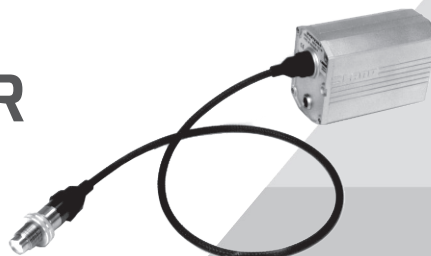


# SYSTEM 4 FIBROPTIC THERMOMETER USER GUIDE

PUBLICATION N° 198.007

LANGUAGE: ENGLISH



System 4 Fibroptic Thermometer



**LAND**<sup>®</sup>  
AMETEK



QUALITY CUSTOMER SOLUTIONS

### Health and Safety Information



Read all of the instructions in this booklet - including all the **WARNINGS** and **CAUTIONS** - *before* using this product. If there is any instruction which you do not understand, **DO NOT USE THE PRODUCT**.

#### Safety Signs



#### WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or personal injury.



#### CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to the user or users, or result in damage to the product or to property.

#### NOTE

Indicates a potentially hazardous situation which, if not avoided, could result in damage or loss of data.

### Signs and Symbols used on equipment and Documentation



Caution, risk of electric shock.



Caution, attention to possibility of risk of damage to the product, process or surroundings. Refer to instruction manual.



Caution, hot surface.



Protective Conductor Terminal.



Observe precautions for handling electrostatic discharge sensitive devices.

### Equipment Operation

Use of this instrument in a manner not specified by LAND may be hazardous. Read **and understand** the user documentation supplied **before** installing and operating the equipment.

The safety of any system incorporating this equipment is the responsibility of the assembler.

### Protective Clothing, Face and Eye Protection

It is possible that this equipment is to be installed on, or near to, machinery or equipment operating at high temperatures and high pressures. Suitable protective clothing, along with face and eye protection must be worn. Refer to the health and safety guidelines for the machinery/equipment before installing this product. If in doubt, contact LAND.



Wear Protective Gloves



Wear Protective Clothing



Wear Eye Protection



Wear Ear Protection



Wear Safety Boots



Wear Face Protection

### Electrical Power Supply

Before working on the electrical connections, all of the electrical power lines to the equipment must be isolated. All the electrical cables and signal cables must be connected exactly as indicated in these operating instructions. If in doubt, contact LAND.

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For further details on all LAND offices, distributors and representatives, please visit our website.

## Storage

The instrument should be stored in its packaging, in a dry sheltered area.

The maximum storage temperature is 10 °C (18 °F) higher than the maximum operating temperature.

The minimum storage temperature is 10 °C (18 °F) lower than the minimum operating temperature.

Refer to the Technical Specification for details of the operating temperature limits.

## Unpacking

Check all packages for external signs of damage. Check the contents against the packing note.

## Lifting Instructions

Where items are too heavy to be lifted manually, use suitably rated lifting equipment. Refer to the Technical Specification for weights. All lifting should be carried out in accordance with local and national regulations.

## Return of Damaged Goods

IMPORTANT If any item has been damaged in transit, this should be reported to the carrier and to the supplier immediately. Damage caused in transit is the responsibility of the carrier not the supplier.

DO NOT RETURN a damaged instrument to the sender as the carrier will not then consider a claim. Save the packing with the damaged article for inspection by the carrier.

## Return of Goods for Repair

If you need to return goods for repair please contact our Customer Service Department for details of the correct returns procedure.

Any item returned to LAND should be adequately packaged to prevent damage during transit.

You must include a written report of the problem together with your own name and contact information, address, telephone number, email address etc.

## Design and Manufacturing Standards

The Quality Management System of Land Instruments International is approved to BS EN ISO 9001 for the design, manufacture and on-site servicing of combustion, environmental monitoring and non-contact temperature measuring instrumentation.

Registered ISO9001 Management System approvals apply in the USA.

UK Calibration Laboratory: UKAS 0034.

USA Calibration Laboratory: ANAB Accredited ISO/IEC 17025.

National Accreditation Board for Testing and Calibration Laboratories approvals apply in India.

Operation of radio transmitters, telephones or other electrical/electronic devices in close proximity to the equipment while the enclosure doors of the instrument or its peripherals are open, may cause interference and possible failure where the radiated emissions exceed the EMC directive.

The protection provided by this product may be invalidated if alterations or additions are made to the structural, electrical, mechanical, pneumatic, software or firmware components of this system. Such changes may also invalidate the standard terms of warranty.

## Copyright

This manual is provided as an aid to owners of LAND's products and contains information proprietary to LAND. This manual may not, in whole or part, be copied, or reproduced without the expressed written consent of LAND.

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# 1

## INTRODUCTION

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### 1.1 About this guide

This guide gives the information necessary for you to operate a LAND System 4 Fiberoptic Thermometer. Basic information regarding installation is contained within the Installation Guide.

### 1.2 About the Fiberoptic thermometer

The LAND System 4 Fiberoptic thermometer is an accurate, non contact thermometer designed for use in conjunction with the System 4 Landmark processors.

The thermometer features include:

- A choice of fibre-optic lightguides, enabling the thermometer's electronics to be located away from the often hostile measurement location.
- A choice of optic head focus distance.
- Electrical connections for a 4 to 20 mA output, linear over the temperature span of the thermometer, and an emissivity input for high accuracy temperature measurement.

### 1.3 About System 4

LAND System 4 is a range of high accuracy thermometers, state of the art processors and rugged mounting accessories designed to provide precise, non contact temperature measurement in a wide range of industrial applications.

An air purge, protection jacket and back cap are available for use with the thermometer in hostile locations.

### 1.4 Unpacking the thermometer

The package containing the thermometer will contain the following items:

- CD containing System 4 User Documentation.
- System 4 Fiberoptic thermometer (fitted with protection caps on the lens and the eyepiece).



Fig. 1 LAND System 4 Fibroptic thermometer

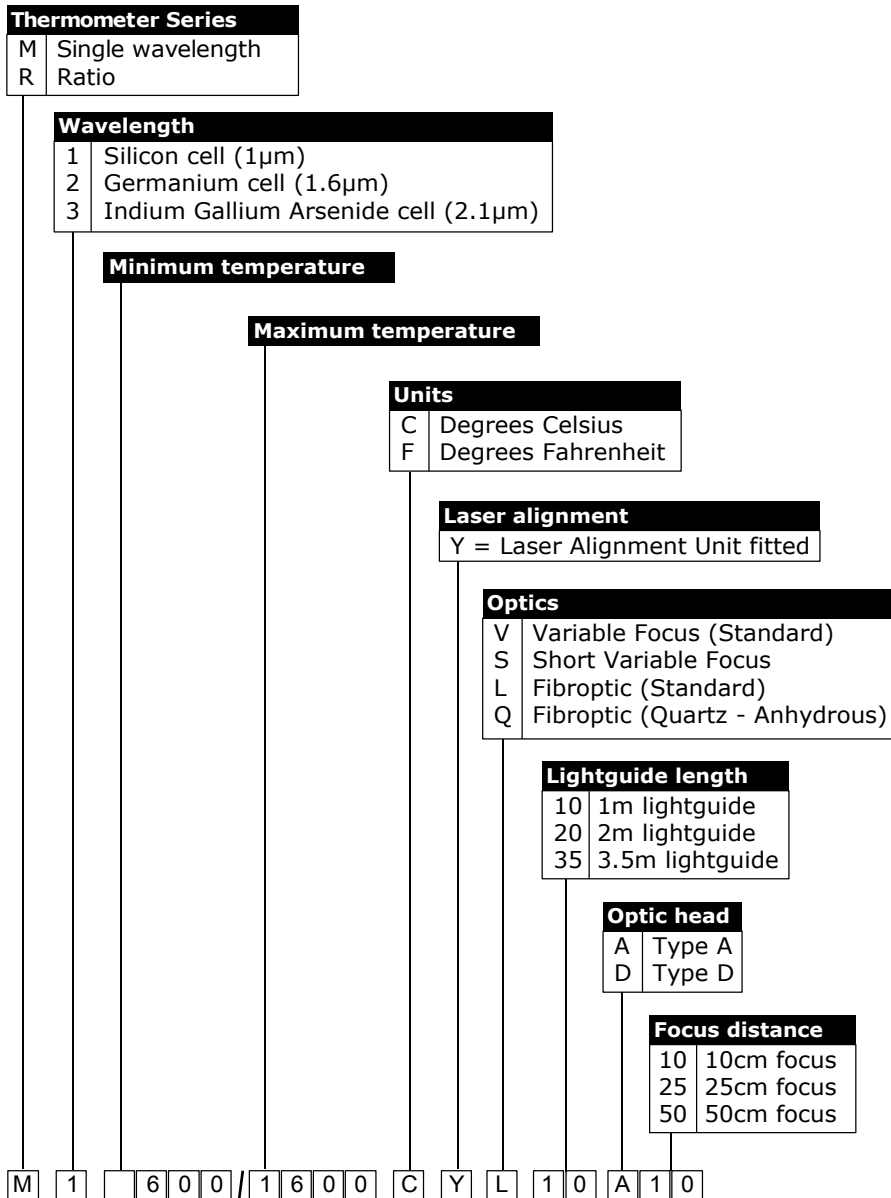


Fig. 2 System 4 Fibroptic Thermometer Nomenclature

### 1.5 Nomenclature

The thermometer detail label is on the rear face of the thermometer above the lightguide connector. The thermometer instrument type nomenclature is explained in Fig. 2.

Make a note of your thermometer instrument type and Serial Number in the space provided below. This information is required to configure a Landmark processor to work with your thermometer.

Instrument type:   /     /

Serial Number:       /   /

## 2

# SPECIFICATIONS

---

## 2.1 M1 Series Thermometers

Thermometer Model	M1 600/1600C-L	M1 1100/2900F-L	M1 800/2600C-L	M1 1500/4700F-L
Temperature Range:	600 to 1600 °C	1100 to 2900 °F	800 to 2600 °C	1500 to 4700 °F
Wavelength:	1µm			
Response Time:	5ms (0 to 95%)			
Field of View (Nominal):	25:1		75:1	
Target diameter:				
A10 optic head:	4 mm at 100 mm (0.15 in at 3.9 in)		1.3 mm at 100 mm (0.05 in at 3.9 in)	
A25 optic head:	10 mm at 250 mm (0.39 in at 9.8 in)		3.3 mm at 250 mm (0.12 in at 9.8 in)	
A50 optic head:	23 mm at 500 mm (0.90 in at 19.6 in)		6.7 mm at 500 mm (0.26 in at 19.6 in)	
Accuracy				
Repeatability:	≤1K		≤2K	
Absolute:	0.4%K		0.7%K	
Stability (Temperature):	0.2°/°ambient		0.3°/°ambient	
Stability (Time):	2 °C (4 °F) per year		2 °C (4 °F) per year	
Vibration:	3G any axis 10 to 300 Hz			
Humidity:	0 to 99% non condensing			
Sealing:	IP65			
Ambient Temperature				
Optic head:	200 °C (392 °F)			
Lightguide	200 °C (392 °F)			
Detector:				
Specified:	0 to 70 °C (32 to 158 °F)			
Operating:	-10 to 80 °C (14 to 176 °F)			
CE	EN 50-082-2 (immunity) EN 50-081-1 (emission) IEC 1010 (safety)			

## 2.2 M2 Series Thermometers

Thermometer Model	M2 300/1100C-L	M2 600/2000F-L
Temperature Range:	300 to 1100 °C	600 to 2000 °F
Wavelength:	1.6µm	
Response Time:	5ms (0 to 95%)	
Field of View (Nominal):	25:1	
Target diameter:		
A10 optic head:	4 mm at 100 mm (0.15 in at 3.9 in)	
A25 optic head:	10 mm at 250 mm (0.39 in at 9.8 in)	
A50 optic head:	23 mm at 500 mm (0.90 in at 19.6 in)	
Accuracy		
Repeatability:	≤1K	
Absolute:	≤0.25%K + 1K	
Stability (Temperature):	0.2°/°ambient	
Stability (Time):	2 °C (4 °F) per year	
Vibration:	3G any axis 10 to 300 Hz	
Humidity:	0 to 99% non condensing	
Sealing:	IP65	
Ambient Temperature		
Optic head:	200 °C (392 °F)	
Lightguide	200 °C (392 °F)	
Detector:		
Specified:	0 to 50 °C (32 to 122 °F)	
Operating:	-10 to 60 °C (14 to 140 °F)	
CE	EN 50-082-2 (immunity) EN 50-081-1 (emission) IEC 1010 (safety)	

## 2.3 M3 Series Thermometers

Thermometer Model	M3 50/250C-Q	M3 150/500F-Q
Temperature Range:	50 to 250 °C	150 to 500 °F
Wavelength:	2.1µm	
Response Time:	100ms (0 to 95%)	
Field of View (Nominal):	20:1	
Target diameter:		
A10 optic head:	5 mm at 100 mm (0.2in at 3.9in)	
A25 optic head:	12.5 mm at 250 mm (0.5in at 9.8in)	
A50 optic head:	25 mm at 500 mm (1.0in at 19.6in)	
Accuracy <sup>1 2</sup>		
Repeatability:	1K	
Absolute:	≤3K	
Stability (Temperature) <sup>2</sup>	0.1°/°ambient	
Stability (Time):	2 °C (4 °F) per year	
Vibration:	3G any axis 10 to 300 Hz	
Humidity:	0 to 99% non condensing	
Sealing:	IP65	
Ambient Temperature		
Optic head:	150 °C (302 °F)	
Lightguide	150 °C (302 °F)	
Detector:		
Specified:	0 to 50 °C (32 to 122 °F)	
Operating:	0 to 50 °C (32 to 122 °F)	
CE	EN 50-082-2 (immunity) EN 50-081-1 (emission) IEC 1010 (safety)	

<sup>1</sup> Applies at target temperatures >75 °C

<sup>2</sup> Optic head/lightguide temperature must be at least 50 °C cooler than target temperature

## 2.4 R1 Series Thermometers

Thermometer Model	R1 600/1600C-L	R1 1100/2900F-L	R1 1000/2600C-L	R1 1800/4700F-L
Temperature Range:	600 to 1600 °C	1100 to 2900 °F	1000 to 2600 °C	1800 to 4700 °F
Wavelength:	0.85 to 1.1 μm			
Response Time:	15ms (0 to 95%)			
Field of View (Nominal):	25:1		75:1	
Target diameter:				
A10 optic head:	4 mm at 100mm (0.15in at 3.9in)		1.3 mm at 100mm (0.05in at 3.9in)	
A25 optic head:	10mm at 250mm (0.39in at 9.8in)		3.3 mm at 250mm (0.12in at 9.8in)	
A50 optic head:	23mm at 500mm (0.90in at 19.6in)		6.7 mm at 500mm (0.26in at 19.6in)	
Accuracy				
Repeatability:	≤1K		≤2K	
Absolute:	≤0.65%K		≤1.1%K	
Stability (Temperature):	0.2°/°ambient		0.3°/°ambient	
Stability (Time):	2 °C (4 °F) per year		2 °C (4 °F) per year	
Vibration:	3G any axis 10 to 300 Hz			
Humidity:	0 to 99% non condensing			
Sealing:	IP65			
Ambient Temperature				
Optic head:	200 °C (392 °F)			
Lightguide	200 °C (392 °F)			
Detector:				
Specified:	0 to 50 °C (32 to 122 °F)			
Operating:	-10 to 60 °C (14 to 140 °F)			
CE	EN 50-082-2 (immunity) EN 50-081-1 (emission) IEC 1010 (safety)			

# 3

## INSTALLING THE FIBROPTIC THERMOMETER

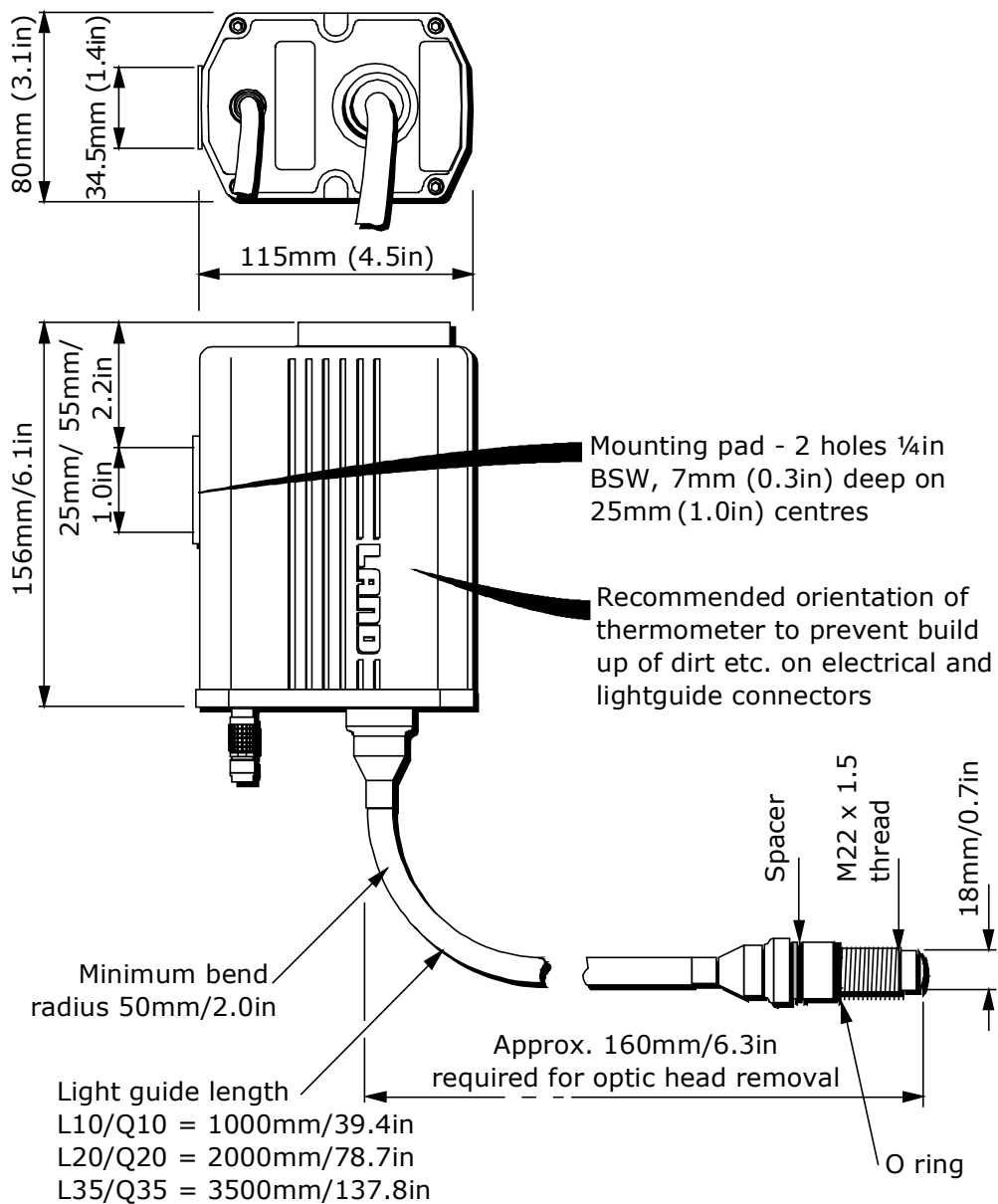


Fig. 3-1 System 4 Fiberoptic thermometer installation dimensions

### 3.1 Positioning the Optic Head

In many cases, there are few options on location of the optic head, as this is generally dictated by the particular measurement application. Observe the following precautions;

- 1) If your thermometer is an 'M' series thermometer (e.g. M1 600/1600 C L), it must be positioned such that, at the chosen target distance, the target is large enough to completely fill the optic head's field of view. Refer to the target size tables, Section 4. The thermometer's view of the target area must not be obstructed.
- 2) Ensure that the angle between the optic head's line of sight and the target area is as near to 90° as possible. However, if this is not possible, a viewing angle of up to 45° is acceptable.
- 3) If the optic head is located in an atmosphere containing a high proportion of dust/smoke etc, an air purge must be used in conjunction with the optic head. This prevents the lens from becoming dirty. Refer to the Installation Guide supplied with the mounting/purge assembly.
- 4) If your thermometer is an 'M3' series, ensure that the amount of visible extraneous light on the target surface is kept to an absolute minimum. This is especially important when the target emissivity is low.

The short operating wavelength of the M3 thermometer is optimised for low temperature measurement with a lightguide. This ensures excellent fibre transmission and extremely high tolerance to variations in emissivity. However, at this wavelength the radiation from the sun is large compared to that emitted by the low temperature target.

For more information on the effects of daylight and how to assess the need for shielding, see Land Technical Note N° S4 TN 011.

- 5) The optic head/lightguide temperature must not exceed the maximum specified. In the case of the M3, the optic head temperature should be at least 50°C lower than the target temperature, to ensure that the specified accuracy is achieved.

### 3.1.1 Installing the optic head

The optic head can either be directly mounted into a threaded hole in a user-supplied mounting plate, or connected to one of the range of Land Fibroptic thermometer mountings by means of the 'Quick Release Fitting', Land Part No 029.591.

To mount the optic head in a plate:

- 1) Refer to Fig. 3-2. Unscrew the clamp nut nearest the lens on the optic head.
- 2) Pass the optic head through a 22.5 mm diameter hole in the plate.
- 3) Re-attach the clamp nut onto the optic head. Tighten the nut so that the mounting plate is held securely between the two clamp nuts on the optic head.

To mount the optic head into Land Fibroptic thermometer mountings:

- 1) Refer to Fig. 3-3. Screw the two clamp nuts up as far as they will go on the thread on the optic head.  
NOTE: For 'D' type optic heads, unscrew and remove the two clamp nuts.
- 2) Screw the optic head into the 'Quick Release Fitting'.
- 3) Attach the fitting, plus the optic head, to the Land Fibroptic thermometer mounting by means of the twist lock on the Quick Release Fitting.

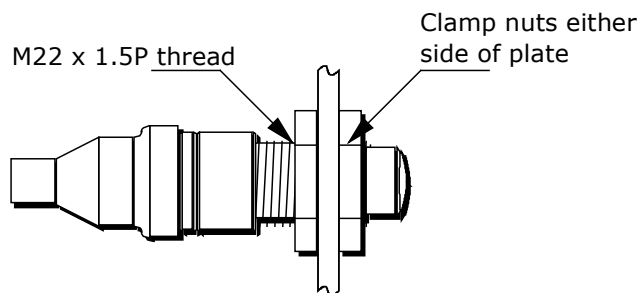


Fig. 3-2 Mounting the optic head into a plate

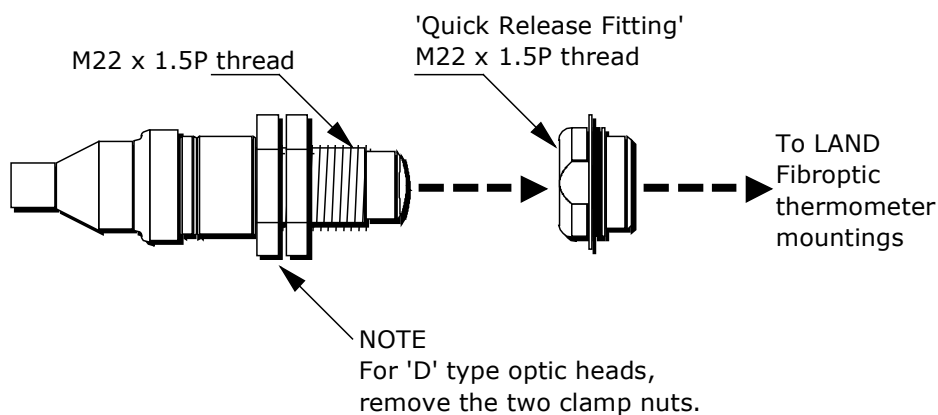



Fig. 3-3 Mounting the optic head into Land Fibroptic thermometer mountings

### 3.2 Using the Laser Alignment Unit (if fitted)



**WARNING**

Class 1 Laser Product. This laser product does not permit human access to laser radiation in excess of the accessible emission limits of Class 1 for applicable wavelengths and emission durations. Refer to BS EN 60825-1, 1994.

Embedded laser (diode) is Class 1M, <5mW. Do not view directly with optical magnifiers.

**Caution**

Use of controls or adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.

System 4 Fiberoptic Thermometers fitted with an optional Laser Alignment Unit are denoted by a letter 'Y' after the units in the product name.

e.g. M1 600/1600CY L10 A25.

The Laser Alignment is designed to aid the installation of the thermometer optic head by defining the target area on which the optic head is aligned. This is particularly useful in applications where the target size is small and/or where correct alignment is critical.

The Laser Alignment Unit may also be used for finding the correct distance from the target at which to mount the optic head, as the laser image is sharpest at this point. This distance may not necessarily be the nominal focal distance.

If you have a thermometer fitted with an A10 optic head, the laser image projected by the alignment unit will be an almost full bright spot. For A25 and A50 optic heads, the laser image will consist of many individual bright light spots, spaced randomly within the field of view.

#### 3.2.1 Laser Alignment Unit Specification

Embedded laser product classification:	Class 1M
Laser 'on' duration:	115 seconds
Laser pulse frequency:	2.5Hz, 54% duty cycle
Emission wavelength:	635nm
Thermometer performance degradation:	Noise, Response time and Ambient drift increased by a factor of 2 (for bottom 5% of span only)
Thermometer ambient temperature limits	0 to 40 °C specified and operating (operation outside these limits will greatly reduce the life expectancy of the laser)

All other Fiberoptic Thermometer specifications are unaffected by the Laser Alignment Unit.

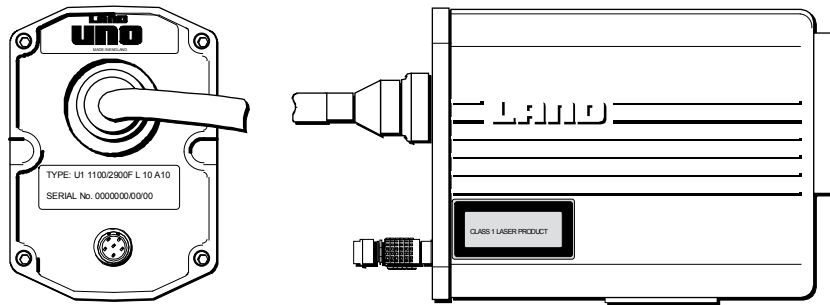
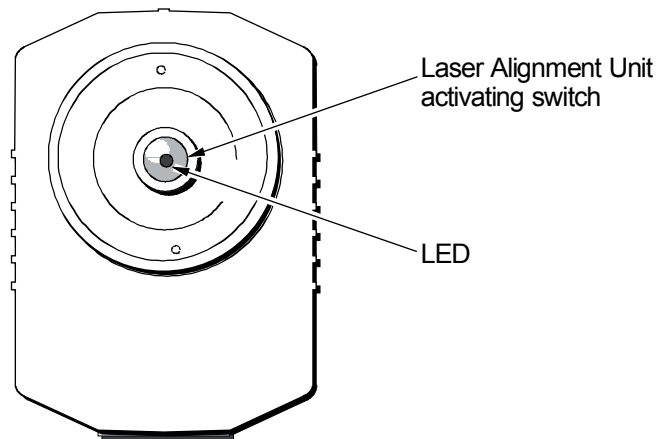


Fig. 3-4 Location of warning label on thermometer fitted with Laser Alignment Unit



#### Note

If you have an R1 Fiberoptic Thermometer, do not rely upon the accuracy of measurements in the bottom 10% of the span of the thermometer when the Laser Alignment Unit is operating.

Fig. 3-5 Location of the Laser Alignment Unit activating switch and LED

### 3.2.3 Using the Laser Alignment Unit

- 1) Choose a measurement location for the Optic Head (Refer to Section 3.1).
- 2) Connect the Thermometer to a suitable power supply.  
When the Thermometer is first switched on, the Laser Alignment Unit is activated and the target spot is illuminated by red laser light. When the laser is activated, a red LED in the push button on the front of the thermometer flashes for the duration of the laser (115 seconds).
- 3) If the Laser Alignment Unit switches off before the optic head is aligned, press the button on the front of the Thermometer. Refer to Fig. 6.
- 4) Adjust the mounting of the optic head so that the required target is in the field of view (i.e. illuminated by the laser). Note that for 'M' series Fiberoptic Thermometers, the target must fill the field of view completely.
- 5) When the alignment of the optic head is correct, secure the mountings and tighten the optic head lock nuts.

### 3.2.4 Laser Alignment Unit maintenance

The Laser Alignment Unit will operate reliably for years, provided it is operated within the ambient temperatures given in the specification (Refer to Section 3.2.1).

If the Laser Alignment Unit develops a fault, return the thermometer to LAND.

### 3.3 Installing the Lightguide

When installing the fibre-optic lightguide, observe the following precautions;

- 1) Ensure that the lightguide is not be subjected to any tension or other undue force. It is not necessary to attach the lightguide to surrounding structures unless, by leaving it hanging, it will vibrate violently, be a nuisance or a hazard.
- 2) Install the lightguide as if it were a lightweight electrical cable and protect it if necessary. The minimum bend radius is 50 mm.

### 3.4 Positioning the Thermometer

When choosing a location for the thermometer, observe the following precautions;

- 1) If the thermometer is to be installed in a location where the ambient temperature is outside the range specified for the thermometer, it must be mounted in a special cooling/heating jacket available from Land Infrared.
- 2) If the thermometer is to be used in conjunction with a protection jacket, refer to the installation guide provided with the jacket.
- 3) If the thermometer is to be installed in a location where the ambient temperature is within the range specified for the thermometer, it can be mounted using the two tapped holes on the mounting pad. Either hole can be used for direct tripod mounting.
- 4) Choose a location for the thermometer which is free from excess vibration, dirt and moisture.
- 5) It is important that, in order to prevent any possibility of water ingress into the electronics/detector module, the thermometer is mounted in the orientation shown in Fig. 3-1.
- 6) It is recommended that, in order to minimise the build-up of dirt etc. on the electrical and lightguide connectors, the thermometer is mounted such that these connectors are on the underside (as shown in Fig. 3-1).

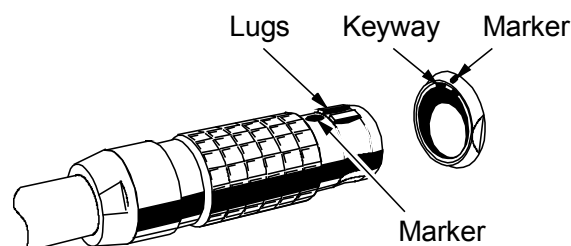


Fig. 3-6 Connection of the pre-wired cable to the thermometer

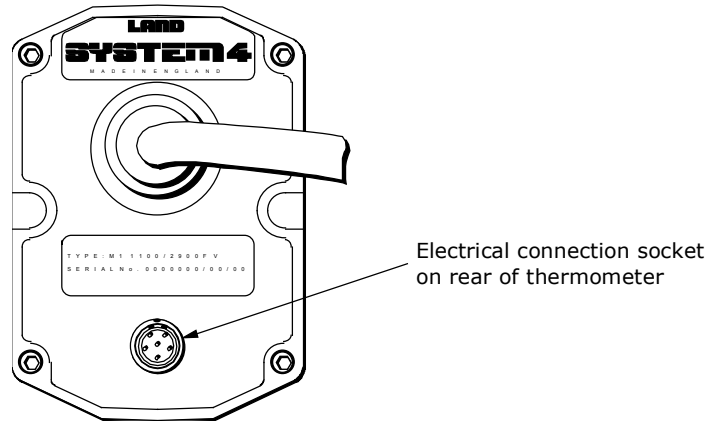


Fig. 3-7 Location of 6-way electrical connection socket

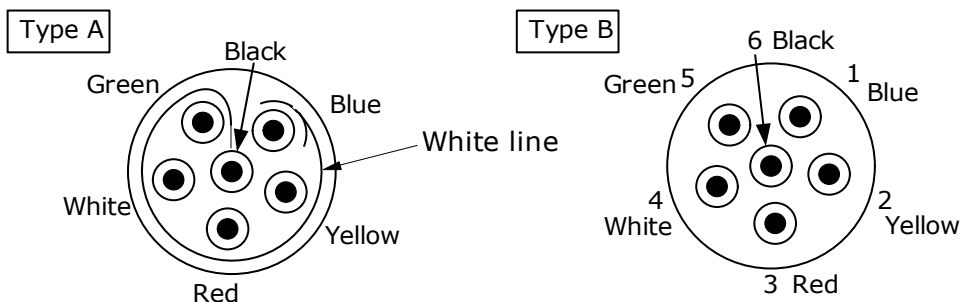
**3.4.1 Electrical connection to Landmark processors**

If the Fibroptic thermometer is to be used in conjunction with a System 4 Landmark Processor, the thermometer derives its power supply, emissivity input and temperature output from the processor via the 6-way cable.

The cable connection schedule is given in Fig. 3-8.

Cable Colour	Label	Function
Yellow	T	4 to 20mA linear temperature signal drive
Blue	T-	4 to 20mA linear temperature signal return
White	E+	4 to 20mA emissivity signal drive
Screen	Screen	Screen
Red	V	24 to 30V d.c. power (positive)
Black	V-	24 to 30V d.c. power (negative)
Green	E-	4 to 20mA emissivity signal return

There are two variants of plug: Type A or Type B



The screen is connected to the shell of the connector at thermometer end of the cable and pin 4 of the processor connector.

View from solder bucket side of 6-way connectors

Fig. 3-8 Cable connection schedule

**NOTE**

**In typical applications, Ratio thermometers require a minimum warm-up time of 2 to 3 minutes after switching on before their accuracy stabilises, However, in the case of R1 Ratio thermometers, this warm-up time can be 20 to 30 minutes.**

# 4

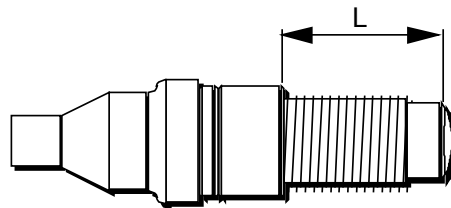
# OPTICS

## 4.1 Focal Distance

There are two variants of optic head used by System 4 Fiberoptic Thermometers

- Type 'A'
- Type 'D'

The optic head variants are differentiated by the dimension 'L', shown in Fig. 4-1.



Optic Head Type	L
A	40mm/1.6in
D	30mm/1.2in

Fig. 4-1 Optic head variant identification

The focal distance is determined by the spacer fitted in the optic head. The focal distance for each combination of spacer and optic head type is given in Table 4-1.

Spacer	Focal distance	
	Optic head type	
	A	D
Red	100 mm (3.9 in)	N/A
Green	180 mm (7.1 in)*	100 mm (3.9 in)
Blue	250 mm (9.8 in)	140 mm (5.5 in)*
Purple	330 mm (13.0 in)*	250 mm (9.8 in)
None	500 mm (19.7 in)	500 mm (19.7 in)

Table 4-1 Optic head focus distances

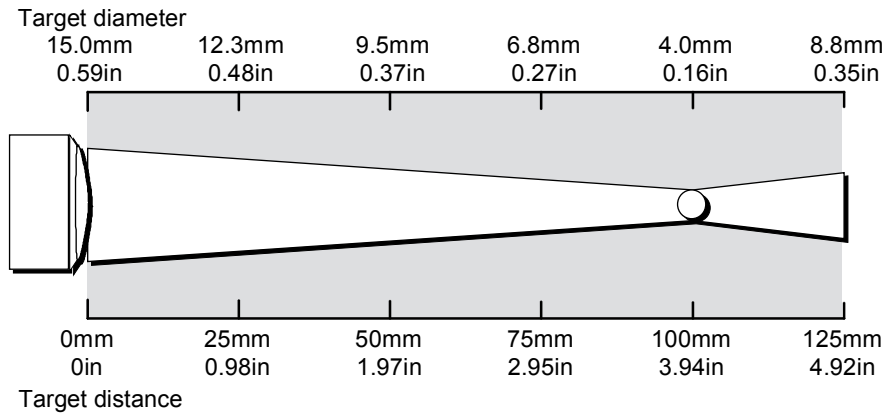
\* Available to special order

## 4.2 Target size tables

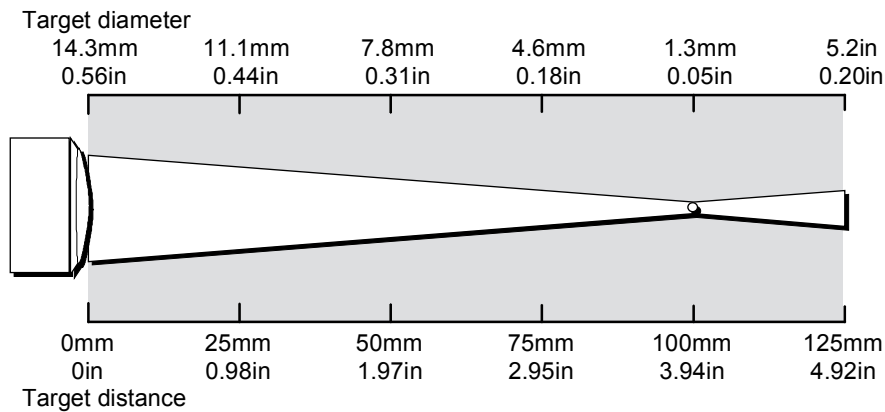
To find out which table applies to your thermometer;

- 1) Refer to the detail label, above the lightguide connector on the thermometer, to find the type of optic head (i.e. A10, A25, A50, D10, D25 or D50) fitted to your thermometer.
- 2) Refer to the specification table for your thermometer, Section 2, to find the field of view (i.e. 20:1, 25:1 or 75:1) for the optic head.

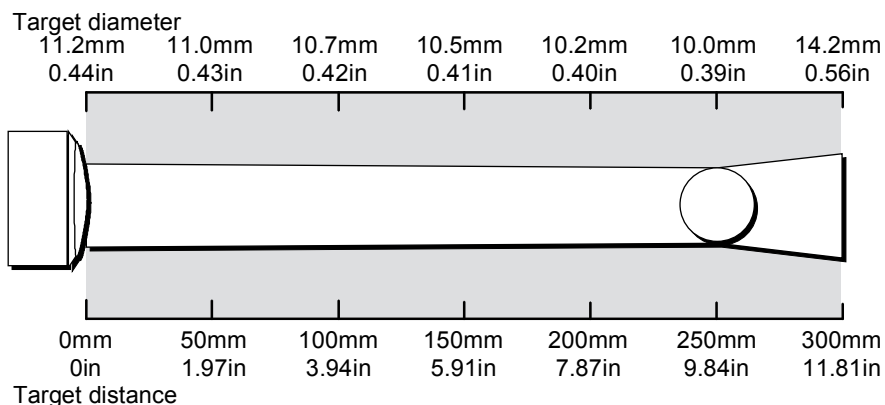
### 4.2.1 Optic Head A10, Field of View 25:1 (Red spacer)



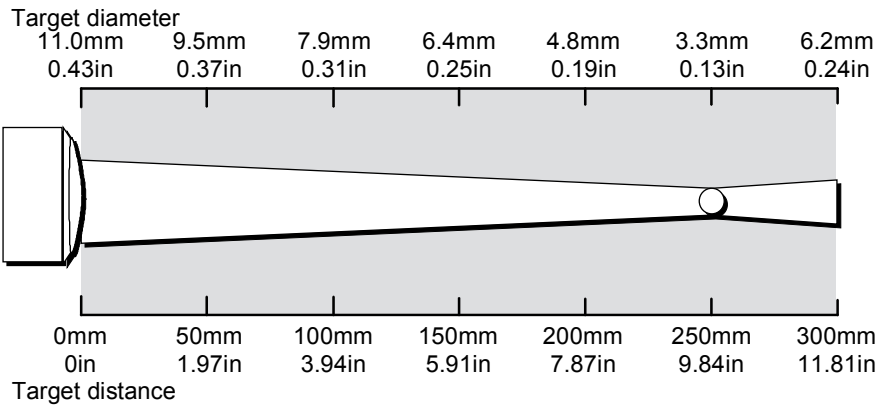
### 4.2.2 Optic Head A10, Field of View 75:1 (Red spacer)



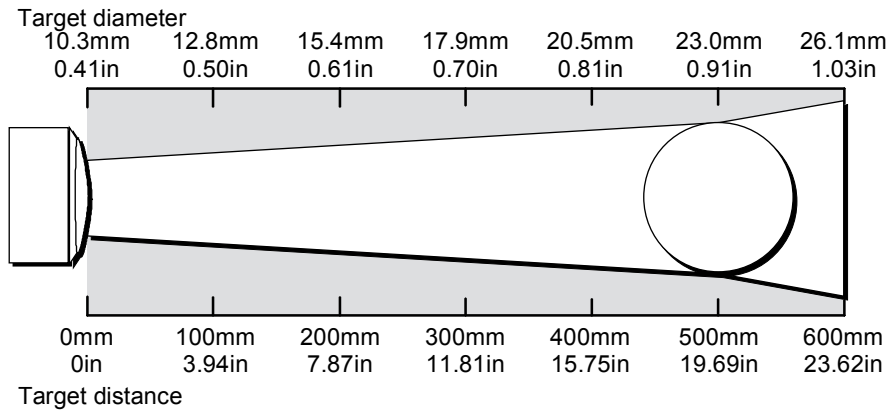
### 4.2.3 Optic Head A25, Field of View 25:1 (Blue spacer)



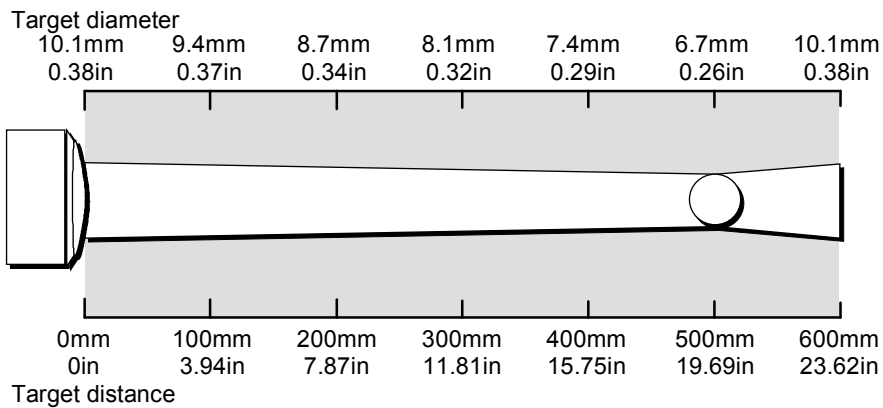
**4.2.4 Optic Head A25, Field of View 75:1 (Blue spacer)**



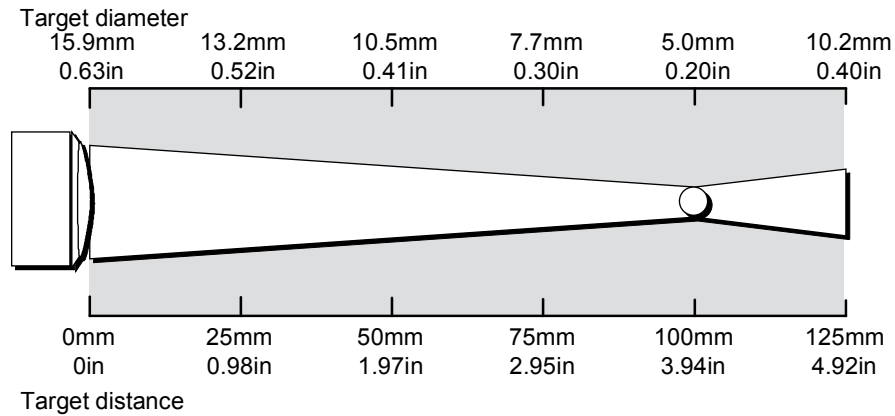
**4.2.5 Optic Head A50, Field of View 25:1 (No spacer)**



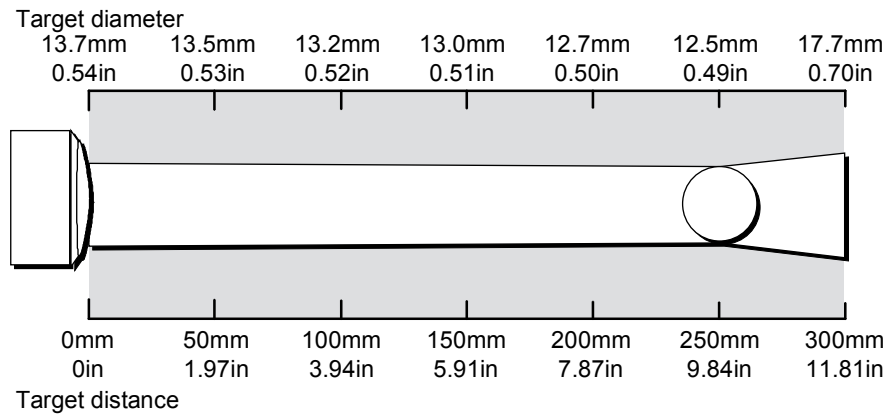
**4.2.6 Optic Head A50, Field of View 75:1 (No spacer)**



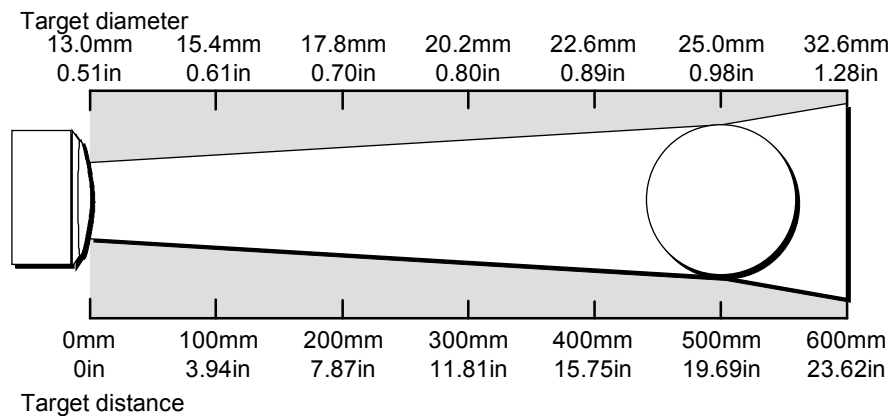
**4.2.7 Optic Head D10, Field of View 20:1 (Green spacer)**



**4.2.8 Optic Head D25, Field of View 20:1 (Purple spacer)**



**4.2.9 Optic Head D50, Field of View 20:1 (No spacer)**



## 5

# EMISSIVITY TABLES

**In order to obtain accurate temperature measurements, the emissivity value of the target surface must be known.**

This section of the Thermometer User Guide contains emissivity values of the most commonly measured materials for each System 4 thermometer. Where no emissivity value is quoted, this means that either the thermometer is not suitable for the measurement application or the temperature of the target is outside the thermometer's measurement span. If you have a query regarding the emissivity of the target in your measurement application, contact LAND.

## 5.1 Alloys

Alloys			
Material	System 4 Thermometer Series		
	M1	M2	M3
Brass	0.20	0.18	-
<i>oxidised</i>	0.70	0.70	0.70
Chromel & Alumel	0.30	0.30	0.30
<i>oxidised</i>	0.80	0.80	0.80
Constantin & Manganin	0.25	0.22	0.20
<i>oxidised</i>	0.65	0.60	0.60
Inconel	0.30	0.30	0.30
<i>oxidised</i>	0.85	0.85	0.85
Monel	0.25	0.22	0.20
<i>oxidised</i>	0.70	0.70	0.70
Nichrome	0.30	0.22	-
<i>oxidised</i>	0.85	0.85	0.85

## 5.2 Metals

Metals			
Material	System 4 Thermometer Series		
	M1	M2	M3
Aluminium	0.13	0.09	0.08
<i>oxidised</i>	0.40	0.40	0.40
Chromium	0.43	0.34	-
<i>oxidised</i>	0.75	0.80	-
Cobalt	0.32	0.28	-
<i>oxidised</i>	0.70	0.65	-
Copper	0.06	0.05	0.04
<i>oxidised</i>	0.85	0.85	0.85
Gold	0.05	0.02	0.02
Iron & Steel	0.35	0.30	-
<i>oxidised</i>	0.85	0.85	0.85
Lead	0.35	0.28	-
<i>oxidised</i>	0.65	0.65	0.65
Magnesium	0.27	0.24	0.20
<i>oxidised</i>	0.75	0.75	0.75
Molybdenum	0.33	0.25	-
<i>oxidised</i>	0.80	0.80	0.80
Nickel	0.35	0.25	-
<i>oxidised</i>	0.85	0.85	-
Palladium	0.28	0.23	-
Platinum	0.27	0.22	0.18
Rhodium	0.25	0.18	-
Silver	0.05	0.04	0.04
<i>oxidised</i>	0.10	0.10	0.10
Tin	0.40	0.28	0.12
<i>oxidised</i>	0.60	0.60	0.60
Titanium	0.55	0.50	0.42
<i>oxidised</i>	0.80	0.80	-
Tungsten	0.39	0.30	0.20
Zinc	0.50	0.32	0.10
<i>oxidised</i>	0.60	0.55	-

### 5.3 Refractories

Refractories				
Material		System 4 Thermometer Series		
		M1	M2	M4
Alumina		0.30	0.30	0.30
Brick	red	0.80	0.80	0.80
	white refractory	0.30	0.35	-
	silica	0.55	0.60	-
	sillimanite	0.60	0.60	-
Ceramics		0.40	0.50	-
Magnesite		-	-	0.60

### 5.4 Miscellaneous

Miscellaneous Materials				
Material		System 4 Thermometer Series		
		M1	M2	M3
Asbestos (board/paper/cloth)		0.90	0.90	-
Asphalt		0.85	0.85	-
Carbon	<i>graphite</i>	0.85	0.85	-
	<i>soot</i>	0.95	0.95	-
Cement & Concrete		0.65	0.70	-
Cloth - all types, close weave (Open weave reduces emissivity)		0.75	0.80	0.85
Glass	<i>3mm thick</i>	-	-	-
	<i>6mm thick</i>	-	-	-
	<i>12mm thick</i>	-	-	-
	<i>20mm thick</i>	0.80	-	-



# 6

## MAINTENANCE

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### 6.1 Optic head

After initial installation, make regular inspections of the lens in order to establish a cleaning cycle.

If the lens requires cleaning, it is preferable to do so without disconnecting the lightguide from the optic head.

Clean the lens with a soft cloth and a little alcohol if necessary. Take care not to scratch the lens.

### 6.2 Air supply

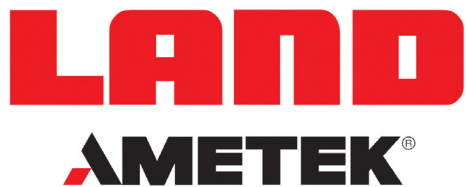
If an air purge is used with the Fiberoptic thermometer, the air filter must be checked and cleaned at regular intervals, determined by the cleanliness of the air supply.

Check the filter daily for the first week or two and then, depending on experience, move to a weekly or monthly routine.



# SYSTEM 4

FIXED SPOT NON-CONTACT THERMOMETERS



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