de Havilland Inc.

Material Specification

TITLE:	**250 MARAGING STEEL EXTRUSIONS**
SPECIFICATION NUMBER:	**DHMS M2.09**
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1 SCOPE

This specification covers the requirements for high strength, 18% nickel maraging steel extrusions.

2 INTRODUCTION

The clauses of this specification are written under the following headings:

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3 APPLICABLE SPECIFICATIONS

3.1 Standards

DHMS MI-1- Ultrasonic Inspection of Maraging Steel.

Federal Test Standard Number 151

4 REQUIREMENTS

4.1 Composition

Maraging steel shall be composed of the following elements in percentage (%) by weight:

Nickel	17.0 - 19.0
Molybdenum	4.6 - 5.1
Cobalt	7.0 - 8.5
Titanium	0.30 - 0.50

4.1 Composition (continued)

Aluminum	.05 - .15
Boron	0.003 added
Zirconium	0.02 added
Calcium	0.06 added
Carbon	0.03 max.
Manganese	0.10 max.
Phosphorous	0.010 max.
Sulphur	0.01 max.
Silicon	0.10 max.

4.2 Conditions

4.2.1 Extrusions shall be available in the fully annealed condition unless otherwise specified.

4.3 Manufacturing Process

4.3.1 The steel shall be consumable electrode vacuum melted.

4.3.2 Decarburization control is not needed on maraging steel because of the low carbon content.

4.3.3 The grain size shall be 5 or finer for cross-sectional areas up to 25 sq. ins. Grain size on larger cross-sectional areas shall be negotiated.

4.3.4 The material shall be solution annealed by the producer at 1500°F - 1650°F for one hour per inch of thickness and air cooled to room temperature to produce a Rockwell "C" hardness of 34 max., having the following MINIMUM mechanical properties:

	Long.	Trans.
U.T.S. KSI	140	140
Yield at .2% offset (KSI) Max.	100	100

4.3.4 (continued)

	Long.	Trans.
Elongation %	12	12
Reduction of Area %	60	60

4.3.5 Subsequent aging performed by the fabricator at 900°F ± 25°F for 3 to 6 hours followed by air cooling produces a Rockwell "C" hardness of 49 - 54, having the following MINIMUM mechanical properties:

	Long.	Trans.
U.T.S. (ksi)	240 Min. 270 Max.	240 Min. 270 Max.
Yield at .2% offset (ksi)	230 Min. 260 Max.	230 Min. 260 Max.
Elongation %	7	5
* Notch Tensile Stg. (ksi) (K_t=9)	350	350
Reduction of Area %	40	30

4.3.6 Test pieces shall be selected as directed in paragraph 7.

4.3.7 The material shall maintain a good dimensional stability throughout the aging process.

* Notch tensile values shall not form a basis for rejection of material.

4.4 Analysis

An analysis check shall be made on one sample taken from each melt, conforming to AMS 2248. Check limits for Molybdenum shall be .10 over max. and .10 under min.

4.5 Workmanship

The product shall be uniform in quality, free of alloy segregation, sound and free from foreign materials and from internal and external defects detrimental to fabrication or to performance of parts.

4.6 Tolerances

Tolerances shall be as agreed to between De Havilland Aircraft of Canada and the supplier, as shown on applicable drawings.

5 REPORTS

5.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment, three copies of a report of the results of tests for chemical composition of each heat in the shipment and the results of tests on each thickness from each heat to determine conformance to the technical requirements of this specification. This report shall include the purchase order number, material specification number, thickness, size and quantity from each heat.

5.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment, three copies of a report showing the purchase order number, material specification number, contractor or other direct supplier of material, part number and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

6 IDENTIFICATION

6.1 Unless otherwise specified, each plate, individual pieces or bundles shall have attached a metal tag stamped with DHMS M2.09, the purchase order number, nominal size and heat number or shall be boxed and the box marked with the same information.

In addition to the above information, extrusion shall be stamped with heat number within 2 in. of one end.

6.2 (continued)

The characters shall not be less than 3/8 in. in height, shall be applied using a suitable marking fluid, and shall be capable of being removed in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the material or its performance. The characters shall be sufficiently stable to withstand ordinary handling.

7 TESTING

7.1 Test specimens shall be taken from each lot and tested in compliance with the requirements of Federal Test Standard Number 151. Whenever practicable, the material shall be tested in full sections. For material less than 1/2 inch in section thickness and of suitable width, which is not tested in full section, a test specimen of type 5 shall be used. For material 1/2 inch or more in section thickness, which is not tested in full section, a test specimen of type 1 or 4 shall be used. For shapes from which a standard test specimen cannot be taken and which cannot be tested satisfactorily in full section, a strip taken from the section shall be tested.

7.2 Micro Inclusion Test

The producer of the material shall prepare radial specimens approximately 0.28 sq. in. surface area, cut from mid-radius and representing material from the top and bottom of each ingot. These specimens shall be solution annealed and aged. The specimens shall be polished on a face parallel to the longitudinal axis for micro-inclusion rating in accordance with the Jernkontoret Chart in ASTM E-45-51. No sample shall exceed the limits laid down in Table 1.

7.3 Ultrasonic Inspection:

Ultrasonic inspection shall be done by the supplier to limits as stated in DHMS MI-1.

8 ORDERING DATA

8.1 Procurement documents should specify the following:

- Title, number and issue of this specification.
- Size and Shape.

9 REJECTIONS

9.1 Material not conforming to this specification or to authorized modifications will be subject to rejection.

Table I

Inclusion Type	Thin	Heavy	Worst Field
A	X		1.05
A		X	1.0
B	X		1.5
B		X	1.0
C	X		1.0
C		X	1.0
D	X		1.5
D		X	1.0
E	X		2.5
E		X	1.5