de Havilland Inc.

Material Specification

TITLE:	**TUBING, ALUMINUM ALLOY DRAWN SEAMLESS, SPECIAL SURFACE QUALITY**
SPECIFICATION NUMBER:	**DHMS M2.21**
ISSUE:	**B**
AMENDMENT:	**1**
DATE:	**JANUARY 22, 1991**
PAGE:	**1 of 9**

Prepared by: Checked by:

SIGNED ORIGINAL ON FILE

D. Cheng
Materials Technology

L. Salnais
Specialist, Protective Finish

Approved by:

S. Morita
Manager
Materials Technology

A. Gordon
Manager
Quality Assurance

1 SCOPE

This specification supplements the requirements for seamless, drawn, aluminum alloy tubing conforming to WW-T-700.

This DHMS shall apply only to those alloys, outside diameter and wall thickness combinations stated in Table 4.

1.1 Tubing surface finish and inspection shall be in accordance with Table I.

TABLE 1

TUBING SIZE		SURFACE FINISH		WORKMANSHIP	
O.D.	WALL THICKNESS	C-4 (PARA 1.2)	STD. AS DRAWN	ASTM E215 (PARA 1.3)	DHMS M2.21
.250" TO .625"	.018" TO .083"	---	x	x	x
.625" TO 4.000"	.028" TO .125"	x	---	---	x

1.2 Tubing will be supplied in a C-4 or equivalent surface finish (ground, with a maximum microinch surface roughness of 32 RMS for 2024 and a maximum of 47 RMS for 6061 alloy).

1.3 Tubing of the stated diameters and wall thickness cannot be supplied in C-4 finish and alternatively will be eddy current inspected to ASTM E215 for surface imperfections.

2 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent defined herein. In the event of conflicting requirements between this and 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.

2.1 U.S Government Specifications

2.1.1 Federal Specification

WW-T-700/3	-	Tube, 2024 Aluminum Alloy, Drawn, Seamless
WW-T-700/6-		Tube, 6061 Aluminum Alloy, Drawn, Seamless

2.1.2 American Society for Testing and Materials

ASTM E215	-	Standardizing Equipment for Electromagnetic Testing of Seamless Aluminum Alloy Tube, Rec. Practice for

3 REQUIREMENTS

3.1 Workmanship

The tube shall be seamless and uniform in quality and temper. The exterior and interior surfaces shall be smooth and free from slivers, burrs, laminations, cracks and drawn-in particles or chips. The tube shall be clean but occasional dark or black patches of aluminum oxides caused by light fretting or abrasion shall not be cause for rejection. In addition, the tube must not contain:

(a) Sharp bottomed surface defects of depths which exceed the limits of Table 2.

(b) Circumferential round bottomed dents.

(c) Longitudinal, round bottomed surface defects deeper than 10% of the tube wall thickness of 0.005 inches, whichever is smaller.

(d) Longitudinal, round bottomed dents deeper than the limits specified in Table 3, or longer than the tube nominal diameter.

(e) Longitudinal, round bottomed dents whose total length (the sum of lengths of all dents in a length of tube) is greater than 5% of the tube length.

(f) Baked on contaminants (this does not include heat treating oxide).

(g) Intergranular or pitting corrosion.

Notes:

1. Surface defects within a longitudinal, round bottomed dent shall be evaluated with regard to the applicable limits for that type of defect.
2. Sharp bottomed defects or dents are those with a bottom angle of 90 degrees, or less (see Fig. 1). Defects or dents with a bottom angle greater than 90 degrees are considered as round bottomed.
3. Circumferential dents are those with an included angle of more than 45 degrees to the axis of the tube.
4. Surface defects are discontinuities, such as grooves, scratches, nicks, seams, folds, pits, die lines and tears, mandrel lines, etc.

D = Max. Depth of Defect

DEFECT PROFILE

FIGURE 1

4 PREPARATION FOR DELIVERY

4.1 Preservation, Packaging and Packing

Tubes shall be preserved, (except 4.1.1.1) packaged and packed in accordance with ASTM-B660, Level A, including the following additional requirements.

4.1.1 Tubes which have the C-4 surface finish do not require oiling, but each tube shall be spiral wrapped with protective paper.

4.1.1.1 Tubes which do not have the C-4 surface finish per Table 1 shall be preserved as follows:

The outside diameter of each tube shall be coated with CRC3-36 or MIL-L-7870 or VV-L-800 oil or corrosion inhibiting compound.

4.1.2 Multiple lengths of one tubing size and form may be bundled by using plastic strapping or nylon tape.

4.1.3 If a shipping container is to accommodate more than one bundle of tubing, cushioning material shall be placed between bundles, especially when tubes of different forms are shipped in one container, i.e., round, square or rectangular.

4.1.4 A bundle(s) of tubes inside a box shall be properly secured and prevented from moving or bouncing around within the box.

4.1.5 Fastener (nails, staples, etc.) used in the construction of the box shall not protrude into the inside of the box.

5 NOTES

5.1 Intended Use

This tubing is intended for use in mechanical systems, such as flight control rods, where fatigue and column buckling strength are of prime importance.

5.2 Ordering Data

Procurement documents shall contain the following additional data. The Purchase Order shall state:

5.2.1 Tubing shall be marked with the appropriate WW-T-700/X specification and DHMS M2.21.

5.2.2 Tubing shall be oiled (4.1.1.1) and conform to WW-T-700/X specification and DHMS M2.21.

.

TABLE 2

NOMINAL WALL THICKNESS IN INCHES	MAXIMUM PERMISSIBLE DEPTH OF DEFECT IN INCHES
Up to 0.020	10 percent of Nominal Wall Thickness
.020 - .030	0.002
.031 - .040	0.0025
.041 - .050	0.003
.051 - .066	0.004
.067 and over	0.006

TABLE 3

Specified Diameter in Inches	Dent Values
Up to .500	.006 inches
.501 - 1.000	.008 inches
1.001 - 2.000	.010 inches
2.001 - 3.000	.012 inches
3.001 - 5.000	.016 inches
5.001 - 6.000	.020 inches

Depth of dents shall not exceed twice the values specified above, except for tube having a wall thickness less than 2-1/2% of the outside diameter in which case the following multipliers apply:

2% - 2.5% Exclusive - 2.5 x dent value (max)
1.5% - 2% Exclusive - 3.0 x dent value (max)
1% - 1.5% Exclusive - 4.0 x dent value (max)
.5% - 1% Exclusive - 5.0 x dent value (max)

5.3 Other Documents

The number and issue of this specification must be stated on DHC Purchase Orders, Supplier Shipping Documents and Test Reports.

TABLE 4

TUBING SIZE O.D. X WALL	MATERIAL CODE	APPLICABLE ALLOY
.500 Dia x .028	A301903	6061
.500 Dia x .035	A301904	6061
.500 Dia x .049	A301904	6061
.625 Dia x .028	A301906	6061
.625 Dia x .035	A301907	6061
.625 Dia x .049	A301908	6061
.625 Dia x .058	A301909	6061
.75 Dia x .028	A301910	6061
.75 Dia x .035	A301911	6061
.75 Dia x .049	A301912	6061
.875 Dia x .035	A301913	6061
.875 Dia x .065	A301914	6061
1.000 Dia x .035	A301915	6061
1.000 Dia x .049	A301916	6061
1.125 Dia x .049	A301917	6061
1.250 Dia x .035	A301918	6061
1.250 Dia x .049	A301919	6061
1.250 Dia x .065	A301921	6061
1.250 Dia x .083	A301922	6061
1.375 Dia x .058	A301923	6061
1.500 Dia x .058	A301927	6061
1.500 Dia x .065	A301924	6061
1.625 Dia x .058	A301925	6061
1.750 Dia x .058	A301926	6061

REVISION RECORD

Issue	Page	Description and Reason for Change
B		This is a revised specification. Detail changes will not be noted.
Amd. 1	9	1.5" Dia x .058" added to Table 4.