TENMA®

72-820

Operating Manual

Infrared Thermometer

TENMA®

Model 72-820
OPERATING MANUAL

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Introduction

The Model **72-820** Infrared Thermometer (hereafter, the "Thermometer") can determine the surface temperature by measuring the amount of infrared energy radiated by the target's surface. They have different distance to spot (D:S) figure and different temperature range, details see the contents.It features a temperature range of $0^{\circ}F \sim 1000^{\circ}F$ and a distance-to-spot ratio of 12:1.

The non-contact infrared thermometer features low power consumption design, allowing extended use without the need to replace batteries. The highly intuitive design allows fast easy temperature measurement for increased efficiency in use.

The Thermometer may also be powered from a standard computer USB port. This can prove very convenient in situations were repeated battery changes are not practical. The Thermometer will automatically select between battery and USB port power.

Safety Information

⚠ **Warning**

A warning identifies conditions and actions that pose hazards to the user. To avoid electrical shock or personal injury, follow these guidelines:

l ☀ **Do not point laser directly at eye or indirectly off reflective surfaces.**
l **Before using the Thermometer inspect the case. Do not use the Thermometer if it appears damaged. Look for cracks or missing plastic.**
l **Replace the battery as soon as the battery indicator 🔋 appears.**
l **Do not use the Thermometer if it operates abnormally. Protection may be impaired. When in doubt, have the Thermometer serviced.**
l **Do not operate the Thermometer around explosive gas, vapor, or dust.**
l **To avoid a burn hazard, remember that highly reflective objects will often result in lower**

than actual temperature measurements.
l   **Do not use in a manner not specified by this manual or the protection supplied by the equipment may be impaired.**

Caution

To avoid damaging the thermometer or the equipment under test protect them from the following:

l   **EMF (electro-magnetic fields) from arc welders, induction heaters, etc.**
l   **Static electricity.**
l   **Thermal shock (caused by large or abrupt ambient temperature changes – all 30 minutes from the Thermometer to stabilize before use).**
l   **Do not leave the Thermometer on or near objects of high temperature.**

Table 1 and Figure 1 show various symbols and safety markings that are on the Thermometer and in this manual.

Table 1. Symbols

Symbol	Explanation
⚠	Risk of danger. Important information. See Manual.
☀	Warning. Laser
CE	Conforms to Standards of European Union
🔋	Low battery.

AVOID EXPOSURE-LASER RADIATION
IS EMITTED FROM THIS APERTURE

CAUTION

LASER RADIATION-DO NOT STARE INTO BEAM

COMPLIES WITH EN61326-1 EMC / EN60825-1 Safety

OUTPUT <1mW   WAVELENGTH 630-670nm   LASER PRODUCT
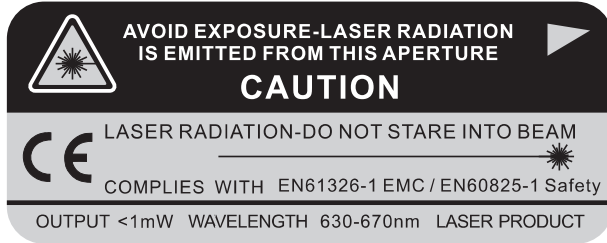
Figure 1. Symbols and Safety Markings

Features

The Thermometer includes:

l   Single-spot Laser Sighting
l   Intelligent USB power source
l   Backlit Display
l   Two level white colour Backlit Display (when using USB power up, this feature will be on automatically).
l   Current Temperature Plus MIN, MAX, DIF, AVG Temperature Displays/
l   Easy Emissivity Selector
l   Trigger Lock

l   Celsius and Fahrenheit Temperature Measurement
l   Tripod mount
l   Included 9V Battery

Thermometer features are shown in Figure 2.
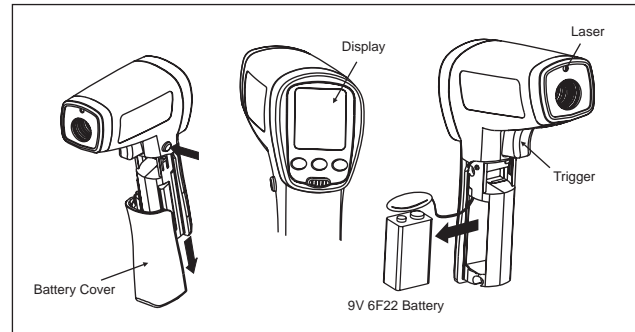
Figure 2. Infrared Thermometer

Display

The primary temperature display reports the current or last IR temperature read until the 8-second hold time elapses.

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The secondary temperature display reports a choice of maximum, minimum, difference between maximum and minimum temperature or average value.

You can toggle through the maximum, minimum, difference and average IR temperatures anytime the display is on. The MAX, MIN, DIF and AV temperatures are constantly calculated and updated when the trigger is pressed. After the trigger is released, the MAX, MIN, DIF and AV temperatures are held for 8 seconds.

Notes

When the battery is low, ⊞ appears on the display. The last selection (MAX/MIN/DIF/AVG) is maintained on the secondary display even after the Thermometer has been turned off, providing the batteries have not failed.

☀	Laser "On" Symbol
HOLD SCAN	SCAN or HOLD
℃℉	°C/°F Symbol (Celsius/Fahrenheit)
A	Primary temperature Display
B	Secondary temperature Display
C	Emissivity LO, MED, HI
D	Temperature values for the MAX, MIN, DIF, AVG
⊞	Low Battery symbol. Appears when the battery charge is <4.5V.
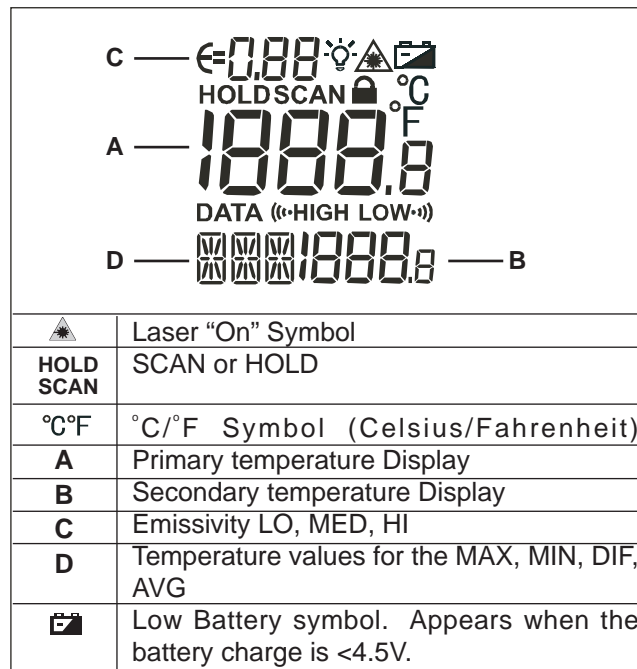
Figure 3. Thermometer Display

Buttons and Connector
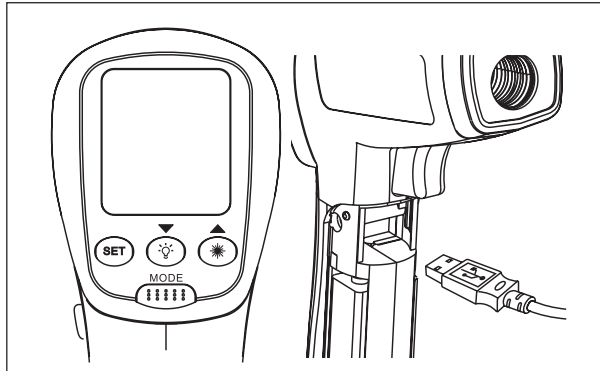
Figure 4. Buttons and Connector

Table 2. Buttons and Connector

Button / Connector	Description
MODE	Press **MODE** button to toggle between MAX, MIN, DIF, and AVG options. Press **MODE** to turn the Thermometer on again and displays the last measurement result.
SET	Press to enter set up mode stepping through Emissivity set up, Trigger Lock and Switching $^{\circ}$C/$^{\circ}$F set up. Details refer to the below Emissivity, Trigger Lock and Switching $^{\circ}$C/$^{\circ}$F topics.
☀/▼	Press ☀ to turn the display backlight on and off. ☀ icon will be on and off also. When the Thermometer enters the setup up mode, press ▼ to select an option, details refer to the below Emissivity, Trigger Lock and Switching $^{\circ}$C/ $^{\circ}$F topics.
☀/▲	Press ☀ to turn the laser on and off. After laser is on, ☀ will be shown. When the Thermometer enters the user setup mode, press ▲ to select an option, details refer to the below Emissivity, Trigger Lock and Switching $^{\circ}$C/ $^{\circ}$F topics.
USB port	After connecting the USB cable, the Thermometer automatically selects USB power supply and two levels white colour Backlit Display will be on.

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How the Thermometer Works
Infrared thermometers measure the surface temperature of an opaque object. The Thermometer's optics sense infrared energy, which is collected and focused onto a detector. The Thermometer's electronics then translate the information into a displayed temperature reading which appears on the display. The laser is used for aiming purposes only.

Operating the Thermometer
The Thermometer turns on when you press the trigger. The Thermometer turns off when no activity is detected for 8 seconds.

To measure temperature, aim the Thermometer at the target, pull and hold the trigger. Release the trigger to hold a temperature reading.

Be sure to consider distance-to-spot size ratio and filed of view. The laser is used for aiming only.

Locating a Hot or Cold Spot

To find a hot or cold spot, aim the Thermometer outside the target area. Then, slowly scan across the area with an up and down motion until you located the hot or cold spot. See Figure 5.
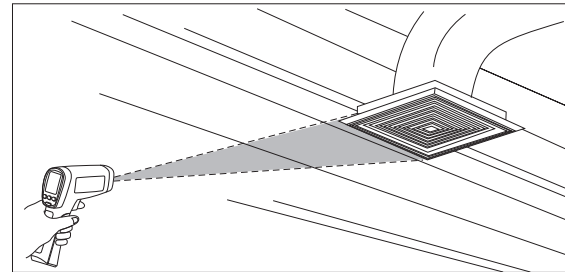
Figure 5. Locating Hot or Cold Spot

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Distance and Spot Size

As the distance (D) from the target being measured increases, the spot size (S) of the area measured by the unit becomes larger. The spot size indicates 90% encircled energy. The maximum D:S is obtained when the Thermometer is 600mm (60 in) form the target resulting in a spot size of 20mm (2 in). See Figure 6.
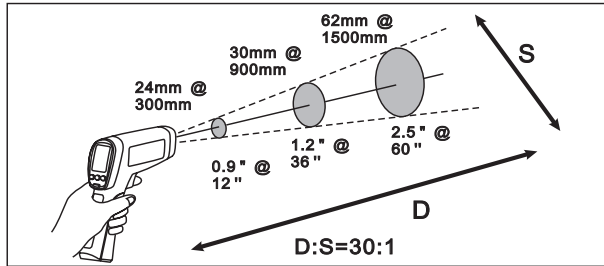
Figure 6. Distance and Spot Size

Field of View

Make sure that the target is larger than the spot size. The smaller the target, the closer you should be to it. See Figure 7.
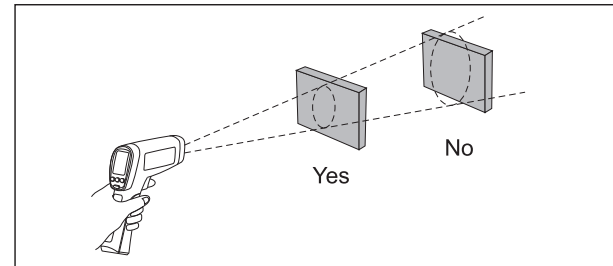
Figure 7. Field of View

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Emissivity

Emissivity describes the energy-emitting characteristics of materials. Most organic materials and painted or oxidized surfaces have an emissivity of about 0.95.

If possible, to compensate for inaccurate readings that may result from measuring shiny metal surfaces, cover the surface to be measured with masking tape or flat black paint (<150 $^{\circ}$C / 302 $^{\circ}$F) and use the high emissivity setting. Allow time for the tape or paint to reach the same temperatures as the surface beneath it. Measure the temperature of the tape or painted surface.

If you cannot use paint or use tape, then you could improve the accuracy of your measurements with the emissivity selector. Even with emissivity selector, it can be difficult to get a completely accurate infrared measurement of a target with a shiny or metallic surface.

The Thermometer allows you to adjust the unit's emissivity for the type of surface before measured. Refer to Table 2. But it is only a typical case. You could base on your own case and materials to have different setting.

To adjust values for emissivity, follow the below procedure:

1 . Press **SET** to select emissivity set up, icon **E** on the display is blinking. The Thermometer steps through emissivity set up, trigger lock and switching $^{\circ}$C / $^{\circ}$F.
2 . Press ▲ to increase the value by 0.01 or press and hold ▲ to access quick setting. The maximum value is 1.00.
3 . Press ▼ to decrease the value by 0.0 or press and hold ▼ to access quick setting. The minimum value is 0.10.

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Table 3. Surface Emissivity

Measure Surface	Switch Setting
METALS	
Aluminum	
Oxidized	0.2-0.4
Alloy A3003	
Oxidized	0.3
Roughened	0.1-0.3
Brass	
Burnished	0.3
Oxidized	0.5
Copper	
Oxidized	0.4-0.8
Electrical Terminal Blocks	0.6
Haynes	
Alloy	0.3-0.8
Inconel	
Oxidized	0.7-0.95
Sandblasted	0.3-0.6
Electoropolished	0.15

Measure Surface	Switch Setting
Iron Cast	
Oxidized	0.6-0.95
Unoxidized	0.2
Molten	0.2-0.3
Iron Wrought	
Dull	0.9
Lead	
Rough	0.4
Oxidized	0.2-0.6
Molydbenum	
Oxidized	0.2-0.6
Nickel	
Oxidized	0.2-0.5
Platinum	
Black	0.9
Steel	
Cold-Rolled	0.7-0.9

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Table 3. Surface Emissivity

Measure Surface	Switch Setting
Iron	
Oxidized	0.5-0.9
Rusted	0.5-0.7
NON-METALS	
Asbestos	0.95
Asphalt	0.95
Basalt	0.7
Carbon	
Unoxidized	0.8-0.9
Graphite	0.7-0.8
Carborundum	0.9
Ceramic	0.95
Clay	0.95
Concrete	0.95
Cloth	0.95

Measure Surface	Switch Setting
Ground Sheet	0.4-0.6
Polished Sheet	0.1
Zinc	
Oxidized	0.1
Glass	
Plate	0.85
Gravel	0.95
Gypsum	0.8-0.95
Ice	0.98
Limestone	0.98
Paper (any colour)	0.95
Plastic	
Opaque	0.95
Soil	0.9-0.98
Water	0.93
Wood, (natural)	0.9-0.95

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Trigger Lock

To lock or unlock the trigger, use the following procedures:
1. Press **SET** to select trigger lock setting, the 🔒 will blink.
2. Press ▼ to select ON or OFF.

When the trigger is locked, the Thermometer will provide continuous measurement. There is no need to pull the trigger.

When the trigger is unlocked, the user must pull the trigger for measurement. When the trigger is released, the Thermometer will hold the measurement result automatically.

Switching $^{\circ}$C */* $^{\circ}$F

1. Press **SET** to choose $^{\circ}$C / $^{\circ}$F selection mode,
2. Press ▼ to select $^{\circ}$C or $^{\circ}$F.

HOLD

The display will remain activated 8 seconds after the trigger is released. HOLD appears in the upper middle of the display. When the trigger is pulled again, the Thermometer will begin measuring in the last function selected.

Typical Measurements

This section describes a variety of measurements often performed by technicians.

Reminder:

l   User could select to turn on or off the backlight and laser whenever you are making readings with the Thermometer. But if you are using USB to power up the Thermometer, the two levels white colour backlight will be on automatically.

l   Relatively high emissivity normally means emissivity setting of about 0.95.

l   Relatively low emissivity normally means emissivity setting of about 0.30.

l   When the emissivity of an object is unknown,

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the user may cover the surface (temperature >150°C) with black electric tape (emissivity of about 0.95). Allow time for the tape to reach the same temperature as the object to be measured. Measure and record the temperature of the tape.

Target the Thermometer to the object to be measured, adjust the emissivity setting to make it as the same temperature as the tape. At this time, the Thermometer emissivity setting is close to the emissivity of the object to be measured, measurement could be started.

Testing Contactors (Starters)

1. Press **SET** to select emissivity. Press ▼/▲ to select relatively low emissivity for bright contacts, or 0.7 mid level for darkened contacts.
2. Press **MODE** to select MAX.
3. Measure line and load side of one pole without releasing trigger.
4. A temperature difference between the line and load sides of a pole indicate increased resistance of one point and a contactor may be failing.

Testing Enclosed Relays

1. Press **SET** and then press ▼/▲ to set emissivity to relatively low for uninsulated connectors or relatively high for plastic encased relays or for bakelite enclosed relays or insulated connectors.
2. Press **MODE** to select MAX.
3. Start to scan.
4. Measure the relay casing, looking for hot spots.
5. Measure electrical connections on relay terminals looking for hot spots.

Testing Fuses and Buss Connections

1. Press **SET** and then press ▼/▲ to set emissivity to relatively high for paper covered fuse body or insulated connections.
2. Press **MODE** to select MAX.
3. Scan the paper covered length of fuse.
4. Without releasing the trigger, scan each fuse. Unequal temperatures between fuses may indicate voltage or amperage imbalance.
5. Press **SET** and then press ▼/▲ to set emissivity to relatively low, for metal fuses and caps and insulated

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buss connections.
6. Press **MODE** to select MAX.
7. Scan each end cap on each fuse/

Note

Unequal temperatures or a high temperature indicates loose or corroded connection through the fuse buss spring clip.

Testing Electrical Connections

1. Press **SET** and then press ▼/▲ to set emissivity to relatively low for uninsulated connectors or buss connections or relatively high for insulated connections.

Note

Conductors are typically smaller than the Thermometer's spot size. If the spot size is bigger than the connector, the temperature reading is the average within the spot.

2. Scan the conductor, moving toward direction of electrical connector (quick connect, wire nut, buss connection, or lug).

Scanning Walls for Air Leaks or Insulation Deficiencies

1. Turn off heating, cooling, and blower.
2. Press **SET** to select emissivity. Press ▼/▲ to select emissivity relatively high for painted surfaces or window surfaces.
3. Press **MODE** to select MIN when opposite side of wall is at lower temperature and or select MAX when opposite side of wall is at higher temperature.
4. Measure an interior partition wall surface temperature. Do not release the trigger. Record this temperature as your baseline (or benchmark) for a "perfectly" insulated wall.
5. Face the wall to be scanned. Stand 1.5m away to scan a 5cm spot on the wall.
6. Scan horizontal rows of wall from top to bottom, or horizontal rows of ceiling from wall to wall. Look for greatest deviations from baseline temperature to identify problems. This completes the insulation test scan.

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Turn on the blower (no heat, no cooling) and retest. If test results with the blower on are different than results with the blower off, this may indicate air leaks in conditioned envelope walls. The air leaks are caused by duct leaks that create a pressure differential across the conditioned space envelope.

Testing Bearings

⚠ **Warning**

To avoid injury when testing bearings:

l **Do not wear loose clothing, jewelry, or anything around neck when working around moving parts such as motors, belts, blower, and fans.**
l **Make sure an electrical disconnect is within reach and operating correctly and freely.**
l **Do not work alone.**

Note

It works best to compare two similar motors operating similar loads.

1. Press **SET** and then press ▼/▲ to select relatively high emissivity.
2. Press **MODE** to select MAX.
3. Enable motor and allow it to reach steady state operating temperatures.
4. Disable the motor if possible.
5. Measure the two motor bearing temperatures
6. Compare the two motor bearing temperatures. Unequal temperatures or a high temperature can indicate a lubrication or other bearing problem that is resulting from excess friction.
7. Repeat the sequence for the blower bearings.

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Testing Belts and Sheaves

1. Press **SET** and then press ▼/▲ to select relatively high emissivity.
2. Press **MODE** to select MAX.
3. Enable the motor and allow it to reach a steady state operating temperatures.
4. Aim the Thermometer at the surface to be measured.
5. Start recording temperature
6. Slowly move the Thermometer up the belt toward second sheave.

   l   If belt is slipping, sheave temperature will be high from friction.
   l   If belt is slipping, belt temperature will remain high between sheaves.
   l   If belt is not slipping, belt temperature will reduce between sheaves.
   l   If inner surfaces of sheaves are not a true "V" shape, this indicates belt slippage and will continue to operate at elevated temperatures until sheave is replaced.
   l   Sheaves must be properly aligned (include "pitch & yaw") for belt and sheaves to operate at appropriate temperatures. A straight edge or taut string, can be used to check alignments.
   l   Motor sheave should operate at a temperature consistent with blower sheaves.
   l   If motor sheave is at a higher temperature at motor shaft than at outer circumference, belt is probably not slipping.
   l   If outer circumference of sheave is at higher temperature than sheave at motor shaft, then belt is probably slipping and sheaves may be misaligned.

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Checking Hydronic Radiant Heat Applications

Radiant heat tubes in the floor will normally run parallel to the outside walls. Starting at the floor wall juncture, scan parallel to the wall while moving into the room away from the wall. Parallel to the outside wall you should find parallel isothermal rows indicating the location of heat tubes below the surface. Perpendicular to the outside wall, you should find rising and falling temperatures at equal distances. High temperatures indicate you are scanning a heat tube beneath the floor surface, low falling temperatures indicate a space between the heat tubes.

1. Press **SET** and then press ▼/▲ to select relatively high emissivity.
2. Press **MODE** to select MAX.
3. To locate radiant heat tubes in floor, temporarily elevate the loop temperature to create hotter spots for identifying tubing runs.
4. Before releasing trigger, press **MODE** to toggle between MIN, MAX, DIF floor temperatures and record the temperature for future comparison and trending under similar conditions.

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Measuring Grille, Register, or Diffuser Discharge Temperature

1. Press **SET** and then press ▼/▲ to select relatively high emissivity.
2. Aim the Thermometer at the discharge air grille, register, or diffuser.
3. Measure discharge temperature.
4. Release trigger to freeze the temperature reading for 8 seconds and record this temperature.
5. Grille, register, or diffuser temperature should be equivalent to discharge temperature at the air handler.

Checking for Blockage in Air-To-Air Evaporators or Condensers

1. Remove panels to gain access to coil return bends or hairpins.
2. Press **SET** and then press ▼/▲ to select relatively high emissivity for copper tube.
3. Start the refrigeration system.
4. Aim the Thermometer at coil turn bends/hairpins.
5. Start recording temperature.
6. Take temperature of each return bend/hairpin.

   l All evaporator return bends/hairpins should be at or slightly above evaporator saturation temperature from the pressure/temperature chart.
   l All condenser return bend/hairpins should be at or slightly less than condenser saturation temperature.
   l If a group of return bends/hairpins do not conform to expected temperatures, that indicates a blocked or restricted distributor or distributor tube.

Maintenance

Changing the Battery

To install or change the 9V battery, open the battery compartment the battery as shown in Figure 2.

Cleaning the Lens

Blow off loose particles using clean compressed air. Carefully wipe the surface with a moist cotton swab. The swab may be moistened with water.

Cleaning the Housing

Use soap and water on a damp sponge or soft cloth.

⚠ **Caution**

To avoid damaging the Thermometer, do NOT submerge it in water.

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Troubleshooting

Table 4. Troubleshooting

Symptom	Problem	Action
OL (on display)	Target temperature is over range	Select target with specifications
-OL (on display)	Target temperature is under range	Select target with specifications
🔋	Low Battery	Replace Battery
Blank Display	Possible dead battery	Check and / or replace battery
Laser does not work	1. Low or dead battery 2. Ambient temperature above 40°C (104°F)	1. Replace battery 2. Use in area with lower ambient temperature.

CE Certification

The Thermometer conforms to the following standards:
  l   EN61326-1 EMC
  l   EN60825-1 Safety
Certification testing was conducted using a frequency range of 80 to 100MHz with instrument in three orientations.

Specifications

Infrared

Measurement Range--18°C to 550°C (0°F to 1022°F)

Spectral Range -- 8 to 14 microns

Accuracy --- ±1.8% or (1.8°C/4°F)

                    Temperature than less ≤0°C , Accuracy add to 1°C(2°F)

            (Assumes ambient operating temperature of 23 to 25°C (73 to 77°F))

Repeatability -- 0.5% of reading or 1°C/2°F

Response Time (95%) -- 250ms

Distance to Spot (D:S) -- 12:1

Emissivty Adjustment -- 0.10~1.00

Display Resulation -- ±0.1°C (0.1°F)

Secondary Display Information --- Maximum, Minimum, Differential, Average

Laser

Sighting -- Single point laser

Power -- Class 2 (II) operation; Output <1mV, wavelength

                         630 to 670mm

Electrical

Power Supply -- 6F22 9V Battery

Power Consumption -- At least 30 hours battery life (Alkarine), At least

                         10 hours battery life (General Purpose)

Physical

Weight --- 0.322kg
Size --17.69cm (H) x 16.36 cm (L) x 5.18cm (W)

Environmental

Operating Temperature Range -- 0°C to 50°C (32°F to 120°F)
Relative Humidity ---0 to 75% noncondensing
Storage Temperature --- -20°C to 65°C (-4°F to 150°F)

** END **

This operating manual is subject to change without notice.

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