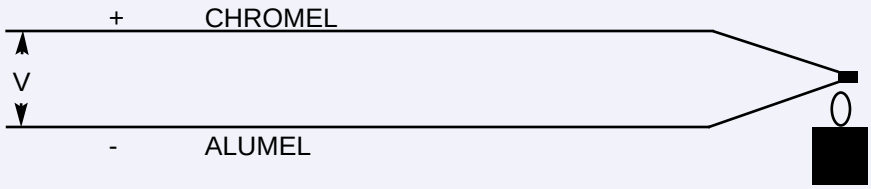
Turbine Temperature

Many early types of thermometers invented by Galileo and Gabriel Fahrenheit were very useful in measuring low temperature applications but can't be used to measure the extremely high temperatures demanded by turbine engines. With the discovery of the Thermocouple temperatures exceeding +1200°C were measurable and accurate. A Thermocouple is a junction where two dissimilar metals are joined together. When the joint is heated a very small current is induced in the wire. This phenomena is called the Seebeck effect, named after the man who discovered it, Thomas Seebeck.



The type K thermocouples are used in turbine engines. The type K thermocouple probe is made of nickel aluminum (Alumel) and nickel chromium (Chromel). This type of temperature sensing device can be used to measure temperatures up to +1200oC. The thermocouple circuit generates approximately 40 microvolts/Degree (Non Linear) which requires a highly sensitive and accurate tester to measure.

A typical aircraft temperature indication system is relatively trouble-free. When an aircraft's Exhaust Gas Temperature (EGT) indicating system has trouble, it's likely to show too little temperature. An EGT system indicating a lower temperature than the actual temperature can result in the pilot demanding more of the engines and causing an over temperature condition and damage to the engines. This problem is the essential justification for periodically checking the system for accuracy and to promptly address the problem. But to properly do that, the maintenance personnel must have a thorough understanding of the temperature indication system as well as access to the proper test equipment. Barfield has been a manufacturer of Turbine Temperature Indicating System Test Sets for more than thirty years and has amassed a vast knowledge of the common thermocouple EGT systems.

A typical aircraft EGT system consists of between 4-16 Chromel-Alumel thermocouples, which are, mounted parallel to each other. As the temperature increases in the engine exhaust a voltage is induced in the thermocouple. Since the thermocouples are also electrically connected in parallel, the individual thermocouple voltages are averaged together to get a more precise voltage output and temperature indication. The voltages induced in a thermocouple is very small (approx. 40 mV/degree) and requires very precise test equipment. The Turbine Temperature test sets offered by Barfield meet all the requirements for testing aircraft Chromel-Alumel and are capable of conducting the following tests:

SYSTEM LEAD RESISTANCE AND INSULATION TESTING
THERMOCOUPLE RESISTANCE
THERMOCOUPLE OUTPUT SIMULATION FOR INDICATOR TEST AND CALIBRATION

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TT1200A
Digital Turbine Temperature Tester

General Information

The Barfield TT1200A is our latest Digital Turbine Temperature Test Set. It is microprocessor based, completely self-contained, battery powered unit housed in a new high visibility ruggedized enclosure. Designed with sufficient accuracies and range to be able to test the newest digital and glass cockpit indicators with simplicity of operation, direct reading, and multi-function versatility.

The TT1200A is specifically designed to accomplish all requirements for testing the aircraft Chromel-Alumel (K type) turbine temperature measuring systems. The Test Set can measure resistances down to 0.001W, measure insulation up to 200 MW, perform indicator run-outs with a resolution of .1oC or 1oC and a range of 1372oC, and can also display the equivalent oF or millivoltages and may be used as a master indicator as well.

The TT1200A exceeds all of the operational capabilities of the popular Barfield TT1000A and includes many new features like: microprocessor based, backlit alphanumeric display, user prompts, oF and millivoltage display, temperature range to 1372°C, 4 resistance and 4 insulation ranges and power comes from common "C" batteries for all functions.

Specifications

TEMPERATURE MEASUREMENT

Range:	-200 to 1372 °C
Accuracy:	± 0.3 °C (Typ at 25 °C)

RESISTANCE MEASUREMENT

20W:	0 - 19.999W	0.001W increments
200W:	0 - 199.99W	0.01W increments
2KW:	0 - 1.9999KW	0.1W increments
20KW:	0 - 19.999KW	1W increments
Accuracy:	± 0.05 % of reading ± 2 counts	

INSULATION MEASUREMENT

200KW:	0 - 199.9KW	0.1KW increments
2MW:	0 - 1.999MW	1KW increments
20MW:	0 - 19.99MW	10KW increments
200MW:	0 - 199.9MW	1001KW increments
Excitation:	45 VDC	
Accuracy:	± 5 % of reading ± 2 counts	

OPERATING TEMP: -10 to 50 °C

Specifications Subject To Change

Features

- Microprocessor based
- Calibration Date available from display with User Alerts to approaching Cal Date
- Backlit 16 Character Alphanumeric Display - With User Prompts
- True 4-Wire Resistance Measurements
- Has °C, °F, and equivalent millivoltage displays
- Powered from long lasting C cell batteries with Auto-Off feature to conserve batteries
- Timed measurement with Display Hold feature for Resistance and Insulation functions - No need to hold push button depressed

Dimensions

	In.	cm.
Height	7.0	17.8
Width	11.0	27.9
Depth	10.0	25.4
	Lbs.	**kg**
Weight	7.3	3.3

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TT1000A
Digital Turbine Temperature Tester

BARFIELD

General Information

The TT1000A is a completely self-contained, battery powered, aircraft turbine temperature system tester capable of measuring system lead resistance, insulation, and performing indicator run-outs with a range up to 1000oC. The unit was specifically designed to meet all requirements for testing aircraft Chromel?Alumel (CH?AL) turbine temperature measuring systems and provides an accurate display of thermocouple outputs in degrees Celsius (oC). The TT1000A is engineered for maximum ease of operation and includes an automatic digital display that practically eliminates human error and reduces testing time to a minimum. The test leads incorporate automatic temperature compensation to remove induced voltage caused by a "Cold Junction" created when the test leads are attached to the aircraft. All of the features designed into the TT1000A have been added to reduce maintenance time and cost as well as provide a maintenance friendly tester for measuring and displaying resistance of thermocouple, thermocouple rings and system lead circuits. Simulates CH?AL thermocouple with or without simulated system lead resistance. Simulates thermocouple outputs and system lead resistances from 0 to 25 ohms. Measures and displays insulation resistance of system wiring and other components. Measures and displays values of CH?AL thermocouple in terms of degrees Celsius (C) temperature.

Features

- High accuracy necessary for bench testing indicators
- Automatically compensates for ambient temperature at test lead connection junction point or indicates this cold junction temperature
- Thermocouple and lead resistance measurements to 0.01 ohm and insulation measurements up to two (2) megohms
- Large, 9mm (0.35") high character, 3 1/2 digit Liquid Crystal Display (LCD) with pre?programmed legends
- Range: from 0 to 1000oC certified, -60 to 1160oC extended

Options and Accessories

MOD B:	Millivoltage doubler. For use on 16 ohm systems.
102-00902	Specially modified TT1000, adapter cable and carrying case for testing GE CF6-80 A, A1, and C2 engines.
102-00903	Specially modified TT1000, adapter cable and carrying case for testing GE CF6-6, and CF6-50 engines.

Dimensions

	In.	cm.
Height	5.0	12.7
Width	8.0	20.3
Depth	5.5	14.0

	lbs.	kg
Weight	4.0	1.8

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2312G-X
Turbine Temperature Tester

General Information

The 2312G provides the means for quickly troubleshooting Chromel?Alumel (CH?AL) turbine temperature measuring systems. The 2312G-X self-contained, battery powered, aircraft turbine temperature system tester's used to measure system lead resistance, insulation, and performing indicator calibration with a range up to 1000oC. The 2312G-X will test a single aircraft lead resistance such as 8 ohm, 15 ohm, 16 ohm, 22 ohm, or 25 ohm, represented by the X following the model number (i.e. a 2312G-8 is usable on 8 ohm systems). The dash model required for a particular aircraft is contingent upon the aircraft manufacturer, not the engine manufacturer.

AIRCRAFT	DASH MODEL
MU-2	**2312G**-22
Porter	-8
Volpar	-8
Carstedt	-8
Fletcher 1160	-8
Beaver	-8
All Bell Helicopters	-8
All Beechcraft	-8
DCH Twin Otter	
Series 100-PT6-20	-8
Series 200-PT6-20	-8
Series 300-PT 6A-27	-25
Vought Alouette III	-16
Boeing 707	-22
727	-15
737	-15
Douglas DC-8	-22
DC-9	-15
Lear Jet	-8
Cessna Citation	-22
Hawker Siddeley 125	-8
Jet Star	-8
Grumman G1	-8
Fan Jet Falcon	-8
Saberliner	-8
Hansa Jet GE CJ-610	-8
Piper Cheyenne	-8
Boeing Vertol	-8
Hughes 500	-8
Fairchild F-27	-8
FH227	-8

Some aircraft have what is generally referred to as a "servoed' or 'null balance" EGT system. This system can be recognized by its multiple pin electrical connector, and requirement of aircraft electrical power to operate. Because the thermocouple lead resistance is not critical with this system, any dash model 2312G-X is applicable (A -8 is recommended due to wider applicability).

Features

- Available for 8, 15, 16, 22, and 25 Ohm systems.
- Resistance measurement from 0.02 Ohms: Insulation to 1 Megohm.
- Indicator tests to ± 5°C.

Dimensions

	In.	cm.
Height	8.0	20.3
Width	6.0	15.2
Depth	4.5	11.4

	lbs.	kg
Weight	3.75	1.7

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Turbine Temperature Specifications

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TEMPERATURE MEASUREMENT

	2312G	TT1000A	TT1200A
RANGE	-20 to 1000°C	0 to 1000°C certified -60 to 1160°C extended	0 to 1200°C certified -200 to 1372°C extended
ACCURACY	±5°C between 600-900°C ±10°C elsewhere	Typical Measurement error at 25°C ambient: Less than ±1°C	Typical Measurement error at 25°C ambient: Less than 0.3°C

LEAD RESISTANCE MEASUREMENT

	2312G	TT1000A	TT1200A
20Ω RANGE AND RESOLUTION	N/A	0-19.99 Ω in 0.01 Ω increments	0-19.999 Ω in 0.001 Ω increments
200Ω RANGE AND RESOLUTION	N/A	0-199.9 Ω in 0.1 Ω increments	0-199.99 Ω in 0.01 Ω increments
2KΩ RANGE AND RESOLUTION	N/A	N/A	0-1.9999K Ω in 0.1 Ω increments
20KΩ RANGE AND RESOLUTION	N/A	N/A	0-19.999K Ω in 1 Ω increments
2312G LEAD RESISTANCE RANGE*	2312G-8 7.8 to 8.2 Ω 2312G-15 14.5 to 15.5 Ω	N/A	N/A
ACCURACY	±0.02 Ω at 15 Ω ±01Ω at 8 Ω	±0.1% of reading ±0.01 Ω (20 Ω) ±0.1% of reading ±0.1 Ω (200Ω)	±0.05% of reading ±2 counts

** The 2312G-X is designed for a single system resistance thus the unit has a limited lead resistance range. The 2312G-X also has Rx1 and Rx10 ranges with an accuracy of ±10%.*

INSULATION MEASUREMENT

	2312G	TT1000A	TT1200A
200KΩ RANGE AND RESOLUTION	N/A	N/A	0-199.9K Ω in 0.1KΩ increments
2MΩRANGE AND RESOLUTION	N/A	0-1.999M Ω in 1KΩ increments	0-1.999M Ω in 1KΩ increments
20MΩ RANGE AND RESOLUTION	N/A	N/A	0-19.99M Ω in 10KΩ increments
200MΩ RANGE AND RESOLUTION	N/A	N/A	0-199.9M Ω in 1001K Ω increments
2312G RANGE & RESOLUTION	2.5K to 1M	N/A	N/A
ACCURACY	10% of reading	3% of reading ±1K Ω	±5% of reading ±2 counts
EXCITATION	45V	45V	45V

OTHER SPECIFICATIONS

	2312G	TT1000A	TT1200A
SYSTEM RESISTANCE RANGE	Single system resistance of 8, 15, 16, 22, or 25 Ω	Variable resistance between 2 Ω to 25 Ω	Variable resistance between 2 Ω to 25 Ω
OPERATING TEMPERATURE	0 TO 50°C	0 TO 50°C	-10 TO 50°C

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Turbine Temperature Tester Comparison

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DISPLAY CHARACTERISTICS	2312G	TT1000A	TT1200A
ANALOG METER.	S	-	-
3.5 DIGIT DIGITAL DISPLAY	-	S	-
4.5 DIGIT DIGITAL DISPLAY	-	-	S
TEMP. SIMULATION/MEASUREMENTS IN Deg. C	-	S	S
TEMP. SIMULATION/MEASUREMENT IN mV	-	-	S
SYSTEM LEAD RESISTANCE COMPATIBILITY			
SPECIFIC LEAD RESISTANCES (8, 15, 16, 22, 25 OHM)	S	-	-
ALL LEAD RESISTANCE SYSTEMS, EXCEPT 16 OHM	-	S	S
MEASUREMENT RANGE AND RESOLUTION			
RESISTANCE to 100 Ohms.	S	-	-
RESISTANCE to 200 Ohms	-	S	-
RESISTANCE to 20K Ohms	-	-	S
HIGHEST RESISTANCE RESOLUTION IS 0.01 Ohms	S	S	-
HIGHEST RESISTANCE RESOLUTION IS 0.001 Ohms	-	-	S
INSULATION to 1 MEGOHMs.	S	-	-
INSULATION to 2 MEGOHMs.	-	S	-
INSULATION to 200 MEGOHMs.	-	-	S
HIGHEST INSULATION RESOLUTION IS 1K Ohms.	S	-	-
HIGHEST INSULATION RESOLUTION IS 100 Ohms	-	-	S
TEMP. RANGE TO 1000 DEGREES CERTIFIED	S	S	-
TEMP. RANGE TO 1200 DEGREES CERTIFIED	-	-	S
TEMP. RESOLUTION 1 Deg. C	S	S	S
ACCURACY			
RESISTANCE ACCURACY OF +/- 10% OF READING	S	-	-
RESISTANCE ACCURACY OF +/- 0.1% +/- 0.1 Ohm.	-	S	-
RESISTANCE ACCURACY OF +/- 0.05% +/- 2 COUNTS	-	-	S
INSULATION ACCURACY OF +/- 5% OF READING	S	-	-
INS. ACCURACY OF +/- 3% OF READING +/- 1K Ohm	-	S	-
INS. ACCURACY OF +/- 5% OF READING +/- 2 COUNTS	-	-	S
TEMP. MEAS. ACCURACY OF +/- 10 Deg. C	S	-	-
TEMP. MEAS. ACCURACY OF +/- 1 Deg. C.	-	S	-
TEMP. MEAS. ACCURACY OF +/- 0.3 Deg. C.	-	-	S
OPTIONS AND OTHER FEATURES			
CAN BE USED AS A MASTER INDICATOR	-	S	S
AUTOMATIC COLD JUNCTION COMPENSATION	-	S	S
FRONT PANEL BATTERY ACCESS	-	-	S
GENERAL ELECTRIC CF6-80 SERIES ADAPTER	-	O	O
GENERAL ELECTRIC CF6-6, -50 SERIES ADAPTER	-	O	O
MILLIVOLTAGE DOUBLED SYSTEM MOD	-	O	-
MILLIVOLTAGE DOUBLED SYSTEM ADAPTER CABLE	-	-	O
S = STD. FEATURE O = OPTION - = N/A			

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Turbine Temperature Tester Adapter Cables

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General Information

The adapter cables in conjunction with the TT1200 or TT1000A permits resistance, insulation measurement and indicator tests of aircraft equipped with General Electric CF6-6, CF6-50 and CF6-80 series engines. These specialized adapter cables permit convenient access to the engine thermocouple harnesses by connecting directly to the existing engine connectors eliminating the need for pin to pin probing.

With these OEM approved packages the user can quickly and efficiently test the entire indicating system. Each package provides for connections at multiple points in the system and permits indicator testing, system resistance measurements, individual thermocouple lead resistance measurements and insulation testing, all to be accomplished through a convenient switching scheme.

When an adapter harness is purchased separately, the TT1000A or TT1200 being used must be returned to Barfield for modification and/or calibration with the new harness. The TT1000A must have a DIN connector (Option A) for interfacing with the adapter cable and a 2K W insulation range (Option B) added. A DIN plug is added to the standard alligator clipped cable so the modified TT1000A is still useful on other turbine engines. The TT1200 does not require modification but the existing unit must be returned so the adapter harness and tester can be calibrated together.

102-00902 Adapter Cable

102-00903 Adapter Cable

Ordering Information

G.E. Engine	TT1000A & CABLE SYSTEM	TT1200 & CABLE SYSTEM	TT1000A CABLE ONLY	TT1200 CABLE ONLY
CF6-80A, A1, C2	102-00902	102-00922	101-00902	101-0922
CF6-6 & CF6-50	102-00903	102-00923	101-00903	101-0923

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Turbine Temperature Tester Adapter Cables

AIRCRAFT

MANUFACTURER	MODEL	ADAPTER CABLE
WESTLAND	LYNX	101-00925

ENGINES

MANUFACTURER	MODEL	ADAPTER CABLE
G.E.	CF6-80A, A1, C2	101-00922
G.E.	CF6-6, CF6-50	101-00923

INDICATORS

MANUFACTURER	MODEL	ADAPTER CABLE
BOEING	10-61990-1	101-00927
BOEING	10-61990-4	101-00927
BOEING	10-61990-5	101-00927
BOEING	10-61990-6	101-00927
BOEING	10-61990-9	101-00927
LEWIS	152BL702	101-00926
LEWIS	152BL702A	101-00926
LEWIS	152BL702C	101-00926
LEWIS	152BL702D	101-00926
LEWIS	152BL702E	101-00926
LEWIS	152BL703	101-00926
LEWIS	152BL706	101-00926
LEWIS	152BL709	101-00926
LEWIS	152BL709A	101-00926
LEWIS	152BL801	101-00926
LEWIS	152BL801A	101-00926
LEWIS	152BL801B	101-00926
LEWIS	152BL801C	101-00926
LEWIS	152BL801D	101-00926
LEWIS	152BL801E	101-00926
LEWIS	152BL802A	101-00926
LEWIS	152BL802B	101-00926
LEWIS	152BL802C	101-00926
LEWIS	152BL802D	101-00926
LEWIS	152BL803	101-00926
LEWIS	152BL803A	101-00926
LEWIS	152BL803B	101-00926
U.S.GAUGE	SEL-0C19D	101-00927
U.S.GAUGE	SEL-0C19E	101-00927
U.S.GAUGE	SEL-0C19F	101-00927
U.S.GAUGE	SEL-0C19G	101-00927
U.S.GAUGE	SEL-0C19AG	101-00927

SPECIAL

AIRCRAFT WITH MILLIVOLTAGE DOUBLED SYSTEMS	101-00924

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