Microcell™ Installation Manual

CAUTION

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

Kistler-Morse®

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NOTICE

CAUTION

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

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

Note

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

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Chapter 1. Introduction

Figure 1-1. The Kistler-Morse Microcell

Equipment Description

The Microcell™ (Figure 1-1) 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. K-M signal processors convert the Microcell voltage outputs to weight or level. Refer to Appendix A 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.

Applications

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 A, Microcell Specifications, for stress limits on each type of Microcell.

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

- Chapter 3 — installation on vertical column legs
- Chapter 4 — installation on horizontal beams

Contact K-M for information on non-standard applications.

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

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 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 or operation of the Microcell.

Chapter 2. Pre-Check Procedures

Introduction

This chapter describes the pre-check procedures for Microcells. Verifying the application and checking the Microcells *before* installation will ensure installation of properly working equipment that will provide accurate monitoring of vessel contents.

Application Verification

Prior to ordering Microcells, you should have read the Microcell Selection Guide (KM #97-5023) and completed the appropriate Application Data Form (KM #97-5025 for Microcells on column legs or KM #97-5024 for Microcells on beams). A copy of the completed form was returned to you with both the order acknowledgment and equipment shipment. If you cannot locate the form, contact K-M to get another copy before you proceed. Review the information on the form now to verify the application details.

Note

If the calculated stress on the Application Data Form is outside the following ranges, this is a special application:

- 3-inch Microcell — 2,500 to 7,500 psi (1.8 to 5.3 kg/mm^2)
- 2-inch Microcell — 3,750 to 11,250 psi (2.6 to 7.9 kg/mm^2)

Consult K-M before proceeding further with a special application.

Order Verification

Prior to beginning installation, verify the order is complete and assemble additional equipment needed for the installation.

Microcell Order

The following are included with the order (quantities dependent on application):

- ***Standard***
  Microcells, each complete with:
    Sensor
    Environmental Cover
    #8-32 socket head cap screws (2)
    #8 hardened flat washers (2)
  JB1 or JB2 Junction Boxes, each complete with:
    Terminal board
    Watertight fittings (4)
    Watertight plugs (for any cable openings that will not be used)
  Installation Kit, each complete with:
    Microcell drill template with #8-32 socket head cap screw
    #29 drill bit
    #8-32, 2-flute, spiral-point tap
    Sikaflex 1A polyurethane sealant or Dow Corning RTV 739 or RTV 738 and Material Safety Data Sheet (MSDS)
    Rust-inhibiting silicone grease
- ***Optional***
  Insulation and insulation hardware (if best performance is required for an outdoor installation on column legs)

If any items are missing from the order, contact K-M before proceeding. Substituting parts without K-M approval may cause system problems and will void the warranty.

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 signal processor.

Microcell Installation Equipment

Tape measure
Marking pen
K-M Test Meter
Drill motor
Tapping fluid
Tap handle
Disk grinder, $4^1/_2$" (114 mm) or larger, or belt grinder
Sandpaper (coarse and fine)
Degreaser (isopropyl alcohol or acetone)
Level
Caulking gun
$^9/_{64}$" hex T-handle driver
Digital Multimeter (DMM)
Tape (electrical or masking)

Note

- If Microcells will be installed by K-M, K-M's service technician will bring this equipment on-site as part of his tool kit.
- **If Microcells will be installed by the customer, purchase of a K-M Test Meter is highly recommended to simplify installation.**

Junction Box and Field Wiring Equipment

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 or cable tray
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 Equipment

CAUTION

Handle Microcells with care. Dropping, striking, etc. can damage Microcells.

Visual Check

Visually inspect all equipment in the order — including Microcells, junction boxes, Installation Kit, and insulation (if provided) — to verify they were not damaged during shipment. If any item was damaged, contact K-M for a replacement.

Functional Check

Perform a functional check of the Microcells before installation to verify they were not damaged during shipment. Described below are two methods of performing the check.

Testing with K-M Test Meter

The K-M Test Meter (Figure 2-1) is designed specifically to test K-M sensors. If you do not have a Test Meter, disregard this section and proceed to *Testing 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. See Figure 2-1. Connect the Microcell's red, white, and black wires to the corresponding Test Meter terminals. Place the Microcell on a stable surface.
2. Turn on the power to the Test Meter and set the Simulate/Test switch to the Test position. Verify the *no-load* output is between +25 mV and -25 mV.
3. Repeat Steps 1 and 2 for each Microcell. If the no-load output for any Microcell is outside these specifications:
   A. Proceed to *Testing with Digital Multimeter* to determine the resistance values for that Microcell, **and**
   B. Contact K-M for assistance after determining the resistance values and before proceeding with installation.

CAUTION

Replace Microcells in packing tubes until ready to install.

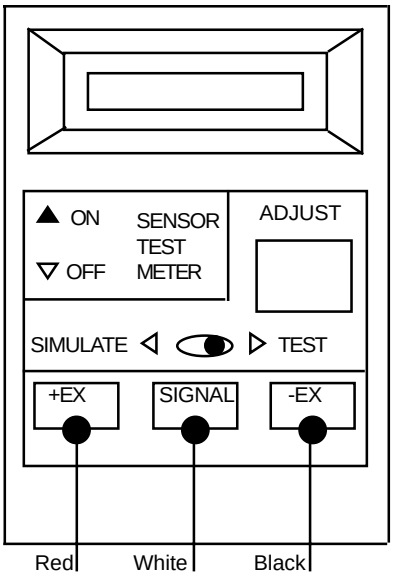


Figure 2-1. K-M Test Meter

Testing with Digital Multimeter (DMM)

Follow this procedure to test the Microcells if you do not have a K-M Test Meter or the readings using the Test Meter were outside the specifications:

1. Set the DMM resistance scale to accommodate a measured range up to 20,000 ohms.
2. Put one DMM lead on the Microcell's white wire and the other lead on the red wire. Place the Microcell on a stable surface. Verify the resistance is within the following limits:
   - **3-inch standardized (light blue cover) Microcell** — 8,300 to 8,700 ohms
   - **2-inch Microcell and 3-inch non-standardized (dark blue cover) Microcell** — 1,800 to 2,200 ohms
3. Put one DMM lead on the Microcell's white wire and the other lead on the black wire. Place the Microcell on a stable surface. Verify the resistance is within the following limits:
   - **3-inch standardized (light blue cover) Microcell** — 8,300 to 8,700 ohms ***and*** within 20 ohms of the reading from Step 2
   - **2-inch Microcell and 3-inch non-standardized (dark blue cover) Microcell** — 1,800 to 2,200 ohms ***and*** within 20 ohms of the reading from Step 2
4. Repeat Steps 2 and 3 for each Microcell. If either reading for any Microcell is outside these specifications, contact K-M for assistance before proceeding with installation.

CAUTION

Replace Microcells in packing tubes until ready to install.

Chapter 3. Microcell Installation on Vertical Column Legs

Introduction

Follow the instructions in this chapter **only** if installing Microcells on vertical column legs.

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

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.

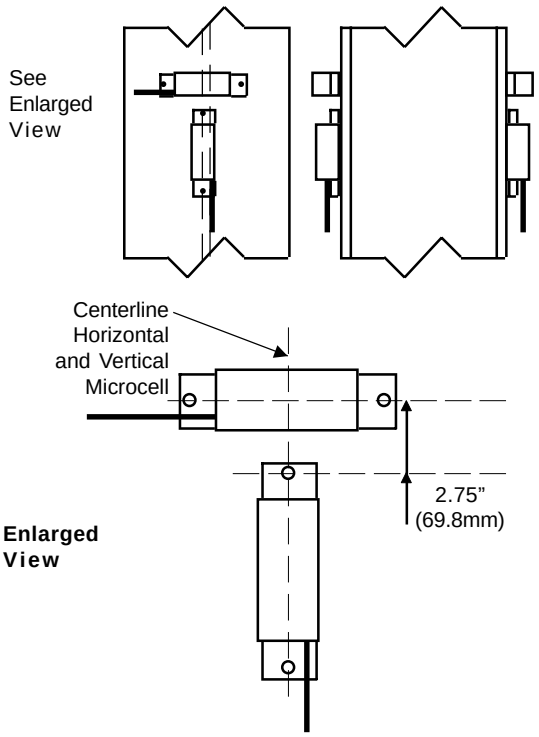


Figure 3-1. Microcell Rosette Array for Best Performance

Mounting Locations

Follow the procedures below to determine and mark Microcell mounting locations prior to beginning installation. Following these procedures will ensure optimal system performance. Consult K-M if special considerations prevent you from installing Microcells at the designated locations.

Microcell Sets

Best Performance

See Figure 3-1. For best performance, Microcells are mounted in a rosette array — a vertical Microcell with a horizontal Microcell above it in a 'T' configuration. A Microcell set consists of two rosette arrays (four Microcells total) mounted on opposite sides of a support leg, at the same elevation.

Note

Best performance cannot be achieved if:

- the leg is too narrow for the horizontal Microcell and its environmental cover, **or**
- installation is on round legs

See *Standard Performance* below.

Standard Performance

See Figure 3-2. For standard performance, Microcells are mounted vertically. A Microcell set consists of two Microcells mounted on opposite sides of a support leg, at the same elevation.

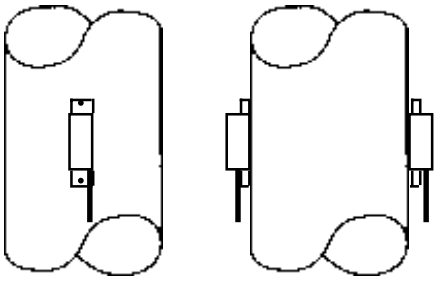
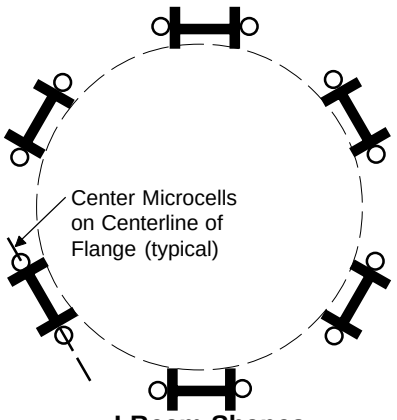


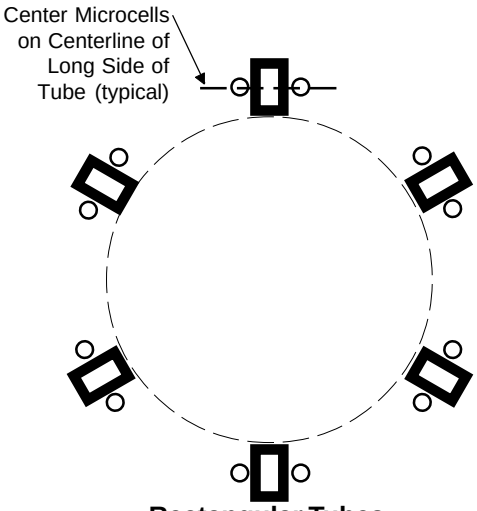
Figure 3-2. Vertical Microcell for Standard Performance



I-Beam Shapes

○ = rosette array (1 vertical and 1 horizontal Microcell) or vertical Microcell

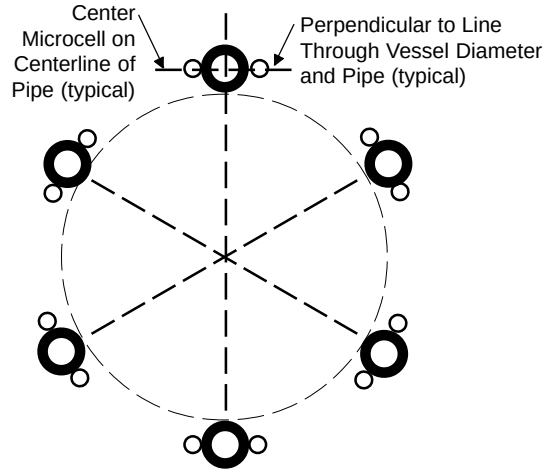
Note: Always place Microcells at center of flange, regardless of orientation of leg to vessel.



Rectangular Tubes

○ = rosette array (1 vertical and 1 horizontal Microcell) or vertical Microcell

Note: Always place Microcells at center of long side of tube, regardless of orientation of leg to vessel.



Pipes (or Round Tubes)

○ = 1 vertical Microcell

Figure 3-3. Microcell Mounting Arrangements on Legs

Horizontal Distribution of Microcell Sets

Microcell sets are placed on each support leg. Refer to Figure 3-3 for the mounting locations for each shape.

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).

Column Legs without X-Braces

See Figure 3-4.

- If the free leg distance is between 12” (305mm) 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 12” (305mm), this is a special application situation. Consult K-M before proceeding further.

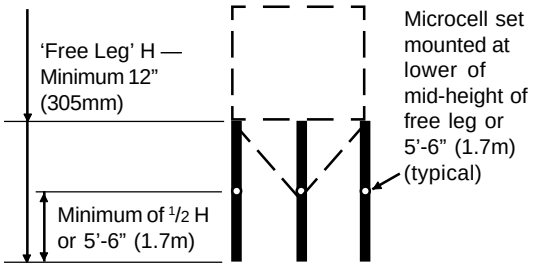


Figure 3-4. Vertical Location of Microcell Sets for Legs without Braces

Column Legs with X-Braces

See Figure 3-5. If the free leg distance is 12" (305mm) 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.

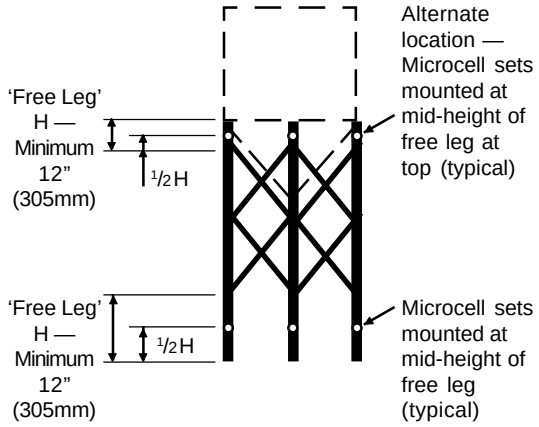


Figure 3-5. Vertical Location of Microcell Sets for Legs with Braces and with Free Leg greater than 12" (305mm)

See Figure 3-6. If the free leg distance is less than 12" (305mm), mount the Microcell sets at the mid-height between the lowest braces. When mounting between the braces, insulation around the adjacent braces is required for best performance, to reduce the effect of sun-induced stresses on the support metal.

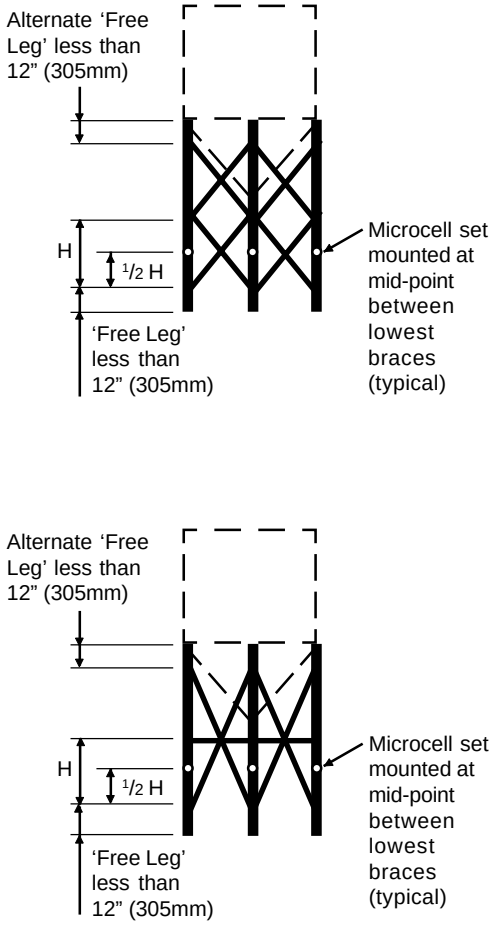


Figure 3-6. Vertical Location of Microcell Sets for Legs with Braces and with Free Leg less than 12" (305mm)

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.

Surface Preparation

1. See Figure 3-7. 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. Repeat for the horizontal Microcell (if applicable).
2. See Figure 3-7. Mark the surface preparation area for the vertical Microcell and horizontal Microcell (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 the Microcell(s). Due to the use of coarse grit, the resulting surface is somewhat coarse.
4. Replace the coarse grit sandpaper with the 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.

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.
2. See Figure 3-8. 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.

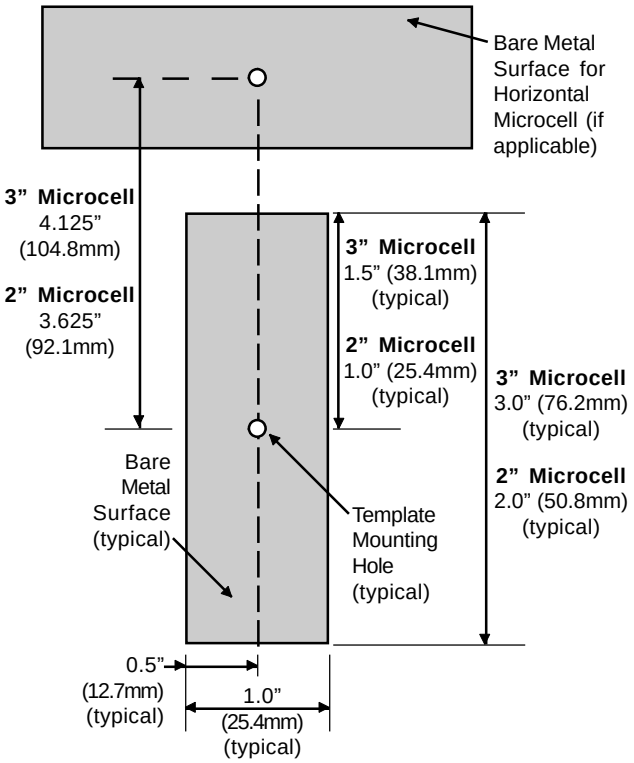
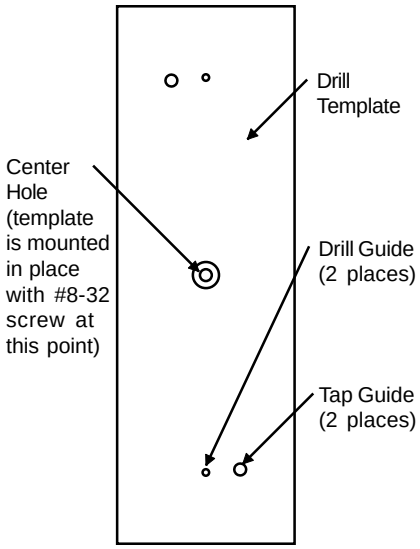


Figure 3-7. Prepared Mounting Surface



Note: For installation of a horizontal Microcell as part of a rosette array, the template is rotated 90°.

Figure 3-8. Drill and Tap Template

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. If installing a rosette array, repeat Steps 1 through 6 for the horizontal Microcell.
8. **Remove burrs** from all the holes created.

Mounting Microcell

CAUTION

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

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 K-M rust inhibitor to the bare metal surface for the vertical Microcell.

CAUTION

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

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.

Note

If a K-M Test Meter is not available, refer to Appendix C, Alternate Method for Checking Output, before proceeding.

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).

Note

3-inch Microcells for vertical and horizontal installation are slightly different. 3-inch Microcells for horizontal installation are labeled 'Horizontal.' 3-inch Microcells for vertical installation are not labeled.

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.
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.

Note

If the following occurs while tightening screws, check Microcell 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).

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. Repeat Steps 1 through 7 for the horizontal Microcell (if applicable).
9. 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.
10. See Figure 3-9. Apply a generous bead of sealant to the inside flange of the environmental cover. Add extra sealant to the cable exit channel.
    A. Align the environmental cover over the installed Microcell, with the cable through the cover's exit channel.
    B. Press the cover against the web, 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, water-tight seal. Ensure the cable exit channel is completely sealed.
    D. Repeat Step 10 for the horizontal Microcell (if applicable).

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.

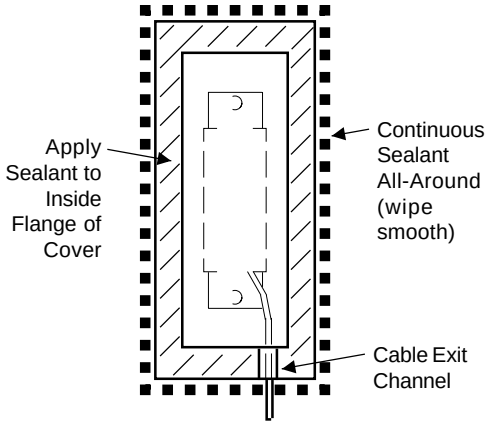


Figure 3-9. Environmental Cover

11. 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.

Mounting Junction Box

Mounting Location

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

- Microcell rosette arrays — the four Microcells on a support leg (two sets, each consisting of a vertical and a horizontal Microcell) are wired to one junction box.
- 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 3-10. 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 Microcell cables when wired to the junction box.

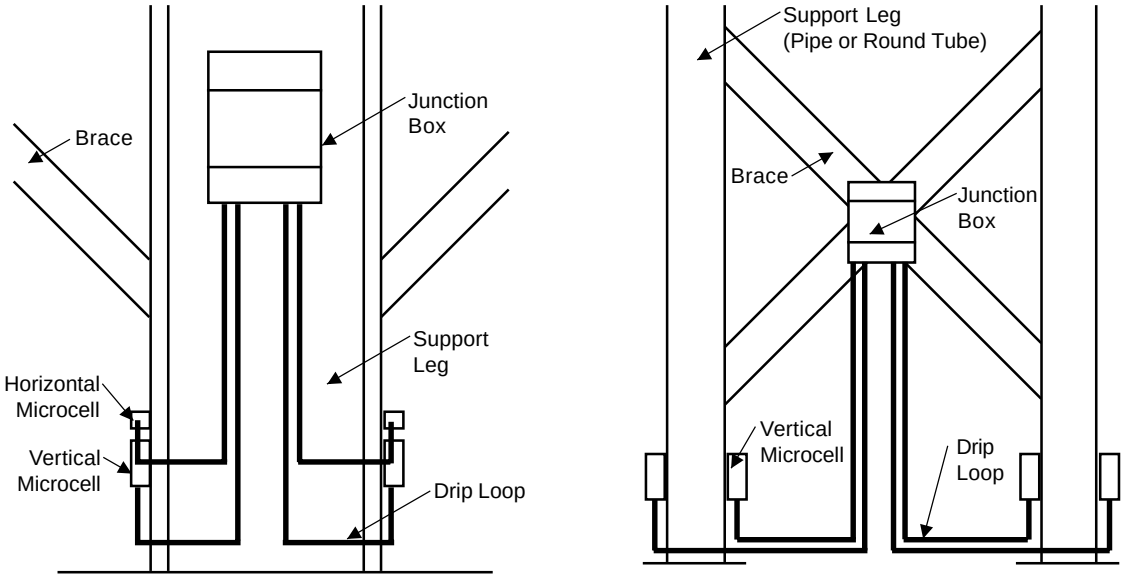


Figure 3-10. Possible Junction Box Mounting Locations

Junction Box Installation

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 K-M. K-M 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 3-11. Hold the junction box at the previously marked mounting location. Mark the mounting holes. Mark the four outside mounting holes if mounting on a flat surface, such as an I-Beam or rectangular tube. Mark the two center mounting holes if mounting on a curved surface, such as a pipe or round tube.
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.

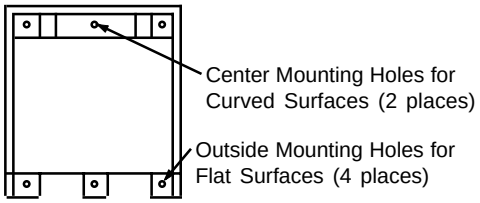


Figure 3-11. Junction Box Mounting

Wiring Microcells to Junction Box

Note

1. There are two versions of the junction box PCB. One version (63-1135-01) is used for vertical Microcells. The other version (63-1135-03) is used for Microcell rosette arrays. **Ensure you have the correct PCB in the junction box (see Figure 3-13).**
2. 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 3-12. 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 3-13).
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.

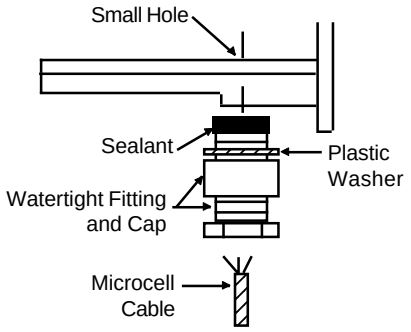
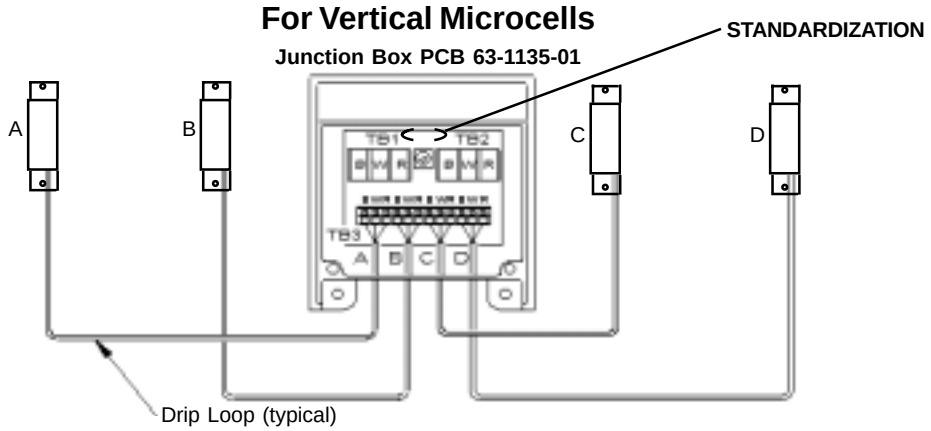
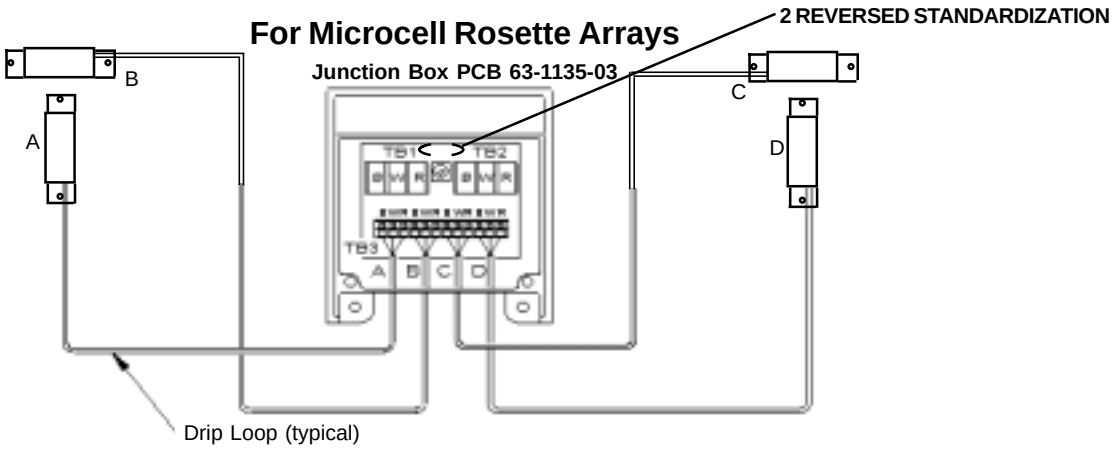


Figure 3-12. Inserting Microcell Cable through Watertight Fitting and Cap



Notes:
- Verify that junction box PCB is 63-1135-01 (bottom center) and shows 'STANDARDIZATION' (top 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.



Notes:
- Verify that junction box PCB is 63-1135-03 (bottom center) and shows '2 REVERSED STANDARDIZATION' (top center).
- Excitation for terminals B and C are reversed from terminals A and D. Wire each Microcell to its corresponding terminal to ensure proper system operation.
- Microcells A and B are in one rosette array — A is vertical and B is horizontal.
- Microcells C and D are in the other rosette array for the same leg — D is vertical and C is horizontal.

Figure 3-13. Wiring Microcells to Junction Box

4. See Figure 3-13. 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.
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 Processor

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. **K-M 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 3-14. 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 3-15 (conduited installation) or Figure 3-16 (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.

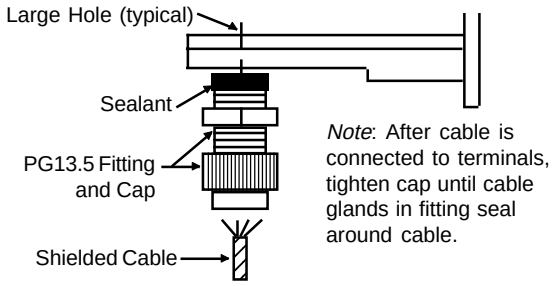


Figure 3-14. Inserting Shielded Interconnect Cable through PG13.5 Fitting and Cap

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.

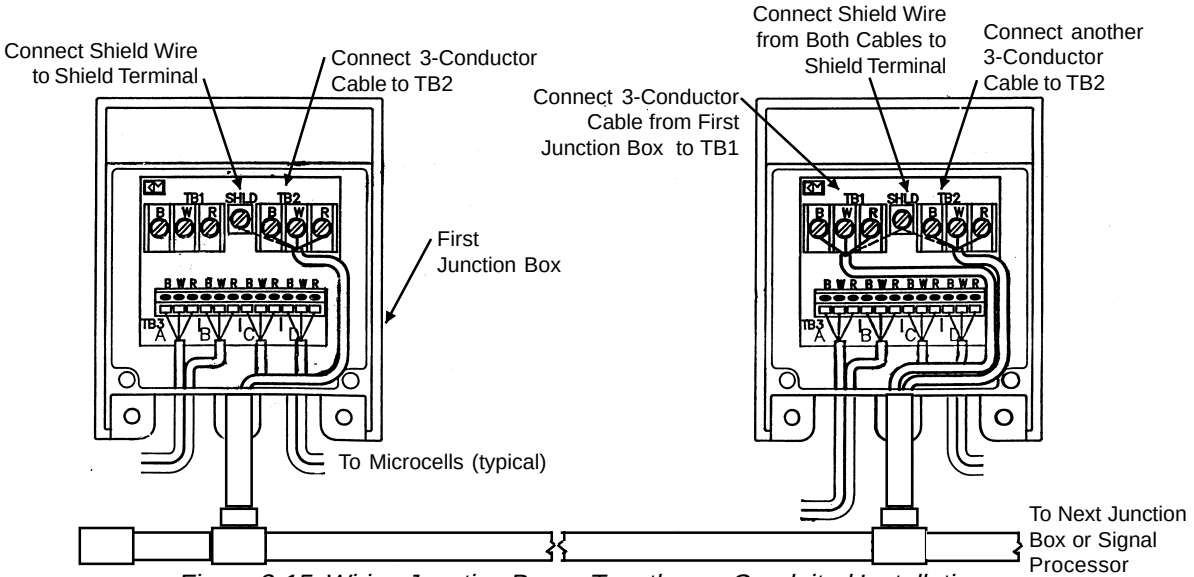


Figure 3-15. Wiring Junction Boxes Together — Conduited Installation

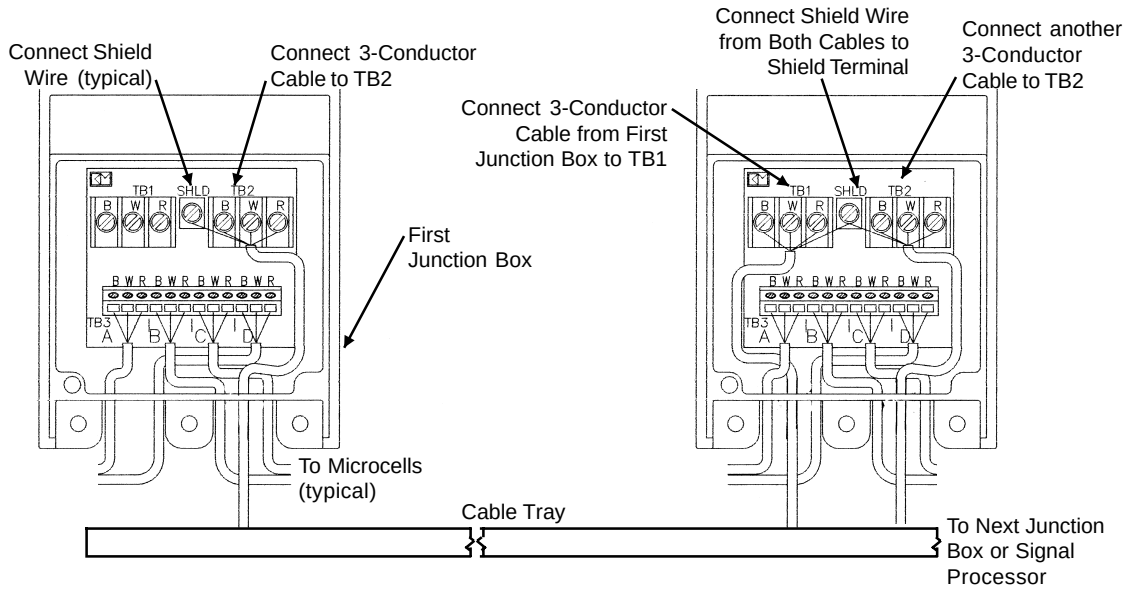


Figure 3-16. Wiring Junction Boxes Together — Non-Conduited Installation

Installing Insulation for Outdoor Vessels (Optional)

The sun affects the performance of an outdoor, bolt-on sensor system. The sun's radiation heats the support metal unevenly, producing stresses in the supports that are unrelated to the weight of material in the vessel. The Microcell system minimizes errors associated with sun-induced stresses in several ways:

- Microcell sets and instrumentation of all support legs allow the system to subtract bending stresses resulting from uneven heating of supports.
- Microcell rosette arrays, where applicable, allow the system to subtract tensile/compressive stresses resulting from the heating of supports.

This configuration of the Microcell system minimizes errors associated with sun-induced stresses. However, if Microcells are installed on the legs between braces (see Figure 3-6), insulation on each of the adjacent braces is required for best performance. This 'brace wrap' insulation increases system accuracy by further reducing sun-induced stresses.

Insulation Order and Installation Equipment

The following are included with the insulation order (quantities are dependent on the number of braces):

- Brace wrap, 60" x 85" (1.5m x 2.2m)
- Tie wraps

The following are used for installation:

Flexible tape measure
Heavy-duty knife

Installing Brace Wrap

1. See Figure 3-17. Using a flexible tape measure, measure and record the wrap width required, allowing for a minimum 2" (51mm) overlap.
2. See Figures 3-17 and 3-18. Lay the wrap on a flat surface. Mark and cut it at the distance from Step 1.
3. See Figure 3-19. The goal is to cover most of the brace with wrap. Covering the brace where it crosses another brace in the middle is unnecessary. Depending on the brace length, multiple sections of wrap may be required, with each section overlapping the one below it by a minimum of 2" (51mm). Measure and record the space available for each section of wrap.
   If the space is more than 60" (1.5m), skip Step 4 and proceed to Step 5.

Note

If a junction box is mounted within the area to be covered by wrap, cut the wrap so it does not cover the junction box.

4. From the top edge, measure and mark the wrap at the distance from Step 3. Cut the wrap where marked.
5. Position the wrap, starting at the bottom of the brace. Wrap it around the brace, overlapping the ends as shown in Figure 3-17. Fasten the wrap to the brace with four tie wraps.
6. Repeat Steps 2 through 5 for additional sections of wrap. Overlap each section of wrap by a minimum of 2" (51mm).

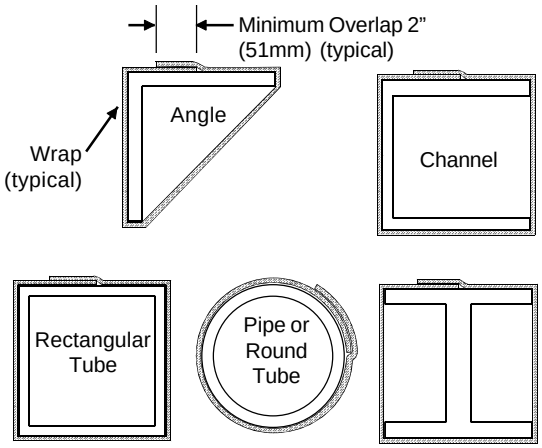


Figure 3-17. Wrap on Various Shapes

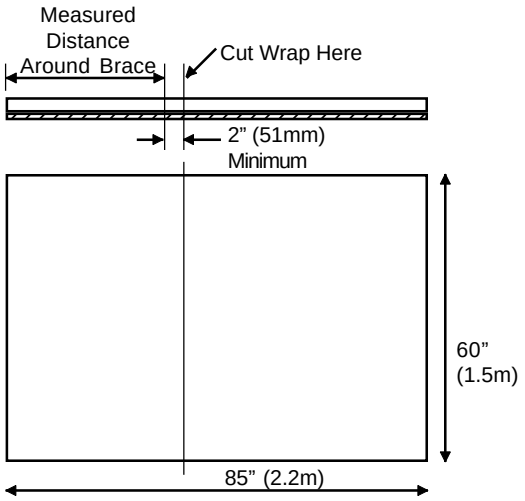
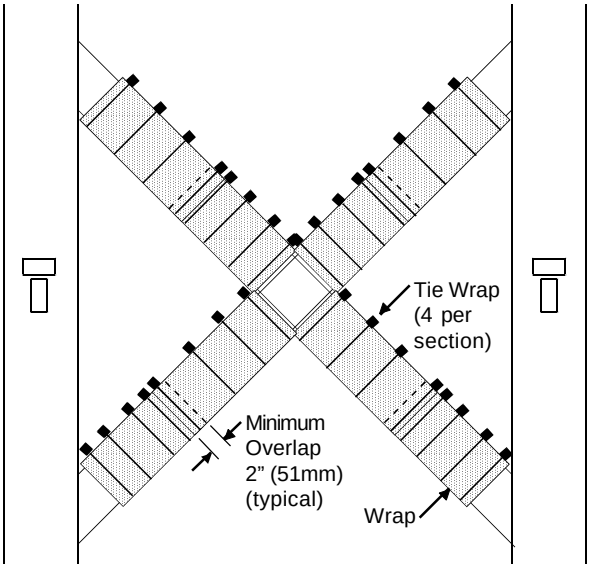


Figure 3-18. Cutting Wrap Width



Note: Install wrap at bottom of brace first, working your way up brace so wrap overlaps as shown.

Figure 3-19. Installing Brace Wrap

Chapter 4. Microcell Installation on Horizontal Beams

Introduction

Follow the instructions in this chapter **only** if installing Microcells on horizontal beams.

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

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

Follow the procedures below to determine and mark Microcell mounting locations prior to beginning installation. Following these procedures will ensure optimal system performance. Consult K-M if special considerations prevent you from installing Microcells at the designated locations.

Microcell Sets

See Figure 4-1. Microcells are mounted on beams in a shear mounting set — a Microcell at a 45° angle to the horizontal with another Microcell perpendicular to it on the other side of the support beam. Both Microcells are mounted with the lead wires on the 'down' end.

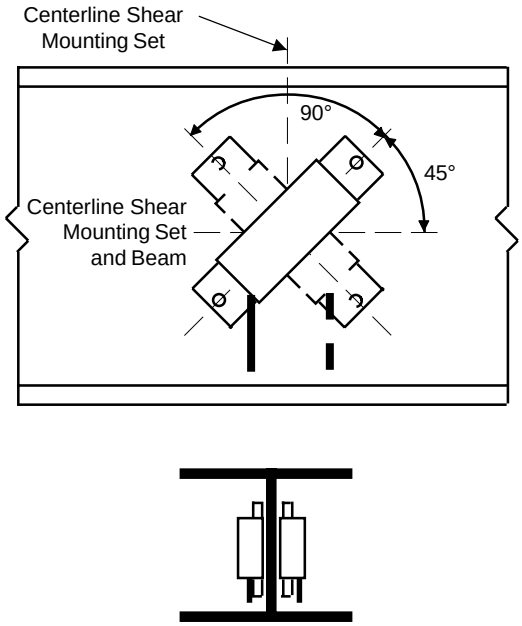
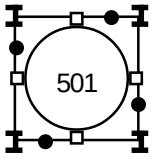
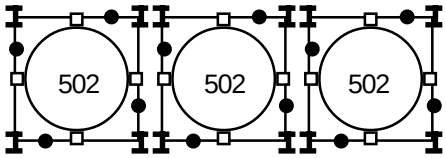
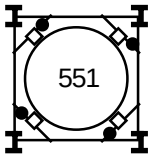
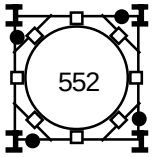
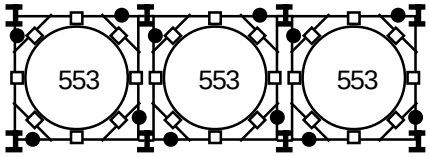
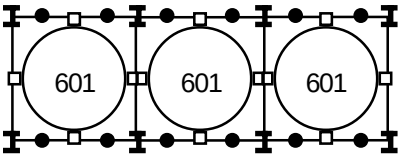
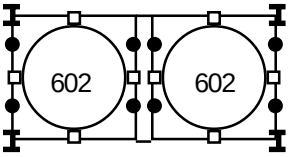
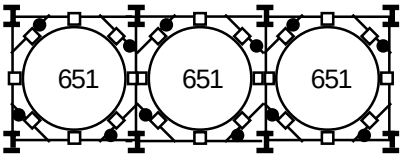


Figure 4-1. Microcell Shear Mounting Set

Distribution of Microcell Sets

The distribution of Microcell 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 beams are not instrumented with Microcells**.

	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	4
	Multiple vessels — no diagonal beam supports, independent internal lateral beams, common longitudinal beams	4
	Multiple vessels — diagonal beam supports, weight supported by horizontal and diagonal beams, common internal lateral beams, common internal vertical legs	8

Notes:

1. Illustrations for Series 501, 502, 551, 552, 553, and 651 show Microcells to the left of the load points. If obstructions prevent use of these locations, locate all Microcells to the right of the load points on the indicated beams.
2. If your application differs from the above, contact K-M for application assistance.

Legend:

- I = vertical leg
- □ = vessel support point
- ● = mounting location for Microcell set

Figure 4-2. Microcell Mounting Locations

Figures 4-3, 4-4, and 4-5 show the location of a Microcell set on a beam. The ideal location is midway between the vessel support bracket and the support column (or supporting 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 is 18" (457mm). If less space is available, this is a special application; consult K-M before proceeding further.

Note

Microcell 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 Microcell in the set from its *ideal* location, move the other Microcell as well).

The top of Microcell A points toward the load point from the vessel, putting the Microcell in compression when the load is applied. Microcell B is mounted on the other side of the web, directly behind and at a 90º angle to Microcell A. The top of Microcell B points away from the load point, putting the Microcell in tension when the load is applied. There is no physical difference in Microcells A and B; the designations relate to how to wire the Microcells to the junction box.

See Figure 4-5. If a second Microcell set is placed on a beam (Series 601 and 602), the Microcells are labeled D (pointing toward the load point) and C.

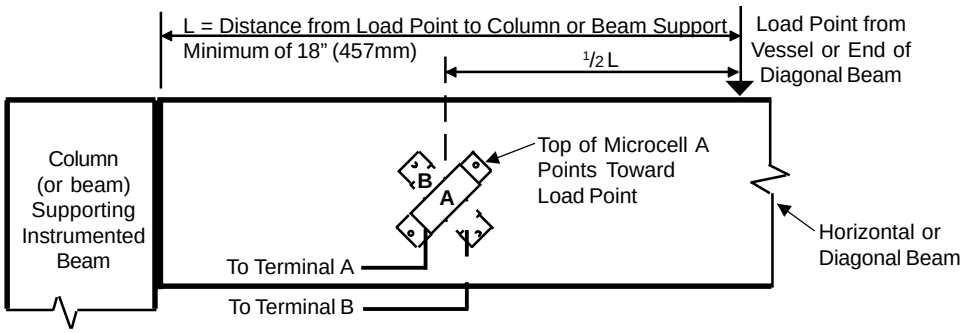


Figure 4-3. Placement of Microcell Set to Left of Load Point

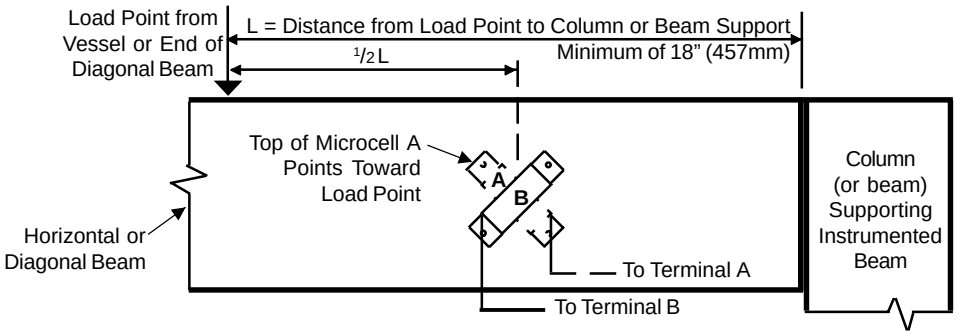


Figure 4-4. Placement of Microcell Set to Right of Load Point

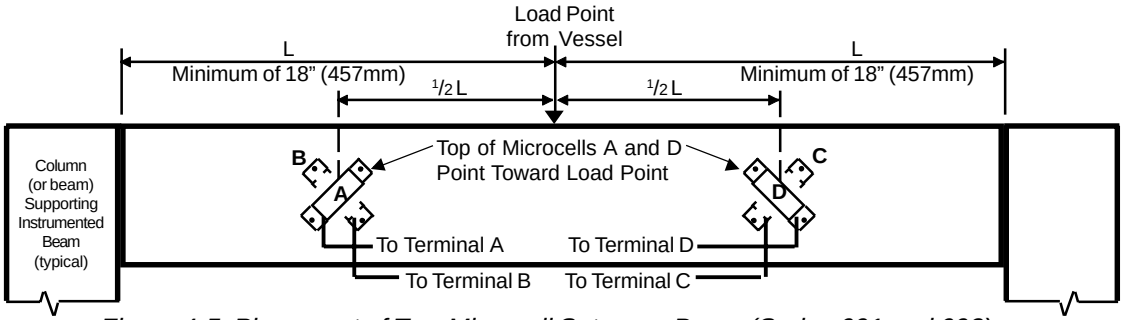


Figure 4-5. Placement of Two Microcell Sets on a Beam (Series 601 and 602)

Installing Microcells

Notes

1. Procedures below refer to Microcells A and B, but also apply to Microcells C and D (if applicable to installation).
2. Use lubricating fluid (Relton RapidTap® Heavy Duty Cutting Fluid or equivalent) when drilling and tapping.
3. 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.

Surface Preparation

1. See Figure 4-6. At the center of the Microcell mounting location, drill all the way through the web with the #29 drill bit. This produces the template mounting hole.
2. See Figure 4-6. Mark the surface preparation area for Microcell A. Repeat for Microcell B on the other side of the web.
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 Microcell A. Due to the use of coarse grit, the resulting surface is somewhat coarse. Repeat for Microcell 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 Microcell A. Repeat for Microcell B.

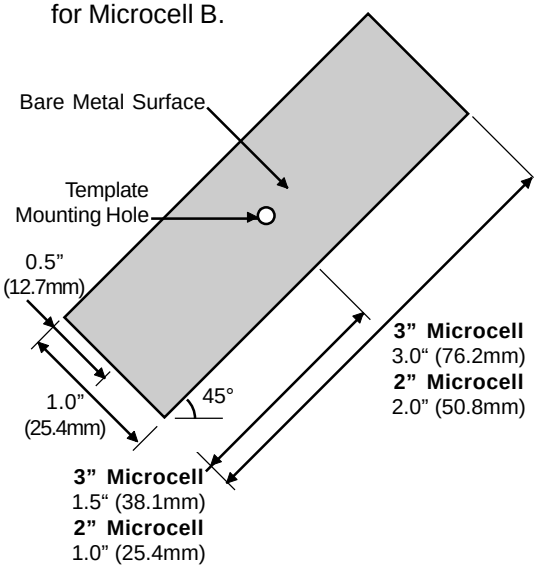


Figure 4-6. Prepared Mounting Surface

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.

Drill and Tap

1. Using the #8-32 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 4-7. Starting with Microcell A's location, 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 (45° angle to the horizontal).
3. Using the #29 drill bit, drill two 3/4" (19mm) deep holes in the web through the template drill guides.
4. 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.
5. 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 web.
6. Repeat Steps 2 through 5 for Microcell B on the other side of the web.
7. **Remove burrs** from all the holes created.

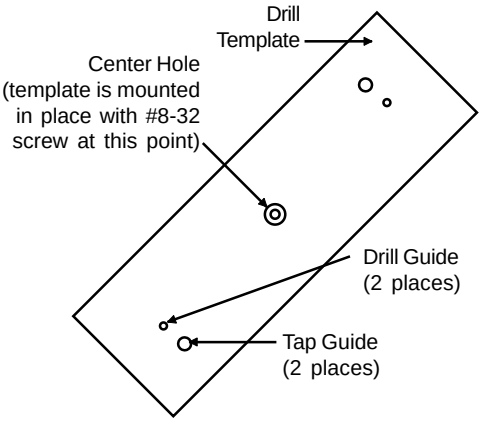


Figure 4-7. Drill and Tap Template

Mounting Microcell

CAUTION

Do not install Microcells 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 Microcell and one piece near the end of the Microcell cable. Repeat for the other Microcell, labeling it 'B.'
2. 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.
3. Apply a thin coat of K-M rust inhibitor to the bare metal surface for Microcell A.

Note

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

4. 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 Meter and set the Simulate/Test switch to the Test position.

Note

If a K-M Test Meter is not available, refer to Appendix C, Alternate Method for Checking Output, before proceeding with Step 5.

5. With the cable end down, align Microcell A with the mounting holes, ensuring that the top of Microcell A faces toward the vessel load point. Fasten the Microcell **loosely** to the web 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).

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 6 through 8 to achieve this goal.

6. 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 web. Check for and 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 -100 to +100 mV, slowly loosen the screw until the voltage is within range again and proceed to Step 7.
7. Repeat Step 6 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.

Note

If the following occurs while tightening screws, check Microcell 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 -100 to +100 mV.
9. Repeat Steps 2 through 8 to install Microcell 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 4-8. Apply a generous bead of sealant to the inside flange of the environmental cover. Add extra sealant to the cable exit channel.
    A. Align the environmental cover over the installed Microcell A, with the cable through the cover's exit channel.
    B. Press the cover against the web, 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.
    D. Repeat Step 11 for Microcell 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.

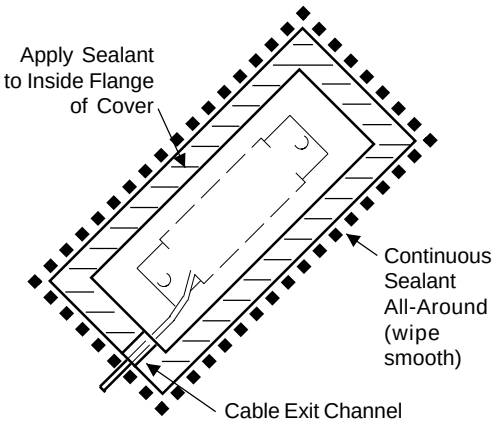


Figure 4-8. Environmental Cover

Mounting Junction Box

Mounting Location

Each junction box can be wired to a maximum of two Microcell sets (four Microcells total):

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

See Figures 4-9 and 4-10. 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 Microcell cables when wired to the junction box.

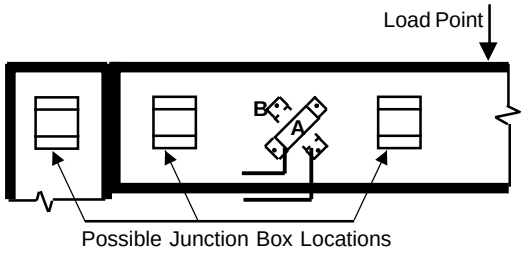


Figure 4-9. Junction Box Location — Two Microcells per Junction Box

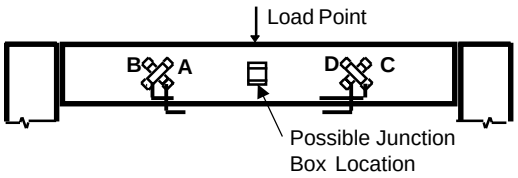


Figure 4-10. Junction Box Location — Four Microcells per Junction Box

Junction Box Installation

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 K-M. K-M 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 4-11. 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.

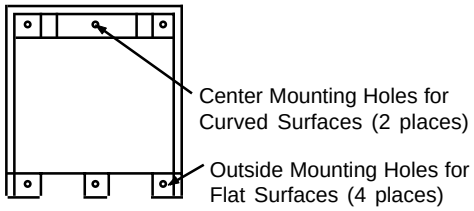


Figure 4-11. Junction Box Mounting

Wiring Microcells to Junction Box

Notes

1. Junction box PCB 63-1135-03 is used for Microcell sets on beams. **Ensure you have this PCB in the junction box (see Figure 4-13)**.
2. 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 4-12. 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 4-13).
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 4-13. 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 (two shear sets). Wire Microcell A to terminal A and Microcell B to terminal B. If there are four Microcells on one beam, wire Microcell C to terminal C and Microcell D to terminal D.

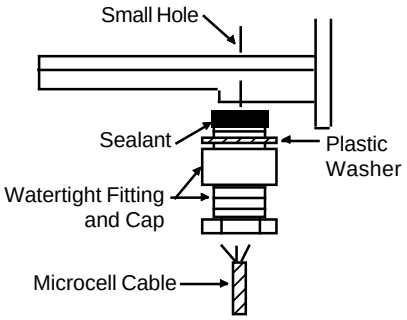
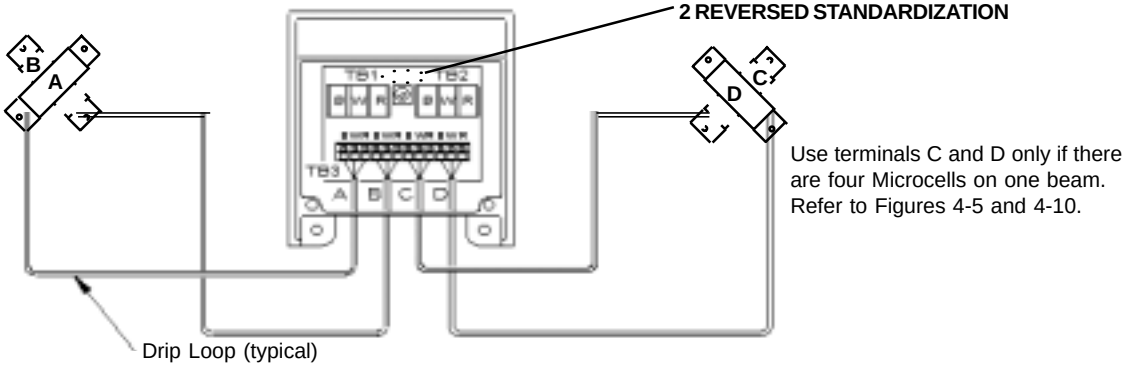


Figure 4-12. Inserting Microcell Cable through Watertight Fitting and Cap



Notes:
- Verify that Junction Box PCB is 63-1135-03 (bottom center) and shows '2 REVERSED STANDARDIZATION' (top center).
- Excitation for terminals B and C are reversed from terminals A and D. Wire each Microcell to its corresponding terminal to ensure proper system operation.
- The top of Microcells A and D point toward the vessel load point.

Figure 4-13. Wiring Microcells to Junction Box

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.
8. Perform Steps 2 through 7 for each Microcell 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.

Wiring Junction Boxes Together and to Signal Processor

There are two versions of the junction box enclosure. Both junction boxes 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. **K-M 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 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 4-13. 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 4-14 (conduited installation) or Figure 4-15 (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 Microcells on the vessel supports.

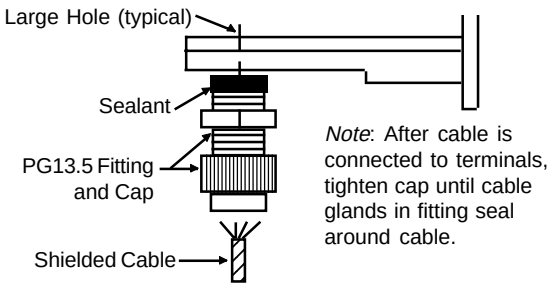


Figure 4-13. Inserting Shielded Interconnect Cable through PG13.5 Fitting and Cap

Note

Ground the cable shield only at the signal processor.

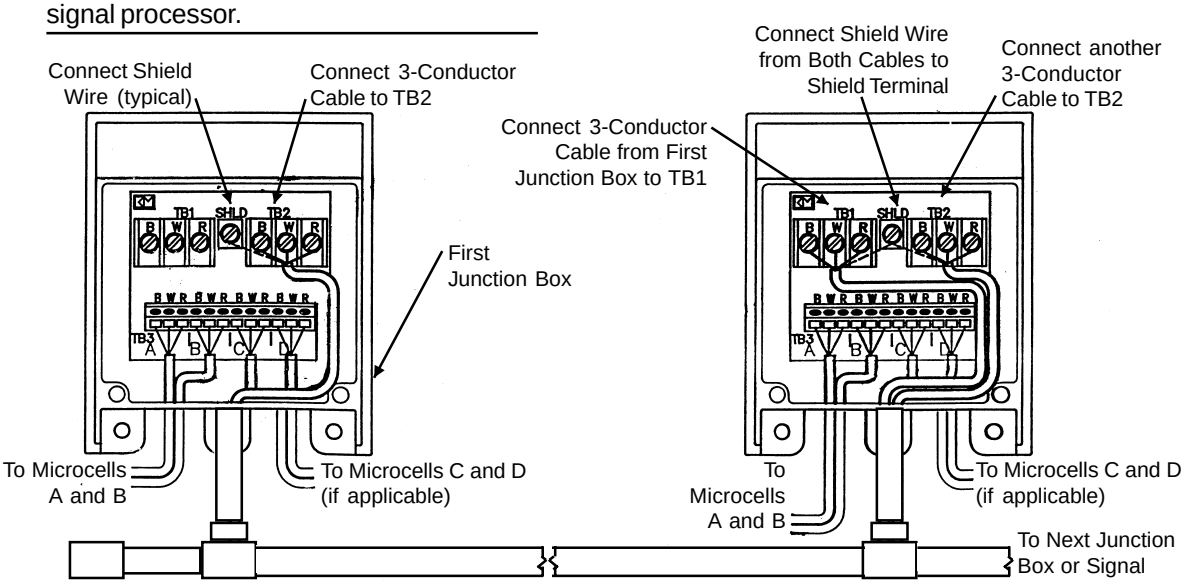


Figure 4-14. Wiring Junction Boxes Together — Conduited Installation

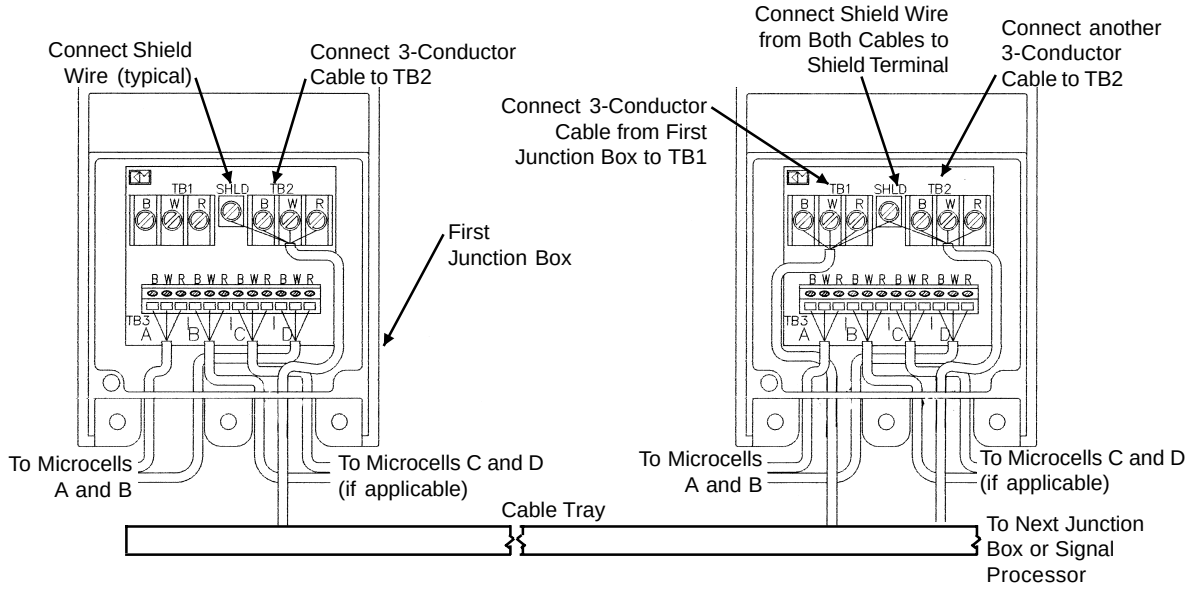


Figure 4-15. Wiring Junction Boxes Together — Non-Conduited Installation

Chapter 5. System Calibration

Introduction

This chapter describes general procedures for calibrating the Microcell 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 Microcells, 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 support 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, 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 5-1:

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 Microcells 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

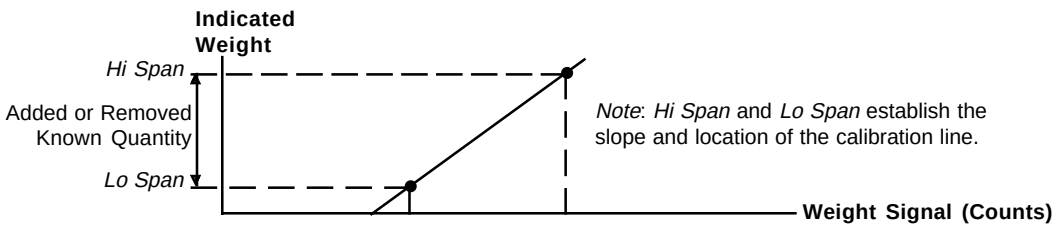


Figure 5-1. Live Load Calibration by Adding or Removing a Known Quantity of Material

Removing Material

See Figure 5-1:

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 Microcells 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 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

Manual Calibration

Note

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

See Figure 5-2:

1. Refer to the signal processor manual to determine how to obtain the A/D converter sensitivity, expressed in Counts/mV. Record this value.
2. Record the Microcell sensitivity (S). Sensitivity for Microcells on legs and beams are shown in Table 5-1.
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 1— Microcells on Vertical Legs:
You are using 3-inch Microcells in rosette arrays on vertical column legs. The vessel has four W10x39 carbon steel legs and no braces. 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 = 0.045 mV/psi (from Table 5-1, for legs with rosette array)
3. From the Application Data Form, the maximum live load is 200,000 lbs. The stress is 4348 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
   = 0.045 mV/psi x 699.05 Cnts/mV x 4348 psi
   = 136,776 Counts
   Zero_Cal = Current live load = 50,000 lbs

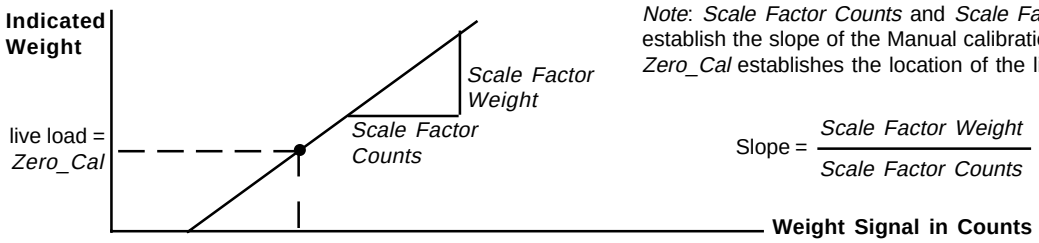
Example 2 — Microcells on Beams:
You are using 3-inch Microcells on beams. The vessel has four W10x39 carbon steel horizontal beams and four W10 x 39 carbon steel diagonal beams. The Microcells are on the horizontal beams only. The vessel currently contains 50,000 lbs of material and can hold a maximum of 150,000 lbs. Following the procedure:

1. Counts/mV = 699.05 (from signal processor)
2. S = 0.070 mV/psi (from Table 5-1, for beams)
3. From the Application Data Form, the maximum live load is 150,000 lbs. The stress is 5929 psi.
4. Current live load = 50,000 lbs
5. Calculate the values for the calibration:
   Scale Factor Weight = Maximum live load
   = 150,000 lbs
   Scale Factor Counts = S x Counts/mV x Stress
   = 0.070 mV/psi x 699.05 Cnts/mV x 5929 psi
   = 290,127 Counts
   Zero_Cal = Current live load = 50,000 lbs

	Vertical Column Legs		Horizontal Beams
	Vertical Microcells	Rosette Array	
3-inch Microcell			
Carbon Steel	0.070 (99.6)	0.045 (64.0)	0.070 (99.6)
Aluminum	0.154 (219)	0.100 (142)	0.154 (219)
Stainless Steel	0.058 (82.5)	0.038 (54.1)	0.058 (82.5)
2-inch Microcell			
Carbon Steel	0.056 (79.7)	0.036 (51.2)	0.056 (79.7)

Note: Units are mV/psi (mV/kg/mm^2 in parentheses)

Table 5-1. Microcell Sensitivity



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 5-2. Manual Calibration Line

Chapter 6. Troubleshooting

This chapter describes some common problems you may encounter while using Microcells. For each problem, one or more possible explanations are listed. An indication of when the problem is likely to be noticed and suggested solutions are provided for each explanation.

Problem 1. Small Amplitude Changes or Erratic Fluctuations in Display Readings

Explanation

Small amplitude drift or oscillation, with peak-to-peak disturbance of 0.1% to 0.3% of full scale, is normal.

Problem Likely to be Noticed

Shortly after initial installation.

Solution

Reduce or eliminate drift or oscillation by setting 'count by' and 'averaging' appropriately on signal processor (refer to signal processor manual).

Explanation

Fluctuations can be caused by moisture in cable conduit, junction boxes, or printed circuit boards (PCBs).

Problem Likely to be Noticed

On system that previously functioned correctly.

Solution

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.

Explanation

Fluctuations can be caused by a damaged Microcell.

Problem Likely to be Noticed

Shortly after initial installation **or** on system that previously functioned correctly.

Solution

Using Digital Multimeter (DMM) or ohmmeter, check resistance for individual Microcells:

1. Set meter resistance scale to accommodate measured range up to 20,000 ohms.
2. Remove one Microcell's wires from junction box terminal TB3.
3. Put one DMM lead on Microcell's white wire and other DMM lead on Microcell's red wire. Record resistance and verify it is within following limits:
   - *3-inch standardized (light blue cover) Microcell* — between 8,300 and 8,700 ohms
   - *2-inch Microcell* and *3-inch non-standardized (dark blue cover) Microcell* — between 1,800 and 2,200 ohms

   If reading is outside this range, Microcell is damaged and must be replaced.
4. Put one DMM lead on Microcell's white wire and other DMM lead on Microcell's black wire. Record resistance and verify it is within following limits:
   - *3-inch standardized (light blue cover) Microcell* — between 8,300 and 8,700 ohms
   - *2-inch Microcell* and *3-inch non-standardized (dark blue cover) Microcell* — between 1,800 and 2,200 ohms

   If reading is outside this range, Microcell is damaged and must be replaced.
5. Verify readings from Steps 3 and 4 are within 140 ohms of each other. If not, Microcell is damaged and must be replaced.
6. Repeat Steps 2 through 5 for each suspect Microcell, until damaged Microcell is located.

Explanation

Fluctuations in readings can be caused by short to ground.

Problem Likely to be Noticed

Shortly after initial installation **or** on system that previously functioned correctly.

Solution

Using a Digital Multimeter (DMM) or ohmmeter, check for shorts to ground:

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), a 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 the 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 further identify location.
   - If no short is indicated, proceed to next junction box in daisy chain. Disconnect wires connecting it to other junction boxes and check resistances. Repeat for each junction box down chain until short is located; proceed to Step 5.
5. Disconnect Microcell wires for one Microcell from above-identified junction box. With one lead to earth ground and other lead to white wire, check resistance on disconnected Microcell wires:
   - If reading is less than infinite (i.e., there is resistance), short is indicated. Replace shorted Microcell.
   - If no short is indicated, disconnect next Microcell's wires from junction box and check resistances. Repeat for each Microcell wired to junction box until short is located. Replace shorted Microcell.

Explanation

Fluctuations in readings can be caused by problems with signal processor.

Problem Likely to be Noticed

Shortly after initial installation **or** on system that previously functioned correctly.

Solution

Check signal processor excitation voltage and incoming AC voltage for accuracy and stability (refer to signal processor manual).

Problem 2. Repeatable Drift over 24-hour Period

Explanation

Periodic drift is most likely caused by thermal expansion of vessel or vessel's supports due to sun's radiation or a vessel's response to its own heating cycles.

Problem Likely to be Noticed

Shortly after initial installation **or** on system that previously functioned correctly in cool or overcast weather.

Solution

1. If periodic drift is outside specifications (Appendix A*),* contact K-M.
2. For Microcells installed on Vertical Column Legs — If drift is within specifications but you want to reduce it further, install K-M insulation. Contact K-M to order insulation. Installation details are included in Chapter 3, Microcell Installation on Vertical Column Legs.
3. If keeping long-term records, take readings at the same time each day to minimize error.

Problem 3. Sudden Change in Display Reading or System Requires Frequent Recalibration

Explanation

A single broken Microcell can cause indicated weight to shift up or down by a large amount, up to 100% of full-scale live load.

Problem Likely to be Noticed

On system that previously functioned correctly.

Solution

Check voltage outputs of individual Microcells (refer to *Testing with K-M Test Meter* in Chapter 2, Pre-Check Procedures). Voltage should be between -500 and +500 mV on installed Microcells. If not, check Microcell resistance as described in Problem 1.

Explanation

Slipping of Microcell can cause indicated weight to shift suddenly.

Problem Likely to be Noticed

Shortly after initial installation.

Solution

If broken Microcell is not indicated, perform the following procedure:

1. Carefully remove environmental cover from Microcell.
2. Retighten Microcell #8-32 socket head cap screws, following procedure in appropriate Microcell Installation Chapter (Chapter 3, Microcell Installation on Vertical Column Legs; Chapter 4, Microcell Installation on Horizontal Beams).
3. Replace environmental cover on Microcell. Follow procedure in appropriate Installation Chapter.

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.

Explanation

Sudden change in weight reading can be caused by problems with signal processor.

Problem Likely to be Noticed

Shortly after initial installation **or** on system that previously functioned correctly.

Solution

Check signal processor excitation voltage and incoming AC voltage for accuracy and stability (refer to signal processor manual).

Appendix A. 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-Black Resistance	
3-inch Microcell	4.0K ± 500 ohms at 70°F (21°C)
2-inch Microcell	4.0K ± 500 ohms at 70°F (21°C)
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)

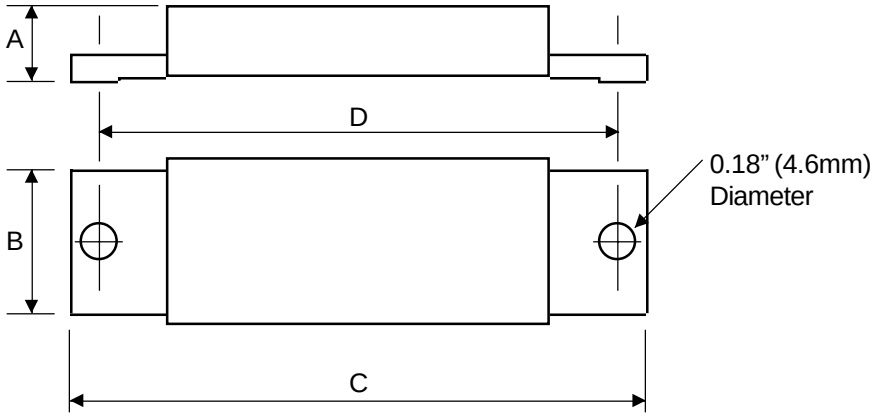
Sensitivity	
3-inch Microcell	70 mV ± 1%/1,000 psi (70 mV ± 1%/0.7 kg/mm^2)
2-inch Microcell	56 mV ± 1%/1,000 psi (56 mV ± 1%/0.7 kg/mm^2)
Zero-Strain Output	0 mV ± 25 mV
Nonlinearity	±0.1% of full-scale output
Repeatability & Hysteresis	0.05% of full-scale output
Output Impedance	
3-inch Microcell	Standardized: 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 B. 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.

Live Load

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

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.

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 firmware and software *box* connected to a sensor (such as a Microcell) 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 applies 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 C. Alternate Method for Checking Output

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 C-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.

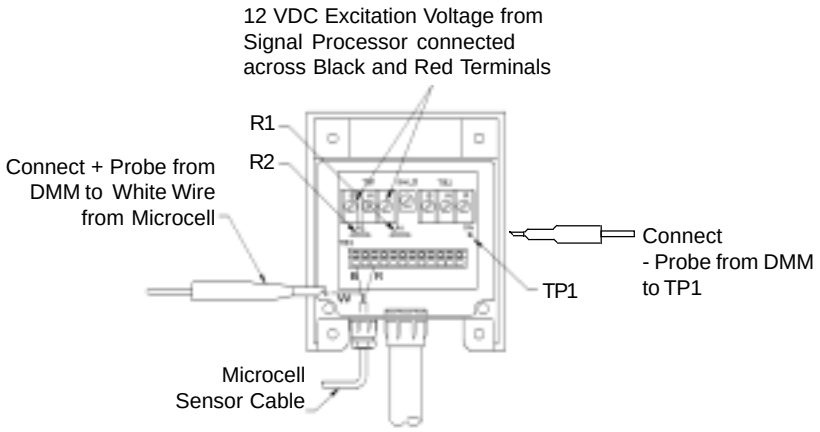


Figure C-1. Using DMM to Monitor Voltage Output

Appendix D. Spare Parts Recommendations

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 E. Kistler-Morse Service and Warranty

Product Warranty

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:

> K-M warrants equipment of its own manufacture to be free from defects in material and workmanship for one year from date of shipment to original user. K-M will replace or repair, at our option, any part found to be defective. Buyer must return any part claimed defective to K-M, transportation prepaid.

Service

K-M 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 Bothell, Washington USA (corporate headquarters) and Antwerp, Belgium (European office).

Phone Consultation

Our Field 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

On-Site Consultation

K-M's Field Service staff can provide additional services at your request. Contact K-M 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

K-M will install Microcells, which includes drilling, tapping, surface preparation, mounting, and wiring of Microcells to junction boxes. All field wiring (junction box to junction box and junction box to signal processor) will be checked for errors.

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 K-M beginning work.

The system will be powered up and checked for proper electrical operation. For best results, K-M requires moving a known amount of material, such as a truckload, 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 K-M is on site) and instruction covering operation and maintenance of the system.

Troubleshooting

K-M will troubleshoot systems for mechanical, electrical, calibration, and wiring errors. Normal component repairs will be made and wiring errors will be corrected, including replacement of non-repairable printed circuit boards.

Service Calls

K-M will perform on-site repair/ replacement services.

Return Material Authorization

If a part needs to be sent to the factory for repair, contact K-M'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.

Address and Telephone Numbers

Corporate Office

Kistler-Morse Corporation
19021 120th Avenue NE
Bothell, WA 98011-9511

Telephone: 425-486-6600
Toll Free (U.S.A. and Canada): 800-426-9010
Fax: 425-402-1500
www.kistler-morse.com

European Office

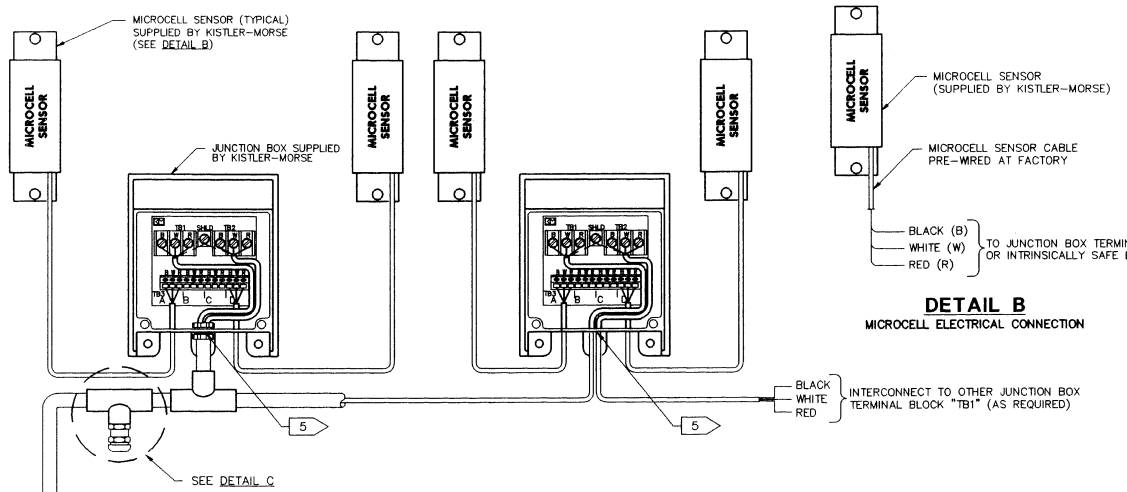
Kistler-Morse Corporation
Rucaplein 531
B2610 Antwerp, Belgium

Telephone: 32.3.218.99.99
Fax: 32.3.230.78.76

Appendix F. Technical Drawings

This appendix contains the following technical drawing:

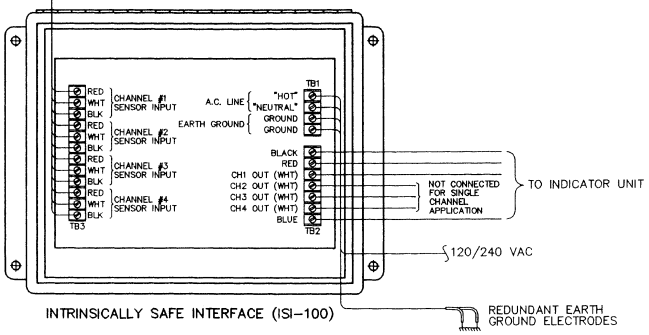
Drawing No.	Drawing Title
TI-MC.FM-01	FM Approved Intrinsically Safe Interconnect Diagram, Microcell Sensor



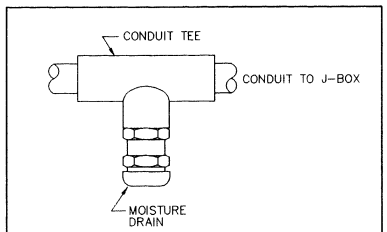
DETAIL B
MICROCELL ELECTRICAL CONNECTION

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



DETAIL A
TYPICAL SENSOR AND JUNCTION–BOX INTERCONNECT WIRING DIAGRAM



DETAIL C
TYPICAL DRAIN INSTALLATION

REVISIONS					
LTR	DESCRIPTION	INCORP.	CHECKED	APPROVED	DATE
NEW	Initial Release	R.M. Collado	S.A.S.	K.P.M.	9/30/91
A	Per ECO 2747	J.M. Pilon	T.K.M	K.P.M	2-4-92
B	Per ECO #2829	R.M. Collado	T.K.M	K.P.M	8/5/92
C	Per ECO #2856	J.M. Pilon	T.K.M	K.P.M	9/8/92
D	Per ECO #2844	J.M. Pilon	T.K.M	K.P.M	9/25/92
E	Per ECO #2864	J.M. Pilon	T.K.M	K.P.M	10/1/92
F	Per ECO #3564	C. Blackburn	–	K.P.M	9/8/95
G	Per ECO #3468	N.T.O	T.J.	S.A. Smith	6/31/96
H	Per ECO #3871	R.M. Collado	C.A.B.	K.P.M.	10/6/97

TABLE 1:

FM APPROVED MICROCELL SENSOR MODEL NUMBERS	FM APPROVED JUNCTION BOX MODEL NUMBERS
M20 SERIES	JB15 SERIES
M30 SERIES	JB25 SERIES

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, TI–0106, 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 MICROCELL 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 PROVIDED PLUGS.

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 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, INTRINSIC SAFETY BARRIERS MAY BE OMITTED PROVIDED INSTALLATION IS IN COMPLIANCE WITH THE N.E.C. ARTICLES APPLICABLE TO THESE LOCATIONS.

ECO ACCUMULATION:	APPROVALS	DATE
ECO No. 1:	DRAWN: Raul M. Collado	03-27-91
ECO No. 2:	CHECKED: S.A. Smith	09-30-91
ECO No. 3:	PROJ. ENGR.: K.P. Masterton	03-30-91
ECO No. 4:	PRODUCTION:	
ECO No. 5: INCORPORATE ABOVE ECO'S	PURCHASING:	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMAL .X± -- .XX± -- .XXX± --
ANGULAR ±--°
DO NOT SCALE DRAWING
SCALE --
FINISH --
USED ON: (REF ONLY) --

Kistler-Morse Corp.
Bothell, WA 98011

TITLE
FM APPVD INTRINSICALLY SAFE INTERCONNECT DIAGRAM, MICROCELL SENSOR

SIZE	DWG. No	REV.
B	TI-MC.FM-01	H
ACAD # MCFM01	DATE: 11/13/97	SHT. 1 OF 1

FM CONTROLLED DOCUMENT
NO CHANGES TO DRAWING
WITHOUT PRIOR FM APPROVAL