BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 23.07

PRODUCTION PROCESS STANDARD

DESIGNATION OF NICKEL ALLOYS

Issue 3 - This standard supersedes PPS 23.07, Issue 2.
- 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) 375-4365.

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1 SCOPE

1.1 This Production Process Standard (PPS) defines alloy and temper designations and material specifications for nickel alloys.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction and the procedure specified 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.

2 HAZARDOUS MATERIALS

2.1 Before receipt at Bombardier Toronto (de Havilland), all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Toronto (de Havilland) Environment, Health and Safety Department. Refer to the manufacturer's MSDS for specific safety data on any of the materials specified in this PPS. If the MSDS is not available, contact the Bombardier Toronto (de Havilland) Environment, Health and Safety Department.

3 REFERENCES

3.1 PPS 13.26 - General Subcontractor Provisions.

4 MATERIALS AND EQUIPMENT

4.1 No materials or equipment are required.

5 NICKEL DESIGNATIONS AND SPECIFICATIONS

5.1 Alloy Designations

5.1.1 Nickel alloys are identified by the accepted trade names assigned by the developers and manufacturers of the alloys. These trade names have no relation to the alloying elements or compositions of the alloys.

5.1.2 Refer to Table I for a listing of the most common nickel-copper and nickel-chromium alloys.

TABLE I - DESIGNATIONS OF NICKEL ALLOYS

TYPE	ALLOY (Note 1)	DESCRIPTION
Nickel-Copper Alloys (Monels)	Monel Alloy 400 (Monel)	Basic nickel-copper alloy - non-heat treatable
	Monel Alloy R-405 (“R” Monel)	Similar to Alloy 400, except sulphurv has been added for easier machining - non-heat treatable
	Monel Alloy K-500 (“K” Monel)	Aluminum and titanium added for precipitation hardenability - heat treatable
	Monel Alloy 501 (“KR” Monel)	Similar to Alloy K-500, except carbon content is higher for easier machining - heat treatable
Nickel-Chromium Alloys (Inconels)	Inconel Alloy 600 (Inconel)	Basic nickel-chromium alloy - non-heat treatable
	Inconel Alloy 625	Molybdenum and niobium (formerly colombium) added for higher strength - non-heat treatable
	Inconel Alloy 718	Molybdenum added for optimum hardness and aluminum and titanium added for precipitation hardenability - heat treatable
	Inconel Alloy X-750 (Inconel “X”)	Aluminum and titanium added for precipitation hardenability - heat treatable
Note 1 - Superseded alloy designations are indicated in parentheses.		

5.2 Temper Designations

5.2.1 No coding system has been developed for designating the tempers of nickel alloys. The tempers are simply referred to by the thermal and mechanical treatment received.

5.2.2 Non-Heat Treatable Alloys

5.2.2.1 Non-heat treatable nickel-copper and nickel-chromium alloys cannot be hardened by thermal treatment. They are, however, hardenable by cold working.

5.2.2.2 Refer to Table II for a listing of the most common non-heat treatable tempers.

5.2.3 Heat Treatable Alloys

5.2.3.1 Heat treatable nickel-copper and nickel-chromium alloys are hardenable by thermal treatment. Hardening is achieved through precipitation heat treatment (ie., artificial aging) following a hot shaping or solution annealing process. The material may or may not be cold worked prior to precipitation heat treatment.

5.2.3.2 Refer to Table III for a listing of the most common heat treatable tempers.

5.3 Material Specifications

5.3.1 Refer to Table IV for a listing of the material specifications for the most common nickel alloys.

TABLE II - TEMPER DESIGNATIONS OF NON-HEAT TREATABLE NICKEL ALLOYS

TEMPER	DESCRIPTION
Drawn	As drawn condition, no subsequent treatment
Forged	As forged condition, no subsequent treatment
Cold Rolled	As cold rolled condition, no subsequent treatment
Hot Rolled	As hot rolled condition, no subsequent treatment
1/4 Hard	Cold worked to 1/4 hard temper
Hard	Cold worked to full hard temper
Spring	Cold worked to spring temper
Annealed	Annealed after shaping process

TABLE III - TEMPER DESIGNATIONS OF HEAT TREATABLE NICKEL ALLOYS

TEMPER	DESCRIPTION
Drawn	As drawn condition, no subsequent treatment
Drawn and Age Hardened	As drawn and precipitation heat treated
Forged	As forged condition, no subsequent treatment
Forged and Age Hardened	As forged and precipitation heat treated
Hot Rolled	As hot rolled, no subsequent treatment
Hot Rolled and Age Hardened	As hot rolled and precipitation heat treated
1/2 Hard	Cold worked to 1/2 hard temper
1/2 Hard and Age Hardened	Cold worked to 1/2 hard temper and precipitation heat treated
Hard	Cold worked to full hard temper
Hard and Age Hardened	Cold worked to full hard temper and precipitation heat treated
Spring	Cold worked to spring temper
Spring and Age Hardened	Cold worked to spring temper and precipitation heat treated
Annealed	Annealed after shaping process
Annealed and Age Hardened	Annealed after shaping process and precipitation heat treated
Solution and Precipitation Heat Treated	Solution heat treated after shaping process and precipitation heat treated

TABLE IV - MATERIAL SPECIFICATIONS FOR NICKEL ALLOYS

MATERIAL SPECIFICATION	ALLOY	MILL PRODUCT FORM
AMS 4544	Monel Alloy 400	Sheet, strip and plate
AMS 4730	Monel Alloy 400	Wire
AMS 5540	Inconel Alloy 600	Sheet, strip and plate
AMS 5542	Inconel Alloy X-750	Sheet, strip and plate
AMS 5599	Inconel Alloy 625	Sheet, strip and plate
AMS 5663	Inconel Alloy 718	Bar, forgings, flash-welded rings
AMS 5596	Inconel Alloy 718	Sheet, strip and plate
QQ-N-281 Class A	Monel Alloy 400	Sheet, strip, plate, bar, rod, wire, forgings, structural and special shapes
QQ-N-281 Class B	Monel Alloy R-405	Sheet, strip, plate, bar, rod, wire, forgings, structural and special shapes
QQ-N-286 Class A	Monel Alloy K-500	Sheet, strip, bar, rod, flats, wire and forgings
QQ-N-286 Class B	Monel Alloy 501	Plate, bar, rod and flats