

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, cylindrical and double ridge cross section. In addition to waveguide designations we provide inner dimensions (without corner radii and tolerances), nominal frequency ranges, cut-off frequencies and letter frequency band designations.

2 References

- [1] IEC 60153-2: 1974, "Hollow metallic waveguides, Part 2: Relevant specifications for ordinary rectangular waveguides", *Standard of the International Electrotechnical Commission*, January 1974.
- [2] EIA RS-261-B, "Rectangular Waveguides (WR3 to WR2300)", *Standard of the Electronic Industries Association of the United States of America*, May 1979.
- [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*, 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*, 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 60153-4: 1973, "Hollow metallic waveguides, Part 4: Relevant specifications for circular waveguides", *Standard of the International Electrotechnical Commission*, January 1973.
- [13] TIA/EIA-200-A, "Circular Waveguides", *Standard of the Telecommunications Industry Association of the United States of America*, March 1965.
- [14] MIL-W-23068, "Waveguides, Rigid, Circular", *Military Specification of the Department of Defense of the United States of America*, October 1961.
- [15] MIL-W-23351/4C, "Waveguides, Double Ridge (Bandwidth Ratio 2.4:1)", *Detail Specification of the Department of Defense of the United States of America*, January 2009.
- [16] 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.
- [17] EIA RS-304, "Ridge Waveguides", *Standard of the Electronic Industries Association of the United States of America*, February 1965.

The standards marked in gray are either cancelled ([3], [11], [14]) or withdrawn and not superseded ([2], [13], [17]). Nevertheless the waveguide designations defined therein are still in use.



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3 Ordinary rectangular waveguides

| Waveguide designations | | | | Basic inner dimensions | | Frequencies | | Letter band designations *** |
|------------------------|---------|--------|---|------------------------|-----------------|-------------------|----------------------------|------------------------------|
| IEC [1] | EIA [2] | UK [3] | MIL PIN [4, 5, 6] | Metric [1] | Imperial [1] | Nominal range [1] | TE ₁₀ cut-off * | |
| - | - | - | - | mm | inches | GHz | GHz | - |
| R 3 | WR 2300 | WG 00 | M85/1-001, 002, 161 | 584.20 x 292.10 | 23.000 x 11.500 | 0.32 - 0.49 | 0.257 | - |
| R 4 | WR 2100 | WG 0 | M85/1-003, 004, 162 | 533.40 x 266.70 | 21.000 x 10.500 | 0.35 - 0.53 | 0.281 | - |
| R 5 | WR 1800 | WG 1 | M85/1-005, 006, 163 | 457.20 x 228.60 | 18.000 x 9.000 | 0.41 - 0.62 | 0.328 | - |
| R 6 | WR 1500 | WG 2 | M85/1-007, 008, 164 | 381.00 x 190.50 | 15.000 x 7.500 | 0.49 - 0.75 | 0.393 | - |
| R 8 | WR 1150 | WG 3 | M85/1-009, 010, 165 | 292.10 x 146.05 | 11.500 x 5.750 | 0.64 - 0.98 | 0.513 | - |
| R 9 | WR 975 | WG 4 | M85/1-011, 012, 166 | 247.65 x 123.82 | 9.750 x 4.875 | 0.76 - 1.15 | 0.605 | - |
| R 12 | WR 770 | WG 5 | M85/1-013, 014, 167 | 195.58 x 97.79 | 7.700 x 3.850 | 0.96 - 1.46 | 0.766 | - |
| R 14 | WR 650 | WG 6 | M85/1-015, 017, 018, 019, 020, 168 | 165.10 x 82.55 | 6.500 x 3.250 | 1.13 - 1.73 | 0.908 | L |
| R 18 | WR 510 | WG 7 | M85/1-021, 023, 024, 025, 026, 169 | 129.54 x 64.77 | 5.100 x 2.550 | 1.45 - 2.20 | 1.157 | - |
| R 22 | WR 430 | WG 8 | M85/1-027, 029, 030, 031, 032, 170 | 109.22 x 54.61 | 4.300 x 2.150 | 1.72 - 2.61 | 1.372 | Ls, R |
| R 26 | WR 340 | WG 9A | M85/1-033, 035, 036, 037, 038, 171 | 86.36 x 43.18 | 3.400 x 1.700 | 2.17 - 3.30 | 1.736 | - |
| R 32 | WR 284 | WG 10 | M85/1-039, 041, 042, 043, 044, 172 M85/2-001, 002, 004 | 72.14 x 34.04 | 2.840 x 1.340 | 2.60 - 3.95 | 2.078 | S |
| R 40 | WR 229 | WG 11A | M85/1-045, 047, 048, 049, 050, 173 | 58.17 x 29.08 | 2.290 x 1.145 | 3.22 - 4.90 | 2.577 | - |

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| Waveguide designations | | | | Basic inner dimensions | | Frequencies | | Letter band designations *** |
|------------------------|---------|--------|---|------------------------|---------------|-------------------|----------------------------|------------------------------|
| IEC [1] | EIA [2] | UK [3] | MIL PIN [4, 5, 6] | Metric [1] | Imperial [1] | Nominal range [1] | TE ₁₀ cut-off * | |
| - | - | - | - | mm | inches | GHz | GHz | - |
| R 48 | WR 187 | WG 12 | M85/1-051, 053, 054, 055, 056, 174 M85/2-003, 005, 006 | 47.549 x 22.149 | 1.872 x 0.872 | 3.94 - 5.99 | 3.152 | C, G |
| R 58 | WR 159 | WG 13 | M85/1-057, 059, 060, 061, 062, 175 | 40.386 x 20.193 | 1.590 x 0.795 | 4.64 - 7.05 | 3.712 | C |
| R 70 | WR 137 | WG 14 | M85/1-063, 065, 066, 067, 068, 176 | 34.849 x 15.799 | 1.372 x 0.622 | 5.38 - 8.17 | 4.301 | Xn, J |
| R 84 | WR 112 | WG 15 | M85/1-069, 071, 072, 073, 074, 177 M85/2-007 | 28.499 x 12.624 | 1.122 x 0.497 | 6.57 - 9.99 | 5.260 | Xb, H |
| R 100 | WR 90 | WG 16 | M85/1-075, 077, 078, 079, 080, 178 M85/2-008, 009 | 22.860 x 10.160 | 0.900 x 0.400 | 8.20 - 12.5 | 6.557 | X |
| R 120 | WR 75 | WG 17 | M85/1-081, 083, 084, 085, 086, 179 | 19.050 x 9.525 | 0.750 x 0.375 | 9.84 - 15.0 | 7.869 | M |
| R 140 | WR 62 | WG 18 | M85/1-087, 089, 090, 091, 092, 093, 180 | 15.799 x 7.899 | 0.622 x 0.311 | 11.9 - 18.0 | 9.488 | Ku, P |
| R 180 | WR 51 | WG 19 | M85/1-094, 096, 097, 098, 099, 181 | 12.954 x 6.477 | 0.510 x 0.255 | 14.5 - 22.0 | 11.571 | N |
| R 220 | WR 42 | WG 20 | M85/1-100, 102, 103, 104, 105, 106, 182 | 10.668 x 4.318 | 0.420 x 0.170 | 17.6 - 26.7 | 14.051 | K |
| R 260 | WR 34 | WG 21 | M85/1-107, 109, 110, 111, 112, 113, 183 | 8.636 x 4.318 | 0.340 x 0.170 | 21.7 - 33.0 | 17.357 | - |
| R 320 | WR 28 | WG 22 | M85/3-006, 007, 008, 009 | 7.112 x 3.556 | 0.280 x 0.140 | 26.3 - 40.0 | 21.077 | Ka, R |
| R 400 | WR 22 | WG 23 | M85/3-010, 011, 012, 013 | 5.690 x 2.845 | 0.224 x 0.112 | 32.9 - 50.1 | 26.344 | Q |
| R 500 | WR 19 | WG 24 | M85/3-014, 015, 016 | 4.775 x 2.388 | 0.188 x 0.094 | 39.2 - 59.6 | 31.392 | U |
| R 620 | WR 15 | WG 25 | M85/3-017, 018 | 3.759 x 1.880 | 0.148 x 0.074 | 49.8 - 75.8 | 39.877 | V |

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| Waveguide designations | | | | Basic inner dimensions | | Frequencies | | Letter band designations *** |
|------------------------|---------|--------|-------------------|------------------------|-----------------|-------------------|----------------------------|------------------------------|
| IEC [1] | EIA [2] | UK [3] | MIL PIN [4, 5, 6] | Metric [1] | Imperial [1] | Nominal range [1] | TE ₁₀ cut-off * | |
| - | - | - | - | mm | inches | GHz | GHz | - |
| R 740 | WR 12 | WG 26 | M85/3-020, 021 | 3.0988 x 1.5494 | 0.122 x 0.061 | 60.5 - 91.9 | 48.372 | E |
| R 900 | WR 10 | WG 27 | M85/3-023, 024 | 2.5400 x 1.2700 | 0.1000 x 0.0500 | 73.8 - 112 | 59.014 | W |
| R 1200 | WR 8 | WG 28 | M85/3-026, 027 | 2.0320 x 1.0160 | 0.0800 x 0.0400 | 92.2 - 140 | 73.768 | F |
| R 1400 | WR 7 ** | WG 29 | M85/3-029, 030 | 1.6510 x 0.8255 | 0.0650 x 0.0325 | 113 - 173 | 90.791 | D |
| R 1800 | WR 5 | WG 30 | M85/3-032, 033 | 1.2954 x 0.6477 | 0.0510 x 0.0255 | 145 - 220 | 115.71 | G |
| R 2200 | WR 4 | WG 31 | M85/3-035, 036 | 1.0922 x 0.5461 | 0.0430 x 0.0215 | 172 - 261 | 137.24 | Y |
| R 2600 | WR 3 | WG 32 | M85/3-038, 039 | 0.8636 x 0.4318 | 0.0340 x 0.0170 | 217 - 330 | 173.57 | H, J |

* The TE₁₀ cut-off frequency is given by $f_c = c_0/(2a)$ with $c_0 = 299792458 \text{ ms}^{-1}$ and the waveguide width a .

** The waveguide WR 7 is sometimes misleadingly referred to as WR-06 (e.g. in [6]).

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



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4 Ordinary rectangular waveguides for millimeter and sub-millimeter waves

| Waveguide designations | | | | | | Inner dimensions | | Frequencies | |
|------------------------|----------|---------|-------------|---------|--------------------|------------------|------------|-------------------|------------------------------|
| IEEE [7] | IEC [1] | EIA [2] | Hesler [8] | UK [3] | MIL PIN [6] | Width [7] | Height [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 1200 | WR 8 | WR 8 | WG 28 | M85/3-026, 027 | 2032 | 1016 | 90 - 140 | 73.768 |
| WM-1651 | R 1400 | WR 7 ** | WR 6.5 | WG 29 | M85/3-029, 030 | 1651 | 825.5 | 110 - 170 | 90.791 |
| WM-1295 | R 1800 * | WR 5 * | WR 5.1 * | WG 30 * | M85/3-032 *, 033 * | 1295 | 647.5 | 140 - 220 | 115.75 |
| WM-1092 | R 2200 * | WR 4 * | WR 4.3 * | WG 31 * | M85/3-035 *, 036 * | 1092 | 546 | 170 - 260 | 137.27 |
| WM-864 | R 2600 * | WR 3 * | WR 3.4 * | WG 32 * | M85/3-038 *, 039 * | 864 | 432 | 220 - 330 | 173.49 |
| WM-710 | - | - | WR 2.8 * | - | - | 710 | 355 | 260 - 400 | 211.12 |
| WM-570 | - | - | WR 2.2 * | - | - | 570 | 285 | 330 - 500 | 262.98 |
| WM-470 | - | - | WR 1.9 * | - | - | 470 | 235 | 400 - 600 | 318.93 |
| WM-380 | - | - | WR 1.5 * | - | - | 380 | 190 | 500 - 750 | 394.46 |
| WM-310 | - | - | WR 1.2 * | - | - | 310 | 155 | 600 - 900 | 483.54 |
| WM-250 | - | - | WR 1.0 * | - | - | 250 | 125 | 750 - 1100 | 599.58 |
| WM-200 | - | - | (WR 0.8 *) | - | - | 200 | 100 | 900 - 1400 | 749.48 |
| WM-164 | - | - | (WR 0.65 *) | - | - | 164 | 82 | 1100 - 1700 | 914.00 |
| WM-130 | - | - | (WR 0.51 *) | - | - | 130 | 65 | 1400 - 2200 | 1153.0 |
| WM-106 | - | - | - | - | - | 106 | 53 | 1700 - 2600 | 1414.1 |
| WM-86 | - | - | - | - | - | 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 nominal internal dimensions of this waveguide differ slightly from those of the corresponding WM waveguide.

** The waveguide WR 7 is sometimes misleadingly referred to as WR-06 (e.g. in [6]).



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5 Rectangular waveguides of reduced height

| Waveguide designations | | | Basic inner dimensions | | Frequencies | | Letter band designations *** |
|------------------------|------------|--|------------------------|----------------------|--------------------------|-----------------------------|------------------------------|
| IEC [9, 10] | ½ EIA * | MIL PIN [11] | Metric | Imperial | Nominal range [1, 9, 10] | TE ₁₀ cut-off ** | |
| - | - | - | mm | inches | GHz | GHz | - |
| - | ½ WR 2300 | - | 584.20 x 146.05 [2] | 23.000 x 5.750 [2] | 0.32 - 0.49 | 0.257 | - |
| - | ½ WR 2100 | - | 533.40 x 133.35 [2] | 21.000 x 5.250 [2] | 0.35 - 0.53 | 0.281 | - |
| - | ½ WR 1800 | - | 457.20 x 114.30 [2] | 18.000 x 4.500 [2] | 0.41 - 0.62 | 0.328 | - |
| - | ½ WR 1500 | - | 381.00 x 145.25 [2] | 15.000 x 3.750 [2] | 0.49 - 0.75 | 0.393 | - |
| - | ½ WR 1150 | - | 292.10 x 73.025 [2] | 11.500 x 2.875 [2] | 0.64 - 0.98 | 0.513 | - |
| - | ≈ ½ WR 975 | M85/4-009, 010, 011, 012, 013, 014, 021, 022 | 247.65 x 61.87 [11] | 9.750 x 2.436 [11] | 0.76 - 1.15 | 0.605 | - |
| M 12 | ½ WR 770 | - | 195.58 x 48.90 [10] | 7.700 x 1.925 [10] | 0.96 - 1.46 | 0.766 | - |
| M 14 | ½ WR 650 | - | 165.10 x 41.30 [10] | 6.500 x 1.626 [10] | 1.14 - 1.73 | 0.908 | L |
| M 18 | ½ WR 510 | - | 129.54 x 32.40 [10] | 5.100 x 1.276 [10] | 1.45 - 2.20 | 1.157 | - |
| M 22 | ½ WR 430 | - | 109.22 x 27,30 [10] | 4.300 x 1.075 [10] | 1.72 - 2.61 | 1.372 | Ls, R |
| F 22 | - | - | 109.22 x 13.100 [9] | 4.300 x 0.5157 [9] | | | |
| M 26 | ½ WR 340 | - | 86.360 x 21.600 [10] | 3.4000 x 0.8504 [10] | 2.17 - 3.30 | 1.736 | - |
| F 26 | - | - | 86.36 x 10.400 [9] | 3.400 x 0.4094 [9] | | | |
| - | - | M85/4-001, 002, 007 | 72.14 x 25.50 [11] | 2.840 x 1.004 [11] | 2.60 - 3.95 | 2.078 | S |
| M 32 | - | - | 72.136 x 18.000 [10] | 2.8400 x 0.7087 [10] | | | |
| - | ½ WR 284 | M85/4-015, 016, 017 | 72.14 x 17.02 [11] | 2.840 x 0.670 [11] | | | |
| F 32 | - | - | 72.14 x 8.600 [9] | 2.840 x 0.3386 [9] | | | |
| M 40 | ≈ ½ WR 229 | - | 58.166 x 14.500 [10] | 2.2900 x 0.5709 [10] | 3.22 - 4.90 | 2.577 | - |
| F 40 | - | - | 58.17 x 7.000 [9] | 2.2900 x 0.2756 [9] | | | |
| M(F) 45 = F 45 | - | - | 50.800 x 16.942 [10] | 2.0000 x 0.6670 [10] | 3.68 - 5.60 | 2.951 | - |

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| Waveguide designations | | | Basic inner dimensions | | Frequencies | | Letter band designations *** |
|------------------------|----------|--------------------------|------------------------|----------------------|--------------------------|-----------------------------|------------------------------|
| IEC [9, 10] | ½ EIA * | MIL PIN [11] | Metric | Imperial | Nominal range [1, 9, 10] | TE ₁₀ cut-off ** | |
| - | - | - | mm | inches | GHz | GHz | - |
| M 48 | - | - | 47.549 x 11.900 [10] | 1.8720 x 0.4685 [10] | 3.94 - 5.99 | 3.152 | C, G |
| - | ½ WR 187 | - | 47.55 x 11.075 [2] | 1.872 x 0.436 [2] | | | |
| - | - | M85/4-018, 019, 020 | 47.55 x 9.45 [11] | 1.872 x 0.372 [11] | | | |
| F 48 | - | - | 47.55 x 5.700 [9] | 1.872 x 0.2244 [9] | | | |
| M 58 | ½ WR 159 | - | 40.386 x 10.100 [10] | 1.5900 x 0.3976 [10] | 4.64 - 7.05 | 3.712 | C |
| F 58 | - | - | 40.39 x 5.000 [9] | 1.5900 x 0.1969 [9] | | | |
| - | - | M85/4-003, 004, 008 | 34.85 x 12.37 [11] | 1.372 x 0.487 [11] | 5.38 - 8.17 | 4.301 | Xn, J |
| M 70 | - | - | 34.849 x 8.700 [10] | 1.3720 x 0.3425 [10] | | | |
| - | ½ WR 137 | - | 34.85 x 7.90 [2] | 1.372 x 0.311 [2] | | | |
| F 70 | - | - | 34.85 x 5.000 [9] | 1.3720 x 0.1969 [9] | | | |
| - | ½ WR 112 | M85/4-030, 031 | 28.50 x 6.32 [11] | 1.122 x 0.249 [11] | 6.57 - 9.99 | 5.260 | Xb, H |
| F 84 | - | - | 28.499 x 5.000 [9] | 1.1220 x 0.1969 [9] | | | |
| - | ½ WR 90 | M85/4-034, 035, 036, 037 | 22.86 x 5.08 [11] | 0.90 x 0.20 [11] | 8.20 - 12.5 | 6.557 | X |
| M(F) 100 = F 100 | - | - | 22.860 x 5.000 [10] | 0.9000 x 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 TE₁₀ cut-off frequency is given by $f_c = c_0/(2a)$ with $c_0 = 299792458 \text{ ms}^{-1}$ and the waveguide width a .

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



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6 Circular waveguides

| Waveguide designations | | | | Inner diameters | | Frequencies | | | |
|------------------------|-------------|-----------|---------------------|-----------------|--|------------------------------------|----------------------------------|----------------------------------|----------------------------------|
| IEC * [12] | EIA [13] | UK [3] | MIL Type ** [14] | Metric [12] | Imperial [12, 13] | TE ₁₁ range *** [13] | TE ₁₁ cut-off [12] | TM ₀₁ cut-off [12] | TE ₂₁ cut-off [12] |
| - | - | - | - | mm | inches | GHz | GHz | GHz | GHz |
| C 3.3 | WC 2551 | CG 1 | WRC 312U14 | 647.9 | 25.508 | 0.312 - 0.427 | 0.27 | 0.35 | 0.45 |
| C 4 | WC 2179 | CG 2 | WRC 365U14 | 553.5 | 21.791 | 0.365 - 0.500 | 0.32 | 0.41 | 0.53 |
| C 4.5 | WC 1862 | CG 3 | WRC 427U14 | 472.8 | 18.616 | 0.427 - 0.586 | 0.37 | 0.48 | 0.62 |
| C 5.3 | WC 1590 | CG 4 | WRC 500U14 | 403.9 | 15.903 | 0.500 - 0.686 | 0.43 | 0.57 | 0.72 |
| C 6.2 | WC 1359 | CG 5 | WRC 586U14 | 345.1 | 13.585 | 0.586 - 0.803 | 0.51 | 0.66 | 0.84 |
| C 7 | WC 1161 | CG 6 | WRC 686U14 | 294.79 | 11.606 | 0.686 - 0.939 | 0.60 | 0.78 | 0.99 |
| C 8 | WC 992 | CG 7 | WRC 803U14 | 251.84 | 9.915 | 0.803 - 1.10 | 0.70 | 0.91 | 1.16 |
| C 10 | WC 847 | CG 8 | WRC 939U14 | 215.14 | 8.470 | 0.939 - 1.29 | 0.82 | 1.07 | 1.35 |
| C 12 | WC 724 | CG 9 | WRC 110D14 | 183.77 | 7.235 | 1.10 - 1.51 | 0.96 | 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 | 97.87 | 3.853 | 2.07 - 2.83 | 1.79 | 2.34 | 2.98 |
| C 25 | WC 329 | CG 14 | WRC 242D14 | 83.62 | 3.292 | 2.42 - 3.31 | 2.10 | 2.74 | 3.49 |
| C 30 | WC 281 | CG 15 | WRC 283D14 | 71.42 | 2.812 | 2.83 - 3.88 | 2.46 | 3.21 | 4.08 |
| C 35 | WC 240 | CG 16 | WRC 331D14 | 61.04 | 2.403 | 3.31 - 4.54 | 2.88 | 3.76 | 4.77 |
| C 40 | WC 205 | CG 17 | WRC 389D14 | 51.99 | 2.047 ≈ 2 ³ / ₆₄ | 3.89 - 5.33 | 3.38 | 4.41 | 5.61 |
| C 48 | WC 175 | CG 18 | WRC 454D14 | 44.45 | 1.750 = 1 ³ / ₄ | 4.54 - 6.23 | 3.95 | 5.16 | 6.56 |
| C 56 | WC 150 | CG 19 | WRC 530D14 | 38.10 | 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 ≈ 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 ≈ 1 ³ / ₃₂ | 7.27 - 9.97 | 6.32 | 8.26 | 10.5 |

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| Waveguide designations | | | | Inner diameters | | Frequencies | | | |
|------------------------|-------------|-----------|---------------------|-----------------|---------------------------------------|------------------------------------|----------------------------------|----------------------------------|----------------------------------|
| IEC * [12] | EIA [13] | UK [3] | MIL Type ** [14] | Metric [12] | Imperial [12, 13] | TE ₁₁ range *** [13] | TE ₁₁ cut-off [12] | TM ₀₁ cut-off [12] | TE ₂₁ cut-off [12] |
| - | - | - | - | mm | inches | 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 | 10.0 | 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 | 9.525 | 0.375 = ³ / ₈ | 21.2 - 29.1 | 18.4 | 24.1 | 30.6 |
| C 255 | WC 33 | CG 29 | WRC 243C14 | 8.331 | 0.328 ≈ ²¹ / ₆₄ | 24.3 - 33.2 | 21.1 | 27.5 | 35.0 |
| C 290 | WC 28 | CG 30 | WRC 283C14 | 7.137 | 0.281 ≈ ⁹ / ₃₂ | 28.3 - 38.8 | 24.6 | 32.2 | 40.8 |
| C 330 | WC 25 | CG 31 | WRC 318C14 | 6.350 | 0.250 = ¹ / ₄ | 31.8 - 43.6 | 27.7 | 36.1 | 45.9 |
| C 380 | WC 22 | CG 32 | WRC 364C14 | 5.563 | 0.219 ≈ ⁷ / ₃₂ | 36.4 - 49.8 | 31.6 | 41.3 | 52.4 |
| C 430 | WC 19 | CG 33 | WRC 424C14 | 4.775 | 0.188 ≈ ³ / ₁₆ | 42.4 - 58.1 | 36.8 | 48.1 | 61.0 |
| C 495 | WC 17 | CG 34 | WRC 463C14 | 4.369 | 0.172 ≈ ¹¹ / ₆₄ | 46.3 - 63.5 | 40.2 | 52.5 | 66.7 |
| C 580 | WC 14 | CG 35 | WRC 566C14 | 3.581 | 0.141 ≈ ⁹ / ₆₄ | 56.6 - 77.5 | 49.1 | 64.1 | 81.4 |
| C 660 | WC 13 | CG 36 | WRC 635C14 | 3.175 | 0.125 = ¹ / ₈ | 63.5 - 87.2 | 55.3 | 72.3 | 91.8 |
| C 765 | WC 11 | CG 37 | WRC 727C14 | 2.769 | 0.109 ≈ ⁷ / ₆₄ | 72.7 - 99.7 | 63.5 | 82.9 | 105 |
| C 890 | WC 9 | CG 38 | WRC 848C14 | 2.388 | 0.094 ≈ ³ / ₃₂ | 84.8 - 116 | 73.6 | 96.1 | 122 |

* This column shows the preferred waveguide types only. Intermediate sizes are given in [12].

** An additional letter added to the MIL type designation indicates material as:

A – Aluminum alloy; B – Brass; C – Copper; M – Magnesium-base alloy; S – Silver alloy. E.g. WRC 312U14A.

*** The specified TE₁₁ frequency range is within 1.15 times the TE₁₁ cut-off frequency and 0.95 times the TE₂₁ cut-off frequency.



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7 Circular waveguides for frequencies of 100 GHz and above

For circular waveguides intended for frequencies of 100 GHz and above we were not able to find a written standard. Various companies (e.g. Cernex, Custom Microwave, Ducommun, Millitech, Quinstar, Spinner, TRG) have defined proprietary waveguide sizes which over the years became a quasi-standard. The following table compiles the most often used waveguide sizes. The waveguide designation used here pursues the well-established EIA designation scheme [13]. **Bold values** of the inner diameter indicate original unrounded values.

| Waveguide designations | | | | Inner diameters | | Frequencies | | | |
|------------------------|------------------------|--------|---------------|-----------------|--------------------------------|--------------------------|-----------------------------|------------------------------|-------------------------------|
| IEC [12] | pursued EIA (EIA [13]) | UK [3] | MIL Type [14] | Metric | Imperial | TE ₁₁ range * | TE ₁₁ cut-off ** | TM ₀₁ cut-off *** | TE ₂₁ cut-off **** |
| - | - | - | - | mm | inches | GHz | GHz | GHz | GHz |
| C 890 | WC 9.4 (WC 9) | CG 38 | WRC 848C14 | 2.388 | 0.094 $\approx 3/32$ | 84.6 - 116 | 73.6 | 96.1 | 122 |
| - | WC 8.9 | - | - | 2.261 | 0.089 $\approx 91/1024$ | 89.4 - 122 | 77.7 | 102 | 129 |
| - | WC 8.2 | - | - | 2.083 | 0.082 $\approx 21/256$ | 97.0 - 133 | 84.4 | 110 | 140 |
| - | WC 7.9 | - | - | 2.000 | 0.07874 $\approx 81/1024$ | 101 - 138 | 87.9 | 115 | 146 |
| - | WC 7.5 | - | - | 1.905 | 0.075 $= 3/40$ | 106 - 145 | 92.2 | 120 | 153 |
| - | WC 7.3 | - | - | 1.854 | 0.073 $\approx 75/1024$ | 109 - 149 | 94.8 | 124 | 157 |
| - | WC 6.7 | - | - | 1.702 | 0.067 $\approx 69/1024$ | 119 - 163 | 103 | 135 | 171 |
| - | WC 5.9 | - | - | 1.500 | 0.05906 $\approx 15/256$ | 135 - 185 | 117 | 153 | 194 |
| - | WC 5.8 | - | - | 1.473 | 0.058 $\approx 59/1024$ | 137 - 188 | 119 | 156 | 198 |
| - | WC 4.9 | - | - | 1.245 | 0.049 $\approx 25/512$ | 162 - 222 | 141 | 184 | 234 |
| - | WC 4.5 | - | - | 1.143 | 0.045 $\approx 23/512$ | 177 - 242 | 154 | 201 | 255 |
| - | WC 3.9 | - | - | 0.991 | 0.039 $\approx 5/128$ | 204 - 280 | 177 | 232 | 294 |

* The specified TE₁₁ frequency range is within 1.15 times the TE₁₁ cut-off frequency and 0.95 times the TE₂₁ cut-off frequency.

** The TE₁₁ cut-off frequency is given by $f_c = 1.8412 c_0 / (\pi d)$ with $c_0 = 299792458 \text{ ms}^{-1}$ and the waveguide diameter d .

*** The TM₀₁ cut-off frequency is given by $f_c = 2.4048 c_0 / (\pi d)$ with $c_0 = 299792458 \text{ ms}^{-1}$ and the waveguide diameter d .

**** The TE₂₁ cut-off frequency is given by $f_c = 3.0542 c_0 / (\pi d)$ with $c_0 = 299792458 \text{ ms}^{-1}$ and the waveguide diameter d .



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8 Double ridge waveguides with bandwidth ratio of 2.4:1

| Waveguide designations | | | Basic inner dimensions | | | | | | | | Frequencies [15] | |
|--------------------------|---------------------------------|-------------|------------------------|--------|--------|--------|---------------|--------|-------|-------|------------------|-------------------------|
| MIL [15] | | EIA [17] | Metric [15] | | | | Imperial [15] | | | | Nominal range | TE ₁₀ cutoff |
| Type * | PIN | | Width | Height | Gap | Ridge | Width | Height | Gap | Ridge | | |
| - | - | - | mm | mm | mm | mm | in. | in. | in. | in. | 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 | 12.33 | 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 | 69.79 | 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 | 12.48 | 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 [15] does not list a type designation for this waveguide. Commonly the designation DR 19 is in use.



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9 Double ridge waveguides with bandwidth ratio of 3.6:1

| Waveguide designations | | | Basic inner dimensions | | | | | | | | Frequencies [16] | |
|--------------------------|---------------------------------|-------------|------------------------|--------|--------|--------|---------------|--------|-------|-------|------------------|-------------------------|
| MIL [16] | | EIA [17] | Metric [16] | | | | Imperial [16] | | | | Nominal range | TE ₁₀ cutoff |
| Type * | PIN | | Width | Height | Gap | Ridge | Width | Height | Gap | Ridge | | |
| - | - | - | mm | mm | mm | mm | in. | in. | in. | in. | 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.



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10 Double ridge waveguides with miscellaneous bandwidth ratios

| Waveguide designations | | Bandwidth ratio | Basic inner dimensions | | | | | | | | Frequencies | |
|------------------------|-------------|-----------------|------------------------|--------|-------|--------|----------|-------|-------|-------|---------------|-------------------------|
| Type * | Material ** | | Metric | | | | Imperial | | | | Nominal range | TE ₁₀ cutoff |
| | | Width | Height | Gap | Ridge | Width | Height | Gap | Ridge | | | |
| - | - | - | mm | mm | mm | mm | in. | in. | in. | in. | 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 [15] and [16]. Nevertheless we were not able to find a corresponding standard document.

** A – Aluminum alloy; B – Copper alloy (Brass); C – Copper; S – Silver alloy.