Bolt-On Weight Measurement Installation Manual

L-Cell® and Microcell®

CAUTION

It is essential that all instructions in this manual be followed precisely to ensure proper operation of the equipment.

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NOTICE

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CAUTION

Equipment should be inspected for damages after packing is removed to insure operating safety.

If there is ever any evidence of damages found to equipment at any time regarding covers being cracked or dented, wiring cut or damaged, or mounting frames bent or broken, equipment safety may have been compromised. Do not use damaged equipment and contact local equipment distributor immediately.

CAUTION

Follow these rules if welding is done on the vessel after installation of the system.
The electrical current of the welder may pass through the cell, causing damage to the sensor and possibly to the signal processor. To avoid damage, follow these precautions:

1. Disconnect the cell cables from the signal processor.
2. Ground the welder as close to the welding joint as possible. The welding ground must be between the cell and the weld joint to prevent the welding current from going through the cell to earth ground.

Note

High temperatures can damage the sensors. If you are welding in the vicinity of a sensor, monitor the temperature of the metal adjacent to the sensor. If it becomes too hot to touch, stop welding immediately and remove the sensor before continuing. Prior to reinstalling the sensor, verify that no damage has occurred by checking the resistance. See *Testing Sensors with Digital Multimeter (DMM)* in Chapter 2, Prepare to Install Bolt On Sensors, for the resistance-checking procedure.

Table of Contents

Introduction *I-1*
Welcome I-1
About This Manual I-1
Contact Information I-2
Technical Service I-2

Chapter 1: Description of the Bolt-On Weight Measurement Sensors *1-1*
Introduction 1-1
Description of the L-Cell 1-1
Description of the Microcell 1-2

Chapter 2: Prepare Sensors for Installation *2-1*
Application Verification 2-1
Order Verification 2-1
L-Cell Order 2-1
Microcell Order 2-2
Prepare Required Installation Equipment 2-2
L-Cell Installation Equipment 2-2
Microcell Installation Equipment 2-3
Customer Supplied Items 2-3
Junction Box and Field Wiring Equipment 2-4
Checking Equipment 2-4
Visual Check 2-4
Functional Check 2-4
Testing Sensors with K-M Test Meter 2-5
Testing Sensors with Digital Multimeter (DMM) 2-5

Chapter 3: Installation of the L-Cell on Vertical Legs *3-1*
Mounting Locations 3-1
Horizontal Location L-Cell Sets 3-1
Vertical Location of L-Cell Sets 3-1
Installing L-Cells 3-3
Surface Preparation 3-3
Drill and Tap 3-3
Mounting L-Cell 3-4
Mounting Junction Box 3-7
Wiring L-Cells to Junction Box 3-8
Wiring Junction Boxes Together and to Signal Processor 3-9

Chapter 4. Installation of the L-Cell on Horizontal Beams *4-1*
Mounting Locations 4-1
L-Cell Sets 4-1
Distribution of L-Cells 4-1
L-Cell Mounting Methods 4-3
Installing L-Cells 4-5
Surface Preparation 4-5
Drill and Tap 4-5
Mounting L-Cell 4-6
Mounting Junction Box 4-8
Wiring L-Cells to Junction Box 4-9
Wiring Junction Boxes Together and to Signal Processor 4-10

Chapter 5: Installation of the L-Cell on Skirt Supported Vessels *5-1*
Mounting Information 5-1
L-Cell Sets 5-1
Distribution of L-Cells and Junction Boxes Around Vessel (Carbon Steel) 5-1
Distribution of L-Cells and Junction Boxes Around Vessel (Aluminum) 5-4
Obstructions 5-6
Installing L-Cells 5-11
Surface Preparation 5-11
Drill and Tap 5-12
Mounting L-Cell 5-13
Mounting Junction Box 5-15
Wiring L-Cells to Junction Box 5-16
Wiring Junction Boxes Together and to Signal Processor 5-17

Chapter 6: Installation of the Microcell on Vertical Pipe Legs *6-1*
Mounting Locations 6-1
Microcell Sets 6-1
Distribution of L-Cells 6-2
Installing Microcells 6-3
Surface Preparation 6-3
Drill and Tap 6-4
Mounting Microcell 6-5
Mounting Junction Box 6-7
Wiring Microcells to Junction Box 6-8
Wiring Junction Boxes Together and to Signal Processor 6-9

Appendix A. L-Cell Specifications..... A-1

Appendix B. Microcell Specifications..... B-1

Appendix C. Glossary..... C-1

Appendix D. System Calibration..... D-1

Appendix E. Troubleshooting..... E-1

Appendix F. Spare Parts List..... F-1

Appendix G: Alternative Method for Checking Output G-1

Appendix H. Technical Drawings..... H-1

Introduction

This chapter will describe the organization, manual conventions, and provide contact and technical service information .

Welcome

This manual describes the installation of the Bolt-On Sensors, L-Cell and Microcell. The L-Cell is installed on Vertical Legs, Horizontal Beams, and Skirted Silo applications. The Microcell is installed on Vertical Pipe Leg applications.

After preparing the Bolt-On Sensor for installation (Chapter 2), go to the specific application installation chapter and follow the instructions for installation.

If you have any questions, please contact us at 1-800-426-9010.

About this manual

The chapters are organized in the following way:

Chapter 1:	Description of the Bolt-On Weight Measurement Sensors
Chapter 2:	Prepare Bolt-On Sensors for Installation
Chapter 3:	Installation of the L-Cell on Vertical Legs
Chapter 4:	Installation of the L-Cell on Horizontal Beams
Chapter 5:	Installation of the L-Cell on Skirted Silos
Chapter 6:	Installation of the Microcell on Vertical Pipe Legs

Appendix A through G include specifications, system calibration, technical drawings, and troubleshooting charts.

Manual Conventions

Three kinds of special explanations appear throughout the manual — *Warning , Caution and Note*. The format and significance of each is defined below:

WARNING

Possible danger to people. Injury may result if this information is ignored.

CAUTION

Possible risk to the product. The L-Cell, Microcell, or other equipment may be damaged if this information is ignored.

Note

Contains additional information about a step or feature critical to the installation of the L-Cell or the Microcell.

Contact Information

You may reach Kistler-Morse at the following:

Mail:	Kistler-Morse 150 Venture Boulevard Spartanburg, South Carolina USA 29306
Telephone:	1-800-426-9010 (864) 574-2763
Fax:	(864) 574-8063
Email:	sales@kistlermorse.com
Website:	http://www.kistlermorse.com

Technical Service

A complete, unabridged copy of our product warranty is available upon request from Kistler-Morse. A summary of the warranty, *subject to the terms and conditions listed fully in the warranty*, follows:

KM warrants the equipment to be free from defects in material and workmanship for one year from date of shipment to original user. KM will replace or repair, at our option, any part found to be defective. Buyer must obtain a Return Material Authorization (RMA) for any part claimed to be defective and return item to KM transportation pre-paid.

KM maintains a fully trained staff of field service personnel who are capable of providing you with complete product assistance. Our field service staff is based in Spartanburg, South Carolina USA.

Phone Consultation

Our Customer Service staff provides the following services by telephone, via our regular and toll free number (toll free in U.S.A. and Canada only):

- Technical, application, and troubleshooting assistance
- Spare parts assistance
- Warranty (replacement) assistance
- Return Material Authorization (RMA)

On-Site Consultation

KM's Field Service staff can provide additional services at your request. Contact KM at the closest office for rate and scheduling information for the following services:

- Technical, application, startup, and troubleshooting assistance on-site
- Training on-site or at our corporate office
- Service calls
- Equipment updates to our latest configuration

General descriptions of some of these standard services follow. Of course, if your service needs vary from those described, we are available to discuss them with you.

Installation, Startup Assistance, and On-Site Training

The system will be powered up and checked for proper electrical operation. For best results, KM requires moving a known amount of material (minimum 1/4 scale capacity) for Live Load calibration. Live Load calibration will be performed if actual material or weight devices can be moved. If it is not possible to move material, a Manual calibration will be performed. Recommendations for the optimal performance of the system will be provided.

On-site training will include simulation of the Live Load calibration process (if Live Load calibration can not be performed while KM is on site) and instruction covering operation and maintenance of the system.

Note

Field wiring, conduit installation, and junction box and signal processor mounting must be performed by the customer. The AC power must be connected to the signal processor, but not energized, prior to KM beginning work.

Troubleshooting

KM will troubleshoot systems for mechanical, electrical, calibration, and wiring errors. Normal component repairs will be made and wiring errors will be corrected. (To troubleshoot your own equipment, see Appendix E for Equipment Troubleshooting charts)

Service Calls

KM will perform on-site repair/replacement services.

Return Material Authorization

If a part needs to be sent to the factory for repair, contact KM's corporate office and request a Return Material Authorization (RMA) number. The RMA number identifies the part and the owner and must be included with the part when it is shipped to the factory.

Chapter 1: Description of the Bolt-On Weight Measurement Sensors

This chapter will describe the L-cell and the Microcell sensors, including their application details.

Introduction

Bolt-On Technology creates weighing systems by:

* mounting L-Cells on structural support members of the vessels legs, shear beam supports, or structural skirts
* mounting Microcells to the vessels pipe leg supports.

No specialized tools are needed for installation and there is no need to empty vessel or take the vessel out of production while the sensors are being installed.

Bolt-on sensing utilizes the vessel structure as the measuring system. To achieve optimal performance a thorough understanding of the vessel, its support structure, and the operating environment is necessary. The process requires that you look at the vessel and its support structure, or have a complete, as built, set of plans or drawings.

General Description of the L-Cell

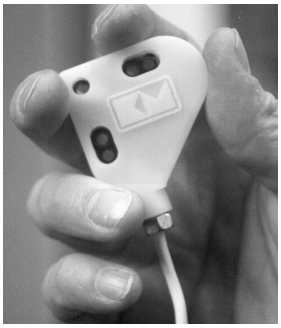


Figure 1-1. KM L-Cell

The patented L-Cell® (Figure 1-1) is a highly sensitive bolt-on strain gage sensor used to determine the weight of material contained in storage vessels. L-Cells bolt onto a vessel's metal support members. As weight is added to or removed from the vessel, the vessel support structure experiences strain changes proportional to the changes in weight.

The L-Cell detects the strain changes in the metal and produces a voltage output proportional to those changes. A signal processor then converts this output to engineering units for display and control. The L-Cell measures strain in two perpendicular directions, eliminating the need for a rosette array of two one-direction strain sensors. Refer to Appendix A for the L-Cell specifications.

The L-Cell is easy to install. It mounts to the surface of the structural support and never comes in contact with the vessel contents. Used in many different industries, it can weigh any type of material stored in a vessel with metal support members. The L-Cell is rugged, can operate in industrial environments, and requires no periodic maintenance. It is immune to electrical noise due to its high-level output voltage.

The L-Cell goes beyond standard traditional passive temperature compensation. The L-Cell's Standardized Axial Strain Sensitivity (SASS®) provides active temperature compensation.

L-Cell Application Details

Currently, L-Cells are available for installation on the following types of vessels:

- Carbon steel, skirt-supported vessels with maximum live load stresses between 1,500 and 8,500 psi (1.0 and 6.0 kg/mm^2)
- Aluminum, skirt-supported vessels with maximum live load stresses between 1,500 and 4,500 psi (1.0 and 3.2 kg/mm^2)
- Leg Supported Vessels (non-pipe) with maximum live load stresses between 1,500 and 8,500 psi (1.0 and 6.0 kg/mm^2)
- Beam Supported Vessels with maximum live load stresses between 1,500 and 8,500 psi (1.0 and 6.0 kg/mm^2)

Contact K-M for information on non-standard applications. Read the entire installation procedure for your application before beginning installation.

General Description of the Microcell

Fig 1-2. KM Microcell

The Microcell™ (Figure 1-2) is a highly sensitive bolt-on strain gage sensor used to determine the weight of material contained in storage vessels. Microcells bolt onto a vessel's metal support structure. As weight is added to or removed from the vessel, the vessel support structure experiences strain changes proportional to the weight changes. The Microcell detects the strain changes and produces a voltage output proportional to those changes, thus indicating the change in weight. KM signal processors convert the Microcell voltage outputs to weight or level. Refer to Appendix B for specifications.

The Microcell is easy to install. It mounts to the surface of the structural support and never comes in contact with the vessel contents. Used in many different industries, it can weigh any type of material stored in a vessel with metal support members. The Microcell is rugged, can operate in industrial environments, and requires no periodic maintenance. It is immune to electrical noise due to its high-level output voltage.

Microcell Application Details

The 3-inch Microcell can be installed on carbon steel, stainless steel, or aluminum vessel supports. The 2-inch Microcell can be installed on carbon steel vessel supports only. Refer to Appendix B, Microcell Specifications, for stress limits on each type of Microcell.

Microcells can be installed on leg-supported vessels. Refer to the appropriate chapter for installation details for your application:

- Chapter 6 — Installation on Vertical Pipe Legs

Contact KM for information on non-standard applications.

Be sure to read the entire installation procedure for your application before beginning installation.

Chapter 2: Prepare Bolt-On Weight Measurement Sensors for Installation

This chapter will describe the pre-installation procedures for L-Cells and Microcells. By verifying the application and checking the cells before installation, it will ensure proper installation of working cells that will provide accurate monitoring of the vessel contents.

Application Verification

Prior to ordering the Bolt-On Sensors, you should have completed the Application Data Form #97-5092. A copy of the completed Application Data Form was returned to you with both the order acknowledgment and equipment shipment. If you cannot locate the form, contact KM to obtain another copy before you proceed. Review the information on the form to verify the application details.

Note

If the calculated stress is outside the following ranges, it is considered a non-standard application. Consult KM before proceeding.

- L-Cell: Carbon steel vessel — 1,500 psi to 8,500 psi (1.0 kg/mm^2 - 6.0 kg/mm^2)
- L-Cell: Aluminum vessel — 1,500 psi to 4,500 psi (1.0 kg/mm^2 to 3.2 kg/mm^2)
- 3-inch Microcell — 2,500 psi to 7,500 psi (1.8 kg/mm^2 to 5.3 kg/mm^2)
- 2-inch Microcell — 3,750 psi to 11,250 psi (2.6 kg/mm^2 to 7.9 kg/mm^2)

Order Verification

Prior to beginning installation, verify that your order is complete and assemble additional equipment needed for the installation. If any items are missing from the order, contact KM before proceeding. Substituting parts without KM aproval may cause system problems and will void the warranty.

L-Cell Order

The following items are included with your order for each vessel (quantities are dependent on vessel data or application):

L-Cells, each complete with:

- Sensor
- Environmental Cover
- #6-32 x 1/4" socket head cap screws (3)

Junction Boxes, each complete with:

- Assy 63-1170-01 terminal board
- Watertight fittings (4)
- Watertight plugs
  (for any cable openings that will not be used)

Microcell Order

The following items may be included with your order for each vessel (quantities are dependent on application):

Microcells, each complete with:

- Sensor
- Environmental Cover
- #8-32 socket head cap screws (2)
- #8 hardened flat washers (2)

Junction Boxes, each complete with:

- Assy #63-1170-01 terminal board (pipe leg application)
- Watertight fittings (4)
- Watertight plugs
  (for any cable openings that will not be used)

Note

A signal processor and its manual are required to calibrate the system. These may be part of your order, or you may be planning to use an existing one.

Prepare Required Installation Equipment

L-Cell Installation Equipment

The following additional equipment is used to install L-Cells.

Optional Installation Kit*#39-2052-03 or -04, each complete with:

- L-Cell drill template with #6-32 x 1 5/8" socket head cap screw
- L-Cell surfacing disk
- 7/64" Hex T-handle driver
- Sander disks, coarse and fine (36 and 60 grit for carbon steel, 80 and 100 grit for aluminum)
- #36 cobalt HSS drill bits
- #6-32, 2-flute, spiral-point taps
- 3/16" drill bits
- Sikaflex 1A polyurethane sealant and Material Safety Data Sheet (MSDS)
- Rust-inhibiting silicone grease
  (for carbon steel surface only)
- KM Test Meter (optional)
- Drill motor (optional)

* Kit items are also available individually.

Microcell Installation Equipment

The following additional equipment is used to install Microcells:

Optional Installation Kit* #39-2012-0X, each complete with:
- Microcell drill template with #8-32 socket head cap screw
- 9/64" Hex T-handle driver
- #29 drill bits
- #8-32, 2-flute, spiral-point taps
- Sikaflex 1A polyurethane sealant and Material Safety Data Sheet (MSDS)
- Rust-inhibiting silicone grease (for carbon steel surface only)
- KM Test Meter (optional)
- Drill motor (optional)

* Kit items are also available individually.

Customer-Supplied Items for both sensors:

Tape measure
Marking pen
Tapping fluid
Level
Tap handle
Tape (electrical or masking)
Degreaser (isopropyl alcohol or acetone)
Caulking gun
Digital Multimeter (DMM)

Notes

- If sensors will be installed by KM, our service technician will bring this equipment on-site as part of their tool kit.
- **If sensors will be installed by the customer, purchase of a KM Test Meter is highly recommended to simplify installation.**
- If the drill motor is not purchased from KM, it must meet the following minimum specifications:
  3/8" (for metal drilling), variable speed reversing, 0-2500 RPM.

Junction Box and Field Wiring Equipment

The following equipment, provided by the customer, is used to install the junction boxes, and to field wire the junction boxes to each other and to the signal processor:

Drill motor
#29 drill bit
#8-32, 2-flute, spiral-point tap
Tap handle
Tapping fluid
9/64" Allen wrench
#8-32 socket head cap screws
#8 flat washers (3/16" inner diameter, 7/16" outer diameter)
Belden™ 8791 18-gage 3-conductor shielded interconnect cable or equivalent (for up to 1,000' [305m] length)
Belden™ 8618 16-gage 3-conductor shielded interconnect cable or equivalent (for 1,000' to 2,000' [305m to 610m] length)
Conduit and fittings
Caulking gun
Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or 738

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

Checking Equpment

Visual Check

Visually inspect all equipment in the order — including sensors, junction boxes, and Installation Kit — to verify they have not been damaged during shipment. If any item has been damaged, contact KM for a replacement.

Functional Check

Perform a functional check of all the sensors before installation to verify they have not been damaged during shipment. The next section describes two methods of performing the functional check.

Testing Sensors with K-M Test Meter

The KM Test Meter (Figure 2-1) is designed specifically to test KM sensors. If you do not own a Test Meter, disregard this section and proceed to *Testing Sensors with Digital Multimeter*.

Note:

The Test Meter display indicates *Low Battery* or behaves erratically when the batteries are weak. When this occurs, replace the batteries before testing.

1. Connect the red, white, and black wires of a sensor to the corresponding Test Meter terminals, as shown in Figure 2-1. Place the sensor on a stable surface.

Fig 2-1. KM Test Meter

2. Turn on the power to the Test Meter and set the Simulate/Test switch to the Test position. Verify the sensor's *no-load* output is 0 ± 100 mV.

3. Repeat Steps 1 and 2 for each sensor.
   If the reading for any sensor is outside the specifications described above:
   A. Proceed to *Testing Sensors with Digital Multimeter* below to determine the resistance values for the sensor, **and**
   B. Contact KM for assistance after determining the resistance values and before proceeding with the installation.

Testing Sensors with Digital Multimeter (DMM)

Follow this procedure to test the sensors if you do not have a KM Test Meter or if the *no-load* output using the Test Meter was out of range for a sensor:

1. Set the ohmmeter resistance scale to accommodate a measured range up to 20,000 ohms.

2. Put one DMM lead on the sensor's white wire and the other lead on the red wire. Place the sensor on a stable surface. Verify the red-to-white resistance is 4000 ± 200 ohms for an L-Cell, 8300-8700 ohms for a 3 inch Microcell (also non-standard), or 1800-2200 ohms for a 2 inch Microcell.

3. Put one DMM lead on the sensor's white wire and the other lead on the black wire. Place the sensor on a stable surface. Verify the black-to-white resistance is 4000 ± 200 ohms **and** within 30 ohms of the red-to-white reading from Step 2 for an L-Cell, 8300-8700 ohms and within 20 ohms of Step 2 for a 3 inch Microcell (also non-standard), or 1800-2200 ohms and within 20 ohms of Step 2 for a 2 inch Microcell.

Repeat this procedure for each sensor. If the reading for any sensor is outside the above ranges, contact KM for assistance before proceeding with installation.

Note:

Replace L-Cell or Microcell in its packing material until ready to install.

Chapter 3: Installation of the L-Cell on Vertical Legs

*Follow the instructions in this chapter **only** if installing L-Cells on vertical column legs. Skip this chapter if installing other options. This chapter describes the mounting locations, and wiring installation details for L-Cells and their junction boxes on vertical leg applications.*

Follow the procedures below to determine L-Cell mounting locations prior to beginning installation. Following these procedures will ensure optimal system performance. Consult KM if special considerations prevent you from installing L-Cells at the designated locations.

L-Cell Mounting Locations

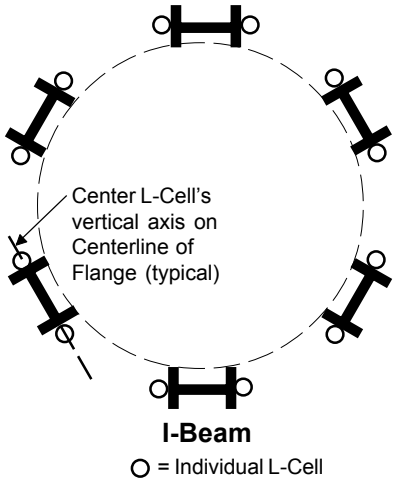


Figure 3-1. L-Cell Mounting Locations

For best performance, L-Cells are mounted on the flanges of the vertical leg. (See Figure 3-1). An L-Cell Set consists of two L-Cells mounted on opposite sides of a support leg, at the same elevation.

Note:

Do not install L-Cell on pipe leg. (See Chapter 6: Microcell Installation)

Always place L-Cells at center of flange, regardless of orientation of leg to vessel.

Horizontal Locations of L-Cell Sets

L-Cell sets are placed on each support leg. Refer to Figure 3-2 for the mounting locations.

Vertical Location of L-Cell Sets

Note

L-Cell locations may be adjusted up to 12" (305mm) vertically to avoid obstacles. If adjusting locations, maintain the configuration of the L-Cell set (i.e., if you move one L-Cell in the set from its ideal location, move the other(s) as well).

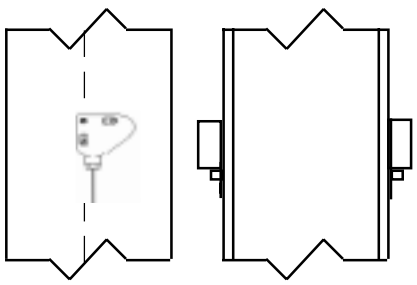


Figure 3-2. L-Cell Mounting for Best Performance

Support Legs without X-Braces

See Figure 3-3.

- If the free leg distance (length between foundation and the vessel) is between minH (**see Note**) and 11' (3.4m), mount the L-Cell sets at mid-height of the free leg.
- If the free leg distance is more than 11' (3.4m), mount the L-Cell sets at 5'6" (1.7m) above the foundation.
- If the free leg distance is less than minH, this is a special application situation. Consult KM before proceeding further.

Note

minH is defined as the minimum free height to install sensors. The height should be three times the beam width or 12" (305 mm) , whichever is highest of the two.

Support Legs with X-Braces

See Figure 3-4. If the free leg distance is minH or more, mount the L-Cell sets at mid-height of the free leg.

- Measure the free leg between the bottom of the lower x-brace or horizontal brace and the top of the foundation.
- For an alternate location, measure the free leg between the top of the upper x-brace or horizontal brace and the beam supporting the vessel.

See Figure 3-5. If the free leg distance is less than minH, mount the L-Cell sets at the mid-height between the lowest braces.

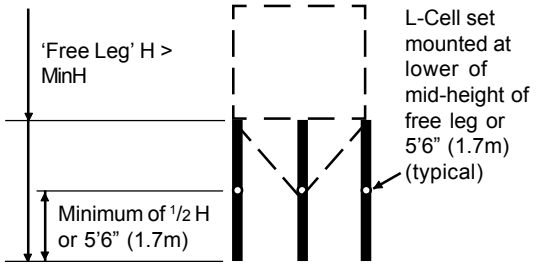


Figure 3-3. Vertical Location of L-Cell Sets for Legs without Braces

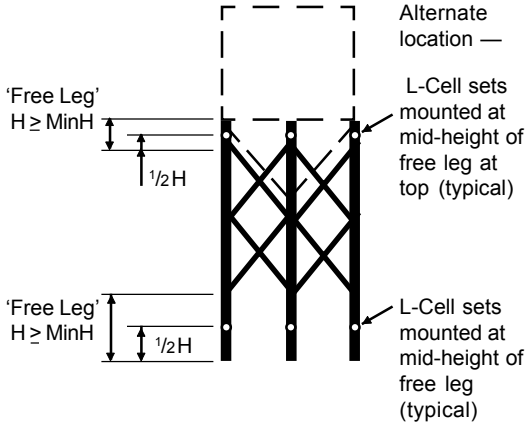


Figure 3-4. Vertical Location of L-Cell Sets for Legs with Braces and with Free Leg greater than MinH

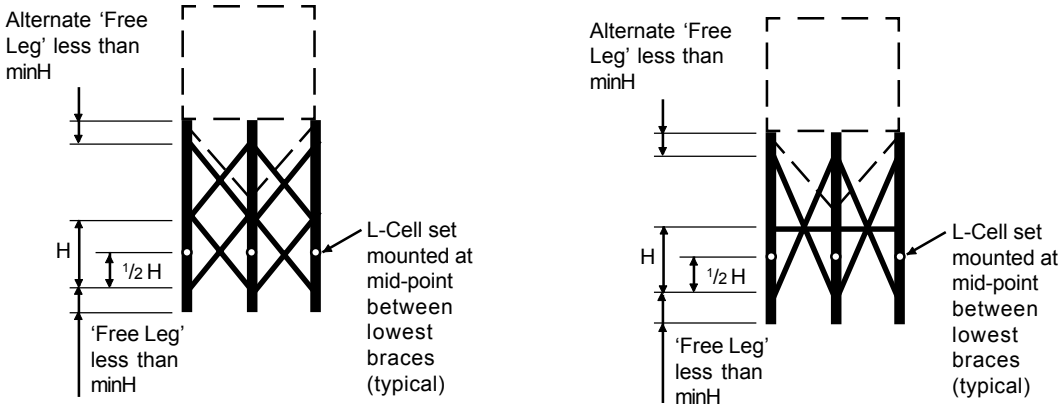


Figure 3-5. Vertical Location of L-Cell Sets for Legs with Braces and with Free Leg less than minH

Installing L-Cells

Notes

1. Use lubricating fluid (Relton RapidTap® Heavy Duty Cutting Fluid or equivalent) when drilling and tapping.
2. Drilling and tapping instructions assume metal thickness greater than 3/4" (19mm). If the thickness is less, drill all the way through the metal and tap until cutting complete threads through the other side. Minimum metal thickness is 0.1875" (5mm), which provides six thread engagement.

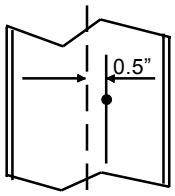


Figure 3-6: Drill Mounting Hole

Surface Preparation

Figure 3-7a: 2.5" Diameter surface for mounting L-Cell

Figure 3-7b: Prepared surface showing mounting hole

1. Fig. 3-6. Mark position of beam axis and of drill template mounting hole.

2. Fig. 3-7a. At the center of the L-Cell mounting location drill a 3/4" (19mm) deep hole with a #36 drill bit. This produces the template mounting hole.

3. Peel the backing off the coarse (36) grit sander disk and press the sander disk onto the surfacing disk. Using the template mounting hole as a tool center, remove heavy paint and rust with the drill-mounted surfacing disk until a 2.50" (63.5mm) diameter bare metal surface is achieved.
   - Use straight, constant pressure.
   - Do not roll or rock the grinding disk as this will cause a 'cupped' surface.
   - The goal is to grind a flat surface for mounting the L-Cell, removing paint and rust.
   - Due to the use of coarse grit, the resulting surface is somewhat coarse.

4. Replace the coarse grit with the fine (60) grit sander disk. Using the template mounting hole as a tool center, grind until the surface is flat and smooth to the touch. This results in a 2.50" (63.5mm) diameter surface where the L-Cell will be mounted. See Figure 3-7b.

Note

The L-Cell must be mounted against smooth, bare metal. All paint and rust must be removed from the area where the L-Cell is to be fastened.

5. Repeat Steps 1 through 3 to prepare the surface on the opposite side of the vertical leg before proceeding with L-Cell installation.

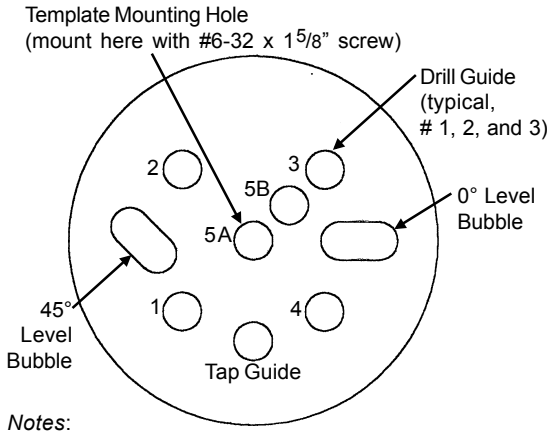
Figure 3-8: Thread the mounting hole using Tap and lubricating fluid.

Drill and Tap

1. Using the #6-32 tap, thread the template mounting hole for the L-Cell (drilled during *Surface Preparation*) to a minimum 5/8" (16mm) depth, full threads. (See Figure 3-8) Remove any burrs from the hole.

2. Position the drill template so the center hole lines up with the template mounting hole.

3. Fasten the drill template to the template mounting hole through the #5A hole, using the #6-32 x 1 5/8" socket head cap screw. Refer to the level bubble to ensure correct orientation.



Notes:
1. After L-Cell mounting holes drilled, rotate template to use tap guide to tap holes.
2. Holes #4 and 5B and 45° bubble not used for this application.

Figure 3-9. Drill and Tap Template

4. Drill the L-Cell mounting holes with the #36 drill bit, using the template guides (Fig. 3-9) as follows:
   A. Drill hole #2.
   B. Insert a spare drill bit through hole #2 in the template to hold the template securely in place.
   C. Drill hole #1 and #3. Remove the spare drill bit from hole #2.

5. Tap the mounting holes:
   A. Loosen the screw securing the template and rotate the template until the tap guide is aligned with hole #1. Retighten the screw.
   B. Using the tap guide, thread hole #1 with the #6-32 tap.
   C. Repeat steps A and B for hole #2 and #3.

6. Repeat Surface Preparation and Drill/Tap for the second L-Cell.

7. Remove burrs from all the holes created.

Mounting the L-Cell

Fig. 3-10: Apply rust inhibitor.

CAUTION

Do not apply rust inhibitor beyond this area, or the environmental cover will not adhere properly.

Fig. 3-11: Test L-Cell

1. Wipe down a 5" by 2 1/4" (127 by 57mm) surface, centered on the template mounting hole, with degreaser. This cleans the bare metal and adjacent mounting surface for the environmental cover.

2. Apply a thin coat of KM rust inhibitor to the bare metal surface for the L-Cell. (Fig 3-10)

3. Connect the L-Cell's red, black, and white wires to the corresponding terminals on the KM Test Meter. Turn on the power to the Test Meter and set the Simulate/Test switch to the Test position. (Fig 3-11)

Note

If a KM Test Meter is not available, refer to Appendix G, Alternate Method for Checking Output, before proceeding.

4. With the cable end down, align an L-Cell with its mounting holes. Fasten the L-Cell **loosely** to the leg using the three #6-32 x 5/8" socket head cap screws. **Do not tighten the screws**. If the voltage goes outside the range -200 to +200 mV, immediately loosen the screw(s).

CAUTION

Do not install L-Cells in the rain.
Do not trap moisture under the environmental cover.

CAUTION

For proper installation, tighten each screw until the T-handle driver flexes in torsion 1/4 turn past the point where the screw stops turning. Repeat this flexing procedure several times to ensure the screw is tight. When all three screws are tight, the voltage must be in the range -200 to +200 mV. Follow the procedure in Steps 5 through 7 to achieve this goal.

5. Fig. 3-12. Using the T-handle driver, **slowly** tighten the S2 screw. While turning the T-handle driver, monitor the Test Meter carefully.
   If the voltage goes outside the range -200 mVto +200 mV while tightening, stop immediately and evaluate the following:
   - If the voltage **jumped** outside the range -200 to +200 mV, it may indicate a burr or rough surface. Remove the screws holding the L-Cell to the leg. Remove burrs and surface roughness (refer to *Surface Preparation* for removing surface roughness). Repeat Steps 1 through 5.
   - If the voltage **gradually moved** outside the range -200 to +200 mV, slowly loosen the screw until the voltage is within range again and proceed to Step 6.

6. Repeat Step 5 for screws S1 and S3. If the voltage is outside the range -200 to +200 mV, attempt to bring the reading within range by loosening the screw being torqued, tightening the other screw, or some combination of loosening and tightening. If you have difficulty staying within the range, try turning each screw 1/4 turn at a time until both screws are tightened.

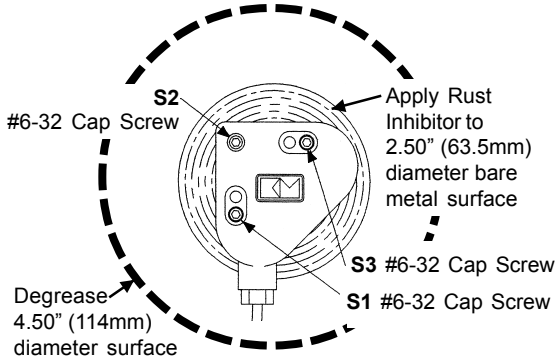
Note

If the following two situations occur while tightening screws, check L-Cell resistance using a DMM (described in Appendix E, Troubleshooting):
- Voltage does not change or changes less than 25 mV as you turn a screw, **or**
- Voltage changes randomly as you turn a screw (i.e., not in a consistent direction).

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

7. To complete installation, ensure that:
   - All three screws are tightened until the T-handle driver flexes in torsion, 1/4 turn past the point where the screw stops turning, with this flexing procedure repeated several times to ensure the screw is tight, **and**
   - Voltage is in the range -200 to +200 mV.



Notes:
1. Do not apply rust inhibitor outside the 2.50" (63.5mm) diameter bare metal, or environmental cover will not adhere properly.
2. Place small amount of sealant on each screw before mounting L-Cell.

Figure 3-12. L-Cell Mounting

8. Prior to installing the environmental cover(s), ensure the mating surface(s) on the leg is free of dirt and grease. Reclean if necessary, being careful not to remove the rust inhibitor on the bare metal.

9. Fig 3-13. Peel the protective backing from the double-sided tape on the environmental cover's inside flange.
   A. Align the environmental cover over the installed L-Cell, with the cable through the cover's exit channel. Press the cover onto mounting surface.
   B. Spread a 1/8" (3.2mm) bead of sealant around the joint between the cover and mounting surface. Add extra sealant to the cable exit channel and between cable and skirt.
   C. Use your finger to smooth the sealant around all edges and joints, eliminating areas where moisture may pool, especially along the top edge. Verify that the sealant forms a continuous, watertight seal. Ensure the cable exit channel is completely sealed.

10. If you created any holes that go completely through the support metal, spread sealant (Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738) over the open holes. Use your finger to press sealant into each hole.

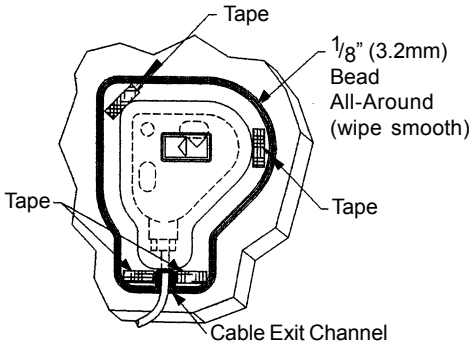


Figure 3-13. Environmental Cover

Mounting the Junction Box

CAUTION

Do not install junction boxes in the rain. Moisture in the junction box will cause corrosion and system errors.

Note

Junction box mounting hardware is not supplied by KM. KM recommends #8-32 socket head cap screws and flat washers. The instructions below reflect this recommendation.

Mounting Location

Each junction box can be wired to a maximum of four L-Cells:

- L-Cells — one junction box **can** be wired to L-Cells from two support legs (two L-Cells on each support leg) if the legs are sufficiently close to each other to allow the L-Cell cables to reach.

See Figure 3-15. Locate the junction box on the support leg web or on a brace. Vertically, locate junction boxes at a convenient height, approximately 4' (1.2m) from the ground. The exact location of the junction box is not critical, but ensure you have sufficient cable length and that a drip loop will be formed by the L-Cell cables when wired to the junction box.

Junction Box Installation

1. Remove the junction box cover.
2. See Figure 3-14. Hold the junction box at the previously marked mounting location. Mark the mounting holes. Mark the four outside mounting holes (mounting on a flat surface), such as an I-Beam.
3. Drill and tap the mounting holes with a #29 drill bit and #8-32 tap.
4. Mount the junction box with #8-32 socket head cap screws and flat washers. Tighten the screws until snug. Replace the junction box cover and screws if not ready to begin wiring, to ensure no moisture enters the junction box.

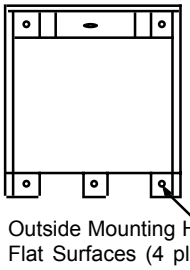


Figure 3-14. Junction Box Mounting

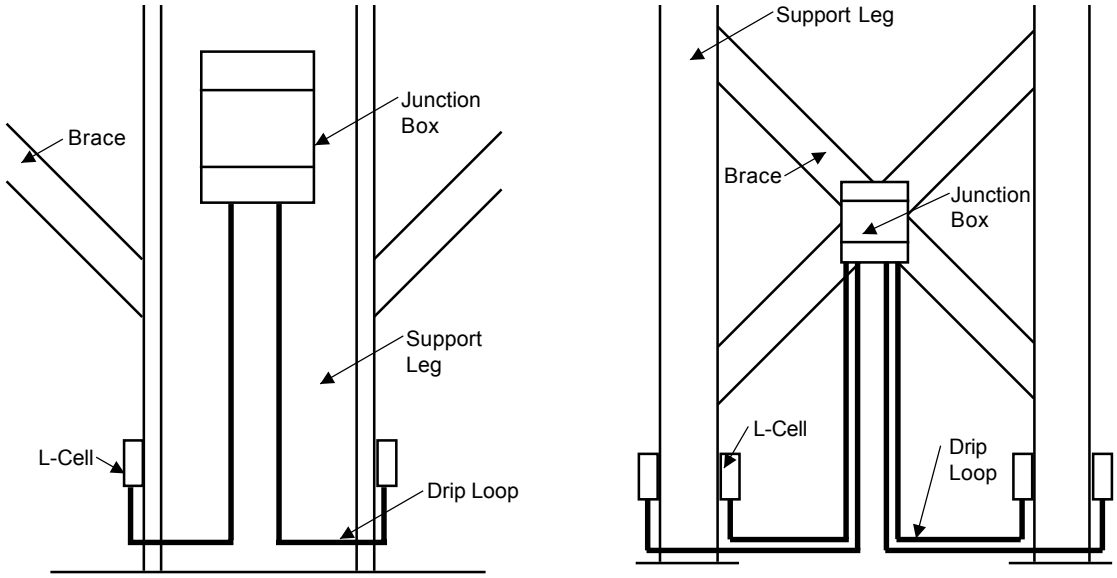


Figure 3-15. Possible Junction Box Mounting Locations

Wiring L-Cells to Junction Boxes

Note

1. The four small holes in the bottom of the junction box are for wiring the L-Cells to the junction box.

1. Remove the junction box cover.

2. See Figure 3-16. Place a plastic washer on a watertight fitting. Thread the L-Cell cable through a cap and watertight fitting. Leave an adequate length of cable between the L-Cell and fitting to provide a drip loop (see Figure 3-15).

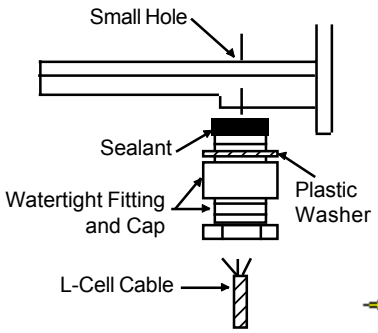


Figure 3-16. Inserting L-Cell Cable through Watertight Fitting and Cap

3. Spread a generous bead of sealant around the sides of the watertight fitting.

4. In the bottom of the junction box, locate one of the four small holes closest to the terminal you will use for that L-Cell. Screw the watertight fitting into the hole.

Note

TB3 terminal block has 12 terminals to accommodate up to four L-Cells (A, B, C, and D). Locate the terminal labeled for the L-Cell you are wiring.

5. Estimate the required length of cable to the terminal strip, allowing a little extra for strain relief. Cut the excess cable.

6. Strip back 3" (76mm) of the cable sheathing to expose the three wires inside. Strip back 1/4" (6mm) of insulation from the end of each of the wires.

7. Fig 3-18. Connect the wires from the L-Cell to the selected TB3 terminals: black wire to B terminal, white wire to W terminal, and red wire to R terminal.

8. Perform Steps 2 through 7 for each L-Cell you wire to this junction box (up to four).

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

9. Spread a generous bead of sealant (Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738) around the sides of the plug for each hole not being used. Screw a plug into each hole.

10. Replace the junction box cover and screws if not ready to begin wiring the junction boxes together, to ensure no moisture enters the junction box.

Wiring Junction Boxes Together and to Signal Processor

There are two versions of the junction box enclosure. Both versions have four small holes for wiring L-Cells to the junction box, as described above. In addition, the junction box has one or two large holes:

- One large hole for conduited installation — The large hole, which accommodates a 3/4" conduit fitting, is for wiring the junction box to the other junction boxes and to the signal processor.
- Two large holes for non-conduited installation — The two large holes, which are equipped with PG13.5 cable fittings, are for wiring the junction box to the other junction boxes and to the signal processor. **KM requires the use of cable trays for non-conduited installations**.

Notes

1. The procedure below assumes the conduit/cable tray has been installed.
2. Seal all conduit fittings against water entry. Install drain holes at conduit's lowest elevation(s) to allow condensation to drain.
3. Use Belden™ 3-conductor shielded interconnect cable or equivalent to wire junction boxes together and to the signal processor. For lengths up to 1,000' (305m) use 18-gauge Belden 8791 cable. For lengths from 1,000' to 2,000' (305m to 610m) use 16-gauge Belden 8618 cable.
4. When wiring cable to junction box terminals, strip back 3" (76mm) of cable sheathing to expose the three conductor wires and shield wire inside. Strip 1/4" (6mm) of insulation from the end of each of the conductor wires.
5. All wiring routed between junction boxes and signal processor must be continuous (no splices).

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

1. Remove the junction box cover.
   - Conduited installation — Install a conduit fitting in the large hole in the bottom of the junction box.
   - Non-conduited installation — See Figure 3-17. Spread a generous bead of sealant around the sides of the PG13.5 cable fittings. Install the fittings in the two large holes in the bottom of the junction box.

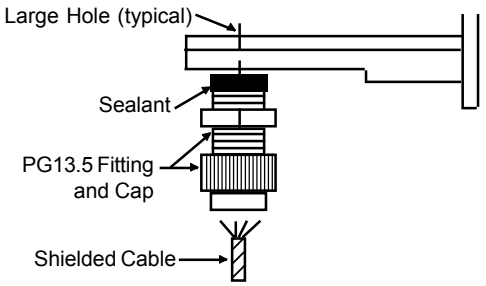


Figure 3-17. Inserting Shielded Interconnect Cable through PG13.5 Fitting and Cap

2. See Figure 3-19 (conduited installation) or Figure 3-20 (non-conduited installation). Route the 3-conductor cable through the fitting into the junction box farthest from the signal processor. Connect wires from the cable to the TB2 terminal in the junction box: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

3. Route the cable through conduit/cable tray to the next junction box. Estimate the required length of cable to the terminal strip, allowing a little extra for strain relief. Cut the excess cable. Connect wires from the cable to the TB1 terminal in the junction box: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

4. Route another 3-conductor cable through the fitting into this junction box, and attach wires to the TB2 terminal: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

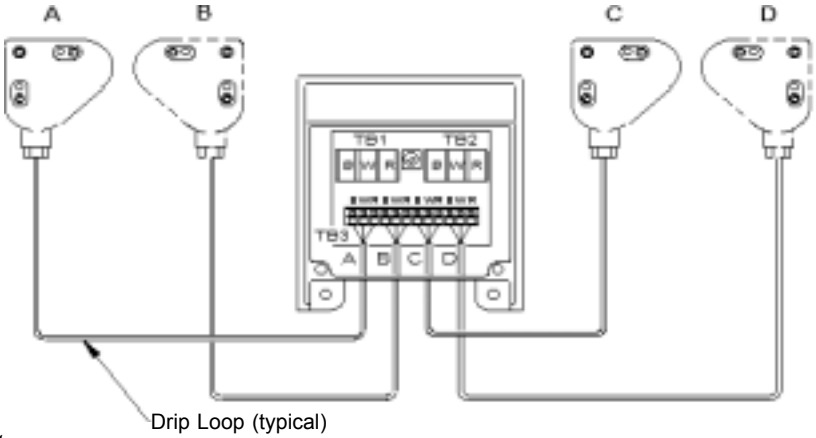
5. Repeat Steps 3 and 4 until all junction boxes for the vessel are wired together.

6. Route the cable from the last junction box through conduit/cable tray to the signal processor. Refer to the signal processor manual for wiring the junction box to the signal processor. One vessel takes up one channel in the signal processor — the channel shows the average value from all the L-Cells on the vessel supports.

Note

SHLD screw is Shield Terminal Ground which is floating. Ground the cable shield through the signal processor.

Junction Box PCB 63-1170-01



Notes:
- Verify that junction box PCB is 63-1170-01 (bottom center)
- L-Cells A and B are on one support leg.
- L-Cells C and D are on another support leg. L-Cells C and D can be wired as shown, or can be wired to its own junction box (terminals A and B) if desired.

Figure 3-18. L-Cells wired to Junction Box

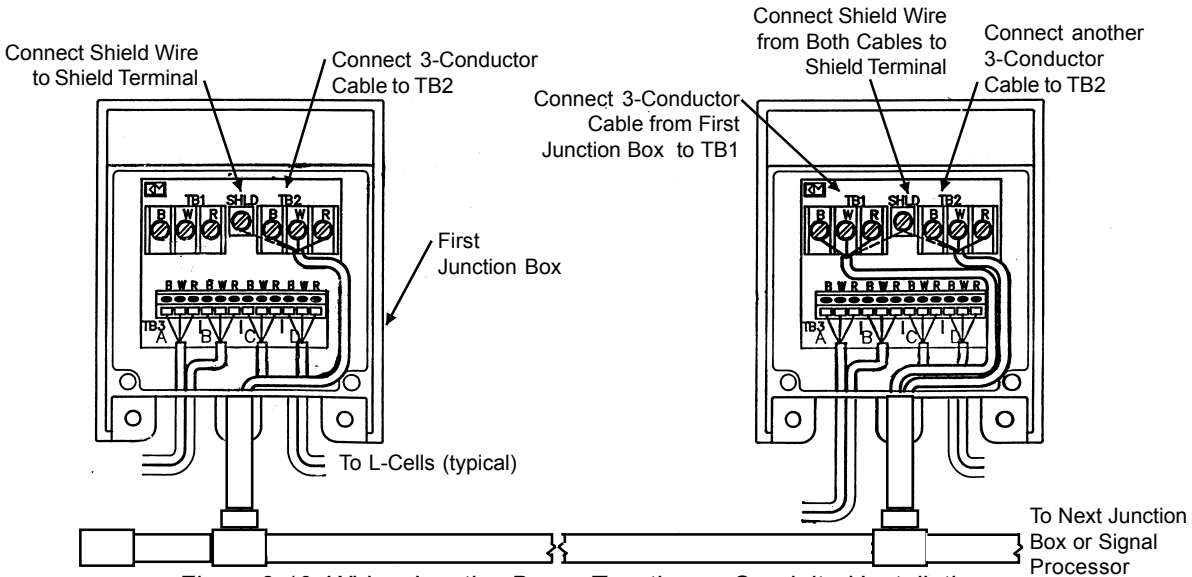


Figure 3-19. Wiring Junction Boxes Together — Conduited Installation

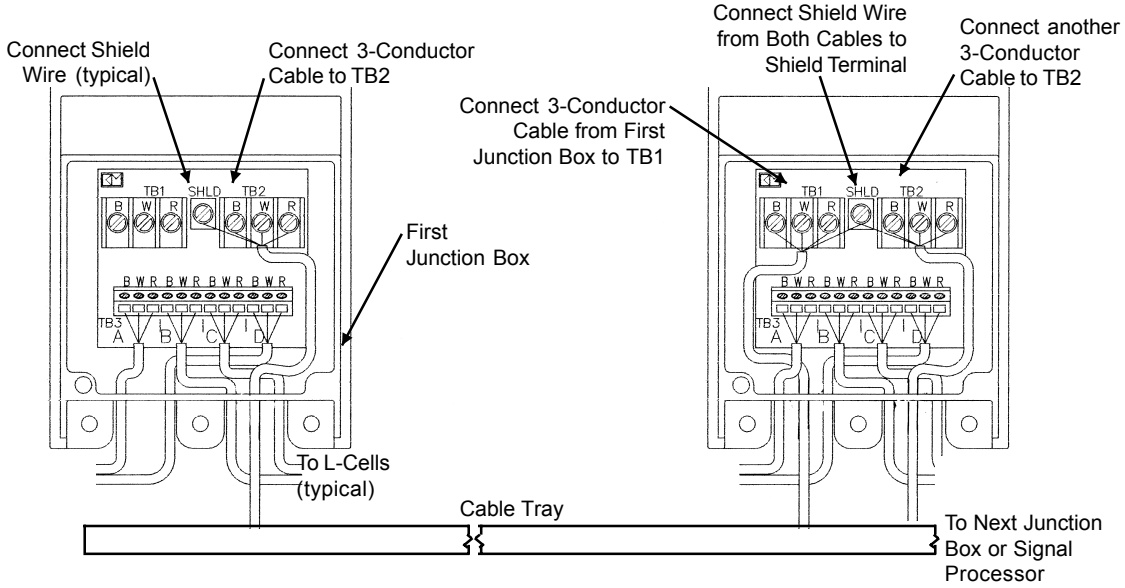


Figure 3-20. Wiring Junction Boxes Together — Non-Conduited Installation

Chapter 4: Installation of the L-Cell on Horizontal Beams

*Follow the instructions in this chapter **only** if installing L-Cells on horizontal beams.*

This chapter describes the mounting locations, installation details, and wiring details for L-Cells and junction boxes. Follow all instructions carefully to ensure proper system operation.

Follow the procedures below to determine L-Cell mounting locations prior to beginning installation. This will ensure optimal system performance. Consult KM if special considerations prevent you from installing L-Cells at the designated locations.

L-Cell Mounting Locations

L-Cell Sets

L-Cells are best mounted on beams in a shear mounting set (Fig 4-1). The number of cells and their placement is a function of desired accuracy, installation requirements, and maintenance considerations. See page 4-3 for a description of the five mounting methods.

Distribution of L-Cell Sets

The distribution of L-Cell sets on beams is dependent on vessel support configuration. Figure 4-2 shows the distribution of sets for eight support configurations, varying from independent vessels to multiple vessels with common columns and beams. Note in all cases with common beams between multiple vessels, **the common lateral beams are not instrumented with L-Cells**.

Figures 4-3 through 4-7 show the location of L-Cell sets on a beam. The ideal location is midway between the vessel support bracket and the support column or beam. This places the shear mounting set away from joints and load points. The minimum distance between the load point and the support column or beam should be equal to the beam height or 18" (457mm), whichever is highest. If less space is available, consult KM before proceeding further.

Note
L-Cell locations may be adjusted up to 12" (305mm) in any direction to avoid obstacles. If adjusting locations, maintain the configuration of the set (i.e., if you move one L-Cell in the set from its *ideal* location, move the other L-Cell as well).

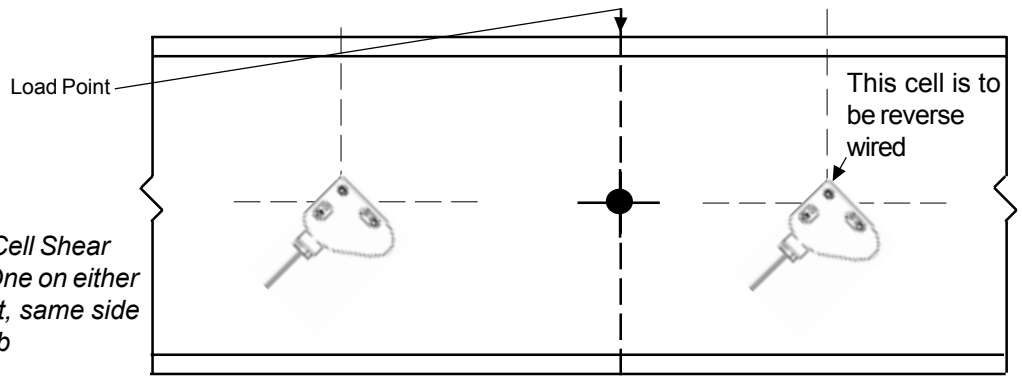
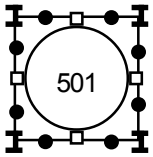
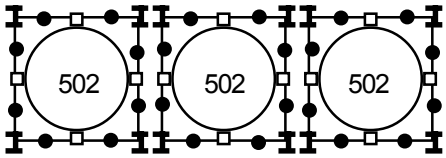
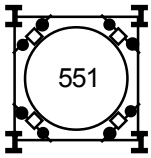
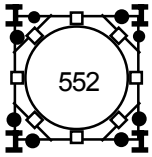
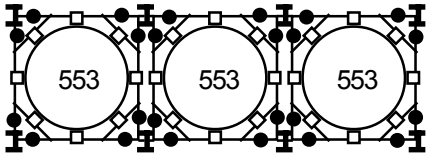
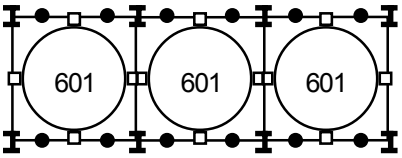
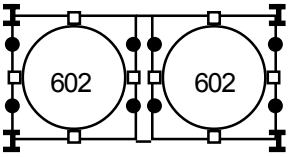
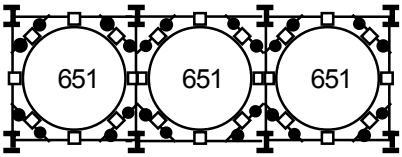


Figure 4-1. L-Cell Shear Mounting Set-- One on either side of load point, same side of web

	Description	# of Support Points for Each Vessel
Series 500 — Independent Beams		
	Single vessel — no diagonal beam supports	4
	Multiple vessels — no diagonal beam supports, no common beams or common vertical legs	4
	Single vessel — diagonal beam supports, weight supported by diagonal beams only	4
	Single vessel — diagonal beam supports, weight supported by horizontal and diagonal beams	8
	Multiple vessels — diagonal beam supports, weight supported by horizontal and diagonal beams, no common beams, common vertical legs	8
Series 600 — Common Horizontal Lateral and/or Longitudinal Beams		
	Multiple vessels — no diagonal beam supports, common internal lateral beams, common internal vertical legs (Note: This application will produce some degree of interference between vessels.)	4
	Multiple vessels — no diagonal beam supports, independent internal lateral beams, common longitudinal beams (Note: This application will produce some degree of interference between vessels.)	4
	Multiple vessels — diagonal beam supports, weight supported by horizontal and diagonal beams, common internal lateral beams, common internal vertical legs (Note: This application will produce some degree of interference between vessels.)	8

Notes:

1. Illustrations for Series 501, 502, 551, 552, 553, and 651 show L-Cells in relationship to the load points.
2. If your application differs from the above, contact K-M for application assistance.

Legend:

I = vertical leg

□ = vessel support point

● = mounting location for L-Cell set

Figure 4-2. L-Cell Mounting Locations

L-Cell Mounting Methods

The sensors are mounted at the neutral axis on the web of the beam, at a 45-degree angle, halfway between the loading point and the support point. The following methods provide varied degrees of accuracy.

I. Same Side: One L-Cell to the left and one L-Cell to the right of the load point equidistant between the load and the support. The L-Cells are mounted on the same side of the web. The excitation of the L-Cell to the right of the load point must be reverse wired (See page 4-8). This arrangement provides average accuracy performance.

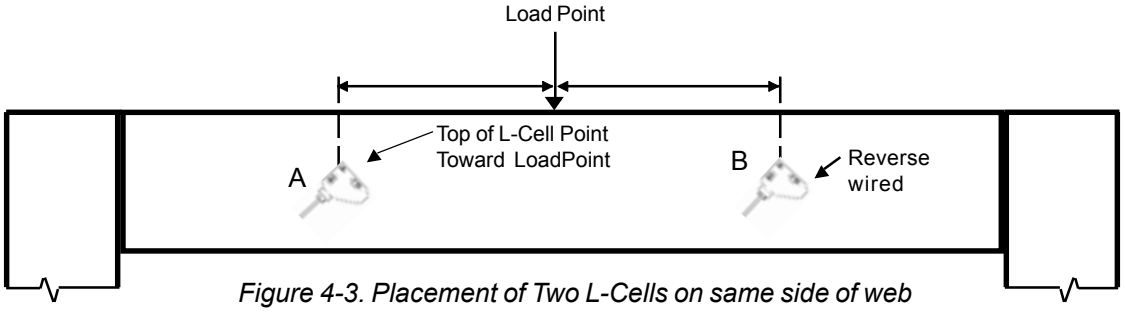


Figure 4-3. Placement of Two L-Cells on same side of web

II. Opposite Side: One L-Cell to the left and one L-Cell to the right of the load point equidistant between the load and the support. The L-Cells are mounted on opposite sides of the web. This arrangement provides average accuracy performance.

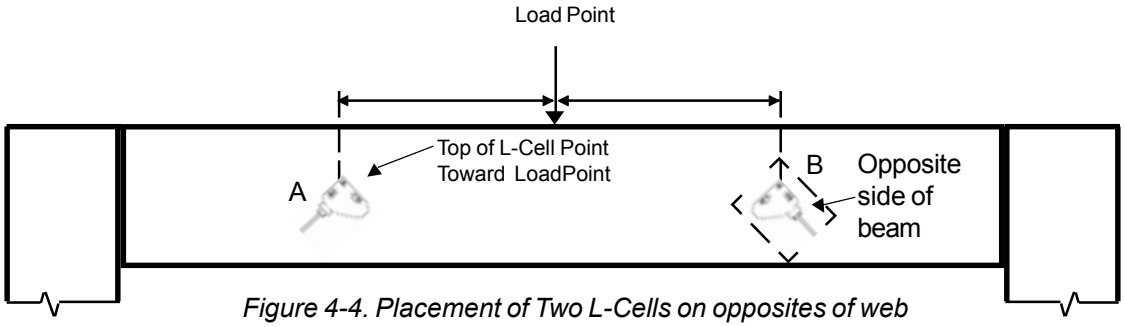


Figure 4-4. Placement of Two L-Cells on opposites of web

III. Back-to Back: Two L-Cells mounted back-to-back on the web. They can be mounted beck-to-back on either side of the load point, equidistant between the load and the support. This arrangement provides average accuracy performance.

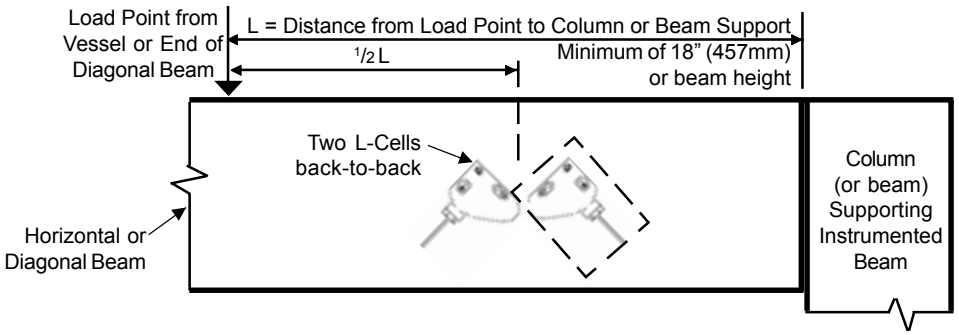


Figure 4-5. Placement of Two L-Cells back-to-back

IV. Single L-Cell: One L-Cell mounted on the web. It can be located on either side of the web and either side of the load point. It should be mounted equidistant between the load and the support. This arrangement yields the lowest accuracy performance.

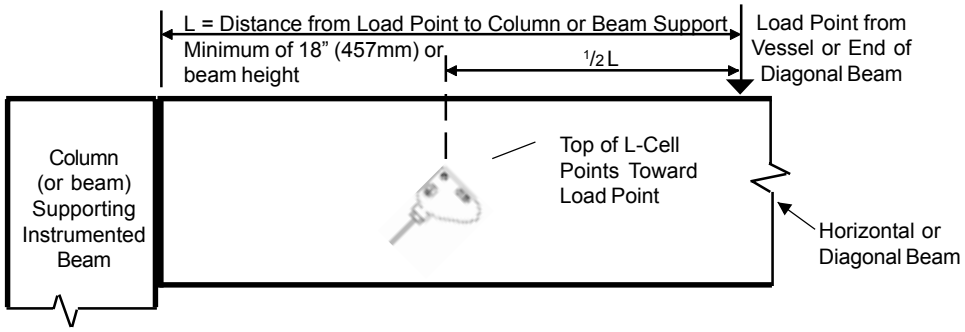


Figure 4-6. Placement of single L-Cell Set to Left of Load Point

V. Four L-Cells: Four L-Cells mounted back-to-back on the web. One pair mounted back-to-back to the right of the load point and one pair mounted back-to-back to the left of the load point. The pairs are mounted equidistant between the load and the support. This arrangement provides a degree of accuracy improvement over a two L-Cell arrangement.

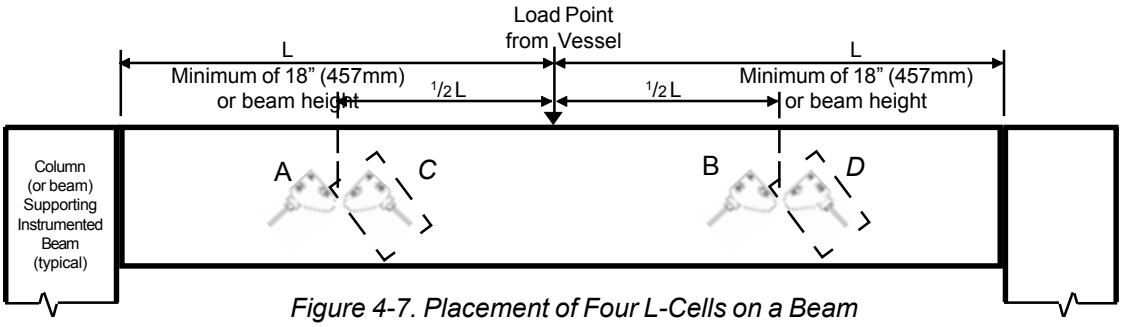


Figure 4-7. Placement of Four L-Cells on a Beam

Installing L-Cells

Notes

1. Use lubricating fluid (Relton RapidTap® Heavy Duty Cutting Fluid or equivalent) when drilling and tapping.
2. Drilling and tapping instructions assume a metal thickness greater than 3/4" (19mm). If the thickness is less, drill all the way through the metal and tap until cutting complete threads through the other side. Minimum metal thickness is 0.1875" (5mm), which provides six thread engagement.

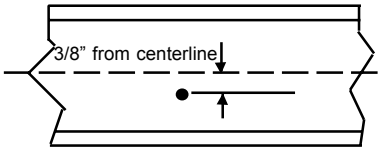


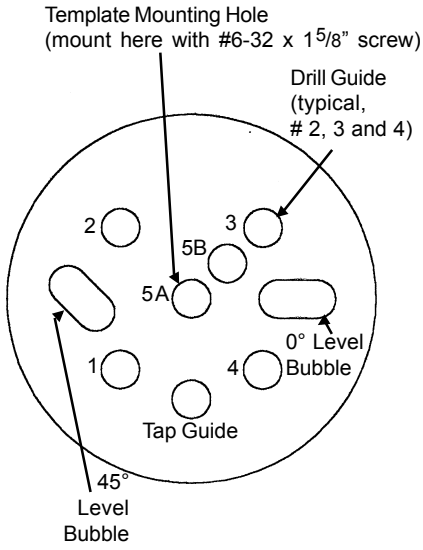
Figure 4-8. Mark Position

Surface Preparation

1. See Figure 4-8. Mark position of beam axis and of drill template mounting hole.
2. At the center of the L-Cell mounting location, drill all the way through the web with the #36 drill bit. This produces the template mounting hole.
2. Mark the surface preparation area for L-Cell A. Repeat for L-Cell B on the other end of the web, if applicable.
3. Attach the coarse grit sandpaper to the grinder. Remove heavy paint and rust with the grinder until a bare metal surface is achieved for L-Cell A. Due to the use of coarse grit, the resulting surface is somewhat coarse. Repeat for L-Cell B.
4. Replace the coarse grit sandpaper with the fine grit sandpaper. Grind until the surface is completely down to bare metal and smooth to the touch for L-Cell A. Repeat for L-Cell B.

Note:

The L-Cells must be mounted against smooth, bare metal. Remove all paint and rust from the area where the L-Cells are to be fastened.



Notes:
1. After L-Cell mounting holes drilled, rotate template to use tap guide to tap holes.
2. Holes #1 and 5B and 0° bubble not used for this application.

Figure 4-9. Drill and Tap Template

Drill and Tap

1. Using the #6-32 tap, thread the template mounting hole (drilled during *Surface Preparation*) until the tap is cutting complete threads through the other side. Remove any burrs from the hole.

2. See Figure 4-9. Starting with L-Cell A's location, fasten the drill template to the template mounting hole through the #5A hole, using the #6-32 socket head cap screw. Use a level to ensure correct orientation (45° angle to the horizontal).

3. Drill the L-Cell mounting holes with the #36 drill bit, using the template guides as follows:

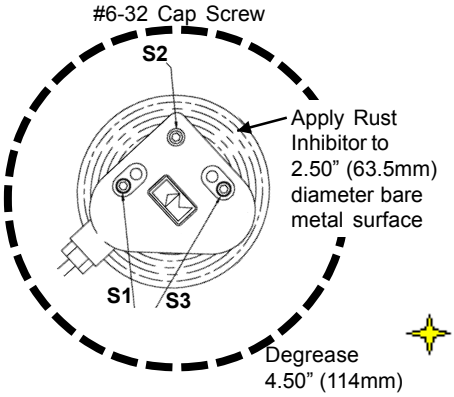
   A. Drill hole #3.
   B. Insert a spare drill bit through hole #3 in the template to hold securely in place.
   C. Drill hole #2 and #4. Remove spare drill bit from hole #3.

4. Loosen the screw securing the template and rotate the template until the tap guide ia aligned with hole #2. Retighten the screw securing the template. Using tap guide, thread hole #2 with the #6-32 tap. Repeat step 4 for hole #3 and #4.

5. Repeat Steps 1 through 4 , starting from Surface Prep for L-Cell B on the other end of the web or other side of beam.

6. Remove burrs from all the holes created.

Mounting L-Cell



Notes:
1. Do not apply rust inhibitor outside the 2.50" (63.5mm) diameter bare metal, or environmental cover will not adhere properly.
2. Place small amount of sealant on each screw before mounting L-Cell.

Figure 4-10. L-Cell Mounting

CAUTION

Do not install L-Cells in the rain.
Do not trap moisture under the environmental cover.

1. Mark two small pieces of masking tape 'A.' Place one piece of tape on the plastic body of a L-Cell and one piece near the end of the L-Cell cable. Repeat for the other L-Cell, labeling it 'B.'
2. Wipe down a 5 in. X 2 1/4 in. (127mm x57mm) surface, centered on the template mounting hole, with degreaser. This cleans the bare metal and adjacent mounting surface for the environmental cover. See Fig 4-10.
3. Apply a thin coat of K-M rust inhibitor to the bare metal surface for L-Cell A.

Note

Do not apply rust inhibitor beyond this area, or the environmental cover will not adhere properly.

4. Connect the L-Cell's red, black, and white wires to the corresponding terminals on the K-M Test Meter. Turn on the power to the Meter and set the Simulate/Test switch to the Test position.

Note

If a KM Test Meter is not available, refer to Appendix G, Alternate Method for Checking Output, before proceeding with Step 5.

5. With the cable end down, align L-Cell A with the mounting holes, ensuring that the top of L-Cell A faces toward the vessel load point. Fasten the L-Cell **loosely** to the web using the three socket head cap screws (and sealant). **Do not tighten the screws**. If the voltage goes outside the range -200 to +200 mV, immediately loosen the screw(s).

CAUTION

For proper installation, tighten each screw until the T-handle driver flexes in torsion 1/4 turn past the point where the screw stops turning. Repeat this flexing procedure several times to ensure the screw is tight. When both screws are tight, the voltage must be in the range -200 to +200 mV. Follow the procedure in Steps 6 through 8 to achieve this goal.

6. Using the T-handle driver, **slowly** tighten screw #S2. While turning the T-handle driver, monitor the Test Meter carefully.
   If the voltage goes outside the range -200 to +200 mV while tightening, stop immediately and evaluate the following:
   - If the voltage **jumped** outside the range -200 to +200 mV, it may indicate a burr or rough surface. Remove the screws holding the L-Cell to the web. Remove burrs and surface roughness (refer to *Surface Preparation* for removing surface roughness). Repeat Steps 1 through 6.
   - If the voltage **gradually moved** outside the range -200 to +200 mV, slowly loosen the screw until the voltage is within range again and proceed to Step 7.

7. Repeat Step 6 for screws S1 and S3. If the voltage is outside the range -200 to +200 mV, attempt to bring the reading within range by loosening the screw being torqued, tightening the other screw, or some combination of loosening and tightening. If you have difficulty staying within the range, try turning each screw 1/4 turn at a time until both screws are tightened.

Note

If the following occurs while tightening screws, check L-Cell resistance using a DMM (described in Problem 1 in Chapter 6, Troubleshooting):

- Voltage does not change or changes less than 25 mV as you turn a screw, **or**
- Voltage changes randomly as you turn a screw (i.e., not in a consistent direction).

8. To complete installation, ensure that:
   - Both screws are tightened until the T-handle driver flexes in torsion, 1/4 turn past the point where the screw stops turning, with this flexing procedure repeated several times to ensure the screw is tight, **and**
   - Voltage is in the range -200 to +200 mV.

9. Repeat Steps 2 through 8 to install L-Cell B on the other side of the web.

10. Prior to installing the environmental covers, ensure the mating surfaces on the web are free of dirt and grease. Reclean if necessary, being careful not to remove the rust inhibitor on the bare metal.

11. See Figure 4-11. Peel the protective backing from the double-sided tape on the environmental cover's inside flange.
    A. Align the cover over the L-Cell, with the cable through the cover's exit channel. Press the cover onto the mounting surface.
    B. Spread a 1/8" (3.2mm) bead of sealant around the joint between the cover and mounting surface. Add extra sealant to the cable exit channel and between cable and skirt.
    C. Use your finger to smooth the sealant around all edges and joints, eliminating areas where moisture may pool, especially along the top edge. Verify the sealant forms a continuous, watertight seal.
    D. Repeat Step 11 for L-Cell B.

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

12. If you created any holes that go completely through the web, spread sealant (Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738) over the open holes. Use your finger to press sealant into each hole.

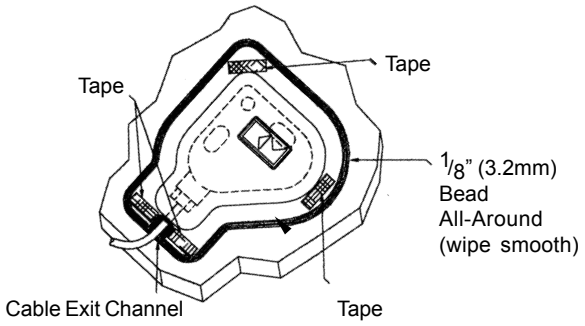


Figure 4-11. Environmental Cover

Mounting Junction Box

Mounting Location

Each junction box can be wired to a maximum of two L-Cell sets (four L-Cells total):

- One set of L-Cells on a beam — both L-Cells are wired to one junction box.
- Two sets of L-Cells on a beam — all four L-Cells are wired to one junction box if the sets are sufficiently close to each other to allow the L-Cell cables to reach the junction box.

See Figures 4-12 and 4-13. Locate the junction box on the instrumented beam or on the supporting column or horizontal beam. Ensure you have sufficient cable length and that a drip loop will be formed by the L-Cell cables when wired to the junction box.

CAUTION

Do not install junction boxes in the rain. Moisture in the junction box will cause corrosion and system errors.

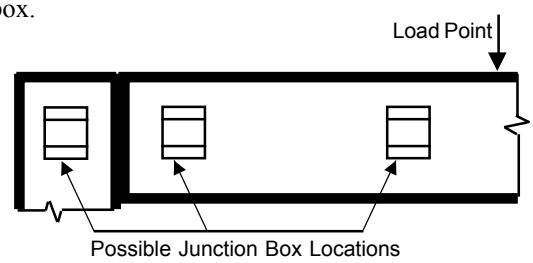


Figure 4-12. Junction Box Location — Two L-Cells per Junction Box

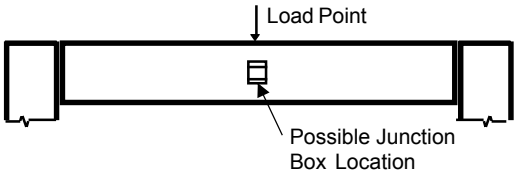


Figure 4-13. Junction Box Location — Four L-Cells per Junction Box

Junction Box Installation

Note

Junction box mounting hardware is not supplied by KM. KM recommends #8-32 socket head cap screws and flat washers. The instructions below reflect this recommendation.

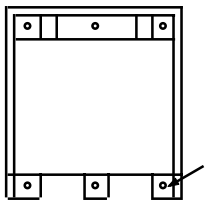


Figure 4-14. Junction Box Mounting

1. Remove the junction box cover.
2. See Figure 4-14. Hold the junction box at the previously marked mounting location. Mark the four outside mounting holes.
3. Drill and tap the mounting holes with a #29 drill bit and #8-32 tap.
4. Mount the junction box with #8-32 socket head cap screws and flat washers. Tighten the screws until snug. Replace the junction box cover and screws if not ready to begin wiring, to ensure no moisture enters the junction box.

Wiring L-Cells to Junction Box

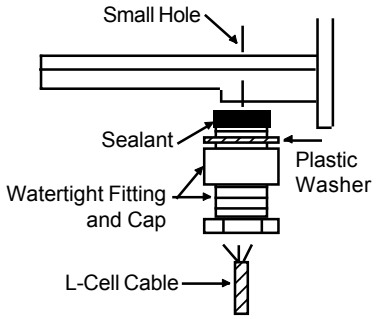


Figure 4-15. Inserting L-Cell Cable through Watertight Fitting and Cap

Notes

1. Junction box PCB 63-1170-01 is used for L-Cell sets on beams. **Ensure you have this PCB in the junction box (see Figure 4-16)**.
2. The four small holes in the bottom of the junction box are for wiring the L-Cells to the junction box.

1. Remove the junction box cover.

2. See Figure 4-15. Place a plastic washer on a watertight fitting. Thread the L-Cell cable through a cap and watertight fitting. Leave an adequate length of cable between the L-Cell and fitting to provide a drip loop. (see Figure 4-16).

3. Spread a generous bead of sealant around the sides of the watertight fitting.

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

4. See Figure 4-16. In the bottom of the junction box, locate one of the four small holes closest to the terminal you will use for that L-Cell. Screw the watertight fitting into the hole.

Note

TB3 terminal block has 12 terminals to accommodate up to four L-Cells (two shear sets). Wire L-Cell A to terminal A and L-Cell B to terminal B. If there are four L-Cells on one beam, wire L-Cell C to terminal C and L-Cell D to terminal D.

Sensor position A and B give different signals if mounted on same side of beam or back-to-back. Correct wiring is very important. See Step 7.

5. Estimate the required length of cable to the terminal strip, allowing a little extra for strain relief. Cut the excess cable.

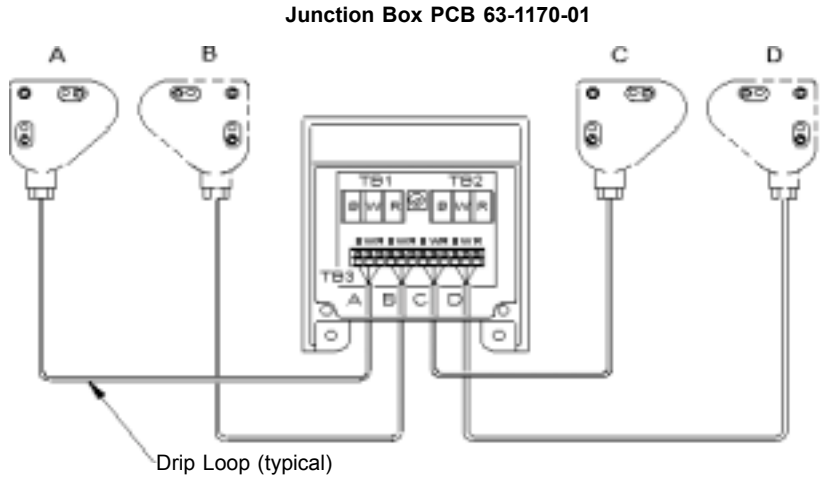
6. Strip back 3” (76mm) of the cable sheathing to expose the three wires inside. Strip back 1/4” (6mm) of insulation from the end of each of the wires.

7. Connect the wires from the left side of the load point and top of sensor pointing toward load point to the selected TB3 terminals: black wire to B terminal, white wire to W terminal, and red wire to R terminal. For second sensor mounted on same side of web or at back side, right side of load point and top of sensor away from load point, reverse wire: black wire to R terminal, white wire to W terminal, and red wire to B terminal.

8. Perform Steps 2 through 7 for each L-Cell you wire to this junction box (up to four).

9. Spread a generous bead of Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738 around the sides of the plug for each hole not being used. Screw a plug into each hole.

10. Replace the junction box cover and screws if not ready to begin wiring the junction boxes together, to ensure no moisture enters the junction box.



Note:
- Verify that junction box PCB is 63-1170-01 (bottom center)

Figure 4-16. Wiring L-Cells to Junction Box

Wiring Junction Boxes Together and to Signal Processors

There are two versions of the junction box enclosure. Both junction boxes have four small holes for wiring L-Cells to the junction box, as described above. In addition, the junction box has one or two large holes:

- One large hole for conduited installation — The large hole, which accommodates a 3/4" conduit fitting, is for wiring the junction box to the other junction boxes and to the signal processor.
- Two large holes for non-conduited installation — The two large holes, which are equipped with PG13.5 cable fittings, are for wiring the junction box to the other junction boxes and to the signal processor. **KM requires the use of cable trays for non-conduited installations**.

Notes

1. The procedure below assumes the conduit/cable tray has been installed.
2. Seal all conduit fittings against water entry. Install drain holes atconduit/cable tray lowest elevation(s) to allow condensa tion to drain.
3. Use Belden™ 3-conductor shielded interconnect cable or equivalent to wire junction boxes together and to the signal processor. For lengths up to 1,000' (305m) use 18-gage Belden 8791 cable. For lengths from 1,000' to 2,000' (305m to 610m) use 16-gage Belden 8618 cable.
4. When wiring cable to junction box terminals, strip back 3" (76mm) of cable sheathing to expose the three conductor wires and shield wire inside. Strip 1/4" (6mm) of insulation from the end of each of the conductor wires.
5. All wiring routed between junction boxes and signal processor must be continuous (no splices).

1. Remove the junction box cover.
   - Conduited installation — Install a conduit fitting in the large hole in the bottom of the junction box.
   - Non-conduited installation — See Figure 4-17. Spread a generous bead of sealant around the sides of the PG13.5 cable fittings. Install the fittings in the two large holes in the bottom of the junction box.

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

2. See Figure 4-18 (conduited installation) or Figure 4-19 (non-conduited installation). Route the 3-conductor cable through the fitting into the junction box farthest from the signal processor. Connect wires from the cable to the TB2 terminal in the junction box: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

3. Route the cable through conduit/cable tray to the next junction box. Estimate the required length of cable to the terminal strip, allowing a little extra for strain relief. Cut the excess cable. Connect wires from the cable to the TB1 terminal in the junction box: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

4. Route another 3-conductor cable through the fitting into this junction box, and attach wires to the TB2 terminal: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

5. Repeat Steps 3 and 4 until all junction boxes for the vessel are wired together.

6. Route the cable from the last junction box through conduit/cable tray to the signal processor. Refer to the signal processor manual for wiring the junction box to the signal processor. One vessel takes up one channel in the signal processor — the channel shows the average value from all the L-Cells on the vessel supports.

Note

Ground the cable shield only at the signal processor.

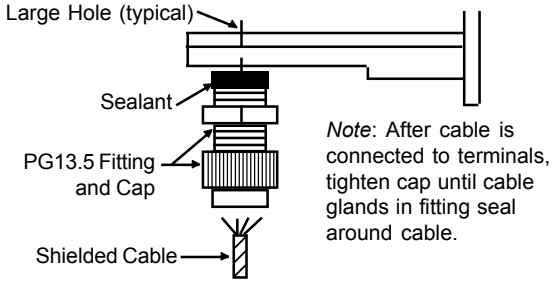


Figure 4-17. Inserting Shielded Interconnect Cable through PG13.5 Fitting and Cap

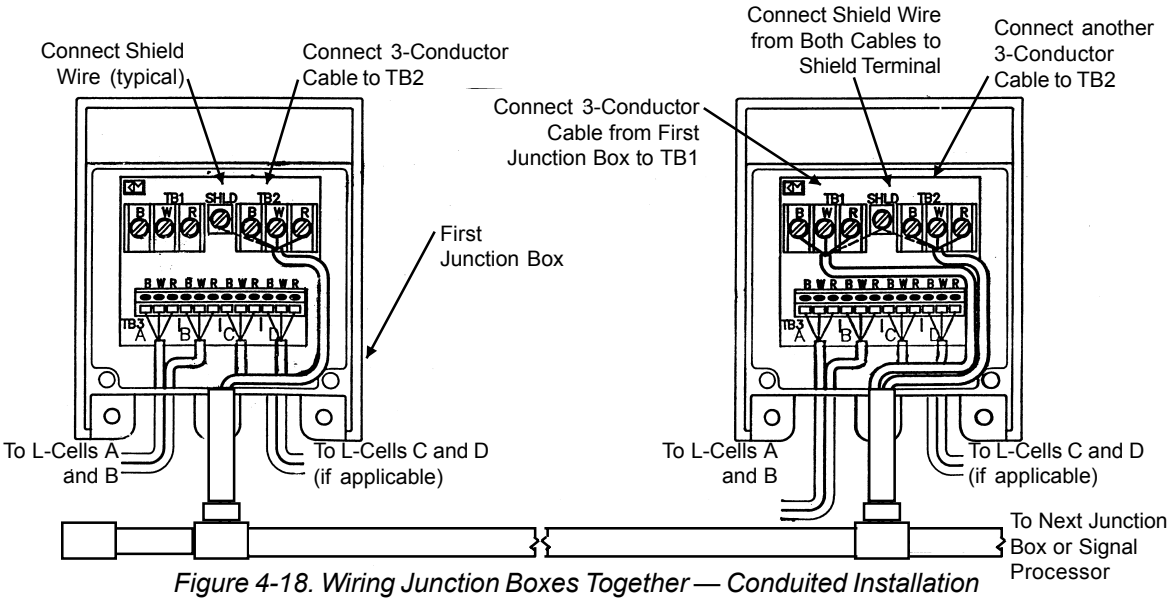


Figure 4-18. Wiring Junction Boxes Together — Conduited Installation

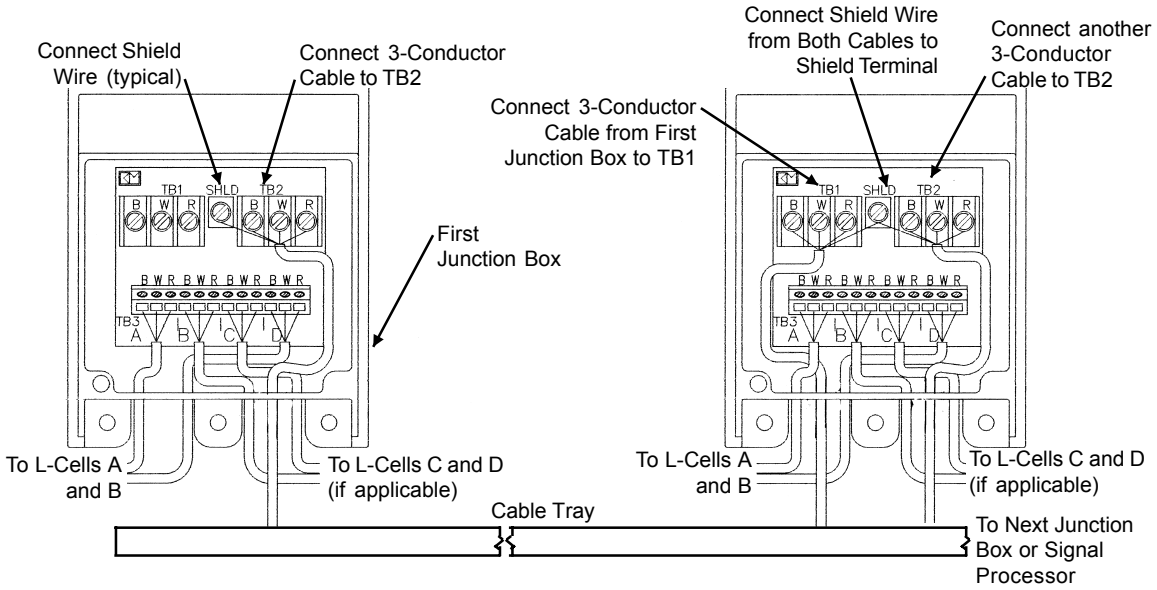


Figure 4-19. Wiring Junction Boxes Together — Non-Conduited Installation

Chapter 5: Installation of the L-Cell on Skirt Supported Vessels

Follow the instructions in this chapter ***only if you are installing L-Cells on skirt-supported vessels (carbon steel or aluminum)****.*

This chapter describes the mounting locations, installation details, and wiring details for L-Cells and junction boxes. Follow all instructions carefully to ensure proper system operation.

Figure 5-1. Skirted Silo

Based on information you provided on the Application Data Form, KM marked the form to show approximate L-Cell and junction box locations. The marked form was returned to you as part of the L-Cell shipment. Consult KM if the information you provided on the form does not reflect the current vessel configuration.

Read *the installation procedures* and follow the procedures in *Marking Mounting Locations* to determine and mark the exact mounting locations of the L-Cells and junction boxes on your vessel, prior to beginning installation. This will ensure optimal performance of the system. Consult KM if special considerations prevent you from installing L-Cells and/or junction boxes at the designated locations.

Note

If you have a skirted silo with spars, legs, or any load-bearing structures that are in addition to the skirt, consult KM for application and mounting location assistance. Stress distribution for these vessels is complex and can adversely affect system performance.

General Mounting Information

L-Cell Sets

See Figure 5-2. L-Cells are mounted around skirt-supported vessels in sets of two. For each set, one L-Cell is mounted on the outside and one on the inside of the skirt, with a 2.50" (63.5mm) horizontal offset.

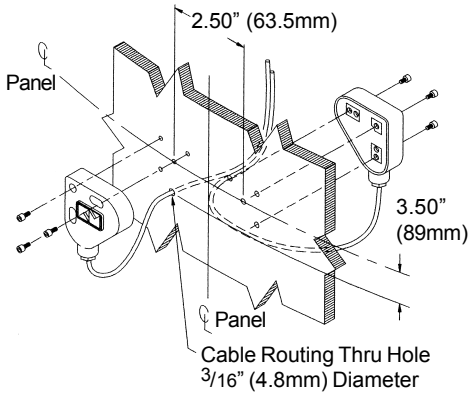


Figure 5-2. L-Cell Set Mounting

Distribution of L-Cells and Junction Boxes Around Vessel-*Carbon Steel*

Bolted, Skirt-Supported Vessels

See Figures 5-3 and 5-4. The skirt-supported vessel manufacturers' industry has standardized on bolted, skirt-supported vessel diameters and number of panels per diameter. Typically, the panels are approximately 5' (1.5m) wide x 8' (2.4m) high, with some overlap between panels. The mounting locations shown in Figures 5-3 and 5-4 are based on this industry standard.

Note

If the vessel panels differ significantly from this industry standard or the panel height is less than 6' (1.8m), consult K-M for assistance in determining optimal mounting locations.

Example: The Application Data Form indicates a 12' diameter bolted vessel. From Figure 5-3, a 12' bolted vessel has 8 panels around its circumference.

1. Locate an L-Cell set on panels 2, 4, 6, and 8 (skipping panel 1, which has a door), for a total of 8 L-Cells (4 panels x 1 L-Cell set/panel x 2 L-Cells/set).
2. Locate junction boxes on panels 3 and 7. The junction boxes will be wired as follows: panel 3 box to L-Cells (4) on panels 2 and 4, and panel 7 box to L-Cells (4) on panels 6 and 8.

Welded, Skirt-Supported Vessels

See Figures 5-3 and 5-4. The placement of L-Cells and junction boxes for welded vessels is similar to that for bolted. However, since there are no standardized panels, the L-Cell placement is based on the nominal distance between L-Cells shown in Figure 5-3.

Note

If the panel height is less than 6' (1.8m), consult K-M for assistance in determining optimal mounting locations.

Example 1: The Application Data Form indicates a 12' diameter welded vessel.

1. From Figure 5-3, for a 12' diameter vessel, the spacing between sensors is approximately 9'-5". Locate L-Cell sets at 9'-5" spacings around the vessel, with the door centered between 2 L-Cell locations, for a total of 8 L-Cells (4 locations x 1 L-Cell set/location x 2 L-Cells/set).

2. Locate junction boxes at 2 places, centered between the L-Cell locations. Two junction boxes will each be wired to 4 adjacent L-Cells.

Example 2: The Application Data Form indicates a 14' diameter welded vessel.

1. From Figure 5-3, for the next largest size (a 15' diameter) vessel, there are 5 L-Cell locations. Calculate the L-Cell spacing for a 14' diameter vessel: (p x diameter)/number of locations = spacing (p x 14')/5 locations= 8.8' = 8'-9" spacing . Locate L-Cell sets at 8'-9" spacings around the vessel, with the door centered between 2 L-Cell locations, for a total of 10 L-Cells (5 locations x 1 L-Cell set/location x 2 L-Cells/set). (Where p = # of panels)

2. Locate junction boxes at 3 places, centered between the L-Cell locations. Two junction boxes will each be wired to 4 adjacent L-Cells and one junction box will be wired to 2 adjacent L-Cells.

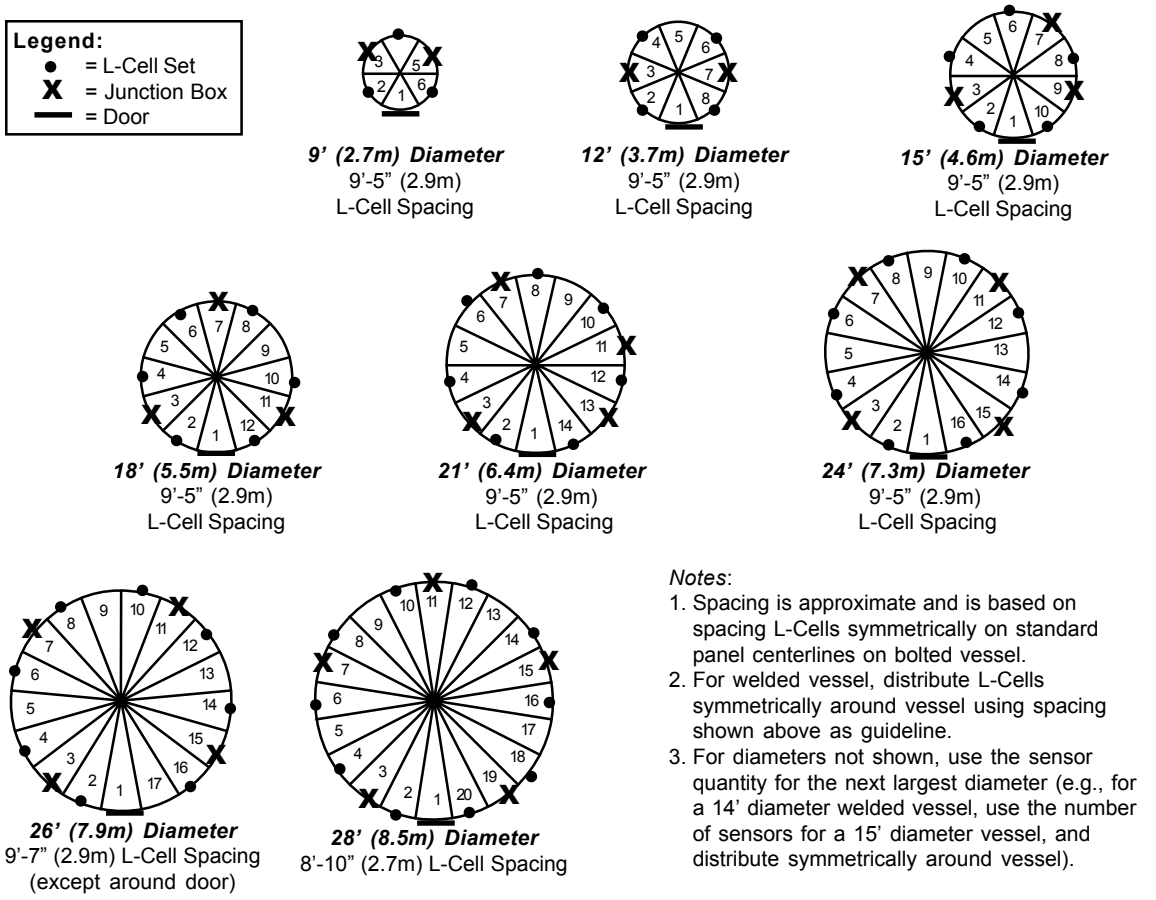


Figure 5-3. Plan View — L-Cell and Junction Box Locations (Carbon Steel)

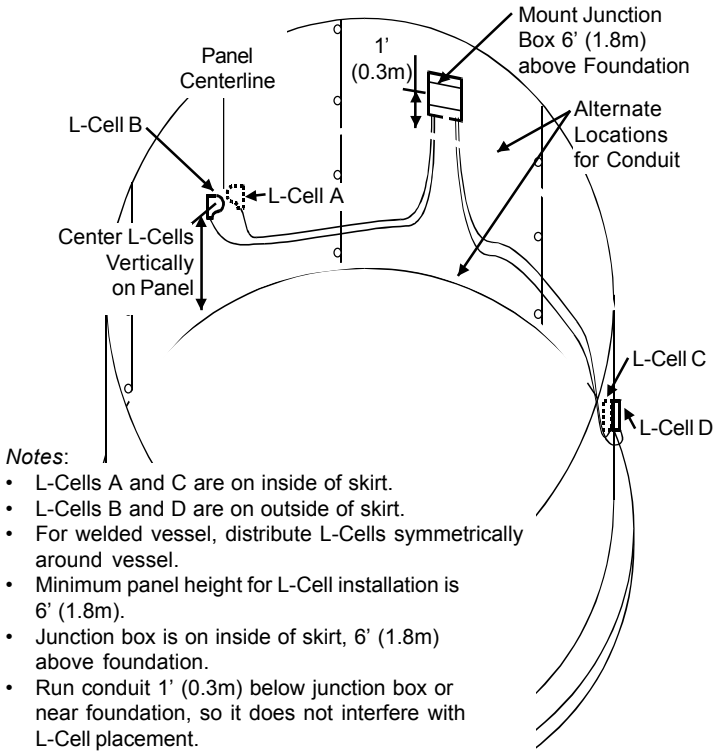


Figure 5-4. Perspective View — L-Cell and Junction Box Locations (Carbon Steel)

Distribution of L-Cells and Junction Boxes Around Vessel (Aluminum Vessels)

See Figures 5-5 and 5-6. Typical aluminum skirt-supported vessel sizes are shown in Figure 5-5. L-Cells are placed symmetrically around the vessel, with a maximum spacing of 4' (1.2m) between L-Cells. Typically, the tiers are 6.6' to 8.2' (2.0 to 2.5m) high, and the L-Cells are placed at the vertical centerline of the tier.

Note

If the vessel diameter is outside the range shown in Figure 4-2 (9.8' to 19.7' [3.0 to 6.0m]) or the tier height is less than 6' (1.8m), consult KM for assistance in determining optimal mounting locations.

See Figure 5-7. Place the first L-Cell set at the centerline of the door, or place one L-Cell at each side of the door.

Example 1: The Application Data Form indicates a 3m diameter aluminum vessel. The distance from top of door to top of tier is 1.0m.

1. From Figure 5-5, for a 3m diameter vessel, the spacing between sensors is approximately 1.18m. Locate L-Cell sets at 1.18m spacings around the vessel, for a total of 16 L-Cells (8 locations x 1 L-Cell set/location x 2 L-Cells/set). From Figure 5-7, center the first set above the door.

2. Locate junction boxes at 4 places, centered between the L-Cell locations. Each junction box will be wired to 4 adjacent L-Cells.

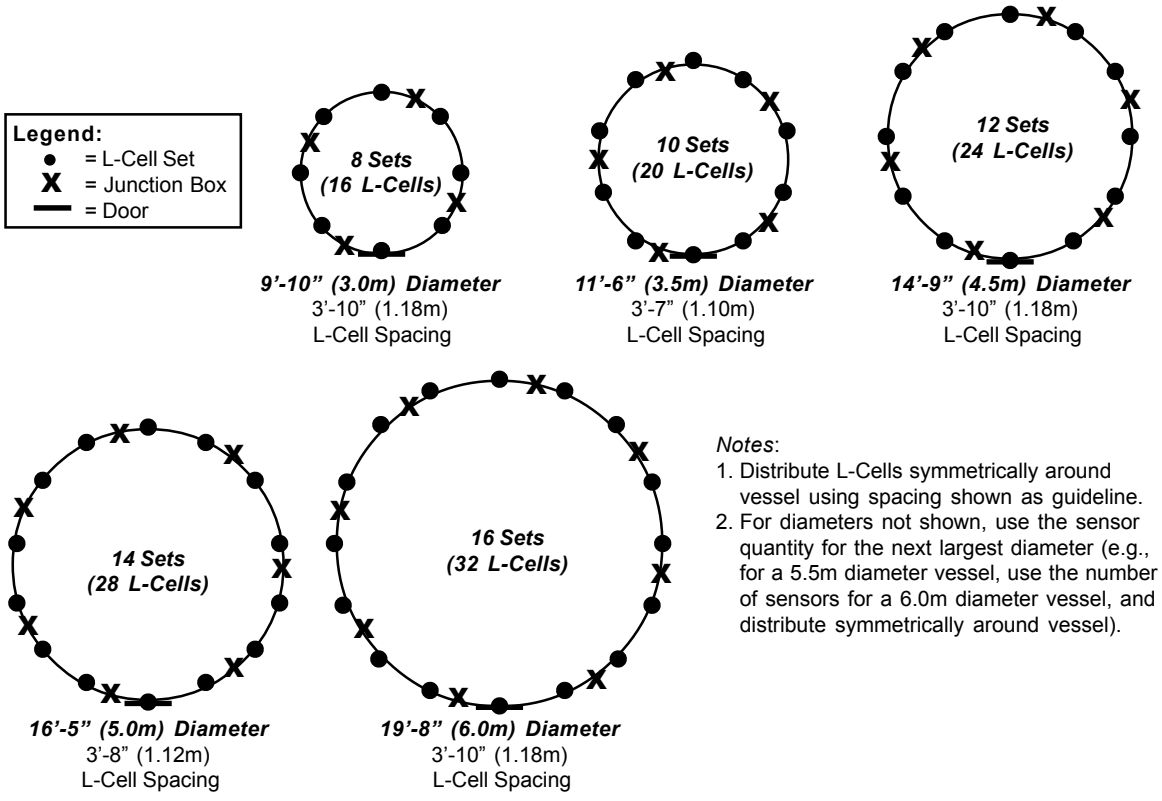
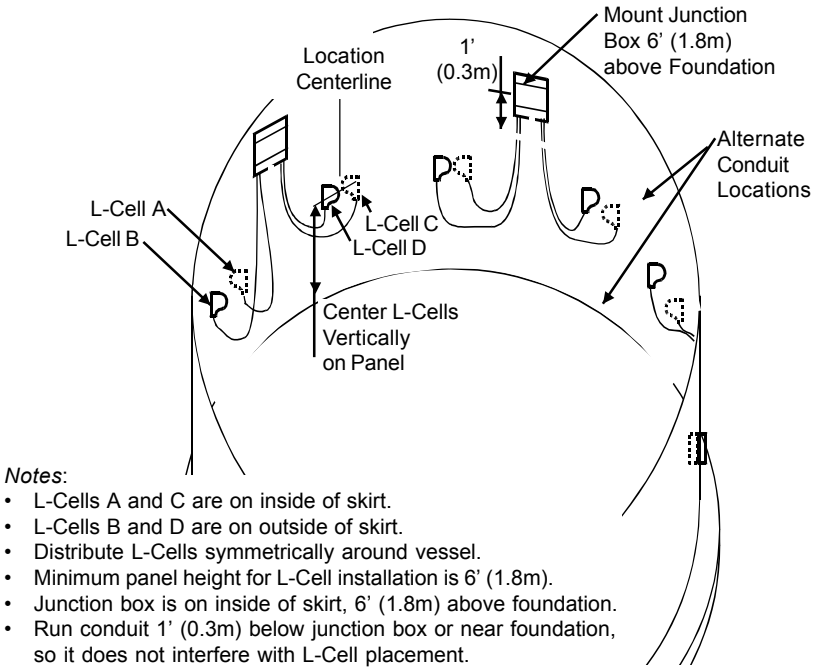


Figure 5-5. Plan View — L-Cell and Junction Box Locations (Aluminum)



Notes:
- L-Cells A and C are on inside of skirt.
- L-Cells B and D are on outside of skirt.
- Distribute L-Cells symmetrically around vessel.
- Minimum panel height for L-Cell installation is 6' (1.8m).
- Junction box is on inside of skirt, 6' (1.8m) above foundation.
- Run conduit 1' (0.3m) below junction box or near foundation, so it does not interfere with L-Cell placement.

Figure 5-6. Perspective View — L-Cell and Junction Box Locations (Aluminum)

**Note*: See Figure 5-5 for spacing, which is dependent on skirt diameter.

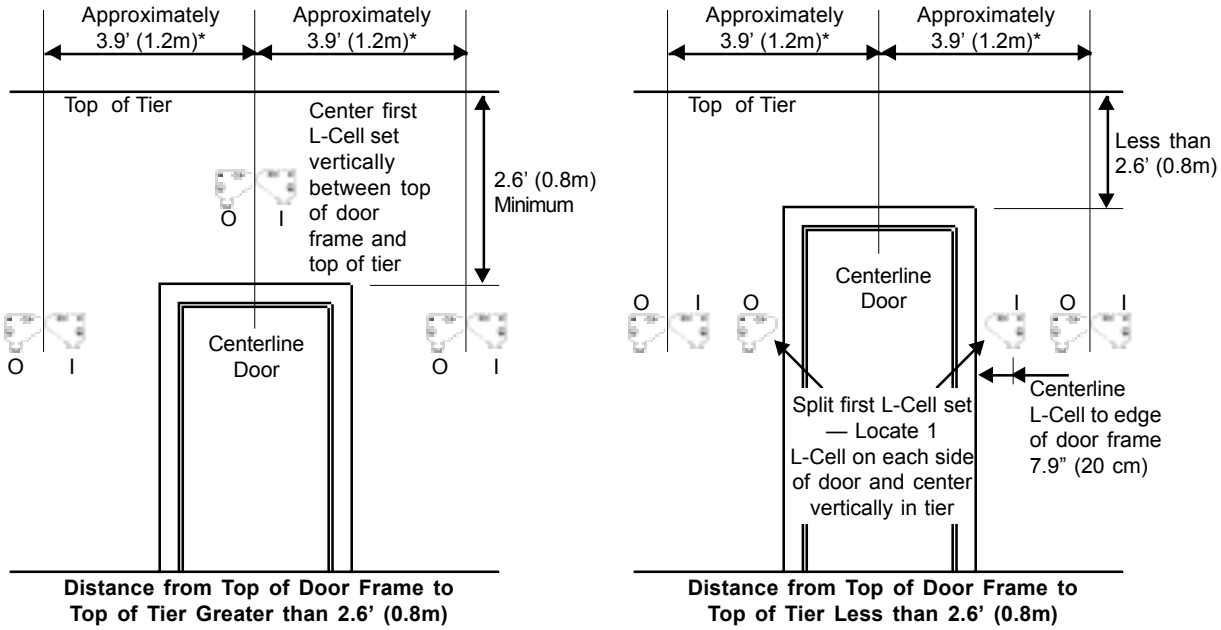


Figure 5-7. L-Cell Detail at Door

Obstructions

Obstructions typically encountered on a skirt-supported vessel include:

- pipe, conduit, auger, or other material conveyor passing through a panel
- open hole in a panel
- welded or bolted seams between panels
- bracket or electrical box welded or bolted to a panel
- welds around a patch, plugged opening

Carbon Steel

Obstructions can be classified as major or minor:

- Figure 5-8 shows an example of a **major obstruction**. For bolted vessels, do not place an L-Cell set on a panel with a major obstruction — skip to the next panel. For welded vessels, do not place an L-Cell set within 4' (1.2m) of a major obstruction.
- Figure 5-9 shows an example of a **minor obstruction**. Do not place an L-Cell set within 2' (0.6m) of a minor obstruction — less than 4" (102mm) in size.

See Figure 5-10. Minor obstructions may occur near the top or bottom of a panel. The *effective* panel height is the distance between the edge of the panel and the minor obstruction. If the *effective* panel height is 6' (1.8m) or greater, modify the vertical location of the L-Cell set so the set is at the center of the *effective* panel height. If the *effective* panel height is less than 6' (1.8m), relocate the L-Cell set as shown in Figure 5-9.

If adjusting L-Cell locations because of obstructions, maintain the offset configuration of the set (i.e., if you move one L-Cell in the set from its *ideal* location, move the other one as well).

See Figure 5-11. On some vessels, most obstructions occur on the first tier of panels, while the second tier is largely free of obstructions. If your vessel has many obstructions on the first tier and meets the requirements shown in Figure 5-11, consider installing the L-Cells on the second tier.

Mark Locations *(Bolted, Skirt-Supported Vessels)*

Note

The procedure for marking mounting locations is based on the nominal locations shown. Refer to the Application Data Form for the approximate mounting locations selected by KM.

1. Beginning on the outside of the skirt at the door panel (panel 1), walk clockwise to panel 2. Mark the preliminary L-Cell location:
   - Locate the L-Cell on the panel horizontal centerline.
   - Vertically, locate the L-Cell at the panel mid-height (typically 3' to 4' [0.9 to 1.2m] above the foundation).
   - Minor obstructions — Move the L-Cell so it is not within 2' (0.6m) of a minor obstruction. Vertically, center the L-Cell within the *effective* panel height.
   - Major obstructions — Move the L-Cell to the centerline of the next panel to avoid major obstructions.
2. Continuing to move clockwise around the outside of the skirt, repeat Step 1, marking preliminary mounting locations on panels 4, 6, etc.

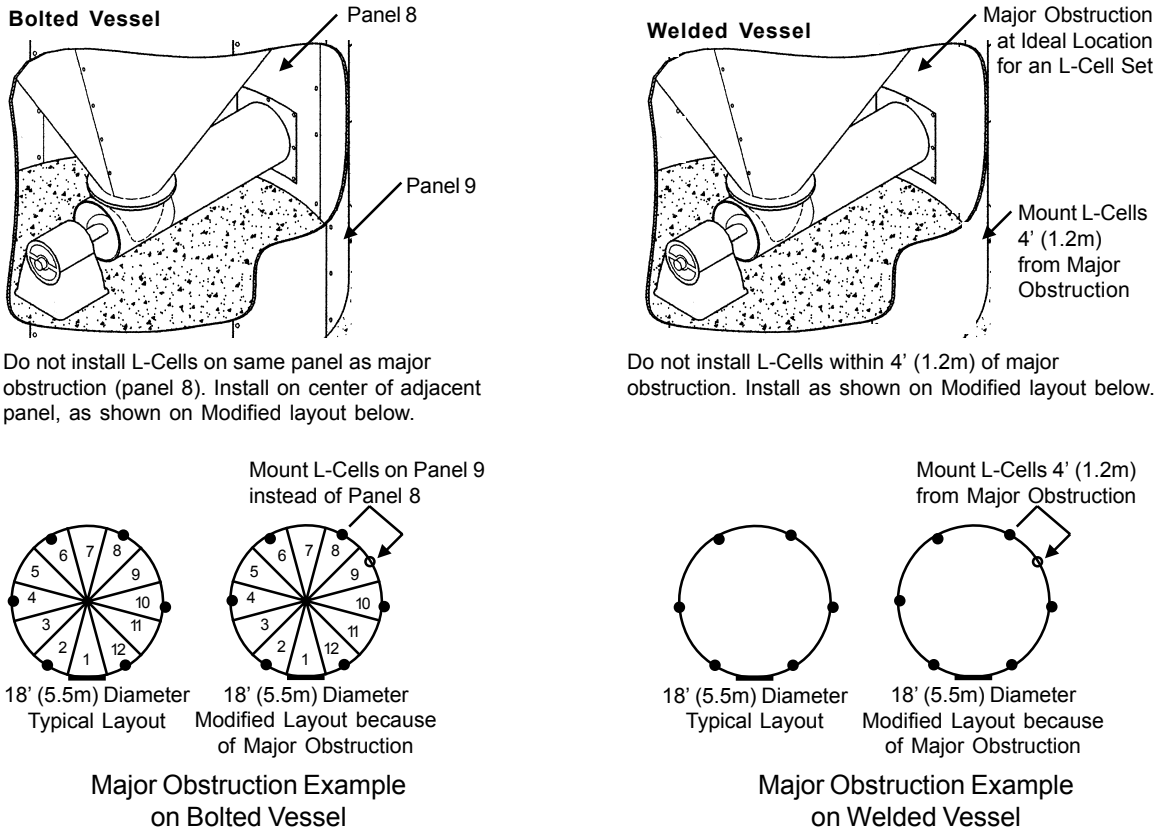


Figure 5-8. Mounting L-Cells in Alternate Locations because of Major Obstructions

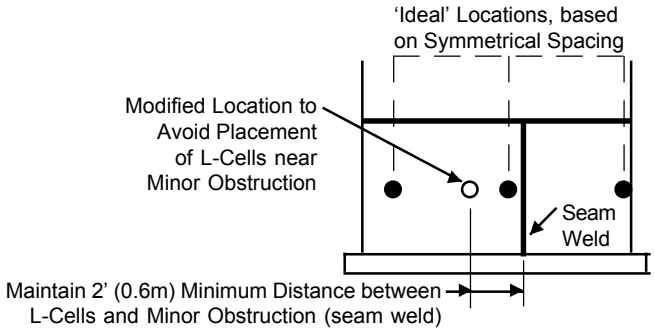
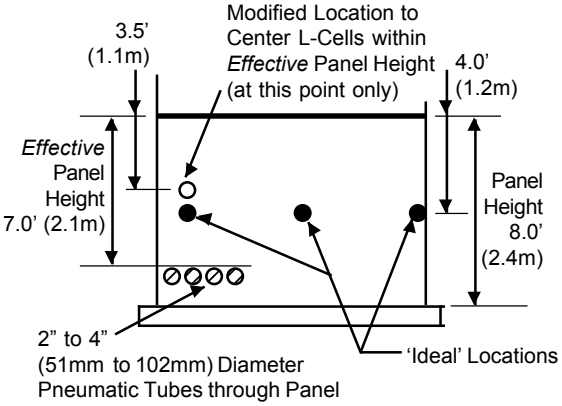


Figure 5-9. Mounting L-Cells in Alternate Locations because of Minor Obstructions

3. Proceed to the inside of the skirt and walk clockwise to panel 2. Mark the preliminary L-Cell location to match the **marked** location on the outside of the skirt:
   - If you adjusted the outside location because of an obstruction, maintain offset configuration of the set (i.e., if you move the outside L-Cell in the set from its *ideal* location, move the inside L-Cell as well).
   - If there is an obstruction on the inside, follow the guidelines in Step 1 for relocating the L-Cell. Verify the L-Cell on the outside can be relocated to match the inside location and remark the outside location.
4. Continuing to move clockwise around the inside of the skirt, repeat Step 3, marking mounting locations on panels 4, 6, etc.
5. Mark junction box locations on the inside of the skirt, centered between the L-Cell sets. Each junction box can be wired to a maximum of two L-Cell sets (four L-Cells total). Vertically, locate junction boxes approximately 6' (1.8m) above the foundation. This minimizes the possibility of interference with L-Cells in the event the L-Cells cannot be placed in the *ideal* locations. Ensure you have sufficient cable length and that a drip loop will be formed by the L-Cell cables when wired to the junction box.

Mark Locations (Welded, Skirt-Supported Vessels)

1. Refer to the Application Data Form for the L-Cell spacing. L-Cells are located symmetrically around the vessel.
   Beginning on the outside of the skirt at the door centerline, measure clockwise **1/2 the spacing distance**. Mark the preliminary location of the first L-Cell:
   - Vertically, locate the L-Cell at the panel mid-height (typically 3' to 4' [0.9 to 1.2m] above the foundation).
   - Minor obstructions — Move the L-Cell so it is not within 2' (0.6m) of a minor obstruction. Vertically, center the L-Cell within the *effective* panel height.
   - Major obstructions — Move the L-Cell so it is not within 4' (1.2m) of a major obstruction.



Note: Minimum effective panel height is 6' (1.8m). If effective height is less than 6' (1.8m), relocate L-Cell set to another location.

Figure 5-10. Modifying L-Cell Vertical Locations because of Minor Obstructions Near Panel Edge

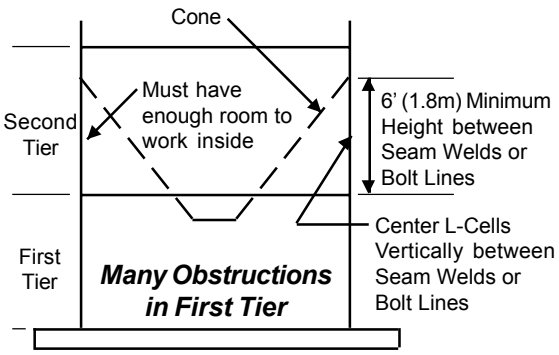


Figure 5-11. Mounting L-Cells on Second Tier

2. Continuing to move clockwise around the outside of the skirt and now **measuring the full spacing distance**, repeat Step 1, marking preliminary mounting locations all the way around the outside of the skirt.
   - Measure the spacing distance from the **ideal** location for the previous L-Cell. Do not measure from the modified location if you relocated the previous L-Cell because of an obstruction.

3. Proceed to the inside of the skirt and walk clockwise to the first L-Cell location. Mark the preliminary L-Cell location to match the **marked** location on the outside of the skirt:
   - If you adjusted the outside location because of an obstruction, maintain the offset configuration of the set (i.e., if you move the outside L-Cell in the set from its *ideal* location, move the inside L-Cell as well).
   - If there is an obstruction on the inside, follow the guidelines in Step 1 for relocating the L-Cell. Verify the L-Cell on the outside can be relocated to match the inside location and remark the outside location.

4. Continuing to move clockwise around the inside of the skirt, repeat Step 3, marking locations all the way around the skirt.

5. Mark junction box locations on the inside of the skirt, centered between the L-Cell sets. Each junction box can be wired to a maximum of two L-Cell sets (four L-Cells total). Vertically, locate junction boxes approximately 6’ (1.8m) above the foundation. This minimizes the possibility of interference with L-Cells in the event the L-Cells cannot be placed in their *ideal* locations. Ensure you have sufficient cable length and that a drip loop will be formed by the L-Cell cables when wired to the junction box.

Obstructions
(Aluminum)

Obstructions can be classified as major or minor:

- Figure 5-12 shows an example of a **major obstruction**. Do not place an L-Cell set within 1.3' (0.4m) of a major obstruction.
- Figure 5-13 shows an example of a **minor obstruction**. Do not place an L-Cell set within 0.7' (0.2m) of a minor obstruction — less than 4" (102mm) in size.

See Figure 5-14. Minor obstructions may occur near the top or bottom of a tier. The *effective* tier height is the distance between the edge of the tier and the minor obstruction. If the *effective* tier height is 2.6' (0.8m) or greater, modify the vertical location of the L-Cell set so the set is at the center of the *effective* tier height. If the *effective* tier height is less than 2.6' (0.8m), relocate the L-Cell set as shown in Figure 5-15.

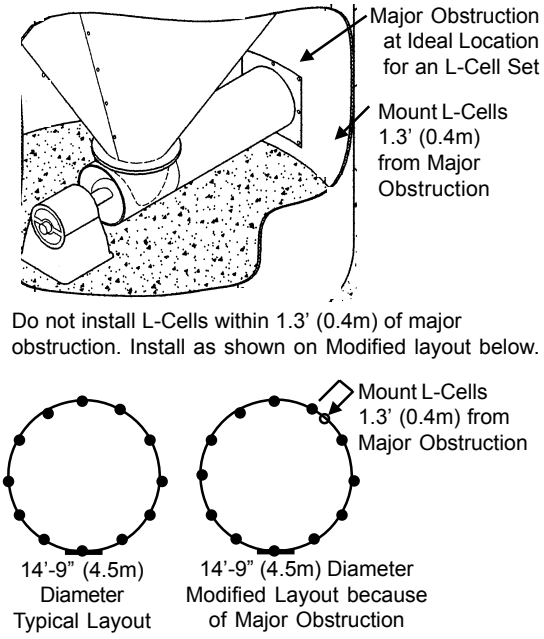


Figure 5-12. Mounting L-Cells in Alternate Locations because of Major Obstructions

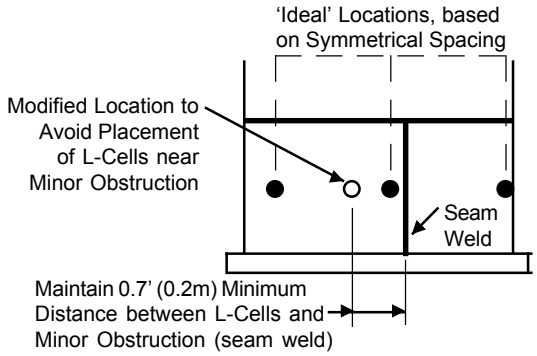
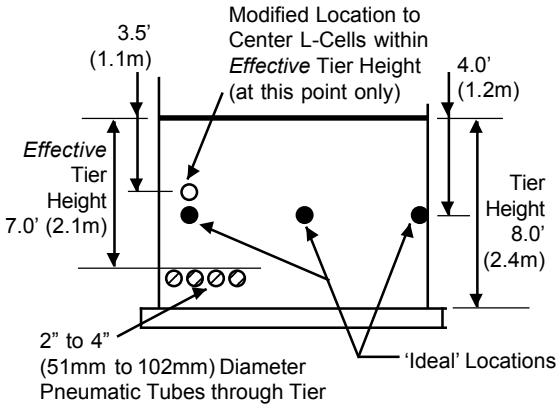


Figure 5-13. Mounting L-Cells in Alternate Locations because of Minor Obstructions



Note: Minimum effective tier height is 2.6' (0.8m). If effective height is less than 2.6' (0.8m), relocate L-Cell set to another location.

Figure 5-14. Modifying L-Cell Vertical Locations because of Minor Obstructions Near Tier Edge

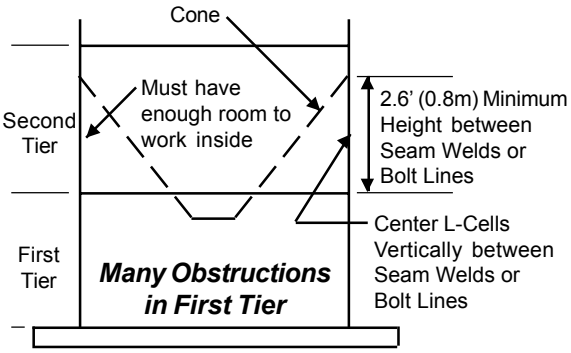


Figure 5-15. Mounting L-Cells on Second Tier

Installing L-Cells

Note: Use industrial-grade, heavy-duty tapping fluid when drilling and tapping.

Surface Preparation

Figure 5-16. Drill Mounting Hole

1. See Figure 5-16. At the center of the previously marked mounting location for the **outside** L-Cell, drill all the way through the skirt with the #36 drill bit. This produces the template mounting hole.

Figure 5-17. Prepare area with Disc Sander

2. Peel the backing off the coarse (36) grit sander disk and press the sander disk onto the surfacing disk. Using the template mounting hole as a tool center, remove heavy paint and rust with the drill-mounted surfacing disk until a 2.50" (63.5mm) diameter bare metal surface is achieved (Fig 5-17)
   - Use straight, constant pressure. Do not roll or rock the grinding disk as this will cause a 'cupped' surface.
     The goal is to grind a flat surface for mounting the L-Cell.
   - Due to the use of coarse grit, the resulting surface is somewhat coarse.

Figure 5-18. Use finer grit sander disc.

3. Replace the coarse grit with the fine (60) grit sander disk. Using the template mounting hole as a tool center, grind until the surface is flat and smooth to the touch. This results in a 2.50" (63.5mm) diameter surface where the L-Cell will be mounted. (Fig 5-18)

Note

The L-Cell must be mounted against smooth, bare metal. All paint and rust must be removed from the area where the L-Cell is to be fastened.

4. Repeat Steps 1 through 3 to prepare the surface on the inside of the skirt before proceeding with L-Cell installation.

Drill and Tap

Figure 5-19. Thread Mounting hole

1. Using the #6-32 tap, thread the template mounting hole for the **outside** L-Cell (drilled during *Surface Preparation*) until the tap is cutting complete threads through to the other side. Remove any burrs from the hole. See Fig. 19.

2. See Figure 5-20. Fasten the drill template to the template mounting hole through hole #5A, using the #6-32 x 1 5/8" socket head cap screw. Refer to the 0° level bubble while positioning the template to ensure proper orientation.

Figure 5-20. Fasten Template

Note

Steps 3 through 5 instruct you to drill and tap completely through the skirt. However, if the skirt thickness is greater than 0.4" (10.2mm), you *may* choose to drill and tap to a minimum depth of 0.4" (10.2mm).

3. Drill the L-Cell mounting holes completely through the skirt with the #36 drill bit, using the template drill guides as follows (Fig 21):
   A. Drill hole #2.
   B. Insert a spare drill bit through hole #2 in the template and skirt, to hold the template securely in place.
   C. Drill hole #1 and #3. Remove the spare drill bit from hole #2.

Figure 5-21. Drill Mounting Holes

4. See Figures 5-22 and 5-23. Tap the mounting holes:
   A. Loosen the screw holding the template to the surface, and rotate the template until the tap guide is aligned with hole #1. Retighten the screw.
   B. Using the tap guide, thread hole #1 with the #6-32 tap, until cutting complete threads through the other side.
   C. Repeat Steps A and B for hole #2 and #3.

5. Repeat Steps 1 through 4 on the inside of the skirt, starting from the template mounting hole drilled on that side during *Surface Preparation*.

Figure 5-22. Tap Mounting Holes

6. Using the 3/16" drill bit, drill a hole all the way through the skirt, 3.5" (89mm) below the **outside** template mounting hole, for the cable routing.

7. **Remove burrs** from all holes created.

Figure 5-23. Tap additional Mounting Holes

Figure 5-24. Wipe down surface

Mounting L-Cell

CAUTION

Do not install L-Cells in the rain.
Do not trap moisture under the environmental cover.

1. See Figure 5-24. Wipe down a 4.5" (114mm) diameter surface for the **outside** L-Cell, centered on the template mounting hole, with degreaser. This cleans the bare metal surface and adjacent area.

2. Apply a thin coat of KM rust inhibitor to the exposed 2.50" (63.5mm) diameter bare metal surface. Fig. 5-25.

CAUTION

Do not apply rust inhibitor beyond this area, or the environmental cover will not adhere properly.

Figure 5-25. Apply rust inhibitor

3. Connect the L-Cell's red, black, and white wires to the corresponding K-M Test Meter terminals. Turn on power to the Meter and set its Simulate/Test switch to theTest position. Fig. 5-26

Note

If a KM Test Meter is not available, refer to Appendix G, Alternate Method for Checking Output, before proceeding.

4. **Apply a small amount of sealant to the threads of the three #6-32 x 1/4" socket head cap screws.**

Figure 5-26. Test L-Cell

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

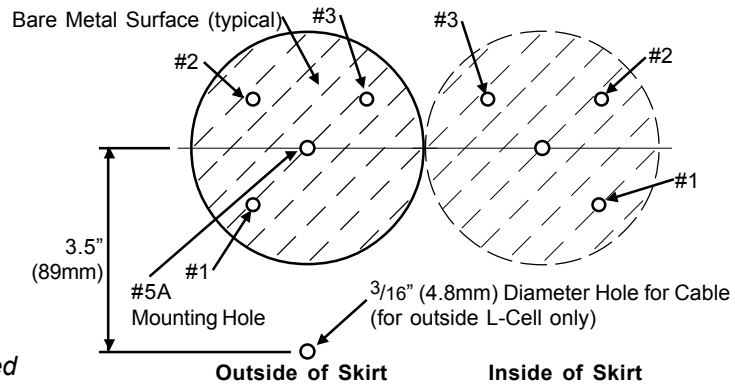
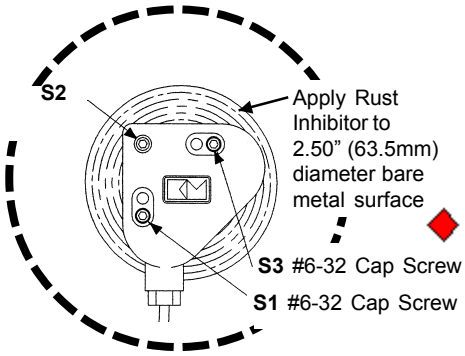


Figure 5-27. Drilled and Tapped Holes (outside view of skirt)



Notes:
1. Do not apply rust inhibitor outside the 2.50" (63.5mm) diameter bare metal, or environmental cover will not adhere properly.
2. Place small amount of sealant on each screw before mounting L-Cell.

Figure 5-28. L-Cell Mounting

Figure 5-29. L-Cell install

5. Holding the L-Cell flat against the surface, **loosely** fasten the L-Cell with the three screws. **Do not tighten the screws**.
   - If the voltage goes outside -200 to +200 mV, immediately loosen the screw(s), as this may indicate a burr or rough surface. Remove the screws and L-Cell. Check for and remove burrs and surface roughness (refer to *Surface Preparation* for removing surface roughness). Repeat Steps 1 through 5.

CAUTION

For proper installation, tighten each screw until the T-handle driver flexes in torsion 1/4 turn past where the screw stops turning. Repeat this flexing procedure several times to ensure the screw is tight The final reading when all screws are tight must be in the range -200 to +200 mV. Follow Steps 6 through 8 to achieve this goal.

6. Using the T-handle driver, **slowly** tighten screw **S2** while monitoring the Meter carefully. If the voltage goes outside -200 to +200 mV while tightening, stop immediately and evaluate the following (Fig 5-28):
   - Voltage **jumped** outside the range — This may indicate a burr or rough surface. Remove the screws and L-Cell. Check for and remove burrs and surface roughness (refer to *Surface Preparation* for removing surface roughness). Repeat Steps 1 through 6.
   - Voltage **gradually moved** outside the range — Slowly loosen the screw until the voltage is within range again and proceed to Step 7.

7. Repeat Step 6 for screws **S1** and **S3**.
   If the voltage is outside -200 to +200 mV, attempt to bring the reading within range by loosening the screw being torqued, tightening another screw(s), or some combination of loosening and tightening. If you have difficulty staying within the range, try turning each screw 1/4 turn at a time until all screws are tightened. (Fig. 29)

Note

If the following occurs while turning screws, check L-Cell resistance using a DMM (described inChapter E, Troubleshooting):
- Voltage does not change or changes less than 25 mV, **or**
- Voltage changes randomly (i.e., not in a consistent direction).

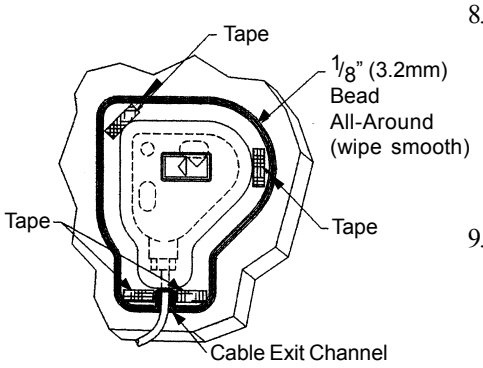
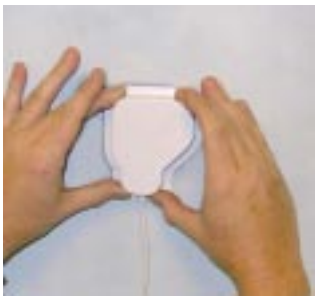


Figure 5-30. Environmental Cover

8. To complete the installation, ensure:
   - All three screws are tightened until the T-handle driver flexes in torsion, 1/4 turn past the point where the screw stops turning, with this flexing procedure repeated several times to ensure the screw is tight, **and**
   - The voltage is in the range -200 to +200 mV.

9. Prior to installing the environmental cover, ensure the mating surface is free of dirt and grease. Clean if necessary, being careful not to remove the rust inhibitor on the bare metal. See Fig. 30.



Figures 5-31, 5-32, 5-33. Installing Cover

10. See Figure 5-31, 5-32, and 5-33. Peel the protective backing from the double-sided tape on the environmental cover's inside flange.

    A. Align the cover over the L-Cell, with the cable through the cover's exit channel. Press the cover onto the mounting surface.

    B. Spread a 1/8" (3.2mm) bead of sealant around the joint between the cover and mounting surface. Add extra sealant to the cable exit channel and between cable and skirt.

    C. Use your finger to smooth the sealant around all edges and joints, eliminating areas where moisture may pool, especially along the top edge. Verify the sealant forms a continuous, watertight seal.

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

11. Repeat Steps 1 through 10 to install the L-Cell on the inside of the skirt wall.

12. Thread the outside L-Cell cable through the 3/16" diameter hole in the skirt wall to bring the cable to the inside of the skirt.

13. Clean with degreaser and then spread Sikaflex 1A sealant:
    A. Over the open hole on the backside of each screw,
    B. Over the template mounting hole, and
    C. Around the cable routing hole in the skirt wall. Use your finger to press sealant into each hole.

Mounting the Junction Box

Note

Mounting hardware for the junction box is not supplied by K-M. Screw size up to 1/4-20 screw is compatible with the box.

1. Remove the junction box cover.
2. See Figure 5-34. Hold the junction box at the previously marked mounting location. Use a pencil to mark the two center mounting holes.
3. Drill and tap the mounting holes.
4. Mount the junction box with screws and flat washers. Tighten the screws until snug. Replace the junction box cover and screws if not ready to begin wiring the junction box, to ensure no moisture enters the junction box.

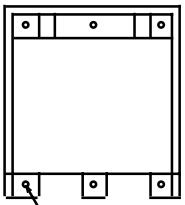


Figure 5-34. Junction Box Mounting

Wiring L-Cells to Junction Box

Figure 5-35. Junction Box

Note

The four small holes in the bottom of the junction box are for wiring L-Cells to the junction box.

1. Remove the junction box cover Fig 5-35.
2. See Figure 5-36. Place a plastic washer on the watertight fitting. Thread the L-Cell cable through a cap and watertight fitting. Leave an adequate length of cable between the L-Cell and fitting to provide a drip loop (see Figure 5-39).
3. See Figure 5-36. Spread a generous bead of sealant around the threads of the watertight fitting.

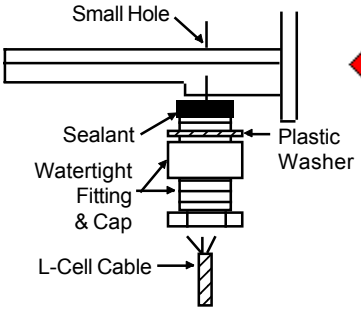


Figure 5-36. Inserting L-Cell Cable through Watertight Fitting and Cap

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

4. In the bottom of the junction box, locate one of the four small holes that is closest to the terminal you will be using for that L-Cell. Screw the watertight fitting into the hole.

Note

TB3 terminal block has 12 terminals to accommodate four L-Cells (L-Cells A, B, C, and D). Locate the terminal labeled for the L-Cell you are wiring.

5. Estimate the required length of cable to the terminal strip, allowing a little extra for strain relief. Cut the excess cable. Fig 5-37

Figure 5-37. Estimate length

6. Strip 3" (76mm) of the cable sheathing to expose the three wires inside. Strip 1/4" (6mm) of insulation from the end of each of the wires.
7. Connect the wires from the L-Cell to the selected TB3 terminals: black wire to B, white wire to W, and red wire to R. Fig 5-38.
8. Perform Steps 2 through 7 for each L-Cell you wire to this junction box (up to four).
9. Spread a generous bead of sealant (Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738) around the threads of the plug for each small hole in the junction box not being used. Screw a plug into each hole.
10. Replace the junction box cover and screws if not ready to begin wiring the junction boxes together, to ensure no moisture enters the junction box.

Wiring Junction Boxes Together and to Signal Processor

There are two versions of the junction box enclosure. Both versions have four small holes for wiring L-Cells to the junction box, as described above. In addition, the junction box has one or two large holes for wiring the junction box to the other junction boxes and to the signal processor:

- One large hole for conduited installation — The large hole accommodates a 3/4" conduit fitting.
- Two large holes for non-conduited installation — The two large holes are equipped with PG13.5 cable fittings.
  KM requires the use of cable trays for non-conduited installations.

Notes

1. The procedure below assumes the conduit/cable tray has been installed.
2. Seal all conduit fittings against water entry. Install drain holes at conduit/cable tray lowest elevation(s) to allow condensation to drain.
3. Use Belden™ 3-conductor shielded interconnect cable or equivalent to wire junction boxes together and to the signal processor. For lengths up to 1,000' (305m) use 18-gage Belden 8791 cable. For lengths from 1,000' to 2,000' (305m to 610m) use 16-gage Belden 8618 cable.
4. When wiring cable to junction box terminals, strip 3" (76mm) of cable sheathing to expose the three conductor wires and shield wire inside. Strip 1/4" (6mm) of insulation from the end of each of the conductor wires.
5. All wiring routed between junction boxes and signal processor must be continuous (no splices).

1. Remove the junction box cover.
   - Conduited installation — Install a conduit fitting in the large hole in the bottom of the junction box.
   - Non-conduited installation — Spread a generous bead of sealant around the sides of the PG13.5 cable fittings. Install the fittings in the two large holes in the bottom of the junction box.
2. See Figure 5-40 (conduited installation) or Figure 5-41 (non-conduited installation). Route the 3-conductor cable through the fitting into the junction box farthest from the signal processor. Connect wires from the cable to the TB2 terminal in the junction box: black wire to B, white wire to W, and red wire to R. Connect the cable shield wire to the Shield terminal between TB1 and TB2.
3. Route the cable through conduit/cable tray to the next junction box. Estimate the required length of cable to the terminal strip, allowing a little extra for strain relief. Cut the excess cable. Connect wires from the cable to the TB1 terminal in the junction box: black wire to B, white wire to W, and red wire to R. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

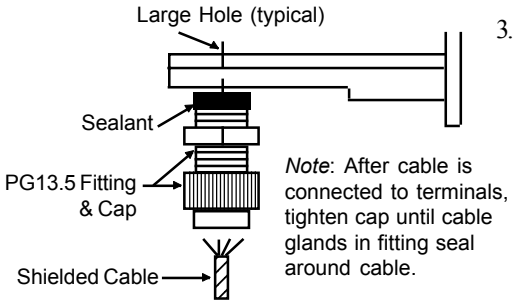


Figure 5-38. Inserting Shielded Interconnect Cable through PG13.5 Fitting and Cap

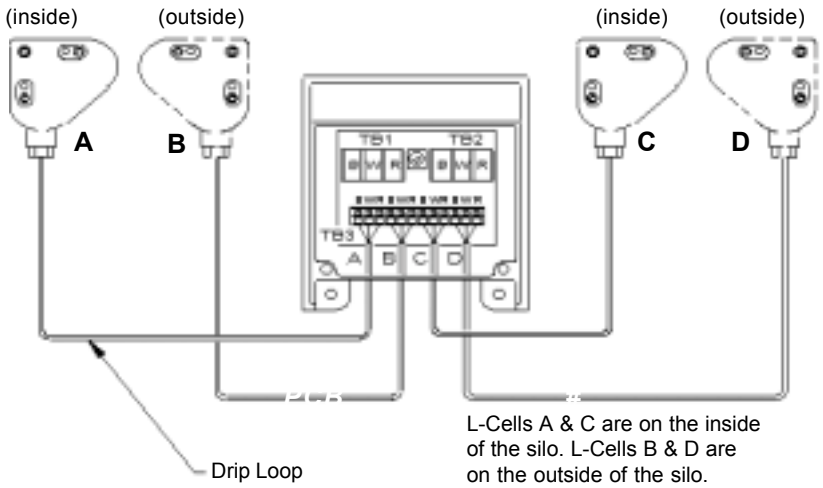


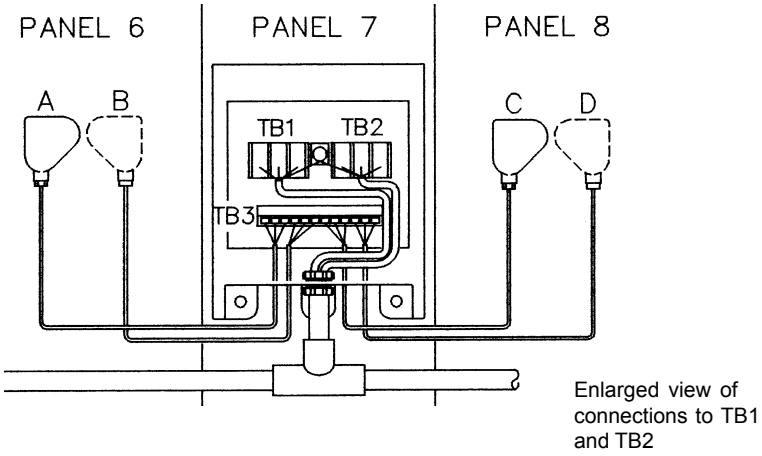
Figure 5-39. Wiring L-Cells to Junction Box (inside view of skirt)

4. Route another 3-conductor cable through the fitting into this junction box, and attach wires to the TB2 terminal: black wire to B, white wire to W, and red wire to R. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

5. Repeat Steps 3 and 4 until all junction boxes for the vessel are wired together.

6. Route the cable from the last junction box through conduit/cable tray to the signal processor. Refer to the signal processor manual for wiring the junction box to the signal processor. One vessel takes up one channel in the signal processor — the channel shows the average value from all the L-Cells on the vessel.

Note: Shield Terminal is floating. Ground the cable shield only at the signal processor.



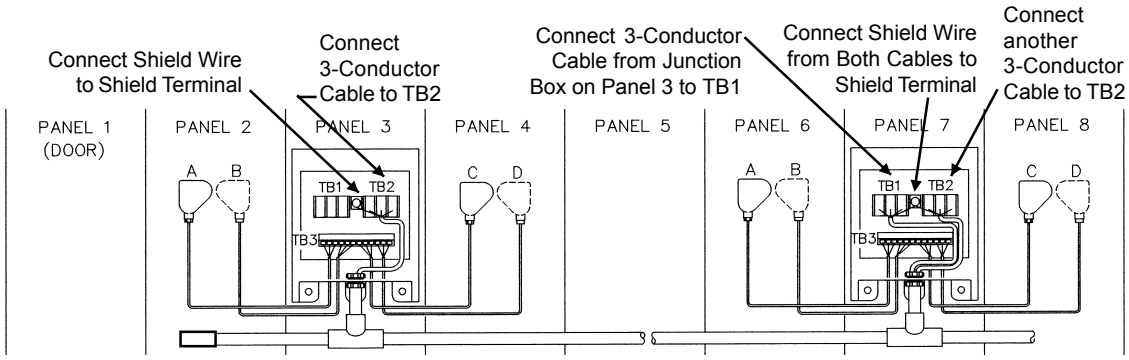
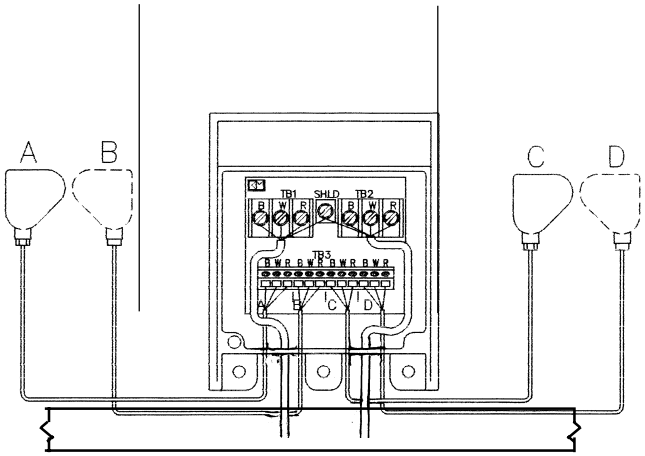


Figure 5-40. Wiring Junction Boxes Together (inside view of skirt) — Conduited Installation



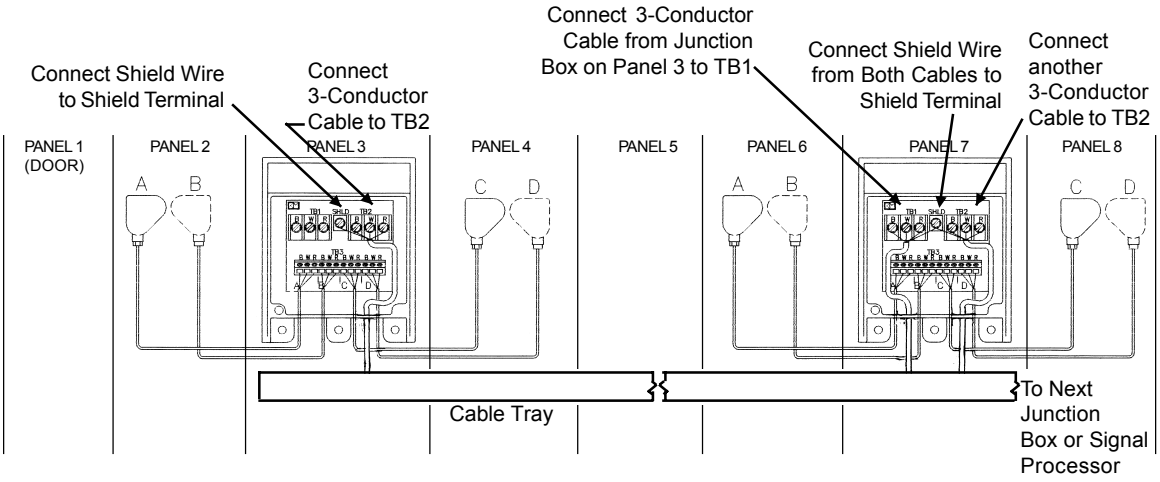


Figure 5-41. Wiring Junction Boxes Together (inside view of skirt) — Non-Conduited Installation

Chapter 6: Installation of the Microcell on Vertical Pipe Legs

*Follow the instructions in this chapter **only** if installing Microcells on vertical pipe legs. Skip this chapter if installing other options. This chapter describes the mounting locations, and wiring installation details for Microcells and junction boxes on vertical pipe leg applications.*

Follow the procedures below to determine Microcell mounting locations prior to beginning installation. This will ensure optimal system performance. Consult KM if special considerations prevent you from installing Microcells at the designated locations.

Note

Do not mix different types of Microcells on one vessel. The three types — 3-inch standardized (light blue cover), 3-inch non-standardized (dark blue cover), and 2-inch — are not interchangeable.

Mounting Locations

Microcell Sets

See Figure 6-1and 6-2. For best performance, Microcells are mounted vertically. A Microcell set consists of two Microcells mounted on opposite sides of a support leg, at the same elevation.

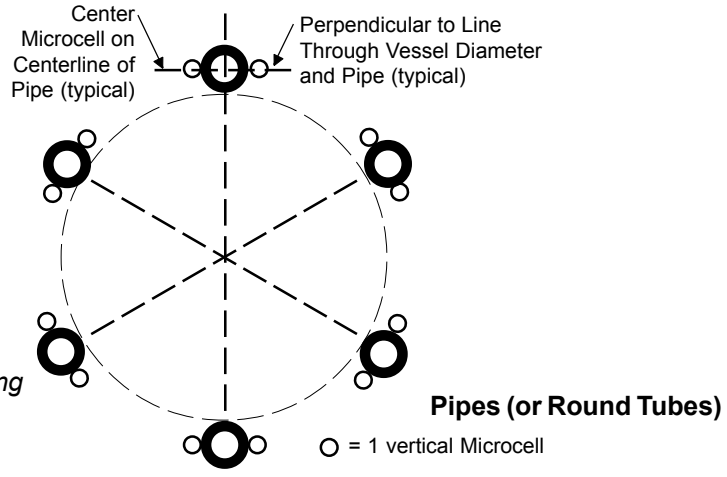


Figure 6-1. Microcell Mounting Arrangements on Legs

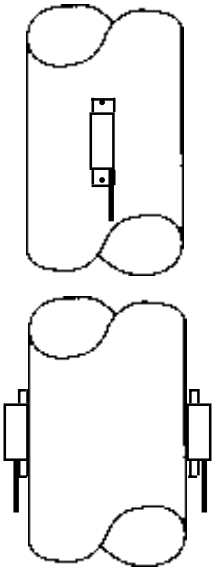


Figure 6-2. Vertical Microcell for Best Performance

Horizontal Distribution of Microcell Sets

Microcell sets are placed on each support leg.

Vertical Location of Microcell Sets

Note

Microcell locations may be adjusted up to 12" (305mm) vertically to avoid obstacles. If adjusting locations, maintain the configuration of the Microcell set (i.e., if you move one Microcell in the set from its ideal location, move the other(s) as well).

Pipe Legs without X-Braces

See Figure 6-3.

- If the free leg distance (length between foundation and vessel) is between minH and 11' (3.4m), mount the Microcell sets at mid-height of the free leg.
- If the free leg distance is more than 11' (3.4m), mount the Microcell sets at 5'-6" (1.7m) above the foundation.
- If the free leg distance is less than minH, this is a special application situation. Consult KM before proceeding further.

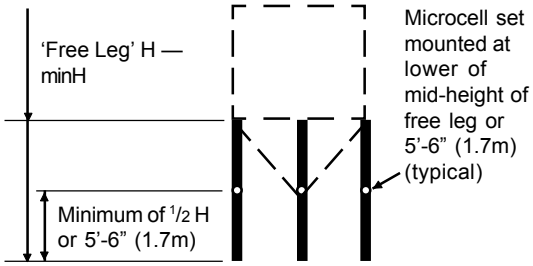


Figure 6-3. Vertical Location of Microcell Sets for Legs without Braces

Note: MinH is defined as the minimum free height to install sensors. The height should be three times the pipe width or 12" (305 mm) whichever is greater.

Pipe Legs with X-Braces

See Figure 6-4. If the free leg distance is minH or more, mount the Microcell sets at mid-height of the free leg.

- Measure the free leg between the bottom of the bottom x-brace or horizontal brace and the top of the foundation.
- For an alternate location, measure the free leg between the top of the top x-brace or horizontal brace and the beam supporting the vessel.

See Figure 6-5. If the free leg distance is less than minH, mount the Microcell sets at the mid-height between the lowest braces.

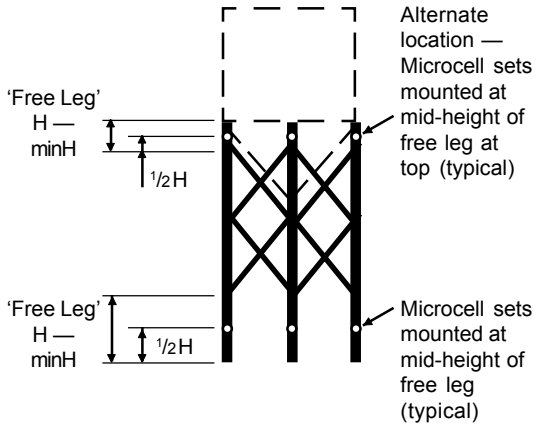


Figure 6-4. Vertical Location of Microcell Sets for Legs with Braces and with Free Leg greater than minH

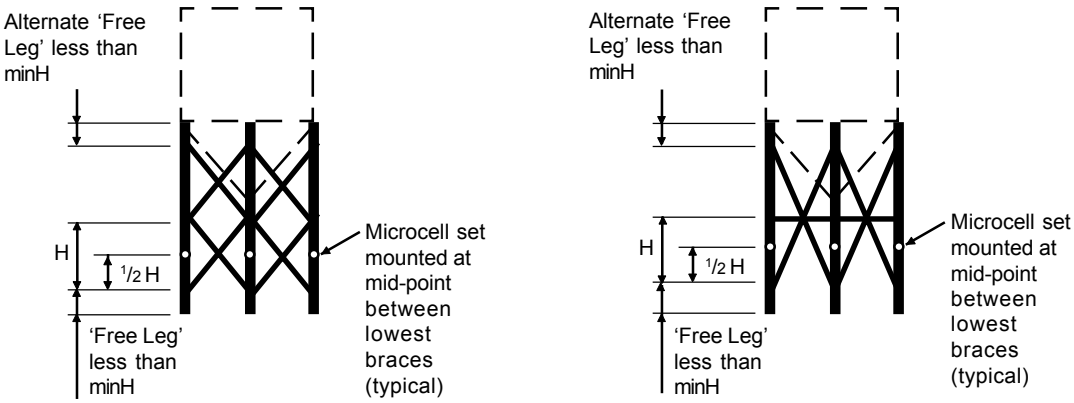


Figure 6-5. Vertical Location of Microcell Sets for Legs with Braces and with Free Leg less than minH

Installing Microcells

Notes

1. Use lubricating fluid (Relton RapidTap® Heavy Duty Cutting Fluid or equivalent) when drilling and tapping.
2. Drilling and tapping instructions assume metal thickness greater than 3/4" (19mm). If the thickness is less, drill all the way through the metal and tap until cutting complete threads through the other side. Minimum metal thickness is 0.1875" (5mm), which provides six thread engagement.

Figure 6-6. Drill mounting hole

Surface Preparation

1. See Figure 6-6. At the center of the vertical Microcell mounting location, drill a 3/4" (19mm) deep hole with the #29 drill bit. This produces the template mounting hole.

Figure 6-7. Prep area

2. Mark the surface preparation area for the vertical Microcell.

3. Attach coarse grit sandpaper to the grinder. Remove heavy paint and rust with the grinder until a bare metal surface is achieved for the Microcell(s). Due to the use of coarse grit, the resulting surface is somewhat coarse. Fig 6-7

4. Replace the coarse grit sandpaper with fine grit sandpaper. Grind until the surface(s) is completely down to bare metal and smooth to the touch.

Note

The Microcell must be mounted against smooth, bare metal. Remove all paint and rust from the area where the Microcell is to be fastened.

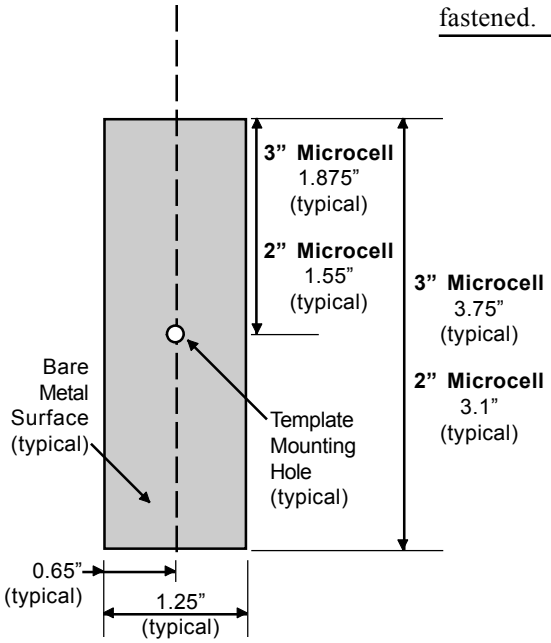


Figure 6-8. Prepared Mounting Surface

Drill and Tap

1. Using the #8-32 tap, thread the template mounting hole for the vertical Microcell (drilled during *Surface Preparation*) to a minimum 5/8" (16mm) depth, full threads. Remove any burrs from the hole.Fig 6-8

2. See Figure 6-9. Position the drill template so the center hole lines up with the template mounting hole.

3. Fasten the drill template to the template mounting hole through the center hole, using the captive #8-32 socket head cap screw. Use a level to ensure correct orientation.

4. Using the #29 drill bit, drill two 3/4" (19mm) deep holes in the leg through the template drill guides.

5. Loosen the screw securing the template and rotate the template until the two tap guides line up with the drilled holes. Push the #8-32 tap into one of the tap guide holes to align the template. Retighten the screw securing the template.

6. Using the #8-32 tap, thread the two holes through the template tap guides. Tap to a minimum 5/8" (16mm) depth, full threads. Remove the template from the leg.

7. **Remove burrs** from all the holes created.

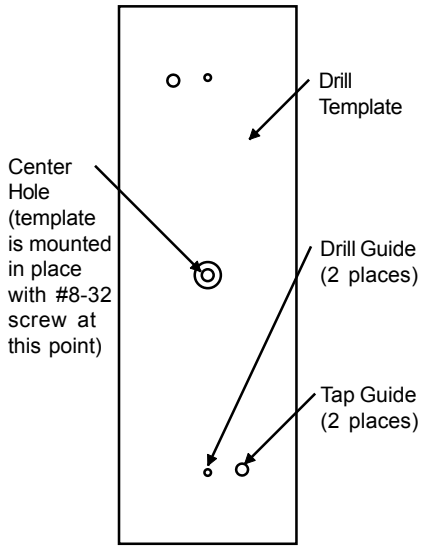


Figure 6-9. Drill and Tap Template

CAUTION

Do not install Microcells in the rain.
Do not trap moisture under the environmental cover.

Mounting Microcell

1. Wipe down a 5" by 2 1/4" (127 by 57mm) surface, centered on the template mounting hole, with degreaser. This cleans the bare metal and adjacent mounting surface for the environmental cover.

Figure 6-10.Apply rust inhibitor

2. Apply a thin coat of KM rust inhibitor to the bare metal surface for the vertical Microcell. Fig 6-10.

CAUTION

Do not apply rust inhibitor beyond this area, or the environmental cover will not adhere properly.

Figure 6-11.Test Microcell

3. Connect the Microcell's red, black, and white wires to the corresponding terminals on the K-M Test Meter. Turn on the power to the Test Meter and set the Simulate/Test switch to the Test position. Fig 6-11.

Note

If a KM Test Meter is not available, refer to Appendix G, Alternate Method for Checking Output, before proceeding.

Figure 6-12.Install Microcell

4. With the cable end down, align a vertical Microcell with its mounting holes. Fasten the Microcell **loosely** to the leg using the two #8-32 x 5/8" socket head cap screws and washers. **Do not tighten the screws**. If the voltage goes outside the range -100 to +100 mV, immediately loosen the screw(s). Fig 6-12.

CAUTION

For proper installation, tighten each screw until the T-handle driver flexes in torsion 1/4 turn past the point where the screw stops turning. Repeat this flexing procedure several times to ensure the screw is tight. When both screws are tight, the voltage must be in the range -100 to +100 mV. Follow the procedure in Steps 5 through 7 to achieve this goal.

5. Using the T-handle driver, **slowly** tighten the top screw. While turning the T-handle driver, monitor the Test Meter carefully. If the voltage goes outside the range -100 to +100 mV while tightening, stop immediately and evaluate the following:
   - If the voltage **jumped** outside the range -100 to +100 mV, it may indicate a burr or rough surface. Remove the screws holding the Microcell to the leg. Check for and remove burrs and surface roughness (refer to *Surface Preparation* for removing surface roughness). Repeat Steps 1 through 5.
   - If the voltage **gradually moved** outside the range -100 to +100 mV, slowly loosen the screw until the voltage is within range again and proceed to Step 6.

Figure 6-13.

6. Repeat Step 5 for the bottom screw. If the voltage is outside the range -100 to +100 mV, attempt to bring the reading within range by loosening the screw being torqued, tightening the other screw, or some combination of loosening and tightening. If you have difficulty staying within the range, try turning each screw 1/4 turn at a time until both screws are tightened. Fig 6-13.

Note

If the following occurs while tightening screws, check Microcell resistance using a DMM (described in Appendix E, Trouble-shooting):
- Voltage does not change or changes less than 25 mV as you turn a screw, **or**
- Voltage changes randomly as you turn a screw (i.e., not in a consistent direction).

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

7. To complete installation, ensure that:
   - Both screws are tightened until the T-handle driver flexes in torsion, 1/4 turn past the point where the screw stops turning, with this flexing procedure repeated several times to ensure the screw is tight, **and**
   - Voltage is in the range -100 to +100 mV.

8. Prior to installing the environmental cover(s), ensure the mating surface(s) on the leg is free of dirt and grease. Reclean if necessary, being careful not to remove the rust inhibitor on the bare metal.

9. See Figure 6-14. Apply a generous bead of sealant to the inside flange of the environmental cover. Add extra sealant to the cable exit channel and between cable and support.
   A. Align the environmental cover over the installed Microcell, with the cable through the cover's exit channel.
   B. Press the cover against the support, squeezing out the sealant around the edges. Be careful not to squeeze too much sealant out.
   C. Use your finger to smooth the sealant around all edges and joints, eliminating areas where moisture may pool, especially along the top edge. Verify the sealant forms a continuous, watertight seal. Ensure the cable exit channel is completely sealed.

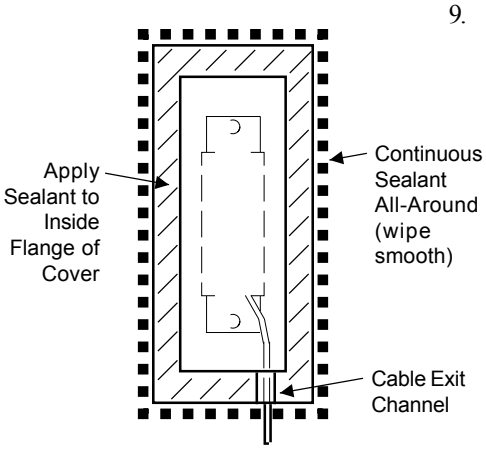


Figure 6-14. Environmental Cover

Mounting Junction Box

Mounting Location

Each junction box can be wired to a maximum of four Microcells:

- Vertical Microcells — one junction box **can** be wired to Microcells from two support legs (two Microcells on each support leg) if the legs are sufficiently close to each other to allow the Microcell cables to reach.

See Figure 6-15. Locate the junction box on the support leg or on a brace. Vertically, locate junction boxes at a convenient height, approximately 4' (1.2m) from the ground. The exact location of the junction box is not critical, but ensure you have sufficient cable length and that a drip loop will be formed by the Microcell cables when wired to the junction box.

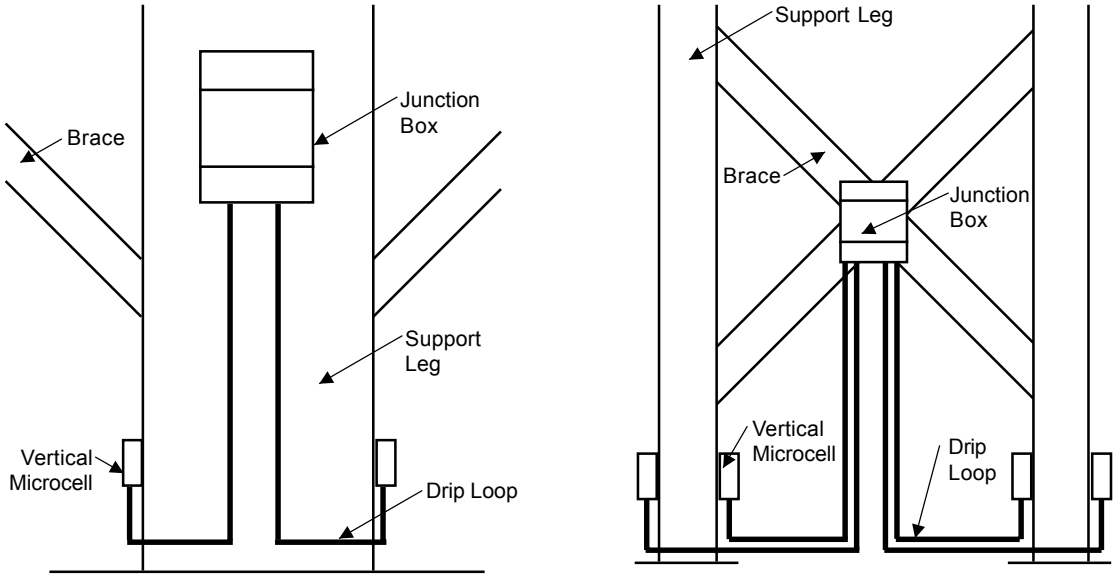


Figure 6-15. Possible Junction Box Mounting Locations

Junction Box Installation

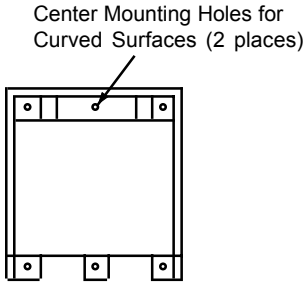


Figure 6-16. Junction Box Mounting

CAUTION

Do not install junction boxes in the rain. Moisture in the junction box will cause corrosion and system errors.

Note

Junction box mounting hardware is not supplied by KM. KM recommends #8-32 socket head cap screws and flat washers. The instructions below reflect this recommendation.

1. Remove the junction box cover.

2. See Figure 6-16. Hold the junction box at the previously marked mounting location. Mark the two center mounting holes.

3. Drill and tap the mounting holes with a #29 drill bit and #8-32 tap.

4. Mount the junction box with #8-32 socket head cap screws and flat washers. Tighten the screws until snug. Replace the junction box cover and screws if not ready to begin wiring, to ensure no moisture enters the junction box.

Wiring Microcells to Junction Box

Note

The four small holes in the bottom of the junction box are for wiring the Microcells to the junction box.

1. Remove the junction box cover.

2. See Figure 6-17. Place a plastic washer on a watertight fitting. Thread the Microcell cable through a cap and watertight fitting. Leave an adequate length of cable between the Microcell and fitting to provide a drip loop (see Figure 6-18).

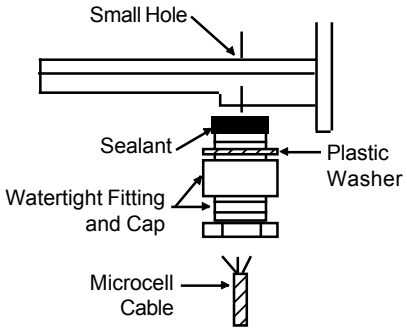


Figure 6-17. Inserting Microcell Cable through Watertight Fitting and Cap

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

3. Spread a generous bead of sealant around the sides of the watertight fitting.

4. In the bottom of the junction box, locate one of the four small holes closest to the terminal you will use for that Microcell. Screw the watertight fitting into the hole.

Note

TB3 terminal block has 12 terminals to accommodate up to four Microcells (A, B, C, and D). Locate the terminal labeled for the Microcell you are wiring.

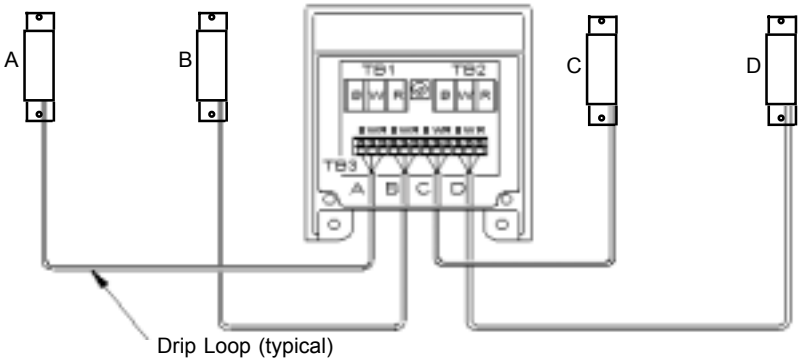
5. Estimate the required length of cable to the terminal strip, allowing a little extra for strain relief. Cut the excess cable.

6. Strip back 3" (76mm) of the cable sheathing to expose the three wires inside. Strip back 1/4" (6mm) of insulation from the end of each of the wires.

7. Connect the wires from the Microcell to the selected TB3 terminals: black wire to B terminal, white wire to W terminal, and red wire to R terminal. (Fig. 6-18)

For Vertical Microcells

Junction Box PCB 63-1170-01



Notes:
- Verify that junction box PCB is 63-1170-01 (bottom center).
- Microcells A and B are on one support leg.
- Microcells C and D are on another support leg. Microcells C and D can be wired as shown, or can be wired to its own junction box (terminals A and B) if desired.

Figure 6-18.Microcell Installation

8. Perform Steps 2 through 7 for each Microcell you wire to this junction box (up to four).

9. Spread a generous bead of sealant (Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738) around the sides of the plug for each hole not being used. Screw a plug into each hole.

10. Replace the junction box cover and screws if not ready to begin wiring the junction boxes together, to ensure no moisture enters the junction box.

Wiring Junction Boxes Together and to Signal Processors

There are two versions of the junction box enclosure. Both versions have four small holes for wiring Microcells to the junction box, as described above. In addition, the junction box has one or two large holes:

- One large hole for conduited installation — The large hole, which accommodates a $^{3}/_{4}$" conduit fitting, is for wiring the junction box to the other junction boxes and to the signal processor.
- Two large holes for non-conduited installation — The two large holes, which are equipped with PG13.5 cable fittings, are for wiring the junction box to the other junction boxes and to the signal processor. **KM requires the use of cable trays for non-conduited installations**.

Notes

1. The procedure below assumes the conduit/cable tray has been installed.

2. Seal all conduit fittings against water entry. Install drain holes at conduit's lowest elevation(s) to allow condensation to drain.

3. Use Belden™ 3-conductor shielded interconnect cable or equivalent to wire junction boxes together and to the signal processor. For lengths up to 1,000' (305m) use 18-gage Belden 8791 cable. For lengths from 1,000' to 2,000' (305m to 610m) use 16-gage Belden 8618 cable.

4. When wiring cable to junction box terminals, strip back 3" (76mm) of cable sheathing to expose the three conductor wires and shield wire inside. Strip 1/4" (6mm) of insulation from the end of each of the conductor wires.

5. All wiring routed between junction boxes and signal processor must be continuous (no splices).

1. Remove the junction box cover.
   - Conduited installation — Install a conduit fitting in the large hole in the bottom of the junction box.
   - Non-conduited installation — See Figure 6-19. Spread a generous bead of sealant around the sides of the PG13.5 cable fittings. Install the fittings in the two large holes in the bottom of the junction box.

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

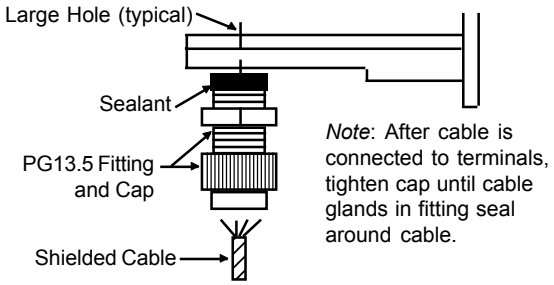


Figure 6-19. Inserting Shielded Interconnect Cable through PG13.5 Fitting and Cap

2. See Figure 6-20 (conduited installation) or Figure 6-21 (non-conduited installation). Route the 3-conductor cable through the fitting into the junction box farthest from the signal processor. Connect wires from the cable to the TB2 terminal in the junction box: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

3. Route the cable through conduit/cable tray to the next junction box. Estimate the required length of cable to the terminal strip, allowing a little extra for strain relief. Cut the excess cable. Connect wires from the cable to the TB1 terminal in the junction box: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

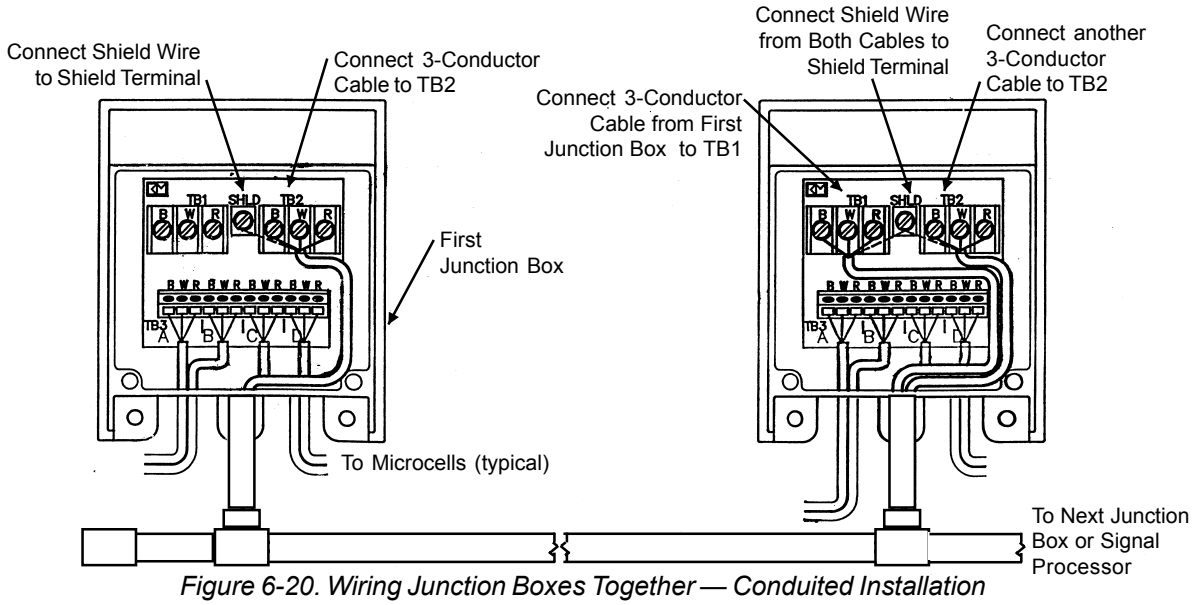


Figure 6-20. Wiring Junction Boxes Together — Conduited Installation

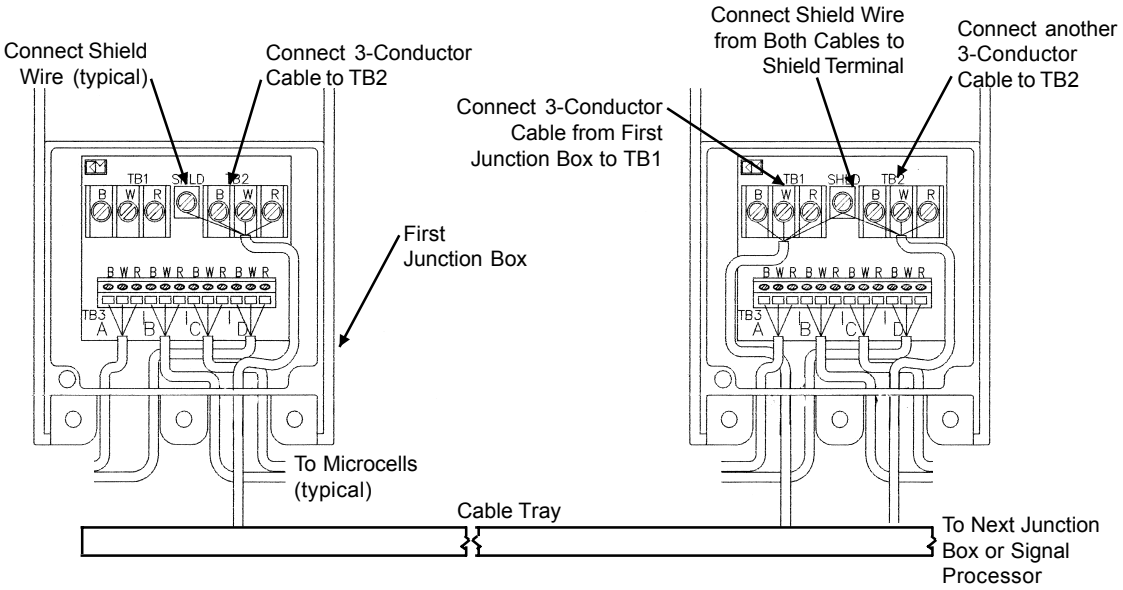


Figure 6-21. Wiring Junction Boxes Together — Non-Conduited Installation

4. Route another 3-conductor cable through the fitting into this junction box, and attach wires to the TB2 terminal: black wire to B terminal, white wire to W terminal, and red wire to R terminal. Connect the cable shield wire to the Shield terminal between TB1 and TB2.

5. Repeat Steps 3 and 4 until all junction boxes for the vessel are wired together.

6. Route the cable from the last junction box through conduit/cable tray to the signal processor. Refer to the signal processor manual for wiring the junction box to the signal processor. One vessel takes up one channel in the signal processor — the channel shows the average value from all the Microcells on the vessel supports.

Note

Ground the cable shield only at the signal processor.

Appendix A: L-Cell Specifications

Mechanical

Stress Level	
Carbon Steel —	
Maximum	±15,000 psi (10.5 kg/mm^2)
Recommended*	5,000 ± 3,500 psi (3.5 ± 2.5 kg/mm^2)
Aluminum —	
Maximum	±6,500 psi (4.6 kg/mm^2)
Recommended*	3,000 ± 1,500 psi (2.1 ± 1.1 kg/mm^2)
Fatigue Life	
Carbon Steel —	> 20 million cycles; load and unload at 0 to 7,500 psi (0 to 5.3 kg/mm^2)
Aluminum —	> 20 million cycles; load and unload at 0 to 3,250 psi (0 to 2.2 kg/mm^2)

**Consult factory for application assistance for stress levels outside the recommended range.*

Electrical

Excitation Voltage	Standard 12 Vdc, ±5%
Excitation Current at 12Vdc	11.8 mA at 0° F (-18° C) to 8.4 mA at 100° F (+38° C)
Insulation Resistance	2M ohms
Strain Gage to Sensor Frame	
Breakdown Voltage	>250 Vdc
Red-to-White Resistance	4.0K ohms, ± 200 ohms at 77° F (25° C)
Black-to-White Resistance	4.0K ohms, ± 200 ohms at 77° F (25° C)

Output (for 12Vdc excitation)

Sensitivity	
Carbon Steel	35 mV ± 1%/1,000 psi (35 mV ± 1%/0.7 kg/mm^2)
Aluminum	80 mV ± 1%/1,000 psi (80 mV ± 1%/0.7 kg/mm^2)
Zero-Strain Output	0 mV ± 100 mV
Nonlinearity & Hysteresis	±0.2% of full-scale output
Repeatability	0.1% of full-scale output
Output Impedance	3.75K ohms, ± 1%
Full Scale	~298 mV @ 8,500 psi (carbon steel) ~360 mV @ 4,500 psi (aluminum)

Environmental

Rating	Designed for rugged, outdoor applications
Temperature Range	
Operational	-30° to +140° F (-34° to +60° C)
Storage	-30° to +140° F (-34° to +60° C)
Temperature Effects	
Sensitivity Change	0.02%/°F (0.036%/°C)
Zero Shift	±2 mV/100° F (±2 mV/56° C) between 0° and 100° F (between -18° and 38° C)

Physical

Weight	1.4 oz (40 gm)
Cable	3-conductor, 22 gage, unshielded
Sensor Frame	17-4 PH stainless steel
Cable Length	15 ft (4.6 m)

Appendix B: Microcell Specifications

Mechanical

Stress Level		
3-inch Microcell	Maximum	10,000 psi (7.0 kg/mm^2)
	Recommended*	5,000 ± 2,500 psi (3.5 ± 1.75 kg/mm^2)
2-inch Microcell	Maximum	15,000 psi (10.5 kg/mm^2)
	Recommended*	7,500 ± 3,750 psi (5.3 ± 2.6 kg/mm^2)
Fatigue Life		> 20 million cycles; load and unload at 0 to 5,000 psi (0 to 3.5 kg/mm^2)

**Consult factory for application assistance for stress levels outside the recommended range.*

Electrical

Excitation Voltage	Standard 12 Vdc, ±5%; maximum 30 Vdc
Excitation Current at 12V	4.0 mA at 0°F (-18°C) to 2.7 mA at 100°F (+38°C)
Insulation Resistance	2M ohms
Strain Gage to Sensor Frame Breakdown Voltage	>500 VDC
Red-to-White & Black-to-White Resistance	
3-inch Microcell	Standardized: 8.50K ± 200 ohms at 70°F (21°C) Non-Standardized: 2.0K ± 200 ohms at 70°F (21°C)
2-inch Microcell	2.0K ± 200 ohms at 70°F (21°C)

Output (for 12V excitation)

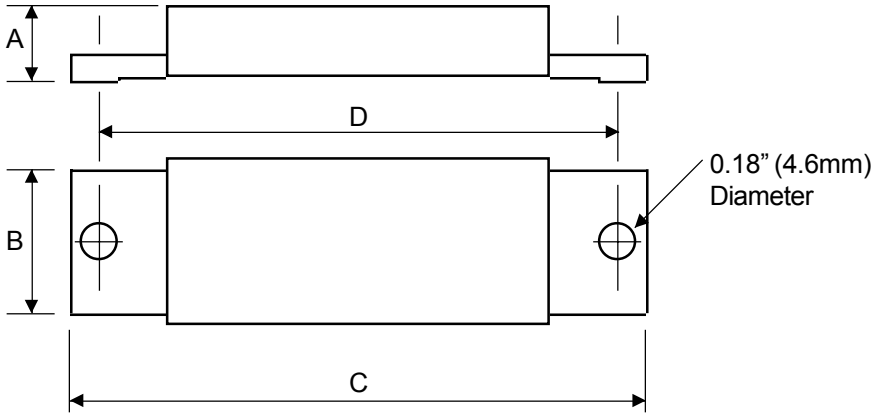
Sensitivity	
3-inch Microcell	70 mV ± 1%/1,000 psi (70 mV ± 1%/0.7 kg/mm^2)
2-inch Microcell	56 mV ± 1%/1,000 psi (56 mV ± 1%/0.7 kg/mm^2)
Zero-Strain Output	0 mV ± 25 mV
Nonlinearity	±0.1% of full-scale output
Repeatability & Hysteresis	0.05% of full-scale output
Output Impedance	
3-inch Microcell	Standardized: 7.5K ± 75 ohms at 70°F (21°C) Non-Standardized: 1000 ohms ± 100 ohms at 70°F (21°C)
2-inch Microcell	1000 ohms ± 100 ohms at 70°F (21°C)

Environmental

Rating	Designed for rugged, outdoor applications
Temperature Range	
Operational	-30° to +150°F (-34° to +66°C)
Storage	-30° to +150°F (-34° to +66°C)
Compensated	Standard: 0° to +100°F (-18° to +38°C) Mid: +50° to +150°F (+10° to +66°C)
Temperature Effects	
Sensitivity Change	0.02%/°F (0.036%/°C), in compensated temperature range
Zero Shift	±5 mV/100°F (±5 mV/56°C), in compensated temperature range

Physical

Weight	3 oz (90 gm)
Cable	3-conductor, 22 gage, unshielded
Steel Base	AISI 1018 carbon steel matched to A36
Aluminum Base	Custom — consult factory
Stainless Steel Base	Custom — consult factory
Cable Length	5.5' (1.7m)
Size	See Reference Dimensions



Reference Dimensions		
	3-inch Microcell	**2-inch Microcell**
A	.375” (9.52mm)	.375” (9.52mm)
B	0.75” (19.0mm)	0.75” (19.0mm)
C	3.00” (76.2mm)	2.00” (50.8mm)
D	2.75” (69.8mm)	1.75” (44.4mm)

Note: These dimensions are for reference only. Use the Microcell drill template to locate, drill, and tap the mounting holes.

Appendix C: Glossary

Calibration Curve

A graph of load versus output. Typically, it is a straight line and relates live load to a voltage or digital count output.

Hysteresis

The maximum difference between sensor readings for the same applied load, with one reading obtained by increasing the load from zero and the other reading obtained by decreasing the load from the rated load. It is usually expressed as a percentage of the rated load.

Live Load

The weight of the material to be measured; in other words, the weight of the contents of the vessel.

Non-Linearity

The maximum deviation of the sensor calibration curve from a straight line between zero load and the rated load.

Repeatability

The maximum difference between sensor readings for repeated loadings under identical loading and environmental conditions.

Sensitivity

The ratio of the change in electrical output to the change in load or stress.

Signal Processor

The electronic hardware and software *box* connected to a sensor (such as an L-Cell) or transducer array. If it is augmented with software, the first stage of the signal processor is an A/D converter. A signal processor generally has provisions for most, if not all, of the following:

1. Excitation voltage applied to each of the sensors/transducers in the network.
2. Adjustable zero calibration.
3. Adjustable scale factor.
4. Long-distance signal transmission options, such as 4-20 mA or serial transmission.
5. Setpoint (commonly referred to as a contact closure) to provide a discrete indication that a specific point has been reached.
6. Some type of indicator or display, such as numerals, needle movement, discrete LED array, etc.

Appendix D: System Calibration

This chapter describes general procedures for calibrating the L-Cell system. Before calibrating, you must install a signal processor. Refer to the signal processor manual for the procedures to input calibration parameters.

There are two calibration methods:

- Live Load calibration — set lo span and hi span while moving material into or out of the vessel. This is the preferred method.
- Manual calibration — set scale factor counts, scale factor weight, and zero calibration value without moving material. This method is less accurate than Live Load calibration.

A Live Load calibration requires you to move a known quantity of material into or out of the vessel while performing the procedure. The quantity of material moved must be *at least* 25% of the vessel's total capacity to provide best accuracy. Live Load calibration is also based on the material weight currently in the vessel.

Manual calibration allows you to start using the system as soon as L-Cells, junction boxes, and signal processor are installed and wired, even if you cannot move any (or enough) material now. Manual calibration values are based on system parameters, including sensor sensitivity, vessel stress, and signal processor A/D converter sensitivity. These values are known, can be calculated, or can be obtained from the signal processor. Manual calibration is also based on the material weight currently in the vessel.

Note that manual calibration does not take into account the *actual* response to changes in weight. Theoretically, a change in weight results in a proportional change in digital counts. However, the structure's actual response to load and interaction with piping, catwalks, a roof, discharge chutes, etc. prevents the system from achieving theoretical values. Manual calibration is a good start, but to obtain the highest accuracy, perform a Live Load calibration when scheduling permits you to move material into or out of the vessel.

The following sections provide procedures for performing Live Load and Manual calibrations.

Live Load Calibration

Live Load calibration can be performed by adding **or** removing a known quantity of material from the vessel. The quantity of material moved must be at least 25% of the vessel's total capacity. The procedures for both Live Load calibration methods follow.

Note

Refer to the signal processor manual to input *Lo Span* and *Hi Span*.

Adding Material

See Figure D-1:

1. Record the current live load.
2. Input *Lo Span*:
   Lo Span = current live load
3. Add known quantity of material to the vessel. Ensure all material has stopped moving before proceeding.
4. Input *Hi Span*:
   Hi Span = *Lo Span* + Added Weight

Example:You are using L-Cells to monitor a vessel. The vessel contains 50,000 lbs of material and can hold a maximum of 200,000 lbs. You plan to add 60,000 lbs of material (>25% of 200,000 lbs). Following the Live Load calibration procedure:

1. Current live load = 50,000 lbs
2. *Lo Span* = current live load = 50,000 lbs
3. Add 60,000 lbs of material.
4. *Hi Span* = *Lo Span* + Added Weight = 50,000 lbs + 60,000 lbs = 110,000 lbs

Removing Material

See Figure D-1:

1. Record the current live load.
2. Input *Hi Span*:
   Hi Span = current live load
3. Remove known quantity of material from the vessel. Ensure all material has stopped moving before proceeding.
4. Input *Lo Span*:
   Lo Span = *Hi Span* – Removed Weight

Example:You are using L-Cells to monitor a vessel. The vessel currently contains 110,000 lbs of material and can hold a maximum of 200,000 lbs. You plan to remove 60,000 lbs of material (>25% of 200,000 lbs). Following the Live Load calibration procedure:

1. Current live load = 110,000 lbs
2. *Hi Span* = current live load = 110,000 lbs
3. Remove 60,000 lbs of material.
4. *Lo Span* = *Hi Span* – Removed Weight = 110,000 lbs – 60,000 lbs = 50,000 lbs

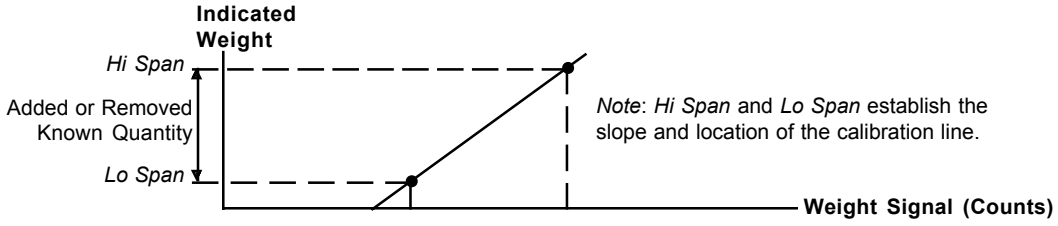


Figure D-1. Live Load Calibration by Adding or Removing a Known Quantity of Material

Manual Calibration

See Figure D-2:

1. Refer to the signal processor manual to determine how to obtain the A/D converter sensitivity, expressed in Counts/mV. Record this value.

Note

K-M's SVS 2000™ signal processor performs a manual calibration automatically, with *Quick Config*.

2. Record the L-Cell sensitivity (S):
   - **Carbon steel vessel** — 35 mV/1000 psi (35 mV/0.7kg/mm^2)
   - **Aluminum vessel** — 80 mV/1000 psi (80 mV/0.7kg/mm^2)

3. Refer to the Application Data Form for the vessel (if you cannot locate the completed form, contact K-M for a copy). Record the maximum live load and the stress.

4. Record the current live load in the vessel.

5. Calculate the Manual calibration values:
   Scale Factor Weight = Maximum live load
   Scale Factor Counts = S x Counts/mV x Stress
   Zero_Cal = Current live load

6. Refer to the signal processor manual to input the calibration values.

Example: You are using L-Cells to monitor a 15' diameter carbon steel, skirt-supported vessel with 0.187" wall thickness. The vessel currently contains 50,000 lbs of material and can hold a maximum of 200,000 lbs. Following the procedure:

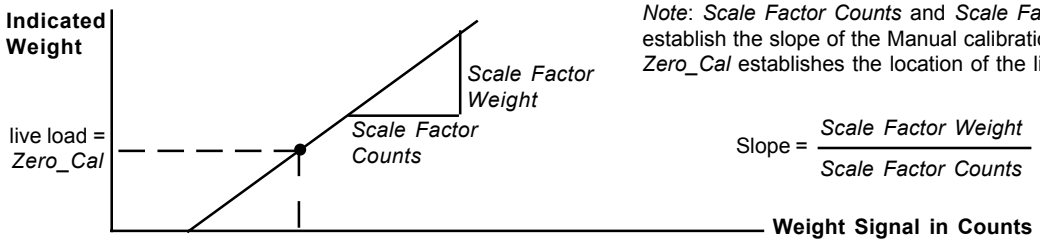
1. Counts/mV = 699.05 (from signal processor)

2. S = 35 mV/1000 psi (from L-Cell manual, for carbon steel vessel) = 0.035 mV/psi

3. From the Application Data Form, the maximum live load is 200,000 lbs. The stress is: $\frac{200{,}000 \text{ lbs}}{3.14 \times (15' \times 12''/\text{ft}) \times 0.187''} = 1892 \text{ psi}$

4. Current live load = 50,000 lbs

5. Calculate the values for the calibration:
   Scale Factor Weight = Maximum live load = 200,000 lbs
   Scale Factor Counts = S x Counts/mV x Stress
   = .035 mV/psi x 699.05 Cnts/mV x 1892 psi
   = 46,291 Counts
   Zero_Cal = Current live load = 50,000 lbs



Note: *Scale Factor Counts* and *Scale Factor Weight* establish the slope of the Manual calibration line. *Zero_Cal* establishes the location of the line.

$$\text{Slope} = \frac{\textit{Scale Factor Weight}}{\textit{Scale Factor Counts}}$$

Figure D-2. Manual Calibration Line

Appendix E: Troubleshooting the Bolt-On System (L-Cell)

This chapter describes some common problems. For each problem, one or more possible explanations are listed. For each explanation, an indication of when the problem is likely to be noticed and suggested solutions are provided.

Problem	Problem Details	Solution
Small Amplitude Changes or Erratic Fluctuations in display readings	Small amplitude drift or oscillation, with peak-to-peak disturbance of 0.1% to 0.3% of full scale, is normal.	Reduce drift or oscillation by setting 'count by' and 'averaging' appropriately on signal processor (refer to signal processor manual).
	Erratic fluctuations can be caused by moisture in cable conduit, junction boxes, or junction box PCBs.	Check conduit, junction boxes, and PCBs for water contamination. Find water entry source and correct problem. Dry with a hair drier. Remove/replace corroded parts and materials. *CAUTION* *If using sealant to eliminate water entry, use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.*
	Fluctuations can be caused by damaged L-Cell.	Using Digital Multimeter (DMM), check resistance for individual L-Cells: 1. Set meter resistance scale to accommodate measured range up to 20,000 ohms. 2. Remove one L-Cell 's wires from junction box terminal TB3. 3. Put one DMM lead on L-Cell's white wire and other lead on red wire. Record resistance reading, and verify it is 4000± 200 ohms. If reading is outside this range, L-Cell is damaged and must be replaced. 4. Put one DMM lead on L-Cell's white wire and other lead on black wire. Record resistance reading, and verify it is 4000± 200 ohms. If reading is outside this range, L-Cell is damaged and must be replaced. 5. Verify readings from Steps 3 and 4 are within 200ohms of each other. If not, L-Cell is damaged and must be replaced. 6. Repeat Steps 2 through 5 for each suspect L-Cell, until damaged L-Cell is located.

Problem	Problem Details	Solution
Small Amplitude Changes or Erratic Fluctuations in display readings	Fluctuations can be caused by short to ground	Using a Digital Multimeter (DMM) or ohmmeter, check for shorts to ground as follows: 1. Set meter resistance scale to accommodate maximum measured range. 2. Disconnect junction box wires from signal processor. 3. With one lead to earth ground and other lead to white wire, check resistance on disconnected junction box wires: • If reading is less than infinite (i.e., there is resistance), short is indicated; proceed to Step 4 to identify location. • If no short is indicated, investigate other explanations for problem. 4. Starting with junction box closest to signal processor in daisy chain, disconnect wires connecting junction box to other junction boxes. With one lead to earth ground and other lead to white wire, check resistance on wires leading from junction box: • If reading is less than infinite (i.e., there is resistance), short is indicated; proceed to Step 5 to identify location. • If no short is indicated, proceed to next junction box in daisy chain, disconnecting wires connecting it to other junction boxes and checking resistances. Perform for each junction box down chain until short is located; proceed to Step 5 to identify location. 5. Disconnect L-Cell wires for one L-Cell from above identified junction box. With one lead to earth ground and other lead to white wire, check resistance on disconnected L-Cell wires: • If reading is less than infinite (i.e., there is resistance), short is indicated. Replace shorted L-Cell. • If no short is indicated, disconnect next L-Cell wires from junction box and check resistances. Repeat for each L-Cell wired to junction box until short is located. Replace shorted L-Cell.

Problem	Problem Details	Solution
Small Amplitude Changes or Erratic Fluctuations in display readings	Fluctuations can be caused by problems with signal processor.	Check signal processor excitation voltage and incoming AC voltage for accuracy and stability (refer to signal processor manual).
Repeatable Drift over 24-hour Period	Periodic drift is most likely caused by vessel thermal expansion due to sun's radiation or vessel's response to its own heating cycles.	1. If periodic drift is outside specifications (Appendix A & B*),* contact KM. 2. If keeping long-term records of material levels, take readings at same time each day to minimize error.
Sudden Change in Display Reading or System Requires Frequent Recalibration	A single broken L-Cell can cause indicated weight to shift up or down by large amount, up to 100% of full-scale live load.	Check voltage outputs of individual L-Cells (refer to Chapter 2, Pre-Installation procedures). Voltage should be between -200 mV and +200 mV on installed L-Cells. If not, check L-Cell resistance as described in Troubleshooting Section page E-2.
	Slipping of L-Cell can cause indicated weight to shift suddenly.	If a broken L-Cell is not indicated, perform following procedure: 1. Carefully remove environmental cover from L-Cell. 2. Retighten L-Cell #6-32 socket head cap screws, following procedure in L-Cell Installation Chapter applicable to installation. 3. Replace environmental cover on L-Cell. Follow procedure provided in L-Cell Installation Chapter applicable to installation. CAUTION **Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738**. Other sealants may contain acetic acid, which is harmful
	Sudden change in weight reading can be caused by problems with signal processor.	Check signal processor excitation voltage and incoming AC voltage for accuracy and stability (refer to signal processor manual).

Appendix F. Spare Parts Recommendations

Spare Parts for L-Cell

K-M recommends you purchase and maintain the following minimum number of spare parts/tools for your L-Cell system:

1 Extra per Vessel

- L-Cell Sensor, each complete with:
  - Sensor
  - Environmental Cover
  - #6-32 socket head cap screws (3)

1 Extra per Plant

- T-handle driver
- Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738
- Kistler-Morse Test Meter

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

Spare Parts for Microcell

K-M recommends you purchase and maintain the following minimum number of spare parts/tools for your Microcell system:

1 Extra per Vessel

- Microcell Sensor, each complete with:
  - Sensor
  - Environmental Cover
  - #8-32 socket head cap screws (2)
  - #8 hardened flat washers (2)

1 Extra per Plant

- T-handle driver
- Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738
- K-M Test Meter

CAUTION

Only use Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738. Other sealants may contain acetic acid, which is harmful to sensors and electronics.

Appendix G: Alternate Method of Checking Output

Microcell

If you do not have a K-M Test Meter, use a Digital Multimeter (DMM) to monitor the voltage output of each Microcell during installation. Set up the DMM as described below and then follow the installation procedure for *Mounting Microcell.*

Note

The junction box must be mounted and wired to the signal processor and powered up before following this procedure. See *Mounting Junction Box, Wiring Microcells to Junction Box, and Wiring Junction Boxes Together and to Signal Processor* before proceeding.

1. See Figure G-1. Connect the red wire from the Microcell cable to the R terminal on terminal block TB3 in the junction box. Connect the black wire to the B terminal on TB3.
2. Connect the signal (+) probe of the DMM to the white wire from the Microcell cable. DO NOT connect the white wire to the terminal block.
3. Connect the common (-) probe of the DMM to TP1 on the junction box circuit board. If a test point is not present, connect the common probe to the lead of either R1 or R2 nearest the TB2 terminal strip.
4. Set a voltage range on the DMM that will accommodate a measured range of ± 1 volt.
5. Complete installation of the Microcell, using the DMM to monitor the voltage output as you tighten the screws. See *Mounting Microcell* for your installation.

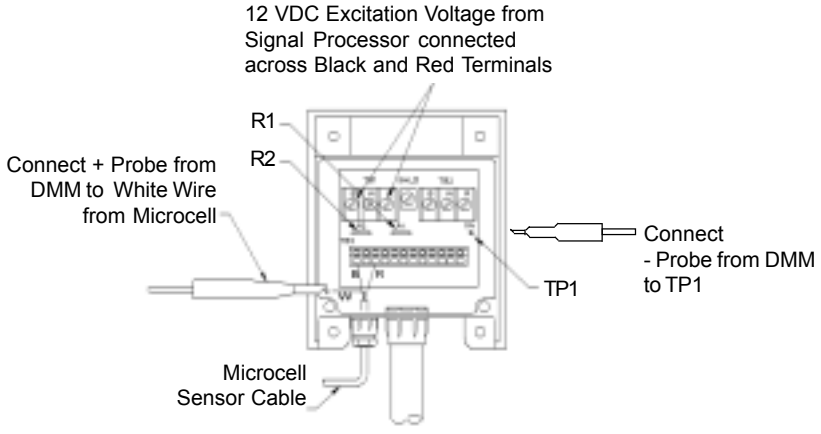


Figure G-1. Using DMM to Monitor Voltage Output

L-Cell

If you do not have a Kistler-Morse Test Meter, use a Digital Multimeter (DMM) to monitor the voltage output of each L-Cell during installation. Set up the DMM as described below and then follow the installation procedure for *Mounting L-Cell.*

Note

The junction box must be mounted and wired to the signal processor and powered up before following this procedure. See *Mounting Junction Box, Wiring L-Cells to Junction Box,* and *Wiring Junction Boxes Together and to Signal Processor* before proceeding.

1. See Figure G-2. Connect the red wire from the L-Cell cable to the R terminal on terminal block TB3 in the junction box. Connect the black wire to the B terminal on TB3.

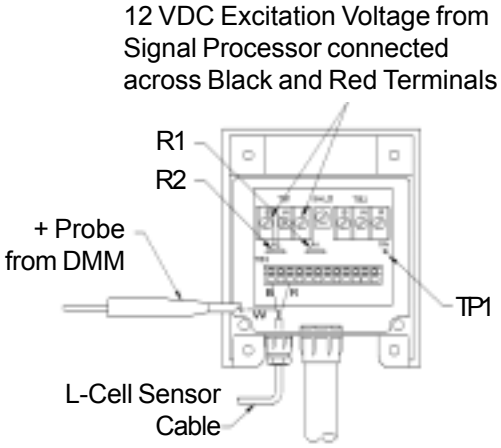


Figure G-2. Using DMM to Monitor Voltage Output

2. Connect the signal (+) probe of the DMM to the white wire from the L-Cell cable. DO NOT connect the white wire to the terminal block.
3. Connect the common (-) probe of the DMM to TP1 on the junction box circuit board. If a test point is not present, connect the common probe to the lead of either R1 or R2 nearest the TB2 terminal strip.
4. Set a voltage range on the DMM that will accommodate a measured range of ± 1 volt.
5. Complete installation of the L-Cell, using the DMM to monitor the voltage output as you use the T-handle driver to tighten the screws. See *Mounting L-Cell* for details.

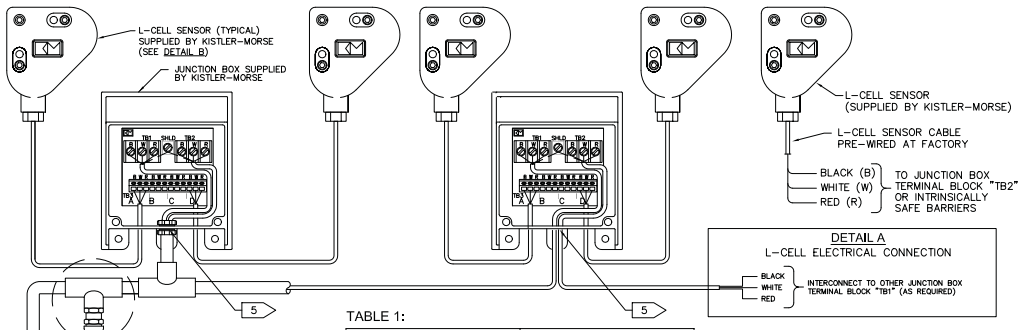
Appendix H: Technical Drawings

This appendix contains the following technical drawings for the L-Cell and the Microcell:

Drawing No.	Drawing Title
TI-LCELL-02	L-Cell Sensor FM Approved Intrinsically Safe Inteconnect Diagram
TI-MC.FM-01	FM Approved Intrinsically Safe Interconnect Diagram, Microcell Sensor
39-1150	Drill and Tap Template Drawing (L-Cell Base)
36-1021-01	Printed Namplate for L-Cell ATEX
36-1022-01	Printed Namplate for M-Cell ATEX
91-1045-01	Load Stand II S.S. Label

FM CONTROLLED DOCUMENT
NO CHANGES TO DRAWING
WITHOUT PRIOR FM APPROVAL

REVISIONS					
LTR	DESCRIPTION	INCORP.	CHECKED	APPROVED	DATE
NEW	RELEASE	CAB	KPM	KPM	3/4/97
A	PER ECO 4155	CAB	KPM	KPM	
B	PER ECO 4343	VCM	ROBB S	KPM	10/27/99
C	PER ECO 5145	BWC	AJR	AJR	6/29/04



DETAIL D

DETAIL A
L-CELL ELECTRICAL CONNECTION

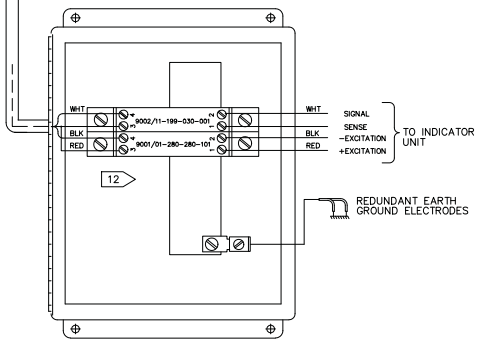
TABLE 1:

FACTORY MUTUAL APPROVED SENSOR TO WHICH THIS DRAWING APPLIES	FACTORY MUTUAL APPROVED JUNCTION BOX MODEL NUMBERS
L-CELL	JB15 SERIES
	JB25 SERIES

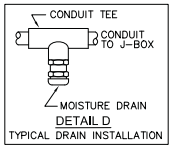
HAZARDOUS LOCATION (CLASS I: DIVISION 1, GROUPS C & D; CLASS I: DIVISION 2, GROUPS A, B, C, & D; CLASS II: DIVISION 1 & 2, GROUPS E, F, & G; CLASS III: DIVISION 1 & 2.

NON-HAZARDOUS LOCATION

STAHL BARRIER NO. 9001/01-280-280-101 CAN BE REPLACED WITH NO. 9001/01-199-390-101 WHEN MORE THAN FOUR L-CELLS ARE CONNECTED TO THE BARRIER.



STAHL SAFETY BARRIER (SBMVS-N4)
L-CELL AND STAHL BARRIER
INTERCONNECT WIRING DIAGRAM
DETAIL C



DETAIL D
TYPICAL DRAIN INSTALLATION

DETAIL B
(DELETED)

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. NO CHANGES IN THIS DOCUMENT ARE ALLOWED WITHOUT FACTORY MUTUAL APPROVAL.
2. FOR FACTORY MUTUAL APPROVAL, INSTALLATION MUST BE IN ACCORDANCE WITH THIS TECHNICAL ILLUSTRATION (TI) DRAWING, AND NEC-1990 ARTICLE 500 AND 501 FOR CLASS I LOCATIONS, ARTICLE 500 AND 502 FOR CLASS II LOCATIONS, OR ARTICLE 500 AND 503 FOR CLASS III LOCATIONS. A CLASS I HAZARDOUS LOCATION REQUIRES CONDUIT SEAL(S) APPROVED FOR THE LOCATION CONDITIONS AND USE. SEE NEC-1990 ARTICLE 500 AND 501.
3. ALL INTERCONNECT CABLE SHOWN IS PROVIDED AND INSTALLED BY THE CUSTOMER. WHEN USING CONDUIT FOR THE INTERCONNECT CABLE RUN TO THE NON-HAZARDOUS AREA, ROUTE ONLY THE INTERCONNECT CABLE THROUGH THIS CONDUIT.
4. UP TO FOUR L-CELL SENSOR SIGNAL CABLES CAN BE ACCOMMODATED IN ONE INTERCONNECT JUNCTION BOX. JUNCTION BOXES CAN BE INTER-CONNECTED TOGETHER AS REQUIRED. INTERCONNECT JUNCTION BOX COVERS MUST BE ON TIGHT AT ALL TIMES AND UNUSED OPENINGS SEALED WITH THE PLUGS PROVIDED.

5. INSTALL 3/4" CONDUIT NUT WITH LIQUID SEALS ON BOTH SIDES OF JUNCTION BOX ENTRY. ACCEPTABLE SOURCES ARE THOMAS & BETTS #142SL, REGAL #802S, OR EQUIVALENT.

6. CAUTION: DO NOT APPLY IN EXCESS OF 8 POUND-INCHES OF TORQUE TO JUNCTION BOX COVER SCREWS.
7. TO PREVENT MOISTURE ACCUMULATION IN JUNCTION BOX, A DRAIN MUST BE IN-STALLED AT A LOWER POINT IN THE CONDUIT (SEE DETAIL D). USE CROUSE-HINDS ECD17 DRAIN OR EQUIVALENT.
8. FOR CLASS I AND II, DIVISION 2, GROUPS A-D, F AND G LOCATIONS, INTRINSIC SAFETY BARRIERS MAY BE OMITTED, PROVIDED INSTALLATION IS IN COMPLIANCE WITH N.E.C. ARTICLES APPLICABLE TO THESE LOCATIONS.
9. DELETED.
10. THE FOLLOWING MAXIMUM SERIES INDUCTANCES AND SHUNT CAPACITANCES APPLY TO THE INSTRINSICALLY SAFE WIRING CONNECTED TO THE STAHL BARRIERS: GP. C AND E – 0.41uF, 1.9mH; GP. D, F, AND G – 1.11uF, 3.41mH.
11. MAXIMUM OPERATING TEMPERATURE: 140°F (60°C).

12. BARRIER #9001/01-280-280-101 INCLUDES ATEX RATING AND CAN BE SUBSITUTED IN SYSTEMS USING 9001/01-280-280-10 (W/O ATEX RATING). BARRIER #9002/11-199-030-001 INCLUDES ATEX RATING AND CAN BE SUBSITUTED IN SYSTEMS USING 9002/11-199-030-00 (W/O ATEX RATING).

ECO ACCUMULATION:	APPROVALS	DATE
ECO 1:	DRAWN: C.BLACKBURN	2/27/97
ECO 2:	CHECKED: KPM	3/4/97
ECO 3:	PROJ. ENGR: KPM	3/4/97
ECO 4:	PRODUCTION:	
ECO 5: INCORPORATE ABOVE ECO'S	PURCHASING	

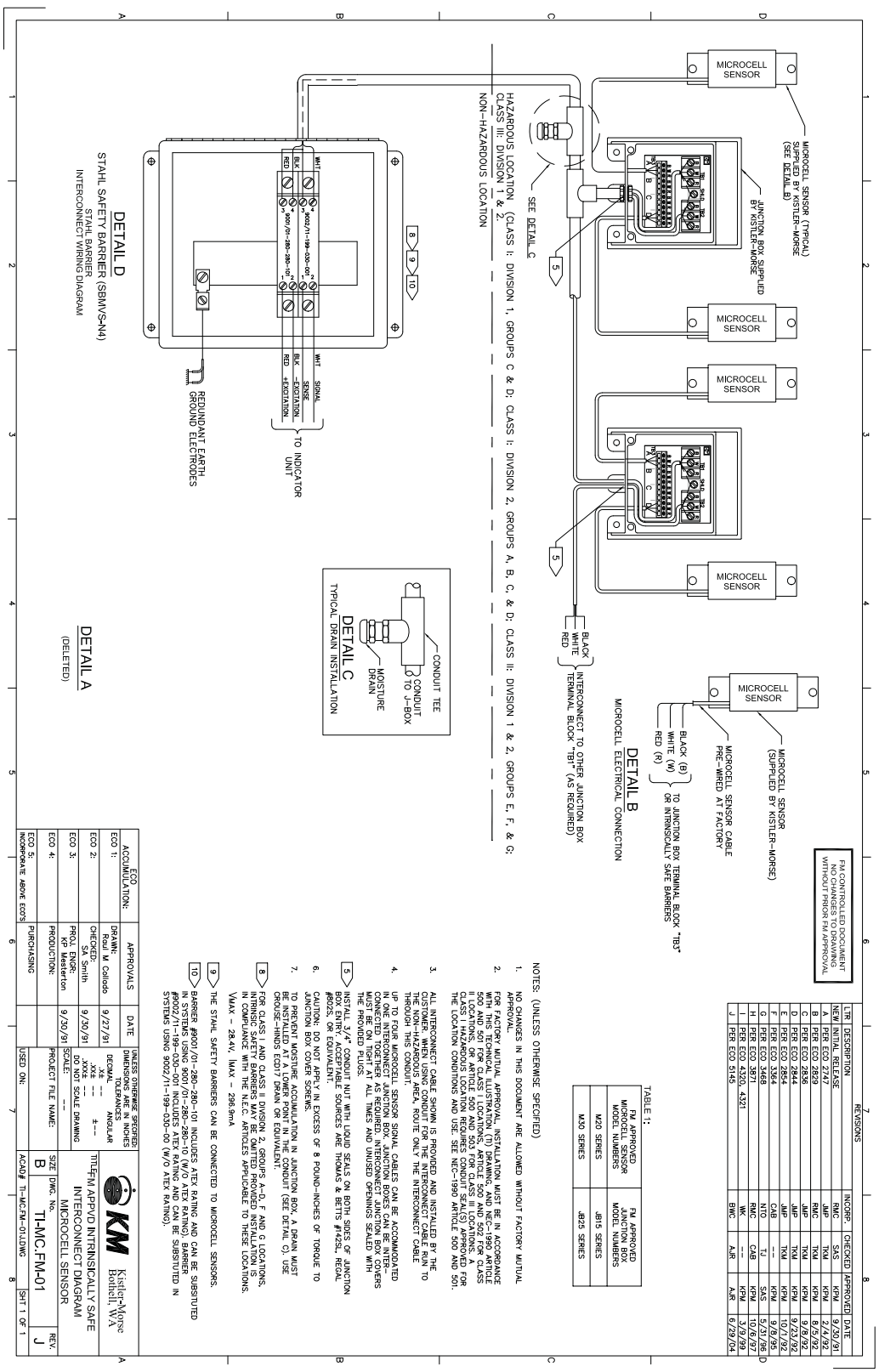
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMAL .X± --- .XX± --- .XXX± ---
ANGULAR ±--
DO NOT SCALE DRAWING
SCALE: --
PROJECT FILE NAME:
USED ON:

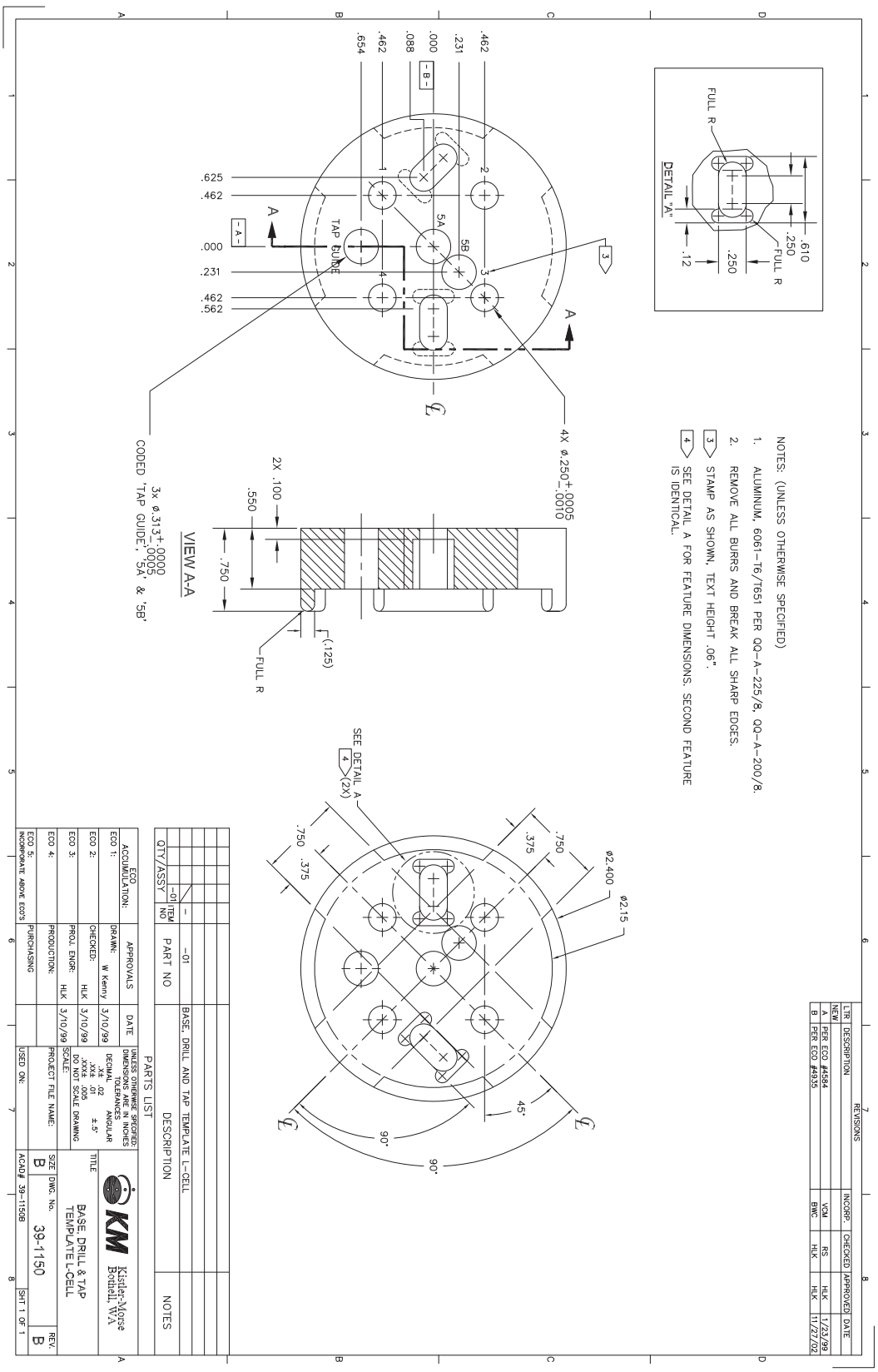
KM Kistler-Morse Bothell, WA

TITLE: L-CELL SENSOR
FM APPROVED INTRINSICALLY
SAFE INTERCONNECT DIAGRAM

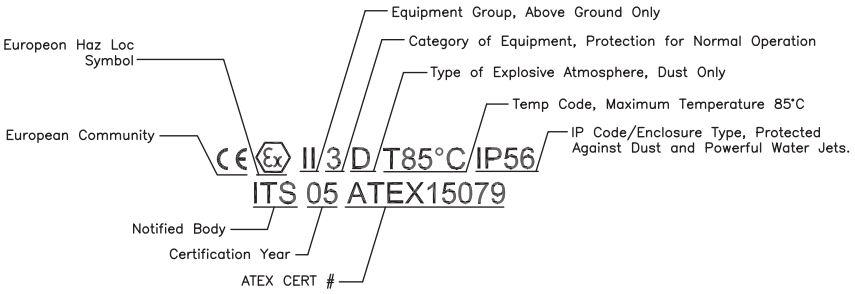
SIZE	DWG. No.	REV.
B	TI-LCELL-02	C

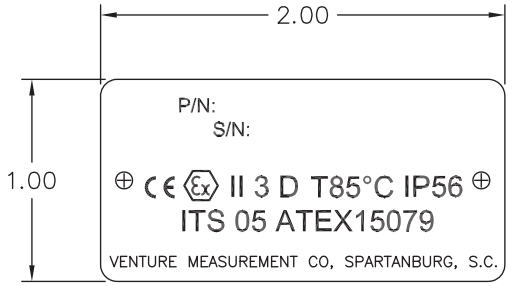
ACAD# TI-LCELL-02C.DWG SHT 1 OF 1


MICROCELL SENSOR
MICROCELL SENSOR (TYPICAL) SUPPLIED BY KISTLER-MORSE (SEE DETAIL B)
JUNCTION BOX SUPPLIED BY KISTLER-MORSE
SEE DETAIL C
HAZARDOUS LOCATION (CLASS I: DIVISION 1, GROUPS C & D; CLASS I: DIVISION 2, GROUPS A, B, C, & D; CLASS II: DIVISION 1 & 2, GROUPS E, F, & G; CLASS III: DIVISION 1 & 2;
NON-HAZARDOUS LOCATION
BLACK
WHITE
RED
INTERCONNECT TO OTHER JUNCTION BOX TERMINAL BLOCK "TB1" (AS REQUIRED)
MICROCELL SENSOR (SUPPLIED BY KISTLER-MORSE)
MICROCELL SENSOR CABLE PRE-WIRED AT FACTORY
BLACK (B)
WHITE (W)
RED (R)
TO JUNCTION BOX TERMINAL BLOCK "TB3" OR INTRINSICALLY SAFE BARRIERS
DETAIL B
MICROCELL ELECTRICAL CONNECTION
NOTES: (UNLESS OTHERWISE SPECIFIED)
1. NO CHANGES IN THIS DOCUMENT ARE ALLOWED WITHOUT FACTORY MUTUAL APPROVAL.
2. FOR FACTORY MUTUAL APPROVAL, INSTALLATION MUST BE IN ACCORDANCE WITH THIS TECHNICAL ILLUSTRATION (TI) DRAWING, AND NEC-1990 ARTICLE 500 AND 501 FOR CLASS I AND II LOCATIONS, OR ARTICLE 500 AND 503 FOR CLASS III LOCATIONS. A CLASS I HAZARDOUS LOCATION REQUIRES CONDUIT SEAL(S) APPROVED FOR THE LOCATION CONDITIONS AND USE. SEE NEC-1990 ARTICLE 500 AND 501.
3. ALL INTERCONNECT CABLE SHOWN IS PROVIDED AND INSTALLED BY THE CUSTOMER. WHEN USING CONDUIT FOR THE INTERCONNECT CABLE RUN TO THE NON-HAZARDOUS AREA, ROUTE ONLY THE INTERCONNECT CABLE THROUGH THIS CONDUIT.
4. UP TO FOUR MICROCELL SENSOR SIGNAL CABLES CAN BE ACCOMMODATED IN ONE FM APPROVED JUNCTION BOX. CABLES CAN BE WIRED CONNECTED TOGETHER AS REQUIRED. INTERCONNECT JUNCTION BOX COVERS MUST BE ON TIGHT AT ALL TIMES AND UNUSED OPENINGS SEALED WITH THE PROVIDED PLUGS.
5 INSTALL 3/4" CONDUIT NUT WITH LIQUID SEALS ON BOTH SIDES OF JUNCTION BOX WITH FLEXIBLE SOURCES ARE THOMAS & BETTS #1452, REGAL #8025, OR EQUIVALENT.
6. CAUTION: DO NOT APPLY IN EXCESS OF 8 POUND-INCHES OF TORQUE TO JUNCTION BOX COVER SCREWS.
7. TO PREVENT MOISTURE ACCUMULATION IN JUNCTION BOX, A DRAIN MUST BE INSTALLED AT A LOWER POINT IN THE CONDUIT (SEE DETAIL C). USE CROUSE-HINDS ECD17 DRAIN OR EQUIVALENT.
8 FOR CLASS I AND CLASS II DIVISION 2, GROUPS A-D, F AND G LOCATIONS, ANY FLEXIBLE CONDUIT USED MUST BE LIQUIDTIGHT FLEXIBLE METAL CONDUIT IN COMPLIANCE WITH THE N.E.C. ARTICLES APPLICABLE TO THESE LOCATIONS.
VMAX = 28.4V, IMAX = 296.9mA
9 THE STAHL SAFETY BARRIERS CAN BE CONNECTED TO MICROCELL SENSORS.
10 BARRIER #9001/01-280-280-101 INCLUDES ATEX RATING AND CAN BE SUBSTITUTED IN SYSTEMS USING 9001/01-280-280-10 (W/O ATEX RATING). BARRIER #9002/11-199-030-001 INCLUDES ATEX RATING AND CAN BE SUBSTITUTED IN SYSTEMS USING 9002/11-199-030-00 (W/O ATEX RATING).
TABLE 1:
FM APPROVED MICROCELL SENSOR MODEL NUMBERS
FM APPROVED JUNCTION BOX MODEL NUMBERS
M20 SERIES
J815 SERIES
M30 SERIES
J825 SERIES
DETAIL C
TYPICAL DRAIN INSTALLATION
CONDUIT TEE
CONDUIT TO J-BOX
MOISTURE DRAIN
DETAIL D
STAHL SAFETY BARRIER (SBMVS-N4)
STAHL BARRIER INTERCONNECT WIRING DIAGRAM
WHT SIGNAL
SENSE
BLK -EXCITATION
RED +EXCITATION
TO INDICATOR UNIT
REDUNDANT EARTH GROUND ELECTRODES
DETAIL A
(DELETED)
FM CONTROLLED DOCUMENT
NO CHANGES TO DRAWING WITHOUT PRIOR FM APPROVAL
LTR DESCRIPTION REVISIONS INCORP: CHECKED APPROVED DATE
NCN INITIAL RELEASE SMC SAS KPM 9/30/91
A PER ECO 2829 RMC TKM KPM 8/7/92
B PER ECO 2829 RMC TKM KPM 8/8/92
C PER ECO 2836 JMP TKM KPM 9/8/92
D PER ECO 2844 JMP TKM KPM 9/23/92
E PER ECO 2854 JMP TKM KPM 10/1/92
F PER ECO 3364 CAB -- KPM 9/8/95
G PER ECO 3468 NTO TJ SAS 5/31/96
H PER ECO 4320, 4321 RMC TKM KPM 10/6/97
I PER ECO 5145 BWC AJR KPM 12/22/03
J PER ECO 5145 BWC AJR KPM 6/29/04
ECO ACCUMULATION:
ECO 1:
ECO 2:
ECO 3:
ECO 4:
ECO 5: INCORPORATE ABOVE ECO'S
APPROVALS DATE
DRAWN: Raul M Collado 9/27/91
CHECKED: SA Smith 9/30/91
PROJ. ENGR: Kyle Masterton 9/30/91
PRODUCTION:
PURCHASING
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES: DECIMAL .XX ±.01 .XXX ±.005 ANGULAR ±1° DO NOT SCALE DRAWING
PROJECT FILE NAME:
USED ON:
Kistler-Morse Bothell, WA
TITLE: FM APPVD INTRINSICALLY SAFE INTERCONNECT DIAGRAM MICROCELL SENSOR
SIZE B DWG. No. TI-MC.FM-01 REV. J
ACAD# TI-MC.FM-01.DWG SHT 1 OF 1


NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALUMINUM, 6061-T6/T651 PER QQ-A-225/8, QQ-A-200/8.
2. REMOVE ALL BURRS AND BREAK ALL SHARP EDGES.
3 STAMP AS SHOWN, TEXT HEIGHT .06".
4 SEE DETAIL A FOR FEATURE DIMENSIONS. SECOND FEATURE IS IDENTICAL.
DETAIL "A"
FULL R
.610
.250
.250
.12
.462
.231
.000
.088
.462
.654
.625
.462
.000
.231
.462
.562
TAP GUIDE
5A
5B
4X ø.250+.0005 -.0010
2X .100
.550
.750
(.125)
VIEW A-A
3x ø.313+.0000 -.0005 CODED 'TAP GUIDE', '5A' & '5B'
SEE DETAIL A (2X)
.750
.375
.750
.375
ø2.400
ø2.15
45°
90°
90°
REVISIONS
LTR DESCRIPTION INCORP. CHECKED APPROVED DATE
NEW
A PER ECO #4584 VCM RS HLK 1/23/99
B PER ECO #4935 BWC HLK HLK 11/27/02
PARTS LIST
QTY/ASSY ITEM NO PART NO DESCRIPTION NOTES
-01 - -01 BASE, DRILL AND TAP TEMPLATE L-CELL
ECO ACCUMULATION:
ECO 1:
ECO 2:
ECO 3:
ECO 4:
ECO 5: INCORPORATE ABOVE ECO'S
APPROVALS DATE
DRAWN: W Kenny 3/10/99
CHECKED: HLK 3/10/99
PROJ. ENGR: HLK 3/10/99
PRODUCTION:
PURCHASING
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
DECIMAL TOLERANCES ANGULAR
.XX± .02 ±.5°
.XXX± .005
DO NOT SCALE DRAWING
SCALE:
PROJECT FILE NAME:
USED ON:
Kistler-Morse Bothell, WA
TITLE
BASE, DRILL & TAP TEMPLATE L-CELL
SIZE B DWG. No. 39-1150 REV. B
ACAD# 39-1150B SHT 1 OF 1

NUMBER STRING DEFINITION





Note:
Nameplate to be marked with All of the information shown, using Prior Nameplate Marking Machine

QTY./ASSY.	ITEM No.	PART No.	DESCRIPTION	REF. DESIG. / NOTE
1		36-1020-01	TAG GP SS 1X2	
		36-1021-01	Printed Nameplate for L-Cell ATEX	
	-01			

PARTS LIST

*DO NOT SCALE. DIMENSIONS ARE IN INCHES.

D	Removed XXXX and Change T6 to T85°C	07-522	SE 10-31-07	NBC 10-31-07
C	Additional Info for ATEX Marking	07-514	SE 10-24-07	NBC 10-24-07
B	Add new file # info	06-071	SE 2-17-06	NBC 3-2-06
A	INIT. RELEASE	05-363	SE 10-27-05	NBC 10-27-05
	REVISIONS	ECN #	DRAWN BY DATE	APP'D BY DATE

Ventura MEASUREMENT
150 VENTURE BLVD.
SPARTANBURG, SC 29306

FILE 36-1021-01

UNSPECIFIED TOLERENCES
DECIMALS: XX ±=.01
XXX ±=.005
ANGLES: ±=1/2°
DEBURR & BREAK EDGES .005
= CRITITCAL DIM. OR NOTE

TITLE: Printed Nameplate for L-Cell ATEX

REF KM

MATERIAL 36-1020-01

FINISH --------

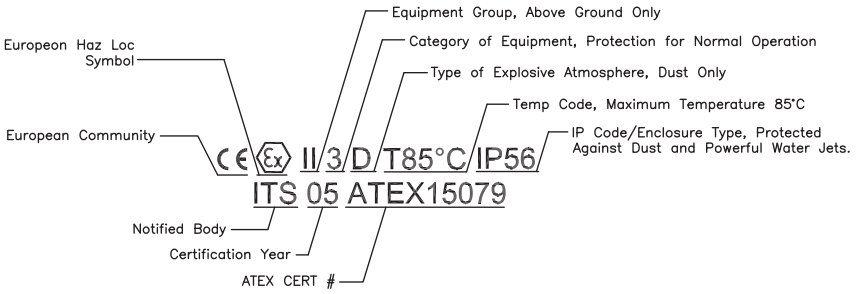
PART 36-1021-01

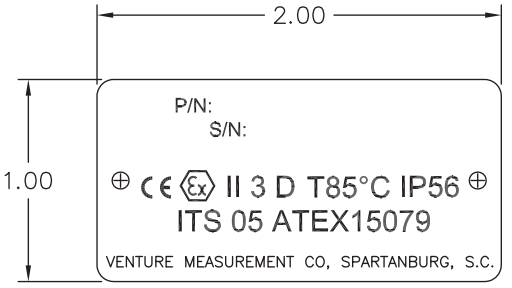
SCALE NONE

SIZE A

SHEET 1 of 1

NUMBER STRING DEFINITION





Note:
Nameplate to be marked with All of the information shown, using Prior Nameplate Marking Machine

QTY./ASSY.	ITEM No.	PART No.	DESCRIPTION	REF. DESIG. / NOTE
1		36–1020–01	TAG GP SS 1X2	
	–01	36–1022–01	Printed Nameplate for M–Cell ATEX	

PARTS LIST

*DO NOT SCALE. DIMENSIONS ARE IN INCHES.

	REVISIONS	ECN #	DRAWN BY / DATE	APP'D BY / DATE
D	Change T6 to T85°C	07–522	SE 10–31–07	NBC 10–31–07
C	Additional Info for ATEX Marking	07–514	SE 10–24–07	NBC 10–24–07
B	Add new file # info	06–071	SE 2–17–06	NBC 3–2–06
A	INIT. RELEASE	05–363	SE 10–27–05	NBC 10–27–05

venture MEASUREMENT
150 VENTURE BLVD.
SPARTANBURG, SC 29306

FILE 36–1022–01

REF KM

TITLE: Printed Nameplate for M–Cell ATEX

SCALE: NONE

SIZE: A

UNSPECIFIED TOLERENCES
DECIMALS: XX ±=.01
XXX ±=.005
ANGLES: ±=1/2°
DEBURR & BREAK EDGES .005
(C) = CRITITCAL DIM. OR NOTE

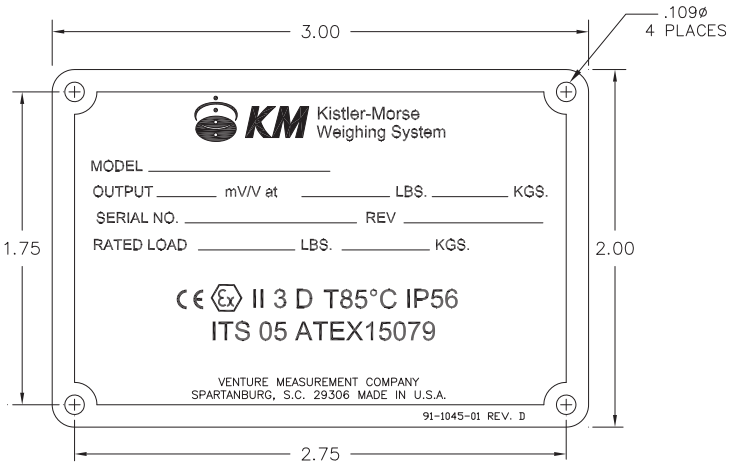
MATERIAL: 36–1020–01

FINISH: ––––––––

PART: 36–1022–01

SHEET: 1 of 1

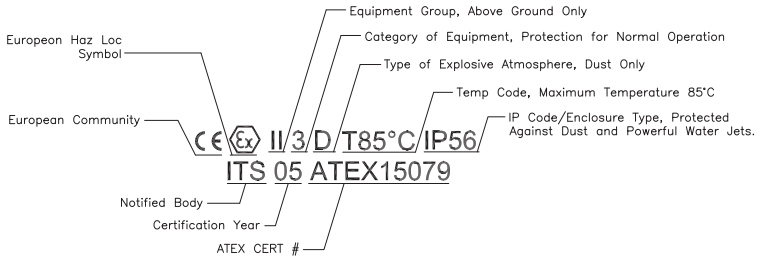
NAMEPLATE



	REVISIONS	ECN #	DRWN/CK'D BY DATE	APP'D BY DATE
A	INIT. RELEASE SE	05-363	SE 10-27-05	NBC 10-27-05
B	Upgrade w/ATEX File # SE	06-071	SE 2-17-06	NBC 3-1-06
C	Additional Info for ATEX Marking	07-514	SE 10-24-07	NBC 10-24-07
D	Removed ETL Logo & Change T6 to T85°C	07-522	SE 10-31-07	NBC 10-31-07

NOTES:
1. LOGO and LETTERING to be CHEMICALLY ETCHED and FILLED with BLACK BAKED-ON PAINT.
2. ADD 3M-468 ADHESIVE (5 MIL THICK) TO BACK OF NAMEPLATE.

NUMBER STRING DEFINITION



*DO NOT SCALE. DIM'S. ARE IN INCHES.

Venture MEASUREMENT 150 VENTURE BLVD. SPARTANBURG, SC 29306	TITLE: LOAD STAND II S.S. LABEL		SCALE: NONE
FILE: 91-1045-01	REF		SIZE: B
UNSPECIFIED TOLERANCES DECIMALS: XX ±=.01 XXX ±=.005 ANGLES: ±=1/2° DEBURR & BREAK EDGES .005 (P) = CRITICAL DIM. OR NOTE	MATERIAL: STAINLESS STEEL TYPE 304 26GA. .018	PART: 91-1045-01	SHEET: 1 of 1
	FINISH: -------		