

**Ministry of Defence  
Defence Procurement Agency, ADRP2  
Abbey Wood  
Bristol  
BS34 8JH**

## **OBSOLESCENCE NOTICE**

All DTD specifications were declared obsolescent from 1<sup>st</sup> April 1999. All DTD 900 series approvals also lapsed at that time. The standards will no longer be updated but will be retained as obsolescent documents to provide for the servicing of existing equipment.

### **Further Guidance**

The aim in declaring the specifications obsolescent is to recognise that the documents are not being updated and thus should be used with care by both purchaser and supplier. For example, a specification could contain valid technical information but may also contain type approval clauses that contradict procurement policy and/or use materials that do not comply with environmental legislation. The obsolescent specification can still be used as a basis for a purchase provided that the supplier and purchaser agree suitable changes to the specification within the purchase order/contract.

For the DTD 9000 system, each specification has provided an MoD approved material and process. For these items, the declaration of obsolescence will constitute the termination of both the extant MoD approval and the continuing MoD assessment that had underpinned those approvals. Again, the technical content of the document remains valid and can be used by both purchaser and supplier as a basis for a contract but an acceptable (to the parties) approval/assessment procedure would be required.

MINISTRY OF AVIATION

**D.T.D. 5057**

*Amendment No. 1*

*June, 1966*

**Aircraft Material Specification**  
**NICKEL-CHROMIUM-COBALT-MOLYBDENUM**  
**WELDABLE HEAT RESISTING ALLOY SHEETS AND STRIPS**  
**(Nickel base, Cr 18, Co 14, Mo 7)**

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**Clause 2. Chemical composition**

Clause 2.1

*Delete* Molybdenum    ...    ...    5.0 min., 9.0 max.  
*Insert* Molybdenum    ...    ...    6.0 min., 8.0 max.

**Clause 10. Mechanical properties**

Clause 10.2 *Tests in the solution treated and aged condition.*  
*Tensile test at 550°C.*

*Delete* 550°C.  
*Insert* 600°C.

*NOTE.*

*Delete* 550°C.  
*Insert* 600°C.

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HER MAJESTY'S STATIONERY OFFICE  
THREE PENCE NET

**Aircraft Material Specification**  
**NICKEL-CHROMIUM-COBALT-MOLYBDENUM WELDABLE HEAT RESISTING**  
**ALLOY SHEETS AND STRIPS**  
**(Nickel base, Cr 18, Co 14, Mo 7)**

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Clause 8.2					
<i>Delete</i>	Existing clause				
<i>Insert</i>	When subjected to a stress of 28 tonf per square inch at $700^{\circ} \pm 2\frac{1}{2}^{\circ}\text{C}$ , the total plastic strain in 23 hours shall not exceed 0.1 per cent.				
Clause 10.2	<i>Tests in the solution treated and aged condition.</i>				
	<i>Tensile test at 600°C.</i>				
<i>Delete</i>	Tensile strength	...	...	...	not less than 55 tonf /square inch
<i>Insert</i>	Tensile strength	...	...	...	not less than 60 tonf/square inch

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**NICKEL-CHROMIUM-COBALT-MOLYBDENUM WELDABLE HEAT**  
**RESISTING ALLOY SHEETS AND STRIPS**  
**(Nickel base, Cr 18, Co 14, Mo 7)**

*NOTE. This specification is one of a series issued by the Ministry of Aviation, either to meet a limited requirement not covered by any existing British Standard for aircraft material or to serve as a basis for inspection of materials the properties and uses of which are not sufficiently developed to warrant submission to the British Standards Institution for standardisation.*

### 1. Scope

This specification covers the supply of vacuum refined nickel-chromium-cobalt-molybdenum weldable heat resisting alloy sheets 0.020 inch to 0.375 inch thick, and strips in coil 0.020 inch to 0.104 inch thick.

### 2. Chemical composition

2.1 The chemical composition of the material shall be:

Element	Per cent	
	min.	max.
Carbon	-	0.07
Silicon	-	0.5
Copper	-	0.2
Iron	-	1.0
Manganese	-	0.5
<b>Chromium</b>	<b>16.0</b>	<b>20.0</b>
<b>Titanium</b>	<b>1.5</b>	<b>3.0</b>
<b>Aluminium</b>	<b>1.7</b>	<b>2.5</b>
<b>Cobalt</b>	<b>12.0</b>	<b>16.0</b>
<b>Molybdenum</b>	<b>5.0</b>	<b>9.0</b>
Zirconium	-	0.06
Boron	-	0.005
Sulphur	-	0.015
<b>Nickel</b>	<b>The remainder</b>	

*NOTE.* The following procedure is recommended for the estimation of sulphur: a suitable sample is ignited in a rapid stream of oxygen at approximately 1400°C, and the absorbed oxides of sulphur are determined by an acid-alkali or oxidation-reduction titration.

2.2 The manufacturer shall supply to the inspector the analysis of each cast for the specified elements.

2.3 A cast is defined as:

- (a) the product of one furnace melt;
- (b) the product of a number of furnace melts mixed prior to casting; or
- (c) as may be otherwise defined by the Inspecting Authority in agreement with the manufacturer.

### 3. Manufacture

The material shall be fabricated from ingots produced by vacuum refining and casting in air.

### 4. Condition

Unless otherwise agreed between the manufacturer and the purchaser and stated on the order, material up to and including 0.104 inch thick (12 S.W.G.) shall be supplied in the cold rolled, solution treated and descaled condition, and material thicker than 0.104 inch (12 S.W.G.) shall normally be supplied in the hot rolled, solution treated and descaled condition.

### 5. Freedom from defects

- 5.1 The material shall be free from harmful defects.
- 5.2 Any sheet or strip may be rejected for faults in manufacture although it may have been passed previously on chemical composition and mechanical tests.

### 6. Dimensional tolerances

- 6.1 *Thickness.* The tolerances on the nominal thickness of sheets and strips shall not exceed those given in Tables 1, 2 and 3 unless otherwise agreed between the manufacturer and the purchaser.
- 6.2 *Width and length.* The tolerances on the nominal width and length of sheets and width of strips shall not exceed those given in Tables 4, 5 and 6 unless otherwise agreed between the manufacturer and the purchaser.
- 6.3 *Lateral curvature.* Each sheet and coil shall be so free from lateral curvature that when laid out flat no part of its edge shall be distant from a 6ft chord by more than ½ inch.

## 7. Heat treatment

### 7.1 Solution heat treatment.

7.1.1 Unless otherwise agreed between the manufacturer and the purchaser, material other than creep test samples shall be heated at a uniform temperature in the range 1080-1120°C for not less than 3 minutes and not more than 30 minutes, followed by rapid cooling.

7.1.2 Unless otherwise agreed between the manufacturer and the purchaser, creep test samples shall be heated at a uniform temperature in the range 1080-1120°C for not less than 2 hours, followed by cooling in air.

7.2 Ageing. Unless otherwise agreed between the manufacturer and the purchaser, creep and tensile test pieces shall be heated at  $850^{\circ} \pm 10^{\circ}\text{C}$  for 2-6 hours, followed by cooling in air.

## 8. Creep test

8.1 The material shall be manufactured from stock which, when heat treated in accordance with Clauses 7.1.2 and 7.2, has met the creep test requirement of Clause 8.2.

8.2 When subjected to a stress of 6 tonf per square inch at  $850^{\circ} \pm 3^{\circ}\text{C}$ . the total plastic strain in 100 hours shall not exceed 0.20 per cent.

## 9. Selection and preparation of mechanical test samples

9.1 Sheets or coils from the same cast, of the same nominal thickness and solution heat treated together or consecutively shall be grouped in batches of not more than 20 cwt.

9.2 The inspector shall select from each batch one test sample for the tensile test specified in Clause 10.2, and not less than three test samples for the hardness and bend tests specified in Clauses 10.3(a) and 10.3(b).

9.3 The test samples shall be marked as directed by the inspector before they are removed from the sheets or strips, and shall not be mechanically worked.

9.4 Where dimensions permit, test pieces shall be cut so that the longer axis is in a direction at right angles to the direction of final rolling.

9.5 Tensile test pieces shall be tested in the solution heat treated and aged condition, and shall be aged in accordance with Clause 7.2.

9.6 Tensile test pieces shall be prepared and tested in accordance with the requirements of B.S.3688, Part 1.

9.7 Bend and hardness tests shall be carried out on materials in the solution heat treated condition.

9.8 Bend test pieces shall be prepared in accordance with the requirements of B.S.A4.

9.9 Hardness tests shall be made in accordance with B.S.427.

9.10 Unless otherwise agreed between the manufacturer and the purchaser, sheets and strips from which test samples have been taken for mechanical tests shall be considered good delivery.

## 10. Mechanical properties

10.1 The mechanical properties obtained from test pieces selected and prepared as stated in Clause 9 shall be as follows:

### 10.2 Tests in the solution treated and aged condition.

*Tensile test at 550°C.*

0.1 per cent proof stress ..... not less than 37 tonf/square inch

Tensile strength ..... not less than 55 tonf/square inch.

Elongation on 2 in ..... not less than 12 per cent.

*NOTE.* When requested by the purchaser, a tensile test at 550°C shall be carried out on a test piece from a welded test sample. The required mechanical properties shall be agreed between the manufacturer and the purchaser.

### 10.3 Tests in the solution treated condition.

#### (a) Hardness test.

Diamond pyramid hardness number ..... not more than 270.

#### (b) Single bend test.

Angle of bend ..... 180°

Radius of former ..... three times the nominal thickness of the sheet or strip.

## 11. Re-tests

If any test piece selected and prepared as specified in Clause 9 fails to comply with the requirements of Clause 10, the inspector shall select from the same batch twice the number of test samples originally selected, including samples from any sheets or strips that failed the initial tests and from positions adjacent to those occupied by the original samples, unless those sheets or strips have been withdrawn by the manufacturer. Test pieces prepared from these further samples as specified in Clause 9 shall satisfy the appropriate test requirements of Clause 10.

## 12. Identification

Bach sheet and each coil passed by the inspector shall be stamped with the mark of the inspector and such other marking as shall ensure full identification of the material.

## DIMENSIONAL TOLERANCES

### TABLE 1

#### Tolerances on thickness of cold rolled sheets

Nominal thickness of sheet in	Tolerance on thickness, in	
	Up to and including 48 in wide	
	Plus	Minus
0-020 up to and including 0-024 ...	0-003	0-004
Over 0-024 up to and including 0-040 ...	0-004	0-004
Over 0-040 up to and including 0-070 ...	0-004	0-005
Over 0-070 up to and including 0-104 ...	0-005	0-005

### TABLE 2

#### Tolerances on thickness of hot rolled sheets

Nominal thickness of sheet in	Tolerance on thickness, in	
	Up to and including 48 in wide	
	Plus or Minus	
Over 0-104 up to and including 0-125 ...	0-007	
Over 0-125 up to and including 0-218 ...	0-008	
Over 0-218 up to and including 0-375 ...	0-015	

### TABLE 3

#### Tolerances on thickness of cold rolled strip in coil

Nominal thickness of strip in	Tolerance on thickness, in	
	$\frac{1}{2}$ in up to and including $9\frac{1}{2}$ in wide	
	Plus	Minus
0-020 up to and including 0-024 ...	0-002	0-002
Over 0-024 up to and including 0-040 ...	0-002	0-002
Over 0-040 up to and including 0-070 ...	0-002	0-003
Over 0-070 up to and including 0-104 ...	0-003	0-003

### TABLE 4

#### Tolerances on width and length of cold rolled sheets

Nominal thickness of sheet in	Tolerance on width and length, in			
	Up to and including 12 in	Over 12 in up to and including 18 in	Over 18 in up to and including 24 in	Over 24 in up to and including 96 in
	±	±	±	±
0-020 up to and including 0-070 ...	1/32	1/32	1/16	1/8
Over 0-070 up to and including 0-104 ...	1/32	1/16	1/16	1/8

**TABLE 5**  
**Tolerances on width and length of hot rolled Sheets**

Nominal thickness of sheet in	Tolerance on width and length, in			
	Up to and including 24 in	Over 24 in up to and including 48 in	Over 48 in up to and including 96 in	Over 96 in up to and including 120 in
	±	±	±	±
Over 0.104 up to and including 0.125 ...	1/8	1/8	3/16	1/4
Over 0.125 up to and including 0.250 ...	1/8	5/32	7/32	1/4
Over 0.250 up to and including 0.375 ...	3/16	1/4	1/4	5/16

**TABLE 6**  
**Tolerances on width of cold rolled strip in coil**

Nominal thickness of strip in	Tolerance on width, in		
	½ in up to and including 3 in wide	Over 3 in up to and including 6 in wide	Over 6 in up to and including 9½ in wide
	±	±	±
0.020 up to and including 0.040	0.010	0.015	0.020
Over 0.040 up to and including 0.070	0.015	0.020	1/32
Over 0.070 up to and including 0.104	1/32	1/32	1/32

Approved for issue,

E. W. RUSSELL,

Director of Materials and Structures Research and Development.

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