PILOT PLANT EVAPORATORS RENOVATION

Audubon Sugar Institute

St. Gabriel, LA

TABLE OF CONTENTS

Notes about this document:

All sections in this Table of Contents (pages 1 & 2) are hyperlinks to the listed document.

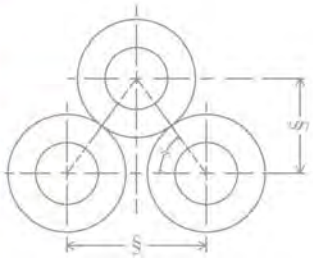
Selecting the bookmark icon  in the left margin will expand the Table of Contents and allow "quick click" navigation to all parts of this document.

When submitting RFI's, RFQ's or general inquiries, please reference the page number(s) at the top right-hand corner of the page (throughout this document).

T.O.C. CONTINUED:

I
PROJECT SPECIFICATIONS

AMERICAN INGENUITY LLC



PILOT PLANT EVAPORATORS RENOVATION
NEW, ROBERTS TYPE, TRIPLE EFFECT EVAPORATORS
FABRICATION SPECIFICATION

Project No. AS-14-01535

SPECIFICATION NUMBER M-001

PREPARED FOR

LSU AgCenter
Research · Extension · Teaching

Louisiana State University Agricultural Center
Office of Facilities Planning
210 J. Norman Efferson Hall
110 LSU Union Square
Baton Rouge, Louisiana 70803-0106

PROJECT LOCATION:

AUDUBON SUGAR INSTITUTE
3845 HWY 75
St. Gabriel, Louisiana 70776

AMERICAN INGENUITY	TRIPLE EFFECT EVAPORATORS FABRICATION SPECIFICATION	Purchase No: Specification No: M-001 Revision No: F Issue Date: 9/17/2015

Table of Contents

1.0 SCOPE

This specification details the technical and quality requirements for the design, manufacture, and delivery of a Roberts Type Triple Effect Skid Mounted Evaporator System, complete with all accessories specified in attached documentation. This set of evaporators shall be delivered to the Audubon Sugar Institute pilot plant at Louisiana State University Agricultural Center. Installation by others. The omission of certain details is not to be construed by the supplier or bidder as a basis for omitting components of engineering and/or manufacture that will affect the material or equipment in quality or performance, or will increase maintenance cost or reduce the life of the material or equipment.

2.0 STANDARDS

All design, workmanship, and documentation shall be governed by the following codes or standards as applicable:

- ASME B&PV Code Section VIII, Div. 1
- ASME B31.3 Process Piping
- AISC Steel Construction Manual
- PIP STS05120 Structural and Miscellaneous Steel Fabrication Specification
- PIP STF05521 Details for Angle Railings for Walking and Working Surfaces
- PIP STF05501 Fixed Ladders and Cages

3.0 SKID

3.1 All equipment, piping, valves, and instruments shown on the P&ID are to be included. Include all necessary fittings, hardware, gaskets required for proper assembly and operation. The name of a certain brand, make, manufacturer, or definite specifications utilized in these documents is to denote the quality standard of the item(s) desired, but does not restrict bidders to the specific brand, make manufacturer, or specification named. It is to set forth and convey to prospective bidders the general style, type, character, and quality of items(s) desired.

3.2 Vacuum pump P-5 is to be placed on a separate skid as denoted in the P&ID. This pump will be located elsewhere at the facility and connected on-site by others.

3.3 Vacuum pump (P-5) shall also be quoted with stainless steel as alternate material.

3.4 Equipment and valves shall be fabricated and arranged on skid for maintenance and inspection access as per 5.0 Testing & Inspection.

3.5 All piping, equipment, and instrumentation to be completely assembled at vendor's shop for final inspection.

3.6 STRUCTURAL:

- Each vessel shall have suitable lifting attachments for offloading and erection.
- Each vessel shall include four pedestal lug supports designed to support the vessel weight when completely filled to the dome vapor outlet with 60+ Brix syrup.

4.0 WELDING

4.1 All welders, welding operators, and weld procedures shall be qualified in accordance with the latest edition and addenda of the appropriate code of construction and this Specification.

4.2 Weld procedures and welder qualifications shall be submitted with approval drawings for review and approval prior to start of fabrication.

5.0 TESTING & INSPECTION

5.1 Hydrotesting shall be conducted on each compartment of the vessel to 1.3x MAWP as per ASME VIII Para. UG-99(b). Hydrotest shall be held for a minimum of 30 min.

5.2 Hydrotest shall be conducted in a manner that leaks are clearly visible and not interfered by condensation due to humidity or rain.

5.3 The test water shall be allowed to reach ambient temperature before test is conducted.

5.4 Hydrotesting shall be witnessed and documented by a representative of American Ingenuity. This is a Hold Point.

5.5 Vacuum test shall be witnessed and documented by a representative of American Ingenuity. This is a Hold Point.

5.6 Periodic shop inspections will be made throughout the fabrication by American Ingenuity and LSU AgCenter. This does not constitute a Hold Point.

5.7 Final Assembly Inspection will be made by American Ingenuity and LSU AgCenter at Vendor's shop prior to shipment. This is a Hold Point.

5.8 Adequate notification of five days shall be given prior to Hold Point tests and inspections.

6.0 CLEANING & SURFACE PREPERATION

6.1 Vessels to be drained, dried, and cleaned inside prior to shipping.

6.2 Exterior of vessels to be cleaned of all weld marks, splatter, grease, oil, etc.

6.3 Painting is not required.

6.4 Skid structure is to be Hot Dip Galvanized after fabrication.

7.0 SCHEDULE

7.1 The vendor is to provide and maintain the project schedule for this scope of work. The schedule is to include the following items at a minimum:

- 7.1.1 Drawing Submittal for Approval, allow 1 week review period by LSU and AI
- 7.1.2 Drawing Submittal for Construction
- 7.1.3 Fabrication of Evaporators
- 7.1.4 Fabrication of Skid
- 7.1.5 Total Skid Assembly
- 7.1.6 Hold points mentioned above
- 7.1.7 Delivery

7.1.8 As-Built drawing and data package

8.0 DELIVERY

8.1 The finished product shall be delivered to the LSU Agricultural Center Audubon Sugar Institute located at 3845 Hwy 75 St. Gabriel, LA 70776.

8.2 Proper care shall be taken to protect instruments, valves, equipment, machined surfaces, insulation, etc. during transportation.

8.3 American Ingenuity shall be notified 5 days prior to shipment to arrange receipt and offloading of deliverables.

9.0 SUBMITTALS

9.1 Design documentation and drawings shall be submitted for approval prior to the start of fabrication. Allow (1) week for review and approval.

9.2 The owner shall be provided with two (2) sets of final record drawings, parts lists and any other pertinent data for the equipment prior to shipment and with distribution as specified in the purchase order.

10.0 BID REQUIREMENTS

10.1 The vendor shall be required to submit a lump sum proposal with an appropriate cost breakdown and preliminary schedule for this firm fixed price contract. The vendor shall provide a formal written communication listing all of the relevant issues or requirements noted during the tendering process as well as details on any limitations on the proposed scope of supply or execution of work. The schedule is to include, at a minimum, milestones and duration for engineering, purchasing materials, and fabrication. This communication must be submitted with the bid package.

11.0 CONTACT

Refer to Bid Documents for proper submission of Requests for Information (RFI's) and Requests for Clarification (RFC's).

12.0 ATTACHMENTS

The Attachment Directory to this specification is on the following page. This directory illustrates the file paths for the various pieces of information associated with this scope. Specification sheets can be provided to the winning bidder in MS Excel format and are expected to be completed at the conclusion of the project and returned to LSU AgCenter for their record.

ATTACHMENT DIRECTORY

- Scope and Drawings
  - Specification M-001 REV F
  - Evaporator Skid Drawing Package
- PFD & Design Details
  - PFD and Design Details
- Instrumentation
  - Instrumentation Spec Sheets
- Specification Sheets
  - Air-Noncondensible Vents
  - Condensate Tanks T1-T4
  - Electrical Tracing
  - Condensate Pump P4
  - Evaporators V1 – V3
  - Optional Steam Filter
  - Sample Circulation Pump P1
  - Sample Circulation Pump P3
  - Steam Traps ST-1A-B
  - Syrup Pump P2
  - Vacuum Condenser E1
  - Vacuum Skid P5 & T5
  - Skid Mounted Packaged Equipment

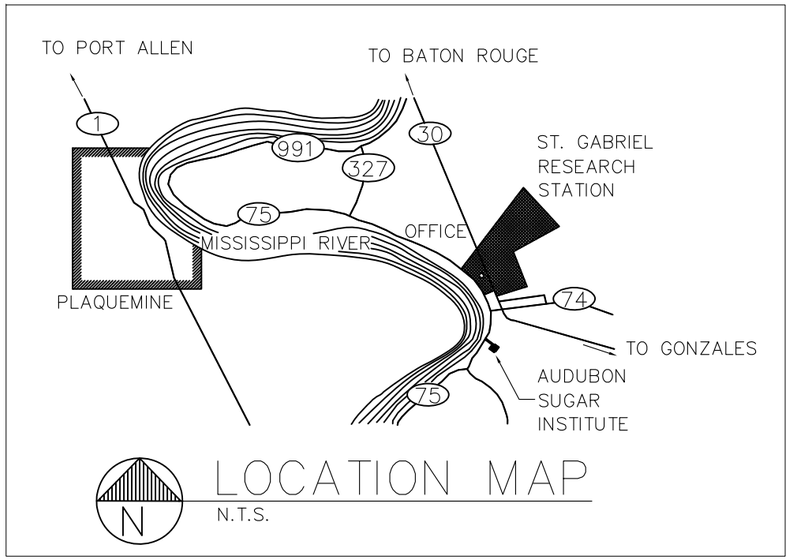
II
PROJECT DRAWINGS

LOUISIANA STATE UNIVERSITY AGRICULTURAL CENTER

PLANS OF
PILOT PLANT EVAPORATORS RENOVATION
NEW, ROBERTS TYPE, TRIPLE EFFECT EVAPORATORS

FOR

AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIEL, LOUISIANA 70776



DRAWING INDEX

REFERENCE DRAWINGS

A	ISSUED FOR BID	JC	9/17/15
REV. NO.	DESCRIPTION TO REVISION	REV. BY	DATE

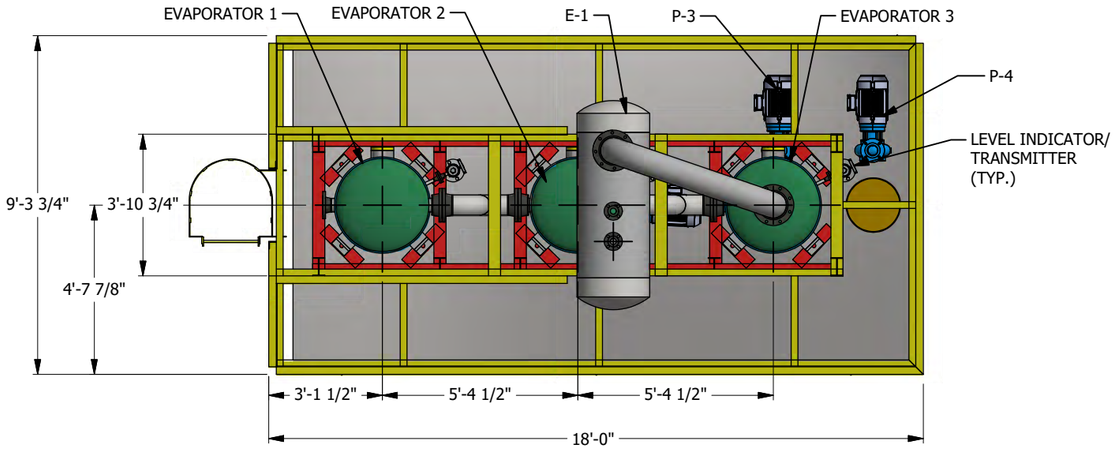
LSU AgCenter Research · Extension · Teaching

AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIAL, LA

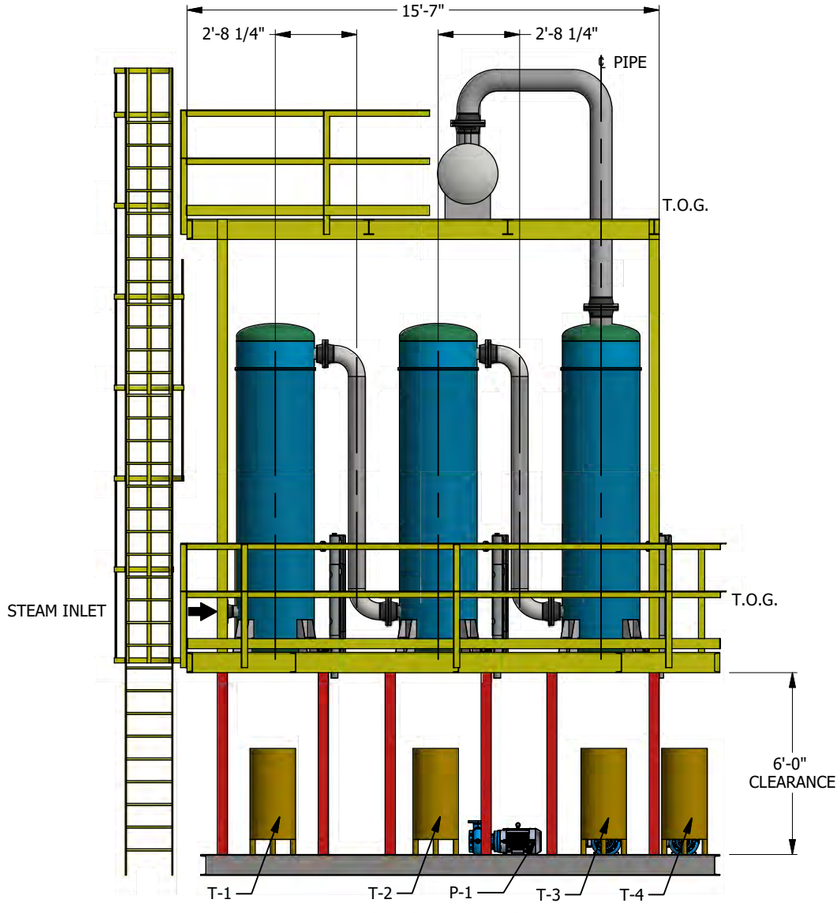
PROJECT: TRIPLE EFFECT EVAPORATORS
FABRICATION SPECIFICATION

AMERICAN INGENUITY LLC
38099 POST OFFICE RD, ST.11
PRAIRIEVILLE, LA 70769
PHONE: (225) 907-4515
WWW.AINGENUITY.COM

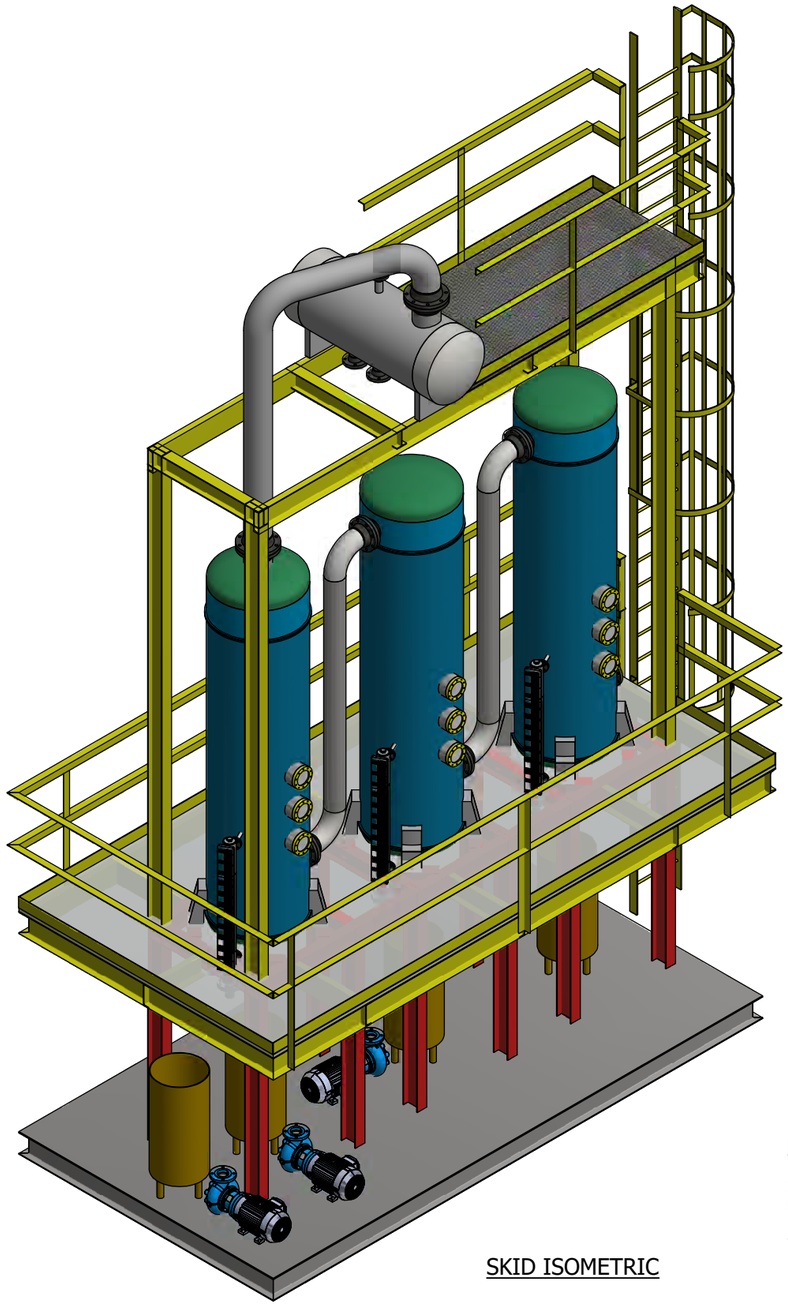
DRAWN BY: GW	DATE:	8/15
ENGINEER: JDC		
PROJECT NO: AS-14-01535	DWG No. 15-012-100	REV. A
SCALE: N.T.S.		



PLAN VIEW



REAR ELEVATION VIEW



SKID ISOMETRIC

NOTES:

1. DRAWING IS FOR FOOTPRINT AND GENERAL ILLUSTRATION PURPOSE ONLY. DO NOT FABRICATE FROM THIS DRAWING.

NOTES:

ENGINEERED BY:

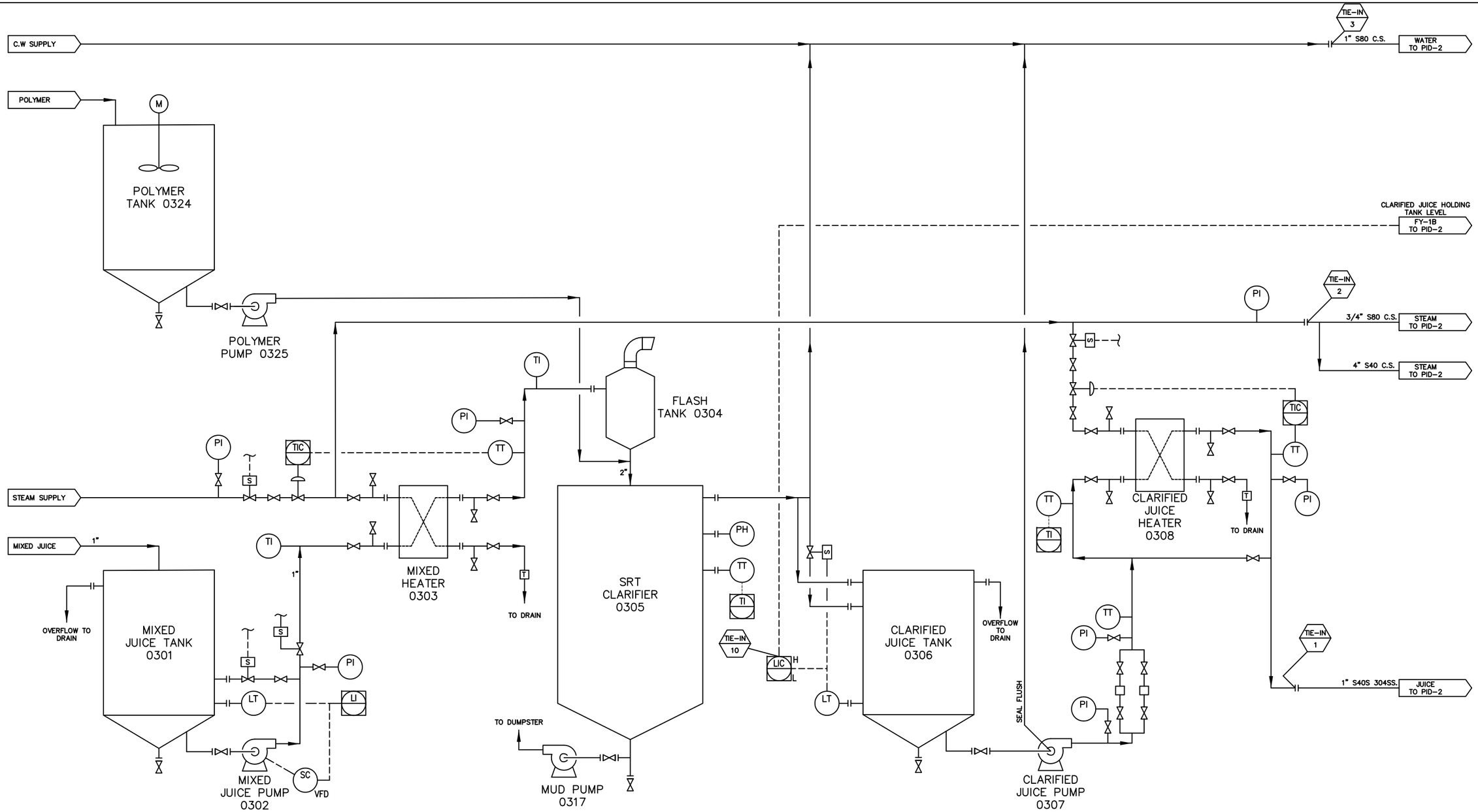
AMERICAN INGENUITY LLC

REV. NO.	DESCRIPTION TO REVISION	REV. BY.	DATE
A	ISSUED FOR BID	GW	9/17/15

CHECKED BY: JC	DESIGNER APPROVED: GW	ENGINEER APPROVED: JC	CLIENT APPROVED:	
DRAWN BY: GW	SCALE: N.T.S.	DWG No. 15-012-101	SHT No. 2 OF 2	REV. A

CUSTOMER: AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIEL, LA

PROJECT: TRIPLE EFFECT EVAPORATORS
EVAPORATOR SKID GENERAL ARRANGEMENT



ABBREVIATIONS:

BT	BRIX CONTROLLER	LV	LEVEL CONTROL VALVE
FC	FLOW CONTROL	LY	LEVEL AIR TO CURRENT TRANSDUCER
FT	FLOW TRANSMITTER	PC	PRESSURE CONTROL
FV	FLOW CONTROL VALVE	PIC	PRESSURE INDICATOR CONTROLLER
HS	HAND SWITCH	PT	PRESSURE TRANSMITTER
LC	LEVEL CONTROL	RV	RELIEF VALVE
LG	LEVEL GAUGE	SC	SPEED CONTROL
LIC	LEVEL INDICATOR SWITCH	SG	SIGHT GLASS
LT	LEVEL TRANSMITTER	SIC	SPEED INDICATOR CONTROLLER
		TIC	TEMPERATURE INDICATOR CONTROLLER
		TT	TEMPERATURE TRANSMITTER

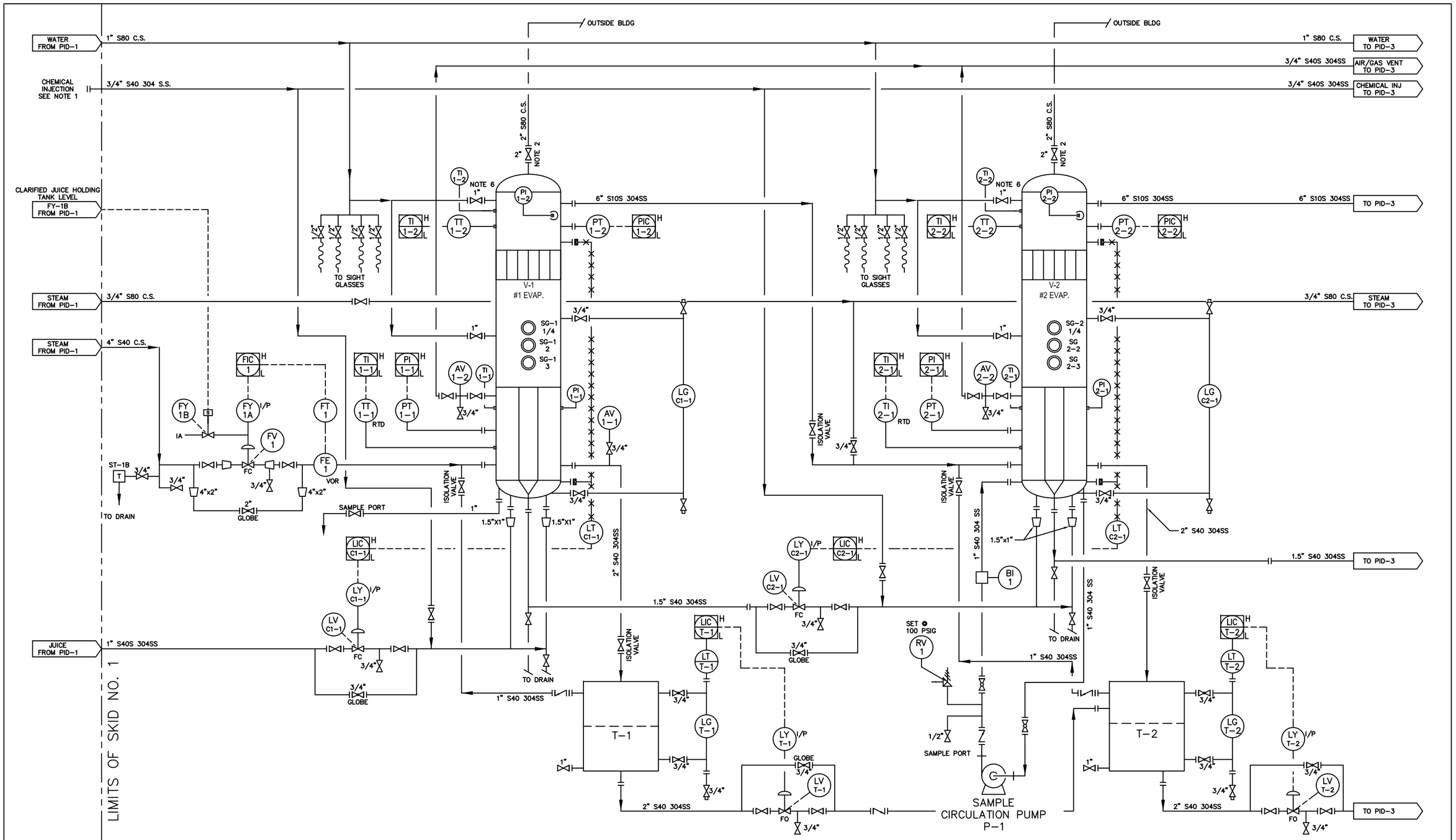
ENGINEERED BY: AMERICAN INGENUITY

REV. NO.	DESCRIPTION TO REVISION	REV. BY	DATE
C	ISSUED FOR BID	JDC	9/17/15
B	ISSUED FOR REVIEW	JDC	8/21/15
A	ISSUED FOR REVIEW	BDL	7/10/15

CHECKED BY:	DESIGNER APPROVED:	ENGINEER APPROVED: JC	CLIENT APPROVED:
DRAWN BY: GWC	SCALE: NONE	DWG No. 15-012-P&ID-01	REV. C

CUSTOMER: AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIEL, LA

PROJECT: TRIPLE EFFECT EVAPORATORS
P&ID
SHEET 1



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NOTES:

1. CHEMICAL INJECTION CONNECTION FOR FUTURE CHEMICAL CLEANING
2. CHAIN WHEEL OPERATED WITH CHAIN DOWN TO TOP OF SKID
3. ALL MANUAL VALVES IN JUICE SERVICE SHALL BE FULL PORT BALL VALVES.

ENGINEERED BY: AMERICAN INGENUITY LLC

REV. NO.	DESCRIPTION TO REVISION	REV. BY	DATE
C	ISSUED FOR BID	JDC	9/17/15
B	ISSUED FOR REVIEW	JDC	8/21/15
A	ISSUED FOR REVIEW	BDL	7/10/15

CHECKED BY: | DESIGNER APPROVED: | ENGINEER APPROVED: JC | CLIENT APPROVED:

DRAWN BY: GWC | SCALE: NONE | DWG No. 15-012-P&ID-02 | REV. C

CUSTOMER: AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIEL, LA

PROJECT: TRIPLE EFFECT EVAPORATORS
P&ID
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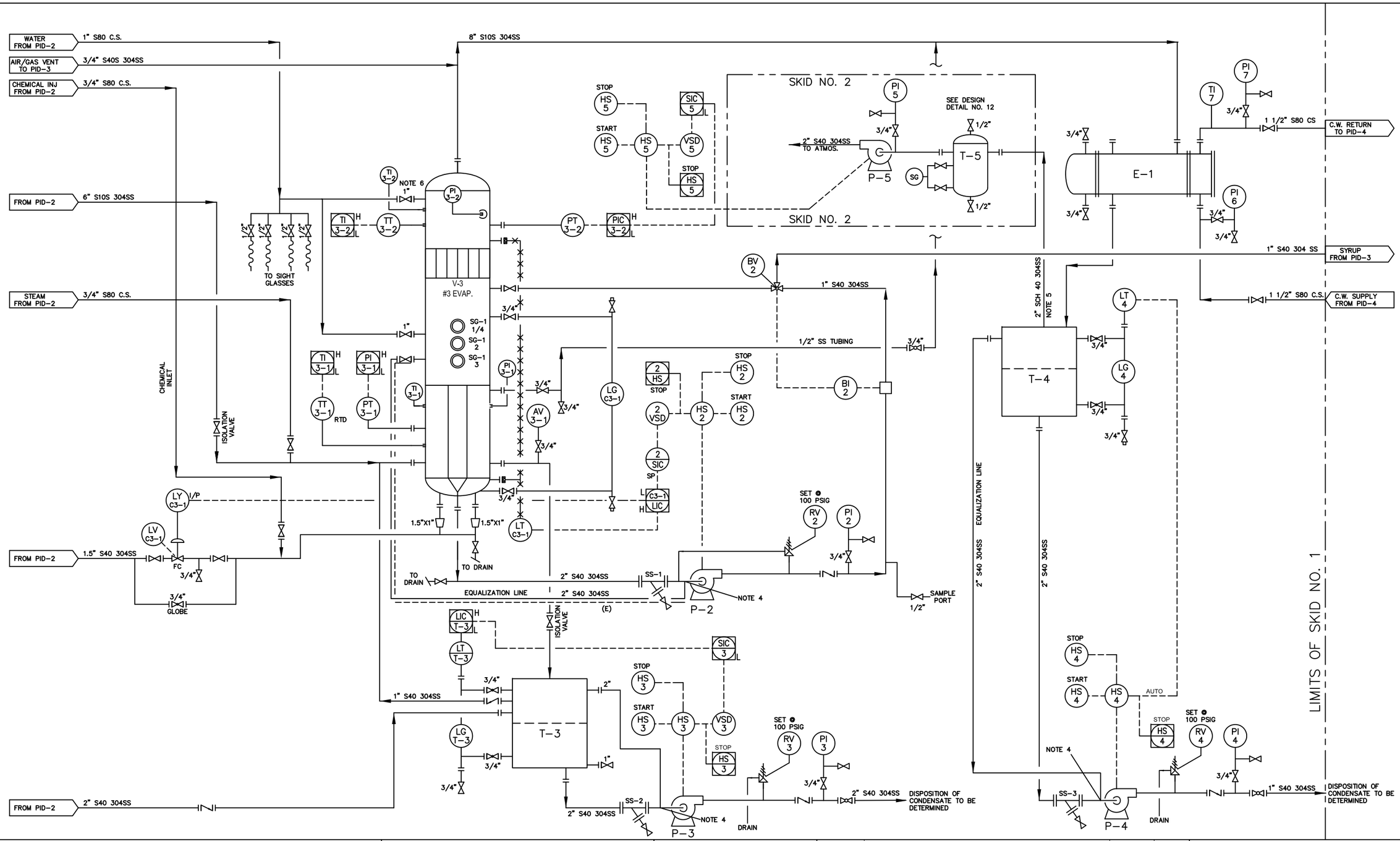

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NOTES:

4. CONNECTION TO BE AS CLOSE AS POSSIBLE TO PUMP INLET, OR ON TOP OF CASING.
5. THIS SECTION OF PIPING WILL BE INSTALLED IN THE FIELD.
6. VALVE SHALL BE ACCESSIBLE FROM PLATFORM DECK.

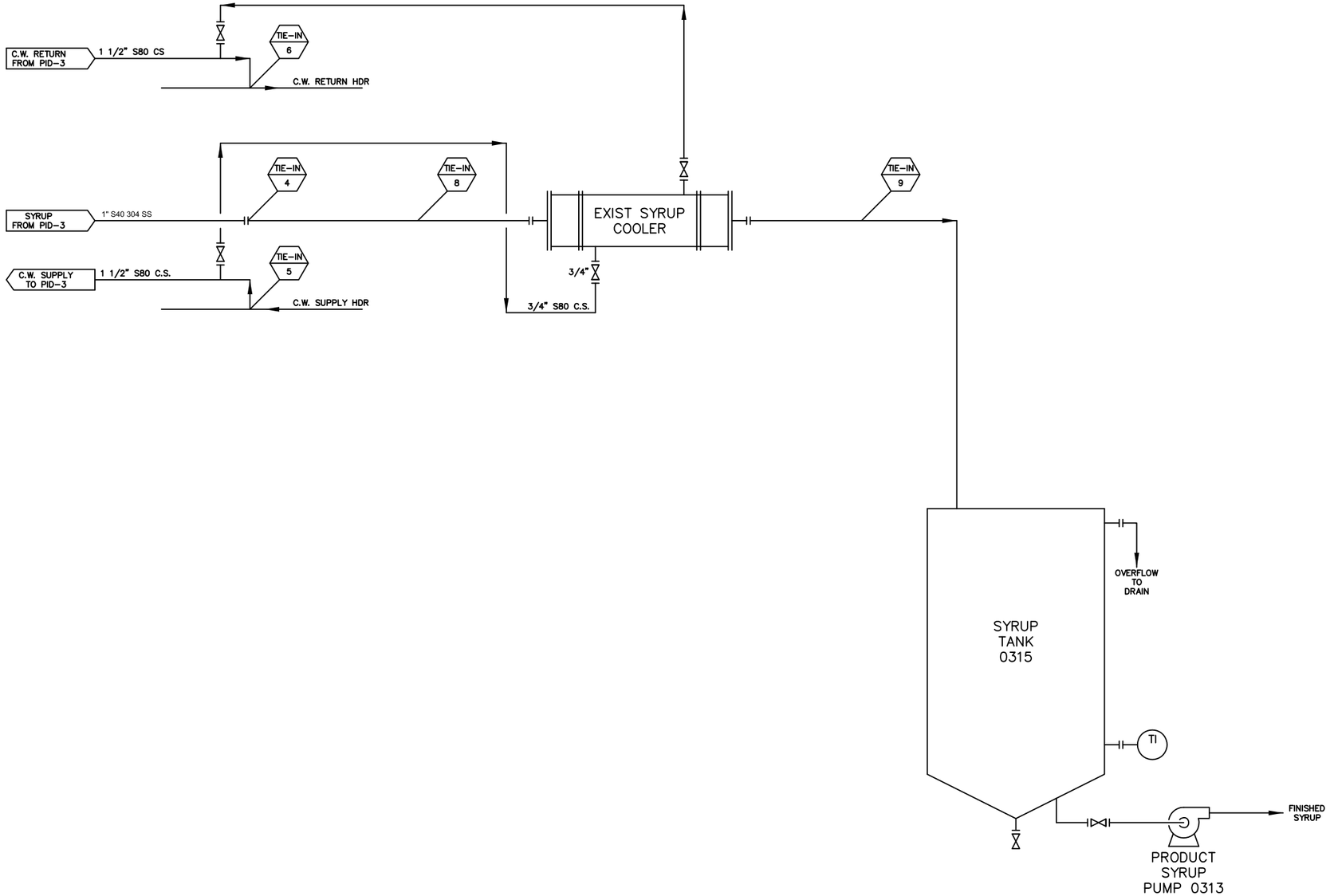
ENGINEERED BY: AMERICAN INGENUITY LLC

REV. NO.	DESCRIPTION TO REVISION	REV. BY	DATE
C	ISSUED FOR BID	JDC	9/17/15
B	ISSUED FOR REVIEW	JDC	8/21/15
A	ISSUED FOR REVIEW	BDL	7/10/15

CHECKED BY:	DESIGNER APPROVED:	ENGINEER APPROVED: JC	CLIENT APPROVED:
DRAWN BY: GWC	SCALE: NONE	DWG No. 15-012-P&ID-03	REV. C

CUSTOMER: AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIEL, LA

PROJECT: TRIPLE EFFECT EVAPORATORS
P&ID
SHEET 3



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ENGINEERED BY: AMERICAN INGENUITY LLC

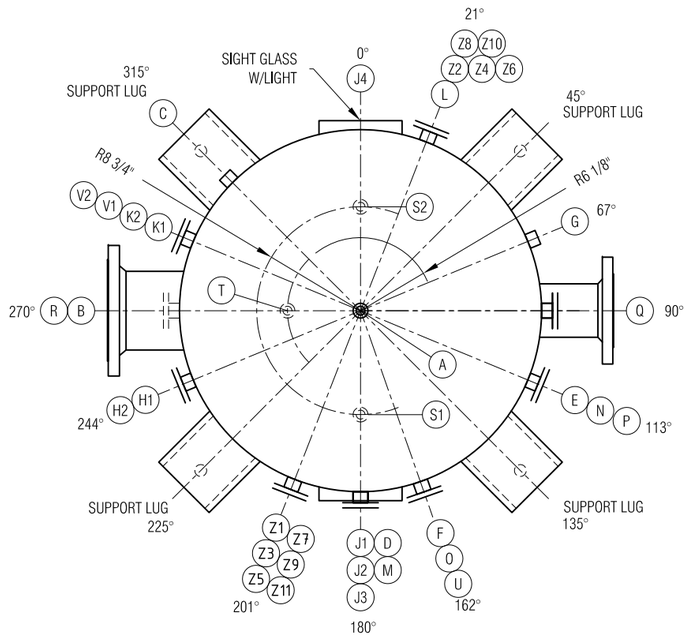
REV. NO.	DESCRIPTION TO REVISION	REV. BY	DATE
C	ISSUED FOR BID	JDC	9/17/15
B	ISSUED FOR REVIEW	JDC	8/21/15
A	ISSUED FOR REVIEW	BDL	7/10/15

CHECKED BY: | DESIGNER APPROVED: | ENGINEER APPROVED: JC | CLIENT APPROVED:

DRAWN BY: GWC | SCALE: NONE | DWG No. 15-012-P&ID-04 | REV. C

CUSTOMER: AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIEL, LA

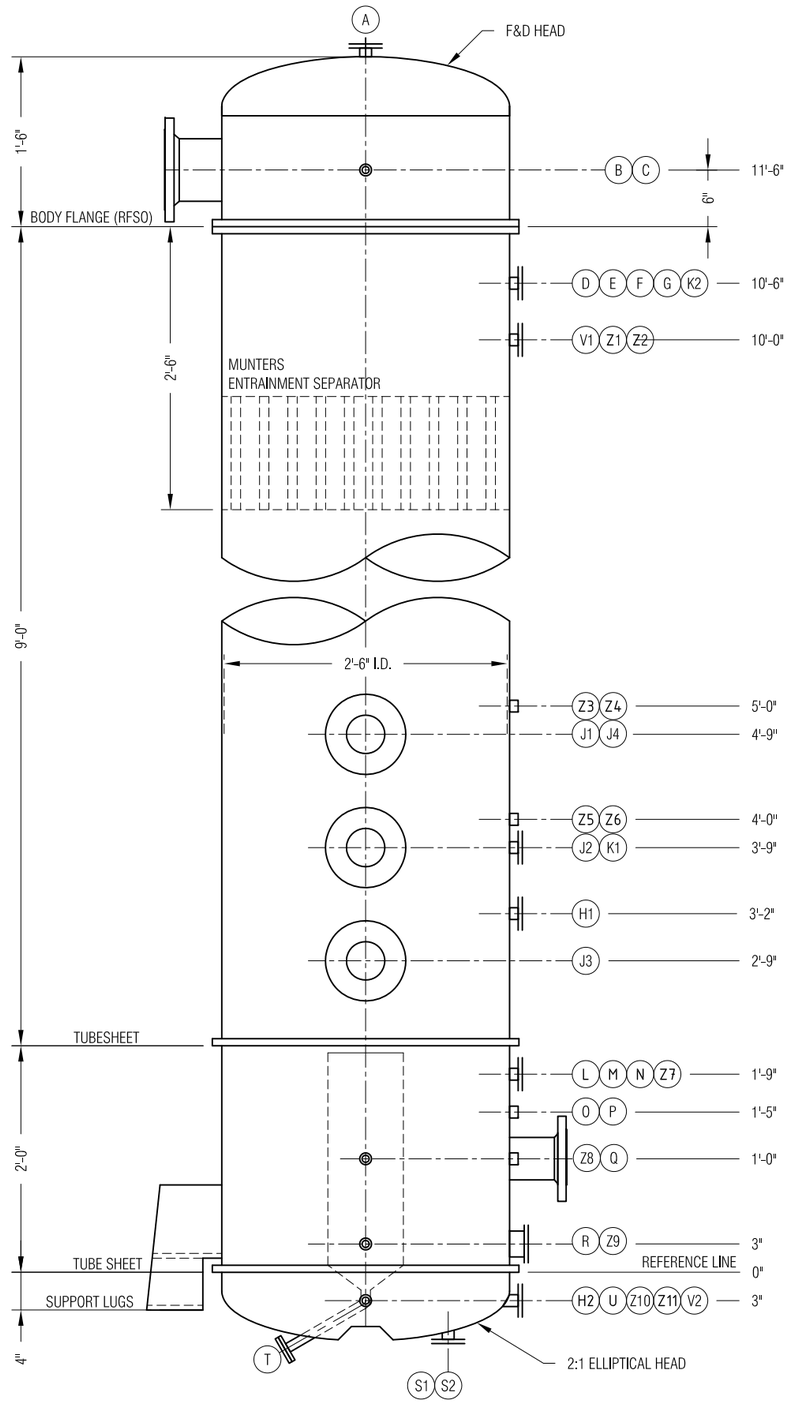
PROJECT: TRIPLE EFFECT EVAPORATORS
P&ID
SHEET 4



ORIENTATION

MARK	QTY.	SIZE	TYPE	DESCRIPTION
Z1 / Z11	11	3/4"	CPLG.	SPARE W/ PLUG
V1/V2	2	2"	FLG.	LEVEL TRANSMITTER
U	1	1"	FLG.	SAMPLE LINE
T	1	1 1/2"	FLG.	JUICE OUTLET
S1 / S2	2	1 1/2"	FLG.	JUICE INLET
R	1	2"	FLG.	CONDENSATE OUTLET
Q	1	4"	FLG.	STEAM INLET
P	1	1"	CPLG.	TEMPERATURE TRANSMITTER
O	1	1"	CPLG.	TEMPERATURE GAUGE
N	1	2"	FLG.	PRESSURE TRANSMITTER
M	1	3/4"	CPLG.	PRESSURE GAUGE
L	1	3/4"	FLG.	CALANDRIA VENT
K2	1	1"	FLG.	WATER
K1	1	1"	FLG.	WATER
J1 / J4	4	5"	FLG.	SIGHT GLASS
H1 / H2	2	2"	FLG.	LEVEL SIGHT GLASS
G	1	1"	CPLG.	TEMPERATURE TRANSMITTER
F	1	1"	CPLG.	TEMPERATURE GAUGE
E	1	2"	FLG.	PRESSURE TRANSMITTER
D	1	3/4"	CPLG.	PRESSURE GAUGE
C	1	3/4"	CPLG.	SPARE W/ PLUG
B	1	6"	FLG.	VAPOR OUTLET
A	1	2"	FLG.	VENT

NOZZLE SCHEDULE



V-1 ELEVATION
(1ea) REQ'D

DESIGN DATA:
VESSEL SHALL BE DESIGNED AND FABRICATED IN ACCORDANCE WITH THE LATEST EDITION OF ASME VIII, DIV. 1.

BODY

DESIGN PRESSURE	= 50 psig / FV
DESIGN TEMP.	= 350 °F
MATERIAL	= SS 304
CORROSION ALLOWANCE	= 0"

CALANDRIA

DESIGN PRESSURE	= 80 psig
DESIGN TEMP.	= 350 °F
MATERIAL	= SS 304 SHELL, NOZZ & TUBESHEET = 14 GA. SS304 TUBES = FLEXITALLIC SIRAL WND. GASKETS = SA-193 B7/2H BOLTS = SA-194 GR 2H NUTS
CORROSION ALLOWANCE	= 0" SHELL

GENERAL
1. CONNECTIONS FLANGED TO BE 150# RFWN, SA-105
2. CONNECTIONS THREADED TO BE 3000# THR'D HALF CPLG.
3. GASKETS FOR HEAD FLANGES SHALL BE FLEXITALLIC 304SS/TEFLON SPIRAL WOUND, TYPE CGI

REFERENCE DRAWINGS

REV. NO.	DESCRIPTION TO REVISION	REV. BY	DATE
D	ISSUED FOR BID	GW	9/11/15
C	ISSUED FOR REVIEW	JC	8/24/15
B	ISSUED FOR REVIEW	JC	5/15/15
E	ISSUED FOR BID	JC	9/17/15

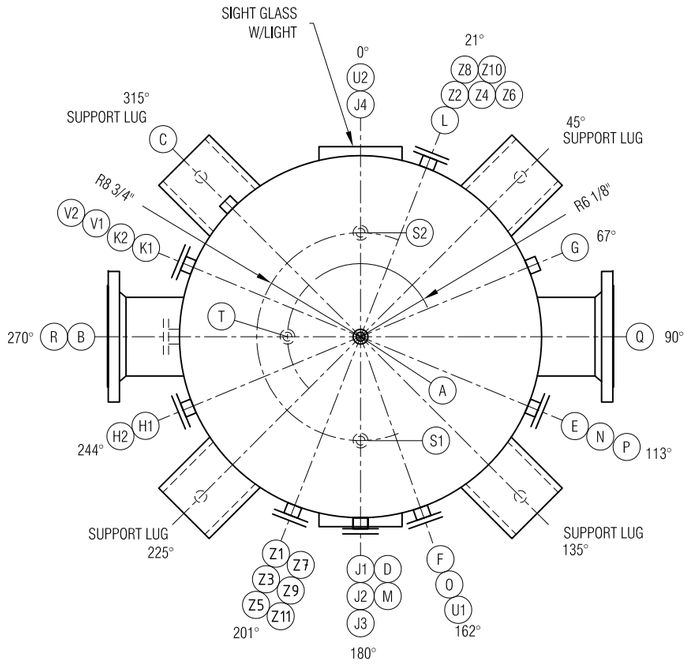
LSU AgCenter Research · Extension · Teaching
AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIAL, LA

PROJECT: TRIPLE EFFECT EVAPORATORS
FABRICATION SPECIFICATION

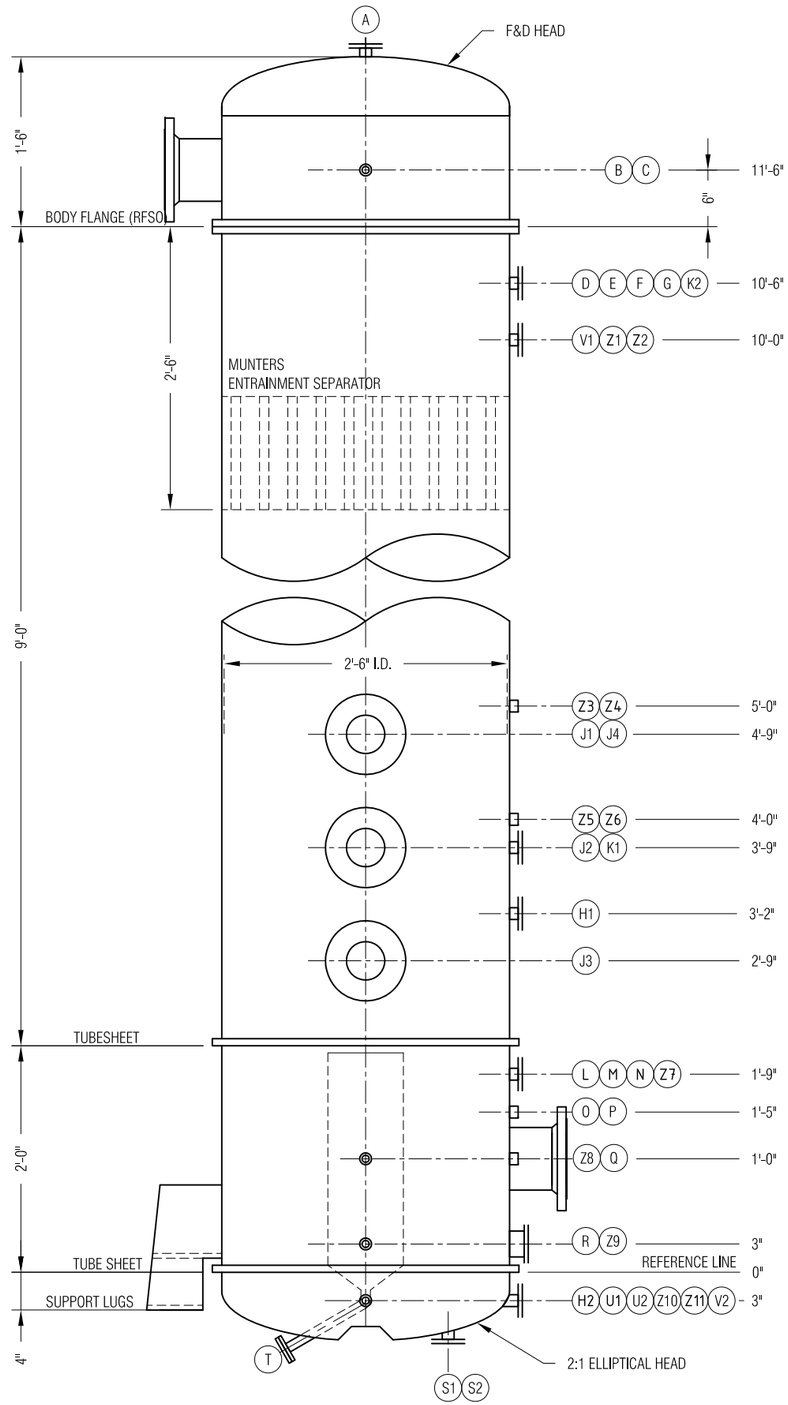
TAG NUMBER: V-1

AMERICAN INGENUITY LLC
38099 POST OFFICE RD, ST.11
PRAIRIEVILLE, LA 70769
PHONE: (225) 907-4515
WWW.AINGENUITY.COM

DRAWN BY: GW	DATE: 8/15	
ENGINEER: JC		
PROJECT NO: AS-14-01535	DWG No. 15-012-M-001-1	REV. E
SCALE: N.T.S.		



ORIENTATION



V-2 ELEVATION
(1ea) REQ'D

MARK	QTY.	SIZE	TYPE	DESCRIPTION
Z1 / Z11	11	3/4"	CPLG.	SPARE W/ PLUG
V1/V2	2	2"	FLG.	LEVEL TRANSMITTER
U1 / U2	2	1"	FLG.	SAMPLE LINE
T	1	1 1/2"	FLG.	JUICE OUTLET
S1 / S2	2	1 1/2"	FLG.	JUICE INLET
R	1	2"	FLG.	CONDENSATE OUTLET
Q	1	6"	FLG.	STEAM INLET
P	1	1"	CPLG.	TEMPERATURE TRANSMITTER
O	1	1"	CPLG.	TEMPERATURE GAUGE
N	1	2"	FLG.	PRESSURE / VACUUM TRANSMITTER
M	1	3/4"	FLG.	PRESSURE / VACUUM GAUGE
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K1	1	1"	FLG.	WATER
J1 / J4	4	5"	FLG.	SIGHT GLASS
H1 / H2	2	2"	FLG.	LEVEL SIGHT GLASS
G	1	1"	CPLG.	TEMPERATURE TRANSMITTER
F	1	1"	CPLG.	TEMPERATURE GAUGE
E	1	2"	FLG.	PRESSURE / VACUUM TRANSMITTER
D	1	3/4"	CPLG.	PRESSURE GAUGE
C	1	3/4"	CPLG.	SPARE W/ PLUG
B	1	6"	FLG.	VAPOR OUTLET
A	1	2"	FLG.	VENT

NOZZLE SCHEDULE

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BODY

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CALANDRIA

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CORROSION ALLOWANCE	= 0" SHELL

GENERAL
1. CONNECTIONS FLANGED TO BE 150# RFWN, SA-105
2. CONNECTIONS THREADED TO BE 3000# THR'D HALF CPLG.
3. GASKETS FOR HEAD FLANGES SHALL BE FLEXITALLIC 304SS/TEFLON SPIRAL WOUND, TYPE CGI

REFERENCE DRAWINGS

REV. NO.	DESCRIPTION TO REVISION	REV. BY	DATE
D	ISSUED FOR BID	GW	9/11/15
C	ISSUED FOR REVIEW	JC	8/24/15
B	ISSUED FOR REVIEW	JC	5/15/15
E	ISSUED FOR BID	JC	9/17/15

LSU AgCenter Research · Extension · Teaching

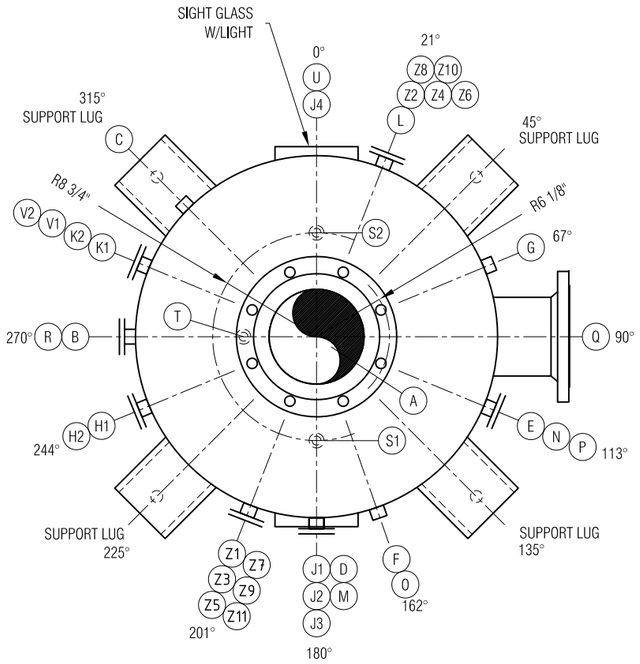
AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIAL, LA

PROJECT: TRIPLE EFFECT EVAPORATORS
FABRICATION SPECIFICATION

TAG NUMBER: V-2

AMERICAN INGENUITY LLC
38099 POST OFFICE RD, ST.11
PRAIRIEVILLE, LA 70769
PHONE: (225) 907-4515
WWW.AINGENUITY.COM

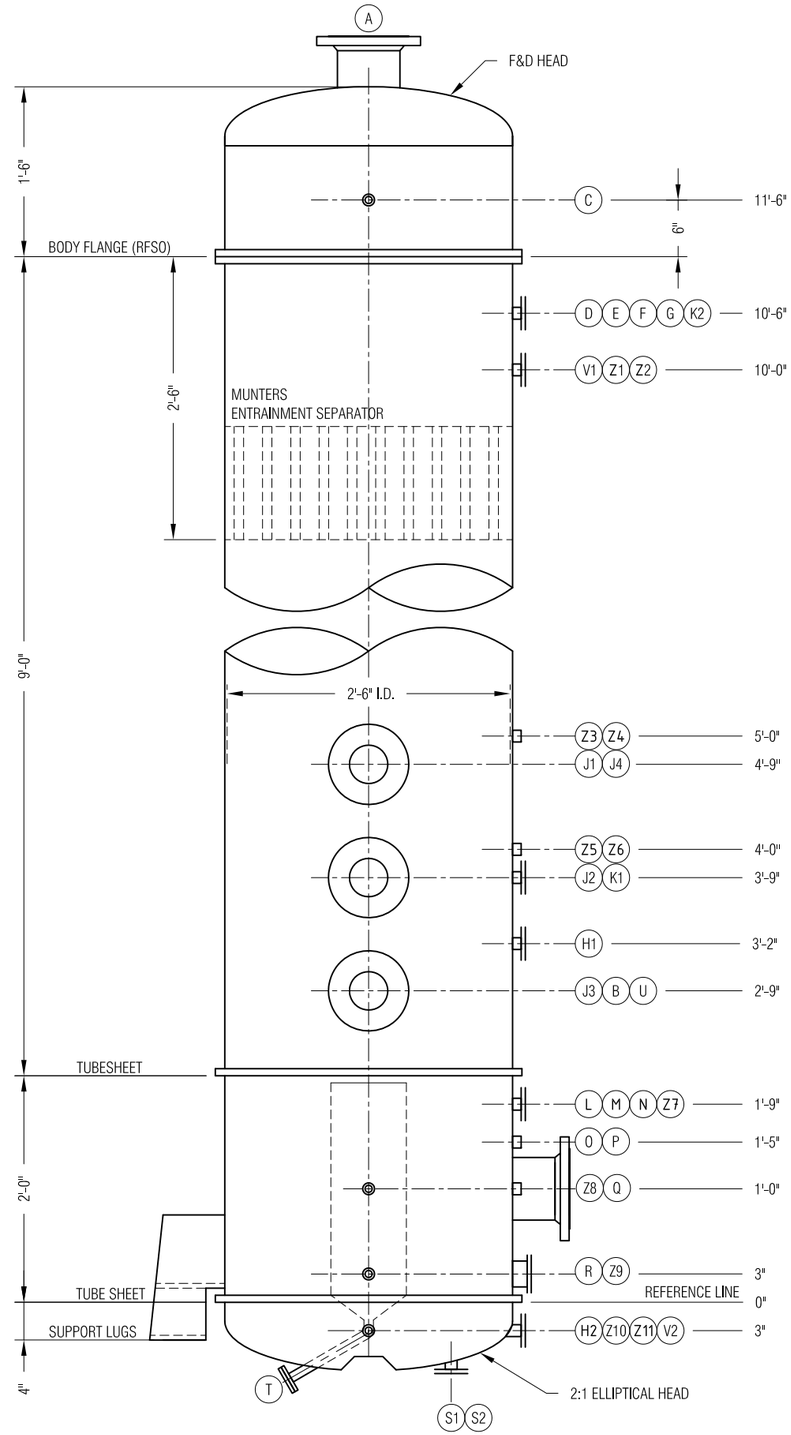
DRAWN BY: GW	DATE: 8/15	
ENGINEER: JDC		
PROJECT NO: AS-14-01535	DWG No. 15-012-M-001-2	REV. E
SCALE: N.T.S.		



ORIENTATION

MARK	QTY.	SIZE	TYPE	DESCRIPTION
Z1 / Z11	11	3/4"	CPLG.	SPARE W/ PLUG
V1/V2	2	2"	FLG.	LEVEL TRANSMITTER
U	1	1"	FLG.	JUICE RECYCLE
T	1	1 1/2"	FLG.	JUICE OUTLET
S1 / S2	2	1 1/2"	FLG.	JUICE INLET
R	1	2"	FLG.	CONDENSATE OUTLET
Q	1	6"	FLG.	STEAM INLET
P	1	1"	CPLG.	TEMPERATURE TRANSMITTER
O	1	1"	CPLG.	TEMPERATURE GAUGE
N	1	2"	FLG.	PRESSURE / VACUUM TRANSMITTER
M	1	3/4"	CPLG.	PRESSURE GAUGE
L	1	3/4"	FLG.	CALANDRIA VENT
K2	1	1"	FLG.	WATER
K1	1	1"	FLG.	WATER
J1 / J4	4	5"	FLG.	SIGHT GLASS
H1 / H2	2	2"	FLG.	LEVEL SIGHT GLASS
G	1	1"	CPLG.	TEMPERATURE TRANSMITTER
F	1	1"	CPLG.	TEMPERATURE GAUGE
E	1	2"	FLG.	PRESSURE / VACUUM TRANSMITTER
D	1	3/4"	CPLG.	PRESSURE GAUGE
C	1	3/4"	CPLG.	SPARE W/ PLUG
B	1	2"	FLG.	EQUALIZATION LINE
A	1	8"	FLG.	VAPOR OUTLET

NOZZLE SCHEDULE



V-3 ELEVATION
(1ea) REQ'D

DESIGN DATA:
VESSEL SHALL BE DESIGNED AND FABRICATED IN ACCORDANCE WITH THE LATEST EDITION OF ASME VIII, DIV. 1.

BODY

DESIGN PRESSURE	= 50 psig / FV
DESIGN TEMP.	= 350 °F
MATERIAL	= SS 304
CORROSION ALLOWANCE	= 0"

CALANDRIA

DESIGN PRESSURE	= 80 psig
DESIGN TEMP.	= 350 °F
MATERIAL	= SS 304 SHELL, NOZZ & TUBESHEET = 14 GA. SS304 TUBES = FLEXITALLIC SIRAL WND. GASKETS = SA-193 B7/2H BOLTS = SA-194 GR 2H NUTS
CORROSION ALLOWANCE	= 0" SHELL

GENERAL
1. CONNECTIONS FLANGED TO BE 150# RFWN, SA-105
2. CONNECTIONS THREADED TO BE 3000# THR'D HALF CPLG.
3. GASKETS FOR HEAD FLANGES SHALL BE FLEXITALLIC 304SS/TEFLON SPIRAL WOUND, TYPE CGI

REFERENCE DRAWINGS

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E	ISSUED FOR BID	JC	4/10/15

LSU AgCenter Research · Extension · Teaching

AUDUBON SUGAR INSTITUTE
3845 HWY 75
ST. GABRIAL, LA

PROJECT: TRIPLE EFFECT EVAPORATORS
FABRICATION SPECIFICATION

TAG NUMBER: V-3

AMERICAN INGENUITY LLC
38099 POST OFFICE RD, ST.11
PRAIRIEVILLE, LA 70769
PHONE: (225) 907-4515
WWW.AINGENUITY.COM

DRAWN BY: GW	DATE: 8/15	
ENGINEER: JDC		
PROJECT NO: AS-14-01535	DWG No. 15-012-M-001-3	REV. E
SCALE: N.T.S.		

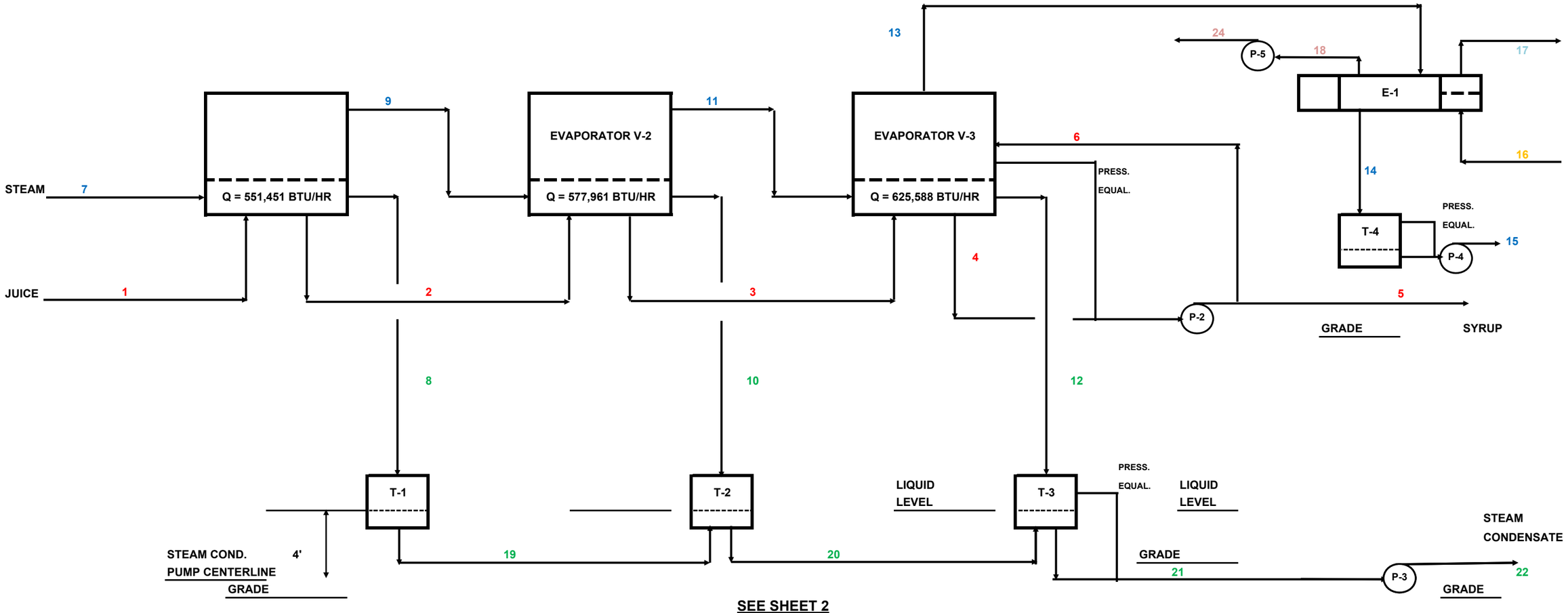
III
PFD's & DESIGN DETAILS

By:	Bruce LaCour			Project.:	BDL-LSU-1 : AUDUBON SUGAR INSTITUTE SUGAR JUICE EVAPORATION SYSTEM
Date:	05/21/15	Rev:	8	Subject:	Front End Design

Index of Documents

(Index is hyperlinked. Click on Listing to access.)

Sheet Name	Rev	Description
PFD 1	6	EVAPORATOR SYSTEM - SHEET 1
PFD 2	5	EVAPORATOR SYSTEM - SHEET 2
DESIGN DETAIL NO. 1	0	DELETED
DESIGN DETAIL NO. 2	4	T-1/2/3 CONDENSATE TANKS
DESIGN DETAIL NO. 3	1	FIRST AND SECOND EFFECT CALANDRIA NONCONDENSIBLE PURGE
DESIGN DETAIL NO. 4	1	THIRD EFFECT CALANDRIA NONCONDENSIBLE PURGE
DESIGN DETAIL NO. 5	0	DELETED
DESIGN DETAIL NO. 6	3	ELECTRICAL LOAD
DESIGN DETAIL NO. 7	4	INSULATION REQUIREMENTS
DESIGN DETAIL NO. 8	0	WATER SPRAY AND LIGHT FOR EVAPORATOR SIGHT GLASSES
DESIGN DETAIL NO. 9A	2	INSTRUMENT LIST - PAGE 1
DESIGN DETAIL NO. 9B	5	INSTRUMENT LIST - PAGE 2
DESIGN DETAIL NO. 10	0	DELETED
DESIGN DETAIL NO. 11	1	T-4 CONDENSATE TANK
DESIGN DETAIL NO. 12	0	VACUUM PUMP VAPOR/LIQUID SEPARATOR - T-5
DESIGN DETAIL NO. 13	0	EVAPORATOR NO. 1/2/3 TUBE SIDE LEVEL INDICATION/CONTROL
CALC 1	1	VACUUM PUMP CALCS - SHEET 1
CALC 2	0	VACUUM PUMP CALCS - SHEET 2
CALC 3	0	THIRD EFFECT OVERHEAD PIPING CALC
CALC 4	0	THIRD EFFECT OVERHEAD VAPOR LINE PRESSURE DROP AND VELOCITY



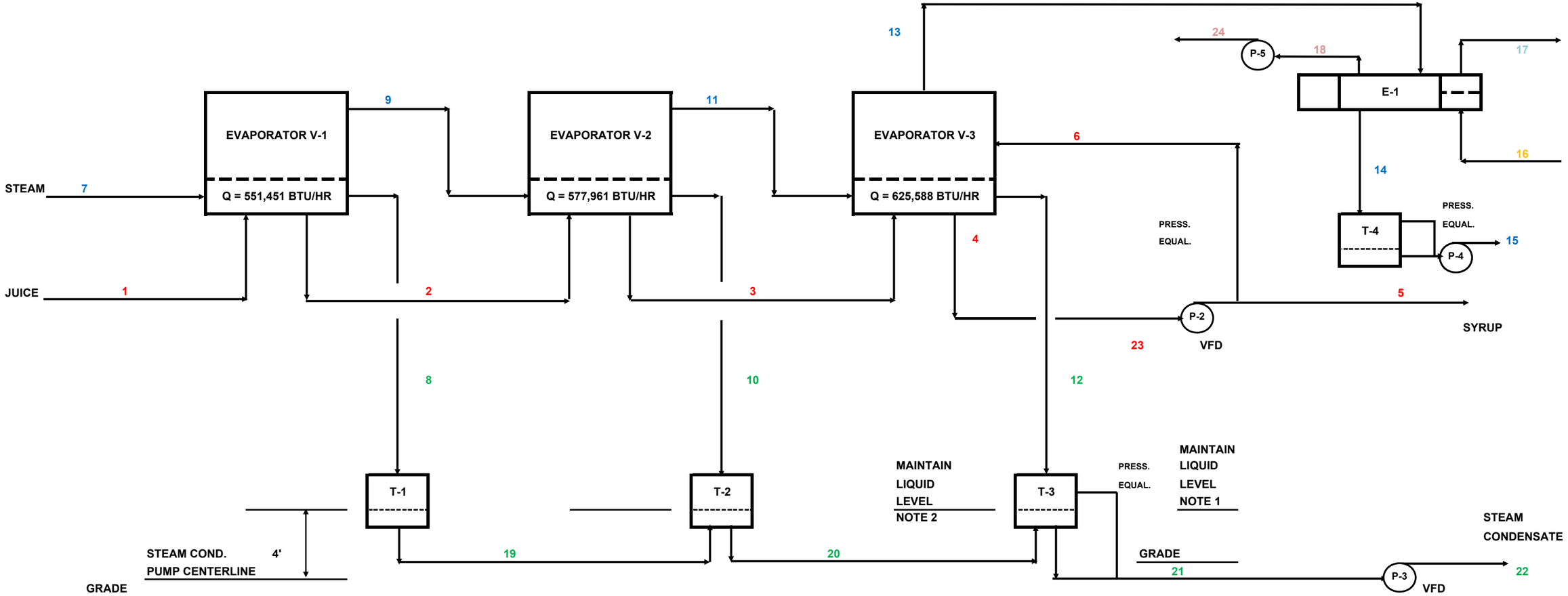
Legend		1	2	3	4	5	6	7	8	9	10	11	12	13
FL	Flow, lbs/hr	2077	1504	911	297	297	0 NORMALLY	562	562	573	573	593	593	614
FG	Flow, gpm or scfm for air	4.0	2.8	1.7	0.4	0.4	0.0		APPOX 1.2		APPOX 1.2		APPOX 1.2	
PG	Pressure, Psig	10.3	4.2	-2.0	-12.3			10.3	10.0	4.2	3.9	-2.0	-2.3	-12.3
PA	Pressure, Psia	25.0	18.9	12.8	2.4	24.7		25.0		18.9		12.7		2.4
L	Latent Heat,Btu/lb							952		962		975		1018
T	Temperature, Degrees F	235	226	207	147	147	147	240	239	226	223	197	195	133
CP	Specific Heat, Btu/lb-Deg F	0.94	0.91	0.87										
SG	Specific Gravity	1.04	1.06	1.09	1.34	1.34			0.95		0.95		0.96	
D	Pipe Diameter, in.	1	1.5	1.5	1.5	1	1	4	2	6	2	6	2	8
V	Velocity, fps		>0.5	>0.5	>0.5	>0.6								
VP	Vapor Pressure, Feet Abs.				5.7									
C	Concentration, Brix	9.99	13.81	22.79	69.99									
VC	Viscosity, cps													

PFD 1

AUDUBON SUGAR INSTITUTE PILOT PLANT EVAPORATOR SYSTEM -SHEET 1

REV. 6 - 8/19/15

6



P 2		P 3	
NPSH AVAIL =	3.8 FT. MAX.	NPSH AVAIL =	4.9 FT. MAX.
+ OPER PRESS =	29.8 FT. ABS. @ 12.4 PSIA	+ OPER PRESS =	11.3 FT ABS @ 4.7 PSIA
+ STATIC HEAD =	4 FT. MIN.	+ STATIC HEAD =	4 FT. MIN.
- DELTA P =	0.2 FT.	- DELTA P =	0.1 FT.
- VAPOR PRESS =	29.8 FT.	- VAPOR PRESS =	11.3 FT.
SUCT. PRESS. =	2.3 - 0.1 = 2.2 PSIG (EQUAL.)	SUCT. PRESS. =	1.7- 0.05 = 1.65 PSIG (EQUAL)

NOTES

1. SEE DESIGN DETAIL NO. 2

TBD = TO BE DETERMINED

COOLING WATER

Legend		14	15	16	17	18	19	20	21	22	23	24		
FL	Flow, lbs/hr	614	614	TBD	TBD	8	562	1135	1728	1728	297	8		
FG	Flow, gpm or scfm for air	1.2	1.2				1.2	2.2	3.6	3.6	0.4			
PG	Pressure, Psig	-12.8					10.0	3.9	2.0	2.5	-10.0			
PA	Pressure, Psia	1.9					24.7	18.6	16.7	17.2	4.7			
L	Latent Heat,Btu/lb													
T	Temperature, Degrees F	133	133	90	100	133	239	231	209	209	147	133		
CP	Specific Heat, Btu/lb-Deg F													
SG	Specific Gravity	0.987	0.987				0.95	0.95	0.96	0.96	1.34			
D	Pipe Diameter, in.	2	1	1.5	1.5	2	2	2	2	1.5	2	2		
V	Velocity, fps													
VP	Vapor Pressure, Feet Abs.													
C	Concentration, Brix										69.99			
VC	Viscosity, cps										LESS THAN 100			

PFD 2

AUDUBON SUGAR INSTITUTE PILOT PLANT EVAPORATOR SYSTEM -SHEET 1

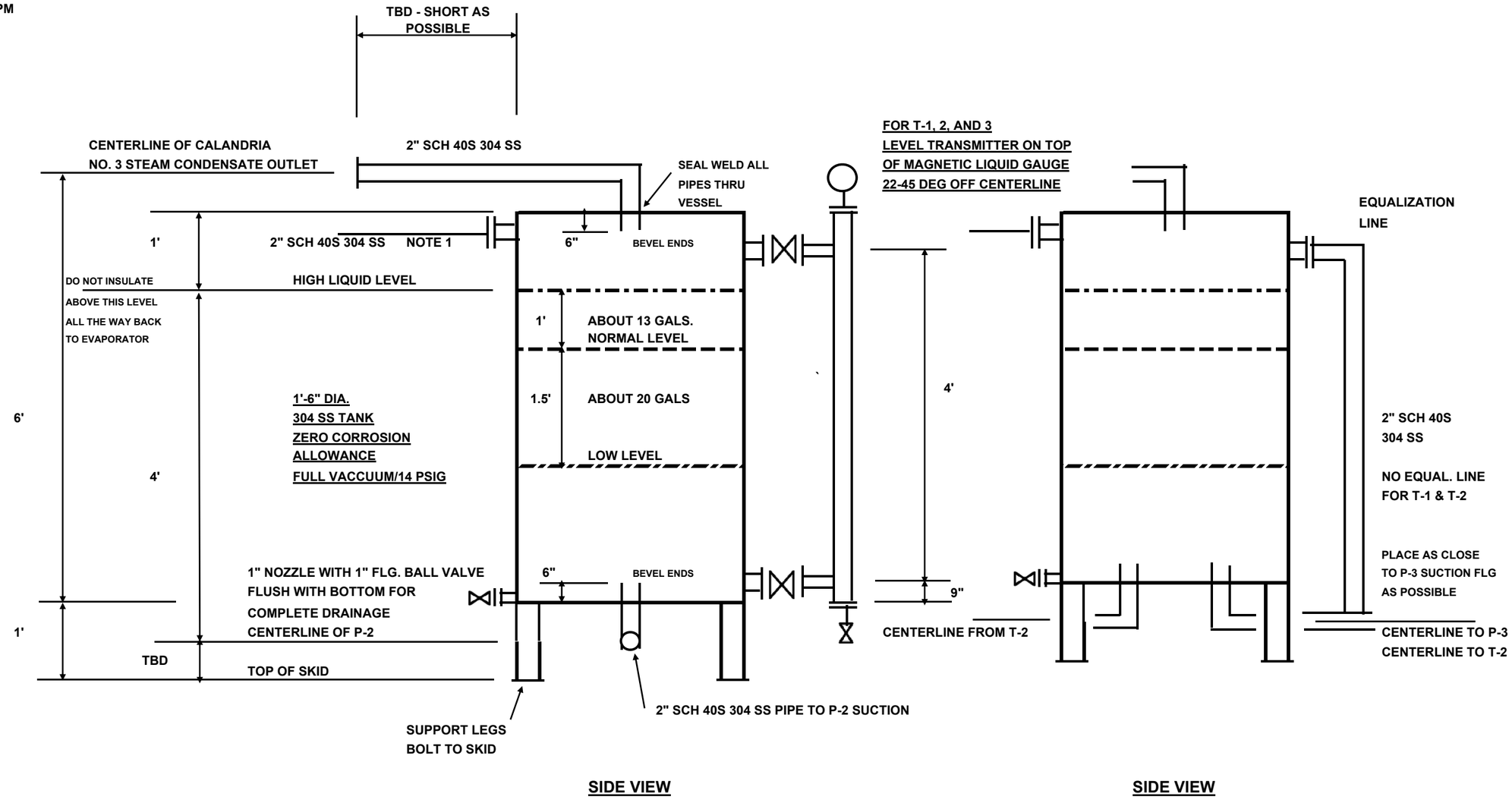
REV. 5 - 8/19/15

5

OPERATING DATA:

1. ONE TANK CAPACITY FROM NORMAL LEVEL TO HIGH LEVEL IS 13 GALS. ALL THREE TANKS 39 GALS.
2. ONE TANK FROM NORMAL LEVEL TO LOW LEVEL IS 20 GALS. ALL THREE TANKS 60 GALS.
3. DESIGN PUMPING RATE FOR P-3 IS 3.6 GPM

THESE ARE CLOSED, INSULATED TANKS DESIGNED FOR FULL VACUUM AND 14 PSIG



SIDE VIEW **SIDE VIEW**

NOTES:

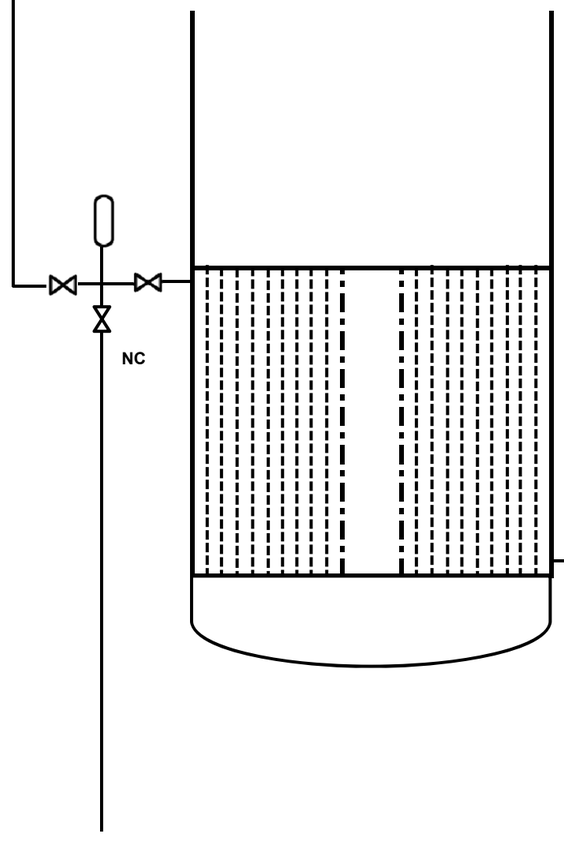
1. THIS LINE IS REQUIRED FOR T-1,2 AND 3. THIS CONNECTS CONDENSATE FLASH BACK TO THE STEAM INLET TO THE CALANDRIA.

DESIGN DETAIL NO. 2

T-1/2/3 CONDENSATE TANKS

REV. 4 -9/4/15/15 **4**

TIE INTO THIRD EFECT
OVERHEAD LINE
FOR MANUAL VENTING



ON EVAPORATOR NO, 1 ONLY
0.75 " SS AIR ELIMINATOR
THRD. CONNECTION.

NC

CALANDRIA
SECTION

ON OUTLET OF EVAPORATOR NO. 2 ONLY
0.75" 150# FLANGED 304 SS BALL VALVES
0.75 " SS AIR ELIMINATOR
THRD. CONNECTION.

2' CONDENSATE OUTLET
NOZZLE

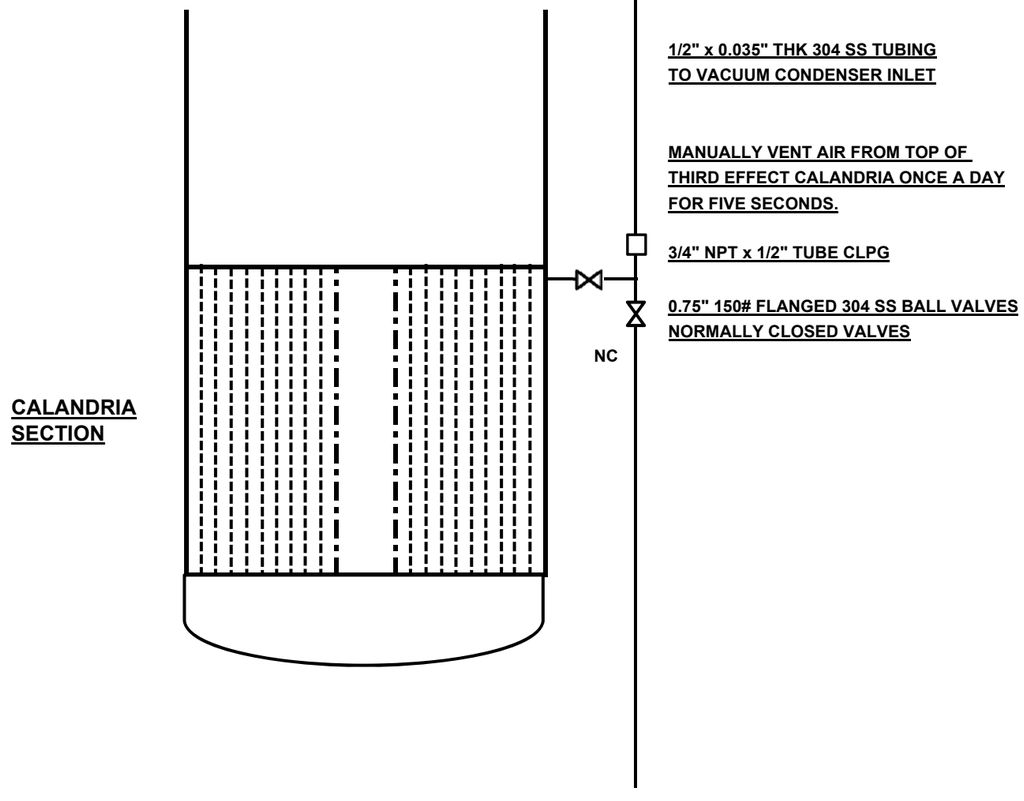
TOP OF SKID

DESIGN DETAIL NO. 3

FIRST AND SECOND EEFCT CALANDRIA
NONCONDENSIBLE PURGE

REV. 1 - 8/17/15

1



DESIGN DETAIL NO. 4

THIRD EFFECT CALANDRIA NONCONDENSIBLE PURGE

REV. 1 - 8/13/15

1

ITEM	EQUIPMENT NO.	HP OR KW	VOLTAGE
EVAPORATOR NO.1 SG-1-4	SG-1-4	TBD	120/1/60
EVAPORATOR NO.2 SG-2-4	SG-2-4	TBD	120/1/60
EVAPORATOR NO. 3 SG-3-4	SG-3-4	TBD	120/1/60
SYRUP PUMP	P-2	TBD	460/3/60
STEAM CONDENSATE PUMP	P-3	TBD	460/3/60
STEAM CONDENSATE PUMP	P-4	TBD	460/3/60
VACUUM PUMP	P-5	TBD	460/3/60
SAMPLE CIRCULATION PUMP	P-1	TBD	120/1/60
INSTRUMENTATION	VARIOUS	TBD	120/1/60
ELECTRICAL TRACING	ET-1/2/3/4	TBD	120/1/60

SKID FABRICATOR SHALL BRING IN 460/3/60 TO SKIDS AT ELECTRICAL JUNCTION BOX AND TRANSFORM DOWN TO 120/1/60.

MOTOR STARTERS WILL BE PROVIDED BY OWNER.

PROVIDE SEPARATE JUCTION BOX WITH 460/120 TRANSFROMER FOR ELECTRICAL TRACING. EACH SEPARATE INSTALLATION SHALL BE CONTROLLED BY AN ADJUSTABLE THERMOSTAT JUNCTION BOX SHALL HAVE DISCONNECT SWITCH TO DEACTIVATE POWER TO ALL FOUR LOCATIONS.

DESIGN DETAIL NO. 6

ELECTRICAL LOAD

REV. 3 - 7/2/15

3

ITEM	EQUIPMENT OR LINE DIAMETER	OPERATING TEMP.	INSULATION TYPE	THICKNESS
STEAM TO EVAPORATOR NO.1	4" NOMINAL	240	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 1 CALANDRIA	2'-6" X 2'	239	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 1 TOP SHELL	2'-6" X 11'7"	226	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 1 BOTTOM HEAD	2'6" 2:1 ELLIPSODIAL	226	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO.1 TOP HEAD	2'6" F& D	226	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 1 OVERHEAD VAPOR	6" NOMINAL	226	AEROGEL	TBD - HEAT CONS.
EVAPORATOR BOTTOM JUICE OUTLET	2" NOMINAL	226	TBD	TBD - HEAT CONS.
EVAPORATOR NO. 2 CALANDRIA	2'-6" X 2'	223	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 2 TOP SHELL	2'-6" X 11'7"	197	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 2 BOTTOM HEAD	2'6" 2:1 ELLIPSODIAL	197	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 2 TOP HEAD	2'6" F& D	197	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 2 OVERHEAD VAPOR	6" NOMINAL	197	AEROGEL	TBD - HEAT CONS.
EVAPORATOR BOTTOM JUICE OUTLET	2" NOMINAL	197	TBD	TBD - HEAT CONS.
EVAPORATOR NO. 3 CALANDRIA	2'-6" X 2'	195	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 3 TOP SHELL	2'-6" X 11'7"	133	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 3 BOTTOM HEAD	2'6" 2:1 ELLIPSODIAL	133	AEROGEL	TBD- PP
EVAPORATOR NO. 3 TOP HEAD	2'6" F& D	133	AEROGEL	TBD - HEAT CONS.
EVAPORATOR NO. 2 OVERHEAD VAPOR	8" NOMINAL	133	AEROGEL	TBD- PP
EVAPORATOR BOTTOM JUICE OUTLET	2" NOMINAL	133	TBD	TBD- PP
DELETED				
STEAM OUT LINE	0.75"	240	TBD	TBD-HEAT CONS.
STEAM CONDENSATE LINES	2" NOMINAL	239-209	TBD	TBD- PP
P-2 SUCTION	2" NOMINAL	133	TBD	TBD- PP
P-3 SUCTION	2" NOMINAL	209	TBD	TBD- PP
CONDENSATE TANK NO. 1	1'6" DIA. X 6'6" SIDE ONLY	239	AEROGEL	TBD- PP
CONDENSATE TANK NO. 2	1'6" DIA. X 6'6" SIDE ONLY	231	AEROGEL	TBD- PP
CONDENSATE TANK. NO.3	1'6" DIA. X 6'6" SIDE ONLY	209	AEROGEL	TBD- PP
P-4 SUCTION	2" NOMINAL	133	AEROGEL	TBD-PP
P-1 SUCTION/DISCHARGE	3/4" NOMINAL	207	TBD	TBD-PP
FOUR ELECTRICALLY TRACED ITEMS	REMOVABLE INSULATION COVERS	226-207-147-147	AEROGEL	TBD-HEAT CONS.

NOTES:

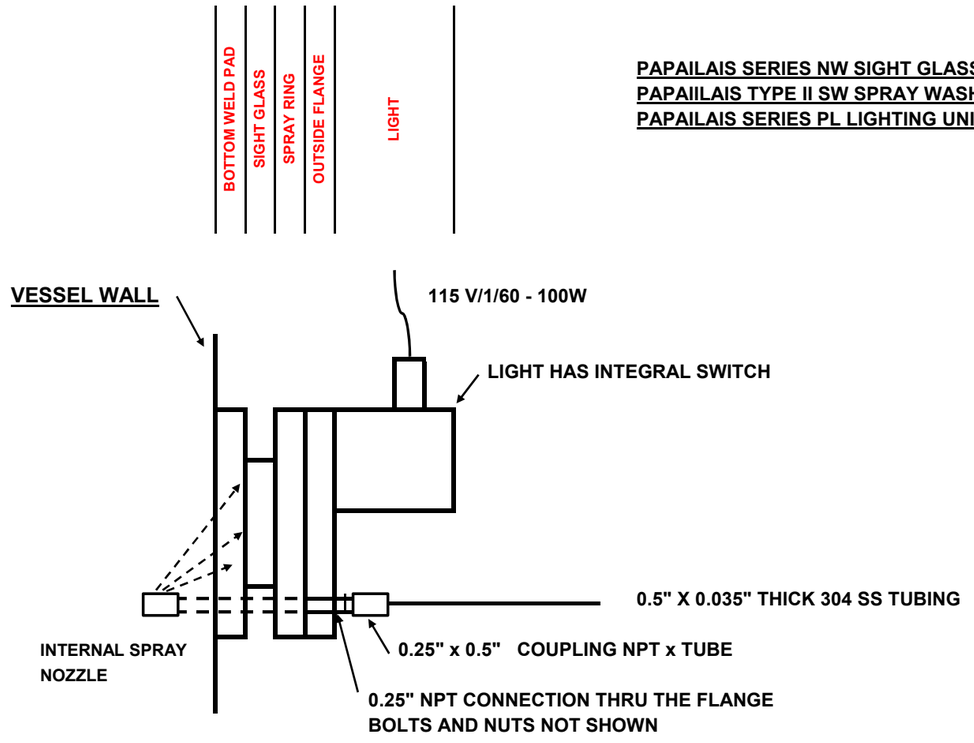
1. ALL INSULATION SHALL BE PROTECTED BY ASTM C1729 ALUMINUM JACKETING, 0.016 INCHES THICK.
2. INSTALLATION DETAILS SHALL BE REVIEWED BY OWNER PRIOR TO INSTALLATION OF ANY INSULATION.
3. THE TWO CONTROL VALVES SHALL REMAIN UNINSULATED. THE IN-LINE BLOCK VALVES SHALL BE INSULATED UNLESS DETAILED PROVES THAT WOULD BE A PROBLEM.
4. WITH AEROGEL INSULATION, ALL INSULATION THICKNESSES SHOULD BE LESS THAN 0.5 INCHES. DESIGNER CAN INSTALL THICKNER THAN RECOMMENDED INSULATION WHERE THIS RESULTS IN PURCHASING TOO MANY DIFFERENT THICKNESSES.
5. INSULATION TYPES DEFINED AS "TBD" MEANS DESIGNER SHALL DETERMINE WHAT INSULATION TYPE IS APPROPRIATE FOR THAT PARTICULAR LOCATION BASED ON EASE OF INSTALLATION AND AVAILABLE SPACE.
6. INSULATE LINE FROM VACUUM CONENDSER, E-1 TO GAS/LIQUID SEPARATOR, T-5 TO AVOID SURFACE CONDENSATION FROM DRIPPING DOWN INSIDE BUILDING. THIS LINE WILL HAVE TO INSTALLED IN THE FIELD.

DESIGN DETAIL NO. 7

INSULATION REQUIREMENTS

REV. 4 - 8/13/15

4



PAPAILAIS SERIES NW SIGHT GLASS (WELD PAD)
PAPAIILAIS TYPE II SW SPRAY WASHER
PAPAILAIS SERIES PL LIGHTING UNIT

SG-1-4, 2-4, AND 3-4 HAVE BOTH THE SPRAY WASH AND THE LIGHT THE OTHER NINE SIGHT GLASSES HAVE ONLY THE SPRAY WASH.

DESIGN DETAIL NO. 8

WATER SPRAY AND LIGHT FOR EVAPORATOR SIGHT GLASSES

REV. 0 - 5/19/15 | 0

ITEM	INSTRUMENT. NO.	TYPE	LOCAL OR DCS	P&ID NO.
JUICE FLOW TO EVAPORATOR NO. 1	FT-1	VORTEX FLOWMETER	LOCAL	2
JUICE FLOW TO EVAPORATOR NO. 1	LV-C1-1	CONTROL VALVE	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA TUBE SIDE LEVEL CONTROL	LG-C1-1	ARMORED SIGHT GLASS	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA TUBE SIDE LEVEL CONTROL	LT-C1-1	DIFFERENTIAL PRESSURE	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA TUBE SIDE LEVEL CONTROL	LIC-C1-1	DCS INDICATION	DCS	2
STEAM FLOW TO EVAPORATOR NO. 1	FV-1	CONTROL VALVE	LOCAL	2
JUICE FLOW TO EVAPORATOR FV-1 SHUTOFF	FY-1B	SOLENOID VALVE	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA SHELL SIDE PRESSURE	PT-1-1	PRESSURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA SHELL SIDE PRESSURE	PI-1-1	DCS INDICATION	DCS	2
EVAPORATOR NO. 1 CALANDRIA SHELL SIDE TEMPERATURE	TT-1-1	TEMPERATURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA SHELL SIDE TEMPERATURE	TI-1-1	DCS INDICATION	DCS	2
EVAPORATOR NO. 1 OVERHEAD PRESSURE INDICATION	PT-1-2	PRESSURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 1 OVERHEAD PRESSURE INDICATION	PI-1-2	DCS INDICATION	DCS	2
EVAPORATOR NO. 1 OVERHEAD TEMPERATURE INDICATION	TT-1-2	TEMPERATURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 1 OVERHEAD TEMPERATURE INDICATION	TI-1-2	DCS INDICATION	DCS	2
EVAPORATOR NO. 1 CONDENSATE TANK LEVEL INDICATION	LG-T1	MAGNETIC GAGE	LOCAL	2
EVAPORATOR NO. 1 CONDENSATE TANK LEVEL INDICATION	LT-T1	MAGNETORESTRICTIVE	LOCAL	2
EVAPORATOR NO. 1 CONDENSATE TANK LEVEL INDICATION/CONTROL	LIC-T1	DCS INDICATION/CONTROL	DCS	2
EVAPORATOR NO. 1 CONDENSATE TANK LEVEL CONTROL	LV-T1	CONTROL VALVE	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA TUBE SIDE LEVEL INDICATION	LG-C2-1	ARMORED SIGHT GLASS	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA TUBE SIDE LEVEL INDICATION	LT-C2-1	DIFFERENTIAL PRESSURE	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA TUBE SIDE LEVEL INDICATION	LIC-C2-1	DCS INDICATION/CONTROL	DCS	2
EVAPORATOR NO. 2 CALANDRIA SHELL SIDE PRESSURE INDICATION	PT-2-1	PRESSURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA SHELL SIDE PRESSURE INDICATION	PI-2-1	DCS INDICATION	DCS	2
EVAPORATOR NO. 2 CALANDRIA SHELL SIDE TEMPERATURE INDICATION	TT-2-1	TEMPERATURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA SHELL SIDE TEMPERATURE INDICATION	TI-2-1	DCS INDICATION	DCS	2
EVAPORATOR NO. 2 OVERHEAD PRESSURE INDICATION	PT-2-2	PRESSURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 2 OVERHEAD PRESSURE INDICATION	PI-2-2	DCS INDICATION	DCS	2
EVAPORATOR NO. 2 OVERHEAD TEMPERATURE INDICATION	TT-2-2	TEMPERATURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 2 OVERHEAD TEMPERATURE INDICATION	TI-2-2	DCS INDICATION	DCS	2
EVAPORATOR NO. 2 CONDENSATE TANK LEVEL INDICATION	LG-T2	MAGNETIC GAGE	LOCAL	2
EVAPORATOR NO. 2 CONDENSATE TANK LEVEL INDICATION	LT-T2	MAGNETORESTRICTIVE	LOCAL	2
EVAPORATOR NO. 2 CONDENSATE TANK LEVEL INDICATION/CONTROL	LIC-T2	DCS INDICATION/CONTROL	DCS	2
EVAPORATOR NO. 2 CONDENSATE TANK LEVEL INDICATION/CONTROL	LV-T2	CONTROL VALVE	LOCAL	2
EVAPORATOR NO. 3 CALANDRIA TUBE SIDE LEVEL CONTROL	LG-C3-1	ARMORED SIGHT GLASS	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA TUBE SIDE LEVEL CONTROL	LT-C3-1	DIFFERENTIAL PRESSURE	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA TUBE SIDE LEVEL CONTROL	LIC-C3-1	DCS INDICATION/CONTROL	DCS	3
EVAPORATOR NO. 3 CALANDRIA SHELL SIDE PRESSURE	PT-3-1	PRESSURE TRANSMITTER	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA SHELL SIDE PRESSURE	PI-3-1	DCS INDICATION	DCS	3
EVAPORATOR NO. 3 CALANDRIA SHELL SIDE TEMPERATURE	TT-3-1	TEMPERATURE TRANSMITTER	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA SHELL SIDE TEMPERATURE	TI-3-1	DCS INDICATION	DCS	3
EVAPORATOR NO. 3 OVERHEAD PRESSURE CONTROL	PT-3-2	PRESSURE TRANSMITTER	LOCAL	3
EVAPORATOR NO. 3 OVERHEAD PRESSURE CONTROL	PIC-3-2	DCS INDICATION	DCS	3
EVAPORATOR NO. 3 OVERHEAD TEMPERATURE INDICATION	TT-3-2	TEMPERATURE TRANSMITTER	LOCAL	3
EVAPORATOR NO. 3 OVERHEAD TEMPERATURE INDICATION	TI-3-2	DCS INDICATION	DCS	3
EVAPORATOR NO. 3 CONDENSATE TANK LEVEL CONTROL	LG-T3	MAGNETIC GAGE	LOCAL	3
EVAPORATOR NO. 3 CONDENSATE TANK LEVEL CONTROL	LT-T3	MAGNETORESTRICTIVE	LOCAL	3
EVAPORATOR NO. 3 CONDENSATE TANK LEVEL CONTROL	LIC-T3	DCS INDICATION/CONTROL	DCS	3
EVAPORATOR NO. 1 CALANDRIA PRESSURE INDICATOR	PI-1-1	PRESSURE GAGE	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA PRESSURE/VACUUM INDICATOR	P1-2-1	PRESSURE/VACUUM GAGE	LOCAL	2
EVAPORATOR NO. 3 CALANDRIA VACUUM INDICATOR	PI-3-1	VACUUM GAGE	LOCAL	3

DESIGN DETAIL NO. 9A

INSTRUMENT LIST - PAGE 1

REV. 2 - 9/4/15 | 2

ITEM	INSTRUMENT. NO.	TYPE	LOCAL OR DCS	P&ID NO.
EVAPORATOR NO. 1 CALANDRIA TEMPERATURE INDICATOR	TI-1-1	THERMOWELL/TEMP. IND.	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA TEMPERATURE INDICATOR	T1-2-1	THERMOWELL/TEMP. IND.	LOCAL	2
EVAPORATOR NO. 3 CALANDRIA TEMPERATURE INDICATOR	TI-3-1	THERMOWELL/TEMP. IND.	LOCAL	3
EVAPORATOR NO. 1 OVERHEAD PRESSURE INDICATOR	PI-1-2	PRESSURE GAGE	LOCAL	2
EVAPORATOR NO. 2 OVERHEAD PRESSURE/VACUUM INDICATOR	PI-2-2	PRESSURE/VACUUM GAGE	LOCAL	2
EVAPORATOR NO. 3 OVERHEAD VACUUM INDICATOR	PI-3-2	VACUUM GAGE	LOCAL	3
EVAPORATOR NO. 1 OVERHEAD TEMPERATURE INDICATOR	TI-1-2	THERMOWELL/TEMP. IND.	LOCAL	2
EVAPORATOR NO. 2 OVERHEAD TEMPERATURE INDICATOR	TI-2-2	THERMOWELL/TEMP. IND.	LOCAL	2
EVAPORATOR NO. 3 OVERHEAD TEMPERATURE INDICATOR	TI-3-2	THERMOWELL/TEMP. IND.	LOCAL	3
P-2 DISCHARGE PRESSURE INDICATOR	PI-2	PRESSURE GAGE	LOCAL	3
P-3 DISCHARGE PRESSURE INDICATOR	PI-3	PRESSURE GAGE	LOCAL	3
FINISHED JUICE BRIX CONTROL	BV-2	THREE-WAY BALL VALVE	LOCAL	3
FINISHED JUICE BRIX CONTROL	BI-2	DCS INDICATION	DCS	3
EVAPORTAOR NO. 2 BRIX INDICATION	BT-1	SEE K-PATENTS QUOTE 7/8/15	LOCAL	3
FINISHED JUICE BRIX CONTROL	BT-2	SEE K-PATENTS QUOTE 7/8/15	LOCAL	3
RELIEF VALVE FOR P-2 DISCHARGE	RV-2	RELIEF VALVE	LOCAL	3
RELIEF VALVE FOR P-3 DISCHARGE	RV-3	RELIEF VALVE	LOCAL	3
RELIEF VALVE FOR P-2 DISCHARGE	RV-2	RELIEF VALVE	LOCAL	3
STEAM CONDENSATE PUMP P-4 DISCHARGE PRESSURE	PI-4	PRESSURE GAGE	LOCAL	3
VACUUM PUMP-5 SUCTION PRESSURE	PI-5	VACUUM GAGE	LOCAL	3
VACUUM CONDENSER LIQUID OUTLET LEVEL CONTROL	LG-4	MAGNETIC LEVEL GAUGE	LOCAL	3
VACUUM CONDENSER LIQUID OUTLET LEVEL CONTROL	LT-4	MAGNETORESTRICTIVE	LOCAL	3
CONDENSER E-1 CW SUPPLY PRESSURE	PI-6	PRESSURE GAGE	LOCAL	3
CONDENSER E-1 CW RETURN PRESSURE	PI-7	PRESSURE GAGE	LOCAL	3
CONDENSER E-1 CW RETURN TEMPERATURE	TI-7	THERMOWELL/TEMP. IND.	LOCAL	3
RELEF VALVE FOR P-4 DISCHARGE	RV-4	RELIEF VALVE	LOCAL	3
EVAP NO. 1 TO EVAP. NO. 2 CONTROL VALVE	LV-C2-1	CONTROL VALVE	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA LEVEL CONTROL	LIC-C2-1	DCS INDICATION	DCS	2
RELIEF VALVE FOR P-1	RV-1	RELIEF VALVE	LOCAL	2
EVAP NO. 2 TO EVAP NO. 3 CONTROL VALVE	LV-C3-1	CONTROL VALVE	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA LEVEL CONTROL	LIC-C3-1	DCS INDICATION	DCS	3
VACUUM PUMP P-5 SPEED CONTROL	SIC-5	DCS INDICATION	DCS	3
SYRUP PUMP P-2 SPEED CONTROL	SIC-2	DCS INDICATION	DCS	3
CONDENSATE PUMP P-3 SPEED CONTROL	SIC-3	DCS INDICATION	DCS	3
CONDENSATE PUMP P-4 SPEED CONTROL	SIC-4	DCS INDICATION	DCS	3
SYRUP TEMPERATURE UPSTREAM COOLER	TI-8	THERMOWELL/TEMP. IND.	LOCAL	4
SYRUP TEMPERATURE DOWNSTREAM COOLER	TI-9	THERMOWELL/TEMP. IND.	LOCAL	4
REFRACTOMETER STEAM WASH VALVE	XV-10A/B	ON-OFF VALVE	LOCAL	SEE K-PATENTS DIAGRAM 1
STEAM PRESSURE REGULATOR FOR STEAM WASH	PV-11A/B	PRESSURE REGULATOR	LOCAL	SEE K-PATENTS DIAGRAM 1

ALL CONTROL VALVES REQUIRE POSITIONERS
ALL INSTRUMENTS MUST HAVE STAINLESS STEEL TAGS ATTACHED.

DESIGN DETAIL NO. 9B

INSTRUMENT LIST - PAGE 2

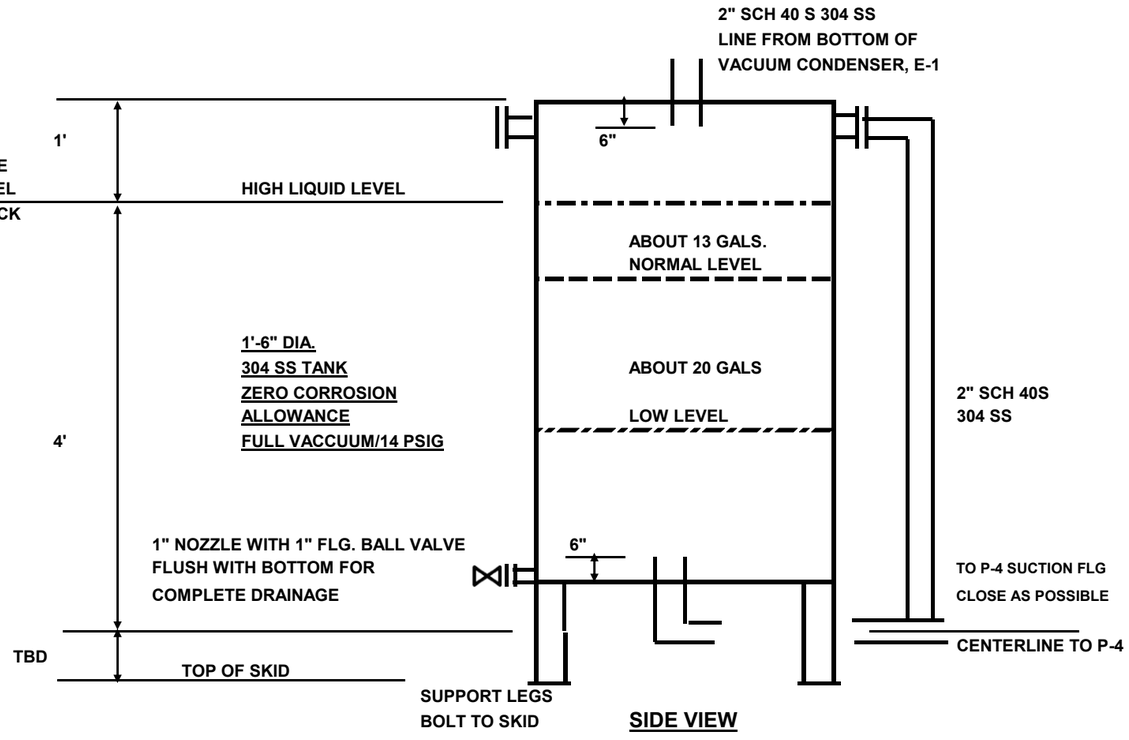
REV. 5 - 8/13/15

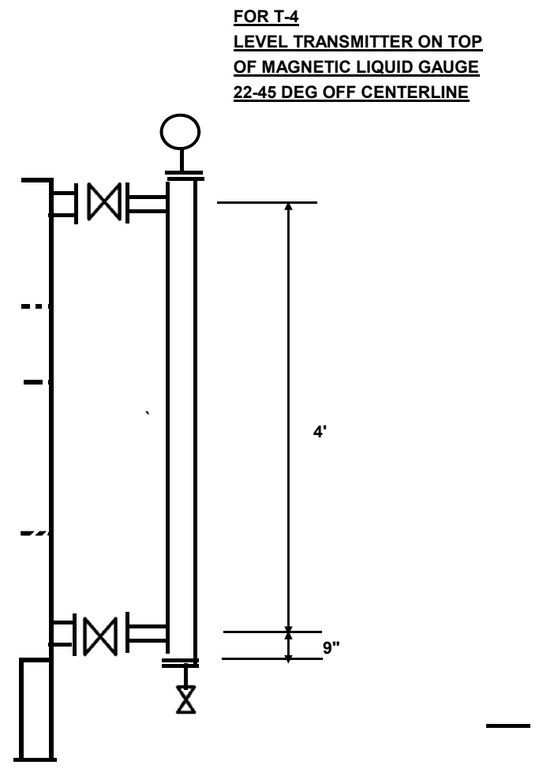
5

OPERATING DATA:

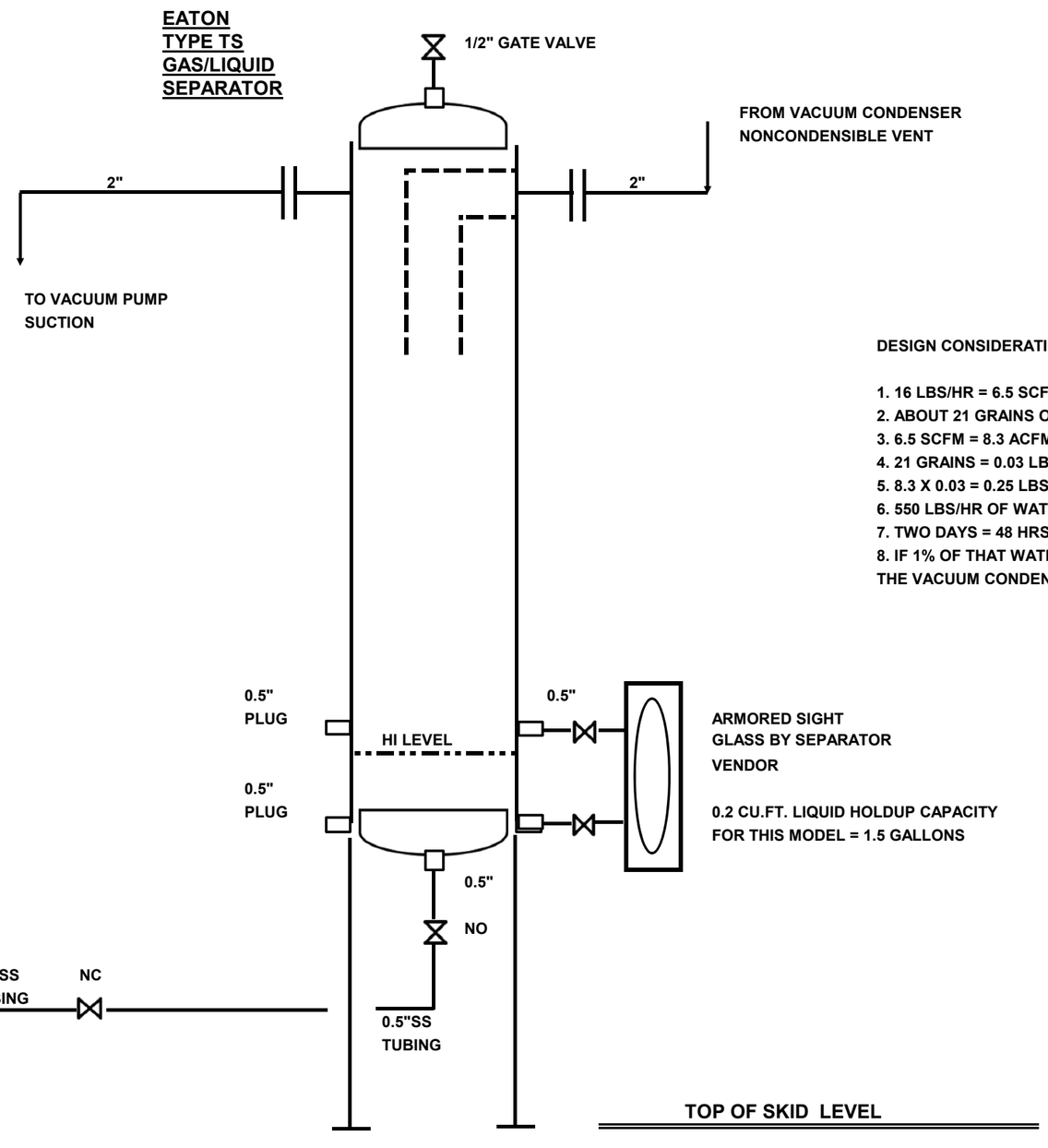
1. TANK CAPACITY FROM NORMAL LEVEL TO HIGH LEVEL IS 13 GALS.
2. TANK FROM NORMAL LEVEL TO LOW LEVEL IS 20 GALS.
3. DESIGN PUMPING RATE FOR P-4 IS 1.2 GPM.

T-4 SHALL BE IDENTICAL IN SIZE TO T-1/2/3





DESIGN DETAIL NO. 11	
CONDENSATE TANK T-4	
REV. 1 - 9/4/15	1



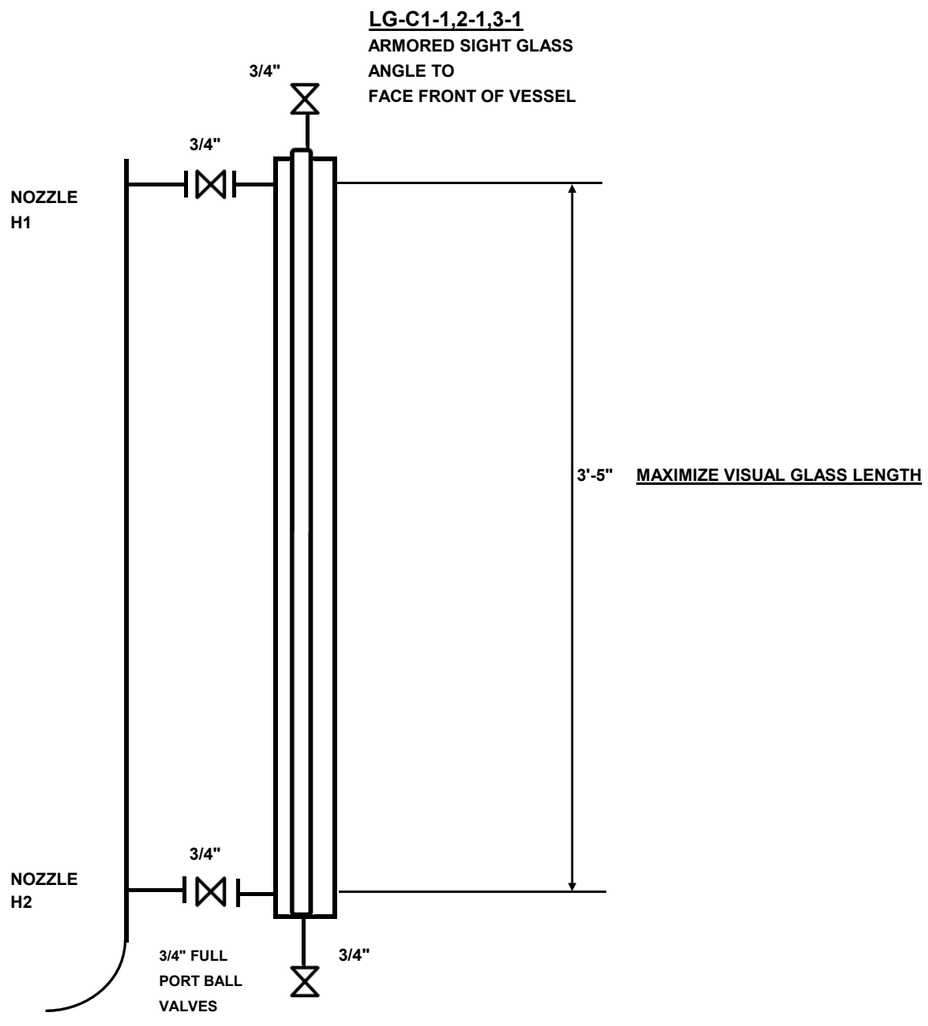
DESIGN CONSIDERATIONS:

1. 16 LBS/HR = 6.5 SCFM FROM CALC 2.
2. ABOUT 21 GRAINS OF WATER PER CU. FT OF 113 DEG F 100% SATURATED AIR.
3. 6.5 SCFM = 8.3 ACFM. AT 113 DEG F, 100% HUMIDITY, AND 2.1 PSIA
4. 21 GRAINS = 0.03 LBS PER CU. FT. OF AIR
5. 8.3 X 0.03 = 0.25 LBS OF WATER PER MIN. = 15 LBS OF WATER PER HR.
6. 550 LBS/HR OF WATER = 1 GPM SO 15 LBS OF WATER PER HR = 0.027 GALLONS PER MIN.
7. TWO DAYS = 48 HRS X 60 x 0.027 = 78 GALLONS
8. IF 1% OF THAT WATER VAPOR CONDENSED IN THE PIPE FROM THE VACUUM CONDENSER TO THE SEPARATOR, THAN 78 x 0.01 = ABOUT 0.8 GALLONS.

DESIGN DETAIL NO. 12

VACUUM PUMP VAPOR/LIQUID SEPARATOR - T-5

REV. 0 - 8/19/15 | **0**



ELEVATION

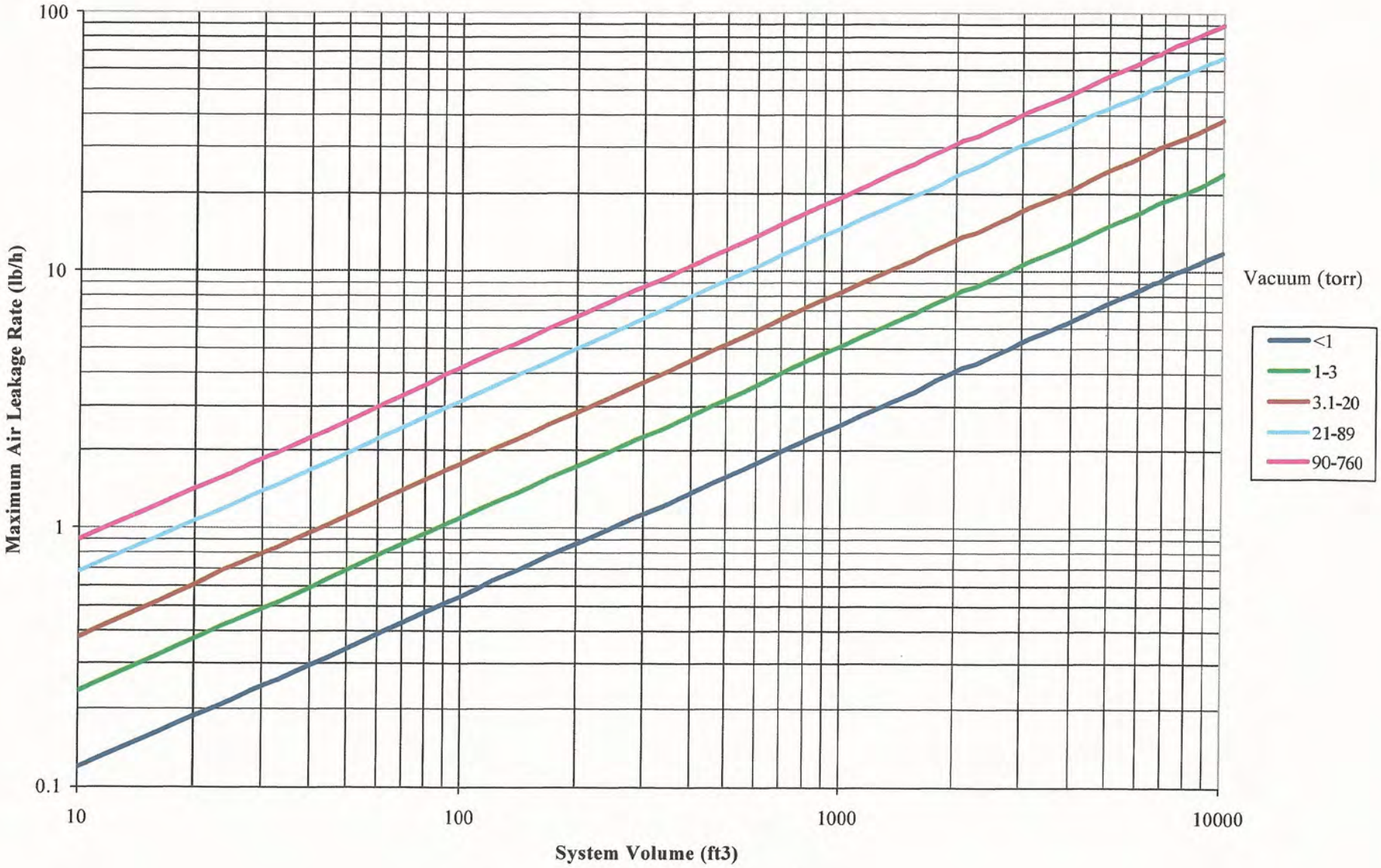
ELECTRICALLY TRACE AND INSULATE ALL SURFACES
STARTING AT NOZZLES AND PLACE
ADJUSTABLE CONTROL THERMOSTAT AT
BOTTOM LEVEL

DESIGN DETAIL NO. 13

EVAPORATOR NO. 1/2/3 TUBE SIDE LEVEL INDICATION/CONTROL

REV. 0 - 8/19/15 | 0

Vacuum System Air Leakage Rates (English Units)



THEORETICAL EXTERNAL COLLAPSE PRESSURE FOR RELATIVELY LONG CYLINDERS UNDER EXTERNAL PRESSURE (PIPES AND TUBES ONLY).

The user is responsible for verifying that method and results are correct.

CLIENT:	DESCRIPTION:	PREPARED BY:	DATE	REV.
AUDUBON SUGAR INSTITUTE	THIRD EFFECT OVRH	BDL	5/22/2015	0
CUSTOMER NO.:	ITEM NO.:			1
				2
OWNER NO.:	DWG. NO.:			3
				4

These methods are not allowed for ASME vessels and pipes, except per ASME BPV Code, UG-28, F.

Pipe Material: A 312 TP304L SS S30403 EFW(S) 18Cr-8Ni

Design Temperature (◉ oF ○ oC)	T =	300	deg. F (148.9 deg. C)
Ambient Temperature		70	deg. F (21.1 deg. C)
Young's modulus of elasticity at design temperature	E =	28,300,000	PSI at 300 deg. F (148.9 deg. C)
Yield Stress	Sy =	25,000	PSI
Poisson's ratio	μ =	0.305	
Pipe size: NPS 8 (DN 200)		NPS 8 (DN 200)	
Schedule, Wt., Wall: Sch 10S per ASME B36.19M		10S	
Actual Outside Diameter	$O.D.$ =	8.625	Inch
Approx. Inside Diameter	$I.D.$ =	8.329	Inch
Nominal Thickness	t_n =	0.148	Inch
Mean radius of pipe or tube, (O.D. - t_n)/2	r =	4.2385	Inch
External design pressure	EP =	15.00	
Distance between stiffeners	L =	530	Inch
Number of lobes at elastic collapse	N =	2	Applies only to *Pe2* and *Pe3* below
Safety Factor	SF =	3.0	

ALLOWABLE EXTERNAL PRESSURE WITHOUT STIFFENING:

PA = Lowest of Pe1, Pe2, Pe3, Pe4, Pe5, or Pp from methods below, divided by SF,

PA = 44.8 psi / 3 = **PA =** 14.9 Negative PSI

T / OD	T / OD =	0.017	
L / OD	L / OD =	61.4	

If External Design Pressure is less than Allowable External Pressure, then the pipe is thick enough.

If the pipe is not thick enough, and T / OD < 15, then stiffening rings can be used.

PIPE THICKNESS MUST BE INCREASED. STIFFENING RINGS WILL NOT HELP.

Stiffening ring thickness, flat plate	ts =	0.0000	Inch
Stiffening ring height, flat plate	hs =	0.0000	Inch
Stiffening ring material	$Matl$ =	Matches pipe	
Ring modulus of elasticity at design temp.	Es =	28,300,000	PSI at 300 deg. F (148.9 deg. C)
Available Ring Moment of Inertia, = 1/12 (ts)(hs)^3	Is =	0.0000	In^4
Required Moment of Inertia, = 1/28 (O.D.)^3 (L)(EP * SF)/Es	Ir =	0.0193	In^4
Check for adequate stiffening ring size		CHANGE RING DIMENSIONS.	

The following methods are not allowed for ASME vessels and pipes, except per ASME BPV Code, UG-28, F.

Reference 1: S. C. Haagsma and D. Schaap, "Collapsing of Submarine Lines Studied," Oil Gas J., pp. 87-95 (February 2, 1981).
Reference 2: S. P. Timoshenko and J. M. Gere, "Theory of Elastic Stability", 2nd ed., McGraw-Hill-Kogakusha, Tokyo.

THEORETICAL EXTERNAL PRESSURE FOR *ELASTIC* COLLAPSE:

Pe1 = 2E / [(1 - μ^2) (OD / tn) (OD / tn - 1)^2] **$Pe1$ =** 326.4 Negative PSI

THEORETICAL EXTERNAL PRESSURE FOR *PLASTIC* BUCKLING:

Pp = 2Sy (tn / OD) **Pp =** 858.0 Negative PSI

Reference paper: Chemical Engineering, April 30, 1984, "Sizing Pipe for External Pressure", by M. Mikasinovic and P. A. Marcucci.

Collapse pressure given by Von Mises' Equation:

THEORETICAL EXTERNAL COLLAPSE PRESSURE: **$Pe2$ =** 315.4 Negative PSI

Pe2 = 1/3 [N^2 - 1 + (2N^2 - 1 - μ) /(N^2 (2L /π OD)^2 - 1)^2] 2E/(1-μ^2) *
(tn / OD)^3 + 2E / (N^2 -1) * tn / OD / (N^2 (2L / π OD))^2 + 1)^2

Reference book: "Buckling of Bars, Plates, and Shells", 1995, By D. O. Brush and B. O. Almroth, page 163, Equation (5.45).

THEORETICAL EXTERNAL COLLAPSE PRESSURE: **$Pe3$ =** 443.0 Negative PSI

Pe3 = (E * tn / r)[[(π * r / L)^2 + N^2]^2 / N^2 * (tn / r)^2 / (12 (1 - μ^2)) +
[(π * r / L)^4 / [(N^2) ((π * r / L)^2 + N^2)^2]]]

Reference : "Strength of Thin Cylindrical Shells Under External Pressure ", Trans. ASME vol. 53, no.15, p. 207, 1931
Roark, Table 35 , case 19a Very long tube with free ends; length L , applicable when L>4.9*r*sqrt(r/t)

THEORETICAL EXTERNAL COLLAPSE PRESSURE: **$Pe4$ =** 332.1 Negative PSI

Pe4 = 1/4* [E/ (1-μ^2)] * (tn^ 3 / r^3)

Reference: Roark, Table 35 , case 19b Short tube of length L, ends held circular, but not otherwise constrained,
or a long tube held circular at intervals L.

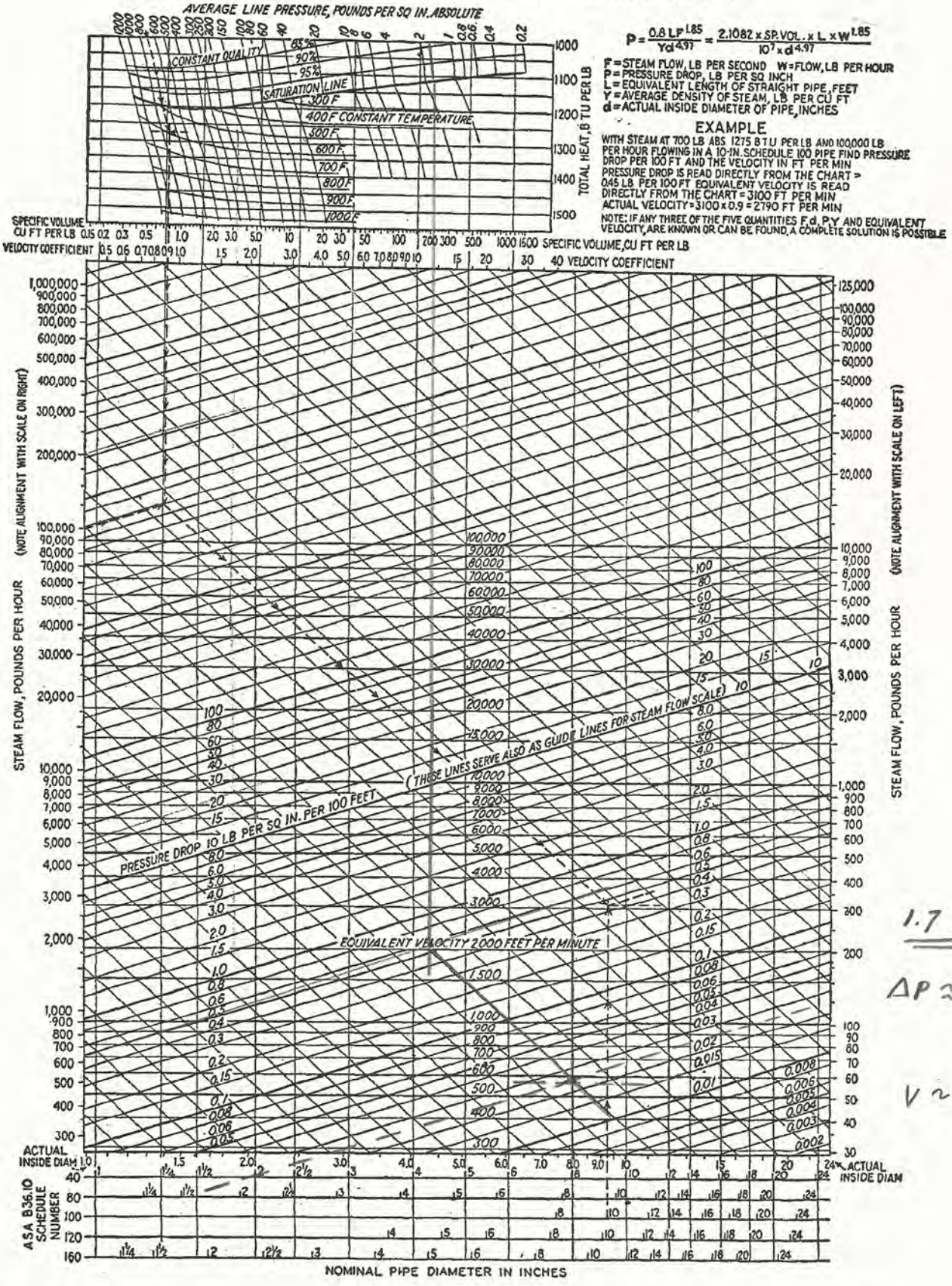
THEORETICAL EXTERNAL COLLAPSE PRESSURE: **$Pe5$ =** 44.8 Negative PSI

Pe5 = 0.807 * [E * tn^2 / L*r] * [(1/(1-μ^2))^3 * (tn^2 / r^2)]^0.25]

THIRD EFFECT OVRH LINE ΔP

FIG. 10-10

Pressure drop in steam pipes – by Fritzsche's formula



$$P = \frac{0.8\,LF^{1.85}}{Yd^{4.97}} = \frac{2.1082 \times SP.VOL. \times L \times W^{1.85}}{10^7 \times d^{4.97}}$$

F = STEAM FLOW, LB PER SECOND W = FLOW, LB PER HOUR
P = PRESSURE DROP, LB PER SQ INCH
L = EQUIVALENT LENGTH OF STRAIGHT PIPE, FEET
Y = AVERAGE DENSITY OF STEAM, LB PER CU FT
d = ACTUAL INSIDE DIAMETER OF PIPE, INCHES

EXAMPLE

WITH STEAM AT 700 LB ABS 1275 B T U PER LB AND 100,000 LB PER HOUR FLOWING IN A 10-IN. SCHEDULE 100 PIPE FIND PRESSURE DROP PER 100 FT AND THE VELOCITY IN FT PER MIN
PRESSURE DROP IS READ DIRECTLY FROM THE CHART = 045 LB PER 100 FT EQUIVALENT VELOCITY IS READ DIRECTLY FROM THE CHART = 3100 FT PER MIN
ACTUAL VELOCITY = 3100 × 0.9 = 2790 FT PER MIN

NOTE: IF ANY THREE OF THE FIVE QUANTITIES F, d, P, Y AND EQUIVALENT VELOCITY, ARE KNOWN OR CAN BE FOUND, A COMPLETE SOLUTION IS POSSIBLE

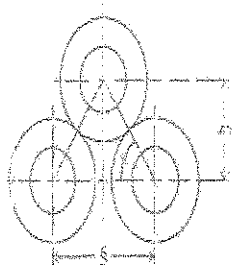
1.7 PSIA

ΔP ≈ 0.025 / 100'

V ~ 550 FPS

IV
INSTRUMENT SPECIFICATION SHEETS

AMERICAN INGENUITY LLC



AUDUBON SUGAR INSTITUTE EVAPORATOR SYSTEM
INSTRUMENT SPECIFICATION SHEETS

September 8, 2015

Revision 5

ITEM	INSTRUMENT. NO.	TYPE	LOCAL OR DCS	P&ID NO.
JUICE FLOW TO EVAPORATOR NO. 1	FT-1	VORTEX FLOWMETER	LOCAL	2
JUICE FLOW TO EVAPORATOR NO. 1	LV-C1-1	CONTROL VALVE	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA TUBE SIDE LEVEL CONTROL	LG-C1-1	ARMORED SIGHT GLASS	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA TUBE SIDE LEVEL CONTROL	LT-C1-1	DIFFERENTIAL PRESSURE	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA TUBE SIDE LEVEL CONTROL	LIC-C1-1	DCS INDICATION	DCS	2
STEAM FLOW TO EVAPORATOR NO. 1	FV-1	CONTROL VALVE	LOCAL	2
JUICE FLOW TO EVAPORATOR FV-1 SHUTOFF	FY-1B	SOLENOID VALVE	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA SHELL SIDE PRESSURE	PT-1-1	PRESSURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA SHELL SIDE PRESSURE	PI-1-1	DCS INDICATION	DCS	2
EVAPORATOR NO. 1 CALANDRIA SHELL SIDE TEMPERATURE	TT-1-1	TEMPERATURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 1 CALANDRIA SHELL SIDE TEMPERATURE	TI-1-1	DCS INDICATION	DCS	2
EVAPORATOR NO. 1 OVERHEAD PRESSURE INDICATION	PT-1-2	PRESSURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 1 OVERHEAD PRESSURE INDICATION	PI-1-2	DCS INDICATION	DCS	2
EVAPORATOR NO. 1 OVERHEAD TEMPERATURE INDICATION	TT-1-2	TEMPERATURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 1 OVERHEAD TEMPERATURE INDICATION	TI-1-2	DCS INDICATION	DCS	2
EVAPORATOR NO. 1 CONDENSATE TANK LEVEL INDICATION	LG-T1	MAGNETIC GAGE	LOCAL	2
EVAPORATOR NO. 1 CONDENSATE TANK LEVEL INDICATION	LT-T1	MAGNETORESTRICTIVE	LOCAL	2
EVAPORATOR NO. 1 CONDENSATE TANK LEVEL INDICATION/CONTROL	LIC-T1	DCS INDICATION/CONTROL	DCS	2
EVAPORATOR NO. 1 CONDENSATE TANK LEVEL CONTROL	LV-T1	CONTROL VALVE	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA TUBE SIDE LEVEL INDICATION	LG-C2-1	ARMORED SIGHT GLASS	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA TUBE SIDE LEVEL INDICATION	LT-C2-1	DIFFERENTIAL PRESSURE	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA TUBE SIDE LEVEL INDICATION	LIC-C2-1	DCS INDICATION/CONTROL	DCS	2
EVAPORATOR NO. 2 CALANDRIA SHELL SIDE PRESSURE INDICATION	PT-2-1	PRESSURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA SHELL SIDE PRESSURE INDICATION	PI-2-1	DCS INDICATION	DCS	2
EVAPORATOR NO. 2 CALANDRIA SHELL SIDE TEMPERATURE INDICATION	TT-2-1	TEMPERATURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA SHELL SIDE TEMPERATURE INDICATION	TI-2-1	DCS INDICATION	DCS	2
EVAPORATOR NO. 2 OVERHEAD PRESSURE INDICATION	PT-2-2	PRESSURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 2 OVERHEAD PRESSURE INDICATION	PI-2-2	DCS INDICATION	DCS	2
EVAPORATOR NO. 2 OVERHEAD TEMPERATURE INDICATION	TT-2-2	TEMPERATURE TRANSMITTER	LOCAL	2
EVAPORATOR NO. 2 OVERHEAD TEMPERATURE INDICATION	TI-2-2	DCS INDICATION	DCS	2
EVAPORATOR NO. 2 CONDENSATE TANK LEVEL INDICATION	LG-T2	MAGNETIC GAGE	LOCAL	2
EVAPORATOR NO. 2 CONDENSATE TANK LEVEL INDICATION	LT-T2	MAGNETORESTRICTIVE	LOCAL	2
EVAPORATOR NO. 2 CONDENSATE TANK LEVEL INDICATION/CONTROL	LIC-T2	DCS INDICATION/CONTROL	DCS	2
EVAPORATOR NO. 2 CONDENSATE TANK LEVEL INDICATION/CONTROL	LV-T2	CONTROL VALVE	LOCAL	2
EVAPORATOR NO. 3 CALANDRIA TUBE SIDE LEVEL CONTROL	LG-C3-1	ARMORED SIGHT GLASS	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA TUBE SIDE LEVEL CONTROL	LT-C3-1	DIFFERENTIAL PRESSURE	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA TUBE SIDE LEVEL CONTROL	LIC-C3-1	DCS INDICATION/CONTROL	DCS	3
EVAPORATOR NO. 3 CALANDRIA SHELL SIDE PRESSURE	PT-3-1	PRESSURE TRANSMITTER	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA SHELL SIDE PRESSURE	PI-3-1	DCS INDICATION	DCS	3
EVAPORATOR NO. 3 CALANDRIA SHELL SIDE TEMPERATURE	TT-3-1	TEMPERATURE TRANSMITTER	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA SHELL SIDE TEMPERATURE	TI-3-1	DCS INDICATION	DCS	3
EVAPORATOR NO. 3 OVERHEAD PRESSURE CONTROL	PT-3-2	PRESSURE TRANSMITTER	LOCAL	3
EVAPORATOR NO. 3 OVERHEAD PRESSURE CONTROL	PIC-3-2	DCS INDICATION	DCS	3
EVAPORATOR NO. 3 OVERHEAD TEMPERATURE INDICATION	TT-3-2	TEMPERATURE TRANSMITTER	LOCAL	3
EVAPORATOR NO. 3 OVERHEAD TEMPERATURE INDICATION	TI-3-2	DCS INDICATION	DCS	3
EVAPORATOR NO. 3 CONDENSATE TANK LEVEL CONTROL	LG-T3	MAGNETIC GAGE	LOCAL	3
EVAPORATOR NO. 3 CONDENSATE TANK LEVEL CONTROL	LT-T3	MAGNETORESTRICTIVE	LOCAL	3
EVAPORATOR NO. 3 CONDENSATE TANK LEVEL CONTROL	LIC-T3	DCS INDICATION/CONTROL	DCS	3
EVAPORATOR NO. 1 CALANDRIA PRESSURE INDICATOR	PI-1-1	PRESSURE GAGE	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA PRESSURE/VACUUM INDICATOR	PI-2-1	PRESSURE/VACUUM GAGE	LOCAL	2
EVAPORATOR NO. 3 CALANDRIA VACUUM INDICATOR	PI-3-1	VACUUM GAGE	LOCAL	3

DESIGN DETAIL NO. 9A

INSTRUMENT LIST - PAGE 1

REV. 2 - 9/4/15 | 2

ITEM	INSTRUMENT. NO.	TYPE	LOCAL OR DCS	P&ID NO.
EVAPORATOR NO. 1 CALANDRIA TEMPERATURE INDICATOR	TI-1-1	THERMOWELL/TEMP. IND.	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA TEMPERATURE INDICATOR	T1-2-1	THERMOWELL/TEMP. IND.	LOCAL	2
EVAPORATOR NO. 3 CALANDRIA TEMPERATURE INDICATOR	TI-3-1	THERMOWELL/TEMP. IND.	LOCAL	3
EVAPORATOR NO. 1 OVERHEAD PRESSURE INDICATOR	PI-1-2	PRESSURE GAGE	LOCAL	2
EVAPORATOR NO. 2 OVERHEAD PRESSURE/VACUUM INDICATOR	PI-2-2	PRESSURE/VACUUM GAGE	LOCAL	2
EVAPORATOR NO. 3 OVERHEAD VACUUM INDICATOR	PI-3-2	VACUUM GAGE	LOCAL	3
EVAPORATOR NO. 1 OVERHEAD TEMPERATURE INDICATOR	TI-1-2	THERMOWELL/TEMP. IND.	LOCAL	2
EVAPORATOR NO. 2 OVERHEAD TEMPERATURE INDICATOR	TI-2-2	THERMOWELL/TEMP. IND.	LOCAL	2
EVAPORATOR NO. 3 OVERHEAD TEMPERATURE INDICATOR	TI-3-2	THERMOWELL/TEMP. IND.	LOCAL	3
P-2 DISCHARGE PRESSURE INDICATOR	PI-2	PRESSURE GAGE	LOCAL	3
P-3 DISCHARGE PRESSURE INDICATOR	PI-3	PRESSURE GAGE	LOCAL	3
FINISHED JUICE BRIX CONTROL	BV-2	THREE-WAY BALL VALVE	LOCAL	3
FINISHED JUICE BRIX CONTROL	BI-2	DCS INDICATION	DCS	3
EVAPORTAOR NO. 2 BRIX INDICATION	BT-1	SEE K-PATENTS QUOTE 7/8/15	LOCAL	3
FINISHED JUICE BRIX CONTROL	BT-2	SEE K-PATENTS QUOTE 7/8/15	LOCAL	3
RELIEF VALVE FOR P-2 DISCHARGE	RV-2	RELIEF VALVE	LOCAL	3
RELIEF VALVE FOR P-3 DISCHARGE	RV-3	RELIEF VALVE	LOCAL	3
RELIEF VALVE FOR P-2 DISCHARGE	RV-2	RELIEF VALVE	LOCAL	3
STEAM CONDENSATE PUMP P-4 DISCHARGE PRESSURE	PI-4	PRESSURE GAGE	LOCAL	3
VACUUM PUMP-5 SUCTION PRESSURE	PI-5	VACUUM GAGE	LOCAL	3
VACUUM CONDENSER LIQUID OUTLET LEVEL CONTROL	LG-4	MAGNETIC LEVEL GAUGE	LOCAL	3
VACUUM CONDENSER LIQUID OUTLET LEVEL CONTROL	LT-4	MAGNETORESTRICTIVE	LOCAL	3
CONDENSER E-1 CW SUPPLY PRESSURE	PI-6	PRESSURE GAGE	LOCAL	3
CONDENSER E-1 CW RETURN PRESSURE	PI-7	PRESSURE GAGE	LOCAL	3
CONDENSER E-1 CW RETURN TEMPERATURE	TI-7	THERMOWELL/TEMP. IND.	LOCAL	3
RELEF VALVE FOR P-4 DISCHARGE	RV-4	RELIEF VALVE	LOCAL	3
EVAP NO. 1 TO EVAP. NO. 2 CONTROL VALVE	LV-C2-1	CONTROL VALVE	LOCAL	2
EVAPORATOR NO. 2 CALANDRIA LEVEL CONTROL	LIC-C2-1	DCS INDICATION	DCS	2
RELIEF VALVE FOR P-1	RV-1	RELIEF VALVE	LOCAL	2
EVAP NO. 2 TO EVAP NO. 3 CONTROL VALVE	LV-C3-1	CONTROL VALVE	LOCAL	3
EVAPORATOR NO. 3 CALANDRIA LEVEL CONTROL	LIC-C3-1	DCS INDICATION	DCS	3
VACUUM PUMP P-5 SPEED CONTROL	SIC-5	DCS INDICATION	DCS	3
SYRUP PUMP P-2 SPEED CONTROL	SIC-2	DCS INDICATION	DCS	3
CONDENSATE PUMP P-3 SPEED CONTROL	SIC-3	DCS INDICATION	DCS	3
CONDENSATE PUMP P-4 SPEED CONTROL	SIC-4	DCS INDICATION	DCS	3
SYRUP TEMPERATURE UPSTREAM COOLER	TI-8	THERMOWELL/TEMP. IND.	LOCAL	4
SYRUP TEMPERATURE DOWNSTREAM COOLER	TI-9	THERMOWELL/TEMP. IND.	LOCAL	4
REFRACTOMETER STEAM WASH VALVE	XV-10A/B	ON-OFF VALVE	LOCAL	SEE K-PATENTS DIAGRAM 1
STEAM PRESSURE REGULATOR FOR STEAM WASH	PV-11A/B	PRESSURE REGULATOR	LOCAL	SEE K-PATENTS DIAGRAM 1

ALL CONTROL VALVES REQUIRE POSITIONERS
ALL INSTRUMENTS MUST HAVE STAINLESS STEEL TAGS ATTACHED.

DESIGN DETAIL NO. 9B

INSTRUMENT LIST - PAGE 2

REV. 5 - 9/13/15 5

AMERICAN INGENUITY

STEAM FLOW TO EVAPORATOR NO. 1 – VORTEX FLOWMETER - FT-1

Fluid	= Saturated Steam	URV	=	*
Line Size	= 4 in. S40 C.S.	LRV	=	*
Line Pressure	= 10.3 psig	C_{17}	=	*
Operating Temp.	= 240 Deg F	Density	=	0.061 lb/cu-ft
Normal Flowrate	= 562 lbs/hr	Vortex Frequency	=	*
Min./Max Flowrate	= 450/675 lbs/hr	Viscosity	=	0.0128 cp
K-Factor	= *			
M	= *			

Required Connections are Class 150 RF flanges. Type is reducer style. Metallurgy is carbon steel. Aluminum conduit entry is ok. Standard temperature range is ok. Output is 4-20 a.

Data by vendor *

ISA S20.50, Rev. 1

CONTROL VALVE DATA SHEET

Second Printing

PROJECT
UNIT
P.O.
ITEM
CONTRACT
*MFR. SERIAL

DATA SHEET 1 of 1
SPEC
TAG LV-C1-1
DWG
SERVICE EVAPORATOR NO.1 CALANDRIA LEVEL

Crit Press PC

Fluid SUGAR CANE JUICE

SERVICE CONDITIONS

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	GPM	7	4	1	—
Inlet Pressure	PSIG		10.3		
Outlet Pressure	PSIG		4.2		
Inlet Temperature	°F		235		
Spec Wt / Spec Grav / Mol Wt			1.04		—
Viscosity / Spec Heats Ratio					—
Vapor Pressure P_v					—
*Required C_v					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	/	/	/	—

LINE

Pipe Line Size & Schedule: In 1" S40S; Out 1" S40S
Pipe Line Insulation NONE

VALVE BODY/BONNET

*Type
*Size ANSI Class 150
Max Press/Temp 80 PSIG / 350°F
*Mfr & Model
*Body/Bonnet Matl 304 SS
*Liner Material/ID
End Connection: In RF FLG. Out RF FLG.
Flg Face Finish
End Ext/Matl
*Flow Direction
*Type of Bonnet
Lub & Iso Valve Lube
*Packing Material
*Packing Type

TRIM

*Type
*Size Rated Travel
*Characteristic
*Balanced/Unbalanced
*Rated C_v F_L X_T
*Plug/Ball/Disk Material
*Seat Material
*Cage/Guide Material
*Stem Material

SPECIALS/ACCESSORIES

NEC Class Group Div
UNCLASSIFIED

ACTUATOR

*Type
*Mfr & Model
*Size Eff Area
On/Off Modulating
Spring Action Open/Close
*Max Allowable Pressure
*Min Required Pressure
Available Air Supply Pressure:
Max Min
*Bench Range /
Actuator Orientation
Handwheel Type
Air Failure Valve Set at

Input Signal

POSITIONER

*Type
*Mfr & Model
*On Incr Signal Output Incr/Decr
Gauges By-pass
*Cam Characteristic

SWITCHES

Type Quantity
*Mfr & Model
Contacts/Rating
Actuation Points

AIR SET

*Mfr & Model
*Set Pressure
Filter Gauge

TESTS

*Hydro Pressure
ANSI/FCI Leakage Class V

Rev	Date	Revision	Orig	App

*Information supplied by manufacturer unless already specified

ISA FORM S20.50, Rev.1

GAGE GLASSES and COCKS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. LG-C1-1 | REV. 0

CONTRACT | DATE

REQ. - P.O.

BY BL | CHK'D | APPR.

1. Gage Column ■ Cocks □
   Assembled with Nipples ■ Unassembled □

GAGE GLASSES

2. Type: Reflex ■ Transparent □ Tubular □
   Large Chamber □ Weld Pad □
3. Conn: Size and Type SEE DESIGN DETAIL 13
   Top & Bot. ■ Side □ Back □
   Vent 3/4" Drain 3/4"
4. Material CARBON STEEL
5. Min. Rating ANSI CLASS 150 psig at — °F
6. Options: Illuminator □ Mica Shield □
   Internal Tube □ External Jkt □
   Non-Frost □ Ext. Length
   Calib. Scale □ Other
7. Manufacturer & Model

GAGE COCKS NONE

8. Type: Offset □ Straight □
9. Conn: Vessel Gage Vent/Drain
10. Material: Body Trim
11. Min. Rating: psig at °F
12. Construction:
13. Type of Conn: Vessel
    Gage
14. Bonnet
15. Options: Ball Checks □ Renewable Seats □
    Other FULL PORT BALL VALVES 3/4" BY OTHERS
16. Manufacturer & Model

Rev.	Quan.	Tag No.	Visible Glass	℄ Conn.	Model No.	Operating Press.	Operating Temp.	Service	
0	1	LG-C1-1				50	300	EVAP NO. 1 TUBE SIDE	

Notes:

ISA FORM S20.28

	DIFFERENTIAL PRESSURE INSTRUMENTS	SHEET 1 OF 1	
		SPEC. NO. LT-C1-1	REV. 0
	NO / BY / DATE / REVISION	CONTRACT	DATE 9-14-16
		REQ. - P.O.	
		BY BL / CHK'D	APPR.

	1	Tag No. LT-C1-1	Service EVAPORATOR NO. 1 TUBE SIDE LEVEL
GENERAL	2	Function	Record ☐ Indicate ☐ Control ■ Blind ☐ Trans ☐ Integ ☐ Other
	3	Case	MFR STD ■ Nom Size ___ Color: MFR STD ■ Other
	4	Mounting	Flush ■ Surface ☐ Yoke ☐ Other 2" FLANGE
	5	Enclosure Class	General Purpose ■ Weather proof ☐ Explosion proof ☐ Class ___ For use in Intrinsically Safe System ☐ Other
	6	Power Supply	117V 60 Hz ■ Other ac ___ dc ☐ Volts
	7	Chart	12 in. Circ. ☐ Other ___ Range ___ No.
	8	Chart Drive	24 hr Other ___ Elec. ☐ Spring ☐ Other
	9	Scale	Type ___ Range: 1 ___ 2 ___ 3
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ___ For Receiver, See Spec Sheet
CONTROLLER	11	Control Modes	P=Prop (Gain), I=Integral (Auto Reset), D=Derivative (Rate) Sub: s=Slow, f=Fast If☐ Df ☐ P ☐ PI ☐ PD ☐ PID ☐ Is ☐ Ds ☐ Other
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ■ Other
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other
	15	Manual Reg.	None ☐ MFR STD ■ Other
	16	Output	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other
UNIT	17	Service	Flow ☐ Level ■ Diff. Pressure ☐ Other S.G. = 1.06
	18	Element Type	Diaphragm ■ Bellows ☐ Mercury ☐ Other
	19	Material	Body MFG STD Element 316 SS
	20	Rating	Overrange ___ Body Rating ___ psig
	21	Diff. Range	Fixed ☐ Adj. Range ___ Set At
	22		Elevation ___ Suppression
	23	Process Data	Fluid SUGAR JUICE Max Temp. 300 °F Max. Press. 50 PSIG
	24	Process Conn.	½ in. NPT ☐ Other 2" RF FLG.
	25	Alarm Switches	Quantity ___ Form ___ Rating
	26	Function	Meas. Var. ☐ Deviation ☐ Contacts To ___ on Inc. Meas.
	27	Options	Pressure Element ☐ Range ___ Material ___ Temp. Element ☐ Range ___ Type ___ Filt Reg. ☐ Sup. Gage ☐ Output Gage ☐ ___ Charts Valve Manifold ___ Cond. Pots ☐ Adj. Damp ☐ Integral Sq. Rt. Ext. ☐ Integrator ___ Other
	28	MFR & Model No.	DIAPHRAGM DP SEAL SYSTEM (TUNED-SYSTEM)

Notes: 1. COORDINATE RANGE WITH VISIBLE LENGTH OF LEVEL GAUGE.

ISA Form S20.20a

ISA S20.50, Rev. 1 **CONTROL VALVE DATA SHEET** Second Printing

PROJECT
UNIT
P.O.
ITEM
CONTRACT
*MFR. SERIAL

DATA SHEET 1 of 1
SPEC
TAG FV-1
DWG
SERVICE STEAM FLOW TO EVAPORATOR NO. 1

1 Fluid STEAM — Crit Press PC

SERVICE CONDITIONS

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	LBS/HR	843	562	281	—
Inlet Pressure	PSIG				
Outlet Pressure	PSIG				
Inlet Temperature	°F		240		
Spec Wt/Spec Grav/Mol Wt					—
Viscosity/Spec Heats Ratio					—
Vapor Pressure P_V					—
*Required C_V					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	/	/	/	—

LINE
Pipe Line Size & Schedule: In 4" S40; Out 4" S40
Pipe Line Insulation: 0.5" AEROGEL

VALVE BODY/BONNET
*Type
*Size ANSI Class 150
Max Press/Temp 50 PSIG/350 °F
*Mfr & Model
*Body/Bonnet Matl C.S.
*Liner Material/ID
End Connection: In RF FLG.; Out RF FLG.
Flg Face Finish
End Ext/Matl
*Flow Direction
*Type of Bonnet
Lub & Iso Valve Lube
*Packing Material
*Packing Type

TRIM
*Type
*Size Rated Travel
*Characteristic
*Balanced/Unbalanced
*Rated C_V F_L X_T
*Plug/Ball/Disk Material
*Seat Material
*Cage/Guide Material
*Stem Material

SPECIALS/ACCESSORIES
NEC Class Group Div
UNCLASSIFIED

ACTUATOR
*Type
*Mfr & Model
*Size Eff Area
On/Off Modulating
Spring Action Open/Close
*Max Allowable Pressure
*Min Required Pressure
Available Air Supply Pressure:
Max Min
*Bench Range /
Actuator Orientation
Handwheel Type
Air Failure Valve Set at

POSITIONER
Input Signal
*Type
*Mfr & Model
*On Incr Signal Output Incr/Decr
Gauges By-pass
*Cam Characteristic

SWITCHES
Type Quantity
*Mfr & Model
Contacts/Rating
Actuation Points

AIR SET
*Mfr & Model
*Set Pressure
Filter Gauge

TESTS
*Hydro Pressure
ANSI/FCI Leakage Class V

Rev	Date	Revision	Orig	App

*Information supplied by manufacturer unless already specified

ISA FORM S20.50, Rev.1

SOLENOID VALVES		SHEET 1 OF 1	
		SPEC. NO. FY-1B	REV. D
		CONTRACT	DATE 8-17-15
		REQ. P.O.	
		BY BL CHK'D	APPR.

NO	BY	DATE	REVISION

	No.	Item				
	1.	Tag Number	FY-1B			
	2.	Service	FV-1 SHUTOFF			
	3.	Line No./Vessel No.				
	4.	Quantity	1			
VALVE BODY	5.	Type	AC			
	6.	Size – Body/Port	1/2"			
	7.	Rating & Type Conn.				
	8.	Material – Body	BRASS			
	9.	Material – Seat				
	10.	Material – Diaphragm				
	11.	Operation Direct/Pilot				
	12.	Packless or Type Packed	PACKLESS			
	13.	Manual Re-Set				
	14.	Manual Operator	YES			
	15.					
	16.					
WHEN DE-ENERGIZED	17.	2-Way Valve Opens/Close	YES			
	18.	3-Way				
	19.	Vent Port Opens/Close				
	20.	Press Port Opens/Close				
	21.	4-Way				
	22.	Press to Cyl. 1/Cyl 2				
	23.	Exh. from Cyl 1/Cyl 2				
	24.					
	25.					
SOLENOID	26.	Enclosure				
	27.	Voltage/Hz	120/3/60			
	28.	Style of Coil				
	29.	Single or Double Coil	SINGLE			
	30.					
	31.					
SERVICE CONDITIONS	32.	Fluid	AIR			
	33.	Qty. Maximum				
	34.	Oper. Diff. Min/Max				
	35.	Allow. Diff. Min/Max				
	36.	Temp. Norm/Max.	/ 90°F			
	37.	Oper. sp. gr.				
	38.	Oper. Viscosity				
	39.	Required C_V				
	40.	Valve C_V				
	41.					
	42.					
	43.					
	44.					
	45.	Manufacturer				
	46.	Model Number				

Notes:

ISA Form S20.55

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

LG-CI-2

Magtech Level Indicator

Magtech MLI Quick Data Sheet

★ Default ○ Select only one of the items provided ☐ One or more of the listed items can be selected

General information

Company: AUDUBON SUGAR INSTITUTE Date: 5-31-15

Contact Name: BRUCE LACOUR Phone No.: 225-933-4450

Email: LACOURB1@ATT.NET RFQ No.:

Customer-specific design criteria

Are there any existing specifications, including weld procedures, general piping specifications, or an approved manufacturer specification, to which this MLI must comply? ○ Yes ○ No

If so, please list or provide: _____

Other Special Request (describe or attach sketch): _____

Process conditions

Pressure	**Min:** FV	**Oper:** 10.3	**Max:** 50	**Units of Measurement:** PSI
Temperature	**Min:** 20	**Oper:** 235	**Max:** 350	**Units of Measurement:** DEG F

Description of Media STEAM CONDENSATE

Specific Gravity (SG) **Min:** 0.93 **Oper:** 0.95

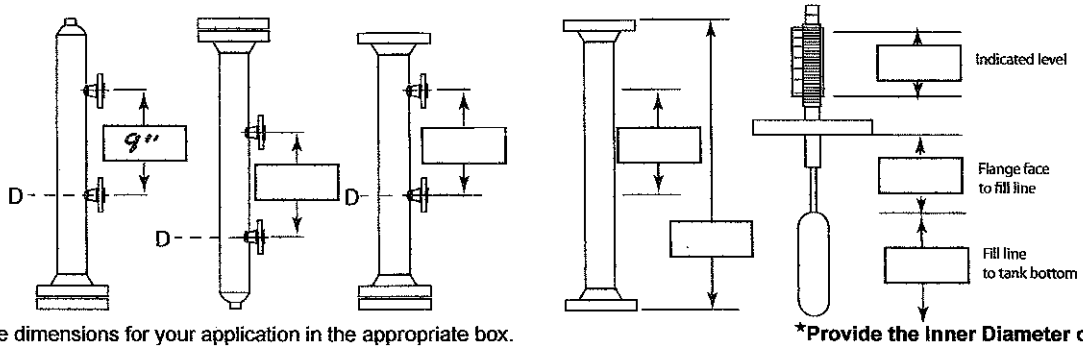
Is this an interface? Yes ☐ No ■

If Yes **Lower Fluid:** **Min SG / Max SG** ___/___ **Upper Fluid: Min SG / Max SG** ___/___

Does Media Boil or Flash? Yes ■ No ☐

Mounting style

Select Style: ●★ ○ ○ ○ ○



Enter the dimensions for your application in the appropriate box.
If your configuration is not shown, mark up an existing diagram or attach a sketch.

*Provide the inner Diameter of the nozzle.

Material of construction	Process connection type	
● 316/316L SS★ ○ 316/316L SS Pipe with Carbon Steel Flanges ○ Other Non-Magnetic Material: _____	○ None ● RFSO ○ RFWN ○ RFLJ ○ RTJWN ○ XW Option - weld to a primary chamber housing guided wave radar	○ NPTM Thread ○ NPTF Thread ○ Socket Weld ○ Plain End Nipple ○ Other: _____

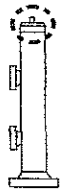
Magtech Level Indicator

LG-CJ-2

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

Rating	Process connection size (inch)
● 150# ○ 300# ○ 600#	○ 1/2 ○ 1 1/2 ○ 3/4
○ 900# ○ 1500# ○ Other: ____	○ 1 ○ 1 1/4 ○ 2 ○ Other: ____

Vent



☐ NPT ■ SW X
● 1/2" THRD OPEN END WITH PLUG
○ 3/4"
○ 1"
☐ Other: ____

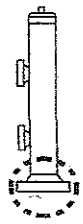
■ Valve (Optional)

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: ____

Drain 316 SS BLD FLG



☐ NPT ■ SW X
● 1/2" THRD OPEN END WITH PLUG
○ 3/4"
○ 1"
☐ Other: ____

■ Valve (Optional)

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: 800

Indicator

○ None
○ Flippers with Scale*
○ Follower with Scale
● Polycarbonate Indicator
○ Standard colors: Red and silver
○ Other color (specify): ____

Zero Offset from datum, if Any: ____

Select scale orientation: Top view (Indicator facing user)


○ Left Hand


● Right Hand


○ Standard*

Units on indicator scale

○ Feet & Inches*
○ %
○ Inches only
○ Metric
○ Other. Please specify: ____

Options & accessories

☐ Welded Support Clip
☐ Adjustable Support Clip
☐ Level Switches (specify number)(1)
☐ Magnetostrictive Transmitter(1)
☐ Reed Type Transmitter(1)
☐ Insulation Blanket
☐ Steam Tracing with Blanket
☐ Electric Heat Tracing with Blanket
☐ Insulation with Hard Shell-Cryogenic

Optional tests, inspections & quality certifications

☐ PMI
☐ Hydrostatic Test
☐ Dye Pen Branch Connections
☐ X-Ray
☐ Post-weld Heat Treatment
○ NACE MR0103
○ NACE MR0175
☐ ASME B31.1
☐ ASME B31.3
☐ Full Penetration Welds
☐ Material Traceability Report (MTR)

(1) Provide additional requirements.

Emerson Process Management
Rosemount Division
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-999-9307
T (International) (952) 906-8888
F (952) 949-8889

www.rosemount.com

EMERSON.
Process Management

PRESSURE INSTRUMENTS

NO	BY	DATE	REVISION

SHEET 1 OF 1

SPEC. NO.	REV.
PT-1-1	0
CONTRACT	DATE 5-30-15
REQ. P.O.	
BY BL / CHK'D / APPR.	

	1	Tag No. PT-1-1	Service EVAPORATOR NO.1 CALANDRIA PRESSURE
GENERAL	2	Function	Record ☐ Indicate ☐ Control ☐ Blind ☐ Trans ■ Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ■ Other ____
	4	Mounting	Flush ■ Surface ☐ Yoke ☐ Other ____
	5	Enclosure Class	General Purpose ■ Weather proof ☐ Explosion proof ☐ Class ____ For Use In Intrin. Safe System ☐ Other ____
	6	Power Supply	117V 60Hz ■ Other ac ____ dc ____ Volts
	7	Chart	____ Strip ☐ ____ Roll ☐ ____ Fold ☐ Circular ____ Time Marks ____ Range ____ Number ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type ____ Range 1 ____ 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____ For Receiver See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain) I=Integral (Auto-Reset) D=Derivative (Rate) Sub: s=Slow f=Fast P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ I_S ☐ D_S ☐ Other ____
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other ____
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other ____
	15	Manual Reg.	None ☐ MFR STD ☐ Other ____
	16	Output	4-20mA ☒ 10-50mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____
ELEMENT	17	Service	Gage Press. ☐ Vacuum ☐ Absolute ■ Compound ☐
	18	Element Type	Diaphragm ■ Helix ☐ Bourdon ☐ Bellows ☐ Other ____
	19	Material	316 SS ■ Ber. Copper ☐ Other ____
	20	Range	Fixed ☐ Adj. Range ____ Set at ____ Overrange protection to ____
	21	Process Data	Press: Normal 10.3 PSIG Max ____ Element Range 0-15 PSIG
	22	Process Conn.	¼ in. NPT ☐ ½ in. NPT ☐ Other 2" FLG Location: Bottom ☐ Back ☐ Other ____
	23	Alarm Switches	Quantity ____ Form ____ Rating ____
	24	Function	Press ☐ Deviation ☐ Contacts To ____ on Inc Press.
OPTIONS	25	Options	Filt-Reg. ☐ Sup Gage ☐ Output Gage ☐ ____ Charts Diaph Seal ☐ Type ____ Diaph ____ Bot Bowl ____ Conn ____ Capillary: Length ____ Mtl. ____ Other ____
	26	MFR & Model No.	

Notes:

ISA Form S20.40a

RESISTANCE TEMPERATURE SENSORS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TT-1-1 REV. D

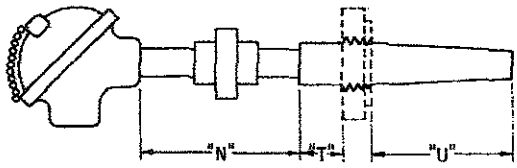
CONTRACT DATE 3-31-15

REQ. - P.O.

BY BL CHK'D APPR.

1. Complete Assembly Other TRANSMITTER
HEAD
2. Screwed Cover ■ Other
3. Explosion Proof □ Class
4. Material Cond. Conn.
5. Nipple Size Dim. "N" Union □
ELEMENT
6. Platinum ■ Nickel □ Other
7. Ice Point Resistance
8. Temperature Range 20 TO 350°F
9. Leads: STD ■ Potted □ Herm. Sealed □
10. Sheath Material O.D.

11. Mounting Thread
12. Connection: 2-Wire ■ 3-Wire □ 4-Wire □
Lead Wires □ Receptacle □ Bayonet Lock □
Other
WELL OR TUBE
13. Material SS
14. Construction: Tapered ■ Straight □
Drilled ■ Built-Up □ Closed-End □
Tube
15. Dim: MFR STD ■ O.D. I.D.
16. Internal Thread
17. Process Connection 1" NPT



Rev.	Tag No.	Process Conn.	Well Dim. U	Well Dim. T	Element Length	Single or Dual	Service	Notes
0	TT-1-1	1" NPT	6"	1"		SINGLE	EVAP. NO. 1 CALANDRIA	

Notes:

ISA FORM S20.13a

PRESSURE INSTRUMENTS

NO	BY	DATE	REVISION

SHEET 1 OF 1

SPEC. NO. PT-1-2 | REV. 0

CONTRACT | DATE 5-30-15

REQ. P.O.

BY BL | CHK'D | APPR.

	1	Tag No. PT-1-2	Service EVAPORATOR NO.1 OVERHEAD PRESSURE
GENERAL	2	Function	Record ☐ Indicate ☐ Control ☐ Blind ☐ Trans ■ Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ☐ Other ____
	4	Mounting	Flush ■ Surface ☐ Yoke ☐ Other ____
	5	Enclosure Class	General Purpose ☐ Weather proof ☐ Explosion proof ☐ Class ____
			For Use In Intrin. Safe System ☐ Other ____
	6	Power Supply	117V 60Hz ■ Other ac ____ dc ____ Volts
	7	Chart	____ Strip ☐ ____ Roll ☐ ____ Fold ☐ Circular ____ Time Marks ____ Range ____ Number ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type ____ Range 1 ____ 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____ For Receiver See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain) I=Integral (Auto-Reset) D=Derivative (Rate) Sub: s=Slow f=Fast P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ Is ☐ Ds ☐ Other ____
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other ____
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other ____
	15	Manual Reg.	None ☐ MFR STD ☐ Other ____
	16	Output	4-20mA ☐ 10-50mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____
ELEMENT	17	Service	Gage Press. ☐ Vacuum ☐ Absolute ■ Compound ■
	18	Element Type	Diaphragm ■ Helix ☐ Bourdon ☐ Bellows ☐ Other ____
	19	Material	316 SS ■ Ber. Copper ☐ Other ____
	20	Range	Fixed ☐ Adj. Range ____ Set at ____ Overrange protection to ____
	21	Process Data	Press: Normal 4.2 PSIG Max ____ Element Range 30 IN Hg / 0-15" PSIG
	22	Process Conn.	¼ in. NPT ☐ ½ in. NPT ☐ Other 2" FLG. Location: Bottom ☐ Back ☐ Other ____
	23	Alarm Switches	Quantity ____ Form ____ Rating ____
	24	Function	Press ☐ Deviation ☐ Contacts To ____ on Inc Press.
OPTIONS	25	Options	Filt-Reg. ☐ Sup Gage ☐ Output Gage ☐ ____ Charts Diaph Seal ☐ Type ____ Diaph ____ Bot Bowl ____ Conn ____ Capillary: Length ____ Mtl. ____ Other ____
	26	MFR & Model No.	

Notes:

ISA Form S20.40a

RESISTANCE TEMPERATURE SENSORS

NO	BY	DATE	REVISION

SHEET 1 OF 1

SPEC. NO. 7T-1-2 | REV. 0

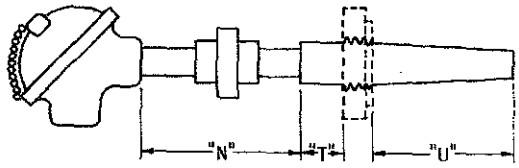
CONTRACT | DATE 5-31-15

REQ. · P.O.

BY BL | CHK'D | APPR.

1. Complete Assembly Other TRANSMITTER
HEAD
2. Screwed Cover ■ Other
3. Explosion Proof □ Class
4. Material Cond. Conn.
5. Nipple Size Dim. "N" Union □
ELEMENT
6. Platinum ■ Nickel □ Other
7. Ice Point Resistance
8. Temperature Range 2070 350°F
9. Leads: STD ■ Potted □ Herm. Sealed □
10. Sheath Material O.D.

11. Mounting Thread
12. Connection: 2-Wire ■ 3-Wire □ 4-Wire □
Lead Wires □ Receptacle □ Bayonet Lock □
Other
WELL OR TUBE
13. Material SS
14. Construction: Tapered □ Straight □
Drilled ■ Built-Up □ Closed-End □
Tube
15. Dim: MFR STD ■ O.D. I.D.
16. Internal Thread
17. Process Connection 1" NPT



Rev.	Tag No.	Process Conn.	Well Dim. U	Well Dim. T	Element Length	Single or Dual	Service	Notes
0	TT-1-2	1" NPT	6"	1"		SINGLE	EVAP. NO.1 DUPH.	

Notes:

ISA FORM S20.13a

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

LG-T1

Magtech Level Indicator

Magtech MLI Quick Data Sheet

★ Default ○ Select only one of the items provided ☐ One or more of the listed items can be selected

General information

Company: AUDUBON SUGAR INSTITUTE Date: 5-31-15

Contact Name: BRUCE LACOUR Phone No.: 225-933-4458

Email: lacourb1@att.net RFQ No.:

Customer-specific design criteria

Are there any existing specifications, including weld procedures, general piping specifications, or an approved manufacturer specification, to which this MLI must comply? ○ Yes ○ No

If so, please list or provide: _____

Other Special Request (describe or attach sketch): _____

Process conditions

Pressure	**Min:** FV	**Oper:** 10.0	**Max:** 50	**Units of Measurement:** PSI
Temperature	**Min:** 20	**Oper:** 239	**Max:** 350	**Units of Measurement:** DEG F

Description of Media STEAM CONDENSATE

Specific Gravity (SG) **Min:** 0.93 **Oper:** 0.95

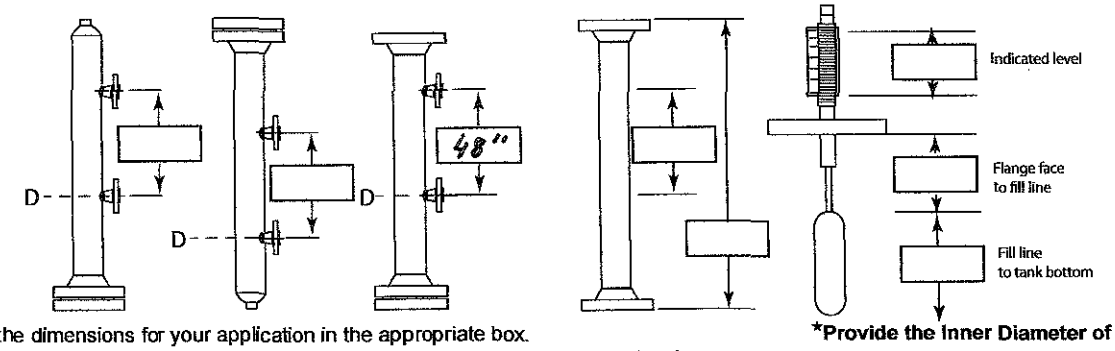
Is this an interface? Yes ☐ No ■

If Yes **Lower Fluid:** **Min SG / Max SG** ___/___ **Upper Fluid: Min SG / Max SG** ___/___

Does Media Boil or Flash? Yes ■ No ☐

Mounting style

Select Style: ○* ○ ○ ○ ○



Enter the dimensions for your application in the appropriate box.
If your configuration is not shown, mark up an existing diagram or attach a sketch.

*Provide the Inner Diameter of the nozzle.

Material of construction	Process connection type	
■ 316/316L SS*	○ None	○ NPTM Thread
○ 316/316L SS Pipe with Carbon Steel Flanges	■ RFSO	○ NPTF Thread
○ Other Non-Magnetic Material: _____	○ RFWN	○ Socket Weld
	○ RFLJ	○ Plain End Nipple
	○ RTJWN	○ Other: _____
	○ XW Option - weld to a primary chamber housing guided wave radar	

LG-T1

Magtech Level Indicator

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

Rating	Process connection size (inch)
● 150# ○ 300# ○ 600#	○ 1/2 ○ 1 1/2 ● 3/4
○ 900# ○ 1500# ○ Other: ____	○ 1 ○ 1 1/4 ○ 2 ○ Other: ____

Vent 316 SS BLD FG

☐ NPT ■ SW X
○ 1/2"
● 3/4" THRD OPEN END WITH PLUG
○ 1"
☐ Other: ____

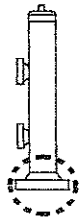
■ **Valve (Optional)**

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: 800

Drain 316 SS BLD FIG



☐ NPT ■ SW X
○ 1/2"
● 3/4" THRD OPEN END WITH PLUG
○ 1"
☐ Other: ____

■ **Valve (Optional)**

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: 800

Indicator

○ None
○ Flippers with Scale*
○ Follower with Scale
● Polycarbonate Indicator
○ Standard colors: Red and silver
○ Other color (specify): ____

Zero Offset from datum, if Any: ____

Select scale orientation: Top view (Indicator facing user)

○ Left Hand

● Right Hand

○ Standard*

Units on indicator scale

○ Feet & Inches*
○ %
○ Inches only
○ Metric
○ Other. Please specify: ____

Options & accessories

☐ Welded Support Clip
☐ Adjustable Support Clip
☐ Level Switches (specify number)(1)
☐ Magnetostrictive Transmitter(1)
☐ Reed Type Transmitter(1)
☐ Insulation Blanket
☐ Steam Tracing with Blanket
☐ Electric Heat Tracing with Blanket
☐ Insulation with Hard Shell-Cryogenic

Optional tests, inspections & quality certifications

☐ PMI
☐ Hydrostatic Test
☐ Dye Pen Branch Connections
☐ X-Ray
☐ Post-weld Heat Treatment
○ NACE MR0103
○ NACE MR0175
☐ ASME B31.1
☐ ASME B31.3
☐ Full Penetration Welds
☐ Material Traceability Report (MTR)

(1) Provide additional requirements.

Emerson Process Management
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Chanhassen, MN 55317 USA
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F (952) 949-8889

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Process Management

ISA S20.50, Rev. 1 **CONTROL VALVE DATA SHEET** Second Printing

PROJECT
UNIT
P.O.
ITEM
CONTRACT
*MFR. SERIAL

DATA SHEET 1 of 1
SPEC
TAG LV-T1
DWG
SERVICE T1 LEVEL CONTROL

1 Fluid STEAM CONDENSATE — Crit Press PC

SERVICE CONDITIONS

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
2 Flow Rate		1.4	1.2	1.0	—
3 Inlet Pressure			10.0		
4 Outlet Pressure			4.2		
5 Inlet Temperature			239		
6 Spec Wt/Spec Grav/Mol Wt			0.95		—
7 Viscosity/Spec Heats Ratio					—
8 Vapor Pressure P_V					—
9 *Required C_V					—
10 *Travel	%				0
11 Allowable/*Predicted SPL	dBA	/	/	/	—
12					

LINE
13 Pipe Line Size & Schedule In 2" S40
14 Out 2" S40
15 Pipe Line Insulation AEROGEL

VALVE BODY/BONNET
16 *Type
17 *Size ANSI Class 150
18 Max Press/Temp 50 PSIG/300°F
19 *Mfr & Model
20 *Body/Bonnet Matl C.S.
21 *Liner Material/ID
22 End Connection In RF FLG.
23 Out RF FLG.
24 Flg Face Finish
25 End Ext/Matl
26 *Flow Direction
27 *Type of Bonnet
28 Lub & Iso Valve Lube
29 *Packing Material
30 *Packing Type
31

TRIM
32 *Type
33 *Size Rated Travel
34 *Characteristic
35 *Balanced/Unbalanced
36 *Rated C_V F_L X_T
37 *Plug/Ball/Disk Material
38 *Seat Material
39 *Cage/Guide Material
40 *Stem Material
41
42

SPECIALS/ACCESSORIES
43 NEC Class Group Div
44 UNCLASSIFIED
45
46
47
48
49
50
51
52

ACTUATOR
53 *Type
54 *Mfr & Model
55 *Size Eff Area
56 On/Off Modulating
57 Spring Action Open/Close
58 *Max Allowable Pressure
59 *Min Required Pressure
60 Available Air Supply Pressure:
61 Max Min
62 *Bench Range /
63 Actuator Orientation
64 Handwheel Type
65 Air Failure Valve Set at
66

67 Input Signal

POSITIONER
68 *Type
69 *Mfr & Model
70 *On Incr Signal Output Incr/Decr
71 Gauges By-pass
72 *Cam Characteristic
73

SWITCHES
74 Type Quantity
75 *Mfr & Model
76 Contacts/Rating
77 Actuation Points
78

AIR SET
79 *Mfr & Model
80 *Set Pressure
81 Filter Gauge
82

TESTS
83 *Hydro Pressure
84 ANSI/FCI Leakage Class
85
86

Rev	Date	Revision	Orig	App

*Information supplied by manufacturer unless already specified

ISA FORM S20.50, Rev.1

GAGE GLASSES and COCKS				SHEET 1 OF 1	
NO	BY	DATE	REVISION	SPEC. NO. LG-C2-1	REV. 0
				CONTRACT	DATE
				REQ. - P.O.	
				BY BL	CHK'D	APPR.

1. Gage Column ■ Cocks □
   Assembled with Nipples ■ Unassembled □

GAGE GLASSES

2. Type: Reflex ■ Transparent □ Tubular □
   Large Chamber □ Weld Pad □
3. Conn: Size and Type SEE DESIGN DETAIL 13
   Top & Bot. ■ Side □ Back □
   Vent 3/4" Drain 3/4"
4. Material CARBON STEEL
5. Min. Rating ANSI CLASS 150 psig at __ °F
6. Options: Illuminator □ Mica Shield □
   Internal Tube □ External Jkt □
   Non-Frost □ Ext. Length
   Calb. Scale □ Other
7. Manufacturer & Model

GAGE COCKS NONE

8. Type: Offset □ Straight □
9. Conn: Vessel Gage Vent/Drain
10. Material: Body Trim
11. Min. Rating: psig at °F
12. Construction:
13. Type of Conn: Vessel
    Gage
14. Bonnet
15. Options: Ball Checks □ Renewable Seats □
    Other FULL PORT BALL VALVES 3/4" BY OTHERS
16. Manufacturer & Model

Rev.	Quan.	Tag No.	Visible Glass	℄ Conn.	Model No.	Operating Press.	Operating Temp.	Service
0	1	LG-C2-1				50	300	EVAP NO.2 TUBE SIDE

Notes:

ISA FORM S20.28

	DIFFERENTIAL PRESSURE INSTRUMENTS				SHEET *1* OF *1*	
	NO	BY	DATE	REVISION	SPEC. NO. *LT-C2-1*	REV. *0*
					CONTRACT	DATE *9-14-15*
					REQ. - P.O.	
					BY *BL* / CHK'D	APPR.

	1	Tag No. *LT-C2-1*	Service *EVAPORATOR NO.2 TUBE SIDE LEVEL*
GENERAL	2	Function	Record □ Indicate □ Control ■ Blind □ Trans □ Integ □ Other ______
	3	Case	MFR STD ■ Nom Size ______ Color: MFR STD □ Other ______
	4	Mounting	Flush ■ Surface □ Yoke □ Other ______
	5	Enclosure Class	General Purpose ■ Weather proof □ Explosion proof □ Class ______ For use in Intrinsically Safe System □ Other *2" FLANGE*
	6	Power Supply	117V 60 Hz ■ Other ac ______ dc □ ______ Volts ______
	7	Chart	12 in. Circ. □ Other ______ Range ______ ______ No. ______
	8	Chart Drive	24 hr Other ______ Elec. □ Spring □ Other ______
	9	Scale	Type ______ Range: 1 ______ 2 ______ 3 ______
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA □ 21-103 kPa (3-15 psig) □ Other ______ For Receiver, See Spec Sheet ______
CONTROLLER	11	Control Modes	P=Prop (Gain), I=Integral (Auto Reset), D=Derivative (Rate) Sub: s=Slow, f=Fast If□ Df □ P □ PI □ PD □ PID □ I_s □ D_s □ Other ______
	12	Action	On Meas. Increase Output: Increases □ Decreases □
	13	Auto-Man Switch	None □ MFR STD ■ Other ______
	14	Set Point Adj.	Manual □ External □ Remote □ Other ______
	15	Manual Reg.	None □ MFR STD ■ Other ______
	16	Output	4-20 mA □ 10-50 mA □ 21-103 kPa (3-15 psig) □ Other ______
UNIT	17	Service	Flow □ Level ■ Diff. Pressure □ Other *S.G. = 1.09*
	18	Element Type	Diaphragm ■ Bellows □ Mercury □ Other ______
	19	Material	Body *MFG STD* Element *316 SS*
	20	Rating	Overrange ______ Body Rating ______ psig
	21	Diff. Range	Fixed □ Adj. Range ______ Set At ______
	22		Elevation ______ Suppression ______
	23	Process Data	Fluid *SUGAR JUICE* Max Temp. *300°F* Max. Press. *50 PSIG*
	24	Process Conn.	½ in. NPT □ Other *2" RF FLG.*
	25	Alarm Switches	Quantity ______ Form ______ Rating ______
	26	Function	Meas. Var. □ Deviation □ Contacts To ______ on Inc. Meas.
	27	Options	Pressure Element □ Range ______ Material ______ Temp. Element □ Range ______ Type ______ Filt Reg. □ Sup. Gage □ Output Gage □ ______ Charts Valve Manifold ______ Cond. Pots □ Adj. Damp □ Integral Sq. Rt. Ext. □ Integrator ______ Other ______
	28	MFR & Model No.	*DIAPHRAGM DP SEAL SYSTEM (TUNED SYSTEM)*

Notes:

1. COORDINATE RANGE WITH VISIBLE LENGTH OF LEVEL GAUGE.

ISA Form S20.20a

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

LG-C2-2

Magtech Level Indicator

Magtech MLI Quick Data Sheet

★ Default ○ Select only one of the items provided ☐ One or more of the listed items can be selected

General information

Company: AUDUBON SUGAR INSTITUTE Date: 5-31-15

Contact Name: BRUCE LACOUR Phone No.: 225-933-4458

Email: LACOURB1@ATT.NET RFQ No.:

Customer-specific design criteria

Are there any existing specifications, including weld procedures, general piping specifications, or an approved manufacturer specification, to which this MLI must comply? ○ Yes ○ No

If so, please list or provide: _____

Other Special Request (describe or attach sketch): _____

Process conditions

Pressure	**Min:** FV	**Oper:** 3.9	**Max:** 50	**Units of Measurement:** PSI
Temperature	**Min:** 20	**Oper:** 223	**Max:** 350	**Units of Measurement:** DEG F

Description of Media STEAM CONDENSATE

Specific Gravity (SG) **Min:** 0.93 **Oper:** 0.95

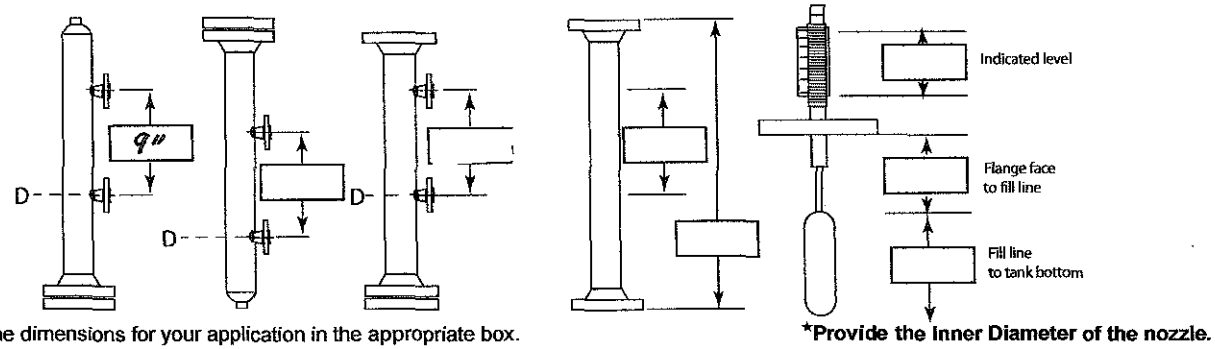
Is this an interface? Yes ☐ No ■

If Yes **Lower Fluid:** **Min SG / Max SG** ___/___ **Upper Fluid: Min SG / Max SG** ___/___

Does Media Boil or Flash? Yes ■ No ☐

Mounting style

Select Style: ●* _____ ○ ○ ○



Enter the dimensions for your application in the appropriate box.
If your configuration is not shown, mark up an existing diagram or attach a sketch.

*Provide the Inner Diameter of the nozzle.

Material of construction

- ■ 316/316L SS*
- ○ 316/316L SS Pipe with Carbon Steel Flanges
- ○ Other Non-Magnetic Material: _____

Process connection type

- ○ None
- ■ RFSO
- ○ RFWN
- ○ RFLJ
- ○ RTJWN
- ○ XW Option - weld to a primary chamber housing guided wave radar
- ○ NPTM Thread
- ○ NPTF Thread
- ○ Socket Weld
- ○ Plain End Nipple
- ○ Other: _____

LG-C2-2

Magtech Level Indicator

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

Rating	Process connection size (inch)
● 150# ○ 300# ○ 600#	○ 1/2 ○ 1 1/2 ● 3/4
○ 900# ○ 1500# ○ Other: ____	○ 1 ○ 1 1/4 ○ 2 ○ Other: ____

Vent

☐ NPT ☐ SW X
● 1/2" THRD OPEN
3/4" END WITH
○ 1" PLUG
☐ Other: PLUG

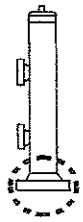
■ Valve (Optional)

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: ____

Drain 316 SS BLD FLG



☐ NPT ■ SW X
● 1/2" THRD OPEN
3/4" END WITH
○ 1" PLUG
☐ Other: PLUG

■ Valve (Optional)

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: 801

Indicator

○ None
○ Flippers with Scale*
○ Follower with Scale
● Polycarbonate Indicator
○ Standard colors: Red and silver
○ Other color (specify): ____

Zero Offset from datum, if Any: ____

Select scale orientation: Top view (Indicator facing user)


○ Left Hand


● Right Hand


○ Standard*

Units on indicator scale

○ Feet & Inches*
○ %
○ Inches only
○ Metric
○ Other. Please specify: ____

Options & accessories

☐ Welded Support Clip
☐ Adjustable Support Clip
☐ Level Switches (specify number)(1)
☐ Magnetostrictive Transmitter(1)
☐ Reed Type Transmitter(1)
☐ Insulation Blanket
☐ Steam Tracing with Blanket
☐ Electric Heat Tracing with Blanket
☐ Insulation with Hard Shell-Cryogenic

Optional tests, inspections & quality certifications

☐ PMI
☐ Hydrostatic Test
☐ Dye Pen Branch Connections
☐ X-Ray
☐ Post-weld Heat Treatment
○ NACE MR0103
○ NACE MR0175
☐ ASME B31.1
☐ ASME B31.3
☐ Full Penetration Welds
☐ Material Traceability Report (MTR)

(1) Provide additional requirements.

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PRESSURE INSTRUMENTS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. P1-2-1 | REV. 0

CONTRACT | DATE 5-30-15

REQ. P.O.

BY BL | CHK'D | APPR.

	1	Tag No. P1-2-1	Service EVAPORATOR NO. 2 CALANDRIA PRESSURE
GENERAL	2	Function	Record ☐ Indicate ☐ Control ☐ Blind ☐ Trans ■ Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ☐ Other ____
	4	Mounting	Flush ■ Surface ☐ Yoke ☐ Other ____
	5	Enclosure Class	General Purpose ■ Weather proof ☐ Explosion proof ☐ Class ____ For Use In Intrin. Safe System ☐ Other ____
	6	Power Supply	117V 60Hz ■ Other ac ____ dc ____ Volts
	7	Chart	____ Strip ☐ ____ Roll ☐ ____ Fold ☐ Circular ____ Time Marks ____ Range ____ Number ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type ____ Range 1 ____ 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____ For Receiver See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain) I=Integral (Auto-Reset) D=Derivative (Rate) Sub: s=Slow f=Fast P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ I_S ☐ D_S ☐ Other ____
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other ____
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other ____
	15	Manual Reg.	None ☐ MFR STD ☐ Other ____
	16	Output	4-20mA ☐ 10-50mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____
ELEMENT	17	Service	Gage Press. ☐ Vacuum ☐ Absolute ■ Compound ■
	18	Element Type	Diaphragm ■ Helix ☐ Bourdon ☐ Bellows ☐ Other ____
	19	Material	316 SS ■ Ber. Copper ☐ Other ____
	20	Range	Fixed ☐ Adj. Range ____ Set at ____ Overrange protection to ____
	21	Process Data	Press: Normal 4.2 PSIG Max ____ Element Range 30 IN Hg / 0-15 PSIG
	22	Process Conn.	¼ in. NPT ☐ ½ in. NPT ☐ Other 2" FLG.
			Location: Bottom ☐ Back ☐ Other ____
	23	Alarm Switches	Quantity ____ Form ____ Rating ____
	24	Function	Press ☐ Deviation ☐ Contacts To ____ on Inc Press.
OPTIONS	25	Options	Filt-Reg. ☐ Sup Gage ☐ Output Gage ☐ ____ Charts Diaph Seal ☐ Type ____ Diaph ____ Bot Bowl ____ Conn ____ Capillary: Length ____ Mtl. ____ Other ____
	26	MFR & Model No.	

Notes:

ISA Form S20.40a

ISA

RESISTANCE TEMPERATURE SENSORS

NO	BY	DATE	REVISION

SHEET 1 OF 1

SPEC. NO. TT-2-1 | REV. 0

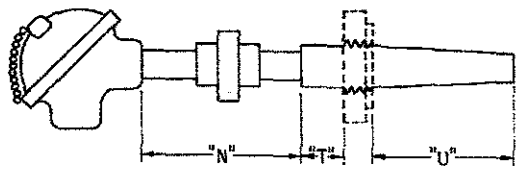
CONTRACT | DATE 5-31-15

REQ. - P.O.

BY BL | CHK'D | APPR.

1. Complete Assembly Other TRANSMITTER
   HEAD
2. Screwed Cover ■ Other
3. Explosion Proof □ Class
4. Material Cond. Conn.
5. Nipple Size Dim. "N" Union □
   ELEMENT
6. Platinum ■ Nickel □ Other
7. Ice Point Resistance
8. Temperature Range 20 TO 350°F
9. Leads: STD ■ Potted □ Herm. Sealed □
10. Sheath Material O.D.

11. Mounting Thread
12. Connection: 2-Wire ■ 3-Wire □ 4-Wire □
    Lead Wires □ Receptacle □ Bayonet Lock □
    Other
    WELL OR TUBE
13. Material SS
14. Construction: Tapered □ Straight □
    Drilled ■ Built-Up □ Closed-End □
    Tube
15. Dim: MFR STD ■ O.D. I.D.
16. Internal Thread
17. Process Connection 1" NPT



Rev.	Tag No.	Process Conn.	Well Dim. U	Well Dim. T	Element Length	Single or Dual	Service	Notes
0	TT-2-1	1" NPT	6"	1"		SINGLE	EVAP. NO.2 CALANDRIA	

Notes:

ISA FORM S20.13a

PRESSURE INSTRUMENTS		SHEET 1 OF 1	
NO | BY | DATE | REVISION		SPEC. NO. PT-2-2	REV. 0
		CONTRACT	DATE 5-30-15
		REQ.	P.O.
		BY BL | CHK'D	APPR.

	No.	Item	Specification
	1	Tag No. PT-2-2	Service EVAPORATOR NO. 2 OVERHEAD PRESSURE
GENERAL	2	Function	Record □ Indicate □ Control □ Blind □ Trans ■ Other ____
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD □ Other ____
	4	Mounting	Flush ■ Surface □ Yoke □ Other ____
	5	Enclosure Class	General Purpose ■ Weather proof □ Explosion proof □ Class ____ For Use In Intrin. Safe System □ Other ____
	6	Power Supply	117V 60Hz ■ Other ac ____ dc ____ Volts
	7	Chart	____ Strip □ ____ Roll □ ____ Fold □ Circular ____ Time Marks ____ Range ____ Number ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type ____ Range 1 ____ 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA □ 21-103 kPa (3-15 psig) □ Other ____ For Receiver See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain) I=Integral (Auto-Reset) D=Derivative (Rate) Sub: s=Slow f=Fast P □ PI □ PD □ PID □ If □ Df □ I_s □ D_s □ Other ____
	12	Action	On Meas. Increase Output: Increases □ Decreases □
	13	Auto-Man Switch	None □ MFR STD □ Other ____
	14	Set Point Adj.	Manual □ External □ Remote □ Other ____
	15	Manual Reg.	None □ MFR STD □ Other ____
	16	Output	4-20mA □ 10-50mA □ 21-103 kPa (3-15 psig) □ Other ____
ELEMENT	17	Service	Gage Press. □ Vacuum □ Absolute ■ Compound ■
	18	Element Type	Diaphragm ■ Helix □ Bourdon □ Bellows □ Other ____
	19	Material	316 SS ■ Ber. Copper □ Other ____
	20	Range	Fixed □ Adj. Range ____ Set at ____ Overrange protection to ____
	21	Process Data	Press: Normal +2 PSIG Max ____ Element Range 30IN Hg / 0-15 PSIG
	22	Process Conn.	¼ in. NPT □ ½ in. NPT □ Other 2" FLG. Location: Bottom □ Back □ Other ____
	23	Alarm Switches	Quantity ____ Form ____ Rating ____
	24	Function	Press □ Deviation □ Contacts To ____ on Inc Press.
OPTIONS	25	Options	Filt-Reg. □ Sup Gage □ Output Gage □ ____ Charts Diaph Seal □ Type ____ Diaph ____ Bot Bowl ____ Conn ____ Capillary: Length ____ Mtl. ____ Other ____
	26	MFR & Model No.	

Notes:

ISA Form S20.40a

RESISTANCE TEMPERATURE SENSORS

NO	BY	DATE	REVISION

SHEET 1 OF 1

SPEC. NO. TT-2-2 | REV. 0

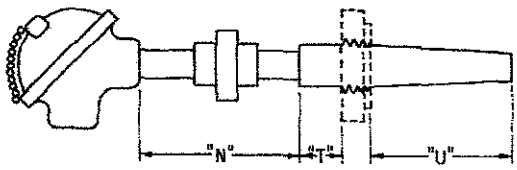
CONTRACT | DATE 5-31-15

REQ. - P.O.

BY BL | CHK'D | APPR.

1. Complete Assembly Other TRANSMITTER
HEAD
2. Screwed Cover ■ Other
3. Explosion Proof □ Class
4. Material Cond. Conn.
5. Nipple Size Dim. "N" Union □
ELEMENT
6. Platinum ■ Nickel □ Other
7. Ice Point Resistance
8. Temperature Range 20 TO 350 °F
9. Leads: STD ■ Potted □ Herm. Sealed □
10. Sheath Material O.D.

11. Mounting Thread
12. Connection: 2-Wire ■ 3-Wire □ 4-Wire □
Lead Wires □ Receptacle □ Bayonet Lock □
Other
WELL OR TUBE
13. Material SS
14. Construction: Tapered □ Straight □
Drilled ■ Built-Up □ Closed-End □
Tube
15. Dim: MFR STD ■ O.D. I.D.
16. Internal Thread
17. Process Connection 1" NPT



Rev.	Tag No.	Process Conn.	Well Dim. U	Well Dim. T	Element Length	Single or Dual	Service	Notes
0	TT 2-2	1" NPT	6"	1"		SINGLE	EVAP. NO. 2 OVRH.	

Notes:

ISA FORM S20.13a

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

LG-T2

Magtech Level Indicator

Magtech MLI Quick Data Sheet

★ Default ○ Select only one of the items provided ☐ One or more of the listed items can be selected

General information

Company: AUDUBON SUGAR INSTITUTE Date: 5-31-15

Contact Name: BRUCE LACOUR Phone No.: 225-933-4458

Email: lacourb1@ATT.NET RFQ No.:

Customer-specific design criteria

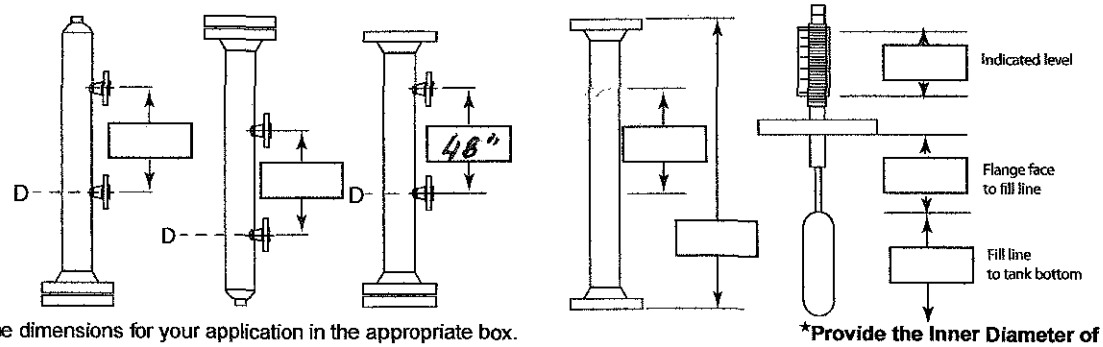
Are there any existing specifications, including weld procedures, general piping specifications, or an approved manufacturer specification, to which this MLI must comply? ○ **Yes** ○ **No**
If so, please list or provide:
Other Special Request (describe or attach sketch):

Process conditions

Pressure	**Min:** FV	**Oper:** 3.9	**Max:** 50	**Units of Measurement:**		
Temperature	**Min:** 20	**Oper:** 231	**Max:** 350	**Units of Measurement:**		
Description of Media	STEAM CONDENSATE					
Specific Gravity (SG)	**Min:** 0.93	**Oper:** 0.95				
Is this an interface?	**Yes** ☐	**No** ■				
If Yes	**Lower Fluid:**	**Min SG / Max SG** ___/___	**Upper Fluid: Min SG / Max SG** ___/___			
Does Media Boil or Flash?	**Yes** ■	**No** ☐				

Mounting style

Select Style: ○* ○ ● ○ ○



Enter the dimensions for your application in the appropriate box.
If your configuration is not shown, mark up an existing diagram or attach a sketch.

*Provide the Inner Diameter of the nozzle.

Material of construction	Process connection type	
■ 316/316L SS*	○ None	○ NPTM Thread
○ 316/316L SS Pipe with Carbon Steel Flanges	■ RFSO	○ NPTF Thread
○ Other Non-Magnetic Material:	○ RFWN	○ Socket Weld
	○ RFLJ	○ Plain End Nipple
	○ RTJWN	○ Other:
	○ XW Option - weld to a primary chamber housing guided wave radar	

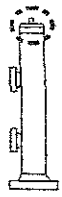
16-72

Magtech Level Indicator

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

Rating	Process connection size (inch)
● 150# ○ 300# ○ 600#	○ 1/2 ○ 1 1/2 ● 3/4
○ 900# ○ 1500# ○ Other: ____	○ 1 ○ 1 1/4 ○ 2 ○ Other: ____

Vent 316 SS BLD FLG ■ Valve (Optional)



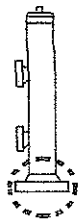
☐ NPT ■ SW X
○ 1/2" THRD OPEN
● 3/4" END WITH
○ 1" PLUG
☐ Other: PLUG

Type
○ Ball
○ Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: ____

Drain 316 SS BLD FLG ■ Valve (Optional)



☐ NPT ■ SW X
○ 1/2" THRD OPEN
● 3/4" END WITH
○ 1" PLUG
☐ Other: PLUG

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: 800

Indicator

○ None
○ Flippers with Scale*
○ Follower with Scale
● Polycarbonate Indicator
○ Standard colors: Red and silver
○ Other color (specify): ____

Zero Offset from datum, if Any: ____

Select scale orientation: Top view (Indicator facing user)


○ Left Hand


○ Right Hand


○ Standard*

Units on indicator scale

○ Feet & Inches*
○ %
○ Inches only
○ Metric
○ Other. Please specify: ____

Options & accessories

☐ Welded Support Clip
☐ Adjustable Support Clip
☐ Level Switches (specify number)(1)
☐ Magnetostrictive Transmitter(1)
☐ Reed Type Transmitter(1)
☐ Insulation Blanket
☐ Steam Tracing with Blanket
☐ Electric Heat Tracing with Blanket
☐ Insulation with Hard Shell-Cryogenic

Optional tests, inspections & quality certifications

☐ PMI
☐ Hydrostatic Test
☐ Dye Pen Branch Connections
☐ X-Ray
☐ Post-weld Heat Treatment
○ NACE MR0103
○ NACE MR0175
☐ ASME B31.1
☐ ASME B31.3
☐ Full Penetration Welds
☐ Material Traceability Report (MTR)

(1) *Provide additional requirements.*

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Rosemount Division
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-999-9307
T (International) (952) 906-8888
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Process Management

ISA S20.50, Rev. 1 **CONTROL VALVE DATA SHEET** Second Printing

	PROJECT	DATA SHEET 1 of 1	
	UNIT	SPEC	
	P.O.	TAG LV-72	
	ITEM	DWG	
	CONTRACT	SERVICE T2 LEVEL CONTROL	
	*MFR. SERIAL		

1 Fluid STEAM CONDENSATE — Crit Press PC

SERVICE CONDITIONS

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
2 Flow Rate		2.4	2.2	2.0	—
3 Inlet Pressure			4.2		
4 Outlet Pressure			-2.3		
5 Inlet Temperature			231		
6 Spec Wt/Spec Grav/Mol Wt			0.95		—
7 Viscosity/Spec Heats Ratio					—
8 Vapor Pressure P_V					—
9 *Required C_V					—
10 *Travel	%				0
11 Allowable/*Predicted SPL	dBA	/	/	/	—
12					

LINE

13 Pipe Line Size & Schedule — In 2" S40
14 Out 2" S40
15 Pipe Line Insulation AEROGEL

VALVE BODY/BONNET

16 *Type
17 *Size ANSI Class 150
18 Max Press/Temp 50PSIG/300°F
19 *Mfr & Model
20 *Body/Bonnet Matl C.S.
21 *Liner Material/ID
22 End Connection — In RF FLG.
23 Out RF FLG.
24 Flg Face Finish
25 End Ext/Matl
26 *Flow Direction
27 *Type of Bonnet
28 Lub & Iso Valve Lube
29 *Packing Material
30 *Packing Type
31

TRIM

32 *Type
33 *Size Rated Travel
34 *Characteristic
35 *Balanced/Unbalanced
36 *Rated C_V F_L X_T
37 *Plug/Ball/Disk Material
38 *Seat Material
39 *Cage/Guide Material
40 *Stem Material
41
42

SPECIALS/ACCESSORIES

43 NEC Class Group Div
44 UNCLASSIFIED
45
46
47
48
49
50
51
52

ACTUATOR

53 *Type
54 *Mfr & Model
55 *Size Eff Area
56 On/Off Modulating
57 Spring Action Open/Close
58 *Max Allowable Pressure
59 *Min Required Pressure
60 Available Air Supply Pressure:
61 Max Min
62 *Bench Range /
63 Actuator Orientation
64 Handwheel Type
65 Air Failure Valve Set at
66

POSITIONER

67 Input Signal
68 *Type
69 *Mfr & Model
70 *On Incr Signal Output Incr/Decr
71 Gauges By-pass
72 *Cam Characteristic
73

SWITCHES

74 Type Quantity
75 *Mfr & Model
76 Contacts/Rating
77 Actuation Points
78

AIR SET

79 *Mfr & Model
80 *Set Pressure
81 Filter Gauge
82

TESTS

83 *Hydro Pressure
84 ANSI/FCI Leakage Class
85
86

Rev	Date	Revision	Orig	App

ISA FORM S20.50, Rev. 1

*Information supplied by manufacturer unless already specified

ISA FORM S20.50, Rev.1

GAGE GLASSES and COCKS				SHEET 1 OF 1	
NO	BY	DATE	REVISION	SPEC. NO. LG-C3-1	REV. 0
				CONTRACT	DATE
				REQ. - P.O.	
				BY BL	CHK'D / APPR.

1. Gage Column ■ Cocks □
   Assembled with Nipples ■ Unassembled □

GAGE GLASSES

2. Type: Reflex ■ Transparent □ Tubular □
   Large Chamber □ Weld Pad □
3. Conn: Size and Type SEE DESIGN DETAIL 13
   Top & Bot. □ Side □ Back □
   Vent 3/4" Drain 3/4"
4. Material CARBON STEEL
5. Min. Rating ANSI CLASS 150 psig at — °F
6. Options: Illuminator □ Mica Shield □
   Internal Tube □ External Jkt □
   Non-Frost □ Ext. Length
   Calb. Scale □ Other
7. Manufacturer & Model

GAGE COCKS NONE

8. Type: Offset □ Straight □
9. Conn: Vessel Gage Vent/Drain
10. Material: Body Trim
11. Min. Rating: psig at °F
12. Construction:
13. Type of Conn: Vessel
    Gage
14. Bonnet
15. Options: Ball Checks □ Renewable Seats □
    Other FULL PORT BALL VALVES 3/4" BY OTHERS
16. Manufacturer & Model

Rev.	Quan.	Tag No.	Visible Glass	℄ Conn.	Model No.	Operating Press.	Operating Temp.	Service
0	1	LG-C3-1						EVAP. NO. 3 TUBE SIDE

Notes:

ISA FORM S20.28

DIFFERENTIAL PRESSURE INSTRUMENTS				SHEET 1 OF 1	
NO	BY	DATE	REVISION	SPEC. NO. LT-C3-1	REV. 0
				CONTRACT	DATE 9-14-15
				REQ. - P.O.	
				BY BL	CHK'D	APPR.

	1	Tag No. LT-C3-1	Service EVAPORATOR NO. 3 TUBE SIDE LEVEL
GENERAL	2	Function	Record ☐ Indicate ☐ Control ■ Blind ☐ Trans ☐ Integ ☐ Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ☐ Other ____
	4	Mounting	Flush ■ Surface ☐ Yoke ☐ Other 2" FLANGE
	5	Enclosure Class	General Purpose ■ Weather proof ☐ Explosion proof ☐ Class ____
			For use in Intrinsically Safe System ☐ Other ____
	6	Power Supply	117V 60 Hz ■ Other ac ____ dc ☐ ____ Volts ____
	7	Chart	12 in. Circ. ☐ Other ____ Range ____ No. ____
	8	Chart Drive	24 hr Other ____ Elec. ☐ Spring ☐ Other ____
	9	Scale	Type ____ Range: 1 ____ 2 ____ 3 ____
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____ For Receiver, See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain), I=Integral (Auto Reset), D=Derivative (Rate) Sub: s=Slow, f=Fast If☐ Df ☐ P ☐ PI ☐ PD ☐ PID ☐ I_s ☐ D_s ☐ Other ____
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ■ Other ____
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other ____
	15	Manual Reg.	None ☐ MFR STD ■ Other ____
	16	Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____
UNIT	17	Service	Flow ☐ Level ■ Diff. Pressure ☐ Other 5.6 = 1.34
	18	Element Type	Diaphragm ■ Bellows ☐ Mercury ☐ Other ____
	19	Material	Body MFG STD. Element 316 SS
	20	Rating	Overrange ____ Body Rating ____ psig
	21	Diff. Range	Fixed ☐ Adj. Range ____ Set At ____
	22		Elevation ____ Suppression ____
	23	Process Data	Fluid SUGAR JUICE Max Temp. 300°F Max. Press. 50 PSIG
	24	Process Conn.	½ in. NPT ☐ Other 2" RF FLG
	25	Alarm Switches	Quantity ____ Form ____ Rating ____
	26	Function	Meas. Var. ☐ Deviation ☐ Contacts To ____ on Inc. Meas.
	27	Options	Pressure Element ☐ Range ____ Material ____ Temp. Element ☐ Range ____ Type ____ Filt Reg. ☐ Sup. Gage ☐ Output Gage ☐ ____ Charts Valve Manifold ____ Cond. Pots ☐ Adj. Damp ☐ Integral Sq. Rt. Ext. ☐ Integrator ____ Other ____
	28	MFR & Model No.	DIAPHRAGM DP SEAL SYSTEM (TUNED-SYSTEM)

Notes:
1. COORDINATE RANGE WITH VISIBLE LENGTH OF LEVEL GAUGE.

ISA Form S20.20a

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

LG-C3-2

Magtech Level Indicator

Magtech MLI Quick Data Sheet

★ Default ○ Select only one of the items provided ☐ One or more of the listed items can be selected

General information

Company: AUDUBON SUGAR INSTITUTE Date: 5-31-15

Contact Name: BRUCE LACOUR Phone No.: 225-933-4458

Email: LACOURB1@ATT.NET RFQ No.:

Customer-specific design criteria

Are there any existing specifications, including weld procedures, general piping specifications, or an approved manufacturer specification, to which this MLI must comply? ○ Yes ○ No

If so, please list or provide: _____

Other Special Request (describe or attach sketch): _____

Process conditions

Pressure	**Min:**	FV	**Oper:**	-2.3	**Max:**	50	**Units of Measurement:** PSI
Temperature	**Min:**	20	**Oper:**	197	**Max:**	350	**Units of Measurement:** DEG F

Description of Media STEAM CONDENSATE

Specific Gravity (SG) **Min:** 0.95 **Oper:** 0.96

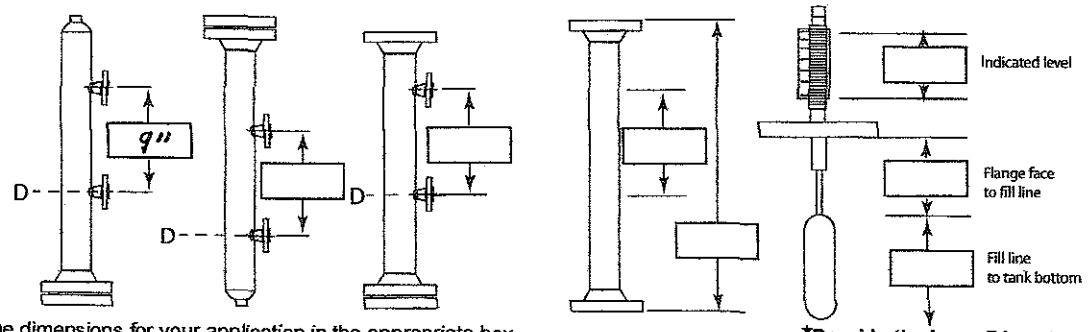
Is this an interface? Yes ☐ No ■

If Yes **Lower Fluid:** **Min SG / Max SG** ___/___ **Upper Fluid: Min SG / Max SG** ___/___

Does Media Boil or Flash? Yes ■ No ☐

Mounting style

Select Style: ●* ○ ○ ○ ○



Enter the dimensions for your application in the appropriate box.
If your configuration is not shown, mark up an existing diagram or attach a sketch.

*Provide the Inner Diameter of the nozzle.

Material of construction

- ● 316/316L SS*
- ○ 316/316L SS Pipe with Carbon Steel Flanges
- ○ Other Non-Magnetic Material: _____

Process connection type

- ○ None
- ○ RFSO
- ○ RFWN
- ○ RFLJ
- ○ RTJWN
- ○ XW Option - weld to a primary chamber housing guided wave radar
- ○ NPTM Thread
- ○ NPTF Thread
- ○ Socket Weld
- ○ Plain End Nipple
- ○ Other: _____

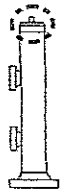
Magtech Level Indicator

LG-C3-2

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

Rating	Process connection size (inch)
● 150# ○ 300# ○ 600#	○ 1/2 ○ 1 1/2 ● 3/4
○ 900# ○ 1500# ○ Other: ____	○ 1 ○ 1 1/4 ○ 2 ○ Other: ____

Vent



☐ NPT ■ SW X
● 1/2" THRD OPEN END WITH PLUG
○ 3/4"
○ 1"
☐ Other: ____

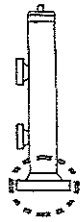
Valve (Optional) ■

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: ____

Drain 316 SS BLD FIG



☐ NPT ■ SW X
● 1/2" THRD OPEN END WITH PLUG
○ 3/4"
○ 1"
☐ Other: ____

Valve (Optional) ■

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: 800

Indicator

○ None
○ Flippers with Scale*
○ Follower with Scale
● Polycarbonate Indicator
○ Standard colors: Red and silver
○ Other color (specify): ____

Zero Offset from datum, if Any: ____

Select scale orientation: Top view (Indicator facing user)

○ Left Hand

● Right Hand

○ Standard*

Units on indicator scale

○ Feet & Inches*
○ %
○ Inches only
○ Metric
○ Other. Please specify: ____

Options & accessories

☐ Welded Support Clip
☐ Adjustable Support Clip
☐ Level Switches (specify number)(1)
☐ Magnetostrictive Transmitter(1)
☐ Reed Type Transmitter(1)
☐ Insulation Blanket
☐ Steam Tracing with Blanket
☐ Electric Heat Tracing with Blanket
☐ Insulation with Hard Shell-Cryogenic

Optional tests, inspections & quality certifications

☐ PMI
☐ Hydrostatic Test
☐ Dye Pen Branch Connections
☐ X-Ray
☐ Post-weld Heat Treatment
○ NACE MR0103
○ NACE MR0175
☐ ASME B31.1
☐ ASME B31.3
☐ Full Penetration Welds
☐ Material Traceability Report (MTR)

(1) Provide additional requirements.

Emerson Process Management
Rosemount Division
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-999-9307
T (International) (952) 906-8888
F (952) 949-8889

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		PRESSURE INSTRUMENTS	SHEET 1 OF 1
			SPEC. NO. PT-3-1 — REV. 0
			CONTRACT — DATE 5-20-15
			REQ. P.O.
			BY RL — CHK'D — APPR.

NO	BY	DATE	REVISION

	1	Tag No. PT-3-1	Service EVAPORATOR NO.3 CALANDRIA PRESSURE
GENERAL	2	Function	Record □ Indicate □ Control □ Blind □ Trans ■ Other ____
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD □ Other ____
	4	Mounting	Flush ■ Surface □ Yoke □ Other ____
	5	Enclosure Class	General Purpose ■ Weather proof □ Explosion proof □ Class ____ For Use In Intrin. Safe System □ Other ____
	6	Power Supply	117V 60Hz ■ Other ac ____ dc ____ Volts
	7	Chart	____ Strip □ ____ Roll □ ____ Fold □ Circular ____ Time Marks ____ Range ____ Number ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type ____ Range 1 ____ 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA □ 21-103 kPa (3-15 psig) □ Other ____ For Receiver See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain) I=Integral (Auto-Reset) D=Derivative (Rate) Sub: s=Slow f=Fast P □ PI □ PD □ PID □ If □ Df □ Is □ Ds □ Other ____
	12	Action	On Meas. Increase Output: Increases □ Decreases □
	13	Auto-Man Switch	None □ MFR STD □ Other ____
	14	Set Point Adj.	Manual □ External □ Remote □ Other ____
	15	Manual Reg.	None □ MFR STD □ Other ____
	16	Output	4-20mA □ 10-50mA □ 21-103 kPa (3-15 psig) □ Other ____
ELEMENT	17	Service	Gage Press. □ Vacuum □ Absolute ■ Compound ■
	18	Element Type	Diaphragm ■ Helix □ Bourdon □ Bellows □ Other ____
	19	Material	316 SS ■ Ber. Copper □ Other ____
	20	Range	Fixed □ Adj. Range ____ Set at ____ Overrange protection to ____
	21	Process Data	Press: Normal -2 PSIG Max ____ Element Range 30IN Hg / 0-15 PSIG
	22	Process Conn.	¼ in. NPT □ ½ in. NPT □ Other 2" FLG. Location: Bottom □ Back □ Other ____
	23	Alarm Switches	Quantity ____ Form ____ Rating ____
	24	Function	Press □ Deviation □ Contacts To ____ on Inc Press.
OPTIONS	25	Options	Filt-Reg. □ Sup Gage □ Output Gage □ ____ Charts Diaph Seal □ Type ____ Diaph ____ Bot Bowl ____ Conn ____ Capillary: Length ____ Mtl. ____ Other ____
	26	MFR & Model No.	

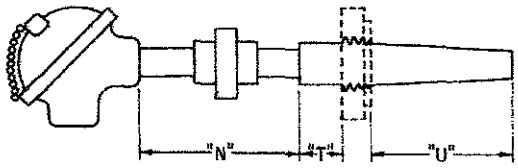
Notes:

ISA Form S20.40a

RESISTANCE TEMPERATURE SENSORS				SHEET 1 OF 1	
NO	BY	DATE	REVISION	SPEC. NO. TT-3-1	REV. 0
				CONTRACT	DATE 5-31-15
				REQ. - P.O.	
				BY BL / CHK'D / APPR.	

1. Complete Assembly Other TRANSMITTER
HEAD
2. Screwed Cover ■ Other
3. Explosion Proof □ Class
4. Material Cond. Conn.
5. Nipple Size Dim. "N" Union □
ELEMENT
6. Platinum ■ Nickel □ Other
7. Ice Point Resistance
8. Temperature Range 20 TO 350°F
9. Leads: STD ■ Potted □ Herm. Sealed □
10. Sheath Material O.D.

11. Mounting Thread
12. Connection: 2-Wire ■ 3-Wire □ 4-Wire □
Lead Wires □ Receptacle □ Bayonet Lock □
Other
WELL OR TUBE
13. Material SS
14. Construction: Tapered □ Straight □
Drilled ■ Built-Up □ Closed-End □
Tube
15. Dim: MFR STD ■ O.D. I.D.
16. Internal Thread
17. Process Connection 1" NPT



Rev.	Tag No.	Process Conn.	Well Dim. U	Well Dim. T	Element Length	Single or Dual	Service	Notes
0	TT-3-1	1" NPT	6"	1"		SINGLE	EVAP. NO. 3 CALANDRIA	

Notes:

ISA FORM S20.13a

PRESSURE INSTRUMENTS

NO	BY	DATE	REVISION

SHEET 1 OF 1

SPEC. NO.	REV.
PT-3-2	0
CONTRACT	DATE
	5-30-15
REQ. P.O.	
BY: BL / CHK'D / APPR.	

	1	Tag No. PT-3-2	Service EVAPORATOR NO.3 OVERHEAD PRESSURE
GENERAL	2	Function	Record ☐ Indicate ☐ Control ■ Blind ☐ Trans ■ DCS CONTROL Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ☐ Other ____
	4	Mounting	Flush ■ Surface ☐ Yoke ☐ Other ____
	5	Enclosure Class	General Purpose ■ Weather proof ☐ Explosion proof ☐ Class ____ For Use In Intrin. Safe System ☐ Other ____
	6	Power Supply	117V 60Hz ■ Other ac ____ dc ____ Volts
	7	Chart	____ Strip ☐ ____ Roll ☐ ____ Fold ☐ Circular ____ Time Marks ____ Range ____ Number ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type ____ Range 1 ____ 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____ For Receiver See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain) I=Integral (Auto-Reset) D=Derivative (Rate) Sub: s=Slow f=Fast P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ I_s ☐ D_s ☐ Other ____
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other ____
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other ____
	15	Manual Reg.	None ☐ MFR STD ☐ Other ____
	16	Output	4-20mA ☐ 10-50mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____
ELEMENT	17	Service	Gage Press. ☐ Vacuum ☐ Absolute ■ Compound ☐
	18	Element Type	Diaphragm ■ Helix ☐ Bourdon ☐ Bellows ☐ Other ____
	19	Material	316 SS ■ Ber. Copper ☐ Other ____
	20	Range	Fixed ☐ Adj. Range ____ Set at ____ Overrange protection to ____
	21	Process Data	Press: Normal -12.3 PSIG Max ____ Element Range ____
	22	Process Conn.	¼ in. NPT ☐ ½ in. NPT ☐ Other 2" FLG. Location: Bottom ☐ Back ☐ Other ____
	23	Alarm Switches	Quantity ____ Form ____ Rating ____
	24	Function	Press ☐ Deviation ☐ Contacts To ____ on Inc Press.
OPTIONS	25	Options	Filt-Reg. ☐ Sup Gage ☐ Output Gage ☐ ____ Charts Diaph Seal ☐ Type ____ Diaph ____ Bot Bowl ____ Conn ____ Capillary: Length ____ Mtl. ____ Other ____
	26	MFR & Model No.	

Notes:

ISA Form S20.40a

RESISTANCE TEMPERATURE SENSORS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TT-3-2 | REV. 0

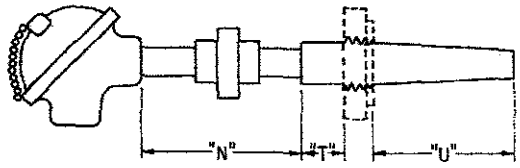
CONTRACT | DATE 5-31-15

REQ. - P.O.

BY BL | CHK'D | APPR.

1. Complete Assembly Other
HEAD
2. Screwed Cover ■ Other TRANSMITTER
3. Explosion Proof □ Class
4. Material Cond. Conn.
5. Nipple Size Dim. "N" Union □
ELEMENT
6. Platinum ■ Nickel □ Other
7. Ice Point Resistance
8. Temperature Range 20 TO 350°F
9. Leads: STD ■ Potted □ Herm. Sealed □
10. Sheath Material O.D.

11. Mounting Thread
12. Connection: 2-Wire ■ 3-Wire □ 4-Wire □
Lead Wires □ Receptacle □ Bayonet Lock □
Other
WELL OR TUBE
13. Material SS
14. Construction: Tapered □ Straight □
Drilled ■ Built-Up □ Closed-End □
Tube
15. Dim: MFR STD ■ O.D. I.D.
16. Internal Thread
17. Process Connection 1" NPT



Rev.	Tag No.	Process Conn.	Well Dim. U	Well Dim. T	Element Length	Single or Dual	Service	Notes
0	TT 3-2	1" NPT	6"	1"		SINGLE	EVAP. NO.3 OVRH.	

Notes:

ISA FORM S20.13a

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

LG-73

Magtech Level Indicator

Magtech MLI Quick Data Sheet

★ Default ○ Select only one of the items provided ☐ One or more of the listed items can be selected

General information

Company: AUDUBON SUGAR INSTITUTE Date: 5-31-15

Contact Name: BRUCE LACOUR Phone No.: 225-933-4458

Email: LACOURB1@ATT.NET RFQ No.:

Customer-specific design criteria

Are there any existing specifications, including weld procedures, general piping specifications, or an approved manufacturer specification, to which this MLI must comply? ○ Yes ○ No

If so, please list or provide: _____

Other Special Request (describe or attach sketch): _____

Process conditions

Pressure	**Min:**	FV	**Oper:**	2.0	**Max:**	50	**Units of Measurement:** PSI
Temperature	**Min:**	20	**Oper:**	209	**Max:**	350	**Units of Measurement:** DEG F

Description of Media 571

Specific Gravity (SG) Min: 0.95 Oper: 0.96

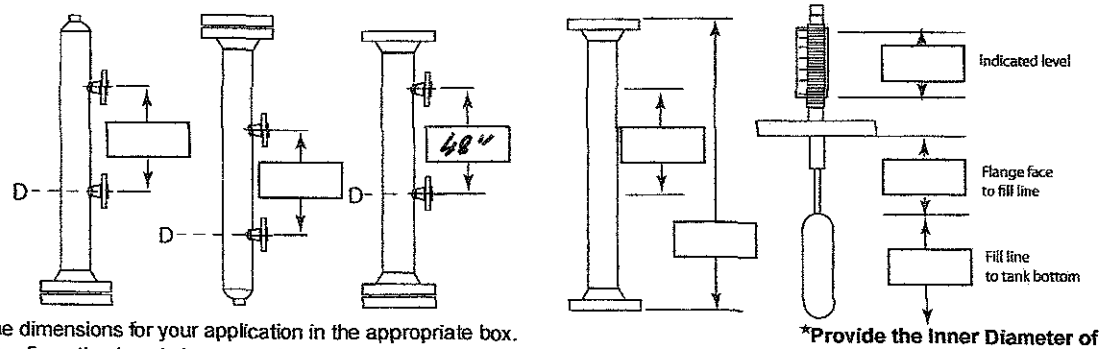
Is this an interface? Yes ☐ No ■

If Yes Lower Fluid: Min SG / Max SG ___/___ Upper Fluid: Min SG / Max SG ___/___

Does Media Boil or Flash? Yes ■ No ☐

Mounting style

Select Style: ○* ○ ● ○ ○



Enter the dimensions for your application in the appropriate box.
If your configuration is not shown, mark up an existing diagram or attach a sketch.

*Provide the Inner Diameter of the nozzle.

Material of construction

- ■ 316/316L SS*
- ○ 316/316L SS Pipe with Carbon Steel Flanges
- ○ Other Non-Magnetic Material: _____

Process connection type

- ○ None
- ■ RFSO
- ○ RFWN
- ○ RFLJ
- ○ RTJWN
- ○ XW Option - weld to a primary chamber housing guided wave radar
- ○ NPTM Thread
- ○ NPTF Thread
- ○ Socket Weld
- ○ Plain End Nipple
- ○ Other: _____

LG-73

Magtech Level Indicator

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

Rating	Process connection size (inch)
● 150# ○ 300# ○ 600#	○ 1/2 ○ 1 1/2 ● 3/4
○ 900# ○ 1500# ○ Other: ____	○ 1 ○ 1 1/4 ○ 2 ○ Other: ____

Vent 316 SS BLD FLG

☐ NPT ■ SW X
○ 1/2"
● 3/4" THRD OPEN END WITH
○ 1" PLUG
☐ Other: ____

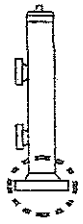
■ Valve (Optional)

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: ____

Drain



☐ NPT ■ SW X
○ 1/2"
● 3/4" THRD OPEN END WITH
○ 1" PLUG
☐ Other: ____

■ Valve (Optional)

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel

**Valve Class: 800

Indicator

○ None
○ Flippers with Scale*
○ Follower with Scale
● Polycarbonate Indicator
○ Standard colors: Red and silver
○ Other color (specify): ____

Zero Offset from datum, if Any: ____

Select scale orientation: Top view (Indicator facing user)

○ Left Hand

● Right Hand

○ Standard*

Units on indicator scale

○ Feet & Inches*
○ %
○ Inches only
○ Metric
○ Other. Please specify: ____

Options & accessories

☐ Welded Support Clip
☐ Adjustable Support Clip
☐ Level Switches (specify number)(1)
☐ Magnetostrictive Transmitter(1)
☐ Reed Type Transmitter(1)
☐ Insulation Blanket
☐ Steam Tracing with Blanket
☐ Electric Heat Tracing with Blanket
☐ Insulation with Hard Shell-Cryogenic

Optional tests, inspections & quality certifications

☐ PMI
☐ Hydrostatic Test
☐ Dye Pen Branch Connections
☐ X-Ray
☐ Post-weld Heat Treatment
○ NACE MR0103
○ NACE MR0175
☐ ASME B31.1
☐ ASME B31.3
☐ Full Penetration Welds
☐ Material Traceability Report (MTR)

(1) Provide additional requirements.

Emerson Process Management
Rosemount Division
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-999-9307
T (International) (952) 906-8888
F (952) 949-8889

www.rosemount.com

EMERSON.
Process Management

Magtech

LTM Series Transmitter Quotation Request

3902 Magnolia Rd.
Pearland, Texas 77584
Phone 281-488-0788 Fax 281-488-7080

LTM Series Transmitter Quotation Request

Quote/Order # _____ Contact _____
Company/Rep. _____ Email _____
Phone # _____ Date _____
Fax # _____

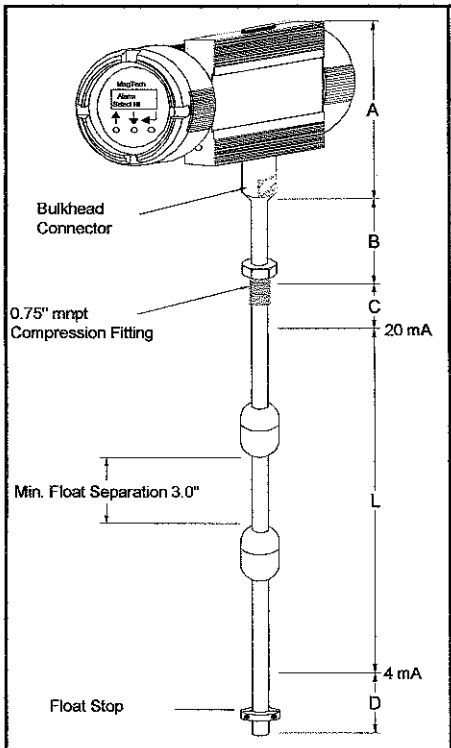


Figure 1: LTM Series Transmitter

A: 7.00" (177.8 mm)	Housing/Bulkhead
B: 6.00" (152.4 mm)	Deadband
C:	Nozzle Height
(3.00" unless specified)	
D: 3.00" (76.2mm)	Deadband
L: 48"	Measurement Range

Units of Measurement
- ■ inches
- ☐ feet (field selectable)
- ☐ mm
- ☐ cm
- ☐ m

Qty: 1 LT-T3

Models and Output Options:

■ **LTM-200D** ☐ **LTM-250**
- Single Level 4/20 mA Analog Output (if interface level, provide upper S. G.)

Lower S. G.: 0.96
Upper S. G.: _____ (if applicable)

☐ **LTM-300 (HART-5)** ☐ **LTM-350 (HART-7)**

Check only one option

☐ Option 1: Single Level 4/20 mA Analog Output (if interface level, provide upper S. G.)

☐ Option 2: Dual Level Output (if interface level, provide upper S. G.)
- Upper Level - 4/20 mA Analog
- Lower (Interface) Level - Digital

(Analog and digital level outputs are interchangeable.)

Lower S. G.: _____
Upper S. G.: _____ (if applicable)

☐ Option 3: Single Level Output with Temperature
- Level Output - 4/20 mA Analog
- Temperature - Digital Only

Temp. Range: _____ (if applicable)(Max. 300°F)

☐ Option 4: Dual Level Output with Temperature
- Upper Level - 4/20 mA Analog
- Lower (Interface) Level - Digital
- Temperature - Digital Only

(Analog and digital level outputs are interchangeable.)

☐ **LTM-300-FF (Foundation Fieldbus.)**

Check only one option

☐ Option 1: Single Level Output (if interface level, provide upper S. G.)

Lower S. G.: _____
Upper S. G.: _____ (if applicable)

☐ Option 2: Dual Level Output

☐ Option 3: Single Level Output w/ Temperature (if interface level, provide upper S. G.)

Temp. Range: _____

☐ Option 4: Dual Level Output w/ Temperature (if applicable)(Max. 300°F)

Standard	Dual Compartment Housing (Aluminum Epoxy Coated) ✓
Standard	Integral LCD Display ✓
Optional:	Stainless Steel Housing (Consult Factory)

** NOTE: PLEASE COMPLETE REVERSE SIDE

LTM Series Transmitter
Quotation Request

3902 Magnolia Rd.
Pearland, Texas 77584
Phone 281-488-0788 Fax 281-488-7080

LT-T3

Probe Specifications: (5/8" (15.875mm) Std.)

- [■] 316 SS Std.
  - [ ] Kynar Sleeved
  - [ ] Teflon Sleeved
  - (if applicable)
- [ ] Alloy 20
- [ ] Hastalloy-C

Process Connections:

- [ ] 3/4" mnpt
- [■] Flange, specify: 316SS LG-T3 TOP FLG

Additional Options:

- [ ] Stilling Well (recommended over 10 ft.)
  (minumum 3.00" I.D. or consult factory)
- [ ] Nozzle Requirements

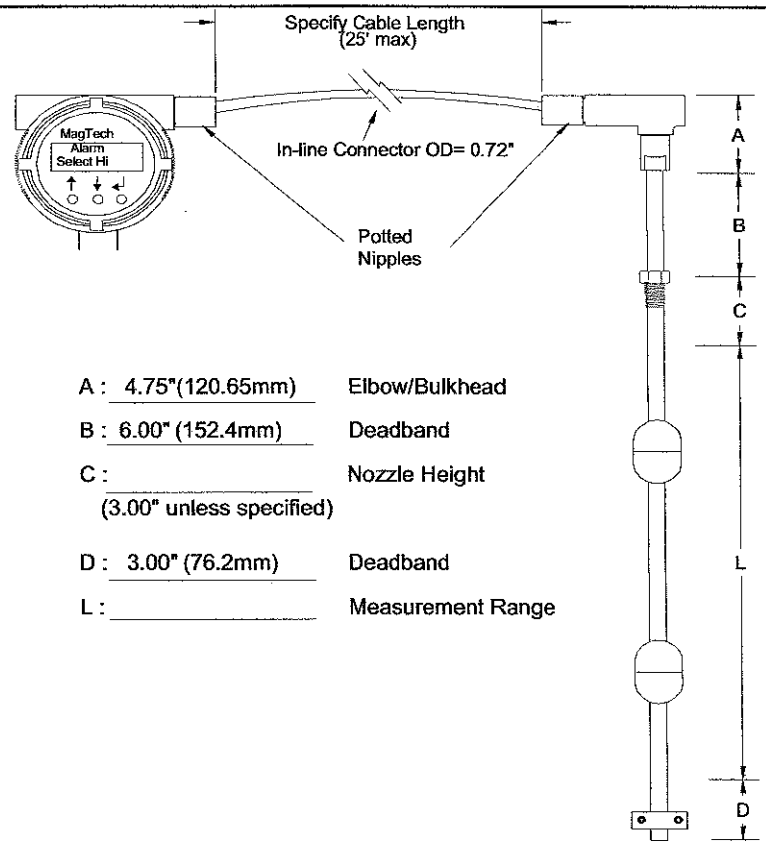
Min. S. G.	I.D.
≥ .64	2.0" (50.8mm)
< .64	4.0" (101.6mm)

(consult factory for more information)

- [ ] Remote Mount Electronics
  Specify Cable Length _____ (25' max.)
  (See Figure 2)

Area Classifications:

- [ ] FM (exp only): LTM-200D / 300
- [ ] CSA (exp): LTM-200D/250/300/350
- [ ] CSA (I/S): LTM-200D/300
- [ ] ATEX (exp only): LTM-300 / 300-FF
- [ ] IECex (exp only): LTM-300 / 300-FF



A : 4.75"(120.65mm) Elbow/Bulkhead

B : 6.00" (152.4mm) Deadband

C : _____ Nozzle Height
(3.00" unless specified)

D : 3.00" (76.2mm) Deadband

L : _____ Measurement Range

Figure 2: Remote Mount Electronics

Other Specifications: _____

PRESSURE GAGES

SHEET 1 OF 1

SPEC. NO. PI-1-1 | REV. 0

CONTRACT | DATE 5-30-15

REQ. | P.O.

BY BL | CHK'D | APPR.

NO	BY	DATE	REVISION
1	BL	9/4/15	DIA. SEAL

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4½" Color Black
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Sylphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR 2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. PG MFG. Type
    Wetted Part Mtl. SS Other Mtl.
    Fill Fluid GOOD FOR 250°F
    Process Conn. ¾" NPT Gage Conn. ½" NPT

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-1-1	0-15 PSI	10.3 PSIG	EVAPORATOR NO.1 CALANDRIA PRESSURE 5' CAPILLARY TUBING

Notes:

ISA FORM S20.41a

ISA

PRESSURE GAGES

SHEET 1 OF 1

NO	BY	DATE	REVISION
1	BL	9/4/15	DIA. SEAL

SPEC. NO. PI-2-1 REV. 0

CONTRACT DATE 5-30-15

REQ. P.O.

BY BL CHK'D APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color BLACK
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Sylphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR. 2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. PG MFG. Type
    Wetted Part Mtl. SS Other Mtl.
    Fill Fluid GOOD FOR 250°F
    Process Conn. 3/4" NPT Gage Conn. 1/2" NPT

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-2-1	30 IN Hg/15 PSI	4.2 PSIG	EVAPORATOR NO. 2 CALANDRIA PRESSURE

Notes:

ISA FORM S20.41a

PRESSURE GAGES

SHEET 1 OF 1

NO	BY	DATE	REVISION
1	BL	9/9/15	DIA SEAL

SPEC. NO. PZ-3-1 | REV. 0
CONTRACT | DATE 5-30-15
REQ. P.O.
BY BL | CHK'D | APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color BLACK
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Syphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required

10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. PG MFG Type
    Wetted Part Mtl. SS Other Mtl.
    Fill Fluid GOOD FOR 250°F
    Process Conn. 3/4" NPT Gage Conn. 1/2" NPT

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-3-1	30"Hg/13 PSI	-2 PSIG	EVAPORATOR NO.3 CALANDRIA PRESSURE

Notes:

ISA FORM S20.41a

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO.	REV.
TE-1-1	0
CONTRACT	DATE 5-31-15
REQ. - P.O.	
BY BL / CHK'D / APPR.	

THERMOMETER

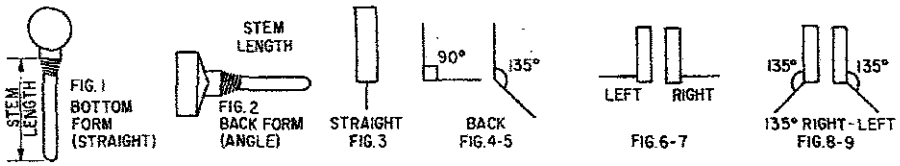
1. Stem: Threaded ■ Plain □ Union □ Material SS
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. ■ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 5" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ ENTRY-ANGLE
8. External Calibrator □ Herm Sealed Case ■ LIQ. FILLED
9. MFR. & Model No.

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □ Other:
12. Construction: Drilled ■ Built-Up □ Other:

Well Length Must Suit Stem Length.

ASME B40.3 GR. A



Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
0	TE-1-1	50/300	735°F	6"	1" NPT	1"	EVAP NO.1 CALANDRIA	

Notes:

ISA FORM S20.14a

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TI-2-1 | REV. 0

CONTRACT | DATE 5-31-15

REQ. - P.O.

BY BL | CHK'D | APPR.

THERMOMETER

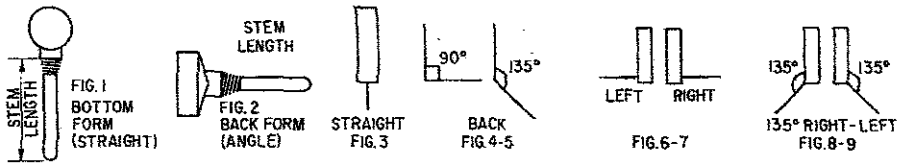
1. Stem: Threaded ■ Plain □ Union □ Material SS
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. ■ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 5" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ EVERY-ANGLE
8. External Calibrator □ Herm Sealed Case ■ LIQ. FILLED
9. MFR. & Model No.

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □ Other:
12. Construction: Drilled ■ Built-Up □ Other:

Well Length Must Suit Stem Length.

ASME B 40.3 GR.A



Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
1	TE-2-1	50/300	226°F	6"	1" NPT	1"	EVAP. NO. 2 CALANDRIA	

Notes:

ISA FORM S20.14a

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TI-3-1 REV. 0

CONTRACT DATE 5-31-15

REQ. - P.O.

BY BL CHK'D APPR.

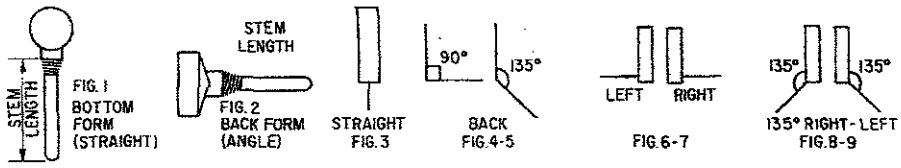
THERMOMETER

1. Stem: Threaded ■ Plain □ Union □ Material SS
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. ■ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 5" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ EVERY-ANGLE
8. External Calibrator □ Herm Sealed Case ■ LIQ. FILLED
9. MFR. & Model No. ASME B40.3 GR.A

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □ Other:
12. Construction: Drilled ■ Built-Up □ Other:

Well Length Must Suit Stem Length.



Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
1	TI-3-1	50/300	197°F	6"	1" NPT	1"	EVAP. NO. 3 CALANDRIA	

Notes:

ISA FORM S20.14a

PRESSURE GAGES

SHEET 1 OF 1

SPEC. NO. PI-1-2 | REV. 0

CONTRACT | DATE 5-30-15

REQ. P.O.

BY BL | CHK'D | APPR.

NO	BY	DATE	REVISION
1	BL	9/4/15	DIA. SEAL

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color Black
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front □ Other
7. Lens: Glass □ Plastic ■
8. Options: Syphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR. 2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. PG MFG. Type
    Wetted Part Mtl. SS Other Mtl.
    Fill Fluid GOOD FOR 250°F
    Process Conn. 3/4" NPT Gage Conn. 1/2" NPT

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-1-2	30 IN Hg/15 PSI	4.2 PSIG	EVAPORATOR NO.1 OVERHEAD PRESSURE

Notes:

ISA FORM S20.41a

PRESSURE GAGES

SHEET 1 OF 1

SPEC. NO. PI-2-2 | REV. 0

CONTRACT | DATE 5-30-15

REQ. | P.O.

NO	BY	DATE	REVISION
1	BL	9/4/15	DIA SEAL

BY BL | CHK'D | APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color BLACK
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Syphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR.2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. PC MFG. Type FLANGED
    Wetted Part Mtl. SS Other Mtl
    Fill Fluid GOOD FOR 250°F
    Process Conn. 3/4" NPT ige Conn. 1/2" NPT

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-2-2	30 IN Hg/15 PSI	-2 PSIG	EVAPORATOR NO. 2 OVERHEAD PRESSURE

Notes:

ISA FORM S20.41a

PRESSURE GAGES

SHEET 1 OF 1

SPEC. NO. PI-3-2 | REV. 0

CONTRACT | DATE 5-30-15

REQ. | P.O.

BY BL | CHK'D | APPR.

NO	BY	DATE	REVISION
1	BL	9/4/15	DIA. SEAL

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color BLACK
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Syphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required

10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom □ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. PG MFG. Type
    Wetted Part Mtl. SS Other Mtl.
    Fill Fluid GOOD FOR 250°F
    Process Conn. 3/4" NPT age Conn. 1/2" NPT

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-3-2	30 INHg/15 PSI	-12.3 PSIG	EVAPORATOR NO. 3 OVERHEAD PRESSURE

Notes:

ISA FORM S20.41a

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

NO	BY	DATE	REVISION

SHEET 1 OF 1

SPEC. NO. TT-1-2 | REV. 0

CONTRACT | DATE 5-31-15

REQ. - P.O.

BY BL | CHK'D | APPR.

THERMOMETER

1. Stem: Threaded ■ Plain □ Union □ Material SS
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. ■ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 5" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ EVERY-ANGLE
8. External Calibrator □ Herm Sealed Case ■ LIQ. FILLED
9. MFR. & Model No. ASME B40.3 GR. A

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □ Other:
12. Construction: Drilled ■ Built-Up □ Other:

Well Length Must Suit Stem Length.

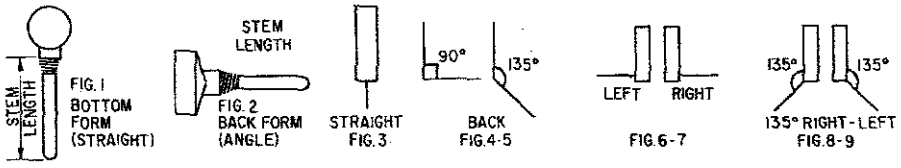


FIG. 1 BOTTOM FORM (STRAIGHT) | FIG. 2 BACK FORM (ANGLE) | STRAIGHT FIG. 3 | BACK FIG. 4-5 | FIG. 6-7 | 135° RIGHT-LEFT FIG. 8-9

Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
1	TT-1-2	50/300	226°F	6"	1" NPT		EVAP. NO. 1 OVRH.	

Notes:

ISA FORM S20.14a

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TT-2-2 | REV. 0

CONTRACT | DATE 5-31-15

REQ. - P.O.

BY BL | CHK'D | APPR.

THERMOMETER

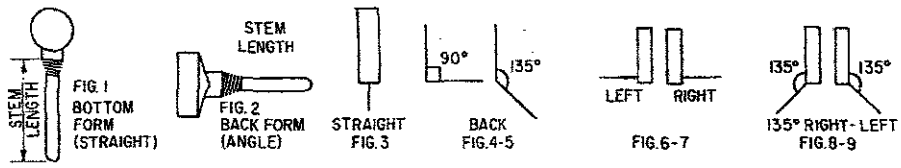
1. Stem: Threaded ■ Plain □ Union □ Material SS
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. ■ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 5" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ EVERY-ANGLE
8. External Calibrator □ Herm Sealed Case ■ LIQ. FILLED
9. MFR. & Model No.

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □ Other:
12. Construction: Drilled ■ Built-Up □ Other:

Well Length Must Suit Stem Length.

ASME B 40.3 GR. A



Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
1	TI-2-2	50/300	197°F	6"	1" NPT	1"	EVAP. NO. 2 OVRH.	

Notes:

ISA FORM S20.14a

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TT-3-2 REV. 0

CONTRACT DATE 5-31-15

REQ. - P.O.

BY BL CHK'D APPR.

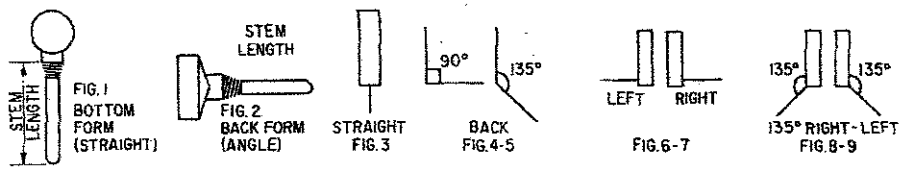
THERMOMETER

1. Stem: Threaded ■ Plain □ Union □ Material SS
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. ■ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 5" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ EVERY-ANGLE
8. External Calibrator □ Herm Sealed Case ■ LIQ FILLED
9. MFR. & Model No. ASME B40.3 GR.A

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □ Other:
12. Construction: Drilled ■ Built-Up □ Other:

Well Length Must Suit Stem Length.



Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
1	TE-3-2	50/300	133	6"	1" NPT		EVAP. NO.3 OVRH	

Notes:

ISA FORM S20.14a

PRESSURE GAGES

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. PE-2 | REV. 0

CONTRACT | DATE 5-30-15

REQ. P.O.

BY BL | CHK'D | APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color BLACK
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Syphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR. 2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. Type
    Wetted Part Mtl. Other Mtl.
    Fill Fluid
    Process Conn. Gage Conn.

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-2	0-30 PSI		PUMP P-2 DISCH. PRESS.

Notes:

ISA FORM S20.41a

PRESSURE GAGES

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. PI-3 REV.

CONTRACT DATE

REQ. P.O.

BY CHK'D APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color BLACK
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Sylphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR 2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. Type
    Wetted Part Mtl. Other Mtl.
    Fill Fluid
    Process Conn. Gage Conn.

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-3	0-30 PSI		PUMP P-3 DISCH. PRESS.

Notes:

ISA FORM S20.41a

VALVE SPECIFICATION

AMERICAN INCENTIVE

REV. NO.	0
BY	BL
APP.	
DATE	5/31/2015

VALVE COMPARISON LIST

STOCK NO.

PRESSURE RATING	ANSI CLASS 150	PRESSURE RATING
TYPE OF VALVE	THREE-WAY BALL VALVE	TYPE OF VALVE
BODY MATERIAL	316 STAINLESS STEEL	BODY MATERIAL
TRIM MATERIAL	316 STAINLESS STEEL	TRIM MATERIAL
END CONNECTION	THREADED ENDS	END CONNECTION
TEMP. LIMITATIONS	0 TO 400 DEG F	TEMP. LIMITATIONS
VALVE OPERATOR	ELECTRIC MOTOR (NOTE 1)	VALVE OPERATOR
BODY CONSTRUCTION	THREE-WAT FULL PORT	BODY CONSTR.
TRIM CONSTRUCTION	TEFLON SEAT	TRIM CONSTR.
STEM SEAL	POLYFILL	PACKING

MANUFACTURER	FIGURE NUMBER	SIZE RANGE
WORCESTER SERIES 18	1"BE1886TT150(PORT ARRANGEMENT TO BE DETERMINED)	1"

NOTES:
1. SERIES 75 ELECTRIC ACUTAOR.

TAG NO. BV-1

AMERICAN INGENUITY

REFRACTOMETERS

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 8/13/15 — P.O. NO.: — EQUIPMENT NO.: BI-1 & 2
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 2

GENERAL

REFRACTOMETERS SHALL BE K-PATENTS PR-23-AC REFRACTOMETERS FOR CONCENTRATION MESUREMENT.

SEE K-PATENTS QUOTATION NO. C13-6583-PW FOR REFERENCE, THIS QUOTATION WILL NEED TO BE UPDATED BOTH FOR BI-2 AND TO ADD BI-1.

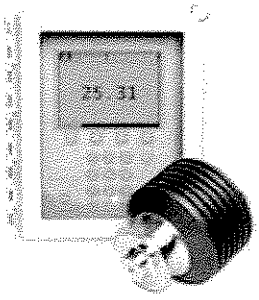
Use one transmitter for both Brix Probes.

Refractometer to be configured for water wash only.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

K-PATENTS
PROCESS INSTRUMENTS

QUOTATION C15-6583-PW (1/2)



Attn: American Ingenuity LLC, Prairieville LA
Jacob Coots
K-Patents Reference: C15-6583-PW
Customer Reference: University Research Skid Refractometer
Date of Quotation: Jul 8, 2015
Valid until: Oct 31, 2015
Application: Sugar cane (evaporation) 0 - 70 Brix

Dear Jacob,

We are pleased to offer you the **K-Patents Process Refractometers PR-23-AC** for concentration measurement.

The digital K-Patents Sanitary Refractometer PR-23 provides truly accurate means for liquid concentrations in food and beverage processing, where in-line monitoring can help to improve product quality and reduce costs.

The K-Patents PR-23 operation is not affected by particles, bubbles or color changes of the medium. Because of the digital sensing technology, even large amounts of suspended solids or bubbles do not affect the measurement or the accuracy.

The measurement range covers 0 - 100 Brix and the process temperature range is from -20 to 130°C (-4 to 266°F). The accuracy is +/- 0.1 Brix and the measurement is automatically temperature compensated. The 4-20 mA output signal is proportional to the process concentration. Low and high concentration alarms can be configured easily. Furthermore, the digital measuring system does not require re-calibration or maintenance.

The key features of the K-Patents PR-23 are:

- Identical calibration of each sensor: measurement range Refractive Index (nD) 1.3200 – 1.5300, which corresponds to 0-100 Conc%b.w. at 100°C (212°F). All sensors are freely interchangeable.
- Direct, digital concentration analysis by actual Refractive Index measurement.
- **Dual connectivity**: transmitter can operate two sensor independently. A second sensor can be easily integrated later.
- Completely digital system: particles and bubbles do not affect operation or accuracy.
- **Patented CORE-optics module**: no drift, no re-calibration, no mechanical adjustments.
- Fast process temperature measurement by built-in Pt1000 and automatic temperature compensation
- Easy on-site instrument verification within users' own quality assurance system with standard Refractive Index liquids

In case you would like to have more information, assistance in specifying the measurement system or comparison of different options, please do not hesitate to contact us.

Sincerely,

Phil Wagner
Regional Manager

K-PATENTS, INC.
1804 Centre Point Circle - Suite 106
Naperville IL 60563
Mobile: Int. 219-218-9706
Phone: (630) 955-1545
Fax: (630) 955-1585
phil.wagner@kpatents-usa.com
www.kpatents.com

K-PATENTS
PROCESS INSTRUMENTS

QUOTATION C15-6583-PW

(2/2)

FOR BJ-2

Item	Description	Qty	Price USD	Total USD
100	**PR-23-AC-62-HSS-GP-AA** PR-23 Sensor -A *Sensor model:* 3A approved C *Sensor type:* Compact type for pipe line installations -62 *Refractive Index range limits:* R.I. 1.320 - 1.530 nD (0 - 100 Brix) Spinel prism -H *Process connection:* Sanitary 3A-clamp, 2 ½ inch, insertion length 14 mm SS *Sensor wetted parts material:* AISI 316 L -GP *Electrical classification:* General Purpose -AA *Sensor housing:* Anodized aluminum	1	6460	6460
200	**AFC-HSS-H10-RI-NC-PG** AFC Elbow flow cell -H *Sensor connection:* Sanitary 3A-clamp, 2½ inch SS *Material of Construction:* AISI 316 L -H *Process connection:* Sanitary 3A clamp 10 *Pipe section diameter:* 25 mm (1 inch) -RI *Flow cell inlet type:* Reduced pipe (cone) -NC *Wash nozzle connection:* Nozzle connection -PG *Wash nozzles:* Plug for nozzle connection	1	1150	1150
300	**Indicating transmitter: DTR-U-CS-AC** DTR Indicating transmitter (connectivity for two sensors) -U *Cable connection:* ½ inch NPT type conduit hubs -CS *Electrical classification:* CSA certified for use in general purpose (ordinary) locations Applicable to CSA and ANSI/UL standards -AC *Power supply:* Power supply 100 - 240 VAC 50/60 Hz	1	5140	5140
400	**Interconnecting cable: PR-8230-010** PR-8230 Interconnecting cable between transmitter and sensor (standard black cable) (for STR transmitter: Interconnecting cable between transmitter and isolator) -010 *Cable length:* 10 meters (33 ft)	1	130	130
500	**PR-9211** PR-9211 Sanitary clamp 1 and 1 ½ inch	2	160	320
600	**PR-9246** PR-9246 3A-gasket EPDM 1 inch	2	65	130
700	**PR-9248** PR-9248 Ferrule for Sanitary clamp 1 inch	2	85	170
800	**FC-11-KIT** FC-11-KIT Field Communicator	1	820	820
	Instruction manual	2	Incl	Incl
	Total Price USD			14320

Terms and conditions

Delivery time:	Normally 6 weeks after receipt of order
Payment terms:	30 days net
Delivery terms:	FOB shipping point Naperville (Incoterms 2010)
Warranty:	Warranty period is 24 months from the date of the delivery
Prices:	All prices are in USD
Documentation:	All needed documents and certificates (e.g. material certificate) addition to K-Patents standard documentation and drawings shall be requested before purchase order and are available for additional price.

4.2.1 Recommended wash pressures and times

The recommended wash pressures and times are given in the tables below.

Wash medium parameters for integral wash nozzles in PR-23-AP/GP					
	Minimum *above process pressure*	**Maximum** *above process pressure*	**Wash time**	**Recovery**	**Interval**
Steam (SN)	2 bar (30 psi)	4 bar (60 psi)	3 s	20–30 s	20–30 min
Water (WN)	2 bar (30 psi)	4 bar (60 psi)	10 s	20–30 s	10–20 min
High pressure water (WP)	15 bar (220 psi)	40 bar (600 psi)	10 s	20–30 s	10–20 min

Wash medium parameters for flow cell wash nozzle AFC					
	Minimum *above process pressure*	**Maximum** *above process pressure*	**Wash time**	**Reco-very**	**Interval**
Steam (SN)	3 bar (45 psi)	6 bar (90 psi)	3–5 s	20–30 s	20–30 min
Water (WN)	3 bar (45 psi)	6 bar (90 psi)	10–15 s	20–30 s	10–20 min
High pressure water (WP)	25 bar (350 psi)	35 bar (500 psi)	10–15 s	20–30 s	10–20 min

Wash medium parameters for Safe-Drive Isolation valve nozzle SDI					
	Minimum *above process pressure*	**Maximum** *above process pressure*	**Wash time**	**Reco-very**	**Interval**
Steam (SN)	5 bar (75 psi)	8 bar (115 psi)	3–5 s	20–30 s	20–30 min
High pressure water (WP)	25 bar (350 psi)	50 bar (725 psi)	10–15 s	20–30 s	5–20 min

Important: In steam wash, do not exceed the recommended wash times, because some process media may burn to the prism surface if steamed for longer time. In case of coating, shorten the wash interval.
See also Section 6.7.2 for the Automatic wash cut parameter.

Note: In water wash, water temperature should be above the process temperature.

Note: The check valve pressure drop is 0.7 bar (10 psi).

4.2.2 Prism wash systems

The prism wash system for steam is described by Figure 4.1 and for sanitary systems Figure 4.2. The prism was system for high pressure water is described by Figure 4.4 and for sanitary systems Figure 4.5.

! **Warning!** In high pressure wash systems, pressure increase can occur in a closed pipe section when the high pressure pump is operated. K-Patents recommends to mount a pressure relief valve in the pipe section. Relief pressure should be according to pipe pressure rating.

			PRESSURE RELIEF VALVES				SHEET 1 OF 1
			NO	BY	DATE	REVISION	SPEC. NO. RV-2 / REV. 0
							CONTRACT / DATE 5-30-15
							REQ. - P.O.
							BY BL / CHK'D / APPR.

GENERAL	1.	Tag Number	RV-2									
	2.	Service	P-2 DISCH									
	3.	Line No./Vessel No.										
	4.	Full Nozzle/Semi Nozzle	FULL									
	5.	Safety or Relief	RELIEF									
	6.	Conv., Bellows, Pilot Op.	CONV									
	7.	Bonnet Type										
CONN.	8.	Size: Inlet / Outlet	3/4" / 1"									
	9.	Flange Rating or Screwed	SCREWED									
	10.	Type of Facing										
MATERIALS	11.	Body and Bonnet	S.S.									
	12.	Seat and Disc	S.S.									
	13.	Resilient Seat Seal	S.S.									
	14.	Guide and Rings	S.S.									
	15.	Spring	S.S.									
	16.	Bellows	S.S.									
	17.											
OPTIONS	18.	Cap: Screwed or Bolted	SCRD.									
	19.	Lever: Plain or Packed										
	20.	Test Gage										
	21.											
	22.											
	23.											
BASIS	24.	Code										
	25.	Fire										
	26.											
	27.											
FLUID DATA	28.	Fluid and State	SUGAR CANE JUICE									
	29.	Required Capacity	5 GPM									
	30.	Mol. Wt. / Oper. sp. gr.		1.37								
	31.	Oper. Press. / Set Press.		100PSIG								
	32.	Oper. Temp. / Rel. Temp.		147°F								
	33.	Back Pressure: Constant										
	34.	Back Pressure: Variable										
	35.	Back Pressure: Total	2 PSIG									
	36.	% Allowable Overpressure	10%									
	37.	Overpressure Factor										
	38.	Compressibility Factor										
	39.	Latent Heat of Vaporization										
	40.	Ratio of Specific Heats										
	41.	Operating Viscosity										
	42.	Barometric Pressure										
	43.											
	44.											
	45.	Calc. Area sq. in.										
	46.	Selected Area	*									
	47.	Orifice Designation	*									
	48.	Manufacturer	*									
	49.	Model No.	*									

Notes:

* VENDOR SUPPLIED INFO

ISA Form S20.53

PRESSURE RELIEF VALVES

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. RV-3 | REV. 0

CONTRACT | DATE 5-30-15

REQ. - P.O.

BY BL | CHK'D | APPR.

GENERAL	1.	Tag Number		RV-3							
	2.	Service		P-3 DISCH							
	3.	Line No./Vessel No.									
	4.	Full Nozzle/Semi Nozzle		FULL							
	5.	Safety or Relief		RELIEF							
	6.	Conv., Bellows, Pilot Op.		CONV							
	7.	Bonnet Type									
CONN.	8.	Size: Inlet	Outlet	3/4"	1"						
	9.	Flange Rating or Screwed		SCREWED							
	10.	Type of Facing									
MATERIALS	11.	Body and Bonnet		C.S.							
	12.	Seat and Disc		MFG. STD.							
	13.	Resilient Seat Seal		MFG. STD.							
	14.	Guide and Rings		MFG. STD.							
	15.	Spring		MFG. STD.							
	16.	Bellows		MFG. STD.							
	17.										
OPTIONS	18.	Cap: Screwed or Bolted		SCRD.							
	19.	Lever: Plain or Packed									
	20.	Test Gage									
	21.										
	22.										
	23.										
BASIS	24.	Code									
	25.	Fire									
	26.										
	27.										
FLUID DATA	28.	Fluid and State		STEAM COND.							
	29.	Required Capacity		5 GPM							
	30.	Mol. Wt.	Oper. sp. gr.		0.96						
	31.	Oper. Press.	Set Press.		100 PSIG						
	32.	Oper. Temp.	Rel. Temp.		209°F						
	33.	Back Pressure	Constant								
	34.		Variable								
	35.		Total		0						
	36.	% Allowable Overpressure			10%						
	37.	Overpressure Factor									
	38.	Compressibility Factor									
	39.	Latent Heat of Vaporization									
	40.	Ratio of Specific Heats									
	41.	Operating Viscosity									
	42.	Barometric Pressure									
	43.										
	44.										
	45.	Calc. Area sq. in.									
	46.	Selected Area		*							
	47.	Orifice Designation		*							
	48.	Manufacturer		*							
	49.	Model No.		*							

Notes: * VENDOR SUPPLIED INFO

ISA Form S20.53

PRESSURE GAGES

NO	BY	DATE	REVISION
1	BDI	4/18/15	CHANGED SERVICE AND RANGE

SHEET 1 OF 1

SPEC. NO. PI-4 REV. 0

CONTRACT DATE 5-30-15

REQ. P.O.

BY BL CHK'D APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4½" Color BLACK
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Sylphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. Type
    Wetted Part Mtl. Other Mtl.
    Fill Fluid
    Process Conn. Gage Conn.

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-4	~~30 IN Hg~~ 0-30 PSIG	1	~~VACUUM PUMP P-4 SUCTION PRESS.~~ STEAM CONDENSATE PUMP, P-4, DISCH. PRESS.

Notes:

ISA FORM S20.41a

PRESSURE GAGES

SHEET 1 OF 1

NO	BY	DATE	REVISION
1	BDL	6-18-15	Changed Service And Range

SPEC. NO. PL-5 | REV. 0

CONTRACT | DATE 5-30-15

REQ. | P.O.

BY BL | CHK'D | APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4½" Color BLACK
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic ■
8. Options: Sylphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR 2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. Type
    Wetted Part Mtl. Other Mtl.
    Fill Fluid
    Process Conn. Gage Conn.

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-5	~~0-30 PSI~~ 30/0 in Hg	1	~~VACUUM CONDENSER C.W. SUPPLY PRESS.~~ VACUUM PUMP P-5 SUCTION PRESS.

Notes:

ISA FORM S20.41a

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

LG-4

Magtech Level Indicator

Magtech MLI Quick Data Sheet

★ Default ○ Select only one of the items provided ☐ One or more of the listed items can be selected

General information

Company: AUDUBON SUGAR INSTITUTE Date: 6-18-15

Contact Name: BRUCE LaCOUR Phone No.: 225-933-4458

Email: lacourb1@att.net RFQ No.:

Customer-specific design criteria

Are there any existing specifications, including weld procedures, general piping specifications, or an approved manufacturer specification, to which this MLI must comply? ○ Yes ○ No

If so, please list or provide:

Other Special Request (describe or attach sketch):

Process conditions

Pressure	**Min:** FV	**Oper:** -12.3	**Max:** 0	**Units of Measurement:** PSIG
Temperature	**Min:** 20	**Oper:** 133	**Max:** 240	**Units of Measurement:** DEG F

Description of Media STEAM CONDENSATE

Specific Gravity (SG) **Min:** 0.990 **Oper:** 0.992

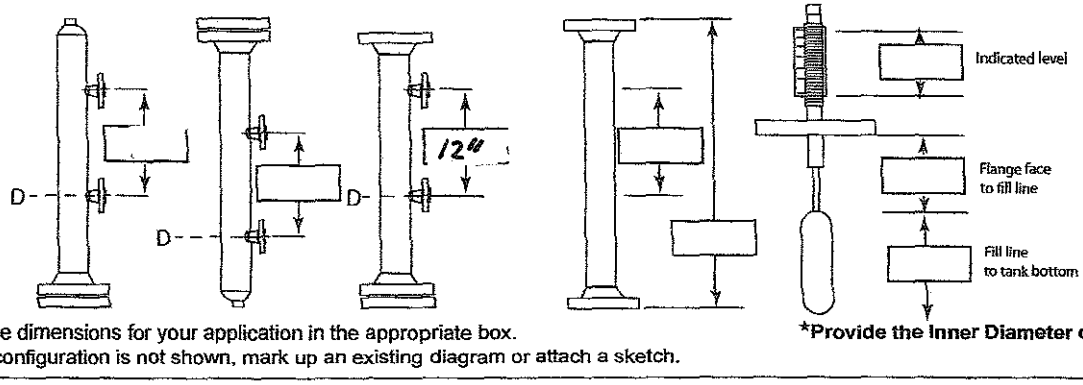
Is this an interface? Yes ☐ No ■

If Yes **Lower Fluid:** **Min SG / Max SG** ___/___ **Upper Fluid: Min SG / Max SG** ___/___

Does Media Boil or Flash? Yes ■ No ☐

Mounting style

Select Style: _____ ○ ● ○ ○



Enter the dimensions for your application in the appropriate box.
If your configuration is not shown, mark up an existing diagram or attach a sketch.

*Provide the Inner Diameter of the nozzle.

Material of construction

- ● 316/316L SS*
- ○ 316/316L SS Pipe with Carbon Steel Flanges
- ○ Other Non-Magnetic Material: _____

Process connection type

- ○ None
- ● RFSO
- ○ RFWN
- ○ RFLJ
- ○ RTJWN
- ○ XW Option - weld to a primary chamber housing guided wave radar
- ○ NPTM Thread
- ○ NPTF Thread
- ○ Socket Weld
- ○ Plain End Nipple
- ○ Other: _____

LG-4

Magtech Level Indicator

Quick Data Sheet
00806-0100-4430, Rev AB
February 2014

Rating	Process connection size (inch)
● 150# ○ 300# ○ 600#	○ ½ ○ 1½ ● ¾
○ 900# ○ 1500# ○ Other: ____	○ 1 ○ 1¼ ○ 2 ○ Other: ____

Vent 316 SS BLD FLG. ☐ Valve (Optional)

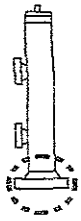
☐ NPT SW
½"
¾"
○ 1"
☐ Other: ____

FOR LEVEL TRANSMITTER

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel
**Valve Class: ____

Drain 316 SS BLD FLG ■ Valve (Optional)



☐ NPT ■ SW ✗
● ½" THRD OPEN
¾" END WITH
○ 1" PLUG
☐ Other: ____

Type
○ Ball
● Gate
○ Globe
○ Other

Material
○ Carbon Steel
● Stainless Steel
**Valve Class: 800

Indicator

○ None
○ Flippers with Scale*
○ Follower with Scale
● Polycarbonate Indicator
○ Standard colors: Red and silver
○ Other color (specify): ____

Zero Offset from datum, if Any: ____

Select scale orientation: Top view (Indicator facing user)


○ Left Hand


● Right Hand


○ Standard*

Units on indicator scale

○ Feet & Inches*
○ %
○ Inches only
○ Metric
○ Other. Please specify: ____

Options & accessories

☐ Welded Support Clip
☐ Adjustable Support Clip
☐ Level Switches (specify number)(1)
☐ Magnetostrictive Transmitter(1)
☐ Reed Type Transmitter(1)
☐ Insulation Blanket
☐ Steam Tracing with Blanket
☐ Electric Heat Tracing with Blanket
☐ Insulation with Hard Shell-Cryogenic

Optional tests, inspections & quality certifications

☐ PMI
☐ Hydrostatic Test
☐ Dye Pen Branch Connections
☐ X-Ray
☐ Post-weld Heat Treatment
○ NACE MR0103
○ NACE MR0175
☐ ASME B31.1
☐ ASME B31.3
☐ Full Penetration Welds
☐ Material Traceability Report (MTR)

(1) Provide additional requirements.

Emerson Process Management
Rosemount Division
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-999-9307
T (International) (952) 906-8888
F (952) 949-8889

www.rosemount.com

EMERSON.
Process Management

Magtech

LTM Series Transmitter Quotation Request

3902 Magnolia Rd.
Pearland, Texas 77584
Phone 281-488-0788 Fax 281-488-7080

LTM Series Transmitter Quotation Request

Quote/Order # _____ Contact BRUCE LACOUR

Company/Rep. _____ Email LACOURB1@ATT.NET

Phone # 225-933-4458 Date 6-18-15

Fax # _____

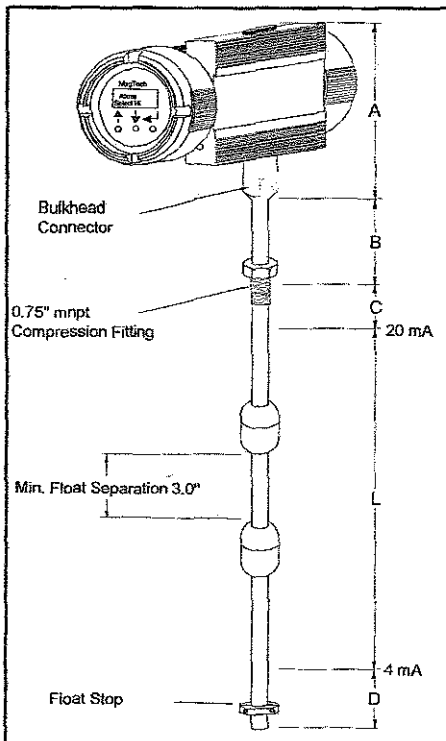


Figure 1: LTM Series Transmitter

Qty: 1

47-4

Models and Output Options:

■ **LTM-200D** **LTM-250**
- Single Level 4/20 mA Analog Output (if interface level, provide upper S. G.)

Lower S. G.: 0.992
Upper S. G.: _____ (if applicable)

☐ **LTM-300 (HART-5)** ☐ **LTM-350 (HART-7)**

Check only one option

☐ Option 1: Single Level 4/20 mA Analog Output (if interface level, provide upper S. G.)

☐ Option 2: Dual Level Output (if interface level, provide upper S. G.)
- Upper Level - 4/20 mA Analog
- Lower (Interface) Level - Digital

(Analog and digital level outputs are interchangeable.)

Lower S. G.: _____
Upper S. G.: _____ (if applicable)

☐ Option 3: Single Level Output with Temperature
- Level Output - 4/20 mA Analog
- Temperature - Digital Only

Temp. Range: _____ (if applicable)(Max. 300°F)

☐ Option 4: Dual Level Output with Temperature
- Upper Level - 4/20 mA Analog
- Lower (Interface) Level - Digital
- Temperature - Digital Only

(Analog and digital level outputs are interchangeable.)

☐ **LTM-300-FF (Foundation Fieldbus.)**

Check only one option

☐ Option 1: Single Level Output (if interface level, provide upper S. G.)

☐ Option 2: Dual Level Output

☐ Option 3: Single Level Output w/ Temperature (if interface level, provide upper S. G.)

☐ Option 4: Dual Level Output w/ Temperature

Lower S. G.: _____
Upper S. G.: _____ (if applicable)

Temp. Range: _____ (if applicable)(Max. 300°F)

A: 7.00" (177.8 mm)	Housing/Bulkhead
B: 6.00" (152.4 mm)	Deadband
C:	Nozzle Height
(3.00" unless specified)	
D: 3.00" (76.2mm)	Deadband
L: 9"	Measurement Range

Units of Measurement

■ inches
☐ feet (field selectable)
☐ mm
☐ cm
☐ m

Standard	Dual Compartment Housing (Aluminum Epoxy Coated) ✓
Standard	Integral LCD Display ✓
Optional:	Stainless Steel Housing (Consult Factory)

** NOTE: PLEASE COMPLETE REVERSE SIDE

LTM Series Transmitter
Quotation Request

3902 Magnolia Rd.
Pearland, Texas 77584
Phone 281-488-0788 Fax 281-488-7080

Probe Specifications: (5/8" (15.875mm) Std.)

- [x] 316 SS Std.
  - [ ] Kynar Sleeved
  - [ ] Teflon Sleeved
  - (if applicable)
- [ ] Alloy 20
- [ ] Hastalloy-C

Process Connections:

- [ ] 3/4" mnpt
- [x] Flange, specify: 316 SS LG-4 TOP FLG

Additional Options:

- [ ] Stilling Well (recommended over 10 ft.)
  (minumum 3.00" I.D. or consult factory)
- [ ] Nozzle Requirements

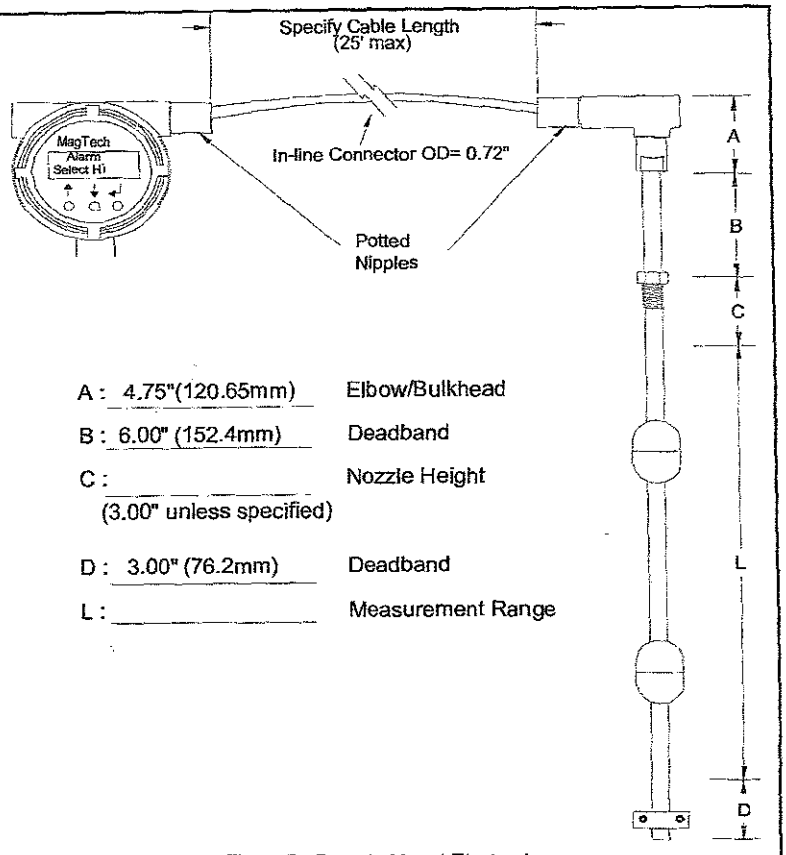
Min. S. G.	I.D.
≥ .64	2.0" (50.8mm)
< .64	4.0" (101.6mm)

(consult factory for more information)

- [ ] Remote Mount Electronics
  Specify Cable Length _____ (25' max.)
  (See Figure 2)

Area Classifications:

- [ ] FM (exp only): LTM-200D / 300
- [ ] CSA (exp): LTM-200D/250/300/350
- [ ] CSA (I/S): LTM-200D/300
- [ ] ATEX (exp only): LTM-300 / 300-FF
- [ ] IECex (exp only): LTM-300 / 300-FF



A : 4.75"(120.65mm) Elbow/Bulkhead

B : 6.00" (152.4mm) Deadband

C : _____ Nozzle Height
(3.00" unless specified)

D : 3.00" (76.2mm) Deadband

L : _____ Measurement Range

Figure 2: Remote Mount Electronics

Other Specifications: _____

PRESSURE GAGES

SHEET 1 OF 1

SPEC. NO. PI-6 | REV. 0

CONTRACT | DATE 6-18-15

REQ. | P.O.

BY BL | CHK'D | APPR.

NO	BY	DATE	REVISION

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic □
8. Options: Sylphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR. 2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. Type
    Wetted Part Mtl. Other Mtl.
    Fill Fluid
    Process Conn. Gage Conn.

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-6	0-60 PSI		CONDENSER E-1 C.W. SUPPLY PRESS.

Notes:

ISA FORM S20.41a

PRESSURE GAGES

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. PI-7 | REV. 0

CONTRACT | DATE 6-18-15

REQ. P.O.

BY BL | CHK'D | APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver □
   Other
2. Mounting: Surface □ Local ■ Flush □
3. Dial: Diameter 4 1/2" Color
4. Case: Cast Iron □ Aluminum □ Phenol ■
   Other
5. Ring: Screwed ■ Hinged □ Slip □ Std □
   Other
6. Blow-out Protection None □ Back ■ Disc □
   Solid Front ■ Other
7. Lens: Glass □ Plastic □
8. Options: Sylphon □ Material
   Snubber □
   Pressure Limit Valve □
   Movement Damping □
9. Nominal Accuracy Required ASME B40.1 GR.2A
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows □
    Other
12. Element Mtl: Bronze □ Steel □ 316L SS
    Other
13. Socket Mtl: Bronze □ Steel □ 316L SS
    Other
14. Connection-NPT: ¼ in. □ ½ in. ■ Other
    Bottom ■ Back □
15. Movement: Bronze □ SS ■ Nylon □
    Other
16. Diaphragm Seal
    MFG. Type
    Wetted Part Mtl. Other Mtl.
    Fill Fluid
    Process Conn. Gage Conn.

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-7	0-60 PSI		CONDENSER E-1 CW RETURN PRESS.

Notes:

ISA FORM S20.41a

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TI-7 REV. 0

CONTRACT DATE 6-18-15

REQ. - P.O.

BY BL CHK'D APPR.

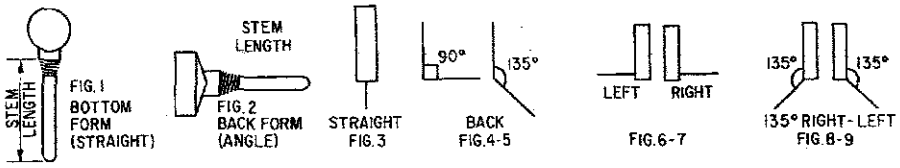
THERMOMETER

1. Stem: Threaded ■ Plain □ Union □ Material
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. ■ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 5" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ EVERY-ANGLE
8. External Calibrator □ Herm Sealed Case ■ - LIQ. FILLED
9. MFR. & Model No. ASME B 40.3 GR. A

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □ Other:
12. Construction: Drilled ■ Built-Up □ Other:

Well Length Must Suit Stem Length.



Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
0	TI-7	0-150		6"	3/4" THRD		CONDENSER E-1 C.W. RETURN TEMP.	

Notes:

ISA FORM S20.14a

			PRESSURE RELIEF VALVES			SHEET 1 OF 1	
			NO	BY	DATE	REVISION	SPEC. NO. RV-4	REV. 0
							CONTRACT	DATE 6/16/15
							REQ. - P.O.	
							BY DL	CHK'D	APPR.

GENERAL	1.	Tag Number	RV-4									
	2.	Service	P-4 DISCH									
	3.	Line No./Vessel No.										
	4.	Full Nozzle/Semi Nozzle	FULL									
	5.	Safety or Relief	RELIEF									
	6.	Conv., Bellows, Pilot Op.	CONV									
	7.	Bonnet Type										
CONN.	8.	Size: Inlet / Outlet	3/4"	1"								
	9.	Flange Rating or Screwed	SCREWED									
	10.	Type of Facing										
MATERIALS	11.	Body and Bonnet	C.S.									
	12.	Seat and Disc	MFG. STD.									
	13.	Resilient Seat Seal	MFG. STD.									
	14.	Guide and Rings	MFG. STD.									
	15.	Spring	MFG. STD.									
	16.	Bellows	MFG. STD.									
	17.											
OPTIONS	18.	Cap: Screwed or Bolted	SCRD.									
	19.	Lever: Plain or Packed										
	20.	Test Gage										
	21.											
	22.											
	23.											
BASIS	24.	Code										
	25.	Fire										
	26.											
	27.											
FLUID DATA	28.	Fluid and State	STEAM COND.									
	29.	Required Capacity	5 GPM									
	30.	Mol. Wt. / Oper. sp. gr.		0.92								
	31.	Oper. Press. / Set Press.		100 PSIG								
	32.	Oper. Temp. / Rel. Temp.		783°F								
	33.	Back Pressure: Constant										
	34.	Back Pressure: Variable										
	35.	Back Pressure: Total		0								
	36.	% Allowable Overpressure		10%								
	37.	Overpressure Factor										
	38.	Compressibility Factor										
	39.	Latent Heat of Vaporization										
	40.	Ratio of Specific Heats										
	41.	Operating Viscosity										
	42.	Barometric Pressure										
	43.											
	44.											
	45.	Calc. Area sq. in.										
	46.	Selected Area	*									
	47.	Orifice Designation	*									
	48.	Manufacturer	*									
	49.	Model No.	*									

Notes: * VENDOR SUPPLIED INFO

ISA Form S20.53

ISA S20.50, Rev. 1 **CONTROL VALVE DATA SHEET** **Second Printing**

PROJECT
UNIT
P.O.
ITEM
CONTRACT
*MFR. SERIAL

DATA SHEET 1 of 1
SPEC
TAG LV-C2-1
DWG
SERVICE EVAPORATOR NO. 2 CALANDRIA LEVEL

1 Fluid SUGAR CANE JUICE — Crit Press PC

SERVICE CONDITIONS

		Units	Max Flow	Norm Flow	Min Flow	Shut-Off
2	Flow Rate	GPM	4	2.8	1	—
3	Inlet Pressure	PSIG		4.2		
4	Outlet Pressure	PSIG		-2.0		
5	Inlet Temperature	°F		226		
6	Spec Wt/(Spec Grav)/Mol Wt			1.06		—
7	Viscosity/Spec Heats Ratio					—
8	Vapor Pressure P_V					—
9	*Required C_V					—
10	*Travel	%				0
11	Allowable/*Predicted SPL	dBA	/	/	/	—
12						

LINE
13 Pipe Line Size & Schedule — In 1" S40S
14 Out 1" S40S
15 Pipe Line Insulation NONE

VALVE BODY/BONNET
16 *Type
17 *Size ANSI Class 150
18 Max Press/Temp 80 PSIG / 350°F
19 *Mfr & Model
20 *Body/Bonnet Matl 304 SS
21 *Liner Material/ID
22 End Connection — In RF FLG
23 Out RF FLG
24 Flg Face Finish
25 End Ext/Matl
26 *Flow Direction
27 *Type of Bonnet
28 Lub & Iso Valve — Lube
29 *Packing Material
30 *Packing Type
31

TRIM
32 *Type
33 *Size — Rated Travel
34 *Characteristic
35 *Balanced/Unbalanced
36 *Rated C_V — F_L — X_T
37 *Plug/Ball/Disk Material
38 *Seat Material
39 *Cage/Guide Material
40 *Stem Material
41
42

SPECIALS/ACCESSORIES
43 NEC Class — Group — Div
44 UNCLASSIFIED
45
46
47
48
49
50
51
52

ACTUATOR
53 *Type
54 *Mfr & Model
55 *Size — Eff Area
56 On/Off — Modulating
57 Spring Action Open/Close
58 *Max Allowable Pressure
59 *Min Required Pressure
60 Available Air Supply Pressure:
61 Max — Min
62 *Bench Range /
63 Actuator Orientation
64 Handwheel Type
65 Air Failure Valve — Set at
66

POSITIONER
67 Input Signal
68 *Type
69 *Mfr & Model
70 *On Incr Signal Output Incr/Decr
71 Gauges — By-pass
72 *Cam Characteristic
73

SWITCHES
74 Type — Quantity
75 *Mfr & Model
76 Contacts/Rating
77 Actuation Points
78

AIR SET
79 *Mfr & Model
80 *Set Pressure
81 Filter — Gauge
82

TESTS
83 *Hydro Pressure
84 ANSI/FCI Leakage Class
85
86

Rev	Date	Revision	Orig	App

ISA FORM S20.50 Rev. 1

*Information supplied by manufacturer unless already specified

ISA FORM S20.50, Rev.1

PRESSURE RELIEF VALVES		SHEET 1 OF 1	
		SPEC. NO. RV-1	REV. 0
		CONTRACT	DATE 7-2-15
		REQ. · P.O.	
		BY BL / CHK'D	APPR.

NO	BY	DATE	REVISION

Section	No.	Item				
GENERAL	1.	Tag Number	RV-1			
	2.	Service	P-1 DISCH			
	3.	Line No./Vessel No.				
	4.	Full Nozzle/Semi Nozzle	FULL			
	5.	Safety or Relief	RELIEF			
	6.	Conv., Bellows, Pilot Op.	CONV			
	7.	Bonnet Type				
CONN.	8.	Size: Inlet / Outlet	3/4" / 1"			
	9.	Flange Rating or Screwed	SCREWED			
	10.	Type of Facing				
MATERIALS	11.	Body and Bonnet	S.S.			
	12.	Seat and Disc	MFG. STD.			
	13.	Resilient Seat Seal	MFG. STD.			
	14.	Guide and Rings	MFG. STD.			
	15.	Spring	MFG. STD.			
	16.	Bellows				
	17.					
OPTIONS	18.	Cap: Screwed or Bolted	SCRD.			
	19.	Lever: Plain or Packed				
	20.	Test Gage				
	21.					
	22.					
	23.					
BASIS	24.	Code				
	25.	Fire				
	26.					
	27.					
FLUID DATA	28.	Fluid and State	SUGAR CANE JUICE			
	29.	Required Capacity	5 GPM			
	30.	Mol. Wt. / Oper. sp. gr.	/ 1.06			
	31.	Oper. Press. / Set Press.	/ 100 PSIG			
	32.	Oper. Temp. / Rel. Temp.	/ 209°F - 226°F			
	33.	Back Pressure: Constant				
	34.	Back Pressure: Variable				
	35.	Back Pressure: Total	0			
	36.	% Allowable Overpressure	10%			
	37.	Overpressure Factor				
	38.	Compressibility Factor				
	39.	Latent Heat of Vaporization				
	40.	Ratio of Specific Heats				
	41.	Operating Viscosity				
	42.	Barometric Pressure				
	43.					
	44.					
	45.	Calc. Area sq. in.	*			
	46.	Selected Area	*			
	47.	Orifice Designation	*			
	48.	Manufacturer	*			
	49.	Model No.	*			

Notes: * VENDOR SUPPLIED INFO

ISA Form S20.53

ISA S20.50, Rev. 1 **CONTROL VALVE DATA SHEET** Second Printing

PROJECT
UNIT
P.O.
ITEM
CONTRACT
*MFR. SERIAL

DATA SHEET 1 of 1
SPEC
TAG LV-C3-1
DWG
SERVICE EVAPORATOR NO.3 CALANDRIA LEVEL

Fluid — Crit Press PC

SERVICE CONDITIONS

	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
Flow Rate	GPM	2.8	1.7	0.5	—
Inlet Pressure	PSIG		-2.0		
Outlet Pressure	PSIG		-12.3		
Inlet Temperature	°F		207		
Spec Wt/Spec Grav/Mol Wt			1.09		—
Viscosity/Spec Heats Ratio					—
Vapor Pressure P_v					—
*Required C_v					—
*Travel	%				0
Allowable/*Predicted SPL	dBA	/	/	/	—

LINE
Pipe Line Size & Schedule: In 1" S40S; Out 1" S40S
Pipe Line Insulation NONE

VALVE BODY/BONNET
*Type
*Size ANSI Class 150
Max Press/Temp 80 PSIG / 350°F
*Mfr & Model
*Body/Bonnet Matl 304 SS
*Liner Material/ID
End Connection: In RF FLG; Out RF FLG
Flg Face Finish
End Ext/Matl
*Flow Direction
*Type of Bonnet
Lub & Iso Valve Lube
*Packing Material
*Packing Type

TRIM
*Type
*Size Rated Travel
*Characteristic
*Balanced/Unbalanced
*Rated C_v F_L X_T
*Plug/Ball/Disk Material
*Seat Material
*Cage/Guide Material
*Stem Material

SPECIALS/ACCESSORIES
NEC Class Group Div
UNCLASSIFIED

ACTUATOR
*Type
*Mfr & Model
*Size Eff Area
On/Off Modulating
Spring Action Open/Close
*Max Allowable Pressure
*Min Required Pressure
Available Air Supply Pressure:
Max Min
*Bench Range /
Actuator Orientation
Handwheel Type
Air Failure Valve Set at

POSITIONER
Input Signal
*Type
*Mfr & Model
*On Incr Signal Output Incr/Decr
Gauges By-pass
*Cam Characteristic

SWITCHES
Type Quantity
*Mfr & Model
Contacts/Rating
Actuation Points

AIR SET
*Mfr & Model
*Set Pressure
Filter Gauge

TESTS
*Hydro Pressure
ANSI/FCI Leakage Class

Rev	Date	Revision	Orig	App

*Information supplied by manufacturer unless already specified

ISA FORM S20.50, Rev.1

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TI-B | REV. 0

CONTRACT | DATE 7-2-15

REQ. - P.O.

BY BL | CHK'D | APPR.

THERMOMETER

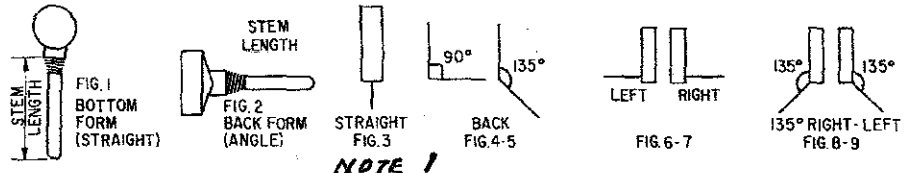
1. Stem: Threaded ■ Plain □ Union □ Material
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. □ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 3" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ EVERY-ANGLE
8. External Calibrator □ Herm Sealed Case ■ LIQ-FILLED
9. MFR. & Model No.

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □ Other:
12. Construction: Drilled ■ Built-Up □ Other:

Well Length Must Suit Stem Length.

ASME B40.3 GR.A



NOTE 1

Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
0	TI-B	0/200		TBD	TBD		UPSTREAM SUGAR CANE JUICE COOLER	

Notes:

1. DETERMINE BEST POSITION OF THERMOWELL AND WELL CONNECTION TYPE DURING DETAILED DESIGN.

ISA FORM S20.14a

INDUSTRIAL BIMETAL AND GLASS THERMOMETERS

SHEET 1 OF 1

NO	BY	DATE	REVISION

SPEC. NO. TI-9 | REV. 0

CONTRACT | DATE 7-2-15

REQ. - P.O.

BY BL | CHK'D | APPR.

THERMOMETER

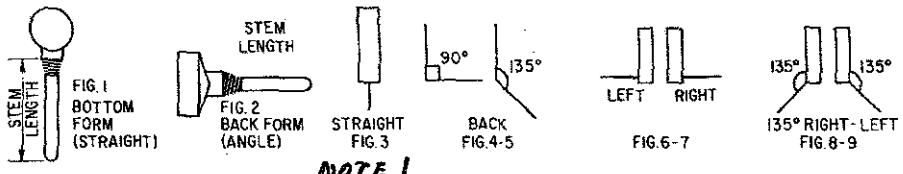
1. Stem: Threaded ■ Plain □ Union □
   Material
2. Stem or Union Thread: ½ in. ■ ¾ in. □
3. Stem Diameter: STD ■ .250 in. □ .375 in. □
4. Case Material: STD ■ Other
5. Dial Size 5" Color WHITE
6. Scale length Color
7. Form: Fig. No. Adjustable ■ EVERY ANGLE
8. External Calibrator □ Herm Sealed Case ■ UR. FILLED
9. MFR. & Model No.

WELL

10. None □ Included ■ By Others □
11. Material: 304SS ■ 316SS □
    Other:
12. Construction: Drilled ■ Built-Up □
    Other:

Well Length Must Suit Stem Length.

ASME B 40.3 GR. A



NOTE 1

Rev.	Tag No.	Range	Operating Temp	Stem Length	Well Conn.	Lag Ext.	Service	Notes
0	TI-9	0/200		TBD	TBD		DOWNSTREAM SUGAR CANE JUICE COOLER	

Notes:

1. DETERMINE BEST POSITION OF THERMOWELL AND WELL CONNECTION TYPE DURING DETAILED DESIGN.

ISA FORM S20.14a

AMERICAN INGENUITY

REFRACTOMETERS

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. PROJ. NO.: SPEC. NO.:
BY: BDL DATE: 8/13/15 P.O. NO.: EQUIPMENT NO.: BI-1 & 2
CHECKED BY: DATE: PRICE EACH $ TOTAL NO. REQ'D.: 2

1	**GENERAL**
2	REFRACTOMETERS SHALL BE K-PATENTS PR-23-AC REFRACTOMETERS FOR CONCENTRATION MESUREMENT.
3	SEE K-PATENTS QUOTATION NO. C13-6583-PW FOR REFERENCE, THIS QUOTATION WILL NEED TO BE UPDATED BOTH FOR BI-2 AND TO
4	ADD BI-1.
5	SEE DIAGRAM NO. 1 FOR GENERAL INSTALLATION DIAGRAM WHICH INCLUDES THE STEAM WASH COMPONENTS FOR THE
6	REFRACTOMETER FACE.
7	XV-19 A/B SHALL BE SPIRAX/SARCO TYPE PF61G-NC PISTON ACTUATED ON/OFF VALVES - A FOR BP-1 AND B FOR BI-2.
8	PV-11 A/B SHALL BE PRESSURE REGULATORS TO CONTROL STEAM PRESSURE FOR STEAM WASH AT 60 PSIG. - A FOR BI-1 AND
9	B FOR BI-2.
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52	* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

VALVE SPECIFICATION

REV. NO.	0		
BY	BL		
APP.			
DATE	5/31/2015		

VALVE COMPARISON LIST

MANUFACTURER	FIGURE NUMBER	SIZE RANGE
WORCESTER SERIES 18	1"BE1866TT150(PORT ARRANGEMENT TO BE DETERMINED)	1"

STOCK NO.

PRESSURE RATING	TYPE OF VALVE	BODY MATERIAL	TRIM MATERIAL	END CONNECTION	TEMP. LIMITATIONS	VALVE OPERATOR	BODY CONSTR.	TRIM CONSTR.	PACKING
ANSI CLASS 150	THREE-WAY BALL VALVE	316 STAINLESS STEEL	316 STAINLESS STEEL	THREADED ENDS	0 TO 400 DEG F	ELECTRIC MOTOR (NOTE 1)	THREE-WAT FULL PORT	TEFLON SEAT	POLYFILL

PRESSURE RATING	TYPE OF VALVE	BODY MATERIAL	TRIM MATERIAL	END CONNECTION	TEMP. LIMITATIONS	VALVE OPERATOR	BODY CONSTRUCTION	TRIM CONSTRUCTION	STEM SEAL

NOTES: 1. SERIES 75 ELECTRIC ACUTAOR.

TAG NO. BV-1

A PROCESS REFRACTOMETER FOR CONCENTRATION MEASUREMENT OF LIQUIDS

K-PATENTS
PROCESS INSTRUMENTS

K-PATENTS PROCESS REFRACTOMETER PR-23-GP

SB:PR-23-GP/4
October 2014

TYPICAL APPLICATIONS

CHEMICALS
Acetic acid, Acrylate, Amine oxide, Amino acid, Ammonium fluoride, Ammonium hydroxide, Ammonium nitrate, Ammonium sulphate, Caustic soda, Cellulose derivates, Citric acid, Copper chloride, Chromium trioxide (or Chromic acid), Ethylene glycol, Formaldehyde, Formic acid, Glycerol, Hydrogen peroxide, Iron chloride, Lactic acid, Lubricating oils, Nickel chloride, Nitric acid, Oleum, Polyamides, Polycarbonates, Polyethylene, Resins, Sodium bicarbonate, Sodium dichromate, Sodium gluconate, Sodium hydroxide, Styrenes, Sulphuric acid, Urea, etc.

PLASTICS AND FIBERS
Acetate, Acrylics, Adipic acid, Caprolactam, Cyclohexanol, Cyclohexanon, Dimethylterephthalate, Dimethylformamide, Fiberglass, Hexamethylene diamine, Nylon salt, Polyamides, Polyesters, Rayon, Spandex, Vinyls. Finishing, coating and dyeing mediums of textiles.

PULP AND PAPER INDUSTRY
Alum, Black liquor, CMC, Latex, Sizing chemicals and binders, Starch, PVA, Retention chemicals.

SALTS AND SODIUM COMPOUNDS
Brine, Glauber's salt, Sodium carbonate, Sodium chloride, Sodium sulfate, Sodium sulfite, etc.

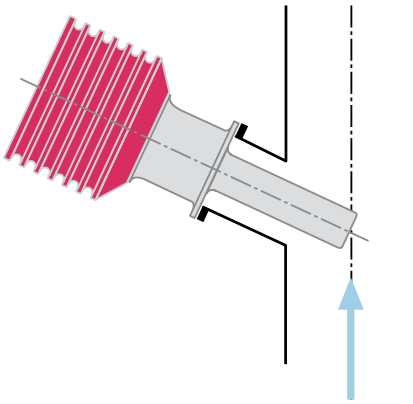
SOAP AND DETERGENTS
Fatty acids, Fatty alcohols, Caustic potash, Caustic soda, Glycerol, Salt, Soda ash, Sodium bicarbonate

STARCH SWEETENERS
Fructose, high fructose corn syrup, sorbitol, dextrose, glucose, xylose, maltose, mannitol, lactitol, aspartame, flavors. Supersaturation and seeding point control of fructose and dextrose syrups, cooling crystallizer, precrystallizer, main crystallizer.

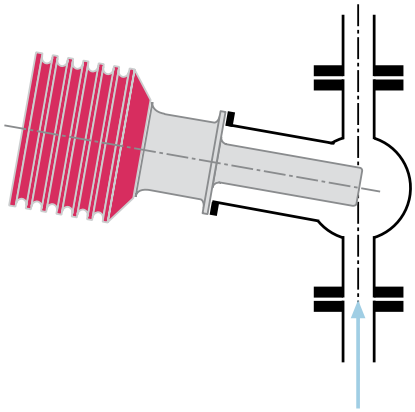
SUGAR
Sucrose, affination, extraction, press water, thick juice, thin juice, vacuum pan, molasses, mother liquor. Supersaturation and seeding point control, cooling crystallizer, precrystallizer, main crystallizer.

INSTALLATION

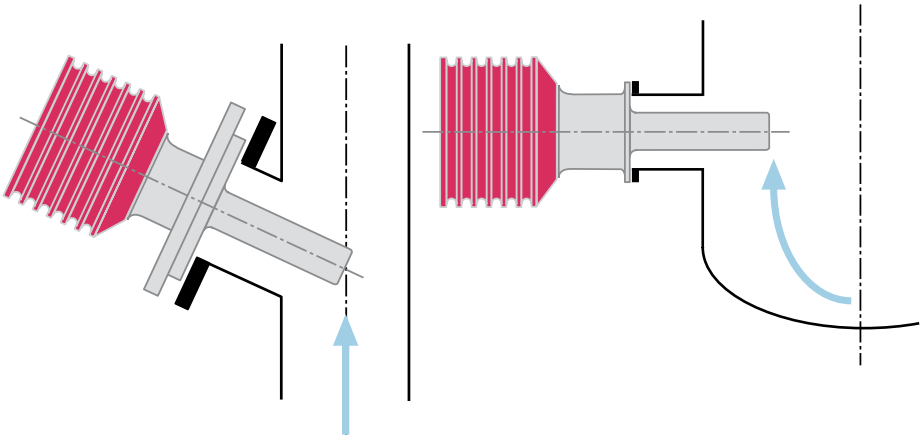
MEDIUM AND LARGE PIPES



PIPES 2" OR SMALLER



VESSELS



DUAL CONNECTIVITY

K-Patents Process Refractometer PR-23-GP sensor is factory calibrated to measure refractive index n_D and temperature T in standard units. Each sensor has identical calibration n_D=1.32...1.53 (corresponding to 0-100 Brix). One or two sensors can be connected to one Indicating transmitter.

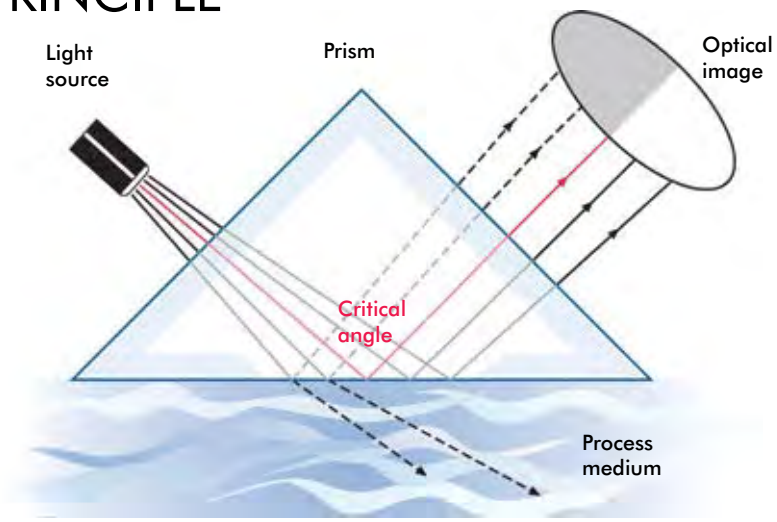
Because the PR-23 sensors have identical calibration, and each sensor gives Refractive Index n_D and temperature as output, all sensors can be freely interchanged without any inconvenience of optical calibration or parameter changes.

The non-linear conversion from refractive index to concentration units and also temperature compensation are based on standard tables. They are programmed inside the transmitter independently of the sensor.

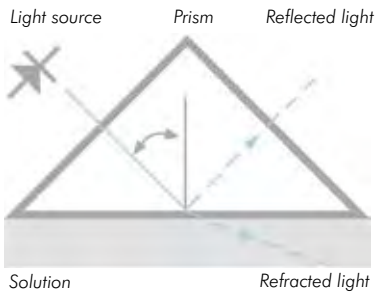
K-Patents' manufacturing process is ISO 9001 certified. K-Patents also supports the verification within the user's own quality system.

Each sensor is provided with a calibration certificate comparing a set of standard liquids to the actual sensor output. Therefore, the calibration and accuracy can be easily verified on-site with the certified refractive index liquids and K-Patents documented verification procedure.

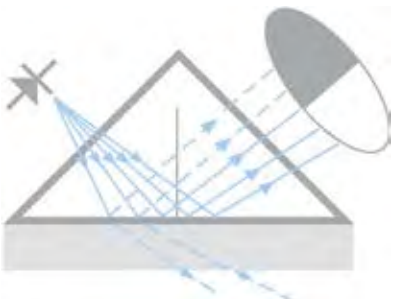
DIGITAL MEASUREMENT PRINCIPLE



The light source emits light at the interface, between a prism and the process solution, where the rays meet the surface at different angles.

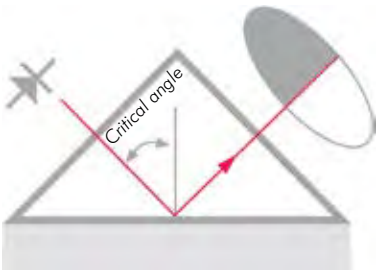


Depending on the angle, some rays undergo a total internal reflection. The rest of the light is refracted into the process solution.



Thus an optical image with a dark sector and a light sector is created.

The angle corresponding to the shadow line is called the Critical Angle of Total Reflection. The Critical Angle is a function of the refractive index and therefore the concentration of the solution.



A digital CCD-camera detects the optical image and the shadow line. The camera transforms the optical image point-by-point to an electrical signal. The exact shadow line position is located and the refractive index n_D is determined.

A built-in temperature sensor measures the temperature T on the interface of the process liquid. The indicating transmitter converts the refractive index n_D and temperature T to concentration units.

The diagnostics program ensures that the measurement is reliable.

OPERATION

K-Patents Process Refractometer PR-23-GP provides truly accurate means for measuring liquid concentrations and Brix in various process applications. The K-Patents PR-23-GP determines the concentration of dissolved solids by making an optical measurement of a solution's refractive index.

The measurement accuracy is not influenced by particles, bubbles, sugar crystals, seeds, fibres, colour or temperature changes in the process medium. The K-Patents PR-23-GP does not require any recalibration or regular maintenance.

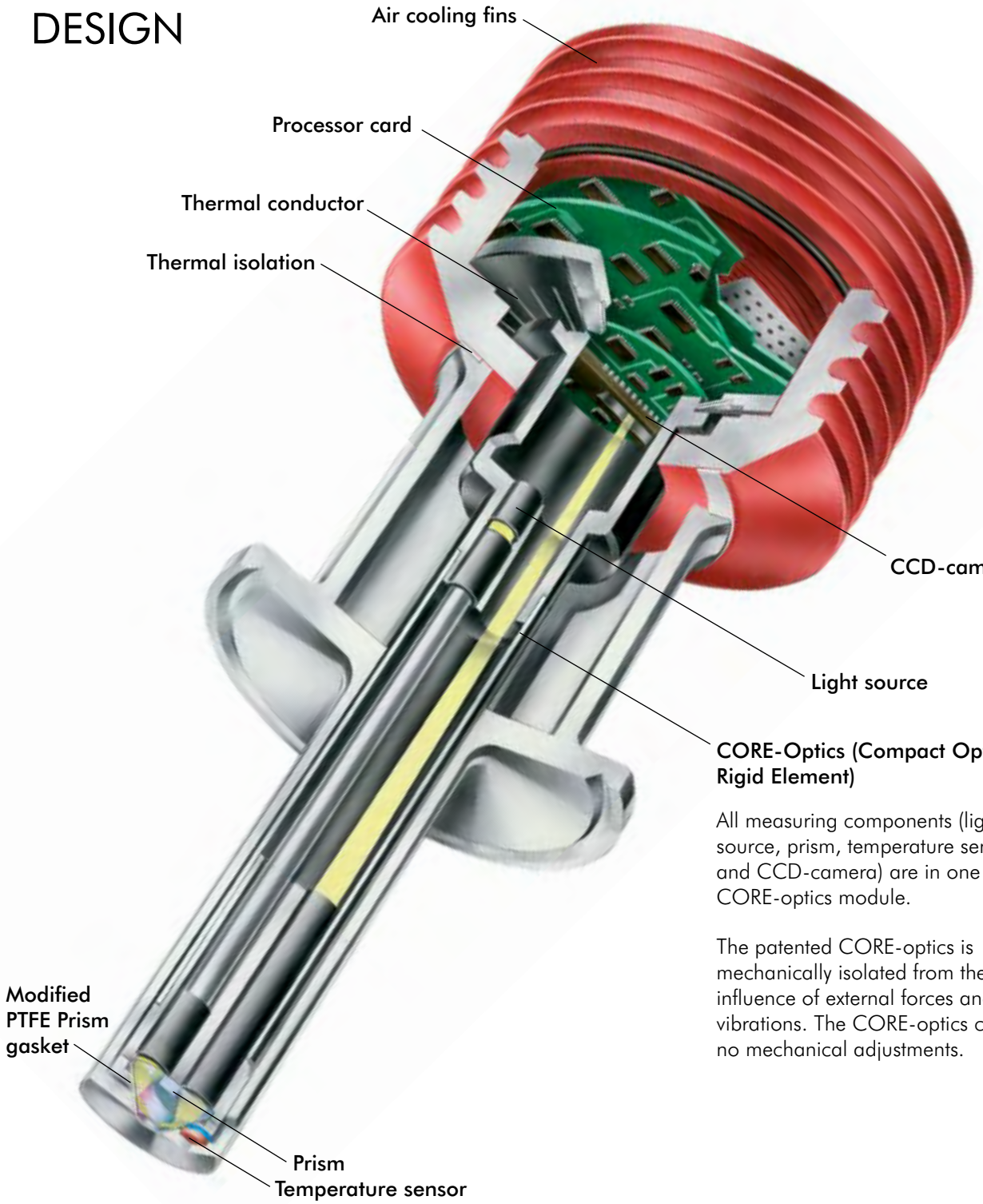
DATA LOGGING VIA ETHERNET

K-Patents PR-23-GP includes an Ethernet based communications solution which allows connection to computer networks (LAN) and to the Internet. Real-time measurement data and diagnostic information may be obtained through this interface, and this makes it also a valuable service tool for parameter changes and software updates.

Only a cross-over cable and data acquisition software are needed for collecting the data from a PR-23 refractometer. The communication is built on standard protocols (UDP/IP) and K-Patents offers ready-to-install software for data acquisition.

The K-Patents data acquisition software is expandable in case the user wants to modify the program. The program is written in Java and thus system independent. It can be tailored to almost any computing environment.

DESIGN



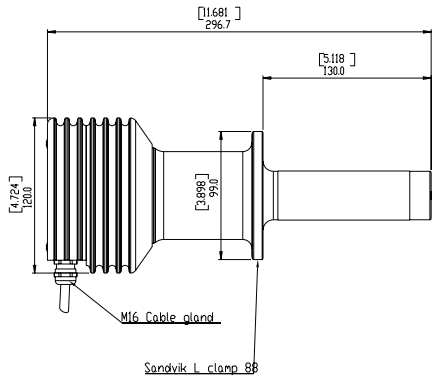
CORE-Optics (Compact Optical Rigid Element)

All measuring components (light source, prism, temperature sensor and CCD-camera) are in one solid CORE-optics module.

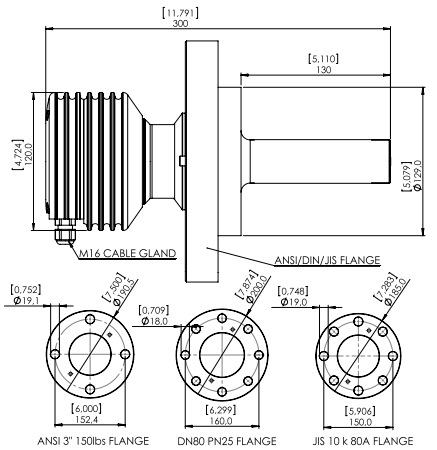
The patented CORE-optics is mechanically isolated from the influence of external forces and vibrations. The CORE-optics contains no mechanical adjustments.

SPECIFICATIONS

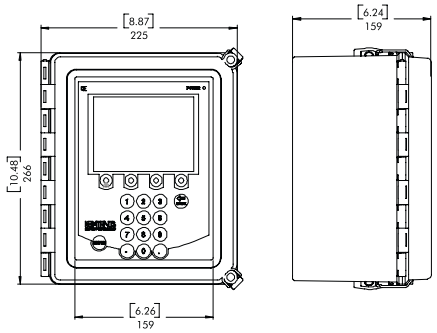
Sensor PR-23-GP with Sandvik coupling L



Sensor PR-23-GP with ANSI/DIN/JIS flange



Indicating transmitter DTR



Refractive Index range, standard:	*Full range, n_D = 1.3200...1.5300 (corresponds to 0...100 % b.w.)*
Accuracy:	*Refractive index n_D ±0.0002 (corresponds typically to ± 0.1% by weight)* *Repeatability n_D ±0.0001 (corresponds typically to ±0.05% by weight)*
Speed of response:	*1 s undamped, damping time selectable up to 5 min*
Calibration:	*With Cargille standard R.I. liquids over full range of n_D 1.3200...1.5300*
CORE-Optics:	*No mechanical adjustments*
Digital measurement:	*3648 pixel CCD element*
Light source:	*Light emitting diode (LED), 589 nm wavelength, sodium D-line*
Temperature sensor:	*Built-in Pt-1000, linearization according to IEC 751*
Temperature compensation:	*Automatic, digital compensation*
Instrument verification:	*With NIST traceable Cargille standard R.I. liquids. A transmitter guided procedure over Ethernet including a printable verification report*
Ambient temperature:	*Sensor: max. 45°C (113°F), min. -40°C (-40°F)* *Indicating transmitter: max. 50°C (122°F), min. 0°C (32°F)*
SENSOR PR-23-GP:	
Process connection:	*Sandvik coupling L 88 mm/DIN-flange 2656, DN80 PN25/ANSI-flange 150 lbs, 3 inch/JIS-flange 10k 80A/Line sizes less than 2" via Pipe flowcell*
Process pressure:	*up to 25 bar (350 psi)*
Process temperature:	*-40°C...150°C (-40°F...302°F)*
Process wetted parts, standard:	*AISI 316L stainless steel, prism spinel, prism gaskets modified PTFE (Teflon)*
Sensor protection class:	*IP67, Nema 4X*
Sensor weight:	*Sandvik coupling L 3.8 kg (8.4 lbs), Flange DIN/ANSI/JIS 6.6 kg (14.1 lbs)*
INDICATING TRANSMITTER DTR:	
Display:	*320x240 pixel graphical LCD with LED backlight*
Keypad:	*18 membrane keys*
Current output:	*Two independent current outputs, 4-20 mA, max. load 1000 Ohm, galvanic isolation 1500 VDC or AC (peak), hold function during prism wash*
Ethernet connection:	*10/100 Mbit/s, data acquisition over UDP/IP Protocol with K-Patents PR-11111 data logging software*
Power:	*AC input 100-240 VAC/50-60 Hz, optional 24 VDC, 30 VA*
Alarms/Wash relays:	*Two built-in signal relays, max. 250 V/3 A*
Sensor connectivity:	*One or two sensors can be connected to the DTR. Sensors independent of each other: own parameter sets and usable in different applications. Two current outputs configurable independently to indicate process concentration or temperature of either sensor.*
Transmitter protection class:	*Enclosure IP66, Nema 4X*
Indicating transmitter weight:	*4.5 kg (10 lbs)*
INTERCONNECTING CABLE:	*IEC 61158-2 compliant two-wire cable*
Interconnecting cable length:	*Standard 10 m (33 ft), max. 200 m (660 ft)*
OPTIONS:	*Stainless steel sensor housing, special wetted parts materials, extended refractive index range limits, prism wash, intrinsic safety and hazardous area approvals, cable fittings to the indicating transmitter: European cable glands M20x1.5 or US conduit hubs*
PATENTS:	*See www.kpatents.com*

ORDERING INFORMATION:

- *Sensor type and process connection*
- *Desired scale*
- *Properties of process solution*
- *Process temperature range*
- *Process pipe size*
- *Process flow rate*
- *Supply voltage and frequency*
- *Options and accessories*

K-PATENTS OY
P.O. BOX 77
ELANNONTIE 5
FI-01511 VANTAA, FINLAND
PHONE: INT.+358-207-291 570
FAX: INT.+358-207-291 577
INFO@KPATENTS.COM
WWW.KPATENTS.COM

K-PATENTS, INC.
1804 CENTRE POINT CIRCLE, SUITE 106
NAPERVILLE, IL 60563
U.S.A.
PHONE: (630) 955 1545
FAX: (630) 955 1585
INFO@KPATENTS-USA.COM
WWW.KPATENTS.COM

K-PATENTS
PROCESS INSTRUMENTS

QUOTATION C15-6583-PW (1/2)

Attn: American Ingenuity LLC, Prairieville LA
Jacob Coots
K-Patents Reference: C15-6583-PW
Customer Reference: University Research Skid Refractometer
Date of Quotation: Jul 8, 2015
Valid until: Oct 31, 2015
Application: Sugar cane (evaporation) 0 - 70 Brix

Dear Jacob,

We are pleased to offer you the **K-Patents Process Refractometers PR-23-AC** for concentration measurement.

The digital K-Patents Sanitary Refractometer PR-23 provides truly accurate means for liquid concentrations in food and beverage processing, where in-line monitoring can help to improve product quality and reduce costs.

The K-Patents PR-23 operation is not affected by particles, bubbles or color changes of the medium. Because of the digital sensing technology, even large amounts of suspended solids or bubbles do not affect the measurement or the accuracy.

The measurement range covers 0 - 100 Brix and the process temperature range is from -20 to 130°C (-4 to 266°F). The accuracy is +/- 0.1 Brix and the measurement is automatically temperature compensated. The 4-20 mA output signal is proportional to the process concentration. Low and high concentration alarms can be configured easily. Furthermore, the digital measuring system does not require re-calibration or maintenance.

The key features of the K-Patents PR-23 are:

- Identical calibration of each sensor: measurement range Refractive Index (nD) 1.3200 – 1.5300, which corresponds to 0-100 Conc%b.w. at 100°C (212°F). All sensors are freely interchangeable.
- Direct, digital concentration analysis by actual Refractive Index measurement.
- **Dual connectivity**: transmitter can operate two sensor independently. A second sensor can be easily integrated later.
- Completely digital system: particles and bubbles do not affect operation or accuracy.
- **Patented CORE-optics module**: no drift, no re-calibration, no mechanical adjustments.
- Fast process temperature measurement by built-in Pt1000 and automatic temperature compensation
- Easy on-site instrument verification within users' own quality assurance system with standard Refractive Index liquids

In case you would like to have more information, assistance in specifying the measurement system or comparison of different options, please do not hesitate to contact us.

Sincerely,

Phil Wagner
Regional Manager

K-PATENTS, INC.
1804 Centre Point Circle - Suite 106
Naperville IL 60563
Mobile: Int. 219-218-9706
Phone: (630) 955-1545
Fax: (630) 955-1585
phil.wagner@kpatents-usa.com
www.kpatents.com

K-PATENTS
PROCESS INSTRUMENTS

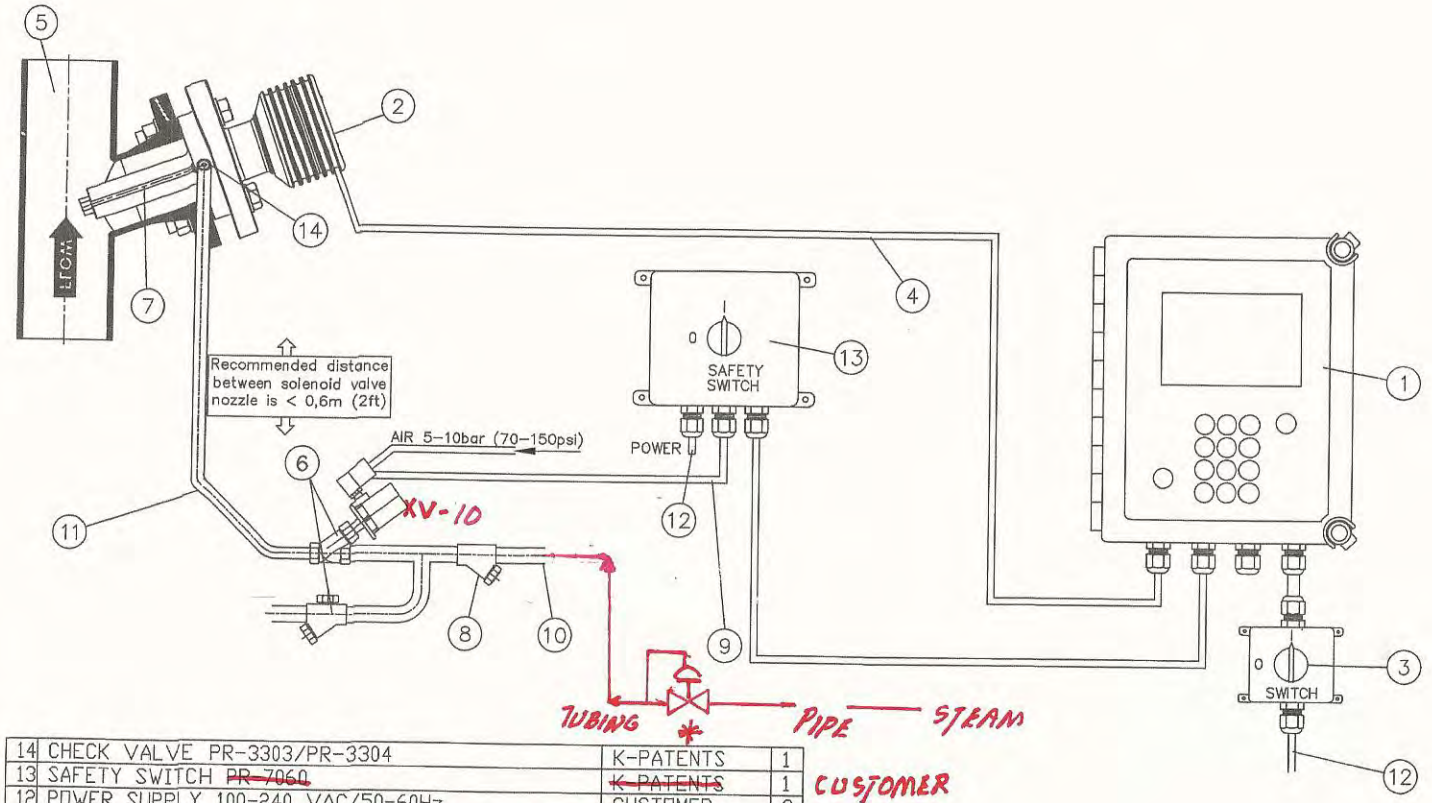
QUOTATION C15-6583-PW (2/2)

Item	Description	Qty	Price USD	Total USD
100	**PR-23-AC-62-HSS-GP-AA** PR-23 Sensor -A *Sensor model:* 3A approved C *Sensor type:* Compact type for pipe line installations -62 *Refractive Index range limits:* R.I. 1.320 - 1.530 nD (0 - 100 Brix) Spinel prism -H *Process connection:* Sanitary 3A-clamp, 2 ½ inch, insertion length 14 mm SS *Sensor wetted parts material:* AISI 316 L -GP *Electrical classification:* General Purpose -AA *Sensor housing:* Anodized aluminum	1	6460	6460
200	**AFC-HSS-H10-RI-NC-PG** AFC Elbow flow cell -H *Sensor connection:* Sanitary 3A-clamp, 2½ inch SS *Material of Construction:* AISI 316 L -H *Process connection:* Sanitary 3A clamp 10 *Pipe section diameter:* 25 mm (1 inch) -RI *Flow cell inlet type:* Reduced pipe (cone) -NC *Wash nozzle connection:* Nozzle connection -PG *Wash nozzles:* Plug for nozzle connection	1	1150	1150
300	**Indicating transmitter: DTR-U-CS-AC** DTR Indicating transmitter (connectivity for two sensors) -U *Cable connection:* ½ inch NPT type conduit hubs -CS *Electrical classification:* CSA certified for use in general purpose (ordinary) locations Applicable to CSA and ANSI/UL standards -AC *Power supply:* Power supply 100 - 240 VAC 50/60 Hz	1	5140	5140
400	**Interconnecting cable: PR-8230-010** PR-8230 Interconnecting cable between transmitter and sensor (standard black cable) (for STR transmitter: Interconnecting cable between transmitter and isolator) -010 *Cable length:* 10 meters (33 ft)	1	130	130
500	**PR-9211** PR-9211 Sanitary clamp 1 and 1 ½ inch	2	160	320
600	**PR-9246** PR-9246 3A-gasket EPDM 1 inch	2	65	130
700	**PR-9248** PR-9248 Ferrule for Sanitary clamp 1 inch	2	85	170
800	**FC-11-KIT** FC-11-KIT Field Communicator	1	820	820
	Instruction manual	2	Incl	Incl
	Total Price USD			14320

Terms and conditions

Delivery time:	Normally 6 weeks after receipt of order
Payment terms:	30 days net
Delivery terms:	FOB shipping point Naperville (Incoterms 2010)
Warranty:	Warranty period is 24 months from the date of the delivery
Prices:	All prices are in USD
Documentation:	All needed documents and certificates (e.g. material certificate) addition to K-Patents standard documentation and drawings shall be requested before purchase order and are available for additional price.

DIAGRAM 1



14	CHECK VALVE PR-3303/PR-3304	K-PATENTS	1
13	SAFETY SWITCH ~~PR-7060~~	~~K-PATENTS~~	1
12	POWER SUPPLY 100-240 VAC/50-60Hz	CUSTOMER	2
11	STEAM PIPE 1/4" 304 SS TUBING 0.035"	CUSTOMER	1
10	STEAM PIPE 1/2" 304 SS TUBING 0.035"	CUSTOMER	1
9	SOLENOID CABLE, 3x1 (AWG 17)	CUSTOMER	1
8	STRAINER ~~PR-3342~~	~~K-PATENTS~~	1
7	STEAM NOZZLE	K-PATENTS	1
6	SHUT-OFF VALVE&STEAM TRAP ~~PR-3340-230/110~~	~~K-PATENTS~~	1
5	FLOW CELL/ PROCESS PIPE	K-P/CUSTOMER	1
4	CABLE BETWEEN DT-R AND SENSOR PR-8230-...	K-P/CUSTOMER	1
3	POWER SWITCH PR-10900	K-P/CUSTOMER	1
2	SENSOR PR-23-G	K-PATENTS	1
1	INDICATING TRANSMITTER DTR	K-PATENTS	1
PART	PART SPECIFICATIONS	SUPPLIED BY	

CUSTOMER

CUSTOMER : 1/2" Y-STRAINER, THRD, 304 SS, CLASS 600

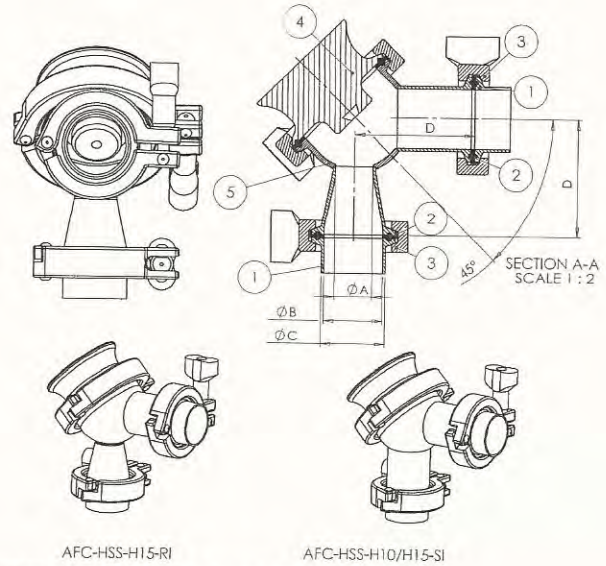
CUSTOMER : 1/2" PISTON ACTUATED ON/OFF VALVE, V-5

1/2" THRD THERMODYNAMIC STEAM TRAP SARCO TD42

* PRESSURE REGULATOR TO CONTROL STEAM PRESSURE AT 60 PSIG : PV-11

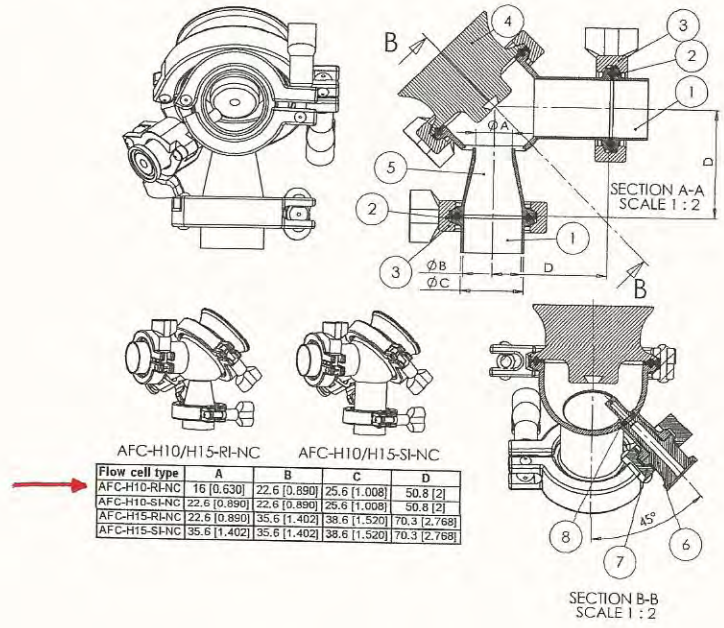
Figure 4.1 A prism wash system for steam (non-sanitary)

DIAGRAM 2



Flow cell type	A	B	C	D
AFC-H10-SI	22.6 [0.890]	22.6 [0.890]	25.6 [1.008]	50.8 [2]
AFC-H15-RI	22.6 [0.890]	35.6 [1.402]	38.6 [1.520]	70.3 [2.768]
AFC-H15-SI	35.6 [1.402]	35.6 [1.402]	38.6 [1.520]	70.3 [2.768]

Figure 9.5 Flowcell AFC-HSS-
H10 for pipe diameter 1" (25 mm) and H15 for pipe diameter 1 1/2" (40 mm)



Flow cell type	A	B	C	D
AFC-H10-RI-NC	16 [0.630]	22.6 [0.890]	25.6 [1.008]	50.8 [2]
AFC-H10-SI-NC	22.6 [0.890]	22.6 [0.890]	25.6 [1.008]	50.8 [2]
AFC-H15-RI-NC	22.6 [0.890]	35.6 [1.402]	38.6 [1.520]	70.3 [2.768]
AFC-H15-SI-NC	35.6 [1.402]	35.6 [1.402]	38.6 [1.520]	70.3 [2.768]

Figure 9.6 Flowcell AFC-HSS- with wash nozzle connection (-NC)
H10 for pipe diameter 1" (25 mm) and H15 for pipe diameter 1 1/2" (40 mm)

DIAGRAM 3

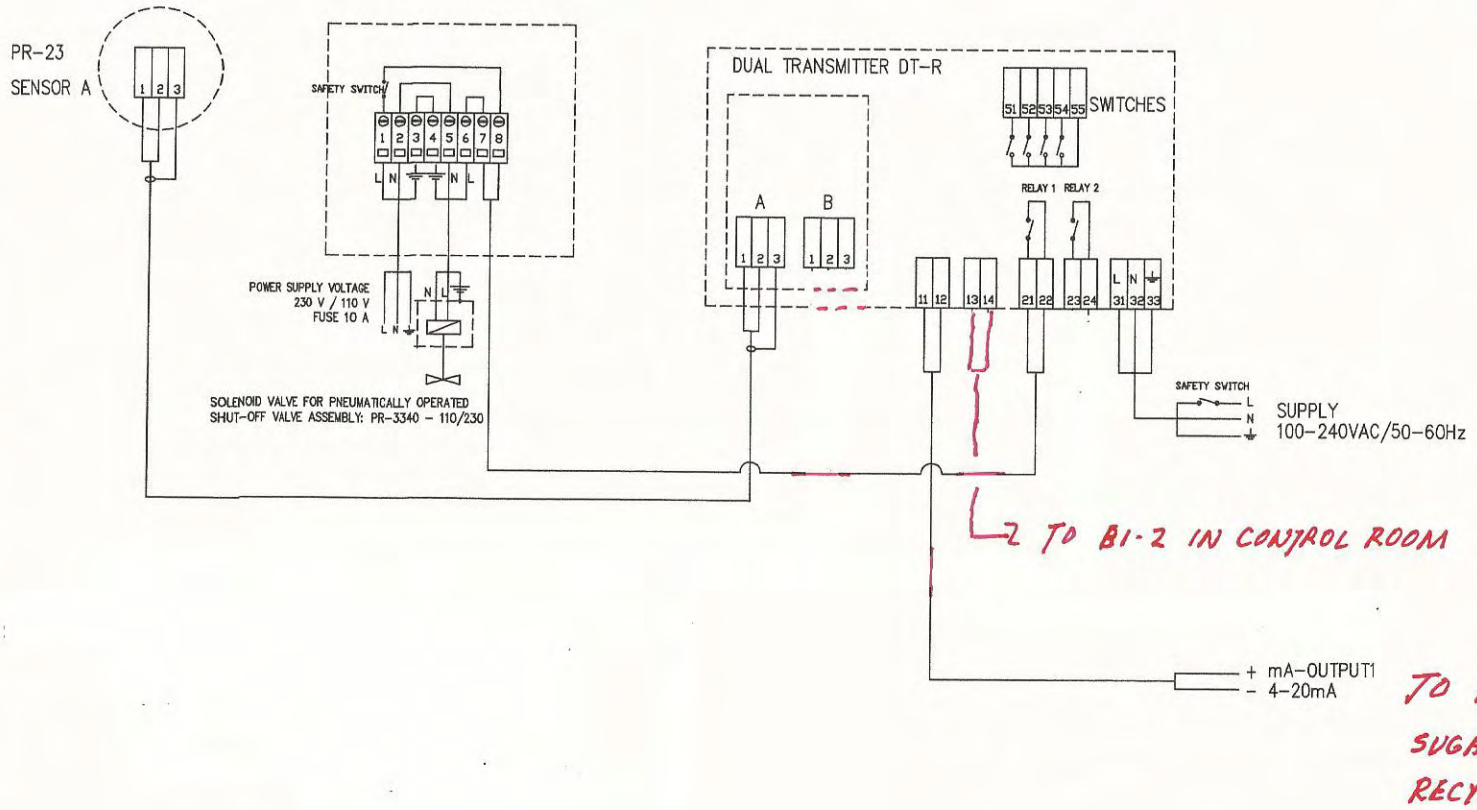


Figure 4.3 Wiring for a prism wash system for steam

4.2.1 Recommended wash pressures and times

The recommended wash pressures and times are given in the tables below.

Wash medium parameters for integral wash nozzles in PR-23-AP/GP					
	Minimum *above process pressure*	**Maximum** *above process pressure*	**Wash time**	**Recovery**	**Interval**
Steam (SN)	2 bar (30 psi)	4 bar (60 psi)	3 s	20–30 s	20–30 min
Water (WN)	2 bar (30 psi)	4 bar (60 psi)	10 s	20–30 s	10–20 min
High pressure water (WP)	15 bar (220 psi)	40 bar (600 psi)	10 s	20–30 s	10–20 min

Wash medium parameters for flow cell wash nozzle AFC					
	Minimum *above process pressure*	**Maximum** *above process pressure*	**Wash time**	**Reco-very**	**Interval**
Steam (SN)	3 bar (45 psi)	6 bar (90 psi)	3–5 s	20–30 s	20–30 min
Water (WN)	3 bar (45 psi)	6 bar (90 psi)	10–15 s	20–30 s	10–20 min
High pressure water (WP)	25 bar (350 psi)	35 bar (500 psi)	10–15 s	20–30 s	10–20 min

Wash medium parameters for Safe-Drive Isolation valve nozzle SDI					
	Minimum *above process pressure*	**Maximum** *above process pressure*	**Wash time**	**Reco-very**	**Interval**
Steam (SN)	5 bar (75 psi)	8 bar (115 psi)	3–5 s	20–30 s	20–30 min
High pressure water (WP)	25 bar (350 psi)	50 bar (725 psi)	10–15 s	20–30 s	5–20 min

Important: In steam wash, do not exceed the recommended wash times, because some process media may burn to the prism surface if steamed for longer time. In case of coating, shorten the wash interval.
See also Section 6.7.2 for the Automatic wash cut parameter.

Note: In water wash, water temperature should be above the process temperature.

Note: The check valve pressure drop is 0.7 bar (10 psi).

4.2.2 Prism wash systems

The prism wash system for steam is described by Figure 4.1 and for sanitary systems Figure 4.2. The prism was system for high pressure water is described by Figure 4.4 and for sanitary systems Figure 4.5.

! **Warning!** In high pressure wash systems, pressure increase can occur in a closed pipe section when the high pressure pump is operated. K-Patents recommends to mount a pressure relief valve in the pipe section. Relief pressure should be according to pipe pressure rating.

XV-10

spirax sarco®

Type PF61G-NC (Normally Closed) Piston Actuated On/Off Valves

Description

A 2-port normally closed pneumatically actuated on/off stainless steel valve for use on steam, water, air, oil and gases.
The valve is designed for flow over the seat (port 1 to 2).
A pneumatic signal acts below the actuator piston to open the valve.
A spring acts above the piston to close the valve. The valve plug has a PTFE soft seal to provide tight shut-off. A valve position indicator is included on standard and flow regulator models.
Note: For water/liquid applications, a bi-directional valve (type BD) is recommended to prevent waterhammer on valve closure.

Available types

PF61G-1NC normally closed with 45 mm diameter actuator
PF61G-2NC normally closed with 63 mm diameter actuator
PF61G-3NC normally closed with 90 mm diameter actuator

Sizes and pipe connections

PF61G-1NC 1/2" and 3/4" NPT
PF61G-2NC 1/2", 3/4", 1", 1-1/4", 1-1/2" and 2" NPT
PF61G-3NC 1", 1-1/4", 1-1/2" and 2" NPT

Options

Travel switch

Relays an electrical signal to indicate open or closed position of the valve. Maximum rating: Voltage (V) = 500 V, Current (I) = 0.5 A, Power (P) = 30 VA. Available on 63 mm and 90 mm actuators with nomenclature suffix '**I**'. i.e. PF61G-2NC-**I**-1" NPT

Stroke regulator

Limits valve lift to regulate maximum flow. Available on 63 mm and 90 mm actuators with nomenclature suffix '**R**'. i.e. PF61G-2NC-**R**-1" NPT

Pilot Solenoid Valves

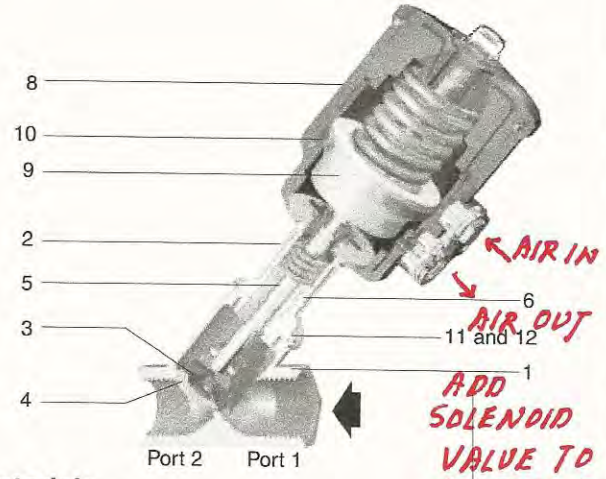
For direct mounting, use type "DM" Pilot Solenoid Valves. (see TI-P373-04US for details)
For remote mounting for a series of PAV's, use type "DMD" banked Pilot Solenoid Valves. (see TIS 8.500 US for details)
For remote mounting for individual PAV's, at a panel or separate location, consult SSI for options.
All Pilot Solenoid Valves are available in 240, 120, 24 VAC and 24 VDC voltages. (see applicable TI sheets)

Technical details

Leakage		PTFE soft seal	ANSI class VI
Flow characteristic		Fast opening	on /off
Flow direction		Flow over seat	port 1 to 2
Pilot media		Air, water or inert gas	(140°F max.)
Actuator housing rotation		360°	
		Pilot connection	Max. pilot pressure
Actuator size	45 mm (1-3/4") dia.	1/8" BSP	150 psig
	63 mm (2-1/2") dia.	1/4" BSP	150 psig
	90 mm (3-9/16") dia.	1/4" BSP	115 psig

Limiting conditions

Maximum design temperature	356°F
Minimum design temperature	14°F
Maximum saturated steam pressure	130 psig
Maximum differential pressure	See table overleaf



Materials

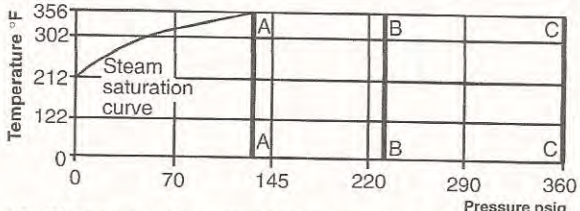
No.	Part	Material	
1	Body	Stainless steel	AISI 316L
2	Bonnet	Stainless steel	AISI 316L
3	Plug	Stainless steel	AISI 316L
4	Plug seal	PTFE	
5	Valve stem	Stainless steel	AISI 316
6	Stem seals	PTFE chevrons	
*7	Stem 'O' ring	Viton	
8	Actuator housing	Glass filled polyamide	
9	Piston	Glass filled polyamide	
10	Piston lip seal	Viton	
11	Gasket	PTFE	
12	'O' ring	Viton	

* not shown

C_V values

Size	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
C_V	4.9	9.1	21.7	31.5	49.0	60.1

Operating range



A-A	Maximum operating pressure on saturated steam	130 psig
B-B	Maximum operating pressure on gas & liquids sizes 1-1/4" to 2"	230 psig
C-C	Maximum operating pressure on gas & liquids sizes 1/2" to 1"	360 psig

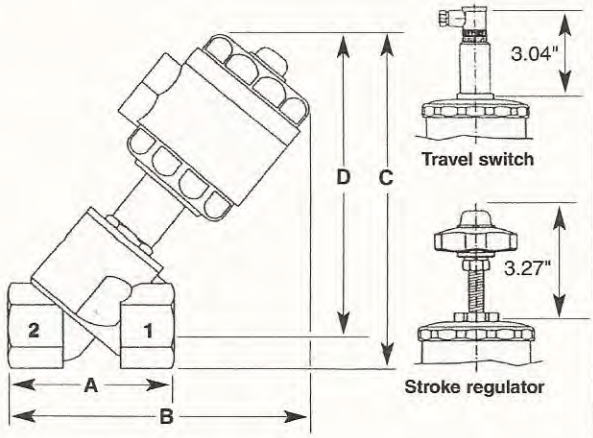
Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Type PF61G-NC (Normally Closed) Piston Actuated On/Off Valves

Dimensions / weight (approximate) in inches and lbs.

Port size (NPT)	Actuator Diameter inches	A inches	B inches	C inches	D inches	St. Steel Weight pounds
1/2"	1-3/4" (45mm)	2.56	5.67	5.36	4.85	2.9
3/4"	1-3/4" (45mm)	2.96	6.11	5.63	5.13	3.1
1/2"	2-1/2" (63mm)	2.56	7.57	7.25	6.74	3.1*
3/4"	2-1/2" (63mm)	2.96	7.81	7.57	6.94	3.3*
1"	2-1/2" (63mm)	3.55	8.36	8.08	7.29	4.2*
1-1/4"	2-1/2" (63mm)	4.35	8.87	8.55	7.61	5.1*
1-1/2"	2-1/2" (63mm)	4.73	9.06	8.87	7.81	6.6*
2"	2-1/2" (63mm)	5.91	9.78	9.50	8.16	8.2*
1"	3-9/16" (90mm)	3.55	8.76	8.44	7.67	5.5*
1-1/4"	3-9/16" (90mm)	4.34	9.27	8.94	7.96	6.4*
1-1/2"	3-9/16" (90mm)	4.73	9.42	9.26	8.16	8.0*
2"	3-9/16" (90mm)	5.91	10.13	9.85	8.51	9.5*

* Plus 0.5 lbs. for travel switch or stroke regulator option

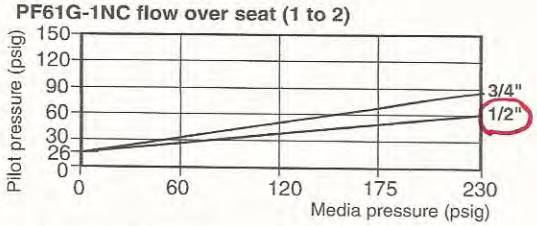


Differential pressures for PF61G-NC (Normally closed) piston actuated valves

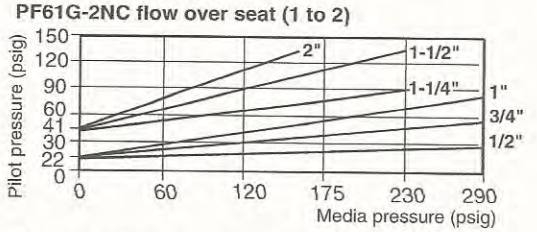
Model	Port size (NPT)	Actuator diameter (mm)	Flow direction (1 to 2)	Max diff. pres.(psig) gas & liquid	Max diff. pres.(psig) steam	Pilot pressure min (psig)	Pilot pressure max. (psig)
PF61G-1NC	1/2"	45	over seat	230	130	26	150
PF61G-1NC	3/4"	45	over seat	230	130	26	150
PF61G-2NC	1/2"	63	over seat	290	130	22	150
PF61G-2NC	3/4"	63	over seat	290	130	22	150
PF61G-2NC	1"	63	over seat	290	130	22	150
PF61G-2NC	1-1/4"	63	over seat	230	130	41	150
PF61G-2NC	1-1/2"	63	over seat	230	130	41	150
PF61G-2NC	2"	63	over seat	160	130	41	150
PF61G-3NC	1"	90	over seat	290	130	15	115
PF61G-3NC	1-1/4"	90	over seat	230	130	41	115
PF61G-3NC	1-1/2"	90	over seat	230	130	41	115
PF61G-3NC	2"	90	over seat	220	130	41	115

Pilot / media pressure relationship

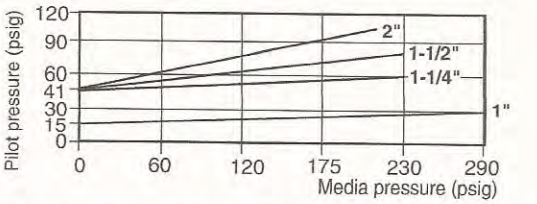
PF61G-1NC flow over seat (1 to 2)



PF61G-2NC flow over seat (1 to 2)



PF61G-3NC flow over seat (1 to 2)



Installation

The valve can be installed in any position with the direction of flow as indicated on the inlet/outlet ports by the connection numbers 1 to 2.
To simplify mounting of the pilot pressure lines or solenoid valves, the actuator can be rotated through 360°.
The pipework should be supported to prevent the valve body being stressed.
Installation and Maintenance Instructions are provided with the valve.

How to order

Standard Valve	**1 - PF61G-2NC-1" NPT**
Valve with travel switch	**1 - PF61G-2NC-I-1" NPT**
Valve with stroke regulator	**1 - PF61G-2NC-R-1" NPT**

Spare parts

A seal kit is available for all valve and actuator sizes comprising: piston lip seal, actuator stem 'O' ring, plug soft seal (PTFE), body seal and 'O' ring.

How to order spare seal kits

Always order spares by specifying the valve size, type and date code (given on actuator label i.e. 120=week 12, year 2000).
Example: 1-seal kit for PF61G-2NC-1" NPT, date code 120

Spirax Sarco, Inc., 1150 Northpoint Blvd, Blythewood, SC 29016 Telephone: (803) 714-2000 FAX (803) 714-2222

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- ***High Pressure***
- ***Cryogenic***
- ***LNG & Light Ends Solutions***

A Superior Float Magnet

Creates a Superior Level Indicator

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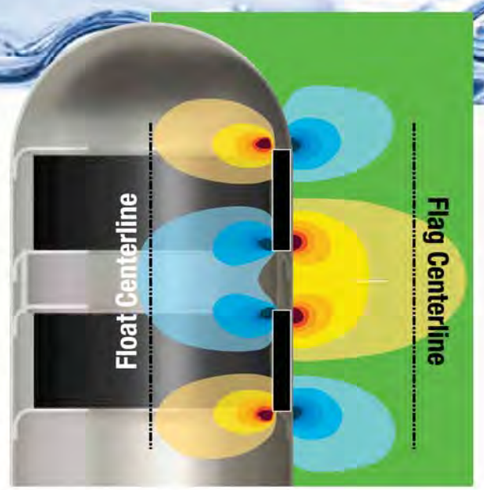
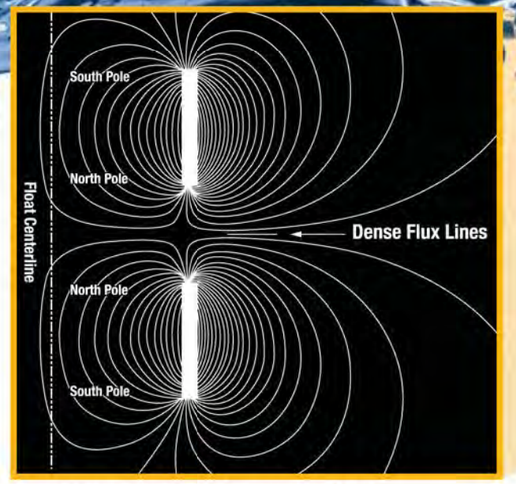
Magnetic Liquid Level Indication Products



Magnetic Field Density Diagram of Magnicator II Float

Reliability is in the physics. A uniquely strong north magnetic field activates flags, switches and transmitters with a certainty not found elsewhere because only the Magnicator II has a magnet arrangement this powerful, and this focused.



Magnetic Flux Density Plot of Magnicator II Float

Opposing magnetic poles project concentrated flux lines away from the outside diameter of the magnets. This forced deflection creates a stronger field than any other float magnet arrangement, greater than 90 Gauss at the centerline of the indicator flags. Physics has guaranteed that the Magnicator float has the strongest magnetic field...which translates to the most reliable instrument.

Magnicator II Float

Typical Float from other Manufacturer

Typical floats from other manufacturers employ a circular array of Alnico 5 Bar Magnets. Other brands use a single ring magnet. Neither can produce as intense a magnetic field as the Magnicator II float.

If you are looking for reliable performance from a magnetic level indicator, start with the float magnet. The stronger and more focused the magnetic field of the float, the more reliable the level indicator...and the more reliable the function of magnetically-actuated flag indicators, switches and transmitters.

The Jerguson Magnicator II float has the strongest magnetic field of any magnetic level indicator. Its patented design (U.S. Patent 5,743,137) uses two 360° annular Alnico 8 ring magnets with opposing north poles.

How it Works

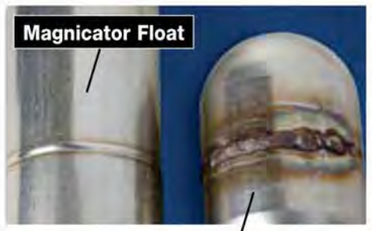
The Magnicator II gage is connected to a process vessel. The chamber, or "column," contains a sealed float with a permanent magnet assembly which rises and falls as the liquid level changes in the process vessel.

The indicator housing is parallel to the gage column but completely isolated from process liquid. Indicator flags are rotated by the float magnet assembly as it moves up and down in the chamber.

Magnetic liquid level gages are an attractive alternative to sight glasses for many applications. They provide improved visibility, reduced maintenance and eliminate the leak paths associated with sealing glass.

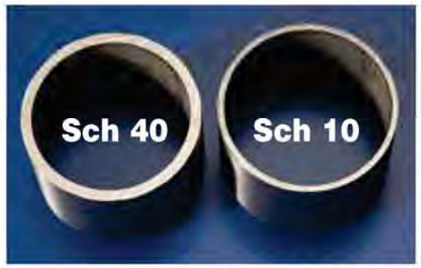
Robust Construction *Inside and Out*

Your demanding application deserves a gage with the guts to stick it out for a long, long time. In addition to complying with ASME B31.1 for power piping and ASME B31.3 for process piping, all Magnicator® II Magnetic Level Gages incorporate additional design and construction benefits you will not find on any comparable product:



Schedule 40 Chamber Construction is Standard

Most other magnetic level gages are offered as Sch 10, with an upgrade to Sch 40 available. Since most plant piping specifications prohibit Sch 10 pipe, this can be misleading. The difference between Sch 10 and Sch 40 is substantial, with a lower pressure rating and a much greater chance of damage during shipping, handling and construction. For even higher pressures, we offer Sch 80 and Sch 160 chambers, see page 13 for details. This is directly related to the strength of our patented float magnet assembly. No other magnetic level indicator can function as reliably with such robust piping.



Schedule 40 construction is standard for Magnicator II gages. Rated to 2200 psi @ 100° F per ASME B31.3

Schedule 10 is not appropriate for most process applications. Rated to 1200 psi @ 100° F per B31.3

Smooth Autogenous Welds

All Magnicator II floats have full penetration autogenous welds. This means an orbital welding machine has fusion-welded the two halves using only heat and no filler metal. This process—the same used for high purity and sanitary tubing—produces an ultra-smooth weld, without a bead which could interfere with the float's motion.

Superior Indicators Mean *You Can Trust What You See*

Jerguson recommends flag indicators for virtually all applications, so flags come as standard on Magnicator® II products*. However, there is nothing "standard" about their design and construction. They are the most reliable, shock-resistant and longest lasting available.

* (Follower-style indicators are available as an option – see Options & Accessories, *page 12*.)

The Jerguson Flag

- Each flag is a single stainless steel precision stamping with its own permanent ceramic magnet
- Each flag has dual rotation points and is free to rotate, a redundancy plastic flags do not have

- At rest, each flag is strongly attracted to each adjacent flag of the same color, with an active magnetic field of 200 Gauss at leading edges

This attraction can only be broken by a magnetic field strong enough to cause the flags to rotate (the Magnicator II float assembly), making each flag assembly ***extremely shock and vibration resistant***

Potential Problems with Other Manufacturers' Indicators

Anodized aluminum or plastic flag construction:

- Flags can fade with exposure to UV light (sunlight) or temperatures over 500ºF (260ºC)
- Rough edges of metal burr or flags can get caught in track

Heat has faded these anodized aluminum flags to make them nearly indistinguishable.

This style relies on colored stickers applied to plastic flags.

Followers are "single-point" indicators, versus "multiple-point" flag style indicators. With 2 1/2 flags per inch, if you "lose" one flag (which is unlikely), you still have many working to indicate level.

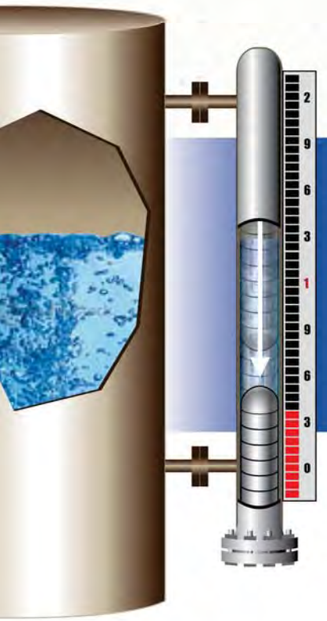
- Vibration (water hammer), rapid movement and turbulence can cause a follower to be "dropped"
- Weak magnetic couplings between flags and float magnet can lead to false trips as shown

Fallen Follower

False Trips

FlashProof Magnicator® Products

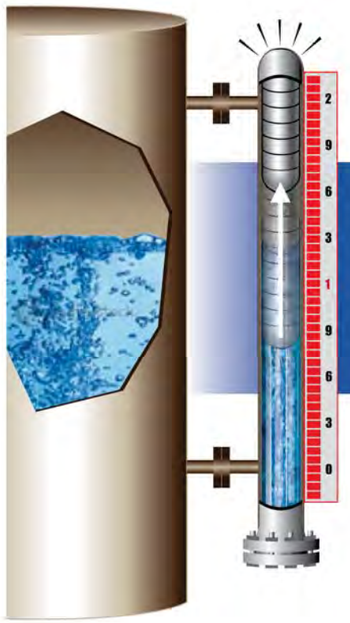
Avoid False Readings in Boiling Fluids and Eliminate Crushed Floats Due to Flashing



Boiling Fluids

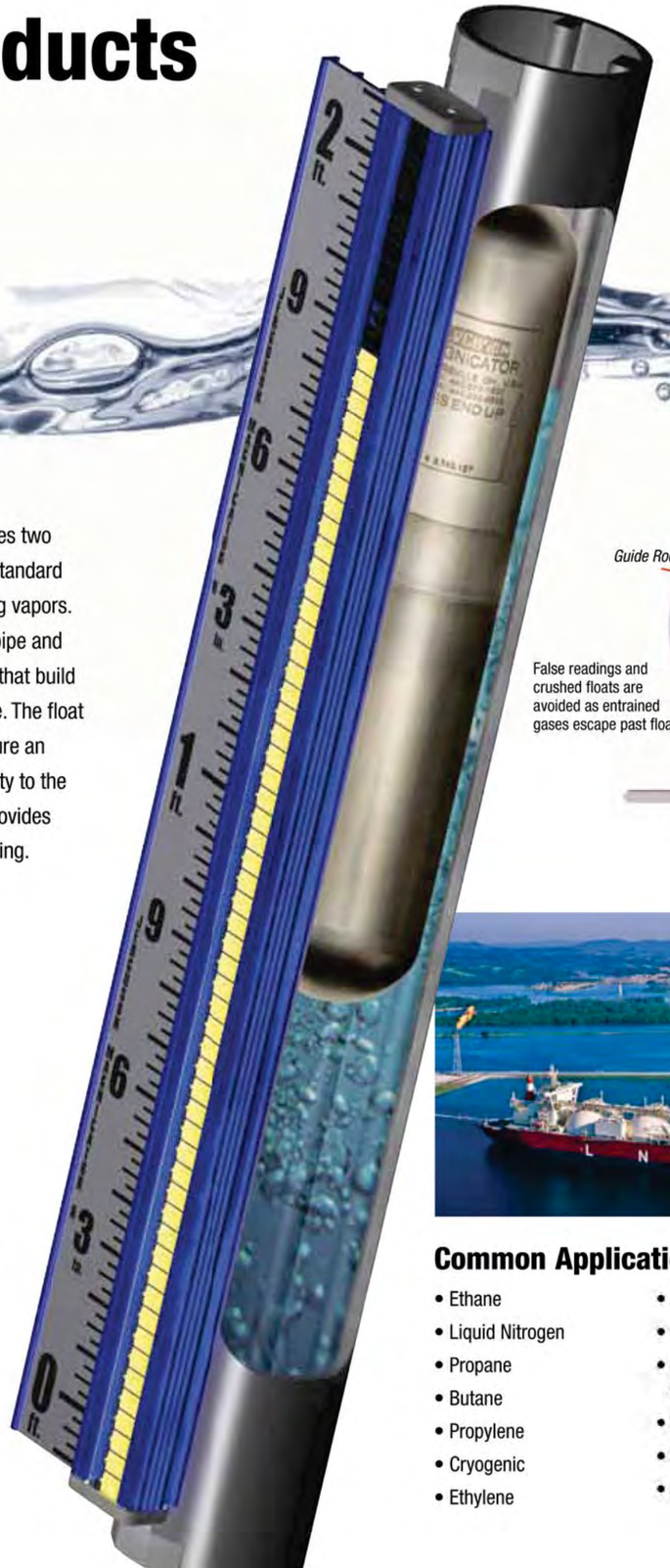
Boiling fluids can cause the float to sink in a traditional level indicator. This situation is common when there are substantial temperature differences between the fluid in a vessel and the fluid in a gage (Think: cold liquid in vessel; hot summer day for gage.)

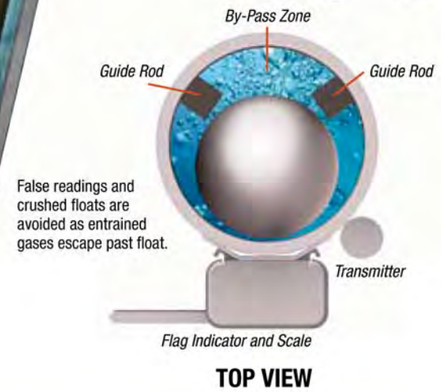
The Jerguson FlashProof design addresses two potential problems that may occur with standard level indicators: boiling fluids and flashing vapors. By employing a larger (3") Schedule 40 pipe and two internal guide rods, entrained gases that build up under the float can harmlessly escape. The float is held to one side of the chamber to insure an optimized magnetic field in close proximity to the indicator, transmitter or switches. This provides an accurate float level and indicator reading.



Flashing Vapors

Flashing vapors can cause a float to accelerate upwards rapidly, crashing into the top of the chamber due to depressurization.





TOP VIEW

Common Applications

- Ethane
- Liquid Nitrogen
- Propane
- Butane
- Propylene
- Cryogenic
- Ethylene
- Methane
- Carbon Dioxide
- Anhydrous Ammonia and other refrigerants
- LPG
- LNG
- Light End Hydrocarbons

FlashProof Indicator

Specification Overview

- Larger diameter chamber with float guides
- Complies to ASME B31.1 and ASME B31.3
- Available with full range of Jerguson indicators, transmitters and switches
- Schedule 40 pipe chamber as standard
- Size Range from 12" to 240" (304mm to 6090mm) vessel centers (Consult factory for longer units)
- Specific gravity minimum: 0.32
- Pressure class rating up to 1900 psi (131 bar) @ 100ºF (37ºC) as per ASME B31.3 (Higher pressures are available with larger diameter chambers.)
- Temperature Range: -325ºF to 1000ºF (-198ºC to 537ºC)

NightStar

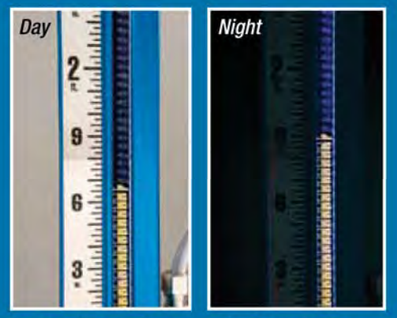
LED Illuminators Provide *24 Hour Visibility*

Here's a Really Bright Idea

NightStar Indicators for the Magnicator® II make a level gage continuously visible... night or day with bright LED illumination. No more flashlight searches, no more spending more time than needed in process areas.

NightStar Illuminators provide an array of bright LEDs to shine on standard mechanical flag indicators. No light or low-light, the operator can easily and reliably verify level.

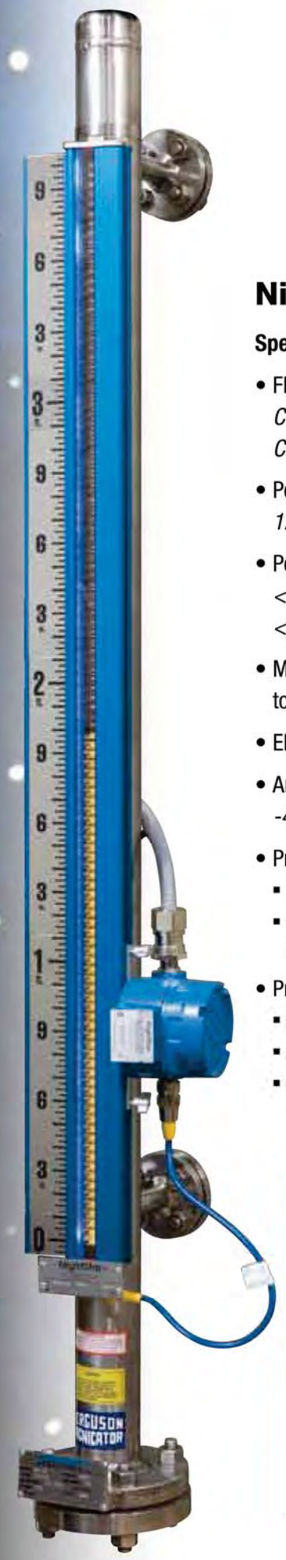
- High contrast indication
- Not angle dependent – viewer can see clearly from many positions
- Reduced operator exposure in process areas can increase safety
- LEDs have a nominal life of 10 years
- Approved for use in Class 1, Div. I classified locations



NightStar LED base illuminator for the Magnicator® II

An Easy Upgrade for Any Magnetic Level Gage

NightStar Indicators can be field-upgraded on any Jerguson magnetic gage, or other manufacturer's gage, by replacing both the float and indicator.



NightStar Indicator

Specification Overview

- FM & CSA Approval to:
  Class I, Div. I, Grps. B, C, & D
  Class II, Div. II, Grps. E, F, & G
- Power Supply:
  120 or 240 VAC
- Power Consumption:
  < 750 mA @ 120 VAC
  < 375 mA @ 240 VAC
- Max. Remote Distance from Power Supply to Light Strip = ~80 feet (24.3m)
- Electrical Connection: 3/4" FNPT
- Ambient Temperature:
  -40ºF (-40ºC) to 170ºF (77ºC)
- Process Temperature:
  - *Up to 450ºF (232ºC)*
  - *450ºF (232ºC) to 600ºF (316ºC) with air purge kit on indicator*
- Protection Methods:
  - *Explosion-proof power supply*
  - *Intrinsically-safe lighting circuit*
  - *NEMA 4X design*

> "Not only have the Jerguson magnetic gauges become the standard for our FCCU in Marcus Hook, but our operators specifically request the NightStar on all models we install."
>
> – **Beth Lavine,**
> *Project Specialist*
> Sunoco-Philadelphia Refinery

Magnicator® II Gage *with Guided Wave Radar*

Redundant Sensing Technologies for the Ultimate in Reliable Level Indication

By combining guided wave radar (GWR) with a magnetic level gage, the Magnicator® II Guided Wave Radar (MGWR) brings a new standard of assurance to level indication.

The primary advantage of a guided wave radar (GWR) transmitter over a Magnetostrictive or Reed Switch transmitter is that the GWR transmitter is an independent device that does not rely on the float's magnetic field to obtain a reading. A Magnetostrictive or Reed Switch transmitter measures the position of the float inside the magnetic gage, while the GWR transmitter detects the actual fluid level.

The GWR transmitter obtains an independent reading of the liquid level, providing an accurate output even in the case of a float failure. Also, the GWR transmitter will read the true level of the fluid, even if the density of the product varies. With a magnetic gage, the float is sized for the minimum specific gravity and the gage float position in the fluid will change with the specific gravity.

Guided Wave Radar
Changes in product specific gravity do not affect output.

Transmitter Features

- Measurement independent of density, conductivity, dielectric constant and temperature
- Measurement unaffected by foam or turbulent surfaces
- Process temperatures from -328˚F (-200˚C) to 752˚F (400˚C)
- Pressure ranges from full vacuum up to 3500 psi (240 bar) for MGWR or 5802 psi (400 bar) for GWR chamber alone
- Models available for interface applications; both total and interface level can be provided on one Hart® signal
- Models available with gas phase compensation for steam applications
- Communication Protocols
  - *4-20 mA SIL Hart®*
  - *Fieldbus Foundation™*

Also available as by-pass chamber or bridle assemblies.

Switches and *Transmitters*

Cutaway view

SAS-16 Tri-Magnet Latching Switch

Unique design creates a snap action switch strictly through the use of repelling magnetic fields.

- No cams or springs
- Highly vibration-resistant
- UL approved for hazardous locations Class 1, Div. I, Grps. A, B, C, & D
- ATEX Ex d IIC T5
- NEMA 4X design
- Easy installation – externally clamps to gage chamber
- Available with integral terminal block enclosure

MTII-4200 Magnetostrictive Transmitter

- .001" resolution continuous output
- FM & CSA - Class 1, Div. I, Grps. B, C, & D; Class 1, Div. II, Grps. E, F, & G
- ATEX EEx ia IIB + H2 T4
- NEMA 4X design
- Adjustable zero and span
- LCD display and window cover are standard
- Communication Protocols
  - *4-20 mA loop-powered transmitter with Hart® protocol (standard)*
  - *Fieldbus Foundation™*

RST2 - Reed Switch Transmitter

- 4-20 mA loop-powered transmitter
- 1/2" (Std), 1/4" (Optional) resolution
- UL & C-UL Class 1, Div. I, Grps. B, C, & D Class 2, Grps. E, F, & G
- NEMA 4X design
- Field Adjustable Span

RS-2 or RS-2/2 Hermetically-Sealed Reed Switch

- Low power switches for DCS and starter circuits
- SPDT and DPDT switch configuration
- 120 Maximum VAC; 1 Amp Maximum; 30 Watts Maximum (Volt X Amps = Watts)
- UL & C-UL listed Class 1, Div. I, Grps. B, C, & D
- NEMA 4X design

Options, Accessories *and Special Gages*

Consult our Specification Guide for complete model numbers and configuration options.

Hermetically-Sealed Flag Indicator

- Designed to meet needs of offshore industry, chemical wash-down, and severe environments
- Flag indicators are purged with inert gas and permanently sealed in:
  - polycarbonate tubing with epoxy-sealed end plugs to 500˚F (260˚C) process temperatures; or
  - glass tubing with 100% fused glass end seals to 1000˚F (537˚C) process temperatures
- No gaskets: ***can't leak or fog***

LevelStar® LED Indicators

- LED indicators have no moving parts
- 10 year nominal life on LED
- Field-upgradeable; easy clamp-on installation
- Approved for use in general purpose areas
- Red and green standard; other colors available
- 120/240 VAC
- -40˚F (-40˚C) to 170˚F (76˚C) ambient
- Process temperature:
  - *Up to 450˚F (232˚C)*
  - *450˚F (232˚C) to 600˚F (316˚C) with air purge kit on indicator*

ASME Section I Boiler Code Gage

- Up to 900 psi (62 bar) per code requirements
- Indicator range 2" less than vessel connections (not to encroach on high/low side of steam/water connections)
- Lowest visibility must be 2" above lowest safe operating level, as determined by boiler manufacturer
- Cannot replace code required direct reading glass level gage
- Accessories are NOT permitted for any control functions. (Includes Point Level Switches, Magnetostrictive Transmitters, or Guided Wave Transmitters.)
- (Reference PG60 of ASME Section I Boiler Code)

Follower Style Indicators

- Gold anodized follower
- Are purged with inert gas and sealed in polycarbonate or glass tube
- Aluminum or 316 stainless steel housing
- Hermetically sealed follower indicators in 316SS housing are available. Suitable for offshore environments.
  - polycarbonate tubing with epoxy-sealed end plugs to 500˚F (260˚C) process temperatures; or
  - glass tubing with 100% fused glass end seals to 1000˚F (537˚C) process temperatures

Hot or Cold Insulation

Hot Insulation 550˚F (287˚C) to 1000˚F (537˚C)

Jacket covers entire gage and includes drawcords at each end for closure. Provided with openings for gage process connections, indicator and switches or transmitters.

- PTFE coated & impregnated fiberglass
- 1" thickness to 550˚F (287˚C)
- 2" thickness to 800˚F (426˚C)
- 3" thickness to 1000˚F (537˚C)
- Stainless steel grommets
- Polypropylene / fiberglass drawcord at ends

Cryogenic Insulation 32˚F (0˚C) to -250˚F (-156˚C)

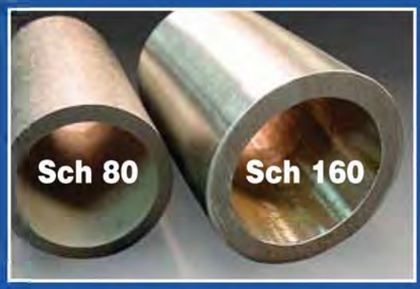
- Polyisocyanurate foam insulation - 2" thick
- .016" aluminum jacketing with moisture barrier
- All joints sealed
- Optional non-frost extension required

Combination Sight Glass / Magnetic Gage

- Use glass level gage for calibration and level verification only
- Maintenance is virtually eliminated
- Available as an upgrade for sight glass installations
- Not for use in ASME Section I Installations

Mini Magnicator

- Economical magnetic gage features single bar magnet float
- Pressures to 400 psi (27 bar)
- Temperatures to 500˚F (260˚C)
- Specific gravity 0.7 or greater
- Local indication only



Sch 80 and Sch 160 Columns for High Pressure

The focused strength of the Magnicator II float permits reliable operation in heavy wall chambers up to Sch 160.

High Pressure Float

for Pressures Up to 3500 psi (241 bar)

This unique spherical float design delivers the same focused magnetic characteristics and reliability as our standard float. The non-pressurized high strength titanium design is safer and more reliable than pressurized versions. Accommodates specific gravity down to 0.5, temperatures up to 600ºF (315ºC) and pressures to 3500 psi (241 bar). Segmented float design reduces required ground clearance under unit.

Float lengths of up to 22" can be provided for low specific gravity applications.

Magnicator® II Level Products

Specifications

Column Construction

- Complies with ASME B31.1 (Power Piping) and B31.3 (Process Piping) design requirements
- NACE MR0175
- ASME Section VIII U Stamp Available
- Welding in accordance with ASME Section IX
- 100% Hydrostatic testing to 1.5x the column rating (typically limited by flange rating)
- 2-1/2" Schedule 40 standard, options for 2-1/2" Sch. 80 or 3" Sch 160
  - *3" Sch 40 standard with FlashProof Chamber (See pages 6-7)*
  - *Schedule 10 utilized for PFA Coated Gages Only*

Materials of Construction - Column

- Austenitic Stainless Steel Grades 304/304L, 316/316L, 317, 321, 347
- Alloy 20, Hastelloy® C-276, Hastelloy® B3, Monel,® Titanium, Inconel® 625/825, Zirconium, AL-6XN, SM0254
- Other non-ferrous alloys
- CPVC, PVDF (Kynar®)
- PFA Teflon or Kynar® Lining Options Available (All flanged connections required)

Pressure Range

- Full vacuum to 3500 psi (241 bar)
  - *Consult Factory for high pressure applications*

Temperature Range

- -328˚F (-200˚C) to 1000˚F (537˚C)

Measurement Range

- 12" (304.8mm) to 240" (6096mm) Standard
- Lengths up to 60 feet (18m) available; consult factory

Specific Gravity

- 0.32 Minimum

Float Construction

- Pressures up to 3500 psi (241 bar) with Sealed Float
- Permanent magnet arrangement of Alnico 8 or higher energy level
- 316L Stainless Steel, Titanium, Monel® or Hastelloy® C-276
- Autogenous welding
- Magnetic field strength of 90 Gauss at flag indicator

Visual Indicators

- Yellow/Black bi-color anti-vibration flag standard (other colors available)
- NightStar white LED Illuminated standard flag
- Hermetically sealed flag indicator in 316SS housing suitable for offshore environments
  - *Polycarbonate tubing with epoxy-sealed end plugs to 500˚F (260˚C) process temperatures*
  - *Glass tubing with 100% fused glass end seals to 1000˚F (537˚C) process temperatures*
- Hermetically sealed follower indicator in 316SS housing suitable for offshore environments
  - *Polycarbonate tubing with epoxy-sealed end plugs to 500˚F (260˚C) process temperatures*
  - *Glass tubing with 100% fused glass end seals to 1000˚F (537˚C) process temperatures*
- LevelStar bi-color LED

Indicator Flag Construction

- Stainless steel indicator flag and rotation pin
- Individual permanent magnet in each indicator flag

Indicator Housing Construction

- Anodized aluminum or 316SS indicator housing with 316SS photo-etched scale
  - *Inches/feet*
  - *Centimeters/meters*
  - *Percentage*
  - *Negative values*
  - *Custom*

Switch Options

- Magnetic snap-action
  - *SAS-16: SPDT 16A @ 120VAC*
- Reed element
  - *RS-2: SPDT 1A, 120VAC, 30W*
  - *RS-2/2: DPDT 1A, 120VAC, 30W*

Transmitter Options

- MTII-4200 magnetostrictive element (0.001" resolution)
- Guided Wave Radar
- RST2 reed switch elements (1/2" or 1/4" resolution)

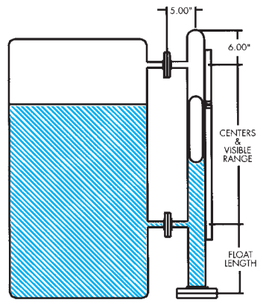
Temperature Maintenance

- Steam or Electric Tracing

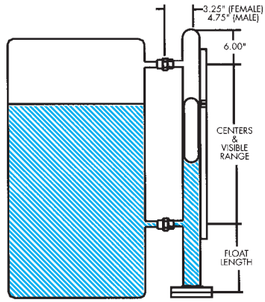
Insulation

- Cyrogenic with non-frost acrylic extension down to -328˚F (-200˚C)
- High Temperature removable jacket up to 1000˚F (537˚C)

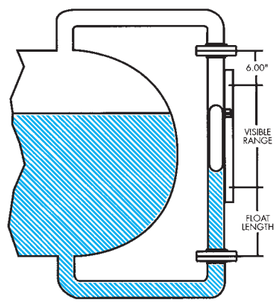
TYPICAL INSTALLATION



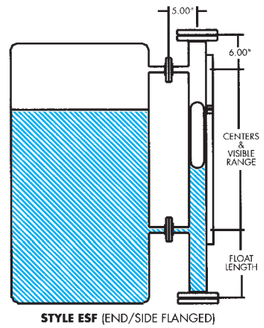
STYLE SF (SIDE FLANGED)



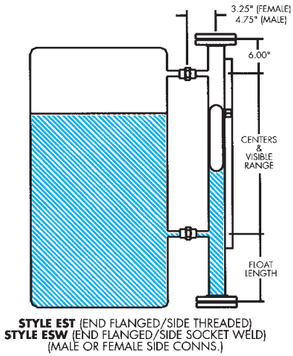
STYLE ST (SIDE THREADED)
STYLE SW (SIDE SOCKET WELD)
(MALE OR FEMALE SIDE CONNS.)



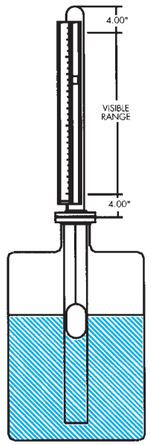
STYLE EF (END FLANGED)



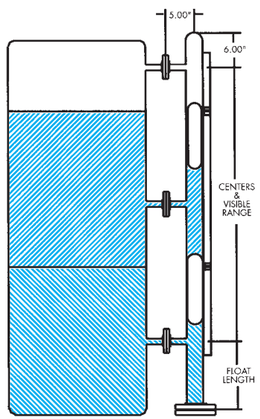
STYLE ESF (END/SIDE FLANGED)



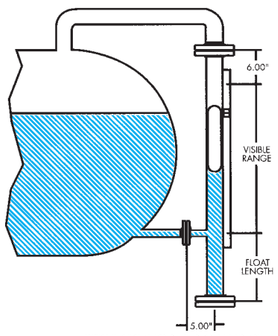
STYLE EST (END FLANGED/SIDE THREADED)
STYLE ESW (END FLANGED/SIDE SOCKET WELD)
(MALE OR FEMALE SIDE CONNS.)



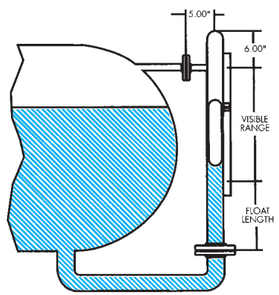
STYLE BEF (BOTTOM END FLANGED)
(TANK TOP)



STYLE SF (SIDE FLANGED w/ MULT. CONNS.)
(INTERFACE w/ DUAL FLOATS)



STYLE MC (MODIFIED CHAMBER)
(TOP/BOTTOM SIDE FLANGED)



STYLE MC (MODIFIED CHAMBER)
(TOP SIDE/BOTTOM FLANGED)

TO CONSTRUCT A PART NUMBER

1. MAGNICATOR ®II
2. SELECT STYLE
3. PROCESS CONNECTION SIZE
4. FLANGE CLASS RATING (ANSI)
5. SPECIFY CHAMBER MATERIAL
6. PROCESS SPECIFIC GRAVITY
7. SPECIFY MAXIMUM WORKING PRESSURE (PSIG)
8. SPECIFY MAXIMUM WORKING TEMPERATURE (°F)
9. CENTER/VISIBLE RANGE
10. INDICATOR TYPE
11. OPTIONS

HOW TO ORDER MAGNICATOR®II

Part Number: MII [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11]

Magnicator® II (1)

Chamber Style (2)
SF
ST
ESF
EST
BEF
EF
MC
SW
ESW

Process Connection Size (3)
04 = ½"
06 = ¾"
08 = 1"
12 = 1 ½"
16 = 2"
20 = 2 ½"
24 = 3"
32 = 4"
48 = 6"

Flange Class (ANSI) (4)
01 = 150#
03 = 300#
06 = 600#
09 = 900#
15 = 1500#
25 = 2500#
50 = 5000#

General Material (5)
R = 304 / 304L SS
RA = 304, CS Flanges
T = 316 / 316L SS
TA = 316, CS Flanges
K = Alloy 20
M = Monel
TT = Titanium
LB = Hastelloy®B
LC = Hastelloy®C
GS = 321 SS
ZR = Zirconium
CP = CPVC
PF = PVDF (Kynar)
TC = PFA Coated
TF = TFE
CM = Customer Spec.

Specific Gravity (6)
.32 and up

Max. Working Press PSIG) (7)
Up to 2400 PSIG
(2400-5600 PSIG available)

Max. Working Temp. (°F) (8)
Up to 1000° F

Centers/Visible Range (9)
Exact Inches (or mm)

Indicator Type (10)
BF = Follower
SF = Stainless Follower
FL = Flag (Wafer)

Options (11)
AS = Acrylic Scale
MS = Metric Scale
PS = Percentage Scale
NGS = Negative Scale
SS = Special Scale (Specify Type)
SP = Set Point Arrows (Specify Qty)
DI = Dual Indication (BF Only)
IF = Interface
IL = Illuminator
NF = Non-Frost Extension
PI = Polycarbonate Indicator
EH = Electric Heat Trace
CI = Cold Insulation
ST = Steam Traced
IB = Insulation Blanket
BW = All Butt Weld Construction
WN = Weld Neck Flanges
RJ = Ring Joint Flanges
SE = Stub End/Lap Joint
NDE = Non-Dest. Exam (Specify Type)
VV = Valves (Specify)
FF = Smooth Finish Flanges (125-250 RMS)
SW = Socket Weld Process Flanges
NS = No Scale
NI = No Indicator
DV = 3/4" Vent / Drain, Plugged
X = Other (Specify)

EXAMPLE:

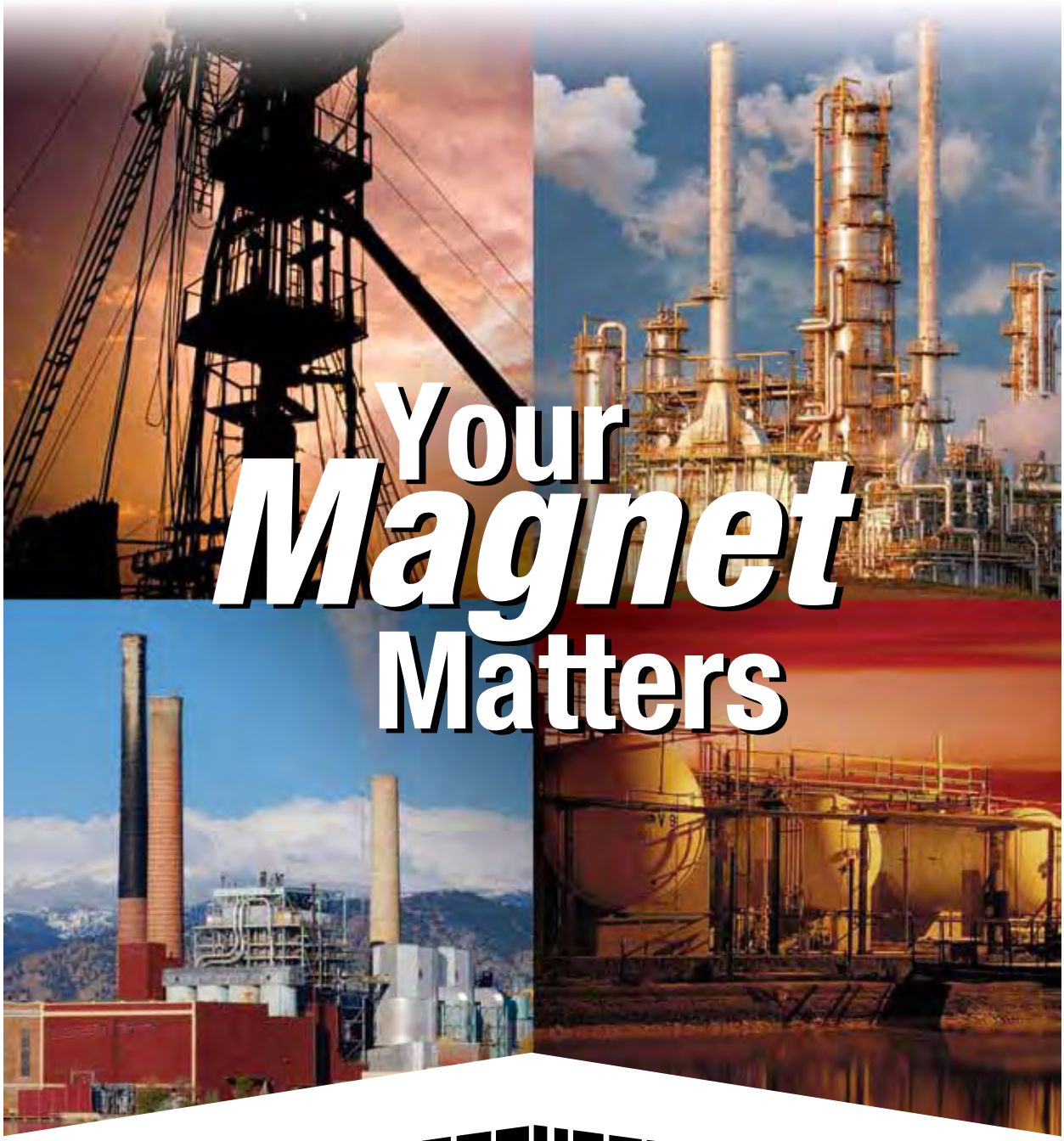
MII-SF-08-15-TA-.55-1000-500-48.0"-FL-IB-WN

DESCRIPTION:

2. STYLE SF (SIDE FLANGED)
3. PROCESS CONNECTIONS: 1.0" RF
4. FLANGE RATING: 1500# ANSI
5. CHAMBER MATERIAL
   316SS WITH CARBON STEEL FLANGES
6. SPECIFIC GRAVITY: .55
7. MAX WORKING PRESSURE: 1000 PSIG
8. MAX WORKING TEMP.: 500 F
9. PROCESS CONNECTION C/L: 48.0"
10. FLAG INDICATION
11. OPTIONS: INSULATION BLANKET
    WELD NECK FLANGES

Magnicator® II

Magnetic Liquid Level Indication Products



JERGUSON®

Products Manufactured by the Clark•Reliance® Corporation

16633 Foltz Parkway, Strongsville, OH 44149 USA Phone: 440.572.1500 Fax: 440.238.8828
www.clark-reliance.com sales@clark-reliance.com

FM c UL us CSA CE Ex ISO 9001:2000

K-TEK

Magnetic Liquid Level Gauge Series

K-TEK
MAGNETIC LIQUID LEVEL GAUGE

Features That Make the KM26™ the World Leader in MLG Technology

MagWave

MW05 Dual Chamber Level System

- Redundant level measurement
  - Guided Wave Radar (GWR)
  - Magnetostrictive Transmitter
- Low cost of ownership
- 5 year warranty
- Highly visible indication

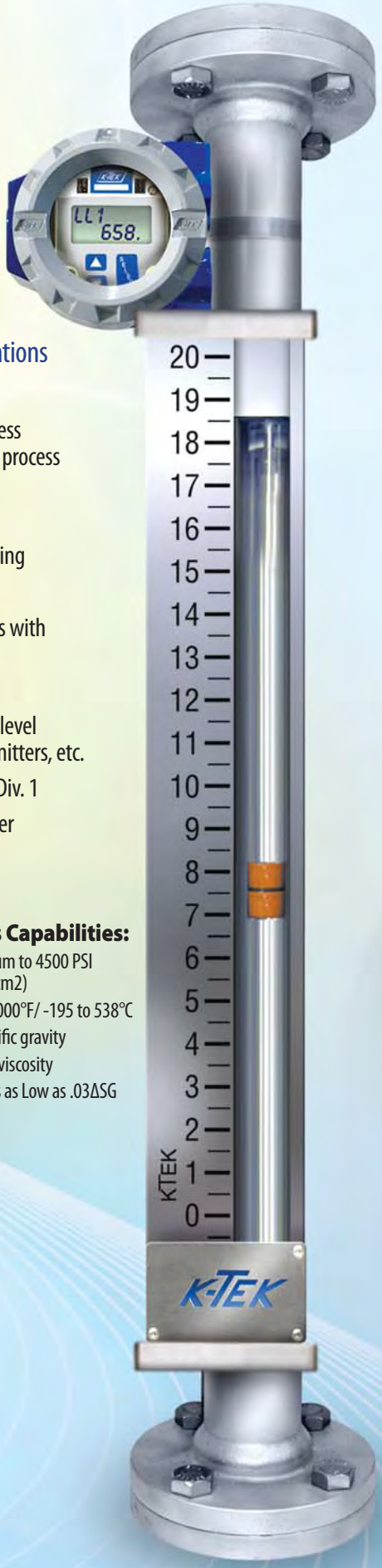
KM26™

Magnetic Level Gauge for Liquid Applications

Extruded Process Connections

K-TEK offers extruded connections for the process connections on most chambers. The extrusion process benefits include:

- Stronger connections
- Eliminates the need of post weld straightening
- Provides full bore process connection
- Eliminates "sink-in" distortion that interferes with float movement
- Improves quality, operation and reliability
- Additional connections can be extruded for level switches, pressure switches, pressure transmitters, etc.
- Meets ANSI B31.1, B31.3, and section VIII - Div. 1
- The weld does not protrude into the chamber



Features:

- Highly visible level indication with no process fluid in contact with the glass
- All construction in-house by code certified welders
- Float designed and weighted for maximum accuracy
- Transmitter and switch options which can be installed, adjusted and maintained with no process interruption
- Safe for corrosive, flammable, toxic, high-temperature and high-pressure applications
- Rugged design - low or no maintenance

Available Materials:

- Stainless steel - 304/304L, 316/316L, 321, 347, 904L
- Alloy 20
- Hastelloy - B3, C-276
- Incoloy 600, 825
- Aluminum
- Titanium
- Teflon coated stainless steel
- Fiberglass - epoxy or vinyl ester resin
- PVC, CPVC, Kynar
- Polypropylene
- Zirconium
- For other materials consult factory

Testing & Documentation Available Includes:

- Radiographic examination
- Liquid dye penetrant examination
- Hydrostatic examination
- PMI (Positive Material Identification) material certification
- ASME "U," "UM," or "S" stamp
- Third party inspection
- Material Certificates
- ANSI/ASME B31.1, B31.3
- PED certification*
- NACE MR0103, NACE MR0175
- Canadian registration number (CRN)
- Marine and industrial type approval for high-pressure boilers (New Zealand)

Process Capabilities:

- Full vacuum to 4500 PSI (316 kg/cm2)
- -320 to 1000°F/ -195 to 538°C
- 0.25 specific gravity
- All liquid viscosity
- Interfaces as Low as .03ΔSG

ASME SETTING THE STANDARD

HSB Global Standards

*PED certification applies to K-TEK Corp. only.

Corrosive/ lightweight

- PVC, CPVC, Polypropylene or Kynar (PVDF) construction
- Pressures to 50 PSI (3.5 kg/cm2)
- Temperatures to 280°F (138°C)

Heat traced & high temperature insulation

- Electrical or steam heat tracing
- Removable insulation

- Keeps magnetic particles out of float chamber
- Fits in line with process connection
- Also available in integral configuration

High pressure

- Flange ratings to 2,500# ANSI

Cryogenic temperature insulation

- Temperatures to -320°F (-195°C)
- Lexan frost extensions available (Required for cryo units)

KM26T (Top Mount)

Magnets above float connected with rod

- Slug catcher level
- Optional stilling wells
- Total or interface level measurement
- Underground tanks & sumps
- Fluids with magnetic particles
- Can be used with transmitters & switches

Vibration Isolator Connections

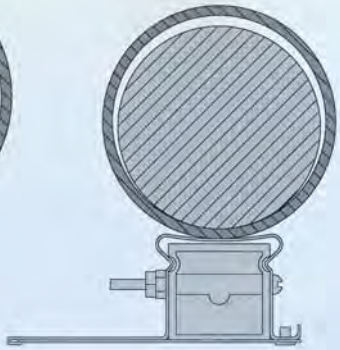
- Absorb large amounts of vibration
- Eliminates signal distortion
- Recommended for use with AT200 on compressor and pump skids

Steam Jacket

- Used to uniformly heat or cool process fluid

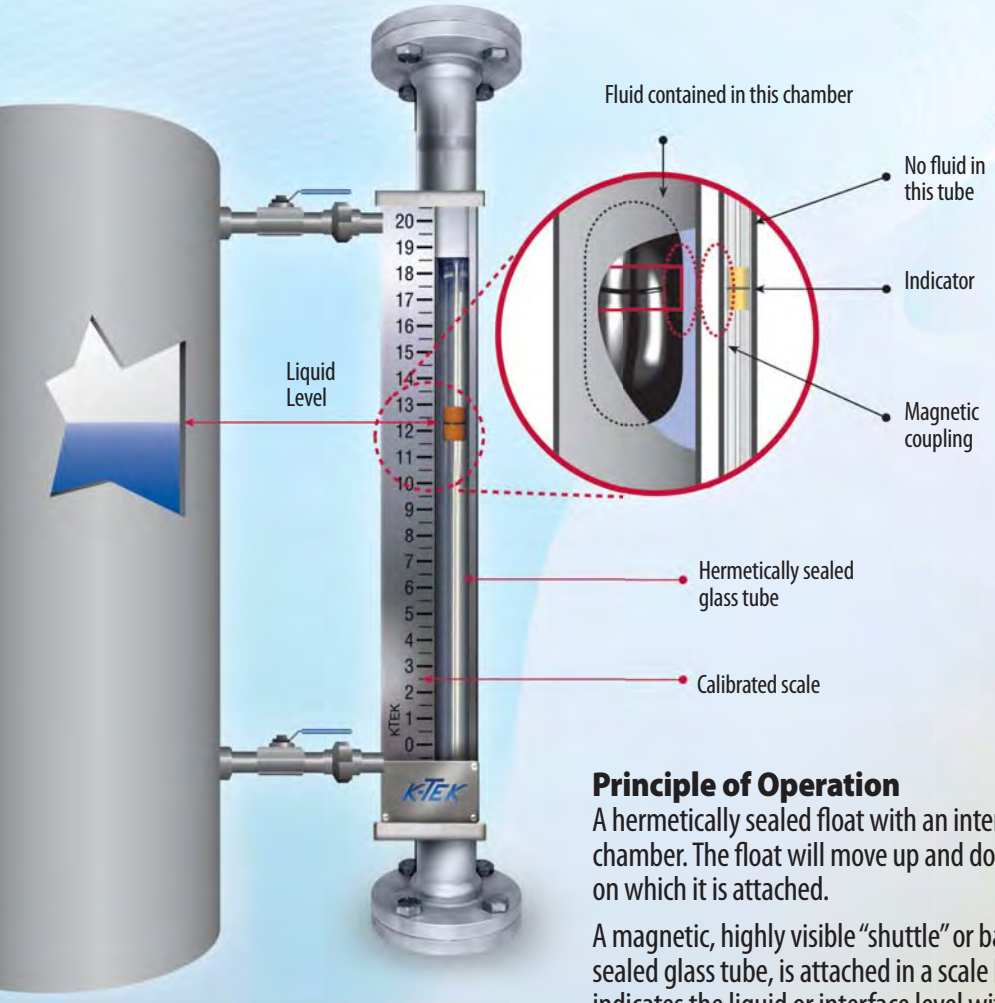
Oversized Chamber

K-TEK's Oversized Chamber With Guide Rods



Standard Chamber

Allows vapors to pass floats when a fluid is close to vapor pressure and can be used in fluids with small suspended particles. Also used in conjunction with Teflon S coating for non-stick.



K-TEK's KM26 Magnetic Liquid Level Gauges are Manufactured to Suit Specific Process Requirements

Principle of Operation

A hermetically sealed float with an internal magnetic ring is housed in a non-magnetic float chamber. The float will move up and down in the chamber as level rises or falls in the vessel on which it is attached.

A magnetic, highly visible "shuttle" or bar graph indicator, encapsulated in a hermetically sealed glass tube, is attached in a scale housing to the outside of the float chamber. It indicates the liquid or interface level without being in contact with the process fluid.

K-TEK floats are designed and weighted so that the center of the magnet assembly is at the true fluid level for absolute accuracy.

Coating, plating, fouling, fugitive emissions and leaks of hazardous material problems are eliminated.

Problems with colorless or dirty fluids are solved since the indicator is non-contact.

No gauge glasses to clean. No leaks to repair.

Typical Industries:

- Oil production and refining facilities
- Petrochemical plants
- Chemical plants
- Gas plants
- Power plants
- Water and waste water treatment
- Food and beverage
- Pharmaceutical
- Pulp and paper
- Liquor production
- Biotech
- Semiconductor

Typical Applications:

- Oil
- Water
- Oil and water interface
- Acids - hydrofluoric, hydrochloric, nitric, sulfuric, etc.
- Refined petrochemical - gasoline, propane, butane, ethylene, etc.
- Solvents - Acetone, Toluene, Xylene, Naphtha
- Gas condensate
- Heat transfer fluids - Dowtherm, Therminol, and Glycol
- Black, green and red liquor
- Refrigerants
- Alcohols
- Caustics
- Chlorine
- Steam condensate - boiler feedwater heater boiler drum level control
- Bitumen
- Vacuum tower bottoms
- Ammonia
- Liquid sulphur
- Most liquid to liquid interfaces

Customer Benefits:

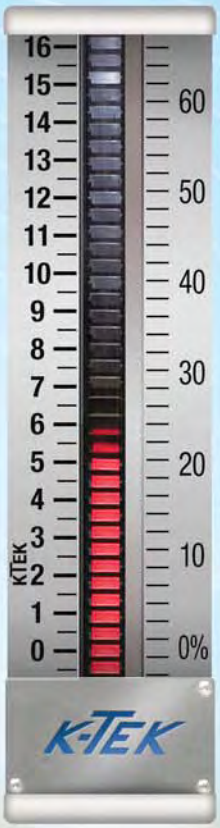
- **Lowest installed cost**
- **Lowest maintenance cost**
- **Lowest engineering cost**
- **Highest visibility**
- **Safest installation**
- **5 year warranty**
- **All gauges are designed to ASME code**
- **All welding by code certified welders**

ASME SETTING THE STANDARD

Indicators

Shuttle and bargraph indicators are available with the following:

- Process temp to 1000°F/538°C
- Hermetically sealed tube
- Shuttle indicator
- Magnetically interlocked bargraph indicator for vibration resistance
- Standard or custom rulers in stainless steel or plastic
- Metric, US units or custom
- Field replaceable



▲ Dual bar graph indicator

▲ Shuttle indicator

▲ Single bar graph indicators available in:
–Yellow/Black
–Red/White
–Red/Green
–Red/Black

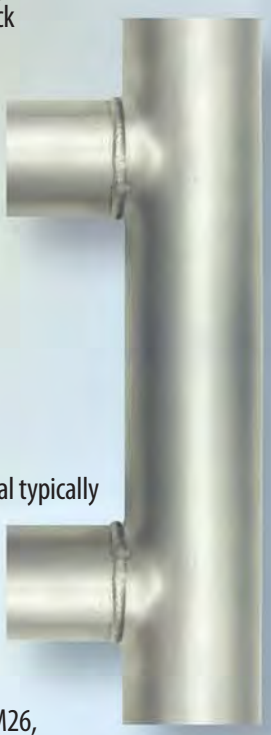
360° magnetic ring ▼

Teflon-S coated ▶

Float Design and Construction

Our floats are individually engineered for each application with the following:

- Minimum positive buoyancy of 75 grams
- Magnetic ring placed at liquid level
- Indicated level is the true level
- Hermetically sealed, no vents
- 360° magnetic ring
- Coated floats (Halar, Tefzel, Teflon-S)



Extruded Outlets

Available in a variety of materials including:

- All stainless steel
- Alloy 20
- Hastelloy
- Sizes depend on material typically 1", 1-1/2" and 2"

Old standard

New standard with K-TEK

◀

Old vs New

Replacement of the instrument bridle with a K-TEK KM26, three MS40 switches and two PS35 switches eliminates:

- 15 Valves
- 43 pipe fittings
- 103 threaded joints
- Two gauge glasses including 16 U-bolts and nuts
- Many possible leaks and fugitive emissions
- Readability problems with gauge glasses

AccuTrak™ AT200™

IEC61508 CERTIFIED

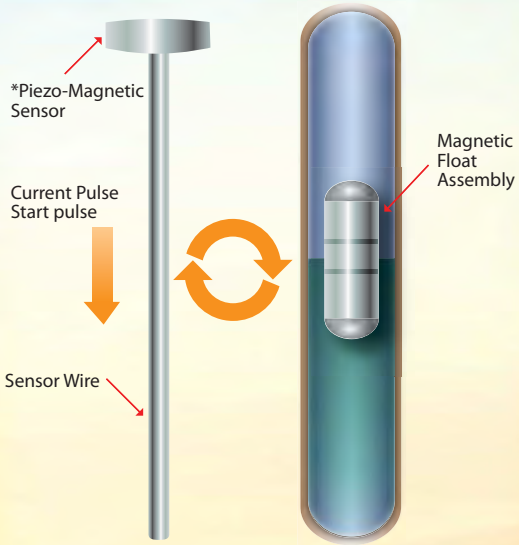
World's FIRST* SIL2 Certified

KM26S shown with AT200 Transmitter

AT200 Level Transmitters
Non-Contact Level Transmission

The Ultimate Level Measurement System:

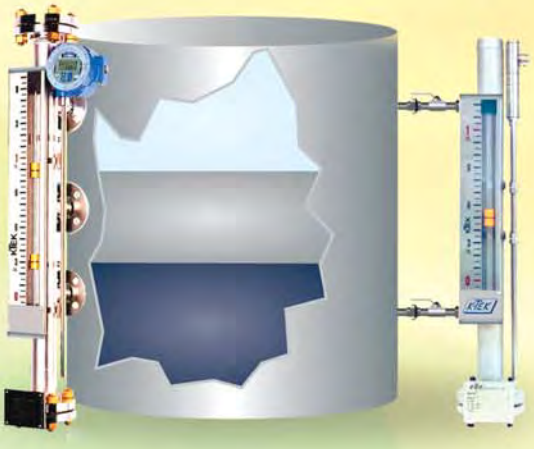
The K-TEK AT200 and AT600 are highly accurate devices designed to be used with the KM26 Magnetic Liquid Level Gauge Series, or any other Magnetic Level Gauge. It is designed to provide continuous level indication, and transmission of an analog signal for monitoring or control. The unique magnetostrictive design allows increased level sensing resolution, which is more than 100 times greater than a conventional reed switch type sensing device.



▲ AT200 operation

* Patent #5,473,245

KM26 Magnetic Liquid Level Gauge Interface Capabilities



KM26 with AT200 Transmitter

KM26S with AT600 Transmitter

Total and Interface Level

- Min. of .03ΔSG
- Any number of process connections
- Multiple floats & Indicators

Interface Level

- Min. of .03ΔSG
- 2 process connections min.
- Available with heat tracing and insulation

ASME SETTING THE STANDARD

*SIL2 certification valid only at Prairieville manufacturing facility.

K-TEK
MAGNETIC LEVEL GAUGE SWITCHES

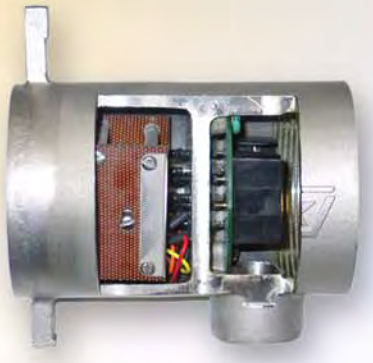
MS30EX™
MS30EX Electric Switch
- Hazardous area rating: FM approved and CSA Certified
- Enclosure: hermetically sealed/explosion proof, NEMA 4x/IP56, ½" FNPT
- Switching mechanism: reed, AC/DC 1 amp, max process temp 600°F (316°C) with IP option, 1/8" deadband, SPDT

MS30™
MS30 Electric Switch
- Hazardous area rating: FM approved and CSA Certified
- Enclosure: hermetically sealed, NEMA 4x/IP56, ½" MNPT
- Switching mechanism: reed, AC/DC 1 amp, max process temp 600°F (316°C) with IP option, 1/8" deadband, SPDT

MS40
MS40 Electric Switch
- Hazardous area rating: FM approved and CSA Certified
- Enclosure: stainless steel, NEMA 4x/IP56, 1/2" FNPT
- Switching mechanism: cam driven, snap-action; AC: 10amp DC: 2.6 amp; min process temp -60°F (-51°C) and max process temp 300°F (149°C), 600°F (316°C) with IP option; 7/8" deadband, DPDT
- For high-temperature, vibration and high-corrosive applications

PS35™
PS35 Pneumatic Switch
- Enclosure: stainless steel, NEMA 4x/IP56, 1/8" MNPT
- Switching mechanism: pneumatic, 15 to 100 psig, min process temp 0°F (-18°C) and max process temp 180°F (82°C), 450°F (232°C) with IP option; 1" deadband, pneumatic signal
- For high-corrosive applications

PS45™
PS45 Pneumatic Switch
- Enclosure: stainless steel, NEMA 4x/IP56, 1/8" MNPT
- Switching mechanism: pneumatic, 1 to 100 psig, min process temp 0°F (-18°C) and max process temp 180°F (82°C), 450°F (232°C) with IP option, 15/16" deadband, pneumatic signal
- For high-corrosive applications



MS41™
MS41 Electric Switch
(Dual compartment housing)
- Hazardous area rating: FM approved; CSA and ATEX Certified
- Enclosure: stainless steel, dual compartment, hermetically sealed, explosion proof; NEMA 4x/IP56; ½" FNPT
- Switching mechanism: cam driven, snap-action; AC: 10 amp DC: 2.6 amp; min process temp -320°F (-195°C) with option and max process temp 300°F (149°C), 1000°F (538°C) with IP option; 15/16", DPDT
- For high-temperature, vibration and high-corrosive applications

MS40EX™
MS40 EX Electric Switch
- Hazardous area rating: FM approved and CSA Certified
- Enclosure: stainless steel/explosion proof, NEMA 4x/Ip56, ¾" FNPT
- Switching mechanism: cam driven, snap-action; AC:10 amp DC: ½ amp; min process temp -60°F (-51°C) and max process temp 300°F (149°C), 600°F (316°C) with IP option; 13/16" deadband, DPDT
- For high-temperature, vibration and high-corrosive applications

All switches have Gost K and Gost R Certification

КазНИИБГП

K-TEK

Providing Level Solutions: Anytime, Anywhere.

Global Manufacturing Facilities

K-TEK Instruments (Pty) Ltd.
Gauteng, South Africa
+27 11 608 2777

K-TEK Level Eng. Pvt. Ltd.
Mumbai, India
+91 022 4156 6100

K-TEK (Tianjin) Level Co., Ltd.
Tianjin, China
+86 22 5981306

K-TEK BV
Rijswijk, The Netherlands
+31 70 3199700

K-TEK Solids Level
Houston, TX USA
+1(713) 462.7665

K-TEK Corp.
Prairieville, LA USA
+1(225) 673.6100

www.ktekcorp.com

K-TEK
The Leader in Level Detection

K-TEK
18321 Swamp Road | Prairieville, LA 70769
tel: +1(225)673.6100 | fax: +1(225)673.2525
toll free: +1(800)735.5835
sales@ktekcorp.com | www.ktekcorp.com

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MAGTECH MAGNETIC LEVEL INDICATORS

Product data information

Magtech

EMERSON
Process Management

LG SERIES MAGNETIC LIQUID LEVEL INDICATORS

Reliable, low maintenance, redundant measurements are vital to the efficiency of your operation, so you need time tested solutions.

Magtech level instruments complement the Rosemount product portfolio and have served the process industry for over 25 years with flexible and creative solutions for a wide variety of applications.

Test, inspection and certification are increasingly important, and managing complex requirements reliably in today's safety conscious environment is a strength of the Magtech brand.

Magtech magnetic level indicators are low-maintenance alternatives to sight glasses and other level indicators. They provide non-invasive level indication while reducing leak points and fugitive emissions.

Combined with our externally mounted transmitters and switches, Magtech magnetic level indicators provide a complete, redundant and cost-effective level solution.

+ Easy to install, no extra piping required in most applications
+ Visual level indication to 100 ft (30 m)
+ No process liquid in contact with indicator glass
+ Ideal for high-temperature, high-pressure and corrosive applications
+ Manufactured to meet ASME B31.1 or ASME B31.3
+ Magnetostrictive and radar transmitter options for non-invasive and/or redundant level control
+ Available with HART™ 5, HART 7 or Foundation Fieldbus™
+ AMS Aware

Magtech magnetic level indicator and magnetostrictive level transmitter

Increased safety and reliability with non-pressurized high pressure floats

The Magtech high pressure float delivers higher safety and reliability than other, pressurized floats. Made from high strength titanium, it is suitable for specific gravities as low as 0.41 and pressures up to 3400 psi (234 bar). For pressures eceeding 3400 psi, please consult the factory.

Higher usability and safety with clearly visible flags

Magtech indicators contain flags made of aluminum coated with 850 °F (454 °C) paint, which can withstand high temperatures. The flags are assembled so that the components are prevented from separating, for example due to vibration in the application.

The Magtech standard flag color is red, which is the universal color of warning and stands out in an industrial environment, making sure the level in the vessel is highly visible.

Safety and reliability are challenges you need to meet

Safety and reliability are ever-increasing challenges. You need more stringent vessel, piping and process connection designs to cope with high pressure and cyclic process services. To meet these needs, we utilize a T-Drill machine to form extruded outlets. This features fully computerized automation control with ultra-precise machining for a more reliable gauge design.

+ Independent certified testing as required by ASME standards
+ Eliminates the need for pipe-tees and minimizes welds
+ 100% X-rayable process connection welds
+ Eliminates internal pipe distortion
+ Provides full bore process connections and all butt-weld construction

Your application is unique. All Magtech MLIs are custom-made based on your requirements

Style A	Style B	Style C	Style D	Style L
Flanged top and bottom, no top and bottom blind, no side process connection	Flanged top and bottom with side(s) process connection	Closed top, flanged bottom with side(s) process connection	Flanged top, closed bottom with side(s) process connection	Closed top and bottom with or without side(s) process connection

Magtech MLI mounting styles

No matter what your application, we can design and manufacture a magnetic level indicator to fit. Above are our standard mounting styles, but if none of these meet your needs we will come up with the best solution based on your requirements.
NOTE: Style "A" is for through process piping only. Other connections shown are examples of typical process connections and need to be specified.

INCREASED CONTROL AT A THIRD OF THE COST - AND REDUCTION IN LEAK POINTS

A process vessel with three point level switches, two short sight glasses, a pneumatic level controller and 15 valves with associated plumbing.

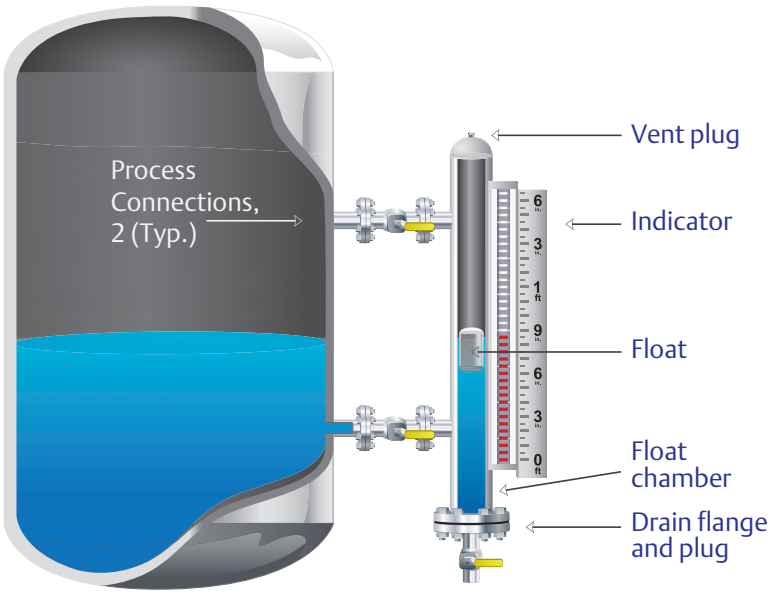
Process vessel after installing a Magtech indicator, providing increased control outputs at a third of the cost.

This is how it works

Magtech magnetic level indicators consist of a chamber, a magnet equipped float which rises and lowers with the fluid level, and an indicator which is mounted to the chamber.

The indicator houses a column of small flags which indicate the level of the fluid in the chamber, based on the position of the float. As the fluid level rises and lowers, the float rises and lowers as well, and the flags are tripped from one orientation to the other; typically the red side indicates the liquid level and the silver side indicates the vapor space.

As the float rises and falls with the process level, tripping the flags, it also stimulates any attached transmitters and switches, providing a signal back to the control system.



Options required by the application

	Typical construction	Optional as required
Chamber material	300 Series stainless wetted parts	Other non-ferrous materials that do not exhibit ferro-magnetic properties such as Hastelloy, CB20, Inconel, Monel 400 and T-321 stainless
Chamber pipe	2½" S10 or S40 welded pipe depending upon the application pressure, temperature and corrosion allowance	2", 3", or 4" may be required or pipe schedules up to S160 or XXS depending upon application requirements
Chamber flanges	Typically supplied ANSI B16.5 RF slip on type, 500 RMS, in 300 Series stainless steel	Common upgrades are ANSI weld neck style, socket weld, or lapjoint, and other flange faces such as RTJ or flat face
Process connections	1" 3000# FNPT unless otherwise specified; vent and drains are ½" 3000# FNPT	As with chamber flanges, upgrades to process connections, vents and drains are ANSI weld neck style, socket weld, or lap joint, and other size or rating NPT or socket weld connections
Float assembly	300 Series stainless steel suitable for applications up to 1000 psig and 0.63 S.G. at temperatures from -320 to 1000 °F (-196 to 538 °C)	Magtech floats are available in a wide variety of materials, for pressures to 3400 psig (234 bar), and in low pressure applications, minimum specific gravities down to 0.40 (lower SG could be possible under certain conditions, please consult factory)
Indicator	Brightly colored red and contrasting silver all metal, high temperature design reading in feet and inches with ½" divisions; approximately 1/3" resolution	Optional all stainless steel housing construction is available for severe environments. In addition, other indicator colors, units of measure or follower type may be specified.
Chamber design	Float chamber is designed to ANSI B31.1and B31.3, and ASME Boiler Code PG60. Welding and welder qualification in accordance with ASME Section IX.	Non-standard welding procedures, qualifications or testing may be supplied if required, as well as designs to proprietary customer design specifications
Testing	Functional and calibration test is performed on every Magtech gauge	Additional testing and documentation, such as MTRs, radiography, hydrostatic pressure tests, PMI, dye penetrant, NACE or witness testing are available if required

A COMPLETE LEVEL SOLUTION

Sourcing the right level equipment is complicated enough without having to go from supplier to supplier to obtain a complete, redundant package for your application.

With Emerson, the solution is available from one source. You don't have to worry about everything fitting and operating together; you can obtain a magnetic level indicator, a magnetostrictive level transmitter and a guided wave radar that are designed to work optimally together to provide the most reliable measurements.

We combine the proven reliability and rugged construction of Magtech LG Series magnetic level indicators, magnetostrictive level transmitters and Rosemount guided wave radar transmitters. The union of these outstanding level measurement technologies provides a redundant system appropriate for use in a wide range of applications.

+ Allows measurement of virtually all level and interface applications
+ Local indication and redundancy via guided wave radar and magnetostrictive level transmitter
+ Manufactured to fit perfectly together - no project delays
+ Each unit designed for optimal performance in each application

Guided wave radar and magnetic level indicator in combination for redundant level measurements

Guided wave radar features and benefits

Guided wave radar provides a top mounted, direct level and interface measurement of liquids and solids, including those with wide temperature and pressure requirements. They are easy to install and are virtually unaffected by process conditions.

- + Highly accurate and reliable
- + Multivariable output includes the choice of level, interface level, distance, upper product thickness, volume and signal strength
- + Best fit for chamber applications and ideal for replacing older technologies
- + No moving parts, no calibration
- + Wide selection of materials and process connections
- + Seamless system integration with HART, Foundation Fieldbus, and Modbus
- + Wireless option available
- + Available with dynamic vapor compensation for steam applications

Principle of operation

Microwave pulses guided down a probe reach the media and part of the signal is reflected back. The time difference between sending and receiving is measured, and the level and/or interface level is derived.

APPLICATIONS

- + Boiler drum level control and indication
- + Safety systems requiring redundancy
- + Displacer replacement
- + Level and interface
- + High temperature/high pressure

Accessories

LTM Series magnetostrictive transmitter

LTM Series magnetostrictive level transmitters offer a variety of configuration options. The LTM transmitter may be utilized as a direct insertion transmitter or externally mounted to a magnetic level indicator for non-invasive level measurement.

In the gauge-mount configuration, the sensor is attached to the exterior of the magnetic indicator. This allows the transmitter to be installed or serviced without removing the indicator from service. As the fluid rises and falls, so does the float. The magnetostrictive level transmitter senses the level of fluid in the vessel by detecting the level of the magnets contained within the float, and then transmits the measurement back to the control system.

LTM transmitters are available with two-wire loop powered 4-20 mA signal output, or bus powered (Fieldbus) with digital output(s).

Remote-mount electronics are available for easy access or high temperature applications. Sensor probes are available in a variety of materials including stainless steel and exotic alloys or electropolished for sanitary service. LTM transmitters feature explosion-proof, dual-compartment enclosures, integral displays and intrinsically safe electronics.

The “plug-and-play” electronics allow easy upgrades. LTM transmitters offer the latest and most advanced software features on the market, introducing a registered HART DD, Rev. 5 with AMS Aware and Rev. 7 with EDD, compliant to IEC 61804-2, and compliant to Foundation Fieldbus software version ITK-4.6.

Specifications	
Housing:	Epoxy coated aluminium or stainless steel
Protection rating:	NEMA 4X, NEMA 7, IP66
Sensor probe	
Material:	316 SS, 5/8 inch (15.88mm) probe (standard), other materials available All wetted parts are non-ferrous compatible materials (stainless steel, Monel, Hastelloy, etc.)
Maximum length:	30 ft (9 m)
Mounting style:	Gauge mount (via 316 SS brackets)
Operating temp.:	-200 to 750 °F (-129 to 399 °C)
Insertion type optional	
Operating temperature:	-58 to 300 °F (-58 to 149 °C)

**All transmitters have the following RFI Limits: SAMA PMC 31.1, 20 to 1000 MHz, up to 30 V/m*

Bottom mount with elbow

Remote mount

Top mount

Accessories

LT-1 Level transmitter

The LT-1 level transmitter is based on tried-and-true measurement technology, where precise accuracy and digital communication are not required. The sensor probe consists of a series of resistors and reed switches. The change in resistance caused by the magnetic float in the level gauge is converted to a 4-20 mA signal proportional to level. The LT-1 transmitter is available in either ½" or ¼" resolution.

This transmitter is a low-cost alternative for level measurement. The following features are included:

+ 4-20 mA output
+ Field-reversible probe (allows transmitter to be top or bottom mounted)

LT-1 Transmitter specifications	
Sensor probe	
Length:	Maximum 20 ft (6 m)
Resolution:	½ inch (¼ inch under 30" measuring length)
Material:	316 stainless steel standard
Max. operating temp.:	750 °F (399 °C) process temperature
Transmitter	
Power:	24 V dc (loop powered) nominal
Output:	4-20 mA
Load:	750 ohm max.
Housing:	Explosion-proof, Class I, Div. I, Groups. B, C and D
Maximum temperature:	150 °F (85 °C) in housing

For high temperature applications, the transmitter should be remote mounted

APPLICATIONS

+ Examples of customer installations of Magtech products

Accessories

Magtech level switches

Magtech level switches are non-invasive alarm switches that clamp to the gauge chamber and are magnetically actuated by the float through the chamber wall. These switches provide a low cost, reliable alarm and control action without making additional cutouts in the vessel.

The external mounting clamps make it easy to adjust the set point or service the switch at any time without interrupting the process. They are also easily added after gauge installation. All Magtech switches may be wired for rising or falling level and NC or NO operation. Each switch has approximately ½ inch deadband to eliminate chattering and all have “break before make” action. The MLS-3EX is CSA, ATEX, UL and C-UL listed for both the U.S. and Canada.

MLS-10EX Series

The MLS-10EX-C is a DPDT cam-actuated switch used to control pumps, solenoids, etc. The switch can be set by the user for rising or falling activation. This switch meets Class 1, Div. 1 codes and the internal micro-switches are UL approved. MLS-10EX-R (relay, requires auxiliary power) is available for higher inductive load.

Specifications	
Deadband:	.50 Inches
Max. temp.:	200 °F (93 °C) Standard
	450 °F (232 °C) High temperature version
Min. temp.:	-40 °F (-40 °C)
Contacts:	DPDT, form C
Current:	10 Amps maximum at 250V ac
	5 Amps maximum at 125V dc
Power:	2 KVA / 300W
Approvals:	UL/CUL and CSA Cl. I Grp. B,C,D; Cl. II Grp. E,F,G; Cl.III

MLS-3 Series

The MLS-3EX is a hermetically sealed switch with Form C contacts. A bias magnet latches the switch, maintaining contact as the float continues to rise or fall within the gauge chamber. A non-latching switch is available.
The MLS-3EX is best suited for low power alarm signals.

MLS-3EX-M Series

Specifications	
Deadband:	.50 Inches (12.7 mm)
Max. temp.:	350 °F (177 °C) standard
	650 °F (343 °C) MLS-3EX-HT
Min. temp:	-40 °F (-40 °C)
Contacts:	SPDT or DPDT, Form C
Current:	1 Amp ac/dc resistive
Switch options:	
MLS-3	Switch only (no housing)
MLS-3EX-M	Standard EXP housing
MLS-3EX-M-A	ATEX EXP housing
MLS-3EX-2	DPDT contacts
MLS-3EX-HT	High temp. option up to 650 °F (343 °C)
Approvals:	UL/CUL & CSA Cl. I Grp. B,C,D; Cl. II Grp. E,F,G; Cl.III, ATEX Ex II 2G EExd IIC T6

PS-2 Series

The PS-2 is a pneumatic switch designed to control air and natural gas from 15 to 100 psi. The PS-2 is rotary cam activated and incorporates a non-bleed switch. When the float passes, the cam rotates and latches the switch in the open position. This will allow unobstructed airflow. When the float moves back in the opposite direction the switch unlatches and blocks the airflow. The non-bleed design of the PS-2 can be used to control pneumatic alarms, valves and pumps, and is configured for rising or falling level.

Other options

Standard insulation

Cryogenic insulation

Insulation

Insulation is recommended when indicators are to be used under extreme temperature conditions. Factory installed, removable insulation blankets are available in two configurations. The standard blanket is for temperatures to 500˚F (260˚C) and consists of a 2 inch thick (compressed to 1 inch), 6# Cer-Wool HP enclosed in 3201-2-SS silicone coated fiberglass cloth. For operating temperatures above 500˚F (260˚C), fiberglass material rated to 1100˚F (593˚C) is included on the contact surface of the blanket.

In cryogenic applications, aluminum-skinned “foamglas” insulation with indicator frost extension to prevent “icing” and flashing for fluids with low boiling points is provided.

Heat tracing

A wide variety of electrical and steam heat tracing options are available. Heat tracing can be used for freeze protection or to maintain the process temperature of molten materials. Electrical tracing is engineered to customer specifications and can be provided with controllers.

Common types are mineral insulated (MI) and self regulating (SR). Steam tracing of Magtech indicators is accomplished by traversing four lengths of the gauge with ¼ inch or 3/8 inch stainless steel tubing.

Specifications	
Standard blanket	
Max. temp.:	500 °F (260 °C)
Material:	6# Cer-Wool HP enclosed in 3201-2-SS silicone coated fiberglass cloth
Cryogenic blanket	
Max temp:	1100 °F (593 °C)
Min. temp:	-320 °F (-196 °C)
Material:	aluminum-skinned “foamglass” insulation with indicator frost extension

Optional scales

In addition to the standard stainless steel scale (graduated in feet and inches), other scale options are available.

+ Inches only
+ Negative/positive (boiler service)
+ Metric (mm/cm)
+ Decimal feet (0.1 ft. or 0.01 ft. divisions)
+ Offset zero (plus and minus scale divisions)
+ Percent (0 to 100)
+ Volumetric (gallons, liters)*

Given that characteristics of every vessel are different, drawings or strapping tables must be supplied.

Testing

All materials are supported by material traceability reports (MTR’s), available upon request. Both NACE MR-01-75 and NACE MR0103 are available as well as dual NACE stamping if required. All peripheral bolts, nuts and fittings are ANSI B31.1/ B31.3 compliant. In addition, random samples are X-rayed in order to insure quality materials and workmanship.

Further testing and documentation is available upon request. This includes dimensional (as built) drawings, positive material identification (PMI), X-ray, dye penetration, and hydrostatic testing.

For more information on industry leading level instrumentation visit us at www.rosemount.com/level

Emerson Process Management
Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-999-9307
T (International) (952) 906 8888
F (952) 949 7001
www.rosemount.com

Emerson Process Management
Blegistrasse 23
P.O. Box 1046
CH 6341 Baar
Switzerland
Tel +41 (0) 41 768 6111
Fax +41 (0) 41 768 6300

Emerson Process Management
Asia Pacific Pte Ltd
1 Pandan Crescent
Singapore 128461
Tel +65 6777 8211
Fax +65 6777 0947
Service Support Hotline : +65 6770 8711

Emerson FZE
P.O. Box 17033
Jebel Ali Free Zone
Dubai, UAE
Tel +971 4 883 5235
Fax +971 4 883 5312

Magtech

00803-0100-6156 Rev AC 9/13

EMERSON
Process Management

ORION® INSTRUMENTS
A Magnetrol® Company

THE NEXT GENERATION OF MAGNETIC LEVEL INDICATION

MAGNETIC LEVEL INDICATORS

DESCRIPTION

Magnetically coupled liquid level indicators, or MLIs, are in widespread use throughout process industries. Originally designed as an alternative to sight and gauge glass devices, the MLI is now commonly used in both new construction and plant expansion.

ORION INSTRUMENTS® Atlas, Gemini, and Aurora® magnetic level indicators are precision engineered and manufactured to indicate liquid level accurately, reliably, and continuously. These units are completely sealed and require no periodic maintenance. MLIs also eliminate vapor or liquid emission problems common with sight and gauge glasses.

To complement these products, Orion produces a complete range of level switches and transmitters, including the Eclipse® Guided Wave Radar transmitter from Magnetrol International.

FEATURES

- Numerous chamber styles (or configurations) for each design. Custom designs available.
- Complete range of level switches and level transmitters, including Eclipse Guided Wave Radar
- Fabricated, non-magnetic chamber assembly produced in a wide range of metal and plastic materials
- ANSI and EN 1092 process connections available
- Precision manufactured float with internal magnets and magnetic flux ring
- Flag or shuttle type indicator with stainless steel scale to measure height, volume, or percentage of level
- Standard float stop springs at top and bottom of chamber
- Exceptional code qualified welding

APPLICATIONS

- Feedwater heaters
- Industrial boilers
- Oil/water separators
- Flash drums
- Surge tanks
- Gas chillers
- Deaerators
- Blowdown flash tanks
- Hot wells
- Vacuum tower bottoms
- Alkylation units
- Boiler drums
- Propane vessels
- Storage tanks

ATLAS & VECTOR MLI

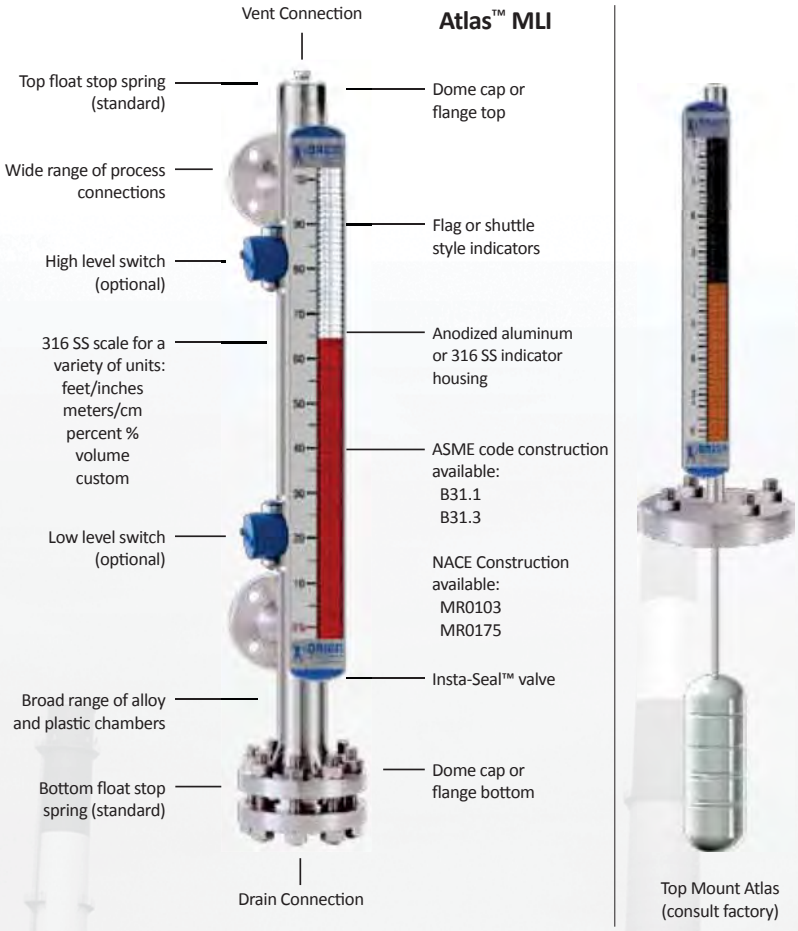
The Atlas is Orion's standard high-performance magnetic level indicator. Atlas is a single chamber design with either a 2", 2½", or 3" chamber diameter, as required by the application. There are twelve basic configuration styles including top mount models. Special configurations are also available.

Atlas MLIs are produced in a wide range of materials, including exotic alloys and plastics. Orion also offers the most complete selection of process connection types and sizes in the industry.

Atlas can be equipped with a variety of level transmitters and switches as well as flag and shuttle indicators with or without stainless steel scales. This enables the Atlas to be a complete level and monitoring control.

Vector™ (not shown) is a simple, rugged, reliable, and cost-effective Magnetic Level Indicator. Suitable for a variety of installations. Vector has many basic features and is precision engineered and manufactured to ensure a long service life.

See bulletin ORI-139 for more information regarding Vector.



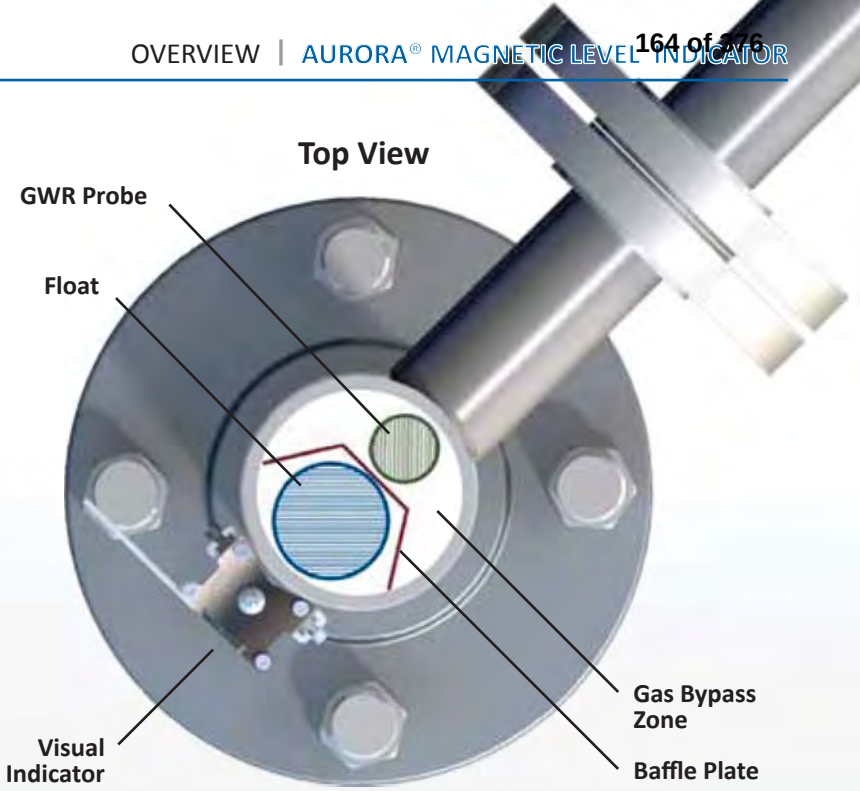
GEMINI

Orion's twin chamber design is unique to the Magnetic level gauge industry. Countless unique configuration styles are available with Gemini. It can be produced in the same metal material selections as Atlas.

The second chamber facilitates the installation of any of a wide selection of transmitters to provide continuous level monitoring in addition to the indication provided by the primary chamber. Eclipse guided wave radar, direct insertion Jupiter magnetostrictive, or Kotron capacitance type level transmitters can be mounted in the secondary chamber to provide totally redundant indication with continuous level output. The primary chamber, which houses the float, can be fitted with clamp-on switches or transmitters for additional level control.

Aurora®

See Brochure ORI-101
for more information



Eclipse® GWR
Level Transmitter

DESCRIPTION

Aurora's patented design is the next generation of magnetic level indicators. It is state of the art and reflects Orion's innovation and commitment to magnetic level indicators.

Aurora is a totally redundant monitoring and control system. Liquid levels are tracked with great accuracy using two different technologies. An Eclipse® guided wave radar probe is housed along with the MLI float in a 3" or 4" diameter chamber. While the indicator relies upon the float and its internal magnets to activate the flags or shuttle, the Eclipse measures the liquid level directly. Two completely separate technologies in a single external chamber equal redundancy unlike any other MLI. The use of a special baffle within the chamber ensures that the float and Eclipse® probe work seamlessly and without interference.

There are ten basic configuration styles and over fifteen material selections for Aurora. For the first time ever, the ability to accurately and reliably measure ultra low dielectric media, high pressure/high temperature process conditions, and media with shifting and changing dielectric values can be accomplished with Aurora.

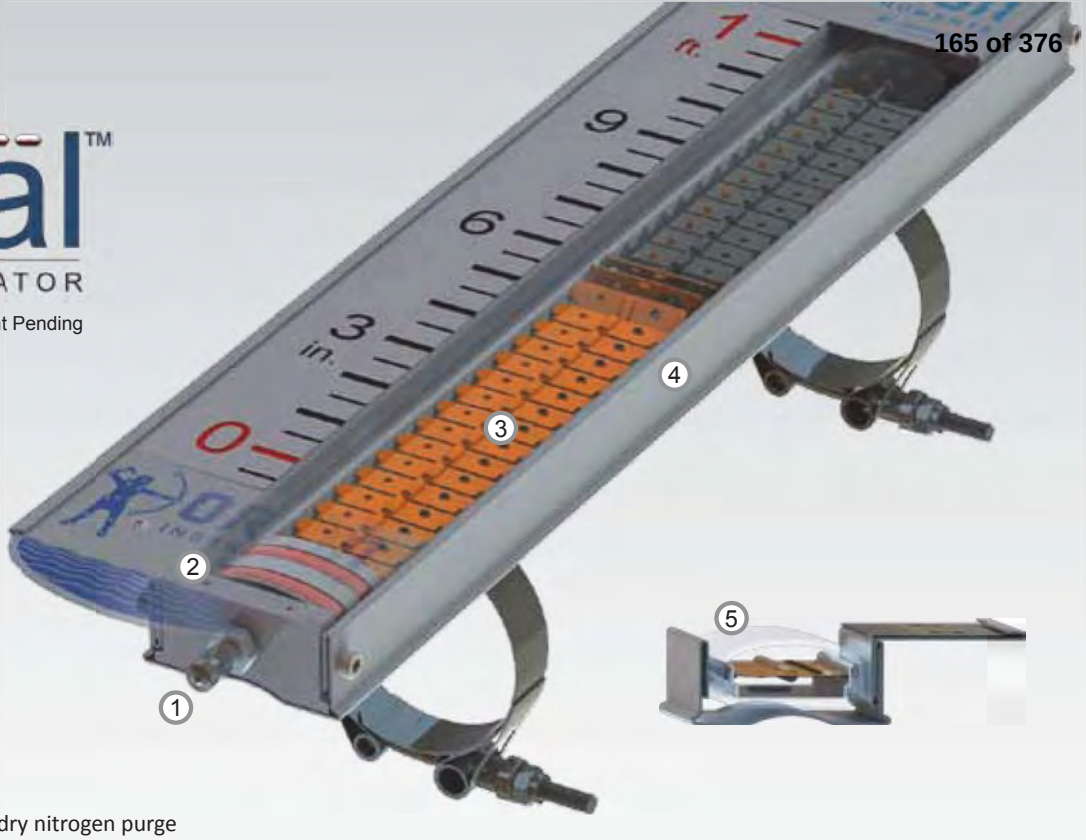
AURORA® FEATURES

- Wide range of alloy materials
- Eclipse available with HART®, FOUNDATION fieldbus™, or PROFIBUS™ communication
- Large selection of process connection options
- Eight probe designs cover a broad range of applications
- Eclipse transmitter available in 316 stainless steel or epoxy-coated aluminum
- ASME B31.1, B31.3, or NACE available; 150# to 2500# ANSI (PN 16 to PN 320)
- Top and bottom float stop springs

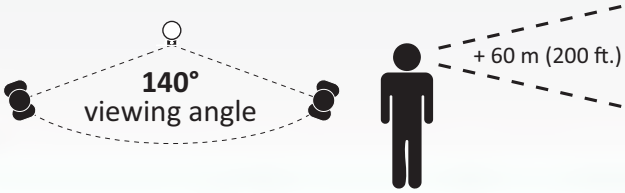
reveal™

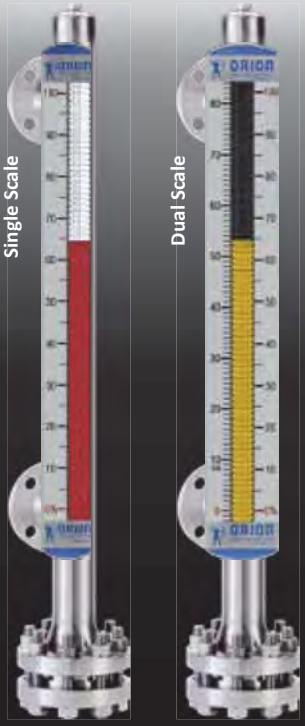
WIDE VIEW INDICATOR

Patent Pending



1. InstaSeal™ valve allows for an effective dry nitrogen purge
2. Double o-ring endplug ensures a reliable seal that keeps moisture out
3. All-metal high contrast powder coated or anodized flags are wider to enhance overall visibility
4. Robust 316 stainless steel enclosure designed to face the elements
5. Extruded shatter-resistant viewing window enhances visibility and allows the flags to position closely to the float, enhancing the magnetic coupling





Scale Options:

- Inches / Feet
- Running Inches
- Centimeters / Meters
- Percent (5% increments)
- Gallons
- Liters
- Barrels of Oil

REVEAL™ indicators incorporate a *positive-stop* design which limits the rotation of each flag to a half-turn. This eliminates "overflipping" which is commonly seen on other indicator designs.

Each flag contains a high-strength magnet

Standard flag and shuttle offering. Custom colors available.

Weld Ring: Secures float cap to main body

Flux Ring: Absorbs magnetic energy and directs it outward

Magnets: A full array surrounds the float with a strong and consistent magnetic field

Support Ring: Provides reinforcement for the main float body

Float Body: Robust and durable construction delivers many years of reliable operation

ORION FLOAT TECHNOLOGY

The float contained within the magnetic level indicator is perhaps the most important element of the instrument. Its structural design, volume displacement, weight, and buoyancy force are all carefully considered when a float is specified for a particular application.

Orion engineers have designed and tested hundreds of floats to gather the most accurate data available. We have designs for thousands of unique applications around the world, including high pressure, high temperature, and interface.

The float's 360° magnet assembly produces a strong and consistent flux array allowing visual indication through chambers as thick as schedule 160.

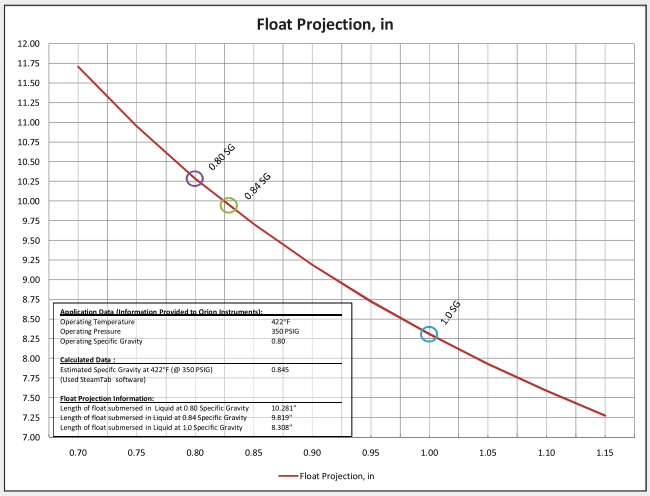
CAPABILITIES

- Process pressures up to 4,500+ psig (310 bar) ①
- Process Temperatures up to 1,000° F (538° C) ①
- Total level specific gravities as low as 0.25 ①
- Interface float designs available for liquid specific gravity differentials as little as 0.1
- Adequate buoyancy to operate effectively and freely in many viscous liquids, including crude oil

① maximum capabilities can vary depending on combination of pressure, temperature, and media specific gravity

OPTIONS

- Teflon-S® PTFE and PFA slip-assistant coating
- Halar® ECTFE Coating for abrasion and chemical resistance
- Float retrieval hook
- Float Projection Curve: If the liquid density changes, a float curve will reveal the offset →

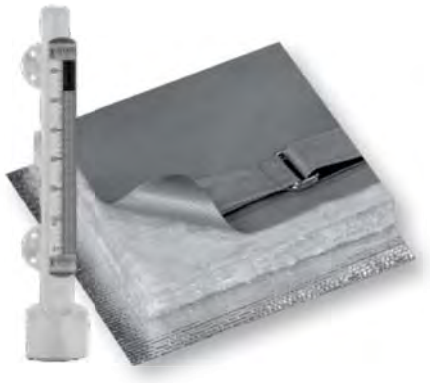


Float Projection Curve

Design	Atlas, Aurora – single chamber	
	Gemini – dual chamber	
Materials of construction – MLI	Metal alloys	316/316L or 304/304L stainless steel,
		321 stainless steel, 347 stainless steel,
		Titanium, Monel, Hastelloy B,
		Hastelloy C-276, Inconel 625, Inconel 825,
		Alloy 20, Electropolished 316 stainless steel,
		904L stainless steel and other non-magnetic alloys
	Plastics / Composites	Fiberglass, PVC, CPVC, Kynar, polypropylene
Materials of construction – Float	varies per application - stainless steel and titanium are standard (exotic alloys available)	
Construction options	Conformance to Industrial Grade, ASME B31.1, ASME B31.3, and NACE available	
Certified material test reports (CMTR)	Available upon request	
Pressure class ratings	ANSI 150#, 300#, 600#, 900#, 1500#, 2500#	
	DIN PN16, PN25, PN40, PN63, PN100, PN160, PN250, PN320	
Process connection sizes	½" to 8"	
	DN 20 to DN 150	
Process connection types	MNPT, FNPT, Weldolet®, Sockolet®, threaded nipple, buttweld nipple, plain-end nipple,	
	slip-on flanges, weldneck flanges, lap joint flanges,	
	TriClamp® fitting, Van Stone flanges	
Measuring range	12 to 600 in (30 to 1524 cm)	
Temperature range	-320° to +1000° F (-196° to +538° C)	
Pressure range	Full vacuum to 4500 psig (310 bar)	
Specific gravity range	As low as 0.25 S.G. (consult factory for lower specific gravities)	
Visual Indicators	Magnetically actuated flag assembly in contrasting orange/black, yellow/black,	
	red/white colors, or high visibility shuttle follower (custom colors available)	
REVEAL™ Flag assembly seal	Inert gas filled and sealed with double o-ring & InstaSeal™ valve	
REVEAL™ visual indicator	Visible from 200 feet (61 meters)	
Aluminum visual indicator	Visible from 100 feet (30.5 meters)	
Scale options	Etched stainless steel with either height, volume, or percentage units (custom markings avail)	
Switch options	Model OES electric cam operated snap action (refer to Orion bulletin: OES-100)	
	Model ORS electric reed type (refer to Orion bulletin: ORS-300)	
	Pneumatic switch available (consult factory)	
Transmitter options	Model 705 Eclipse guided wave radar (refer to Magnetrol bulletin: 57-101 & 57-102)	
	Model 2xx Jupiter Magnetostrictive (refer to Orion bulletin: ORI-148)	
	Model OCT analog reed chain (refer to Orion bulletin: OCT-400)	
High temperature options	Electric or steam tracing with or without special high temperature insulation	
Low temperature options	Cryogenic insulation with special polymeric frost extension	

HIGH-TEMPERATURE INSULATION

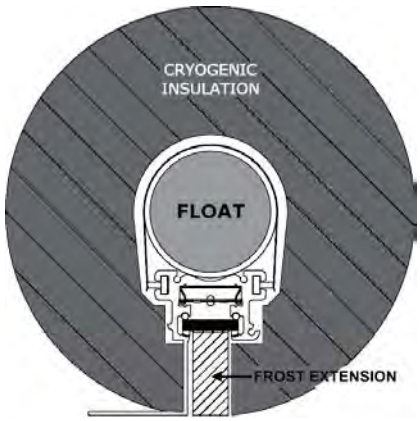
Orion specializes in custom fiberglass insulation blankets for MLIs of all shapes and sizes. They are constructed with high-quality materials capable of constant contact with temperatures up to 1,000° F (538° C). This insulation is available as personnel protection or with heat tracing options for freeze protection or process temperature maintenance.



CRYOGENIC INSULATION & FROST EXTENSION

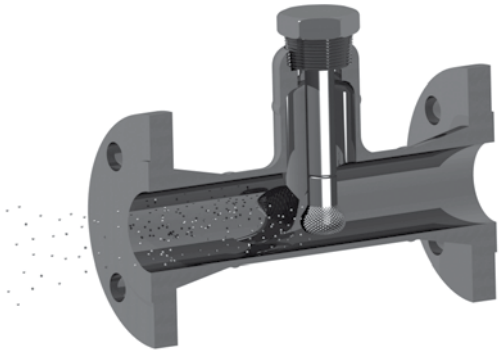
To facilitate operation where the product is kept cold via chillers, refrigerants, and condensers, cryogenic insulation is provided. By insulating the MLI with a specialized cryogenic jacket, process temperatures can be maintained in the liquid state down to -320° F (-195° C).

A frost extension option is available to prevent ice from collecting on the visual indicator, thereby decreasing the visibility. The extension is constructed of durable acrylic plastic and is provided standard with all cryogenic insulation.



MAGNETIC PARTICLE TRAP

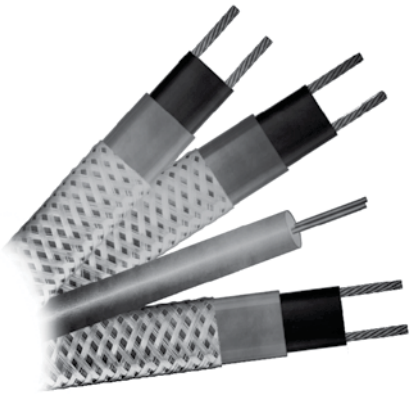
Magnetic Particle Traps, or Magtraps, provide protection for Orion's line of Magnetic Level Indicators. Particles composed mostly of ferrite, often from carbon steel piping, are widespread throughout process piping. These particles enter the MLI via the process connections during normal fill and drain operations. The magnetic float located inside the MLI attracts these particles over time. Eventually, the build-up will be enough to cause the float to become stuck inside the chamber. This results in the MLI either reading inaccurately or not at all. The trap collects the particles which can be cleaned periodically to ensure continued operation of the magnetic level indicator.



HEAT TRACING: ELECTRIC & STEAM

For applications where process freeze protection or temperature maintenance is required, heat tracing will allow the MLI to operate uninterrupted throughout harsh, cold conditions.

Electric Heat Tracing is available in self-regulating, constant wattage, and mineral insulated varieties. Contact the factory for more information.



TRANSMITTER SPECIFICATIONS

	Eclipse Guided Wave Radar	Jupiter Magnetostrictive
Measuring Range:	6 to 240 inches (15 to 610 cm)	6 to 400 inches (15 to 999 cm)
Resolution:	0.01 mA analog 0.1 inch (cm) display	0.01 mA analog 0.1 inch (cm) display
Repeatability:	<0.1 inch (2.5 mm)	±0.005% of full span or 0.005 inches (0.127 mm) (whichever is greater)
Non-Linearity:	<0.1% of probe length or 0.1 inch (2.5 mm) (whichever is greater)	0.020% of full span or 0.031 inches (0.794 mm) (whichever is greater)
Upper Dead Zone:	None	less than 3 inches (7.6 cm) when bottom mounted electronics
Lower Dead Zone:	None	less than 3 inches (7.6 cm) when top mounted electronics
Damping:	0 - 10 seconds; adjustable	0 - 25 seconds; adjustable
Power (at terminals):	GP/IS: 11 to 28.6 VDC EP (with IS probe): 13.5 to 28 VDC FOUNDATION fieldbus™ & PROFIBUS PA™(FISCO): 9 to 17.5 VDC FOUNDATION fieldbus™ & PROFIBUS PA™(FNICO Exd): 9 to 32 VDC	HART®: 12 to 28 VDC FOUNDATION fieldbus™ Explosion Proof: 9 to 17.5 VDC FISCO/FNICO: 9 to 17.5 VDC
Signal Output:	4-20 mA with HART®: 3.8 to 20.5 mA usable FOUNDATION fieldbus™: H1 (ITK Ver. 5.01) PROFIBUS PA™: PROFIBUS PA™ H1	4-20 mA with HART®: 3.8 to 20.5 mA usable FOUNDATION fieldbus™: H1 (ITK Ver. 4.61)
Display:	2 line x 8 character LCD	2 line x 8 character LCD
Housing Material:	IP66/Aluminum A356T6 or 316 SS	NEMA 4X/7/9IP66/Aluminum A356T6 or 316 SS
Area Classifications:	FM/CSA/ATEX/IEC - EP, IS, NI (see specific product literature for more detail)	FM/CSA/ATEX/IEC/INMETRO - EP, IS, NI (see specific product literature for more detail)
Safety Integrity Level:	Standard Electronics: SIL 1 as 1oo1, SFF 85.4% Enhanced Electronics: SIL 2 as 1oo1, SFF 91%	Standard Electronics: SIL 1 as 1oo1, SFF 83.7% Enhanced Electronics: SIL 2 as 1oo1, SFF 90.7%
Process Temperature:	probe dependent (see specific product literature for more detail)	External Mount: -320° F to +850° F (-195 to 455° C) *with insulation Direct Insertion: -320° F to + 500° F (-195 to 260° C)
Ambient Temperature at Electronics:	-40° to 175° F (-40° to 80° C) LCD: -5° to +160° F (-20° to +70° C)	-40° to 175° F (-40° to 80° C) LCD: -10° to +160° F (-20° to +70° C)
Process Pressure:	probe dependent (see specific product literature for more detail)	Direct insertion: +1700 psig (117 bar) (see specific product literature for more detail)
Mounting Arrangement:	Direct insertion probe with integral mount or remote mount electronics	Direct insertion probe with integral mount or external top or bottom mount on MLI

TRANSMITTER SPECIFICATIONS

	OCT Reed Chain
Measuring Range:	6 to 198 inches (15 to 503 cm)
Resolution:	±0.50 inches (13 mm)
Repeatability:	< 0.25 inches (6 mm)
Non-Linearity:	<0.4% full span averaged over span
Upper Transition Zone:	4 inches (10.2 cm)
Lower Transition Zone:	4 inches (10.2 cm)
Power Input:	12 to 36 VDC
Signal Output:	4 to 20 mA
Housing Type:	NEMA 4X, IP66
Housing Material:	Cast Aluminum or 316 SS
Area Classifications:	FM/CSA EP
Process Temperature:	-40° to +425° F (-40° to +218° C)
Ambient Temperature at Electronics:	-40° to +158° F (-40° to +70° C)
Mounting Arrangement:	External mount probe with integral top or bottom mounted electronics

Eclipse®

Jupiter™
on Atlas™

OCT
on Atlas™

ELECTRONIC SWITCH SPECIFICATIONS		
Model:	OES	ORS
Description:	SPDT magnetically actuated, bi-stable cam drive snap action switch	Hermetically sealed bi-stable reed switch
Supply Voltage:	250V AC/DC max	150V AC/DC max
Maximum Dead Band:	±0.75" float travel	±0.50" float travel
Temperature Range:	-58° to +392° F (-50° to +200° C)	-58° to +482° F (-50° to +250° C)
Enclosure Rating:	NEMA 4X	NEMA 4X
Enclosure Material:	Cast aluminum (standard)	Stainless steel

Model OES

Model ORS

PNEUMATIC SWITCH SPECIFICATIONS

consult factory for more information regarding pneumatic switches

Agency	Model	Area Classification
FM FM APPROVED	OES-xxxx-001	Class I, II, III, Div. 1, Groups B,C,D,E,F,G; T6 @ 80°C; Type 4X
	ORS-xxxx-001	Class I, II, III, Div. 1, Groups B,C,D,E,F,G; T6 @ 80°C; Type 4X Class I, Div. 2, Groups A, B, C, & D; T6 @ 80°C
	OCT-xxxx-xxx	Class I, II, III, Div. 1, Groups B,C,D,E,F,G; T6 @ 80°C; Type 4X Class I, Div. 2, Groups A, B, C, & D; T6 @ 80°C
CSA	OES-x1xx-001	Class I, Div. I/II, Groups B, C, & D; T6 @ 80°C; Type 4X Class II, Groups E, F, & G;T6 @ 80°C; Type 4X Class III
	ORS-x1xx-001 OCT-xxxx-001	Class I, Div. I, Groups B, C, & D; T6 @ 80°C; Type 4X Class I, Div. II, Groups A, B, C, & D; T6 @ 80°C; Type 4X Class II, Groups E, F, & G; T6 @ 80°C; Type 4X Class III
ATEX	ORS-xAxx-001	ATEX II 2 G Ex d IIC T6 Ta = -40 to +70° C
IEC	ORS-xAxx-001	IECEx d IIC T6 Ta = -40 to +70° C
CE	OES-xxxx-001 ORS-xxxx-001 OCT-xxxx-xxxx	Low Voltage Directives, 2006/95/EC Installation Category II, Pollution Degree 2

Agency	Model	Protection Method	Area Classification
FM	705-5XXX-1XX 705-5XXX-2XX	Intrinsically Safe	Class I, Div. 1, Groups A, B, C, & D Class II, Div. 1, Groups E, F, & G T4 Class III, Type 4X, IP66 Entity
	705-5XXX-3XX 705-5XXX-4XX	Explosion Proof ① (with Intrinsically Safe probe)	Class I, Div. 1, Groups B, C, & D Class II, Div. 1, Groups E, F, & G T4 Class III, Type 4X, IP66
	705-5XXX-XXX 705-5XXX-XXX	Non-Incendive Suitable for: ②	Class I, Div. 2, Groups A, B, C, & D Class II, Div. 2, Groups F & G T4 Class III, Type 4X, IP66
CSA	705-5XXX-1XX 705-5XXX-2XX	Intrinsically Safe	Class I, Div. 1, Groups A, B, C, & D Class II, Div. 1, Groups E, F, & G T4 Class III, Type 4X Entity
	705-5XXX-3XX 705-5XXX-4XX	Explosion Proof ① (with Intrinsically Safe probe)	Class I, Div. 1, Groups B, C, & D Class II, Div. 1, Groups E, F, & G T4 Class III, Type 4X
	705-5XXX-XXX 705-5XXX-XXX	Non-Incendive Suitable for: ②	Class I, Div. 2, Groups A, B, C, & D Class II, Div. 2, Groups E, F, & G T4 Class III, Type 4X
ATEX	705-5XXX-AXX 705-5XXX-BXX	Intrinsically Safe ③	Ⓔx II 1G, EEx ia IIC T4 FISCO
	705-5XXX-CXX 705-5XXX-DXX	Flame Proof	Ⓔx II 1/2G, EEx d [ia] IIC T6
	705-51XX-EXX 705-51XX-FXX 705-52XX-EXX 705-52XX-FXX	Non-sparking	Ⓔx II 3(1)G, EEx nA [ia] IIC T4..T6 with probe II 1 G EEx ia IIC T6 Ⓔx II 3(1)G, EEx nA [nL] [ia] IIC T4..T6 with probe II 1 G EEx ia IIC T6
IEC	705-5XXX-AXX 705-5XXX-BXX	Intrinsically Safe ③	Zone 0 Ex ia IIC T4 FISCO

CE 0344

These units are in conformity of:

1. The EMC Directive: 2004/108/EC. The units have been tested to EN 61326.
2. Directive 94/9/EC for equipment or protective system for use in potentially explosive atmospheres.

Note: Single and twin rod probes must be used in metallic vessel or stillwell to maintain CE compliance.

① Factory Sealed: This product has been approved by Factory Mutual Research (FM), and Canadian Standards Association (CSA), as a Factory Sealed device.

② **IMPORTANT:** Measured media inside vessel must be non-flammable only. If media inside vessel is flammable, then the explosion proof version (which contains an internal barrier making the probe Intrinsically Safe) is required.

③ Special conditions for safe use
Because the enclosure of the Guided Wave Radar Level Transmitter Eclipse Model 705-5_ _ _-_ 1 _ and/or Probe Eclipse Model 7_ _-_ _ _ _-_ _ _ is made of aluminum, if it is mounted in an area where the use of category 1 G (Zone 0) apparatus is required, it must be installed such, that, even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.

For applications in explosive atmospheres caused by gases, vapours or mists and where category 1G (Zone 0) apparatus is required, electrostatic charges on the non-metallic parts of the Probe Eclipse Model 7x5-_ _ _ _-_ _ _, Model 7x7-_ _ _ _-_ _ _ , and Model 7_F-_ _ _ _-_ _ _ shall be avoided.

Agency	Model	Protection Method	Area Classification
FM & CSA	2xx-1xxx-xxxxx-xxx	Intrinsically Safe	Class I, Div. 1, Groups A, B, C, & D, T4 Ta @ 80°C Class II, Div. 1, Groups E, F, & G; Class III, T4 Ta @ 80°C IP66 TYPE 4X Entity
	2xx-3xxx-xxxxx-xxx	Explosion Proof ①③	Class I, Div. 1, Groups B, C, & D, T5 Ta @ 80°C Class II, Div. 1, Groups E, F, & G; Class III, T5 Ta @ 80°C IP66 Type 4X
	2xx-1xxx-xxxxx-xxx 2xx-3xxx-xxxxx-xxx	Non-Incendive ④	Class I, Div. 2, Groups A, B, C, & D, T5 Ta @ 80°C Class II, Div. 2, Groups E, F, & G②; Class III, T5 Ta @ 80°C IP66 Type 4X T5
ATEX	2xx-Axxx-xxxxx-xxx	Flame Proof	Ⓔx II 1/2 G EEx d IIC T6 @ 70°C
	2xx-Exxx-xxxxx-xxx	Intrinsically Safe	Ⓔx II 1 G EEx ia IIC T4 @ 70°C FISCO
IEC	2xx-Jxxx-xxxxx-xxx	Flame Proof	Ex d IIC T6 @ 70°C
	2xx-Kxxx-xxxxx-xxx	Intrinsically Safe ⑤	Ex ia IIC T4 @ 70°C Ga FISCO
INMETRO	2xx-Lxxx-xxxxx-xxx	Flame Proof	Br- Ex d IIC T6 @ 70°C, IP66W
	2xx-Mxxx-xxxxx-xxx	Intrinsically Safe ⑤	Br-Ex ia IIC T4 @ 70°C, IP66W FISCO

CE 0344

These units are in conformity of:

1. The EMC Directive: 2004/108/EC. The units have been tested to EN 61326.
2. Directive 94/9/EC for equipment or protective system for use in potentially explosive atmospheres.

① M20 conduit connections not CSA approved explosion proof

② FM approval class II, Div. 2 Groups F & G only

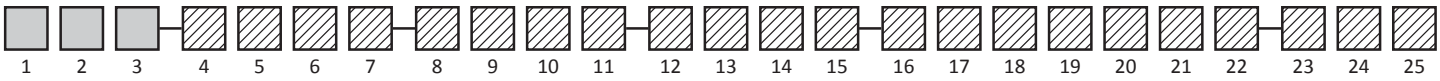
③ Factory Sealed: This product has been approved by Factory Mutual Research (FM), and Canadian Standards Association (CSA), as a Factory Sealed device.

④ **IMPORTANT:** Measured media inside vessel must be non-flammable only. If media inside vessel is flammable, then the explosion proof version (which contains an internal barrier making the probe Intrinsically Safe) is required.

⑤ **Special conditions for safe use**
Materials marked as category 1 equipment and used in hazardous areas requiring this category, shall be installed in such a way that, even in the event of rare incidents, the aluminum enclosure cannot be an ignition source due to impact or friction.

ADDITIONAL CERTIFICATIONS

GOST R Russian Certificate of Conformity
GOST Pattern Approval Certificate for Measuring Instruments (Metrology Certificate)
GOST R Ex-Proof Certificate of Conformity



1 PRODUCT TYPE

1	Atlas MLI
2	Aurora MLI with Eclipse® GWR transmitter
3	Gemini dual-chamber MLI with Eclipse® GWR
5	External Cage for Jupiter® transmitter

2 UNIT OF MEASURE

E	English Units (Inches)	Specifies the unit of measure for the ***Center-to-Center*** and ***Visual Indication Length*** (digits 23 - 25)
M	Metric Units (Centimeters)	

orionxpress

Blue shaded cells are eligible. See back cover for more information.

Select the appropriate ***Chamber Configuration*** from the following five tables (match product type from digit 1)

3[1] ATLAS - CHAMBER CONFIGURATION

Process Connection Orientation		Chamber Top	Chamber Bottom
1	Side / Side	Dome cap	Flanged (including mating blind flange)
2	Side / Side	Flanged (including mating blind flange)	Dome cap
3	Side / Side	Flanged (including mating blind flange)	Flanged (including mating blind flange)
4	Top / Bottom	Flanged	Flanged
5	Top / Bottom with Spool Pieces	Flanged (including mating blind flange)	Flanged (including mating blind flange)
6	Top / Side	Flanged	Flanged (including mating blind flange)
7	Top / Side	Dome cap with process connection	Flanged (including mating blind flange)
8	Side / Bottom	Flanged (including mating blind flange)	Flanged
9	Side / Bottom	Flanged (including mating blind flange)	Dome cap with process connection
T	Top Mount	Threaded cap	Flanged process connection ①

① See pg. 19 for additional mounting options, or consult factory for custom solutions.

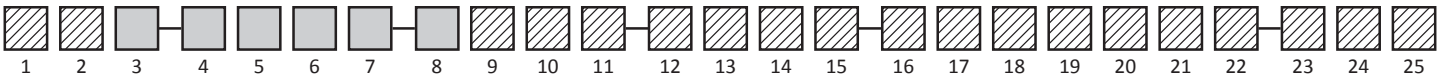
3[2] AURORA - CHAMBER CONFIGURATION

Process Connection Orientation		Chamber Top	Chamber Bottom
1	Side / Side	Welded cap with threaded Eclipse probe	Flanged (including mating blind flange)
2	Side / Side	Flanged with threaded Eclipse probe	Dome cap
3	Side / Side	Flanged with threaded Eclipse probe	Flanged (including mating blind flange)
4	Side / Side	Flanged with seal welded Eclipse probe	Dome cap
5	Side / Side	Flanged with seal welded Eclipse probe	Flanged (including mating blind flange)
A	Side / Bottom	Welded cap with threaded Eclipse probe	Flanged with process connection
B	Side / Bottom	Flanged with threaded Eclipse probe	Dome cap with process connection
C	Side / Bottom	Flanged with threaded Eclipse probe	Flanged with process connection
D	Side / Bottom	Flanged with seal welded Eclipse probe	Dome cap with process connection
F	Side / Bottom	Flanged with seal welded Eclipse probe	Flanged with process connection

3[3] GEMINI - CHAMBER CONFIGURATION

Process Connection Orientation		Primary Chamber Top	Primary Chamber Bottom	Secondary Chamber (with Eclipse GWR transmitter) ①	
				Top	Bottom
1	Side / Side	Dome cap	Flanged (with blind)	Dome cap with threaded Eclipse	Dome cap
2	Side / Side	Flanged (with blind)	Dome cap	Dome cap with threaded Eclipse	Dome cap
3	Side / Side	Flanged (with blind)	Flanged (with blind)	Dome cap with threaded Eclipse	Dome cap
4	Side / Side	Dome cap	Flanged (with blind)	Flanged with threaded Eclipse	Dome cap
5	Side / Side	Flanged (with blind)	Dome cap	Flanged with threaded Eclipse	Dome cap
6	Side / Side	Flanged (with blind)	Flanged (with blind)	Flanged with threaded Eclipse	Dome cap
7	Side / Side	Dome cap	Flanged (with blind)	Flanged with threaded Eclipse	Flanged (with blind)
8	Side / Side	Flanged (with blind)	Dome cap	Flanged with threaded Eclipse	Flanged (with blind)
9	Side / Side	Flanged (with blind)	Flanged (with blind)	Flanged with threaded Eclipse	Flanged (with blind)
A	Top / Bottom	Flanged	Flanged	Dome cap with threaded Eclipse	Dome cap
B	Top / Bottom	Flanged	Flanged	Flanged with threaded Eclipse	Dome cap
C	Top / Bottom	Flanged	Flanged	Flanged with threaded Eclipse	Flanged (with blind)

① consult factory for seal welded Eclipse probe in secondary chamber



3[5] EXTERNAL CAGE FOR JUPITER DIRECT INSERTION - CHAMBER CONFIGURATION

Process Connection Orientation		Chamber Top	Chamber Bottom
2	Side / Side	Flanged (with threaded Jupiter)	Dome Cap
3	Side / Side	Flanged (with threaded Jupiter)	Flanged (including blind flange)
8	Side / Bottom	Flanged (with threaded Jupiter)	Flanged
9	Side / Bottom	Flanged (with threaded Jupiter)	Dome Cap with Spool Piece
B	Side / Side	Flanged (with seal welded Jupiter)	Dome Cap
C	Side / Side	Flanged (with seal welded Jupiter)	Flanged (including blind flange)
H	Side / Bottom	Flanged (with seal welded Jupiter)	Flanged
J	Side / Bottom	Flanged (with seal welded Jupiter)	Dome Cap with process connection

4 FLANGE RATING

ANSI	
A	150#
B	300#
C	600#
D	900#
E	1500#
F	2500#

EN 1092	
1	PN 16
2	PN 25
3	PN 40
4	PN 63
5	PN 100
6	PN 160
7	PN 250
8	PN 320

5 MATERIAL SELECTION

Stainless Steels	
A	316/316L Stainless Steel
B	316/316L Stainless Steel w/Carbon Steel Flanges
C	304/304L Stainless Steel
D	304/304L Stainless Steel w/Carbon Steel Flanges
F	317 Stainless Steel
G	321 Stainless Steel
H	347 Stainless Steel
J	904L Stainless Steel
K	Electropolished 316 Stainless Steel

Exotic Alloys	
N	Titanium
P	Monel® 400
Q	Hastelloy C-276
R	Alloy 20
S	Inconel® 625
T	Incoloy® 825

Plastics / Composites	
1	PVC
2	CPVC
3	Kynar
4	Polypropylene
5	Fiberglass

Carbon Steels (for *External Cage* product only)	
L	Carbon Steel

6 CONSTRUCTION CODE

1	Industrial Grade (std.)
2	ASME B31.1 for Power Piping Standard
3	ASME B31.3 for Process Piping Standard
4	Industrial Grade and NACE MR0103

5	Industrial Grade and NACE MR0175
6	ASME B31.3 for Process Piping Standard and NACE MR0103
7	ASME B31.3 for Process Piping Standard and NACE MR0175
8	PED

7 CHAMBER FLANGE STYLE

A	RF Slip-on Flange
B	RF Weldneck Flange
C	RF Socketweld Flange
D	FF Slip-on Flange
F	FF Weldneck Flange

G	FF Socketweld Flange
H	RTJ Slip-on Flange
J	RTJ Weldneck Flange
K	RTJ Socketweld Flange
L	RF Lap Joint Flange

P	Full Face Socket Flange (for plastic units only)
Q	Socket Flange, Serrated Face (for fiberglass units only)

EN 1092 European Standard	
6	EN 1092 Type 11 with Type A Face
7	EN 1092 Type 11 with Type B2 Face
8	EN 1092 Type 12 with Type A Face
9	EN 1092 Type 12 with Type B2 Face

8 PROCESS CONNECTION TYPE

Flanged (Alloy)	
A	RF Slip-on Flange
B	RF Weldneck Flange
C	RF Socketweld Flange
D	FF Slip-on Flange
F	FF Weldneck Flange
G	FF Socketweld Flange
H	RTJ Slip-on Flange
J	RTJ Weldneck Flange
K	RTJ Socketweld Flange
L	RF Lap Joint Flange

Other	
M	Male Threaded (NPT)
N	Female Threaded (NPT)
P	Plain-end Nipple
Q	Socketweld
R	Buttweld
S	Weldolet™
T	Sockolet™
W	Threadolet™
Y	Tri-Clamp® Fitting

Flanged (Plastic / Composite)	
1	Van-Stone Socket Flange (2-Piece, for PVC / CPVC units only)
2	Full Face Socket Flange (for plastic units only)
3	Serrated Face Socket Flange (for fiberglass units only)

continued from digit 8 (Process Connection Type)

	EN 1092 European Standard
6	EN 1092 Type 11 with Type A Face
7	EN 1092 Type 11 with Type B2 Face
8	EN 1092 Type 12 with Type A Face
9	EN 1092 Type 12 with Type B2 Face

9 PROCESS CONNECTION SIZE

	Standard
A	½"
B	¾"
C	1"
D	1½"
E	2"
F	2½"
G	3"
H	4"
J	6"
K	8"

	EN 1092
1	DN 15
2	DN 20
3	DN 25
4	DN 40
5	DN 50
6	DN 65
7	DN 80
8	DN 100
9	DN 150

10 GASKET STYLE

	Gaskets for Metallic Flanges	
A	Flexible graphite ring ①	
B	Spiral wound with graphite filler and carbon steel outer ring②③	
C	Spiral wound with graphite filler, inner ring matching chamber material ③, and carbon steel outer ring	
D	RTJ oval ring ④	
E	RTJ octagonal ring ④	
F	Virgin PTFE Ring	-140° to +450° F (-96° to +232° C)

	Gaskets for Plastic/Composite Flanges	
P	EPDM rubber	-40° to +200° F (-40° to +93° C)
Q	Neoprene rubber	-60° to +250° F (-51° to +121° C)
R	Buna-N / Nitrile rubber	-60° to +250° F (-51° to +121° C)
S	ePTFE soft ring (expanded)	-140° to +450° F (-96° to +232° C)
T	Viton®	-15° to +300° F (-26° to +149° C)

N	None

① Standard gasket for 150# and 300# flange ratings suitable for most applications.
② Standard gasket for 600# and above flange ratings suitable for most applications.
③ Winding material matches chamber material.
④ Ring type gasket material matches flange material.

11 CHAMBER FLANGE BOLTING

	Stainless Steel	
A	304 stainless steel (standard)	A193 Gr. B8 Class I / A194 Gr. 8
B	304 stainless steel w/PTFE coating	A193 Gr. B8 Class I / A194 Gr. 8
C	316 stainless steel	A193 Gr. B8M Class I / A194 Gr. 8M
D	316 stainless steel w/PTFE coating	A193 Gr. B8M Class I / A194 Gr. 8M

	Alloy Steel	
M	Alloy Steel	A193 Gr. B7 / A194 Gr. 2H
P	Alloy Steel	A193 Gr. B7M / A194 Gr. 2HM
Q	Alloy Steel w/cadmium plating	A193 Gr. B7 / A194 Gr. 2H
R	Alloy Steel w/cadmium plating	A193 Gr. B7M / A194 Gr. 2HM

N	None (if mating flanges are not supplied)

12 VENT SIZE

14 DRAIN SIZE

1	½"
2	¾"
3	1"
4	1½"
5	2"
6	2½"
7	3"
8	4"
N	None

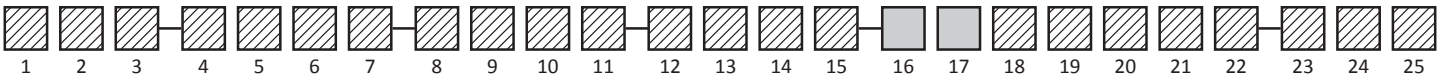
13 VENT TYPE

15 DRAIN TYPE

1	FNPT w/ Hex Head Plug (std.)
2	Socketweld
3	Male Threaded (MNPT)
4	Plain-End Nipple
5	Buttweld Nipple
6	RF Slip On Flange
7	RF Weld Neck Flange
8	RTJ Slip On Flange
9	RTJ Weld Neck Flange

A	Ball Valve, FNPT x FNPT
B	Ball Valve, SW x SW
C	Ball Valve, SW x FNPT
D	Gate Valve, FNPT x FNPT
E	Gate Valve, SW x SW
F	Gate Valve, SW x FNPT

N	None



16 ACCESSORY / TECHNOLOGY CODE

N	None

Switches Only (No Transmitter. See options below if transmitter is required)	
Y	Orion Electronic Switch (OES or ORS) clamp-mounted to chamber
Z	Orion Electronic Switch (OES or ORS) with switch mount rod

When MLIs are combined with compatible accessory items, such as continuous transmitters or point switches, minor changes to the chamber and float design may be required. This code captures that relationship.

For digit 16, match up the MLI product type with the appropriate transmitter, switch, or combination of both. The corresponding code should be entered into the model number shown above.

All transmitters and switches must be ordered separately.

FOR **ATLAS ONLY** WITH EXTERNAL TRANSMITTER (code in first digit of model number must be "1")

Jupiter Magnetostrictive Transmitter (mounting configurations shown below)	Jupiter Only, No switches	Jupiter and at least one OES/ORS Switch (Clamp-mounted)	Jupiter and at least one OES/ORS Switch (Rod-mounted)
Top Mount	1	A	L
Top Mount Offset/High-Temp	2	B	M
Bottom Mount Offset/High-Temp	3	C	P

OCT Reed Chain Transmitter (mounting configurations shown below)	
Top Mount	8
Bottom Mount	9

FOR **AURORA & GEMINI ONLY** (code in first digit of model number must be "2" or "3")

Eclipse Probe Configuration	Eclipse Only, No switches	Eclipse and at least one OES/ORS Switch (Clamp-mounted)	Eclipse and at least one OES/ORS Switch (Rod-mounted)
Standard Coaxial Probe	1	A	L
Rigid Single Rod Probe	2	B	M
Flexible Single Rod Probe	3	C	P
Enlarged Coaxial Probe	4	D	R

Jupiter Probe Configuration (Gemini only option if GWR not used)	Jupiter Only, No switches	Jupiter and at least one OES/ORS Switch (Clamp-mounted)	Jupiter and at least one OES/ORS Switch (Rod-mounted)
Jupiter, Direct Insertion	9	K	W

FOR **JUPITER EXTERNAL CHAMBER/CAGE ONLY** (code in first digit of model number must be "5")

Jupiter Direct Insertion	1

17 TEMPERATURE OPTIONS

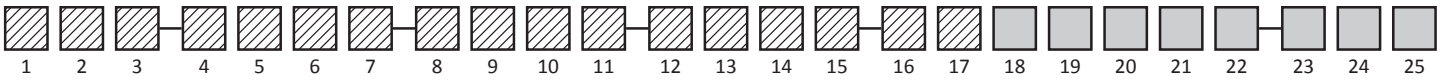
N	None

Insulation Blanket for Personnel Protection		
A	Chamber pipe only	up to 500 °F (260 °C)
B	Chamber pipe only	up to 1000 °F (538 °C)
C	Chamber and flanges	up to 500 °F (260 °C)
D	Chamber and flanges	up to 1000 °F (538 °C)

Insulation Pad for Indicator & Transmitter Protection		
Y	Indicator only	≥ 375 °F (191 °C)
T	Jupiter or OCT transmitter	165°F to 375°F (74° to 191° C)
V	Indicator and Jupiter	376°F to 850°F (192° to 454° C)
W	Indicator and OCT	376°F to 425°F (192° to 218° C)

Other Options for Temperature Maintenance or Freeze Protection		
H	Electric Heat Tracing	includes insulation blanket
S	Steam Tracing (3/8" tubing)	includes insulation blanket
J	Steam Jacket (1/2" NPT inlet/outlet)	

Cryogenic Insulation	
L	Process temperatures down to -150 °F (-101 °C)
P	Process temperatures down to -320 °F (-196 °C)



18 | MEASUREMENT TYPE & INDICATOR STYLE

Total Level Measurement	
S	Fluorescent Orange Shuttle / Follower
1	Orange / Black Flags
2	Yellow / Black Flags
3	Red / White Flags
4	Red / Silver Flags

Interface Level Measurement	
T	Fluorescent Orange Shuttle / Follower
5	Orange / Black Flags
6	Yellow / Black Flags
7	Red / White Flags
8	Red / Silver Flags

A	Orange / Black Flags with Yellow Float Diagnostics ①
B	Yellow / Black Flags with Orange Float Diagnostics ①
C	Red / White Flags with Yellow Float Diagnostics ①
D	Red / Silver Flags with Green Float Diagnostics ①

F	Orange / Black Flags with Yellow Float Diagnostics ①
G	Yellow / Black Flags with Orange Float Diagnostics ①
H	Red / White Flags with Yellow Float Diagnostics ①
J	Red / Silver Flags with Green Float Diagnostics ①

N	No Indicator (For use with Jupiter external cage)

① Float diagnostics is a safety feature which indicates a contrasting color on the visual indicator when the float has fallen below the lowest measurable point on the scale. This can occur when the specific gravity of the liquid drastically decreases or the float collapses due to a pressure spike. (see pg. 4)

19 | INDICATOR HOUSING MATERIAL & SCALE ②

reveal *Wide View* Stainless Steel indicator	
A	Foot / Inch Measurement
B	Meter / Centimeter Measurement
C	Running Inch Measurement
D	Percent (0 - 100%) Measurement
E	Gallon Measurement
F	Liter Measurement

P	No scale

Anodized Aluminum Housing	
1	Foot / Inch Measurement
2	Meter / Centimeter Measurement
3	Running Inch Measurement
4	Percent (0 - 100%) Measurement
5	Gallon Measurement
6	Liter Measurement

N	No scale

② Aluminum indicator is required if either of the following conditions are true:
a) A glass viewing window is desired instead of shatter-resistant polycarbonate.
b) Process operating temperatures exceed above 600°F (316° C)

20, 21, 22 | FACTORY ASSIGNED

X X X	These codes are factory assigned. ③

③ Not all chamber diameters and wall thicknesses are eligible for *OrionXpress*. Contact the factory or your local representative for more information.

23, 24, 25 | CENTER-TO-CENTER PROCESS CONNECTION DIMENSION & VISUAL INDICATION LENGTH

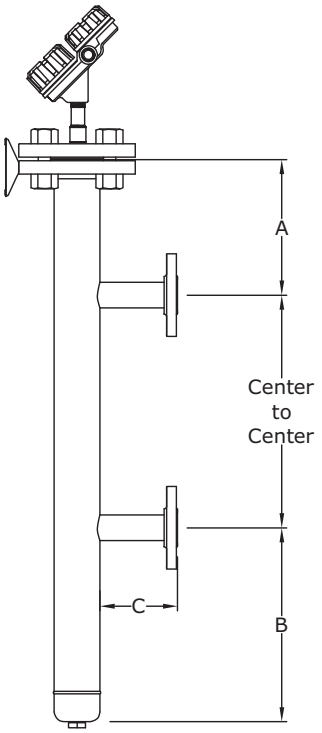
X X X	Specify in **INCHES** when model code 2 is **E** Specify in **CENTIMETERS** when model code 2 is **M**

Example #1 : Center-to-Center is 84 inches. Enter as 084. (model digit 2 must be "E")

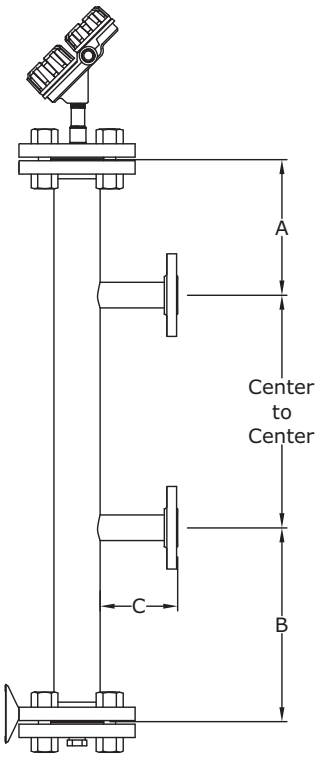
Example #2: Center-to-Center is 124 centimeters. Enter as 124. (model digit 2 must be "M")

Example #3: Center-to-Center is 124.25 inches. Enter as 124 inches and X the model for 124.25 inches. Or consult factory for assistance.

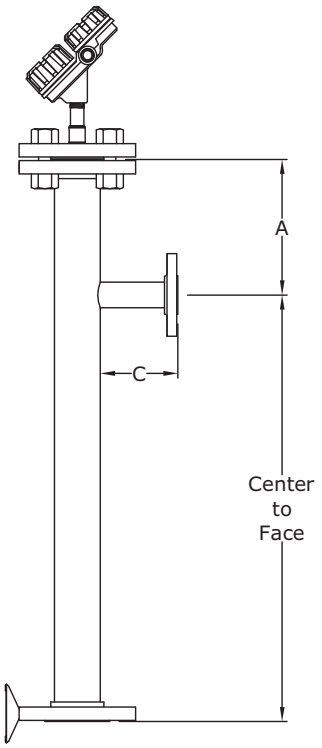
Example #4: Center-to-Center is 724 millimeters. Enter as 072 centimeters and X the model for 724 millimeters. Or consult factory for assistance.



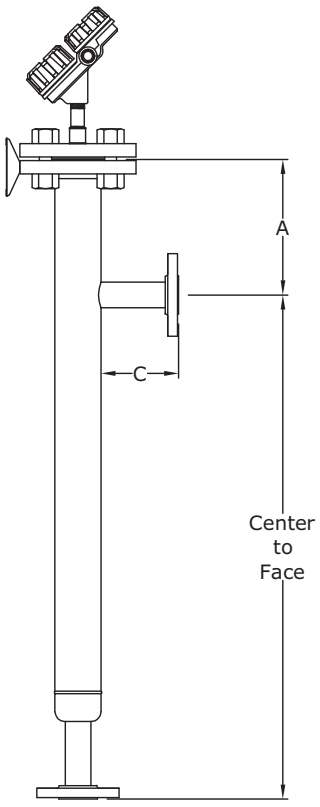
Configuration 2 & B



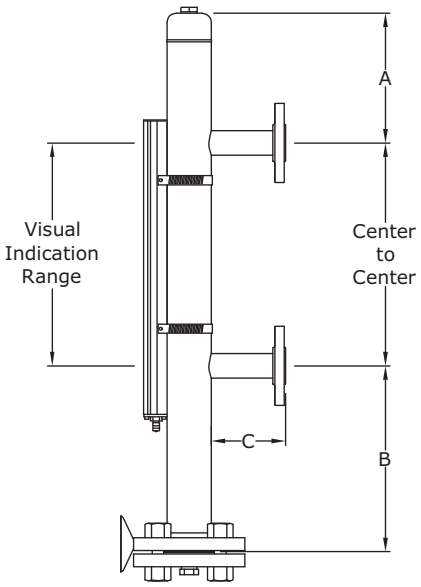
Configuration 3 & C



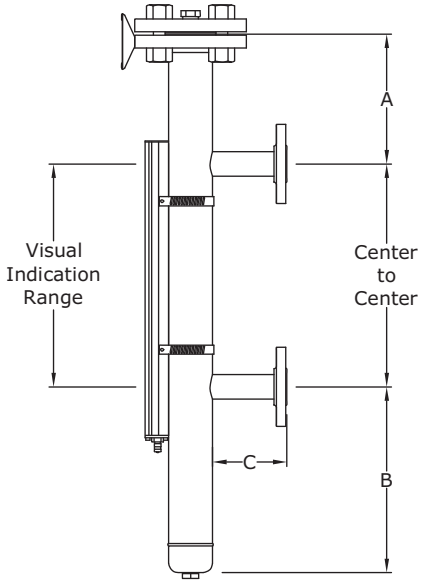
Configuration 8 & H



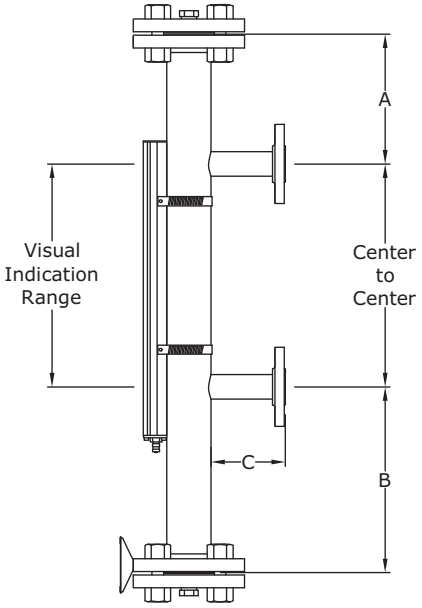
Configuration 9 & J



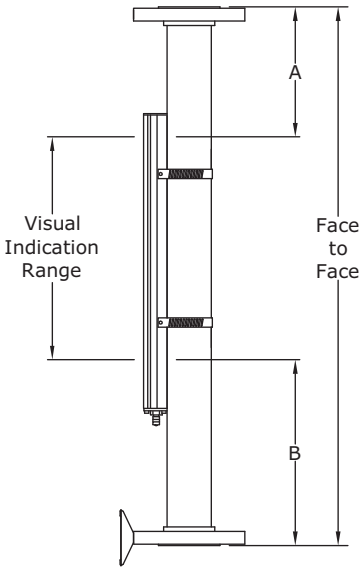
Configuration 1



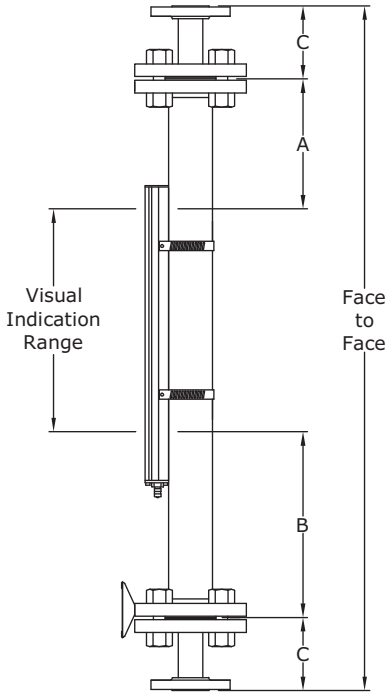
Configuration 2



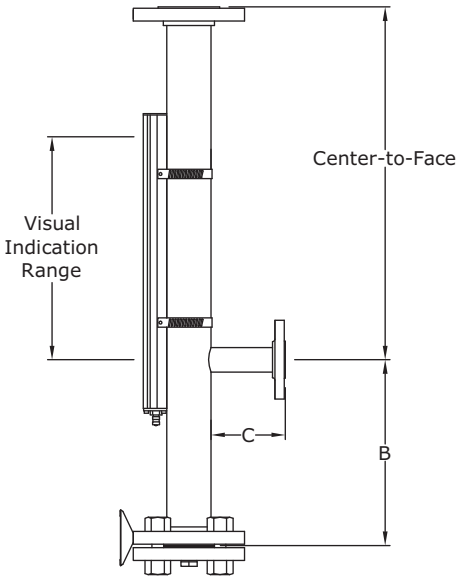
Configuration 3



Configuration 4

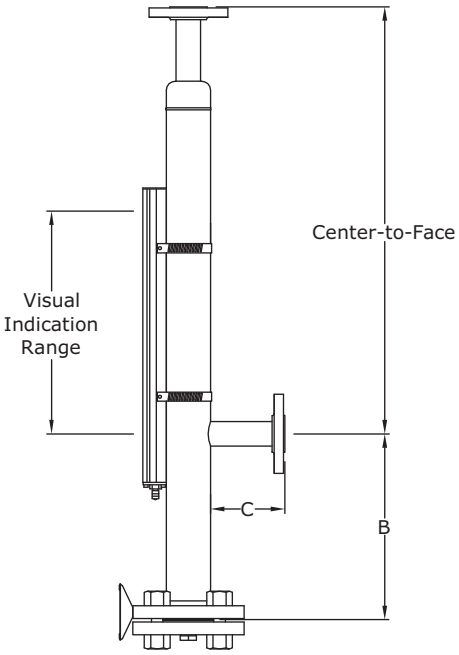


Configuration 5

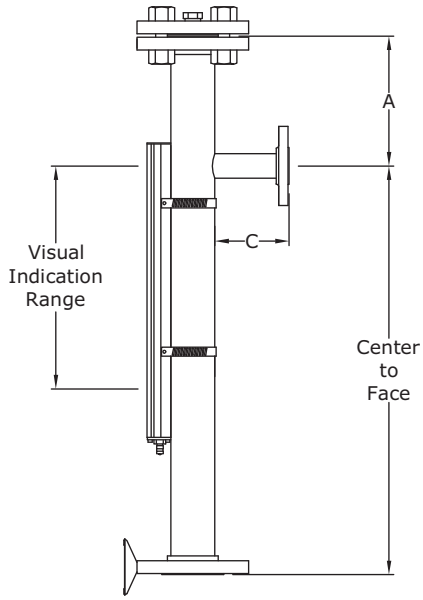


Configuration 6

All dimensions vary depending on application parameters and/or accessory items. Dimensional drawings are available by contacting the factory.



Configuration 7



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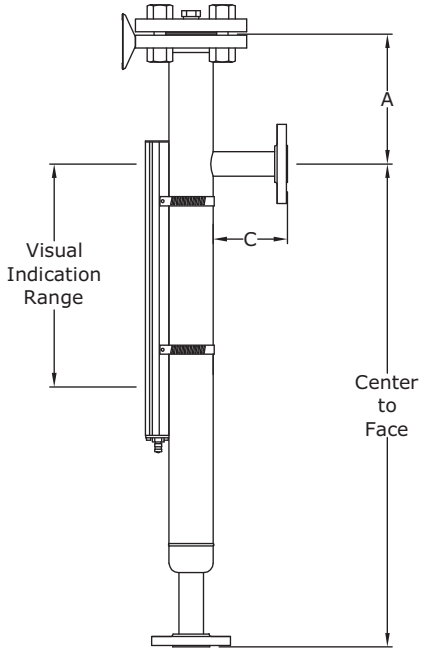

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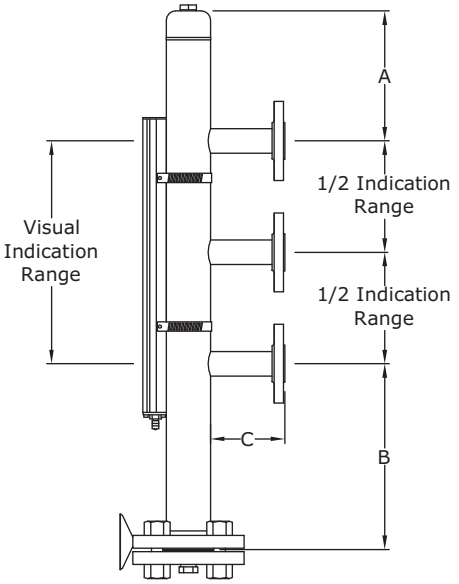
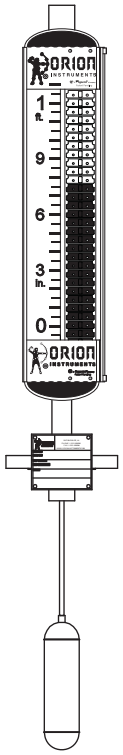


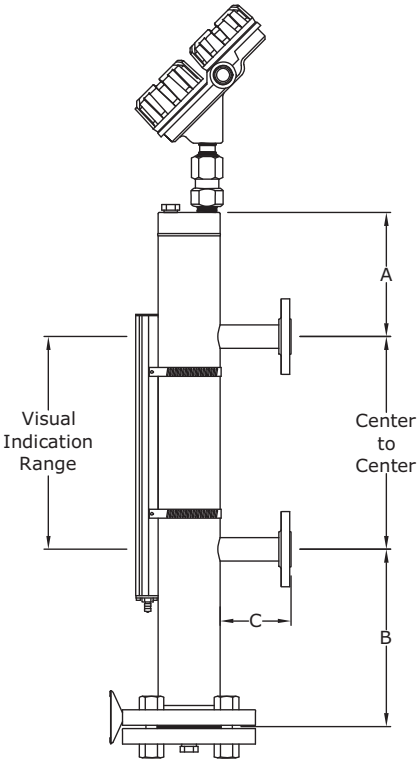
Multiple Process Connections
consult factory



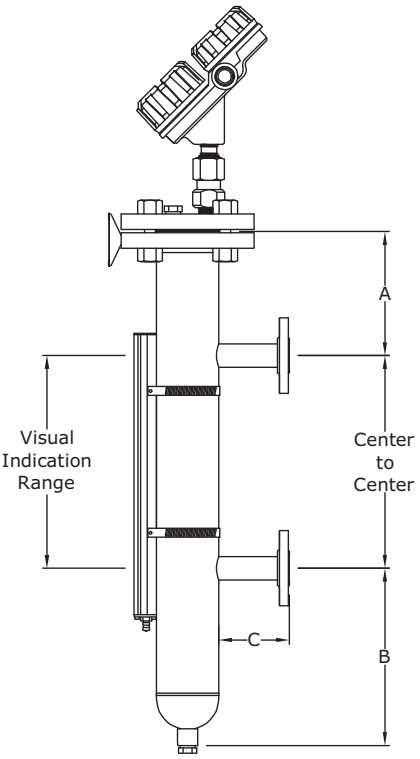
Atlas Top Mount
configuration T

Atlas Top Mount w/stilling well
consult factory

Atlas Top Mount w/threaded process connection
consult factory



Configuration 1



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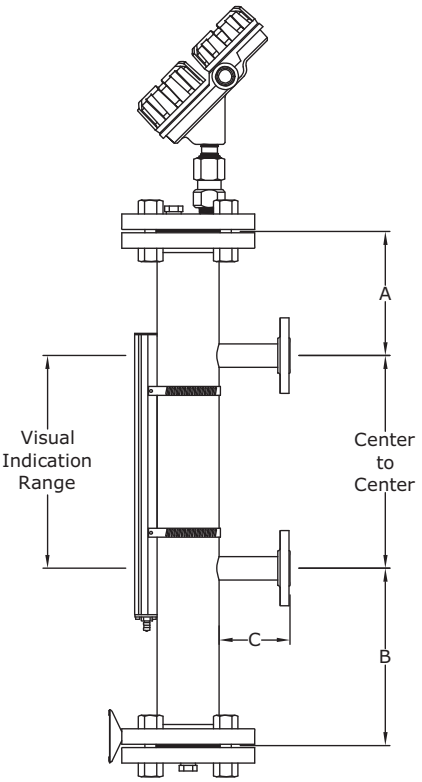

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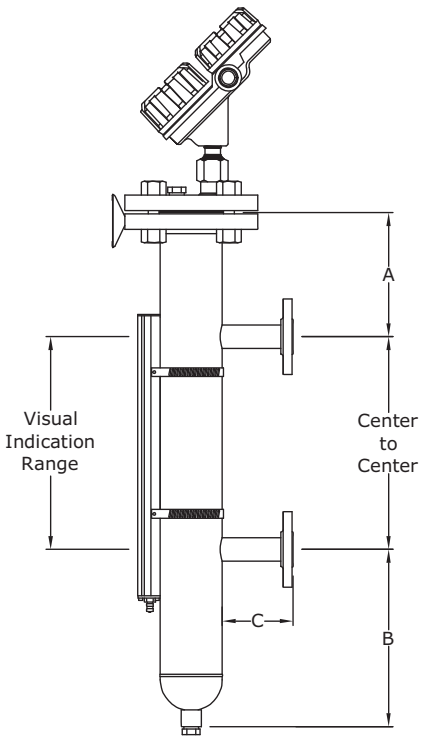

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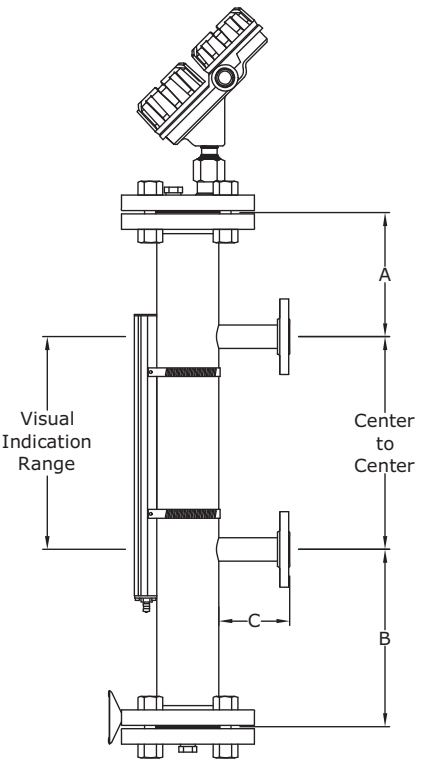
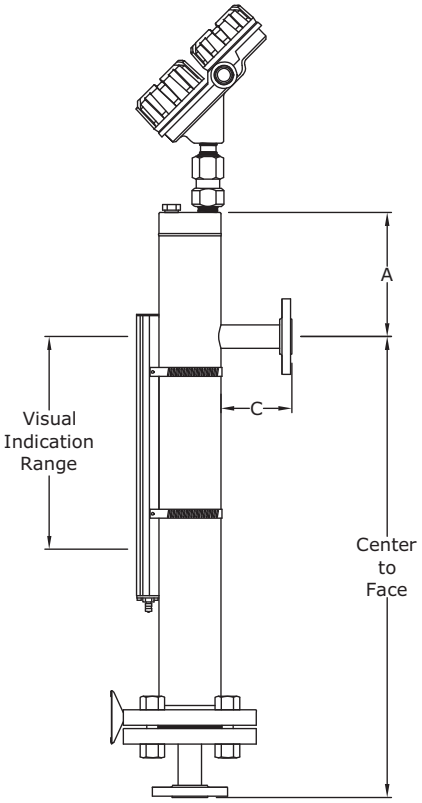
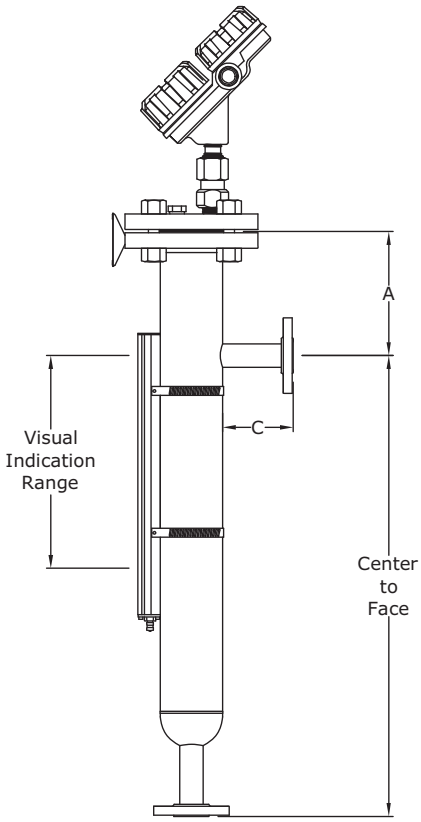


Configuration 5

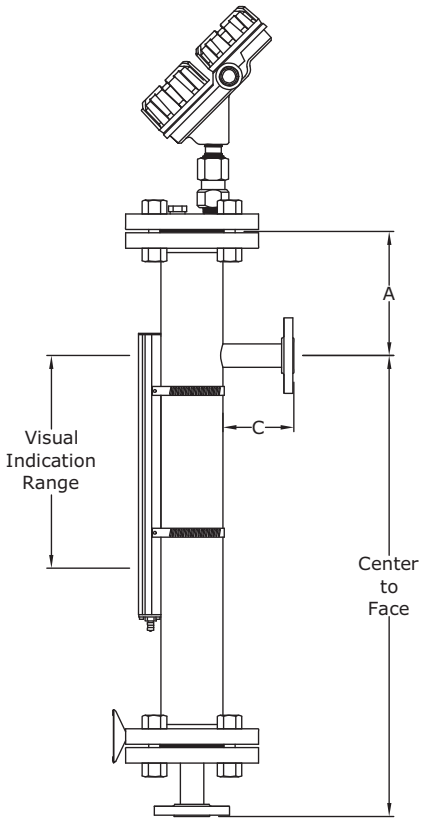
All dimensions vary depending on application parameters and/or accessory items. Dimensional drawings are available by contacting the factory.



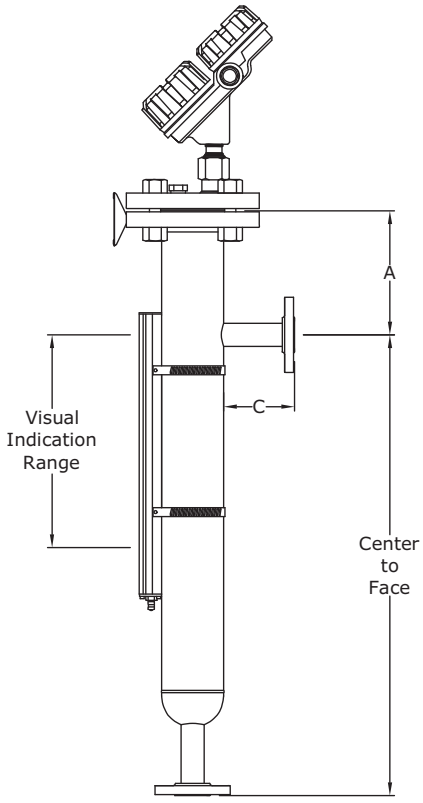
Configuration A



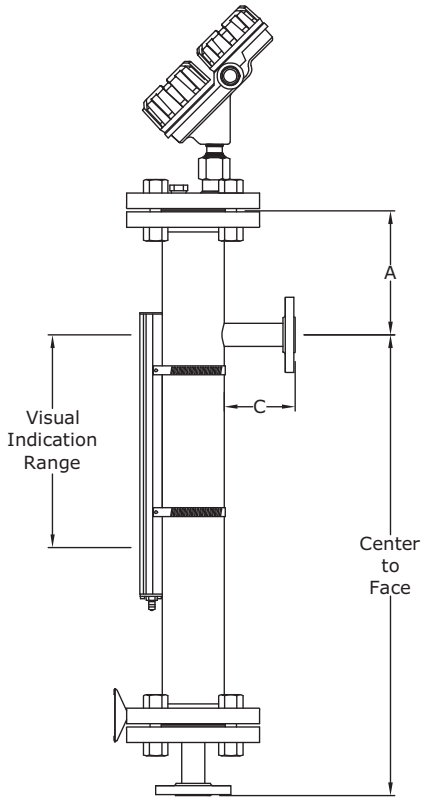
Configuration B



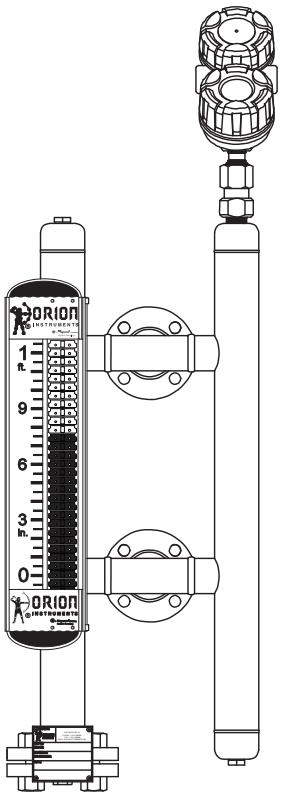
Configuration C



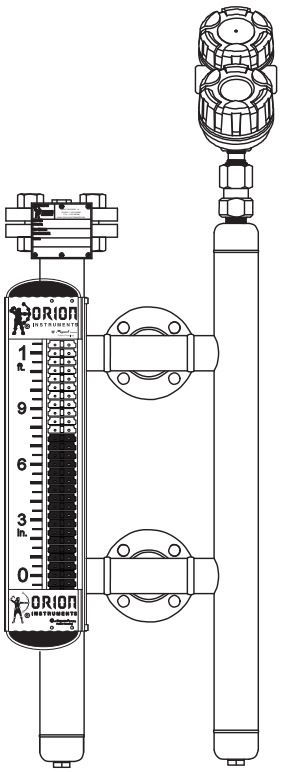
Configuration D



Configuration F



Configuration 1



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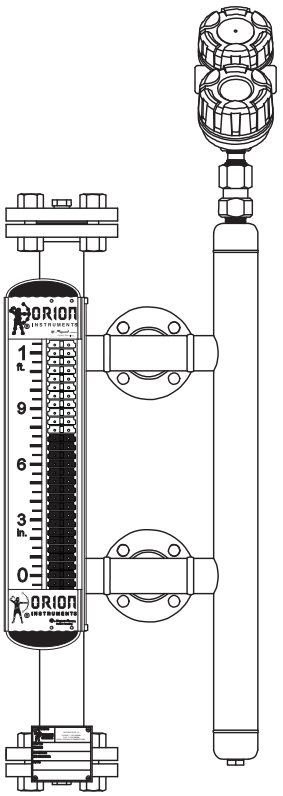

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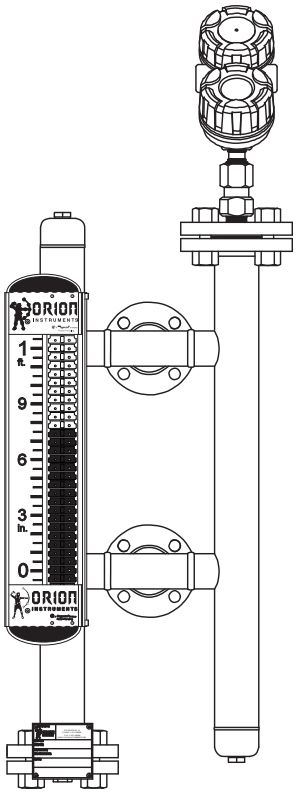

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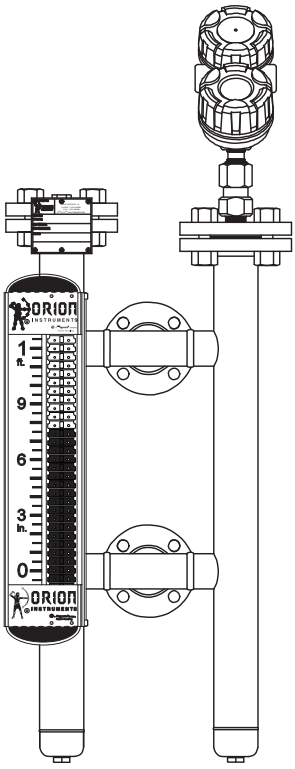

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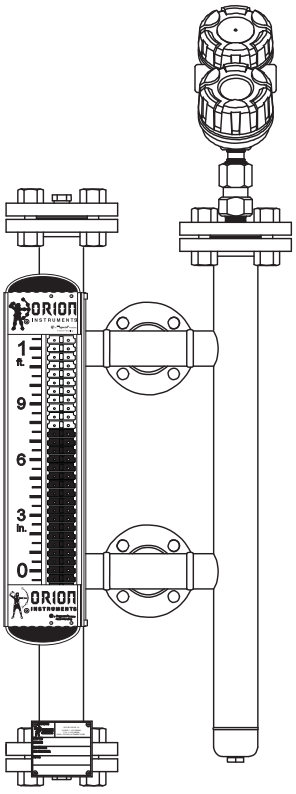
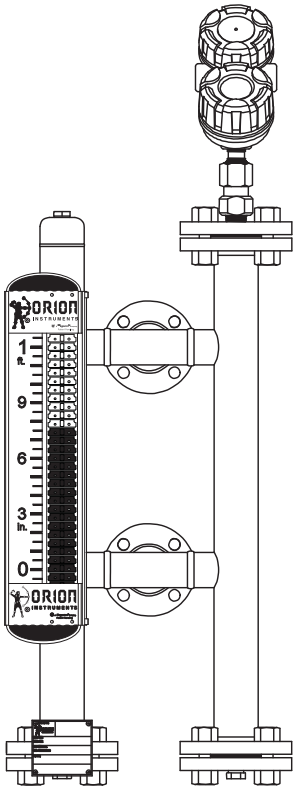
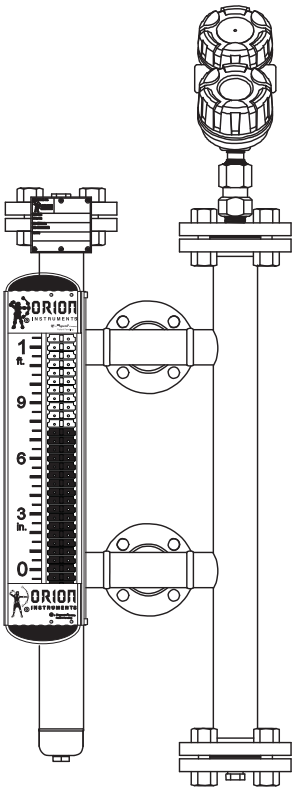


Configuration 6

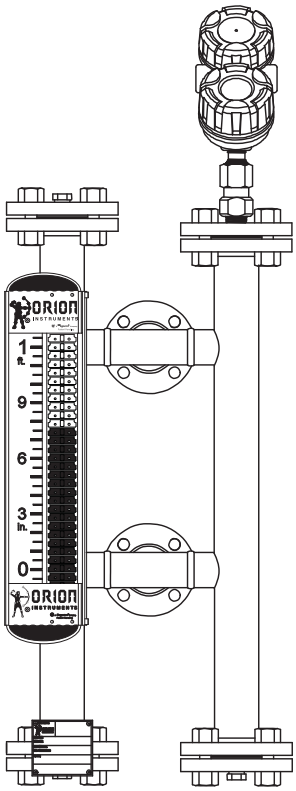
All dimensions vary depending on application parameters and/or accessory items. Dimensional drawings are available by contacting the factory.



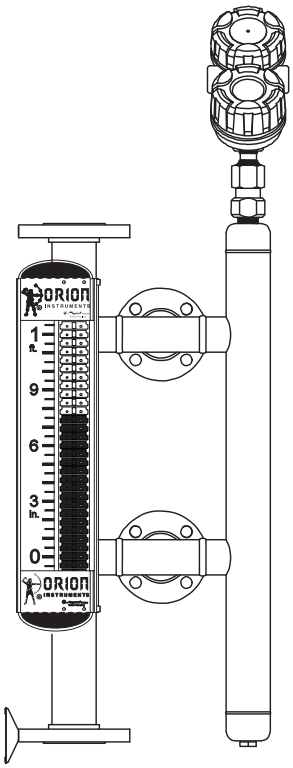
Configuration 7



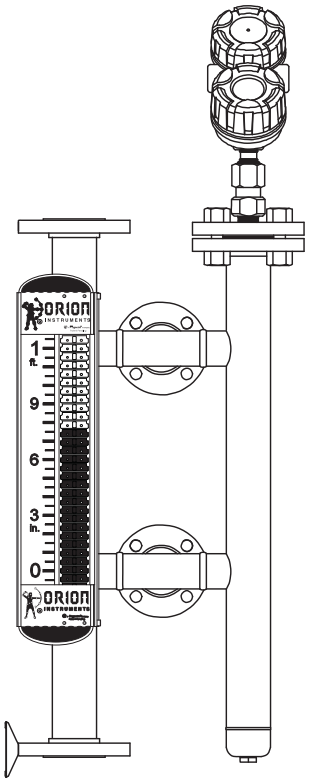
Configuration 8



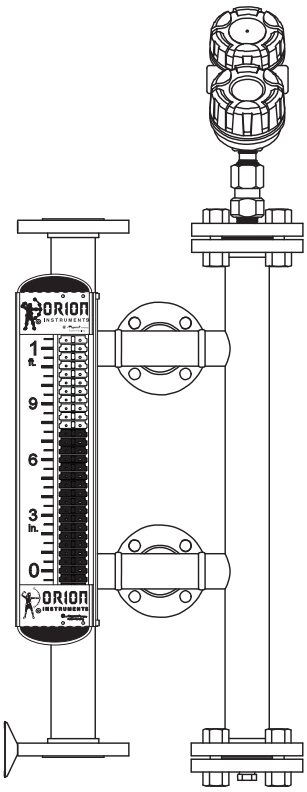
Configuration 9



Configuration A



Configuration B



Configuration C

7	0	5	—				—			
1	2	3	4	5	6	7	8	9	10

1, 2, 3 BASIC MODEL

705	Eclipse Guided Wave Radar Level Transmitter

4 POWER

5	24 VDC, Two-wire

5, 6 SIGNAL OUTPUT & ELECTRONICS

1 0	4-20 mA with HART - SIL 1 standard electronics (SFF: 85.4%)
1 A	4-20 mA with HART - SIL 2 enhanced electronics (SFF: 91%)
2 0	FOUNDATION fieldbus™ Communication
3 0	PROFIBUS PA™ Communication

7 ACCESSORIES

0	No digital display and keypad
A	Digital display and keypad

8 MOUNTING / CLASSIFICATION

1	Integral, General Purpose & Intrinsically Safe (FM & CSA) , Non-incendive (Class I, Div. 2)
2	Remote, General Purpose & Intrinsically Safe (FM & CSA) , Non-incendive (Class I, Div. 2)
3	Integral, Explosion Proof (FM & CSA) & Non-incendive
4	Remote, Explosion Proof (FM & CSA) & Non-incendive
A	Integral, General Purpose & Intrinsically Safe (ATEX & JIS EEx ia IIC T4)
B	Remote, General Purpose & Intrinsically Safe (ATEX & JIS EEx ia IIC T4)
C	Integral, Explosion Proof (ATEX & JIS EEx d [ia] IIC T6) (must be ordered with Conduit Connection Codes 0 and 1)
D	Remote, Explosion Proof (ATEX & JIS EEx d [ia] IIC T6) (must be ordered with Conduit Connection Codes 0 and 1)
E	Integral, Non-incendive (ATEX EEx n II T4..6)
F	Remote, Non-incendive (ATEX EEx n II T4..6)

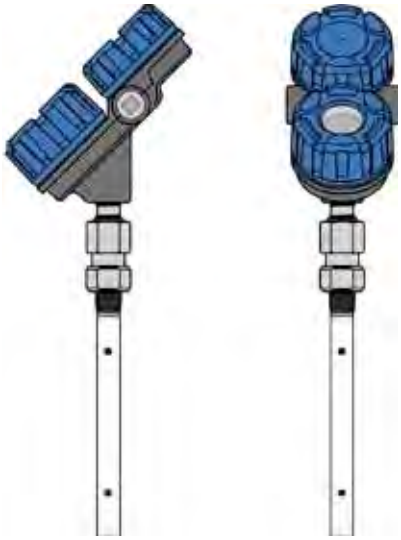
9 HOUSING

1	Cast aluminum, dual compartment, 45° angle
2	316 SS, dual compartment, 45° angle
7	Cast aluminum, dual compartment, 45° angle, 12-ft remote
8	316 SS, dual compartment, 45° angle, 12-ft remote ①

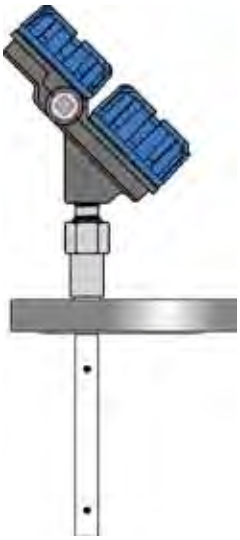
10 CONDUIT CONNECTION

0	¾" NPT
1	M20

① To reduce the possibility of probe damage due to vibration, it is recommended to use a remote mount transmitter (*Mounting/Classification* codes 2, 4, B, D, or F) when ordering the heavier 316 SS version.



Eclipse with threaded process fitting



Eclipse transmitter with probe offset for Aurora MLI

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Available Eclipse® models include:

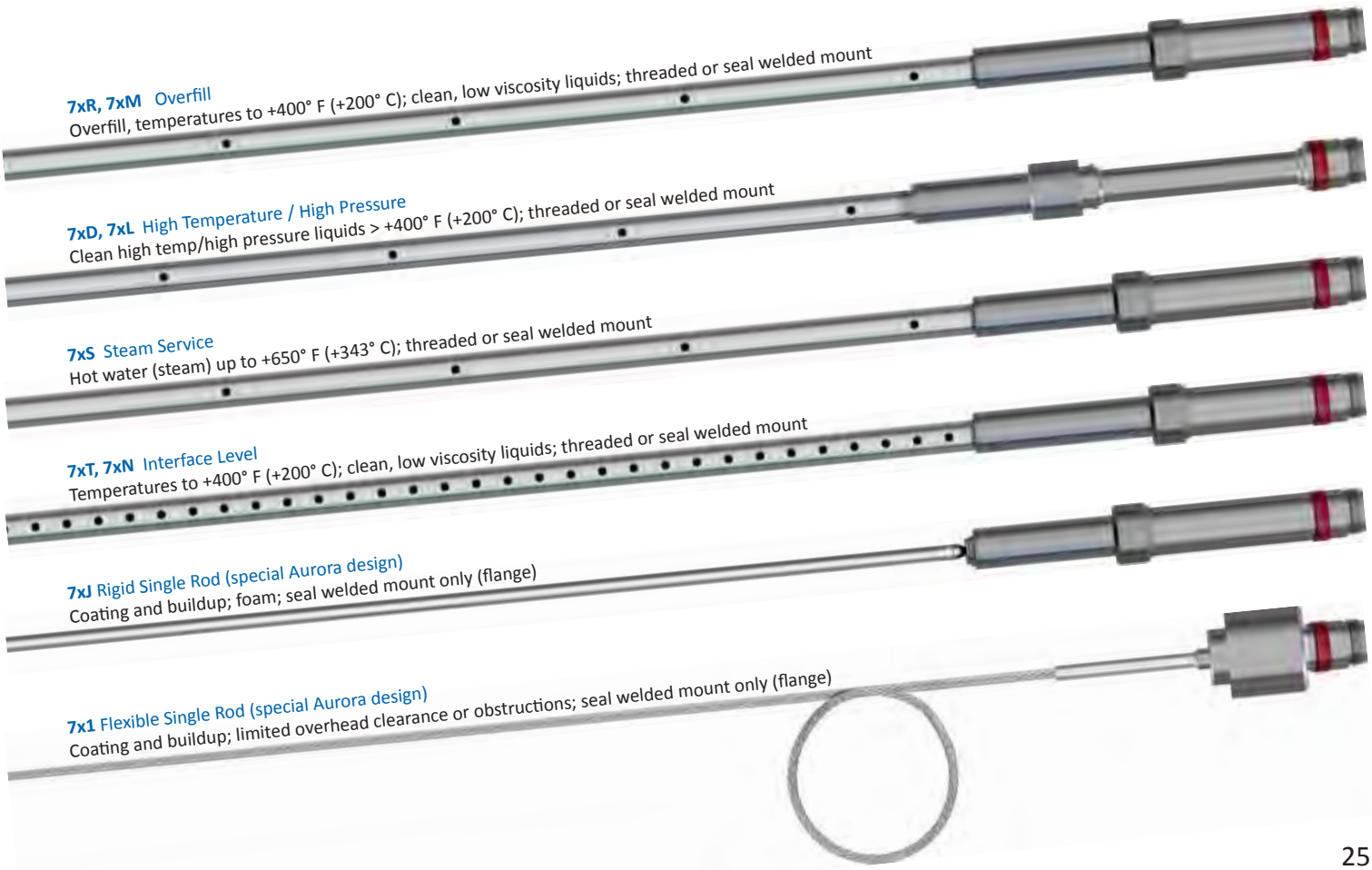
705-510A-110
705-510A-310
705-510A-270
705-510A-C10

ECLIPSE PROBE SPECIFICATIONS

Coaxial Probe Type	Basic Model	Maximum Pressure	Maximum Temperature	Minimum Temperature	Dielectric Range	Length ①
Overfill probe	7 x R	1000 psig @ +70° F (70 bar @ +20° C)	+400° F @ 270 psig (+200° C @ 18 bar)	-40° F @ 1000 psig (-40° C @ 50 bar)	1.4 to 100	24" to 240" (60 to 610 cm)
Overfill probe w/flushing port	7 x M	1000 psig @ +70° F (70 bar @ +20° C)	+400° F @ 270 psig (+200° C @ 18 bar)	-40° F @ 1000 psig (-40° C @ 50 bar)	1.4 to 100	24" to 240" (60 to 610 cm)
High Temp / High Pressure	7 x D	6250 psig @ +70° F (431 bar @ +20° C)	+800° F @ 2000 psig (+427° C @ 133 bar)	-320° F @ 6250 psig (-195° C @ 430 bar)	1.4 to 100	24" to 240" (60 to 610 cm)
Hi-Temp / Hi-Press w/flushing port	7 x L	6250 psig @ +70° F (431 bar @ +20° C)	+800° F @ 2000 psig (+427° C @ 133 bar)	-320° F @ 6250 psig (-195° C @ 430 bar)	1.4 to 100	24" to 240" (60 to 610 cm)
Steam Service	7 x S	2400 psig @ +650° F (165 bar @ +343 C) Saturated Steam	+650° F @ 2400 psig (+343 C @ 165 bar) Saturated Steam	N/A	10 to 100	24" to 180" (60 to 455 cm)
Interface Level	7 x T	1000 psig @ +70° F (70 bar @ +20° C)	+400° F @ 270 psig (+200° C @ 18 bar)	-40° F @ 1000 psig (-40° C @ 70 bar)	Upper: 1.4 to 5 Interface: 15 to 100	24" to 240" (60 to 610 cm)
Interface probe w/ flushing port	7 x N	1000 psig @ +70° F (70 bar @ +20° C)	+400° F @ 270 psig (+200° C @ 18 bar)	-40° F @ 1000 psig (-40° C @ 70 bar)	Upper: 1.4 to 5 Interface: 15 to 100	24" to 240" (60 to 610 cm)

Single Rod Probe Type	Probe 3rd Digit	Maximum Pressure	Maximum Temperature	Minimum Temperature	Dielectric Range	Length
Rigid	7 x J	3000 psig @ +70° F (207 bar @ +20° C)	+600° F @ 1600 psig (+316° C @ 110 bar)	0° F @ 3000 psig (-18° C @ 207 bar)	1.9 to 100	24" to 240" (60 to 610 cm)
Flexible	7 x 1	1000 psig @ +70° F (70 bar @ +20° C)	+300° F @ 400 psig (+150° C @ 27 bar)	0° F @ 1000 psig (-15° C @ 70 bar)	1.9 to 100	24" to 240" ① (60 to 610 cm)

① Consult factory for longer probe lengths



7									
1	2	3	4	5	6	7	8	9	10

1, 2 BASIC MODEL

7E	Eclipse GWR probe, **English** unit of measure
7M	Eclipse GWR probe, **Metric** unit of measure

The Aurora® MLI utilzes Magnetrol's Eclipse® GWR level transmitter. All probes specified for an Aurora® should be selected from this model number. Consult factory for special requests.

3 PROBE TYPE

R	Coaxial	Overfill	minimum ¾" process connection (threaded or seal welded)	Media dielectric range ≥ 1.4 (2.0 with ceramic spacers)
M	Coaxial	Overfill w/flushing connection		
D	Coaxial	Hi-Temp/Hi-Pressure		
L	Coaxial	Hi-Temp/Hi-Pressure w/flushing connection		
S	Coaxial	Hot water/steam service		
T	Coaxial	Interface		
N	Coaxial	Interface w/flushing connection		
J	Single Rod	Hi-Temp, Rigid probe	seal welded process connection only	Media dielectric range ≥ 1.9
1	Single Rod	Flexible probe		

4 MATERIAL OF CONSTRUCTION

Seal Welded Probe & Flange Material	
Z	316/316L SS probe with carbon steel flange
Y	316/316L SS probe
T	Hastelloy C276 (probe types R, M, T, N, D, and L)
U	Monel (probe types R, M, T, N, D, and L)

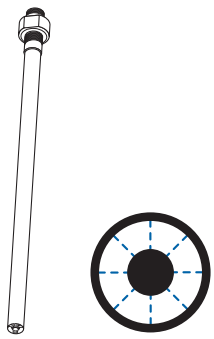
Threaded Probe Material	
A	316/316L SS probe
B	Hastelloy C276 (probe types R, M, T, N, D, and L)
C	Monel (probe types R, M, T, N, D, and L)

5, 6 PROCESS CONNECTION - SIZE / TYPE

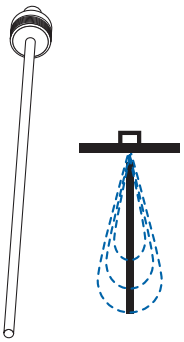
Threaded	
11	¾" NPT threaded connection

3" ANSI Flanges	
53	3" 150# RF ANSI Flange
54	3" 300# RF ANSI Flange
55	3" 600# RF ANSI Flange
56	3" 900# RF ANSI Flange
57	3" 1500# RF ANSI Flange
58	3" 2500# RF ANSI Flange

4" ANSI Flanges	
63	4" 150# RF ANSI Flange
64	4" 300# RF ANSI Flange
65	4" 600# RF ANSI Flange
66	4" 900# RF ANSI Flange
67	4" 1500# RF ANSI Flange
68	4" 2500# RF ANSI Flange



Coaxial Probe



Single Rod Probe

7 PROCESS SEAL - O-RING MATERIAL

0	Viton® GFLT - universal use
2	Kalrez® 4079 - for aggressive media
8	Aegis PF128 - for steam and NACE applications
N	Borosilicate seal - for non-steam applications

8, 9, 10 INSERTION LENGTH

XXX	24 to 240 inches (60 to 610 cm) ①
	Example: 24 inches = 024; 160 centimeters = 160

① consult factory for insertion lengths less than 24" (60 cm) or greater than 240" (610 cm)

See Magnetrol bulletin 57-101 for additional information regarding Eclipse guided wave radar specifications.

Consult factory for special probe options including:

- NACE construction
- ASME construction
- Enlarged coaxial
- Custom spacers
- Special requests

Eclipse® Guided Wave Radar

The Enhanced Eclipse Model 705 is a loop-powered, 24 VDC, level transmitter based upon the revolutionary Guided Wave Radar (GWR) technology. GWR offers effective and reliable level indication by pulsing high-frequency microwave energy down a waveguide. Once the energy reaches the liquid surface, an impedance mismatch creates a reflection that is detected by the onboard electronics. Eclipse boasts an impressive accuracy specification of ± 0.10 inches and has proven to be effective in hundreds of applications common around the world. This single transmitter can be used with all probe types and offers enhanced reliability, as demonstrated by a Safe Failure Fraction of 91%.

Modulevel® Displacer Controller

The Digital E3 Modulevel is an advanced, intrinsically safe two-wire instrument utilizing simple buoyancy principle to detect and convert liquid level changes into a stable 4–20 mA output signal. The linkage between the level sensing element and output electronics provides a simple mechanical design and construction.

Kotron® RF Capacitance

The Kotron Model 801 Transmitter is a new generation RF Capacitance multi-function transmitter that offers the user unparalleled power. The preamplifier circuit provides installation flexibility of a 2500 feet (762 m) maximum remote distance. The Model 801 can interface with two separate vessels, essentially making it a mini-multiplexer, while software mathematics allow for the sum or differential of the two signals.

Jupiter® Magnetostrictive

The Enhanced Jupiter Magnetostrictive level transmitter provides a 4–20 mA output proportional to the level being measured or FOUNDATION fieldbus™ output. Jupiter is available as an externally mounted model for use with Orion Atlas™, Gemini™, and Aurora® magnetic level indicators or as a direct insertion version for use in a wide variety of process vessels or external chambers.

Digits 1 through 8 (See next page for digits 11 through 15)

2								0	0					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

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See back cover for more details

1 PRODUCT SELECTION

2	Jupiter Magnetostrictive Level Transmitter

2 OUTPUT

4	HART®, 4-20 mA, LCD Display, SIL 1
5	FOUNDATION fieldbus™, LCD Display
6	HART®, 4-20 mA, LCD Display, SIL 2
7	Two level tracking, HART utilizing two MLI floats
8	Two level tracking, FOUNDATION fieldbus™ utilizing two MLI floats

3 HOUSING AND CONDUIT ENTRY

1	Cast Aluminum, Integral Mount with ¾" NPT Conduit Entry
2	Cast Aluminum, Integral Mount with M20 Conduit Entry
3	316 SS, Integral Mount with ¾" NPT Conduit Entry
4	316 SS, Integral Mount with M20 Conduit Entry

4 AREA CLASSIFICATION

1	FM/CSA, Intrinsically Safe, Non-Incendive
3	FM/CSA, Explosion Proof, Non-Incendive
A	ATEX, Ex d IIC T6, Flameproof
E	ATEX, Ex ia IIC T4, Intrinsically Safe
J	IEC, Ex d IIC T6, Flameproof
K	IEC, Ex ia IIC T4, Intrinsically Safe
L	INMETRO, Ex d IIC T6, Flameproof
M	INMETRO, Ex ia IIC T4, Intrinsically Safe

5 CONFIGURATION

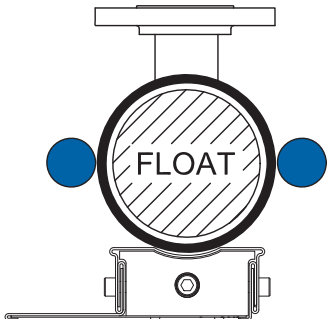
E	Top Mount, Material Code 1 only
F	Top Mount Offset, Material Code 1 only
G	Top Mount Offset, High Temperature, Material Code A only
H	Bottom Mount Offset, Material Code 1 only
J	Bottom Mount Offset, High Temperature, Material Code A only

6-7 MOUNTING LOCATION

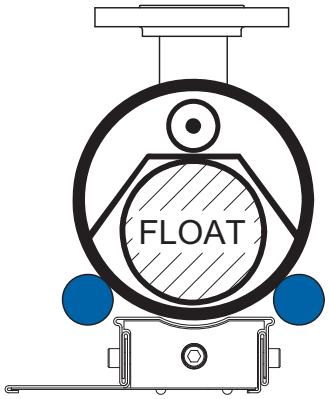
00	External Mount on MLI or Chamber, Left Side (standard)
01	External Mount on MLI or Chamber, Right Side

8 PROBE MATERIAL OF CONSTRUCTION

1	316/316L SS (standard), +250° F (+120° C) Maximum
A	316/316L SS (high temp), +500° F (+260° C) Maximum *+850° F (+454° C) with factory-installed fiberglass insulation*

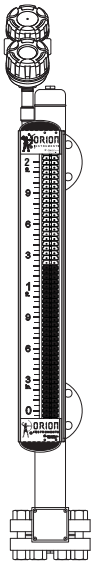


Probe mounting positions on Atlas™, Vector™, and Gemini™ Magnetic Level Indicators

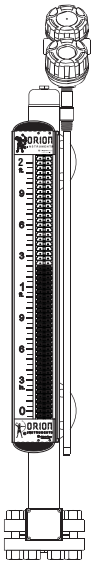


Probe mounting positions on Aurora® MLI

Probe proximity to the float is critical

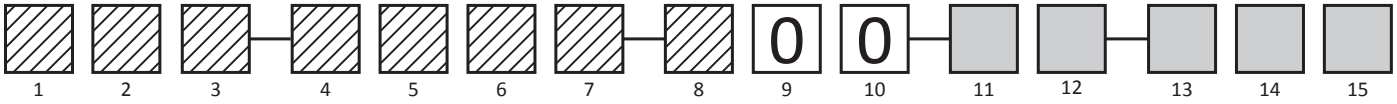


Left side mount (standard)



Right side mount

Note: When specifying the mounting location, be aware of other accessories that may also mount on the MLI (i.e. switches, heat tracing, etc). Choose left side mount whenever possible.



11 CHAMBER MOUNTING CODE

Without High-Temp Chamber Insulation	
1	MLI model code digit 20 is 1, 2, or 7
2	MLI model code digit 20 is 3, 4, 5 or 6
3	MLI model code digit 20 is A, B, C, or D
4	MLI model code digit 20 is E, F, G, H, or J
5	MLI is a Top Mount design
0	None (if clamps already exist)

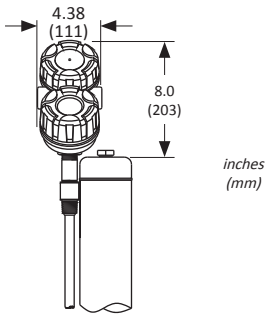
With High-Temp Chamber Insulation	
E	MLI model code digit 20 is 1, 2, or 7
F	MLI model code digit 20 is 3, 4, 5 or 6
G	MLI model code digit 20 is A, B, C, or D
H	MLI model code digit 20 is E, F, G, H, or J
J	MLI is a Top Mount design
0	None (if clamps already exist)

12 UNIT OF MEASURE

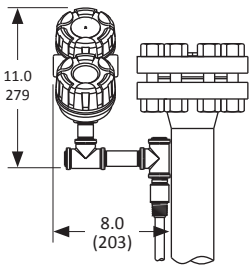
E	Probe length in English units (inches)
M	Probe length in Metric units (centimeters)

13-15 PROBE LENGTH

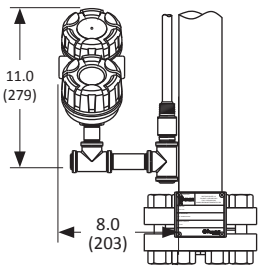
XXX	Specify required probe length. *See figures to the right.*



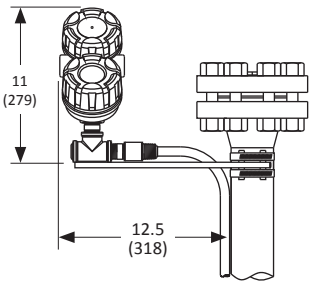
Top Mount



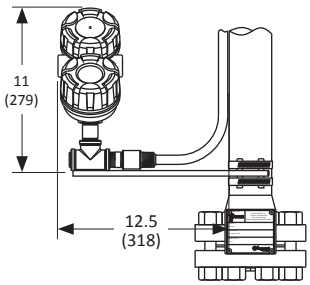
Top Mount Offset



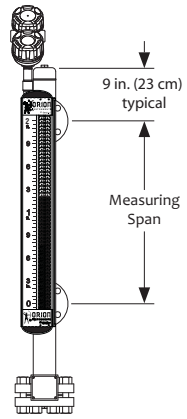
Bottom Mount Offset



Top Mount Offset
High Temperature

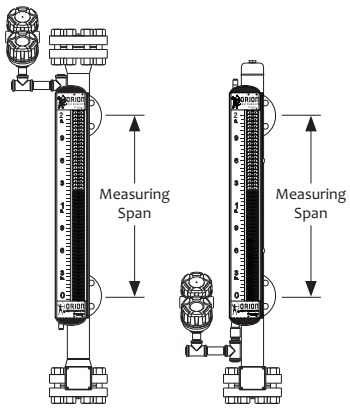


Bottom Mount Offset
High Temperature



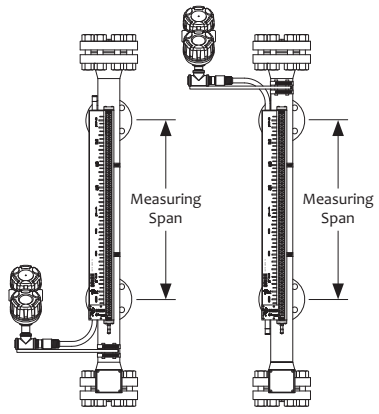
Top Mount Configuration

Probe Length = Center-to-Center + 8 in. (20 cm)



Top/Bottom Mount Offset Configuration

Probe Length = Center-to-Center + 6 in. (15 cm)



Hi-Temp Top/Bottom Mount Offset Configuration

Probe Length = Center-to-Center + 15 in. (38 cm)

OES 10-Amp DPDT Point Level Switch

O	E	S	—				—	0	0	1
1	2	3	4	5	6	7	8	9	10	

Designed for optimal repeatability and reliability, the OES is actuated by simple magnetic coupling. As the liquid level moves, the MLI float follows. When the float moves into the proximity of the snap switch, the switch magnet interacts with the float's magnetic field actuating the switch.

see Orion bulletin OES-100 for more information

4 ENCLOSURE MATERIAL

A	Cast Aluminum
S	Stainless Steel

5 AGENCY APPROVAL

1	FM / CSA

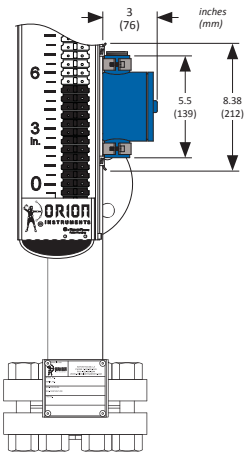
6 CHAMBER MOUNTING CODE

1	MLI model code digit 20 is 1, 2, or 7
2	MLI model code digit 20 is 3, 4, 5 or 6
3	MLI model code digit 20 is A, B, C, or D
4	MLI model code digit 20 is E, F, G, H, or J
5	MLI is a Top Mount design
N	No clamps required (for use with switch mount rod)

7 MOUNTING STYLE

C	Clamp mounted on MLI (standard)
P	Clamp mounted on MLI with insulation pad
R	Attached to switch mount rod

Model: OES



Physical Dimensions

ORS 1-Amp SPDT Point Level Switch

O	R	S	—				—	0	0	1
1	2	3	4	5	6	7	8	9	10	

The **Model ORS** reed switch is available to augment the control capabilities of Orion's extensive line of magnetic level indicators. Housed in an explosion proof enclosure, the ORS mounts to the outside of the MLI via clamps. This mounting style allows addition or repositioning of switches at any time, without disruption of the process.

see Orion bulletin ORS-300 for more information

4 ENCLOSURE

1	Standard stainless body without junction box
A	Option 1 with cast aluminum junction box
S	Option 1 with stainless steel junction box

5 AGENCY APPROVAL

1	FM / CSA
A	ATEX

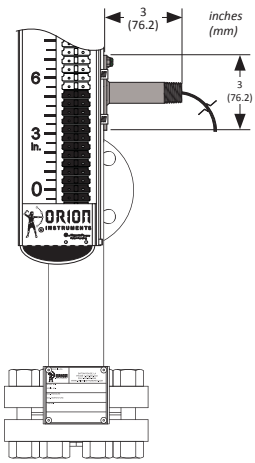
6 CHAMBER MOUNTING CODE

1	MLI model code digit 20 is 1, 2, or 7
2	MLI model code digit 20 is 3, 4, 5 or 6
3	MLI model code digit 20 is A, B, C, or D
4	MLI model code digit 20 is E, F, G, H, or J
5	MLI is a Top Mount design
N	No clamps required (for use with switch mount rod)

7 MOUNTING STYLE

C	Clamp mounted on MLI (standard)
P	Clamp mounted on MLI with insulation pad
R	Attached to switch mount rod

Model: ORS
(shown with optional aluminum junction box)



Physical Dimensions

OCT Reed Chain Transmitter

O	C	T							
1	2	3	4	5	6	7	8	9	10

The **OCT** analog transmitter mounts directly to the side of the Atlas, Aurora or Gemini chamber, and provides a continuous 4–20 mA output signal proportional to liquid level. Using simple and reliable reed switches surface mounted to a printed circuit board, the unit provides level accuracy of ±0.50" (13 mm). Activated by the field of the float magnets, the transmitter is totally non-invasive and designed for years of maintenance free service.

see Orion bulletin OCT-400 for more information

4 ENCLOSURE

A	Cast Aluminum
S	Stainless Steel

5 ENCLOSURE MOUNTING POSITION

T	Top mounted
B	Bottom mounted

6 CHAMBER MOUNTING CODE

No insulation present on MLI	
1	MLI model code digit 20 is 1, 2, or 7
2	MLI model code digit 20 is 3, 4, 5 or 6
3	MLI model code digit 20 is A, B, C, or D
4	MLI model code digit 20 is E, F, G, H, or J
5	¾" (for Atlas top mount configuration only)

High-temp insulation on MLI	
E	MLI model code digit 20 is 1, 2, or 7
F	MLI model code digit 20 is 3, 4, 5 or 6
G	MLI model code digit 20 is A, B, C, or D
H	MLI model code digit 20 is E, F, G, H, or J
J	¾" (for Atlas top mount configuration only)

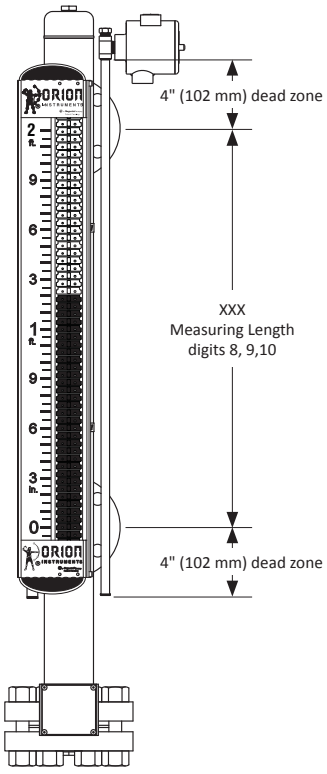
7 UNIT OF MEASURE

E	Measuring length specified in inches
M	Measuring length specified in centimeters

8, 9, 10 MEASURING LENGTH

XXX	6" to 198" (15 cm to 503 cm)
	same as MLI center-to-center dimension

Model: OCT
(shown with optional stainless steel enclosure)



Probe dimensions

Field Service and Commissioning Support

Orion is equipped with a support network that stretches across the globe. We can provide on-site field service support, as well as remote technical assistance via phone or e-mail.

Although all Orion products are tested, calibrated, and configured at the factory, the presence of an expert field service technician during the commissioning of your new instrumentation can provide the added insurance that everything is set up specifically for each individual application.

For more information on our support services, please contact us.

An Orion technician operates PACT*ware* on a drilling rig

orionxpress shipment program

Orion Instruments is dedicated to reducing product lead times through ongoing efficiency initiatives and strategic inventory management. *OrionXpress* is available for select product configurations and will allow your product to ship within 3 weeks of placing the order.

Look for the blue shaded options throughout the model number: E Example

some restrictions apply

ORION INSTRUMENTS

2105 Oak Villa Boulevard • Baton Rouge, Louisiana 70815 • 225-906-2343 • Toll Free 866-55-ORION (866-556-7466) • Fax 225-906-2344 • www.orioninstruments.com

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BULLETIN: ORI-138.4
EFFECTIVE: JULY 2012

LTM IntelliGage™ Series Magnetostrictive Level Transmitters

LTM-350 IntelliGage™

Next-Generation Design

Magtech introduces the world's smartest magnetostrictive level transmitter – the LTM-350. The LTM-350 series has a similar look and feel to the second generation model LTM-300, but is packed with many innovative enhancements – from HART 7 to error preventive configuration.

In addition, the LTM-350 features modular electronics and multiple output options, including 4/20 mA, HART 7 and wireless HART. The LTM 350 may be externally mounted to any Magtech LG Series magnetic gauge, or used as a direct insertion level probe. This feature-packed instrument is the perfect solution to many of the industry's most difficult level measurement applications.

Features

- Dynamic RoC filter
- Simple configuration
- Auto detect configuration errors
- Power optimization software
- Factory set threshold – fit and forget
- Outputs include 4-20mA, HART 7
- LTM-350/250 Series has field-reversible mounting

Magtech

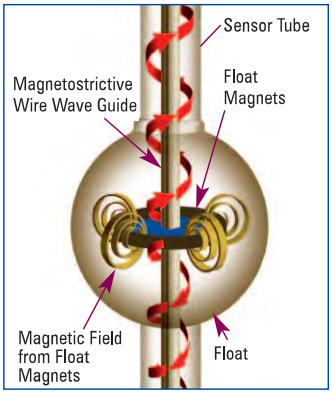
Description

Magtech's LTM Series magnetostrictive level transmitters offer highly accurate and precise liquid level measurement with a variety of configuration options. The LTM may be utilized as a direct insertion transmitter or externally mounted to a magnetic level gauge for non-invasive level control.

The LTM sensor probe with magnetic float(s) is inserted directly into a tank. As the float rises or falls with the fluid, the transmitter provides level output. LTM transmitters are available with two-wire loop powered 4-20 mA signal output and HART.

LTM Series level transmitter operation is based on the principle of magnetostrictive technology. To explain briefly, the sensor consists of an alloy wire with specific magnetic characteristics called the *wave guide*. The wave guide is housed within a stainless steel tube, creating the probe assembly. The transmitter electronically generates a high current pulse which is transmitted down the wave guide, producing a circular magnetic field as it travels down the wire. Another magnetic field is generated on the wave guide by the permanent magnet in the float along the length of the probe. When the pulse field interferes with the float magnetic field, a torsional force is produced, twisting the wire and producing a torsional wave. The time of flight of the torsional wave is measured and the distance to the float magnet is easily calculated.

Other configurations include remote-mount electronics for easy access or high temperature and vibration applications. Sensor probes are available in a variety of materials including stainless steel and exotic alloys (Monel, Hastelloy, etc.). Sensor probes may also be electropolished for sanitary applications. All LTM transmitters feature explosion-proof, dual compartment enclosures with integral displays.



Magnetostrictive Principle

The "plug-and-play" electronics allow easy upgrades without replacing the sensor probe. LTM transmitters offer the latest and most advanced software features on the market, introducing the only registered HART DD compliant to IEC 61804-2 and compliance certified to HART 7.

Industries

- Marine
- Coatings
- Oil and Gas
- Petrochemicals
- Pharmaceutical
- Power Industries
- Food and Beverage
- Water/Wastewater

Applications

- Position Sensing
- Sanitary Service
- Valve Positioning
- Inventory Control
- Corrosive Process
- Batching Processes
- Underground Tanks
- Primary Level/ Interface
- Process Temperature and Level

Redundancy Radar Packages

LTM IntelliGage™ Transmitter Options

HART REGISTERED

AMS Suite

LTM 350 (4/20mA) (HART)

LTM 250 (4/20mA)

Advantages

RoC filter
- Integral filter to suppress noise
- Ignores momentary external noise

Simple 4/20 mA configuration and reranging
- Simply change LRV or URV in units
- No recalibration required

Field-reversible mounting
- Gauge mount units are convertible to bottom mount or top mount with a few simple steps

One point calibration
- Unit may be calibrated by using one reference point; process shutdown not required

Error-proof calibration
- Auto-detects calibration errors

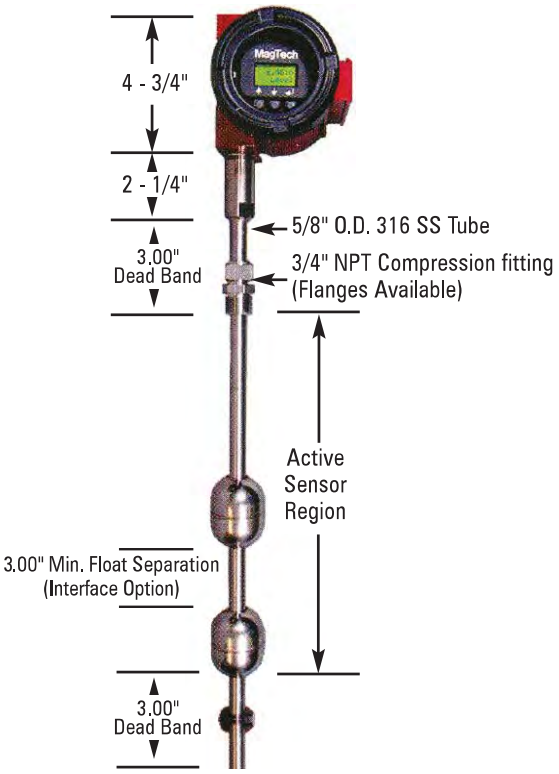
Factory default settings
- Reverts back to factory settings
- Holds three additional configurations

Electronic Specifications

Supply Voltage	13 to 36 VDC
Repeatability	.005% of full scale or .010 in., whichever is greater
Non-Linearity	.01% of full scale or .030 in., whichever is greater
Level Sensor Accuracy	.01% of full scale or .030 in., whichever is greater
Analog Output	(1) 4/20 mA primary level
Resolution	.025% of full scale
Output	Primary level, (1) 4/20 mA optional digital outputs via HART for temperature or interface detection
Calibration	Zero and span field adjustable with push buttons, HART and AMS
Advanced Diagnostics	With HART or AMS for troubleshooting
Dampening	1 to 25 seconds (field adjustable via DISPLAY)
Operating Temperature (electronics)	-58 to 185° F (-50°C to 85°C)
Housing	Explosion proof, dual compartment, 1/2-in NPT, epoxy coated aluminum; stainless steel optional
Polarity Protection	Diode in series with the loop
Humidity Limits	SAMA PMC 31.1-5.2
Vibration Limits	SAMA PMC 31.1-5.3
RFI Limits	SAMA PMC 31.1-20 to 1,000 MHz up to 30V/m

Transmitter Sensor Tube

Material	316 ss standard, optional Hastelloy, Monel, Kynar sleeve
Operating Temperature	Gauge type up to 750° F (399° C) Insertion type -50 to 300° F (-45 to 149° C)
Max. Pressure	2000 psig @ 300° F
Range	12 in. to 30 ft.



LTM IntelliGage™ Approvals

Approvals	LTM-250	LTM-350
CSA-US EXP	Class I, Div. I and II; Groups B,C,D Class II, Div. I; Groups E,F,G Class III, NEMA 4X, NEMA 7, IP66	Class I, Div. I and II; Groups B,C,D Class II, Div. I; Groups E,F,G Class III, NEMA 4X, NEMA 7, IP66

Top-mounted LTM–SST Model Transmitter on LG Series Magnetic Gauge

Bottom-mounted LTM–SST Model Transmitter on LG Series Magnetic Gauge

Remote-mounted LTM–SST Model Transmitter for High-temperature Applications

LTM IntelliGage™ Order Information

Insertion Type

Model # (Example): **LTM 350S – 3 – 3 – 0.64 – 150F – 300 – 30.00 – RM10**

- 250 Single Output Analog, Alum. Housing
- 251 Single Output Analog, SST Housing
- 350 HART* (3 Variables), Alum. Housing
- 351 HART* (3 Variables), SST Housing

Probe Material
- 3 = 316 SS
- K = Kynar Sleeve
- O = Other (Specify)

Mounting Connection
- 3 = 3/4" NPT (Standard)
- O = Other (Specify)

Min. Oper. S.G.

Max. Oper. Temp.

(°F or °C)

Max. Oper. Press. (psig)

Measuring Length (in inches, 2 decimal places)

Options
- * Temp = Temp output (Digital)
- * Dual = Dual Level Outputs
- INT = Interface (Specify both S.G.'s)
- SW = Stilling Well (Specify size; **Required over 10 Ft**)
- 3A = 3A Sanitary Application
- RM = Remote Electronics (Specify cable length, in ft.)

*Available on LTM 350 HART version only
All units are CSA-US approved standard

Gauge Mount *(Gauge dimensions may vary)*

Model # (Example): **LTM 250G – 30.00 – RM10**

- 250 Single Output Analog, Alum. Housing
- 251 Single Output Analog, SST Housing
- 350 HART* (3 Variables), Alum. Housing
- 351 HART* (3 Variables), SST Housing

Measuring Length

Options
- RM = Remote Mount Electronics (Specify cable length, in ft.) (Mounting elbow standard)

All transmitters ≥10 ft are supplied with rigid tube-in-tube design

LTM 300/200D Series Transmitter Options

4/20mA

4/20mA
HART

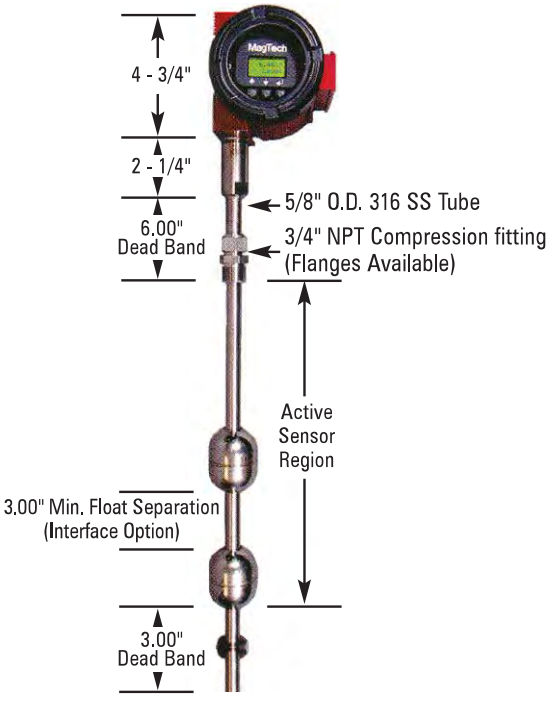
Foundation
Fieldbus

Model	LTM200D	LTM300	LTM300FF
Supply Voltage	15 to 36 VDC (loop)	15-36VDC (loop)	Bus powered
Repeatability	0.005% of range or .030 in., whichever is greater		
Non-Linearity	.01% of full scale or .030 in., whichever is greater		
Level Sensor Accuracy	0.01% of range or .030 in., whichever is greater		
Output Options	Single Analog (4-20mA) (Primary or Interface)	Up to 3 outputs Primary, Interface level & temperature (1 analog 4-20mA, 2 digital)	Up to 3 outputs Primary, Interface level & temperature (All digital)
Calibration/Configuration	Pushbutton	HART/pushbutton	Host/pushbutton
Housing:			
Description/Material	Dual compartment, aluminum, epoxy coated enclosure with glass window (optional stainless steel housing)		
Protection Rating	NEMA 4X, NEMA 7, IP 66		
Sensor Probe:			
Material	316 SS, 5/8" probe (standard), other materials available		
Maximum Length	30 ft (914.4 cm)		
Mounting Style	3/4" MNPT compression fitting, Insertion type (flanges available) Non-invasive mount optional		
Operating Temperature	Insertion type -50 to 300° F (-45 to 149° C) Gauge type up to 750° F (399° C)		

*Note: All transmitters feature a standard digital display

Features

- The only Magneto with registered DD's for HART and Foundation Fieldbus to IEC-61804-2
- HART (Rev. 5.0), FF (ITK 4.6), AMS Aware
- Sensor trim from anywhere in the loop with HART
- Measure level, interface and temperature simultaneously
- User-friendly setup via self-prompting menus
- Continuous monitoring of instrument health via HART
- Ideal for high-temperature/high-pressure, corrosive or dirty service



Fieldbus Option

The LTM-300FF is available with Foundation Fieldbus compliant electronics (ITK-4.6), allowing a wide range of interoperability with host manufacturers. There is no PID control in the function block, keeping control in the final control element (pump, valve, etc.) where it belongs. In addition, there is no Link Active Scheduler (LAS), eliminating interference in execution or response time. The LTM-300FF offers a unique configuration method, guiding the user step-by-step through the calibration process. Setup and maintenance are quick and easy. The LTM-300FF is explosion proof and carries CSA, ATEX and IECEx approvals (see LTM Series Transmitter Options) for use in hazardous locations.

LTM Order Information

Insertion Type

LTM 300 – 3 – 3 – 0.64 – 150F – 300 – 30.00 – RM10

Model # (Example):
- 200D
- 201D, SST Housing
- 300
- 301, SST Housing
- 300FF
- 301FF, SST Housing

Probe Material
- 3 = 316 SS
- TFE = Teflon
- KYN = Kynar
- O = Other (Specify)

Mounting Connection
- 3 = 3/4" NPT (Standard)
- O = Other (Specify)

Min. Oper. S.G.

Max. Oper. Temp. (°F or °C)

Max. Oper. Press. (psig)

Measuring Length (in inches, 2 decimal places)

Options
- * Temp = Temp output (Digital)
- * Dual = Dual Level Outputs (LTM-300 Only)
- INT = Interface (Specify both S.G.'s)
- SW = Stilling Well (Specify size; **Required over 10 Ft)**
- 3A = 3A Sanitary Application
- RM = Remote Electronics (Specify cable length, in ft.)
- A = Atex Approval
- I = IEC Approval

*Available on LTM 300 & LTM 300 FF only
All units are CSA-US approved, standard

Gauge Mount *(Gauge dimensions may vary)*

LTM200D - 30.00 - RM10

Model # (Example):
- 200D
- 201D, SST Housing
- 300
- 301, SST Housing
- 300FF
- 301FF, SST Housing

Measuring Length

Options
- RM = Remote Mount Electronics (Specify cable length, in ft.)
- A = Atex Approval
- ELB = Elbow mounted electronics
- FM = Factory Mutual

All transmitters ≥10 ft are supplied with rigid tube-in-tube design

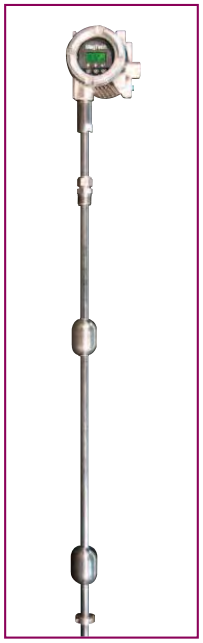
LTM 300/200D Description and Approvals

Approvals	LTM-200D	LTM-300	LTM-300FF
FM-Exp	Class I, Div. I and II; Groups B,C,D Class II, Div.I and II; Groups E,F,G Class III, NEMA 4X, NEMA 7, IP66	Class I, Div. I and II; Groups B,C,D Class II, Div.I and II; Groups E,F,G Class III, NEMA 4X, NEMA 7, IP66	
CSA-US EXP	Class I, Div. I and II; Groups B,C,D Class II, Div.I and II; Groups E,F,G Class III, NEMA 4X, NEMA 7, IP66	Class I, Div. I and II; Groups B,C,D Class II, Div.I and II; Groups E,F,G Class III, NEMA 4X, NEMA 7, IP66	Class I, Div. I and II; Groups B,C,D Class II, Div.I and II; Groups E,F,G Class III, NEMA 4X, NEMA 7, IP66
CSA-IS	Class I, Div. I and II; Groups C,D	Class I, Div. I and II; Groups C,D	
ATEX-Exp 0344		II 2 G EEx d IIC T4	II 2 G EEx d IIC T4
IECEx-Exp		Ex d IIC T4	Ex d IIC T4

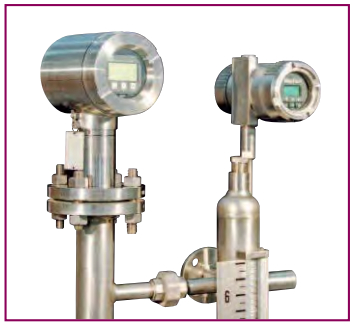
Top-mounted LTM Transmitter on LG Series Magnetic Gauge

Bottom-mounted LTM Transmitter on LG Series Magnetic Gauge

Remote-mounted LTM Transmitter for High-temperature Applications



Stainless Steel Dual Level Transmitter



Stainless Steel Redundancy Package Designed for Severe Offshore Service

Battery Powered Wireless Magnetostrictive Transmitter

Process Indicators & More

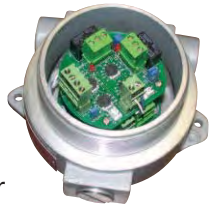
LT-6678-4, Quad Alarm

The LT-6678 is a quad relay output alarm system. When the process variable crosses a set point, a SPDT relay is energized and its respective LED located on the front panel is illuminated. Field adjustable set points and Hysteresis are provided.

This quad alarm system can be housed in a NEMA-4X or explosion-proof housing.

Input: *4/20 mA*
Output: *4 relays SPDT*
Power: *24VDC or 117/220 Vac*

ISE-042 Dual Alarm



The ISE-042 is a general-purpose dual alarm. It can accept inputs from a variety of signal sources, including millivolt, voltage or mA.

The comparator stage has single-turn dial set point adjustments for Alarm 1 and Alarm 2, along with Hysteresis adjustments for each set point.

Output: *2 SPDT 5A relays*
Power: *24VDC or 117/220 VAC*

ISE-6902A

The 6902A is used as a field mounted local indicator showing the contents of a tank on six bright red, seven-segment LED's. Optional features include HI/LO alarm relays (used for annunciation or level control), isolated mA output, level, volume (requires strapping table) and mass.

Housings: *NEMA 4X or explosion proof (NEMA 7).*
Power: *117/220 VAC*

Wireless Adapters & Gateways

Magtech wireless adapters and gateways provide add-on infrastructure to level transmitters and switches to allow wireless operation. Gateways can be configured to support a variety Fieldbus protocols, including Wireless HART, Modbus TCP and Profibus DP-V1. Communication from the gateway to the host uses standard ethernet. For remote applications requiring long-range wireless host connectivity, GPRS modem support is available.

Wireless field instrument adapters can be battery operated or line powered. They communicate with the gateway using reliable and secure 2.4GHz mesh-networking protocols and support integration with 4-20mA instruments or intelligent HART instruments. Up to 32 instruments can be supported per gateway.

Wireless Adapter

Magtech is a value-added manufacturer of support instruments for flow, pressure and level processes without manufacturing the process sensors themselves.

Magtech
3902 Magnolia Road · Pearland, Texas 77584
Tel: 281.488.0788 · Fax: 281.488.7080
E-mail: sales@isemagtech.com
www.isemagtech.com

L13001 2M0710


ORION
INSTRUMENTS
A Magnetrol Company
A New Generation in
Magnetic Level Indication

2.

The Next Generation of MLIs: It took a whole new company to bring it to you.

Orion Instruments® was created with one objective: to devise new standards for quality and operability in Magnetic Level Indicators (MLI).

As a wholly owned subsidiary of Magnetrol International, Incorporated®, ORION INSTRUMENTS products are engineered under the same strict unyielding standards as those of Magnetrol®—a company whose level and flow control products are known worldwide.

Recognizing the need for a world class producer of MLIs, MAGNETROL created a completely new company built upon its experience in level instrumentation dating back to 1932. With operations in Baton Rouge, Louisiana—the very heart of North America's petrochemical industry—ORION INSTRUMENTS is well positioned to provide outstanding service to its customers.

Organized into four technology groups, ORION INSTRUMENTS products combine market-tested MLI design principles with advanced level sensing technology. The result is destined to create new standards for MLIs and the process control industry.

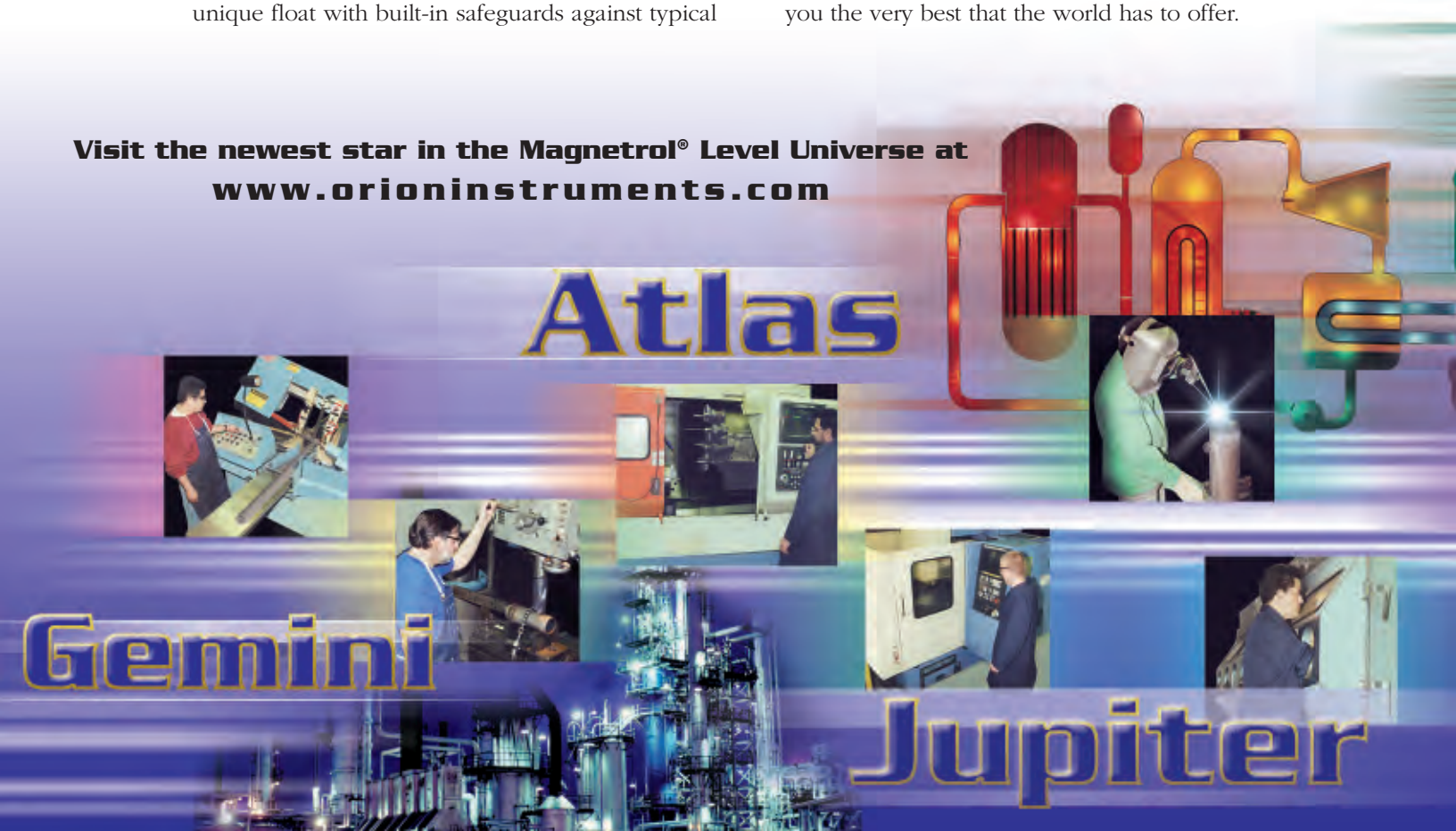
At the heart of every ORION INSTRUMENTS MLI is a unique float with built-in safeguards against typical MLI float limitations. Aurora® and Gemini® MLIs fuse Magnetic Level Indication with MAGNETROL Eclipse® Guided Wave Radar to extend the parameters of gauge design into a revolutionary instrument with redundant level sensing capabilities.

Our product line has also been structured to offer customers the broadest range of options assuring each ORION INSTRUMENTS MLI is engineered to meet the exact measurement and control needs of your process. This includes your requests for special designs, materials of construction, dimensions, and accessories.

Our manufacturing facility is structured for the production and supply of defect-free products of unparalleled quality. We're further dedicated to providing you with total support services for as long as your ORION INSTRUMENTS MLI is in service.

ORION INSTRUMENTS MLIs are designed specifically for the most demanding challenges in level measurement and control. When you're looking for enhanced operability in a Magnetic Level Indicator, see your ORION INSTRUMENTS Representative. We'll show you the very best that the world has to offer.

Visit the newest star in the Magnetrol® Level Universe at
www.orioninstruments.com



Principle of Operation:

The ORION INSTRUMENTS **Magnetic Level Indicator** (MLI) is connected to a process vessel. Within the piping column ❶ of the MLI is a float ❷ containing an internal group of magnets. A rise or fall of the fluid in the process tank corresponds to a similar change within the piping column. In response to the level movement the float moves up or down accordingly.

Clamped to the piping column in total isolation from the process liquid is a visual indicator housing. It contains the choice of indicator, either a series of flags ❸ or a follower ❹.

The individual flags or the follower contain an alignment magnet which couples with the float magnets as the float moves up or down within the piping column. Float movement rotates the flags and changes their color—or in the case of the follower— moves it to the point of level.

The position of the follower or the point at which the flags change color represents true level. Level is indicated or “read” by the corresponding point on the measuring scale. ■

4.

Product Overview

SIL 2

HART COMMUNICATION PROTOCOL

AMS aware

Fieldbus Foundation

PACTware

FDT Group Certified

Aurora®

- Patented design combines Guided Wave Radar and MLI technology into a truly redundant system.
- Application-proven ECLIPSE Guided Wave Radar technology.
- AURORA chamber houses both the probe for MAGNETROL ECLIPSE Guided Wave Radar transmitter and the float. The instrument transmits level data accurately and reliably.
- Baffle plate design provides flawless guide for float.

Atlas™

- For the most demanding high pressure/temperature liquid level applications. Ideal replacement for sight and gauge glass instruments.
- Wide range of materials available includes 304/304L SS, 316/316L SS, Inconel®, Hastelloy®, Alloy 20, PVC, CPVC, Kynar® and many others.
- Broad range of pressure classes, process connections, styles and sizes. Top and bottom float stop springs are standard.
- Options include flag-type or shuttle indicator, switches and transmitters, blankets, steam or electric heat tracing, and frost extensions.

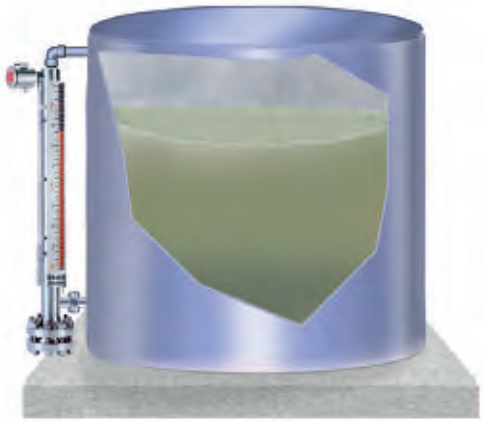
Tank Configurations

ORION INSTRUMENTS MLIs are applicable to a wide range of tank types, media, and services. Atlas™ is designed for side and top mounting. GEMINI and AURORA units are designed for side mounting on vertical, horizontal or spherical vessels. Either level or continuous interface (or both) measurement is available.

Type:
Side Mount

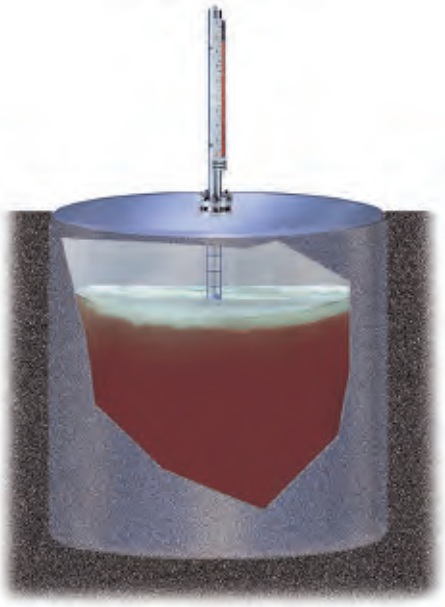
Media:
Sodium Hypochlorite

Accessory:
Continuous Transmitter



Type:
Top Mount

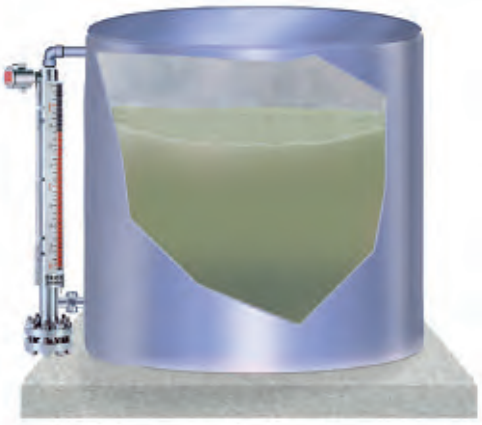
Media:
Chemical Waste Tank



Type:
Top In, Bottom Out

Media:
Liquid Nitrogen

Accessory:
Cryogenic Services Accessories



Gemini™

- Twin chamber design for use on applications where redundant measurement is critical. GEMINI features two separate technologies.
- Either ECLIPSE guided wave radar, Jupiter® magnetostrictive, capacitance, or displacer transmitters may be installed in the secondary chamber.
- Add electric or pneumatic switches for high, low, or high and low level.
- Perfect solution for precision visual measurement and a highly reliable method for transmitting level data to a remote display, analog input point or controller.

Enhanced Jupiter®

- A JUPITER transmitter utilizes market-tested, application-proven, magnetostrictive technology.
- Reliable technology senses liquid level, interface level, or both.
- JUPITER mounts to the side of the MLI gauge or directly into the secondary chamber or process vessel.
- Provides a 4–20 mA process signal proportional to level.
- HART® communications protocol is standard—FOUNDATION fieldbus™ is an available option.
- Transmitter on externally mounted versions may be top or bottom mounted.

SIL 2

HART COMMUNICATION PROTOCOL

AMS aware™

Fieldbus Foundation

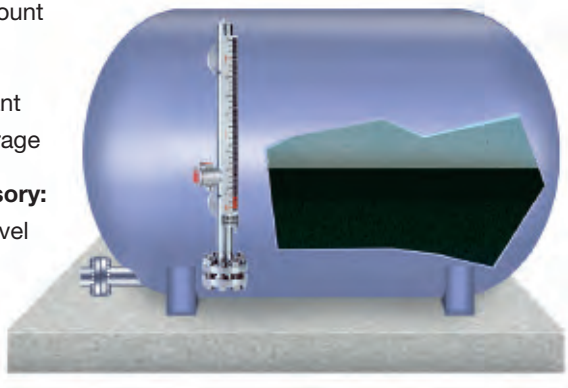
FACTORY

FDT Group Certified

Type:
Side Mount

Media:
Lubricant
Oil Storage

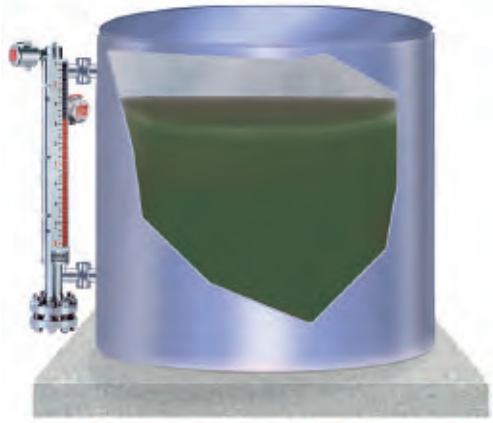
Accessory:
Low Level
Switch



Type:
Side Mount

Media:
Hydrochloric
Acid Storage

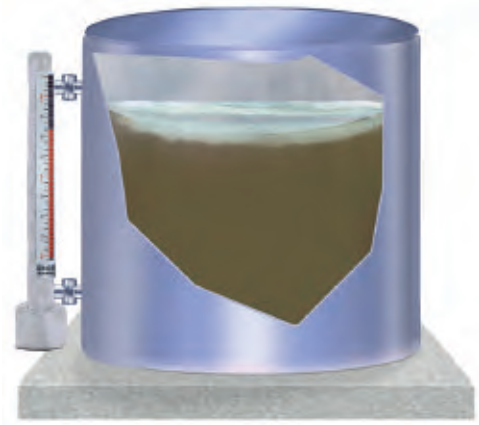
Accessory:
High Level
Switch &
Continuous
Transmitter



Type:
Side Mount

Media:
Sodium
Hydroxide

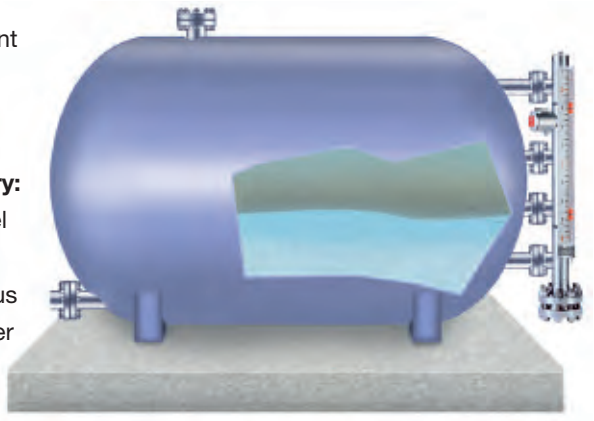
Accessory:
Chamber
Blanket



Type:
Side Mount

Media:
Interface

Accessory:
High Level
Switch &
Continuous
Transmitter



6.

Design Attributes: Basic Gauge

Basic Gauge Construction

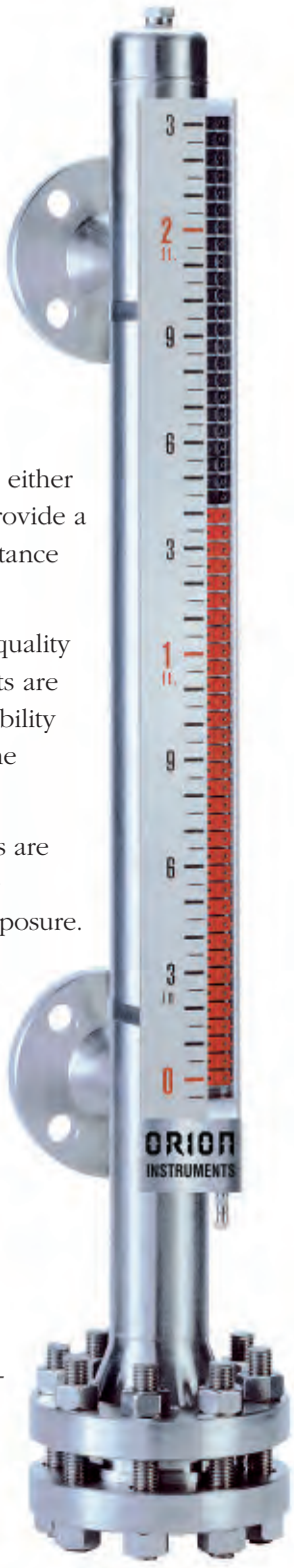
- ASME B31.1 and B31.3 construction available.
- 100% full penetration X-ray quality welds are standard.
- NACE compliance available.
- CMTRs are available upon request.
- **All** ORION INSTRUMENTS MLIs, including the float, are hydro tested prior to shipment.
- CRN compliance available.
- PED compliance available

Visual Indication

- ORION INSTRUMENTS MLIs are available with either a flag assembly or a shuttle unit designed to provide a visual representation of level visible from a distance of 100 feet.
- Flag version is manufactured with the highest quality components. Flags are all metal; no plastic parts are used. Three different combinations of high-visibility fluorescent colors are available and enhance the indicator's readability.
- All ORION INSTRUMENTS MLI scale assemblies are purged with an inert gas to prevent condensate buildup and discol-oration due to direct sun exposure.
- Glass flag chamber is sealed with our Insta-seal™ valve method. We are the only MLI manufacturer utilizing this technique.
- Vibration resistant flag indicator optional.

Process Connections

- ORION INSTRUMENTS will engineer and design any process connections, configurations and special alloy materials. Our goal is to ensure that the exact design and material requirements are fulfilled.
- Side-bottom and top-side process connections are available upon request.



Quality Warranty

ORION INSTRUMENTS warrants all MLIs to be free of defects in materials and workmanship for a period of **FIVE YEARS** after date of shipment. All electronics and indicators are similarly warranted for a period of one year. ■

Measurement Scales

- Standard scales are manufactured in stainless steel with etched and epoxy filled numbers and graduations. Plastic scales are available upon request.
- English or Metric units available and in stock.
- Custom volumetric or percentage scales available upon request.

Switches & Transmitters

- ORION INSTRUMENTS offers the broadest range of switches and transmitters available.
- Customers can specify either reed, snap action, or pneumatic switches for high, low, or high/low level control as well as a dependable analog transmitter for continuous level measurement.
- For applications requiring higher accuracy, the JUPITER magnetostrictive transmitter is available to provide an output with an accuracy of ±1 mm.
- For applications requiring redundancy, and transmitters with no moving parts, the ECLIPSE Guided Wave Radar transmitter is the ideal choice. See AURORA or GEMINI models.

The Orion Float

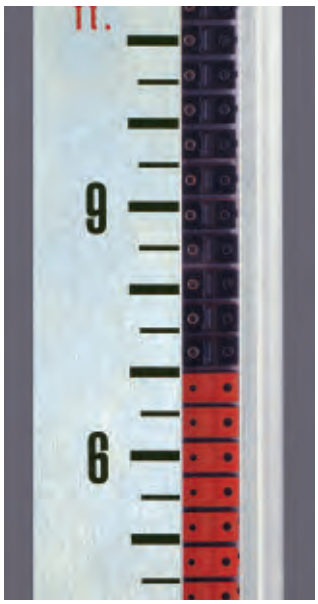
The ORION INSTRUMENTS float has been engineered to provide the best MLI performance in the world.

Float Features

- Magnetic retainer and flux ring assembly within the float ensures top performance regardless of process conditions.
- The 360-degree vertical placement of the magnets assures proper coupling with the flag or shuttle of the indicator, even as the float turns within the chamber.
- The magnetic assembly creates a constant Gauss rating optimized to ensure reliable performance.
- Float magnets are designed to function at temperatures up to +1000° F (+538° C) for many years of reliable service.
- Special float alloys that are available include Titanium, Hastelloy® C-276, Monel®, Inconel®, Alloy 20, and durable plastics. Consult factory for availability of additional materials.

MLI Indicator Options

- **Flag Assembly** operation is smooth and reliable. Magnetic coupling between the flags ensures "true level" indication even during violent surging or upset conditions within a process vessel.
- **Shuttle** provides an optional visual indicator suitable for most applications except where flashing or extreme turbulence exists. The standard shuttle is fluorescent orange.
- **Flag Color Combinations** include either orange/black, yellow/black, or red/white.
- **Magnetic** traps are available, per customer specification, for removal of ferrous (magnetic) particles which might interfere with float function.



Flag Type

Shuttle Type

8.

SIL 2

ORION Aurora

Combining MAGNETROL ECLIPSE Guided Wave Radar with an ORION INSTRUMENTS Magnetic Level Indicator represents Level Measurement's leading-edge.

Operating Principle

The ORION INSTRUMENTS AURORA combines the operating system of a conventional float-based MLI with the leading-edge Guided Wave Radar transmitter developed for level measurement applications by MAGNETROL INTERNATIONAL. The result is ***true level measurement redundancy*** in a single-chamber design.

Guided Wave Radar combines micropower impulse radar, time domain reflectometry and equivalent time sampling to detect level. Since the signal is carried within the waveguide, process conditions which hamper other measurement technologies have virtually no effect on ECLIPSE.

Features

- Single-chamber redundancy in a compact, precision fabricated chamber.
- An ECLIPSE coaxial type probe is mounted off center within the chamber unimpeded by the probe, permitting the float to rise and fall as level changes. True Level Measurement Redundancy results.
- ECLIPSE is all electronic with no moving parts to wear or deteriorate. Requires no calibration or change in level to set up.
- Because Guided Wave Radar technology measures actual product it is not influenced by process conditions that affect thru-air units.
- Ideal for low specific gravity applications and low-dielectric media such as propane, butane, and hexane.
- HART and FOUNDATION fieldbus™ communications with local indication available.
- ECLIPSE is suitable for a broad media range and is not affected by changing dielectric or changing specific gravity.
- Unique baffle plate design provides flawless guide for float.

ORION ENHANCED Jupiter

With a JUPITER Magnetostrictive Transmitter, an ORION INSTRUMENTS MLI offers high accuracy and high linearity at a reasonable price.

External Mount JUPITER

SIL 2

Operating Principle

JUPITER utilizes a precision, loop-powered magnetostrictive transmitter. The magnetic field generated by the float interacts with the magnetostrictive wire to create a torsional twist in the wire. A sensitive piezo sensor then detects the return acoustic signal and determines the precise elapsed time from pulse generation to detection of the return signal. A sampling update of ten times per second ensures high-accuracy measurement.

Features

- Two-wire, 4–20 mA operation simplifies installation.
- Suitable for continuous level or interface applications.
- Offers excellent linearity, resolution and repeatability.
- External mounting to the chamber is simple and straightforward requiring only supplied clamps to attach the waveguide to the chamber.
- SIL 2 – HART version is suitable for SIL 2 loops:
  Safe Failure Fraction = 90.7%
- HART protocol standard, FOUNDATION fieldbus available as option.
- Liquid crystal display with push-button keypad configuration.
- External mount JUPITER is suitable for high-temperature applications since the waveguide is placed outside the insulation.
- Magnetostrictive technology is inherently highly reliable and more accurate than reed chain type transmitters.
- External mount transmitter enclosure may be mounted at the top or bottom of the chamber.
- Direct insertion JUPITER will provide accurate level tracking in a wide variety of process vessels.

Direct Insertion JUPITER

10.

Switches

Model OES-100

Electro-magnetic Switches

The Model OES-100 snap switch and Model ORS-300 reed switch may be utilized to expand the control capabilities of the ORION INSTRUMENTS extensive line of magnetic level indicators. These electro-magnetic switches are clamp-mounted to the outside of the MLI. This mounting style allows easy addition or repositioning of switches without disruption of the process.

Model ORS-300

Model OPS-200

Pneumatic Switch

The Model OPS-200 is a non-bleed pneumatic switch for use with the ORION INSTRUMENTS extensive line of magnetic level indicators. The OPS-200 utilizes a clamp-on mounting style for easy attachment to the outside of the MLI chamber.

Transmitters

Model OCT-400

Reed Chain Transmitter

The OCT-400 analog transmitter mounts directly to the side of the ATLAS or GEMINI chamber, providing a continuous 4–20 mA output signal proportional to liquid level. Using simple and reliable reed switches surface mounted to a printed circuit board, the unit provides level accuracy of ±0.50". Activated by the field of the float magnets, the transmitter is totally non-invasive and designed for years of maintenance free service.

Model 705

Guided Wave Radar Transmitter

MAGNETROL ECLIPSE Transmitters are loop-powered, 24 VDC, liquid level transmitters based upon the revolutionary Guided Wave Radar (GWR) technology.

These leading-edge transmitters are designed to provide measurement performance well beyond that of many traditional technologies.

ORION INSTRUMENTS has incorporated ECLIPSE into the advanced AURORA MLI to achieve true redundancy in level measurement.

Thermal Insulation Blankets

ORION INSTRUMENTS offers high-temperature and low-temperature blankets fabricated specifically for each application. These blankets include:

- Cryogenic insulation from +32° to -320° F (0° to -196° C) which is suitable for liquified gases and media that vaporize at ambient temperature, such as liquid natural gas and liquid petroleum gas.
- High-temperature insulation fabricated to specific customer requirements for product media that must be maintained at elevated temperatures up to +1000° F (+538° C).
- Steam tracing or electrical heat tracing with or without insulation blankets per customer requirements.

Frost Extension

ORION INSTRUMENTS offers custom designed frost extensions engineered to our customers' specifications.

ORION INSTRUMENTS frost extensions are hermetically sealed and engineered to prevent frost accumulation while ensuring the highest degree of readability for the user.

Frost extensions are manufactured from highly durable polymers.

ORION INSTRUMENTS
A Magnetrol Company

2105 Oak Villa Boulevard, Baton Rouge, LA 70815
Telephone: 225.906.2343
Toll Free: 866.55.Orion (866.556.7466)
Fax: 225.906.2344
E-mail: info@orioninstruments.com

Bulletin: ORI-100.4
Effective: December 2006
Supersedes: December 2003

Product Data Sheet
November 2014
00813-0100-4004, Rev KA

Rosemount 8800D Series Vortex Flowmeter

HART® and FOUNDATION™ fieldbus Protocols

- All welded, non-clog design provides maximum performance, reliability and enhanced safety by eliminating ports and gaskets. No seals, just steel.
- CriticalProcess™ Vortex eliminates bypass piping and optimizes safety during sensor health verification.
- Available with optional multivariable output. Internal temperature compensation provides cost-effective saturated steam mass flow measurement.
- Adaptive Digital Signal Processing (ADSP) provides vibration immunity and flow range optimization.
- Reducer™ Vortex extends the measurable flow range, reduces installation costs, and minimizes project risk.
- Simplified troubleshooting through device diagnostics and meter verification.
- Available in wafer, flanged, dual, reducer and high pressure designs.

The Rosemount 8800D delivers reliability and maximum process availability

- Rosemount Reliability -The 8800D Vortex eliminates impulse lines, ports, and gaskets to improve reliability.
- Non-clog Design - Unique all welded, gasket-free construction which has no ports or crevices that can clog.
- Vibration Immunity - Mass balancing of the sensor system, and Adaptive Digital Signal Processing (ADSP) provide vibration immunity.
- Replaceable Sensor - The sensor is isolated from the process and can be replaced without breaking the process seal. All line sizes use the same sensor design allowing a single spare to serve every meter.
- Simplified Troubleshooting - Device Diagnostics enable field verification of meter electronics and sensor without process shutdown.

The Rosemount 8800D offering

- The 8800D is available in wafer style meter bodies for $^1/_2$ through 8-in. line sizes, and ASME B16.5, EN 1092-1, or JIS B2220 flanged style meter bodies for $^1/_2$ through 12-in. line sizes.
- Alignment rings, provided with each wafer-style flowmeter, ensure that the meter body is properly centered with the adjacent piping.
- The wafer, flanged, and weld end style meter bodies are available in 316 stainless steel and nickel alloy materials of construction.
- Available up to ASME B16.5 class 1500 for 1 through 8-in. (25 mm through 200 mm) line sizes.

Available with FOUNDATION fieldbus functionality which includes Device Diagnostics and PlantWeb® Alerts.

Contents

The Rosemount 8800D CriticalProcess Vortex increases process availability and enhances overall safety

- Eliminate bypass piping for critical process installations
  Traditional vortex installations in critical applications include a bypass line to allow process fluid to be re-directed around the vortex flow meter during routine sensor maintenance. Rosemount's unique non-wetted sensor can be installed without bypass piping, even in the most difficult process environments.
- Improve process availability
  Eliminate the need to shut down the process during routine maintenance and meter verification.
- Enhances safety in hazardous process fluid applications
  A needle valve enables access to the sensor cavity to verify that no process fluid is present.
- Available in Flanged, Reducer, and Dual Vortex meter designs in 1 through 12 inch meter body sizes for ASME B16.5 flange connections. Available in 40 through 300 mm meter body sizes for EN 1092-1 and JIS B2220 flange connections.

The 8800DD Dual Sensor Vortex provides enhanced safety

½” through 4” design

6” through 12” design

- Safety Integrated Systems (SIS) - Ideal solution where redundant flow signals are required.
- Rosemount Reliability - Designed with same electronics, sensor, and meter body as the 8800D.
- Redundant Flow Measurement - The Dual Vortex meter is constructed of two complete vortex meters: sensor, electronics, and shedder bar. The 6- through 12-inch design leverages a single shedder bar for both sensors, maintaining redundancy while reducing the lay-length of the flowmeter body. The meters are flow calibrated to provide an accurate single flowmeter with two independent flow measurements.
- Available as flanged meter for $^{1}/_{2}$-in. through 12-in. stainless steel and nickel alloy materials of construction.

The Rosemount 8800D MultiVariable™ Vortex reduces installation costs, simplifies installation, and improves performance in saturated steam.

- MultiVariable Vortex Design
  Incorporates temperature sensor into the vortex meter using the shedder bar as a thermowell, which keeps the vortex and temperature sensors isolated from process for easy verification and replacement.
- Increased performance in Saturated Steam
  Performance in saturated steam is improved due to the fact that the electronics will be compensating for changes in the process temperature.
- Temperature Compensated Capability for Saturated Steam
  Calculates density from measured process temperature and uses the calculated density to provide a temperature compensated mass flow.
- Reduces Installed Costs
  MultiVariable Vortex eliminates the need for an external thermowell and temperature sensor.
- Available with Flanged and Reducer Vortex in 1 $^{1}/_{2}$ through 12 inch meter body sizes

- Available with Flow Computer for additional functionality.
  Integrating the MultiVariable Vortex with a pressure transmitter for full pressure and temperature compensation of superheated steam and various gases provides the following additional functionality:
  - Remote Communications
  - Heat Flow Calculations
  - Remote Totalization
  - Peak Demand Calculation
  - Data Logging Capabilities

See Product Data Sheet 00813-0100-4005 for more information on the Rosemount Flow Computer.

The Rosemount 8800D offers a wide range of wetted materials to accommodate the most demanding process applications.

Carbon steel

- Carbon steel vortex meters offer resistance against stress cracking and are available in both high (min temp 32 °F/0 °C) and low (min temp -40 °F/-40 °C) temperature carbon steel.
- Carbon Steel is available in a full range of offerings as A105N forged and WCB cast materials for high temperature and LF2 forged and LCC cast materials for low temperature applications.

Super duplex

- The UNS S32760 wrought and 6A cast super duplex stainless steel material allows for increased chloride corrosion resistance.
- The super duplex material properties allow for increased pressure class ratings up to class 900 for 10 in and 12 in line sizes.
- Super duplex is available as flanged and dual meters in 6-in. through 12-in. line sizes, 8-in. through 12-in. for reducer.

Also available in Stainless Steel and Nickel Alloy.

The Armored Remote cable allows for remote electronics mounting while protecting the cable, maximizing reliability, and eliminating the need for conduit in many installations.

- Improved protection against abrasion, impact, and moisture.
- Available in 10, 20, 33, 50, and 75 foot lengths.
- Two aluminum glands are provided to securely connect cable to transmitter and meter body.
- Available with stainless steel glands when ordered in conjunction with stainless steel electronics housing.

Rosemount 8800D Vortex Flowmeter with FOUNDATION fieldbus

The software for the 8800D Flowmeter with FOUNDATION fieldbus permits remote testing and configuration using any FOUNDATION fieldbus-compliant host, such as the DeltaV™ system from Emerson Process Management.

Transducer block

The transducer block calculates flow from sensor frequency. The calculation includes information about damping, shedding frequency, K-factor, process fluid, pipe ID, and diagnostics.

Resource block

The resource block contains physical transmitter information, including available memory, manufacturer identification, device type, software tag, and unique identification.

Backup Link Active Scheduler (LAS)

The transmitter is classified as a device link master. A device link master can function as an LAS if the current link master device fails or is removed from the segment.

The host or other configuration tool is used to download the schedule for the application to the link master device. In the absence of a primary link master, the transmitter will claim the LAS and provide permanent control for the H1 segment.

Diagnostics

The transmitter automatically performs continuous self-diagnostics. The user can perform on-line testing of the transmitter digital signal. Advanced simulation diagnostics are available. This enables remote verification of the electronics via a flow signal generator built into the electronics. The sensor strength value can be used to view the process flow signal and provide information regarding filter settings.

FOUNDATION fieldbus function blocks

Analog input

The AI function block processes the measurement and makes it available to other function blocks. The AI function block also allows filtering, alarming, and engineering unit changes.

The 8800D Flowmeter with FOUNDATION fieldbus comes with five AI function blocks. Two of the AI function blocks, flow and signal strength, come as standard. Three additional AI function blocks are available when the MTA option is selected: electronics temperature, process temperature, and process density. Note that process density is only available when the process fluid is configured as temperature compensated saturated steam, shown as TComp Sat Steam in the device.

Proportional/Integral/Derivative

The optional PID function block provides a sophisticated implementation of the universal PID algorithm. The PID function block features input for feed forward control, alarms on the process variable, and control deviation. The PID type (series or Instrument Society of America [ISA]) is user-selectable on the derivative filter.

Integrator

The standard integrator block is available for totalization of flow.

Arithmetic

The standard arithmetic block is available for various computations.

Setup

Basic setup requires connecting the transmitter to a fieldbus network or Field Communicator. The FOUNDATION fieldbus-compliant host will automatically establish communication with the device.

The Rosemount 8800D Flowmeter can be easily configured using the DeltaV system. User-configurable parameters include: tag, scaling and units, process fluid type, damping, fixed process density, pipe inside diameter (ID)(1), and fixed process temperature(1).

Tagging information can be entered into the transmitter to allow identification and a physical description. 32-character tags are provided for identification of the transmitter and each function block.

(1) *Process temperature and pipe ID have known effects on the K-factor. The 8800D software automatically accounts for these effects by compensating the K-factor.*

Ordering Information

Table 1. Rosemount 8800D Vortex Flowmeter

H **The Standard offering represents the most common options. The starred options (H) should be selected for best delivery.**

The Expanded offering is subject to additional delivery lead time.

Model	Product description	
8800D	Vortex Flowmeter	
Meter style		
F	Flanged style	H
W	Wafer style	H
R	Reducer Style (Flanged style only)	H
D	Dual-sensor style (Flanged style only)	
Line size		
005	1/2-in. (15 mm) (Not available for Rosemount 8800DR)	H
010	1-in. (25 mm)	H
015	1 1/2-in. (40 mm)	H
020	2-in. (50 mm)	H
030	3-in. (80 mm)	H
040	4-in. (100 mm)	H
060	6-in. (150 mm)	H
080	8-in. (200 mm)	H
100	10-in. (250mm)	
120	12-in. (300mm)	
Wetted materials		
S	316 wrought stainless and CF-3M cast stainless Note: Material of construction is 316/316L	H
H	UNS N06022 wrought Nickel Alloy; CW2M cast Nickel Alloy Note: See Table 2.	
C	A105 forged carbon steel and WCB cast carbon steel	
L	LF2 forged carbon steel and LCC cast carbon steel	
D(1)	UNS S32760 wrought duplex stainless steel and 6A cast duplex stainless steel	
Flange or alignment ring size		
A1	ASME B16.5 (ANSI) RF Class 150	H
A3	ASME B16.5 RF Class 300	H
K1	EN 1092-1 PN 16 (PN 10/16 for wafer style) Type B1	H
K3	EN 1092-1 PN 40 (PN 25/40 for wafer style) Type B1	H
A6	ASME B16.5 RF Class 600	
A7(2)	ASME B16.5 RF Class 900	
A8(3)	ASME B16.5 RF Class 1500	
B1(4)	ASME B16.5 RTJ Class 150 for flange-style only	

Table 1. Rosemount 8800D Vortex Flowmeter

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B3	ASME B16.5 RTJ Class 300 for flange-style only	
B6	ASME B16.5 RTJ Class 600 for flange-style only	
B7[(2)]	ASME B16.5 RTJ Class 900 for flange-style only	
B8[(3)]	ASME B16.5 RTJ Class 1500 for flange-style only	
C1	ASME B16.5 RF Class 150, smooth finish	
C3	ASME B16.5 RF Class 300, smooth finish	
C6	ASME B16.5 RF Class 600, smooth finish	
C7[(2)]	ASME B16.5 RF Class 900, smooth finish	
C8[(3)]	ASME B16.5 RF Class 1500, smooth finish	
K0	EN 1092-1 PN 10 Type B1	
K2	EN 1092-1 PN 25 Type B1	
K4	EN 1092-1 PN 63 Type B1	
K6	EN 1092-1 PN 100 Type B1	
K7[(2)]	EN 1092-1 PN 160 Type B1	
L0	EN 1092-1 PN 10 Type B2	
L1	EN 1092-1 PN 16 (PN 10/16 for wafer style) Type B2	
L2	EN 1092-1 PN 25 Type B2	
L3	EN 1092-1 PN 40 (PN 25/40 for wafer style) Type B2	
L4	EN 1092-1 PN 63 Type B2	
L6	EN 1092-1 PN 100 Type B2	
L7[(2)]	EN 1092-1 PN 160 Type B2	
M0	EN 1092-1 PN 10 Type D for flange style only	
M1	EN 1092-1 PN 16 Type D for flange style only	
M2	EN 1092-1 PN 25 Type D for flange style only	
M3	EN 1092-1 PN 40 Type D for flange style only	
M4	EN 1092-1 PN 63 Type D for flange style only	
M6	EN 1092-1 PN 100 Type D for flange style only	
M7[(2)]	EN 1092-1 PN 160 Type D for flange style only	
J1	JIS 10K	
J2	JIS 20K	
J4	JIS 40K	
W1[(5)]	Weld End, Schedule 10S	
W4[(5)]	Weld End, Schedule 40S	
W8[(5)]	Weld End, Schedule 80S	
W9[(4)(5)]	Weld End, Schedule 160S	

Table 1. Rosemount 8800D Vortex Flowmeter

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The Expanded offering is subject to additional delivery lead time.

Sensor process temperature range		
N	Standard: -40 to 450°F (-40 to 232°C)	H
E	Extended: -330 to 800°F (-200 to 427°C)	H
S	Severe Service: -330 to 800 °F (-200 to 427 °C)	
Conduit entry		
1	1/2 -14 NPT – Aluminum Housing	H
2	M20 x 1.5 – Aluminum Housing	H
3	PG 13.5 – Aluminum Housing	H
4	G1/2 (One Conduit Entry) – Aluminum Housing	H
5	G1/2 (Two Conduit Entries) – Aluminum Housing	H
6(6)	1/2 - 14 NPT - SST Housing	
7(6)	M20 x 1.5 - SST Housing	
Outputs		
D	4-20 mA digital electronics (HART protocol)	H
P	4-20 mA digital electronics (HART protocol) with scaled pulse	H
F	FOUNDATION fieldbus digital signal	H
Calibration		
1	Flow calibration	H

Options

Multivariable options		
MTA(7)	MultiVariable output with Integral Temperature Sensor	
Hazardous locations certifications		
E5	FM Explosion-proof; Dust Ignition-proof	H
I5	FM Intrinsically Safe; Non-incendive	H
IE(8)	FM FISCO Intrinsically Safe	H
K5	FM Explosion-proof; Intrinsically Safe; Non-incendive; Dust Ignition-proof	H
E6	CSA Explosion-proof; Division 2 Dust Ignition-proof	H
I6	CSA Intrinsically Safe	H
IF(8)	CSA FISCO Intrinsically Safe	H
K6	CSA Explosion-proof; Intrinsically Safe; Division 2; Dust-Ignition-proof	H
KB	FM and CSA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, Non-incendive	H
E1	ATEX Flameproof	H
I1	ATEX Intrinsic Safety ia; Intrinsic Safety ic	H
IA(8)	ATEX FISCO Intrinsic Safety	H
N1	ATEX Type n	H

Table 1. Rosemount 8800D Vortex Flowmeter

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The Expanded offering is subject to additional delivery lead time.

ND	ATEX Dust	H
K1	ATEX Flameproof; Intrinsic Safety; Type n; Dust	H
E7	IECEx Flameproof	H
I7	IECEx Intrinsic Safety	H
IG[8]	IECEx FISCO Intrinsic Safety	H
N7	IECEx Type n	H
K7	IECEx Flameproof; Intrinsic Safety; Type n; Dust	H
E2	INMETRO Flameproof	H
I2	INMETRO Intrinsic Safety	H
E3	China Flameproof; Dust	H
I3	China Intrinsic Safety	H
N3	China Type n	H
IH[8]	China FISCO/FNICO Intrinsic Safety	H
K3	China Flameproof; Dust; Intrinsic Safety; Type n	H
E4[9]	TIIS Flameproof	H
IB[8]	INMETRO FISCO Intrinsic Safety	H
PlantWeb control functionality		
A01[10]	Basic Control: One Proportional/Integral/Derivative (PID) Function Block	H
Conduit electrical connector		
GE[11]	M12, 4-pin, Male Connector (eurofast®)	
GM[11]	A size Mini, 4-pin, Male Connector (minifast®)	
GN	ATEX Flameproof A size, Mini 4-pin male connector (minifast)	
Other options		
C4[12]	NAMUR alarm and saturation values, high alarm	H
CN[12]	NAMUR alarm and saturation values, low alarm	H
V5	External ground screw assembly	H
T1	Transient protection terminal block	H
P2	Cleaning for special services	H
PD	Pressure Equipment Directive (PED, per 97/23/EC)	H
M5	LCD indicator	H
R10	Remote electronics with 10 ft (3,0 m) cable	H
R20	Remote electronics with 20 ft (6,1 m) cable	H
R30	Remote electronics with 30 ft (9,1 m) cable	H
R33	Remote electronics with 33 ft. (10.1m) cable	H
R50	Remote electronics with 50 ft (15.2 m) cable	H
RXX[13]	Remote electronics with customer-specified cable length (up to 75 ft (23 m) maximum)	

Table 1. Rosemount 8800D Vortex Flowmeter

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A10	Armored remote electronics with 10 ft (3.0 m) cable	
A20	Armored remote electronics with 20 ft (6.1 m) cable	
A33	Armored remote electronics with 33ft (10.1 m) cable	
A50	Armored remote electronics with 50 ft (15.2 m) cable	
A75	Armored remote electronics with 75ft (22.9 m) cable	
CPA[14]	CriticalProcess Online Sensor	
Certification options		
Q4	Certificate of Calibration - Consistent with ISO 10474 3.1B or EN 10204 3.1	H
Q8	Material traceability certification per ISO 10474 3.1B and EN 10204 3.1	H
Q25	NACE® MR0103 Certificate of Compliance	H
Q69[15]	Inspection certificate weld examination (wafer) per ISO 10474 3.1B and EN 10204 3.1	H
Q70	Inspection certificate weld examination (flanged) per ISO 10474 3.1B and EN 10204 3.1	
Q71	Inspection certification weld examination (flanged) per ISO 10474 3.1B (includes x-rays) and EN 10204 3.1	
Q72	Inspection certification weld examination (flanged) per ISO 10474 3.1B (includes x-rays on film) and EN 10204 3.1	
Q76	Certification of Positive Material Identification	H
Q79	Certification for Combo PQR/WPQ/WPS with Weld Maps	H
QC2	Visual and Dimensional, Quantity, Display and Configuration Inspection with Certificate	
J2	ASME B31.1 General Compliance (carbon steel only)	
J7	ASME B31.1 Boiler External Piping (BEP) Code Stamp (carbon steel only)	
QKH	KHK Documentation Package	
QP	Calibration certification and tamper evident seal	H
SBS	ABS (American Bureau of Shipping)	
SBV	Bureau Veritas	
SDN	Det Norske Veritas	
SLL	Lloyd's Register (LR) Type Approval	

Table 1. Rosemount 8800D Vortex Flowmeter

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Quick Start Guide (QSG) language options (default is English)		
YA	Danish QIG	H
YB	Hungarian QIG	H
YC	Czech QIG	H
YD	Dutch QIG	H
YF	French QIG	H
YG	German QIG	H
YH	Finnish QIG	H
YI	Italian QIG	H
YJ	Japanese QIG	H
YM	Chinese (Mandarin) QIG	H
YN	Norwegian QIG	H
YL	Polish QIG	H
YP	Portuguese QIG	H
YR	Russian QIG	H
YS	Spanish QIG	H
YW	Swedish QIG	H
Typical model number: 8800D F 020 S A1 N 1 D 1 M5		

(1) Available in Flanged and Dual from 6-in. through 12-in. and Reducer from 8-in. through 12-in. Class 1500 in 6-in. and 8-in. meterbody sizes and class 900 in 10 through 12-in. meterbody sizes.
(2) Available on flanged and dual style meters from 1/2" - 8" (15-200 mm) and reducer style meters from 1" - 8" (25 - 200 mm). Also available in 10"-12" (250-300 mm) flanged and dual meters along with 12" (300mm) reducers when using Super Duplex material of construction.
(3) Only available for flange and dual style meters from 1-in. through 8-in. (25-200 mm).
(4) Not available with $^{1}/_{2}$-in. line size.
(5) W1, W4, W8, and W9 are only available with Meter Style F.
(6) No TIIS approval
(7) Available with Rosemount 8800DF from $1^{1}/_{2}$-in. (40 mm) through 12-in. (300 mm). Available with 8800DR from 2-in. (50 mm) through 12-in. (300 mm). Not available with 8800DW or 8800DD.
(8) Fieldbus Intrinsic Safe Concept (FISCO) available with output code F (FOUNDATION Fieldbus digital signal) only.
(9) TIIS Flameproof Approval requires G1/2 conduit entry.
(10) Requires output code F.
(11) Not available with certain hazardous location certifications. Contact a Rosemount representative for details.
(12) NAMUR compliant operation and the alarm latch options are pre-set at the factory and can be changed to standard operation in the field.
(13) XX is a customer specified length in feet.
(14) The CPA option is not available on wafer, $^{1}/_{2}$-in. flange, or 1-in. reducer units. In addition it is not available on 1-in. flanged and $1^{1}/_{2}$-in. reducer JIS 10K, EN PN40, or EN PN16. Not available with Super Duplex or B31.1 line sizes greater than 6".
(15) Q69 available for all Nickel Alloy wafers and stainless steel wafers in line sizes $^{1}/_{2}$-in. (15 mm), 6-in. (150 mm), and 8-in. (200 mm).

Table 2. Method of Construction for the 8800DF/8800DD in Nickel Alloy

Line size	A1	A3	A6	A7	K1	K3	K4	K6	K7
½ (15)	C	C	C	W	W	W	NA	W	W
1 (25)	C	C	C	W	W	W	NA	W	W
1½ (40)	C	C	C	W	W	W	NA	W	W
2 (50)	C	C	C	W	C	C	W	W	W
3 (80)	C	C	C	W	C	C	W	W	W
4 (100)	C	C	C	W	C	C	W	W	W
6 (150)	C	C	C	CF	W	W	W	W	CF
8 (200)	C	C	C	CF	W	W	W	W	CF
10 (250)	W	W	W	NA	W	W	W	W	NA
12 (300)	W	W	W	NA	W	W	W	W	NA
C = Nickel Alloy collar and 316 SST lap flange. If weld neck flange is required, V0022 can be ordered.									
W = Nickel Alloy weld neck flange.									
CF = Consult Factory									
NA = Not Available									
All 8800DR Reducer Vortex Meters with Nickel Alloy materials of construction use weld neck flanges.									
Flange codes other than those listed in Table 2 all use weld neck flanges.									

Specifications

Functional specifications

Process fluids

Liquid, gas, and steam applications. Fluids must be homogeneous and single-phase.

Line sizes

Wafer

1/2, 1, 1 1/2, 2, 3, 4, 6, and 8 inches
(DN 15, 25, 40, 50, 80, 100, 150, and 200)

Flanged and dual-sensor style

1/2, 1, 1 1/2, 2, 3, 4, 6, 8, 10, and 12 inches
(DN 15, 25, 40, 50, 80, 100, 150, 200, 250, and 300)

Reducer

1, 1 1/2, 2, 3, 4, 6, 8, 10, and 12 inches
(DN 25, 40, 50, 80, 100, 150, 200, 250, and 300)

Pipe schedules

Process piping Schedules 10, 40, 80, and 160.

Note
The appropriate bore diameter of the process piping must be entered using the Field Communicator or AMS® Device Manager. Meters will be shipped from the factory at the Schedule 40 default value unless otherwise specified.

Measurable flow rates

Capable of processing signals from flow applications which meet the sizing requirements below.

To determine the appropriate flowmeter size for an application, process conditions must be within the Reynolds number and velocity limitations for the desired line size provided in Table 3, Table 4, and Table 5.

Note
Consult your local sales representative to obtain a computer sizing program that describes in greater detail how to specify the correct flowmeter size for an application.

The Reynolds number equation shown below combines the effects of density *(r)*, viscosity *(m_{cp})*, pipe inside diameter *(D)*, and flow velocity *(V)*.

$$R_D = \frac{VD\rho}{\mu_{cp}}$$

Table 3. Minimum Measurable Meter Reynolds Numbers

Meter sizes (Inches/DN)	Reynolds number limitations
1/2 through 4/15 through 100	5000 minimum
6 through 12/150 through 300	

Table 4. Minimum measurable meter velocities(1)

	Feet per second	Meters per second
Liquids(2)	$\sqrt{36/\rho}$	$\sqrt{54/\rho}$
Gases(2)	$\sqrt{36/\rho}$	$\sqrt{54/\rho}$
The ρ is the process fluid density at flowing conditions in lb/ft^3 for ft/s and kg/m^3 for m/s.		

(1) Velocities are referenced to schedule 40 pipe.
(2) This minimum measurable meter velocity is based on default filter settings.

Table 5. Maximum Measurable Meter Velocities(1) (use the smaller of the two values)

	Feet per second	Meters per second
Liquids	$\sqrt{90,000/\rho}$ or 25	$\sqrt{134,000/\rho}$ or 7.6
Gases(2)	$\sqrt{90,000/\rho}$ or 300	$\sqrt{134,000/\rho}$ or 91.4
The ρ is the process fluid density at flowing conditions in lb/ft^3 for ft/s and kg/m^3 for m/s.		

(1) Velocities are referenced to schedule 40 pipe.
(2) Accuracy limitations for gas and steam for Dual-style meters (1/2-in. to 4-in.): max velocity of 100 ft/s (30.5 m/s).

Process temperature limits

Standard

–40 to 450 °F (–40 to 232 °C)

Extended

–330 to 800 °F (–200 to 427 °C)

Severe

–330 to 800 °F (–200 to 427 °C)

- The meter body and sensor, in remote mount configurations, is functionally rated to 842 °F process temperature. Process temperature may be further restricted depending on hazardous area options and PED certificates. Consult applicable certificates for particular installation limits.
- 157 °F to 800 °F (-105 to 427 °C) for European Pressure Equipment Directive (PED), consult factory for lower temperature requirements.
- The Super Duplex material of construction is limited to use with the standard sensor for –40 to 450 °F (–40 to 232 °C).

MultiVariable (MTA option)

–40 to 800 °F (–40 to 427 °C)

- Use above 450 °F (232 °C) requires Extended Sensor

Output signals

4–20 mA Digital HART signal

Superimposed on 4–20 mA signal

Optional scalable pulse output

0 to 10000 Hz; transistor switch closure with adjustable scaling via HART communications; capable of switching up to 30 Vdc, 120 mA maximum

Digital FOUNDATION fieldbus signal

Completely digital output with FOUNDATION fieldbus communication (ITK 5.2 compliant).

Analog output adjustment

Engineering units and lower and upper range values are user-selected. Output is automatically scaled to provide 4 mA at the selected lower range value, 20 mA at the selected upper range value. No frequency input is required to adjust the range values.

Scalable frequency adjustment

The scalable pulse output can be set to a specific velocity, volume, or mass (i.e. 1 pulse = 1 lb). The scalable pulse output can also be scaled to a specific rate of volume, mass, or velocity (i.e. 100 Hz = 500 lb/hr).

Ambient temperature limits

Operating

–58 to 185 °F (–50 to 85 °C)
–4 to 185 °F (–20 to 85 °C) for flowmeters with local indicator

Storage

–58 to 185 °F (–50 to 85 °C)
–50 to 185 °F (–46 to 85 °C) for flowmeters with local indicator

Pressure limits

Flange style meter

Rated for ASME B16.5 Class 150, 300, 600, 900, and 1500, EN 1092-1 PN 10, 16, 25, 40, 63, 100, and 160, and JIS 10K, 20K, and 40K

Reducer style meter

Rated for ASME B16.5 Class 150, 300, 600, and 900, EN 1092-1 PN 10, 16, 25, 40, 63, 100, and 160.

Dual sensor style meter

Rated for ASME B16.5 Class 150, 300, 600, 900, and 1500, EN 1092-1 PN 10, 16, 25, 40, 63, 100, and 160, and JIS 10K, 20K, and 40K

Wafer style meter

Rated for ASME B16.5 Class 150, 300, and 600, EN 1092-1 PN 10, 16, 25, 40, 63, and 100, and JIS 10K, 20K, and 40K

Note
All wafer style meters are pressure rated and labeled at 1500 PSI/10.34 MPa at 100 °F/38 °C regardless of alignment ring size code ordered.

Weld-end style meter

W1 Welds to Schedule 10 mating pipe

- 1-4 inch line size 720 psig (4.96 MPa-g)

W4 Welds to Schedule 40 mating pipe

- 1-4 inch line size 1440 psig (9.93 Mpa-g)
- 6-12 inch line size 720 psig (4.96 MPa-g)

W8 Welds to Schedule 80 mating pipe

- 1-4 inch line size 2160 psig (14.9 Mpa-g)
- 6-12 inch line size 1440 psig (9.93 Mpa-g)

W9 Welds to Schedule 160 mating pipe

- 1-4 inch line size 3600 psig (24.8 Mpa-g)
- 6-12 inch line size 2160 psig (14.9 Mpa-g)

Note
1-in. (25 mm), and 1.5-in. (40 mm) weld to Schedule 80 mating pipe.

Power supply

HART analog

External power supply required. Flowmeter operates on 10.8 to 42 Vdc terminal voltage (with 250-ohm minimum load required for HART communications, 16.8 Vdc power supply is required)

FOUNDATION fieldbus

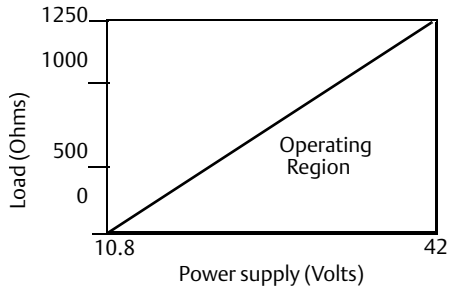
External power supply required. Flowmeter operates on 9 to 32 Vdc, 18 mA maximum.

Power consumption

One watt maximum

Load limitations (HART analog)

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:



R_{max} = $41.7(V_{ps} - 10.8)$
V_{ps} = Power Supply Voltage (Volts)
R_{max} = Maximum Loop Resistance (Ohms)

Note

HART Communication requires a minimum loop resistance of 250 ohms.

Optional LCD indicator

The optional LCD indicator is capable of displaying:

HART	FOUNDATION fieldbus
Primary Variable	Primary Variable
Velocity Flow	Percent of Range
Volumetric Flow	Shedding Frequency
Mass Flow	Electronics Temperature (MTA only)
Percent of Range	Process Temperature (MTA only)
Analog Output	Calculated Process Density (MTA only)
Totalizer	Integrator Output
Shedding Frequency	Totalizer
Pulse Output Frequency	
Electronics Temperature	
Process Temperature (MTA only)	
Calculated Process Density (MTA only)	

If more than one item is selected, the display will scroll through all items selected.

Enclosure rating

FM Type 4X; CSA Type 4X; IP66

Permanent pressure loss

The approximate permanent pressure loss (PPL) from the Rosemount 8800D Flowmeter is calculated for each application in the Vortex sizing software available from your local Rosemount representative.

The PPL is determined using the equation:

$$PPL = \frac{A \times \rho_f \times Q^2}{D^4}$$

where:

PPL = Permanent Pressure loss (psi or kPa)
Where:
r_f = Density at operating conditions (lb/ft^3 or kg/m^3)
Q = Actual volumetric flow rate (Gas = ft^3/min or m^3/hr; Liquid = gal/min or l/min)
D = Flowmeter bore diameter (in. or mm)
A = Constant depending on meter style, fluid type and flow units. Determined per following table:

Table 6. Determining the PPL

Meter style	English units		SI units	
	A_{Liquid}	A_{Gas}	A_{Liquid}	A_{Gas}
8800DF/W	3.4×10^{-5}	1.9×10^{-3}	0.425	118
8800DR	3.91×10^{-5}	2.19×10^{-3}	0.489	136
8800DD(1)	6.12×10^{-5}	3.42×10^{-3}	0.765	212

(1) For all 6-in. thru 12-in. line sizes A is the same for 8800DD and 8800DF

Minimum downstream pressure (liquids)

Flow metering conditions that would allow cavitation, the release of vapor from a liquid, should be avoided. This flow condition can be avoided by remaining within the proper flow range of the meter and by following appropriate system design.

For some liquid applications, incorporation of a back pressure valve should be considered. To prevent cavitation, the minimum downstream pressure should be:

$P = 2.9*\Delta P + 1.3*p_v$ or $P = 2.9*\Delta P + p_v + 0.5$ psia (3.45 kPa) (use the smaller of the two results)
P = Line pressure five pipe diameters downstream of the meter (psia or kPa abs)
ΔP = Pressure loss across the meter (psi or kPa)
p_v = Liquid vapor pressure at operating conditions (psia or kPa abs)

Failure mode alarm

HART analog

If self-diagnostics detect a gross flowmeter failure, the analog signal will be driven to the values below:

Low	3.75
High	21.75
NAMUR Low	3.60
NAMUR High	22.6

High or low alarm signal is user-selectable through the fail mode alarm jumper on the electronics. NAMUR-compliant alarm limits are available through the C4 or CN Option. Alarm type is field configurable also.

FOUNDATION fieldbus

The AI block allows the user to configure the alarm to HI-HI, HI, LO, or LO-LO with a variety of priority levels.

Saturation output values

When the operating flow is outside the range points, the analog output continues to track the operating flow until reaching the saturation value listed below; the output does not exceed the listed saturation value regardless of the operating flow. The NAMUR-Compliant Saturation Values are available through the C4 or CN option. Saturation type is field configurable.

Low	3.9
High	20.8
NAMUR Low	3.8
NAMUR High	20.5

Damping

Flow Damping adjustable between 0.2 and 255 seconds.

Process Temperature Damping adjustable between 0.4 and 32.0 seconds (MTA Option Only).

Response time

Three vortex shedding cycles or 300 ms, whichever is greater, maximum required to reach 63.2% of actual input with the minimum damping (0.2 seconds).

Turn-on time

HART analog

Less than four (4) seconds plus the response time to rated accuracy from power up (less than 7 seconds with the MTA Option).

FOUNDATION fieldbus

Performance within specifications no greater than 10.0 seconds after power is applied.

Transient protection

The optional transient terminal block prevents damage to the flowmeter from transients induced by lightning, welding, heavy electrical equipment, or switch gears. The transient protection electronics are located in the terminal block.

The transient terminal block meets the following specifications:
IEEE C62.41 - 2002 Category B
3 kA crest (8 × 20 μs)
6 kV crest (1.2 × 50 μs)
6 kV/0.5 kA (0.5 μs, 100 kHz, ring wave)

Security lockout

When the security lockout jumper is enabled, the electronics will not allow you to modify parameters that affect flowmeter output.

Output testing

Current source

Flowmeter may be commanded to set the current to a specified value between 4 and 20 mA.

Frequency source

Flowmeter may be commanded to set the frequency to a specified value between 0 and 10000 Hz.

Low flow cutoff

Adjustable over entire flow range. Below selected value, output is driven to 4 mA and zero pulse output frequency.

Humidity limits

Operates in 0–95% relative humidity under noncondensing conditions (tested to IEC 60770, Section 6.2.11).

Overrange capability

HART analog

Analog signal output continues to 105 percent of span, then remains constant with increasing flow. The digital and pulse outputs will continue to indicate flow up to the upper sensor limit of the flowmeter and a maximum pulse output frequency of 10400 Hz.

FOUNDATION fieldbus

For liquid process fluid type, the transducer block digital output will continue to a nominal value of 25 ft/s. After that, the status associated with the transducer block output will go to UNCERTAIN. Above a nominal value of 30 ft/s, the status will go to BAD.

For gas/steam service, the transducer block digital output will continue to a nominal value of 220 ft/s for 0.5 and 1.0-in. line sizes and a nominal value of 250 ft/s for 1.5–12-in. line sizes. After that, the status associated with the transducer block output will go to UNCERTAIN. Above a nominal value of 300 ft/s for all line sizes, the status will go to BAD.

Flow calibration

Meter bodies are flow-calibrated and assigned a unique calibration factor (K-factor) at the factory. The calibration factor is entered into the electronics, enabling interchangeability of electronics and/or sensors without calculations or compromise in accuracy of the calibrated meter body.

Status (FOUNDATION fieldbus only)

If self-diagnostics detect a transmitter failure, the status of the measurement will inform the control system. Status may also set the PID output to a safe value.

Schedule entries (FOUNDATION fieldbus only)

Six (6)

Links (FOUNDATION fieldbus only)

Twelve (12)

Virtual communications relationships (VCRs) (FOUNDATION fieldbus only)

Maximum VCRs20

Number of Permanent Entries1

Table 7. Block Information

Block	Base index	Execution time (milliseconds)
Resource (RB)	1000	N/A
Transducer (TB)	1200	N/A
Analog Input 1 (AI 1)	1400	15
Analog Input 2 (AI 2)	1600	15
Proportional/ Integral/Derivative (PID)	1800	20
Integrator (INTEG)	2000	25
Arithmetic (ARITH)	2200	20
Analog Input 3 (AI 3)	2400	15
Analog Input 4 (AI 4)	2600	15
Analog Input 5 (AI 5)	2800	15

Typical Flow Ranges

Table 8 - Table 19 show typical flow ranges for some common process fluids with default filter settings. Consult your local sales representative to obtain a computer sizing program that describes in greater detail the flow range for an application.

Table 8. Typical Pipe Velocity Ranges for 8800D and 8800DR(1)

Process line size	Vortex meter (2)	Liquid velocity ranges		Gas velocity ranges	
(inches/ DN)		(ft/s)	(m/s)	(ft/s)	(m/s)
0.5/ 15	8800DF005	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
1/ 25	8800DF010	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR010	0.25 to 8.8	0.08 to 2.7	2.29 to 87.9	0.70 to 26.8
1.5/ 40	8800DF015	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR015	0.30 to 10.6	0.09 to 3.2	2.76 to 106.1	0.84 to 32.3
2/ 50	8800DF020	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR020	0.42 to 15.2	0.13 to 4.6	3.94 to 151.7	1.20 to 46.2
3/ 80	8800DF030	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR030	0.32 to 11.3	0.10 to 3.5	2.95 to 113.5	0.90 to 34.6
4/ 100	8800DF040	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR040	0.41 to 14.5	0.12 to 4.4	3.77 to 145.2	1.15 to 44.3
6/ 150	8800DF060	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR060	0.31 to 11.0	0.09 to 3.4	2.86 to 110.2	0.87 to 33.6
8/ 200	8800DF080	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR080	0.40 to 14.4	0.12 to 4.4	3.75 to 144.4	1.14 to 44.0
10/ 250	8800DF100	0.90 to 25.0	0.27 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR100	0.44 to 15.9	0.13 to 4.8	4.12 to 158.6	1.26 to 48.3
12/ 300	8800DF120	1.10 to 25.0	0.34 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR120	0.63 to 17.6	0.19 to 5.4	4.58 to 176.1	1.40 to 53.7

(1) Table 8 is a reference of pipe velocities that can be measured for the standard Rosemount 8800D and the reducer Rosemount 8800DR Vortex Meters. It does not consider density limitations, as described in tables 2 and 3. Velocities are referenced in schedule 40 pipe.
(2) Velocity range of the Rosemount 8800DW is the same as Rosemount 8800DF.

Table 9. Water Flow Rate Limits for the Rosemount 8800D and 8800DR(1)

Process line size	Vortex meter (2)	Minimum and maximum measurable water flow rates*	
(inches/ DN)		Gallons/minute	Cubic meters/hour
0.5/ 15	8800DF005	1.76 to 23.7	0.40 to 5.4
1/ 25	8800DF010	2.96 to 67.3	0.67 to 15.3
	8800DR010	1.76 to 23.7	0.40 to 5.4
1.5/ 40	8800DF015	4.83 to 158	1.10 to 35.9
	8800DR015	2.96 to 67.3	0.67 to 15.3
2/ 50	8800DF020	7.96 to 261	1.81 to 59.4
	8800DR020	4.83 to 158.0	1.10 to 35.9
3/ 80	8800DF030	17.5 to 576	4.00 to 130
	8800DR030	7.96 to 261.0	1.81 to 59.3
4/ 100	8800DF040	30.2 to 992	6.86 to 225
	8800DR040	17.5 to 576	4.00 to 130
6/ 150	8800DF060	68.5 to 2251	15.6 to 511
	8800DR060	30.2 to 992	6.86 to 225
8/ 200	8800DF080	119 to 3898	27.0 to 885
	8800DR080	68.5 to 2251	15.6 to 511
10/ 250	8800DF100	231 to 6144	52.2 to 1395
	8800DR100	119 to 3898	27.0 to 885
12/ 300	8800DF120	391 to 8813	88.8 to 2002
	8800DR120	231 to 6144	52.2 to 1395
*Conditions: 77 °F (25 °C) and 14.7 psia (1.01 bar absolute)			

(1) Table 9 is a reference of flow rates that can be measured for the standard Rosemount 8800D and the reducer 8800DR Vortex Meters. It does not consider density limitations, as described in tables 2 and 3.
(2) Velocity range of the 8800DW is the same as 8800DF.

Table 10. Air Flow Rate Limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and Maximum air flow rates for line sizes 1/2-in./DN 15 through 1-in./DN 25							
		1/2-in./DN 15				1-in./DN 25			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max min	27.9 4.62	47.3 7.84	Not Available	Not Available	79.2 9.71	134 16.5	27.9 4.62	47.3 7.84
50 psig (3,45 bar G)	max min	27.9 1.31	47.3 2.22	Not Available	Not Available	79.2 3.72	134 6.32	27.9 1.31	47.3 2.22
100 psig (6,89 bar G)	max min	27.9 0.98	47.3 1.66	Not Available	Not Available	79.2 2.80	134 4.75	27.9 0.98	47.3 1.66
150 psig (10,3 bar G)	max min	27.9 0.82	47.3 1.41	Not Available	Not Available	79.2 2.34	134 3.98	27.9 0.82	47.3 1.41
200 psig (13,8 bar G)	max min	27.9 0.82	47.3 1.41	Not Available	Not Available	79.2 2.34	134 3.98	27.9 0.82	47.3 1.41
300 psig (20,7 bar G)	max min	27.9 0.82	47.3 1.41	Not Available	Not Available	79.2 2.34	134 3.98	27.9 0.82	47.3 1.41
400 psig (27,6 bar G)	max min	25.7 0.82	43.9 1.41	Not Available	Not Available	73.0 2.34	124 3.98	25.7 0.82	43.9 1.41
500 psig (34,5 bar G)	max min	23.0 0.82	39.4 1.41	Not Available	Not Available	66.0 2.34	112 3.98	23.0 0.82	39.4 1.41

Table 11. Air Flow Rate Limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and maximum air Flow rates for line sizes 1 1/2-in./DN 40 through 2-in./DN 50							
		1½-in./DN 40				2-in./DN 50			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	212	360	79.2	134	349	593	212	360
	min	18.4	31.2	9.71	16.5	30.3	51.5	18.4	31.2
50 psig (3,45 bar G)	max	212	360	79.2	134	349	593	212	360
	min	8.76	14.9	3.72	6.32	14.5	24.6	8.76	14.9
100 psig (6,89 bar G)	max	212	360	79.2	134	349	593	212	360
	min	6.58	11.2	2.80	4.75	10.8	18.3	6.58	11.2
150 psig (10,3 bar G)	max	212	360	79.2	134	349	593	212	360
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36
200 psig (13,8 bar G)	max	212	360	79.2	134	349	593	212	360
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36
300 psig (20,7 bar G)	max	198	337	79.2	134	326	554	198	337
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36
400 psig (27,6 bar G)	max	172	293	73.0	124	284	483	172	293
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36
500 psig (34,5 bar G)	max	154	262	66.0	112	254	432	154	262
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36

Table 12. Air Flow Rate Limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and maximum air flow rates for line sizes 3-in./DN 80 through 4-in./DN 100							
		3-in./DN 80				4-in./DN 100			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	66.8	114	30.3	51.5	115	195	66.8	114
50 psig (3,45 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	31.8	54.1	14.5	24.6	54.8	93.2	31.8	54.1
100 psig (6,89 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	23.9	40.6	10.8	18.3	41.1	69.8	23.9	40.6
150 psig (10,3 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0
200 psig (13,8 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0
300 psig (20,7 bar G)	max	718	1220	326	554	1237	2102	718	1220
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0
400 psig (27,6 bar G)	max	625	1062	284	483	1076	1828	625	1062
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0
500 psig (34,5 bar G)	max	560	951	254	432	964	1638	560	951
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0

Table 13. Air Flow Rate Limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and maximum air flow rates for line sizes 6-in./DN 150 through 8-in./DN 200							
		6-in./DN 150				8-in./DN 200			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	261	443	115	195	452	768	261	443
50 psig (3,45 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	124	211	54.8	93.2	215	365	124	211
100 psig (6,89 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	93.3	159	41.1	69.8	162	276	93.3	159
150 psig (10,3 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	78.2	133	34.5	58.6	135	229	78.2	133
200 psig (13,8 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	78.2	133	34.5	58.6	135	229	78.2	133
300 psig (20,7 bar G)	max	2807	4769	1237	2102	4862	8260	2807	4769
	min	78.2	133	34.5	58.6	135	229	78.2	133
400 psig (27,6 bar G)	max	2442	4149	1076	1828	4228	7183	2442	4149
	min	78.2	133	34.5	58.6	136	229	78.2	133
500 psig (34,5 bar G)	max	2188	3717	964	1638	3789	6437	2188	3717
	min	78.2	133	34.5	58.6	136	229	78.2	133

Table 14. Air Flow Rate Limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and maximum air flow rates for line sizes 10-in./DN 250 through 12-in./DN 300							
		10-in./DN 250				12-in./DN 300			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	8214	13956	5211	8853	11781	20016	8214	13956
	min	712.9	1211	452	768	1022	1736	712.9	1211
50 psig (3,45 bar G)	max	8214	13956	5211	8853	11781	20016	8214	13956
	min	339.5	577	215	365	486.9	827	339.5	577
100 psig (6,89 bar G)	max	8214	13956	5211	8853	11781	20016	8214	13956
	min	254.7	433	162	276	365.4	621	254.7	433
150 psig (10,3 bar G)	max	8214	13956	5211	8853	11781	20016	8214	13956
	min	213.6	363	135	229	306.3	520	213.6	363
200 psig (13,8 bar G)	max	8214	13956	5211	8853	11781	20016	8214	13956
	min	213.6	363	135	229	306.3	520	213.6	363
300 psig (20,7 bar G)	max	7664	13021	4862	8260	10992	18675	7664	13021
	min	213.6	363	135	229	306.3	520	213.6	363
400 psig (27,6 bar G)	max	6664	11322	4228	7183	9559	16241	6664	11322
	min	213.6	363	136	229	306.3	520	213.6	363
500 psig (34,5 bar G)	max	5972	10146	3789	6437	8565	14552	5972	10146
	min	213.6	363	136	229	306.3	520	213.6	363

Note

The Rosemount 8800D measures the volumetric flow under operating conditions (i.e. the actual volume at the operating pressure and temperature–acfm or acmh), as shown above. However, gas volumes are strongly dependent on pressure and temperature. Therefore, gas quantities are typically stated in standard or normal conditions (e.g. SCFM or NCMH). (Standard conditions are typically 59 °F and 14.7 psia. Normal conditions are typically 0 °C and 1.01 bar abs.) The flow rate limits in standard conditions are found using the equations below:

Standard Flow Rate = Actual Flow Rate X Density Ratio

Density Ratio = Density at Actual (Operating) Conditions / Density at Standard Conditions

Table 15. Saturated Steam Flow Rate Limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 1/2-in./DN 15 through 1-in./DN 25							
		½-in./DN 15				1-in./DN 25			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	120	54.6	Not Available	Not Available	342	155	120	54.6
	min	12.8	5.81			34.8	15.8	12.8	5.81
25 psig (1,72 bar G)	max	158	71.7	Not Available	Not Available	449	203	158	71.7
	min	14.0	6.35			39.9	18.1	14.0	6.35
50 psig (3,45 bar G)	max	250	113	Not Available	Not Available	711	322	250	113
	min	17.6	8.00			50.1	22.7	17.6	8.00
100 psig (6,89 bar G)	max	429	194	Not Available	Not Available	1221	554	429	194
	min	23.1	10.5			65.7	29.8	23.1	10.5
150 psig (10,3 bar G)	max	606	275	Not Available	Not Available	1724	782	606	275
	min	27.4	12.5			78.1	35.4	27.4	12.5
200 psig (13,8 bar G)	max	782	354	Not Available	Not Available	2225	1009	782	354
	min	31.2	14.1			88.7	40.2	31.2	14.1
300 psig (20,7 bar G)	max	1135	515	Not Available	Not Available	3229	1464	1135	515
	min	37.6	17.0			107	48.5	37.6	17.0
400 psig (27,6 bar G)	max	1492	676	Not Available	Not Available	4244	1925	1492	676
	min	44.1	20.0			125	56.7	44.1	20.0
500 psig (34,5 bar G)	max	1855	841	Not Available	Not Available	5277	2393	1855	841
	min	54.8	24.9			156	70.7	54.8	24.9

Table 16. Saturated Steam Flow Rate Limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 1 1/2-in./DN 40 through 2-in./DN 50							
		1½-in./DN 40				2-in./DN 50			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	917	416	342	155	1511	685	917	416
	min	82.0	37.2	34.8	15.8	135	61.2	82.0	37.2
25 psig (1,72 bar G)	max	1204	546	449	203	1983	899	1204	546
	min	93.9	42.6	39.9	18.1	155	70.2	93.9	42.6
50 psig (3,45 bar G)	max	1904	864	711	322	3138	1423	1904	864
	min	118	53.4	50.1	22.7	195	88.3	118	53.4
100 psig (6,89 bar G)	max	3270	1483	1221	554	5389	2444	3270	1483
	min	155	70.1	65.7	29.8	255	116	155	70.1
150 psig (10,3 bar G)	max	4616	2094	1724	782	7609	3451	4616	2094
	min	184	83.2	78.1	35.4	303	137	184	83.2
200 psig (13,8 bar G)	max	5956	2702	2225	1009	9818	4453	5956	2702
	min	209	94.5	88.7	40.2	344	156	209	94.5
300 psig (20,7 bar G)	max	8644	3921	3229	1464	14248	6463	8644	3921
	min	252	114	107	48.5	415	189	252	114
400 psig (27,6 bar G)	max	11362	5154	4244	1925	18727	8494	11362	5154
	min	295	134	125	56.7	487	221	295	134
500 psig (34,5 bar G)	max	14126	6407	5277	2393	23284	10561	14126	6407
	min	367	167	156	70.7	605	274	367	167

Table 17. Saturated Steam Flow Rate Limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 3-in./DN 80 through 4-in./DN 100							
		3-in./DN 80				4-in./DN 100			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	3330	1510	1511	685	5734	2601	3330	1510
	min	298	135	135	61.2	513	233	298	135
25 psig (1,72 bar G)	max	4370	1982	1983	899	7526	3414	4370	1982
	min	341	155	155	70.2	587	267	341	155
50 psig (3,45 bar G)	max	6914	3136	3138	1423	11905	5400	6914	3136
	min	429	195	195	88.3	739	335	429	195
100 psig (6,89 bar G)	max	11874	5386	5389	2444	20448	9275	11874	5386
	min	562	255	255	116	968	439	562	255
150 psig (10,3 bar G)	max	16763	7603	7609	3451	28866	13093	16763	7603
	min	668	303	303	137	1150	522	668	303
200 psig (13,8 bar G)	max	21630	9811	9818	4453	37247	16895	21630	9811
	min	759	344	344	156	1307	593	759	344
300 psig (20,7 bar G)	max	31389	14237	14248	6463	54052	24517	31389	14237
	min	914	415	415	189	1574	714	914	415
400 psig (27,6 bar G)	max	41258	18714	18727	8494	71047	32226	41258	18714
	min	1073	487	487	221	1847	838	1073	487
500 psig (34,5 bar G)	max	51297	23267	23284	10561	88334	40068	51297	23267
	min	1334	605	605	274	2297	1042	1334	605

Table 18. Saturated Steam Flow Rate Limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 6-in./DN 150 through 8-in./DN 200							
		6-in./DN 150				8-in./DN 200			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	13013	5903	5734	2601	22534	10221	13013	5903
	min	1163	528	513	233	2015	914	1163	528
25 psig (1,72 bar G)	max	17080	7747	7526	3414	29575	13415	17080	7747
	min	1333	605	587	267	2308	1047	1333	605
50 psig (3,45 bar G)	max	27019	12255	11905	5400	46787	21222	27019	12255
	min	1676	760	739	335	2903	1317	1676	760
100 psig (6,89 bar G)	max	46405	21049	20448	9275	80356	36449	46405	21049
	min	2197	996	968	439	3804	1725	2197	996
150 psig (10,3 bar G)	max	65611	29761	28866	13093	113440	51455	65611	29761
	min	2610	1184	1150	522	4520	2050	2610	1184
200 psig (13,8 bar G)	max	84530	38342	37247	16895	146375	66395	84530	38342
	min	2965	1345	1307	593	5134	2329	2965	1345
300 psig (20,7 bar G)	max	122666	55640	54052	24517	212411	96348	122666	55640
	min	3572	1620	1574	714	6185	2805	3572	1620
400 psig (27,6 bar G)	max	161236	73135	71047	32226	279200	126643	161236	73135
	min	4192	1901	1847	838	7259	3293	4192	1901
500 psig (34,5 bar G)	max	200468	90931	88334	40068	347134	157457	200468	90931
	min	5212	2364	2297	1042	9025	4094	5212	2364

Table 19. Saturated Steam Flow Rate Limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 10-in./DN 250 through 12-in./DN 300							
		10-in./DN 250				12-in./DN 300			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	35519	16111	22534	10221	50994	23130	35519	16111
	min	3175	1440	2015	914	4554	2066	3175	1440
25 psig (1,72 bar G)	max	46618	21146	29575	13415	66862	30328	46618	21146
	min	4570	2073	2308	1047	5218	2367	4570	2073
50 psig (3,45 bar G)	max	73748	33452	46787	21222	105774	47978	73748	33452
	min	4575	2075	2903	1317	6562	2976	4575	2075
100 psig (6,89 bar G)	max	126660	57452	80356	36449	181663	82401	126660	57452
	min	5996	2720	3804	1725	8600	3901	5996	2720
150 psig (10,3 bar G)	max	178808	81106	113440	51455	256457	116327	178808	81106
	min	7125	3232	4520	2050	10218	4635	7125	3232
200 psig (13,8 bar G)	max	230722	104654	146375	66395	330915	150101	230722	104654
	min	8092	3670	5134	2329	11607	5265	8092	3670
300 psig (20,7 bar G)	max	334810	151867	212411	96348	480203	217816	334810	151867
	min	9749	4422	6185	2805	13983	6343	9749	4422
400 psig (27,6 bar G)	max	440085	199619	279200	126643	631195	286305	440085	199619
	min	11442	5190	7259	3293	16411	7444	11442	5190
500 psig (34,5 bar G)	max	547165	248190	347134	157457	784775	355968	547165	248190
	min	14226	6453	9025	4094	20404	9255	14226	6453

Performance specifications

The following performance specifications are for all Rosemount models except where noted. Digital performance specifications applicable to both Digital HART and FOUNDATION fieldbus output.

Flow accuracy

Includes linearity, hysteresis, and repeatability.

Liquids - for Reynolds numbers over 20000

Digital and pulse output

±0.65% of rate

Note

The accuracy for the 8800DR, line sizes 6-in. to 12-in. (150 to 300mm), is ±1.0% of rate.

Analog output

Same as pulse output plus an additional 0.025% of span

Gas and steam - for Reynolds numbers over 15,000

Digital and pulse output

±1.0% of rate

Note: The accuracy for the 8800DR, line sizes 6 to 12-in. (150 to 300mm), is ±1.35% of rate.

Analog output

Same as pulse output plus an additional 0.025% of span

Accuracy limitations for gas and steam:

For $^1/_2$ and 1-in. (DN 15 and DN 25): max velocity of 220 ft/s (67.06 m/s)

For $^1/_2$ to 4-in. (DN 15 to DN 200) Dual-style meters: max velocity of 100 ft/s (30.5 m/s)

Note

As the meter Reynolds Numbers decreases below the stated limit to 10,000 the accuracy error band will increase linearly to +/-2.0%. For Reynolds Numbers down to 5,000 the accuracy error band will increase linearly from +/-2.0% to +/-6.0%.

Process temperature accuracy

2.2 °F (1.2 °C) or 0.4% of reading (in °C), whichever is greater.

Note

For remote mount installations, add ±0.018 °F/ft. (±0.03 °C/m) of uncertainty to the temperature measurement.

Mass flow accuracy for temperature compensated mass flow

± 2.0% of rate (Typical)

Repeatability

± 0.1% of actual flow rate

Stability

± 0.1% of rate over one year

Process temperature effect

Automatic K-factor correction with user-entered process temperature.

Table 20 indicates the percent change in K-factor per 100 °F (55.6 °C) in process temperature from reference temperature of 77 °F (25 °C).

Table 20. Process Temperature Effect

Material	Percent change in K-factor per 100 °F (55.6 °C)
316L @ < 77 °F (25 °C)	+ 0.23
316L @ > 77 °F (25 °C)	- 0.27
Nickel Alloy C < 77 °F (25 °C)	+ 0.22
Nickel Alloy C > 77 °F (25 °C)	- 0.22

Ambient temperature effect

Digital and pulse outputs

No effect

Analog output

±0.1% of span from –58 to 185 °F (–50 to 85 °C)

Vibration effect

An output with no process flow may be detected if sufficiently high vibration is present.

The meter design will minimize this effect, and the factory settings for signal processing are selected to eliminate these errors for most applications.

If an output error at zero flow is still detected, it can be eliminated by adjusting the low flow cutoff, trigger level, or low-pass filter.

As the process begins to flow through the meter, most vibration effects are quickly overcome by the flow signal.

Vibration specifications

Integral aluminum housings, remote aluminum housings, and remote SST housings

At or near the minimum liquid flow rate in a normal pipe mounted installation, the maximum vibration should be 0.087-in. (2,21 mm) double amplitude displacement or 1 g acceleration, whichever is smaller. At or near the minimum gas flow rate in a normal pipe mounted installation, the maximum vibration should be 0.043-in. (1,09 mm) double amplitude displacement or $^1/_2$ g acceleration, whichever is smaller.

Integral SST housing

At or near the minimum liquid flow rate in a normal pipe mounted installation, the maximum vibration should be 0.044-in. (1,11 mm) double amplitude displacement or $^1/_3$ g acceleration, whichever is smaller. At or near the minimum gas flow rate in a normal pipe mounted installation, the maximum vibration should be 0.022-in. (0,55 mm) double amplitude displacement or $^1/_6$ g acceleration, whichever is smaller.

Mounting position effect

Meter will meet accuracy specifications when mounted in horizontal, vertical, or inclined pipelines. Best practice for mounting in a horizontal pipe is to orient the shedder bar in the horizontal plane. This will prevent solids in liquid applications and liquid in gas/steam applications from disrupting the shedding frequency.

EMI/RFI effect

Meets EMC requirements to EU Directive 2004/108/EC.

HART analog

Output error less than ±0.025% of span with twisted pair from 80-1000 MHz for radiated field strength of 10 V/m; 1.4 - 2.0 GHz for radiated field strength of 3 V/m; 2.0 - 2.7 GHz for radiated field strength of 1 V/m. Tested per EN61326.

FOUNDATION fieldbus and digital HART

No affect on the values that are being given if using HART digital signal or FOUNDATION fieldbus. Tested per EN 61326.

Magnetic-field interference

HART analog

Output error less than ±0.025% of span at 30 A/m (rms). Tested per EN 61326.

FOUNDATION fieldbus

No effect on digital output accuracy at 30 A/m (rms). Tested per EN 61326.

Series mode noise rejection

HART analog

Output error less than ±0.025% of span at 1 V rms, 60 Hz.

FOUNDATION fieldbus

No effect on digital output accuracy at 1 V rms, 60 Hz.

Common mode noise rejection

HART analog

Output error less than ±0.025% of span at 30 V rms, 60 Hz.

FOUNDATION fieldbus

No effect on digital output accuracy at 250 V rms, 60 Hz.

Power supply effect

HART analog

Less than 0.005% of span per volt

FOUNDATION fieldbus

No effect on accuracy.

Physical specifications

NACE compliance

Materials of Construction meet NACE material recommendations per MR0175/ISO15156 for use in H_2S containing environments in oil field production. Materials of construction also meet NACE recommendations per MR0103-2003 for corrosive petroleum refining environments. MR0103 compliance requires Q25 option in model code.

Note

Certificate of compliance for MR0175/ISO15156 requires Q15 as a separate line item.

Electrical connections

1/2 –14 or M20 3 1.5 conduit threads; screw terminals provided for 4–20 mA, FOUNDATION Fieldbus, and pulse output connections; communicator connections permanently fixed to terminal block.

Non-wetted materials

Housing

Low-copper aluminum (FM Type 4X, CSA Type 4X, IP66)
Optional SST housing

Paint

Polyurethane

Cover O-rings

Buna-N

Flanges

316/316L lap joint

Temperature sensor (MTA option)

Type-N Thermocouple

Process-wetted materials

Meter body

CF-3M cast stainless, N06022 wrought Nickel Alloy and CW2M cast Nickel Alloy. Also available in WCB and LCC cast carbon steel and 6A duplex stainless steel.

Flanges

316/316L stainless steel
Nickel Alloy N06022 Weld Neck
A105 forged carbon steel
LF2 forged carbon steel
UNS S32760 wrought duplex stainless steel

Collars

Nickel Alloy N06022
316/316L Stainless Steel

Surface finish of flanges and collars

Standard: To the requirements of the applicable flange standard.
Smooth: 63 to 125 µ inches
(1.6 to 3.1 µ meters) Ra roughness

Process connections

Mounts between the following flange configurations:
ASME B16.5: Class 150, 300, 600, 900, 1500
EN 1092-1: PN 10, 16, 25, 40, 64, 100, 160
JIS B2220: 10K, 20K, and 40K
Weld-end: Schedule 10, Schedule 40, Schedule 80, Schedule 160

Mounting

Integral (standard)

Electronics are mounted on meter body.

Remote (optional)

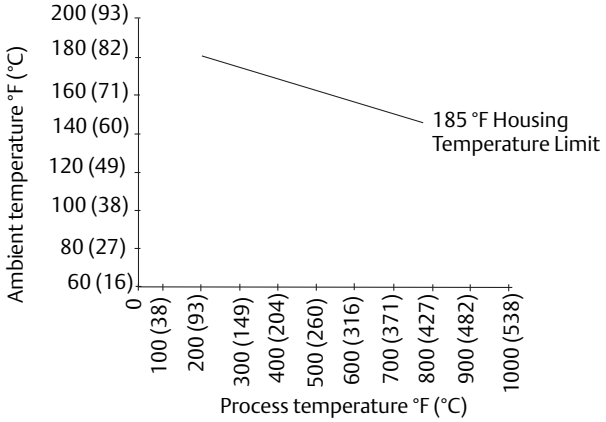
Electronics may be mounted remote from the meter body. Interconnecting coaxial cable available in nonadjustable 10, 20, 30, 33, and 50 ft (3,0, 6,1, 9,1, 10, and 15,2 m) lengths. Consult factory for non-standard lengths up to 75 ft (22,9 m). Remote mounting hardware includes a pipe mount bracket with one u-bolt. Armored remote cables are also available in lengths of 10, 20, 33, 50 and 75 feet. The armored remote option comes standard with an aluminum gland to connect the cable to the meter and electronics. A stainless steel gland is provided when ordered in conjunction with a stainless steel electronics housing.

Temperature limitations for integral mounting

The maximum process temperature for integral mount electronics is dependent on the ambient temperature where the meter is installed. The electronics must not exceed 185 °F (85 °C). The following is for reference, please note that the pipe was insulated with 3 inches of ceramic fiber insulator.

Figure 1. Rosemount 8800 Vortex Flowmeter Ambient/Process Temperature Limits

Shows combinations of ambient and process temperatures needed to remain at or below 185 °F (85 °C) housing temperature.



Meter and pipe insulated with 3 inches of ceramic fiber insulation. Horizontal Pipe and Vertical meter position.

Pipe length requirements

The vortex meter may be installed with a minimum of ten diameters (D) of straight pipe length upstream and five diameters (D) of straight pipe length downstream.
Rated Accuracy is based on the number of pipe diameter from an upstream disturbance. No K-factor correction is required if the meter is installed with 35 D upstream and 5 D downstream. The value of the K-factor may shift up to 0.5% when the upstream straight pipe length is between 10D and 35D. Please see Technical Data Sheet (00816-0100-3250) on Installation Effects for optional K-factor corrections. This effect can be corrected in the electronics.

Tagging

The flowmeter will be tagged at no charge. All tags are stainless steel. The standard tag is permanently attached to the flowmeter. Character height is $^{1}/_{16}$-in. (1,6 mm). A wired-on tag is available on request. Character height on the wire-on tag is 0.236-in. (6 mm). Wire on tags can contain five lines with an average of 19 characters per line at standard character height.

Flow calibration information

Flowmeter calibration and configuration information is provided with every flowmeter. For a certified copy of flow calibration data, Option Q4 must be ordered in the model number.

Product Certifications

Approved Manufacturing Locations

Rosemount Inc. — Eden Prairie, Minnesota, USA

Emerson Process Management BV - Ede, The Netherlands

Emerson Process Management Flow Technologies Company, Ltd - Nanjing, Jiangsu Province, P.R. China

SC Emerson SRL - Cluj, Romania

Flameproof enclosure Ex d protection type in accordance with IEC 60079-1, EN 60079-1

- Transmitters with Flameproof enclosure type protection shall only be opened when power is removed.
- Closing of entries in the device must be carried out using the appropriate Ex d cable gland or blanking plug. Unless otherwise marked on housing, the standard conduit entry thread forms are 1/2-14 NPT.

Type n protection type in accordance with IEC 60079-15, EN60079-15

Closing of entries in the device must be carried out using the appropriate Ex e or Ex n cable gland and metal blanking plug or any appropriate ATEX or IECEx approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.

European Directive Information

The CE Declaration of Conformity for all applicable European directives for this product can be found on our website at www.rosemount.com. A hard copy may be obtained by contacting our local sales office.

ATEX Directive

Rosemount Inc. complies with the ATEX Directive.

European Pressure Equipment Directive (PED)

Rosemount 8800D Vortex Flowmeter Line Size 40 mm to 300 mm

Certificate Number 4741-2014-CE-HOU-DNV

CE 0575

Module H Conformity Assessment

Mandatory CE-marking for flowmeters in accordance with Article 15 of the PED can be found on the flowtube body.

Flowmeter categories I – III use module H for conformity assessment procedures.

Rosemount 8800D Vortex Flowmeter Line Size 15 mm and 25 mm

Sound Engineering Practice

Flowmeters that are SEP are outside the scope of PED and cannot be marked for compliance with PED.

Hazardous Location Certifications

Rosemount 8800D

North American Certifications

Factory Mutual (FM)

E5 Explosionproof-Intrinsically Safe for Class I, Division 1, Groups B, C, and D;
Dust-ignition proof for Class II/III, Division 1, Groups E, F, and G;
Temperature Code T6 (-50 °C ≤ Ta ≤ 70 °C)
Factory Sealed
Enclosure Type 4X, IP66

I5 Intrinsically safe for use in Class I, II, III Division 1, Groups A, B, C, D, E, F, and G;
Non-incendive for Class I, Division 2, Groups A, B, C, and D
NIFW (Non-incendive Field Wiring) when installed per Rosemount Drawing 08800-0116
Temperature Code T4 (-50 °C ≤ Ta ≤ 70 °C) 4-20 mA HART
Temperature Code T4 (-50 °C ≤ Ta ≤ 60 °C) Fieldbus
Enclosure Type 4X, IP66

IE FISCO for Class I, II, III, Division 1, Groups A, B, C, D, E, F and G;
FNICO for Class 1 Division 2, Groups A, B, C, and D
Temperature Code T4 (-50 °C ≤ Ta ≤ 60 °C)
when installed per Rosemount control drawing 08800-0116
Enclosure Type 4X, IP66

K5 E5 and I5 Combination

Special Conditions for Safe Use (X):

1. When fitted with 90V transient suppressors (T1 Option), the equipment is not capable of passing the 500V insulation test. This must be taken into account upon installation.
2. The Model 8800D Vortex Flowmeter when ordered with aluminum electronics housing is considered to constitute a potential risk of ignition by impact or friction. Care should be taken into account during installation and use to prevent impact or friction.

Canadian Standards Association (CSA)

E6 Explosion-Proof for Class I, Division 1, Groups B, C, and D;
Dust-ignition proof for Class II and Class III, Division 1, Groups E, F, and G
Class I, Zone 1, Ex d[ia] IIC
Temperature Code T6 (-50 °C ≤ Ta ≤ 70 °C)
Factory Sealed
Single Seal
Enclosure Type 4X

I6 Intrinsically safe for use in Class I, II, III Division 1, Groups A, B, C, D, E, F, G;
Non-incendive for Class I, Division 2, Groups A, B, C and D
Temperature Code T4 (-50 °C ≤ T_a ≤ 70 °C) 4-20 mA HART
Temperature Code T4 (-50 °C ≤ T_a ≤ 60 °C) Fieldbus
Single Seal.
Enclosure Type 4X.

IF FISCO for Class I, Division 1, Groups A, B, C, and D;
FNICO for Class 1 Division 2, Groups A, B, C, and D.
Temperature Code T4 (-50 °C ≤ T_a ≤ 60 °C).
When installed per Rosemount drawing 08800-0112
Enclosure Type 4X

K6 E6 and I6 Combination

Combination Certifications

KB E5, I5, E6, and I6 Combination

European Certifications

ATEX Intrinsic Safety

EN 60079-0: 2012
EN 60079-11: 2012

I1 Certification No. Baseefa05ATEX0084X
ATEX Marking
Ex II 1 G Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ 70 °C) 4-20 HART
Ex II 1 G Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ 60 °C) Fieldbus
CE 0575

4-20 mA HART entity parameters		Fieldbus entity parameters		FISCO input parameters	
U_i	= 30 VDC	U_i	= 30 VDC	U_i	= 17.5 VDC
I_i(1)	= 185 mA	I_i	= 300 mA	I_i	= 380 mA
P_i(1)	= 1.0 W	P_i	= 1.3 W	P_i	= 5.32 W
C_i	= 0 µF	C_i	= 0 µF	C_i	= 0 µF
L_i	< 0.97 mH	L_i	< 10 µH	L_i	< 10 µH

(1) Total for transmitter.

ATEX FISCO

IA Certification No. Baseefa05ATEX0084X
ATEX Marking
Ex II 1 G Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ 60 °C)
CE 0575

Special Conditions for Safe Use (X):

1. When fitted with 90V transient suppressors (T1 Option), the equipment is not capable of passing the 500V isolation test. This must be taken into account upon installation.
2. The enclosure may be made from aluminium alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion when located in Zone 0 environment. The polyurethane paint finish may constitute an electrostatic hazard and must only be cleaned with a damp cloth.
3. When the equipment is installed, particular precautions must be taken to ensure taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

ATEX Type N Certification

EN 60079-0: 2012
EN 60079-11: 2012
EN 60079-15: 2010

N1 Certification No. Baseefa05ATEX0085X
ATEX Marking
Ex II 3 G Ex nA ic IIC T5 Gc (-50 °C ≤ Ta ≤ 70 °C) 4 -20 mA HART
Ex II 3 G Ex nA ic IIC T5 Gc (-50 °C ≤ Ta ≤ 60 °C) Fieldbus
Input Parameters:
Maximum Working Voltage = 42 VDC Max 4-20 mA HART
Maximum Working Voltage = 32 VDC Max Fieldbus

Special Conditions for Safe Use (X):

1. When fitted with 90V transient suppressors (T1 Option), the equipment is not capable of passing the 500V isolation test. This must be taken into account upon installation.
2. The enclosure may be made from aluminium alloy with a protective polyurethane paint finish. The polyurethane paint finish may constitute and electrostatic hazard and must only be cleaned with a damp cloth.
3. When the equipment is installed, particular precautions must be taken to ensure, taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

ATEX Flameproof Certification

EN 60079-0: 2009
EN 60079-1: 2007
EN 60079-11: 2012

E1 Certificate: KEMA99ATEX3852X
Integral Flowmeter marked:
Ex II 1/2 G Ex d [ia] IIC T6 Ga/Gb (-50 °C ≤ Ta ≤ 70 °C)
Remote Transmitter marked:
Ex II 2(1) G Ex d [ia Ga] IIC T6 Gb (-50 °C ≤ Ta ≤ 70 °C)
with meter body marked:
Ex II 1 G Ex ia IIC T6 Ga (-50 °C ≤ Ta ≤ 70 °C)
42 VDC Max 4-20 mA HART
32 VDC Max Fieldbus
U_m = 250V

Installation instructions:

1. The cable and conduit entry devices shall be of a certified flameproof type Ex d, suitable for the conditions of use and correctly installed.
2. Unused apertures shall be closed with suitable blanking elements.
3. When the ambient temperature at the cable or conduit entries exceed 60 °C, cables suitable for at least 90 °C shall be used.
4. Remote mounted sensor; in type of protection EX ia IIC, only to be connected to the associated Model 8800D Vortex Flowmeter electronics. the maximum allowable length of the interconnecting cable is 152 m (500 ft).

Special Conditions for Safe Use (X):

1. For information regarding the dimensions of the flameproof joints, the manufacturer shall be contacted.
2. The Flowmeter shall be provided with special fasteners of property class A2-70 or A4-70.
3. Units marked with "Warning: Electrostatic Charging Hazard" may use non-conductive paint thicker that 0.2 mm. Precaution shall be taken to avoid ignition due to electrostatic charge on the enclosure.

K1 E1, I1, and N1 Combination

International IECEx Certifications

Intrinsic Safety

IEC 60079-0: 2011
IEC 60079-11: 2011

I7 Certificate No. IECEx BAS05.0028X
Ex ia IIC T4 Ga (-60 °C ≤ T_a ≤ 70 °C) 4-20 mA HART
(-60 °C ≤ T_a ≤ 60 °C) Fieldbus

4-20 mA HART entity parameters		Fieldbus entity parameters		FISCO input parameters	
U_i	= 30 VDC	U_i	= 30 VDC	U_i	= 17.5 VDC
I_i(1)	= 185 mA	I_i	= 300 mA	I_i	= 380 mA
P_i(1)	= 1.0 W	P_i	= 1.3 W	P_i	= 5.32 W
C_i	= 0 µF	C_i	= 0 µF	C_i	= 0 µF
L_i	< 0.97 mH	L_i	< 10 µH	L_i	< 10 µH

(1) Total for transmitter.

FISCO

IG Certificate: IECEx BAS 05.0028X
Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ 60 °C)

Special Conditions for Safe Use (X):

1. When fitted with 90V transient suppressors (T1 Option), the equipment is not capable of passing the 500V isolation test. This must be taken into account upon installation.
2. The enclosure may be made from aluminium alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion when located in Zone 0 environment. The polyurethane paint finish may constitute an electrostatic hazard and must only be cleaned with a damp cloth.
3. When the equipment is installed, particular precautions must be taken to ensure, taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

Type n Certification

IEC 60079-0: 2011
IEC 60079-11: 2011
IEC 60079-15: 2010

N7 Certificate No. IECEx BAS05.0029X
Ex nA ic IIC T5 Gc (-50 °C ≤ Ta ≤ 70 °C) 4-20 mA HART
Ex nA ic IIC T5 Gc (-50 °C ≤ Ta ≤ 60 °C) Fieldbus
Maximum Working Voltage = 42 VDC 4-20 mA HART
Maximum Working Voltage = 32 VDC Fieldbus

Special Conditions for Safe Use (X):

1. When fitted with 90V transient suppressors (T1 Option), the equipment is not capable of passing the 500V isolation test. This must be taken into account upon installation.
2. The enclosure may be made from aluminium alloy with a protective polyurethane paint finish. The polyurethane paint finish may constitute an electrostatic hazard and must only be cleaned with a damp cloth.
3. When the equipment is installed, particular precautions must be taken to ensure, taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

Flameproof Certification

IEC 60079-0: 2007-10
IEC 60079-1: 2007-04
IEC 60079-11: 2011
IEC 60079-26: 2006

E7 Certificate: IECEx KEM05.0017X
Integral Flowmeter marked:
Ex d [ia] IIC T6 Ga/Gb (-50 °C ≤ T_a ≤ 70 °C)
Remote Transmitter marked:
Ex d [ia Ga] IIC T6 Gb(-50 °C ≤ T_a ≤ 70 °C)
with meter body marked:
Ex ia IIC T6 Ga (-50 °C ≤ Ta ≤ 70 °C)
42 VDC Max 4-20 mA HART
32 VDC Max Fieldbus
U_m = 250V

Installation instructions:

1. The cable and conduit entry devices shall be of a certified flameproof type Ex d, suitable for the conditions of use and correctly installed.
2. Unused apertures shall be closed with suitable blanking elements.
3. When the ambient temperature at the cable or conduit entries exceed 60 °C, cables suitable for at least 90 °C shall be used.
4. The remote mounted sensor may only be connected to the transmitter with the associated cable, supplied by the manufacturer.

Special Conditions for Safe Use (X):

1. For information regarding the dimensions of the flameproof joints, the manufacturer shall be contacted.
2. The Flowmeter shall be provided with special fasteners of property class A2-70 or A4-70.
3. Units marked with "Warning: Electrostatic Charging Hazard" may use non-conductive paint thicker that 0.2 mm. Precaution shall be taken to avoid ignition due to electrostatic charge on the enclosure.

Combination Certifications

K7 E7, I7, and N7 Combination

Chinese Certifications (NEPSI)

Flameproof Certification

GB3836.1 – 2010
GB3836.2 – 2010
GB3836.4 – 2010
GB3836.20 – 2010

E3 Certification No. GYJ12.1493X
Ex ia / d IIC T6 Ga/Gb (Integral Transmitter)
Ex d [ia Ga] IIC T6 Gb (Remote Transmitter)
Ex ia IIC T6 Ga (Remote Sensor)
Ambient temperature range: -50 °C ≤ Ta ≤ +70 °C
Process temperature range: -202 °C to +427 °C
Power Supply: 42 Vdc Max 4-20 mA HART
Power Supply: 32 Vdc Max Fieldbus

Special Conditions for Safe Use (X):

1. The maximum allowable length of the interconnecting cable between transmitter and sensor is 152 m. The cable shall also be provided by Rosemount Inc., or by Emerson Process Management Flow Technologies Co., Ltd.
2. Suitable heat-resisting cables rated at least +80 °C shall be used when the temperature around the cable entry exceeds +60 °C.
3. Dimensions of flameproof joints are other than the relevant minimum or maximum specified in Table 3 of GB3836.2-2010. Contact manufacturer for details.
4. The Flowmeter is provided with special fasteners of property class A2-70 or A4-70.
5. Any friction should be prevented in order to avoid the risk of electrostatic charge on the enclosure due to non-conductive paint.
6. The earthing terminal should be connected to the ground reliably at site.
7. Do not open when energized.
8. The cable entry holes have to be connected by means of suitable entry device or stopping plugs with type of protection of Ex d IIC Gb the cable entry device and stopping plugs are approved in accordance with GB3836.1-2010 and GB3836.2-2010, and which are covered by a separate examination certificate, any unused entry hole is to be fitted with type of protection of Ex d IIC Gb flameproof stopping plug.
9. Users are forbidden to change the configuration to ensure the explosion protection performance of the equipment. Any faults shall be settled with experts from the manufacturer.
10. Precautions shall be taken to ensure that the electronic parts are within permissible ambient temperature considering the effect of the allowed fluid temperature.
11. During installation, operation and maintenance, users shall comply with the relevant requirements of the product instruction manual, GB3836.13-1997 "Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres", GB3836.15-2000 "Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines)", GB3836.16-2006 "Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)", and GB50257-1996 "Code for construction and acceptance of electrical device for explosion atmospheres and fire hazard electrical equipment installation engineering".

I. S. Certification

GB3836.1 – 2010
GB3836.20 – 2010
GB3836.4 – 2010
GB12476.1 – 2010

I3 Certification No. GYJ12.1106X
Ex ia IIC T4 Ga (-60 °C ≤ T_a ≤ + 70 °C) HART
Ex ia IIC T4 Ga (-60 °C ≤ T_a ≤ + 60 °C) Fieldbus

4-20 mA HART entity parameters		Fieldbus entity parameters		FISCO input parameters	
U_i	= 30 VDC	U_i	= 30 VDC	U_i	= 17.5 VDC
I_i(1)	= 185 mA	I_i	= 300 mA	I_i	= 380 mA
P_i(1)	= 1.0 W	P_i	= 1.3 W	P_i	= 5.32 W
C_i	= 0 µF	C_i	= 0 µF	C_i	= 0 µF
L_i	≤ 0.97 mH	L_i	≤ 10 µH	L_i	≤ 10 µH

(1) Total for transmitter.

FISCO/FINCO

IH Certification No. IECEx BAS 05.0028X
Ex ia IIC T4 Ga (-60 °C ≤ T_a ≤ +60 °C)

Special Conditions for Safe Use (X):

1. The maximum allowable length of the interconnecting cable between transmitter and sensor is 152 m. The cable shall also be provided by manufacturer.
2. When transient protection terminal block applied to this product, during installation, users shall comply with Clause 12.2.4 in GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines).”
3. Suitable heat-resisting cables rated at least +80 °C shall be used when the temperature around the cable entry exceeds +60 °C.
4. Only be connected to the certified associated apparatus, the Vortex Flowmeter could be used in the explosive atmosphere. The connection should be complied with the requirements of the manual of the associated apparatus and the Vortex Flowmeter.
5. The enclosure should be taken to protect it from impact.
6. Any friction should be prevented in order to avoid the risk of electrostatic charge on the enclosure due to non-conductive paint.
7. The cable with shield is suitable for connection, and the shield should be connected to earth.
8. The enclosure shall be kept from the dust, but the dust shall not be blown by compressed air.
9. The cable entry holes have to be connected by means of suitable cable entry, the way of being installed shall be ensure that the equipment satisfies degree of protection IP66 according to GB4208-2008.
10. Users are forbidden to change the configuration to ensure the explosion protection performance of the equipment. Any faults shall be settled with experts from the manufacturer.
11. Precautions shall be taken to ensure that the electronic parts are within permissible ambient temperature considering the effect of the allowed fluid temperature.
12. During installation, operation and maintenance, users shall comply with the relevant requirements of the product instruction manual, GB3836.13- 1997 “Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres”, GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines)”, GB3836.16-2006 “Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)”, and GB50257-1996 “Code for construction and acceptance of electrical device for explosion atmospheres and fire hazard electrical equipment installation engineering”.

Type “n” Certification

GB3836.1 – 2010
GB3836.8 – 2003
GB3836.4 – 2010

Special Conditions for Safe Use (X):

1. The maximum allowable length of the interconnecting cable between transmitter and sensor is 152 m. The cable shall also be provided by the manufacturer.
2. Suitable heat-resisting cables rated at least +80 °C shall be used when the temperature around the cable entry exceeds +60 °C.
3. When transient protection terminal block (The Other Option is T1) applied to this product, during installation, users shall comply with Clause 12.2.4 in GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines).”
4. Any friction should be prevented in order to avoid the risk of electrostatic charge on the enclosure due to non-conductive paint.
5. Do not open when energized.
6. The cable entry holes have to be connected by means of suitable cable entry, the way of being installed shall be ensure that the equipment satisfies degree of protection IP54 according to GB4208-2008.
7. Users are forbidden to change the configuration to ensure the explosion protection performance of the equipment. Any faults shall be settled with experts from the manufacturer.
8. Precautions shall be taken to ensure that the electronic parts are within permissible ambient temperature considering the effect of the allowed fluid temperature.
9. During installation, operation and maintenance, users shall comply with the relevant requirements of the product instruction manual, GB3836.13- 1997 “Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres”, GB3836.15-2000 “Electrical apparatus for explosive gas atmospheres Part 15: Electrical installations in hazardous areas (other than mines)”, GB3836.16-2006 “Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)”, and GB50257-1996 “Code for construction and acceptance of electrical device for explosion atmospheres and fire hazard electrical equipment installation engineering”.

Combination Certifications: China

K3 E3, I3, and N3 Combination

Brazilian Certifications - INMETRO

I. S. Certification

ABNT NBR IEC 60079-0: 2008
ABNT NBR IEC 60079-11: 2009
ABNT NBR IEC 60079-26: 2008

I2 Certification Number: NCC 11.0699 X
Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ + 70 °C) HART
Ex ia IIC T6 Ga (-50 °C ≤ Ta ≤ + 60 °C) Fieldbus

IB Certification Number: NCC 11.0699 X
Ex ia IIC T4 Ga (-60 °C ≤ Ta ≤ + 60 °C) FISCO

4-20 mA HART entity parameters		Fieldbus entity parameters		FISCO input parameters	
U_i	= 30 VDC	U_i	= 30 VDC	U_i	= 17.5 VDC
I_i(1)	= 185 mA	I_i	= 300 mA	I_i	= 380 mA
P_i(1)	= 1.0 W	P_i	= 1.3 W	P_i	= 5.32 W
C_i	= 0 µF	C_i	= 0 µF	C_i	= 0 µF
L_i	≤ 0.97 mH	L_i	≤ 10 µH	L_i	≤ 10 µH

(1) Total for transmitter.

Special Conditions for Safe Use (X):

1. When fitted with 90V transient suppressors, the equipment is not capable of passing the 500V insulation test. This must be taken into account upon installation.
2. The enclosure may be made from aluminum alloy with a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion when located in Zone 0. The polyurethane paint finish may constitute an electrostatic hazard and must only be cleaned with a damp cloth.
3. When the equipment is installed, particular precautions must be taken to ensure, taking into account the effect of process fluid temperature, that the ambient temperature of the electrical housing of the equipment meets the marked protection type temperature range.

Flameproof Certification

ABNT NBR IEC 60079-0: 2008
ABNT NBR IEC 60079-1: 2009
ABNT NBR IEC 60079-11: 2009
ABNT NBR IEC 60079-26: 2008

E2 Certification Number: NCC 11.0622 X
Ex d [ia] IIC T6 Ga/Gb (Integral Transmitter)
Ex d [ia Ga] IIC T6 Gb (Remote Transmitter)
Ex ia IIC T6 Ga (Remote Sensor)
Ambient temperature range: -50 °C ≤ Ta ≤ +70 °C
Process temperature range: -202 °C to +427 °C
Power Supply: 42 Vdc Max 4-20 mA HART
Power Supply: 32 Vdc Max Fieldbus
Transmitter Um = 250 V

Remote mounted sensor

In type of protection Ex ia IIC, only to be connected to the associated Model 8800D Vortex Flowmeter electronics. The maximum length of the interconnecting cable is 152 m (500 ft).

Special Conditions for Safe Use (X):

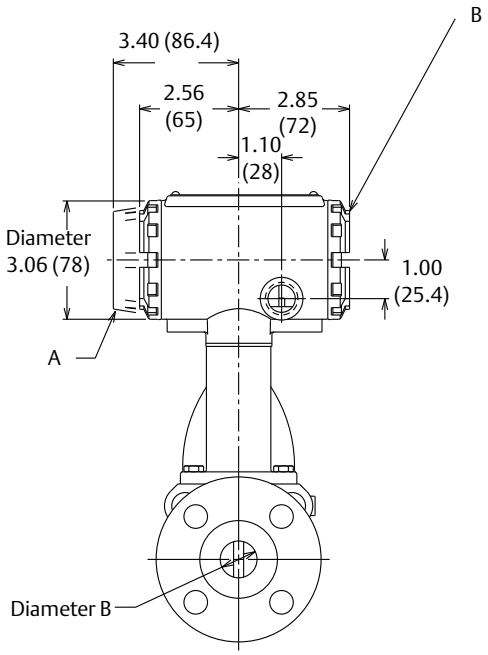
1. For information regarding the dimensions of the flameproof joints, the manufacturer shall be contacted.
2. The Flowmeter is provided with special fasteners of property class A2-70 of A4-70.
3. Units marked with “Warning: Electrostatic Charging Hazard” may use non-conductive paint thicker than 0.2 mm. Precautions shall be taken to avoid ignition due to electrostatic charge of the enclosure.

Combined Certifications: INMETRO

K3 E2 and I2 Combination

Dimensional Drawings

Figure 2. Flanged-Style Flowmeter (1/2-through 12-in./15 through 300 mm Line Sizes)



A. Display Option
B. Terminal Cover

Diagram illustrated without MTA option

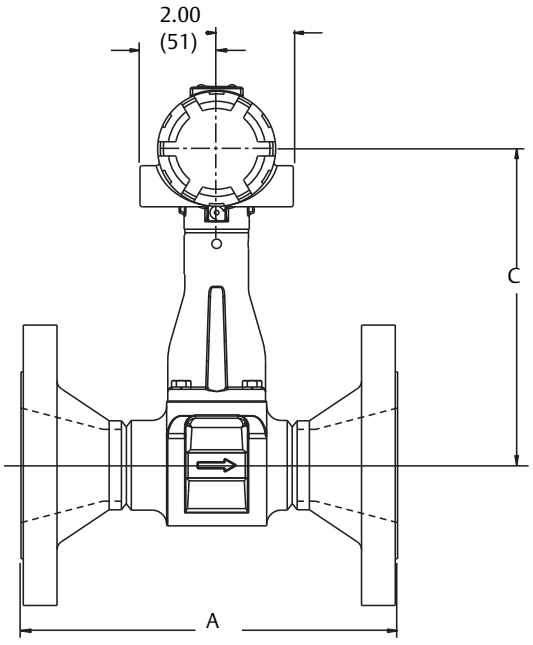
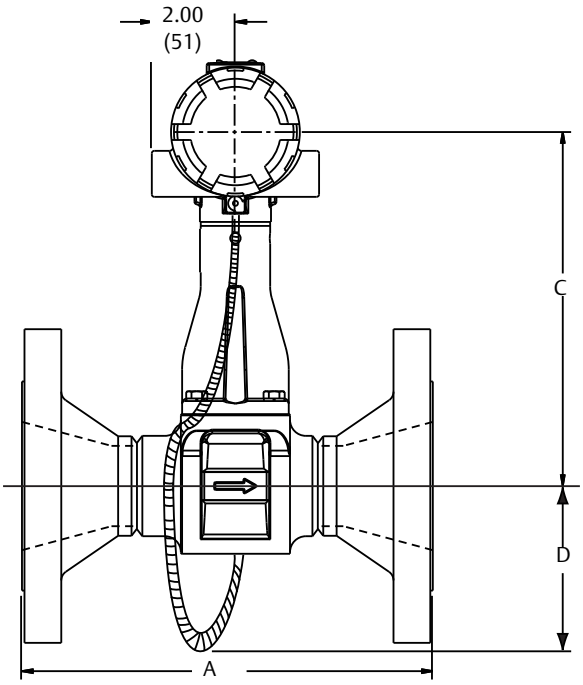


Diagram illustrated with MTA option



Dimensions are in inches (millimeters).

Table 21. Flanged-Style Flowmeter (1/2-in. through 2-in./15 through 50 mm Line Sizes)

Nominal size inch (mm)	Flange rating	Face-to-face A inch (mm)	A-ANSI RTJ inch (mm)	Diameter B inch (mm)	C inch (mm)	Weight lb (kg)
½ (15)	Class 150	6.8 (173)	–	0.54 (13,7)	7.6 (193)	9.1 (4,1)
	Class 300	7.2 (183)	7.6 (193)	0.54 (13,7)	7.6 (193)	10.4 (4,7)
	Class 600	7.7 (196)	7.6 (193)	0.54 (13,7)	7.6 (193)	10.8 (4,9)
	Class 900	8.3 (211)	8.3 (211)	0.54 (13,7)	7.6 (193)	15.3 (6,9)
	PN 16/40	6.1 (155)	–	0.54 (13,7)	7.6 (193)	10.4 (4,7)
	PN 100	6.6 (168)	–	0.54 (13,7)	7.6 (193)	12.4 (5,6)
	JIS 10K/20K	6.3 (160)	–	0.54 (13,7)	7.6 (193)	10.2 (4,6)
	JIS 40K	7.3 (185)	–	0.54 (13,7)	7.6 (193)	13.7 (6,2)
1 (25)	Class 150	7.5 (191)	8.0 (203)	0.95 (24,1)	7.7 (196)	12.3 (5,6)
	Class 300	8.0 (203)	8.5 (216)	0.95 (24,1)	7.7 (196)	15.0 (6,8)
	Class 600	8.5 (216)	8.5 (216)	0.95 (24,1)	7.7 (196)	15.8 (7,2)
	Class 900	9.4 (239)	9.4 (239)	0.95 (24,1)	7.7 (196)	24.1 (11,1)
	Class 1500	9.4 (239)	9.4 (239)	0.95 (24,1)	7.7 (196)	24.4 (11,1)
	PN 16/40	6.2 (157)	–	0.95 (24,1)	7.7 (196)	13.6 (6,2)
	PN 100	7.7 (196)	–	0.95 (24,1)	7.7 (196)	19.6 (8,9)
	PN 160	7.7 (196)	–	0.95 (24,1)	7.7 (196)	19.6 (8,9)
	JIS 10K/20K	6.5 (165)	–	0.95 (24,1)	7.7 (196)	14.0 (6,3)
	JIS 40K	7.8 (198)	–	0.95 (24,1)	7.7 (196)	17.7 (7,9)
1 ½ (40)	Class 150	8.2 (208)	8.7 (221)	1.49 (37,8)	8.1 (206)	17.6 (8,0)
	Class 300	8.7 (221)	9.2 (234)	1.49 (37,8)	8.1 (206)	23.0 (10,4)
	Class 600	9.3 (236)	9.3 (236)	1.49 (37,8)	8.1 (206)	25.5 (11,6)
	Class 900	10.3 (262)	10.3 (262)	1.49 (37,8)	8.1 (206)	36.6 (16,6)
	Class 1500	10.3 (262)	10. 3(262)	1.49 (37,8)	8.1 (206)	36.6 (16,6)
	PN 16/40	6.9 (175)	–	1.49 (37,8)	8.1 (206)	19.4 (8,8)
	PN 100	8.2 (208)	–	1.49 (37,8)	8.1 (206)	28.0 (12,7)
	PN 160	8.4 (213)	–	1.49 (37,8)	8.1 (206)	29.5 (13,4)
	JIS 10K/20K	7.3 (185)	–	1.49 (37,8)	8.1 (206)	18.6 (8,4)
	JIS 40K	8.4 (213)	–	1.49 (37,8)	8.1 (206)	25.5 (11,6)
2 (50)	Class 150	9.2 (234)	9.7(246)	1.92 (48,8)	8.5 (216)	22.0 (10,0)
	Class 300	9.7 (246)	10.4 (264)	1.92 (48,8)	8.5 (216)	26.1 (11,8)
	Class 600	10.5 (267)	10.6 (269)	1.92 (48,8)	8.5 (216)	29.8 (13,5)
	Class 900	12.7 (323)	12.9 (328)	1.92 (48,8)	8.5 (216)	59.5 (27,0)
	Class 1500	12.7 (323)	12.9 (328)	1.79 (45,5)	8.5 (216)	59.5 (27,0)
	PN 16/40	8.0 (203)	–	1.92 (48,8)	8.5 (216)	23.2 (10,5)
	PN 63/64	9.1 (231)	–	1.92 (48,8)	8.5 (216)	30.8 (13,9)
	PN 100	9.6 (244)	–	1.92 (48,8)	8.5 (216)	36.5 (16,6)
	PN 160	10.2 (259)	–	1.92 (48,8)	8.5 (216)	38.8 (17,6)
	JIS 10K	7.7 (195)	–	1.92 (48,8)	8.5 (216)	19.5 (8,8)
	JIS 20K	8.3 (210)	–	1.92 (48,8)	8.5 (216)	20.4 (9,3)
	JIS 40K	9.8 (249)	–	1.92 (48,8)	8.5 (216)	28.5 (12,9)

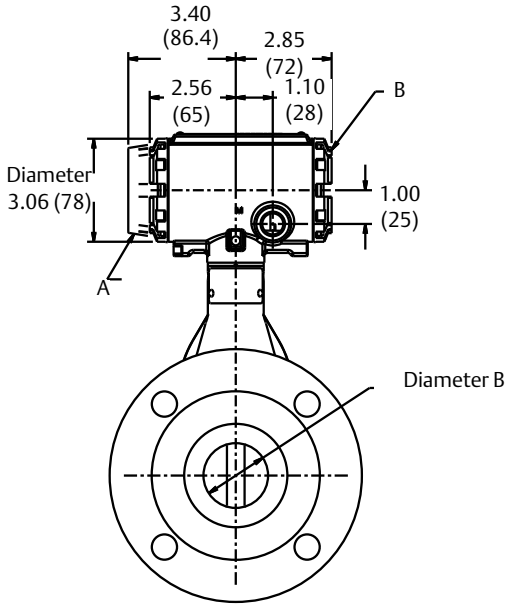
Table 22. Flanged-Style Flowmeter (3-in. through 6-in./80 through 150mm Line Sizes) (refer to previous drawing)

Nominal size inch (mm)	Flange rating	Face-to-face A inch (mm)	A ANSI RTJ inch (mm)	Diameter B inch (mm)	C inch (mm)	Weight lb (kg)
3 (80)	Class 150	9.9 (251)	10.4 (264)	2.87 (72,9)	9.1 (231)	37.2 (16,9)
	Class 300	10.6 (269)	11.2 (284)	2.87 (72,9)	9.1 (231)	46.5 (21,1)
	Class 600	11.4 (290)	11.5 (292)	2.87 (72,9)	9.1 (231)	52.6 (23,8)
	Class 900	12.9 (328)	13.0 (330)	2.87 (72,9)	9.1 (231)	76.1 (34,5)
	Class 1500	14.1 (358)	14.2 (361)	2.60 (66)	9.1 (231)	108.9 (49,4)
	PN 16/40	8.9 (226)	–	2.87 (72,9)	9.1 (231)	36.6 (16,6)
	PN 63/64	10.0 (254)	–	2.87 (72,9)	9.1 (231)	45.3 (20,6)
	PN 100	10.5 (267)	–	2.87 (72,9)	9.1 (231)	54.7 (24,8)
	PN 160	11.1 (282)	–	2.87 (72,9)	9.1 (231)	59.6 (27,0)
	JIS 10K	7.9 (201)	–	2.87 (72,9)	9.1 (231)	28.0 (12,7)
	JIS 20K	9.3 (236)	–	2.87 (72,9)	9.1 (231)	35.4 (16,1)
	JIS 40K	11.0 (279)	–	2.87 (72,9)	9.1 (231)	50.3 (22,8)
4 (100)	Class 150	10.3 (262)	10.8 (274)	3.79 (96,3)	9.6 (244)	51.3 (23,3)
	Class 300	11.0 (279)	11.6 (295)	3.79 (96,3)	9.6 (244)	71.5 (32,4)
	Class 600	12.8 (325)	12.9 (328)	3.79 (96,3)	9.6 (244)	97.5 (44,2)
	Class 900	13.8 (351)	13.9 (353)	3.79 (96,3)	9.6 (244)	120.8 (54,8)
	Class 1500	14.5 (368)	14.6 (371)	3.40 (86,4)	9.6 (244)	162.6 (73,8)
	PN 16	8.4 (213)	–	3.79 (96,3)	9.6 (244)	40.4 (18,3)
	PN 40	9.4 (239)	–	3.79 (96,3)	9.6 (244)	49.5 (22,4)
	PN 63/64	10.4 (264)	–	3.79 (96,3)	9.6 (244)	62.5 (28,3)
	PN 100	11.3 (287)	–	3.79 (96,3)	9.6 (244)	78.9 (35,8)
	PN 160	12.1 (307)	–	3.79 (96,3)	9.6 (244)	86.2 (39,1)
	JIS 10K	8.7 (220)	–	3.79 (96,3)	9.6 (244)	37.5 (17,0)
	JIS 20K	8.7 (220)	–	3.79 (96,3)	9.6 (244)	45.4 (20,6)
	JIS 40K	11.8 (300)	–	3.79 (96,3)	9.6 (244)	75.8 (34,4)
6 (150)	Class 150	11.6 (295)	12.1 (307)	5.7 (144,8)	10.8 (274)	81 (37)
	Class 300	12.3 (312)	13.0 (330)	5.7 (144,8)	10.8 (274)	120 (55)
	Class 600	14.3 (363)	14.4 (366)	5.7 (144,8)	10.8 (274)	187 (55)
	Class 900	16.1 (409)	16.2 (411)	5.14 (130,6)	10.8 (274)	277.9 (126,0)
	Class 1500	18.6 (472)	18.8 (478)	5.14 (130,6)	10.8 (274)	375.8 (170.4)
	PN 16	8.9 (226)	–	5.7 (144,8)	10.8 (274)	66 (30)
	PN 40	10.5 (267)	–	5.7 (144,8)	10.8 (274)	86 (39)
	PN 63/64	12.1 (307)	–	5.7 (144,8)	10.8 (274)	130 (59)
	PN 100	13.6 (345)	–	5.7 (144,8)	10.8 (274)	160 (73)
	JIS 10K	10.6 (270)	–	5.7 (144,8)	10.8 (274)	70 (32)
	JIS 20K	10.6 (270)	–	5.7 (144,8)	10.8 (274)	88 (40)
	JIS 40K	14.2 (361)	–	5.7 (144,8)	10.8 (274)	166 (75)

Table 23. Flanged-Style Flowmeter (8-in. through 12-in./200 through 300mm Line Sizes) (refer to previous drawing)

Nominal size inch (mm)	Flange rating	Face-to-face A inch (mm)	A ANSI RTJ inch (mm)	Diameter B inch (mm)	C inch (mm)	Weight lb (kg)
8 (200)	Class 150	13.5 (343)	14.0 (356)	7.55 (191,8)	11.7 (297)	141.6 (64,2)
	Class 300	14.3 (363)	14.9 (378)	7.55 (191,8)	11.7 (297)	198.7 (90,1)
	Class 600	16.5 (419)	16.7 (424)	7.55 (191,8)	11.7 (297)	298.6 (135,4)
	Class 900	18.8 (478)	18.9 (480)	6.62 (168,1)	11.7 (297)	479.2 (217,4)
	Class 1500	22.8 (579)	23.2 (589)	6.62 (168,1)	11.7 (297)	652.4 (295,9)
	PN 10	10.4 (264)	–	7.55 (191,8)	11.7 (297)	110.5 (50,1)
	PN 16	10.4 (264)	–	7.55 (191,8)	11.7 (297)	109.4 (49,6)
	PN 25	11.8 (300)	–	7.55 (191,8)	11.7 (297)	137.7 (62,5)
	PN 40	12.5 (318)	–	7.55 (191,8)	11.7 (297)	156.5 (71,0)
	PN 63/64	14.2 (361)	–	7.55 (191,8)	11.7 (297)	217.1 (98,5)
	PN 100	15.8 (401)	–	7.55 (191,8)	11.7 (297)	282.7 (128,2)
	JIS 10K	12.2 (310)	–	7.55 (191,8)	11.7 (297)	110.1 (49,9)
	JIS 20K	12.2 (310)	–	7.55 (191,8)	11.7 (297)	134.5 (61,0)
	JIS 40K	16.5 (419)	–	7.55 (191,8)	11.7 (297)	255.7 (116)
10 (250)	Class 150	14.5 (368)	15.0 (381)	9.56 (243)	12.8 (325)	197.7 (89,7)
	Class 300	15.8 (401)	16.4 (417)	9.56 (243)	12.8 (325)	286.2 (129,8)
	Class 600	19.0 (483)	19.2 (488)	9.56 (243)	12.8 (325)	477.9 (219,9)
	PN 10	11.9 (302)	–	9.56 (243)	12.8 (325)	157.1 (71,3)
	PN 16	12.0 (305)	–	9.56 (243)	12.8 (325)	161.9 (73,5)
	PN 25	13.5 (343)	–	9.56 (243)	12.8 (325)	198.6 (90,1)
	PN 40	14.8 (376)	–	9.56 (243)	12.8 (325)	246.8 (111,9)
	PN 63/64	16.4 (417)	–	9.56 (243)	12.8 (325)	308.2 (139,8)
	PN 100	18.9 (480)	–	9.56 (243)	12.8 (325)	445.2 (201,9)
	JIS 10K	14.5 (368)	–	9.56 (243)	12.8 (325)	174.5 (79,1)
	JIS 20K	14.5 (368)	–	9.56 (243)	12.8 (325)	221.8 (100,6)
	JIS 40K	18.1 (460)	–	9.56 (243)	12.8 (325)	378.5 (171,7)
12 (300)	Class 150	16.8 (427)	17.3 (439)	11.38 (289)	13.7 (348)	297.5 (134,9)
	Class 300	18.0 (457)	18.6 (472)	11.38 (289)	13.7 (348)	415.7 (188,6)
	Class 600	20.5 (521)	20.6 (523)	11.38 (289)	13.7 (348)	595.4 (270,1)
	PN 10	13.1 (333)	–	11.38 (289)	13.7 (348)	204.1 (92,6)
	PN 16	13.9 (353)	–	11.38 (289)	13.7 (348)	224.6 (101,9)
	PN 25	15.0 (381)	–	11.38 (289)	13.7 (348)	269.4 (122,2)
	PN 40	16.8 (427)	–	11.38 (289)	13.7 (348)	347.9 (157,8)
	PN 63/64	18.8 (478)	–	11.38 (289)	13.7 (348)	431.2 (195,6)
	PN 100	21.2 (538)	–	11.38 (289)	13.7 (348)	644.1 (292,2)
	JIS 10K	15.7 (399)	–	11.38 (289)	13.7 (348)	222.9 (101,1)
	JIS 20K	15.7 (399)	–	11.38 (289)	13.7 (348)	284.2 (128,9)
	JIS 40K	19.6 (498)	–	11.38 (289)	13.7 (348)	493.8 (224,0)

Figure 3. Rosemount 8800DR Reducer Flowmeter (1-in. through 12-in./25 through 300 mm Line Sizes)



A. Display Option
B. Terminal Cover

Diagram illustrated without MTA option

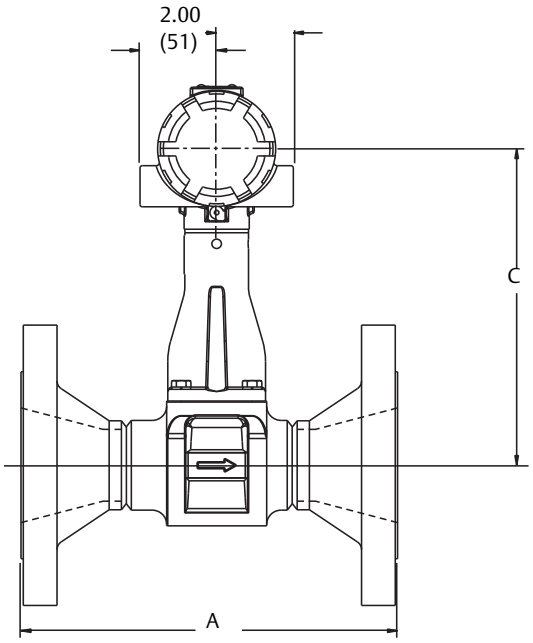
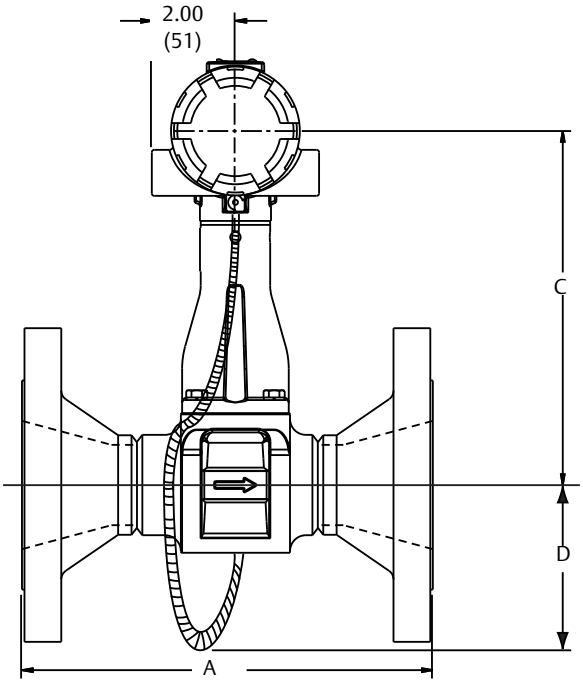


Diagram illustrated with MTA option



Dimensions are in inches (millimeters).

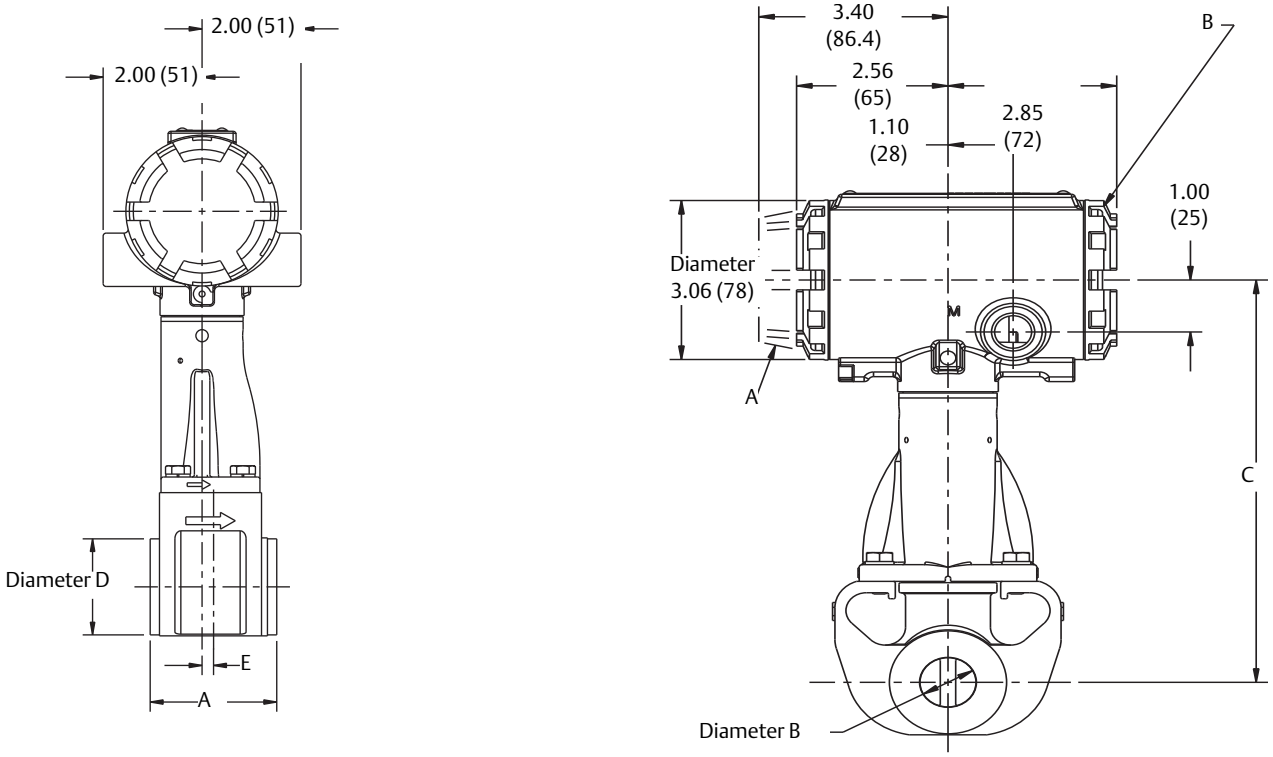
Table 24. Reducer Flowmeter (1-in. through 3-in./25 through 80 mm Line Sizes)

Nominal size inch (mm)	Flange rating	Face-to-face A inch (mm)	A-ANSI RTJ inch (mm)	Diameter B inch (mm)	C inch (mm)	Weight lb (kg)
1 (25)	Class 150	7.5 (191)	8.0 (203)	0.54 (13,7)	7.6 (193)	11.56 (5,24)
	Class 300	8.0 (203)	8.5 (216)	0.54 (13,7)	7.6 (193)	14.22 (6,45)
	Class 600	8.5 (216)	8.5 (216)	0.54 (13,7)	7.6 (193)	15.11 (6,85)
	Class 900	9.4 (239)	9.4 (239)	0.54 (13,7)	7.6 (193)	20.70 (9.40)
	PN 16/40	6.2 (157)	–	0.54 (13,7)	7.6 (193)	12.64 (5,73)
	PN 100	7.7 (196)	–	0.54 (13,7)	7.6 (193)	18.44 (8,36)
1 ½ (40)	Class 150	8.2 208	8.7 (221)	0.95 (24,1)	7.7 (196)	15.81 (7,17)
	Class 300	8.7 (221)	9.2 (234)	0.95 (24,1)	7.7 (196)	21.20 (9,62)
	Class 600	9.3 (236)	9.3 (236)	0.95 (24,1)	7.7 (196)	23.77 (10,78)
	Class 900	10.3 (262)	10.3 (262)	0.95 (24,1)	7.7 (196)	34.98 (15,87)
	PN 16/40	6.9 (175)	–	0.95 (24,1)	7.7 (196)	17.50 (7,94)
	PN 100	8.2 (208)	–	0.95 (24,1)	7.7 (196)	26.20 (11,88)
	PN 160	8.4 (213)	–	0.95 (24,1)	7.7 (196)	27.67 (12,55)
2 (50)	Class 150	9.2 (234)	9.7 (246)	1.49 (37,8)	8.1 (206)	22.61 (10,26)
	Class 300	9.7 (246)	10.4 (264)	1.49 (37,8)	8.1 (206)	26.76 (12,14)
	Class 600	10.5 (267)	10.6 (269)	1.49 (37,8)	8.1 (206)	30.59 (13,88)
	Class 900	12.7 (323)	12.9 (328)	1.49 (37,8)	8.1 (206)	60.76 (27,56)
	PN 16/40	8.0 (203)	–	1.49 (37,8)	8.1 (206)	23.52 (10,67)
	PN 63/64	9.1 (231)	–	1.49 (37,8)	8.1 (206)	31.28 (14,19)
	PN 100	9.6 (244	–	1.49 (37,8)	8.1 (206)	37.25 (16,90)
	PN 160	10.2 (259)	–	1.49 (37,8)	8.1 (206)	39.64 (17,98)
3 (80)	Class 150	9.9 (251)	10.4 (264)	1.92 (48,8)	8.5 (216)	33.15 (15,04)
	Class 300	10.6 (269)	11.2 (284)	1.92 (48,8)	8.5 (216)	42.66 (19,35)
	Class 600	11.4 (290)	11.5 (292)	1.92 (48,8)	8.5 (216)	49.46 (22,43)
	Class 900	12.9 (328)	13.0 (330)	1.92 (48,8)	8.5 (216)	73.28 (33,24)
	PN 16/40	8.9 (226)	–	1.92 (48,8)	8.5 (216)	33.30 (15,10)
	PN 63/64	10.0 (254)	–	1.92 (48,8)	8.5 (216)	42.45 (19,25)
	PN 100	10.5 (267)	–	1.92 (48,8)	8.5 (216)	52.21 (23,68)
	PN 160	11.1 (282)	–	1.92 (48,8)	8.5 (216)	57.94 (26,28)

Table 25. Reducer Flowmeter (4-in. through 12-in./100 through 300mm Line Sizes) (refer to previous drawing)

Nominal size inch (mm)	Flange rating	Face-to-face A inch (mm)	A ANSI RTJ inch (mm)	Diameter B inch (mm)	C inch (mm)	Weight lb (kg)
4 (100)	Class 150	10.3 (262)	10.8 (274)	2.87 (72,9)	9.1 (231)	46.33 (21,01)
	Class 300	11.0 (279)	11.6 (295)	2.87 (72,9)	9.1 (231)	67.04 (30,41)
	Class 600	12.8 (325)	12.9 (328)	2.87 (72,9)	9.1 (231)	94.26 (42,76)
	Class 900	13.8 (351)	13.9 (353)	2.87 (72,9)	9.1 (231)	118.04 (53,54)
	PN 16	8.4 (213)	–	2.87 (72,9)	9.1 (231)	36.36 (16,49)
	PN 40	9.4 (239)	–	2.87 (72,9)	9.1 (231)	45.89 (20,81)
	PN 63/64	10.4 (264)	–	2.87 (72,9)	9.1 (231)	59.72 (27,09)
	PN 100	11.3 (287)	–	2.87 (72,9)	9.1 (231)	76.73 (34,80)
	PN 160	12.1 (307)	–	2.87 (72,9)	9.1 (231)	84.73 (38,43)
6 (150)	Class 150	11.6 (295)	12.1 (307)	3.79 (96,3)	9.6 (244)	70.27 (31,87)
	Class 300	12.3 (312)	13.0 (330)	3.79 (96,3)	9.6 (244)	113.09 (51,30)
	Class 600	14.3 (363)	14.4 (366)	3.79 (96,3)	9.6 (244)	185.13 (83,97)
	Class 900	16.1 (409)	16.2 (411)	3.79 (96,3)	9.6 (244)	246.33 (111,73)
	PN 16	8.9 (226)	–	3.79 (96,3)	9.6 (244)	59.20 (26,85)
	PN 40	10.5 (267)	–	3.79 (96,3)	9.6 (244)	81.94 (37,17)
	PN 63/64	12.1 (307)	–	3.79 (96,3)	9.6 (244)	125.36 (56,86)
	PN 100	13.6 (345)	–	3.79 (96,3)	9.6 (244)	162.29 (73,61)
	PN 160	14.7 (373)	–	3.79 (96,3)	9.6 (244)	187.91 (85,23)
8 (200)	Class 150	13.5 (343)	14.0 (356)	5.70 (144,8)	10.8 (274)	124 (56)
	Class 300	14.3 (363)	14.9 (378)	5.70 (144,8)	10.8 (274)	186 (84)
	Class 600	16.5 (419)	16.7 (424)	5.70 (144,8)	10.8 (274)	295 (134)
	PN 10	10.4 (264)	–	5.70 (144,8)	10.8 (274)	91 (41)
	PN 16	10.4 (264)	–	5.70 (144,8)	10.8 (274)	91 (41)
	PN 25	11.8 (300)	–	5.70 (144,8)	10.8 (274)	124 (56)
	PN 40	12.5 (318)	–	5.70 (144,8)	10.8 (274)	145 (66)
	PN 63/64	14.2 (361)	–	5.70 (144,8)	10.8 (274)	211 (96)
	PN 100	15.8 (401)	–	5.70 (144,8)	10.8 (274)	283 (128)
10 (250)	Class 150	14.5 (368)	15.0 (381)	7.55 (191,8)	11.7 (297)	182.45 (82,76)
	Class 300	15.8 (401)	16.4 (417)	7.55 (191,8)	11.7 (297)	281.66 (127,76)
	Class 600	19.0 (483)	19.2 (488)	7.55 (191,8)	11.7 (297)	489.89 (222,21)
	PN 10	11.9 (302)	–	7.55 (191,8)	11.7 (297)	138.63 (62,88)
	PN 16	12.0 (305)	–	7.55 (191,8)	11.7 (297)	148.58 (67,39)
	PN 25	13.5 (343)	–	7.55 (191,8)	11.7 (297)	191.00 (86,64)
	PN 40	14.8 (376)	–	7.55 (191,8)	11.7 (297)	245.85 (111,52)
	PN 63/64	16.4 (417)	–	7.55 (191,8)	11.7 (297)	314.13 (142,49)
	PN 100	18.9 (480)	–	7.55 (191,8)	11.7 (297)	463.49 (210,24)
12 (300)	Class 150	16.8 (427)	17.3 (439)	9.56 (242,8)	12.8 (325)	281.98 (127,90)
	Class 300	18.0 (457)	18.6 (472)	9.56 (242,8)	12.8 (325)	412.18 (186,96)
	Class 600	20.5 (521)	20.6 (523)	9.56 (242,8)	12.8 (325)	609.89 (296,64)
	PN 10	13.1 (333)	–	9.56 (242,8)	12.8 (325)	188.28 (85,40)
	PN 16	13.9 (353)	–	9.56 (242,8)	12.8 (325)	211.79 (96,07)
	PN 25	15.0 (381)	–	9.56 (242,8)	12.8 (325)	262.45 (119,05)
	PN 40	16.8 (427)	–	9.56 (242,8)	12.8 (325)	349.92 (158,72)
	PN 63/64	18.8 (478)	–	9.56 (242,8)	12.8 (325)	444.21 (201,49)
	PN 100	21.2 (538)	–	9.56 (242,8)	12.8 (325)	672.07 (304,85)

Figure 4. Wafer-Style (1/2-in. through 8-in./15 through 200 mm Line Sizes)



A. Display Option

B. Terminal Cover

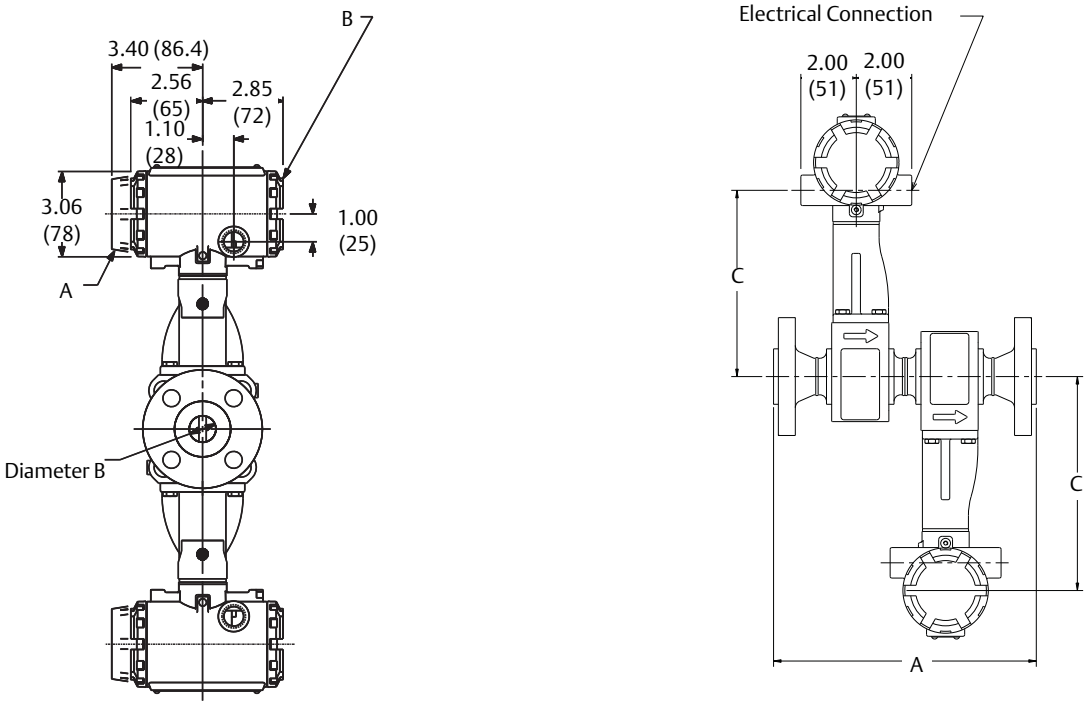
Dimensions are in inches (millimeters).
Electronics housing may be rotated in 90 degree increments.

Table 26. Rosemount 8800D Wafer-Style Meter

Nominal size inch (mm)	Face-to-face A inch (mm)	Diameter B inch (mm)	C inch (mm)	E inch (mm)	Weight lb (kg)(1)
½ (15)	2.56 (65)	0.52 (13,2)	7.63 (194)	0.17 (4,3)	6.8 (3,1)
1 (25)	2.56 (65)	0.95 (24,1)	7.74 (197)	0.23 (5,9)	7.4 (3,4)
1½ (40)	2.56 (65)	1.49 (37,8)	8.14 (207)	0.18 (4,6)	10.0 (4,5)
2 (50)	2.56 (65)	1.92 (49)	8.85 (225)	0.12 (3)	10.6 (4,8)
3 (80)	2.56 (65)	2.87 (73)	9.62 (244)	0.25 (6)	13.6 (6,2)
4 (100)	3.42 (87)	3.79 (96)	10.48 (266)	0.44 (11)	21.4 (9,7)
6 (150)	5.00 (127)	5.70 (145)	10.29 (261)	0.30 (7,6)	36 (16)
8 (200)	6.60 (168)	7.55 (192)	11.22 (285)	0.70 (17,8)	62 (28)

(1) Add 0.2 lb (0,1 kg) for display option.

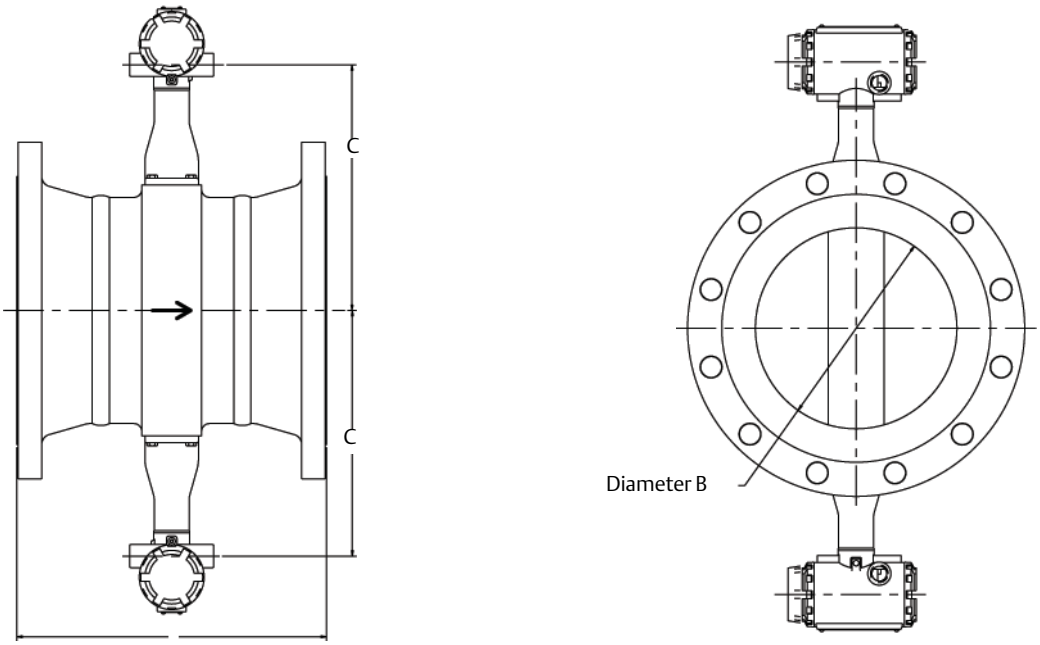
Figure 5. Vortex Dual-Sensor Style Flowmeter (1/2-in. through 4-in. /15 through 100 mm Line Sizes)



A. Display Option

B. Terminal Cover

Figure 6. Vortex Dual-Sensor Style Flowmeter (6-in. through 12-in./150 through 300 mm Line Sizes)



Dimensions are in inches (millimeters).

Table 27. Vortex Dual-Sensor Style Flowmeter (1/2-in. through 3-in./15 through 80 mm Line Sizes)

Nominal size inch (mm)	Flange rating	Face-to-face A inch (mm)	A ANSI RTJ inch (mm)	Diameter B inch (mm)	C inch (mm)	Weight lb (kg)
½ (15)	Class 150	11.9 (302)	–	0.54 (13,7)	7.6 (193)	16.2 (7,4)
	Class 300	12.3 (312)	12.7 (323)	0.54 (13,7)	7.6 (193)	17.4 (7,9)
	Class 600	12.8 (325)	12.7 (323)	0.54 (13,7)	7.6 (193)	17.9 (8,1)
	Class 900	13.4 (340)	13.4 (340)	0.54 (13,7)	7.6 (193)	22.7 (10,3)
	PN 16/40	11.2 (284)	–	0.54 (13,7)	7.6 (193)	17.4 (7,9)
	PN 100	11.7 (297)	–	0.54 (13,7)	7.6 (193)	19.4 (8,8)
	JIS 10K/20K	11.4 (290)	–	0.54 (13,7)	7.6 (193)	17.3 (7.8)
	JIS 40K	12.4 (315)	–	0.54 (13,7)	7.6 (193)	20.8 (9.4)
1 (25)	Class 150	15.0 (381)	15.6 (396)	0.95 (24,1)	7.7 (196)	20.7 (9,4)
	Class 300	15.6 (396)	16.1 (409)	0.95 (24,1)	7.7 (196)	23.3 (10,6)
	Class 600	16.1 (409)	16.1 (409)	0.95 (24,1)	7.7 (196)	24.2 (11,0)
	Class 900	16.9 (429)	16.9 (429)	0.95 (24,1)	7.7 (196)	32.8 (14,9)
	Class 1500	16.9 (429)	16.9 (429)	0.95 (24,1)	7.7 (196)	32.8 (14,9)
	PN 16/40	13.8 (351)	–	0.95 (24,1)	7.7 (196)	21.9 (9,9)
	PN 100	15.3 (389)	–	0.95 (24,1)	7.7 (196)	28.0 (12,7)
	PN 160	15.3 (389)	–	0.95 (24,1)	7.7 (196)	28.0 (12,7)
	JIS 10K/20K	14.0 (356)	–	0.95 (24,1)	7.7 (196)	22.3 (10.1)
	JIS 40K	15.4 (391	–	0.95 (24,1)	7.7 (196)	26.08 (11,8)
1½ (40)	Class 150	11.3 (287)	11.8 (300)	1.49 (37,8)	8.1 (206)	27.0 (12,3)
	Class 300	11.8 (300)	12.3 (312)	1.49 (37,8)	8.1 (206)	32.4 (14,7)
	Class 600	12.4 (315)	12.4 (315)	1.49 (37,8)	8.1 (206)	34.8 (15,8)
	Class 900	13.4 (340)	13.4 (340)	1.49 (37,8)	8.1 (206)	45.9 (20.8)
	Class 1500	13.4 (340)	13.4 (340)	1.49 (37,8)	8.1 (206)	45.9 (20.8)
	PN 16/40	9.9 (251)	–	1.49 (37,8)	8.1 (206)	28.7 (13,0)
	PN 100	11.3 (287)	–	1.49 (37,8)	8.1 (206)	37.4 (17,0)
	PN 160	11.4 (290)	–	1.49 (37,8)	8.1 (206)	38.8 (17,6)
	JIS 10K/20K	10.3 (262)	–	1.49 (37,8)	8.1 (206)	27.9 (12,6)
	JIS 40K	11.5 (292)	–	1.49 (37,8)	8.1 (206)	34.9 (15,8)
2 (50)	Class 150	13.0 (330)	13.5 (343)	1.92 (48,8)	8.5 (216)	31.9 (14,5)
	Class 300	13.5 (343)	14.0 (356)	1.92 (48,8)	8.5 (216)	35.9 (16,3)
	Class 600	14.3 (363)	14.3 (363)	1.92 (48,8)	8.5 (216)	39.4 (17,9)
	Class 900	16.5 (419)	16.7 (424)	1.92 (48,8)	8.5 (216)	69.1 (31,4)
	Class 1500	15.6 (396)	15.7 (399)	1.67 (42.4)	8.5 (216)	72.4 (32,9)
	PN 16/40	11.8 (300)	–	1.92 (48,8)	8.5 (216)	32.8 (14,9)
	PN 63/64	12.9 (328)	–	1.92 (48,8)	8.5 (216)	40.4 (18,3)
	PN 100	13.4 (340)	–	1.92 (48,8)	8.5 (216)	46.2 (20,9)
	PN 160	13.9 (353)	–	1.92 (48,8)	8.5 (216)	48.4 (21,9)
	JIS 10K	11.5 (292)	–	1.92 (48,8)	8.5 (216)	29.1 (13,2)
	JIS 20K	12.0 (305)	–	1.92 (48,8)	8.5 (216)	30.0 (13,6)
	JIS 40K	13.6 (345)	–	1.92 (48,8)	8.5 (216)	38.1 (13,6
3 (80)	Class 150	14.3 (363)	14.8 (376)	2.87 (72,9)	9.1 (231)	50.6 (23,0)
	Class 300	15.0 (381)	15.7 (399)	2.87 (72,9)	9.1 (231)	59.9 (27,2)
	Class 600	15.8 (401)	15.9 (404)	2.87 (72,9)	9.1 (231)	65.9 (29,9)
	Class 900	17.3 (439)	17.4 (442)	2.87 (72,9)	9.1 (231)	88.4 (40.8)
	Class 1500	18.5 (470)	18.7 (475)	2.60 (66.0)	9.1 (232)	123.8 (56,2)
	PN 16/40	13.4 (340)	–	2.87 (72,9)	9.1 (231)	50.0 (22,7)
	PN 63/64	14.5 (367)	–	2.87 (72,9)	9.1 (231)	58.7 (26,6)
	PN 100	14.9 (378)	–	2.87 (72,9)	9.1 (231)	68.0 (30,9)
	PN 160	15.6 (396)	–	2.87 (72,9)	9.1 (231)	73.4 (33,3)
	JIS 10K	12.3 (312)	–	2.87 (72,9)	9.1 (231)	41.4 (18,8)
	JIS 20K	13.7 (348)	–	2.87 (72,9)	9.1 (231)	48.8 (22,1)
	JIS 40K	15.5 (394)	–	2.87 (72,9)	9.1 (231)	63.7 (28,9)

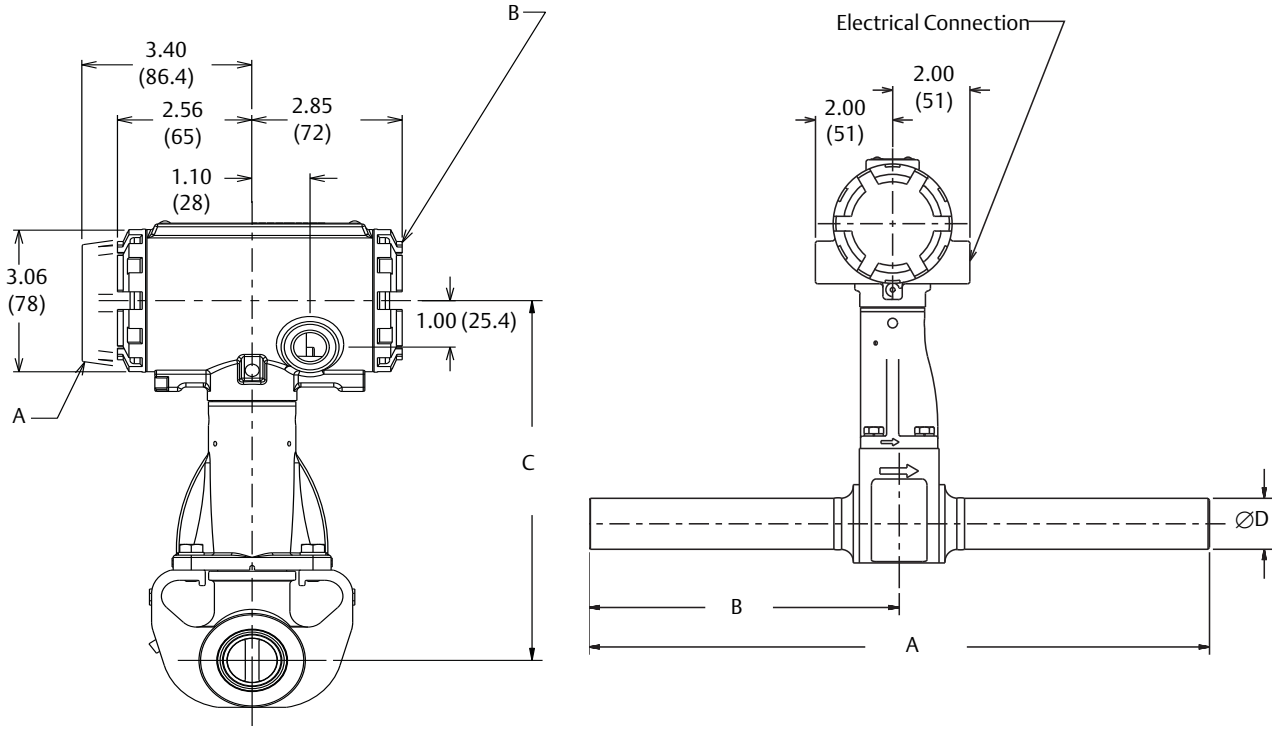
Table 28. Vortex Dual-Sensor Style Flowmeter (4-in. through 12-in./100 through 300 mm Line Sizes)

Nominal size inch (mm)	Flange rating	Face-to-face A inch (mm)	A ANSI RTJ inch (mm)	Diameter B inch (mm)	C inch (mm)	Weight lb (kg)
4 (100)	Class 150	15.2 (386)	15.7 (399)	3.79 (96,3)	9.6 (244)	69.7 (31.6)
	Class 300	16.0 (406)	16.6 (422)	3.79 (96,3)	9.6 (244)	88.9 (40.8)
	Class 600	17.7 (450)	17.9 (454)	3.79 (96,3)	9.6 (244)	116 (52.5)
	Class 900	18.7 (475)	18.9 (480)	3.79 (96,3)	9.6 (244)	139 (63.1)
	Class 1500	20.0 (509)	20.2 (512)	3.40 (86.4)	9.6 (244)	184 (83,3)
	PN 16	13.3 (338)	–	3.79 (96,3)	9.6 (244)	58.7 (26,6)
	PN 40	14.4 (366)	–	3.79 (96,3)	9.6 (244)	67.8 (30,8)
	PN 63/64	15.4 (391)	–	3.79 (96,3)	9.6 (244)	80.8 (36,7)
	PN 100	16.3 (414)	–	3.79 (96,3)	9.6 (244)	97.2 (44,1)
	PN 160	17.1 (434)	–	3.79 (96,3)	9.6 (244)	104 (47,4)
	JIS 10K	13.6 (345)	–	3.79 (96,3)	9.6 (244)	55.8 (25,3)
	JIS 20K	13.6 (345)	–	3.79 (96,3)	9.6 (244)	63.8 (28,9)
	JIS 40K	16.8 (427)	–	3.79 (96,3)	9.6 (244)	94.2 (42,7)
6 (150)	Class 150	11.6 (295)	12.1 (307)	5.7 (144,8)	10.8 (274)	85 (39)
	Class 300	12.3 (312)	13.0 (330)	5.7 (144,8)	10.8 (274)	124 (57)
	Class 600	14.3 (363)	14.4 (366)	5.7 (144,8)	10.8 (274)	191 (87)
	Class 900	16.1 (409)	16.2 (411)	5.14 (130.6)	10.8 (274)	282 (128)
	Class 1500	18.6 (472)	18.8 (478)	5.14 (130.6)	10.8 (274)	380 (173)
	PN 16	8.9 (226)	–	5.7 (144,8)	10.8 (274)	70 (32)
	PN 40	10.5 (267)	–	5.7 (144,8)	10.8 (274)	90 (41)
	PN 63/64	12.1 (307)	–	5.7 (144,8)	10.8 (274)	134 (61)
	PN 100	13.6 (345)	–	5.7 (144,8)	10.8 (274)	164 (75)
	JIS 10K	10.6 (269)	–	5.7 (144,8)	10.8 (274)	74 (34)
	JIS 20K	10.6 (269)	–	5.7 (144,8)	10.8 (274)	92 (42)
	JIS 40K	14.2 (361)	–	5.7 (144,8)	10.8 (274)	170 (77)
8 (200)	Class 150	13.5 (343)	14.0 (356)	7.55 (191,8)	11.7 (297)	146 (66)
	Class 300	14.3 (363)	14.9 (378)	7.55 (191,8)	11.7 (297)	203 (92)
	Class 600	16.5 (419)	16.7 (424)	7.55 (191,8)	11.7 (297)	303 (138)
	Class 900	18.8 (478)	18.9 (480)	6.62 (168,1)	11.7 (297)	484 (220)
	Class 1500	22.8 (580)	23.2 (589)	6.62 (168,1)	11.7 (297)	657 (299)
	PN 10	10.4 (264)	–	7.55 (191,8)	11.7 (297)	115 (52)
	PN 16	10.4 (264)	–	7.55 (191,8)	11.7 (297)	114 (52)
	PN 25	11.8 (300)	–	7.55 (191,8)	11.7 (297)	142 (65)
	PN 40	12.5 (318)	–	7.55 (191,8)	11.7 (297)	161 (73)
	PN 63/64	14.2 (361)	–	7.55 (191,8)	11.7 (297)	221 (101)
	PN 100	15.8 (401)	–	7.55 (191,8)	11.7 (297)	287 (130)
	JIS 10K	12.2 (310)	–	7.55 (191,8)	11.7 (297)	114 (52)
	JIS 20K	12.2 (310)	–	7.55 (191,8)	11.7 (297)	139 (63)
	JIS 40K	16.5 (419)	–	7.55 (191,8)	11.7 (297)	260 (118)
10 (250)	Class 150	14.5 (368)	15.0 (381)	9.56 (243)	12.8 (325)	202 (91,6)
	Class 300	15.8 (401)	16.4 (417)	9.56 (243)	12.8 (325)	290 (132)
	Class 600	19.0 (483)	19.2 (488)	9.56 (243)	12.8 (325)	482 (219)
	PN 10	11.9 (302)	–	9.56 (243)	12.8 (325)	161 (73,2)
	PN 16	12.0 (305)	–	9.56 (243)	12.8 (325)	166 (75,4)
	PN 25	13.5 (343)	–	9.56 (243)	12.8 (325)	203 (92,0)
	PN 40	14.8 (376)	–	9.56 (243)	12.8 (325)	251 (114)
	PN 63/64	16.4 (417)	–	9.56 (243)	12.8 (325)	312 (142)
	PN 100	18.9 (480)	–	9.56 (243)	12.8 (325)	450 (204)
	JIS 10K	14.5 (368)	–	9.56 (243)	12.8 (325)	179 (81,1)
	JIS 20K	14.5 (368)	–	9.56 (243)	12.8 (325)	226 (103)
	JIS 40K	18.1 (460)	–	9.56 (243)	12.8 (325)	383 (174)

Table 28. Vortex Dual-Sensor Style Flowmeter (4-in. through 12-in./100 through 300 mm Line Sizes)

12 (300)	Class 150	16.8 (427)	17.3 (439)	11.38 (289)	13.7 (348)	302 (137)
	Class 300	18.0 (457)	18.7 (475)	11.38 (289)	13.7 (348)	420 (191)
	Class 600	20.5 (521)	20.7 (526)	11.38 (289)	13.7 (348)	600 (272)
	PN 10	13.1 (331)	–	11.38 (289)	13.7 (348)	208 (94,5)
	PN 16	13.9 (353)	–	11.38 (289)	13.7 (348)	229 (104)
	PN 25	15.0 (381)	–	11.38 (289)	13.7 (348)	274 (124)
	PN 40	16.8 (427)	–	11.38 (289)	13.7 (348)	352 (160)
	PN 63/64	18.8 (478)	–	11.38 (289)	13.7 (348)	435 (198)
	PN 100	21.2 (538)	–	11.38 (289)	13.7 (348)	648 (294)
	JIS 10K	15.7 (399)	–	11.38 (289)	13.7 (348)	227 (103)
	JIS 20K	15.7 (399)	–	11.38 (289)	13.7 (348)	288 (131)
	JIS 40K	19.6 (498)	–	11.38 (289)	13.7 (348)	498 (226)

Figure 7. Vortex Weld-End Style Flowmeter (1/2-in. through 4-in. [15 - 100 mm] Line Sizes)

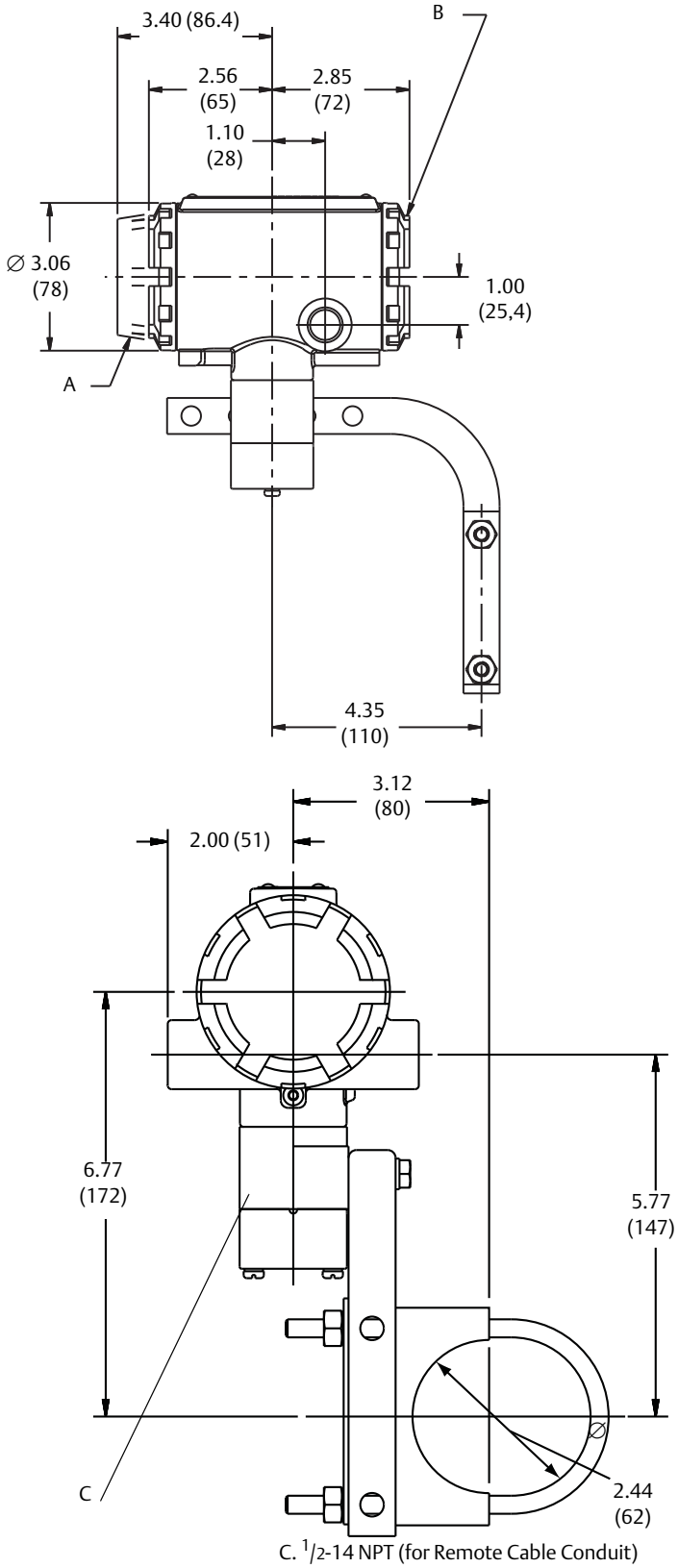


A. Display Option
B. Terminal Cover

Table 29. Vortex Weld-End Style Flowmeter (1/2-in. through 4-in. [15 - 100 mm] Line Sizes)

Nominal size in. (mm)	A in. (mm)	B in. (mm)	C ± 0.20 in. (5.1 mm)	Diameter D ± 0.031 in. (0.79 mm)
0.5	16.0 (406)	8.0 (203)	7.63 (194)	.840 (21.34)
1	16.0 (406)	8.0 (203)	7.74 (197)	1.315 (33.40)
1.5	16.0 (406)	8.0 (203)	8.14 (207)	1.900 (48.26)
2	16.0 (406)	8.0 (203)	8.49 (216)	2.375 (60.33)
3	16.0 (406)	8.0 (203)	9.05 (230)	3.500 (88.90)
4	16.0 (406)	8.0 (203)	9.60 (244)	4.500 (114.30)

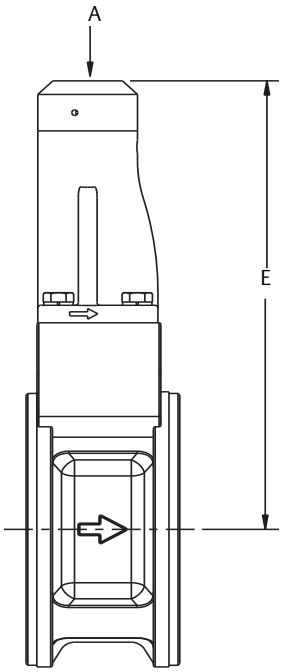
Figure 8. Remote Mount Transmitters



Note
Consult factory for SST installation.
Dimensions are in inches (millimeters).

A. Display Option
B. Terminal Cover
C. $^{1}/_{2}$-14 NPT (for Remote Cable Conduit)

Figure 9. Remote Mount Wafer-Style Flowmeters (1/2-in. through 8-in./15 through 200 mm Line Sizes)



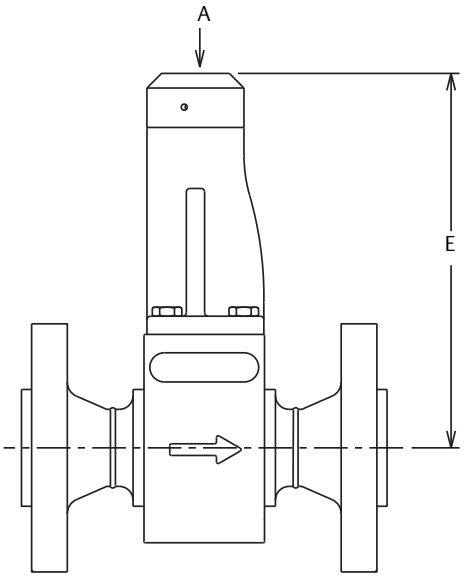
A. 1/2-14 NPT (for Remote Cable Conduit)

Table 30. Rosemount 8800D Wafer-Style Meter

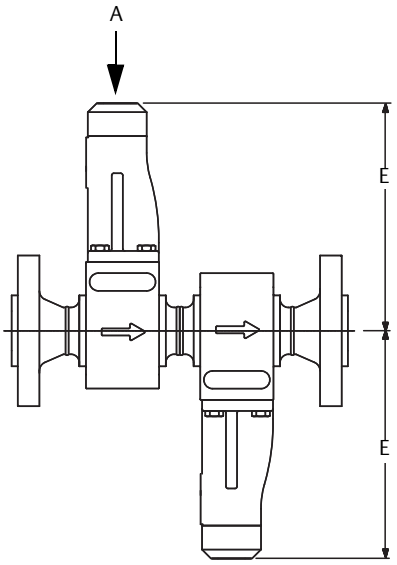
Nominal size inch (mm)	E Wafer style inch (mm)
½ (15)	6.3 (160)
1 (25)	6.5 (165)
1½ (40)	6.7 (191)
2 (50)	7.5 (191)
3 (80)	8.3 (211)
4 (100)	9.2 (234)
6 (150)	9.5 (241)
8 (200)	10.4 (264)

Figure 10. Flanged-and Dual Sensor Flanged-Style Remote Mount Flowmeters (1/2-through 12-inch/15 through 300 mm Line Sizes)

Flanged flowmeter



Dual-sensor style flowmeter



A. 1/2-14 NPT (for Remote Cable Conduit)

Table 31. Remote Mount, Flanged-and Dual Sensor Flowmeter Dimensions

Nominal size inch (mm)	E Flange style inch (mm)
½ (15)	6.4 (162)
1 (25)	6.5 (165)
1½ (40)	6.8 (173)
2 (50)	7.2 (183)
3 (80)	7.8 (198)
4 (100)	8.3 (211)
6 (150)	9.5 (241)
8 (200)	10.4 (264)
10 (250)	11.4 (290)
12 (300)	12.3 (313)

Emerson Process Management
Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-522-6277
T (International) (303) 527-5200
F (303) 530-8549
www.rosemount.com

Emerson Process Management
Flow
Neonstraat 1
6718 WX Ede
The Netherlands
T +31 (0)318 495555
F +31(0) 318 495556
www.rosemount.com

Emerson Process Management
Asia Pacific Pte Ltd
1 Pandan Crescent
Singapore 128461
T +65 6777 8211
F +65 6777 0947
Service Support Hotline: +65 6770 8711
Email: Enquiries@AP.EmersonProcess.com
www.rosemount.com

Emerson Process Management
Latin America
1300 Concord Terrace, Suite 400
Sunrise, Florida 33323 USA
T + 1 954 846 5030
www.rosemount.com

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FLOWSERVE

Worcester Controls Directional Ball Valves

Series D44/D4, Series D51, Series 18/19

Experience In Motion

FLOWSERVE

Series D44/D4: A rugged directional ball valve that conforms to the requirements of ANSI B16.34

Diverter Ball Valve

Separate Seats and Body Seals, One Flow Direction

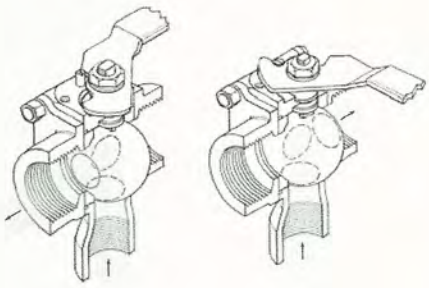
The diverter valve is designed to accept media through a bottom inlet port and direct it out either of two outlet ports. It is commonly used for alternately diverting flow from a single source to two different lines, for example dumping operations in which one outlet permits media to flow from a common source to the process while the other outlet alternately dumps or recirculates excess media.

The Diverter Ball Valve is available with two different porting configurations. V1 Porting is 90° operation for manual, pneumatic or reversing type electric actuation. The flow from the bottom inlet port cannot be shut off, only diverted to either of the two outlet ports.

V2 Porting is 180° operation for manual or 180° electric actuation. With this configuration, the flow can be shut off by simply operating the valve 90°. However, there is no mechanical stop arrangement for this position.

The diverter valve is constructed with separate seat and body seal.

V1 Porting



0° 90°

V2 Porting

0° 90° 180°

Automation

Diverter and 3-way valves with V1 Porting (90° operations) may be automated with Series 34 or 39 pneumatic actuators or Series 75 electric actuators. For V2 Porting configuration (180° operation), use the Series 75 electric actuator, also available with center-off option. The Series 36 electric actuator is not suitable for use with Worcester Controls Directional Ball Valves. 180° pneumatic actuators are available through custom products.

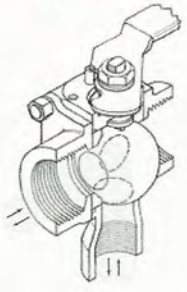
3-Way Ball Valve

One Piece Seat and Body Seal, Bi-Directional Flow

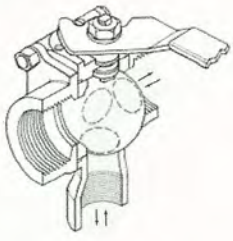
The 3-way ball valve provides greater flexibility in operation. Constructed with a one piece seat and body seal, the 3-way valve permits flow in both directions. It can function as a selector valve, alternately accepting media from either of two inlet sources and directing through a single outlet. Or, it may be used as a true 3-way valve, accepting media from two inlet sources for alternate discharge through either of two outlet ports. For example, in a pressurized line or system, the inlet port pressurizes or fills the system. The valve is then operated through its travel to allow the pressurized contents to be discharged through the second outlet port with the original outlet port now functioning as the inlet.

The 3-way ball valve is available with two different porting configurations. V1 Porting provides 90° operation for manual, pneumatic or reversing type electric actuation. With V1 Porting, alternate side ports are shut off at the 0° and 90° positions. V2 Porting shuts off one side at 0°, the opposite side at 180° and both sides at 90°, but there is no mechanical stop at 90°. V2 Porting permits 0° and 180° operation for manual or electric actuation only. Both positions can be shut off completely.

V1 Porting

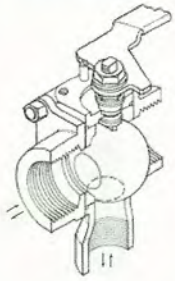


0°

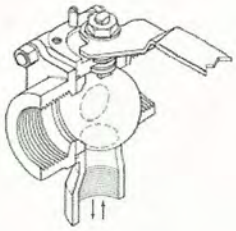


90°

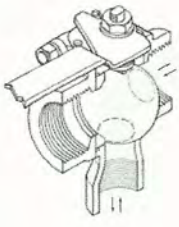
V2 Porting



0°



90°

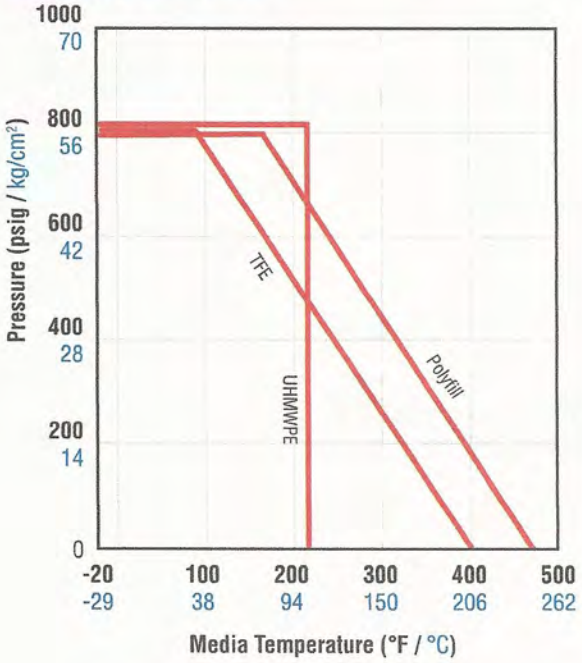


180°

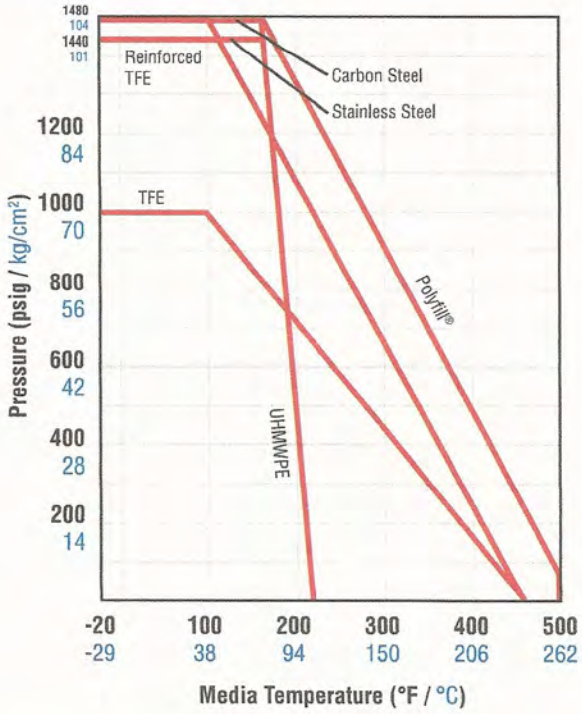
FLOWSERVE

Series D44/D4

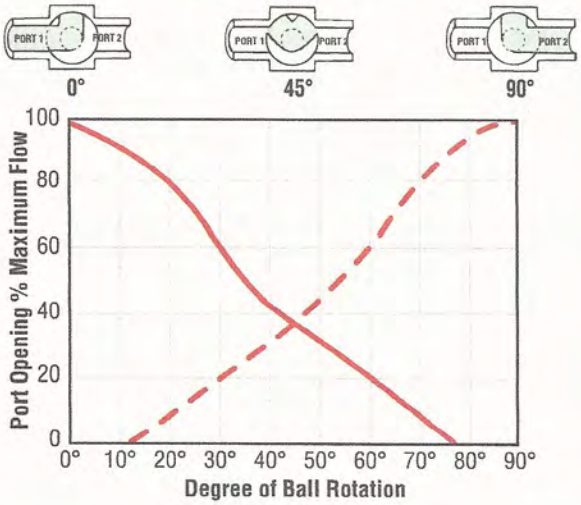
Seat Pressure/Temperature Ratings: Three-way Ball Valve



Seat Pressure/Temperature Ratings: Diverter Ball Valve



Flow Characteristic Curves for Diverter Valve: V1 Porting, 90° Operation



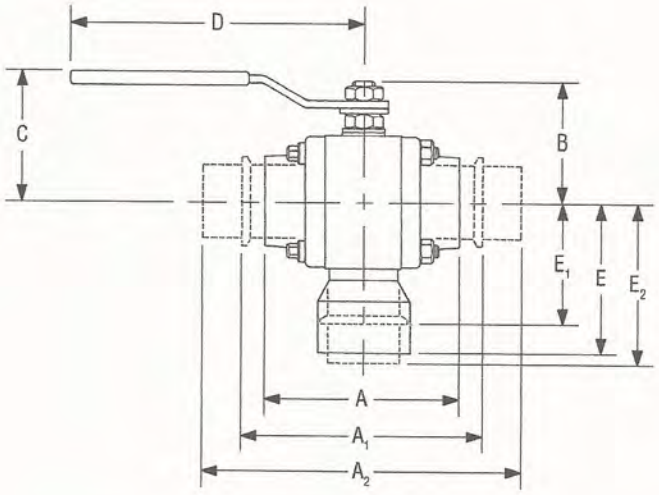
NOTE: In three-way ball valves (one piece seat and body seal), 200°F maximum thermal cycle is allowed for Polyfill seats; 100°F maximum thermal cycle for TFE and UHMWPE seats.

Series D44/D4

Dimensions

Metric dimensions are converted from Standard English dimensions. Dimensions are given for layout purposes only; for tolerances, consult factory.

Flanged versions of the diverter valve are available in 2"–8" in carbon steel or stainless steel with ANSI Class 150 flanges. ANSI Class 300 flanges are also available. Consult factory. Refer to Brochure WCABR1020.



inches / millimeters

Valve	A, SE, SW, TE	A1 TC	A2 XBO	B	C	D	E	E1 TC	E2 XBO	Side Port Dia.	Bottom Port Dia.	Approx. Wt. lb. / kg
½"	**2.54**	**3.50**	**5.53**	**1.55**	**1.76**	**5.53**	**2.25**	**1.66**	**2.94**	**.38**	**.34**	**1.5**
	64.5	88.9	140	39.4	44.7	141	57.2	42.2	74.4	9.7	8.6	0.7
¾"	**2.76**	**4.00**	**5.77**	**1.64**	**1.86**	**5.53**	**2.50**	**1.76**	**3.03**	**.52**	**.50**	**2.0**
	70.1	102	147	41.7	47.2	141	63.5	44.8	76.9	13.2	12.7	0.9
1"	**3.66**	**4.50**	**6.33**	**2.19**	**2.28**	**6.53**	**3.06**	**1.94**	**3.21**	**.75**	**.71**	**3.6**
	93.0	114	161	55.6	57.9	166	77.7	49.3	81.5	19.1	18.0	1.6
1½"	**4.50**	**5.50**	**7.43**	**2.88**	**2.83**	**8.03**	**3.56**	**2.29**	**3.56**	**1.25**	**1.12**	**7.4**
	114	140	189	73.2	71.9	204	90.4	58.2	90.4	31.8	28.4	3.4
2"	**4.94**	**6.25**	**7.60**	**3.06**	**3.02**	**8.03**	**3.94**	**2.44**	**3.72**	**1.50**	**1.38**	**11.1**
	126	159	193	77.7	76.7	204	100	62.0	94.5	38.1	35.0	5.0

Valve Body Pressure Ratings

Carbon Steel and S.S.	ANSI Class 600
½"–1" Brass	1500 psi
1½"–2" Brass	1000 psi

NOTE: These are body pressure ratings. Seat and seal selection will derate the valve.

Optional High Pressure Valves

½"–2"	Series D4 Diverter Valves with Lubetal® (Delrin®) seats are available for high pressure service.	
½"–¾"	Carbon Steel and S.S.	3000 psi
1"	Carbon Steel and S.S.	2500 psi
1½" and 2"	Carbon Steel and S.S.	2000 psi

Flow Coefficient

Valve Size	C_v	Equivalent Length of Schedule 40 Pipe (feet)
½"	3	23.1
¾"	5	36.6
1"	10	33.4
1½"	24	55.6
2"	36	90.1

FLOWSERVE

Series D51: A Simple, Dependable Way to Divert Flow to Two Pipe Lines with Tight Shutoff to Either Line

Worcester's Series D51 is a standardized line of flanged diverter ball valves in sizes 2", 3", 4", 6", and 8" with ANSI Class 150 flanges.

D51 diverter valves are designed to accept media through a bottom inlet port and direct it out either of two outlet ports. They are commonly used for alternately diverting flow from a single source to two different lines; for example, dumping operations in which one outlet permits media to flow from a common source to the process while the other outlet alternately dumps or recirculates excess media.

Ball porting for D51 diverter valves is referred to as V1 (see illustration opposite) for 90° valve operation. Flow from the bottom inlet port cannot be shut off, only diverted to either of the two outlet ports. At either end of the valve stroke, one port is wide open and the other is shut off bubble-tight. Relief slots assist in sealing and reduce torque. The ball is forced into the seat of the blocked port under pressure to affect and maintain a tight seal.

Series D51 Options

V2 porting for 180° full shutoff operations and T51 three-way valves for bidirectional flow applications are available through Custom Products.

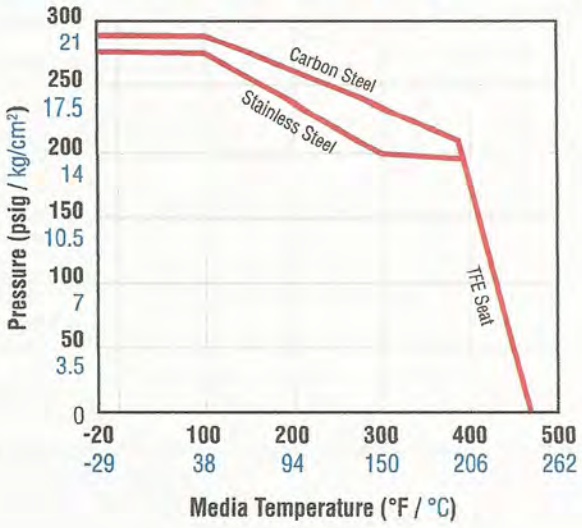
Automation

D51 flanged diverter valves may be automated with Series 75 electric actuators (refer to brochure WCABR1014) or Series 39 double piston pneumatic actuators (refer to brochure WCABR1003). Both actuators may be used in on/off or modulating applications. Limit switches, feedback potentiometers, 4-20 mA circuit boards providing remote indication of valve position and other accessories including a full line of advanced positioners are available.

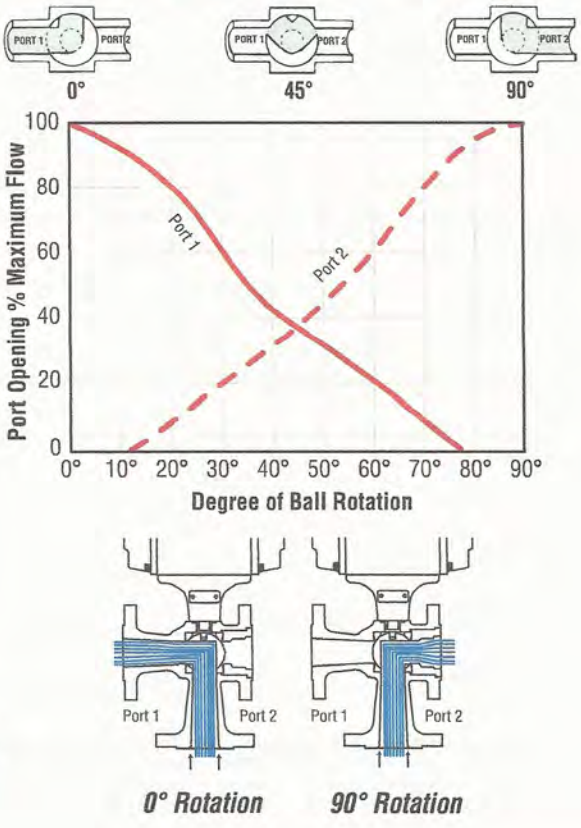
Flow Coefficient

Valve Size	C_v	Equivalent Length of Schedule 40 Pipe (feet)
2"	36	95
3"	135	62.5
4"	230	81
6"	330	312
8"	605	387

Seat Pressure/Temperature Rating

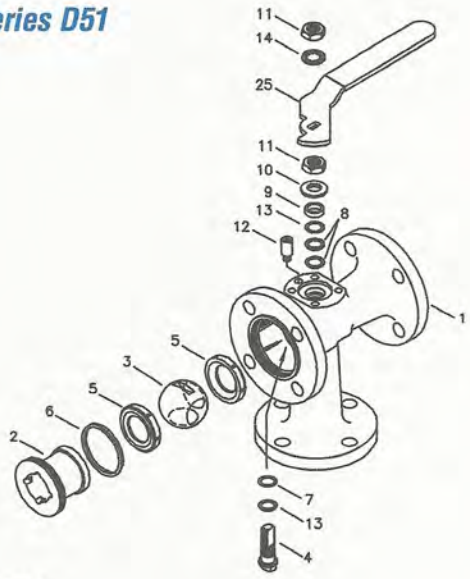


Flow Characteristic Curves for Diverter Valve V1 Porting, 90° Operation

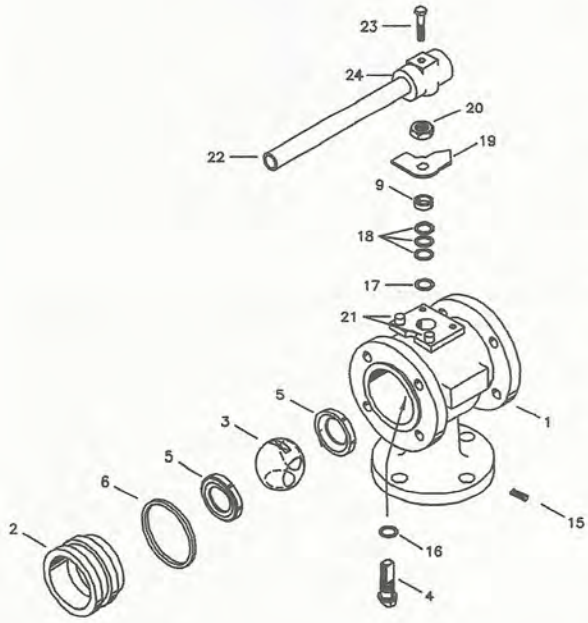


Parts Identification and Materials Specifications

Series D51



2" D51



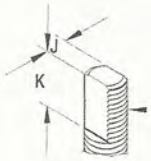
3", 4", 6", 8" D51

Part	Part Name	Qty.	Materials
1	Body	1	Carbon Steel - ASTM 216 – WCB Stainless Steel - ASTM A351 CF8M
2	End Plug	1	Carbon Steel - ASTM A108 Stainless Steel - ASTM A479 - 316, Cond. A
3	Ball	1	Stainless Steel - ASTM A479 - 316, Cond. A
4	Stem	1	Stainless Steel - ASTM A479 - 316, Cond. A
5	Seats	2	TFE
6	Body Seal	1	TFE
7	Thrust Bearing	1	Polyfill®
8	Stem Seal	2	Polyfill®
9	Follower	1	Stainless Steel - ANSI 316L
10*	Belleville Washers	2	Carbon Steel - Zinc Plated Stainless Steel 301
11*	Handle & Ret. Nuts	2	Carbon Steel - Zinc Plated Stainless Steel - ANSI 300 Series
12	Stop Screw	1	Carbon Steel - Black Oxide Coated
13	Thrust Bearing/ Seal Protector	2	PEEK
14	Lockwasher	1	Carbon Steel - Zinc Plated Stainless Steel - ANSI 300 Series
15	Shipping Screw	4-12	Stainless Steel - ANSI 304
16	Thrust Bearing	1	RTFE - Reinforced
17	Centering Washer	1	Carbon Steel - Black Oxide Coated Stainless Steel - ANSI 316
18	Stem Seals	3	RTFE - Reinforced
19	Stop Plate	1	Carbon Steel - Zinc Plated
20	Retaining Nut	1	Carbon Steel - Zinc Plated Stainless Steel - ANSI 300 Series
21	Stop Screw	2	Carbon Steel - Black Oxide Coated
22	Wrench Extension	1	Carbon Steel - ASTM A53/Galv.
23	Wrench Assy. Bolt.	1	Carbon Steel - SAE J429 GR.2
24	Wrench Block	1	Malleable Iron - ASTM A47, Black Oxide Coated
25	Handle	1	Carbon Steel - Zinc Plated, Vinyl Coated Stainless Steel - ANSI 300 Series, Vinyl coated

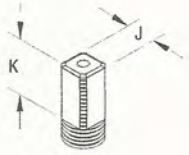
* **NOTE:** Four Belleville washers, and a lock nut (in place of handle and retaining nuts) are used if the valve is automated with a pneumatic or electric actuator.

FLOWSERVE

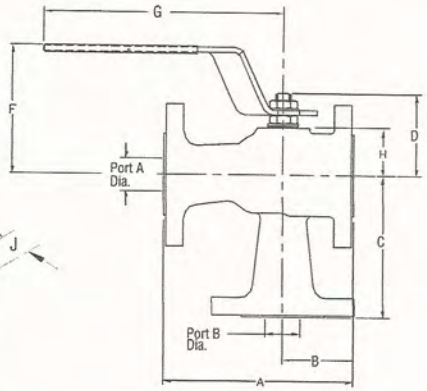
Series D51



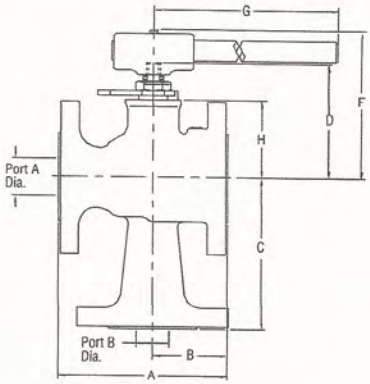
2" D51



3" - 8" D51



2" D51



3", 4", 6, 8" D51

Dimensions

***inches** / millimeters*

Valve Size	Ball Port A Dia.	Ball Port B Dia.	A	B	C	D	F	G	H	J	K	Weight lb. / kg
2"	**1.44**	**1.44**	**7.00**	**2.68**	**5.00**	**3.06**	**4.77**	**8.10**	**1.92**	**.343**	**.60**	**26.5**
	36.6	36.6	178.0	68.1	127.0	77.8	121.2	205.7	48.8	8.71	15.24	12.0
3"	**2.50**	**2.00**	**8.00**	**3.63**	**6.00**	**5.69**	**7.22**	**22.00**	**3.88**	**.745**	**.65**	**52.6**
	63.5	50.8	203.2	92.2	152.4	144.5	183.4	559.0	98.6	18.92	16.51	23.6
4"	**3.25**	**2.50**	**9.00**	**4.00**	**7.13**	**6.31**	**7.84**	**22.00**	**4.48**	**.745**	**.65**	**80.7**
	82.6	63.5	228.6	101.6	181.1	160.3	199.1	559.0	113.8	18.92	16.51	36.6
6"	**3.94**	**3.00**	**10.50**	**4.25**	**9.85**	**8.96**	**11.21**	**26.00**	**6.19**	**1.12**	**1.03**	**137.8**
	100.1	76.2	266.7	108.0	250.2	227.6	284.7	660.0	157.2	28.45	26.16	62.5
8"	**5.69**	**4.00**	**11.50**	**5.69**	**11.00**	**10.08**	**12.31**	**26.00**	**7.28**	**1.12**	**1.03**	**204.0**
	144.5	101.6	292.0	144.5	279.4	256.0	312.7	660.0	184.9	28.45	26.16	92.5

Series 18/19: Upgrade the efficiency of your fluid diverting, filling and distribution systems through piping simplification, automation and safety

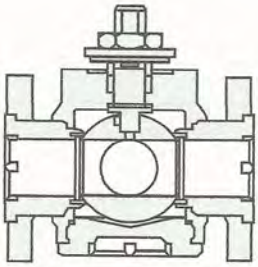
Flowserve Worcester Controls' Series 18 and 19 multi-way valves are designed to improve the efficiency and productivity of your process systems with up to 5 ports, slip-on flanges, multiple seat and body materials, standard or full port, and optional pneumatic and electric automation and anti-fugitive emission design. Screwed, socket weld and butt weld ends are available as are slip-on flanges (ANSI Class 150 or 300).

Worcester Controls' multi-way valves are available in four general configurations:

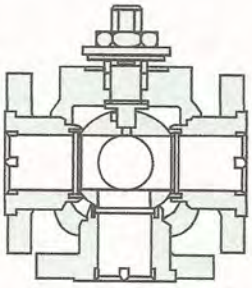
- Series 18 side entry, standard port valves
- Series B18 side entry, full port valves
- Series 19 bottom and side entry, standard port valves
- Series B19 bottom and side entry, full port valves

The wide variety of ball ports and piping connections present a large number of diverting possibilities.

Series 18 and 19 multi-way valves are available in sizes 1", 1½", 2", 3", 4" and 6". Standard body materials are carbon steel and type 316 stainless steel; standard seat/seal materials are TFE and Polyfill®.



Series B18 Full Port Side Entry Valve

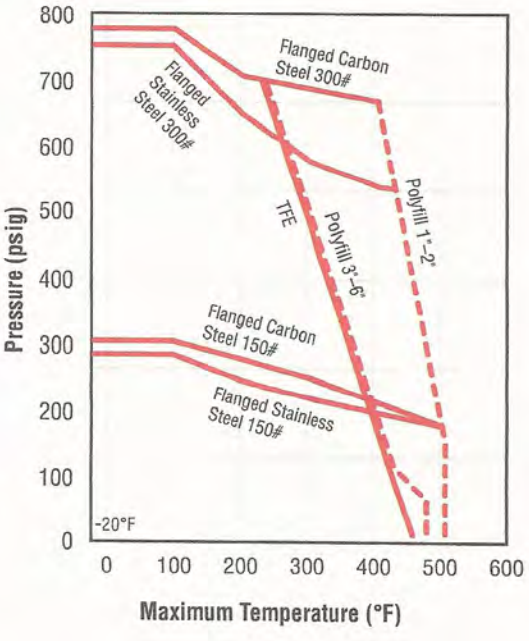


Series B19 Full Port Bottom Entry Valve

Flow Coefficient

Valve Size (Inches)	C_V		Operating Torque (in-lb)	
	Std. Port 90° Flow	Full Port 90° Flow	Standard Port	Full Port
1	9	19	95	220
1½	46	46	220	305
2	49	85	305	800
3	149	204	1600	2500
4	210	360	2500	4800
6	505	880	4700	11000

Seat Pressure/Temperature Ratings



Optional Screwed, Socket Weld and Butt Weld End

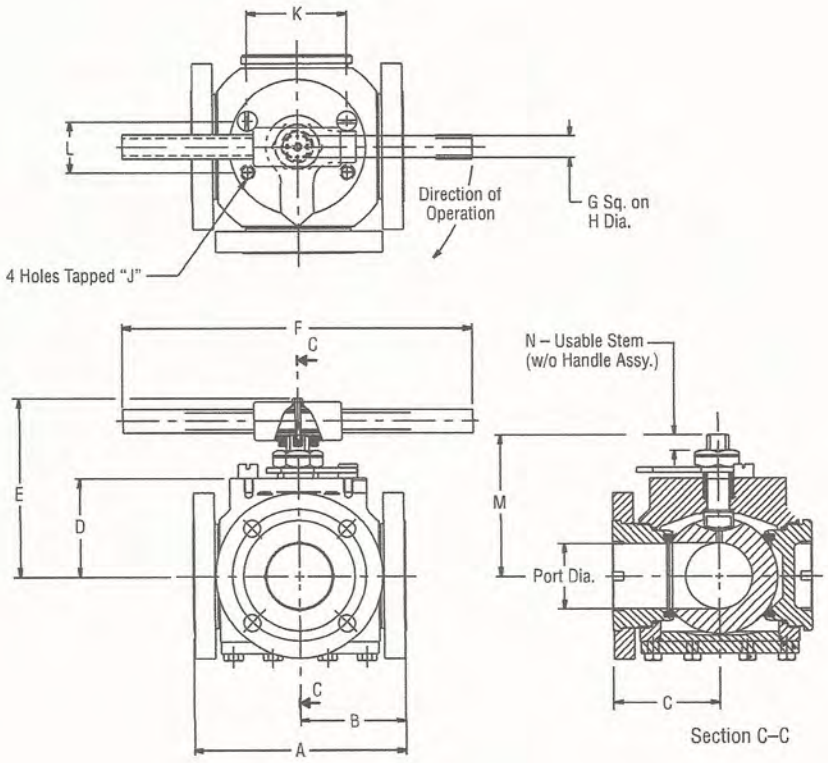
Pneumatic Automation

Electric Automation

Anti-Fugitive Emission Valve Option (Series E18 or E19)

FLOWSERVE

Series 18/19

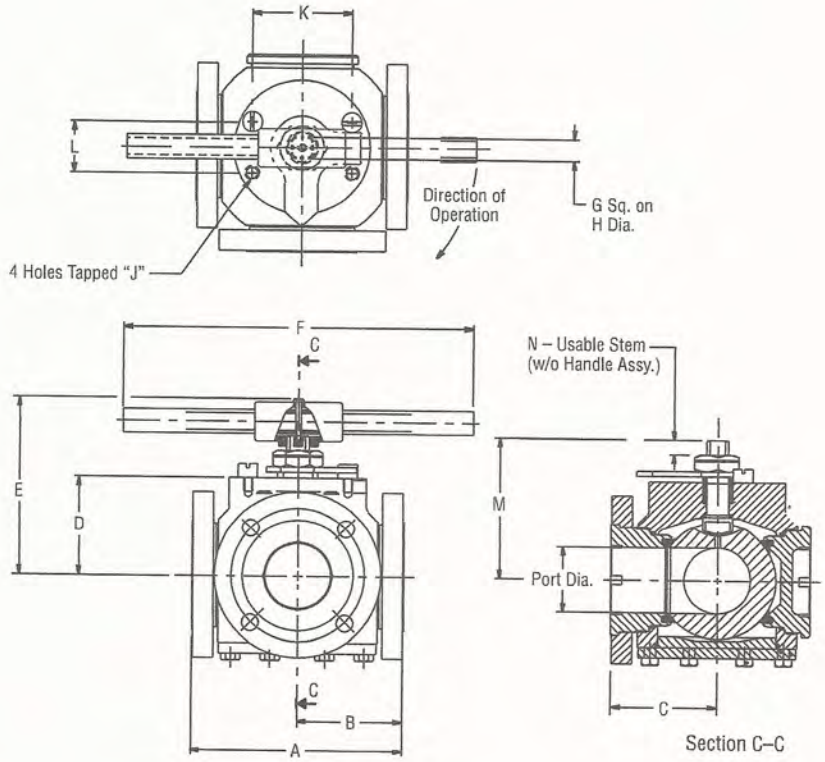


Dimensions: Series 18 Side Entry Standard Port Ball Valves

inches / millimeters

Valve size	A		B		C		D	E	F	G	H	J	K	L	Port Dia.	M	N
	ANSI Class 150	ANSI Class 300	ANSI Class 150	ANSI Class 300	ANSI Class 150	ANSI Class 300											
1"	5.00	6.50	2.50	3.25	3.05	3.25	1.35	3.51	7.28	0.297	0.44	¼–20	1.17	1.17	0.67	2.25	.42
	127	165	63.5	82.6	77.5	82.6	34.3	89.2	185	7.5	11.2		29.7	29.7	17.0	57.2	10.7
1½"	6.50	7.50	3.25	3.75	3.25	4.13	2.72	5.97	10.00	0.551	0.79	M8	2.75	1.25	1.46	4.36	.73
	165	191	82.6	95.3	82.6	105	69.1	152	254	14.0	20.1		69.9	31.8	37.1	111	18.5
2"	7.00	8.50	3.50	4.25	3.94	4.25	2.72	5.97	10.00	0.551	0.79	M8	2.75	1.25	1.46	4.36	.73
	178	216	88.9	108.0	100	108	69.1	152	254	14.0	20.1		69.9	31.8	37.1	111	18.5
3"	9.50	11.14	4.75	5.57	4.75	5.57	4.05	7.48	24.00	0.745	0.88	M10	3.38	1.75	2.52	5.95	.65
	241	283	121	142	121	142	103	190	610	18.9	22.4		85.9	44.5	64.0	151	16.5
4"	12.00	12.00	6.00	6.00	6.00	6.89	4.44	7.87	24.00	0.745	0.88	M10	3.38	1.75	2.95	6.28	.65
	305	305	152.4	152	152.4	175	113	190	610	18.9	22.4		85.9	44.5	74.9	160	16.5
6"	15.50	15.88	7.75	7.94	7.75	7.94	5.91	10.83	28.50	1.120	1.39	M12	4.00	3.00	3.86	8.58	1.03
	394	403	197	202	197	202	150	275	724	28.4	35.3		102	76.2	98.0	218	26.2

Series 18/19



Dimensions: Series B18 Side Entry Standard Port Ball Valves

***inches** / millimeters*

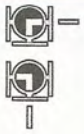
Valve size	A		B		C		D	E	F	G	H	J	K	L	Port Dia.	M	N
	ANSI Class 150	ANSI Class 300	ANSI Class 150	ANSI Class 300	ANSI Class 150	ANSI Class 300											
1"	**5.00**	**6.50**	**2.50**	**3.25**	**2.95**	**3.25**	**1.72**	**4.91**	**9.53**	**0.343**	**0.56**	¼–20	**1.39**	**1.39**	**0.95**	**2.85**	**.59**
	127	165	63.5	82.6	74.9	82.6	43.7	125	242	8.7	14.2		35.3	35.3	24.1	72.4	15.0
1½"	**6.50**	**7.50**	**3.25**	**3.75**	**3.25**	**4.13**	**2.72**	**5.97**	**10.00**	**0.551**	**0.79**	M8	**2.75**	**1.25**	**1.46**	**4.36**	**.73**
	165	191	82.6	95.3	82.6	105	69.1	152	254	14.0	20.1		69.9	31.8	37.1	111	18.5
2"	**8.00**	**8.50**	**4.00**	**4.25**	**4.00**	**4.25**	**3.08**	**6.33**	**10.00**	**0.551**	**0.79**	M8	**2.75**	**1.25**	**1.93**	**5.31**	**.73**
	203	216	102	108	102	108	78.2	161	254	14.0	20.1		69.9	31.8	49.0	135	18.5
3"	**9.50**	**11.14**	**4.75**	**5.57**	**4.75**	**5.57**	**4.44**	**7.87**	**24.00**	**0.745**	**0.88**	M10	**3.38**	**1.75**	**2.95**	**6.28**	**.65**
	241	283	121	142	121	142	113	190	610	18.9	22.4		85.9	44.5	74.9	160	16.5
4"	**12.00**	**12.00**	**6.00**	**6.00**	**6.00**	**6.89**	**5.91**	**10.83**	**28.5**	**1.120**	**1.39**	M12	**4.00**	**3.00**	**3.86**	**8.58**	**1.03**
	305	305	152	153	152	175	150	275	724	28.4	35.3		102	76.2	98.0	218	26.2
6"	**15.50**	**15.88**	**7.75**	**7.94**	**7.75**	**7.94**	**7.36**	**12.28**	**28.50**	**1.120**	**1.39**	M12	**4.00**	**3.00**	**5.83**	**10.03**	**1.03**
	394	403	197	202	197	202	187	312	724	28.4	35.3		102	76.2	148	255	26.2

NOTE: Dimensions for the Series 19 and B19 bottom and side entry ball valves are similar to the Series 18 and B18 with the addition of the bottom flange with dimension C from the centerline. Weights of Series 18/19 valves vary depending upon the number of ports selected. Consult Flowserve.

FLOWSERVE

Series 18/19 Diverting Options (Plan Views)

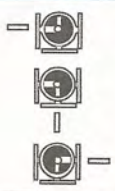
Three-Way Series 18 and B18 Options 90° — Side Entry

L Port	T Port			
LA1	TA1	TA2	TA3	TA4
				

Three-Way Series 18 and B18 Options 180° — Side Entry

L Port	T Port			
LB1	TB1	TB2	TB3	TB4
				

Series 19 and B19 — Bottom Entry

Two-Way Option 90°	Two-Way Option 180°	Three-Way Option 180°	Four-Way Option 360°
L Port		T Port	L Port
LA1	LB1	TB1	LD1
			

Flowserve Worcester Directional Ball Valves

! **CAUTION:** Ball valves can retain pressurized media in the body cavity when closed. Use care when disassembling. Always open valve to relieve pressure prior to disassembly.

Due to continuous development of our product line, we reserve the right to alter the information contained in this brochure as required.

FLOWSERVE

How to Order

Series D44/D4

1"	D	X	44	6	6	T	M	SW	V1
Size	Type	Special Service Options	Series	Body & Pipe Ends	Ball & Stem	Seats*	Body Seals*	End Types §	Porting
½" ¾" 1" 1½" 2"	D – Diverter T – 3-way	V – Vacuum Service X – Oxygen Service G – Grounded Stem E – No handle, Valve built for automation	44 4**	1 – Brass (¾"–2") 4 – Carbon Steel 6 – 316 Stainless Steel	6 – 316 Stainless Steel	T – TFE P – Polyfill Y – Lubetal R – Reinforced TFE U – UHMWPE B – Buna N – Neoprene	T – TFE B – Buna E – EPR M – TFE Coated Gasket V – Viton® N – Neoprene U – UHMWPE	SE – Screw End SW† – Socket Weld TE†† – Tube End TC – Quick Disconnect XBO – Extended Butt Weld NP – No Pipe Ends	V1 V2

ORDERING EXAMPLE: 1" Diverter Valve for Oxygen Service, Stainless Steel Body and Pipe Ends with Stainless Steel Ball and Stem, TFE Seats and Seals, Socket Weld Ends, and V1 Porting.

** The body seal is integral with the seat (one piece) on 3-way valves. 3-way valves are available with Fluoropolymer (T), Polyfill (P), or UHMWPE (U) seats only. When ordering 3-way valves, ignore the body seal column. Example: 1"TX4466USEV1.*

*** Optional high pressure valve with Lubetal seats only.*

§ In some cases, other pipe end styles are available for the right and/or left ports. Consult your Worcester Controls Distributor.

† Carbon Steel or Stainless Steel only.

†† Brass only.

NOTE:

- *3-way valves cannot be used in steam service or applications with large thermal cycles.*
- *3-way valves do not have a separate body seal.*
- *Diverter valves with metal body seals as well as filled metal seats are available. Consult Worcester Controls.*
- *Multiport (diverter) valves are also available. Refer to brochure WCABR1002.*
- *WK44 with XBO and TC end connections available as Three-Way. Refer to brochure WCABR1035.*
- *Lubetal Seats cannot be used for oxygen service.*

Series D51

3"	D	51	6	6	T	150	V1**
Size	Type	Series	Body & Pipe Ends	Ball & Stem	Seats & Body Seals	End Types	Porting
2" 3" 4" 6" 8"	D - Diverter	51 - Flanged Valve	4 - Carbon Steel 6 - Stainless Steel	6 - 316 Stainless Steel	T - TFE	150 - ANSI Class 150 Flanges	V1 - Porting 1*

***Variations (V–Numbered Options) are noted at the end of the order number if needed. Leave blank if no variations. See list below for details.*

Ordering Example: 3" Series D51 Flanged Diverter Valve with stainless steel body, stainless steel ball and stem, TFE Seats and body seal, ANSI Class 150 Flanges, and V1 Porting.

Note: Series D51 valves use standard Series 51 repair kits. Multiport diverter valves are also available. Refer to brochure WCABR1002.

! **CAUTION:** Series D51 flanged diverter valves with V1 porting (90° operation) lack indication of flow direction. The user should consider providing external flow indication when using these valves. Ball valves can retain pressurized media in the body cavity when closed. Use care when disassembling. Always open valve to relieve pressure prior to disassembly.

Variations (V-numbers): Listing of V-Number Descriptions

V5 - Hydrostatic Testing
V6 - Source Inspection
V14 - Handleless Valves
V17 - Grounding Thrust Bearing
V36 - Certificate of Compliance
V37 - Cert. of Compliance & Hydro Testing
V46 - Silicon Free Lubricant
V51 - High Cycle Stem Build
V66 - Cert. of Compliance for European valve orders/contracts

How to Order

Series 18/19

2"	B	18	4	6	P	T	150	LA1
Size	Options	Series	Body & Pipe Ends	Ball & Stem	Seats	Body Seals	End Types	Diverting Options
1" 1½" 2" 3" 4" 6"	Blank – Standard Port with Handle E – Standard Port, no Handle B – Full Port, with handle BE – Full Port, no handle	18 – Side Entry 19 – Bottom and side Entry	4 – Carbon Steel 6 – Stainless Steel	6 -Stainless Steel	T – TFE P – Polyfill	T – TFE	150 – ANSI Class 150 Flanges 300 – ANSI Class 300 Flanges	LA1 LB1 LD1 TA1 TA2 TA3 TA4 TB1 TB2 TB3 TB4

The above code describes a 2" Series B18 side entry, full port valve (with handle) with carbon steel body and flanges, stainless steel trim, Polyfill seats, TFE body seals and ANSI Class 150 flanges, with LA1 porting.

NOTE: These valves are custom products. Please consult Flowserve for multi-way valve torque and more detailed dimensional information.

FLOWSERVE

United States
Flowserve Corp.
Flowserve Flow Control
1978 Foreman Drive
Cookeville, TN 38501 USA
Telephone: 1 931 432 4021
Telefax: 1 931 432 5518

FCD WCABR1052-01 Printed in USA.

To find your local Flowserve representative:

For more information about Flowserve Corporation, visit www.flowserve.com or call USA 1 800 225 6989

AMERICAN INGENUITY

AUTOMATIC AIR/VACUUM VALVES

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 8/13/15 | P.O. NO.: | EQUIPMENT NO.: AV-1-1&2
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 2

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 1 CALANDRIA VENTS	LOCATION: EVAPORATOR NO. 1
MANUFACTURER:	N-S/E-W COORDINATES:
MODEL:	

PROCESS DESIGN

INLET PRESS.: 4.2 PSIG	INLET TEMP.: 226 DEG F
PIPELINE SIZE: IN	MAX. ALLOWABLE PIPELINE PRESS: PSIG
PIPELINE DESIGN TEMP. DEG F	MAX. PIPELINE FLOWRATE:

CONSTRUCTION

TYPE: ■ AIR RELEASE ☐ VACUUM	CONNECTION SIZE: 0.75 IN
☐ AIR/VACUUM ☐ COMBINATION AIR	BODY MAT'L: STAINLESS STEEL
☐ SLOW CLOSING AIR ☐ HYDR. CONTROLLED AIR/VACUUM	INTERNAL MAT'L: STAINLESS STEEL
☐ SYPHON AIR VALVE ☐ VACUUM RELIEF/AIR INLET	CONNECTION TYPE: ■ NPT ☐ FF FLG ☐ RF FLG
☐ AIR VALVE FOR VERTICAL TURBINE PUMP	DESIGN AIR FLOW: 0.05 CFS
☐ PUMP PROTECTOR	MAX ALLOW. DIFF. PRESS. ACROSS ORIFICE: PSI
DESIGN PRESSURE: 50 PSIG	MAX. PIPELINE FILL RATE: GPM
DESIGN TEMP: 300 DEG F	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO VALVE WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

AUTOMATIC AIR/VACUUM VALVES

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 8/13/15 — P.O. NO.: — EQUIPMENT NO.: AV-2-2
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE:	EVAPORATOR NO. 2 CALANDRIA VENT
LOCATION:	EVAPORATOR NO. 2
MANUFACTURER:	
N-S/E-W COORDINATES:	
MODEL:	

PROCESS DESIGN

INLET PRESS.:	4.2 TO -2.0 PSIG	INLET TEMP.:	207 DEG F
PIPELINE SIZE:	IN	MAX. ALLOWABLE PIPELINE PRESS:	PSIG
PIPELINE DESIGN TEMP.	DEG F	MAX. PIPELINE FLOWRATE:	

CONSTRUCTION

TYPE:
- ☐ AIR RELEASE
- ☐ VACUUM
- ■ AIR/VACUUM
- ☐ COMBINATION AIR
- ☐ SLOW CLOSING AIR
- ☐ HYDR. CONTROLLED AIR/VACUUM
- ☐ SYPHON AIR VALVE
- ☐ VACUUM RELIEF/AIR INLET
- ☐ AIR VALVE FOR VERTICAL TURBINE PUMP
- ☐ PUMP PROTECTOR

CONNECTION SIZE:	0.75 IN
BODY MAT'L:	STAINLESS STEEL
INTERNAL MAT'L:	STAINLESS STEEL
CONNECTION TYPE:	■ NPT ☐ FF FLG ☐ RF FLG
DESIGN AIR FLOW:	0.05 CFS
MAX ALLOW. DIFF. PRESS. ACROSS ORIFICE:	PSI
DESIGN PRESSURE:	50 PSIG
MAX. PIPELINE FILL RATE:	GPM
DESIGN TEMP:	300 DEG F

NOTES:
1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO VALVE WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

STORAGE TANK

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 5/10/15 — P.O. NO.: — EQUIPMENT NO.: T-1
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL DESCRIPTION

MFG:	*		FABRICATION: ■ SHOP ☐ FIELD	NOTE 3
PRODUCT STORED:	STEAM CONDENSATE		CAPACITY OPERATING:	SEE DESIGN DETAIL NO. 2 GAL
DESIGN SP. GR.:	0.948 @ 239 °F		DESIGN:	SEE DESIGN DETAIL NO. 2 GAL
VAPOR PRESSURE:	mmHG	24.7 PSIA	PRESSURE VACUUM RELIEF SETTING:	IN H_2O
DESIGN TEMPERATURE:	300 °F		PUMPING RATES: IN: 562 PPH	OUT: 562 PPH

CONSTRUCTION

TANK SIZE: DIAM.: 1.5 FT. S.S. HT.: NOTE 1 RESTRICTIONS: DIAM.: HEIGHT:

SHELL DESIGN: ☐ UL142 ☐ UL2085 ☐ UL 2245 ☐ F921 ☐ F942 ☐ OTHER

SHELL POSITION: ☐ HORIZONTAL ■ VERTICAL

WALL DESIGN : ■ SINGLE ☐ DOUBLE

ROOF DESIGN: ☐ UL142 VERTICAL ■ HORIZONTAL SHELL

ROOF TO SHELL DETAIL: ☐ UL 142 VERTICAL ■ HORIZONTAL SHELL

EMERGENCY VENTING DESIGN: ☐ UL-142 ☐ FRANGIBLE ROOF TO SHELL JOINT; DETAIL:

ROOF LOADS: UNIFORM LIVE (INCLUDING SNOW): LB/SF; WIND LOAD: NONE

BOTTOM: ■ SINGLE ☐ DOUBLE SEAMS: ■ BUTT JOINT ☐ LAP JOINT

INTEGRAL DIKE: ☐ YES ■ NO DIKE DESIGN:

SUPPORTS FOR HORIZONTAL TANK: ☐ SADDLES ☐ SKID-MOUNTED

FOUNDATION TYPE: ☐ SAND ☐ CONCRETE RING WALL ☐ CONCRETE PAD ■ OTHER LEGS

AGITATION: ☐ YES IMPELLER DIAM.: RPM: DRIVE HP: WEIGHT: LBS

MFG.: MODEL: ☐ HORIZ. ☐ VERT. STARTING TORQUE: FT/LBS

PLATE INFORMATION:	SHELL	ROOF	BOTTOM	STRUCTURES
CORROSION ALLOW. (IN) :	0	0	0	0
MATERIAL SPEC.:	304 SS	304 SS	304 SS	304 SS
PLATE THICKNESS (IN) :	*	*	*	*

HEATING OR COOLING: ☐ COILS ☐ PLATE COIL ☐ CLAMP JACKET ☐ OTHER

COIL TYPE: AREA: LGTH:

COIL MATERIAL: PIPE DIAM.: PIPE SCH.:

COIL DESIGN: PRESSURE: TEMPERATURE: TEST PRESS.:

GASKETS: 304 SS/GRAHPOIL SPIRAL WOUND

	INTERIOR	EXTERIOR
BOLTS AND STUDS: TYPE		STUD
BOLT MATERIAL:		ASTM A193 GR. B7
NUTS: TYPE		HEX
NUT MATERIAL		ASTM A194 GR. 2H

WEIGHT: EMPTY: * FILLED WITH WATER: * FILLED WITH CONTENTS:

INSULATION: AEROGEL THICKNESS: NOTE 2 SUPPORTS: ☐ RING ☐ CLIP ☐ STUD; SIZE:

PAINTING: NONE

OPTIONS: ☐ STAIRWAY: STYLE: ☐ CIRCULAR ☐ STRAIGHT; ANGLE WITH HORIZ.:

☐ ANCHOR BOLT CLIPS ■ GROUNDING LUGS ■ LIFTING LUGS ☐ ROOF GUARD RAIL

☐ LADDER OR LADDER AND CAGE ☐ OTHER

NOTES: 1. SEE DESIGN DETAIL NO. 2.

2. CONSULT LOCAL AEROGEL VENDOR FOR APPROPRIATE THICKNESS FOR PERSONNEL PROTECTION OF SIDES ONLY.

3. DESIGN FOR FULL VACUUM/14 PSIG. SEE DESIGN DETAIL NO. 2 AND PLAN VIEW DWG. FOR NOZZLES.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

STORAGE TANK

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 5/10/15 — P.O. NO.: — EQUIPMENT NO.: T-2
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL DESCRIPTION

MFG:	*		FABRICATION: ■ SHOP ☐ FIELD	NOTE 3
PRODUCT STORED:	STEAM CONDENSATE		CAPACITY OPERATING:	SEE DESIGN DETAIL NO. 2 GAL
DESIGN SP. GR.:	0.948 @ 239 °F		DESIGN:	SEE DESIGN DETAIL NO. 2 GAL
VAPOR PRESSURE:	mmHG	24.7 PSIA	PRESSURE VACUUM RELIEF SETTING:	IN H_2O
DESIGN TEMPERATURE:	300 °F		PUMPING RATES: IN: 1135 PPH	OUT: 1135 PPH

CONSTRUCTION

TANK SIZE: DIAM.: 1.5 FT. S.S. HT.: NOTE 1 RESTRICTIONS: DIAM.: HEIGHT:

SHELL DESIGN: ☐ UL142 ☐ UL2085 ☐ UL 2245 ☐ F921 ☐ F942 ☐ OTHER

SHELL POSITION: ☐ HORIZONTAL ■ VERTICAL

WALL DESIGN : ■ SINGLE ☐ DOUBLE

ROOF DESIGN: ☐ UL142 VERTICAL ■ HORIZONTAL SHELL

ROOF TO SHELL DETAIL: ☐ UL 142 VERTICAL ■ HORIZONTAL SHELL

EMERGENCY VENTING DESIGN: ☐ UL-142 ☐ FRANGIBLE ROOF TO SHELL JOINT; DETAIL:

ROOF LOADS: UNIFORM LIVE (INCLUDING SNOW): LB/SF; WIND LOAD: NONE

BOTTOM: ■ SINGLE ☐ DOUBLE SEAMS: ■ BUTT JOINT ☐ LAP JOINT

INTEGRAL DIKE: ☐ YES ■ NO DIKE DESIGN:

SUPPORTS FOR HORIZONTAL TANK: ☐ SADDLES ☐ SKID-MOUNTED

FOUNDATION TYPE: ☐ SAND ☐ CONCRETE RING WALL ☐ CONCRETE PAD ■ OTHER LEGS

AGITATION: ☐ YES IMPELLER DIAM.: RPM: DRIVE HP: WEIGHT: LBS

MFG.: MODEL: ☐ HORIZ. ☐ VERT. STARTING TORQUE: FT/LBS

PLATE INFORMATION:	SHELL	ROOF	BOTTOM	STRUCTURES
CORROSION ALLOW. (IN) :	0	0	0	0
MATERIAL SPEC.:	304 SS	304 SS	304 SS	304 SS
PLATE THICKNESS (IN) :	*	*	*	*

HEATING OR COOLING: ☐ COILS ☐ PLATE COIL ☐ CLAMP JACKET ☐ OTHER

COIL TYPE: AREA: LGTH:

COIL MATERIAL: PIPE DIAM.: PIPE SCH.:

COIL DESIGN: PRESSURE: TEMPERATURE: TEST PRESS.:

GASKETS: 304 SS/GRAHPOIL SPIRAL WOUND

	INTERIOR	EXTERIOR
BOLTS AND STUDS: TYPE		STUD
BOLT MATERIAL:		ASTM A193 GR. B7
NUTS: TYPE		HEX
NUT MATERIAL		ASTM A194 GR. 2H

WEIGHT: EMPTY: * FILLED WITH WATER: * FILLED WITH CONTENTS:

INSULATION: AEROGEL THICKNESS: NOTE 2 SUPPORTS: ☐ RING ☐ CLIP ☐ STUD; SIZE:

PAINTING: NONE

OPTIONS: ☐ STAIRWAY: STYLE: ☐ CIRCULAR ☐ STRAIGHT; ANGLE WITH HORIZ.:

☐ ANCHOR BOLT CLIPS ■ GROUNDING LUGS ■ LIFTING LUGS ☐ ROOF GUARD RAIL

☐ LADDER OR LADDER AND CAGE ☐ OTHER

NOTES: 1. SEE DESIGN DETAIL NO. 2.

2. CONSULT LOCAL AEROGEL VENDOR FOR APPROPRIATE THICKNESS FOR PERSONNEL PROTECTION OF SIDES ONLY.

3. DESIGN FOR FULL VACUUM/14 PSIG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

STORAGE TANK

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 5/10/15 — P.O. NO.: — EQUIPMENT NO.: T-3
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL DESCRIPTION

MFG:	*		FABRICATION: ■ SHOP ☐ FIELD	NOTE 3	
PRODUCT STORED:	STEAM CONDENSATE		CAPACITY OPERATING:	SEE DESIGN DETAIL NO. 2	GAL
DESIGN SP. GR.:	0.96 @	209 °F	DESIGN:	SEE DESIGN DETAIL NO. 2	GAL
VAPOR PRESSURE:	mmHG	16.7 PSIA	PRESSURE VACUUM RELIEF SETTING:		IN H_2O
DESIGN TEMPERATURE:		300 °F	PUMPING RATES: IN:	1728 PPH	OUT: 1728 PPH

CONSTRUCTION

TANK SIZE: DIAM.: 1.5 FT. S.S. HT.: NOTE 1 RESTRICTIONS: DIAM.: HEIGHT:

SHELL DESIGN: ☐ UL142 ☐ UL2085 ☐ UL 2245 ☐ F921 ☐ F942 ☐ OTHER

SHELL POSITION: ☐ HORIZONTAL ■ VERTICAL

WALL DESIGN : ■ SINGLE ☐ DOUBLE

ROOF DESIGN: ☐ UL142 VERTICAL ■ HORIZONTAL SHELL

ROOF TO SHELL DETAIL: ☐ UL 142 VERTICAL ■ HORIZONTAL SHELL

EMERGENCY VENTING DESIGN: ☐ UL-142 ☐ FRANGIBLE ROOF TO SHELL JOINT; DETAIL:

ROOF LOADS: UNIFORM LIVE (INCLUDING SNOW): LB/SF; WIND LOAD: NONE

BOTTOM: ■ SINGLE ☐ DOUBLE SEAMS: ■ BUTT JOINT ☐ LAP JOINT

INTEGRAL DIKE: ☐ YES ■ NO DIKE DESIGN:

SUPPORTS FOR HORIZONTAL TANK: ☐ SADDLES ☐ SKID-MOUNTED

FOUNDATION TYPE: ☐ SAND ☐ CONCRETE RING WALL ☐ CONCRETE PAD ■ OTHER LEGS

AGITATION: ☐ YES IMPELLER DIAM.: RPM: DRIVE HP: WEIGHT: LBS

MFG.: MODEL: ☐ HORIZ. ☐ VERT. STARTING TORQUE: FT/LBS

PLATE INFORMATION:	SHELL	ROOF	BOTTOM	STRUCTURES
CORROSION ALLOW. (IN) :	0	0	0	0
MATERIAL SPEC.:	304 SS	304 SS	304 SS	304 SS
PLATE THICKNESS (IN) :	*	*	*	*

HEATING OR COOLING: ☐ COILS ☐ PLATE COIL ☐ CLAMP JACKET ☐ OTHER

COIL TYPE: AREA: LGTH:

COIL MATERIAL: PIPE DIAM.: PIPE SCH.:

COIL DESIGN: PRESSURE: TEMPERATURE: TEST PRESS.:

GASKETS: 304 SS/GRAHPOIL SPIRAL WOUND

	INTERIOR	EXTERIOR
BOLTS AND STUDS: TYPE		STUD
BOLT MATERIAL:		ASTM A193 GR. B7
NUTS: TYPE		HEX
NUT MATERIAL		ASTM A194 GR. 2H

WEIGHT: EMPTY: * FILLED WITH WATER: * FILLED WITH CONTENTS:

INSULATION: AEROGEL THICKNESS: NOTE 2 SUPPORTS: ☐ RING ☐ CLIP ☐ STUD; SIZE:

PAINTING: NONE

OPTIONS: ☐ STAIRWAY: STYLE: ☐ CIRCULAR ☐ STRAIGHT; ANGLE WITH HORIZ.:

☐ ANCHOR BOLT CLIPS ■ GROUNDING LUGS ■ LIFTING LUGS ☐ ROOF GUARD RAIL

☐ LADDER OR LADDER AND CAGE ☐ OTHER

NOTES: 1. SEE DESIGN DETAIL NO. 2.

2. CONSULT LOCAL AEROGEL VENDOR FOR APPROPRIATE THICKNESS FOR PERSONNEL PROTECTION OF SIDES ONLY.

3. DESIGN FOR FULL VACUUM/14 PSIG. SEE DESIGN DETAIL NO. 2 AND PLAN VIEW DWG. FOR NOZZLES.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

ELECTRICAL HEAT TRACING SYSTEMS

REV.: 2
DATE: 9/17/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 8/13/15 — P.O. NO.: — EQUIPMENT NO.: ET-1/2/3/4
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1 SYSTEM

SITE DATA

MAX. AMBIENT TEMPERATURE:	100 DEG F	DESIGN WIND SPEED:	0	MPH
MIN. AMBIENT TEMPERATURE:	50 DEG F	DESIGN SAFETY FACTOR:	10	%
INSTALLED : ■ INDOORS ☐ OUTDOORS		OTHER FACTORS:		

GENERAL SYSTEM DESIGN REQUIREMENTS

☐ FREEZE PROTECTION ■ PROCESS TEMPERATURE CONTROL ■ PIPELINE ☐ VESSEL ☐ SAFETY SHOWER ☐ INSTRUMENTATION

HEAT TRACING TYPE

■ SELF-REGULATING ☐ MI ☐ SKIN-EFFECT ☐ POWER-LIMITING ☐ CONSTANT-WATT ☐ OTHER

PROCESS INFORMATION

MATERIAL IN PIPE OR VESSEL:	SUGAR CANE JUICE	■ LIQUID ☐ GAS ☐ VAPOR		
PIPE MAINTENANCE TEMP.:	SEE NOTE 1 DEG F	NORMAL OPERATING TEMP.:	SEE NOTE 1	DEG F
MIN. ALLOWABLE PRODUCT TEMP.:	SEE NOTE 1 DEG F	MAX. ALLOWABLE PRODUCT TEMP.:	SEE NOTE 1	DEG F
MAX. SYSTEM TEMP.:	SEE NOTE 1 DEG F	LINE STEAM OUT: ■ YES ☐ NO TEMP:		DEG F

ELECTRICAL SYSTEM

VOLTAGE AVAILABLE: VOLTS: 480 PHASE: 3 HERTZ: 60 TOTAL POWER REQ'D: * KW

AREA CLASSIFICATION: ■ UNCLASSIFIED ☐ CLASSIFIED CLASS: GROUP: DIVISION:

AIT/T-RATING: DETERMINING GAS/VAPOR (LOWEST AIT):

THERMAL INSULATION SYSTEM

TYPE:	REMOVABLE AEROGEL OR OTHER APPROVED INSULATION	THICKNESS:	* IN.
JACKET:	REMOVABLE INSULATION COVERS	INSTRUMENT INSULATION: ☐ HARDPAK ☐ SOFTPAK	
PUMP INSULATION: ☐ RIGID ☐ REMOVABLE		OTHER:	

GENERAL DESIGN DATA

ELECTRICAL HEAT TRACING PANEL NOS:

PIPE LINE NUMBER:

HEAT TRACING DRAWINGS NUMBERS:

PROCESS DRAWING NUMBER:

PIPING ISOMETRIC NUMBER:

PIPING(VESSEL) SYSTEM

PIPE(VESSEL) MATERIAL: 304 SS — PIPE/VESSEL THICKNESS:

SPECIAL HEATING REQUIREMENT: ■ HEAT-UP ☐ MELT OTHER:

VOLUME OF FLUID /SOLID TO BE HEATED: TO BE DETERMINED

INTIAL MATERIAL TEMP., DEG F: 50 — FINAL MATERIAL TEMP., DEG F: SEE NOTE 1 — FREEZE TEMP., DEG F

PROCESS FLUID/GAS/VAPOR CHARATERISTICS (NOTE 1)

TEMPERATURE, DEG F	VISCOSITY, CPS	SPECIFIC HEAT, BTU/LB-DEG F	SPECIFIC GRAVITY	HEAT OF FUSION/VAPORIZATION, BTU/LB
226	LESS THAN 50	0.91	1.06	
207	LESS THAN 50	0.87	1.09	
147	50 MAX	0.83	1.34	
147	50 MAX	0.83	1.34	

DISTRIBUTION PANELS

ARRANGEMENT: ☐ PANELBOARD INTERNAL TO CONTROL PANEL ☐ PANELBOARD EXTERNAL TO CONTROL PANEL

☐ MAIN BREAKER EXTERNAL TO PANELBOARD ☐ OTHER:

OPTIONS

☐ SPACE HEATER ☐ PANEL COOLING ☐ INTERIOR LIGHTING WITH ON/OFF SWITCH ☐ Z-PURGE ■ THERMOSTATS

NOTES: 1. SYSTEM SHALL BE DESIGNED FOR THE FOLLOWING:

- SEE PID NO. 2 EVAPORATOR NO. 1 LEVEL CONTROL - LG-C1-1
- SEE PID NO. 2 EVAPORATOR NO. 2 LEVEL CONTROL - LG-C2-1
- SEE PID NO. 3 EVAPORATOR NO. 3 LEVEL CONTROL - LG-C3-1
- SEE PID NO. 3 P-2 SUCTION EQUALIZATION LINE.

2. HEAT TRACING IS REQUIRED TO CONTROL VISCOSITY AND PREVENT PLUGGAGE. HEAT TRACING SHALL BE PROVIDED BY THERMON.

CHOOSE THE HEAT TRACING WITH A MAXIMUM EXPOSURE TEMPERATURE OF 300 DEG F.

3. EACH INDIVIDUAL INSTALLATION SHALL BE CONTROLLED WITH AN ADJUSTABLE CONTROL THERMOSTAT.

4. INSTALL REMOVABLE INSUALTION COVER OVER EACH INSTALLATION.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

PRODUCT SPECIFICATIONS

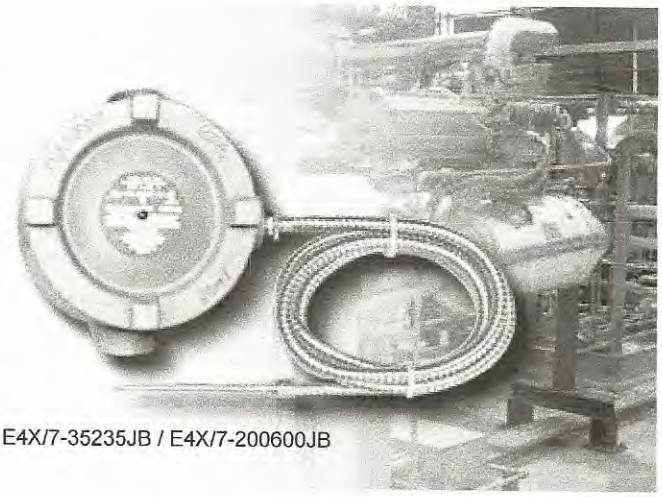
E4X/7-35235JB and E4X/7-200600JB

ADJUSTABLE CONTROL THERMOSTATS

APPLICATION

The E4X/7-35235JB and E4X/7-200600JB are designed for use as adjustable control thermostats for freeze protection and temperature maintenance applications requiring pipewall or tankwall sensing. The design of the thermostats permits their use as a junction box for connecting the heating cable to power by using the optional mounting kit (TM4X for ordinary locations or TM7 for Division 2 hazardous locations). Both thermostats feature an epoxy-coated cast aluminum NEMA 4X/NEMA 7 enclosure to provide watertight, dust tight, corrosion-resistant and explosion-proof protection to the thermostat switch. The differentiating factors between the two thermostats are the adjustable control range and maximum bulb exposure temperature.

The E4X/7-35235JB and E4X/7-200600JB thermostats are approved for use in both ordinary (nonclassified) and hazardous (classified) locations.



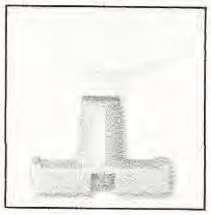
E4X/7-35235JB / E4X/7-200600JB

RATINGS

Voltage rating	125/240/277/480 Vac
Switch rating	30/30/25/15 amps
Switch type	SPST[1]
Electrical connection[2]	screw terminals on switch
Adjustable control range	
E4X/7-35235JB	35°F to 235°F (2°C to 113°C)
E4X/7-200600JB	200°F to 600°F (93°C to 316°C)
Maximum control differential	
E4X/7-35235JB	9°F (5°C)
E4X/7-200600JB	15°F (5°C)
Maximum bulb exposure temperature	
E4X/7-35235JB	300°F (149°C)
E4X/7-200600JB	650°F (343°C)
Bulb dimensions	1/4" x 6-3/8" (6.4 x 162 mm)
Bulb material	nickel-plated copper
Capillary length	6' (1.8 m)
Capillary material	nickel-plated copper
Capillary armor	flexible stainless steel

Notes

1. The National Electrical Code, Article 427-56(b) states: "Temperature- controlled switching devices which do not have an "off" position shall not be required to open all ungrounded conductors and shall not be permitted to serve as the disconnecting means." The E4X/7-35235JB and E4X/7-200600JB thermostats have no "off" position and therefore may be used for switching one conductor of a two-phase heating circuit.
2. The E4X/7-35235JB and E4X/7-200600JB utilize two 1" NPT conduit hub openings for the mounting expediter and incoming power. The thermostats include an internal grounding terminal and are available with an optional TB2F terminal block.



TM4X optional mounting kit (purchased separately) components include:

- Pipe-mounted expediter
- 2 stainless steel pipe attachment bands.
- Heater cable grommet
- 2 power connection boots
- RTV adhesive
- Wire fasteners and grounding lug

TM7 optional mounting kit (purchased separately) components include:

- Pipe-mounted expediter
- Cable seal assembly
- 2 stainless steel pipe attachment bands
- Heater cable grommet
- 2 power connection boots
- RTV adhesive
- Wire fasteners and grounding lug

CERTIFICATIONS/APPROVALS

FM Approvals
Ordinary Locations
Hazardous (Classified) Locations
Class I, Divisions 1 and 2, Groups B, C and D
Class II, Divisions 1 and 2, Groups F and G
Class III, Divisions 1 and 2

THERMON **The Heat Tracing Specialists®**

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For the Thermon office nearest you visit us at . . . www.thermon.com

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PRODUCT SPECIFICATIONS

E4X/7-35235JB and E4X/7-200600JB

ADJUSTABLE CONTROL THERMOSTATS

The following installation procedures are suggested guidelines for the installation of a Thermon mechanical thermostat. They are not intended to preclude the use of other methods utilizing accepted engineering or field construction practices.

UPON RECEIVING, THERMOSTAT

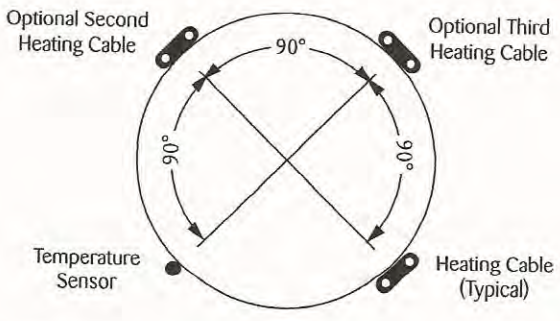
1. Upon receiving thermostat, check to make sure the proper type has been received.
2. Store in a dry place.

APPLICATIONS

1. Mechanical thermostats are used for freeze protection or temperature maintenance of piping, tanks and instrumentation.
2. Thermostat may be installed in ordinary (nonclassified) and hazardous (classified) locations depending on the specific approvals. Ensure that thermostat/junction box combination is suitable for the area classification. If installed in classified (hazardous) locations, approved explosion-proof seal fittings shall be installed on all electrical wire entries.
3. Check the line voltage and the heater circuit current to be sure that the ratings of the thermostat are not exceeded.
4. Mount the thermostat/junction box vertically upright and in a position that will prevent condensation from draining into the enclosure from the connected conduit.

THERMOSTAT CONNECTIONS

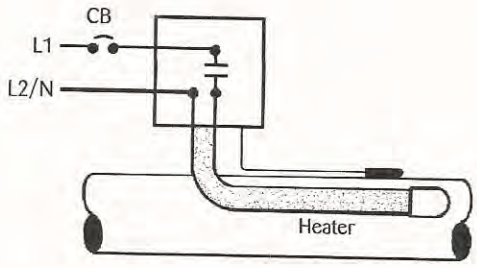
- When a line sensing controller is specified, the sensor should be placed at least 90° around the circumference from the heating cable, or at least 2" (5 cm) from the cable. Mount the bulb in a location that is representative of the overall system temperature away from valves, pipe supports, nozzles, or other heat sinks. Fasten the bulb, capillary and flexible armor (where provided) securely to the pipe/vessel with fiber or metallic tape, being sure that the entire length of the bulb is in intimate contact with the pipe surface. The bulb may be covered with a parallel pass of metallic tape to enhance heat transfer. The thermostat may require more than one support point. Prevent kinking of the capillary.
- For line sensing control, a leg of the heating circuit is to be connected in series with the control contacts as shown in the illustration below. Seal all thermal insulation penetrations after installation to prevent moisture intrusion.
- For ambient sensing control, a leg of the heating circuit should be connected in series with the control contacts as shown in the illustration below. When using an ambient sensing temperature controller, the mounting location should be representative of the coldest region, and the sensing element should not be exposed to direct sunlight or any additional heat source.



Heating Cable vs. Sensor Location (Line Sensing Control)

5. **All electric power supply circuits should be disconnected and locked out prior to beginning wiring of the thermostat/junction box.**
6. Set the thermostat dial to the control set point, and complete the electrical wiring. The heating system should not be energized prior to the circuit being properly tested.
7. Once the piping or vessel is insulated and in service, the temperature of the process fluid may be measured and compared with the control set point. Adjust the set point where necessary.
8. **Power should always be disconnected and a lockout/tagout procedure performed prior to opening the thermostat/junction box enclosure for maintenance.**
9. Any modification to the enclosure or deviation from these procedures may affect unit's rating or approvals. Contact factory if modifications are necessary.
10. If recalibration becomes necessary, contact factory for procedures/assistance.

TYPICAL WIRING DIAGRAM



PRODUCT SPECIFICATIONS

HTSX™ SELF-REGULATING HEATING CABLE

APPLICATION

HTSX self-regulating heating cables are designed specifically for process temperature maintenance or freeze protection where high temperature exposure capability is required. HTSX withstands the temperature exposures associated with steam purging.

The heat output of HTSX cable varies in response to the surrounding temperature. Variations in the ambient temperature or heat lost through the thermal insulation are compensated for automatically along the entire length of a heat-traced pipe.

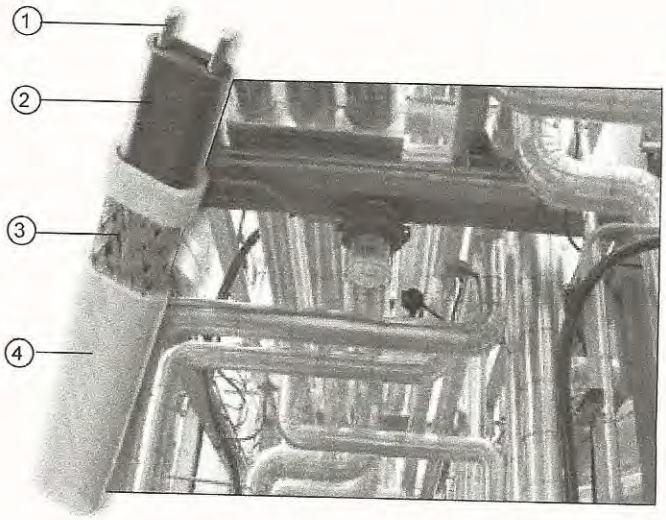
HTSX cables are approved for use in ordinary (nonclassified) areas and hazardous (classified) areas.

RATINGS

Available watt densities	3, 6, 9, 12, 15, 20 W/ft @ 50°F (10, 20, 30, 39, 49, 66 W/m @ 10°C)
Supply voltages	110-120 or 208-277 Vac
Max. maintenance temperature	250°F (121°C)
Max. exposure temperature	
Intermittent power-on	420°F (215°C)
Intermittent power-off	482°F (250°C)
Continuous power-off	400°F (204°C)
Minimum installation temperature	-76°F (-60°C)
Minimum bend radius	
@ 5°F (-15°C)	0.38" (10mm)
@ -76°F (-60°C)	1.25" (32 mm)
T-rating [1]	
3,6,9,12, 15-2 W/ft	T3 392°F (200°C)
15-1 and 20-1 W/ft	T2D 419°F (215°C)
20-2 W/ft	T2C 446°F (230°C)
Based on stabilized design [2]	T3 to T6

Notes

1. T-rating per the National Electrical Code and Canadian Electrical Code.
2. Thermon heating cables are approved for the listed T-ratings using the stabilized design method. This enables the cable to operate in hazardous areas without limiting thermostats. The T-rating may be determined using CompuTrace® Electric Heat Tracing Design Software or contact Thermon for design assistance.



CONSTRUCTION

1 Nickel-plated copper bus wires (16 AWG)

2 Semiconductive heating matrix and fluoropolymer dielectric insulation

3 Tinned copper braid

4 Fluoropolymer overjacket provides additional protection for cable and braid where exposure to chemicals or corrosives is expected.

BASIC ACCESSORIES

Thermon offers system accessories designed specifically for rapid, trouble-free installation of Thermon heating cables.

All cables require a connection kit to comply with approval requirements. Information on accessories to complete a heater circuit installation can be found in the "Heating Cable Systems Accessories" product specification sheet (Form TEP0010).

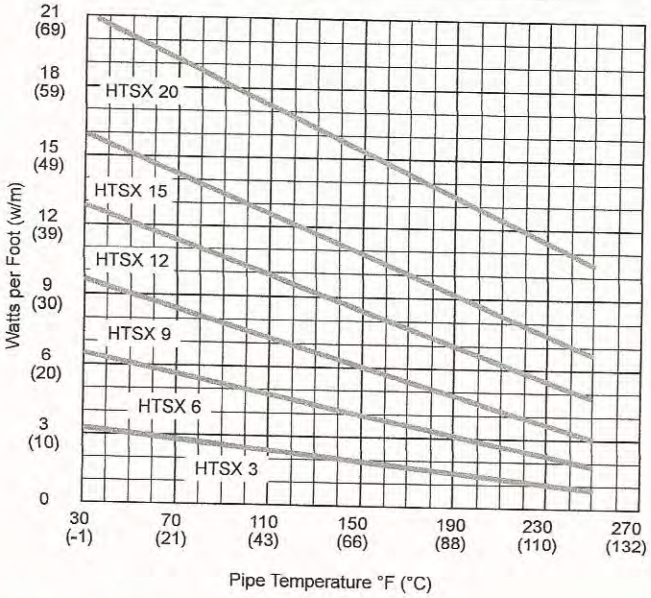
PRODUCT SPECIFICATIONS

HTSX™ SELF-REGULATING HEATING CABLE

POWER OUTPUT CURVES [1]

The power outputs shown apply to cable installed on insulated metallic pipe (using the procedures outlined in IEEE 515) at the service voltages stated below. For use on other service voltages, contact Thermon.

Catalog Number 120 Vac Nominal	Catalog Number 240 Vac Nominal	Power Output at 50°F (10°C) w/ft (m)
HTSX 3-1	HTSX 3-2	3 (10)
HTSX 6-1	HTSX 6-2	6 (20)
HTSX 9-1	HTSX 9-2	9 (30)
HTSX 12-1	HTSX 12-2	12 (39)
HTSX 15-1	HTSX 15-2	15 (49)
HTSX 20-1	HTSX 20-2	20 (66)



CERTIFICATIONS/APPROVALS

FM Approvals
Ordinary Locations
Hazardous (Classified) Locations
Class I, Division 2, Groups B, C and D
Class II, Division 2, Groups F and G
Class III, Divisions 1 and 2
Class I, Zones 1 and 2, AEx e II

Underwriters Laboratories Inc.
Ordinary Locations
Hazardous (Classified) Locations
Class I, Division 2, Groups A, B, C and D
Class II, Division 2, Groups F and G
Class III, Divisions 1 and 2

Canadian Standards Association
Ordinary Locations
Hazardous (Classified) Locations
Class I, Divisions 1 and 2, Groups A, B, C and D
Class II, Divisions 1 and 2, Groups E, F and G
Ex e II

Notes

1. For more precise power output values as a function of pipe temperature, refer to CompuTrace®.
2. Based on the trip current characteristic of Type QOB or Type QO equipment protection devices. For devices with other trip current characteristics, contact Thermon.
3. The maximum circuit length is for one continuous length of cable, not the sum of segments of cable. Refer to CompuTrace® design software or contact Thermon for current loading of segments.

CIRCUIT BREAKER SIZING [2]

Maximum circuit lengths for various circuit breaker amperages are shown below. Breaker sizing should be based on the National Electrical Code, Canadian Electrical Code or any other applicable code. The National Electrical Code and Canadian Electrical Code require ground-fault protection of equipment for each branch circuit supplying electric heating equipment. Check local codes for ground-fault protection requirements.

120 Vac Service Voltage		Max. Circuit Length [3] vs. Breaker Size ft (m)		
Catalog Number	Start-Up Temp °F (°C)	20A	30A	40A
HTSX 3-1	50 (10)	360 (109)	360 (109)	360 (109)
	0 (-18)	360 (109)	360 (109)	360 (109)
	-20 (-29)	360 (109)	360 (109)	360 (109)
	-40 (-40)	360 (109)	360 (109)	360 (109)
HTSX 6-1	50 (10)	235 (71)	250 (77)	250 (77)
	0 (-18)	235 (71)	250 (77)	250 (77)
	-20 (-29)	235 (71)	250 (77)	250 (77)
	-40 (-40)	235 (71)	250 (77)	250 (77)
HTSX 9-1	50 (10)	170 (52)	205 (62)	205 (62)
	0 (-18)	170 (52)	205 (62)	205 (62)
	-20 (-29)	170 (52)	205 (62)	205 (62)
	-40 (-40)	165 (50)	205 (62)	205 (62)
HTSX 12-1	50 (10)	135 (41)	175 (54)	175 (54)
	0 (-18)	135 (41)	175 (54)	175 (54)
	-20 (-29)	135 (41)	175 (54)	175 (54)
	-40 (-40)	125 (38)	175 (54)	175 (54)
HTSX 15-1	50 (10)	100 (30)	160 (48)	160 (49)
	0 (-18)	95 (29)	150 (46)	160 (49)
	-20 (-29)	90 (27)	145 (44)	160 (49)
	-40 (-40)	85 (26)	135 (41)	160 (49)
HTSX 20-1	50 (10)	85 (26)	130 (40)	140 (42)
	0 (-18)	80 (24)	120 (37)	140 (42)
	-20 (-29)	75 (23)	115 (35)	140 (42)
	-40 (-40)	70 (21)	110 (33)	140 (42)

240 Vac Service Voltage		Max. Circuit Length [3] vs. Breaker Size ft (m)		
Catalog Number	Start-Up Temp °F (°C)	20A	30A	40A
HTSX 3-2	50 (10)	710 (217)	710 (217)	710 (217)
	0 (-18)	700 (214)	710 (217)	710 (217)
	-20 (-29)	615 (187)	710 (217)	710 (217)
	-40 (-40)	530 (162)	710 (217)	710 (217)
HTSX 6-2	50 (10)	470 (143)	505 (154)	505 (154)
	0 (-18)	435 (132)	505 (154)	505 (154)
	-20 (-29)	390 (120)	505 (154)	505 (154)
	-40 (-40)	355 (108)	505 (154)	505 (154)
HTSX 9-2	50 (10)	340 (104)	410 (125)	410 (125)
	0 (-18)	310 (95)	410 (125)	410 (125)
	-20 (-29)	290 (88)	410 (125)	410 (125)
	-40 (-40)	265 (81)	410 (125)	410 (125)
HTSX 12-2	50 (10)	270 (82)	355 (109)	355 (109)
	0 (-18)	245 (74)	355 (109)	355 (109)
	-20 (-29)	230 (70)	355 (109)	355 (109)
	-40 (-40)	215 (65)	340 (104)	355 (109)
HTSX 15-2	50 (10)	200 (61)	315 (96)	315 (96)
	0 (-18)	175 (53)	275 (84)	315 (96)
	-20 (-29)	165 (51)	260 (79)	315 (96)
	-40 (-40)	155 (48)	245 (74)	315 (96)
HTSX 20-2	50 (10)	155 (48)	245 (75)	275 (84)
	0 (-18)	140 (42)	215 (65)	275 (84)
	-20 (-29)	130 (40)	205 (62)	275 (84)
	-40 (-40)	125 (38)	190 (59)	265 (80)

AMERICAN INGENUITY LLC

PLANT	STEAM CONDENSATE	PROJECT NO.	
LOCATION	ST. GABRIEL., LA.	W.R. NO.	
CLIENT	AUDUBON SUGAR INSTITUTE	APPR. NO.	
PUMP MANUFACTURER		P.O. NO.	
MODEL	NO. UNITS 1 ANSI Pump ☐	Non-ANSI Pump ☐	

No.	Section	Item	Details
1	SERVICE CONDITIONS	Liquid Pumped: STEAM CONSENSATE	Normal / Design Capacity @ P.T. 1 gpm
2		Pumping Temperature (P.T.): 133 °F	Discharge Pressure psia ft.
3		Specific Gravity at P.T.: 0.987	Suction Pressure psia ft.
4		Viscos at P.T.: 0.65 cp: Vap Press at P.T. 2.2 psia	Differential Pressure 0 psi ft.
5		Percent/Size Solids:	Differential Head 15 ft.
6		Corrosion or Erosion Factors:	NPSH Available 5.4 ft.;NPSH Required (Water) * ft.
7	CONSTRUCTION DETAILS	Arrangement: Horiz. Number of Stages 1	Shut Off Pressure * ft. Min. Continuous gpm* *
8		Direction of Rotation Facing Pump Coupling: CW - CCW *	Efficiency at Rating * BHP Rated *
9		Case: D.P. @ T/M.A.W.P. @ T: * NOTE 1	PSIG °F Max. BHP Rated imp *
10		Case Mount: ☐ Between brgs ☑ Overhung ☐ Centerline ☐ Foot	☐ Bracket ☐ Vert. (Type)
11		Split: ☐ Axial ☐ Rad. Type Volute: ☑ SGL ☐ DBL	☐ Diffuser Impeller Type ☑ Open ☐ Closed
12		Impeller Diameter: Supplied * in; Max * in; Min *	in Suction ☑ Single ☐ Double Speed * rpm
13		Vent and Drain Tapped: Yes	Type Bearings:* Radial
14		Nozzles / Size / Rating / Facing / Location	Lubrication: ☐ Ring Oil ☐ Flood ☐ Flinger ☐ Grease
15		Suction / * / ANSI 150 / RF / END	Oiler: Yes ; Type TRICO
16		Discharge / * / ANSI 150 / RF / TOP	Coupling: Yes ; Mfg. Coupl. Grd: Yes
		Circ. Port	
17		Drains	Baseplate: Yes; Type FABRICATED STEEL
18		Cooling H2O	Cooling Water Supply: Type
19			Available at psig and °F
20		Water Cooling: Case-Stuff. Box-Bearing-Pedestal-Gland-None	Total Water Required: gpm
21		Smothering Gland: Lantern Rings: Packing: No Mfr.:	Type
22		Mechanical Seal: ; Furnished by: ; Mfr.	MFR. CODE
23		Type: SINGLE	API Class Code
24		Rotary Unit ; Seal Ring ; Face Material	;Shaft Packing
25		Insert ; Reversible: Yes - No ; Face Material	☐ Sight F.I. Req'd
26		Insert Mounting: Clamped In - "O" Ring - Press Fit API C.W. Pipe Plan	☐ CU; ☐ S.S. ☑ Tubing ☐ Pipe
27		Gland ; Plain: Yes - No Throttle Bushing Carbon: Yes - No	;Other
28		Gland/Stuffing Box Machined & Tapped for: Dead - End Lub. - Circulating Lub. - Quenching - Vent and Drain	
29			
30		Auxiliary Stuffing Box Req'd: No API Seal Plan	☐ C.S. ☐ S.S. ☐ Tubing ☐ Pipe
31		Weight of Pump * lb ; Weight of Driver lb ; Weight of Base	lb ; Shipping Weight lb
32	MATERIALS	Casing & Covers: DUCTILE IRON	Shaft:
33		Casing Wear Rings:	Shaft Sleeves:
34		Impeller: 316 SS	Lantern Rings:
35		Impeller Wear Rings:	Glands:
36		Thrust Washers:	Adaptor:
37		Stuffing Box Bushings:	Bearings:
38		Stator/Rotor Liner:	Bearing Housing:
39		Stator End Caps:	Gaskets:
40		Stator Housing:	External Bolts:
41		Pump O-rings:	Baseplate:
42		Motor O-rings:	Casing Jacket:
43		Internal Bolts:	Coupling Guard:
44	DRIVER	Furnished by: Pump Vendor ; Type: AC Induction Premium Efficiency	; Direct - Gear - Belt
45		Electric Motor: Make Mounted by: PUMP VENDOR	Speed * rpm Driver Specification No.
46		Enclosure TEFC SF 1.5 Temp. Rise °C	Volts 460 ; Phase 3 Cycle 60
47		Insulation Frame	Speed Reducer: Integral - Separate
48		Normal Motor Size (Non-overloading) hp	Mfr. Ratio
49			Model Class
50	NOTES	1. SEE PI&D AND DESIGN DETAIL NO.2.	
51		2. ENTRAINMENT OF GASSES IS POSSIBLE.	
52		3. QUOTE RECOMMENDED SPARE PARTS.	
53		4. THIS MOTOR SHALL HAVE A SOFT STARTER FOR FREQUENT STARTS.	
54			
55	Tests	Std Shop Test - Yes; NPSH Test - Yes	Hydrostatic Test: Yes ; Pressure * psi
56		Performance Test - Yes; Witnessed - No	Shop Inspection: No

SPEC. BY: BDL		P-4	EQUIP. NO.
CHECKED:	SERVICE EVAPORATOR NO. 3 OVERHEAD STEAM CONDENSATE	CENTRIFUGAL PUMP SPECIFICATION	
APP'D:			
DATE: 9/4/2015	Revision Date: A B C		
VENDOR TO COMPLETE ALL INFORMATION MARKED *	SHEET 1 OF 1	SPEC. NO.	

AMERICAN INGENUITY

STRAINER

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 8/13/15 — P.O. NO.: — EQUIPMENT NO.: SS-3
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: SUCTION STRAINER OF P-4		LOCATION: SUCTION OF P-4
MANUFACTURER: *		N-S/E-W COORDINATES:
MODEL: *		

PROCESS DESIGN

INLET PRESS.:	>2	PSIG	INLET TEMP.:	133	DEG F
FLOWING FUID: STEAM CONDENSATE			MAX. FLOWRATE	2	GPM
ALLOWABLE PRESS DROP AT MAX. FLOWRATE:	0.2	PSI	EXPECTED PRESS DROP AT MAX. FLOWRATE:	*	PSI
REQUIRED MESH OR PERFORATIONS: 40			PERCENT OPEN AREA:	*	%
PIPE MATING FLANGES: 2" RF					

CONSTRUCTION

TYPE OF STRAINER: ☐ TEMP. CONE ☐ TEMP. BASKET ■ Y-STRAINER ☐ PERMANENT BASKET WITH FLG HEAD (NOTE 3)

BODY MAT'L: SS			CONNECTION SIZE:	2	IN
SCREEN OR MESH MAT'L: SS			FLANGE RATING: ANSI CLASS 150		
GASKET MAT'L FOR PERMANENT STRAINER: 304 SS/GRAPHITE SW			DESIGN PRESS.:	*	PSIG
TYPE OF CONNECTIONS: ☐ NPT ☐ FF FLG ■ RF FLG			DESIGN TEMP:	*	DEG F
SIZE OF DRAIN CONNECTION:	*	IN	WEIGHT OF STRAINER:	*	LBS
LENGTH OF TEMPORARY STRAINER:	*	IN			
FACE TO FACE OF PERMANENT STRAINER:	*	IN			

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO STRAINER WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

V
EVAPORATOR SPECIFICATION SHEETS

AMERICAN INGENUITY

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 4
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 5/10/15 — P.O. NO.: — EQUIPMENT NO.: V-1
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL DESCRIPTION

1	SERVICE: SUGAR CANE JUICE EVAPORATOR NO. 1				TYPE: ☐ HORIZONTAL ■ VERTICAL					
2	MFG.:				LOCATION: ■ INDOORS ☐ OUTDOORS					
3	DESIGN CAPACITY:			GAL.	WIND LOAD:			MPH		PSIG
4	OPERATING CAPACITY:			GAL.	SEISMIC ZONE: 0					

MECHANICAL

		VESSEL	JACKET	COIL						
6	CODE: ■ ASME SEC. VIII, DIV. I ☐ NATIONAL BOARD									
7	CONTENTS	SUGAR JUICE			MDMT@ MAWP: 20 DEG F					
8	OPER. PRESS. PSIG				STRESS RELIEF: ☐ NO ☐ YES PER CODE					
9	DESIGN PRESS. PSIG	50			RADIOGRAPH: ☐ NO ☐ YES PER CODE					
10	OPER. VAC. mmHG				ASME CODE STAMP REQ'D: ☐ NO ■ YES					
11	DESIGN VAC. mmHG	FULL			NATIONAL BOARD REGIST. REQ'D: ■ NO ☐ YES					
12	OPER. TEMP. °F				HYDRO TEST VESSEL: ☐ NO ■ YES @ PSIG					
13	DESIGN TEMP. °F	350			JACKET: ☐ NO ☐ YES @ PSIG					
14	S.G. @ °F				COIL: ☐ NO ☐ YES @ PSIG					
15	CORROSION ALLOW. IN.	0			FREON LEAK TEST: ■ NO ☐ YES @ PSIG					
16	VOLUME GAL				SPECIAL TESTING REQ'D: ■ NO ☐ YES					
17	VESSEL LINING MAT'L:			THK.:	WT. OF AGITATOR:			LBS; W/MTR:		LBS
18	SHELL DIAM:	T.L.-T.L.:		MAT'L: 304 SS					THK.:	
19	TOP HEAD: ☐ ASME F&D	■ STD F&D	☐ FLAT	☐ CONE	☐ 2 : 1 ELLIP	☐ HEMIS.	☐ OTHER		THK.:	
20	BTM HEAD: ☐ ASME F&D	☐ STD F&D	☐ FLAT	☐ CONE	■ 2 : 1 ELLIP	☐ HEMIS.	☐ OTHER		THK.:	
21	JACKET: ☐ FULL	☐ PARTIAL	TYPE: ☐	CONVENTIONAL	☐ DIMPLE	☐ HALF PIPE				
22	AREA:	MAT'L:							THK.:	
23	COIL: TYPE:	LGTH:		MAT'L:				SIZE:	SCH.:	
24	BAFFLES: NO. REQ'D:	SIZE:		SPACING:	MAT'L:					
25	INTERIOR FINISH:				INTERNAL WELD FINISH:					
26	EXTERIOR FINISH:				EXTERNAL WELD FINISH:					
27	INTERNAL PIPE:				REINFORCEMENT MAT'l;					
28	INTERNAL ATTACHMENTS:				EXTERNAL ATTACHMENTS:					
29	BOLTS/STUDS: MAT'L INTERNAL:				MAT'L EXTERNAL:					
30	NUTS: MAT'L INTERNAL:				MAT'L EXTERNAL:					
31	FLANGES:	ASTM A182 304 SS			GASKETS:					
32	FIITINGS:				PAINT: NONE					
33	VESSEL WEIGHT EMPTY:			LBS;	FILLED WITH WATER:					LBS
34	VESSEL SHIPPING WEIGHT:			LBS;	FILLED WITH CONTENTS:					LBS

OPTIONS

36	SUPPORTS: ■ LEGS	☐ LUGS	☐ SKIRT	☐ SADDLES		INSULATION: ■ BY VENDOR ☐ BY OTHERS				
37	NO: * MAT'l;		THK.:			MAT'L: AEROGEL			THK:	
38	LIFTING LUGS: ☐ NO	■ YES; NO.:	LOCATION:			SUPPORTS: ☐ RING	☐ CLIP	☐ STUD		
39	STIFFENING RINGS: ■ NO	☐ YES; NO.:	WTH:	THK:		SHEATHING MAT'L: ALUMINUM			THK:	
40	PLATFORM CLIPS: ■ NO	☐ YES; NO.:	SIZE:			VORTEX BREAKER: ■ NO	☐ YES	SIZE:		
41	LADDER CLIPS: ■ NO	☐ YES; NO.:	SIZE:			INTERNALS: ☐ TRAYS	☐ PACKING			
42	MIST ELIMINATOR: ☐ NO	■ YES				FIREPROOFING SUPPORTS:				
43	BASE RING & CHAIRS: NO					GROUNDING LUGS: ONE EACH				
44	PLATFORMS FURNISHED: NO					NAMEPLATE: S.S EACH VESSEL				

45 * VENDOR SHALL SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

EVAPORATOR

REV.: 1
DATE: 8/19/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 2 OF 4
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/10/15 | P.O. NO.: | EQUIPMENT NO.: V-1
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

NOZZLES AND COUPLINGS

MARK	SIZE, IN.	NUMBER	PRESSURE RATING / TYPE	MATERIAL	SERVICE
A	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	NONCONDENSIBLE VENT
B	6	1	ANSI CLASS 150/ RFSO FLG.	304 SS	VAPOR OUTLET
C	0.75	1	ANSI CLASS 3000/THRD. CLPG. WITH THRD. PLUG	304 SS	SPARE WITH PLUG
D	0.75	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	PRESSURE/VACUUM INDICATOR
E	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	PRESSURE/VACUUM TRANSMITTER
F	1	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	TEMPERATURE INDICATOR
G	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	TEMPERATURE TRANSMITTER
H1-H2	2	2	ANSI CLASS 150/STUDDING OUTLET	304 SS	LEVEL SIGHT GLASS/LEVEL TRANSMITTER
J1-J4	5	4	ANSI CLASS 150 STUDDING FLANGE (SEE DESIGN DETAIL NO. 8)	304 SS	SIGHT GLASSES
K	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	WATER IN
L	1	0.75	ANSI CLASS 150/ RFSO FLG.	304 SS	CALANDRIA VENT
M	0.75	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	PRESSURE/VACUUM INDICATOR
N	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	PRESSURE/VACUUM TRANSMITTER
O	1	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	TEMPERATURE INDICATOR
P	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	TEMPERATURE TRANSMITTER
Q	4	1	ANSI CLASS 150/ RFSO FLG.	304 SS	STEAM INLET
R	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	STEAM CONDENSATE OUT
S1-2	1.5	2	ANSI CLASS 150/ RFSO FLG.	304 SS	JUICE IN
T	1.5	1	ANSI CLASS 150/ RFSO FLG.	304 SS	JUICE OUTLET
U	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	SAMPLE OUT
V1-2	2	2	ANSI CLASS 150/ RFSO FLG.	304 SS	LEVEL TRANSMITTER
Z1-11	0.75	11	ANSI CLASS 3000/THRD. CLPG. WITH THRD. PLUG	304 SS	SPARE WITH PLUG

NOTES:

1. VAPOR OUTLET AND STEAM INLET SIZES AREA DIFFERENT FOR V-1, V-2, AND V-3.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE SHEET 3 OF 4
LOCATION: ST. GABRIEL, LA. PROJ. NO.: SPEC. NO.:
BY: BDL DATE: 5/10/15 P.O. NO.: EQUIPMENT NO.: V-1
CHECKED BY: DATE: PRICE EACH $ TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

DESCRIPTION: EVAPORATOR V-1 CALANDRIA

SIZE: UNCONVENTIONAL TYPE: UNCONVENTIONAL

SURFACE AREA TOTAL (SQ.FT.) : 75 UNITS REQUIRED: 1 SURFACE PER UNIT (SQ.FT.) : 75

PERFORMANCE OF ONE UNIT

	HOT SIDE - SHELL SIDE	COLD SIDE - TUBE SIDE
FLUID CIRCULATED	STEAM	SUGAR CANE JUICE
TOTAL FLUID ENTERING LBS/HR	562	2077
VAPOR LBS/HR		
LIQUID LBS/HR		2077
STEAM LBS/HR	562	
NON-CONDENSABLES LBS/HR		
FLUID VAPORIZED LBS/HR		573
STEAM CONDENSED LBS/HR	562	
SPECIFIC GRAVITY		
VISCOSITY CP		
MOLECULAR WEIGHT		
SPECIFIC HEAT BTU/LB-°F		0.94
THERMAL CONDUCTIVITY BTU/HR-FT-°F		
LATENT HEAT - VAPOR BTU/LB	952	
TEMPERATURE IN °F		235
TEMPERATURE OUT °F		227
OPERATING PRESSURE PSIG		10.5
NO. PASSES		1
VELOCITY FT/SEC		
PRESSURE DROP PSI		
FOULING FACTOR		

HEAT EXCHANGED (BTU/HR) : 551,451 LMTD CORRECTED (°F) :

TRANSFER RATE: SERVICE: 415 BTU/HR-SQ.FT.-DEG F CLEAN: 398 BTU/HR-SQ.FT.

DETAILS OF CONSTRUCTION

	HOT SIDE - SHELL SIDE	COLD SIDE - TUBE SIDE
DESIGN PRESSURE PSIG	50 PSIG/FV	80 PSIG/FV
TEST PRESSURE PSIG	75 PSIG	120 PSIG
DESIGN TEMPERATURE °F	350	350
MATERIAL - GASKETS	304 SS/TEFLON SPIRAL WOUND FELXITALLIC TYPE CGI	304 SS/TEFLON SPIRAL WOUND FELXITALLIC TYPE CGI
MATERIAL - NOZZLES	NOTE 1	304 SS TUBESHEET

MATERIAL - SHELL: 304 SS NO.: 1 THICKNESS: *

MATERIAL - BAFFLES: NONE MATERIAL - TUBES: 2" 14 GAUGE 304 SS/304 SS TUBESHEET

MATERIAL - BOLTS: ASTM A-193 GR. B7 MATERIAL - NUTS: ASTM A-194 GR. 2H

OPTIONS: ■ ASME SECT. VIII, DIV. I CODE AND STAMP ☐ SANITARY CONSTRUCTION ☐ OTHER

NOTES:
1. SEE SHEET 2 AND ATTACHED DRAWING 15-012-M-001 OF TOTAL EVAPORATOR FOR NOZZLES ON CALANDRIA.
2. SEE DRAWING 15-012-M-002 FOR CALANDRIA INTERNAL JUICE COLLECTION CHAMBER.
3. SHELL AND TUBES SHALL HAVE ZERO CORROSION ALLOWANCE.
4. SPECIFY STANDARD INDUSTRIAL CLASS 75 FLANGES RATED FOR 108 PSI AT 350 DEG F.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 4 OF 4
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/10/15 | P.O. NO.: | EQUIPMENT NO.: V-1
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

ENTRAINMENT SEPARATOR

GAS COMPOSITION AT INLET TO MIST ELIMINATOR: SATURATED STEAM WITH ENTRAINED LIQUID SUGAR CANE JUICE

MANUFACTURER/MODEL: MUNTERS MODEL DV270 (T271) DROPLET SEPARATOR - ONE SECTION

GAS MOLECULAR WEIGHT: | DENSITY, LBS/CU.FT.: 0.047 (STEAM) 1.04 (JUICE)

GAS VISCOSITY, CP.:

FLOWRATE: 573 LBS/HR | TEMPERATURE: 226 DEG F

GASPRESSURE, PSIA: MIN.: | MAX.: | NORMAL: 4.2 PSIG

ARE ANY SOLIDS PRESENT IN GAS: ■ NO ☐ YES | IF YES, DESCRIBE IN NOTES:

PREFERRED MIST ELIMINATOR TYPE: ■ VANE ☐ MESH

PAD DENSITY, LBS/ CU. FT.: | PAD THICKNESS, IN.:

DESIRED COLLECTION EFFICIENCY, %: | OF | MICRON DROPLETS | WT% | VOL% | PPM

MAX. ALLOWABLE PRESSURE DROP, PSI: 0.1 PSI

MATERIALS OF CONSTRUCTION: 304 SS

NOTES:

1. SUPPORT FOR SEPARATOR SHALL BE PER MANUFACTURER'S RECOMMENDATION.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 4
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 5/10/15 — P.O. NO.: — EQUIPMENT NO.: V-2
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL DESCRIPTION

1	SERVICE: SUGAR CANE JUICE EVAPORATOR NO. 2				TYPE: ☐ HORIZONTAL ■ VERTICAL			
2	MFG.: *				LOCATION: ■ INDOORS ☐ OUTDOORS			
3	DESIGN CAPACITY:			GAL.	WIND LOAD: 110	MPH		PSIG
4	OPERATING CAPACITY:			GAL.	SEISMIC ZONE: 0			

MECHANICAL

		VESSEL	JACKET	COIL				
6					CODE: ■ ASME SEC. VIII, DIV. I ☐ NATIONAL BOARD			
7	CONTENTS	SUGAR JUICE			MDMT@ MAWP: 20 DEG F			
8	OPER. PRESS. PSIG	4.2			STRESS RELIEF: ■ NO ☐ YES PER CODE			
9	DESIGN PRESS. PSIG	50			RADIOGRAPH: ☐ NO ☐ YES PER CODE			
10	OPER. VAC. mmHG				ASME CODE STAMP REQ'D: ☐ NO ■ YES			
11	DESIGN VAC. mmHG	FULL			NATIONAL BOARD REGIST. REQ'D: ■ NO ☐ YES			
12	OPER. TEMP. °F	226			HYDRO TEST VESSEL: ☐ NO ■ YES @			PSIG
13	DESIGN TEMP. °F	350			JACKET: ☐ NO ☐ YES @			PSIG
14	S.G. @ °F	1.06			COIL: ☐ NO ☐ YES @			PSIG
15	CORROSION ALLOW. IN.	0			FREON LEAK TEST: ■ NO ☐ YES @			PSIG
16	VOLUME GAL				SPECIAL TESTING REQ'D: ■ NO ☐ YES			

17	VESSEL LINING MAT'L:			THK.:	WT. OF AGITATOR:		LBS; W/MTR:		LBS
18	SHELL DIAM: 2'6"	T.L.-T.L.: SEE DWG.		MAT'L: 304 SS				THK.:	*
19	TOP HEAD: ☐ ASME F&D	■ STD F&D	☐ FLAT	☐ CONE	☐ 2 : 1 ELLIP	☐ HEMIS.	☐ OTHER	THK.:	*
20	BTM HEAD: ☐ ASME F&D	☐ STD F&D	☐ FLAT	☐ CONE	■ 2 : 1 ELLIP	☐ HEMIS.	☐ OTHER	THK.:	*
21	JACKET: ☐ FULL	☐ PARTIAL	TYPE: ☐	CONVENTIONAL	☐ DIMF	☐ HALF PIPE			
22	AREA:	MAT'L:						THK.:	
23	COIL: TYPE:	LGTH:		MAT'L:			SIZE:	SCH.:	
24	BAFFLES: NO. REQ'D:	SIZE:		SPACING:	MAT'L:				
25	INTERIOR FINISH:				INTERNAL WELD FINISH:				
26	EXTERIOR FINISH:				EXTERNAL WELD FINISH:				
27	INTERNAL PIPE:	304 SS			REINFORCEMENT MAT'I; 304 SS				
28	INTERNAL ATTACHMENTS:				EXTERNAL ATTACHMENTS:				
29	BOLTS/STUDS: MAT'L INTERNAL:				MAT'L EXTERNAL: 304 SS				
30	NUTS: MAT'L INTERNAL:				MAT'L EXTERNAL: 304 SS				
31	FLANGES:	ASTM A182 304 SS (SEE SHEET 3 FOR CALANDRIA FLANGES			GASKETS: SS304/TEFLON SPIRAL WOUND STYLE CGI				
32	FIITINGS:				PAINT: NONE				
33	VESSEL WEIGHT EMPTY: *	LBS;			FILLED WITH WATER: *				LBS
34	VESSEL SHIPPING WEIGHT: *	LBS;			FILLED WITH CONTENTS:				LBS

OPTIONS

36	SUPPORTS: ■ LEGS	☐ LUGS	☐ SKIRT	☐ SADDLES	INSULATION: ■ BY VENDOR	☐ BY OTHERS		
37	NO: * MAT'I;		THK.:		MAT'L: AEROGEL			THK:
38	LIFTING LUGS: ☐ NO	■ YES; NO.:	LOCATION: TOP		SUPPORTS: ☐ RING	☐ CLIP	☐ STUD	
39	STIFFENING RINGS: ■ NO	☐ YES; NO.:	WTH:	THK:	SHEATHING MAT'L: ALUMINUM			THK:
40	PLATFORM CLIPS: ■ NO	☐ YES; NO.:	SIZE:		VORTEX BREAKER: ■ NO	☐ YES	SIZE:	
41	LADDER CLIPS: ■ NO	☐ YES; NO.:	SIZE:		INTERNALS: ☐ TRAYS	☐ PACKING		
42	MIST ELIMINATOR: ☐ NO	■ YES			FIREPROOFING SUPPORTS:			
43	BASE RING & CHAIRS: NO				GROUNDING LUGS: ONE EACH			
44	PLATFORMS FURNISHED: NO				NAMEPLATE: S.S EACH VESSEL			

45 * VENDOR SHALL SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

EVAPORATOR

REV.: 1
DATE: 8/19/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 2 OF 4
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/10/15 | P.O. NO.: | EQUIPMENT NO.: V-2
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

NOZZLES AND COUPLINGS

MARK	SIZE, IN.	NUMBER	PRESSURE RATING / TYPE	MATERIAL	SERVICE
A	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	NONCONDENSIBLE VENT
B	6	1	ANSI CLASS 150/ RFSO FLG.	304 SS	VAPOR OUTLET
C	0.75	1	ANSI CLASS 3000/THRD. CLPG. WITH THRD. PLUG	304 SS	SPARE WITH PLUG
D	0.75	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	PRESSURE/VACUUM INDICATOR
E	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	PRESSURE/VACUUM TRANSMITTER
F	1	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	TEMPERATURE INDICATOR
G	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	TEMPERATURE TRANSMITTER
H1-H2	2	2	ANSI CLASS 150/STUDDING OUTLET	304 SS	LEVEL SIGHT GLASS/LEVEL TRANSMITTER
J1-J4	5	4	ANSI CLASS 150 STUDDING FLANGE (SEE DESIGN DETAIL NO. 8)	304 SS	SIGHT GLASSES
K	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	WATER IN
L	1	0.75	ANSI CLASS 150/ RFSO FLG.	304 SS	CALANDRIA VENT
M	0.75	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	PRESSURE/VACUUM INDICATOR
N	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	PRESSURE/VACUUM TRANSMITTER
O	1	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	TEMPERATURE INDICATOR
P	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	TEMPERATURE TRANSMITTER
Q	6	1	ANSI CLASS 150/ RFSO FLG.	304 SS	STEAM INLET
R	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	STEAM CONDENSATE OUT
S1-2	1.5	2	ANSI CLASS 150/ RFSO FLG.	304 SS	JUICE IN
T	1.5	1	ANSI CLASS 150/ RFSO FLG.	304 SS	JUICE OUTLET
U1-2	1	2	ANSI CLASS 150/ RFSO FLG.	304 SS	SAMPLE CIRC.
V1-2	2	2	ANSI CLASS 150/ RFSO FLG.	304 SS	LEVEL TRANSMITTER
Z1-11	0.75	11	ANSI CLASS 3000/THRD. CLPG. WITH THRD. PLUG	304 SS	SPARE WITH PLUG

NOTES:

1. VAPOR OUTLET AND STEAM INLET SIZES AREA DIFFERENT FOR V-1, V-2, AND V-3.
2. EVAPORATOR ALSO HAS 26 3/4" THREADED COUPINGS AND 2 1-1/4" THREADED COUPINGS ANSI 3000 #. SEE EVAPORATOR DRAWING.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 3 OF 4
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 5/10/15 — P.O. NO.: — EQUIPMENT NO.: V-2
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

DESCRIPTION: EVAPORATOR V-1 CALANDRIA

SIZE: UNCONVENTIONAL — TYPE: UNCONVENTIONAL

SURFACE AREA TOTAL (SQ.FT.): 75 — UNITS REQUIRED: — SURFACE PER UNIT (SQ.FT.): 75

PERFORMANCE OF ONE UNIT

		HOT SIDE - SHELL SIDE	COLD SIDE - TUBE SIDE
FLUID CIRCULATED		STEAM	SUGAR CANE JUICE
TOTAL FLUID ENTERING	LBS/HR	573	1504
VAPOR	LBS/HR		
LIQUID	LBS/HR		1504
STEAM	LBS/HR	573	
NON-CONDENSABLES	LBS/HR		
FLUID VAPORIZED	LBS/HR		593
STEAM CONDENSED	LBS/HR	573	
SPECIFIC GRAVITY			
VISCOSITY	CP		
MOLECULAR WEIGHT			
SPECIFIC HEAT	BTU/LB-°F		0.91
THERMAL CONDUCTIVITY	BTU/HR-FT-°F		
LATENT HEAT - VAPOR	BTU/LB	962	
TEMPERATURE IN	°F		227
TEMPERATURE OUT	°F		207
OPERATING PRESSURE	PSIG		4.2
NO. PASSES			1
VELOCITY	FT/SEC		
PRESSURE DROP	PSI		
FOULING FACTOR			

HEAT EXCHANGED (BTU/HR): — LMTD CORRECTED (°F):

TRANSFER RATE: SERVICE: 325 BTU/HR-SQ.FT.-DEG F — CLEAN: 312 BTU/HR-SQ.FT.

DETAILS OF CONSTRUCTION

		HOT SIDE - SHELL SIDE	COLD SIDE - TUBE SIDE
DESIGN PRESSURE	PSIG	50 PSIG/FV	80 PSIG/FV
TEST PRESSURE	PSIG	75 PSIG	120 PSIG
DESIGN TEMPERATURE	°F	350	350
MATERIAL - GASKETS		304 SS/TEFLON SPIRAL WOUND FELXITALLIC TYPE CGI	304 SS/TEFLON SPIRAL WOUND FELXITALLIC TYPE CGI
MATERIAL - NOZZLES		NOTE 1	304 SS TUBESHEET

MATERIAL - SHELL: 304 SS — NO.: 1 — THICKNESS: *

MATERIAL - BAFFLES: NONE — MATERIAL - TUBES: 2" 14 GAUGE 304 SS/304 SS TUBESHEET

MATERIAL - BOLTS: ASTM A-193 GR. B7 — MATERIAL - NUTS: ASTM A-194 GR. 2H

OPTIONS: ■ ASME SECT. VIII, DIV. I CODE AND STAMP ☐ SANITARY CONSTRUCTION ☐ OTHER

NOTES:
1. SEE SHEET 2 AND ATTACHED DRAWING 15-012-M-001 OF TOTAL EVAPORATOR FOR NOZZLES ON CALANDRIA.
2. SEE DRAWING 15-012-M-002 FOR CALANDRIA INTERNAL JUICE COLLECTION CHAMBER.
3. SHELL AND TUBES SHALL HAVE ZERO CORROSION ALLOWANCE.
4. SPECIFY STANDARD INDUSTRIAL CLASS 75 FLANGES RATED FOR 108 PSI AT 350 DEG F.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 4 OF 4
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/10/15 | P.O. NO.: | EQUIPMENT NO.: V-2
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

ENTRAINMENT SEPARATOR

GAS COMPOSITION AT INLET TO MIST ELIMINATOR: SATURATED STEAM WITH ENTRAINED LIQUID SUGAR CANE JUICE

MANUFACTURER/MODEL: MUNTERS MODEL DV270 (T271) DROPLET SEPARATOR - ONE SECTION

GAS MOLECULAR WEIGHT: | DENSITY, LBS/CU.FT.: 0.028 (STEAM) 1.06 (JUICE)

GAS VISCOSITY, CP.:

FLOWRATE: 593 LBS/HR | TEMPERATURE: 197 DEG F

GASPRESSURE, PSIA: MIN.: | MAX.: | NORMAL: -2.0 PSIG

ARE ANY SOLIDS PRESENT IN GAS: ■ NO ☐ YES | IF YES, DESCRIBE IN NOTES:

PREFERRED MIST ELIMINATOR TYPE: ■ VANE ☐ MESH

PAD DENSITY, LBS/ CU. FT.: | PAD THICKNESS, IN.:

DESIRED COLLECTION EFFICIENCY, %: | OF | MICRON DROPLETS | WT% | VOL% | PPM

MAX. ALLOWABLE PRESSURE DROP, PSI: 0.1 PSI

MATERIALS OF CONSTRUCTION: 304 SS

NOTES:

1. SUPPORT FOR SEPARATOR SHALL BE PER MANUFACTURER'S RECOMMENDATION.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 4
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 5/10/15 — P.O. NO.: — EQUIPMENT NO.: V-3
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL DESCRIPTION

1	SERVICE: SUGAR CANE JUICE EVAPORATOR NO. 3				TYPE: ☐ HORIZONTAL	■ VERTICAL		
2	MFG.: *				LOCATION: ■ INDOORS	☐ OUTDOORS		
3	DESIGN CAPACITY:			GAL.	WIND LOAD: 110	MPH		PSIG
4	OPERATING CAPACITY:			GAL.	SEISMIC ZONE: 0			

MECHANICAL

6		VESSEL	JACKET	COIL	CODE: ■ ASME SEC. VIII, DIV. I	☐ NATIONAL BOARD		
7	CONTENTS	SUGAR JUICE			MDMT@ MAWP: 20 DEG F			
8	OPER. PRESS. PSIG	-2			STRESS RELIEF: ■ NO	☐ YES	PER CODE	
9	DESIGN PRESS. PSIG	50			RADIOGRAPH: ☐ NO	☐ YES	PER CODE	
10	OPER. VAC. mmHG				ASME CODE STAMP REQ'D:	☐ NO	■ YES	
11	DESIGN VAC. mmHG	FULL			NATIONAL BOARD REGIST. REQ'D:	■ NO	☐ YES	
12	OPER. TEMP. °F	207	b+A1		HYDRO TEST VESSEL: ☐ NO	■ YES @		PSIG
13	DESIGN TEMP. °F	350			JACKET: ☐ NO	☐ YES @		PSIG
14	S.G. @ °F	1.09			COIL: ☐ NO	☐ YES @		PSIG
15	CORROSION ALLOW. IN.	0			FREON LEAK TEST: ■ NO	☐ YES @		PSIG
16	VOLUME GAL				SPECIAL TESTING REQ'D: ■ NO	☐ YES		

17	VESSEL LINING MAT'L:			THK.:	WT. OF AGITATOR:		LBS; W/MTR:	LBS
18	SHELL DIAM: 2'6"	T.L.-T.L.: SEE DWG.		MAT'L: 304 SS			THK.:	*
19	TOP HEAD: ☐ ASME F&D	■ STD F&D	☐ FLAT	☐ CONE	☐ 2 : 1 ELLIP	☐ HEMIS.	☐ OTHER	THK.: *
20	BTM HEAD: ☐ ASME F&D	☐ STD F&D	☐ FLAT	☐ CONE	■ 2 : 1 ELLIP	☐ HEMIS.	☐ OTHER	THK.: *
21	JACKET: ☐ FULL	☐ PARTIAL	TYPE: ☐	CONVENTIONAL	☐ DIMF	☐ HALF PIPE		
22	AREA:	MAT'L:						THK.:
23	COIL: TYPE:	LGTH:		MAT'L:			SIZE:	SCH.:
24	BAFFLES: NO. REQ'D:	SIZE:		SPACING:	MAT'L:			
25	INTERIOR FINISH:				INTERNAL WELD FINISH:			
26	EXTERIOR FINISH:				EXTERNAL WELD FINISH:			
27	INTERNAL PIPE:	304 SS			REINFORCEMENT MAT'I; 304 SS			
28	INTERNAL ATTACHMENTS:				EXTERNAL ATTACHMENTS:			
29	BOLTS/STUDS: MAT'L INTERNAL:				MAT'L EXTERNAL: 304 SS			
30	NUTS: MAT'L INTERNAL:				MAT'L EXTERNAL: 304 SS			
31	FLANGES:	ASTM A182 304 SS (SEE SHEET 3 FOR CALANDRIA FLANGES			GASKETS: SS304/TEFLON SPIRAL WOUND STYLE CGI			
32	FIITINGS:				PAINT: NONE			
33	VESSEL WEIGHT EMPTY: *	LBS;			FILLED WITH WATER: *			LBS
34	VESSEL SHIPPING WEIGHT: *	LBS;			FILLED WITH CONTENTS:			LBS

OPTIONS

36	SUPPORTS: ■ LEGS	☐ LUGS	☐ SKIRT	☐ SADDLES	INSULATION: ■ BY VENDOR	☐ BY OTHERS		
37	NO: * MAT'I;		THK.:		MAT'L: AEROGEL			THK:
38	LIFTING LUGS: ☐ NO	■ YES; NO.:	LOCATION: TOP		SUPPORTS: ☐ RING	☐ CLIP	☐ STUD	
39	STIFFENING RINGS: ■ NO	☐ YES; NO.:	WTH:	THK:	SHEATHING MAT'L: ALUMINUM			THK:
40	PLATFORM CLIPS: ■ NO	☐ YES; NO.:	SIZE:		VORTEX BREAKER: ■ NO	☐ YES	SIZE:	
41	LADDER CLIPS: ■ NO	☐ YES; NO.:	SIZE:		INTERNALS: ☐ TRAYS	☐ PACKING		
42	MIST ELIMINATOR: ☐ NO	■ YES			FIREPROOFING SUPPORTS:			
43	BASE RING & CHAIRS: NO				GROUNDING LUGS: ONE EACH			
44	PLATFORMS FURNISHED: NO				NAMEPLATE: S.S EACH VESSEL			

45 * VENDOR SHALL SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

EVAPORATOR

REV.: 1
DATE: 8/19/15

COMPANY: AUDUBON SUGAR INSTITUTE SHEET 2 OF 4
LOCATION: ST. GABRIEL, LA. PROJ. NO.: SPEC. NO.:
BY: BDL DATE: 5/10/15 P.O. NO.: EQUIPMENT NO.: V-3
CHECKED BY: DATE: PRICE EACH $ TOTAL NO. REQ'D.: 1

NOZZLES AND COUPLINGS

MARK	SIZE, IN.	NUMBER	PRESSURE RATING / TYPE	MATERIAL	SERVICE
A	8	1	ANSI CLASS 150/ RFSO FLG.	304 SS	VAPOR OUT
B	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	EQUALIZATION LINE
C	0.75	1	ANSI CLASS 3000/THRD. CLPG. WITH THRD. PLUG	304 SS	SPARE WITH PLUG
D	0.75	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	PRESSURE/VACUUM INDICATOR
E	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	PRESSURE/VACUUM TRANSMITTER
F	1	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	TEMPERATURE INDICATOR
G	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	TEMPERATURE TRANSMITTER
H1-H2	2	2	ANSI CLASS 150/STUDDING OUTLET	304 SS	LEVEL SIGHT GLASS/LEVEL TRANSMITTER
J1-J4	5	4	ANSI CLASS 150 STUDDING FLANGE (SEE DESIGN DETAIL NO. 8)	304 SS	SIGHT GLASSES
K	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	WATER IN
L	1	0.75	ANSI CLASS 150/ RFSO FLG.	304 SS	CALANDRIA VENT
M	0.75	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	PRESSURE/VACUUM INDICATOR
N	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	PRESSURE/VACUUM TRANSMITTER
O	1	1	ANSI CLASS 3000/THRD. CLPG.	304 SS	TEMPERATURE INDICATOR
Q	6	1	ANSI CLASS 150/ RFSO FLG.	304 SS	STEAM INLET
R	2	1	ANSI CLASS 150/ RFSO FLG.	304 SS	STEAM CONDENSATE OUT
S1-2	1.5	2	ANSI CLASS 150/ RFSO FLG.	304 SS	JUICE IN
T	1.5	1	ANSI CLASS 150/ RFSO FLG.	304 SS	JUICE OUTLET
U	1	1	ANSI CLASS 150/ RFSO FLG.	304 SS	JUICE RECYCLE
V1-2	2	2	ANSI CLASS 150/ RFSO FLG.	304 SS	SPARE WITH PLUG
Z1-11	0.75	11	ANSI CLASS 3000/THRD. CLPG. WITH THRD. PLUG	304 SS	SPARE WITH PLUG

NOTES:

1. VAPOR OUTLET AND STEAM INLET SIZES AREA DIFFERENT FOR V-1, V-2, AND V-3.
2. EVAPORATOR ALSO HAS 26 3/4" THREADED COUPINGS AND 2 1-1/4" THREADED COUPINGS ANSI 3000 #. SEE EVAPORATOR DRAWING.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE SHEET 3 OF 4
LOCATION: ST. GABRIEL, LA. PROJ. NO.: SPEC. NO.:
BY: BDL DATE: 5/10/15 P.O. NO.: EQUIPMENT NO.: V-3
CHECKED BY: DATE: PRICE EACH $ TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

DESCRIPTION: EVAPORATOR V-1 CALANDRIA

SIZE: UNCONVENTIONAL TYPE: UNCONVENTIONAL

SURFACE AREA TOTAL (SQ.FT.) : 75 UNITS REQUIRED: SURFACE PER UNIT (SQ.FT.) : 75

PERFORMANCE OF ONE UNIT

	HOT SIDE - SHELL SIDE	COLD SIDE - TUBE SIDE
FLUID CIRCULATED	STEAM	SUGAR CANE JUICE
TOTAL FLUID ENTERING LBS/HR	593	911
VAPOR LBS/HR		
LIQUID LBS/HR		911
STEAM LBS/HR	593	
NON-CONDENSABLES LBS/HR		
FLUID VAPORIZED LBS/HR		614
STEAM CONDENSED LBS/HR	593	
SPECIFIC GRAVITY		
VISCOSITY CP		
MOLECULAR WEIGHT		
SPECIFIC HEAT BTU/LB-°F		0.87
THERMAL CONDUCTIVITY BTU/HR-FT-°F		
LATENT HEAT - VAPOR BTU/LB	975	
TEMPERATURE IN °F		207
TEMPERATURE OUT °F		147
OPERATING PRESSURE PSIG		-2.0
NO. PASSES		1
VELOCITY FT/SEC		
PRESSURE DROP PSI		
FOULING FACTOR		

HEAT EXCHANGED (BTU/HR) : LMTD CORRECTED (°F) :

TRANSFER RATE: SERVICE: 104 BTU/HR-SQ.FT.-DEG F CLEAN: 100 BTU/HR-SQ.FT.

DETAILS OF CONSTRUCTION

	HOT SIDE - SHELL SIDE	COLD SIDE - TUBE SIDE
DESIGN PRESSURE PSIG	50 PSIG/FV	80 PSIG/FV
TEST PRESSURE PSIG	75 PSIG	120 PSIG
DESIGN TEMPERATURE °F	350	350
MATERIAL - GASKETS	304 SS/TEFLON SPIRAL WOUND FELXITALLIC TYPE CGI	304 SS/TEFLON SPIRAL WOUND FELXITALLIC TYPE CGI
MATERIAL - NOZZLES	NOTE 1	304 SS TUBESHEET

MATERIAL - SHELL: 304 SS NO.: 1 THICKNESS: *

MATERIAL - BAFFLES: NONE MATERIAL - TUBES: 2" 14 GAUGE 304 SS/304 SS TUBESHEET

MATERIAL - BOLTS: ASTM A-193 GR. B7 MATERIAL - NUTS: ASTM A-194 GR. 2H

OPTIONS: ■ ASME SECT. VIII, DIV. I CODE AND STAMP ☐ SANITARY CONSTRUCTION ☐ OTHER

NOTES:
1. SEE SHEET 2 AND ATTACHED DRAWING 15-012-M-001 OF TOTAL EVAPORATOR FOR NOZZLES ON CALANDRIA.
2. SEE DRAWING 15-012-M-002 FOR CALANDRIA INTERNAL JUICE COLLECTION CHAMBER.
3. SHELL AND TUBES SHALL HAVE ZERO CORROSION ALLOWANCE.
4. SPECIFY STANDARD INDUSTRIAL CLASS 75 FLANGES RATED FOR 108 PSI AT 350 DEG F.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

EVAPORATOR

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 4 OF 4
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/10/15 | P.O. NO.: | EQUIPMENT NO.: V-3
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

ENTRAINMENT SEPARATOR

GAS COMPOSITION AT INLET TO MIST ELIMINATOR: SATURATED STEAM WITH ENTRAINED LIQUID SUGAR CANE JUICE

MANUFACTURER/MODEL: MUNTERS MODEL DV270 (T271) DROPLET SEPARATOR - ONE SECTION

GAS MOLECULAR WEIGHT: | DENSITY, LBS/CU.FT.: 0.0069 (STEAM) 1.09 (JUICE)

GAS VISCOSITY, CP.:

FLOWRATE: 614 LBS/HR | TEMPERATURE: 133 DEG F

GASPRESSURE, PSIA: MIN.: | MAX.: | NORMAL: -12.3 PSIG

ARE ANY SOLIDS PRESENT IN GAS: ■ NO ☐ YES | IF YES, DESCRIBE IN NOTES:

PREFERRED MIST ELIMINATOR TYPE: ■ VANE ☐ MESH

PAD DENSITY, LBS/ CU. FT.: | PAD THICKNESS, IN.:

DESIRED COLLECTION EFFICIENCY, %: | OF | MICRON DROPLETS | WT% | VOL% | PPM

MAX. ALLOWABLE PRESSURE DROP, PSI: 0.1 PSI

MATERIALS OF CONSTRUCTION: 304 SS

NOTES:

1. SUPPORT FOR SEPARATOR SHALL BE PER MANUFACTURER'S RECOMMENDATION.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

VI
SIGHT GLASS SPECIFICATION SHEETS

AMERICAN INGENUITY LLC

PRESSSURE VESSEL SIGHT GLASS

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/27/15 | P.O. NO.: | EQUIPMENT NO.: SP-V-1-1-3
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 3

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 1 NO. 1-3 SIGHT GLASSES	LOCATION: EVAPORATOR NO. 1 - 90 DEGREES
MANUFACTURER: PAPAILAIS	N-S/E-W COORDINATES:
MODEL: NW150 WITH TYPE II SPRAY WASHER	

PROCESS DESIGN

INLET PRESS.: 4.2 PSIG	OPERATING TEMP.: 235 DEG F
FLOWING FUID: STEAM VAPOR	EXPECTED CONTAMINATION: SUGAR CANE JUICE DROPLETS
VESSEL DESIGN PRESS.: 50 PSIG	VESSEL DESIGN TEMP.: 350 DEG F
VESSEL DIAMETER 30 IN	

CONSTRUCTION

TYPE OF SIGHTGLASS ■ CIRCULAR ■ CLEAR ■ WELD PAD ON VESSEL ■ LIGHT ☐ WASHER

BODY MAT'L: 304 SS	CONNECTION SIZE: 5 IN
TYPE OF CONNECTIONS: ☐ BW ☐ THRD ■ RF FLG	FLANGE RATING: ANSI CLASS 150
WINDOWS: ■ SINGLE ☐ DUAL	DESIGN PRESS.: * PSIG
WINDOW MAT'L: TEMPERED BOROSILICATE	DESIGN TEMP: * DEG F
GASKET MAT'L: TEFLON	WEIGHT OF SIGHT GLASS: * LBS
SPRAY RING: ■ YES ☐ NO	
SPRAY RING MATERIAL: 304 SS	
SIGHT LIGHT: ☐ YES ■ NO	
POWER TO LIGHT:	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO SIGHT GLASS WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

PRESSSURE VESSEL SIGHT GLASS

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/27/15 | P.O. NO.: | EQUIPMENT NO.: SP-V-1-4
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 1 NO. 4 SIGHT GLASS	LOCATION: EVAPORATOR NO. 1 - 0 DEGREES
MANUFACTURER: PAPAILAIS	N-S/E-W COORDINATES:
MODEL: NW150 WITH SERIES PL/NW GLASS LIGHT & TYPE II WASHER	

PROCESS DESIGN

INLET PRESS.: 4.2 PSIG	OPERATING TEMP.: 235 DEG F
FLOWING FUID: STEAM VAPOR	EXPECTED CONTAMINATION: SUGAR CANE JUICE DROPLETS
VESSEL DESIGN PRESS.: 50 PSIG	VESSEL DESIGN TEMP.: 350 DEG F
VESSEL DIAMETER 30 IN	

CONSTRUCTION

TYPE OF SIGHTGLASS ■ CIRCULAR ■ CLEAR ■ WELD PAD ON VESSEL ■ LIGHT ☐ WASHER

BODY MAT'L: 304 SS	CONNECTION SIZE: 5 IN
TYPE OF CONNECTIONS: ☐ BW ☐ THRD ■ RF FLG	FLANGE RATING: ANSI CLASS 150
WINDOWS: ■ SINGLE ☐ DUAL	DESIGN PRESS.: * PSIG
WINDOW MAT'L: TEMPERED BOROSILICATE	DESIGN TEMP: * DEG F
GASKET MAT'L: TEFLON	WEIGHT OF SIGHT GLASS: * LBS
SPRAY RING: ■ YES ☐ NO	
SPRAY RING MATERIAL: 304 SS	
SIGHT LIGHT: ■ YES ☐ NO ALUMINUM	
POWER TO LIGHT: UL-1571 - 120V/1/60	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO SIGHT GLASS WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

PRESSSURE VESSEL SIGHT GLASS

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/27/15 | P.O. NO.: | EQUIPMENT NO.: SP-V-2-4
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 2 NO. 4 SIGHT GLASS	LOCATION: EVAPORATOR NO. 2 - 0 DEGREES
MANUFACTURER: PAPAILAIS	N-S/E-W COORDINATES:
MODEL: NW150 WITH SERIES PL/NW GLASS LIGHT & TYPE II WASHER	

PROCESS DESIGN

INLET PRESS.: 4.2 PSIG	OPERATING TEMP.: 235 DEG F
FLOWING FUID: STEAM VAPOR	EXPECTED CONTAMINATION: SUGAR CANE JUICE DROPLETS
VESSEL DESIGN PRESS.: 50 PSIG	VESSEL DESIGN TEMP.: 350 DEG F
VESSEL DIAMETER 30 IN	

CONSTRUCTION

TYPE OF SIGHTGLASS ■ CIRCULAR ■ CLEAR ■ WELD PAD ON VESSEL ■ LIGHT ☐ WASHER

BODY MAT'L: 304 SS	CONNECTION SIZE: 5 IN
TYPE OF CONNECTIONS: ☐ BW ☐ THRD ■ RF FLG	FLANGE RATING: ANSI CLASS 150
WINDOWS: ■ SINGLE ☐ DUAL	DESIGN PRESS.: * PSIG
WINDOW MAT'L: TEMPERED BOROSILICATE	DESIGN TEMP: * DEG F
GASKET MAT'L: TEFLON	WEIGHT OF SIGHT GLASS: * LBS
SPRAY RING: ■ YES ☐ NO	
SPRAY RING MATERIAL: 304 SS	
SIGHT LIGHT: ■ YES ☐ NO ALUMINUM	
POWER TO LIGHT: UL-1571 - 120V/1/60	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO SIGHT GLASS WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

PRESSSURE VESSEL SIGHT GLASS

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/27/15 | P.O. NO.: | EQUIPMENT NO.: SP-V-2-1-3
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 3

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 2 NO. 1-3 SIGHT GLASSES	LOCATION: EVAPORATOR NO. 2 - 90 DEGREES
MANUFACTURER: PAPAILAIS	N-S/E-W COORDINATES:
MODEL: NW150 WITH TYPE II WASHER	

PROCESS DESIGN

INLET PRESS.: 4.2 PSIG	OPERATING TEMP.: 235 DEG F
FLOWING FUID: STEAM VAPOR	EXPECTED CONTAMINATION: SUGAR CANE JUICE DROPLETS
VESSEL DESIGN PRESS.: 50 PSIG	VESSEL DESIGN TEMP.: 350 DEG F
VESSEL DIAMETER 30 IN	

CONSTRUCTION

TYPE OF SIGHTGLASS ■ CIRCULAR ■ CLEAR ■ WELD PAD ON VESSEL □ LIGHT ■ WASHER

BODY MAT'L: 304 SS	CONNECTION SIZE: 5 IN
TYPE OF CONNECTIONS: □ BW □ THRD ■ RF FLG	FLANGE RATING: ANSI CLASS 150
WINDOWS: ■ SINGLE □ DUAL	DESIGN PRESS.: * PSIG
WINDOW MAT'L: TEMPERED BOROSILICATE	DESIGN TEMP: * DEG F
GASKET MAT'L: TEFLON	WEIGHT OF SIGHT GLASS: * LBS
SPRAY RING: ■ YES □ NO	
SPRAY RING MATERIAL: 304 SS	
SIGHT LIGHT: □ YES ■ NO	
POWER TO LIGHT:	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO SIGHT GLASS WITH FIRMLY SECURED
STAINLESS STEEL TAG.

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AMERICAN INGENUITY LLC

PRESSSURE VESSEL SIGHT GLASS

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/27/15 | P.O. NO.: | EQUIPMENT NO.: SP-V-3-4
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 3 NO. 4 SIGHT GLASS	LOCATION: EVAPORATOR NO. 3 - 0 DEGREES
MANUFACTURER: PAPAILAIS	N-S/E-W COORDINATES:
MODEL: NW150 WITH SERIES PL/NW GLASS LIGHT & TYPE II WASHER	

PROCESS DESIGN

INLET PRESS.: 4.2 PSIG	OPERATING TEMP.: 235 DEG F
FLOWING FUID: STEAM VAPOR	EXPECTED CONTAMINATION: SUGAR CANE JUICE DROPLETS
VESSEL DESIGN PRESS.: 50 PSIG	VESSEL DESIGN TEMP.: 350 DEG F
VESSEL DIAMETER 30 IN	

CONSTRUCTION

TYPE OF SIGHTGLASS ■ CIRCULAR ■ CLEAR ■ WELD PAD ON VESSEL ■ LIGHT ■ WASHER

BODY MAT'L: 304 SS	CONNECTION SIZE: 5 IN
TYPE OF CONNECTIONS: ☐ BW ☐ THRD ■ RF FLG	FLANGE RATING: ANSI CLASS 150
WINDOWS: ■ SINGLE ☐ DUAL	DESIGN PRESS.: * PSIG
WINDOW MAT'L: TEMPERED BOROSILICATE	DESIGN TEMP: * DEG F
GASKET MAT'L: TEFLON	WEIGHT OF SIGHT GLASS: * LBS
SPRAY RING: ■ YES ☐ NO	
SPRAY RING MATERIAL: 304 SS	
SIGHT LIGHT: ■ YES ☐ NO ALUMINUM	
POWER TO LIGHT: UL-1571 - 120V/1/60	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO SIGHT GLASS WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

PRESSSURE VESSEL SIGHT GLASS

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/27/15 | P.O. NO.: | EQUIPMENT NO.: SP-V-3-1-3
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 3

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 3 NO. 1-3 SIGHT GLASSES	LOCATION: EVAPORATOR NO. 3 - 90 DEGREES
MANUFACTURER: PAPAILAIS	N-S/E-W COORDINATES:
MODEL: NW150 WITH TYPE II SPRAY WASHER	

PROCESS DESIGN

INLET PRESS.: 4.2 PSIG	OPERATING TEMP.: 235 DEG F
FLOWING FUID: STEAM VAPOR	EXPECTED CONTAMINATION: SUGAR CANE JUICE DROPLETS
VESSEL DESIGN PRESS.: 50 PSIG	VESSEL DESIGN TEMP.: 350 DEG F
VESSEL DIAMETER 30 IN	

CONSTRUCTION

TYPE OF SIGHTGLASS ■ CIRCULAR ■ CLEAR ■ WELD PAD ON VESSEL ☐ LIGHT ■ WASHER

BODY MAT'L: 304 SS	CONNECTION SIZE: 5 IN
TYPE OF CONNECTIONS: ☐ BW ☐ THRD ■ RF FLG	FLANGE RATING: ANSI CLASS 150
WINDOWS: ■ SINGLE ☐ DUAL	DESIGN PRESS.: * PSIG
WINDOW MAT'L: TEMPERED BOROSILICATE	DESIGN TEMP: * DEG F
GASKET MAT'L: TEFLON	WEIGHT OF SIGHT GLASS: * LBS
SPRAY RING: ■ YES ☐ NO	
SPRAY RING MATERIAL: 304 SS	
SIGHT LIGHT: ☐ YES ■ NO	
POWER TO LIGHT:	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO SIGHT GLASS WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

DV 270
Droplet Separator (Mist Eliminator)

PRODUCT INFORMATION

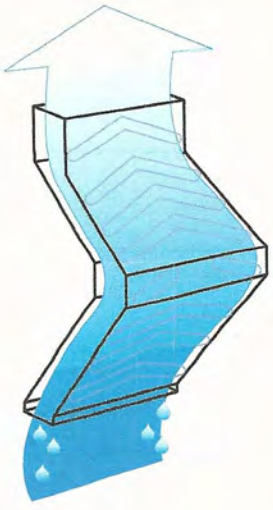
DV 270 *(T 271)*

- The most established droplet separator for vertical flow scrubber applications
- Extremely low pressure loss
- Suitable for retrofits
- Available in PE, PP, PPGC, PVDF and stainless steel alloys ASTM 304, ASTM 316Ti, ASTM 316L, ASTM 321; DIN 1.4301, DIN 1.4404, DIN 1.4541, DIN 1.4571. Special materials are available upon request.
- Equipped with flushing / cleaning systems for plugging sensitive applications

The DV 270 *(T 271)* droplet separator is a vane type separator for vertical flow. The gas flow charged with liquid droplets is directed through separator chambers which are designed for maximum effect on the gas flow. As a result of this configuration, inertial forces act on the droplets. The droplets impinge onto the profiles, where they form a liquid film which is subsequently drained off as a result of gravity. V-shaped impressions on the separator plates ensure that the liquid is drained off in the correct manner and returns to the gas flow.

Target applications

- Evaporators
- Absorbers
- Gas scrubbers
- Desulphurization units
- Gas coolers
- Exhaust air treatment plants
- Chemical plant



Principle illustration.

Munters

Performance data

All technical performance data apply for a system air / water at 20 °C and 1 bar.

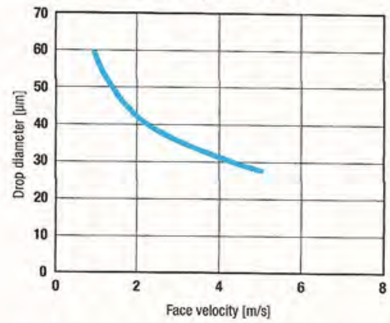
The limit drop size represents a performance characteristic of the profile. At the relevant velocity and operating conditions, it is the size of the smallest droplet that is completely separated.

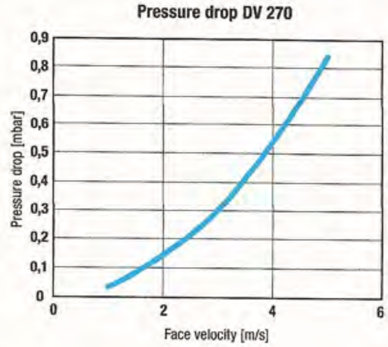
The pressure loss of a mist eliminator should be as low as possible, in order to ensure favorable operating costs.

The separation efficiency specifies how much liquid the mist eliminator removes from the gas flow. It is customary to specify a maximum permissible inlet load and a guaranteed level of residual liquid content downstream of the eliminator.

Materials

- PE, PP, PPGC, PVDF,
- Stainless steel alloys ASTM: 304, 316Ti, 316L, 321; DIN 1.4301, DIN 1.4404, DIN 1.4541, DIN 1.4571
- Special material available upon request



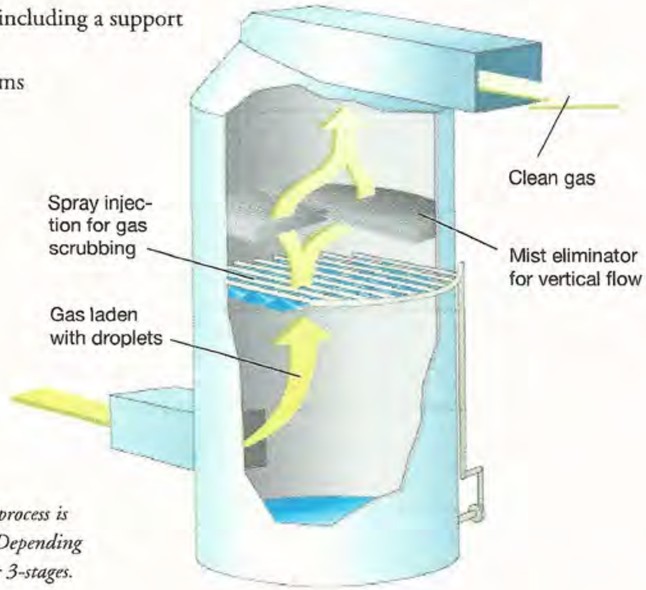


Scope of supply

The DV 270 is available in different configurations:

- Eliminator packs
- Framed pack for installation as internal
- Eliminator together with casing or pressure vessel
- Framed packs including a support structure
- Cleaning systems

Material certificates can be delivered for most materials upon request. Pressure loss, limit drop sizes and fractional efficiency curves for given operating data are delivered upon request.



Wet scrubber with mist eliminator. Liquid carry-over from the cleaning process is eliminated in the vane section of the scrubber and falls back by gravity. Depending on the required cleaning efficiency the mist eliminator can consist of 2 or 3-stages.

Munters

Munters, HumiCool Division, Kung Hans Väg 8, P.O. Box 434, SE-191 24 Sollentuna, Sweden. Phone +46 8 626 63 00, Fax +46 8 754 56 66.
Munters Euroform GmbH, Aachen, Germany. Phone +49 241 89 00 0, Fax +49 241 89 00 5199, munters@muntersac.de
Munters Corporation, Fort Myers, USA. Phone +1 239 936 1555, Fax +1 239 936 8858, moreinfo_me@americas.munters.com
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Part UHX
White Paper

This "White Paper" is intended to describe the basis of requirements contained in Mandatory Section UHX of Section VIII Division 1 of the Boiler and Pressure Vessel Code. The discussion provides the highlights for the derivation of the analytical methodology and a discussion of the differences of between the ASME requirements and those of TEMA and other international Codes. Likewise, a general discussion is provided regarding the significance of the calculated stresses and how the rules are intended to be applied.

I U-TUBE TUBESHEETS

I.1 **Appendix AA – 1 for U-tube tubesheet** appeared in Section VIII Division 1 for the first time in 1982. The rules were based on Gardner's method (1969). The same method was adopted in BS 5500 (1976) and in CODAP (1982), using for the allowable bending stress in the tubesheet: $\Omega S = 2S$ as recommended by Gardner (where Ω is a multiplier of the basic Code allowable stress).

The method was improved in 1990 by ASME, based on works of Alan Soler (1984) and Urey Miller to account for the configurations b and e (tubesheet gasketed on one side and integral on the other side). (See Figure 1.)

In year 2000, F. Osweiller proposed a more refined approach, based on the latter, to provide an analysis model to cover the 6 configurations of tubesheets shown in Figure 1.

This method, which follows the stress analysis of Section VIII – Div. 2 Appendix 4, is based on the following (see Figure 2):

a) the perforated tubesheet is treated as a solid equivalent circular plate of effective elastic constants E^* (effective modulus of elasticity) and ν^* (effective Poisson's Ratio) depending on the ligament efficiency μ^* of the tubesheet;

b) the unperforated tubesheet rim is treated as a rigid ring;

c) the connection of the tubesheet with shell and channel accounts for the edge displacements and rotations of the 3 components. The effect of the pressure P_s (shell side pressure) and P_t (tube side pressure) acting on shell and channel, respectively, is considered;

d) the maximum stresses in tubesheet, shell and channel are determined and limited to the appropriate allowable stress-based stress classifications of Section VIII Division 2 Appendix 4.

This method is the only method which accounts for all the 4 items a) through d) above.

I.2 This method has been adopted in 2001 by ASME (Section VIII – Div. 1 Appendix AA-1), by CODAP (Chapter C7) and European Standard (UPV Design Part – Clause 13). Publication is scheduled by the 3 Codes in 2002. This is also the basis of Part UHX-12 of Section VIII – Div. 1.

For more details of the specific derivation, see paper from F. Osweiller (2002), attached.

"ICPVT 2002 Vancouver Rev 11.pdf"

I.3 The TEMA rule appeared for the first time in 3rd Edition 1952 using the well-known tubesheet formula:

$$T = F\frac{G}{2}\sqrt{\frac{P}{S}} \quad \text{with} \qquad F = \begin{cases} 1.0 & \text{if the tubesheet is clamped} \\ 1.25 & \text{if the tubesheet is simply supported} \end{cases}$$

(where T is the TEMA tubesheet thickness)

The TEMA formula is based on the classical circular plate formula:

$$T = C\frac{G}{2}\sqrt{\frac{P}{\mu^* \Omega S}} \quad \text{with} \quad C = \begin{cases} 0.866 & \text{if the plate is clamped} \\ 1.113 & \text{if the plate is simply supported} \end{cases}$$

where μ^* is the effective ligament efficiency and ΩS the allowable stress.

If we use $\mu^* = 0.5$ and $\Omega = 1.5$ we obtain approximately the values of TEMA formula which in this 3rd Edition does not consider any ligament efficiency as a direct input.

Current edition corrects that and provides a new formula:

$$T = F\frac{G}{3}\sqrt{\frac{P}{\eta S}}$$

where η is the TEMA ligament efficiency based on the mean width of the ligament (ASME ligament efficiency μ^* is based on the minimum width of the ligament, which leads to lower values than TEMA).

The minimum values of η are 0.42 (triangular pitch) and 0.50 (square pitch). Coefficient 3 in the new TEMA formula has been determined so that old and new formulas led to approximately same results for these minimum values of η. In real cases η will generally range between 0.45 and 0.60, which leads to a decrease of T by about 10 to 15 %.
For more details see F. Osweiller's paper (2002).

I.4 **TEMA ligament efficiency** η is significantly higher than ASME ligament efficiency μ^* (generally $0.25 \le \mu^* \le 0.35$).

Comparison of TEMA new formula and classical plate formula shows that TEMA allows the bending stress in the equivalent solid plate to be 2.6 S, instead of 1.5 S recommended by ASME Section VIII – Div. 2.

Nevertheless, for about 40 years, TEMA formula did not lead to failures in U-tube tubesheets. It is likely that a value of allowable stress of 2S could be used without affecting the safety margin. This value was also recommended by GARDNER in 1969 and has been used in most European codes (BS 5500, CODAP) for about 20 years. This is also justified by limit load analysis applied to circular plates, which leads to $\Omega = 1.9$ if the tubesheet is simply supported and $\Omega = 2.1$ if the tubesheet is clamped. The SWGHTE is considering revising the rules to effectively allow $\Omega = 2.0$.

For these reasons tubesheet thickness obtained by ASME is generally thicker than TEMA, which is not the case for CODAP and UPV. See Table 1, which shows a comparison on 4 U-tube tubesheet heat exchangers.

I.5 **In conclusion** ASME method has the advantage of accounting for the perforated tubesheet, the unperforated rim, the interaction of the tubesheet with shell and/or channel, which are not treated rigorously in TEMA. The ASME method is considered more rigorous and allows the designer to more accurately account for actual geometry.

II. FIXED TUBESHEETS

II.1 **Appendix AA-2 for fixed tubesheets appeared in 1992**. The method was validated by performing a benchmark of 10 industrial heat exchangers with comparison to TEMA Standards and to CODAP rules which have been used in France since 1980.

The design method is based on the same stress analysis as described for U-tube tubesheets. However, the tube bundle is considered as an elastic foundation, which adds considerable complications. For more details, see Alan Soler's book (1984) and the Soler/Caldwell PVP paper that is attached. CODAP method is based on the same approach, except that the unperforated rim is not considered. CODAP method has been adopted by BS 5500 (1986) and by UPV (1992).

"Soler Caldwell PVP Paper.pdf"

It should be noted that both ASME and CODAP came to the same conclusion in the 80's (without consulting each other) that is was necessary to develop new design rules accounting better for the behavior of the tubesheets than TEMA.

II.2 TEMA rules are based on the same basic approach as ASME and CODAP, but drastic simplifications have been made in TEMA:

- unperforated rim is not considered;
- connection of tubesheet with shell and channel is not treated rigorously (ratio e_s / D_s (where e_s is shell thickness and D_s is the shell diameter) in coefficient F cannot account for the rotational stiffness of the shell or channel);
- coefficient F does not account for the stiffening effect of the tube-bundle, nor for the holes which weaken the tubesheet. TEMA assumes that these 2 effects are counterbalanced.

These simplifications have a significant impact on the results obtained by TEMA.

II.3 The design of the heat-exchanger tubesheet is significantly affected by the stiffness ratio X_a:

$$X_a = \frac{\text{axial tube bundle rigidity}}{\text{tubesheet bending rigidity}}$$

which accounts for the support afforded to the tubesheet by the tube bundle which strengthen the tubesheet and for the perforations which weaken it. It may range between $X_a = 1$ (low support) and $X_a = 20$ (high support) but lies generally between 2 and 8.

The ASME formula for tubesheet stress can be written:

$$h = F_{\text{ASME}} \frac{G}{3} \sqrt{\frac{P_e (X_a)}{\eta S}} \quad \text{with:} \quad F_{\text{ASME}} = 3 \sqrt{\frac{\eta}{\mu^*} F_M (X_a)}$$

(Where "h" is the required ASME tubesheet thickness)
so as to compare to the TEMA formula :

$$T = F_{\text{TEMA}} \frac{G}{3} \sqrt{\frac{P_e (X_a)}{\eta S}} \quad \text{with:} \quad F_{\text{TEMA}} = \begin{cases} 0.8 & \text{if the tubesheet is clamped} \\ 1.0 & \text{if the tubesheet is simply supported} \end{cases}$$

In the TEMA formula, the equivalent pressure, P_e, accounts correctly for the tube bundle through X_a (despite some simplifications), but coefficient F_{TEMA} does not depend on X_a. The rigorous solution of the equations shows that the term F_{ASME} is a strong function of X_a. It can be demonstrated that when X_a is small, then F_{ASME} is greater than F_{TEMA}. When X_a is large, then F_{ASME} is smaller than F_{TEMA}. Since the tubesheet stress is directly proportional to F_{ASME}, then it follows that small values of X_a results in a thicker tubesheet than TEMA and large values of X_a results in a thinner tubesheet than TEMA.

Coefficient F_{ASME} is represented in Figure 3 when the tubesheet is either simply supported or clamped. Figure 3 shows that F_{ASME} varies significantly with X_{a}:

- for low values of X_{a} $(X_{\text{a}} < 3)$ TEMA rules generally lead to an unconservative thickness;
- for high values of X_{a} $(X_{\text{a}} > 6)$ TEMA rules will generally lead to conservative thickness
- values of X_{a} between 3 and 6, TEMA rules lead to tubesheet thickness that is close to ASME.

Due to simplifications mentioned above, TEMA does not ensure an overall and consistent design margin for all heat exchangers. Numerical comparison between ASME, CODAP and TEMA illustrates this in Table 2. However, it must be pointed out that the value of coefficient F_{TEMA} has been remarkably well chosen as it represents approximately the mean value of coefficient F_{ASME}.

For more details see Alan Soler's book - § 9.8 (1984) and F. Osweiller's paper (Analysis of TEMA tubesheet design rules-comparison with up to date Code methods – PVP 1986).

"Osweillers PVP Paper -1986.pdf"

III. FLOATING TUBESHEETS

The same analytical approach applies to floating tubesheets, with the simplification that the equivalent pressures $P_{\text{e}}(X_{\text{a}}) = P_{\text{s}} - P_{\text{t}}$.

Again TEMA ignores the effect of the tube bundle and same comments as above apply.

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K.G. GARDNER (1969)
"Tubesheet Design: a basis for standardization" – Pressure Vessel Technology – 1969 Delft Conference – p. 621-648.

A.I. SOLER (1984)
"Mechanical Design of Heat Exchangers" – Arcturus publishers – 1047 pages.

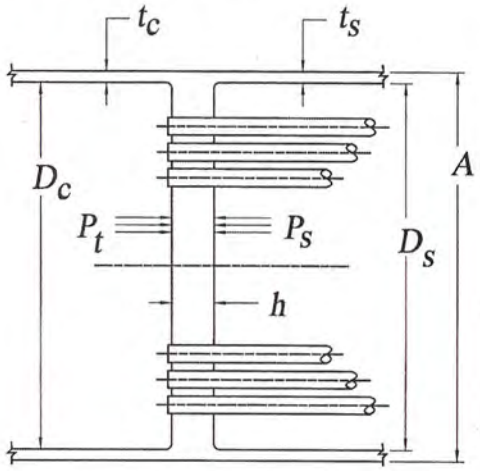
F. OSWEILLER (1986)
"Analysis of TEMA tubesheet design rules – Comparison with up-to-date Code Methods" PVP Vol. 107 ASME Pressure Vessel & Piping Conference – Chicago – p. 1-9.

F. OSWEILLER (2000)
"Tubesheet Heat Exchangers: New Common Design Rules in UPV, CODAP and ASME "ASME Journal of Pressure Vessel Technology – Vol. 122- August 2000.

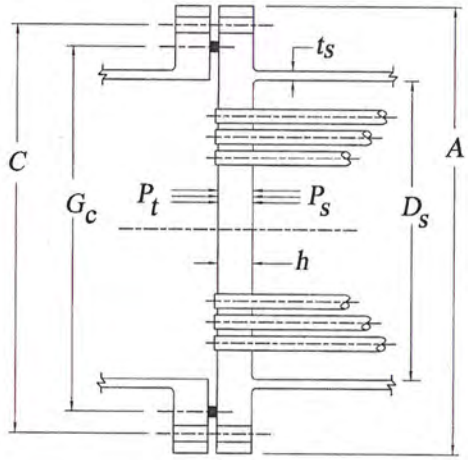
F. OSWEILLER (2002)
"New common design rules for U-tube heat-exchangers in ASME, CODAP and UPV Codes" PVP – Vancouver – August 4 to 8, 2002.

Code References

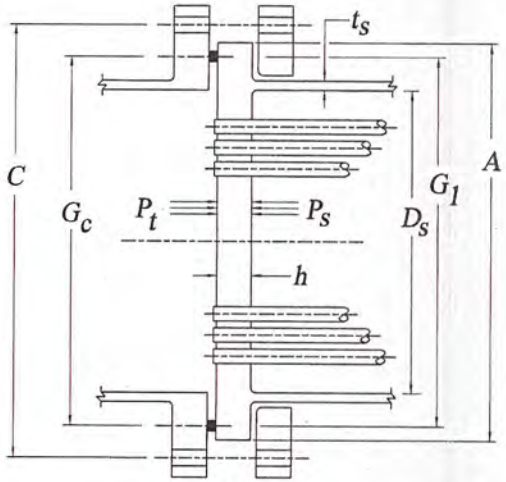
- ASME Section VIII – Div. 1 – Appendix AA: July 2001 Edition (Addenda July 2002)
  – Draft UHX Chapter (May 2002, Rev. 0)
- CODAP 2000: French Code for Unfired Pressure Vessels – Section C7: January 2001 Edition
- UPV: Draft European Standard for Unfired Pressure Vessels (Pr EN 13 445) – Part 3 – Clause 13: to be published in 2002
- TEMA Standards: 3rd Edition – 1952
- TEMA Standards: 6th Edition – 1978
- TEMA Standards: 8th Edition – 1999
- BS 5500 (UK): Specifications for Unfired Fusion Welded Pressure Vessels: 2000 Edition.



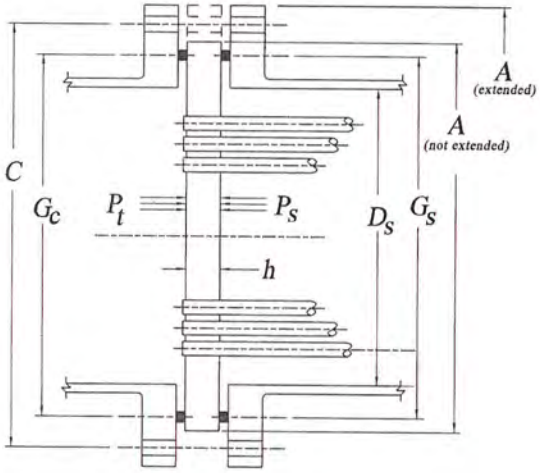
(a) Configuration a:
Tubesheet integral with shell and channel



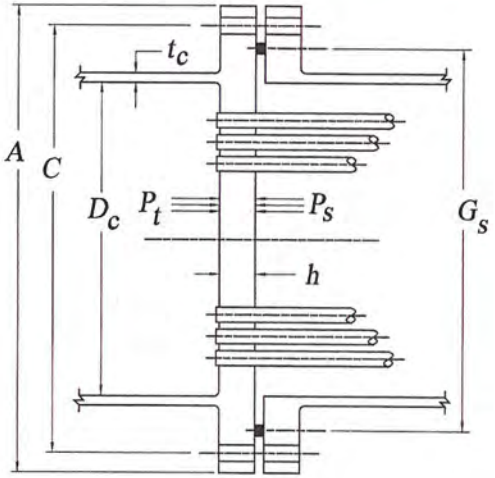
(b) Configuration b:
Tubesheet integral with shell and gasketed with channel, extended as a flange



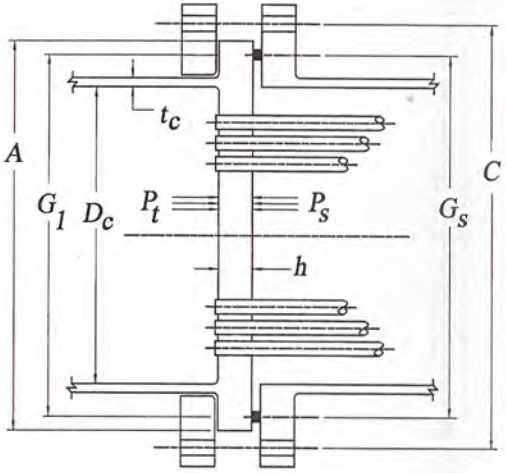
(c) Configuration c:
Tubesheet integral with shell and gasketed with channel, not extended as a flange



(d) Configuration d:
Tubesheet gasketed with shell and channel



(e) Configuration e:
Tubesheet gasketed with shell and integral with channel, extended as a flange



(f) Configuration f:
Tubesheet gasketed with shell and integral with channel, not extended as a flange

Figure 1 : Configurations of tubesheets in ASME, CODAP and UPV

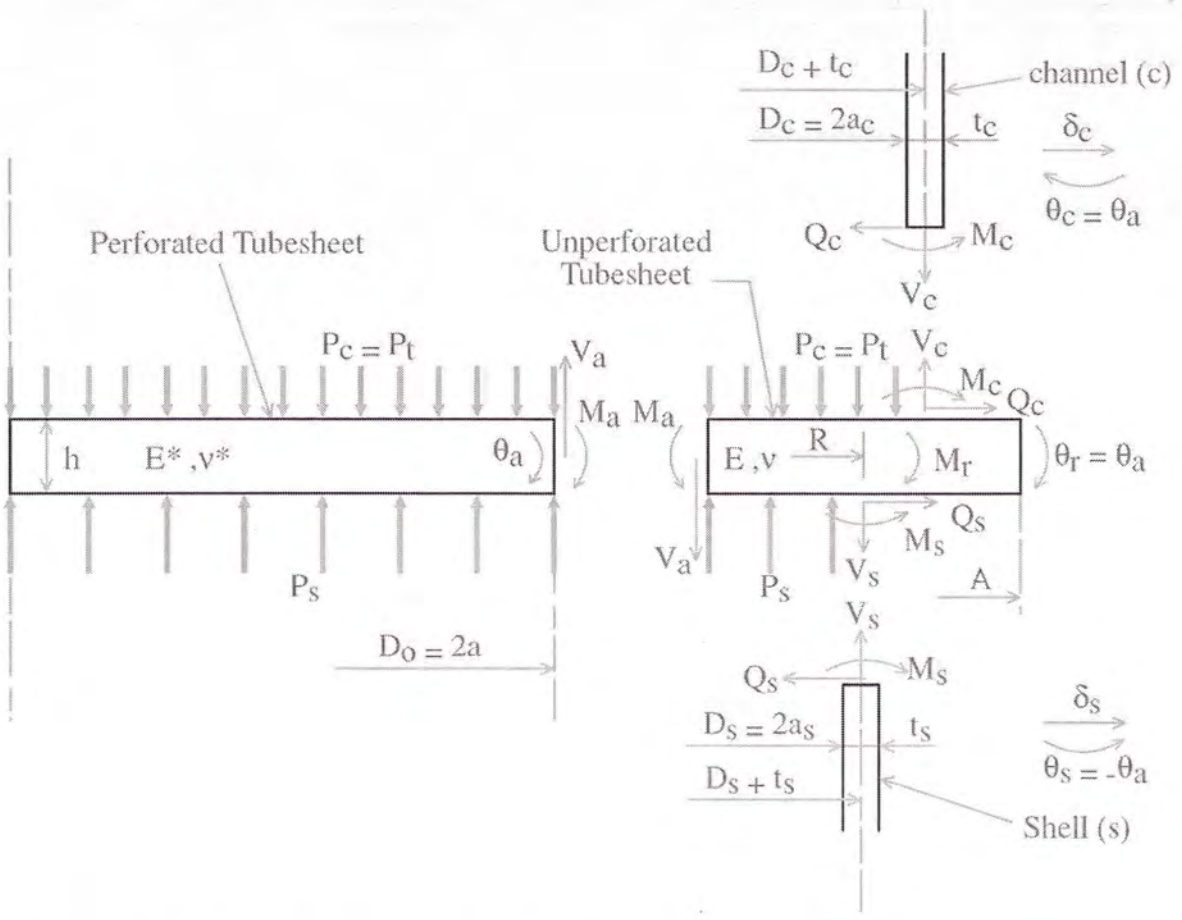


Figure 2 : Analytical model for tubesheet integral both sides (configuration a)

Thicknesses (h, T) are in mm

$h_o = C\frac{G}{2}\sqrt{\frac{P}{\mu^* \Omega S}}$ $T_{new} = F\frac{G}{3}\sqrt{\frac{P}{\eta S}}$ No direct formula : iterative calculations to obtain the optimized tubesheet thickness h

EXAMPLE			LIGAMENT EFFICIENCIES			CIRCULAR PLATE FORMULA (using μ*)		TEMA (using η)			ASME (using μ*)			ASME (using η)	CODAP/UPV (using μ*)	
N°	Config.	Pitch (Δ, □)	μ 1- d_t/p	μ* (ASME) (CODAP) (UPV)	η (TEMA)	h_o Ω = 1.5 (ss, cl)	h_o Ω = 2.0 (ss, cl)	F (ss, cl)	T old	***T*** **new**	F (ss, cl)	h old Ω = 1.5	***h*** **new Ω = 1.5**	h new Ω = 1.5	***h*** **new Ω = 2.0**	h new Ω = 3.0
1	***A***	□	0.25	0.35	0.56	22.0 (cl)	19.1 (cl)	1.21 (ss)	17.3	**15.5**	3.90 (cl)	20.6	**15.0**	11.9	**13.2**	11.0
2	***D***	Δ	0.17	0.28	0.37	40.9 (ss)	35.6 (ss)	1.25 (ss)	29.5	**32.3**	0.43 (ss)	38.1	**37.6**	33.2	**32.5**	26.4
3	***D***	Δ	0.2	0.24	0.42	131.3 (ss)	113.8 (ss)	1.25 (ss)	87.4	**89.7**	0.46 (ss)	124.2	**121.4**	92.2	**105.2**	86.3
4	***E***	□	0.25	0.39	0.56	108.7 (ss)	94.2 (ss)	1.25 (ss)	103.3	**92.2**	0.86 (ss)	109.5	**103.1**	89.4	**87.8**	69.2

ss = simply supported
cl = clamped

Δ : triangular pitch
□: square pitch

Table 1 : Comparison of TEMA, ASME and CODAP/UPV tubesheet thickness on 4 U-tube Heat Exchangers

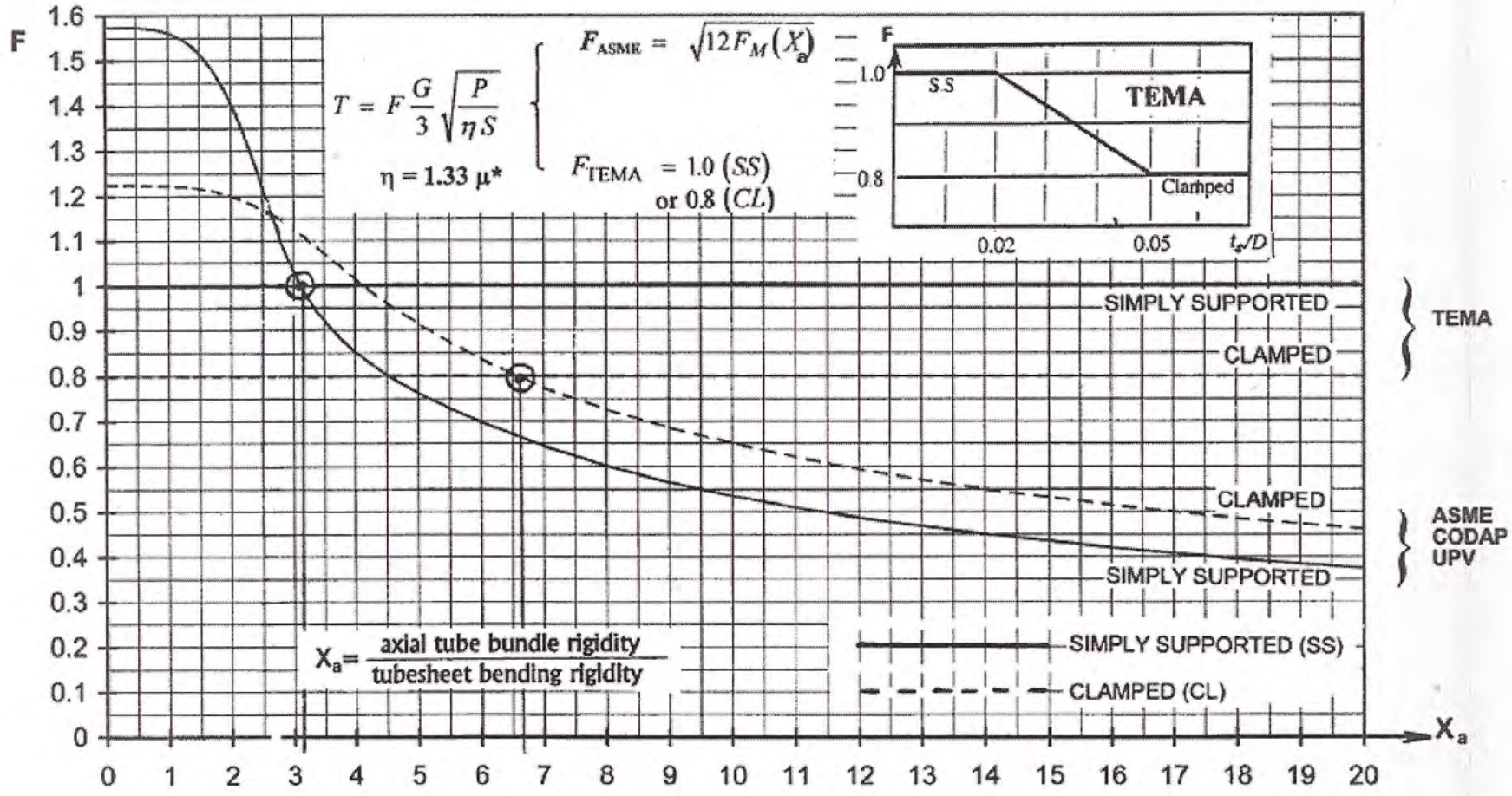


Figure 3 : Comparison of TEMA and ASME-UHX Rules for Fixed Tubesheets

	SI Units	DATA				TUBESHEET OPTIMIZED THICKNESS (in mm) (exclusive of corrosion allowance and partition grooves)				
	CASE	Dimensions (mm)		Pressures (MPa)	Temperatures (°C)	TEMA 1		ASME 2	CODAP 95 3	CODAP 99-EUPV 4
	N° Type	D x L	Yes No	P_t P_s	T_t T_s	X	T (mm)	h (mm)	e (mm)	e (mm)
INTEGRAL CHANNEL	1 NEN	1524 x 13995	N	23,44 0,0	149 149	1,8	314,6	330,7	360,3	324,0
	2 NEN	3251 x 7010	N	6,14 5,0	260 260	7,5	230,2	185,9	169,1	149,1
	3 NEN	2743 x 5994	N	5,5 5,2	275 265	8,4	234,9	113,5	126,3	114,4
	4 NEN	2565 x 1702	N	-0,1 0,34	185 185	41,1	43,2	5,8	12,0	11,8
	5 NEN	2007 x 4775	Y	0,55 0,86	204 232	19,2	77,3	27,4	25,4	23,2
	6 NEN	635 x 4877	Y	0,0 1,38	177 93	14,6	11,9	14,2	7,6	6,0
GASKETED CHANNEL	7 AEL	1803 x 4572	N	0,28 0,28	149 149	12,3	66,6	26,2	33,3	34,0
	8 AEL	914 x 4267	Y	2,76 1,03	288 288	5,4	80,8	60,2	55,2	49,6
	9 AEL	610 x 5486	Y	1,72 2,59	135 186	4,0	49,5	25,9	39,4	36,3
	10 AEL	152 x 3658	Y	0,86 0,86	49 163	2,5	16,7	7,4	11,4	10,5

Table 2 : Fixed tubesheet heat exchangers

IV. Significance of Calculated Stresses

This Section discusses the significance of the stresses in a heat exchanger at the tubesheet/shell/channel in order that the heat exchanger engineer may correctly apply the Part UHX rules. In order to understand the significance of the determined stresses, one has to understand the difference between primary stresses and secondary stresses and how each may have an influence on the design.

The tubesheet rules of Part UHX are intended to generally follow the stress classification of Section VIII, Div. 2 for primary and primary plus secondary stresses. The definitions of primary and secondary stresses are defined in Section VIII Division 2, Appendix 4. The scope of Part UHX does not include any consideration of peak stresses or any requirements for fatigue.

The bending stress resulting from a pressure loading in a flat plate is a primary bending stress. Any yielding of the plate material results in a permanent deformation, and the deformation may continue to occur until the plate fails (or the deformation is so large that the plate cannot perform its intended function). When the tubesheet is extended as a flange, the loading imposed by the bolting moment is considered primary. Thus, primary bending stress limits are appropriate when considering the tubesheet bending stress resulting from pressure loading acting alone or in combination with the bolt loading when applicable.

The stresses in the shell and channel are somewhat more complex to categorize. The axial membrane stresses (the average stress across the thickness) in the shell and channel remote from the tubesheet resulting from pressure loadings are primary.

The bending stress at the shell-to-tubesheet juncture and the channel-to-tubesheet juncture result from restrained differential motion at these junctures. As such, these bending stresses have the basic characteristic of a secondary stress. However, there is a very important distinction that has to be made regarding these stresses. This distinction is clearly defined by footnote 2 of Table 4-120.1 of Section VIII Div. 2. The bending stress at a shell to flat plate juncture may be defined as secondary unless the discontinuity bending moment at the edge of a flat plate is required to maintain the bending stress elsewhere in the plate to within its allowable stress. In this instance, the shell/channel bending stress is classified as primary bending and should be limited to the primary bending stress limit.

When an elastic stress analysis includes the rotational stiffness of the shell and channel in determining the tubesheet stress under primary loading, the discontinuity bending stress should be categorized as primary bending stress and be limited accordingly.

However, there may be instances where the design need not consider the full strengthening effect of the shell/channel. For example, if one chose to not include the stiffening effect of the shell and channel for the tubesheet analysis, the shell and channel bending stresses could be correctly categorized as secondary and be limited according to the secondary stress considerations.

If the shell/channel bending stresses resulting from pressure/bolting loads only do not satisfy the primary stress limits, then full credit cannot be taken for the stiffness of that component. In such cases, it is deemed appropriate to apply a "knockdown" factor to the stiffness of the shell or channel component by reducing its modulus of elasticity when the primary bending stress criteria has not been satisfied. The "knockdown" factor used in the Part UHX "Elastic-Plastic" analysis is based on evaluations of the extent of strengthening offered by the fully plastic moment at the shell and channel junction when the primary stress limits are not satisfied.

Thus, when considering pressure/bolting loads only, the shell/channel stresses are considered primary bending stresses in the initial calculation. If the shell/channel stress membrane plus bending stress does not meet the primary bending stress allowable, then the engineer may, at his option:

- conduct simplified, pseudo elastic-plastic analysis to determine if reduced strengthening effect results in acceptable tubesheet design.
- increase shell/channel thickness adjacent to tubesheet
- increase tubesheet thickness to lower shell/channel stress
- increase the tubesheet thickness and shell/channel thickness

The stresses resulting from the temperature differential are secondary in that they are self-limiting. The Code limits on secondary stress are derived to accomplish "shakedown to elastic action". The Part UHX rules consider the tubesheet, shell, channel, and tube stresses to be secondary stresses under the action of thermal load.

It has been a long, standing practice of TEMA to divide the loads resulting from thermal expansion by a factor of two, including the tube loads. Thus, the TEMA allowable tube tensile stress for thermal load cases is effectively increased by a factor of two. This practice has not led to any noted problems or deficiencies in allowed tube loads, and this practice is continued for the Part UHX rules for allowable tensile stress when considering any thermal load conditions. The maximum axial compressive load in Part UHX parallels that as given in TEMA. For compressive stresses, tube buckling may restrict the tube's load carrying ability. This is true for either pressure or thermal load conditions. If a substantial number of tubes were above their buckling limit, it is possible that the bundle could not sustain the required loading. For this reason, no distinction is made between primary and secondary allowable compressive loads in the tubes.

V. How to Use the Rules

Based on the above discussion, the rules of Part UHX for tubesheet should generally be used in the following manner.

- Establish the geometry for the initial set of calculations.
- Calculate the tubesheet stress based on the full support of an integrally attached shell and/or channel using Load Cases 1, 2 and 3. (See Part UHX for definition of Load Cases. Load Cases 1,2, and 3 consider pressure loads only.)
- Once the tubesheet stress is shown to be acceptable using an allowable stress based on 1.5 S (where S is the basic allowable stress from Section II Part D), calculate the shell/channel stresses as appropriate for Load Cases 1, 2, and 3.
- If the shell/channel stresses do not exceed their respective allowable stress based on 1.5 S, then the geometry is acceptable for Load Cases 1, 2, and 3, and it is not necessary to conduct a plastic analysis.
- If the shell/channel stress exceeds its primary stress allowable of 1.5 S, but less than the secondary stress allowable (greater of 3S or $2S_y$), then the simplified elastic-plastic analysis may be used for Load Cases 1, 2, and 3. For the elastic-plastic analysis, it is required that the tubesheet stress be less than the primary bending allowable stress (of 1.5 S) after reducing the strengthening effect of the adjacent cylinder(s). It is not required to recheck the shell/channel stress for the elastic-plastic analysis. If the tubesheet stress from the elastic-plastic analysis exceeds the allowable primary bending stress, then a new geometry shall be established and it is necessary to start over at the first step.
- If the shell/channel stress exceeds its primary plus secondary stress limit (larger of 3S or $2S_y$), then the geometry is not acceptable and must be revised. It will then be necessary to start over and return to the first step
- Determine the tube loading for Load Cases 1, 2, and 3. The maximum tube stress shall not exceed its allowable in either tension or compression using the primary stress limits.
- For Load Cases 4, 5, 6, and 7, (which consider pressure plus restrained differential thermal expansion) determine tubesheet, shell/channel, and tube stresses using the unaltered elastic properties for the shell and/or channel (use the elastic analysis parameters). If any of the stresses exceed their respective allowable stress of the largest of 3S or $2S_y$, then the geometry is not acceptable and shall be reconsidered and it is necessary to restart and return to the first step. Use the allowable buckling stress for determining the tube allowable compressive stresses. If the allowable stresses are satisfied, then the design is considered acceptable.

Because of the complexity of the procedure in Appendix AA of the Code, it is likely that users will computerize the solution. The criteria and logic presented in this Section will facilitate the understanding of the correct application of the rules.

VI. Effect of Ligament Efficiency in Calculation Procedure

The TEMA and Part UHX tubesheet design methods both define and use a ligament efficiency. The TEMA method is based on the average width of the ligament between the tube holes, and is different for triangular pitch vs. square pitch. The Part UHX method uses the minimum ligament width; however, if the tubes are expanded into the tubesheet, then tube wall may be considered as part of the effective ligament.

For this purpose, the Part UHX calculation procedure defines the effective tube hole diameter d^*, used to calculate μ^* (the effective ligament efficiency) as follows.

$$\mu^* = \frac{p - d^*}{p}$$

$$d^* = MAX\left\{\left[d_t - 2t_t\left(\frac{E_t}{E}\right)\left(\frac{S_t}{S}\right)\rho\right], [d_t - 2t_t]\right\}$$

In these equations:

μ^* = effective ligament efficiency
p = tube pitch, in.
d^* = effective tube hole diameter, in.
d_t = nominal outside diameter of tubes, in.
t_t = nominal tube wall thickness, in.
E_t = modulus of elasticity for tube material at design temperature, psi
E = modulus of elasticity for tubesheet material at design temperature, psi
S_t = allowable stress for tube material at design temperature, psi For a welded tube, use the allowable stress for an equivalent seamless tube, psi
S = allowable stress for tubesheet material at design temperature, psi
ρ = tube expansion depth ratio = ℓ_{tx}/h, $(0 \le \rho \le 1)$
ℓ_{tx} = expanded length of tube in tubesheet $(0 \le \ell_{tx} \le h)$
h = tubesheet thickness, in.

The Part UHX calculation procedure also takes into account differences in material properties of the tube and tubesheet. It allows the Manufacturer to take advantage of the stiffening effect of a tube expanded into a tubesheet for all tubesheet configurations, whether U-tube or straight tube.

To illustrate the difference between the TEMA method and the Part UHX methods for determining ligament efficiency, consider a 1 inch diameter, 16 BWG tube that is the same material as the tubesheet. If the tube is expanded the full depth of the tubesheet, then $\mu^* = 0.304$, but if the tube is welded and not expanded at all, then $\mu^* = 0.20$. However, the TEMA ligament efficiency is 0.420 and 0.498 for triangular and square pitch layouts respectively regardless of whether the tubes are expanded or not.

The ligament efficiency has a direct bearing on the calculated tubesheet stress. A smaller ligament efficiency results in a larger predicted tubesheet stress and a larger ligament efficiency results in a smaller predicted tubesheet stress. Thus, as may be seen, if the same basic theory is used to determine the stress in a plate, then the TEMA ligament efficiency would result in a smaller calculated stress as compared to the ASME method, even when the full tube wall is considered. This difference is exacerbated when the tube is not expanded. The Part UHX method for determining ligament efficiency is consistent with that found in Section VIII Division 2 Appendix 4. Inclusion of the tube wall in contributing to the ligament efficiency is considered a rational consideration as opposed to using a greater ligament efficiency that does not consider how the tube is joined to the tubesheet.

In order to maintain joint integrity, the Manufacturer's design and tube expanding procedure must be adequate to ensure that there will be tube-hole contact under all operating conditions such as start-ups, shut-downs, normal operation, and upsets. Therefore, action being developed under Item BC02-2366 will require that Manufacturers have written, qualified expanding procedures for joints (whether welded and expanded or expanded only) to demonstrate that the expanded joint is capable of providing the required properties for its intended application. Qualification under BC02-2366 shall consist of the Manufacturer demonstrating to the Authorized Inspector a record of having produced satisfactory expanded joints using an existing written procedure, or by shear-load testing specimens produced using a proposed procedure.

VII. Tube Stresses and Tube-to-Tubesheet Joint Loads

VII.1 General

Both ASME and TEMA require that the design of the tubes and tube joints consider various loading cases. For the calculation of the tube stresses and the tube joint loads, the ASME (TEMA) loading cases are correlated as follows using P_t (P_2) for the tube side pressure, P_s (P_3) for the shell side pressure, and P_γ (P_d) for the pressure due to the differential thermal expansion γ.

ASME Loading Case	ASME Loads	TEMA RCB-7.23 P_t*
1	P_t	P_2
2	P_s	$-P_3$
3	P_t , P_s	$P_2 - P_3$
4	P_γ	P_d
5	P_t , P_γ	$P_2 + P_d$
6	P_s , P_γ	$-P_3 + P_d$
7	P_t , P_s , P_γ	$P_2 - P_3 + P_d$

ASME Loading Cases 1, 2 and 3 consider only the effects of pressure loading (TEMA P_2 & P_3) and are referred to as the **pressure loading** cases. For tube-to-tubesheet joint loads (UHX-15), ASME also describes these cases as those due to pressure-induced axial forces.

ASME Loading Cases 4, 5, 6 and 7 include the effects of thermal expansion P_γ (TEMA P_d) and are referred to as the **thermal loading** cases. For tube-to-tubesheet joint loads, ASME also describes these cases as those due to thermally-induced or pressure plus thermally-induced axial forces.

VII.2 Tube Stresses

1) TEMA

The TEMA calculation for the tube longitudinal stress S_t at the periphery of the tube bundle is given in RCB-7.23.

When the tubes are in tension (P_t^* positive), and a thermal loading case (the equivalent differential expansion pressure P_d is included in the P_t^* term) is being considered, the calculated tensile stress is divided by two ($C_t = 0.5$).

TEMA requires that the calculated stress S_t not exceed 1.0 times the Code allowable tensile stress. By dividing the longitudinal tensile stress S_t by two for the thermal loading cases, TEMA effectively permits the allowable stress to be 2.0 times the Code allowable tensile stress for the thermal loading cases.

When the tubes are in compression (S_t negative), the stress must not exceed the buckling stress limit (allowable tube compressive stress) calculated in RCB-7.24.

2) ASME

The ASME calculation for the tube longitudinal stress $\sigma_{t,o}$ is given in UHX-13.5.9 for fixed tubesheet heat exchangers and UHX-14.5.9 for floating tubesheet heat exchangers.

The ASME equation does not require a C_t term because $\sigma_{t,o}$ is compared to 1.0 times the allowable stress for the pressure loading cases and to 2.0 times the allowable stress for cases that include thermal loading.

When the tubes are in compression ($\sigma_{t,o}$ negative), the stress must not exceed the buckling stress limit S_{tb} calculated in UHX-13.5.9(b) or UHX-14.5.9(b).

CONCLUSION

The TEMA and ASME calculated tube stresses will not yield the same results due to differences in the their tube loading models, but both compare these stresses to the same allowable stress limits.

TEMA and ASME calculate the buckling stress limit (allowable tube compressive stress) the same; however, F_q may be different because it is calculated using a different model. Both TEMA and ASME do not permit the allowable buckling stress to exceed 1.0 times the Code allowable stress.

Note that ASME paragraphs UHX-13.4(b) and UHX-14.4(c) permit the allowable stresses for the thermal loading cases to be taken at the operating temperature.

TEMA and ASME only calculate the tube longitudinal stress and the buckling stress limit at the periphery of the tube bundle, because it is presumed that this is the location of the highest tube stress. SWGHTE, under BC94-439, is working on developing the maximum stress of the interior tubes, because it has been shown that sometimes the interior tube stress is higher than the peripheral tubes stress. CODAP presently has rules for calculating the interior tube stress.

VII.3 Tube-to-Tubesheet Joint Loads

1) TEMA

The TEMA calculation for the tube-to-tubesheet joint load W_j at the periphery of the tube bundle is given in RCB-7.25. This load only considers the effect of pressure; because, TEMA assumes that the joint loads caused by the thermal loading are within acceptable limits if the tube stresses calculated for pressure loading are within the allowable stress limits. This assumption could lead to joint loads for the thermal loading cases that are greater than the joint strength.

TEMA directs the user to calculate the allowable joint load in accordance with the Code or by other means.

2) ASME

ASME does not give the tube joint load equation, but it can easily be calculated as follows:

$$W_j = \sigma_{t,o} A_t$$

W_j	=	tube-to-tubesheet joint load, lb (N)
$\sigma_{t,o}$	=	axial tube stress from UHX-13.5.9 or UHX-14.5.9, psi (MPa)
A_t	=	tube cross-sectional area, in. (mm)

The ASME Code specifies the allowable tube joint load L_{max} in either UHX-15 (formerly UW-20) for strength welded tube joints or Appendix A for all other tube joints. For the pressure loading cases, L_{max} cannot exceed 1.0 times the tube joint strength. For the thermal loading cases, L_{max} cannot exceed 2.0 times the tube joint strength; except, that for welded-only tube joints where the thickness through the throat of the weld is less than the nominal tube thickness, L_{max} is limited to 1.0 times the tube joint strength for **all** loading cases.

ASME uses the following guidelines:

a) For full strength welds meeting the requirements of UHX-15.4, the tube joint strength is tube strength F_t.
b) For partial strength welds meeting the requirements of UHX-15.5, the tube joint strength is the weld design strength F_d, which is the fillet weld strength F_f, or the groove weld strength F_g, or a combination of both ($F_f + F_d$).
c) For partial strength welds meeting the requirements of UW-18(d), the tube joint strength is the allowable load on the fillet weld.
d) For all other tube joints, the tube joint strength is the allowable load for tube-to-tubesheet joints as established by meeting the requirements of Appendix A.

CONCLUSION

The ASME method permits the designer to calculate the tube joint load for every loading case, whereas the TEMA method only requires this calculation for pressure loading.

TEMA assumes that the tube joint strength will be at least equal tube joint load for all loading case just by meeting the ASME allowable load criteria for the pressure loading cases. A review of the ASME allowable tube joint load described above shows that the tube joint loads should be calculated for every loading case and properly compared with the corresponding allowable tube-to-tubesheet joint load.

VIII. In-service Implications for Existing Exchangers

There has been some concern expressed regarding the in-kind replacement of heat exchanger bundles if new rules are adopted that are different from those of the original fabrication.

Repairs and alterations are not affected by UHX, because the Codes and Standards in effect at the time of construction may be used. In substantiation, it is noted that Paragraph RC-1020 of the National Board Inspection Code (NBIC) states:

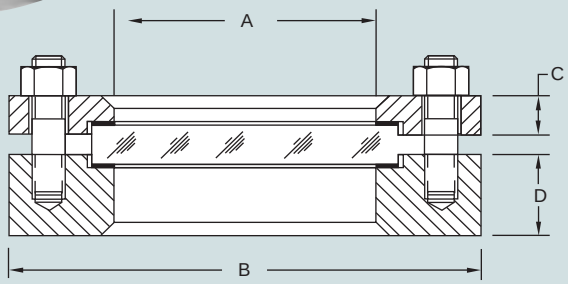
"When the standard governing the original construction is the ASME Code, repairs and alterations shall conform insofar as possible to the section and edition of the ASME Code most applicable to the work planned."

The rules of nearly all North American political jurisdictions require repairs and alterations to be made in accordance with either the NBIC or API-510 Pressure Vessel Inspection Code: Maintenance, Inspection, Rating, Repair, and Alteration. API 510 has provisions similar to those of the NBIC. These Inspection Codes are used worldwide.

For replacement heat exchanger bundles in-kind, it is a common and acceptable practice for an owner to ship a drawing of a tube bundle (or for that matter, a drawing of a shell section) to fabricator with no consideration at all given to whether design calculations are required or not. The fabricator builds the bundle (or part of a shell) to the current code rules, and, if needed, applies a Part Stamp and sends it back to the owner who fills out the necessary post construction paper work to the satisfaction of the jurisdiction. (The Part Stamp holder is not required by Section VIII to certify any design.) This does not violate any ASME requirements and is, in fact, what the NBIC suggests be done. Since a U Stamp is not normally required for replacement heat exchanger bundles, Section VIII does not prohibit "fabrication to the drawing" because design calculations are required by Section VIII for Parts or materials. For Section VIII construction, the design responsibility belongs to the U Stamp Certificate holder; however, for a post construction replacement bundle, there is not necessarily a U Stamp Certificate holder involved.

If there is a replacement bundle that requires a U Stamp, then all mandatory rules, including the design rules, in effect must be satisfied. This is not any different than for any other component or piece of equipment going into an operating facility and any differences in geometry from the old to the new has to taken into consideration.

CIRCULAR SIGHTGLASSES
Series NW



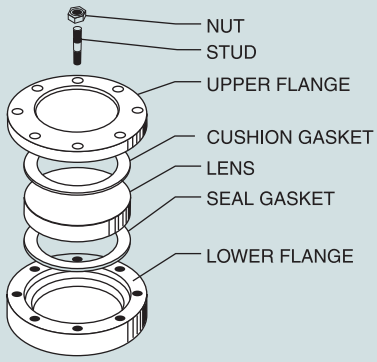
SERIES NW WELD PAD CONNECTION

Series NW sightglasses are offered with nominal viewing diameters of 3", 4", 5", 6", 7", and 9". Other sizes are available upon request. Series NW sightglasses are manufactured from ASME Section VIII acceptable metals. Each sightglass is thoroughly inspected and will provide long and useful service under the most demanding processing conditions. Optional accessories include Type I wiper, Type II wiper and Type I spray washer or Type II spray washer assemblies. Series NW sightglasses are also available with Series PL, MSL, SLEX, REX, or FBX illuminators.

SPECIFICATIONS

- Lower flanges constructed of carbon steel and stainless steel are standard. Virtually any machinable alloy can be specified to meet user requirements.
- Sizes NW50, NW80, NW100, and NW125 have standard ratings of 150 PSIG (10.3 Barg) pressure and full vacuum at 300°F (149°C) temperature. NW150 and NW200 are rated standard for 125 PSIG (8.6 Barg) pressure and full vacuum at 300°F (149°C) temperature. Higher pressure and temperature ratings are available upon request.
- The Papailias Co. sightglass lens is tempered soda lime for operating temperatures up to 300°F (149°C) standard. Tempered borosilicate lens material is available for operating temperatures up to 500°F (260°C). Lenses of quartz, Vycor®, and BoroAlloy™ are also available for higher temperatures.
- The standard sightglass seal gasket is neoprene. Teflon®, Viton®, EPDM, and silicon rubber seal gaskets are also available from stock. Virtually any elastomeric material may be specified to meet operating conditions.
- The lower flange can be supplied thicker if required to reinforce the vessel opening in accordance with ASME Section VIII requirements.
- The lower flange can be provided curved cylindrically or spherically to match the vessel geometry. See page 7 for more details.

Size	A		B		C		D		APPROX. WEIGHT	
	Inches	MM	Inches	MM	Inches	MM	Inches	MM	LBS	KGS
NW50	3 1/4	83	7	178	3/4	19	1 3/16	30	18	8
NW80	4	102	7 1/2	191	3/4	19	1 3/16	30	19	9
NW100	5	127	9	229	3/4	19	1 3/16	30	26	12
NW125	6	152	10	254	3/4	19	1 7/16	37	33	15
NW150	6 7/8	175	11	279	3/4	19	1 7/16	37	37	17
NW200	8 13/16	224	13 1/2	343	13/16	21	1 7/16	37	55	25



SIGHTGLASSES

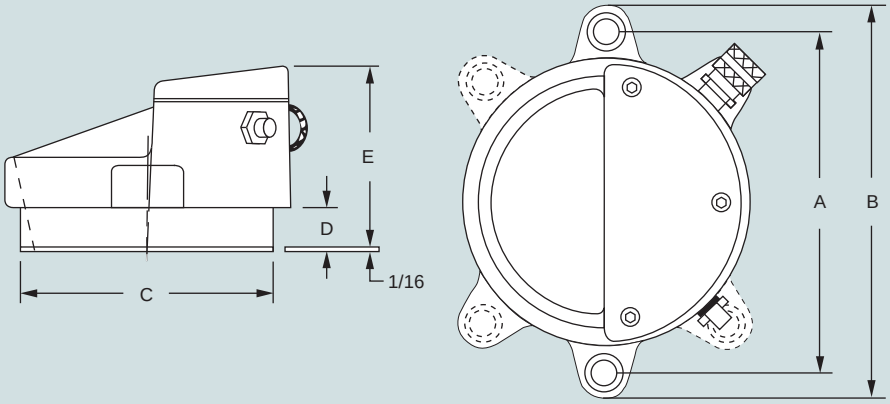
LIGHTING FOR NONHAZARDOUS LOCATIONS
Series PL

SERIES PL

The UL-1571 Listed Series PL lighting units are mounted on the upper flange of our circular sightglasses. Combined, they offer glare-free illumination of the interior of vessels, tanks, hoppers, silos, mixers, and other normally enclosed containers in nonhazardous locations. The Series PL lighting units described on this page can also be mounted on existing sightglass installations having the same viewing diameter.

FEATURES

- High intensity halogen lamp provides bright illumination. Approximate lumens for 24V/20W: 350 and 115V/100W: 1800.
- Built-in momentary on/off switch for energy savings and increased lamp life.
- Lighting units mount to upper sightglass flange, completely independent of process pressure/vacuum.
- Dust-tight and watertight enclosure.
- Cast aluminum housing.



Size	SIGHTGLASS VIEW DIAMETER		VOLTAGE	WATTS	A		BOLT ORIENTATION	BOLT SIZE		B		C		D		E		APPROX. WEIGHT	
	Inches	MM			Inches	MM		Inches	MM	Inches	MM	Inches	MM	Inches	MM	Inches	MM	LBS	KGS
PL-80	3 1/4	83	24	20	4 11/64	106	2 @ 180°	1/4	6	4 13/16	122	3 1/8	79	5/8	16	2 7/16	62	2	1
PL-100	4	102	115	100	5 1/32	128	2 @ 180°	1/4	6	5 13/16	148	3 7/8	98	5/8	16	4 5/16	110	2	1
PL-125	5	127	115	100	6 3/16	157	4 @ 90°	1/4	6	6 15/16	176	4 7/8	124	5/8	16	4 5/16	110	2	1
PL-150	6	152	115	100	7 11/64	182	4 @ 90°	1/4	6	8 1/16	205	5 7/8	149	5/8	16	4 5/16	110	3	1
PL-175	6 7/8	175	115	100	8 1/4	210	4 @ 90°	5/16	8	9 3/16	233	6 13/16	173	5/8	16	4 5/16	110	4	2
PL-225	8 13/16	224	115	100	10 5/8	270	4 @ 90°	5/16	8	11 1/2	292	8 11/16	221	11/16	17	4 5/16	110	4	2

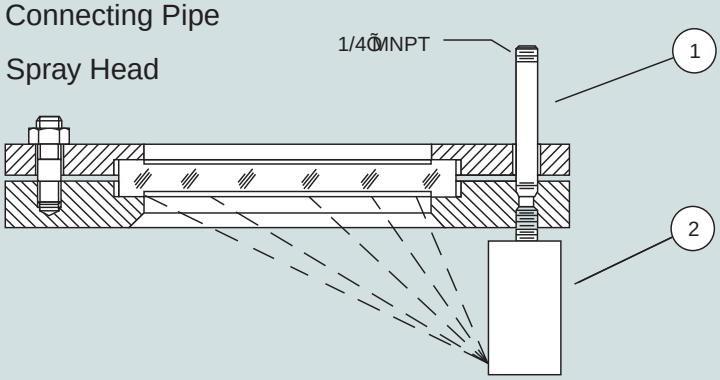
SIGHTGLASS ACCESSORIES
Spray Washers

TYPE II SPRAY WASHER

A convenient option for occasional or continuous automatic cleaning of the sightglass lens without the need to dismantle the lens. Permits clear, unobstructed viewing of vessel interior. Type II Spray Washer is available for NW100, NW125, NW150, and NW200. All parts in contact with the process fluid are made of stainless steel.

Specify as TY II SW *Sightglass size*.

ITEM	DESCRIPTION
1	Connecting Pipe
2	Spray Head



TYPE III SPRAY RING

A convenient option for occasional or continuous cleaning of a sightglass lens without the need to dismantle the sightglass. The Type III Spray Ring can be used for our NW Weldpad Type Sightglass, NW-RF Flanged Type Sightglass, and FIF & FIS Series Sightflow Indicators. The Type III Spray Ring permits clear viewing of the vessel contents in applications where dirt, fog, or residue on the inside glass lens presents a problem. All parts in contact with the process fluid are stainless steel or virtually any machineable metal.

VII
FILTERS, PUMPS, STRAINERS & TRAPS
SPECIFICATION SHEETS

AMERICAN INGENUITY LLC

CARTRIDGE FILTER

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. PROJ. NO.: SPEC. NO.:
BY: BDL DATE: 8/13/15 P.O. NO.: EQUIPMENT NO.: FL-1
CHECKED BY: DATE: PRICE EACH $ TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

MFR.: PALL
ELEMENT MODEL: *
HOUSING MODEL: *
SERVICE: AREA STEAM FILTER
REQUIRED FILTRATION PERFORMANCE:
NO. OF SPARES: NONE

PROCESS INFORMATION

FLUID FILTERED: SATURATED STEAM
FLOW RATE: 3500-4500 LBS/HR
OPERATING TEMP.: LESS THAN 250 °F
DENSITY AT OPER. TEMP.: LB/FT^3
SP. GR. AT OPER. TEMP.:
VISCOSITY AT OPER. TEMP.: CP
OPERATING PRESSURE: LESS THAN 100 PSIG
pH:
ALLOWABLE DIRTY ΔP: 5 PSI
CALCULATED CLEAN ΔP: * PSI
NAME OF PARTICLES REMOVED: DIRT AND STEEL SHAVINGS
MAXIMUM PARTICLE SIZE: µm
MINIMUM PARTICLE SIZE: 5 µm
FILTER RATING NOMINAL: * µm
FILTER RATING ABSOLUTE: * µm
QUANTITY OF PARTICLES TO BE REMOVED: 0.1 LB/HR

MECHANICAL DESIGN

DESIGN PRESSURE: 150 PSIG
DESIGN TEMPERATURE: 300 °F
CORROSION ALLOWANCE: 0 IN.
CODE CONSTRUCTION: ■ ASME ☐ OTHER
CODE STAMP: ■ NO ☐ ASME ☐ OTHER
FILTER WEIGHT: LBS

MATERIALS

HOUSING: 316 SS
SIZE: * THK: *
COVER: 316 SS
SIZE: * THK: *
FINISHES: INTERNAL:
EXTERNAL:
FILTER ELEMENT: PALL PSS POROUS METAL
HOUSING SUPPORT: LEGS
GASKET: 316 SS/GRAPHITE SPIRAL WOUND
BOLT: ASTM A 193 GR. B7 NUTS: ASTM A194 GR 2H
SPECIAL PAINTING:

CONSTRUCTION

FLOW PATH: ☐ IN-LINE ■ T-TYPE
MOUNTING: ☐ HORIZONTAL ■ VERTICAL
ELEMENT TYPE: ■ CLEANABLE ☐ THROWAWAY
☐ PLEATED ☐ DEPTH ☐ CODE 7 STYLE
NO. ELEMENTS PER UNIT: *
SIZE ELEMENTS: DIAM.: * LGTH: *
TOTAL ELEMENT DIRT CAPACITY: * FT^3
TOTAL ELEMENT SURFACE AREA: * FT^2
MAXIMUM ΔP ACROSS ELEMENT: * PSI
METHOD OF REMOVING ELEMENTS:
STEAM STERILIZE: ☐ AUTOCLAVE ☐ IN-SITU ☐ NONE
FILTER COVER TYPE: ■ THRU BOLTED ☐ SWING BOLTED
☐ SCREWED ☐ CLAMP ON ☐ OTHER
COVER DAVIT: ■ NO ☐ YES
JACKETED: ■ NO ☐ YES

NOZZLES AND COUPLINGS

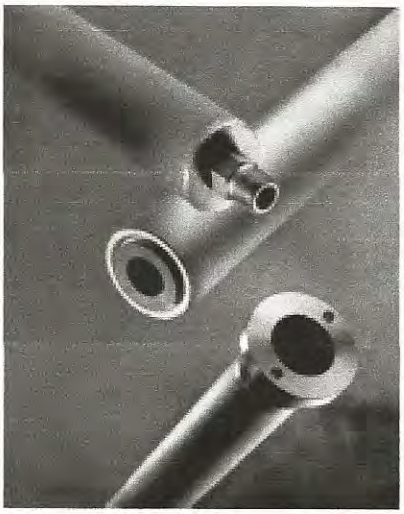
SERVICE	NUMBER	SIZE	RATING	TYPE
INLET	1	4	ANSI CLASS 150	RF FLG
OUTLET	1	4	ANSI CLASS 150	RF FLG
VENT	1	0.5	ANSI CLASS 3000	CLPG
DRAIN	1	0.5	ANSI CLASS 3000	CLPG
INSTRUMENT				

NOTES: ATTACH SS TAG WITH EQUIP. NO.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

PSS Porous Metal Filter Cartridges

Sintered Metal Powder Filters for Liquid and Gas Service



Pall **PSS** porous metal filter cartridges are made from fine stainless steel powders sintered to form rugged high voids and fixed pore filters with high-temperature, pressure, and solvent resistance. P Series cartridges begin as flat porous sheets which are shaped and welded into cylindrical elements. S Series cartridges are produced in cylindrical form with higher voids and narrower pore size distributions for greater flows at comparable ratings. Double open-ended (DOE) style cartridges are standard. They are recommended for steam service and well suited for liquid or gas applications including solvents, chemical intermediates, heat transfer and cryogenic fluids, polymers, pharmaceuticals, and high-temperature gases. Single open-ended (SOE) AB sanitary and threaded styles are also available.

Features and Benefits

- All-stainless steel construction
- Controlled and fixed pore size
- PH grade for clean steam
- Up to 2x life of competitive filters
- High pressure and corrosion resistant
- Withstands high reverse-flows
- High-temperature capabilities
- Repeatedly cleanable
- No soluble polymeric extractables
- No unloading or shedding
- Absolute rated for reliable performance
- ISO 9000 Certified Quality System
- Manufactured for use in conformance with cGMP
- FDA-listed materials per 21 CFR

PSS Porous Metal Filter Cartridges

Technical Specifications

Materials of Construction

Medium	Type 316L stainless steel[1]
End Caps	Type 316 stainless steel[1]
Gasket	Buna-N (Standard)[2]

[1] Other grades and alloys available
[2] Other Polymers available.

Configuration[3]

Double open-ended (DOE), flat gasket seals

[3] Single open-ended AB sanitary and threaded styles available.

Nominal Dimensions

Diameters	**P Series:** 2.5 in. (64 mm)
	S Series: 2.38 in. (60.5 mm)

Operating Conditions

Maximum Differential Pressure[4]	
Forward and Reverse Flow Direction	3.4 bard (50 psid) to 232 °C (450 °F)

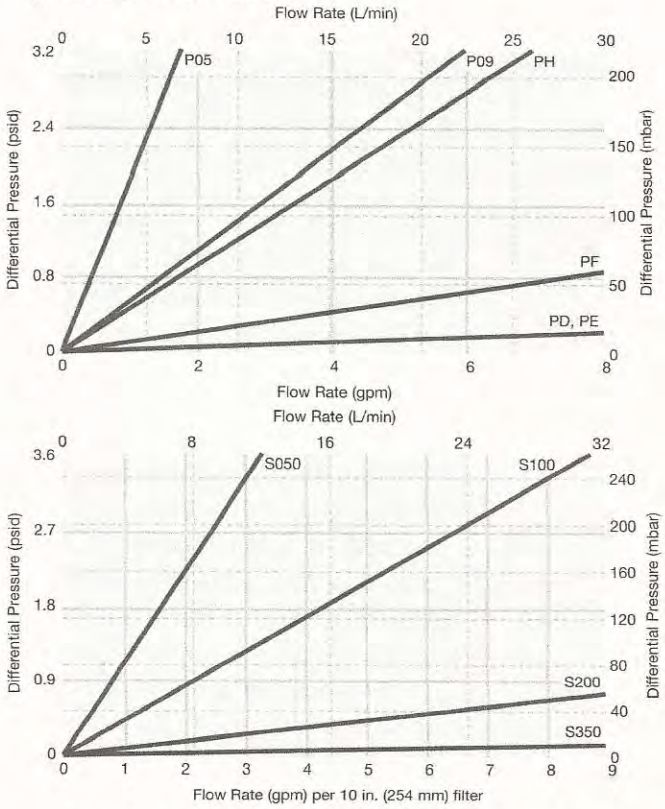
[4] Minimum collapse differential pressure. Temperature limit with Buna-N gaskets: 121 °C (250 °F). Other gasket materials to 232 °C (450 °F). For temperatures to 316 °C (600 °F), or in other alloys to 677 °C (1250 °F), contact your local Pall distributor.

Recommended Maximum Flow Densities[5]

Grade	Aqueous L/min (gal/min)	Air Nm³/hr (acfm)
P Series		
PD	3.5 (0.9)	13 (80)
PE	2.5 (0.7)	9.5 (60)
PF	2.1 (0.6)	7.9 (50)
PH	1.4 (0.4)	6.3 (40)
P09	1.1 (0.3)	4.7 (30)
P05	0.7 (0.2)	1.6 (10)
S Series		
S350	3.5 0.9)	13 (80)
S200	2.5 (0.7)	7.9 (50)
S100	1.8 (0.5)	6.3 (40)
S050	1.1 (0.3)	3.2 (20)

[5] Ratings are absolute particulate in liquids and gases. Aqueous water, 1 cp and air flows per 10 in. (254 mm) cartridge.

Typical Liquid Flow Rates[6]



[6] Typical initial clean medium ΔP per 10 in. (254 mm) element, water at 20 °C (68 °F), 1 cp. For assistance in sizing and housing selection, contact your local Pall representative.

Ordering Information

MBS100 ☐

Code	Nominal Length	Filter Area
1	10 in. (254 mm)	0.05 m² (0.5 ft²)
2	20 in. (508 mm)	0.09 m² (1.0 ft²)
3	30 in. (762 mm)	0.14 m² (1.5 ft²)

☐

Code	Liquid Ratings[7]	Gas Ratings[7]
PD	55 µm	20 µm
PE	35 µm	11 µm
PF	20 µm	2.8 µm
PH	13 µm	1.3 µm
P09	9 µm	0.8 µm
P05	5 µm	0.4 µm
S35	35 µm	11 µm
S200	20 µm	2.8 µm
S100	10 µm	0.8 µm
S050	5 µm	0.4 µm

[7] **Liquids:** > 99.98% by mod. OSU-F2 test.
Gases: 100% for hard spherical particles.

☐

Code	Gasket Options
H13	Buna-N gaskets (Standard)
H	Viton*
J	Ethylene Propylene
J7	Ethylene Propylene (Steam Service)

Other materials available on request.
* Viton is a registered trademark of DuPont Dow (non-FDA materials).

AMERICAN INGENUITY LLC

GEAR PUMP

REV.: 0
DATE: 7/2/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 7/2/15 | P.O. NO.: | EQUIPMENT NO.: P-1
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 2 SAMPLE CIRCULATION PUMP
TYPE: INTERNAL CLOSE COUPLED GEAR PUMP
DUTY: ☐ CONTINUOUS ■ INTERMITTENT
DESIGN: ☐ ANSI ☐ API676 ■ OTHER

PROCESS INFORMATION

LIQUID: SUGAR CANE JUICE
■ BOILING ☐ TOXIC ☐ FOAMING ☐ FLAMMABLE
DESIGN FLOW: NORMAL 0.1 MAX 0.5 GPM
PUMPING TEMP.: 226 °F
SP. GR. @ PUMPING TEMP.: 1.06
VISC. @ PUMPING TEMP.: 15 CPS
VAPOR PRESS. @ PUMPING TEMP.: (PSIA)(mmHG)
CORROSIVE MAT'L: pH VALUE:
SOLIDS (MAX. DIAM.): % BY WEIGHT:
☐ ABRASIVE ■ NON-ABRASIVE

HYDRAULIC INFORMATION

	FT. LIQ.
SUCTION PRESS. ABOVE LIQ. (ABS)(+)	
STATIC SUCTION LIFT (-) HEAD (+)	
SUCTION FRICTION (-)	
TOTAL SUCTION HEAD (19+20+21)	
STATIC DISCHARGE HEAD (+)	
DISCHARGE FRICTION HEAD (+)	
DISCHARGE PRESS. ABOVE LIQ. (ABS)(+)	
TOTAL DISCHARGE HEAD (23+24+25)	
TOTAL DYNAMIC HEAD (26-22)	4
NPSH AVAILABLE (22-14)	3
NPSH REQ'D	*

PUMP

MANUFACTURER: MICROPUMP
MODEL: * RPM: *
BHP @ SERVICE CONDITIONS: *
@ MAX FLOW FOR FRAME: *
ROTATION @ DRIVE SHAFT END: *
PERF. CURVE: *
SERIAL NO.: *

MATERIALS

steam conder 316 SS
LINER: NONE
ROTOR OR GEARS: 316 SS
BEARINGS: WEARPLATE:
SHAFT: 316 SS SHAFT SLEEVE: INTERNAL
MOUNTING BASE: NONE

CONSTRUCTION

	SIZE	RATING	TYPE	POSITION
SUCTION CONN	*	ANSI 150	THRD	END
DISCH. CONN	*	ANSI 150	THRD	END

VENT CONN.: DRAIN CONN.:
TYPE: GEAR: ☐ HELICAL ☐ HERRINGBONE ☐ SPUR
CASE: MOUNT: ■ HORIZONTAL ☐ VERITCAL
SPLIT: ☐ AXIAL ☐ RADIAL
JACKET: ☐ NO ☐ YES; PSIG @ °F
TIMING GEAR: ■ NONE ☐ INTERNAL ☐ EXTERNAL
ROTOR MOUNT: ■ BETWEEN BEARINGS ☐ OVERHUNG
PACKING TYPE: SHAFT DIA.:
LANTERN RINGS: MAT'L:
MECH SEAL TYPE: ■ SINGLE ☐ DOUBLE ☐ SEALLESS
MECH SEAL MFG: MFG. STD. MODEL:
STUFFING BOXES: NO.: DEPTH: ☐ JACKETED
BEARINGS: TYPE ☐ GREASE ☐ OIL FLOOD
RELIEF VALVE: ■ NONE ☐ INTERNAL; SET @ NOTE 1 PSIG
BASEPLATE: ☐ MFG. STANDARD ☐ OTHER
WEIGHT: PUMP/BASE/MOTOR: *

DRIVE

FURNISHED BY: ■ VENDOR ☐ OTHER
TYPE: AC INDUCTION NEMA PREMIUM EFFICIENCY
HP: * RPM: * ENCL.: TEFC
VOLTS: 120 PHASE: 1 CYCLE: 60
REF, SEVERE DUTY MOTOR DATA SHEET
GEAR BOX MFG: MODEL:
GEAR RATIO: MIN. S.F.: ACT. S.F.:
COUPLING TYPE: NONE GUARD:
COUPLING MFG: MODEL:

NOTES:

1. SUPPLY RELIEF VALVE TO BE MOUNTED ON DISCHARGE PIPING. SEE P&ID.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

PLANT	STEAM CONDENSATE							PROJECT NO.		
LOCATION	ST. GABRIEL., LA.							W.R. NO.		
CLIENT	AUDUBON SUGAR INSTITUTE							APPR. NO.		
PUMP MANUFACTURER								P.O. NO.		
MODEL				NO. UNITS 1		ANSI Pump ☐		Non-ANSI Pump ☐		
1	SERVICE CONDITIONS	Liquid Pumped: STEAM CONSENSATE				Normal / Design Capacity @ P.T.			5	gpm
2		Pumping Temperature (P.T.): 218 °F				Discharge Pressure		psia	ft.	
3		Specific Gravity at P.T.: 0.957				Suction Pressure		psia	ft.	
4		Viscos at P.T.: 0.27 cp: Vap Press at P.T. psia				Differential Pressure	0	psi	ft.	
5		Percent/Size Solids:				Differential Head			15 ft.	
6		Corrosion or Erosion Factors:				NPSH Available	5.4	ft.;NPSH Required (Water)	*	ft.
7	CONSTRUCTION DETAILS	Arrangement: Horiz.		Number of Stages 1		Shut Off Pressure	*	ft. Min. Continuous gpm*	*	
8		Direction of Rotation Facing Pump Coupling: CW - CCW *				Efficiency at Rating	*	BHP Rated	*	
9		Case: D.P. @ T/M.A.W.P. @ T: *				NOTE 1		PSIG °F Max. BHP Rated imp	*	
10		Case Mount: ☐ Between brgs ☑ Overhung ☐ Centerline ☐ Foot ☐ Bracket ☐ Vert. (Type)								
11		Split: ☐ Axial ☐ Rad. Type Volute: ☑ SGL ☐ DBL ☐ Diffuser Impeller Type ☑ Open ☐ Closed								
12		Impeller Diameter: Supplied * in; Max *				in; Min *	in	Suction ☑ Single ☐ Double Speed	*	rpm
13		Vent and Drain Tapped: Yes				Type Bearings:*		Radial		
14		Nozzles	Size	Rating	Facing	Location	Lubrication: ☐ Ring Oil ☐ Flood ☐ Flinger ☐ Grease			
15		Suction	*	ANSI 150	RF	END	Oiler: Yes ; Type TRICO			
16		Discharge	*	ANSI 150	RF	TOP	Coupling: Yes ; Mfg.		Coupl. Grd: Yes	
		Circ. Port								
17		Drains					Baseplate: Yes; Type FABRICATED STEEL			
18		Cooling H2O					Cooling Water Supply: Type			
19							Available at psig and °F			
20		Water Cooling: Case-Stuff. Box-Bearing-Pedestal-Gland-None					Total Water Required: gpm			
21		Smothering Gland: Lantern Rings: Packing: No Mfr.: Type								
22		Mechanical Seal: ; Furnished by: ; Mfr. MFR. CODE								
23		Type: SINGLE API Class Code								
24		Rotary Unit ; Seal Ring ; Face Material ;Shaft Packing								
25		Insert ; Reversible: Yes - No ; Face Material ☐ Sight F.I. Req'd								
26		Insert Mounting: Clamped In - "O" Ring - Press Fit API C.W. Pipe Plan ☐ CU; ☐ S.S. ☑ Tubing ☐ Pipe								
27		Gland ; Plain: Yes - No Throttle Bushing Carbon: Yes - No ;Other								
28		Gland/Stuffing Box Machined & Tapped for: Dead - End Lub. - Circulating Lub. - Quenching - Vent and Drain								
29										
30		Auxiliary Stuffing Box Req'd: No API Seal Plan ☐ C.S. ☐ S.S. ☐ Tubing ☐ Pipe								
31		Weight of Pump * lb ; Weight of Driver lb ; Weight of Base lb ; Shipping Weight								lb
32	MATERIALS	Casing & Covers: DUCTILE IRON				Shaft:				
33		Casing Wear Rings:				Shaft Sleeves:				
34		Impeller: 316 SS				Lantern Rings:				
35		Impeller Wear Rings:				Glands:				
36		Thrust Washers:				Adaptor:				
37		Stuffing Box Bushings:				Bearings:				
38		Stator/Rotor Liner:				Bearing Housing:				
39		Stator End Caps:				Gaskets:				
40		Stator Housing:				External Bolts:				
41		Pump O-rings:				Baseplate:				
42		Motor O-rings:				Casing Jacket:				
43		Internal Bolts:				Coupling Guard:				
44	DRIVER	Furnished by: Pump Vendor ; Type: AC Induction Premium Efficiency Inverter Duty ; Direct - Gear - Belt								
45		Electric Motor: Make		Mounted by: PUMP VENDOR		Speed * rpm Driver Specification No.				
46		Enclosure TEFC SF 1.5 Temp. Rise °C				Volts 460 ; Phase 3 Cycle 60				
47		Insulation Frame				Speed Reducer: Integral - Separate				
48		Normal Motor Size (Non-overloading) hp				Mfr. Ratio				
49						Model Class				
50	NOTES	1. VFD TO VARY SPEED TO MAINTAIN LEVEL IN CONDENSATE TANK, T-3. SEE PI&D AND DESIGN DETAIL NO.2.								
51		2. ENTRAINMENT OF GASSES IS POSSIBLE.								
52		3. QUOTE RECOMMENDED SPARE PARTS.								
53										
54										
55		Std Shop Test - Yes; NPSH Test - Yes Hydrostatic Test: Yes ; Pressure * psi								
56	Tests	Performance Test - Yes; Witnessed - No Shop Inspection: No								

SPEC. BY: BDL		P-3 EQUIP. NO.
CHECKED:	SERVICE EVAPORATOR STEAM CONDENSATE	CENTRIFUGAL PUMP SPECIFICATION
APP'D:		
DATE: 9/4/2015	Revision Date: A B C	
VENDOR TO COMPLETE ALL INFORMATION MARKED *	SHEET 1 OF 1	SPEC. NO.

AMERICAN INGENUITY LLC

STRAINER

REV.: 0
DATE: 5/10/15

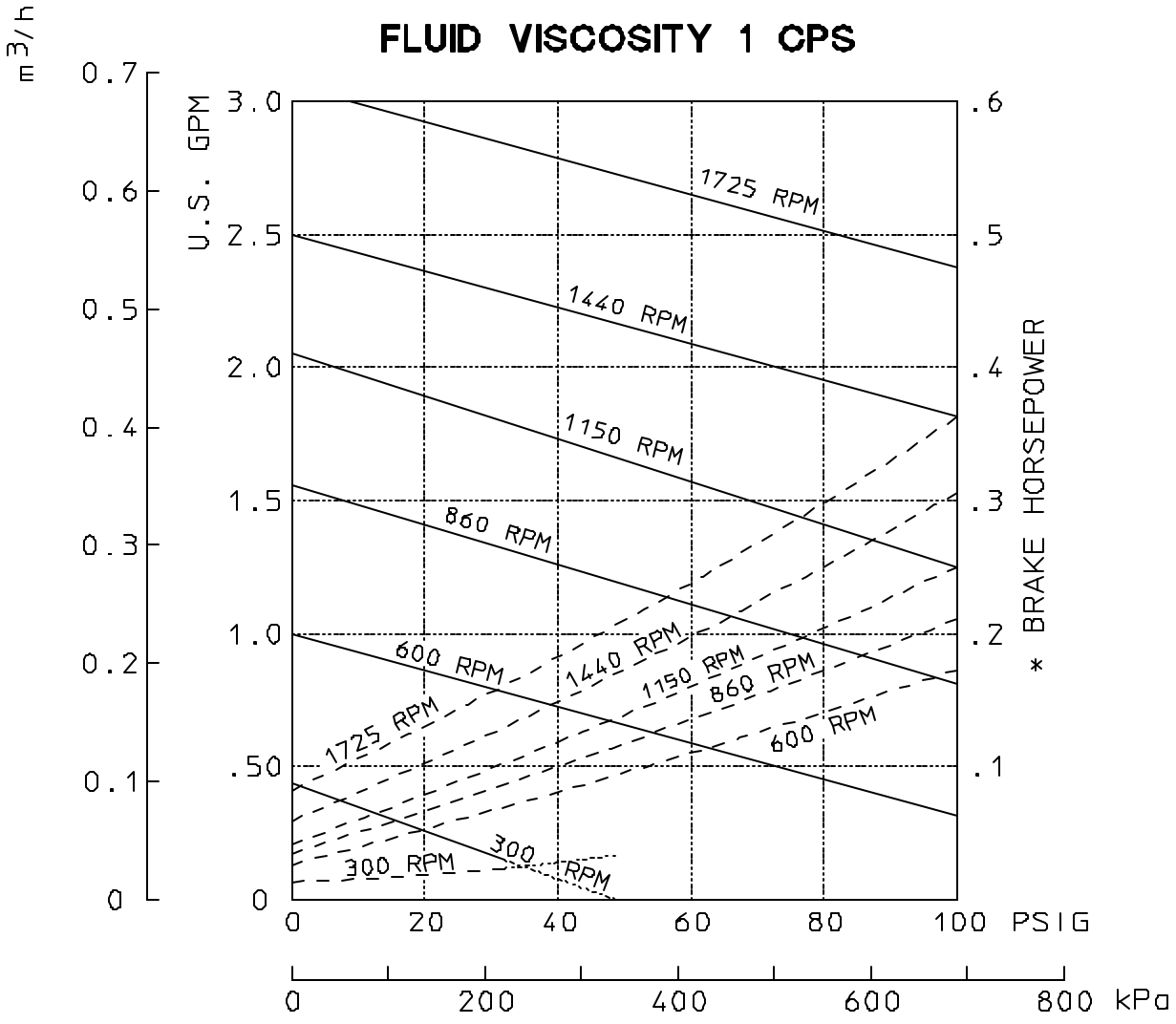
COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/10/15 | P.O. NO.: | EQUIPMENT NO.: SS-2
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

	GENERAL INFORMATION	
SERVICE:	SUCTION STRAINER OF P-3	LOCATION: SUCTION OF P-3
MANUFACTURER:	*	N-S/E-W COORDINATES:
MODEL:	*	
	PROCESS DESIGN	
INLET PRESS.:	>2 PSIG	INLET TEMP.: 209 DEG F
FLOWING FUID:	STEAM CONDENSATE	MAX. FLOWRATE 5 GPM
ALLOWABLE PRESS DROP AT MAX. FLOWRATE:	0.2 PSI	EXPECTED PRESS DROP AT MAX. FLOWRATE: * PSI
REQUIRED MESH OR PERFORATIONS:	40	PERCENT OPEN AREA: * %
PIPE MATING FLANGES:	2" RF	
	CONSTRUCTION	
TYPE OF STRAINER:	☐ TEMP. CONE ☐ TEMP. BASKET ■ Y-STRAINER ☐ PERMANENT BASKET WITH FLG HEAD (NOTE 3)	
BODY MAT'L:	SS	CONNECTION SIZE: 2 IN
SCREEN OR MESH MAT'L:	SS	FLANGE RATING: ANSI CLASS 150
GASKET MAT'L FOR PERMANENT STRAINER:	304 SS/GRAPHITE SW	DESIGN PRESS.: * PSIG
TYPE OF CONNECTIONS:	☐ NPT ☐ FF FLG ■ RF FLG	DESIGN TEMP: * DEG F
SIZE OF DRAIN CONNECTION:	* IN	WEIGHT OF STRAINER: * LBS
LENGTH OF TEMPORARY STRAINER:	* IN	
FACE TO FACE OF PERMANENT STRAINER:	* IN	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO STRAINER WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

G/GA/GC4 GEARCHEM PUMP
1/2" PORTS
FLUID VISCOSITY 1 CPS



* BRAKE HORSEPOWER SHOWN AS DASHED CURVES

			SECTION/PAGE	C/G4 / 4601	ECO / PULSAFEEDER (A Unit of IDEX Corporation)
			EFFECTIVE	12/01/97	PERFORMANCE CURVE G / GA / GC4
A			SUPERSEDES	05/10/74	DWN BY PTP
REF	REVISION UPDATE	DATE			DATE: 02/11/98
					AE00055-001

AMERICAN INGENUITY LLC

STRAINER

REV.: 0
DATE: 6/17/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 6/17/15 | P.O. NO.: | EQUIPMENT NO.: SS-1
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: STEAM TRAP ST-1 UPSTREAM STRAINER	LOCATION: UPSTREAM OF ST-1
MANUFACTURER: *	N-S/E-W COORDINATES:
MODEL: *	

PROCESS DESIGN

INLET PRESS.: 10 PSIG	INLET TEMP.: 239 DEG F
FLOWING FUID: STEAM CONDENSATE	MAX. FLOWRATE 2 GPM
ALLOWABLE PRESS DROP AT MAX. FLOWRATE: 0.2 PSI	EXPECTED PRESS DROP AT MAX. FLOWRATE: * PSI
REQUIRED MESH OR PERFORATIONS: 40	PERCENT OPEN AREA: * %
PIPE MATING FLANGES: 2" RF	

CONSTRUCTION

TYPE OF STRAINER: ☐ TEMP. CONE ☐ TEMP. BASKET ■ Y-STRAINER ☐ PERMANENT BASKET WITH FLG HEAD (NOTE 3)

BODY MAT'L: SS	CONNECTION SIZE: 2 IN
SCREEN OR MESH MAT'L: SS	FLANGE RATING: ANSI CLASS 150
GASKET MAT'L FOR PERMANENT STRAINER: 304 SS/GRAPHITE SW	DESIGN PRESS.: * PSIG
TYPE OF CONNECTIONS: ☐ NPT ☐ FF FLG ■ RF FLG	DESIGN TEMP: * DEG F
SIZE OF DRAIN CONNECTION: * IN	WEIGHT OF STRAINER: * LBS
LENGTH OF TEMPORARY STRAINER: * IN	
FACE TO FACE OF PERMANENT STRAINER: * IN	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO STRAINER WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

STEAM TRAP

REV.: 0
DATE: 6/17/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 6/17/15 — P.O. NO.: — EQUIPMENT NO.: ST-1A
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: EVAPORATOR NO. 1 CALANDRIA STEAM TRAP	LOCATION: OUTLET OF EVAPORATOR NO. 1 CALANDRIA SHELL SIDE
MANUFACTURER: TLV	N-S/E-W COORDINATES:
MODEL:	

PROCESS DESIGN

INLET PRESS.: 10 PSIG	INLET TEMP.: 239 DEG F
DISCHARGE TO : ■ ATMOSPHERE ☐ PRESSURIZED SYSTEM	OUTLET PRESS.: 0 PSIG
DIFFERENTIAL PRESS: 10 PSIG	REQUIRED CAPACITY: 562 LBS/HR

CONSTRUCTION

TYPE: ☐ THERMODYNAMIC ☐ THERMOSTATIC	SAFETY FACTOR: ☐ 1.5 FOR F&T ☐ 2 FOR INV. BUCKET
☐ FLOAT & THERMOSTATIC ☐ INVERTED BUCKET	☐ 2 FOR THERMOSTATIC ☐ 1 FOR DISC
☐ BIMETALLIC ■ FREE FLOAT	■ VENDOR TO RECOMMEND SAFETY FACTOR
CONNECTION SIZE: 1 IN	CONNECTION TYPE: ☐ NPT ☐ SW ■ RF FLG
BODY MAT'L: CAST IRON	INTERNAL MAT'L: SS
INTEGRAL STRAINER: ☐ YES ■ NO	INTEGRAL BLOWDOWN VALVE: ☐ YES ■ NO
TEMP. DISCH. CONTROLLER: ☐ YES ■ NO	ORIFICE SIZE: * IN
DISCHARGE TEMP. IND. ☐ YES ■ NO	DISCHARGE DIFFUSER: ☐ YES ■ NO
	MODEL:
	BODY MAT'L:

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO STEAM TRAP WITH FIRMLY SECURED
STAINLESS STEEL WIRE.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

STEAM TRAP

REV.: 0
DATE: 6/17/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 6/17/15 — P.O. NO.: — EQUIPMENT NO.: ST-1B
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: STEAM LINE UPSTREAM OF FV-1	LOCATION: UPSTREAM OF FV-1
MANUFACTURER: TLV	N-S/E-W COORDINATES:
MODEL:	

PROCESS DESIGN

INLET PRESS.: 10 PSIG	INLET TEMP.: 239 DEG F
DISCHARGE TO : ■ ATMOSPHERE ☐ PRESSURIZED SYSTEM	OUTLET PRESS.: 0 PSIG
DIFFERENTIAL PRESS: 10 PSIG	REQUIRED CAPACITY: 50 LBS/HR

CONSTRUCTION

TYPE: ■ THERMODYNAMIC ☐ THERMOSTATIC	SAFETY FACTOR: ☐ 1.5 FOR F&T ☐ 2 FOR INV. BUCKET
☐ FLOAT & THERMOSTATIC ☐ INVERTED BUCKET	☐ 2 FOR THERMOSTATIC ■ 1 FOR DISC
☐ BIMETALLIC ■ FREE FLOAT	☐ VENDOR TO RECOMMEND SAFETY FACTOR
CONNECTION SIZE: 0.75 IN	CONNECTION TYPE: ■ NPT ☐ SW ☐ RF FLG
BODY MAT'L: SS	INTERNAL MAT'L: SS
INTEGRAL STRAINER: ■ YES ☐ NO	INTEGRAL BLOWDOWN VALVE: ■ YES ☐ NO
TEMP. DISCH. CONTROLLER: ☐ YES ■ NO	ORIFICE SIZE: * IN
DISCHARGE TEMP. IND. ☐ YES ■ NO	DISCHARGE DIFFUSER: ☐ YES ■ NO
	MODEL:
	BODY MAT'L:

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO STEAM TRAP WITH FIRMLY SECURED
STAINLESS STEEL WIRE.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

GEAR PUMP

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/10/15 | P.O. NO.: | EQUIPMENT NO.: P-2
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

GENERAL INFORMATION

SERVICE: SYRUP PUMP
TYPE: INTERNAL CLOSE COUPLED GEAR PUMP
DUTY: ■ CONTINUOUS ☐ INTERMITTENT
DESIGN: ☐ ANSI ☐ API676 ■ OTHER

PROCESS INFORMATION

LIQUID: 70 BRIX SUGAR CANE SYRUP
☐ BOILING ☐ TOXIC ☐ FOAMING ☐ FLAMMABLE
DESIGN FLOW: NORMAL 0.4 MAX 1.0 GPM
PUMPING TEMP.: 147 °F
SP. GR. @ PUMPING TEMP.: 1.465
VISC. @ PUMPING TEMP.: 50 CPS
VAPOR PRESS. @ PUMPING TEMP.: (PSIA)(mmHG)
CORROSIVE MAT'L: pH VALUE:
SOLIDS (MAX. DIAM.): % BY WEIGHT:
☐ ABRASIVE ■ NON-ABRASIVE

HYDRAULIC INFORMATION

	FT. LIQ.
SUCTION PRESS. ABOVE LIQ. (ABS)(+)	
STATIC SUCTION LIFT (-) HEAD (+)	
SUCTION FRICTION (-)	
TOTAL SUCTION HEAD (19+20+21)	1.4
STATIC DISCHARGE HEAD (+)	
DISCHARGE FRICTION HEAD (+)	
DISCHARGE PRESS. ABOVE LIQ. (ABS)(+)	
TOTAL DISCHARGE HEAD (23+24+25)	
TOTAL DYNAMIC HEAD (26-22)	30
NPSH AVAILABLE (22-14)	1,4
NPSH REQ'D	*

PUMP

MANUFACTURER: ECO GEARCHEM OR MICROPUMP
MODEL: * RPM: *
BHP @ SERVICE CONDITIONS: *
@ MAX FLOW FOR FRAME: *
ROTATION @ DRIVE SHAFT END: *
PERF. CURVE: *
SERIAL NO.: *

MATERIALS

CASING: 316 SS
LINER: NONE
ROTOR OR GEARS: 316 SS
BEARINGS: GLASS-FILLED TFE WEARPLATE: CARBON 72
SHAFT: 316 SS SHAFT SLEEVE: INTERNAL
MOUNTING BASE: NONE

CONSTRUCTION

	SIZE	RATING	TYPE	POSITION
SUCTION CONN	*	ANSI 150	THRD	END
DISCH. CONN	*	ANSI 150	THRD	END

VENT CONN.: DRAIN CONN.:
TYPE: GEAR: ☐ HELICAL ☐ HERRINGBONE ☐ SPUR
CASE: MOUNT: ■ HORIZONTAL ☐ VERITCAL
SPLIT: ☐ AXIAL ☐ RADIAL
JACKET: ☐ NO ☐ YES; PSIG @ °F
TIMING GEAR: ■ NONE ☐ INTERNAL ☐ EXTERNAL
ROTOR MOUNT: ■ BETWEEN BEARINGS ☐ OVERHUNG
PACKING TYPE: SHAFT DIA.:
LANTERN RINGS: MAT'L:
MECH SEAL TYPE: ■ SINGLE ☐ DOUBLE ☐ SEALLESS
MECH SEAL MFG: MFG. STD. MODEL:
STUFFING BOXES: NO.: DEPTH: ☐ JACKETED
BEARINGS: TYPE ☐ GREASE ☐ OIL FLOOD
RELIEF VALVE: ■ NONE ☐ INTERNAL; SET @ NOTE 1 PSIG
BASEPLATE: ☐ MFG. STANDARD ☐ OTHER
WEIGHT: PUMP/BASE/MOTOR: *

DRIVE

FURNISHED BY: ■ VENDOR ☐ OTHER
TYPE: AC INDUCTION NEMA PREMIUM EFICIENCY INVERTER DUTY
HP: * RPM: * ENCL.: TEFC
VOLTS: 460 PHASE: 3 CYCLE: 60
REF, SEVERE DUTY MOTOR DATA SHEET
GEAR BOX MFG: MODEL:
GEAR RATIO: MIN. S.F.: ACT. S.F.:
COUPLING TYPE: NONE GUARD:
COUPLING MFG: MODEL:

NOTES:

1. SUPPLY RELIEF VALVE TO BE MOUNTED ON DISCHARGE PIPING. SEE P&ID.
2. VFD TO VARY SPEED TO MAINTAIN LIQUID LEVEL IN THIRD EFFECT CALANDRIA. SEE P&ID AND DESIGN DETAIL NO, 3.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY LLC

STRAINER

REV.: 0
DATE: 5/10/15

COMPANY: AUDUBON SUGAR INSTITUTE | SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. | PROJ. NO.: | SPEC. NO.:
BY: BDL | DATE: 5/10/15 | P.O. NO.: | EQUIPMENT NO.: SS-1
CHECKED BY: | DATE: | PRICE EACH $ | TOTAL NO. REQ'D.: 1

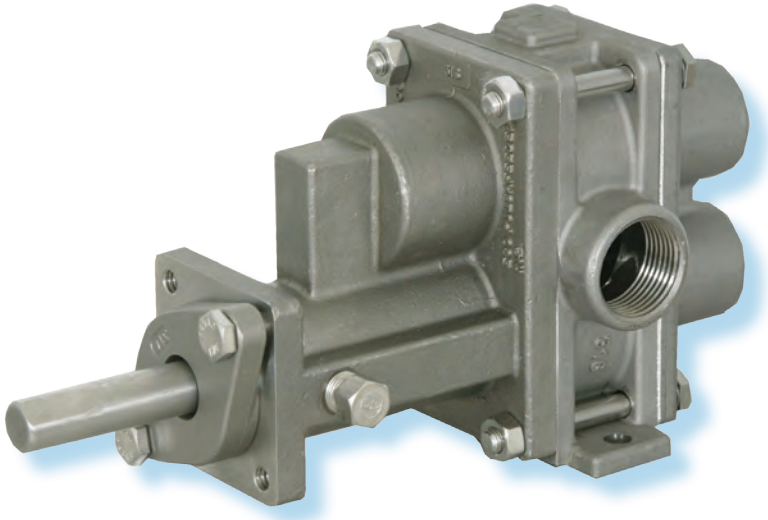
	GENERAL INFORMATION	
SERVICE:	SUCTION STRAINER OF P-2	LOCATION: SUCTION OF P-2
MANUFACTURER:	*	N-S/E-W COORDINATES:
MODEL:	*	
	PROCESS DESIGN	
INLET PRESS.:	>2 PSIG	INLET TEMP.: 147 DEG F
FLOWING FUID:	SUGAR CANE SYRUP	MAX. FLOWRATE 1 GPM
ALLOWABLE PRESS DROP AT MAX. FLOWRATE:	0.2 PSI	EXPECTED PRESS DROP AT MAX. FLOWRATE: * PSI
REQUIRED MESH OR PERFORATIONS:	40	PERCENT OPEN AREA: * %
PIPE MATING FLANGES:	2" RF	VISCOSITY: LESS THAN 100 CPS
	CONSTRUCTION	
TYPE OF STRAINER:	☐ TEMP. CONE ☐ TEMP. BASKET ■ Y-STRAINER ☐ PERMANENT BASKET WITH FLG HEAD (NOTE 3)	
BODY MAT'L:	SS	CONNECTION SIZE: 2 IN
SCREEN OR MESH MAT'L:	SS	FLANGE RATING: ANSI CLASS 150
GASKET MAT'L FOR PERMANENT STRAINER:	TEFLON	DESIGN PRESS.: * PSIG
TYPE OF CONNECTIONS:	☐ NPT ☐ FF FLG ■ RF FLG	DESIGN TEMP: * DEG F
SIZE OF DRAIN CONNECTION:	* IN	WEIGHT OF STRAINER: * LBS
LENGTH OF TEMPORARY STRAINER:	* IN	
FACE TO FACE OF PERMANENT STRAINER:	* IN	

NOTES: 1. VENDOR SHALL ATTACH STAINLESS STEEL TAG STAMPED WITH EQUIPMENT NUMBER TO STRAINER WITH FIRMLY SECURED
STAINLESS STEEL TAG.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

PULSAFEEDER®
An IDEX Water & Wastewater Business

pulsafeeder.com



ECO & Isochem® Gear Pumps

Pulsafeeder Technology

Since 1936, Pulsafeeder has been the global leader in fluid handling technology and innovation in chemical dosing. Pulsafeeder has built a foundation of success with thousands of installations in fluid handling applications. Our extensive product breadth enables us to provide the convenience and efficiency of single-source solutions across various industries.

Pulsafeeder ECO® and Isochem® Gear Pumps

Pulsafeeder gear pumps are constructed out of the strongest materials available to provide superior chemical resistance and assure long life. Designed to handle a wide range of viscosities and temperatures, the ECO and ISOCHEM gear pumps are perfect for most transfer or metering applications. Gearchem pumps offer laminar flows for consistent, continuous, measurable transfer of liquids. With Pulsafeeder's ECO and ISOCHEM pumps, you can count on years of safe, leak-free service, easy maintenance and a solid reputation for quality.

Product Specifications

- Flows to 55 gpm (208 lpm)
- Pressures to 200 psi (13.8 bar)
- Accuracy of +/-5% of flow with repeatability of +/-2%
- Fluid Temperatures of -40°F to 450°F (-40°C to 232°C)
- Viscosity up to 1,000,000 cPs
- Minimum Suction NPSHR of 1 to 2ft

*All shaft materials can be hard coated for superior abrasion resistance. Standard with Silicon Carbide bearing selection.

Materials of Construction

- *Casing/Housing materials*: 316SSL, 316SS, Alloy C, Alloy 20
- *Drive and Idler Gear materials:* 316SSL, 316SS, Alloy C, Alloy 20, TFE (Glass-Filled), PEEK
- *Bearing materials:* Carbon 72, Carbon 92, Glass-filled PTFE, Silicon Carbide
- *Wearplate materials:* Carbon 72, Ceramic, Glass-filled PTFE, PEEK
- *Shaft materials*:* 316SSL, 316SS, Alloy 20, Alloy C

Typical Applications

- Adhesives and Resins
- Catalysts
- Odor Control Additives
- Fertilizers
- Polymers
- Flocculants
- Caustics
- Hydrochloric Acid
- Solvents
- Biocides
- Dyes and Bleaching chemicals
- Detergents
- Many More

ECO® & Isochem®

Flow and Pressures Specifications

SERIES	MAX FLOW GPM (LPM)	MAX WORKING PRESSURE PSI (BAR)
2	1.5 (6)	200 (14)
4	3 (11)	200 (14)
6	10 (38)	150 (10)
8	22 (83)	150 (10)
H6	10 (38)	250 (17)
H8	22 (83)	200 (14)
12*	28 (106)	200 (14)
16*	60 (227)	200 (14)

* Consult factory for extended flows and their materials of constructions.

Theory of Operation

Gear pumps are frequently relied upon for product transfer. They can handle both high and low viscosity and high and low temperature fluids including liquefied gasses. Typically they are employed to transfer fluids from vehicles to storage tanks or from tank to tank.

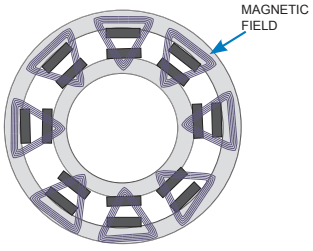
The advantage of utilizing gear pumps in metering is based in its consistency. Feedback from flow meters and sensors can control motor speed to maintain a steady consistent flow regardless of changes in viscosity, pressure or temperature. When you control the motor, you control the output.

Gear Pump Technology

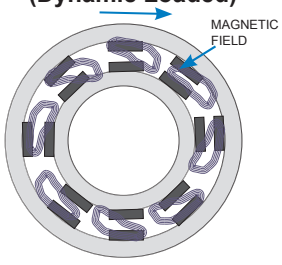
ECO® TECHNOLOGY

At the heart of each ECO Gearchem pump are two tightly toleranced, machine-generated spur gears-a drive and an idler gear. Self priming capability is accomplish by our closely toleranced gears which seal tightly to evacuate air from the suction piping. Gearchem pumps provide linear, laminar flows. The pumps are bidirectional which lets your easily change flow direction.

MAGNETIC COUPLING
(Static-No Load)



MAGNETIC COUPLING
(Dynamic Loaded)



Isochem® TECHNOLOGY

The science behind Isochem centers on sealless magnetic technology which results in a completely leak-free pump. The drive magnet is fixed to the motor shaft and works in conjunction with the driven magnet. As the pump is engaged, the drive magnet begins its rotation and pulls the driven magnet along due to the magnetic force. As the shaft is completely contained, there is no possibility of fluid leakage and therefore no need for mechanical seals. The permanent magnet material is available in either neodymium iron or rare earth samarium cobalt. The torque capacity of both are incredibly high and virtually eliminates any possibility of coupling slippage.

ECO® & Isochem® CONFIGURATIONS

The ECO family is available in the following models: G2, GA2, G4, GA4, G6, GA6, GH6, G8, GA8, GH8, GA12 and GA16.

GA2

GA4

GA8

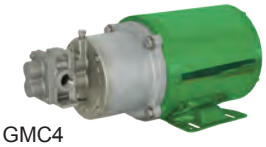
ECO GC2
Closed Coupled

ECO GC4
Closed Coupled

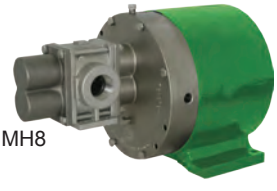
ECO GC8
Closed Coupled

The ISOCHEM family is available in the following models: GMC1, GMC2, GMC4, GMC6, GMH6, GMC8, GMH8, GM12 and GM16.

GMC2



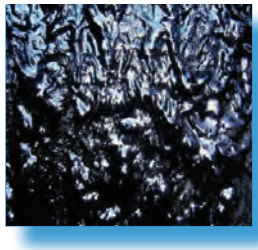
GMC4



GMH8

Features and Benefits

ECO®



Can Handle a Variety of Fluid Viscosities

- Extensive material availability provides versatility for pumping low or high viscosity fluids
- Can handle clear lubricating and non-lubricating fluids including hydrocarbons and polymer 0.8 to 1,000,000 cPs

Three Types of Seal and Packing Arrangements

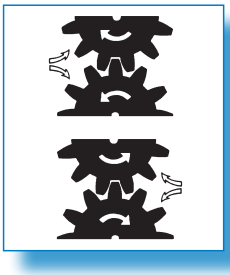
- Internal mechanical seals (single or double)
- External mechanical seals (for pressure or vacuum service)
- Packing (standard or lantern ring)

Replaceable Wearplates Restore ECO to "Like New" Performance

- Easily replaceable
- Available in a variety of materials including carbon, PTFE (glass-filled), PEEK and ceramic.
- Prevents gears from coming into contact with the housing

Internal Sleeve Type Bearings

- Lubricated by the process fluid
- No risk of contamination from external lubrication materials
- Offered in glass-filled PTFE, carbon graphite impregnated, carbon graphite impregnated sintered for hardness and to extend life-also available is Silicon Carbide (sintered).



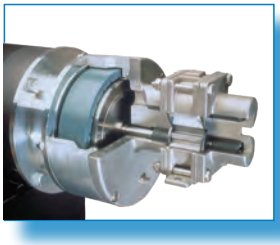
Self-Priming* and Bi-Directional

- Closed running and operating clearances evacuate air from the suction piping
- Pumps are bi-directional for ease of installation
- Suction and discharge ports are dependent upon motor wiring and shaft rotation
- Flow direction can be reversed by changing motor direction

* After initial priming (wetted)

Features and Benefits

Isochem®



Magnetic Coupling Eliminates Mechanical Seals

- Magnetic Drive Technology eliminates leakage of hazardous, toxic, and corrosive chemicals
- Downtime and maintenance costs are reduced as there are no worn seals to replace
- Eliminates costly seal flush systems required with all pumps with double mechanical seals

Superior Corrosion Resistance and Long Life

- 316SS, Alloy 20 and Alloy C housing provide maximum chemical resistance
- Alternate gear, bearing, and wearplate materials for maximizing pump life and compatibility

Minimizes Heating

- Reduced eddy heating current with optional Alloy C containment can
- Designed with recirculation wearplates and bearings
- Positive lubrication groves in bearings help to reduce heat caused by friction
- One piece containment can eliminates any chance for leakage

Closed Coupled Design

- Eliminates the alignment problems that are inherent in long coupled base units
- Close coupled mounting for NEMA C-Face and IEC B14 (B34) motors
- Laser alignment equipment is not required
- Reduce overall pump and motor footprint

Compact and Self-Priming

- Compact size makes pumps ideal for a variety of footprints
- Self-priming and reliable
- Manufactured to close tolerances to assure repeatable performance

Control Options

MPC VECTOR

The MPC Vector is a microprocessor based motor speed control device, for use with all pump technologies and has been designed for simplicity, yet has many advanced features that allow a wide variety of environments and applications. The product is not just a variable speed drive, rather it is a state of the art multifunctional controller.

- Sensorless, vector type drive
- Wide range of flow control
- Infinite turndown with the appropriate motor
- Displays flow in GPH, LPH, GPM, or LPM
- Displays speed in RPM
- Display can be set in one of five programmable languages
- NEMA 4X (IP56) rating on the control and handheld key-pad enclosures
- Can be mounted up to 1000ft (304m)
- Security code to lock out unauthorized users
- Input, output processor (4-20 mA and digital)
- PID loop for closed loop flow control

Use the MPC Vector to Monitor:

- Supply tank level
- Pump flow verification
- Remote status indication of pump (on/off)
- Pump alarm status
- Pump auto/manual status

Pump Options

In addition to the material offerings for ECO and Isochem pumps, there are a variety of options that allow you to customize your ECO or Isochem pump to meet the application specifications. Not shown but also available are flush ports and pedestal assemblies.

Base Mounted Units: Both pumps can be mounted on formed bases of heavy-gauge carbon or stainless steel. These complete units provide easy installation.

Close coupled ECO Gearchem pumps provide a compact alterative to limited space requirements. The one piece design affords simple installation, eliminates misalignments, and is inherent safe for rotating components.

Bolt-On Thermal Jackets help to regulate the pumping temperature of the process liquid. The jackets are designed to conform closely to pump contours to transfer heat evenly.

Flanged Ports: Raised faced 150lb ANSI flanges are available on the suction and discharge ports of both Isochem and ECO. They are available in all sizes (excluding GMC1).

Systems

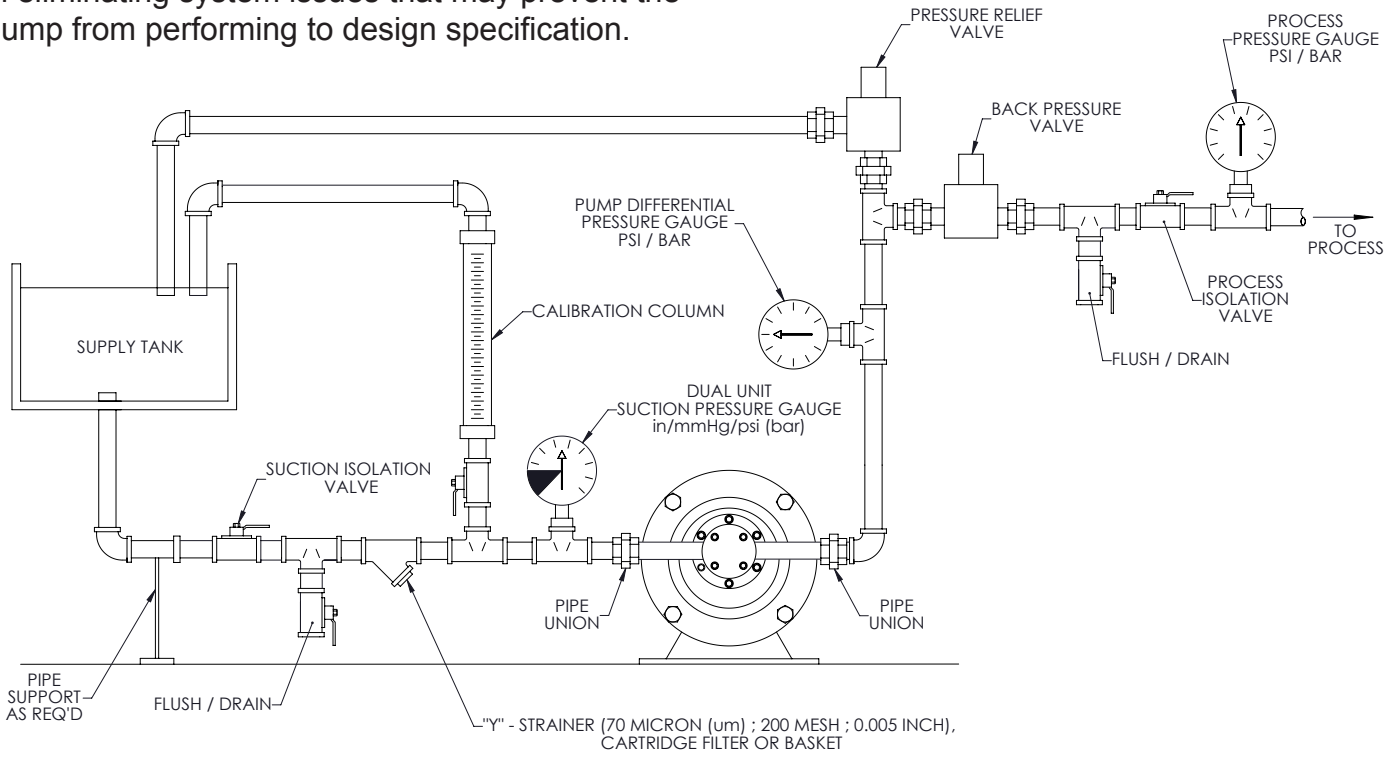
Utilizing ECO GA12 Flanged Pump to pump resin.

ISOCHEM GMC4

Canadian municipal water treatment plants rely upon Isochem to keep their water supply clean.

RECOMMENDED INSTALLATION

Accessories and instrumentation are essential in eliminating system issues that may prevent the pump from performing to design specification.



Parts & Accessories

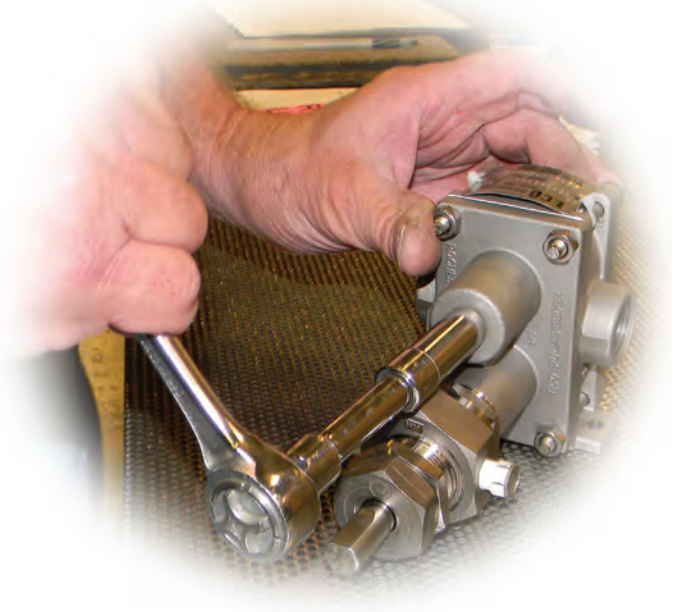
PULSAFEEDER
pulsafeeder.com
GENUINE PARTS

A **KOPkit® (Keep On Pumping)** can help you cut downtime and put you back in business fast. Use KOPkits for preventive maintenance and to ensure continuous high performance from your Pulsafeeder metering pump.

Pressure Relief Valves prevent an overpressurization situation from ever damaging your pumps or pumping system. Overpressurization can occur when a valve is closed or a blockage occurs. They are always recommended equipment for any pump or skid system.

MPC Vector
A state of the art multi-functional controller that utilizes a sensorless vector motor control technology.

Pedestals and Base Mounts help to provide proper alignment of the pump with the motor. They provide stability, strength, and assure proper positioning.



Y-Strainers arrest out debris in pipelines, protecting equipment and processes. They prevent premature wear of the rotating components within a pump.

Calibration Columns
These columns are constructed of clear PVC tubes with PVC end caps or an option for Borosilicate glass with Teflon end caps and should be sized for a 30-second draw down.

Pressure Gauges are relied on to measure pressure in the system. Proper pressure is necessary to ensure flow. Pulsafeeder Pressure Gauges are accurate and reliable.

Back Pressure Valves provide positive back pressure for systems with less than the minimum required pressure difference between the discharge and suction side of the metering pump. They assure optimum metering performance.

PULSAFEEDER
2883 Brighton Henrietta TL Rd
Rochester, NY 14623
Phone: ++1(585) 292-8000
Fax: ++1 (585) 424-5619

An IDEX Water & Wastewater Business IDEX

An ISO 9001 and ISO 14001 Certified Company

VIII
CONDENSORS AND SKID SPECIFICATION SHEETS

HEAT EXCHANGER SPECIFICATION SHEET

								Job No					
Customer	LSU AUBUDON SUGAR INSTITUTE							Reference No					
Address								Proposal No					
Plant Location	ST. GABRIEL, LA.							Date	9/7/2015	Rev	1		
Service of Unit	THIRD EFFECT VACUUM CONDENSER							Item No	E-1				
Size	*	inch	x	*	ft	Type	BEU	Connected In		Parallel		Series	
Surf/Unit (Gross/Eff)	NOTE 4	/	*	ft²	Shell/Unit	1		Surf/Shell (Gross/Eff)	*	/	*	ft²	

PERFORMANCE OF ONE UNIT

Fluid Allocation		Shell Side		Tube Side	
Fluid Name		SATURATED STEAM		WATER	
Fluid Quality, Total	lb/hr	614		*	
Vapor (In/Out)		614			
Liquid			614	*	*
Steam					
Water					
Noncondensable		8	8		
Temperature (In/Out)	F	133	133	90	100
Specific Gravity					
Viscosity, Liquid	cP				
Molecular Weight, Vapor					
Molecular Weight, Noncondensable					
Specific Heat	Btu/lb-F				
Thermal Conductivity	Btu/hr-ft-F				
Latent Heat	Btu/lb	1118			
Inlet Pressure	psia	2.4		35 MINIMUM	
Velocity	ft/sec			3 MINIMUM	
Pressure Drop, Allow/Calc	psi	0.2 / *		10 / *	
Fouling Resistance (min)		0.003 HR-SQ.FT.-DEG F/BTU		0.001 HR-SQ.FT.-DEG F/BTU	

Heat Exchanged	686,452	Btu/hr	MTD (Corrected)	*	F
Transfer Rate, Service	*		Clean	*	Btu/hr-ft²-F

CONSTRUCTION OF ONE SHELL

Sketch (Bundle/Nozzle Orientation)

			Shell Side		Tube Side	
Design/Test Pressure		psig	FV/50 / 75		100 / 150	
Design Temperature		F	300		150	
No Passes per Shell			1		2	
Corrosion Allowance		inch	0.0625		0	
Connections	In	inch	8 @	ANSI CLASS 150 RF	2 @	ANSI CLASS 150 RF
Size &	Out	inch	2 @	ANSI CLASS 150 RF	2 @	ANSI CLASS 150 RF
Rating	Vents and Drains		@		0.75 @	ANSI CLASS 150 RF

Tube No	*	OD	0.750	inch	Thk(Avg)	*	inch	Length	*	ft	Pitch	inch	Layout
Tube Type	SEAMLESS							Material	304 SS				
Shell	304 S.S	ID		OD	*	inch		Shell Cover					
Channel or Bonnet	304 S.S							Channel Cover					
Tubesheet-Stationar	YES							Tubesheet-Floating					
Floating Head Cover								Impingement Plate					

Baffles-Cross	304.S.S	Type	%Cut (Diam)	Spacing(c/c)	Inlet	inch
Baffles-Long	304.S.S		Seal Type			
Supports-Tube	304.S.S		U-Bend	Type		
Bypass Seal Arrangement			Tube-Tubesheet Joint			
Expansion Joint			Type	Bolting 304 S.S.		
Rho-V2-Inlet Nozzle			Bundle Entrance	Bundle Exit		
Gaskets-Shell Side	304 SS/TEFLON SPIRAL WOUND		Tube Side	304 SS/TEFLON SPIRAL WOUND		
-Floating Head						
Code Requirements	ASME SECTION VIII AND TEMA			TEMA Class	C	
Weight/Shell	*		Filled with Water	*	Bundle	* lb

Remarks
1. FABRICATOR SHALL CALCULATE DATA IDENTIFIED BY * AND SUBMIT FOR APPROVAL PRIOR TO FABRICATION.
2. FABRICATOR SHALL INSTALL AEROGEL INSULATION PER MANUFACTURER'S SUGGESTED THICKNESS.
3. INSULATION SHALL BE PROTECTED BY ASTM C-1729 ALUMIUM JACKETING, 0.016 IN. THICK.
4. MINIMUM SURFACE AREA SHALL BE 150 SQ.FT.

* FABRICATOR TO CALCULATE AND PROVIDE.

AMERICAN INGENUITY LLC

GAS/LIQUID SEPARATOR

REV.: 0
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. PROJ. NO.: SPEC. NO.:
BY: BDL DATE: 8/13/15 P.O. NO.: EQUIPMENT NO.: T-5
CHECKED BY: DATE: PRICE EACH $ TOTAL NO. REQ'D 1

GENERAL INFORMATION

DESCRIPTION: VACUUM PUMP LIQUID SEPARATOR MANUFACTURER/MODEL: EATON/MODEL TS (SEE DESIGN DETAIL NO. 12)
TYPE: VERTICAL VANE SEPARATOR
WIND LOAD: MFG. STD. MPH PSIG; LOCATION: ☐ INDOORS ■ OUTDOORS

PROCESS INFORMATION

GAS DATA

FLOWING FLUID: MOIST AIR MOLECULAR WEIGHT:
SPECIFIC GRAVITY: FLOWRATE: 8 LBS/HR
OPERATING PRESSURE: 2.2 PSIA OPERATING TEMP.: 133 DEG F
COMPRESSIBILITY FACTOR:

LIQUID DATA

FLOWING FLUID: ENTRAINED WATER DENSITY:
SPECIFIC GRAVITY: FLOWRATE:

PERFORMANCE DATA

REMOVAL OF: SOLIDS LIQUIDS BOTH
DESIRED REMOVAL EFFICIENCY: 99.5 % OF 10 MICRONS OR MORE
ALLOWABLE PRESSURE DROP INLET FLANGE TO OUTLET FLANGE: 0.1 PSI ACTUAL CLEAN PRESS. DROP: *

CONSTRUCTION

DESIGN PRESS.: 50 PSIG DESIGN TEMP.: 150 DEG F TOTAL WEIGHT: *
ASME CODE: SECTION VIII. DIV.1 SUPPORT TYPE: SKIRT
MINIMUM TEMPERATURE: 20 DEG F SHELL MATERIAL: CARBON STEEL
CORROSION ALLOWANCE: 0.0625 IN. INTERNAL MATERIAL: S.S.
SPECIAL SERVICE: LETHAL SERVICE NACE OTHER
RADIOGRAPHY: NONE SPOT FULL OTHER

VESSEL CONNECTIONS

QUANTITY	SERVICE	SIZE, IN.	PRESSURE RATING & TYPE	MATERIAL
1	GAS INLET	2	ANSI CLASS 150 RF FLG.	C.S
1	GAS OUTLET	2	ANSI CLASS 150 RF FLG.	C.S
1	LIQUID DRAIN	0.75	ANSI CLASS 3000 THRD. WITH 1/2" THRD. GATE VALVE	C.S
	LIQUID OUT			
2	LEVEL GAUGE	0.5	ANSI CLASS 3000 THRD.	C.S
2	LEVEL SWITCH	0.5	ANSI CLASS 3000 THRD. (PLUGGED)	C.S
	LEVEL CONTROLLER			
	PRESSURE GAUGE			
	TEMPERATURE INDICATOR			
	DIFFERENTIAL PRESSURE			
	RELIEF VALVE			
1	SIGHT GLASS	0.5	ARMORED CLEAR SIGHT GLASS INSTALLED WITH BLOCK VALVES	C.S
1	VENT	0.5	ANSI CLASS 3000 THRD. WITH 1/2" THRD. GATE VALVE	C.S

SPECIAL REQUIREMENTS

INLET ORIENTATION: SIDE TOP BOTTOM
OUTLET ORIENTATION: SIDE TOP BOTTOM
HYDROSTATIC TEST: YES NO CERTIFIED DATA: YES NO
SUPPORTS: VERTICAL SHALL BE SUPPORTED BY FOUR ANGLE LEGS WITH 18 IN. CLEARANCE FROM BOTTOM TO BASE.

* VENDOR TO SUPPLY DATA

AMERICAN INGENUITY

SKID-MOUNTED PACKAGED EQUIPMENT - GENERAL DESIGN

REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. PROJ. NO.: BDL-LSU-1 SPEC. NO.:
BY: BDL DATE: 5/10/15 P.O. NO.: EQUIPMENT NO.: SKID NO. 1
CHECKED BY: DATE: PRICE EACH $ TOTAL NO. REQ'D.: 1 SYSTEM

GENERAL

AUBUDON INSTITUTE SUGAR JUICE EVAPORATION SYSTEM

LOCATION: ■ INDOOR ☐ OUTDOOR ■ HEATED ☐ UNDER ROOF ☐ UNHEATED ■ GRADE ☐ ELEVATED

SITE DATA: ELEVATION: 0 FT. BAROMETER: 14.7 PSIA TEMP.: MIN 50 DEG F MAX 100 DEG F

RELATIVE HUMIDITY: 100 % UNUSUAL CONDITIONS: SEE ATTACHED PLOT PLAN

PURCHASER INTERFACES: INTERCONNECTING PIPING BY: ☐ PURCHASER ■ SUPPLIER EXPLAIN: TERMINATE PIPING AS SHOWN ON P&ID.

INSTRUMENTATION BY: ☐ PURCHASER ■ SUPPLIER EXPLAIN: TERMINATE INSTRUMENTATION IN NEMA 4 JUNCTION BOX.

ELECTRICAL BY: ☐ PURCHASER ■ SUPPLIER EXPLAIN: TERMINATE ELECTRICAL IN NEMA 4 JUNCTION BOX.

AVAILABLE UTILITIES: 460/3/60 VOLT ELECTRICAL. 4-20 MA HART INSTRUMENTATION. 90 DEGREE COOLING WATER.

DESIGN OF SYSTEM COMPONENTS

ALL COMPONENTS SHALL BE FURNISHED BY THE SKID DESIGNER IN ACCORDANCE WITH ATTACHED EQUIPMENT SPECIFICATION SHEETS.

PRESSURE VESSELS: DESIGN PER ASME SECTION VII, DIV, 1.

PIPING: DESIGNED PER ASME B31.3. ALL BLOCK VALVES SHALL BE FULL PORT BALL VALVES. CHECK VALVES SHALL BE SWING CHECK. 3/4" DRAIN VALVES SHALL BE REGULAR PORT BALL VALVES. GASKETS IN EVAPORATION SYSTEM SHALL BE FLEXITALLIC STYLE CGI, 304 SS WITH TEFLON FILLER.

PUMPS: POSITIVE DISPLACEMENT GEAR PUMPS WITH DISCHARGE RELIEF VALVE ON PIPING SET AT MAXIMUM PUMP CASING PRESSURE.

EXCHANGERS: DESIGNED PER ASME SECTION VIII, DIV, 1 AND TEMA C.

CONTROLS: SEE P&ID AND INDIVIDUAL INSTRUMENT SPEC SHTS. EVERY INSTRUMENT SHALL HAVE A STAINLESS STEEL TAG.

ELECTRICAL: SEE DESIGN DETAIL NO. 6.

SKID DESIGN: PAINTED CARBON STEEL SKID WITH OPEN GALVANIZED STEEL GRATING.

PAINTING: NO PAINTING UNDER INSULATED STAINLESS STEEL. ONE COAT PRIME INORGANIC ZINC UNDER INSULATED CARBON STEEL. THREE-COAT HUMID ENVIRONMENT PAINT SCHEME FOR UNINSULATED CARBON STEEL.

INSULATION: SEE DESIGN DETAIL NO. 6.

WINTERIZATION/HEAT TRACING: NONE

TESTING

FACTORY OR SITE TESTING REQUIRED: ■ NO ☐ YES ☐ FACTORY TEST ☐ PERFORMANCE TEST

POSITIVE MATERIAL IDENTIFICATION (PMI) REQUIRED: ☐ NO ■ YES

HYDROSTATIC TESTING OF PIPING REQUIRED: ☐ NO ■ YES

INSTRUMENTATION TESTING REQUIRED: ☐ NO ■ YES

ELECTRICAL TESTING REQUIRED: ☐ NO ■ YES

ADDITIONAL TESTING REQUIREMENTS: TEST SYSTEM FOR VACUUM TIME TO THIRD EFFECT OPERATING PRESSURE. FABRICATOR WILL BE REQUIRED TO SUBMIT DESIGN, OPERATING, AND MAINTENANCE INFORMATION ON EACH EQUIPMENT AND INSTRUMENT IN THE ENTIRE PACKAGE.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY

SKID-MOUNTED PACKAGED EQUIPMENT - GENERAL DESIGN

1
8/13/15

COMPAN	AUDUBON SUGAR INSTITUTE			SHEET 1 OF 1	
LOCATIO	ST. GABRIEL, LA.		PROJ. NO	BDL-LSU-1	SPEC. NO
BY:	BDL	DATE 8/13/15	P.O. NO.	EQUIPMENT NO	SKID NO. 2
CHECKED BY:		DATE	PRICE EAC	TOTAL NO. REQ	1 SYSTEM

GENERAL

AUBUDON INSTITUTE SUGAR JUICE EVAPORATION SYSTEM

LOCATION: ☐ INDOOR ■ OUTDOOR ☐ HEATED ☐ UNDER ROO ■ UNHEATED ■ GRADE ☐ ELEVATE

SITE DATA: ELEVATION: 0 FT. BAROMETER 14.7 PSIA TEMP.: MIN 25 DEG F MAX 100 DEG F

RELATIVE HUMID 100 % UNUSUAL CONDITIC SEE ATTACHED PLOT PLAN

PURCHASER INTERFACES: INTERCONNECTING PIPING BY: PURCHASER ■ SUPPLIER EXPLAIN: TERMINATE PIPING AS SHOWN ON P&ID.

INSTRUMENTATION BY: ☐ PURCHASER ■ SUPPLIER EXPLAIN: TERMINATE INSTRUMENTATION IN NEMA 4 JUNCTION BOX.

ELECTRICAL BY: ☐ PURCHASER ■ SUPPLIER EXPLAIN: TERMINATE ELECTRICAL IN NEMA 4 JUNCTION BOX.

AVAILABLE UTILITIE 460/3/60 VOLT ELECTRICAL. 4-20 MA HART INSTRUMENTATION. 90 DEGREE COOLING WATER.

DESIGN OF SYSTEM COMPONENTS

ALL COMPONENTS SHALL BE FURNISHED BY THE SKID DESIGNER IN ACCORDANCE WITH ATTACHED EQUIPMENT SPECIFICATION SHEETS.

PRESSURE VESSEI DESIGN PER ASME SECTION VII, DIV, 1.

PIPING: DESIGNED PER ASME B31.3. ALL BLOCK VALVES SHALL BE FULL PORT BALL VALVES. CHECK VALVES SHALL BE SWING CH 3/4" DRAIN VALVES SHALL BE REGULAR PORT BALL VALVES. GASKETS IN EVAPORATION SYSTEM SHALL BE FLEXITALLIC STYLE CG 304 SS WITH TEFLON FILLER.

PUMPS: VACUUM PUMP SHALL BE PER SPEC SHT. P-5.

EXCHANGERS:

CONTROLS: SEE P&ID AND INDIVIDUAL INSTRUMENT SPEC SHTS. EVERY INSTRUMENT SHALL HAVE A STAINLESS STEEL TAG.

ELECTRICAL SEE DESIGN DETAIL NO. 6.

SKID DESIGN PAINTED CARBON STEEL SKID WITH OPEN GALVANIZED STEEL GRATING.

PAINTING ALL CARBON STEEL SURFACES SHALL BE PAINTED WITH APPROPRIATE PAINT SPEC FOR HUMID LOUISIANA CLIMATE. FINISH COAT SHALL BE GREY.

INSULATION:

WINTERIZATION/HEAT TRACIN NONE

TESTING

FACTORY OR SITE TESTING REQUIR ■ NO ☐ YES ☐ FACTORY TEST ☐ PERFORMANCE TEST

POSITIVE MATERIAL IDENTIFICATION (PMI) REQUIREI ☐ NO ■ YES

HYDROSTATIC TESTING OF PIPING REQUIRED: ☐ NO ■ YES

INSTRUMENTATION TESTING REQUIREI NO ■ YES

ELECTRICAL TESTING REQUIRED: ☐ NO ■ YES

ADDITIONAL TESTING REQUIREMEN TEST SYSTEM FOR VACUUM TIME TO THIRD EFFECT OPERATING PRESSURE. FABRICATOR WILL BE REQUIRED TO SUBMIT DESIGN, OPERATING, AND MAINTENANCE INFORMATION ON EACH EQUIPMENT AND INSTRUMENT IN THE ENTIRE PACKAGE.

* VENDOR TO SUPPLY INFORMATION WITH QUOTATION

AMERICAN INGENUITY INC

VACUUM PUMP

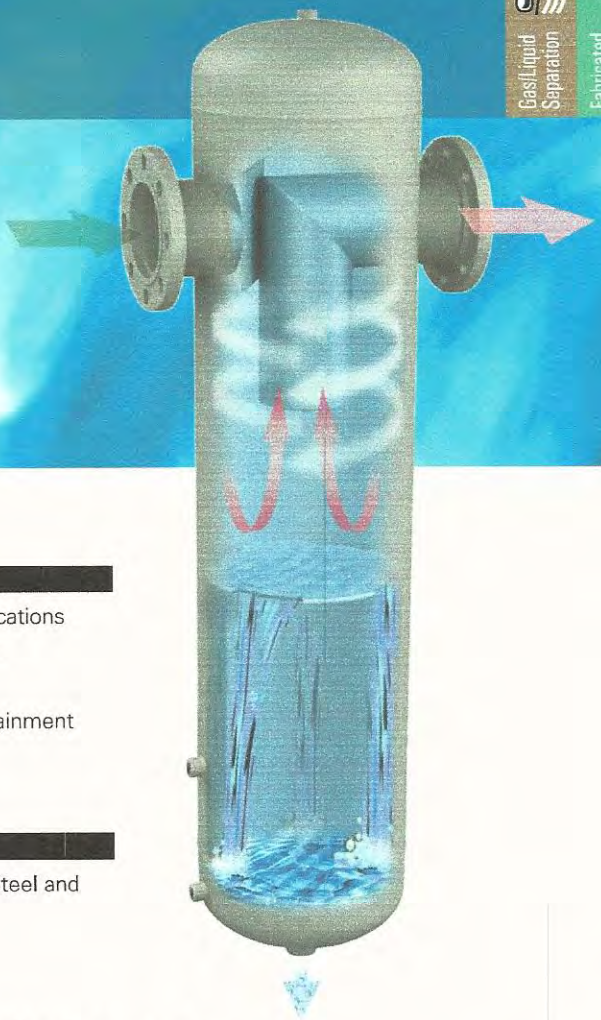
REV.: 1
DATE: 8/13/15

COMPANY: AUDUBON SUGAR INSTITUTE — SHEET 1 OF 1
LOCATION: ST. GABRIEL, LA. — PROJ. NO.: — SPEC. NO.:
BY: BDL — DATE: 6/6/15 — P.O. NO.: — EQUIPMENT NO.: P-5
CHECKED BY: — DATE: — PRICE EACH $ — TOTAL NO. REQ'D.: 1

1	**GENERAL DESCRIPTION**	**MATERIALS**
2	TYPE: DRY	PUMP: ☐ NO ■ YES — HEAT EXCHANGER: ■ NO ☐ YES
3		CASING: DUCTILE IRON — SHELL:
4	DUTY: ■ CONTINUOUS ☐ INTERMITTENT	ROTOR: MFG. STD. — TUBES:
5	LOCATION: ☐ INDOORS ■ OUTDOORS	SHAFT: MFG. STD. — CHANNEL:
6	SERVICE: VACUUM PUMP FOR EVAPORATION SYSTEM	RECEIVER: MFG. STD. — BAFFLES:
7	**PROCESS INFORMATION**	**CONSTRUCTION**
8	GAS HANDLED: MOIST AIR — MOLECULAR WEIGHT:	SUCTION CONN. SIZE: * — POSITION: *
9		DISCHARGE CONN. SIZE: * — POSITION: *
10	SUCTION PRESSURE: 2.1 PSIA	CONN. RATING: ANSI CLASS 150 — TYPE: RF FLG.
11	DISCHARGE PRESSURE: 14.7 PSIA	PACKING TYPE: MFG.'S BEST STD.
12	SUCTION TEMPERATURE: 133 °F	MECHANICAL SEAL:
13	CAPACITY: 6.5 OF AIR SFCM	
14	"k" VALUE:	BEARINGS: *
15	RELATIVE HUMIDITY: 100 %	LUBRICATION: *
16	ALTITUDE: 0 FT	
17		RECEIVER: ☐ NO ■ YES — SIZE: SEE T-5
18	SEAL FLUID:	DESIGN PRESS.: — DESIGN TEMP:
19	COMPOSITION:	CODE: — CODE STAMP: ■ NO ☐ YES
20	TEMPERATURE: °F	HEAT EXCHANGER, SIZE:
21	DENSITY: LB/CF	DESIGN PRESS.: — DESIGN TEMP:
22	VISCOSITY: CP	CODE: — CODE STAMP: ☐ NO ☐ YES
23	VAPOR PRESSURE: PSIA	**DRIVER**
24	FLOW RATE: * GPM	FURNISHED BY: ■ VENDOR ☐ OTHER
25	HEAT EXCHANGER COOLING WATER:	TYPE: AC INDUCTION NEMA PREMIUM EFICIENCY INVERTER DUTY
26	INLET TEMP.: °F	HP: * — RPM: * — ENCL.: TEFC
27	OUTLET TEMP.: °F	VOLTS: 460 — PHASE: 3 — CYCLE: 60
28	INLET PRESS.: PSIG	REF. SEVERE DUTY MOTOR DATA SHEET
29	FLOW RATE: GPM	COUPLING TYPE: * — GUARD: OSHA
30	MAX PRESS DROP: PSI	COUPLING MFG: * — MODEL:
31	**PUMP**	**OPTIONS**
32	PERFORMANCE CURVE: *	
33	RPM: * — NO. OF STAGES: 1	
34	BHP @ SERVICE CONDITIONS: *	
35	ROTATION @ DRIVER SHAFT END: *	
36	REMARKS:	
37	1. VENDOR SHALL FURNISH A COMPLETE SKID MOUNTED SYSTEM PER P&ID NO. 3.	
38	2. VENDOR SHALL INSTALL MOTOR STARTER ON SKID. NEMA 4 ENCLOSURE.	
39	3. INSTALL SS TAGS ON EQUIPMENT. 4. RECEIVER SHALL BE TAGGED T-5.	
40	4. SPEED IS CONTROLLED BY THIRD EFFECT OVERHEAD PRESSURE CONTROLLER.SEE PI&D NO. 3.	
41		
42		
43		
44	* VENDOR TO SUPPLY INFORMATION WITH QUOTATION	

Gas/Liquid Separators

Type TS
Vertical Fabricated Construction



- Custom Sizes
- Threaded, Flanged or Socket Weld
- Carbon Steel or Stainless Steel

FEATURES

- Designed for High Liquid Loading Applications
- High Efficiency Over Wide Flow Range
- No Required Maintenance
- Removes 99% of Liquid and Solid Entrainment Particles Larger Than 10 Microns
- Gas, Steam, or Air Applications

OPTIONS

- ASME UM or U Code Stamp (Carbon Steel and Stainless Steel Models)
- Support Legs

High Efficiency – No Maintenance

The Eaton Type TS Gas/Liquid Separator automatically removes 99% of all liquid and solid entrainment particles 10 microns in size or larger from air, gas, and steam processes. And it does so with no moving parts to wear out and with no required maintenance.

Applications

The Eaton Type TS Gas/Liquid Separator is designed for applications where heavier than normal liquid loading causes a "slugging" problem. These applications are widely found in refineries and chemical plants. In many cases, there is a liquid holdup requirement where instrumentation is provided for controlling the level of the liquid in the reservoir of the vessel. Some common applications include upstream of gas turbines, absorption towers, steam generator outlets and gas scrubbers.

Exclusive Design

Moisture-laden gas enters the inlet of the separator, where it is deflected in a centrifugal downward motion. The entrained solids and moisture droplets are separated out by a reduction in velocity. Separated liquid and solids fall into a reservoir where the exclusive Eaton Vortex Containment Plate (VCP) ensures that they can't be re-entrained. The clean, dry flow is then directed to the outlet by the VCP. This eliminates the need for expensive, delicate baffles used in ordinary separators.

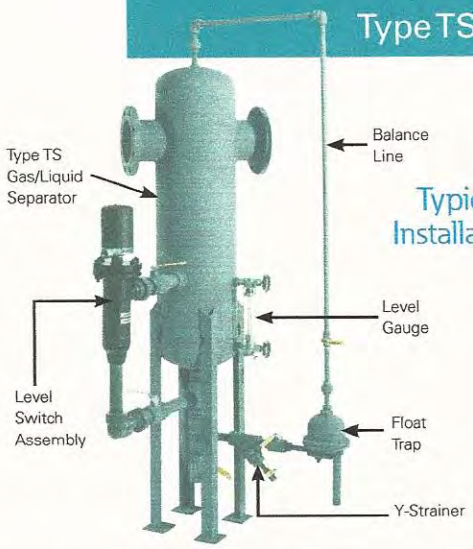
Fabricated Construction

The Type TS Separator is available in fabricated carbon steel, stainless steel, or other alloy construction with socket weld, threaded or 150 lb., 300 lb., or 600 lb. flange connections. Depending on the separator size, liquid holdup capacities range from 0.19 cu. ft. to 32.64 cu. ft., or larger should the application require. The separators can be furnished with an ASME Code Stamp as an option. Optional integral support legs can also be specified.

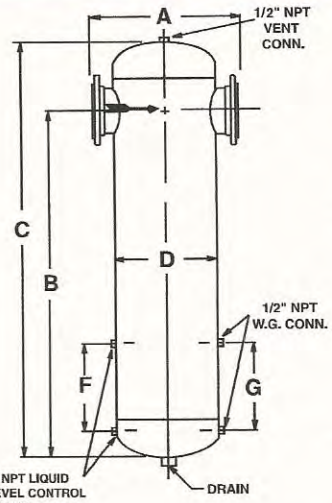
EATON

Powering Business Worldwide

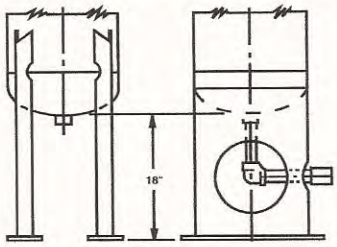
Type TS Vertical Fabricated Gas/Liquid Separators



Typical Installation



Four angle legs with base plates or skirts are optional.



Dimensions: Type TS (Carbon Steel) with ANSI Flanges (in/mm)

Pipe Size	Threaded & Skt Weld A	Flanged A	B	C	D	F	G	NPT Drain Std	NPT Drain Opt'l	Weight (lb/kg) Thd'd & Socket Weld 1000 psig @ 650 °F	Weight (lb/kg) 150 lb Flanged 150 psig @ 450 °F	Weight (lb/kg) 300 lb Flanged 500 psig @ 650 °F	Liquid Holdup Cap (cu ft/m)
1	6.87 / 174	10.5 / 267	22 / 559	28 / 711	5.56 / 141	–	7.87 / 200	1	1-½	44 / 20	47 / 21	49 / 22	0.19 / 0.0053
1-¼	6.87 / 174	10.5 / 267	22 / 559	28 / 711	5.56 / 141	–	7.87 / 200	1	1-½	45 / 20	50 / 23	52 / 24	0.19 / 0.0053
1-½	7.87 / 200	11.5 / 292	24 / 610	30 / 762	6.62 / 168	9.12 / 232	9.12 / 232	1	2	83 / 38	69 / 31	75 / 34	0.20 / 0.0056
2	7.87 / 200	11.5 / 292	24 / 610	30 / 762	6.62 / 168	9.12 / 232	9.12 / 232	1	2	85 / 39	74 / 34	78 / 36	0.20 / 0.0056
2-½	–	16 / 406	27 / 686	35 / 889	8.62 / 219	9.12 / 232	9.12 / 232	1	2	–	122 / 55	132 / 60	0.39 / 0.011
3	–	18 / 457	30 / 762	38 / 965	10.75 / 273	9.12 / 232	9.12 / 232	1-½	2-½	–	170 / 77	180 / 82	0.66 / 0.018
4	–	20 / 508	36 / 914	45 / 1143	12.75 / 324	10.25 / 260	10.25 / 260	1-½	2-½	–	225 / 102	250 / 114	1.07 / 0.03
5	–	22 / 559	40 / 1016	50 / 1270	14 / 356	10.25 / 260	10.25 / 260	1-½	2-½	–	265 / 120	335 / 152	1.35 / 0.04
6	–	24 / 610	55 / 1397	66 / 1676	16 / 406	10.25 / 260	10.25 / 260	1-½	2-½	–	400 / 182	435 / 198	3.03 / 0.084
8	–	28 / 711	62 / 1575	75 / 1905	18 / 457	11.87 / 301	11.87 / 301	2	3	–	545 / 248	700 / 318	3.83 / 0.107
10	–	34 / 864	76 / 1930	91 / 2311	24 / 610	11.87 / 301	11.87 / 301	2	3	–	800 / 364	1355 / 616	6.94 / 0.194
12	–	38 / 965	82 / 2083	99 / 2515	28 / 711	11.87 / 301	11.87 / 301	2-½	4*	–	1090 / 495	1735 / 789	11.74 / 0.33
14	–	42 / 1067	89 / 2261	108 / 2743	32 / 813	12.62 / 321	12.62 / 321	2-½	4*	–	1335 / 607	2535 / 1152	16.81 / 0.47
16	–	47 / 1194	98 / 2489	119 / 3023	36 / 914	12.62 / 321	12.62 / 321	3	5*	–	1850 / 841	3200 / 1455	20.22 / 0.57
18	–	54 / 1372	108 / 2743	132 / 3353	42 / 1067	12.62 / 321	12.62 / 321	3	5*	–	2600 / 1182	5025 / 2284	22.99 / 0.64
20	–	62 / 1575	118 / 2997	145 / 3683	48 / 1219	15 / 381	15 / 381	3	5*	–	3275 / 3275	6480 / 2945	26.47 / 0.74
22	–	64 / 1626	121 / 3073	149 / 3785	48 / 1219	15 / 381	15 / 381	3	5*	–	3450 / 1568	7000 / 3182	26.47 / 0.74
24	–	70 / 1778	127 / 3226	158 / 4013	54 / 1372	15 / 381	15 / 381	4*	6*	–	4940 / 2245	9020 / 4100	32.64 / 0.91

* Flanged drain

Note: Type TS Separators are of welded steel construction in accordance with ASME code for unfired pressure vessels. Available in stainless steel on request. Inlet and outlet connections can be rotated radially, if specified

North America — HQ
70 Wood Avenue, South
2nd Floor
Iselin, NJ 08830

Toll Free: (800) 656-3344
(North America only)

Voice: (732) 767-4200

Brazil
Voice: +55 (11) 2465-8822

China
Voice: +86-21-5200-0099

Europe/Africa/Middle East
Voice: +49-2486-809-0

Singapore
Voice: +65-6825-1668

For more information, e-mail us at filtration@eaton.com, or call 732-767-4200.

Visit us online at eaton.com/filtration for a complete list of Eaton's filtration products.

EATON
Powering Business Worldwide

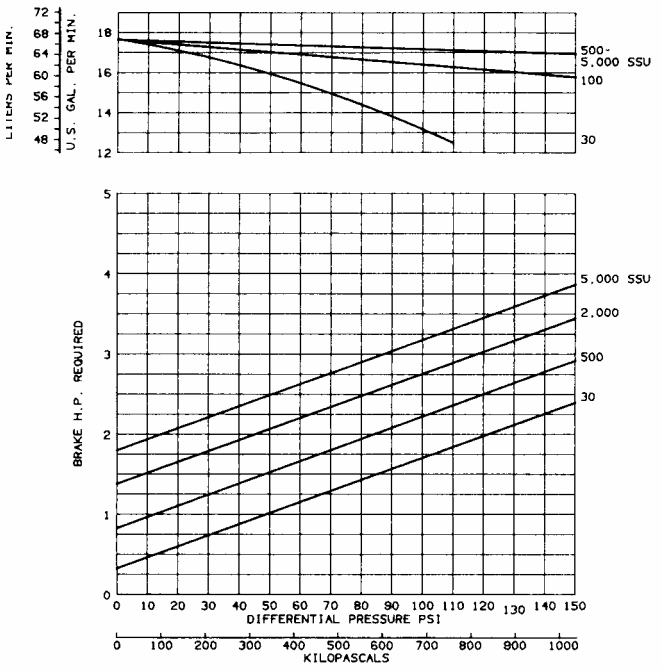
EF-G/L-4
6-2012

IX
PUMP & MOTOR CURVES AND SPECIFICATIONS

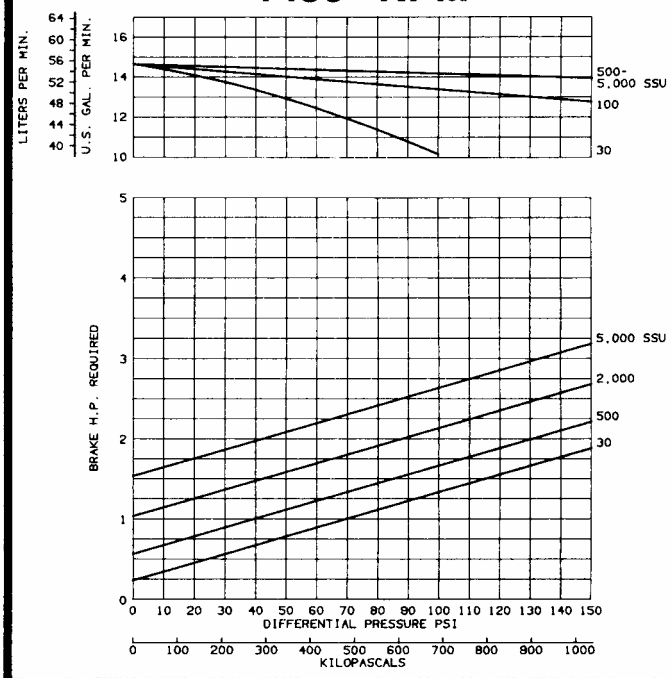
CHARACTERISTIC CURVES
Models: XRL1.25, XRLF1.25

Page Number	107-021
Effective	Dec 2007
Replaces	Oct 2001
Section	107

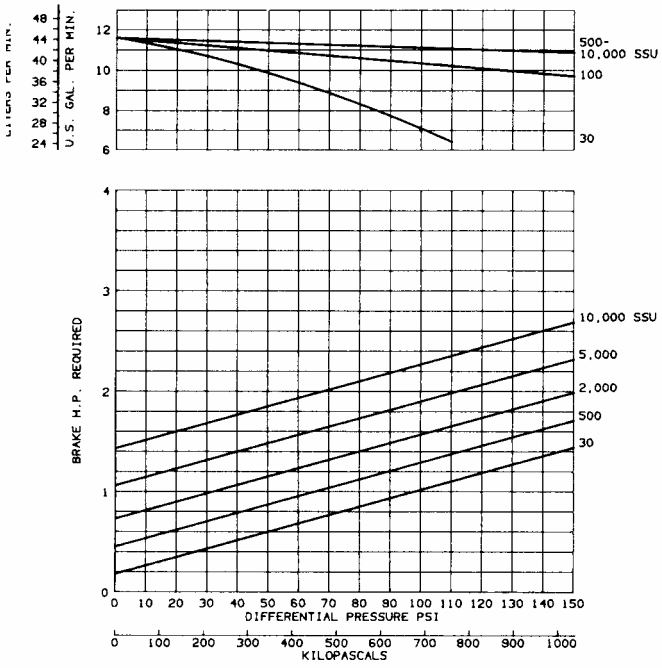
1750 RPM



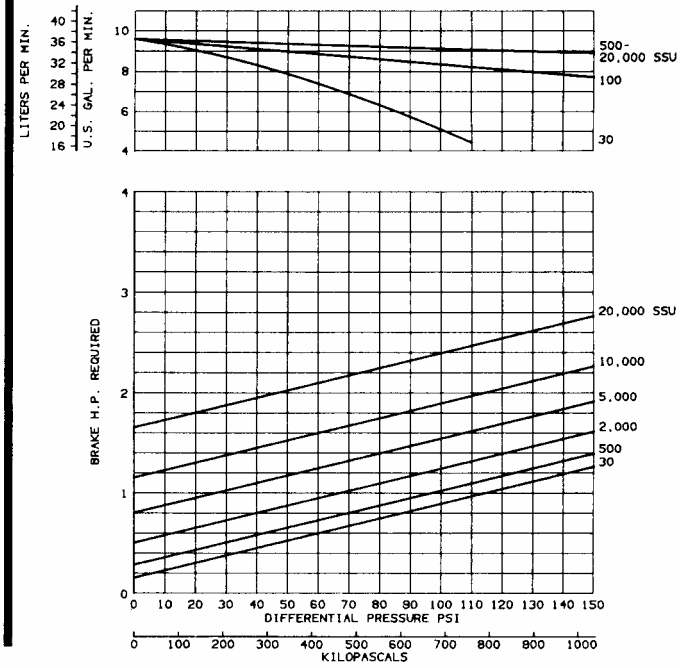
1450 RPM



1150 RPM



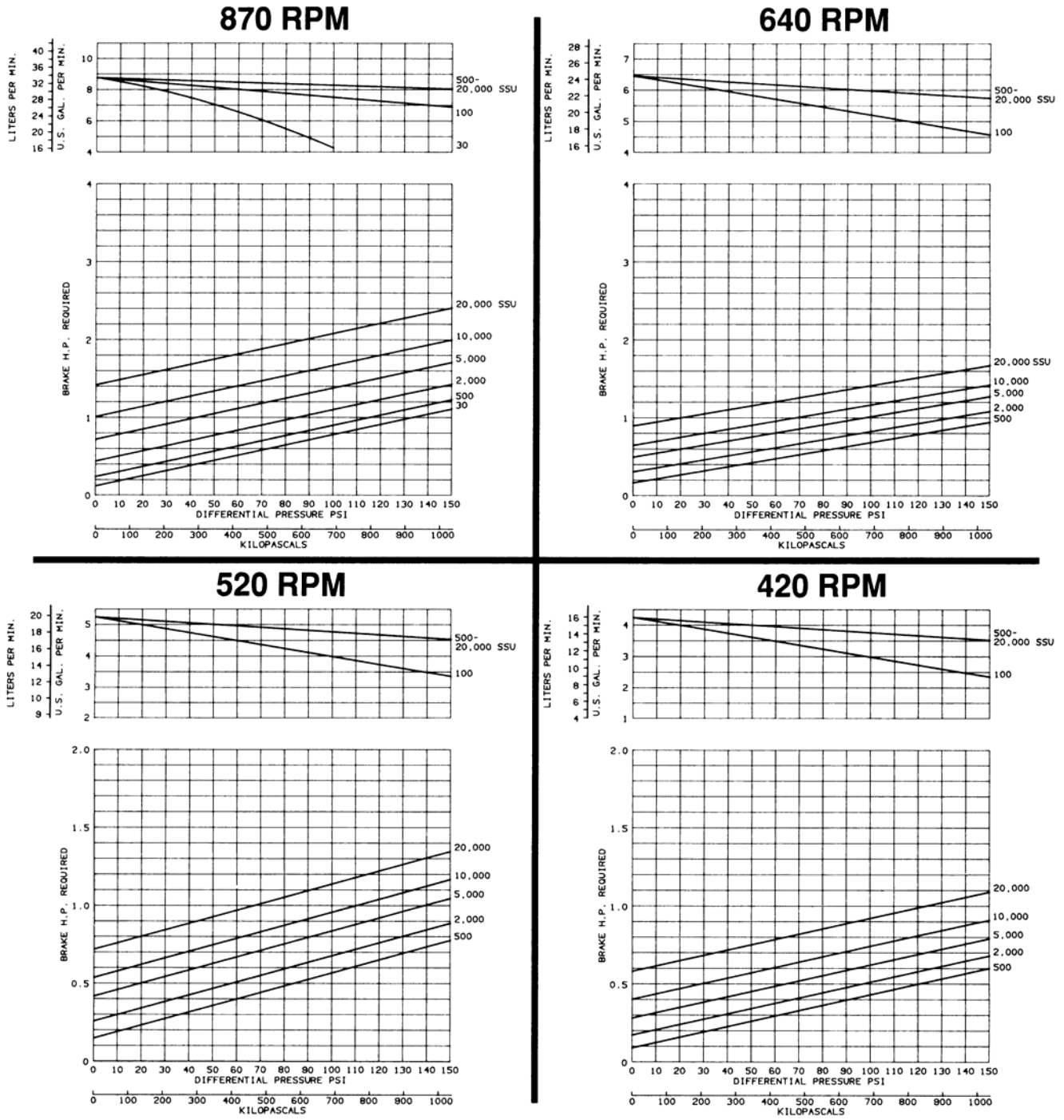
950 RPM



NOTE: Blackmer Characteristic Curves are based on Brake Horsepower (bhp). To determine Motor Horsepower, drive train inefficiencies must be added to the bhp.

Actual capacities are dependent upon the vapor pressure of the liquid and the inlet conditions of the system.

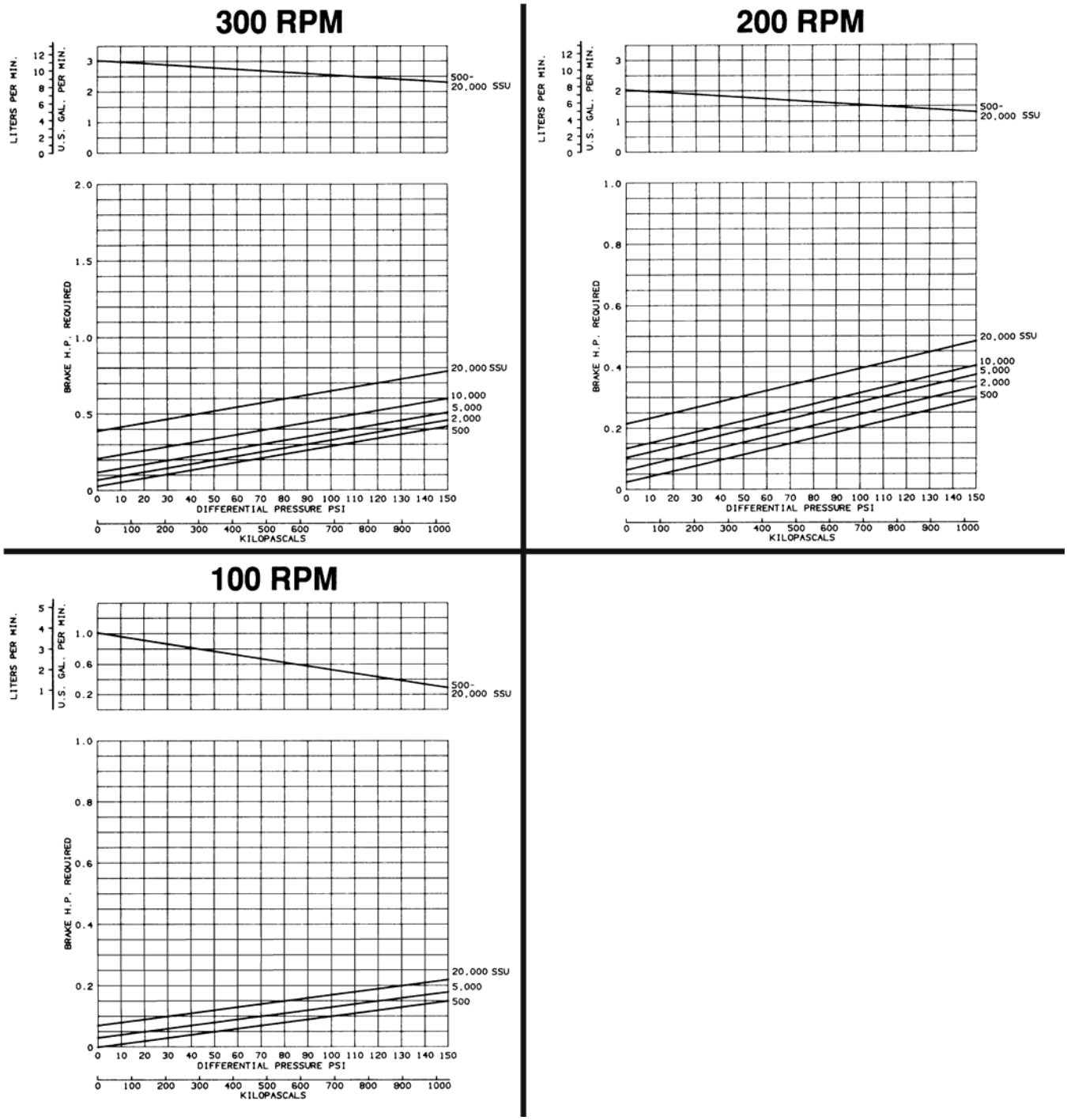
CHARACTERISTIC CURVES
Models: XRL1.25, XRLF1.25



NOTE: Blackmer Characteristic Curves are based on Brake Horsepower (bhp). To determine Motor Horsepower, drive train inefficiencies must be added to the bhp.

Actual capacities are dependent upon the vapor pressure of the liquid and the inlet conditions of the system.

CHARACTERISTIC CURVES
Models: XRL1.25, XRLF1.25



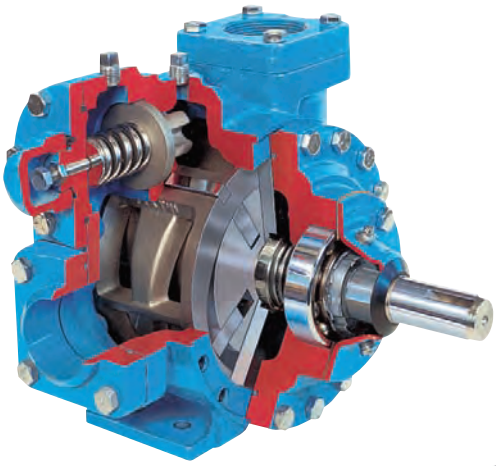
NOTE: Blackmer Characteristic Curves are based on Brake Horsepower (bhp). To determine Motor Horsepower, drive train inefficiencies must be added to the bhp.

Actual capacities are dependent upon the vapor pressure of the liquid and the inlet conditions of the system.

Section: 107
Effective: January 2014
Replaces: June 2005

XL Series
Shock-Resistant, Ductile Iron Pumps

X(R)L1.25, XL1.5-DM



XL cutaway

X(R)L1.25, XL1.5 cutaway

X(R)LF1.25, XLF1.5

XL3-HR

Design Features

The XL pumps are constructed of ductile iron (ASTM 536) that will withstand sudden thermal shock and stress well beyond the capabilities of cast iron. All models are fitted with replaceable casing liners and end discs that allow easy rebuilding of the pump, without removing the pump from the piping.

Models are available in 1.25, 1.5, 2, 3 and 4-inch port sizes with capacities from 5 to 345 gpm (19 to 1,305 L/min). The 1.25 and 1.5-inch models have NPT tapped ports. The 2, 3 and 4-inch models have flanged ports.

Standard elastomers include FKM O-rings. Optional Buna-N or PTFE elastomers are available. A wide range of mechanical seal components and a variety of vane materials are optional.

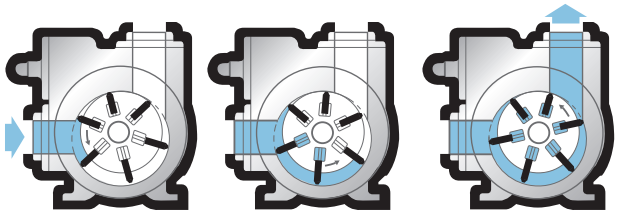
The X(R)L1.25 and XL1.5 motor speed pumps are base mounted. The X(R)LF1.25 and XLF1.5 models are fitted with an integral bracket for direct mounting to a NEMA C-face motor. Base mounted unit assemblies with helical gear reduction drive are available for all XL models.

Application

Blackmer XL type pumps are commonly used in refineries, lube oil plants and general industry for processing, filling and transfer applications.

Benefits

Utilizing Blackmer's unique sliding vane designs, these positive displacement rotary pumps offer the best combined characteristics of sustained high level performance, energy efficiency, trouble-free operation and low maintenance cost.



How Blackmer's sliding vane action works

XL Series
Shock-Resistant, Ductile Iron Pumps

Pump Performance Data*

	Pump Model																							
	XRL1.25 XRLF1.25				XL1.25 XLF1.25				XL1.5 XLF1.5				XL2				XL3				XL4			
Speed (RPM)	1800	1500	1200	1000	1800	1500	1200	1000	1800	1500	1200	1000	780	640	520	420	780	640	520	420	640	520	420	350
U.S. GPM	17	14	11	9	23	19	15	12	34	28	22	18	88	72	57	47	183	149	120	95	344	280	225	187
L/min	64	53	42	34	87	72	57	45	129	106	83	68	333	273	216	178	693	564	455	360	1303	1061	852	708
HP	1.2	0.9	0.8	0.6	1.4	1.1	0.9	0.7	1.8	1.6	1.2	0.8	4.0	3.2	2.5	1.9	8.0	6.3	5.0	3.9	15.0	11.1	8.3	6.5

* Approximate capacities and horsepower (HP) are based upon a 100 ssu (22 cSt) liquid at 50 PSI (3.45 bar) differential pressure. Refer to characteristic curves for capacities and horsepower at other pressures and viscosities.

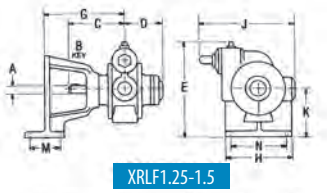
Maximum Operating Limits

Pump Model	Nominal Flowrate		Pump Speed	Viscosity		Differential Pressure		Working Pressure		Temperature	
	gpm	L/min	rpm	ssu	cSt	psi	bar	psi	bar	°F	°C
XRL(F)1.25	17	64	1800	50,000	10,625	150	10.3	350	24.1	300	148
XL(F)1.25	23	87	1800	30,000	6,375	150	10.3	350	24.1	300	148
XL(F)1.5	35	132	1800	20,000	4,250	150	10.3	350	24.1	300	148
XL2	95	359	780	75,000	15,750	150	10.3	350	24.1	300	148
XL3	192	726	780	75,000	15,750	150	10.3	350	24.1	300	148
XL4	345	1306	640	60,000	12,600	150	10.3	350	24.1	300	148

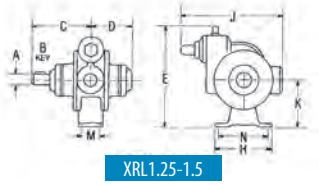
For applications that require higher capacities, please refer to Blackmer Spec Sheets 102-001 and 106-001 for the HXL and ML4 pump series.
Note: Optional materials of construction may be required to meet specific application requirements – refer to Blackmer Material Specification Sheets.
For operating conditions that exceed those listed, consult factory.

Companion Flanges

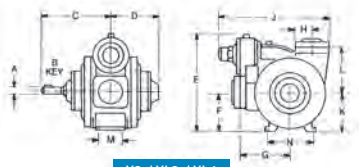
Pump Model	Standard	Optional
XRL1.25 XL1.25 XRLF1.25 XLF1.25	1¼" NPT Tapped Ports	–
XL1.5 XLF1.5	1½" NPT Tapped Ports	–
XL2	2" NPT	2" Weld 2" ANSI 150#
XL3	3" NPT	3" Weld 3" ANSI 150#
XL4	4" Weld	3" NPT



XRLF1.25-1.5



XRL1.25-1.5



X2 / XL3 / XL4

Dimensions

Pump Model		A	B	C	D	E	G	H	J	K	M	N	Approximate Wt. Less Motor
XRLF1.25 XLF1.25 XLF1.5	in.	7/8	3/16	5 1/2	3 7/8	8 7/8	8 1/16	6 5/8	9 1/8	4 1/2	2 3/8	5 1/4	39 lb
	mm	–	–	140	98	225	205	168	232	114	60	133	18 kg

Pump Model		A	B	C	D	E	G	H	J	K	M	N	Approximate Wt. Less Motor
XRL1.25 XL1.25 XL1.5	in.	7/8	3/16	5 1/2	3 7/8	8 7/8	–	5 1/2	9 1/8	4 1/2	1 3/8	4	30 lb
	mm	–	–	140	98	225	–	140	232	114	35	102	14 kg

Pump Model		A	B	C	D	E	F	G	H	J	K	L	M	N	Approximate Wt. Less Motor
XL2	in.	1 1/8	1/4	8	5 7/16	10	3 3/4	4 13/16	2 3/8	11 1/16	4	4 7/8	1 5/8	5	85 lb
	mm	–	–	203	138	254	95	122	60	281	102	124	41	127	39 kg
XL3	in.	1 1/8	1/4	9 5/8	6 5/16	13 3/8	5 3/8	7	3 1/8	15 1/16	5 3/8	6 5/16	2 1/2	6	160 lb
	mm	–	–	245	160	340	137	178	79	383	137	160	64	152	73 kg
XL4	in.	1 1/4	5/16	9 5/8	6 3/4	15 7/16	4 7/8	6 5/8	2 5/8	16 15/16	5 13/16	7 1/2	2 1/2	8 1/4	205 lb
	mm	–	–	245	172	392	124	168	67	430	151	190	64	210	93 kg

Sales Information and Equipment Application Assistance

Blackmer has a world-wide distribution network to assist you in specifying any of our family of pumps, compressors and other equipment for your application. For more information or to find the distributor nearest you, please contact us at the telephone, fax or internet address listed below.

Distributed By:

Printed in USA

PSG PUMP SOLUTIONS GROUP A DOVER COMPANY

Blackmer Part of Pump Solutions Group A DOVER COMPANY

Process | Energy | Military & Marine

World Headquarters
1809 Century Avenue SW, Grand Rapids, MI 49503-1530 USA
T 616.241.1611 F 616.241.3752 www.blackmer.com

CERTIFIED DRAWING BY PULSAFEEDER
A Unit of IDEX Corporation

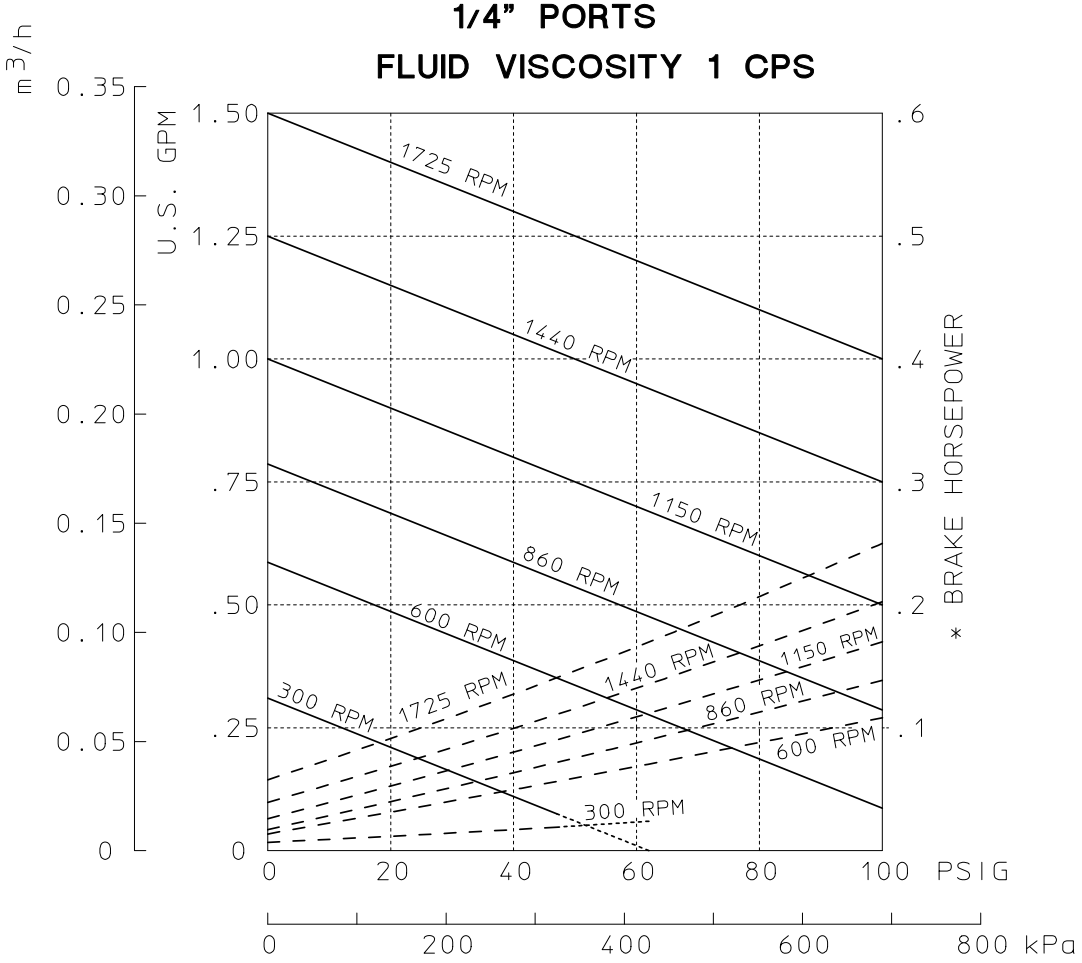
FOR: _____ SERIAL NO.: _____

CUSTOMER P.O. NO: _____ SERIAL NO.: _____

ITEM: GA/GC 2 DATED: _____ BY: _____ PULSA. ORDER NO.: _____

TAGGING: _____

GA/GC2 GEARCHEM PUMP
1/4" PORTS
FLUID VISCOSITY 1 CPS



* BRAKE HORSEPOWER SHOWN AS DASHED CURVES

			SECTION/PAGE	C/G2 / 2601	ECO / PULSAFEEDER A Unit of IDEX Corporation
			EFFECTIVE	08/15/13	PERFORMANCE CURVE GA / GC2
A	UPDATED DRAWING	08/15/13			
REF	REVISION UPDATE	DATE	SUPERSEDES	12/01/97	DWN BY: PTP
					DATE: 02/11/98
					AE00054-001

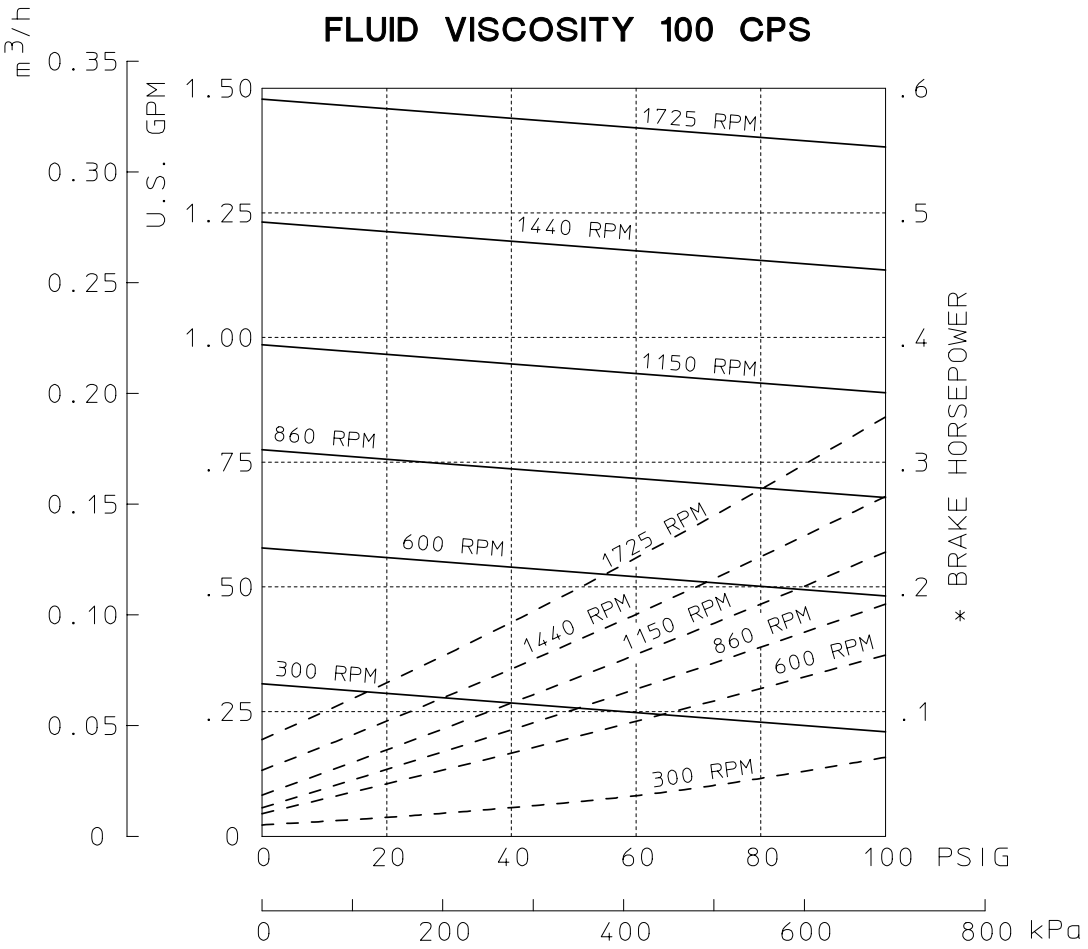
FOR: _____ SERIAL NO.: _____

CUSTOMER P.O. NO: _____ SERIAL NO.: _____

ITEM: G/GA/GC 2 DATED: _____ BY: _____ PULSA. ORDER NO.: _____

TAGGING: _____

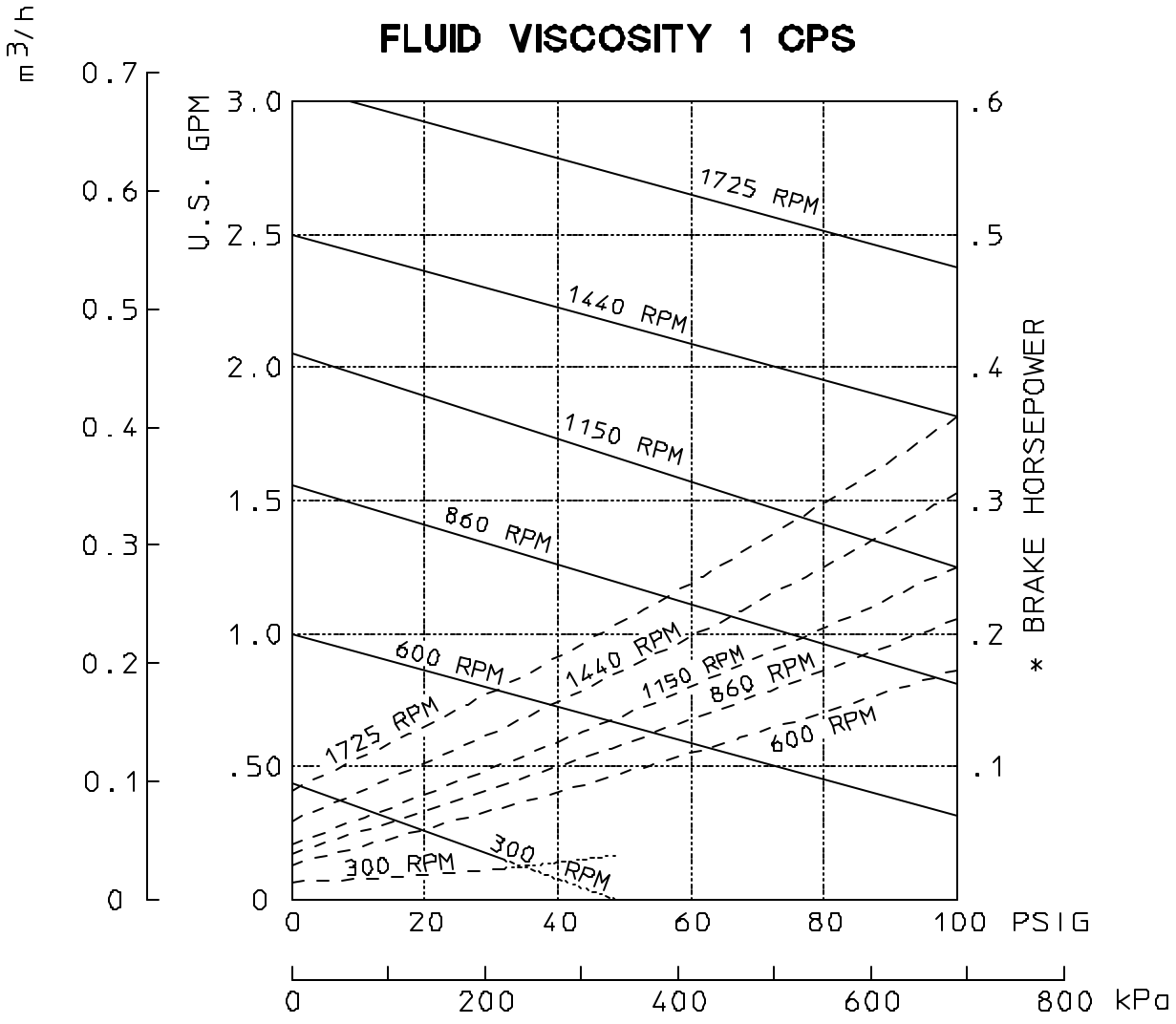
G/GA/GC2 GEARCHEM PUMP
1/4" PORTS
FLUID VISCOSITY 100 CPS



* BRAKE HORSEPOWER SHOWN AS DASHED CURVES

A			SECTION/PAGE	C/G2 / 2602	ECO PULSAFEEDER A Unit of IDEX Corporation
REF	REVISION UPDATE	DATE	EFFECTIVE	12/01/97	PERFORMANCE CURVE G / GA / GC2
			SUPERSEDES	12/01/88	DWN BY: PTP DATE: 02/11/98 AE00054-002

G/GA/GC4 GEARCHEM PUMP
1/2" PORTS
FLUID VISCOSITY 1 CPS



* BRAKE HORSEPOWER SHOWN AS DASHED CURVES

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A			SUPERSEDES	05/10/74	DWN BY PTP
REF	REVISION UPDATE	DATE			DATE: 02/11/98
					AE00055-001

PULSAFEEDER®
An IDEX Water & Wastewater Business

pulsafeeder.com

The Gearchem pumps are designed for continuous on duty use. They are constructed out of the strongest material available to provide superior chemical resistance and assure long life. Designed to handle a variety of process liquids including liquefied gasses, the G2, GA2, and GC2 can handle highly viscous fluids to very thin, clear, non-abrasive fluids. Typically employed to transfer fluids they are equally advantageous in metering fluids because of their consistency.

Key Features

- Gearchem pumps offer laminar flows for consistent, continuous and measurable transfer of liquids.
- Fully inline serviceable. Do not need to disconnect from piping.
- Self-priming and bi-directional
- Closed running and operating clearance evacuate air from the suction piping
- Can handle clear lubricating and non-lubricating fluids including hydrocarbons and polymers
- Variety of gears available and easily convertible to satisfy different service conditions
- All gear materials are non-sparking for use with hazardous fluids
- Internal sleeve type bearings are lubricated by process fluid eliminating the need for periodic lubrication maintenance and prevents contamination of external lubrication materials
- Three types of seals and two packing arrangements available

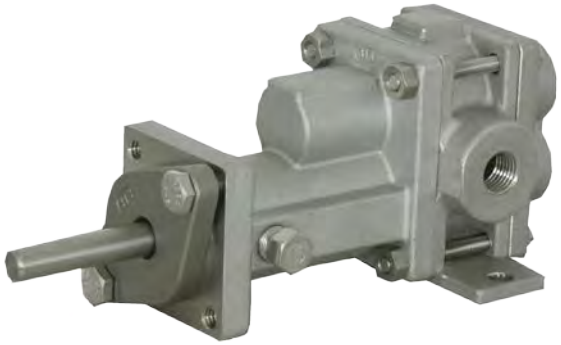
Control Options

MPC Vector

- The MPC VECTOR is an advanced pump controller that is physically separated from the pump's enclosure. Its purpose is to precisely adjust output flow of a process media by means of pump motor speed control, and is designed for a wide variety of control applications.

Operating Benefits

- Simplified maintenance due to quick disassembly
- Do not require periodic lubrication, since the pumped fluid provides the necessary lubrication and cooling.
- Possibility of contamination of pumped fluid is eliminated
- Bi-directional for easy installation
- Dual purposed: can be used as either a transfer pump or a metering pump
- Handles a variety of fluids and viscosities
- Has superior chemical resistance



Aftermarket & Accessory Offerings

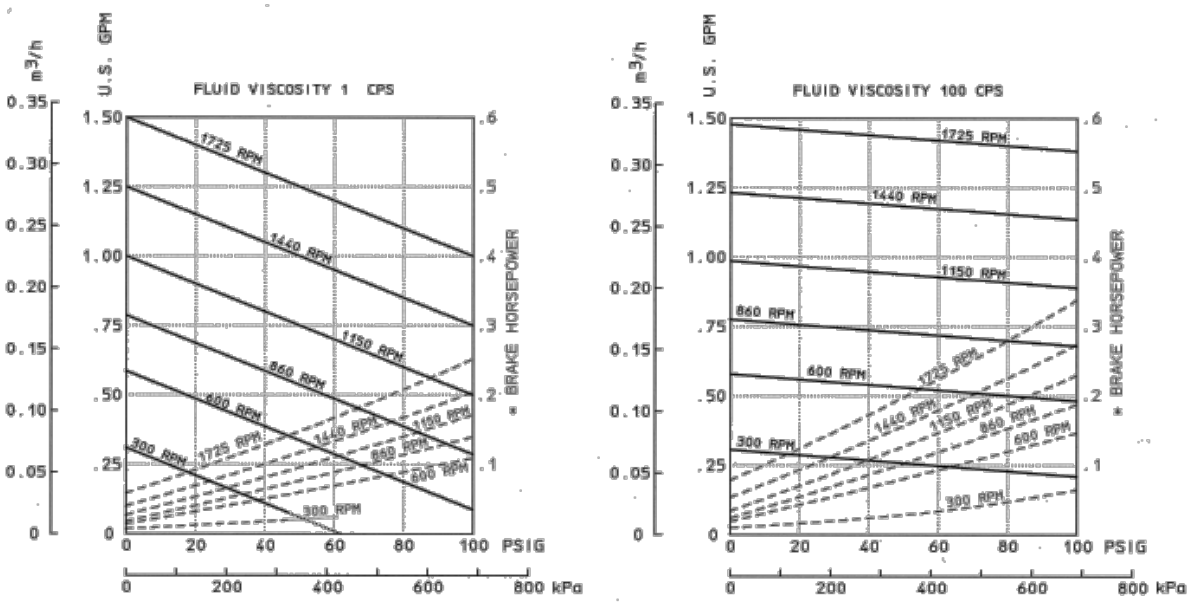
- KOPkit®
- Bolt-on Heating/Cooling jackets
- Pressure Relief Valves
- Back Pressure Diaphragm Valves
- Base-Mounted Units
- Close-Coupled Units

ECO Gearchem® Series 2

External Spur Gear Pump

ECO Gearchem® Series 2

Typical Performance



Engineering Data

Casing/Housings: 316SSL, 316 SS, Alloy C, Alloy 20

Drive/Idler Gears: 316SSL, 316 SS, Alloy C, Alloy 20

Shafts: 316SSL, 316 SS, Alloy C, Alloy 20

Bearings: Carbon 72, Carbon 92, Glass-filled PTFE, Silicon Carbide

Bearing Type: Internal Sleeve

Wearplate: Carbon 72

Bearing Lubrication: By pumped fluid

Packing Arrangements: Standard or lantern ring

Mechanical Seals: Single internal or double seals to 175 psi. Single external seal to 50 psi.

Port Size and Type: .25" NPT or BSPT, .5" 150# ANSI Flange

Direction of Rotation: Bi-directional

Theoretical Displacement: .108 gal/100 rev (4.10cc/rev)

Drive Shaft Diameter: 0.375"

Maximum Allowable Working Pressure: 200 psig

Maximum Differential Pressure: 175 psi (12 bar)

Minimum System Pressure: .1mm Hg (abs)

Maximum Speed: 1725 rpm

Maximum Viscosity: 100,000 cPS

Maximum Fluid Temperature: 450°F (232°C)

Minimum Fluid Temperature: -100°F (-73°C)

Fluid pH range: 0-14

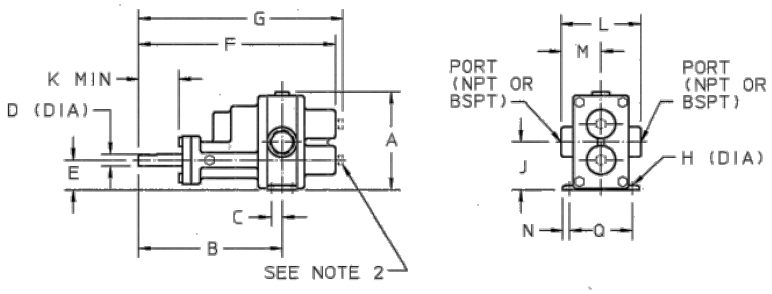
Approximate Weight: 4.2 lbs. (1.9kg) pump only

Custom Engineered Designs

- Bearing flush plugs
- Housing vent port
- Bolt-on Heating/cooling jackets
- Pressure relief valves
- Backpressure valves

Dimensions

Model	Ports	A	B	C	D	E	F	G	H	J	K MIN	L	M	N	O
GA2	25	2.88	5.7	--	38	0.88	7.32	7.63	0.29	1.38	1.07	2.88	1.44	0.25	3
		73.0	144.8	--	9.5	22.2	185.9	193.7	7.4	34.9	27.2	73	36.5	6.4	76.2



NOTES: 1. SUCTION AND DISCHARGE PORTS ARE DEPENDENT UPON ROTATION.
2. BEARING FLUSH PLUGS (.12 N.P.T.) ARE OPTIONAL.
3. ALL DIMENSIONS ARE IN INCHES.

PULSAFEEDER
2883 Brighton Henrietta Townline Road
Rochester, NY 14623
Phone: ++1 (585) 292-8000
Fax: ++1 (585) 424-5619

IDEX CORPORATION

An ISO 9001 and ISO 14001 Certified Company