TD-00036

CROSS REFERENCE FOR HOLLOW METALLIC WAVEGUIDES

1 Introduction

This document cross-references the designations of common waveguides with ordinary rectangular, reduced-height rectangular, square, circular, and double ridge cross section. In addition to standard-compliant waveguide designations, this document provides inner dimensions (without corner radii and tolerances), nominal frequency ranges, cut-off frequencies and letter frequency band designations.

2 References

[1] IEC 60153-2:2016, “Hollow metallic waveguides − Part 2: Relevant specifications for ordinary rectangular waveguides”, *Standard of the International Electrotechnical Commission*, Edition 3, May 2016.

[2] EIA-261-C, “Rectangular Waveguides (WR3 to WR2300)”, *Standard of the Electronic Components Industry Association of the United States of America*, January 2018.

[3] MOD UK DEF-5351, “Specification for Tubing, Waveguide”; *Standard of the Ministry of Defence of the United Kingdom*, June 1959, incorporating Amendments Nos. 1 (1960) to 6 (1974).

[4] MIL-DTL-85/1G, “Waveguides, Rigid, Rectangular”, *Detail Specification of the Department of Defense of the United States of America*, March 2009.

[5] MIL-DTL-85/2E “Waveguides, Rigid, Rectangular (Heavy Wall)”, *Detail Specification of the Department of Defense of the United States of America*, March 2009.

[6] MIL-DTL-85/3D, “Waveguides, Rigid, Rectangular (Millimeter Wavelength)”, *Detail Specification of the Department of Defense of the United States of America*, April 2012.

[7] IEEE Std 1785.1-2012, “Rectangular metallic waveguides and their interfaces for frequencies of 110 GHz and above, Part 1: Frequency bands and waveguide dimensions”, *Standard of the Institute of Electrical and Electronics Engineers*, March 2013.

[8] Hesler, J.L., Kerr, A.R., Grammer, W. and Wollack, E., “Recommendations for Waveguide Interfaces to 1 THz”, *Proc. 18th Int. Symp. on Space THz Tech.*, Pasadena, California, USA, March 2007.

[9] IEC 60153-3:1964, “Hollow metallic waveguides, Part 3: Relevant specifications for flat rectangular waveguides”, *Standard of the International Electrotechnical Commission*, Edition 1, January 1964.

[10] IEC 60153-6:1967 + A1:1977, “Hollow metallic waveguides, Part 6: Relevant specifications for medium flat rectangular waveguides”, *Standard of the International Electrotechnical Commission*, Edition 1, January 1967, and Amendment 1, May 1977.

[11] MIL-W-85/4C, “Waveguides, Rigid, Rectangular, Reduced Height”, Military Specification of the Department of Defense of the United States of America, December 1981.

[12] IEC 60153-7:1972, “Hollow metallic waveguides, Part 7: Relevant specifications for square waveguides”, *Standard of the International Electrotechnical Commission*, Edition 1, January 1972.

[13] IEC 60153-4:2022, “Hollow metallic waveguides, Part 4: Relevant specifications for circular waveguides”, *Standard of the International Electrotechnical Commission*, Edition 4, June 2022.

[14] EIA-200-B, “Circular Waveguides and Flanges”, *Standard of the Electronic Components Industry Association of the United States of America*, April 2018.

[15] MIL-W-23068, “Waveguides, Rigid, Circular”, *Military Specification of the Department of Defense of the United States of America*, October 1961.

[16] MIL-W-23351/4B, “Waveguides, Double Ridge (Bandwidth Ratio 2.4:1)”, *Military Specification of the Department of Defense of the United States of America*, October 1977.
Note: MIL-W-23351/4B was replaced by MIL-W-23351/4C in January 2009, but this edition is full of dimensional errors and therefore cannot be referenced.

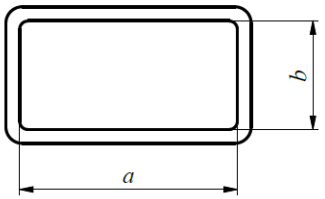
[17] MIL-W-23351/2B, “Waveguides, Double Ridge (Bandwidth Ratio 3.6:1)”, *Military Specification of the Department of Defense of the United States of America*, October 1977.

[18] EIA-304-A, “Ridge Waveguides”, *Standard of the Electronic Components Industry Association of the United States of America*, February 2019.

The standards highlighted in gray ([3], [11], [15], [16], [17]) are cancelled. Nevertheless, the waveguide designations defined therein are still in use.

3 Document Revision Control

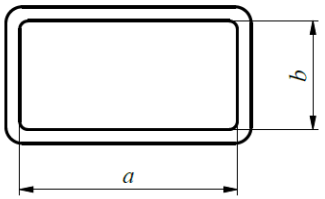
Issue	Date	Description
V	2025-02-26	- Figures improved; - Minor editorial changes.
U	2024-07-09	- Cross-sectional view of the waveguide type under consideration has been added to each table; - Harmonization of dimensions with regard to the number of decimal places (chapter 6).
T	2023-08-23	- Change of the style of section “Document Revision Control”; - Use of a lower case “k” in the IEC designations for the ordinary rectangular waveguides; - Update of references [2], [14], and [18].
S	2022-09-09	- Chapters 8 and 9 have been revised and supplemented to bring them into line with IEC 60153-4:2022. - Minor editorial changes have been made.
R	2020-09-11	- Chapter 4: Waveguides R 35, R 41, and R 3.2K to R 26K from IEC 60153-2: 2016 have been added. - Minor editorial changes have been made.
Q	2020-08-26	- Circular waveguides with preferred sizes have been revised and supplemented according to IEC 60153-4:2017. - Circular waveguides with intermediate sizes have been amended according to IEC 60153-4:1973. - Minor editorial changes have been made.
P	2020-06-04	- Start of the document revision control. Chapter numbers have been changed accordingly. - A few dimensions of the double ridge waveguides WRD 420U24, WRD 200D24, WRD 475D24 have been corrected and Ref. [16] has been changed back from MIL-W-23351/4C to its predecessor /4B.



4 Ordinary rectangular waveguides

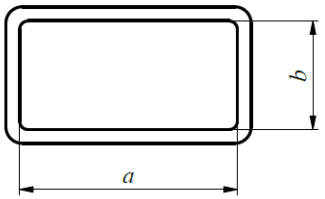
Waveguide designation				Basic inner dimension $a \times b$		Frequency		Letter band designation *****
IEC [1]	EIA [2]	UK [3]	MIL PIN [4], [5], [6]	Metric [1]	Imperial [4], [5], [6]	Nominal range * [1]	TE_{10} cut-off **	
-	-	-	-	mm	inch	GHz	GHz	-
R 3	WR 2300	WG 00	M85/1-001, 002, 161	584.20 × 292.10	23.000 × 11.500	0.32 - 0.49	0.257	-
R 4	WR 2100	WG 0	M85/1-003, 004, 162	533.40 × 266.70	21.000 × 10.500	0.35 - 0.53	0.280	-
R 5	WR 1800	WG 1	M85/1-005, 006, 163	457.20 × 228.60	18.000 × 9.000	0.41 - 0.62	0.327	-
R 6	WR 1500	WG 2	M85/1-007, 008, 164	381.00 × 190.50	15.000 × 7.500	0.49 - 0.75	0.392	-
R 8	WR 1150	WG 3	M85/1-009, 010, 165	292.10 × 146.05	11.500 × 5.750	0.64 - 0.98	0.512	-
R 9	WR 975	WG 4	M85/1-011, 012, 166	247.65 × 123.82	9.750 × 4.875	0.76 - 1.15	0.603	-
R 12	WR 770	WG 5	M85/1-013, 014, 167	195.58 × 97.79	7.700 × 3.850	0.96 - 1.46	0.764	-
R 14	WR 650	WG 6	M85/1-015, 017, 018, 019, 020, 168	165.10 × 82.55	6.500 × 3.250	1.13 - 1.73	0.905	**L**
R 18	WR 510	WG 7	M85/1-021, 023, 024, 025, 026, 169	129.54 × 64.77	5.100 × 2.550	1.45 - 2.20	1.15	-
R 22	WR 430	WG 8	M85/1-027, 029, 030, 031, 032, 170	109.22 × 54.61	4.300 × 2.150	1.72 - 2.61	1.37	Ls, R
R 26	WR 340	WG 9A	M85/1-033, 035, 036, 037, 038, 171	86.36 × 43.18	3.400 × 1.700	2.17 - 3.30	1.73	-
R 32	WR 284	WG 10	M85/1-039, 041, 042, 043, 044, 172 M85/2-001, 002, 004	72.14 × 34.04	2.840 × 1.340	2.60 - 3.95	2.07	**S**
R 35	-	-	-	66.37 × 29.50	-	2.82 - 4.29	2.25	-

TD-00036



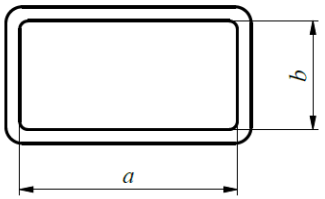
Waveguide designation				Basic inner dimension $a \times b$		Frequency		Letter band designation *****
IEC [1]	EIA [2]	UK [3]	MIL PIN [4], [5], [6]	Metric [1]	Imperial [4], [5], [6]	Nominal range * [1]	TE_{10} cut-off **	
-	-	-	-	mm	inch	GHz	GHz	-
R 40	WR 229	WG 11A	M85/1-045, 047, 048, 049, 050, 173	58.17 × 29.08	2.290 × 1.145	3.22 - 4.90	2.58	-
R 41	-	-	-	57.00 × 25.33	-	3.29 - 5.00	2.62	-
R 48	WR 187	WG 12	M85/1-051, 053, 054, 055, 056, 174 M85/2-003, 005, 006	47.549 × 22.149	1.872 × 0.872	3.94 - 5.99	3.14	**C**, G
R 58	WR 159	WG 13	M85/1-057, 059, 060, 061, 062, 175	40.386 × 20.193	1.590 × 0.795	4.64 - 7.05	3.70	C
R 70	WR 137	WG 14	M85/1-063, 065, 066, 067, 068, 176	34.849 × 15.799	1.372 × 0.622	5.38 - 8.17	4.29	Xn, J
R 84	WR 112	WG 15	M85/1-069, 071, 072, 073, 074, 177 M85/2-007	28.499 × 12.624	1.122 × 0.497	6.57 - 9.99	5.24	Xb, H
R 100	WR 90	WG 16	M85/1-075, 077, 078, 079, 080, 178 M85/2-008, 009	22.860 × 10.160	0.900 × 0.400	8.20 - 12.5	6.54	**X**
R 120	WR 75	WG 17	M85/1-081, 083, 084, 085, 086, 179	19.050 × 9.525	0.750 × 0.375	9.84 - 15.0	7.84	M
R 140	WR 62	WG 18	M85/1-087, 089, 090, 091, 092, 093, 180	15.799 × 7.899	0.622 × 0.311	11.9 - 18.0	9.46	**Ku**, P
R 180	WR 51	WG 19	M85/1-094, 096, 097, 098, 099, 181	12.954 × 6.477	0.510 × 0.255	14.5 - 22.0	11.5	N
R 220	WR 42	WG 20	M85/1-100, 102, 103, 104, 105, 106, 182	10.668 × 4.318	0.420 × 0.170	17.6 - 26.7	14.0	**K**
R 260	WR 34	WG 21	M85/1-107, 109, 110, 111, 112, 113, 183	8.636 × 4.318	0.340 × 0.170	21.7 - 33.0	17.3	-
R 320	WR 28	WG 22	M85/3-006, 007, 008, 009	7.112 × 3.556	0.280 × 0.140	26.3 - 40.0	21.0	**Ka**, R
R 400	WR 22	WG 23	M85/3-010, 011, 012, 013	5.690 × 2.845	0.224 × 0.112	32.9 - 50.1	26.3	**Q**

TD-00036



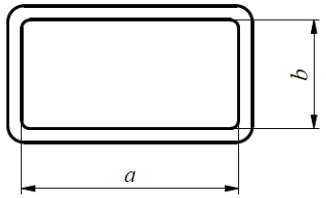
Waveguide designation				Basic inner dimension $a \times b$		Frequency		Letter band designation *****
IEC [1]	EIA [2]	UK [3]	MIL PIN [4], [5], [6]	Metric [1]	Imperial [4], [5], [6]	Nominal range * [1]	TE_{10} cut-off **	
-	-	-	-	mm	inch	GHz	GHz	-
R 500	WR 19	WG 24	M85/3-014, 015, 016	4.775 × 2.388	0.188 × 0.094	39.2 - 59.6	31.3	**U**
R 620	WR 15	WG 25	M85/3-017, 018	3.759 × 1.880	0.148 × 0.074	50 - 75	39.7	**V**
R 740	WR 12	WG 26	M85/3-020, 021	3.0988 × 1.5494	0.122 × 0.061	60 - 90	48.2	**E**
R 900	WR 10	WG 27	M85/3-023, 024	2.5400 × 1.2700	0.1000 × 0.0500	75 - 110	58.8	**W**
R 1.2k	WR 8	WG 28	M85/3-026, 027	2.0320 × 1.0160	0.0800 × 0.0400	90 - 140	73.5	**F**
R 1.4k	WR 7 ***	WG 29	M85/3-029, 030	1.6510 × 0.8255	0.0650 × 0.0325	110 - 170	90.5	**D**
R 1.8k	WR 5 ****	WG 30 ****	M85/3-032 ****, 033 ****	1.295 × 0.6475	0.0510 × 0.0255	140 - 220	115	**G**
R 2.2k	WR 4 ****	WG 31 ****	M85/3-035 ****, 036 ****	1.092 × 0.546	0.0430 × 0.0215	170 - 260	137	**Y**
R 2.6k	WR 3 ****	WG 32 ****	M85/3-038 ****, 039 ****	0.864 × 0.432	0.0340 × 0.0170	220 - 330	173	**H**, J
R 3.2k	-	-	-	0.710 × 0.355	-	260 - 400	210	-
R 4k	-	-	-	0.570 × 0.285	-	330 - 500	262	-
R 5k	-	-	-	0.470 × 0.235	-	400 - 600	318	-
R 6.2k	-	-	-	0.380 × 0.190	-	500 - 750	393	-
R 7.4k	-	-	-	0.310 × 0.155	-	600 - 900	482	-

TD-00036



Waveguide designation				Basic inner dimension $a \times b$		Frequency		Letter band designation *****
IEC [1]	EIA [2]	UK [3]	MIL PIN [4], [5], [6]	Metric [1]	Imperial [4], [5], [6]	Nominal range * [1]	TE_{10} cut-off **	
-	-	-	-	mm	inch	GHz	GHz	-
R 9k	-	-	-	0.250 × 0.125	-	750 - 1100	598	-
R 12k	-	-	-	0.200 × 0.100	-	900 - 1400	747	-
R 14k	-	-	-	0.164 × 0.082	-	1100 - 1700	911	-
R 18k	-	-	-	0.130 × 0.065	-	1400 - 2200	1149	-
R 22k	-	-	-	0.106 × 0.053	-	1700 - 2600	1410	-
R 26k	-	-	-	0.086 × 0.043	-	2200 - 3300	1737	-

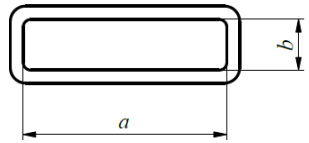
* The nominal frequency range is from approximately 1.25 to 1.9 times the TE_{10} cut-off frequency.
** The TE_{10} cut-off frequency is given by $f_c = c_0/(2a)$ with c_0 = 299792458 ms^{-1} and the waveguide width a.
*** The WR 7 waveguide per EIA [2] is sometimes misleadingly referred to as WR-06 (e.g. in [6]).
**** The internal dimensions of this waveguide differ slightly from those of the corresponding R waveguide.
***** Bold characters indicate classic band designations. Standard characters indicate other common band designations.
The waveguide designation R 26k has been corrected by the author because the designation given in standard [1] is obviously wrong.



5 Ordinary rectangular waveguides for millimeter and sub-millimeter waves

Waveguide designation						Inner dimension		Frequency	
IEEE [7]	IEC [1]	EIA [2]	Hesler [8]	UK [3]	MIL PIN [6]	Width *a* [7]	Height *b* [7]	Nominal range [7]	TE_{10} cut-off [7]
-	-	-	-	-	-	µm	µm	GHz	GHz
WM-2540	R 900	WR 10	WR 10	WG 27	M85/3-023, 024	2540	1270	75 - 110	59.014
WM-2032	R 1.2k	WR 8	WR 8	WG 28	M85/3-026, 027	2032	1016	90 - 140	73.768
WM-1651	R 1.4k	WR 7 **	WR 6.5	WG 29	M85/3-029, 030	1651	825.5	110 - 170	90.791
WM-1295	R 1.8k	WR 5 *	WR 5.1 *	WG 30 *	M85/3-032 *, 033 *	1295	647.5	140 - 220	115.75
WM-1092	R 2.2k	WR 4 *	WR 4.3 *	WG 31 *	M85/3-035 *, 036 *	1092	546	170 - 260	137.27
WM-864	R 2.6k	WR 3 *	WR 3.4 *	WG 32 *	M85/3-038 *, 039 *	864	432	220 - 330	173.49
WM-710	R 3.2k	-	WR 2.8 *	-	-	710	355	260 - 400	211.12
WM-570	R 4k	-	WR 2.2 *	-	-	570	285	330 - 500	262.98
WM-470	R 5k	-	WR 1.9 *	-	-	470	235	400 - 600	318.93
WM-380	R 6.2k	-	WR 1.5 *	-	-	380	190	500 - 750	394.46
WM-310	R 7.4k	-	WR 1.2 *	-	-	310	155	600 - 900	483.54
WM-250	R 9k	-	WR 1.0 *	-	-	250	125	750 - 1100	599.58
WM-200	R 12k	-	(WR 0.8 *)	-	-	200	100	900 - 1400	749.48
WM-164	R 14k	-	(WR 0.65 *)	-	-	164	82	1100 - 1700	914.00
WM-130	R 18k	-	(WR 0.51 *)	-	-	130	65	1400 - 2200	1153.0
WM-106	R 22k	-	-	-	-	106	53	1700 - 2600	1414.1
WM-86	R 26k	-	-	-	-	86	43	2200 - 3300	1743.0
(WM-71)	-	-	-	-	-	71	35.5	2600 - 4000	2111.2
(WM-57)	-	-	-	-	-	57	28.5	3300 - 5000	2629.8

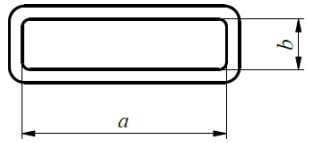
* The internal dimensions of this waveguide differ slightly from those of the corresponding WM and R waveguide.
** The WR 7 waveguide per EIA [2] is sometimes misleadingly referred to as WR-06 (e.g. in [6]).
The waveguide designation R 26k has been corrected by the author because the designation given in standard [1] is obviously wrong.



6 Rectangular waveguides of reduced height

Waveguide designation			Basic inner dimension $a \times b$		Frequency		Letter band designation ****
IEC [9], [10]	½ EIA *	MIL PIN [11]	Metric	Imperial	Nominal range** [1], [9], [10]	TE_{10} cut-off ***	
-	-	-	mm	inch	GHz	GHz	-
-	½ WR 2300	-	584.20 × 146.05 [2]	23.000 × 5.750 [2]	0.32 - 0.49	0.257	-
-	½ WR 2100	-	533.40 × 133.35 [2]	21.000 × 5.250 [2]	0.35 - 0.53	0.281	-
-	½ WR 1800	-	457.20 × 114.30 [2]	18.000 × 4.500 [2]	0.41 - 0.62	0.328	-
-	½ WR 1500	-	381.00 × 145.25 [2]	15.000 × 3.750 [2]	0.49 - 0.75	0.393	-
-	½ WR 1150	-	292.10 × 73.025 [2]	11.500 × 2.875 [2]	0.64 - 0.98	0.513	-
-	≈ ½ WR 975	M85/4-009, 010, 011, 012, 013, 014, 021, 022	247.65 × 61.87 [11]	9.750 × 2.436 [11]	0.76 - 1.15	0.605	-
M 12	½ WR 770	-	195.58 × 48.90 [10]	7.700 × 1.925 [10]	0.96 - 1.46	0.766	-
M 14	½ WR 650	-	165.10 × 41.30 [10]	6.500 × 1.626 [10]	1.14 - 1.73	0.908	**L**
M 18	½ WR 510	-	129.54 × 32.40 [10]	5.100 × 1.276 [10]	1.45 - 2.20	1.157	-
M 22	½ WR 430	-	109.22 × 27.30 [10]	4.300 × 1.075 [10]	1.72 - 2.61	1.372	Ls, R
F 22	-	-	109.22 × 13.10 [9]	4.300 × 0.5157 [9]			
M 26	½ WR 340	-	86.36 × 21.60 [10]	3.4000 × 0.8504 [10]	2.17 - 3.30	1.736	-
F 26	-	-	86.36 × 10.40 [9]	3.400 × 0.4094 [9]			
-	-	M85/4-001, 002, 007	72.14 × 25.50 [11]	2.840 × 1.004 [11]	2.60 - 3.95	2.078	**S**
M 32	-	-	72.136 × 18.000 [10]	2.8400 × 0.7087 [10]			
-	½ WR 284	M85/4-015, 016, 017	72.14 × 17.02 [11]	2.840 × 0.670 [11]			
F 32	-	-	72.14 × 8.60 [9]	2.840 × 0.3386 [9]			
M 40	≈ ½ WR 229	-	58.166 × 14.500 [10]	2.2900 × 0.5709 [10]	3.22 - 4.90	2.577	-
F 40	-	-	58.17 × 7.00 [9]	2.2900 × 0.2756 [9]			
M(F) 45 = F 45	-	-	50.800 × 16.942 [10]	2.000 × 0.667 [10]	3.68 - 5. 60	2.951	-

TD-00036



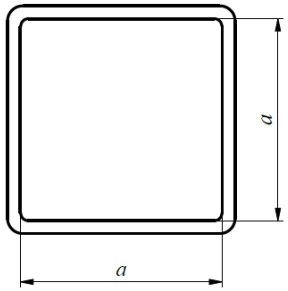
Waveguide designation			Basic inner dimension $a \times b$		Frequency		Letter band designation ****
IEC [9], [10]	½ EIA *	MIL PIN [11]	Metric	Imperial	Nominal range** [1], [9], [10]	TE_{10} cut-off ***	
-	-	-	mm	inch	GHz	GHz	-
M 48	-	-	47.549 × 11.900 [10]	1.8720 × 0.4685 [10]	3.94 - 5.99	3.152	**C**, G
-	½ WR 187	-	47.550 × 11.075 [2]	1.872 × 0.436 [2]			
-	-	M85/4-018, 019, 020	47.55 × 9.45 [11]	1.872 × 0.372 [11]			
F 48	-	-	47.55 × 5.70 [9]	1.872 × 0.2244 [9]			
M 58	½ WR 159	-	40.386 × 10.100 [10]	1.5900 × 0.3976 [10]	4.64 - 7.05	3.712	C
F 58	-	-	40.39 × 5.00 [9]	1.5900 × 0.1969 [9]			
-	-	M85/4-003, 004, 008	34.85 × 12.37 [11]	1.372 × 0.487 [11]	5.38 - 8.17	4.301	Xn, J
M 70	-	-	34.849 × 8.700 [10]	1.3720 × 0.3425 [10]			
-	½ WR 137	-	34.85 × 7.90 [2]	1.372 × 0.311 [2]			
F 70	-	-	34.85 × 5.00 [9]	1.3720 × 0.1969 [9]			
-	½ WR 112	M85/4-030, 031	28.50 × 6.32 [11]	1.122 × 0.249 [11]	6.57 - 9.99	5.260	Xb, H
F 84	-	-	28.499 × 5.000 [9]	1.1220 × 0.1969 [9]			
-	½ WR 90	M85/4-034, 035, 036, 037	22.86 × 5.08 [11]	0.90 × 0.20 [11]	8.20 - 12.5	6.557	**X**
M(F) 100 = F 100	-	-	22.860 × 5.000 [10]	0.9000 × 0.1969 [10]			

* The waveguide designations listed here, e.g. “1/2 WR 90”, are composed of the EIA designations as per [2] and the prefix “½” to indicate a bisection of the original heights. Other common designations are “WR 90 Half Height” and “WR 90 H/H”.

** The nominal frequency range is from approximately 1.25 to 1.9 times the TE_{10} cut-off frequency.

*** The TE_{10} cut-off frequency is given by $f_c = c_0/(2a)$ with c_0 = 299792458 ms^{-1} and the waveguide width a.

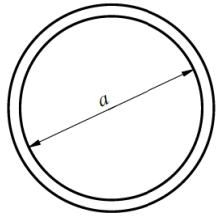
**** Bold characters indicate classic band designations. Standard characters indicate other common band designations.



7 Square waveguides

Waveguide designation	Inner width a		Frequency	
IEC [12]	Metric [12]	Imperial [12]	Nominal range * [12]	$TE_{10/01}$ cut-off **
-	mm	inch	GHz	GHz
Q 41	48.000	1.8898	3.59 – 4.29	3.123
Q 49	40.000	1.5748	4.31 – 5.15	3.747
Q 54	36.000	1.4173	4.79 – 5.73	4.164
Q 61	32.000	1.2598	5.39 – 6.44	4.684
Q 65 ***	30.000	1.1811	5.75 – 6.87	4.997
Q 70	28.000	1.1024	6.16 – 7.36	5.353
Q 75	26.000	1.0236	6.63 – 7.93	5.765
Q 85	23.000	0.9055	7.50 – 8.96	6.517
Q 100	19.500	0.7677	8.84 – 10.57	7.687
Q 115	17.000	0.6693	10.14 – 12.12	8.817
Q 130	15.000	0.5906	11.49 – 13.74	9.993

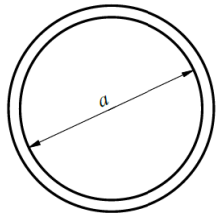
* The nominal frequency range is from approximately 1.15 to 1.375 times the $TE_{10/01}$ cut-off frequency.
** The $TE_{10/01}$ cut-off frequency is given by $f_c = c_0/(2a)$ with c_0 = 299792458 ms^{-1} and the waveguide width a.
*** According to [12] Q 65 is not a preferred size.



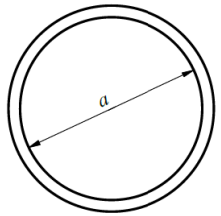
8 Circular waveguides (preferred sizes)

Waveguide designation				Inner diameter a		Frequency			
IEC [13]	EIA [14]	UK [3]	MIL Type * [15]	Metric [13]	Imperial [14]	Nominal range ** [14]	TE_{11} cut-off [13]	TM_{01} cut-off [13]	TE_{21} cut-off [13]
-	-	-	-	mm	inch	GHz	GHz	GHz	GHz
C 3.3	WC 2551	CG 1	WRC 312U14	647.90	25.508	0.312 - 0.427	0.271	0.354	0.450
C 4	WC 2179	CG 2	WRC 365U14	553.49	21.791	0.365 - 0.500	0.317	0.415	0.527
C 4.5	WC 1862	CG 3	WRC 427U14	472.85	18.616	0.427 - 0.586	0.372	0.485	0.616
C 5.3	WC 1590	CG 4	WRC 500U14	403.94	15.903	0.500 - 0.686	0.435	0.568	0.722
C 6.2	WC 1359	CG 5	WRC 586U14	345.06	13.585	0.586 - 0.803	0.509	0.665	0.845
C 7	WC 1161	CG 6	WRC 686U14	294.79	11.606	0.686 - 0.939	0.596	0.778	0.989
C 8	WC 992	CG 7	WRC 803U14	251.84	9.915	0.803 - 1.10	0.698	0.911	1.16
C 10	WC 847	CG 8	WRC 939U14	215.14	8.470	0.939 - 1.29	0.817	1.07	1.35
C 12	WC 724	CG 9	WRC 110D14	183.77	7.235	1.10 - 1.51	0.956	1.25	1.59
C 14	WC 618	CG 10	WRC 129D14	157.00	6.181	1.29 - 1.76	1.12	1.46	1.86
C 16	WC 528	CG 11	WRC 151D14	134.11	5.280	1.51 - 2.07	1.31	1.71	2.17
C 18	WC 451	CG 12	WRC 176D14	114.58	4.511	1.76 - 2.42	1.53	2.00	2.54
C 22	WC 385	CG 13	WRC 207D14	97.866	3.853	2.07 - 2.83	1.80	2.34	2.98
C 25	WC 329	CG 14	WRC 242D14	83.617	3.292	2.42 - 3.31	2.10	2.74	3.49
C 30	WC 281	CG 15	WRC 283D14	71.425	2.812	2.83 - 3.88	2.46	3.21	4.08
C 35	WC 240	CG 16	WRC 331D14	61.036	2.403	3.31 - 4.54	2.88	3.76	4.78
C 40	WC 205	CG 17	WRC 389D14	51.994	$2.047 \approx 2\ ^{3}/_{64}$	3.89 - 5.33	3.38	4.41	5.61
C 48	WC 175	CG 18	WRC 454D14	44.450	$1.750 = 1\ ^{3}/_{4}$	4.54 - 6.23	3.95	5.16	6.56
C 56	WC 150	CG 19	WRC 530D14	38.100	$1.500 = 1\ ^{1}/_{2}$	5.30 - 7.27	4.61	6.02	7.65
C 65	WC 128	CG 20	WRC 621D14	32.537	$1.281 \approx 1\ ^{9}/_{32}$	6.21 - 8.51	5.40	7.05	8.96
C 76	WC 109	CG 21	WRC 727D14	27.788	$1.094 \approx 1\ ^{3}/_{32}$	7.27 - 9.97	6.32	8.26	10.5

TD-00036



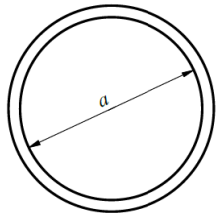
Waveguide designation				Inner diameter a		Frequency			
IEC [13]	EIA [14]	UK [3]	MIL Type * [15]	Metric [13]	Imperial [14]	Nominal range ** [14]	TE_{11} cut-off [13]	TM_{01} cut-off [13]	TE_{21} cut-off [13]
-	-	-	-	mm	inch	GHz	GHz	GHz	GHz
C 89	WC 94	CG 22	WRC 849D14	23.825	0.938 ≈ $^{15}/_{16}$	8.49 - 11.6	7.37	9.63	12.2
C 104	WC 80	CG 23	WRC 997D14	20.244	0.797 ≈ $^{51}/_{64}$	9.97 - 13.7	8.68	11.3	14.4
C 120	WC 69	CG 24	WRC 116C14	17.475	0.688 ≈ $^{11}/_{16}$	11.6 - 15.9	10.1	13.1	16.7
C 140	WC 59	CG 25	WRC 134C14	15.088	0.594 ≈ $^{19}/_{32}$	13.4 - 18.4	11.6	15.2	19.3
C 165	WC 50	CG 26	WRC 159C14	12.700	0.500 = $^{1}/_{2}$	15.9 - 21.8	13.8	18.1	22.9
C 190	WC 44	CG 27	WRC 182C14	11.125	0.438 ≈ $^{7}/_{16}$	18.2 - 24.9	15.8	20.6	26.2
C 220	WC 38	CG 28	WRC 212C14	9.5250	0.375 = $^{3}/_{8}$	21.2 - 29.1	18.4	24.1	30.6
C 255	WC 33	CG 29	WRC 243C14	8.3312	0.328 ≈ $^{21}/_{64}$	24.3 - 33.2	21.1	27.5	35.0
C 290	WC 28	CG 30	WRC 283C14	7.1374	0.281 ≈ $^{9}/_{32}$	28.3 - 38.8	24.6	32.2	40.8
C 330	WC 25	CG 31	WRC 318C14	6.3500	0.250 = $^{1}/_{4}$	31.8 - 43.6	27.7	36.1	45.9
C 380	WC 22	CG 32	WRC 364C14	5.5626	0.219 ≈ $^{7}/_{32}$	36.4 - 49.8	31.6	41.3	52.4
C 430	WC 19	CG 33	WRC 424C14	4.7752	0.188 ≈ $^{3}/_{16}$	42.4 - 58.1	36.8	48.1	61.0
C 495	WC 17	CG 34	WRC 463C14	4.3688	0.172 ≈ $^{11}/_{64}$	46.3 - 63.5	40.2	52.5	66.7
C 580	WC 14	CG 35	WRC 566C14	3.5814	0.141 ≈ $^{9}/_{64}$	56.6 - 77.5	49.1	64.1	81.4
C 660	WC 13	CG 36	WRC 635C14	3.1750	0.125 = $^{1}/_{8}$	63.5 - 87.2	55.3	72.3	91.8
C 765	WC 11	CG 37	WRC 727C14	2.7686	0.109 ≈ $^{7}/_{64}$	72.7 - 99.7	63.5	82.9	105
C 890	WC 9	CG 38	WRC 848C14	2.3876	0.094 ≈ $^{3}/_{32}$	84.8 - 116	73.6	96.1	122
C 1.04k	-	-	-	2.0244	-	-	86.8	113	144
C 1.2k	-	-	-	1.7475	-	-	101	131	167
C 1.4k	-	-	-	1.5088	-	-	116	152	193
C 1.65k	-	-	-	1.2700	-	-	138	181	229
C 1.9k	-	-	-	1.1125	-	-	158	206	262



Waveguide designation				Inner diameter a		Frequency			
IEC [13]	EIA [14]	UK [3]	MIL Type * [15]	Metric [13]	Imperial [14]	Nominal range ** [14]	TE_{11} cut-off [13]	TM_{01} cut-off [13]	TE_{21} cut-off [13]
-	-	-	-	mm	inch	GHz	GHz	GHz	GHz
C 2.2k	-	-	-	0.9525	-	-	184	241	306
C 2.55k	-	-	-	0.8331	-	-	211	275	350
C 2.9k	-	-	-	0.7137	-	-	246	322	408
C 3.3k	-	-	-	0.6350	-	-	277	361	459
C 3.8k	-	-	-	0.5563	-	-	316	413	524
C 4.3k	-	-	-	0.4775	-	-	368	481	610
C 4.95k	-	-	-	0.4369	-	-	402	525	667
C 5.8k	-	-	-	0.3581	-	-	491	641	814
C 6.6k	-	-	-	0.3175	-	-	553	723	918
C 7.65k	-	-	-	0.2769	-	-	635	829	1050
C 8.9k	-	-	-	0.2388	-	-	736	961	1220
C 10.4k	-	-	-	0.2024	-	-	868	1130	1440
C 12k	-	-	-	0.1748	-	-	1010	1310	1670
C 14k	-	-	-	0.1509	-	-	1160	1520	1930
C 16.5k	-	-	-	0.1270	-	-	1380	1810	2290
C 19k	-	-	-	0.1113	-	-	1580	2060	2620
C 22k	-	-	-	0.0953	-	-	1840	2410	3060
C 25.5k	-	-	-	0.0833	-	-	2110	2750	3500
C 29k	-	-	-	0.0714	-	-	2460	3210	4080

* An additional letter added to the MIL type designation identifies the material as:
A - aluminium alloy; B - brass; C - copper; M - magnesium-based alloy; S - silver alloy. E.g. WRC 312U14A.

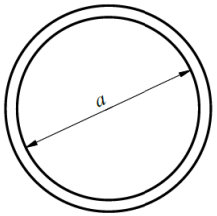
** The nominal frequency range defined in [14] is from approximately 1.15 times the TE_{11} cut-off frequency to 0.95 times the TE_{21} cut-off frequency.



9 Circular waveguides (preferred and intermediate sizes) [13]

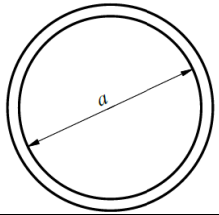
Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*
IEC	Metric	IEC	Metric	IEC	Metric	IEC	Metric	IEC	Metric
-	mm	-	mm	-	mm	-	mm	-	mm
C 3.3	647.90	C 7	294.79	C 16	134.11	C 35	61.036	C 76	27.788
C 3.43	623.00	C 7.54	283.00	C 16.5	129.00	C 36.4	58.600	C 80.0	26.700
C 3.56	599.00	C 7.85	272.00	C 17.2	124.00	C 37.8	56.400	C 83.1	25.700
C 3.71	576.00	C 7.99	262.00	C 17.9	119.00	C 39.4	54.200	C 86.1	24.800
C 4	553.49	C 8	251.84	C 18	114.58	C 40	51.994	C 89	23.825
C 4.01	532.00	C 8.82	242.00	C 19.4	110.00	C 42.7	50.000	C 93.2	22.900
C 4.17	512.00	C 9.16	233.00	C 20.1	106.00	C 44.4	48.100	C 97.0	22.000
C 4.34	492.00	C 9.53	224.00	C 20.9	102.00	C 46.2	46.200	C 101	21.100
C 4.5	472.85	C 10	215.14	C 22	97.866	C 48	44.450	C 104	20.244
C 4.69	455.00	C 10.3	207.00	C 22.7	94.000	C 49.9	42.800	C 109	19.500
C 4.88	437.00	C 10.7	199.00	C 23.6	90.400	C 51.8	41.200	C 114	18.800
C 5.08	420.00	C 11.2	191.00	C 24.5	87.000	C 53.9	39.600	C 118	18.150
C 5.3	403.94	C 12	183.77	C 25	83.617	C 56	38.100	C 120	17.475
C 5.50	388.00	C 12.1	176.50	C 26.6	80.400	C 58.3	36.600	C 127	16.850
C 5.72	373.00	C 12.6	170.00	C 27.7	77.200	C 60.6	35.200	C 129	16.250
C 5.95	359.00	C 13.1	163.50	C 28.7	74.400	C 63.2	33.800	C 136	15.650
C 6.2	345.06	C 14	157.00	C 30	71.425	C 65	32.537	C 140	15.088
C 6.43	332.00	C 14.1	151.00	C 31.1	68.600	C 68.2	31.300	C 148	14.450
C 6.69	319.00	C 14.7	145.00	C 32.3	66.000	C 70.9	30.100	C 154	13.850
C 6.95	307.00	C 15.3	139.50	C 33.7	63.400	C 73.9	28.900	C 161	13.250

TD-00036



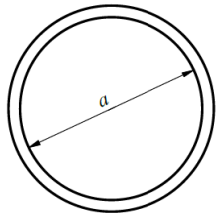
Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*
IEC	Metric	IEC	Metric	IEC	Metric	IEC	Metric	IEC	Metric
-	mm	-	mm	-	mm	-	mm	-	mm
C 165	12.700	C 330	6.3500	C 660	3.1750	C 1.4k	1.5088	C 2.9k	0.7137
C 174	12.300	C 348	6.1400	C 696	3.0700	C 1.48k	1.4450	C 3.08k	0.6940
C 179	11.900	C 359	5.9400	C 721	2.9600	C 1.54k	1.3850	C 3.17k	0.6740
C 186	11.500	C 372	5.7400	C 746	2.8600	C 1.61k	1.3250	C 3.27k	0.6520
C 190	11.125	C 380	5.5626	C 765	2.7686	C 1.65k	1.2700	C 3.3k	0.6350
C 198	10.760	C 398	5.3600	C 799	2.6700	C 1.74k	1.2300	C 3.48k	0.6140
C 207	10.300	C 414	5.1600	C 831	2.5700	C 1.79k	1.1900	C 3.59k	0.5940
C 219	9.7000	C 429	4.9500	C 876	2.4400	C 1.86k	1.1500	C 3.72k	0.5740
C 220	9.5250	C 430	4.7752	C 890	2.3876	C 1.9k	1.1125	C 3.8k	0.5563
C 232	9.2200	C 457	4.6700	C 932	2.2900	C 1.98k	1.0760	C 3.98k	0.5360
C 239	8.9200	C 467	4.5700	C 970	2.2000	C 2.07k	1.0300	C 4.14k	0.5160
C 248	8.6200	C 478	4.4700	C 1.01k	2.1100	C 2.19k	0.9700	C 4.29k	0.4950
C 255	8.3312	C 495	4.3688	C 1.04k	2.0244	C 2.2k	0.9525	C 4.3k	0.4775
C 266	8.0200	C 512	4.1700	C 1.09k	1.9500	C 2.32k	0.9220	C 4.57k	0.4670
C 277	7.7200	C 539	3.9600	C 1.14k	1.8800	C 2.39k	0.8920	C 4.67k	0.4570
C 288	7.4200	C 568	3.7600	C 1.18k	1.8150	C 2.48k	0.8620	C 4.78k	0.4470
C 290	7.1374	C 580	3.5814	C 1.2k	1.7475	C 2.55k	0.8331	C 4.95k	0.4369
C 308	6.9400	C 613	3.4800	C 1.27k	1.6850	C 2.66k	0.8020	C 5.12k	0.4170
C 317	6.7400	C 632	3.3800	C 1.29k	1.6250	C 2.77k	0.7720	C 5.39k	0.3960
C 327	6.5200	C 651	3.2800	C 1.36k	1.5650	C 2.88k	0.7420	C 5.68k	0.3760

TD-00036



Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*	Designation	Inner dia. *a*
IEC	Metric	IEC	Metric	IEC	Metric	IEC	Metric	IEC	Metric
-	mm	-	mm	-	mm	-	mm	-	mm
C 5.8k	0.3581	C 12k	0.1748	C 25.5k	0.0833				
C 6.13k	0.3480	C 12.7k	0.1685	C 26.6k	0.0802				
C 6.32k	0.3380	C 12.9k	0.1625	C 27.7k	0.0772				
C 6.51k	0.3280	C 13.6k	0.1565	C 28.8k	0.0742				
C 6.6k	0.3175	C 14k	0.1509	C 29k	0.0714				
C 6.96k	0.3070	C 14.8k	0.1445						
C 7.21k	0.2960	C 15.4k	0.1385						
C 7.46k	0.2860	C 16.1k	0.1325						
C 7.65k	0.2769	C 16.5k	0.1270						
C 7.99k	0.2670	C 17.4k	0.1230						
C 8.31k	0.2570	C 17.9k	0.1190						
C 8.76k	0.2440	C 18.6k	0.1150						
C 8.9k	0.2388	C 19k	0.1113						
C 9.32k	0.2290	C 19.8k	0.1076						
C 9.7k	0.2200	C 20.7k	0.1030						
C 10.1k	0.2110	C 21.9k	0.0970						
C 10.4k	0.2024	C 22k	0.0953						
C 10.9k	0.1950	C 23.2k	0.0092						
C 11.4k	0.1880	C 23.9k	0.0892						
C 11.8k	0.1815	C 24.8k	0.0862						

The preferred waveguide types are highlighted in gray, while the intermediate sizes are without highlighting.

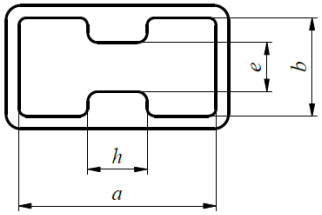


10 Circular waveguides (proprietary sizes) for frequencies of 100 GHz and above

For circular waveguides intended for frequencies of 100 GHz and above, various companies (e.g. Cernex, Custom Microwave, Ducommun, Millitech, Quinstar, SPINNER, TRG) have defined proprietary waveguide sizes in the past. Over the years, these have developed into a quasi-standard. The following table lists the most used sizes of these proprietary waveguides. The waveguide designation used here follows the well-established EIA designation scheme [14]. Bold printed values of the inner diameter indicate the original unrounded values.

Waveguide designation				**Inner diameter a**		**Frequency**			
IEC [13]	**pursued EIA (EIA [14])**	**UK [3]**	**MIL Type [15]**	**Metric**	**Imperial**	**Nominal range ***	**TE_{11} cut-off ****	**TM_{01} cut-off *****	**TE_{21} cut-off ******
-	**-**	**-**	**-**	**mm**	**inch**	**GHz**	**GHz**	**GHz**	**GHz**
C 890	WC 9.4 (WC 9)	CG 38	WRC 848C14	2.388	**0.094** ≈ $^{3}/_{32}$	84.6 - 116	73.6	96.1	122
-	WC 8.9	-	-	2.261	**0.089** ≈ $^{91}/_{1024}$	89.4 - 122	77.7	102	129
-	WC 8.2	-	-	2.083	**0.082** ≈ $^{21}/_{256}$	97.0 - 133	84.4	110	140
-	WC 7.9	-	-	**2.000**	0.07874 ≈ $^{81}/_{1024}$	101 - 138	87.9	115	146
-	WC 7.5	-	-	1.905	**0.075** = $^{\mathbf{3}}/_{\mathbf{40}}$	106 - 145	92.2	120	153
-	WC 7.3	-	-	1.854	**0.073** ≈ $^{75}/_{1024}$	109 - 149	94.8	124	157
-	WC 6.7	-	-	1.702	**0.067** ≈ $^{69}/_{1024}$	119 - 163	103	135	171
-	WC 5.9	-	-	**1.500**	0.05906 ≈ $^{15}/_{256}$	135 - 185	117	153	194
-	WC 5.8	-	-	1.473	**0.058** ≈ $^{59}/_{1024}$	137 - 188	119	156	198
-	WC 4.9	-	-	1.245	**0.049** ≈ $^{25}/_{512}$	162 - 222	141	184	234
-	WC 4.5	-	-	1.143	**0.045** ≈ $^{23}/_{512}$	177 - 242	154	201	255
-	WC 3.9	-	-	0.991	**0.039** ≈ $^{5}/_{128}$	204 - 280	177	232	294

* The nominal frequency range is from approximately 1.15 times the TE_{11} cut-off frequency to 0.95 times the TE_{21} cut-off frequency.
** The TE_{11} cut-off frequency is given by $f_c = 1.8412\ c_0/(\pi a)$ with $c_0 = 299792458$ ms^{-1} and the waveguide diameter a.
*** The TM_{01} cut-off frequency is given by $f_c = 2.4048\ c_0/(\pi a)$ with $c_0 = 299792458$ ms^{-1} and the waveguide diameter a.
**** The TE_{21} cut-off frequency is given by $f_c = 3.0542\ c_0/(\pi a)$ with $c_0 = 299792458$ ms^{-1} and the waveguide diameter a

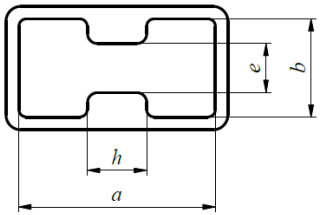


11 Double ridge waveguides with bandwidth ratio of 2.4:1

Waveguide designation			Basic inner dimension								Frequency [16]	
MIL [16]		EIA [18]	Metric [16]				Imperial [16]				Nominal range	TE_{10} cutoff
Type *	PIN		Width *a*	Height *b*	Gap *e*	Ridge *h*	Width *a*	Height *b*	Gap *e*	Ridge *h*		
-	-	-	mm	mm	mm	mm	inch	inch	inch	inch	GHz	GHz
WRD 175U24 A, B, C, S	M23351/4-001, 002, 003, 004	WD 2970-742	753.54	350.39	148.92	188.39	29.667	13.795	5.863	7.417	0.175 - 0.420	0.146
WRD 267U24 A, B, C, S	M23351/4-005, 006, 007, 008	WD 1940-486	493.47	229.46	97.51	123.37	19.428	9.034	3.839	4.857	0.267 - 0.640	0.222
WRD 420U24 A, B, C, S	M23351/4-009, 010, 011, 012	WD 1230-308	313.26	145.72	61.90	78.31	12.333	5.737	2.437	3.083	0.420 - 1.000	0.350
WRD 640U24 A, B, C, S	M23351/4-013, 014, 015, 016	WD 810-203	205.74	95.68	40.67	51.44	8.100	3.767	1.601	2.025	0.640 - 1.530	0.533
WRD 840U24 A, B, C, S	M23351/4-017, 018, 019, 020	WD 617-154	156.64	72.85	30.96	39.17	6.167	2.868	1.219	1.542	0.840 - 2.000	0.700
WRD 150D24 A, B, C, S	M23351/4-021, 022, 023, 024	WD 346-86	87.76	40.82	17.348	21.946	3.455	1.607	0.683	0.864	1.500 - 3.600	1.249
WRD 200D24 A, B, C, S	M23351/4-025, 026, 027, 028	WD 259-65	65.79	30.61	13.00	16.46	2.590	1.205	0.512	0.648	2.000 - 4.800	1.666
WRD 350D24 A, B, C, S	M23351/4-029, 030, 031, 032	WD 148-37	37.59	17.48	7.417	9.398	1.480	0.688	0.292	0.370	3.500 - 8.200	2.915
WRD 475D24 A, B, C, S	M23351/4-033, 034, 035, 036	WD 109-27	27.69	12.85	5.46	6.91	1.090	0.506	0.215	0.272	4.750 - 11.000	3.961
WRD 750D24 A, B, C, S	M23351/4-037, 038, 039, 040	WD 69-17	17.55	8.15	3.45	4.39	0.691	0.321	0.136	0.173	7.500 - 18.000	6.239
WRD 110C24 A, B, C, S	M23351/4-041, 042, 043, 044	WD 47-12	11.96	5.56	2.362	2.997	0.471	0.219	0.093	0.118	11.000 - 26.500	9.363
WRD 180C24 A, B, C, S	M23351/4-045, 046, 047, 048	WD 29-7	7.32	3.40	1.448	1.829	0.288	0.134	0.057	0.072	18.000 - 40.000	14.995
DR 19 **	M23351/4-049, 050, 051, 052	-	26.04	12.06	4.85	6.50	1.025	0.475	0.191	0.256	4.750 - 11.000	4.086

* The additional letter added to the MIL type designation indicates material as: A – aluminum alloy; B – copper alloy (brass); C – copper; S – silver alloy.

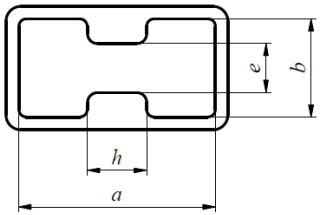
** The MIL specification [16] does not list a type designation for this waveguide. Commonly the designation DR 19 is in use.



12 Double ridge waveguides with bandwidth ratio of 3.6:1

Waveguide designation			Basic inner dimension								Frequency [17]	
MIL [17]		EIA [18]	Metric [17]				Imperial [17]				Nominal range	TE_{10} cutoff
Type *	PIN		Width *a*	Height *b*	Gap *e*	Ridge *h*	Width *a*	Height *b*	Gap *e*	Ridge *h*		
-	-	-	mm	mm	mm	mm	inch	inch	inch	inch	GHz	GHz
WRD 108U36 A, B, C, S	M23351/2-001, 002, 003, 004	WD 3460-866	879.80	378.31	73.76	219.96	34.638	14.894	2.904	8.660	0.108 - 0.390	0.092
WRD 270U36 A, B, C, S	M23351/2-005, 006, 007, 008	WD 1390-348	353.47	152.00	29.64	88.37	13.916	5.984	1.167	3.479	0.270 - 0.970	0.229
WRD 390U36 A, B, C, S	M23351/2-009, 010, 011, 012	WD 963-241	244.55	105.16	20.498	61.14	9.628	4.140	0.807	2.407	0.390 - 1.40	0.331
WRD 970U36 A, B, C, S	M23351/2-013, 014, 015, 016	WD 388-97	98.48	42.34	8.255	24.613	3.877	1.667	0.325	0.969	0.970 - 3.50	0.822
WRD 140D36 A, B, C, S	M23351/2-017, 018, 019, 020	WD 269-67	68.25	29.34	5.72	17.07	2.687	1.155	0.225	0.672	1.40 - 5.00	1.186
WRD 350D36 A, B, C, S	M23351/2-021, 022, 023, 024	WD 107-27	27.28	11.73	2.29	6.83	1.074	0.462	0.090	0.269	3.50 - 12.40	2.966
WRD 500D36 A, B, C, S	M23351/2-025, 026, 027, 028	WD 75-19	19.10	8.20	1.60	4.78	0.752	0.323	0.063	0.188	5.00 - 18.00	4.237
WRD 124C36 A, B, C, S	M23351/2-029, 030, 031, 032	WD 30-8	7.70	3.30	0.64	1.93	0.303	0.130	0.025	0.076	12.40 - 40.00	10.508

* The additional letter added to the MIL type designation indicates material as: A – aluminum alloy; B – copper alloy (brass); C – copper; S – silver alloy.



13 Double ridge waveguides with special bandwidth ratios

Waveguide designation		Bandwidth ratio	Basic inner dimension								Frequency	
			Metric				Imperial				Nominal range	TE_{10} cutoff
Type *	Material **		Width *a*	Height *b*	Gap *e*	Ridge *h*	Width *a*	Height *b*	Gap *e*	Ridge *h*		
-	-	-	mm	mm	mm	mm	inch	inch	inch	inch	GHz	GHz
WRD 250D30	A, B, C, S	3.0:1	42.037	18.161	3.810	11.176	1.655	0.715	0.150	0.440	2.60 - 7.80	2.093
WRD 580D28	A, B, C, S	2.8:1	19.812	9.398	3.048	5.080	0.780	0.370	0.120	0.200	5.80 - 16.00	4.892
WRD 650D28	A, B, C, S	2.8:1	18.288	8.153	2.565	4.394	0.720	0.321	0.101	0.173	6.50 - 18.00	5.348
WRD 700D26	A, B, C, S	2.6:1	17.424	7.874	2.667	4.394	0.686	0.310	0.105	0.173	7.00 - 18.50	5.679

* The type designations listed here are in common use. They pursue the well-established MIL designations given in [16] and [17]. Nevertheless, we were not able to find a corresponding standard document.

** A – aluminum alloy; B – copper alloy (brass); C – copper; S – silver alloy.