BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 23.03

PRODUCTION PROCESS STANDARD

DESIGNATION OF STEEL ALLOYS

Issue 6 - This standard supersedes PPS 23.03, Issue 5.
- Vertical lines in the left hand margin indicate changes over the previous issue.

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This PPS is effective as of the distribution date specified on the accompanying distribution notice.

Direct any PPS related questions to the PPS Group (416) 375-7641.

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Tables

1 SCOPE

1.1 This Production Process Standard (PPS) explains the alloy designations, temper designations and material specifications of carbon, low alloy and corrosion resistant steels.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS must be followed to ensure compliance with all applicable specifications. In general, if this PPS conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

1.1.2 Refer to PPS 13.26 for the subcontractor provisions applicable to this PPS.

1.1.3 Procedure or requirements specified in a Bombardier BAPS, MPS, LES or P. Spec. **do not** supersede the procedure or requirements specified in this PPS. Similarly, the procedure and requirements specified in this PPS are not applicable when use of a BAPS, MPS, LES or P. Spec. is specified.

1.2 Heat treatment operations are explained in detail in PPS 30.12.

2 REFERENCES

2.1 PPS 13.26 - General Subcontractor Provisions.

2.2 PPS 30.12 - General Steel Heat Treatment.

3 STEEL ALLOY AND TEMPER DESIGNATIONS

3.1 Alloy Designations

3.1.1 Carbon and Low Alloy Steels

3.1.1.1 Carbon and low alloy steels are identified by a standard four or five digit number system, as defined by the Society of Automotive Engineers (SAE).

3.1.1.2 The first two digits indicate the type of steel. The remaining two or three digits indicate the nominal carbon content of the steel in 1/100ths of a percent.

3.1.1.3 Refer to Table I for a listing of carbon steels and Table II for a listing of low alloy steels.

3.1.1.4 Table II also lists several common proprietary alloys. These alloys do not have an SAE type designation and are referred to by their commercial designation (i.e. trade name).

3.1.2 Corrosion Resistant Steels

3.1.2.1 Except as noted below, corrosion resistant steels are identified by a three digit number system, as defined by the American Iron and Steel Institute (AISI). These steels may also be referred to by their grade number, which is a numeric code indicating the nominal chromium and nickel content.

3.1.2.2 Some corrosion resistant steels do not have an AISI type designation. These steels are designated by a commercial designation which may include the grade number.

3.1.2.3 Refer to Table III for a listing of corrosion resistant steels.

3.2 Temper Designations

3.2.1 Carbon and Low Alloy Steels

3.2.1.1 Codes denoting the tempers of carbon and low alloy steels are shown in Table IV.

3.2.1.2 Table V lists the material specifications for various steel alloys and product forms used at de Havilland.

3.2.1.3 The hardened and tempered code “HT” is normally followed by a number specifying the minimum ultimate tensile strength in ksi (1 ksi = 1,000 psi).

3.2.2 Corrosion Resistant Steel

3.2.2.1 Codes denoting the tempers of corrosion resistant steels are shown in Table IV.

TABLE I - DESIGNATION OF CARBON STEELS

SAE NUMBER	TYPE OF STEEL	DESCRIPTION
1010 to 1030	Low Carbon Steel	Carburizing grade
1031 to 1050	Medium Carbon Steel	Machining or forging grade
1051 to 1095	High Carbon Steel	Heat treating grade
11XX	Resulphurized Carbon Steel	Free machining
12XX	Resulphurized & Rephosphorized Carbon Steel	Free machining, increased strength & hardenability
13XX	Manganese (1.75%)	Increased strength & hardenability
Note 1. XX denotes variable carbon content in 1/100ths of a percent.		

TABLE II - DESIGNATION OF LOW ALLOY STEELS (NOTE 1)

SAE NUMBER	MAJOR ALLOYING ELEMENTS	DESCRIPTION
20XX 21XX 23XX 25XX	Nickel	Increased hardness, toughness and hardenability while maintaining good ductility, suitable for case hardening
30XX 31XX 32XX 33XX 34XX	Nickel-Chromium	Good hardening properties with excellent ductility
40XX 44XX	Molybdenum	Improved hardenability, increased high temperature tensile strength
41XX	Chromium-Molybdenum	Excellent hardenability with satisfactory ductility
43XX 47XX	Nickel-Chromium-Molybdenum	Can be heat treated to higher strength levels than 41XX grades
46XX 48XX	Nickel-Molybdenum	Carburizing grades
50XX 51XX 50XXX 51XXX 52XXX	Chromium	Increased depth hardenability, exceptional wear resistance
61XX	Chromium-Vanadium	Spring steels
71XX 72XX	Tungsten-Chromium	Nitriding grades
81XX 86XX 87XX 88XX	Nickel-Chromium-Molybdenum	Lower nickel content than 43XX or 47XX grades, similar to 41XX grades
92XX	Silicon-Manganese	High strength, toughness and shock resistance
93XX 94XX 98XX	Nickel-Chromium-Molybdenum	Case hardening grades
PROPRIETARY NAME	**REMARKS**	
H11 Mod. (Vascojet 1000)	High strength, air hardening grade, suitable for heavy sections	
HY-TUF	High strength, greater than 220 ksi tensile strength	
300M	High strength, greater than 220 ksi tensile strength	

Note 1. XX denotes variable carbon content in 1/100ths of a percent.

TABLE III - DESIGNATION OF CORROSION RESISTANT STEELS (NOTE 1)

GROUP	HARDENABILITY	STRUCTURE	GRADE (Cr-Ni)	AISI OR COMMERCIAL NUMBER	DESCRIPTION
Chromium-Nickel	Strain hardenable (cold working)	Austentic (non-stabilized)	17-7	301	Lower Cr and Ni for greater work hardening
			18-8	302	Basic type, 18% Cr & 8% Ni
			18-8	303S	S added for easier machining
			18-8	303Se	Se added for easier machining
			18-8	304	C lower to reduce carbide precipitation
			25-20	310	Higher Cr and Ni to increase scaling resistance
			18-8	316	Mo added for better corrosion resistance
		Austenitic (stabilized)	18-8	321	Ti added to avoid carbide precipitation
			18-8	347	Cb (Nb) and Ta added to avoid carbide precipitation
			19-9	19-9DL	Cb (Nb), Ta and Ti added to increase high temperature strength properties
			21-6	21-6-9	9% Mn added to increase high temperature strength properties
	Precipitation hardenable	Martensitic	15-5	15-5PH	High strength, good corrosion resistance up to 600°F
			17-4	17-4PH	High strength, good corrosion and oxidation resistance up to 600°F
			17-7	17-7PH	High strength, good corrosion and oxidation resistance up to 600°F
			æ	Custom 455	High strength than 17-4PH and 17-7PH (greater than 200 ksi obtainable), temperature resistance up to 800°F
Chromium-Iron	Transformation hardenable (harden & temper)		12-0	410	Basic type, 12% Cr
			16-1	431	Higher Cr and Ni added for better corrosion resistance

Note 1. Abbreviations of alloying elements are as follows:

C: Carbon	Mo: Molybdenum	Se: Selenium
Cr: Chromium	Ni: Nickel	Ta: Tantalum
Cb: Colombium (Note 2)	Nb: Niobium (Note 2)	Ti: Titanium
Mn: Manganese	S: Sulphur	

Note 2. The name “Niobium” may be used in some cases to designate the element “Colombium”.

TABLE IV - TEMPER DESIGNATIONS OF STEEL ALLOYS

TYPE OF STEEL	TEMPER	DEFINITION
Carbon & Low Alloy Steel	A or C	Annealed
	N or D	Normalized
	E	Normalized & Tempered
	HT (XXX)	Fully Heat Treated
	F	Hardened & Tempered
Strain Hardenable Corrosion Resistant Steel	A	Annealed
	B	Cold Worked or Spring Temper
	1/8 Hard	Cold Worked 1/8 Hard
	1/4 Hard	Cold Worked 1/4 Hard
	1/2 Hard	Cold Worked 1/2 Hard
	3/4 Hard	Cold Worked 3/4 Hard
	Hard	Cold Worked Full Hard
Quench and Temper Hardenable Corrosion Resistant Steel	A	Annealed
	HT (XXX)	Hardened & Tempered
Precipitation Hardenable Corrosion Resistant Steel	A	Solution Heat Treated (Solution Annealed)
	H950	Precipitation Hardened (see Note 1)
	RH950	
	H1000	
	H1025	
	TH1050	
	H1100	
	H1150	

Note 1. Numeric portion of the code denotes the actual heat treatment temperature used to produce the designated condition.

TABLE V - MATERIAL SPECIFICATIONS FOR STEEL ALLOYS

MATERIAL SPECIFICATION	ALLOY	MILL PRODUCTION
MIL-S-5000	4340	Bar and rod
MIL-S-5059	301	Sheet, strip and plate
MIL-S-6709	7140 (135M)	Bar, rod and forging (also see AMS 6470)
MIL-S-6721	Type Ti 321	Superseded by AMS 5510
MIL-S-6721	Type Cb-Ta 347	Superseded by AMS 5512
MIL-T-6736	4130	Seamless and welded tube
MIL-S-6758	4130	Bar and rod
MIL-T-6845	304	1/8 hard seamless or welded hydraulic tube
MIL-S-7420	52100	Bar
MIL-S-7947	1095	Sheet and strip
MIL-S-7952	1020	Sheet, strip and plate
	1025	Sheet, strip and plate
MIL-T-8504	304	Annealed seamless or welded hydraulic tube
MIL-T-8506	304	Annealed seamless or welded tube
MIL-T-8606	321	Annealed seamless or welded tube
	347	Annealed seamless or welded tube
MIL-T-8808	321	Seamless or welded tube
MIL-S-18728	8630	Sheet, strip and plate
MIL-S-18729	4130	Sheet, strip and plate
MIL-S-18732	431	Bar, forging and tube
MIL-S-25043	17-7PH	Sheet, strip and plate
QQ-S-633	1020	Bar
QQ-S-763	303	Bar, rod, forging and wire
	303Se	Bar, rod, forging and wire
	321	Bar, rod, forging and wire
	347	Bar, rod, forging and wire
	410	Bar, rod, forging and wire
QQ-S-764	303	Annealed bar and rod
	303S	Annealed bar and rod
QQ-S-764	303Se	Superseded by AMS 5738 (cold worked)
QQ-S-766	304	Sheet and plate
QQ-S-777	1095	Strip
QQ-W-423	302	Wire
QQ-W-470	Spring steel	Wire

TABLE V - MATERIAL SPECIFICATIONS FOR STEEL ALLOYS, CONT'D

MATERIAL SPECIFICATION	ALLOY	MILL PRODUCT FORM
AMS 5333	8615	Investment castings
AMS 5334	8630 Mod.	Investment castings
AMS 5336	4130	Investment castings
AMS 5342	17-4PH	Investment castings (H1100)
AMS 5343	17-4PH	Investment castings (H1000)
AMS 5344	17-4PH	Investment castings (H900)
AMS 5350	410	Investment castings
AMS 5362	347	Investment castings
AMS 5510	Type Ti 321	Sheet, strip and plate
AMS 5528	17-7PH	Sheet, strip and plate
AMS 5595 (DHMS M2.16)	21-6-9	Tube
AMS 5604	17-4PH	Sheet, strip and plate
AMS 5617	Custom 455	Bar and forging
AMS 5643	17-4PH	Bar
AMS 5659	15-5PH	Consumable electrode melted bar and forging
AMS 5673	17-7PH	Wire (spring temper)
AMS 5721	19-9DL	Bar, rod and forging
AMS 5738	303F	Cold worked bar and rod
AMS 6260	9310	Bar, rod, forging and tube
AMS 6359	4340	Sheet, strip and plate
AMS 6371	4130	Tube
AMS 6372	4135	Tube
AMS 6411	4330V	Bar, forging and tube
AMS 6418	Hy-Tuf	Bar, rod, forging and tube
AMS 6419	300M	Premium quality consumable electrode vacuum melted bar, rod, forging and tube
AMS 6470	7140 (135M)	Bar, rod, forging and tube
AMS 6485	H11 Mod. (Vascojet 1000)	Bar and forging
AMS 6487	H11 Mod. (Vascojet 1000)	Premium quality consumable electrode vacuum melted bar and forging
Commercial Quality	1010	Sheet