IOM
97-1505-15 Rev. A

KISTLER-MORSE®
Measure of Success

TC1& TC2 Tension Cells
Installation & Operation Manual

KISTLER-MORSE®
Measure of Success

TC1 & TC2 Tension Cells
Installation & Operation Manual

CONTENTS

SAFETY SYMBOLS

WARNING:

IDENTIFIES CONDITIONS OR PROCEDURES, WHICH IF NOT FOLLOWED, COULD RESULT IN SERIOUS INJURY.

CAUTION:

IDENTIFIES CONDITIONS OR PROCEDURES, WHICH IF NOT FOLLOWED, COULD RESULT IN SERIOUS DAMAGE OR FAILURE OF THE EQUIPMENT.

TC1 & TC2 Tension Cells

I. HANDLING AND STORAGE

SAVE THESE INSTRUCTIONS

INSPECTION AND HANDLING

Do not dispose of the carton or packing materials.

Each package should be inspected upon receipt for damage that may have occurred due to mishandling during shipping. If the unit is received damaged, notify the carrier or the factory for instructions. Failure to do so may void your warranty. If you have any problems or questions, consult Customer Support at 1-800-426-9010.

DISPOSAL AND RECYCLING

This product can be recycled by specialized companies and must not be disposed of in a municipal collection site. If you do not have the means to dispose of properly, please contact for return and disposal instructions or options.

STORAGE

If the device is not scheduled for immediate installation following delivery, the following steps should be observed:

1. Following inspection, repackage the unit into its original packaging.
2. Select a clean dry site, free of vibration, shock and impact hazards.
3. If storage will be extended longer than 30 days, the unit must be stored at temperatures between -40º and 158º F (-40º to 70° C) in non-condensing atmosphere with humidity less than 85%.

CAUTION: DO NOT STORE A NON-POWERED UNIT OUTDOORS FOR A PROLONGED PERIOD.

II. GENERAL SAFETY

AUTHORIZED PERSONNEL

All instructions described in the document must be performed by authorized and qualified service personnel only. Before installing the unit, please read these instructions and familiarize yourself with the requirements and functions of the device. The required personal protective equipment must always be worn when servicing this device.

USE

The device is solely intended for use as described in this manual. Reliable operation is ensured only if the instrument is used according to the specifications described in this document. For safety and warranty reasons, use of accessory equipment not recommended by the manufacturer or modification of this device is explicitly forbidden. All servicing of this equipment must be performed by qualified service personnel only. This device should be mounted in locations where it will not be subject to tampering by unauthorized personnel.

MISUSE

Improper use or installation of this device may cause the following:

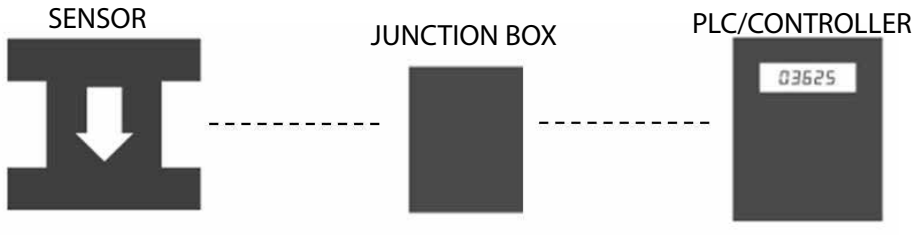
- Personal injury or harm
- Application specific hazards such as vessel overfill
- Damage to the device or system

If any questions or problems arise during installation of this equipment, please contact Customer Support at 800-426-9010.

III. PRODUCT DESCRIPTION

FUNCTION

Tension Load Cells deliver a high-accuracy weighing system for suspended in-process vessels. The TC1 and high capacity TC2 are sensors as part of a full system that includes a junction box and PLC; this manual will only cover the sensor portion; reference other component manuals for additional instruction.



SENSOR TECHNICAL SPECIFICATIONS

FUNCTIONAL	**STANDARD TENSION CELL - TC1**	**HIGH CAPACITY TENSION CELL - TC2**
Functional Integrity*	± 150% of rated capacity	± 150% of rated capacity
Mechanical Integrity*	± 300% of rated capacity	± 500% of rated capacity
Excitation Voltage - Standard	10 VDC	10 VDC
Excitation Voltage - Maximum	15 VDC	15 VDC
Input Resistance	350 ± 3.5 ohms	800 ± 20 ohms
Insulation Resistance	> 2000 m ohms	> 2000 m ohms
PERFORMANCE		
Non-linearity	< 0.03% of rated output	≤ 0.1% of rated output
Hysteresis	< 0.03% of rated output	≤ 0.1% of rated output
Non-repeatability	< 0.02% of rated output	≤ 0.05% of rated output
Creep (after 20 minutes)	0.03% of rated output (determined at rated capacity; performance at reduced loads proportional to applied load)	0.03% of rated output
Nominal Output	3 mV/V ± 0.5%	1.0 mV/V ± 0.5%
Rated Full Scale Output	30mV	10mV
Zero Balance	< 1% of rated output	≤ 1% of rated output
Output Resistance	350 ± 5 ohms	700 ± 10 ohms
PHYSICAL		
Temperature Range	Operational: -65° to 200° F (-20° to 80° C)	Operational: -65° to 200° F (-20° to 80° C)
	Compensated: 0° to 150° F (-10° to 70° C)	Compensated: 0° to 150° F (-10° to 70° C)
	Rated Output: < 0.1% of rated output/10° C	Rated Output: ≤ 0.03% of rated output/10° C
	Zero Shift: < 0.05% of rated output/10° C	Zero Shift: ≤ 0.03% of rated output/10° C
PHYSICAL		
Construction	Electroless nickel-plated steel	Alloy Tool Steel
Cable	4-connector shielded cable (AWG22); 10 ft (3 m)	16 ft (5 m)
Environmental Protection Rating	IP67	Meets IP67
Shipping Weight (without hardware)	1 to 4 lb (453 to 1814 g)	12 to 90 lb (6 to 41 kg)

* For a complete assembly, sensor and hardware, maximum weight should not exceed rated capacity.

IV. MECHANICAL INSTALLATION

WARNING: REMOVE POWER BEFORE INSTALLING REMOVING OR MAKING ADJUSTMENTS.

WARNING: USE PROPER SUPPORTS TO PREVENT THE VESSEL FROM TIPPING OF FALLING DURING INSTALLATION. DO NOT PUT ALL THE VESSEL LOAD ON ONE TENSION CELL FOR A THREE OR FOUR-POINT SYSTEM.

WARNING: DO NOT OVERLOAD THE SENSORS. FOR MULTIPLE POINT INSTALLATIONS: SUPPORT BEAMS MUST BE OF EQUAL SIZE AND/OR STIFFNESS. ONE BEAM MAY DEFLECT MORE THAN OTHERS AND TRANSFER EXCESSIVE WEIGHT TO OTHER SENSORS.

CAUTION: LOCK ANY THREADED CONNECTIONS WITH JAM NUTS OR OTHER THREAD LOCKER.

CAUTION: IF ADDITIONAL SAFETY CABLE IS INSTALLED, LEAVE ENOUGH SLACK IN THE CABLE TO ALLOW FREE MOVEMENT.

CAUTION: AVOID SHOCK LOADS, AS THEY CAN DAMANGE THE SENSOR.

CAUTION: INSTALL PROTECTIVE BARRIERS OR STOPS TO PREVENT VEHICLES FROM HITTING THE VESSEL.

FUNCTION CHECK SENSORS AND EQUIPMENT

Perform a functional check of all the Sensors before installation to verify they have not been damaged during shipment. Select one of the functional check methods described below.

	TC1 Tension Cells	**TC2 Tension Cells**
Resistence	350 ohm	700 ohm
+Signal Leads	Blue	Blue
- Signal Leads	Green	Green
Rated Full Scale Output	30mV	10mV
+ Excitation Leads	Red	Red
- Excitation Leads	White	White

Method 1: Measuring Resistance

1. Place the Sensor on a stable surface. Disconnect the Sensor from the signal processor, if previously wired.
2. Using the DMM, measure the resistance across the Sensor's -Exc and +Exc leads. Verify the resistance using the chart above is +/- 40 ohms.
3. Measure the resistance across the -Sig and +Sig leads. Verify the resistance using the chart above is +/- 40 ohms.
4. Repeat Steps 1 through 3 for each Sensor. If any reading for any Sensor is outside the specifications described above, contact Kistler-Morse for assistance before proceeding with installation.

Method 2: Measuring Output

1. Place the Sensor on a stable surface.
2. Wire the Sensor to the signal processor, but do not connect the -Sig and +Sig leads.
3. Apply power to the signal processor.
4. Using the DMM, measure the voltage across the Sensor's -Sig and +Sig leads. Verify the no-load output is 0 ±1% of Rated Full Scale Output.
5. Repeat Steps 1 through 4 for each Sensor. If the reading for any Sensor is outside the specifications described above, contact Kistler-Morse for assistance before proceeding with installation.

VESSEL PREPARATION

There are two aspects to successfully use the Sensors — properly functioning Sensors and appropriate vessel support characteristics. Review the following list of error sources, and make the recommended corrections before you install the Sensors:

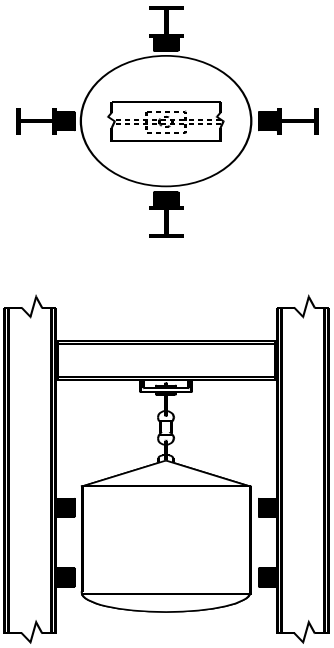
- Hidden load-bearing structures, such as discharge chutes or plumbing supported by the floor, can reduce loads on the vessel supports. Install flexible couplings to minimize this problem.
- Cross-connecting structures, such as catwalks and manifolds, can transfer loads from adjacent vessels. Install slip joint or flex couplings to minimize this problem.
- Shock loads can damage the Sensor. Install protective barriers or stops to prevent vehicles from hitting the vessel.
- For three- and four-point support installations — Support beams must be of equal size and/or stiffness. If one beam deflects more than the other(s), it may transfer excessive weight to the other Sensors, possibly overloading them.

INSTALLATION TYPES

SINGLE-POINT SUPPORTS

Often used for vessels containing liquids.

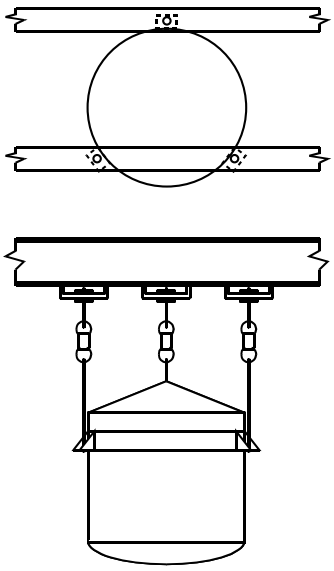
Considerations: Bumpers, check rods, or cables are required to limit accidental side motion. Ensure the bumpers, check rods, or cables do not cause friction and do not restrain vertical movement of the vessel. Use rotational restraints to prevent the vessel from rotating and unscrewing hardware. Do not use single-point supports for vessels containing solids, because off-center loading may occur. Off-center loading shifts the center of gravity and causes the vessel to contact the bumpers, resulting in erroneous readings.



THREE-POINT SUPPORTS

Distributes vessel weight on three tension cells.

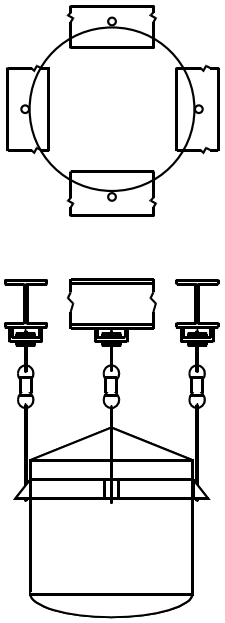
Considerations: Use turnbuckles to control the support length, ensuring each Sensor carries a proportional share of weight.



FOUR-POINT SUPPORTS

Distributes vessel weight on four tension cells.

Considerations: Use turnbuckles to control the support length, ensuring each Sensor carries a proportional share of weight.



INSTALLATION PROCEDURES

1. Empty the vessel.

2. Locate each tension cell so the cable cannot be snagged or chafed and can be easily routed to the junction box.

3. Install tension cell(s) and hardware using a steel rod, cable, or chain to connect the Sensor to the vessel and overhead support.

4. Lock any threaded connections with jam nuts, or other appropriate thread locker for added safety.

5. Install a safety cable, connecting it above and below the tension cell assembly. Leave enough slack in the cable to allow free movement of the tension cell. Figure 4.

6. Complete installation by installing field wiring and leveling the vessel as described in the next section.

7. After leveling vessel, install safety wires on any screw connections (shackles, etc.), to prevent the hardware from coming loose.

VESSEL LEVELING

Leveling the vessel distributes the weight evenly on all the Sensors, increasing system accuracy. Perform this procedure while the vessel is still empty:

1. Check if Leveling Needed

A. Disconnect the +Sig and -Sig wires for all Sensors.

B. Using the DMM, measure and record the dead weight voltage output across one Sensor's +Sig and -Sig leads. The output must be positive. If you observe a negative output:

(1) Check the wiring. Ensure the wires are connected to the correct terminals.

(2) If the wiring is correct and you still observe a negative output, the vessel may be tilted. Vessel tilting shifts the load onto some Sensors while putting other Sensor(s) in a no-load or compression load condition. This can occur in cases of unequal support length, unequal support beam stiffness, or extreme thermal deformation. Proceed to Step 2 to level the vessel.

C. Repeat Step B for each Sensor.

D. Calculate the output range:

Output Range = largest output - smallest output The output range must be less than 5% of rated output. For a system with 10 V excitation, the output range must be less than 1.5 mV (3.0 mV/V x 10 V x 0.05 = 1.5 mV).

E. If the installation meets the criteria described above (each output is positive and output range is less than 1.5mV), the vessel is sufficiently level. • If sufficiently level, proceed to Step 3. If not sufficiently level, proceed to Step 2 to level the vessel.

2. Level Vessel

A. Loosen the connections between the Sensors and the vessel.

B. Use the turnbuckle or adjust the cable chain/rod length as required to adjust the weight distribution on the Sensors. Shortening the support length increases the weight on the Sensor. Lengthening the support length decreases the weight on the Sensor.

NOTE: Adjusting support length on one Sensor affects the weight distribution on all the Sensors.

C. Re-tighten the connections between the Sensors and the vessel.

D. Repeat Step 1, rechecking the voltage output of all the Sensors and recalculating the Output Range (largest output - smallest output).

E. Repeat Steps 2A through 2D until the installation meets the criteria for weight distribution.

3. Complete Installation

A. Reconnect the +Sig and -Sig wires for all Sensors to the junction box terminals.

B. Install safety wires on any screw connections (shackles, etc.) to prevent the hardware from coming loose, if needed.

V. ELECTRICAL INSTALLATION

WARNING: REMOVE POWER BEFORE INSTALLING, REMOVING OR MAKING ADJUSTMENTS

GENERAL SAFETY

When using electrical equipment, you should always follow basic safety precautions, including the following:

- The installation/wiring of this product must comply with all national, federal, state, municipal, and local codes that apply.
- Properly ground the enclosure to an adequate earth ground.
- Do not modify any factory wiring. Connections should only be made to the terminals described in this section.
- All connections to the unit must use conductors with an insulation rating of 300 V minimum, rated for 105 C, a minimum flammability rating of VW-1, and be of appropriate gauge for the voltage and current required (see specs).
- Do not allow moisture to enter the electronics enclosure. Install drip loops.

Tension cells should be wired to a junction box, bringing all the wires into one location. See separate Junction Box Installation & Operation Manual for wiring and instructions.

WIRING INFORMATION

NOTE: Non-coated wire is the ground wire.

	TC1 TENSION CELLS	**TC2 TENSION CELLS**
+ EXCITATION	RED WIRE	RED WIRE
- EXCITATION	WHITE WIRE	WHITE WIRE
+ SIGNAL	BLUE WIRE	BLUE WIRE
- SIGNAL	GREEN WIRE	GREEN WIRE

VI. SET-UP

Reference the Installation & Operation manual for the controller/processor for detailed calibration instructions.

VII. MAINTENANCE

PREVENTATIVE MAINTENANCE

There are no preventative maintenance procedures for the tension cell sensors.

REPLACEMENT PARTS

PART NUMBER	DESCRIPTION
TC1-R110	Hardware, Clevis Assemly for Rated Load 110 lb (50 kg)
TC1-R2200	Hardware, Clevis Assebmly for Rated Load 440 lb (200 kg)
TC1-R4400	Hardware, Clevis Assebmly for Rated Load 4,400 lb (2,000 kg)
TC1-R6600	Hardware, Clevis Assebmly for Rated Load 6,613 lb (3,000 kg)
TC1-R11000	Hardware, Clevis Assebmly for Rated Load 11,023 lb (5,000 kg)
TC2-A	Hardware, Shackles 22,046 lb (10,000 kg)
TC2-B	Hardware, Shackles 44,092 lb (20,000 kg)
TC2-C	Hardware, Shackles 66,138 lb (30,000 kg)
TC2-D	Hardware, Shackles 110,231 lb (50,000 kg)

VIII. TROUBLESHOOTING

For technical or service questions, please call the manufacturer Customer Support at 1-800-426-9010.

For detailed dimensional drawings, go to www.kistlermorse.com

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Small amplitude changes or erratic fluctuations in display readings	Small amplitude drift or oscillation, with peakto-peak disturbance of 0.1% to 0.3% of full scale, is normal.	Reduce drift or oscillation by setting 'count by' and 'averaging' appropriately on the signal processor (refer to signal processor manual).
	Fluctuations can be caused by mechanical binding in supports. Binding may have resulted from hanging equipment on vessel after initial Sensor installation.	Check for binding in eye nuts, shackles, etc. If necessary, re-level vessel
	Fluctuations can be caused by moisture in cable conduit, junction boxes, or PCBs.	Check conduit, junction boxes, and PCBs for water contamination. Find water entry source and correct problem, and dry out. Remove/replace corroded parts and materials.
	Fluctuations can be caused by a damaged Sensor	Using a DMM, check resistance for individual Sensors: 1. Remove one Sensor's wires from junction box terminal. 2. Measure Sensor resistances and verify they meet the requirements: Leads Range -Exc and +Exc: See Figure 1 -Sig and +Sig: See Figure 1 If any reading is outside specifications, Sensor if damaged and must be replaced. 3. Repeat Step 2 for each suspect Sensor, until damaged Sensor is located.

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
	Fluctuations can be caused by a short to ground.	Using a DMM, check for shorts to ground: 1. Set DMM resistance scale to accommodate maximum measured range. 2. Disconnect junction box cable from signal processor. 3. With one lead to earth ground, place other lead on a wire from isconnected cable and check resistance. Repeat for each wire in cable. • If any reading is less than infinite (i.e., there is resistance), short is indicated; proceed to Step 4 to identify location. • If no short is indicated, investigate other explanations for problem. 4. Starting with junction box closest to signal processor in daisy chain, disconnect cable that connects junction box to other junction boxes. With one lead to earth ground, place other lead on a wire from disconnected cable, and check resistance. Repeat for each wire in cable. • If any reading is less than infinite, short is indicated; proceed to Step 5 to identify location. • If no short is indicated, proceed to next junction box in daisy chain. Disconnect cable 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 cable for one Sensor from identified junction box. With one lead to earth ground, place other lead on a wire from Sensor cable and check resistance. Repeat for each wire in cable. • If any reading is less than infinite, short is indicated. Replace shorted Sensor. • If no short is indicated, disconnect another Sensor cable from junction box and check resistances. Repeat for each Sensor wired to junction box until short is located. Replace shorted Sensor.

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
Repeatable drift over 24-hour period	Periodic drift is most likely caused by vessel thermal expansion due to the sun's radiation or a vessel's response toits own heating cycles.	If periodic drift is outside specifications contact Kistler-Morse. 2. If keeping long-term records, take readings at same time each day to minimize error.
Sudden change in display reading or frequent recalibration required.	A single broken Sensor can cause indicated weight to shift up or down by a large amount, up to 100% of full-scale live load.	Using a DMM, check voltage output for individual Sensors: 1. Remove one Sensor's +Sig and -Sig wires from junction box terminal. 2. Measure voltage across Sensor's +Sig and -Sig leads. Verify output is within range; assuming 10 V excitation. 3. Repeat Steps 1 and 2 for each suspect sensor. If any reading is outside specified range, sensor may be damaged; check sensor resistance to verify (see Symptom 1).
	Change in weight reading can be caused by material buildup on horizontal surfaces.	Remove material from sensor horizontal surfaces.
	Sudden change in weight reading can be caused by problems with signal processor.	Check signal processor excitation voltage and incoming AC voltage for accuracy and stability (refer to signal processor manual).

NOTES

NOTES

KISTLER-MORSE®
Measure of Success

150 Venture Boulevard
Spartanburg, SC 29306
Tel: (800) 426-9010
Tel: (864) 574-2763 [Local]
Fax: (864) 574-8063
sales@kistlermorse.com
www.kistlermorse.com

venture
MEASUREMENT

97-1505-15 Rev. A