# GEAR COUPLINGS

## INSTALLATION, LUBRICATION, USE AND MAINTENANCE

### *A - STATUS AT DELIVERY*

A.1 Maina gear couplings are generally supplied assembled (complete gear coupling or half gear coupling), with no lubricant.

A.2 A proper surface protection coat normally realizes protection against corrosion on the inner and interface surfaces. Different anticorrosion treatments shall be required in the order.

### *B - SUGGESTIONS FOR HANDLING AND STORAGE*

B.1 Before handling the couplings, check the weight of the units and their barycenter, looking up in the tables below or in the catalogue and/or in the drawings.

A SERIES GEAR COUPLING MASS

| SIZE | STANDARD | AMM | FA | AO | AO-FA | GC-MA |
|---|---|---|---|---|---|---|
| 0 | 4.3 | 8 | 4.5 | 22.8 | 26.0 | 4 |
| 1 | 7.5 | 13 | 8 | 21.5 | 39.4 | 7 |
| 2 | 13.5 | 23 | 14 | 32.5 | 62.4 | 13 |
| 3 | 25 | 41 | 26 | 53.5 | 104.0 | 24 |
| 4 | 37 | 60 | 39 | 79.5 | 138.8 | 34 |
| 5 | 60 | 91 | 63 | 113 | 207.7 | 53 |
| 6 | 90 | 141 | 95 | 155 | 294.6 | 80 |
| 7 | 124 | 199 | 131 | 212 | 390.6 | 113 |
| 8 | 170 | 285 | 180 | 270 | 514 | 146 |
| 9 | 233 | 352 | 248 | 356 | 664 | 190 |
| 10 | 298 | 428 | 318 | 438 | 819 | 247 |
| 11 | 457 | 596 | 488 | 662 | 1188 | 392 |

The values, expressed in Kg, are calculated with solid hubs, for AO with spacer length of LS=1000 (mm), and for AO-FA with Shaft length of LS=1000 (mm).

B AND B.HT SERIES GEAR COUPLING MASS

| SIZE | STANDARD | AO | FB | MB |
|---|---|---|---|---|
| 4 | 688 | 907 | 718 | 612 |
| 5 | 926 | 1157 | 946 | 832 |
| 6 | 1231 | 1575 | 1231 | 1078 |
| 7 | 1613 | 1942 | 1718 | 1457 |
| 8 | 2089 | 2446 | 2140 | 1865 |
| 9 | 2617 | 2935 | 2690 | 2276 |
| 10 | 3011 | 3421 | 3090 | 2721 |
| 11 | 3787 | 4278 | 3880 | 3451 |
| 12 | 4550 | 5105 | 4685 | 4114 |
| 13 | 6080 | 6763 | 6330 | 5140 |
| 14 | 8720 | 9535 | 8950 | 7900 |
| 15 | 11262 | 12212 | 11500 | 10300 |
| 16 | 14864 | 15788 | 15220 | 13690 |
| 17 | 18347 | 19434 | 18710 | 16890 |
| 18 | 22210 | 23412 | 22750 | 20545 |
| 19 | 27637 | 28830 | 28360 | 25710 |

The values, expressed in Kg, are calculated with solid hubs, and for AO with spacer length of LS=1000 (mm)

G20 COUPLING MASS

| GRANDEZZA | F | FS | FR |
|---|---|---|---|
| 12 | 24.5 | 66.5 | 25.5 |
| 14 | 35.5 | 86 | 38 |
| 17 | 52.5 | 120 | 56.5 |
| 19 | 76.0 | 162 | 81.5 |
| 23 | 111 | 215 | 123 |
| 26 | 189 | 337 | 198 |
| 30 | 270 | 442 | 288 |
| 35 | 403 | 645 | 430 |
| 40 | 583 | 903 | 615 |
| 46 | 843 | 1219 | 895 |
| 52 | 1171 | 1615 | 1239 |
| 58 | 1754 | 2257 | 1751 |

The values, expressed in Kg, are calculated with solid hubs, and for FS with spacer length of LS=1000 (mm

B.2 Do not employ equipment and procedures that could damage the couplings and their components when handling them.

B.3 To lift and handle the couplings and their components tighten the eyebolts in their holes, making sure that the equipment you are employing are adequate and that everything is always done in the maximum safety conditions.

B.4 Avoid any kind of impact when handling and storing.

B.5 Store in a covered and dry place and never at direct contact with the floor.

B.6 When storing for more than six months, check the status of protection on the non painted parts and apply a new protection film.

### *C - SAFETY STANDARDS*

C.1 **Couplings in operation may be dangerous units so the user must provide for adequate protection devices complying with the work safety measures in force in the country of installation.**

C.2 **The operations of handling, installation, lubrication and maintenance must be carried out by qualified personnel only.**

C.3 **While performing the operations of handling, installation, lubrication and maintenance, wear garments which cannot get entangled with the mechanical components and employ appropriate individual protection devices.**

C.4 **If any toxic chemical substances are employed to clean the couplings, provide for**

adequate protection to personnel and environment.

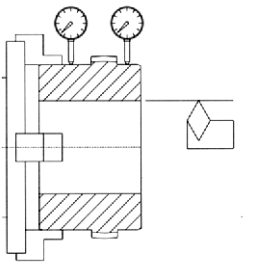
C.5 Make sure the machines the coupling connects are off and cannot restart throughout the different operations.

C.6 Never exceed, in operation, the load data agreed in the order (torque, speed, working angles etc.)

## *D - BORE FINISHING*

The hub bores, when no tolerance finishing is required, or no semifinishing, are supplied with pilot bores or simply bored. These bores may not be concentrical with the other turned diameters. Finish the hub bores, checking that they are concentric with the reference diameters used in the operations of alignment and that they are orthogonal with the hub face surfaces too. Check by means of a centesimal comparator to get the closest-to-zero centering value.

Bore finishing



### D.1 KEYWAYED BORES

In these cases, the finishing of cylindrical or taper bores and their keyways must be strictly complying with the standardization specifications for keyways and/or for taper bores and with the design drawings (see also AGMA 9002-A96 standards). Therefore, special cases excepted, it is always advisable using a fitting with a slight interference of 0.5/1000 of the diameter. To obtain a tight interference fit, we suggest these tolerances: H7 for the bore and m6-r6 for the shaft (never use too high interference in case of keyways). Normally the bore, for roughness, shape and concentricity, does not require any grinding and can be finished by turning. The keyway cutting, in the hubs of the GO A gear couplings with max bore, may create some ovalizations in the hub which can then be eliminated in the following shrink fitting of the hub onto the cylindrical shaft. The keyways too, after fitting, must be slightly forced on the hub and shaft keyway sides; you can therefore use a tolerance of JS9 or P9 for the keyways. For standard keyways in standard hubs, for nominal load conditions in heavy unidirectional duty and no-backlash fit, it is advisable not to exceed these values of specific pressures on the sides, also according to AGMA 420-04 point 5.5:

- for flex hubs made of hardened and tempered steel Pmax = 160 N/mm2
- for rigid hubs made of normalized steel Pmax = 100 N/mm2

On the contrary, when choosing a transition fit or a clearance fit, it is advisable providing for suitable devices for hub and keyway axial blocking, so to avoid that these components slip out of the shafts, when in operation.

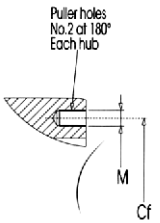
### D.2 BORES FOR SHRINK FITTINGS

Interference values from 1/1000 to 2.5/1000 of the diameter are commonly used for this type of fits, employing fits with H6 bores and s6-x6 shafts or special ones, avoiding to exceed the 80% stress of the hub yielding load. Besides, in order to avoid problems of disassembly, it is important never to exceed the fit limit pressure of 300 Mpa. The bore finishing, for roughness, shape and concentricity, needs being ground. In this case, ask Maina Engineers who, according to AGMA 9003-A91 and SKF standards, will calculate both the slipping torque (which must be at least four times the calculated motor nominal

torque, or 20% higher than the max possible overload), and the expansions and stresses produced in the hub. Depending on the fit procedures, the friction coefficients must be included between 0,12 and 0,18, never higher than 0,2. On the hubs, make some bores for SKF injector connections (special pumps for oil at 3500 bar useful to perform the shrink fit and the oil pressure removal), and some grooves for the oil spreading. Besides, arrange for a suitable number of screwed bores (refer to TAB.V for dimensions and position) for the connections of fitting and removal devices like oildynamic jacks or other similar suitable devices. Remember that, for various reasons, the real removal axial forces may be remarkably higher than the theoretic calculated ones.

TAB.V

PULLER HOLES




| GO-A SIZE | Bores M | Dia. Cf |
|---|---|---|
| * 0 | M5 | 61 |
| * 1 | M6 | 73 |
| * 2 | M8 | 91 |
| * 3 | M10 | 115 |
| * 4 | M12 | 132 |
| * 5 | M12 | 154 |
| 6 | M16 | 180 |
| 7 | M16 | 204 |
| 8 | M20 | 220 |
| 9 | M20 | 240 |
| 10 | M24 | 268 |
| 11 | M24 | 316 |

* - only if requested.

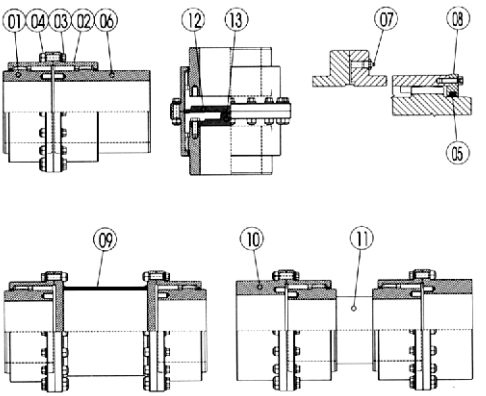
| GO-A.HT SIZE | Bores M | Dia. Cf |
|---|---|---|
| 3 | M10 | 98 |
| 4 | M10 | 118 |
| 5 | M10 | 154 |
| * 6 | M12 | 170 |
| * 7 | M12 | 200 |
| 8 | M16 | 220 |
| 9 | M16 | 237 |
| 10 | M16 | 266 |
| 11 | M24 | 294 |

| GO-B SIZE | Bores M | Dia. Cf |
|---|---|---|
| 4 | M24 | 350 |
| 5 | M24 | 400 |
| 6 | M30 | 430 |
| 7 | M30 | 490 |
| 8 | M30 | 550 |
| 9 | M36 | 580 |
| 10 | M36 | 600 |
| 11 | M36 | 670 |
| 12 | M42 | 710 |
| 13 | M42 | 790 |
| 14 | M48 | 900 |
| 15 | M48 | 1000 |
| 16 | M48 | 1120 |
| 17 | M56 | 1190 |
| 18 | M56 | 1280 |
| 19 | M56 | 1400 |

| G20 SIZE | Bores M | Dia. Cf |
|---|---|---|
| 12 | M10 | 90 |
| 14 | M10 | 110 |
| 17 | M10 | 130 |
| 19 | M12 | 145 |
| 23 | M12 | 175 |
| 26 | M16 | 205 |
| 30 | M16 | 235 |
| 35 | M16 | 280 |
| 40 | M24 | 320 |
| 46 | M24 | 360 |
| 52 | M24 | 410 |
| 58 | M24 | 460 |

## *E - PREPARATION FOR ASSEMBLY*

### LIST OF COMPONENTS




| | |
|---|---|
| 01 | Standard hub |
| 02 | Flange sleeve |
| 03 | Set screw |
| 04 | Hexagon self-locking nut |
| 05 | Seal |
| 06 | Long hub |
| 07 | Grease nipple or plug |
| 08 | Removable side flange |
| 09 | Tubular spacer |
| 10 | Rigid hub |
| 11 | Intermediate shaft |
| 12 | Intermediate disc |
| 13 | Button disc |

E.1 The operations of inspection and assembly must be carried out by qualified and skilled personnel only.

E.2 Before proceeding with installation, make sure the operation data (nominal and max torque, working misalignment, motor nominal and absorbed power, min and max speed, transient over-loads etc.), as well as the dimensional data and tolerances (DBSE, shaft and keyway diameters and lengths, end floats, strokes etc.) shown in the coupling overview drawing, do correspond to the plant requirements and adaptability. For couplings with particularly long spacers and rotation speed > 300 rpm, check that the max rotation speed does not exceed the 80% of the critical bending speed.
**Never exceed these load and dimensional data.**

E.3 Unless different and specific instructions are involved, the standard gear couplings cannot be employed with temperatures lower than -20°C and higher than +120°C. For temperatures constantly lower than -20°C or higher than +60°C, it is necessary to employ special seals and lubricants and to verify the residual end floats (modified according to coupling and connected machine thermal expansions).

E.4 Gear couplings in operation, under load, produce resistance to axial sliding (translation of the hub in the sleeve). This movement is opposed by a force which is directly proportional to the transmitted torque and inversely proportional to the pitch diameter of the coupling gear teeth. Besides, the axial force is linked to the friction coefficient present in the gear teeth according to the type of lubrication performed. The friction coefficient may vary from 0,05 to 0,3. Ask Maina Engineering Department for further details.

E.5 Unpack the coupling and check its conservation. Should you find any oxidation, ask immediately our technical department to decide about the intervention to perform.

E.6 Disassemble the coupling into its main components.

E.7 Remove anticorrosion protection from machined surfaces.

E.8 Carefully clean the bore surfaces and the fit chamfers.
**NEVER USE CORROSIVE PRODUCTS**

## *F - HUB FITTING*

F.1 **BEFORE PROCEEDING WITH THE HUB FITTING, MAKE SURE THE FLANGE SLEEVES OR THE REMOVABLE SIDE FLANGES ARE PROPERLY POSITIONED ON THE SHAFTS.**
Uniformly heat the hubs, either in air furnace or in oil bath, both thermostatically controlled, or by suitable induction systems. It is also possible to heat the hubs of limited dimensions by a free flame, provided that you take care of heating uniformly the whole surface, you do not generate overheating and you frequently check the temperature so not to exceed the max allowed value. When heating, do not direct the flame to the gear teeth. To avoid any excessive oxidation, slightly preheat the outer surface of the hub. Work in the maximum safe conditions, far from flammable materials or substances.

F.2 **HUB KEY-FITTING**
Before fitting, check that bores, keyseats, shafts and keyways have the suitable fit chamfers, and that the hub has the puller holes and any hole for the screws needed to stop the axial movement of the hub and/or the keyway. Also check that the key is properly fitted in the shaft keyseat. In case of rigid hubs with a max bore, seal by some silicone, so to prevent any possible loss of grease. For taper bores, check that the surface of contact bore/shaft is > than 75%.
**Heating temperatures are to be comprised between 110-130°C. Never exceed 180°C.**

F.3 **KEYLESS HUB SHRINK-FITTING**
Before any operation of fitting, carefully check that any dimension and tolerance, as well as any surface finishing of shafts and fitting holes do correspond to the project and to the calculations (no exception admitted). For oil pressure removals, refer to SKF instructions, to AGMA 9003-A91 standards and to the use and maintenance instructions for oildynamic fitting equipment. For shrink fitting, the heating temperatures must be

calculated taking into account an expansion such as to generate a clearance, between bore and shaft, equal to 1-1.5/1000 of the diameter itself.

**Heating temperatures are to be comprised between 180 and 250°C. Never exceed 320°C.**

For any further information, refer to SKF technical issues, to the above mentioned AGMA standard and ask for our PFB 1202 procedure for cylindrical shafts, and for PFB 1208 for taper shafts. Interference fits and removals are very delicate operations and must be therefore performed by specialized and very skilled personnel only.

F.4 Once the hubs are heated and after wearing suitable thermal insulated gloves, clear the hole seats from any carbon residuals by a proper cleaning paper and measure the entity of expansions.

Then lubricate hole, shaft and any possible key surface by non-additivated pure mineral oil. Once verified the accurate cleanness of shaft, hub and fitting holes, proceed with shrink fitting. Unless differently instructed in the project (please refer to the machine drawings), the hubs must be fitted onto the shaft protrusions until their head surface is aligned with the shaft head surface.

F.5 Check that the flange sleeves or the removable side flanges have integral seals and are correctly inserted in their seats.

Avoid any contact between the hub hot surfaces and the seals; assemble the flange sleeves and the removable side flanges on the hubs only once the hub temperature is lower than 60°C.

## *G - ASSEMBLY*

G.1 Position the machines to be connected so that the axial distance between the hubs (or between the shaft heads = D.B.S.E.) is according to and in tolerance with dimension A or LA (distance between shaft ends) shown in the catalogue or in the drawings.

Obviously, this dimension must be proportionate to any possible thermal expansion or axial movement/stroke of the connected shafts or axial clearance limiting devices. Moreover, in order to enable the half coupling further alignment operations, the flange sleeves shall be allowed to move back as to show the necessary part of the hub; the necessary minimum movement is called "cA" in TAB. I or in the drawings. To make assembly, alignment and following checks on the gear teeth easier, you should be able to move the flange sleeves back as far as they withdraw from the gear teeth. Shouldn't there be the necessary side space, we recommend asking for gear couplings equipped with removable side flanges. To remove the gear couplings without moving the connected machines, ask for gear couplings with intermediate spacer.

**TAB.I** SIZES AND OVERALL DIMENSIONS FOR ALIGNMENT

| GO-A SIZE | ℄ | F | cA | H |
|---|---|---|---|---|
| 0 | 24 | 69 | 55 | 1.5 ± 0.5 |
| 1 | 29 | 85 | 62 | 1.5 ± 0.5 |
| 2 | 38 | 107 | 74 | 1.5 ± 0.5 |
| 3 | 44 | 133 | 86 | 2.5 ± 0.5 |
| 4 | 57 | 152 | 100 | 2.5 ± 0.5 |
| 5 | 66 | 178 | 115 | 3 ± 0.5 |
| 6 | 76 | 209 | 130 | 3 ± 0.5 |
| 7 | 86 | 234 | 145 | 4 ± 0.5 |
| 8 | 100 | 264 | 160 | 4 ± 0.5 |
| 9 | 114 | 279 | 175 | 4 ± 0.5 |
| 10 | 124 | 305 | 190 | 4 ± 0.5 |
| 11 | 146 | 365 | 220 | 5 ± 0.5 |

| GO-B SIZE | GO-B ℄ | F | cA | H | AO-B ℄ |
|---|---|---|---|---|---|
| 4 | 155 | 400 | 251 | 9 ± 1 | 63 |
| 5 | 175 | 450 | 275 | 9 ± 1 | 67 |
| 6 | 190 | 490 | 292 | 9 ± 1 | 69 |
| 7 | 205 | 560 | 310 | 9 ± 1 | 72 |
| 8 | 215 | 610 | 322 | 9 ± 1 | 74 |
| 9 | 230 | 660 | 345 | 15 ± 1.5 | 80 |
| 10 | 240 | 680 | 357 | 15 ± 1.5 | 82 |
| 11 | 255 | 750 | 376 | 15 ± 1.5 | 86 |
| 12 | 270 | 790 | 415 | 22 ± 2 | 93 |
| 13 | 295 | 870 | 444 | 22 ± 2 | 97 |
| 14 | 335 | 1000 | 490 | 22 ± 2 | 103 |
| 15 | 370 | 1100 | 537 | 30 ± 3 | 112 |
| 16 | 410 | 1220 | 598 | 30 ± 3 | 118 |
| 17 | 440 | 1310 | 632 | 30 ± 3 | 122 |
| 18 | 470 | 1400 | 666 | 30 ± 3 | 126 |
| 19 | 510 | 1520 | 710 | 30 ± 3 | 130 |

| G20 SIZE | ℄ | F | cA | H |
|---|---|---|---|---|
| 12 | 54 | 105 | 108 | 6 ± 1 |
| 14 | 65 | 128 | 121 | 6 ± 1 |
| 17 | 75 | 152 | 133 | 6 ± 1 |
| 19 | 83 | 170 | 146 | 9 ± 1 |
| 23 | 96 | 206 | 162 | 9 ± 1 |
| 26 | 108 | 242 | 177 | 9 ± 1 |
| 30 | 122 | 274 | 207 | 12 ± 1 |
| 35 | 137 | 322 | 226 | 12 ± 1 |
| 40 | 152 | 370 | 255 | 12 ± 1 |
| 46 | 170 | 420 | 280 | 15 ± 1.5 |
| 52 | 187 | 480 | 301 | 15 ± 1.5 |
| 58 | 208 | 540 | 321 | 15 ± 1.5 |

G.2 Perform the angular and parallel alignment of the half couplings and of the connected machines. To assure long coupling gear tooth lifetime, once the machines are aligned, in working dynamic conditions and stable temperature, it is advisable that the total residual misalignment between the two half couplings is contained in a value very close to 1/1000 of the distance between the gear teeth of the coupling ℄. The max allowed limit for standard applications correspond to what prescribed for each coupling type, in the paragraph covering alignment, as max dynamic angle D°. In special cases however, this must always be lower than the allowed working angle complying with the max rotation speed in operation (see kv diagrams shown in the catalogue). Secure the machines to their foundations and frames, by tightening all the locking bolts and nuts. After this operation, check once more the alignment of the half couplings, and remember that the coupling must be aligned both in working dynamic conditions and when the working temperature has settled.

G.3 Assemble the flange sleeves and the side flanges on the gear hubs, carefully avoiding damaging the seals; should they be spoiled (cut or burnt), immediately replace them with new seals (see TAB.IV), then fill with grease the half couplings by means of a spatula, from both sides of the gear teeth.

G.4 Close the gear couplings, by assembling all their components and devices (center rings, head discs or spacers, discs and support buttons etc.). To assure a perfect fitting, it is advisable spreading a slight mastic film on the flanges before closing them. During the assembly operations, respect the mutual position of the components; the assembly marks show the correct alignment and orientation of the hubs.

G.5 Screw the main bolts of flange connection, by tightening them at the torques shown in TAB.IV or, for the component fitting, in the coupling overview drawing. Carefully fit and tighten all the remaining screws, and employ original bolts, supplied by Maina.

**TAB.IV** SEALS AND SCREW TIGHTENING TORQUES

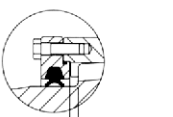
| GO-A SIZE | Seals OR TN414 | Tightening Torque (Nm) |
|---|---|---|
| 0 | OR 68 | 18 |
| 1 | OR 85 | 36 |
| 2 | OR 107 | 36 |
| 3 | OR 133 | 65 |
| 4 | OR 152 | 65 |
| 5 | OR 177 | 150 |
| 6 | OR 209 | 150 |
| 7 | OR 234 | 150 |
| 8 | OR 253 | 220 |
| 9 | OR 279 | 400 |
| 10 | OR 304 | 400 |
| 11 | OR 355 | 520 |

| GO-A.HT SIZE | Seals GDL TN559 | Tightening Torque (Nm) |
|---|---|---|
| 3 | 12.136 | 38 |
| 4 | 12.160 | 38 |
| 5 | 12.200 | 38 |
| 6 | 12.220 | 65 |
| 7 | 12.254 | 65 |
| 8 | 12.278 | 155 |
| 9 | 20.314 | 155 |
| 10 | 20.346 | 155 |
| 11 | 20.378 | 520 |

| GO-B SIZE | Seals GDL TN559 | Tightening Torque (Nm) |
|---|---|---|
| 4 | 20.440 | 670 |
| 5 | 20.490 | 670 |
| 6 | 20.530 | 1250 |
| 7 | 20.590 | 1250 |
| 8 | 20.650 | 1250 |
| 9 | 20.690 | 2170 |
| 10 | 20.720 | 2170 |
| 11 | 20.790 | 2170 |
| 12 | 30.850 | 3480 |
| 13 | 30.930 | 3480 |
| 14 | 30.1060 | 5230 |
| 15 | 30.1160 | 5230 |
| 16 | 40.1300 | 5230 |
| 17 | 40.1390 | 8300 |
| 18 | 40.1480 | 8300 |
| 19 | 40.1600 | 8300 |

| G20 SIZE | Seals GDL TN559 | Tightening Torque (Nm) |
|---|---|---|
| 12 | 12.129 | 38 |
| 14 | 12.152 | 38 |
| 17 | 12.176 | 38 |
| 19 | 12.194 | 65 |
| 23 | 12.230 | 65 |
| 26 | 12.266 | 155 |
| 30 | 20.314 | 155 |
| 35 | 20.362 | 155 |
| 40 | 20.410 | 520 |
| 46 | 20.460 | 520 |
| 52 | 20.520 | 520 |
| 58 | 20.580 | 520 |


Seal OR Type TN414




Seal GDL Type TN559

G.6 For high speed gear couplings, dynamically balanced, in order to maintain the balancing conditions providing for a limited residual unbalance, besides following the assembly marks used when balancing, it is also recommended to respect the position of the bolts which really must not be replaced or mixed, in these cases. Should you notice any vibration, in operation, we suggest a further dynamic balancing of the coupling, when

installed, so to eliminate any residual unbalance.

G.7 Complete lubrication through grease nipples or taper plugs, while opening the drain holes. Employ manual grease pumps or pumps equipped with pressure controls set at 15 ± 20 bar; never put the inner parts of the couplings under pressure. Check that the floating items of the coupling (flange sleeves or spacers) are free to move axially of dimension H (see TAB.I or the drawings).

G.8 Check that all screws, grease nipples and/or plugs have been properly tightened.

G.9 Before starting the machines, set adequate safety protections around the coupling.

G.10 After the machine start-up, the foundation settling, and a certain period (about six months) of operation at the max torques, speed and at different temperatures, check the wear condition. Revise and correct the alignment if necessary.

## *H - ALIGNMENT*

A CORRECT ALIGNMENT IS ESSENTIAL FOR A LONG GEAR COUPLING LIFETIME

The initial static no-load alignment conditions (machines off) must take into consideration what then happens under load and under temperature (dynamic conditions). This implies that they must be able to compensate even misalignments generated by load (yieldings and bendings linked to the stiffness of machines, shafts and connected supports), and to any thermal expansion of the couplings and of the connected units (see point G.2). A coupling submitted to torque, rotation speed and alignment contained within the allowed values, will never show wear on its gear teeth, if properly lubricated. Check the alignment conditions of the half couplings, by means of modern laser equipment. In this case, to perform alignment, you have to follow the instruction procedures of such equipment, by carefully checking both parallel and angular misalignments (repeat alignment both on vertical and horizontal planes on two different positions of the shafts, like on their head and on their shoulder). Shouldn't you have these devices, you must employ a thickness gauge or an inside micrometer with extension and a centesimal test indicator having adequate support devices. In this case, depending on the coupling type, proceed as follows:

H.1 Determine the angular misalignment value by processing, in accordance with the scheme below, the measurements of the head parallelism between the reference face surfaces of the two hubs. For this purpose, by inserting the thickness gauge between the heads of the two hubs, perform a first 360° test to identify the position and the min. and max entity of the distance between the hubs. After defining the extreme positions, take a precise measurement of four points at 90°, as **A** in Fig. 01.
The max difference between two values at 180° is **ΔA**. Determine the parallel misalignment value by processing, according to what prescribed, the mutual eccentricity between the reference diameters of the two hubs. For this purpose, rigidly fasten the test indicator on a band in two halves to the reference diameter of one hub, like **B** in Fig. 02.

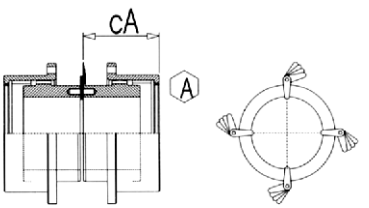


Fig.01

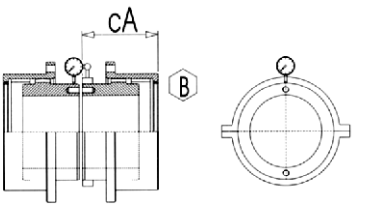


Fig.02

Verify that the whole checking unit, during a 360° rotation, does not have any clearance, then measure the min and max eccentricity. The max difference is **ΔP**.

H.2 Determine the angular misalignment value by processing, according to what prescribed in the scheme below, the head parallelism between the reference face surfaces of the two hubs. For gear couplings with tubular spacer or with floating shaft, check the head parallelism between the hub reference surfaces, by employing an inside micrometer positioned like **C** in Fig. 03 or a comparator positioned like **D** in Fig. 04 or like **E** in Fig. 05. The max difference between two values at 180° is **ΔA**.

Determine the parallel misalignment value by processing, according to what prescribed, the mutual eccentricity between the reference diameters of the two hubs. A comparator, positioned like **F** in Fig. 03, **G** in Fig. 04 or **H** in Fig. 05, shall measure the hub eccentricity. The spacer couplings, having a long distance between gear teeth, require less alignment accuracy than the standard gear couplings. In any case, verify that the checking unit, in a 360° rotation, does not have any clearance, then measure the min. and max eccentricity. The max difference is **ΔP**.

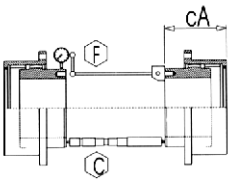


Fig.03

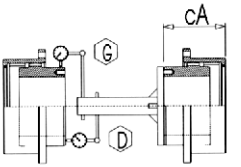


Fig.04

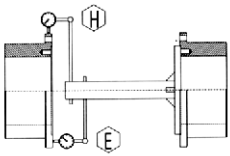


Fig.05

According to the values measured for parallelism **ΔA** and concentricity **ΔP**, check the alignment precision by following the instructions shown in the calculation scheme below. Verify that the calculation results expressed by **T°** are always lower than the max dynamic angles allowed by the different gear coupling types. Otherwise, correct the alignment of the two half couplings so to reach the correct values of the max dynamic angle. The axial movement of the sleeve in condition of regular operation or during the acceleration or overload phases, prove the presence of excessive angular misalignment.

See TAB.I for the values of: distance between gear centers **℄**, hub diameter **F**, alignment length **cA** and sleeve axial slide **H**.

**TAB.I**

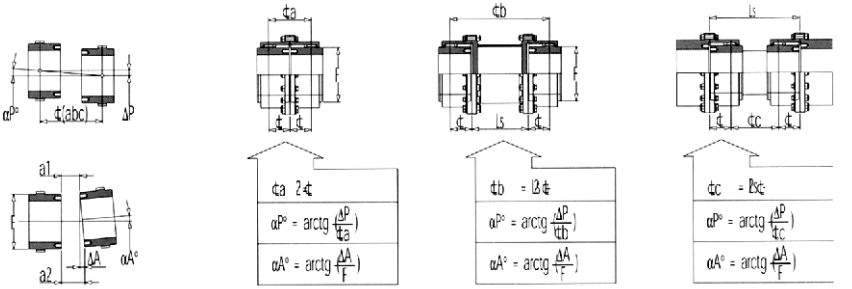
SIZES AND OVERALL DIMENSIONS FOR ALIGNMENT

| GO-A SIZE | ℄ | F | cA | H |
|---|---|---|---|---|
| 0 | 24 | 69 | 55 | 1.5 ± 0.5 |
| 1 | 29 | 86 | 62 | 1.5 ± 0.5 |
| 2 | 38 | 107 | 74 | 1.5 ± 0.5 |
| 3 | 44 | 133 | 86 | 2.5 ± 0.5 |
| 4 | 57 | 152 | 100 | 2.5 ± 0.5 |
| 5 | 66 | 178 | 115 | 3 ± 0.5 |
| 6 | 76 | 209 | 130 | 3 ± 0.5 |
| 7 | 86 | 234 | 145 | 4 ± 0.5 |
| 8 | 100 | 254 | 160 | 4 ± 0.5 |
| 9 | 114 | 279 | 175 | 4 ± 0.5 |
| 10 | 124 | 305 | 190 | 4 ± 0.5 |
| 11 | 146 | 355 | 220 | 5 ± 0.5 |

| GO-B SIZE | GO-B ℄ | F | cA | H | AO-B ℄ |
|---|---|---|---|---|---|
| 4 | 155 | 400 | 251 | 9 ± 1 | 63 |
| 5 | 175 | 450 | 275 | 9 ± 1 | 67 |
| 6 | 190 | 490 | 292 | 9 ± 1 | 69 |
| 7 | 205 | 550 | 310 | 9 ± 1 | 72 |
| 8 | 215 | 610 | 322 | 9 ± 1 | 74 |
| 9 | 230 | 650 | 345 | 15 ± 1.5 | 80 |
| 10 | 240 | 680 | 357 | 15 ± 1.5 | 82 |
| 11 | 255 | 750 | 376 | 15 ± 1.5 | 86 |
| 12 | 270 | 790 | 415 | 22 ± 2 | 93 |
| 13 | 295 | 870 | 444 | 22 ± 2 | 97 |
| 14 | 335 | 1000 | 490 | 22 ± 2 | 103 |
| 15 | 370 | 1100 | 537 | 30 ± 3 | 112 |
| 16 | 410 | 1220 | 598 | 30 ± 3 | 118 |
| 17 | 440 | 1310 | 632 | 30 ± 3 | 122 |
| 18 | 470 | 1400 | 665 | 30 ± 3 | 125 |
| 19 | 510 | 1520 | 710 | 30 ± 3 | 130 |

| G20 SIZE | ℄ | F | cA | H |
|---|---|---|---|---|
| 12 | 54 | 106 | 106 | 6 ± 1 |
| 14 | 65 | 128 | 121 | 6 ± 1 |
| 17 | 75 | 152 | 133 | 6 ± 1 |
| 19 | 83 | 170 | 146 | 9 ± 1 |
| 23 | 96 | 206 | 162 | 9 ± 1 |
| 26 | 108 | 242 | 177 | 9 ± 1 |
| 30 | 122 | 274 | 207 | 12 ± 1 |
| 35 | 137 | 322 | 226 | 12 ± 1 |
| 40 | 152 | 370 | 255 | 12 ± 1 |
| 46 | 170 | 420 | 280 | 15 ± 1.5 |
| 52 | 187 | 480 | 301 | 15 ± 1.5 |
| 58 | 203 | 540 | 321 | 15 ± 1.5 |

## MISALIGNMENT CALCULATION SCHEME




### Recommended Max Dynamic Angle

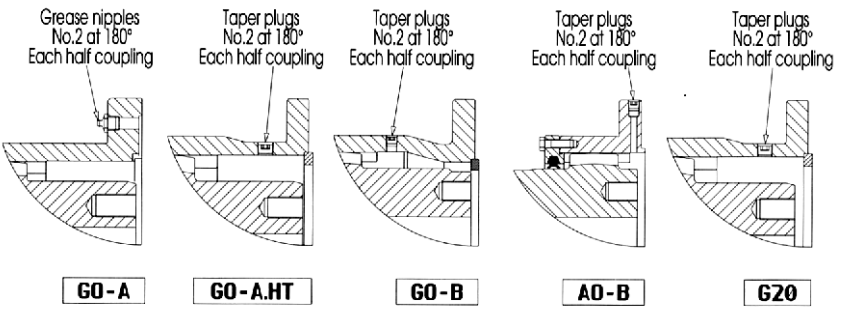
αD° = 0°10' - **GO-A** Standard gear couplings
αD° = 0°15' - N.O. treated **GO-A** gear couplings
αD° = 0°15' - **GO-B** & **GO-B.HT** gear couplings
αD° = 0°30' - **G20** gear couplings

## *I - LUBRICATION*

A CORRECT LUBRICATION IS ESSENTIAL FOR A LONG GEAR COUPLING LIFETIME

I.1 After the hub fitting and the positioning of the flange sleeves and the side flanges, fill with grease any space between the hubs and the sleeves by means of a spatula. Then close the coupling and spread a slight mastic film on the flange connection surfaces.

I.2 Close the coupling and tighten all the screws at the required torques (see TAB. IV or the drawings), then complete lubrication through all the grease nipples and/or all the plugs (2 each half coupling). For vertical couplings, spacer couplings, safety couplings, limited end float couplings and sliding couplings you'll have to fill with grease the two half couplings separately.



I.3 To fill the coupling chambers, remove the plug or the grease nipple of each half coupling. Connect the pump to the remaining grease nipple or to the connection hole and pump grease to fill the coupling completely, until the excess of grease comes out of the free holes. For horizontal couplings, to be sure the chambers are filled with grease, pump it from the vertical bore (max 45°) downwards and wait until it comes out from the opposite hole upwards. For the operation, employ manual pumps or pumps equipped with pressure controls. Never put the inner parts of the coupling under pressure. For the grease quantity, in standard couplings, refer to the table below:

GO-A GEAR COUPLINGS

| SIZE | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREASE AMOUNT (Kg) | 0.08 | 0.09 | 0.16 | 0.27 | 0.47 | 0.68 | 0.93 | 1.54 | 2.28 | 3.10 | 3.90 | 6.20 |

GO-B GEAR COUPLINGS

| SIZE | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREASE AMOUNT (Kg) | 5 | 6 | 8 | 10 | 12 | 18 | 21 | 25 | 38 | 48 | 60 | 85 | 105 | 120 | 135 | 160 |

G20 GEAR COUPLINGS

| SIZE | 12 | 14 | 17 | 19 | 23 | 26 | 30 | 35 | 40 | 46 | 52 | 58 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GREASE AMOUNT (Kg) | 0.4 | 0.7 | 0.9 | 1.6 | 2.2 | 2.9 | 5.0 | 6.5 | 8.2 | 14 | 17 | 21 |

Consider half the amount of grease for the half couplings.

I.4 Once lubrication is performed, make sure the coupling is completely filled with grease, then insert the plugs and/or the grease nipples carefully checking their tightening.

I.5 At the beginning, relubricate the couplings at regular intervals, every 3-4 months. This initial interval is suggested in case of integral seals, industrial applications and average duty, non-corrosive environments, working temperatures between 0 and 60°C. Shouldn't the seals assure a perfect tightness, make any refilling necessary to keep the coupling constantly full of grease and replace the seals soon. After the first use and observation year, and after checking the results, time intervals can be extended up to 6 months. For different conditions, time intervals between lubrications can be still extended, yet never longer than 12 months or 36 months when special synthetic Long-Life grease is employed. When lubricating, you must always have a certain grease turnover. When using multipurpose grease, you'll have to renew about ¼ of the old grease every three months. To let the old grease out, remove a plug or a grease nipple at 180° from the new grease filling point and pump the new grease until the worn-out grease comes out of the breather. The worn-out grease shall have to be collected and kept in suitable containers for disposal.

**Do not disperse grease.**

At the end of this operation, reassemble the plugs and/or the grease nipples, checking that they are properly tightened.

I.6 When lubricating, always check the tangential clearance on the gear teeth - if this is feasible and the dimensions allow it - and check that the floating item of the coupling is axially free. If no movement is allowed or if the tangential clearance is excessive, open the coupling and examine its gear teeth.

I.7 When employing multipurpose grease, you have to replace it completely every 8000 hours or max every two years. You shall have to open the coupling, clean the flange surfaces, remove the old grease completely, clean any interstice, check the gear tooth condition and perform steps 1 to 4. Never use contaminated grease or grease inadequate

to the operating conditions.
To open the two flanges of the sleeves do not employ tools that may damage the seal surfaces.

I.8 To lubricate standard couplings, use new lithium soap or complex lithium grease (not older than three years), composed of paraffinic mineral oils or high viscosity synthetic oils (>= 68 cSt at 40°C), having a max $H_2O$ content of 0,3% and EP additivated (showing Timken Ok load >= 30 lb). The flash point must be > 145°C, and grease must be centrifugation resistant, antioxidant, water-repellent, anticorrosive and antihygroscopic. For heavy-loaded or high load capacity couplings (G20, G35, G60 and HT design of GO A and GO B), we recommend employing special EP grease (showing Timken Ok load test results >= 50 lb) containing high viscosity oil > 630 cSt at 40°C, micronized $MoS_2$ additivated (particle max dimension 5 micron).

I.9 The minimum features of EP multipurpose grease employable to lubricate gear couplings must be similar to those shown in TAB.II. The grease NLGI grade (consistence) must be selected according to the ambient temperature and to the coupling rotation speed. If the working rotation speed is not included between 15% and 80% of the coupling nk nominal speed (see our catalogue), you have to select a lower NLGI grade grease, in other words a softer grease. NLGI 0 grade can fit any speed range.
For any further information on gear coupling lubrication, please refer to AGMA 9001-A86 and AGMA 250.03 standards. For all the conditions mentioned below, select the suitable grease, by directly contacting the lubricant producers, then submit the features of the selected grease to Maina Technical Department for acceptance.

- Extreme duty conditions
- Very high, pulsating, reversible loads
- Extreme or highly variable rotation speed
- Frequent axial movements
- Extreme operating temperatures
- High humidity environments
- "LONG-LIFE" lubrication
- Presence of parasitic currents or vibrations

For your guidance, you can find in TAB. III some brands and names of grease to lubricate couplings operating under conditions of medium speed, loads and duties, and temperatures ranging from -20 to +70°C.

**TAB.II** LUBRICANT FEATURES

| Working temperature | ASTM penetration index | NLGI grade |
|---|---|---|
| > -20°C < 30°C | 350 - 380 | 0 |
| > 30°C < 70°C | 300 - 350 | 1 |
| > 70°C < 93°C | 265 - 295 | 2 |
| < -20°C | Please ask our Technical Department | |
| > 93°C | | |

**TAB.III** RECOMMENDED LUBRICANT FOR GO-A E GO-B

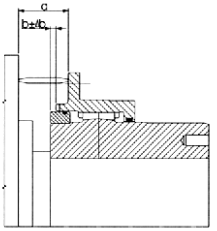
| | | | |
|---|---|---|---|
| **AGIP** | GR-MU EP | **IP** | ATHESIA EP |
| **CHEVRON** | DURA-LIGHT EP | **MOBIL** | MOBILTEMP 78 |
| **MONTESHELL** | ALVANIA EP | **ESSO** | BEACON EP |

**TAB.VII** RECOMMENDED LUBRICANT FOR GO-A.HT, GO-B.HT, G20 AND GTS

| | | | |
|---|---|---|---|
| **AGIP** | ROCOL MTS 2000 | **MOBIL** | MOBILTEMP 78 |
| **TRIBOL - CASTROL** | TRIBOL MOLIB ALLOY 777 | **KLUBER** | KLUBERLUB BE41-1501 |
| **SHELL** | SHELL ALBIDA GREASE HDX2 | **VISCOL** | SIGNAL MOLYVIS GLA |

NEVER MIX DIFFERENT TYPES AND/OR DIFFERENT BRANDS OF GREASE. THEY MAY BE INCOMPATIBLE AND MAY LOSE THEIR LUBRICATING FEATURES. UNLESS OTHER-WISE INSTRUCTED, NEVER USE OIL TO LUBRICATE GEAR COUPLINGS.

## *L - INSTALLATION, LUBRICATION, USE AND MAINTENANCE INSTRUCTIONS FOR GTS GEAR COUPLINGS*




L.1 To enable the GTS coupling compensate the axial movement between barrel and gear box, it has to be assembled by respecting the "**b**" dimension. Any admissible further axial movement will be "**Δb**". To check the alignment, take the measurement of dimension "a" between gear box and coupling (to be taken at the flange outer side) and take 4 readings at 90°. The gap between min and max reading must not exceed "**Δa**" (see TAB. VI).

**TAB.VI**

| SIZE | 20 | 22 | 24 | 26 | 28 | 31 | 34 | 40 | 42 | 46 | 53 | 56 | 60 | 67 | 73 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Δa | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.8 | 0.8 | 1 | 1 | 1 | 1 |
| b | 5 | 5 | 5 | 5 | 5 | 5 | 10 | 10 | 10 | 10 | 12 | 12 | 20 | 20 | 20 |
| Δb | 3 | 5 | 5 | 5 | 5 | 5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |

L.2 The GTS coupling must be grease lubricated. The ideal lubricant is a lithium soap grease with E.P. features, NLGI 1-2 consistence, $MoS_2$ (3-8%) additivated.

For your guidance, we list some brands in TAB. VII. The grease replacement shall be made once a year at least and at each maintenance shutdown. Ask our Technical Department in case of high duty service and long time intervals between two lubricant replacements.

| SIZE | 20 | 22 | 24 | 26 | 28 | 31 | 34 | 40 | 42 | 46 | 53 | 56 | 60 | 67 | 73 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ** MASS (Kg) | 28 | 36 | 44 | 53 | 73 | 96 | 120 | 158 | 223 | 284 | 466 | 574 | 718 | 956 | 1230 |
| Q.TY GREASE (Kg) | 0.15 | 0.17 | 0.18 | 0.20 | 0.26 | 0.28 | 0.32 | 0.48 | 0.58 | 0.70 | 1.10 | 1.40 | 1.80 | 2.20 | 2.60 |
| * TIGHTENING TORQUE (Nm) | 214 | 214 | 214 | 214 | 214 | 214 | 562 | 562 | 562 | 562 | 562 | 562 | 1058 | 1058 | 1058 |

* the value shown in the table are calculated with class 8.8.
** the value shown in the table are calculated with solid hubs.

By means of the external device, check more frequently the wear condition on the gear teeth. Index points the notch in the middle when the gear teeth are in perfect conditions. When the index moves towards the two side notches, it shows wear on the gear teeth. A check disassembly and a replacement may therefore be required (FIG. 6).

Index for wear check on the gear teeth Fig. 6