SEPTEMBER, 1941

EMERGENCY STANDARD
No. (E)D.538—1941

STANDARDS ASSOCIATION OF AUSTRALIA.

Headquarters :

Science House, Gloucester and Essex Streets, Sydney.

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL

(Emergency Series)

35-TON CHROME-MOLYBDENUM STEEL TUBES (Suitable for Welding)

For all sizes of non-circular tubes.

This standard forms one of a series prepared by the Standards Association of Australia at the request of Departments of the Commonwealth Government for use in relation to the supply of materials required for defence purposes. In appropriate cases these specifications will be reviewed for inclusion in the normal series of Australian standards.

AUGUST, 1942.

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AMENDMENT.

Page 1. **Clause 1 (a), Chemical Composition.**

Add the following note relating to
Carbon . . . 0·25 to 0·35 per cent.* :

"* Attention is drawn to the desirability of limiting the carbon content to 0·32 per cent. maximum owing to difficulties which may arise in welding tubes if the carbon percentage exceeds this figure."

(*c*) Normalised tubes shall be uniformly heated to a temperature not exceeding 920° C. and cooled freely in air.

(*d*) The hardened and tempered tubes shall be hardened by heating to a temperature not exceeding 900° C. and quenching in oil. They shall then be tempered to give the specified mechanical properties. No tube shall be re-hardened more than twice.

4. Mechanical Properties.

(*a*) Test pieces selected and prepared as specified in Clause 11 shall, without further heat-treatment, comply with the following test requirements :

(i)	Ultimate Tensile Strength (unwelded) ...	Not less than 35 tons per sq. in. nor more than 55 tons per sq. in.
(ii)	Ultimate Tensile Strength (welded)* ...	Not less than 35 tons per sq. in.
(iii)	0·2% Proof Stress (unwelded)	Not less than 30 tons per sq. in.
(iv)	Flattening Test	See Clause 13.
(v)	Hardness Test	See Clause 14.

*NOTE :—The 0·2% proof stress of these tubes after welding may be expected to be not less than 25 tons per sq. in.

Price 1/-, *post free* 1/2

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---

1. Chemical Composition.

(*a*) The chemical composition of the tubes shall be :

Carbon	0·25 to 0·35 per cent.
Manganese	0·40 to 0·80 ,, ,,
Phosphorus	0·05 (max.) ,, ,,
Sulphur	0·05 (max.) ,, ,,
Chromium	0·80 to 1·10 ,, ,,
Molybdenum	0·15 to 0·25 ,, ,,
Silicon	0·15 to 0·35 ,, ,,

(*b*) The complete analysis of each cast of steel shall be supplied by the tube-maker.

2. Inspection of Blooms. Every bloom for tube-making shall be visually inspected at each end. Blooms showing pipe shall be rejected or cut back to sound metal.

One of the top blooms so passed shall be examined by sulphur-printing or deep etching at each end, and if any harmful segregation is revealed each end of each top end bloom in the heat shall be similarly examined.

Blooms showing defects or harmful segregations shall be rejected or shall be further cropped and re-tested until sound steel is indicated.

3. Heat-Treatment.

(*a*) The tubes shall be cold drawn and blued, normalised or hardened and tempered to give the mechanical properties specified in Clause 4 and shall be delivered in this condition.

(*b*) The cold drawn and blued tubes shall be blued by being uniformly heated to a temperature between 350° C. and 480° C. and cooling freely in still air.

(*c*) Normalised tubes shall be uniformly heated to a temperature not exceeding 920° C. and cooled freely in air.

(*d*) The hardened and tempered tubes shall be hardened by heating to a temperature not exceeding 900° C. and quenching in oil. They shall then be tempered to give the specified mechanical properties. No tube shall be re-hardened more than twice.

4. Mechanical Properties.

(*a*) Test pieces selected and prepared as specified in Clause 11 shall, without further heat-treatment, comply with the following test requirements :

(i) Ultimate Tensile Strength (unwelded) ...	Not less than 35 tons per sq. in. nor more than 55 tons per sq. in.
(ii) Ultimate Tensile Strength (welded)* ...	Not less than 35 tons per sq. in.
(iii) 0·2% Proof Stress (unwelded)	Not less than 30 tons per sq. in.
(iv) Flattening Test	See Clause 13.
(v) Hardness Test	See Clause 14.

---

*NOTE :—The 0·2% proof stress of these tubes after welding may be expected to be not less than 25 tons per sq. in.

Price 1/-, *post free* 1/2

5. Manufacture.

(*a*) The tubes shall be made from billets rolled from blooms complying with Clause 2. The billets and hollows shall be free from all surface and other defects which might produce defects in the tubes made therefrom.

(*b*) The tubes shall be seamless and cold drawn.

(*c*) The tubes shall be straightened before heat-treatment.

6. Margins of Manufacture. The dimensions and tolerances of the tubes shall comply with Tables I to V of this specification, except that the dimension " B " and " C " shall be either as given in Tables I, II, III and IV or $\pm$ 0·010 in., whichever is the greater.

7. Freedom from Defects.

(*a*) The tubes shall be free from defects.

(*b*) Any tube may be rejected for faults in manufacture, notwithstanding that it has been passed previously for chemical composition and physical properties.

8. Straightness. The tubes shall be free from kinks, and straight tubes shall not depart from straightness in any selected length of 20 in. or more by an amount exceeding 1/600th of the length measured.

9. Identification. To ensure full identification of the material with its particular cast, with this specification and with the manufacturer

(*a*) Each tube shall be marked at one end with painted identification bands in accordance with the provisions of Australian Standard No. (E.)D. 500.†

(*b*) Tubes of the same nominal dimensions, manufactured from the same cast and heat-treated together shall be wired up in bundles to each of which shall be securely attached a tag stamped with the number of this specification ((E.)D. 538), the cast and heat-treatment batch numbers and the manufacturer's mark.

10. Surface Treatment. Unless otherwise specified on the order, the tubes shall be protected against corrosion internally and externally by an approved method.

11. Selection and Preparation of Mechanical Test Samples.

(*a*) Tubes of the same nominal dimensions, from the same cast and heat-treated together, shall be grouped in parcels.

(*b*) (i) *Tensile Test* (*unwelded*). One test sample for tensile testing as specified in Clause 4 shall be taken from a tube selected to represent each 400 ft. or less of each parcel.

The test pieces shall be the selected test samples as cut from the tubes, or strips machined therefrom when the size is such as to exceed the capacity of the testing machine.

(ii) *Tensile Test* (*welded, weld not dressed*). Two test samples each at least 4 in. long shall be cut from a tube selected to represent all tubes of the same nominal dimensions from the same cast.

The test samples for the tensile test (welded) specified in Clause 4 shall be prepared by butt welding the two samples taken from each selected tube and allowing to cool in air.

The tensile test pieces shall be the welded test sample, or strips machined therefrom when the size is such as to exceed the capacity of the testing machine.

(*c*) *Flattening Test.* A test sample for the flattening test shall be cut from a tube selected from each 100 ft. of each parcel.

(*d*) Test samples shall not be further heat-treated or cold worked before testing.

(*e*) Test samples shall be marked in such a way as will positively identify them with the tubes they represent.

12. Tensile Test.

(*a*) The test pieces* selected and prepared as specified in Clause 11 (*b*) shall comply with the values given in Clause 4.

The tensile values shall be calculated on the nominal dimensions of the test piece except in the case of a strip cut from the tube, when the actual dimensions shall be measured.

The load shall be applied axially.

Proof stress determinations shall be carried out as follows :

(i) On one test piece from each cast of steel the proof stress shall be obtained from an accurately determined load-elongation diagram, the proof stress being defined as that stress at which the load-elongation curve departs by 0·2% of the gauge length from the straight line of proportionality.

(ii) On all remaining tensile test pieces proof stress determinations shall be carried out by any approved method.

(*b*) *Re-tests.* If any test piece fails to comply with the tensile test, unwelded, the inspector may reject the tubes represented by that test piece or, at the request of the manufacturer select for test from these tubes two other tubes. One tube shall be that from which the original test sample was taken, unless that tube has been withdrawn by the manufacturer. Test pieces prepared from both these tubes shall comply with the tensile test specified in Clause 4.

---

†A.S. No. (E.)D. 500, " Colour Identification of Metallic Materials for Aircraft," in course of preparation.

*A suitable test piece is shown in British Standard Specification No. 18.

(*c*) (i) If any test piece fails to comply with the tensile test, welded, other than by failure through the weld at a stress less than 35 tons per sq. in., calculated on the cross-sectional area of the tube, the inspector may reject the complete parcel from which that test piece was selected or, at the request of the manufacturer, select for test from the same parcel two tubes. One of the tubes shall be that from which the original test samples for welding were taken, unless that tube has been withdrawn by the manufacturer. Two test samples, each at least 4 in. long, shall be cut from each tube, and after welding as specified in Clause 11 (*b*) (ii) shall comply with the tensile test specified in Clause 4.

(ii) If any tensile test piece breaks through the weld at a stress less than 35 tons per sq. in., calculated on the cross-sectional area of the tube, the test may be discarded and another welding test made on the same tube.

13. Flattening (or Bending) Test.

(*a*) Flattening shall be effected between flat faces by an approved method; a distance piece of the required thickness may be inserted in the tube to limit the degree of flattening.

(*b*) *Square Tubes.* The test samples, selected as specified in Clause 11, or sections of the tubes cut therefrom, shall withstand without sign of cracking being flattened diagonally until the distance A (Fig. A) equals five times the original wall thickness of the tube.

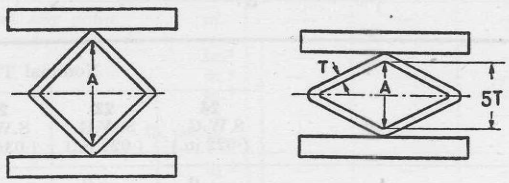


FIG. A.

(*c*) *Streamline Tubes.* The test samples, selected as specified in Clause 11, or sections of the tubes cut therefrom, shall withstand without sign of cracking being flattened on the edges until the major axis is reduced by a percentage equal to $\frac{0{\cdot}8C}{T}$ (see Fig. B). For example, if $\frac{C}{T} = 80$, then the reduction required is 64% of the major axis.

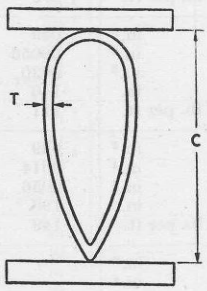


FIG. B.

(*d*) *Re-tests.* If any test piece fails to comply with the flattening (or bending) test the inspector may reject the complete parcel from which that test piece was selected or, at the request of the manufacturer adopt either of the following procedures:

(i) Select for test from the same parcel two other samples from each 100 ft. in the parcel. One sample shall be from the tube from which the original test sample was taken, unless that tube has been withdrawn by the manufacturer. All the test pieces prepared from these further test samples shall comply with the flattening (or bending) test specified above.

(ii) Allow the parcel to be re-heat-treated in accordance with Clause 3 and re-tested in accordance with Clauses 11 and 12 and 13.

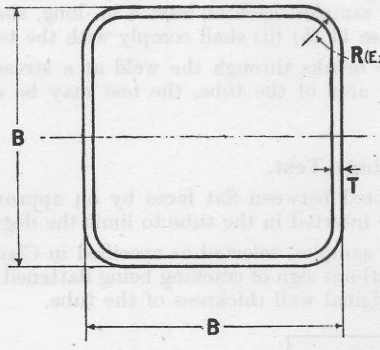
14. Hardness Test.

(*a*) All tubes shall be tested for hardness at each end by an approved method, and the hardness numbers shall not be less than 153 nor more than 255 on the Brinell scale or their equivalents on the scale of the method adopted.

(*b*) Tubes which fail to pass the hardness test may be rejected or, at the request of the manufacturer be re-heat-treated in accordance with Clause 3, and re-tested in accordance with Clauses 11, 12, 13 and 14.

TABLE I.

SQUARE TUBES.



A = Nom. Sectional Area.
I = Moment of Inertia.
Z = Modulus of Section.
k = Radius of Gyration.
W = Maximum Weight per ft.

Nominal Dimensions.				Nominal Thickness of Tube (T).					
Width. **B** ±0·5% (See footnote page 5)	Ext. Rad. **R**			**24** S.W.G. (·022 in.)	**22** S.W.G. (·028 in.)	**20** S.W.G. (·036 in.)	**17** S.W.G. (·056 in.)	**14** S.W.G. (·080 in.)	**11** S.W.G. (·116 in.)
		Mean thickness	in.	$\cdot 022^{-0}_{+\cdot 003}$	$\cdot 028^{-0}_{+\cdot 004}$	$\cdot 036^{-0}_{+\cdot 004}$	$\cdot 056^{-0}_{+\cdot 004}$	$\cdot 080^{-0}_{+\cdot 006}$	—
in.	in.	Max. thickness at any point	in.	·027	·035	·044	·066	·094	—
		Min. thickness at any point	in.	·020	·025	·032	·050	·072	—
		A	in.²	·019	·023	—	—	—	—
		I	in.⁴	·00015	·00018	—	—	—	—
0·250	0·050	Z	in.³	·0012	·0015	—	—	—	—
		k	in.	·091	·089	—	—	—	—
(*E.D.** = 0·291 *in.*)		W	lb. per ft.	·072	·089	—	—	—	—
		A	in.²	·029	·036	·045	—	—	—
		I	in.⁴	·00056	·00069	·00083	—	—	—
0·375	0·075	Z	in.³	·0030	·0037	·0044	—	—	—
		k	in.	·140	·138	·135	—	—	—
(*E.D.* = 0·436 in.)		W	lb. per ft.	·111	·139	·170	—	—	—
		A	in.²	·039	·049	·062	—	—	—
		I	in.⁴	·0014	·0017	·0021	—	—	—
0·500	0·100	Z	in.³	·0056	·0068	·0084	—	—	—
		k	in.	·190	·187	·185	—	—	—
(*E.D.* = 0·582 in.)		W	lb. per ft.	·149	·189	·233	—	—	—
		A	in.²	—	·062	·078	·118	—	—
		I	in.⁴	—	·0034	·0043	·0061	—	—
0·625	0·125	Z	in.³	—	·011	·014	·019	—	—
		k	in.	—	·237	·234	·227	—	—
(*E.D.* = 0·727 *in.*)		W	lb. per ft.	—	·238	·295	·429	—	—
		A	in.²	—	·074	·095	·144	—	—
		I	in.⁴	—	·0061	·0076	·011	—	—
0·750	0·150	Z	in.³	—	·016	·020	·029	—	—
		k	in.	—	·286	·283	·276	—	—
(*E.D.* = 0·873 *in.*)		W	lb. per ft.	—	·288	·357	·522	—	—
		A	in.²	—	—	·111	·169	·236	—
		I	in.⁴	—	—	·012	·018	·024	—
0·875	0·175	Z	in.³	—	—	·028	·041	·054	—
		k	in.	—	—	·333	·326	·317	—
(*E.D.* = 1·018 *in.*)		W	lb. per ft.	—	—	·419	·615	·858	—
		A	in.²	—	—	·128	·195	·272	—
		I	in.⁴	—	—	·019	·027	·037	—
1·000	0·200	Z	in.³	—	—	·037	·055	·073	—
		k	in.	—	—	·382	·375	·367	—
(*E.D.* = 1·164 *in.*)		W	lb. per ft.	—	—	·481	·709	·992	—
		A	in.²	—	—	·146	·223	·312	—
		I	in.⁴	—	—	·027	·040	·055	—
1·125	0·200	Z	in.³	—	—	·049	·072	·097	—
		k	in.	—	—	·434	·426	·418	—
(*E.D.* = 1·323 *in.*)		W	lb. per ft.	—	—	·549	·810	1·138	—

*E.D. = Equivalent Outside Diameter of Circular Tube.

(*continued on next page*)

TABLE I—(*continued.*)

SQUARE TUBES.

Nominal Dimensions.			Nominal Thickness of Tube (T.)					
Width. **B** ±0·5% (See footnote).	Ext. Rad. **R**		**24** S.W.G. (·022 in.)	**22** S.W.G. (·028 in.)	**20** S.W.G. (·036 in.)	**17** S.W.G. (·056 in.)	**14** S.W.G. (·080 in.)	**11** S.W.G. (·116 in.)
		Mean thickness in.	—	—	—	$\cdot 056^{-0}_{+\cdot 004}$	$\cdot 080^{-0}_{+\cdot 006}$	$\cdot 116^{-0}_{+\cdot 009}$
in.	in.	Max. thickness at any point in.	—	—	—	·066	·094	·137
		Min. thickness at any point in.	—	—	—	·050	·072	·104
		A in.²	—	—	—	·251	·352	—
		I in.⁴	—	—	—	·058	·078	—
1·250	0·200	Z in.³	—	—	—	·093	·124	—
		k in.	—	—	—	·482	·469	—
(*E.D.** = 1·482 *in.*)		W lb. per ft.	—	—	—	·912	1·284	—
		A in.²	—	—	—	·279	·392	·556
		I in.⁴	—	—	—	·078	·106	·143
1·375	0·200	Z in.³	—	—	—	·113	·154	·208
		k in.	—	—	—	·529	·520	·508
(*E.D.* = 1·641 *in.*)		W lb. per ft.	—	—	—	1·015	1·431	2·028
		A in.²	—	—	—	·304	·428	·608
		I in.⁴	—	—	—	·102	·139	·188
1·500	0·230	Z in.³	—	—	—	·135	·185	·251
		k in.	—	—	—	·578	·569	·557
(*E.D.* = 1·784 *in.*)		W lb. per ft.	—	—	—	1·106	1·562	2·218
		A in.²	—	—	—	·357	·504	·718
		I in.⁴	—	—	—	·164	·226	·310
1·750	0·260	Z in.³	—	—	—	·188	·258	·354
		k in.	—	—	—	·678	·669	·657
(*E.D.* = 2·086 *in.*)		W lb. per ft.	—	—	—	1·300	1·840	2·622
		A in.²	—	—	—	—	·579	·826
		I in.⁴	—	—	—	—	·342	·472
2·000	0·300	Z in.³	—	—	—	—	·342	·472
		k in.	—	—	—	—	·769	·756
(*E.D.* = 2·383 *in.*)		W lb. per ft.	—	—	—	—	2·112	3·017
		A in.²	—	—	—	—	·653	·934
		I in.⁴	—	—	—	—	·493	·684
2·250	0·340	Z in.³	—	—	—	—	·438	·608
		k in.	—	—	—	—	·869	·856
(*E.D.* = 2·679 *in.*)		W lb. per ft.	—	—	—	—	2·385	3·414
		A in.²	—	—	—	—	·728	1·042
		I in.⁴	—	—	—	—	·682	·951
2·500	0·380	Z in.³	—	—	—	—	·546	·761
		k in.	—	—	—	—	·968	·955
(*E.D.* = 2·975 *in.*)		W lb. per ft.	—	—	—	—	2·657	3·809

*E.D. = Equivalent Outside Diameter of Circular Tube.

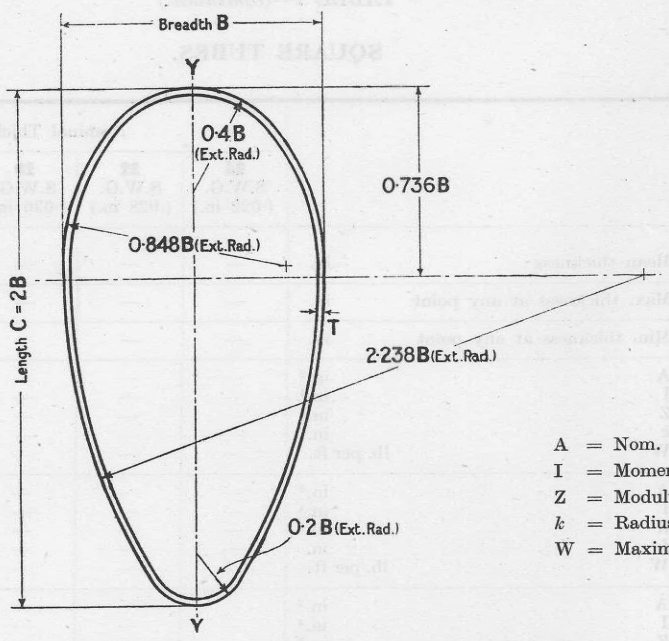
NOTE.—The limits specified for the width **B** shall not apply within 6 inches of the cut ends and in no case shall they be less than those specified for the extreme outside diameter of a circular tube of the same nominal thickness and of a nominal diameter equal to the width **B**.

The figures for the Maximum Weights and for the Equivalent Outside Diameters of Circular Tubes are given for information of designers and not for purposes of inspection.

TABLE II.

STREAMLINE TUBES.

Fineness Ratio 2 : 1.



A = Nom. Sectional Area.
I = Moment of Inertia.
Z = Modulus of Section.
k = Radius of Gyration.
W = Maximum Weight per ft.

Nominal Dimensions.			Nominal Thickness of Tube (T).					
Length. C ±0·5%	Breadth. B ±1·0%		24 S.W.G. (·022 in.)	22 S.W.G. (·028 in.)	20 S.W.G. (·036 in.)	17 S.W.G. (·056 in.)	14 S.W.G. (·080 in.)	11 S.W.G. (·116 in.)
(See footnote, page 7)		Mean thickness in.	$\cdot022^{-0}_{+\cdot003}$	$\cdot028^{-0}_{+\cdot004}$	$\cdot036^{-0}_{+\cdot004}$	$\cdot056^{-0}_{+\cdot004}$	$\cdot080^{-0}_{+\cdot006}$	—
in.	in.	Max. thickness at any point in.	·027	·035	·044	·066	·094	—
		Min. thickness at any point in.	·020	·025	·032	·050	·072	—
		A in.²	·052	—	·083	—	—	—
		Iyy in.⁴	·0017	—	·0025	—	—	—
1·0	**0·50**	Zyy in.³	·0066	—	·010	—	—	—
		k_{yy} in.	·179	—	·174	—	—	—
(*E.D.** = 0·770 *in.*)		W lb. per ft.	·200	—	·313	—	—	—
		A in.²	—	·099	—	·193	—	—
		Iyy in.⁴	—	·0072	—	·013	—	—
1·5	**0·75**	Zyy in.³	—	·019	—	·035	—	—
		k_{yy} in.	—	·270	—	·260	—	—
(*E.D.* = 1·156 *in.*)		W lb. per ft.	—	·385	—	·703	—	—
		A in.²	—	·133	—	·261	—	—
		Iyy in.⁴	—	·018	—	·033	—	—
2·0	**1·00**	Zyy in.³	—	·035	—	·065	—	—
		k_{yy} in.	—	·363	—	·353	—	—
(*E.D.* = 1·541 *in.*)		W lb. per ft.	—	·517	—	·951	—	—
		A in.²	—	·167	—	·329	—	—
		Iyy in.⁴	—	·035	—	·066	—	—
2·5	**1·25**	Zyy in.³	—	·056	—	·105	—	—
		k_{yy} in.	—	·457	—	·446	—	—
(*E.D.* = 1·926 *in.*)		W lb. per ft.	—	·648	—	1·197	—	—
		A in.²	—	—	·257	—	·561	—
		Iyy in.⁴	—	—	·077	—	·158	—
3·0	**1·50**	Zyy in.³	—	—	·103	—	·211	—
		k_{yy} in.	—	—	·547	—	·531	—
(*E.D.* = 2·311 *in.*)		W lb. per ft.	—	—	·971	—	2·046	—
		A in.²	—	—	·301	—	·658	—
		Iyy in.⁴	—	—	·123	—	·256	—
3·5	**1·75**	Zyy in.³	—	—	·141	—	·293	—
		k_{yy} in.	—	—	·641	—	·624	—
(*E.D.* = 2·697 *in.*)		W lb. per ft.	—	—	1·136	—	2·401	—

*E.D. = Equivalent Outside Diameter of Circular Tube.

(*continued on next page*)

TABLE II—(*continued.*)

STREAMLINE TUBES.

FINENESS RATIO 2 : 1.

Nominal Dimensions.			Nominal Thickness of Tube (T).					
Length. **C** ±0·5%	Breadth. **B** ±1·0%		**24** S.W.G. (·022 in.)	**22** S.W.G. (·028 in.)	**20** S.W.G. (·036 in.)	**17** S.W.G. (·056 in.)	**14** S.W.G. (·080 in.)	**11** S.W.G. (·116 in.)
(See footnote).		Mean thickness in.	—	—	—	$\cdot 056^{-\ 0}_{+\cdot 004}$	—	$\cdot 116^{-\ 0}_{+\cdot 009}$
in.	in.	Max. thickness at any point in.	—	—	—	·066	—	·137
		Min. thickness at any point in.	—	—	—	·050	—	·104
4·0 (*E.D.** = 3·082 *in.*)	**2·0**	A in.²	—	—	—	·532	—	1·081
		Iyy in.⁴	—	—	—	·281	—	·537
		Zyy in.³	—	—	—	·281	—	·537
		k_{yy} in.	—	—	—	·727	—	·705
		W lb. per ft.	—	—	—	1·939	—	3·953
4·5 (*E.D.* = 3·467 *in.*)	**2·25**	A in.²	—	—	—	·600	—	1·221
		Iyy in.⁴	—	—	—	·403	—	·778
		Zyy in.³	—	—	—	·359	—	·691
		k_{yy} in.	—	—	—	·820	—	·798
		W lb. per ft.	—	—	—	2·185	—	4·466
5·0 (*E.D.* = 3·852 *in.*)	**2·5**	A in.²	—	—	—	·668	—	1·362
		Iyy in.⁴	—	—	—	·557	—	1·082
		Zyy in.³	—	—	—	·446	—	·866
		k_{yy} in.	—	—	—	·913	—	·891
		W lb. per ft.	—	—	—	2·433	—	4·981

*E.D. = Equivalent Outside Diameter of Circular Tube.

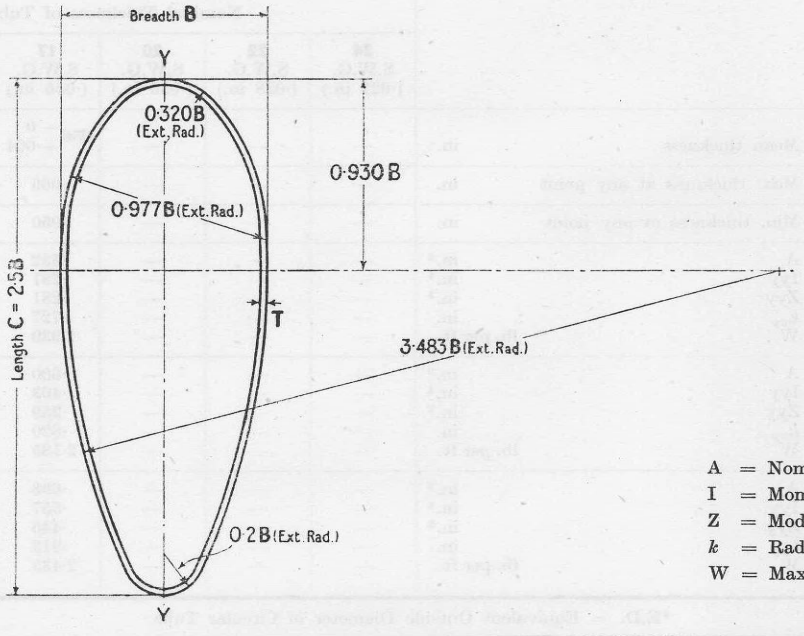
NOTE.—The limits specified for the length **C** and the breadth **B** shall not apply within 6 inches of the cut ends and in no case shall they be less than those specified for the extreme outside diameter of a circular tube of the same nominal thickness and of a nominal diameter equal to the length **C**.

The figures for the Maximum Weights and Equivalent Outside Diameters of Circular Tubes are given for information of designers and not for purposes of inspection.

TABLE III.

STREAMLINE TUBES.

FINENESS RATIO $2\frac{1}{2}$: 1.



A = Nom. Sectional Area.
I = Moment of Inertia.
Z = Modulus of Section.
k = Radius of Gyration.
W = Maximum Weight.

Nominal Dimensions.				Nominal Thickness of Tube (T).					
Length. C ±0·5%	Breadth. B ±1·0%			24 S.W.G. (·022 in.)	22 S.W.G. (·028 in.)	20 S.W.G. (·036 in.)	17 S.W.G. (·056 in.)	14 S.W.G. (·080 in.)	11 S.W.G. (·116 in.)
(See footnote, page 9.)		Mean thickness	in.	$\cdot022^{-0}_{+\cdot003}$	$\cdot028^{-0}_{+\cdot004}$	$\cdot036^{-0}_{+\cdot004}$	$\cdot056^{-0}_{+\cdot004}$	—	—
in.	in.	Max. thickness at any point	in.	·027	·035	·044	·066	—	—
		Min. thickness at any point	in.	·020	·025	·032	·050	—	—
		A	in.²	·049	·062	—	—	—	—
		Iyy	in.⁴	·0010	·0013	—	—	—	—
1·00	**0·40**	Zyy	in.³	·0051	·0063	—	—	—	—
		k_{yy}	in.	·144	·142	—	—	—	—
(*E.D.** = 0·734 *in.*)		W	lb. per ft.	·190	·241	—	—	—	—
		A	in.²	·062	·078	·100	—	—	—
		Iyy	in.⁴	·0021	·0025	·0031	—	—	—
1·25	**0·50**	Zyy	in.³	·0082	·010	·013	—	—	—
		k_{yy}	in.	·182	·180	·177	—	—	—
(*E.D.* = 0·918 *in.*)		W	lb. per ft.	·239	·304	·376	—	—	—
		A	in.²	—	·094	·121	—	—	—
		Iyy	in.⁴	—	·0045	·0056	—	—	—
1·50	**0·60**	Zyy	in.³	—	·015	·019	—	—	—
		k_{yy}	in.	—	·218	·215	—	—	—
(*E.D.* = 1·102 *in.*)		W	lb. per ft.	—	·366	·454	—	—	—
		A	in.²	—	·111	·141	—	—	—
		Iyy	in.⁴	—	·0073	·0091	—	—	—
1·75	**0·70**	Zyy	in.³	—	·021	·026	—	—	—
		k_{yy}	in.	—	·256	·253	—	—	—
(*E.D.* = 1·285 *in.*)		W	lb. per ft.	—	·429	·533	—	—	—
		A	in.²	—	·127	·162	·249	—	—
		Iyy	in.⁴	—	·011	·014	·020	—	—
2·00	**0·80**	Zyy	in.³	—	·027	·034	·050	—	—
		k_{yy}	in.	—	·294	·291	·284	—	—
(*E.D.* = 1·469 *in.*)		W	lb. per ft.	—	·492	·611	·904	—	—

*E.D. = Equivalent Outside Diameter of Circular Tube.

(*continued on next page*)

STREAMLINE TUBES.

TABLE III—(*continued.*)

FINENESS RATIO $2\frac{1}{2}$: 1.

Nominal Dimensions.			Nominal Thickness of Tube (T).					
Length. **C** ±0·5%	Breadth. **B** ±1·0%		**24** S.W.G. (·022 in.)	**22** S.W.G. (·028 in.)	**20** S.W.G. (·036 in.)	**17** S.W.G. (·056 in.)	**14** S.W.G. (·080 in.)	**11** S.W.G. (·116 in.)
(See footnote).		Mean thickness in.	—	$\cdot 028^{-0}_{+\cdot 004}$	$\cdot 036^{-0}_{+\cdot 004}$	$\cdot 056^{-0}_{+\cdot 004}$	$\cdot 080^{-0}_{+\cdot 006}$	$\cdot 116^{-0}_{+\cdot 009}$
in.	in.	Max. thickness at any point in.	—	·035	·044	·066	·094	·137
		Min. thickness at any point in.	—	·025	·032	·050	·072	·104
		A in.²	—	·143	·183	·281	—	—
		Iyy in.⁴	—	·016	·020	·029	—	—
2·25	**0·90**	Zyy in.³	—	·035	·044	·065	—	—
		k_{yy} in.	—	·333	·330	·322	—	—
(*E.D.** = 1·652 *in.*)		W lb. per ft.	—	·555	·690	1·022	—	—
		A in.²	—	·159	·204	·313	—	—
		Iyy in.⁴	—	·022	·028	·041	—	—
2·5	**1·00**	Zyy in.³	—	·044	·055	·081	—	—
		k_{yy} in.	—	·371	·368	·360	—	—
(*E.D.* = 1·836 *in.*)		W lb. per ft.	—	·617	·768	1·139	—	—
		A in.²	—	—	·245	·378	·534	—
		Iyy in.⁴	—	—	·048	·072	·098	—
3·0	**1·20**	Zyy in.³	—	—	·081	·120	·163	—
		k_{yy} in.	—	—	·444	·436	·428	—
(*E.D.* = 2·203 *in.*)		W lb. per ft.	—	—	·925	1·375	1·947	—
		A in.²	—	—	·287	·442	·626	—
		Iyy in.⁴	—	—	·078	·116	·159	—
3·5	**1·40**	Zyy in.³	—	—	·111	·166	·227	—
		k_{yy} in.	—	—	·520	·513	·504	—
(*E.D.* = 2·570 *in.*)		W lb. per ft.	—	—	1·082	1·611	2·285	—
		A in.²	—	—	·328	·507	·718	1·028
		Iyy in.⁴	—	—	·117	·176	·242	·330
4·0	**1·60**	Zyy in.³	—	—	·146	·220	·302	·413
		k_{yy} in.	—	—	·597	·589	·580	·567
(*E.D.* = 2·938 *in.*)		W lb. per ft.	—	—	1·239	1·846	2·622	3·759
		A in.²	—	—	—	·572	·810	1·162
		Iyy in.⁴	—	—	—	·253	·349	·480
4·5	**1·80**	Zyy in.³	—	—	—	·281	·388	·533
		k_{yy} in.	—	—	—	·665	·656	·643
(*E.D.* = 3·305 *in.*)		W lb. per ft.	—	—	—	2·082	2·960	4·250
		A in.²	—	—	—	·636	·903	1·296
		Iyy in.⁴	—	—	—	·350	·484	·670
5·0	**2·00**	Zyy in.³	—	—	—	·350	·484	·670
		k_{yy} in.	—	—	—	·742	·732	·719
(*E.D.* = 3·672 *in.*)		W lb. per ft.	—	—	—	2·317	3·297	4·741
		A in.²	—	—	—	·701	·995	1·430
		Iyy in.⁴	—	—	—	·469	·651	·904
5·5	**2·20**	Zyy in.³	—	—	—	·426	·592	·822
		k_{yy} in.	—	—	—	·818	·809	·795
(*E.D.* = 4·039 *in.*)		W lb. per ft.	—	—	—	2·553	3·635	5·232

*E.D. = Equivalent Outside Diameter of Circular Tube.

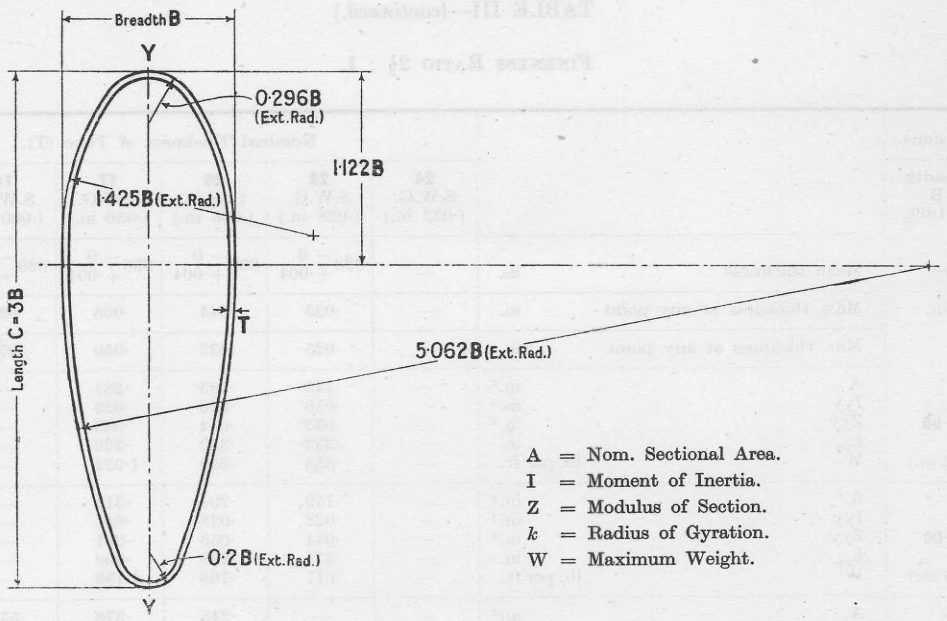
NOTE.—The limits specified for the length **C** and the breadth **B** shall not apply within 6 inches of the cut ends and in no case shall they be less than those specified for the extreme outside diameter of a circular tube of the same nominal thickness and of a nominal diameter equal to the length **C**.

The figures for the Maximum Weights and Equivalent Outside Diameters of Circular Tubes are given for information of designers and not for purposes of inspection.

TABLE IV.

STREAMLINE TUBES.

FINENESS RATIO 3 : 1.



A = Nom. Sectional Area.
I = Moment of Inertia.
Z = Modulus of Section.
k = Radius of Gyration.
W = Maximum Weight.

Nominal Dimensions.			Nominal Thickness of Tube (T).				
Length. C ±0·5%	Breadth. B ±1·0%		22 S.W.G. (·028 in.)	20 S.W.G. (·036 in.)	17 S.W.G. (·056 in.)	14 S.W.G. (·080 in.)	11 S.W.G. (·116 in.)
(See footnote.)		Mean thickness in.	$\cdot 028^{-0}_{+\cdot 004}$	$\cdot 036^{-0}_{+\cdot 004}$	$\cdot 056^{-0}_{+\cdot 004}$	$\cdot 080^{-0}_{+\cdot 006}$	$\cdot 116^{-0}_{+\cdot 009}$
in.	in.	Max. thickness at any point in.	·035	·044	·066	·094	·137
		Min. thickness at any point in.	·025	·032	·050	·072	·104
1·5 (E.D.* = 1·069 in.)	0·50	A in.²	·092	—	—	—	—
		Iyy in.⁴	·0030	—	—	—	—
		Zyy in.³	·012	—	—	—	—
		k_{yy} in.	·182	—	—	—	—
		W lb. per ft.	·355	—	—	—	—
2·25 (E.D. = 1·604 in.)	0·75	A in.²	·139	—	·272	—	—
		Iyy in.⁴	·011	—	·019	—	—
		Zyy in.³	·029	—	·052	—	—
		k_{yy} in.	·279	—	·267	—	—
		W lb. per ft.	·538	—	·991	—	—
3·0 (E.D. = 2·138 in.)	1·00	A in.²	—	·238	—	—	—
		Iyy in.⁴	—	·033	—	—	—
		Zyy in.³	—	·066	—	—	—
		k_{yy} in.	—	·372	—	—	—
		W lb. per ft.	—	·898	—	—	—
3·75 (E.D. = 2·673 in.)	1·25	A in.²	—	·298	—	·652	—
		Iyy in.⁴	—	·065	—	·133	—
		Zyy in.³	—	·105	—	·213	—
		k_{yy} in.	—	·469	—	·452	—
		W lb. per ft.	—	1·126	—	2·379	—
4·5 (E.D. = 3·208 in.)	1·50	A in.²	—	—	·554	—	—
		Iyy in.⁴	—	—	·172	—	—
		Zyy in.³	—	—	·229	—	—
		k_{yy} in.	—	—	·557	—	—
		W lb. per ft.	—	—	2·019	—	—
5·25 (E.D. = 3·742 in.)	1·75	A in.²	—	—	·649	—	1·321
		Iyy in.⁴	—	—	·277	—	·526
		Zyy in.³	—	—	·317	—	·601
		k_{yy} in.	—	—	·654	—	·631
		W lb. per ft.	—	—	2·362	—	4·835

*E.D. = Equivalent Outside Diameter of Circular Tube.

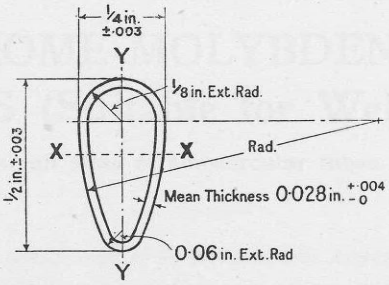
NOTE.—The limits specified for the length **C** and the breadth **B** shall not apply within 6 inches of the cut ends and in no case shall they be less than those specified for the extreme outside diameter of a circular tube of the same nominal thickness and of a nominal diameter equal to the length **C**.

The figures for the Maximum Weights and Equivalent Outside Diameters of Circular Tubes are given for information of designers and not for purposes of inspection.

TABLE V.

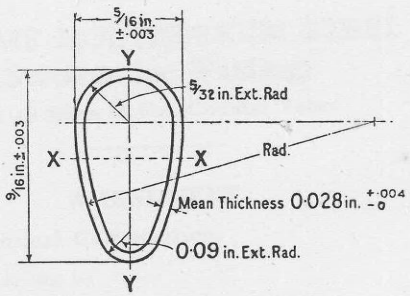
AEROFOIL EDGE TUBES.

½ Inch Aerofoil Edge.



Nominal Thickness.	22 S.W.G. (·028 in.)
Nominal Sectional Area	·032 in.²
Moment of Inertia about XX	·00075 in.⁴
Moment of Inertia about YY	·00022 in.⁴
Modulus of Section about XX	·0029 in.³
Modulus of Section about YY	·0018 in.³
*Maximum Weight	·123 lb. per ft.

9/16 Inch Aerofoil Edge.



Nominal Thickness.	22 S.W.G. (·028 in.)
Nominal Sectional Area	·037 in.²
Moment of Inertia about XX	·0012 in.⁴
Moment of Inertia about YY	·00043 in.⁴
Modulus of Section about XX	·0040 in.³
Modulus of Section about YY	·0027 in.³
*Maximum Weight	·144 lb. per ft.

*The figures for the Maximum Weights are given for information of designers and not for purposes of inspection.

For the purposes of this specification as an Australian standard the term "Inspector" shall be interpreted in the manner directed by the Australian Airworthiness Authority concerned.

This specification, prepared by the Special Committee on Aircraft Materials and Components, was approved on behalf of the Council of the Association on 4th September, 1941.

NOTE.

In order to keep abreast of progress in the industries concerned, Australian standards are subject to periodical review. Suggestions for improvement, addressed to the Headquarters of the Association, will be welcomed.

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