



BARTON® MODEL 242E TEMPERATURE/PRESSURE RECORDER

User Manual

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Safety Information

Before installing this instrument, become familiar with the installation instructions in Section 3.



WARNING: This symbol identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

CAUTION: Indicates actions or procedures which if not performed correctly may lead to personal injury or incorrect function of the instrument or connected equipment.

IMPORTANT: Indicates actions or procedures which may affect instrument operation or may lead to an instrument response that is not planned.

Section 1—Introduction

General

The Barton Model 242E Temperature and Pressure Recorder is a versatile and rugged instrument designed for general temperature and pressure applications. It records monitored temperature and pressure on a 12-inch diameter chart. Up to four elements may be used in any combination to operate up to four individual recording pens.

Main Components

Static Pressure Systems

The static pressure system consists of a helical bourdon tube connected to system piping. The static pressure element measures the static pressure in a piping system. Elements are available for measuring pressures ranging from 30 in. of vacuum (mercury) to 30,000 psi. For a list of elements and ranges, see [Table 7.3—Static Pressure Elements on page 31](#).

Thermal Systems

The thermal systems consist of a spiral bourdon tube, a capillary, and a bulb. All parts are made of stainless steel. The bulb is fitted with a bendable extension, and the capillary is protected with stainless steel armor.

Recording Mechanism

The recording mechanism is a linkage and pen system that permanently records data. It converts mechanical inputs from the pressure and temperature elements to link lines on a revolving chart. All operative parts of the recorder mechanism are made of stainless steel for a long field life. The pen mount is exceptionally rugged. All lines are adjustable. Screw adjustments for zero, range, and linearity assure fast and accurate calibration.

Chart Drive

A variety of chart drives are available. Both electrical and spring-wound chart drives fit a wide variety of chart speeds and time intervals that reduce maintenance time (see [Section 5—Troubleshooting on page 19](#)). All chart drives are interchangeable and fitted with a recorder hub clip that features a simple yet secure method of locking the chart in place. Explosion-proof electrical chart drives are available.

Case

The 242E is housed in an aluminum case with a hinged door providing access for chart changes and calibration adjustment. The case is finished in a black, polyurethane electrostatic powder paint that is highly resistant to weathering, scratches, marring, and industrial fumes. The Model 242E connects to the system or transmitter through fittings in the bottom of the case.

Section 2—Theory of Operation

General

Pressure and temperature elements in the 242E are connected by tubing or pipe to measure system pressure and system temperature (Figure 2.1).

The capillary tubes from the static pressure element connect directly to the piping system and are filled with the process system fluid. Two thermal systems are available: a Class V mercury-filled system and a Class I hydrocarbon-filled system. See [Instrument Specifications on page 34](#) for details.

A chart drive mechanism turns the chart at a selected speed. The chart is driven by either an electrical motor or a mechanical, spring-wound type motor (see [Table 7.2—Chart Drives on page 30](#)).

Static Pressure Element

The sensor element consists of a helically coiled bourdon tube with a slightly flattened cross-section of tubing coiled into a helix or flat spiral. The upper end of the element attaches to a drive arm, and the bottom end of the element connects to the capillary tubing, which extends into the bottom of the recorder case and attaches to a connector in the back wall of the case. The connector allows system piping to be connected externally through the back of the case.

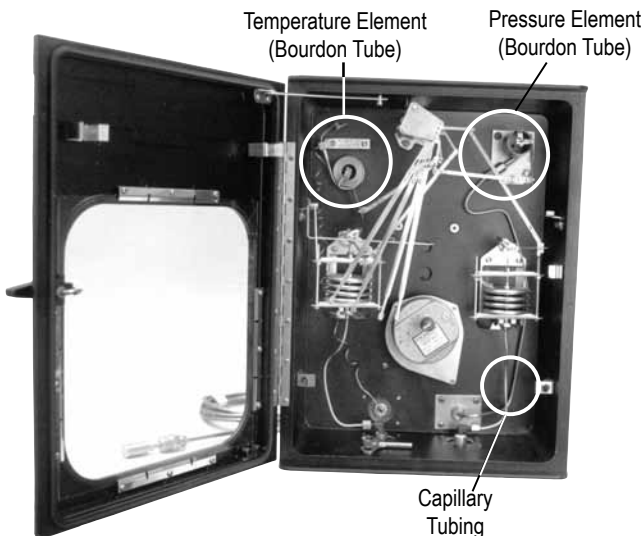


Figure 2.1—242E recorder components

Static pressure introduced through the tubing into the static pressure element causes the element to unwind. Conversely, a reduction of pressure within the tubing causes the element to wind up more tightly. This motion is transmitted through the lever arm assembly and its intermediate linkage to the pen shaft, which controls the movement of the recorder pen. The pen transcribes the motion onto a rotating chart to permanently record changes in static pressure.

Temperature Element

The thermal system senses temperature changes, using the thermal expansion principle. Temperature changes cause thermal expansion and contraction of mercury in the bulb. When heated mercury expands, it increases in volume, causing the bourdon tube to exert mechanical force. The bourdon tube movement is transmitted through mechanical linkage to a recording pen ([Figure 2.2—Temperature element on page 7](#)).

Thermal Bulb

The thermal bulb acts as the sensing element. Its physical and dimensional characteristics determine response time of the system. Large surface area to volume, minimum wall thickness, and high heat conductivity are desirable for high speed temperature response. The metal used in thermal bulb fabrication should have a minimum coefficient of expansion and low specific heat factor—stainless steel is used in the Model 242E thermal bulb.

Capillary Tubing

The capillary tubing provides a thermal seal between the temperature bulb and bourdon tube. The tubing, fabricated from thick-walled stainless steel, minimizes the internal volume for mercury. The capillary is provided with 1/4-inch spiral armor to assure a strong and pliable transmission line between the primary element and the secondary mechanism (bourdon tube).

Filling Fluid

Mercury's thermal properties make it highly sensitive to temperature changes and suitable for use with a wide range of temperatures.

Secondary Mechanism

The measuring element is a precision-wound stainless steel bourdon tube, which converts the volumetric expansion and contraction of the mercury-fill to an angular output of 17 degrees nominal for the full temperature range.

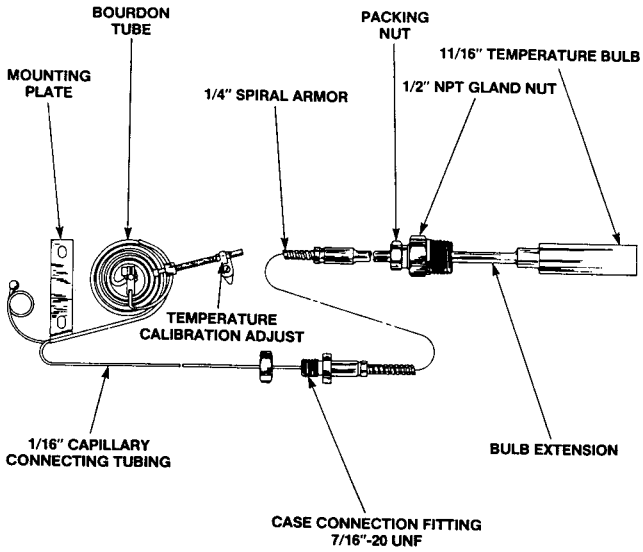


Figure 2.2—Temperature element

Section 3—Installation

General

Inspect the instrument as it is removed from packing and report any damage that may have occurred during shipment.

Standard Practice Considerations

The following practices should be observed upon installation:

Distances—The distances between the temperature bulb and the recorder case should be minimized. Maximum allowable distances are:

VA (fully compensated system): 100 feet

VB (case compensated system): 20 feet

Elevation—Maximum elevation of the temperature bulb with respect to the recorder must not exceed 30 feet. The percent of zero shift can be calibrated by the following:

$$\text{Percent Zero Shift} = \frac{5 X \pm \text{Elevation (feet)}}{\text{Span (Degree Fahrenheit)}}$$

Process Temperature—The normal operating temperature ranges for Class V systems are listed in the Specifications list on [page 34](#). The maximum (momentary) overrange limit is 20% of the total temperature range, while the (momentary) underrange temperature limit of a properly pre-loaded system is -50°F (-45°C).

Vibration—Vibration can be minimized by mounting the instrument on a secure support.

Mounting

IMPORTANT: Mount the instrument as level as possible. Limit drill penetration and remove chips. Temperature bulb capillary must precede the recorder case through the panel cutout. Do not apply wrench or bar pressure to the recorder case, when using a thread mount.

Flush or Panel Mounting

To use a flush or panel mount, perform the following steps:

1. Cut opening in panel to the dimensions shown in [Section 6—Installation/Dimensional Drawings](#).
2. Drill out pilot holes located on top and bottom of case. Use a No. 7 (0.201) drill and 1/4-20 tap as required.

3. Attach two flush mounting brackets to bottom of case using the enclosed self-tapping screws.
4. Pass instrument through the panel cutout.
5. Attach remaining flush mounting bracket and install panel mounting screws.

Pipe Mounting

To mount the recorder to a 2-in. pipe, perform the following steps:

1. Place a suitable length of 2-inch pipe into a well-secured floor or wall flange; or if preferred, attach the 2-inch pipe to existing pipe with a saddle that is fitted with a 2-inch pipe.
2. Attach the recorder to the pipe, orient the instrument, and tighten retaining screws.

Bulb Mounting

IMPORTANT: When locating the thermal bulb within a furnace, tank, line, etc., avoid dead spots where fluid circulation is sluggish and temperature is not responsive. Elevation of the temperature bulb, with respect to the recorder, will cause a slight zero shift.

To install the temperature element, perform the following steps. Refer to [Figure 2.2—Temperature element on page 7](#) as needed.

1. If a thermal well was ordered with the temperature system, thread the thermal well into a 3/4-inch NPT threaded pipeline connection and secure it with a 1-1/8-inch wrench. If the pipeline is already fitted with a thermal well, proceed to step 2.
2. Insert the temperature bulb into the thermal well to its full depths.
3. Secure the gland nut into the thermal well or existing 1/2-inch NPT connection with a 7/8-inch wrench.
4. With the bulb properly installed, secure the packing nut into the gland nut.

To compensate for zero shift due to elevation, shift the pen arm linkage of the recorder to realign the pen on the zero line of the chart. See [Temperature Pen Calibration on page 13](#) for the adjustment procedure.

Chart Installation

Perform the following steps to install the chart:

1. Open the recorder door.
2. Release the chart hub lock (located on the chart drive hub).
3. Raise the pen lifter arm.
4. Slide the chart between the pen(s) and the chart plate. Insert the chart in

the chart guides in the chart plate, position the hole in the chart over the chart hub, and press the chart onto the hub.

5. Lower the pen lifter arm and position the chart to place the pen(s) on the desired chart time line.
6. Secure the chart in place with the chart hub lock.

Calibration Check

Pressure System

Check the calibration of the pressure system prior to placing the recorder into service.

1. Connect the recorder to the calibration equipment as shown in Figure 3.1.
2. Apply zero pressure and adjust the pen to the zero circle on the chart using the zero adjust screw.
3. Apply 100% pressure. (For example, 100% pressure for an element with a standard range of 0 to 1500 psi is 1500 psi; 50% pressure is 750 psi.) Verify that the pen moves across scale to the 100% pressure indication.
4. Apply 50% pressure. Verify that the pen indicates 50% pressure on the chart.
5. If the pen does not accurately indicate the pressure being applied, recalibrate the static pressure pen (see [Static Pressure Pen Calibration on page 15](#)).

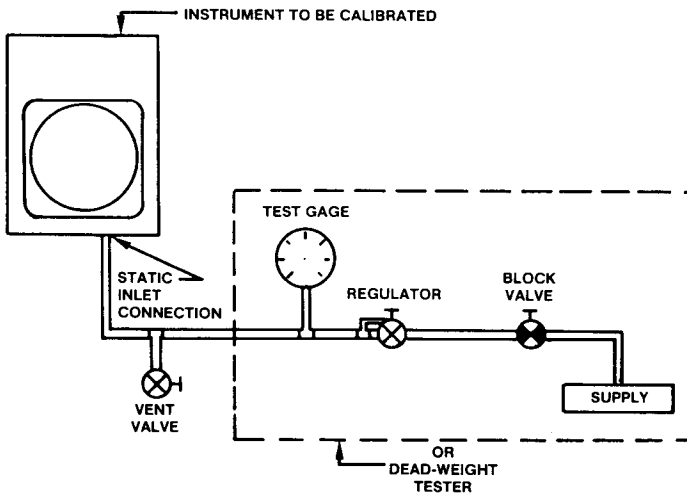


Figure 3.1—Pressure system calibration

Temperature System

All instruments are calibrated at the factory and normally do not require more than a check before startup. The Model 242E has been calibrated at 0, 25, 50, 75, and 100% of full temperature range and checked for proper overtravel. Because of the extensive procedure and elaborate test stand requirements needed to simulate operating conditions, it is recommended that only a zero check be performed. If the temperature system appears to be out of calibration, recalibrate the temperature pen (see [Temperature Pen Calibration on page 13](#)).

Piping

Connect the pressure element to the system pressure or transmitter output using tubing or pipe. The pressure connection on the outside of the recorder case is 1/4-in. NPT, female.

Operation

To place the instrument into operation, proceed as follows:

1. Verify that the pen has ink and is in contact with chart. Replace the pen, if necessary.
2. Turn on the drive.
3. Turn on the pressure to the recorder.

To remove the instrument from service:

1. Turn off the pressure to the recorder.
2. Turn off the chart drive.
3. Lift the pen from the chart.

Section 4 - Maintenance and Calibration

Maintenance

Generally, Barton recorders require no maintenance other than replacement of the chart, replacement of pens, winding of the spring-wound chart drives, and occasional calibration. In addition, the operator should periodically check the door seal for wear and the pressure fittings for tightness. See Table 4.1 for a list of tools required for routine maintenance.

Table 4.1—Required Tools

Tool	Purpose
1/8-inch open-end wrench	Calibration adjustment (zero adjust)
5/64-inch Allen wrench	Calibration adjustment
5/64-inch open-end wrench	Capillary mounting nut
1-1/8-inch open-end wrench	Thermal well
7/8-inch open-end wrench	Gland nut
3/4-inch open-end wrench	Packing nut
Phillips screwdriver	Adjustments

Periodic Maintenance

Periodically inspect and clean the thermal well. In services where the temperature bulb or thermal well is in contact with semisolids, sludge build up can appreciably affect the heat conductivity of the sensing element. Inspect and clean the temperature bulb or well in the following manner:

1. Carefully remove the temperature bulb from the thermal well by loosening the packing nut and slipping it back on the bulb extension. Loosen the jam nut and remove the temperature bulb.
2. Remove the thermal well from the socket.
3. With a fine-grade steel wool, remove excess residue from the temperature bulb and thermal well.
4. Examine the capillary tubing for damage or kinking.

Temperature Pen Calibration

IMPORTANT: Verify that all linkage is free. Adjust the range arm and the drive arm so that they are parallel in the same plane (at the same distance from back of the case). Adjust the lever arm and pen zero adjust screws to their midpoints, and make sure that all midscale linkage angles are 90°.

Calibrate the temperature pen after replacing the thermal element. The complete calibration procedure is as follows:

1. Apply a temperature equal to 50% of the total temperature range.
2. Adjust the drive arm and the driven arm until they form an approximate 90° angle with the intermediate arm.
3. Reduce the temperature to zero or the starting point of the temperature range. Fine-tune the zero adjustment with the zero adjusting screw.
4. Apply 100% temperature and set the pen to full scale by turning the adjusting screw.
5. Reduce the temperature to zero or the starting point of the temperature range and check the zero reading. If the reading is correct, proceed to step 7.
6. If zero adjustment is required, repeat steps 3 through 5 until desired accuracy is achieved.
7. Apply 50% temperature and observe the pen indication.
 - a. If the pen indicates high or low, adjust the drive link to make a correction approximately 40 times the error — in the direction of the error.
 - b. Reset the pen to the 50% line by slipping the pen at the range arm pivot point.
8. Reduce the temperature to zero or the starting point of the temperature range and reset the zero point.
 - a. If the zero offset is minor, reset the zero point with zero adjust screw.
 - b. If the zero offset is major, reset the zero point by loosening the bourdon mounting screws and rotating the connecting linkage to approximately zero. Fine-tune the zero adjustment with the zero adjust screw.
9. Repeat steps 3 through 8 until desired accuracy is maintained.

Static Pressure Pen Calibration

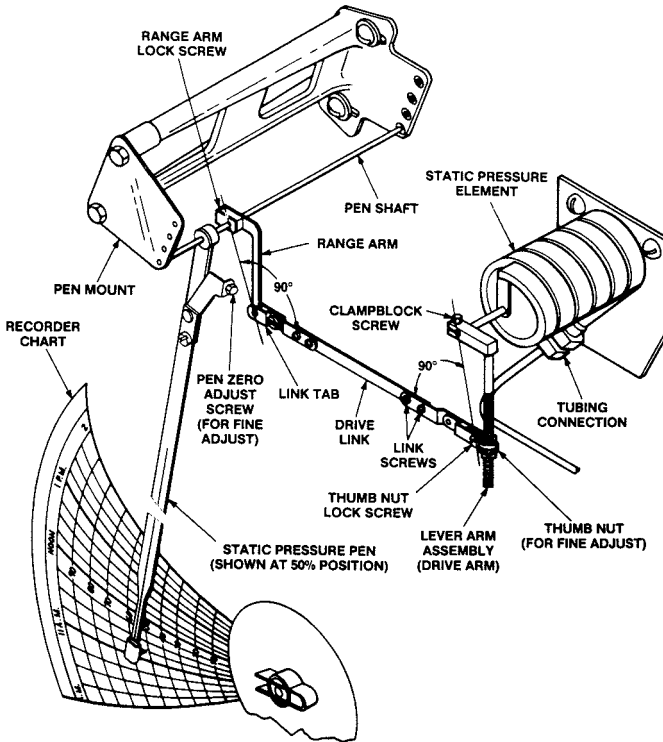


Figure 4.1—Static pressure pen calibration

To calibrate the static pressure pen and associated linkage, proceed as follows:

1. Adjust the static range arm and drive arm at precisely the same distance from the back of the case.
2. Place the static drive link in the fourth hole from the pen shaft of the range arm.
3. Adjust the static pressure linkage to form 90° angles between the drive link (see above illustration) and the pivot points of the associated linkage, as follows:
 - a. Apply 50% static pressure, center the thumb nut on the drive arm, and arrange the static linkage as illustrated in Figure 4.1.
 - b. Set a 90° angle between the drive arm and the link. Tighten the clamp block screw.
 - c. Vary the length of the link to get a 90° angle between the range arm and the link.
 - d. Slip the range arm on the pen shaft to 50% on the chart.

4. Release the pressure and reset the pen to zero indication, using the pen zero adjust screw for fine adjustment (10% or less). For major adjustments (more than 10%), loosen the range arm lock screw, slip the pen to zero on the chart, and retighten the lock screw.

IMPORTANT: It may be necessary to raise or lower the pivot point of the drive link on the range arm, as in step 3. If counterclockwise movement of the thumb nut (step 5) does not increase the span sufficiently, move the pivot pin up to the next pivot hole; if clockwise movement of the thumb nut does not decrease the span sufficiently, move the pivot pin down to the next pivot hole.

5. Apply 100% pressure and observe the pen. If the pen is slightly under-ranged, turn the drive arm thumb nut counterclockwise; if the pen is slightly over-ranged, turn the drive arm thumb nut clockwise.
6. Repeat zero and 100% adjustment until calibration at these two points is achieved.
7. Apply 50% pressure and observe the pen indication.
 - a. If the pen indicates high or low, adjust the drive link to make a correction approximately 40 times the error — in the direction of the error.
 - b. Reset the pen to the 50% line by slipping the pen shaft at the range arm pivot point.
 - c. Reapply 50% pressure and observe the pen indication.
 - d. Repeat this step (7), as necessary.
8. Release pressure and reset the pen to zero indication, using pen zero adjust screw for precise adjustment.
9. Repeat steps 4 through 8 until calibration of zero, linearity, and span (0%, 50%, and 100% indication) is achieved.
10. Assure that range arm lock screws, thumb nut lock screw, and link screws are tight.
11. Unlock the recorder hub clip and remove the temporary calibration chart.
12. Replace the chart plate by sliding it into the chart plate retainer brackets and engaging each side into the chart plate latches.

Static Pressure Element Replacement

If the static pressure element requires replacement, proceed as follows:

1. Close all valves and turn off the power switch to the recorder.
2. Separate the drive link arm by opening the link table and disengaging the pivot pin from the clamp.
3. Loosen the clamp block screw on the lever arm assembly and separate the drive arm from the static pressure element shaft.
4. Disconnect the tubing from the static pressure element at the tubing connection (refer to [Figure 4.1—Static pressure pen calibration on page 15](#)).

5. Remove the mounting screws from the static pressure element and discard the damaged element.
6. Install the new element, using the old mounting screws.
7. Connect the tubing to the element at the tubing connection.
8. Assemble the lever arm assembly onto the static pressure element shaft; do not tighten the clamp block screw.
9. Connect the drive link to the drive arm by engaging the pivot pin and locking the link tab into place.
10. Align the static pressure linkage (range arm, drive link, and drive arm) so that it lies in the same plane without binding or bending.
11. Tighten the clamp block screw.
12. Calibrate the static pressure pen in accordance with the procedure outlined in [Static Pressure Pen Calibration on page 15](#).

Temperature System Replacement

To replace the temperature system, proceed as follows:

1. Loosen the packing and gland nuts. Remove the temperature bulb from the thermal well.
2. Loosen the capillary retaining nut and slip it back on the tubing.
3. Remove the four temperature element connection screws located on the back side of the recorder case where the capillary tubing enters the case.
4. Remove the union bracket by slipping the bracket onto the capillary connecting tubing. Slip the bracket through the slit provided.
5. Remove the intermediate drive arm from the bourdon drive extension.
6. Remove the bourdon mounting screws and remove the complete temperature unit by feeding the capillary through the entry hole provided.
7. Install a new element by reversing steps 1 through 6.
8. Calibrate the temperature pen in accordance with the procedure outlined in [Temperature Pen Calibration on page 13](#).

Chart Drive Replacement

To replace the chart drive, proceed as follows:

1. Release the pressure to the recorder.
2. Turn off the chart drive.
3. Raise the pen lifter and remove the chart and chart plate.
4. Remove the chart drive mounting screws and remove the chart drive from the recorder case.
5. Position the new chart drive at the back of the recorder case and attach with mounting screws.
6. Replace the chart plate and the chart. Lower the pen to the recording position.

7. Disconnect the linkage for the second pen arm from the chart so that the arm moves freely. Make sure the pen follows the timeline on the chart.
8. Reattach the linkage and make sure that the second pen arm is on the zero line of the chart.
9. Verify calibration.

Linkage Adjustments

Finger-tightening the range arm and drive arm lock screws can leave the screws too loose; tightening them more than a full turn can break them.

To correctly tighten linkage screws, perform the following steps. Refer to [Figure 4.2 - Linkage adjustments on page 18](#) as needed.

1. Tighten the lock screw until snug.
2. Hold the drive arm at the clamp block by hand or with a 1/4-inch open-end wrench. If a wrench is used, place it between the torque tube shaft or bearing. (In the case of the range arm lock screw, place the wrench between the pen shaft and lock screw.)
3. Tighten the lock screw 1/3 of a turn to 1/2 of a turn beyond snug.
4. Test for tightness by moving the free end of drive arm approximately 1/2 inch in either direction. The drive arm should spring back with no yielding.

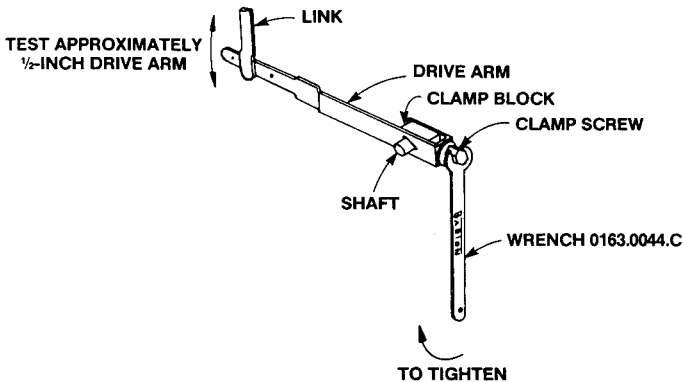


Figure 4.2 - Linkage adjustments

Section 5—Troubleshooting

Table 5.1 provides a description of problems, common causes, and recommended corrections. For further assistance, contact your local Cameron field representative.

Table 5.1—Troubleshooting Guide

Problem	Source	Probable Cause	Corrective Action
Low or No Indication	Excessive residue formation on temperature bulb	Heating conductivity of temperature bulb is impaired	Remove from service and clean element
	Mechanism	Loose links or movements	Tighten or replace
		Out of calibration	Recalibrate
		Corrosion or dirt in mechanism	Clean or replace
		Pen arm loose	Tighten
	Loss of fill	Capillary cracked, kinked, or broken	Replace temperature bulb
	Element	Defective element	Replace element
	Tubing	Loose connection	Tighten connections
		Tubing plugged	Clear tubing
Pen arm	Pen arm bent	Straighten or replace pen arm	
High Indication	Mechanism	Loose links or movements	Tighten or replace
		Out of calibration	Recalibrate
Erratic Indication	Mounting	Excessive vibration	Secure the means of mounting
	Mechanism	Linkage dragging or dirty	Adjust or clean
		Excessive pen pressure on chart	Adjust
No Chart Rotation	Fuse	Fuse Blown	Check and replace fuse
	Chart Drive	Electric drive not turned on	Turn on chart drive
		Clock motor not wound	Wind chart drive
		Defective drive	Replace drive
Wrong Chart Speed	Chart Hub Lock	Lock not latched	Latch hub lock
	Chart Drive	Wrong chart drive	Replace with proper chart drive

Section 6—Installation/Dimensional Drawings

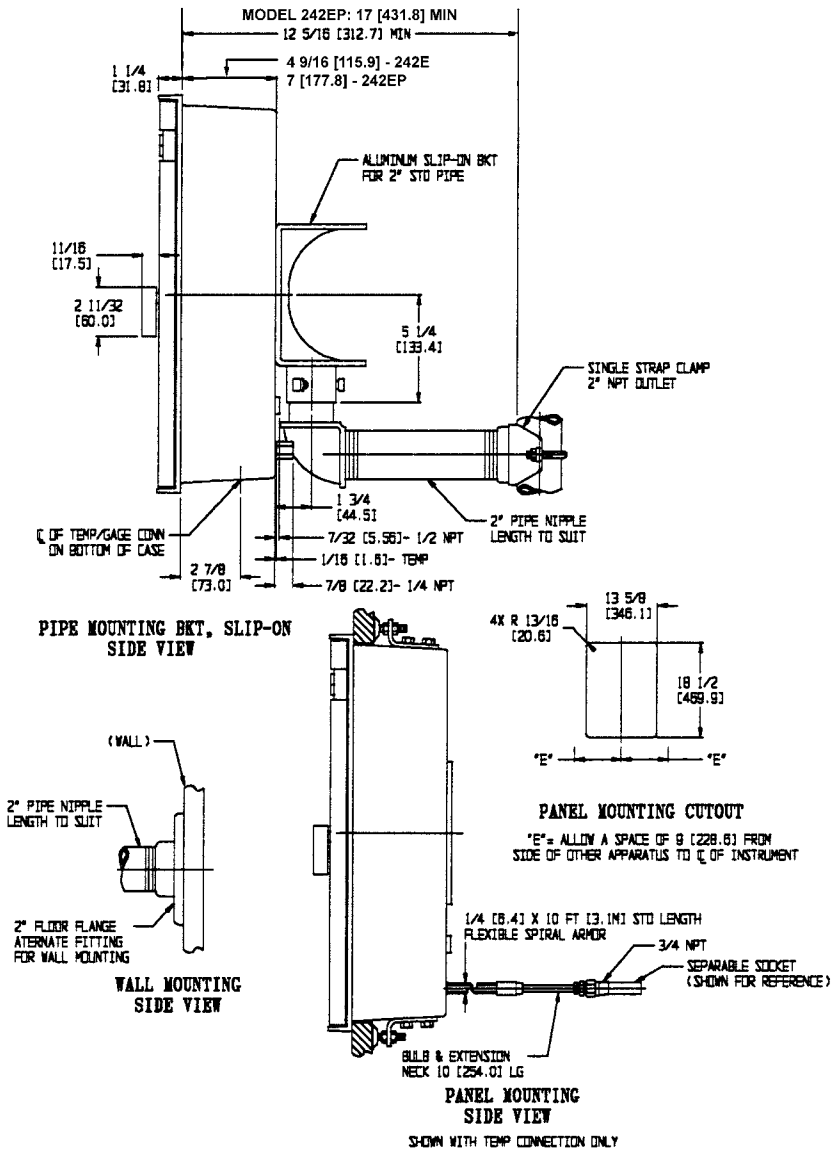


Figure 6.1—242E mounting options

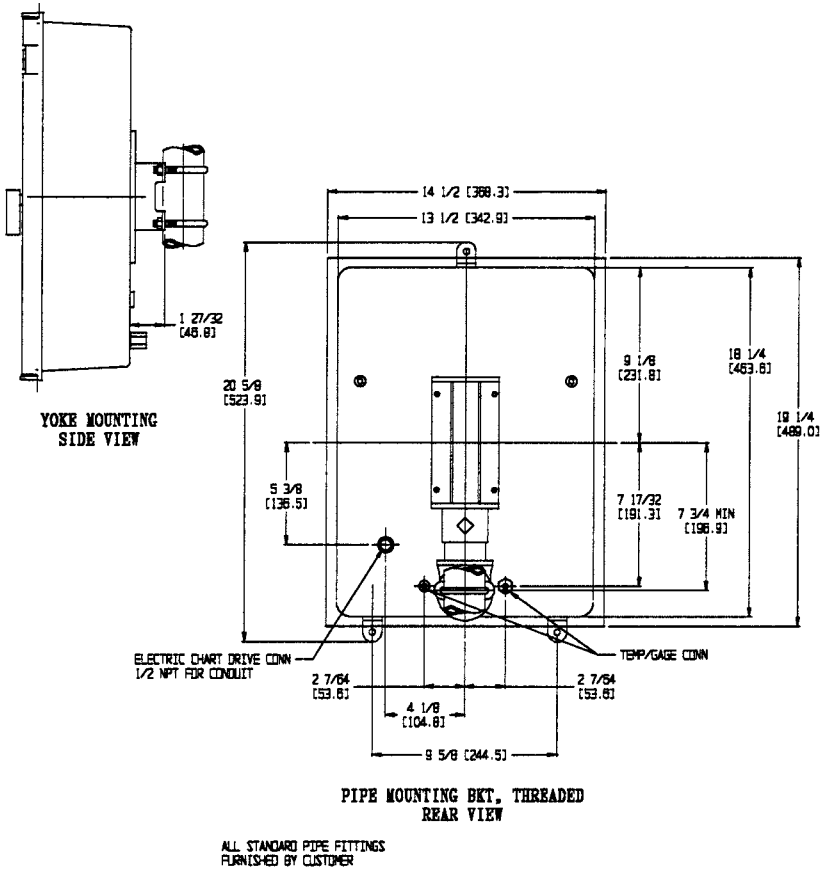


Figure 6.2—242E mounting options (cont'd)

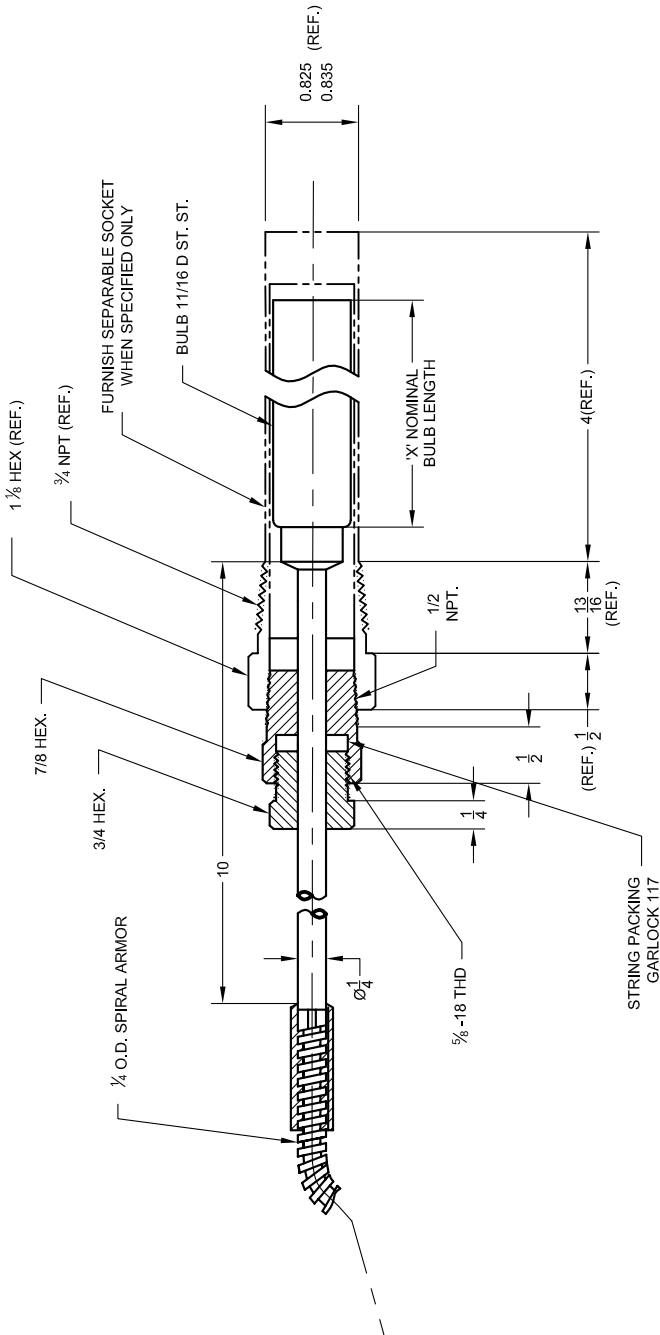


Figure 6.3—Typical thermal well installation

Section 7—Assembly Drawings and Parts Lists

242E Assembly

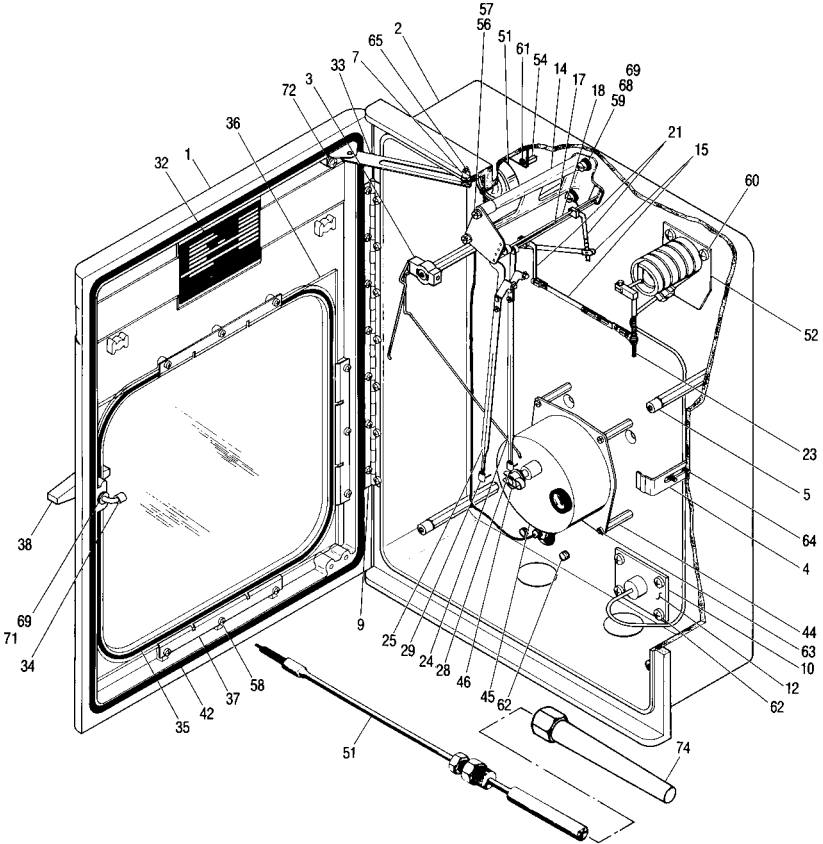


Table 7.1—242E Parts List

Item	Description	Part No.	Per Unit
1	Door Assembly, Recorder**	9A-0238-1023B	1
2	Case, Recorder	9A-0238-1022C (242E)	1
3	Pen Lifter Assembly	9A-0238-1159B	1
4	Latch, Door**	9A-0238-0071C	2
5	Riser, Chart Plate	9A-0238-1210C	4
6	Screw, FIL. HD., 8-32x3/8 (Not Shown) (Use w/Riser)	9A-0114-1036J	4
7	Bushing, Door Stop**	9A-0238-1018C	1

Table 7.1—242E Parts List

Item	Description	Part No.	Per Unit
8	Screw, CAP 1/4-20x5/8 (Not Shown) (Used w/Riser)	9A-S797-0048Z	4
9	Hinge, Door**	9A-0238-1034C	1
10*	Gasket, Connection Static Pressure	9A-0238-0019C	1***
11*	Gasket, Connection Temperature (Not Shown)	9A-0265-0006C	1***
12	Connection, Static Pressure	9A-0238-0046B	1***
13	Connection, Temperature (Not Shown)	9A-0265-0003C	1***
14	Pen Mount Assembly		1
	Dual	9A-0242-1002B	
	1 Pen (Not Shown)	9A-0242-1001B	
	3 Pen (Pressure)(Not Shown)	9A-0242-1003B	
	3 Pen (Temperature)(Not Shown)	9A-0265-1001B	
	4 Pen (Not Shown)	9A-0242-1004B	
15*	Link Assembly (First or Second Pen)	9A-0238-0015B	1***
16*	Link Assembly (Third or Fourth Pen; Not Shown)	9A-0262-0004B	1***
17	Shaft Assembly, Pen Arm (First from Chart)	9A-0238-0006B	1
18	Shaft Assembly, Pen Arm (Second from Chart)	9A-0238-0007B	1
19	Shaft Assembly, Pen Arm (Third from Chart; Not Shown)	9A-0238-0008B	1
20	Shaft Assembly, Pen Arm (Fourth from Chart; Not Shown)	9A-0238-0009B	1
21	Pen Shaft Arm Assembly (First or Second from Chart)	9A-0202-0034B	1***
22	Pen Shaft Arm Assembly (Third from Chart; Not Shown)	9A-0242-0003B	1***
	Pen Shaft Arm Assembly (Fourth from Chart; Not Shown)	9A-0265-0001B	1***
23*	Lever Arm Assembly	9A-0238-0031B	1***
24*	Pen Arm	9A-BDP-A-2-1	A/R***
25*	Pen Arm	9A-BDP-A-2-1	A/R***
26	Not Used		
27	Not Used		
28*	Disposable Pen, 1st from Chart, 6 per pkg		A/R

Table 7.1—242E Parts List

Item	Description	Part No.	Per Unit
	Blue, Scanner, High Temp.	9A-BDP-S-1-BL-S-6	
	Blue Scanner, Low Temp.	9A-BDP-S-1-BL-L-6	
	Black, Scanner, High Temp.	9A-BDP-S-1-BK-S-6	
	Black Scanner, Low Temp	9A-BDP-S-1-BK-L-6	
	Blue, Integrator, High Temp.	9A-BDP-I-1-BL-S-6	
	Blue Integrator, Low Temp.	9A-BDP-I-1-BL-L-6	
	Black, Integrator, High Temp.	9A-BDP-I-1-BK-S-6	
	Black Integrator, Low Temp.	9A-BDP-I-1-BK-L-6	
	Blue, Universal, High Temp. ****	9A-BDP-U-1-BL-S-6	
	Blue Universal, Low Temp. ****	9A-BDP-U-1-BL-L-6	
	Black, Universal, High Temp. ****	9A-BDP-U-1-BK-S-6	
	Black Universal, Low Temp. ****	9A-BDP-U-1-BK-L-6	
	High Temp = +20° to +120° F (-7° to 48°C); Low Temp = -40° to +90° F (-40° to 32° C)		
29*	Disposable Pen, 2nd from Chart, 6 per pkg		A/R
	Red, Scanner, High Temp.	9A-BDP-S-2-RD-S-6	
	Red Scanner, Low Temp.	9A-BDP-S-2-RD-L-6	
	Red, Integrator, High Temp.	9A-BDP-I-2-RD-S-6	
	Red Integrator, Low Temp	9A-BDP-I-2-RD-L-6	
	Red, Universal, High Temp. ***	9A-BDP-U-2-RD-S-6	
	Red Universal, Low Temp ***	9A-BDP-U-2-RD-L-6	
	High Temp = +20° to +120° F (-7° to 48°C); Low Temp = -40° to +90° F (-40° to +32°C)		
30*	Disposable Pen, 3rd from Chart, 6 per pkg (Not shown)		A/R
	Green, Scanner, High Temp.	9A-BDP-S-3-GN-S-6	
	Green Scanner, Low Temp.	9A-BDP-S-3-GN-L-6	
	Green, Integrator, High Temp.	9A-BDP-I-3-GN-S-6	
	Green Integrator, Low Temp.	9A-BDP-I-3-GN-L-6	
	Green, Universal, High Temp. ****	9A-BDP-U-3-GN-S-6	
	Green Universal, Low Temp ****	9A-BDP-U-3-GN-L-6	
	High Temp = +20° to +120° F (-7° to 48°C); Low Temp = -40° to +90° F (-40° to 32°C)		
31*	Disposable Pen, 3rd from Chart, 6 per pkg (Not shown)		A/R
	Purple, Universal, High Temp. ****	9A-BDP-U-4-PL-S-6	

Table 7.1—242E Parts List

Item	Description	Part No.	Per Unit
	Purple Universal, Low Temp. ****	9A-BDP-U-4-PL-L-6	
	High Temp = +20° to +120° F (-7° to 48°C); Low Temp = -40° to +90° F (-40° to +32°C)		
32	Plate, Data Recorder	9A-0238-1026G	1
33	Door Stop Assembly**	9A-0238-1019B	1
34	Door Latch Assembly Hook**	9A-0238-0029B	1
35*	Gasket, Cover Glass**	9A-0238-0015C	1
36	Cover, Glass**	9A-0238-0016C	1
	Cover, Plastic**	9A-0238-0182C	
37	Clip, Cover Glass**	9A-0238-0017C	4
38	Handle**	9A-0238-1038C	1
39	Bushing, Door Handle (Not Shown)**	9A-0238-0094C	1
40	NOT USED		
41	Pin, Door Handle (Not Shown)**	9A-0003-0022T	1
42*	Gasket, Recorder Door**	9A-0096-1003T	A/R
43	Plate, Chart (Not Shown)	9A-0238-0903C	1
44	Riser, Chart Drive	9A-0238-0007C	3
45*	Drive, Chart	(See Table 7.2)	1
46*	Hub, Chart	9A-0238-0033B	1
47	NOT USED		
48	Conduit Assembly, Electric Chart Drive (Not Shown)	9A-0238-0003B	1
49*	Gasket, Connection, Electric Chart Drive (Not Shown)	9A-0238-0019C	1
50	Not Used		
51	Element, Temperature	(See Tables 7.4, 7.5)	
52	Element, Pressure	(See Table 7.3)	
54	Riser, Element, Temperature	9A-0265-0005C	2
55	Not Used		
56	Screw, Hex. Head, 8-32 x 1/4 (Pen Mount Top Plate)	9A-0116-0014J	2
57	Washer, Lock, No. 8	9A-0003-0036K	2
58	Screw, Round Head, 6-32 x 1/4**	9A-0938-0001J	26
59	Screw, Fil. Head, 10-32 x 1/2	9A-0114-0031J	2
60	Screw, Round Head, 10-32 x 5/16, Element Mounting (Pressure)	9A-0111-0085J	2**

Table 7.1—242E Parts List

Item	Description	Part No.	Per Unit
61	Screw, Round Head, 10-32 x 5/16, Element Mounting (Temperature)	9A-0111-0085J	2***
62	Screw, Self-tapping, 10-24 x 1/4, Temp. & Pressure Connections	9A-0946-0002J	4***
63	Screw, 6-40 x 1/4	9A-0114-0017C	3
64	Screw, Self-tapping, 10-24 x 1/4**	9A-0946-0002J	2
65	Screw, Self-tapping, 10-24 x 5/8**	9A-0918-1009J	1
66	Screw, Round Head, 10-32 x 1/4 (Not Shown)	9A-0111-0086J	1
67	Screw, Round Head, 10-32 x 5/16 (Not Shown)	9A-0111-0085J	6
68	Washer, Flat, No. 10	9A-0003-0047K	2
69	Washer, Shakeproof, No. 10**	9A-0003-0033K	3
70	Set Screw, Handle, 8-32 x 1/4 (Not Shown)**	9A-0320-0010J	1
71	Washer, Flat**	9A-0003-1064K	2
72	Screw, Self-tapping, Door Stop, 10-24 x 1/4**	9A-0946-0002J	2
73	Screw, Self-tapping, 10-24 x 1/4, Conduit Assembly & Plug, Electric Chart Drive (Not Shown)	9A-0946-0002J	6
74	Temperature Well	Consult Factory	A/R
	Screw, Self-tapping, T23, 1/4-20 Hex (Not Shown)	9A-0938-0004J	4
	Wrench, Zero Adj	9A-0163-0044C	1
75	Mounting Bracket Assy., Slip-on (Not Shown)		
	Bracket, Slip-on	9A-0199-1179B	1
	Screw, Flat Head, 1/4-20 x 1/2	9A-0240-0009J	4
76	Mounting Bracket Assy., Threaded (Not Shown)		
	Bracket, Threaded	9A-0199-1190B	1
	Screw, Flat Head, 1/4-20 x 1/2	9A-0240-0009J	4
77	Mounting Bracket Assy., Panel (Not Shown)		
	Plate, Mounting (Black)	9A-0199-1196C	1
	Bracket, Panel Mounting	9A-0238-0068C	3
	Pad, Pressure	9A-0238-0069C	3
	Panel, Mounting Screw, 5/16-18	9A-0238-0070C	3
	Screw, 1/4-20 x 5/8	9A-0911-0004J	6

Table 7.1—242E Parts List

Item	Description	Part No.	Per Unit
	Nut, Hex., 5/16-18	9A-0500-0033J	6
	Screw, Flat Head, 1/4-20 x 1/2	9A-0240-0009J	4
78	Mounting Bracket Assy., Yoke (Not Shown)		
	Bracket, Yoke Mounting	9A-0199-1195B	1
	Screw, Flat Head, 1/4-20 x 1/2	9A-0240-0009J	4
	U-Bolt, 2-inch Pipe, 5/16 x 1-1/4, Kit	9A-0440-0001J	1
	Brace, Mounting Bracket	9A-0224-1049C	1
	Set Screw, SQ Head, 3/8 - 16 x 5/8 ST (Not Shown)	9A-0310-0013J	3

*Recommended Spare Parts

** 242E only

*** Multiply by number of pens used

**** Universal type pens are required for (4) four pen meters

A/R As Required

Table 7.2—Chart Drives

Part No.	Description	Model No.
Mechanical (Spring Wound)		
9A-0042-0015T	24 Hour/9 Day	725R060
9A-0042-0016T	7 Day	725R061
9A-0042-0017T	24 Hour/7 Day	725R084
9A-0042-0030	8 Day	725R067
9A-0042-0031T	24 Hour/8 Day	725R068
9A-0042-1004T	31 Day	725R070
9A-0042-1003T	2 Hour/8 Hour	725R077
9A-0042-0024T	4 Hour	725R081
9A-0042-1007T	1 Hour/15 Minute	725R086
9A-0042-0020T	96 Minute/24 Hour	725R175
9A-0042-1009T	1 Hour/3 Hour	725R138
Battery Driven (1.5 VDC - C Cell Alkaline)		
9A-0043-1002T	11 Selectable Speeds	820R001
9A-0043-1003T	11 Selectable Speeds (Foxboro)	820R007
9A-0043-1004T	11 Selectable Speeds (CSA Approved)	820R011
9A-0043-1005T	12 Selectable Speeds (Including 4 Hour)	820R029
9A-0043-2001T	Fast Slow Speeds	830R001

Table 7.2—Chart Drives

Part No.	Description	Model No.
Chart Drive Accessories		
9A-0238-0033B	One Piece Hub	725G190
	Hub (Used w/ 625G070)	725G198
	Cap & Chain (Used w/ 725G198)	625R070
	Universal Mounting Plate	620G164
	Wind Key	725G364
	Wind Key, Long Shank	725G357
	Push/Pull Hub (Foxboro)	725R004

Table 7.3—Static Pressure Elements

Part No.	Alt. Part No.	Standard Range (psi)^a
Helical Elements (316 SST; 1/8" Union Connection; Ranges in PSIG)		
9A-B17SL-25		0-25
9A-B17SL-35		0-35
9A-B17SL-50	9A0044-0040T	0-50
9A-B17SL-75		0-75
9A-B17SL-100	9A-0044-0035T	0-100
9A-B17SL-150	9A-0044-0099T	0-150
9A-B17SL-200		0-200
9A-B17SL-250	9A-0044-0036T	0-250
9A-B17SL-300	9A-0044-0044T	0-300
9A-B17SL-350		0-350
9A-B17SL-400		0-400
9A-B17SL-500	9A-0044-0041T	0-500
9A-B17SL-600		0-600
9A-B17SL-750	9A-0044-0100T	0-750
9A-B17SL-1000	9A-0044-0042T	0-1000
9A-B17SL-1500	9A-0044-0046T	0-1500
9A-B17SL-2000		0-2000
9A-B17SL-2500	9A-0044-0048T	0-2500
9A-B17SL-3000		0-3000
9A-B17SL-3500	9A-0044-0050T	0-3500
9A-B17SL-4000		0-4000
9A-B17SL-5000	9A-0044-0054T	0-5000

Table 7.3—Static Pressure Elements

Part No.	Alt. Part No.	Standard Range (psi)^a
Helical Elements (316 SST; 1/8" Union Connection; Ranges in PSIG)		
9A-B17SL-6000		0-6000
9A-B17SL-8000		0-8000
9A-B17SL-10MU		0-10,000
Part No.	Standard Range (psi)^a	
High Pressure (9/16-18 Aminco Process Connection)		
9A-B17SL-10M	0-10,000 (W/18" Welded Connection Line) Autoclave Conn.	
9A-B17SL-15M	0-15,000 (W/18" Welded Connection Line) Autoclave Conn.	
9A-B17SL-20M	0-20,000 (W/18" Welded Connection Line) Autoclave Conn.	
9A-B17SL-25M	0-25,000 (W/18" Welded Connection Line) Autoclave Conn.	
9A-B17SL-30M	0-30,000 (W/18" Welded Connection Line) Autoclave Conn.	
9A-SS44M-7-4	¼"HP x ¼" FNPT High Pressure Adaptor	
Monel		
9A-B17MK-XXXX "XXXX" = Range in PSIG	Available in ranges from 0-250 PSIG thru 0-6000 PSIG (W/18" Welded Connection Line) ¼" FNPT Conn.	

^a Unit can be adjusted to include vacuum measurement.

Table 7.4—Case-Compensated Temperature Elements

Class VB, Mercury Filled, 1/8" capillary w/armor, 11/16" diameter sensing bulb			
Temp (°F)	10 ft (3 m)	15 ft (4.57 m)	20 ft (6 m)
0-100	9A-CO-100F10F9A	9A-CO-100F15F9A	9A-CO-100F20F9A
0-150	9A-CO-150F10F9A	9A-CO-150F15F9A	9A-CO-150F20F9A
0-200	9A-CO-200F10F9A	9A-CO-200F15F9A	9A-CO-200F20F9A
0-300	9A-CO-300F10F9A	9A-CO-300F15F9A	9A-CO-300F20F9A
0-500	9A-CO-500F10F9A	9A-CO-500F15F9A	9A-CO-500F20F9A
Class IB, Hydrocarbon Filled, 1/8" capillary w/armor, 3/8" diameter sensing bulb			
Temp (°F)	10 ft (3 m)	15 ft (4.57 m)	20 ft (6 m)
0-100	9A-CO-100F10F7B	9A-CO-100F15F7B	9A-CO-100F20F7B
0-150	9A-CO-150F10F7B	9A-CO-150F15F7B	9A-CO-150F20F7B
0-200	9A-CO-200F10F7B	9A-CO-200F15F7B	9A-CO-200F20F7B
0-300	9A-CO-300F10F7B	9A-CO-300F15F7B	9A-CO-300F20F7B
0-500	9A-CO-500F10F7B	9A-CO-500F15F7B	9A-CO-500F20F7B

Table 7.5—Fully Compensated Temperature Elements

Class VA, Fully Compensated, Mercury Filled, 1/8" capillary w/armor, 11/16" diameter sensing bulb			
Temp (°F)	20 ft (6 m)	25 ft (7.6 m)	30 ft (9.1 m)
0-100	9A-F0-100F20F8A	9A-F0-100F25F8A	9A-F0-100F30F8A
0-150	9A-F0-150F20F8A	9A-F0-150F25F8A	9A-F0-150F30F8A
0-200	9A-F0-200F20F8A	9A-F0-200F25F8A	9A-F0-200F30F8A
0-300	9A-F0-300F20F8A	9A-F0-300F25F8A	9A-F0-300F30F8A
0-500	9A-F0-500F20F8A	9A-F0-500F25F8A	9A-F0-500F30F8A
Class IA, Fully Compensated, Hydrocarbon Filled, 1/8" capillary w/armor, 3/8" diameter sensing bulb			
Temp (°F)	20 ft (6 m)	25 ft (7.6 m)	30 ft (9.1 m)
0-100	9A-F0-100F20F6B	9A-F0-100F25F6B	9A-F0-100F30F6B
0-150	9A-F0-150F20F6B	9A-F0-150F25F6B	9A-F0-150F30F6B
0-200	9A-F0-200F20F6B	9A-F0-200F25F6B	9A-F0-200F30F6B
0-300	9A-F0-300F20F6B	9A-F0-300F25F6B	9A-F0-300F30F6B
0-500	9A-F0-500F20F6B	9A-F0-500F25F6B	9A-F0-500F30F6B

Instrument Specifications

General:

Case (242E)	Die-cast aluminum, black polyurethane electrostatic powder paint, hinged glass-front door, neoprene gasket seal
Chart Drive	Spring-wound or battery-operated
Chart Size	12-inch diameter
Chart Rotation	60 minutes to 31 days
Number of Pens	1 to 4 (one for each element)
Pen Style	Disposable

Element:

Type	Pressure: Helical (bourdon) Temperature: Helical (bourdon), Class V mercury-filled
Number	1 to 4 (any combination)
Range	Helical: (0-30" Hg vacuum to 0-30,000 psi)
Accuracy	Static Pressure: $\pm 1\%$ of full scale Temperature: $\pm 1\%$ of full scale
Material	Helical: Stainless steel and K-Monel

Class V Thermal System (Ambient Temperature Compensated):

Class VA	Fully compensated -40° to 600°F (-40° to 315°C)
Class VB	Case compensated -40° to 600°F (-40° to 315°C)

Class I Thermal System: (Ambient Temperature Compensated):

Class IA	Fully compensated
Class IB	Case compensated
Class I Range Limits:	
Ethyl-Benzene (EB)	-125° to 350°F (-87° to 177°C)
Kerosene (KER)	-20° to 500°F (-29° to 260°C)
Alcohol (ALC)	-200° to 150°F (-129° to 66°C)

Product Warranty

A. Warranty

Cameron International Corporation ("Cameron") warrants that at the time of shipment, the products manufactured by Cameron and sold hereunder will be free from defects in material and workmanship, and will conform to the specifications furnished by or approved by Cameron.

B. Warranty Adjustment

1. If any defect within this warranty appears, Buyer shall notify Cameron immediately
2. Cameron agrees to repair or furnish a replacement for, but not install, any product which within one (1) year from the date of shipment by Cameron shall, upon test and examination by Cameron, prove defective within the above warranty.
3. No product will be accepted for return or replacement without the written authorization of Cameron. Upon such authorization, and in accordance with instructions by Cameron, the product will be returned shipping charges prepaid by Buyer. Replacements made under this warranty will be shipped prepaid.

C. Exclusions from Warranty

1. THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER EXPRESSED OR IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE.
2. Components manufactured by any supplier other than Cameron shall bear only the warranty made by the manufacturer of that product, and Cameron assumes no responsibility for the performance or reliability of the unit as a whole.
3. "In no event shall Cameron be liable for indirect, incidental, or consequential damages nor shall the liability of Cameron arising in connection with any products sold hereunder (whether such liability arises from a claim based on contract, warranty, tort, or otherwise) exceed the actual amount paid by Buyer to Cameron for the products delivered hereunder."
4. The warranty does not extend to any product manufactured by Cameron which has been subjected to misuse, neglect, accident, improper installation or to use in violation of instructions furnished by Cameron.
5. The warranty does not extend to or apply to any unit which has been repaired or altered at any place other than at Cameron's factory or service locations by persons not expressly approved by Cameron.

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HOUSTON
HEAD OFFICE | **281.582.9500**

NORTH
AMERICA | **1.800.654.3760**
ms-us@c-a-m.com

ASIA
PACIFIC | **+603.5569.0501**
ms-kl@c-a-m.com

EUROPE,
MIDDLE EAST
& AFRICA | **+44.1243.826741**
ms-uk@c-a-m.com

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