

Birmingham gauge

The **Birmingham gauge**^[1] is a wire gauge system, and is also used to specify thickness or diameter of hypodermic needles and tube products.

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Terminology

Birmingham gauge is also known as the **Stubs Iron Wire Gauge** or **Birmingham Wire Gauge**. It is not the same as, though similar to, the **Stubs Steel Wire Gauge**.

Birmingham gauge is often simply termed **Gauge**, with the abbreviation **G**.^[2] However, this should not be confused with French gauge.

System

The gauge starts at the lowest gauge number of 5Ø or 00000, corresponding to the largest size of 0.500 inches (12.7 mm) to the highest gauge number of 36, corresponding to the smallest size of 0.004 inches (0.10 mm). Size steps between gauges range from 0.001 inches (0.025 mm) between high gauge numbers to 0.046 inches (1.2 mm) between the two lowest gauge numbers and do not correspond to a particular mathematical pattern, although for the most part the steps get smaller with increasing gauge number.^[3] Concerning wire and fine tubing, the gauge number is used to specify the outside diameter of the product, whereas for larger mechanical tubing the gauge number specifies the wall thickness independent of the overall size of the tube.

In medicine, the Birmingham gauge specifies the outside diameter of hypodermic needles, catheters, cannulae and suture wires. It was originally developed in early 19th-century England for use in wire manufacture, and it began appearing in a medical setting in the early 20th century.

Another common needle gauge system is the French catheter scale.

Needle wire gauge was derived from the Stubs Iron Wire Gauge.

Sizes of hypodermic needles

Hypodermic needles are available in a wide variety of outer diameters described by gauge numbers. Smaller gauge numbers indicate larger outer diameters.^[4] Inner diameter depends on both gauge and wall thickness. The following chart shows nominal inner diameter and wall thickness for regular-wall needles.^{[4][5]} Thin-wall needles (not shown) have identical outer diameters but larger inner diameters for a given gauge.

Gauge, G	Nominal outer diameter		Nominal inner diameter ^[a]		Nominal wall thickness ^[a]		ISO 6009 color ^[6]
	(inch)	(mm)	(inch)	(mm)	(inch)	(mm)	
7	0.180 ± 0.001	4.572 ± 0.025	0.150 ± 0.003	3.810 ± 0.076	0.015 ± 0.001	0.381 ± 0.025	
8	0.165 ± 0.001	4.191 ± 0.025	0.135 ± 0.003	3.429 ± 0.076	0.015 ± 0.001	0.381 ± 0.025	
9	0.148 ± 0.001	3.759 ± 0.025	0.118 ± 0.003	2.997 ± 0.076	0.015 ± 0.001	0.381 ± 0.025	
10	0.134 ± 0.001	3.404 ± 0.025	0.106 ± 0.003	2.692 ± 0.076	0.014 ± 0.001	0.356 ± 0.025	Olive brown
11	0.120 ± 0.001	3.048 ± 0.025	0.094 ± 0.003	2.388 ± 0.076	0.013 ± 0.001	0.330 ± 0.025	Green-yellow
12	0.109 ± 0.001	2.769 ± 0.025	0.085 ± 0.003	2.159 ± 0.076	0.012 ± 0.001	0.305 ± 0.025	Pale blue
13	0.095 ± 0.001	2.413 ± 0.025	0.071 ± 0.003	1.803 ± 0.076	0.012 ± 0.001	0.305 ± 0.025	Purple
14	0.083 ± 0.001	2.108 ± 0.025	0.063 ± 0.003	1.600 ± 0.076	0.010 ± 0.001	0.254 ± 0.025	Pale green
15	0.0720 ± 0.0005	1.829 ± 0.013	0.0540 ± 0.0015	1.372 ± 0.038	0.0090 ± 0.0005	0.229 ± 0.013	Blue-grey
16	0.0650 ± 0.0005	1.651 ± 0.013	0.0470 ± 0.0015	1.194 ± 0.038	0.0090 ± 0.0005	0.229 ± 0.013	White
17	0.0580 ± 0.0005	1.473 ± 0.013	0.0420 ± 0.0015	1.067 ± 0.038	0.0080 ± 0.0005	0.203 ± 0.013	Red-violet
18	0.0500 ± 0.0005	1.270 ± 0.013	0.0330 ± 0.0015	0.838 ± 0.038	0.0085 ± 0.0005	0.216 ± 0.013	Pink
19	0.0420 ± 0.0005	1.067 ± 0.013	0.0270 ± 0.0015	0.686 ± 0.038	0.0075 ± 0.0005	0.191 ± 0.013	Cream
20	0.03575 ± 0.00025	0.9081 ± 0.0064	0.02375 ± 0.00075	0.603 ± 0.019	0.00600 ± 0.00025	0.1524 ± 0.0064	Yellow
21	0.03225 ± 0.00025	0.8192 ± 0.0064	0.02025 ± 0.00075	0.514 ± 0.019	0.00600 ± 0.00025	0.1524 ± 0.0064	Deep green
22	0.02825 ± 0.00025	0.7176 ± 0.0064	0.01625 ± 0.00075	0.413 ± 0.019	0.00600 ± 0.00025	0.1524 ± 0.0064	Black
22s	0.02825 ± 0.00025	0.7176 ± 0.0064	0.00600 ± 0.00075	0.152 ± 0.019	0.01110 ± 0.00025	0.2826 ± 0.0064	
23	0.02525 ± 0.00025	0.6414 ± 0.0064	0.01325 ± 0.00075	0.337 ± 0.019	0.00600 ± 0.00025	0.1524 ± 0.0064	Deep blue
24	0.02225 ± 0.00025	0.5652 ± 0.0064	0.01225 ± 0.00075	0.311 ± 0.019	0.00500 ± 0.00025	0.1270 ± 0.0064	Medium purple
25	0.02025 ± 0.00025	0.5144 ± 0.0064	0.01025 ± 0.00075	0.260 ± 0.019	0.00500 ± 0.00025	0.1270 ± 0.0064	Orange
26	0.01825 ± 0.00025	0.4636 ± 0.0064	0.01025 ± 0.00075	0.260 ± 0.019	0.00400 ± 0.00025	0.1016 ± 0.0064	Brown
26s	0.01865 ± 0.00025	0.4737 ± 0.0064	0.00500 ± 0.00075	0.127 ± 0.019	0.00680 ± 0.00025	0.1734 ± 0.0064	
27	0.01625 ±	0.4128 ±	0.00825 ±	0.210 ±	0.00400 ±	0.1016 ±	Medium

	0.00025	0.0064	0.00075	0.019	0.00025	0.0064	grey
28	0.01425 ± 0.00025	0.3620 ± 0.0064	0.00725 ± 0.00075	0.184 ± 0.019	0.00350 ± 0.00025	0.0889 ± 0.0064	Blue-green
29	0.01325 ± 0.00025	0.3366 ± 0.0064	0.00725 ± 0.00075	0.184 ± 0.019	0.00300 ± 0.00025	0.0762 ± 0.0064	Red
30	0.01225 ± 0.00025	0.3112 ± 0.0064	0.00625 ± 0.00075	0.159 ± 0.019	0.00300 ± 0.00025	0.0762 ± 0.0064	Yellow
31	0.01025 ± 0.00025	0.2604 ± 0.0064	0.00525 ± 0.00075	0.133 ± 0.019	0.00250 ± 0.00025	0.0635 ± 0.0064	White
32	0.00925 ± 0.00025	0.2350 ± 0.0064	0.00425 ± 0.00075	0.108 ± 0.019	0.00250 ± 0.00025	0.0635 ± 0.0064	Deep green
33	0.00825 ± 0.00025	0.2096 ± 0.0064	0.00425 ± 0.00075	0.108 ± 0.019	0.00200 ± 0.00025	0.0508 ± 0.0064	Black
34	0.00725 ± 0.00025	0.1842 ± 0.0064	0.00325 ± 0.00075	0.0826 ± 0.019	0.00200 ± 0.00025	0.0508 ± 0.0064	Orange

a. Not strictly defined, and may vary for a given gauge.



Six hypodermic needles on Luer connectors. These needles are normally used with other medical devices, such as a syringe; from top to bottom:

- 26G × ½" (0.45 × 12 mm) (brown)
- 25G × ⅝" (0.5 × 16 mm) (orange)
- 22G × 1¼" (0.7 × 30 mm) (black)
- 21G × 1½" (0.8 × 40 mm) (green)
- 20G × 1½" (0.9 × 40 mm) (yellow)
- 19G × 1½" (1.1 × 40 mm) (cream)

Rapid blood transfusion through 23G or smaller needles can cause hemolysis.^[7]

Sizes of catheters

This includes peripheral venous catheters and central venous catheters. The gauge compared to outer diameter is the same as for needles, but the color coding is different.

Gauge	Outer diameter (mm)	Maximum flow rate (ml/min)	Color
14	2.10	250–300	Orange
16	1.65	200	Grey
18	1.27	75–120 ^[8]	Green ^[8]
20	0.90	40–80 ^[8]	Pink ^[8]
22	0.71	55 ^[8]	Blue ^[8]
24	0.56	35 ^[8]	Yellow ^[8]
26	0.46	13–15 ^[8]	Black ^[8]

See also

- Wire gauge, including other systems
 - Wire gauge comparison chart (https://upload.wikimedia.org/wikipedia/commons/2/28/Gauge_Chart.pdf)
- French gauge, mainly for catheters
- American Wire Gauge

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Further reading

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External links

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 - Sheet Metal Gauge Size Data - Engineers Edge (<http://www.engineersedge.com/gauge.htm>)
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