



INSTRUCTION MANUAL

VIBRATING WIRE JOINTMETER

JM Series

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This product should be installed and operated only by qualified personnel. Its misuse is potentially dangerous. The Company makes no warranty as to the information furnished in this manual and assumes no liability for damages resulting from the installation or use of this product. The information herein is subject to change without notification.

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1 GENERAL

The JM-Series jointmeter is used to measure movements such as:

- the opening or closing of construction joints in buildings, bridges, pipelines
- the amount of opening of contraction joints in concrete dams
- tension cracks in soils
- joint and crack openings within rock and concrete masses or at rock-concrete interfaces.

The jointmeter is supplied with either an embedment type or surface-mounted installation fixture.

2 DESCRIPTION

The JM jointmeter assembly is comprised of the following elements:

- a vibrating wire displacement transducer,
- a telescopic protective housing with a circular flanged end,
- anchor(s) or an embedment socket,
- an electrical cable.

A vibrating wire sensing element is linked to a spring and a connecting rod at the other end for displacement. As the connecting rod is pulled out from the gage body, the spring is elongated causing an increase in tension which is sensed by the vibrating wire element. This change is measured with the readout MB-6T or MB-6TL.

3 INSTALLATION

The main considerations are to obtain readings prior to the beginning of displacement, correct alignment of the meter with the direction of motion and protection of the lead wires.

3.1 PRELIMINARY TESTS

On receipt of the jointmeter, the general condition of the jointmeter should be checked and a reading taken (including the thermistor), with the shaft extended approximately 1/8" or 20% of the range of the instrument. A stable reading should be seen if the shaft is held stationary. Stable readings can be difficult to obtain when the gage is not attached to the structure to be monitored.

To check the reading, follow the instructions given in the "Reading procedure" Section of this manual.

**DO NOT ROTATE THE SHAFT OF THE JOINTMETER.
THIS CAN CAUSE IRREPARABLE DAMAGE TO THE INSTRUMENT.
WITNESS PIN IS ON THE SHAFT AND SLOT ON THE BODY TO SERVE AS
A GUIDE FOR ALIGNMENT.**

3.2 JOINTMETER INSTALLATION

3.2.1 JM-S – SURFACE JOINTMETER

The JM-S jointmeter is designed to be attached to steel, rock, concrete or other structural materials either by drilling and tapping (2) 1/4 UNF holes on opposite sides of the joint to be monitored and screwing the rod end connectors into these points or alternatively have a 3/4 in. x 6 in. long rebar with this type of thread.

Before installing the jointmeter, it must be decided where to set the starting point, whether at mid-range or mostly compression or mostly tension. When this has been determined, the jointmeter itself can be used as the setting jig. Check and record the jointmeter reading using the readout to ensure proper gage functioning as well as correct initial setting. The rod ends are usually attached to the jointmeter when delivered and, when connected to the readout, the gage can be set at the starting point and the mounting holes can be located using the rod ends as locating points. Be sure the rod ends are perpendicular to the jointmeter body when making these marks. Drill and tap the holes about 3/4 inch deep (drill 1 inch). Remove the cotter pin from the ball joint and loosen the socket screw until the ball end comes free. Tighten the end into the tapped hole using thread-locking cement. Repeat this for the other end. Place the gage down over the ball end and tighten the socket screw until it is snug but not tight against the ball. Replace the cotter pin in the hole in the body. Repeat for the other end. Alternatively, the ball ends can be screwed into the holes while still connected to the socket joint if care is taken during tightening.

If the two surfaces are at different levels, extension pieces, or “stand-offs”, will have to be added to ensure that the body or connecting rod does not contact the surface.

In concrete structures and soil, rebar is grouted or driven into the material and the rod ends are then screwed into the rebar. In concrete, drill (2) 2-inch deep holes as a minimum of the proper diameter at the proper location for the rebar end pieces. Grout the pieces of rebar (keeping the threaded end uppermost) into the concrete with quick setting cement or epoxy. Attach the gage as described above.

3.2.2 JM-E – EMBEDMENT JOINTMETER

The JM-E embedment jointmeter consists of 2 parts: the socket and the gage by itself.

The socket is installed in the first lift of concrete. The finished face of the socket must be accessible for installing the gage on the second lift. There is a protective plug with a 5/16” – 18 thread.

After the forms of the first lift are dismantled, the socket is exposed. The plug is then removed and grease is put on the thread of the socket to ease installation of the gage.

Place thread-locking compound to secure the gage to the socket and screw the gage into the socket. Secure the body of the gage and cable for the second lift of concrete. Another set of readings should be taken before concrete is set. Please adjust the gage allowing compression.

Avoid pouring concrete directly onto the instrument or cable. Do not use mechanical vibrators in the immediate area of the jointmeter or cable. If necessary, hand place and/or puddle the concrete around the jointmeter.

Take a reading before and after pouring of the concrete.

3.2.3 JM-F – FOUNDATION DEFORMETER

The JM-F foundation deformer is comprised of the following elements:

- A vibrating wire transducer housed in a body;
- An electrical cable;
- Lengths of 3/8 pipes SCH 40;
- A polyethylene protective tubing;
- Screw clamps;
- An anchor;
- An adapter;
- Installing tools (optional).

The foundation meter is also factory preset at mid range unless specified otherwise.

To install the JM-F, follow the next steps:

1. If necessary, drill an NX (76 mm/3-inch diameter) hole to the required depth.
2. Thread the adapter to the anchor.
3. Apply soapy water on the adapter, slide the protective tubing onto it, then install a screw clamp in order to maintain them tightly coupled.
4. Lower the anchor to the appropriate depth, wait a while as the protective tubing may shrink a little bit due to temperature differential, then cut the latter longer than necessary.
5. Insert a length of 3/8 pipe SCH 40 into protective tubing, thread additional lengths of pipes until you reach the anchor.
6. Since protective tubing exceeds SCH 40 pipe, you have to use specially designed installing tools in order to screw the latter to the anchor. Use Installing tools as indicated on figure below.

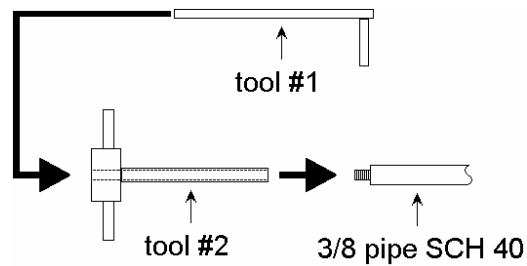


Figure 1: Screwing extension tube to anchor

7. Cut protective tubing one inch longer than the top of the SCH 40 pipe's threading.
8. Install a screw clamp onto protective tubing.
9. Apply some soapy water on the JM-F transducer's lower extremity and screw it to the SCH 40 pipe's threading.
10. Tighten the screw clamp.
11. Wrap some foam padding at the transducer-protective tubing junction to allow free movement once grouted.
12. Take a reading before and after pouring of the concrete.

Note: Take care not to prematurely shear the pins while manipulating the JM-F transducer. Do not suspend the assembly by the JM-F transducer. If necessary, use a cable attached to the protective tubing to support it.

4 CABLE ROUTING AND PROTECTION

Rout the cable towards the junction or switching panel. Make sure that the cable is protected from cuts or abrasion and, if necessary, run the cable through rigid or flexible conduit to the terminal location. To provide protection for cable running over concrete lifts, hand placed concrete is sometimes used, depending on site conditions.

Record the cable routing with care and transfer this routing to the drawings.

At all times during the installation, any cable that is exposed to lightening must be protected. A large grounded metal cage placed over the cable bundle combined with direct grounding of all leads and shields are an effective way to prevent lightening damage to the instruments.

5 CABLE SPLICES

Cable splices are to be avoided. If necessary, use only the manufacturer's approved standard or high-pressure splice kit. Splicing instructions are included with the splice kit.

6 READING PROCEDURE

Manual readings of deformation and temperature of the JM-Series jointmeter can be taken either directly on the cable end or through a switching panel using the MB-6T or MB-6TL readout unit.

The readout unit with the four-pin, male, panel-mounted electrical connector is supplied with one multi-core cable fitted with a mating female connector at one end and a set of four color coded alligator clips at the other. The conductor's insulation is color coded to match that of the alligator clips and the instrument cable conductors' insulation jacket. Connect the alligator clips to the gage lead wire according to the table below.

Cable	Connections				
	Wire High (red)	Wire Low (black)	Temp. High (white)	Temp. Low / Shield (green)	
IRC-41A(P)	red	black	white	green	shield

Table 1: Wiring code for electrical cables

To obtain a reading, move the MB-6T(L) GAGE selector to position 2 (JM) and the THERMISTOR selector to position B (3K).

Then, flick the power switch towards the "ON" position. The display will successively show:

- the readout self-testing sequence
- the gage and thermistor settings
- the gage NORMAL (N) and LINEAR (L) readings and the temperature of the gage in Celsius and Fahrenheit degrees.

Record these numbers as they appear on the display.

Note: If you use a MB-6T(L) readout unit that was built prior to February 1995, contact Roctest – Telemac for appropriate selection position and calibration data.

The jumper cables should never be short-circuited when they are connected to the readout unit front panel.

7 CONVERSION OF READINGS

7.1 MEASUREMENT OF THE DISPLACEMENT

For the absolute measurement of the displacement, the following equation applies using LINEAR units displayed by the MB-6T(L):

$$D = A \cdot L^2 + B \cdot L + C$$

where D = displacement in millimetres

A, B, C = calibration factors (see calibration sheet)

L = reading in LINEAR units (LU)

Example:

With $L = 6\,000$ LU

$A = -1.0839\text{E-}08$ mm/LU²

$B = 4.6608\text{E-}03$ mm/LU

$C = -1.4810\text{E+}01$ mm

We get: $D = 12.76$ mm

Note that increasing readings in LINEAR units indicate increasing displacement.

To get the relative displacement, just subtract the initial reading to the absolute reading.

$$D_r = D - D_0$$

where D_r = relative displacement in millimetres

D = absolute reading in millimetres

D_0 = initial reading in millimetres

If the frequency is measured, convert it into LINEAR units using the following equation:

$$L = K \frac{F^2}{1000}$$

where L = reading in LINEAR units

K = gage constant for ERI fill extensometer = 1.0000

F = frequency in Hz

Example:

With $F = 1\,739$ Hz,

$$\text{We get: } L = 1.0 \times \frac{1739^2}{1000} = 3\,024.1 \text{ LU}$$

7.2 ENVIRONMENTAL FACTORS

Since the purpose of the extensometer installation is to monitor site conditions, factors which may affect these conditions should always be observed and recorded. Seemingly minor effects may have a real influence on the behaviour of the structure being monitored and may give an early indication of potential problems. Some of these factors include, but are not limited to: blasting, rainfall, tidal levels, excavation and fill levels and sequences, traffic, temperature and barometric changes, changes in personnel, nearby construction activities, seasonal changes, etc.

8 TROUBLESHOOTING

Maintenance and troubleshooting of vibrating wire transducers are required. Periodically check cable connections and terminals. The transducers themselves are sealed and cannot be opened for inspection.

8.1 UNSTABLE READING

- Check if the same troubles occur with other instruments. If so, compare cable routes or check the readout unit.
- Is the shield drain wire correctly connected to the readout unit?
- Isolate the readout unit from the ground by placing it on a piece of wood or similar non-conductive material.
- Check the battery of the readout unit.
- Check for nearby sources of electrical noise such as motors, generators, electrical cables or antennas. If noise sources are nearby, shield the cable or move it.
- If a data logger is used to take the readings, are the swept frequency excitation settings well adjusted?
- The sensor may have gone outside its range. See previous records.
- The sensor body may be shorted to the shield. Check the resistance between the shield drain and the sensor housing.
- Check the integrity of the cable.
- The sensor may have been damaged by shocks.

8.2 NO READING

- Check the battery of the readout unit.

- Check if the same troubles occur with other instruments. If so, the readout unit may be suspected and the factory should be consulted.
- If a data logger is used to take the readings, are the swept frequency excitation settings well adjusted?
- The sensor may have gone outside its range. See previous records.
- Check the coil resistance. Nominal coil resistance is $190\Omega \pm 10\Omega$, plus cable resistance (22 gage copper = approximately $0.07\Omega/m$).
 - If the resistance is high or infinite, a cut cable must be suspected.
 - If the resistance is low or near zero, a short must be suspected.
 - If resistances are within the nominal range and no reading is obtained, the transducer is suspect and the factory should be consulted.
- Cuts or shorts are located, the cable may be spliced in accordance with recommended procedures.
- The sensor may have been damaged by shocks or water may have penetrated inside its body. There is no remedial action.

8.3 TEMPERATURE TROUBLES

If troubles occur when reading the temperature, this is likely due to a cable cut or short because of the technology used (simple thermistor). Check the cable and splice it in accordance with recommended procedures.

If furthermore, no reading of displacement is got, water may have penetrated inside the sensor body. There is no remedial action.

9 MISCELLANEOUS

9.1 CONVERSION FACTORS

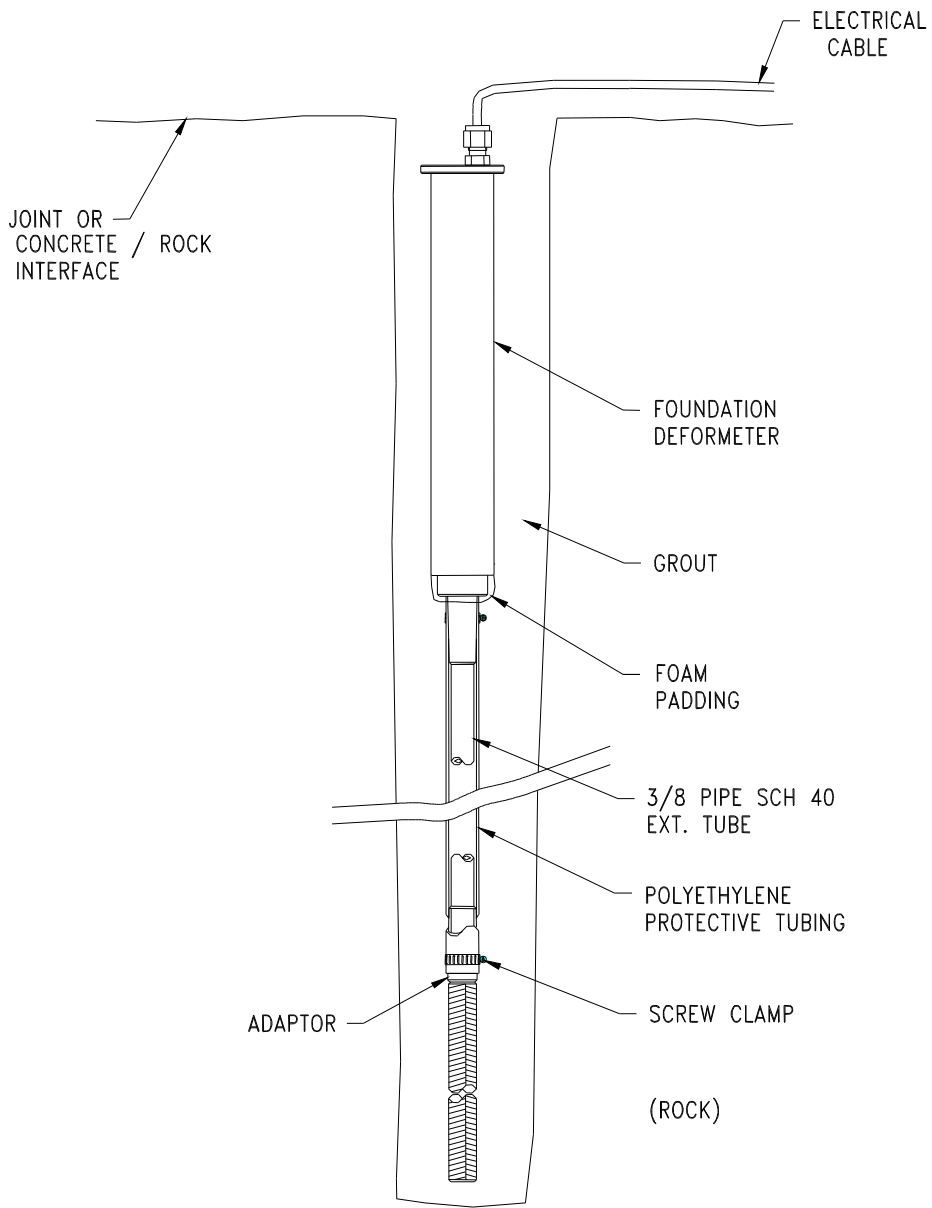
	To Convert From	To	Multiply By
LENGTH	Microns	Inches	3.94E-05
	Millimetres	Inches	0.0394
	Meters	Feet	3.2808
AREA	Square millimetres	Square inches	0.0016
	Square meters	Square feet	10.7643
VOLUME	Cubic centimetres	Cubic inches	0.06101
	Cubic meters	Cubic feet	35.3357
	Litres	U.S. gallon	0.26420
	Litres	Can-Br gallon	0.21997
MASS	Kilograms	Pounds	2.20459
	Kilograms	Short tons	0.00110
	Kilograms	Long tons	0.00098
FORCE	Newtons	Pounds-force	0.22482
	Newtons	Kilograms-force	0.10197
	Newtons	Kips	0.00023
PRESSURE AND STRESS	Kilopascals	Psi	0.14503
	Bars	Psi	14.4928
	Inches head of water*	Psi	0.03606
	Inches head of Hg	Psi	0.49116
	Pascal	Newton / square meter	1
	Kilopascals	Atmospheres	0.00987
	Kilopascals	Bars	0.01
	Kilopascals	Meters head of water*	0.10197
TEMPERATURE	Temp. in °F = (1.8 x Temp. in °C) + 32 Temp. in °C = (Temp. in °F - 32) / 1.8		

* at 4 °C

E6TabConv-990505

Table 2: Conversion factors

9.2 FIGURES



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Figure 2: Foundation deformer, model JM-F

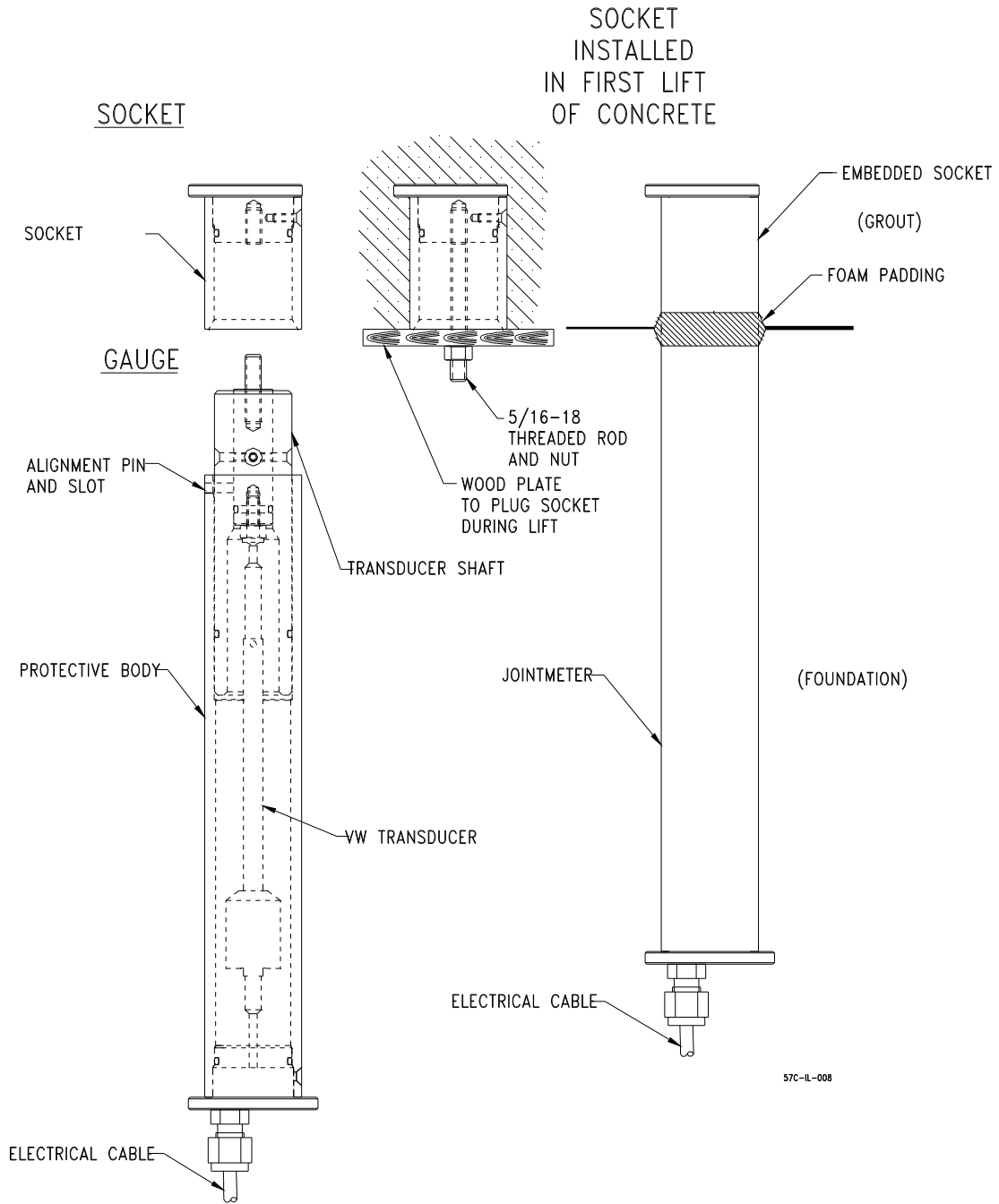
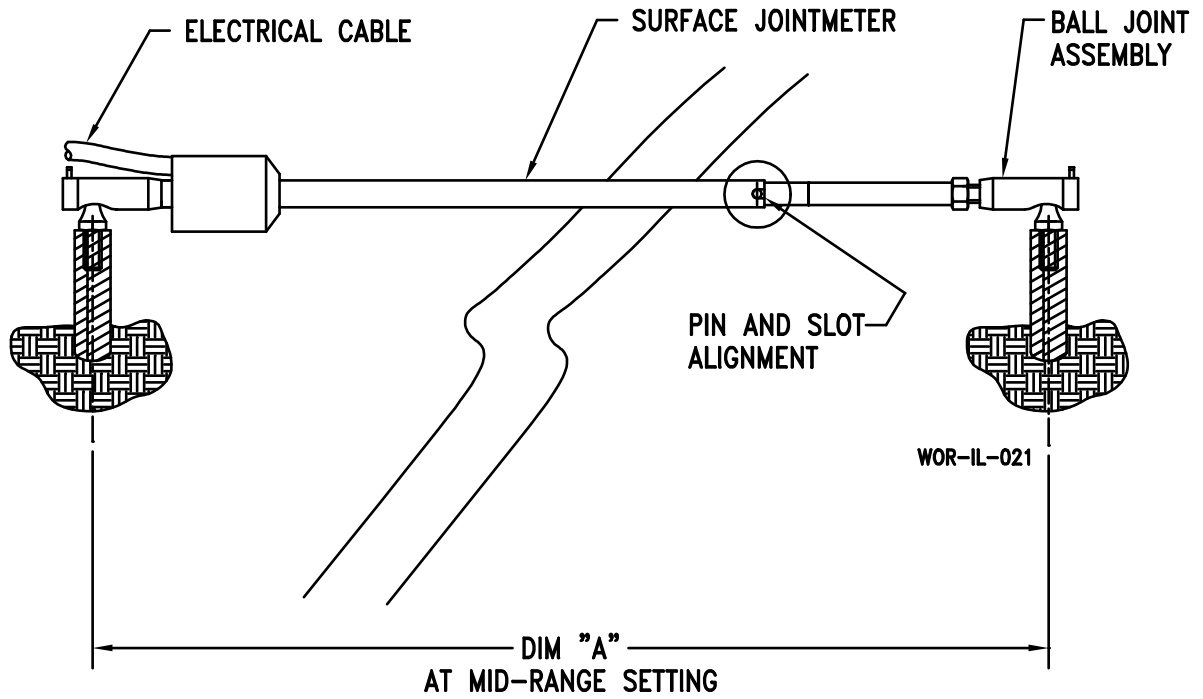


Figure 3: Embedment jointmeter, model JM-E



WOR-IL-021

JMS MODEL	DIM "A"
25mm (1")	265mm (10.4")
50mm (2")	371mm (14.6")
100mm (4")	513mm (20.2")
150mm (6")	663mm (26.1")
200mm (8")	826mm (32.5")
250mm (10")	953mm (37.5")

Figure 4: Surface jointmeter, model JM-S