BOMBARDIER

de Havilland
Material Specification

TITLE:	**THERMOCOUPLE WIRE**
SPECIFICATION NUMBER:	**DHMS M 2.24**
ISSUE:	**C**
AMENDMENT:	**2**
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PAGE:	**1 of 6**

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REVISION RECORD

Issue	Page	Description and Reason for Change
NC	ALL	New Specification
A	All	Clerical changes.
	QPL	Eustis/Pyrocom Company is added to the Qualified Product List.
B		Removed Table 4: Frequency testing. Re-number Table 5. Added ".....there should be no more than 3000 feet of wire..." Added refereces to ASTM E220, E230
C	3	Corrected Table 3 : Was "260± 2" Now "250± 2"
Amd. 1	QPL	Dynatherm company is added to the Qualified Product List.
Amd. 2	QPL	Revised Eustis company name and address. Added "WJ242516X0" to Manufacturer's Product Identification No. for Type J, Class 1.

1 SCOPE

This Specification establishes the requirements for type J & K thermocouple wire used in the production of composite and metal bonded parts.

2 CLASSIFICATION

Table 1: Classification

Class	Size (AWG)
1	24
2	20

Table 2: Construction of wire

Type	Construction	Color	Temperature range
J	Iron (anode) Constantan (cathode)	White Red	32 - 1300^{o}F
K	Chromel (anode) Alumel (cathode)	Yellow Red	-320 - 2200^{o}F

3 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflicting requirements between this and the specifications listed below. The requirements of this specification shall govern. Where a specific issue of a document is not specified, the current issue shall be used.

MIL-W-5845C	Wire, Electrical, Iron and Constantan, thermocouple.
MIL-W-5846 Rev. B	Wire, Electrical, Chromel and Alumel, thermocouple.
DSC 234	Materials, Expendable, Composite Manufacture.
ASTM E220	Standard Method for Calibration of Thermocouples by Comparison Techniques.
ASTM E230	Standard Definitions and Terms Relating to Temperature Measurements.

4 REQUIREMENTS

4.1 Physical Requirements

Material purchased to this specification must be free from damage, or defect in either the conducting metal or the insulation.

The insulating jacket must be able to withstand temperatures of up to 500°F for a period of up to 10 hours.

The insulation should be smooth and uniform in shape and shall exhibit a tight continuous contact with the conductor along the full length of the wire.

4.2 Accuracy Requirements

All thermocouple wire purchased to this specification must meet the requirements listed in Table 3 when tested in accordance with Section 5.

Thermocouples covered by this specification shall be of the special limit error type of ASTM E230.

Table 3: Accuracy Requirement

True Temperature °F	Indicated Temperature °F
250 ± 2	248 - 252
350 ± 2	348 - 358

5 ACCEPTANCE TESTING

Unless otherwise specified in the contract or purchase order, the supplier is responsible for all acceptance tests, as specified in the specification.

The supplier, performing acceptance tests shall furnish with each batch of product one copy of an acceptance test report showing actual test data conformance to the acceptance tests specified in Table 3. The report shall include the supplier's batch identification. de Havilland reserves the right to perform any or all of the tests set forth in this specification to ensure that the product continues to meet specification requirements. Any product not meeting the requirements of this specification will be returned to the supplier at the supplier's expense.

For the purpose of testing consistency there should be no more than 3000 feet of wire on any one spool. Test the beginning and the end of each spool in the batch.

5.1 Test Specimen

Manufacture test thermocouples according to the following procedure:

Step 1. Cut a section of thermocouple wire of the spool to be tested (max. length 15')

Step 2. Strip 1/4" of insulation from the reference end of both wires, being careful not to nick or score the conductors.

Step 3. Crimp a M81824/1-1 splice connector onto the reference end of the thermocouple using either a Raychem AD-1377 crimping tool or a Daniels HX3 crimper with a 528 die.

Step 4. Install a thermocouple plug onto the opposite end of the test specimen. Use the combination of wire and plug specified in Table 4.

Alternatively, if the splice connectors and/or tools cannot be acquired, the following procedure may be used to produce the test thermocouples:

Step 1. Cut a section of thermocouple wire from the spool to be tested (max. length 15')

Step 2. Strip 3/4" - 1" of insulation from the reference end of both wires, being careful not to nick or score the conductors.

Step 3. Twist the stripped ends of the wires together (1 to 2 turns).

Step 4. Solent wipe the twisted wires using a clean cloth soaked in methanol.

Step 5. Spot or resistance weld the twisted thermocouple wires together.

Step 6. Install a thermocouple plug onto the opposite end of the test specimen. Use the combination of wire and plug specified in Table 4.

Table 4: Combination of wire and plug

Thermocouple wire	Thermocouple plug to be used
DSC 234-22-1	DSC 234-23-1
DSC 234-22-2	DSC 234-23-2
DSC 234-22-3	DSC 234-23-3

5.2 Test Procedure

All thermocouple to be used in the manufacture of composite, metal bonded parts shall be calibrated for 250^{o}F and 350^{o}F according to ASTM E 220 or the following procedure:

Step 1. Set the calibration furnace (Lindburg/Blue "Horizontal Tube Furnace" model HTF55322C, or equivalent) controls to the desired temperature.

Step 2. Connect the pre-calibrated reference thermocouple to the temperature recording device (Yokogawa "Hybrid Recorder" model DR240 or equivalent). Insert the reference thermocouple into the furnace and wait for the temperature reading to stabilize at the desired temperature. Adjust furnace control if necessary to bring the furnace temperature within the requirements.

Step 3. Connect the test thermocouple to the temperature recorder and insert it into the furnace. Wait for the indicated temperature to stabilize, and begin to record the indicated vs. true temperature. Take readings every minutes for at least 10 minutes after equilibrium is achieved.

Step 4. Calculate the average "true" and "indicated" temperatures for the test.

compare the test averages to the requirements listed in Table 3.

If a test specimen fails to meet the listed requirements two subsequent samples from the same roll (at lease 100' apart" shall be tested. If either of these samples also fails, the roll shall be rejected and all of the remaining rolls in the batch shall be tested individually.If at any point during the test, the sample thermocouple produces an erratic spike (sudden high or low reading), the test shall be aborted and a new test specimen fabricated.

6 PREPARATION FOR DELIVERY

6.1 Packaging

The product shall be prepared for shipment in accordance with the manufacturers commercial practice and applicable rules and regulations to ensure safe delivery.

6.2 Shipping Documentation

Each shipment of materials shall be accompanied with a shipping document containing the following information.

- Manufacturer
- Date of Manufacture
- Purchase Order Number
- Lot and Package Numbers
- Quantity
- Class and Type
- Certificate of Conformance to DHMS M 2.24 Issue

7 ORDERING DATA

7.1 Prerequisite

Produces furnished under this specification for production use shall be qualified and listed on the Qualified Products List prior to issuing of a purchase order.

7.2 Procurement Documents

Procurement documents shall specify the following:

- Manufacturer
- Purchase Order Number
- Class and Type of Thermocouple
- Quantity
- Certificate of Conformance to DHMS M 2.24 Issue

8 HEALTH AND SAFETY

Material supplied to de Havilland must be accompanied by a Materials Safety Data Sheet (MSDS) complying with the "Controlled Products Regulations" of the Hazardous Products Act (also known as W.H.M.I.S. Regulations). The document must state all assiduous ingredients, safe-handling procedures, first aid measures and fire and explosion data.

QUALIFIED PRODUCTS LIST

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MATERIALS SAFETY DATA SHEET NO.	PRODUCT QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
Type J. Class 1				
Thermo Electric Canada Ltd. 12 Rutherford Rd. South Brampton, Ontario L6W-3J2 905-451-0813	Tex/TW-24-JJ	N/A	N/A	
Technology Marketing 6122 South Stratler St. Salt Lake City, Utah	Vac Type, F8	N/A	N/A	
Eustis Company Inc. 12407-B Mukilteo Speedway Suite 200 Lynnwood, WA 98087 425-423-9996	JJ-TEAB-24 WJ242516X0	N/A	N/A	
Dynatherm Instrument Inc. 709 Avenue Meloche Dorval, QC H9P 2S4	Tex/TW-24-JJ	N/A	N/A	January 2011
Type K, Class 2				
Thermo Electric Canada Ltd. 12 Rutherford Rd. South Brampton, Ontario L6W-3J2 905-451-0813	Tex/Tex-20-KK	N/A	N/A	
Dynatherm Instrument Inc. 709 Avenue Meloche Dorval, QC H9P 2S4	Tex/Tex-20-KK	N/A	N/A	January 2011