U Series Non-Contact Ultrasonic Transmitters

Form 1035

The SOR Ultrasonic Transmitter - ULT -

is a proven solution offering more flexibility and reliability than similar transmitters. With unique features, such as state-of-the-art programming, adaptive gain and a very powerful transmit pulse, it provides consistent operation under conditions where other ultrasonics fail.

Features and Benefits

- **Powerful transmitted pulse for greater flexibility**
- **Low frequency sound for superior penetration in tough conditions**
- **Automatic adaptive gain continually adjusts to process conditions**
- **Superior application flexibility – dust, foam, steam, fog and condensation are automatically compensated for**

Technology Comparison

The ULT is unmatched in tough conditions where level measurement is critical. The following chart shows how the ULT matches up against other level transmitters.

	ULT	Other Ultrasonics	Radar	RF Capacitance	Differential Pressure	Laser
Easily selected for liquids, slurries or solids	A	B	B	C	X	A
Changing dielectric constant	A	A	B	X	A	A
Changing specific gravity	A	A	A	A	X	A
Dusty atmospheres	A	C	C	A	X	C
Water vapor (steam, fog, condensation, etc.)	A	C	C	A	A	X
Long Measuring ranges (over 100 feet)	A	B	B	C	C	A
Poor surface conditions (foam, etc.)	A	C	A	B	B	X
High Turbulence	A	B	B	C	A	B
Vessel Intursions	A	B	B	B	A	A

A = Excellent B = Average C = Poor X = Not Recommended

Theory of Operation

The ULT uses pulses of sound to determine the distance to a target. It measures the time for the sound pulse to travel to the target and return as an echo. The distance can be calculated using the measured time and speed of sound in the atmosphere of the vessel.

Any condition that affects the size of echo, creates false echoes or alters the speed of sound can cause problems with this process. In industrial applications there are many of these situations. The following pages show how the ULT handles these issues, where it can be used successfully and what to avoid.

Features of the ULT

There are three main features of the ULT that allow it to outperform other level transmitters – high power signal, low frequency sound and adaptive gain control.

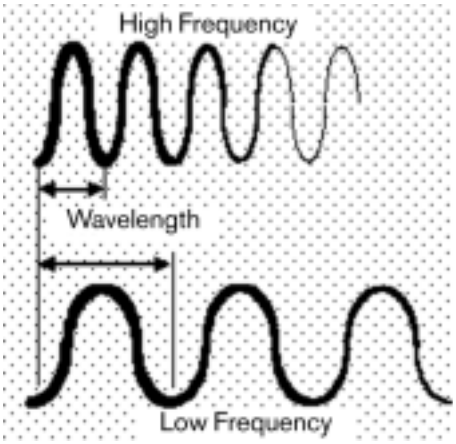
High Power

The ULT produces the most intense sound pulse of all ultrasonic transmitters available. When conditions like dust or foam absorb sound it makes sense to use as much energy as possible. This is a "bigger hammer" approach – when trying to get through a tough barrier, hit it with a bigger hammer! This chart illustrates how the ULT's sound energy compares to some other common sounds.

Sound Source	Energy
Space Shuttle Launch	180 dB
Jet Engine at Takeoff	140
ULT Transmitter	138
Jackhammer	105
Normal Conversation	60

Low Frequency

Airborne particles absorb sound each time it hits them. High frequency sound has a shorter wavelength, so it must travel farther to go the same linear distance. Therefore it hits more particles and loses more energy the farther it travels into a process vessel.



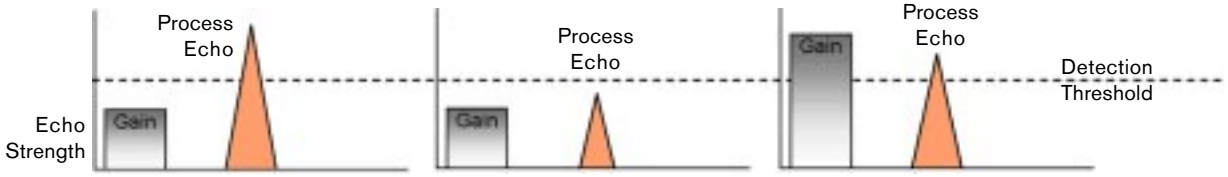
This example shows high and low frequency sound traveling through dust. High frequency hits more dust particles and loses energy more quickly. This is why foghorns on ships have such low frequency, so the sound will travel farther through the water particles in fog. This is also why the ULT uses lower frequency sound, to provide better penetration through dust, steam and fog.

Adaptive Gain Control

High power and low frequency may not be enough to ensure proper level detection in tough processes. If a device is not sensitive enough it will not detect the returned echo, and if it is too sensitive then problems can occur when conditions improve. The ULT addresses this through the use of adaptive gain control.

The sensitivity of sound devices is called gain. The ULT monitors application conditions through the size of echo returned from the process. If the echo gets too small, the ULT increases its gain. If the echo gets too large, it decreases its gain. In effect, the ULT monitors process conditions and adapts its sensitivity accordingly.

Example: Silo filling with a dusty material.



Silo is not filling, no dust present, strong echo from process.

Silo starts filling, much dust present, echo size is reduced as dust absorbs sound.

ULT adaptive gain feature increases gain and echo size is increased while dust is still present.

Applications to Look For

The ULT is suitable for many applications found in industrial settings. The features previously discussed allow this product to perform in many difficult applications. These same features make the ULT more reliable than other transmitters in common applications. Some samples of applications where the ULT excels are given here.

Powder and Bulk Solids

The ULT has been successfully used in a wide variety of bulk solids applications. It is routinely used to measure dusty and clean solids, large and small particle sizes, and extremely long ranges. Some common solids applications where it has been successful are:

- Power – fly ash, coal, limestone
- Food – whole kernel grains, various meals, flour, sugar, etc.
- Cement – powdered cement, fly ash, limestone, clinkers
- Manufacturing – soda ash, sand, carbon black, bauxite, etc.
- Pulp & Paper – bentonite, wood chips, fines, etc.

Liquids/Slurries

Many industrial liquids applications have steam, fog and/or condensation present. The ULT performs excellent in liquid applications where the atmosphere gases will not be changing in composition (see below for details). Some typical applications where the ULT offers unique advantages are:

- Power – cooling towers, waste ponds for geothermal plants, sump pits, lime slurries, etc.
- Food – mixture/cooking vessels, alcohol storage, waste oil pits, batching slurries, etc.
- Manufacturing – liquid latex, effluent, machine coolant, etc.
- Oil and Gas – crude oil sumps, water reclamation tanks, fuel storage, etc.
- Water/Wastewater – chemical storage, digesters, sediment ponds, etc.

These are just a sample of the successful applications the ULT has done. If you want to know if the ULT can handle your application, fill out the worksheets on pages 14 and 15 of this catalog and forward them to either you local SOR representative or the factory.

Applications to Avoid

As with any technology, the ULT is not a perfect fit for all applications. Below are some types of applications where any ultrasonic transmitter, including the ULT, should not be used:

- Sealed tanks where the atmospheric gases are either layered or changing in composition – this changes the speed of sound in the tank and will cause erroneous readings
- Very high pressure and/or temperature vessels – both pressure and temperature have a pronounced effect on sound waves, the listed specifications for ultrasonics should always be observed
- Solids applications where the angle of repose (angle of the side of the pile of material) is greater than 45° - in applications with large chunks of material (1", 25mm or greater) the ULT can do this, but in smaller sizes the sound is actually reflected away from the instrument

We recognize that some applications that fall into these categories may have unique properties that allow the ULT to operate. If you think ultrasonics may work despite the conditions listed above, fill out the worksheets on pages 14 and 15 of this catalog and forward them to either your local SOR representative or the factory.

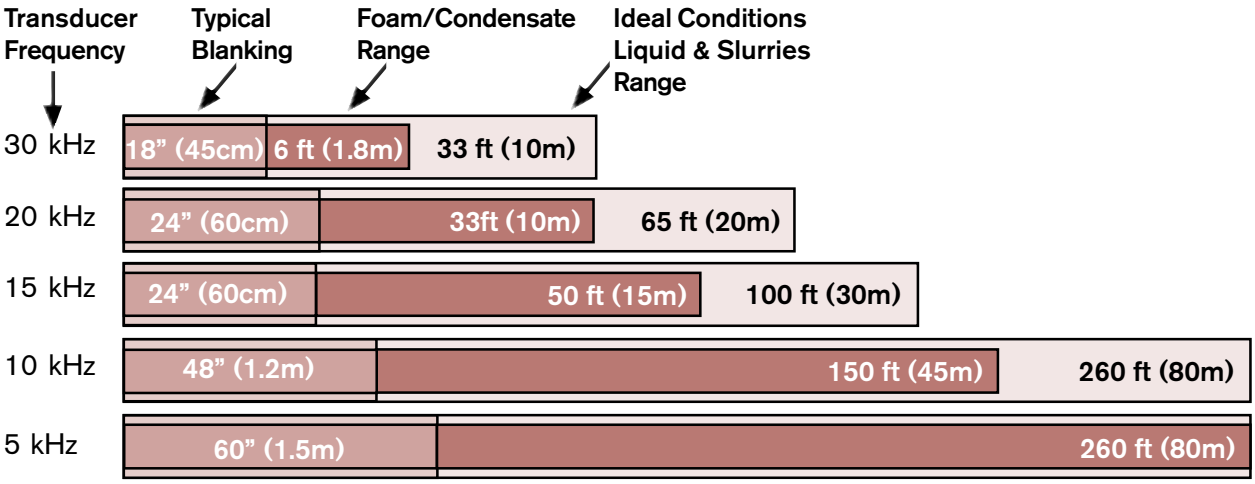
The transducers produce the transmit pulse and detect returning echoes. They have a fixed frequency that determines the measured distance and what effects process conditions will have. ULT transducers are selected based on the range to be measured, the media type and the expected vessel conditions.

Transducer Selection for Liquids and Slurries

Typical Blanking – a dead zone where the transmitter cannot detect the process.

Foam/Condensate Range – some conditions, like foam, steam, fog and condensate, reduce the effective range of the ULT. Use this value to determine the estimated effective range of the transducer when any of these conditions are present.

Ideal Conditions Range – ideal conditions for liquids and slurries are little or no foam, steam, fog or condensate. Use this maximum range to select a transducer for these conditions.

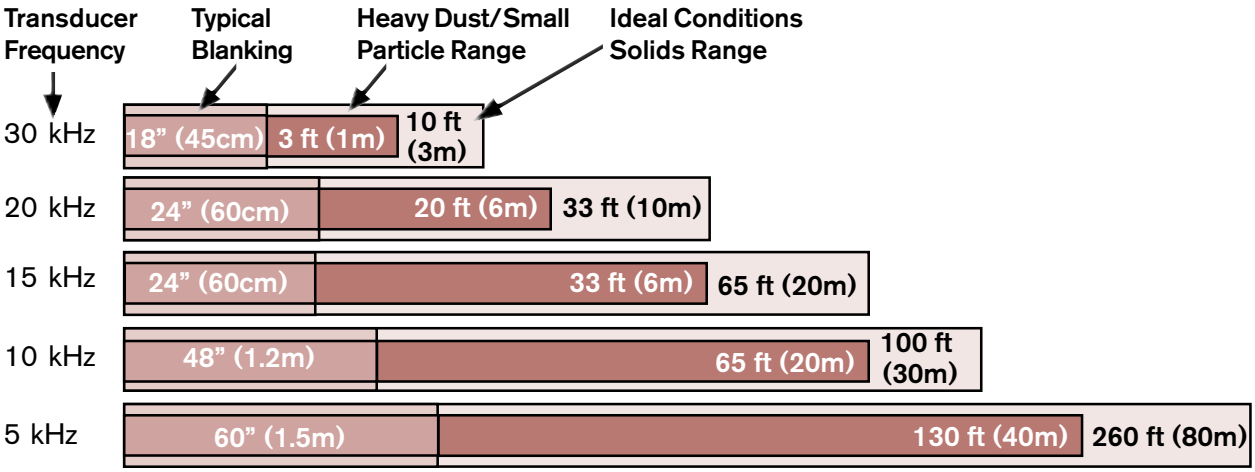


Transducer Selection for Solids

Typical Blanking – a dead zone where the transmitter cannot detect the process.

Heavy Dust/Small Particle Range – solids with heavy dust (visibility of 3 ft., 1m or less) and/or small particles (less than 1/16", 1mm) reduce the effective range of the ULT.

Ideal Conditions Range – ideal conditions for solids are when little or no dust is present and particle sizes are above 1/16", 1mm. Use this maximum range to select a transducer for these conditions.



Product Specifications

Operating Voltage

110 VAC Version	22-27 VDC and/or 100-126 VAC
220 VAC Version	22-27 VDC and/or 205 - 250 VAC

Power Consumptions

24 VDC Power Supply	10 W maximum
110/220 VAC Power Supply	10 VA maximum

Relay Output

Integral Version	2 Form 'C' (SPDT) contacts rated 10A @ 240 VAC
Remote Version	4 Form 'C' (SPDT) contacts rated 10A @ 240 VAC

All relays have independently adjustable deadbands.

Analog Output	4-20 mA or 20-4 mA (700 ohm)
Electronic Accuracy	+0.25% of maximum range
Remote Cable Length	<100m (330 feet)
Remote Cable Type	TYCAB DMC 71402 or Carol Cable C0784 7-conductor, 22 Ga. shielded cable
Memory	Non-volitile with >10 years retention
Electrical Connections	2x3/4" NPT(F) on integral units Customer supplied on remote units
Operating Temperature	-40°F (-40°C) to 140°F (60°C)

Agency Approvals

CSA
Process Control Equipment - Hazardous Locations
Class I, Groups B, C, D;
Class II; Groups E, F, G
Class III
Division 1 & 2 - Integral
Divison 2 - Remote Transducers

FM
Pending

ATEX (Pending)

Product Specifications

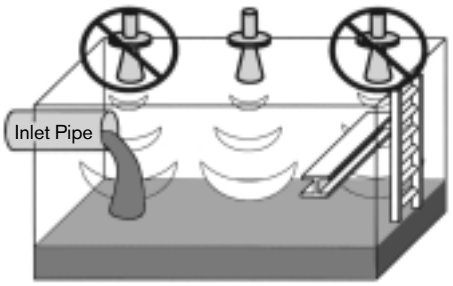
Transducer Model (Frequency)	Maximum Blanking Distance	Maximum Liquid/Slurry Range	Maximum Solid/Powder Range	SPL at 3 ft. (1m) in front of transducer	SPL at 3 ft. (1m) to side of unit
D (30 kHz)	60 inches (1.52m)	260 feet (80m)	260 feet (80m)	137 dB	113 dB
C (20 kHz)	48 inches (1.22m)	260 feet (80m)	100 feet (30m)	138 dB	105 dB
K (15 kHz)	24 inches (0.61m)	100 feet (30m)	65 feet (20m)	135 dB	107 dB
B (10 kHz)	24 inches (0.61m)	65 feet (20m)	33 feet (10m)	132 dB	108 dB
A (5 kHz)	18 inches (0.46m)	33 feet (10m)	10 feet (3m)	129 dB	102 dB

Installation Notes

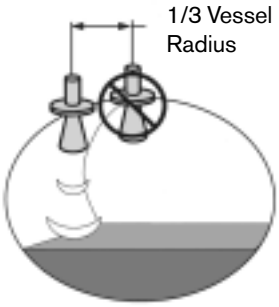
The ULT can be adversely affected by improper installation. The sound waves used by any ultrasonic transmitter have some specific properties that can make certain installations very difficult to deal with. Many headaches can be avoided by following some simple installation guidelines. The figures below show some things to avoid and how to correct other situations. Following these recommendations will greatly increase the chance of a successful application and reduce frustration in trying to get the product to work in an installation where there are physical problems.

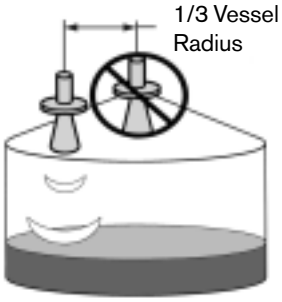
Location

Where the ULT is mounted is the first critical item to look at. The sound waves come out in a cone-shaped beam. This beam should not intersect any physical obstructions such as inlet pipes, ladders or I-beams. Cone or domed top tanks can act as a focusing cone and cause multiple echoes that confuse an ultrasonic transmitter. Where possible, mount the ULT up to 1/3 of the radius away from the center of these types of vessels.



Mount the ULT away from internal obstructions.





Do not mount the ULT in the center of domed or cone-topped vessels if possible – offset it 1/3 of the vessel radius.

How to Mount

The most common mounting for ULT transducers is on a flange. Some can be mounted on a threaded connection, but most are flange mounted. The key issue to be careful of when mounting on threads or a flange is to make sure the pulses of sound are not inhibited. Some common mounting problems are shown below along with SOR's recommendations to fix these situations.

Flanged Mounting

Do not mount end of transducer assembly inside standpipe.

Use a shorter standoff so end of transducer assembly is inside vessel, or...

Extend standpipe into the vessel and cut the end at a 45° angle.

Threaded Mounting

Do not mount end of transducer assembly inside standpipe.

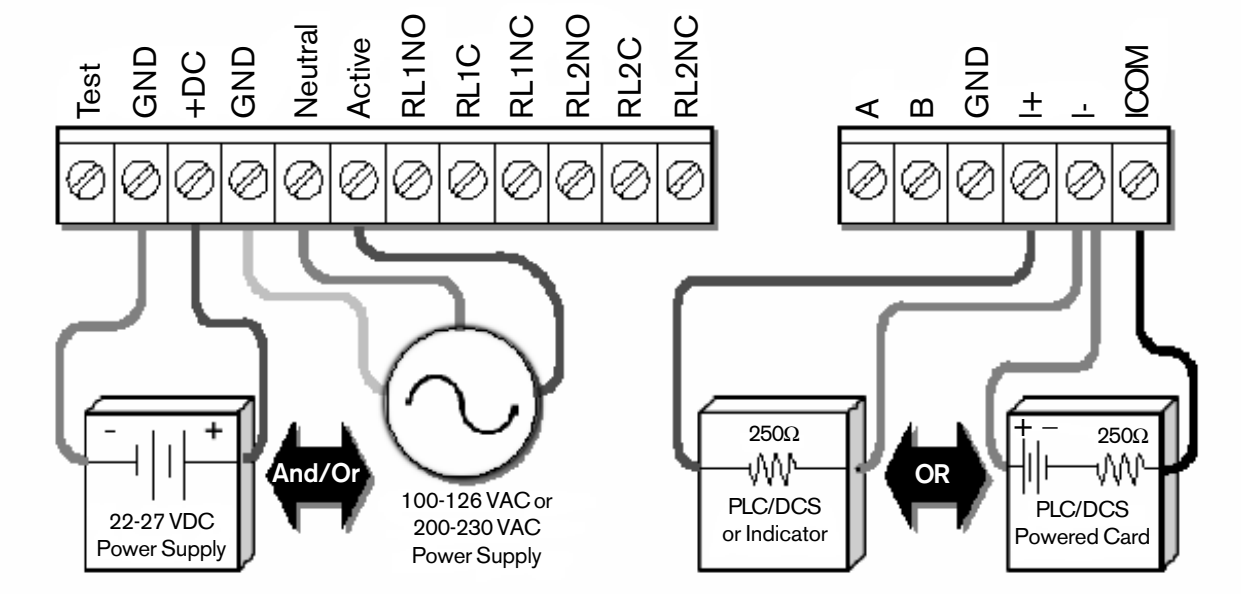
Use a threaded coupling directly on top of the vessel, or...

Extend standpipe into the vessel and cut the end at a 45° angle.

Wiring Diagrams

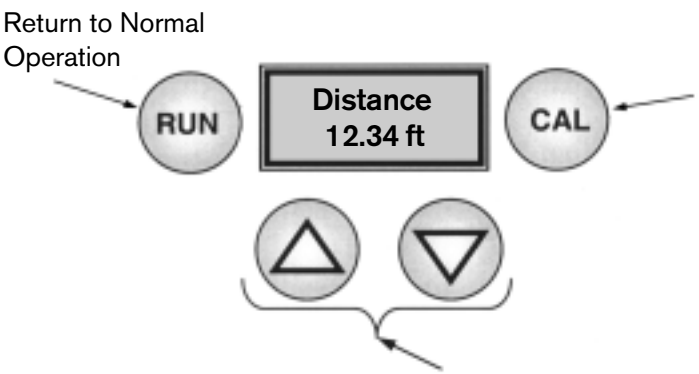
The ULT comes standard with a universal input power supply (AC and DC) and an isolated 4-20 mA output. Unit power can be connected to either AC or DC, or can be connected to both at the same time. This provides the capability to use AC main power and DC battery backup as well as the flexibility to use either AC or DC for main power.

The isolated 4-20 mA output can be either powered internally by the ULT to run a separate meter or straight input or it can be externally powered through an I/O card. This circuit is compatible with all input/output devices and provides the flexibility to fit all user needs.



Programming Basics

The ULT is programmed through a 4-button interface following on-screen directions. The diagram below shows the basic user interface and function of the four buttons. Menus are designed to be intuitive and easy to setup. Refer to the General Instructions form #1034 for menu specifics.



PLEASE NOTE; Push-button interface is the same for integral and remote units

NOTE: Change number values faster, hold down the arrow key and press CAL

U Series Non-Contact Ultrasonic Transmitter

How to Order

The U Series is selected as two separate model numbers - one for the electronics package and one for the transducer.

Model Number System

U71 - CL7J - ZZ - 20 - PP

Ultrasonic Level Transmitter; line-powered integral unit; weathertight and explosion-proof housing with window; 110 VAC and/or 24 VDC power supply with 4-20 mA and two discrete outputs, 20 kHz sensor range; all associated agency listings and a paper supplemental tag.

1 Transmitter Type
- U — Ultrasonic

2 Power Type
- 7 — Line Powered

3 Mounting
- 1 — Integral
- 3 — Remote

4 Housing
- C — NEMA 4 / Explosion Proof with Window (Integral Only)
- D — NEMA 4 / Explosion Proof without Window (Integral Only)
- F — NEMA 4X with Window (Remote Only)
- P — NEMA 4X without Window (Remote Only)

5 Level Measurement
- L — Level Measurement

6 Input Power
- 7 — 110 VAC and / or 24 VDC
- 8 — 220 VAC and / or 24 VDC

7 Output Type
- J — 4-20 mA with Discrete Outputs

8 Agency Approvals*
- 00 — None
- ZZ — All associated agency listings

9 Transducer Frequency
- 30 — 30 kHz
- 20 — 20 kHz
- 15 — 15 kHz
- 10 — 10 kHz
- 05 — 5 kHz

10 Accessories
- PP — Paper tag
- RR — Wired-on SS tag
- VV — Fungicidal varnish on housing

Model Number	U	7	1	C	L	7	J	ZZ	20	PP

*Match electronics and transducer approvals to maintain the agency listing integrity.

Model Number System

BCP - 3A - ZZ - 00000

Integral-mount transducer; 20kHz; polypropylene sensor; 3" NPT(M) Process Connection; all associated agency listings; no transducer cable and no accessories.

14 Process Connection Size

3" (standard on 30, 20, 15 kHz transducers)	3
4" (flange only - required on 20, 15 kHz with FC option)	4
6" (flange only)	6
8" (flange only)	F
10" (flange ony - standard on 10, 5 kHz transducers)	G

15 Process Connection Type

A	NPT pipe thread (3" size only)
C	150# ANSI style FF polypropylene flange

13 Sensor Material of Construction

Polypropylene sensor body Teflon face for 30, 20, 15 kHz Rubber face for 10, 5 kHz	P

16 Agency Approvals*

00	None
ZZ	All associated agency listings

12 Transducer Range

30 kHz	D
20 kHz	C
15 kHz	K
10 kHz	B
5 kHz	A

17 Cable Length

XXX.X	Remote transducer cable length in feet (330 ft. maximum)
00000	Integral transducer (no cable required)

11 Transducer Type

Integral Mount	B
Remote Mount	R

18 Accessories

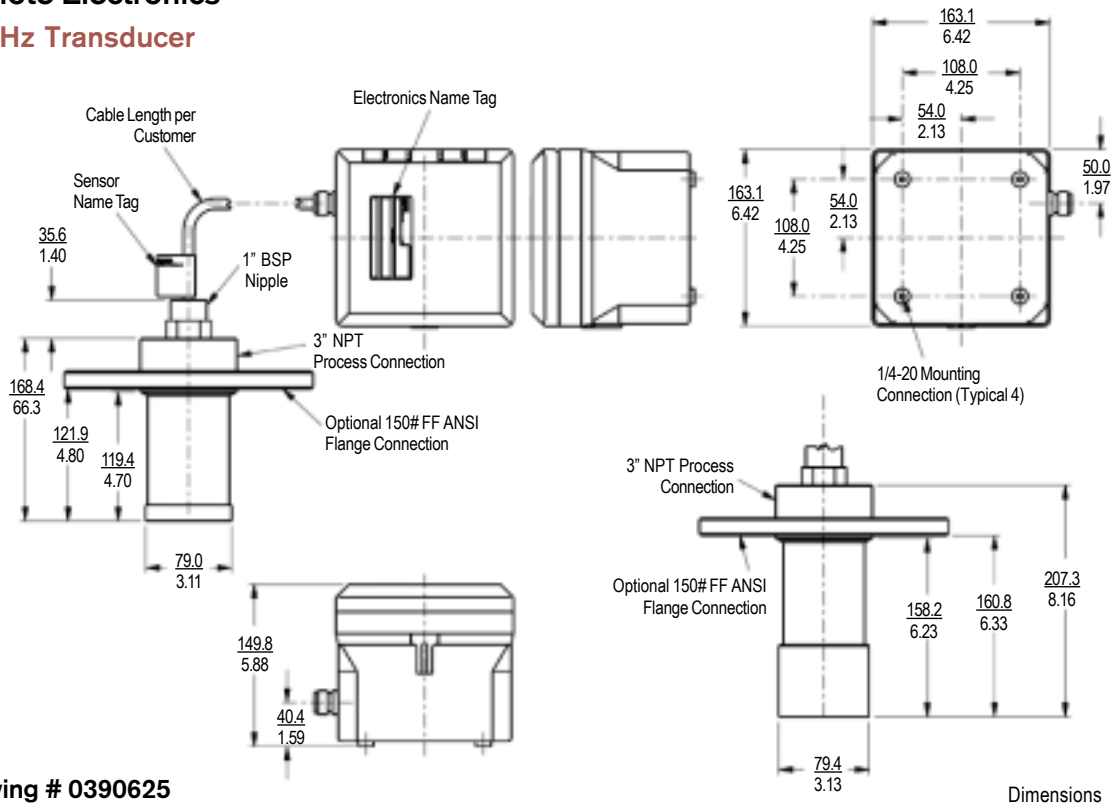
FC	Focusing cone for 30, 20, 15 kHz transducers (minimum 4" flange on 20, 15 kHz)
PP	Paper tag (remote only)
RR	Wired-on SST tag (remote only)

B	C	P	3	A	ZZ	00000	PP	**Model Number**

*Match electronics and transducer approvals to maintain the agency listing integrity.

Remote Electronics

30 kHz Transducer



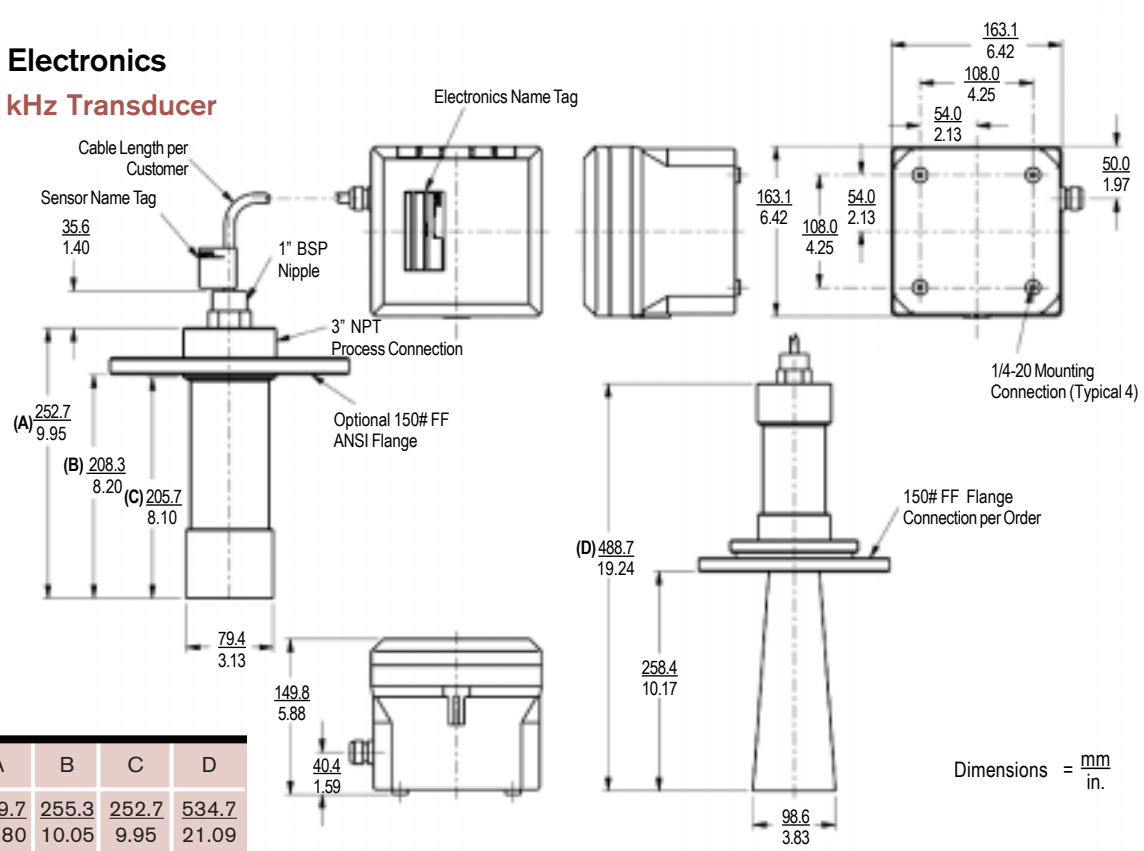
Drawing # 0390625

Dimensions = mm / in.

FC Option

Remote Electronics

15 or 20 kHz Transducer



	A	B	C	D
15 kHz	299.7 11.80	255.3 10.05	252.7 9.95	534.7 21.09

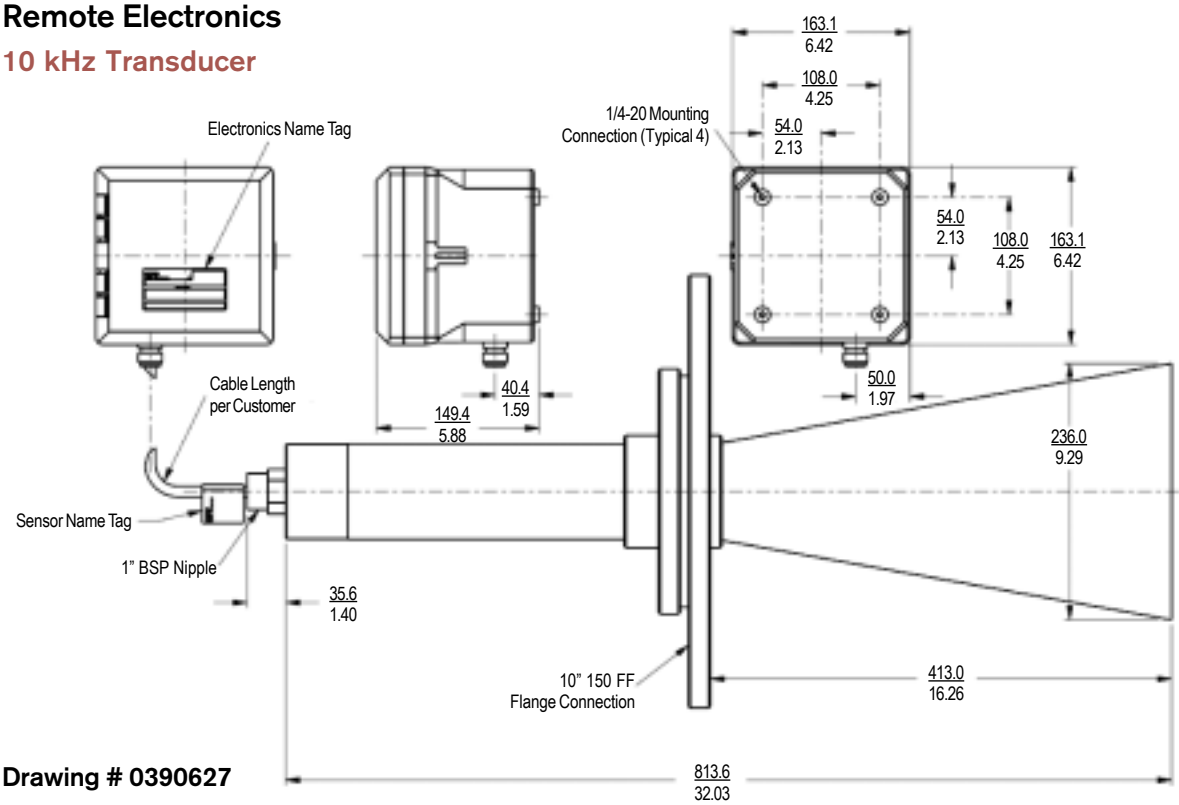
Drawing # 0390626

Dimensions = mm / in.

FC Option

Remote Electronics

10 kHz Transducer

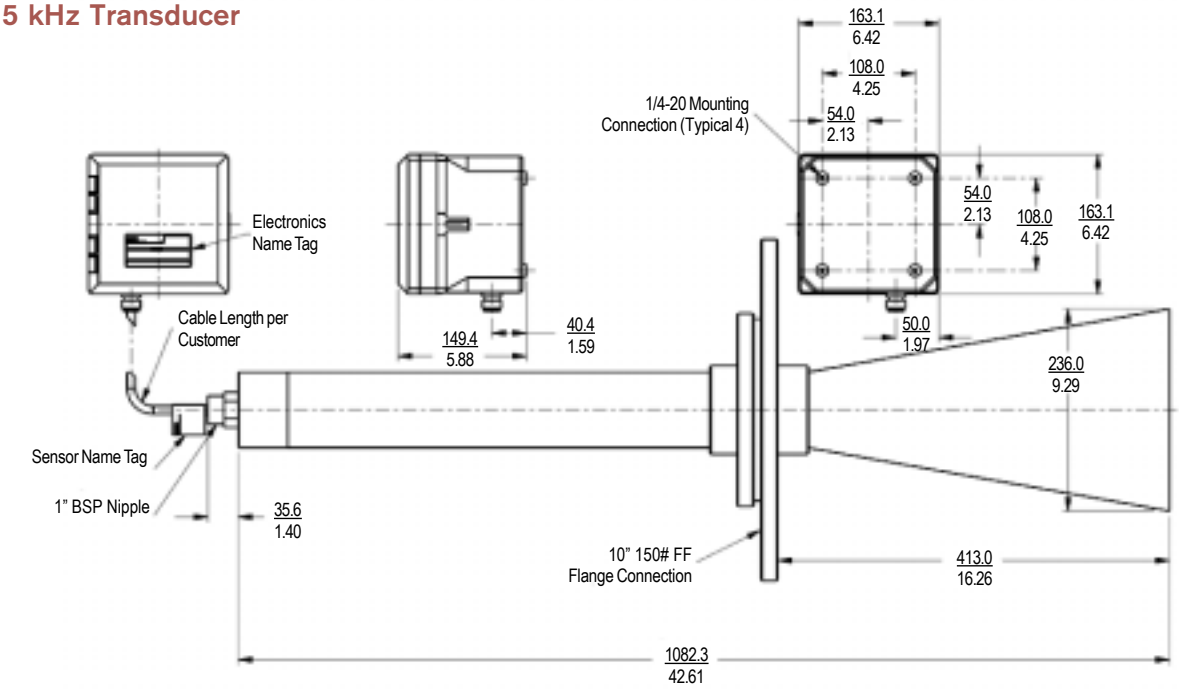


Drawing # 0390627

Dimensions = mm / in.

Remote Electronics

5 kHz Transducer



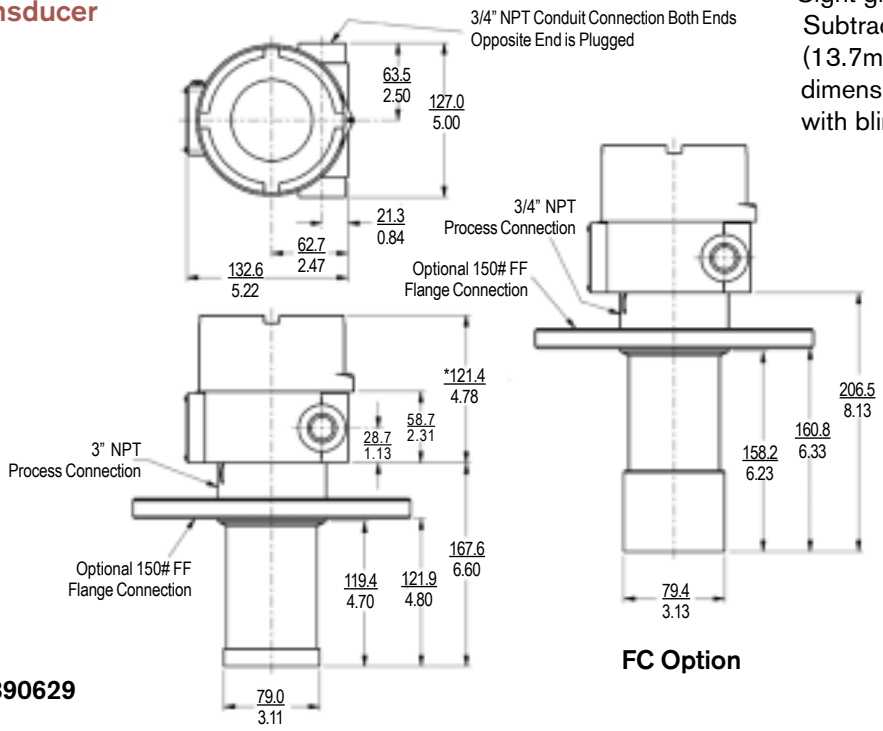
Drawing # 0390628

Dimensions = mm / in.

Integral Electronics

30 kHz Transducer

*Sight glass cover shown. Subtract 0.52 inches (13.7mm) from this dimension for housings with blind covers.



FC Option

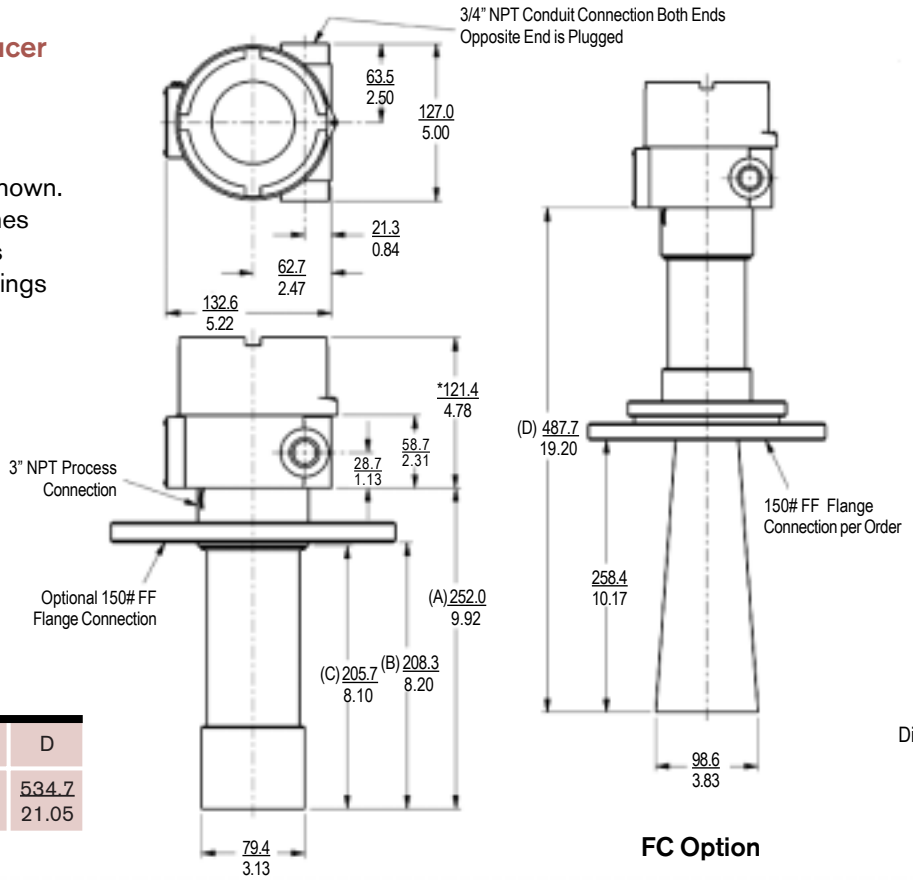
Dimensions = mm / in.

Drawing # 0390629

Integral Electronics

15 or 20 kHz Transducer

*Sight glass cover shown. Subtract 0.52 inches (13.7mm) from this dimension for housings with blind covers.



FC Option

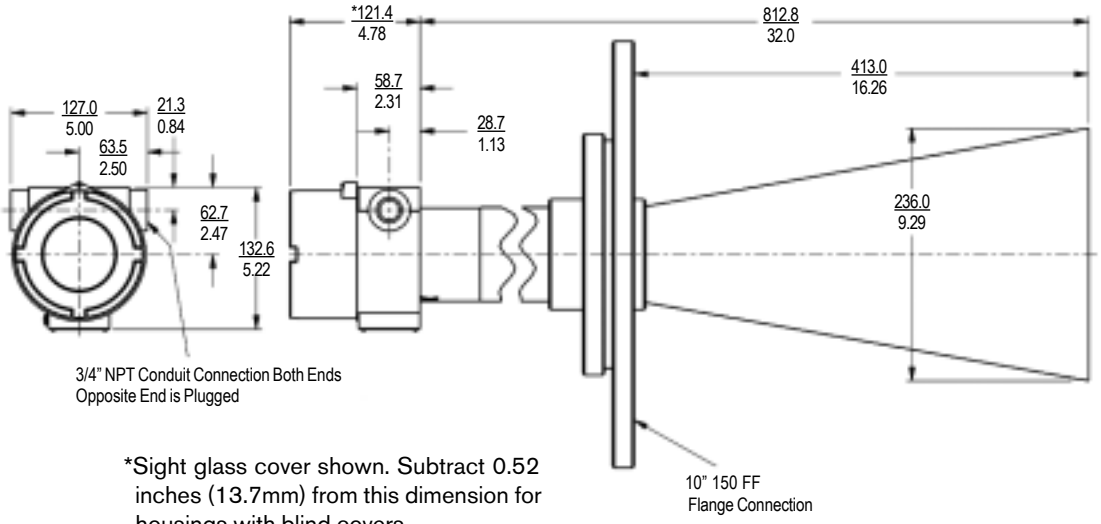
Dimensions = mm / in.

	A	B	C	D
15 kHz	289.9 11.77	255.3 10.05	252.7 9.95	534.7 21.05

Drawing # 0390630

Integral Electronics

10 kHz Transducer



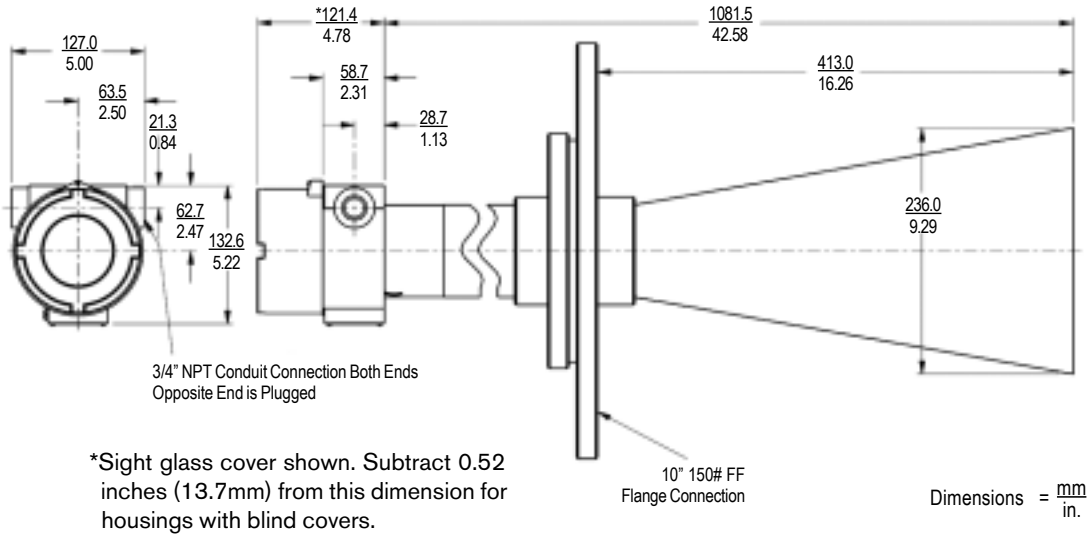
*Sight glass cover shown. Subtract 0.52 inches (13.7mm) from this dimension for housings with blind covers.

Dimensions = mm / in.

Drawing # 0390627

Integral Electronics

5 kHz Transducer



*Sight glass cover shown. Subtract 0.52 inches (13.7mm) from this dimension for housings with blind covers.

Dimensions = mm / in.

Drawing # 0390628

Applications Worksheet for Non-Contact Ultrasonic Transmitters

Company _____ Phone _____

Address _____ FAX _____

_____ E-mail _____

_____ Rep Company _____

Contact Name _____ Rep Contact _____

General	1	Tag Number	
	2	Application	Level
	3	Function	
	4	Area Classification	Hazardous/Non-hazardous
	5	Agency Approval	
Sensor	6	SOR Transducer Model	
	7	Process Connection Type	NPT / 150# ANSI Flange
	8	Process Connection Size	
	9	Focusing Options	Standard / High-Gain
	10	Process Wetted Mateials	Polypropylene / Teflon*
	11	Measured Range	_____ft / m
	12	Mounting Distance from Sidewall	_____ft / m
	13	Mounting Distance from Filling Port	_____ft / m
Electronics	14	SOR Electronics Model	
	15	Location	Integral / Remote
	16	Remote Distance	_____ft / m
	17	Enclosure Class	
	18	Conduit Connection	3/4" NPT (Integral)
	19	Power Supply (Line is also 22-27 VDC)	100-126 VAC Line 205-250 VAC Line
	20	Transmitter	4-20mA / 20-4mA
	21	Number of Setpoints	
	22	Switching Type and Qty	Relay 1 / 2 / 3 / 4
Process Conditions	23	Media Name	
	24	Media Type	Liquid / Slurry / Solid
	25	Density	
	26	Particle Size	
	27	Coating or Buildup	Yes / No
	28	Foam	Yes / No
	29	Agitation	Yes / No
	30	Vapors (not air)	Yes / No
	31	Pressure Maximum	
	32	Pressure Normal	
	33	Temperature Maximum	
	34	Temperature Normal	
	35	Ambient Temperature	

Vessel	36	Vessel Materials	
	37	Vessel Diameter	_____ft / m
	38	Vessel Height	_____ft / m
	39	Vessel Top	Open / Sloped Domed / Flat
	40	Vessel Bottom	Conical / Flat
	41	Filling Method	Pneumatic / Gravity Other_____
	42	Noise in or Around Vessel	Yes / No (describe below)
	43	Obstructions Inside Vessel	Yes / No (sketch below)
	44	Mounting	Standpipe/Coupling Bracket/Other
	45	Standpipe Diameter	_____in/mm
	46	Standpipe Length	_____in/mm

Application Notes

Instructions

1. Complete the company and contact information.
2. Fill out the form above as completely as possible.
3. In boxes where an option is given, cross out the undesirable choice(s).
4. In boxes that are blank, fill in the appropriate information. Please remember to use engineering units where required.
5. In boxes with only one choice, this is the standard feature for the product.
6. Provide any additional details in the Application Notes section.
7. Provide a sketch of the application showing vessel shape, size, mounting location and any internal obstructions on the Installation Sheet.
8. Fax completed sheet to SOR: **913-888-0767**

Applications Worksheet for Non-Contact Ultrasonic Transmitters

Company _____ Phone _____

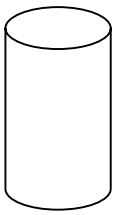
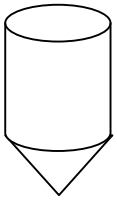
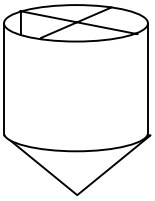
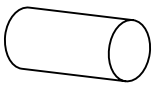
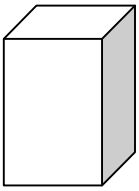
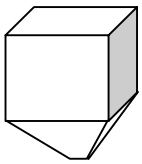
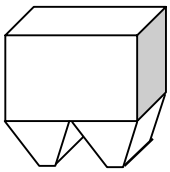
Address _____ FAX _____

_____ E-mail _____

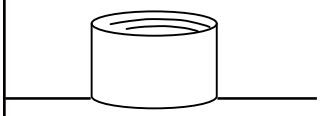
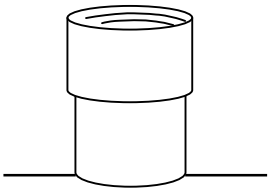
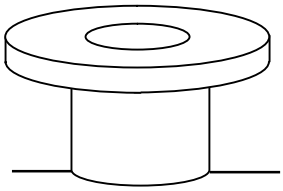
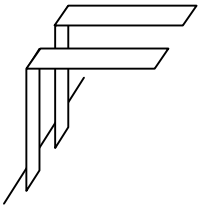
_____ Rep Company _____

Contact Name _____ Rep Contact _____

Vessel Shape (circle the one that applies, or sketch vessel below)

Cylinder	Cone-bottom cylinder	Section cylinder	"Bullet" tank	Box	Cone-bottom box	Dual outlet box
						

Installation Method (circle the one that applies, or sketch vessel below)

Threaded coupling	Threaded coupling on standoff	Flanged standoff	Open bracket
			

Vessel Sketch and Dimensions

Process Instrumentation

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