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sciences and engineering*

6220 Culebra Road · San Antonio · Texas, U.S.A. 78228-5166

MEMORANDUM

Date: November 16, 2000
From: Darrell S. Dunn *DD*
To: SwRI Calibration Laboratory
Subject: Calibration of Thermocouples and RTDs

I would like to check the calibration of the Duro-Sense Corporation thermocouples (serial numbers 326 to 335) and RTDs (serial numbers 322 to 325) using temperatures of 0 and 150 °C. The calibration check for the thermocouples should be conducted with 12 inches of the thermocouple exposed to controlled temperature bath. The output of the thermocouples in mV should be recorded at these temperatures. Similarly, the entire length of the RTDs should be exposed to the controlled temperature bath and the resistance of the RTDs should be recorded at these temperatures.

Following calibration at 0 and 150 °C, the thermocouples and RTDs need to be appropriately marked. A 6 month interval for checking the calibration of the thermocouples and RTDs is suggested. The vendor documentation is attached for your reference. Please call me at extension 6090 if you have any questions.

Sincerely,

Darrell S. Dunn



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



Certificate #
0972-01

Certificate of Calibration

6 December 2000

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: DURO-SENSE J-00
Description: RTD
Serial Number: 325
Asset Number: 008425

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NC SL Z540-1-1994. The results of this calibration relate only to the individual item as described above. 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 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.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results of this calibration certificate were determined in accordance with the terms of accreditation unless stated otherwise below.

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: 68.0 Degrees Fahrenheit Humidity: 41 % RH

Calibration Date: 6 Dec 00 **Calibration Procedure:** CUSTOMER

Condition as Received: SEE REMARKS

Condition as Released: SEE REMARKS

Remarks: CALIBRATION DATA ATTACHED

Approved by:

Jim Patterson, Supervisor, or Walt Hill, Metrologist
Certificate # 444041442

Measurements performed by:

Mack Wood, Technician

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Processed by RCRUZ at 2:49:32PM on 6/8/01



Work Order **444043981**

Arrived 6/8/01

Asset No. 008425 Manufacturer DURO-SENSE

Model J-00

Instrument Type/Class RTD

Serial No. 325

Accessory No. Calibration Procedure CUSTOMER

Location B57

Div/Client DIV20

Custodian DARRELL DUNN

Mail Stop B57

Tel. 6090

Charge/Project No. 00751.006 1.20

Delivered By / Telephone

IN4CAL

Special Instructions _____

WORK NOTES

Date	Hours	Remarks/Notes
<u>6/12</u>	<u>1.0</u>	<u>Cal</u>
<u>6/13</u>	<u>1.0</u>	<u>Cal</u>

REPAIR PARTS

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

WORK SUMMARY

Failure Description N/A

Repair Action N/A

Calibration Procedure Customer Temp 73 F Hum. 59 %

Tech R Dyker Totals Cal Hours 2.0 Repair Hours Parts Cost

Standards Used S2A2, 7001, 0219

Date Picked Up 6/15/01

Picked Up By Darrell Dunn

43981

This spreadsheet calculates temperatures or resistance based on the IEC 751 Standard (for 385 RTD probes)

It also computes the tolerance in degrees C and Ohms

To use just enter a value for resistance or for temperature. Answer is to the right (uncertainty +/-0/01 C)

Note: Spreadsheet is good only for the range -40C to 850C (limited negative range)

(1) Know Resistance. Want temperature

Enter Measured res:

Equivalent temp is:

	degrees	ohms
Class A tolerance is:	0.45	0.17
Class B tolerance is:	1.05	0.39

(2) Know Temperature. Want resistance

Enter Temperature in degrees C:

Equivalent resistance is:

	degrees	ohms
Class A tolerance is:	0.15	0.06
Class B tolerance is:	0.3	0.11

Temperature conversion:

Enter degrees C:	<input type="text" value="100"/>	deg F =	<input type="text" value="212.00"/>
Enter degrees F:	<input type="text" value="212"/>	deg C =	<input type="text" value="100.00"/>

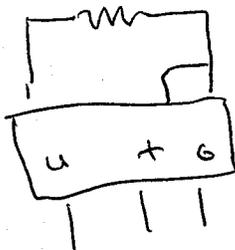
To validate, compare to standard table

Serial # 325

AF 99.990 ohms ✓

class A

100 +/- .06



G - +	26131 Ω	28599 Ω
+ - u	100.25872 Ω	157.5825 Ω
+ - G	100.24468 Ω	157.536 Ω

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To use just enter a value for resistance or for temperature. Answer is to the right (uncertainty +/-0/01 C)

Note: Spreadsheet is good only for the range -40C to 850C (limited negative range)

(1) Know Resistance. Want temperature

Enter Measured res:

Equivalent temp is:

	degrees	ohms
Class A tolerance is:	0.45	0.17
Class B tolerance is:	1.05	0.39

(2) Know Temperature. Want resistance

Enter Temperature in degrees C

Equivalent resistance is:

	degrees	ohms
Class A tolerance is:	0.44985	0.17
Class B tolerance is:	1.049625	0.39

Temperature conversion:

Enter degrees C:	<input type="text" value="100"/>	deg F =	<input type="text" value="212.00"/>
Enter degrees F:	<input type="text" value="212"/>	deg C =	<input type="text" value="100.00"/>

To validate, compare to standard table

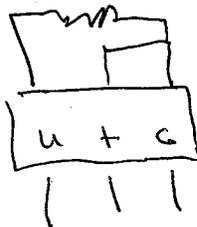
Serial # 325

A.F

Class A

157.273 ohms ✓

157.2971 +/- .17 ohms





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Department of Quality Assurance
Calibration Laboratory

Certificate of Calibration

13 June 2001

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: DURO-SENSE J-00
Description: RTD
Serial Number: 325
Asset Number: 008425
Work Order Number: 444043981

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: 73.0 Degrees Fahrenheit Humidity: 58 % RH

Calibration Date: 13 Jun 01 **Calibration Procedure:** CUSTOMER

Condition as Received: SEE REMARKS

Condition as Received: SEE REMARKS

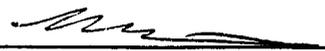
Remarks: CALIBRATION DATA SHEET ATTACHED.

Approved by:



Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:



Roger Dykstra, Technician

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Received by JIBARRA, 1/8/02 11:36:03AM

||||| ||||| ||||| ||||| ||||| ||||| ||||| |||||

Arrived 1/8/02

Work Order **444046671**

Asset No. 008425 Manufacturer DURO-SENSE

Model J-00

Equipment Type RTD

Serial No. 325

Accessory No.

Interval 6 M

Calibration Procedure CUSTOMER

Location B57

Div/Client DIV20

Custodian DARRELL DUNN

Mail Stop B57

Tel 6090

IN4CAL

Special Instructions _____

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

Charge/Project No. 00751.006 1.20

Requester / Telephone DARRELL DUNN/ X6090

This information is correct for the work requested. *Darrell Dunn*

WORK NOTES

Date	Hours	Remarks/Notes
<u>1/11/02</u>	<u>1.0</u>	<u>Cal</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Date	Hours	Part Name	Part Number	Failure Description	Cost
<u>n/a</u>	<u>_____</u>	<u>_____</u>	<u>_____</u>	<u>_____</u>	<u>_____</u>
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

WORK SUMMARY

Failure Description n/a

Repair Action n/a

Tech R Dg ksh Cal Hrs. 1.0 Repair Hrs. _____ Parts Cost _____ Temp 76 F Hum. 27 %

Standards Used 0219, 7001

Date Picked Up 1/21/02

Picked Up By *Darrell Dunn*

444046671

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To use just enter a value for resistance or for temperature. Answer is to the right (uncertainty +/-0/01 C)

Note: Spreadsheet is good only for the range -40C to 850C (limited negative range)

(1) Know Resistance. Want temperature

Enter Measured res:

Equivalent temp is:

	degrees	ohms
Class A tolerance is:	0.15	0.06
Class B tolerance is:	0.30	0.11

(2) Know Temperature. Want resistance

Enter Temperature in degrees C:

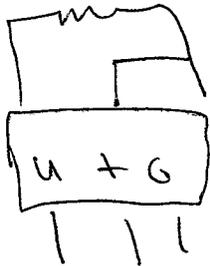
Equivalent resistance is:

	degrees	ohms
Class A tolerance is:	0.449812	0.17
Class B tolerance is:	1.04953	0.39

Temperature conversion:

Enter degrees C:	<input type="text" value="100"/>	deg F =	<input type="text" value="212.00"/>
Enter degrees F:	<input type="text" value="212"/>	deg C =	<input type="text" value="100.00"/>

To validate, compare to standard table



G-t =
 +-U =
 U-G -

$$R = \frac{(+U + U-G)}{2} - (G-t) =$$

This spreadsheet calculates temperatures or resistance based on the IEC 751 Standard (for 385 RTD probes)
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Equivalent temp is:

	degrees	ohms
Class A tolerance is:	0.15	0.06
Class B tolerance is:	0.30	0.11

(2) Know Temperature. Want resistance

Enter Temperature in degrees C:

Equivalent resistance is:

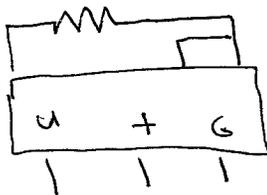
	degrees	ohms
Class A tolerance is:	0.15	0.06
Class B tolerance is:	0.3	0.11

Temperature conversion:

Enter degrees C:	<input type="text" value="100"/>	deg F =	<input type="text" value="212.00"/>
Enter degrees F:	<input type="text" value="212"/>	deg C =	<input type="text" value="100.00"/>

To validate, compare to standard table

Assn
 Serial # 8425



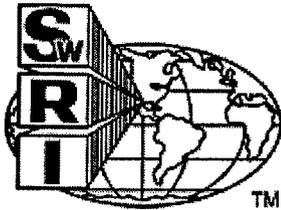
$$G + = 0.38207$$

$$+ - U = 100.3236$$

$$U - G = 100.3573$$

$$R = \frac{(+ - U + U - G)}{2} - (G - +) = 99.95839$$

meets class A 100 +/- .06 Ω



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Certificate of Calibration

11 January 2002

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: DURO-SENSE J-00
Description: RTD
Serial Number: 325
Asset Number: 008425
Work Order Number: 444046671

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: 11 Jan 02 **Calibration Procedure:** CUSTOMER

Condition as Received: SEE ATTACHED DATA

Condition as Returned: SEE ATTACHED DATA

Remarks: CUSTOMER IS PROVIDED READING ONLY.

Approved by:



Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:



Roger Dykstra, Technician