

SYSTEM4

Fiberoptic Thermometer

User Guide

Land Instruments International
Dronfield, S18 1DJ
England
Telephone: (01246) 417691
Facsimile: (01246) 410585
Email: infrared.sales@landinst.com
Internet: www.landinst.com

Land Instruments International
10 Friends Lane
Newtown PA 18940-1804 U.S.A.
Telephone: (215) 504 8000
Facsimile: (215) 504 0879
Email: irsales@landinstruments.net
Internet: www.landinstruments.net

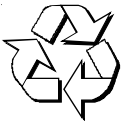


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Calibration certificates are available from our UKAS accredited Calibration Laboratory No. 0034. The Land calibration laboratory complies with the requirements of the international standard BS EN ISO/IEC 17025.



This product complies with current European directives relating to electromagnetic compatibility and safety (EMC directive 89/336/EEC; Low voltage directive 73/23/EEC).



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1.0 INTRODUCTION

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. More detailed information regarding servicing, repair and calibration of the thermometer is contained in the Service Manual.

1.2 About the Fiberoptic thermometer

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

The thermometer features include:

- A choice of fibre optics 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 20mA output, linear over the temperature span of the thermometer, and an emissivity input for high accuracy temperature measurement.

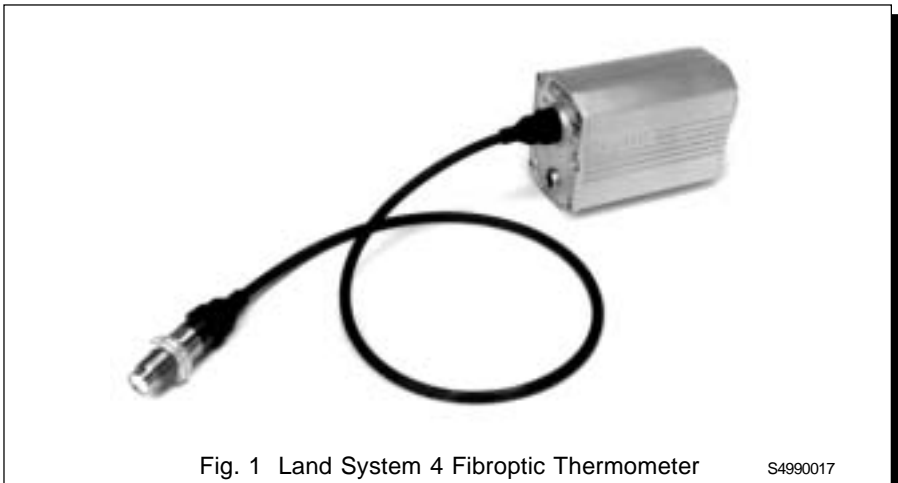


Fig. 1 Land System 4 Fiberoptic Thermometer

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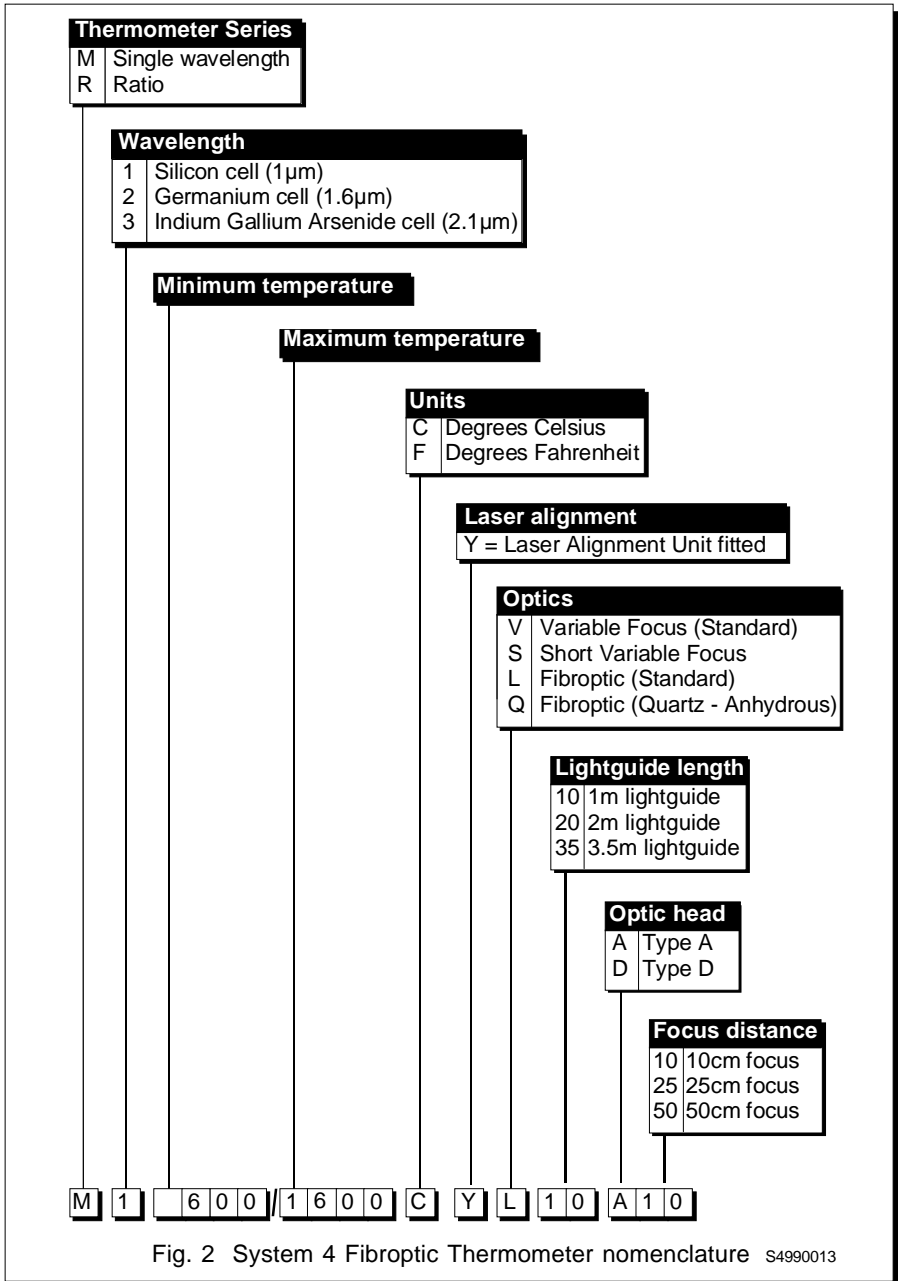


Fig. 2 System 4 Fibroptic Thermometer nomenclature S4990013

1.6 Specifications

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:	4mm (0.15in) at 100mm (3.9in)		1.3mm (0.05in) at 100mm (3.9in)	
A25 optic head:	10mm (0.39in) at 250mm (9.8in)		3.3mm (0.12in) at 250mm (9.8in)	
A50 optic head:	23mm (0.90in) at 500mm (19.6in)		6.7mm (0.26in) at 500mm (19.6in)	
Accuracy:				
Repeatability:	≤1K		≤2K	
Absolute:	0.4%K		0.7%K	
Stability (Temp):	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)			

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:	4mm (0.15in) at 100mm (3.9in)	
A25 optic head:	10mm (0.39in) at 250mm (9.8in)	
A50 optic head:	23mm (0.90in) at 500mm (19.6in)	
Accuracy:		
Repeatability:	≤1K	
Absolute:	≤0.25%K + 1K	
Stability (Temp):	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)	

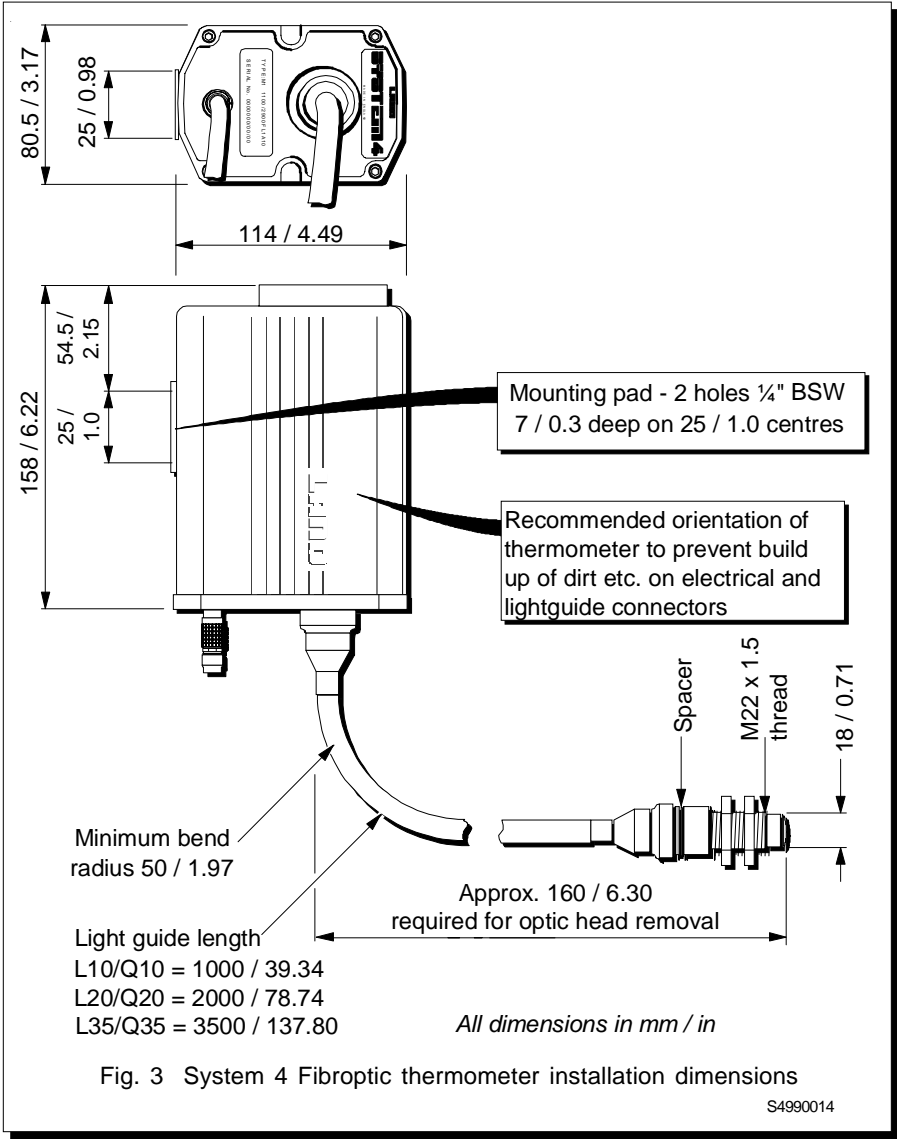
Thermometer Model	M3 50/250C-Q	M3 150/500F-Q
Temperature range:	50 to 250°C	150 to 500°F
Wavelength:	2.1µm	
Response time:	<100ms (0 to 95%)	
Field of view (nominal):	20:1	
Target diameter:		
D10 optic head:	5mm (0.2in) at 100mm (3.9in)	
D25 optic head:	12.5mm (0.5in) at 250mm (9.8in)	
D50 optic head:	25mm (1.0in) at 500mm (19.6in)	
Accuracy ^{1,2} :		
Repeatability:	1K	
Absolute:	≤3K	
Stability (Temp) ¹ :	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)	

¹ Applies at target temperatures >75°C.

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

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 1.1µm			
Response time:	15ms (0 to 95%)			
Field of view (nominal):	25:1		75:1	
Target diameter:				
A10 optic head:	4mm (0.15in) at 100mm (3.9in)		1.3mm (0.05in) at 100mm (3.9in)	
A25 optic head:	10mm (0.39in) at 250mm (9.8in)		3.3mm (0.12in) at 250mm (9.8in)	
A50 optic head:	23mm (0.90in) at 500mm (19.6in)		6.7mm (0.26in) at 500mm (19.6in)	
Accuracy:				
Repeatability:	≤1°K		≤2K	
Absolute:	≤0.65%K		≤1.1%K	
Stability (Temp):	0.05%/°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)			

2.0 INSTALLING THE FIBROPTIC THERMOMETER



2.1 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 3.0. 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.

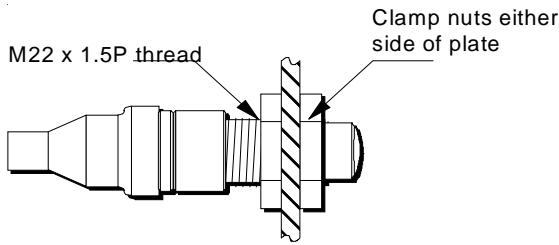


Fig. 4(a) Mounting the optic head into a plate

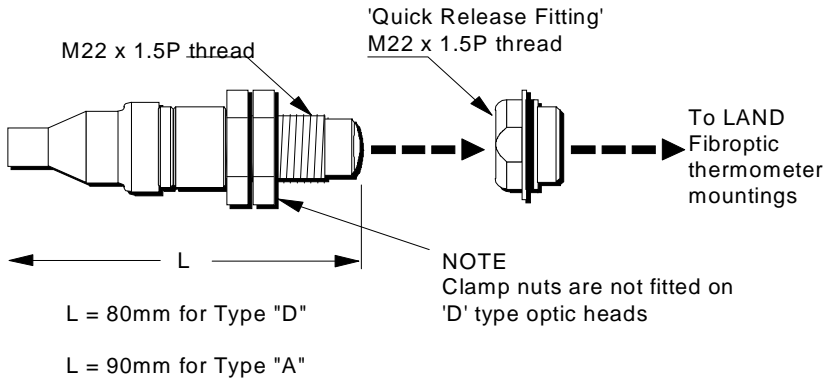


Fig. 4(b) Mounting the optic head into Land Fiberoptic thermometer mountings

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2.1.1 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 Fiberoptic thermometer mountings by means of the 'Quick Release Fitting', Land Part N° 029.591.

To mount the optic head in a plate

- 1) Refer to Fig. 4(a). Unscrew the clamp nut nearest the lens on the optic head.
- 2) Pass the optic head through a Ø 22.5mm 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 Fiberoptic thermometer mountings

- 1) Refer to Fig. 4(b). 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 Fiberoptic thermometer mounting by means of the twist lock on the Quick Release Fitting.

2.2 Installing the lightguide

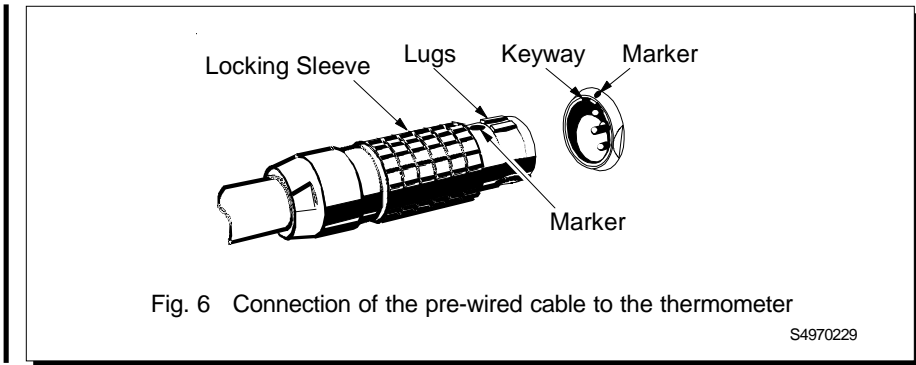
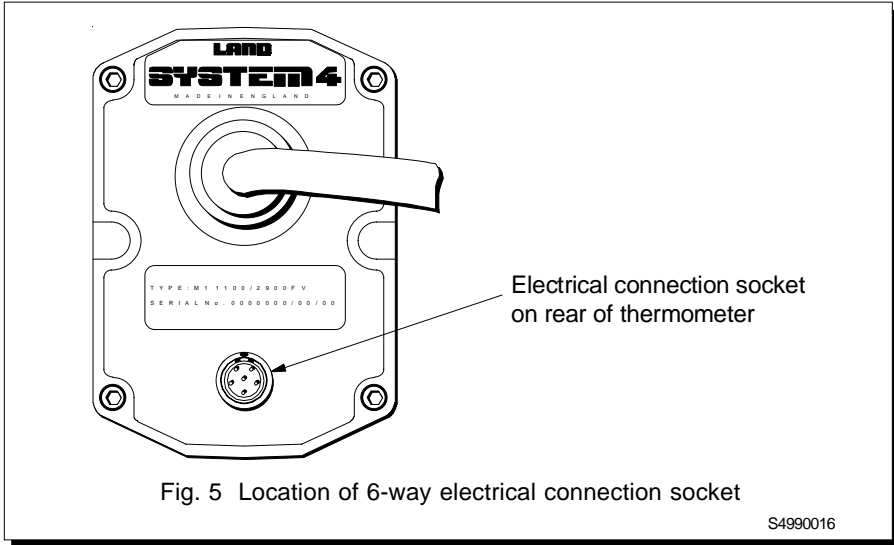
When installing the fibre optics lightguide, observe the following precautions;

- 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 50mm.

2.3 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.
- 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).



2.4 Electrical connections

The electrical connections for the thermometer's power supply, emissivity input and temperature output are made via the 6-way socket on the rear of the thermometer. See Fig. 5.

Electrical connection to the thermometer must be made via the pre-wired plug (LAND Part N° 029.673).

To connect the cable;

- 1) Refer to Fig. 6. Align the red marker near the lugs of the pre-wired plug with the red marker above the keyway in the socket on the thermometer.
- 2) Push the plug into the socket.

To disconnect the cable;

- 1) Grip the locking sleeve section of the plug.
- 2) Pull the plug outwards to release the locking mechanism and disconnect the cable.

2.4.1 Electrical connection to Landmark processors

If the Fiberoptic 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. 7.

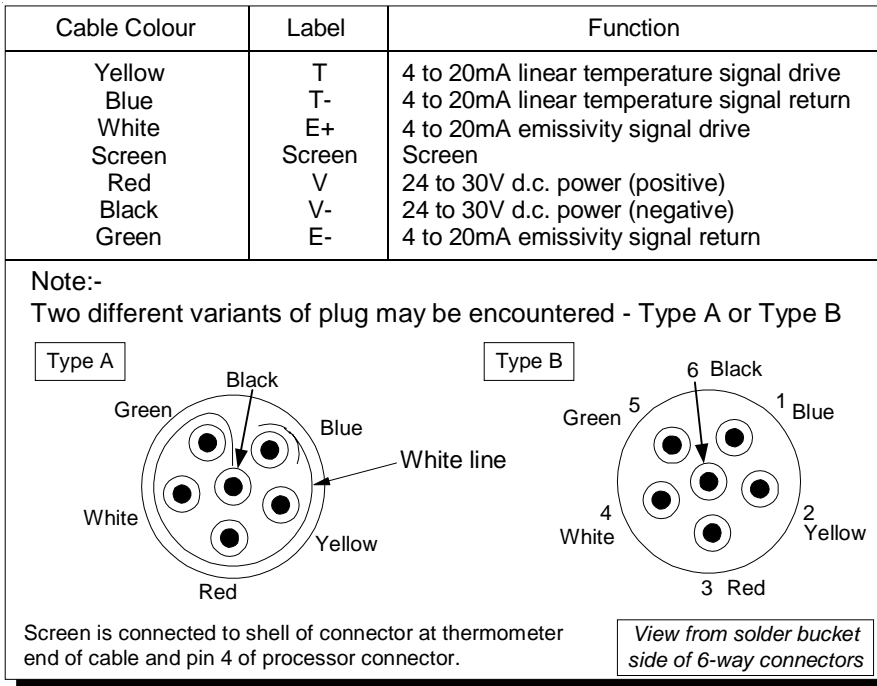


Fig. 7 Cable connection schedule

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3.0 OPTICS

3.1 Focal distance

There are two variants of optic head used by System 4 Fibroptic Thermometers - Type 'A' and Type 'D'.

The optic head variants are differentiated by the dimension 'L', shown in Fig. 8.

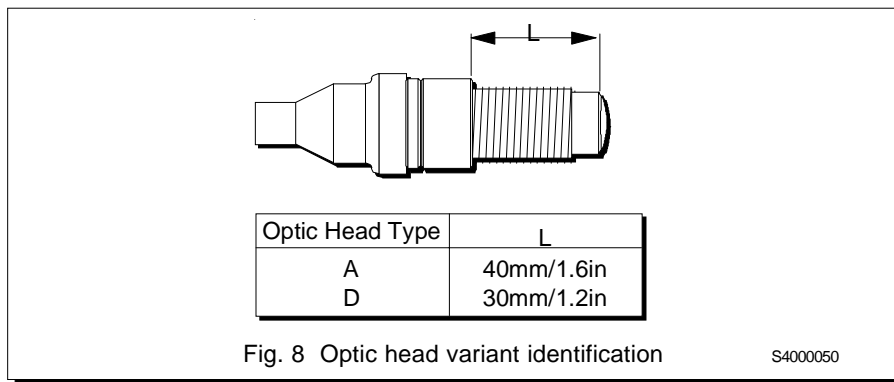


Fig. 8 Optic head variant identification

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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 1.

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

Table 1 Optic head focal distances

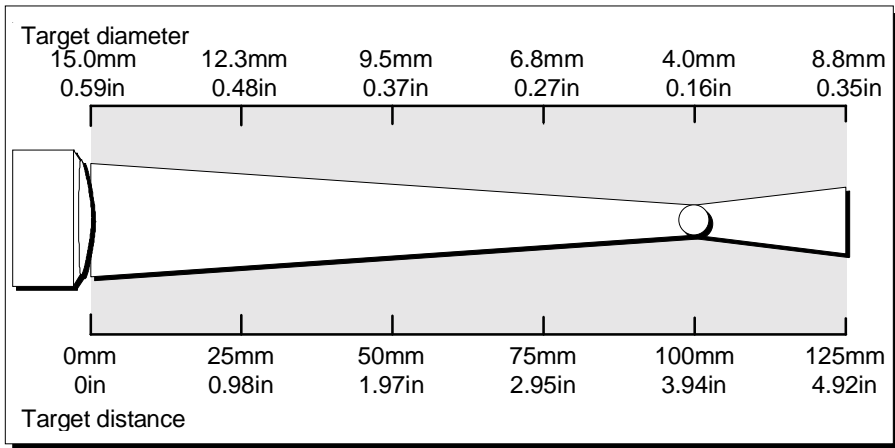
* Available to special order

3.2 Target size tables

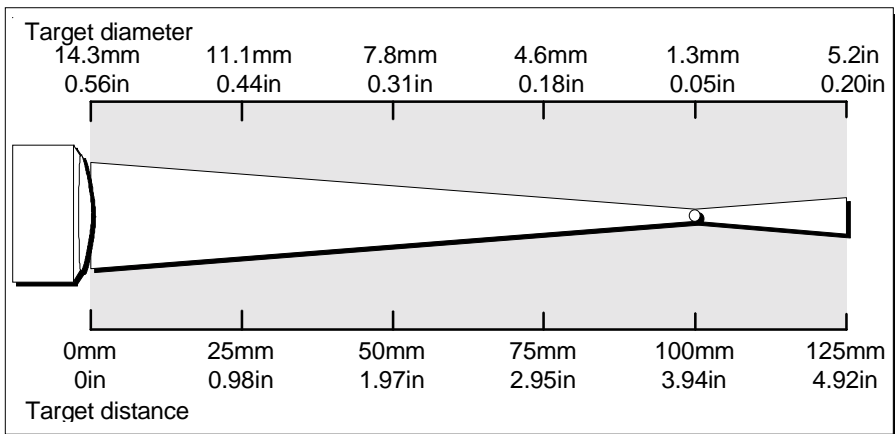
To find out which table applies to your thermometer;

- 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 1.6, to find the field of view (i.e. 20:1, 25:1 or 75:1) for the optic head.

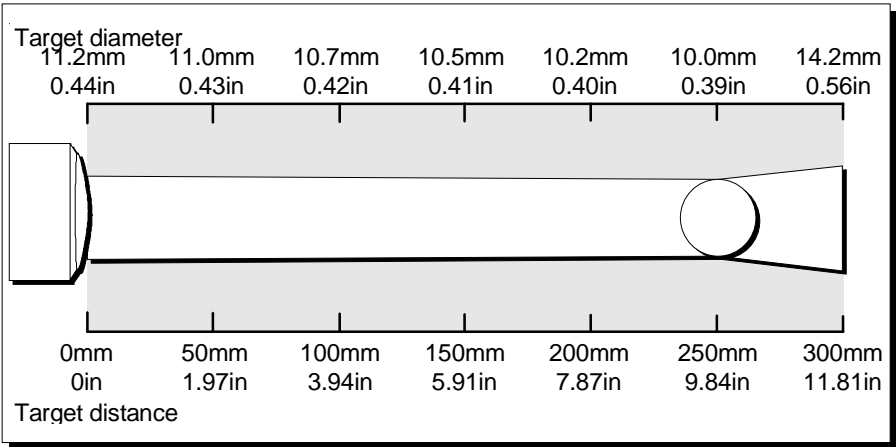
3.2.1 Optic Head A10, Field of View 25:1 (Red spacer)



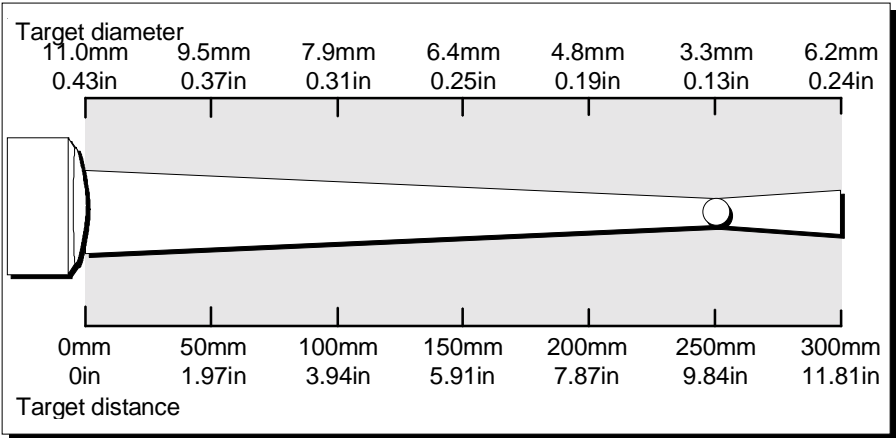
3.2.2 Optic Head A10, Field of View 75:1 (Red spacer)



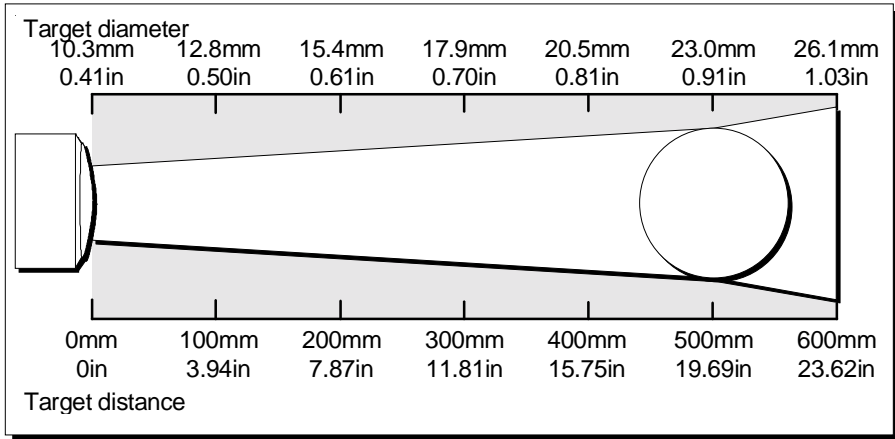
3.2.3 Optic Head A25, Field of View 25:1 (Blue spacer)



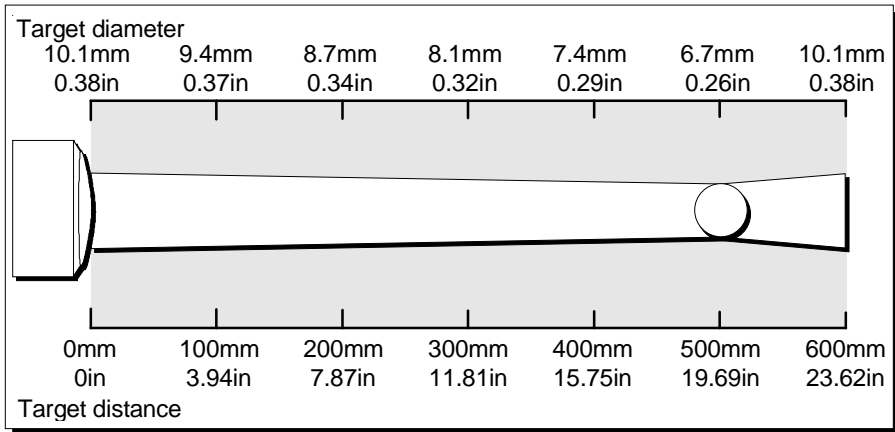
3.2.4 Optic Head A25, Field of View 75:1 (Blue spacer)



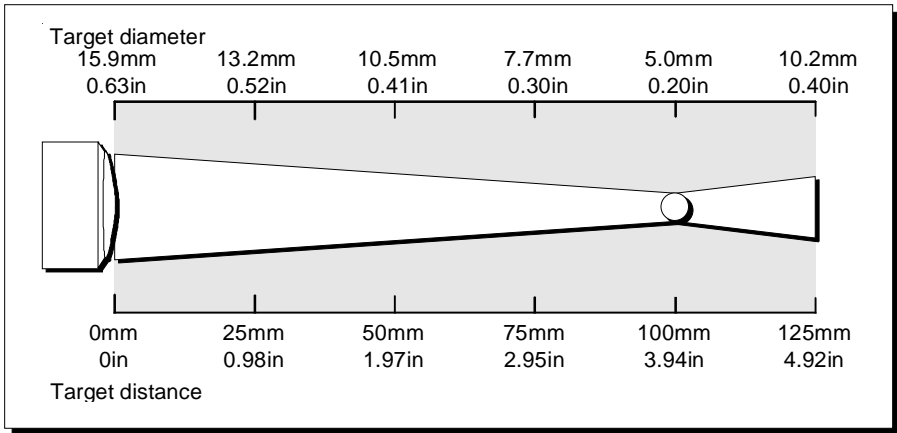
3.2.5 Optic Head A50, Field of View 25:1 (No spacer)



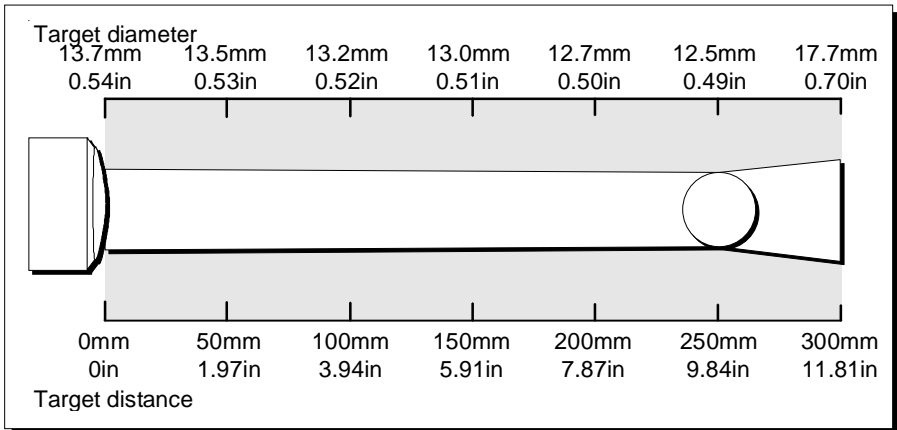
3.2.6 Optic Head A50, Field of View 75:1 (No spacer)



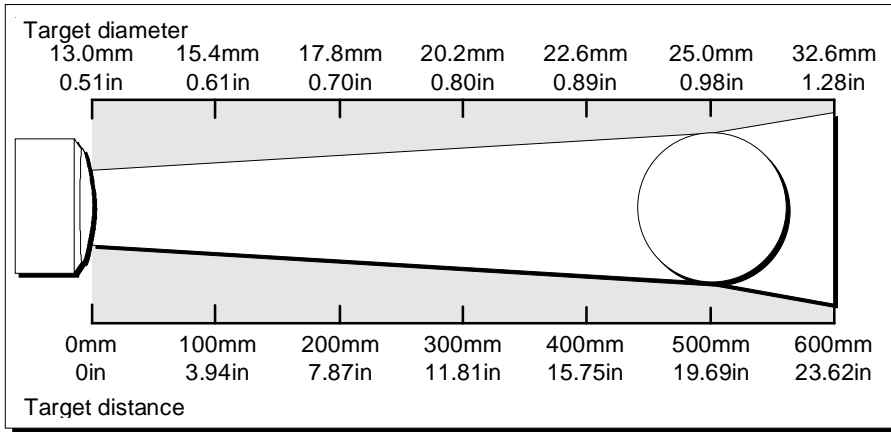
3.2.7 Optic Head D10, Field of View 20:1 (Green spacer)



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



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



4.0 EMISSIVITY TABLES

In order to obtain accurate temperature measurements, the emissivity value of the target surface must be known. This section of the User Guide contains emissivity values of the materials most commonly measured. 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 measurement span of the thermometer. If you have a query regarding the emissivity of the target in your measurement application, contact Land Infrared.

4.1 Refractories				
Material		System 4 Thermometer Series		
		M1	M2	M3
Alumina		0.30	0.30	0.30
Brick	<i>red</i>	0.80	0.80	0.80
	<i>white</i>	0.30	0.35	-
	<i>refractory</i>	0.55	0.60	-
	<i>sillimanite</i>	0.60	0.60	-
Ceramics		0.40	0.50	-
Magnesite		-	-	0.60

4.2 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	0.28	-
	<i>oxidised</i>	0.85	0.85	0.85

4.3 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	-

4.4 Miscellaneous

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	-	-

5.0 MAINTENANCE

5.1 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.

5.2 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.

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