



Submitted to: Adam Larky and Jennifer Boyer, Cornerstone

Date: 11/13/2012

Submitted by: Ben Peotter

Submitted via: E-Mail

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Riverview BioCNG Final Design Submittal List (Cont'd.)

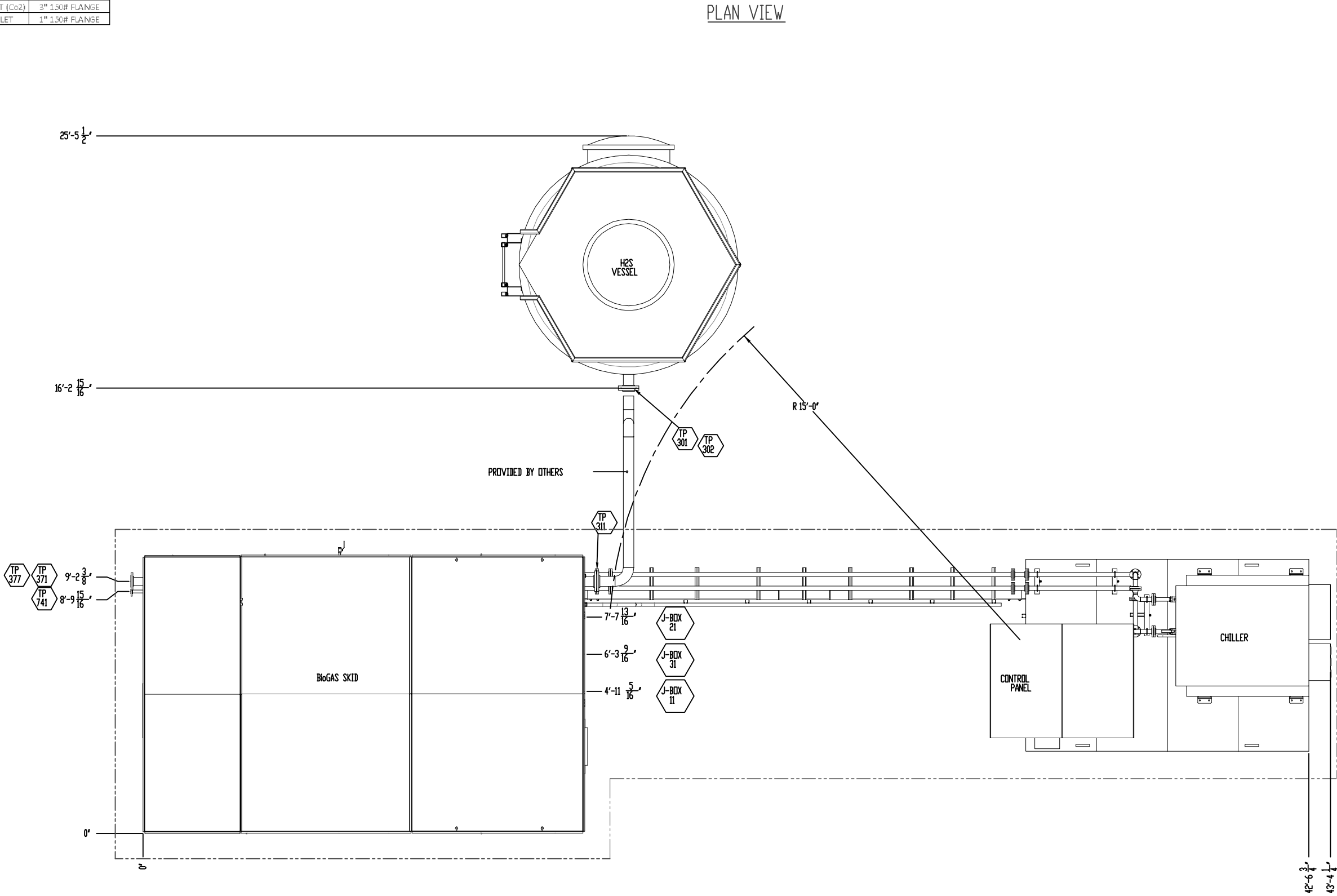
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1. Unison Design Information

1.1 Overall System Drawings

TIE POINT		
#	DESCRIPTION	SIZE
301	H2S INLET	4" 150# FLANGE
302	H2S OUTLET	4" 150# FLANGE
311	BIOGAS INLET	4" 150# FLANGE
371	OFFGAS OUTLET (CH4)	3" 150# FLANGE
377	PRODUCT GAS OUTLET (CO2)	3" 150# FLANGE
741	CONDENSATE OUTLET	1" 150# FLANGE

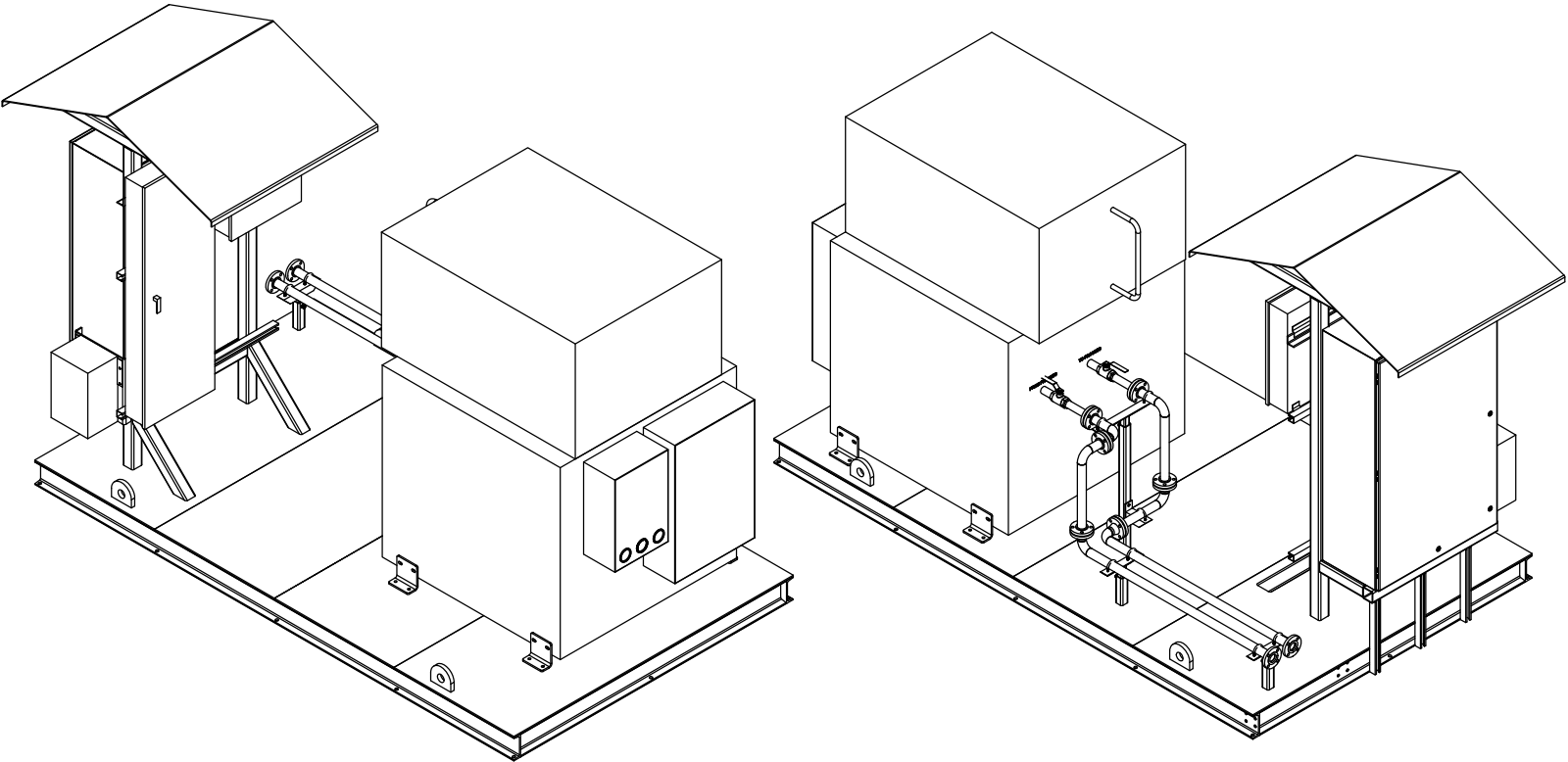
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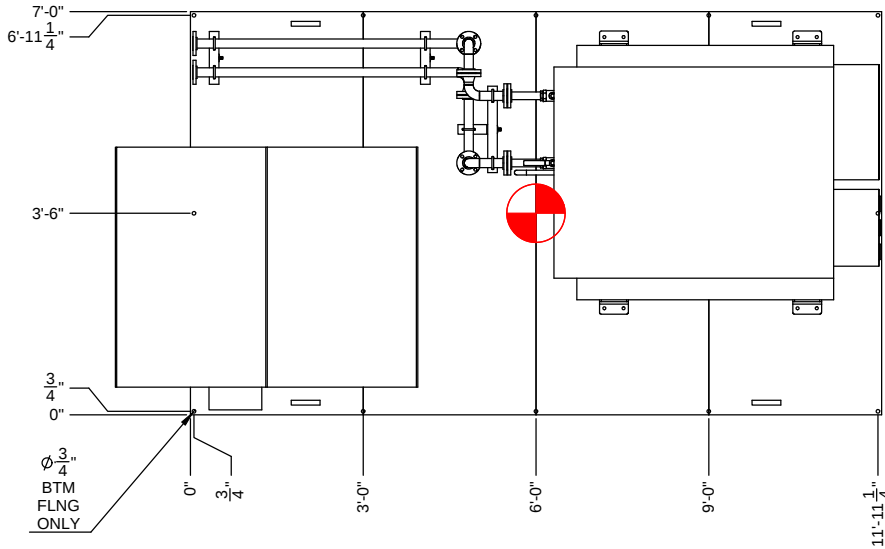
		Unison Solutions Inc. 5451 Chavenelle Road Dubuque, IA 52002 PHONE: 563-585-0967 FAX: 563-585-0970	
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PROJECT		BioCNG-100	
DESCRIPTION		SITE LAYOUT	
DRAWN BY		TAB	DATE
REVISION		-	DWG. NO.
			10/4/2012
			6L-B100-51

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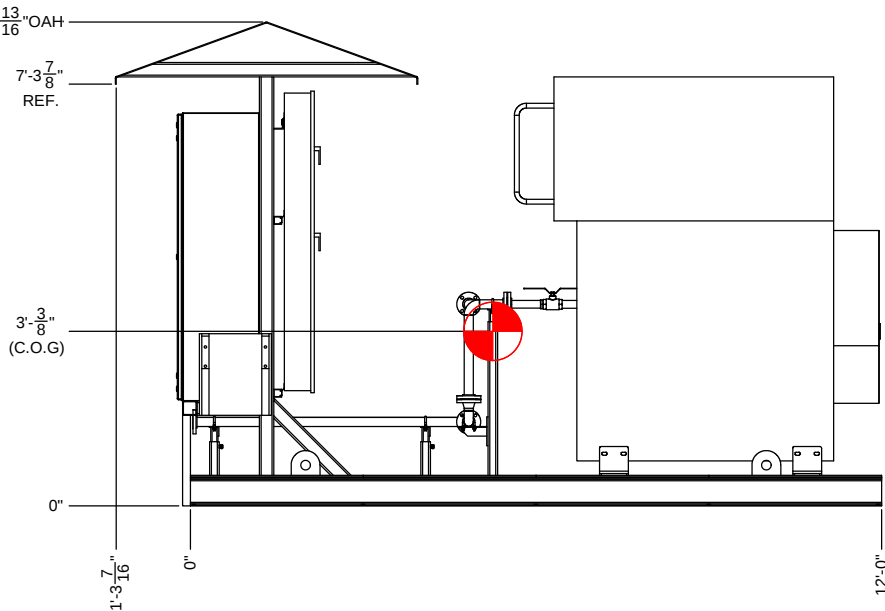
ISOMETRIC VIEW



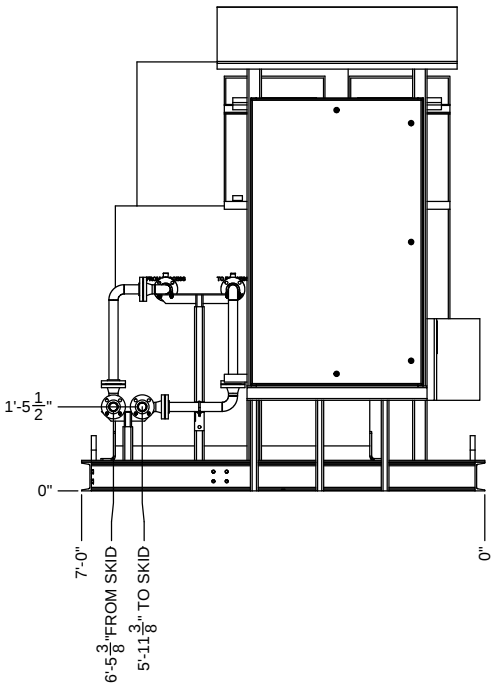
TOP VIEW



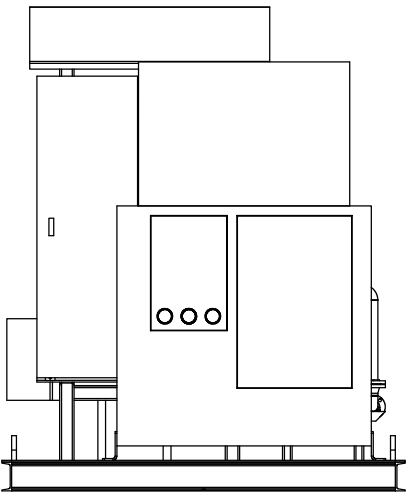
FRONT VIEW



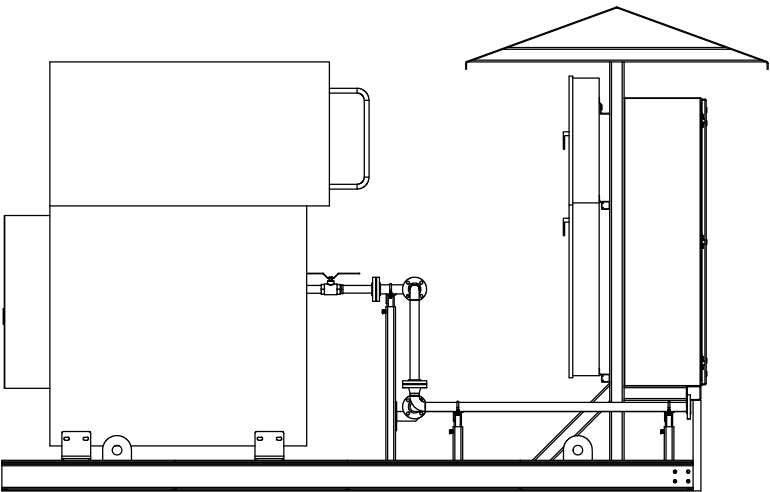
SIDE VIEW



SIDE VIEW



REAR VIEW





Unison Solutions Inc.

5451 Chavenelle Road

Dubuque, IA 52002

PHONE: 563-585-0967 FAX: 563-585-0970

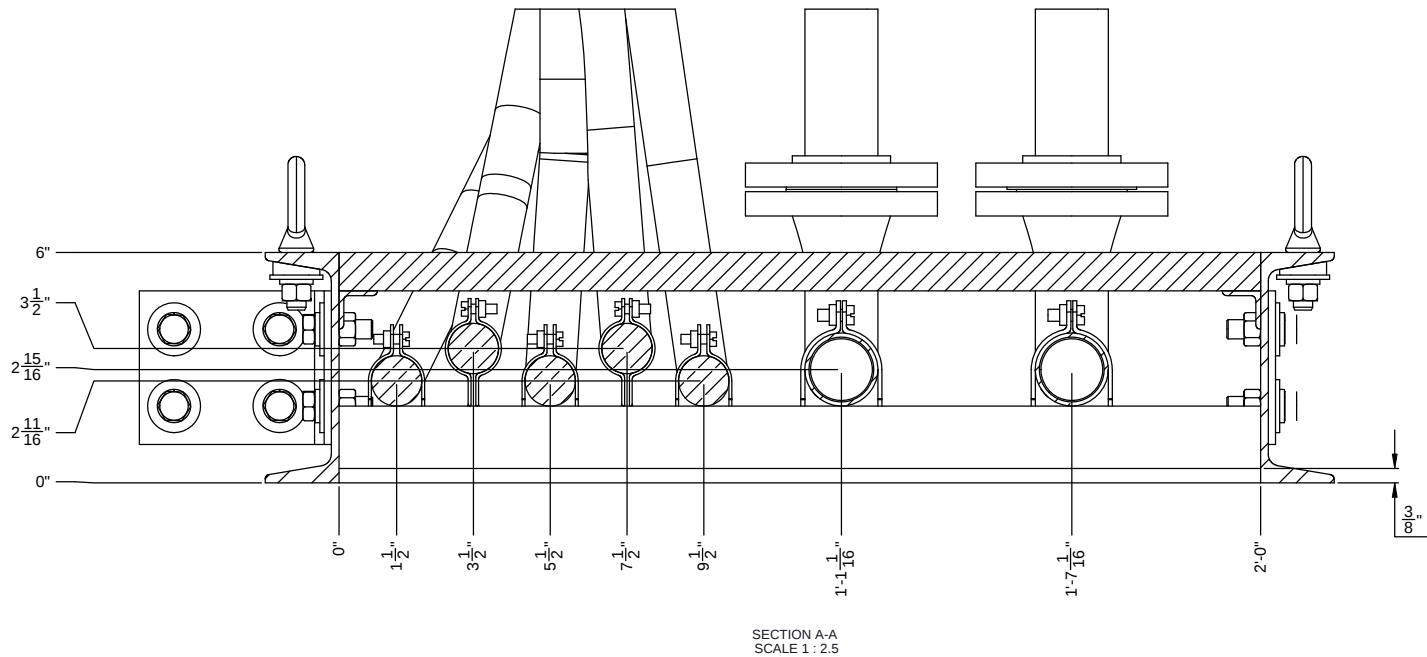
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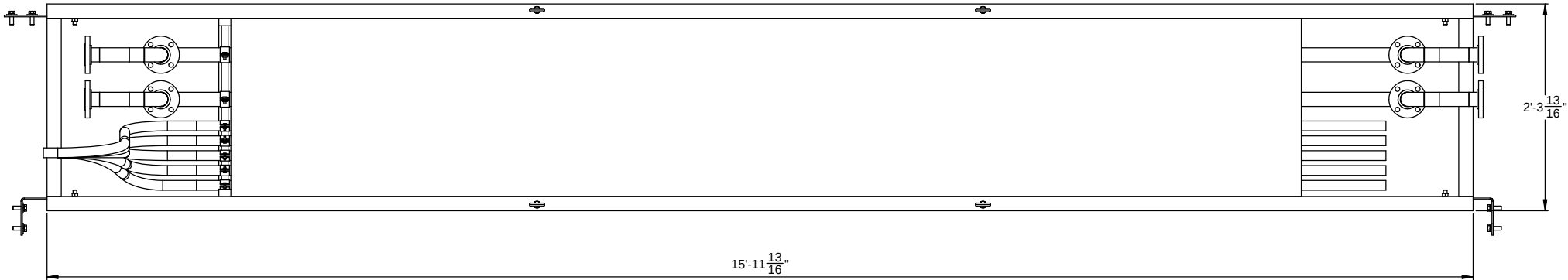
PROJECT	BioCNG-100		
DESCRIPTION	PRE-FABRICATION LAYOUT (CHILLER SKID)		
DRAWN BY	TAB	DATE	10/15/2012
REVISION	-	DWG. NO.	6L-B101-2-01

Notes:
CONDUIT NOT SHOWN.
APPROX. WEIGHT: 7,500 LBS.

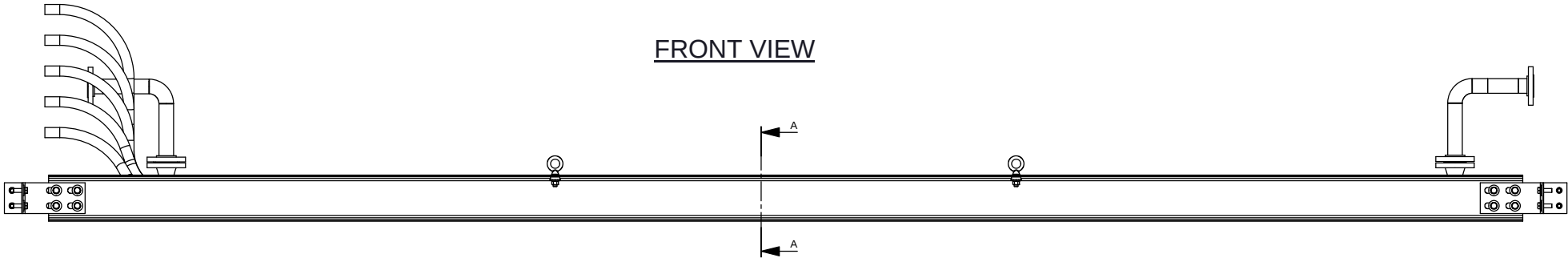
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TOP VIEW



FRONT VIEW



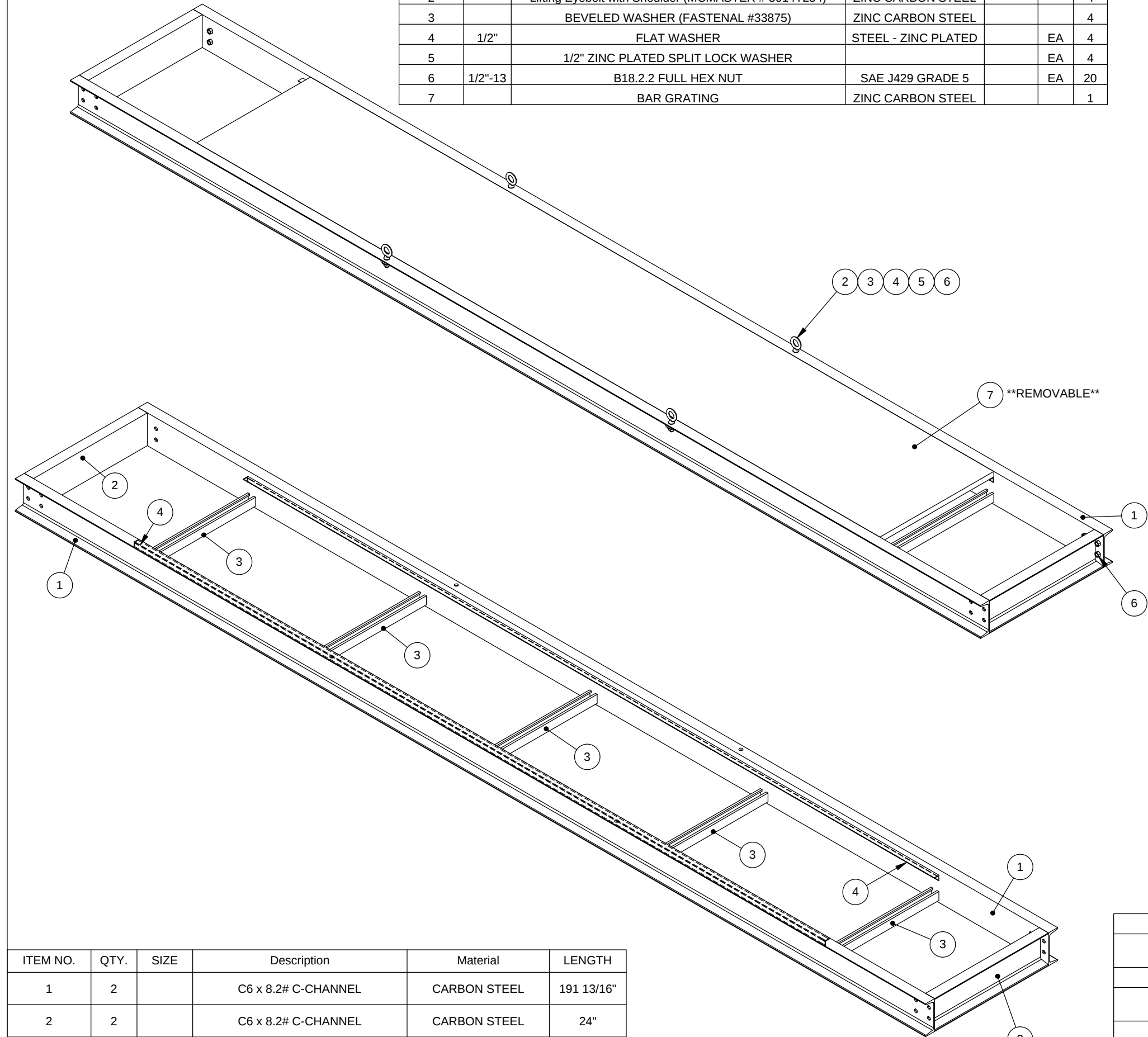
ISOMETRIC VIEW

Note: Three additional 3/4" conduits are supplied on the outside of beam to run wiring for heat trace power supply and pressure transmitter signal back to control panel

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	PROJECT	BioCNG-100	
	DESCRIPTION	EASY INSTALL KIT	
	DRAWN BY	TAB	DATE
	REVISION	-	DWG. NO.
			10/15/2012
			6L-B102-2-01

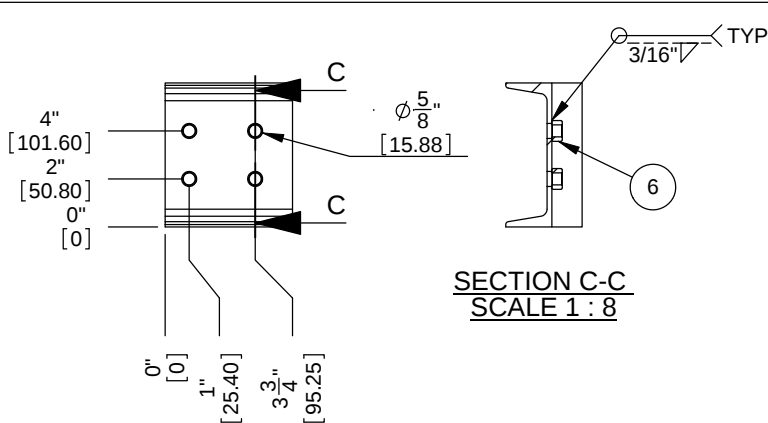
ITEM NO.	SIZE	DESCRIPTION	MATERIAL	LENGTH	UOM	QTY.
1		WELDMENT				1
2		Lifting Eyebolt with Shoulder (MCMASTER # 3014T254)	ZINC CARBON STEEL			4
3		BEVELED WASHER (FASTENAL #33875)	ZINC CARBON STEEL			4
4	1/2"	FLAT WASHER	STEEL - ZINC PLATED		EA	4
5		1/2" ZINC PLATED SPLIT LOCK WASHER			EA	4
6	1/2"-13	B18.2.2 FULL HEX NUT	SAE J429 GRADE 5		EA	20
7		BAR GRATING	ZINC CARBON STEEL			1

REVISIONS				
REVISION SYMBOL	REVISED BY	APPROVED BY	DATE	DESCRIPTION OF CHANGE



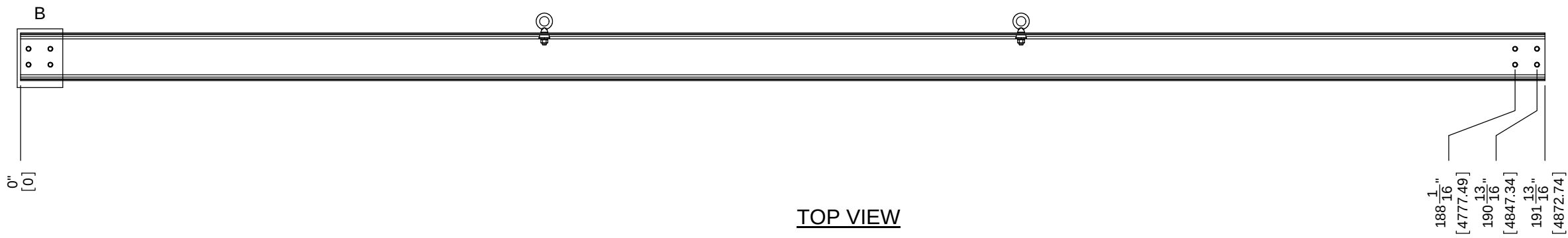
ITEM NO.	QTY.	SIZE	Description	Material	LENGTH
1	2		C6 x 8.2# C-CHANNEL	CARBON STEEL	191 13/16"
2	2		C6 x 8.2# C-CHANNEL	CARBON STEEL	24"
3	5	1-5/8" x 1-5/8"	SQ. UNI-STRUT	CARBON STEEL	24"
4	2		1" x 1" x 1/8" WALL ANGLE IRON	CARBON STEEL	145 5/8"

<u>TOLERANCE</u>		Unison Solutions Inc.		
ALL DIMENSIONS ARE +/- 1/16" UNLESS OTHERWISE SPECIFIED		5451 Chavenelle Road		
<u>DIMENSIONS</u>		Dubuque, IA 52002		
ALL DIMENSIONS ARE IN INCHES [MM] UNLESS OTHERWISE SPECIFIED		PHONE: 563-585-0967 FAX: 563-585-0970		
<u>PROPRIETARY AND CONFIDENTIAL</u>	PROJECT	BioCNG-100		
DESIGN AND CONTENT OF THIS DRAWING REMAINS THE PROPERTY OF UNISON SOLUTIONS INC. THIS DRAWING MAY NOT BE DISTRIBUTED TO A THIRD PARTY WITHOUT THE CONSENT OF UNISON SOLUTIONS INC.	DESCRIPTION	EASY INSTALL KIT		
	DRAWN BY	TAB	DATE	10/15/2012
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	DWG. NO.	6B-B102-01		

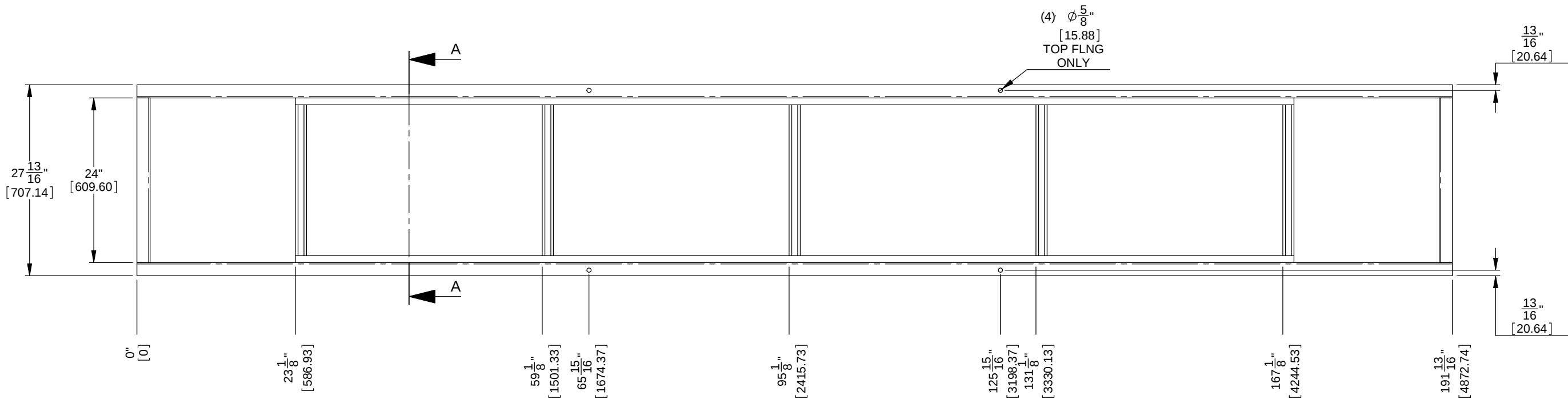


SECTION C-C
SCALE 1 : 8

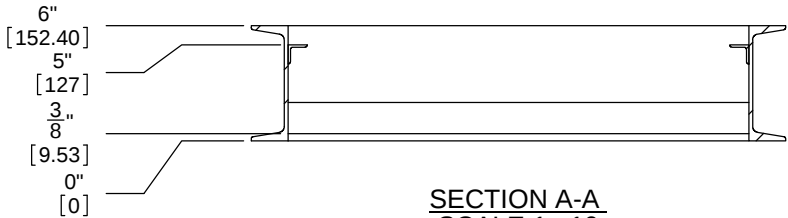
DETAIL B
SCALE 1 : 8



TOP VIEW



SECTION A-A
SCALE 1 : 10

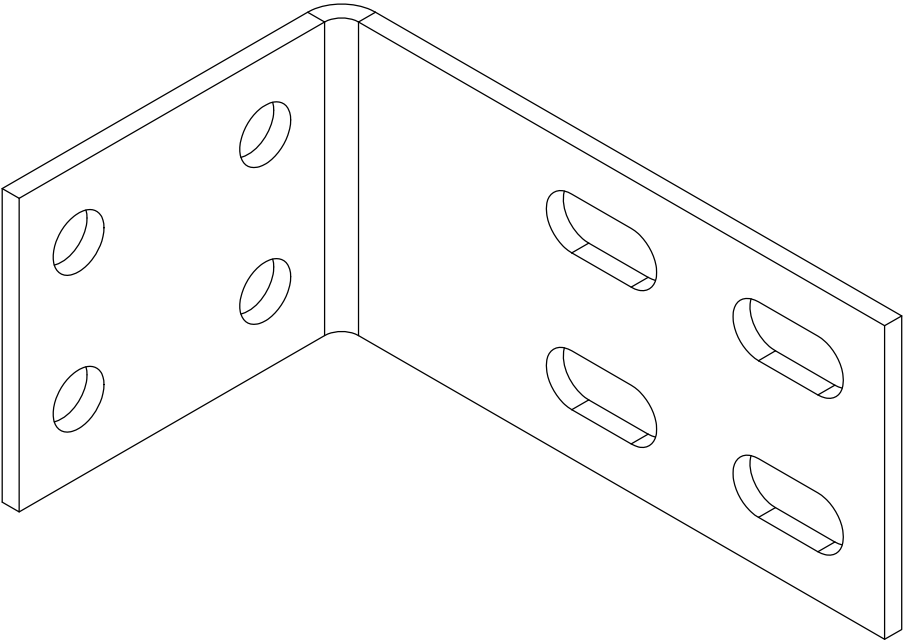


REVISIONS				
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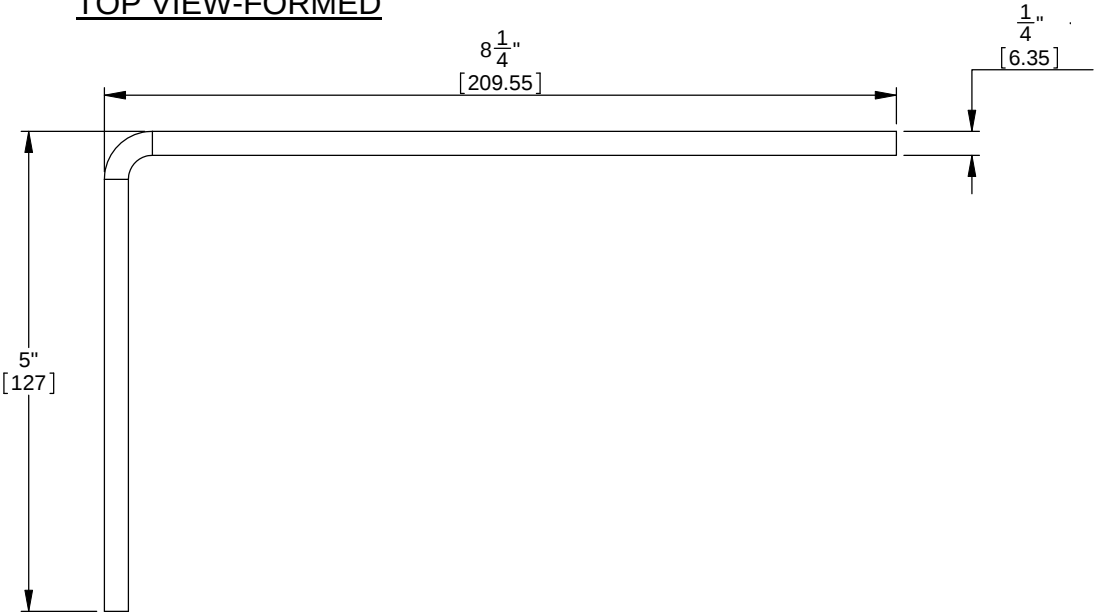
<u>TOLERANCE</u>		Unison Solutions Inc. 5451 Chavenelle Road Dubuque, IA 52002 PHONE: 563-585-0967 FAX: 563-585-0970		
ALL DIMENSIONS ARE +/- 1/16" UNLESS OTHERWISE SPECIFIED				
<u>DIMENSIONS</u>				
ALL DIMENSIONS ARE IN INCHES [MM] UNLESS OTHERWISE SPECIFIED				
<u>PROJECT</u>	PROJECT	BioCNG-100		
<u>DESCRIPTION</u>	DESCRIPTION	EASY INSTALL KIT		
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	QUANTITY	1	WEIGHT	327.91 LBS.
	DWG. NO.	6B-B102-01		

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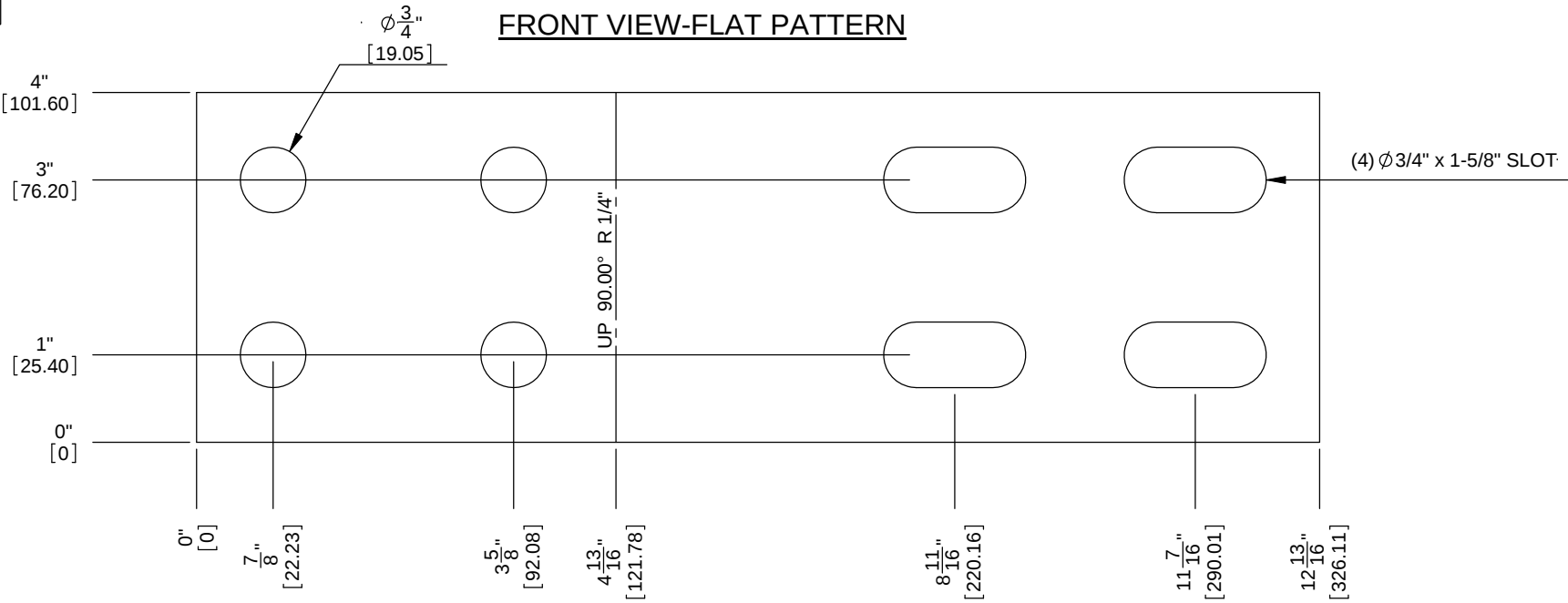
ISOMETRIC VIEW



TOP VIEW-FORMED



FRONT VIEW-FLAT PATTERN

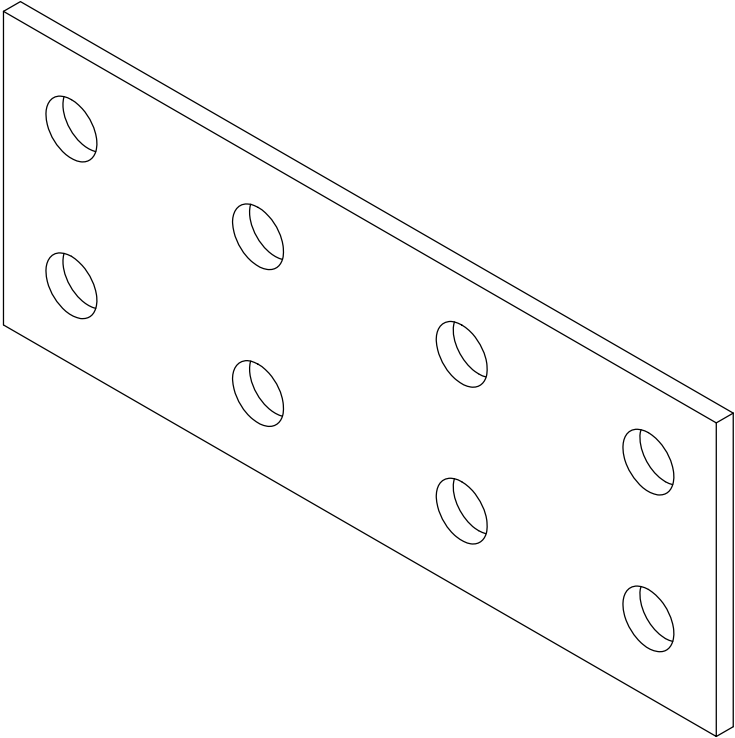


MATERIAL: CARBON STEEL

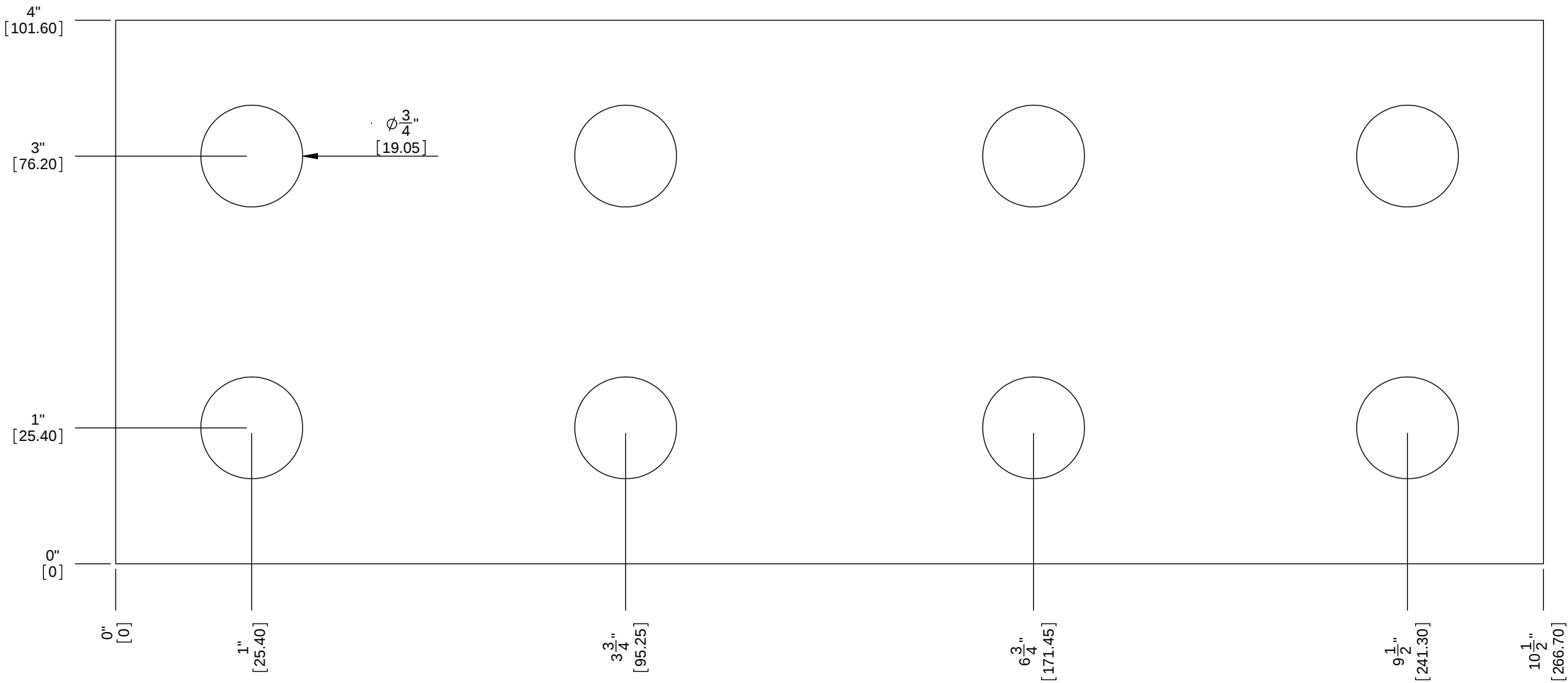
<u>TOLERANCE</u>	 UNISON SOLUTIONS	Unison Solutions Inc. 5451 Chavenelle Road Dubuque, IA 52002		
ALL DIMENSIONS ARE +/- 1/16" UNLESS OTHERWISE SPECIFIED		PHONE: 563-585-0967 FAX: 563-585-0970		
<u>DIMENSIONS</u>		PROJECT BioCNG-100		
ALL DIMENSIONS ARE IN INCHES [MM] UNLESS OTHERWISE SPECIFIED		DESCRIPTION CONNECTION BRACKET		
<u>PROPRIETARY AND CONFIDENTIAL</u>		DRAWN BY TAB DATE 10/15/2012		
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	DWG. NO.	6C-B102-01		

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ISOMETRIC VIEW

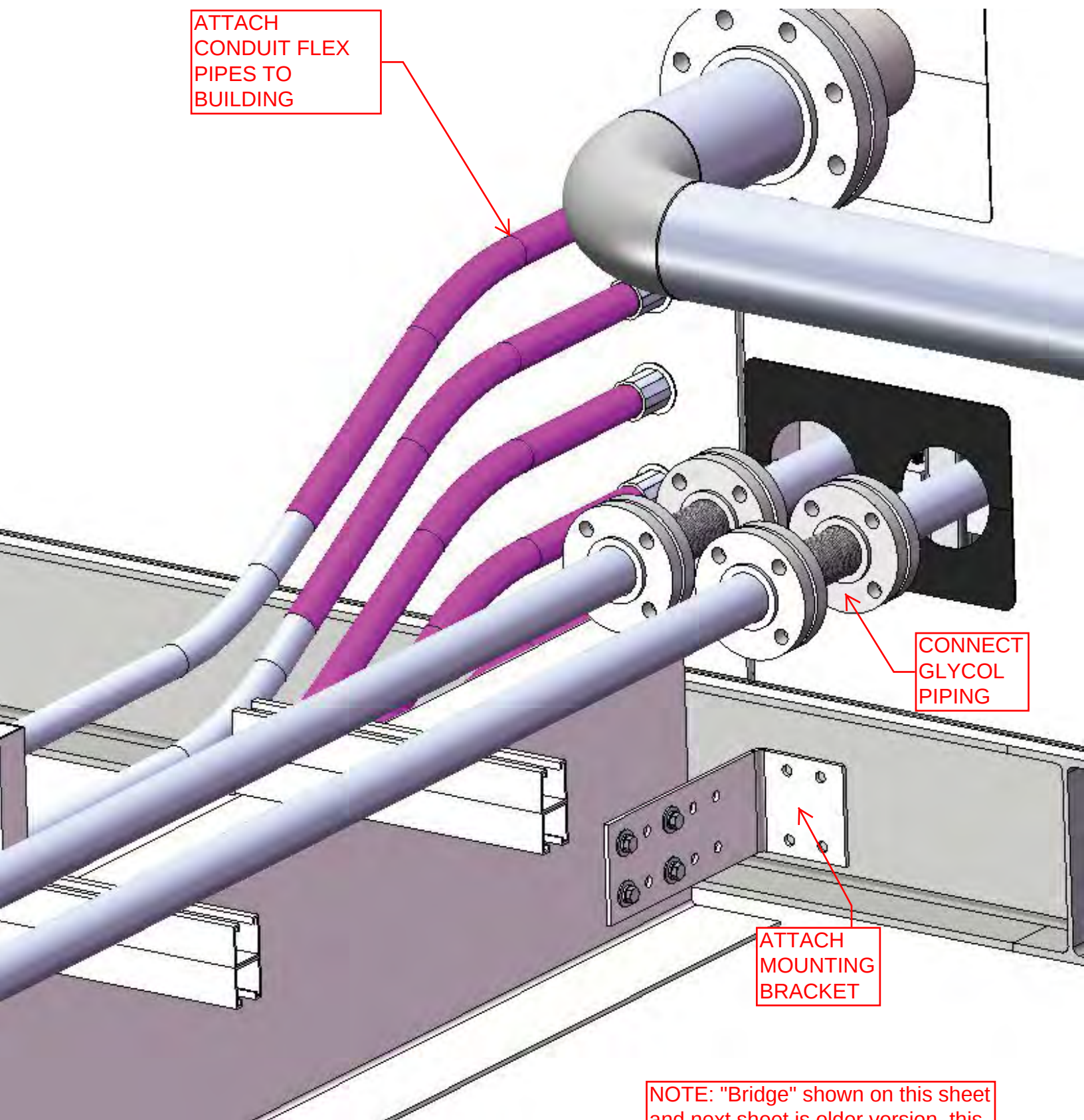


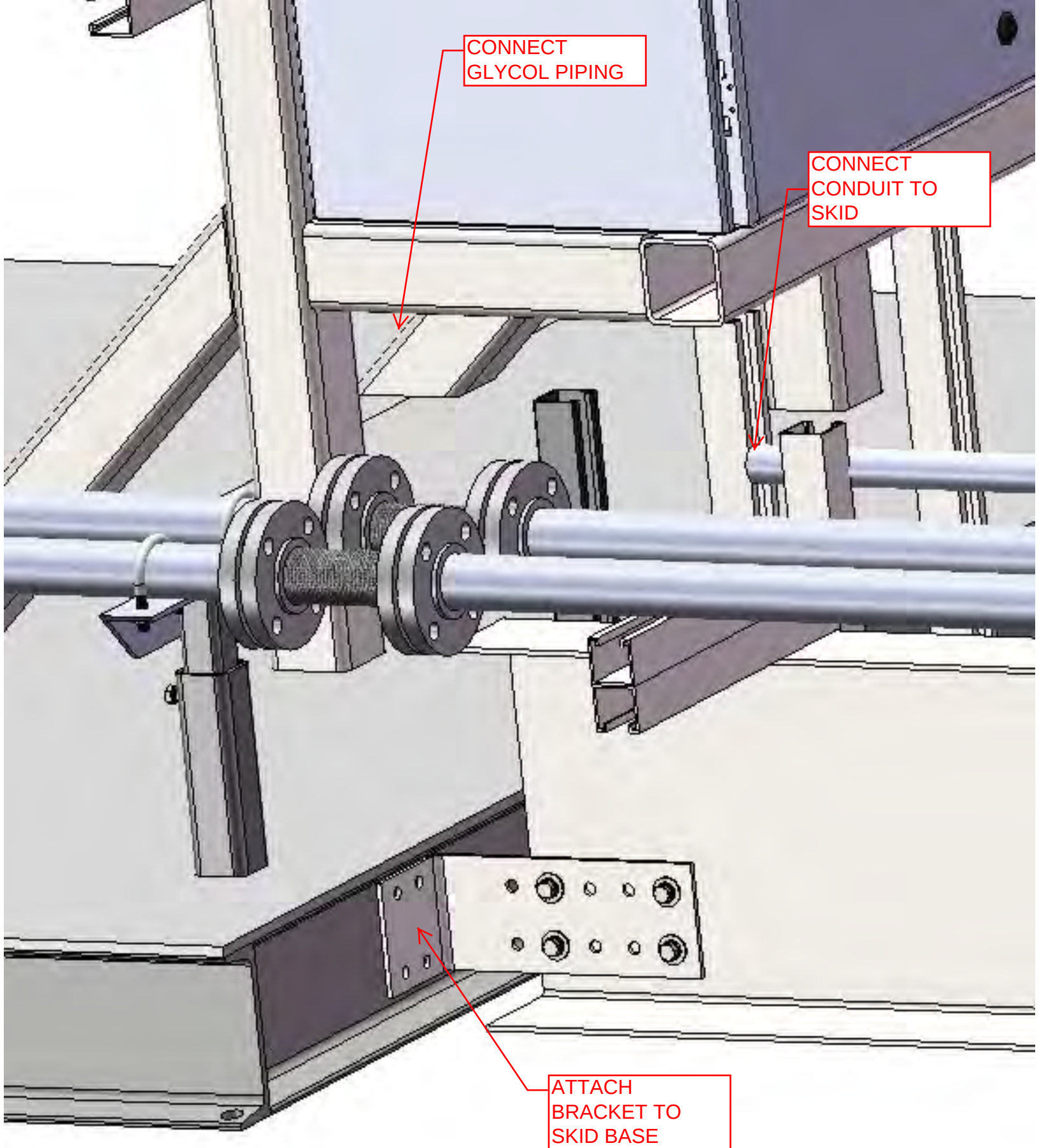
FRONT VIEW

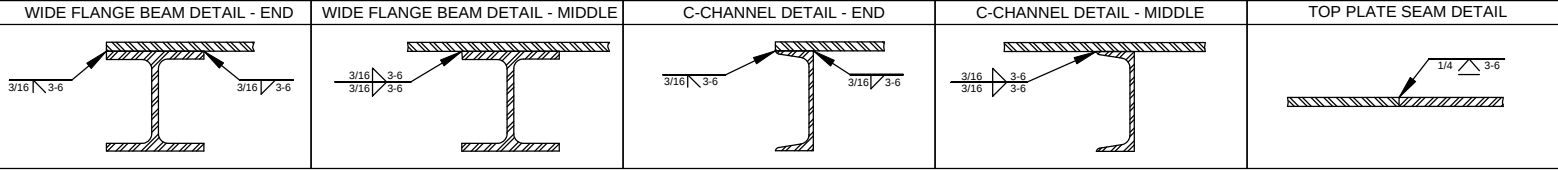


ITEM NO.	QTY.	SIZE	Description	Material	LENGTH
1	1	4"	FLAT BAR 1/4" WALL	CARBON STEEL	10 1/2"

<u>TOLERANCE</u>	 UNISON SOLUTIONS	Unison Solutions Inc. 5451 Chavenelle Road Dubuque, IA 52002		
ALL DIMENSIONS ARE +/- 1/16" UNLESS OTHERWISE SPECIFIED		PHONE: 563-585-0967 FAX: 563-585-0970		
<u>DIMENSIONS</u>		PROJECT BioCNG-100		
ALL DIMENSIONS ARE IN INCHES [MM] UNLESS OTHERWISE SPECIFIED		DESCRIPTION CONNECTION BRACKET		
<u>PROPRIETARY AND CONFIDENTIAL</u>				
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	DRAWN BY	TAB	DATE	10/15/2012
	QUANTITY	2	WEIGHT	LBS.
	DWG. NO.	6C-B102-02		





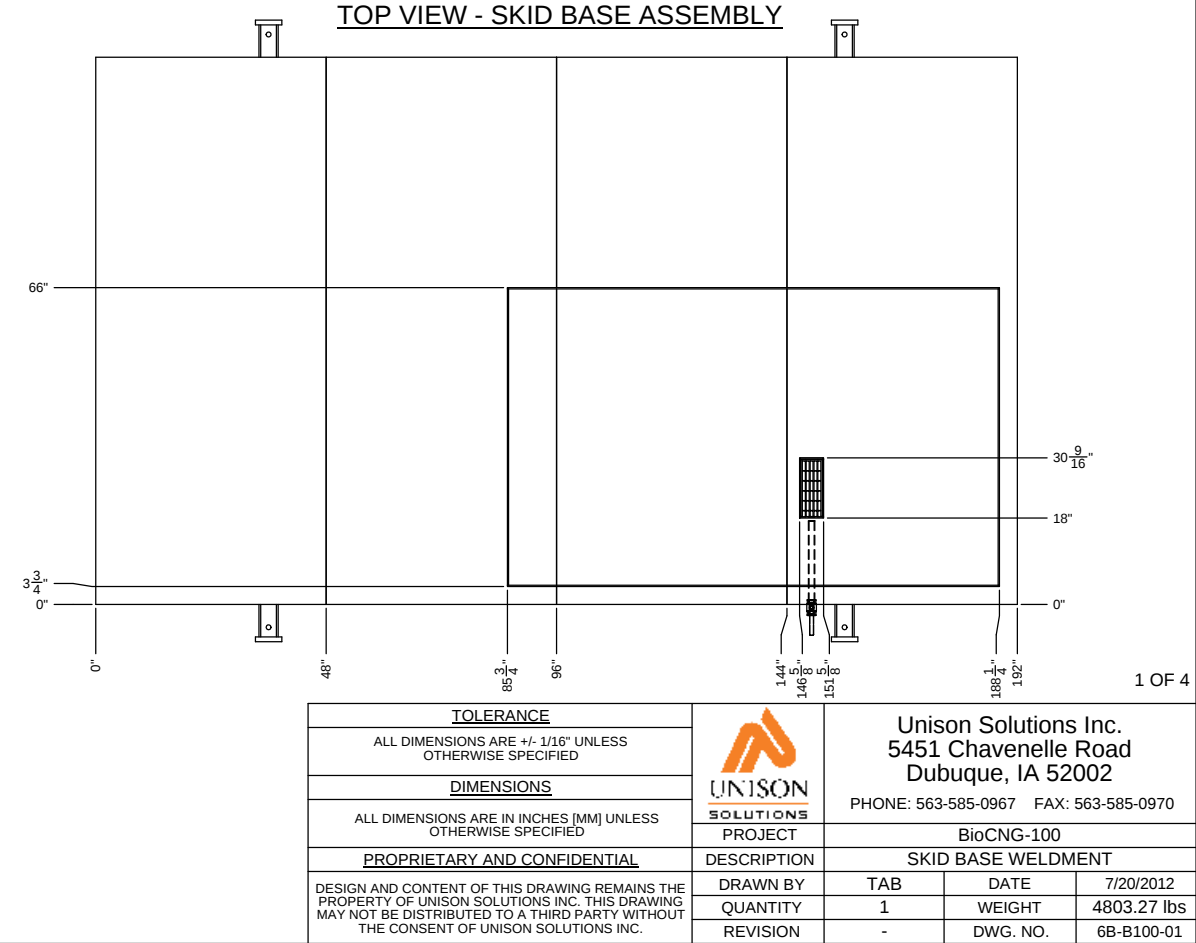
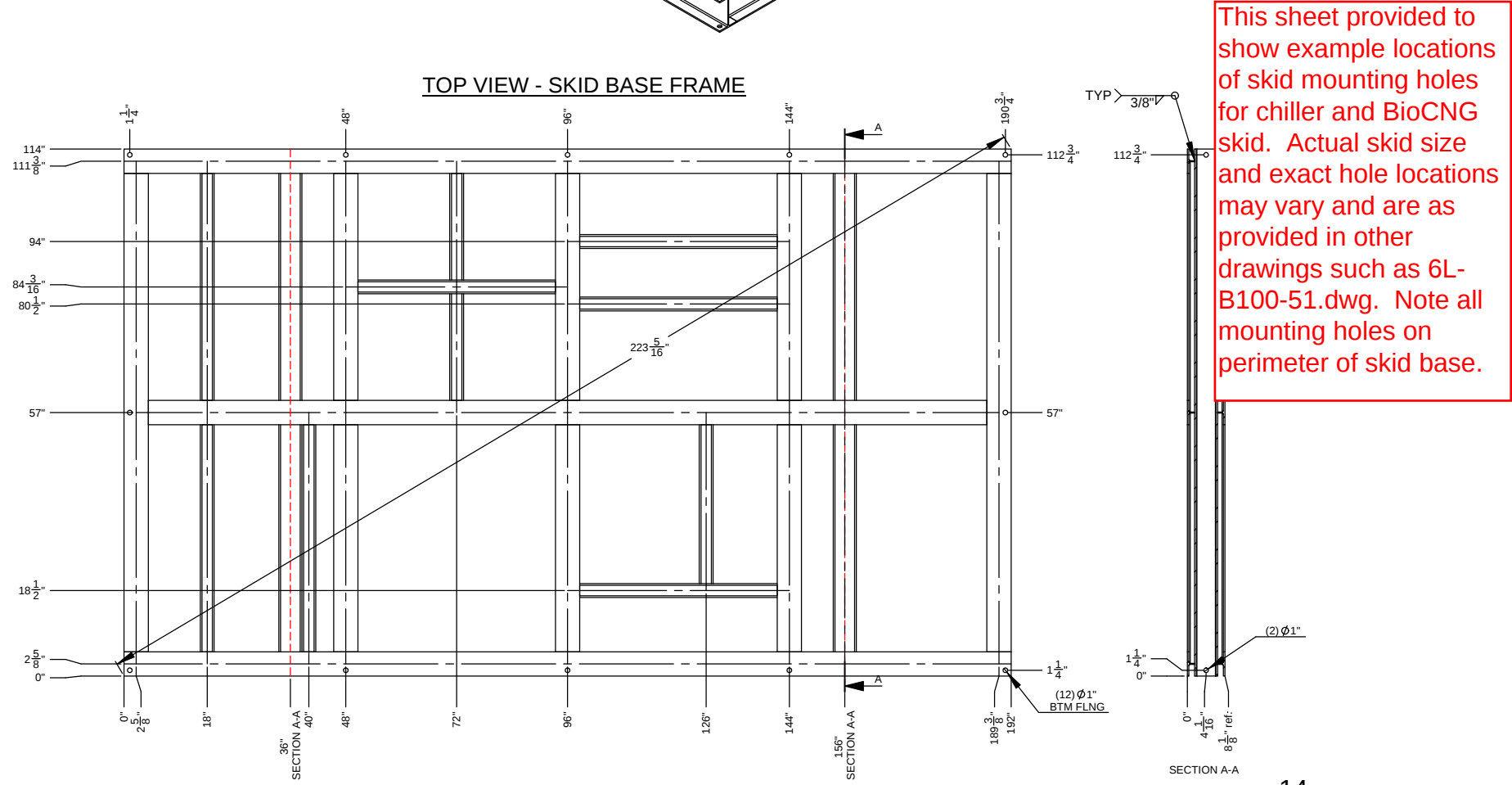
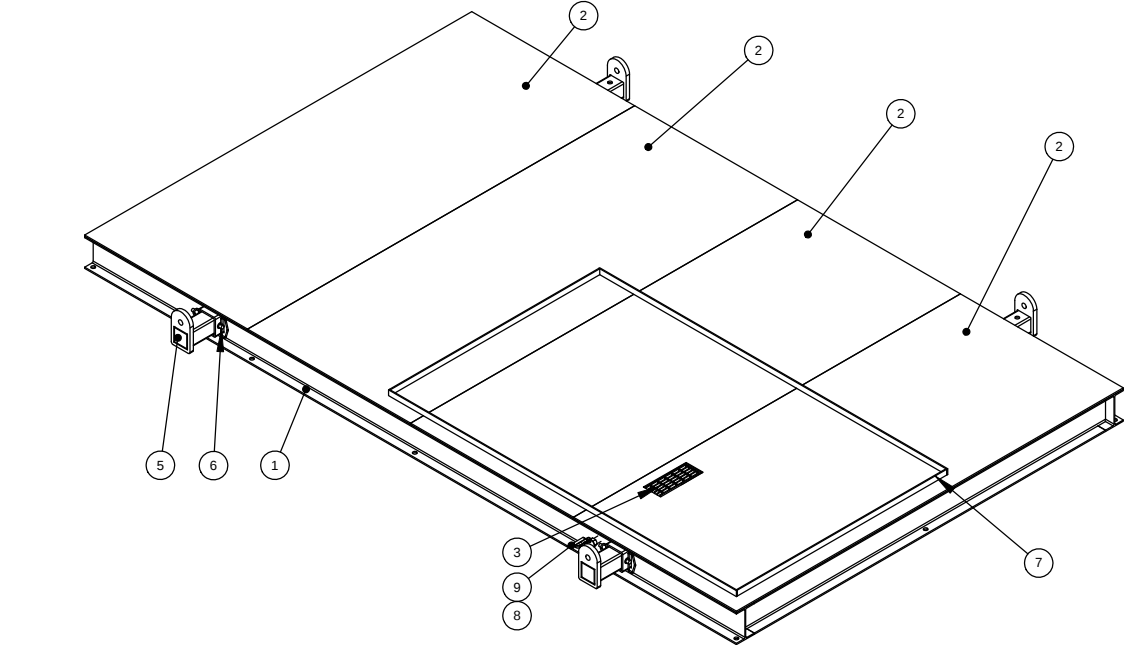
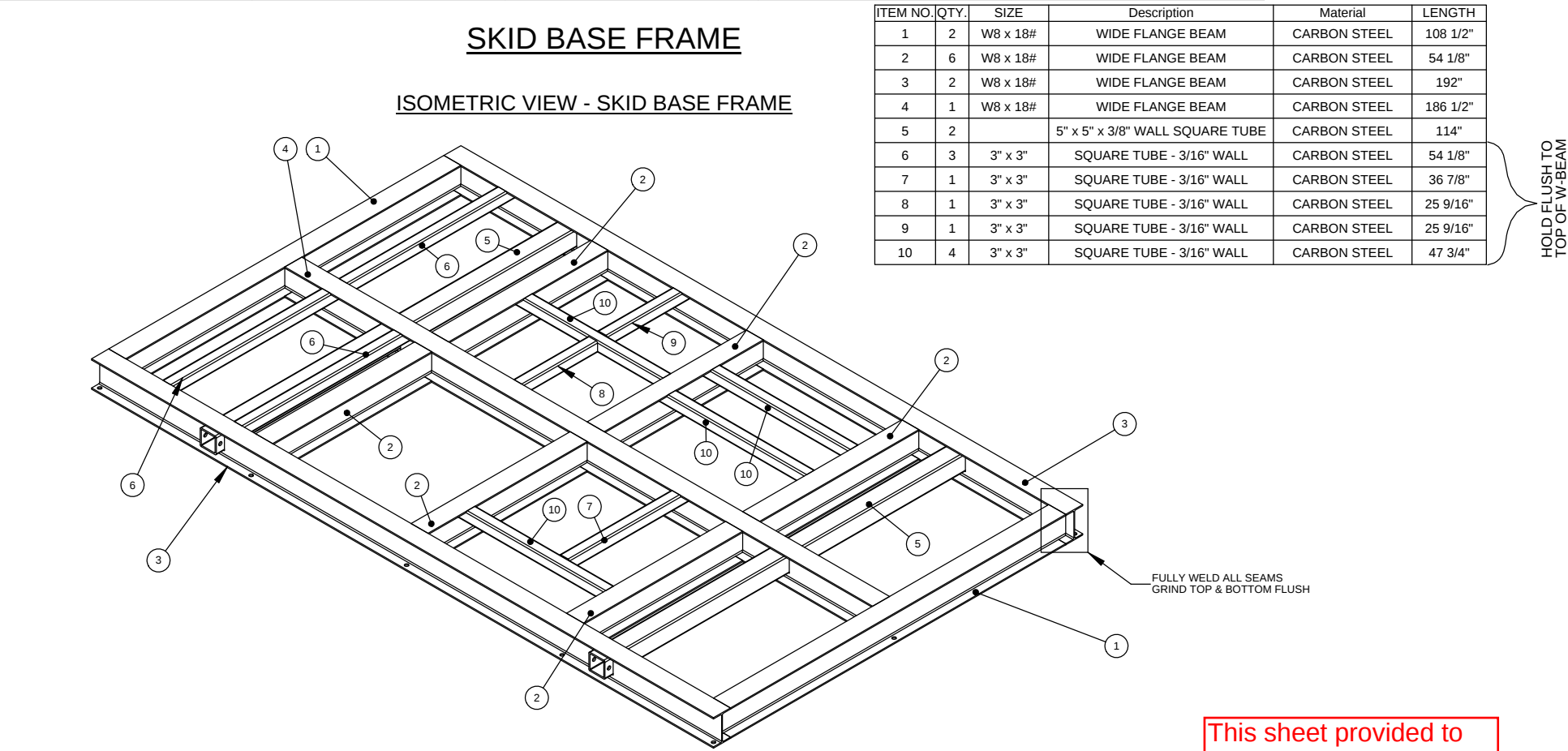


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SKID BASE ASSEMBLY

ISOMETRIC VIEW - SKID BASE ASSEMBLY

ITEM NO.	SIZE	DESCRIPTION	MATERIAL	LENGTH	UOM	QTY.
1		SKID BASE WELDMENT				1
2	4'W x 9'-6"L x 3/8" T	SKID BASE TOP PLATE	CARBON STEEL		EA	4
3		FLOOR DRAIN	CARBON STEEL			1
4	1"	HALF COUPLING CLASS 3000	SA/A-182 F304L		EA	1
5		REMOVABLE LIFT LUG WELDMENT				4
6		7/8" HITCH PIN(MCMMASTER# 98497A666)	HARDENED ZINC			4
7		OIL DAM	CARBON STEEL			1
8	1"	WELD PIPE SCH 40S	SA-312 TP304L	17	IN	1
9	1"	(VB) - SHARPE - 50M76	CF8M 316		EA	1



Decal provided on
BioCNG skid
enclosure by
BioCNG





INSTALLATION GUIDE

Site Information:

Engineering Services:

Manufactured By:

Unison Solutions, Inc
5451 Chavenelle Rd
Dubuque, IA 52002
(563) 585-0967
(563) 585-0970 (f)
Project #: ###

Upon arrival of the BioCNG system, it should be inspected for shipping damage. Report any damage immediately to the carrier. There will be a packing list included with the shipment. Verify that everything has arrived, and store additional pallets etc. in a safe dry place for use during the installation and commissioning process. For long term storage of equipment, verify with Unison for proper maintenance procedures for equipment stored.

CODE COMPLIANCE / SAFETY

It is the responsibility of the customer to install all BioCNG equipment in compliance with local and national codes applicable to the installation site. These codes may dictate things such as electrical service interconnection requirements, protective barrier requirements, ventilation requirements, combustible gas detection, fire detection/suppression, noise emission regulations, proximity to electrical gear or combustible materials, local motor disconnect requirements, emergency stop requirements and others.

Proper safety practices should be used on site during and after the installation process. It may be desirable to keep a fire extinguisher on site and provide earplugs for use by site personnel or visitors. Signs should be posted on site calling out any of the following conditions that are applicable:

- Flammable Gas
- No Smoking
- Hearing Protection Required
- Trip Hazards
- Sharp edges
- Bottled gas placards (propane for flare pilot, nitrogen for actuated valves, etc.)

UNPACKING

Site Layout and Mounting:

Before the BioCNG gas conditioning system is installed, it will be necessary to pick a suitable area to mount the skid. It is recommended that a clearance of 40" be maintained around the entire perimeter of the skid to allow adequate room for maintenance.



Figure IG-1: Typical Site Layout

The mounting surface should be a flat level area. A concrete pad extending a foot or more beyond each edge of the skid is recommended. The surface should have less than a 2% grade.

Outdoor Installation:

For outdoor BioCNG systems installed in cold climates, heat tracing and insulation will need to be installed on all condensate piping as well as some gas conditioning piping. Heat tracing should be wired directly to the site switchgear or other power distribution panel, not to the skid control panel. Refer to the Piping Interconnection section below for instruction on properly venting pressure relief valves.

Indoor Installation:

For indoor systems, it is recommended that ventilation be provided in the building at a rate of 12 air exchanges per hour. This serves the purpose of dissipating excess heat and preventing any combustible gases from accumulating inside the building. When installing the skid in an enclosed building, it is highly recommended to install a combustible gas detector that alarms when levels reach

10% of the lower explosive limit of the gas. Refer to the Piping Interconnection section below for instruction on properly venting pressure relief valves.

Moving the Skid:

The skid will be equipped with lifting eyes; a crane will be required to set the skid. In this scenario, a sling with spreader bars is required to avoid damaging skid components.

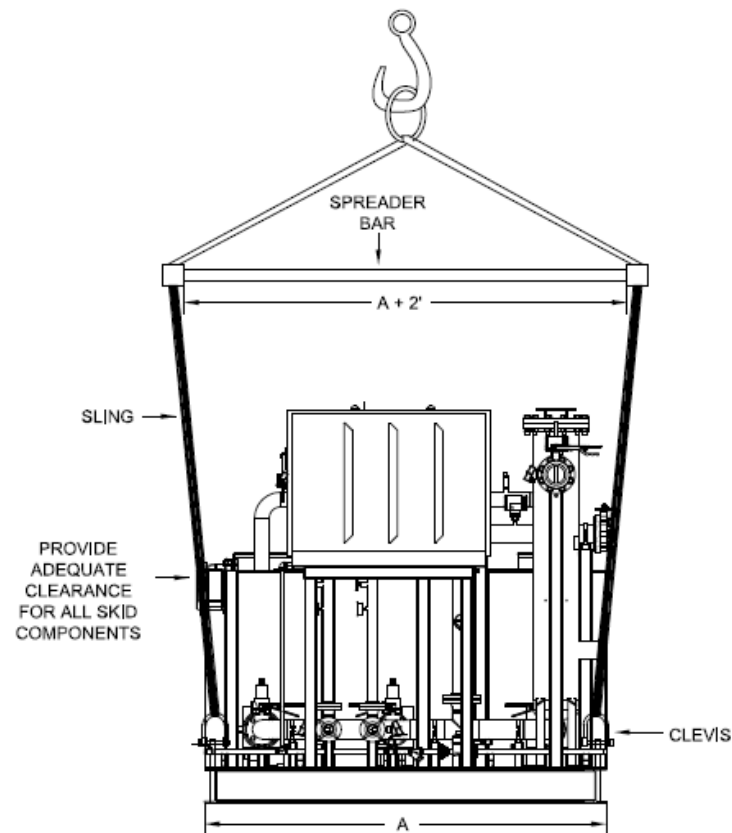


Figure IG-2: Typical Rigging

The skid has also been designed so that machine dollies can also be used to maneuver the skid to an indoor location.

SKID BASE INSTALLATION GUIDE

I. General Information:

- A. This guide is intended to provide a recommended standard method of mounting steel skid base framing members to an existing concrete slab.
 - B. Place anchors and grout at all predrilled bottom flange skid holes provided.
 - C. Existing concrete slab requirements:
 - 1. Minimum 8 inches thick.
 - 2. Minimum 3000 psi 28-day concrete compressive strength.
 - 3. Minimum 7 days of slab cure time before skid installation.
- **Owner/contractor must verify that the slab and subgrade system has adequate capacity and stiffness to support the skid and minimize/eliminate system vibration.

II. Material List with Suggested Product or Material Specification:

- A. Wooden shims.
- B. High performance epoxy grout system capable of properly transmitting static and dynamic loads to the skid foundation. Reference products:
 - 1. Masterflow® 648 CP as manufactured by BASF The Chemical Company or equivalent.
- C. Epoxy adhesive anchoring system capable of sustaining long-term cyclic loading. Reference products:
 - 1. HIT-RE 500-SD as manufactured by Hilti, Inc. or equivalent.
- D. Threaded anchor rods: ASTM A36 or A307

III. Recommended Installation Procedure:

- A. Position skid at desired location.
- B. Mark the center of each mounting hole and the grout locations on the concrete slab. (see Figure IG-3)
- C. Remove skid from installation location.
- D. Drill anchor holes in concrete slab at previously marked locations per epoxy adhesive manufacturer's instructions.

Required anchor rod embedment depths:

Anchor rod diameter (in)	Minimum embedment into epoxy (in)
3/8	2 1/2
1/2	2 7/8
5/8	3 1/4
3/4	3 1/2
1	4

- E. Chip the concrete surface at grout locations so aggregate is exposed to create a rough surface.
- F. Prepare anchor holes in concrete slab per epoxy adhesive manufacturer's instructions.
- G. Vacuum clean chipped concrete surfaces and anchor holes.
- H. Reposition skid over anchor holes.
- I. Level skid with wooden shims – set shims outside of grout locations and allow for a minimum of 1/2" gap between top of slab and bottom of base beam at each grout location (see Figure IG-3).

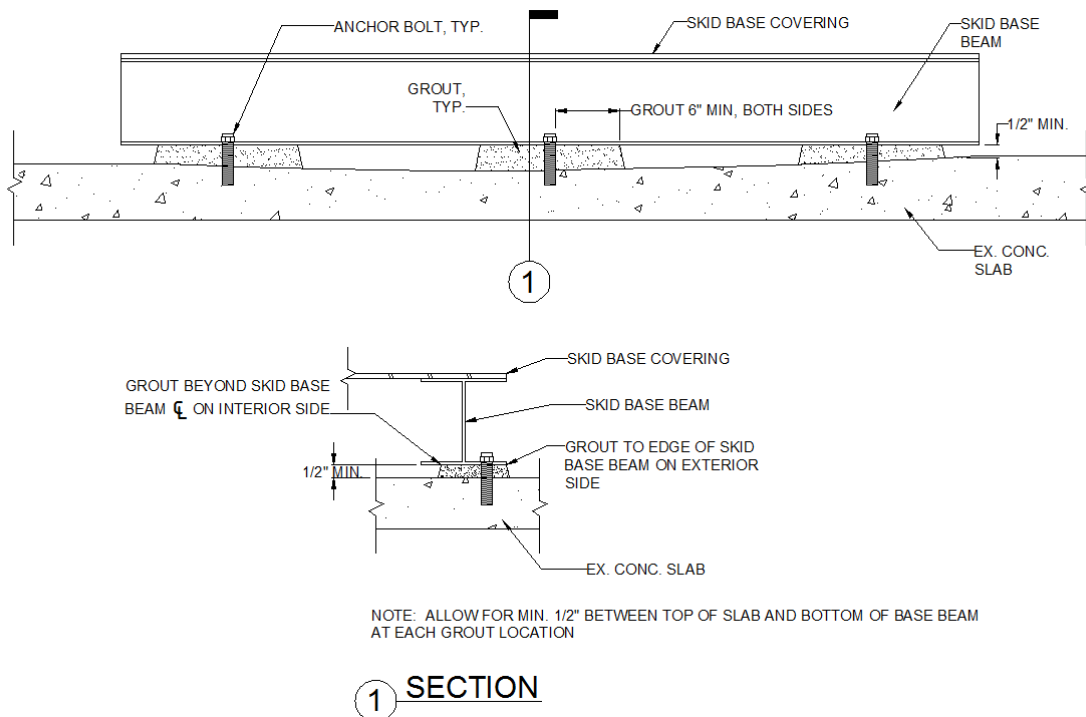


Figure IG-3: Typical Grout Locations

- J. Install threaded anchor rods into epoxy adhesive per manufacturer's instructions. Take care to install plumb and provide minimum 1" thread projection above skid base beam bottom flange.
- K. Grout under skid base beams per grout manufacturer's instructions and Figure IG-3. (If skid base is open, place grout under entire flange width)
- L. Allow grout to cure a minimum of 16 hours at 70°F. For other temperatures refer to manufacturers recommendations.
- M. Remove wooden shims.
- N. Snug-tighten skid base beams to concrete slab with anchor nuts. The snug-tightened condition is the tightness that is attained by the full effort of a worker using an ordinary spud wrench.

**** These instructions do not replace/supersede any local codes, standards or required professional review or stamp. It is the owner's responsibility to ensure all local, state or federal guidelines are followed. (i.e. wind, seismic, etc.)**

ELECTRICAL INSTALLATION

Panel Mounting:

The standard design for nearly all BioCNG systems includes a skid designed to be mounted in a Class I Division 1 area, and a control panel designed to be mounted in an unclassified area. Therefore, nearly all skid control panels are shipped loose to be field installed at a location remote from the skid. The following installation instructions describe this scenario.

In addition to the system control panel, some skids have separate motor control panels, gas monitoring panels, or other auxiliary electrical panels which need to be mounted in unclassified areas. If the panels included with the skid are not free standing and are not provided with their own stands, mounting height instructions will be attached to each panel so that they can be wall mounted to achieve an optimum height for viewing display screens and operating controls. Panels can be mounted outdoors only if the panel holds an outdoor rating. Follow local and national electric codes for all panel installations. On the side of the control panel, there is a serial number tag for the system. This tag will list the rating for the panel.

Conduit and Wiring:

Rigid metal conduit will need to be run between the electrical panel(s) and one or more explosion proof motors and J-boxes on the skid. The maximum conduit run distance should be limited to 200 feet to avoid signal losses in the field wiring. A conduit plug should then be installed into any unused holes in the skid J-boxes. Explosion proof flexible conduit connectors should be used to connect to motors, and conduit seals shall be provided for conduits entering and/or leaving the Class I, Division 1 Electrical Area. Conduit seals will need to be filled during Start-up & Commissioning after verification of field wiring by Unison's Start-up Technician. Conduit seals are to be filled prior to the introduction of gas to the equipment. For more information on wiring in classified areas, refer to article 500 of the NEC

Conduit and wire sizing is the responsibility of the customer. However, full load amperage ratings for 480V circuits and for the control panel feed circuit, and some other general guidelines are provided on the electrical drawings listed below. For UL approved panels, a label inside the panel will specify the type of field wiring to be used, type of conduit hubs to be used for panel entry, and tightening torques on terminal blocks.

Lightning Protection System:

For outdoor installations, it is recommended that a lightning protection system be installed and bonded to the electrical service grounding electrode system according to article 250.106 of the NEC

2008 Edition. Ground lugs will need to be attached to the base of each skid (including chillers), one leg of each vessel, and any other metal equipment which is electrically isolated. Do not attach lugs to the bodies of vessels, as this may compromise the integrity of the vessel and cause leaks or ruptures. It is the responsibility of the customer to install proper equipment lightning protection per NEC 250.106 2008 Edition, and other local codes that may apply.

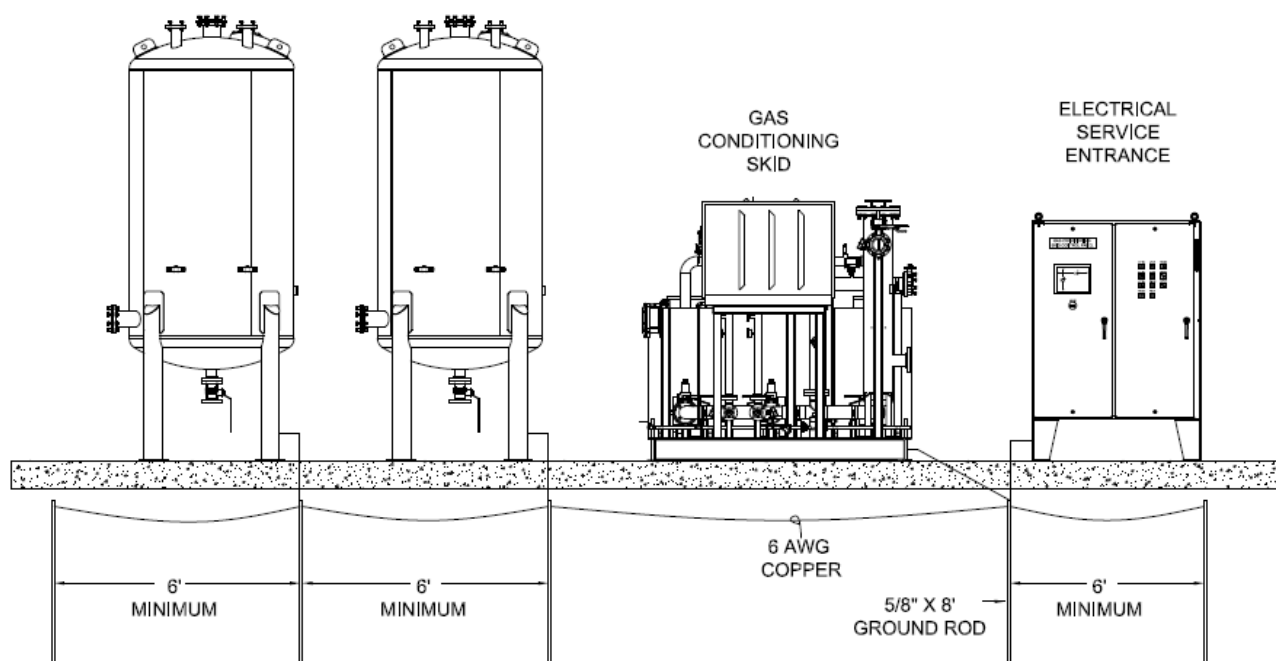


Figure IG-4: Typical Lightning Protection

Installation / Wiring Diagrams:

An electrical conduit one-line diagram is provided on drawing # 4L-###-#-01. This diagram shows conduit runs required to install the BioCNG system, and also the number of wires required in each conduit. To determine J-box placement on a skid that has not yet been delivered, refer to drawing 6L-###-X-01. A termination schedule for landing wires is provided on the 7E-###-#-XX drawings.

Wiring of Optional Contacts:

All BioCNG systems include several skid status contacts and customer input terminals that can be used to interlock the system to the vehicle fueling station as well as other customer devices. Each of these connections are outlined below:

Customer Fault Contact: Designated as CC 31, this contact is found on page 7E-###-X-11 of the termination schedule. This contact is powered from the panel and comes with a factory jumper installed. To utilize this input, remove the factory jumper and wire the terminals to a normally closed customer contact (such as an LEL sensor). When the contact opens, the system will shut down immediately.

Spare Customer Contact: Designated as CC 32, this contact is found on page 7E-###-X-11 of the termination schedule. This contact is powered from the panel. To utilize this contact, wire the terminals to a normally open customer contact.

Vehicle Fueling Station Available Contact: Designated as CC 33, this contact is found on page 7E-###-X-11 of the termination schedule. The contact is powered from the panel. To utilize this input wire the terminals to the vehicle fueling station gas storage low pressure switch. Upon depletion of gas storage and the subsequent loss of pressure this contact will close alerting the BioCNG system that it must start processing biogas.

Vehicle Fueling Station Fault Contact: Designated as CC 34, this contact is found on page 7E-###-X-11 of the termination schedule. This contact is powered from the panel and comes with a factory jumper installed. To utilize this input, remove the factory jumper and wire the terminals to a normally closed vehicle fueling station contact. When the contact opens, the system will shut down immediately.

Vehicle Fueling Station Run Permissive Contact: Designated as CR 4002, this contact is found on page 7E-###-X-11 of the termination schedule. This is a normally open contact that shall be used as a run permissive for the vehicle fueling station. On initial startup, the contact will not close until all the operating parameters for the BioCNG system are in range and the operating pressure has been reached. After the contact is closed, it will not open again until the system is shut down. Power for this contact is supplied from the customer monitoring device.

PIPING INTERCONNECTION

The following are generic piping instructions for all BioCNG systems. No system will include all of these connections, to identify the connections and device placement which apply to each installation, use the piping interconnection drawing(s) 6L-### -X-01. Be sure to remove any plastic pipe plugs or tape covering connections points prior to installing field piping.

Gas Piping Connections:

It is recommended that stainless steel pipe be used for all biogas piping connections. Unison also recommends that expansion joints or flexible sleeves be used on the gas inlet and outlet to ensure isolation of the piping systems from the BioCNG skid. Pipe stands should be placed off the skid at all connection points to support the field piping. At no time should field piping be supported from the skid or vessel connection points.

Pressure Relief Valve Connections:

These connections should be piped away from the system. The discharge pipe shall be a dedicated pipe vented to a location which will not put people, animals, or property in harm's way. Refer to local codes when installing vent piping. Unison recommends a 5 ft. clearance from the discharge of the pipe to any electrical components for outdoor applications. Relief valves on skids being installed indoors should have a dedicated vent to the exterior of the building. Some other general rules to follow:

- Do not install isolation valves on either side of pressure relief valves.
- The open end of the discharge piping should be protected from debris and animals.
- Place a warning label on the piping which identifies the media inside the piping.

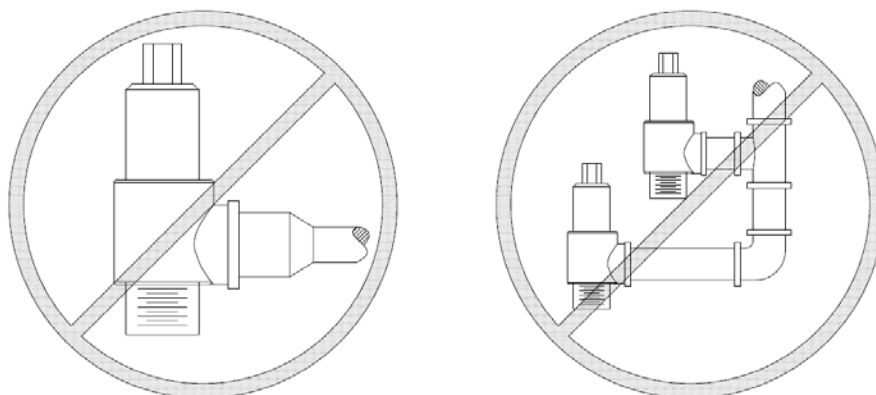


Figure IG-5: Pressure Relief Valve Installation

Condensate Drain Connections:

All BioCNG systems will include condensate drain connections. The size and number of condensate drain connections will vary from system to system. It is recommended that stainless steel pipe be used for all condensate piping connections.

MOTOR ALIGNMENT

Shipping and transportation of the BioCNG equipment requires that the compressor will need final alignment in the field prior to start-up. Correct shaft alignment ensures long life and reduced service to the BioCNG equipment. Misalignment is one of the most common causes of machine vibration and premature bearing failure.

Direct Drive:

Alignment can be achieved using several methods:

1. Laser Alignment
2. Reverse Dial Indicator Method
3. Single Dial Indicator Method

The following conditions can affect alignment and will need to be checked to ensure proper alignment.

1. Base foundation is level and smooth
2. Piping is isolated using flexible sleeves or expansion joints
3. Vibration pads (if equipped) must be installed
4. Check for soft foot.

Lack of vibration at start-up does not necessarily indicate proper alignment.

Belt Drive:

Alignment can be achieved using the following method:

1. Alignment is checked by placing a straight edge across the faces of both sheaves. If properly aligned the straight edge will contact both sheave faces squarely.
2. Incorrect alignment can be adjusted by moving the motor into proper position.

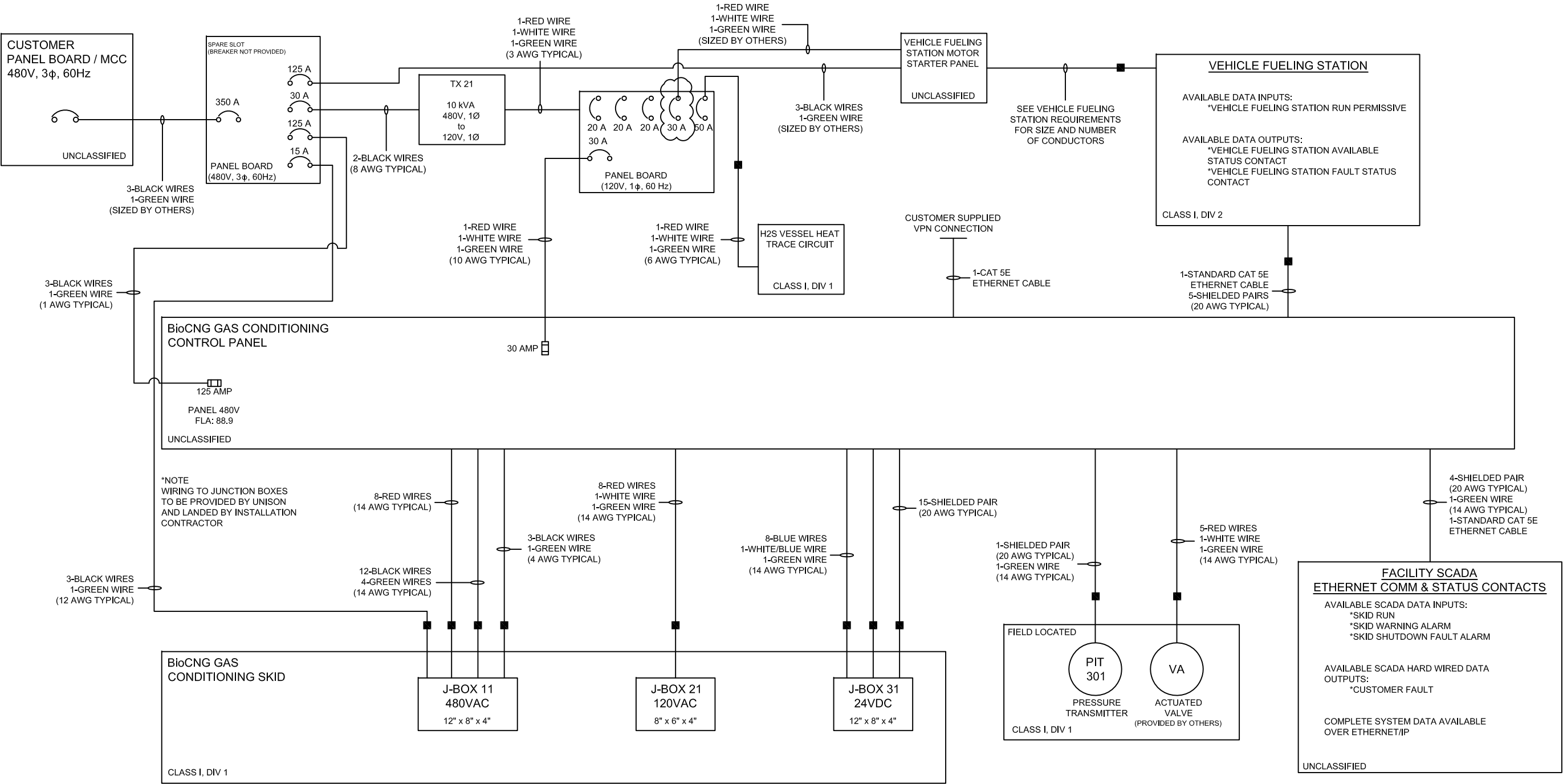
The following conditions can affect alignment and will need to be checked to ensure proper alignment.

1. Base foundation is level and smooth
2. Piping is isolated using flexible sleeves or expansion joints
3. Vibration pads (if equipped) must be installed
4. Check for soft foot.

Proper belt tension is important to ensure maximum belt and bearing life. Follow the instructions provided with your belt tension meter to determine proper belt tension. Belts may stretch slightly when first placed into service; therefore belt tension will need to be checked after the system has been running a few hours. When replacing belts, always replace with matching belts of the same

type and manufacturer. Never mix new and used belts on a drive. Never force belts over the sheave. Remove tension from the belts when out of service for extended periods.

1.2 Electrical

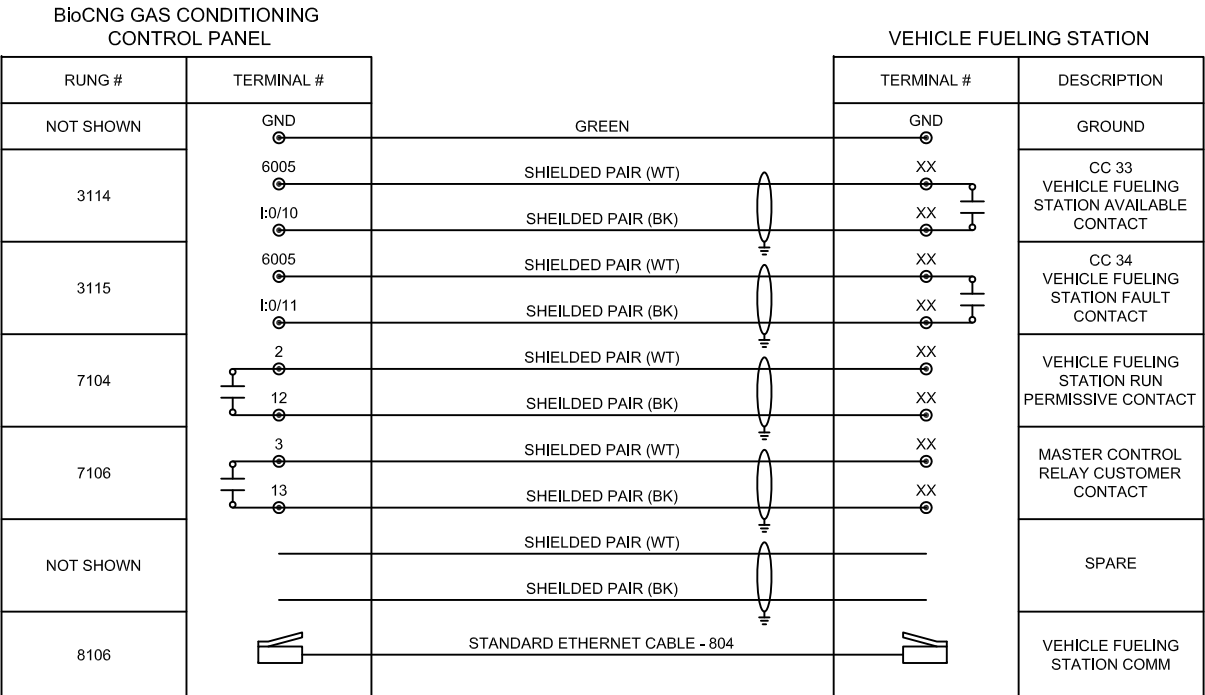
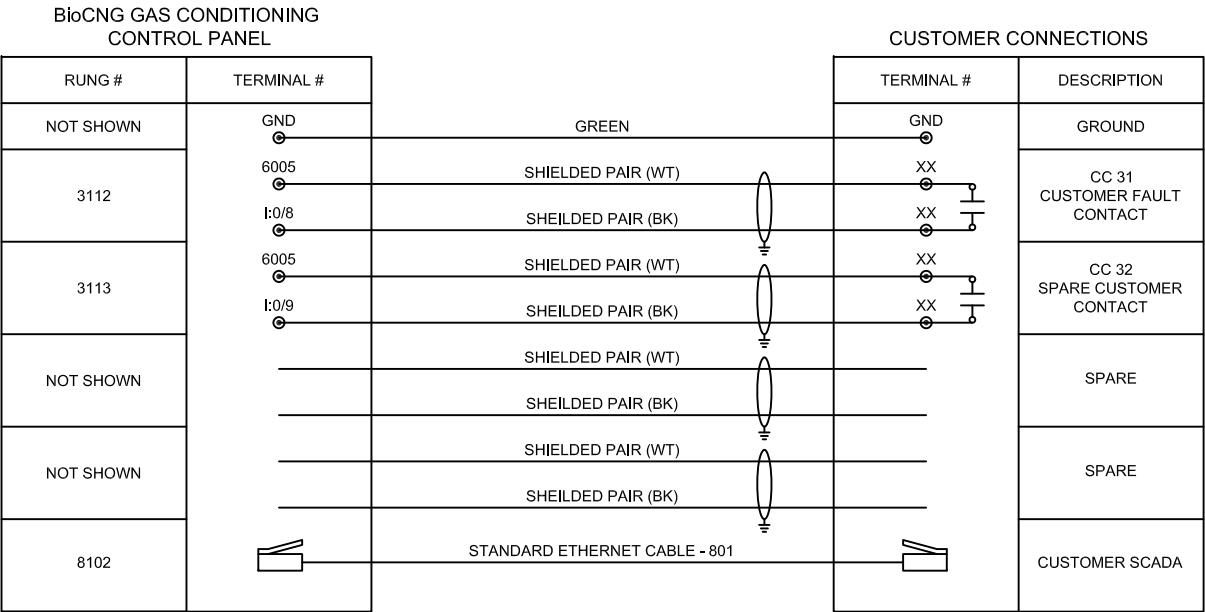


- CONDUIT RUNS TO UNCLASSIFIED AREAS WHICH PASS THROUGH CLASSIFIED AREAS MAY REQUIRE SEAL OFFS AT EACH CLASSIFIED AREA BOUNDARY
- SEALS OFFS IN FIELD AND BEAM MOUNTED CONDUITS ARE TO BE FILLED DURING START-UP AND COMMISSIONING AFTER WIRING HAS BEEN VERIFIED BY THE UNISON STARTUP TECHNICIAN
- WIRE COUNTS INCLUDE SPARES
- CONDUITS SIZED BY OTHERS
- THE INSTALLATION CONTRACTOR RESPONSIBLE FOR PROVIDING AND POWERING FIELD LOCATED RECEPTACLES, HEAT TRACING AND/OR LIGHTING
- SHIELDED PAIR WIRE TO BE BELDEN PART NUMBER 1033A (20 AWG) OR EQUIVALENT
- SHIELDED TRIAD WIRE TO BE BELDEN PART NUMBER 1526A (20 AWG) OR EQUIVALENT
- FOR OUTDOOR EQUIPMENT, IT IS RECOMMENDED THAT PROPER GROUNDING BE INSTALLED TO PROVIDE LIGHTNING PROTECTION ACCORDING TO THE NEC 250.106. DRILL AND TAP GROUND LUGS TO EACH OUTDOOR SKID DECK AND TO ONE LEG OF EACH OUTDOOR FILTRATION VESSEL. BOND THE EQUIPMENT TO THE SERVICE ENTRANCE ELECTRODE SYSTEM.
- CUSTOMER CONDUIT ENTRIES INTO J-BOXES ARE PRE-DRILLED AT 1" NPT

APPROVED FOR FABRICATION
APPROVED BY: JDL
DATE: 11/13/12

 UNISON SOLUTIONS		Unison Solutions Inc. 5451 Chavenelle Road Dubuque, IA 52002 PHONE: 563-585-0967 FAX: 563-585-0970	
PROPRIETARY AND CONFIDENTIAL DESIGN AND CONTENT OF THIS DRAWING REMAINS THE PROPERTY OF UNISON SOLUTIONS INC. THIS DRAWING MAY NOT BE DISTRIBUTED TO A THIRD PARTY WITHOUT THE CONSENT OF UNISON SOLUTIONS INC.			
PROJECT		165 - RIVERVIEW	
DESCRIPTION		ELECTRICAL ONE LINE DIAGRAM	
DRAWN BY		JDL	DATE 10/4/12
DWG. NO.		4L-165-2-01	

1. 14 AWG WIRE TYPICAL
2. SEAL OFFS REQUIRED AT ENTRY INTO CLASSIFIED AREAS
3. MAY REQUIRE REQUIRE MULTIPLE CONDUIT RUNS
4. 20 AWG SHIELDED PAIR & TRIAD TYPICAL
5. SHIELDED PAIR TO BE BELDEN P/N 1033A OR EQUIVALENT
6. SHIELDED TRIAD TO BE BELDEN P/N 1526A OR EQUIVALENT
7. MAY REQUIRE CONDUIT RUNS TO MULTIPLE LOCATIONS



APPROVED FOR FABRICATION

APPROVED BY: JDL
DATE: 10/19/12



UNISON
SOLUTIONS

Unison Solutions Inc.
5451 Chavenelle Road
Dubuque, IA 52002
PHONE: 563-585-0967 FAX: 563-585-0970

PROPRIETARY AND CONFIDENTIAL

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PROJECT	165 - RIVERVIEW		
DESCRIPTION	TERMINATION SCHEDULE		
DRAWN BY	JDL	DATE	10/04/12
DWG. NO.	7E-165-2-11		



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



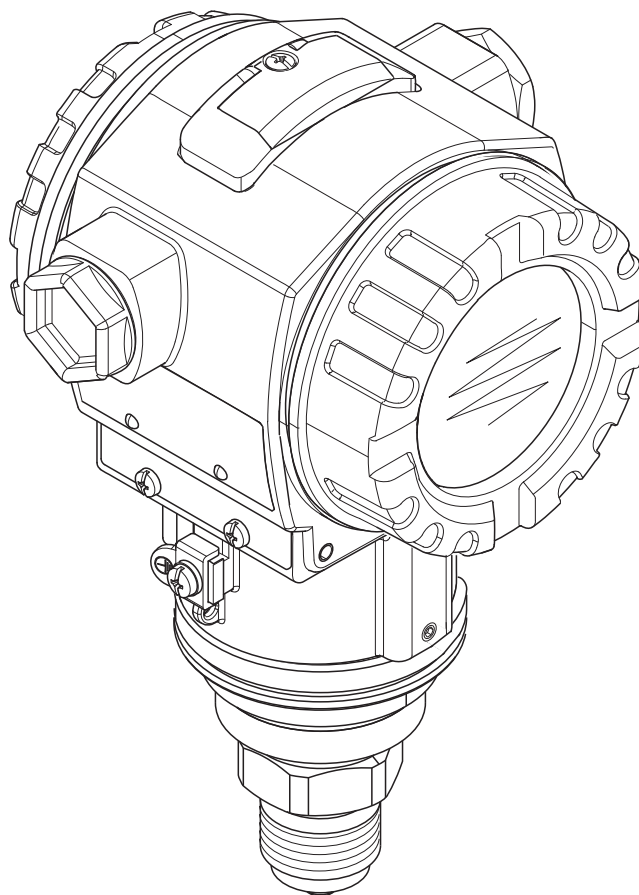
Solutions

Operating Instructions

Cerabar S **PMC71**, PMP71, PMP75

Process pressure measurement

Model Number PMC71-TBC1EBRAAAA, with 1/2"
MNPT Connection



BA00271P/00/EN/13.11
71139779

valid from Software version:
02.10.zz

Overview documentation

Device	Documentation	Content	Remarks
Cerabar S 4 to 20 mA HART	Technical Information TI00383P	Technical data	– The documentation is located on the supplied CD-ROM. – The documentation is also available via the Internet. See: www.endress.com → Download
	Operating Instructions BA00271P	– Identification – Installation – Wiring – Operation – Commissioning, Description of Quick Setup menus – Maintenance – Trouble-shooting and spare parts – Appendix: Illustration of menu	
	Operating Instructions BA00274P	– Examples of configuration for pressure and level measurement – Description of parameters – Trouble-shooting – Appendix: Illustration of menu	
	Brief Operating Instructions KA01019P	– Installation – Wiring – Operation on-site – Commissioning – Description of Quick Setup menus	– The documentation is supplied with the device. – The documentation can also be found on the supplied CD-ROM. – The documentation is also available on the internet: See www.endress.com → Download
	Brief Operating Instructions KA00218P	– Wiring – Operation without on-site display – Description of Quick Setup menus – Operation HistoROM®/M-DAT	– The documentation is supplied with the device. See cover of the terminal compartment. – The documentation can also be found on the supplied CD-ROM.
	Functional Safety Manual SD00190P	– Safety function with Cerabar S – Behaviour in operation and failure – Commissioning and iterative tests – Settings – Technical safety characteristic quantities – Management Summary	– The documentation is valid for devices showing version "E" in feature 100 "Additional options 1" or in feature 110 "Additional options 2". See also Technical Information TI00383P, chapter "Ordering information".

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1 Safety instructions

1.1 Designated use

The Cerabar S is a pressure transmitter for measuring pressure and level.

The manufacturer accepts no liability for damages resulting from incorrect use or use other than that designated.

1.2 Installation, commissioning and operation

The device has been designed to operate safely in accordance with current technical, safety and EU standards. If installed incorrectly or used for applications for which it is not intended, however, it is possible that application-related dangers may arise, e.g. product overflow due to incorrect installation or calibration. For this reason, the instrument must be installed, connected, operated and maintained according to the instructions in this manual: personnel must be authorised and suitably qualified. The manual must have been read and understood, and the instructions followed. Modifications and repairs to the device are permissible only when they are expressly approved in the manual. Pay particular attention to the technical data on the nameplate.

1.3 Operational safety and process safety

Alternative monitoring measures must be taken to ensure operational safety and process safety during configuration, testing and maintenance work on the device.

1.3.1 Hazardous areas (optional)

Devices for use in hazardous areas are fitted with an additional nameplate (→ 6). If the device is to be installed in an explosion hazardous area, then the specifications in the certificate as well as all national and local regulations must be observed. The device is accompanied by separate "Ex documentation", which is an integral part of this Operating Instructions. The installation regulations, connection values and Safety Instructions listed in this Ex document must be observed. The documentation number of the related Safety Instructions is also indicated on the additional nameplate.

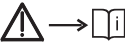
- Ensure that all personnel are suitably qualified.

1.3.2 Functional Safety SIL3 (optional)

If using devices for applications with safety integrity, the Functional Safety Manual (SD00190P) must be observed thoroughly.

1.4 Notes on safety conventions and icons

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding icon in the margin.

Safety conventions	
	Warning! A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument.
	Caution! Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument.
	Note! A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.
	Device certified for use in explosion hazardous area If the device has this symbol embossed on its nameplate, it can be installed in an explosion hazardous area or a non-explosion hazardous area, according to the approval.
	Explosion hazardous area Symbol used in drawings to indicate explosion hazardous areas. – Devices used in hazardous areas must possess an appropriate type of protection.
	Safe area (non-explosion hazardous area) Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. – Devices used in hazardous areas must possess an appropriate type of protection. Lines used in hazardous areas must meet the necessary safety-related characteristic quantities.
	Direct voltage A terminal to which or from which a direct current or voltage may be applied or supplied.
	Alternating voltage A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied.
	Grounded terminal A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system.
	Protective grounding (earth) terminal A terminal which must be connected to earth ground prior to making any other connection to the equipment.
	Equipotential connection (earth bonding) A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice.
	Temperature resistance of the connection cables States, that the connection cables must be resistant to a temperature of at least 85 °C (185 °F).
	Safety instruction For safety instructions refer to the manual for the appropriate instrument version.

2 Identification

2.1 Device designation

2.1.1 Nameplate



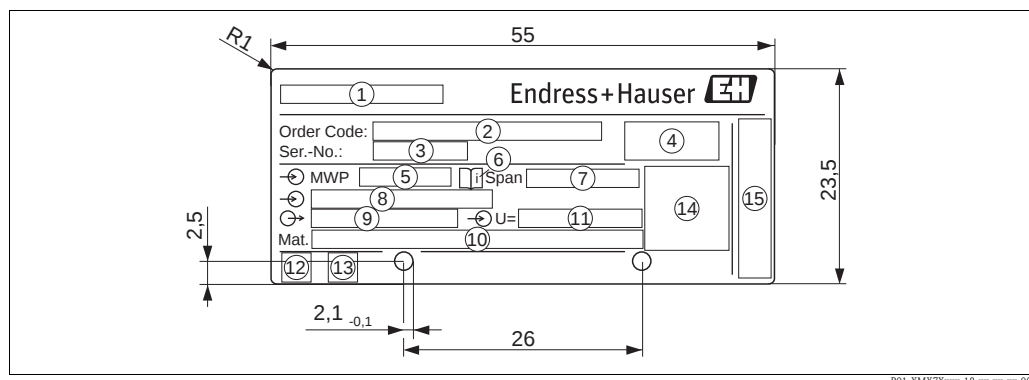
Note!

- The MWP (maximum working pressure) is specified on the nameplate. This value refers to a reference temperature of 20°C (68°F) or 100°F (38 °C) for ANSI flanges.
- The pressure values permitted at higher temperatures can be found in the following standards:
 - EN 1092-1: 2001 Tab. 18 ¹⁾
 - ASME B 16.5a – 1998 Tab. 2-2.2 F316
 - ASME B 16.5a – 1998 Tab. 2.3.8 N10276
 - JIS B 2220
- The test pressure corresponds to the over pressure limit (OPL) of the device = MWP x 1.5 ²⁾.
- The Pressure Equipment Directive (EC Directive 97/23/EC) uses the abbreviation "PS".
The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the measuring device.

1) With regard to their temperature stability properties, the materials 1.4404 and 1.4435 are grouped under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.

2) The equation does not apply for PMP71 and PMP75 with a 40 bar (600 psi) or a 100 bar (1500 psi) measuring cell.

Aluminium and stainless steel housing (T14)

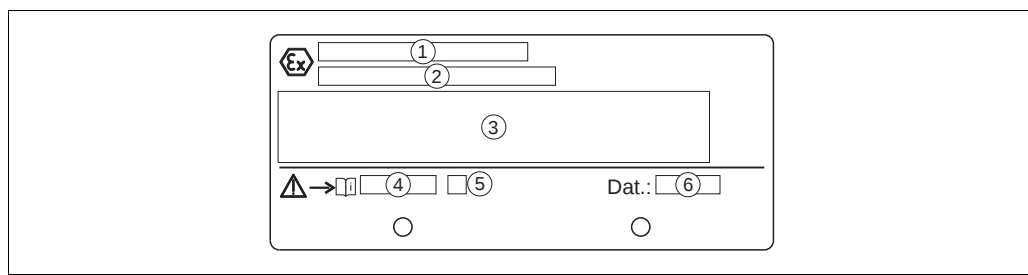


P01-XMK7Lxxx-18-xx-xx-xx-000

Fig. 1: Nameplate

- 1 Device name
- 2 Order code
See the specifications on the order confirmation for the meanings of the individual letters and digits.
- 3 Serial number
- 4 Degree of protection
- 5 MWP (Maximum working pressure)
- 6 Symbol: Note: pay particular attention to the data in the "Technical Information"!
- 7 Minimum/maximum span
- 8 Nominal measuring range
- 9 Electronic version (output signal)
- 10 Wetted materials
- 11 Supply voltage
- 12 GL-symbol for GL marine certificate (optional)
- 13 SIL-symbol for devices with SIL3/IEC 61508 Declaration of conformity (optional)
- 14 Approval ID and ID numbers
- 15 Address of manufacturer

Devices for use in hazardous areas are fitted with an additional nameplate.

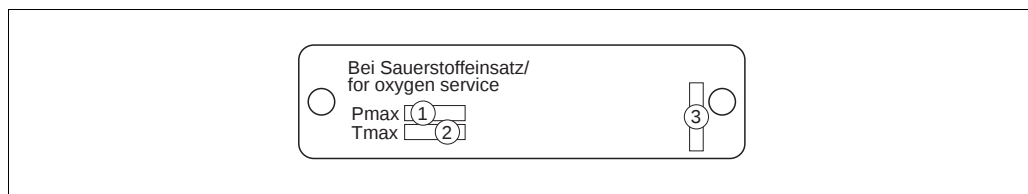


P01-xMD7xxxx-18-xx-xx-xx-002

Fig. 2: Additional nameplate for devices for hazardous areas

- 1 EC type examination certificate number
- 2 Type of protection e.g. II 1/2 G Ex ia IIC T4/T6
- 3 Electrical data
- 4 Safety Instructions number e.g. XA00235P
- 5 Safety Instructions index e.g. A
- 6 Device manufacture data

Devices suitable for oxygen applications are fitted with an additional nameplate.



P01-xxxxxxx-18-xx-xx-xx-000

Fig. 3: Additional nameplate for devices suitable for oxygen applications

- 1 Maximum pressure for oxygen applications
- 2 Maximum temperature for oxygen applications
- 3 Layout identification of the nameplate

Hygienic stainless steel housing (T17)

The nameplate is divided into two main sections. The left section contains fields for basic identification and technical specifications, while the right section contains fields for safety and compliance information.

Left Section:

- 1: Device name (Endress+Hauser)
- 2: Address of manufacturer
- 3: Order Code
- 4: Ser.-No.
- 5: MWP (Maximum working pressure)
- 6: Symbol (Note: pay particular attention to the data in the "Technical Information")
- 7: Span
- 8: Nominal measuring range
- 9: Electronic version (output signal)
- 10: Supply voltage
- 11: Wetted materials
- 12: Degree of protection
- 13: Approval ID and ID numbers
- 14: 3A-symbol
- 15: CSA-symbol
- 16: FM-symbol
- 17: SIL-symbol for devices with SIL3/IEC 61508 Declaration of conformity
- 18: GL-symbol for GL marine certificate

Right Section:

- 19: EC type examination certificate
- 20: Type of protection
- 21: Approval number for WHG overspill protection
- 22: Temperature operating range for devices for use in hazardous areas
- 23: Electrical data for devices for use in hazardous areas
- 24: Safety Instructions number
- 25: Safety Instructions index
- 26: Device manufacture data
- 27: Maximum temperature for devices suitable for oxygen applications
- 28: Maximum pressure for devices suitable for oxygen applications

P01-XXMX7XXXX-18-xx-xx-xx-001

Fig. 4: Nameplate

- 1 Device name
- 2 Address of manufacturer
- 3 Order code
- 4 Serial number
- 5 MWP (Maximum working pressure)
- 6 Symbol: Note: pay particular attention to the data in the "Technical Information"!
- 7 Minimum/Maximum span
- 8 Nominal measuring range
- 9 Electronic version (output signal)
- 10 Supply voltage
- 11 Wetted materials
- 12 Degree of protection
- Optional:
- 13 Approval ID and ID numbers
- 14 3A-symbol
- 15 CSA-symbol
- 16 FM-symbol
- 17 SIL-symbol for devices with SIL3/IEC 61508 Declaration of conformity
- 18 GL-symbol for GL marine certificate
- 19 EC type examination certificate
- 20 Type of protection
- 21 Approval number for WHG overspill protection
- 22 Temperature operating range for devices for use in hazardous areas
- 23 Electrical data for devices for use in hazardous areas
- 24 Safety Instructions number
- 25 Safety Instructions index
- 26 Device manufacture data
- 27 Maximum temperature for devices suitable for oxygen applications
- 28 Maximum pressure for devices suitable for oxygen applications

2.1.2 Identifying the sensor type

See parameter "Sensor Meas.Type" in Operating Instruction BA00274P.
The Operating Instruction BA00274P can be found on the supplied CD-ROM.

2.2 Scope of delivery

The scope of delivery comprises:

- Cerabar S pressure transmitter
- For devices with the "HistoROM/M-DAT" option:
CD-ROM with Endress+Hauser operating program and documentation
- Optional accessories

Documentation supplied:

- The Operating Instructions BA00271P and BA00274P, the Technical Information TI00383P and the Safety Instructions, Functional Safety Manual and brochures can be found on the supplied CD-ROM.
- Brief Operating Instructions KA01019P
- Leporello KA00218P
- Final inspection report
- Also Safety Instructions with ATEX, IECEx and NEPSI devices
- Optional: factory calibration form, test certificates

2.3 Certificates and approvals

CE mark, declaration of conformity

The device is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The device complies with the applicable standards and regulations as listed in the EC declaration of conformity and thus complies with the statutory requirements of the EC Directives. Endress+Hauser confirms the successful testing of the device by affixing to it the CE mark.

2.4 Registered trademarks

KALREZ®, VITON®, TEFLON®

Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP®

Registered trademark of Ladish & Co., Inc., Kenosha, USA

HART®

Registered trademark of the HART Communication Foundation, Austin, USA.

GORE-TEX®

Registered trademark of W.L. Gore & Associates, Inc., USA

3 Installation

3.1 Incoming acceptance, transport, storage

3.1.1 Incoming acceptance

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport



Caution!

Follow the safety instructions and transport conditions for devices of more than 18 kg (39.69 lbs). Transport the measuring device to the measuring point in its original packaging or at the process connection.

3.1.3 Storage

The device must be stored in a dry, clean area and protected against damage from impact (EN 837-2).

Storage temperature range:

- -40 °C to $+90\text{ °C}$ (-40 °F to $+194\text{ °F}$)
- On-site display: -40 °C to $+85\text{ °C}$ (-40 °F to $+185\text{ °F}$)
- Separate housing: -40 °C to $+60\text{ °C}$ (-40 °F to $+140\text{ °F}$)

3.2 Installation conditions

3.2.1 Dimensions

For dimensions, please refer to "Mechanical construction" section in TI00383P.

3.3 Installation instructions



Note!

- Due to the orientation of the Cerabar S, there may be a shift in the measured value, i.e. when the container is empty, the measured value does not display zero. You may correct this zero point shift either directly on the device using the "E"-key or by remote operation. See
→ 28, "Function of the operating elements – on-site display not connected" or
→ 44, "Position adjustment".
- For PMP75, please refer to → 13, "Installation instructions for devices with diaphragm seals – PMP75".
- To ensure optimal readability of the on-site display, it is possible to rotate the housing up to 380° .
→ 19, "Rotating the housing".
- Endress+Hauser offers a mounting bracket for installing on pipes or walls.
→ 16, "Wall and pipe-mounting (optional)".

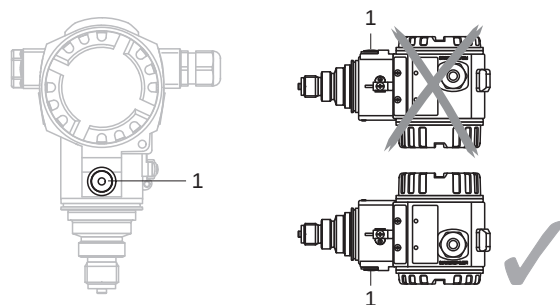
3.3.1 Installation instructions for devices without diaphragm seals – PMP71, PMC71



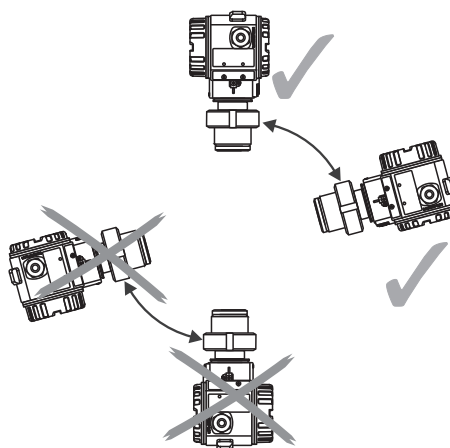
Note!

- If a heated Cerabar S is cooled during the cleaning (e.g. by cold water), a vacuum develops for a short time, whereby water can penetrate the sensor through the pressure compensation (1).

If this is the case, mount the sensor with the pressure compensation (1) pointing downwards.



- Keep the pressure compensation and GORE-TEX® filter (1) free from contaminations and water.
- Cerabar S without diaphragm seal are mounted as per the norms for a manometer (DIN EN 837-2). We recommend the use of shut-off devices and siphons. The orientation depends on the measuring application.
- Do not clean or touch process isolating diaphragm seals with hard or pointed objects.
- The device must be installed as follows in order to comply with the cleanability requirements of the ASME-BPE (Part SD Cleanability):



Pressure measurement in gases

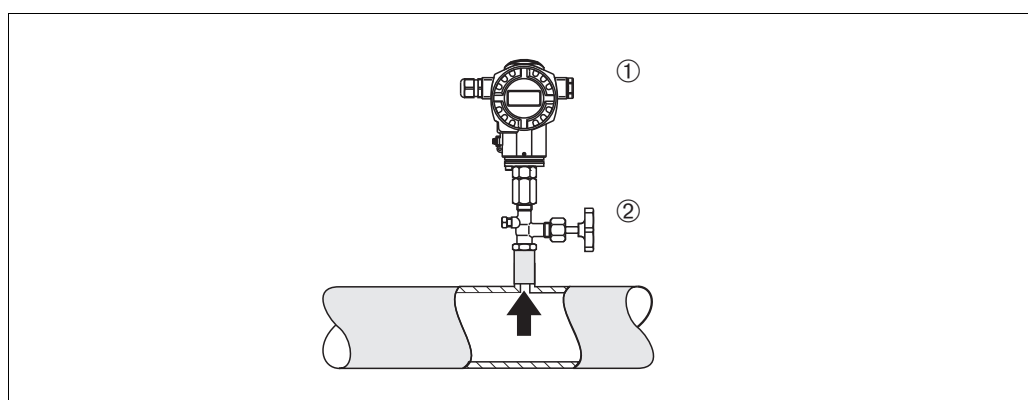
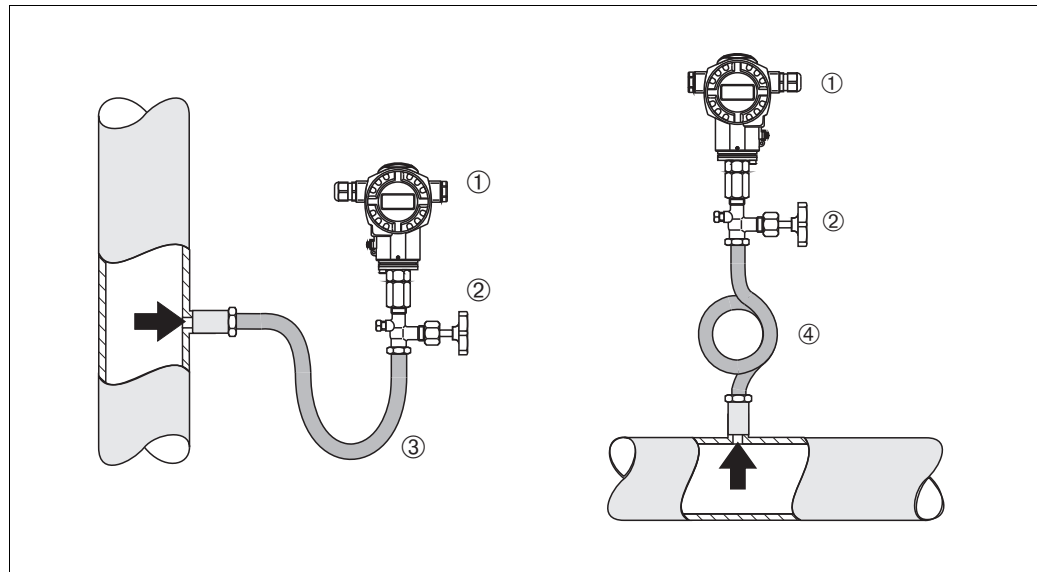


Fig. 5: Measuring arrangement for pressure measurement in gases

- 1 Cerabar S
2 Shut-off device

Mount Cerabar S with shut-off device above the tapping point so that any condensate can flow into the process.

Pressure measurement in steams



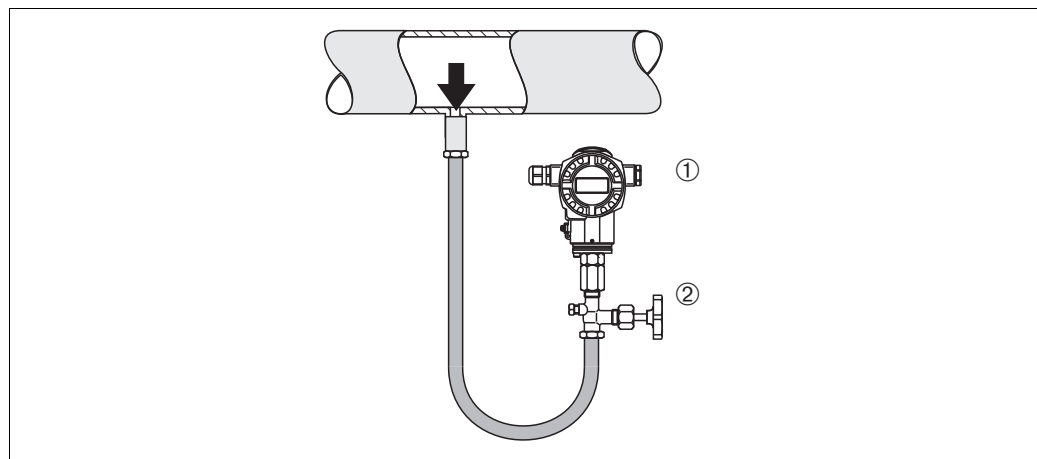
P01-PMx7xxxx-11-xx-xx-xx-002

Fig. 6: Measuring arrangement for pressure measurement in steams

- 1 Cerabar S
- 2 Shut-off device
- 3 U-shaped siphon
- 4 Circular siphon

- Mount Cerabar S with siphon above the tapping point. The siphon reduces the temperature to almost ambient temperature.
- Fill the siphon with fluid before commissioning.

Pressure measurement in liquids



P01-PMx7xxxx-11-xx-xx-xx-003

Fig. 7: Measuring arrangement for pressure measurement in liquids

- 1 Cerabar S
- 2 Shut-off device

Mount Cerabar S with shut-off device below or at the same level as the tapping point.

Level measurement

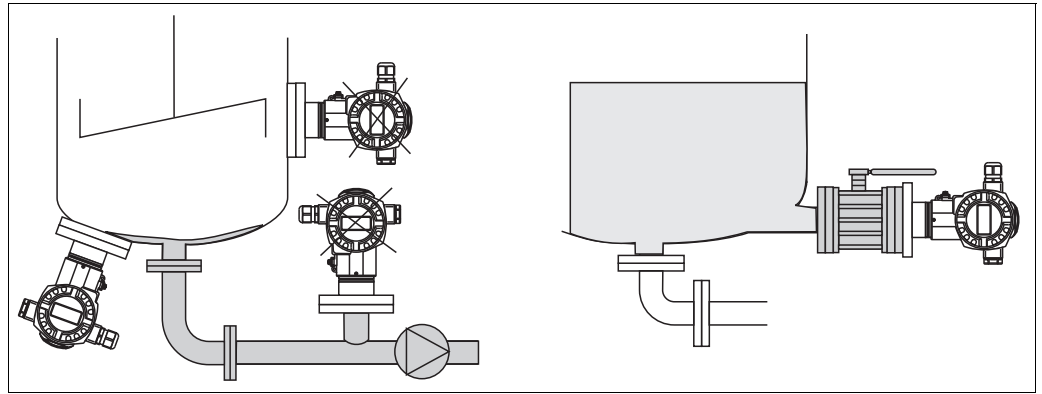


Fig. 8: Measuring arrangement for level

- Mount Cerabar S below the lowest measuring point.
- Do not mount the device at the following positions:
In the fill flow, in the tank outlet or at a point in the container which could be affected by pressure pulses from an agitator.
- Do not mount the device in the suction area of a pump.
- The calibration and functional test can be carried out more easily if you mount the device after a shut-off device.

PVDF adapter



Note!

For instruments with PVDF adapter, a maximum torque of 7 Nm (5.16 lbf ft) is permitted. The thread connection may become loose at high temperatures and pressures. This means that the integrity of the thread must be checked regularly and may need to be tightened using the torque given above. Teflon tape is recommended for sealing with the 1/2 NPT thread.

3.3.2 Installation instructions for devices with diaphragm seals – PMP75



Note!

- The Cerabar S with diaphragm seal is screwed in, flanged or clamped, depending on the type of diaphragm seal.
- The diaphragm seal and the pressure sensor together form a closed and calibrated system which is filled with filling fluid through a hole in the upper part. This hole is sealed and not to be opened.
- Do not clean or touch process isolating diaphragm of the diaphragm seals with hard or pointed objects.
- Do not remove the protection of the process isolating diaphragm until shortly before installation.
- When using a mounting bracket, sufficient strain relief must be ensured for the capillaries in order to prevent the capillary bending down (bending radius ≥ 100 mm (3.94 in)).
- Please note that the hydrostatic pressure of the liquid columns in the capillaries can cause zero point shift. The zero point shift can be corrected. → 44, "Position adjustment".
- Please note the application limits of the diaphragm seal filling oil as detailed in the Technical Information for Cerabar S TI00383P, Section "Planning instructions for diaphragm seal systems".

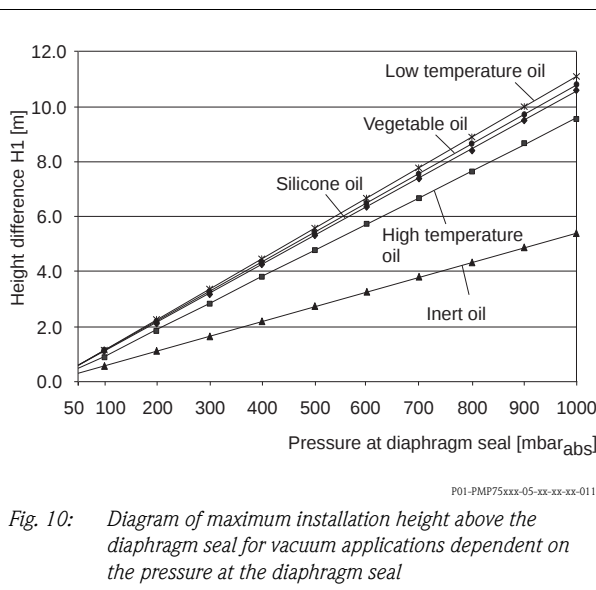
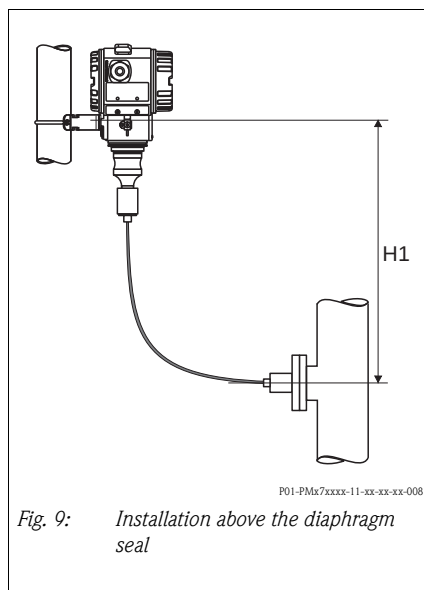
In order to obtain more precise measurement results and to avoid a defect in the device, mount the capillaries as follows:

- Vibration-free (in order to avoid additional pressure fluctuations)
- Not in the vicinity of heating or cooling lines
- Insulate if the ambient temperature is below or above the reference temperature
- With a bending radius of ≥ 100 mm (3.94 in).

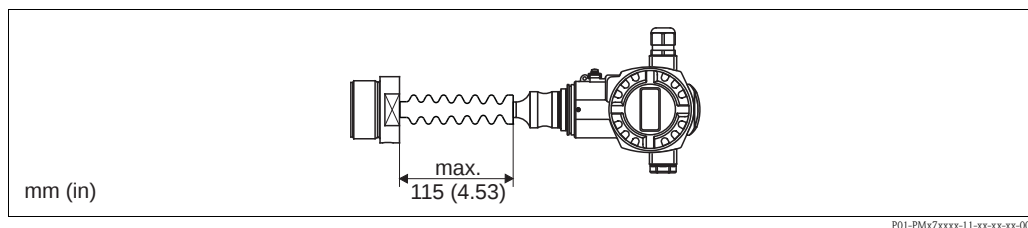
Vacuum application

For applications under vacuum, Endress+Hauser recommends mounting the pressure transmitter underneath the diaphragm seal. A vacuum load of the diaphragm seal caused by the presence of filling oil in the capillaries is hereby prevented.

When the pressure transmitter is mounted above the diaphragm seal, the maximum height difference H1 in accordance with the illustration below on the left must not be exceeded. The maximum height difference is dependent on the density of the filling oil and the smallest ever pressure that is permitted to occur at the diaphragm seal (empty container), see illustration below, on the right.



Mounting with temperature isolator



Endress+Hauser recommends the use of temperature separators in the event of constant extreme fluid temperatures which lead to the maximum permissible electronics temperature of +85 °C (+185 °F) being exceeded. To minimise the influence of rising heat, Endress+Hauser recommends the device be mounted horizontally or with the housing pointing downwards. The additional installation height also brings about a zero point shift of approx. 21 mbar (0.315 psi) due to the hydrostatic columns in the temperature isolator. You can correct this zero point shift. See also → 28, "Function of the operating elements – on-site display not connected" or → 44, "Position adjustment".

3.3.3 Seal for flange mounting

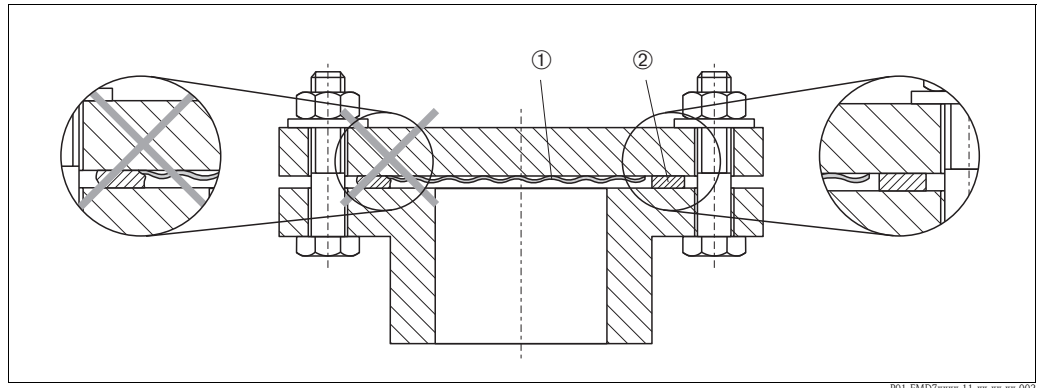


Fig. 11: Mounting the versions with flange or diaphragm seal

- 1 Process isolating diaphragm
- 2 Seal



Warning!

The seal is not allowed to press on the process isolating diaphragm as this could affect the measurement result.

3.3.4 Installation with heat insulation – PMC71 high temperature version and PMP75

The devices must only be insulated up to a certain height. The maximum permitted insulation height is labelled on the devices and applies to an insulation material with a specific heat conductivity and to the maximum permitted ambient and process temperature (see following table). The data were determined under the most critical application "quiescent air".

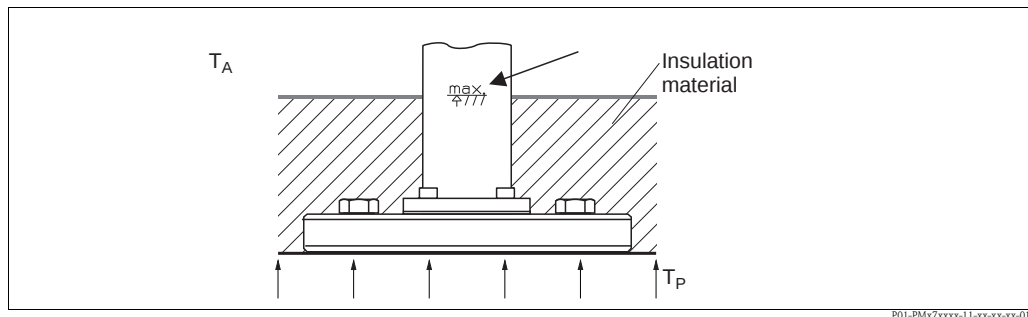


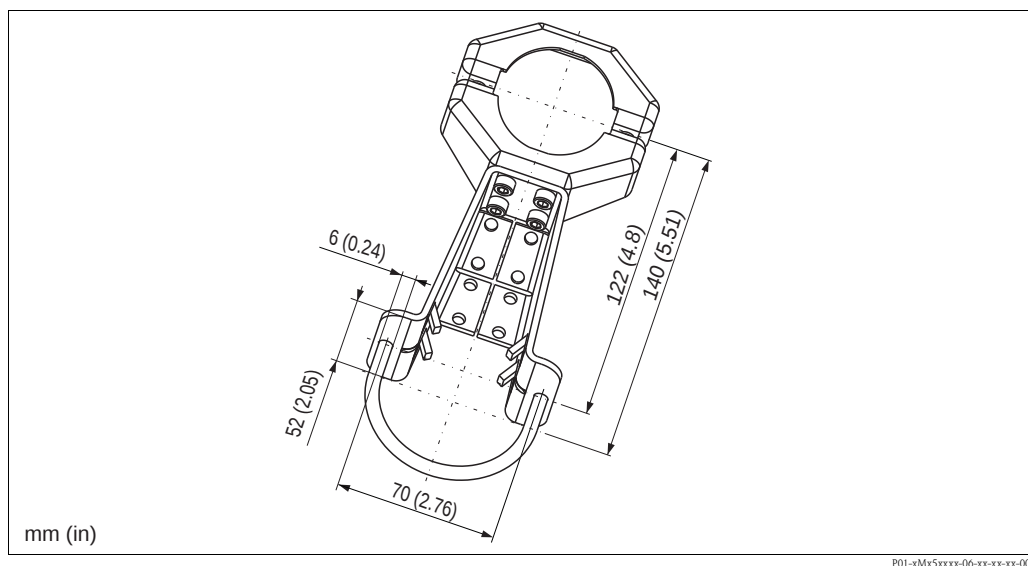
Fig. 12: Maximum insulation height, here e.g. PMC71 with flange

	PMC71	PMP75
Ambient temperature (T_A)	$\leq 70^\circ\text{C}$ (158°F)	$\leq 70^\circ\text{C}$ (158°F)
Process temperature (T_P)	$\leq 150^\circ\text{C}$ (302°F)	$\leq 400^\circ\text{C}$ (752°F) ¹⁾
Heat conductivity Insulation material	$\leq 0,04 \text{ W}/(\text{m} \times \text{K})$	

1) Depending on the diaphragm seal filling oil used (see Technical Information TI00383P Cerabar S)

3.3.5 Wall and pipe-mounting (optional)

Endress+Hauser offers a mounting bracket for installing on pipes or walls.



Please note the following when mounting:

- Devices with capillary lines: mount capillaries with a bending radius of $\geq 100 \text{ mm}$ (3.94 in).
- In the case of pipe mounting, the nuts on the bracket must be tightened uniformly with a torque of at least 5 Nm (3.69 lbf ft).

3.3.6 Assembling and mounting the "separate housing" version

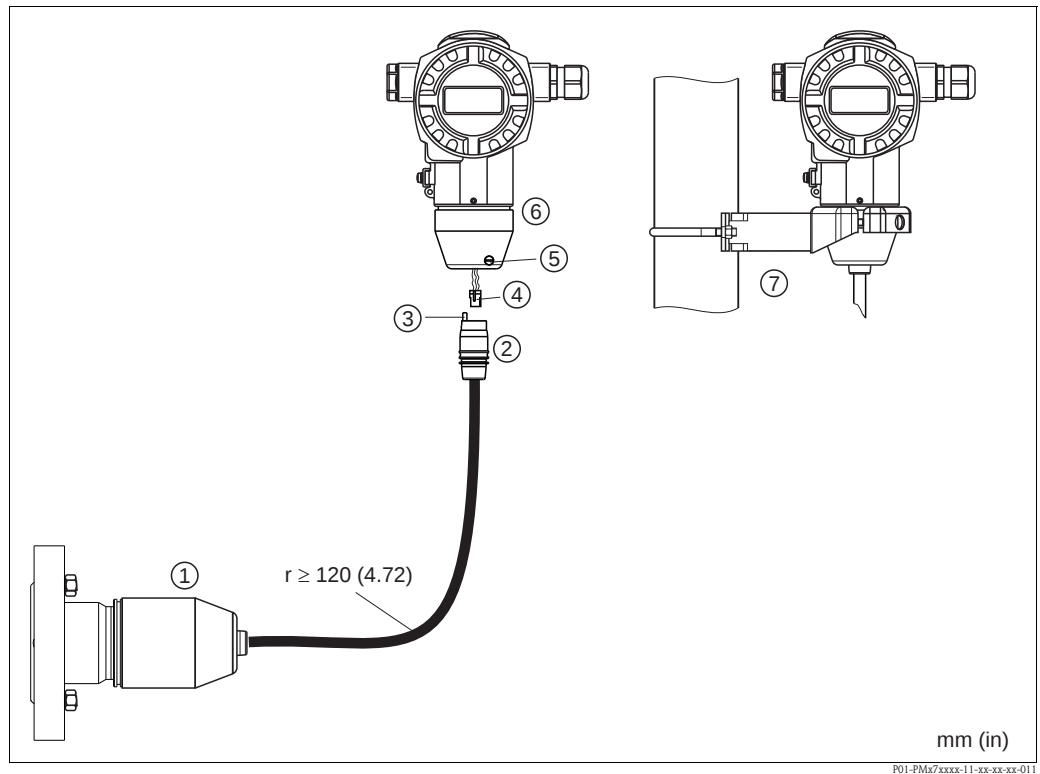


Fig. 13: "Separate housing" version

- 1 In the "separate housing" version, the sensor is supplied with process connection and cable fitted.
- 2 Cable with connection jack
- 3 Pressure compensation
- 4 Plug
- 5 Locking screw
- 6 Housing fitted with housing adapter, included
- 7 Mounting bracket suitable for wall and pipe mounting, included

Assembly and mounting

1. Connect plug (item 4) into the corresponding connection jack of the cable (item 2).
2. Plug the cable into the housing adapter (item 6).
3. Tighten the locking screw (item 5).
4. Mount the housing on a wall or pipe using the mounting bracket (item 7). When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbf ft). Mount the cable with a bending radius (r) ≥ 120 mm (4.72 in).

3.3.7 PMP71, version prepared for diaphragm seal mount – welding recommendation

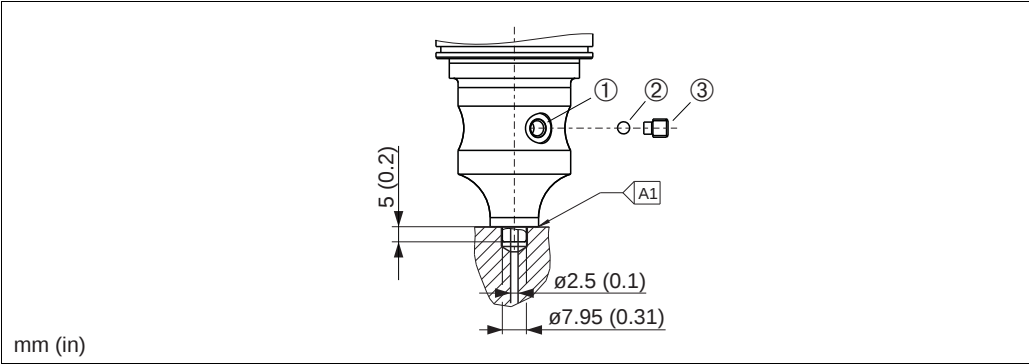
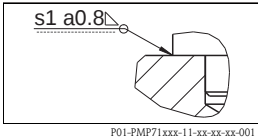


Fig. 14: Version U1: prepared for diaphragm seal mount

- 1 Hole for filling fluid
- 2 Bearing
- 3 Threaded pin
- A1 See the following table "Welding recommendation"

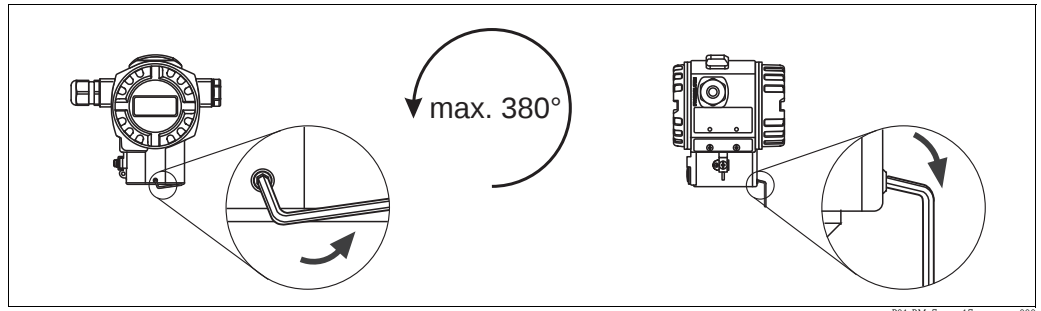
Welding recommendation

For the "U1 Prepared for diaphragm seal mount" version in feature 70 "Process connection; Material" in the order code of up to including 40 bar (600 psi)-sensors, Endress+Hauser recommends welding on the diaphragm seal as follows: the total welding depth of the fillet weld is 1 mm (0.04 in) at an external diameter of 16 mm (0.63 in). Welding is performed according to the WIG method.

Consecutive seam no.	Sketch/welding groove shape, dimension as per DIN 8551	Base material matching	Welding process DIN EN ISO 24063	Welding position	Inert gas, additives
A1 for sensors ≤ 40 bar (600 psi)	 P01-PMP71xxx-11-xx-xx-xx-001	Adapter made of 316L (1.4435) to be welded to diaphragm seal made of 316L (1.4404/1.4435)	141	PB	Inert gas Ar/H 95/5 Additive: 1.4430 (ER 316L Si)

3.3.8 Rotating the housing

The housing can be rotated up to 380° by loosening the Allen screw.

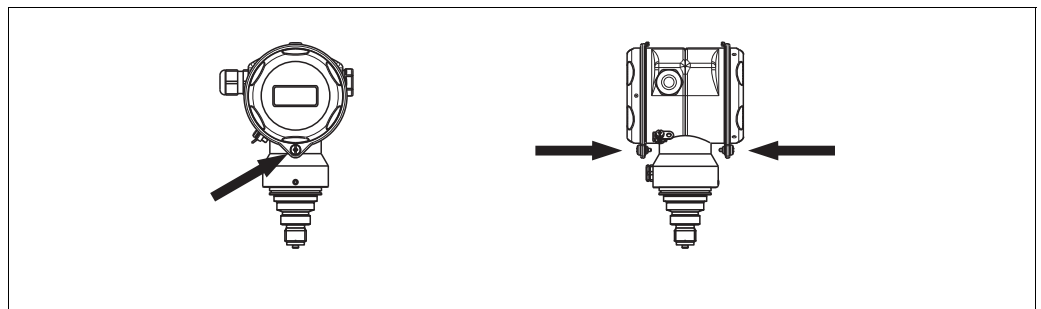


P01-PMx7xxxx-17-xx-xx-xx-000

Fig. 15: Aligning the housing

- T14 and T15 housing: Loosen setscrew with a 2 mm (0.08 in) Allen key.
- Hygienic T17 housing: Loosen setscrew with a 3 mm (0.12 in) Allen key.
- Rotate housing (max. up to 380°).
- Retighten setscrew with 1 Nm (0,74 lbf ft).

3.3.9 Close cover on a hygienic stainless steel housing (T17)



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Fig. 16: Close cover

The covers for the terminal and electronics compartment are hooked into the casing and closed with a screw. These screws should be finger-tightened (2 Nm (1.48 lbf ft)) to the stop to ensure that the covers sit tightly.

3.4 Post-installation check

After installing the device, carry out the following checks:

- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

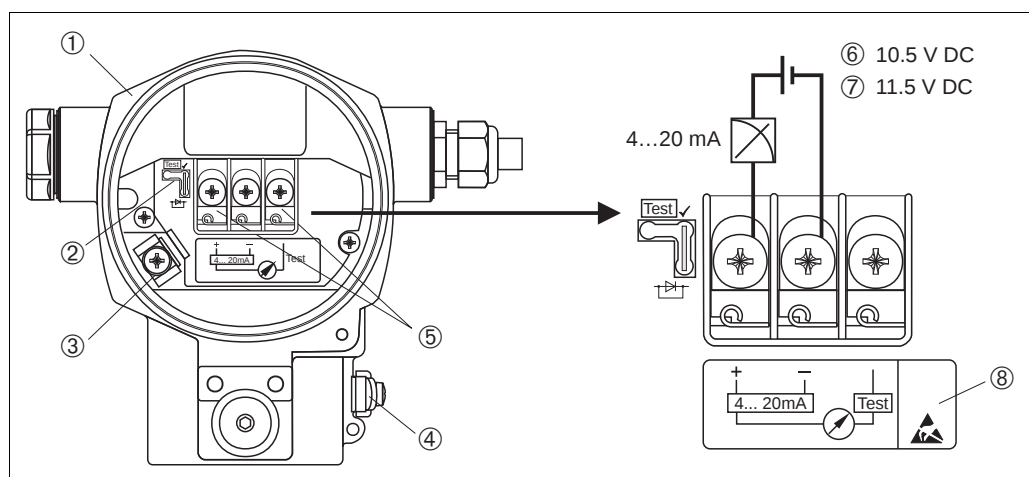
4 Wiring

4.1 Connecting the device



Note!

- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- Devices with integrated overvoltage protection must be earthed.
- Protective circuits against reverse polarity, HF influences and overvoltage peaks are installed.
- The supply voltage must match the supply voltage on the nameplate (→ 6, "Nameplate").
- Switch off the supply voltage before connecting the device.
- Remove housing cover of the terminal compartment.
- Guide cable through the gland. Preferably use twisted, screened two-wire cable.
- Connect device in accordance with the following diagram.
- Screw down housing cover.
- Switch on supply voltage.



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Fig. 17: Electrical connection 4 to 20 mA HART. Observe also → 22, "Supply voltage".

- 1 Housing
- 2 Jumper for 4 to 20 mA test signal.
→ 22, "Taking 4 to 20 mA test signal" part.
- 3 Internal earth terminal
- 4 External earth terminal
- 5 4 to 20 mA test signal between plus and test terminal
- 6 Minimum supply voltage = 10.5 V DC, jumper is inserted in accordance with the illustration.
- 7 Minimum supply voltage = 11.5 V DC, jumper is inserted in "Test" position.
- 8 Devices with integrated overvoltage protection are labelled OVP (overvoltage protection) here.

4.1.1 **Devices with Harting plug Han7D**

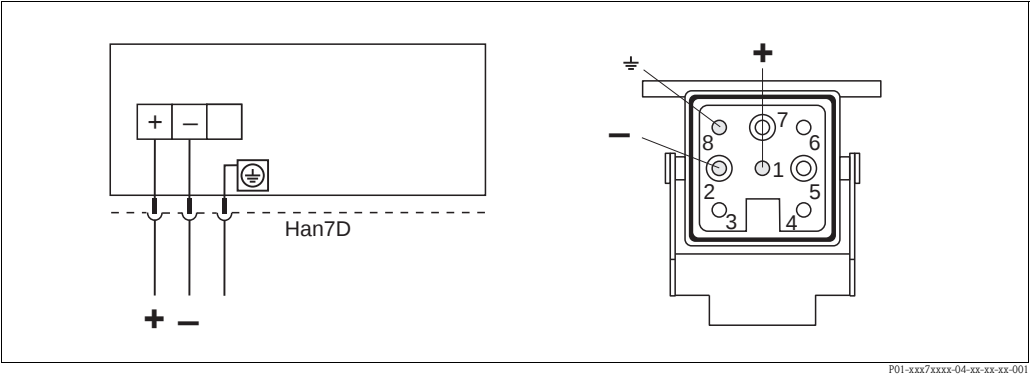


Fig. 18: *Left: electrical connection for devices with Harting plug Han7D*
 Right: view of the plug connector at the device

4.1.2 **Devices with M12 plug**

	PIN	Meaning
	1	signal +
	2	not used
	3	signal -
	4	ground

4.2 Connecting the measuring unit

4.2.1 Supply voltage



- Note!
- All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.
 - When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.

Electronic version	Jumper for 4 to 20 mA test signal in "Test" position (Delivery status)	Jumper for 4 to 20 mA test signal in "Non-Test" position
4 to 20 mA HART, for non-hazardous areas	11.5 to 45 V DC	10.5 to 45 V DC

Taking 4 to 20 mA test signal

A 4 to 20 mA signal may be measured via the positive and test terminal without interrupting the measurement. The minimum supply voltage of the device can be reduced by simply changing the position of the jumper. As a result, operation is also possible with lower voltage sources. To keep the measured error below 0.1 %, the current measuring device should display an internal resistance of < 0.7 Ω. Observe the position of the jumper in accordance with the following table.

Jumper position for test signal	Description
	– Taking 4 to 20 mA test signal via plus and test terminal: possible. (Thus, the output current can be measured without interruption via the diode.) – Delivery status – Minimum supply voltage: 11.5 V DC
	– Taking 4 to 20 mA test signal via plus and test terminal: not possible. – Minimum supply voltage: 10.5 V DC

4.2.2 Cable specification

- Endress+Hauser recommends using twisted, screened two-wire cables.
- Terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- Cable external diameter: 5 to 9 mm (0.2 to 0.35 in)

4.2.3 Load

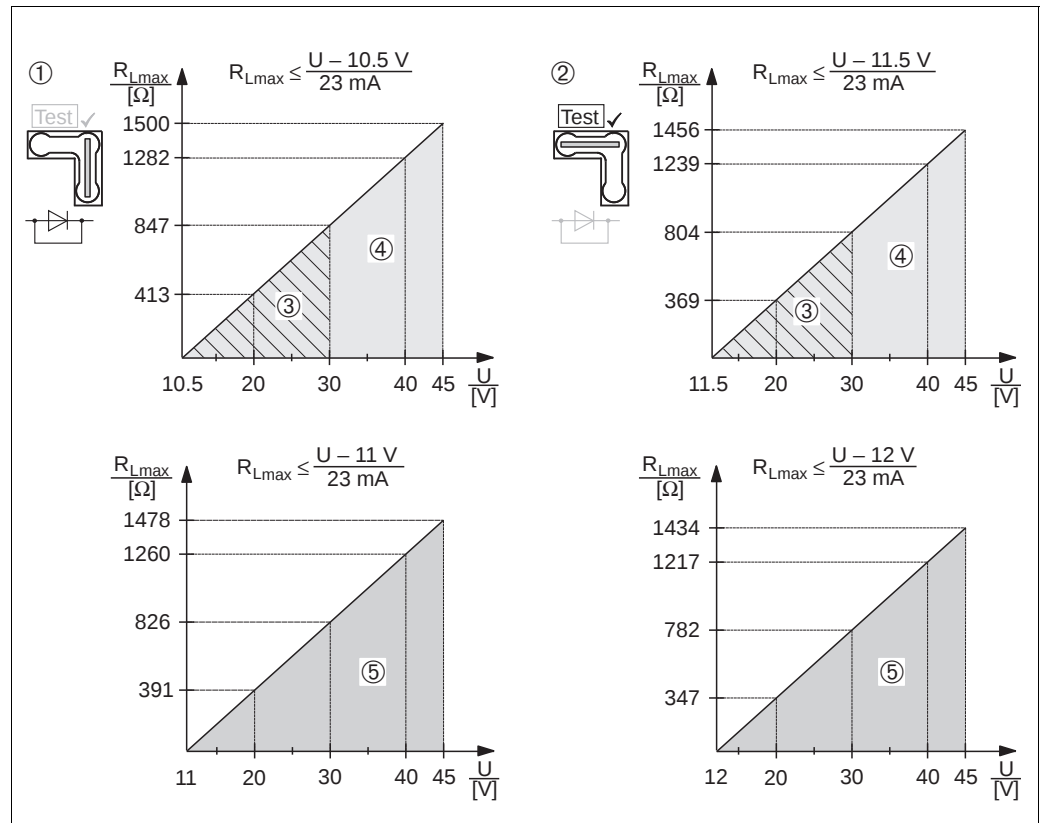


Fig. 19: Load diagram, observe the position of the jumper and the explosion protection.
(→ 22, "Taking 4 to 20 mA test signal" part.)

- 1 Jumper for the 4 to 20 mA test signal inserted in "Non-Test" position
 - 2 Jumper for the 4 to 20 mA test signal inserted in "Test" position
 - 3 Supply voltage 10.5 (11.5) to 30 V DC for 1/2 G, 1 GD, 1/2 GD, FM IS, CSA IS, IECEx ia, NEPSI Ex ia
 - 4 Supply voltage 10.5 (11.5) to 45 V DC for devices for non-hazardous areas, 1/2 D, 1/3 D, 2 G Ex d, 3 G Ex nA, FM XP, FM DIP, FM NI, CSA XP and CSA Dust-Ex, NEPSI Ex d
 - 5 Supply voltage 11 (12) to 45 V DC for PMC71, Ex d[ia], NEPSI Ex d[ia]
- R_{Lmax} Maximum load resistance
 U Supply voltage



Note!

When operating via a handheld terminal or via PC with an operating program, a minimum communication resistance of 250 Ω must exist within the loop.

4.2.4 Screening/potential matching

- You achieve optimum screening against disturbances if the screening is connected on both sides (in the cabinet and on the device). If you have to reckon with potential equalisation currents in the plant, only earth screening on one side, preferably at the transmitter.
- When using in hazardous areas, you must observe the applicable regulations. Separate Ex documentation with additional technical data and instructions is included with all Ex systems as standard.

4.2.5 Connecting HART handheld terminal

With a HART handheld terminal you can set and check the transmitter and avail of additional functions all along the 4 to 20 mA line.

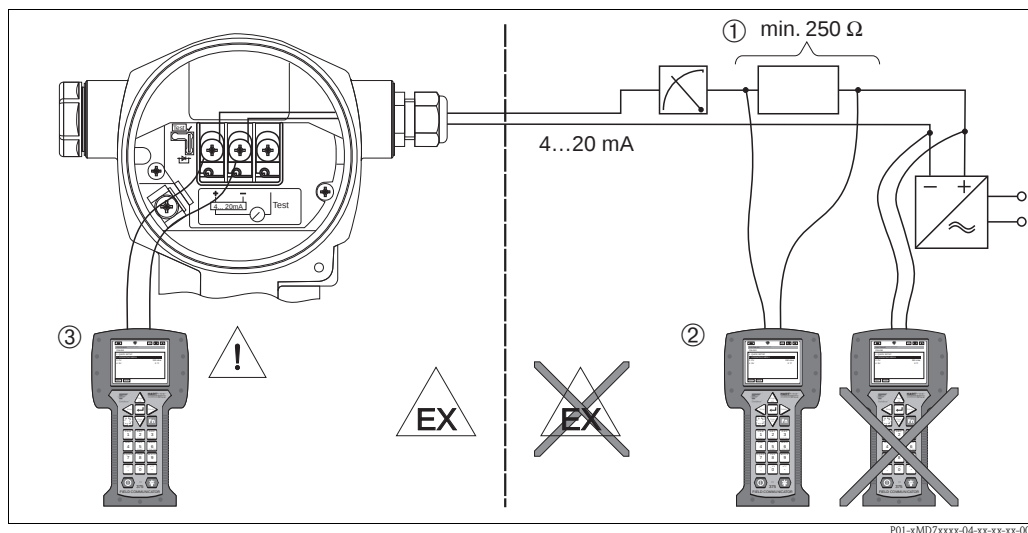


Fig. 20: Connecting an HART handheld terminal, e.g. Field Communicator 375, 475

- 1 Necessary communication resistor $\geq 250 \Omega$
- 2 HART handheld terminal
- 3 HART handheld terminal, directly connected to the device even in the Ex i-area



Warning!

- In the case of Ex d type of protection, do not connect the handheld terminal in the hazardous area.
- Do not replace the battery of the handheld terminal in the hazardous area.
- For devices with FM or CSA certificates, establish electrical connection as per Installation or Control Drawing (ZD) supplied.

4.2.6 Connecting Commubox FXA195

The Commubox FXA195 connects intrinsically safe transmitters with the HART protocol to a computer's USB port. This allows remote operation of the transmitter using Endress+Hauser's FieldCare operating program. Power is supplied to the Commubox through the USB port. The Commubox is also suitable for connection to intrinsically safe circuits. → See Technical Information TI00404F for further information.

4.2.7 Connecting Commubox FXA291/ToF Adapter FXA291 for operation via FieldCare

Connecting Commubox FXA291

The Commubox FXA291 connects Endress+Hauser field instruments with CDI interface (= Endress+Hauser Common Data Interface) to the USB interface of a personal computer or a notebook. For details refer to TI00405C/07/EN.



Note!

For the device you need the "ToF Adapter FXA291" as an additional accessory.

Connecting ToF Adapter FXA291

The ToF Adapter FXA291 connects the Commubox FXA291 via the USB interface of a personal computer or a notebook to the device. For details refer to KA00271F/00/A2.

4.3 Potential matching

Ex applications: Connect all devices to the local potential matching.
Observe the applicable regulations.

4.4 Overvoltage protection (optional)

Devices showing version "M" in feature 100 "Additional options 1" or feature 110 "Additional options 2" in the order code are equipped with overvoltage protection (see also Technical Information TI00383P "Ordering information").

- Overvoltage protection:
 - Nominal functioning DC voltage: 600 V
 - Nominal discharge current: 10 kA
- Surge current check $\hat{i} = 20$ kA as per DIN EN 60079-14: 8/20 μ s satisfied
- Arrester AC current check $I = 10$ A satisfied



Warning!

Devices with integrated overvoltage protection must be earthed.

4.5 Post-connection check

Perform the following checks after completing electrical installation of the device:

- Does the supply voltage match the specifications on the nameplate?
- Is the device properly connected ($\rightarrow$ 20)?
- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

As soon as voltage is applied to the device, the green LED on the electronic insert lights up for a few seconds or the connected on-site display lights up.

5 Operation

Feature 20 "Output; operation" in the order code provides you with information on the operating options available to you.

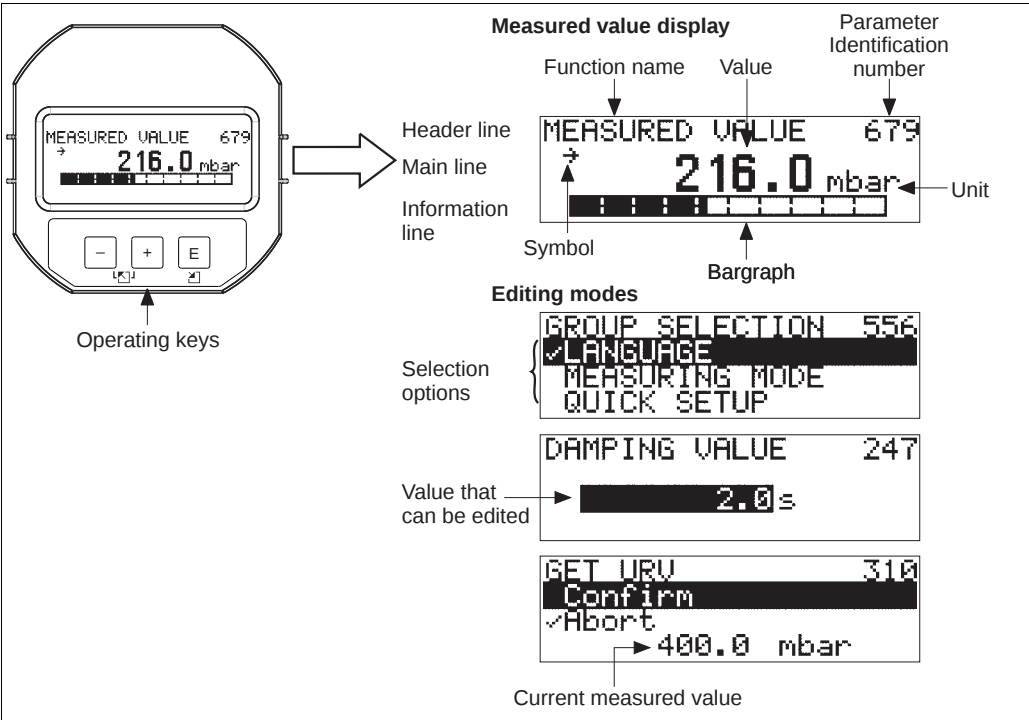
Versions in the order code		Operation
A	4 to 20 mA HART; external operation, LCD	Via on-site display and 3 keys on the exterior of the device
B	4 to 20 mA HART; internal operation, LCD	Via on-site display and 3 keys on the inside of the device
C	4 to 20 mA; internal operation	Without on-site display, 3 keys on the inside of the device

5.1 On-site display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation.
The on-site display shows measured values, dialog texts, fault messages and notice messages.
The display of the device can be turned in 90° steps. Depending on the installation position of the device, this makes it easy to operate the device and read the measured values.

Functions:

- 8-digit measured value display including sign and decimal point, bargraph for current display
- Simple and complete menu guidance thanks to separation of the parameters into several levels and groups
- Menu guidance in 8 languages (de, en, fr, es it, nl, jp, ch)
- Each parameter is given a 3-digit ID number for easy navigation
- Option for configuring the display according to individual requirements and desires, such as language, alternating display, contrast setting, display of other measured values such as sensor temperature
- Comprehensive diagnostic functions (fault and warning message, peak-hold indicators, etc.)
- Rapid and safe commissioning with the Quick Setup menus



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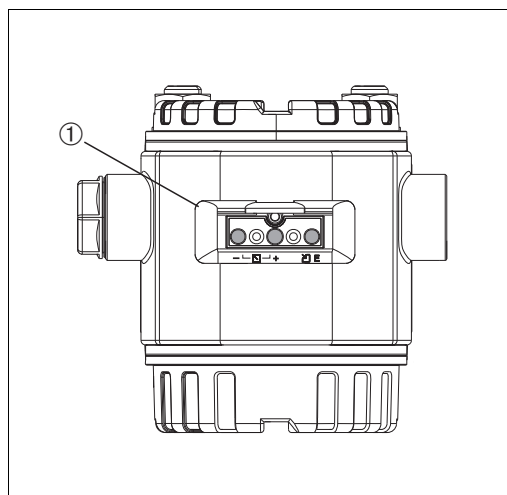
The following table illustrates the symbols that can appear on the on-site display. Four symbols can occur at one time.

Symbol	Meaning
	Alarm symbol – Symbol flashing: warning, device continues measuring. – Symbol permanently lit: error, device does not continue measuring. <i>Note:</i> The alarm symbol may overlie the tendency symbol.
	Lock symbol The operation of the device is locked. Unlock device, → 40.
	Communication symbol Data transfer via communication. <i>Note:</i> The alarm symbol may overlie the communication symbol.
	Tendency symbol (increasing) The measured value is increasing.
	Tendency symbol (decreasing) The measured value is decreasing.
	Tendency symbol (constant) The measured value has remained constant over the past few minutes.

5.2 Operating elements

5.2.1 Position of operating elements

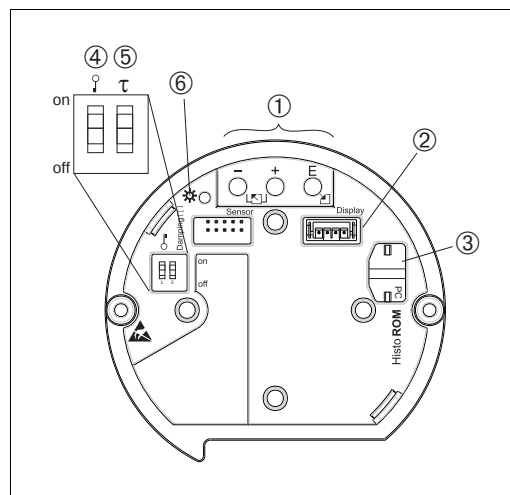
With regard to aluminium or stainless steel housings (T14), the operating keys are located either outside the device under the protection cap or inside on the electronic insert. In hygienic stainless steel housings (T17), the operating keys are always located inside on the electronic insert.



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Fig. 21: Operating keys, external

- 1 Operating keys on the exterior of the device under the protective flap



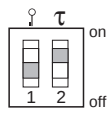
P01-xxxxxxx-19-xx-xx-xx-104

Fig. 22: Operating keys, internal

- 1 Operating keys
2 Slot for optional display
3 Slot for optional HistoROM®/M-DAT
4 DIP-switch for locking/unlocking measured-value-relevant parameters
5 DIP-switch for damping on/off
6 Green LED to indicate value being accepted

5.2.2 Function of the operating elements – on-site display not connected

Press and hold the key or the key combination for at least 3 seconds to execute the corresponding function. Press the key combination for at least 6 seconds for a reset.

Operating key(s)	Meaning
	Adopt lower range value. A reference pressure is present at the device. See also → 29, "Pressure measuring mode" or → 30, "Level measuring mode".
	Adopt upper range value. A reference pressure is present at the device. See also → 29, "Pressure measuring mode" or → 30, "Level measuring mode".
	Position adjustment
 and  and 	Reset all parameters. The reset via operating keys corresponds to the software reset code 7864.
 and 	Copy the configuration data from the optional HistoROM®/M-DAT module to the device.
 and 	Copy the configuration data from the device to the optional HistoROM®/M-DAT module.
	– DIP-switch 1: for locking/unlocking measured-value-relevant parameters Factory setting: off (unlocked) – DIP-switch 2: damping on/off, Factory setting: on (damping on)

5.2.3 Function of the operating elements – on-site display connected

Operating key(s)	Meaning
	– Navigate upwards in the picklist – Edit the numerical values and characters within a function
	– Navigate downwards in the picklist – Edit the numerical values and characters within a function
	– Confirm entry – Jump to the next item
 and 	Contrast setting of on-site display: darker
 and 	Contrast setting of on-site display: brighter
 and 	ESC functions: – Exit edit mode without saving the changed value. – You are in a menu within a function group. The first time you press the keys simultaneously, you go back a parameter within the function group. Each time you press the keys simultaneously after that, you go up a level in the menu. – You are in a menu at a selection level. Each time you press the keys simultaneously, you go up a level in the menu. <i>Note:</i> The terms function group, level and selection level are explained in → 32, "General structure of the operating menu".

5.3 On-site operation – on-site display not connected



Note!

To operate the device with a HistoROM®/M-DAT module see → 34, "HistoROM®/M-DAT (optional)".

5.3.1 Pressure measuring mode

If no on-site display is connected, the following functions are possible by means of the three keys on the electronic insert or on the exterior of the device:

- Position adjustment (zero point correction)
- Setting lower range value and upper range value
- Device reset, → 28, "Function of the operating elements – on-site display not connected".



Note!

- The operation must be unlocked. → 39, "Locking/unlocking operation".
- The device is configured for the Pressure measuring mode as standard. You can switch measuring modes by means of the MEASURING MODE parameter. → 42, "Selecting language and measuring mode".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

Carry out position adjustment. ¹⁾		Setting lower range value.		Setting upper range value.	
Pressure is present at device.		Desired pressure for lower range value is present at device.		Desired pressure for upper range value is present at device.	
↓		↓		↓	
Press "E"-key for 3 s.		Press "-"-key for 3 s.		Press "+"-key for 3 s.	
↓		↓		↓	
Does the LED on the electronic insert light up briefly?		Does the LED on the electronic insert light up briefly?		Does the LED on the electronic insert light up briefly?	
Yes	No	Yes	No	Yes	No
↓	↓	↓	↓	↓	↓
Applied pressure for position adjustment has been accepted.	Applied pressure for position adjustment has not been accepted. Observe the input limits.	Applied pressure for lower range value has been accepted.	Applied pressure for lower range value has not been accepted. Observe the input limits.	Applied pressure for upper range value has been accepted.	Applied pressure for upper range value has not been accepted. Observe the input limits.

1) Observe "Warning", → 42, "Commissioning".

5.3.2 Level measuring mode

If no on-site display is connected, the following functions are possible by means of the three keys on the electronic insert or on the exterior of the device:

- Position adjustment (zero point correction)
- Set the lower and upper pressure value and assign to the lower and upper level value
- Device reset, → 28, "Function of the operating elements – on-site display not connected".



Note!

- The "-" and "+"- keys only have a function in the following cases:
 - LEVEL SELECTION "Level Easy Pressure", CALIBRATION MODE "Wet"
 - LEVEL SELECTION "Level Standard", LEVEL MODE "Linear", CALIBRATION MODE "Wet"

The keys have no function in other settings.

- The device is configured for the Pressure measuring mode as standard. You can switch measuring modes by means of the MEASURING MODE parameter. → 42, "Selecting language and measuring mode".

The following parameters are set to the following values in the factory:

- LEVEL SELECTION: Level Easy Pressure
- CALIBRATION MODE: Wet
- OUTPUT UNIT or LIN. MEASURAND: %
- EMPTY CALIB.: 0.0
- FULL CALIB.: 100.0.
- SET LRV: 0.0 (corresponds to 4 mA value)
- SET URV: 100.0 (corresponds to 20 mA value)

These parameters can only be modified by means of the on-site display or remote operation such as the FieldCare.

- The operation must be unlocked. → 39, "Locking/unlocking operation".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.
- See also → 47, "Level measurement". For parameter description see Operating Instructions BA00274P.
- LEVEL SELECTION, CALIBRATION MODE, LEVEL MODE, EMPTY CALIB., FULL CALIB, SET LRV and SET URV are parameter names used for on-site display or remote operation such as FieldCare, for instance.

Carry out position adjustment. ¹⁾		Setting lower pressure value.		Setting upper pressure value.	
Pressure is present at device.		Desired pressure for lower pressure value (EMPTY PRESSURE ²⁾) is present at device.		Desired pressure for upper pressure value (FULL PRESSURE ¹⁾) is present at device.	
↓		↓		↓	
Press "E"-key for 3 s.		Press "-"-key for 3 s.		Press "+"-key for 3 s.	
↓		↓		↓	
Does the LED on the electronic insert light up briefly?		Does the LED on the electronic insert light up briefly?		Does the LED on the electronic insert light up briefly?	
Yes	No	Yes	No	Yes	No
↓	↓	↓	↓	↓	↓
Applied pressure for position adjustment has been accepted.	Applied pressure for position adjustment has not been accepted. Observe the input limits.	The pressure present was saved as the lower pressure value (EMPTY PRESSURE ¹⁾) and assigned to the lower level value (EMPTY CALIB. ¹⁾).	The pressure present was not saved as the lower pressure value. Observe the input limits.	The pressure present was saved as the upper pressure value (FULL PRESSURE ¹⁾) and assigned to the upper level value (FULL CALIB. ¹⁾).	The pressure present was not saved as the upper pressure value. Observe the input limits.

1) Observe "Warning", →  42, "Commissioning".

2) Parameter name used for the on-site display or remote operation such as the FieldCare.

5.4 On-site operation – on-site display connected

If the on-site display is connected, the three operating keys are used to navigate through the operating menu, → 28, "Function of the operating elements – on-site display connected".

5.4.1 General structure of the operating menu

The menu is split into four levels. The three upper levels are used to navigate while you use the bottom level to enter numerical values, select options and save settings. The entire menu is illustrated in Section 10.1 "Operating menu for on-site display, FieldCare and HART handheld terminal". The structure of the OPERATING MENU depends on the measuring mode selected, e.g. if the "Pressure" measuring mode is selected, only the functions necessary for this mode are displayed.

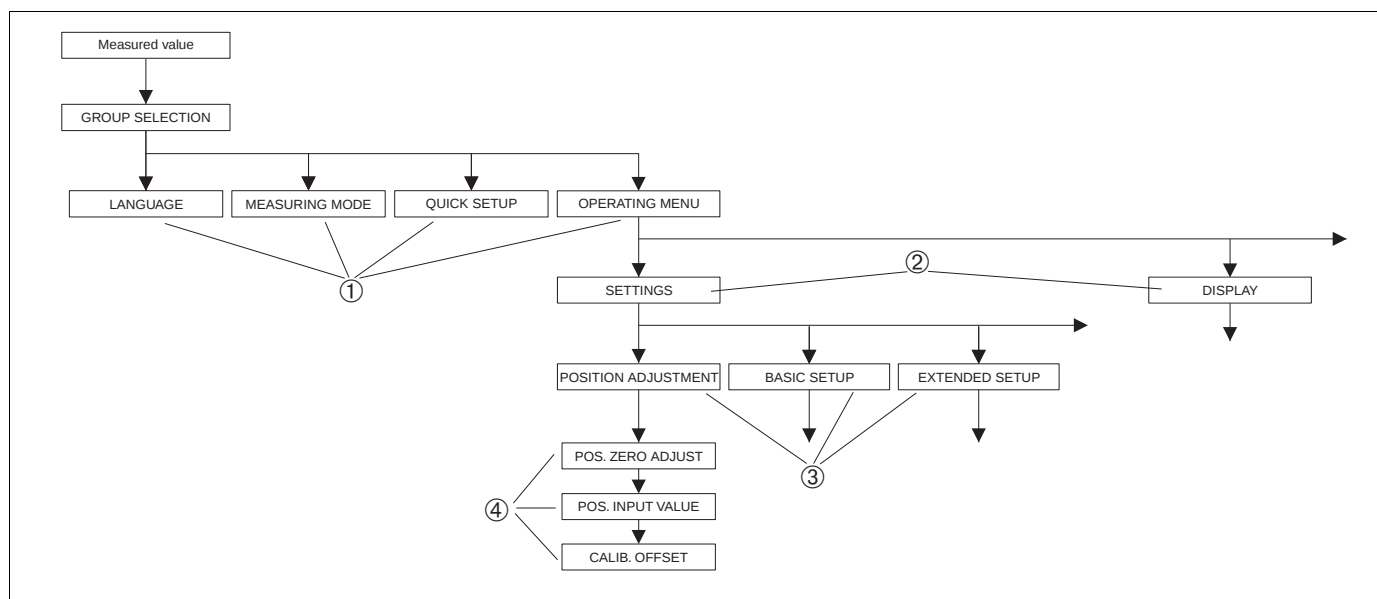


Fig. 23: Structure of the operating menu

- 1 1. Selection level
- 2 2. Selection level
- 3 Function groups
- 4 Parameter

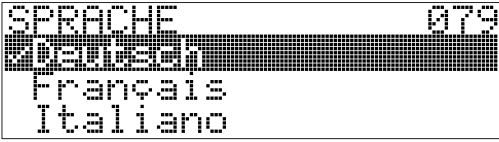
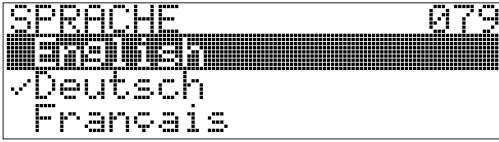
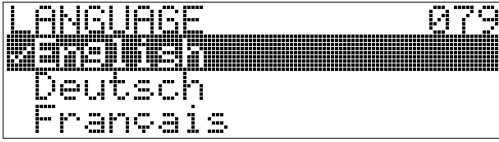


Note!

The LANGUAGE and MEASURING MODE parameters are only displayed via the on-site display on the 1st selection level. In the digital communication, the LANGUAGE parameter is displayed in the DISPLAY group and the MEASURING MODE parameter is displayed in the QUICK SETUP menus or in the BASIC SETUP function group. → 67, "Operating menu for on-site display, FieldCare and HART handheld terminal".

5.4.2 Selecting an option

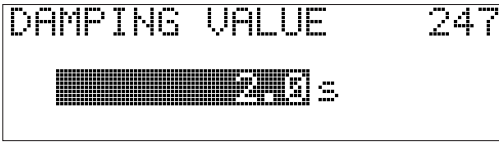
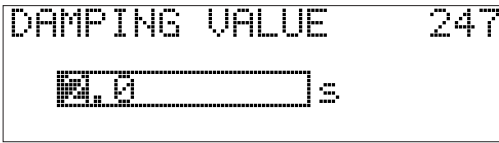
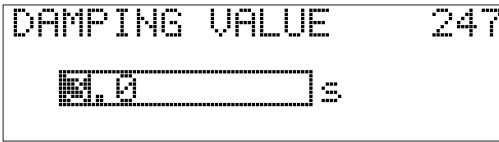
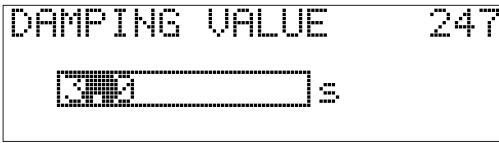
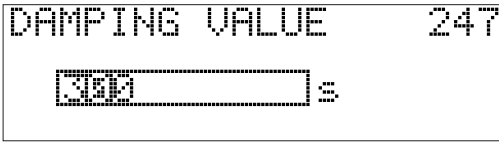
Example: select "English" as the language of the menu.

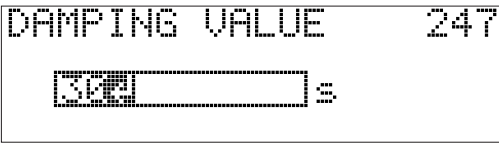
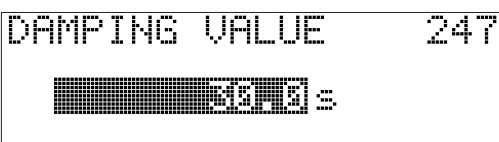
On-site display	Operation
 SPRACHE 079 Deutsch Français Italiano P01-xxxxxxx-19-xx-xx-xx-017	German is selected as the language. A ✓ in front of the menu text indicates the active option.
 SPRACHE 079 English ✓Deutsch Français P01-xxxxxxx-19-xx-xx-xx-033	Select English with "+" or "-".
 LANGUAGE 079 English Deutsch Français P01-xxxxxxx-19-xx-xx-xx-034	1. Confirm your choice with "E". A ✓ in front of the menu text indicates the active option. (English is now selected as the menu language.) 2. Jump to the next item with "E".

5.4.3 Editing a value

Example: adjusting DAMPING VALUE function from 2.0 s to 30.0 s.

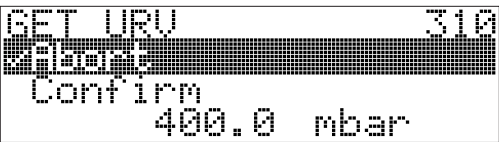
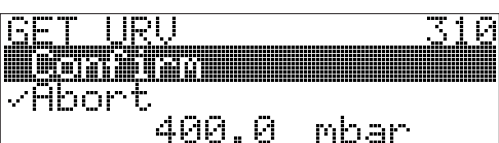
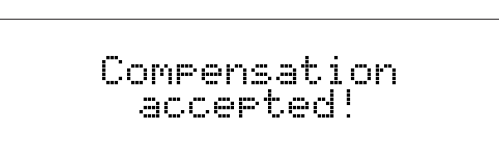
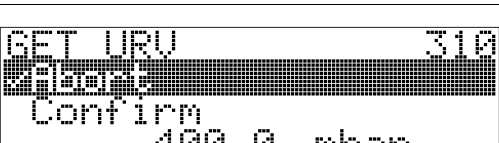
→ 28, "Function of the operating elements – on-site display connected".

On-site display	Operation
 DAMPING VALUE 247 2.0 s P01-xxxxxxx-19-xx-xx-xx-023	The on-site display shows the parameter to be changed. The value highlighted in black can be changed. The "s" unit is fixed and cannot be changed.
 DAMPING VALUE 247 2.0 s P01-xxxxxxx-19-xx-xx-xx-027	1. Press "+" or "-" to get to the editing mode. 2. The first digit is highlighted in black.
 DAMPING VALUE 247 3.0 s P01-xxxxxxx-19-xx-xx-xx-028	1. Use "+" to change "2" to "3". 2. Confirm "3" with "E". The cursor jumps to the next position (highlighted in black).
 DAMPING VALUE 247 30.0 s P01-xxxxxxx-19-xx-xx-xx-029	The decimal point is highlighted in black, i.e. you can now edit it.
 DAMPING VALUE 247 300.0 s P01-xxxxxxx-19-xx-xx-xx-030	1. Keep pressing "+" or "-" until "0" is displayed. 2. Confirm "0" with "E". The cursor jumps to the next position. ↵ is displayed and is highlighted in black. → See next graphic.

On-site display	Operation
 P01-xxxxxxx-19-xx-xx-xx-031	Use "E" to save the new value and exit the editing mode. See next graphic.
 P01-xxxxxxx-19-xx-xx-xx-032	The new value for the damping is now 30.0 s. – Jump to the next parameter with "E". – You can get back to the editing mode with "+" or "-".

5.4.4 Taking pressure applied at device as value

Example: configuring upper range value – assign 20 mA to the pressure value 400 mbar (6 psi).

On-site display	Operation
 P01-xxxxxxx-19-xx-xx-xx-035	The bottom line on the on-site display displays the pressure present, here 400 mbar (6 psi).
 P01-xxxxxxx-19-xx-xx-xx-036	Use "+" or "-" to switch to the "Confirm" option. The active selection is highlighted in black.
 P01-xxxxxxx-19-xx-xx-xx-037	Use "E" to assign the value (400 mbar (6 psi)) to the GET URV parameter. The device confirms the calibration and jumps back to the parameter, here GET URV (see next graphic).
 P01-xxxxxxx-19-xx-xx-xx-035	Switch to the next parameter with "E".

5.5 HistoROM®/M-DAT (optional)

HistoROM®/M-DAT is a memory module, which is attached to the electronic insert and fulfils the following functions:

- Back-up copy of configuration data
- Copying configuration data of a transmitter into another transmitter
- Cyclic recording of pressure and sensor-temperature measured values
- Recording diverse events, such as alarms, configuration changes, counters for measuring range undershooting and exceeding for pressure and temperature, exceeding and undershooting the user limits for pressure and temperature, etc.



Warning!
Detach HistoROM®/M-DAT from the electronic insert or attach it to the insert in a deenergised state only.



Note!

- The HistoROM®/M-DAT module may be retrofitted at any time (Order No.: 52027785).
- The HistoROM data and the data in the device are analysed once a HistoROM®/M-DAT is attached to the electronic insert and power is reestablished to the device. During the analysis, the messages "W702, HistoROM data not consistent" and "W706, Configuration in HistoROM and device not identical" can occur. For measures, → 52, "Messages."

5.5.1 Copying configuration data

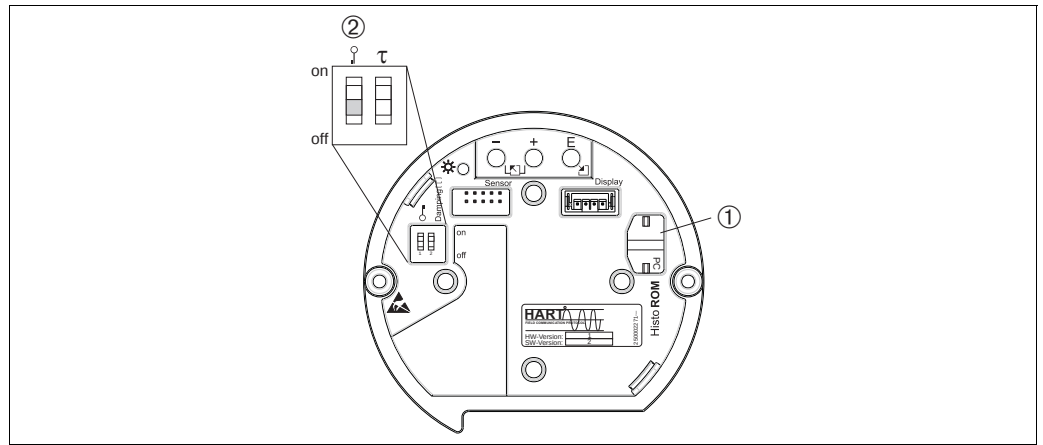


Abb. 24: Electronic insert with optional HistoROM®/M-DAT memory module

- 1 Optional HistoROM®/M-DAT
- 2 To copy configuration data from the HistoROM®/M-DAT module to a device or from a device to a HistoROM®/M-DAT, the operation must be unlocked DIP-switch 1, Position "off", parameter INSERT PIN NO. = 100).
Observe → 39, "Locking/unlocking operation".

On-site operation – on-site display not connected

Copying configuration data from a device to a HistoROM®/M-DAT module:



Note!

The operation must be unlocked.

1. Disconnect device from supply voltage.
2. Attach the HistoROM®/M-DAT module to the electronic insert.
3. Reestablish supply voltage to the device.
4. Press "E" and "-"-keys (for at least 3 seconds) until the LED on the electronic insert lights up.
5. Wait approx. 20 seconds. Configuration data are loaded from the device to the HistoROM®/M-DAT. The device is not restarted.
6. Disconnect device from the supply voltage again.
7. Detach memory module.
8. Reestablish supply voltage to the device.

Copying configuration data from a HistoROM®/M-DAT to a device:

Note!

The operation must be unlocked.

1. Disconnect device from supply voltage.
2. Attach the HistoROM®/M-DAT module to the electronic insert. Configuration data from another device are stored in the HistoROM®/M-DAT.
3. Reestablish supply voltage to the device.
4. Press "E" and "+"-keys (for at least 3 seconds) until the LED on the electronic insert lights up.
5. Wait approx. 20 seconds. All parameters except DEVICE SERIAL No, DEVICE DESIGN., CUST. TAG NUMBER, LONG TAG NUMBER, DESCRIPTION, BUS ADDRESS and the parameters in the POSITION ADJUSTMENT and PROCESS CONNECTION group are loaded into the device by HistoROM®/M-DAT. The device is restarted.
6. Before removing the HistoROM®/M-DAT again from the electronic insert, disconnect the device from supply voltage.

On-site operation via on-site display (optional) or remote operation**Copying configuration data from a device to a HistoROM®/M-DAT:**

Note!

The operation must be unlocked.

1. Disconnect device from supply voltage.
2. Attach the HistoROM®/M-DAT module to the electronic insert.
3. Reestablish supply voltage to the device.
4. The DOWNLOAD SELECT. parameter setting has no influence on an upload from the device into HistoROM.
(Menu path: (GROUP SELECTION →) OPERATING MENU → OPERATION)
5. Using the HistoROM CONTROL parameter select the option "Device → HistoROM" as the data transfer direction.
(Menu path: GROUPSELECTION → OPERATING MENU → OPERATION)
6. Wait approx. 20 seconds. Configuration data are loaded from the device to the HistoROM®/M-DAT. The device is not restarted.
7. Disconnect device from the supply voltage again.
8. Detach memory module.
9. Reestablish supply voltage to the device.

Copying configuration data from a HistoROM®/M-DAT to a device:

Note!

The operation must be unlocked.

1. Disconnect device from supply voltage.
2. Attach the HistoROM®/M-DAT module to the electronic insert. Configuration data from another device are stored in the HistoROM®/M-DAT.
3. Reestablish supply voltage to the device.
4. Use the DOWNLOAD SELECT parameter to select which parameters are to be overwritten (Menu path: (GROUPS SELECTION →) OPERATING MENU → OPERATION).

The following parameters are overwritten according to the selection:

– **Configuration copy (factory setting):**

all parameters except DEVICE SERIAL No., DEVICE DESIGN, CUST. TAG NUMBER, LONG TAG NUMBER, DESCRIPTION, BUS ADDRESS and the parameters in the POSITION ADJUSTMENT, PROCESS CONNECTION, CURR. TRIM (SERVICE/SYSTEM 2), SENSOR TRIM and SENSOR DATA group.

– **Device replacement:**

all parameters except DEVICE SERIAL No., DEVICE DESIGN and the parameters in the POSITION ADJUSTMENT, PROCESS CONNECTION, CURR. TRIM (SERVICE/SYSTEM 2), SENSOR TRIM and SENSOR DATA group.

– **Electronics replace:**

all parameters except the parameters in the CURR. TRIM (SERVICE/SYSTEM 2), POSITION ADJUSTMENT and SENSOR DATA group.

Factory setting: Configuration copy

5. Using the HistoROM CONTROL parameter select the option "HistoROM → Device" as the data transfer direction.
(Menu path: GROUP SELECTION → OPERATING MENU → OPERATION)
6. Wait approx. 20 seconds. Configuration data are loaded from the device to the HistoROM®/M-DAT. The device is restarted.
7. Before removing the HistoROM®/M-DAT again from the electronic insert, disconnect the device from supply voltage.

5.6 Operation via HART handheld terminal

Use the HART handheld terminal to set all parameters all the way along the 4 to 20 mA cable via menu operation.



Note!

- See also → 24, "Connecting HART handheld terminal".
- For further information, please refer to the Operating Instructions for the handheld terminal. The Operating Instructions are supplied with the handheld terminal.

5.7 Endress+Hauser operating program

The operating program FieldCare is an Endress+Hauser Plant Asset Management Tool based on FDT technology. You can use FieldCare to configure all your Endress+Hauser devices, as well as devices from other manufacturers that support the FDT standard. Hardware and software requirements you can find on the www.endress.com → select your country → Search: FieldCare → FieldCare → Technical Data.

FieldCare supports the following functions:

- Configuration of transmitters in online operation
- Loading and saving device data (upload/download)
- Tank linearization
- HistoROM®/M-DAT analysis
- Documentation of the measuring point

Connection options:

- HART via Fieldgate FXA520
- HART via Commubox FXA195 and USB interface of a computer
- Commubox FXA291 with ToF Adapter FXA291 via service interface



Note!

- See also → 24, "Connecting Commubox FXA195".
- Further information on the FieldCare can be found on the Internet: <http://www.endress.com> → Download → Text Search: FieldCare.

5.8 Locking/unlocking operation

Once you have entered all the parameters, you can lock your entries against unauthorised and undesired access.

You have the following possibilities for locking/unlocking the operation:

- Via a DIP-switch on the electronic insert, locally on the display.
- Via the on-site display (optional)
- Via digital communication.

The -symbol on the on-site display indicates that operation is locked. Parameters which refer to how the display appears, e.g. LANGUAGE and DISPLAY CONTRAST can still be altered.



Note!

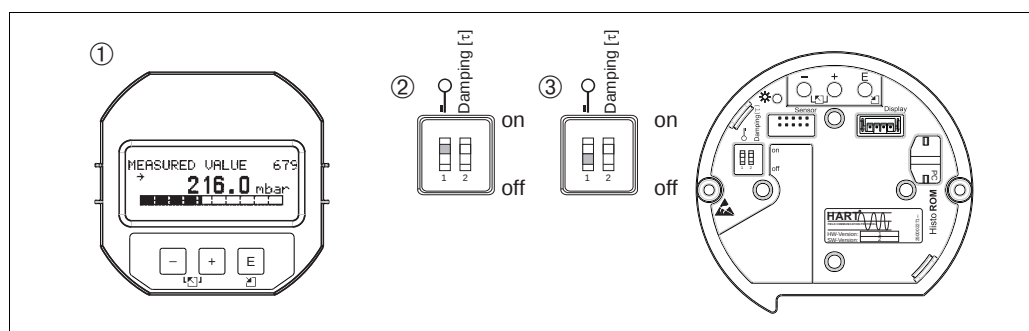
If operation is locked by means of the DIP-switch, you can only unlock operation again by means of the DIP-switch. If operation is locked by means of the on-site display or remote operation e.g. FieldCare, you can only unlock operation again by means of the on-site display or remote operation.

The table provides an overview of the locking functions:

Locking via	View/read parameter	Modify/write via ¹⁾		Unlocking via		
		On-site display	Remote operation	DIP-switch	On-site display	Remote operation
DIP-switch	Yes	No	No	Yes	No	No
On-site display	Yes	No	No	No	Yes	Yes
Remote operation	Yes	No	No	No	Yes	Yes

1) Parameters which refer to how the display appears, e.g. LANGUAGE and DISPLAY CONTRAST can still be altered.

5.8.1 Locking/unlocking operation locally via DIP-switch



P01-xxxxxxx-19-xx-xx-xx-133

Fig. 25: DIP-switch position "Hardware locking" on the electronic insert

- 1 If necessary, remove on-site display (optional)
- 2 DIP-switch is at "on": operation is locked.
- 3 DIP-switch is at "off": operation is unlocked (operation possible)

5.8.2 Locking/unlocking operation via on-site display or remote operation

	Description
Locking operation	1. Select INSERT PIN NO. parameter, Menu path: OPERATING MENU → OPERATION → INSERT PIN NO. 2. To lock operation, enter a number for this parameter between 0 to 9999 that is ≠100.
Unlocking operation	1. Select INSERT PIN NO. parameter. 2. To unlock operation, enter "100" for the parameter.

5.9 Factory setting (reset)

By entering a certain code, you can completely, or partially, reset the entries for the parameters to the factory settings. (For factory settings refer to the Operating Instructions BA00274P "Cerabar S/Deltabar S/Deltapilot S, Description of device functions".) Enter the code by means of the ENTER RESET CODE parameter (Menu path: (GROUP SELECTION →) OPERATING MENU → OPERATING).

There are various reset codes for the device. The following table illustrates which parameters are reset by the particular reset codes. Operation must be unlocked to reset parameters (→ 39, "Locking/unlocking operation").



Note!

Any customer-specific configuration carried out by the factory is not affected by a reset (customer-specific configuration remains). If, after a reset, you wish the parameters to be reset to the factory settings, please contact Endress+Hauser Service.

Reset code	Description and effect
1846	Display reset – This reset resets all parameters which have to do with how the display appears (DISPLAY group). – Any simulation which may be running is ended. – The device is restarted.
62	PowerUp reset (warm start) – This reset resets all the parameters in the RAM. Data are read back anew from the EEPROM (processor is initialised again). – Any simulation which may be running is ended. – The device is restarted.
2710	Measuring mode level reset – Depending on the settings for the LEVEL MODE, LIN MEASURAND, LINdMEASURAND or COMB. MEASURAND parameters, the parameters needed for this measuring task will be reset. – Any simulation which may be running is ended. – The device is restarted. Example LEVEL MODE = linear and LIN. MEASURAND = Height ■ HEIGHT UNIT = m ■ CALIBRATION MODE = wet ■ EMPTY CALIB. = 0 ■ FULL CALIB. = Sensor end value converted to mH₂O, e.g. 4.79 mH₂O for a 400 mbar (6 psi) sensor
333	User reset – Affects the following parameters: – Function group POSITION ADJUSTMENT – Function group BASIC SETUP, except for the customer-specific units – Function group EXTENDED SETUP – Group OUTPUT – Function group HART DATA: BUS ADDRESS and PREAMBLE NUMBER – Any simulation which may be running is ended. – The device is restarted.

Reset code	Description and effect
7864	Total reset – Affects the following parameters: – Function group POSITION ADJUSTMENT – Function group BASIC SETUP – Function group EXTENDED SETUP – Function group LINEARISATION (an existing linearisation table is erased) – Group OUTPUT – Function group PEAK HOLD INDICATOR – Function group HART DATA – All configurable messages ("Error" type) are set to factory setting. →  52, "Messages" and →  59, "Response of outputs to errors". – Function group USER LIMITS – Function group SYSTEM 2 – Any simulation which may be running is ended. – The device is restarted.
8888	HistoROM reset The measured value memory and event memory are cleared. During the reset, the HistoROM must be attached to the electronic insert.

6 Commissioning



Warning!

- If a pressure smaller than the minimum permitted pressure is present at the device, the messages "E120 Sensor low pressure" and "E727 Sensor pressure error – overrange" are output in succession.
- If a pressure greater than the maximum permitted pressure is present at the device, the messages "E115 Sensor overpressure" and "E727 Sensor pressure error – overrange" are output in succession.
- Messages E727, E115 and E120 are "Error"-type messages and can be configured as a "Warning" or an "Alarm". These messages are configured as "Warning" messages at the factory. This setting prevents the current output from assuming the set alarm current value for applications (e.g. cascade measurement) where the user is consciously aware of the fact that the sensor range can be exceeded
- We recommend setting messages E727, E115 and E120 to "Alarm" in the following instances:
 - The sensor range does not have to be exceeded for the measuring application.
 - Position adjustment has to be carried out that has to correct a large measured error as a result of the orientation of the device (e.g. devices with a diaphragm seal).



Note!

The device is configured for the Pressure measuring mode as standard. The measuring range and the unit in which the measured value is transmitted correspond to the specifications on the nameplate.

6.1 Function check

Carry out a post-installation and a post-connection check as per the checklist before commissioning the device.

- "Post-installation check" checklist, → 19.
- "Post-connection check" checklist, → 25.

6.2 Selecting language and measuring mode

6.2.1 On-site operation

The LANGUAGE and MEASURING MODE parameters are located on the top menu level. See also → 32, "General structure of the operating menu".

The following languages are available:

- Deutsch
- English
- Français
- Italiano
- Español
- Nederlands
- Chinese (CHS)
- Japanese (JPN)

The following measuring modes are available:

- Pressure
- Level

6.2.2 Digital communication

The MEASURING MODE parameter is displayed in the digital communication in the QUICK SETUP menus and in the BASIC SETUP function group (OPERATING MENU → SETTINGS → BASIC SETUP).

The following measuring modes are available:

- Pressure
- Level

The LANGUAGE parameter is arranged in the DISPLAY group (OPERATING MENU → DISPLAY).

- Use the LANGUAGE parameter to select the menu language for the on-site display.
- Select the menu language for FieldCare by means of the "Language Button" in the configuration window. Select the menu language for the FieldCare frame via the "Extra" menu → "Options" → "Display" → "Language".

The following languages are available:

- Deutsch
- English
- Français
- Italiano
- Español
- Nederlands
- Chinese (CHS)
- Japanese (JPN)

6.3 Position adjustment

Due to the orientation of the device, there may be a shift in the measured value, i.e. when the container is empty or partly filled, the measured value parameter does not display zero. There are three options to choose from when performing position adjustment.

(Menu path: (GROUP SELECTION →) OPERATING MENU → SETTINGS → POSITION ADJUSTMENT)

Parameter name	Description
POS. ZERO ADJUST (685) Entry	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. Example: – MEASURED VALUE = 2.2 mbar (0.032 psi) – Correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option. This means that you are assigning the value 0.0 to the pressure present. – MEASURED VALUE (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. The CALIB. OFFSET parameter displays the resulting pressure difference (offset) by which the MEASURED VALUE was corrected. Factory setting: 0.0
POS. INPUT VALUE (563) Entry	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. To correct the pressure difference, you need a reference measurement value (e. g. from a reference device). Example: – MEASURED VALUE = 0.5 mbar (0.0073 psi) – For the POS. INPUT VALUE parameter, specify the desired set point for the MEASURED VALUE, e.g. 2.0 mbar (0.029 psi). ($\text{MEASURED VALUE}_{\text{new}} = \text{POS. INPUT VALUE}$) – MEASURED VALUE (after entry for POS. INPUT VALUE) = 2.0 mbar (0.029 psi) – The CALIB. OFFSET parameter displays the resulting pressure difference (offset) by which the MEASURED VALUE was corrected. $\text{CALIB. OFFSET} = \text{MEASURED VALUE}_{\text{old}} - \text{POS. INPUT VALUE}$, here: $\text{CALIB. OFFSET} = 0.5 \text{ mbar (0.0073 psi)} - 2.0 \text{ mbar (0.029 psi)} = -1.5 \text{ mbar (0.022 psi)}$ – The current value is also corrected. Factory setting: 0.0
CALIB. OFFSET (319) Entry	Position adjustment – the pressure difference between zero (set point) and the measured pressure is known. Example: – MEASURED VALUE = 2.2 mbar (0.032 psi) – Via the CALIB. OFFSET parameter, enter the value by which the MEASURED VALUE should be corrected. To correct the MEASURED VALUE to 0.0 mbar, you must enter the value 2.2 here. ($\text{MEASURED VALUE}_{\text{new}} = \text{MEASURED VALUE}_{\text{old}} - \text{CALIB. OFFSET}$) – MEASURED VALUE (after entry for calib. offset) = 0.0 mbar – The current value is also corrected. Factory setting: 0.0

6.4 Pressure measurement

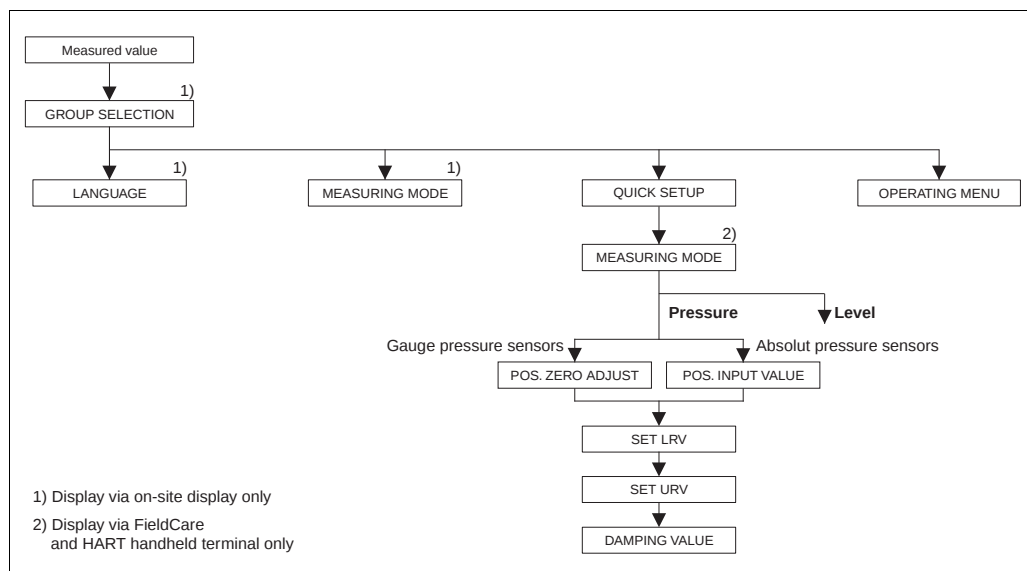
6.4.1 Information on pressure measurement



Note!

- There is a Quick Setup menu for each of the measuring modes Pressure and Level which guides you through the most important basic functions. With the setting in the MEASURING MODE parameter, you specify which Quick Setup menu should be displayed.
→ 42, "Selecting language and measuring mode".
- For a detailed description of the parameters see the Operating Instructions BA00274P "Cerabar S/Deltabar S/Deltapilot S, Description of device functions"
 - Table 6, POSITION ADJUSTMENT
 - Table 7, BASIC SETUP
 - Table 15, EXTENDED SETUP
- For pressure measurement, select the "Pressure" option by means of the MEASURING MODE parameter. The operating menu is structured appropriately. See also → 67, "Operating menu for on-site display, FieldCare and HART handheld terminal".

6.4.2 Quick Setup menu for Pressure measuring mode



P01-PMx7xxxx-19-xx-xx-xx-002

Fig. 26: Quick Setup menu for Pressure measuring mode

On-site operation	Digital communication
Measured value display On-site display: Switch from the measured value display to GROUP SELECTION with $\square$.	Measured value display Select QUICK SETUP menu.
GROUP SELECTION Select MEASURING MODE.	MEASURING MODE Select "Pressure" option.
MEASURING MODE Select "Pressure" option.	
GROUP SELECTION Select QUICK SETUP menu.	
POS. ZERO ADJUST Due to orientation of the device, there may be a shift in the measured value. You correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option, i. e. you assign the value 0.0 to the pressure present.	POS. ZERO ADJUST Due to orientation of the device, there may be a shift in the measured value. You correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option, i. e. you assign the value 0.0 to the pressure present.

On-site operation	Digital communication
POS. INPUT VALUE Due to orientation of the device, there may be a shift in the measured value. For the POS. INPUT VALUE parameter, specify the desired set point for the MEASURED VALUE.	POS. INPUT VALUE Due to orientation of the device, there may be a shift in the measured value. For the POS. INPUT VALUE parameter, specify the desired set point for the MEASURED VALUE.
SET LRV Set the measuring range (enter 4 mA value). Specify a pressure value for the lower current value (4 mA value). A reference pressure does not have to be present at the device.	SET LRV Set the measuring range (enter 4 mA value). Specify a pressure value for the lower current value (4 mA value). A reference pressure does not have to be present at the device.
SET URV Set the measuring range (enter 20 mA value). Specify a pressure value for the upper current value (20 mA value). A reference pressure does not have to be present at the device.	SET URV Set the measuring range (enter 20 mA value). Specify a pressure value for the upper current value (20 mA value). A reference pressure does not have to be present at the device.
DAMPING TIME Enter damping time (time constant τ). The damping affects the speed at which all subsequent elements, such as the on-site display, measured value and current output react to a change in the pressure.	DAMPING TIME Enter damping time (time constant τ). The damping affects the speed at which all subsequent elements, such as the on-site display, measured value and current output react to a change in the pressure.



Note!
For on-site operation, see also
→ 28, "Function of the operating elements – on-site display connected" and
→ 32, "On-site operation – on-site display connected".

6.5 Level measurement

6.5.1 Information on level measurement



Note!

- The Pressure and Level operating modes each have a quick setup menu which guides you through the most important basic functions. → 49, "Quick Setup menu for Level measuring mode".
- Furthermore, the three level modes "Level Easy Pressure", "Level Easy Height" and "Level Standard" are available to you for level measurement. You can select from the "Linear", "Pressure linearized" and "Height linearized" level types for the "Level Standard" level mode. The table in the "Overview of level measurement" section below provides an overview of the various measuring tasks.
 - In the "Level Easy Pressure" and "Level Easy Height" level modes, the values entered are not tested as extensively as in the "Level Standard" level mode. The values entered for EMPTY CALIB./FULL CALIB., EMPTY PRESSURE/FULL PRESSURE, EMPTY HEIGHT/FULL HEIGHT and SET LRV/SET URV must have a minimum interval of 1 % for the "Level Easy Pressure" and "Level Easy Height" level modes. The value will be rejected with a warning message if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring device can measure correctly.
 - The "Level Easy Pressure" and "Level Easy Height" level modes encompass fewer parameters than the "Level Standard" mode and are used for quick and easy configuration of a level application.
 - Customer-specific units of fill level, volume and mass or a linearization table may only be entered in the "Level Standard" level mode.
 - Where the device is intended for use as a subsystem in a safety function (SIL), a "Device configuration with enhanced parameter security" (SAFETY CONFIRM.) is only possible for the "Level" operating mode in the "Level Easy Pressure" level mode. All parameters previously entered are checked after a password is entered. Once the "Level Easy Height" or "Level Standard" has been selected, the configuration will first have to be reset to the ex-works setting using the RESET parameter (menu path: (GROUP SELECTION →) OPERATING MENU → OPERATION) using the reset code "7864".
For further information see the Cerabar S (SD00190P) Functional Safety Manual.
- See the Operating Instructions BA00274P "Cerabar S/Deltabar S/Deltapilot S, Description of device functions".

6.5.2 Overview of level measurement

Measuring task	LEVEL SELECTION/ LEVEL MODE	Measured variable options	Description	Comment	Measured value display
The measured variable is in direct proportion to the measured pressure. Calibration is performed by entering two pressure-level value pairs.	LEVEL SELECTION: Level Easy Pressure	Via OUTPUT UNIT parameter: %, level, volume or mass units.	– Calibration with reference pressure – wet calibration, see Operating Instructions BA00274P. – Calibration without reference pressure – dry calibration, see Operating Instructions BA00274P.	– Incorrect entries are possible – SIL mode possible – Customised units are not possible	The measured value display and the LEVEL BEFORE LIN parameter show the measured value.
The measured variable is in direct proportion to the measured pressure. Calibration is performed by entering the density and two height-level value pairs.	LEVEL SELECTION: Level Easy Height	Via OUTPUT UNIT parameter: %, level, volume or mass units.	– Calibration with reference pressure – wet calibration, see Operating Instructions BA00274P. – Calibration without reference pressure – dry calibration, see Operating Instructions BA00274P.	– Incorrect entries are possible – SIL mode not possible – Customised units are not possible	The measured value display and the LEVEL BEFORE LIN parameter show the measured value.
The measured variable is in direct proportion to the measured pressure.	LEVEL SELECTION: Level standard/ LEVEL MODE: Linear	Via LIN. MEASURAND parameter: – % (level) – Level – Volume – Mass	– Calibration with reference pressure – wet calibration, see Operating Instructions BA00274P. – Calibration without reference pressure – dry calibration, see Operating Instructions BA00274P.	– Incorrect entries are rejected by the device – SIL mode not possible – Customised level, volume and mass units are possible	The measured value display and the LEVEL BEFORE LIN parameter show the measured value.
The measured variable is not in direct proportion to the measured pressure as, for example, with containers with a conical outlet. A linearisation table must be entered for the calibration.	LEVEL SELECTION: Level standard/ LEVEL MODE: Pressure linearized	Via LINd MEASURAND parameter: – Pressure + % – Pressure + volume – Pressure + mass	– Calibration with reference pressure: semiautomatic entry of linearisation table, see Operating Instructions BA00274P. – Calibration without reference pressure: manual entry of linearisation table, see Operating Instructions BA00274P.	– Incorrect entries are rejected by the device – SIL mode not possible – Customised level, volume and mass units are possible	The measured value display and the TANK CONTENT parameter show the measured value.
– Two measured variables are required or – The container shape is given by value pairs, such as height and volume. The 1st measured variable %-height or height must be in direct proportion to the measured pressure. The 2nd measured variable volume, mass or % must not be in direct proportion to the measured pressure. A linearisation table must be entered for the 2nd measured variable. The 2nd measured variable is assigned to the 1st measured variable by means of this table.	LEVEL SELECTION: Level standard/ LEVEL MODE: Height linearized	Via COMB. MEASURAND parameter: – Height + volume – Height + mass – Height + % – %-Height + volume – %-Height + mass – %-Height + %	– Calibration with reference pressure: wet calibration and semiautomatic entry of linearisation table, see Operating Instructions BA00274P. – Calibration without reference pressure: dry calibration and manual entry of linearisation table, see Operating Instructions BA00274P.	– Incorrect entries are rejected by the device – SIL mode not possible – Customised level, volume and mass units are possible	The measured value display and the TANK CONTENT parameter show the 2nd measured value (volume, mass or %). The LEVEL BEFORE LIN parameter displays the 1st measured value (%-height or height).

6.5.3 Quick Setup menu for Level measuring mode



Note!

- Some parameters are only displayed if other parameters are appropriately configured. For example, the EMPTY CALIB. parameter is only displayed in the following cases:
 - LEVEL SELECTION "Level Easy Pressure" and CALIBRATION MODE "Wet"
 - LEVEL SELECTION "Level Standard", LEVEL MODE "Linear" and CALIBRATION MODE "WET"
- You can find the LEVEL MODE parameter in the BASIC SETTINGS function group (menu path: (GROUP SELECTION →) OPERATING MENU → SETTINGS → BASIC SETTINGS).
- The following parameters are set to the following values in the factory:
 - LEVEL SELECTION: Level Easy Pressure
 - CALIBRATION MODE: Wet
 - OUTPUT UNIT or LIN. MEASURAND: %
 - EMPTY CALIB.: 0.0
 - FULL CALIB.: 100.0
 - SET LRV (BASIC SETTINGS group): 0.0 (corresponds to 4 mA value)
 - SET URV (BASIC SETTINGS group): 100.0 (corresponds to 20 mA value).
- The quick setup is suitable for simple and quick commissioning. If you wish to make more complex settings, e.g. change the unit from "%" to "m", you will have to calibrate using the BASIC SETTINGS group. See Operating Instructions BA00274P.

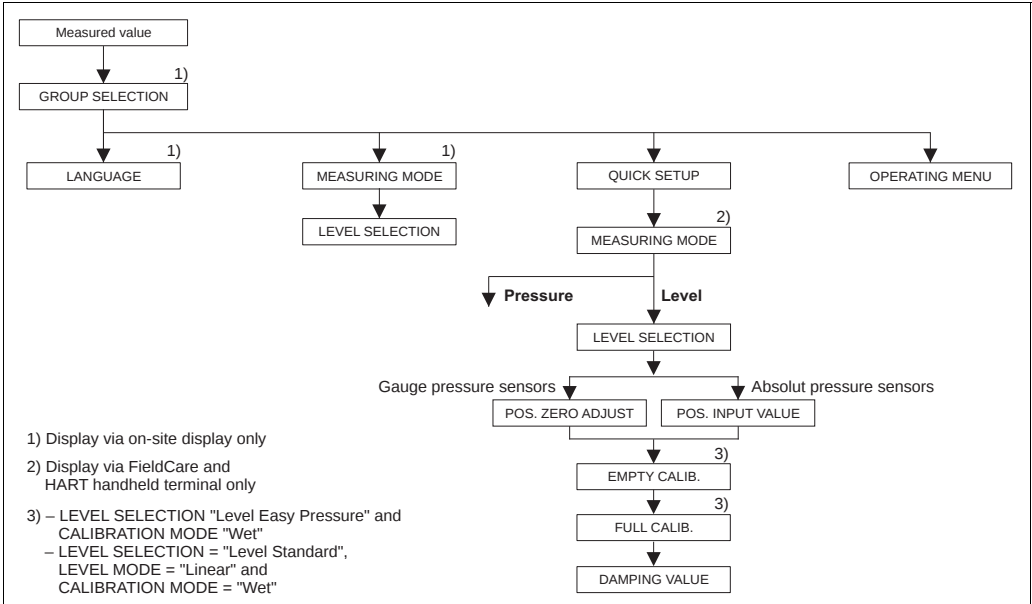


Fig. 27: Quick Setup menu for the Level measuring mode

On-site operation	Digital communication
Measured value display On-site display: Switch from the measured value display to GROUP SELECTION with .	Measured value display Select QUICK SETUP menu.
GROUP SELECTION Select MEASURING MODE.	MEASURING MODE Select "Level" option.
MEASURING MODE Select "Level" option.	
LEVEL SELECTION Select level mode. For an overview see → 48.	LEVEL SELECTION Select level mode. For an overview see → 48.
GROUP SELECTION Select QUICK SETUP menu.	

On-site operation	Digital communication
POS. ZERO ADJUST Due to orientation of the device, there may be a shift in the measured value. You correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option, i. e. you assign the value 0.0 to the pressure present.	POS. ZERO ADJUST Due to orientation of the device, there may be a shift in the measured value. You correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option, i. e. you assign the value 0.0 to the pressure present.
POS. INPUT VALUE Due to orientation of the device, there may be a shift in the measured value. For the POS. INPUT VALUE parameter, specify the desired set point for the MEASURED VALUE.	POS. INPUT VALUE Due to orientation of the device, there may be a shift in the measured value. For the POS. INPUT VALUE parameter, specify the desired set point for the MEASURED VALUE.
EMPTY CALIB. ¹⁾ Enter level for the lower calibration point. For this parameter, enter a level value which is assigned to the pressure present at the device.	EMPTY CALIB. ¹⁾ Enter level for the lower calibration point. For this parameter, enter a level value which is assigned to the pressure present at the device.
FULL CALIB. ¹⁾ Enter level for the upper calibration point. For this parameter, enter a level value which is assigned to the pressure present at the device.	FULL CALIB. ¹⁾ Enter level for the upper calibration point. For this parameter, enter a level value which is assigned to the pressure present at the device.
DAMPING TIME Enter damping time (time constant τ). The damping affects the speed at which all subsequent elements, such as the on-site display, measured value and current output react to a change in the pressure.	DAMPING TIME Enter damping time (time constant τ). The damping affects the speed at which all subsequent elements, such as the on-site display, measured value and current output react to a change in the pressure.

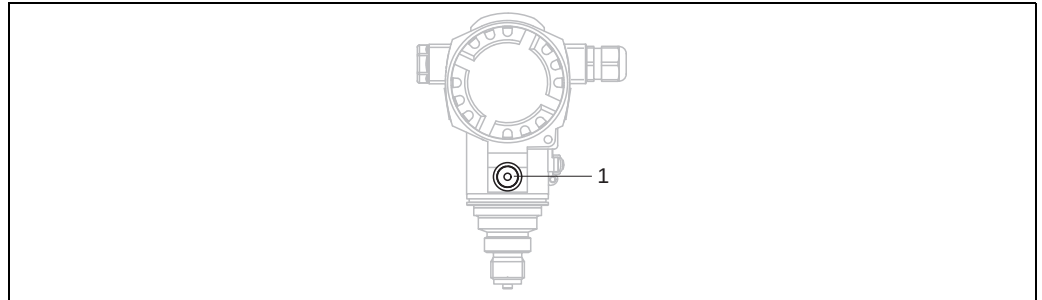
1) – LEVEL SELECTION "Level Easy Pressure" and CALIBRATION MODE "Wet"
 – LEVEL SELECTION "Level Standard", LEVEL MODE "Linear" and CALIBRATION MODE "Wet"



Note!
For on-site operation, see also
→ 28, "Function of the operating elements – on-site display connected" and
→ 32, "On-site operation – on-site display connected".

7 Maintenance

Keep the pressure compensation and GORE-TEX® filter (1) free from contaminations and water.



P01-PMC71xxx-17-xx-xx-xx-001

7.1 Exterior cleaning

Please note the following points when cleaning the device:

- The cleaning agents used should not attack the surface and the seals.
- Mechanical damage to the process isolating diaphragm, e.g. due to pointed objects, must be avoided.
- Observe degree of protection. See therefor nameplate if necessary (→ 6).

8 Trouble-shooting

8.1 Messages

The following table lists all the possible messages that can occur.

The device differentiates between the error types "Alarm", "Warning" and "Error". You may specify whether the instrument should react as if for an "Alarm" or "Warning" for "Error" messages.

→ See "Error type/NA 64" column and Section 8.2 "Response of outputs to errors".

In addition, the "Error type/NA 64" column classifies the messages in accordance with NAMUR Recommendation NA 64:

- Break down: indicated with "B"
- Maintenance need: indicated with "C" (check request)
- Function check: indicated with "I" (in service)

Error message display on the on-site display:

- The measured value display shows the message with the highest priority. → See "Priority" column.
- The ALARM STATUS parameter shows all the messages present in descending order of priority. You can scroll through all the messages present with the -key or -key.

Message display via the digital communication:

The ALARM STATUS parameter shows the message with the highest priority.

See "Priority" column.



Note!

- If the device detects a defect in the on-site display during initialization, special error messages are generated. For the error messages →  59, "On-site display error messages".
- For support and further information, please contact Endress+Hauser Service.
- See also Section "Repair", "Repair of Ex-certified devices" and "Spare Parts".

Code	Error type/ NA 64	Message/description	Cause	Measure	Priority
101 (A101)	Alarm B	B>Sensor electronic EEPROM error	– Electromagnetic effects are greater than specifications in the technical data. (→  67) This message normally only appears briefly. – Sensor defect.	– Wait a few minutes. – Restart the device. Perform reset (Code 62). – Block off electromagnetic effects or eliminate source of disturbance. – Replace sensor.	17
102 (W102)	Warning C	C>Checksum error in EEPROM: peakhold segment	– Main electronics defect. Correct measurement can continue as long as you do not need the peak hold indicator function.	– Replace main electronics.	53
106 (W106)	Warning C	C>Downloading - please wait	– Downloading.	– Wait for download to complete.	52
110 (A110)	Alarm B	B>Checksum error in EEPROM: configuration segment	– The supply voltage is disconnected when writing. – Electromagnetic effects are greater than specifications in the technical data. (→  67) – Main electronics defect.	– Reestablish supply voltage. Perform reset (Code 7864) if necessary. Carry out calibration again. – Block off electromagnetic effects or eliminate sources of disturbance. – Replace main electronics.	6
113 (A113)	Alarm B	B>ROM failure in transmitter electronic	– Main electronics defect.	– Replace main electronics.	1

Code	Error type/ NA 64	Message/description	Cause	Measure	Priority
115 (E115)	Error B factory setting; Warning	B>Sensor overpressure	– Overpressure present. – Sensor defect.	– Reduce pressure until message disappears. – Replace sensor.	29
116 (W116)	Warning C	C>Download error, repeat download	– The file is defect. – During the download, the data are not correctly transmitted to the processor, e.g. because of open cable connections, spikes (ripple) on the supply voltage or electromagnetic effects.	– Use another file. – Check cable connection PC – transmitter. – Block off electromagnetic effects or eliminate sources of disturbance. – Perform reset (Code 7864) and carry out calibration again. – Repeat download.	36
120 (E120)	Error B factory setting; Warning	B>Sensor low pressure	– Pressure too low. – Sensor defect.	– Increase pressure until message disappears. – Replace sensor.	30
121 (A121)	Alarm B	B>Checksum error in factory segment of EEPROM	– Main electronics defect.	– Replace main electronics.	5
122 (A122)	Alarm B	B>Sensor not connected	– Cable connection sensor –main electronics disconnected. – Electromagnetic effects are greater than specifications in the technical data. (→ 67) – Main electronics defect. – Sensor defect.	– Check cable connection and repair if necessary. – Block off electromagnetic effects or eliminate source of disturbance. – Replace main electronics. – Replace sensor.	13
130 (A130)	Alarm B	B>EEPROM is defect.	– Main electronics defect.	– Replace main electronics.	10
131 (A131)	Alarm B	B>Checksum error in EEPROM: min/max segment	– Main electronics defect.	– Replace main electronics.	9
132 (A132)	Alarm B	B>Checksum error in totalizer EEPROM	– Main electronics defect.	– Replace main electronics.	7
133 (A133)	Alarm B	B>Checksum error in History EEPROM	– An error occurred when writing. – Main electronics defect.	– Perform reset (Code 7864) and carry out calibration again. – Replace electronics.	8
602 (W602)	Warning C	C>Linearisation curve not monoton	– The linearisation table is not monotonic increasing or decreasing.	– Add to linearisation table or perform linearisation again.	57

Code	Error type/ NA 64	Message/description	Cause	Measure	Priority
604 (W604)	Warning C	C>Linearisation table not valid. Less than 2 points or points too close	– The linearisation table consists of less than 2 points. – At least 2 points in the linearisation table are too close together. A minimum gap of 0.5 % of the distance between two points must be maintained. Spans for the "Pressure linearized" option: HYDR. PRESS MAX. – HYDR. PRESS MIN.; TANK CONTENT MAX. – TANK CONTENT MIN. Spans for the "Height linearized" option: LEVEL MAX – LEVEL MIN; TANK CONTENT MAX. – TANK CONTENT MIN.	– Add to linearisation table. If necessary, perform linearisation again. – Correct linearisation table and accept again.	58
613 (W613)	Warning I	I>Simulation is active	– Simulation is switched on, i.e. the device is not measuring at present.	– Switch off simulation.	60
620 (E620)	Error C Factory setting: Warning	C>Current output out of range	– The current is outside the permitted range 3.8 to 20.5 mA. – The pressure applied is outside the set measuring range (but within the sensor range). – Loose connection at sensor cable	– Check pressure applied, reconfigure measuring range if necessary (See also Operating Instructions BA00274P, chapter 4 to 6 or these Operating Instructions) – Perform reset (Code 7864) and carry out calibration again. – Wait a short period of time and tighten the connection, or avoid loose connection.	49
700 (W700)	Warning C	C>Last configuration not stored	– An error occurred when writing or reading configuration data or the power supply was disconnected. – Main electronics defect.	– Perform reset (Code 7864) and carry out calibration again. – Replace main electronics.	54
701 (W701)	Warning C	C>Measuring chain config. exceeds sensor range	– The calibration carried out would result in the sensor nominal operating range being undershot or overshoot.	– Carry out calibration again.	50
702 (W702)	Warning C	C>HistoROM data not consistent.	– Data were not written correctly to the HistoROM, e.g. if the HistoROM was detached during the writing process. – HistoROM does not have any data.	– Repeat upload. – Perform reset (Code 7864) and carry out calibration again. – Copy suitable data to the HistoROM. (See also → 35, "Copying configuration data".)	55
703 (A703)	Alarm B	B>Measurement error	– Fault in the main electronics. – Main electronics defect.	– Briefly disconnect device from the power supply. – Replace main electronics.	22
704 (A704)	Alarm B	B>Measurement error	– Fault in the main electronics. – Main electronics defect.	– Briefly disconnect device from the power supply. – Replace main electronics.	12
705 (A705)	Alarm B	B>Measurement error	– Fault in the main electronics. – Main electronics defect.	– Briefly disconnect device from the power supply. – Replace main electronics.	21

Code	Error type/ NA 64	Message/description	Cause	Measure	Priority
706 (W706)	Warning C	C>Configuration in HistoROM and device not identical	– Configuration (parameters) in the HistoROM and in the device is not identical.	– Copy data from the device to the HistoROM. (See also → 35, "Copying configuration data".) – Copy data from the HistoROM to the device. (See also → 35, "Copying configuration data".) The message remains if the HistoROM and the device have different software versions. The message goes out if you copy the data from the device to the HistoROM. – Device reset codes such as 7864 do not have any effect on the HistoROM. That means that if you do a reset, the configurations in the HistoROM and in the device may not be the same.	59
707 (A707)	Alarm B	B>X-VAL. of lin. table out of edit limits.	– At least one X-VALUE in the linearisation table is either below the value for HYDR. PRESS MIN. or MIN. LEVEL or above the value for HYDR. PRESS. MAX. or LEVEL MAX.	– Carry out calibration again. (See also Operating Instructions BA00274P, chapter 5 or these Operating Instructions)	38
710 (W710)	Warning C	B>Set span too small. Not allowed.	– Values for calibration (e.g. lower range value and upper range value) are too close together. – The sensor was replaced and the customer-specific configuration does not suit the sensor. – Unsuitable download carried out.	– Adjust calibration to suit sensor. (See also Operating Instructions BA00274P, parameter description MINIMUM SPAN or these Operating Instructions) – Adjust calibration to suit sensor. – Replace sensor with a suitable sensor. – Check configuration and perform download again.	51
711 (A711)	Alarm B	B>LRV or URV out of edit limits	– Lower range value and/or upper range value undershoot or overshoot the sensor range limits. – The sensor was replaced and the customer-specific configuration does not suit the sensor. – Unsuitable download carried out.	– Reconfigure lower range value and/or upper range value to suit the sensor. Pay attention to position factor. – Reconfigure lower range value and/or upper range value to suit the sensor. Pay attention to position factor. – Replace sensor with a suitable sensor. – Check configuration and perform download again.	37
713 (A713)	Alarm B	B>100% POINT level out of edit limits	– The sensor was replaced.	– Carry out calibration again.	39
715 (E715)	Error C Factory setting: Warning	C>Sensor over temperature	– The temperature measured in the sensor is greater than the upper nominal temperature of the sensor. (See also Operating Instructions BA00274P, parameter description Tmax SENSOR or these Operating Instructions) – Unsuitable download carried out.	– Reduce process temperature/ ambient temperature. – Check configuration and perform download again.	32

Code	Error type/ NA 64	Message/description	Cause	Measure	Priority
716 (E716)	Error B Factory setting: Alarm	B>Process isolating diaphragm broken	– Sensor defect.	– Replace Sensor. – Reduce pressure.	24
717 (E717)	Error C Factory setting: Warning	C>Transmitter over temperature	– The temperature measured in the electronics is greater than the upper nominal temperature of the electronics (+88 °C (+190 °F)). – Unsuitable download carried out.	– Reduce ambient temperature. – Check configuration and perform download again.	34
718 (E718)	Error C Factory setting: Warning	C>Transmitter under temperature	– The temperature measured in the electronics is smaller than the lower nominal temperature of the electronics (–43 °C (–45 °F)). – Unsuitable download carried out.	– Increase ambient temperature. Insulate device if necessary. – Check configuration and perform download again.	35
719 (A719)	Alarm B	B>Y-VAL of lin. table out of edit limits	– At least on Y-VALUE in the linearisation table is below the MIN. TANK CONTENT or above the MAX. TANK CONTENT.	– Carry out calibration again. (See also Operating Instructions BA00274P, chapter 5 or these Operating Instructions)	40
720 (E720)	Error C Factory setting: Warning	C>Sensor under temperature	– The temperature measured in the sensor is smaller than the lower nominal temperature of the sensor. (See also Operating Instructions BA00274P, parameter description Tmin SENSOR or Operating Instructions) – Unsuitable download carried out. – Loose connection at sensor cable	– Increase process temperature/ ambient temperature. – Check configuration and perform download again. – Wait a short period of time and tighten the connection, or avoid loose connection.	33
721 (A721)	Alarm B	B>ZERO POSITION level out of edit limits	– LEVEL MIN or LEVEL MAX has been changed.	– Perform reset (Code 2710) and carry out calibration again.	41
722 (A722)	Alarm B	B>EMPTY CALIB. or FULL CALIB. out of edit limits	– LEVEL MIN or LEVEL MAX has been changed.	– Perform reset (Code 2710) and carry out calibration again.	42
723 (A723)	Alarm B	B>MAX. FLOW out of edit limits	– FLOW-MEAS. TYPE has been changed.	– Carry out calibration again.	43
725 (A725)	Alarm B	B>Sensor connection error, cycle disturbance	– Electromagnetic effects are greater than specifications in the technical data. (→ See Section 9.) – Setscrew loose. – Sensor or main electronics defect.	– Block off electromagnetic effects or eliminate source of disturbance. – Retighten setscrew with 1 Nm (0,74 lbf ft) (see Chap. 3.3.8). – Replace sensor or main electronics.	25
726 (E726)	Error C Factory setting: Warning	C>Sensor temperature error - overrange	– Electromagnetic effects are greater than specifications in the technical data. (→ 67) – Process temperature is outside permitted range. – Sensor defect.	– Block off electromagnetic effects or eliminate source of disturbance. – Check temperature present, reduce or increase if necessary. – If the process temperature is within the permitted range, replace sensor.	31

Code	Error type/ NA 64	Message/description	Cause	Measure	Priority
727 (E727)	Error C Factory setting; Warning	C>Sensor pressure error - overrange	- Electromagnetic effects are greater than specifications in the technical data. (→ 67) - Pressure is outside permitted range. - Sensor defect.	- Block off electromagnetic effects or eliminate source of disturbance. - Check pressure present, reduce or increase if necessary. - If the pressure is within the permitted range, replace sensor.	28
728 (A728)	Alarm B	B>RAM error	- Fault in the main electronics. - Main electronics defect.	- Briefly disconnect device from the power supply. - Replace main electronics.	2
729 (A729)	Alarm B	B>RAM error	- Fault in the main electronics. - Main electronics defect.	- Briefly disconnect device from the power supply. - Replace main electronics.	3
730 (E730)	Error C Factory setting; Warning	C>LRV user limits exceeded	- Pressure measured value has undershot the value specified for the Pmin ALARM WINDOW parameter. - Loose connection at sensor cable	- Check system/pressure measured value. - Change value for Pmin ALARM WINDOW if necessary. (See also Operating Instructions BA00274P, parameter description Pmin ALARM WINDOW or these Operating Instructions) - Wait a short period of time and tighten the connection, or avoid loose connection.	46
731 (E731)	Error C Factory setting; Warning	C>URV user limits exceeded	- Pressure measured value has overshoot the value specified for the Pmax ALARM WINDOW parameter. - Loose connection at sensor cable	- Check system/pressure measured value. - Change value for Pmax ALARM WINDOW if necessary. (See also Operating Instructions BA00274P, parameter description Pmax ALARM WINDOW or these Operating Instructions) - Wait a short period of time and tighten the connection, or avoid loose connection.	45
732 (E732)	Error C Factory setting; Warning	C>LRV Temp. User limits exceeded	Temperature measured value has undershot the value specified for the Tmin ALARM WINDOW parameter.	- Check system/temperature measured value. - Change value for Tmin ALARM WINDOW if necessary. (See also Operating Instructions BA00274P, parameter description Tmin ALARM WINDOW or these Operating Instructions)	48
733 (E733)	Error C Factory setting; Warning	C>URV Temp. User limits exceeded	Temperature measured value has overshoot the value specified for the Tmax ALARM WINDOW parameter.	- Check system/temperature measured value. - Change value for Tmax ALARM WINDOW if necessary. (See also Operating Instructions BA00274P, parameter description Tmax ALARM WINDOW or these Operating Instructions)	47
736 (A736)	Alarm B	B>RAM error	- Fault in the main electronics. - Main electronics defect.	- Briefly disconnect device from the power supply. - Replace main electronics.	4
737 (A737)	Alarm B	B>Measurement error	- Fault in the main electronics. - Main electronics defect.	- Briefly disconnect device from the power supply. - Replace main electronics.	20

Code	Error type/ NA 64	Message/description	Cause	Measure	Priority
738 (A738)	Alarm B	B>Measurement error	– Fault in the main electronics. – Main electronics defect.	– Briefly disconnect device from the power supply. – Replace main electronics.	19
739 (A739)	Alarm B	B>Measurement error	– Fault in the main electronics. – Main electronics defect.	– Briefly disconnect device from the power supply. – Replace main electronics.	23
740 (E740)	Error C Factory setting: Warning	C>Calculation overflow, bad configuration	– Level measuring mode: the measured pressure has undershot the value for HYDR. PRESS. MIN. or overshot the value for HYDR. PRESS MAX. – Level measuring mode: The measured level did not reach the LEVEL MIN value or exceeded the LEVEL MAX value. – Flow measuring mode: the measured pressure has undershot the value for MAX. PRESS FLOW.	– Check configuration and carry out calibration again if necessary. – Select a device with a suitable measuring range. – Check configuration and carry out calibration again if necessary. (See also Operating Instructions BA00274P, parameter description LEVEL MIN. these Operating Instructions) – Check configuration and carry out calibration again if necessary. – Select a device with a suitable measuring range.	27
741 (A741)	Alarm B	B>TANK HEIGHT out of edit limits	– LEVEL MIN or LEVEL MAX has been changed.	– Perform reset (Code 2710) and carry out calibration again.	44
742 (A742)	Alarm B	B>Sensor connection error (upload)	– Electromagnetic effects are greater than specifications in the technical data. (→ 67) This message normally only appears briefly. – Cable connection sensor –main electronics disconnected. – Sensor defect.	– Wait a few minutes. – Perform reset (Code 7864) and carry out calibration again. – Check cable connection and repair if necessary. – Replace sensor.	18
743 (E743)	Alarm B	B>Electronic PCB error during initialisation	– This message normally only appears briefly. – Main electronics defect.	– Wait a few minutes. – Restart the device. Perform reset (Code 62). – Replace main electronics.	14
744 (A744)	Alarm B	B>Main electronic PCB error	– Electromagnetic effects are greater than specifications in the technical data. (→ 67) – Main electronics defect.	– Restart the device. Perform reset (Code 62). – Block off electromagnetic effects or eliminate source of disturbance. – Replace main electronics.	11
745 (W745)	Warning C	C>Sensor data unknown	– Sensor does not suit the device (electronic sensor nameplate). Device continues measuring.	– Replace sensor with a suitable sensor.	56
746 (W746)	Warning C	C>Sensor connection error - initialising	– Electromagnetic effects are greater than specifications in the technical data. (→ 67) This message normally only appears briefly. – Overpressure or low pressure present.	– Wait a few minutes. – Restart the device. Perform reset (Code 7864). – Block off electromagnetic effects or eliminate source of disturbance. – Reduce or increase pressure.	26
747 (A747)	Alarm B	B>Sensor software not compatible to electronics	– Sensor does not suit the device (electronic sensor nameplate).	– Replace sensor with a suitable sensor.	16
748 (A748)	Alarm B	B>Memory failure in signal processor	– Electromagnetic effects are greater than specifications in the technical data. (→ 67) – Main electronics defect.	– Block off electromagnetic effects or eliminate source of disturbance. – Replace main electronics.	15

8.1.1 On-site display error messages

If the device detects a defect in the on-site display during initialization, the following error messages can be displayed:

Message	Measure
Initialization, VU Electr. Defect A110	Exchange on-site display.
Initialization, VU Electr. Defect A114	
Initialization, VU Electr. Defect A281	
Initialization, VU Checksum Err. A110	
Initialization, VU Checksum Err. A112	
Initialization, VU Checksum Err. A171	

8.2 Response of outputs to errors

The device differentiates between the error types Alarm, Warning and Error.
See the following table and → 52, "Messages".

Output	A (Alarm)	W (Warning)	E (Error: Alarm/Warning)
Current output	Assumes the value specified via the OUTPUT FAIL MODE ¹⁾ , ALT. CURR. OUTPUT ¹ and SET MAX. ALARM ¹ parameter. See also the following section "Configuring current output for an alarm".	Device continues measuring.	For this error, you can enter whether the device should react as in the event of an alarm or as in the event of a warning. See corresponding "Alarm" or "Warning" column. (See also Operating Instructions BA00274P, parameter description SELECT ALARM TYPE or these Operating Instructions)
Bargraph (on-site display)	The bargraph adopts the value defined by the OUTPUT FAIL MODE ¹ parameter.	The bargraph adopts the value which corresponds to the current value.	See this table, "Alarm" or "Warning" column, depending on selection.
On-site display	- The measured value and message are displayed alternately - Measured value display: -symbol is permanently displayed. Message display 3-digit number such as A122 and description	- The measured value and message are displayed alternately - Measured value display: -symbol flashes. Message display: 3-digit number such as W613 and description	- The measured value and message are displayed alternately - Measured value display: see corresponding "Alarm" or "Warning" column Message display: 3-digit number such as E731 and description
Remote operation (digital communication)	In the case of an alarm, the ALARM STATUS ²⁾ parameter displays a 3-digit number such as 122 for "Sensor not connected".	In the case of a warning, the ALARM STATUS ²⁾ parameter displays a 3-digit number such as 613 for "Simulation is active".	In the case of an error, the ALARM STATUS ²⁾ parameter displays a 3-digit number such as 731 for "URV user limits exceeded".

- 1) Menu path: (GROUP SELECTION →) OPERATING MENU → OUTPUT
- 2) Menu path: (GROUP SELECTION →) OPERATING MENU → MESSAGES

8.2.1 Configuring current output for an alarm

You can configure the current output for the event of an alarm by means of the OUTPUT FAIL MODE, ALT. CURR. OUTPUT and SET MAX. ALARM parameters. These parameters are displayed in the OUTPUT group (menu path: (GROUP SELECTION →) OPERATING MENU → OUTPUT).

In the event of an alarm, the current and the bargraph assume the value entered with the OUTPUT FAIL MODE parameter.

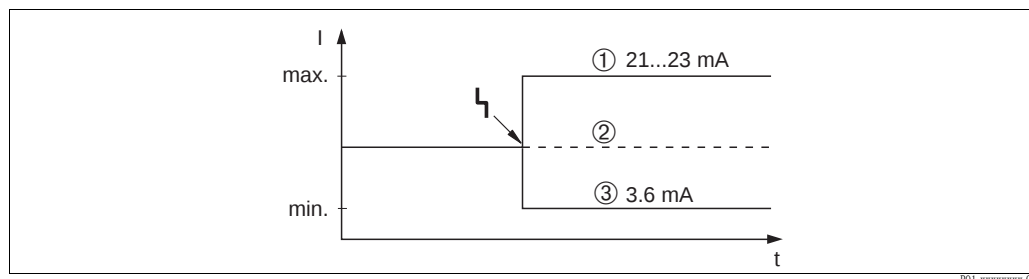


Fig. 28: Current output in the event of an alarm

Options:

- 1 Max. alarm (110%): can be set between 21 to 23 mA via the SET MAX. ALARM parameter
- 2 Hold meas. value: last measured value is kept
- 3 Min. alarm (−10%): 3.6 mA

Factory setting:

- OUTPUT FAIL MODE: Max. Alarm (110%)
- SET MAX. ALARM: 22 mA

Use the ALT. CURR. OUTPUT parameter to set the current output value for the error messages E 120 "Sensor low pressure" and E 115 "Sensor overpressure". You have the following options:

- Normal: the current output assumes the value set via the OUTPUT FAIL MODE and SET MAX. ALARM parameters.
- NAMUR
 - Lower sensor limit undershot (E 120 "Sensor low pressure"): 3.6 mA
 - Upper sensor limit overshoot (E 115 "Sensor overpressure") overshoot: current output assumes the value set via the SET MAX ALARM parameter.

Factory setting:

ALT. CURR. OUTPUT: normal

8.3 Confirming messages

Depending on the settings for the ALARM DISPL. TIME and ACK. ALARM MODE parameters, the following measures should be taken to clear a message:

Settings ¹⁾	Measures
– ALARM DISPL. TIME = 0 s – ACK. ALARM MODE = off	– Rectify cause of the message (→ 52).
– ALARM DISPL. TIME > 0 s – ACK. ALARM MODE = off	– Rectify cause of the message (→ 52). – Wait for the alarm display time to elapse.
– ALARM DISPL. TIME = 0 s – ACK. ALARM MODE = on	– Rectify cause of the message (→ 52). – Confirm message using ACK. ALARM parameter.
– ALARM DISPL. TIME > 0 s – ACK. ALARM MODE = on	– Rectify cause of the message (→ 52). – Confirm message using ACK. ALARM parameter. – Wait for the alarm display time to elapse. If a message appears and the alarm display time elapses before the message has been acknowledged, the message will be cleared once it has been acknowledged.

1) Menu path for ALARM DISPL. TIME and ACK. ALARM MODE: (GROUP SELECTION →) OPERATING MENU → DIAGNOSTICS → MESSAGES

If the on-site display displays a message, you can suppress it with the -key.

If there are several messages, the on-site display shows the message which has the highest priority (→ 52). Once you have suppressed this message using the -key, the message with the next highest priority is displayed. You can use the -key to suppress each message, one after the other. The ALARM STATUS parameter continues to display all the messages present.

8.4 Repair

The Endress+Hauser repairs concept provides for measuring devices to have a modular design and also the customer may carry out repairs (→  63, "Spare Parts").



Note!

- For certified devices, please consult Chapter "Repair of Ex-certified devices".
- For more information on service and spare parts contact the Endress+Hauser Service.
See www.endress.com/worldwide.

8.5 Repair of Ex-certified devices



Warning!

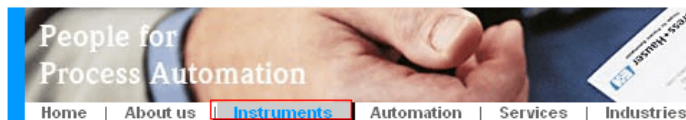
When repairing Ex-certified devices, please note the following:

- Only specialist personnel or Endress+Hauser may undertake repairs of certified devices.
- Relevant standards, national hazardous area regulations and Safety Instructions and Certificates must be observed.
- Only genuine Endress+Hauser spare parts may be used.
- When ordering spare parts, please check the device designation on the nameplate. Identical parts may only be used as replacements.
- Electronic inserts or sensors already in use in a standard instrument may not be used as spare parts for a certified device.
- Carry out repairs according to the instructions. After repairs, the device must fulfil the requirements of the specified individual tests.
- A certified device may only be converted into another certified variant by Endress+Hauser.
- All repairs and modifications must be documented.

8.6 Spare Parts

An overview of the spare parts for your device is available in the internet at www.endress.com. To obtain information on the spare parts, proceed as follows:

1. Go to "www.endress.com" and select your country.
2. Click "Instruments".



3. Enter the product name into the "product name" field.

Endress+Hauser product search

Via product name
Enter the product name

4. Select the device.
5. Click the "Accessories/Spare parts" tab.

General information	Technical information	Documents/ Software	Service	Accessories/ Spare parts
---------------------	-----------------------	---------------------	---------	---------------------------------

▶ Accessories
 ▼ All Spare parts

- ▶ Housing/housing accessories
- ▶ Sealing
- ▶ Cover
- ▶ Terminal module
- ▶ HF module
- ▶ Electronic
- ▶ Power supply
- ▶ Antenna module

Advice
Here you'll find a list of all available accessories and spare parts. To only view accessories and spare parts specific to your product(s), please contact us and ask about our Life Cycle Management Service.

◀ | 1 / 2 | ▶ | 🔍

6. Select the required spare parts (You may also use the overview drawing on the right side of the screen.)

When ordering spare parts, always quote the serial number indicated on the nameplate. As far as necessary, the spare parts also include replacement instructions.

8.7 Returning the device

Before you send in a device for repairs or checking:

Remove all signs of fluids, paying particular attention to seal grooves and gaps in which fluid can become lodged. This is especially important if the fluid is hazardous to health. Please refer also to the "Declaration of Hazardous Material and De-Contamination".

Please enclose the following when returning the device:

- Please fill out completely and sign the "Declaration of Hazardous Material and De-Contamination".

It is only then possible for Endress+Hauser to inspect or repair the returned device.

- The chemical and physical properties of the fluid.
- A description of the application.
- A description of the error which occurred.
- Special instructions on handling, if necessary, e.g. safety data sheet as per EN 91/155/EEC.

8.8 Disposal

When disposing, separate and recycle the device components based on the materials.

8.9 Software history

Date	Software version	Changes software	Documentation		
			CD-ROM	Operating Instructions	Description of Instrument Functions
11.2003	01.00.zz	Original software. Compatible with: – ToF Tool Field Tool Package, version 1.04.00 or higher – Commuwin II version 2.08.-1, Update G or higher – HART Communicator 375 with Device Rev.: 10, DD Rev.: 1	—	BA271P/00/EN/10.03 52020517	—
06.2004	02.00.zz	– Number of parameters in the Quick Setup menus has been reduced. – On-site operation: LANGUAGE and MEASURING MODE parameters have been moved to the top level. – New SAFETY CONFIRM. group implemented for SIL. → See also SD00190P Safety Manual Cerabar S. – MEASURING MODE "Level", LEVEL MODE "Linear": AREA UNIT and TANK SECTION parameters have been replaced with the TANK VOLUME and TANK HEIGHT parameters. – Function of the UNIT FLOW parameter has been split across four parameters. – Function of the SIMULATED VALUE parameter has been split across six parameters. – SENSOR TRIM and CURRENT TRIM groups have been removed. – Sensor adapt reset, code 1209 and sensor calibration reset, code 2509 have been removed. – Quick Setup menus are available via ToF Tool. Compatible with: – ToF Tool Field Tool Package version 2.00.00 or higher – Commuwin II version 2.08.-1, Update > G – HART Communicator 375 with Device Rev.: 20, DD Rev.: 1	—	BA271P/00/EN/05.04 52022795	BA274P/00/EN/05.04 52021469
06.2005	02.01.zz	– Operating keys also integrated on the optional on-site display. – Chinese and Japanese are available as the menu language on request. Compatible with: – ToF Tool Field Tool Package version 3.00.00 or higher – FieldCare version 2.01.00, DTM Library version 2.06.00, DTM: Deltabar S/MD7x/V02.00 V 1.4.98.74* – HART Communicator 375 with Device Rev.: 20, DD Rev.: 1* * Menu languages Chinese and Japanese not selectable	—	BA271P/00/EN/06.05 71000115	BA274P/00/EN/05.04 52021469
			—	BA271P/00/EN/11.05 71009589	BA274P/00/EN/05.04 52021469

Date	Software version	Changes software	Documentation		
			CD-ROM	Operating Instructions	Description of Instrument Functions
06.2006	02.10.zz	– New "Level Easy Pressure" and "Level Easy Height" level modes implemented. New LEVEL SELECTION parameter implemented. – OPERATION group with DOWNLOAD SELECT parameter extended. – SAFETY CONFIRM group extended for the "Level" operating mode in the "Level Easy Pressure" level selection. → See also SD00190P Safety Manual Cerabar S. – Factory setting for the "Error" messages redefined. – Chinese and Japanese included as menu languages by default. Compatible with: – ToF Tool Field Tool Package version 4.0 – FieldCare version 2.02.00 – HART Communicator 375 with Device Rev.: 21, DD Rev.: 1	—	BA271P/00/EN/07.06 71027246	BA274P/00/EN/07.06 71027249
			—	BA271P/00/EN/08.06 71027246	BA274P/00/EN/07.06 71027249
			CD507P/00/A2/10.07 71033931	BA271P/00/EN/10.07 71043296	BA274P/00/EN/07.07 71061022
			CD507P/00/A2/12.07 71033931	BA271P/00/EN/12.07 71043296	BA274P/00/EN/07.07 71061022
			CD507P/00/A2/05.08 71071801	BA271P/00/EN/05.08 71071770	BA274P/00/EN/05.08 71071855
			CD507P/00/A2/08.08 71077559	BA271P/00/EN/08.08 71077544	BA274P/00/EN/05.08 71071855
			CD507P/00/A2/06.09 71095448	BA271P/00/EN/06.09 71095434	BA274P/00/EN/06.09 71095452
			CD507P/00/A2/05.10 71111804	BA271P/00/EN/05.10 71111792	BA274P/00/EN/05.10 71118244
			CD00507P/00/A2/13.11 71139793	BA00271P/00/EN/13.11 71139779	BA00274P/00/EN/13.11 71139795

9 Technical data

For technical data, please refer to TI00383P.

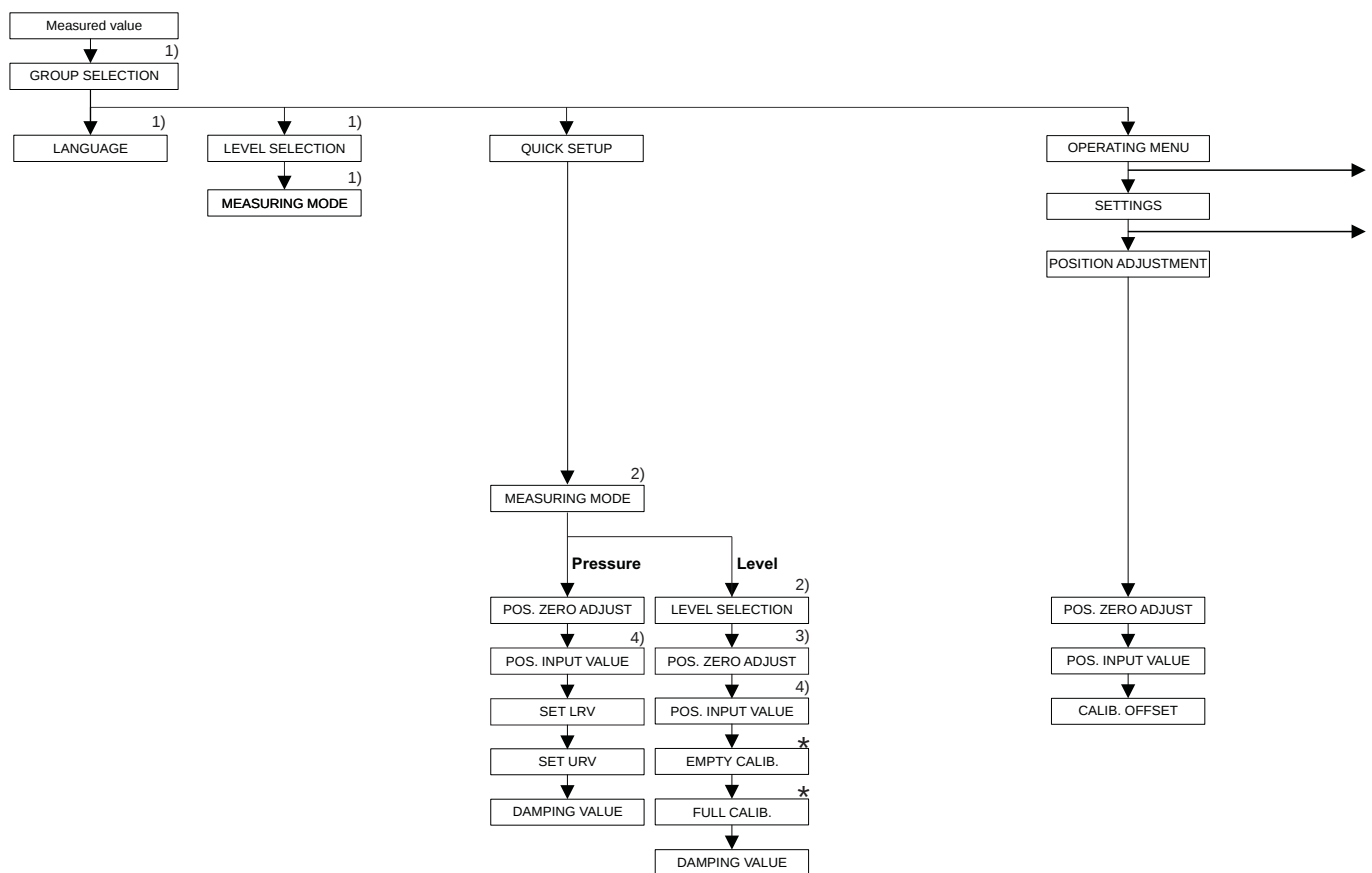
10 Appendix

10.1 Operating menu for on-site display, FieldCare and HART handheld terminal



Note!

- The entire menu is depicted on the following pages.
- The menu has a different structure depending on the measuring mode selected. This means that some function groups are only displayed for one measuring mode, e.g. "LINEARISATION" function group for the Level measuring mode.
- In addition, there are also parameters that are only displayed if other parameters are appropriately configured. For example the Customer Unit P parameter is only displayed if the "User unit" option was selected for the PRESS. ENG. UNIT parameter. These parameters are indicated with a "*".
- For a description of the parameters, please refer to Operating Instructions BA00274P "Description of Device Functions". The exact dependency of individual parameters on one another is explained here.



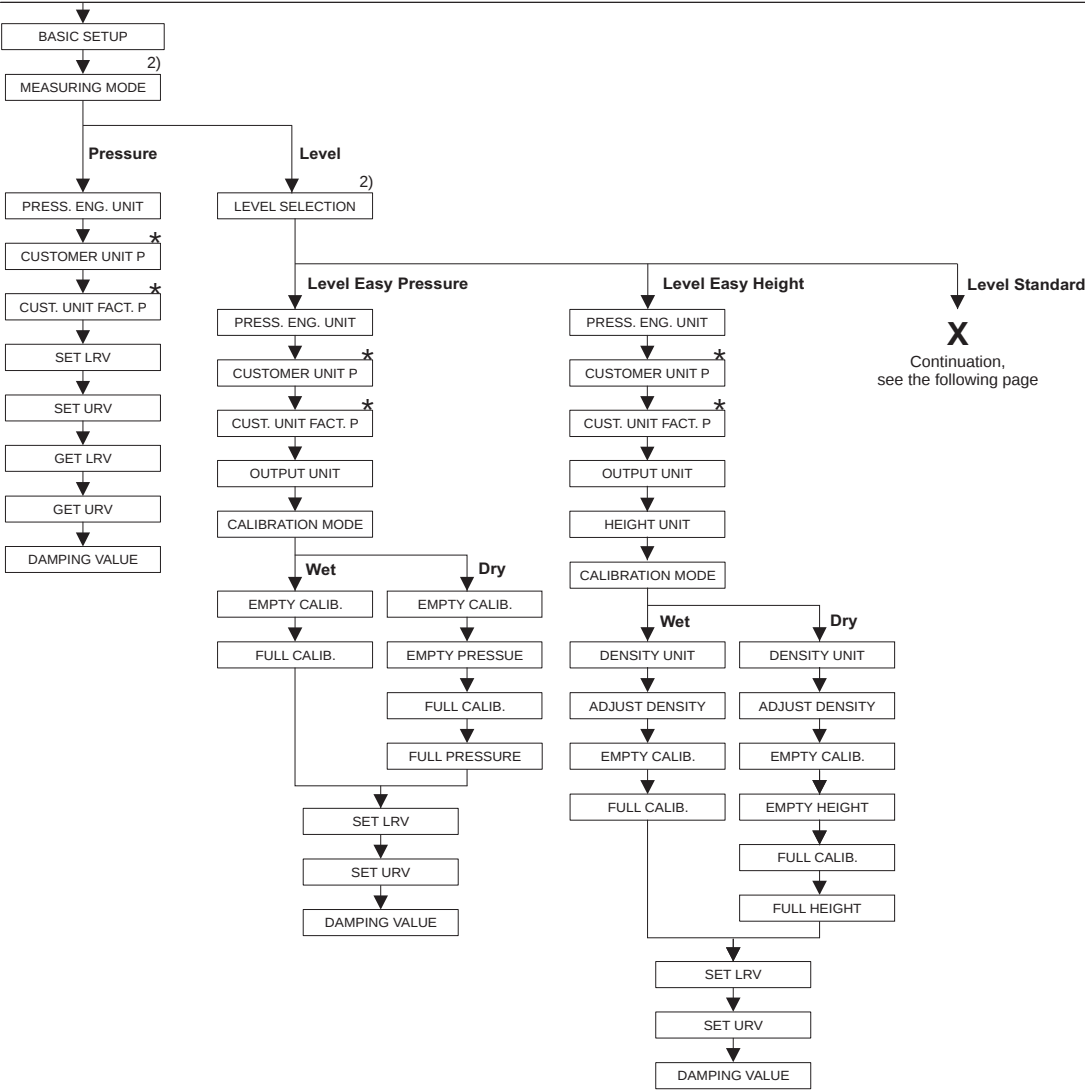
1) Display via on-site display only

2) Display via FieldCare and HART Handheld terminal only

3) Cerabar S with gauge pressure sensor

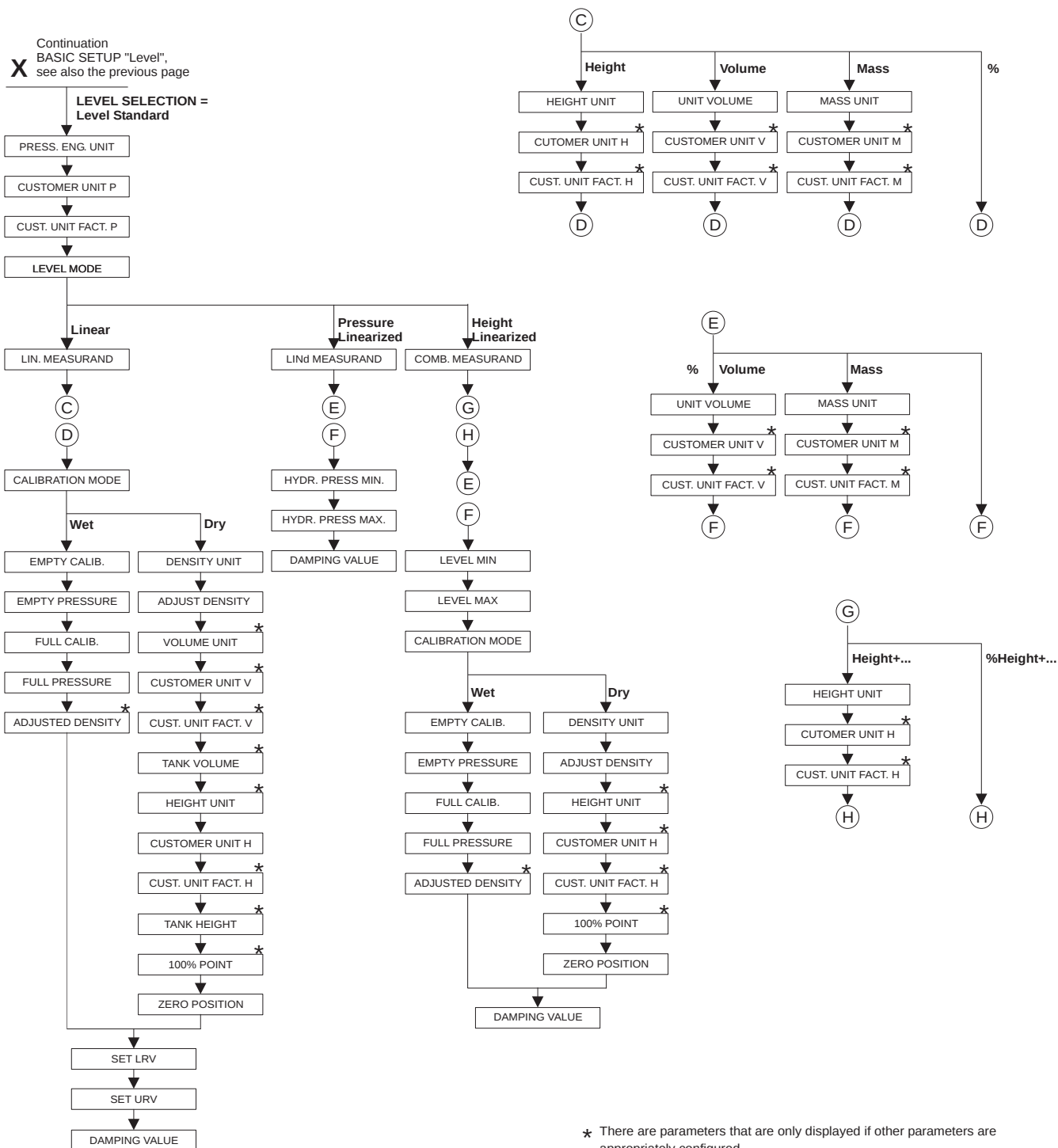
4) Cerabar S with absolute pressure sensor

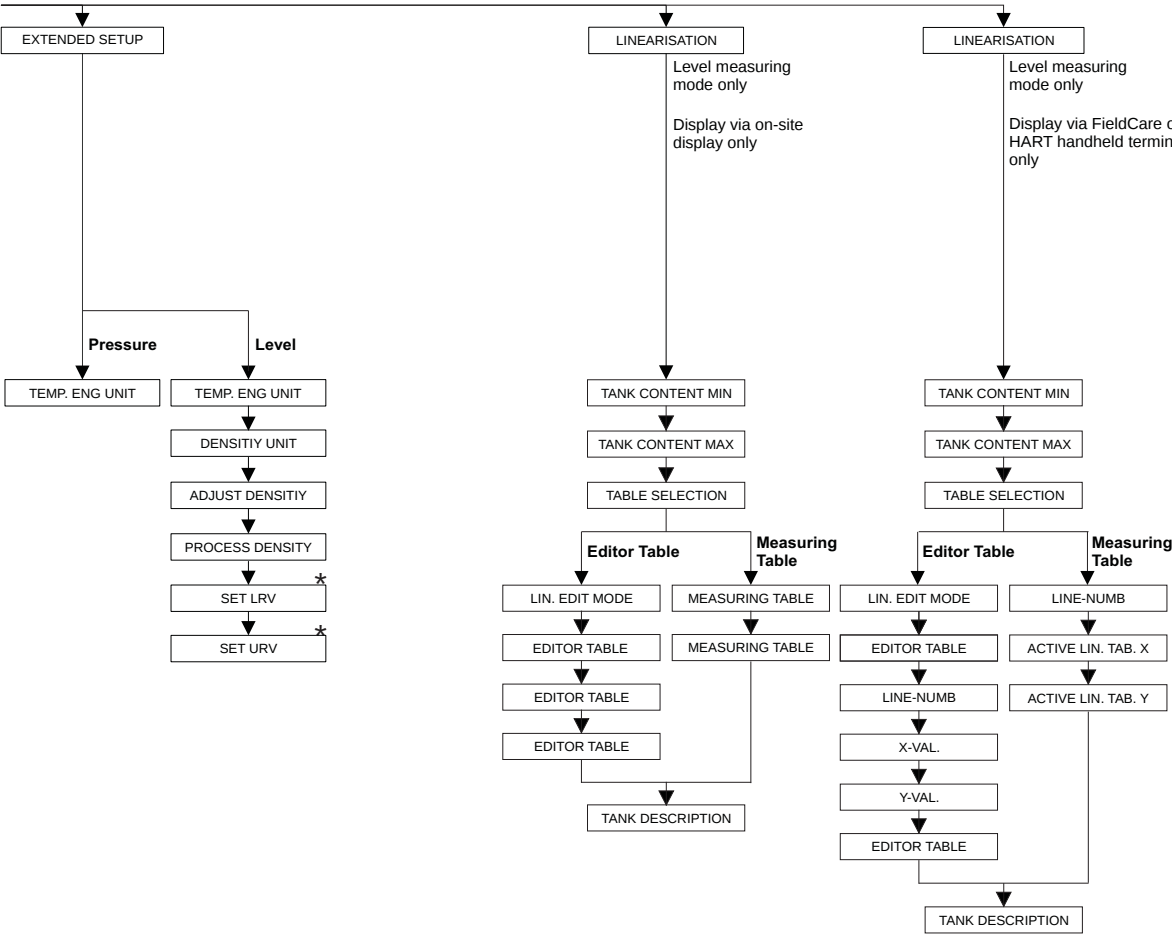
* There are parameters that are only displayed if other parameters are appropriately configured.
For example the CUSTOMER UNIT P parameter is only displayed if the "User unit" option was selected for the PRESS. ENG. UNIT parameter.
These parameters are indicated with a "*".



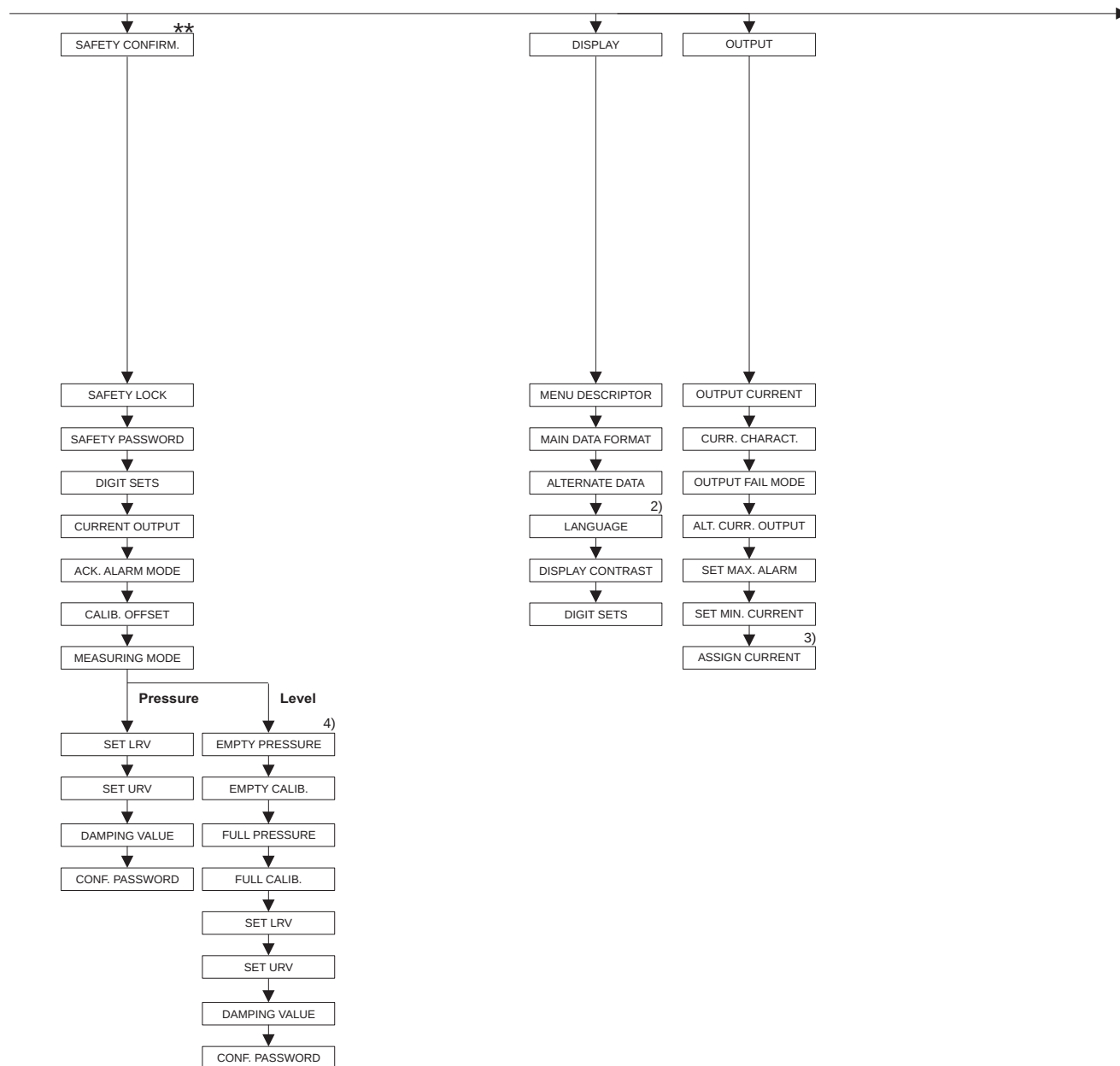
2) Display via FieldCare and HART Handheld terminal only

★ There are parameters that are only displayed if other parameters are appropriately configured.
For example the CUSTOMER UNIT P parameter is only displayed if the "User unit" option was selected for the PRESS. ENG. UNIT parameter. These parameters are indicated with a "★".





★ There are parameters that are only displayed if other parameters are appropriately configured.
These parameters are indicated with a "★".



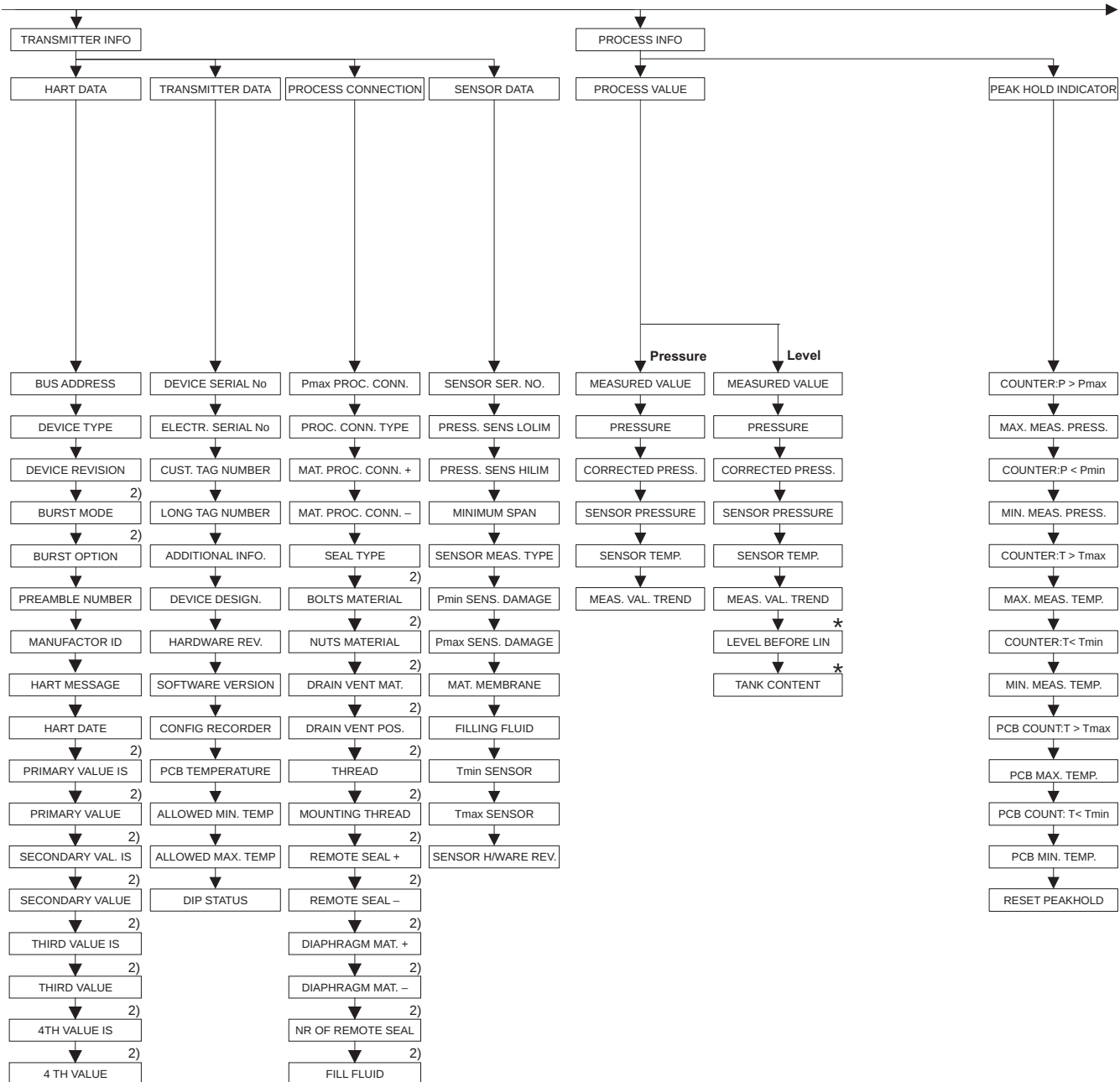
2) Display via
HART handheld terminal only

3) Level measuring mode only

4) only LEVEL SELECTION = Level Easy Pressure

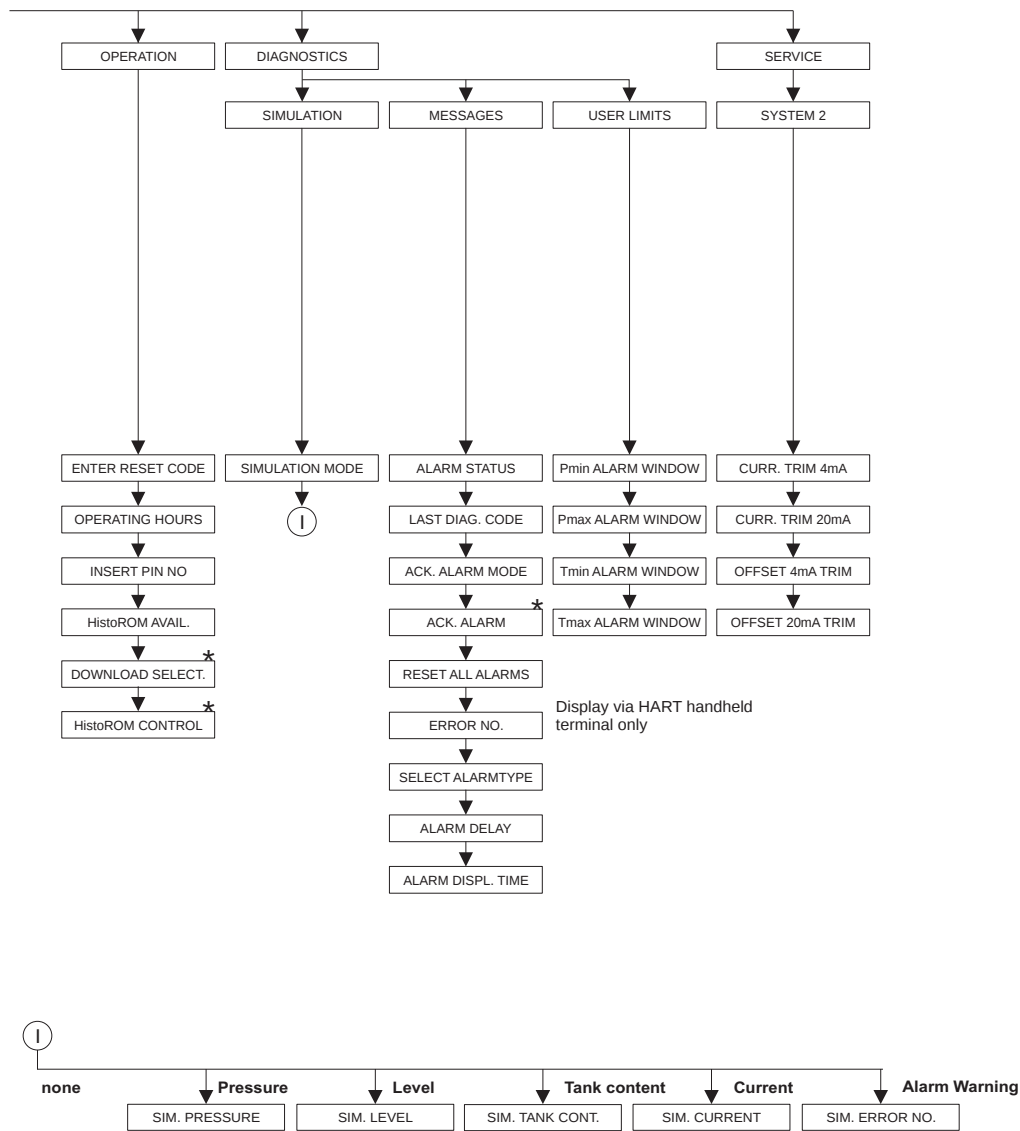
★ There are parameters that are only displayed if other parameters are appropriately configured.
These parameters are indicated with a "★".

★★ See Safety Manual SD190P.



2) Display via FieldCare and HART handheld terminal only

* There are parameters that are only displayed if other parameters are appropriately configured.
These parameters are indicated with a "*".



★ There are parameters that are only displayed if other parameters are appropriately configured. These parameters are indicated with a "★".

10.2 Patents

This product may be protected by at least one of the following patents. Further patents are pending.

- US 5,836,063 A1 $\cong$ EP 0 797 084 B1
- US 5,877,424 A1 $\cong$ EP 0 780 674 B1
- DE 203 05 869 U1
- US 6,363,790 A1 $\cong$ EP 0 995 979 B1
- US 5,670,063 A1 $\cong$ EP 0 516 579 B1
- US 5,539,611 A1
- US 5,050,034 A1 $\cong$ EP 0 445 382 B1
- US 5,005,421 A1 $\cong$ EP 0 351 701 B1
- EP 0 414 871 B1
- EP 1 061 351 B1
- US 5,334,344 A1 $\cong$ EP 0 490 807 B1
- US 6,703,943 A1

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Declaration of Hazardous Material and De-Contamination *Erklärung zur Kontamination und Reinigung*

RA No.

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.

Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor

Geräte-/Sensortyp

Serial number

Seriennummer

☐ Used as SIL device in a Safety Instrumented System / Einsatz als SIL Gerät in Schutzeinrichtungen

Process data / Prozessdaten

Temperature / Temperatur [°F] [°C] Pressure / Druck [psi] [Pa]

Conductivity / Leitfähigkeit [µS/cm] Viscosity / Viskosität [cp] [mm²/s]

Medium and warnings

Warnhinweise zum Medium



	Medium / concentration Medium / Konzentration	Identification CAS No.	flammable entzündlich	toxic giftig	corrosive ätzend	harmful/ irritant gesundheitsschädlich/ reizend	other * sonstiges*	harmless unbedenklich
Process medium Medium im Prozess								
Medium for process cleaning Medium zur Prozessreinigung								
Returned part cleaned with Medium zur Endreinigung								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive

* explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.

Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / Fehlerbeschreibung

Company data / Angaben zum Absender

Company / Firma	Phone number of contact person / Telefon-Nr. Ansprechpartner:
Address / Adresse	Fax / E-Mail
Your order No. / Ihre Auftragsnr.	

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge. We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."

"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefährbringender Menge sind."

(place, date / Ort, Datum)

Name, dept./Abt. (please print / bitte Druckschrift)

Signature / Unterschrift

www.endress.com/worldwide

Endress+Hauser 
People for Process Automation

BA00271P/00/EN/13.11
71139779
CCS/FM+SGML6.0





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NF Panelboards
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I-Line® Panelboards
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QMB Panelboards
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INDUSTRIAL SERIES (IN) ●

**120 And 240 Volts
3, 5, 8 and 10 Watts/Ft.
Above Standard Ratings Are
Heat Output At 50°F (10°C)**

DESCRIPTION

Delta-Therm self-regulating heating cable increases heat output as pipe temperature decreases, and conversely, decreases heat output as pipe temperature increases. This cable is intended for use on metal and plastic pipes.

Industrial Series cables contain two parallel bus wires electrically connected by a web of PTC (positive temperature coefficient) conductive polymer. A thermoplastic elastomer jacket surrounds the cable to provide mechanical protection and electrical isolation. A tinned copper (CB) or stainless steel (SB) braid provides additional mechanical protection as well as a ground path for fault currents. IN Series cables can also be specified with either a thermoplastic (T) overjacket to protect against non-organic corrosives or a fluoropolymer (F) overjacket to protect against organic corrosives. A monitor wire option is also available for continuous monitoring of both bus wires for continuity.

APPLICATIONS

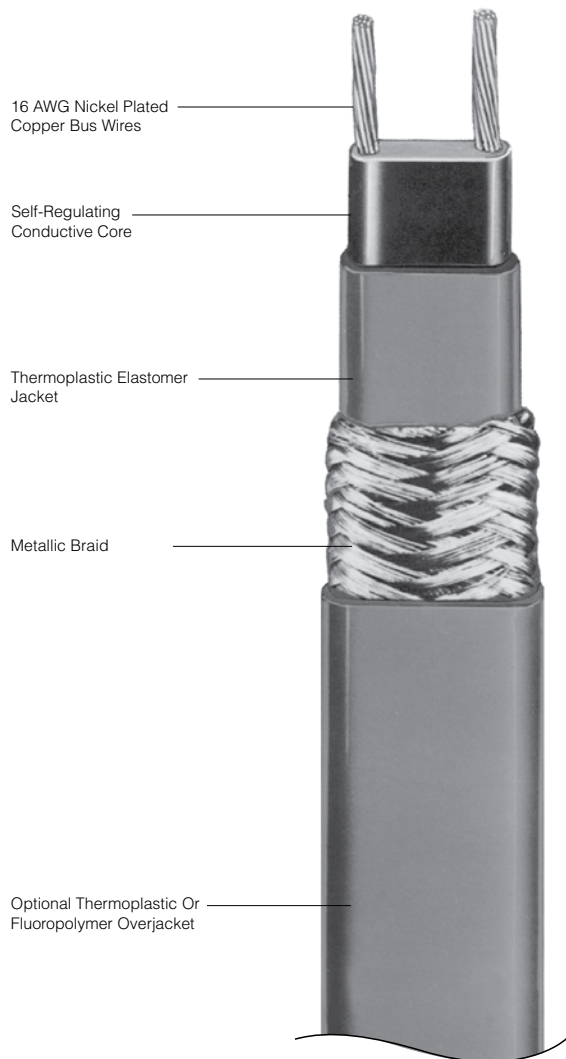
External Pipe Tracing

APPROVALS

Ordinary: IN Series cables are FM approved and CSA certified for pipe tracing when used with a PCK-IN connection kit (FM) or PCK-INC (CSA).

Hazardous: IN Series CB or SS cables (regardless of overjacket) are FM approved and CSA certified for pipe tracing in the following categories:

CSA	FM
Class I, Div. 1 And 2, Grps. A, B, C And D	Class I, Div. 2, Grps B, C, And D
Class II, Div. 1 And 2, Grps. E, F, And G	Class II, Div. 2, Grps F And G
Class III, Div. 1 And 2	Class III, Div. 2
For CSA Certification, Use PCK-HLC.	For FM Approval, Use PCK-IN.



WARNING

WARNING: This cable is designed for industrial applications and must be installed by a qualified electrician. Improper installation can result in property damage, serious injury, and/or death due to electric shock and fires.



TECHNICAL INFORMATION, INDUSTRIAL (IN) SERIES

IN Series - 120 VAC Breaker Size And Max. Circuit Lengths Ft. (m)

	15A	20A	30A	40A
IN120-3 If Started At				
50°F (10°C)	300' (91)	-	-	-
35°F (2°C)	270' (82)	300' (91)	330' (101)	-
0°F (-18°C)	200' (61)	270' (82)	330' (101)	-
-20°F (-29°C)	180' (55)	230' (70)	330' (101)	-
IN120-5 If Started At				
50°F (10°C)	230' (70)	270' (82)	-	-
35°F (2°C)	200' (61)	240' (73)	270' (82)	-
0°F (-18°C)	150' (46)	200' (61)	270' (82)	-
-20°F (-29°C)	130' (40)	175' (53)	260' (79)	270' (82)
IN120-8 If Started At				
50°F (10°C)	150' (46)	200' (61)	210' (64)	-
35°F (2°C)	130' (40)	175' (53)	200' (61)	210' (64)
0°F (-18°C)	95' (29)	125' (38)	190' (58)	210' (64)
-20°F (-29°C)	85' (26)	100' (31)	170' (52)	210' (64)
IN120-10 If Started At				
50°F (10°C)	115' (35)	150' (46)	180' (55)	-
35°F (2°C)	100' (31)	130' (40)	170' (52)	180' (55)
0°F (-18°C)	70' (21)	95' (29)	145' (44)	180' (55)
-20°F (-29°C)	60' (18)	85' (26)	120' (37)	165' (50)

IN Series - 240 VAC Breaker Size And Max. Circuit Lengths Ft. (m)

	15A	20A	30A	40A
IN240-3 If Started At				
50°F (10°C)	660' (201)	-	-	-
35°F (2°C)	580' (177)	610' (186)	660' (201)	-
0°F (-18°C)	410' (125)	560' (171)	660' (201)	-
-20°F (-29°C)	360' (110)	480' (146)	660' (201)	-
IN240-5 If Started At				
50°F (10°C)	460' (140)	540' (165)	-	-
35°F (2°C)	410' (125)	490' (149)	540' (165)	-
0°F (-18°C)	300' (91)	400' (122)	540' (165)	-
-20°F (-29°C)	260' (79)	345' (105)	520' (159)	540' (165)
IN240-8 If Started At				
50°F (10°C)	295' (90)	390' (119)	420' (128)	-
35°F (2°C)	260' (79)	340' (104)	410' (125)	-
0°F (-18°C)	195' (59)	250' (76)	375' (114)	420' (128)
-20°F (-29°C)	170' (52)	225' (69)	340' (104)	420' (128)
IN240-10 If Started At				
50°F (10°C)	230' (70)	305' (93)	360' (110)	-
35°F (2°C)	200' (61)	270' (82)	330' (100)	360' (110)
0°F (-18°C)	150' (46)	200' (61)	300' (91)	360' (110)
-20°F (-29°C)	130' (40)	175' (53)	260' (79)	360' (110)

IN Series Electrical Specifications

	IN120-3	IN120-5	IN120-8	IN120-10	IN240-3	IN240-5	IN240-8	IN240-10
Voltage	120 VAC	120 VAC	120 VAC	120 VAC	240 VAC	240 VAC	240 VAC	240 VAC
Max. Circuit Length Ft. (m)	330' (100)	270' (82)	210' (64)	180' (55)	660' (201)	540' (165)	420' (128)	360' (110)
Thermal Rating at 50°F (10°C) Watts/Ft. (Watts/m)	3 (10)	5 (16)	8 (26)	10 (33)	3 (10)	5 (16)	8 (26)	10 (33)
Maximum Maint. Temp °F (°C)	150° (66°)	150° (66°)	150° (66°)	150° (66°)	150° (66°)	150° (66°)	150° (66°)	150° (66°)
Maximum Exp. Temp. °F (°C)	185° (85°)	185° (85°)	185° (85°)	185° (85°)	185° (85°)	185° (85°)	185° (85°)	185° (85°)

TO ORDER:

Series (IN) _____

Volts (120, 240) _____

Watts/Ft. (3, 5, 8, 10) _____

Braid (CB/SS) _____

Optional Overjacket (T/F) _____

Optional Monitor Wires (M2) _____

IN Series Conversion Table For Alternate Voltages

Delta-Therm 240V self-regulating heating cable is multi-voltage. It can be used in 208V, 240V, and 277V applications. The conversion table below lists voltage with various power output ratings at 50°F (10°C)

Alternate Voltages	Nominal Watts/Ft. (Watts/m) At 50°F (10°C)			
	IN240-3	IN240-5	IN240-8	IN240-10
208	2.3 (7.5)	4.3 (14.1)	7.3 (24.7)	9.3 (31.4)
240	3.0 (10.1)	5.0 (16.9)	8.0 (27.0)	10.0 (33.8)
277	3.8 (12.5)	5.8 (19.6)	8.8 (29.74)	10.8 (36.5)

Accessories

ETK-IN	End Termination Kit - FM/CSA
PCK-HLC	Power Connection Kit (Hazardous Locations)- CSA
PCK-IN	Power Connection Kit - FM
PCK-INC	Power Connection Kit - CSA
PCK-IN/MC	Power Connection Kit - FM
ETK-IN-5	End Termination Kit - FM/CSA
SPK-IN	Splice Connection Kit - FM/CSA
SPK-IN-5	Splice Connection Kit - FM/CSA
CL-S/CL-L	Small And Large Caution Labels
DT-Box	Weatherproof 2 Gang Aluminum Box With Five .75" (2cm) Hubs And Cover
T-ALXXX	Aluminum Heat Distribution Tape
T-FXXX	Fiberglass Banding Tape

Circuit Breakers

Do not use magnetic-type circuit breakers. Delta-Therm recommends using the following thermal-magnetic circuit breakers (or equivalent) to prevent nuisance tripping caused by inrush currents:

Westinghouse:	Types BA, EB, EHB, FB, HFB
Gen. Electric:	Types TEB, THED
Square D:	Types EH, FA

Use of Ground Fault Protective Devices and Tinned Copper Metallic Overshield

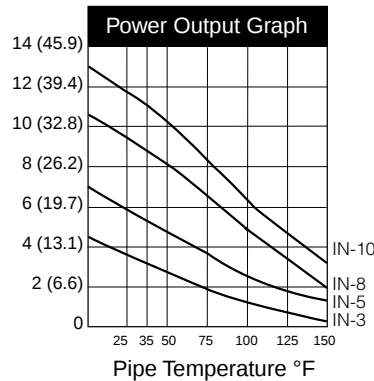
NEC CODE 2005, ARTICLE 427-22:

Equipment Protection.

Ground-fault protection of equipment shall be provided for electric heat tracing and heating panels. This requirement shall not apply in industrial establishments where there is alarm indication of ground faults and

(1) Conditions of maintenance and supervision ensure that only qualified persons service the installed systems.

(2) Continued circuit operation is necessary for safe operation of equipment or processes.



NEC CODE 2005, ARTICLE 427-23:

Grounded Conductive Covering. Electric heating equipment shall be listed and have a grounded conductive covering in accordance with 427.23(A) or (B). The conductive covering shall provide an effective ground path for equipment protection.

(A) Heating Wires or Cables. Heating wires or cables shall have a grounded conductive covering that surrounds the heating element and bus wires, if any, and their electrical insulation.

(B) Heating Panels. Heating panels shall have a grounded conductive covering over the heating element and its electrical insulation on the side opposite the side attached to the surface to be heated.

The metal covering shall provided an effective ground path.

The material contained in this document is presented in good faith and believed to be reliable and accurate. However, because testing conditions may vary and material quality or information that may be provided in whole or in part by others may be beyond our control, no warranty, expressed or implied, is given. Delta-Therm can assume no liability for results obtained or damages incurred through the application of the data and tests presented.

1.3 Sulfur Tank & Piping Information

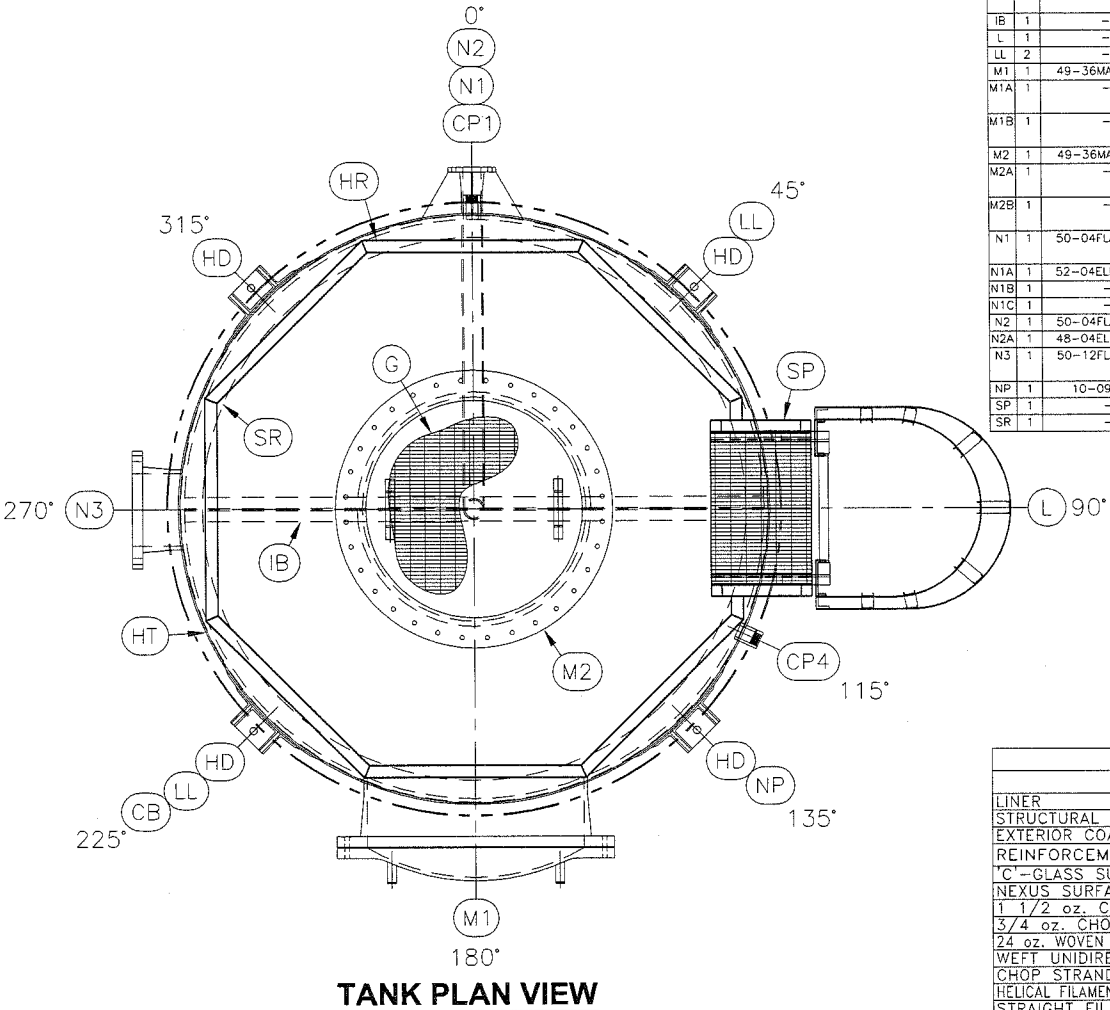
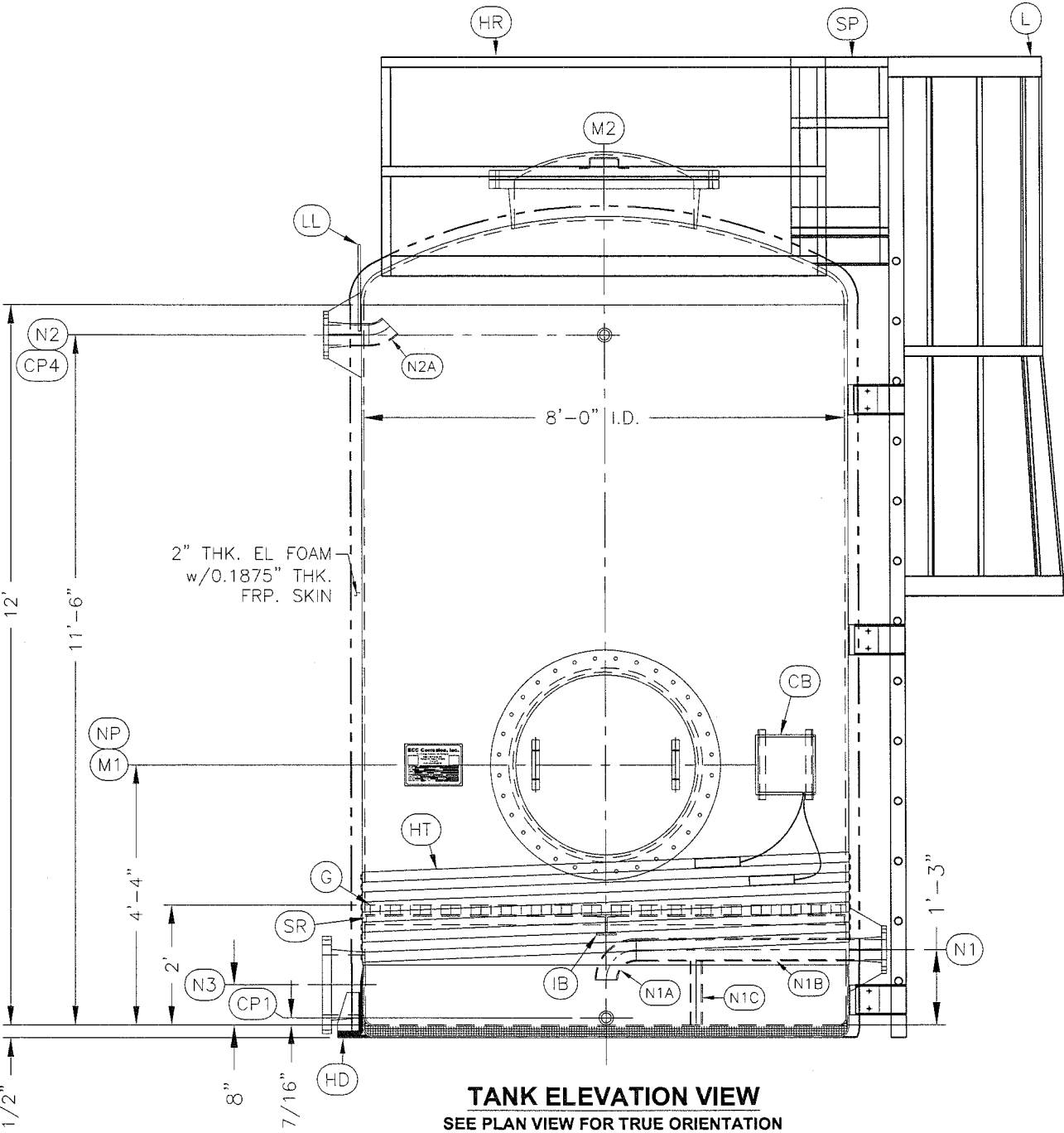
UNLESS OTHERWISE SPECIFIED, DIMENSIONAL TOLERANCES ARE:
FRACTIONAL +/-1/8", DECIMAL +/- .125", ANGULAR +/-2°

ECC Corrosion, Inc.

An Energy Composites Company

4400 Commerce Drive
Wisconsin Rapids, WI 54494
715-421-2060
www.ecccorrosion.com

CUSTOMER NAME UNISON SOLUTIONS COMPANY
ECC JOB # 84956 CUSTOMER PO # 122551
DATE 10-19-12 DWG # 84956-1 USERS ID # BIOCNG100
SERVICE HYDROGEN SULFIDE
SIZE: DIA 8'-0" I.D. HEIGHT 12'-0" S.S. CAPACITY 3,760 GALLON
RESIN DERAKANE 411 CURE MEKP S.G. 1.0
CORROSION LINER 100 MILS. SINGLE C-VEIL
MAX TEMP 120°F MIN PRESS -3 PSIG MAX PRESS +3 PSIG
VISUAL INSP. LEVEL RTP-1 EST. EMPTY WT. 12,000 LBS



TANK PLAN VIEW

PRELIMINARY
NOT FOR CONSTRUCTION

ECC, Inc. 10-19-12
Date

This document is submitted to UNISON SOLUTION CO. for approval. Preliminary ECC, Inc. scheduling or engineering and production is based upon return of this document within 7 days after its receipt. Any delays in approving and returning this document could have a direct effect upon fabrication time and completion date. Revisions or changes that directly effect the basic engineering and design set forth on this document and/or differs from ECC, Inc. proposal/job number 84956 will be reviewed and may require revision of contract price and delivery schedule.

- ☐ Approved as drawn
- ☐ Approved as noted, submit revised drawings for record
- ☐ Resubmit for approval

Authorized Signature Date

FOR APPROVAL ONLY
NOT FOR FABRICATION

OCT 19 2012

1	REVISED PER CUSTOMER REQ.	10-19-12	PK
0	NEW DRAWING	10-03-12	PK
REV	REVISION	DATE	INT
COPYRIGHT © 2010 BY ECC CORROSION, INC.			

BILL OF MATERIALS					
ITEM QTY	PART NUMBER	DESCRIPTION	GUSSET TYPE	NZL. PROJ.	MATERIAL
CB 1	-	CONTROL BOX	N/A	N/A	FRP
CP1 1	58-2CPB150411	2"ø HALF COUPLING 150PSI RATED (DRAIN)	N/A	4"	FRP
CP4 1	58-2CPB150411	2"ø HALF COUPLING 150PSI RATED (VENT)	N/A	4"	FRP
G 1	70-006	2" GRATING	N/A	N/A	FRP
HD 4	-	HOLD DOWN LUG	N/A	N/A	FRP
HR 1	-	HANDRAIL	N/A	N/A	FRP
HT 1	-	SELF-REGULATING HEATING TAPE (10w/ft. AT 50°F ON 120VOLTS)	N/A	N/A	-
IB 1	-	I-BEAM 4" x 4" x 3/8" (TRIM TO FIT)	N/A	N/A	FRP
L 1	-	LADDER w/ CAGE	N/A	N/A	FRP
LL 2	-	LIFTING LUGS	N/A	N/A	FRP
M1 1	49-36MAN25411	36"ø MANWAY w/COVER 25 PSI RATED	N/A	8"	FRP
MTA 1	-	GASKET 46" O.D. x 36" I.D. (32) 3/4"ø BOLT HOLE ON 42 3/4" B.C.	N/A	N/A	VITON
M1B 1	-	(32) 5/8"ø BOLTS x 5" LONG w/ 32 NUTS AND 64 WASHER	N/A	N/A	ZINC
M2 1	49-36MAN25411	36"ø MANWAY w/COVER 25 PSI RATED	N/A	8"	FRP
M2A 1	-	GASKET 46" O.D. x 36" I.D. (32) 3/4"ø BOLT HOLE ON 42 3/4" B.C.	N/A	N/A	VITON
M2B 1	-	(32) 5/8"ø BOLTS x 5" LONG w/ 32 NUTS AND 64 WASHER	N/A	N/A	ZINC
N1 1	50-04FLA150411	4"ø FLANGE NOZZLE 150 PSI RATED (DISCHARGE)	1/4" PLATE	8"	FRP
N1A 1	52-04ELB150411	4"ø 90° ELBOW 150 PSI RATED	N/A	N/A	FRP
N1B 1	-	4"ø PIPE 150 PSI RATED FOR DISCHARGE	N/A	N/A	FRP
N1C 1	-	2"ø PIPE 150 PSI RATED (PIPE SUPPORT)	N/A	N/A	FRP
N2 1	50-04FLA150411	4"ø FLANGE NOZZLE 150 PSI RATED (INLET)	1/4" PLATE	8"	FRP
N2A 1	48-04ELB150411	4"ø 45° ELBOW 150 PSI RATED	N/A	N/A	FRP
N3 1	50-12FLA150411	12"ø FLANGE NOZZLE 150 PSI RATED (CLEANOUT)	N/A	8"	FRP
NP 1	10-099-SS	ECC NAME PLATE	N/A	N/A	304SS
SP 1	-	STEP OFF PLATFORM w/HAND RAIL	N/A	N/A	FRP
SR 1	-	2" x 2" x 1/4" ANGLE RING	N/A	N/A	FRP

MATERIALS OF CONSTRUCTION			
RESIN SYSTEM		CURE SYSTEM	
100 MILS. SINGLE C-VEIL		MEKP	
DERAKANE 411		MEKP	
GEL COAT w/UV-INHIBITOR (LIGHT GRAY)			
REINFORCEMENTS		REMARKS	
THK./LAYER		SYMBOL	
C-GLASS SURFACING VEIL		V	
NEXUS SURFACING VEIL		N	
1 1/2 oz. CHOP STRAND MAT		M	
3/4 oz. CHOP STRAND MAT		Z	
24 oz. WOVEN ROVING		R	
WEFT UNIDIRECTIONAL FABRIC		U	
CHOP STRAND GLASS		CP	
HELICAL FILAMENT WIND		FW	
STRAIGHT FILAMENT WIND		SW	
COMPONENT		REMARKS	
LAMINATE THK.		LAMINATE TYPE	
TOP HEAD		TYP. II	
SHELL		TYP. X	
BOTTOM		TYP. II	

CAPACITIES & WEIGHTS			
OPERATING CAP.	4,512 GAL.	CU-FT	
FULL CAPACITY	GAL.	CU-FT	
EMPTY WEIGHT	LBS	FULL H ₂ O	LBS
OPERATING WT.	LBS	FULL PROD.	LBS

DESIGN CONDITIONS	
DESIGN INTERNAL PRESS.	3 PSIG
DESIGN EXTERNAL PRESS. (VAC.)	-3 PSIG
DESIGN TEMP.	120°F
HYDRO TEST	Y
POST CURE	N
SP.GR. CONTENTS	1.0
WIND LOAD	N/A
SEISMIC ZONE	ZONE 0
ROOF LOAD	N/A
VISUAL INSPECTION	RTP-1
PRODUCT	HYDROGEN SULFIDE
DESIGN PER.	RTP-1

CUSTOMER: UNISON SOLUTIONS COMPANY			
TITLE: BIOCNG 100 HYDROGEN SULFIDE 8'-0" I.D. x 12'-0" S.S. TANK ASSEMBLY DRAWING		SCALE: NONE	
MATERIAL: FRP		DR: PK CK: DATE PM: DATE	
SERIAL NO: 84956		DATE: 10-03-12	
QTY REQ'D: 1		DATE: -	
DWG NO: 84956-1		DATE: -	
OF 1		REV 1	
ECC Corrosion, Inc. An Energy Composites Company Formerly Advanced Fiberglass Technologies, Inc.		4400 Commerce Drive Wisconsin Rapids, WI 54494 P(715) 421-2060 F(715) 421-2048	





FRP Equipment Handling and Installation

**Specification Standard SS-08-301, Rev-2
8-Jun-09**

**Instructions for handling and installing Tanks,
Pressure Vessels, Scrubbers and other FRP
Process Equipment**



4400 Commerce Drive
Wisconsin Rapids, WI, 54494
Phone: (715) 421-2060
www.ecccorrosion.com

FRP Equipment Handling and Installation

Specification Standard SS-08-301, Rev-2

Instructions for handling and installing Tanks, Pressure Vessels, Scrubbers and other FRP* Process Equipment

*(Fiberglass Reinforced Plastics)

GENERAL

ECC Corrosion, Inc. (ECC) has prepared this bulletin as a guide to assist our customers in handling and installing FRP equipment (herein after referred to as vessels). The material contained herein is accurate to the best of our knowledge, but cannot be expected to cover all handling and installation conditions. They do not relieve the purchaser from full responsibility for proper inspection, handling and installation. Improper handling or installation, which results in damage or vessel failure, is the sole responsibility of the purchaser. This bulletin is not intended as a warranty of any ECC product or service. Terms of warranties offered by ECC are contained in contract documents prepared for each sale of an ECC product or service. Failure by the customer to comply with these handling and installation instructions will void the vessel warranty. Unknown situations or conditions are also the burden of the purchaser. Furthermore, an ECC representative at the installation site does not relieve the purchaser of their responsibilities for safe and proper handling and installation.

INSPECTION

The customer shall be responsible for inspecting the vessel at the time of delivery for damage during transit. The inside and outside of the vessel must be inspected. If any damage has occurred it must be noted on the delivery receipt prior to signing acceptance. In the case of a common carrier, all claims should be filed immediately by the customer with the delivering carrier. When the delivery is made by an ECC truck, the factory must be contacted prior to unloading. The customer accepts all future responsibility for a damaged tank if these procedures are not followed. Minor damage can be repaired at the delivery site. If damage is noted the customer must contact ECC with full information describing the damage. Supplying photos of the damage will help us determine the extent of damage and if the vessel can be unloaded.

GENERAL HANDLING PRECAUTIONS

ECC vessels are designed to withstand normal handling. However, the flexural, impact, and shear properties of FRP laminated structures are significantly lower than those of metallic structures. Therefore, special consideration must be given to weight and weight distribution at contact points during handling, storage, and installation of FRP vessels. The following precautions are to be followed to avoid damage:

1. Never roll or slide a vessel. Always lift the vessel using a crane or other approved method.
2. Operators of cranes and hoists should follow proper rigging procedures at all times. A Tag line must be used to prevent the vessel from swinging out of control and striking other objects.
3. Do not handle vessels by only one lifting lug. Always use all of the lifting lugs to lift a vessel.
4. Never lift a Vessel by the Hold Down Lugs / Bottom Lugs.
5. Never apply lifting or moving forces to nozzles or other inlet/outlet connections.
6. Under no conditions should chains or cables be put around the vessel. Use polyester or nylon straps at least 4" wide to sling the tank. Avoid the use of equipment inside the vessel that could scratch or damage the inner corrosion barrier. Use caution not to crush the outer Jacket of an Insulated Vessel if slinging.
7. Do not drop the vessel, or allow hard impact from other objects. Dropping the vessel, or allowing hard impact from other objects will result in cracks in the inner corrosion barrier, as well as damage to the exterior of the vessel.
8. Do not position the vessel on any uneven surface which may concentrate the weight on a localized area.
9. When working around the vessel, care should be taken to prevent tools from striking, or being dropped inside the vessel. Soft soled shoes should be worn by workmen entering the vessel. Ladders used inside or outside of vessels must be fiberglass, wooden rope, or have rubber protection on both ends to prevent scratching the surface.
9. During storage or repositioning FRP vessels should remain in the shipping crate or skids and be placed on firm level surfaces. Unskidded vessels should be placed on firm level surfaces that are free of stones, tools, and other small hard objects, since contact with such objects can cause localized damage. Unskidded vessels stored outside should be tied down.

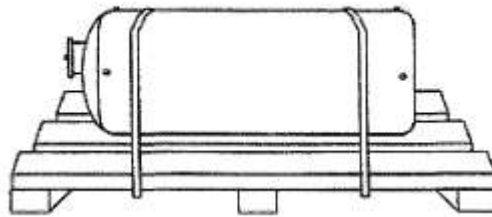
HANDLING SKIDDED VESSELS

Small vessels are normally skidded to provide protection and facilitate handling. This type of vessel can be moved by sliding the skid, however, precautions should be taken to prevent damage to fittings.

Generally this type of vessel can be moved or lifted with sufficient man power because of their light weight.

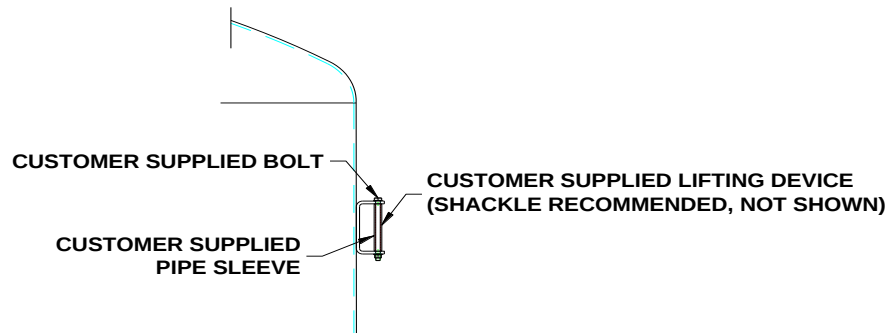
When a fork lift is used to move or lift the vessel, care must be taken to prevent damage of the vessel by the forks.

A skidded vessel can be moved by attaching pull lines to the skid. Pull only on the lower portion of the skid. Do not pull on the hold down bands as this may damage the vessel wall.



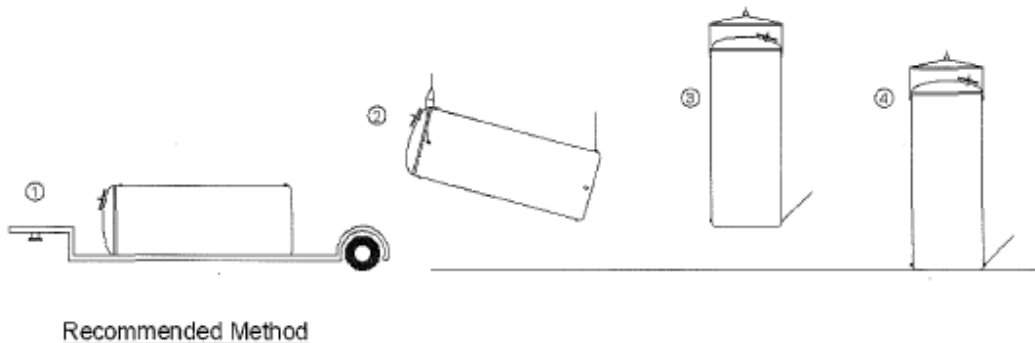
LIFTING/HANDLING LUGS

The lugs are designed for equal load on both ear tabs of the lug. ECC recommends using a pipe spacer between the ear tabs to achieve equal load and a lifting device to allow the vessel to easily rotate from horizontal to vertical, as shown in the illustration below.



FLAT BOTTOM VESSELS

Larger vessels shipped by trailers, require a spreader bar and slings attached to the appropriate lifting lugs to unload vessels. Always use guide lines to keep the load under control. Do not allow the vessel to swing freely. Use a spreader bar and lines attached to appropriate lifting lugs to hoist the vessel to an upright position and place the vessel on its foundation as shown in the illustration below. Control the vessel with guide lines to ensure the vessel is gently set on its base.



VESSEL BOTTOM SUPPORT PAD

The support pad surface should be nonporous and free of cracks, depressions, and vertical projections. Reinforced concrete, trowel finished to American Concrete Institute specifications is often used as a support pad. Design for bearing strength of the support pad is the responsibility of the purchaser. The support pad must exceed tank diameter by 6" minimum, and be flat within $\pm \frac{1}{4}$ " of a horizontal plane. Local irregularities should not exceed $\frac{1}{8}$ ". Sloping pads should be equally as flat.

VESSEL BOTTOM CUSHIONING PAD

Every flat-bottom vessel should be set on a cushioning pad to minimize stress caused by seams, shrinkage distortion, and/or support pad or vessel bottom irregularities. This pad should be $\frac{1}{4}$ " thick, closed cell elastomeric sponge material of suitable composition and compression deflection range of 5 psi to 9 psi, resin or cement grout, petroleum-base mastic/sand mortar, or other suitable conforming material that will cushion the vessel bottom over surface irregularities of the support pad or vessel bottom.

SUPPORT PAD CUT-OUT FOR SIDE BOTTOM DRAIN

Where a vessel has a bottom drain, provisions should be made in the support pad with clearances so that contact will not occur between the support pad and nozzles or nozzle flanges.

Where a trench in a support pad is required to accommodate bottom discharge piping, a structural trench cover should be installed flush with the top of the support pad to minimize the unsupported area of the vessel bottom.

Failure to follow these precautions may result in serious damage to the vessel and void the warranty.

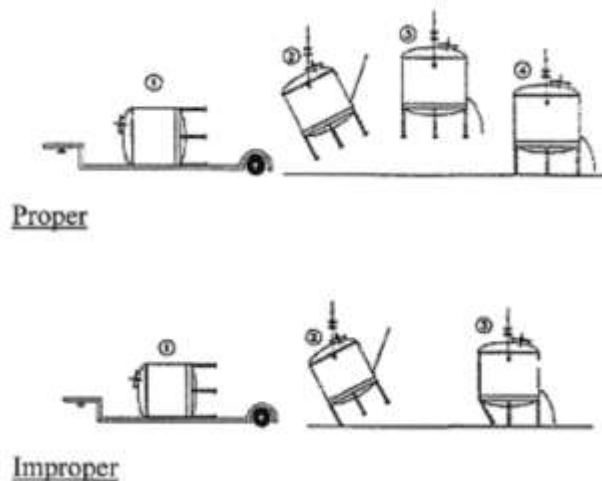
HOLD-DOWN LUGS

The required hold-down lugs are supplied as standard equipment on all ECC vessels. Anchor bolts and hold-down hardware are supplied by the customer. It is critical that the hold-down lugs set firmly on the support pad prior to tightening the bolts. If there is a gap between the hold-down lug and the support pad make sure spacers/shims are inserted beneath the lugs before tightening bolts. It is also recommended that the vessel be filled to operating capacity prior to installing the spacers/shims and tightening the bolts.

HANDLING VESSELS WITH SUPPORT LEGS

When standing up a vessel with legs do not pivot the vessel on the legs. Lift the entire vessel using the lifting lugs as shown in the illustration below.

FRP Equipment Handling and Installation
ECC Specification Standard SS-08-301, Rev-2



DISHED BOTTOM VESSELS

FRP vessels with dished or cone bottoms are often constructed with legs for support and consideration must be given to the concentrated nature (4-12 points) of the loading. Installers must ensure that these supports rest on solid footings. To avoid point loading and uneven stresses, the supports must be perfectly level. Shim as necessary under the supporting members to properly balance weight distribution.

PIPE CONNECTIONS

Flexible pipe connections should be used wherever possible. Valves and rigid piping attached to vessel nozzles must be independently supported so that the weight does not transmit directly to the nozzle. Any damage that occurs to a vessel as a result of improper attachment of valves or piping to a nozzle or fitting will not be covered under warranty.

Metallic fittings should not be used on threaded FRP nipples or couplings.

HORIZONTAL VESSEL INSTALLATION

Installation of horizontal vessels is much the same as the dished bottom vessels. Vessels are supplied with the required number of support saddles. These saddles are to be placed under the designated support rings. The saddles should be centered on the support ring and through the centerline of the vessel. Caution must be taken to insure that the vessel support rings are in contact with the bottom of the saddles. To avoid point loading and uneven stresses, the support saddles must be perfectly level. Shim as necessary under the saddles to properly balance weight distribution.

WATER FILL TESTING

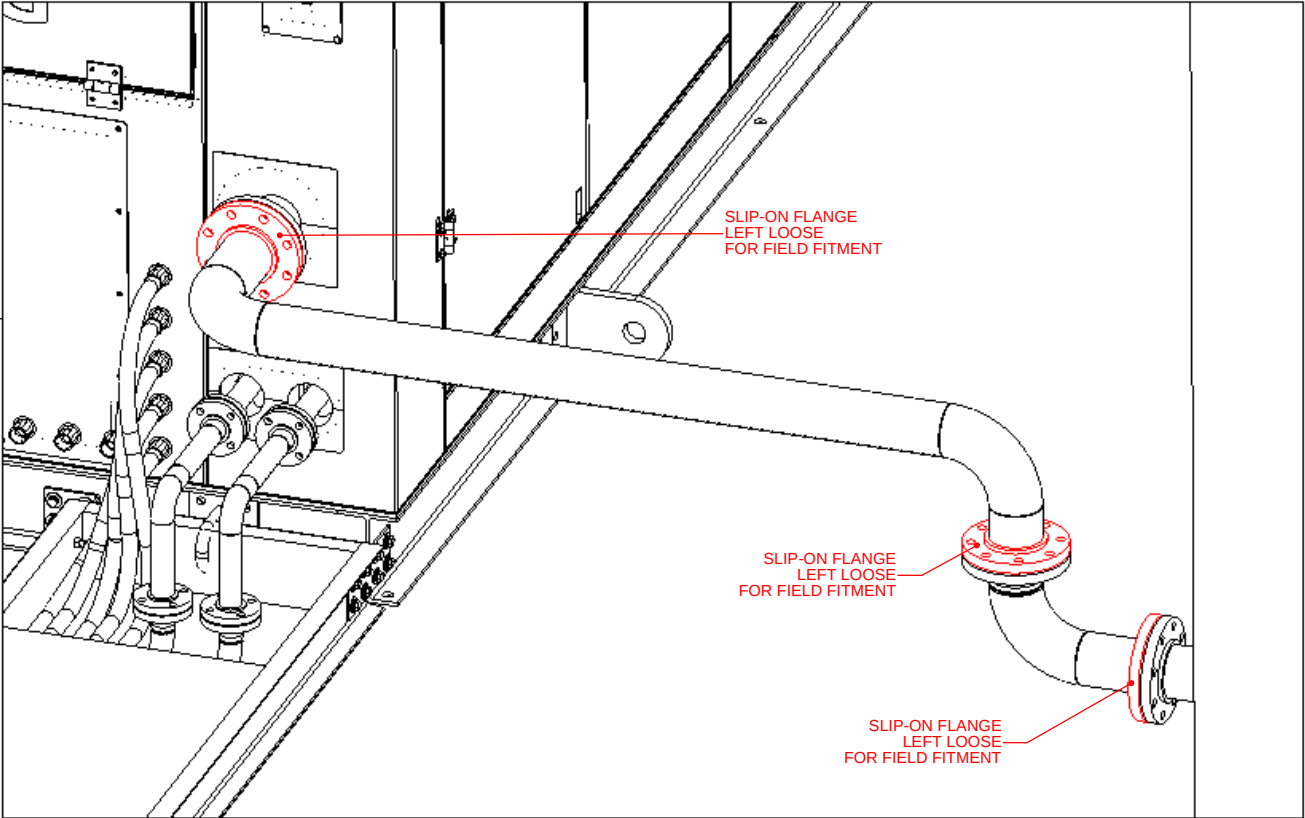
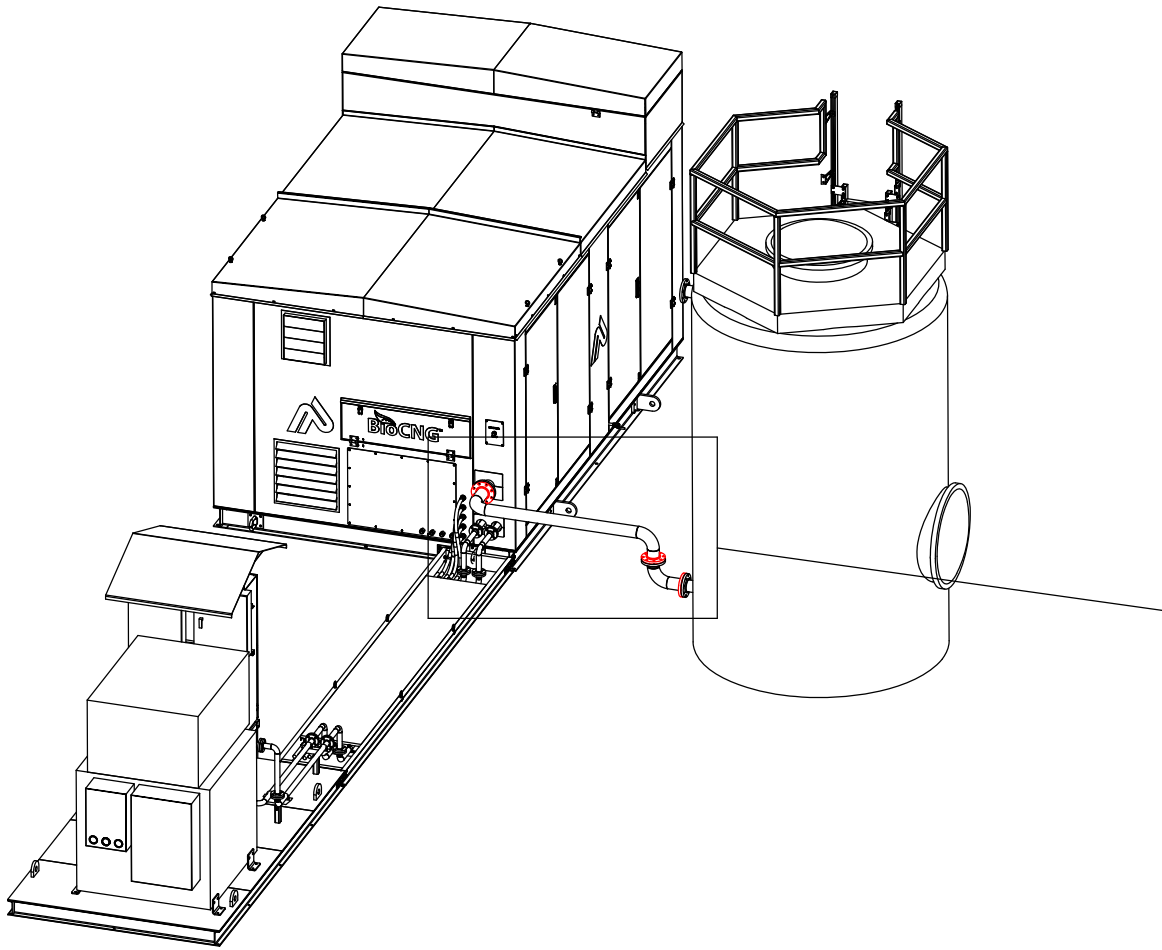
ECC Corrosion, Inc. recommends that each vessel be water filled (hydro tested) for a minimum of 2 hours at atmospheric pressure, after the vessel is installed and prior to use.



REVISIONS				
REV. SYMBOL	REV. BY	APPR. BY	DATE	DESCRIPTION OF CHANGE

ISOMETRIC VIEW

NOTE: Flex connections (braided steel) provided at each connection point by BioCNG



DETAIL A
SCALE 1 : 8

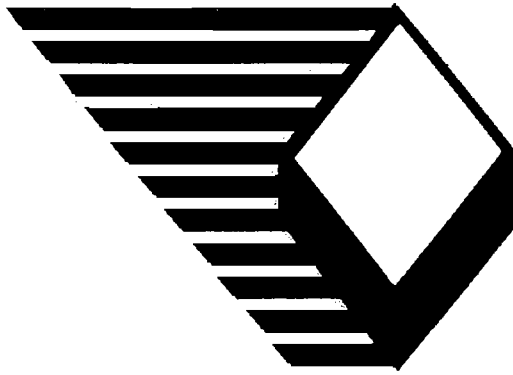


Unison Solutions Inc.
5451 Chavenelle Road
Dubuque, IA 52002

PHONE: 563-585-0967 FAX: 563-585-0970

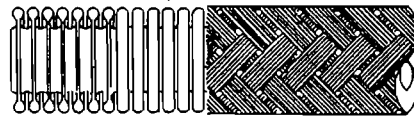
PROPRIETARY AND CONFIDENTIAL
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 THE CONSENT OF UNISON SOLUTIONS INC.

PROJECT	BioCNG-100		
DESCRIPTION	H2S FIELD PIPING		
DRAWN BY	TAB	DATE	10/24/2012
REVISION	-	DWG. NO.	6L-B100-53

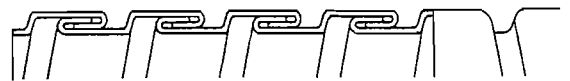


Midwest Flexible Hose Corporation

Corrugated



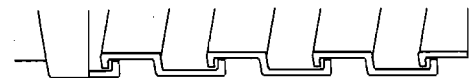
Interlocked



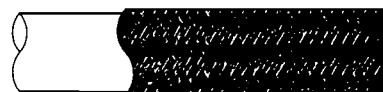
Smooth Bore Interlocked



Square Locked



Teflon



**1-800-642-HOSE
(4673)**

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How to read and use Midwest connector part numbers.

MC - says what part it is: a Midwest Connector.

B, U - designates if the connector is Braided or Unbraided.

S321, B, CS, SBTFE or CTFE denotes hose and braid type: Stainless steel 321 or 316, (braid is 304 unless specified), Bronze, Carbon Steel, or Teflon. (Monel also available.)

SM, UF, X, XF - specifies fitting style: Solid Male, Union Female, fiXed flange, or Floating flange. The complete list of fittings available for your assembly is in no way limited to these few shown here as examples. (See page for standard fittings.)

S304, S316, B, CS - denotes fitting metal type: 304SS, 316SS, Brass, or Carbon Steel.

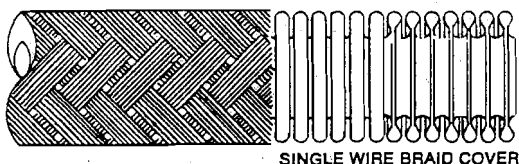
ID X LGTH - describes the dimensions of the assembly: Inside Diameter by Length. (Specify if overall length or live length.)

SAMPLE PART #: MCBS321SMUFS304 1" x 24"

Description: Midwest Connector, Braided, Stainless 321 hose with 304 stainless braid, Solid Male one end, Union Female other end, fittings are Stainless Steel 304.

1" inside diameter by 24" overall length.

Corrugated Metal Hose



321 Stainless Steel					Centerline Radius	
Nominal I.D.	Number of Braids	Nominal O.D.	Max. W.P. @ 70F	Weight Foot	Constant Flexing	Static Bend
1/4"	1	0.57	2550	0.18	5.00	1.00
3/8"	1	0.74	1825	0.24	5.50	1.25
1/2"	1	0.89	1075	0.34	6.00	1.50
3/4"	1	1.28	775	0.59	8.00	2.25
1"	1	1.58	550	.075	9.00	2.75
1 1/4"	1	1.93	525	1.06	10.50	3.50
1 1/2"	1	2.27	450	1.23	12.00	4.00
2"	1	2.80	475	1.73	15.00	5.00
2 1/2"	1	3.33	375	1.88	20.00	8.00
3"	1	3.88	300	2.04	22.00	9.00
4"	1	4.98	275	2.92	27.00	13.00
5"	1	6.03	200	3.47	31.00	18.00
6"	1	6.10	190	5.16	36.00	19.00

* Also available in 316 Stainless

Bronze					Centerline Radius	
Nominal I.D.	Number of Braids	Nominal O.D.	Max. W.P. @ 70F	Weight Foot	Constant Flexing	Static Bend
1/4"	1	0.57	1175	0.21	5.50	1.00
3/8"	1	0.74	763	0.33	6.00	1.25
1/2"	1	0.90	675	0.46	7.00	1.50
3/4"	1	1.29	525	0.60	8.00	2.25
1"	1	1.59	437	0.78	10.50	3.00
1 1/4"	1	1.93	350	0.90	12.00	3.50
1 1/2"	1	2.31	325	1.16	13.50	4.00
2"	1	2.88	250	1.94	17.00	5.00
2 1/2"	1	3.27	250	1.52	22.00	8.00
3"	1	3.68	187	1.57	24.00	12.00

Corrugated Metal Hose Standard Fittings

Style SHM: Hex Male

N.P.T. Male Thread

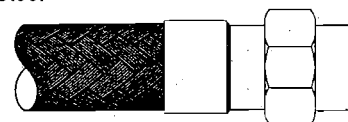
1/4" thru 1 1/2" supplied with Integral Hex

Materials: Stainless Steels
Carbon Steel
Brass

**Style UF: Female Union**

N.P.T. Female Thread

Materials: Stainless Steel
Carbon Steel
Brass

**Style SM: Male Nipple**

N.P.T. Male Thread

SCH 40/40S Pipe

Materials: Stainless Steel
Carbon Steel
Brass

**Style WE: Weld End**

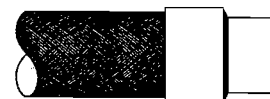
Materials: Stainless Steel
Carbon Steel

Specify Pipe: SCH 5

Schedule: SCH 10

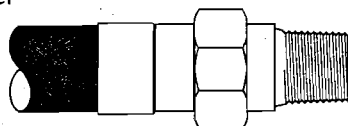
SCH 40

SCH 80

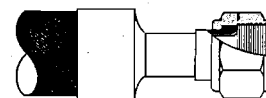
**Style UM: Male Union**

N.P.T. Male Thread

Materials: Stainless Steel
Carbon Steel
Brass

**Style JIC: Swivel Female (37deg.)**

Materials: Stainless Steel
Carbon Steel

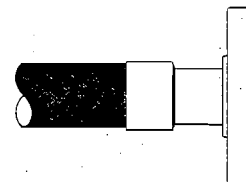
**Style SF: Female Pipe Coupling**

N.P.T. Female Thread

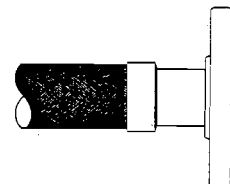
Materials: Stainless Steel
Carbon Steel

**Style X: Fixed Flange**

Materials: Stainless Steel
Carbon Steel

**Style XF: Floating Flange**

Materials: Stainless Steel
Carbon Steel

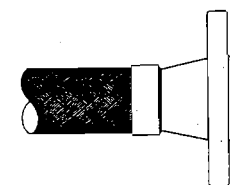
**Style SHF: Half Pipe Coupling**

N.P.T. Female Thread

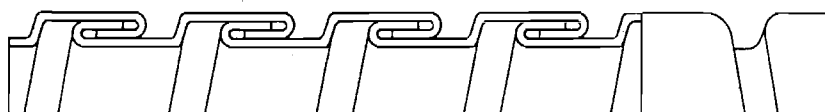
Materials: Stainless Steel
Carbon Steel

**Style WNX: Weld Neck Flange**

Materials: Stainless Steel
Carbon Steel



Interlocked Hose



M100G Light-Weight Galvanized Steel .010-.012 Strip Thickness

Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.	Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
1/2	5/8	3.5	.14	2 1/2	2 5/8	15.0	.80
5/8	3/4	4.0	.17	2 3/4	2 7/8	17.0	.92
3/4	7/8	4.5	.20	3	3 1/8	19.0	1.02
7/8	1	5.5	.25	3 1/2	3 5/8	22.0	1.26
1	1 1/8	6.5	.26	4	4 1/8	24.0	1.38
1 1/8	1 1/4	7.0	.30	4 1/2	4 5/8	27.0	1.55
1 1/4	1 3/8	7.5	.32	5	5 1/8	29.0	1.70
1 3/8	1 1/2	8.0	.36	6	6 1/8	38.0	2.00
1 1/2	1 5/8	8.5	.40	7	7 1/8	43.0	2.30
1 3/4	1 7/8	10.0	.45	8	8 1/8	48.0	2.60
2	2 1/8	11.5	.60	9	9 1/8	52.0	3.10
2 1/4	2 3/8	13.0	.70	10	10 1/8	56.0	3.50

M150G Medium-Weight Galvanized Steel .013-.016 Strip Thickness

Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.	Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
1/2	11/16	4.0	.18	2 3/4	2 15/16	18.0	1.12
5/8	13/16	4.5	.22	3	3 3/16	19.5	1.33
3/4	15/16	5.0	.26	3 1/2	3 11/16	23.5	1.64
7/8	1 1/16	6.0	.33	4	4 3/16	25.5	1.80
1	1 3/16	7.0	.35	4 1/2	4 11/16	28.5	2.02
1 1/8	1 5/16	7.5	.39	5	5 3/16	31.0	2.21
1 1/4	1 7/16	8.5	.42	6	6 3/16	40.5	2.6
1 3/8	1 9/16	9.0	.47	7	7 3/16	46.0	3.00
1 1/2	1 11/16	10.0	.52	8	8 3/16	51.0	3.38
1 3/4	1 15/16	11.0	.65	9	9 3/16	56.0	4.03
2	2 3/16	12.5	.78	10	10 3/16	60.0	4.55
2 1/4	2 7/16	14.0	.91	12	12 3/16	70.0	5.46
2 1/2	2 11/16	16.0	1.04				

M180G Medium-Heavy Galvanized Steel .017-.020 Strip Thickness

Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.	Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
1	1 1/4	7.5	.50	3 1/2	3 3/4	25.0	2.01
1/8	1 3/8	8.0	.60	4	4 1/4	27.0	2.30
1 1/4	1 1/2	9.0	.64	4 1/2	4 3/4	30.0	2.59
1 3/8	1 5/8	10.0	.70	5	5 1/4	33.0	2.86
1 1/2	1 3/4	11.0	.85	6	6 1/4	43.0	3.45
1 3/4	2	11.5	.95	7	7 1/4	48.0	4.03
2	2 1/4	13.0	1.15	8	8 1/4	55.0	4.60
2 1/4	2 1/2	15.0	1.29	9	9 1/4	59.0	5.18
2 1/2	2 3/4	17.0	1.44	10	10 1/4	63.0	5.75
2 3/4	3	19.0	1.58	12	12 1/4	76.0	6.90
3	3 1/4	21.0	1.73	14	14 1/4	85.0	8.05

M240G Heavy-Weight Galvanized Steel .023-.026 Strip Thickness

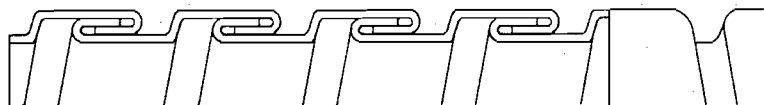
Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.	Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
2	2 9/32	15.0	1.45	5	5 9/32	34.0	3.63
2 1/4	2 17/32	17.0	1.63	6	6 9/32	45.0	4.35
2 1/2	2 25/32	19.5	1.81	7	7 9/32	50.0	5.08
2 3/4	3 1/32	22.0	1.99	8	8 9/32	57.0	5.80
3	3 9/32	24.0	2.18	9	9 9/32	61.0	6.53
3 1/2	3 25/32	26.0	2.54	10	10 9/32	66.0	7.25
4	4 9/32	38.5	2.90	12	12 9/32	78.0	8.70
4 1/2	4 25/32	31.0	3.26	14	14 9/32	88.0	10.15

Note: Aluminized Steel available on 2" I.D. & above

M290G Extra-Heavy Galvanized Steel .027-.030 Strip Thickness

Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.	Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
2	2 5/16	17.0	1.71	5	5 5/16	36.0	4.28
2 1/4	2 9/16	18.0	1.92	6	6 5/16	47.0	5.13
2 1/2	2 13/16	20.0	2.14	7	7 5/16	52.0	5.99
2 3/4	3 1/16	23.0	2.35	8	8 5/16	59.0	6.84
3	3 5/16	26.0	2.56	9	9 5/16	63.0	7.70
3 1/2	3 13/16	27.0	2.99	10	10 5/16	59.0	8.55
4	4 5/16	30.0	3.42	12	12 5/16	80.0	
4 1/2	4 13/16	33.0	3.85	14	14 5/16	95.0	

Interlocked Hose

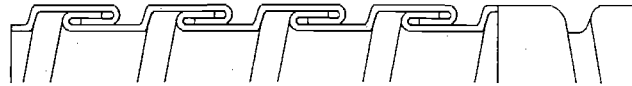
**M100S304****Light-Weight Stainless Steel****.010-.012 Strip Thickness**

Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.	Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
1/2	5/8	3.5	.14	2 1/2	2 5/8	15.0	.80
5/8	3/4	4.0	.17	2 3/4	2 7/8	17.0	.92
3/4	7/8	4.5	.20	3	3 1/8	19.0	1.02
7/8	1	5.5	.25	3 1/2	3 5/8	22.0	1.26
1	1 1/8	6.5	.26	4	4 1/8	24.0	1.38
1 1/8	1 1/4	7.0	.30	4 1/2	4 5/8	27.0	1.55
1 1/4	1 3/8	7.5	.32	5	5 1/8	29.0	1.70
1 3/8	1 1/2	8.0	.36	6	6 1/8	38.0	2.00
1 1/2	1 5/8	8.5	.40	7	7 1/8	43.0	2.30
1 3/4	1 7/8	10.0	.45	8	8 1/8	48.0	2.6
2	2 1/8	11.5	.60	9	9 1/8	52.0	3.10
2 1/4	2 3/8	13.0	.70	10	10 1/8	56.0	3.50

M150S304**Medium-Weight Stainless Steel****.013-.016 Strip Thickness**

Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.	Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
1/2	11/16	4.0	.18	2 3/4	2 15/16	18.0	1.12
5/8	13/16	4.5	.22	3	3 3/16	19.5	1.33
3/4	15/16	5.0	.26	3 1/2	3 11/16	23.5	1.64
7/8	1 1/16	6.0	.33	4	4 3/16	25.5	1.80
1	1 3/16	7.0	.35	4 1/2	4 11/16	28.5	2.02
1 1/8	1 5/16	7.5	.39	5	5 3/16	31.0	2.21
1 1/4	1 7/16	8.5	.42	6	6 3/16	40.5	2.6
1 3/8	1 9/16	9.0	.47	7	7 3/16	46.0	3.00
1 1/2	1 11/16	10.0	.52	8	8 3/16	51.0	3.38
1 3/4	1 15/16	11.0	.65	9	9 3/16	56.0	4.03
2	2 3/16	12.5	.78	10	10 3/16	60.0	4.55
2 1/4	2 7/16	14.0	.91	12	12 3/16	70.0	5.46
2 1/2	2 11/16	16	1.04				

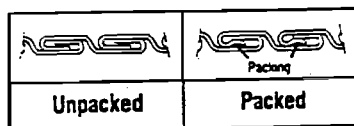
Interlocked Hose

**M180S304****Heavy-Weight Stainless Steel****.017-.020 Strip Thickness**

Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.	Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
1	1 1/4	7.5	.50	3 1/2	3 3/4	25.0	2.01
1 1/8	1 3/8	8.0	.60	4	4 1/4	27.0	2.30
1 1/4	1 1/2	9.0	.64	4 1/2	4 3/4	30.0	2.59
1 3/8	1 5/8	10.0	.70	5	5 1/4	33.0	2.86
1 1/2	1 3/4	11.0	.85	6	6 1/4	43.0	3.45
1 3/4	2	11.5	.95	7	7 1/4	48.0	4.03
2	2 1/4	13.0	1.15	8	8 1/4	55.0	4.60
2 1/4	2 1/2	15.0	1.29	9	9 1/4	59.0	5.18
2 1/2	2 3/4	17.0	1.44	10	10 1/4	63.0	5.75
2 3/4	3	19.0	1.58	12	12 1/4	76.0	6.90
3	3 1/4	21.0	1.73	14	14 1/4	85.0	8.05

Packing:

For additional leak proofing, a continuous strand is inserted into the groove of the hose during manufacture. The strand is sealed inside the hose, and will not contaminate the product during transference.



Packing Type	Benefits	Temperature Ability
Cotton	Lowest cost.	180° F.
Pyro-Pak	Coated high temperature filament.	1000° F.
Hard Packing (Copper, Stainless Steel)	For extreme high temperatures.	1200° F.
Elastomeric	Maximum pressure/vacuum resistance.	180° F.

Smooth-Bore Interlocked Hose



Stainless Steel						
*Series	M150SLS 015/.015		M180SLS .018/.015		M200SLS .020/.015	
Size (In.)	Wt./Ft.	Inside Bend Dia. (In.)	Wt./Ft.	Inside Bend Dia. (In.)	Wt./Ft.	Inside Bend Dia. (In.)
1 1/2	1.3	16	-	-	-	-
2	1.5	17	1.8	22	-	-
2 1/2	1.8	19	2.1	25	-	-
3	2.5	21	2.9	27	3.2	30
3 1/2	3.0	26	3.4	29	3.7	32
4	3.4	29	3.9	31	4.3	34
4 1/2	3.8	32	4.4	36	4.8	40
5	4.2	36	4.9	40	5.4	44
6	5.1	43	5.9	48	6.4	53
7	-	-	6.9	57	7.5	63
8	-	-	7.8	62	8.6	68
10	-	-	9.8	78	10.7	86
12	-	-	11.8	93	12.8	102
14	-	-	13.7	109	15.0	120

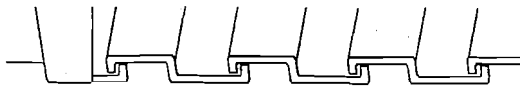
* STD Liners .015 Stainless steel on SLS series

Galvanized						
*Series	M150GLC M150GLG M150GLS 015/.015		M200GLC M200GLG M200GLS 018/.015		M250GLC M250GLG M250GLS .024/.015	
Size (In.)	Wt./Ft.	Inside Bend Dia. (In.)	Wt./Ft.	Inside Bend Dia. (In.)	Wt./Ft.	Inside Bend Dia. (In.)
1 1/2	1.3	17	-	-	-	-
2	1.5	18	1.8	23	-	-
2 1/2	1.8	20	2.1	27	-	-
3	2.5	22	3.2	29	3.9	32
3 1/2	3.0	26	3.7	31	4.6	34
4	3.4	31	4.3	33	5.2	36
4 1/2	3.8	34	4.8	38	5.9	42
5	4.2	38	5.4	42	6.5	47
6	5.1	46	6.4	51	7.8	56
7	-	-	7.5	60	9.1	67
8	-	-	8.6	66	10.4	72
10	-	-	10.7	83	13.0	91
12	-	-	12.8	99	15.6	108
14	-	-	15.0	116	18.2	127

* Standard Liners .015 available in either Carbon Steel (C) or Galvanized (G) or Stainless Steel (S)

* Also available with Aluminum outer guard

Square Locked Hose



TYPE MSL Square Locked Flexible Conduit*

Inside Dia. Inches	Approx. Outside Dia. Inches	Min. Inside Bend Dia. Inches	Approx. Weight Per Foot, Lbs.
3/16	9/32	1 1/4	5
7/32	5/16	1 5/16	5.5
1/4	.360	1 3/8	6
9/32	.375	1 1/2	6.5
5/16	.420	1 5/8	7
11/32	.460	1 11/16	7.5
3/8	.500	1 3/4	8
7/16	9/16	2	9
1/2	5/8	2 1/4	10
9/16	11/16	2 1/2	12
5/8	3/4	2 3/4	15
3/4	31/32	3	24
7/8	1 1/16	3 1/4	26
1	1 3/16	3 1/2	28
1 1/8	1 5/16	3 3/4	32
1 1/4	1 7/16	4	36

* Flexible armor for electrical wiring or control devices on appliances and industrial machinery. Ideal for bend restriction. Bends to very small diameters when needed. Highly compressible for easy installation between fixed connectors. Special sizes, packing available upon request.

* Available in Galvanized Steel, Stainless Steel, Aluminum, Brass, and others.

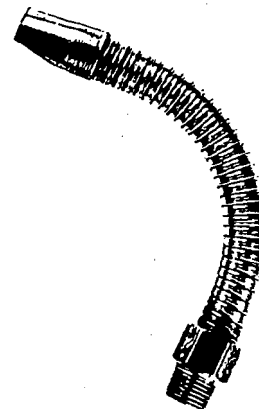
Economy Coolant Hoses

Made from high-tensile spring steel, these coolant hoses convey cutting oils for all types of metalworking machinery.

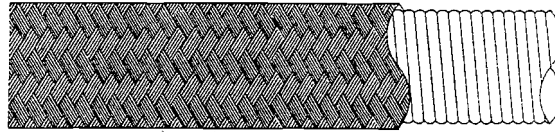
All assemblies are supplied with brass fittings. Standard assemblies have Male (npt) x Nozzle.

I.D. Range: 1/8" - 3/4"

Standard Lengths (in inches):
6, 9, 12, 15, 18, 21, 24, 30.



Convuluted Teflon* Hose



CTFE Medium Pressure Convuluted Transfer Hose

Non-conductive, PTFE lined, fiberglass reinforced innercore, overbraided with 300 series stainless steel.

Hose Part Number	Nominal I.D. In.	Nominal O.D. In.	Op. Pressure PSI	Burst Pressure PSI	Bend Radius In.	Weight Lbs./Ft.
CTFE-06	3/8	.59	1000	4000	1.00	.12
CTFE-08	1/2	.76	1250	5000	1.50	.20
CTFE-10	5/8	.91	1400	5600	2.00	.38
CTFE-12	3/4	1.07	1100	4400	2.50	.33
CTFE-16	1	1.34	1000	4000	3.00	.43
CTFE-20	1 1/4	1.57	1000	4000	3.50	.53
CTFE-42	1 1/2	1.81	750	3000	4.50	.65
CTFE-32	2	2.32	500	2000	5.25	.73

Temperature Range: -65deg F to 400deg F (-54deg C to 204deg C)

Also available with Conductive Teflon (please specify).

*a DuPont registered trademark.

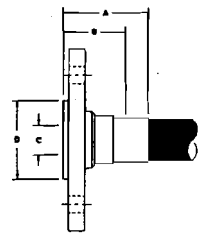
Male Pipe

Hose Size	Thread	A Overall Length In.	B Deduct Length In.	C Nominal I.D. In.
-06				
-08	1/2-14	2.70	1.52	.40
-12	3/4-14	2.70	1.65	.63
-16	1-11 1/2	2.90	1.85	.85
-20	1 1/4-11 1/2	3.50	2.04	1.07
-24	1 1/2-11 1/2	3.70	2.13	1.31
-32	2-11 1/2	3.90	2.35	1.76
-24HV	1 1/2-11 1/2	3.70	2.13	1.31



Flange Retainer

Hose Size	A Overall Length In.	B Deduct Length In.	C Nominal I.D. In.	D Face Diameter In.
-08	2.50	1.39	.40	1.37
-12	2.77	1.64	.63	1.69
-16	2.85	1.72	.85	2.00
-20	3.35	1.84	1.07	2.50
-24	3.56	2.17	1.31	2.87
-32	3.86	2.31	1.76	3.62
-48	5.38	2.50	2.63	5.00
-64	5.38	2.69	3.50	6.19
-24HV	3.56	2.17	1.31	2.87



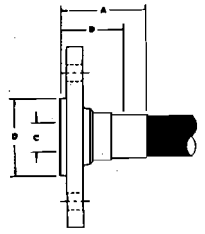
Female Swivel-JIC

Hose Size	Thread	A Overall Length In.	B Deduct Length In.	C Nominal I.D. In.
-08	3/4-16	2.60	1.04	.40
-12	1 1/16-12	2.80	1.22	.63
-16	1 5/16-12	3.00	1.27	.85
-20	1 5/8-12	3.60	1.45	1.07
-24	1 7/8-12	3.80	1.50	1.31
-32	2 1/2-12	4.10	1.67	1.76



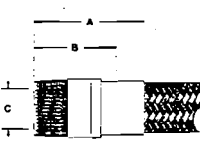
Teflon Lined Flange Retainer

Hose Size	A Overall Length In.	B Deduct Length In.	C Nominal I.D. In.	D Face Diameter In.
-08	2.67	1.48	.25	1.38
-12	2.97	1.76	.45	1.69
-16	3.08	1.84	.65	2.00
-20	3.58	1.98	.90	2.50
-24	3.93	2.35	1.12	2.87
-32	4.12	2.50	1.51	3.62
-48	5.46	2.54	2.55	5.08
-64	5.46	2.73	3.42	6.27
-24HV	3.93	2.35	1.12	2.87



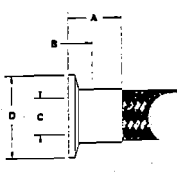
Male Pipe-No Hex

Hose Size	Thread	A Overall Length In.	B Deduct Length In.	C Nominal I.D. In.
-24	1 1/2-11 1/2	4.00	2.51	1.27
-32	2-11 1/2	4.75	3.26	1.73
-48	3-8	5.38	2.50	2.63
-64	4-8	5.38	2.69	3.63

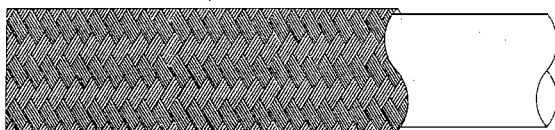


Sanitary Fitting - Tri Clamp Style

Hose Size	A Overall Length In.	B Deduct Length In.	C Nominal I.D. In.	D Face Diameter In.
-16	1.81	.71	.85	1.99
-20	2.69	1.17	1.07	1.99
-24	2.87	1.38	1.31	1.99
-32	2.87	1.38	1.76	2.50
-48	5.00	—	2.67	3.50
-64	4.94	—	3.67	4.50



Smooth Bore Teflon* Hose

**SBTFE Medium Pressure Smooth Bore Hose**

.030 wall, non-conductive virgin PTFE tubing, overbraided with 300 series stainless steel wire.

Hose Part Number	Hose Size	Average I.D. In.	Average O.D. In.	Op. Pressure PSI	Burst Pressure PSI	Bend Radius In.	Weight Lbs./Ft.	Max. Contin. Length In./Ft.
SBTFE-03	3/16	.125	.250	3000	12000	2	.047	300
SBTFE-04	1/4	.187	.312	3000	12000	2	.077	400
SBTFE-05	5/16	.250	.375	3000	12000	3	.098	300
SBTFE-06	3/8	.312	.445	2500	10000	4	.110	300
SBTFE-07	7/16	.375	.503	2250	9000	4.5	.124	300
SBTFE-08	1/2	.405	.549	2000	8000	5.2	.124	200
SBTFE-10	5/8	.500	.648	1500	6000	6.5	.154	180
SBTFE-12	3/4	.625	.778	1200	4800	7.7	.170	150
SBTFE-14	7/8	.750	.885	1100	4400	8.2	.198	100
SBTFE-16	1	.875	1.030	1000	4000	9	.273	100
SBTFE-18	1 1/8	1.000	1.135	900	3600	10	.305	75
SBTFE-20	1 1/4	1.125	1.290	750	3000	16	.350	75

- Temperature Range: -65deg F to 450deg F (-54deg C to 232deg C) Continuous Service
-100deg F to 500deg F (-73deg C to 260deg C) Intermittent Service.
- Special high pressure assemblies available.
- All Teflon hose assemblies will be Stainless Steel Braided unless Bronze is specialized.
- A variety of fittings are available for your smooth bore Teflon hose assemblies. Standard fittings are available in stainless steel, brass, or carbon steel.

*a DuPont registered trademark.

SBTFE Medium Pressure Smooth Bore Bronze Braided Hose

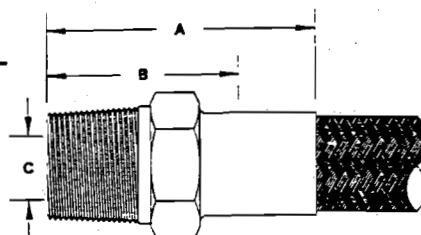
.030 wall, non-conductive virgin PTFE tubing, overbraided with 80/20 bronze wire.

Hose Part Number	Hose Size	Average I.D. In.	Average O.D. In.	Op. Pressure PSI	Burst Pressure PSI	Bend Radius In.	Weight Lbs./Ft.	Max. Contin. Length In./Ft.
SBTFE-B-04	1/4	.187	.312	1000	4000	2	.080	400
SBTFE-B-05	5/16	.250	.375	750	3000	3	.100	300
SBTFE-B-06	3/8	.312	.445	625	2500	4	.115	300
SBTFE-B-08	1/2	.405	.549	500	2000	5	.140	200
SBTFE-B-10	5/8	.500	.648	425	1700	6.5	.150	180
SBTFE-B-12	3/4	.625	.778	300	1200	7.5	.175	150
SBTFE-B-16	1	.875	1.030	200	800	9	.205	100
SBTFE-B-20	1 1/4	1.125	1.290	175	700	16	.260	75

Smooth Bore Teflon Hose Standard Fittings

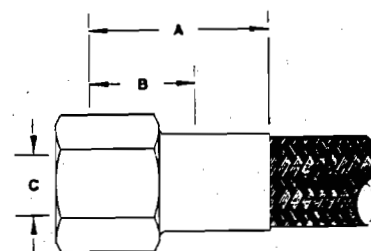
Male Pipe

Hose Size	Thread	A Overall Length In	B Deduct Length In	C Nominal ID In
-03	1/8-27	1.26	.80	.095
-04	1/8-27	1.26	.80	.156
-04	1/4-18	1.47	1.02	.156
-05	1/4-18	1.47	1.02	.207
-06	1/4-18	1.60	1.05	.277
-06	3/8-18	1.63	1.08	.277
-08	3/8-18	1.68	1.08	.358
-08	1/2-14	1.93	1.32	.358
-10	1/2-14	2.05	1.35	.469
-12	3/4-14	2.21	1.44	.594
-16	1-11 1/2	2.56	1.65	.812



Female Swivel SAE/JIC

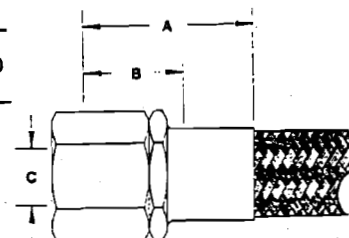
Hose Size	Thread	A Overall Length In	B Deduct Length In	C Nominal ID In
-03	3/8-24	1.31	.50	.095
-04	7/16-20	1.33	.50	.156
-05	1/2-20	1.40	.56	.207
-06*	9/16-18	1.56	.63	.277
-08	3/4-16	1.72	.69	.358
-10	7/8-14	1.99	.77	.469
-12*	1 1/16-12	2.13	.79	.594
-16	1 5/16-12	2.37	.84	.812



*JIC Only

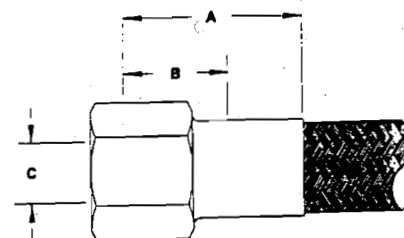
Female Swivel SAE - Wrenching Hex

Hose Size	Thread	A Overall Length In	B Deduct Length In	C Nominal ID In
-04	7/16-20	1.45	.63	.156
-05	1/2-20	1.50	.69	.207
-06	5/8-18	1.68	.76	.277
-08	3/4-16	1.88	.82	.358
-10	7/8-14	2.09	.90	.469
-16	1-5/16-12	2.71	1.02	.812



Female Swivel - SAE

Hose Size	Thread	A Overall Length In	B Deduct Length In	C Nominal ID In
-06	5/8-18	1.56	1.00	.277
-12	1-1/16-14	1.97	1.22	.594

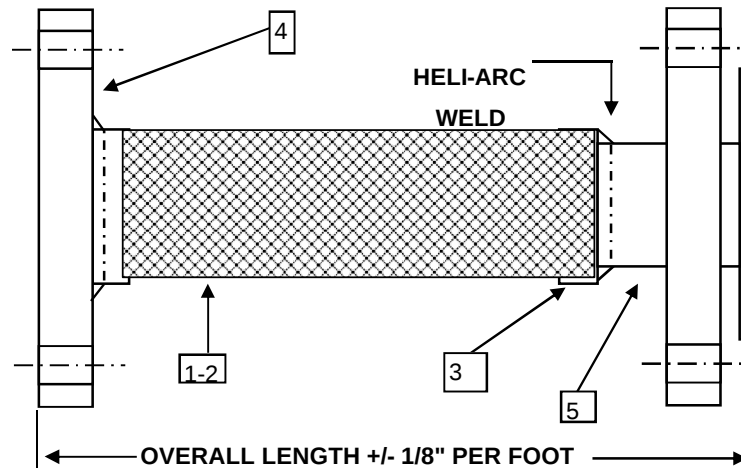




Midwest Flexible Hose Corp.

**1-800-642-HOSE
(4673)**

TWIN CITY HOSE, INC.
20615 COMMERCE BLVD. ROGERS, MN 55374
PHONE 763-428-5100 FAX 763-428-5111



MATERIALS:

#1-2 HOSE: T-321 FLEXONICS 1-LAYER T-304 BRAID

#3 BRAID COLLAR: T-304 STAINLESS STEEL

#4 FLANGES: 150# T-304 STAINLESS STEEL PLATE FLANGES

#5 STUB END: SCH.10 TYPE "C" T-304 STAINLESS STEEL

QTY	SIZE	OVERALL LENGTH	MAX O.D.	WRK. PSIG	TEMP	MAX TEST	LATERAL OFFSET
	1.25"		4.625"	450	70° F	675	
	1.5"		5.5"	410	70° F	615	
	2"		6"	450	70° F	675	
	2.5"		7"	570	70° F	855	
	3"		7.5"	450	70° F	675	
	4"		9"	285	70° F	428	
	5"	10"	10"	210	70° F	315	0
	6"		11"	240	70° F	360	
	8"		13.5"	217	70° F	326	
	10"		16"	165	70° F	248	
	12"		19"	155	70° F	233	
	14"		21"	125	70° F	188	
	16"		23.5"	110	70° F	165	

TEMPERATURE DERATING FACTORS: MULTIPLY X WRK. PSIG

200° F	250° F	300° F	350° F	400° F	500° F	600° F	700° F
0.94	0.92	0.88	0.86	0.83	0.78	0.74	0.7

Notes: Too Short To Warranty

DISTRIBUTED BY:

ENGINEER _____



Braided Corrugated Stainless Steel Hose Assembly

General Installation Instructions

1. Handle the braided assembly in such a manner as to protect the braided outer covering from external damage. The braid covering is the PRESSURE controlling component of the assembly. The integrity of the braided wire sheath must be kept intact during handling and installation.
 - a. Do Not drag the braided hose assembly where damage to the braid could occur.
 - b. Do Not lay the braided section down on sharp objects which could puncture or otherwise damage the braided wire.
 - c. Do Not lay the braided section down in a wet area which may contain chemicals which could corrode the braid. Chlorine and hydrochloric acid are extremely corrosive to stainless steels and should be avoided.
2. Install the Hose Assembly using the proper tools for the job. Only wrench on the proper fitting area of the assembly.
 - a. Do Not wrench on the braided region of the hose or the braid collar. The braid will be damaged and the assembly will lose its pressure capacity.
 - b. Do Not apply torsion to the hose. Use wrenches on the male and female fittings only. Support the hose to protect it during installation from torsion or an excessive bend radius created from its own weight.
 - c. Do Not stand on the hose assembly at any time.
3. Install the hose in accordance with the manufacturers' stated bend radius.
 - a. Do Not create sharp bends. If a bend restrictor is needed, one can be installed at the factory.
 - b. Do Not install the hose if the bend is not as close to the center as possible
 - c. Do Not install the hose if a 2" minimum straight hose length is not present at each end fitting.
 - d. Do Not over-bend the hose assembly- if the installation requires a greater than 90 degree bend, consult the manufacturer at the toll-free number provided below.
 - e. Do Not pre-bend the hose. It is not necessary to "limber up the hose" -its degree of flexibility is preset from the factory.
4. Install the hose using the length of the assembly as designed for the application.
 - a. Do Not attempt to stretch the hose
 - b. Do Not restrict the movement of the hose by allowing it to come into contact with the floor, other components, or equipment during installation or service.
 - c. Do Not weld or attach objects to the hose at any time unless the hose assembly was designed with "weld ends".
5. Ensure piping is properly guided and anchored to prevent torsion or applied motion not perpendicular to hose centerline.
 - a. For example, at each change of direction, an anchor must be used on each leg of the piping system.
6. After installation- check for leaks and free movement
 - a. Do Not exceed the pressure limitations of the hose assembly.
 - b. Do Not allow external liquid to drip on the hose.
 - c. Do Not allow objects to interfere with hose movement.

Phone: 800-670-9475 ~ Fax: 763-428-5111 ~ www.twincityhose.com



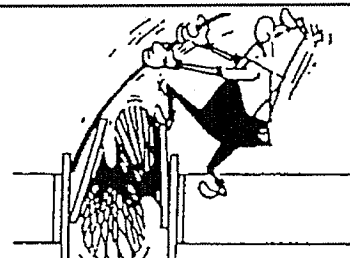
TWIN CITY HOSE INC.

Install Hints for Metal Hose

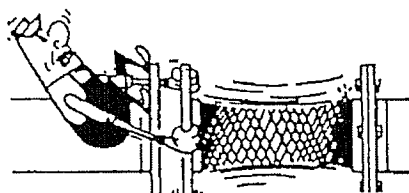
A flexible metal pipe connector (or flexible metal hose) is a relatively expensive part of your piping system. Fabricated of thin-wall tubing, it cannot take as much abuse as pipe of the same nominal diameter. The connectors are designed to do a specific job, and will give you excellent service if they are installed properly. Carelessness and lack of foresight have proven costly in many jobs. **Install it correctly, if you want it to work correctly.**

Don't COMPRESS a flexible connector to make it fit! Installing it under compression stresses corrugated element, slackens braid pressure-restrainer, reduces further compressive movement, and generally results in early failure.

DO be sure to install it at exact normal free length as supplied. If connector is too long, shorten piping.

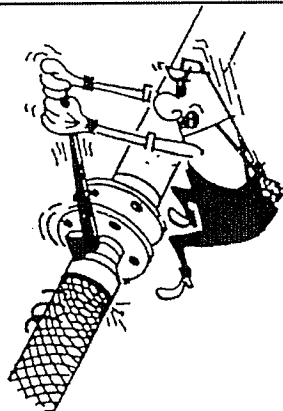


Don't STRETCH connector to fit a gap longer than its factory-furnished length. Stretching places excessive residual stresses on braid and fittings. Result? Early rupture.

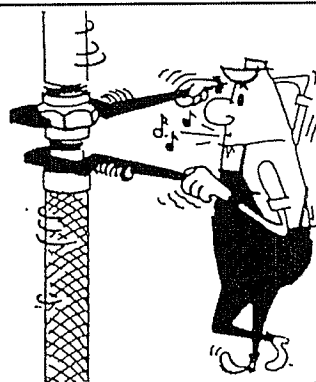


DO measure carefully to be sure connecting pipe is cut to exact length.

Don't FORCE-ROTATE one end of connector to match bolt holes in mating flange. This sets up residual torque-stress in connector, which causes cracking of corrugations or fitting joint. A flexible connector absorbs vibration, or slow movement perpendicular to its axis. It is **NOT** capable of withstanding torque.



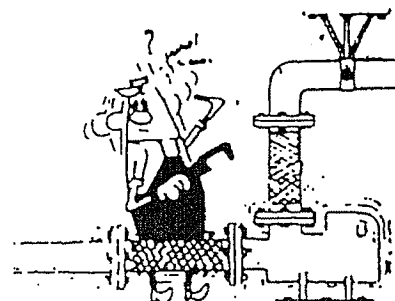
DO be sure all bolt holes are perfectly lined up before welding pipe flange into place. Best insurance is use of one floating flange, to ease matching of bolt holes.



Don't IMPOSE TORQUE on connector when making up fittings and don't use a wrench on the ferrule or on the braid. Where a hex end is provided, use it. If not, use the wrench on the fitting length provided. Always use two wrenches, to keep the hose from being torqued as the joint is made up.

Don't let welding sparks hit the braid; they may burn some of the braid stands. Protect braid with asbestos cloth or place other non-flammable material in front of it when piping must be welded very close nearby.

Don't DON'T FAIL TO ANCHOR. Anchor piping close to flexible connector, at end opposite source of vibration. If not, hose will transmit all vibration to pipe line, it may even amplify it. Anchor flexible metal hose at the piping end, never at the equipment end. If hose is not securely anchored, it will transmit all vibration to the piping system. Not only that, it will often act like a spring and actually amplify the vibrations. Whenever possible, install flexible connector to pump, compressor, or other vibrating equipment- before valves, pipe line, fittings so that most vibration is absorbed and isolated instead of being transmitted.

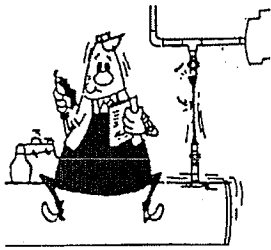
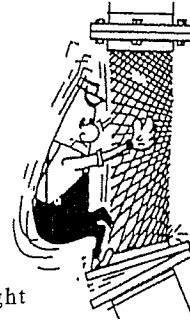




TWIN CITY HOSE INC.

Install Hints for Metal Hose

Don't BEND HOSE sharply near fittings. Fitting end or flange face must always remain perfectly perpendicular to axis of hose. If piping meets at an angle, install hose with a shallow curve along its entire length, leaving small straight section at each end. This kind of installation generally requires a longer hose. Consult Twin City Hose.

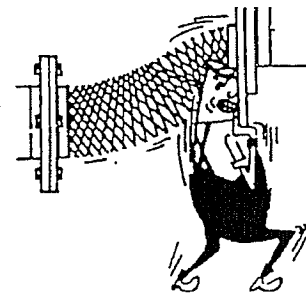


Don't LET HOSE support any weight except its own. Its light wall was designed to contain internal pressure, but not to carry external loads. Extra weight will stress and stretch it.

DO use hangers on all adjacent piping. Install hangers before installing hose, to be certain weight of pipe is on hangers.

Don't FORCE HOSE into too much lateral offset. This puts it under great strain. Also, it cannot then handle any movement of any kind. Avoid excessive force.

DO check with TCH literature and do not exceed maximum permissible offset. For large offsets, we can furnish factory pre-bent units.



Installation Checklist

You will get best results with flexible pipe connectors if you answer these questions before ordering:

1. Pipe size and material of pipeline and equipment?
2. Specify liquid or gas conveyed?
3. Working pressure (if known). Minimum? Normal working? Maximum? Static? Pulsating? Shock?
4. What kind of valve in the line closest to the connector? (Permits hose manufacture to determine if there may be sudden closing or openings which may cause water hammer or shock waves.)
5. Temperature (if known)? Minimum? Working? Maximum? Ambient?
Will maximum pressure and temperature occur at same time?
6. Any special space limitations?
7. How much vibration anticipated? Amplitude, cycles, frequency?
8. Will equipment be mounted on vibration-isolating mounts?
9. How much pipeline thermal growth? (If known, furnish a rough piping schematic, plus temperature fluctuations.)
10. Which types of end fittings are preferred?



INNOVATIONS FOR LIVING™

FIBERGLAS™ Pipe Insulation

Product Data Sheet



- ☐ Evolution™ - Paper-Free ASJ
- ☒ SSL II® - ASJ
- ☐ SSL I® - ASJ
- ☐ No-Wrap

Description

Owens Corning FIBERGLAS™ Pipe Insulations are molded of heavy density resin bonded inorganic glass fibers. The one-piece, 36" (914mm) long, hinged sections are opened, placed over the pipe, closed and secured by means specific to the type as described below.

FIBERGLAS™ Pipe Insulation with Evolution™ Paper-Free ASJ is jacketed with durable, paper free all-service vapor retarder jacket. The SSL II® double adhesive closure provides positive mechanical and vapor sealing of the longitudinal jacket seam. All Evolution™ sizes come with the SSL II® closure system.

FIBERGLAS SSL II® Pipe Insulation is jacketed with a smooth, reinforced, wrinkle resistant all-service vapor retarder jacket (ASJ). This product has the same SSL II®

closure system as Evolution™ and is available in the most popular pipe sizes. For the larger ASJ sizes, FIBERGLAS™ Pipe Insulation is furnished with a SSL I® single adhesive lap seal.

Both systems include pressure sensitive butt strip seals that complete the positive closure system.

FIBERGLAS™ Pipe Insulation is also available without a jacket. "No Wrap" pipe insulation intended for field installation with jacketing appropriate to the vapor control, damage or corrosion resistance requirements of the application.

Uses

Insulation of hot, cold, concealed and exposed piping operating at temperatures from 0°F (-18°C) to 850°F (454°C) in commercial buildings, industrial facilities and process or power plants.

Product Attributes

Evolution™ Jacket

The jacket is over 3X tougher* than standard ASJ. The paper free all service jacket does not support mold growth** and is designed to have compatible finished job appearance with standard ASJ.

SSL II® Positive Closure System

The double adhesive lap seal and two-part butt strip seal provide effective long term vapor sealing of the longitudinal and butt joints. Positive closure is fast, neat and foolproof. There is no need for staples which promotes job site productivity.

Jacket and Lap Shipped Adhered

Short pieces of insulation can be cut without jacket loss and the section will not come apart in handling. There are no "dog-ears" in or out of the carton. Dust and moisture cannot reach the lap seal. Butt strips come in sealed bags inside the carton so they can stay clean until the moment of use.

Excellent Thermal Performance

FIBERGLAS™ Pipe Insulation's low thermal conductivity contributes to lower operating costs of heating and cooling equipment.

Meets Model Code Fire Ratings

The flame spread rating of 25 or less and smoke developed rating of 50 or less usually means that FIBERGLAS™ Pipe Insulation will be granted immediate building code approval.

Application Recommendations

The hinged sections of FIBERGLAS™ Pipe Insulation are opened, placed over the pipe, carefully aligned, and sealed or jacketed as required by the form of the insulation and the application.

All jacketed SSL II® Pipe Insulation is shipped with the jacket and longitudinal lap closed, the two adhesives separated by a release strip. The insulation is opened by pulling the release strip from between the two adhesive strips. The insulation is placed on the pipe, carefully aligned, and the two adhesives rubbed firmly together to close and seal. The two part butt strip seal completes

*Based on puncture resistance, burst strength and tensile strength testing.

** Evolution™ Jacket does not support mold growth when tested in accordance with ASTM C1338.



INNOVATIONS FOR LIVING™

FIBERGLAS™ Pipe Insulation

Product Data Sheet

the positive closure. Application may be at ambient temperatures from 25°F (-4°C) to 110°F (43°C).

FIBERGLAS™ “No-Wrap” Pipe Insulation is designed for field-jacketing. The pipe covering is secured by wires or bands, and vapor sealed where required.

Outdoor applications must be protected from weather. If painting is required, use only water based latex paint.

Specification Compliance

- ASTM C 547, Mineral Fiber Pipe Insulation, Type I to 850°F (454°C)
- ASTM C 1136, Flexible Low Permeance Vapor Retarders for Thermal Insulation: Types I-IV
- ASTM C 795, Thermal Insulation for Use in Contact with Austenitic Stainless Steel¹
- MIL-I-22344D, Insulation, Pipe, Thermal, Fibrous Glass
- Nuclear Regulatory Commission Guide 1.36, Non-Metallic Thermal Insulation¹
- U.S. Coast Guard Approval No. 164.009, Noncombustible Materials (no-wrap)
- CAN/CGSB-51.9 – Type I, Class 2²
- New York City MEA No. 344-83³
- NFPA 90A

Notes

1. Preproduction qualification testing complete and on file. Chemical analysis of each production lot required for total conformance.

2. Standard Obsolete, replaced by ASTM C 547.

3. Standard ASJ only - Contact your customer service representative for status on Evolution™

Availability

FIBERGLAS™ Pipe Insulations are available in thicknesses and for pipe sizes as follows¹:

Insulation Thickness		Nominal Pipe Size	
in.	(mm)	in.	(mm)
½	(13)	½ - 2 ½	(15 - 65)
1	(25)	½ - 33	(15 - 825)
1 ½	(38)	½ - 33	(15 - 825)
2	(51)	½ - 33	(15 - 825)
2 ½	(64)	½ - 32	(15 - 800)
3	(76)	½ - 31	(15 - 775)
3 ½	(89)	½ - 30	(15 - 750)
4	(102)	½ - 29	(15 - 725)
4 ½	(114)	½ - 28	(15 - 700)
5	(127)	½ - 27	(15 - 675)
5 ½	(140)	6 - 26	(150 - 650)
6	(152)	6 - 25	(150 - 625)

¹Please refer to product packaging and data guide for load factors, standard products, minimum order quantity and carton sizes. Contact your customer service representative for product leadtime.

Physical Property Data

Property	Test Method	Value
Density (size dependent)	ASTM C302	3.5 to 5.5 pcf
Operating Temperature Range ¹	ASTM C 411	0°F to 850°F (-18°C to 454°C)
Jacket Temperature Limitation	ASTM C 1136	-20°F to 150°F (-29°C to 66°C)
Jacket Permeance	ASTM E 96, Proc.A	0.02 perm
Burst Strength, min	ASTM D 774/D 774M	55 psi
Composite Surface Burning Characteristics ²	UL 723, ASTM E 84 or CAN/ULC-S102-M	Flame spread 25 Smoke Developed 50

¹Limited to single layer applications above 650°F (343°C), but not greater than 6" (152mm) thickness.

²The surface burning characteristics of these products have been determined in accordance with UL 723, ASTM E 84 or CAN/ULC-S102-M. These standards should be used to measure and describe the properties of materials, products or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use. Values are reported to the nearest 5 rating.

Thermal Conductivity

Mean Temperature °F	k Btu•in/hr•ft ² •°F	Mean Temperature °C	λ W/m•°C
50	0.22	10	0.032
75	0.23	25	0.034
100	0.24	50	0.037
150	0.27	100	0.043
200	0.29	125	0.047
250	0.32	150	0.051
300	0.35	175	0.056
350	0.39	200	0.062
400	0.43	225	0.068
450	0.48	250	0.075
500	0.54	275	0.082

Apparent thermal conductivity values determined in accordance with ASTM practice C 1045 with data obtained by ASTM Test Method C 335. Values are nominal, subject to normal testing and manufacturing tolerances.



INNOVATIONS FOR LIVING™

FIBERGLAS™ Pipe Insulation

Product Data Sheet

Personnel Protection Table

Thickness Required for Surface Temperatures ≤ 140 °F, inches (mm)^{1,2}

Nominal Pipe Size		System Operating Temperatures °F (°C)									
in.	(mm)	200 °F (93 °C)	300 °F (149 °C)	400 °F (204 °C)	500 °F (260 °C)	600 °F (316 °C)	800 °F (427 °C)				
0.5	(15)	0.5 (15)	0.5 (15)	0.5 (15)	1.0 (25)	1.0 (25)	1.5 (38)				
0.75	(20)	0.5 (15)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	2.0 (51)				
1	(25)	0.5 (15)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	2.0 (51)				
1.25	(32)	0.5 (15)	0.5 (15)	1.0 (25)	1.0 (25)	1.5 (38)	2.0 (51)				
1.5	(40)	0.5 (15)	0.5 (15)	1.0 (25)	1.0 (25)	1.5 (38)	2.0 (51)				
2	(50)	0.5 (15)	0.5 (15)	1.0 (25)	1.0 (25)	1.5 (38)	2.0 (51)				
2.5	(65)	0.5 (15)	0.5 (15)	1.0 (25)	1.0 (25)	1.5 (38)	2.0 (51)				
3	(80)	0.5 (15)	0.5 (15)	1.0 (25)	1.0 (25)	1.5 (38)	2.5 (64)				
4	(100)	0.5 (15)	0.5 (15)	1.0 (25)	1.0 (25)	1.5 (38)	2.5 (64)				
5	(125)	0.5 (15)	0.5 (15)	1.0 (25)	1.0 (25)	1.5 (38)	2.5 (64)				
6	(150)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	1.5 (38)	2.5 (64)				
7	(175)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	1.5 (38)	2.5 (64)				
8	(200)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	1.5 (38)	2.5 (64)				
9	(225)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	1.5 (38)	2.5 (64)				
10	(250)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	1.5 (38)	2.5 (64)				
12	(300)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	1.5 (38)	3.0 (76)				
14	(350)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	2.0 (51)	3.0 (76)				
16	(400)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	2.0 (51)	3.0 (76)				
18	(450)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	2.0 (51)	3.0 (76)				
20	(500)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	2.0 (51)	3.0 (76)				
24	(600)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	2.0 (51)	3.0 (76)				
30	(750)	0.5 (15)	0.5 (15)	1.0 (25)	1.5 (38)	2.0 (51)	3.0 (76)				

¹Calculations estimated using NAIMA 3E Plus Version 4.0 Software. Fixed Design Conditions: Steel horizontal piping, 80°F (27°C) average ambient temperature, 0 mph wind speed and outer surface jacket emittance of 0.9. For alternate design conditions, contact your Owens Corning representative.

²Thermal conductivity values used in these calculations are subject to normal manufacturing tolerances.

Thickness to Prevent Surface Condensation

Owens Corning ASJ Jacket for up to 16" NPS (400mm DN), in. (mm)^{1,2}

Ambient Temperature °F (°C)	Relative Humidity	System Operating Temperatures		
		35°F (2°C)	45°F (7°C)	55°F (13°C)
110 (43)	70%	1 (25)	1 (25)	1 (25)
	80%	1½ (38)	1½ (38)	1½ (38)
	90%	3½ (89)	3½ (89)	3 (76)
100 (38)	70%	1 (25)	1 (25)	1 (25)
	80%	1½ (38)	1½ (38)	1 (25)
	90%	3½ (89)	3 (76)	2½ (64)
90 (32)	70%	1 (25)	1 (25)	1 (25)
	80%	1½ (38)	1 (25)	1 (25)
	90%	3½ (89)	3 (76)	2½ (64)
80 (27)	80%	1½ (38)	1 (25)	1 (25)
	90%	3 (76)	2½ (64)	2 (51)
70 (21)	80%	1 (25)	1 (25)	1 (25)
	90%	2½ (64)	2 (51)	1 (25)

¹Calculations estimated using NAIMA 3E Plus version 4.0 software. Fixed design conditions: Steel Horizontal Piping, 16" NPS, 0mph wind speed, Outer Surface Jacket Emittance of 0.9.

²Thermal conductivity values used in these calculations are subject to normal manufacturing tolerances.



INNOVATIONS FOR LIVING™

FIBERGLAS™ Pipe Insulation

Product Data Sheet



Evolution™ Paper-Free ASJ and
No-Wrap pipe insulation are not yet
GREENGUARD Certified.

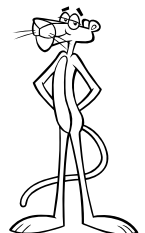


INNOVATIONS FOR LIVING™

OWENS CORNING INSULATING SYSTEMS, LLC
ONE OWENS CORNING PARKWAY
TOLEDO, OHIO 43659
1-800-GET-PINK™

www.owenscorning.com

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DESCRIPTION

ITW Pabco/Childers Aluminum Roll Jacketing is manufactured from alloys 3105 and 3003, conforming to ASTM B-209 designation, half-hard temper (H-14) and heavier gauges quarter-hard (H-12 lock-forming quality).

Commercially pure aluminum is relatively soft as structural material. Its strength can be greatly improved by alloying aluminum with small percentages of one or more other elements such as manganese, silicon, copper, magnesium or zinc. Additional strength can be achieved by cold working, such as cold rolling.

Standard alloys and nominal chemical composition

<u>Alloy</u>	<u>Copper</u>	<u>Manganese</u>	<u>Magnesium</u>
3105		.6	.50
3003	.12	1.2	~

ITW reserves the right to ship whichever alloy is in stock at time of order placement, unless advised a specific alloy is requested (may affect lead-time and/or price). Other alloys are special order and minimum quantities and extended lead-time required.

ITW's aluminum roll jacketing is available in smooth, stucco embossed or 3/16 corrugations (cross-crimped) finishes.

POLYSURLYN MOISTURE RETARDER

Polysurlyn consists of a 3 mil thickness of a co-extrusion of polyethylene and DuPont's Surlyn® which is heat laminated to the metal jacketing. Due to its superior performance characteristics, it replaces the old standard 1 mil and 3 mil polykraft moisture retarders. **For cold rooftop and hot work cyclical applications, refer to Technical Information for recommendations.**

THICKNESS & Suggested Applications

.016" (.4mm) & .020" (.5mm)	The standard for industrial use. Recommended over insulated lines up to 36" O.D. including insulation.
.024" (.6mm)	A heavier weight jacketing used on larger diameter lines and large equipment up to 8 feet in diameter.
.032" (.8mm)	Used in special applications where extra thickness and protection is required, such as fabricated tank head covers and other special fabrications.
.040" (1.0mm) & .050" (1.2mm)	Available in rolls, where extra heavy gauges are required because of severe mechanical abuse or special fabricating requirements, such as flat ducts or precipitators. Also recommended for areas subject to high wind conditions.

RECOMMENDED USES

Jacketing is recommended for insulated piping, tanks and vessels less than 8 feet in diameter. Deep corrugated sheets are recommended for diameters greater than 8 feet.

SURFACE BURNING CHARACTERISTICS ASTM E 84

FLAME SPREAD INDEX 0
SMOKE DEVELOPED INDEX 5
Tested with exterior surface facing the flame.

Sulfur Vessel Pressure Testing Notes (sent by e-mail 11/5/12)

There is no standard procedure for pressure testing. The vessel will have an MAWP of 3psig, so you could pressurize it up to that value. Really there should be no pressure loss (keep in mind that changes in ambient temperature will affect pressure and there is no relief valve on the vessel). I would only take it up to 2psig to be safe. If the tank sat for 2 hours without losing pressure you would be good. As stated before, the installation guide is generic. The portion of the installation guide that talks about water testing appears to be for an atmospheric tank that has not been pressure tested. This particular vessel will be designed following RTP-1 and will be hydro tested at the factory. We do not feel that water testing is necessary. If the tank is rated for 3psig then there should be no warranty issues pressurizing it up to 3psig.

You can contact Dan Look at ECC if you have any additional questions dan.look@ecccorrosion.com

Email from ECC "...Regarding the hydro test prior to commissioning, it is in the quote that we will be performing one at our facility, therefore you will not need to perform a hydro test at your job site."

Temperature Gauge Installation Notes

To be supplied loose by BioCNG (Unison Solutions). Connect into inlet pipe going into Sulfur Tank. Screwed directly into pipe, ½" NPT connection.

Vessel Media Notes

(sent by e-mail 10/31/12)

Sulfur Tank Media: will be delivered to the site in an estimated 10 supersacks weighing an estimated 2,000 lbs each. The supersacks will be provided with straps and should be placed above the top manway before releasing the contents within the sulfur vessel. Prior to the first media sack being opened, a foam pad, also provided by BioCNG, will need to be placed in the bottom of the vessel utilizing the side manway. After the first bag or two, resituate the foam pad as necessary. Following emptying of the last bag, level the media out with appropriate tools. No compaction or tamping of the media is necessary.

Activated Carbon Media: will be delivered to the site in estimated twenty 55 lb. bags. These should be placed in the BioCNG siloxane removal vessels, with access from the top of the enclosure. Each vessel should receive about 6 and 2/3 bags. The media shall simply be dumped in (no compaction necessary) and be placed no higher than a foot from the discharge nozzle within the vessel.

Note:

Media should be stored in dry, environmentally protected area until ready to install in vessels.

2 ANGI Design Information

2.1 Overall System & Site Drawings

COMPRESSOR DATA

WEIGHT: 14,000 LBS. (APPROXIMATE).

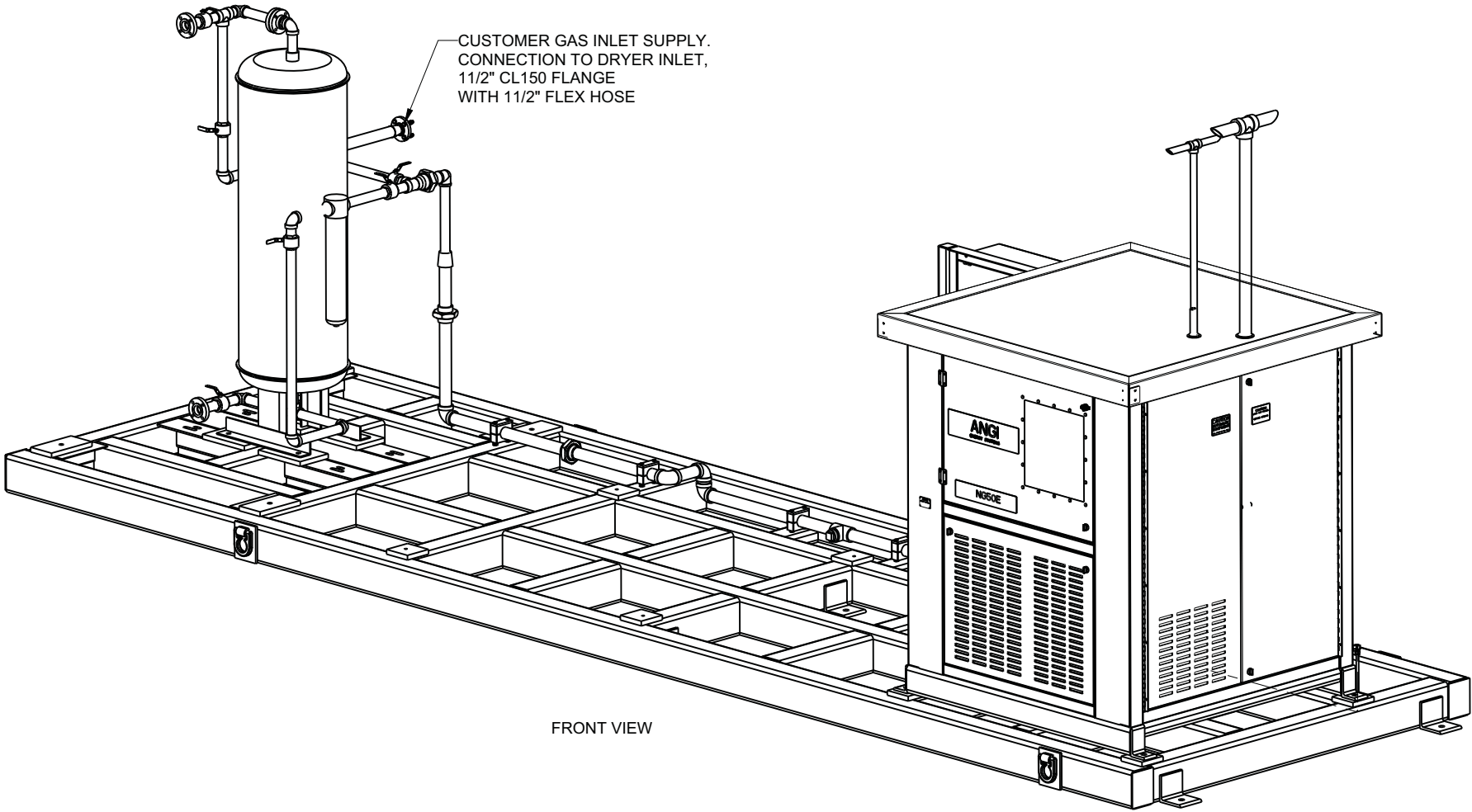
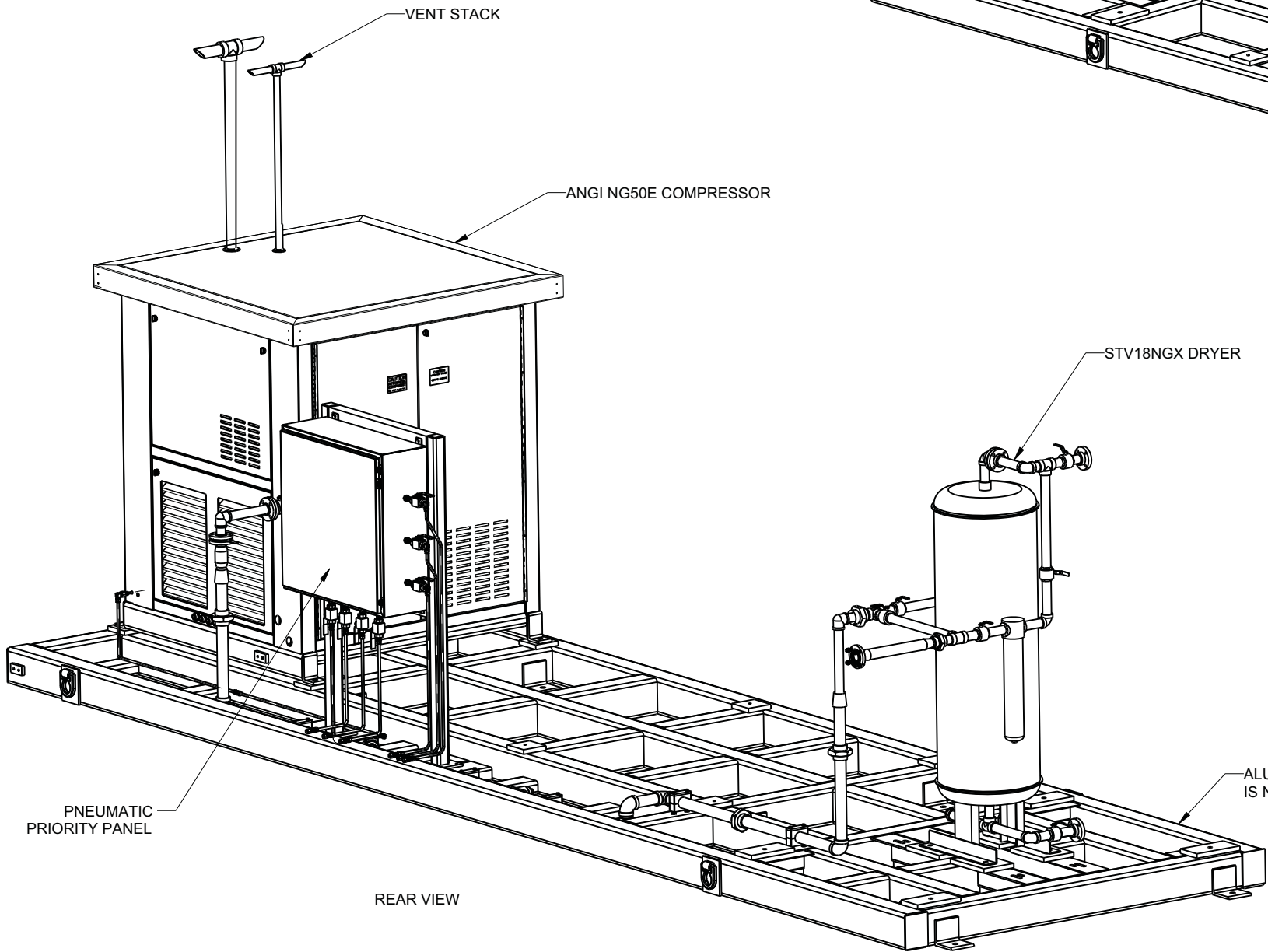
TYPE: ANGI NG50 RECIPROCATING COMPRESSOR.

CLEARANCE: ALLOW 36 INCHES MINIMUM ON ALL SIDES FOR ACCESS UNLESS OTHERWISE INDICATED.

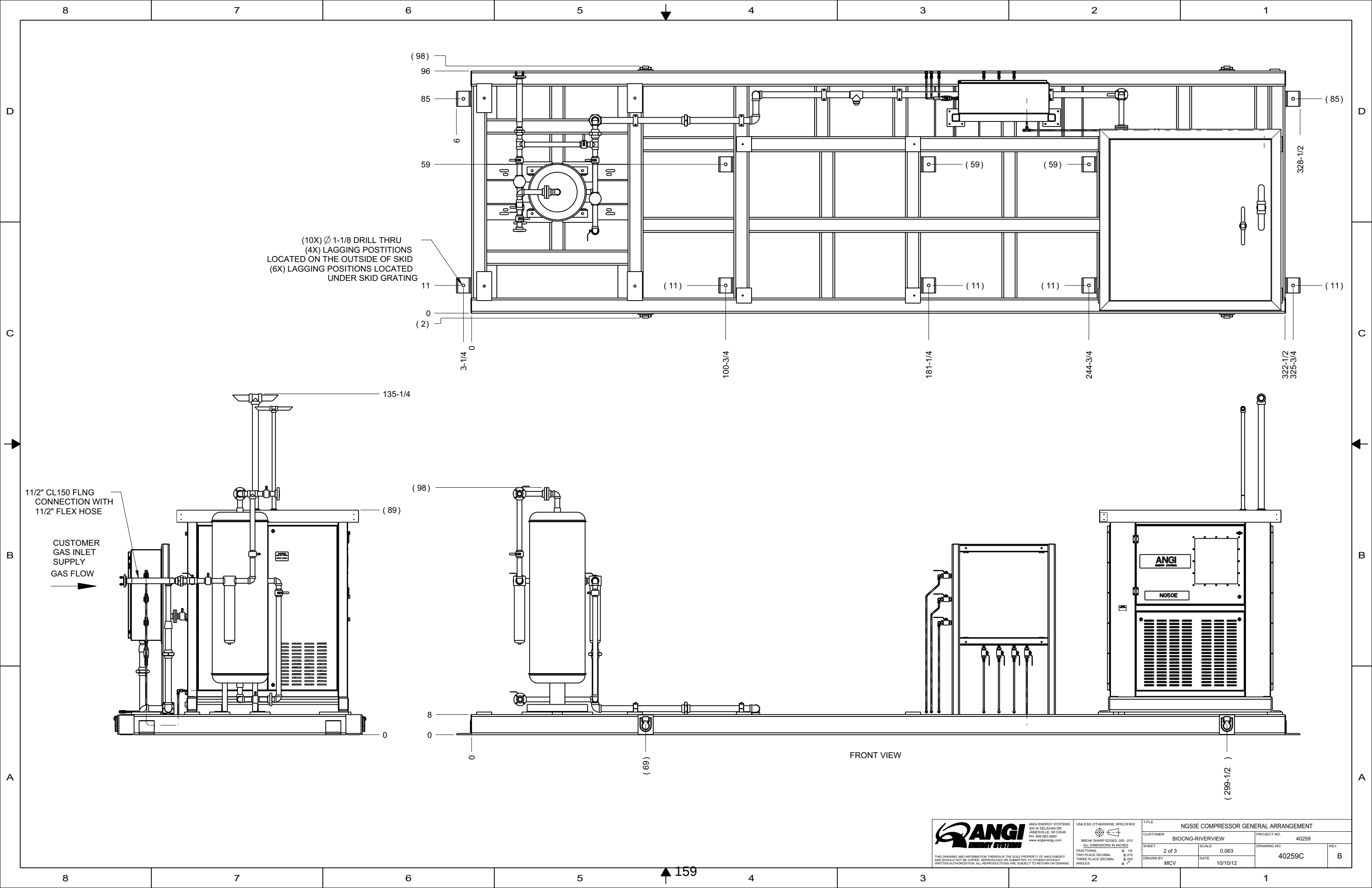
MOUNTING: REQUIRES (10) 1 INCH DIAMETER ANCHOR BOLTS (NOT PROVIDED), GROUTING THE COMPRESSOR TO THE CONCRETE PAD IS NOT RECOMMENDED.

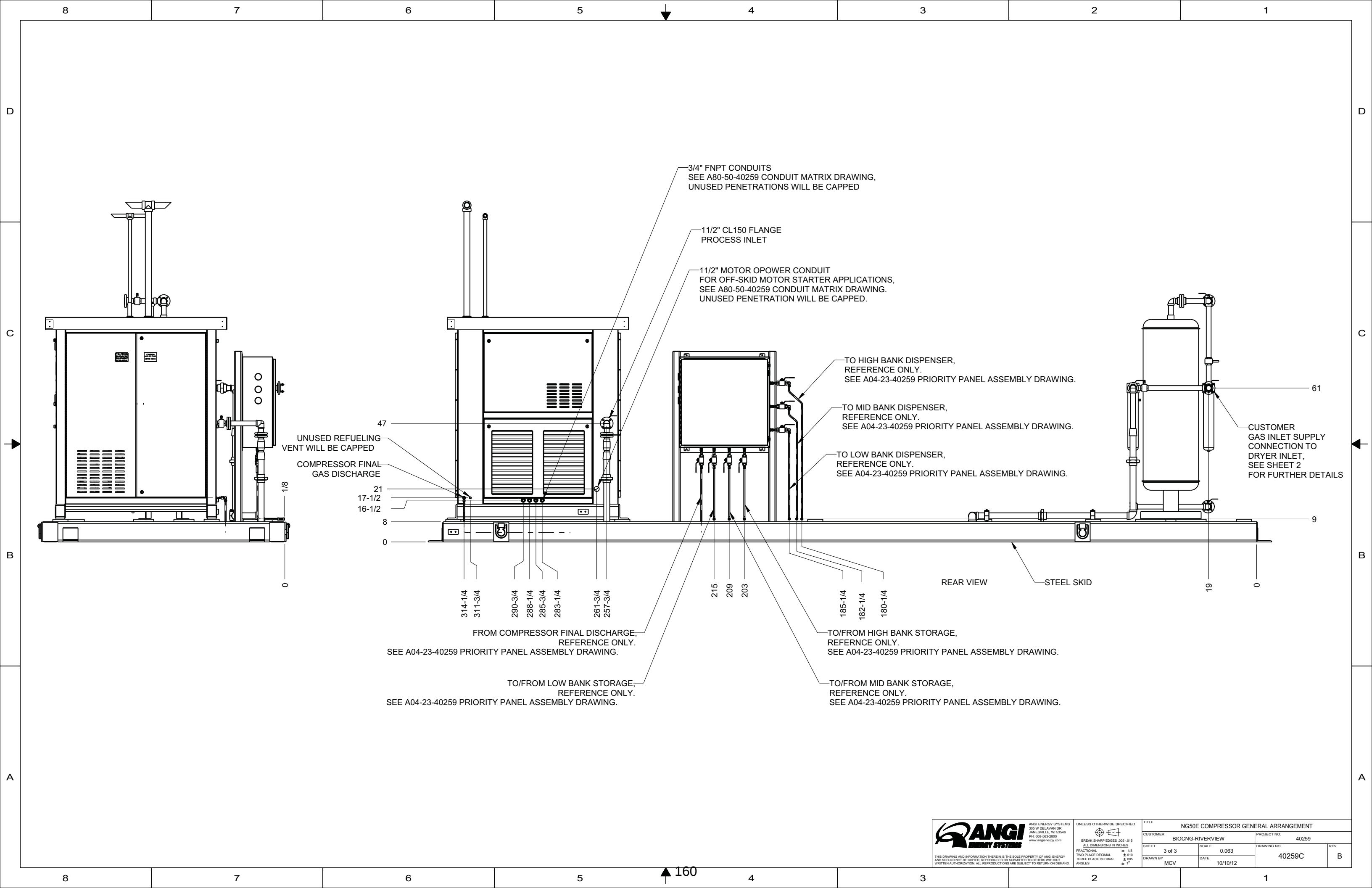
LIFTING: MINIMUM 13 FEET SPREADER BAR IS REQUIRED. UTILIZE FOUR (4) LIFT RINGS.

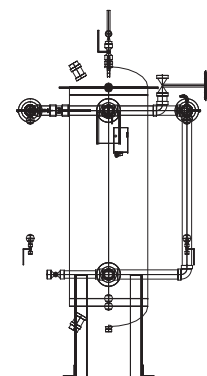
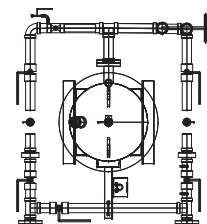
SHIPPING: 1 INCH AND 2 INCH VENT STACKS ARE REMOVED FOR SHIPPING.



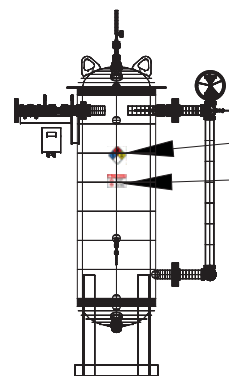
B	11/07/12	M.VOLZER	REMOVED REGULATOR & UPDATED VIEWS
A	10/12/12	M.VOLZER	EARLY SUBMITTAL.
REV	DATE	APPROVED	DESCRIPTION
TITLE			
NG50E COMPRESSOR GENERAL ARRANGEMENT			
CUSTOMER		PROJECT NO.	
BIOCNG-RIVERVIEW		40259	
SHEET		SCALE	
1 of 3		0.063	
DRAWN BY		DATE	
MCV		10/10/12	
DRAWING NO.			REV.
40259C			B







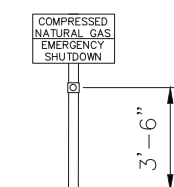
DRYER UNIT
TYPICAL



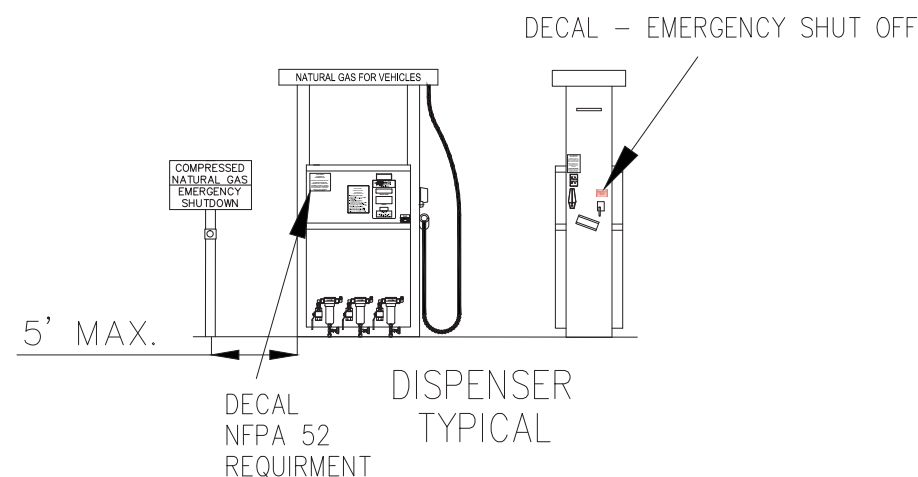
DECAL - HFPA SIGN
DECAL - FLAMMABLE MATERIAL



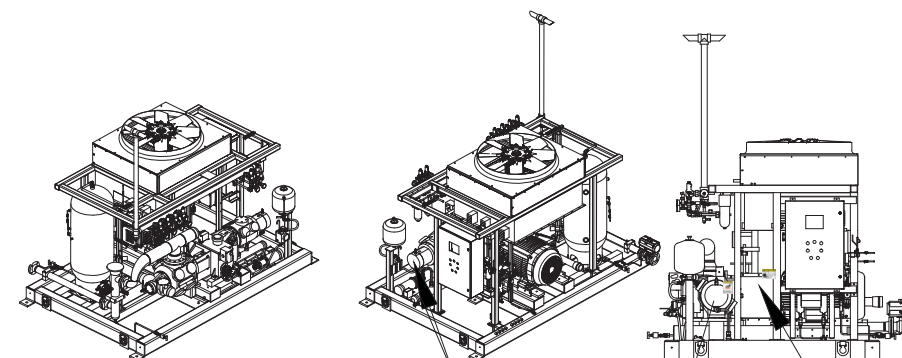
FIRE
EXTINGUISHERS
TYPICAL



EMERGENCY
SHUTDOWN
DEVICE
TYPICAL

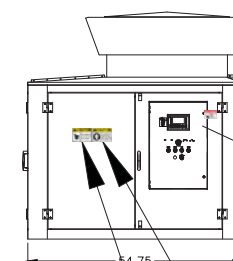
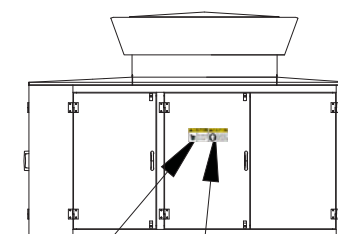
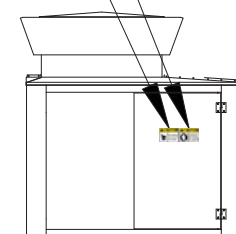


DISPENSER
TYPICAL



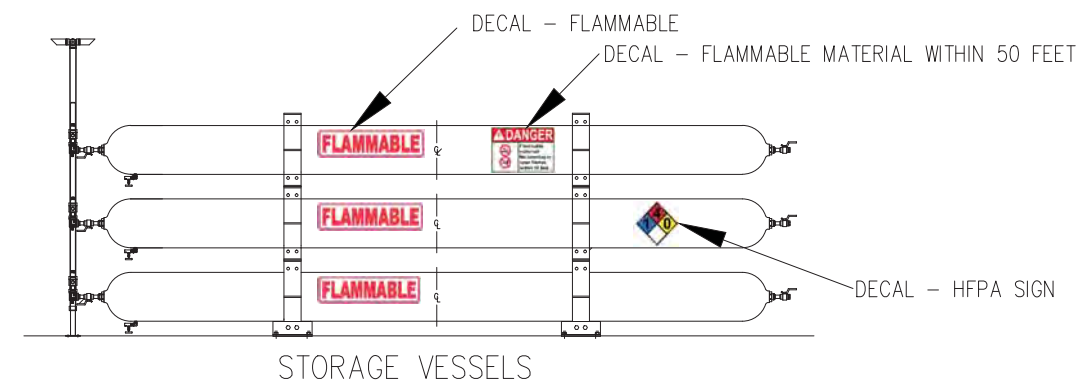
DECAL - CAUTION HOT
DECAL - CAUTION GUARD

COMPRESSOR UNIT



DECAL - EAR PROTECTION REQUIRED
DECAL - CAUTION AUTOMATIC
DECAL - ELECTRICAL HAZARD
DECAL - EAR PROTECTION REQUIRED
DECAL - CAUTION AUTOMATIC

TYPICAL COMPRESSOR SIGNAGE SUPPLIED BY ANGI



STORAGE VESSELS

REV	DATE/BY	DESCRIPTION	REV	DATE/BY	DESCRIPTION
*					



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ANGI ENERGY SYSTEMS
15 PLUMB STREET
MILTON, WI 53563
PH: 608-868-4626
FX: 608-868-2723

UNLESS OTHERWISE SPECIFIED
BREAK SHARP EDGES
ALL DIMENSIONS IN INCHES
FRACTIONAL ±.125
TWO PLACE DECIMAL ±.010
THREE PLACE DECIMAL ±.005
ANGLES ±1°

TITLE			
CUSTOMER		PROJECT NO.	
SHEET	SCALE	DRAWING NO.	REV.
DRAWN BY	DATE		—

2.2 Electrical

THIS DRAWING IS NOT TO BE USED TO
DETERMINE CONDUIT RUNS OR WIRE PULL
NEEDS!

PRELIMINARY RELEASE ONLY
DRAWING IS SUBJECT TO CHANGE



QTY	BHP	DISCRIPTION	FLA		FLA
1	50	MAIN MOTOR	65	X 1.25	81.25
1	5KVA	TRANSFORMER	10.4		10.4
				TOTAL	91.65

 **ANGI**
ENERGY SYSTEMS

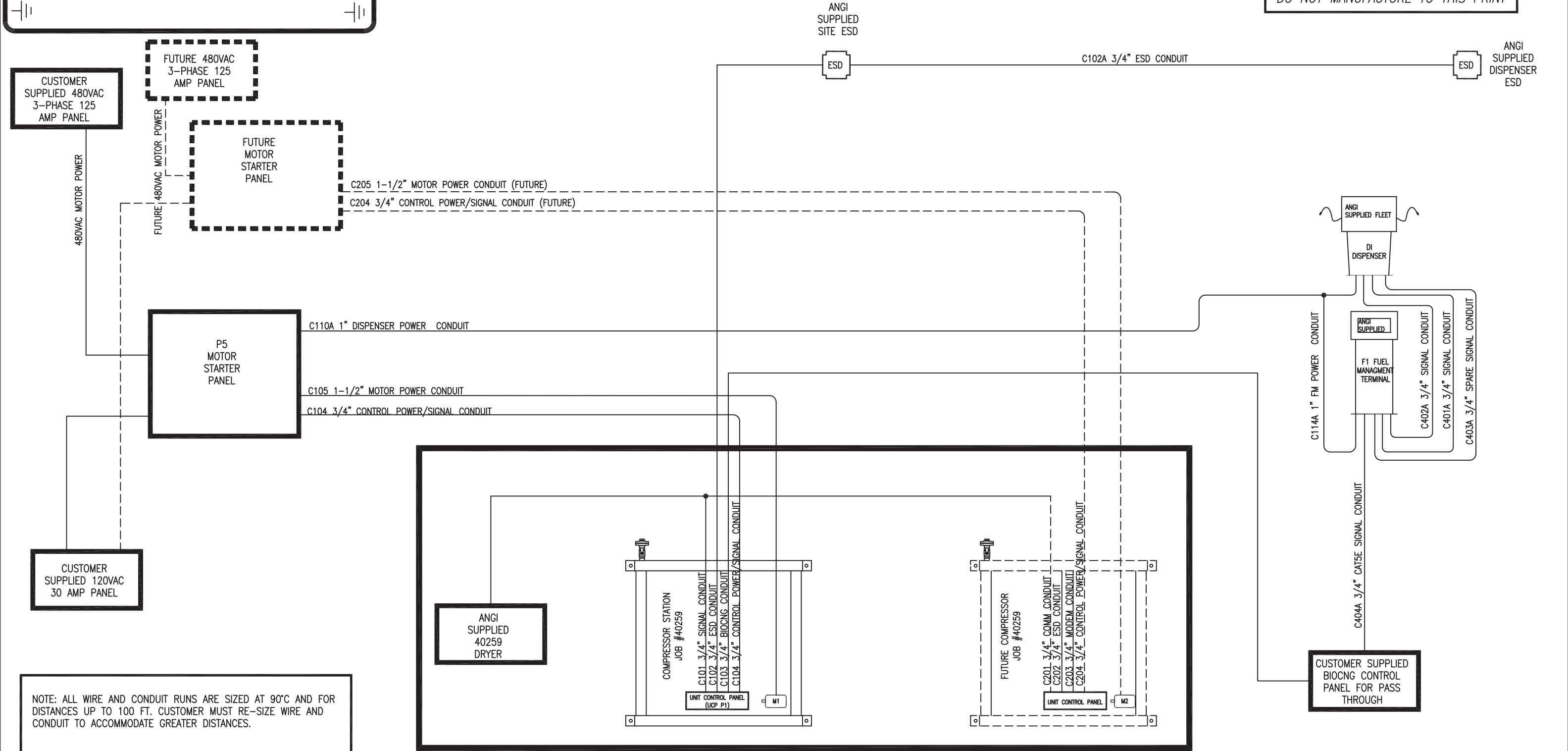
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TITLE		NG50-MC-050-2-FV-3 SINGLE 50HP SINGLE LINE	
CUSTOMER	BioCNG,LLC-CITY OF RIVERVIEW,MI	PROJECT NO.	40259
SHEET	1/1	SCALE	NA
DRAWN BY	MAP	DATE	10/10/12
		A80-70-40259	REV. B

NOTE: ALL ELECTRICAL CONNECTION MUST BE COMPLETED OR SUPERVISED BY QUALIFIED PERSONNEL, AND MEET ALL LOCAL AND APPLICABLE CODES. REFER TO NEC FOR MORE INFORMATION.

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NOTE: ALL WIRE AND CONDUIT RUNS ARE SIZED AT 90°C AND FOR DISTANCES UP TO 100 FT. CUSTOMER MUST RE-SIZE WIRE AND CONDUIT TO ACCOMMODATE GREATER DISTANCES.

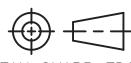
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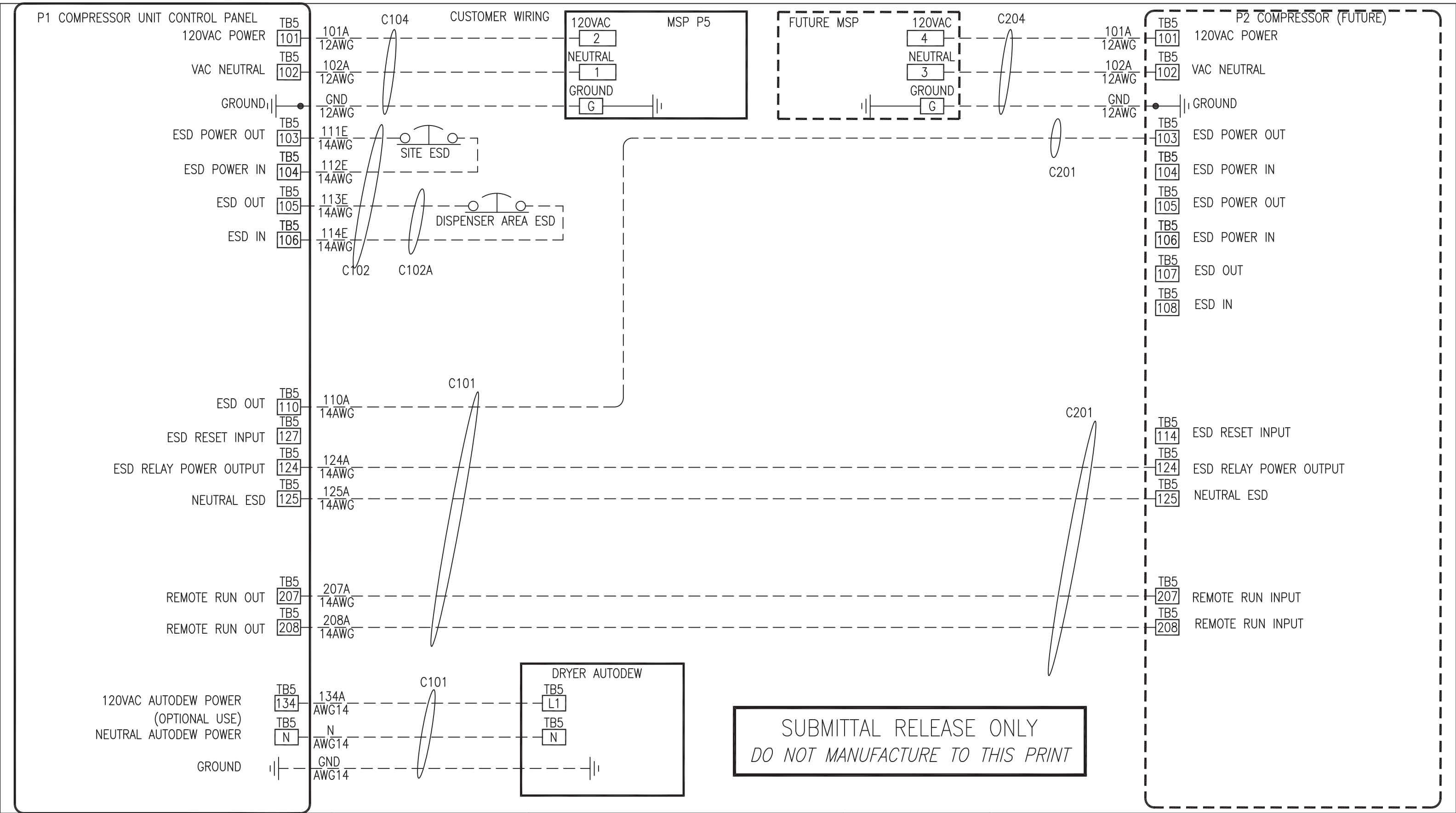
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 BREAK SHARP EDGES

ALL DIMENSIONS IN INCHES

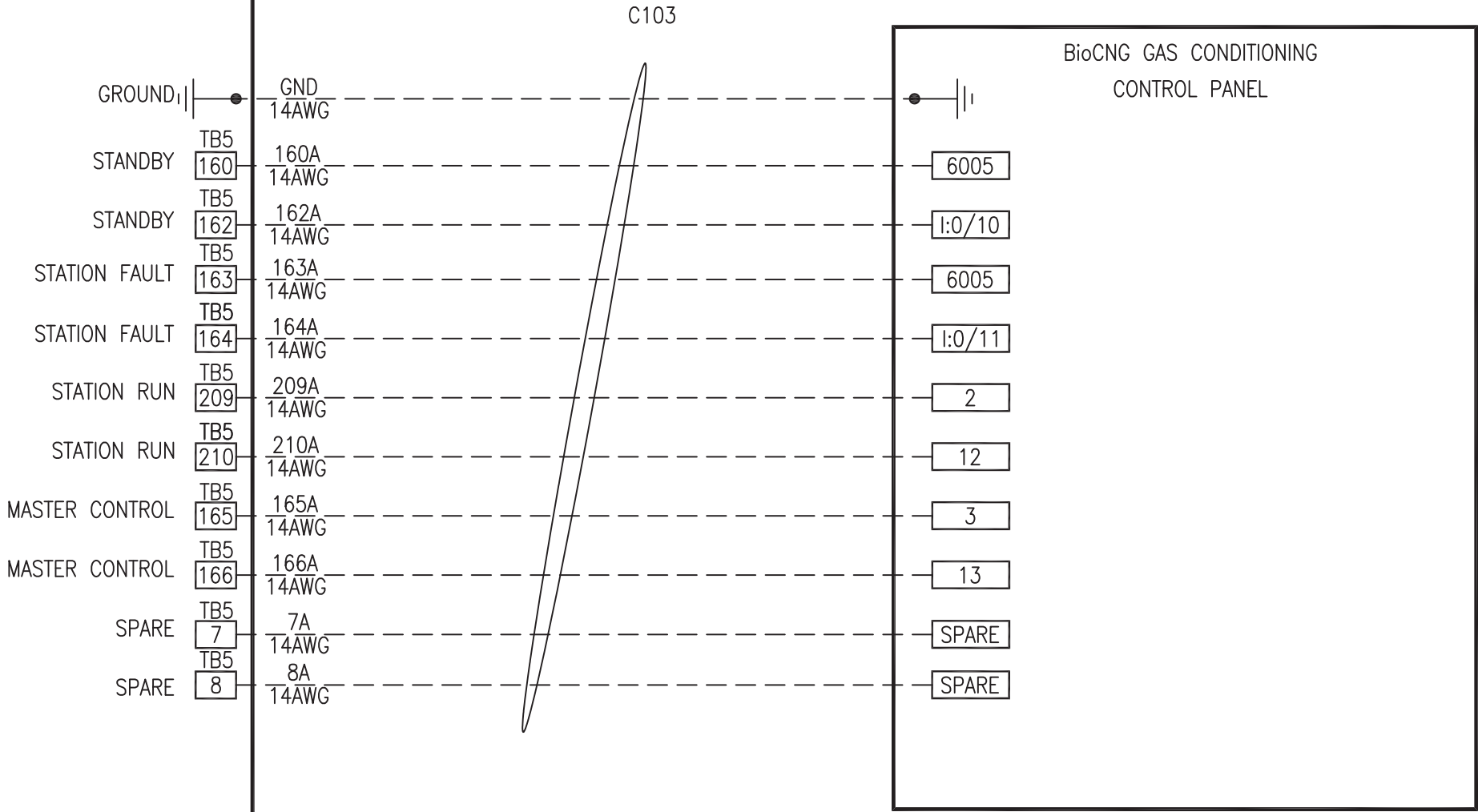
FRACTIONAL ±.125
TWO PLACE DECIMAL ±.010
THREE PLACE DECIMAL ±.005
ANGLES ±1°

TITLE		WIRING/CONDUIT MATRIX NG50E			
CUSTOMER		BioCNG,LLC-CITY OF RIVERVIEW,MI		PROJECT NO.	
SHEET		1/6		SCALE	
DRAWN BY		MAP		DATE	
				DRAWING NO.	
				REV.	
				A80-50-40259	
				A	



						 ANGI ENERGY SYSTEMS 15 PLUMB STREET MILTON, WI 53563 PH: 608-868-4626 FX: 608-868-2723 THIS DRAWING AND ALL INFORMATION THEREIN IS THE SOLE PROPERTY OF ANGI AND SHOULD NOT BE COPIED, REPRODUCED, OR SUBMITTED TO OTHERS WITHOUT WRITTEN AUTHORIZATION. ALL REPRODUCTIONS ARE SUBJECT TO RETURN ON DEMAND.	UNLESS OTHERWISE SPECIFIED		TITLE SINGLE LINE/CUSTOMER INTERCONNECT DETAILS NG50E				
									CUSTOMER BioCNG,LLC-CITY OF RIVERVIEW,MI		PROJECT NO. 40259		
							BREAK SHARP EDGES		SHEET 2/6		SCALE NA	DRAWING NO. A80-50-40259	REV. A
							ALL DIMENSIONS IN INCHES		FRACTIONAL ±.125				
*							TWO PLACE DECIMAL ±.010		THREE PLACE DECIMAL ±.005				
REV	DATE/BY	DESCRIPTION				REV	DATE/BY	DESCRIPTION					
								ANGLES ±1°		DRAWN BY MAP		DATE 10/10/12	

P1 COMPRESSOR UNIT CONTROL PANEL



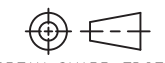
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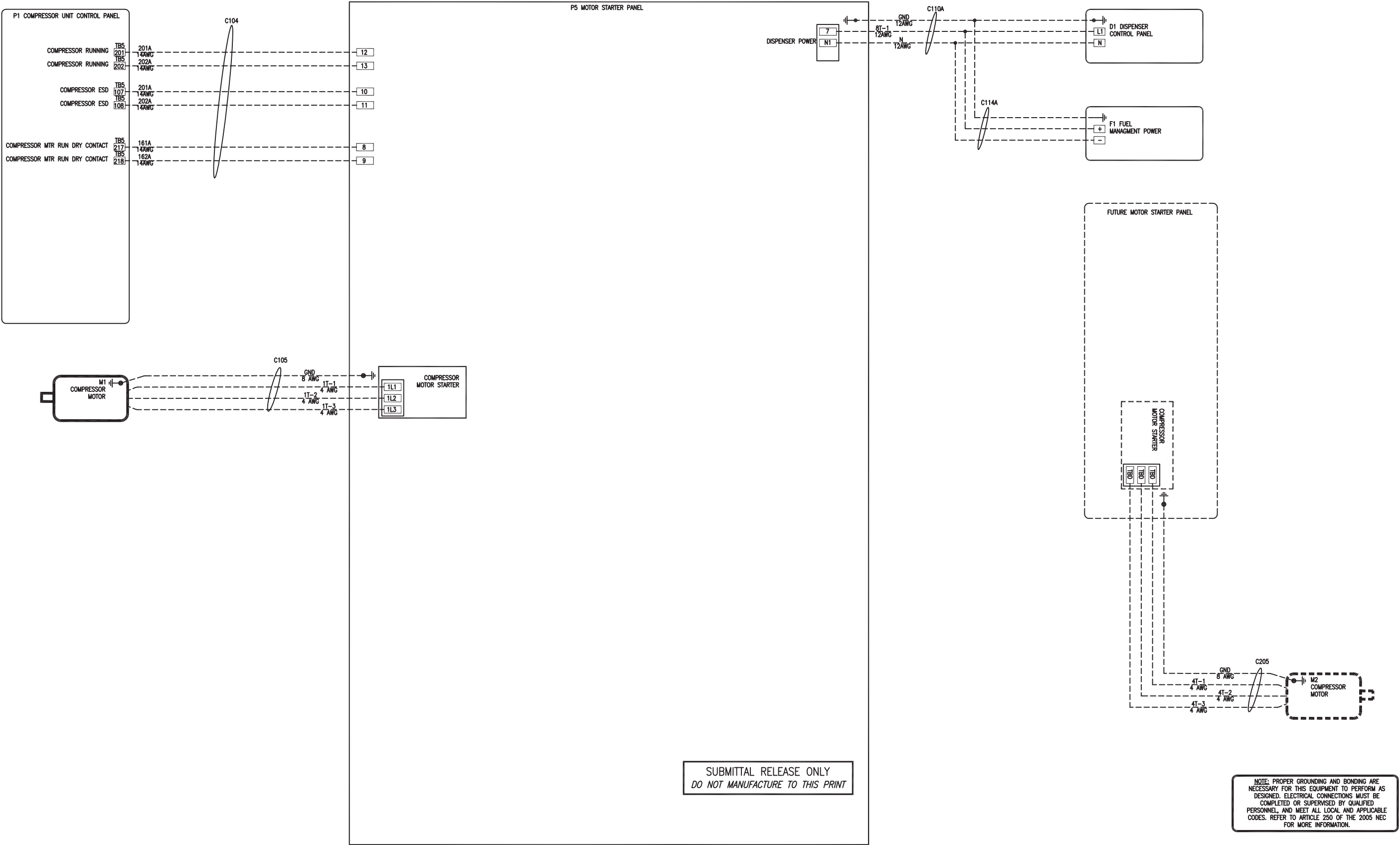


BREAK SHARP EDGES
ALL DIMENSIONS IN INCHES

FRACTIONAL	±.125
TWO PLACE DECIMAL	±.010
THREE PLACE DECIMAL	±.005
ANGLES	±1°

TITLE SINGLE LINE/CUSTOMER INTERCONNECT DETAILS NG50E			
CUSTOMER BioCNG,LLC-CITY OF RIVERVIEW,MI		PROJECT NO. 40259	
SHEET 3/6	SCALE NA	DRAWING NO. A80-50-40259	REV. A
DRAWN BY MAP	DATE 10/10/12		

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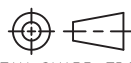
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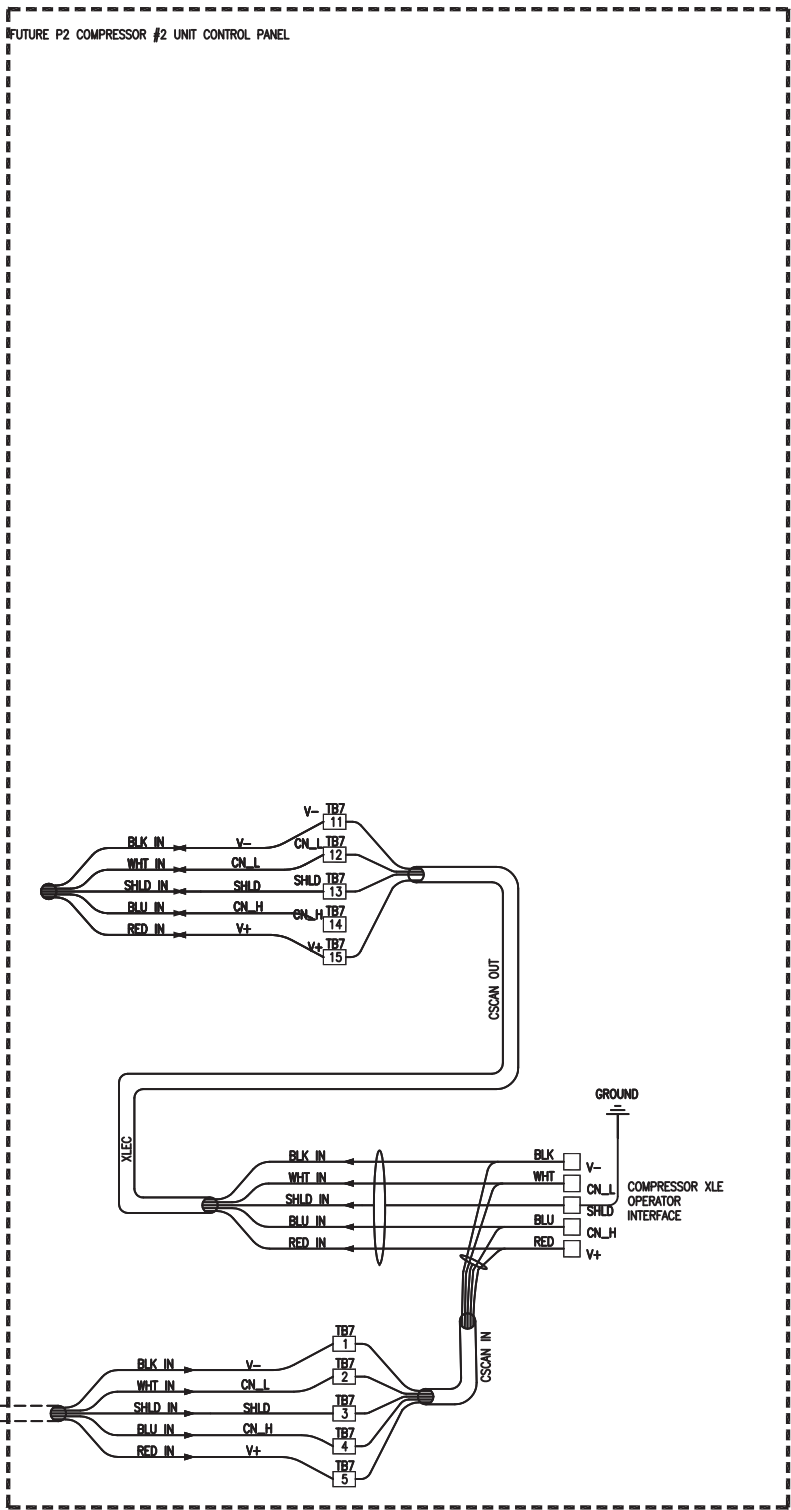
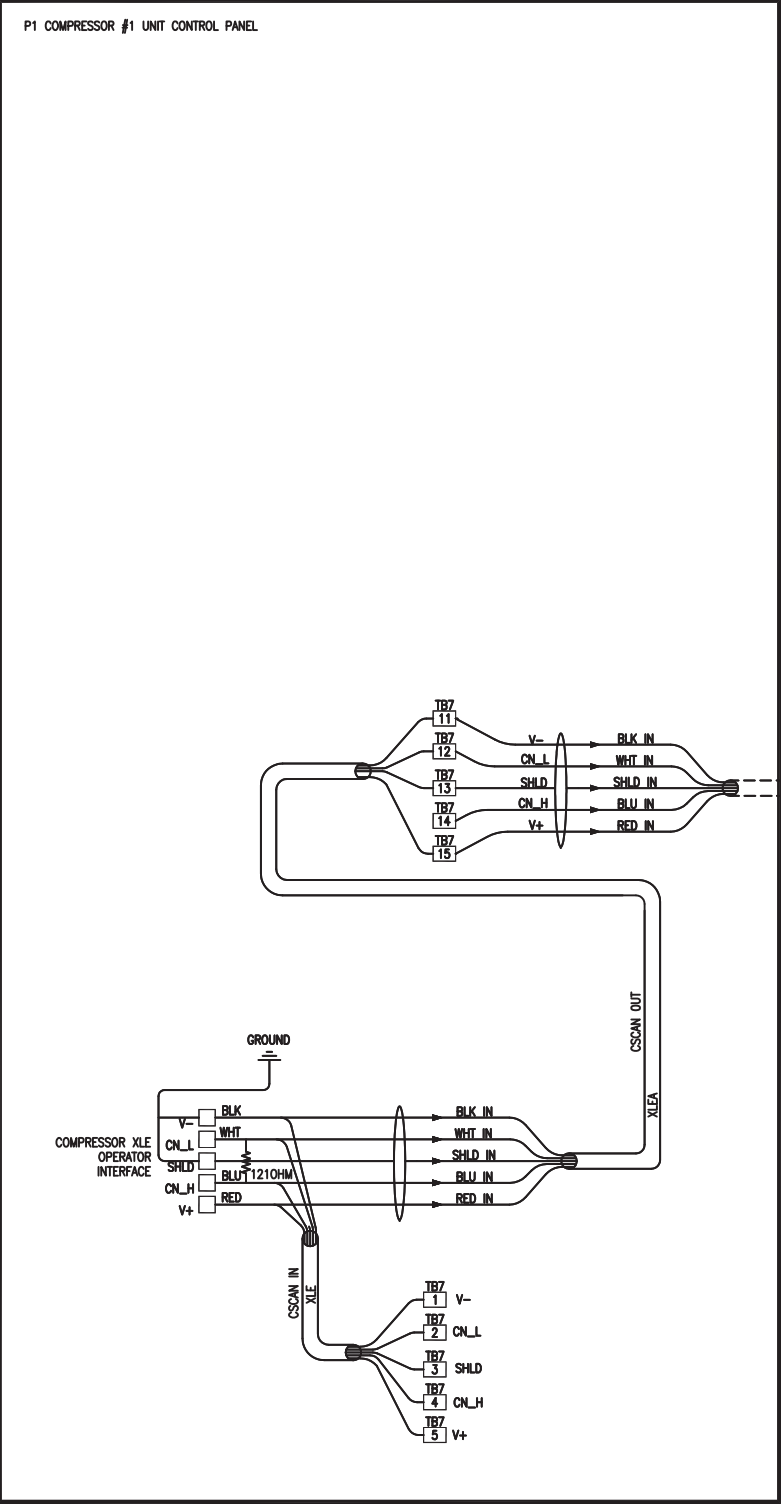
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BREAK SHARP EDGES
ALL DIMENSIONS IN INCHES

FRACTIONAL ±.125
TWO PLACE DECIMAL ±.010
THREE PLACE DECIMAL ±.005
ANGLES ±1°

TITLE				SINGLE LINE/CUSTOMER INTERCONNECT DETAILS	
NG50E				CUSTOMER BioCNG,LLC-CITY OF RIVERVIEW,MI	
PROJECT NO. 40259				DRAWING NO. A80-50-40259	
SHEET 4/6				SCALE NA	
DRAWN BY MAP				DATE 10/10/12	
				REV. A	



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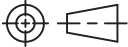
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BREAK SHARP EDGES
ALL DIMENSIONS IN INCHES
FRACTIONAL ±.125
TWO PLACE DECIMAL ±.010
THREE PLACE DECIMAL ±.005
ANGLES ±1°

TITLE					
SINGLE LINE/CUSTOMER INTERCONNECT DETAILS NG50E					
CUSTOMER BioCNG,LLC-CITY OF RIVERVIEW,MI			PROJECT NO. 40259		
SHEET 5/6		SCALE NA		DRAWING NO. A80-50-40259	
DRAWN BY MAP		DATE 10/10/12		REV. A	

Class I, Div. 1 and 2
Groups B, C, D
Class II, Div. 1 and 2
Groups E, F, G
Class III
NEMA 3, 7CD, 9EFG

EFD/EFDB Factory Sealed Push Button Stations: Explosionproof, Dust- Ignitionproof

UNILETS® for use with Threaded Metal Conduit.
10 Ampere, 600V A.C. Max. for Heavy Duty Use.
Furnished with Internal Ground Screw.

U.S. Pat. 3,699,276 Patented Canada 1974	Hub Size, Inches	Description	Nameplate Marking	Catalog Number Dead-End	Feed-Thru
	Single Gang*				
	Momentary Contact				
	1/2 1 Circuit				
	3/4 Universal				
	1				
	Maintained Contact				
	1/2 1 Circuit				
	3/4 Universal				
	Two Gang*				
	Momentary Contact				
	1/2 2 Circuits				
	3/4 Universal				
	1				
	Three Device†				
	Momentary Contact				
	1/2 3 Circuits				
	3/4 Universal				
	1				

* Malleable iron body and aluminum cover. For aluminum body, add suffix —A.

† Aluminum body, not available.

◇ Shaded area indicates items suitable for Class I, Div. 1 and 2, Groups B, C and D; Class II, Groups E, F and G and Class III.
For Class I, Group B, external seals must be installed at each conduit entrance.

See page 16 for push button accessories and parts. Dimensions on pages 24 and 25.

Factory Sealed Control Stations and Pilot Lights: EFDB/efd and EDS Series Explosionproof, Dust- Ignitionproof

UNILETS® for use with Threaded Metal Conduit.

Applications

- Push buttons and selector switches are used in conjunction with contactors or magnetic starters for remote control of motors. They provide circuit control and/or selection.
- Pilot lights provide visual assurance that an electrical function is being performed at a remote or local location.
- EFD/EFDB and EDS factory sealed control stations confine arcing of device within the enclosure, preventing ignition of ignitable atmospheres during control operation of motors and other equipment.
- Used in classified areas where flammable vapors, gases or highly combustible dusts are present.
- For installation in chemical and petrochemical plants, refineries, and other process industries.

Features: EFD/EFDB Factory Sealed Push Buttons and Selector Switches

- Eliminate need for adding sealing fittings and compound at each conduit entrance.
- Heavy-duty, 10 ampere 600V rated.
- Dozens of possible combinations of push buttons, pilot lights and selector switches.
- Smooth, rounded integral bushing in each EFD/EFDB hub protects conductor insulation.
- Accurately tapped, tapered hubs for tight, rigid joints and ground continuity.
- Stainless steel push button shaft operates within stainless steel bushing assuring long, maintenance-free operation.
- Push button and selector switch contacts are silver cadmium oxide which are "sealed" in lower phenolic chamber isolated from corrosive elements. Assures positive contact and long, trouble-free operation.
- Enclosed stainless steel helper spring prevents accidental operation of push button in severe vibration installations.
- Push button models also available with Dust Cap for use in areas where excessive dust, moisture or corrosive conditions are encountered.
- Corrosion-resistant captive stainless steel hex-head cap screws hold EFDB covers to body.



EFDB
Push
Button



EFDB Photocontrol



EFD Combination Pilot
Light and Push Buttons



EDS Rocker Arm
Push Button



EFDB Push
Button with
Dust Cap



EFDB Pilot Light



EFDB
Selector
Switch



Maintained
Contact
Push Button

- All EFD/EFDB front-operated push buttons are supplied with lockout type guards as standard. Hole in guard will accept locks with up to 1/4" hasp. Permits locking of push button to prevent unauthorized operation.
- Clearly marked terminals with brass screws assure quick, easy wiring.

Features: EFD/EFDB Pilot Lights

- Factory sealed pilot lights supplied with red jewel/guard assembly and 120V, 6W type 6S6 lamp.

- Models also available in combination with factory sealed push buttons and selector switches.

Features: EFD/EFDB Selector Switches

- Factory sealed selector switches furnished with nylon cam-operated, heavy-duty push buttons for either two-position or three-position maintained contact operation.
- High thermal and arc resistance, high dielectric strength.

Factory Sealed Control Stations and Pilot Lights: EFDB/efd and EDS Series Explosionproof, Dust- Ignitionproof

UNILETS® for use with Threaded Metal Conduit.

Features: EDS Push Buttons

- Factory sealed—eliminates need for adding sealing fittings and compound at each conduit entrance.
- Heavy duty, 10 ampere 600V rated.
- Switch is enclosed in separate sealing chamber.
- Sealing chamber has smooth, double flanges that mate both to cover and mounting enclosure to provide flame-tight joints.
- Pigtail leads from push buttons are factory sealed in sealing well.
- Stainless steel hex-head screws attach sealing chamber to cover and mounting enclosure.
- Side rocker arm push button has lockout holes.
- EFD/EFDB back box supplied with internal ground screw.

Standard Materials

- *EFDB control stations*: malleable iron body with aluminum cover.
- *SPBB push button*: aluminum upper barrel and phenolic lower barrel with nylon plastic button (Dust Cap models have neoprene buttons).
- *SPLN/SPLS pilot light*: aluminum guard and body assembly; steel clamping ring; and tempered glass jewel.
- *SSBA selector switch*: aluminum operator mechanism, nylon cam, and sealed phenolic contact block.
- *EDS control stations*: malleable iron body and cover; aluminum sealing chamber; and nylon 6/6 operating handle.

Standard Finishes

- *EFD/EFDB control stations*: body, triple-coat—(1) zinc electroplate, (2) dichromate, and (3) epoxy powder coat.
- *SPBB push button, SPLN/SPLS pilot light and SSBA selector switch*: natural finish.
- *EDS control stations*: body and cover, triple-coat—(1) zinc electroplate, (2) dichromate, and (3) epoxy powder coat sealing chamber, natural finish.

Options

- Three position selector switches with modified operation. Momentary contact right position, spring return to center, maintained contact left position. For description and switch diagram see page M-15. Add suffix **—SRC**.

- Three position selector switches with modified operation. Momentary contact left position, spring return to center, maintained contact right position. Add suffix **—SLC**.
- Alternate contacts add suffix **—ALT**.
- EFD/EFDB selector switch Lockout—locks two- or three-position handle in any position. Suffix **—LD**.
- Push button front operated mushroom head (momentary contact): In red, add suffix **—NMRBRE**; In green, add suffix **—NMRBGR**; In black, add suffix **—NMRBBL**.
- EFD/EFDB pilot light jewel/guard assembly. Order by suffixes if color desired is other than red, as follows: Amber, **—JGBA**; Blue, **—JGBB**; Clear **—JGBC**; Green, **—JGBG**; Opal, **—JGBO**. For colored LED jewel/guard assembly, order by suffixes: red **—LEDR**; green **—LEDG**; amber **—LEDA**.
- EFD/EFDB pilot light transformers for single pilot light per gang. Order by suffix:

Primary Lamp

Voltage	Voltage	Suffix
220	120	—TR-2
277	120	—TR-3
440	120	—TR-4
550	120	—TR-5

- EFD and EDS units may be supplied with brazed hubs as 3, 4, and 5 gang in a variety of hub configurations. See Ordering Information page for how to order these and other “custom” units by adding suffixes to mounting body catalog numbers.

- Securing Rod for EFD/EFDB Push Button Lockout Guard. Suffix **—SR**.

- For complete list of options, see Catalog Numbering Guide on Pages M-2 through M-4.

Compliances

- UL Standard 698.
- Class I, Div. 1 and 2; Class II, Div. 1 and 2. See listing pages for specific groups.
- Appleton malleable iron products conform to ASTM A47-77, Grade 32510, which has the following properties: tensile strength, 50,000 psi; yield, 32,000 psi; and elongation, 10%.
- Appleton aluminum products are produced from high strength copper-free (4/10 of 1% max.) alloy.



EDS factory sealed rocker arm push button control station—shows separate sealing chamber and device construction. Rocker arm has holes for lock.



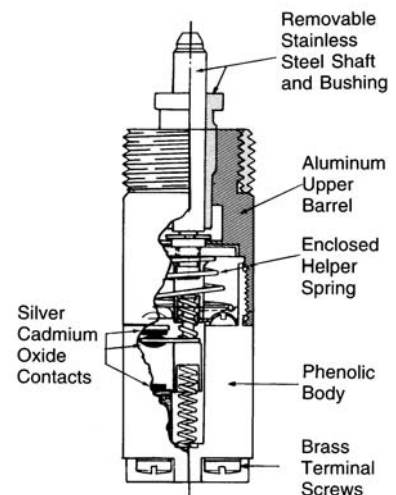
Securing Rod for EFD/EFDB Push Button Lockout Guard—available as an optional item as catalog number NBL-SR (single guard only) or add Suffix **—SR** to push button catalog number. Lockout Guard, furnished as standard with the EFD/ EFDB push button, may also be padlocked.



SPBB factory sealed push button used in EFD/EFDB Series—standard type and unit with dust cap.

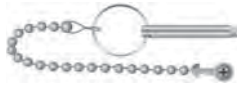


SPBB Design Features



Contender® Series Replacement Parts and Accessories

Class I, Division 1, Groups C, D
Class I, Division 2, Groups B, C, D
Class II, Division 1 and 2, Groups E, F, G
Class III

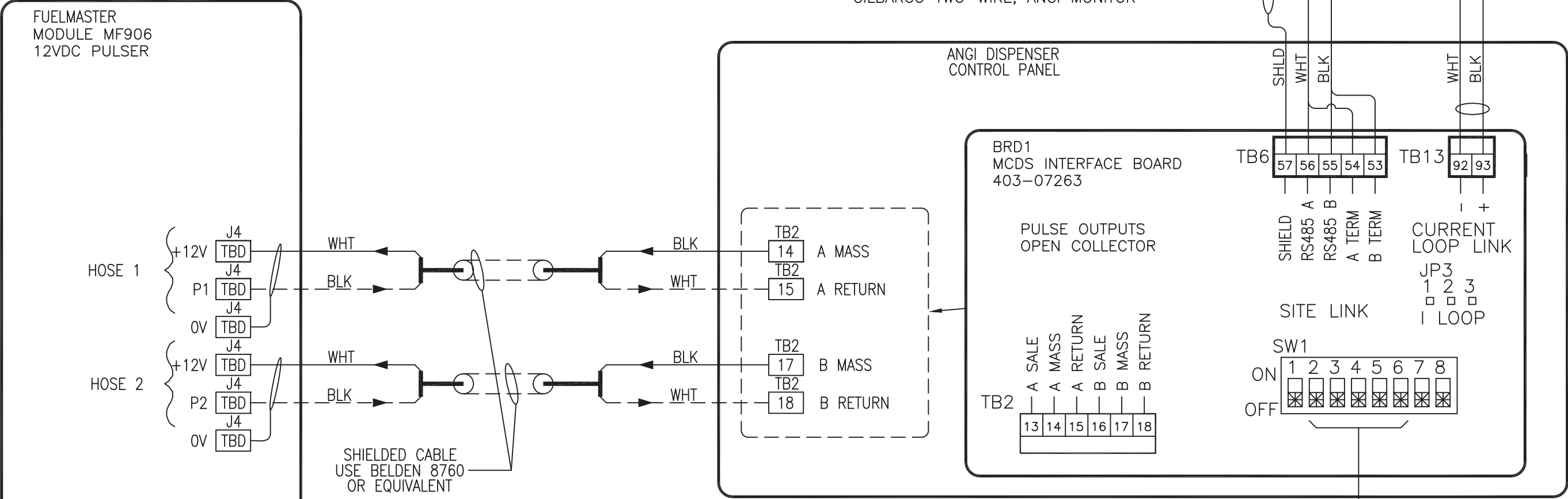
Description				Catalog Number
Push Button — Factory Sealed — Momentary Contact				
 SPBB-U1-Q	10 Amp 600 Vac Heavy Duty 1/2" thread size (NPSM). Furnished with 1/2" to 3/4" enlarger, Weather Boot, Guard, Start, Stop and Blank Nameplates.			
	Single Push Button	Universal		SPBB-U1-Q
 SPBB-U2DBL	Double Push Button	Universal		SPBB-U2DBL
Push Button — Red Mushroom Head — Factory Sealed — Maintained Contact				
	10 Amp 600 Vac Heavy Duty 1/2" thread size (NPSM). Furnished with 1/2" to 3/4" enlarger and Emergency Stop Nameplate (guard not furnished).			
	Single Push Button	Universal		SMPB-U1-Q
Rectangular Button with Weather Boot				
	Furnished with Start, Stop and Blank Nameplates.			NBN-WB
Nameplates for Rectangular Push Buttons				
 SNP-OFF-Q	Blank	SNP-B-Q	Off	SNP-OFF-Q
	Forward	SNP-FWD-Q	On	SNP-ON-Q
	Jog	SNP-JOG-Q	Reverse	SNP-REV-Q
	Run	SNP-RUN-Q	Open	SNP-OPEN-Q
	Stop	SNP-SP-Q	Close	SNP-CLOSE-Q
 SNP-ON-Q	Start	SNP-ST-Q	Up	SNP-UP-Q
	Down	SNP-DOWN-Q	Test	SNP-TEST-Q
	Fast	SNP-FAST-Q	Low	SNP-LOW-Q
	Slow	SNP-SLOW-Q	High	SNP-HIGH-Q
	Raise	SNP-RAISE-Q		
	Lower	SNP-LOWER-Q		
	Reset	SNP-RESET-Q		
Push Button Replacement Locking Guards — Glass Reinforced Polypropylene — Gasketed				
 Maintained Mushroom Head Switch Guard	Has hole for 1/4" hasp.			
	Single Guard (Maintained Mushroom Head Switch)			SMPB-LG
 Single Guard	Single Guard			NPB-LG1
	Double Guard			NPB-LG2
 Double Guard	Single Guard (No Lockout Holes)			NPB-LG1-LL
	Double Guard (No Lockout Holes)			NPB-LG2-LL
Push Button Securing Rod with Chain — Stainless Steel				
	For use with Single Guard Only			NBL-SR
Mushroom Head Button with Weather Boot for Use with Momentary Contact — Gasketed				
	Black			NMRB-BL
	Green			NMRB-GR
	Red			NMRB-RE

2.3 Fuel Management System

NOTE: THE CURRENT LOOP COMM LINK
USES THE SAME COMM PROT AS THE RS485 LINK

OPTIONAL:
TO FUEL MANAGMENT
GILBARCO TWO-WIRE PROTOCOL

OPTIONAL:
TO OTHER SITE EQUIPMENT RS485 HALF DUPLEX
PROTOCOLS: MODBUS RTU, MODBUS ASCII
GILBARCO TWO-WIRE, ANGI MONITOR



JUMPER 2 AND 3 ON
JP3 FOR CURRENT
LOOP COMM LINK.
LEAVE OPEN FOR
RS485 SIGNALS.

NOTE: MODBUS NOE = SWITCH SETTING + MODBUS ADDRESS OFFSET
MODBUS NODE = 0 IS AN INVALID SETTING
SWITCH SW8: OFF = ANGI MONITOR, ON = MODBUS PROTOCOL

NOTE: MODBUS NOE = SWITCH SETTING + MODBUS ADDRESS OFFSET
MODBUS NODE = 0 IS AN INVALID SETTING
SWITCH SW8: OFF = ANGI MONITOR, ON = MODBUS PROTOCOL

NODE	SW2	SW3	SW4	SW5	SW6	NODE	SW2	SW3	SW4	SW5	SW6
0	OFF	OFF	OFF	OFF	OFF	16	OFF	OFF	OFF	OFF	ON
1	ON	OFF	OFF	OFF	OFF	17	ON	OFF	OFF	OFF	ON
2	OFF	ON	OFF	OFF	OFF	18	OFF	ON	OFF	OFF	ON
3	ON	ON	OFF	OFF	OFF	19	ON	ON	OFF	OFF	ON
4	OFF	OFF	ON	OFF	OFF	20	OFF	OFF	ON	OFF	ON
5	ON	OFF	ON	OFF	OFF	21	ON	OFF	ON	OFF	ON
6	ON	OFF	ON	OFF	OFF	22	ON	OFF	ON	OFF	ON
7	OFF	ON	ON	OFF	OFF	23	OFF	ON	ON	OFF	ON
8	OFF	OFF	OFF	ON	OFF	24	OFF	OFF	OFF	ON	ON
9	ON	OFF	OFF	ON	OFF	25	ON	OFF	OFF	ON	ON
10	OFF	ON	OFF	ON	OFF	26	OFF	ON	OFF	ON	ON
11	ON	ON	OFF	ON	OFF	27	ON	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	28	OFF	OFF	ON	ON	ON
13	ON	OFF	ON	ON	OFF	29	ON	OFF	ON	ON	ON
14	OFF	ON	ON	ON	OFF	30	OFF	ON	ON	ON	ON
15	ON	ON	ON	ON	OFF	31	ON	ON	ON	ON	ON

A HOSE	B HOSE	SWITCH SW6 = OFF			
B HOSE	A HOSE	SWITCH SW6 = ON (NODES SWAPPED)			
HOSE NODE		SW2	SW3	SW4	SW5
16	1	OFF	OFF	OFF	OFF
1	2	ON	OFF	OFF	OFF
2	3	OFF	ON	OFF	OFF
3	4	ON	ON	OFF	OFF
4	5	OFF	OFF	ON	OFF
5	6	ON	OFF	ON	OFF
6	7	ON	OFF	ON	OFF
7	8	OFF	ON	ON	OFF
8	9	OFF	OFF	OFF	ON
9	10	ON	OFF	OFF	ON
10	11	OFF	ON	OFF	ON
11	12	ON	ON	OFF	ON
12	13	OFF	OFF	ON	ON
13	14	ON	OFF	ON	ON
14	15	OFF	ON	ON	ON
15	16	ON	ON	ON	ON

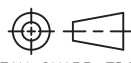
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MILTON, WI 53563
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BREAK SHARP EDGES
ALL DIMENSIONS IN INCHES

FRACTIONAL	±.125
TWO PLACE DECIMAL	±.010
THREE PLACE DECIMAL	±.005
ANGLES	±1°

TITLE			
FUEL MASTER FMU2550PLUS (120 VAC) INTERFACE TO SERIES II DISPENSER CUSTOMER INTERCONNECT			
CUSTOMER		PROJECT NO.	
SHEET	SCALE	DRAWING NO.	REV.
2/2	1:1	E45-50-007	A
DRAWN BY		DATE	
SZEPP/NDA		5/19/08	



Fuel Management Unit (FMU) Installation Manual

FMU-2500, 3000, 3500,
Classic and Plus,
Commercial and DoD

26 October 2010

SYN-TECH SYSTEMS, INC.

100 Four Points Way
Tallahassee FL 32305
800-888-9136 Toll Free
850-878-2558
850-877-9327 Fax

WWW.SYNTECH-FUELMASTER.COM

FuelMaster® Installation Manual

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FuelMaster® Installation Manual

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