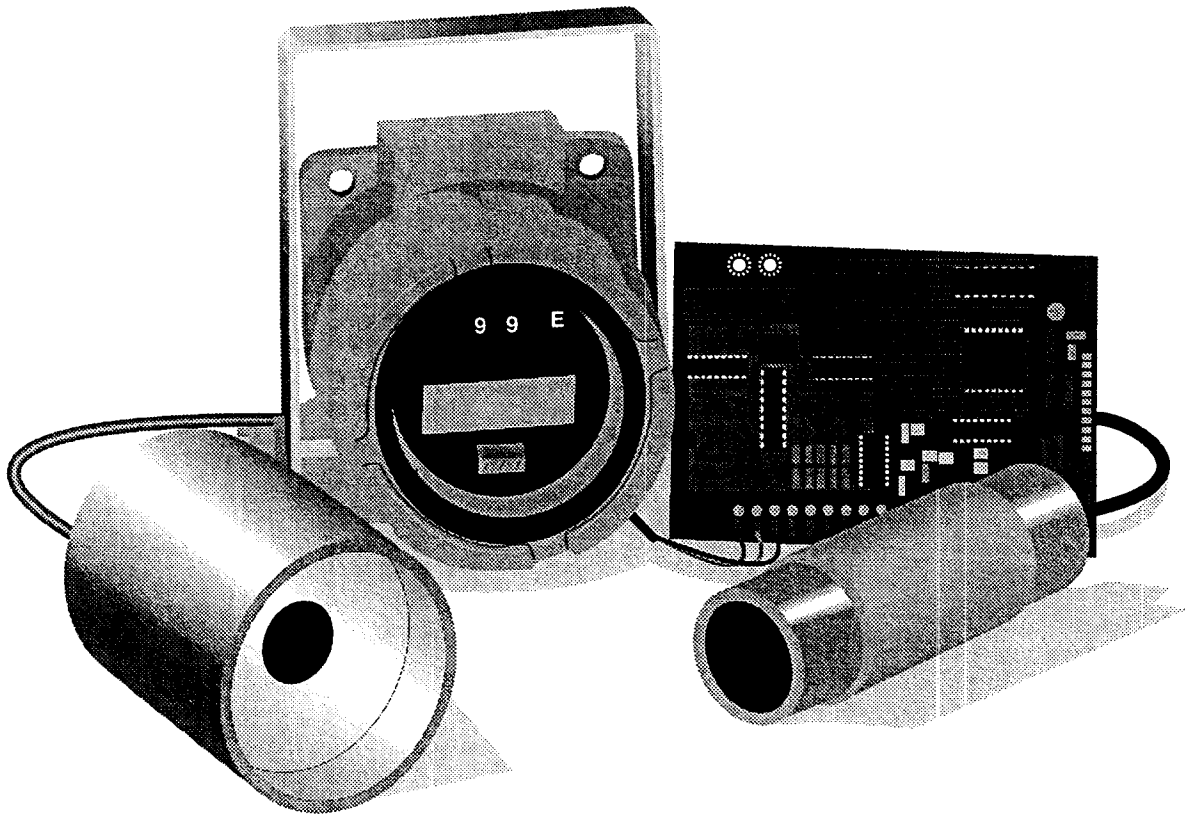
OS1600, OS1700, OS1800 Series

Infrared Temperature Transmitter



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Unpacking Instructions

Remove the Packing List and verify that you have received all equipment, including the following:

OS1600 includes:	OS1700 includes:	OS1800 includes:
Infrared sensor	Infrared sensor	Infrared sensor
10' interconnecting cable	Operator's manual	OS1800-SB swivel bracket
Electronics board		
OS1600-2LN lock nuts		
OS1600-MB mounting base		
Operator's manual		

If you have any questions about the shipment, please call the OMEGA Customer Service Department. When you receive the shipment, inspect the container and equipment for signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor damage claims unless all shipping material is saved for inspection. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

CONTENTS

SECTION 1 - INTRODUCTION

The OS1600, OS1700 and OS1800 series is a complete family of non-contact infrared two-wire transmitters, with temperature ranges from -45 to 2500°C (-50 to 4500°F). This family provides the ultimate in performance and versatility at an economical price, with two-wire simplicity, a choice of six infrared spectral responses, and a broad range of temperature capabilities. The linear 4-20mA output signal allows the sensor to be interfaced with a variety of remote devices: indicators, controllers, recorders, and/or computers, etc.

For fine tuning, the sensors have an adjustable response time of 0.2-5.0 seconds, an emissivity adjustment of 0.1-0.99 and an adjustable peak hold option. Accessories include air purge collar to protect the lens, and a water cooling/air purge unit for high ambient exposure temperatures up to 177°C (350°F).

Completely self-contained in a rugged, compact NEMA-4 enclosure, the OS1800 series sensor offers the additional convenience of a built-in digital display for local on-site readings. The OS1800 series is supplied complete with the OS1800-SB swivel mounting bracket for aligning the sensor (on the back of the unit) to "look" at the surface being measured.

The OS1700 series is completely self-contained in rugged, compact housing. By combining the electronics with the infrared sensor, the OS1700 is ideal for OEM and multi-unit installations.

Mounting accessories for the OS1700 are optional and must be ordered separately, (see accessory ordering matrix on p. 49).

The OS1600 series rugged sensor combines a miniature sensing head with remote electronics for applications with restrictive areas. It is designed for OEM and multi-unit applications where cost and space are limiting factors. The OS1600 series comes complete with infrared sensing head, 10 feet of interconnecting cable, electronics board, OS1600-2LN mounting lock nuts, OS1600-MB mounting base and complete operator's manual.

Power for the transmitter is provided by a 10-40 Vdc power supply which is typically capable of powering up to five transmitters ganged in series. The linear 4-20mA output signal generated by the unit will drive a number of readout devices such as digital panel meters, analog meters, strip chart recorders, and controllers at distances of up to 5000 ft. while providing noise immunity in the current loop.

The OS1600, OS1700, OS1800 Series provides accurate temperature readings even in harsh environments and ambient temperatures from 32° to 140° F (0° to 60° C). With optional water cooling, the instrument will withstand ambient temperatures up to 350° F (177° C). An optional air purge system is also available to keep the lens free of airborne contaminants.

Detailed specifications for the temperature transmitter covered by this manual are listed in Section 2, Paragraph 2.2.

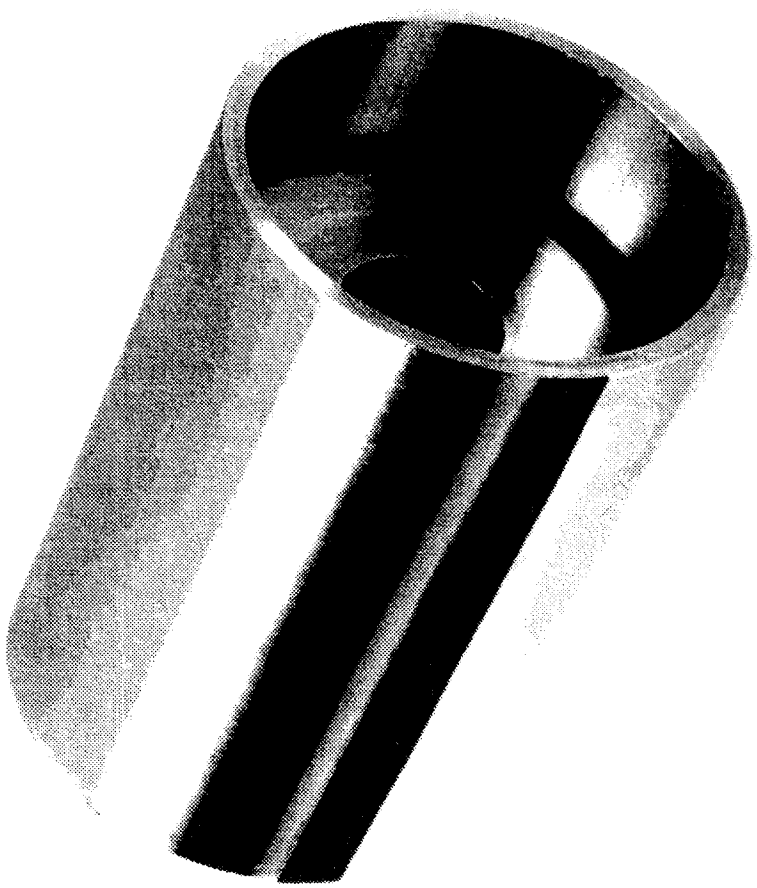


Figure 1-1a OS1700 SERIES

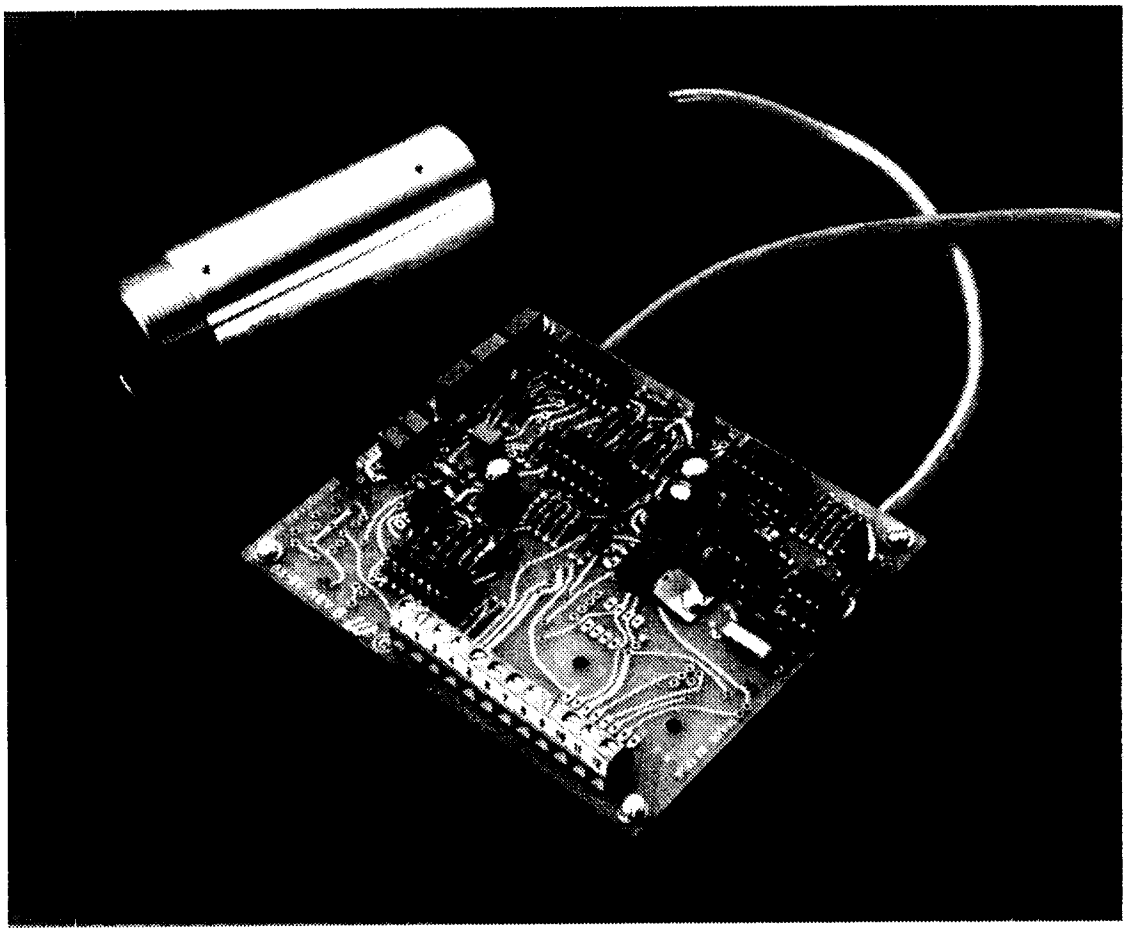


Figure 1-1b OS1600 SERIES

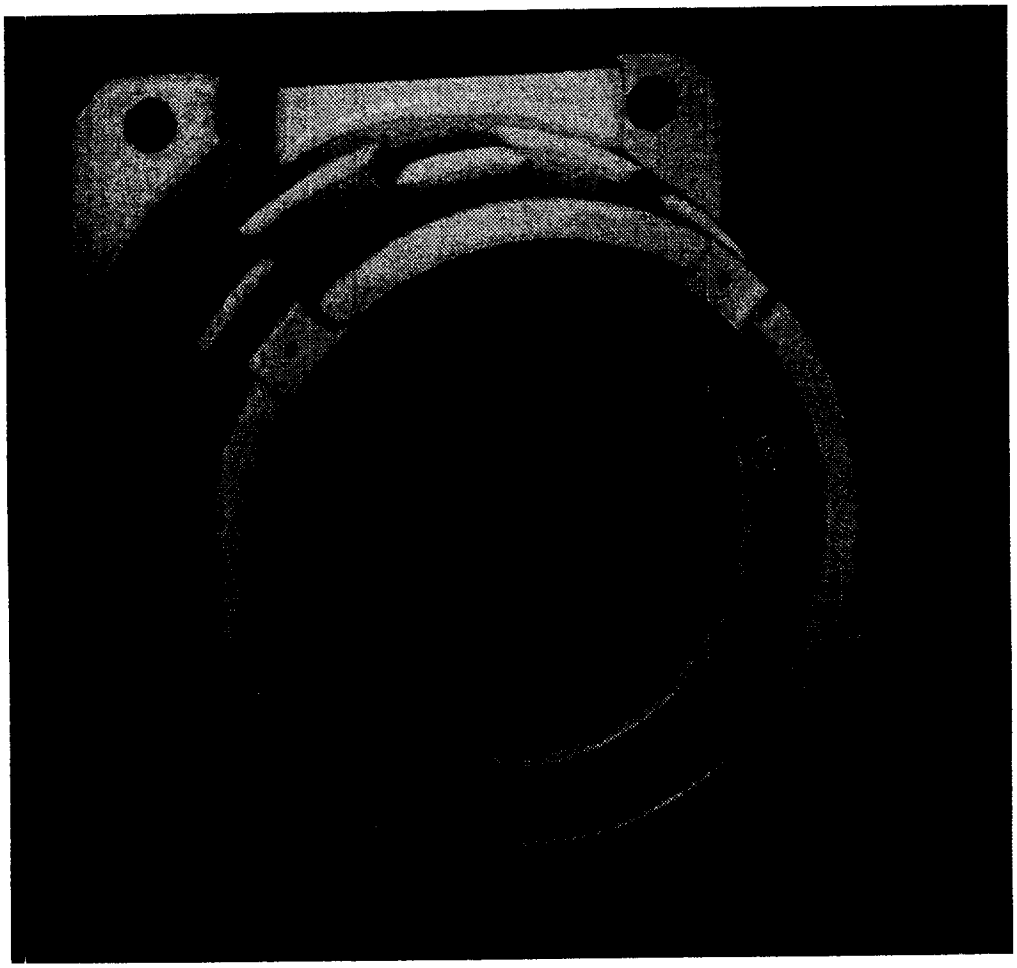


Figure 1-1c OS1800 SERIES

SECTION 2 - SPECIFICATIONS

2.1 GENERAL SPECIFICATIONS, OS1600, OS1700, OS1800

2.1.1 SENSOR

Standard Field of View (FOV)	1 in. at 15 in.
Optional Close Focus Field-of-View (FOV)	1/2 in. at 7 in.
Optional Long-Range (Distant) Field-of-View (FOV)	3 in. at 5 ft.
Working Distance	6in. to infinity
Ambient Operating Temperature	OS1600: 32° - 165°F (0° - 75°C) OS1700, OS1800: 32° - 140°F (0° - 60°C) (32° - 350°F (0° - 177°C) with water cooling)
Accuracy	0.75% of full scale or ±3°F (whichever is greater)
Repeatability	±0.5% of reading
Response time	0.2 - 5.0 sec (adjustable)
Emissivity Range	0.10 - 0.99 (adjustable)
Input	10-40 Vdc; 15-24 Vdc nominal
Output Signal	linear 4-20mA DC, isolated

2.1.2 SPECIFICATIONS FOR OS1600-WCAP, OS1700-WCAP, OS1800-WCAP WATER COOLING/AIR PURGE ACCESSORY

OS1600-WCAP, OS1700-WCAP, OS1800-WCAP Water Cooling/Air purge

Ambient Exposure	32° - 350°F (0° - 177°C)
Water Flow	2-5 gal/hr.
Air Flow	1-3 std. cfm

2.2 DETAILED SPECIFICATIONS

Model No.:_____ Serial No.:_____

Temp. Range:_____ Spectral Response:_____

Field of View: See Figure 2-1

Linear Output vs. Temperature:

See Table [ ]2-1u; [ ]2-2u; [ ]2-4u; [ ]2-5u; [ ]2-8u; [ ]2-9u

Other:_____

_____

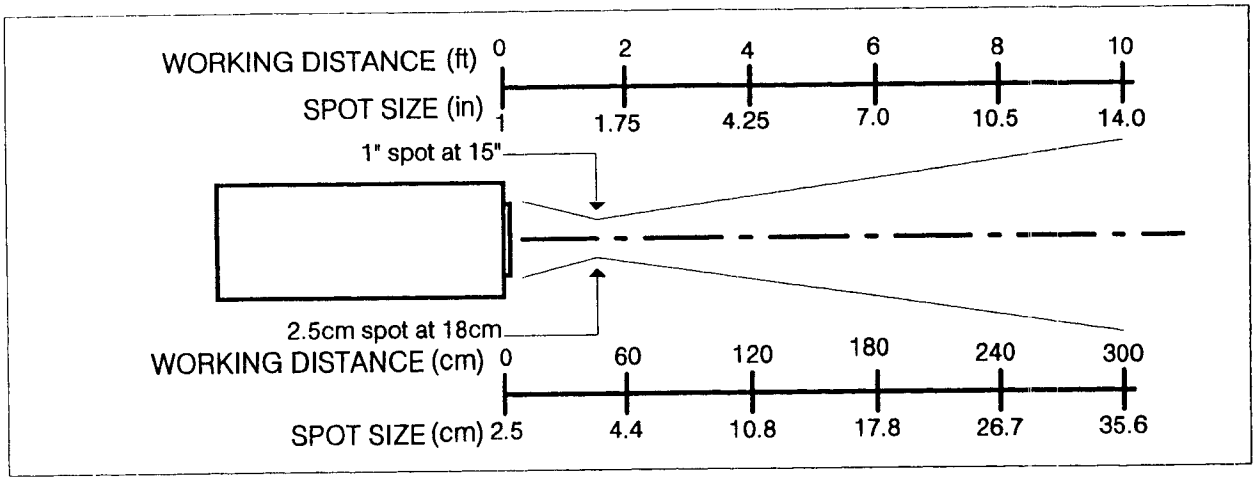
_____

Figure 2-1

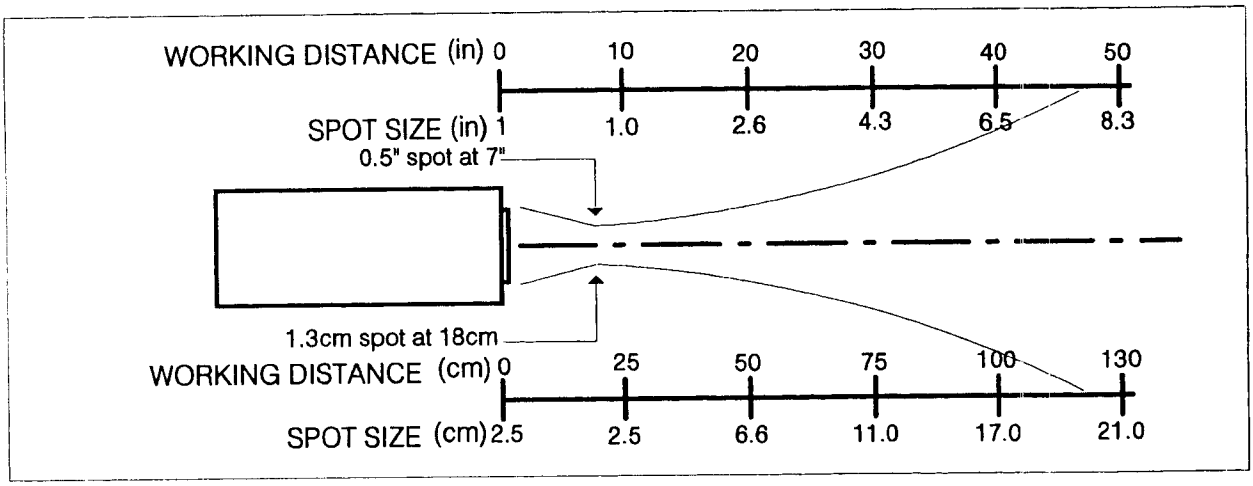
Field of View Data

Focal Options Available for 0S1600, 0S1700 and 0S1800 Series

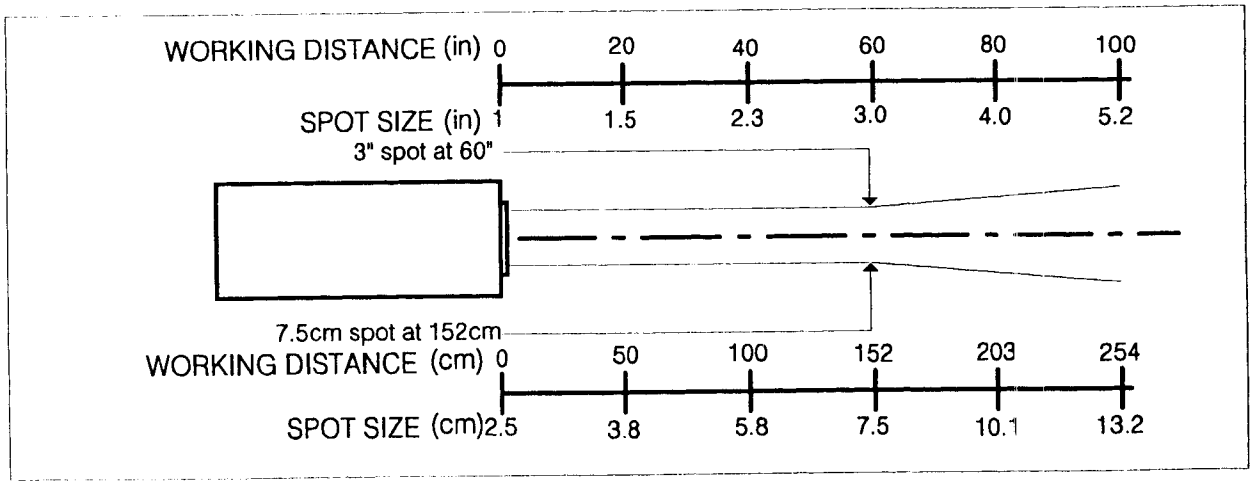
Standard Field of View



Close Field of View



Long Range Field of View



LINEAR OUTPUT TEMPERATURE RELATIONSHIP

TABLE 2-lu ( ) MODELS OS1611, OS1711, OS1811: S/N_____

Temperature ° F

(Range Code)

19 ( )	110 ( )	111 ( )	112 ( )	113 ( )	114 ( )	115 ( )	116 ( )	4-20 dcmA
500	700	900	1200	1500	1800	2000	2500	4.0
540	730	960	1280	1600	1920	2150	2700	5.6
580	770	1020	1360	1700	2040	2300	2900	7.2
620	805	1080	1440	1800	2160	2450	3100	8.8
660	840	1140	1520	1900	2280	2600	3300	10.4
700	875	1200	1600	2000	2400	2750	3500	12.0
740	910	1260	1680	2100	2520	2900	3700	13.6
780	945	1320	1760	2200	2640	3050	3900	15.2
820	980	1380	1840	2300	2760	3200	4100	16.8
860	1015	1440	1920	2400	2880	3350	4300	18.4
900	1050	1500	2000	2500	3000	3500	4500	20.0

LINEAR OUPUT/TEMPERATURE RELATIONSHIP

TABLE 2-lu ( ) MODELS OS1611, OS1711, OS1811 S/N_____

Temperature ° C

(Range Code)

11 ( )	12 ( )	13 ( )	14 ( )	15 ( )	16 ( )	17 ( )	18 ( )	4-20 dcmA
250	375	500	650	800	1000	1100	1400	4.0
275	393	530	695	860	1065	1190	1510	5.6
300	410	560	740	920	1130	1280	1620	7.2
325	428	590	785	980	1195	1370	1730	8.8
350	445	620	830	1040	1260	1460	1840	10.4
375	463	650	875	1100	1325	1550	1950	12.0
400	480	680	920	1160	1390	1640	2060	13.6
425	498	710	965	1220	1455	1730	2170	15.2
450	515	740	1010	1280	1520	1820	2280	16.8
475	533	770	1055	1340	1585	1910	2390	18.4
500	550	800	1100	1400	1650	2000	2500	20.0

LINEAR OUTPUT TEMPERATURE RELATIONSHIP

TABLE 2-2u ( ) MODELS OS1621,OS1721, 0S1821: S/N_____

Temperature ° F (Range Code)				Temperature ° C (Range Code)				
24 ( )	25 ( )	26 ( )		21 ( )	22 ( )	23 ( )		4-20 dcmA
500	700	1000		250	400	500		4.0
560	780	1100		285	440	560		5.6
620	860	1200		320	480	620		7.2
680	940	1300		355	520	680		8.8
740	1020	1400		390	560	740		10.4
800	1100	1500		425	600	800		12.0
860	1180	1600		460	650	860		13.6
920	1260	1700		495	680	920		15.2
980	1340	1800		530	720	980		16.8
1040	1420	1900		565	760	1040		18.4
1100	1500	2000		600	800	1100		20.0

LINEAR OUTPUT TEMPERATURE RELATIONSHIP

TABLE 2-4u ( ) MODELS OS1631, OS1731, OS1831: S/N_____

Temperature ° F (Range Code)					Temperature ° C (Range Code)				
35 ( )	36 ( )	37 ( )	38 ( )		31 ( )	32 ( )	33 ( )	34 ( )	4-20 dcmA
600	800	1200	2000		300	400	700	1100	4.0
720	940	1400	2200		370	480	800	1210	5.6
840	1080	1600	2400		440	560	900	1320	7.2
960	1220	1800	2600		510	640	1000	1430	8.8
1080	1360	2000	2800		580	720	1100	1540	10.4
1200	1500	2200	3000		650	800	1200	1650	12.0
1320	1640	2400	3200		720	880	1300	1760	13.6
1440	1780	2600	3400		790	960	1400	1870	15.2
1560	1920	2800	3600		860	1040	1500	1980	16.8
1680	2060	3000	3800		930	1120	1600	2090	18.4
1800	2200	3200	4000		1000	1200	1700	2200	20.0

LINEAR OUTPUT TEMPERATURE RELATIONSHIP

TABLE 2-5u ( ) MODELS OS1641, OS1741, OS1841 S/N_____

Temperature ° F (Range Code)				Temperature ° C (Range Code)				
44 ( )	45 ( )	46 ( )		41 ( )	42 ( )	43 ( )		4-20 dcmA
200	500	500		100	300	300		4.0
280	600	700		145	350	400		5.6
360	700	900		190	400	500		7.2
440	800	1100		235	450	600		8.8
520	900	1300		280	500	700		10.4
600	1000	1500		325	550	800		12.0
680	1100	1700		370	600	900		13.6
760	1200	1900		415	650	1000		15.2
840	1300	2100		460	700	1100		16.8
920	1400	2300		505	750	1200		18.4
1000	1500	2500		550	800	1300		20.0

LINEAR OUTPUT TEMPERATURE RELATIONSHIP

TABLE 2-8u ( ) MODELS OS1651, OS1751, OS1851 S/N_____

Temperature ° F (Range Code)					Temperature ° C (Range Code)				
55 ( )	56 ( )	57 ( )	58 ( )		51 ( )	52 ( )	53 ( )	54 ( )	4-20 dcmA
100	200	500	500		40	100	300	300	4.0
150	280	600	700		66	150	350	400	5.6
200	360	700	900		92	200	400	500	7.2
250	440	800	1100		118	250	450	600	8.8
300	520	900	1300		144	300	500	700	10.4
350	600	1000	1500		170	350	550	800	12.0
400	680	1100	1700		196	400	600	900	13.6
450	760	1200	1900		222	450	650	1000	15.2
500	840	1300	2100		248	500	700	1100	16.8
550	920	1400	2300		274	550	750	1200	18.4
600	1000	1500	2500		300	600	800	1300	20.0

LINEAR OUTPUT TEMPERATURE RELATIONSHIP

TABLE 2-9u ( ) **MODELS OS1661, OS1761, OS1861** **S/N_____**

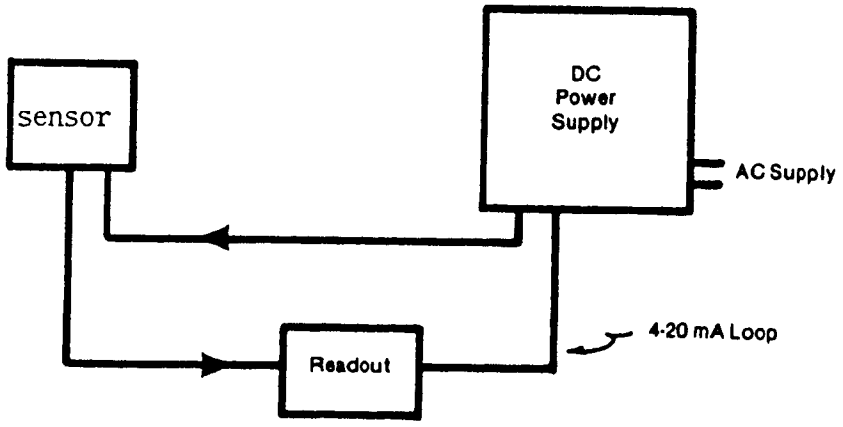
Temperature ° F (Range Code)						Temperature ° C (Range Code)					
66 ( )	67 ( )	68 ( )	69 ( )	610 ( )		61 ( )	62 ( )	63 ( )	64 ( )	65 ( )	4-20 dcmA
-50	0	0	200	100		-45	0	0	100	40	4.0
-25	50	100	280	290		-31	25	55	150	146	5.6
0	100	200	360	480		-16	50	110	200	252	7.2
25	150	300	440	670		-02	75	165	250	358	8.8
50	200	400	520	860		13	100	220	300	464	10.4
75	250	500	600	1050		28	125	275	350	570	12.0
100	300	600	680	1240		42	150	330	400	676	13.6
125	350	700	760	1430		57	175	385	450	782	15.2
150	400	800	840	1620		71	200	440	500	888	16.8
175	450	900	920	1810		86	225	495	550	994	18.4
200	500	1000	1000	2000		100	250	550	600	1100	20.0

SECTION 3

OPERATING PRINCIPLE

The OS1600, OS1700, OS1800 Series temperature transmitter is sensitive to the radiation or infrared energy given off by the target or object to be measured. When the instrument is aimed at the target, the radiation is focused on an infrared detector causing it to generate an electrical signal. This signal is converted by the system electronics into a dc output current which varies with the intensity of the target radiation, i.e., the higher the target temperature, the greater the intensity of the radiation, and the higher the output current. Simply stated, the temperature transmitter produces a linear dc current (4 to 20mA) which is proportional to the infrared energy emitted by the target. Feeding the current through a "loop" containing, for example, a readout device such as a digital meter causes the meter to display the temperature of the target. A typical basic measurement loop is shown in Figure 3-1.

Figure 3-1. Basic Measurement System



SECTION 4 - SYSTEM INSTALLATION

4.1 LOCATING THE TRANSMITTER

OS1700 and OS1800 Series temperature transmitters will provide accurate readings in ambient temperatures from 32° to 140° F (0° to 60° C). OS1600 Series transmitters have an ambient operating temperature range of 32° to 165°F (0° to 75°C). If the instrument will be exposed to temperatures below freezing, consider enclosing it in a temperature-controlled housing or wrapping it with electrical heating tape. If the instrument will be exposed to ambient temperatures exceeding 140° F, it is recommended that it be equipped with water cooling. If the surrounding ambient temperature is within the tolerable limits but the instrument is exposed to high radiant energy, then a heat shield should be used between the transmitter and the target.

The accuracy of the transmitter will also be affected by accumulations of dust, oil films, etc., on the instrument lens. If it is probable that the unit will be exposed to these contaminants, it is recommended that it be equipped with an optional air purge assembly.

For operation in extreme temperatures or dirty environments, consult OMEGA for recommendations.

4.2 MOUNTING AND ALIGNING THE TRANSMITTER

The front surface of the transmitter case is drilled through in two places and drilled and tapped in one place for bolting to the vertical surface of an optional pipe mounting bracket. The unit can also be mounted on an optional L-shaped bracket or post mounting bracket. The transmitter dimensions are shown in Figure 4-1.

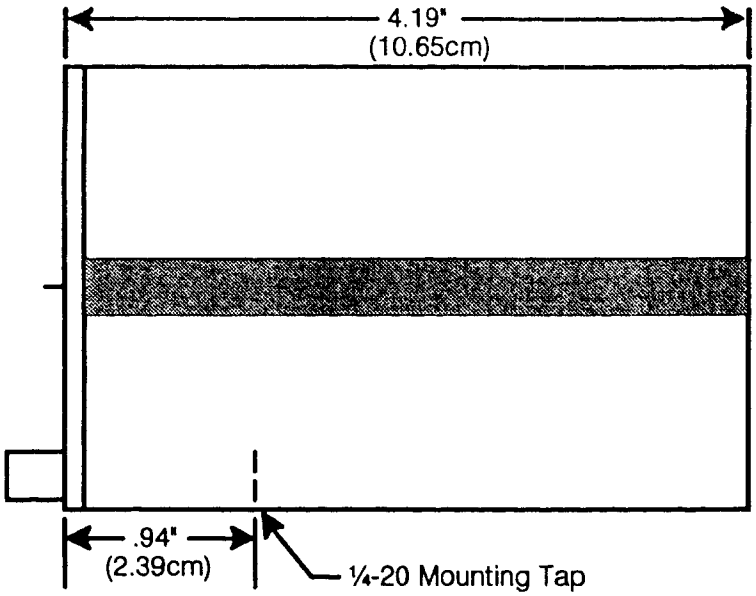
In selecting the mounting location, note that several conditions must be fulfilled in order to measure the temperature accurately:

There must be an unobstructed line of sight between the transmitter and the point at which the temperature is to be measured. Although this line should be as near perpendicular to the surface of the target as possible to reduce the possibility of measurement error from stray reflections, it may be angled up to 60 degrees from the perpendicular if targets with smooth surfaces are to be viewed. Angles greater than 60 degrees could result in stray reflectance and a decrease in target emittance.

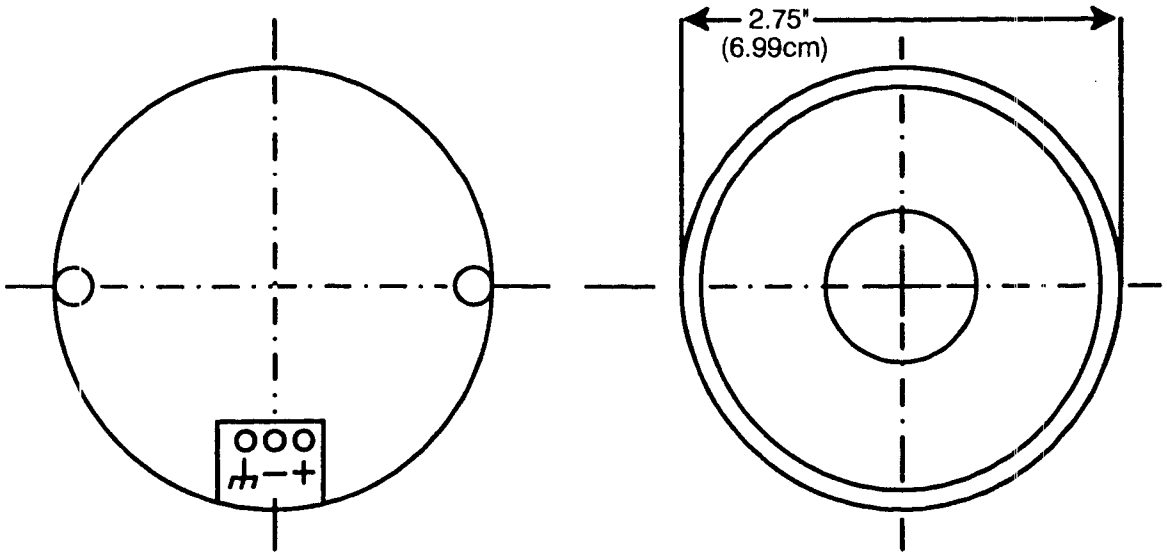
The instrument field of view must be completely filled by the target so that all parts of the detector receive radiation from the target. To ensure this, refer to the Field of View Data, Figure 2-1, for the FOV for this particular instrument, and mount the instrument at the appropriate distance from the target. If, for example, the FOV is 1 inch at 15 inches, it means that for a target diameter of 1 inch the distance between the target and front face of the instrument must be 15 inches. In any case, the target size should always be larger than the field of view.

Figure 4-1a

0S1700 TRANSMITTER MOUNTING DIMENSIONS



Side View



Rear View

Front View

Figure 4-1b

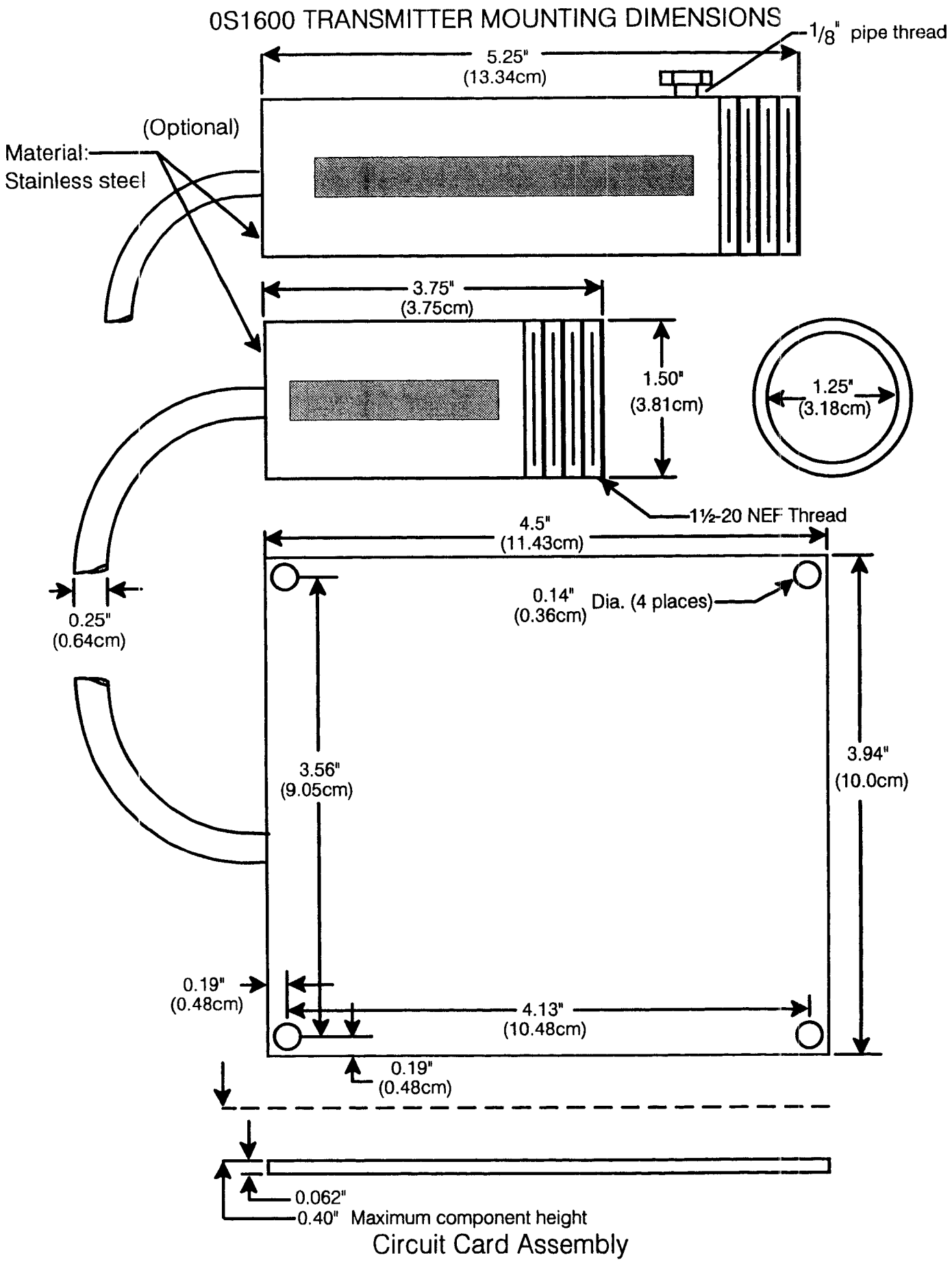
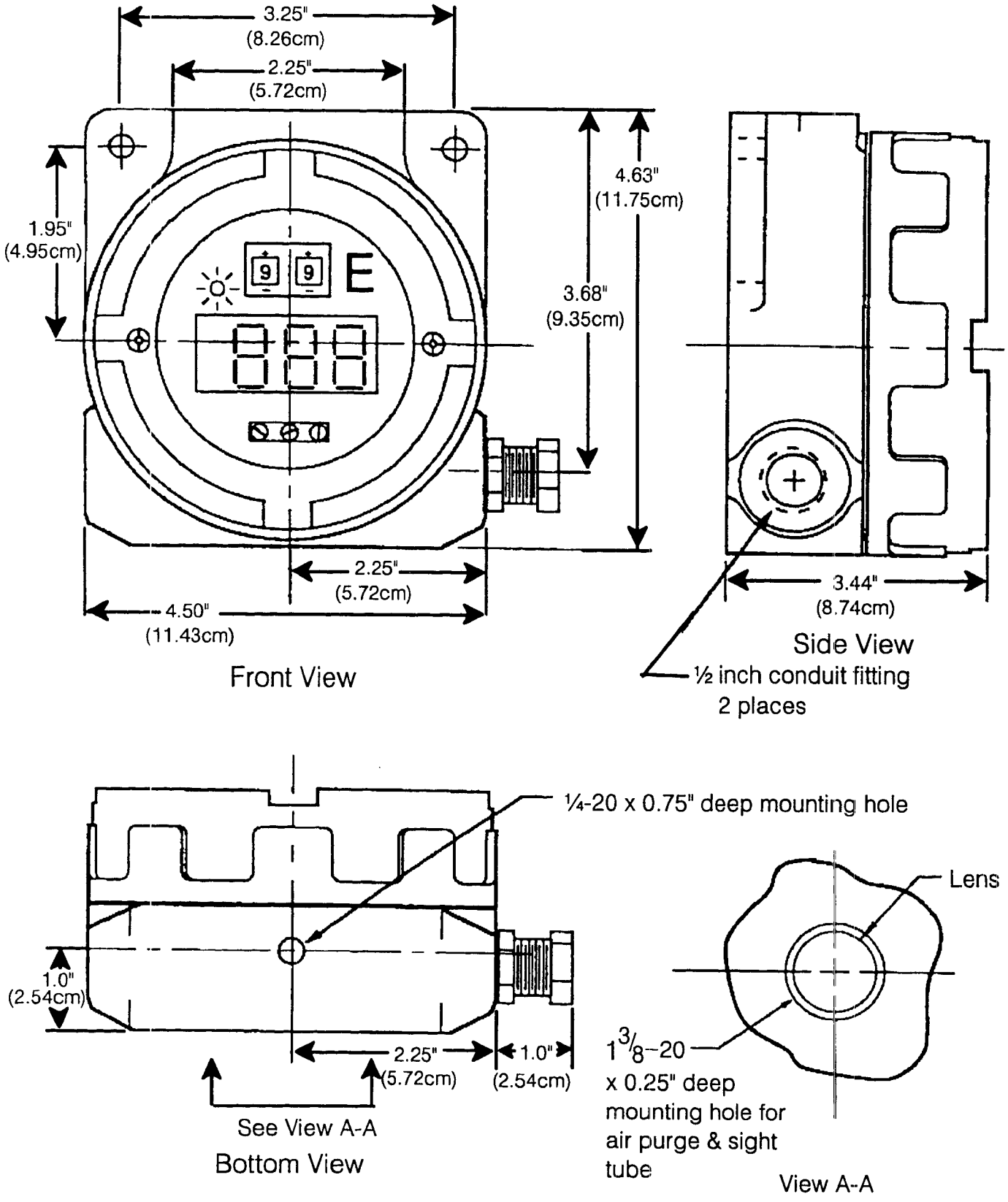

0S1600 TRANSMITTER MOUNTING DIMENSIONS
1/8" pipe thread
5.25"
(13.34cm)
(Optional)
Material:
Stainless steel
3.75"
(3.75cm)
1.50"
(3.81cm)
1.25"
(3.18cm)
1½-20 NEF Thread
4.5"
(11.43cm)
0.14"
(0.36cm)
Dia. (4 places)
0.25"
(0.64cm)
3.56"
(9.05cm)
3.94"
(10.0cm)
0.19"
(0.48cm)
4.13"
(10.48cm)
0.19"
(0.48cm)
0.062"
0.40" Maximum component height
Circuit Card Assembly

Figure 4-1c

0S1800 TRANSMITTER MOUNTING DIMENSIONS



The transmitter housing must be grounded to ensure protection of the electronic circuits. This can be achieved by grounding the surface to which the unit is mounted or, if a grounded conduit is to be used for the cable runs, by connecting the conduit directly to the transmitter housing. Another method is to mount the unit on an ungrounded surface and, using shielded cable, connect the shield lead to the ground terminal in the transmitter housing. Here, the transmitter must be isolated from the mounting surface by means of an insulator and must be secured in place with non-conductive hardware.

4.3 VIEWING THE TARGET THROUGH PORTS OR WINDOWS

If the target is to be viewed through a port, the port must be large enough to permit a full view of the target. If the target is to be viewed through a window, the window must be made from a material which transmits radiation in the wavelength to which the instrument is sensitive. Suitable window materials are listed in Table 4-1 together with their usable wavelength regions and effective transmittance values.

Window Materials

Although a minimum window thickness is recommended, any thickness will introduce radiation losses due to reflection and absorption. However, these can be compensated for as described in Section 5, Paragraph 5.2.

Table 4–1

Window Selection Guide

Approximate Spectral Region	Sensors	Available Windows					
		Pyrex #7740	Water-free Quartz GE# 125	Sapphire	Zinc Selenide, Zinc Sulfide	Calcium Fluoride	Germanium (AR Coated)
0.8	0S1611 0S1711 0S1811	Suitable x=0.92	Suggested x=0.94	Suggested x=0.85	Suitable x=0.70	Suggested x=0.94	No
2.4	0S1621 0S1721 0S1821	No	Suggested x=0.94	Suggested x=0.85	Suitable x=0.70	Suggested x=0.94	No
3.8	0S1631 0S1731 0S1831	No	No	Suggested x=0.88	Suitable x=0.70	Suggested x=0.94	No
5.1	0S1641 0S1741 0S1841	No	No	Suggested x=0.88	Suitable x=0.70	Suggested x=0.94	Suggested x=0.97
8.0	0S1651 0S1751 0S1851	No	No	No	Suitable x=0.70	Suggested x=0.94	Suggested x=0.97
8-14	0S1661 051761 0S1861	No	No	No	Suitable x=0.70	No	Suggested x=0.97
Suggested Cleaning Material		Alcohol, Window cleaner	Alcohol, Window cleaner	Alcohol, Window cleaner	Alcohol	Alcohol	Alcohol

x= Emissivity compensation factor for 0.125" thick optical quality window.

Recommended Window Suppliers:

Adolph Miller Co., P.O. Box 6001, Providence, RI 02940
Janos Optical Corp., Route 35, Townshend, VT 05353
Karl Lambrecht Corp., 4204 Lincoln Ave., Chicago, IL 60618
Bond Research Lab, Lebanon, NY

Again, the instrument must be mounted so that the line of sight is as near perpendicular to the surface of the target as possible to reduce the possibility of measurement error from stray reflections.

4.4 WIRING A SINGLE TRANSMITTER

The wiring of the temperature transmitter is straightforward and involves completing the current loop between the (+) and (-) terminals of the power supply as shown in Figure 4-2. Use a No. 18 (or heavier) twisted-pair cable to connect the transmitter to the power supply and readout device.

If long cable lengths are to be used, avoid routing the cable near heat sources or high-voltage or RF wiring. Also, make sure that the power supply voltage is adequate for both the cable and accessory voltage drop and transmitter operating voltage requirement.

To connect the components: (OS1800 Series)

1. Unscrew the cover from the case for access to the terminal strip.
2. Remove the conduit fitting from the side of the transmitter case, and loosen the cap to permit the cable to be threaded through.
3. Thread the cable through the cap and fitting, and curve the end of the cable slightly to help its passage through the case to the terminal strip.

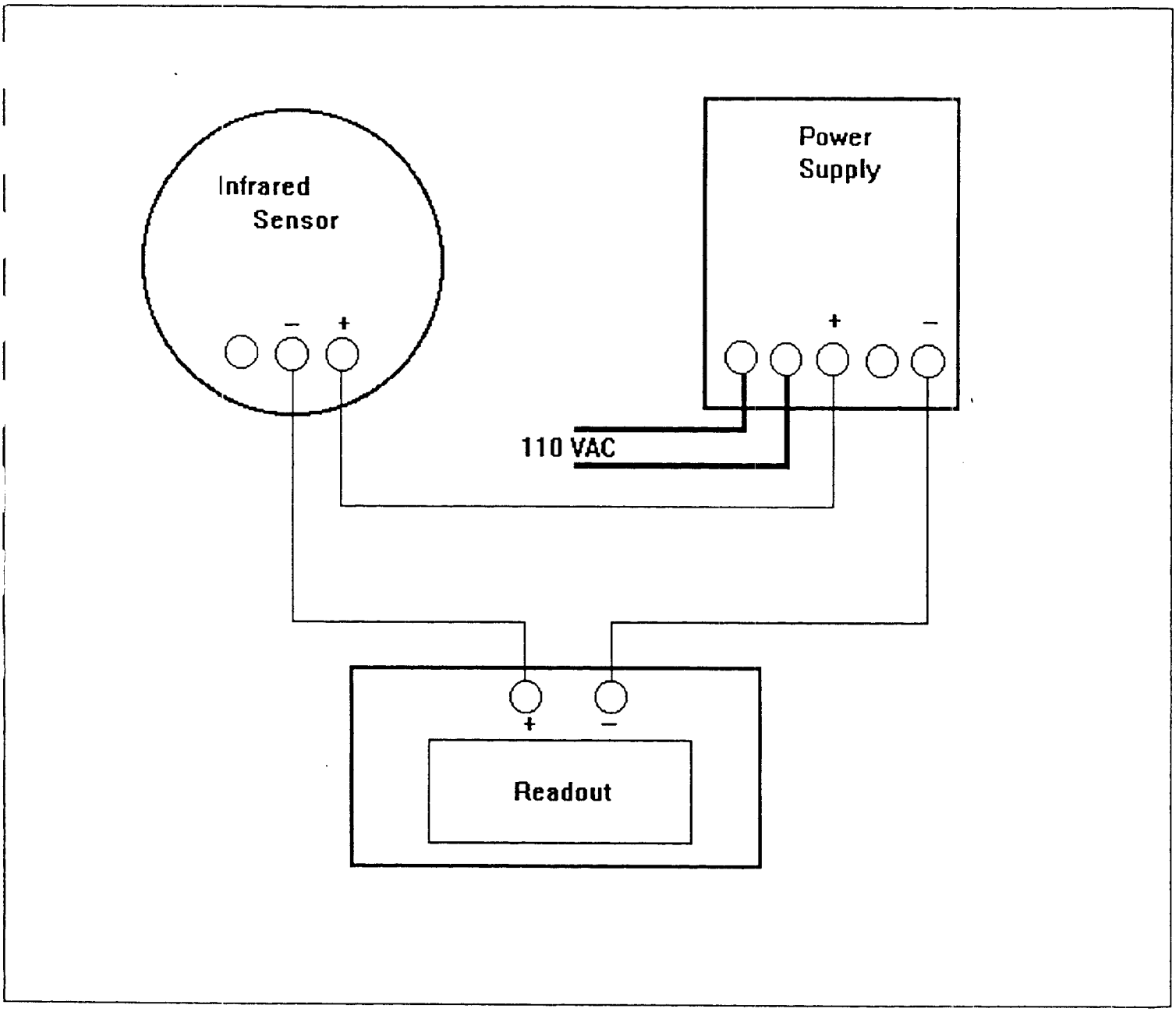


Figure 4-2. Connecting the transmitter, power supply and readout device.

4. Push the cable carefully through the conduit and case until the end appears below the terminal strip.

   Note: If the cable cannot be fed through the case, remove the four screws holding the transmitter assembly to the case, and raise the assembly carefully for access to the cable. Replace the assembly, and tighten the four screws uniformly to ensure a watertight seal on the front gasket.

5. Expose the twisted-pair wire, and strip 1/4 inch of the insulation from the end of each wire.

6. Loosen the screws marked (+) and (-) on the terminal strip (See Figure 4-3a, b or c), attach a wire to each screw, and tighten the screws.

7. If shielded cable is being used and the transmitter is to be grounded via the shield lead, attach the lead to the left-hand position of the terminal strip.

   Note: If the cable conduit is being used to ground the transmitter, do not connect the shield lead to the terminal strip.

8. Use a sealant such as Teflon tape on the threads of the conduit fitting, and install and tighten the fitting. Tighten the compression cap around the cable, and make sure that the plug is secure in the unused conduit.

9. Install and tighten the gasketed cover hand tight.

10. Install the readout device in the loop as shown in Figure 4-2. Note that this device must be loop-powered, i.e., operable on 4-20mA current. Conventional recorders, meters, controllers etc., require a separate source of ac power.

    To connect the components (OS1600 and OS1700 Series): For OS1600 and OS1700

Figure 4-3a

MAKING THE TERMINAL CONNECTIONS

Model OS1700

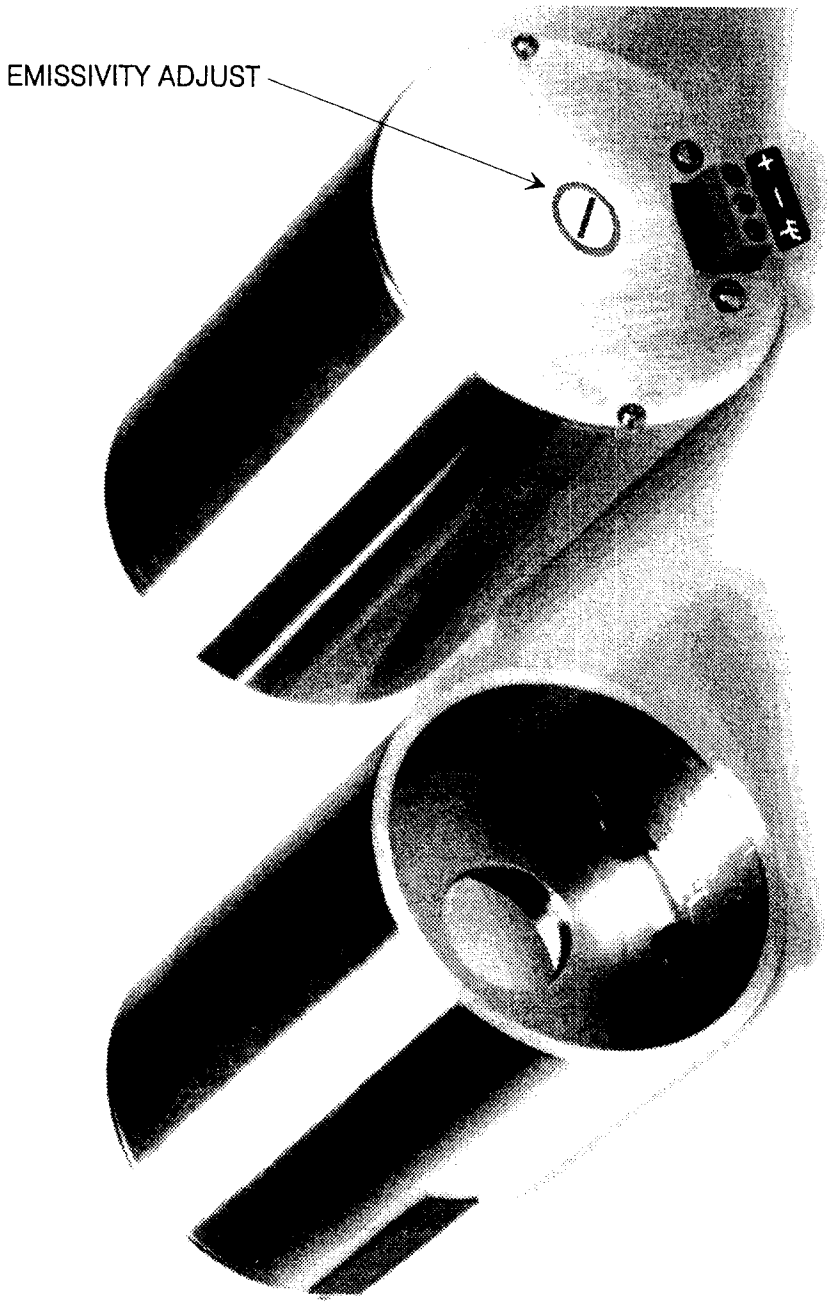


Figure 4-3b

MAKING THE TERMINAL CONNECTIONS

Model OS1600

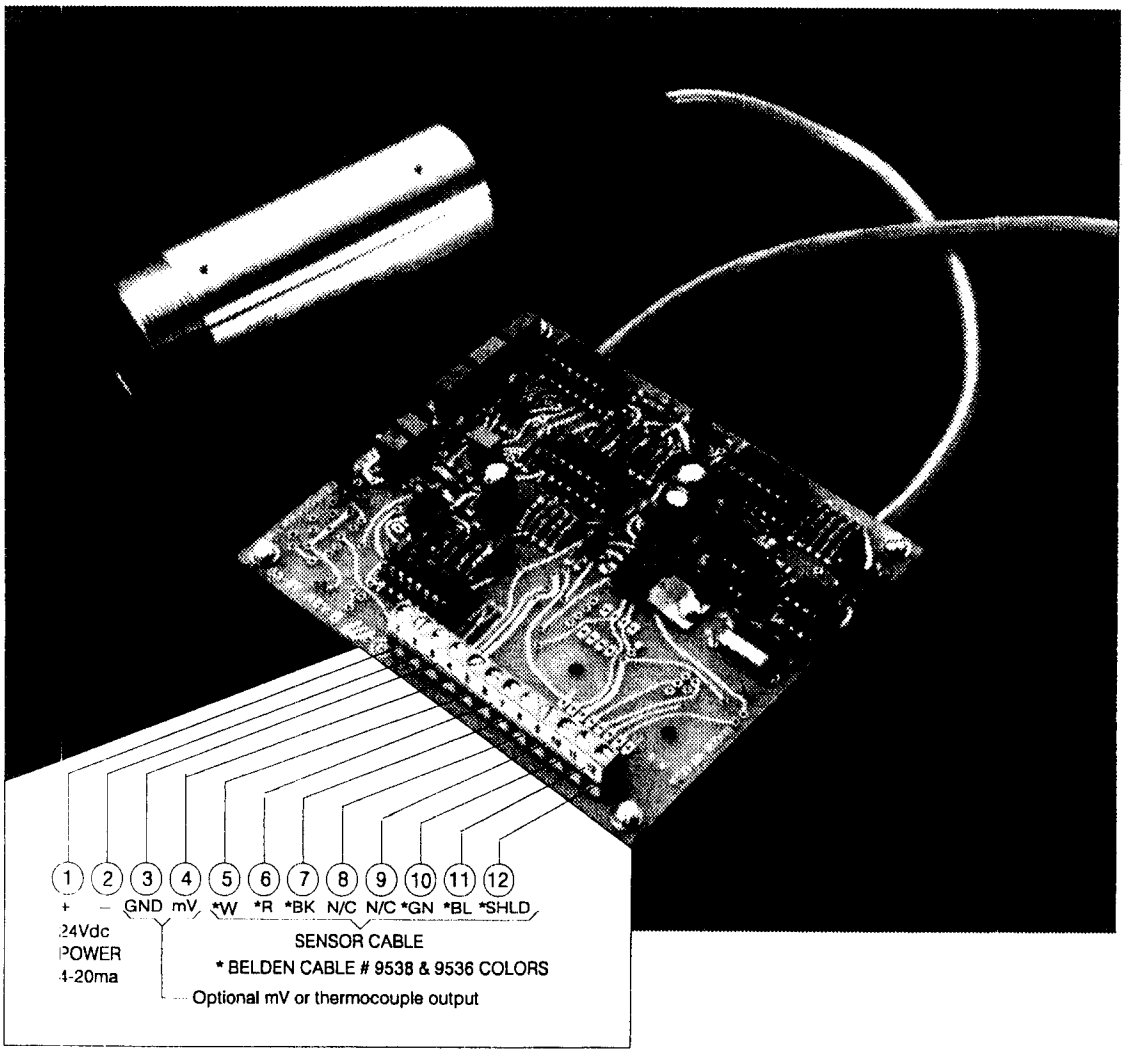
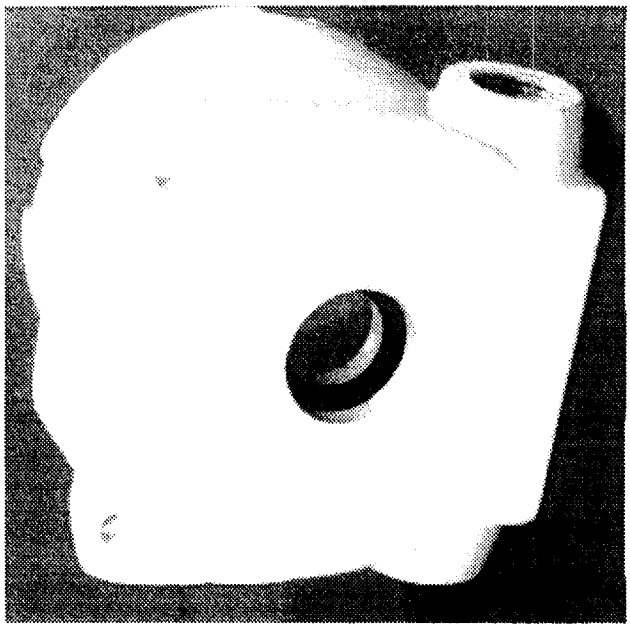
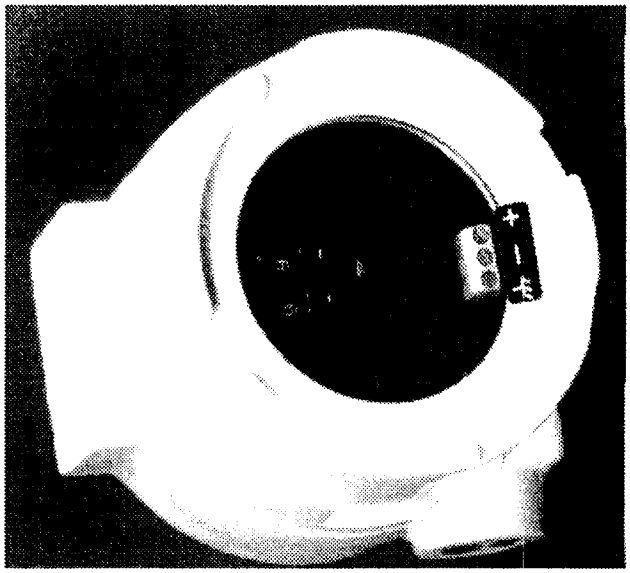


Figure 4-3c

MAKING THE TERMINAL CONNECTIONS

Model OS1800





transmitters, connect the components as shown in Figure 4-2 while making the terminal connections as shown in Figure 4-3.

4.4.1 INSTALLING MULTIPLE READOUT DEVICES

One of the advantages of the two-wire temperature transmitter is that it can be used to drive a number of readout devices connected in series in the same loop. Thus, it permits the user to create a custom multiple-load temperature measurement system to meet the requirements of specific applications. An example of a multiple-load system is shown in Figure 4-4. For such applications, consult OMEGA for power supply voltage requirements.

4.5 WIRING MULTIPLE TRANSMITTERS

For even greater versatility and economy, up to five temperature transmitters can be connected to a single power supply with each providing an output current to its own loop. A typical multiple-loop system is shown in Figure 4-5. Such a configuration permits the transmitters to be used at different locations with an indicator at each location. For such installations, consult OMEGA for power supply current limitations.

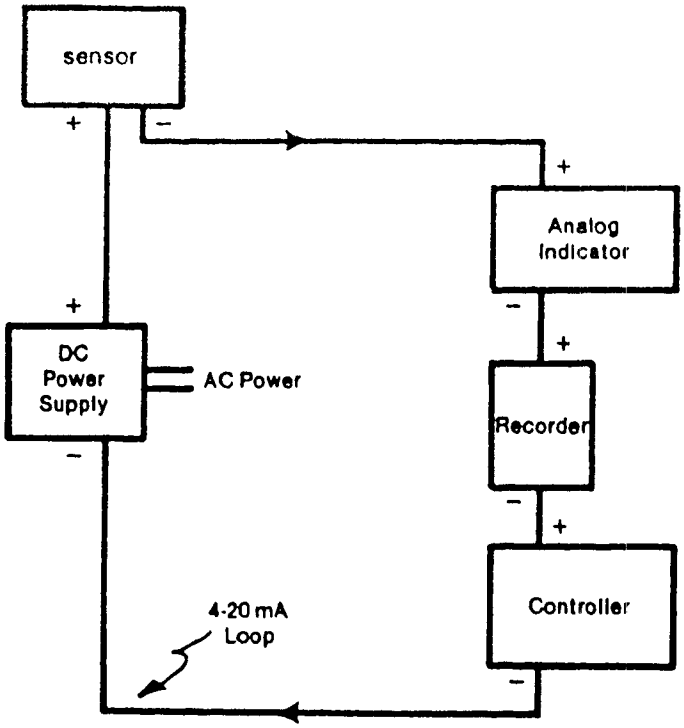


Figure 4-4. A typical multiple-load measurement system

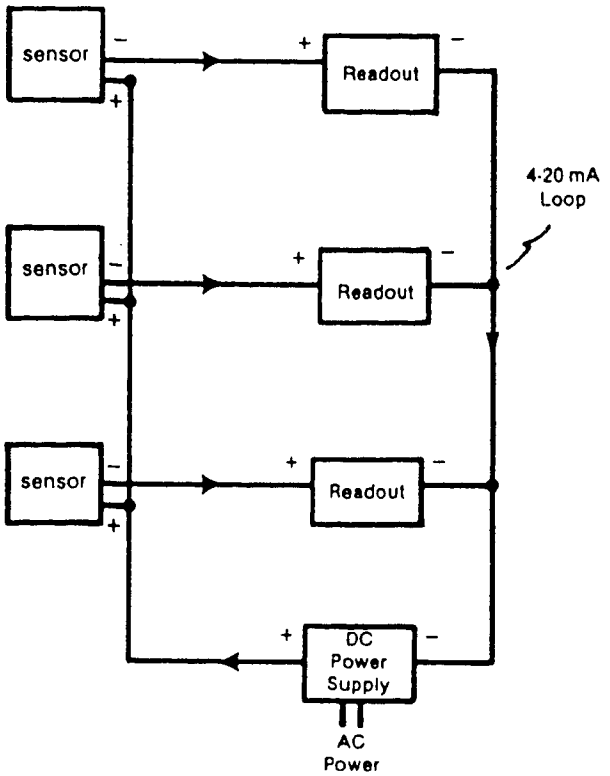


Figure 4-5. A typical multiple-loop measurement system

SECTION 5 - SYSTEM OPERATION

5.1 PRESTART CHECKLIST

Before actually measuring temperatures, make sure that the following conditions have been met:

1. _____ Water cooling and/or air purge (if furnished) are on.
2. _____ All conduit connections are made up with Teflon tape or pipe joint compound to ensure NEMA 4 compliance.
3. _____ Connectors are secured with Teflon tape or pipe joint compound to ensure NEMA 4 compliance.
4. _____ Emissivity control is set at 0.99 for standard applications (refer to Paragraph 5.3).
5. _____ Response time control is set fully counter-clockwise at 0.2 second (refer to Paragraph 5.5).

Aim the instrument at the target as described below. The settings of the response time and emissivity controls may require changing during system operation.

5.2 CHECKING INSTRUMENT ALIGNMENT

If the target to be measured is small, check the alignment of the temperature transmitter with the target as follows:

1. Apply power to the system, and monitor the temperature display meter.
2. Hold a heat source far enough to one side of the target so that it cannot be "seen" by the transmitter, Figure 5-1.

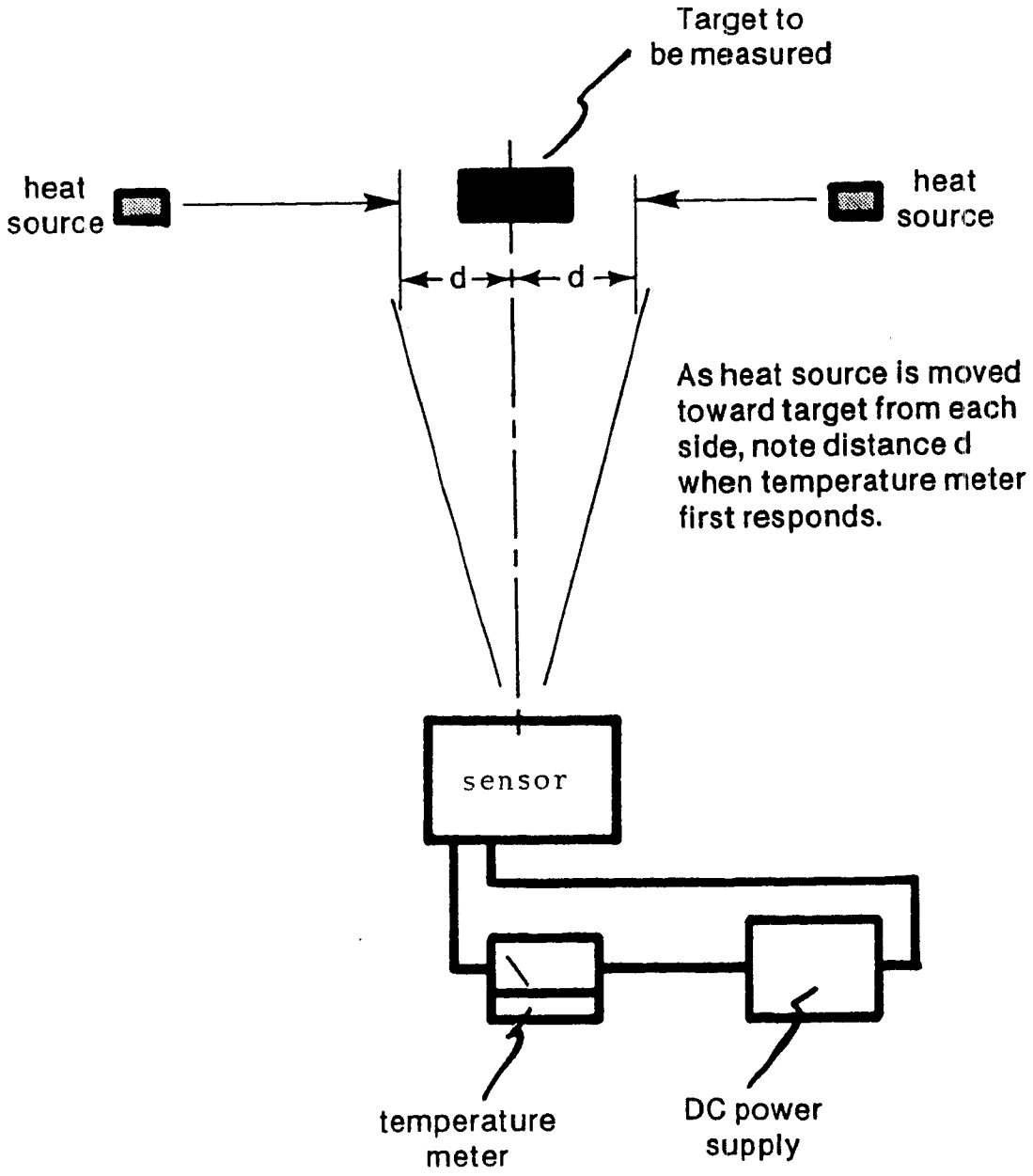


Figure 5-1. Checking Transmitter / Target Alignment.

3. Move the heat source slowly toward the target, and note its distance (d) from the target when the temperature display meter first responds.

4. Repeat the procedure from the opposite side of the target.

5. Compare the distances (d) of the heat source from the target on each side when the meter responses were first noted. They should be nearly equal. If they are not, adjust the aim of the transmitter to either side of the target as required, and repeat the test.

5.3 SETTING THE EMISSIVITY CONTROL

The emissivity control on the temperature transmitter is adjustable from 0.10 to 0.99 and must be set to correspond to the emissivity of the target material to be measured in order to obtain the true temperature. If the emissivity of the target material is known, for the OS1800 Series remove the glass cover from the transmitter and set the number on the digital switch by pressing the tabs above and below each dial (See Figure 5-2c). Emissivity adjustment for the OS1600 and OS1700 Series is made by analog trim pot. Refer to Figures 5-2a and 5-2b for location of emissivity adjusting pots. If the emissivity of the target material is not known, refer to Table 5-1 for the value. Note, however, that these values are ideal, i.e., determined under laboratory conditions and can be used only as a guide. Also, with some materials the value varies with temperature. Therefore, the emissivity must be measured for the actual target material and the value corresponding to the measured temperature used for true temperature measurements. Methods for measuring emissivity are described in Paragraph 5.4.

TABLE 5-1

EMISSIVITY OF SURFACES

Surface	Temp.* deg F	Emissivity*
Metals and Their Oxides		
Aluminum:		
Highly polished	44-1070	0.039-0.057
Polished	73	0.040
Rough plate	78	0.055-0.07
Oxidised at 1110 F	390-1110	0.11-0.19
Oxide	530-1520	0.63-0.26
Alloy 758T	75	0.10
758T, repeated heating	450-900	0.22-0.16
Brass:		
Highly polished	497-710	0.03-0.04
Rolled plate, natural	72	0.06
Rolled, coarse-emeried	72	0.20
Oxidised at 1110 F	390-110	0.61-0.59
Chromium	100-1000	0.08-0.26
Copper:		
Electrolytic, polished	176	0.02
Comm'l plate, polished	66	0.030
Heated at 1110 F	390-110	0.57-0.57
Thick oxide coating	77	0.78
Cuprous oxide	1470-2010	0.66-0.54
Molten copper	1970-2330	0.16-0.13
Dow metal, cleaned, heated	450-750	0.24-0.20
Gold, highly polished	440-1160	0.02-0.40
Iron and Steel:		
Pure Fe, polished	350-1800	0.05-0.37
Wrought iron, polished	100-480	0.28
Smooth sheet iron	1650-1900	0.55-0.60
Rusted plate	67	0.69
Smooth oxidised iron	260-980	0.78-0.82
Strongly oxidised	100-480	0.95
Molten iron and steel	2730-3220	0.40-0.45
Lead:		
99.96%, unoxidised	260-440	0.06-0.08
Gray oxidised	75	0.28
Oxidised at 390 F	390	0.63
Mercury, pure, clean	32-212	0.09-0.12
Molybdenum filament	1340-4700	0.10-0.29
Monel metal, K5700		
Washed, abrasive soap	75	0.17
Repeated heating	450-1610	0.46-0.65
Nickel and alloys:		
Electrolytic, polished	74	0.05
Electroplated, not polished	68	0.11
Wire	368-1844	0.10-0.19
Plate, oxid. at 1110 F	390-1110	0.37-0.48
Nickel oxide	1200-2290	0.59-0.86
Copper-nickel, polished	212	0.06
Nickel-silver, polished	212	0.14
Nickelin, gray oxide	70	0.26
Nichrome wire, bright	120-1830	0.65-0.79
Nichrome wire, oxid.	120-930	0.95-0.98
ACI-H (60Ni, 12Cr); firm black ox. coat	520-1045	0.89-0.82
Platinum, polished plate	440-2960	0.05-0.17
Silver, pure polished	330-1160	0.02-0.03
Stainless Steels:		
Type 316, cleaned	75	0.28
316, repeated heating	450-1600	0.57-0.66
304, 42 hr. at 980 F	420-980	0.62-0.73
310, furnace service	420-980	0.90-0.97
Allegheny #4, polished	212	0.13
Tantalum filament	2420-5430	0.194-0.33
Thorium oxide	530-1520	0.58-0.21
Tin, bright	76	0.04-0.06
Tungsten, aged filament	80-6000	0.03-0.35
Zinc: 99.1%, comm'l., polished	440-620	0.05
Galv., iron, bright	82	0.23
Galv., gray oxid.	75	0.28
Refractories, Building Materials, Paints, Misc.		
Alumina, 50u grain size	1850-2850	0.39-0.28
Alumina-silica, cont'g	1850-2850	
0.4% Fe_2O_3		0.61-0.43
1.7% Fe_2O_3		0.73-0.62
2.9% Fe_2O_3		0.78-0.68
Al (vary with am't lacquer body, age)	212	0.27-0.67
Asbestos	100-700	0.93-0.95
Candle soot; lampblack-water glass	70-700	0.95 ± 0.01
Carbon plate, heated	260-1160	0.81-0.79
Oil Layers:		
Lube oil, 0.01" on pol. Ni	68	0.82
Linseed, 1-2 coats on Al	68	0.56-0.57
Rubber, soft gray reclaimed	76	0.86
Mis. I: shiny black lacquer, planed oak, white enamel, serpentine, gypsum, white enamel paint, roofing paper, lime plaster, black matte shellac	70	0.87-0.91
Misc. II: glazed porcelain, white paper, fused quarts, polished marble, rough red brick, smooth glass, hard glossy rubber, flat black lacquer, water, electrographite	70	0.92-0.96

*When two temperatures and two emissivities are given they correspond, first to first and second to second,and linear interpolation is permissible.

5.3.1 MEASUREMENTS THROUGH WINDOWS

If the target is located behind a window, relative temperature measurements can be made with the emissivity control set at the value of the target material. However, if true temperature measurements are required, the emissivity setting must be calculated from the following equation to compensate for the target radiation lost due to reflection and absorption:

$$\text{Emissivity Setting} = Tw \times E$$

where: Tw = the effective window transmittance as listed in Table 4-1, Section 4, and

E = the emissivity of the target material.

5.4 MEASURING EMISSIVITY

If the material being measured is not listed in the table, determine its emissivity by either of the two methods of temperature measurement described below. Choose the method which best fits the application or which makes use of equipment readily available.

5.4.1 DIRECT TEMPERATURE METHOD

This method involves measuring the temperature of the material by means of an accurate thermocouple. Note, however, that it is impractical for very thin and/or fragile materials where the actual thermocouple measurement may be inconsistent and inaccurate. To measure the temperature of the material:

1. Attach the thermocouple to the material.
2. Focus the temperature transmitter on an area of the material immediately adjacent to the thermocouple and heat the material to approximately the operating temperature with a blast of hot air. Do not use a radiant heater. The stray reflections will cause erroneous

readings.

3. After the temperature stabilizes, read the temperature of the target surface using the thermocouple, then adjust the emissivity control in the transmitter until the temperature indicated on the display meter agrees with that obtained with the thermocouple.

4. Record the emissivity setting and use this value when measuring targets of the same material.

5.4.2 INDIRECT TEMPERATURE METHOD

This method involves the use of thin coatings and paints whose exact emissivities are known. Typical materials are listed in Table 5-2.

Table 5-2. High Emissivity Coatings

Type	Brand	Temp. Limit	Emissivity
Flat Black Paint	Krylon Ultra Flat Black Enamel	≤350°F	0.98
Flat Black Paint	3M Black Velvet Coating, #101-C10	≤450°F	0.98
Colloidal Graphite	Aquadag	≤750°F	0.80

To measure the material temperature:

1. Apply a thin coating to the material until the film is visibly opaque.

2. When the coating is completely dry, heat the material to approximately the operating temperature with a blast of hot air. Do not use a radiant heater since the higher absorbency of the coated area would result in a temperature rise much higher than in the uncoated area.

3. Focus the temperature transmitter on the coated area, set the emissivity control to the known value of the coating, and read the surface temperature display meter.
4. Immediately focus the transmitter on an adjacent uncoated (natural) area and adjust the emissivity control until the temperature reading is the same as that obtained from the coated area.
5. Record the emissivity setting and use this value when measuring targets of the same material.

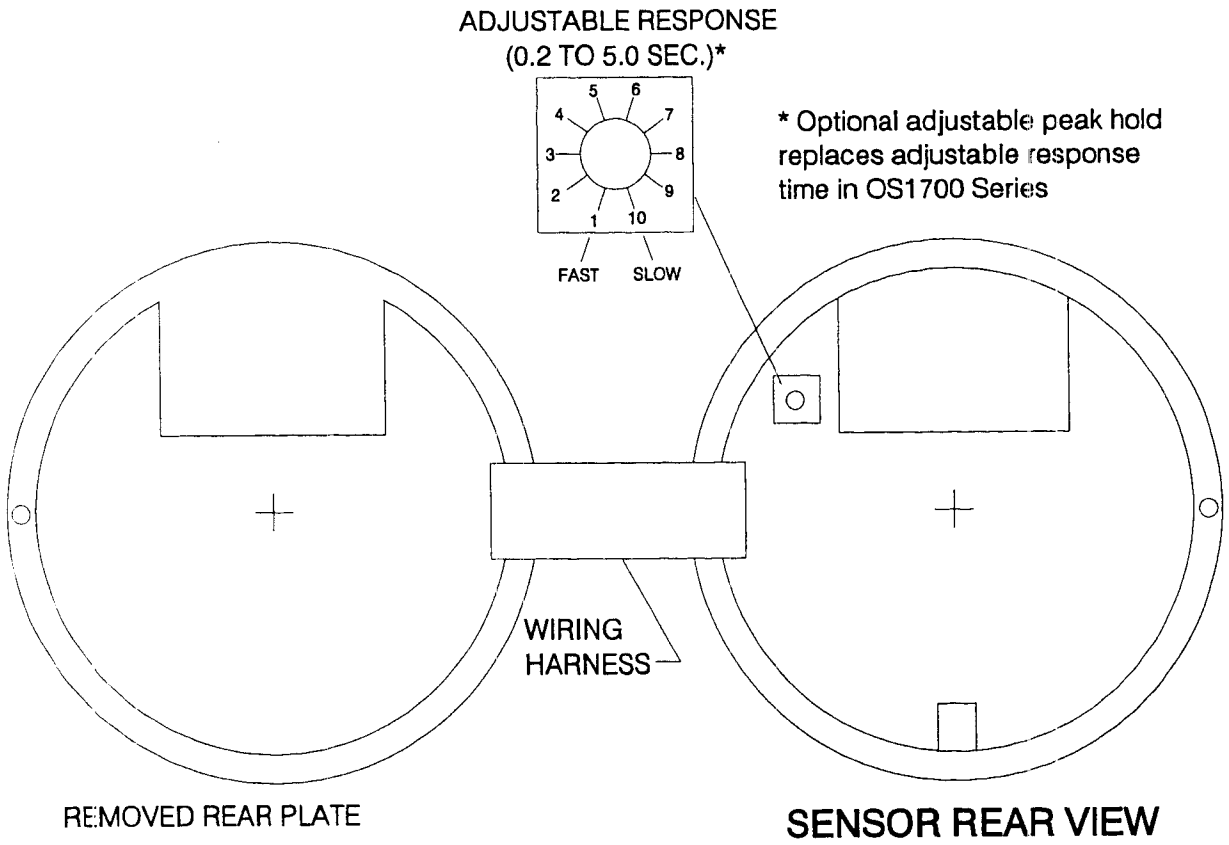
5.5 SETTING THE RESPONSE TIME

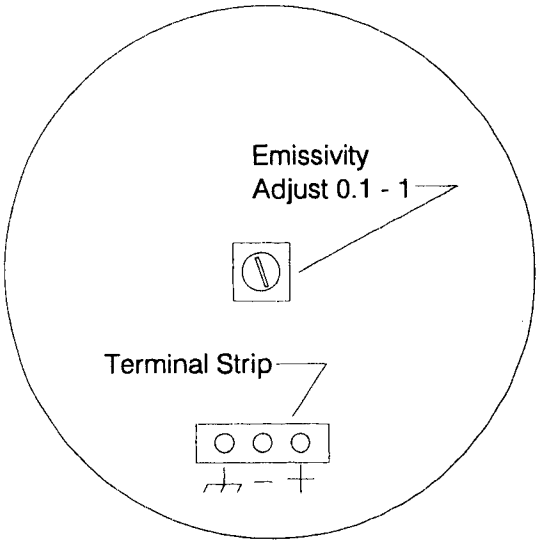
The response time of the temperature transmitter is adjustable from 0.2 to 5 seconds. The fast response time (0.2) allows the transmitter to follow rapid temperature changes. The slow response time (5 seconds) allows the transmitter to average the temperature variations and produce more constant output signals and hence more uniform displays. Therefore, the response-time control should be set to provide useful temperature data without causing distracting fluctuations on the display meter or other readout devices. To set the response time:

1. Remove the cover from the transmitter.
2. Use a small screwdriver to rotate the control, Figure 5-2. Turn the control fully counter-clockwise to set the 0.2-second minimum response time. Turn the control fully clockwise to set the 5-second maximum response time. Control rotation from fully counterclockwise to fully clockwise is 270 degrees. Do not force the control when it reaches the end of its travel.
3. Replace the cover after making the adjustment.

Figure 5-2a

SETTING RESPONSE TIME AND EMISSIVITY
Model OS1700





Sensor Rear View with Rear Plate Attached

Figure 5-2b

SETTING RESPONSE TIME AND EMISSIVITY

Model OS1600

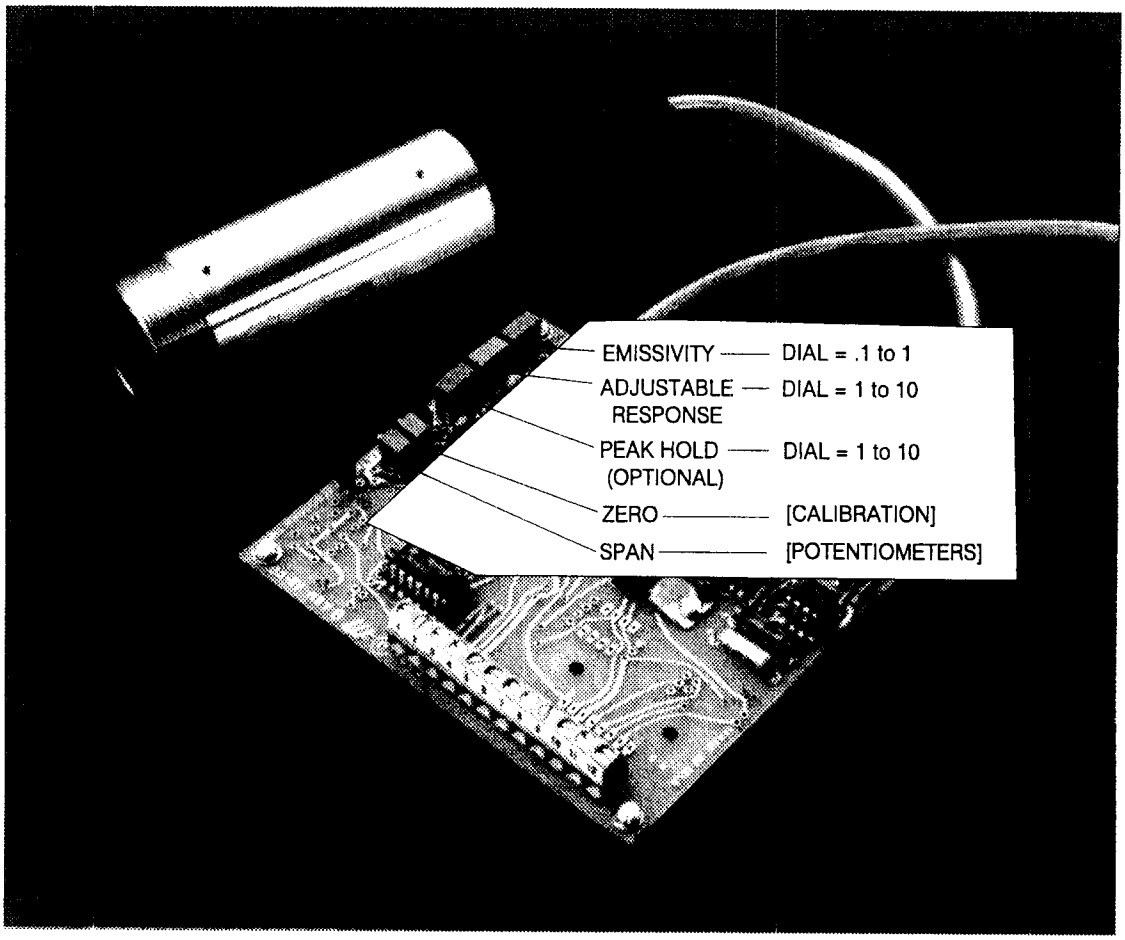
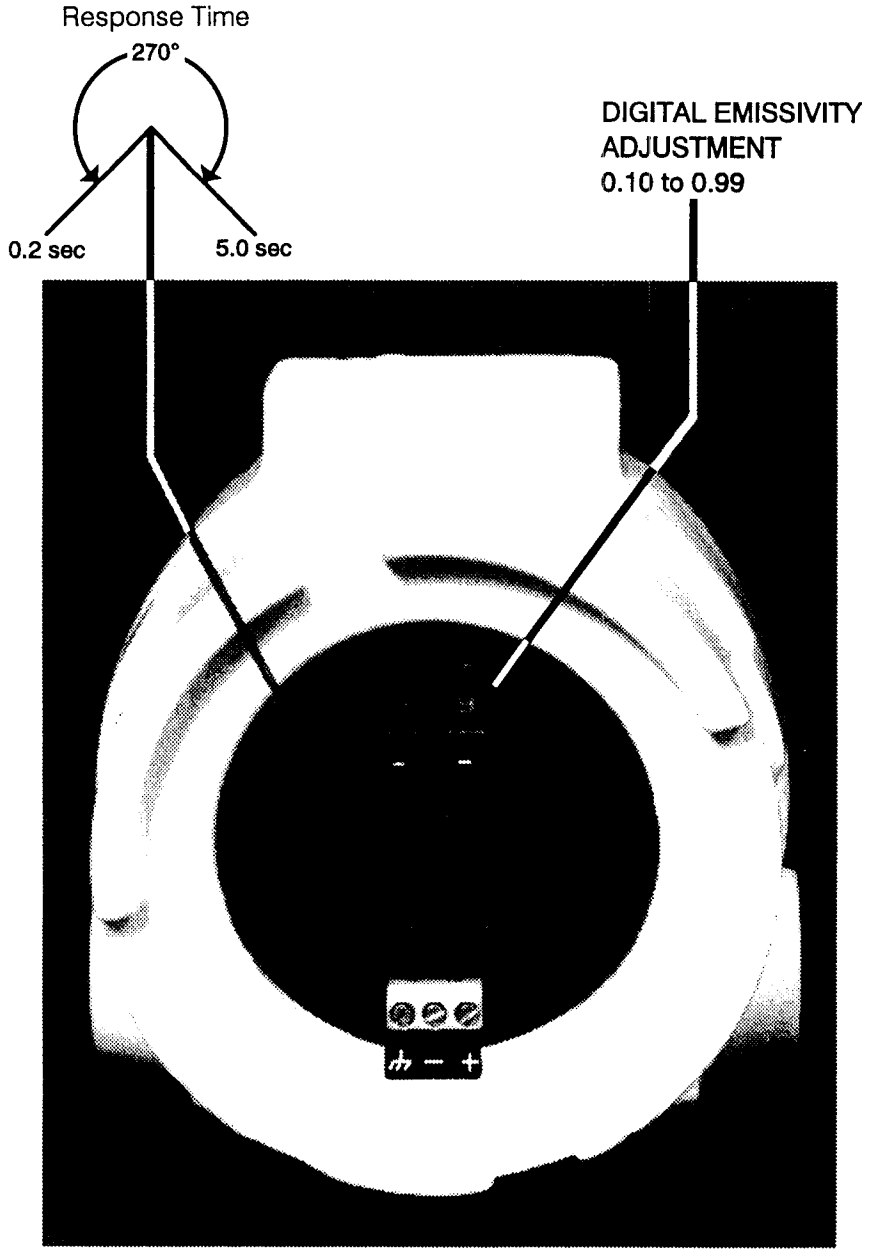


Figure 5-2c

SETTING RESPONSE TIME AND EMISSIVITY

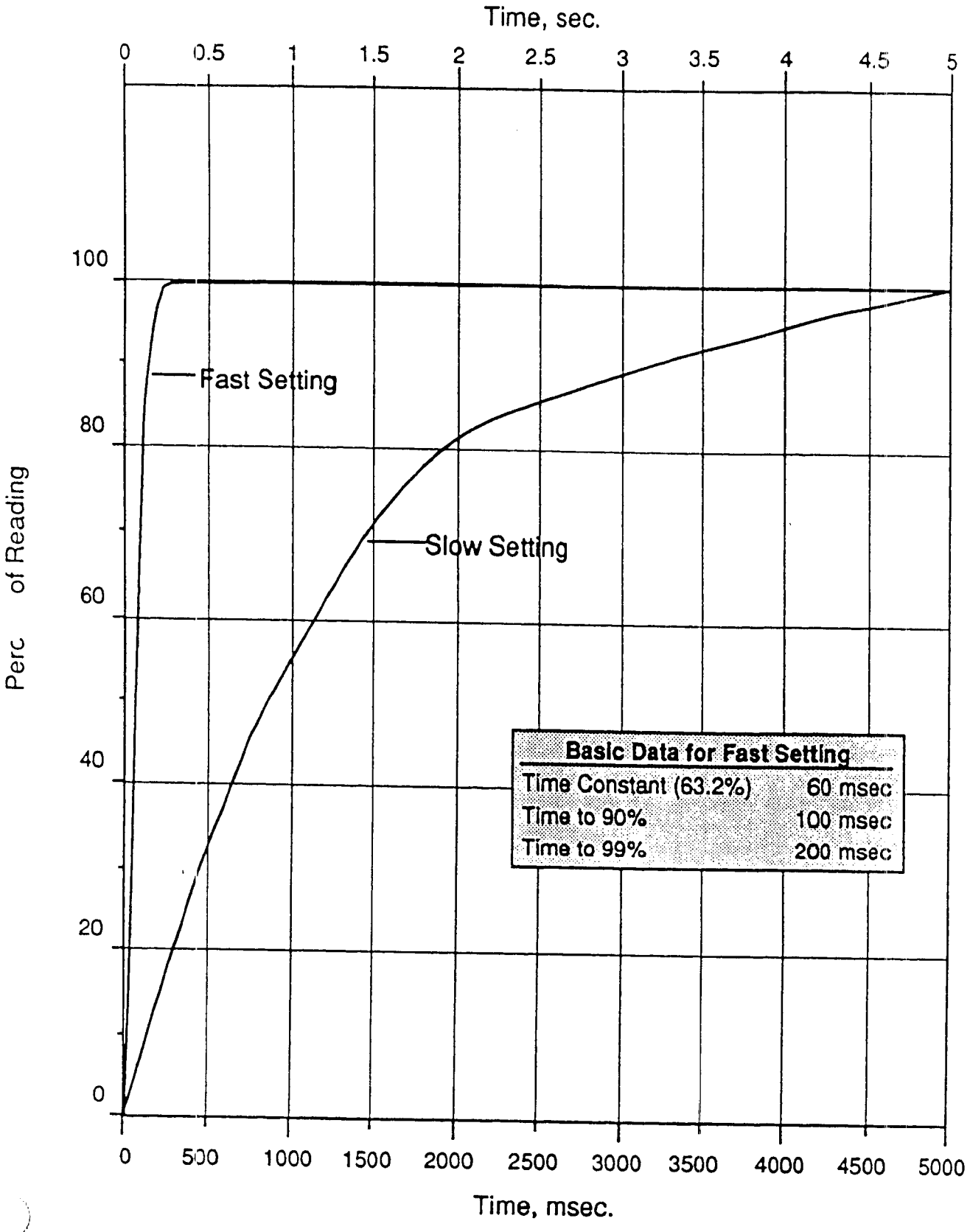
Model OS1800



NOTE: Optional adjustable peak hold replaces adjustable response time in OS1800 Series.

Figure 5-3

ADJUSTABLE RESPONSE
OS1600, OS1700, OS1800 Series



SECTION 6 - MAINTENANCE

6.1 PREVENTIVE MAINTENANCE

The only maintenance required by the OS1600, OS1700, OS1800 Series is a periodic cleaning of the lens, viewing window (if used) and case, as described below. The frequency will depend upon environmental conditions.

6.1.1 CLEANING THE LENS

To clean the lens:

1. With air or a brush, gently remove all particulate contaminants from the lens. Or, dampen a cotton swab or clean, soft, lint-free cloth with laboratory-grade isopropyl alcohol and very gently swab the surface of the lens. Pay particular attention to the edges where contaminants are most likely to accumulate. Dry the lens thoroughly and repeat the cleaning procedure using a new swab or clean cloth.
2. Inspect the lens closely and make sure that all areas are clean and free from scratches which may result from repeated cleanings. Minor scratches will not normally affect instrument performance.

6.1.2 CLEANING THE VIEWING WINDOW

If the target is being viewed through a window, clean the window thoroughly according to the manufacturer's recommendations.

6.1.3 CLEANING THE CASE

The case may be cleaned with a solution of mild soap and water and rinsed with clean water. Make sure that the cover is tight to keep water out of the sensor.

6.2 SYSTEM TROUBLESHOOTING

NOTE: If multiple temperature meters are being used and a measurement is known to be too high or too low, compare the readings of all meters first. If the readings are identical, assume that the meters are functional and troubleshoot the system as described below. If the reading of one meter varies significantly, either the meter is faulty or not compatible with the loop current. Replace the meter.

Trouble	Probable Cause/Remedy
1. Temperature reading known known to be too high.	1a. Sensor receiving reflections from adjacent energy source. Remove source or shield sensor from reflections.
	1b. Sensor reading radiant energy from source behind target. Remove source or block energy transmission to sensor.
	1c. Emissivity setting inadvertently changed. Check and adjust setting if necessary.
	1d. Emissivity setting too low for new material being measured. Refer to Table 5-1 for correct E value, or determine E per Paragraph 5.4. Reset emissivity control.
	1e. Measurements being made outside calibrated range of sensor. Refer to Paragraph 2.1 for temperature limits.
	1f. Faulty sensor. Consult OMEGA.

2. Temperature reading known to be too low.

2a. See 1c above.

2b. Emissivity setting too high for new material being measured. Refer to Table 5-1 for correct E value, or determine E per Paragraph 5.4. Reset emissivity control.

2c. Target size too small (sensor was inadvertently moved, or new target is being measured.) Check distance between sensor and target. Refer to Figure 2-1 and Paragraph 4.2 for FOV data and sensor setup.

2d. Target obscured by atmospheric haze, dust, smoke, etc. Consult OMEGA for sight tube and/or air purge recommendations.

2e. Blocked FOV. Make sure sensor "sees" target.

2f. Dirty lens and/or sight window. Refer to Paragraphs 6.1.1, 6.1.2 for cleaning procedures.

2g. Moisture in sensor from improper sealing. Remove cover and check case interior. If wet, consult OMEGA.

2h. Low power supply voltage. Check for 10-40Vdc max at +/- terminals. Replace power supply if necessary.

2i. Sensor being operated outside ambient temperature limits (32° - 140° F). If temperature exceeds high limit, water cooling is needed.

2j. Measurements being made outside calibrated range of sensor. Refer to Paragraph 2.1 for temperature limits.

2k. Faulty sensor. Consult OMEGA.

3. No temperature reading.

3a. Sensor lens cap on. Remove cap.

3b. Low power supply voltage as a result of faulty power supply or excessive loop loading. Check for 10-40 Vdc max. Replace power supply if necessary. Check load resistance vs. power requirement, Figure 4-4.

3c. Incorrect window material. Refer to Table 4-1 for recommended materials.

3d. Target obscured. Provide unobstructed line of sight between sensor and target.

3e. System measurement loop not closed, or improper loop wiring, or loop grounded at more than one point. Check connections for proper polarity. Check circuit for multiple ground points.

3f. Faulty sensor. Consult OMEGA.

4. Temperature readings are erratic (particularly "latching" at high temperature limit). Assume stable target temperature.

4a. Loose intermittent circuit connections. Check circuit connections.

4b. Case grounded at more than one point, or no ground. Refer to Paragraph 4.2 for grounding recommendations.

4c. Interference from nearby RF wiring. Separate system and RF wiring.

4d. Interference from transient voltages on instrument power line. Use "clean" power line.

4e. Sensor being operated outside ambient temperature limits (32° - 140° F). If temperature exceeds high limit, water cooling is needed.

4f. Target obscured by atmospheric haze, dust, smoke, etc. Consult OMEGA for sight tube and/or air purge recommendations.

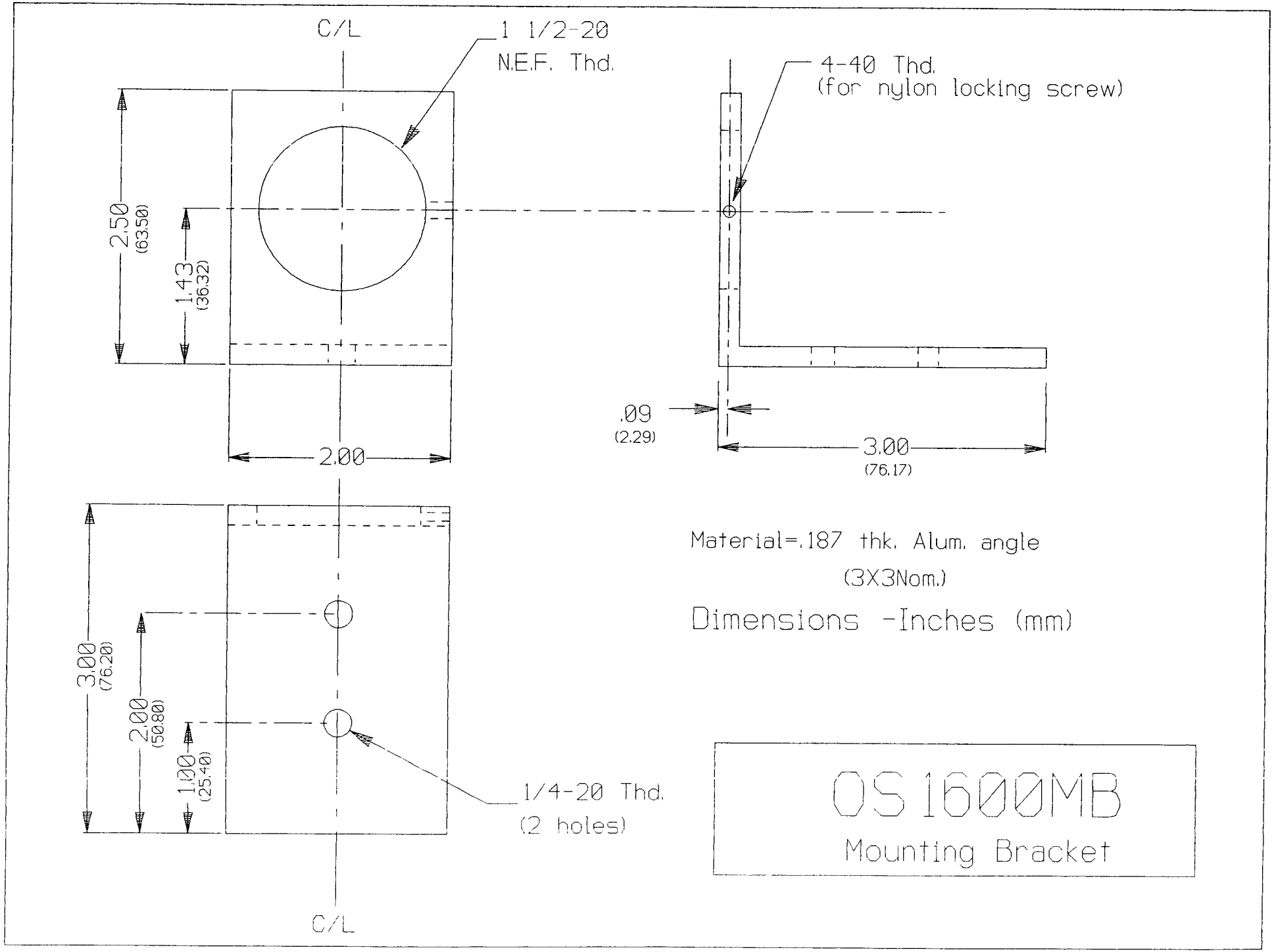
4g. System measurement loop not closed. Check for 10 Vdc at terminal strip. Replace power supply if necessary.

4h. Faulty sensor. Consult OMEGA.

SECTION 7 - ACCESSORIES

The following OS1600, OS1700, OS1800 Series accessories are available from OMEGA:

Model Number	Description
OS1600-AP:X7	Air purge for OS1600
OS1700-AP:X7	Air purge for OS1700
OS1800-AP:X7	Air purge for OS1800
OS1600-WCAP:X7	Water cooling/air purge for OS1600
OS1700-WCAP:X7	Water cooling/air purge for OS1700
OS1800-WCAP:X7	Water cooling/air purge for OS1800
OS1700-PMB:X7	Pipe mounting bracket for OS1700
OS1800-PMB:X7	Pipe mounting bracket for OS1800
OS1700-SB:X7	Swivel bracket for OS1700 Series
OS1800-SB:X7	Swivel bracket for OS1800 Series
OS1600-2LN:X7	Two lock nuts for OS1600 Series
OS1600-MB:X7	Mounting base for OS1600 Series
OS1600-C-10	Replacement 10' cable for OS1600
OS1600-C-25	Optional 25' cable for OS1600
OS1600-C-50	Optional 50' cable for OS1600
OS1600-C-100	Optional 100' cable for OS1600
PSU-24B:X7	Power supply, 24 Vdc, 200ma

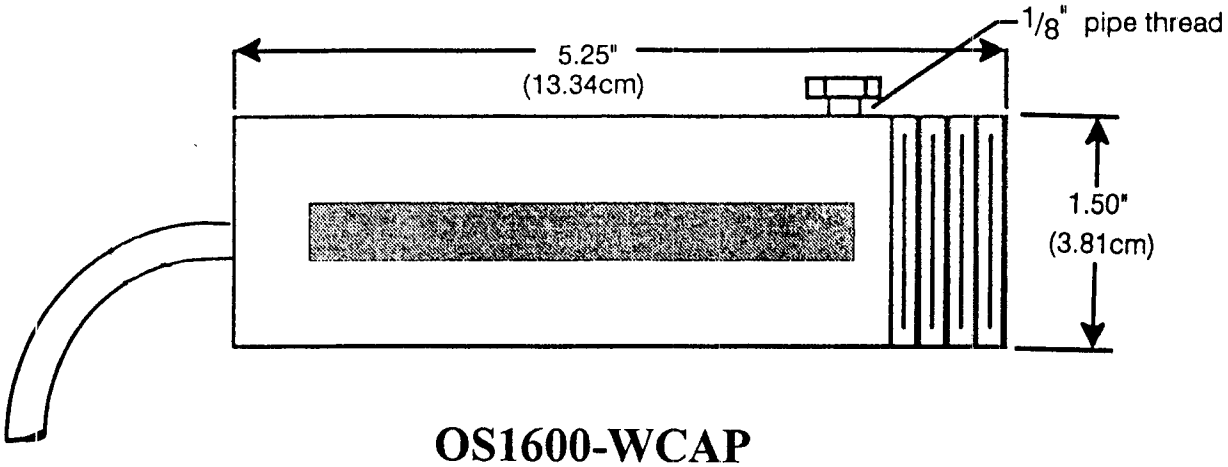


Material=.187 thk. Alum. angle
(3X3Nom.)

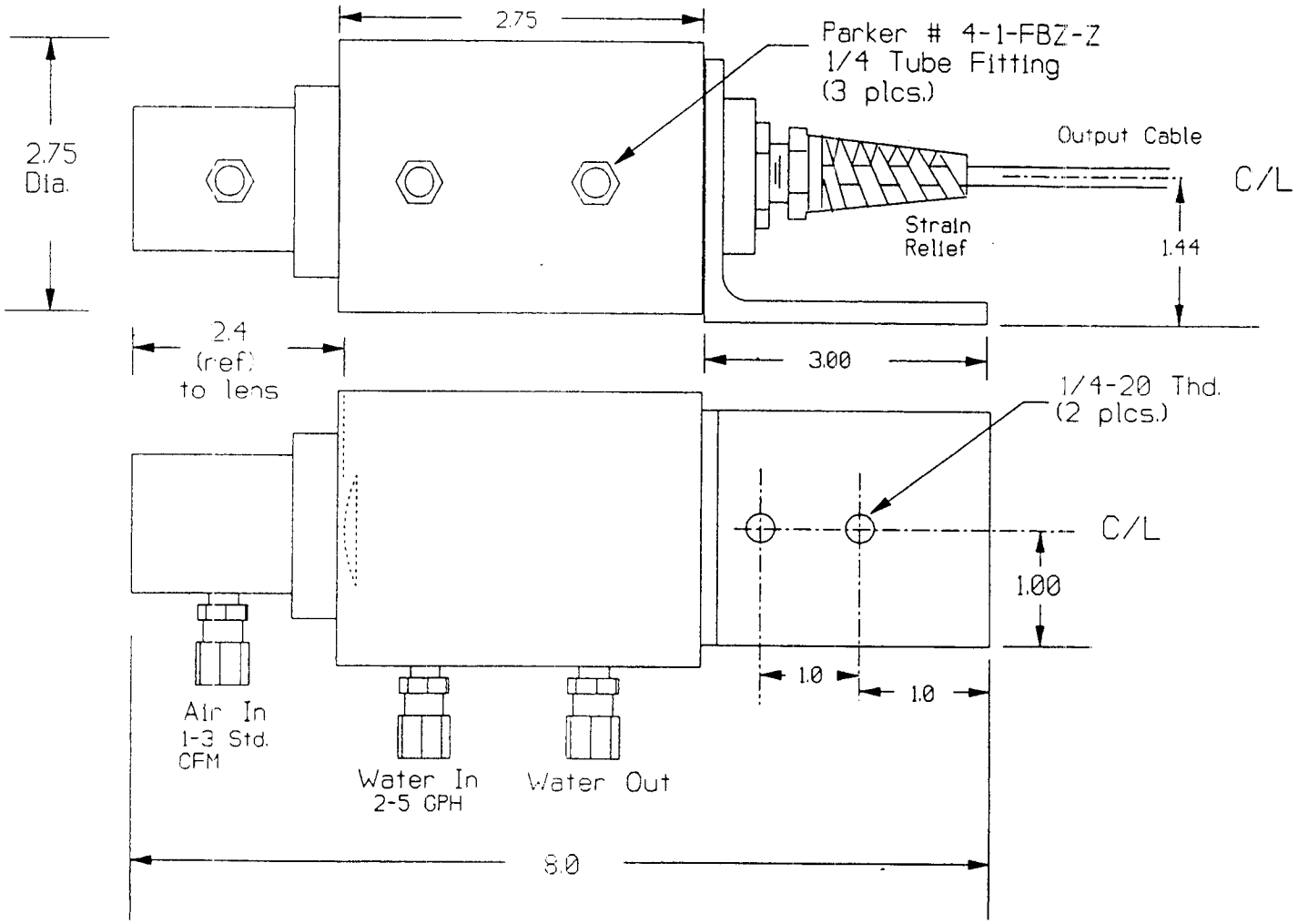
Dimensions -Inches (mm)

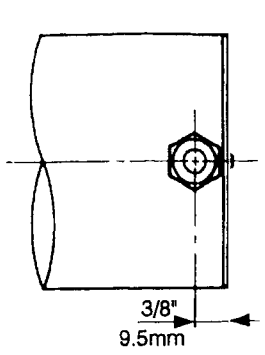
OS1600MB
Mounting Bracket

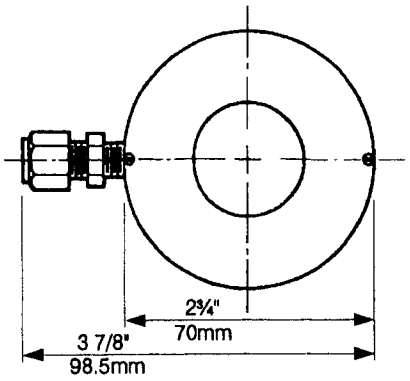
OS1600AP
AIR PURGE FOR OS1600



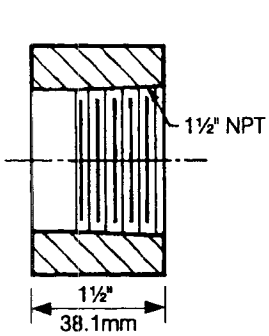
OS1600-WCAP
WATER COOLING AIR PURGE FOR OS1600

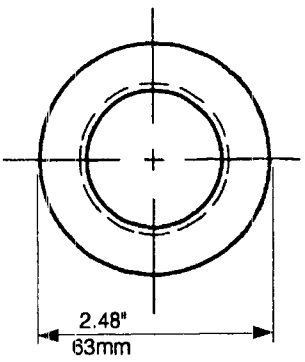




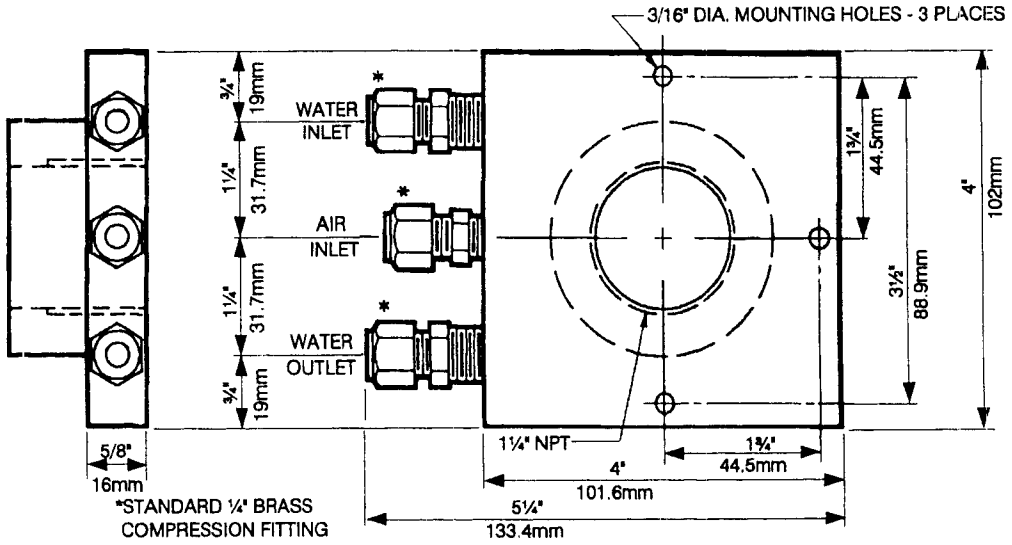


AIR PURGE (AP) OS1700 - AP

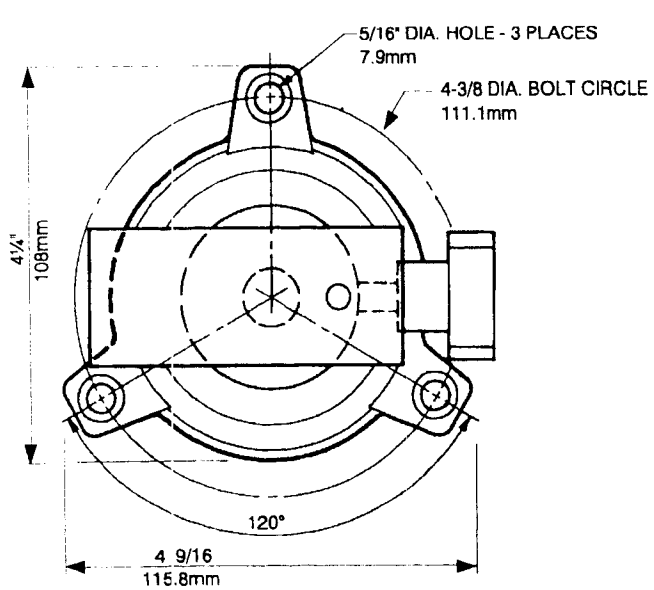


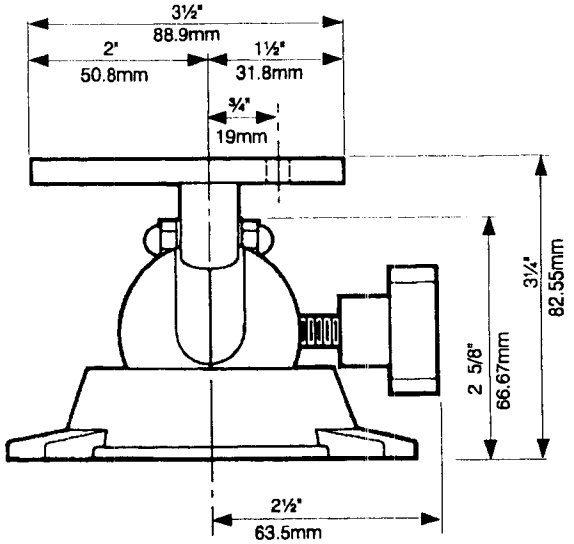


PIPE MOUNTING (PM) OS1700 - PMB

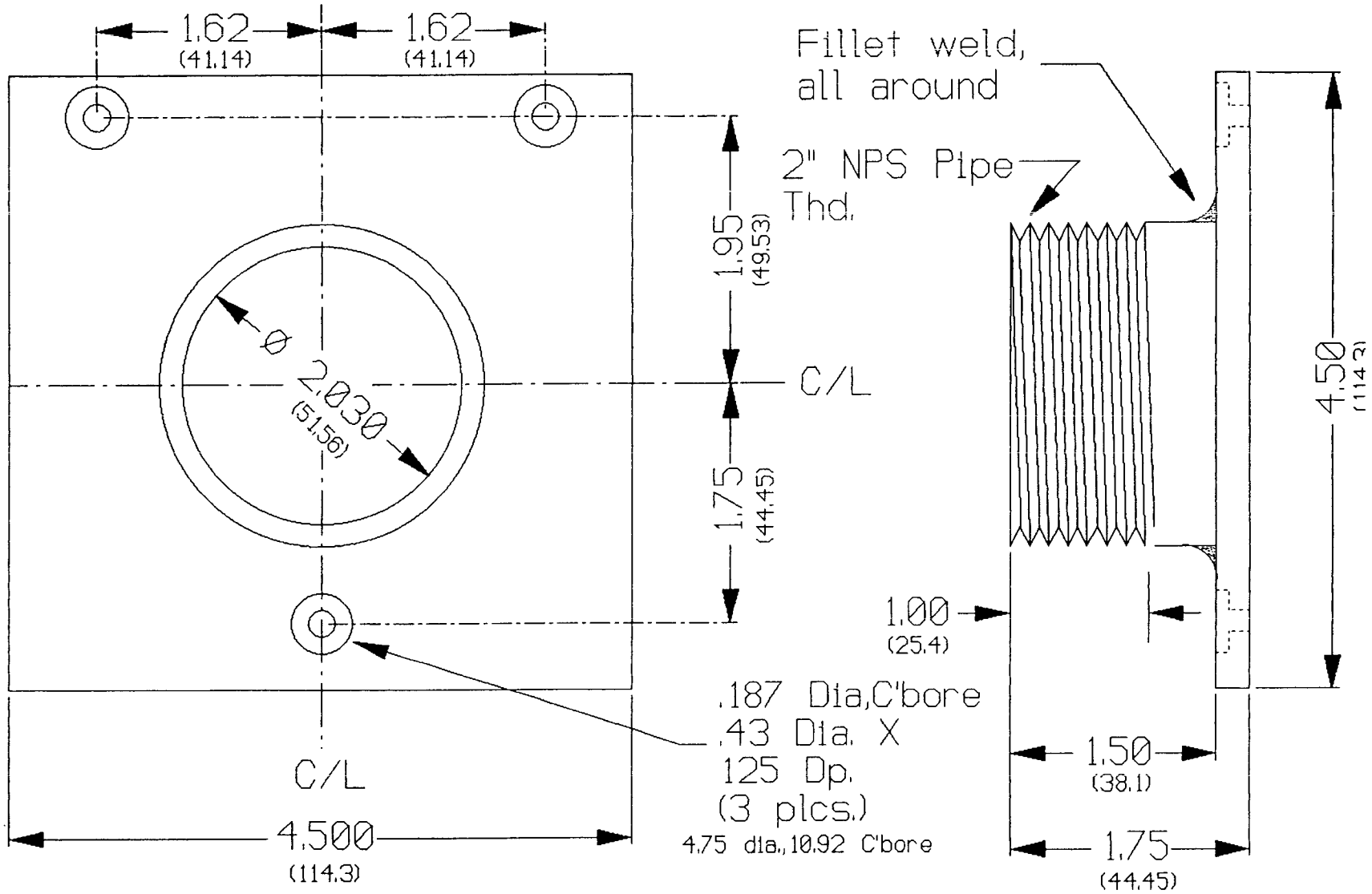


WATER COOLING / AIR PURGE (WCAP) OS1700 - WCAP



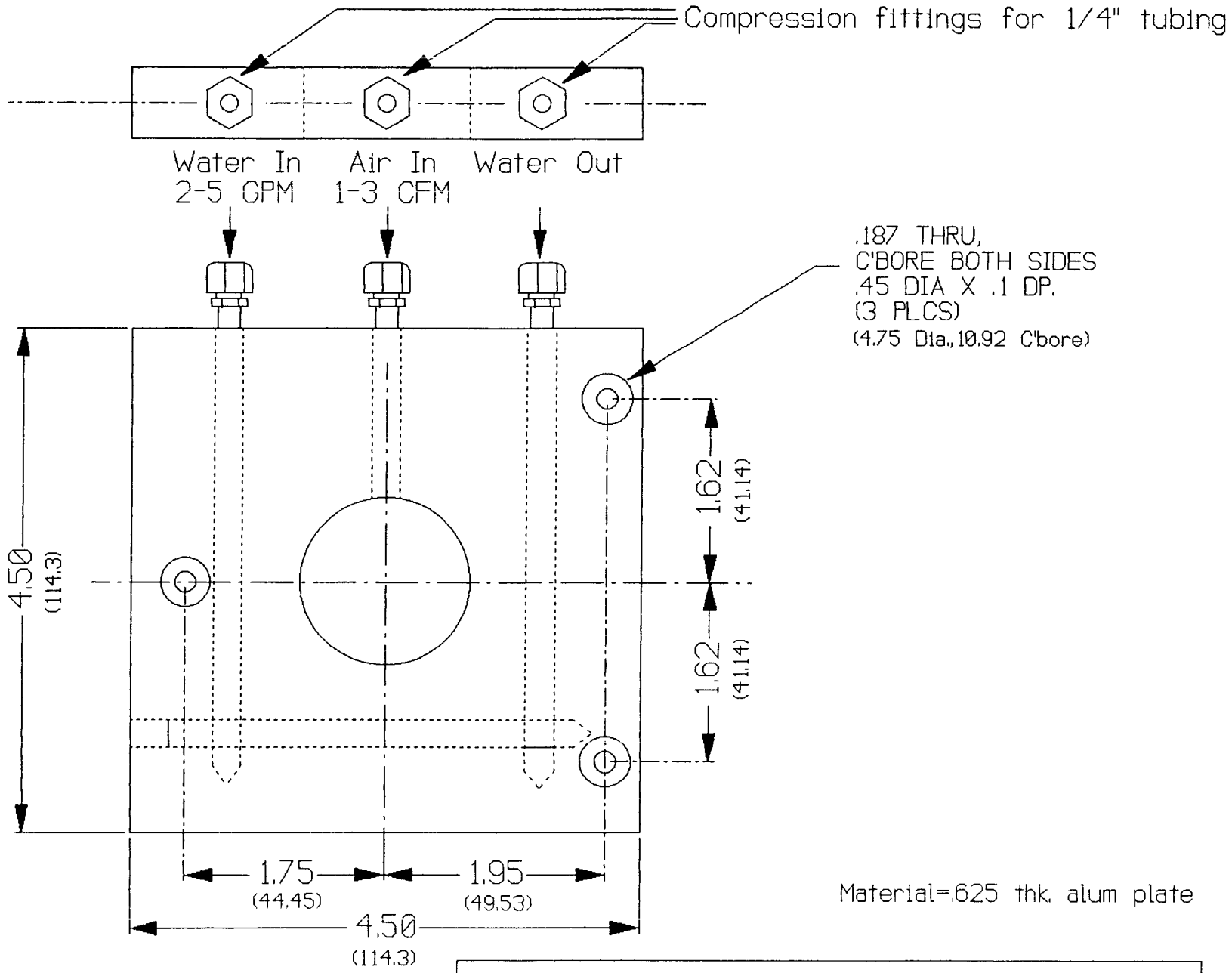


SWIVEL BRACKET (SB) OS1700 - SB



Material=Aluminum
Dimensions-Inches (mm)

OS1800-PMB
Pipe Mounting Bracket

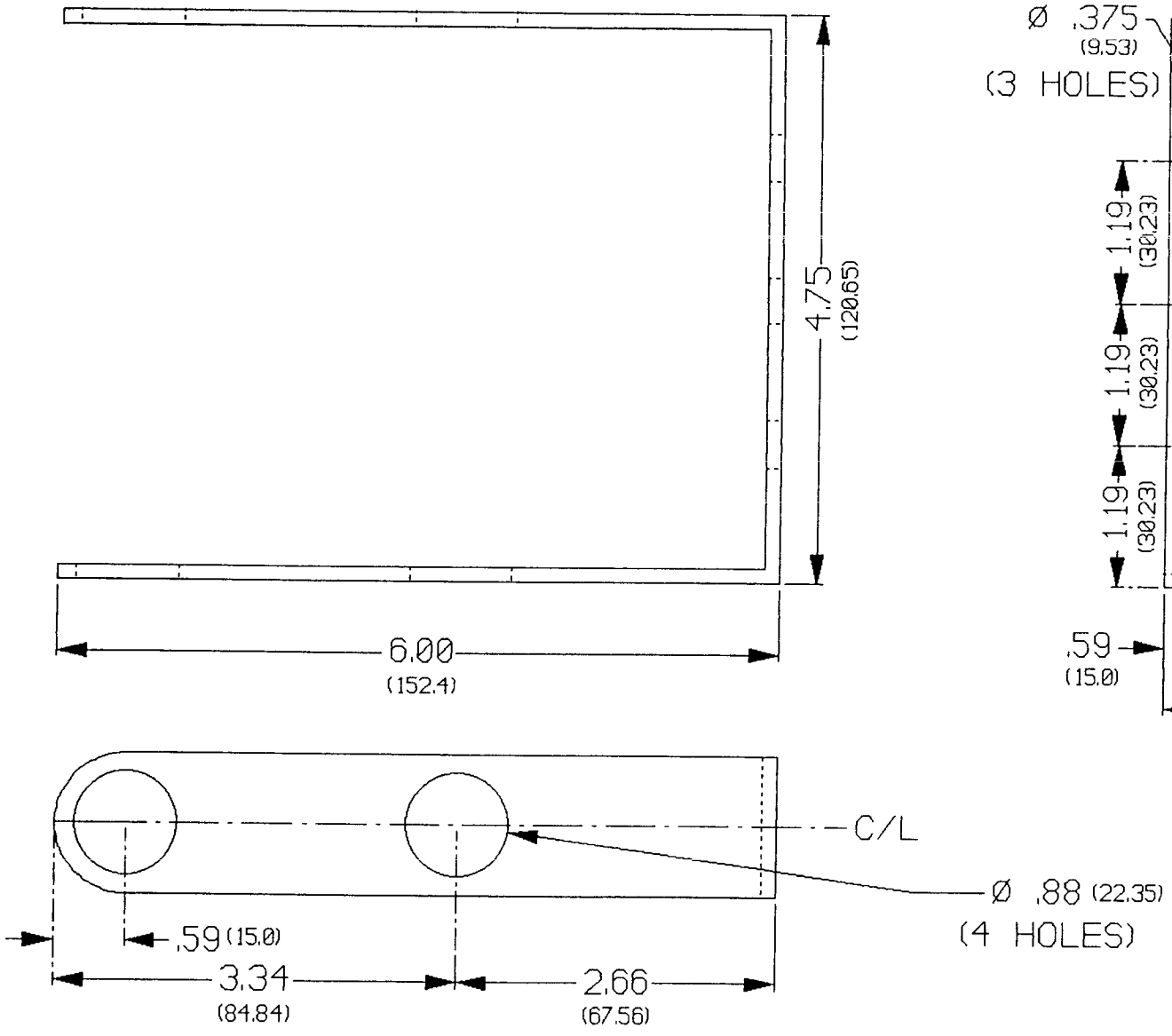


Material=.625 thk. alum plate

Dimensions- Inches (mm)

OS1800-WCAP

Water Cooling/Air Purge



Material= .125 Thk Alum.

Dimensions- Inches (mm)

OS1800-SB

Swivel Bracket