User's Guide

OMEGA®

An OMEGA Technologies Company

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OS6000 Fiber optic system

OS8000 Sight optic system

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INTRODUCTORY NOTE

ATTENTION: THIS MANUAL IS VALID FOR OS8000 WITH SERIAL NUMBER HIGHER THAN 9233, OS6000 WITH SERIAL NUMBER HIGHER THAN 8454

This publication contains operating instructions, as well as a description of the principles of operation, of ***OS6000 & OS8000 Series*** *IR thermometers.*
This information covers all models of the instrument, including the basic equipment and its options and accessories. This manual is a complete "USER GUIDE", providing step-by-step instructions to operate the instrument in each of its designed functions.

OMEGA *has used the best care and efforts in preparing this book and believes the information in this publication are accurate. The* ***OMEGA*** *products are subjected to continuous improvement, in order to pursue the technological leadership; these improvements could require changes to the information of this book.*
OMEGA *reserves the right to change such information without notice.*

OS *IR thermometers uses sophisticated analogic and digital technologies. Any maintenance operation must be carried out by qualified personnel* ***ONLY****. We recommend to contact our technicians for any support requirements.*

OS *is fully tested in conformity with the directive n°89/336/CEE Electromagnetic Compatibility.* ***OMEGA*** *shall not be liable in any event, technical and publishing error or omissions, for any incidental and consequential damages, in connection with, or arising out of the use of this book.*

TABLE OF CONTENTS

1 GENERAL DESCRIPTION

The temperature measurement of a liquid or gaseous compound has been successfully made with thermoelectric or expansion thermometers thanks to the good thermal exchange between the fluid and the sensor.
With solid bodies a good thermal exchange is difficult to be obtained and an additional measuring error should be considered.
Direct contact measurement is impractical when the object being measured is moving, or electrically hazardous, or for any other reasons cannot be touched with a thermocouple. A non-contact IR temperature measurement is a solution to the above problems. Other applications benefit because non-contact thermometers do not add or remove heat or disturb the process in any way.

There are two different series of **OMEGA** thermometers available:

OS8000
Every **OMEGA** thermometer consists of a cylindrical chassis with a: lens, filter, IR sensor, and electronic circuits. The 4/20 mA linear output version has the emissivity and response time adjustments accessible.
For accurate positioning of **OS8000** thermometer, a telescope and a laser pinpointing removable systems are available as accessories.

OS6000
The fiber optic head is the ideal solution for: temperature measurements of surface that afford no direct straight-sight view, installing the fiber optic head in remote locations with environments at extreme temperatures, avoiding the requirement of water cooling systems.
Every **OMEGA** thermometer consists of:

- Optic head
- Fiber optic
- Electronic module able to contain the IR sensor and all electronic circuits. The 4/20 mA linear output version has the emissivity and response time adjustments accessible.

The infrared spectral band energy emitted by the measured objects is focused by the "optic head - optic fiber" system installed on the sensor and converted in to an electric signal. The thermometer output signal resulting after its amplification has a 4/20 mA value based upon the object temperature.

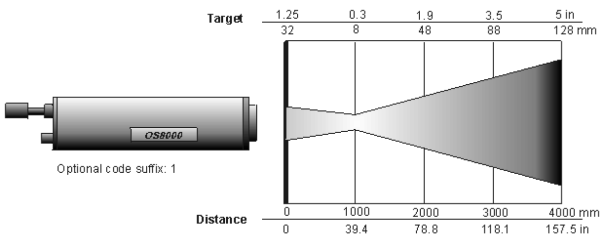
Common Features
2-Wire 4-20 mA Linear output
Repeatability ±0.25% rdg
Fast response 50/100 msec

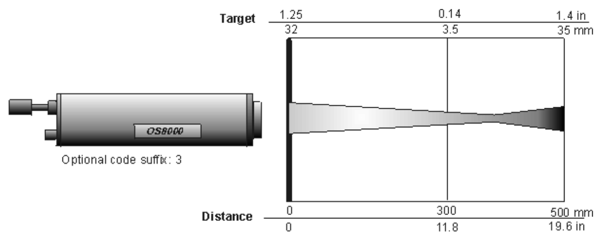
OS6000 Additional features
Wide temperature range: 300 to 1600°C (592 to 2912°F)
.8 and 1.6µm Spectral response
Fiber optic cable lengths 12 to 26’ (3.5 to 8 meters)
Five target size vs. distance from .08” (2mm) size @ 3” (75mm) distance to 4.7” (12mm) size @ 35” (900mm) distance
Compressed air conditioning option

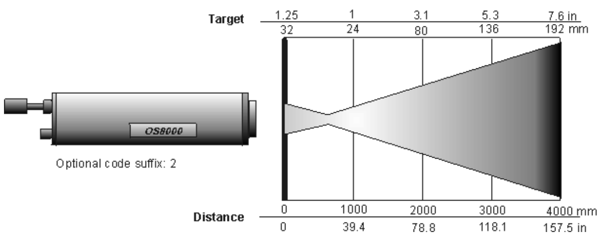
OS8000 Additional features
Wide temperature range: -40 to 1700°C (-40 to 3092°F)
Seven Spectral response ranges
Line of sight viewing with lens system
Optional laser pointer & Sighting telescopes
Compressed air and water conditioning option

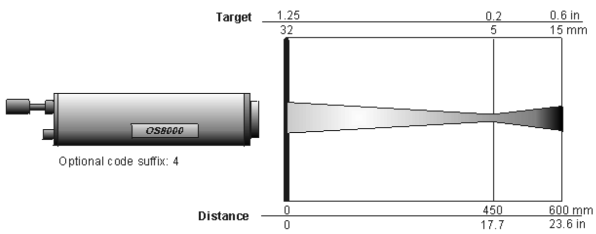
1.1 OS8000 specifications

- **Measuring ranges:**
  see ordering table
- **Spectral band:**
  see ordering table
- **Limit of error:** with ambient temp. from +15 to +35 °C
  <u>*OS8003/04/05/12/13/14*</u> ± (0.5% of rdg. + 1 °C)
  <u>*Other models*</u> ± (1% of rdg. + 1 °C)
- **Repeatability:**
  <u>*OS8003/04/05/12/13/14*</u> ± 0.25% of the reading
  <u>*Other models*</u> ± 0.5% of the reading
- **Temperature stability:**
  <0.02% / °C for the band exceeding +15 to +35°C
- **Response time:**
  <u>*OS8003/04/05/12/13/14*</u> from 50 ms to 10 s adjustable
  <u>*Other models*</u> from 100 ms to 10 s adjustable
- **Ambient temperature:**
  from 0 to +60 °C (without cooling)
- **Storage temperature:**
  from -30 to +60 °C
- **Output signal:**
  4/20 mA 2 wire current loop
- **Protection:**
  IP65
- **Loop power supply:**
  from 18 to 32 Vdc
- **Dimension / Weight:**
  <u>*OS8003/04/05/12/13/14:*</u> 2.24D x 8.35"L – 1.76 lb (57D x 212mm L - 0.8 Kg)
  <u>*Other models:*</u> 2.24D x 7.48"L – 1.76 lb (57D x 190mm L - 0.8 Kg)



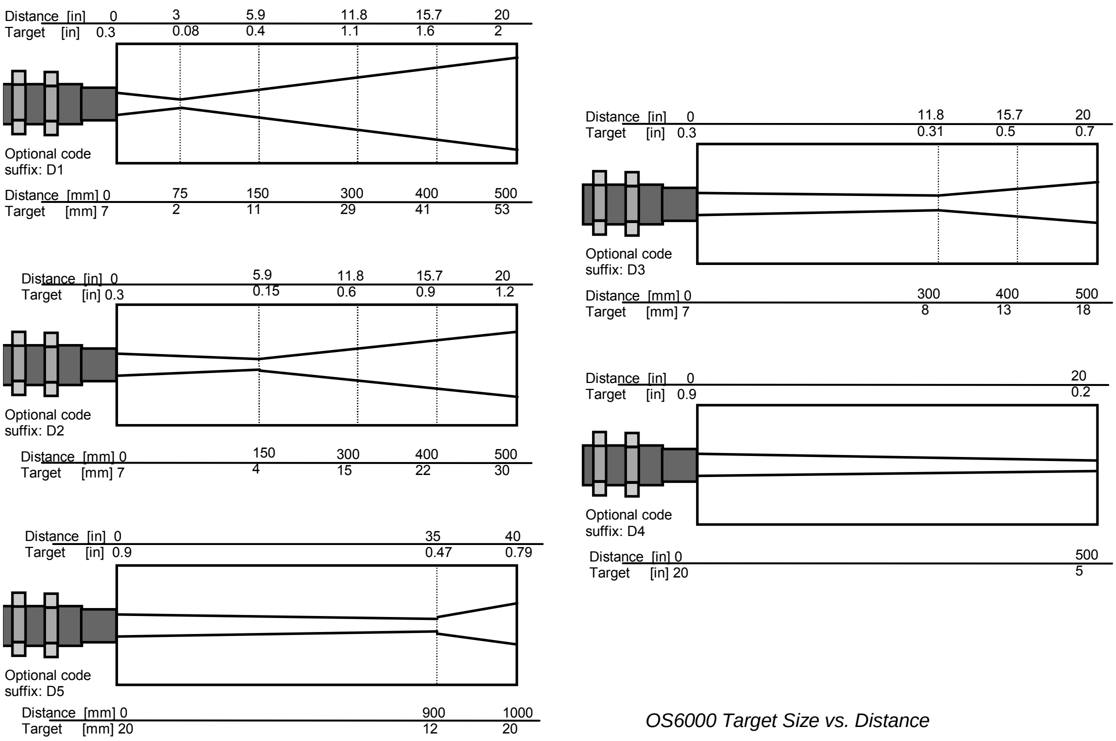






1.2 OS6000 specifications

- **Measuring ranges:**
  see ordering Table
- **Limit of error:**
  ±(0.5% of rdg + 1 °C) with ambient temp. from +15 to +35 °C
- **Repeatability:**
  ±0.25% of the reading
- **Temperature stability**:
  < 0.02% of rdg / °C for the band exceeding +15 to +35°C
- **Response time**:
  from 50 ms to 10 s adjustable
- **Spectral band**:
  0.8 to 1.6 µm
- **Fiber to optic connection:**
  fast lock coupling
- **Operating temperature**:
  optical adapter: 200 °C max
  fiber optic: 200 °C max
  electronic module: from 0 to +60 °C
- **Storage temperature**:
  from -30 to +60 °C
- **Output signal**:
  4/20 mA 2 wire 24 Vdc - Load 0 ÷ 300 Ω
- **Protection:**
  IP65
- **Loop power supply**:
  from 18 to 32 Vdc
- **Dimension / Weight**:
  electronic module: 2.24D x 4.67”L – 1.1 lb (57D x 121mm L - 0.5Kg)
  fiber optic: 0.31” (8mm) D
  optic head: code 1,2 & 3 0.63 D x 2.05” L (16 x 52 mm)
  optic head: code 4 & 5 1.18 D x 3.78” L (30 x 94 mm)



OS6000 Target Size vs. Distance

1.3 OS8000 ordering table

To Order *(specify model number)*			
Model No.	**Spectral response CWL**	**Temperature range**	**Typical application**
OS8001-2 **OS8002-2**	8-14μ	-40 to 200°C (-40 to 392°F) 0 to 500°C (-32 to 932°F)	General low temperature applications such as textile, printing, paper, food, rubber, Thick plastic, paint.
OS8003(*) **OS8004(*)** **OS8005(*)**	1μ	600 to 1100°C (1112 to 2012°F) 700 to 1300°C (1292 to 2372°F) 900 to 1600°C (1652 to 2912°F)	High temperature applications such as metal treating, foundries, forging, glass gob, iron and steel.
OS8006-2 **OS8007-2**	3.43μ	50 to 200°C (122 to 392°F) 100 to 400°C (212 to 752°F)	Thin film plastic (CH composition) such as: polyethylene, polypropylene, polystyrene, vinyl and nylon.
OS8008-2 **OS8009-2**	5.10μ	100 to 1000°C (212 to 1832°F) 300 to 1600°C (572 to 2912°F)	Glass under-skin such as bending, forming, tempering, laminating and anealing.
OS8010-2	7.90μ	0 to 600°C (-32 to 1112°F)	Thin film plastic polyester, fluorocarbon and very thin glass
OS8011-2	3.86μ	600 to 1700°C (1112 to 3092°F)	Objects through clean flames such as reformer tubes, chemical reactor, klins.
OS8012(*) **OS8013(*)** **OS8014(*)**	1.6μ	300 to 900°C (572 to 1652°F) 300 to 1300°C (572 to 2372°F) 400 to 1350°C (752 to 2462°F)	Applications which require high accuracy in low emissivity values

** Add optics code*

Optics code

Suffix	Target/Distance ratio
-1	.03 @ 39.4” (8mm OD at 1000mm) only with OS8003/04/05/12/13/14
-2	1 @ 39.4” (24mm OD at 1000mm) only with OS8001/02/06-11
-3	.14 @ 11.8” (3.5mm OD at 300mm) only with OS8012/13/14
-4	.2 @ 17.2” (5mm OD at 450mm) only with OS8012/13/14

Accessories

Suffix	Description
OS8000-0	Sighting telescope
OS8000-11	Economy support with air water cooling and air purge
OS8000-13	Removable laser pointer
OS8000-14	Alignment support

Unit comes with: optics, sensor, 4 to 20 mA linear output, calibration report and instruction manual.

1.4 OS6000 ordering table

To Order *(specify model number)*			
Model No.	**Spectral response CWL**	**Temperature range**	**Typical application**
OS6001(*) † **OS6002(*) †** **OS6003(*) †**	1µ	600 to 1100°C (1112 to 2012°F) 700 to 1300°C (1292 to 2372°F) 900 to 1600°C (1652 to 2912°F)	High temperature applications such as metal treating, foundries, forging, glass gob, iron and steel.
OS6004(*)-C2 **OS6005(*)-C2** **OS6006(*)-C2**	1.6µ	300 to 900°C (572 to 1652°F) 300 to 1300°C (572 to 2372°F) 400 to 1350°C (752 to 2462°F)	Applications which require high accuracy in low emissivity values

** Add optics code*
† Add fiber optic length

Optics code

Suffix	**Target/Distance ratio**
-D1	.08 @ 3" (2mm OD at 75mm)
-D2	.15 @ 5.9" (4mm OD at 150mm)
-D3	.31 @ 11.8" (8mm OD at 300mm)
-D4	.2 @ 20" (5mm OD at 500mm)
-D5	.47 @ 35" (12mm OD at 900mm)

Fiber optic lenght

Suffix	**Description**
-C2	12' (3.5m)
-C3	20' (6m)
-C4	26' (8m)

Accessories

Suffix	**Description**
OS6000-11	Air purge collar
OS6000-16	Electronics support
OS6000-18	Air purge system

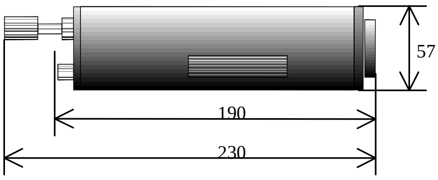
Unit comes with: head, fiber optic, electronic module with 4 to 20mA linear output, calibration report and instruction manual.

2 PHYSICAL DESCRIPTION

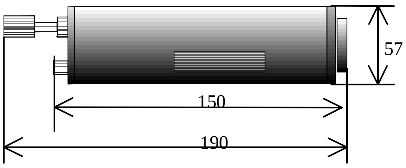
<u>OMEGA OS8000</u>

OS8000 radiation thermometers are protected by an extruded aluminum that provides the positioning guidelines and the internal body blocking system.
The internal body is aluminum made with anti-reflection treatment. It provides the room for the optic system, the pointing system, the optic filter, the sensor and the electronics for signal conditioning.
An optional Pt100 sensor allows to detect the internal temperature, with the possibility to supply a control signal when the environment is critical.

OS8003/04/05/12/13/14 models



OS8001/02/06/07/08/09/10/11 models



<u>OMEGA OS6000</u>

The **OS6000** is composed of:
- optic head
- optic fiber
- electronic module

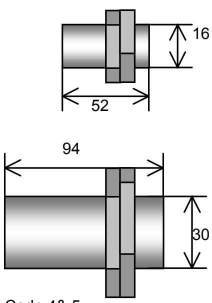
The infrared radiation emitted by the target is focused by a lens placed on the optic head, and transmitted, by the fiber optic, to the sensor installed on the electronic module, that provides the treatment of the thermoelectric signal, generating a 4/20 mA signal.

The **optical head** is a metallic cylinder with a length of 52 mm and a diameter of 16 mm (or with length of 94mm and diameter of 30mm).
It has 2 hexagonal fixing washers to ease the installation. A 13 mm lens, a filter and a field stop that defines, with very high precision, the result cones of the optic system are placed into the cylinder.

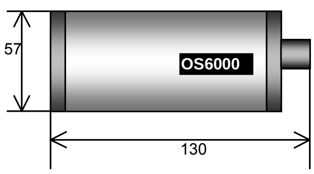
The flexible **fiber optic** has an 8 mm diameter with different lengths.
It is protected by a spiraled metallic sheath covered with silicon rubber, and it's suitable to be used for ambient temperatures higher than 200 °C.
Its function is to interconnect the optical head with the electronic module where the sensor is inserted.

The **electronic module** which connects and treats the signal is placed in an anodized aluminum cylinder
(ϕ 57 mm - length 130 mm), with an IP65 protection.
Its function is to generate an electric signal (4/20 mA) proportional to the measured temperature.

Code 1, 2 & 3



Code 4& 5



3 PRINCIPLE OF OPERATION

3.1 Emissivity adjustment

The IR thermometers incorporate, on the electronic module, a potentiometer to adjust the thermometer to the target emissivity value.

3.2 Response time adjustment

The IR thermometers incorporate, on the electronic module, a potentiometer to adjust their response time (from 50/100ms to 10s). This is a feature able to permit the measurement also in unstable measuring condition (e.g. flames, moving target, etc.)

3.3 OS8000 principle

The optical system of **OS8000** transmitters collects the infrared energy into the infrared detector through a single lens, a filter and a field stop that defines the visual cone and therefore the dimensions of the target.
A filter is placed between the optic system and the infrared radiation sensor, to determine the working spectral band and to eliminate any radiation effect in the visible band.
In order to obtain a correct alignment of the thermometer, sighting devices or laser pointers are available. When the alignment is achieved the sighting telescope or laser pointer can be removed.
The infrared radiation is converted, by the sensor, into an electric signal with a non-linear dependence on the target temperature. The electrical signal is linearized and amplified by the internal circuitry that makes available a 4/20 mA linear output.

3.3.1 Electronic module

The components used in the electronic circuits allow to use the optic head in environments with an ambient temperature up to +60 °C.
The 4/20 mA linear with temperature circuit incorporates the emissivity and response time adjustment. It requires a 24Vdc power supply and can be used together with the any other measurement/regulation system.

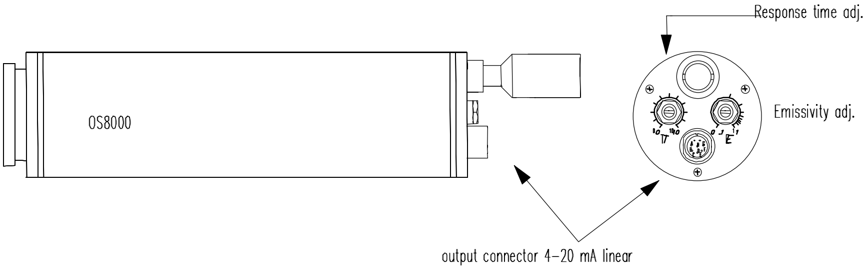


Fig. 3.3.1: Connectors and controls of OS8000

3.4 OS6000 principle

The infrared radiation emitted by the target is focused by the optic system, with a collector that has a sensitivity covering the spectral band required.
The optic system geometry, combined with a field stop, determines with accuracy the dimension of the target and the distance between the thermometer and the target.
A filter is placed, between the optic system and the infrared radiation sensor, to determine the working spectral band and to eliminate any radiation effect from the visible band.
The infrared radiation is converted into an electric signal proportional to the target temperature in a non-linear mode.
The electric signal is treated by the internal circuitry that makes an output from 4 to 20 mA signal available.

3.4.1 Electronic module

The components used in the electronic circuits allow to use the optic head in environment with an ambient temperature up to +60 °C.
The 4/20 mA linear with temperature circuit incorporates the emissivity and response time adjustment. It requires a 24Vdc power supply and can be used together with the any other measurement/regulation system.

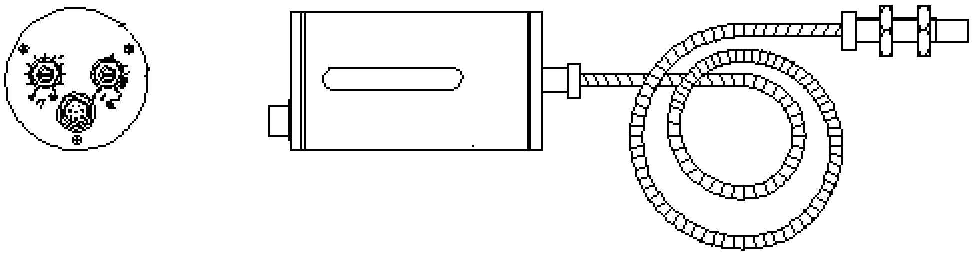


Fig. 3.4.1: connectors and controls of OS6000

4 UNPACKING

Remove the instrument from its packing case and remove any shipping ties, clamps or packing materials.
Carefully follow any instruction given by any attached tags.
Inspect the instrument from scratches, dents, damages to case corners etc. which may have occurred during shipment.
If any mechanical damage is noted, report the damage to the shipping carrier and then notify **OMEGA Engineering** directly, and save the damaged packaging for inspection.
A label, on the back panel, indicates the serial number of the instrument. Refer to this number for any inquiry for service, spare parts supply or application and technical support requirements. **OMEGA Engineering** keeps a data base with every information regarding your instrument.

4.1 Pre-operational check

Store the instrument in the original package, at a temperature from –30 °C to +60°C, with R.H. less than 90%.

WARNING

THE FIBRE OPTIC IS A CRITICAL COMPONENT IN THE SYSTEM.
TO BEND, TO TWIST, OR TO PULL THE FIBRE OR THE CONNECTORS CAN DAMAGE THE SAME FIBRE MODIFYING THE OPTICAL TRANSMISSION OF THE COMPONENT AND COMPROMISING THE CORRECT OPERATION OF THE MEASURE SYSTEM.

5 START-UP

5.1 OS8000 operations

- Connect the air or the water tubes, making sure to have the possibility to align and point the thermometer.
- Verify the support to be clean and free.
- Insert the connector.

WARNING
DO NOT LEAVE THE THERMOMETER IN A HOT AREA WITHOUT HAVING CONNECTED THE COOLING SYSTEM.

After the connection to a controller or monitor, the thermometer is ready to operate (see the relevant manual for the controller or monitor).

5.1.1 Positioning

The optic head has to be installed in an accessible place for any further maintenance operation, and it hasn't to be exposed to excessive heat, smoke and water vapors.
The optical path between the lens and the target, should be as much free as possible from smoke and steam.
The pointing axis should be placed with a 90° angle against the target surface.

NOTE: A LARGE NUMBER OF MATERIALS HAVE THE EMISSIVITY COEFFICIENT DEPENDENT ON THE VIEWING ANGLE. LARGE ANGLES (MORE THAN 45°) CAN INDUCE A LARGE ERROR IN MEASUREMENT.

Before the installation, it's useful to look at the tables supplied together with the instrument, in order to determine the correct distance and visual field.

5.1.2 Mounting and Alignment

Install the mounting plate in a suitable place in the most favorable position from a thermal, and mechanical point of view.
Mount on the plate, if it is necessary, the protection device and the purge air ejector.
If a cooling jacket has to be used, use the water outlet on the upper part of the support in order not to create air bubbles in the jacket.

WARNING
IT ADVISABLE TO USE A PROTECTIVE SCREEN DURING THE THERMOMETER ALIGNMENT OPERATIONS IF THE TARGET HAS A STRONG RADIATION.

In order to align the support with the target, look through the support hole (without the thermometer) and find the best position. It's important for the optic path to be free from any obstacle. In particular, when the surface is targeted through a hole, the hole diameter has to be big enough according to the distance from the instrument.

5.1.3 Electrical connection

The temperature signal is converted, amplified and linearized by the internal electronics that makes available a 4/20 mA linear output. OMEGA supply a connector for 4/20 mA active current loop connection.

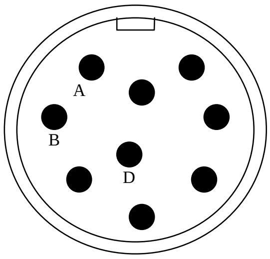


Fig. 5.1.3a: OS8000 connector (soldering side)

To connect OS8000 to a measurement or control system, follow the table below:

Pin A (+) ———————————— o (+)
24 Vdc power supply
OS8000 [o (-)
Connector [o (-)
INDICATOR INPUT 4 ÷ 20 mA
Pin B (-) ———————————— o (+)
Pin D (GND)————

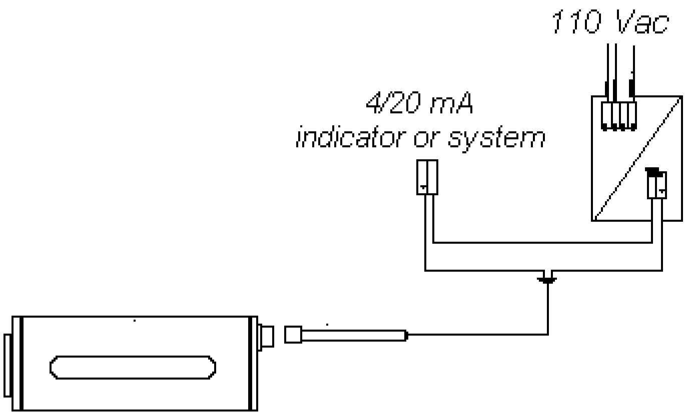


Fig. 5.1.3b: Power supply for OS8000 using external current loop

5.1.4 Pointing systems

A removable telescope is optionally available for an accurate alignment of the thermometer. It is particularly useful when little objects are to be targeted.
The telescope has to be inserted in the thermometer, and removed when the alignment has been done.
In order to insert the telescope, the protection cap must be removed.
The focusing of the target must be carried-out varying the telescope introduction inside the thermometer body. This operation can be also carried-out by using the laser pointing system.

5.1.5 Air supply

According to the application, it could be necessary to cool the thermometer using an air flow. The maximum pressure for an air purge system is 0.7 bar. Just for a normal air purge, only the tenth part of this flow is required.
Remember that the air tube must have a diameter bigger enough not to have flow losses.

IMPORTANT NOTE:
WHEN A PURGE AIR IS USED, IT MUST BE CLEAN AND DRY. THE DIFFUSOR PRODUCES A LAMINAR FLOW THAT KEEPS THE LENS CLEAN. IF THE AIR ISN'T PERFECTLY CLEAN, TRACKS OF OIL AND DIRT MAY DEPOSIT ON THE LENS.

IMPORTANT NOTE:

WHEN MEASURING TEMPERATURES INSIDE OVENS, DO NOT USE ANY AIR COMING FROM THE FAN OF THE OVEN. THE AIR FROM THE OVEN, IN FACT, MAY VARY, AND THE PRESSURE ON THE THERMOMETER MAY BE NOT SUFFICIENT TO GRANT ITS CLEANING AND COOLING.

5.1.6 Water Supply

When the thermometer is installed in a very hot environment it is useful to cool it with water. The water must be clean in order not to create any obstruction and cold enough to ease the thermometer cooling.

IMPORTANT NOTE:

DO NOT USE TOO COOL WATER AS IT COULD CREATE CONDENSE ON THE SUPPORT OR ON THE LENS.
IT IS ADVISABLE TO HAVE A LOW WATER FLOW TO KEEP THE TEMPERATURE OF THE SUPPORT HIGHER THAN THE DEW-POINT OF A HOT AND HUMID DAY.
THE FLOW SHOULDN'T BE HIGHER THAN 0.7 BAR AND THE AMBIENT TEMPERATURE SHOULD BE LOWER THAN 200°C.

The cooling water line has to be made using the following precautions:

- The outlet of the cooling jacket must be kept free in order to control the flow and water temperature;
- It's useful to use a thermometer to control the water temperature.

NOTE: IN CLOSE CIRCUIT SYSTEMS, ALWAYS USE A FLOW WATER WITH A LOW LEVEL ALARM

5.2 OS6000 operations

5.2.1 Optical Head Positioning

The optic head has to be installed in an accessible place for any further maintenance operation, and it hasn't to be exposed to excessive heat, smoke and water vapors.
The optical path between the lens and the target, should be as much free as possible from smoke and steam.
The pointing axis should be placed with a 90° angle against the target surface.

NOTE: A LARGE NUMBER OF MATERIALS HAVE THE EMISSIVITY COEFFICIENT DEPENDENT ON THE VIEWING ANGLE. LARGE ANGLES (MORE THAN 45°) CAN INDUCE A LARGE ERROR IN MEASUREMENT.

Before the installation, it' s useful to look at the tables supplied together with the instrument, in order to determine the correct distance and visual field.

5.2.2 Optic Head Mounting and Alignment

Fix the optic head on the suitable support using the supplied hexagonal washers. Place the support in the best possible position from a thermal point of view (the maximum ambient temperature is 200 °C), from a mechanical point of view (minimum to no vibration) and environmental one (dust, smoke, vapors, and so on).
Align the support with the surface to be measured, center the target by looking through the optic head after the optic fiber has been removed. In order to make the pointing operations easier, it's possible to have a pointing device that aligns the head using a luminous track. It's important for the optic path to be free from any obstacle. In particular, when the surface is targeted through a hole, the hole diameter has to be big enough according to the distance from the instrument.

5.2.3 Air Supply

In the applications where a purge air is needed to clean the optic system, adjust the flow at 0.5 bar. If a cooling effect is required, embance the flow up to 10 bar. The supply tubing system has to be designed with a correct diameter in the thermometer proximity, in order not to have charge losses.

IMPORTANT NOTE:

THE PURGE AIR MUST BE DRY AND CLEAN.
IF THE AIR ISN'T CLEAN, THE DIFFUSER MAY BECOME OBSTRUCTED, OIL AND DIRT MAY DEPOSIT ON THE LENS.
THIS WILL CREATE MEASURING ERRORS AND FREQUENT MAINTENANCE OPERATIONS.

5.2.4 Optic Fiber Connection

The connection between the optic head and the electronic unit is made with an optic fiber cable. The cable is supplied with two special connectors to connect the two components.
Before the installation, be sure that the connectors are perfectly clean. The cable should be installed protected by a tube and without too sharp bends. Firmly screw the female connector to the optic head, and the male one on the electronic unit.

5.2.5 Electronic module mounting

The electronic equipment must be installed far from heat sources, basing the distance upon the length of the optic fiber. The electronics can be fixed using the 1/4" hole or with the OS6000-16 support. (See the figure below).

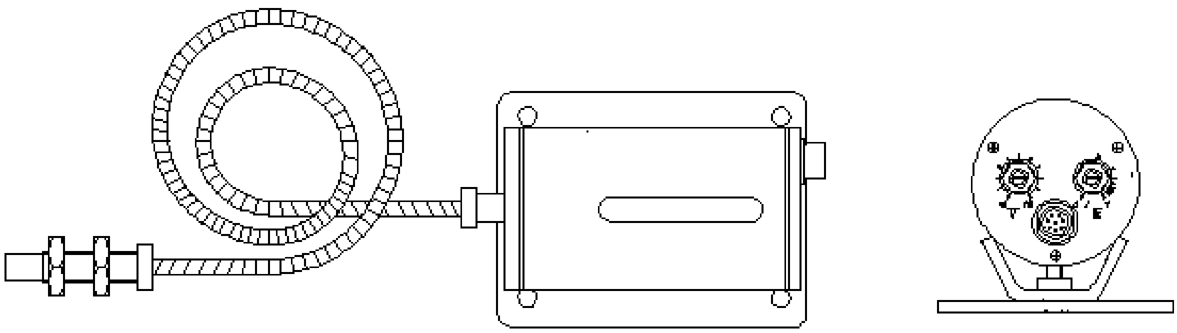


Fig. 5.2.5: OS6000 thermometer complete of electronic module support.

5.2.6 Head mounting bracket

The optic head can be supplied with a mounting bracket to aim at the target in an accurate way. It's dimensions are as per the figure below:

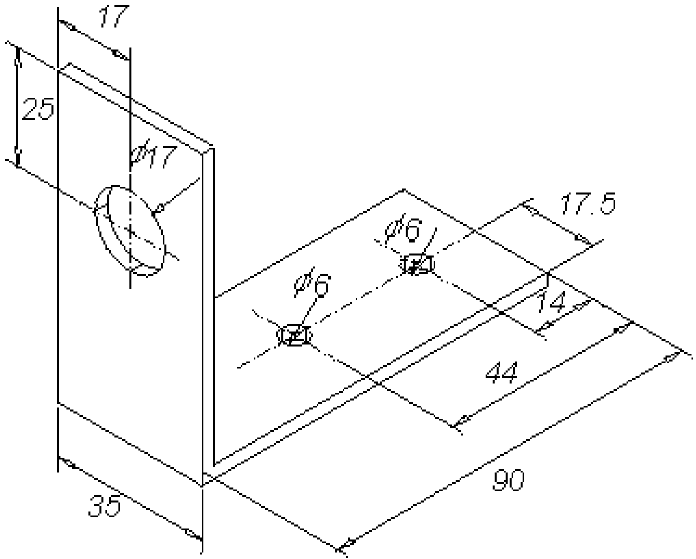


Fig. 5.2.6: OS6000 head mounting bracket

5.2.7 Electrical connection

The temperature signal is converted, amplified and linearized by the internal electronics that makes available a 4/20 mA linear output. OMEGA supply a connector for 4/20 mA active current loop connection.

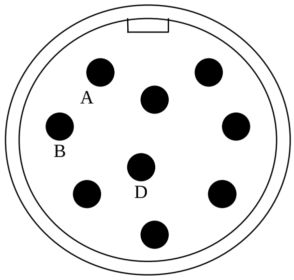


Fig. 5.2.7a: OS6000 connector (soldering side)

To connect OS6000 to a measurement system, follow the table below:

Pin A (+) ———————————— o (+)
24 Vdc power supply
OS6000 [o (-)
Connector [o (-)
INDICATOR INPUT 4 ÷ 20 mA
Pin B (-) ———————————— o (+)
Pin D (GND)————

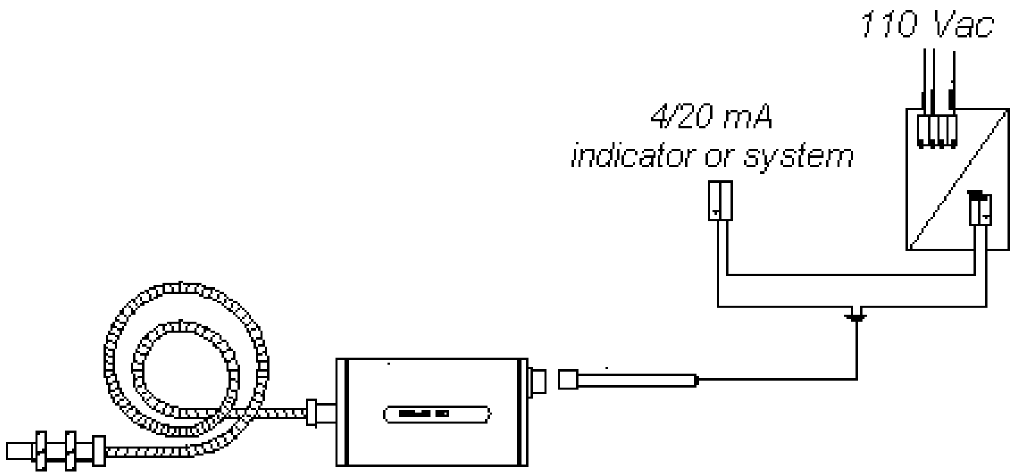


Fig. 5.2.7b: Power supply for OS6000 using external current loop

6 MAINTENANCE

The **OMEGA** thermometer **OS6000 and OS 8000** have been tested and calibrated before shipment. The calibration has to be verified only if any measurement error is present or when any electronic component has been replaced.
OS6000 and OS 8000 use a sophisticated analog and digital technology. All the maintenance operations must be carried on by qualified personnel. Please contact **OMEGA Engineering** for any support.

For a correct working of the instrument, the optic system must be kept clean and it mustn't reach temperatures higher than the specified ones. The maintenance department should ensure these working conditions with a periodical check of the cooling system and cleaning the lens.

6.1 Purge Air Supply

The air filters cleanliness must be checked at regular intervals. Our suggestion is to check it every day, then, according to your experience, find a correct time interval. If the optic system reaches temperatures higher than the working one, it has to be returned to **OMEGA** and calibrated.

The purge air device is to be accurately checked, as the diffuser may become obstructed by non-clean air. When this happens, the air flow from the diffuser is not uniform, and dust particles appear on the lens. In this case, the diffuser should be drowned in a detergent solution and blown with compressed air, then dried. A good air filtering can solve this problems.

6.2 Water Supply

Verify the water flow according to your experience: daily first, and then when the system is running well, weekly.
Check the thermometer temperature: it has to be high enough to prevent any condense formation. Once the water continuity is defined, it's enough to verify the support temperature, that has to be slightly warm.
If the thermometer reaches too high temperatures, due to water absence or to a flow partial interruption, it has to be verified and calibrated by **OMEGA**.

6.3 Optic cleaning

OS8000
Remove the terminal connector of the jacket by unscrewing the fixing brackets and disconnect the connection wires terminal board. Remove the thermometer from its support and verify the lens that has to be clean.
If necessary, clean the lens with a very soft cloth and then reinstall the thermometer.
Verify the alignment by inserting the pointing telescope in its slot. Remove the telescope, close its slot with the appropriate cap, and reconnect everything.
Now you can remove the telescope pointing, close the remaining hole in the thermometer using the dedicated plug and remount the electrical connector.

OS6000
First of all you should remove the optic head from the positioning support. Verify the lens state. If it isn’t perfectly clean, remove the lens from the head unscrewing from the front side the screw and the O-ring.
Use a clean, soft and dry cloth or use a non abrasive detergent solution.
Remount all the components on the optical head.

6.4 Protection and Support Device

Verify the cleanliness of the internal part of the cylinder removing any dirt particles or oil .
Examine the purge air device as the diffuser may become obstructed, creating problems of dirt on the lens.
A good filtering system prevents this problem. Anyway, when this condition occurs, the diffuser has to be immersed in a detergent solution for a few minutes and then blown dry with compressed air.

6.5 Mounting Device

Verify at regular intervals that these devices are in good conditions and that no damage has occurred.

6.6 Electrical connection cable

Verify at regular intervals that it is in good conditions and that no damage has occurred. Verify also the good connections with the indicator or the acquisition system.

6.7 Storage

Store the instrument in the original package, at a temperature from –30 °C to +60°C, with R.H. less than 90%.

7 SUPPORT AND ACCESSORIES

This chapter describes available accessories that can be supplied with the measuring systems.

7.1 Air Purge

To eliminate fumes or vapors from the front of the optic head, and to keep the lens clean, an air flux is used. This air flux can also be used to cool, when necessary. It's important to use very clean air to prevent dirt from depositing on the main lens. Every particle in the air could obstruct part of the diffuser, and modify the aerodynamic characteristics in the air flux. So, the flux would be modified, and dirt air could reach the lens.
The air system must be periodically checked.
To add a filtering system is strongly recommended.
OMEGA can supply an air filtering system to be used on the already present air network. This system needs dry and clean air at a pressure up to 10 bar. If a compressed air network isn't available, a fan generating system can be used.

7.1.1 OS8000 air purge and water cooling devices

The purge air devices have been designed to be coupled with the protection support in order to maintain the lens clean. The air flow eases the dispersion of fumes and vapors in the area beside the targeted object. An exhaust outlet is provided to prevent the vapor condense when the pointing tube is porous material made.
OS8000 works with ambient temperature up to 60°C. Some times the ambient conditions are different. When extreme ambient conditions occur, it is possible to use a flanged water jacket with air purge (code OS8000-11). This accessory allows to use the OS8000 thermometers with ambient temperature up to 200°C.

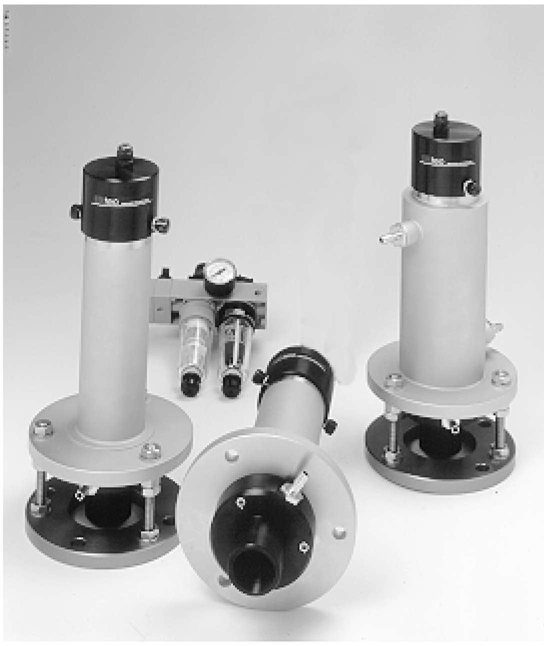


Fig. 7.1.1 : Air purge and water cooling code OS8000-11

7.1.2 OS6000 Purge Air Device

These devices are used to keep the thermometer lens clean. The air flow allows the air dispersion in the area immediately opposite to the target and it cools the optic head. To make the maintenance and installation fast and easy, the unit is composed by an optics support flange and an ejector body. On the flange the optics in mounted and fixed with two hexagonal washers. The ejector body can be supplied with a 1” ½ stainless steel pointing tube, with a length from 250 mm to 500 mm.

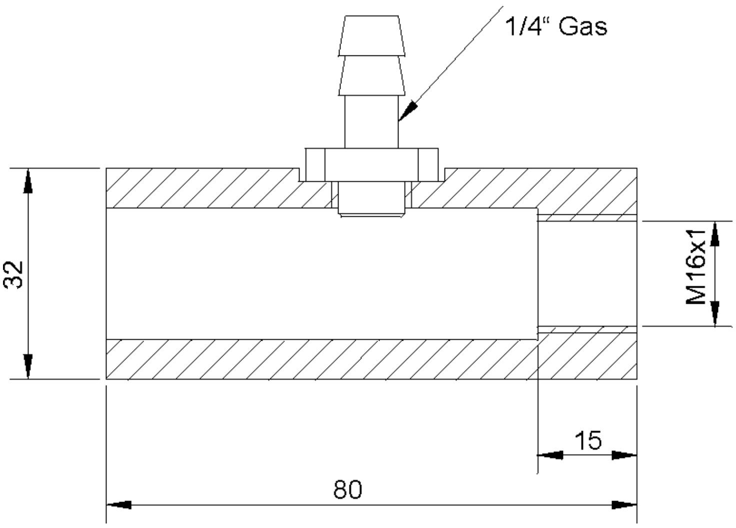


Fig. 7.1.2 a: Air purge collar code OS6000-11

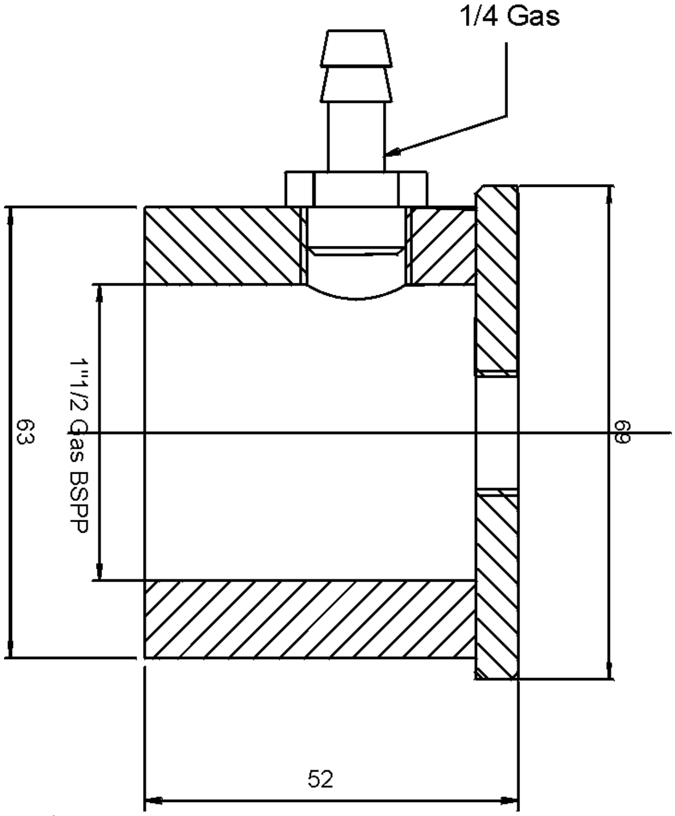


Fig. 7.1.2b : Air purge system code OS6000-18

7.2 Pointing Tubes

The pointing tubes, designed by the customer, must be used when the target is covered by fumes or flames. These devices can be designed for the user application with Open bottom or Close bottom
The **open bottom** is recommended to pass through fumes and/or flames in order to have a clear sight of the target.
The **close bottom** is used when the target is drowned in fumes or flames. Therefore, the measured temperature will be the temperature of the bottom part of the tube.

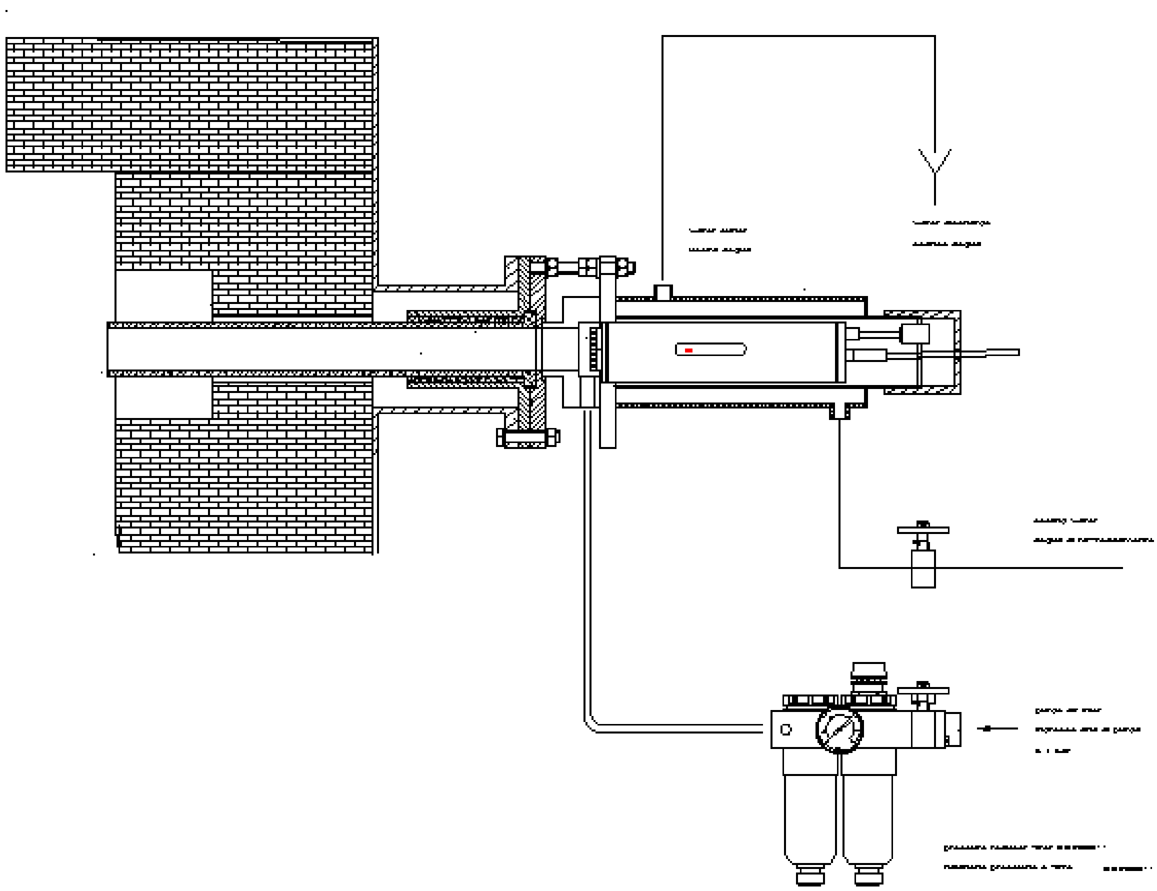


Fig. 7.2.1 : Complete OS8000 system installation

APPENDIX

A1 How to determine an object emissivity

Emissivity is the measure of an object ability to absorb, transmit, and emit infrared energy. It can have a value from 0 (shiny mirror) to 1.0 (blackbody). If a value of emissivity higher than the actual one is set, the output will read low, provided that the target temperature is above the ambient one. For example, if 0.95 is set in and the actual emissivity is 0.9, the reading will be lower than the true temperature when the target temperature is above the ambient one.

The emissivity can be determined by one of the following methods, in order of preference:

1. Determine the actual temperature of the material using a sensor such as a RTD, thermocouple or another suitable method. Next, measure the object temperature and adjust the emissivity setting until the correct value is reached. This is the correct emissivity for the measured material.

2. For relatively low temperature objects (up to 260°C or 500°F, place a piece of tape, such as a masking, on the object. Make sure the tape is large enough to cover the field of view. Next, measure the tape temperature using an emissivity setting of 0.95. Finally, measure an adjacent area on the object and adjust the emissivity setting until the same temperature is reached. This is the correct emissivity for the measured material.

3. If a portion of the surface of the object can be coated, use a flat black paint, which will have an emissivity of about 0.98. Next, measure the painted area using an emissivity setting of 0.98. Finally, measure an adjacent area on the object and adjust the emissivity setting until the same temperature is reached. This is the correct emissivity for the measured material.

A1.1 Typical Emissivity Values

The following table provides a brief reference guide to determine emissivity and can be used when one of the above methods is not practical. Emissivity values shown in the table below are only approximate, since several parameters may effect the emissivity of an object. These include the following ones:

1. Temperature
2. Angle of measurement
3. Geometry (plane, concave, convex, etc.)
4. Thickness
5. Surface quality (polished, rough, oxidized, sandblasted)
6. Spectral region of measurement
7. Transmissivity (i.e., thin film plastics)

A1.2 Metals - Typical Emissivity Values

	1.0 µm	1.6 µm	5.1 µm	8-14 µm
Aluminum				
Non-Oxidized	0.1-0.2	0.02-0.2	0.02-0.2	0.02-0.1
Oxidized	0.4	0.4	0.2-0.4	0.2-0.4
Alloy A 3003				
Oxidized	—	0.4	0.4	0.3
Roughened	0.2-0.8	0.2-0.6	0.1-0.4	0.1-0.3
Polished	0.1-0.2	0.02-0.1	0.02-0.1	0.02-0.1
Brass				
Polished	0.8-0.95	0.01-0.05	0.01-0.05	0.01-0.05
Burnished	—	—	0.3	0.3
Oxidized	0.6	0.6	0.5	0.5
Carbon				
Non-oxidized	0.8-0.95	0.8-0.9	0.8-0.9	0.8-0.9
Graphite	0.8-0.9	0.8-0.9	0.7-0.9	0.7-0.8
Chromium	0.4	0.4	0.03-0.3	0.02-0.2
Copper				
Polished	0.05	0.03	0.03	0-03
Roughened	0.05-0.2	0.05-0.2	0.05-0.15	0.05-0.1
Oxidized	0.2-0.8	0.2-0.9	0.5-0.8	0.4-0.8
Gold	0.3	0.01-0.1	0.01-0.1	0.01-0.1
Haynes Alloy	0.5-0.9	0.6-0.9	0.3-0.8	0.3-0.8
Inconel				
Oxidized	0.4-0.9	0.6-0.9	0.6-0.9	0.7-0.95
Sandblasted	0.3-0.4	0.3-0.6	0.3-0.6	0.3-0.6
Electro-polished	0.2-0.5	0.25	0.15	0.15
Iron				
Oxidized	0.4-0.8	0.5-0.9	0.6-0.9	0.5-0.9
Non-oxidized	0.35	0.1-0.3	0.05-0.25	0.05-0.2
Rusted	—	0.6-0.9	0.5-0.8	0.5-0.7
Molten	0.35	0.4-0.6	—	—
Iron Cast				
Oxidized	0.7-0.9	0.7-0.9	0.65-0.95	0.6-0.95
Non-oxidized	0.35	0.3	0.25	0.2
Molten	0.35	0.3-0.4	0.2-0.3	0.2-0.3
Iron Wrought				
Dull	0.9	0.9	0.9	0.9
Lead				
Polished	0.35	0.05-0.2	0.05-0.2	0.05-0.1
Rough	0 65	0.6	0.4	0-4
Oxidized	—	0.3-0.7	0.2-0.6	0.2-0.6
Magnesium	0.3-0.8	0.05-0.3	0.03-0.15	0.02-0.1
Mercury	—	0.05-0.15	0.05-0.15	0.05-0.15
Molybdenum				
Oxidized	0.5-0.9	0.4-0.9	0.3-0.7	0.2-0.6
Non-oxidized	0.25-0.35	0.1-0.3	0.1-0.15	0.1
Monel (Ni-Cu)	0.3	0.2-0.6	0.1-0.5	0.1-0.14
Nickel				
Oxidized	0.8-0.9	0.4-0.7	0.3-0.6	0.2-0.5
Electrolytic	0.2-0.4	0.1-0.3	0.1-0.15	0.05-0.15
Platinum				
Black	—	0.95	0.9	0.9
Silver	0.04	0.02	0.02	0.02
Steel				
Cold-Rolled	0.8-0.9	0.8-0.9	0.8-0.9	0.7-0.9
Ground Sheet	—	—	0.5-0.7	0.4-0.6
Polished Sheet	0.35	0.25	0.15	0.1
Molten	0.35	0.25-0.4	0.1-0.2	—
Oxidized	0.8-0.9	0.8-0.9	0.7-0.9	0.7-0.9
Stainless	0.35	0.2-0.9	0.15-0.8	0.1-0.8
Tin (Non-oxidized)	0.25	0.1-0.3	0.05	0.05
Titanium				
Polished	0.5-0.75	0.3-0.5	0.1-0.3	0.05-0.2
Oxidized	—	0.6-0.8	0.5-0.7	0.5-0.6

	1.0 µm	1.6 µm	5.1 µm	8-14 µm
Tungsten		0.1-0.6	0.05-0.5	0.03
Polished	0.35-0.4	0.1-0.3	0.05-0.25	0.03-0.1
Zinc				
Oxidized	0.6	0.15	0.1	0.1
Polished	0.5	0.05	0.03	0.02

A1.3 Non-Metals - Typical Emissivity Values

	1.0 µm	2.2 µm	5.1 µm	8-14 µm
Asbestos	0.9	0.8	0.9	0.95
Asphalt	—	—	0.95	0.95
Basalt	—	—	0.7	0.7
Carborundum	—	0.95	0.9	0.9
Ceramic	0.4	0.8-0.95	0.85-0.95	0.95
Clay	—	0.8-0.95	0.85-0.95	0.95
Concrete	0.65	0.9	0.9	0.95
Cloth	—	—	0 95	0.95
Glass				
Plate	—	0.2	0.98	0.85
"Gob"	—	0.4-0.9	0.9	
Gravel	—	—	0.95	0.95
Gypsum	—	—	0.4-0.97	0.8-0.95
Ice	—	—	—	0.98
Limestone	—	—	0.4-0.98	0.98
Paint				0.9-0.95
Paper (any color)	—	—	0.95	0.9S
Plastic (opaque, over 20 mils)	—	—	0.95	0.95
Rubber	—	—	0.9	0 95
Sand	—	—	0.9	0.9
Snow	—	—		0.9
Soil	—	—	—	0.9-0.98
Water	—	—	—	0.93
Wood, Natural	—	—	0.9-0.95	0.9-0.95

To optimize surface temperature measurements consider the following guidelines:

1. Determine the object emissivity using the instrument to be used for the measurement.
2. Avoid reflections by shielding the object from surrounding high temperature sources.
3. For Higher temperature objects use shorter wavelength instruments, whenever any overlap occurs.
4. For semi-transparent materials such as plastic films and glasses, assure that the background is uniform and lower in temperature than the object.
5. Mount the sensor perpendicular to the surface whenever the emissivity is less than 0.9. In any case, do not exceed angles more than 30 degrees from incidence.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WAR-RANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSEO OR IMPUED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABIUTY AND RTNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein ate exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence. Indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please has the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

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- ☑ Immersion & Band Heaters
- ☑ Flexibie Heaters
- ☑ Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL
- ☑ Metering & Control Instrumentation
- ☑ Refractometers
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- ☑ Air, Soil & Water Monitors
- ☑ Industrial Water & Wastewater Treatment
- ☑ pH, Conductivity & Dissolved Oxygen Instruments

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