SEPTEMBER, 1941

EMERGENCY STANDARD
No. (E)D.539–1941

STANDARDS ASSOCIATION OF AUSTRALIA.
Headquarters :
Science House, Gloucester and Essex Streets, Sydney.

AUGUST, 1942.

EMERGENCY STANDARD
No. (E)D. 539—1941.

STANDARDS ASSOCIATION OF AUSTRALIA

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL.
(Emergency Series.)

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

AMENDMENT.

Page 1, **Title Note.**

Delete the existing title note relating to sizes of tubes and *substitute* the following :

" For circular tubes ½ in. diameter and over, and for all sizes of non-circular tubes. (For circular tubes under ½ in. diameter, see A.S. No. (E)2D. 537.) "

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."

Pages 9 and 10, TABLE I. **CIRCULAR TUBES.**

Add, as the first line in each gauge tabulation as set out, the following data corresponding to each gauge size :

	1	2	3	4	5	6	7	8
	Nominal Outside Diameter.	Limits on Diameter.		Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†
		Mean Outside or Inside Diameter.	Extreme Outside Diameter.*					
	in.	in.	in.	sq. in.	in.⁴	in.³	1000 in. lb.	lb. per ft.
30 S.W.G.	⅛	±·003	±·003	·019	·00057	·0023	·206	·080
28 S.W.G.	⅛	±·003	±·003	·023	·00066	·0027	·242	·092
26 S.W.G.	⅛	±·003	±·003	·027	·00079	·0032	·287	·108
24 S.W.G.	⅛	±·003	±·003	·033	·00095	·0038	·340	·127
22 S.W.G.	⅛	±·003	±·003	·042	·0012	·0046	·412	·161
20 S.W.G.	½	±·003	±·003	·052	·0014	·0057	·511	·198
17 S.W.G.	⅛	±·003	±·003	·078	·0020	·0078	·699	·284
14 S.W.G.	½	—	—	—	—	—	—	—
11 S.W.G.	½	—	—	—	—	—	—	—

* The 0·2% proof stress of these tubes after welding may be expected to be not less than 28 tons per sq. in.

Price 1/–, *post free* 1/2.

SEPTEMBER, 1941

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No. (E)D.539—1941

STANDARDS ASSOCIATION OF AUSTRALIA.
Headquarters :
Science House, Gloucester and Essex Streets, Sydney.

AUSTRALIAN STANDARD SPECIFICATION FOR AIRCRAFT MATERIAL

(Emergency Series)

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

For circular tubes over ½ in. diameter and for all sizes of non-circular tubes.
(For circular tubes ½ in. diameter and under, see A.S. No. (E)D.537.)

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.

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 end 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 retested 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.** 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 45 tons per sq. in. nor more than 60 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 40 tons per sq. in.
(iv) Flattening Test	See Clause 13.
(v) Proof bend Test	See Clause 14.
(vi) Hardness Test	See Clause 15.

* The 0·2% proof stress of these tubes after welding may be expected to be not less than 28 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 and any subsequent re-straightening shall be performed after the tubes have passed the proof bend test.

6. **Margins of Manufacture.** The dimensions and tolerances of the tubes shall comply with Tables I to VI of this specification except that

(*a*) the limits on the extreme outside diameter shall be either as given in Col. 3 of Table I or $\pm\left(0{\cdot}005+\frac{0{\cdot}6D^3}{1000T^2}\right)$ in., whichever is the greater.

(*b*) the dimensions "B" and "C" shall be either as given in Tables II, III, IV and V or $\pm 0{\cdot}010$ 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.539), 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*). Test samples for tensile testing specified in Clause 4 shall be taken from a tube selected to represent each parcel, if such tubes are proof loaded in accordance with Clause 14 (*a*). Where tubes are not suitable for proof loading, one tensile test 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 samples, 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.

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* 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.

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.

(*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 the test piece was selected or, at the request of the manufacturer select for test from the same parcel two tubes. One of the tubes must 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*) *Circular Tubes.* (i) The test samples selected as specified in Clause 11 shall withstand flattening in the middle over a parallel length of not less than 1 in. without sign of cracking until the greatest distance between the inner sides of the test piece in the direction of flattening is equal to six times the nominal thickness of the tube or three-quarters of the bore, whichever is the smaller. (See Fig. A.)

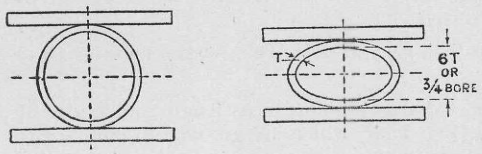


FIG. A.

(ii) When agreed between the purchaser and the manufacturer, the flattening test may be substituted by a bend test on a strip cut transversely from the selected tube. The test piece shall withstand without sign of cracking being bent into the form of a U over a radius equal to three times the nominal thickness of the tube. (See Fig. B.)

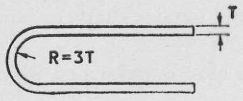


FIG. B.

(*c*) *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. C) equals eight times the original wall thickness of the tube.

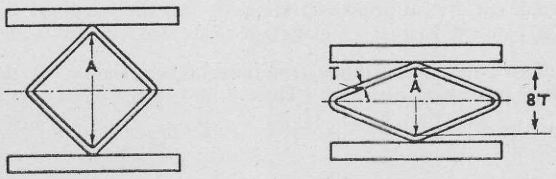


FIG. C.

(*d*) *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 $\frac{0{\cdot}6C}{T}$ (see Fig. D). For example, if $\frac{C}{T}=80$ then the reduction required is 48% of the major axis.

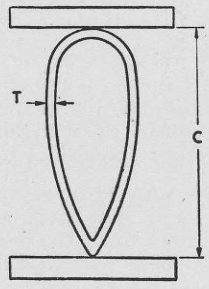


FIG. D.

(*e*) *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, 12 and 13.

14. **Proof Bend Test.**

(*a*) One end of each tube shall be subjected by an approved method to the appropriate proof bending moment specified in Col. 7 of Table I. Alternate ends of the tubes in each batch heat-treated together shall be tested.

When the tubes are 10 ft. long and over, 10% of the tubes shall in addition be tested near the middle of their length.

The tube shall be supported at two points in its length and loaded at a third. The supports shall consist of two metal blocks (Fig. 1 (*a*)) which are grooved to embrace the tube round approximately half its circumference. The diameter of the groove at the centre of the length (L) shall be D+q where D is the nominal outside diameter of the tube and q is 0·004 in. for tubes up to 2 in. diameter and 0·001 in. for each ½ in. diameter for diameters greater than 2 in. The surface of the groove shall have a radius of sixty times the nominal outside diameter of the tube as shown in Fig. 1 (*b*). The length (L) of the blocks shall not exceed the outside diameter of the tube, and the blocks shall be pivoted at the centre of their length (see Fig. 1 (*a*)) so as to turn when the tube deflects.

The resulting set shall be determined at a point in the length subjected to bending and near to the point of loading or support and shall be measured with reference to a line through the remaining two points.

The set shall not exceed 5% of the calculated elastic deflection, which shall be based on a bending stress of 40 tons per sq. in., the nominal outside diameter and thickness of the tube and a value for Young's Modulus of 13,300 tons per sq. in.

An approved type of testing machine is described in the Appendix.

(*b*) *Re-tests.* If any tube fails to comply with the proof bend test, all the tubes in the same parcel shall be proof bend tested at both ends, and if 10 ft. long and over 20% of the tubes shall in addition be tested near the middle of their length. Tubes which fail to comply with the proof bend test may at the request of the manufacturer be rejected or re-heat-treated in accordance with Clause 3 and re-tested at both ends, and if 10 ft. long and over they shall in addition be tested near the middle of their length.

15. **Hardness Test.**

(*a*) All tubes which cannot be tested on the manufacturer's proof bend testing machine shall be tested for hardness at each end by an approved method, and the hardness numbers shall not be less than 207 nor more than 277 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, 14 and 15.

APPENDIX.

An approved Method of carrying out the Proof Bend Test.

An approved type of testing machine is illustrated in Fig. 2. In this machine a beam is pivoted near one end at C and supported at the other end on a post F. The beam including the fittings at A is balanced about C. The beam is provided with a weight W adjustable in amount and position, so that its moment about C can be given the specified value for the tube under test. (See Col. 7 of Table I.)

One of the grooved metal blocks with its groove facing upward is pivoted immediately above the point C.

At a distance " A " of 10 in. to 20 in. along the beam the second block is pivoted with its groove facing downwards. The tube is inserted between the two blocks and is pressed downwards at some point B until the beam just rises from the supporting block F and is maintained suspended for about 15 seconds. The bending moment in the tube at the point C is then equal to the deadweight moment about pivot C.

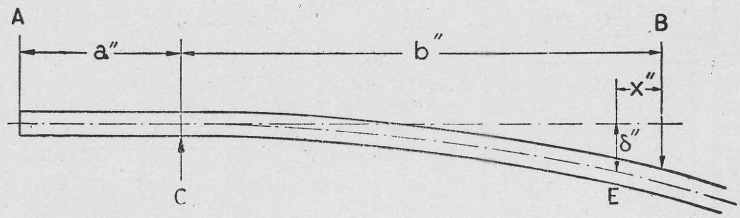
The point B at which the load is applied shall be at a fixed distance from C, say 30 in.

To enable heavy tubes to be tested a lever (H) is pivoted on an upward extension of the post at C and extends to any desired distance beyond B. This lever carries a downward projecting arm which presses on the tube at B through the medium of a grooved pulley shaped to take any size of tube (see Fig. 3). This pulley may be of hard wood. It is convenient to over-balance the lever so that the pulley is held clear when the tube is being removed.

After removal of the load the resulting set is measured at a point E between B and C and as close as possible to B.

The apparatus for measuring the set consists of a fairly heavy plunger which is freely guided so that it may move vertically downwards when the tube deflects. One end of a fine cord is attached to the top of the plunger and the other end passes round a spindle carrying a pointer which moves over a graduated dial, thus recording the movements of the plunger on a magnified scale. The cord may be maintained at a definite tension by a small weight or by a spring. (See Fig. 4.)

The elastic deflection is calculated from the following formula :



A and C are the points of support.

B is the point of loading.

E is the point for which the elastic deflection " δ " is calculated and at which the set is measured.

$$\delta = \frac{S}{20{,}000\ D}\left(b(a+b) - \frac{X}{2}(3b+2a) + \frac{X^3}{2b}\right)$$

S = 40 tons per sq. in.

D = Nominal outside diameter of the tube in inches.

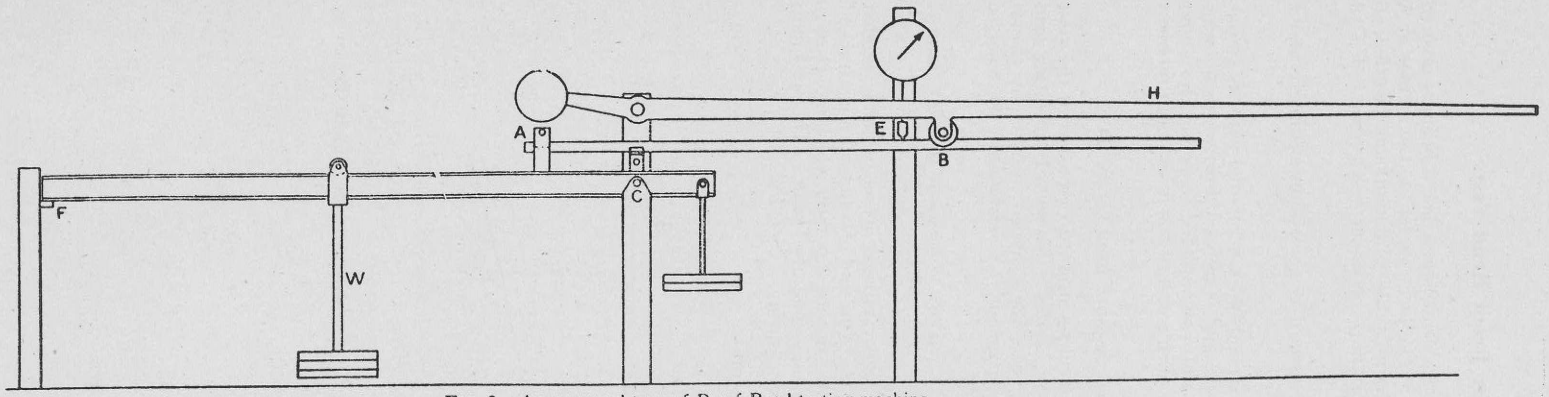
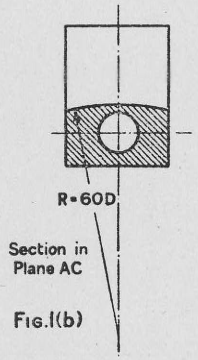


FIG. 2. An approved type of Proof Bend testing machine.



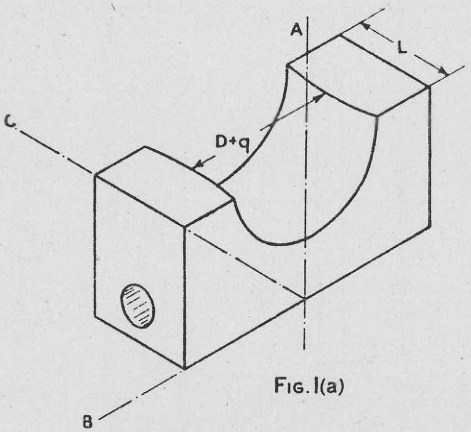


FIG. 1. Supporting blocks.

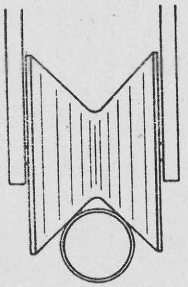


FIG. 3. Grooved pulley.

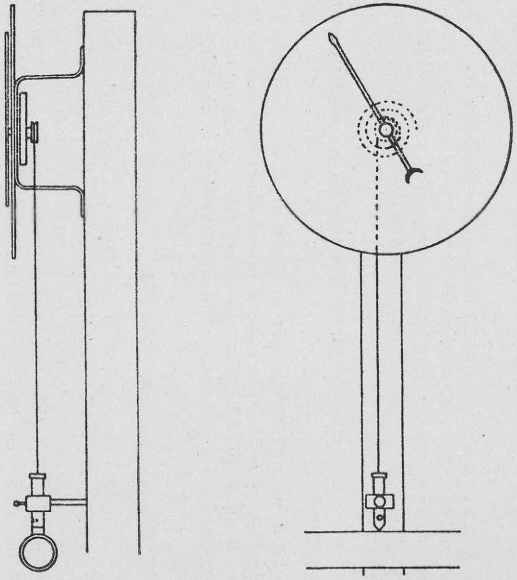


FIG. 4. Apparatus for measuring set.

NOTES ON TABLE I (*pages 9 and 10*).

The limits given in the table are derived as follows:

D=Nominal outside diameter of tube in inches.
T=Nominal thickness of tube in inches.

(*a*) *On Mean Inside or Outside Diameter* { ±·003 in. for tubes up to and including 1½ in. diameter. ±·001 in. for each ½ in. (or part thereof) of diameter for tubes over 1½ in. diameter.

(*b*) *On Extreme Outside Diameter* - As in (*a*) above, or $\pm\left\{\cdot 005+\frac{0\cdot 6\ D^3}{(1000\ T)^2}\right\}$ in., whichever is the greater. Each limit to be taken to the nearest ·001 in. under the calculated figure.

(*c*) *On Mean Thickness* - - - {
Tubes 24 S.W.G. and thinner: −0+·003 in.
Tubes thicker than 24 S.W.G. and up to and including 17 S.W.G.: −0+·004 in.
Tubes thicker than 17 S.W.G.: −0+8%

The maximum and minimum thicknesses are derived as follows:

(*d*) *Maximum Thickness* - - - (1·1×Nominal Thickness) + Tolerance on Mean Thickness.

(*e*) *Minimum Thickness* - - - 0·9×Nominal Thickness.

The proof bending moment M in 1,000 in. lb. is derived from the following formula:

$$M=S\times\frac{\pi(D^4-d^4)}{32\ D}\times 2\cdot 24$$

Where S=40 tons per sq. in.
D=Nominal outside diameter of tube in inches.
d=Nominal bore of tube in inches (i.e., D less twice nominal thickness).

TABLE I.

CIRCULAR TUBES.

(See Notes on Table, page 7.)

3	4	5	6	7	8	2	3	4	5	6	7	8	1
28 S.W.G. (·0148 in.). Mean thickness ·0148 in. $^{-0}_{+\cdot003}$ Maximum thickness at any point ·0193 in. Minimum ,, ,, ,, ,, ·0133 in.						**26** S.W.G. (·018 in.). Mean thickness ·018 in. $^{-0}_{+\cdot003}$ Maximum thickness at any point ·023 in. Minimum ,, ,, ,, ,, ·016 in.							
ameter.						Limits on Diameter.							Nominal Outside Diameter.
xtreme Outside Diameter.*	Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	Mean Outside or Inside Diameter.	Extreme Outside Diameter.*	Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	
in.	sq. in.	in.^{4}	in.^{3}	1000 in. lb.	lb. per ft.	in.	in.	sq. in.	in.^{4}	in.^{3}	1000 in. lb.	lb. per ft.	in.
±·003	·028	·0013	·0042	·376	·116	±·003	±·003	·034	·0016	·0051	·457	·136	$\frac{5}{8}$
±·004	·034	·0023	·0062	·556	·140	±·003	±·003	·041	·0028	·0074	·663	·164	$\frac{3}{4}$
±·004	·040	·0037	·0085	·762	·163	±·003	±·004	·048	·0045	·010	·896	·192	$\frac{7}{8}$
—	—	—	—	—	—	±·003	±·004	·056	·0067	·013	1·165	·220	1
—	—	—	—	—	—	±·003	±·005	·063	·0096	·017	1·523	·248	$1\frac{1}{8}$

3	4	5	6	7	8	2	3	4	5	6	7	8	1
22 S.W.G. (·028 in.). Mean thickness ·028 in. $^{-0}_{+\cdot004}$ Maximum thickness at any point ·035 in. Minimum ,, ,, ,, ,, ·025 in.						**20** S.W.G. (·036 in.). Mean thickness ·036 in. $^{-0}_{+\cdot004}$ Maximum thickness at any point ·044 in. Minimum ,, ,, ,, ,, ·032 in.							
ameter.						Limits on Diameter.							Nominal Outside Diameter.
xtreme Outside Diameter.*	Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	Mean Outside or Inside Diameter.	Extreme Outside Diameter.*	Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	
in.	sq. in.	in.^{4}	in.^{3}	1000 in. lb.	lb. per ft.	in.	in.	sq. in.	in.^{4}	in.^{3}	1000 in lb.	lb. per ft.	in.
±·003	·053	·0023	·0075	·672	·203	±·003	±·003	·067	·0029	·0093	·833	·251	$\frac{5}{8}$
±·003	·064	·0041	·011	·986	·246	±·003	±·003	·081	·0052	·014	·125	·304	$\frac{3}{4}$
±·003	·075	·0067	·015	1·34	·289	±·003	±·003	·095	·0084	·019	1·70	·358	$\frac{7}{8}$
±·003	·086	·010	·020	1·79	·332	±·003	±·003	·109	·013	·025	2·24	·411	1
±·004	·096	·015	·026	2·33	·374	±·003	±·003	·123	·018	·032	2·87	·464	$1\frac{1}{8}$
±·004	·107	·020	·032	2·87	·417	±·003	±·003	·137	·025	·041	3·67	·518	$1\frac{1}{4}$
±·004	·118	·027	·039	3·49	·460	±·003	±·004	·151	·034	·049	4·39	·571	$1\frac{3}{8}$
±·005	·129	·035	·047	4·21	·502	±·003	±·004	·166	·044	·059	5·29	·624	$1\frac{1}{2}$
±·006	·140	·045	·055	4·93	·545	±·004	±·004	·180	·057	·070	6·27	·678	$1\frac{5}{8}$
±·007	·151	·056	·064	5·73	·588	±·004	±·005	·194	·071	·081	7·26	·731	$1\frac{3}{4}$
±·008	·162	·069	·074	6·63	·631	±·004	±·006	·208	·088	·094	8·42	·785	$1\frac{7}{8}$
±·009	·173	·084	·084	7·53	·673	±·004	±·006	·222	·107	·107	9·59	·838	2
±·010	·184	·101	·095	8·51	·716	±·005	±·007	·236	·129	·121	10·84	·892	$2\frac{1}{8}$
±·011	·195	·121	·107	9·59	·759	±·005	±·008	·250	·153	·136	12·19	·945	$2\frac{1}{4}$
±·013	·206	·142	·120	10·75	·802	±·005	±·009	·265	·181	·152	13·62	·999	$2\frac{3}{8}$
±·014	·217	·166	·133	11·92	·844	±·005	±·010	·279	·212	·169	15·14	1·052	$2\frac{1}{2}$
±·016	·228	·193	·147	13·17	·887	±·006	±·011	·293	·245	·187	16·76	1·106	$2\frac{5}{8}$
±·018	·239	·222	·161	14·43	·930	±·006	±·012	·307	·283	·206	18·46	1·159	$2\frac{3}{4}$
—	—	—	—	—	—	±·006	±·014	·321	·324	·225	20·16	1·212	$2\frac{7}{8}$
—	—	—	—	—	—	±·006	±·015	·335	·368	·245	21·95	1·266	3

ven in Col. 3 above or $^{+}_{-}\left\{\cdot005+\frac{D^3}{(1000T)^2}\right\}$ in., whichever is the greater. Each limit to be taken to the nearest ·001 in. under the calculated figure.

e given for the information of designers and not for purposes of inspection.

(continued on next page)

TABLE I.

CIRCULAR TUBES.

(*See Notes on Table, page 7.*)

1	2	3	4	5	6	7	8	2	3	4	5	6
	30 S.W.G. (·0124 in.).							**28** S.W.G. (·0148 in.).				
	Mean thickness ·0124 in. $^{-0}_{+\cdot003}$ Maximum thickness at any point ·0166 in. Minimum ,, ,, ,, ,, ·0112 in.							Mean thickness ·0148 in. $^{-0}_{+\cdot00}$ Maximum thickness at any point ·01 Minimum ,, ,, ,, ,, ·01				
Nominal Outside Diameter.	Limits on Diameter.		Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	Limits on Diameter.		Nominal Area of Section.	Moment of Inertia.	Modulus of Section.
	Mean Outside or Inside Diameter.	Extreme Outside Diameter.*						Mean Outside or Inside Diameter.	Extreme Outside Diameter.*			
in.	in.	in.	sq. in.	in.^{4}	in.^{3}	1000 in.lb.	lb. per ft.	in.	in.	sq. in.	in.^{4}	in.^{3}
$\frac{5}{8}$	±·003	±·003	·024	·0011	·0036	·323	·101	±·003	±·003	·028	·0013	·0042
$\frac{3}{4}$	—	—	—	—	—	—	—	±·003	±·004	·034	·0023	·0062
$\frac{7}{8}$	—	—	—	—	—	—	—	±·003	±·004	·040	·0037	·0085
1	—	—	—	—	—	—	—	—	—	—	—	—
$1\frac{1}{8}$	—	—	—	—	—	—	—	—	—	—	—	—

1	2	3	4	5	6	7	8	2	3	4	5	6
	24 S.W.G. (·022 in.).							**22** S.W.G. (·028 in.).				
	Mean thickness ·022 in. $^{-0}_{+\cdot003}$ Maximum thickness at any point ·027 in. Minimum ,, ,, ,, ,, ·020 in.							Mean thickness ·028 in. $^{-0}_{+\cdot004}$ Maximum thickness at any point ·03 Minimum ,, ,, ,, ,, ·02				
Nominal Outside Diameter.	Limits on Diameter.		Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	Limits on Diameter.		Nominal Area of Section.	Moment of Inertia.	Modulus of Section.
	Mean Outside or Inside Diameter.	Extreme Outside Diameter.*						Mean Outside or Inside Diameter.	Extreme Outside Diameter.*			
in.	in.	in.	sq. in.	in.^{4}	in.^{3}	1000 in.lb.	lb. per ft.	in.	in.	sq. in.	in.^{4}	in.^{3}
$\frac{5}{8}$	±·003	±·003	·042	·0019	·0061	·547	·161	±·003	±·003	·053	·0023	·0075
$\frac{3}{4}$	±·003	±·003	·050	·0033	·0089	·797	·194	±·003	±·003	·064	·0041	·011
$\frac{7}{8}$	±·003	±·003	·059	·0054	·012	1·07	·228	±·003	±·003	·075	·0067	·015
1	±·003	±·004	·068	·0081	·016	1·43	·261	±·003	±·003	·086	·010	·020
$1\frac{1}{8}$	±·003	±·004	·076	·012	·021	1·88	·294	±·003	±·004	·096	·015	·026
$1\frac{1}{4}$	±·003	±·005	·085	·016	·026	2·33	·328	±·003	±·004	·107	·020	·032
$1\frac{3}{8}$	±·003	±·006	·094	·021	·031	2·78	·361	±·003	±·004	·118	·027	·039
$1\frac{1}{2}$	±·003	±·007	·102	·028	·037	3·32	·394	±·003	±·005	·129	·035	·047
$1\frac{5}{8}$	±·004	±·008	·111	·036	·044	3·94	·428	±·004	±·006	·140	·045	·055
$1\frac{3}{4}$	±·004	±·009	·119	·045	·051	4·57	·461	±·004	±·007	·151	·056	·064
$1\frac{7}{8}$	±·004	±·011	·128	·055	·059	5·29	·495	±·004	±·008	·162	·069	·074
2	±·004	±·012	·137	·067	·067	6·00	·528	±·004	±·009	·173	·084	·084
$2\frac{1}{8}$	±·005	±·014	·145	·080	·076	6·81	·561	±·005	±·010	·184	·101	·095
$2\frac{1}{4}$	±·005	±·017	·154	·096	·085	7·62	·595	±·005	±·011	·195	·121	·107
$2\frac{3}{8}$	—	—	—	—	—	—	—	±·005	±·013	·206	·142	·120
$2\frac{1}{2}$	—	—	—	—	—	—	—	±·005	±·014	·217	·166	·133
$2\frac{5}{8}$	—	—	—	—	—	—	—	±·006	±·016	·228	·193	·147
$2\frac{3}{4}$	—	—	—	—	—	—	—	±·006	±·018	·239	·222	·161
$2\frac{7}{8}$	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—

* In the case of hardened and tempered tubes the limits on extreme outside diameter shall be as given in Col. 3 above or $^{+}_{-}\Big\{\cdot005+\frac{D^3}{(1000T)}$

† The figures in Column 8 are given for the information of designers

TABLE I.—*Continued.*

CIRCULAR TUBES.

(*See Notes on Table, page 7.*)

1	2	3	4	5	6	7	8	2	3	4	5	6	7
	17 S.W.G. (·056 in.).							**14** S.W.G. (·080 in.).					
	Mean thickness ·056 in. $^{-0}_{+\cdot004}$ Maximum thickness at any point ·066 in. Minimum ,, ,, ,, ,, ·050 in.							Mean thickness ·080 in. $^{-0}_{+\cdot006}$ Maximum thickness at any point ·094 in. Minimum ,, ,, ,, ,, ·072 in.					
Nominal Outside Diameter.	Limits on Diameter.		Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	Limits on Diameter.		Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bendin Moment
	Mean Outside or Inside Diameter.	Extreme Outside Diameter.*						Mean Outside or Inside Diameter.	Extreme Outside Diameter.*				
in.	in.	in.	sq. in.	in.^{4}	in.^{3}	1000 in.lb.	lb. per ft.	in.	in.	sq. in.	in.^{4}	in.^{3}	1000 in.l
$\frac{5}{8}$	±·003	±·003	·100	·0041	·013	1·16	·364	—	—	—	—	—	—
$\frac{3}{4}$	±·003	±·003	·122	·0074	·020	1·79	·444	±·003	±·003	·168	·0096	·026	2·33
$\frac{7}{8}$	±·003	±·003	·144	·012	·028	2·51	·524	—	—	—	—	—	—
1	±·003	±·003	·166	·019	·037	3·32	·604	±·003	±·003	·231	·025	·049	4·39
$1\frac{1}{8}$	±·003	±·003	·188	·027	·048	4·30	·684	—	—	—	—	—	—
$1\frac{1}{4}$	±·003	±·003	·210	·038	·060	5·38	·764	±·003	±·003	·294	·051	·081	7·26
$1\frac{3}{8}$	±·003	±·003	·232	·051	·074	6·63	·844	—	—	—	—	—	—
$1\frac{1}{2}$	±·003	±·003	·254	·066	·088	7·88	·924	±·003	±·003	·357	·090	·120	10·75
$1\frac{5}{8}$	±·004	±·004	·276	·085	·105	9·41	1·004	—	—	—	—	—	—
$1\frac{3}{4}$	±·004	±·004	·298	·107	·122	10·93	1·084	±·004	±·004	·420	·147	·168	15·05
$1\frac{7}{8}$	±·004	±·004	·320	·132	·141	12·63	1·164	—	—	—	—	—	—
2	±·004	±·004	·342	·162	·162	14·52	1·244	±·004	±·004	·483	·223	·223	19·98
$2\frac{1}{8}$	±·005	±·005	·364	·195	·183	16·40	1·325	—	—	—	—	—	—
$2\frac{1}{4}$	±·005	±·005	·386	·232	·207	18·55	1·405	±·005	±·005	·545	·321	·286	25·63
$2\frac{3}{8}$	±·005	±·005	·408	·274	·231	20·70	1·485	—	—	—	—	—	—
$2\frac{1}{2}$	±·005	±·005	·430	·321	·257	23·07	1·565	±·005	±·005	·608	·446	·357	31·99
$2\frac{5}{8}$	±·006	±·006	·452	·373	·284	25·45	1·646	—	—	—	—	—	—
$2\frac{3}{4}$	±·006	±·006	·474	·430	·313	28·04	1·726	±·006	±·006	·671	·599	·435	38·98
$2\frac{7}{8}$	±·006	±·007	·496	·493	·343	30·73	1·806	—	—	—	—	—	—
3	±·006	±·008	·518	·561	·374	33·51	1·886	±·006	±·006	·734	·783	·522	46·77
$3\frac{1}{8}$	±·007	±·008	·540	·636	·407	36·47	1·966	—	—	—	—	—	—
$3\frac{1}{4}$	±·007	±·009	·562	·717	·441	39·51	2·046	±·007	±·007	·797	1·001	·616	55·19
$3\frac{3}{8}$	±·007	±·010	·584	·804	·477	42·74	2·127	—	—	—	—	—	—
$3\frac{1}{2}$	±·007	±·011	·606	·899	·513	45·96	2·207	±·007	±·007	·860	1·257	·719	64·42
$3\frac{5}{8}$	±·008	±·012	·628	1·000	·552	49·46	2·287	—	—	—	—	—	—
$3\frac{3}{4}$	±·008	±·013	·650	1·109	·591	52·95	2·367	±·008	±·008	·922	1·554	·829	74·28
$3\frac{7}{8}$	±·008	±·014	·672	1·225	·632	56·63	2·447	—	—	—	—	—	—
4	±·008	±·015	·694	1·349	·675	60·48	2·527	±·008	±·009	·985	1·893	·947	84·85
$3\frac{1}{2}$	—	—	—	—	—	—	—	±·009	±·010	1·048	2·279	1·072	96·05
$4\frac{1}{2}$	—	—	—	—	—	—	—	±·009	±·011	1·111	2·714	1·206	108·06
$4\frac{3}{4}$	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—

* In the case of hardened and tempered tubes the limits on extreme outside diameter shall be as given in Col. 3 above or $^{+}_{-}\left\{\cdot005+\frac{D^3}{(1000T)^2}\right\}$ in., w

† The figures in Column 8 are given for the information of designers and no

TABLE I.—*Continued.*

CIRCULAR TUBES.

(*See Notes on Table, page 7.*)

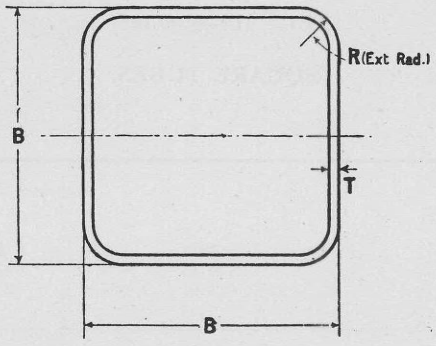
3	4	5	6	7	8	2	3	4	5	6	7	8	1
14 S.W.G. (·080 in.).						**11** S.W.G. (·116 in.).							
Mean thickness ·080 in. $^{-0}_{+\cdot006}$ Maximum thickness at any point ·094 in. Minimum ,, ,, ,, ,, ·072 in.						Mean thickness ·116 in. $^{-0}_{+\cdot009}$ Maximum thickness at any point ·137 in. Minimum ,, ,, ,, ,, ·104 in.							
ameter.						Limits on Diameter.							Nominal Outside Diameter.
Extreme Outside Diameter.*	Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	Mean Outside or Inside Diameter.	Extreme Outside Diameter.*	Nominal Area of Section.	Moment of Inertia.	Modulus of Section.	Proof Bending Moment.	Maximum Weight.†	
in.	sq. in.	in.^{4}	in.^{3}	1000 in.lb.	lb. per ft.	in.	in.	sq. in.	in.^{4}	in.^{3}	1000 in.lb.	lb. per ft.	in.
—	—	—	—	—	—	—	—	—	—	—	—	—	$\frac{5}{8}$
±·003	·168	·0096	·026	2·33	·612	—	—	—	—	—	—	—	$\frac{3}{4}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$\frac{7}{8}$
±·003	·231	·025	·049	4·39	·841	±·003	±·003	·322	·032	·064	5·73	1·171	1
—	—	—	—	—	—	—	—	—	—	—	—	—	$1\frac{1}{8}$
±·003	·294	·051	·081	7·26	1·071	±·003	±·003	·413	·067	·107	9·59	1·504	$1\frac{1}{4}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$1\frac{3}{8}$
±·003	·357	·090	·120	10·75	1·300	±·003	±·003	·504	·122	·162	14·52	1·838	$1\frac{1}{2}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$1\frac{5}{8}$
±·004	·420	·147	·168	15·05	1·530	±·004	±·004	·595	·200	·228	20·43	2·172	$1\frac{3}{4}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$1\frac{7}{8}$
±·004	·483	·223	·223	19·98	1·760	±·004	±·004	·687	·306	·306	27·42	2·506	2
—	—	—	—	—	—	—	—	—	—	—	—	—	$2\frac{1}{8}$
±·005	·545	·321	·286	25·63	1·990	±·005	±·005	·778	·444	·395	35·39	2·841	$2\frac{1}{4}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$2\frac{3}{8}$
±·005	·608	·446	·357	31·99	2·219	±·005	±·005	·869	·619	·495	44·35	3·174	$2\frac{1}{2}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$2\frac{5}{8}$
±·006	·671	·599	·435	38·98	2·450	±·006	±·006	·960	·834	·607	54·39	3·509	$2\frac{3}{4}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$2\frac{7}{8}$
±·006	·734	·783	·522	46·77	2·679	±·006	±·006	1·051	1·094	·730	65·41	3·842	3
—	—	—	—	—	—	—	—	—	—	—	—	—	$3\frac{1}{8}$
±·007	·797	1·001	·616	55·19	2·909	±·007	±·007	1·142	1·404	·864	77·41	4·177	$3\frac{1}{4}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$3\frac{3}{8}$
±·007	·860	1·257	·719	64·42	3·139	±·007	±·007	1·233	1·767	1·010	90·50	4·510	$3\frac{1}{2}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$3\frac{5}{8}$
±·008	·922	1·554	·829	74·28	3·369	±·008	±·008	1·324	2·188	1·167	104·56	4·845	$3\frac{3}{4}$
—	—	—	—	—	—	—	—	—	—	—	—	—	$3\frac{7}{8}$
±·009	·985	1·893	·947	84·85	3·599	±·008	±·008	1·415	2·671	1·336	119·71	5·178	4
±·010	1·048	2·279	1·072	96·05	3·829	±·009	±·009	1·507	3·221	1·516	135·83	5·513	$4\frac{1}{4}$
±·011	1·111	2·714	1·206	108·06	4·058	±·009	±·009	1·598	3·841	1·707	152·95	5·847	$4\frac{1}{2}$
—	—	—	—	—	—	±·010	±·010	1·689	4·536	1·910	171·14	6·181	$4\frac{3}{4}$
—	—	—	—	—	—	±·010	±·010	1·780	5·310	2·124	190·31	6·515	5

iven in Col. 3 above or $\pm\left\{\cdot005+\frac{D^3}{(1000T)^2}\right\}$ in., whichever is the greater. Each limit to be taken to the nearest ·001 in. under the calculated figure.

re given for the information of designers and not for purposes of inspection.

TABLE II.

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 12)	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 II.—(*continued.*)

SQUARE TUBES.

Nominal Dimensions.			Nominal Thickness of Tube (T).					
Width. **B** ±0·5%	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.).
(See footnote.)		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.

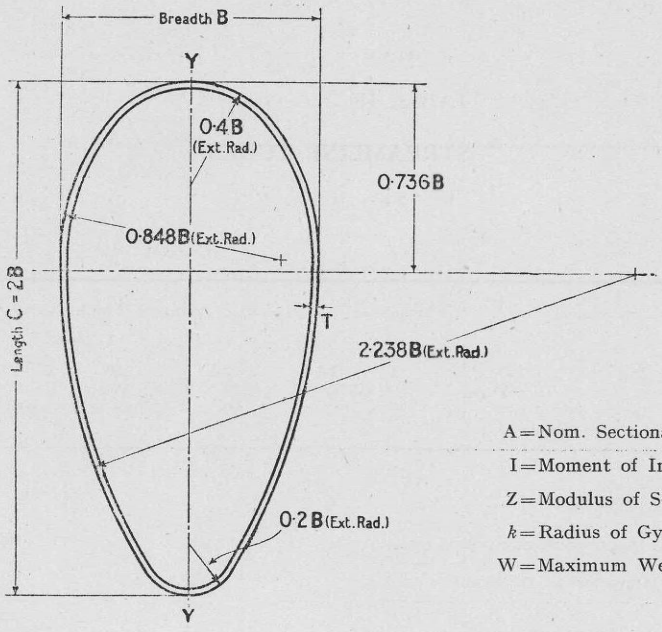
NOTE.—The limits specified for the width **B** shall not apply within 6 inches of the cut ends and in no case shall they be less than those specified for the extreme outside diameter of a circular tube of the same nominal thickness and of a nominal diameter equal to the width **B**.

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 III.

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. Length. C ±0·5%	Nominal Dimensions. Breadth. B ±1·0%		Nominal Thickness of Tube (T). 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 14.)		Mean thickness in.	·022 $^{-0}_{+·003}$	·028 $^{-0}_{+·004}$	·036 $^{-0}_{+·004}$	·056 $^{-0}_{+·004}$	·080 $^{-0}_{+·006}$	—
in.	in.	Max. thickness at any point in.	·027	·035	·044	·066	·094	—
		Min. thickness at any point in.	·020	·025	·032	·050	·072	—
1·0 (*E.D.**=0·770 *in.*)	**0·50**	A in.²	·052	—	·083	—	—	—
		Iyy in.⁴	·0017	—	·0025	—	—	—
		Zyy in.³	·0066	—	·010	—	—	—
		k_{yy} in.	·179	—	·174	—	—	—
		W lb. per ft.	·200	—	·313	—	—	—
1·5 (*E.D.*=1·156 *in.*)	**0·75**	A in.²	—	·099	—	·193	—	—
		Iyy in.⁴	—	·0072	—	·013	—	—
		Zyy in.³	—	·019	—	·035	—	—
		k_{yy} in.	—	·270	—	·260	—	—
		W lb. per ft.	—	·385	—	·703	—	—
2·0 (*E.D.*=1·541 *in.*)	**1·00**	A in.²	—	·133	—	·261	—	—
		Iyy in.⁴	—	·018	—	·033	—	—
		Zyy in.³	—	·035	—	·065	—	—
		k_{yy} in.	—	·363	—	·353	—	—
		W lb. per ft.	—	·517	—	·951	—	—
2·5 (*E.D.*=1·926 *in.*)	**1·25**	A in.²	—	·167	—	·329	—	—
		Iyy in.⁴	—	·035	—	·066	—	—
		Zyy in.³	—	·056	—	·105	—	—
		k_{yy} in.	—	·457	—	·446	—	—
		W lb. per ft.	—	·648	—	1·197	—	—
3·0 (*E.D.*=2·311 *in.*)	**1·50**	A in.²	—	—	·257	—	·561	—
		Iyy in.⁴	—	—	·077	—	·158	—
		Zyy in.³	—	—	·103	—	·211	—
		k_{yy} in.	—	—	·547	—	·531	—
		W lb. per ft.	—	—	·971	—	2·046	—
3·5 (*E.D.*=2·697 *in.*)	**1·75**	A in.²	—	—	·301	—	·658	—
		Iyy in.⁴	—	—	·123	—	·256	—
		Zyy in.³	—	—	·141	—	·293	—
		k_{yy} in.	—	—	·641	—	·624	—
		W lb. per ft.	—	—	1·136	—	2·401	—

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

(*continued on next page*)

TABLE III.—(*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
		A in.²	—	—	—	·532	—	1·081
		Iyy in.⁴	—	—	—	·281	—	·537
4·0	**2·0**	Zyy in.³	—	—	—	·281	—	·537
		kyy in.	—	—	—	·727	—	·705
(*E.D.**=3·082 *in.*)		W lb. per ft.	—	—	—	1·939	—	3·953
		A in.²	—	—	—	·600	—	1·221
		Iyy in.⁴	—	—	—	·403	—	·778
4·5	**2·25**	Zyy in.³	—	—	—	·359	—	·691
		kyy in.	—	—	—	·820	—	·798
(*E.D.*=3·467 *in.*)		W lb. per ft.	—	—	—	2·185	—	4·466
		A in.²	—	—	—	·668	—	1·362
		Iyy in.⁴	—	—	—	·557	—	1·082
5·0	**2·5**	Zyy in.³	—	—	—	·446	—	·866
		kyy in.	—	—	—	·913	—	·891
(*E.D.*=3·852 *in.*)		W lb. per ft.	—	—	—	2·433	—	4·981

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

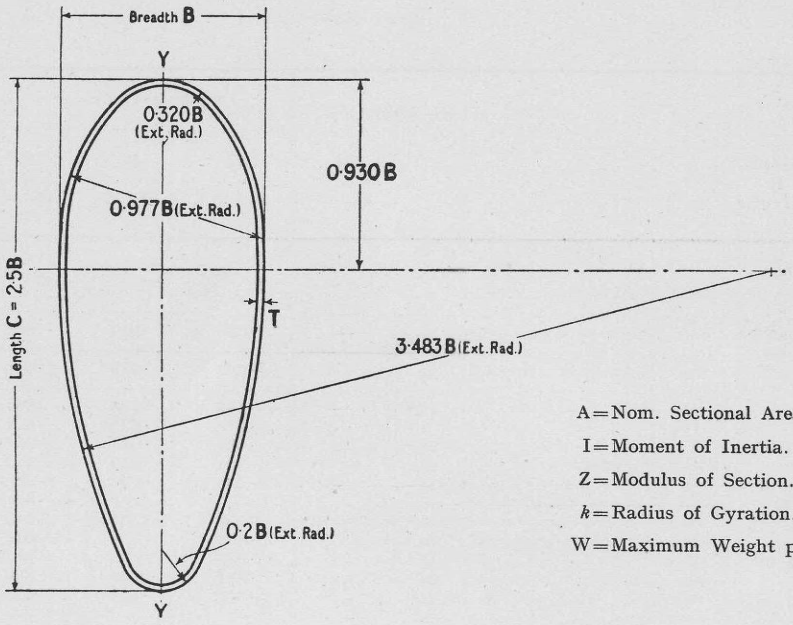
NOTE.—The limits specified for the length **C** and the breadth **B** shall not apply within 6 inches of the cut ends and in no case shall they be less than those specified for the extreme outside diameter of a circular tube of the same nominal thickness and of a nominal diameter equal to the length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

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 per ft.

Nominal Dimensions. Length. C ±0·5%	Nominal Dimensions. Breadth. B ±1·0%			Nominal Thickness of Tube (T). 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 16.)		Mean thickness	in.	$\cdot 022^{-0}_{+\cdot 003}$	$\cdot 028^{-0}_{+\cdot 004}$	$\cdot 036^{-0}_{+\cdot 004}$	$\cdot 056^{-0}_{+\cdot 004}$	—	—
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*)

TABLE IV.—*Continued.*

STREAMLINE TUBES.

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
2·25 (*E.D.**=1·652 *in.*)	**0·90**	A in.²	—	·143	·183	·281	—	—
		Iyy in.⁴	—	·016	·020	·029	—	—
		Zyy in.³	—	·035	·044	·065	—	—
		k_{yy} in.	—	·333	·330	·322	—	—
		W lb. per ft.	—	·555	·690	1·022	—	—
2·5 (*E.D.*=1·836 *in.*)	**1·00**	A in.²	—	·159	·204	·313	—	—
		Iyy in.⁴	—	·022	·028	·041	—	—
		Zyy in.³	—	·044	·055	·081	—	—
		k_{yy} in.	—	·371	·368	·360	—	—
		W lb. per ft.	—	·617	·768	1·139	—	—
3·0 (*E.D.*=2·203 *in.*)	**1·20**	A in.²	—	—	·245	·378	·534	—
		Iyy in.⁴	—	—	·048	·072	·098	—
		Zyy in.³	—	—	·081	·120	·163	—
		k_{yy} in.	—	—	·444	·436	·428	—
		W lb. per ft.	—	—	·925	1·375	1·947	—
3·5 (*E.D.*=2·570 *in.*)	**1·40**	A in.²	—	—	·287	·442	·626	—
		Iyy in.⁴	—	—	·078	·116	·159	—
		Zyy in.³	—	—	·111	·166	·227	—
		k_{yy} in.	—	—	·520	·513	·504	—
		W lb. per ft.	—	—	1·082	1·611	2·285	—
4·0 (*E.D.*=2·938 *in.*)	**1·60**	A in.²	—	—	·328	·507	·718	1·028
		Iyy in.⁴	—	—	·117	·176	·242	·330
		Zyy in.³	—	—	·146	·220	·302	·413
		k_{yy} in.	—	—	·597	·589	·580	·567
		W lb. per ft.	—	—	1·239	1·846	2·622	3·759
4·5 (*E.D.*=3·305 *in.*)	**1·80**	A in.²	—	—	—	·572	·810	1·162
		Iyy in.⁴	—	—	—	·253	·349	·480
		Zyy in.³	—	—	—	·281	·388	·533
		k_{yy} in.	—	—	—	·665	·656	·643
		W lb. per ft.	—	—	—	2·082	2·960	4·250
5·0 (*E.D.*=3·672 *in.*)	**2·00**	A in.²	—	—	—	·636	·903	1·296
		Iyy in.⁴	—	—	—	·350	·484	·670
		Zyy in.³	—	—	—	·350	·484	·670
		k_{yy} in.	—	—	—	·742	·732	·719
		W lb. per ft.	—	—	—	2·317	3·297	4·741
5·5 (*E.D.*=4·039 *in.*)	**2·20**	A in.²	—	—	—	·701	·995	1·430
		Iyy in.⁴	—	—	—	·469	·651	·904
		Zyy in.³	—	—	—	·426	·592	·822
		k_{yy} in.	—	—	—	·818	·809	·795
		W lb. per ft.	—	—	—	2·553	3·635	5·232

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

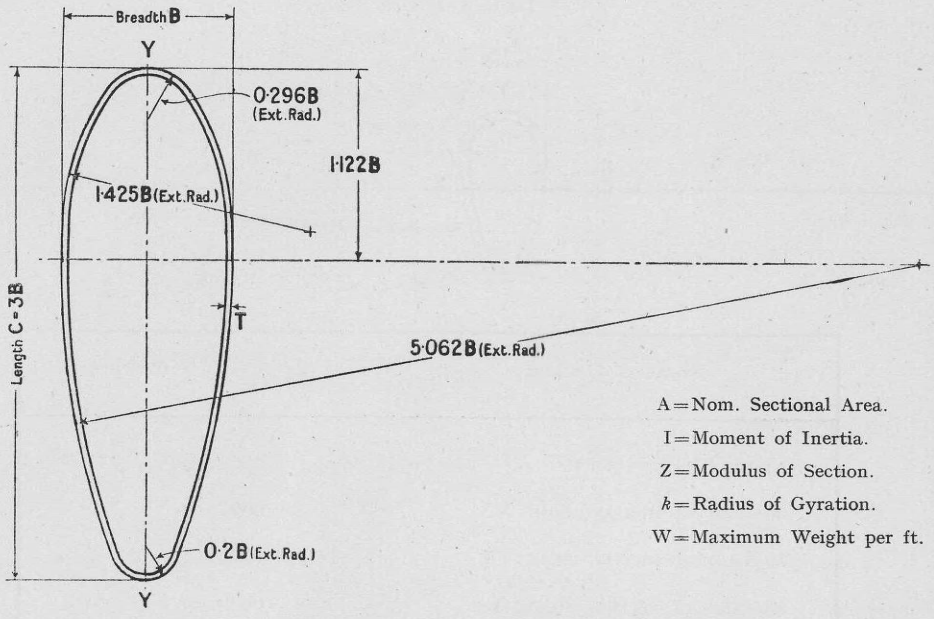
NOTE.—The limits specified for the length **C** and the breadth **B** shall not apply within 6 inches of the cut ends and in no case shall they be less than those specified for the extreme outside diameter of a circular tube of the same nominal thickness and of a nominal diameter equal to the length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

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 per ft.

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
		A	in.²	·092	—	—	—	—
		Iyy	in.⁴	·0030	—	—	—	—
1·5	**0·50**	Zyy	in.³	·012	—	—	—	—
		k_{yy}	in.	·182	—	—	—	—
(*E.D.**=1·069 *in.*)		W	lb. per ft.	·355	—	—	—	—
		A	in.²	·139	—	·272	—	—
		Iyy	in.⁴	·011	—	·019	—	—
2·25	**0·75**	Zyy	in.³	·029	—	·052	—	—
		k_{yy}	in.	·279	—	·267	—	—
(*E.D.*=1·604 *in.*)		W	lb. per ft.	·538	—	·991	—	—
		A	in.²	—	·238	—	—	—
		Iyy	in.⁴	—	·033	—	—	—
3·0	**1·00**	Zyy	in.³	—	·066	—	—	—
		k_{yy}	in.	—	·372	—	—	—
(*E.D.*=2·138 *in.*)		W	lb. per ft.	—	·898	—	—	—
		A	in.²	—	·298	—	·652	—
		Iyy	in.⁴	—	·065	—	·133	—
3·75	**1·25**	Zyy	in.³	—	·105	—	·213	—
		k_{yy}	in.	—	·469	—	·452	—
(*E.D.*=2·673 *in.*)		W	lb. per ft.	—	1·126	—	2·379	—
		A	in.²	—	—	·554	—	—
		Iyy	in.⁴	—	—	·172	—	—
4·5	**1·50**	Zyy	in.³	—	—	·229	—	—
		k_{yy}	in.	—	—	·557	—	—
(*E.D.*=3·208 *in.*)		W	lb. per ft.	—	—	2·019	—	—
		A	in.²	—	—	·649	—	1·321
		Iyy	in.⁴	—	—	·277	—	·526
5·25	**1·75**	Zyy	in.³	—	—	·317	—	·601
		k_{yy}	in.	—	—	·654	—	·631
(*E.D.*=3·742 *in.*)		W	lb. per ft.	—	—	2·362	—	4·835

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

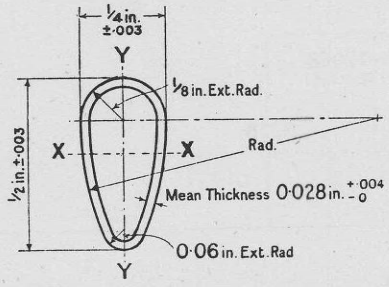
NOTE.—The limits specified for the length **C** and the breadth **B** shall not apply within 6 inches of the cut ends and in no case shall they be less than those specified for the extreme outside diameter of a circular tube of the same nominal thickness and of a nominal diameter equal to the length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

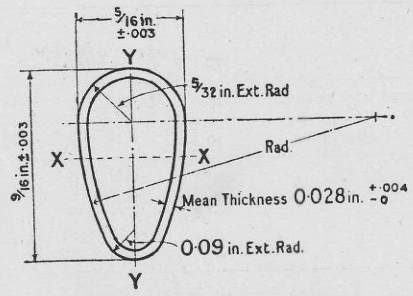
AEROFOIL EDGE TUBES.

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 ..	·0043 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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