

REPAIR SERVICE INSTRUCTIONS — CALIBRATION

2276-20 12V Laser TEMP-GUN™ Thermometer

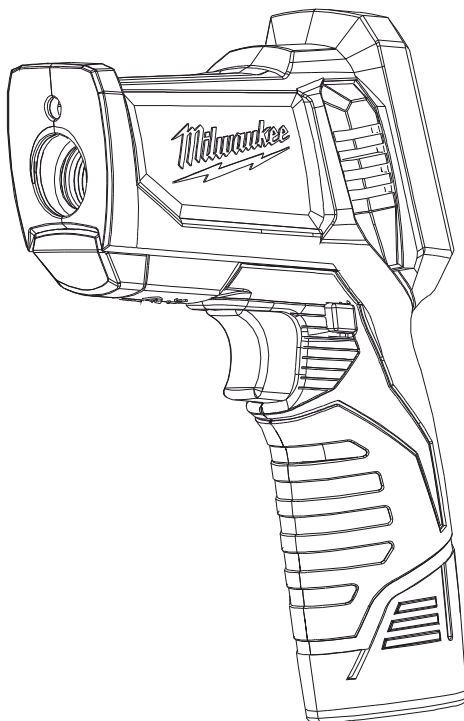
2277-20 12V Laser TEMP-GUN™ Thermometer w/humidity measurement

Environmental Condition

Perform all calibration at an ambient temperature of 23°C ~ 25°C and ambient relative humidity <55% in a controlled room. Each thermometer should be uniquely identified as to the room and/or area in which it is used or tested.



REPAIR SERVICE INSTRUCTIONS Calibration



MILWAUKEE TOOL

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Introduction

WARNING

To avoid shock or injury, do not perform the verification tests or calibration procedures described in the manual unless you are qualified to do so.

The information provided in this document is for the use of qualified personnel only.

CAUTION

The 2276-20 and 2277-20 contain parts that can be damaged by static discharge.

Follow the standard practices for handling static sensitive devices.

Precautions and Safety Information

Use the Laser TEMP-Gun™ only as described in the Operator's Manual. If you do not do so, the protection provided by the Laser TEMP-Gun™ may be impaired. Read the "Safety Information" page before servicing this product. In this manual, a  **WARNING** identifies conditions and actions that pose hazard (s) to the user; a **CAUTION** identifies conditions and actions that may damage the Gun or the test instruments.

The Symbols

The symbols used on the Laser TEMP-GUN™ and in this manual are explained in Table 1.

Table A. The Symbols

Symbol	Meaning
	Volts Direct Current
	CAUTION Laser Light - Do Not Stare Into Beam
	Laser Product - Avoid Exposure: Laser Radiation Is Emitted From This Aperture
	Refer to the manual, Important information.
	Battery
	Do not discard this product or throw away.

SAFETY

Review the following safety precautions to avoid injury and prevent damage to this product or products connected to it. To avoid potential hazards, use the product only as specified.

⚠ WARNING: These statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION: These statements identify conditions or practices that could result in damage to the equipment or other property.

Specific precautions

To reduce the risk of injury, user must read and understand operator's manual.

Laser light - Do not stare into beam or view directly with optical instruments. Do not point laser light at others. Laser light can cause eye damage.

Avoid exposure to laser radiation. Laser may emit hazardous radiation.

Do not point laser at reflective surfaces. Unpredictable results may occur.

Do not operate in wet/damp conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

SPECIFICATIONS

All specifications are warranted unless noted typical and apply to the 2276-20 and 2277-20 Laser TEMP-GUN™ Thermometer.

Stated accuracies are at 23°C±5°C at than 80% relative humidity and without the battery indicator displayed.

General specifications

Laser Type:	Class II
Max Power:	<1mW
Wavelength:	630-670 nm
IR Temperature range:	-30°C to 800°C (-22°F to 1472°F)
IR Accuracy:	-30°C to 0°C (-22°F to 32°F): ±1.5°C (3°F) +0.1/1°C or F 0°C to 120°C (32°F to 248°F): ±1.0°C (2°F) +0.1/1°C or F 120°C to 380°C (148°F to 716°F): ±1.5°C (3°F) or 1.5% of reading, whichever is greater 380°C to 800°C (716°F to 1472°F): ±2°C (4°F) or 2% of reading, whichever is greater *Assume ambient operating temperature of 23°C to 25°C (73°F to 77°F)
Min. measuring distance:	2" < 50°C (122°F), 4" > 50°C (122°F)
Display resolution:	0.1°C (0.1°F) Primary and secondary
Contact temperature range:	-40°C to 550°C (-40°F to 1022°F)
Contact temperature input accuracy:	± 1.1°C (± 2°F)
Temperature display resolution:	0.1°C/°F in Primary, 1°C/°F in Secondary
K-Type Probe temp. range:	-40°C to 280°C (-40°F to 500°F)
K-Type Probe temp. input accuracy:	<400°C ±2.5°C (<752°F ±5°F)
Emissivity:	Pre-set 0.95 (can be manually set)
RH display (2277-20 only):	10% - 90%
RH accuracy (2277-20 only):	±5%
Response time:	<500 msec
Spectral response:	8 to 14µm
Distance to spot:	40 to 1
Drop:	1.5 meter
Log spaces:	20
Repeatability:	±0.5% OR ±1°C(±2°F) (whichever is greater)
Operating temperature:	0°C to 50°C (32°F to 122°F)
Storage temperature:	-20°C to 60°C (-4°F to 140°F) w/o battery
Relative humidity:	10 to 90% RH non-condensing at <30°C (<86°F) ambient
Voltage:	12 DC
Battery life:	Greater than 12 hrs with all functions

Basic Maintenance

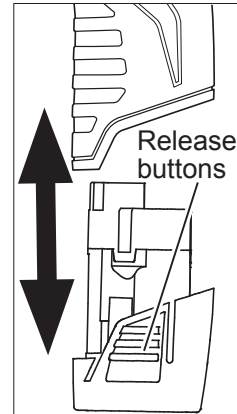
⚠WARNING

To reduce the risk of injury, always remove the batteries from the tool before performing any maintenance. Never disassemble the tool. Contact a MILWAUKEE service facility for ALL repairs.

Inserting / Removing the Batteries

To **remove** the battery, push the release buttons on each side of battery pack and pull the battery pack away from the tool.

To **insert** the battery, slide the pack into the body of the tool. Make sure it latches securely into place.



Maintaining Tool

Keep your tool in good repair by adopting a regular maintenance program. After six months to one year, depending on use, return the tool to a MILWAUKEE service facility for repairs. If the tool does not start or operate at full power with fully charged batteries, clean the contacts on the battery door. If the tool still does not work properly, return the tool to a MILWAUKEE service facility for repairs.

Cleaning the Laser Windows

Clean the laser windows with a soft, moist cloth to keep them clean and clear. Remove battery pack before cleaning.

⚠WARNING

To reduce the risk of personal injury and damage, never immerse your tool in liquid or allow a liquid to flow inside it.

Cleaning

Clean dust and debris from tool. Keep tool handles clean, dry and free of oil or grease. Use only mild soap and a damp cloth to clean the tool since certain cleaning agents and solvents are harmful to plastics and other insulated parts. Some of these include gasoline, turpentine, lacquer thinner, paint thinner, chlorinated cleaning solvents, ammonia and household detergents containing ammonia. Never use flammable or combustible solvents around tools.

1.0 **TESTING PERSONNEL QUALIFICATION:**

1.1 Testing personnel are required to be knowledgeable of the procedures in this manual.

2.0 **EQUIPMENT USE:**

2.1 Below is Recommended Reference Thermometer Traceable to NIST:

Manufacturer	Model No.	Range	Accuracy
Hart Scientific	1502A	-200°C to 962°C	±0.006°C accuracy at 0°C

2.2 Below are recommended IR Black Bodies Sources / TC Calibrator:

Manufacturer	Model No.	Range	Accuracy	Emissivity	Target Size
Omega	BB-4A	100°C~+150°C	±1.0°C accuracy at 100°C	0.99(±0.15)	0.88in(22mm)
Hart Scientific	9133	-35°C~+150°C	±0.4°C accuracy at 100°C	0.95(±0.02)	2.0in(50mm)
Hart Scientific	4181	35°C ~ +500°C	±0.5°C accuracy at 100°C	0.90~0.95(±0.02)	6.0in(152mm)
Fluke TC	714	-200°C ~ +1370°C	±0.5°C accuracy at 100°C	NA	NA
Fluke	5500A	-200°C ~ +1370°C	±0.16°C accuracy at 100°C	NA	NA
Fluke	5200A	-200°C ~ +1370°C	±0.16°C accuracy at 100°C	NA	NA

2.3 Operate only the test equipment within its calibration period.

3.0 **TESTING CONDITION AND INTERFERENCE:**

3.1 Calibration and verification are performed at an ambient temperature of 23°C ~ 25°C and ambient relative humidity <55% in a controlled room. Each thermometer should be uniquely identified as to the room and/or area in which it is used or tested.

3.2 If the meter is exposed to significant changes in ambient temperature (hot to cold or cold to hot) allow at least 3 hours for the unit to acclimate with room temperature before taking any temperature reading or calibration.

3.3 Operate the unit under test (UUT) and the reference thermometer within its specified range.

3.4 Calibration can be verified using a certified NIST traceable standard thermometer. Recalibration must be performed in similar environment conditions as it was calibrated to get similar results.

3.5 Strong electromechanical radiation or static discharges can cause reading errors if situated near the meter.

3.6 The object size under test should be larger than the spot size calculated by the field of view diagram of the meter.

4.0 **PRODUCTION CALIBRATION AND TESTING PROCEDURE:**

4.1 **IR Software Calibration Check using Black Body Source (Calibrator 9133/4181/BB-4A)**

- 4.1.1 Put all units inside the control room for about 3 hours where the temperature is kept at around 23°C -- 25°C and humidity is <55%.
- 4.1.2 Press and hold the “SET” button, then apply power. Press the “▲” button 4 times. After 4 seconds, the unit will enter into IR calibration mode.
- 4.1.3 The “25°C” is displayed. Press the “▼” button to skip “25°C” as it is for factory calibration only.
- 4.1.4 The 50°C calibration point will appear.
- 4.1.5 Put the unit on the test fixtyre. Wait for about 5 seconds and then press the “MODE” button to confirm. “PASS” will display.



- 4.1.6 The next calibration point 150°C will appear. Repeat step 4 to complete all calibration points (50°C, 150°C, 300°C, 450°C, 700°C, 0°C and -20°C) according to the below calibration table.

*Remarks: For High temperature (>200°C), if measurement time is too long, it would cause a larger difference in reading. Please follow below table.

Blackbody [°C]	Distance [inch]	Stable Time (sec)	Fluke	Remark
50	3	5	9133	
150	21	5	4181	
300	21	3	4181	
450	30	3	4181	After calibration, wait for 30 seconds before move to next point.
700	1	3	Omega	After calibration, wait for 15 minutes before move to next point.
0	3	5	9133	
-20	3	5	9133	

- 4.1.7 You can skip any calibration points by pressing the “▼” button until the unit will exit and turn off.
- 4.1.8 Once exit, the unit will default to Normal Temperature Mode.

4.2 KTC Software Calibration Check using Temperature Calibrator (Fluke 714 or 5500A/5520A)

4.2.1 Condition the unit to be calibrated and the calibrator in a stable environment as described in 3.1 to ensure they are in thermal equilibrium.

4.2.2 Set the Fluke 714 or 5500A/5520A to be 0°C and “K” type mode.



4.2.3 Connect the KTC cable to Fluke 714 or 5500A/5520A. Press and hold the “SET” button, then apply power. Press the “▲” button 4 times. After 4 seconds, the unit will enter into KTC calibration mode.

4.2.4 Press the “▼” button to skip 25°C and move to 0°C calibration point. Wait for 60 seconds to stable first calibration point.



4.2.5 Press the “MODE” button to confirm. The next calibration point 50°C will appear.

4.2.6 Set the Fluke 714 to 50°C. Wait for 30 seconds and then press the “MODE” button to confirm (For retest, the stable time is 10 seconds).

4.2.7 Repeat steps 4.2.6 to complete all calibration points per table below.

Calibration points	Stable time for calibration	Stable time for retest	Fluke
0 (Thermocouple)	60s	60s	714 or 5500A/5520A
50 (Thermocouple)	30s	10s	714 or 5500A/5520A
150 (Thermocouple)	30s	10s	714 or 5500A/5520A
250 (Thermocouple)	30s	10s	714 or 5500A/5520A
450 (Thermocouple)	30s	10s	714 or 5500A/5520A
-20 (Thermocouple)	30s	10s	714 or 5500A/5520A

4.2.8 You can skip any calibration points by pressing “▼” button until the unit will exit and turn off.

4.2.9 Once exit, the unit will default to Normal Temperature Mode.

4.3 Relative Humidity Software Calibration Check using Humidity Chamber (2277 only)

- 4.3.1 Put the units inside the Humidity Chamber ER-04KA for 1.5 hours where the temperature is set to 25°C and the humidity is set to 50% RH.



- 4.3.2 Press and hold the “SET” button, then apply power. Press the “▲” button 4 times. After 4 seconds, the unit will enter into IR calibration mode.
- 4.3.3 The “25°C” is displayed. Press the “▼” button to skip 25°C, 50°C, 150°C, 300°C, 450°C, 700°C, 0°C and -20°C until the LCD displays 50% RH.
- 4.3.4 Press “MODE” button to confirm. LCD displays “PASS”.
- 4.3.5 Press the “▼” button to exit the calibration.