(Reaffirmed 1995)

Indian Standard

SPECIFICATION FOR HIGH SPEED TUBELESS TYRES FOR CIVIL AIRCRAFT

PART 1 DESIGN REQUIREMENTS

[Ref : Doc : EDC 74 (3777)]
Aircraft and Space Vehicles Sectional Committee, EDC 74; Panel for Aircraft Tyres and Their Associated Accessories, EDC 74/P-4

1. Scope — In this part, the design specification for new high speed, tubeless tyres of main/nose wheel of civil aircraft whose ground speeds are greater than 192 km/h (120 mph) are covered. It includes the following:

a) Definitions,

b) Tyre size designation,

c) Tyre (identification and sidewall) markings, and

d) Tyre design: methods of determination of:

i) new tyre dimensional tolerances,

ii) growth allowances, and

iii) clearance allowances.

2. Definitions — The following definitions shall apply for the purpose of this standard.

2.1 *New Tyre* — A tyre which has been neither used nor subjected to a retreading operation.

2.2 *Grown Tyre* — A tyre which has undergone expansion due to use in service.

2.3 *Ply Rating* — A term used to identify a given tyre with its maximum rated load when used in a specific type of service. It is an index of relative tyre strength and does not necessarily represent the actual number of plies in the tyre.

2.4 *Load Rating (Rated Load)* — A term used to indicate the maximum load carrying capacity of a tyre of a given ply rating at the rated inflation pressure.

2.5 *Speed Rating* — A term used to indicate the maximum qualification test speed of a tyre, which will not be less than the maximum ground roll speed of the aircraft application.

2.6 *Tread Groove Depth* — Depth of the groove nearest the centre line of the tyre.

2.7 *Mould Skid Depth* — Height of any projection from and measured normal to the tread surface in the mould.

2.8 *Aspect Ratio* — Ratio of mean section height at mean section width (*see* Fig. 1).

2.9 *Tyre Deflection* — The radial distance between the outermost surface of the rim flange and outermost surface of the unloaded inflated tyre is defined as 100 percent deflection (*see* Fig. 1).

2.10 *Loaded Radius* — This is defined as the radial distance between the axle centre line and the operating surface of a loaded tyre (*see* Fig. 1).

2.11 *Balance Marker* — An identifying red dot, located on the side wall at a light spot of the tyre.

2.12 *Venting Marker* — An identifying dot, other than red, located at the vents of tyres.

3. Tyre Size Designation

3.1 The tyre size designation for new design tyres in accordance with this standard shall consist of a three-part size marking as follows:

Overall diameter × Overall section width — Rim diameter.

The size designation may also include one of the following letter prefixes:

B — Indicates tyres for 15° bead seat rims with 60 to 70 percent rim width to tyre section width ratio.

C — Indicates tyres for 15° bead seat rims with 50 to 60 percent rim width to section width ratio.

H — Indicates tyres for 5° bead seat rims with 60 to 70 percent rim width to section width ratio.

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

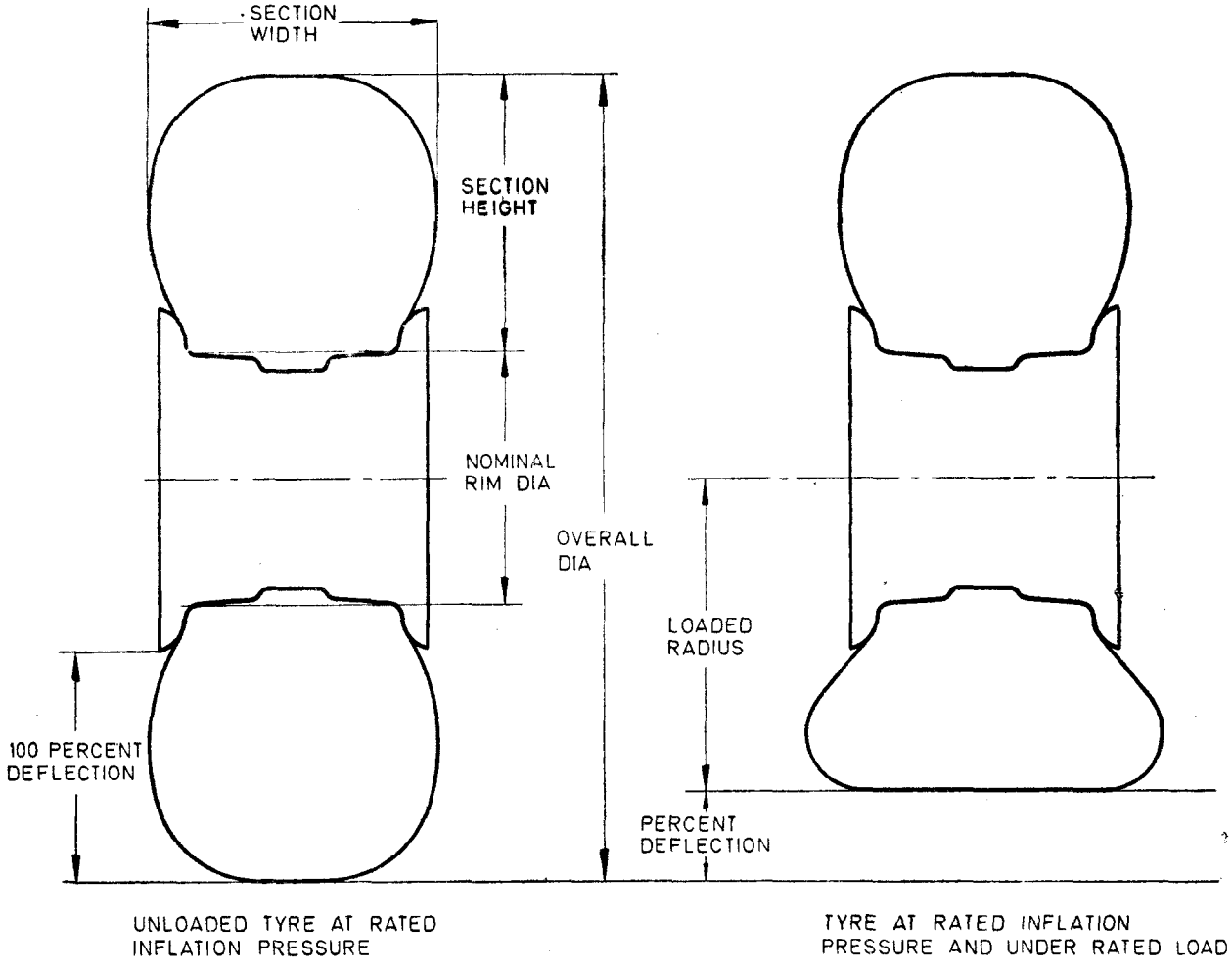


FIG. 1 AIRCRAFT TYRE DEFINITIONS

3.2 *Tyre Size Dimensions*

3.2.1 The overall diameter and overall section width are the maximum permitted new unloaded inflated tyre dimensions when the tyre is mounted on the specified rim, inflated to its rated inflation pressure, and allowed to stand for a minimum of 12 h at specified ambient temperature and the inflation pressure readjusted to the original value.

3.2.2 Dimensions shall be expressed in millimetres or inches as follows:

a) Tyre, overall diameter and overall width in millimetres (mm), or

b) Tyre, overall diameter and overall section width in inches (in).

c) Rim diameter: millimetres (mm) or inches (in).

4. Design Requirements

4.1 *Growth Allowance* — Provides for increase in tyre dimensions beyond the maximum new inflated tyre dimensions to allow for growth or stretch of the tyre during service.

4.2 The nomenclature for various terms adopted for design calculations shall be in accordance with Appendix A for both 'new' and 'grown' tyres to be read with Fig. 5 and 5A.

4.3 The dimensions for new inflated tyres shall be as given in Table 1. Obtain the new inflated tyre dimensions, D_O , D_S , W and W_S as shown in tyre tables; such dimensions shall be considered as permitted maxima. For calculation purposes, it is taken as follows:

$$W_S = 0{\cdot}88W$$

$$H_S = 0{\cdot}82H$$

TABLE 1 AIRCRAFT TYRE DATA DIMENSIONS FOR NEW INFLATED TYRES

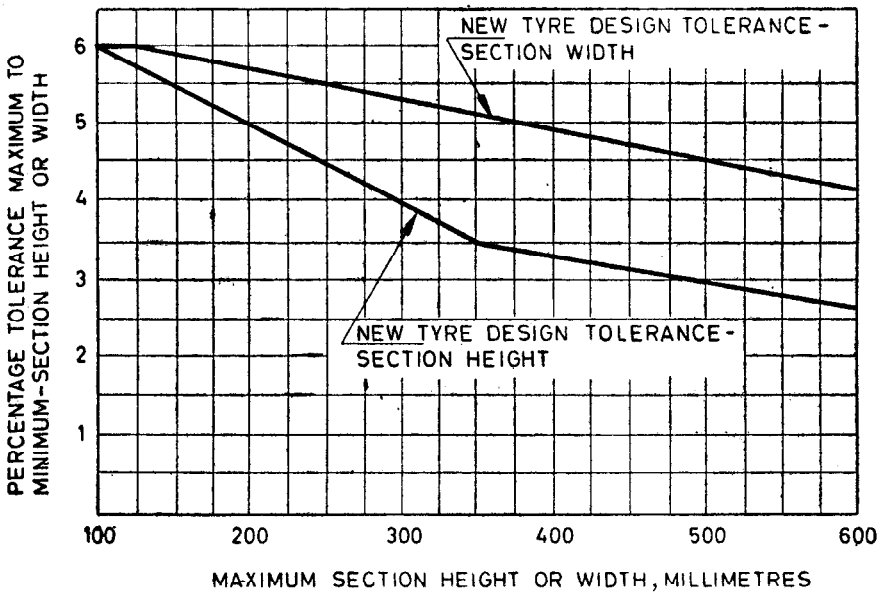
(*Clause* 4.3)

Size Overall Diameter × Section Width in inch	Ply Rating	Aspect Ratio	Rating					Inflated Dimensions							Rim Data (Inches)				
			Speed	Maximum Static Load	Inflation Pressure		Maximum Nose Tyre Load During Breaking	Widths			Diameters			Normal Loaded Radius	Width Between Flanges	Ledge Diameter	Flanges Height	Minimum Ledge Width	Minimum Well Depth
					Loaded	Unloaded		Cross-section		Shoulder	Centre Line		Shoulder						
								Min	*Max*	*Max*	*Min*	*Max*	*Max*						
			km/h (mph)	kg (lb)	kpa lbf/in²	kpa lbf/in²	kg (lb)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	mm (in)	*A*		H_f	G_{Min}	I_{Min}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
24×7·7	16	0·92	320 (200)	4 420 (9 730)	1 186 (172)	1 140 (165)	6 630 (14 590)	185 (7·20)	195 (7·65)	170 (6·75)	590 (23·30)	615 (24·15)	545 (21·50)	255 (10·0)	5·50	10·00	0·906	1·70	0·180
39×13	16	0·86	360 (225)	7 800 (17 200)	822 (120)	790 (115)	11 727 (25 800)	311 (12·25)	330 (13·00)	291 (11·45)	947 (37·30)	972 (38·25)	870 (34·25)	401 (15·8)	10·00	16·00	1·250	2·30	0·254
40×14	24	0·86	336 (210)	12 570 (27 700)	1 217 (177)	1 170 (170)	18 886 (41 550)	337 (13·25)	356 (14·00)	305 (12·00)	987 (38·35)	1 011 (39·80)	892 (35·10)	419 (16·5)	11·00	16·00	1·625	2·95	0·306
46×16	28	0·80	336 (210)	18 960 (41 800)	1 508 (218)	1 450 (210)	28 500 (62 700)	382 (15·05)	406 (16·00)	358 (14·10)	1 125 (44·30)	1 149 (45·25)	1 034 (40·70)	480 (18·90)	13·25	20·00	1·750	3·25	0·350
49×17	30	0·84	360 (225)	21 230 (46 700)	1 400 (203)	1 345 (195)	31 840 (70 050)	417 (16·40)	438 (17·25)	368 (14·50)	1 212 (47·70)	1 238 (48·75)	1 092 (43·00)	513 (20·2)	13·25	20·00	1·875	3·50	0·368
49×17	32	0·84	360 (225)	22 882 (50 400)	1 506 (218)	1 448 (210)	34 363 (75 600)	417 (16·40)	438 (17·25)	368 (14·50)	1 212 (47·70)	1 238 (48·75)	1 092 (43·00)	513 (20·2)	13·25	20·00	1·875	3·65	0·381

100 kPa = 1 bar

4.4 *New Inflated Tyre Dimensional Tolerances (Mean Dimensions)*

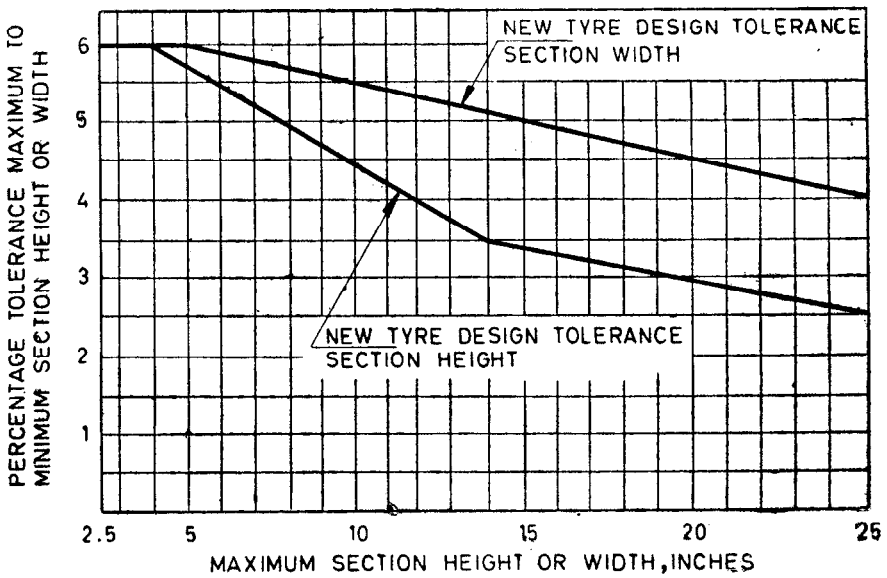
4.4.1 The mean dimensions for new inflated tyres are taken for consideration while calculating the dimensional tolerances. For the above purpose, the factors given in Fig. 2 and 3 are to be followed.



Note 1 — Below 100 mm section height and width, tolerance is constant at 6 percent.

Note 2 — Round all minimum tyre diameters and section widths to nearest millimetre.

FIG. 2 NEW AIRCRAFT TYRE SECTION HEIGHT AND WIDTH — DIMENSIONAL TOLERANCES (mm)



Note 1 — Below 4 inch section height and width, tolerance is constant at 6 percent.

Note 2 — Round all minimum tyre diameters and section widths to nearest 0·05 inch.

FIG. 3 NEW AIRCRAFT TYRE SECTION HEIGHT AND WIDTH — DIMENSIONAL TOLERANCES (INCHES)

4.4.2 The size designation as defined in **3.1** determines the maximum permitted new inflated tyre outside diameter and width of section, and tolerances shall therefore be calculated as a minus from the permitted maximum dimensions giving the minima. The average of these shall represent the mean dimensions.

4.5 *Grown Dimensions*

4.5.1 *Growth factors* — The section height growth factor G_H is obtained from Fig. 4, G_H versus Aspect ratio (A_R).

The section width growth factor (G_W) is to be assumed as 1·04.

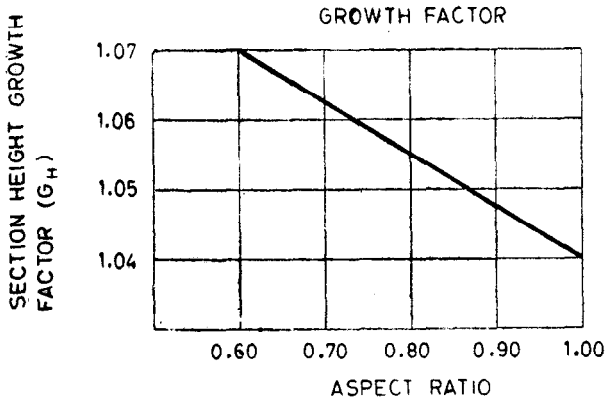


FIG. 4 G_H *vs* ASPECT RATIO

4.5.2 The empirical relationship for calculating the 'grown' dimensions are given below:

$$W_G = G_W W$$

$$H = \frac{D_O - D}{2}$$

$$D_G = D + 2\,G_H\,H$$

$$W_S\,G = G_W\,W_S$$

$$D_S\,G = D + 2\,G_H\,H_S$$

$$H_S = \frac{D_S - D}{2}$$

4.6 *Determination of Clearance Allowances*

4.6.1 *Clearance around individual tyres* — Clearance allowances between the individual tyre and the adjacent parts of the aircraft (wheel bay) shall be based on the maximum overall tyre dimensions, plus growth allowance due to service, plus the increase in diameter due to centrifugal force.

4.6.1.1 The minimum distances to adjacent parts of the aircraft are determined as follows:

a) Determine the maximum grown tyre envelope as illustrated in Fig. 5. [This is the line labelled 'grown (used) inflated tyre'].

b) Obtain the radial clearance C_R and lateral clearance C_W from Fig. 6 or 7 as a function of maximum ground speed.

c) Determine the distance to adjacent parts as follows:

R_X, *Min* = radial distance from the centre line of wheel to the adjacent part = $\frac{D_G}{2} + C_R$

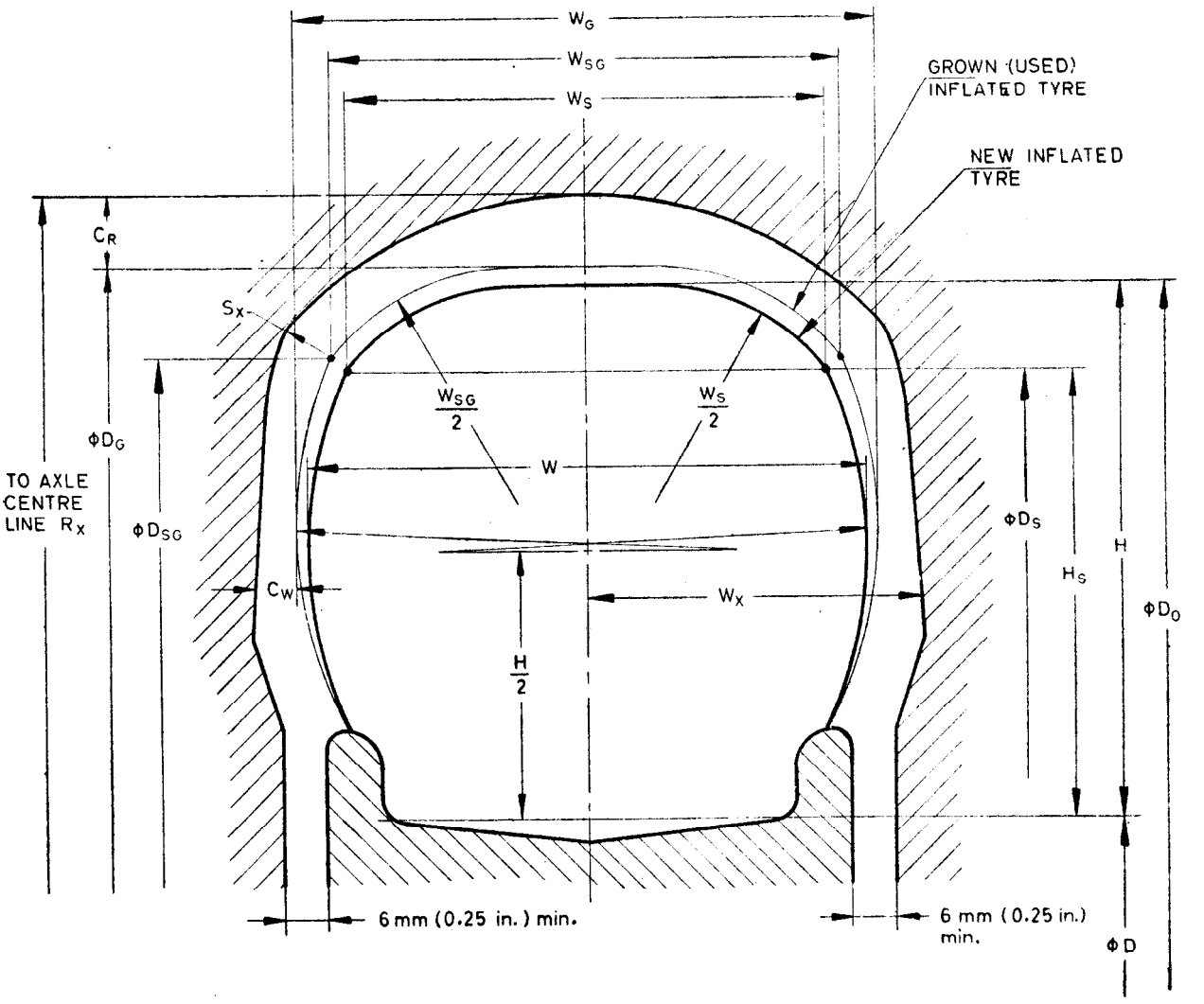
W_X, *Min* = lateral distance from the centre line wheel to adjacent part = $\frac{W_G}{2} + C_W$

S_X, *Min* = clearance radius allowed between shoulder and adjacent part = $\frac{C_W + C_R}{2}$

Note — The above radial clearance includes allowances for increase in tyre diameter due to centrifugal force at speed up to 400 kmph (250 mph).

4.6.2 *Spacing between twin tyres* — The minimum distance between the tyre tread centre lines shall be 1·18 × W_G where W_G is the maximum grown width of the tyres.

4.6.3 *Spacing between tyres in tandem* — The minimum distance between axle centres shall be $D_G + 2C_R$, where D_G is the maximum grown tyre diameter and C_R is the tyre radial clearance allowance for the maximum aircraft ground speed.

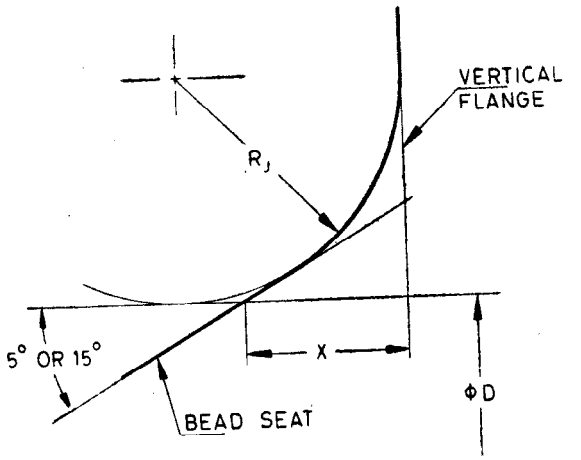


Note — Radii $\frac{W_S}{2}$ and $\frac{W_{SG}}{2}$ are drawn through their respective shoulder points tangent to D_O and D_G respectively.

Radii below the shoulder points pass through the shoulder points and are tangent to W and W_G respectively.

Dimensions W and W_G include all protective side ribs, lettering, bars and decorations.

FIG. 5 DETAILS OF INFLATED TYRE



$X = 0{\cdot}956\ R_J$ (5° Bead seat taper)

$= 0{\cdot}869\ R_J$ (15° Bead seat taper)

FIG. 5A DETERMINATION OF POINT '*D*'

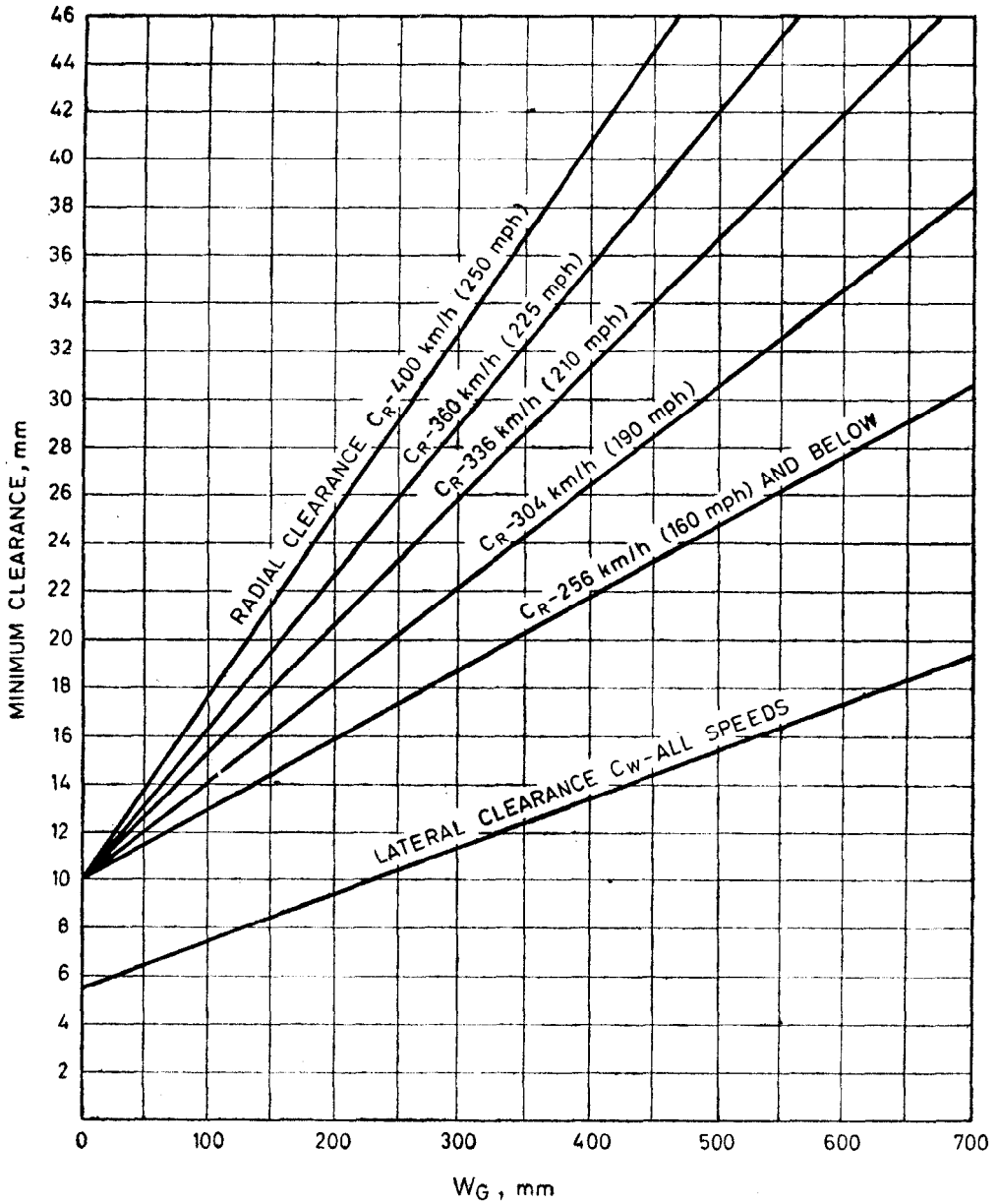


FIG. 6 CHART TO BE USED FOR CALCULATING RADIAL C_R AND LATERAL C_W CLEARANCES

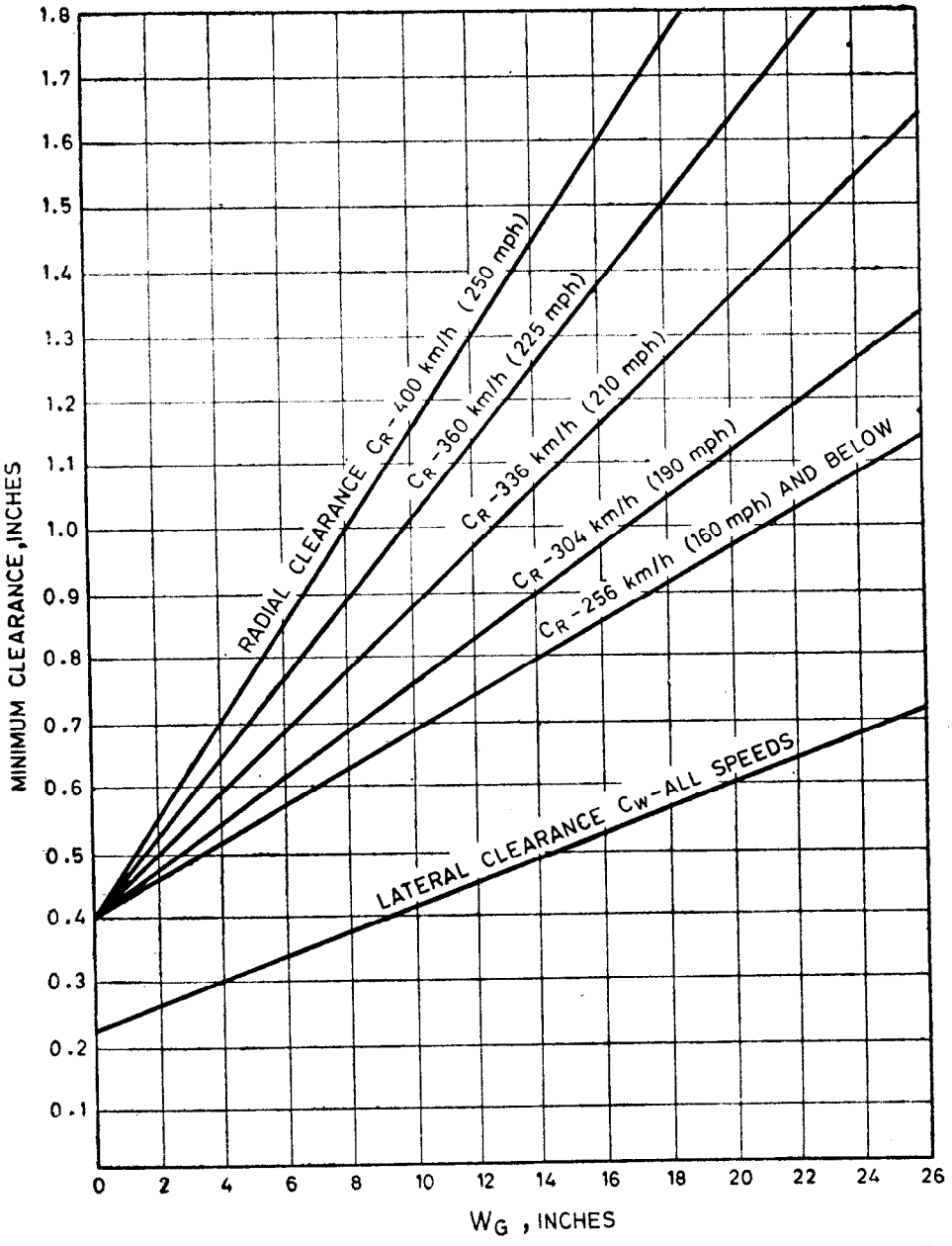


FIG. 7 CHART TO BE USED FOR CALCULATING RADIAL C_R AND LATERAL C_W CLEARANCES

5. Tyre Markings — Are to be made individually on each tyre with the following permanent and legible markings:

a) Tyre size designation.

b) Load rating and the corresponding ply rating.

c) Speed rating (expressed in kmph or mph) indicating the qualification test speed for applications exceeding 192 kmph (120 mph).

d) Date of manufacture expressed numerically by year and day of the year of manufacture using an 8-digit system of date marking based on the Julian calender. For example, 84072 corresponds to 12 March 1984. The first five digits of manufacturer's unique serial number may indicate the date of manufacture.

e) The word 'TUBELESS'.

f) Manufacturer's name and/or registered trade-mark, brand, part number, plant code, 'Made in India'.

g) Mould skid depth (mm or inch).

h) Maximum static unbalance and balance marker.

j) Awl venting details and venting markers.

k) Test standards to which the tyre has qualified.

m) Any additional/optional markings to be agreed between tyre and airframe manufacturer's to indicate certain relevant tyre design characteristics, such as deflection, inflation pressure and aspect ratio.

APPENDIX A

(*Clauses* 4.2 *and* 4.6)

NOMENCLATURE OF TERMS FOR NEW AND GROWN TYRES

Term	*Inflated New Tyre*	*Inflated Grown Tyre*	
Maximum section width	W	W_G	
Maximum shoulder width	W_s*	W_{SG}	
Maximum overall diameter	D_O	D_G	
Maximum shoulder diameter	D_S	D_{SG}	
Maximum section height	H	—	
Maximum shoulder height	H_s†	—	
Rim ledge diameter	D	D	
Minimum lateral distance required from wheel centre line to adjacent structure	W_X	W_X	
Minimum radial distance required from axle centre line to adjacent structure	R_X	R_X	
Minimum lateral clearance	—	C_W	These are minimum clearance allowances between the maximum grown tyre and adjacent structure.
Minimum radial clearance	—	C_R	
Minimum shoulder clearance	—	S_X (radial distance)	

*$W_s = 0{\cdot}88\ W$

†$H_s = 0{\cdot}82\ H$

Note — Maximum section width includes protective side ribs, lettering bars and decorations, but does not include chines (water deflectors) present on certain types of nose wheel (or auxiliary gear) tyres.

EXPLANATORY NOTE

In the preparation of this standard considerable assistance has been derived from the following publication.

ISO 3324 (Part 1)-1976 Aircraft tyres and rim: Part 1 Specifications.

ISO 3324 (Part 2)-1979 Aircraft tyres and rims: Part 2 Test methods for tyres.

T. & R. A. Data Book — 1984. Tyre and rim association, USA.

Reference to FPS system has also been made to accommodate present practice of the industry and till the complete change over to MKS system.

The conversion factors are as follows:

Pounds to kilograms — multiply by $\frac{1}{2{\cdot}204\,62}$ (rounded the nearest 5 kg)

Pounds per square inch to bars — multiply by $\frac{1}{14{\cdot}504}$ (rounded to the first decimal place)

Inch to millimetres — multiply by 25·4 (rounded to the nearest 5 mm)

Miles per hour to kilometres per hour — multiply by 1·6 (rounded to the first decimal place)

Knots to mph — multiply by 1·51 (rounded to the first decimal place)

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