

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Received by RCRUZ, 3/6/02 10:53:03AM



Arrived 3/6/02

Work Order **444047536**

Asset No. 009261 Manufacturer DURO-SENSE

Model B02 (18ea)

Equipment Type THERMOCOUPLE

Serial No. 293376W

Accessory No.

Interval 12 M

Calibration Procedure _____ Location _____

Div/Client DIV20

Custodian DARRELL DUNN

Mail Stop B57

Tel X6090

QUEUE

Special Instructions Provide milli volt reading

Notify before adjustments or repairs. () Provide data with certificate (✓) Certificate Typ. _____

Charge/Project No. 00751.006 1.20

Requester / Telephone _____

This information is correct for the work requested.

Darrell Dunn

WORK NOTES

Date	Hours	Remarks/Notes
<u>2/13/</u>	<u>30</u>	<u>C.O</u>

Date	Hours	Part Name	Part Number	Failure Description	Cost
<u>n/A</u>	<u>→</u>				

WORK SUMMARY

Failure Description _____

Repair Action _____

Tech R. Dykstra Cal Hrs. _____ Repair Hrs. _____ Parts Cost _____ Temp 76 F Hum 27 %

Standards Used S243, 517A

Date Picked Up 3/14/02

Picked Up By Darrell Dunn

444047536

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Calibration Procedure		Reviewer:
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Calibration Data Sheet

Work Order:444047536	Mfr. Duro- Sense	Technician: R Dykstra
Asset No.009261	Model: B02 (18 Ea)	Cal Date: 3/13/02
Serial No.293376W	Type: Type K	Found/Left

Remarks: The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, which provides a level of confidence of approximately 95% unless otherwise stated.
Used ITPs-90 Type K thermocouple (Excel spread sheet based upon thermocouple table) to determine temperature from mV reading.
Expected limits are due to extension wire hooked up to thermocouple.

Parameter Temperature Degree C				
	Test Point	Readings C and mV	Expected Limits	Uncertainty
# 1 Thermocouple	0.08 Degree C	0.54 C (0.02166 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 2 Thermocouple	0.08 Degree C	0.54 (0.02127 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 3 Thermocouple	0.08 Degree C	0.54 C (0.02127 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 4 Thermocouple	0.08 Degree C	0.54 C (0.02177 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 5 Thermocouple	0.08 Degree C	0.57 C (0.02270 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 6 Thermocouple	0.08 Degree C	0.57 C (0.02299 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 7 Thermocouple	0.08 Degree C	0.57 C (0.0227 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 8 Thermocouple	0.08 Degree C	0.57 C (0.02273 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 9 Thermocouple	0.08 Degree C	0.54 C (0.02154 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 10 Thermocouple	0.08 Degree C	0.54 C (0.02147 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 11 Thermocouple	0.08 Degree C	0.54 C (0.02178 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 12 Thermocouple	0.08 Degree C	0.00 C (0.00055 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 13 Thermocouple	0.08 Degree C	0.55 C (0.02205 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
#14 Thermocouple	0.08 Degree C	0.54 C (0.02187 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
#15 Thermocouple	0.08 Degree C	0.54 C (0.02219 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C

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#16 Thermocouple	0.08 Degree C	0.54 C (0.02164 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
#17 Thermocouple	0.08 Degree C	0.55 C (0.02266 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
#18 Thermocouple	0.08 Degree C	0.55 C (0.02266 mV)	-2.2 TO 2.2 Degree C	0.2 Degree C
# 1 Thermocouple	149.92 Degree C	150.48 C (6.1715 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 2 Thermocouple	149.92 Degree C	150.84 C (6.17237 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 3 Thermocouple	149.92 Degree C	150.84 C (6.17131 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 4 Thermocouple	149.92 Degree C	150.88 C (6.17293)	-147.8 to 152.2 Degree C	0.2 Degree C
# 5 Thermocouple	149.92 Degree C	151.15 C (6.17991 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 6 Thermocouple	149.92 Degree C	150.85 C (6.17115 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 7 Thermocouple	149.92 Degree C	150.91 C (6.17564 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 8 Thermocouple	149.92 Degree C	150.87 C (6.17258 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 9 Thermocouple	149.92 Degree C	151.01 C (6.17802 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 10 Thermocouple	149.92 Degree C	150.90 C (6.17370 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 11 Thermocouple	149.92 Degree C	150.90 C (6.17370 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 12 Thermocouple	149.92 Degree C	149.95 C (6.12016 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 13 Thermocouple	149.92 Degree C	150.89 C (6.17324 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
#14 Thermocouple	149.92 Degree C	150.83 C (6.17098 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
#15 Thermocouple	149.92 Degree C	150.87 C (6.17222 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
#16 Thermocouple	149.92 Degree C	150.88 C (6.17294 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
#17 Thermocouple	149.92 Degree C	150.85 C (6.1715 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
#18 Thermocouple	149.92 Degree C	150.86 C (6.17090 mV)	-147.8 to 152.2 Degree C	0.2 Degree C
# 1 Thermocouple	375.26 Degree C	375.34 C (15.3575 mV)	374.8 to 377.2 Degree C	0.2 Degree C

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# 2 Thermocouple	375.26 Degree C	375.79 C (15.3768 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 3 Thermocouple	375.26 Degree C	375.80 C (15.3772 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 4 Thermocouple	375.26 Degree C	375.87 C (15.38300 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 5 Thermocouple	375.26 Degree C	376.10 C (15.38962 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 6 Thermocouple	375.26 Degree C	376.86 C (15.42179 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 7 Thermocouple	375.26 Degree C	357.54 C (15.36628 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 8 Thermocouple	375.26 Degree C	357.21 C (15.35202 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 9 Thermocouple	375.26 Degree C	375.60 C (15.36385 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 10 Thermocouple	375.26 Degree C	357.73 C (15.37457 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 11 Thermocouple	375.26 Degree C	357.82 C (15.37879 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 12 Thermocouple	375.26 Degree C	373.2 C (15.26676 mV)	374.8 to 377.2 Degree C	0.2 Degree C
# 13 Thermocouple	375.26 Degree C	375.76 C (15.37545 mV)	374.8 to 377.2 Degree C	0.2 Degree C
#14 Thermocouple	375.26 Degree C	375.50 C (15.36425 mV)	374.8 to 377.2 Degree C	0.2 Degree C
#15 Thermocouple	375.26 Degree C	375.05 C (15.35430 mV)	374.8 to 377.2 Degree C	0.2 Degree C
#16 Thermocouple	375.26 Degree C	375.34 C (15.35873 mV)	374.8 to 377.2 Degree C	0.2 Degree C
#17 Thermocouple	375.26 Degree C	375.30 C (15.355.06 mV)	374.8 to 377.2 Degree C	0.2 Degree C
#18 Thermocouple	375.26 Degree C	375.20 C (15.35183 mV)	374.8 to 377.2 Degree C	0.2 Degree C

Measurement uncertainty Budget for Duro-sense Type K thermocouple model 502.

UUT Characteristics

Temperature

Performance Specifications

Resolution: 0.01 Degree C

Range: -200 to 1370 Degree C

The following are assumptions and estimates used in the measurement uncertainty budget.

a.) The 1 Yr. specification for the HP 3458A is +/- (9 ppm of Rdg + 3uV of Rng).

Repeatability is not significant to list.

b.) Using Type K thermocouple inverse polynomials to determine temperatures associated with uV readings.

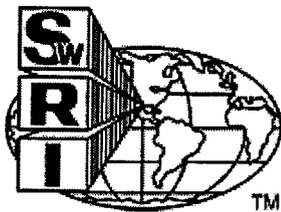
c.) Worst case.

UUT Tolerance

2.2 Degree C

15.343 mV

	Units	Reading	Accuracy +/-	Resolution
	+/- Deg C	375	2.2	0.01
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty Deg C
Std probe & Ind	0.04	Normal	2	0.020
Ice bath	0.05	Rectangular	Sqrt 3	0.029
HP 3458 A	0.01	Rectangular	Sqrt 3	0.006
Omega TRP	0.1	Rectangular	Sqrt 3	0.058
Instrument Resolution	0.01	Rectangular	Sqrt 3	0.006
Combined Uncertainty			RSS	0.068
Expanded Uncertainty			K=2	0.14
Test Accuracy Ratio	TI Accuracy / Standard Tolerance			
	18.5	to 1		
Test Uncertainty Ratio	TI Accuracy / k=2			
	16.2	to 1		



Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
(210) 522-5215
Department of Quality Assurance
Calibration Laboratory

Certificate of Calibration

14 March 2002

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: DURO-SENSE B02 (18ea)
Description: THERMOCOUPLE
Serial Number: 293376W
Asset Number: 009261
Work Order Number: 444047536

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Standards used in this calibration, described in the referenced calibration procedure with associated uncertainties or tolerances, are traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request. This certificate is not to be reproduced, except in full, without the written approval of the Southwest Research Institute Department of Quality Assurance Calibration Laboratory.

The uncertainty of the calibration was sufficient to determine that the item met the manufacturer's published specifications unless stated otherwise below.

Ambient Conditions: Temperature: 76.0 Degrees Fahrenheit Humidity: 27 % RH

Calibration Date: 14 Mar 02 **Calibration Procedure:**

Condition as Received: SEE ATTACHED DATA

Condition as Returned: SEE ATTACHED DATA

Remarks: SEE ATTACHED DATA SHEET.

Approved by:



Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:



Roger Dykstra, Technician