D.T.D.5638

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

OBSOLESCENCE NOTICE

All DTD specifications were declared obsolescent from 1st 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 900 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.

PROCUREMENT EXECUTIVE
MINISTRY OF DEFENCE

D. T. D. 5638
July 1985

Aerospace Material Specification

HEAT RESISTING NICKEL BASE ALLOY

Fe - 52.5 Ni - 19 Cr - 3 Mo - 5 (Nb+Ta) - 0.9 Ti - 0.5 Al

Vacuum melted

Bar and wire for fasteners
Maximum diameter or sectional dimension 50mm

NOTE I *This specification is one of a series issued by Procurement Executive, Ministry of Defence, to meet a requirement not covered by an existing European or British Standard for aerospace material.*

NOTE 2 *The use of this specification will be reviewed periodically. Whenever possible it will be offered to AECMA as the basis of a European Standard (Aerospace) or to BSI for issue as a British Standard (Aerospace).*

NOTE 3 *To promote easy conversion the format of this document follows closely the standard system developed for European Standards.*

NOTE 4 *Information on the status and currency of this specification can be obtained from Specification Section, Materials and Structures Department, Royal Aircraft Establishment, Farnborough, Hants.*

Approved for issue,

Dr D K Thomas
Head of Materials & Structures Dept
Royal Aircraft Establishment
FARNBOROUGH
Hants
GU14 6TD

FORMAT

The layout of the requirement lines and columns in this document conforms to that developed for European Standards (Aerospace).

The line numbering is maintained as defined in Part 8 of AECMA CN/DIR 1.

For greater legibility however, this document does not follow the practice of including every numbered line from 1 to 27, irrespective of whether or not a value is given for the requirement.

REFERENCES

Reference is made in this specification to the following:

British Standard HR 100 Procedure for inspection and testing of wrought heat resisting alloys.

British Standard A4 Part 1 Test pieces and test methods for metallic material for aircraft : Tensile tests.

American Society for Testing and Materials E112: Estimating the average grain size of metals.

AECMA CN/DIR 1 Standardization Directives.

Except where stated the edition current at the time of tender, contract or order is intended. The Quality Assurance Authority named in the contract will supply any information concerning changes that may be necessary due to cancellation, replacement, supersession or amendment of these documents.

Note: AECMA is Association Europeenne des Constructeurs de Materiel Aerospatial, 88 Boulevard Malesherbes, 75008 Paris.

1	Chemical Composition % or (ppm) *See note (1)	Element	C	Si	Mn	P	S	Ag	Al	B	Bi	Ca
		Minimum	0.02	-	-	-	-		0.2	0.002		
		Maximum	0.08	0.35	0.35	0.015	0.015	<5>	0.8	0.006	<1>	<100>
		Element	Co	Cr	Cu	Mg	Mo	Nb+Ta	Ni	Pb	Ti	Fe
		Minimum	-	17	-		2.8	4.75	50		0.65	Rem
		Maximum	1.00	21	0.3	<100>	3.3	5.5	55	<10>	1.15	

2	1	2	3	4
3	Method of Melting and Manufacture	a) Air melt and double consumable electrode vacuum arc remelt. or b) Vacuum induction melt and consumable electrode vacuum arc remelt. or c) Air melt, vacuum refine, and consumable electrode vacuum arc remelt. or d) Vacuum induction melt and electro flux remelt. See Note 2		
4	Form	Bar and Wire for Machining.	Bar and Wire for Hot Upset Forging. See note (3)	Bar, wire or coil for continuous forging or extrusions. See note (5)
	Method of Production	Rolled and/or Drawn	Rolled and/or Drawn	Rolled and/or Drawn
	Limit dimensions	50mm	50mm	50mm
5	Inspection and Testing Procedures	British Standard BS HR100 Sections 1 and 9 See note (11)		
6	Condition and Heat treatment } Supply	Cold worked and solution treated See notes (4) and (8). Descaled (other than round) Round bars-ground or turned. Hardness<277HB. Straight lengths.	Solution treated, cold worked, straightened and ground. See notes (8) and (4) Straight lengths	Solution treated see Note (8) Additional requirements see note (6)
7	Condition and Heat treatment } Use	As Supplied	As Supplied	As Supplied
8	Test Piece:			
	Heat treatment	As Supplied + Precipitation Treatment See note (9)	As Supplied + Solution treated + Precipitation Treatment. See notes (8) and (9)	As Supplied + Solution treated + Precipitation Treatment See notes (7) (8) and (9).
	Sampling	BS HR 100	BS HR 100	BS HR 100
11	Direction of Sample	Longitudinal	Longitudinal	Longitudinal

12	Tensile	Temperature	°C	RT	650	RT	650	RT	650
13	Tensile	0.2% Proof Stress	MPa	≥1035	≥860	≥1035	≥860	≥1035	≥860
14	Tensile	Tensile Strength	MPa	≥1275	≥1000	≥1275	≥1000	≥1275	≥1000
15	Tensile	Elongation	%	≥11	≥11	≥11	≥11	≥11	≥11
16	Tensile	Reduction of area	%	≥15	≥15	≥15	≥15	≥15	≥15
17		Hardness		≥331 HB or ≥360 HV		≥331 HB or ≥360 HV		≥331 HB or ≥360 HV	
21	Creep/rupture	Temperature	°C	650		650		650	
22	Creep/rupture	Time	h	≥23		≥23		≥23	
23	Creep/rupture	Stress	MPa	690		690		690	
24	Creep/rupture	Total plastic Strain	%						
25	Creep/rupture	Rupture Stress							
26	Creep/rupture	Elongation at rupture in 5D	%	≥5 note (10)		≥5 note (10)		≥5 note (10)	
27		Notes		See line 98					

28	1	2
30	Microstructure	Each sample for Macro-examination shall be examined. The microstructure shall be fully recrystallised.
34	Grain Size Check	Each sample for Macro-examination shall be examined for Grain Size. Examination shall be to ASTM E112 using either direct visual comparison with the standard photographs Plate II or the intercept procedure. The grain size shall be fully recrystallised ASTM 5 or finer. Isolated grains, not exceeding a mean diameter* of 0.23 mm are permitted providing the overall limit of ASTM 5 or finer is not exceeded. *Note: Mean diameter – the average of the major and minor axes of an Individual grain. The grain size shall be substantially uniform without pronounced segregation of fine and coarse grain areas conforming to standards agreed upon by the purchaser and manufacturer.
44	Non-Destructive Testing	To the requirements of British Standard BS HR 100
51	Microstructure	Frequency of sampling and inspection to the requirements of British Standard BS HR 100. Note: Bar samples shall be examined in the fully heat treated condition.

98 NOTES

(1) The method of analysis for elements marked with an asterisk shall be agreed between the manufacturer and the purchaser.

(2) The method of melting shall be agreed between the manufacturer and the purchaser and stated on the order.

(3) Hot Upset forging relates to the forming of Bolt and Screw heads only.

(4) All material shall be reduced 10 to 25% in cross sectional area during final rolling, drawing or stretching at a temperature <870°C.

(5) Continuous forging relates to the combined working operations that form the head and shank features of the bolt or screw.

(6) Following solution treatment, the degree of cold work, and surface condition, shall be agreed between the Manufacturer and Purchaser and stated on the order.

(7) Test Piece Heat Treatment - continuous forging stock.
Solution treatment in line 8 column 4 is only required on material supplied in the cold worked condition.

(8) Solution Treatment: 925-1010°C/ >1h/Air cool or faster.

Note The selected temperature ±10°C shall fall strictly within the range 925 to 1010°C.

(9) Precipitation Treatment.
The material shall undergo a two stage precipitation treatment with an intermediate furnace cool as follows:

720 ±5°C/8h
Furnace cool* to 620°C at a rate between 50 and 60°C/h
Hold at 620 ±5°C/8h/Air Cool

*Alternative Furnace Cool
Instead of a controlled furnace cool at a rate between 50 and 60°C/h to 620°C, product may be furnace cooled at any rate provided the time at 620 ±5°C is adjusted to give precipitation heat treatment time of not less than 18 hours.

(10) Stress Rupture Testing

10.1 Notched and unnotched specimens shall be machined and tested in accordance with British Standard A4, Part 1, Section 3.

In addition the test parameters and stress rupture properties shall meet the requirements of this specification, see lines 21 to 26 inclusive.

10.2 Combined notched and unnotched specimens shall rupture in the unnotched portion of the test piece.

10.3 Alternatively, separate plain and notched test pieces, machined from adjacent sections of the same test sample may be used. The notched test piece shall not rupture in less time than the comparison smooth test piece, but need not be tested to rupture.

10.4 The tests of 10.2 and 10.3 may be conducted using a higher load than required to produce an initial stress of 520 MPa, but load shall not be changed while test is in progress.

Time to rupture, rupture location, and elongation requirements shall be as specified above.

NOTES (continued)

10.5 When permitted by purchaser, the tests of 10.2 and 10.3 may be conducted using incremental loading. In each case, the load required to produce an initial axial stress of 520 MPa shall be used to rupture or for 23h, whichever occurs first.

After 23h and at intervals of 8 - 10h thereafter, the stress shall be increased in increments of 34.5 MPa.

Time to rupture, rupture location, and elongation requirements shall be as specified above.

(11) Heat Treatment Response

As part of the release documentation required under BS HR 100, the manufacturer shall record on the Release Note or Test Certificate, the test piece heat treatment, grain size and microstructure for each cast of finished bars.

First published 1986
Second Impression 1986

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ISBN 0 11 772565 X

Printed in the U.K. for H.M.S.O. by Norfolk Central Printers

Dd739172 C3 4/86