

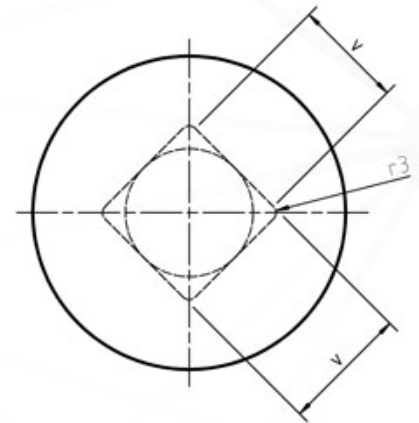
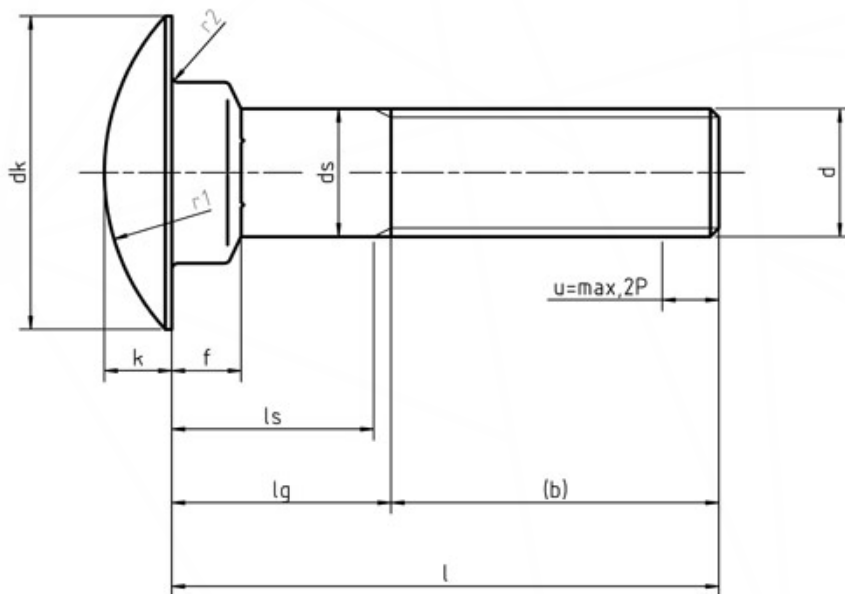
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All dimensions in mm

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Legend:

- b - length of the thread (at least)
- l - length of bolt
- d - the nominal diameter of the thread
- k - head height
- ds - diameter of the screw shank
- dk - head diameter
- f - height squared
- v - width of the square
- r1 - Head radius
- lg - length of the shank to thread
- ls - length of the shank to the start of the thread

Makings:

- Steel: 4,6,8,8
- Stainless: A2, A4
- Plastic: -
- Non Ferrous: -
- Thread: 6g

Notes:

Disclaimer

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TABLE 1: ACCORDING TO DIN 603

| Thread d | | M5 | M6 | M8 | M10 | M12 | M16 | M20 |
|----------|-----------------|-------|-------|-------|-------|-------|------|-------|
| P | | 0,8 | 1 | 1,25 | 1,5 | 1,75 | 2 | 2,5 |
| b | l < 125mm | 16 | 18 | 22 | 26 | 30 | 38 | 46 |
| | 125 < l < 200mm | 22 | 24 | 28 | 32 | 36 | 44 | 52 |
| | l > 200mm | - | - | 41 | 45 | 49 | 57 | 65 |
| dk | max. | 13,55 | 16,55 | 20,65 | 24,65 | 30,65 | 38,8 | 46,8 |
| | min. | 12,45 | 15,45 | 19,35 | 23,35 | 29,35 | 37,2 | 45,2 |
| ds | max. | 5 | 6 | 8 | 10 | 12 | 16 | 20 |
| | min. | 4,52 | 5,52 | 7,42 | 9,42 | 11,3 | 15,3 | 19,16 |
| f | max. | 4,1 | 4,6 | 5,6 | 6,6 | 8,75 | 12,9 | 15,9 |
| | min. | 2,9 | 3,4 | 4,4 | 5,4 | 7,25 | 11,1 | 14,1 |
| k | max. | 3,3 | 3,88 | 4,88 | 5,38 | 6,95 | 8,95 | 11,05 |
| | min. | 2,7 | 3,12 | 4,12 | 4,62 | 6,05 | 8,05 | 9,95 |
| r1 | approx. | 10,7 | 12,6 | 16 | 19,2 | 24,1 | 29,3 | 33,9 |
| r2 | max. | 0,5 | 0,5 | 0,5 | 0,5 | 1 | 1 | 1 |
| r3 | max. | 0,75 | 0,9 | 1,2 | 1,5 | 1,8 | 2,4 | 3 |
| v | max. | 5,48 | 6,48 | 8,58 | 10,58 | 12,7 | 16,7 | 20,84 |
| | min. | 4,52 | 5,52 | 7,42 | 9,42 | 11,3 | 15,3 | 19,16 |

| nomi- nal size | l | | M5 | | M6 | | M8 | | M10 | | M12 | | M16 | | M20 | |
|-------------------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | min. | max. | ls min. | lg max. | ls min. | lg max. | ls min. | lg max. | ls min. | lg max. | ls min. | lg max. | ls min. | lg max. | ls min. | lg max. |
| 16 | 15,1 | 16,9 | - | 8 | - | 10 | | | | | | | | | | |
| 20 | 18,95 | 21,05 | - | 8 | - | 10 | - | 12 | - | 14 | | | | | | |
| 25 | 23,95 | 26,05 | - | 8 | - | 10 | - | 12 | - | 14 | | | | | | |
| 30 | 28,95 | 31,05 | - | 18 | - | 10 | - | 12 | - | 14 | - | 18 | | | | |
| 35 | 33,75 | 36,25 | 15 | 19 | 12 | 17 | - | 12 | - | 14 | - | 18 | | | | |
| 40 | 38,75 | 41,25 | 20 | 24 | 17 | 22 | 11,75 | 18 | - | 14 | - | 18 | | | | |
| 45 | 43,75 | 46,25 | 25 | 29 | 22 | 27 | 16,75 | 23 | 11,5 | 19 | - | 18 | | | | |
| 50 | 48,75 | 51,25 | 30 | 34 | 27 | 32 | 21,75 | 28 | 16,5 | 24 | - | 18 | | | | |
| 55 | 53,5 | 56,5 | 35 | 39 | 32 | 37 | 26,75 | 33 | 21,5 | 29 | 16,25 | 25 | - | 23 | | |
| 60 | 58,5 | 61,5 | 40 | 44 | 37 | 42 | 31,75 | 38 | 26,5 | 34 | 21,25 | 30 | - | 23 | | |
| 65 | 63,5 | 66,5 | 45 | 49 | 42 | 47 | 36,75 | 43 | 31,5 | 39 | 26,75 | 35 | 17 | 27 | | |
| 70 | 68,5 | 71,5 | 50 | 54 | 47 | 52 | 41,75 | 48 | 36,5 | 44 | 31,25 | 40 | 22 | 32 | - | 28,5 |
| 80 | 78,5 | 81,5 | 60 | 64 | 57 | 62 | 51,75 | 58 | 46,5 | 54 | 41,25 | 50 | 32 | 42 | 21,5 | 34 |
| 90 | 88,25 | 91,75 | | | 67 | 72 | 61,75 | 68 | 56,5 | 64 | 51,25 | 60 | 42 | 52 | 31,5 | 44 |
| 100 | 98,25 | 101,75 | | | 77 | 82 | 71,75 | 78 | 66,5 | 74 | 61,25 | 70 | 52 | 62 | 41,5 | 54 |
| 110 | 108,25 | 111,75 | | | 87 | 92 | 81,75 | 88 | 76,5 | 84 | 71,25 | 80 | 62 | 72 | 51,5 | 64 |
| 120 | 118,25 | 121,75 | | | 97 | 102 | 91,75 | 98 | 86,5 | 94 | 81,25 | 90 | 72 | 82 | 61,5 | 74 |
| 130 | 128 | 132 | | | 101 | 106 | 95,75 | 102 | 90,5 | 98 | 85,25 | 94 | 76 | 86 | 65,5 | 78 |
| 140 | 138 | 142 | | | 111 | 116 | 105,75 | 112 | 108,5 | 108 | 95,25 | 104 | 86 | 96 | 75,5 | 8 |
| 150 | 148 | 152 | | | 121 | 126 | 115,75 | 122 | 110,5 | 118 | 105,25 | 114 | 96 | 106 | 85,5 | 98 |
| 160 | 156 | 164 | | | | | | | 120,5 | 128 | 115,25 | 124 | 106 | 116 | 95,5 | 108 |
| 180 | 176 | 184 | | | | | | | 140,5 | 148 | 135,25 | 144 | 126 | 136 | 115,5 | 128 |
| 200 | 195,4 | 204,6 | | | | | | | 160,5 | 168 | 155,25 | 164 | 146 | 156 | 135,5 | 148 |

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Chemical Composition and Tempering

According to NEN-EN-ISO 898-1:2013 this table specifies limits for the chemical composition of steels and minimum tempering temperatures for the different property classes of bolts, screws and studs. The chemical composition shall be assessed in accordance with the relevant International Standards. For fasteners that have to be hot dip galvanized, the additional material requirements given in ISO 10684 apply.

TABLE 2: CHEMICAL COMPOSITION AND TEMPERING

| Property class | Material and heat treatment | Chemical composition limit (cast analysis, %) ^a | | | | | Tempering temperature °C min |
|---------------------------|--|--|-----------|-----------|-----------|------------------------|---------------------------------|
| | | C min. | C max. | P max. | S max. | B ^b max. | |
| 4.6^{c,d} | Carbon steel or carbon steel with additives | - | 0,55 | 0,050 | 0,060 | Not specified | - |
| 4.8^d | | | | | | | |
| 5.6^d | | 0,13 | 0,55 | 0,050 | 0,060 | | |
| 5.8^d | | - | 0,55 | 0,050 | 0,060 | | |
| 6.8^d | | 0,15 | 0,55 | 0,050 | 0,060 | | |
| 8.8^f | Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered or | 0,15 ^e | 0,40 | 11,2 | 2,4 | 0,003 | 425 |
| | Carbon steel quenched and tempered or | 0,25 | 0,55 | 0,025 | 0,025 | | |
| | Alloy steel quenched and tempered ^g | 0,20 | 0,55 | 0,025 | 0,025 | | |
| 9.8^f | Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered or.. | 0,15 ^e | 0,40 | 0,025 | 0,025 | 0,003 | 425 |
| | Carbon steel quenched and tempered or | 0,25 | 0,55 | 0,025 | 0,025 | | |
| | Alloy steel quenched and tempered ^g | 0,20 | 0,55 | 0,025 | 0,025 | | |
| 10.9^f | Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered or.. | 0,20 ^e | 0,55 | 0,025 | 0,025 | 0,003 | 425 |
| | Carbon steel quenched and tempered or.. | 0,25 | 0,55 | 0,025 | 0,025 | | |
| | Alloy steel quenched and tempered ^g | 0,20 | 0,55 | 0,025 | 0,025 | | |
| 12.9^{h,i} | Alloy steel quenched and tempered ^g | 0,30 | 0,50 | 0,025 | 0,025 | 0,003 | 425 |
| 12.9^{h,i} | Carbon steel with additives (e.g. Boron or Mn or Cr or Molybdenum) quenched and tempered | 0,28 | 0,50 | 0,025 | 0,025 | 0,003 | 425 |

a) In case of dispute, the product analysis applies. **b)** Boron content can reach 0,005 %, provided non-effective boron is controlled by the addition of titanium and/or aluminium. **c)** For cold forged fasteners of property classes 4.6 and 5.6, heat treatment of the wire used for cold forging or of the cold forged fastener itself may be necessary to achieve required ductility. **d)** Free cutting steel is allowed for these property classes with the following maximum sulfur, phosphorus and lead contents: S: 0,34 %; P: 0,11 %; Pb: 0,35 %. **e)** In case of plain carbon boron steel with a carbon content below 0,25 % (cast analysis), the minimum manganese content shall be 0,6 % for property class 8.8 and 0,7 % for property classes 9.8 and 10.9. **f)** For the materials of these property classes, there shall be a sufficient hardenability to ensure a structure consisting of approximately 90 % martensite in the core of the threaded sections for the fasteners in the "as-hardened" condition before tempering. **g)** This alloy steel shall contain at least one of the following elements in the minimum quantity given: chromium 0,30 %, nickel 0,30 %, molybdenum 0,20 %, vanadium 0,10 %. Where elements are specified in combinations of two, three or four and have alloy contents less than those given above, the limit value to be applied for steel class determination is 70 % of the sum of the individual limit values specified above for the two, three or four elements concerned. **h)** Fasteners manufactured from phosphated raw material shall be dephosphated before heat treatment; the absence of white phosphorus enriched layer shall be detected by a suitable test method. **i)** Caution is advised when the use of property class 12.9/12.9 is considered. The capability of the fastener manufacturer, the service conditions and the wrenching methods should be considered. Environments can cause stress corrosion cracking of fasteners as processed as well as those coated.

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Mechanical and physical properties of steel Metric Coarse fasteners

The Mechanical and physical properties according to NEN-EN-ISO 898-1:2013 The bolts, screws and studs of the specified property classes shall, at ambient temperature, meet all the applicable mechanical and physical properties in accordance with the tables regardless of which tests are performed during manufacturing or final inspection. For specific details consult NEN-EN-ISO 898-1:2013

TABLE 3: MECHANICAL AND PHYSICAL PROPERTIES OF STEEL FOR METRIC COARSE FASTENERS

| No. | Mechanical or physical property | Property class | | | | | | | | | | |
|-----|---|---|------------------|------------------|------|------------------|------------------|------------------------|------------------------|-----------|---------------|-------|
| | | 4.6 | 4.8 | 5.6 | 5.8 | 6.8 | 8.8 | | 9.8 | 10.9 | 12.9/ 12.9 | |
| | | | | | | | | d ≤ 16 mm ^a | d > 16 mm ^b | d ≤ 16 mm | | |
| 1 | Tensile strength, R _m , MPa | nom. ^c | 400 | | 500 | | 600 | 800 | | 900 | 1 000 | 1 200 |
| | | min. | 400 | 420 | 500 | 520 | 600 | 800 | 830 | 900 | 1 040 | 1 220 |
| 2 | Lower yield strength, R _{eL} ^d , MPa | nom. ^c | 240 | — | 300 | — | — | — | — | — | — | — |
| | | min. | 240 | — | 300 | — | — | — | — | — | — | — |
| 3 | Stress at 0,2 % non-proportional elongation, R _{p0,2} ^e , MPa | nom. ^c | — | — | — | — | — | 640 | 640 | 720 | 900 | 1 080 |
| | | min. | — | — | — | — | — | 640 | 660 | 720 | 940 | 1 100 |
| 4 | Stress at 0,0048d non-proportional elongation for full-size fasteners, R _{pf} ^f , MPa | nom. ^c | — | 320 | — | 400 | 480 | — | — | — | — | — |
| | | min. | — | 340 ^e | — | 420 ^e | 480 ^e | — | — | — | — | — |
| 5 | Stress under proof load, S _p ^g , MPa | nom. ^c | 225 | 310 | 280 | 380 | 440 | 580 | 600 | 650 | 830 | 970 |
| | | Proof strength ratio: S _{p,nom} /R _{eL,min} or S _{p,nom} /R _{p0,2,min} or S _{p,nom} /R _{pf,min} | 0,94 | 0,91 | 0,93 | 0,9 | 0,92 | 0,91 | 0,91 | 0,9 | 0,88 | 0,88 |
| 6 | Percentage elongation after fracture for machined test pieces, A, % | min. | 22 | — | 20 | — | — | 12 | 12 | 10 | 9 | 8 |
| 7 | Percentage reduction of area after fracture for machined test pieces, Z, % | min. | — | | | | | 52 | | 48 | 48 | 44 |
| 8 | Elongation after fracture for full-size fasteners, Af min. (see also Annex C) | min. | — | 0,24 | — | 0,22 | 0,2 | — | — | — | — | — |
| 9 | Head soundness | No fracture | | | | | | | | | | |
| 10 | Vickers hardness HV F ≥ 98 N | min. | 120 | 130 | 155 | 160 | 190 | 250 | 255 | 290 | 320 | 385 |
| | | max. | 220 ^g | | | | | 250 | 320 | 335 | 360 | 380 |
| 11 | Brinell hardness, HBW F = 30 D ² | min. | 114 | 124 | 147 | 152 | 181 | 245 | 250 | 286 | 316 | 380 |
| | | max. | 209 ^g | | | | | 238 | 316 | 331 | 355 | 375 |

Table 3 (continued)

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| No. | Mechanical or physical property | Property class | | | | | | | | | | |
|-----|--|----------------|-------------------|-----|-----|-----|------------------------|------------------------------|-----------|--------------------|--------------------|----|
| | | 4.6 | 4.8 | 5.6 | 5.8 | 6.8 | 8.8 | | 3.05 | 10.9 | 12.9/ 12.9 | |
| | | | | | | | d ≤ 16 mm ^a | d > 16 mm ^b | d ≤ 16 mm | | | |
| 12 | Rockwell hardness. HRB | min. | 67 | 71 | 79 | 82 | 89 | — | | | | |
| | | max. | 95,0 ^a | | | | 99,5 | — | | | | |
| | Rockwell hardness. HRC | min. | — | | | | | 22 | 23 | 28 | 32 | 39 |
| | | max. | — | | | | | 32 | 34 | 37 | 39 | 44 |
| 13 | Surface hardness. HV 0.3 | max. | — | | | | | — | | 390 | 435 | |
| 14 | Non-carburization. HV 0.3 | max. | — | | | | | h | | h | h | |
| 15 | Height of non-decarburized thread zone. E. mm | min. | — | | | | | 1/2 H ₁ | | 2/3 H ₁ | 3/4 H ₁ | |
| | Depth of complete decarburization in the thread. G. mm | max. | — | | | | | 0.015 | | | | |
| 16 | Reduction of hardness after retempering. HV | min. | — | | | | | 20 | | | | |
| 17 | Breaking torque. M _g . Nm | min. | — | | | | | in accordance with ISO 898-7 | | | | |
| 18 | Impact strength. KV i j. J | min. | — | 27 | — | | 27 | 27 | 27 | 27 | — | |
| 19 | Surface integrity in accordance with | min. | ISO 6157-II | | | | | | | | ISO 6157-3 | |

a) Values do not apply to structural bolting. **b)** For structural bolting $d \geq M12$ **c)** Nominal values are specified only for the purpose of the designation system for property classes. See Clause 5. **d)** In cases where the lower yield strength, ReL, cannot be determined, it is permissible to measure the stress at 0.2 % non-proportional elongation Rp0.2. **e)** For the property classes 4.8, 5.8 and 6.8, the values for Rp_f.min are under investigation. The values at the time of publication of this part of ISO 898 are given for calculation of the proof stress ratio only. They are not test values. **f)** Proof loads are specified in original ISO 898-1:2013. **g)** Hardness determined at the end of a fastener shall be 250 HV, 238 HB or 99.5 HRB maximum. **h)** Surface hardness shall not be more than 30 Vickers points above the measured base metal hardness of the fastener when determination of both surface hardness and base metal hardness are carried out with HV 0.3 **i)** Values are determined at a test temperature of -20 °C. **j)** Applies to $d \geq 16$ mm. **k)** Value for KV is under investigation. **l)** Instead of ISO 6157-1, ISO 6157-3 may apply by agreement between the manufacturer and the purchaser.

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Minimum Ultimate Tensile loads

According to NEN-EN-ISO 898-1:2013 the minimum ultimate tensile loads are applicable for coarse pitch thread.

TABLE 4: MINIMUM ULTIMATE TENSILE LOADS FOR STEEL METRIC COARSE FASTENERS

| Thread ^a _d | Nominal stress area As,nom ^b mm ² | Property class | | | | | | | | |
|-------------------------------------|---|--|---------|---------------------|---------|---------|----------------------|---------|---------------------|-----------|
| | | 4.6 | 4.8 | 5.6 | 5.8 | 6.8 | 8.8 | 9.8 | 10.9 | 12.9/12.9 |
| | | Minimum ultimate tensile load, Fm,min (As,nom × Rm,min), N | | | | | | | | |
| M3 | 5,03 | 2 010 | 2 110 | 2 510 | 2 620 | 3 020 | 4 020 | 4 530 | 5 230 | 6 140 |
| M3,5 | 6,78 | 2 710 | 2 850 | 3 390 | 3 530 | 4 070 | 5 420 | 6 100 | 7 050 | 8 270 |
| M4 | 8,78 | 3 510 | 3 690 | 4 390 | 4 570 | 5 270 | 7 020 | 7 900 | 9 130 | 10 700 |
| M5 | 14,2 | 5 680 | 5 960 | 7 100 | 7 380 | 8 520 | 11 350 | 12 800 | 14 800 | 17 300 |
| M6 | 20,1 | 8 040 | 8 440 | 10 000 | 10 400 | 12 100 | 16 100 | 18 100 | 20 900 | 24 500 |
| M7 | 28,9 | 11 600 | 12 100 | 14 400 | 15 000 | 17 300 | 23 100 | 26 000 | 30 100 | 35 300 |
| M8 | 36,6 | 14 600 ^c | 15 400 | 18 300 ^c | 19 000 | 22 000 | 29 200 ^c | 32 900 | 38 100 ^c | 44 600 |
| M10 | 58 | 23 200 ^c | 24 400 | 29 000 ^c | 30 200 | 34 800 | 46 400 ^c | 52 200 | 60 300 ^c | 70 800 |
| M12 | 84,3 | 33 700 | 35 400 | 42 200 | 43 800 | 50 600 | 67 400 ^d | 75 900 | 87 700 | 103 000 |
| M14 | 115 | 46 000 | 48 300 | 57 500 | 59 800 | 69 000 | 92 000 ^d | 104 000 | 120 000 | 140 000 |
| M16 | 157 | 62 800 | 65 900 | 78 500 | 81 600 | 94 000 | 125 000 ^d | 141 000 | 163 000 | 192 000 |
| M18 | 192 | 76 800 | 80 600 | 96 000 | 99 800 | 115 000 | 159 000 | — | 200 000 | 234 000 |
| M20 | 245 | 98 000 | 103 000 | 122 000 | 127 000 | 147 000 | 203 000 | — | 255 000 | 299 000 |
| M22 | 303 | 121 000 | 127 000 | 152 000 | 158 000 | 182 000 | 252 000 | — | 315 000 | 370 000 |
| M24 | 353 | 141 000 | 148 000 | 176 000 | 184 000 | 212 000 | 293 000 | — | 367 000 | 431 000 |
| M27 | 459 | 184 000 | 193 000 | 230 000 | 239 000 | 275 000 | 381 000 | — | 477 000 | 560 000 |
| M30 | 561 | 224 000 | 236 000 | 280 000 | 292 000 | 337 000 | 466 000 | — | 583 000 | 684 000 |
| M33 | 694 | 278 000 | 292 000 | 347 000 | 361 000 | 416 000 | 576 000 | — | 722 000 | 847 000 |
| M36 | 817 | 327 000 | 343 000 | 408 000 | 425 000 | 490 000 | 678 000 | — | 850 000 | 997 000 |
| M39 | 976 | 390 000 | 410 000 | 488 000 | 508 000 | 586 000 | 810 000 | — | 1 020 000 | 1 200 000 |

a) Where no thread pitch is indicated in a thread designation, coarse pitch is specified. **b)** To calculate As,nom, see 9.1.6.1. in ISO 898-1:2013 **c)** For fasteners with thread tolerance 6az in accordance with ISO 965-4 subject to hot dip galvanizing, reduced values in accordance with ISO 10684:2004, Annex A, apply. **d)** For structural bolting 70 000 N (for M12), 95 500 N (for M14) and 130 000 N (for M16).

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