DATA THERMOMETERS

Models:

931B, 932B Data Thermometers

Operation Manual

rev B

Manual Part Number: 931B-900, Rev. B

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This Manual

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WARNING — WARNING denotes an imminent hazard that *could* result in injury to personnel or death.

CAUTION — CAUTION denotes a hazard that *could* result in damage to the unit or other equipment.

REMINDER denotes important information about instrument functions, menus, and measurements.

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1. INSTRUMENT DESCRIPTION

1.1 Specifications

GENERAL SPECIFICATIONS:			
Basic Accuracy	±(0.04% |rdg| + 0.3 °C)[1]		
Conformity	ITS-90		
Temperature Ranges	**°C**	**°F**	**K**
K	-200 to 1372	-328 to 2502	73 to 1645
J	-210 to 1200	-346 to 2192	63 to 1473
T	-250 to 400	-418 to 752	23 to 673
E	-250 to 1000	-418 to 1832	23 to 1273
B	600 to 1820	1112 to 3308	873 to 2093
N	-200 to 1300	-328 to 2372	73 to 1573
R	0 to 1760	32 to 3200	273 to 2033
S	0 to 1760	32 to 3200	273 to 2033
Connector Type	One (1) Mini-TC (931B)	Two (2) Mini-TC (932B)	
Probe Zero Function	Resolution 0.1 °C/°F/K		
Display	Four (4) digit LCD, with Temperature, Units, Function, Trend, Polarity, Battery, Data, Real-time Clock, and Decimal Indicators		
Display Backlight	Four (4) LED Backlight with 30-second timeout		
Display Resolution	0.1° <1000 °	1 ° ≥ 1000 °	
Reading Rate	3 / Second for Readings and Trend Indicators		
Battery Type	3 AA (IEC LR6, ANSI 15) Alkaline		
Battery Life	1000 Hours Typical		
Battery Indicator	Four (4) Stage Battery Charge Indicator		
Statistics	Minimum Reading Maximum Reading Average Reading	Reading Range Standard Deviation T1–T2 (932B Only)	
Keypad	Twelve (12) momentary switches with audible and tactile feedback		
Clock	Real-Time Clock and Elapsed Statistics Run Time		
Power Cycle Configuration Retention	Instrument retains:		
	- Sensor Type - Temperature Unit	- Saved Measurements - Real-Time Clock	

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	- Offset Values	
Input Current	±50 nA	
Maximum Common Mode Voltage	42 V peak to earth	1 V p-p between T1 and T2
Compliance	CE (2014/30/EU) / RoHS2 (2011/65/EU)	
ESD	IEC 61000-4 2:2009, Class B	
EMC	EN 55022:2010+A1:2015, Class A; EN 61000-4 3:2006+A2:2010, 10 V/m (80 MHz to 1 GHz)	MIL-PRF-28800F, Class 2
DATA STORAGE AND COMMUNICATION		
Communication	*Bluetooth*® low energy technology / version 4.0	
Communication Range	10 m	30 ft
Transmitter FCC ID	J7V1740	
Internal Data Storage	Last 1000 Measurements with Time Stamp	
Storage Modes	Automatic and Manual	
Remote Operation	Android™ and Apple Mobile Device Applications	
Internet Data Collection	Via Thermometer Link™ mobile app and TEGAM Cloud™ data storage system	
Mobile Compatibility	**Device**	**Operating System**
Android	Devices with *Bluetooth* low energy technology / version 4.0 support	Android 4.3 or higher
Apple	iPhone 4S or newer	iOS 5.0 or higher
	iPad 3 or newer	iOS 5.1 or higher
TEGAM Cloud Requirements	PC or Mac OS computer with internet connection	
Data Storage Rate	User programmable	
	Local Storage	1 second minimum interval
	Mobile and Cloud Storage	5 second minimum interval
ENVIRONMENT:		
Standards	MIL-PRF-28800F, Class 2	UL 60079-0 § 26.4.2
Operating Temp	-20 to 55 °C	-4 to 131 °F
Temperature Coefficient	For specification variances due to ambient operating temperature, see the Expanded Instrument Uncertainty charts in *Appendix B* of this manual. For ambient operating temperatures not shown in *Appendix B*, accuracies shall	

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	be interpolated linearly.	
Humidity	<10 °C (50 °F): Non-condensing 10 to 30 °C (50 to 86 °F): 5 to 95% RH 30 to 40 °C (86 to 104 °F): 5 to 85% RH 40 to 55 °C (104 to 131 °F): 5 to 60% RH	
Altitude	0 to 4600 m	0 to 15,092 ft
Vibration	Random 10 – 500 Hz, 0.03 g^2/Hz	
Shock	30g Half Sine	
Drop	4 Drops from 1 m to Concrete	
Storage Temp	-40 to 71 °C	-40 to 159 °F
PHYSICAL CHARACTERISTICS:		
Dimensions	193 x 84 x 28 mm	7.6 x 3.3 x 1.1 in
Weight (incl. Batteries)	931B: 301.2 g (10.6 oz.)	932B: 303.6 g (10.7 oz.)

[1] For complete instrument accuracies, see the Expanded Instrument Uncertainty charts in *Appendix B* of this manual.

1.2 Optional Accessories and Ordering Information

PRODUCT	MODEL	DESCRIPTION
Accessories	911-910	Tilt Stand/Magnet/Hanger Factory Installed
	911-912	Tilt Stand/Magnet/Hanger User Installed
	911-911	Foam-Filled Hard Carry Case
	SDK-93X	Developers' Kit for custom implementations of the 931B and 932B Data Thermometers
		See TEGAM *Temperature Probe Selection Guide* at tegam.com for available temperature probes
Printed Manual	931B-900	Operation Manual
Manual Translations		Chinese, Dutch, French, German, Japanese, Korean, and Spanish (download at tegam.com)
Service Options		Calibration with Statement of Traceability

1.3 TEGAM Family of Thermometers

Thermocouple Thermometers	911B	Thermocouple Thermometer, Single Input
	912B	Thermocouple Thermometer, Dual Input
	931B	Data Thermometer, Single Input

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Data Thermometers	932B	Data Thermometer, Dual Input

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2. PREPARATION FOR USE

2.1 General Information

The TEGAM 931B and 932B Data Thermometers are high-accuracy handheld digital thermometers that provide accurate temperature readings in a wide range of manufacturing and service applications. With wireless communication to your mobile device and the TEGAM Cloud™, maintaining a record of your critical temperature data is easier, more efficient, and more accurate than ever before. These full-featured, durable, and versatile instruments simplify the process of temperature measurement through an intuitive user-interface. They are compatible with eight NIST-traceable thermocouple types: B, E, J, K, N, R, S, and T.

2.2 Feature Overview

- Data collection, storage, and analysis via TEGAMCloud
- Two-way communication and control with the Thermometer Link™ mobile app for Android™ and Apple mobile devices
- *Bluetooth*® low energy wireless technology
- Internal storage of up to 1000 measurements with time stamp
- 1000-hour battery life[1]
- Four (4) digit dual LCD with LED Backlight
- All eight (8) NIST-traceable thermocouple types: B, E, J, K, N, R, S, and T
- Comprehensive real-time statistics: MIN, MAX, AVG, RNG, STDEV, and T1-T2[2]
- Easy to clean
- Probe offset function to minimize probe error
- 0.1° / 1 ° display resolution
- °F, °C, and K temperature units
- Reading HOLD mode
- Conforms to ITS-90 thermocouple tables
- Durable: Meets MIL-PRF-28800F, Class 2 requirements
- Optional Tilt Stand/Magnet/Hanger
- User-friendly operation
- Retains measurement parameters, even when turned off
- Self-diagnostic routine to identify fault conditions
- Low battery and open sensor indications
- Optional Software Developers' Kit with example Windows 10 executable application, source code and example code for iOS and Android™ Apps.

[1] Typical battery life under normal use conditions in laboratory environment. Continuous or repeated use of features such as the backlight, maintaining an active *Bluetooth* connection for extended periods, or use or storage at high or low temperature extremes may reduce battery life.
[2] T1-T2 is available on model 932B only.

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2.3 Safety Notices and Information

Read this Operation Manual thoroughly before using the instrument to become familiar with its operations and capabilities.

Visually inspect instrument before using. Do not use if unit appears damaged or with any part of the case removed.

WARNING

MAINTENANCE INSTRUCTIONS WITHIN THIS MANUAL ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. DO NOT ATTEMPT TO SERVICE THIS UNIT UNLESS YOU ARE QUALIFIED TO DO SO.

SHOCK HAZARD

Disconnect all temperature probes and turn the unit off before removing the battery cover.

Never connect thermocouple leads to any source where more than 42 Volts (peak) could exist between the lead and ground. If it is necessary to make measurements of an object at elevated electrical potential, the user is responsible for obtaining and properly using a probe that provides adequate insulation between the surface with elevated potential and the thermocouple wiring.

Always disconnect probe leads before opening the battery door or the instrument housing. Internal circuits can present a shock hazard if leads are connected to a source of elevated potential.

Do not use this instrument if the housing, probe wiring, probe, or probe handle are damaged or distorted. Housings and wire insulation are part of the personnel protection system, and if damaged could expose users to elevated potentials.

EXPLOSION HAZARD

Never use or store this product with batteries installed, or change batteries, in an environment where explosive or flammable vapors or dust suspensions may exist. For thermocouple thermometers suitable for use in explosive environments, see TEGAM's 921A or 922A Intrinsically Safe Thermometers.

Do not attempt to recharge alkaline batteries.

Do not put batteries into bags designed to protect parts from electrostatic discharge (ESD). These bags are specially designed with metal shielding which can short circuit a battery.

Do not expose batteries to extreme heat or fire. Observe all regional laws and regulations when disposing batteries.

Never use this instrument or any temperature probe or sensor inside a microwave oven.

BURN HAZARD

Do not touch a temperature probe sheath that has been exposed to toxic substances or extremely high or low temperatures.

Do not attempt to measure temperatures beyond the range of the temperature probe. Probe damage or personal injury could result from exceeding a probe's maximum temperature rating.

Safety Notices and Information continued on next page . . .

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CAUTION

RISK OF INCORRECT READING

Do not use when AC or DC voltages in excess of 1V exist between thermocouple channels (on instruments with more than one channel). Excessive voltage could result in an incorrect reading, or in more extreme cases, a blown fuse that will result in incorrect readings and need for repair.

RISK OF INSTRUMENT DAMAGE

Only replace batteries with size AA (IEC LR6, ANSI 15). Observe proper polarity when installing batteries. Do not mix old and new batteries.

Do not apply voltages across thermocouple leads in excess of normal thermocouple voltage for the selected range. Excessive input voltage could result in blown fuse, component damage, or fire. Application of excessive voltage is not covered by the warranty.

Avoid making sharp bends in probe or sensor lead wires. Bending lead wires at sharp angles can damage the wire and cause probe failure.

When using both thermometer inputs and a voltage differential exists between the two measurement points, at least one probe should be electrically insulated. If not, a ground-loop current can flow through the thermocouple leads causing measurement error or instrument damage.

Static discharge through a connected temperature probe may cause instrument damage. Use care to avoid static discharge when handling the instrument or connected probes.

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2.4 Unpacking and Inspection

Each instrument is electrically and mechanically inspected before shipment. Upon receiving your new TEGAM Data Thermometer, unpack all items from the shipping container and check for any obvious damage that may have occurred during transit. Use the original packing materials if reshipment is necessary.

If any dents, broken, or loose parts are seen, do not use the equipment. Notify TEGAM immediately.

Check that all items are present. If any items are missing, notify TEGAM immediately.

The following items are included with every new instrument:

- One (1) Data Thermometer;
- One (1) Quick Start Guide;
- Statement of Traceability;
- Three (3) AA, 1.5 V batteries; and
- Optional accessories (if purchased).

2.5 Battery Installation and Replacement

Three (3) AA 1.5 V batteries are supplied with the instrument, but not installed. Read the following battery replacement instructions before attempting to install or remove the batteries.

CAUTION	Always turn the instrument off and disconnect any input connections before replacing the batteries. Re-install the battery compartment cover before resuming use of the instrument.

CAUTION	The battery compartment is sealed with a rubber gasket. Use care to not damage the gasket when removing or installing the battery compartment cover.

CAUTION	Remove the batteries when storing the instrument for an extended period of time or in a high temperature environment to prevent battery leakage and possible damage to the instrument.

	All measurement parameters may be reset to factory default if batteries are removed while the instrument is powered on. Always turn the instrument off before changing batteries.

To install or replace batteries:

Required Tools: Phillips Head Screwdriver

1. Identify the battery compartment located on the back of the instrument (*see Figure 1 below*);
2. Remove the two (2) battery compartment retaining screws;
3. Remove the battery compartment cover;
4. If present, carefully remove old batteries being careful to not damage the battery contacts;

5. Observing proper polarity, install three (3) new, AA alkaline (IEC LR6, ANSI 15) batteries;

6. Re-install the battery cover and two (2) retaining screws;

7. At initial power on after battery replacement, allow approximately 30 seconds for instrument to stabilize.

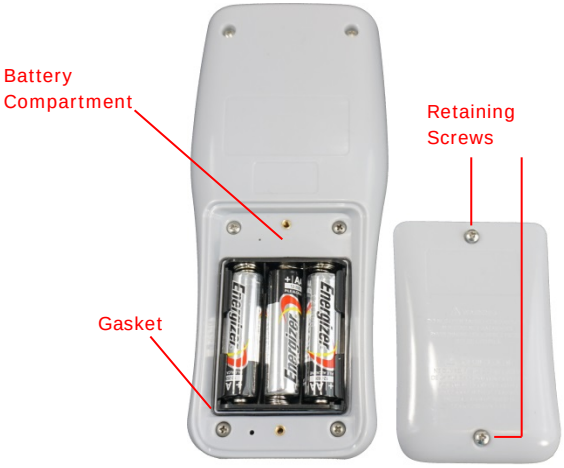

Figure 1: Battery Installation

2.6 Making Your First Temperature Measurement

TEGAM's 900 Series Data Thermometers are designed for easy operation, while still providing a feature-rich experience via the intuitive user interface.

To get started making temperature measurements right away, follow these steps:

1. Perform *Section 2.5, Battery Installation and Replacement*;

2. Connect a compatible temperature probe to the Channel 1 and/or Channel 2 input connector located at the top of the instrument;

> To ensure best measurement accuracy, allow several minutes for the thermocouple probe and connector to thermally stabilize after connection to the instrument.

3. The instrument will immediately display a temperature measurement for the connected channels. However, to ensure valid and best accuracy measurements, continue to Step 4 below;

4. Set the desired measurement parameters as follows:

    a. Enter the Setup Menu by pressing SET, hold the key down for approximately 1.5 seconds, and then release it;

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b. The active thermocouple type is flashing on the display. Use ▲▼ to select the thermocouple type of the connected temperature probe (B, E, J, K, N, R, S, or T);

c. Momentarily (do not hold) press SET to save your selection and move to the next parameter;

d. The active temperature unit is flashing on the display. Use ▲▼ to select the desired temperature unit (°C, °F, or K);

e. Momentarily press SET to save your selection and move to the next parameter;

f. Channel 1 probe offset value is flashing on the display. If the temperature probe's offset value is known, press ▲▼ to set the Channel 1 probe offset to the probe's offset value. See *Section 3.10, Probe Offset*, for more information.

g. Momentarily press SET to save your selection and move to Channel 2 probe offset (if equipped);

h. If desired, repeat Step (f) above for Channel 2;

i. Momentarily press VIEW to save your selection and exit the setup menu.

2.7 Recording Temperature Data

The TEGAM Thermometer Link mobile application provides convenient two-way communication between your TEGAM Data Thermometer and compatible *Bluetooth* low energy technology / version 4.0 mobile devices. Thermometer Link duplicates the Data Thermometer display for easy monitoring from up to 30 feet away and provides real-time measurement charting for both channels. See *Figure 2* below for a description of the Thermometer Link user interface.

Thermometer Link is also the gateway to the TEGAMCloud™ (tegamcloud.com), where you can save, store, review, analyze, and download, all your measurement data. Once created, your TEGAM Cloud account can be personalized to meet your organization's needs with user-created locations, custom data filtering, and measurement charting.

Both Thermometer Link and TEGAM Cloud are provided free to TEGAM customers for use with TEGAM Data Thermometers. If your organization has specific or unique data storage, interface, or security requirements, please contact TEGAM to discuss customization options.

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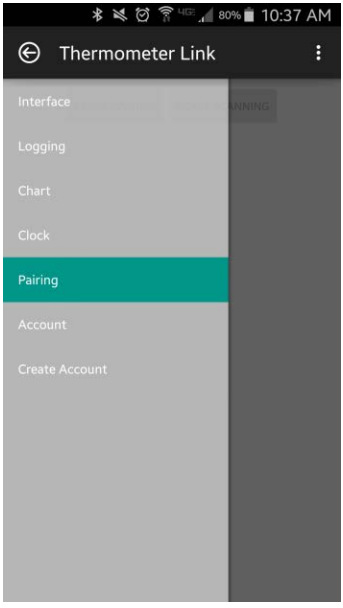

	Open or close the mobile app menu
Interface	View real-time measurement data
	Control most Data Thermometer features
Logging	View instrument connection state, model, serial number, and the active user account and location
	Manually record a temperature measurement
Chart	Real-time chart of current temperature measurement for each active channel
Clock	View instrument connection state and current mobile device date and time
	Manually set instrument date and time from user-input date and time
	Automatically set instrument date and time from mobile device time
Pairing	View available Data Thermometers
	Pair mobile device to Data Thermometer
	Clear pairing to a paired Data Thermometer
Account	View or change current account information
Create Account	Create a new user account on the TEGAM Cloud

Figure 2: Thermometer Link User Interface Description

To connect to the TEGAM Thermometer Link mobile app using the default account:

Thermometer Link is initially set to save data to a default TEGAM Cloud account, the "*TEGAMUser*" account. This is a public account accessible by all TEGAM Data Thermometer users and should not be used to store production measurement data. Before saving critical or sensitive temperature data, create a personalized account with a strong password through Thermometer Link or at tegamcloud.com.

1. Before beginning, ensure your mobile device is *Bluetooth* low energy technology / version 4.0 compatible and has an active internet connection;
2. Visit the Google Play™[3] store or iTunes and search for "TEGAM" to download Thermometer Link;
3. Install the mobile app to your device and accept the license agreement and permissions requests;
4. Verify that *Bluetooth* wireless communication is active on your mobile device;

[3] China customers may download the TEGAM Thermometer Link from 360 Mobile Assistant, Baidu App Store, or Tencent App Store.

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5. On your Data Thermometer, press  to turn *Bluetooth* wireless communication on;

The display *Bluetooth* icon is flashing, indicating the instrument is in pairing mode.

6. In Thermometer Link, touch  and select **Pairing**;

7. In the displayed list of available instruments, touch the entry that corresponds to your Data Thermometer's MAC address (located on back of instrument) and touch **Yes** in the resulting dialogue box;

The display *Bluetooth* icon is steadily illuminated, indicating the instrument is paired to the mobile device.

8. Touch  and select **Interface** to monitor real-time temperature measurements and to remotely control your Data Thermometer;

9. Touch  in Thermometer Link or press  on your Data Thermometer, to begin automatic data collection at the programmed measurement acquisition interval (default is 10s).

To access the TEGAM Cloud and view saved measurement data:

1. Go to tegamcloud.com;

2. Click **Login**;

3. Click **Login** to accept the pre-filled user name and password and access the default "*TEGAMUser"* account;

If a personalized user account has already been created for your organization, enter the appropriate username and password to access that account.

4. Click **View Data** to access your saved measurement data;

5. Click **Select Device** and choose your Data Thermometer's serial number from the drop-down list;

6. Click **Create Chart** to display your saved measurement data.

Congratulations! You're now ready to make accurate and reliable temperature measurements, wherever and whenever you may need to.

We know you are eager to begin using your new thermometer, but this overview is just the beginning. Please take a moment to familiarize yourself with this Operation Manual to learn about all the features and benefits of your new TEGAM Data Thermometer.

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3. Operating Instructions

3.1 Keypad Functions

The instrument keypad is a twelve (12) key, sealed membrane keypad. Each key provides audible and tactile user feedback when pressed. Key functions are described in *Figure 3* below.

	⏻	Power instrument ON or OFF and exits Key Lock mode.
	⏻ (1.5s)	Disable auto-power OFF
	SET (1.5s)	Enter instrument Setup Menu
	SET	While in Setup Menu, save current value and step to next parameter
	☼	Toggle display backlight
	☼ (1.5s)	Disable backlight 30-second timeout
	HOLD	Hold currently displayed measurement and pause statistics collection
	CLR (1.5s)	Delete all saved measurement data and reset all statistics currently stored in memory
CLR	While in Setup Menu, discard all unsaved changes and exit menu	
VIEW	Cycle through view modes and statistics	
	While in Setup Menu, save changes and exit menu	
	While in Setup Menu, cycle through individual digits for Date, Real-Time Clock and Measurement Acquisition Interval	
DATA	Initiate or stop automatic data collection	
STO	Manually store the current measurement and time stamp	
RCL	Review saved measurement data and time stamps	

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	Activate *Bluetooth* connection pairing mode
	Turn wireless communication OFF
	While in Setup Menu, advance or reverse selected setting
	While viewing saved data, advance or reverse displayed measurement
	While in Calibration mode and when pressed simultaneously for 1.5 seconds, resets active calibration factor to default.

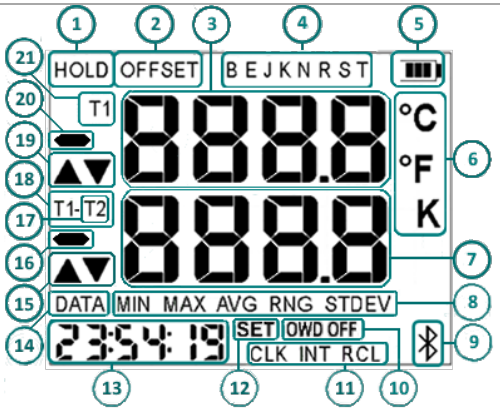
Figure 3: Keypad Button Functional Description

The , , , and keys have multiple functions which can be accessed by momentarily pressing the key, or alternatively, by pressing and holding the key for approximately 1.5 seconds. Throughout this Operation Manual, the press and hold sequence is indicated by the key designator followed by the subscript (1.5s). For instance, (1.5s) indicates that the key should be pressed and held for 1.5 seconds, then released to access the desired function.

3.2 LCD Display

The display is a large, easy to read, dual LCD display, with an LED backlight for clear viewing in low-light conditions. It simultaneously displays temperature measurements for Channel 1 and Channel 2, current thermocouple type and temperature unit, trend indicators for both Channel 1 and Channel 2, and a battery voltage indicator.

In Statistics View, the display substitutes the Channel 2 temperature measurement with the active statistic result and displays an active statistic mode indicator and the elapsed time of the current statistic session. See *Figure 4* below for further description of each display indicator.



1	HOLD function is active **Flashing:** Key Lock mode is active.
2	T1 and/or T2 OFFSET is active[1]
3	Channel 1 temperature measurement
4	The active thermocouple type
5	Remaining battery life
6	Active temperature unit
7	Channel 2 temperature measurement[2]
8	Active statistic
9	**Flashing:** *Bluetooth* connection pairing mode **Solid On:** *Bluetooth* connection active

Figure 4 continued on next page . . .

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10	Set Open Wire Detection On/Off
11	Real-time clock mode indicator
12	Set indicator active while in set mode
13	Real-time Clock
	When viewing statistics, time elapsed since start of statistics collection
	When reviewing saved data, alternates between displayed data time and date stamp
14	Automatic data collection active
15	Channel 2 trend indicators[2]
16	Channel 2 minus indicator
17	Channel 2 indicator[2]
18	T1-T2 temperature measurement indicator[2]
19	Channel 1 trend indicators
20	Channel 1 minus indicator
21	Channel 1 indicator

[1] T2 Probe Offset available on model 932B only.
[2] Model 932B only.

Figure 4: LCD Display Description

The LCD can display error information about the current measurement, as shown in *Figure 5*.

DISPLAY	DESCRIPTION
OPEn	No thermocouple probe is connected or making connection
-Or-	Over range: The applied temperature is greater than the maximum temperature for the selected thermocouple type
-Ur-	Under range: The applied temperature is less than the minimum temperature for the selected thermocouple type

Figure 5: LCD Error Indications

3.3 Setup Menu

Key designators followed by (1.5s), e.g. SET(1.5s), indicate that the key should be pressed and held for 1.5 seconds, then released to access the desired function.

Measurement settings are configured in the Setup Menu. Press SET(1.5s) to access the Setup Menu. The SET annunciator will appear at the bottom of the display and the currently selected thermocouple type will begin to flash.

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From within the Setup Menu, press SET to step through the user-definable parameters and the ▲▼ keys to advance or reverse the selected value for the active parameter. The active parameter value will flash on the display.

To enter the Setup Menu, press SET(1.5s). The active parameter value will flash on the display. To differentiate between the date and real-time clock parameters when the date parameter is active, the **CLK** indicator is lit. When the real-time clock parameter is active, the **CLK** indicator is flashing.

Press SET to save a setting and step to the next parameter. Press VIEW to save a setting and exit the Setup Menu. Press CLR to disregard unsaved changes and exit the Setup Menu. If no key is pressed for 10 seconds, the current configuration is saved, and the instrument will exit the Setup Menu.

Figure 6: Setup Menu Parameters and Values lists the user-definable parameters and the available values for each parameter.

To set a parameter value:

1. Press SET(1.5s) to enter the Setup Menu;
2. Press SET to cycle through parameters as shown in *Figure 6*: Setup Menu Parameters and Values until the desired parameter is reached;
3. To change the value of the current parameter, press ▲▼;
4. To cycle through individual digits for Date, Real-Time Clock and Measurement Acquisition Interval, press VIEW.
5. To save the current parameter value and cycle to the next parameter, press SET(1.5s);

PARAMETER	AVAILABLE VALUES
Thermocouple Type	E, J, K, T, B, R, N, S
Temperature Units	°C, °F, K
T1 Probe Offset	±0.1 ° increments
T2 Probe Offset[4]	
Date	Valid date on or after 01 01 16 (mm dd yy)
Real-Time Clock	Any valid 24-hour time (hh mm ss)
Measurement Acquisition Interval	Minimum 1 s (hh mm ss)
Open Wire Detection	ON, OFF
Resolution and Rounding functions	rndG, Auto, CEIL, nOrL, trnC
trnd	ON, OFF

Figure 6: Setup Menu Parameters and Values

[4] T2 Probe Offset available on model 932B only.

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6. To save the current parameter value and exit the Setup Menu, press VIEW;
7. To disregard changes made to the current parameter value and exit the Setup Menu, press CLR.

Instrument date and time may also be set using the TEGAM Thermometer Link mobile app (see *Figure 2*, page 2-7).

While in the Setup Menu, the **CLK** indicator will flash on and off when the date parameter is active and remain on when the real-time clock parameter is active.

If no key is pressed for 10 seconds, the instrument will save the current configuration and exit the Setup Menu.

3.4 View Modes and Statistics

The instrument features multiple view modes including a variety of real-time statistics, all available at the touch of a button. *Figure 7* below describes each view mode.

VIEW MODE	DISPLAY INDICATOR	DESCRIPTION
T1–T2	T1-T2	Current Channel 1 measurement – current Channel 2 measurement
Minimum	MIN	Minimum temperature recorded during current session
Maximum	MAX	Maximum temperature recorded during current session
Average	AVG	Average of all temperatures recorded during current session
Range	RNG	Maximum - Minimum
Standard Deviation	STDEV	Standard deviation of all temperatures recorded during the current session[1].

[1] Standard Deviation is calculated using the population formula: $\sigma = \sqrt{\frac{\sum(x-\mu)^2}{N}}$

Figure 7: View Modes and Statistics

Press VIEW to change view modes. For each mode, the active measurement or statistic result is displayed on the second line of the display.

The T1-T2 view mode displays the current Channel 1 measurement minus the current Channel 2 measurement. The display indicates **T1-T2** at the left side of the display. If either

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channel is not connected to a probe, or the current measurement on either channel is over- or under-range, T1-T2 view mode is not available.

When viewing statistics, the active statistic is indicated directly below the result. The elapsed time of the current statistics session is displayed in the lower-left corner of the display.

Statistics are calculated continuously, beginning when the instrument is powered on or when CLR (1.5s) is pressed. To pause statistics collection temporarily, press HOLD. To resume statistics collection, press HOLD again.

It is important to note that changing parameter values or temperature probes will invalidate the current statistics session. When using statistics, always begin by pressing CLR (1.5s) to delete existing statistics data and initiate a new statistics session.

Press VIEW to step through the available statistics. Statistics are displayed in the order shown in *Figure 8* below. For dual-channel models, the LCD T1 or T2 indicators are lit to identify the channel's statistics currently being displayed.

When using statistics, always begin by pressing CLR (1.5s) to clear existing statistics results and initiate a new statistics session.

The first line of the display indicates the current Channel 1 temperature, regardless of which view mode or channel's statistic is currently displayed.

MODEL	CHANNEL	STATISTIC VIEW SEQUENCE				
931B	T1	MIN	MAX	AVG	RNG	STDEV
932B	T1	MIN	MAX	AVG	RNG	STDEV
	T2	MIN	MAX	AVG	RNG	STDEV

Figure 8: Statistics Sequence

If the instrument records invalid measurement data during the statistics session such as an over-range, under-range, or open input value,
———— will be displayed for each affected statistic result.

To return to the active measurement mode, press VIEW repeatedly to step through the remaining view modes, or cycle power.

3.5 Auto-Power Off

Key designators followed by (1.5s), e.g. (1.5s), indicate that the key should be pressed and held for 1.5 seconds, then released to access the desired function.

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To conserve battery life, the instrument automatically turns off if no key is pressed for 20 minutes. To disable this feature, press (1.5s). The remaining battery life indicator will flash once, indicating auto-power off is disabled.

Auto-power off will remain disabled until instrument power is cycled. At next power on, auto-power off returns to the default enabled condition.

While data collection is active, the auto-power off feature is automatically disabled to ensure uninterrupted data collection.

3.6 Backlight and Backlight Timeout

The instrument includes an LED backlight feature to ensure measurement data can be easily read in low-light conditions. To activate the backlight, press .

Once the backlight is activated, it will automatically turn off after 30 seconds if no key is pressed to preserve battery life. To disable the backlight timeout feature, press (1.5s). The backlight will flash to indicate the timeout feature has been disabled. To re-enable the backlight timeout feature, turn the backlight off then on by pressing twice.

The backlight feature cannot be activated or deactivated from the TEGAM Thermometer Link mobile app.

3.7 Hold Function

Press HOLD to hold the current reading and/or statistics result, and to pause statistics accumulation. **HOLD** is displayed at the top-left of the LCD display. New measurements are not displayed, trend indicators are not refreshed, and statistics are not calculated while the hold function is active.

While the hold function is active, both automatic and manual data collection features remain available. Both methods continue to collect real-time temperature measurements, regardless of the measurement data displayed while hold is active.

To disable the hold function and resume normal operation and statistics data accumulation, press HOLD again.

3.8 Trend Indicators

Trend indicators provide a visual representation of the measurement's stability, and separate indicators are provided for each channel. An up arrow indicates that the current measurement is trending upwards, while a down arrow indicates the measurement is trending downwards. Neither arrow is visible when the measurement is stable. For best accuracy, always allow the measurement to stabilize before evaluating or recording the measured temperature. This feature can be turned on and off in the Setup menu. See section 3.3 above.

3.9 Battery Indicator

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Battery depletion or battery replacement will reset all measurement parameters to their default values and deletes all existing statistics data. After battery replacement, set measurement parameters as required.

The battery voltage indicator provides a visual representation of approximate remaining battery life. It is located at the top-right of the display.

The battery voltage indicator uses three bars to represent remaining battery life. *Figure 9* shows the approximate battery life for each bar.

BARS	APPROX. BATTERY LIFE
3	100% - 50%
2	50% - 20%
1	20% - 5%
0	0% - Shutdown Initiated

Figure 9: Battery Voltage Indicator

At zero (0) bars, the instrument will momentarily display **bATT** and initiate a shutdown sequence. To prevent disruption of the measurement process and statistics and data collection, the batteries should be replaced before the battery voltage indicator reaches zero (0) bars. *See Section 2.5, Battery Installation and Replacement*.

3.10 Probe Offset

The probe offset feature compensates for temperature probe errors, significantly improving overall measurement uncertainty. Probe offset can be set for Channel 1 and 2 individually. Once set, the probe offset is automatically applied to all subsequent measurements and statistics on the offset channel.

Current statistics will be invalidated after changing settings such as probe offset. Press CLR (1.5s) to delete existing statistics data and initiate a new statistics session.

Probe offset rounding errors may occur if temperature units are changed while a probe offset is active. When using a probe offset, verify and if necessary correct the programmed probe offset after changing temperature units.

To set the probe offset when using an un-calibrated temperature probe:

1. Connect the temperature probe to Channel 1 or Channel 2 (as desired) of the instrument;
2. Place the probe into a known temperature reference such as a thermowell or ice bath[5];

Neither trend indicator is displayed when the temperature measurement has stabilized.

[5] Probe offset measurement using an ice bath or thermowell should only be performed by personnel trained and qualified in the use of such instruments and related metrology methods.

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3. Allow the temperature probe to stabilize in the ice bath or thermowell by observing the instrument trend indicators for the appropriate channel;
4. Press SET (1.5s) to enter the Setup Menu;
5. Press SET three (3) times to cycle to the Channel 1 Offset parameter;
6. Observe the current Channel 1 temperature measurement displayed on the top measurement line of the display, and current offset value displayed on the second line of the display;
7. Press ∧∨ to set the offset in 0.1 ° increments until the displayed temperature equals the known temperature reference value;
8. Press SET to save the offset value and proceed to Channel 2 offset (932B only), or press VIEW to save the offset value and exit the Setup Menu.
    a. Alternatively, to disregard the new offset value and exit the Setup Menu, press CLR.
9. **OFFSET** is displayed at the top-left of the LCD display.

To set the probe offset when using a calibrated temperature probe with a known offset:

1. Press SET (1.5s) to enter the Setup Menu;
2. Press SET three (3) times to cycle to the Channel 1 Offset parameter;
3. Observe the current offset value displayed on the second line of the display;
4. Press ∧∨ to set the offset in 0.1 ° increments until the displayed offset value equals the calibrated probe offset value;
5. Press SET to save the offset value and proceed to Channel 2 offset (932B only), or press VIEW to save the offset value and exit the Setup Menu.
    a. Alternatively, to disregard the new offset value and exit the Setup Menu, press CLR.
6. **OFFSET** is displayed at the top-left of the LCD display.

3.11 Open Wire Detection On/Off

Open Wire Detection allows the unit to detect if a thermocouple probe is connected to the thermometer. This feature is not compatible with some thermocouple calibrators and can result in measurement instability.

Disabling Open Wire Detection in these situations can significantly improve reading stability. Once turned off, Open Wire Detection will remain off until changed by following the below steps, or the instrument is powered off.

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If no thermocouple probe is connected and Open Wire Detection is off, the unit will not indicate OPEn and may display erratic readings.

To change the Open Wire Detection setting:

1. Press SET (1.5s) to enter the Setup Menu;
2. Press SET four (4) times for 931B, seven (7) times for 932B, to cycle to the Open Wire Detection parameter;
    a. "OWD OFF" is flashing near the bottom of the LCD, and the current Open Wire Detection status is displayed on Line 2.
3. Press ^ v to change the Open Wire Detection setting;
    a. ON indicates that Open Wire Detection is enabled;
    b. OFF indicates that Open Wire Detection is disabled;
4. Press VIEW or SET to save the Open Wire Detection setting and exit the Setup Menu.
    a. Alternatively, to disregard the Open Wire Detection setting and exit the Setup Menu, press CLR.
5. While Open Wire Detection is disabled, the "OWD OFF" annunciator will be shown during active measurement mode.

3.12 Clear Function

From active measurement or hold mode, press CLR (1.5s) to clear the statistics registers and begin a new statistics session. The LCD display will indicate **CLr** to confirm the action and return to active measurement mode.

Pressing CLR (1.5s) deletes all measurement data currently saved in the instrument's internal memory. To prevent data loss, connect to the Thermometer Link mobile app and TEGAM Cloud to upload saved data before performing this action.

From the Setup Menu, press CLR to disregard changes to the current parameter value and exit the Setup Menu.

3.13 Real-Time Clock

The real-time clock is displayed in the lower-left of the display. In active measurement mode, the clock displays the current time in 24-hour format (hh:mm:ss). See *Section 3.3, Setup Menu* to set the date and clock.

When reviewing saved measurement data, the clock alternates between the currently displayed data point time stamp and date stamp. The **CLK** indicator is lit when the time stamp is displayed and is off when the date stamp is displayed. When viewing statistics, the clock displays the elapsed time of the current statistics session.

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3.14 Measurement Data Collection Overview

The data collection features of the TEGAM Data Thermometers accurately record and store accurate time stamped measurements at the touch of a button. Saved data can be reviewed on the device, or uploaded to the TEGAM Cloud via the TEGAM Thermometer Link mobile app.

Measurement data is collected automatically at user-programmed intervals, or manually as desired by the user. All saved measurements can be viewed directly on the instrument, monitored in real-time with the mobile app, or reviewed, analyzed, and downloaded from the TEGAM Cloud.

Each saved measurement includes a time and date stamp based on the date and time programmed into the instrument. Through the mobile app and TEGAM Cloud, data collection sessions can be associated with user-customizable locations to establish an auditable record for a given asset, product, batch, bin, etc.

3.15 Measurement Data Collection Configurations

Data collection can be accomplished using three distinct configurations to provide the most flexibility and adaptability based on equipment availability and internet or cellular access.

If no compatible mobile device is available, measurement data may be collected and stored directly on the Data Thermometer. To manually save a measurement, press while the measurement of interest is displayed. Up to 1000 time-stamped measurements can be saved directly to the instrument.

Measurement data may also be collected and stored via the TEGAM Thermometer Link mobile app, without a connection to the internet and the TEGAM Cloud. Once connected to Thermometer Link, any saved measurement data stored on the instrument is uploaded, and new saved measurements will be immediately transmitted to Thermometer Link. Transmitted measurement data is stored on the mobile device and removed from the instrument.

When both a compatible mobile device and internet access are available, saved measurement data can be uploaded to the TEGAM Cloud for long-term storage, review, analysis, and download. See *Figure 10* below.

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CONFIGURATION	DESCRIPTION
Data Thermometer	Measurement data stored on thermometer
	Limited to 1000 stored measurements
	Saved measurement data is reviewable on the thermometer
Data Thermometer + Thermometer Link	Measurement data is stored on mobile device
	Number of stored measurements limited by available memory on the mobile device
	Real-time measurement monitoring
	When connected, any data stored in the thermometer internal memory is automatically uploaded to mobile device
Data Thermometer + Thermometer Link + TEGAM Cloud	Measurement data stored on TEGAM Cloud
	Measurement data can be reviewed, analyzed, and downloaded from the TEGAM Cloud
	When connected, any data stored in mobile device memory is automatically uploaded to the TEGAM Cloud

Figure 10: Data Collection Configurations

3.16 Measurement Acquisition Interval

The measurement acquisition interval determines the time interval between saved measurements while in automatic data collection mode. The minimum acquisition interval is 1 second when storing data to the instrument's internal memory. When connected to the Thermometer Link mobile app, the minimum supported acquisition interval is 5 seconds. See *Section 3.3, Setup Menu* to set the measurement acquisition interval.

Real-time measurements, trend indicators, and statistics collection are unaffected by the acquisition interval.

3.17 Internal Memory

Up to 1000 measurements may be saved directly to the instrument, including both automatically and manually saved measurements. Once 1000 measurements have been saved, each new saved measurement will replace the earliest measurement stored in memory.

When the instrument is connected to the Thermometer Link mobile app, measurement data saved in instrument memory are automatically uploaded to the mobile device and removed from the instrument.

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3.18 Manual Measurement Storage

Press STO to manually save the current temperature data and time/date stamp. If the instrument is not connected to Thermometer Link, the saved measurement data will be stored in the instrument's internal memory. When connected to the mobile app, existing saved data and new saved measurements are automatically transmitted to the mobile device and cleared from the instrument memory.

To avoid data loss, periodically connect to Thermometer Link whenever possible to upload saved measurement data to the mobile device or TEGAM Cloud. Uploading saved measurement data clears the instrument memory.

If STO is pressed while the hold function is active, the current real-time temperature measurement is saved, regardless of the measurement data currently displayed on the display.

3.19 Automatic Measurement Storage

Press DATA to start automatic measurement data collection. The **DATA** indicator is lit on the display. Measurement data is saved at the programmed measurement acquisition interval. If the instrument is not connected to Thermometer Link, saved measurement data will be stored in the instrument's internal memory. When connected to the mobile app, existing saved data and new saved measurements are automatically transmitted to the mobile device and cleared from the instrument memory.

Using automatic measurement collection at fast measurement acquisition intervals while not connected to Thermometer Link can quickly consume available instrument memory. To avoid data loss, periodically connect to Thermometer Link whenever possible to upload saved measurement data to the mobile device or TEGAM Cloud. Uploading saved measurement data clears the instrument memory.

While the hold function is active during automatic measurement storage, the current real-time temperature measurement is saved at each acquisition interval, regardless of the measurement data currently displayed on the display.

Pressing RCL will exit automatic measurement collection mode.

3.20 Recall Saved Measurement Data

Press RCL to recall and review measurement data stored in instrument memory. The first saved measurement and time/date stamp is shown on the display. The **CLK** indicator is lit when the time stamp is displayed and is off when the date stamp is displayed.

Press ▲▼ to step through the saved measurements. Press RCL again to return to active measurement mode.

3.21 Invalid Measurement Indications

The LCD display indicates when a measurement or statistic is invalid, as shown in *Figure 11* below.

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INDICATION	DESCRIPTION
- Or -	The current measurement or statistic is over-range for the selected thermocouple type
- Ur -	The current measurement or statistic is under-range for the selected thermocouple type
OPEn	No probe is connected, or the probe sensor is faulty
————	Cannot compute a valid statistical result

Figure 11: Invalid Measurement Indications

3.22 Key Lock Mode

Key Lock is a feature that is accessed via custom programming using the optional Developers' Kit. All the keys except  ,  and  are inoperative when in Key Lock mode. The HOLD indicator on the LCD display will flash continually and LOC will be displayed for 1.5 seconds when a key is pressed to indicate that Key Lock mode is active. The instrument will exit Key Lock mode when instructed by the custom program, the Bluetooth connection is lost or the instrument is powered off.

3.23 Resolution and Rounding Functions (Serial Number 2148 and later)

This feature allows the user to select between four rounding methods or modes. These modes are Automatic (AutO), Normal (nOrL), Ceiling (CEIL) and Truncate (trnC). In these modes the rounding methods are different, but the resolution, (except AutO), are all set at a 1° increment and cannot be changed.

Two functions, ceiling (CEIL) and truncate (trnC) have special algorithms designed to assure that the target temperature is fully achieved depending upon the direction you are approaching the target temperature.

The nOrl function provides standard rounding, round down <0.5° and round up ≥ 0.5°

The CEIL function provides 1° resolution and is used when approaching the target temperature moving towards zero in either direction, up or down.

The Trunc function provides 1° resolution and is used when approaching the target temperature moving away from zero in either direction, up or down.

See detailed descriptions below.

rndG

1. AutO: 0.1° Resolution for readings <1000° and 1°>999.9°. AutO is the default setting.

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2. CEIL: 1° Resolution with ceiling rounding is used for a decreasing positive temperature to assure the lower temperature is fully reached or an increasing negative temperature to assure a higher temperature is fully reached.

For Example: A decreasing (cooling) temperature 20.4° actual temperature will display 21° until 20.0° is reached. An increasing (thawing) temperature -20.6° will display -21° until -20.0° is reached.

3. nOrL: 1° Resolution with normal rounding, 20.4° displays 20°, 20.5° displays 21°

4. trnC: 1° Resolution with truncate rounding is used to assure that an increasing positive temperature is fully reached or a decreasing negative temperature to assure the lower temperature is fully reached.

For Example: An increasing temperature (heating) 20.6° will display 20° until 21.0° is reached.

A decreasing temperature (cooling) -20.6° will display -20° until -21.0° is reached.

This is for data on the instrument display only. Data transferred via the TEGAM Thermometer link to the TEGAM Cloud or via Bluetooth from the instrument will not have any rounding applied.

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4. SERVICE INFORMATION

4.1 Inspection and Cleaning

To extend the life of the instrument, inspect and clean the instrument regularly. Inspect the instrument for any significant abrasions, cuts, cracks, dents, or other signs of damage on the case, keypad, and display lens. Inspect the connectors for breaks, dirt, or corrosion. Ensure all screws are securely fastened, and if equipped, that the tilt stand/magnet/hanger is in good condition and locks into position properly.

With all screws securely fastened and the battery compartment cover in place, use a damp cloth or towel to wipe down the instrument. Use care to avoid scratching the display lens. Mild, non-abrasive detergents may be used providing the instrument is then wiped down with a clean damp cloth or towel.

4.2 Calibration

4.2.1 Verification Procedure

1. This procedure shall be performed within environmental conditions of 23 ±1 °C and 5% to 95% RH.
2. The unit under test ("UUT") shall be acclimated to the controlled environment for a minimum of four (4) hours.
3. The equipment listed in *Appendix A* is required to fully verify the UUT to the expanded instrument uncertainties specified in *Appendix B*.
4. Refer to *Appendix C* for standard measurement points and tolerances for each thermocouple type.
5. One, several, or all the available thermocouple types may be verified as necessary. In the steps below, use the appropriate Thermocouple Cable and Thermocouple Calibrator settings as appropriate for the desired thermocouple type.
6. For two channel UUTs, both channels may be verified concurrently.
7. Set the UUT parameters as shown in *Figure 12* below. Refer to *Section 3.3, Setup Menu* as necessary for UUT parameter setup instructions.

PARAMETER	VALUE
Thermocouple Type	As Desired
Temperature Units	°C
Offset Ch. 1	0.0 °C
Offset Ch. 2 (932B only)	0.0 °C
Open Wire Detection On/Off	As Needed (see *Section 3.11, Open Wire Detection On/Off*

Figure 12: UUT Verification Parameter Settings

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8. Connect the miniature thermocouple connector of the Thermocouple Cable to Channel 1 of the UUT.

    a. For two channel UUTs using the Split Thermocouple Cable, connect the miniature thermocouple connector of one leg to the UUT Channel 1 input, and the miniature thermocouple connector of the other leg to the Channel 2 input.

9. Connect the opposite end of the Thermocouple Cable (or the single-connector end of the Split Thermocouple Cable) to the Thermocouple Calibrator thermocouple output.

10. Set the Thermocouple Calibrator thermocouple type to the desired thermocouple type.

11. Allow at least five minutes for this connection to stabilize.

12. Set the calibrator to output to the first Standard Value in *Appendix C* for the desired thermocouple type.

13. Record the UUT measurement in the Reading column of *Appendix C* for the appropriate Standard Value.

14. Record the cable correction value for the Thermocouple cable in the Cable Correction column of *Appendix C*.

15. Subtract the Cable Correction value from the Reading and record the result as the Corrected Reading (*Reading – Cable Correction = Corrected Reading*) in *Appendix C*.

16. Compare the Corrected Reading to the tolerances stated in the 2-Sigma Tolerance column of *Appendix C* to determine whether the UUT measurement is within published specifications.

17. Repeat Steps 12 through 16 for each remaining Standard Value in *Appendix C* for the current thermocouple type.

18. Repeat Steps 4 through 17 for each desired thermocouple type.

19. If Open Wire Detection was Off in Step 4 above, enable the feature as shown in *Section 3.11*, *Open Wire Detection On/Off*

4.2.2 Alignment Procedure

Preparation

1. This procedure shall be performed within environmental conditions of 23 ±1 °C and 5% to 95% RH.

2. The unit under test (“UUT”) shall be acclimated to the controlled environment for a minimum of four (4) hours.

3. The equipment listed in *Appendix A* is required to align the UUT to the expanded instrument uncertainties specified in *Appendix B*.

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4. Remove the UUT battery door housing to expose the alignment access hole.

5. Press UUT ⏻ to turn the UUT on.

6. Set the UUT parameters as shown in *Figure 13* below. Refer to *Section 3.3, Setup Menu* as necessary for UUT parameter setup instructions.

PARAMETER	VALUE
Thermocouple Type	Type E[1]
Temperature Units	°C
Offset Ch. 1	0.0 °C
Offset Ch. 2 (932B only)	0.0 °C

[1] Other thermocouple types may be used in this procedure as desired. For instance, if the UUT is used primarily with Type J applications, Cold Junction Compensation may be aligned using Type J. Note however that the expanded instrument uncertainties provided in *Appendix A* assume alignment using Type E.

Figure 13: UUT Alignment Parameter Settings

7. Insert the Straightened Paper Clip through the alignment access hole and gently press the calibration enable switch located on the circuit board. See *Figure 14* for location.

Figure 14: Alignment Access Hole Location

Voltage Gain and Offset Alignment

8. The UUT display will indicate as follows:

   a. Line 1: CAL1

   b. Line 2: mV portion of Channel 1 voltage reading

   c. Line 3: nV portion of Channel 1 voltage reading

9. Connect the miniature thermocouple connector of the Copper Mini-TC Cable to the Channel 1 input of the UUT.

   a. For two channel UUTs using the Split Copper Mini-TC Cable, connect one miniature thermocouple connector to the Channel 1 input of the UUT, and the other connector to the Channel 2 input.

10. Connect the opposite end of the Copper Mini-TC Cable (or Split Copper Mini-TC Cable) to the appropriate output connectors of the DC Voltage Source.

11. Allow at least three minutes for the connections to temperature stabilize before proceeding.

CAUTION	Do not apply voltages greater than 80 mV DC to the UUT inputs. Voltages greater than 80 mV may damage the instrument.

12. Set the DC Voltage Source to output the first Applied Voltage value in *Figure 15* below.

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13. Allow the DC Voltage source output to stabilize before proceeding.
14. The UUT will display the current voltage reading.
15. Allow the UUT displayed voltage to stabilize before proceeding.
16. Press UUT HOLD to automatically adjust the UUT voltage reading to the Applied Voltage, ±0.001 mV.
    a. If the UUT displayed voltage is not within ±0.001 mV of the Applied Voltage, press ▲▼ until the UUT displayed voltage is within ±0.001 mV, adjusting as close to the Applied Voltage as possible.
    b. If the UUT displayed voltage is too far from nominal, HOLD may not function as expected. The UUT will typically indicate 8999 or -999 in this state. To set the active CAL factor to its default value, press the ▲▼(1.5s) arrow buttons simultaneously for 1.5 seconds. Fine adjustments may still be necessary.
17. Press UUT VIEW. The display will change to rES1 [2, 3 …] showing the actual measured value saved in the previous step.
18. Press UUT VIEW again. This will increment to the next CAL value.
19. Repeat Steps 12 through 18 for each remaining value in *Figure 15* below. For single channel UUTs, omit Channel 2 values.
    a. For two channel UUTs using the single-ended Copper Mini-TC Cable, disconnect the cable from the UUT Channel 1 input, and reconnect the cable to the Channel 2 input after completing CAL4 in *Figure 15* below. Repeat Step 11.

CHANNEL	UUT DISPLAY	APPLIED VOLTAGE (mV)
1	CAL1	-10
	CAL2	75
	CAL3	-10
	CAL4	30
2	CAL5	-10
	CAL6	75
	CAL7	-10
	CAL8	30

Figure 15: Gain Alignment Values

20. Remove the copper cable from the DC Voltage Source and UUT.

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Cold Junction Compensation Alignment

21. Connect one end of the Type E[6] Thermocouple Cable to the UUT Channel 1 input.
    a. For two channel UUTs using the Split Thermocouple Cable, connect the miniature thermocouple connector of one leg to the UUT Channel 1 input, and the miniature thermocouple connector of the other leg to the Channel 2 input.
22. Connect the opposite end of the Thermocouple Cable (or the single-connector end of the Split Thermocouple Cable) to the Thermocouple Calibrator thermocouple output.
23. The UUT display will indicate as follows:
    a. Line 1: CALA
    b. Line 2: temperature in °C
    c. Line 3: temperature in tenths of °C (out to 1 µ or 0.000001 °C)
24. Set the Thermocouple Calibrator thermocouple type to Type E[7].
25. Set the calibrator to output 0.0 °C.
26. Allow at least five minutes for this connection to stabilize.
27. Press UUT  to set the UUT display equal to the Thermocouple Cable calibrated correction value ± 0.02 °C.
28. Press UUT  .
29. The display will change to rESA showing the actual measured value saved in the previous steps.
30. For single channel UUTs, skip to Step 36 below.
31. For two channel UUTs, continue with Step 32.
    a. For two channel UUTs using the single-ended Thermocouple Cable, disconnect the cable from the UUT Channel 1 input, and reconnect the cable to the Channel 2 input. Repeat Step 26.
32. Press UUT  .
33. The UUT display will indicate as follows:
    a. Line 1: CALb
    b. Line 2: temperature in °C

[6] If substituting another thermocouple type, use the appropriate Thermocouple Cable for the selected thermocouple type.
[7] If substituting another thermocouple type, set the Thermocouple Calibrator as appropriate for the selected thermocouple type.

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c. Line 3: temperature in tenths of °C (out to 1 µ or 0.000001 °C)

34. Repeat Steps 27 and 28.

35. The display will change to rESb showing the actual measured value saved in the previous steps.

36. Press UUT SET to save the current alignment values and return the UUT to normal operation.

4.3 Troubleshooting

TEGAM's digital handheld thermometers are designed and built to provide years of uninterrupted use. In the event the instrument malfunctions or does not perform as expected, helpful troubleshooting tips are provided below. *Figure 16* below lists some of the more common issues and their resolutions.

SYMPTOM	DESCRIPTION	RESOLUTION
Unexpected reading on Line 2 of Display	Statistics View Mode is active	Press VIEW to cycle through statistics views until active measurement is displayed (see *Section 3.4 View Modes and Statistics*)
Unexpected or Erroneous Measurement	Probe offset is active	Set probe offset to correct value for connected temperature probe (see *Section 3.10, Probe Offset)*
	Temperature probe has not stabilized	Observe display trend indicators and wait for stable measurement (see *Section 3.8 Trend Indicators*)
	Instrument is set to the wrong thermocouple type for the attached probe	Set the thermocouple type as appropriate for the attached probe (see *Section 3.3, Setup Menu*)
	When sourcing from a thermocouple simulator, Open Wire Detection is enabled.	See *Section 3.11, Open Wire Detection On/Off* to disable.
Unresponsive	Hold Mode is active	Press HOLD, and verify that the **HOLD** indicator is not active (see *Section 3.7, Hold Function)*
	Instrument is in Key Lock mode	Press ⏻ to cycle instrument power
	Static discharge through connected probes	Press ⏻ to cycle instrument power

Figure 16 continued on next page . . .

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Shuts down unexpectedly or will not power on	Batteries are low or depleted	Replace batteries (see *Section 2.5, Battery Installation and Replacement*)
Connection	Instrument will not connect to mobile device	Ensure mobile device supports *Bluetooth* low energy technology / version 4.0 and device operating system is updated to the latest version
		Verify mobile device *Bluetooth* connection is active
		Ensure no other mobile apps have control of the *Bluetooth* connection or paired devices
	Thermometer Link will not connect to TEGAM Cloud	Ensure either wireless or cellular internet connection is active
		Verify a valid account number, username, and password are entered in Thermometer Link

Figure 16: Common Troubleshooting Issues

4.4 Diagnostic Routines and Error Codes

The instrument momentarily activates all display annunciators and segments during startup to allow for visual inspection of the LCD. Observe the LCD and verify all segments activate.

Internal diagnostic routines are also executed during startup. If any diagnostic routine detects a malfunction, an error will be displayed as shown in *Figure 17* below.

ERROR CODE	DESCRIPTION
Err ADC	Analog to digital converter error
Err CJC	Cold junction compensation error
Err FLSH	Flash memory error
Err InP	Stuck key or other keypad error

Figure 17: Diagnostic Routine Error Codes

4.5 Memory Sterilization

To erase all locally stored measurement data and reset accumulated statistics, press CLR (1.5s). See *Section 3.12, Clear Function* for instructions.

Instrument parameters will be retained. Refer to *Section 3.3, Setup Menu* to set instrument parameters as desired.

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4.6 Preparation for Calibration or Repair Service

Once you have verified that the cause of the malfunction cannot be solved in the field and the need for repair and calibration service arises, contact TEGAM customer service to obtain an RMA (Returned Material Authorization) number. You can contact TEGAM customer service via the TEGAM website, www.tegam.com or by calling 440-466-6100 (*All Locations*) or 800-666-1010 (*United States Only*).

The RMA number is unique to your instrument and will help us identify you instrument and to address the particular service request by you which is assigned to that RMA number.

Of even greater importance, a detailed written description of the problem should be attached to the instrument. Many times repair turnaround is unnecessarily delayed due to a lack of repair instructions or a detailed description of the problem.

This description should include information such as measurement range and other instrument settings at the time of the malfunction, type of components being tested, frequency of the symptoms (intermittent or continuous), conditions that may cause the symptoms, changes to the test setup or operating environment that may affect the instrument, etc. Any detailed information provided to our technicians will assist them in identifying and correcting the problem in the quickest possible manner. Use a copy of the Repair and Calibration Service form provided on the next page.

Once this information is prepared and sent with the instrument to our service department, we will do our part to make sure that you receive the best possible customer service and turnaround time possible.

4.7 Expedite Repair & Calibration Form

Use this form to provide additional repair information and service instructions. The completion of this form and including it with your instrument will expedite the processing and repair process.

RMA#:		Instrument Model #:	
Serial Number:		Company:	
Technical Contact:		Phone Number:	
Additional Contact Info:			

Service Instructions:

☐ Evaluation ☐ Calibration Only ☐ Repair Only

☐ Repair & Calibration ☐ ISO 17025 Calibration with Data

Detailed Symptoms:

Include information such as measurement range, instrument settings, type of components being tested, is the problem intermittent? When is the problem most frequent?, has anything changed with the application since the last time the instrument was used?, etc.

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4.8 Warranty

TEGAM, Inc. warrants this product to be free from defects in material and workmanship for a period of three (3) years from the date of shipment. During this warranty period, if a product proves to be defective, TEGAM Inc., at its option, will either repair the defective product without charge for parts and labor, or exchange any product that proves to be defective.

TEGAM, Inc. warrants the calibration of this product for a period of two (2) years from date of shipment. During this period, TEGAM, Inc. will recalibrate any product, which does not conform to the published accuracy specifications.

In order to exercise this warranty, TEGAM, Inc., must be notified of the defective product before the expiration of the warranty period. The customer shall be responsible for packaging and shipping the product to the designated TEGAM service center with shipping charges prepaid. TEGAM Inc. shall pay for the return of the product to the customer if the shipment is to a location within the country in which the TEGAM service center is located. The customer shall be responsible for paying all shipping, duties, taxes, and additional costs if the product is transported to any other locations. Repaired products are warranted for the remaining balance of the original warranty, or 90 days, whichever is greater.

4.9 Warranty Limitations

The TEGAM, Inc. warranty does not apply to defects resulting from unauthorized modification or misuse of the product or any part. This warranty does not apply to fuses, batteries, or damage to the instrument caused by battery leakage.

The foregoing warranty of TEGAM is in lieu of all other warranties, expressed or implied. TEGAM specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. In no event will TEGAM be liable for special or consequential damages. Purchaser's sole and exclusive remedy in the event any item fails to comply with the foregoing express warranty of TEGAM shall be to return the item to TEGAM; shipping charges prepaid and at the option of TEGAM obtain a replacement item or a refund of the purchase price.

4.10 Statement of Calibration

This instrument has been inspected and tested in accordance with specifications published by TEGAM, Inc.

TEGAM, Inc. certifies the above listed instrument has been inspected and calibrated and meets or exceeds all published specifications and has been calibrated using standards whose accuracies are traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other recognized National Metrology Institutes.

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A. Required Equipment

Equipment	Function	Range	Specification (2-Sigma)
DC Voltage Source	DC Voltage Output	-10 to 75 mV	± (30 ppm of output + 2 µV)
Thermocouple Calibrator	Thermocouple Type B	600 to 799 °C 800 to 1549 °C 1550 to 1820 °C	± 0.36 °C ± 0.29 °C ± 0.23 °C
	Thermocouple Type E	-250 to -201 °C -200 to -101 °C -100 to -1 °C 0 to 599 °C 600 to 1000 °C	± 0.26 °C ± 0.13 °C ± 0.11 °C ± 0.10 °C ± 0.12 °C
	Thermocouple Type J	-210 to -101 °C -100 to 799 °C 800 to 1200 °C	± 0.15 °C ± 0.11 °C ± 0.12 °C
	Thermocouple Type K	-200 to -101 °C -100 to 799 °C 800 to 1372 °C	± 0.17 °C ± 0.12 °C ± 0.14 °C
	Thermocouple Type N	-250 to -201 °C -200 to -101 °C -100 to -1 °C 0 to 799 °C 800 to 1300 °C	± 0.73 °C ± 0.24 °C ± 0.13 °C ± 0.12 °C ± 0.13 °C
	Thermocouple Type R	-50 to -26 °C -25 to -1 °C 0 to 99 °C 100 to 399 °C 400 to 599 °C 600 to 999 °C 1000 to 1599 °C 1600 °C	± 0.55 °C ± 0.45 °C ± 0.39 °C ± 0.29 °C ± 0.23 °C ± 0.22 °C ± 0.20 °C ± 0.24 °C
	Thermocouple Type S	-50 to -26 °C -25 to -1 °C 0 to 99 °C 100 to 399 °C 400 to 599 °C 600 to 1599 °C 1600 °C	± 0.51 °C ± 0.43 °C ± 0.38 °C ± 0.30 °C ± 0.24 °C ± 0.23 °C ± 0.27 °C
	Thermocouple Type T	-250 to -201 °C -200 to -101 °C -100 to -1 °C 0 to 400 °C	± 0.36 °C ± 0.17 °C ± 0.12 °C ± 0.12 °C

Appendix A continued on next page . . .

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EQUIPMENT	FUNCTION	RANGE	SPECIFICATION (2-SIGMA)
Thermocouple Cables	Thermocouple Cables must be calibrated to a 2-Sigma uncertainty of 1 µV or less. Calibrated Thermocouple Cables with recorded correction values shall be used throughout this procedure to adhere to the expanded instrument uncertainties provided in *Appendix B*. Thermocouple Cables must be calibrated to the accuracies listed in the Thermocouple Calibrator Specification column of *Appendix A,* or better. Thermocouple Cables are only required for each desired thermocouple type. The thermocouple cables must be terminated at one end with a male miniature thermocouple connector for connection to the UUT. The opposite end should be terminated as appropriate for the thermocouple calibrator. For two channel UUTs, a split or "Y" cable may be used, terminated with two (2) male miniature thermocouple connectors. Correction values must be established for each leg of the Split Thermocouple Cable.		
Copper Mini-TC Cable	Copper Mini-TC Cable is required for Voltage Gain and Offset alignment only. This cable does not require calibration. One end shall be terminated with a male miniature thermocouple connector for connection to the UUT. The opposite end shall be terminated with copper connections appropriate for the DC Voltage Source. For two channel UUTs, a split or "Y" cable may be used, terminated with two (2) male miniature thermocouple copper connectors.		
Straightened Paper Clip	Required to access the calibration enable switch. Any rigid wire, approximately 0.8 mm in diameter, may be used.		

[1] Fluke 7526A meets the Thermocouple Calibrator specifications of *Appendix A*.
[2] All "Specification (2-Sigma)" column values rounded up to nearest hundredth.

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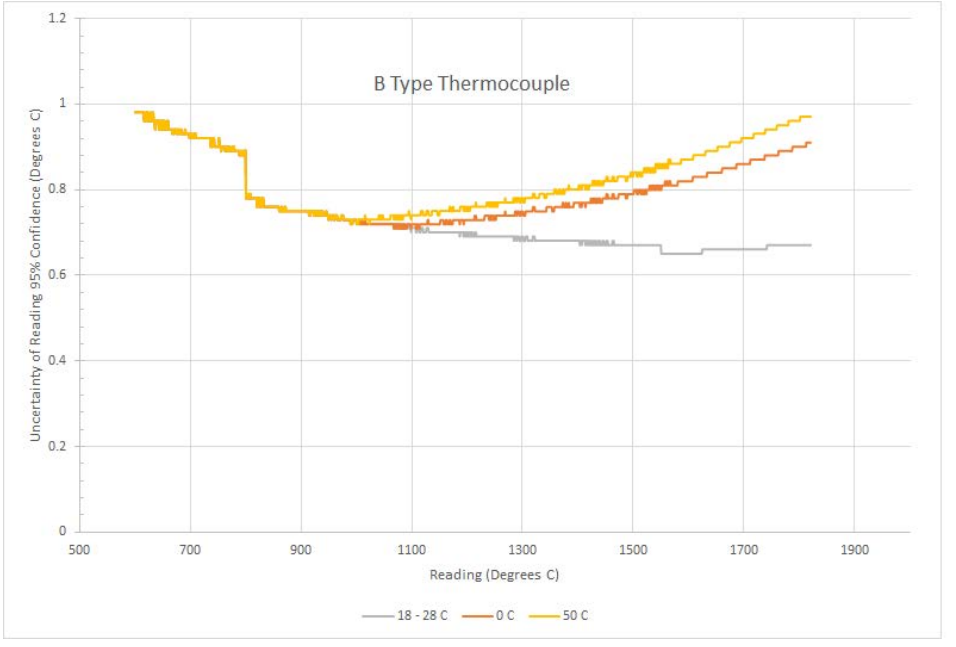
B. Expanded Instrument Uncertainties

Thermocouple Type B



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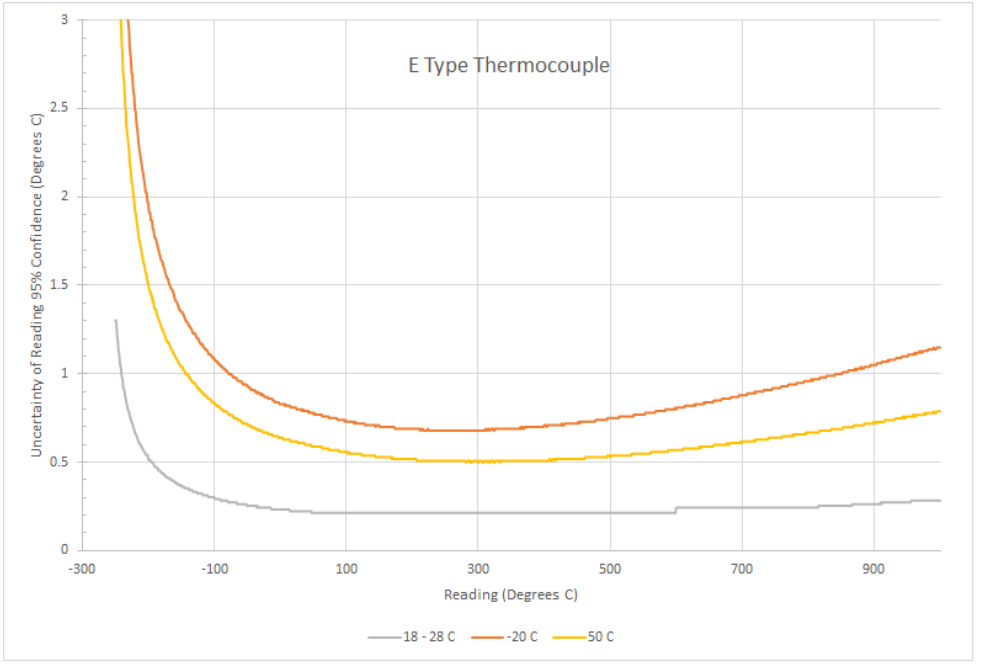
Thermocouple Type E



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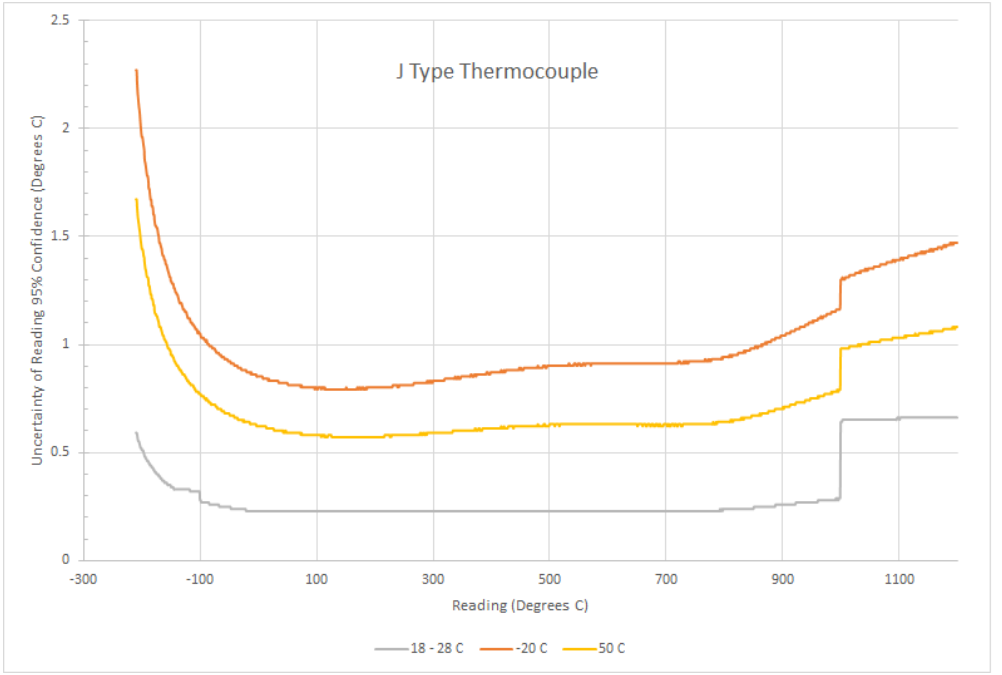
Thermocouple Type J



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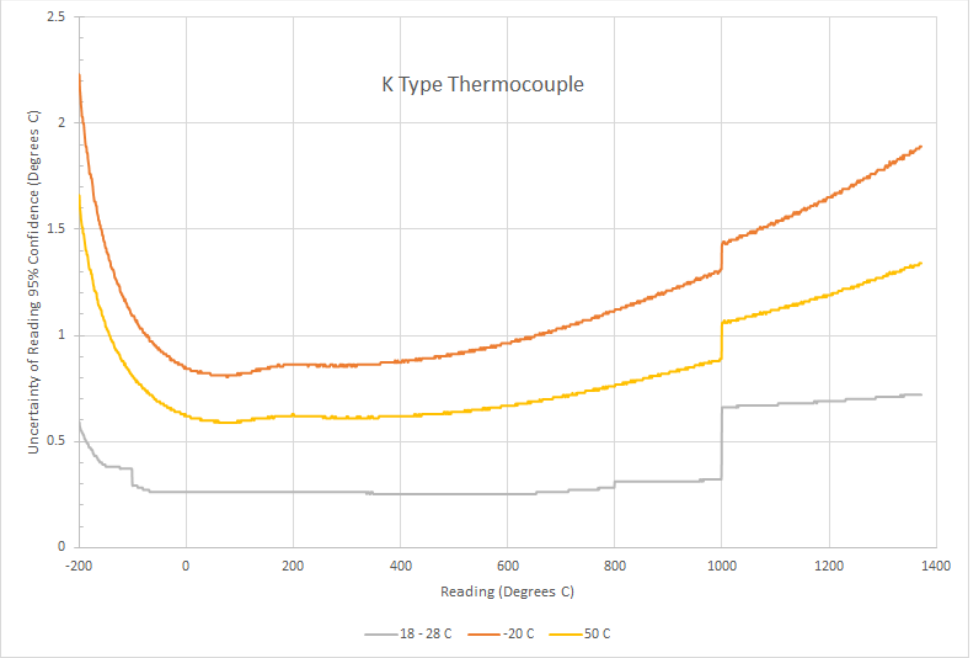
Thermocouple Type K



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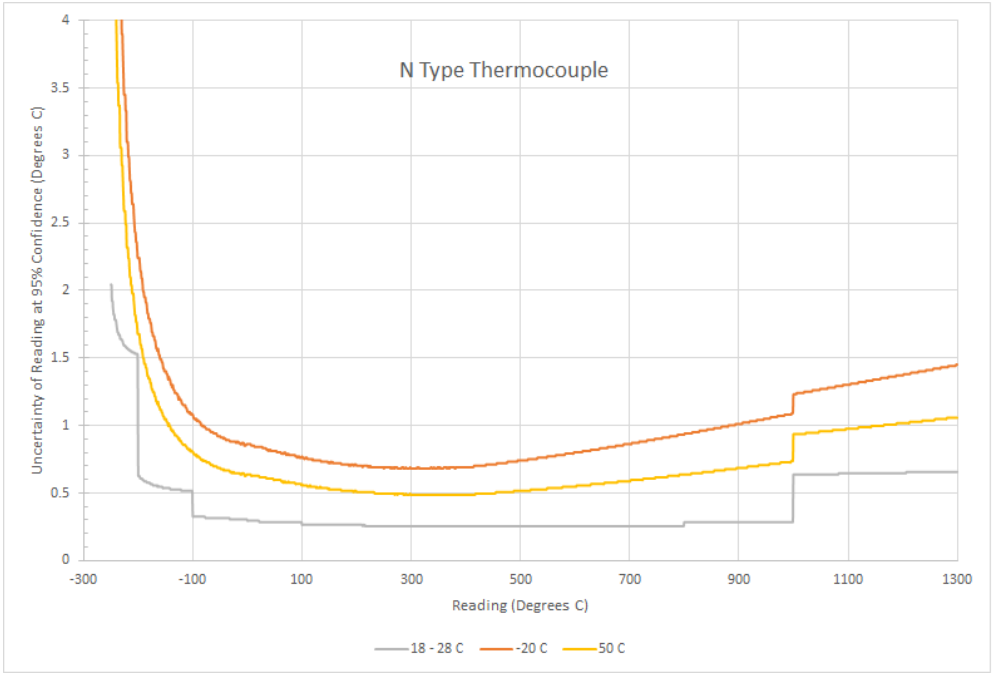
Thermocouple Type N



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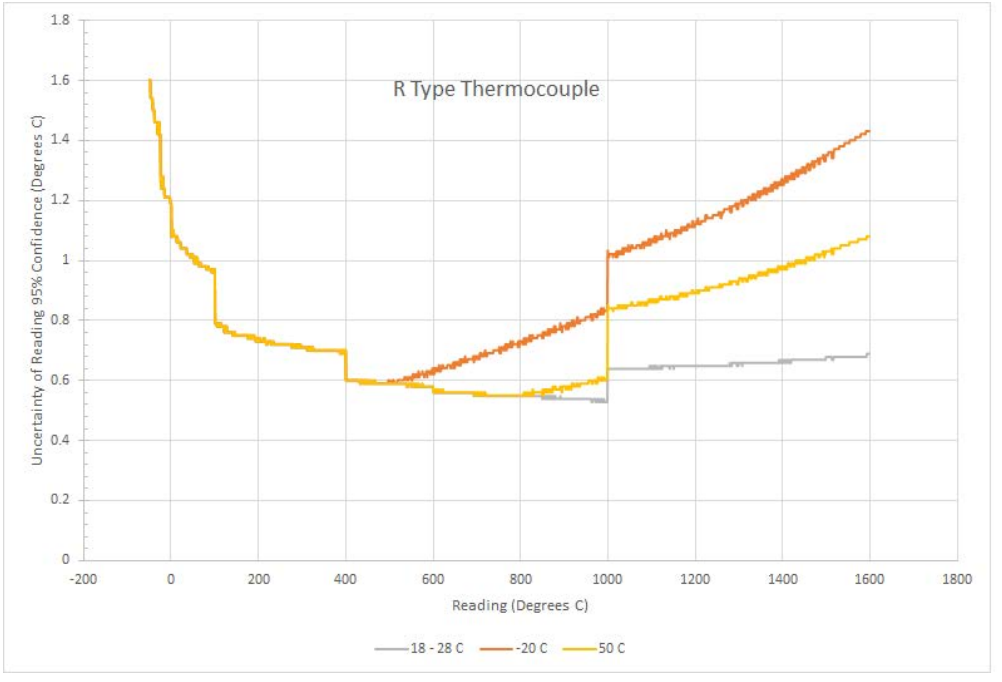
Thermocouple Type R



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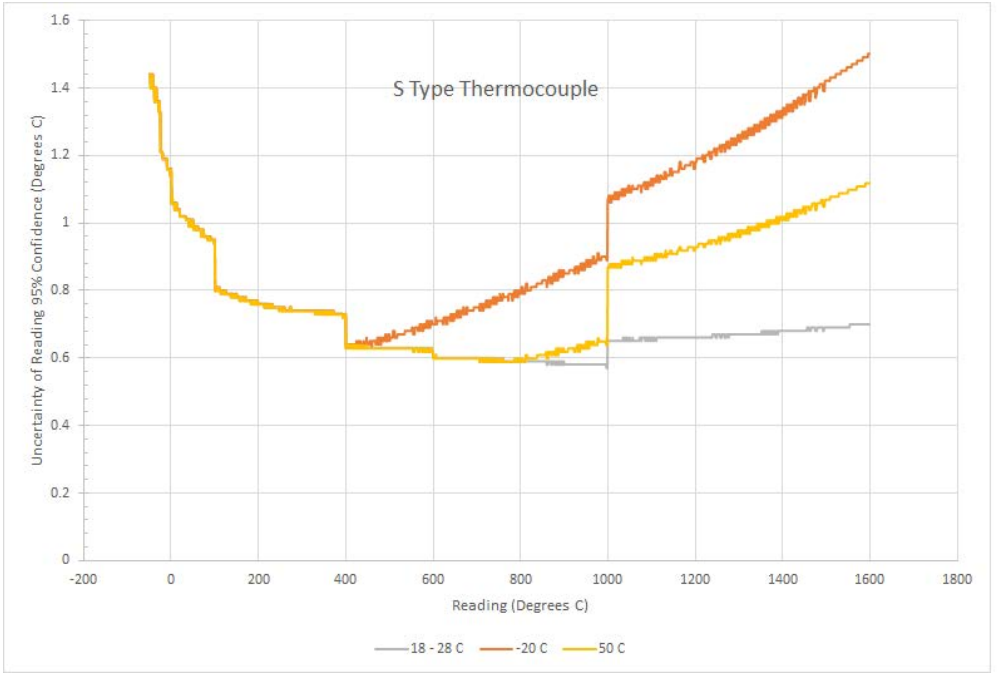
Thermocouple Type S



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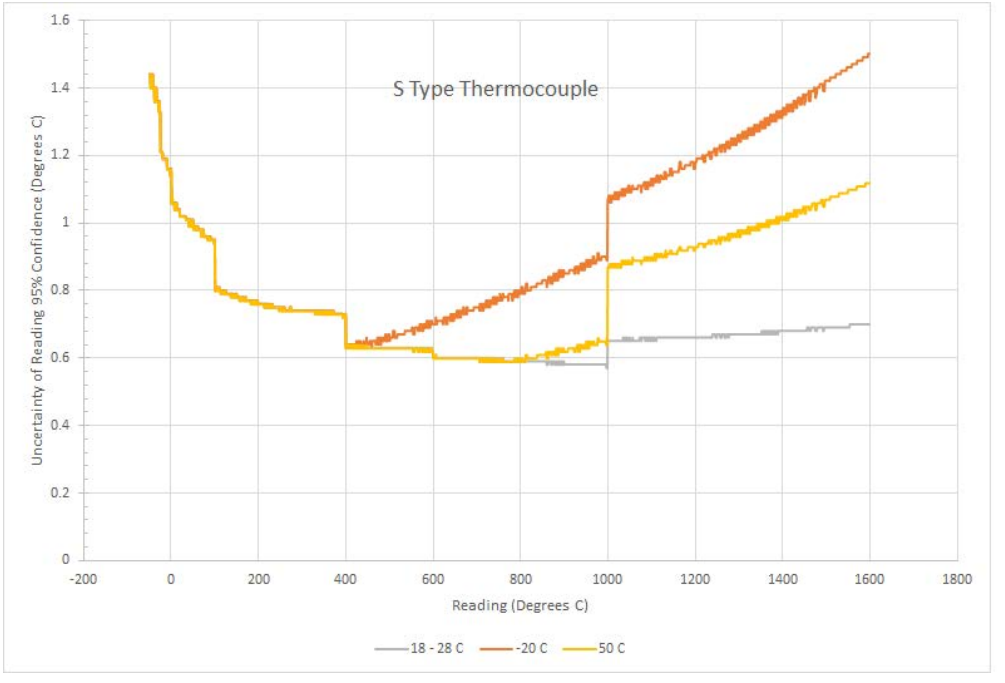
Thermocouple Type T



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C. Instrument Verification Data Sheet

Thermo-couple Type	Standard Value (°C)	Reading (°C)	Cable Offset (°C)	Corrected Reading (°C)	2-Sigma Tolerance (± ° C)
B	600				0.98
	995				0.73
	1820				0.67
E	-250				1.30
	-95				0.29
	0				0.23
	995				0.28
K	-200				0.59
	-95				0.29
	0				0.26
	995				0.32
	1372				0.72
J	-210				0.59
	-95				0.27
	0				0.23
	995				0.28
	1200				0.66
N	-200				0.63
	-95				0.33
	0				0.30
	995				0.29
	1300				0.66
R	0				1.08
	995				0.53
	1600				0.69
S	0				1.06
	995				0.58
	1600				0.70
T	-250				1.36
	-95				0.31
	0				0.24
	400				0.23

Appendix C: Instrument Verification Worksheet

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