DELIVERY SERVICING - incl. delivered or stocked parts

GENERAL INFORMATION

PROTECTION

For dispatch, a liquid protection is given to parts packaged separately, i.e. motor shafts and other exposed machined surfaces. These should be cleaned before assembly.

Bolted joints between structural members, i.e. mast and jib sections, portal beams and legs and not painted-on mating machined surfaces, **any protecting tape left on must be removed.**

WINCHES

These should be checked after delivery and again after crane erection, not only for damage but also for **motor drive misalignment** caused by incorrect slinging or stocking.

GEARBOXES

Lubricant levels in gearboxes should be checked and note taken of any sign of leakage.

BRAKES

These should be checked for disc and other operational member corrosion.

ELECTR. EQUIPMENT/MOTORS

Equipment should be checked for atmospheric exposure and temperature deterioration.

STRUCTURAL MEMBERS

All structural members should be checked for sling and transport damage.

MECHANICAL SERVICING - GENERAL INFORMATION

POINTS TO NOTE ON STRIPPING AND RE-ASSEMBLY

- **Any instructions** referring to the stripping and re-assembly of sub-assembly concerned (a special sheet may be issued or info. given on the rear side of the spare parts sheet).
- **The order** in which any referred-to parts must be removed or replaced.
- **Any requirements** for the use of special tools (extractors, special-form spanners, etc.).
- **Torque spanner settings** for bolts with dry or waxed threads.
- **Lubricant type & level instruction** especially for refilling parts, e.g. turbo couplings, etc.
- **Shims, packing plates or spacing bushes** and the correct number or length to be used.
- **Measurements given** indicating max. allowed wear (especially on bake linings).
- **Safety information** for the attachment of wire ropes.
- **Power must be off** on sub-assemblies with electr. connections.
- **Overhang assemblies** should be supported before finally disconnecting bolts or joint pins.
- **Correct extractors** should be used for withdrawing in-line parts (couplings from shafts, etc.).
- **Oil level & drain checks** should be made before removing gearbox covers.
- **Gaskets** should always be replaced on re-assembly, if damaged.
- **Bearings** should be withdrawn or replaced by applying force direct to the interference-fit part.
- **Oil/grease retaining rings** on semi or non-sealed bearings must be replaced the correct way.
- **Burrs & abrasions** on shaft ends and diameters, key way slots, etc., should be removed before re-assembly.
- **Oil seal** assemblies should be checked for indications of leakage. Seal lips and 'O'-ring seals are liable to damage from burrs on shaft ends and from incorrect out-of-line assembly.
- **Springs** either coil or cone washer type should be checked for overall length, especially when used in multiple sets.
- **Bolts** with head or thread damage must be replaced.
- **CORRECT ALIGNMENT, CORRECT TOOLS AND CLEANLINESS ARE ESSENTIAL FOR RE-ASSEMBLY OF PARTS.**

ELECTRICAL SERVICING - GENERAL INFORMATION

POINTS TO NOTE

A - On maintenance service

- **Any instructions** referring to the servicing of the sub-assembly concerned (a special sheet may be issued).
- **The order** in which any referred-to parts must be checked/tested.
- **Any requirements** for the use of special test equipment.

CHECK:

- **Motors, Transformers, etc.** for overheating.
- **Fuses** for correct type and value.
- **Thermal cut-outs** for correct setting.
- **Resistors & heating elements** for any defects.
- **Resistor boxes** for any defects.
- **Indicator lights & bells** for proper functioning.
- **Max. load & moment load devices, relay contacts, etc.**
- **Cables** must not be under stress or bent over sharp edges.
- **Insulation resistance** of motors and brakes, etc.
- **Cleaning condition** of relays and other components.

B - On service exchange

- **Power must be off.**

CHECK:

- **Motors:** HP/RPM/Volts/Amps. & Hz.
- **Relays:** Type/number of make/break contacts/coil voltage, etc.
- **PC-boards:** Type no. & index.
- **Sundries:** Volts/Amps. & Watts.
- **Retighten** all screws (also if no leads are fitted).

C - On fault finding

- **Instruction sheets** covering the individual components & units should be used, if available.
- **Test instruments** of the correct type should be used.
- **Fuses & maximum current breakers** should be checked - when 3 phases check 3 times, using the following order: R-S, S-T & T-R.
- **Switch & contact positions** should be checked.
- **Proceed systematically**, using the appropriate circuit diagram.

FASEBRUD

I tilfælde af fasebrud (1, 2 eller alle 3 faser) vil det elektriske styresystem reagere på samme måde, som hvis nødstoppet aktiveres.

SYSTEMET ER FEJLSIKKERT, IDET ALLE MOTORER STOPPER, OG BREMSERNE AKTIVERES ØJEBLIKKELIGT!

Når fejlen er rettet, skal den grønne "reset-knap" i manøvrepulten nedtrykkes, før kranen atter kan tages i drift.

PHASE FAILURE

In the event of phase failure (1, 2 or all 3 phases), the electrical control system will react in the same way as when the emergency stop button is operated.

THE SYSTEM IS FAIL-SAFE, MOTOR DRIVE TO ALL MOTIONS WILL STOP AND THE BRAKES WILL IMMEDIATELY BE APPLIED!

After correction of the phase failure, the green "reset button" on the operator control must be actuated before the crane can again be operated.

STRUCTURE SERVICING - Forming/Welding/Painting

General information for repair or alteration

Dismantling/Refitting

When dismantling, certain bolted joint surfaces which have been left "as machined" should be protected against rust. This protection should be removed and the surface checked for handling damage, before refitting.

Structural members which have been damaged and required straightening or reforming to their original shape must be corrected while hot. **NOTE:** A check should be made to see if any cracks, other than weld fracture, have been caused. Particularly where acute bending has occurred, with this type of damage the member should be replaced. Heat should be applied evenly over the damaged area to a temperature of approx. 650 deg. C (1200 deg. F), and after reforming to the correct line, the heated area must be protected to prevent too rapid cooling, especially if the work has been carried out under cold or wet conditions.

Structure re-welding

Welding on structural members must be done with the correct classification of electrode (see information sheet 2003). All surface treatment must be removed within the weld area. The original weld (if any) must be removed, until the base metal is exposed. The area within which the weld is to be made must be brought up to hand warmth. Where one or both of the parts to be welded exceeds 50 mm (2 ins) in thickness, the pre-heat should be approx. 200 deg. C (425 deg. F).

After welding, the area should be protected to prevent too rapid cooling, especially if the work is carried out under cold or wet conditions.

The earth connection of the welding transformer must be positioned adjacent to the weld area, and for repair work carried out on erected cranes, **earthing must not pass through the slewing bearing ring.**

Repair finish

After repair, the area worked on should be cleaned: All weld slag must be removed. If traces of oil and fat, this should be removed with suitable detergents before (high pressure-) freshwater washing to remove salt, dirt and other impurities. When dry mechanical cleaning with wire brush or alike. Care should be taken not to polish the area. Dust off and apply a coat off zinc-powder base, rust preventive paint followed by a specified finish coat.

Painting

If parts are in a dismantled condition and paint is to be applied either as a repaint before erection or after repair, etc., note should be taken of any joint, bolted surfaces which have not been painted during initial delivery. Paint **MUST NOT** be applied to these faces.

Repair, metallization: HEMPEL Zinc Primer 16490
Repair, topcoat: HEMPEL Hempatex Hi-Build 46410

STEEL QUALITY

DESIGNATION				STRENGTH		IMPACT ENERGY		TYPICAL ANALYSIS					
after EN 10027.1 IC10	after EN 10027.2	after DS/ISO 630 EU 225-72	after DIN 17100	Reh N/mm² t < 16 mm	Rmt N/mm² T=3-100 mm	KV Joule	Temp. ° C t < 15 mm	C % max.	Mn % Max.	Si % max.	P % max.	S % max.	N % max.
S185	1.0035	Fe 310-0	St33	185	310-540			-	-	-	-	-	-
S235 JR	1.0037	Fe 360B	St37-2	235	340-470			0.17	-	-	0.045	0.045	0.009
S235 JRG1	1.0036	Fe 360B	USt37-2	235	340-470	27	+20	0.17	-	-	0.045	0.045	0.007
S235 JRG2	1.0038	Fe 360B	St37-2	235	340-470	27	+20	0.17	-	-	0.045	0.045	0.009
S235 J0	1.0114	Fe 360C	St37-3U	235	340-470	27	0	0.17	-	-	0.040	0.040	-
S235 J2G3	1.0116	Fe 360D1	St37-3N	235	340-470	27	-20	0.17	-	-	0.035	0.035	-
S235 J2G4	1.0117	Fe 360D2	-	235	340-470	27	-20	0.17	-	-	0.035	0.035	-
S275 JR	1.0044	Fe 430B	RSt44-2	275	410-560	27	+20	0.22	-	-	0.045	0.045	0.009
S275 J0	1.0143	Fe 430C	St44-3U	275	410-560	27	0	0.18	-	-	0.040	0.040	0.009
S275 J2G3	1.0144	Fe 430D1	St44-3N	275	410-560	27	-20	0.18	-	-	0.035	0.035	-
S275 J2G4	1.0145	Fe 430D2	-	275	410-560	27	-20	0.18	-	-	0.035	0.035	-
S355 JR	1.0045	Fe 510B	-	355	510-680	27	+20	0.24	1.60	0.55	0.045	0.045	0.009
S355 J0	1.0553	Fe 510C	St52-3U	355	510-680	27	0	0.22	1.60	0.55	0.040	0.040	0.009
S355 J2G3	1.0570	Fe 510D1	St52-3N	355	510-680	27	-20	0.22	1.60	0.55	0.035	0.035	-
S355 J2G4	1.0577	Fe 510D2	-	355	510-680	27	-20	0.22	1.60	0.55	0.035	0.035	-
S355 K2G3	1.0295	Fe 510DD1	-	355	510-680	40	-20	0.22	1.60	0.55	0.035	0.035	-
S355 K2G4	1.0596	Fe 510DD2	-	355	510-680	40	-20	0.22	1.60	0.55	0.035	0.035	-
E295	1.0050	Fe 490-2	St50-2	295	490-660	-		-	-	-	0.045	0.045	0.009
E335	1.0060	Fe 590-2	St60-2	335	590-770	-		-	-	-	0.045	0.045	0.009
E360	1.0070	Fe 690-2	St70-2	295	690-900	-		-	-	-	0.045	0.045	0.009

KRØLL RECOMMANDATION

ELEKTRODER / ELECTRODES

GRUNDMATERIALE BASE MATERIAL			KLASSE / CLASS			
			DS/EN ISO 2560 2006	AWS A5.1 2004		Bemærkninger / Remarks
S355	til / to	S355 ***	E-51 3B	E-7018		
S355	-	S235	E-42 2B			
S355	-	S275		E-7028		
S275	-	S275	E43 3B	E-7018		
S235	-	S235	E-35 2B	E-7028		

NOTE * :**

- Ved servicesvejsninger skal **ALTID** anvendes elektroder i denne klasse. Maling og galvanisering skal fjernes før svejsning.

- When welding under servicing conditions, **ALWAYS** use electrodes of this class. Remove paint and galvanizing before welding.

Fig. 1

Fig. 2

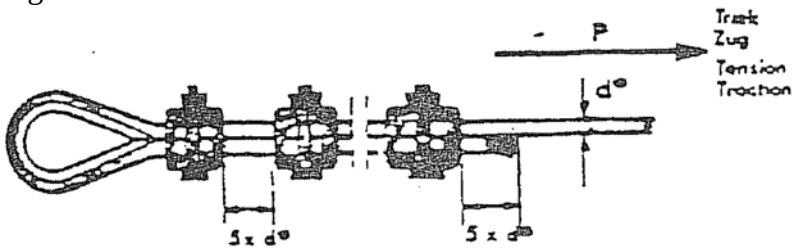
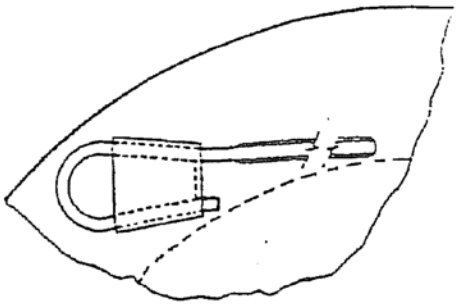
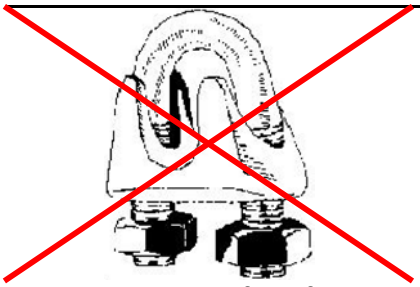
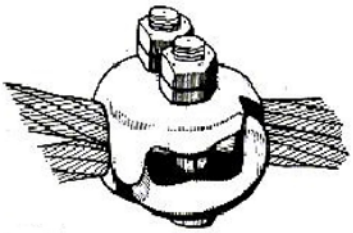


Fig. 3





NOT allowed for lifting equipment



Use counter nut on both bolts

Type BG-	M6	M8	M9	M10	M12	M16	M20	M25	M35
dØ mm	5-6	7-8	9	10	11-12	13-16	17-20	21-25	27-37
Stk. / No.	3			4			5	6	7

WIREFASTGØRELSE

Til fastgørelse af belastede stålwirer må kun bruges enten kilelås (fig. 1) eller wirelås af typen **IRON GRIP BG-M** (fig. 2). IRON GRIP wirelås **SKAL** vende som vist på tegningen ovenfor. Anvendes kilelås, skal denne desuden sikres med 1 stk. IRON GRIP (fig. 1).

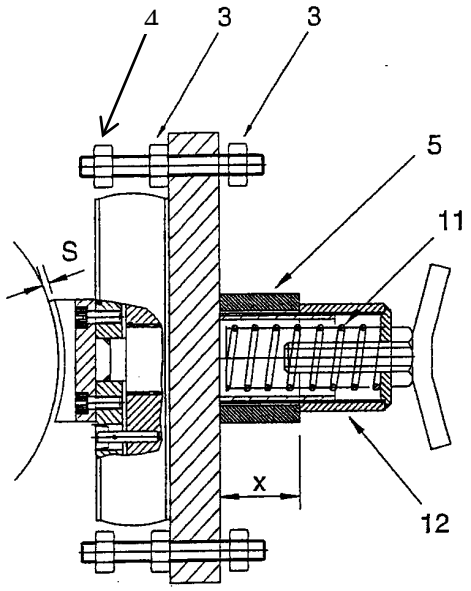
Stålwirer fastgøres på wiretromler ved hjælp af kileklemforbindelse (fig. 3).

WIRE ROPE ATTACHMENT

Wire ropes which are under load should be attached either by using wedge clamps (fig. 1) or **IRON GRIPS type BG-M** (FIG. 2). **IRON GRIPS MUST** be fitted as shown on the drawing above. Wedge clamps should also be secured by one **IRON GRIP BG-M** as shown on fig. 1.

Wire ropes are attached to wire drums by wedges (fig. 3).

SPRING APPLIED BRAKE WITH ELECTROMAGNETIC RELEASE



ADJUSTMENT OF K-BRAKE TYPE K

The air gap (S) should be between 1.0 and 1.5 mm and is set by adjusting the nut (3) while the brake is energized. Be sure to tighten the lock nut (4).

The distance ring (5) for the respective brake torque must always be fitted.

The maximum brake torque is obtained by turning the adjusting nut (12) up against the ring (5). If required, the brake torque can be reduced by loosening the adjusting nut (12), thus releasing the compression of the spring (11).

When used as a slewing brake, the adjusting nut (12) must be loosened when the crane is out of service to allow the jib to weather-vane, see info. No. 2067.

The internal parts of the brake are greased with light ball bearing grease before leaving the works. It is advisable to keep these parts well greased.

CHECKING SLEWING BEARING RING BOLTS (combination cranes)

BOLT TIGHTENING

All the fixing bolts should be tightened to the same torque to avoid non-uniform load distribution which might result in overloading of some of the bolts and hence a risk of fatigue fracture.

After an initial operating period of 2 to 4 weeks it is necessary to check the pre-loading of the bolts as settlement of the slewing ring contact face following erection cannot be avoided. The procedure is as follows:

- Balance the crane by suspending a load on the hook.
- Use a properly adjusted torque spanner/tool set.
- Each bolt should be retightened to the correct torque. Be sure that only one bolt at a time is completely loosened or removed.
- Always check all the inner and outer ring bolts.
- Bolt torque's - see information sheet 2266.

CHECK INTERVALS

1:	2 to 4 weeks after the crane has been put into operation.	Retighten all the bolts to the given torque.
2:	After every re-erection of the crane or once a year or every 2000 operation hours.	Retighten all bolts to the given torque. If it appears that some of the bolts are tightened to less than 80% of the given torque, replace the loose bolt(s) plus the adjacent bolt on either side. If 20% of the total number or bolts are tightened to less than 80% of the given torque, replace all the bolts.
3:	When replacing the slewing bearing ring or every 7 years or every 14000 operating hours.	Replace all bolts.
4:	After test/shock loading.	See point 2.

WHEN ANY BOLTS IS REPLACED, THE CORRECT TYPE OF WASHER SHOULD BE FITTED BOTH UNDER THE BOLT HEAD AND NUT.

BOLTS AND NUTS ARE SUPPLIED WITH A BLACK FINISH AND LIGHTLY OILED THREAD. A THIN COAT OF MOLYKOTE PASTE 1000 SHOULD BE APPLIED TO THE THREAD OF THE NUTS BEFORE FITTING.

BOLT HEADS ARE MARKED "10.9 HV", NUTS "10 HV" AND WASHERS "HV". THESE ARE THE ONLY TYPES TO BE USED.

FITTING/EXCHANGE OF SLEWING BEARING RINGS

1. Machined contact faces for slewing bearing rings on mast head and slewing frame must be cleaned. The surface should be smooth, even and plain. Remove rust, paint, burrs at bolt holes, etc., using a steel brush, emery cloth or similar.

2. The contact faces should be lightly oiled after cleaning.

3. Remove paint, rust, burrs, etc., from the supporting surfaces of the bolt head and nut. Note that the bolt heads/nuts must abut the supporting surfaces.

4. Do not fit used bolts. Only special bolts and lightly oiled nuts are to be used. Apply a thin coat of Molykote Paste 1000 to the thread of the nuts before fitting.

5. Remove the protective coating (red or blue) from the contact faces of the slewing ring using a solvent. Be careful when cleaning to prevent the solvent from entering the bearing.

6. Fit two eye bolts equally spaced on the inner ring bolt circle, lift the slewing ring and carefully lower it onto the machined contact face of the mat head. Fit the bolts with loose nuts.
   NOTE: - Each bolt is to be fitted with a washer both under the head and also under the nut.

7. The contact faces of the mast head and slewing bearing ring must be checked for out-of-flatness by inserting a feeler gauge between the mating surfaces both from outside and inside. The permissible out-of-flatness depends on the length of any unevenness; up to 200 mm length = 0.1 mm max., up to 500 mm length = 0.2 mm max. If the deviation exceed these values, the supporting surface must be machined to prevent distortion of the bearing when the bolts are tightened. If machining is not possible, then an air-hardening plastic grout should be used, see special information sheet.

8. Suspend the slewing frame on the hook so that it is vertical when lifted. Lift the slewing frame and carefully lower it onto the slewing bearing inner ring. The filler plug for the balls (which is located on the inner ring) should be positioned approx. 90 deg. from the jib centre line. Turn the slewing frame until the teeth marked in green of the bearing are in mesh with the slewing pinion of one of the gearboxes. Fit the bolts with loose nuts.
   NOTE: - Each bolt is to be fitted with washers both under the head and also under the nut.

9. Check out-of-flatness between slewing frame and slewing bearing ring as described in para. 7.

10. Check tooth clearance at the point marked in green, see sheet 2011.

11. Tighten all nuts lightly.

12. Tighten all inner and outer ring bolts crosswise with the torque tool set (which must be well-adjusted). For torque's, see sheet 2266.

13. Grease the slewing bearing ring in accordance with sheet 5413.

On the first erection of a crane fitted with a new slewing bearing ring a test run with no load on the hook should be carried out by slewing the jib to the right/left for approx. 2 hrs. and checking the motors for uniform current consumption. Then, the crane should be test loaded followed by re-tightening of all bolts.

The crane is now operational.

CHECKING WEAR OF RACEWAY IN BALL/ROLLER BEARING SLEWING RINGS

It is recommended to check the slewing race for wear once a year using the following procedure:

1. The amount of wear is determined by measuring the distance "X" using a suitable instrument (dial indicator, venire calliper or similar).

2. First, check distance "X" at the max. backward moment, i.e. with no load in the hook and the trolley parked in the inner position close to the mast.

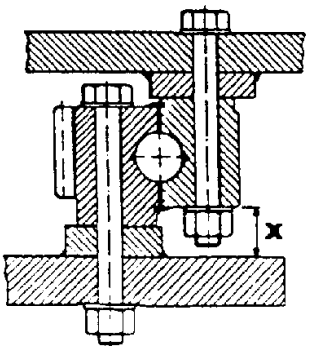
3. Then, check distance "X" at the max. forward moment, i.e. with the permissible tip load suspended in the hook and the trolley parked at the jib tip.

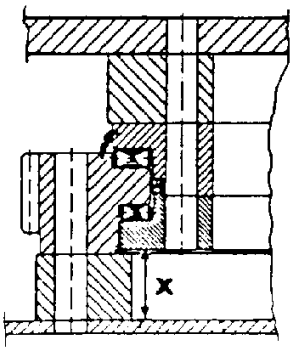
   NOTE: - The jib must remain in the same position during both measurements.

4. Slew the jib 90 degrees and repeat the procedure.

The measured values in the fitted condition are the axial movement made up of the play in the bearing and the elastic deformation of the supporting structure. The table on the next side shows theoretical max. values, however, in practice these values may vary quite a lot. In case actual values exceed too much please consult Krøll Cranes A/S. If in doubt feel free to consult us. Control measurements in the future should be compared with the initial/base values, which should be filled into the table at page 3. The table at the next page shows the permissible wear – meaning that future measurement should not exceed the sum of the base values and the permissible wear.

To obtain accurate values it is advisable to make basic figure measurements before a new ball/roller bearing slewing ring is put into operation so that the amount of elastic deformation of the supporting structure is known. The play in the fitted bearing on delivery of the crane is given in the Rothe Erde test certificate.





CRANE TYPE	DRWG. NO.	BEARING TYPE	BALL/ROLL. DIA.	PERMISSIBLE PLAY ON DELIVERY	AXIAL MOVEMENT IN FITTED CONDITION	PERM. WEAR	MAX. AXIAL MOVEMENT EXCHANGE BEARING
K-154/160/175 80L/125L	061.50.1390.203.49.1503	Balls	50	0.8 mm	2.0 mm	2.6 mm	
K-130F	161.45.1250.000.41.1522	Rollers	45	0.2 mm	0.4 mm	0.6 mm	
K-200D (S)	061.50.1700.001.41.1503	Balls	50	0.8 mm	2.0 mm	2.7 mm	
K-250D (S)	061.50.1700.000.41.1503	Balls	50	up to 1972 0.51 mm	1.275 mm	2.7 mm	
K-320/333	061.50.1700.002.41.1503	Balls	50	0.8 mm	2.0 mm	2.7 mm	
K-400D (S)	061.50.2140.003.49.1503	Balls	50	0.54 mm	1.35 mm	2.9 mm	
	061.50.2140.002.49.1503	Balls	50	0.54 mm	1.35 mm	2.9 mm	
	061.50.2140.001.19.1503	Balls	50	0.96 mm	2.4 mm	2.9 mm	
	061.50.2140.000.11.1503	Balls	50	0.54 mm	1.35 mm	2.9 mm	
K-400D (S)	011.50.2134.000.49.1502	Two-row balls	50	0.50 mm	0.75 mm	3.8 mm	
K-420 / K-365L	091.40.1696.000.41.1522	Balls	40	0.54 mm	1.35 mm	2.9 mm	
K-550/560	191.25.2000.700.41.1502	Rollers	25	0.08 mm	0.16 mm	0.64 mm	Base values
K-800/1000	061.60.2950.000.11.1504	Balls	60	0.65 mm	1.625 mm	3.2 mm	+
K-800/1000	011.50.2947.000.49.1502	Two-row balls	50	0.5 mm	0.75 mm	4.1 mm	Permissible wear
*K-1000	199.25.2956.000.41.1522	Rollers	25	0.2 mm	0.4 mm	0.93 mm	
K-1400/1800	191.40.2808.000.41.1501	Rollers	40	0.12 mm	0.24 mm	0.93 mm	
K-2500/300(L)	191.36.4012.000.41.1522	Rollers	36	0.2 mm	0.4 mm	1.05 mm	
K-3000-K5000	191.45.4479.000.41.1522	Rollers	45	0.2 mm	0.4 mm	1.05 mm	
	191.32.4007.002.41.1502	Rollers	32	0.2 mm	0.4 mm	1.05 mm	
K-10000	191.40.4408.002.41.1501	Rollers	40	0.28 mm	0.56 mm	1.13 mm	
	191.40.4408.001.41.1501	Rollers	40	0.28 mm	0.56 mm	1.13 mm	
	191.40.4408.000.31.1501	Rollers	40	0.2 mm	0.4 mm	1.13 mm	
MK- 2480	192.40.3584.004.41.1522	Rollers	40	0.28 mm	0.56 mm	0.93 mm	

*)From K-1000 S/N 1528

DATA SHEET FOR MEASURING THE AMOUNT OF PLAY IN BALL/ROLLER BEARING SLEWING RING

DATE	SLEWING OPERAT. HOURS	JIB POSITION								NOTES
		0°		90°		180°		270°		
		1.1	2.2	3.1	4.2	2.1	1.2	4.1	3.2	
										BASIC FIGURE MEASUREMENT

SLEWING RING TYPE : _____

CRANE TYPE : _____ SERIAL NO.: _____

TORQUE'S FOR SLEWING BEARING RING BOLTS

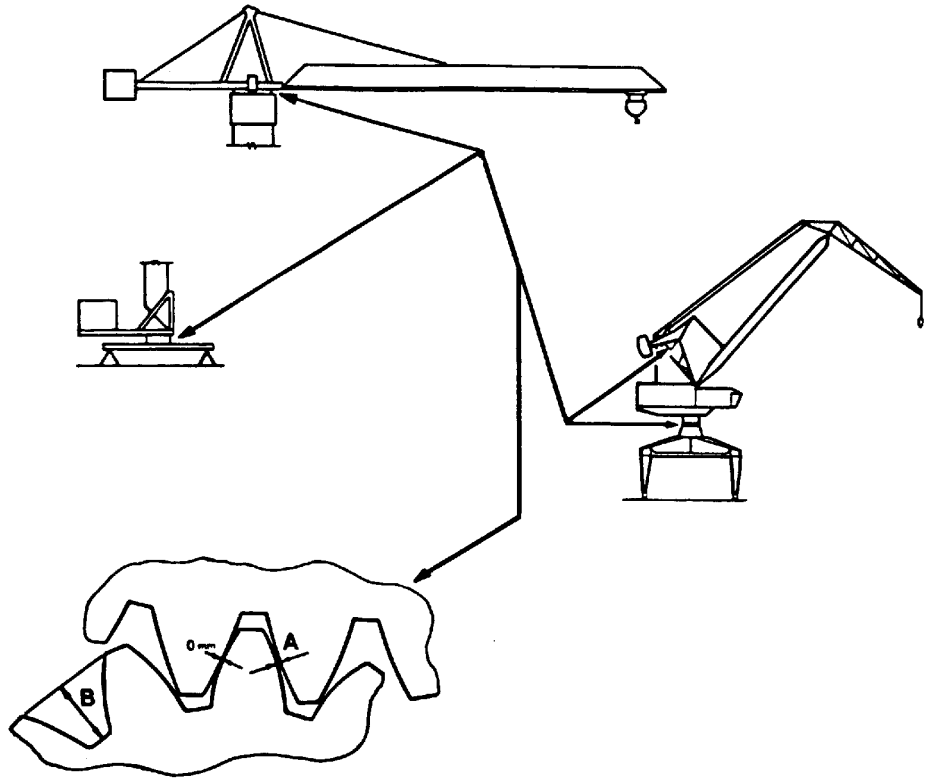
The bolts and nuts are supplied with a black finish and lightly oiled thread. A thin coat of Molykote Paste 1000 should be applied to the thread of the nuts before fitting.

CRANE TYPE	THREAD	GRADE	TORQUE			REMARKS
			kpm	Nm	ft.lbs.	
K-68	M20	10.9	54	540	388	
K-130F	M24	10.9	93	930	680	
K-154/175 K-200D K-200L K-300/320/333 K-400D	M27	10.9	140	1400	1030	
K-420 / K-365L K-550 / K-500L K-560 K-600 K-800	M30	10.9	185	1850	1340	
K-1000	M33	10.9	258	2580	1870	
*K-1000						
K-1200 K-1400 K-1800 K-2500	M36	10.9	330	3300	2390	
K-3000/4000/5000	M45		634	6340	4677	Ref FFCM drawing: A1-2600.165-A
MK-2480	M60	10.9	1450	14500	10465	
K-10000						

* From S/N 1528

Applies to all slewing bearing rings supplied as a spare part.

TOOTH CLEARANCE FOR SLEWING BEARING RINGS



MODULE	A = mm
8 and 10 14 and 16	0.6 - 1.0 0.8 - 1.4
	B = mm
	approx.
8	17
10	22
14	29
16	34

The tooth clearances given on this sheet **ONLY** apply to new slewing rings/rack segments and pinions. In all other cases, adjustment should be based on the distance from centre line slewing ring/segment to centre line pinion. Please consult **KRØLL CRANES A/S** for information.

When mounting/exchanging slewing bearing rings and gear units on the slewing assembly, the clearance in tooth mesh should be measured at the point on the slewing ring which is marked with a green spot. If the clearance at this point is correct, the tooth mesh will be correct over the full diameter. If the mark cannot be found, at least 4 checks at equidistant points should be taken. The tooth clearance for rack segments should be checked at 3 points, i.e. at the centre plus 0.5 m (20") from both ends. The tolerance given is the minimum.

First, fit the slewing bearing ring on the slewing table/undercarriage of the crane, then check the tooth clearance for each slewing gear unit and, finally, tighten the slewing bolts.

Tighten the bolts crosswise, first with 20%, then with 60% and finally with 100% of the max. torque.

For mounting/exchange of slewing bearing rings, see info. sheet 2059.

BOLT TORQUES - NOT APPLICABLE TO SLEWING BEARING RING BOLTS

THREAD	QUALITY	TORQUE kpm	TORQUE Nm	TORQUE ft.lbs.	NOTE
M10	8.8	4.8	48	35	
M12	8.8	8	80	58	8.8 – BOLTS:
	10.9	9.6	96	70	
M14	8.8	12.5	125	90	Norm: DIN 931/933
M16	8.8	20	200	145	Finish: Bright zinc (fzb)
	10.9	25	250	180	
M18	8.8	27	270	195	Can be used direct from the packing.
M20	8.8	39	390	280	
	10.9	45	450	325	
M22	8.8	51	510	360	
	10.9	65	650	470	
M24	8.8	66	660	480	10.9 – BOLTS:
	10.9	80	800	580	
M27	8.8	98	980	710	Norm: DIN 6914/6915/6916
	10.9	125	1250	905	
M30	8.8	132	1350	975	Finish: Hot zinc (fzv)
	10.9	165	1650	1195	
M33	8.8	185	1850	1340	Nut Molykote-greased (MOS2)
M36	8.8	240	2400	1735	
	10.9	285	2850	2060	
M39	8.8	310	3100	2240	
M42	8.8	380	3800	2750	
M45	8.8	475	4750	3435	Finish: Hot zinc (fsv)
M45	**10.9**	**664**	**6640**	**4800**	**Finish: Black, DIN 931**
M45	10.9	475	4750	3435	Nut: RG-1100 grease, (KEMA)
M48	8.8	570	5700	4025	
5/8" UNC	8.8	21	210	145	
3/4" UNC	8.8	34	340	245	
7/8" UNC	8.8	52	520	370	
1" UNC	8.8	75	750	545	
1 1/4" UNC	8.8	87	870	630	
1 1/2" UNC	8.8	152	1520	1090	
2"-6 UN	9.9	300	3000	2170	
2 1/4" UN	9.9	-	-	-	**See Inf. Ref. 5498**

Torques for slewing bearing ring bolts: Info No. 2266

BOLT CONNECTIONS, GENERAL

1. General.

2. Threaded connections tightened by hand with a wrench.

3. Prestressed high-tensile threaded connections.

   3.1 Explanation of term.
   3.2 Areas of application.
   3.3 Components of prestressed high-tensile threaded connections.
   3.4 Assembly of prestressed high-tensile threaded connections.

4. Checking prestressed high-tensile threaded connection components before installation.

   4.1 Condition of prestressed high-tensile threaded connection components.

5. Tightening prestressed high-tensile threaded connections.

   5.1 The importance of correct tightening.
   5.2 Tightening torque.
   5.3 The torque wrench.

6. Checking installed prestressed high-tensile threaded connections.

   6.1 The importance of checking.
   6.2 Initial and recurring checks on prestressed high-tensile threaded connections.
   6.3 Renewing prestressed high-tensile threaded connections.

1. GENERAL

Tower cranes have a number of threaded connections, the purposes of which are to join structural components and transmit loads.

A distinction is made between high-tensile and other prestressed threaded connections.

Threaded connections are among those components which are of vital importance for the crane's operating safety. Threaded connection components must be installed, maintained, serviced and checked.

2. THREADED CONNECTIONS TIGHTENED BY HAND WITH A WRENCH

This type of threaded connection can be tightened by hand with a wrench.

The tightness of these connections must be checked at regular intervals so that there is no danger of them becoming loose. Looseness can lead to damage, even in the event of a single part of the connection falling off.

3. PRESTRESSED HIGH-TENSILE THREADED CONNECTIONS

3.1 Explanation of term.

Prestressed high-tensile threaded connections are connections comprising bolts, nuts, washers and possibly spacing sleeves all manufactured from high-strength materials.

Threaded connections of this type must be tightened to a prescribed torque using an appropriate torque wrench.

3.2 Areas of application.

Prestressed high-tensile threaded connections are used wherever high loads have to be transmitted between two structural components.

On tower cranes, the following connections are usually of this type:

- Ball slewing ring.
- Mast.
- Jib and counter jib sections.
- Under certain circumstances; drive assemblies such as slewing and hoisting gears.

3.3 Components forming a prestressed high-tensile threaded connection.

All components of a prestressed high-tensile threaded connection are specifically marked. The grade and marking requirements results from the national and international standards.

NOTE: Although bolts of the strength rating 10.9 with a thread diameter of 24 mm and more are also marked according to the international standards, they must in addition correspond to the quality of KRØLL factory standard. Therefore, these bolts should only be bought from KRØLL or the manufacturers approved by KRØLL.

If bolts are used which do not correspond to the KRØLL standard there is a risk of accidents resulting in personal injuries and/or material damage.

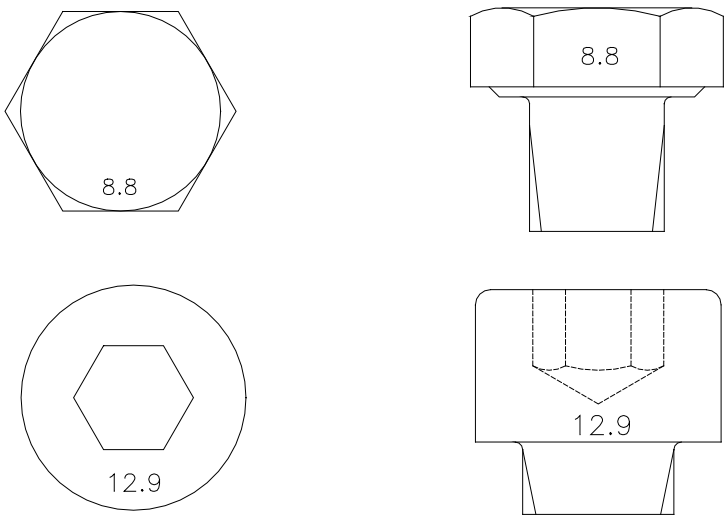
3.3.1 Bolts.

Bolts must be identified according to International Standard ISO 898, part 1.

The strength rating, e.g. 8.8 or 10.9, must be marked on the bolt head.

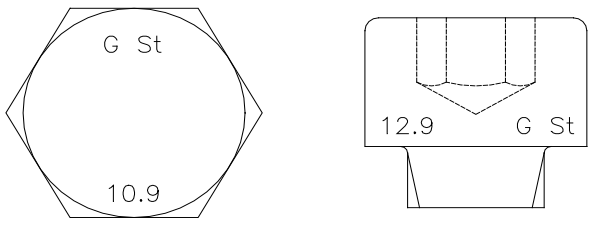
ISO 898, part 1, gives the following examples:

Fig. 1



In addition, bolts must be marked with the bolt manufacturer's designation. This designation generally appears near the strength rating identification as illustrated below, for example:

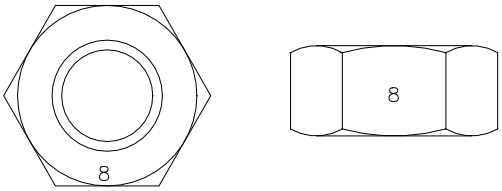
Fig. 2



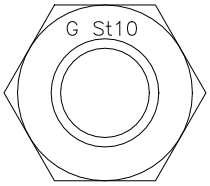
3.3.2 Nuts.

Nuts must be identified according to International Standard ISO 898, part 2.
The strength rating, e.g. 8 or 10, must be inset on the contact face or one of the flat faces.
ISO 898, part 2, gives the following example amongst others:

Fig. 3



ISO 898, part 2, also states that symbols can be used to identify the nut strength ratings. A description of the various symbols which can be used is beyond the scope of this information.



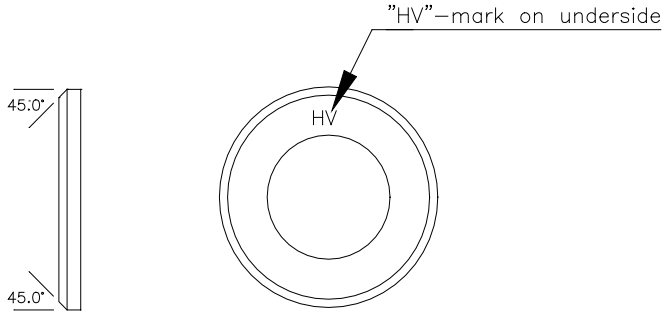
When choosing a nut, always make sure that its strength rating matches that of a bolt.

3.3.3 Washers.

Only washers manufactured from high-strength materials corresponding to the materials for bolts and nuts described in 3.3.1 and 3.3.2 may be used on prestressed high-tensile threaded connections.
Since there is not yet an ISO norm for washers, washers manufactured in West Germany for use on prestressed high-tensile threaded connections are marked "HV" as illustrated on Fig. 5.

If washers from other sources are used, make sure that their strength is according to the strength ratings of the bolts and nuts.
Washers used on prestressed high-tensile threaded connections must be chamfered on one side to prevent damage to the rounded fillet of the bolt head. The chamfer must always face towards the bolt head.

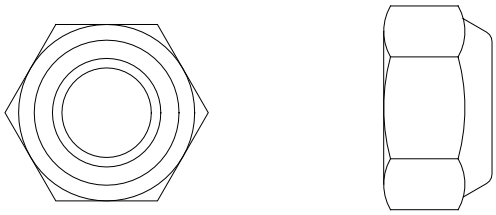
Fig. 4



3.3.4 Lock nuts.

Prestressed high-tensile threaded connections with through-bolts are often secured with lock nuts. These are manufactured from spring steel. They are not identified. Their shape is illustrated on the fig. below:

Fig. 5



3.4 Assembly of prestressed high-tensile threaded connections.

Two types of prestressed high-tensile threaded connection are used on KRØLL cranes:

Fig. 6 Through-bolt connections

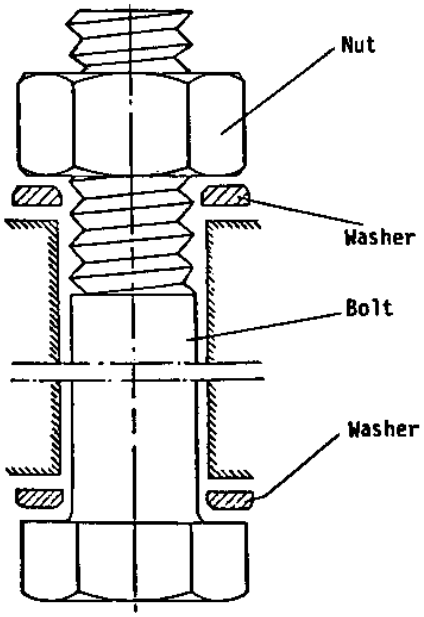
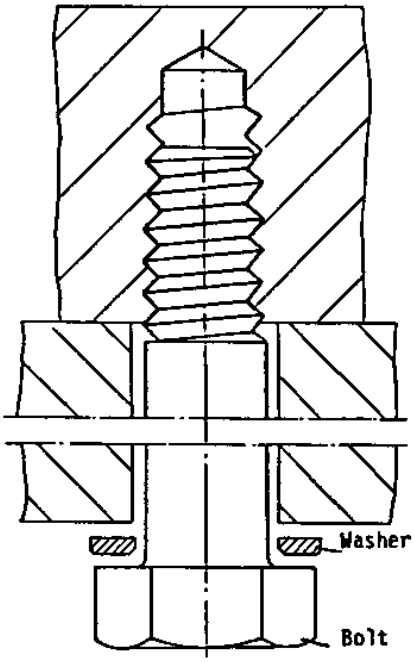


Fig. 7 Socket-bolt connections



The materials from which the bolts and nuts used on prestressed high-tensile threaded connections are manufactured must be matched to each other. This is the case when the following identification marks are present together:

Bolts marked 8.8 used with nuts marked 8
Bolts marked 10.0 used with nuts marked 10

4. CHECKING PRESTRESSED HIGH-TENSILE THREADED CONNECTION COMPONENTS BEFORE INSTALLATION

4.1 Condition of prestressed high-tensile threaded connection components.

All prestressed high-tensile threaded connection components must be cleaned and visually examined before installation.

Items to be examined are the bolt and nut threads and location of the nut on the bolt. Damaged bolts or nuts must not be used.

Bolts with traces of rust on the shank or thread and nuts with traces of rust on the thread must not be used.

5. TIGHTENING PRESTRESSED HIGH-TENSILE THREADED CONNECTIONS

5.1 The importance of correct tightening.

Prestressed high-tensile threaded connections can only fulfil their function properly if they are tightened to the correct torque. The bolt is stretched at the correct torque, thereby pressing the structural crane elements together and achieving an intensive clamping action between these components. This is known as prestressing or preloading.

Correct torque and preload are decisive for the operating life of a bolt.

Torque values which are too high or too low can lead to premature failure of a threaded connection.

5.2 Tightening torque.

To achieve the required design preload, the threaded connection must be tightened to the correct torque. The tightening torque value is dependent on the type and size of the bolts and nuts used on the connection.

Bolts according to DIN 6914, 931, 933 or 912 can be identified with reference to the width across the flat "s".

If there is any doubt as to which DIN standard applies to the bolts and nuts used, the nominal thread diameter and width across flats must be measured. Refer to the table "Distance across flats "s" to identify which DIN standard applies.

In some cases different torque values used to be quoted for bolts according to whether they were greased or not and whether galvanized surface protection had been applied.

5.3 The torque wrench.

Prescribed tightening torques can only be achieved by using a torque wrench. The torque wrench must permit adjustment of the torque value and tightening direction.

Higher torque values can be achieved by using power wrenches with reduction gearing. The power wrenches must be tested from time to time.

Hydr. power wrenches can also be used to achieve the required torque.

6. CHECKING INSTALLED PRESTRESSED HIGH-TENSILE THREADED CONNECTIONS

6.1 The importance of checking.

All threaded connections can become loose. This also applies to prestressed high-tensile threaded connections. When threaded connections of this type become loose, prestressing is partially or completely lost. In this event, bolt material fatigue will occur at a much accelerated rate and a fracture may occur.

6.2 Initial and recurring checks on prestressed high-tensile threaded connections.

6.2.1 Initial check.

Since threaded connections bed down after tightening, all prestressed high-tensile threaded connections on new cranes and new crane parts must be checked initially not later than 100 hrs. of running after the crane is first erected. Checks must be conducted using a torque wrench with or without power wrench, as appropriate.

Take up slack at the nut (or bolt) according to the nominal tightening torque given. If there is no further slack, it is reasonable to assume that the connection is in order. If the connection is loose, it must be slackened off, re-greased if prescribed, and then re-installed.

6.2.2 Recurring checks.

Regular checks must be carried out once a year. If the crane is operated continuously over several shifts, checks must be carried out at appropriately more frequent intervals. Random checks should be conducted by removing connecting bolts and examining them according to the instructions in item 4.1 The bolts must then be re-greased if prescribed, re-installed and re-tightened to the prescribed torque value.

6.2.3 Visual checks.

Regular visual checks must be conducted at least every three months. It is sufficient to establish whether there are any signs of threaded connections becoming loose by checking that there are no gaps between the clamped structural components.

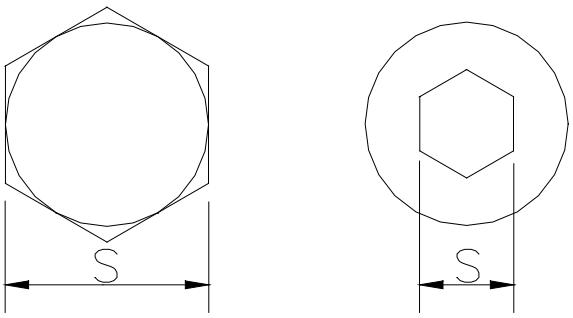
6.3 Renewing prestressed high-tensile threaded connection components.

If fractured bolts or bolts with surface cracks are identified at any crane component connection (e.g. mast sections, ball slewing ring), all bolts at this connection must be renewed.

DISTANCE ACROSS FLATS "s"

DIN 931, 933, 934
DIN 6914, 6915

DIN 912



The distance across flats on bolts according to DIN 6914 and nuts according to DIN 6915 is greater than on bolts according to DIN 931 and nuts according to DIN 934.

Distances across flats "s" are given in the following table:

Nominal thread diameter	Distance across flats "s" for bolts acc. to DIN 931/933 and nuts acc. to DIN 934	Distance across flats "s" for bolts acc. to DIN 6914 and nuts acc. to DIN 6915	Distance across flats "s" for Allen screws acc. to DIN 912
Metric	mm	mm	mm
M12	19	22	10
M14	22	-	12
M16	24	27	14
M18	27	-	14
M20	30	32	17
M22	32	36	17
M24	36	41	19
M27	41	46	19
M30	46	50	22
M33	50	-	24
M36	55	60	27
M39	60	-	-
M42	65	-	32
M45	70	-	-
M48	75	-	36

7. DIN STANDARDS USED, AND THEIR EQUIVALENT ISO / EN STANDARDS

DIN 912	DIN 931	DIN 933	DIN 934	DIN 6914	DIN 6915	ISO 898-2
EN / ISO 4762	EN / ISO 4014	EN / ISO 4017	EN / ISO 4032	ISO 7412*	ISO 7414*	EN / ISO 898-2

Standards marked "*" are, as the DIN standards, withdrawn documents.

STRUCTURAL BOLT CONNECTIONS

1. Threaded connections tightened by hand with a calibrated torque wrench. This type of connections is of high-strength steel and consist of following components:

Bolt quality 8.8 (Marked on bolt head)
Nut quality 8 (Marked on the nut)
Washer acc. to DIN 125

Inspection before re-use

All components must be carefully cleaned and carefully visually examined before installation. Especially around bolt and nut thread where the nut have been placed the finish assembling.

Damaged bolts must **NOT** be used.

Bolts and nuts with traces of rust on the threads or shank must **NOT** be used.

All prestressed high-strength threaded connection components tightened to the torque values prescribed by Krøll can be reused when subsequently erecting cranes as long as they are examined as described and show no signs of damage.

If any doubt do not re-use the components.

2. Prestressed high-tensile threaded connections. (Friction assembling).

Prestressed high-tensile threaded connections are used wherever high loads have to be transmitted between two structural components. The connection components consist of:

Bolt quality 10.9 (Marked on bolt head)
Nut quality 10 (Marked on nut flat)
Washer quality "HV" (Marked on the washer)

Prestressed high-tensile threaded bolt connection must **NOT** be re-used.

3. Krøll special bolts and nuts type 2" x 6 un and 2¼" x 6 un.

Bolt quality 9.9
Nut quality 9

These bolts and nuts are made according to Krøll drawings.
The bolt end opposite the head is marked with fabrication month and year and quality.

Normally for standard building cranes, we recommend special structure bolts to be replaced every 7 years or every 14,000 operating hours.

4. Re-use of special structure bolts:

All special structure bolts and nuts that have been tightened to the torque values prescribed by Krøll can be re-used, when subsequently erecting crane, as long as they are examined carefully for damaged threads, cracks, rust etc.

Only bolts that show no signs of damage can be re-used. If any doubt do not re-use the bolts.

Torque tightening of 2¼"x6UN special Krøll bolts

The bolts are used for connecting main structural units (mast, jib and counterjib sections)

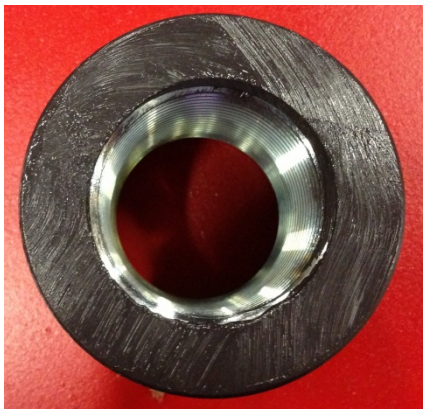
Tightening procedure

Always check the thread before use.

Torque : 2950 Nm
Grease : Molykote G-Rapid Plus paste, or Molykote 1000

- Apply G-Rapid Plus paste to the thread of the bolt using a brush.

  Also apply paste to the contact face of the nut:



- Insert the bolt into the bolt hole. Fit the nut and hand-tighten.
- Use a hydraulic torque wrench to tighten the nut to 2950 Nm.

Checking procedure

The preloading of the bolt can be checked (if found necessary) using the angle-of-rotation method.

- Insert the bolt into the bolt hole. Fit the nut and hand-tighten.
- Use an impact wrench and gentle strokes with a hammer to pre-tighten the nut. There will be a significant sound when there is full contact between the bolt, the structural steel and the nut.
- Mark both the bolt (if the head is not locked during the torque tightening) and the nut.
- Tighten the nut to 2950 Nm.
- The nut should have turned approx. 115° relative to the bolt head.

Re-use after dismantling

- Clean bolt and nut for grease and dirt.
- Check for damages and cracks. If any doubt – dispose the bolt or nut.
- Check that bolt/nut fits smoothly.
- Apply grease on damaged spots in the chrome plating for corrosion protection.
- Do NOT re-use bolts or nuts older than 10 years.