middle Terminals (Left to Right)					
	11	12	13	14	15	16
2PRG (SPDT Relays)	N/A	N/A	N/A	N/A	N/A	N/A
4PRG (SPDT Relays)	NO3	CM3	NC3	NO4	CM4	NC4
2 DPDT Relays	Relay 2 NO1	Relay 2 CM1	Relay 2 NC1	Relay 2 NO2	Relay 2 CM2	Relay 2 NC2

Output/Power Type	Bottom Terminals (Left to Right)									
	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
2PRG (SPDT Relays)	NO1	CM1	NC1	NO2	CM2	NC2	Not Used	AC or DC	ACC or DCC	GND
4PRG (SPDT Relays)	NO1	CM1	NC1	NO2	CM2	NC2	Not Used	AC or DC	ACC or DCC	GND
2 DPDT Relays	Relay 1 NO1	Relay 1 CM1	Relay 1 NC1	Relay 1 NO2	Relay 1 CM2	Relay 1 NC2	Not Used	AC or DC	ACC or DCC	GND

NOTES:
1. Terminal blocks can accommodate 14-22 AWG solid wiring, tighten to four inch-pounds (maximum).
2. ±Io/±Vo labeling is present only when the unit is equipped with the Analog Output (-AO) option.
3. Your input power requirement (AC or DC / ACC or DCC) will depend upon your unit's power need.

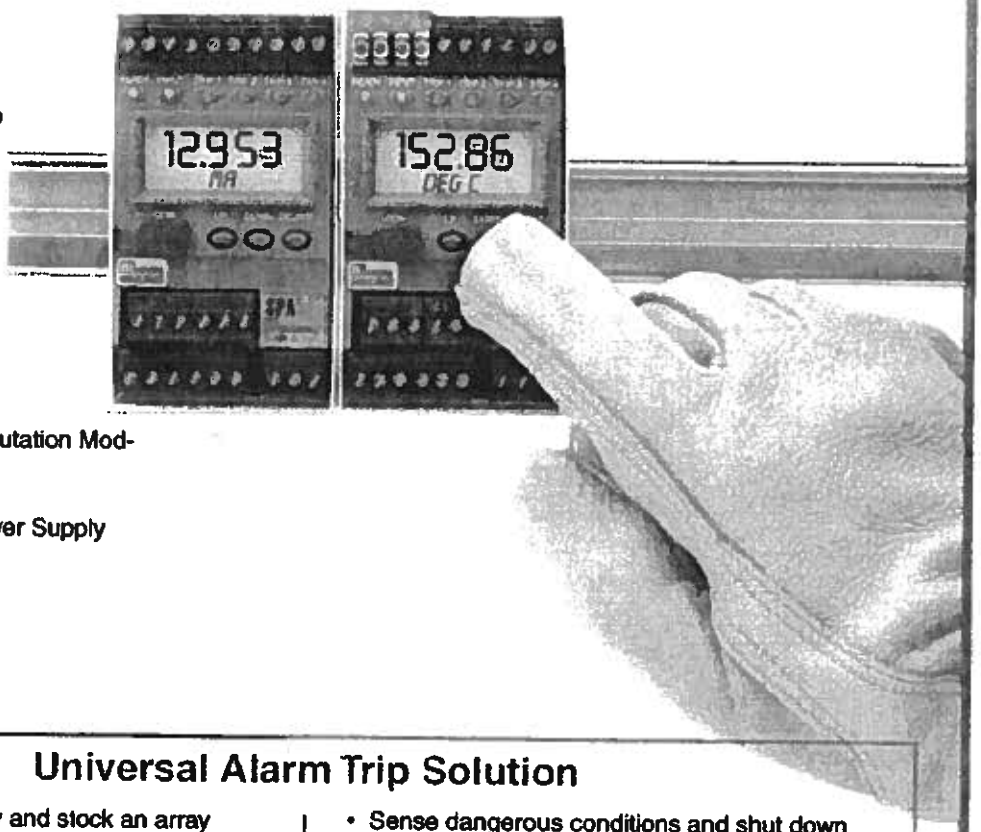
KEY:
AC/DC = Power Input
ACC/DCC = Power Input
CM = Relay Common
COM = Analog Common
DPDT = Double-Pole/Double-Throw
GND = Ground (case)
I = Current Input
Io = Current Output
MR = Manual Reset
NO = Normally Open
NC = Normally Closed
Sink = Current Sink
Source = Current Source
SPDT = Single-Pole/Double-Throw
TX = Power for 2-wire transmitter
V = Voltage Input
Vo = Voltage Output

SPA²

Programmable Current/Voltage
and RTD/Thermocouple Limit Alarm Trips

Six Universal Instruments in One!

1. Dual and Quadruple Limit Alarm Trip
2. Analog or Temperature Transmitter
3. Signal Isolator and Converter
4. Local Process Display in Engineering Units
5. Linearizing, Averaging, Differential, and Rate-of-Change Computation Module
6. 2-Wire Transmitter Power Supply (Transmitter Excitation)



Universal Alarm Trip Solution

There's no need to specify and stock an array of single-function alarm trips. Our SPA² is the perfect solution:

- Standardize on, and stock just one, universal instrument for all of your alarm trip needs.
- Warn of trouble by providing an alarm output when a process signal exceeds a high and/or low limit.
- Provide dependable, redundant warning and/or shutdown capabilities to compensate for a DCS or PLC failure.
- Use combination alarm trip/transmitter models to reduce costs when both alarming and monitoring functions are needed at the same location.
- Sense dangerous conditions and shut down control equipment before it is damaged.
- Compare two variables and trip an alarm when the difference between the two exceeds a preset value.
- Install multi-trip alarms to provide several levels of warning and shutdown action.
- Use for reliable and cost-effective on/off control of pumps and motors.
- Create custom, 128 point linearization curves to compensate for non-linear measurements and instruments.
- Keep track of sensor operation and quickly diagnose sensor failures with our patented *Total Sensor Diagnostics.*

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High Level Switch

(Madison)

EnSol, Inc.

MADISON Vertical Liquid Level Switch, 316 SS

Pumps > Pump Controls > Float Switches

Switch, Magnetically Actuated Dry Reed, Wire Gauge 22, Float Length 2 In., Float Dia. 2 In., Max. Temp. 200 C, Max. Pressure 500 PSI, Float Material 316 SS

Grainger Item #	4YM33
Your Price (ea.)	[redacted]
Brand	MADISON
Mfr. Model #	M5600-PR
Ship Qty.	1
Sell Qty. (Will-Call)	1
Ship Weight (lbs.)	0.25
Usually Ships**	Today
Catalog Page No.	3609
Country of Origin (Country of Origin is subject to change.)	USA

Qty.

Enlarge Image

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Add to Order | Add to Personal List

Tech Specs | Additional Information | Compliance & Restrictions | MSDS | Required Accessories | Optional Accessories | Alternate Products | Repair Parts

Item	Switch
Type	Magnetically Actuated Dry Reed
Wire Gauge	22
Overall Length (In.)	3.38
Float Length (In.)	2
Float Dia. (In.)	2
Fitting	1/4" NPT
VA Rating	100
Max. Temp. (C)	200
Max. Pressure (PSI)	500
Operation	NO/NC
Stem Length (In.)	2.63
Stem Material	316 SS
Float Material	316 SS
Mounts	Vertical
Wire Lead	24

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The "Usually Ships" reflects when an item is generally expected to ship from Grainger based on its stocking location. Real-time availability information will be shown during the checkout process and on the e-mail order confirmation (for U.S. and Puerto Rico - US customers only). Please allow additional delivery time for international orders.

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HI-HI TANK LEVEL FLOAT

Installation and Maintenance

Madison®

Liquid Level Switches

English • Español

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E-mail: info@madisonco.com
www.madisonco.com

ECN #08-493 • Effective Date 04/09 • MF-002, Rev. J

General Information

1. Switches should be installed rigidly so the float or floats are free to move as the liquid level changes.
2. Switches should be mounted in a tank area free of severe turbulence or protected from such turbulence by appropriate and adequate slosh shields.
3. Vertical switch stems should be vertical for best results, but satisfactory operation is possible in most liquids with the stem at up to a 30° angle from vertical.
4. Side mount switch stems must be mounted with the arrow vertically either up or down depending on switch operation.
5. Care should be taken that switches are always operated within electrical ratings.
6. Orientation for standard Vertical switches can be changed from normally open to normally closed dry or vice versa by removing the float and reversing it in the stem, except with the M3326.

Wire Table for Reed Switch		
Model	GA	Color
MT3920-1, -2, -3 MT5000-1, -2, -3, -4 MT8000-1, -2	22 22 22	Brown Black White

Note: Temperature lead wires normally smaller gauge size

Información General

1. Los interruptores deben de ser instalados rígidamente de manera que el flotador o los flotadores tengan libertad de movimiento cuando cambie el nivel de líquido.
2. Los interruptores deben de ser montados en un área del tanque que esté libre de turbulencia severa o protegidos de tal turbulencia con protectores de chapoteo apropiados.
3. Los vástagos de interruptor vertical deben de estar verticales para obtener óptimos resultados, pero es posible lograr una operación satisfactoria en la mayoría de los líquidos si el vástago está a un ángulo de hasta 30° de la línea vertical.
4. Los vástagos de interruptor de montaje lateral deben ser montados con la flecha en posición vertical, ya sea hacia arriba o hacia abajo, dependiendo de la operación del interruptor.
5. Hay que tener cuidado para que los interruptores siempre sean operados a los niveles eléctricos correspondientes.
6. Se puede cambiar la orientación para interruptores verticales estándar de normalmente cerrada a normalmente abierta seca o viceversa, retirando el flotador y colocándolo en el sentido opuesto en el vástago, excepto con el M3326.

Maintenance

Maintenance should consist of inspection to see that the float is free to move and not coated with any substance, which would change its weight or volume significantly. If this occurs, the float should be cleaned. This is easily accomplished without disturbing the installation. In addition, the stem may be wiped down to remove any build-up.

The only repair possible in the field is replacement of either the float or stem. Dents or nicks on the float are usually of no consequence to operation.

Mantenimiento

El mantenimiento debe consistir en una inspección para verificar que el flotador tenga libertad de movimiento y que no esté cubierto de ninguna sustancia que podría cambiar significativamente su peso o volumen. Si esto ocurre, deberá limpiar el flotador. Esto se logra fácilmente sin afectar la instalación. Además, el vástago puede limpiarse hacia abajo para quitar cualquier acumulación.

La única reparación de campo posible es el reemplazo del flotador o del vástago. Las abolladuras o melladuras en el flotador normalmente no tienen consecuencias para su operación.

Cautions

1. The pressure, temperature and electrical limitations shown for the specified level switches must not be exceeded.
2. The pressures and temperatures must take into consideration possible surges in the temperature and pressure of the system.
3. The liquids used must be compatible with the materials of construction. Specifications of materials will be given upon request.
4. Life expectancy of the switch varies with applications. Contact the factory if life cycle testing is required.
5. Ambient temperature changes can affect switch set points, since specific gravities of liquids vary with temperature. Consult factory for assistance.
6. Level switches have been designed to be shock and vibration resistant. For maximum life, both shock and vibration should be minimized. Consult factory for assistance.
7. Excessive contaminants in fluid may inhibit float operation, and occasional wipe down may be necessary.
8. Level switches must not be field repaired
9. Physical damage to product may render product unserviceable.
10. Installation in a vessel made from magnetic materials may affect operation.

Precauciones

1. Los límites de presión, temperatura y electricidad mostrados para los interruptores de nivel especificados no deben ser excedidos.
2. Las presiones y temperaturas deben tomar en consideración posibles fluctuaciones en la temperatura y la presión del sistema.
3. Los líquidos usados tienen que ser compatibles con los materiales de construcción. Las especificaciones de los materiales se brindarán a pedido.
4. La vida útil del interruptor varía según la aplicación. Comuníquese con la fábrica si se requieren pruebas cíclicas de la vida útil.
5. Los cambios en la temperatura ambiente pueden afectar los puntos fijos del interruptor, dado a que el peso específico de los líquidos varía con la temperatura. Consulte con la fábrica si requiere asistencia.
6. Los interruptores de nivel han sido diseñados para ser resistentes a golpes y vibraciones. Para una máxima vida útil, se debe minimizar la cantidad de golpes y vibraciones. Consulte con la fábrica si requiere asistencia.
7. El exceso de contaminantes en el líquido puede inhibir la operación del flotador, y puede ser necesaria una limpieza ocasional.
8. Los interruptores de nivel no deben ser reparados en el lugar de la instalación.
9. Los daños físicos al producto pueden dejarlo inservible.
10. La instalación en un recipiente hecho de materiales magnéticos puede afectar la operación.

Installation

Operation is stated in the tank dry position.

Vertical Switches:

NC Operation: SS Floats: Witness mark (round circle) down. Plastic Floats: Magnets up.

NO Operation: SS Floats: Witness mark (round circle) up. Plastic Floats: Magnets down.

**Note: M3326, M3326-NO are not reversible. The M3326 is Normally Closed. The M3326-NO is Normally Open*

Side Mounted Switches:

NC Operation: Arrow mounted vertically pointed down.

NO Operation: Arrow mounted vertically pointed up.

Instalación

El funcionamiento se define en la posición de tanque seco.

Interruptores Verticales:

Normalmente Cerrado: Flotadores de acero inoxidable (SS): Marca testigo (círculo) hacia abajo. Flotadores de plástico: Imanes hacia arriba.

Normalmente Abierto: Flotadores de acero inoxidable (SS): Marca testigo (círculo) hacia arriba. Flotadores de plástico: Imanes hacia abajo.

Nota: Los modelos M3326 y M3326-NO no son reversibles. El M3326 es Normalmente Cerrado. El M3326-NO es normalmente abierto.

Interruptores de Montaje Lateral:

Normalmente Cerrado: Flecha montada vertical señalando hacia abajo.

Normalmente Abierto: Flecha montada vertical señalando hacia arriba.

Typical Current and Voltage Ratings

** Note: The ratings at right are for resistive loads only. For inductive loads, maximum switch life will be achieved if appropriate arc suppression is used.*

** Nota: Las clasificaciones de la derecha son sólo para cargas resistivas. Para cargas inductivas, se logrará una vida útil máxima si se usa la supresión de arco apropiada.*

Watts	Voltage	Current Amps
15	240 AC	-
	120 AC	0.12
	100 DC	0.10
	24 DC	0.30
30	240 AC	0.14
	120 AC	0.28
	120 DC	0.07
	24 DC	0.28
60	240 AC	0.40
	120 AC	0.50
	120 DC	0.20
	24 DC	0.50
100	240 AC	0.40
	120 AC	1.00
	120 DC	0.40
	24 DC	1.00

Approvals
(See details for part number specific approvals on reverse.)

1. UL
2. UL Haz Loc
3. Ulc
4. CSA
5. CSA Haz Loc
6. CE
7. NSF
8. ABS

Aprobaciones
(Ver detalles de aprobaciones para número de partes específicas al reverso.)

Wiring

Madison Part Number: _____

Número de Parte Madison : _____

Switch Location (from bottom of fitting)	Colors	Watt Rating	Switch Type	Dry Position

Madison Co.
27 Business Park Dr.
Branford, CT 06405 US
Phone: 203-488-4477
Fax: 203-481-5036
Toll-free: 800-466-5383
Email: info@madisonco.com
Website: http://www.madisonco.com

Item # M5600-PR, Stainless Steel Full Size Switches

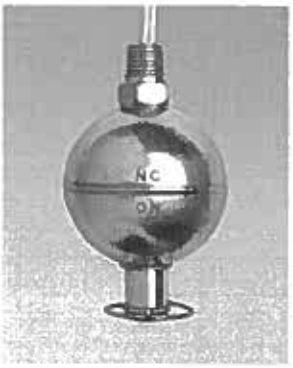
$69.04

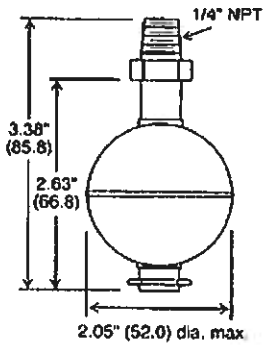
Stainless Steel Full Size Switches

The M5600-PR liquid level switch has a stainless steel stem and a stainless steel float. Stainless steel stems and floats are well suited for corrosive environments as well as food processing, medical, heating, and cooling applications.

The M5600-PR carries CE, NSF International, and American Bureau of Shipping (ABS) approvals.
Same day shipping available under our Switch-In-Time program.

Note: SPST = Single Pole, Single Throw





SPECIFICATIONS

Type	Full Size Switch
Stem Material	316 Stainless Steel
Float Material	316 Stainless Steel
Max. Temperature	200 °C
Fittings	1/4" NPT
Nominal Current Rating(s)	100 VA SPST Switch
Float SG	0.70
Max. Pressure	500 psig

Dwg. No.	3
Lead Wires	22 ga. Teflon 24"
Approvals	ABS CE NSF International
Maximum Order Quantity for Switch In Time Same Day Shipment	17

Turbine Flow Sensor and Flow Meter Cut Sheet

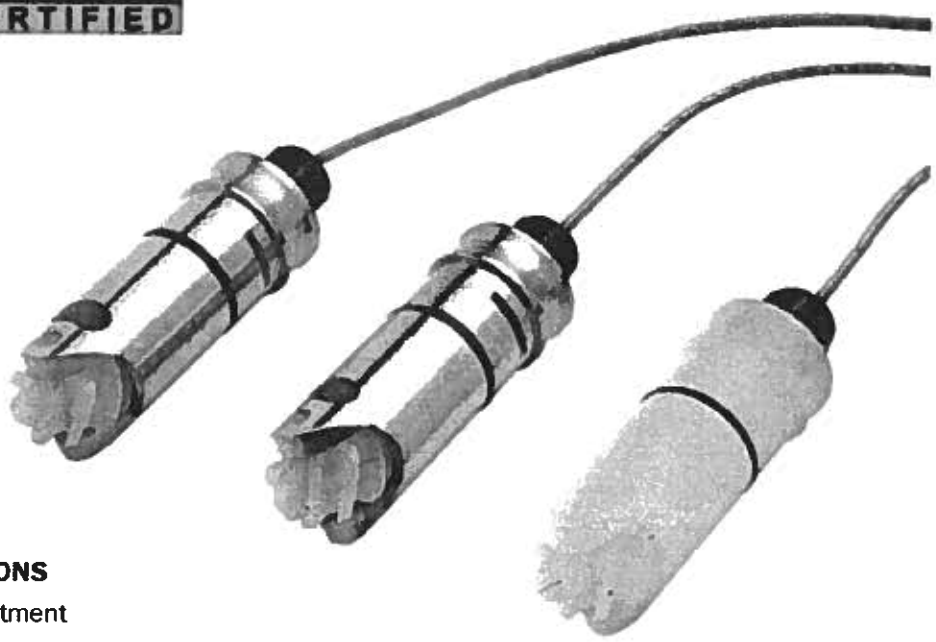
(Seametrics)

EnSol, Inc.

Seametrics

TX80-SERIES
Insertion Turbine Flow Sensor

ISO 9001:2008 CERTIFIED



APPLICATIONS

- Water treatment
- Industrial wastewater treatment
- Cooling water monitoring
- Industrial fluid control

FEATURES

- Low-friction, long-life jewel bearings
- One moving part
- Field repairable
- Choice of materials for chemical compatibility
- Fits 1-1/2" to 8" pipe
- Fixed depth in fitting ensures correct depth in pipe

GENERAL INFORMATION

The TX80-Series are insertion turbine meters designed for use in 1-1/2" to 8" pipe. High-quality jewel bearings and precision shafts ensure long life and low friction. Available in 316 stainless steel, brass, PVC and polypropylene, sensor bodies are machined from solid rod for maximum low-flow performance. The TX80-Series use special fittings that ensure ease of installation and correct depth setting in the pipe.

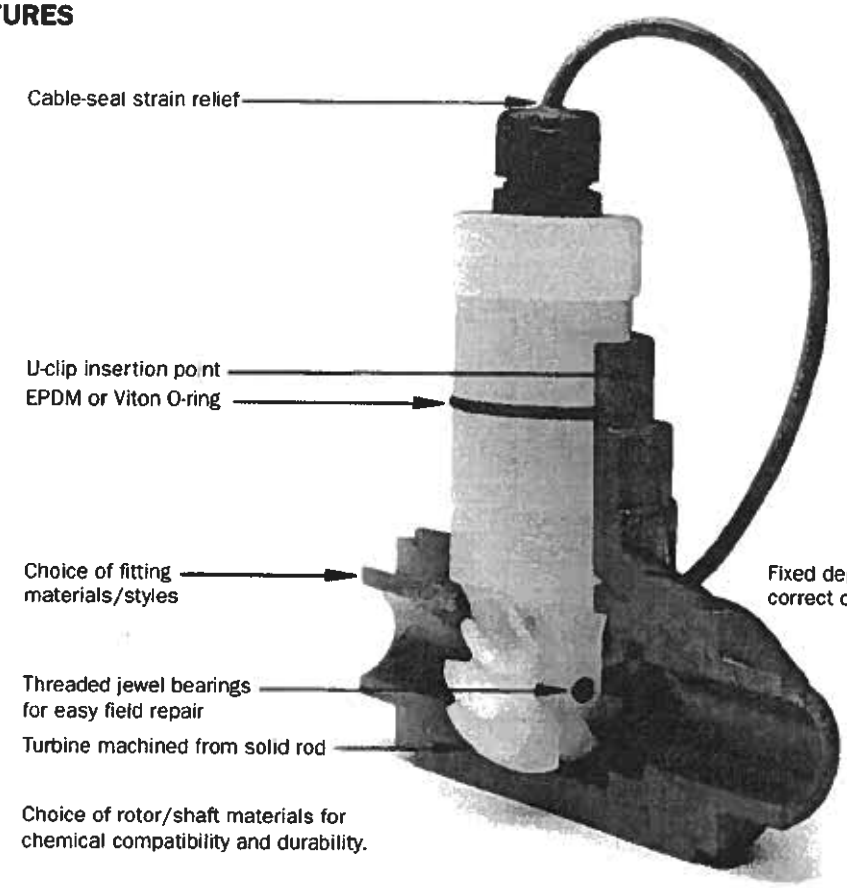
The rotation of the turbine is detected by a non-drag Hall-effect sensor. Output is a pulse-type square wave, which can be sent long distances (up to 2,000 feet) without a transmitter. This signal can be connected directly to Seametrics controls and displays, as well as PLC's, counters, and computer cards.

Seametrics TX80 meters are ideal for chemical proportioning applications. If no display is required, a simple divider such as the PD10 provides adjustable pump pacing. For rate and total display, as well as pump pacing, the FT420 flow indicator can be mounted directly on the TX80-Series, or remotely on a wall or panel. The FT415 offers a battery-operated rate/totalizer where power is not available.

Seametrics

TX80-SERIES
Insertion Turbine Flow Sensor

FEATURES



SPECIFICATIONS*

Materials	**Body**	Polypropylene, brass or stainless steel		
	Rotor Assembly	Polypropylene rotor/carbide shaft (PVDF rotor/ceramic shaft optional)		
	Bearings	Ruby jewel		
	O-Ring	EPDM (Viton optional)		
Rotor Pickup		GMR (Giant Magnetoresistive Sensor)		
Maximum		**Brass**	**316 SS**	**PVC/Polypro**
	Pressure	200 psi (14 bar)	250 psi (17 bar)	175 psi (12 bar) at 75°
	Temperature	200° F (93° C)		130° F (55° C) at 0 psi
Flow Range		0.2 to 30 ft./sec.		
Calibrated Accuracy		+/- 1.5% of full scale		
Signal		Current sinking pulse, 20 mA max, 30 Vdc max (Micropower option: Pulse output swings between supply voltage and 0 Vdc)		
Power		6-30 Vdc @ 8 mA (Micropower option: 3.5-16 Vdc @ 0.3 mA max)		
Cable		22 AWG, 3 Con, 18'; 2000' max run		
Regulatory		CE Mark (Stainless Steel, Brass and Standard Power Only)		

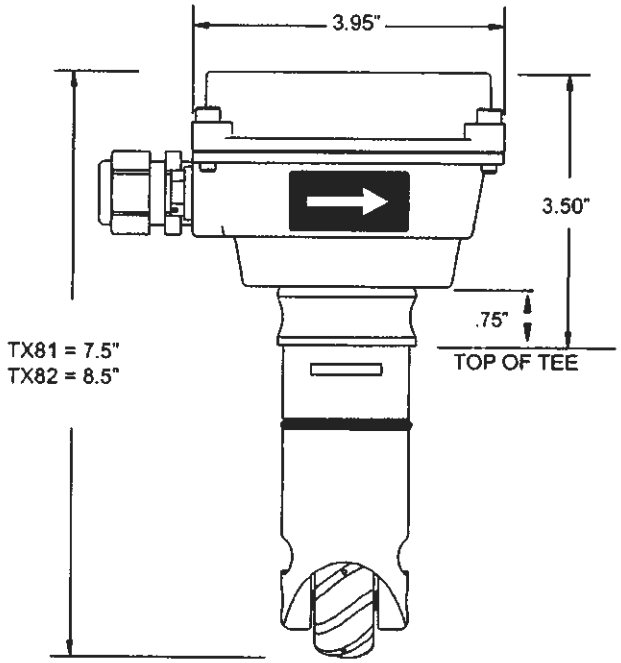
Specifications subject to change. Please consult our website for the most current data (www.seametrics.com).

Seametrics

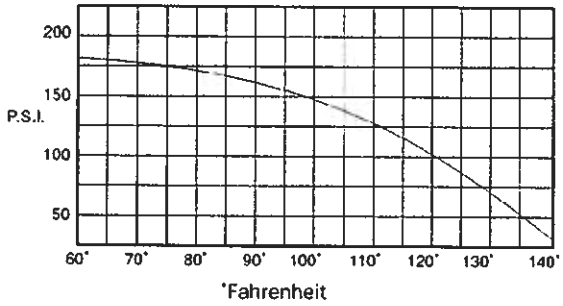
TX80-SERIES
Insertion Turbine Flow Sensor

DIMENSIONS

NOTE: Top Housing Optional



PRESSURE VS. TEMPERATURE (PVC/Polypro)



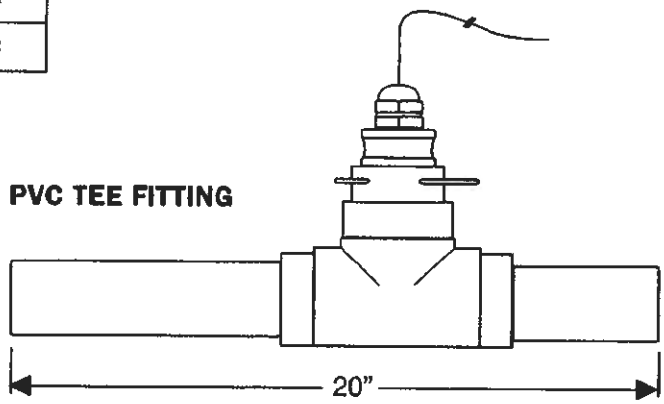
AVAILABLE FITTINGS

	Tee	Saddle	Weld	Braze	Sweat Tee
Bronze	1-1/2"-4"	3"-8"	x	3"-8"	1-1/2"-4"
PVC	1-1/2"-2"	3"-8"	x	x	x
Stainless Steel	1-1/2"-2" 304SS	x	3"-8" 316SS	x	x
Carbon Steel	1-1/2"-2"	x	3"-8"	x	x
Ductile Iron	x	3"-8"	x	x	x

FLOW RANGE (in Gallons Per Minute)

	1-1/2"	2"	3"	4"	6"	8"
Min	1.9	3.1	4.6	7.9	18	31
Max	190	314	691	1190	2700	4680

PVC TEE FITTING



Seametrics

TX80-SERIES
Insertion Turbine Flow Sensor

HOW TO ORDER

MODEL

1-1/2" - 3" = **TX81**

4" - 8" = **TX82**

MATERIAL

Brass = **B**

316SS = **S**

PVC = **P**

Polypro = **Y**

OPTIONS

Micropower Pickup = **-04**
(Use with FT415 or DL76)

Rotor/Ceramic Shaft, PVDF (Kynar) = **-05**

LMI Pump Connector = **-06**

Seametrics Control Connector = **-07**

Viton® O-Ring = **-60**

FITTINGS

Select from chart above
(Fitting Type and Material)

ACCESSORIES

Rate and Total Indicator with pulse & 4-20 mA outputs = **FT420**

Rate and Total Indicator, battery powered = **FT415**

Analog transmitter, blind 4-20 mA converter = **AO55**

Power converter, plug-in, 110-115 Vac, 24 Vdc = **PC3**

Pulse divider = **PD10**

Data logger = **DL76**

Mounting kit, converts wall to meter mount = **MK10**

Mounting kit, converts meter to wall mount = **MK20**

CONTACT YOUR SUPPLIER

Seametrics Incorporated • 19026 72nd Avenue South • Kent, Washington 98032 • USA
(P) 253.872.0284 • (F) 253.872.0285 • 1.800.975.8153 • www.seametrics.com

LT-65650031-C
7/15/10

FT400-Series

Seametrics

RATE/TOTAL INDICATOR INSTRUCTIONS

- FT415
- FT420

FT400-SERIES RATE TOTAL/INDICATOR INSTRUCTIONS

9001:2008 CERTIFIED

GENERAL INFORMATION

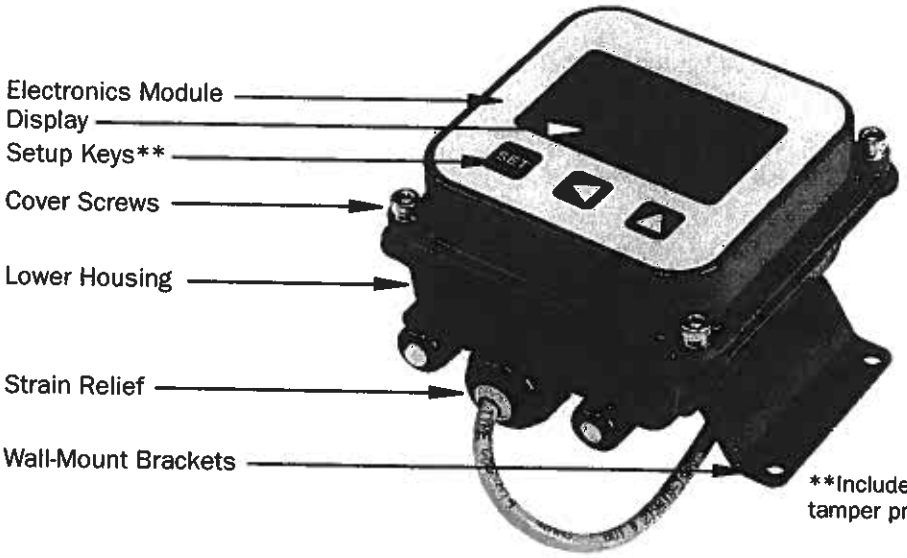
The FT400-Series flow computers are microcontroller-based indicator/transmitters that display flow rate and total and provide output signals. The FT415 is battery-powered and provides a scalable pulse output. The FT420 is powered by external DC voltage and has both pulse and 4-20 mA analog outputs. When the FT420 is being used in the 4-20 mA mode, it is a "two-wire" or "loop-powered" device, meaning that the 4-20 mA output signal doubles as its power supply.

The addition of a dual-relay output board (FT420 only) allows for certain applications requiring contact output isolation (e.g., certain metering pumps and water treatment controls). Dual solid state relays provide exactly the same pulse output as the standard unit, and each can signal one external device. A non-resettable total is also available. The FT420 can be ordered in a plastic enclosure with a 115 Vac power supply for use with mechanical meters, or with a built-in 115 Vac/12-24 Vdc dual power supply for magmeters. Both the FT415 and the FT420 can be factory-mounted on the meter (-M) or remotely wall mounted with the brackets provided (-W). The FT420 is also available as a panel mount (-P) with an open back for easy installation in the user's own electrical enclosure. Most FT400's can be converted from wall-to-meter or meter-to-wall mount configurations after installation if needed.

Housings for the -W and -M models are rugged cast aluminum, potted and gasketed for maximum environmental protection. A membrane keypad allows settings to be changed without removing the cover. (Password protection, a standard feature, can be used to prevent settings from being changed.)

**Includes password protection for tamper prevention when needed

FEATURES



**Includes password protection for tamper prevention when needed

SPECIFICATIONS*

		FT415	FT420
Power		Lithium "C", 3.6 Vdc, replaceable, 3-5 year life	12-30 Vdc, 4mA (4-20 mA when loop-powered)
Display	**Rate**	6-digit autorange, 1/2" character height	6-digit autorange, 1/2" character height
	Total	8-digit, 5/16" character height	8-digit, 5/16" character height
Outputs	**Current Sinking Pulse**	Scaled Pulse output (0.1 sec duration 6.1 Hz max) (or High Alarm output or Low Alarm output on FT420 only)	
		Sensor pass-through Pulse output (unscaled)	
	Analog	None	4-20 mA loop; 24-30 Vdc
Pulse Output Range		0.1 - 9999999.9 units/pulse	0.1 - 9999999.9 units/pulse
Input		Micropower GMR Sensor (square wave)	5V pulse or contact closure
Input Range		1.0 - 150 pulses/second	1.0 - 1,500 pulses/second
K-Factor Range		.001 - 99999.999	.001 - 99999.999
Flow Alarm Output Range		.01 - 999999.99	.01 - 999999.99
Operating Temperature		-30° to 65° C (-22° to 148° F)	-30° to 65° C (-22° to 148° F)
Environmental		NEMA 4X, IP66	NEMA 4X, IP66
Regulatory		None	CE Mark

*Specifications subject to change • Please consult our website for current data (www.seametrics.com).

HDPE Pipe Data

(Chevron Phillips)

EnSol, Inc.

PERFORMANCE PIPE
A Division of Chevron Phillips Chemical Company LP

PERFORMANCE PIPE DRISCOPLEX® 4000/4100 Pipe

Water and Wastewater Piping Systems

- Corrosion Resistant
- Leak Proof Fused Joints
- Ideal for Trenchless Applications
- Flexible
- Hydraulically Efficient ID
- Will Not Tuberculate
- Reduces Surge Pressure
- Outstanding Resistance to Fatigue
- Excellent Impact Strength
- Thrust Blocks Not Needed
- Resistant to Sewer Gas
- Less Maintenance
- Mechanical Fittings Available for Transitions and Repairs
- Environmentally Friendly

When Performance Matters
Rely on Us!

ASCE Report Card

The American Society for Civil Engineers (ASCE) issues a "report card" on the condition of America's infrastructure about once every five years. In the 2009 report they gave water and wastewater infrastructure a grade of D minus. EPA has identified the two biggest problems facing America's infrastructure as corrosion and leakage. DriscoPlex® 4000 and 4100 High Density Polyethylene (HDPE) pipes offer a solution. HDPE pipes do not undergo galvanic corrosion and are suited for "aggressive soils." They do not rust, rot, corrode, tuberculate, or support biological growth. DriscoPlex® 4000 and 4100 pipes are joined by heat fusion which means the pipes are essentially a continuous pipe without gasket joints to leak. The heat-fused joint is as strong as the pipe itself and fully restrained requiring no thrust blocks.

The Future for Water and Wastewater Piping

Polyethylene pipe's wide acceptance and use for natural gas distribution is the strongest statement that can be made about polyethylene pipe's corrosion resistance and leak-tight nature. Polyethylene pipe has been used for gas distribution pipe since the early 1960's. More than 95% of new gas distribution piping is polyethylene. By 2008, over 577,000 miles of polyethylene natural gas pipe and 39.6 million polyethylene pipe services were installed in the United States. Natural gas service is the most safety critical usage of piping in a municipality. Leakage cannot be tolerated. In addition to the excellent record in gas distribution, polyethylene pipe has been used for water in Europe and North America for 50 years. Recognizing these successes, more and more water and wastewater utilities are turning to polyethylene pipe for both trenchless construction and open-cut applications. For municipal usage, DriscoPlex® pipe is manufactured to ASTM F714, AWWA C901 and AWWA C906 standards. It meets the requirements of NSF/ANSI-61 (NSF/ANSI-14 where noted) and comes in either Iron Pipe Sizes or Ductile Iron Pipe Sizes, i.e. the outside diameter (OD) matches the OD of iron pipe or ductile iron pipe, respectively. In addition to pipe, standard products such as heat-fusion and electrofusion saddles, flanges, mechanical-joint adapters are available for hot tapping and connecting to pumps, hydrants or valves. Mechanical connections and hot taps requiring no fusion are available as well.

Performance Pipe Means the Highest Quality

Performance Pipe is a name you can trust in water and sewer piping. Performance Pipe has produced quality polyethylene piping products for fifty years. Our internal QA/QC requirements meet or exceed those required by industry standards. Each production line is continuously monitored throughout the manufacturing cycle to ensure that the product adheres to all internal quality control specifications and the manufacturing standard.

All nine of Performance Pipe's manufacturing facilities and our headquarters are certified in accordance with the latest edition of ISO 9001:2000. Certificates of Conformance are available through our website. Performance Pipe produces all pipe and molded fittings products in the United States. These products are compliant with the Buy American requirement of the 2009 American Recovery and Reinvestment Act.

When you select Performance Pipe DriscoPlex® 4000 and 4100 pipe and fittings, in addition to receiving quality products, you also gain access to our team of experts for technical support, sales and assistance. Our territory sales teams are dedicated to the municipal piping industry and are active

Performance Pipe, a division of Chevron Phillips Chemical Company LP | 5085 W. Park Blvd | Suite 500 | Plano, TX 75093 | Phone: 800-527-0662 | Fax: 972-599-7348

members of the ASTM International, Plastics Pipe Institute, American Water Works Association (AWWA) and many other industry associations. As a company we provide technical expertise and service to these organizations on an ongoing basis.

The unmatched quality and performance of Performance Pipe's polyethylene piping products is further enhanced and strengthened by more than five decades of quality polyolefin plastic resin production from our parent company Chevron Phillips Chemical Company LP.

Polyethylene Resin Continues to Improve

DriscoPlex® pipe and fittings for M&I applications are made from polyethylene materials that are engineered for high density, extra high molecular weight, and broad molecular weight distribution. These characteristics give DriscoPlex® products strength, flexibility, toughness and durability. Since the introduction of polyethylene piping materials in the 1950's, polyethylene resin manufacturers have worked continually to improve their resins. In 2005 "High Performance" polyethylene pipe materials were adopted in U.S. ASTM standards. The most improved of the new materials has a designation code of PE4710. Compared to PE3408 (now PE3608) materials, PE4710 resins have increased density, higher tensile strength and higher resistance to slow crack growth. These increased properties allow the pipe to meet higher performance requirements.

Performance Pipe manufactures pipe and fittings of high performance PE4710. Performance Pipe's PE4710 materials are listed in PPI TR-4 with a Hydrostatic Design Stress of 1000 psi at 73°F. Where specifications and standards permit, PE4710 materials can be operated at higher pressures than PE3408 materials due to the higher Hydrostatic Design Stress rating at 73°F. PE4710 materials meet or exceed all of the requirements of the former PE3408 resin.

For a more detailed explanation of PE4710 materials and information regarding temperature, design factors and calculation of pressure rating, see PP 816-TN *PE3608 and PE4710 Materials Designation Codes and Pipe Pressure Ratings.* All Performance Pipe documents may be found at www.performancepipe.com.

Cell Classification for PE4710 Material

ASTM D3350, *Standard Specification for Polyethylene Plastics Pipe and Fittings Materials,* identifies polyethylene materials for pipe and fittings according to a cell classification system. Performance Pipe's DriscoPlex® 4000 and 4100 series pipe cell classification is listed in Table 1. For specific material properties see PP101, *"DriscoPlex® 4000 (DIPS)/4100 (IPS) Water, Wastewater and Industrial".*

Table 1: Cell Classifications

Performance Pipe Product Series	Material Designation Code (MDC)		ASTM D3350 Cell Classification
	Present	Past	
DRISCOPLEX® 4000/4100 Pipe	PE4710	PE3408	445574C

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PE Durability and Disinfectants in Potable Water Applications

HDPE pipes are used extensively in municipal water applications throughout Europe and the United Kingdom – boasting the lowest failure rates of any piping material. HDPE pipes contain additives which protect the pipe from the oxidizing effects of disinfectants. At Performance Pipe, our HDPE water pipes meet AWWA requirements and are evaluated to the toxicological requirements of NSF/ANSI 61. A recent study by Jana Laboratories examined the projected lifespan of polyethylene pipe under typical operating conditions at utilities in Indiana, Florida, North Carolina, and California. Their findings indicate a life expectancy greater than 100 years. Read Jana Laboratories' report, *Impact of Potable Water Disinfectants on PE Pipe*.

DriscoPlex® Piping Products for Municipal Applications

Performance Pipe offers pipe for municipal applications that are manufactured to both ASTM and AWWA standards simultaneously. Performance Pipe standard products are generally stocked by distributors and, for many sizes and DR's, are readily available. Specialty products are available but generally not stocked and thus have to be produced at Performance Pipe manufacturing plants. Table 2 lists the various products, applicable standards, and the pipe material designation code. DriscoPlex® pipes series are identified by a four digit number code. For example, DriscoPlex® 4000 pipe.

Table 2. DriscoPlex® Pipes

DriscoPlex® Municipal Water and Wastewater Pipe				
DriscoPlex® Pipe Series	**Features**	**Size Range**	**Applicable Standards**	**Pipe Materials Designation Codes Available (PPI TR-4)**
4000 (DIPS) Municipal potable water, raw water, process water, sewer	Black w/ blue stripes	4" through 42" DIPS	AWWA C906 & ASTM F714 (4" to 42") NSF/ANSI 61	**PE4710**
4100 (IPS) Municipal potable water, raw water, process water, sewer	Black pipe is standard	1-1/2" through 54" IPS	AWWA C901 & ASTM D3035 (3" & smaller) ASTM F714 & AWWA C906 (4" to 54") and NSF/ANSI 61	**PE4710**

For ¾" through 2" SIDR and CTS and for ¾" through 3" IPS for municipal potable water service lines consider 5100 Ultraline®. See PP410,"DriscoPlex® 5100 Series Ultraline® HDPE Water Service Pipe & Tubing".

DriscoPlex® Pipe is Manufactured to Both ASTM F714 and AWWA C906

DriscoPlex® 4000/4100 pipe meets or exceeds the requirements of ASTM F714 and AWWA C906. ASTM F714 designates a "Pressure Rating (PR)" whereas AWWA C906 designates a "Pressure Class, PC." Currently these are not calculated the same way and therefore are not equal. ASTM F714 recognizes PE4710 material, whereas AWWA C906 is being updated but currently treats PE4710 material as having the same PC as the former PE3408 material. For AWWA C906 ratings, see Appendix 1.

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The pressure rating of PE pipe varies with the pipe's Dimension Ratio (DR). The DR is equal to the average pipe outside diameter (OD) divided by the minimum wall thickness. The Plastics Pipe Institute's *Handbook of Polyethylene Pipe* gives the method for calculating the pressure rating. The pressure ratings for DriscoPlex® 4000/4100 pipe allowed by ASTM F714 are given in Table 3.

Water and force main sewer lines have frequent and recurring surges. The designer will consider both the pipe's working or pumping pressure and the total pressure (pumping pressure plus surge pressure) when determining an application's DR. Rating for both are given in Table 3 for easy comparison with design flow conditions.

Table 3 DriscoPlex® 4000 and 4100 Pipe Pressure Ratings per ASTM F714 at 80°F

PE4710 Pipe Pressure Ratings Per ASTM F714[1]			
Dimension Ratio	**Working Pressure Rating (psi)**	**Allowable Total Pressure During Recurring Surge (psi)**	**Allowable Total Pressure During Occasional Surge (psi)**
9	**250**	**375**	**500**
11	**200**	**300**	**400**
13.5	**160**	**240**	**320**
14.3	**150**	**225**	**300**
17	**125**	**185**	**250**
21	**100**	**150**	**200**
26	**80**	**120**	**160**

[1]For Pressure Class and Working Pressure Ratings per AWWA C906, see Appendix 1. Ratings are for water and can vary for other fluids and temperature. Table 3 Working Pressure Ratings may be used with AWWA C901 pipe.

The temperature range for polyethylene pipe is -40°F to 140°F for pressure pipe and -40°F to 180°F for non-pressurized pipe, e.g. gravity flow. When DriscoPlex® pipe operates at a temperature above 80°F the Pressure Rating and Pressure Class of the pipe are decreased. The PR/PC for temperatures above 80°F may be determined by multiplying the PC in Table 3 by the temperature factor from Table 4.

Table 4: Service Temperature Design Factor

Service Temperature Design Factor, F_T[1]							
Service Temperature, °F (°C)	≤80 (27) (1)	≤90 (32)	≤100 (38)	≤110 (43)	≤120 (49)	≤130 (54)	≤140 (60)
	1.0	0.9	0.8	0.71	0.63	0.57	0.50

[1]Use 80°F (27°C) service factor for service temperatures below 80°F (27°C). F_T for temperatures below 100°F are from AWWA M-55. F_T for temperatures above 100°F found by interpolation.

***PPI Design & Engineering Calculator for PE Pipe* is available on the Performance Pipe website.**

DriscoPlex®4000/4100 Pipe Common Sizes

Tables 5 and 6 give dimensions and weights for commonly used DR's in the water and wastewater industry. For other available DR's, see PP152 and PP153, *Size and Dimension Sheets*. All pipes of a given nominal size are made to the same OD regardless of DR. Therefore, the average inside diameter (ID) varies with the pipe wall thickness. DriscoPlex® 4000/4100 pipe is available in 40 or 50 foot lengths and is also available in coils through 6" DIPS. *Packaging and Loading* information is available on our website.

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Table 5 DriscoPlex® 4000 DIPS Pipe Sizing System

Common Dimension Ratio's for DriscoPlex® 4000 DIPS Pipe (Custom DR's available. Contact Performance Pipe)													
DIPS		DR 21			DR 14.3			DR 11			DR 9		
ASTM F714 PR		PR = 100 psi			PR = 150 psi			PR = 200 psi			PR = 250 psi		
AWWA C906 PC		PC = 80 psi			PC = 120 psi			PC = 160 psi			PC = 200 psi		
Pipe Size, in.	OD, in.	Min. Wall, in.	Avg. ID, in.	Wgt. lbs/ft	Min. Wall, in.	Avg. ID, in.	Wgt. lbs/ft	Min. Wall, in.	Avg. ID, in.	Wgt. lbs/ft	Min. Wall, in.	Avg. ID, in.	Wgt. lbs/ft
4	4.80	0.229	4.315	1.45	0.336	4.088	2.07	0.436	3.876	2.62	0.533	3.670	3.13
6	6.90	0.329	6.203	2.99	0.483	5.877	4.27	0.627	5.571	5.42	0.767	5.274	6.47
8	9.05	0.431	8.136	5.13	0.633	7.708	7.35	0.823	7.305	9.33	1.006	6.917	11.13
10	11.10	0.529	9.979	7.73	0.776	9.454	11.06	1.009	8.961	14.03	1.233	8.486	16.74
12	13.20	0.629	11.867	10.93	0.923	11.243	15.64	1.200	10.656	19.84	1.467	10.090	23.67
14	15.30	0.729	13.755	14.68	1.070	13.032	21.01	1.391	12.351	26.65	1.700	11.696	31.80
16	17.40	0.829	15.643	18.98	1.217	14.820	27.17	1.582	14.046	34.47	1.933	13.302	41.13
18	19.50	0.929	17.531	23.84	1.364	16.609	34.12	1.773	15.741	43.30	2.167	14.906	51.66
20	21.60	1.029	19.419	29.25	1.510	18.398	41.87	1.964	17.436	53.13	2.400	16.512	63.38
24	25.80	1.229	23.195	41.73	1.804	21.975	59.73	2.345	20.829	75.77	2.867	19.722	90.43
30	32.00	1.524	28.769	64.18	2.238	27.256	91.89	2.909	25.833	116.58			
†36	38.30	1.824	34.433	91.93	2.678	32.622	131.63	3.482	30.918	167.02			
†42	44.50	2.119	40.008	124.09	3.112	37.903	177.70						

Average inside diameter is calculated using Nominal OD and Minimum Wall plus 6% for use in estimating fluid flow. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimensions and tolerances in the applicable pipe manufacturing specification. †OD available upon special request.

Table 6 DriscoPlex® 4100 IPS Pipe Sizing System

Common Dimension Ratio's for DriscoPlex® 4100 IPS Pipe (Custom DR's available. Contact Performance Pipe)																
IPS		DR 21			DR 17			DR 13.5			DR 11			DR 9		
ASTM F714 PR		PR = 100 psi			PR = 125 psi			PR = 160 psi			PR = 200 psi			PR = 250 psi		
AWWA C906 PC		PC = 80 psi			PC = 100 psi			PC = 130 psi			PC = 160 psi			PC = 200 psi		
Pipe Size in.	OD, in.	Min. Wall, in.	Avg. ID, in.	Wgt. lbs/ft	Min. Wall, in.	Avg. ID, in.	Wgt. lbs/ft	Min. Wall, in.	Avg. ID, in.	Wgt. lbs/ft	Min. Wall, in.	Avg. ID, in.	Wgt. lbs/ft	Min. Wall, in.	Avg. ID, in.	Wgt. Lbs/ft
2	2.375				0.140	2.078	0.43	0.176	2.002	0.53	0.216	1.917	0.64	0.264	1.815	0.77
3	3.500				0.206	3.063	0.94	0.259	2.951	1.16	0.318	2.826	1.39	0.389	2.675	1.66
4	4.500	0.214	4.046	1.27	0.265	3.938	1.55	0.333	3.794	1.92	0.409	3.633	2.31	0.500	3.440	2.75
6	6.625	0.315	5.957	2.75	0.390	5.798	3.36	0.491	5.584	4.15	0.602	5.349	5.00	0.736	5.065	5.96
8	8.625	0.411	7.754	4.66	0.507	7.550	5.69	0.639	7.270	7.04	0.784	6.963	8.47	0.958	6.594	10.11
10	10.750	0.512	9.665	7.24	0.632	9.410	8.83	0.796	9.062	10.93	0.977	8.679	13.16	1.194	8.219	15.70
12	12.750	0.607	11.463	10.19	0.750	11.160	12.43	0.944	10.749	15.38	1.159	10.293	18.51	1.417	9.746	22.08
14	14.000	0.667	12.586	12.28	0.824	12.253	14.98	1.037	11.802	18.54	1.273	11.301	22.32	1.556	10.701	26.63
16	16.000	0.762	14.385	16.04	0.941	14.005	19.57	1.185	13.488	24.22	1.455	12.915	29.15	1.778	12.231	34.78
18	18.000	0.857	16.183	20.30	1.059	15.755	24.77	1.333	15.174	30.65	1.636	14.532	36.89	2.000	13.760	44.02
20	20.000	0.952	17.982	25.07	1.176	17.507	30.58	1.481	16.860	37.84	1.818	16.146	45.54	2.222	15.289	54.34
22	22.000	1.048	19.778	30.33	1.294	19.257	37.00	1.630	18.544	45.79	2.000	17.760	55.10	2.444	16.819	65.75
24	24.000	1.143	21.577	36.10	1.412	21.007	44.03	1.778	20.231	54.49	2.182	19.374	65.58	2.667	18.346	78.25
26	26.000	1.238	23.375	42.36	1.529	22.759	51.67	1.926	21.917	63.95	2.364	20.988	76.96	2.889	19.875	91.84
28	28.000	1.333	25.174	49.13	1.647	24.508	59.93	2.074	23.603	74.17	2.545	22.605	89.26	3.111	21.405	106.51
30	30.000	1.429	26.971	56.40	1.765	26.258	68.80	2.222	25.289	85.14	2.727	24.219	102.47	3.333	22.934	122.27
32	32.000	1.524	28.769	64.17	1.882	28.010	78.28	2.370	26.976	96.87	2.909	25.833	116.58	3.333	22.934	122.27
34	34.000	1.619	30.568	72.44	2.000	29.760	88.37	2.519	28.660	109.36	3.091	27.447	131.61			
36	36.000	1.714	32.366	81.21	2.118	31.510	99.07	2.667	30.346	122.60	3.273	29.061	147.55			
42	42.000	2.000	37.760	110.54	2.471	36.761	134.84	3.111	35.405	166.88						
48	48.000	2.286	43.154	144.38	2.824	42.013	176.12									
54	54.000	2.571	48.549	182.73	3.176	47.266	222.90									

For pipe smaller than 2" see PP415, DriscoPlex® 5100 Water Service Pipe and Tubing.
Average inside diameter is calculated using Nominal OD and Minimum Wall plus 6% for use in estimating fluid flow. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimensions and tolerances in the applicable pipe manufacturing specification.

PERFORMANCE ADVANTAGES OF DRISCOPLEX® 4000/4100 PIPE

Stripes

Stripes allow easy field identification of pipe. DriscoPlex® 4000 (DIPS) pipe comes standard with three pairs of blue stripe, but lavender, green, and no stripes is optional. The standard DriscoPlex® 4100 (IPS) is black, but blue, lavender and green striping is optional with 4 single stripes at 90 degrees apart.

Flow

DriscoPlex® 4000/4100 pipes are characterized as hydraulically smooth and typically have an absolute surface roughness (ε) of 0.000005 ft. The Hazen-Williams Friction Factor (C) equals 150 to 155 for polyethylene pipes. Even though the inside diameter of polyethylene pipe may be smaller for the same nominal size as metallic or concrete pipes, flow is often equal or greater through polyethylene pipe. For example, an 8" DR17 DriscoPlex® 4000 pipe has a lower pressure drop per given flow rate than an 8" CL350 concrete lined DI pipe (C equals 120). For gravity flow, the n-factor in the Manning equation is typically taken as 0.009 for clear water and 0.010 for sanitary sewer. For design information, see the *Handbook of Polyethylene Pipe*, Chapter 6.

Surge Pressure

When it comes to surges, polyethylene has two advantages over most piping materials. 1) As Table 3 shows, it has the capacity to handle surge pressures significantly in excess of its pressure rating. 2) It also has the lowest surge pressure of all common water pipes. For example, a 5 ft/sec velocity change in a DR17 Polyethylene pipe will produce a 56 psi surge, in a DR18 PVC pipe the surge is 88 psi, and in a Class 50 DI pipe the surge is 268 psi. Thus, with polyethylene pipe there are lower surge pressures and less wear and tear on valves, hydrants, and other system components and, when surges occur, HDPE pipes may be quite capable of handling them with a lower Pressure Class (PC) than required for other materials.

Fatigue

Repeated surges will cause fatigue stress in pipelines. This is particularly significant in certain thermoplastic pipes, excluding polyethylene. Fortunately, polyethylene has an excellent resistance to fatigue. The projected design life for DriscoPlex® 4000/4100 pipes exceeds 100 years for pipe operating at a velocity of 4 fps with a surge frequency of 4 times per hour continuously. See Bulletin PP-402, *Working Pressure Rating and Fatigue Life*.

Comparison with Other Piping Products

Polyethylene's superior performance is due to its fused joint, toughness, and flexibility. Comparisons of polyethylene to other piping materials based on PC alone can lead to costly over-designs, since the definition of "Pressure Class" varies from material to material (see AWWA C906, C905, etc). When correctly incorporating HDPE's lower surge magnitudes, higher surge allowances, and greater fatigue strength into the design, the PC required for HDPE may be much lower than the PC required for other pipe materials.

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Impact Resistance
Polyethylene pipe is routinely used in mining applications above the Arctic Circle and can withstand water freezing internally. A product that can be handled in these extreme conditions has to have excellent impact resistance. The Izod Impact Strength of high density polyethylene using ASTM D256 Method A is 4 to 5 ft-lbs/in at 73°F, again a value significantly greater than other plastic pipe materials.

Rapid Crack Propagation
Impact damage, fatigue, or joint failure in metal or thermoplastic pipes under certain operating conditions can lead to long, running cracks that will propagate through fused joints and can travel hundreds of feet. This cracking is referred to as Rapid Crack Propagation (RCP). One published report cites an 1100 ft long crack that occurred in a fusion joined PVC pipeline. Polyethylene pipe has excellent resistance to RCP. In fact, laboratory testing has shown that RCP cannot occur in a water filled polyethylene pipe. PP838, *Preventing RCP in Fused Water Pipelines* indicates that the best way to avoid this type of cracking is to specify polyethylene pipe as opposed to other thermoplastic pipes.

INSTALLATION ADVANTAGES OF DRISCOPLEX® 4000/4100 PIPE

Heat Fusion of Polyethylene Pipe
Heat fusion of polyethylene pipe is proven, reliable, and time-tested, with over 50 years of success. The procedure is standardized, published in ASTM F2620, and there are thousands of trained operators around the nation. Compared to fusing other types of thermoplastic pipes, the process for polyethylene pipe is easier to learn, more forgiving, and results in higher productivity rates. Joints have the same tensile strength as the pipe and no thrust blocks or restraints are required at fittings and bends. Polyethylene pipe can be fused and installed in subfreezing weather. See PP750, *Heat Fusion Joining Procedures and Qualification Guide*.

Exceptional for Trenchless Installations
DriscoPlex® pipe is flexible and tough. As a result, polyethylene pipes are well-suited for horizontal directional drilling, plowing, river and water crossings, pipe bursting and sliplining. Installers like the fact that polyethylene pipe is tough enough to stand up to rigors of field handling with higher impact resistance, greater ductility, more flexibility, and higher resistance to RCP than its closest thermoplastic competitor. There is a wealth of technical publications for trenchless usage of polyethylene pipe including the *Handbook of Polyethylene Pipe*. See Chapter 11 “Pipeline Rehabilitation by Sliplining with PE Pipe,” Chapter 12, “Horizontal Directional Drilling,” and Chapter 16, “Pipe Bursting.”

Small Bend Radius; Big Installation Advantage
Installers often choose DriscoPlex® 4000/4100 pipe because of its flexibility and tight bend radius. The bend radius is the smallest radius to which a pipe can be bent without causing permanent damage. In open-cut and above-grade applications pipe may be strung around corners or over swales often eliminating fittings. Polyethylene water mains can typically be laid around a cul-de-sac without the use of fittings. In trenchless applications, a more flexible pipe results in shorter insertions pits and reduced costs.

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For horizontal directional drilling, a tight bend radius greatly reduces laydown space, the area where pipe is placed prior to pullback. In tight suburban right-of-ways, it is often necessary to string pipe around corners or bends while awaiting pullback. Flexibility facilitates this and polyethylene pipe can be curved to a radius 1/10th of that of its closest thermoplastic pipe competitor. Thus, it is more convenient for the installer and less disruptive to the public by eliminating inconvenient street closures. In addition, this extra flexibility provides a safety factor against damage during pullback as the polyethylene pipe will almost always have a tighter bending radius than the drill rod used to install it. Thus, polyethylene pipe is protected from over-bending unlike other fused thermoplastic pipes.

Bend radius should not be confused with the length of the pipe required to make a specific turn. Table 7 gives both the bend radius and the length required to make a 90° bend. For additional information on bending see PP407, "*Small Bend Radius Big Installation Advantage"* and PP819, "*Field Bending of PE Pipe".*

Table 7. DriscoPlex® 4000/4100 Minimum Bend Radius

DriscoPlex® 4000/4100 Minimum Bend Radius														
4100 IPS Size (in)	Minimum Bend Radius (ft)			Length of Pipe Required to Make a 90° Bend (ft)			4000 DIPS Size (in)	Minimum Bend Radius (ft)			Length of Pipe Required to Make a 90° Bend (ft)		
	DR 9	DR 11 DR 13.5	DR 17 DR 21	DR 9	DR 11 DR 13.5	DR 17 DR 21		DR 9	DR 11 DR 14.3	DR 21	DR 9	DR 11 DR 14.3	DR 21
2	4.0	4.9	5.3	6.2	7.8	8.4	---		---	---		---	---
3	5.8	7.3	7.9	9.2	11.5	12.4	---		---	---		---	---
4	7.5	9.4	10.1	11.8	14.7	15.9	**4**	8.0	10.0	10.8	12.6	15.7	17.0
6	11.0	13.8	14.9	17.3	21.7	23.4	**6**	11.5	14.4	15.5	18.1	22.6	24.4
8	14.4	18.0	19.4	22.6	28.2	30.5	**8**	15.1	18.9	20.4	23.7	29.6	32.0
10	17.9	22.4	24.2	28.1	35.2	38.0	**10**	18.5	23.1	25.0	29.1	36.3	39.2
12	21.3	26.6	28.7	33.4	41.7	45.1	**12**	22.0	27.5	29.7	34.6	43.2	46.7
14	23.3	29.2	31.5	36.7	45.8	49.5	**14**	25.5	31.9	34.4	40.1	50.1	54.1
16	26.7	33.3	36.0	41.9	52.4	56.5	**16**	29.0	36.3	39.2	45.6	56.9	61.5
18	30.0	37.5	40.5	47.1	58.9	63.6	**18**	32.5	40.6	43.9	51.1	63.8	68.9
20	33.3	41.7	45.0	52.4	65.5	70.7	**20**	36.0	45.0	48.6	56.5	70.7	76.3
22	36.7	45.8	49.5	57.6	72.0	77.8	---		---	---		---	---
24	40.0	50.0	54.0	62.8	78.5	84.8	**24**	43.0	53.8	58.1	67.5	84.4	91.2
28	46.7	58.3	63.0	73.3	91.6	99.0	---		---	---		---	---
30	50.0	62.5	67.5	78.5	98.2	106.0	**30**		66.7	72.0		104.7	113.1
32		66.7	72.0		104.7	113.1	---		---	---		---	---
34		70.8	76.5		111.3	120.2	---		---	---		---	---
36		75.0	81.0		117.8	127.2	**36**		79.8	86.2		125.3	135.4
42		87.5	94.5		137.4	148.4	**42**		92.7	100.1		145.6	157.3
48			108.0			169.6	---		---	---		---	---
54			121.5			190.9	---		---	---		---	---
When fittings or flanges are present the bend radius is normally taken as 100 times the pipe diameter.													

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Safe Pull Strength

Most all trenchless methods using polyethylene pipe are pull-in or pullback techniques. Pull-in distance is often proportional to the pipe's safe pull strength, which is the maximum tensile force that can be applied to the pipe with adequate assurance that the pipe will not be damaged or changed in any way that could affect its long term performance. The maximum safe tensile stress in DriscoPlex® PE4710 pipe for a 10 hour pull is 1300 psi. Table 8 lists the safe pull strength for DriscoPlex® 4000/4100 pipe.

Table 8. Safe Pull Strength for DriscoPlex® 4000/4100

Safe Pull Strength for DriscoPlex® 4000/4100 (PE4710)										
4100 IPS Nom. Size (in)	Safe Pull Strength (lbs)					4000 DIPS Nom. Size (in)	Safe Pull Strength (lbs)			
	DR 9	DR 11	DR 13.5	DR 17	DR 21		DR 9	DR 11	DR 14.3	DR 21
2	2,275	1,904	1,580	1,275	1,045	--	--	--	--	--
3	4,941	4,135	3,431	2,770	2,269	--	--	--	--	-
4	8,168	6,835	5,672	4,579	3,751	4	9,294	7,777	6,120	4,267
6	17,704	14,814	12,294	9,924	8,129	6	19,204	16,070	12,647	8,818
8	30,007	25,109	20,838	16,820	13,779	8	33,037	27,644	21,756	15,170
10	46,614	39,005	32,371	26,130	21,404	10	49,699	41,587	32,728	22,821
12	65,572	54,869	45,536	36,757	30,110	12	70,282	58,811	46,283	32,273
14	79,060	66,155	54,903	44,317	36,303	14	94,424	79,012	62,181	43,358
16	103,262	86,407	71,709	57,884	47,416	16	122,123	102,190	80,422	56,077
18	130,691	109,359	90,757	73,259	60,011	18	153,380	128,345	101,005	70,430
20	161,346	135,011	112,046	90,443	74,088	20	188,194	157,477	123,931	86,416
22	195,229	163,363	135,576	109,436	89,646	--	--	--	--	--
24	232,339	194,416	161,346	130,238	106,686	24	268,496	224,672	176,813	123,289
28	316,239	264,621	219,610	177,269	145,212	--	--	--	--	--
30	363,029	303,775	252,104	203,497	166,697	30	--	345,628	272,003	189,664
32	--	345,628	286,838	231,535	189,664	--	--	--	--	--
34	--	390,182	323,813	261,381	214,113	--	--	--	--	--
36	--	437,435	363,029	293,036	240,044	36	--	410,898	389,647	271,696
42	--	--	494,123	398,855	326,726	42	--	--	526,010	366,780
48	--	--	--	520,953	426,745	--	--	--	--	--
54	--	--	--	--	540,099	--	--	--	--	--

Horizontal Directional Drilling Resources

In developing plans for a directional drilling project, the designer must determine what DR to use. In addition to working-pressure considerations, DR selection depends on how much force will be required to pull the pipe back into the bore and on how much external force will be applied to the pipe during and afterward from the drilling slurry, soil and groundwater. Several resources are available to help the designer select an appropriate DR. Some of these resources offer additional and important information for planning a crossing. Resources include the following: ASTM F1962, a standard guide for the design

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of a directional drilled crossing with polyethylene pipe; the PPI *Handbook of Polyethylene Pipe*, Chapter 12; ASCE MOP 108, *Pipeline Design for Installation by Horizontal Directional Drilling*; and the Plastics Pipe Institute's Technical Report 46, *Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of Polyethylene Pipe*. In addition, the PPI ***BoreAid*** program is useful for making a preliminary evaluation of the DR requirements and the anticipated pullback force. A link to PPI BoreAid can be found on the Performance Pipe website on the Engineering Information page.

Burial in Open-Cut Trenching

The PPI *Handbook of Polyethylene Pipe*, Chapter 6, gives design guidance for open-cut trench installations of polyethylene pipes. HDPE pipe has been placed in landfills with cover depths well in excess of 100 ft. However, most municipal applications are significantly shallower. For the convenience of the designer, AWWA M-55, *PE Pipe—Design and Installation*, offers a safe design window. Pipe within the window meets the design deflection limits of M-55 and provide at least a 2:1 Safety Factor against buckling. For deeper depths or heavier loading, calculations are required.

Table 9. AWWA M-55 Minimum and Maximum Depths without doing calculations

AWWA M-55 Design Window	
DriscoPlex® 4000/4100 Pipe DR7.3 through DR21	
Minimum Cover Depth with no surface load	2 feet
Minimum Cover Depth with H20 truck load	3 feet
Maximum Cover Depth	25 feet
Requirements Minimum E' of native soil of 1000 psi. Maximum backfill weight of 120 pcf. No water above ground surface. Granular embedment soil around pipe with a minimum density of 85% Standard Proctor. Pipe installed per ASTM D2774 and PP-901.	

Like all piping materials, HDPE piping must be properly installed. DriscoPlex® 4000/4100 pipe should be installed in accordance with ASTM D 2774 *Standard Practice for Underground Installation of Thermoplastic Pressure Piping* and Performance Pipe's PP-901, *Field Handbook*. HDPE is a flexible piping material that works together with its soil embedment to sustain the earth and live loads above it. Suitable embedment is required to provide support around the pipe, and embedment materials must be placed so that the pipe is properly surrounded. Under roadways, compacted coarse sands and gravels are preferred, but other materials may be used under the direction of the design engineer. For more information on installation of 12" and smaller diameter DriscoPlex® pipe see the Plastics Pipe Institute's *Polyethylene Piping Systems Field Manual for Municipal Water Applications*. For installation by plowing and planting see the special underground installation techniques section of PP-901.

Ground Movement and Seismic Resistance

A large number of water main breaks occur every year due to soil settlement, freeze/thaw cycles, and shrinking or swelling of expansive soils, not to mention the occasional widespread damage that accompanies earthquakes. Polyethylene's flexibility and its fusion joints make it considerably less susceptible to damage from ground movement. California gas utilities recognize polyethylene's excellent record in enduring seismic events without damage.

Poisson Effect

When polyethylene pipe connects to a gasket jointed pipeline, the polyethylene pipe must be anchored or the gasket joints upstream (or downstream) from the transition must be restrained to prevent pullout of the gasket joints. See PP813, *Poisson Effect*.

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Above Grade and Aerial Installation

Performance Pipe black polyethylene pipe contains carbon black allowing indefinite above grade storage and use. For details on above grade applications see PP814, *Thermal Effects* and PP815, *Above Grade Pipe Supports*.

Vacuum Resistance (External Pressure)

Many pipelines operate under full or partial vacuum or experience negative internal pressures when subject to pressure surges. External pressure exceeding the internal pressure (external differential pressure) creates the same effect. Pipelines may be subject to external pressure during installation, submergence, grouting of sliplined pipe, or directional drilling. All pipes have a limit to the amount of external differential pressure (or vacuum) they can withstand. Exceeding that limit will cause the pipe to collapse. Table 10 gives the allowable external differential pressure based on Equation 3-39 in Chapter 6 of the *Handbook of Polyethylene Pipe* with a safety factor of two against collapse and with 3% ovality in the pipe. Higher resistance to collapse can be achieved by embedding the pipe in soil, flowable fill, grout, or concrete. For additional temperatures, see PP-901, *Field Handbook*.

Table 10. DriscoPlex® 4000/4100 Collapse Resistance (Vacuum Resistance)

DriscoPlex® 4000/4100 External Pressure Resistance PE4710									
Service Temperature	Pipe DR	External Differential Pressure or Vacuum Resistance 3% ovality with 2:1 safety factor[1] (psi)							
		50 yr	10 yr	1 yr	1000 hr	100 hr	10 hr	0.5 hr	Short-Term
Modulus Value (psi)		*29000*	*34000*	*40000*	*46000*	*55000*	*65000*	*82000*	*130000*
73°F	9	54.0	63.3	74.5	85.6	102.4	121.0	152.6	242.0
	11	27.6	32.4	38.1	43.8	52.4	61.9	78.1	123.9
	13.5	14.1	16.6	19.5	22.4	26.8	31.7	40.0	63.4
	14.3	11.7	13.8	16.2	18.6	22.3	26.3	33.2	52.7
	17	6.7	7.9	9.3	10.7	12.8	15.1	19.1	30.2
	21	3.5	4.1	4.8	5.5	6.6	7.7	9.8	15.5
120°F	9	31.3	36.7	43.2	49.7	59.4	70.2	88.5	140.3
	11	16.0	18.8	22.1	25.4	30.4	35.9	45.3	71.9
	13.5	8.2	9.6	11.3	13.0	15.6	18.4	23.2	36.8
	14.3	6.8	8.0	9.4	10.8	12.9	15.3	19.3	30.5
	17	3.9	4.6	5.4	6.2	7.4	8.8	11.1	17.5
	21	2.0	2.3	2.8	3.2	3.8	4.5	5.7	9.0

[1]Gray shading indicates value equals or exceeds full vacuum of 14.7 psi.

Fittings

Performance Pipe manufactures HDPE molded *Fittings* including tees and elbows in sizes through 8" diameter. Flange adapters for flange connections are available through 24" diameter. MJ Adapters for both DriscoPlex® 4000 and 4100 pipe are available through 12" diameter. Larger fittings are available through third party fabricators.

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Transition to Non-Polyethylene Pipes

Polyethylene pipe can be conveniently connected to metallic valves, pumps and even pipe. Normally the connection is made using a polyethylene Van Stone style Flange Adapter with a metallic backup ring which mates to a metallic flange or using a polyethylene Mechanical Joint (MJ) Adapter which mates to a DI mechanical joint bell. The MJ Adapter works with both IPS and DIPS polyethylene pipe. Acceptable methods also include metallic transition couplings that slide on, seal, and grip the polyethylene pipe or metallic transition couplings that slide on and seal but require additional external restraint rings. These types of couplings may require the use of an insert stiffener in the polyethylene pipe. DriscoPlex® 4000 pipe may be inserted directly into an MJ Bell. This requires placing an insert stiffener inside the end of the DriscoPlex® pipe and restraining the connection with an external ring or clamp on the DriscoPlex® pipe. When selecting mechanical couplings or components for use with DriscoPlex® pipe, make sure the mechanical coupling manufacturer recommends the particular part for HDPE pipe. For additional information on HDPE to non-HDPE pipe transitions, see the Plastics Pipe Institute's TN-36, *General Guidelines for Connecting Potable Water HDPE Pressure Pipes to DI and PVC Piping Systems* and *Polyethylene Piping Systems Field Manual for Municipal Water Applications.*

Tapping

A variety of heat fusion and mechanical fittings make hot or cold tapping a straightforward process. Heat fusion jointed products include saddle fusion tapping tees, electrofusion tapping tees, and branch-saddles. A number of manufacturers produce metallic full body tapping saddles and sleeves for polyethylene pipe. Performance Pipe recommends that the manufacturer be contacted to make sure their saddles work with polyethylene pipes. Service saddles are available as well. These may come with double or extra wide straps, with spring washers, or with both.

Repair

Polyethylene pipe has an excellent field record. However, circumstances may arise where repair is necessary. The most likely form of damage is impact or an underground strike which is usually localized. A variety of repair clamps (both mechanical and electrofusion) and tapping saddles are available. If a section of pipe has to be removed, a new pup piece can be inserted using mechanical couplings, polyethylene flange adapters, or electrofusion couplings.

Leak Testing

Polyethylene pipe may be hydrostatically tested to determine system integrity for leaks. When testing is required, observe all safety measures. See Performance Pipe PP 802, *Leak Testing of Polyethylene Pipe*. Typically, HDPE pipe is leak tested to 1.5 times its Pressure Rating (PR). See Tables 5 and 6.

Water Quality

Water utilities aim to maintain a high standard of water quality and to protect public drinking water from any internal and external contaminates. All piping systems have some potential for contamination from external agents through permeation of gaskets, jointed connections, or permeation through the pipe wall. Literature suggests that permeation of organic chemicals and hydrocarbons through polyethylene pipe is possible, while actual cases of soil contaminated hydrocarbon permeation are extremely rare.

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Hydrocarbons do not degrade polyethylene but can diffuse through the wall of the pipe in areas of gross contamination. The exterior contact may affect sidewall fusions and or butt fusions; thus, after polyethylene pipes have been exposed to grossly contaminated soils, mechanical connections may be preferred.

There are several ways to address gross hydrocarbon contamination of soil surrounding the pipe including removal and replacement of the contaminated soil with good clean soil of Class I or Class II materials, sleeving the pipe, and rerouting the pipe around the contaminated area.

Safety

Polyethylene piping has been safely used in thousands of applications. However, there are general precautions that should be observed when using any product. In this respect, polyethylene piping is no different. Performance Pipe's recommends the following reading for a more detailed list of cautions and safety features.

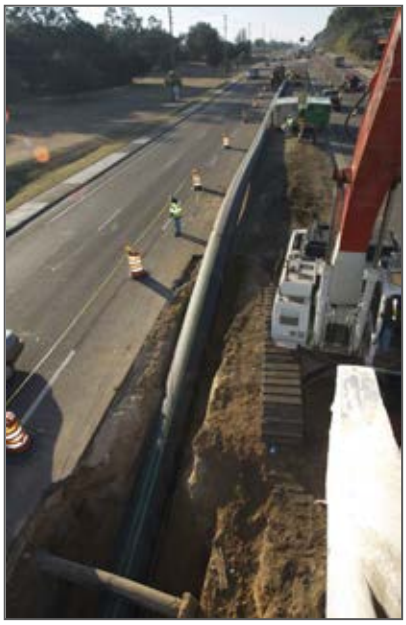
1. The Plastic Pipe Institute Handbook of Polyethylene Pipe, Chapter 2. *Inspections, Tests and Safety Features*.

2. *The Performance Pipe Field Handbook*.

3. *Pipe Loading/Unloading-Truck Driver Safety Video*

Technical Information

A large body of technical information related to the design and installation of polyethylene pipe is available at the Plastics Pipe Institute's website, www.plasticpipe.org and on Performance Pipe's website, www.performancepipe.com. Additional information on polyethylene pipe including case history information is available at the PE Alliance site, www.pepipe.org.



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APPENDIX A. PRESSURE CLASS SELECTION PER AWWA C906

Selecting the right Pressure Class for High Density Polyethylene pipe in accordance with AWWA C906 is easy. Just two steps! AWWA C906 takes into account the continuous pumping and transient (surge) pressures that occur in municipal water pipes.

Step 1. Compare the pipeline working pressure with the pipe's Pressure Class.

AWWA C906 defines working pressure as "the maximum anticipated, sustained **operating pressure applied to the pipe exclusive of transient pressures".** The maximum working pressure for a pipe must be less than or equal to the pipe's Pressure Class. Table A-1 gives Pressure Class for standard Dimension Ratio's (DR) HDPE pipe made from PE3608 material.

Table A-1: Maximum Allowable Pressures for HDPE Pipe (PE3608) at 80°F[1] (Per AWWA C906)

	Pressure Class/ Maximum Working Pressure (psi)	Maximum Total Pressure[2] Allowed During Recurring Surge (psi)	Maximum Total Pressure[2] Allowed During Occasional Surge (psi)	Maximum Test Pressure Allowed per AWWA Manual M55 (psi)
Pipe DR 7.3	254	380	510	380
Pipe DR 9	200	300	400	300
Pipe DR 11	160	240	320	240
Pipe DR 13.5	128	185	250	185
Pipe DR 17	100	150	200	150
Pipe DR 21	80	120	160	120

[1]Pressures above 80°F require derating. See Table 4.

[2]Total pressure equals the combined pumping (working) pressure plus surge pressure. Recurring surges are frequently occurring surges inherent to the design and operation of the system. Occasional surges are caused by emergency operations such as fire flows.

Step 2. Compare the peak pipeline pressure during surge with the pipe's allowable Maximum Total Pressure.

Peak pressure during a surge is equal to the sum of the pumping pressure and the transient surge pressure. Transient surge pressure depends on the instantaneous change in flow velocity. Maximum transient pressure due to an instantaneous change in flow velocity is given in Table A-2. Peak pressure may be obtained by adding the surge pressure at the design velocity from Table A-2 to the pumping pressure. Peak pressure is compared with the Maximum Total Pressure Allowed During Surge in Table A-1. The Maximum Total Pressure Allowed equals 1.5 times the pipe's Pressure Class for recurring surge and 2.0 times the pipe's Pressure Class for occasional surge.

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Note: *The surge pressure occurring in HDPE pipe is significantly lower than surge pressures occurring in cast or ductile iron pipe and is lower than that in PVC pipe of the same DR. For example, a 4 fps instantaneous velocity change in HDPE DR17 pipe results in a 45.0 psi surge whereas for DI pipe the surge is 200 psi and for PVC DR18 pipe the surge is 69.6 psi. When HDPE pipe is connected to DI pipe the surge pressure is dampened by the HDPE pipe.*

Table A-2. Surge Pressure at 80°F for Sudden Velocity Change, psi (Per AWWA M-55)

		Surge Pressure, psi							
		1 fps	2 fps	3 fps	4 fps	5 fps	6 fps	7 fps	8 fps
Pipe DR	7.3	18.4	36.8	55.2	73.6	92.0	110.4	128.8	147.2
	9	16.2	32.4	48.5	64.7	80.9	97.1	113.2	129.4
	11	14.4	28.7	43.1	57.5	71.9	86.2	100.6	115.0
	13.5	12.8	25.6	38.4	51.2	63.9	76.7	89.5	102.3
	17	11.3	22.5	33.8	45.0	56.3	67.5	78.8	90.0
	21	10.0	20.1	30.1	40.1	50.2	60.2	70.2	80.3

Working Pressure and Surge Pressure Example:

An engineer is designing a water system that operates at 85 psi and has some runs in it where the flow velocity is 4 fps. In addition, his/her state requires a 150 psi test for the pipeline. What DR pipe does the engineer use?

Step 1. Compare the pumping pressure, 85 psi, with the available Pressure Classes in Table A-1. DR17 has a PC of 100 psi>85 psi. The test pressure of DR17 is also 150 psi, which meets the specified test pressure.

Step 2. The anticipated peak pressure in the pipeline is found by adding the pumping pressure of 85 psi to the surge pressure of 45.0 psi (given in Table A-2 for a 4 fps velocity). The sum equals 130.2 psi and is less than the Maximum Total Pressure Allowed for Recurring Surge for DR17 pipe of 150 psi. DR17 pipe is O.K. A similar comparison can be made for peak pressure during fire flow where velocity may reach 8 fps. In this case add 90.0 psi (from Table A-2) to 85 psi to obtain a peak pressure during occasional surge of 175 psi. Compare with the Maximum Total Pressure Allowed for Occasional Surge for DR17 of 200 psi. DR17 pipe is O.K.

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When Performance Matters Rely on Performance Pipe

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AWWA MEMBER

Ball Valve and Hose Adapter

(Grainger)

EnSol, Inc.

GRAINGER
FOR THE ONES WHO GET IT DONE

Ball Valve, Two Piece, 2 In, 316 SS Body

Two Piece Ball Valve, FNPT Connection, Max. Pressure 1000 psi WOG, Full Port, Material of Construction 316 Stainless Steel, Seats PTFE, Ball Material 316 Stainless Steel, Stem Material 316 Stainless Steel, Stem Blowout Proof, Handle Stainless Steel, Lockable, With Vinyl Grip, Standards -

Grainger Item #	1WMY7
Price (ea.)	$202.00
Brand	GRAINGER APPROVED VENDOR
Mfr. Model #	1WMY7
Ship Qty.	1
Sell Qty. (Will-Call)	1
Ship Weight (lbs.)	5.5
Availability	Ready to Ship
Catalog Page No.	4364

Price shown may not reflect your price. Log in or register.

Additional Info

316 Stainless Steel Ball Valves with Handle Options

Stainless steel handle with vinyl grip. Bottom-loaded stem resists blowout. 2-pc. valves with PTFE seats and FNPT connections. Vacuum service to 29" Hg. For use with water, oil, and gas in most corrosive industrial environments.

- Rated: 1000 psi; 150 psi WSP Temp. range: -25° to 450°F

Tech Specs

Item: Ball Valve
Type: Two Piece
Connection: FNPT
Max. Pressure: 1000 psi WOG
Pipe Size: 2"
Port: Full
Material of Construction: 316 Stainless Steel
Seats: PTFE
Ball Material: 316 Stainless Steel
Stem Material: 316 Stainless Steel
Stem: Blowout Proof
Handle: Stainless Steel, Lockable, With Vinyl Grip
Temp. Range (F): -25 to 450 Degrees
Overall Length (In.): 4-29/32

Notes & Restrictions

There are currently no notes or restrictions for this item.

MSDS

This item does not require a Material Safety Data Sheet (MSDS).

Required Accessories

There are currently no required accessories for this item.

Optional Accessories

There are currently no optional accessories for this item.

Alternate Products

Ball Valve, Two Piece, 2 In, 316 SS Body

Item #: 1WNA7
Brand: GRAINGER APPROVED VENDOR
Usually Ships: Ready to Ship
Price (ea): $207.75

Repair Parts

A Repair Part may be available for this item. Visit our Repair Parts Center or contact your local branch for more information.

GRAINGER
FOR THE ONES WHO GET IT DONE

Adapter, Male, 2 In

Cam And Groove Coupling, Size 2 In, Male Adapter x FNPT Connection, Max Working Pressure 250 PSI, Material of Construction Aluminum

Grainger Item #	3LX26
Price (ea.)	$13.43
Brand	GRAINGER APPROVED VENDOR
Mfr. Model #	3LX26
Ship Qty.	1
Sell Qty. (Will-Call)	1
Ship Weight (lbs.)	0.35
Availability	Ready to Ship
Catalog Page No.	4066

Price shown may not reflect your price. Log in or register.

Additional Info

Aluminum and Stainless Steel

- Max. pressure: 250 psi (up to 2"); 125 psi (3"); 100 psi (4") Temp. range: -40° to 212°F Interchangeable with all product produced to MIL-C-27487F Buna N gasket

Cam and Groove Couplings

Couplings have Buna N seals and stainless steel pins. Pull rings and locking pins are plated carbon steel.

Meet ASTMC 38000 and MIL-C-27487F specifications.

Tech Specs

Item: Adapter
Type: A
Size: 2"
Connection: Male Adapter x FNPT
Max. Working Pressure (PSI): 250
Material of Construction: Aluminum

Notes & Restrictions

There are currently no notes or restrictions for this item.

MSDS

This item does not require a Material Safety Data Sheet (MSDS).

Required Accessories

There are currently no required accessories for this item.

Optional Accessories

Coupler, Female, 2 In
Item #: 3LX32
Brand: GRAINGER APPROVED VENDOR
Usually Ships: Ready to Ship
Price (ea): $27.20

Cap with Handle, 2 In, Polypropylene
Item #: 4YLL3
Brand: GRAINGER APPROVED VENDOR
Usually Ships: Ready to Ship
Price (ea): $41.00

Alternate Products

Adapter, Male, 2 In, 316 SS
Item #: 3LX27
Brand: GRAINGER APPROVED VENDOR
Usually Ships: Ready to Ship
Price (ea): $63.40

Repair Parts

Repair Parts Information is available for this item.