D.T.D.5073

Ministry of Defence
Defence Procurement Agency, ADRP2
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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.

MINISTRY OF SUPPLY

D.T.D. 5073

November, 1957

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Aircraft Material Specification

COMMERCIALLY PURE TITANIUM TUBES

(Suitable for pipe lines and high pressure hydraulic systems where flaring is required)

NOTE: This specification is one of a series issued by the Ministry of Supply, 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 deveIoped to warrant submission to the British Standards Institution for standardisation.*

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1. **Chemical composition**

1.1 The chemical composition of the material shall be as follows:—

Carbon	not more than 0.10 per cent.
Iron	not more than 0.20 per cent.
Hydrogen	not more than 0.015 per cent.
Titanium	the remainder

1.2 The manufacturer shall supply to the inspector the results of analysis for iron of every ingot of material.

1.3 The manufacturer shall supply to the inspector the results of analysis for the hydrogen content of a sample from each parcel of tubes as defined in Clause 5.1.

1.4 Subject to the discretion of the Inspecting Authority, determination of carbon need be made on a small proportion only of the ingots analysed.

2. **Condition**

2.1 The tubes shall be seamless.

2.2 The tubes shall be supplied in the condition as annealed and subsequently descaled, or bright annealed. The annealing temperature shall be 675 ± 25°C.

3. **Freedom from defects**

3.1 The tubes shall be free from harmful defects.

3.2 Any tube may be rejected for faults in manufacture although it may have been passed previously on chemical composition and mechanical tests.

4. **Margins of manufacture**

4.1 The range of tubes covered by this Specification is that given in Table 1.

4.2 Tubes shall comply with the limits specified in Table 1.

4.3 Tubes shall be free from kinks and shall not depart from straightness in any selected straight length of 20 in. or more by an amount exceeding 1/144th of the length measured.

5. **Selection and preparation of mechanical test samples**

5.1 Tubes of the same nominal size, from the same ingot and processed at the same time shall be grouped in parcels.

5.2 The inspector shall select test samples from each parcel as follows:—

(a) Tensile test. One test sample from each 400 ft. in the parcel for the tensile test specified in Clause 7.1.

(b) Flattening test. One test sample from each 100 ft. in the parcel for the flattening test specified in Clause 7.2.

(c) Drifting test. One test sample from each 100 ft. in the parcel for the drifting test specified in Clause 7.3.

(d) Pressure test. One test sample from each 400 ft. in the parcel, and not less than 2 ft. in length, for the distortion test specified in Clause 9.1.

5.3 The test samples shall be marked as directed by the inspector before they are cut off, and shall not be further mechanically worked or heat treated after being separated from the material they represent.

5.4 The tensile test pieces shall be prepared in accordance with British Standard A.4.

6. **Methods of testing**

6.1 The tensile and drifting tests shall be carried out in accordance with British Standard A.4.

6.2 If a re-test is necessary, the tensile test shall be carried out in accordance with the requirements of Appendix I, as specified in Clause 8.1.

7. **Mechanical tests**

7.1 *Tensile test*

Ultimate tensile stress .. .. not less than 25 tons per sq. in.

Note.—The 0.1 per cent. proof stress may be expected to be not less than 18 tons per sq. in.

7.2 *Flattening test.* Flattening shall be effected between flat faces; hammer blows may be used at the option of the manufacturer. The selected test pieces shall withstand, without cracking, being flattened over a parallel length of not less than one inch until the distance between the inner sides of the test pieces in the direction of flattening is two and a half times the wall thickness of the tube, or half the bore, whichever is the smaller. The flattened portion shall be at the middle of the test piece. The length of the test piece shall be such as to leave equal lengths of not less than one inch of unflattened tube at each end of the flattened portion.

7.3 *Drifting test.* Sharp edges, notches and burrs shall be removed from the ends of test samples. Each end of each tube, selected in accordance with Clause 5.2*(c)* shall, without showing signs of cracking, withstand being drifted to an angle of 32° ± ½° as shown in Fig. 1 until the inside diameter of the drifted end has a dimension not less than that given for the appropriate tube size in Column (7) of Table 1. Drifting tests shall be made by the application of steadily applied pressure to the drift. Belling of the tubes by spinning methods is not acceptable.

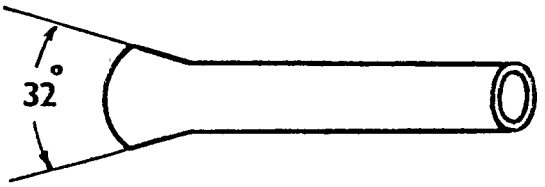

Fig. 1

8. **Re-tests**

8.1 *Tensile test.* If any test piece fails to comply with the requirement of Clause 7.1, the inspector shall select for test from the same parcel two further samples from each 400 ft. in the parcel. One sample shall be from the tube from which the sample that failed was taken, unless that tube has been withdrawn by the manufacturer. All the test pieces prepared from these further samples as specified in Clause 5 shall be tested in accordance with the requirements of Appendix I, and shall satisfy the test requirement of Clause 7.1.

8.2 *Flattening test.* If any test piece fails to comply with the requirements of Clause 7.2, the inspector shall select for test from the same parcel two further samples from each 100 ft. in the parcel. One sample shall be from the tube from which the sample that failed was taken, unless that tube has been withdrawn by the manufacturer. All the test pieces prepared from these further samples as specified in Clause 5 shall satisfy the requirements of Clause 7.2.

8.3 *Drifting test.* If any tube fails to comply with the requirements of Clause 7.3, the inspector shall adopt one of the following procedures, at the request of the manufacturer :—

(a) Each tube in the parcel from which the tube that failed was taken shall be tested at each end in accordance with Clause 7.3, and all tubes that fail shall be rejected.

(b) The parcel of tubes shall be re-annealed in accordance with Clause 2.2 and re-tested in accordance with Clauses 5,6,7,9 and 10.

9. **Pressure tests**

9.1 Each distortion test sample shall be subjected to the hydraulic test pressure appropriate to the size as given in column (8) of Table 1 and the pressure shall be maintained for not less than 30 seconds. Mean outside diameters shall be determined at the same locations, not less than 1 ft. from any clamp, coupling or other support, before and after the application of pressure.

The maximum permanent increase in mean diameter at any location shall be: —

For tubes with outside diameters less than ⅜ in. .. .. .. 0.0010 in.

For tubes ⅜ in. outside diameter and over .. .. 0.0020 in.

9.2 If any test sample fails to comply with the requirements of Clause 9.1, the inspector shall select for test from the same parcel 25 per cent of all tubes in that parcel, or 50 per cent. if there is less than 100 ft. in the parcel. One of the further samples shall be from the tube from which the sample that failed was taken, unless that tube has been withdrawn by the manufacturer. All the additional samples shall comply with the test requirements of Clause 9.1.

9.3 All the remaining tubes in the parcel, after completion of the distortion tests, shall be subjected to a hydraulic test pressure appropriate to the size of the tubes as given in column (8) of Table 1. All tubes which show any sign of failure shall be rejected.

10. **Bore test**

10.1 The bore of each tube shall permit of a metallic bob or wire being passed through freely. The diameter of the bob or wire shall be 80 per cent. of the nominal internal diameter of the tube. The length of the bob shall be not less than twice its diameter.

11. **Identification**

11.1 Tubes from the same ingot passed by the inspector shall be tied in bundles, each of which shall bear a metal label stamped with the mark of the inspector and such other marking as shall ensure full identification of the material.

TABLE I

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Nominal outside diameter of tube	Tolerances on diameter		Nominal gauge of tube S.W.G.	Tolerances on gauage		Minimum inside diameter of tube after drifting	Hydraulic test pressure lb./sq. in.
	Mean	Out of round		Mean	Extreme		
in. $\frac{3}{16}$	in. ±0.003 ±0.003	in. ±0.005 ±0.005	24 22	in. ±0.002 ±0.004	in. ±0.003 ±0.004	in. 0.235 0.230	4500 6750
$\frac{1}{4}$	±0.003 ±0.003	±0.005 ±0.005	24 22	±0.002 ±0.003	±0.003 ±0.004	0.330 0.320	4500 6750
$\frac{5}{16}$	±0.003 ±0.003	±0.005 ±0.005	22 20	±0.003 ±0.003	±0.004 ±0.004	0.400 0.390	4500 6750
$\frac{3}{8}$	±0.003 ±0.003	±0.005 ±0.005	22 20	±0.003 ±0.003	±0.004 ±0.004	0.470 0.460	4500 6750
$\frac{7}{16}$	±0.003 ±0.003 ±0.003	±0.005 ±0.005 ±0.005	22 20 18	±0.003 ±0.003 ±0.004	±0.004 ±0.004 ±0.006	0.540 0.530 0.510	4500 4500 6750
$\frac{1}{2}$	±0.003 ±0.003 ±0.003	±0.005 ±0.005 ±0.005	22 20 18	±0.003 ±0.003 ±0.004	±0.004 ±0.004 ±0.006	0.610 0.600 0.580	3750 4500 6750
$\frac{5}{8}$	±0.003 ±0.003	±0.005 ±0.005	22 20	±0.003 ±0.003	±0.004 ±0.004	0.735 0.725	3000 3750
$\frac{3}{4}$	±0.004 ±0.004	±0.005 ±0.005	22 20	±0.003 ±0.003	±0.004 ±0.004	0.860 0.850	2500 3000
$\frac{7}{8}$	±0.004 ±0.004	±0.006 ±0.005	22 20	±0.003 ±0.003	±0.004 ±0.004	0.985 0.975	2100 2750
1	±0.004 ±0.004	±0.006 ±0.005	20 18	±0.003 ±0.004	±0.004 ±0.006	1.100 l.075	2250 3000

APPENDIX 1
STRAINING RATE DURING
MECHANICAL PROPERTY TESTING OF TITANIUM AND ITS ALLOYS

1. **Introduction**

For the method of test specified herein two operators are required who are able to co-ordinate the straining and extensometer reading to an extent which is not common in material testing laboratories. It has, however, been established that the rates of straining and the short pauses specified for readings can be achieved after a little practice by operators who have not previously used this technique.

2. **Specified method of testing**

Each test is divided into two parts for which the following straining rate and pause periods are specified :—

Phase	Straining rate	Stops for readings	
		Duration of each stop	Total stopped time
I. Up to the 0.5% proof stress but not beyond 0.02 total strain	As **high** as possible in the range: 0.002—0.005 in/in/min.	As **short** as possible consistent with accurate readings and not longer than 1 sec.	As **short** as possible consistent with obtaining sufficient readings and not greater than 20 secs.
REMOVE EXTENSOMETER (if desired) in shortest possible time but not longer than 10 sec.			
II. Beyond 0.5% proof stress	Between 0.15 and 0.3 in/in/min. (This corresponds to a time for this phase of 30 - 60 secs. for material having 15% elongation.)		

3. **Measurement of straining rate**

The straining rate specified in the above table is that measured by the extensometer on the gauge length and averaged for the duration of all the loading increments, i.e. the total strain divided by the time during which strain is applied. Comparative tests have shown that the straining rate as measured on the crosshead of the machine is many times greater than that measured by the extensometer, and that no value constant throughout a test on a particular machine can be assigned to the ratio of the rate of straining of the crosshead to the rate of straining of the specimen. Consequently, all checks on straining rate must be calculated from the extensometer reading.

4. **Use of strain pacing instuments**

The straining rate specified in Clause 2 may be achieved by a strain pacing instrument.

5. **Records**

There is evidence that on some alloys there will be appreciable variations in mechanical properties even within the limited range of straining rate specified in the table. Therefore, as a rate approaching the top end of the permissible range may not be feasible on some testing machines, it is important that the straining rate and the total length of pause should be recorded for all tests. Some indication should also be given in all test reports of the average straining rate and total stopped time used for the tests concerned. This will ensure that if a particular alloy shows a considerable variation in properties over the specified range, or a high creep rate, the results can be corrected for these effects at a later date.

Approved for issue,

H. SUTTON,

Director of Materials Research and Development (Air)

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