

INTRODUCTION

This repair manual is intended to guarantee that the maintenance and repair work required for BMW cars is done in the correct manner. The manual should be used by shop foremen and mechanics to supplement the practical and theoretical knowledge they have acquired at our service training school.

Specifications are provided at the beginning of each main group.

These specifications apply to standard models which have not been involved in an accident and have not been modified since leaving the factory.

The group system is taken from our Flat Rate Catalog.

Taking our page numbering system as an example, 32-21/6 means:
32 main group
-21 subgroup
/6 consecutively numbered page in subgroup

The special tools required for proper repair work are listed in our microfilmed Special Tool Catalog No. 01 99 9 699 422. Their application is illustrated along with the job text.

Each job text always describes the removal procedures. There are appropriate installation notes, if installation cannot be completed in reverse sequence.

Supplements to this manual will include alterations and additions. A sheet with the word "alteration" as a footnote replaces an old sheet. Sheets marked "addition" are simply filed at the right place without removing any sheets.

In addition to information on improvements and modifications as announced regularly in our bulletins, we recommend that you use the illustrated parts catalogs (microfilms) as a source of reference.

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SERVICE DEPARTMENT

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00 Maintenance and General Information

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Tightening Torques and Preload Forces

Applicable only to bolts according to DIN 912, 931, 933, 960, 961, 6912 and nuts with a nut height of $0.8 \times d$ according to DIN 934 and exclusively for $\mu_{ges} = 0.14$ (Bolts phosphate treated, nuts without aftertreatment or galvanized. Lubricated condition: either non-lubricated or oiled.)

For cadmium plated bolts or nuts ($\mu_{ges} \approx 0.08$ to 0.09) the tightening torque must be $\approx 30\%$ less than in the table with the same utilization factor of the bolt material.

Not applicable when another surface or lubricated condition of the thread is used or if there is a variation in the nut height. In such cases it is necessary to determine the values separately.

Not applicable to bolts with expansion shanks, self-locking screw connections as well as screw connections of parts made of different materials. The utilization factor of the bolt in the case of a standard metric thread is:

$$\sigma_{red} = 0.09 \cdot \sigma_{0.2}$$

| Thread | Tightening torque M_A $\frac{mkp}{ft. lb}$ | | | | | | Preload force P_v $\frac{kp}{lb}$ | | | | | |
|-------------|---|---|--|---|--|---|-------------------------------------|---------------|---------------|----------------|----------------|----------------|
| | Property class as per DIN 267 | | | | | | Property class as per DIN 267 | | | | | |
| | 5.6 | 6.8 | 6.9 | 8.8 | 10.9 | 12.9 | 5.6 | 6.8 | 6.9 | 8.8 | 10.9 | 12.9 |
| M 6 | 0.4 ^{+0.1} 2.9 ^{+0.7} | 0.6 ^{+0.1} 4.3 ^{+0.7} | 0.7 ^{+0.1} 5 ^{+0.7} | 0.9 ^{+0.1} 6.5 ^{+0.7} | 1.2 ^{+0.2} 8.7 ^{+1.4} | 1.5 ^{+0.2} 10.8 ^{+1.4} | 425 937 | 600 1323 | 685 1510 | 855 1885 | 1210 2668 | 1440 3175 |
| M 8 | 1.0 ^{+0.1} 7.25 ^{+0.7} | 1.6 ^{+0.2} 11.6 ^{+1.4} | 1.8 ^{+0.2} 13 ^{+1.4} | 2.2 ^{+0.2} 16 ^{+1.4} | 3.0 ^{+0.3} 21.7 ^{+2.2} | 3.6 ^{+0.4} 26 ^{+2.9} | 740 1631 | 1190 2624 | 1330 2932 | 1570 3462 | 2170 4785 | 2630 5799 |
| M 10 | 2.0 ^{+0.2} 14.5 ^{+1.4} | 3.2 ^{+0.4} 23.1 ^{+2.9} | 3.6 ^{+0.4} 26 ^{+2.9} | 4.3 ^{+0.5} 29 ^{+3.6} | 6.0 ^{+0.7} 43.4 ⁺⁵ | 7.3 ^{+0.8} 52.8 ^{+5.8} | 1160 2558 | 1880 4145 | 2090 4608 | 2500 5512 | 3480 7673 | 4200 9261 |
| M 8 x 1 | 1.0 ^{+0.1} 7.2 ^{+0.7} | 1.0 ^{+0.2} 7.2 ^{+1.4} | 1.8 ^{+0.2} 13 ^{+1.4} | 2.2 ^{+0.2} 16 ^{+1.4} | 3.0 ^{+0.3} 21.7 ^{+2.2} | 3.6 ^{+0.4} 26 ^{+2.9} | 740 1631 | 1190 2624 | 1330 2932 | 1610 3550 | 2200 4851 | 2670 5887 |
| M 10 x 1.25 | 2.0 ^{+0.2} 14.5 ^{+1.4} | 3.2 ^{+0.4} 23.1 ^{+2.9} | 3.6 ^{+0.4} 26 ^{+2.9} | 4.3 ^{+0.5} 29 ^{+3.6} | 6.0 ^{+0.7} 43.4 ⁺⁵ | 7.3 ^{+0.8} 52.8 ^{+5.8} | 1160 2558 | 1900 4189 | 2120 4674 | 2520 5556 | 3530 7784 | 4250 9371 |
| M 12 x 1.25 | 3.4 ^{+0.4} 24.6 ^{+2.9} | 5.4 ^{+0.6} 39 ^{+4.3} | 6.1 ^{+0.7} 44.1 ⁺⁵ | 7.2 ^{+0.8} 52 ^{+5.8} | 10.3 ⁺¹ 74.5 ^{+7.2} | 12.0 ^{+1.5} 86.7 ^{+10.8} | 1720 3792 | 2710 5975 | 3070 6769 | 3610 7960 | 5100 11245 | 6090 13428 |
| M 12 x 1.5 | 3.4 ^{+0.4} 24.6 ^{+2.9} | 5.4 ^{+0.6} 39 ^{+4.3} | 6.1 ^{+0.7} 44.1 ⁺⁵ | 7.2 ^{+0.8} 52 ^{+5.8} | 10.3 ⁺¹ 74.5 ^{+7.2} | 12.0 ^{+1.5} 86.7 ^{+10.8} | 1690 3726 | 2670 5887 | 3030 6681 | 3570 7872 | 5040 11113 | 6000 13230 |
| M 14 x 1.5 | 5.4 ^{+0.6} 39 ^{+4.3} | 8.6 ⁺¹ 62.2 ^{+7.2} | 9.8 ⁺¹ 71 ^{+7.2} | 11.5 ^{+1.5} 83 ^{+10.8} | 16.0 ⁺² 115.7 ^{+14.5} | 20 ⁺² 144.6 ^{+14.5} | 2330 5137 | 3720 8202 | 4180 9217 | 5030 11091 | 6970 15369 | 8510 18764 |
| M 16 x 1.5 | 8.3 ⁺¹ 60.0 ^{+7.2} | 13.5 ^{+1.5} 97.6 ^{+10.8} | 15.5 ^{+1.5} 112 ^{+10.8} | 18.0 ⁺² 130 ^{+14.5} | 25 ⁺³ 180.7 ⁺²² | 30.0 ⁺⁴ 217 ⁺²⁹ | 3240 7144 | 5190 11444 | 5840 12877 | 6920 15258 | 9710 21410 | 11770 25953 |
| M 18 x 1.5 | 11.0 ^{+1.5} 19.5 ^{+10.8} | 18.0 ⁺² 130 ^{+14.5} | 20.0 ^{+2.5} 144.6 ⁺¹⁸ | 24.0 ⁺³ 173.5 ⁺²² | 34.0 ⁺⁴ 246 ⁺²⁹ | 40.0 ⁺⁵ 289 ⁺³⁶ | 3890 8577 | 6240 13759 | 7020 15479 | 8380 18478 | 11800 26019 | 13960 30782 |
| M 20 x 1.5 | 16.0 ⁺² 115.7 ^{+14.5} | 26.0 ⁺³ 188 ⁺²² | 29.0 ^{+3.5} 210 ⁺²⁵ | 34.0 ⁺⁴ 246 ⁺²⁹ | 49.0 ⁺⁵ 354 ⁺³⁶ | 59.0 ⁺⁶ 426.6 ^{+43.4} | 5070 11179 | 8170 18015 | 9180 20242 | 10680 23549 | 15200 33516 | 18250 40159 |

The values stipulated in the table apply to a screw connection which corresponds to the above conditions. The tightening torque including tolerance is only given on the layout or assembly drawing if

- a value different from the standard sheet is necessary for operational reasons,
- the property class of the bolt and nut is not evident.

Note: All deviations from this table have been taken into account in the technical data

A BMW Standard regarding tightening and test torques for screw connections with self-locking nuts as per DIN 985 and BMW N 113 48.0 is being prepared.

Tightening Torques

for self-locking nuts

BMW N
113 49.0

Applicable only to nuts according to BMW N 113 48.0 and DIN 985.

Surface condition: Bolt phosphate treated or galvanized, nut galvanized and not waxed.
Lubricated condition of bolt: either non-lubricated or lightly oiled.

For cadmium plated bolts or nuts the tightening torque, with the same utilization factor of the bolt material, must be $\approx 30\%$ less than the value in the table.

Not applicable in the case of another surface or lubricated condition of the thread, a property class of the bolt of less than 8.8 (e. g. 6.9) in conjunction with expansion bolts.

In such cases it is necessary to determine the values separately.














| Thread | Tightening torque M_A $\frac{\text{mkp}}{\text{ft. lb}}$ | | | | | |
|-------------|--|---------------------|---------------------|---------------------------------------|--------------------|---------------------|
| | Nuts as per BMW N 113 48.0 Property class | | | Nuts as per DIN 985 Property class | | |
| | 8 | 10 | 12 | 8 | 10 | 12 |
| M 6 | 1.1+0.1 7.9+0.7 | 1.5+0.2 10.8+1.4 | 1.8+0.2 13.0+1.4 | 1.0+0.1 7.2+0.7 | 1.3+0.2 9.4+1.4 | 1.6+0.2 11.6+1.4 |
| M 8 | 2.5+0.3 | 3.4+0.4 | 4.0+0.5 | 2.5+0.2 | 3.3+0.3 | 3.9+0.4 |
| M 8 x 1 | 17.0+2.2 | 24.6+2.9 | 29.0+3.6 | 18.0+1.4 | 24.0+2.2 | 28.2+2.5 |
| M 10 | 35.4+0.5 | 6.8+0.8 | 8.0+0.9 | 4.7+0.5 | 6.4+0.7 | 7.7+0.8 |
| M 10 x 1.25 | 4.9+3.6 | 49.0+5.8 | 57.8+6.5 | 34.0+3.6 | 46.3+5 | 55.7+5.8 |
| M 12 | 8.1+0.9 | 11.4+1.3 | 13.5+1.5 | 7.8+0.8 | 10.9+1 | 12.6+1.5 |
| M 12 x 1.5 | 58.5+6.5 | 82.4+9.4 | 97.6+10.8 | 56.4+5.8 | 78.8+7.2 | 91.0+10.8 |
| M 14 | 13.0+1.5 | 18.0+2 | 22.0+2 | 12.7+1.5 | 17.0+2 | 21.0+2 |
| M 14 x 1.5 | 94.0+10.8 | 130.0+14.5 | 159.0+14.5 | 92.0+10.8 | 123.0+14.5 | 152.0+14.5 |
| M 16 | 22.5+2 | 28.0+3 | 33.0+4 | 19.5+2 | 26.0+3 | 31.0+4 |
| M 16 x 1.5 | 162.7+14.5 | 202.0+22 | 238.6+29 | 141.0+14.5 | 188.0+22 | 224.0+29 |
| M 18 | 27.0+3 | 38.0+4 | 44.0+5 | 26.0+3 | 36.0+4 | 42.0+5 |
| M 18 x 1.5 | 195.0+22 | 274.7+29 | 318.0+36 | 188.0+22 | 260.0+29 | 303.6+36 |











The respective preload forces P_v (kp/lb), according to the individual property classes, can be taken from the table "Tightening torques and preload forces" in BMW N 600 02.0.

The values stipulated in the table apply to a screw connection which corresponds to the above mentioned conditions. The tightening torque including tolerance is only given on the layout or assembly drawing if a value different from the standard sheet is necessary for operational reasons.




In the case of a screw connection which is highly stressed dynamically an exact examination by means of calculations and tests is essential.







Bolts and Screws

| Description | Head Shape | DIN No. | Property class |
|------------------------------------|---|-------------|-------------------|
| Hex. head screws |  | 931 | 8.8 |
| | | 933 | |
| | | 960 | |
| | | 961 | |
| | | 70614 | 12.9 |
| | | 561 | 8.8 |
| Fillister head Cap screws |  | 84 | 4.8 8.8 |
| |  | 912 6912 | 8.8 10.9 |
| Round head |  | 7986 | 4.8 |
| Mushroom head screws |  | 603 | 4.6 8.8 |
| Countersunk screws |  | 63 | 4.8 8.8 |
| |  | 7987 | 4.8 8.8 |
| Oval head screws |  | 920 921 | 5.6 ⁴⁾ |
| |  | 7985 | 4.8 |
| Oval head countersunk screws |  | 91 | 4.8 8.8 |
| |  | 7988 | 4.8 |
| Fillister head self-tapping screws |  | 7971 | 1) |
| Hexagon head self-tapping screws |  | 7976 | 1) |

| Description | Head Shape | DIN No. | Property class |
|---|---|---------|-------------------|
| Countersunk self-tapping screws |  | 7982 | 1) |
| Oval head self-tapping screws |  | 7981 | 1) |
| Oval head countersunk self-tapping screws |  | 7983 | 1) |
| Studs | - | 833 | 8.8 |
| | | 835 | |
| | | 836 | |
| | | 838 | |
| | | 939 | |
| | | 940 | |
| Threaded pins |  | 417 | 2) 4) |
| | | 551 | |
| | | 553 | |
| | | 438 | 4.8 ⁴⁾ |
| Grub screws |  | 427 | 5.8 |
| Winged screws |  | 316 | 4.6 |
| Plugs |  | 906 | 4.6 |
| | | 908 | |
| | | 910 | 5.6 ⁴⁾ |
| | | 7604 | |
| Hollow screws |  | 7623 | 6.8 |
| | | 71436 | |
| Cap screws |  | 3871 | 5.6 ⁴⁾ |
| Slotted plugs |  | 71022 | 5.6 ⁴⁾ |

Nuts

| Description | Shape | DIN No. | Property class |
|--------------|---|------------|-----------------------|
| Hexagon nuts |  | 439 | 5) |
| | | 985 | 8 10 ⁴⁾ |
| | | 934 | 3) |
| | | 936 | 6G 8G |
| | | 70615 | 8/10 ⁴⁾ |
| | | 70616 | 6G/8G ⁴⁾ |
| Castle nuts |  | 935 937 | 8/10 6S/8G |
| Wing nuts |  | 315 | GTS |

| Description | Shape | DIN No. | Property class |
|--------------------------------------|---|---------|--------------------|
| Square nuts |  | 557 | 5-2 |
| | | 562 | 4D-2 |
| Cap nuts |  | 986 | 8 ⁴⁾ |
| | | 1587 | 6-2 |
| Slotted nuts |  | 70851 | 6G ⁴⁾ |
| | | 70852 | |
| Screw caps |  | 3870 | 5D-2 ⁴⁾ |
| | | 7606 | |
| Knurled nuts |  | 466 | 5-2 |
| | | 467 | |
| Ball collar nuts Flat collar nuts |  | 74361 | 8/10 |

1) Case hardened steel, tempered file-hard, depth of case 0.1 ... 0.2 mm (0.004 ... 0.008")

2) up to M 10: 4.8, from M 12: 4.6

3) up to M 4: 5-2, from M 5: 8 and 10

4) The stipulated property characteristics deviate from the DIN specification

5) up to M 8: 4D-2, for M 10: 5S-2

Conversion and comparison table for statutory measurement units

| Measurement/value | Standard symbol | | Conversion or equivalent | | |
|-----------------------------------|---|---|---|--|--|
| | Old | New | | | |
| Length | m | m | 1 m = 1000 mm | 1 km = 1000 m | 1 μ m = 0.01 mm |
| Surface area | m ² qm | m ² | 1 m ² = 10 ⁶ mm ² | 1 mm ² = 0.01 cm ² | |
| Volume | m ³ cbm | m ³ | 1 m ³ = 10 ⁶ cm ³ | 1 dm ³ = 0.001 m ³ | |
| | 1 | 1 | 1 l = 1 dm ³ | | |
| Angle | plane | ° | ° _{rad} | 1 rad = 1 m/m \approx 57° | 1° = $\pi/180$ rad |
| | spatial | (°) ² | sr | 1 sr = 1 m ² /m ² | (1°) ² = ($\pi/180$) ² sr |
| Mass | kg | kg | 1 kg = 1000 g | 1 g = 1000 mg | 1 t = 1 Mg = 1000 kg |
| Density | kg/m ³ | kg/m ³ | 1 kg/m ³ = 0.001 kg/dm ³ | | 1 kg/dm ³ = 1 kg/l |
| Unbalance | kgm | kgm | 1 kgm = 1 000 000 g mm | | |
| Time | sec s | s | 1 min = 60 s | 1 h = 60 min | |
| Speed of rotation | rev/sec rev/min | 1 s 1/min | 1 rev/min = 1/min | 1/min = 1/(60s) | |
| Speed | m/s | m/s | 1 m/s = 3.6 km/h | | |
| Acceleration | m/s ² | m/s ² | | | |
| Force, effort | kp | N | 1 N = 1 kgm/s ² | 1 kp = 9,81 N | |
| Pressure (in gases, liquids) | at kp/cm ² m WG Torr mm Hg | N/m ² Pa bar | 1 at = 1 kp/cm ² = 0.981 bar = 98,066.5 Pa 1 m WG = 9 806.65 Pa = 9 806.65 N/m ² 1 Torr = 1.333 224 mbar 1 mm Hg = 133.322 Pa = 133.322 N/m ² | | |
| Mechanical stress | kp/mm ² | N/m ² Pa N/mm ² | 1 N/m ² = 1 Pa 1 kp/mm ² = 9.81 N/mm ² | | |
| Energy, work, heat | kpm Hp/h cal | J | 1 J = 1 Nm 1 kpm = 9.81 J | 1 kWh = 3.6 MJ 1 cal = 4.1868 J | |
| Torque | kpm | Nm | 1 kpm = 9.81 Nm | | |
| Output, performance | Hp (bhp) kpm/s kcal/h | kW Nm/s | 1 kW = 1000 W 1 hp = 736 W = 75 kpm/s = 632 kcal 1 kW = 1.36 hp = 102 kpm/s = 860 kcal/h = 0.239 kcal/s | 1 W = 1 Nm/s = 1 J/s | |
| Viscosity | dynamic | P | Pas | 1 Pas = 1 Ns/m ³ | 1 P = 0.1 Pas = 1 g/cms |
| | kinematic | St | m ² /s | 1 m ² /s = 1 Pas m ³ /kg | 1 St = 1 cm ² /s = 0.0001 m ² /s |
| Temperature | deg °C °K | °C K | 0°C \approx 273.15°K 1 deg = 1°K = 1 K = 1°C (temperature difference) | | |
| Electrical current | A | A | 1 mA = 0.001 A | 1 kA = 1000 A | |
| Electrical voltage (potential) | V | V | 1 V = 1 W/A | 1 mV = 0.001 V | 1 MV = 10 ⁶ V |
| Electrical resistance | Ω | Ω | 1 Ω = 1 V/A = 1/S | | |
| Magnetic flux | M | Wb, Vs | 1 Wb = 1 Vs | 1 M = 10 ⁻⁴ Wb | |
| Magnetic flux density | G | T | 1 T = 1 Wb/m ² | 1 G = 10 ⁻⁴ T | |
| Magnetic field strength | Oe | A/m | 1 A/m = 1 N/Wb | 1 Oe = 10 ³ /4 π A/m | |
| Light strength | HK | cd | 1 cd = 1.107 HK | 1 HK = 0.903 342 cd | |
| Light (optical) density | sb | cd/m ² | 1 sb = 10 ⁴ cd/m ² | | |
| Lighting (illumination) intensity | ph | lx | 1 ph = 10 ⁻⁴ lx | | |

| Model | 320 i | 320 i A |
|--|----------|---|
| Overall length | mm(in.) | 4508 (177.480) |
| Overall width | mm(in.) | 1610 (63.386) |
| Overall height (unloaded) | mm(in.) | 1380 (54.331) |
| Ground clearance (loaded at max. total weight) | mm(in.) | 145 (5.709) |
| Wheelbase (at max. axle loads) | mm(in.) | 2563 (100.905) |
| Curbweight (ready for driving, full fuel tank) | kg(lbs.) | 1180 (2601) (acc. FMVSS 110) 1190 (2623) (acc. FMVSS 110) |
| Max. total weight | kg(lbs.) | 1600 (3527) (acc. FMVSS 110) |
| Max. axle load, front | kg(lbs.) | 785 (1731) (acc. FMVSS 105) |
| rear | kg(lbs.) | 835 (1841) (acc. FMVSS 105) |