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## MIX TANK OPERATION MANUAL



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## STANDARD OPERATING PROCEDURE – 420 bbl. MIX TANK

### SPECIFICATIONS:

Length:	47' 9 ¾"
Width:	8' 6"
Height:	9' 7 ½" sitting on the ground
Weight:	31,500 lbs.
Thickness:	¼" A-36 Carbon Steel
Tank Volume:	(17,630 gallons) - (420 bbl.)
Agitator Gear Boxes:	3 Phase – 480V at 60 Hz, 52A Full Load Amperage.
Agitator Motors:	Four (4) 60 Hz WEG 10 HP Explosion Proof Motors, 1800 RPM C-Faced Motor, 215TC.
Steam Coils:	180' of 2" Schedule 80 Piping – Steam Coils

### INSTALLATION:

#### **!!DANGER!!**

***SEVERE INJURY OR DEATH CAN RESULT FROM TOUCHING ANY ENERGIZED PARTS IN THE CONTROL PANEL. THIS EQUIPMENT SHOULD ONLY BE WIRED TO A POWER SOURCE BY A LICENSED ELECTRICIAN. ONLY PERSONNEL SPECIFICALLY TRAINED IN THE OPERATION OF THE MIX TANK SHOULD BE ALLOWED TO WORK ON THIS EQUIPMENT. LOCK OUT ALL POWER BEFORE SERVICING THIS EQUIPMENT.***

1. The Mix Tank should be located on a level and properly compacted surface for proper operation.
2. The Mix Tank requires 60Hz, 480-volt 3-phase electrical service at 44 full load amps. The wire required to connect the tank to a power source is located on the front exterior wall of the tank in the round junction box with a threaded cap. Twist off the threaded cap to expose the connecting wire. The wire is a 6 conductor 4 awg cable. The cable is labeled "leg 1, leg 2, leg 3" for line power and green for the ground to be plugged into the power source. The cable should be wired directly to the generator or power source. The unit should be properly grounded before connecting power from the power source. All connections should be performed by a licensed electrician. Power connections should be done in accordance with all applicable codes and standards and with the highest regard to safety for all personnel.
3. Once power is connected, turn circuit breaker switch to the "ON" position. Engage the start button on ONLY one of the agitators to assure that the mixers are rotating in the proper direction. Rotation of the mixer motors should be clockwise when viewed from top of tank. If

the rotation is correct, proceed to start-up. If the rotation is wrong, disengage agitator, shut off circuit breaker and disconnect main power source before re-wiring. **DO NOT ATTEMPT TO REWIRE WITHOUT DISCONNECTING POWER FROM SUPPLY LINES FIRST!**

Note: ***IT IS NECESSARY THAT PROPER MOTOR ROTATION IS VERIFIED AND THAT ALL MIXERS ARE ROTATING IN THE PROPER DIRECTION. FAILURE TO DO SO WILL CAUSE DAMAGE TO THE GEAR DRIVE MECHANISM. ALL MOTORS HAVE BEEN PRE-WIRED FROM THE FACTORY SO THAT THEY ALL ROTATE IN THE SAME DIRECTION.***

### **START – UP PROCEDURE:**

**!!IMPORTANT!!**

***NEVER PUMP SLURRY INTO THE MIX TANK UNLESS THE AGITATORS ARE RUNNING.***

1. Make sure all suction and discharge valves are in the correct operating position.
2. Turn on the (4) agitators.
3. When the entire Mix Tank is running, slurry can be pumped into the Mix Tank.
4. Monitor agitators periodically to make sure material is mixing properly.

### **ROUTINE MAINTENANCE:**

1. Maintain gearbox on agitator as per EURODRIVE Operating and Maintenance Manual.
2. See WEG Maintenance Manual for maintenance requirements.
3. Operator should continually monitor his/her work area on top of the tank and practice good housekeeping. Do not leave anything lying on top of the tank which may present a trip hazard. Operators should always keep the unit clean.

### **WINTERIZATION PROCEDURE FOR MIX TANK:**

#### **GEARBOXES**

1. Fill with oil if idle for an extended period. One month or better.
2. Run for 30 seconds to 1 minute then refill.
3. During shutdown, run for 30 seconds every 2 weeks.

#### **ELECTRICAL SYSTEM**

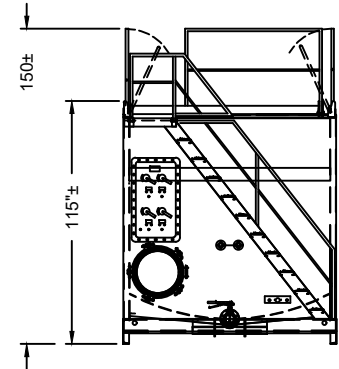
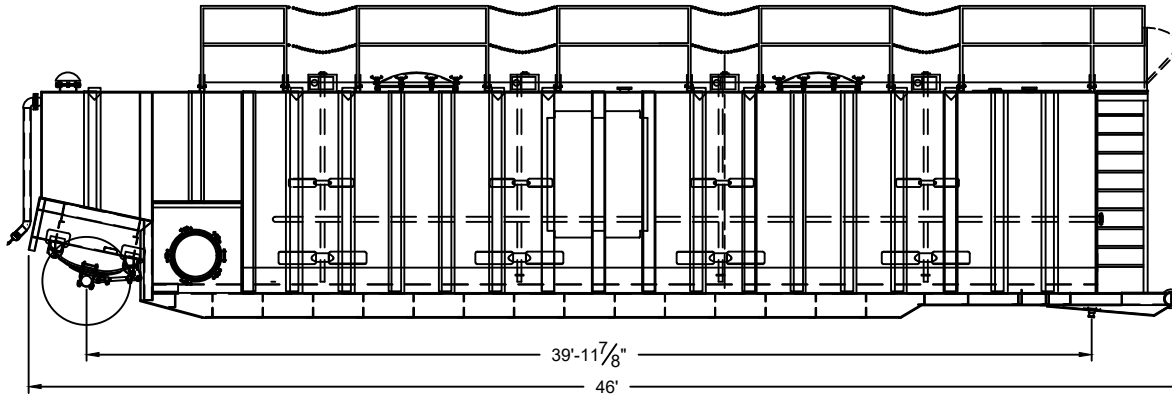
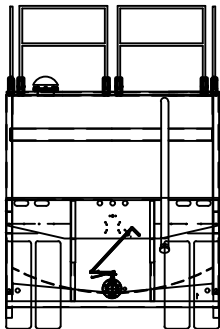
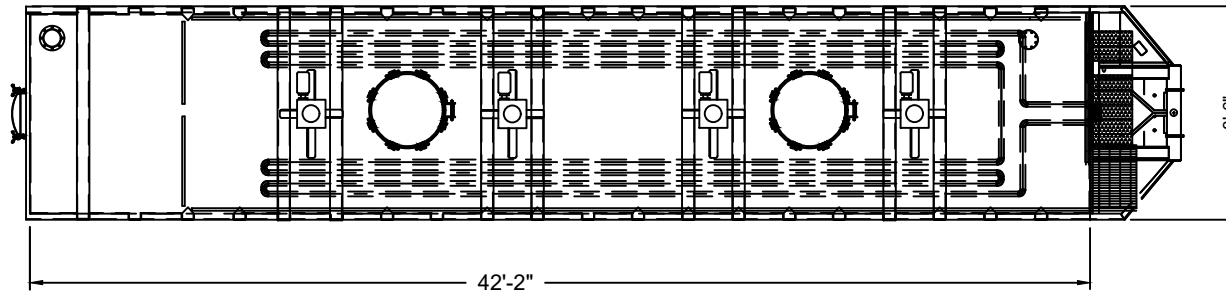
1. Check for moisture.
2. Replace moisture pads in electrical boxes.

#### **TANK**

1. Completely drain and rinse tank.
2. Close and lock hatches.

**STANDARD SPECIFICATION**

CAPACITY: .... 17,630 GALLONS (420 BBL)  
 SIDE SHEETS: .... 1/4" A36 PLATE  
 TOP SHEET: .... 1/4" A36 PLATE  
 FRONT SHEET: .... 1/4" A36 PLATE  
 REAR SHEET: .... 1/4" A36 PLATE  
 FLOOR: .... 1/4" A36 PLATE  
 MAIN FLOOR RAILS: .... 12" x 20.7# STRUCTURAL CHANNEL  
 FLOOR CROSSMEMBERS: .... 1/4" A36 PLATE  
 SIDE STAKES: .... ONE PIECE 3/16" A36 PLATE  
 SUSPENSION: .... 3 LEAF SPRING, 22,500 LBS.  
 AXLE:.... 77" TRACK, 22,500 LBS. CAPACITY  
 TIRES: .... 11R22.5  
 WHEELS: .... 8.25 x 22.5 STEEL  
 MANWAYS: .... 1 - 22" DIA. (CURB SIDE)  
           1 - 22" DIA. (FRONT)  
           2 - 36" DIA. (ROOF)  
 VALVES: .... 1 - 4" BUTTERFLY VALVE (FRONT)  
           1 - 4" BUTTERFLY VALVE w/ REMOTE  
 HANDLE (REAR)  
           1 - 4" BLIND FLANGED PORT (ROOF)  
           1 - BLAYLOCK PRESSURE VALVE  
 (ROOF)  
 COIL: .... 2" SCH 80 PIPE COIL ASSEMBLY  
 PIPING: .... 1 - 3" FILL LINE (REAR)  
 STAIRS: .... 22" FRONT STAIRS  
 FOLDING HANDRAILS  
 BLAST: .... (INTERIOR) SSPC-SP-10 (NEAR  
 WHITE)  
           (EXTERIOR) SSPC-SP-6  
 (COMMERCIAL BLAST)  
 PAINT: .... (INTERIOR) EPOXYPHENOLIC  
 100% SOLID 20.0 TO 25.0MILS D.F.T.  
           (EXTERIOR) FINISH COAT  
 POLYURETHANE 4.0 TO 6.0 D.F.T.



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DESCRIPTION: **AL470-MX4 Standard**

DWG BY: KA

DATE: 09.19.19

SIZE: **A**

DRAWING NO.: 1

REV. -

SCALE: 1/8" = 1'-0"

CRD BY: ----

REV	CHANGE	DATE	BY
REVISION			

## SELECTION & SPECIFICATION DATA

<b>Generic Type</b>	Polyamine Epoxy
<b>Description</b>	Single-coat, plural-component applied, ultra-high build coating for use on steel and concrete substrates where rapid cure characteristics are required. Phenoline 310 is applied by plural component spray equipment and offers the same high performance properties of Phenoline 309, yet in a quick-curing formulation.
<b>Features</b>	<ul style="list-style-type: none"> <li>• Rapid cure-to-handle and cure-to-service characteristics</li> <li>• Low temperature (35°F) cure capabilities</li> <li>• Single coat application reduces labor costs</li> <li>• Ultra-high build capabilities provides a void-free film and excellent edge protection</li> <li>• Wide chemical resistance to acids, caustics and aliphatic solvents</li> <li>• Exceptional bond strength</li> <li>• Can be mat reinforced where exposure conditions dictate</li> <li>• VOC compliant to current AIM regulations</li> </ul>
<b>Color</b>	White (0800), Gray (F744)
<b>Finish</b>	Eggshell
<b>Primer</b>	Self-priming
<b>Dry Film Thickness</b>	20 - 30 mils (508 - 762 microns) per coat Most applications are applied in a single coat at 20-30 mils (500-750 microns). May be applied at heavier thicknesses up to 60 mils (1500 microns) as needed or specified. See Shelf Life for film build limitations.
<b>Solids Content</b>	By Volume 100% +/- 0%
<b>Theoretical Coverage Rate</b>	1604 ft <sup>2</sup> /gal at 1.0 mils (39.4 m <sup>2</sup> /l at 25 microns) 80 ft <sup>2</sup> /gal at 20.0 mils (2.0 m <sup>2</sup> /l at 500 microns) 53 ft <sup>2</sup> /gal at 30.0 mils (1.3 m <sup>2</sup> /l at 750 microns) Allow for loss in mixing and application.
<b>VOC Values</b>	<b>As Supplied</b> : 0.0 lbs/gal (0 g/l) These are nominal values and may vary slightly with color.
<b>Dry Temp. Resistance</b>	Continuous: 140°F (60°C) Non-Continuous: 180°F (82°C) Discoloration and loss of gloss is observed above 140°F (60°C).
<b>Limitations</b>	Epoxies lose gloss, discolor and eventually chalk in sunlight exposure. This coating commonly develops an amine-blush during cure. While this condition will not adversely affect performance of the coating, this blush must be removed before applying additional coats and may require removal before placing into service.

## SUBSTRATES & SURFACE PREPARATION

<b>General</b>	Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.
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# Phenoline<sup>®</sup> 310

## PRODUCT DATA SHEET



### SUBSTRATES & SURFACE PREPARATION

<b>Steel</b>	Immersion: SSPC-SP10 Profile: 3 mils (76 microns) minimum
<b>Concrete or CMU</b>	The concrete must be cured for 28 days (at 75°F/50% R.H.) or until the concrete reaches its designated compressive strength. Prepare and clean the surface in accordance with SSPC-SP13/ NACE No. 6 guidelines. Test for moisture by conducting a plastic sheet testing in accordance with ASTM D4263.

### MIXING & THINNING

<b>Mixing</b>	Power mix each component separately. Phenoline 310 is applied with two-component, heated, airless spray.
<b>Thinning</b>	Not recommended. Use of thinners other than those supplied or recommended by Carboline may adversely affect product performance and void product warranty, whether expressed or implied.
<b>Ratio</b>	4:1 Ratio (A to B)
<b>Pot Life</b>	25 minutes at 75°F (24°C). Pot life ends when material begins to thicken and starts to heat up. Pot life times will be less at higher temperatures.
<b>Material Temperature</b>	Part A: 110-140°F Part B: 90-110°F Difference between Part A and B should be within 20°F.

### APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

<b>Spray Application (General)</b>	Recommended for application by plural component airless spray. This is a high solids coating and may require adjustments in spray techniques. Wet film thickness is easily and quickly achieved. Contact Carboline Technical Service for plural component equipment recommendations.
<b>Conventional Spray</b>	Not recommended
<b>Brush &amp; Roller (General)</b>	Not recommended

### APPLICATION CONDITIONS

Condition	Material	Surface	Ambient	Humidity
Minimum	35°F (2°C)	35°F (2°C)	35°F (2°C)	0%
Maximum	125°F (52°C)	125°F (52°C)	110°F (43°C)	90%

This product simply requires the substrate temperature to be above the dew point. Condensation due to substrate temperatures below the dew point can cause flash rusting on prepared steel and interfere with proper adhesion to the substrate. Special application techniques may be required above or below normal application conditions. To reduce outgassing when applying to concrete substrates, do not apply in direct sunlight or when surface temperatures are increasing. Best results are obtained when ambient and surface temperatures are decreasing or constant.

## CURING SCHEDULE

Surface Temp.	Final Cure General	Maximum Recoat Time	Minimum Recoat Time
35°F (2°C)	36 Hours	36 Hours	16 Hours
60°F (16°C)	16 Hours	16 Hours	8 Hours
75°F (24°C)	8 Hours	8 Hours	4 Hours
90°F (32°C)	6 Hours	6 Hours	2 Hours

These times are based on a 20.0 mil (500 micron) dry film thickness. Higher film thickness, insufficient ventilation or cooler temperatures will require longer cure times. Condensation on the surface or humidity above 25% during application and curing will result in a surface haze or blush. Any haze or blush must be removed by water washing before recoating. During high humidity conditions, it is recommended that the application be done while temperatures are increasing. If the maximum recoat time is exceeded, the surface must be washed with detergent and water, then abraded by sweep blasting prior to the application of additional coats. For force curing, contact Carboline Technical Service for specific requirements.

## CLEANUP & SAFETY

<b>Cleanup</b>	Use Thinner #2 or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.
<b>Safety</b>	Read and follow all caution statements on this product data sheet and on the SDS for this product. Employ normal workmanlike safety precautions.
<b>Ventilation</b>	Spray mist may cause explosion. When used as a tank lining or in enclosed areas, thorough air circulation must be used during and after application until the coating is cured. In addition to ensuring proper ventilation, appropriate respirators must be used by all application personnel.
<b>Caution</b>	This product contains flammable materials. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workmen should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

## PACKAGING, HANDLING & STORAGE

<b>Shelf Life</b>	The cure mechanism of this product is not affected for a minimum of 24 months. Film build (per coat) decreases with age. <i>Fresh:</i> Over 60 mils; <i>3-6 months:</i> 50-30 mils; <i>After 6 months:</i> less than 30 mils. Follow intercoat preparation requirements.  *Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.
<b>Storage Temperature &amp; Humidity</b>	50°- 85°F (11°-30°C) 0-100% Relative Humidity
<b>Storage</b>	Store Indoors, out of direct sunlight.
<b>Shipping Weight (Approximate)</b>	1 Gallon Kit - 12 lbs. (5 kg) 20 Gallon Kit - 165 lbs. (75 kg)
<b>Flash Point (Setaflash)</b>	Part A: >205°F (96°C) Part B: >205°F (96°C)

# Phenoline<sup>®</sup> 310

## PRODUCT DATA SHEET

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### WARRANTY

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To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance, injuries or damages resulting from use. Carbolines sole obligation, if any, is to replace or refund the purchase price of the Carboline product(s) proven to be defective, at Carbolines option. Carboline shall not be liable for any loss or damage. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. All of the trademarks referenced above are the property of Carboline International Corporation unless otherwise indicated.

## SELECTION & SPECIFICATION DATA

<b>Generic Type</b>	Two component, acrylic, aliphatic polyurethane.
<b>Description</b>	Carbothane 8845 is a fast dry, high solids, low VOC, high gloss, high build, two component polyurethane coating. Carbothane 8845 exhibits the excellent dry times and handling characteristics required by Original Equipment Manufacturers. This coating has outstanding hardness, adhesion and resistance to: impact, marring, abrasion, chemicals and staining. Carbothane 8845 is recommended as a direct to metal finish coat or as a finish coat over properly primed substrates. Typical applications include air compressors, propane tanks, trailer chassis and frames, valves, pumps, waste water treatment plant equipment, agricultural equipment, hazardous material storage buildings and general industrial equipment. Not recommended for continuous immersion service.
<b>Features</b>	<ul style="list-style-type: none"> <li>• VOC compliant – 1.9 lbs/gal (228 g/l) as supplied</li> <li>• Direct-To-Metal (DTM)</li> <li>• 6 hours to handle at 75 °F (24 °C)</li> <li>• High solids, high build, high gloss</li> <li>• Excellent abrasion resistance</li> <li>• Application by conventional, airless spray, HVLP or electrostatic</li> <li>• Excellent chemical resistance</li> <li>• Ambient air or force cure with conventional or infrared ovens</li> </ul>
<b>Color</b>	Wide variety of custom colors.
<b>Finish</b>	High Gloss
<b>Primer</b>	Self-priming, epoxy, zinc rich epoxy or as recommended by Carboline.
<b>Dry Film Thickness</b>	3 - 5 mils (76 - 127 microns) per coat
<b>Solids Content</b>	By Volume 71% +/- 2%
<b>Theoretical Coverage Rate</b>	1139 ft <sup>2</sup> /gal at 1.0 mils (27.9 m <sup>2</sup> /l at 25 microns) 380 ft <sup>2</sup> /gal at 3.0 mils (9.3 m <sup>2</sup> /l at 75 microns) 228 ft <sup>2</sup> /gal at 5.0 mils (5.6 m <sup>2</sup> /l at 125 microns) Allow for loss in mixing and application.
<b>VOC Value(s)</b>	Per EPA Method 24: 1.9 lbs/gal (228 g/l) 6 oz/gal of Thinner 76: 2.1 lbs/gal (252 g/l)
<b>Dry Temp. Resistance</b>	Continuous: 200°F (93°C) Non-Continuous: 250°F (121°C)  Discoloration is observed above 180°F (82°C).

## SUBSTRATES & SURFACE PREPARATION

<b>General</b>	Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.
<b>Steel</b>	Abrasive blast to a commercial finish in accordance with SSPC-SP6 and obtain a 1½ - 2 mil (35-50 micron) blast profile.
<b>Phosphatized Steel</b>	Apply 8845 directly to dry, properly phosphatized substrate. Perform adhesion tests to insure proper, uniform and acceptable adhesion of 8845 direct to phosphatized metal substrate.

### SUBSTRATES & SURFACE PREPARATION

**Primed Surfaces** | Remove any oil or grease from the surface to be coated with Thinner 2 or Carboline Surface Cleaner 3 (Refer to Data Sheet) in accordance with SSPC-SP1.

### TYPICAL CHEMICAL RESISTANCE

Exposure	Fumes	Splashes & Spills
Acids	Excellent	Very Good
Alkalies	Excellent	Very Good
Salt	Excellent	Excellent
Solvents	Excellent	Very Good
Water	Excellent	Excellent

1. Certain colors may discolor.
2. Resistance may vary dependent on the type of solvent involved.

### MIXING & THINNING

**Mixing** | For plural component application equipment follow the equipment manufacturer's instructions. For batch mixing, power mix part A separately, then combine with part B and power mix thoroughly in the following proportions: THIS PRODUCT IS MOISTURE SENSITIVE. AVOID MOISTURE CONTAMINATION. DO NOT MIX PARTIAL KITS.

**Thinning** | Normally not required. May be thinned up to 6 oz/gal (49 g/l) (5%) with Thinner 76. Thinner 97 or Thinner 214 may be used when applying 8845 in very hot conditions or longer working time is required. Thinner 215 may be used for brush/roll applications.

Use of thinners other than those supplied or recommended by Carboline may adversely affect product performance and void product warranty, whether expressed or implied.

**Ratio** | 4:1 Ratio (A to B)  
Part A (Carbothane 8845): 4 parts  
Part B (Carbothane 8843 Converter): 1 part  
**1 Gallon Kit**  
Part A (8845): 0.8 gallons (in 1 gallon can)  
Part B (Urethane Converter 8843): 25.6 fluid oz  
**5 Gallon Kit**  
Part A (8845): 4 gallons (in 5 gallon can)  
Part B (Urethane Converter 8843): 1 gallon

**Pot Life** | 90 min at 75°F (24°C) unthinned.  
Pot life decreases at higher temperatures. Pot life ends when coating becomes too viscous to use. This product is moisture sensitive. Avoid moisture contamination. Some colors made with Rapid Tint System (RTS) colorants added to Part A CLER base may result in significantly shorter pot life.

### APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

**Spray Application (General)** | The following spray equipment has been found suitable and is available from manufacturers.

## APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

<b>Conventional Spray</b>	Pressure pot equipped with dual regulators, 3/8" (0.95 cm) I.D. minimum material hose, 0.070" (0.18 cm) I.D. fluid tip and appropriate air cap.
<b>Airless Spray</b>	Pump Ratio: 30:1 (min.)* GPM Output: 3.0 (min.) Material Hose: 3/8" (0.95 cm) I.D. (min.) Tip Size: 0.013-0.017" (0.03-0.04 cm) Output PSI: 2500-3500 Filter Size: 60 mesh *PTFE packings are recommended and available from the pump manufacturer.
<b>Touch Up</b>	Respray or brush. Brushing recommended only for touchup of small areas. Use natural bristle brush applying with full strokes.
<b>Electrostatic</b>	Contact Carboline for specific equipment recommendations.
<b>HVLP</b>	Contact Carboline for specific equipment recommendations.

## APPLICATION CONDITIONS

Condition	Material	Surface	Ambient	Humidity
Minimum	50°F (10°C)	35°F (2°C)	35°F (2°C)	10%
Maximum	130°F (54°C)	120°F (49°C)	95°F (35°C)	80%

Industry standards are for substrate temperatures to be 5°F (3°C) above the dew point.

**Caution:** This product is moisture sensitive in the liquid stage and until fully cured. Protect from high humidity, dew and direct moisture contact until fully cured. Application and/or curing in humidities above maximum, or exposure to moisture from rain or dew may result in loss of gloss and/or microbubbling of the product.

## CURING SCHEDULE

Surface Temp.	Dry to Touch	Dry to Handle	Final Cure
75°F (24°C)	90 Minutes	6 Hours	7 Days

These are minimum times are based on a 4.0 mil (100 micron) dry film thickness. Higher film thickness, insufficient ventilation or cooler temperatures will require longer cure times and could result in solvent entrapment and premature failure.

Carboline Additive 8509 can be used to accelerate the film forming process in this product for conditions outside of the parameters of this data sheet. Carboline Additive 8509 is added at a rate of up to 0.5 oz per mixed gallon or up to 2.5 oz per mixed five gallons. At this addition rate, Additive 8509 will accelerate the cure rate of the urethane product between 25-40% depending on the substrate temperature range and reduce the pot life of the product by approximately 40-50% of that stated on the product data sheet. With the use of Additive 8509, this product will continue to cure at temperatures as low as 20°F (-7°C).

<b>Force Cure</b>	<b>Oven Temperature at 150°F (66°C)</b> Flash Time is 20 minutes. Oven Dwell Time is 45 minutes. Cool Down is 10 minutes. <b>Oven Temperature at 180°F (82°C)</b> Flash Time is 20 minutes. Oven Dwell Time is 30 minutes. Cool Down is 10 minutes
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### CLEANUP & SAFETY

<b>Cleanup</b>	Use Thinner 2 or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.
<b>Safety</b>	Read and follow all caution statements on this product data sheet and on the SDS for this product. Employ normal workmanlike safety precautions. Hypersensitive persons should wear protective clothing, gloves and use protective cream on face, hands and all exposed areas.
<b>Ventilation</b>	When used in enclosed areas, thorough air circulation must be used during and after application until the coating is cured. The ventilation system should be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. User should test and monitor exposure levels to insure all personnel are below guidelines. If not sure, use MSHA/NIOSH approved supplied air respirator.
<b>Caution</b>	This product contains flammable solvents. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workmen should be required to use nonferrous tools and wear conductive and non-sparking shoes.

### PACKAGING, HANDLING & STORAGE

<b>Shelf Life</b>	Part A: Min. 36 months at 75°F (24°C) Part B: Min. 24 months at 75°F (24°C)  *Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.
<b>Storage Temperature &amp; Humidity</b>	40° - 110°F (4-43°C) 0-80% Relative Humidity
<b>Storage</b>	Store Indoors
<b>Shipping Weight (Approximate)</b>	<b>1 Gallon Kit</b> 15 lbs. (6 kg) Thinner 76: 8 lbs. (4 kg) Thinner 97: 8 lbs. (4 kg) <b>5 Gallon Kit</b> 58 lbs. (22 kg) Thinner 76: 41 lbs. (19 kg) Thinner 97: 41 lbs. (19 kg) Carbothane 8845 is also available in drum quantities.
<b>Flash Point (Setaflash)</b>	Part A: 63°F (17°C) Part B: 62°F (17°C) Thinner 76: 21°F (-6°C)

## **WARRANTY**

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance, injuries or damages resulting from use. Carbolines sole obligation, if any, is to replace or refund the purchase price of the Carboline product(s) proven to be defective, at Carbolines option. Carboline shall not be liable for any loss or damage. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. All of the trademarks referenced above are the property of Carboline International Corporation unless otherwise indicated.

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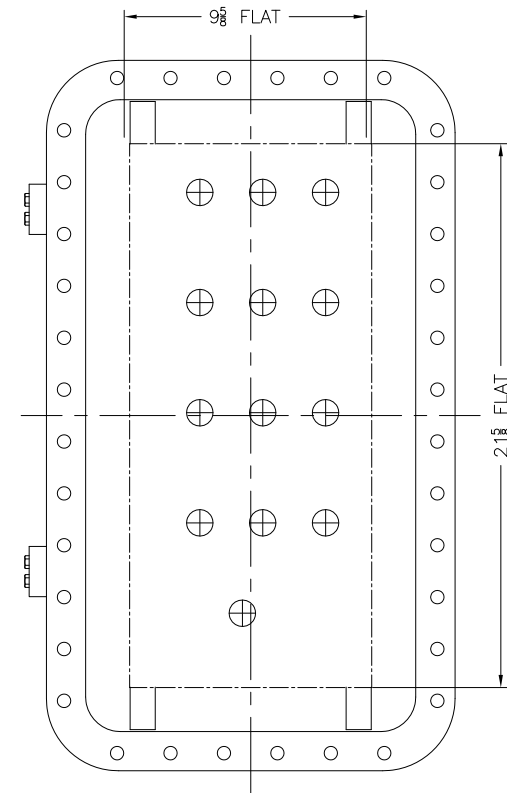
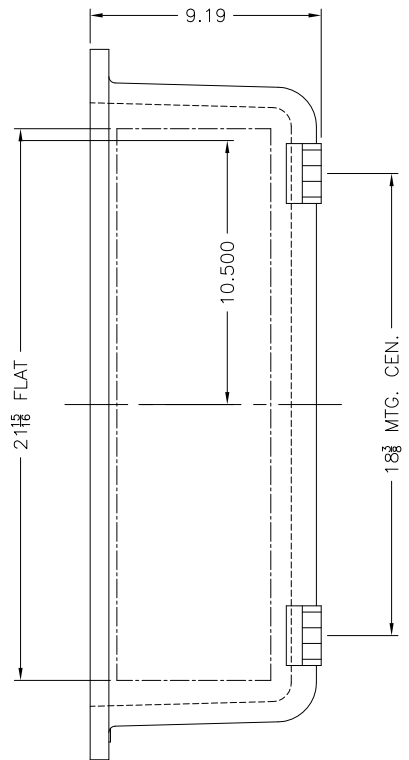
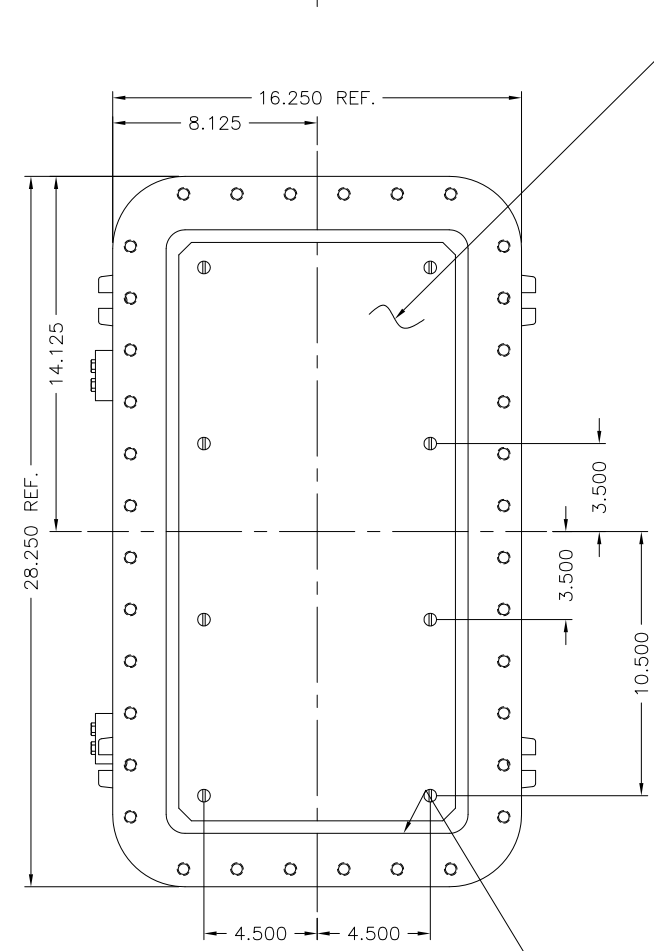
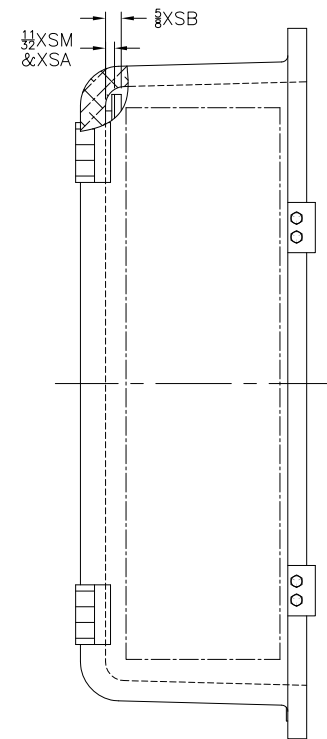
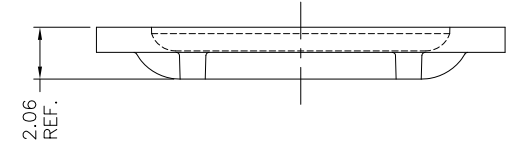
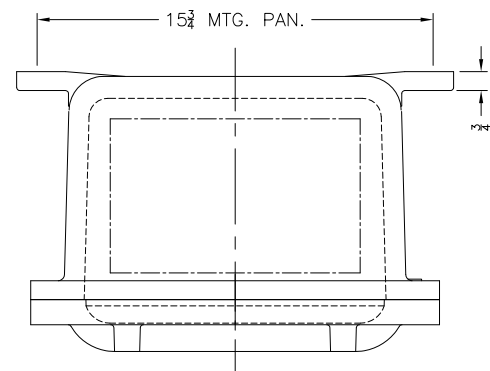
NO.	DATE	REVISION	BY

ENGINEER	DRAWN BY	CHECKED BY	DWG NO	CREATED	SCALE	SHEET	OF
JSW	JSW	JS	JSW080614-01B	06 AUG 14	NTS	1	2

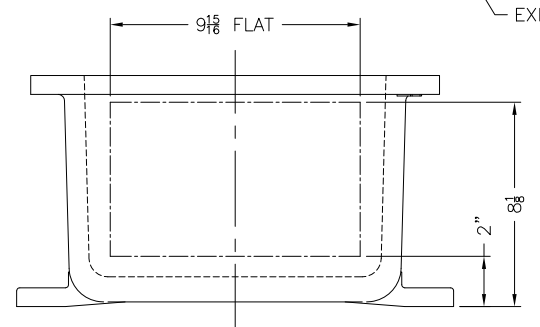
CLIENT INFORMATION, PROJECT / DRAWING NOTES:

PROJECT: DUPLEX XP SIZE 1  
STARTERS W/MAIN CB  
PLUS TWO REMOTE CTRL

**WorldWide Electric Corporation**  
1 GROVE STREET, SUITE 201B  
PITTSFORD, NEW YORK 14534 USA  
TOLL FREE: 1-800-808-2131



OPTIONAL XHC-2 HINGES

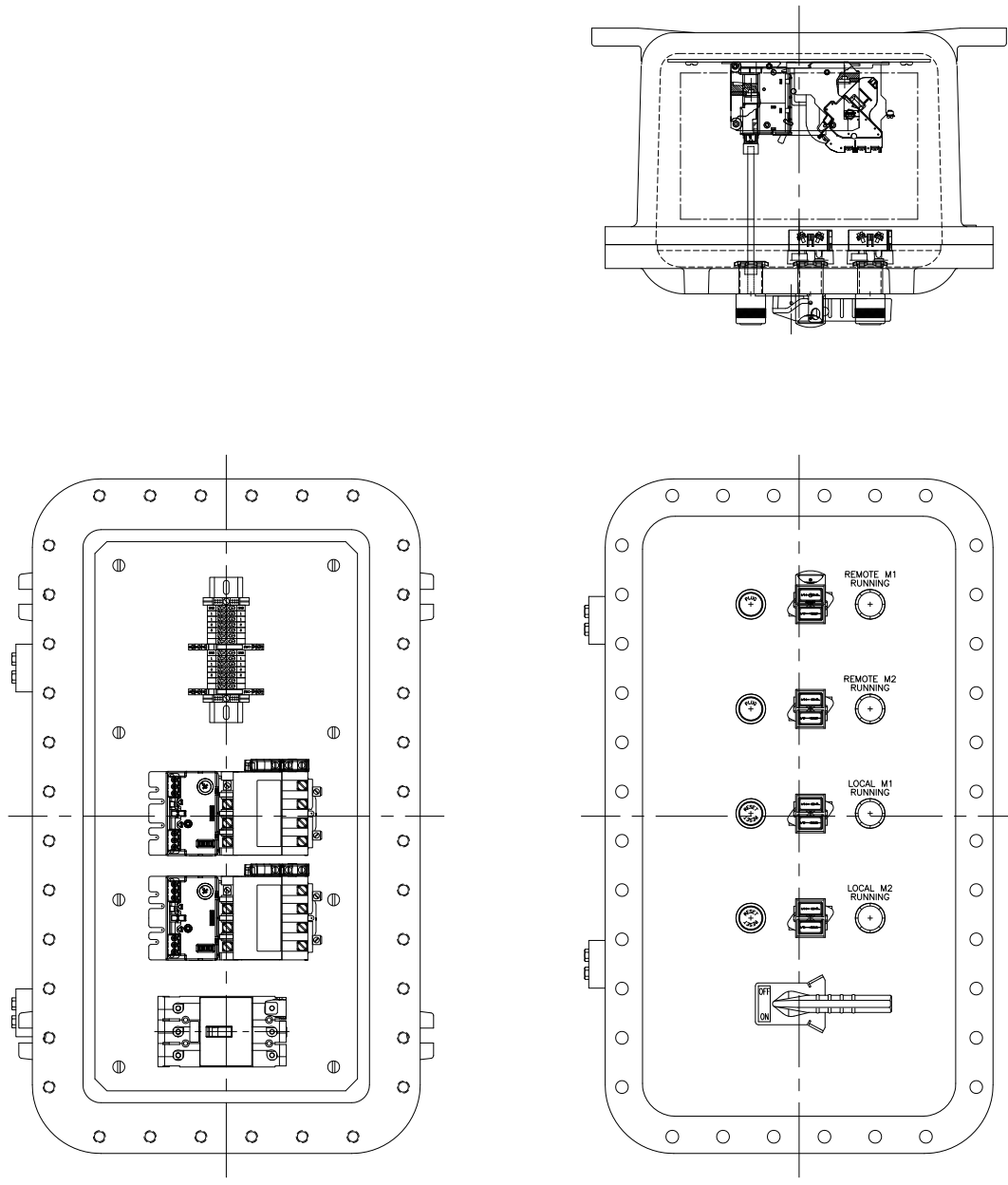


EXISTING GRD. SCREW

XCE 1224 COVER

- NOTES:
- COVER DRILLING ALLOWABLE IN XCE ONLY
1. MINIMUM SPACING FROM CENTER OF OPERATOR TO NEAREST FLAT IS 1 1/8.
  2. MINIMUM SPACING BETWEEN 1/2-14 NPSM OPERATOR CENTERS IS 3 FOR THIS ENCLOSURE.
  3. MAXIMUM NUMBER OF OPERATORS IS 21.
  4. DIMENSION FROM CENTER LINES OF COVER FOR OPERATORS.
  5. DIMENSION FROM CENTER LINE AND BACK OF MTG. LUG FOR CONDUIT.
  6. FOR MTG. ENCLOSURE USE 1/2 BOLT.

ISSUED FOR REVIEW 12 AUG 2014



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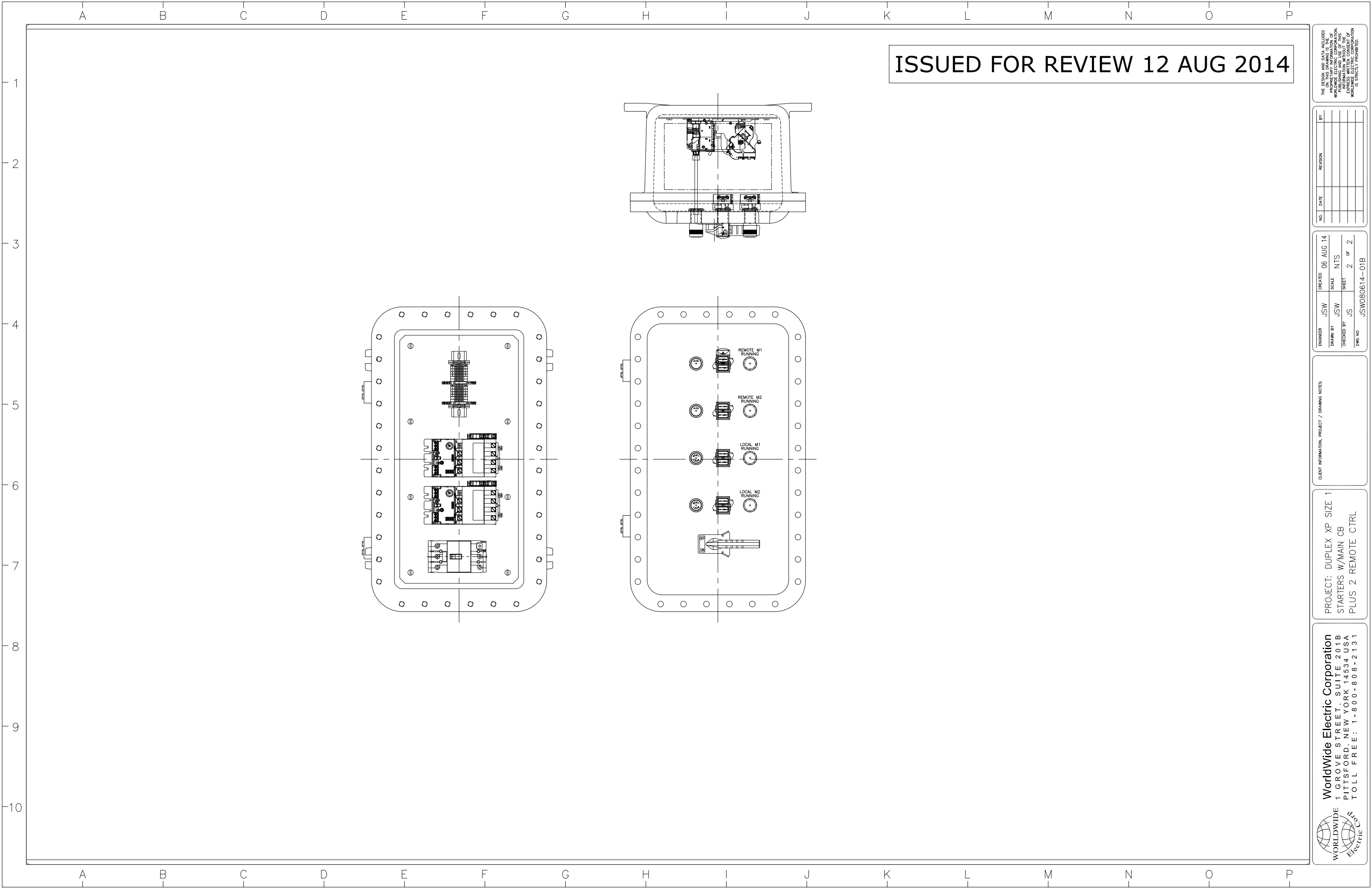
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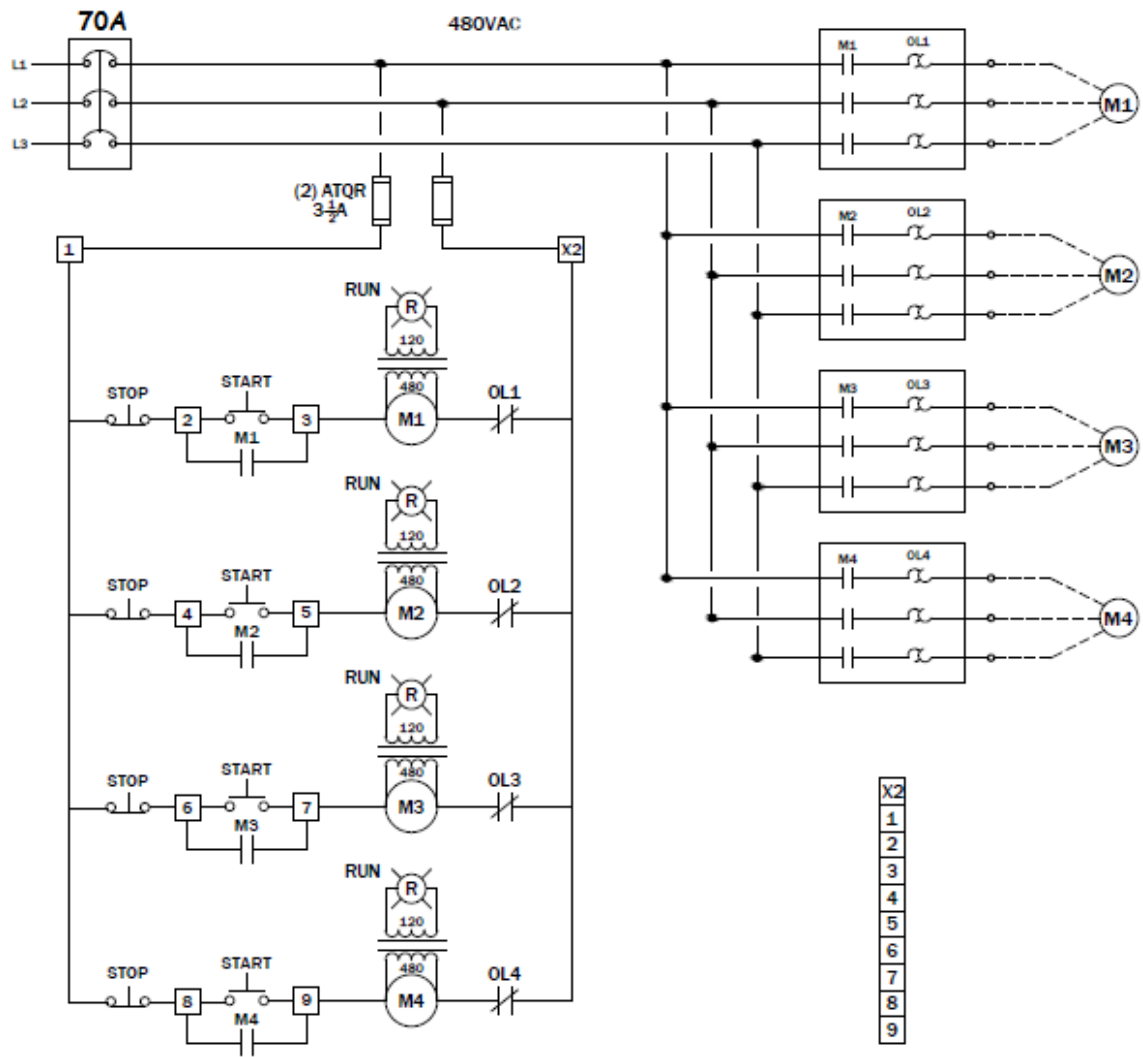
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CHECKED BY	JS	SHEET	2 OF 2
DWG NO	JSW080614-01B		

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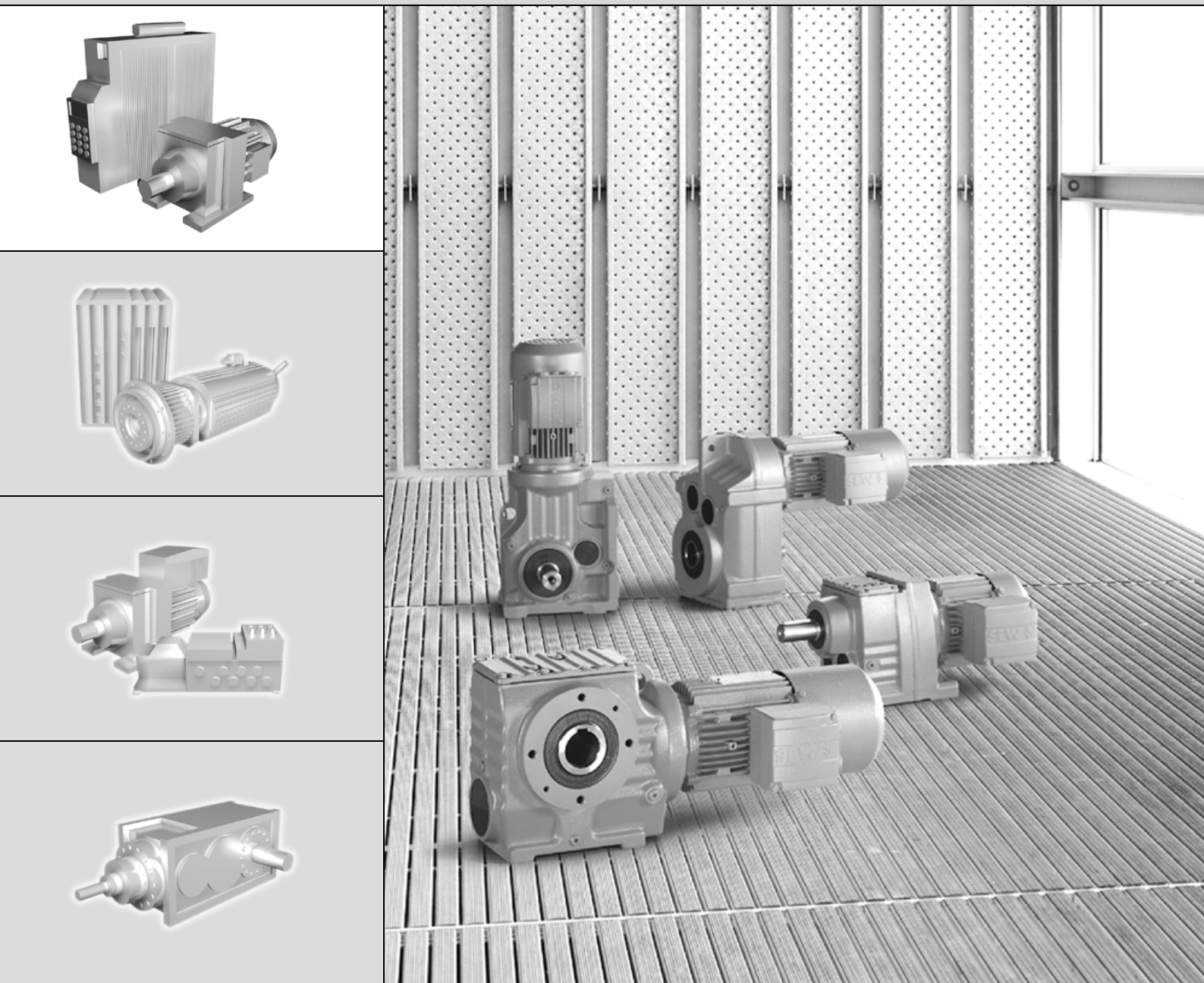
PROJECT: DUPLEX XP SIZE 1  
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PLUS 2 REMOTE CTRL

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CUSTOMER NAME:		P.O.# (T.B.D.)	SHEET: 1	REV:#	ISO 9001:2008 Registered # 04118011 UL Listing file numbers: NNNY.E341094 Enclosures in Hazardous Locations NITW.E318078 Industrial Control Panels NRBX.E328931 Intrinsically-Safe Panels
CHECKED BY: R.S.	S.O.# 14109	DATE: 09/18/14	SCALE: N.T.S.	REV.DATE: DATE	
DESIGNED BY: E-CONTROLS 4122 SOUTHERLAND HOUSTON, TX 77092	DWG NAME: XCE-122408_WIRING-DIAGRAM  THIS DRAWING IS THE PROPERTY OF ECONTROLS Co. INC. AND MAY NOT BE COPIED USED OR DISCLOSED FOR ANY PURPOSE EXCEPT AS AUTHORIZED IN WRITING BY ECONTROLS Co. INC.				

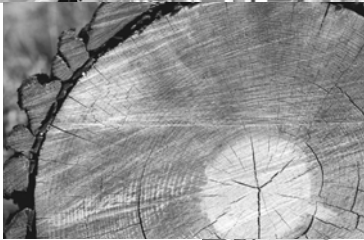


**Gear Units, R..7, F..7, K..7, S..7 Series,  
SPIROPLAN® W**

Edition 10/2007

11226811 / US

**O**perating Instructions





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## 1 Important Notes

### Safety and warning instructions

Always follow the safety and warning instructions in this publication!



#### Electrical hazard

Possible consequences: Severe or fatal injuries.



#### Hazard

Possible consequences: Severe or fatal injuries.



#### Hazardous situation

Possible consequences: Slight or minor injuries.



#### Harmful situation

Possible consequences: Damage to the drive and the environment.



Tips and useful information.



You must adhere to the operating instructions to ensure:

- Trouble-free operation
- Fulfillment of any rights to claim under guarantee

Consequently, read the operating instructions before you start working with the gear unit!

The operating instructions contain important information about servicing. Therefore, keep the operating instructions close to the gear unit.



- Adjust the lubricant fill volume and position of the breather valve accordingly in the event of a change of mounting position (see Sec. "Lubricants" and "Mounting Positions").
- Follow the instructions in Sec. "Mechanical installation" / "Installing the gear unit"!

**Waste disposal**

Please follow the latest instructions: Dispose of the following materials in accordance with the regulations in force:

- Steel scrap:
  - Housing parts
  - Gears
  - Shafts
  - Anti-friction bearing
  - Gray-cast iron (if there is no special collection)
- Parts of the worm gears are made of non-ferrous metals. Dispose of the worm gears as appropriate.
- Collect waste oil and dispose of it correctly.



## 2 Safety Notes

### **Preface**

The following safety notes are primarily concerned with the use of gear units. If using **gearmotors**, please also refer to the safety notes for motors in the relevant operating instructions.

**Please also consider the supplementary safety notes in the individual sections of these operating instructions.**

### **General information**

During and after operation, gearmotors, gear units and motors have:

- Live parts
- Moving parts
- Hot surfaces (may be the case)

Only qualified personnel may carry out the following work:

- Transportation
- Putting into storage
- Installation / assembly
- Connection
- Startup
- Maintenance
- Servicing

The following information and documents must be observed during these processes:

- Relevant operating instructions and wiring diagrams
- Warning and safety signs on the gear unit / gearmotor
- System-specific regulations and requirements
- National / regional regulations governing safety and the prevention of accidents

**Serious injuries and property damage may result from:**

- Improper use
- Incorrect installation or operation
- Unauthorized removal of necessary protection covers or the housing

### **Designated use**

Gearmotors / gear units from SEW are intended for industrial systems. They correspond to the applicable standards and regulations.

Technical data and information about the permitted conditions can be found on the nameplate and in the documentation.

It is essential that you follow all the instructions!



**Transportation**

**Inspect the shipment for any damage that may have occurred in transit as soon as you receive the delivery. Inform the shipping company immediately. It may be that you are not permitted to startup the drive due to the damage.**

Tighten installed eyebolts. The eyebolts are only designed for the weight of the gearmotor / gear unit. Do not attach any additional loads.

The installed lifting eyebolts comply with DIN 580. The loads and regulations specified in this standard must always be observed. If two eyebolts are available, use both of them for transport. In this case, the tension force vector of the slings must not exceed a 45° angle in accordance with DIN 580.

Use suitable, sufficiently rated handling equipment if necessary. Remove any transportation fixtures prior to startup.

**Extended storage of gear units**

Gear units of the "extended storage" type have:

- An oil fill suitable for the mounting position so the unit is ready to run (mineral oil CLP and synthetic oil CLP HC). You should still check the oil level before startup (see Sec. "Inspection / Maintenance" / "Inspection and maintenance of the gear unit").
- A higher oil level in some cases (synthetic oil CLP PG / food grade oil). Correct the oil level before startup (see Sec. "Inspection / Maintenance" / "Inspection and maintenance of the gear unit").

Comply with the storage conditions specified in the following table for extended storage:

Climate zone	Packaging <sup>1)</sup>	Storage location	Storage time
<b>Temperate (Europe, USA, Canada, China and Russia, excluding tropical zones)</b>	Packed in containers, with desiccant and moisture indicator sealed in the plastic wrap.	With roof, protected against rain and snow, no shock loads.	Up to three years with regular checks on the packaging and moisture indicator (relative atmospheric humidity < 50 %).
	Open	With roof, enclosed at constant temperature and atmospheric humidity (5 °C < θ < 60 °C, < 50 % relative atmospheric humidity). No sudden temperature fluctuations and controlled ventilation with filter (free from dirt and dust). No aggressive vapors and no shock loads.	Two years or more given regular inspections. Check for cleanliness and mechanical damage as part of the inspection. Check corrosion protection.
<b>Tropical (Asia, Africa, Central and South America, Australia, New Zealand excluding temperate zones)</b>	Packed in containers, with desiccant and moisture indicator sealed in the plastic wrap. Protected against insect damage and mildew by chemical treatment.	With roof, protected against rain, no shock loads.	Up to three years with regular checks on the packaging and moisture indicator (relative atmospheric humidity < 50 %).
	Open	With roof, enclosed at constant temperature and atmospheric humidity (5 °C < θ < 60 °C, < 50 % relative atmospheric humidity). No sudden temperature fluctuations and controlled ventilation with filter (free from dirt and dust). No aggressive vapors and no shock loads. Protection against insect damage.	Two years or more given regular inspections. Check for cleanliness and mechanical damage as part of the inspection. Check corrosion protection.

1) Packaging must be performed by an experienced company using the packaging materials that have been expressly specified for the particular application.

***Installation /  
assembly***

Observe the instructions in the sections "Installation" and "Assembly/Removal"!

***Startup /  
operation***

Check that the direction of rotation is correct in **decoupled** status. Listen out for unusual grinding noises as the shaft rotates.

Secure the shaft keys for test mode without drive components. Do not render monitoring and protection equipment inoperative even for test mode.

Switch off the gearmotor if in doubt whenever changes occur in relation to normal operation (e.g. increased temperature, noise, vibration). Determine the cause; contact SEW-EURODRIVE if necessary.

***Inspection /  
maintenance***

Follow the instructions in the section "Inspection and Maintenance"!



### 3 Gear Unit Structure



The following figures are block diagrams. Their purpose is only to make it easier to assign components to the spare parts lists. Discrepancies may occur depending on the gear unit size and version!

#### 3.1 Basic structure of helical gear units

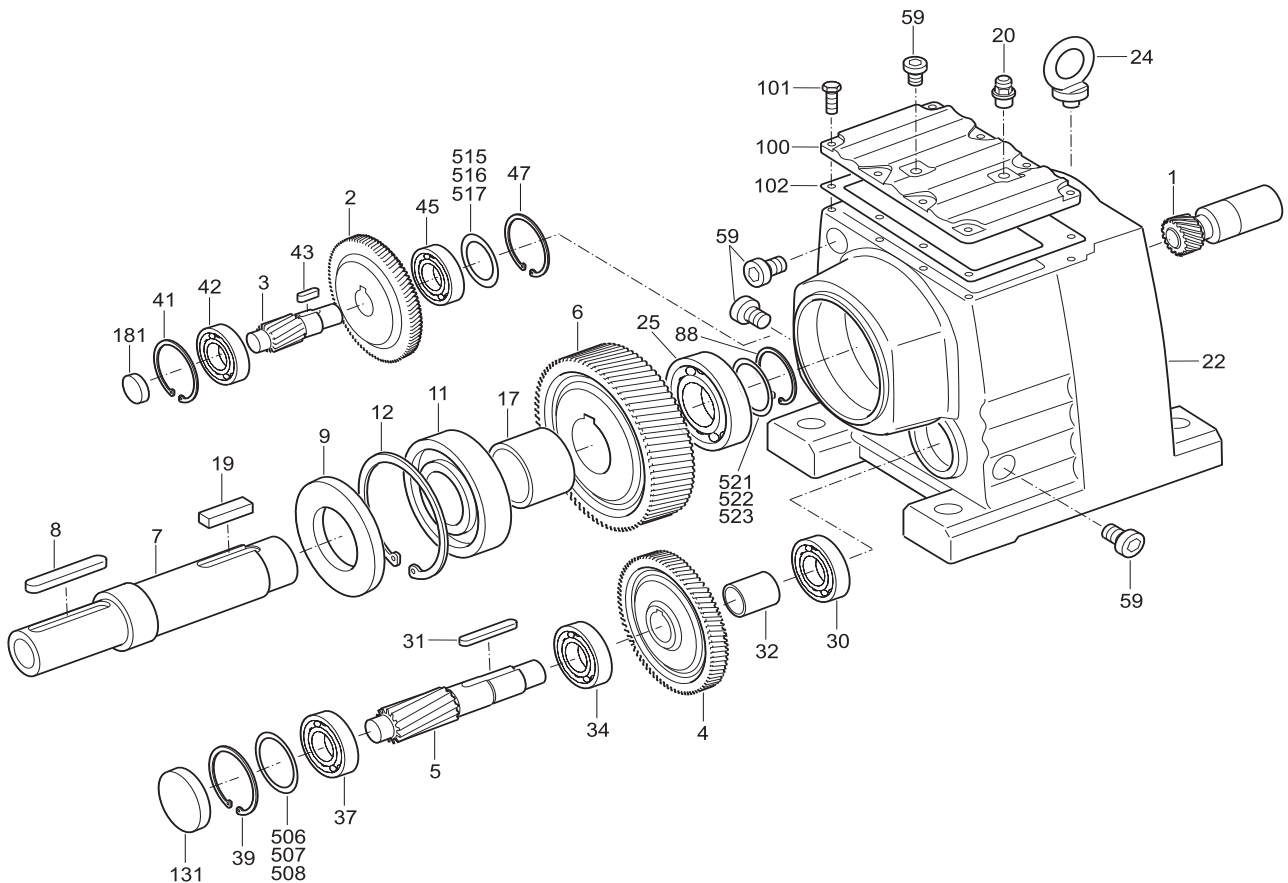


Figure 1: Basic structure of helical gear units

03438AXX

**Key**

1 Pinion	19 Key	42 Anti-friction bearing	507 Shim ring
2 Gear	20 Breather valve	43 Key	508 Shim ring
3 Pinion shaft	22 Gearcase	45 Anti-friction bearing	515 Shim ring
4 Gear	24 Lifting eyebolt	47 Circlip	516 Shim ring
5 Pinion shaft	25 Anti-friction bearing	59 Screw plug	517 Shim ring
6 Gear	30 Anti-friction bearing	88 Circlip	521 Shim ring
7 Output shaft	31 Key	100 Gearcase cover	522 Shim ring
8 Key	32 Spacer	101 Hex head bolt	523 Shim ring
9 Oil seal	34 Anti-friction bearing	102 Gasket	
11 Anti-friction bearing	37 Anti-friction bearing	131 Closing cap	
12 Circlip	39 Circlip	181 Closing cap	
17 Spacer	41 Circlip	506 Shim ring	



### 3.2 Basicstructure of parallel shaft helical gear units

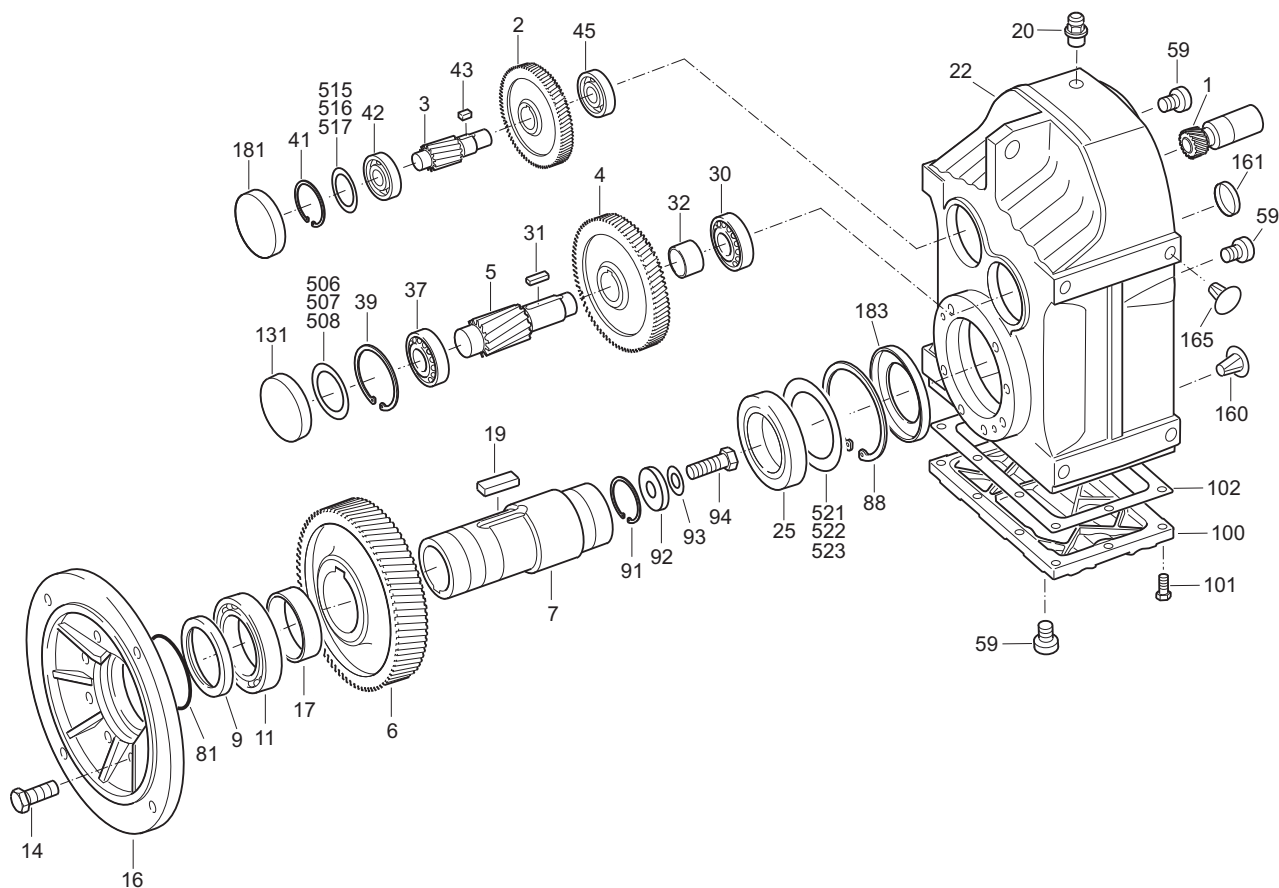


Figure 2: Basic structure of parallel shaft helical gear units

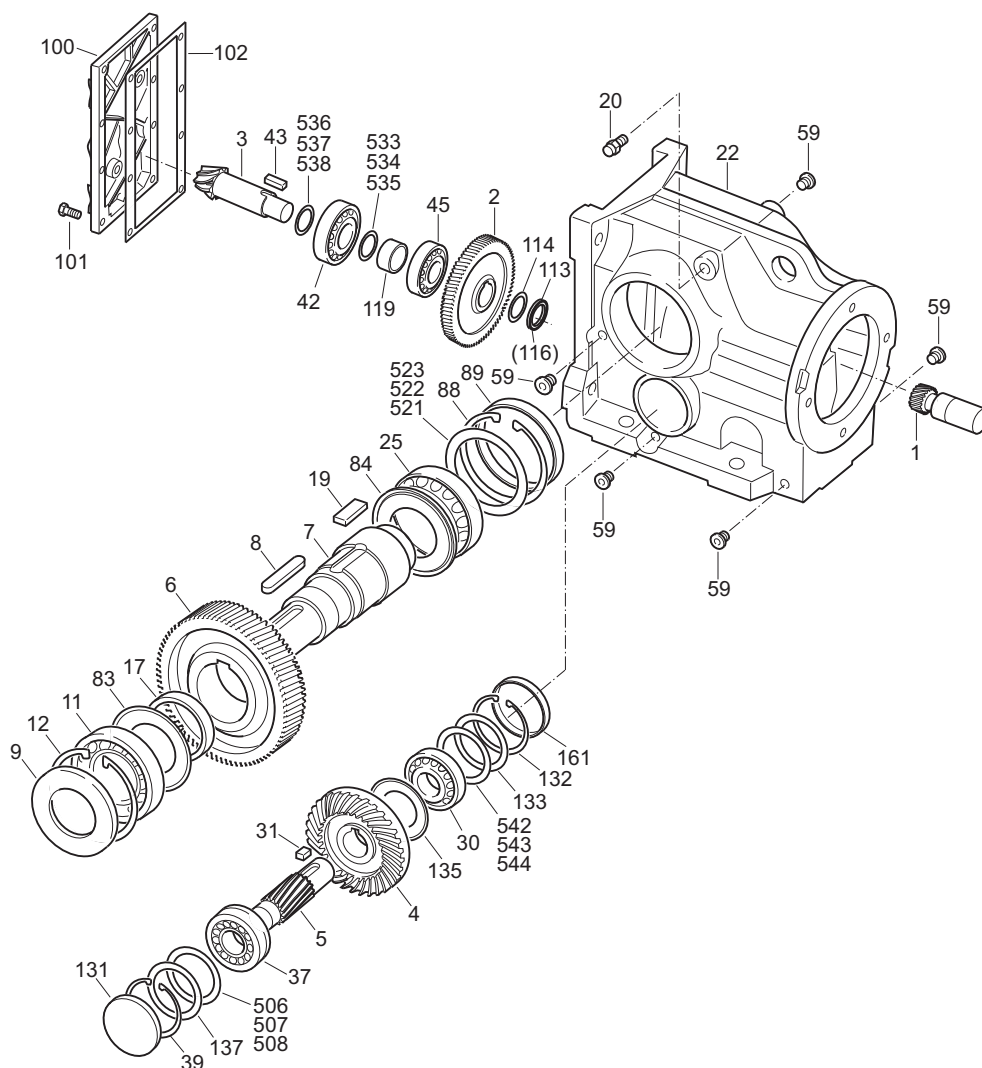
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#### Key

1 Pinion	22 Gearcase	91 Circlip	506 Shim ring
2 Gear	25 Anti-friction bearing	92 Washer	507 Shim ring
3 Pinion shaft	30 Anti-friction bearing	93 Lock washer	508 Shim ring
4 Gear	31 Key	94 Hex head bolt	515 Shim ring
5 Pinion shaft	32 Spacer	100 Gearcase cover	516 Shim ring
6 Gear	37 Anti-friction bearing	101 Hex head bolt	517 Shim ring
7 Hollow shaft	39 Circlip	102 Gasket	521 Shim ring
9 Oil seal	41 Circlip	131 Closing cap	522 Shim ring
11 Anti-friction bearing	42 Anti-friction bearing	160 Closing plug	523 Shim ring
14 Hex head bolt	43 Key	161 Closing cap	
16 Output flange	45 Anti-friction bearing	165 Closing plug	
17 Spacer	59 Screw plug	181 Closing cap	
19 Key	81 O-ring	183 Oil seal	
20 Breather valve	88 Circlip		



**3.3 Basic structure of helical-bevel gear units**



05675AXX

Figure 3: Basic structure of helical-bevel gear units

**Key**

1 Pinion	25 Anti-friction bearing	102 Adhesive and sealing compound	522 Shim ring
2 Gear	30 Anti-friction bearing	113 Slotted round nut	523 Shim ring
3 Pinion shaft	31 Key	114 Multi-tang washer	533 Shim ring
4 Gear	37 Anti-friction bearing	116 Thread lock	534 Shim ring
5 Pinion shaft	39 Circlip	119 Spacer	535 Shim ring
6 Gear	42 Anti-friction bearing	131 Closing cap	536 Shim ring
7 Output shaft	43 Key	132 Circlip	537 Shim ring
8 Key	45 Anti-friction bearing	133 Spacer	538 Shim ring
9 Oil seal	59 Screw plug	135 Nilos ring	542 Shim ring
11 Anti-friction bearing	83 Nilos ring	161 Closing cap	543 Shim ring
12 Circlip	84 Nilos ring	506 Shim ring	544 Shim ring
17 Spacer	88 Circlip	507 Shim ring	
19 Key	89 Closing cap	508 Shim ring	
20 Breather valve	100 Gearcase cover	521 Shim ring	
22 Gearcase	101 Hex head bolt	521 Shim ring	



#### 3.4 Basic structure of helical-worm gear units

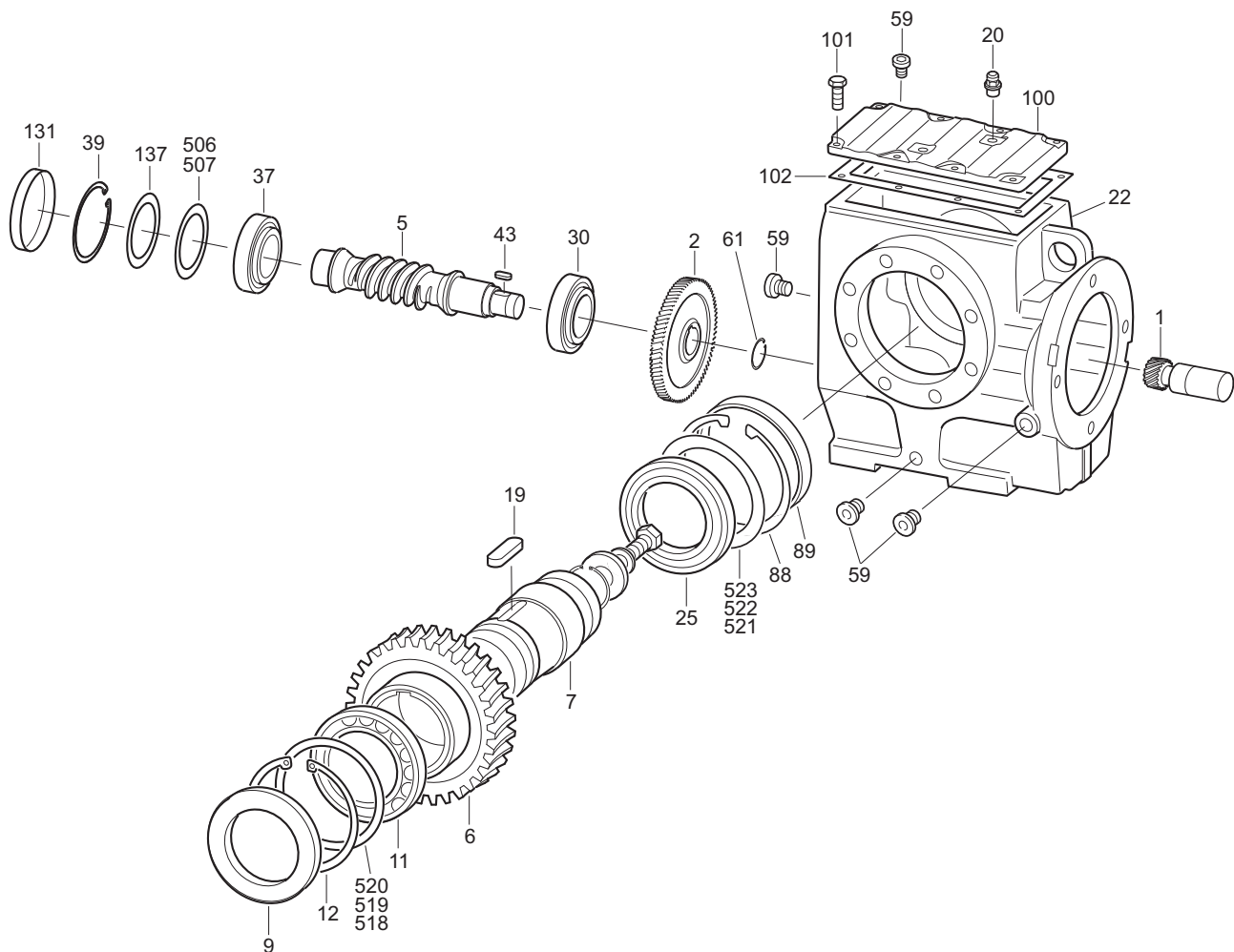


Figure 4: Basic structure of helical-worm gear units

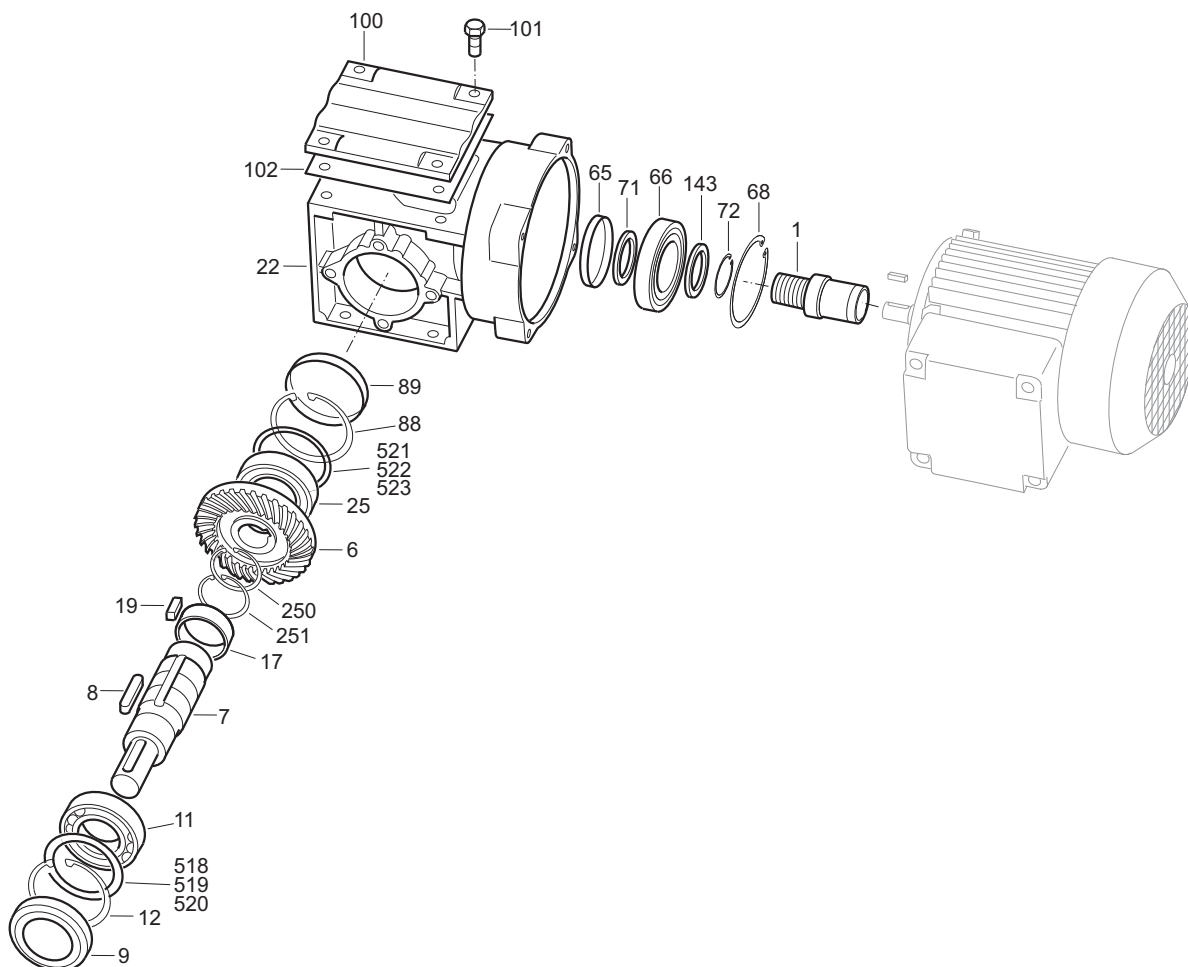
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#### Key

1	Pinion	20	Breather valve	88	Circlip	518	Shim ring
2	Gear	22	Gearcase	89	Closing cap	519	Shim ring
5	Worm	25	Anti-friction bearing	100	Gearcase cover	520	Shim ring
6	Worm gear wheel	30	Anti-friction bearing	101	Hex head bolt	521	Shim ring
7	Output shaft	37	Anti-friction bearing	102	Rubber seal	522	Shim ring
9	Oil seal	39	Circlip	131	Closing cap	523	Shim ring
11	Anti-friction bearing	43	Key	137	Spacer		
12	Circlip	59	Screw plug	506	Shim ring		
19	Key	61	Circlip	507	Shim ring		



### 3.5 Basic structure of SPIROPLAN® gear units



05674AXX

Figure 5: Basic structure of SPIROPLAN® gear units

**Key**

1	Pinion	19	Key	88	Circlip	251	Circlip
6	Gear	22	Gearcase	89	Closing cap	518	Shim ring
7	Output shaft	25	Anti-friction bearing	100	Gearcase cover	519	Shim ring
8	Key	65	Oil seal	101	Hex head bolt	520	Shim ring
9	Oil seal	66	Anti-friction bearing	102	Gasket	521	Shim ring
11	Anti-friction bearing	71	Spacer	132	Circlip	522	Shim ring
12	Circlip	72	Circlip	183	Oil seal	523	Shim ring
17	Spacer	143	Spacer	250	Circlip		



**3.6 Nameplate, unit designation**

*Sample nameplate*

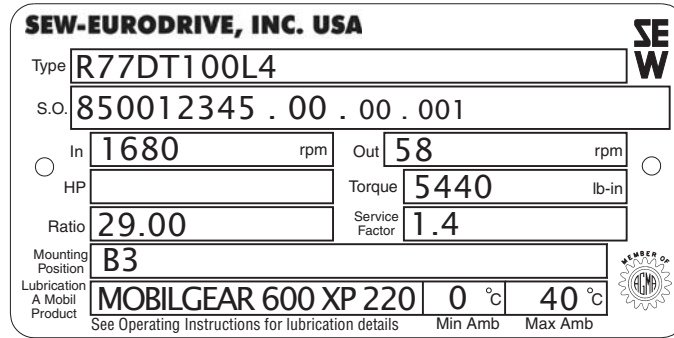
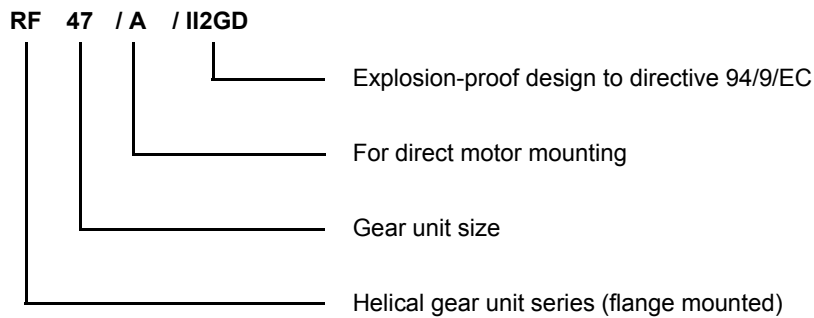


Figure 6: Sample nameplate

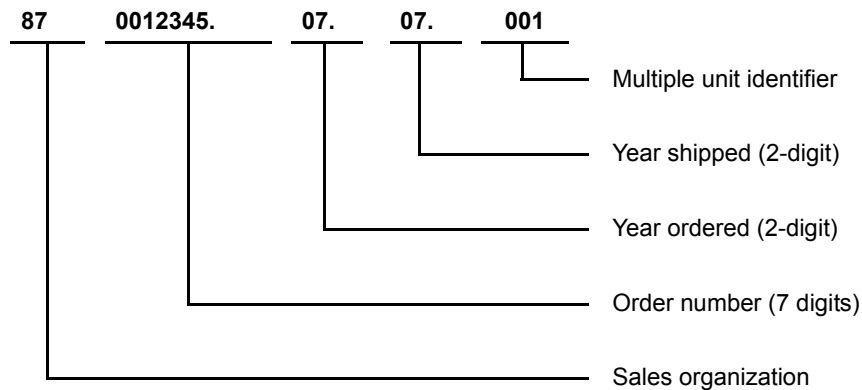
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**Unit designation**

**Example: Helical gear unit, category II2GD**



**Example: Serial number**





## 4 Mechanical Installation

### 4.1 Required tools / aids

- Set of spanners
- Torque wrench for:
  - Shrink discs
  - AQH motor adapter
  - Input shaft assembly with centering shoulder
- Mounting device
- Shims and distance rings if necessary
- Fixing devices for input and output elements
- Lubricant (e.g. NOCO<sup>®</sup> Fluid)
- Bolt adhesive (for input shaft assembly with centering shoulder), e.g. Loctite<sup>®</sup> 243
- Standard parts are not part of the delivery

#### Installation tolerances

Shaft end	Flanges
Diameter tolerance in accordance with DIN 748 <ul style="list-style-type: none"> <li>• ISO k6 for solid shafts with <math>\varnothing \leq 50</math> mm (1.97")</li> <li>• ISO m6 for solid shafts with <math>\varnothing &gt; 50</math> mm (1.97")</li> <li>• ISO H7 for hollow shafts</li> <li>• Center bore in accordance with DIN 332, shape DR</li> </ul>	Centering shoulder tolerance in accordance with DIN 42948 <ul style="list-style-type: none"> <li>• ISO j6 with <math>b1 \leq 230</math> mm (9.06")</li> <li>• ISO h6 with <math>b1 &gt; 230</math> mm (9.06")</li> </ul>

### 4.2 Prerequisites for assembly

Check that the following conditions have been met:

- The data on the nameplate of the gearmotor matches the voltage supply system.
- The drive has not been damaged during transportation or storage.
- Ensure that the following requirements have been met:
  - **For standard gear units:**  
Ambient temperature according to the lubricant table in Sec. "Lubricants" (see standard).  
The drive must not be assembled in the following ambient conditions:
    - Potentially explosive atmosphere
    - Oil
    - Acids
    - Gas
    - Vapors
    - Radiation
  - **For special versions:**  
The drive configured in accordance with the ambient conditions.
  - **For helical-worm / SPIROPLAN<sup>®</sup> W gear units:**  
No large external mass moments of inertia which could exert a retrodriving load on the gear unit.  
[At  $\eta'$  (retrodriving) =  $2 - 1/\eta < 0.5$  self-locking]



## Mechanical Installation

### Installing the gear unit

- You must clean the output shafts and flange surfaces thoroughly to ensure they are free of anti-corrosion agents, contamination or similar. Use a commercially available solvent. Do not let the solvent come into contact with the sealing lips of the oil seals – danger of damage to the material!
- When the drive is installed in abrasive ambient conditions, protect the output end oil seals against wear.

#### 4.3 Installing the gear unit

The gear unit or gearmotor is only allowed to be installed in the specified mounting position. SPIROPLAN® gear units are not dependent on the mounting position.

The support structure must have the following characteristics:

- Level
- Vibration damping
- Torsionally rigid

Maximum permitted flatness error for foot and flange mounting (approximate values with reference to DIN ISO 1101):

- Gear unit size  $\leq 67$ : max. 0.4 mm (0.016")
- Gear unit size 77 ... 107: max. 0.5 mm (0.020")
- Gear unit size 137 ... 147: max. 0.7 mm (0.028")
- Gear unit size 157 ... 187: max. 0.8 mm (0.031")

Do not tighten the housing legs and mounting flanges against one another and ensure that you comply with the permitted overhung and axial loads!

Secure the gearmotors with bolts of quality 8.8.

Secure the following gearmotors with bolts of quality 10.9:

- RF37, R37F with flange  $\varnothing$  120 mm (4.72")
- RF47, R47F with flange  $\varnothing$  140 mm (5.51")
- RF57, R57F with flange  $\varnothing$  160 mm (6.30")



**The oil checking and drain screws and the breather valves must be freely accessible!**

At the same time, also check that the oil fill is as specified for the mounting position (see Sec. "Lubricants" / "Lubricant fill quantities" or refer to the information on the nameplate). The gear units are filled with the required oil volume at the factory. There may be slight deviations at the oil level plug as a result of the mounting position, which are permitted within the manufacturing tolerances.



**Adjust the lubricant fill volumes and the position of the breather valve accordingly in the event of a change of mounting position.**

Please contact our SEW customer service if you change the mounting position of K gear units to M5 or M6 or between M5 and M6.

Please contact our SEW customer service if you change the mounting position of size S47 S97 S gear units to mounting position M2.

Use plastic inserts (2 ... 3 mm thick) if there is a risk of electrochemical corrosion between the gear unit and the driven machine. The material used must have an electrical bleeder resistor  $< 10^9 \Omega$ . Electrochemical corrosion can occur between various metals, for example, cast iron and high-grade steel. Also install the bolts with plastic washers! Ground the housing additionally – use the grounding bolts on the motor.

*Installation in damp locations or in the open*

Drives are supplied in corrosion-resistant versions for use in damp areas or in the open air. Repair any damage to the paint work (e.g. on the breather valve).

When mounting the motors onto AM, AQ, AR, AT adapters, seal the flange areas with a suitable sealing compound, e.g. Loctite® 574.



## Mechanical Installation

### Installing the gear unit

#### **Gear unit venting**

No breather plug is required for the following gear units:

- R07 in mounting positions M1, M2, M3, M5 and M6
- R17, R27 and F27 in mounting positions M1, M3, M5 and M6
- SPIROPLAN® W gear units

SEW-EURODRIVE supplies all other gear units with the breather valve installed and activated according to the particular mounting position.

#### **Exceptions:**

1. SEW supplies the following gear units with a screw plug on the vent hole provided:

- Gear units for extended storage
- Pivoted mounting positions, if possible
- Gear units for mounting on a slant

The breather valve is supplied with the unit. Before startup, you must install the breather plug in the location specified.

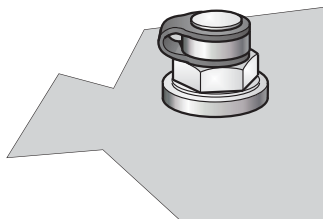
2. SEW supplies a breather valve in a plastic bag for **gear head units** requiring venting on the input end.

3. **Enclosed gear units** are supplied without a breather valve.

#### **Activating the breather valve**

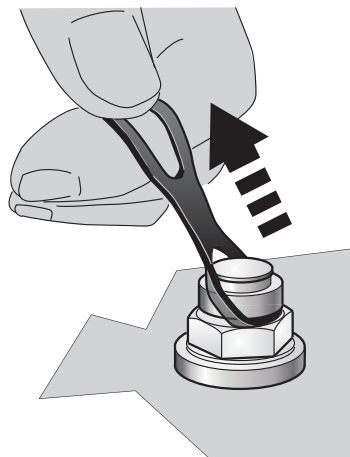
If the breather valve has not been activated, you must remove the transport fixture from the breather valve before starting up the gear unit!

1. Breather valve with transport fixture



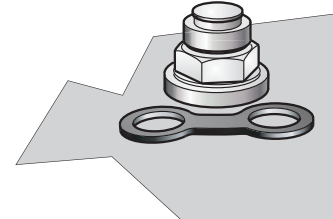
02053BXX

2. Remove the transport fixture



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3. Breather valve activated



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#### **Painting the gear unit**

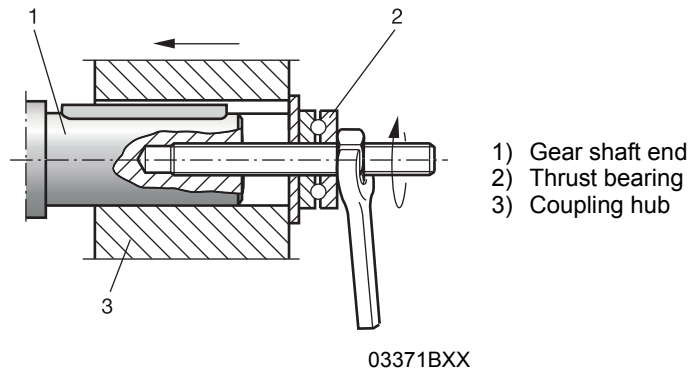
If you paint or respray the drive, ensure that you cover the breather valve and oil seals carefully. Remove the strips of tape after completing the painting work.



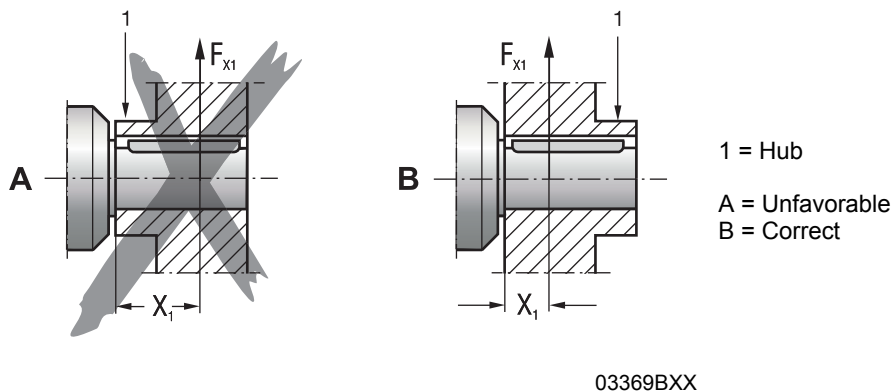
#### 4.4 Gear unit with solid shaft

##### Installing input and output elements

The following figure shows a mounting device for installing couplings or hubs on gear unit or motor shaft ends. It may be possible to dispense with the thrust bearing on the mounting device.



Avoid impermissibly high overhung loads: Install the gear or chain sprocket according to figure B.



- Only use a mounting device for installing input and output elements. Use the center bore and the thread on the shaft end for positioning.
- **Never drive belt pulleys, couplings, pinions, etc. onto the shaft end by hitting them with a hammer. This will damage the bearings, housing and the shaft!**
- **In the case of belt pulleys, make sure the belt is tensioned correctly in accordance with the manufacturer's instructions.**
- Power transmission elements should be balanced after fitting and must not give rise to any impermissible radial or axial forces (see the "Gearmotor" or "Explosion-Proof Drives" catalogs for permitted values).



##### Note:

Assembly is easier if you first apply lubricant to the output element or heat it up briefly to 80 ... 100 °C (176 ... 212°F).



## Mechanical Installation

### Gear unit with solid shaft

#### Installing couplings

Couplings must be mounted and balanced according to the information provided by the coupling manufacturer:

- a) Maximum and minimum clearance
- b) Axial misalignment
- c) Angular misalignment

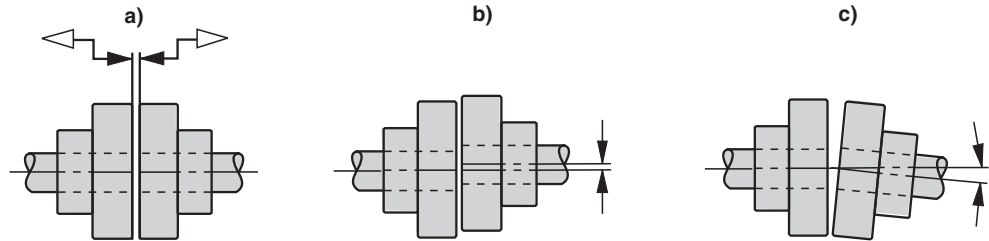


Figure 7: Clearance and misalignment for coupling installation

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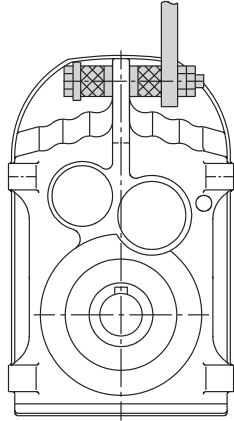
**Input and output elements such as belt pulleys, couplings, etc. must be protected against contact!**



#### 4.5 Torque arms for shaft mounted gear units

Do not place torque arms under strain during installation!

##### Parallel shaft helical gear units

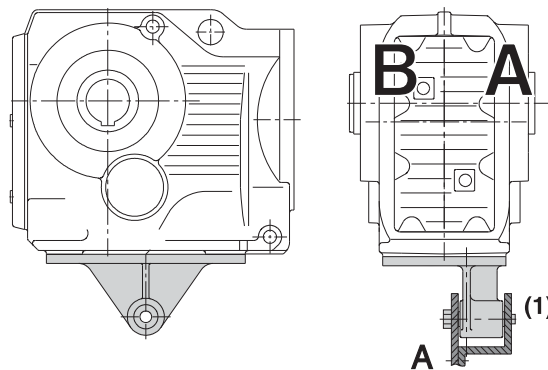


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Figure 8: Torque arm for parallel shaft helical gear units

##### Helical-bevel gear units

- Secure on each side of torque arm → (1).
- Install connection end B as a mirror image of A.



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Figure 9: Torque arm for helical-bevel gear units

Gear unit	Bolts	Tightening torque
KA37	4 × M10 × 25 – 8.8	48 Nm (425 lb-in)
KA47	4 × M10 × 30 – 8.8	48 Nm (425 lb-in)
KA67	4 × M12 × 35 – 8.8	86 Nm (761 lb-in)
KA77	4 × M16 × 40 – 8.8	210 Nm (1858 lb-in)
KA87	4 × M16 × 45 – 8.8	210 Nm (1858 lb-in)
KA97	4 × M20 × 50 – 8.8	410 Nm (3628 lb-in)
KA107	4 × M24 × 60 – 8.8	710 Nm (6283 lb-in)
KA127	4 × M36 × 130 – 8.8	2500 Nm (22125 lb-in)
KA157	4 × M36 × 130 – 8.8	2500 Nm (22152 lb-in)

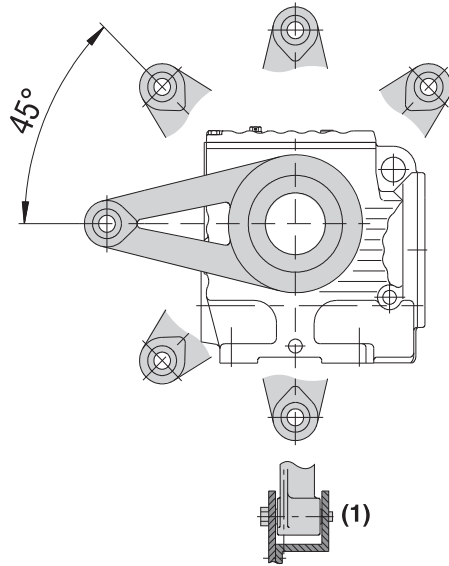


## Mechanical Installation

### Torque arms for shaft mounted gear units

#### Helical-worm gear units

- Secure on each side of torque arm → (1).



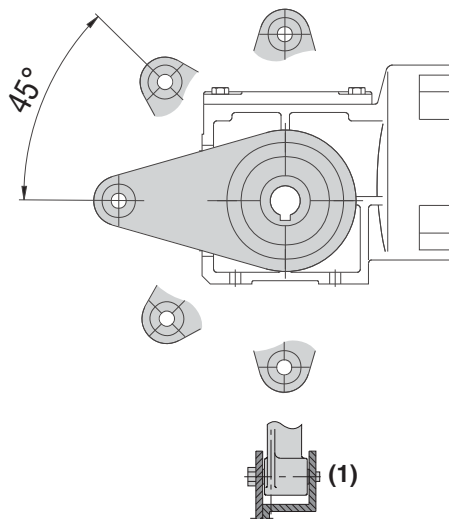
01031CXX

Figure 10: Torque arm for helical-worm gear units

Gear unit	Bolts	Tightening torque
SA37	M6 × 16 – 8.8	11 Nm (97 lb-in)
SA47	M8 × 20 – 8.8	25 Nm (222 lb-in)
SA57	M8 × 20 – 8.8	25 Nm (222 lb-in)
SA67	M12 × 25 – 8.8	86 Nm (761 lb-in)
SA77	M12 × 35 – 8.8	86 Nm (761 lb-in)
SA87	M16 × 35 – 8.8	210 Nm (1858 lb-in)
SA97	M16 × 35 – 8.8	210 Nm (1858 lb-in)

#### SPIROPLAN® W gear units

- Secure on each side of torque arm → (1)



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Figure 11: Torque arm for SPIROPLAN® W gear units

Gear unit	Bolts	Tightening torque
WA10	M6 × 16	11 Nm (97 lb-in)
WA20	M6 × 16	11 Nm (97 lb-in)
WA30	M6 × 16	11 Nm (97 lb-in)

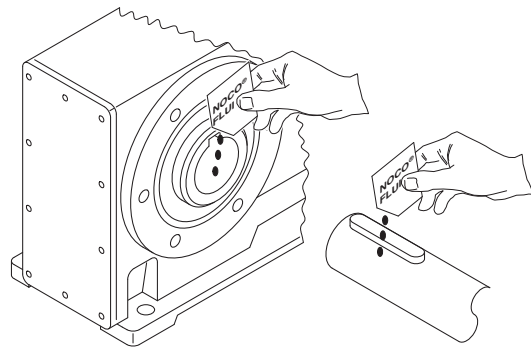


#### 4.6 Mounted gear unit with keyway or splined hollow shaft



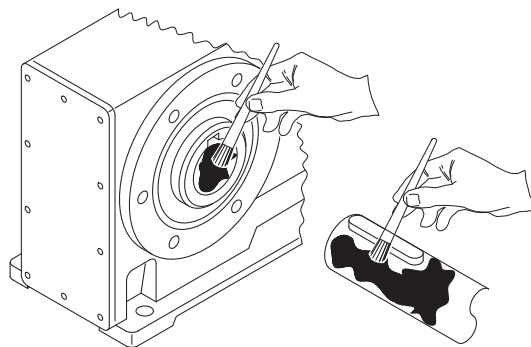
For the configuration of customer shafts, please also refer to the design notes in the Gearmotors catalog!

**Installation notes** 1. Apply NOCO® fluid.



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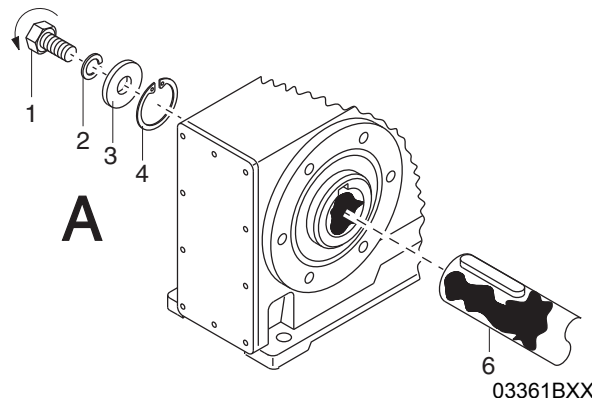
2. Distribute the NOCO® fluid carefully.



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3. Install the shaft and secure it axially  
(mounting is facilitated by using a mounting device)

**3A: Mounting with standard scope of delivery**



- 1 Short retaining bolt  
(standard scope of delivery)
- 2 Lock washer
- 3 Washer
- 4 Circlip
- 6 Customer shaft

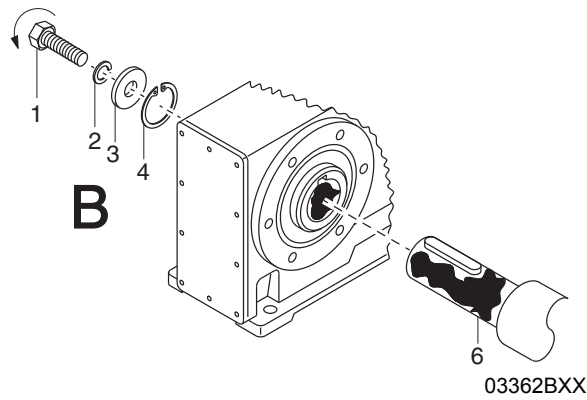


## Mechanical Installation

### Mounted gear unit with keyway or splined hollow shaft

#### 3B: Assembly with SEW-EURODRIVE assembly/disassembly kit (→ page 26)

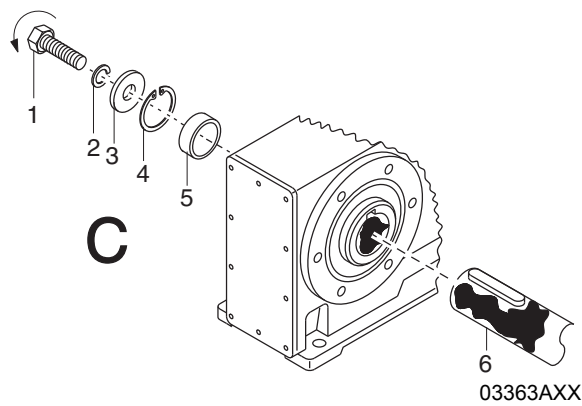
– Customer's shaft **with** contact shoulder



- 1 Retaining bolt
- 2 Lock washer
- 3 Washer
- 4 Circlip
- 6 Customer's shaft with contact shoulder

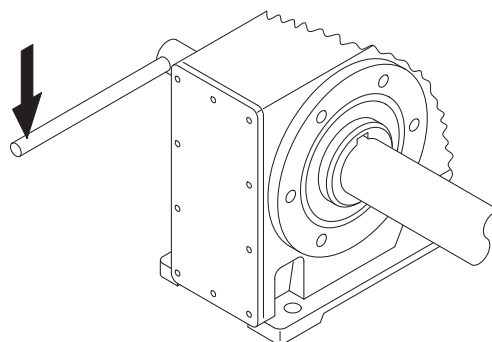
#### 3C: Assembly with SEW-EURODRIVE assembly/disassembly kit (→ page 26)

– Customer's shaft **without** contact shoulder



- 1 Retaining bolt
- 2 Lock washer
- 3 Washer
- 4 Circlip
- 5 Spacer
- 6 Customer's shaft without contact shoulder

4. Tighten the retaining bolt to the appropriate torque (see table).



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Bolt	Tightening torque
M5	5 Nm (44 lb-in)
M6	8 Nm (70 lb-in)
M10/12	20 Nm (177 lb-in)
M16	40 Nm (354 lb-in)
M20	80 Nm (708 lb-in)
M24	200 Nm (1770 lb-in)



**Note:**

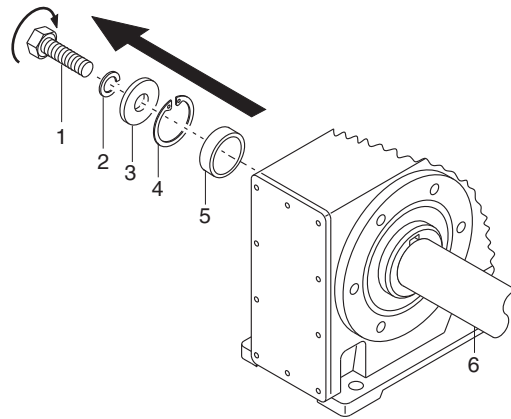
To avoid contact corrosion, we recommend that the customer's shaft should additionally be recessed between the two contact surfaces!



**Removal notes**

This description is only applicable when the gear unit was assembled using the installation/removal kit from SEW-EURODRIVE(→ page 26) (see the previous description, point 3B or 3C).

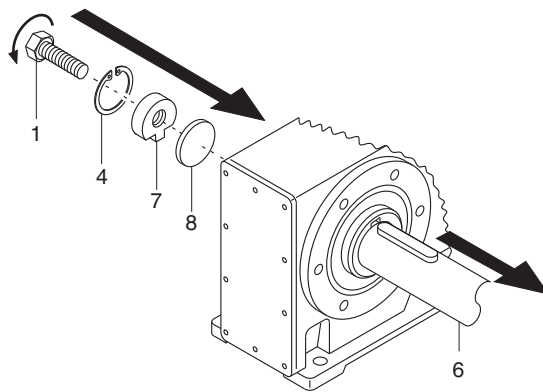
1. Loosen the retaining bolt [1].
2. Remove parts 2 to 4 and, if fitted, spacer 5.



- 1 Retaining bolt
- 2 Lock washer
- 3 Washer
- 4 Circlip
- 5 Spacer
- 6 Customer shaft

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3. Insert the forcing washer [8] and the fixed nut [7] from the SEW-EURODRIVE installation/removal kit between the customer's shaft [6] and the circlip [4].
4. Re-insert the circlip [4].
5. Screw the retaining bolt [1] back in. Now you can force the gear unit off the shaft by tightening the bolt.



- 1 Retaining bolt
- 4 Circlip
- 6 Customer shaft
- 7 Fixed nut
- 8 Forcing washer

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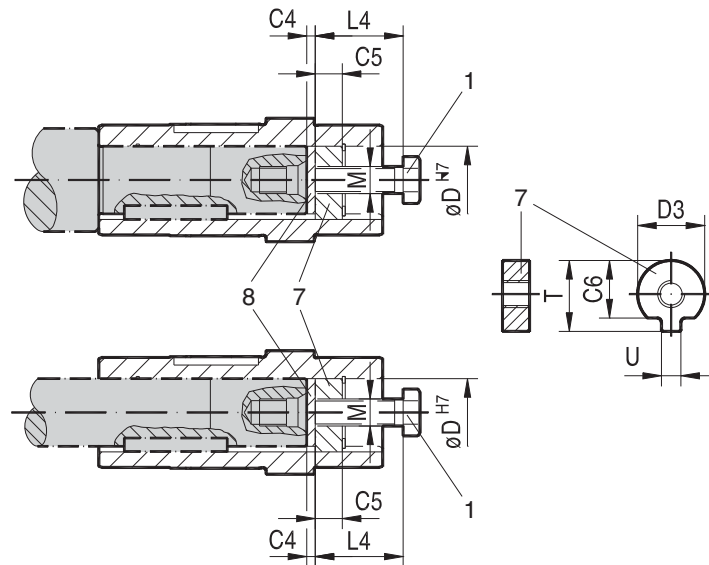


## Mechanical Installation

### Mounted gear unit with keyway or splined hollow shaft

#### SEW installation/removal kit

The SEW-EURODRIVE installation/removal kit can be ordered under the following part number. The kits are currently only available for metric shaft sizes.



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Figure 12: SEW-EURODRIVE installation/removal kit

- 1 Retaining bolt
- 7 Fixed nut for disassembly
- 8 Forcing washer

Type	$D_{H7}$ [mm]	$M^1)$	$C4$ [mm]	$C5$ [mm]	$C6$ [mm]	$U^{-0.5}$ [mm]	$T^{-0.5}$ [mm]	$D3^{-0.5}$ [mm]	$L4$ [mm]	Part number of installa- tion/removal kit
WA..10	16	M5	5	5	12	4.5	18	15.7	50	643 712 5
WA..20	18	M6	5	6	13.5	5.5	20.5	17.7	25	643 682 X
WA..20, WA..30, SA..37	20	M6	5	6	15.5	5.5	22.5	19.7	25	643 683 8
FA..27, SA..47	25	M10	5	10	20	7.5	28	24.7	35	643 684 6
FA..37, KA..37, SA..47, SA..57	30	M10	5	10	25	7.5	33	29.7	35	643 685 4
FA..47, KA..47, SA..57	35	M12	5	12	29	9.5	38	34.7	45	643 686 2
FA..57, KA..57, FA..67, KA..67, SA..67	40	M16	5	12	34	11.5	41.9	39.7	50	643 687 0
SA..67	45	M16	5	12	38.5	13.5	48.5	44.7	50	643 688 9
FA..77, KA..77, SA..77	50	M16	5	12	43.5	13.5	53.5	49.7	50	643 689 7
FA..87, KA..87, SA..77, SA..87	60	M20	5	16	56	17.5	64	59.7	60	643 690 0
FA..97, KA..97, SA..87, SA..97	70	M20	5	16	65.5	19.5	74.5	69.7	60	643 691 9
FA..107, KA..107, SA..97	90	M24	5	20	80	24.5	95	89.7	70	643 692 7
FA..127, KA..127	100	M24	5	20	89	27.5	106	99.7	70	643 693 5
FA..157, KA..157	120	M24	5	20	107	31	127	119.7	70	643 694 3

1) Retaining bolt

The SEW assembly kit for mounting the customer shaft is a recommendation from SEW-EURODRIVE. You must always check whether this design can compensate the axial loads. In particular applications (e.g. mounting mixer shafts), a different design may have to be used to secure the shaft axially. In these cases, customers can use their own devices. However, you must ensure that these designs do not cause potential sources of combustion according to DIN EN 13463 (for example, impact sparks).

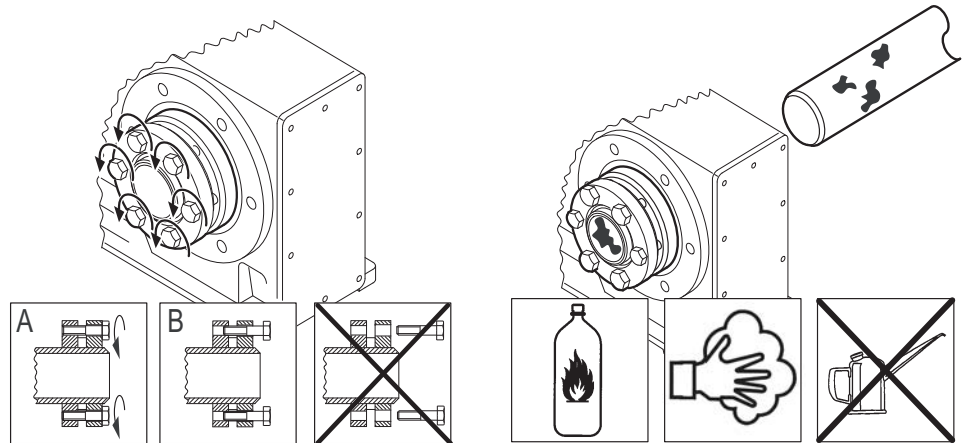


### 4.7 Mounted gear units with shrink disc

**Installation notes**

- Do not tighten the locking bolts unless the shaft is installed - the hollow shaft could become deformed!

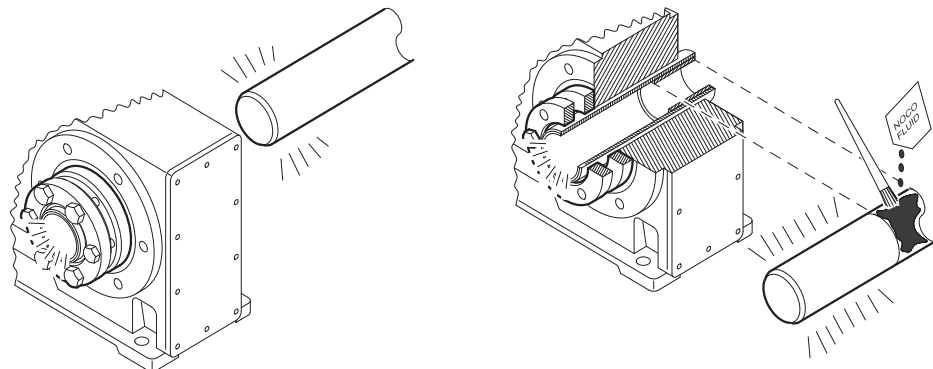
- Loosen the locking bolts by a few turns (do not unscrew them completely!).
- Carefully degrease the hollow shaft hole and the input shaft.



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- Hollow shaft/input shaft after degreasing
- Apply NOCO® fluid to the input shaft<sup>1)</sup> in the area of the bushing.



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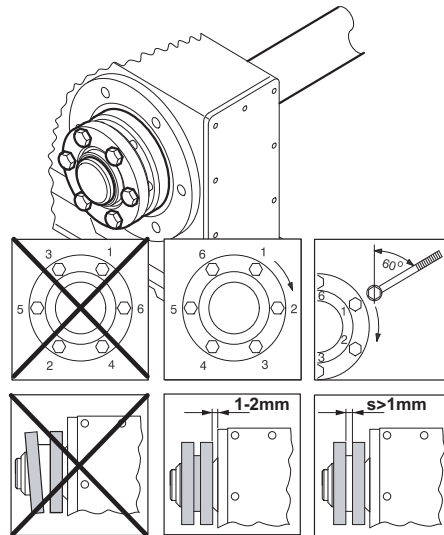
- It is essential to make sure that the clamping area of the shrink disc is free from grease!  
For this reason, never apply NOCO® fluid directly to the bushing as the paste may be able to get into the clamping area of the shrink disc when the input shaft is put on.



## Mechanical Installation

### Mounted gear units with shrink disc

5. Install the input shaft, making sure that the locking collars of the shrink disc are installed in parallel to each other<sup>2)</sup>. For gear unit housing **with a shaft collar**, mount the **shrink disc to the stop on the shaft collar**. For gear unit housing **without a shaft collar**, mount the **shrink disc with a clearance of 1 to 2 mm from the gear unit housing**. Tighten the locking bolts with the torque wrench by working round several times from one bolt to the next (not in diametrically opposite sequence) until the bolts cannot be tightened any more. See the following table for tightening torques.




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#### 2) After installation

- There must be a gap  $s > 1 \text{ mm}$  between the locking collars
- Grease the outside of the hollow shaft in the area of the shrink disc to prevent corrosion.

Gear unit type	Bolt	Nm (lb-in)	 max. <sup>1)</sup>
SH37	M5	5 Nm (44 lb-in)	60°
KH37...77 FH37...77 SH47...77	M6	12 Nm (106 lb-in)	
KH87/97 FH87/97 SH87/97	M8	30 Nm (265 lb-in)	
KH107 FH107	M10	59 Nm (522 lb-in)	
KH127/157 FH127	M12	100 Nm (885 lb-in)	
KH167	M16	250 Nm (2212 lb-in)	
KH187	M20	470 Nm (4159 lb-in)	

1) Maximum tightening angle per cycle



**Notes on removing the shrink disc**

1. Unscrew the locking bolts evenly one after the other. Each locking bolt may only be unscrewed by about one quarter turn in the initial cycle. This is in order to avoid tilting and jamming the locking collars. Do not fully unscrew the locking bolts!
2. Remove the shaft or pull the hub off the shaft. (You must first remove any rust that may have formed between the hub and the end of the shaft.)
3. Pull the shrink disc off the hub.



**Caution!**

Risk of injury if the shrink disc is not removed correctly!

**Cleaning and lubricating the shrink disc**

There is no need to strip down and re-grease disassembled shrink disks before they are screwed back on.

The shrink disc only needs to be cleaned and re-greased if it is contaminated.

Use one of the following solid lubricants for the tapered surfaces.

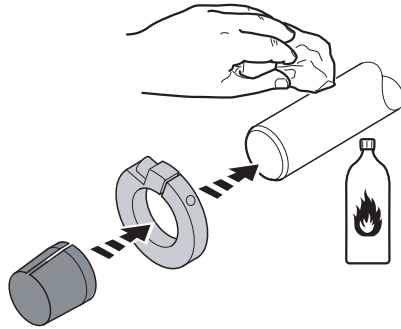
Lubricant (Mo S2)	Sold as
Molykote 321 (lube coat)	Spray
Molykote spray (powder spray)	Spray
Molykote G Rapid	Spray or paste
Aemasol MO 19P	Spray or paste
Aemasol DIO-sétral 57 N (lube coat)	Spray

Grease the locking bolts with a multipurpose grease such as Molykote BR 2 or similar.



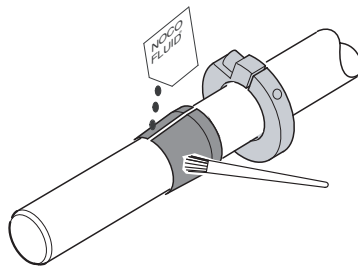
#### 4.8 Mounted gear units with TorqLOC®

1. Clean the inside of the hollow shaft and the customer shaft. Ensure that all traces of grease or oil are removed.
2. Install the split ring and the bushing on the customer shaft.



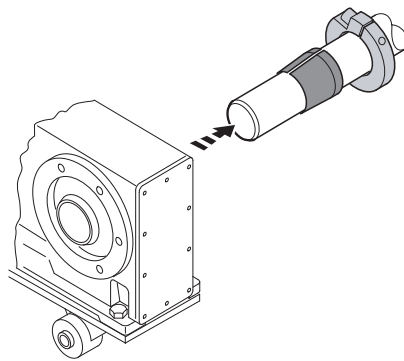
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3. Apply NOCO® fluid to the bushing and distribute it carefully.



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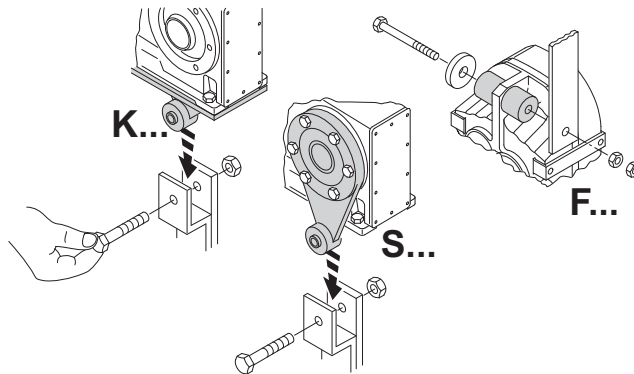
4. Push the gear unit onto the customer shaft.



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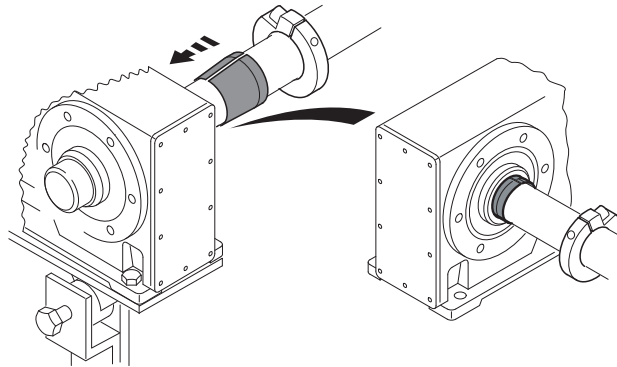


5. Preassemble the torque arm (do not tighten the bolts). Refer to "Torque arms for shaft mounted gear units" on page 21.



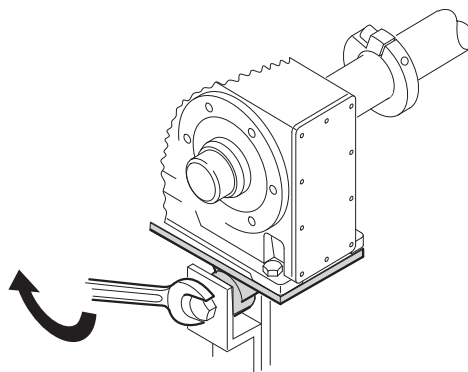
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6. Push the bushing onto the gear unit up to the stop.



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7. Tighten all the retaining bolts for the torque arm. Refer to "Torque arms for shaft mounted gear units" on page 21.



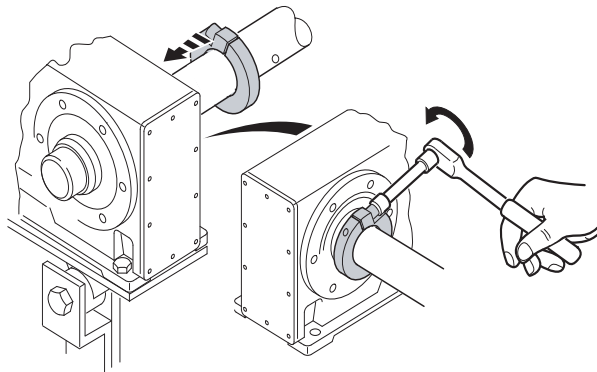
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## Mechanical Installation

### Mounted gear units with TorqLOC®

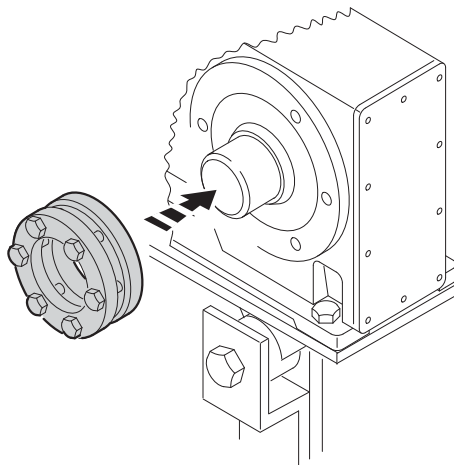
8. Secure the bushing with the split ring. Tighten the split ring on the bushing using the appropriate torque as specified in the following table.



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Type		Torque [Nm (lb-in)]	
KT/FT	ST	Steel	Stainless steel
-	37	18 (159)	7.5 (66)
37	47	18 (159)	7.5 (66)
47	57	18 (159)	7.5 (66)
57, 67	67	35 (309)	18 (159)
77	77	35 (309)	18 (159)
87	87	35 (309)	18 (159)
97	97	35 (309)	18 (159)

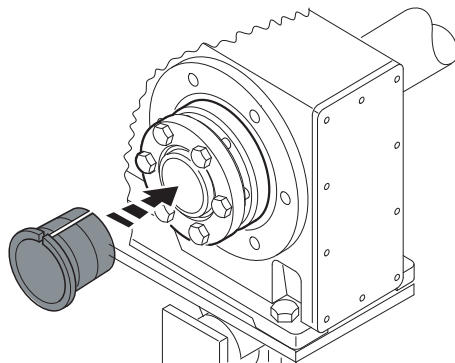
9. Slide the shrink disk onto the hollow shaft. Ensure that all bolts have been loosened.



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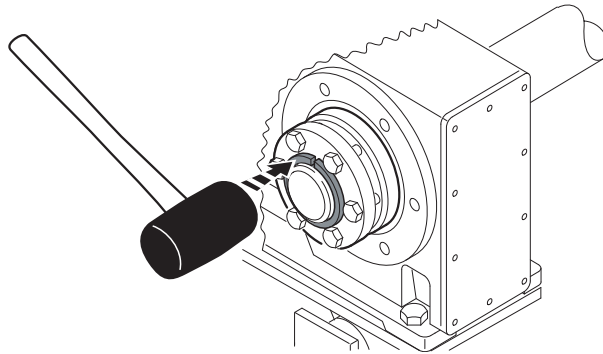


10. Push the counter bushing onto the customer shaft and into the hollow shaft or shrink disk right into the seat.



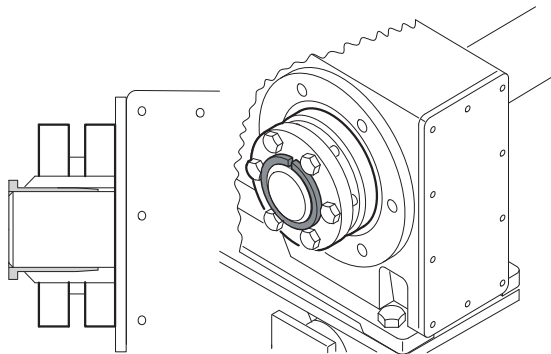
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11. Tap lightly on the flange of the counter bushing to ensure that the socket is fitted securely in the hollow shaft.



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12. Ensure that the customer shaft is fitted in the counter bushing.

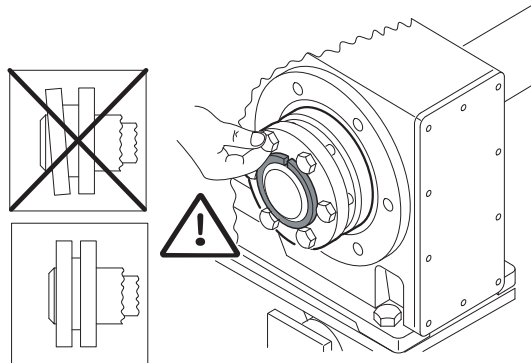


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**Mechanical Installation**  
 Mounted gear units with TorqLOC®

13. Tighten the bolts of the shrink disk by hand and ensure that the end rings of the shrink disk are parallel.

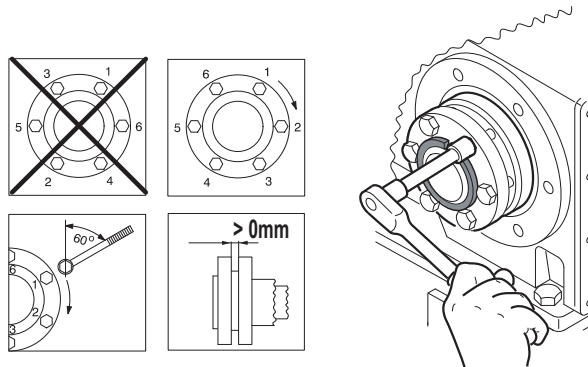


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14. Tighten the locking bolts by working round several times from one bolt to the next (not in diametrically opposite sequence). See the table for tightening torques.



**After installation, the remaining gap between the outer rings of the shrink discs must be > 0 mm.**

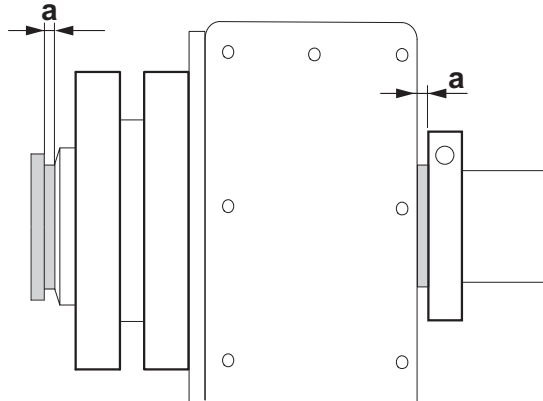


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Type		Steel	Stainless steel
KT/FT	ST	Torque [Nm (lb-in)]	
-	37	4.1 (36)	6.8 (60)
37	47	10 (89)	6.8 (60)
47	57	12 (106)	6.8 (60)
57, 67	67	12 (106)	15 (133)
77	77	30 (266)	30 (266)
87	87	30 (266)	50 (443)
97	97	30 (266)	50 (443)



15. The distance between the counter bushing and the hollow shaft end and between the split ring and the clamping ring must not exceed the following values. The following table lists the maximum and minimum gap width.



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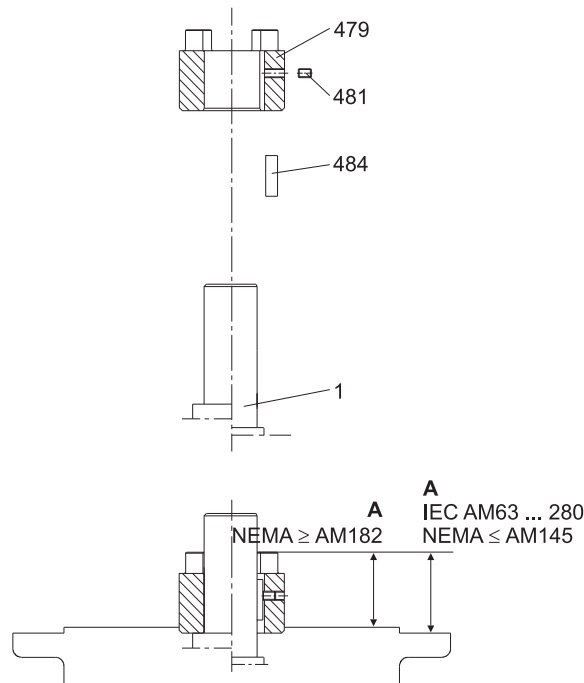
Type		Distance [mm (in)]	
KT/FT	ST	a min.	a max.
-	37	3.3 (0.130)	5.6 (0.220)
37	47	3.3 (0.130)	5.6 (0.220)
47	57	5.0 (0.197)	7.6 (0.299)
57, 67	67	5.0 (0.197)	7.6 (0.299)
77	77	5.0 (0.197)	7.6 (0.299)
87	87	5.8 (0.228)	8.6 (0.339)
97	97	5.8 (0.228)	8.6 (0.339)



#### 4.9 AM adapter coupling

IEC adapter AM63  
225 / NEMA  
adapter AM56  
365

04469CXX



1 = Motor shaft

1. Clean the motor shaft and flange surfaces of the motor and adapter.
2. Remove the key from the motor shaft and replace it with the supplied key (484) (not AM63 and AM250).
3. Heat the coupling half (479) to approx. 80 – 100 °C (176 – 212°F) and push the coupling half onto the motor shaft until stop at motor shaft shoulder (position to point **A** for AM250 / AM280 and NEMA).
4. Secure key and coupling half using set screw (481) and tightening torque  $T_A$  on motor shaft according to the table.
5. Check point **A**.
6. Seal the contact surfaces between the adapter and motor using a suitable sealing compound.
7. Mount the motor on the adapter. When doing this, make sure the coupling jaws of the adapter shaft engage the plastic spider.

IEC AM	uom	63 / 71	80 / 90	100 / 112	132	160 / 180	200	225	250 / 280
<b>A</b>	mm	24.5	31.5	41.5	54	76	78.5	93.5	139
	in	0.965	1.240	1.634	2.126	2.992	3.091	3.681	5.472
<b>T<sub>A</sub></b>	Nm	1.5	1.5	4.8	4.8	10	17	17	17
	lb-in	13.3	13.3	42.5	42.5	88.5	150	150	150
<b>Thread</b>		M4	M4	M6	M6	M8	M10	M10	M10
NEMA AM	uom	56	143 / 145	182 / 184	213 / 215	254 / 256	284 / 286	324 / 326	364 / 365
<b>A</b>	mm	46	43	55	63.5	78.5	85.5	107	107
	in	1.811	1.693	2.165	2.500	3.091	3.366	4.213	4.213
<b>T<sub>A</sub></b>	Nm	1.5	1.5	4.8	4.8	10	17	17	17
	lb-in	13.3	13.3	42.5	42.5	88.5	150	150	150
<b>Thread</b>		M4	M4	M6	M6	M8	M10	M10	M10



To avoid contact corrosion, we recommend applying NOCO® fluid to the motor shaft before mounting the coupling half.

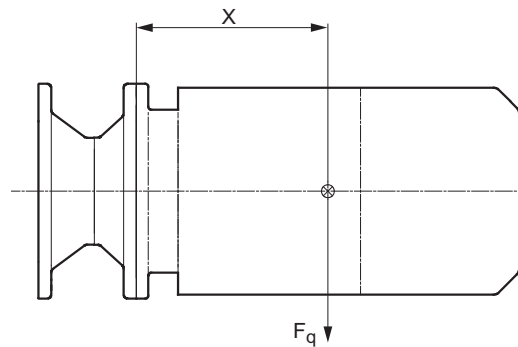


When installing a motor onto the adapter, you must use an anaerobic sealant to ensure that moisture cannot penetrate the adapter.

Permitted loads



The load data specified in the following table must not be exceeded when a motor is mounted.



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Adapter type		x <sup>1)</sup> [mm (in)]	F <sub>q</sub> <sup>1)</sup> [N (lb)]	
IEC	NEMA		IEC adapter	NEMA adapter
AM63/71	AM56	77 (3.03)	530 (119)	410 (92)
AM80/90	AM143/145	113 (4.45)	420 (94)	380 (85)
AM100/112	AM182/184	144 (5.67)	2000 (450)	1760 (396)
AM132 <sup>2)</sup>	AM213/215 <sup>2)</sup>	186 (7.32)	1600 (360)	1250 (281)
AM132..	AM213/215		4700 (1057)	3690 (830)
AM160/180	AM254/286	251 (9.88)	4600 (1034)	4340 (976)
AM200/225	AM324 - AM365	297 (11.69)	5600 (1259)	5250 (1180)
AM250/280	-	390 (15.35)	11200 (2518)	-

- 1) The maximum permitted weight of the attached motor  $F_{qmax}$  must be reduced proportionally as the distance between the adapter flange and the middle of the motor ( $x$ ) increases. When this distance is reduced, the maximum permitted weight  $F_{qmax}$  cannot be increased.
- 2) Diameter of the adapter drive flange: 160 mm (6.30 in)



## Mechanical Installation

### AQ adapter coupling

Adapter AM with  
backstop AM../RS

Check the direction of rotation of the drive before installation and startup. Please inform the SEW-EURODRIVE customer service if the direction of rotation is incorrect.

The backstop is maintenance-free in operation, and does not require any further maintenance work.

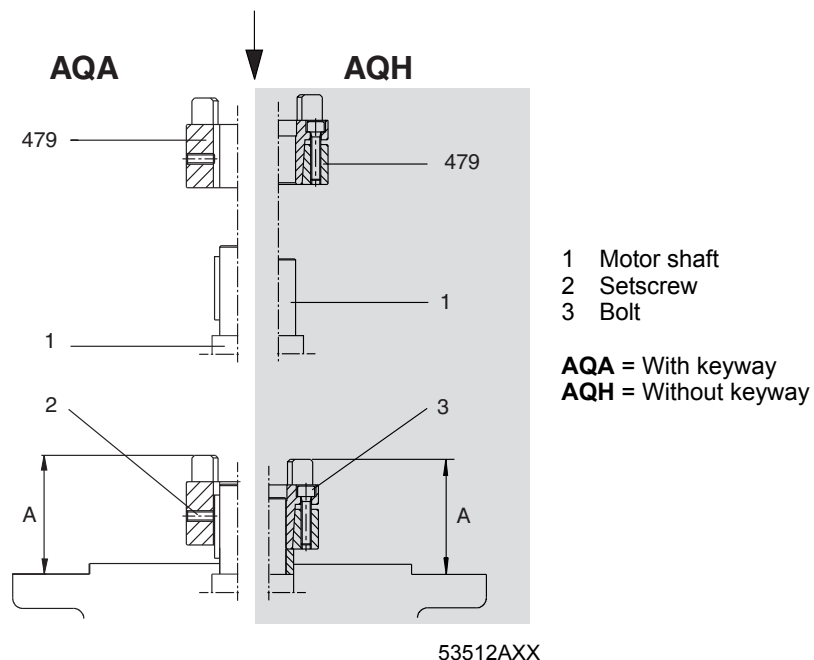
The backstops have a minimum lift-off speed depending on the size (→ following table). If the minimum lift-off speeds are violated, the backstops are subject to wear, and the resulting friction causes the temperature to increase.

Type	Maximum locking torque of backstop [Nm (lb-in)]	Minimum lift-off speed [rpm]
AM80/90/RS, AM143/145/RS	90 (797)	640
AM100/112/RS, AM182/184/RS	340 (3009)	600
AM132/RS, AM213/215/RS	700 (6195)	550
AM160/180/RS, AM254/286/RS	1200 (10620)	630
AM200/225/RS, AM324-365/RS	1450 (12832)	430



In rated operation, the lift-off speeds must not drop below the minimum values. The lift-off speeds are only permitted to drop below the minimum values during start-up or braking.

#### 4.10 AQ adapter coupling



1. Clean the motor shaft and flange surfaces of the motor and adapter.
2. **Type AQH:** Unscrew the bolts of the coupling half (479) and loosen the conical connection.
3. Heat the coupling half 80°C – 100°C (176°F – 212°F) and push it onto the motor shaft.

**Type AQA / AQH:** Up to clearance "A" (see table).



- Type AQH:** Tighten the bolts on the coupling half in diametrically opposite sequence (work round several times tightening the bolts evenly one after the other) until all bolts reach the tightening torque  $T_A$  specified in the table.

**Type AQA:** Use a setscrew to secure the coupling half (see table).

- Check the position of the coupling half (clearance "A", see table).

Install motor onto the adapter making sure that the dogs of the two coupling halves engage in each other. The force that must be applied when joining the two coupling halves is dissipated after final assembly, so there is no risk of any axial load being applied to adjacent bearings.



**Only for AQA, not permitted for AQH:** To avoid contact corrosion, we recommend applying NOCO<sup>®</sup> fluid to the motor shaft before mounting the coupling half.



**When installing a motor onto the adapter, you must use an anaerobic sealant to ensure that moisture cannot penetrate the adapter.**

**Setting dimensions, tightening torques**

Type	Coupling size	Clearance "A" [mm (in)]	Bolts DIN 912		Tightening torque $T_A$ [Nm (lb-in)]	
			AQA	AQH	AQA	AQH
AQA /AQH 80 /1/2/3	19/24	44.5 (1.75)	M5	M4	2 (17.7)	3 (26.5)
AQA /AQH 100 /1/2		39 (1.54)				
AQA /AQH 100 /3/4		53 (2.09)				
AQA /AQH 115 /1/2		62 (2.44)				
AQA /AQH 115 /3	24/28	62 (2.44)	M5	M5	2 (17.7)	6 (53.1)
AQA /AQH 140 /1/2		62 (2.44)				
AQA /AQH 140 /3	28/38	74.5 (2.93)	M8	M5	10 (88.5)	6 (53.1)
AQA /AQH 190 /1/2		76.5 (3.01)				
AQA /AQH 190 /3	38/45	100 (3.94)	M8	M6	10 (88.5)	10 (88.5)

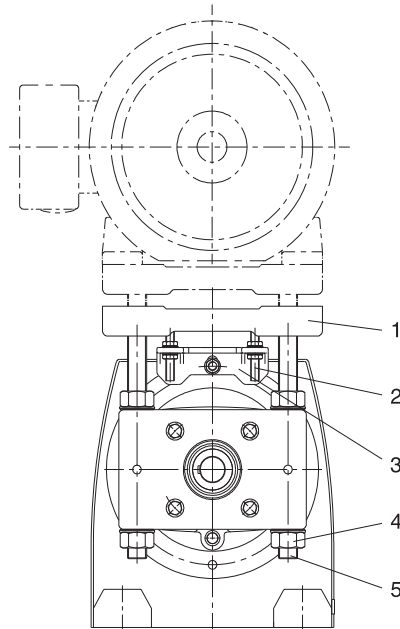


#### 4.11 AD input shaft assembly

Please refer to Sec. "Installing input and output shafts" for information on mounting of input elements.

**Cover with motor mounting platform AD../P**

Mounting the motor and adjusting the motor mounting platform.



- 1 Motor mounting platform
- 2 Stud bolt (only AD6/P / AD7/P)
- 3 Support (only AD6/P / AD7/P)
- 4 Nut
- 5 Threaded column

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1. Set the motor mounting platform to the required mounting position by evenly tightening the adjusting nuts. It may be necessary to remove the lifting eyebolt from helical gear units in order to achieve the lowest adjustment position. Touch up any damage to the paint work.
2. Align the motor on the motor mounting platform (shaft ends must be in alignment) and secure it.
3. Mount the input elements on the input shaft end and the motor shaft. Line them up with one another. Correct the motor position again if necessary.
4. Put on traction elements (V-belt, chain, etc.) and apply a preload by evenly adjusting the motor mounting platform. Do not stress the motor mounting platform and the columns against one another when doing this.
5. Tighten the threaded columns using the nuts which are not used for adjustment.

**Only AD6/P and AD7/P:**

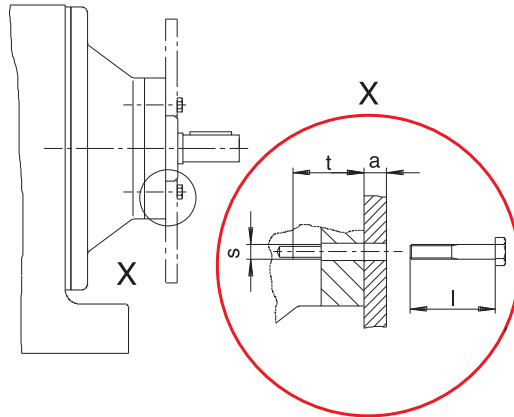
Unscrew the nuts on the stud bolts before adjustment to allow the stud bolts to move axially in the support without restriction. Do not tighten the nuts until the final adjustment position has been achieved. Do not adjust the motor mounting platform using the support.



**Type with centering shoulder  
AD../ZR**

Mounting applications on the input shaft assembly with centering shoulder.

1. Retaining bolts of a suitable length must be used to secure the application. The length  $l$  of the new bolts is calculated as follows:



$l = t + a$   
 $t$  = Screw-in depth (see table)  
 $a$  = Thickness of the application  
 $s$  = Retaining thread (see table)

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**Round down the calculated bolt length to the next smaller standard length.**

2. Remove the retaining bolts from the centering shoulder.
3. Clean the contact surface and the centering shoulder.
4. Clean the threads of the new bolts and apply a bolt locking compound (e.g. Loctite 243) to the first few threads.
5. Position the application against the centering shoulder and tighten the retaining bolts to the specified tightening torque  $T_A$  (see table).

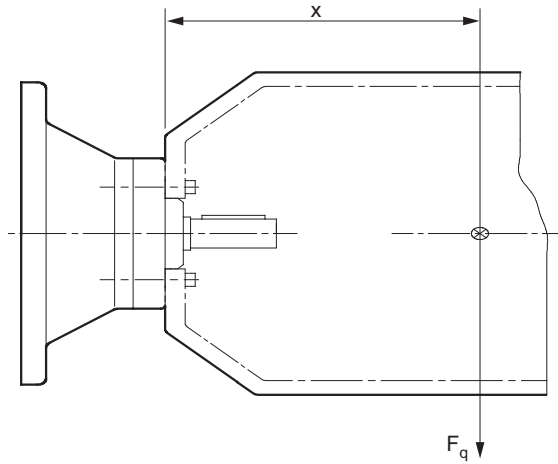
Type	Screw-in depth $t$ [mm (in)]	Retaining thread $s$	Tightening torque $T_A$ for connection bolts in strength class 8.8 [Nm (lb-in)]
AD2/ZR	25.5 (1.00)	M8	25 (221)
AD3/ZR	31.5 (1.24)	M10	48 (425)
AD4/ZR	36 (1.42)	M12	86 (761)
AD5/ZR	44 (1.73)	M12	86 (761)
AD6/ZR	48.5 (1.91)	M16	210 (1859)
AD7/ZR	49 (1.93)	M20	410 (3629)
AD8/ZR	42 (1.65)	M12	86 (761)



#### Permitted loads



The load values specified in the following table must not be exceeded.



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Type	$x^1$ [mm (in)]	$F_q^1$ [N (lb)]
AD2/ZR	193 (7.60)	330 (74)
AD3/ZR	274 (10.79)	1400 (315)
AD4/ZR <sup>2)</sup>	361 (14.21)	1120 (252)
AD4/ZR		3300 (742)
AD5/ZR	487 (19.17)	3200 (719)
AD6/ZR	567 (22.32)	3900 (877)
AD7/ZR	663 (26.10)	10000 (2248)
AD8/ZR	516 (20.31)	4300 (967)

1) Maximum load values for connection bolts in strength class 8.8. The maximum permitted weight of the attached motor  $F_{qmax}$  must be reduced proportionally as the distance between the adapter flange and the middle of the motor ( $x$ ) increases. When this distance is reduced, the  $F_{qmax}$  cannot be increased.

2) Diameter of the adapter output flange: 160 mm (6.30 in)



**Cover with backstop AD../RS**

Check the direction of rotation of the drive before installation and startup. Please inform the SEW-EURODRIVE customer service if the direction of rotation is incorrect.

The backstop is maintenance-free in operation, and does not require any further maintenance work.

The backstops have a minimum lift-off speed depending on the size (→ following table). If the minimum lift-off speeds are violated, the backstops are subject to wear, and the resulting friction causes the temperature to increase.

Type	Maximum locking torque of backstop [Nm (lb-in)]	Minimum lift-off speed [rpm]
AD2/RS	90 (797)	640
AD3/RS	340 (3009)	600
AD4/RS	700 (6195)	550
AD5/RS	1200 (10620)	630
AD6/RS	1450 (12833)	430
AD7/RS	1450 (12833)	430
AD8/RS	2860 (25311)	430



**In rated operation, the lift-off speeds must not drop below the minimum values. The lift-off speeds are only permitted to drop below the minimum values during start-up or braking.**



## Startup

### Startup of helical-worm and SPIROPLAN® W gear units

## 5 Startup



Prior to startup check that the oil level is as specified for the mounting position. The oil checking and drain screws and the breather valves must be freely accessible.

### 5.1 Startup of helical-worm and SPIROPLAN® W gear units



Note: The direction of rotation of the output shaft in series S..7 helical-worm gear units has been changed from CW to CCW; this is different from the S..2 series. Change direction of rotation: Swap over two motor feeder cables.

#### Run-in period

SPIROPLAN® and helical-worm gear units require a run-in period of at least 24 hours before reaching their maximum efficiency. A separate run-in period applies for each direction of rotation if the gear unit is operated in both directions of rotation. The table shows the average power reduction during the run-in period.

No. of starts	Worm		Spiroplan®	
	Power reduction	i range	Power reduction	i range
1 start	ca. 12 %	ca. 50...280	ca. 15 %	approx. 40 ... 75
2 start	ca. 6 %	ca. 20...75	ca. 10 %	ca. 20...30
3 start	ca. 3 %	ca. 20...90	ca. 8 %	ca. 15
4 start	-	-	ca. 8 %	ca. 10
5 start	ca. 3 %	ca. 6...25	ca. 5 %	ca. 8
6 start	ca. 2 %	ca. 7...25	-	-

### 5.2 Startup of helical, parallel shaft helical and helical-bevel gear units

No special startup instructions are required for helical, parallel shaft helical and helical-bevel gear units providing the gear units have been installed in accordance with Sec. "Mechanical Installation".

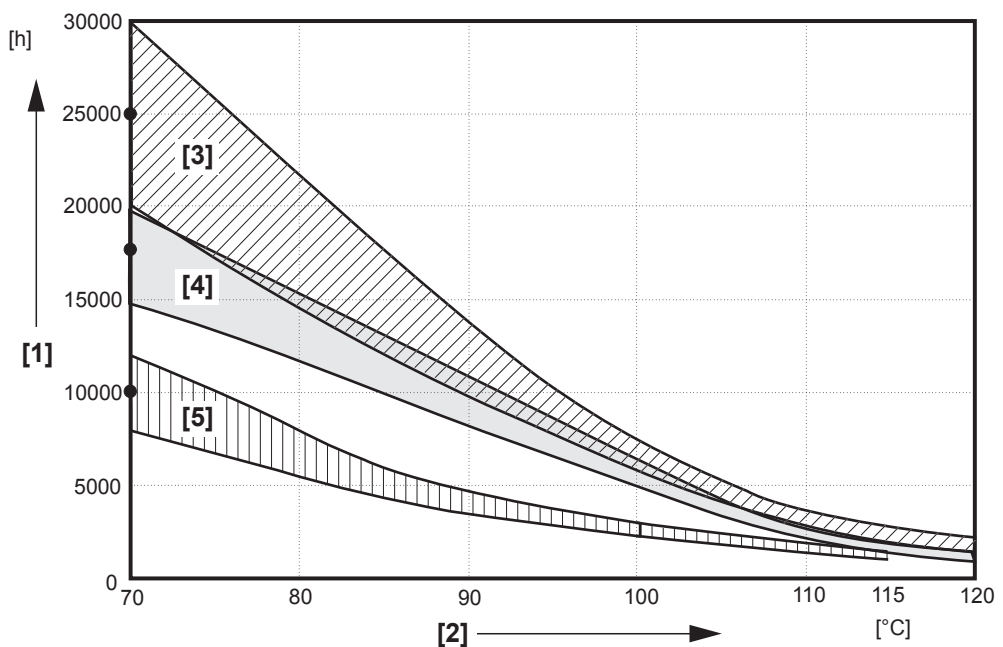


## 6 Inspection and Maintenance

### 6.1 Inspection and maintenance intervals

Frequency	What to do?
<ul style="list-style-type: none"> <li>Every 3000 machine hours, at least every 6 months.</li> </ul>	<ul style="list-style-type: none"> <li>Check oil and oil level.</li> <li>Check the seals visually for leakage.</li> <li>For gear units with a torque arm: Check the rubber buffer and change it, if necessary</li> </ul>
<ul style="list-style-type: none"> <li>Depending on the operating conditions (see chart below), every 3 years at the latest.</li> <li>According to oil temperature.</li> </ul>	<ul style="list-style-type: none"> <li>Change mineral oil.</li> <li>Replace anti-friction bearing grease (recommendation).</li> <li>Replace oil seal (do not install it in the same track).</li> </ul>
<ul style="list-style-type: none"> <li>Depending on the operating conditions (see chart below), every 5 years at the latest.</li> <li>According to oil temperature.</li> </ul>	<ul style="list-style-type: none"> <li>Change synthetic oil</li> <li>Replace anti-friction bearing grease (recommendation).</li> <li>Replace oil seal (do not install it in the same track).</li> </ul>
<ul style="list-style-type: none"> <li>Gear units R07, R17, R27, F27 and Spiroplan® are have lubrication for life and are therefore maintenance-free</li> </ul>	
<ul style="list-style-type: none"> <li>Varying (depending on external factors).</li> </ul>	<ul style="list-style-type: none"> <li>Touch up or renew the surface/anticorrosion coating.</li> </ul>

### 6.2 Lubricant change intervals



53232AXX

Figure 13: Oil change intervals for standard gear units under normal environmental conditions

[1] Operating hours

[2] Sustained oil bath temperature

- Average value per oil type at 70 °C

[3] CLP PG

[4] CLP HC / HCE 

[5] CLP / HLP / E 



#### 6.3 Inspection and maintenance of the gear unit

Do not intermix synthetic lubricants and do not mix synthetic and mineral lubricants together!

The standard lubricant is mineral oil (except for Spiroplan® gear units).

**The position of the oil level and oil drain plug and the breather valve depends on the mounting position. Refer to the diagrams of the mounting positions.**

##### Checking the oil level



1. **De-energize the gearmotor and secure it to prevent it from being switched on inadvertently!**

**Wait until the gear unit has cooled off – Danger of burns!**

2. Refer to Sec. "Installing the gear unit" when changing the mounting position!
3. For gear units with an oil level plug: Remove the oil level plug, check the fill level and correct it if necessary. Screw the oil level plug back in.

##### Checking the oil



1. **De-energize the gearmotor and secure it to prevent it from being switched on inadvertently!**

**Wait until the gear unit has cooled off – Danger of burns!**

2. Remove a little oil from the oil drain plug.
3. Check the oil consistency.
  - Viscosity
  - If you can see that the oil is heavily contaminated, we recommend that you change the oil even if this is outside the service intervals specified in "Inspection and maintenance periods".
4. For gear units with an oil level plug: Remove the oil level plug, check the fill level and correct it if necessary. Screw the oil level plug back in.

##### Changing the oil



Only change the oil when the gear unit is at operating temperature.

**De-energize the gearmotor and secure it to prevent it from being switched back on inadvertently!**

**Wait until the gear unit cools down - Danger of burns!**

**Note: The gear unit must still be warm otherwise the high viscosity of excessively cold oil will make it harder to drain the oil correctly.**

*With oil drain plug /  
oil level screw*

1. Place a container underneath the oil drain plug
2. Remove the oil level plug, breather plug/breather valve and oil drain plug.
3. Drain all the oil.
4. Screw in the oil drain plug.
5. Pour in new oil of the same type through the vent hole (if changing the oil type, please first contact our customer service). Do not mix synthetic lubricants.
  - Pour in the volume of oil in accordance with the mounting position (see Sec. "Lubricant fill quantities") or as specified on the nameplate.
  - Check at the oil level plug.
6. Screw the oil level plug back in
7. Screw in the breather plug/breather valve.



*Without oil drain plug / oil level plug*

1. Remove cover plate.
2. Drain the oil through the cover plate opening.
3. Pour in new oil of the same type through the vent hole (if changing the oil type, please first contact our customer service). Do not mix synthetic lubricants.
  - Pour in the volume of oil in accordance with the mounting position (see Sec. "Lubricant fill quantities") or as specified on the nameplate.
4. Check the oil level (→ Sec. "Check oil level for gear units with oil level plug")
5. Attach cover plate (observe the tightening torque and series → Sec. "Check the oil level for gear units without an oil level plug")

**Changing the oil seal**



1. **De-energize the gearmotor and secure it to prevent it from being switched on inadvertently!**  
**Wait until the gear unit has cooled off – Danger of burns!**
2. When changing the oil seal, ensure that there is a sufficient grease reservoir between the dust lip and protective lip, depending on the type of gear unit.
3. If you use double oil seals, the space has to be filled one-third with grease.

**6.4 Inspection / maintenance of AM / AQA adapters**

Frequency	What to do?
<ul style="list-style-type: none"> <li>• Every 3000 machine hours, at least every 6 months</li> </ul>	<ul style="list-style-type: none"> <li>• Check torsional play</li> <li>• Visually check the elastic annular gear</li> <li>• Check the adapter visually for leakage</li> </ul>
<ul style="list-style-type: none"> <li>• After 25000 - 30000 machine hours</li> </ul>	<ul style="list-style-type: none"> <li>• Renew the anti-friction bearing grease</li> <li>• Replace oil seal (do not install it in the same track)</li> <li>• Change the elastic coupling spider</li> </ul>

**6.5 Inspection / maintenance of AD adapters**

Frequency	What to do?
<ul style="list-style-type: none"> <li>• Every 3000 machine hours, at least every 6 months</li> </ul>	<ul style="list-style-type: none"> <li>• Check running noise for possible bearing damage</li> <li>• Check the adapter visually for leakage</li> </ul>
<ul style="list-style-type: none"> <li>• After 25000 - 30000 machine hours</li> </ul>	<ul style="list-style-type: none"> <li>• Renew the anti-friction bearing grease</li> <li>• Change the oil seal</li> </ul>



## 7 Malfunctions

### Customer service

**Please have the following information to hand if you require the assistance of our customer service:**

- Data from the nameplate (complete)
- Nature and extent of the fault
- Time and peripheral circumstances of the fault
- Presumed cause

### 7.1 Gear unit malfunctions

Problem	Possible cause	Remedy
Unusual, regular running noise	A Meshing/grinding noise: Bearing damage. B Knocking noise: Irregularity in the gearing	A Check the oil (see Sec. "Inspection and Maintenance"), change bearings B Contact customer service
Unusual, irregular running noise	Foreign bodies in the oil	<ul style="list-style-type: none"> <li>• Check the oil (see Sec. "Inspection and Maintenance")</li> <li>• Stop the drive, contact customer service</li> </ul>
Oil leaking <sup>1)</sup> <ul style="list-style-type: none"> <li>• From the gear cover plate</li> <li>• From the motor flange</li> <li>• From the motor oil seal</li> <li>• From the gear unit flange</li> <li>• From the output end oil seal</li> </ul>	A Rubber seal on the gear cover plate leaking B Seal defective C Gear unit not vented	A Tighten the bolts on the gear cover plate and observe the gear unit. Oil still leaking: Contact customer service B Contact customer service C Vent the gear unit (see Sec. "Mounting Positions")
Oil leaking from breather valve	A Too much oil B Drive operated in incorrect mounting position C Frequent cold starts (oil foams) and/or high oil level	A Correct the oil level (see Sec. "Inspection and Maintenance") B Mount the breather valve correctly (see Sec. "Mounting Positions") and correct the oil level (see "Lubricants")
Output shaft does not turn although the motor is running or the input shaft is rotated	Connection between shaft and hub in gear unit interrupted	Send in the gear unit/gearmotor for repair

1) Short-term oil/grease leakage at the oil seal is possible in the run-in phase (24 hours running time).

### 7.2 AM / AQA / AL adapter malfunctions

Problem	Possible cause	Remedy
Unusual, regular running noise	Meshing/grinding noise: Bearing damage	Contact SEW-EURODRIVE customer service
Oil leaking	Seal defective	Contact SEW-EURODRIVE customer service
Output shaft does not turn although the motor is running or the input shaft is rotated	Connection between shaft and hub in gear unit interrupted	Send the gear unit to SEW-EURODRIVE for repair.
Change in running noise and / or vibrations occur	A Annular gear wear, short-term torque transfer through metal contact B Bolts to secure hub axially are loose.	A Change the coupling spider B Tighten the bolts
Premature wear in annular gear	A Contact with aggressive fluids / oil; ozone influence; too high ambient temperatures etc, which can cause a change in the physical properties of the annular gear. B Impermissibly high ambient/contact temperature for the annular gear; maximum permitted temperature –20 °C to +80 °C. C Overload	Contact SEW-EURODRIVE customer service



### 7.3 AD input shaft assembly malfunctions

Problem	Possible cause	Remedy
Unusual, regular running noise	Meshing/grinding noise: Bearing damage.	Contact SEW-EURODRIVE customer service
Oil leaking	Seal defective	Contact SEW-EURODRIVE customer service
Output shaft does not turn although the input shaft is rotated.	Connection between shaft and hub in gear unit or cover interrupted	Send the gear unit to SEW-EURODRIVE for repair.



## 8.2 Key to the mounting position sheets



SPIROPLAN® gearmotors do not depend on any particular mounting position. However, mounting positions M1 to M6 are also shown for SPIROPLAN® gearmotors to assist you in working with this documentation.

**Important:** SPIROPLAN® gearmotors cannot be equipped with breather valves, oil level plugs or drain plugs.

### Symbols used

The following table shows the symbols used in the mounting position sheets and what they mean:

Symbol	Meaning
	Breather valve
	Oil level plug
	Oil drain plug

### Churning losses



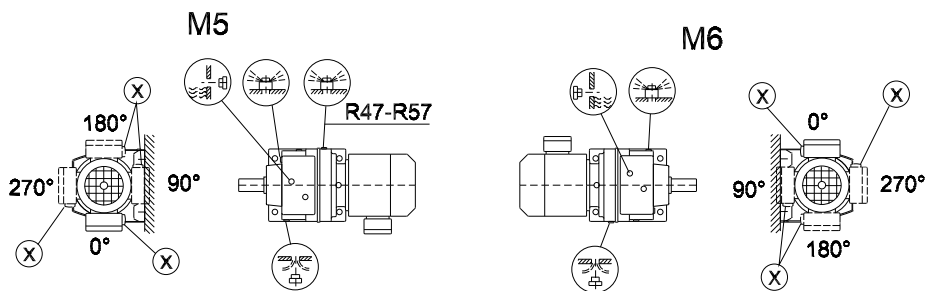
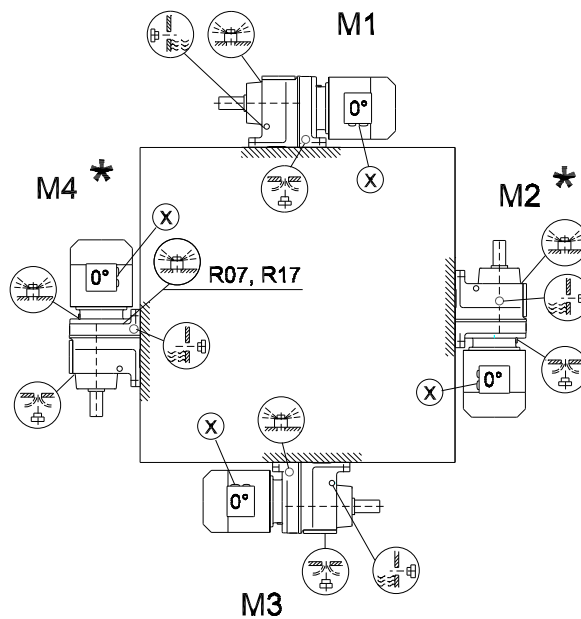
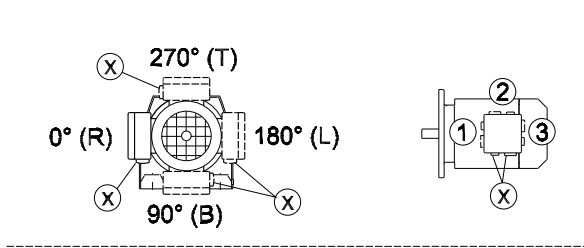
Increased churning losses may arise in some mounting positions. Contact SEW-EURODRIVE in case of the following combinations:

Mounting position	Gear unit type	Gear unit size	Input speed [rpm]
<b>M2, M4</b>	R	97 ... 107	> 2500
		> 107	> 1500
<b>M2, M3, M4, M5, M6</b>	F	97 ... 107	> 2500
		> 107	> 1500
	K	77 ... 107	> 2500
		> 107	> 1500
	S	77 ... 97	> 2500

**8.3 Mounting positions for R helical gearmotors**

R07-R167

04 040 200

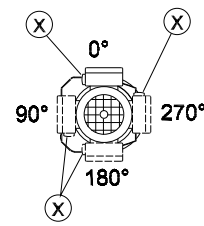
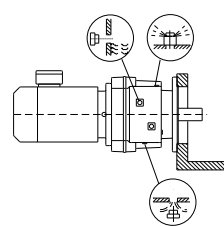
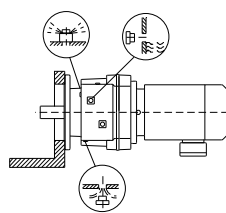
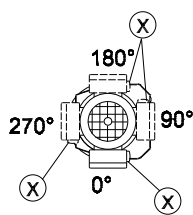
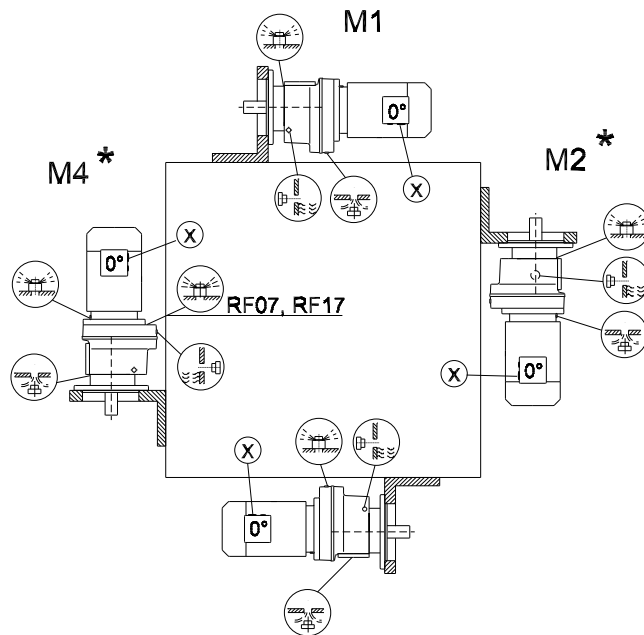
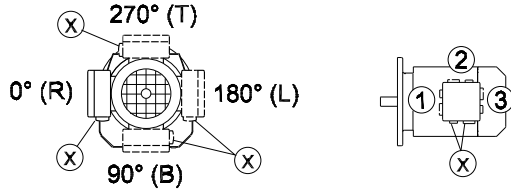


R07		M1, M2, M3, M5, M6
R17, R27		M1, M3, M5, M6
R07, R17, R27		
R47, R57		M5

\* → page 51

RF07-RF167

04 041 200



RF07		M1, M2, M3, M5, M6
RF17, RF27		M1, M3, M5, M6
RF07, RF17, RF27		
RF47, RF57		M5

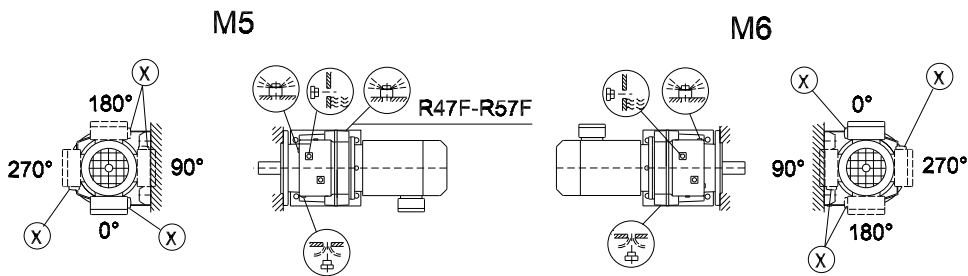
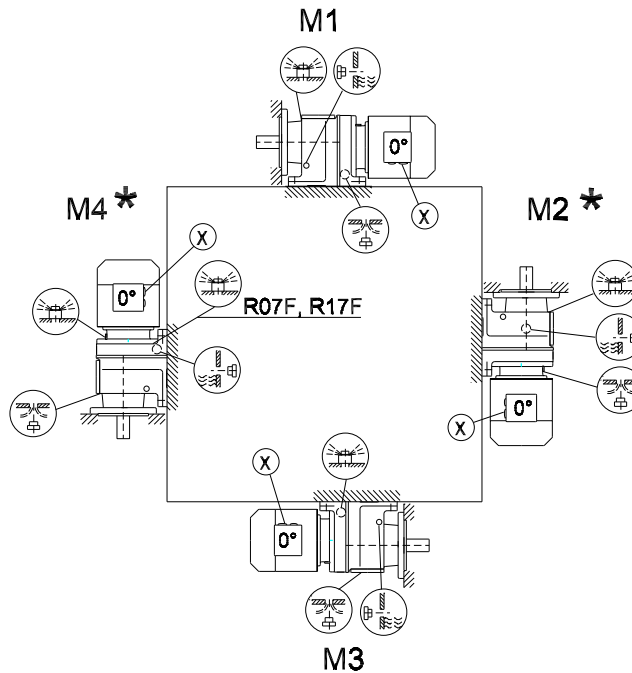
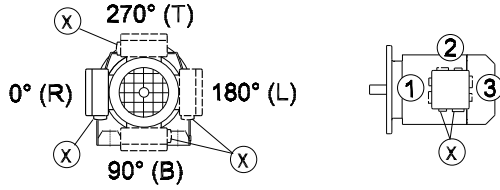
\* → page 51

# Mounting Positions

## Mounting positions for R helical gearmotors

R07F-R87F

04 042 200



R07F		M1, M2, M3, M5, M6
R17F, R27F		M1, M3, M5, M6
R07F, R17F, R27F		
R47F, R57F		M5

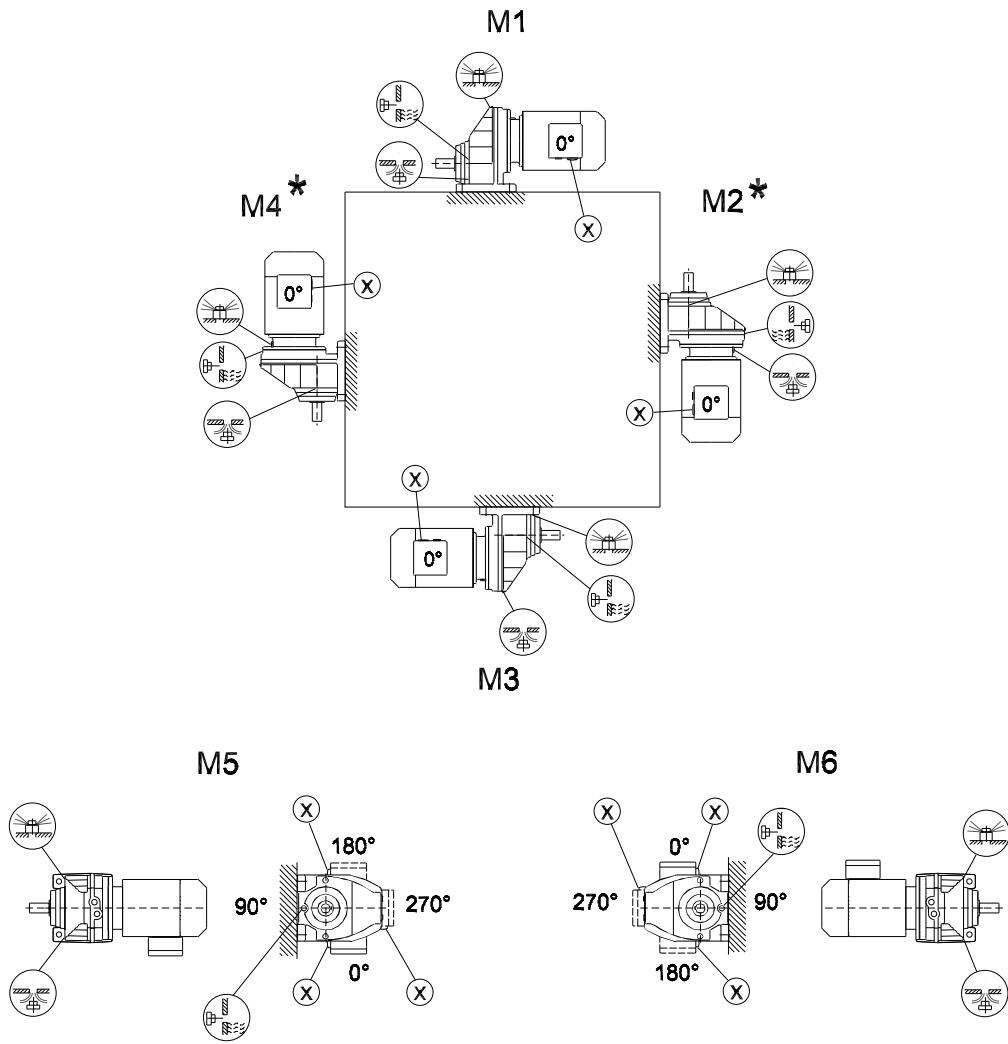
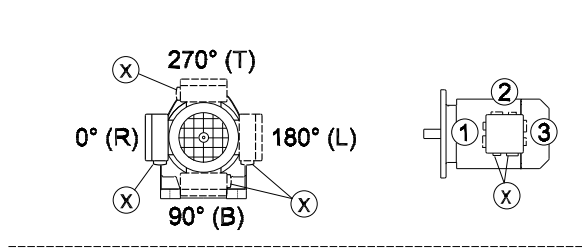
\* → page 51

**Important:** See the information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

8.4 Mounting positions of RX helical gearmotors

RX57-RX107

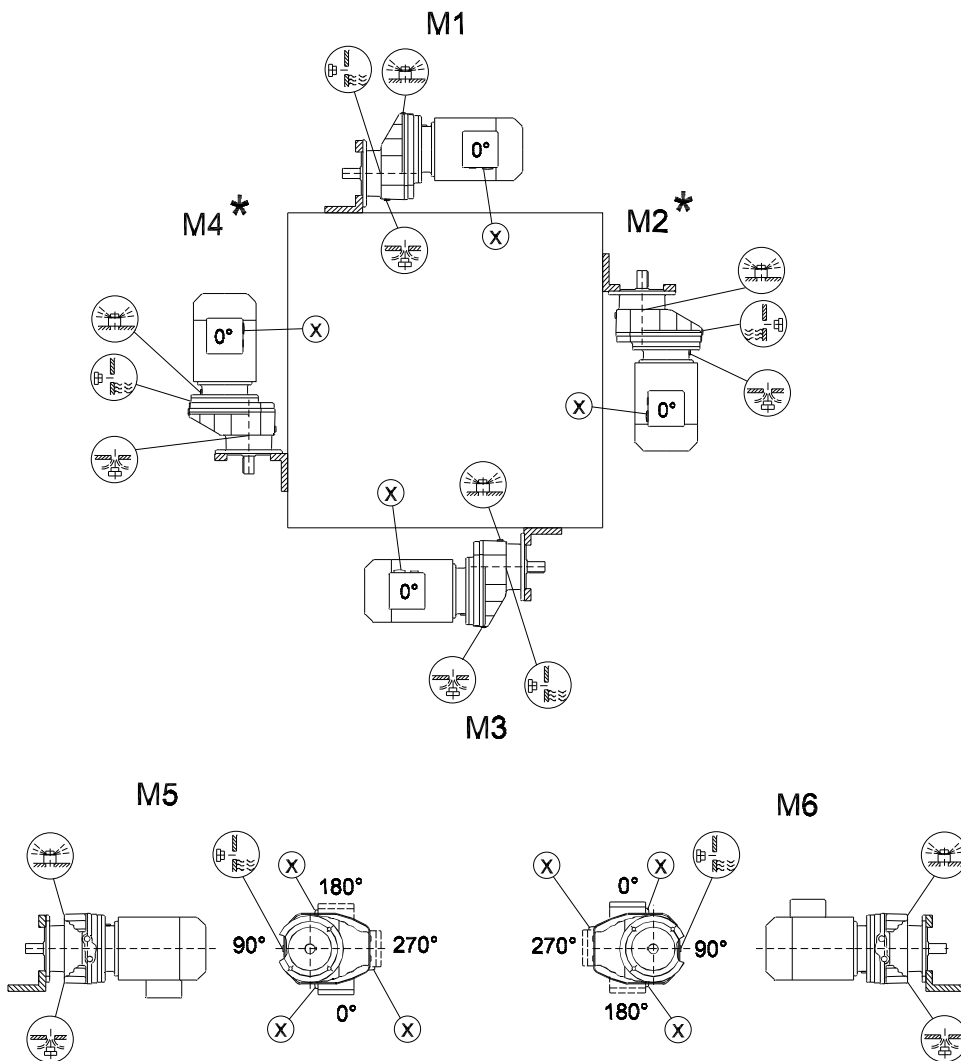
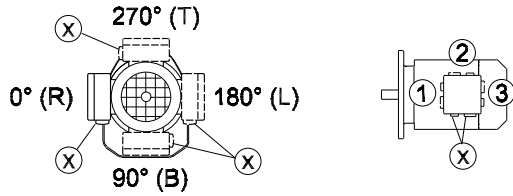
04 043 200



\* → page 51

RXF57 - RXF107

04 044 200

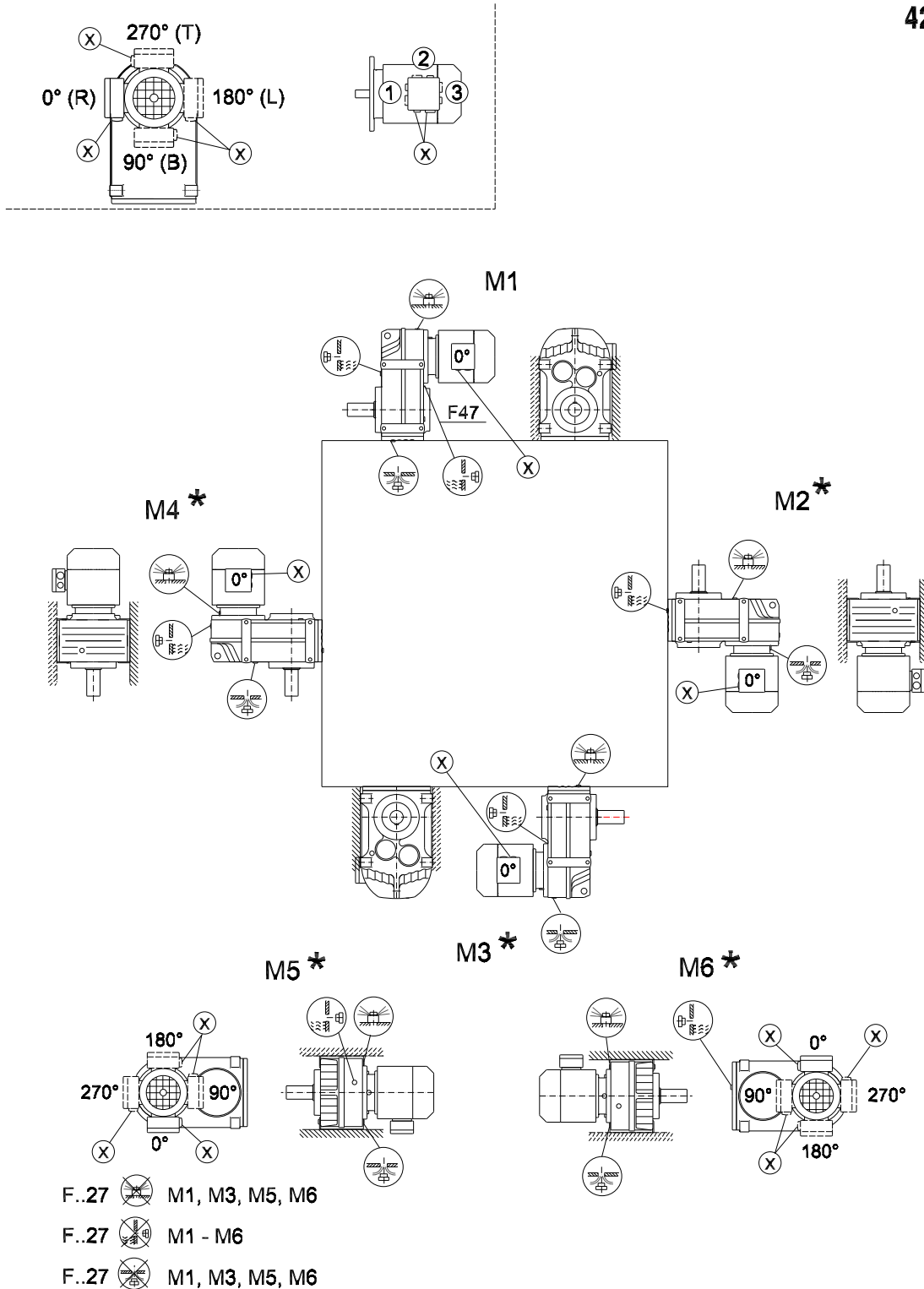


\* → page 51

8.5 Mounting positions for parallel shaft helical gearmotors

F/FA..B/FH27B-157B, FV27B-107B

42 042 200



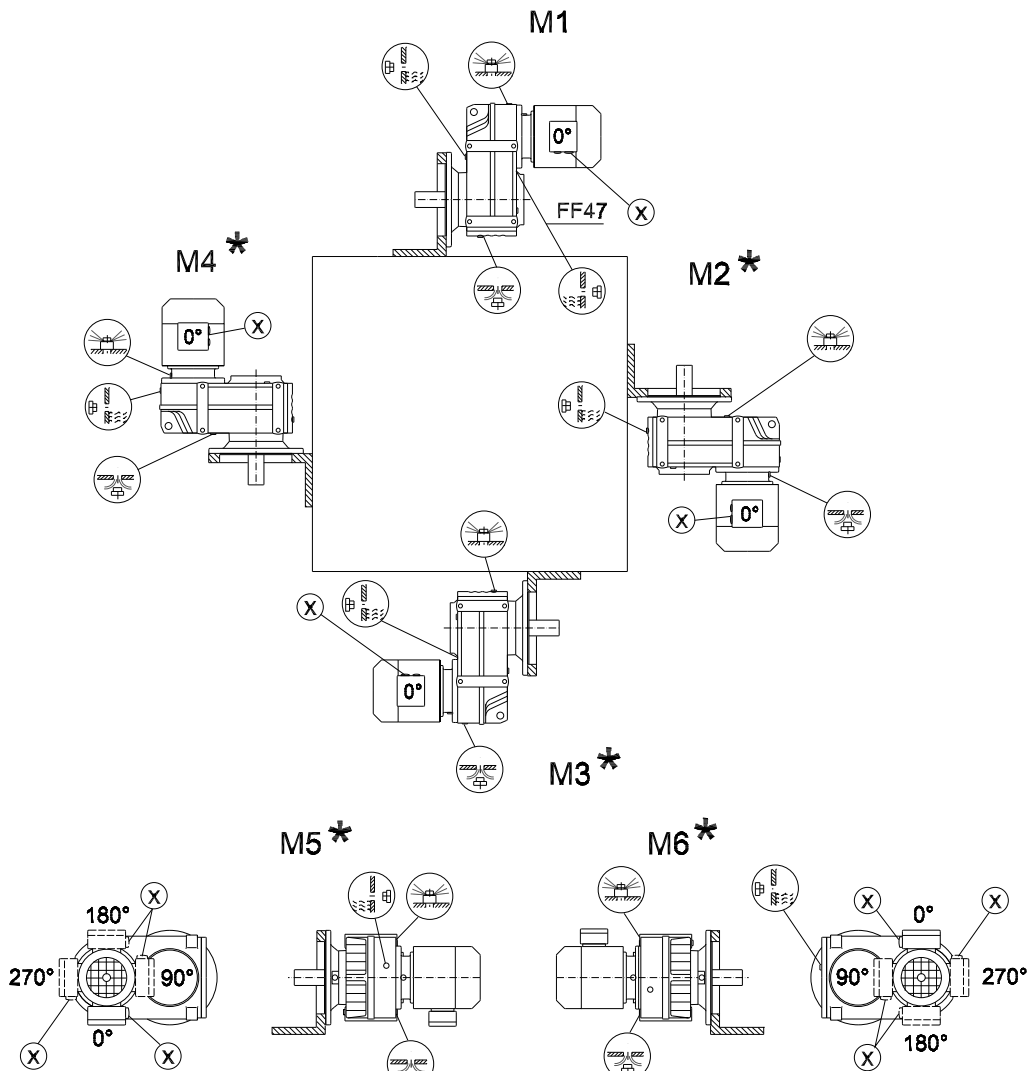
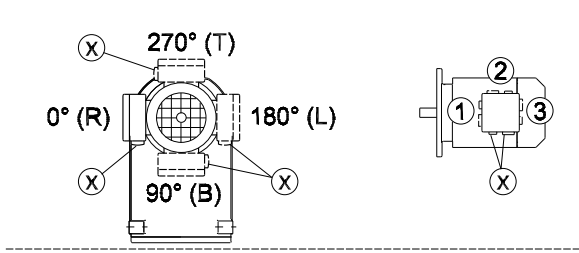
\* → page 51

**Mounting Positions**

Mounting positions for parallel shaft helical gearmotors

FF/FAF/FHF/FAZ/FHZ27-157, FVF/FVZ27-107

42 043 200

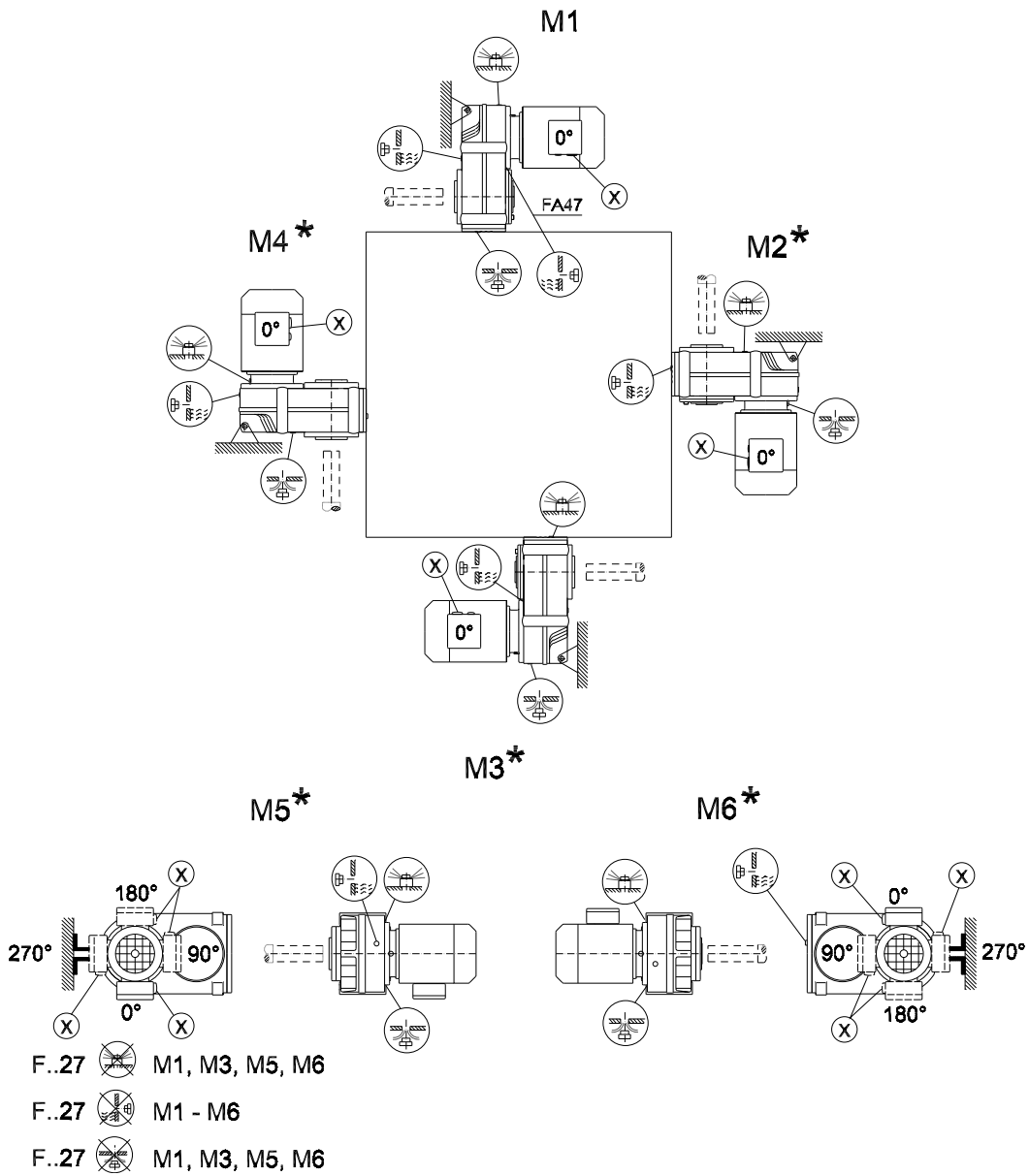
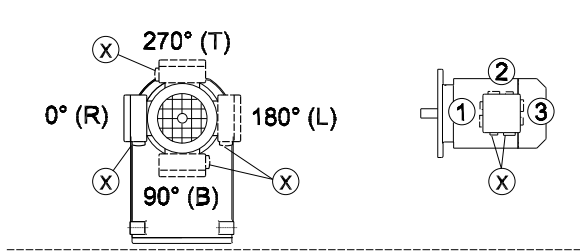


- F..27 M1, M3, M5, M6
- F..27 M1 - M6
- F..27 M1, M3, M5, M6

\* → page 51

FA/FH27-157, FV27-107, FT37-97

42 044 200

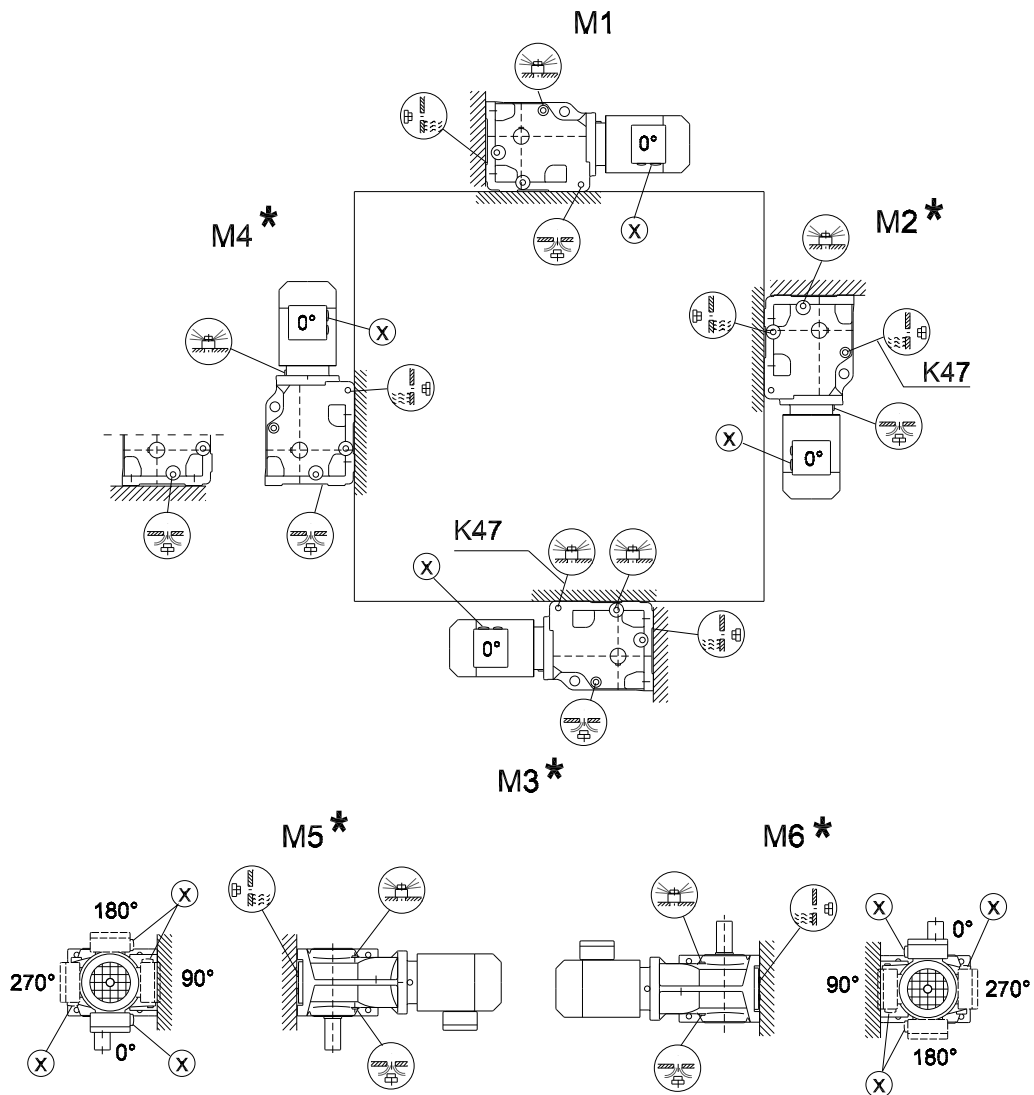
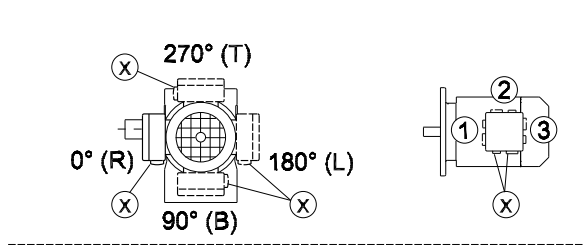


\* → page 51

8.6 Mounting positions for helical-bevel gearmotors

K/KA..B/KH37B-157B, KV37B-107B

34 025 200

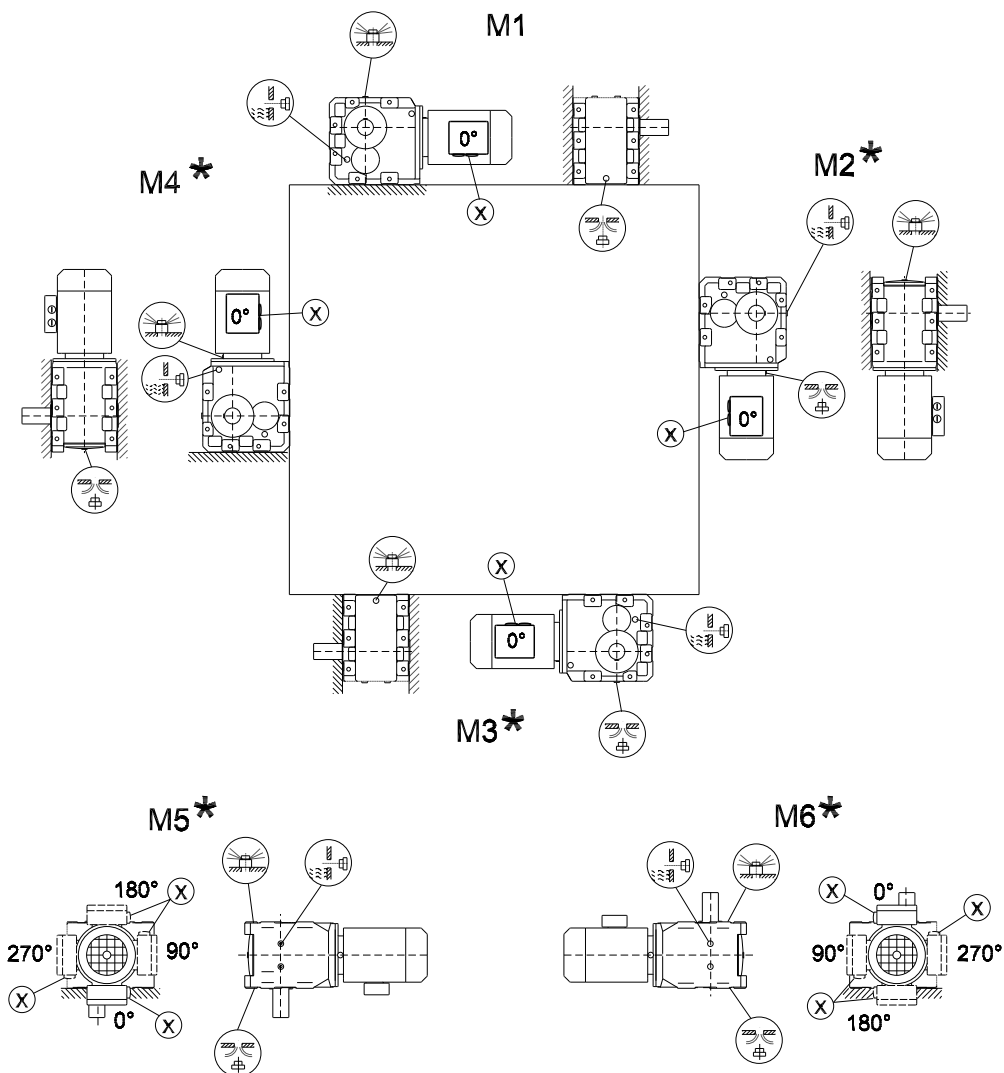
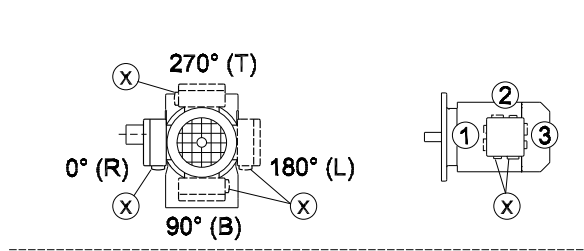


\* → page 51

**Important:** See the information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

K167-187, KH167B-187B

34 026 200



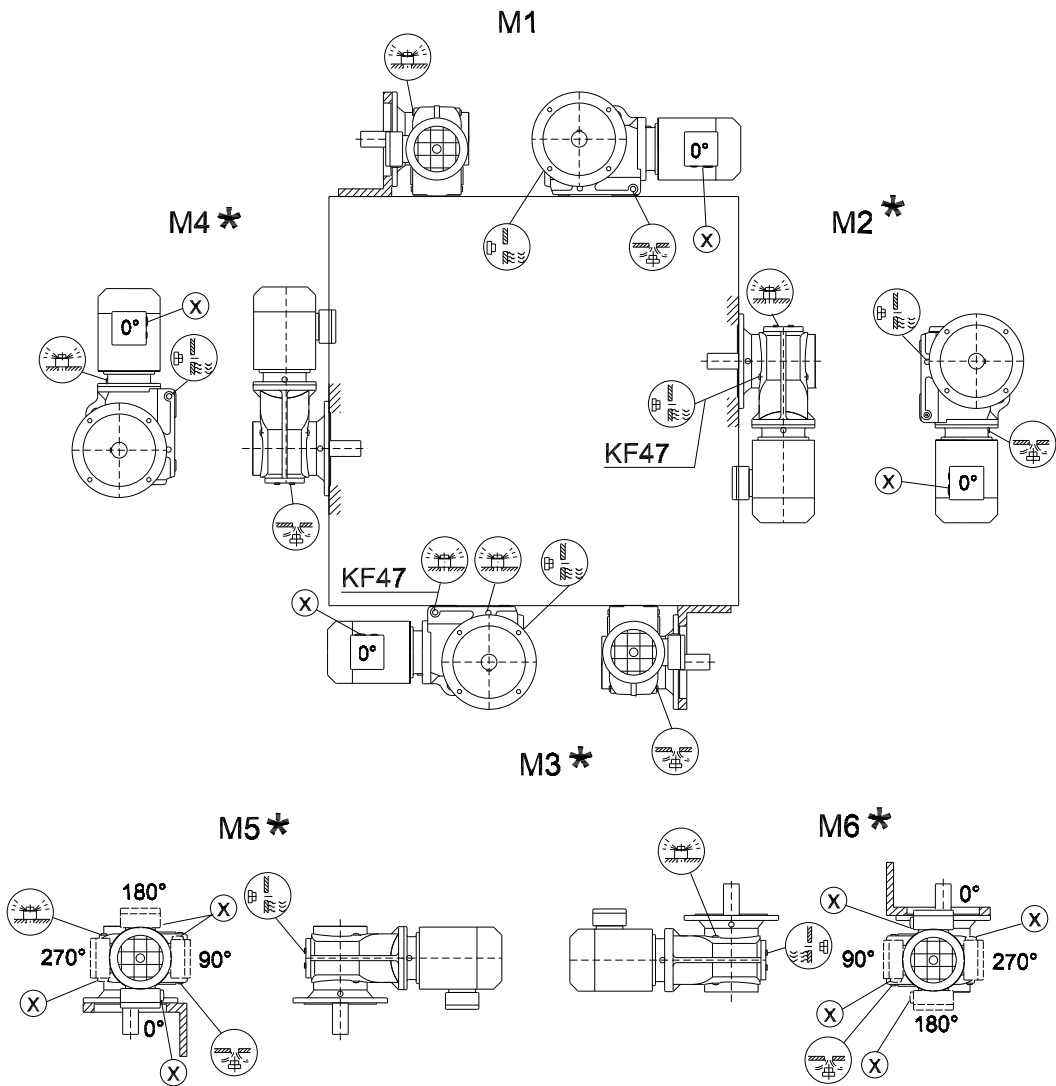
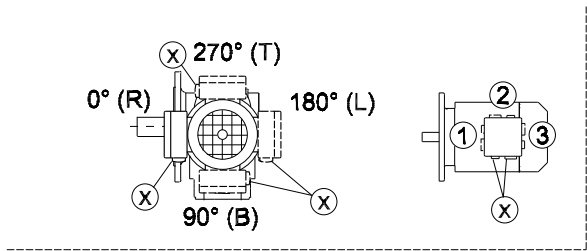
\* → page 51

**Important:** See the **i** information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

**Mounting Positions**  
Mounting positions for helical-bevel gearmotors

KF/KAF/KHF/KAZ/KHZ37-157, KVF/KVZ37-107

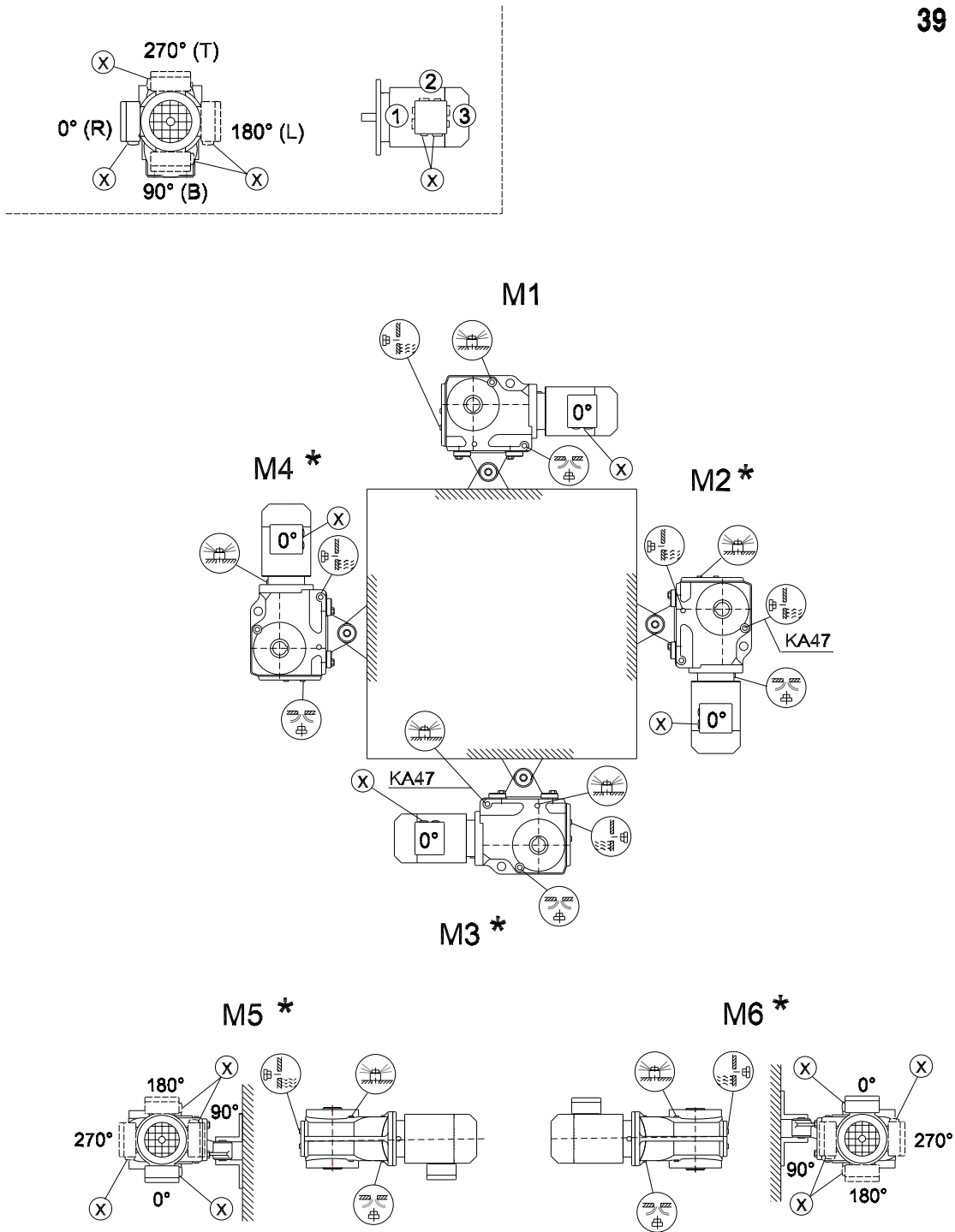
34 027 200



\* → page 51

KA/KH37-157, KV37-107, KT37-97

39 025 200



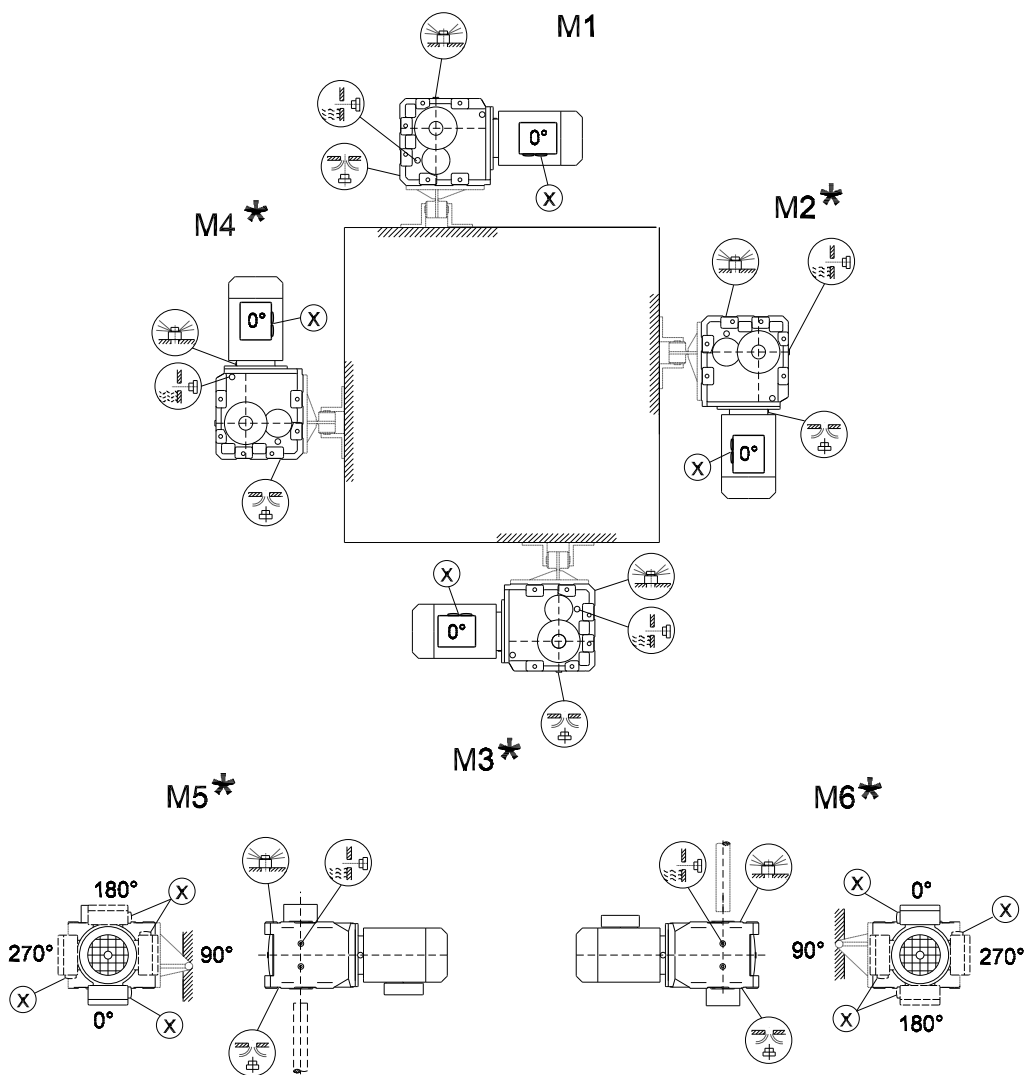
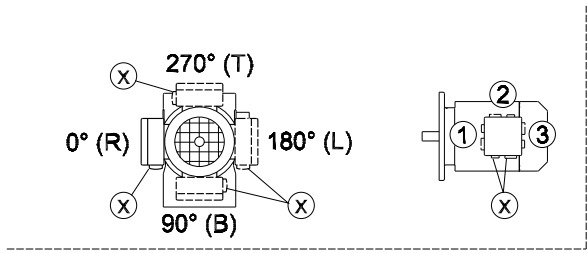
\* → page 51

Mounting Positions

Mounting positions for helical-bevel gearmotors

KH167-187

39 026 200

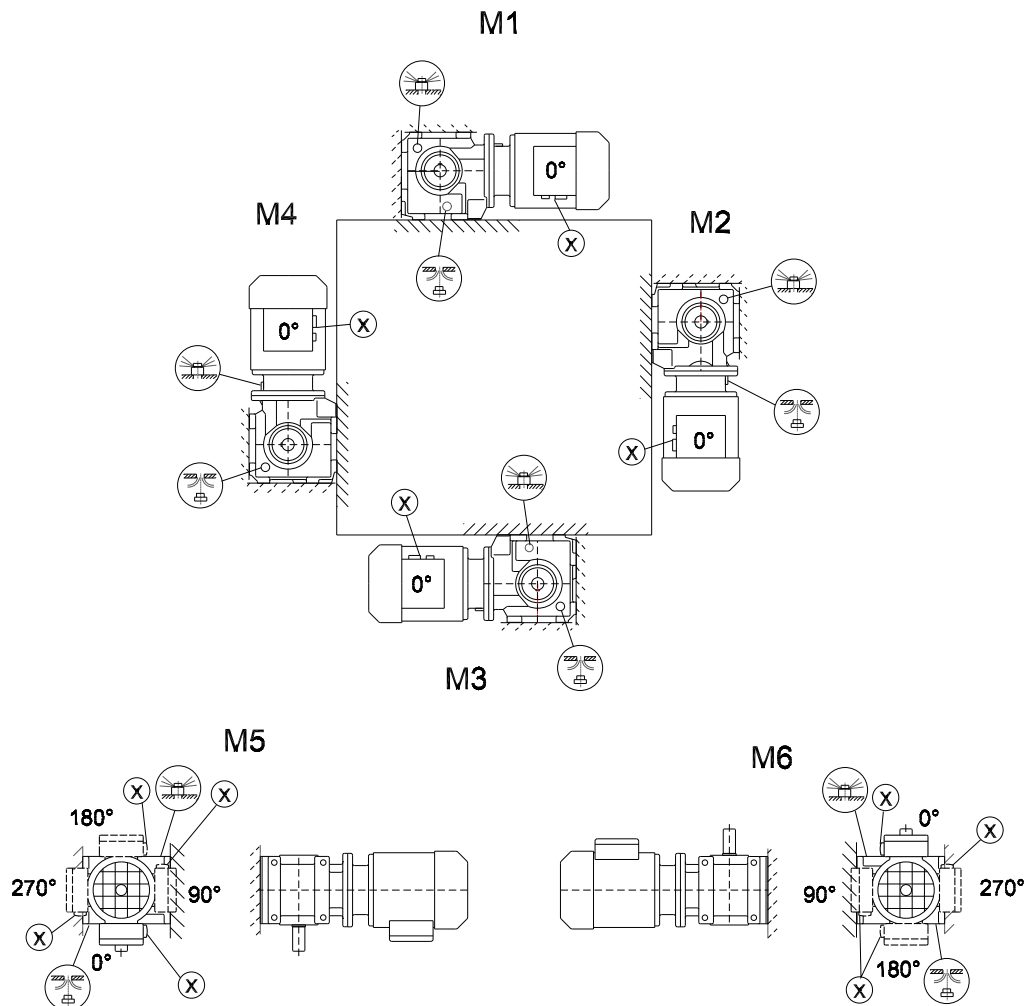
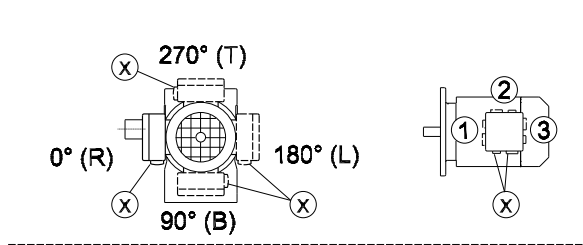



\* → page 51

8.7 Mounting positions for helical-worm gearmotors

S37

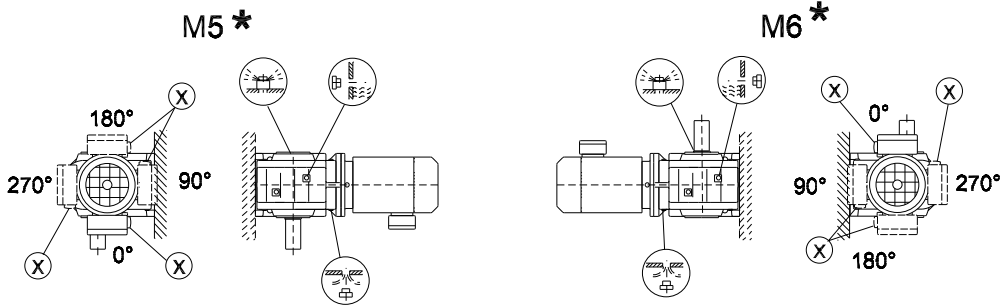
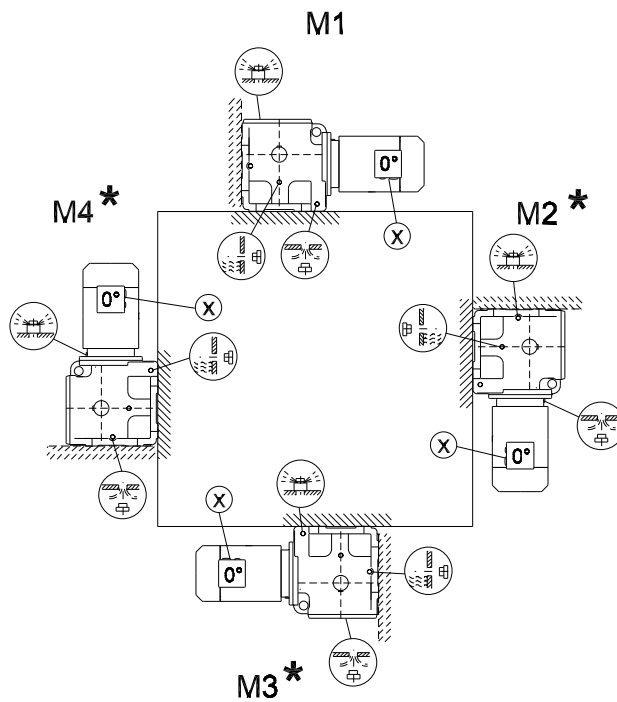
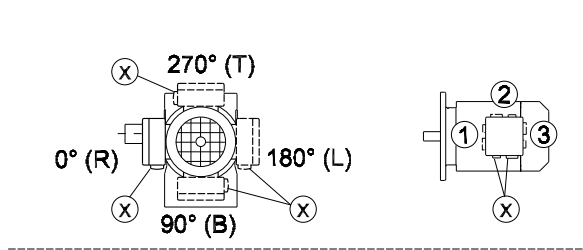
05 025 200



**Important:** See the  information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

S47 - S97

05 026 200

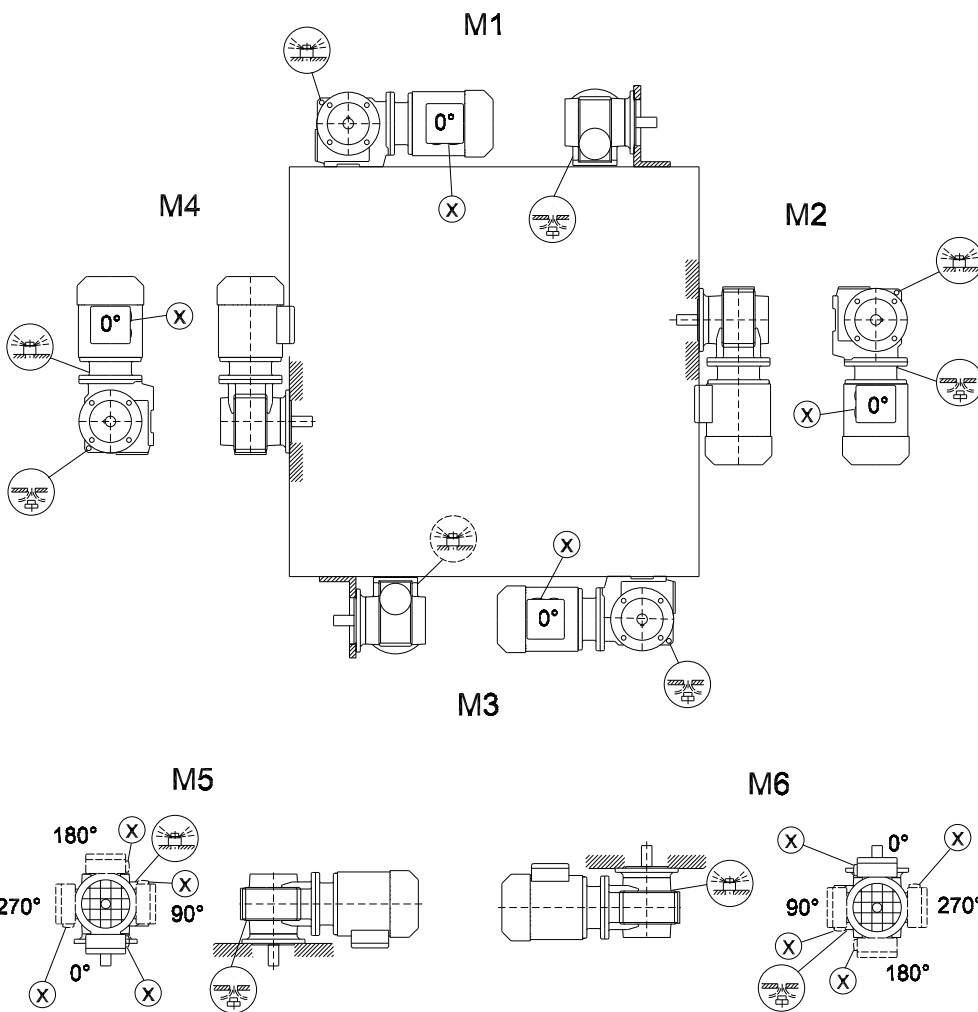
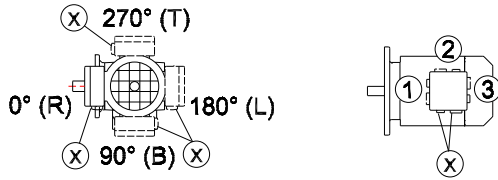


\* → page 51

**Important:** See the **i** information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

SF/SAF/SHF37

05 027 200

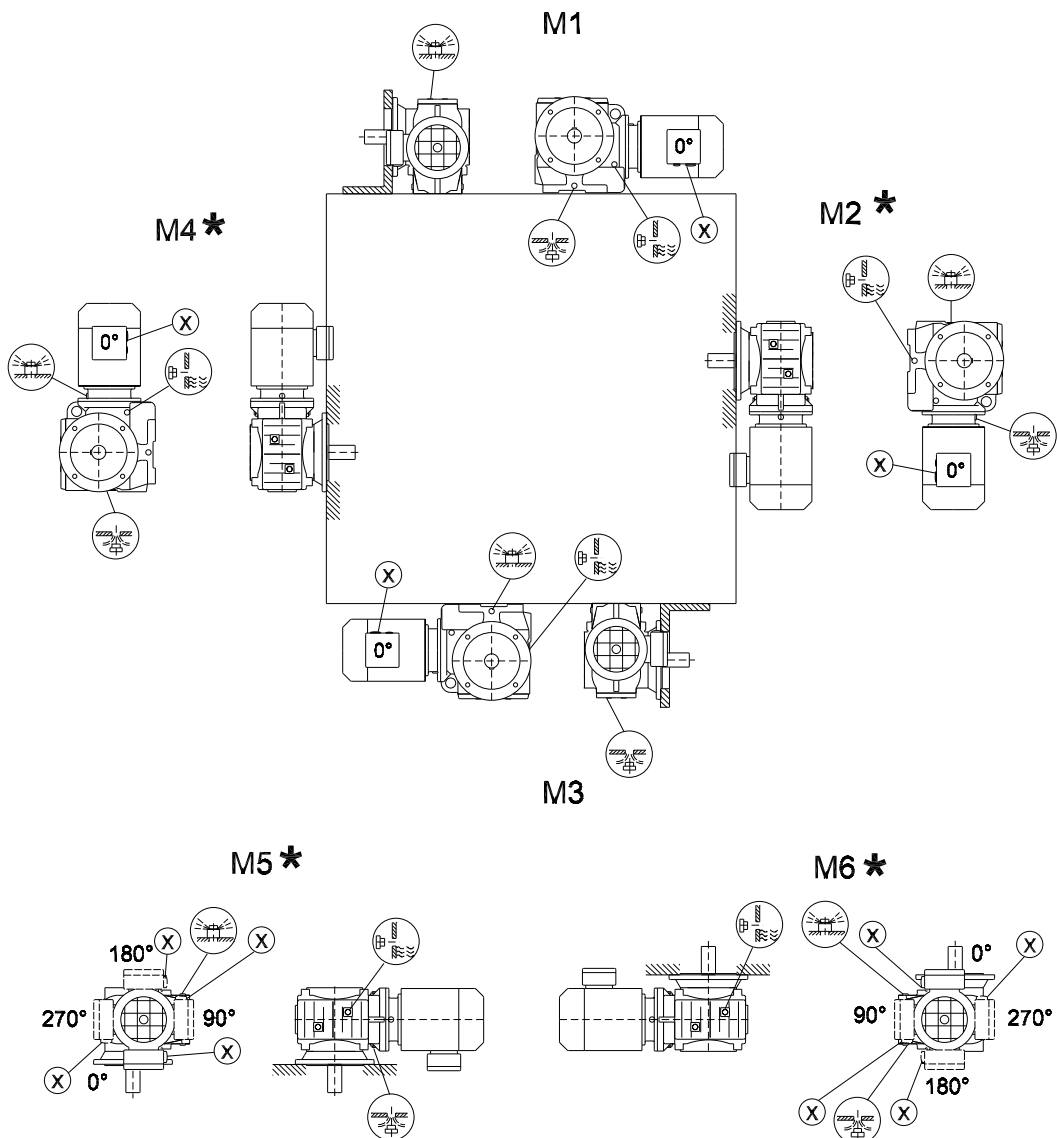
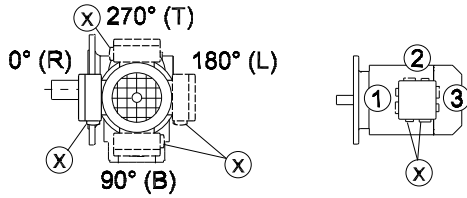


# Mounting Positions

Mounting positions for helical-worm gearmotors

SF/SAF/SHF/SAZ/SHZ47-97

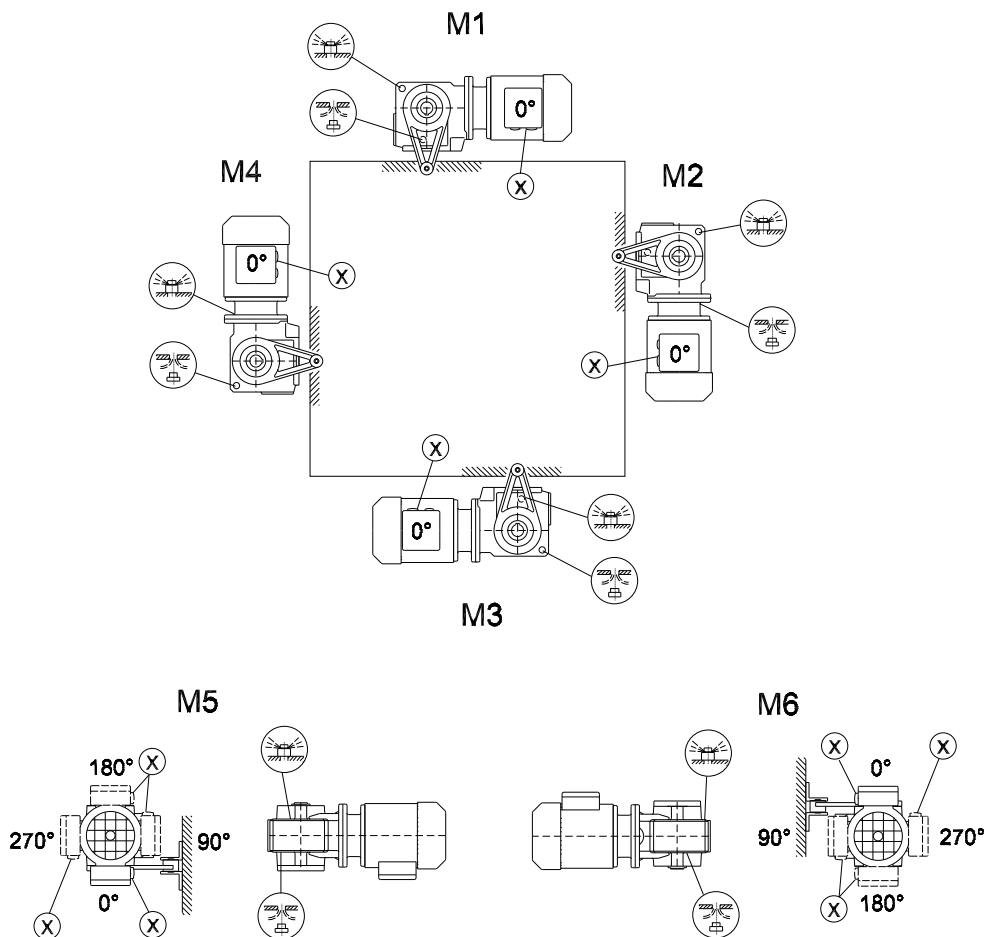
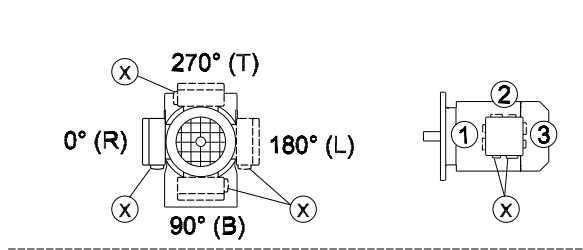
05 028 200



\* → page 51

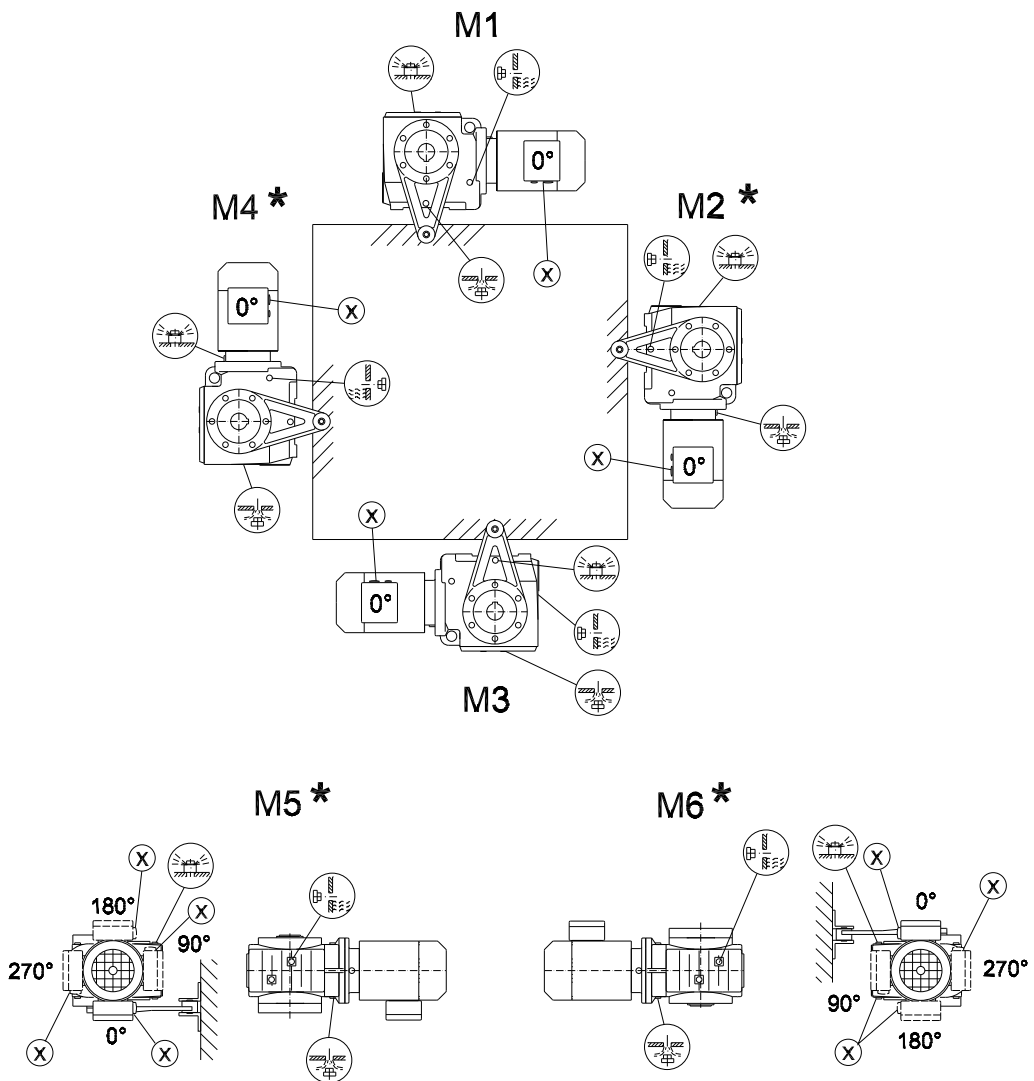
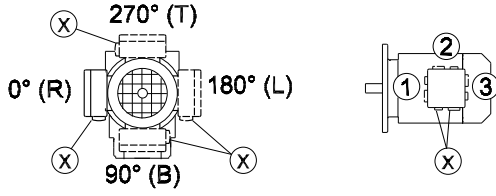
SA/SH/ST37

28 020 200



SA/SH/ST47-97

28 021 200

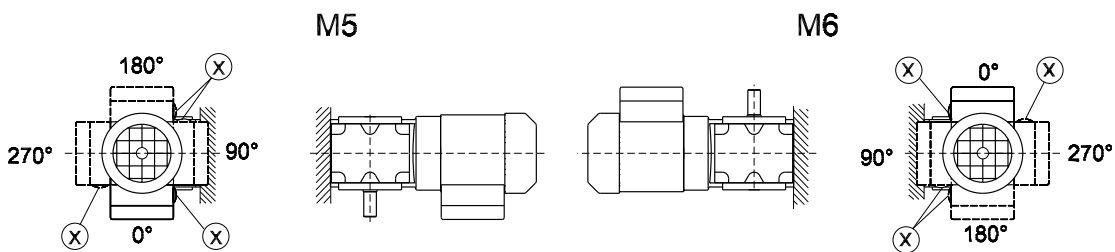
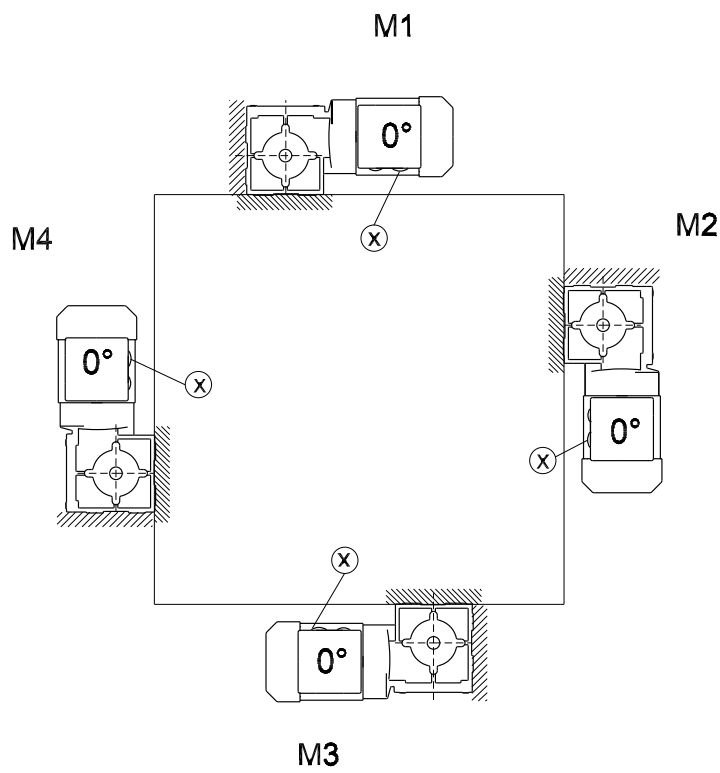
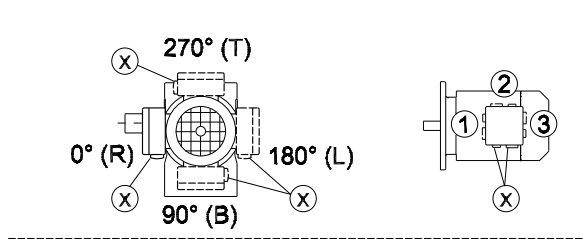


\* → page 51

8.8 Mounting positions for SPIROPLAN® W gearmotors

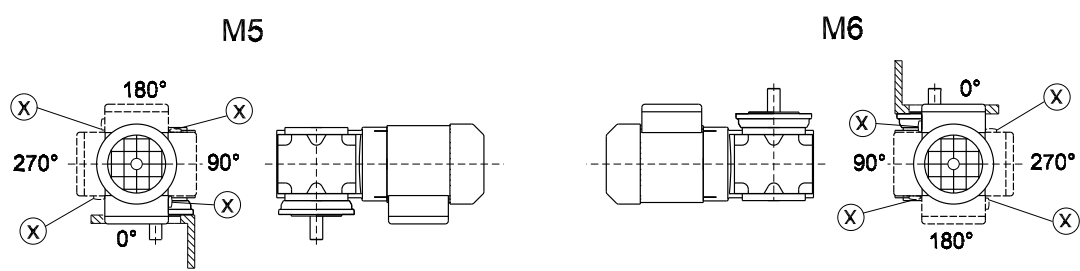
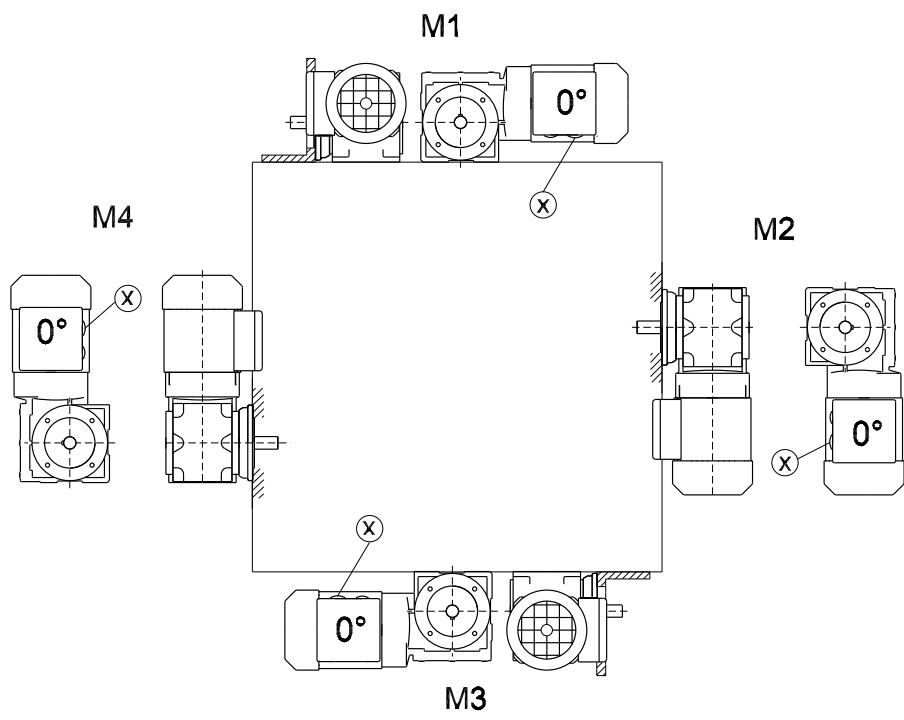
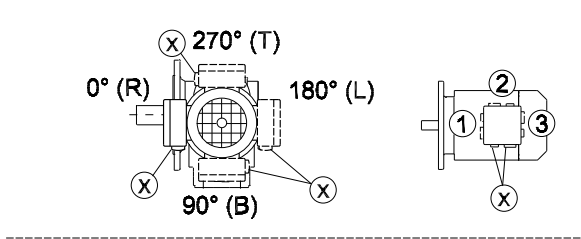
W10-30

20 001 002



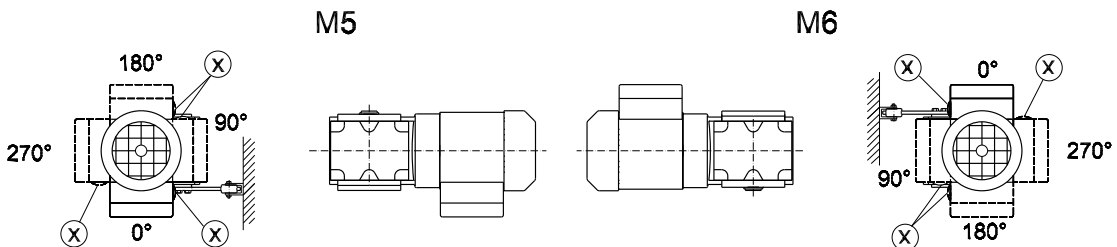
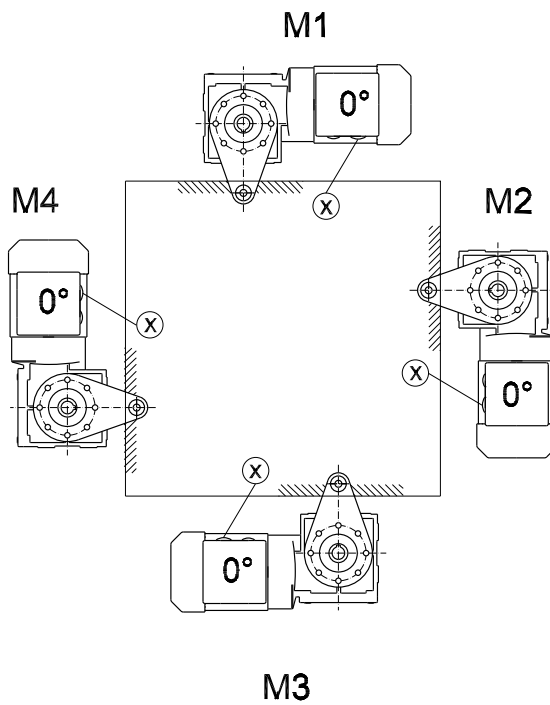
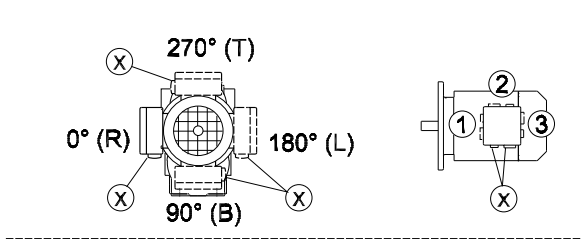
WF/WAF10-30

20 002 002



WA10-30

20 003 002





## 9 Lubricants

### General information


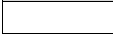


Unless a special arrangement is made, SEW-EURODRIVE supplies the drives with a lubricant fill adapted for the specific gear unit and mounting position. The decisive factor is the mounting position (M1 ... M6, → Sec. "Mounting Positions and Important Order Information") specified when ordering the drive. You must adapt the lubricant fill to any subsequent changes made to the mounting position (→ Lubricant fill quantities).

### 9.1 Lubricant table

The lubricant table on the following page shows the permitted lubricants for SEW-EURODRIVE gear units. Please note the following key to the lubricant table.

### Key to the lubricant table

Abbreviations used, meaning of shading and notes:

CLP	= Mineral oil
CLP PG	= Polyglycol (W gear units, NSF certified H1)
CLP HC	= Synthetic hydrocarbons
E	= Ester oil (water hazard class 1 (German regulation))
HCE	= Synthetic hydrocarbons + ester oil (NSF certified H1)
HLP	= Hydraulic oil
	= Synthetic lubricant (= synthetic-based anti-friction bearing grease)
	= Mineral lubricant (= mineral-based anti-friction bearing grease)
1)	Helical-worm gear units with PG oil: Please contact SEW-Eurodrive
2)	Special lubricant for Spiroplan® gear units only
3)	SEW $f_B \geq 1.2$ required
4)	Pay attention to critical starting behavior at low temperatures!
5)	Ambient temperature
	Lubricant for the food industry (food grade oil)
	Biodegradable oil (lubricant for use in agriculture, forestry and water resources)



**Anti-friction bearing greases**

The anti-friction bearings in gear units and motors are given a factory-fill with the greases listed below. SEW-EURODRIVE recommends regreasing anti-friction bearings with a grease fill at the same time as changing the oil.

	Ambient temperature	Manufacturer	Type
Anti-friction bearing in gear unit	-20 °C ... +60 °C	Mobil	Mobilux EP2
	-40 °C ... +60 °C	Mobil	Mobiltemp SHC 100
Anti-friction bearing in motor <sup>1)2)</sup>	-20 °C ... +80 °C	Esso	Polyrex EM
	+20 °C ... +100 °C	Klüber	Barrierta L55/2
	-40 °C ... +60 °C	Kyodo Yushi	Multemp SRL <sup>3)</sup>
<b>Special greases for anti-friction bearings in gear units:</b>			
	-35 °C ... +40 °C	Shell	Shell Cassida Grease EPS 2
	-25 °C ... +40 °C	Klüber	Klübersynth UH1 14-222
	-40 °C ... +40 °C	Klüber	Klüberbio M 72-82

- 1) The motor anti-friction bearings are covered on both sides and cannot be regreased.
- 2) Greases providing equivalent performance are acceptable
- 3) Recommended for continuous operation at ambient temperature below 0°C, example in a cold storage.



**The following grease quantities are required:**

- For fast-running bearings (motor and gear unit input end): Fill the cavities between the rolling elements one third full with grease.
- For slow-running bearings (in gear units and at gear unit output end): Fill the cavities between the rolling elements two thirds full with grease.



Lubricants  
Lubricant table

Lubricant table

01 805 09 92US

			ISO, NLGI	ExxonMobil	Shell	KLÖBER	ARAL	bp	Tribol	TEXACO	Optimal	FUCHS	TOTAL	
R...  K...(HK...)  F... 	Standard -10 +40	CLP (CC)	VG 220	Mobilgear 600XP 220	Shell Omala 220	Küberoil GEM 1-220 N	Aral Degol BG 220	BP Energol GR-XP 220	Tribol 1100/220	Meropa 220	Optigear BM 220	Renolin CLP 220	Carter EP 220	
	-25 +80	CLP PG	VG 220	Mobil Glygoyle 30	Shell Tivela S 220	Kübersynth GH 6-220	Aral Degol GS 220	BP Energol SG-XP 220	Tribol 800/220	Synlube CLP 220	Optiflex A 220		Carter SY 220	
	-40 +80	CLP HC	VG 220	Mobil SHC 630	Shell Omala HD 220	Kübersynth GEM 4-220 N	Aral Degol PAS 220				Optigear Synthetic A 220	Renolin Unisyn CLP 220		
	-40 +40		VG 150	Mobil SHC 629	Shell Omala HD 150	Kübersynth GEM 4-150 N					Pinnacle EP 150		Carter SH 150	
	-20 +25	CLP (CC)	VG 150	Mobilgear 600XP 100	Shell Omala 100	Küberoil GEM 1-150 N	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 150	Optigear BM 100	Renolin CLP 150	Carter EP 100	
	-30 +10	HLP (HM)	VG 68-46	Mobil D.T.E. 13M	Shell Tellus T 32	Küberoil GEM 1-68 N	Aral Degol BG 46				Rando EP Ashless 46	Optigear 32	Renolin B 46 HVI	Equivis ZS 46
	-40 +10	CLP HC	VG 32	Mobil SHC 624		Küber-Summit HySyn FG-32					Cetus PAO 46			Dacnis SH 32
	-40 -20	HLP (HM)	VG 22	Mobil D.T.E. 11M	Shell Tellus T 15	Isoflex MT 30 ROT			BP Energol HLP-HM 15		Rando HDZ 15			Equivis ZS 15
	Standard 0 +40	CLP (CC)	VG 680	Mobilgear 600XP 680	Shell Omala 680	Küberoil GEM 1-680 N	Aral Degol BG 680		BP Energol GR-XP 680	Tribol 1100/680	Meropa 680	Optigear BM 680	Renolin CLP 680	Carter EP 680
	-20 +60	CLP PG	VG 680 <sup>1)</sup>		Shell Tivela S 680	Kübersynth GH 6-680			BP Energol SG-XP 680	Tribol 800/680	Synlube CLP 680			
S...(HS...) 	-30 +80	CLP HC	VG 460	Mobil SHC 634	Shell Omala HD 460	Kübersynth GEM 4-460 N					Pinnacle EP 460			
	-40 +10		VG 150	Mobil SHC 629	Shell Omala HD 150	Kübersynth GEM 4-150 N					Pinnacle EP 150		Carter SH 150	
	-20 +10	CLP (CC)	VG 150	Mobilgear 600XP 100	Shell Omala 100	Küberoil GEM 1-150 N	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 150	Optigear BM 100	Renolin CLP 150	Carter EP 100	
	-25 +20	CLP PG	VG 220 <sup>1)</sup>	Mobil Glygoyle 30	Shell Tivela S 220	Kübersynth GH 6-220	Aral Degol GS 220	BP Energol SG-XP 220	Tribol 800/220	Synlube CLP 220	Optiflex A 220		Carter SY 220	
	-40 0	CLP HC	VG 32	Mobil SHC 624		Küber-Summit HySyn FG-32					Cetus PAO 46		Dacnis SH 32	
	Standard -20 +40	CLP PG	VG 460 <sup>1)</sup>			Kübersynth UH1 6-460								
	-30 +40	HCE	VG 460		Shell Cassida Fluid GL 460	Küberoil 4UH1-460 N	Aral Eural Gear 460					Optilube GT 460		
	-20 +40	E	VG 460			Küberbio CA2-460	Aral Degol BAB-460					Optisyn BS 460		
	Standard -20 +40	SEW PG	VG 460 <sup>2)</sup>			Küber SEW HT-460-5								
	-40 +10	API GL5	SAE 75W90 (-VG 100)	Mobilube SHC 75 W90-LS										
-20 -40	CLP PG	VG 460 <sup>3)</sup>			Kübersynth UH1 6-460									
R..., K...(HK...), F..., S...(HS...) W...(HW...) 														



## 9.2 Lubricant fill quantities

The specified fill quantities are **recommended values**. The precise values vary depending on the number of stages and gear ratio. When filling, it is essential to check the **oil level plug since it indicates the precise oil capacity**.

The following tables show guide values for lubricant fill quantities in relation to the mounting position M1 ... M6.

### Helical (R) gear units

Gear unit type R..., R..F	Fill quantity in liters					
	M1 <sup>1)</sup>	M2 <sup>1)</sup>	M3	M4	M5	M6
R07/R07F	0.12	0.20	0.20	0.20	0.20	0.20
R17/R17F	0.25	0.55	0.35	0.55	0.35	0.35
R27/R27F	0.25/0.40	0.70	0.50	0.70	0.50	0.50
R37/R37F	0.30/0.95	0.85	0.95	1.05	0.75	0.95
R47/R47F	0.70/1.50	1.60	1.50	1.65	1.50	1.50
R57/R57F	0.80/1.70	1.90	1.70	2.10	1.70	1.70
R67/R67F	1.10/2.30	2.60/3.50	2.80	3.20	1.80	2.00
R77/R77F	1.20/3.00	3.80/4.10	3.60	4.10	2.50	3.40
R87/R87F	2.30/6.0	6.7/8.2	7.2	7.7	6.3	6.5
R97	4.60/9.8	11.7/14.0	11.7	13.4	11.3	11.7
R107	6.0/13.7	16.3	16.9	19.2	13.2	15.9
R137	10.0/25.0	28.0	29.5	31.5	25.0	25.0
R147	15.4/40.0	46.5	48.0	52.0	39.5	41.0
R167	27.0/70.0	82.0	78.0	88.0	66.0	69.0
Gear unit type RF.. / RM..	Fill quantity in liters					
	M1 <sup>1)</sup>	M2 <sup>1)</sup>	M3	M4	M5	M6
RF07	0.12	0.20	0.20	0.20	0.20	0.20
RF17	0.25	0.55	0.35	0.55	0.35	0.35
RF27	0.25/0.40	0.70	0.50	0.70	0.50	0.50
RF37	0.35/0.95	0.90	0.95	1.05	0.75	0.95
RF47	0.65/1.50	1.60	1.50	1.65	1.50	1.50
RF/RM57	0.80/1.70	1.80	1.70	2.00	1.70	1.70
RF/RM67	1.20/2.50	2.70/3.60	2.70	2.60	1.90	2.10
RF/RM77	1.20/2.60	3.80/4.10	3.30	4.10	2.40	3.00
RF/RM87	2.40/6.0	6.8/7.9	7.1	7.7	6.3	6.4
RF/RM97	5.1/10.2	11.9/14.0	11.2	14.0	11.2	11.8
RF/RM107	6.3/14.9	15.9	17.0	19.2	13.1	15.9
RF/RM137	9.5/25.0	27.0	29.0	32.5	25.0	25.0
RF/RM147	16.4/42.0	47.0	48.0	52.0	42.0	42.0
RF/RM167	26.0/70.0	82.0	78.0	88.0	65.0	71.0

1) The output end gear unit of multi-stage gear units must be filled with the larger oil volume.



## Lubricants

### Lubricant fill quantities

#### Helical (RX) gear units

Gear unit type RX..	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
RX57	0.60	0.80	1.30	1.30	0.90	0.90
RX67	0.80	0.80	1.70	1.90	1.10	1.10
RX77	1.10	1.50	2.60	2.70	1.60	1.60
RX87	1.70	2.50	4.80	4.80	2.90	2.90
RX97	2.10	3.40	7.4	7.0	4.80	4.80
RX107	3.90	5.6	11.6	11.9	7.7	7.7
Gear unit type RXF..	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
RXF57	0.50	0.80	1.10	1.10	0.70	0.70
RXF67	0.70	0.80	1.50	1.40	1.00	1.00
RXF77	0.90	1.30	2.40	2.00	1.60	1.60
RXF87	1.60	1.95	4.90	3.95	2.90	2.90
RXF97	2.10	3.70	7.1	6.3	4.80	4.80
RXF107	3.10	5.7	11.2	9.3	7.2	7.2

#### Parallel shaft helical (F) gear units

F.., FA..B, FH..B, FV..B:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
F..27	0.60	0.80	0.65	0.70	0.60	0.60
F..37	0.95	1.25	0.70	1.25	1.00	1.10
F..47	1.50	1.80	1.10	1.90	1.50	1.70
F..57	2.60	3.50	2.10	3.50	2.80	2.90
F..67	2.70	3.80	1.90	3.80	2.90	3.20
F..77	5.9	7.3	4.30	8.0	6.0	6.3
F..87	10.8	13.0	7.7	13.8	10.8	11.0
F..97	18.5	22.5	12.6	25.2	18.5	20.0
F..107	24.5	32.0	19.5	37.5	27.0	27.0
F..127	40.5	54.5	34.0	61.0	46.3	47.0
F..157	69.0	104.0	63.0	105.0	86.0	78.0

FF..:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
FF27	0.60	0.80	0.65	0.70	0.60	0.60
FF37	1.00	1.25	0.70	1.30	1.00	1.10
FF47	1.60	1.85	1.10	1.90	1.50	1.70
FF57	2.80	3.50	2.10	3.70	2.90	3.00
FF67	2.70	3.80	1.90	3.80	2.90	3.20
FF77	5.9	7.3	4.30	8.1	6.0	6.3
FF87	10.8	13.2	7.8	14.1	11.0	11.2
FF97	19.0	22.5	12.6	25.6	18.9	20.5
FF107	25.5	32.0	19.5	38.5	27.5	28.0
FF127	41.5	55.5	34.0	63.0	46.3	49.0
FF157	72.0	105.0	64.0	106.0	87.0	79.0



FA.., FH.., FV.., FAF.., FHF.., FVF.., FAZ.., FHZ.., FVZ..:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
F..27	0.60	0.80	0.65	0.70	0.60	0.60
F..37	0.95	1.25	0.70	1.25	1.00	1.10
F..47	1.50	1.80	1.10	1.90	1.50	1.70
F..57	2.70	3.50	2.10	3.40	2.90	3.00
F..67	2.70	3.80	1.90	3.80	2.90	3.20
F..77	5.9	7.3	4.30	8.0	6.0	6.3
F..87	10.8	13.0	7.7	13.8	10.8	11.0
F..97	18.5	22.5	12.6	25.2	18.5	20.0
F..107	24.5	32.0	19.5	37.5	27.0	27.0
F..127	39.0	54.5	34.0	61.0	45.0	46.5
F..157	68.0	103.0	62.0	104.0	85.0	77.0

**Helical-bevel (K)  
gear units**

K.., KA..B, KH..B, KV..B:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
K..37	0.50	1.00	1.00	1.25	0.95	0.95
K..47	0.80	1.30	1.50	2.00	1.60	1.60
K..57	1.20	2.30	2.50	2.80	2.60	2.40
K..67	1.10	2.40	2.60	3.45	2.60	2.60
K..77	2.20	4.10	4.40	5.8	4.20	4.40
K..87	3.70	8.0	8.7	10.9	8.0	8.0
K..97	7.0	14.0	15.7	20.0	15.7	15.5
K..107	10.0	21.0	25.5	33.5	24.0	24.0
K..127	21.0	41.5	44.0	54.0	40.0	41.0
K..157	31.0	62.0	65.0	90.0	58.0	62.0
K..167	33.0	95.0	105.0	123.0	85.0	84.0
K..187	53.0	152.0	167.0	200	143.0	143.0

KF..:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
KF37	0.50	1.10	1.10	1.50	1.00	1.00
KF47	0.80	1.30	1.70	2.20	1.60	1.60
KF57	1.30	2.30	2.70	3.15	2.90	2.70
KF67	1.10	2.40	2.80	3.70	2.70	2.70
KF77	2.10	4.10	4.40	5.9	4.50	4.50
KF87	3.70	8.2	9.0	11.9	8.4	8.4
KF97	7.0	14.7	17.3	21.5	15.7	16.5
KF107	10.0	21.8	25.8	35.1	25.2	25.2
KF127	21.0	41.5	46.0	55.0	41.0	41.0
KF157	31.0	66.0	69.0	92.0	62.0	62.0



## Lubricants

### Lubricant fill quantities

KA..., KH..., KV..., KAF..., KHF..., KVF..., KAZ..., KHZ..., KVZ...:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
K..37	0.50	1.00	1.00	1.40	1.00	1.00
K..47	0.80	1.30	1.60	2.15	1.60	1.60
K..57	1.30	2.30	2.70	3.15	2.90	2.70
K..67	1.10	2.40	2.70	3.70	2.60	2.60
K..77	2.10	4.10	4.60	5.9	4.40	4.40
K..87	3.70	8.2	8.8	11.1	8.0	8.0
K..97	7.0	14.7	15.7	20.0	15.7	15.7
K..107	10.0	20.5	24.0	32.4	24.0	24.0
K..127	21.0	41.5	43.0	52.0	40.0	40.0
K..157	31.0	66.0	67.0	87.0	62.0	62.0
KH167	33.0	95.0	105.0	123.0	85.0	84.0
KH187	53.0	152.0	167.0	200	143.0	143.0

### Spiroplan® (W) gear units

The fill quantity of Spiroplan® gear units does not vary, irrespective of their mounting position:

Gear unit type	Fill quantity in liters, regardless of mounting position
W..10	0.16
W..20	0.26
W..30	0.50

### Helical-worm (S) gear units

S...:

Gear unit type	Fill quantity in liters					
	M1	M2	M3 <sup>1)</sup>	M4	M5	M6
S37	0.25	0.40	0.50	0.55	0.40	0.40
S47	0.35	0.80	0.70/0.90	1.00	0.80	0.80
S57	.50	1.20	1.00/1.20	1.45	1.30	1.30
S67	1.00	2.00	2.20/3.10	3.10	2.60	2.60
S77	1.90	4.20	3.70/5.4	5.9	4.40	4.40
S87	3.30	8.1	6.9/10.4	11.3	8.4	8.4
S97	6.8	15.0	13.4/18.0	21.8	17.0	17.0

1) The larger gear unit of multi-stage gear units must be filled with the larger oil volume.

SF...:

Gear unit type	Fill quantity in liters					
	M1	M2	M3 <sup>1)</sup>	M4	M5	M6
SF37	0.25	0.40	0.50	0.55	0.40	0.40
SF47	0.40	0.90	0.90/1.05	1.05	1.00	1.00
SF57	0.50	1.20	1.00/1.50	1.55	1.40	1.40
SF67	1.00	2.20	2.30/3.00	3.20	2.70	2.70
SF77	1.90	4.10	3.90/5.8	6.5	4.90	4.90
SF87	3.80	8.0	7.1/10.1	12.0	9.1	9.1
SF97	7.4	15.0	13.8/18.8	22.6	18.0	18.0

1) The larger gear unit of multi-stage gear units must be filled with the larger oil volume.



SA..., SH..., SAF..., SHF..., SAZ..., SHZ...:

Gear unit type	Fill quantity in liters					
	M1	M2	M3 <sup>1)</sup>	M4	M5	M6
<b>S..37</b>	0.25	0.40	0.50	0.50	0.40	0.40
<b>S..47</b>	0.40	0.80	0.70/0.90	1.00	0.80	0.80
<b>S..57</b>	0.50	1.10	1.00/1.50	1.50	1.20	1.20
<b>S..67</b>	1.00	2.00	1.80/2.60	2.90	2.50	2.50
<b>S..77</b>	1.80	3.90	3.60/5.0	5.8	4.50	4.50
<b>S..87</b>	3.80	7.4	6.0/8.7	10.8	8.0	8.0
<b>S..97</b>	7.0	14.0	11.4/16.0	20.5	15.7	15.7

1) The larger gear unit of multi-stage gear units must be filled with the larger oil volume.



## 10 Appendix

### 10.1 Index of changes

The following additions and changes have been made compared to the previous edition of the "Explosion-Proof Gear Units R..7, F..7, K..7, S..7, SPIROPLAN® W" (publication number: 1055520x, edition 11/2002) operating instructions:

General additions and corrections.

#### ***Mechanical installation***

- Installing the gear unit: Data on flatness error
- Installing torque arms for mounted gear units: Data on retaining bolts
- Mounted gear units with shrink disks: Information on assembly / removal has been added
- Mounted gear units with TorqLOC®
- AM adapter coupling: Point A

#### ***Inspection and maintenance***

- Lubricant change intervals

#### ***General***

Manual adapted for US market.



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<b>Sales Service</b>	<b>Athen</b>	Christ. Boznos & Son S.A. 12, Mavromichali Street P.O. Box 80136, GR-18545 Piraeus	Tel. +30 2 1042 251-34 Fax +30 2 1042 251-59 <a href="http://www.boznos.gr">http://www.boznos.gr</a> info@boznos.gr
Hong Kong			
<b>Assembly Sales Service</b>	<b>Hong Kong</b>	SEW-EURODRIVE LTD. Unit No. 801-806, 8th Floor Hong Leong Industrial Complex No. 4, Wang Kwong Road Kowloon, Hong Kong	Tel. +852 2 7960477 + 79604654 Fax +852 2 7959129 contact@sew-eurodrive.hk
Hungary			
<b>Sales Service</b>	<b>Budapest</b>	SEW-EURODRIVE Kft. H-1037 Budapest Kunigunda u. 18	Tel. +36 1 437 06-58 Fax +36 1 437 06-50 office@sew-eurodrive.hu
India			
<b>Assembly Sales Service</b>	<b>Baroda</b>	SEW-EURODRIVE India Pvt. Ltd. Plot No. 4, Gidc Por Ramangamdi • Baroda - 391 243 Gujarat	Tel. +91 265 2831086 Fax +91 265 2831087 <a href="http://www.seweurodriveindia.com">http://www.seweurodriveindia.com</a> mdoffice@seweurodriveindia.com
Ireland			
<b>Sales Service</b>	<b>Dublin</b>	Alperton Engineering Ltd. 48 Moyle Road Dublin Industrial Estate Glasnevin, Dublin 11	Tel. +353 1 830-6277 Fax +353 1 830-6458 info@alperton.ie
Israel			
<b>Sales</b>	<b>Tel-Aviv</b>	Liraz Handasa Ltd. Ahofer Str 34B / 228 58858 Holon	Tel. +972 3 5599511 Fax +972 3 5599512 office@liraz-handasa.co.il



Italy			
<b>Assembly</b>	<b>Milano</b>	SEW-EURODRIVE di R. Blickle & Co.s.a.s.	Tel. +39 02 96 9801
<b>Sales</b>		Via Bernini,14	Fax +39 02 96 799781
<b>Service</b>		I-20020 Solaro (Milano)	<a href="http://www.sew-eurodrive.it">http://www.sew-eurodrive.it</a> sewit@sew-eurodrive.it
Ivory Coast			
<b>Sales</b>	<b>Abidjan</b>	SICA Ste industrielle et commerciale pour l'Afrique 165, Bld de Marseille B.P. 2323, Abidjan 08	Tel. +225 2579-44 Fax +225 2584-36
Japan			
<b>Assembly</b>	<b>Iwata</b>	SEW-EURODRIVE JAPAN CO., LTD	Tel. +81 538 373811
<b>Sales</b>		250-1, Shimoman-no,	Fax +81 538 373814
<b>Service</b>		Iwata Shizuoka 438-0818	<a href="http://www.sew-eurodrive.co.jp">http://www.sew-eurodrive.co.jp</a> sewjapan@sew-eurodrive.co.jp
Korea			
<b>Assembly</b>	<b>Ansan-City</b>	SEW-EURODRIVE KOREA CO., LTD.	Tel. +82 31 492-8051
<b>Sales</b>		B 601-4, Banweol Industrial Estate	Fax +82 31 492-8056
<b>Service</b>		1048-4, Shingil-Dong Ansan 425-120	<a href="http://www.sew-korea.co.kr">http://www.sew-korea.co.kr</a> master@sew-korea.co.kr
	<b>Busan</b>	SEW-EURODRIVE KOREA Co., Ltd. No. 1720 - 11, Songjeong - dong Gangseo-ku Busan 618-270	Tel. +82 51 832-0204 Fax +82 51 832-0230 master@sew-korea.co.kr
Latvia			
<b>Sales</b>	<b>Riga</b>	SIA Alas-Kuul Kattakalna 11C LV-1073 Riga	Tel. +371 7139253 Fax +371 7139386 <a href="http://www.alas-kuul.com">http://www.alas-kuul.com</a> info@alas-kuul.com
Lebanon			
<b>Sales</b>	<b>Beirut</b>	Gabriel Acar & Fils sarl B. P. 80484 Bourj Hammoud, Beirut	Tel. +961 1 4947-86 +961 1 4982-72 +961 3 2745-39 Fax +961 1 4949-71 gacar@beirut.com
Lithuania			
<b>Sales</b>	<b>Alytus</b>	UAB Irseva Naujoji 19 LT-62175 Alytus	Tel. +370 315 79204 Fax +370 315 56175 info@irseva.lt <a href="http://www.sew-eurodrive.lt">http://www.sew-eurodrive.lt</a>
Luxembourg			
<b>Assembly</b>	<b>Brüssel</b>	CARON-VECTOR S.A.	Tel. +32 10 231-311
<b>Sales</b>		Avenue Eiffel 5	Fax +32 10 231-336
<b>Service</b>		B-1300 Wavre	<a href="http://www.sew-eurodrive.lu">http://www.sew-eurodrive.lu</a> info@caron-vector.be
Malaysia			
<b>Assembly</b>	<b>Johore</b>	SEW-EURODRIVE SDN BHD	Tel. +60 7 3549409
<b>Sales</b>		No. 95, Jalan Seroja 39, Taman Johor Jaya	Fax +60 7 3541404
<b>Service</b>		81000 Johor Bahru, Johor West Malaysia	sales@sew-eurodrive.com.my



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<b>Assembly</b> <b>Sales</b> <b>Service</b>	<b>Queretaro</b>	SEW-EURODRIVE MEXIKO SA DE CV SEM-981118-M93 Tequisquiapan No. 102 Parque Industrial Queretaro C.P. 76220 Queretaro, Mexico	Tel. +52 442 1030-300 Fax +52 442 1030-301 <a href="http://www.sew-eurodrive.com.mx">http://www.sew-eurodrive.com.mx</a> <a href="mailto:scmexico@seweurodrive.com.mx">scmexico@seweurodrive.com.mx</a>
Morocco			
<b>Sales</b>	<b>Casablanca</b>	Afit 5, rue Emir Abdelkader MA 20300 Casablanca	Tel. +212 22618372 Fax +212 22618351 <a href="mailto:ali.alami@premium.net.ma">ali.alami@premium.net.ma</a>
Netherlands			
<b>Assembly</b> <b>Sales</b> <b>Service</b>	<b>Rotterdam</b>	VECTOR Aandrijftechniek B.V. Industrieweg 175 NL-3044 AS Rotterdam Postbus 10085 NL-3004 AB Rotterdam	Tel. +31 10 4463-700 Fax +31 10 4155-552 <a href="http://www.vector.nu">http://www.vector.nu</a> <a href="mailto:info@vector.nu">info@vector.nu</a>
New Zealand			
<b>Assembly</b> <b>Sales</b> <b>Service</b>	<b>Auckland</b>	SEW-EURODRIVE NEW ZEALAND LTD. P.O. Box 58-428 82 Greenmount drive East Tamaki Auckland	Tel. +64 9 2745627 Fax +64 9 2740165 <a href="http://www.sew-eurodrive.co.nz">http://www.sew-eurodrive.co.nz</a> <a href="mailto:sales@sew-eurodrive.co.nz">sales@sew-eurodrive.co.nz</a>
	<b>Christchurch</b>	SEW-EURODRIVE NEW ZEALAND LTD. 10 Settlers Crescent, Ferrymead Christchurch	Tel. +64 3 384-6251 Fax +64 3 384-6455 <a href="mailto:sales@sew-eurodrive.co.nz">sales@sew-eurodrive.co.nz</a>
Norway			
<b>Assembly</b> <b>Sales</b> <b>Service</b>	<b>Moss</b>	SEW-EURODRIVE A/S Solgaard skog 71 N-1599 Moss	Tel. +47 69 241-020 Fax +47 69 241-040 <a href="http://www.sew-eurodrive.no">http://www.sew-eurodrive.no</a> <a href="mailto:sew@sew-eurodrive.no">sew@sew-eurodrive.no</a>
Peru			
<b>Assembly</b> <b>Sales</b> <b>Service</b>	<b>Lima</b>	SEW DEL PERU MOTORES REDUCTORES S.A.C. Los Calderos, 120-124 Urbanizacion Industrial Vulcano, ATE, Lima	Tel. +51 1 3495280 Fax +51 1 3493002 <a href="http://www.sew-eurodrive.com.pe">http://www.sew-eurodrive.com.pe</a> <a href="mailto:sewperu@sew-eurodrive.com.pe">sewperu@sew-eurodrive.com.pe</a>
Poland			
<b>Assembly</b> <b>Sales</b> <b>Service</b>	<b>Lodz</b>	SEW-EURODRIVE Polska Sp.z.o.o. ul. Techniczna 5 PL-92-518 Łódź	Tel. +48 42 67710-90 Fax +48 42 67710-99 <a href="http://www.sew-eurodrive.pl">http://www.sew-eurodrive.pl</a> <a href="mailto:sew@sew-eurodrive.pl">sew@sew-eurodrive.pl</a>
Portugal			
<b>Assembly</b> <b>Sales</b> <b>Service</b>	<b>Coimbra</b>	SEW-EURODRIVE, LDA. Apartado 15 P-3050-901 Mealhada	Tel. +351 231 20 9670 Fax +351 231 20 3685 <a href="http://www.sew-eurodrive.pt">http://www.sew-eurodrive.pt</a> <a href="mailto:infosew@sew-eurodrive.pt">infosew@sew-eurodrive.pt</a>
Romania			
<b>Sales</b> <b>Service</b>	<b>București</b>	Sialco Trading SRL str. Madrid nr.4 011785 Bucuresti	Tel. +40 21 230-1328 Fax +40 21 230-7170 <a href="mailto:sialco@sialco.ro">sialco@sialco.ro</a>



Russia			
<b>Assembly</b>	<b>St. Petersburg</b>	ZAO SEW-EURODRIVE	Tel. +7 812 3332522 +7 812 5357142
<b>Sales</b>		P.O. Box 36	Fax +7 812 3332523
<b>Service</b>		195220 St. Petersburg Russia	<a href="http://www.sew-eurodrive.ru">http://www.sew-eurodrive.ru</a> sew@sew-eurodrive.ru
Senegal			
<b>Sales</b>	<b>Dakar</b>	SENEMECA	Tel. +221 849 47-70
		Mécanique Générale	Fax +221 849 47-71
		Km 8, Route de Rufisque	senemeca@sentoo.sn
		B.P. 3251, Dakar	
Serbia			
<b>Sales</b>	<b>Beograd</b>	DIPAR d.o.o.	Tel. +381 11 347 3244 / +381 11 288 0393
		Ustanicka 128a	Fax +381 11 347 1337
		PC Košum, IV floor	dipar@yubc.net
		SCG-11000 Beograd	
Singapore			
<b>Assembly</b>	<b>Singapore</b>	SEW-EURODRIVE PTE. LTD.	Tel. +65 68621701
<b>Sales</b>		No 9, Tuas Drive 2	Fax +65 68612827
<b>Service</b>		Jurong Industrial Estate	<a href="http://www.sew-eurodrive.com.sg">http://www.sew-eurodrive.com.sg</a>
		Singapore 638644	sewsingapore@sew-eurodrive.com
Slovakia			
<b>Sales</b>	<b>Bratislava</b>	SEW-Eurodrive SK s.r.o.	Tel. +421 2 49595201
		Rybničná 40	Fax +421 2 49595200
		SK-83554 Bratislava	sew@sew-eurodrive.sk
		<a href="http://www.sew-eurodrive.sk">http://www.sew-eurodrive.sk</a>	
	<b>Žilina</b>	SEW-Eurodrive SK s.r.o.	Tel. +421 41 700 2513
		ul. Vojtecha Spanyola 33	Fax +421 41 700 2514
		SK-010 01 Žilina	sew@sew-eurodrive.sk
	<b>Banská Bystrica</b>	SEW-Eurodrive SK s.r.o.	Tel. +421 48 414 6564
		Rudlovska cesta 85	Fax +421 48 414 6566
		SK-97411 Banská Bystrica	sew@sew-eurodrive.sk
Slovenia			
<b>Sales</b>	<b>Celje</b>	Pakman - Pogonska Tehnika d.o.o.	Tel. +386 3 490 83-20
<b>Service</b>		Ul. XIV. divizije 14	Fax +386 3 490 83-21
		SLO - 3000 Celje	pakman@siol.net
South Africa			
<b>Assembly</b>	<b>Johannesburg</b>	SEW-EURODRIVE (PROPRIETARY) LIMITED	Tel. +27 11 248-7000
<b>Sales</b>		Eurodrive House	Fax +27 11 494-3104
<b>Service</b>		Cnr. Adcock Ingram and Aerodrome Roads	<a href="http://www.sew.co.za">http://www.sew.co.za</a>
		Aeroton Ext. 2	dross@sew.co.za
		Johannesburg 2013	
		P.O.Box 90004	
		Bertsham 2013	
	<b>Capetown</b>	SEW-EURODRIVE (PROPRIETARY) LIMITED	Tel. +27 21 552-9820
		Rainbow Park	Fax +27 21 552-9830
		Cnr. Racecourse & Omuramba Road	Telex 576 062
		Montague Gardens	dswanepoel@sew.co.za
		Cape Town	
		P.O.Box 36556	
		Chempet 7442	
		Cape Town	



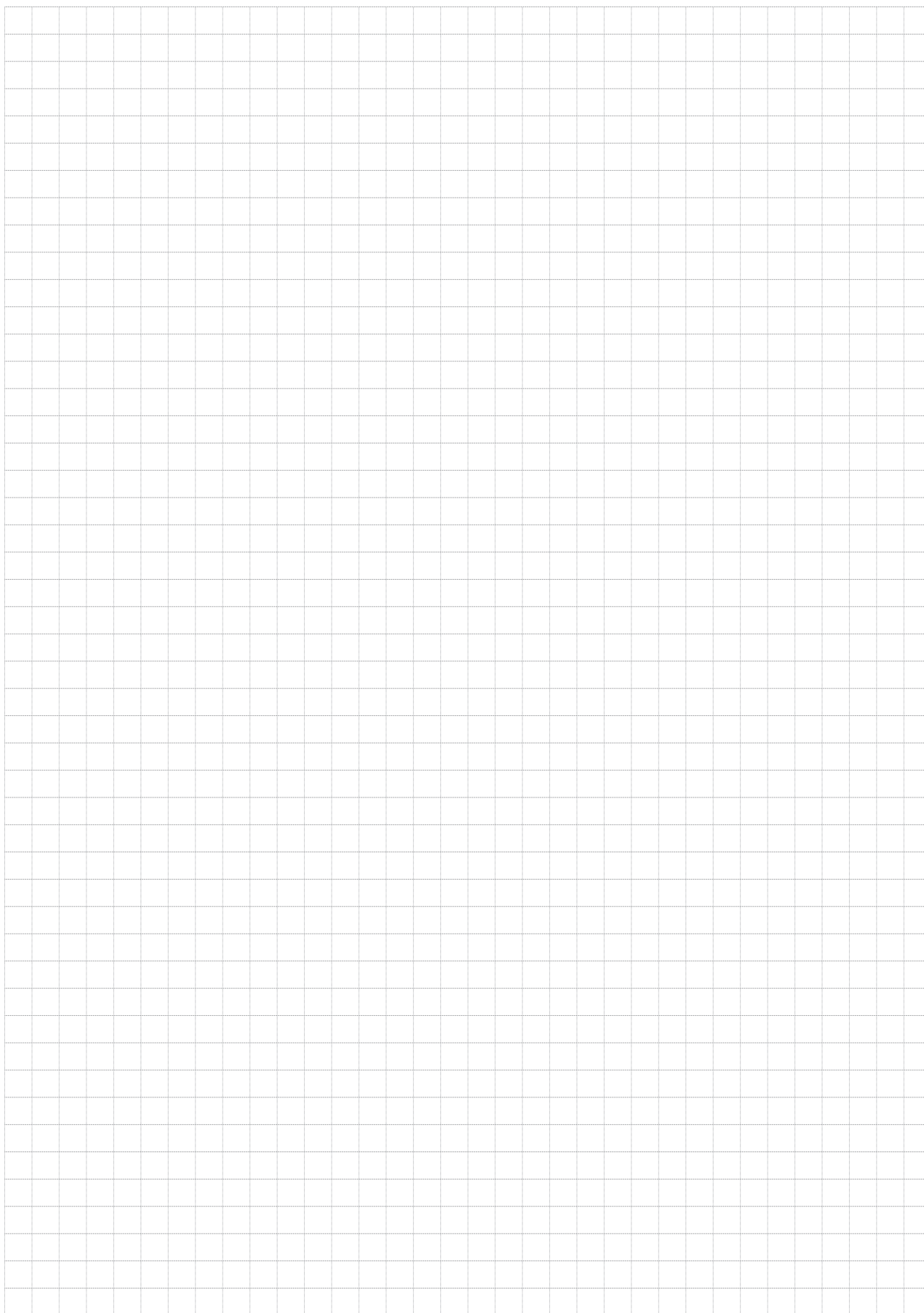
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South Africa			
	<b>Durban</b>	SEW-EURODRIVE (PROPRIETARY) LIMITED 2 Monaceo Place Pinetown Durban P.O. Box 10433, Ashwood 3605	Tel. +27 31 700-3451 Fax +27 31 700-3847 dtait@sew.co.za
Spain			
<b>Assembly Sales Service</b>	<b>Bilbao</b>	SEW-EURODRIVE ESPAÑA, S.L. Parque Tecnológico, Edificio, 302 E-48170 Zamudio (Vizcaya)	Tel. +34 94 43184-70 Fax +34 94 43184-71 <a href="http://www.sew-eurodrive.es">http://www.sew-eurodrive.es</a> sew.spain@sew-eurodrive.es
Sweden			
<b>Assembly Sales Service</b>	<b>Jönköping</b>	SEW-EURODRIVE AB Gnejsvägen 6-8 S-55303 Jönköping Box 3100 S-55003 Jönköping	Tel. +46 36 3442-00 Fax +46 36 3442-80 <a href="http://www.sew-eurodrive.se">http://www.sew-eurodrive.se</a> info@sew-eurodrive.se
Switzerland			
<b>Assembly Sales Service</b>	<b>Basel</b>	Alfred Imhof A.G. Jurastrasse 10 CH-4142 Münchenstein bei Basel	Tel. +41 61 417 1717 Fax +41 61 417 1700 <a href="http://www.imhof-sew.ch">http://www.imhof-sew.ch</a> info@imhof-sew.ch
Thailand			
<b>Assembly Sales Service</b>	<b>Chonburi</b>	SEW-EURODRIVE (Thailand) Ltd. 700/456, Moo.7, Donhuaroh Muang Chonburi 20000	Tel. +66 38 454281 Fax +66 38 454288 sewthailand@sew-eurodrive.com
Tunisia			
<b>Sales</b>	<b>Tunis</b>	T. M.S. Technic Marketing Service 5, Rue El Houdaibiah 1000 Tunis	Tel. +216 71 4340-64 + 71 4320-29 Fax +216 71 4329-76 tms@tms.com.tn
Turkey			
<b>Assembly Sales Service</b>	<b>Istanbul</b>	SEW-EURODRIVE Hareket Sistemleri San. ve Tic. Ltd. Sti. Bagdat Cad. Koruma Cikmazi No. 3 TR-34846 Maltepe ISTANBUL	Tel. +90 216 4419163 / 164 3838014/15 Fax +90 216 3055867 <a href="http://www.sew-eurodrive.com.tr">http://www.sew-eurodrive.com.tr</a> sew@sew-eurodrive.com.tr
Ukraine			
<b>Sales Service</b>	<b>Dnepropetrovsk</b>	SEW-EURODRIVE Str. Rabochaja 23-B, Office 409 49008 Dnepropetrovsk	Tel. +380 56 370 3211 Fax +380 56 372 2078 <a href="http://www.sew-eurodrive.ua">http://www.sew-eurodrive.ua</a> sew@sew-eurodrive.ua
USA			
<b>Production Assembly Sales Service</b>	<b>Greenville</b>	SEW-EURODRIVE INC. 1295 Old Spartanburg Highway P.O. Box 518 Lyman, S.C. 29365	Tel. +1 864 439-7537 Fax Sales +1 864 439-7830 Fax Manuf. +1 864 439-9948 Fax Ass. +1 864 439-0566 Telex 805 550 <a href="http://www.seweurodrive.com">http://www.seweurodrive.com</a> cslyman@seweurodrive.com
<b>Assembly Sales Service</b>	<b>San Francisco</b>	SEW-EURODRIVE INC. 30599 San Antonio St. Hayward, California 94544-7101	Tel. +1 510 487-3560 Fax +1 510 487-6381 cshayward@seweurodrive.com

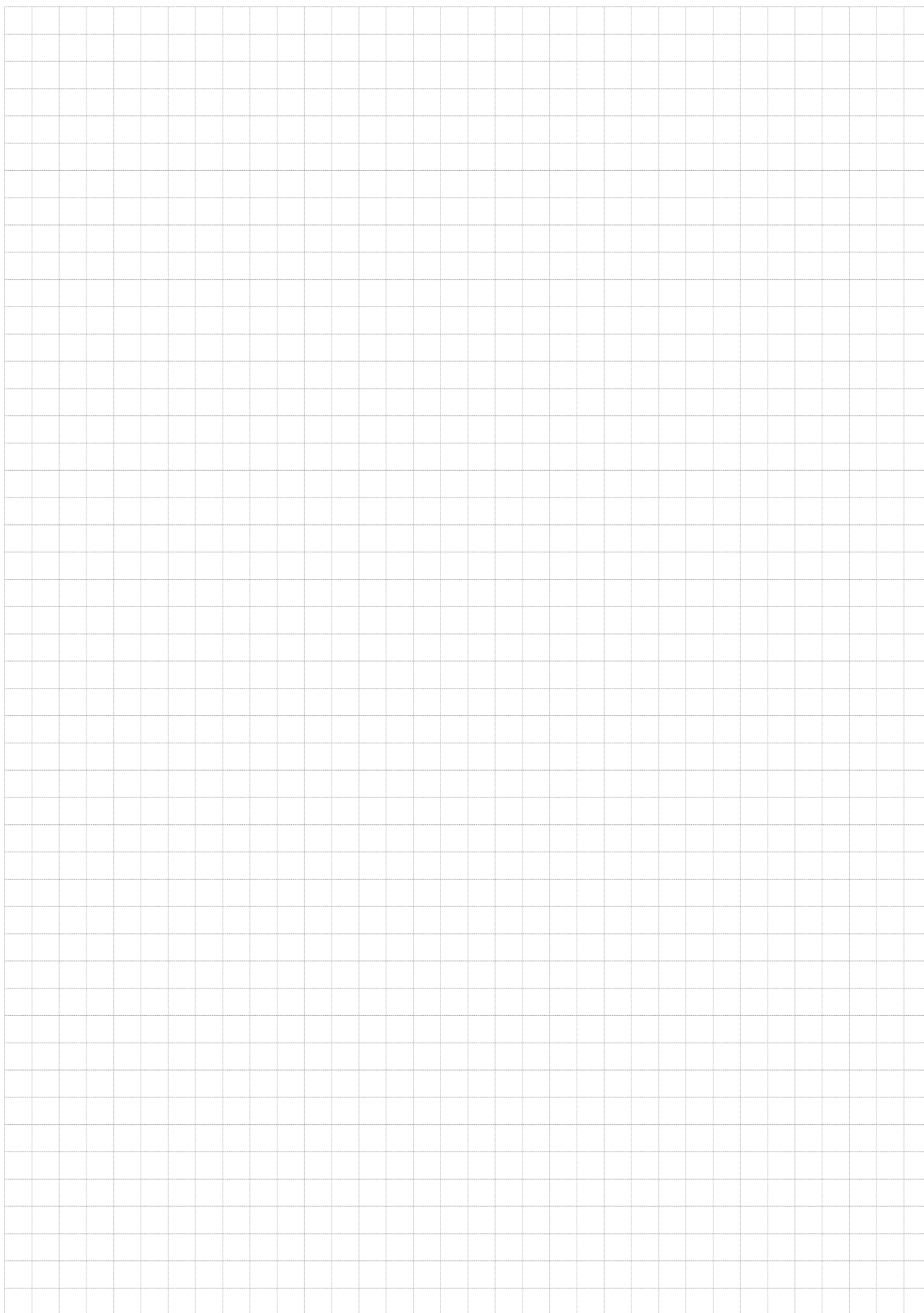


USA			
	<b>Philadelphia/PA</b>	SEW-EURODRIVE INC. Pureland Ind. Complex 2107 High Hill Road, P.O. Box 481 Bridgeport, New Jersey 08014	Tel. +1 856 467-2277 Fax +1 856 845-3179 csbridgeport@seweurodrive.com
	<b>Dayton</b>	SEW-EURODRIVE INC. 2001 West Main Street Troy, Ohio 45373	Tel. +1 937 335-0036 Fax +1 937 440-3799 cstroy@seweurodrive.com
	<b>Dallas</b>	SEW-EURODRIVE INC. 3950 Platinum Way Dallas, Texas 75237	Tel. +1 214 330-4824 Fax +1 214 330-4724 csdallas@seweurodrive.com
Additional addresses for service in the USA provided on request!			
Venezuela			
<b>Assembly Sales Service</b>	<b>Valencia</b>	SEW-EURODRIVE Venezuela S.A. Av. Norte Sur No. 3, Galpon 84-319 Zona Industrial Municipal Norte Valencia, Estado Carabobo	Tel. +58 241 832-9804 Fax +58 241 838-6275 <a href="http://www.sew-eurodrive.com.ve">http://www.sew-eurodrive.com.ve</a> ventas@sew-eurodrive.com.ve sewfinanzas@cantv.net











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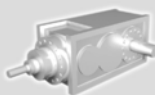
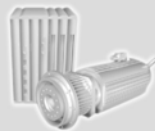


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## AL470-MX / Mixer Frac Tank

Strapping Chart +/- 3%

Inches	Gallons	Barrels	Inches	Gallons	Barrels	Inches	Gallons	Barrels
1	27.16	0.65	33	5520.92	131.45	65	11687.06	278.26
2	107.93	2.57	34	5697.01	135.64	66	11884.90	282.97
3	241.32	5.75	35	5873.10	139.84	67	12082.74	287.68
4	414.32	9.86	36	6050.17	144.05	68	12280.58	292.39
5	590.41	14.06	37	6229.16	148.31	69	12478.42	297.11
6	766.50	18.25	38	6410.12	152.62	70	12676.27	301.82
7	942.59	22.44	39	6593.04	156.98	71	12874.11	306.53
8	1118.68	26.64	40	6777.90	161.38	72	13071.95	311.24
9	1294.77	30.83	41	6964.71	165.83	73	13269.79	315.95
10	1470.86	35.02	42	7153.55	170.32	74	13467.63	320.66
11	1646.95	39.21	43	7344.26	174.86	75	13665.48	325.37
12	1823.04	43.41	44	7536.92	179.45	76	13863.32	330.08
13	1999.13	47.60	45	7731.52	184.08	77	14061.16	334.79
14	2175.22	51.79	46	7928.08	188.76	78	14259.00	339.50
15	2351.31	55.98	47	8125.90	193.47	79	14456.84	344.21
16	2527.40	60.18	48	8323.74	198.18	80	14654.69	348.92
17	2703.49	64.37	49	8521.58	202.89	81	14852.53	353.63
18	2879.58	68.56	50	8719.42	207.61	82	15050.37	358.34
19	3055.67	72.75	51	8917.27	212.32	83	15248.21	363.05
20	3231.76	76.95	52	9115.11	217.03	84	15446.06	367.76
21	3407.85	81.14	53	9312.95	221.74	85	15643.90	372.47
22	3583.94	85.33	54	9512.79	226.45	86	15841.74	377.18
23	3760.03	89.52	55	9708.63	231.16	87	16039.58	381.89
24	3936.12	93.72	56	9906.48	235.87	88	16237.42	386.61
25	4112.21	97.91	57	10104.32	240.58	89	16435.27	391.32
26	4288.30	102.10	58	10302.16	245.29	90	16633.11	396.03
27	4464.39	106.29	59	10500.00	250.00	91	16830.95	400.74
28	4640.48	110.49	60	10697.84	254.71	92	17028.79	405.45
29	4816.56	114.68	61	10895.69	259.42	93	17226.63	410.16
30	4992.65	118.87	62	11093.53	264.13	94	17424.48	414.87
31	5168.74	123.07	63	11291.37	268.84	95	17622.32	419.58
32	5344.83	127.26	64	11489.21	273.55			

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# DATA SHEET



## Three Phase Induction Motor - Squirrel Cage

Customer	:			
Product line	: W21 Explosion-proof Motor NEMA Premium Efficiency Three-Phase		Product code :	14284619
			Catalog # :	01018XT3E215TC
Frame	: L215TC		Locked rotor time	: 27s (cold) 15s (hot)
Output	: 10 HP (7.5 kW)		Temperature rise	: 80 K
Poles	: 4		Duty cycle	: Cont.(S1)
Frequency	: 60 Hz		Ambient temperature	: -20°C to +40°C
Rated voltage	: 208-230/460 V		Altitude	: 1000 m.a.s.l.
Rated current	: 28.1-25.4/12.7 A		Protection degree	: IP55
L. R. Amperes	: 183-165/82.5 A		Cooling method	: IC411 - TEFC
LRC	: 6.5x(Code H)		Mounting	: F-1
No load current	: 9.48-11.0/5.50 A		Rotation <sup>1</sup>	: Both (CW and CCW)
Rated speed	: 1765 rpm		Noise level <sup>2</sup>	: 58.0 dB(A)
Slip	: 1.94 %		Starting method	: Direct On Line
Rated torque	: 29.8 ft.lb		Approx. weight <sup>3</sup>	: 229 lb
Locked rotor torque	: 210 %			
Breakdown torque	: 300 %			
Insulation class	: F			
Service factor	: 1.15			
Design	: B			
Output	25%	50%	75%	100%
Efficiency (%)	89.4	90.2	91.0	91.7
Power Factor	0.42	0.62	0.75	0.81
	Foundation loads			
			Max. traction	: 379 lb
			Max. compression	: 615 lb
		<u>Drive end</u>		<u>Non drive end</u>
Bearing type	:	6308 2RS		6207 2RS
Sealing	:	Oil Seal		Lip Seal
Lubrication interval	:	-		-
Lubricant amount	:	-		-
Lubricant type	:	Mobil Polyrex EM		
Notes				
This revision replaces and cancel the previous one, which must be eliminated. (1) Looking the motor from the shaft end. (2) Measured at 1m and with tolerance of +3dB(A). (3) Approximate weight subject to changes after manufacturing process. (4) At 100% of full load.			These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.	
Rev.	Changes Summary		Performed	Checked
Performed by				
Checked by			Page	Revision
Date	27/04/2020		1 / 2	

# DATA SHEET

## Three Phase Induction Motor - Squirrel Cage



Customer : \_\_\_\_\_

### Thermal protection

ID	Application	Type	Quantity	Sensing Temperature
1	Winding	Thermostat - 2 wires	1 x Phase	155 °C

Rev.	Changes Summary	Performed	Checked	Date
Performed by				
Checked by			Page	Revision
Date	27/04/2020		2 / 2	

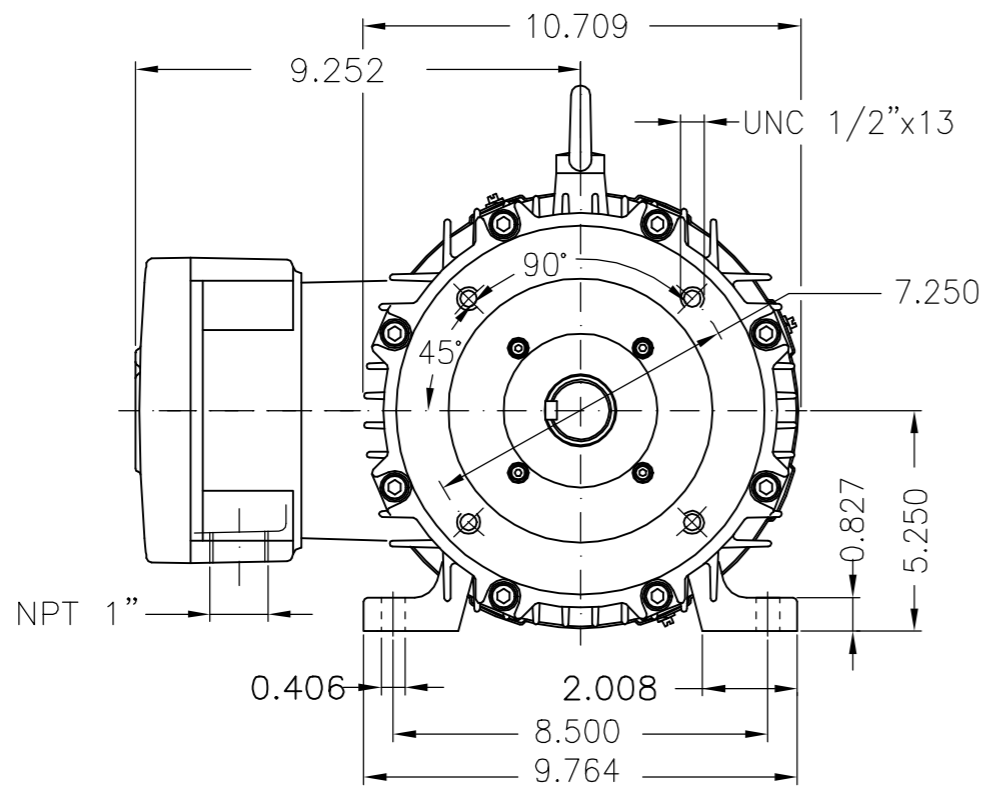
EIXO/SHAFT	
PADRÃO/STANDARD	X
OPCIONAL/OPTIONAL	
ESPECIAL/SPECIAL	

Dimensões em polegada  
Dimensions in inches

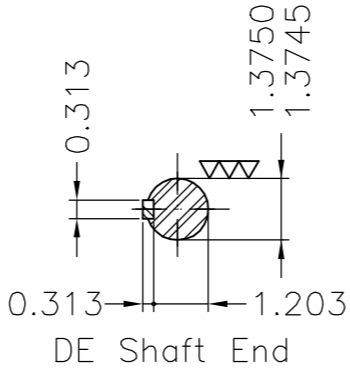
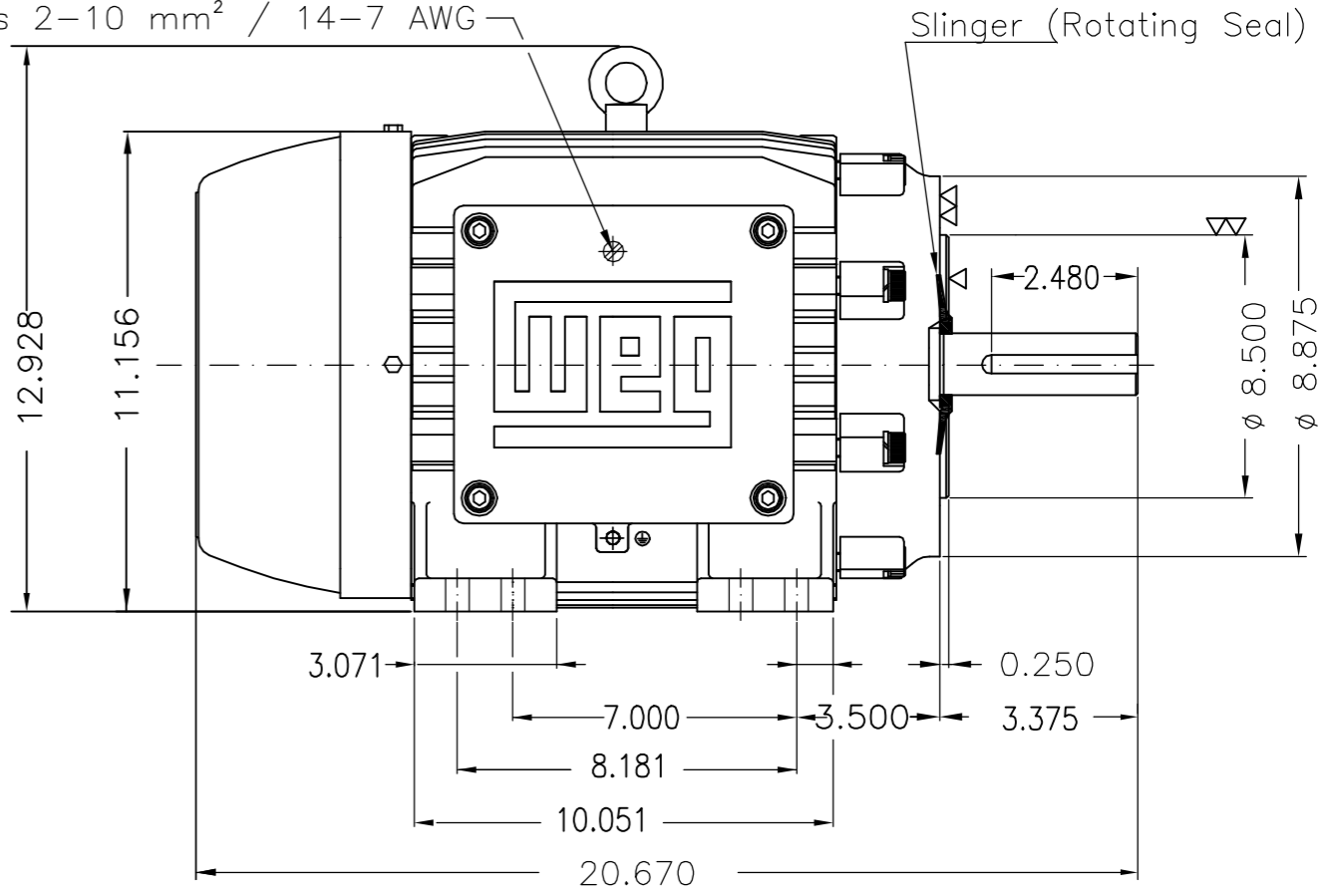
**CERTIFIED  
WEG MOTORES**  
Certified document.  
Not subject to changes.

THIS IS AN UPDATED REVISION, THE  
PREVIOUS ONE MUST BE DISREGARDED.

A  
B  
C  
D  
E



Grounding for leads 2-10 mm<sup>2</sup> / 14-7 AWG



Caixa de ligação W21 / W21 terminal box						
Cor RAL 5009 / Color RAL 5009						
Plano de pintura 202P / Painting plan 202P						
Forma construtiva NEMA F-1 / Mounting NEMA F-1						
Forma construtiva B34D / Mounting B34R(D)						
<b>WEG ELECTRIC CORPORATION - WEC</b>						
500001594952		ALTERADO CONF. CLAIM 415204042	RICLAV		20.05.2019	03
500001427824		REMOVED HIDDEN NOTE CODE 485	ERIC	MENSOR	MENSOR	13.03.2018 02
ECM	LOC	RESUMO MODIFICAÇÃO	EXECUTADO	VERIFICADO	LIBERADO	DATA
ECM	LOC	SUMMARY OF MODIFICATIONS	EXECUTED	CHECKED	RELEASED	DATE
EXEC. /EXECUTED	NSCHMIDT	THREE-PHASE EXPLOSION PROOF MOTOR FRAME L215TC IP55 TEFC	10005474706		000   03	
VERIF. /CHECKED						
LIBER. /RELEASED	DANIELAW					
DATA LB /REL DT	18.01.2018	WMO	Jaraguá do Sul	Product Engineering	FOLHA/SHEET	1 / 1

10 HP 04 Poles 60Hz 414924098/1

UNCONTROLLED COPY RELEASED ZME A3

MADE IN BRAZIL


**W21X NEMA**  
**Premium**

14284619



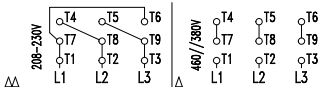
LISTED

CC029A

*Inverter Duty Motor*  
*Severe Duty*

MODEL 01018XT3E215TC

PH 3	FR L215TC		
HP(kW) 10.0(7.5)		HZ 60	IP55
V 230/460		A 25.4/12.7	
RPM 1765		NEMA NOM EFF 91.7%	
PF 0.81		SFA 29.2/14.6	DES B
INS CL F $\Delta$ T 80 K		SF 1.15	ENCL TEFC
DUTY CONT.		CODE H	ALT 1000 m.a.s.l.
AMB 40°C	USABLE @208V	28.1 A	SF 1.15 SFA 32.3

**10HP 7.5kW 50Hz 380V 15.3A 1450RPM SF1.00 EFF 88.5% (IE1)**

 → 6308-2RS MOBIL POLYREX EM  
 → 6207-2RS

236 Lbs


 TEMP CODE T3C  
 CSA/UL: Class I - Div. 1 - Groups C and D  
 CSA: Class II - Div. 1 - Groups F and G  
 CSA: Class I - Zone 1 - IIB

EXPLOSION PROOF MOTOR

FOR USE ON VPWM VFD 1000:1VT, 20:1CT, 1.0SF, T3C, AMB 40°C.



# INSTALLATION AND MAINTENANCE



# WEG ELECTRIC MOTORS



## INTRODUCTION

Maintenance of electric motors embodies two important aspects, the mechanical and the electrical aspects. The knowledge of these two areas is important to keep the overall equipment well maintained.

Besides the electric aspect, we will approach several items like the correct specification and motor connection, as well as techniques and methods for recover from eventual electric damages, fundamental factors for its perfect functioning and durability.

However, many people involved with electric motors maintenance think in electrical problems only. We will see that this kind of machine is subject to all kind of mechanical problems too, since it has mechanical moving parts.

Just to highlight, while a regular medium size car bearing travels around 27 millions of rotations during 50,000 km, an electric motor, 1800 rpm (4 pole/60Hz) running 24 hours/day reaches the same 27 millions of rotations in about only 10 days and 9 hours. It should be not a surprise if the major mechanical problems of the electric machines are related to the **bearings**.

Many times, because of the application severity, continuous operation, the basic maintenance is left to a second plan. Indispensable factors to the motor operation life like the regreasing, alignment, specification and dimensioning, if not carried out, will reflect negatively on to the motor performance. As a consequence, premature failures may occur as well as unexpected losses of production.

As a way to contribute with the **maintenance technicians**, we made this course “Electric Motors Installation and Maintenance”, wishing it will be the beginning of a new road, that if been traveled according the desirable procedures and methods, may bring satisfactory results of all maintenance aspects.



# ELECTRIC MOTORS INSTALLATION AND MAINTENANCE

## 1 - NAMEPLATE

The nameplate has the information that shows the performance and nominal characteristics of the motors according Standards.

MADE IN BRAZIL		CC029A		ALSO ENERGY VERIFIED CSA C390-98		Class I – Division 2 Groups B, C and D CL. I ZONE 2 IIC T3C		19127
PH 3	FRAME 404/5T	BJ88578 29SET03		MODEL 10018EP3E405T				
HP(KW) 100(75)		RPM 1775						
ENCL TEFC	TYPE ET	PF 0.87	IP55					
SF 1.25	INS CL F	$\Delta$ 80 K	CODE G	HZ 60				
NEMA NOM EFF 94.5	3/4-LOAD EFF 94.5	DES B	MAX AMB. 40°C					
V 208-230/460		A 229/115						
DUTY CONT.	SFA 286/143 A	ALT 1000 m.a.s.l						
→ NU-316-C3 POLYREX EM-EXXON		111B lbs						
→ 6314-C3 34 g 6000 h								

208-230 V

460 V

Three Phase Electric Motor Nameplate

### 1.1 NAMEPLATE INTERPRETATION

For a three phase motor:

**~ 3:** indicates it is an alternated current three phase electric motor

**404/5T:** the number “404/5” indicate the motor frame size, it is the distance measured between the shaft center hole down to foot base.

**29SET03:** this is the manufacturing date code, in this case it means a motor manufactured in September 29, 2003.

**BJ88578:** this is the motor serial number composed by two letters and five numbers. This code is engraved on the all three phase and single phase motors IP55 manufactured since January 1995.



**60Hz:** power supply frequency for which the motor was designed for.

**Des. B:** motor design, which is, speed against torque performance.

**HP (kW) 100 (75):** shows the motor output power in HP and in kW.

**1775 RPM:** this value is called nominal speed or full load speed.

**SF 1.25:** it is the service factor and it's refer to a factor when applied to the nominal output power, shows the permissive output power that can be applied continuously to the motor under specific conditions, which is, some power reserve that gives the motor the capability of support better some disadvantageous working conditions.

**INS.F:** shows the motor insulation class. For this particular case, the temperature rise is 80 K. There are three insulation classes used by WEG: B (temp. rise of 80 K), F (temp. rise of 105K) e H (temp. rise of 125 K).

**CODE G:** relationship between the starting current (IP) and nominal current (IN). In other words, we can say the starting current is 8.8 times bigger then the nominal current.

**IP 55:** Degree of protection according IEC std. First digit refers to the protection against solid bodies and the second digit against water. Tables showing the meaning of each digit you can find on the Electric Motor Manual from WEG.

**208-230/460V:** voltages to supply this motor. It has 12 leads and can be connected to power supplies where the voltage is 208-230V (delta / parallel) and 460V (delta series).

**229/115A:** those are the electric current values in Amps for the voltages of 208-230/460V.

**DUTY CONT.:** duty cycle on which this motor was designed for. In this case it refers to a constant load and time rating continuously.

**Max. Amb. :** It is the maximum ambient on which this motor was designed for. When it is not shown in the nameplate it should be considered as 40°C.

**ALT.:** is the maximum altitude on which the motor was designed for. When not shown in the nameplate it should be considered as 1000 meters.



Nameplate also indicates the possible electrical diagrams that can be connected to the power supply.

Below the main data, we can find the type of bearings. For this particular case bearings are NU-316-C3 and 6314-C3. The type and quantity of grease (grams) as well as the lubrication interval time is also indicated.

The motor approximately weight is indicated too (1118 Lbs).

**EFF. % = 94.5%:** It is the motor efficiency. It changes according the load.

**PF 0.87:** this is the motor power factor, meaning, the relationship between the active power (kW) and the reactive power (kVA). The electric motor absorbs active energy (which produce useful power) and reactive energy (necessary for the winding magnetization).

**19127** = Indicates the motor manufacturing item.

For single phase motors there are no serial number as identification, only the motor item number. Be aware that single phase motors nameplate has the capacitor value indicated also. For this example we have 1 x 53 up to 64  $\mu$ F at 250V.

## 2 – ELECTRICAL FEATURES

### 2.1 – FUNDAMENTAL PRINCIPLES

#### Electric Motors

Electric motor is a machine designed to transform electric energy in mechanical energy. It is the most widely usual type of motors, because it combines the following advantages: The use of electric energy – low cost, easy to transport, cleanness and easy to command – easy construction, low cost, highly adapted to the different loads and better efficiency.

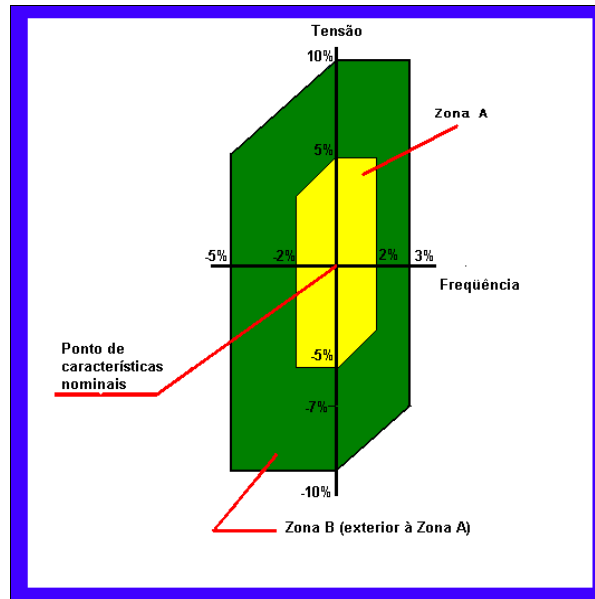
**Three Phase Motors:** The three-phase winding is similar to the above mentioned single phase; the difference is now we have three phases symmetrically distributed, or in other words, displaced against each other of 120°. If this system is fed by a three phase power supply, each current I1, I2 and I3 will create in the same way the magnetic fields H1, H2 and H3. These fields are displaced against each other of 120°.



## 2.2 – MOTOR POWER SUPPLY

It is very important to check for the correct power supply. The selections of the wires should be based according to the motor nominal current, according to standards.

## 2.3 – VOLTAGE AND FREQUENCY VARIATION



Voltage and frequency variation graph according to standards.

Voltage and frequency variation was divided into two zones:

- **Zone A:** Motor should be able to perform its basic function continuously, but might not be met completely all its performance characteristics as at nominal voltage and frequency, presenting some deviation. Temperature rise can be higher than the temperature at nominal voltage and frequency.
- **Zone B:** Motor should be able to perform its basic function, but can present higher deviations than Zone A, regarding the performance characteristics. Temperatures can be higher than Zone A. It is not recommended motor running for long time in this Zone.



### 2.3 – START UP AND PRELIMINARY CHECKINGS:

Before start the electric motor for the first time it is necessary:

1	Check if it can turn freely the shaft, removing any locking device used during transportation;
2	Check if the power supply has the same frequency and voltage as indicated in the motor nameplate.
3	Check if the connections are according the motor nameplate diagram, and check if all screws are properly tightened
4	Start the motor uncoupled and check if the sense of rotation is correct
5	Check if the motor is firmly secured in its base and if all coupling elements are correctly mounted and properly aligned
6	Check if the motor is properly grounded. If there is no requirement for the motor to be isolated, it is necessary a properly grounding. Please follow the local standards for grounding system
7	For grounding the motor you should use the inside terminal box grounding screw or the grounding screw located at the motor foot.
8	Check the power supply cables and also all control and protection wiring according the local technical standards
9	If the motor was kept in stock for a long period, or was not running for a long period, check the insulation resistance before start the motor
10	To change the sense of direction in a three phase motor, just invert two phases connected to the power supply.
11	Motors that have an arrow marking the sense of rotation must rotate only on that direction.



### 3 – ELECTRIC MAINTENANCE

Maintenance of electric motor is also important as the correct installation is.

In this chapter it will be described the main tests that normally are performed to electrically evaluate the motors.

#### 3.1 – MAIN ELECTRIC TESTS

##### 3.1.1 – Insulation Resistance

**Purpose:** To check the insulation condition and to have a quantitative record of the result.

**Procedure:** Use a megohmmeter with at least 500V DC. Connect the motor lead wires all together into the positive (+) terminal of the megohmmeter and the negative (-) terminal to the motor frame. Any remaining wire from protection devices for example, not under test, must be grounded to the motor frame. Apply the test voltage during 1 minute and take the reading.

**Caution:** Make sure to discharge the motor lead wires before touch it. This can be done placing the lead wires terminals against the motor frame.

**Important:**

Periodical records are useful to trace the motor conditions to operate safely.

Table below shows the limits for the insulation resistance.

Limit Value (M Ω)		Insulation Evaluation
-----	2	Dangerous
2	50	Bad
50	100	Unsatisfactory
100	500	<b>GOOD *</b>
500	1000	Very Good
Above 1000		Excellent

**\*Minimum requirement for acceptance.**



**Warning:**

If the insulation resistance is less than 100 MΩ , the winding must be dried according to the following:

Warm it up inside an oven at a minimum temperature of 80°C increasing 5°C every hour until 105°C, remaining under this temperature for at least one hour.

Check if the stator insulation resistance remains constant within the accepted values. If not, stator must be reimpregnated.

**3.1.2 – Polarization Index**

**Purpose:** To verify the insulation resistance condition, measuring the winding insulation related to the motor metallic mass.

**Procedure:** It's necessary to use a megohmmeter.

Connect the motor lead wires all together into the positive (+) terminal of the megohmmeter and the negative (-) terminal to the motor frame. Any remaining wire from protection devices for example, not under test, must be grounded to the motor frame. Apply the test voltage and take a reading at 1 minute and 10 minutes.

**Caution:** Make sure to discharge the motor lead wires before touch it. This can be done placing the lead wires terminals against the motor frame.

The Polarization Index is:

$$IP = \frac{R(10')}{R(1')}$$

Table below shows the limits for the Polarization Index.

Limit Value		Insulation Evaluation
Higher or equal	Lower	
-----	1.0	Dangerous
1.0	1.5	Bad
1.5	2.0	Unsatisfactory
2.0	3.0	<b>GOOD *</b>
3.0	4.0	Very Good
4.0		Excellent

**\*Minimum requirement for acceptance.**



### 3.1.3 – Winding Resistance

**Purpose:** To check if the resistance is balanced and according the factory specification.

**Procedure:** It will be necessary a multimeter, Kelvin bridge or Wheatstone bridge according the value to be measured.

Check the phase resistance and the unbalancing among them. Also record the ambient temperature for reference.

The resistance unbalancing should be lower or equal to 3%, according to below:

$$\frac{\text{Higher resistance}}{\text{Lower resistance}} - 1 ( \times 100) \leq 3\%$$

**Example:**

Phase1: 0.125Ω    Phase2: 0.130Ω    Phase3: 0.120Ω

We have:

$$DR = \frac{0.130}{0.120} - 1 ( \times 100)$$

$$DR = (1.0833 - 1) \times 100 = 8.33\%$$

For this example the result is higher than the limit, so it must be something wrong in the winding.



### 3.1.4 – No Load Current

**Purpose:** To check the phase current and it's balancing.

**Procedure:** Run the motor at no load with nominal voltage and frequency and check the current unbalancing according below:

$$DI = (DMD / MTF) \times 100$$

Where:

**DI** = Current Unbalancing

**DMD** = Higher phase current deviation against the average

**MTF** = Average current

**Causes:**

Current unbalancing may be caused by voltage unbalancing, wrong winding or load unbalanced distribution.

**Limits:**

For VII, VI and IV pole motors, unbalancing should be not higher than 10% ( $DI \leq 10\%$ );

For II pole, the maximum is 20% ( $DI \leq 20\%$ ).

**Example:**

10 HP, IV Pole, 220/380V Three phase Motor

$$I1 = 15 \text{ A}$$

$$I2 = 12 \text{ A}$$

$$I3 = 11 \text{ A}$$

$$MTF \text{ (Average current)} = (I1 + I2 + I3) / 3 = (15 + 12 + 11) / 3$$

$$MTF = 12.6 \text{ A}$$

$$DMD = I1 - MTF = 15 - 12.6 = 2.4 \text{ A}$$

$$DI = (2.4 / 12.6) \times 100 = 19\% \rightarrow \text{motor or power supply with problem!}$$



### 3.1.5. Current Unbalancing Investigation

To investigate a motor current unbalancing it is important that the motor should be inspected in the original site. The motor should only be removed from its base if are sure the cause of unbalancing is the motor.

During the investigation we suggest two tests:

1 – Voltage unbalancing test:

Normally the current unbalancing is caused by some voltage unbalancing. As an example a voltage unbalancing of 1% can provoke a current unbalancing up to 5% or even more. To calculate the voltage unbalancing you can follow the script below:

Measure and record the voltage between phases ( $V_{rs}$ ,  $V_{st}$  e  $V_{tr}$ ) with the motor in normal operation. Measurements must be made into the motor lead wires instead the panel.

Calculate the average voltage(  $V_m$  ) :  $V_m = (V_{rs} + V_{st} + V_{tr}) / 3$

Calculate the difference between the phase voltages and the average voltage (dif):

$$\text{dif 1} = V_m - V_{rs}$$

$$\text{dif 2} = V_m - V_{st}$$

$$\text{dif 3} = V_m - V_{tr}$$

Identify the highest dif disregarding the negative signal and calculate the percentage of unbalancing:

$$\% \text{ unbalancing} = (\text{highest dif} / V_m) * 100\%$$

OBS: The current unbalancing is calculated of the same way using the current instead voltage in the above formulas.



Example:

$$V_{rs} = 445V$$

$$V_{st} = 435V$$

$$V_{tr} = 442V$$

$$V_m = (445 + 435 + 442) / 3 \quad V_m = 440.67V$$

$$\text{dif 1} = 440.67 - 445 \quad \text{dif 1} = 4.33V$$

(disregarding the negative signal)

$$\text{dif 2} = 440.67 - 435 \quad \text{dif 2} = 5.67V$$

$$\text{dif 3} = 440.67 - 442 \quad \text{dif 3} = 1.33V$$

(disregarding the negative signal)

$$\% \text{ unbalancing} = (5.67 / 440.67) * 100\% = 1.29\%$$

**Important:** Some Stds. define that an electric motor can delivery full output power since the voltage unbalancing is equal or lower than 1%. When unbalancing is higher than 1% the output power should be reduced according table below.

Voltage unbalancing %	Output power reduction
1 %	0 %
2 %	4,9 %
3 %	10 %
4 %	16 %
5 %	24 %

## 2 – Checking the source of unbalancing (motor or power supply)

To find out this you should use the method of swapping the motor power leads. Firstly measure and record the motor currents as shown in picture 1:  $I_{r1}$ ,  $I_{s2}$  e  $I_{t3}$ .

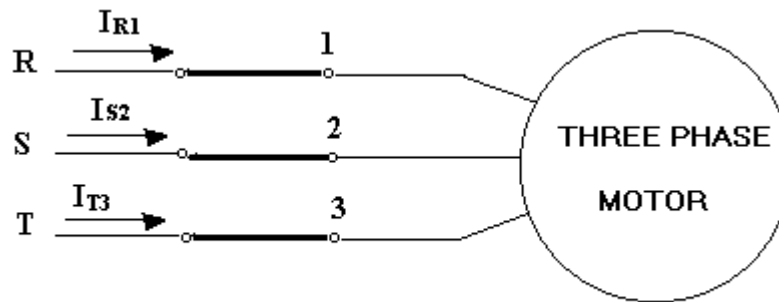
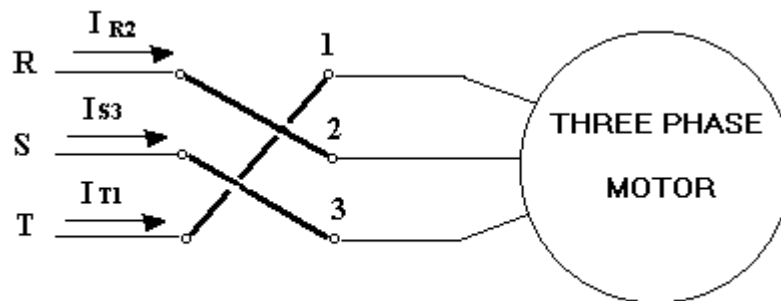


Figura 1

Secondly reconnect the motor according picture 2. Observe that all three phases were swapped and the motor will turn at the same original sense of rotation. It is very important to swap the cables at the motor terminal box and not at the panel. If not possible to do this at the



Picture 2

terminal box just remember we are looking for swapping all the phases. Then measure and record the currents  $I_{r2}$ ,  $I_{s3}$  e  $I_{t1}$ .

To identify where the source of unbalancing is we need to compare the measured currents after and before the swapping:

1- If  $I_{r2} = I_{r1}$ ,  $I_{s3} = I_{s2}$  e  $I_{t1} = I_{t3}$  ---→ unbalancing source is the power supply

2- If  $I_{r2} = I_{s2}$ ,  $I_{s3} = I_{t3}$  e  $I_{t1} = I_{r1}$  ----→ unbalancing source is the motor

We emphasize that normally the source of unbalancing is not the motor but the power supply: voltage unbalancing, single phase loads not equally distributed over the phases, long power cables, bad contacts in starters and or contactors are the most common causes of problems. However if

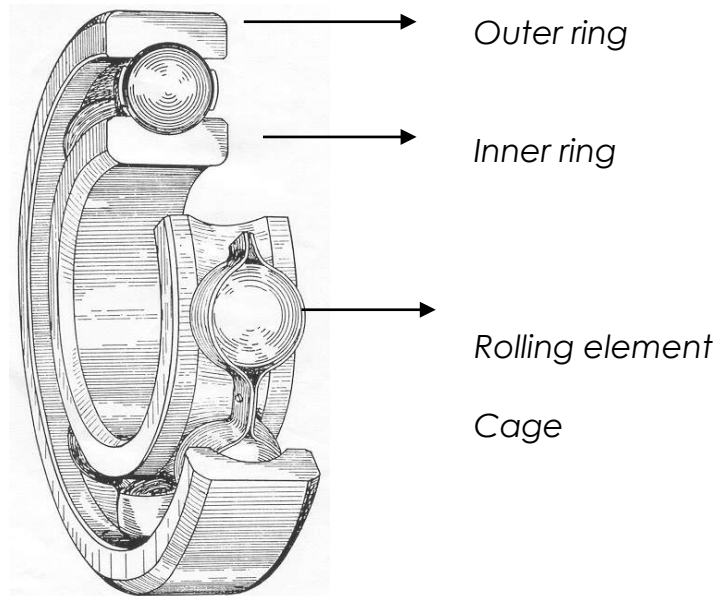


the test show the motor is causing the problem it should be inspected. Check the resistance with all phases opened using a proper instrument (Kelvin or Wheatstone bridge) and look for some possible unbalancing between resistances. According the design motors can allow a maximum of 3% between phase resistances. If higher then 3% then the motor should be opened to be checked against bad connections or poor welding between lead wires and winding that might be able to correct. As a last solution, motor should be rewound.

## 4. MECHANICAL MAINTENANCE

### 4.1. BEARINGS:

**Bearings** are devices where the load is transferred through rotating moving elements.



*Example of a ball bearing.*

#### 4.1.1. Bearing Classification:

Bearings are classified according:

- Type of bearing;
- Width;
- Bore diameter.





X   X   XX



The last digits multiplied by 5 indicate the bearing bore in millimeter.

Second number indicates the bearing series of width and external diameter.

First number indicates the type of bearing.

**Example:**

6 2 09 → 09 x 5 = 45 mm (bearing bore)

Ext. Dia. = 85 mm Width = 19 mm according

Ball bearing.

Most of the motors uses ball bearings in the drive end as well as in the non drive end.

NU 3 22 → 22 x 5 = 110 mm (bearing bore)

Ext. Dia. = 240 mm Width = 50 mm according

Roller bearing.

Roller bearings are used when the motor is submitted to very high **radial effort** like when coupled with pulley and belt.



**! It is not recommended to use roller bearings when the motor is direct coupling. Roller bearings require radial forces to work properly.**

#### **Exceptions:**

Bearings from series XX01, XX02 and XX03 do not present bore diameter according the above mentioned rule:

**XX01:** bore of 12mm;

**XX02:** bore of 15mm;

**XX03:** bore of 17mm;

#### **4.1.2. Sealing:**

The bearing sealing is indicated after the numbers (suffix).

Z – metallic sealing (shield) in one side of bearing;

ZZ – double metallic sealing (shielded in both bearing sides);

2RS / DDU – double rubber sealing, with contact (both sides of bearing).

#### **Example:**

**6203 – ZZ:** ball bearing, width series 3, bore of 17mm diameter, with **double metallic seal** (shield).

#### **4.1.3. Internal Clearances:**

Indicated bearing clearances are measured radial (clearance between the moving elements and the raceways);

Are indicated after the bearing numbering (suffix);

In crescent order: C1 - C2 - NORMAL - C3 - C4 - C5;

#### **Example:**

**6309 – C3:** ball bearing, width series 3, bore of 45mm diameter, **radial clearance C3** (higher than the normal clearance).

**! From frame size 160 M the WEG motors use C3 clearance bearings C3. It is very important to keep this feature during maintenances.**



#### 4.1.4. Guidelines to storage bearings:

Keep it into the original packing;

Clean environment, dry, vibration free;

Ambient temperature between 10°C and 30°C;

Humidity not greater than 60%;

Do not stock over green wood (fresh wood), touching walls or over stone floor;

Keep away from water pipelines or heaters;

Do not stock close to chemical products environments;

Maximum pile stock of 5 boxes;

Pre lubricated bearings (suffix Z, ZZ, DDU, 2RS) cannot be stocked more than two years;

Rotate the stock (first in first out);

**! When the bearing is assembled into the motor, turn the shaft regularly to renew the greasing between the moving elements and raceways.**

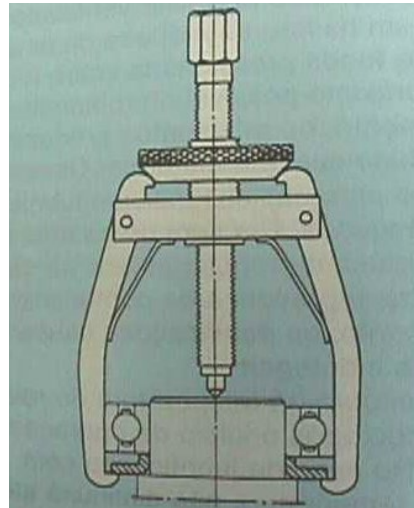
#### 4.1.5. Bearings disassembling:

There are many ways to disassembly bearings. Motors manufactured by WEG have a cylinder type bearing seat. For this case the disassembling can be mechanical, by oil spilling or by heating. The method choice might depend on the bearing sizes. For the bearings used in WEG motors, hydraulic and mechanical tools are enough. Bigger bearings might require heaters.

##### **Mechanical Tools:**

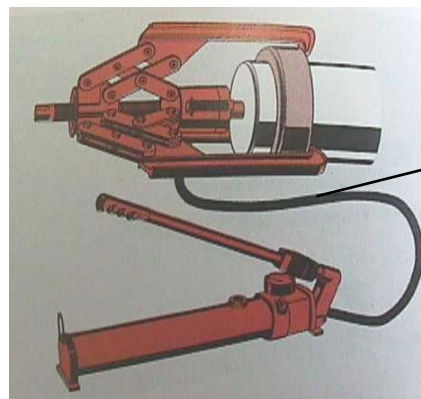
Small and medium sizes bearings (up to 6312) can be disassembled by a jaw puller, and the arms must support the inner bearing raceway (bearing is assembled into the shaft with some interference).

To avoid damage the shaft bearing seat, the puller should be correctly positioned; the use of auto centered puller will avoid such damage and the disassembling is faster.



**Jaw Puller supporting the bearing inner raceway.**

Medium sizes bearings assembled with interference require some good amount of strength to disassembly. In this case it is advisable to use some hydraulic jaw puller.



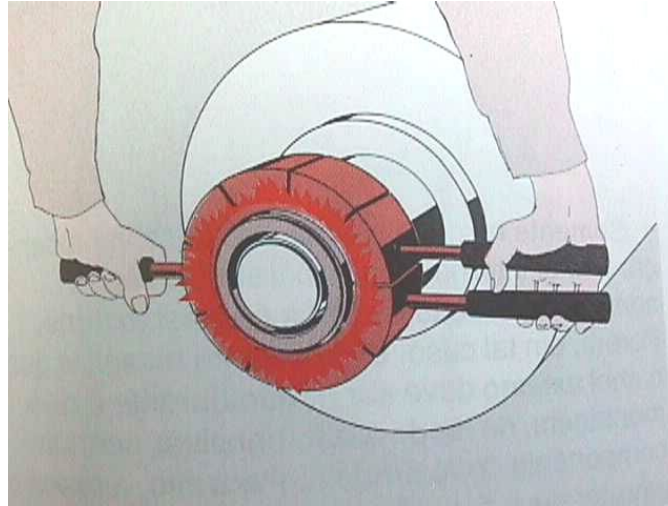
**Hydraulic Jaw Puller**

Heaters are used when removing roller bearings inner raceway. Bearing manufacturers developed an easier and practical system for this procedure. It is an Aluminum heating rings. They are available for all bearing sizes NU, NJ and NUP series, i.e. bearings without flanges or with only one flange on the inner ring. The rings are available as standard for the following bearing sizes: 204 to 252, 304 to 340, and 406 to 430. To disassembly is simple: first remove the external raceway with the cage; then spill some corrosion resistant oil over the inner raceway, high viscosity is better. Warm up the aluminum ring up to 280°C (536°F) and place it over the inner raceway;



squeeze it with the tool holders. When the inner ring is dilated, remove it together with the ring and separate one from the other.

It is also possible to use an induction heater when the aluminum rings are not available and disassembling are frequently.



*Aluminum ring to disassembly the roller bearing inner raceway.*

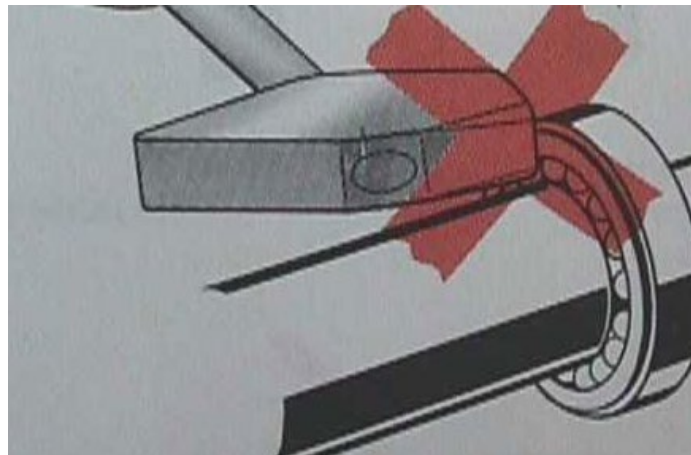
Some tips when disassembling bearings:

Always replace any rubber sealing: v 'ring and /or seals;

Make sure the shaft is firmly otherwise damage into the bearing or shaft may occur;

If the bearing will be reused, place it in the same position into the shaft. Before disassembly mark the bearing position;

**! Never use hammer directly over the bearing.**





#### 4.1.6. Bearing Assembly:

It is necessary to use the right method during assembly and to observe the cleaning rules in order to the bearing works properly. Assembly must be done in a dry and clean place.

Assembly can be done in 4 different ways: mechanic, hydraulic, by spillin oil and by heating. Bearing manufacturers supply most of the tools for assembling. Small bearings can be cold assembled, using a small press (up to 6312). Higher bearing sizes we recommend do it by heating.

##### **Cold Assembly:**

Bearings with bore size up to 60mm can be made with a hydraulic or mechanical press. A sleeve can be used between the press and the bearing **inner ring**.

##### **Hot Assembly:**

Bigger bearings are difficult to be cold assembled, so the bearing or one of its ring can be warmed up to facilitate the assembly.

The temperature difference between the shaft seat and the bearing depends on the fitting tolerance. Usually 80 (176) to 90°C (194°F) above the shaft temperature is enough to assemble it.

**! Never heat the bearing over 125°C (257°F).**

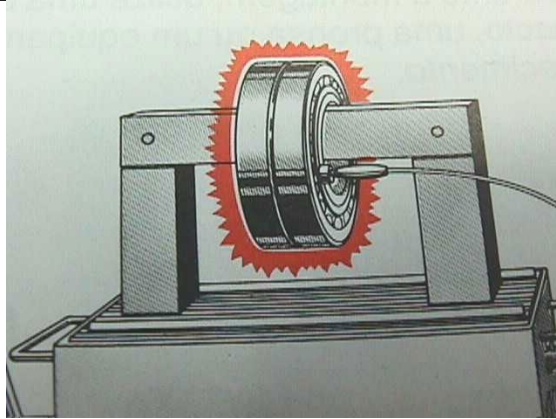
Use a thermometer to check the bearing temperature.

##### **Inductive Heater:**

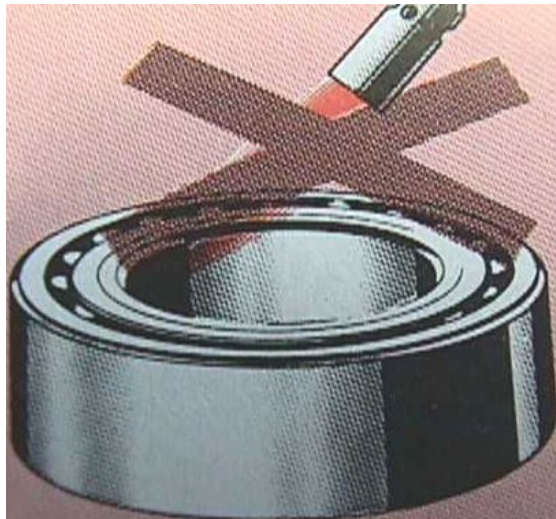
The inductive heater can be used on bearing assembly with interference on shaft. In this case the assembly is faster and simple and the bearing can be already lubricated.

**! Measure the temperature at the inner ring of the bearing : never exceed 125°C (257°F).**

**! Use a demagnetizer to avoid circulation of electrical current by the bearing.**



*Inductive Heater for Bearings*



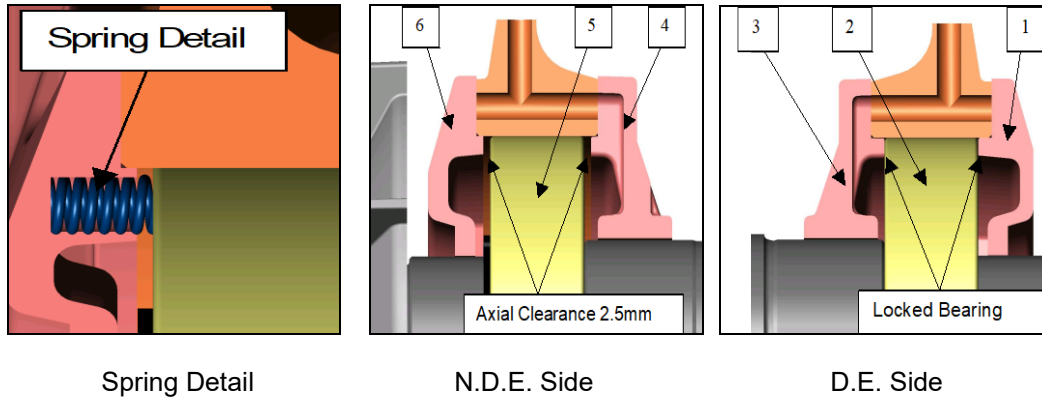
**! Never apply fire directly on bearing.**



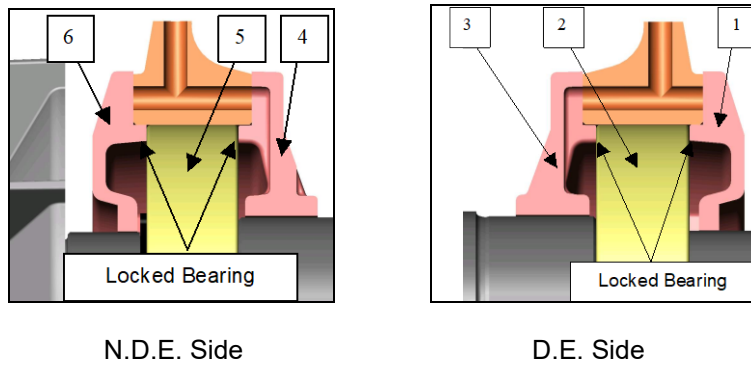
### 4.1.7 Bearing Fastening

#### Ball Bearings:

WEG Motors system locks the D.E. bearing in axial way and keeps the N.D.E. bearing free, with pre load helical springs.



#### Roller Bearings:



- 1: D.E. External Bearing Cap;
- 2: D.E. Bearing;
- 3: D.E. Internal Bearing Cap;
- 4: N.D.E. Internal Bearing Cap;
- 5: N.D.E. Bearing;
- 6: N.D.E. External Bearing Cap;

When using Roller bearing, both, D.E. and N.D.E. bearings, are locked.

**! Attention: Do not exchange the positions of the Bearing Caps.**



## 4.2. LUBRICATION:

The purposes for bearing lubrication are:

To reduce the friction and wearing of the bearing;

To extend the bearing life;

To dissipate the heat;

To reduce the temperature;

Others: sealing against entrance of solid foreign bodies, protection against corrosion of the bearing.

Lubrication can be divided on two methods: by oil or by grease. At electrical motors, lubrication with grease is more used due to its simplicity and low operation cost.

### 4.2.1. Lubrication by Grease:

The grease is a liquid lubricant (oil) thickened in order to form a solid or semi fluid product, using a thicker agent. Others components that grant special properties can also be present in grease composition (additives).

**GREASE = OIL + THICKER AGENT +**

Mineral;

Synthetic;

Vegetable;

Silicone

Lithium;

Lithium complex;

Calcium

complex;

Antioxidant;

Anticorrosive;

Agent against wearing;

Adhesiveness agent.

## ADDITIVES

### 4.2.2. Characteristics of Lubrication by Grease:

#### Advantages of the grease:

Lubricate and seal;

Reduce the noise;

Not require constant grease feeding.

#### Disadvantages of the grease:

Not exchange heat;

Not remove contaminants;

Less capacity of penetration;

Not flow.



### **Why relubricate the bearings?**

Bearings must be relubricated if the grease life is lesser than bearing life.

### **What influence the grease life?**

Temperature;  
Contaminants;  
Deficient seals.

### **What happens if the bearing is not relubricated?**

The grease can become solid, wasting its lubricant properties;  
It is possible to have accumulation of contaminant, reducing drastically the bearing life.

#### **4.2.3. Lubrication failures:**

##### **Excess of grease cause:**

Resistance to the movement;  
Increase of the temperature;  
Reduction of the bearing life and lubricant;  
Penetration of the grease excess over the winding head of the motor;  
Reduction of the insulation resistance.

##### **Lack of grease cause:**

Breaking of the lubricant film;  
Increase of the friction and temperature of the bearing;  
Beginning of the peeling at the bearing raceway;  
Locking of the bearing due to excess of temperature and lack of radial clearance.



**Quantity of grease:**

For lubrication of the bearings, it is used the following equation:

$$G = \frac{DXB}{200} [ g ]$$

Where:

D = External diameter of the bearing [mm].

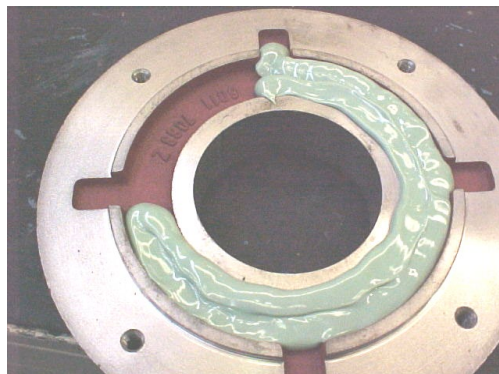
B = Width of the bearing [mm].

**Recommendations for relubrication and handling of the grease:**

Avoid excess of grease;

For new bearings, fill the empty space of bearings with grease;

Fill around ¾ of the bearing caps with grease;



*Bearing cap filled correctly with grease.*

For relubrication, use manual grease gun only;

Keep the recipient with grease always closed to avoid contamination;

Keep the surface of the grease always flat;

Keep away from ignition sources;

Avoid the continuous contact with the skin.

**! Always avoid mixture of greases.**



### 4.3 RELUBRICATION OF THE BEARINGS:

Relubrication is not simply adding grease to the bearing. It consists to put the correct quantity and lubricant indicated, in a foreseen interval and at the right place. It is recommended to use the relubrication procedure based on the following recommendations:

#### 4.3.1. Motors without grease nipple:

Motors from frame 63 up to 132M don't have grease nipple and they are assembled with ZZ bearings. This kind of bearing does not allow relubrication, they are lubricated for its entire lifetime. Therefore, the bearing must be removed and replaced when expired its lifetime.

Motors from frame 160M up to 200L are normally supplied without grease nipple. For these motors, it is recommended the following procedures:

Remove the endshields with care to avoid damage to the bearings;

Wash with kerosene or diesel oil;

Do not turn without lubricant;

Put thin oil and inspect;

Lubricate with the properly grease, filling the internal spaces of the bearing.

**! For this procedure, it is not necessary to remove the bearings from the shaft.**

#### 4.3.2. Motors with grease nipple:

Frames 160M up to 200L can be supplied with grease nipple as an optional item.

Frames 225S/M up to 355M/L are supplied with grease nipple (Standard). For these frames must be used the following procedures:

Clean the grease nipple;

If possible, add the quantity of recommended grease with the motor in operation;

If it is not possible, add half of the recommended grease for the relubrication with the motor turned off;

Put the motor in operation;

Put the rest of the grease;

Avoid excess of grease and obey the relubrication interval;

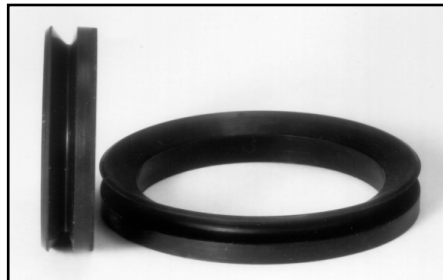


Do not mix different type of greases;  
Use only manual grease gun for this operation.

#### 4.4. SEALINGS:

##### 4.4.1. V'ring seal:

Standard for W21 and Top / Premium Efficiency Lines / IP55.



##### **Application:**

Seal or rasper ring in rotative movements.

##### **Installation:**

Over the shaft, external side of the motor, with the lip assembled to the motor side in contact with the end shield and / or bearing cap.

##### **Cares:**

Install with determined pressure in the motor's direction;  
The lip must be lubricated with a thin layer of oil or grease for perfect sealing;  
For all maintenance of the motor, always replace it.



#### 4.4.2. Lip / Oil seal:

Used in motors installed in ambient with humidity and / or liquid contaminants. They can be without spring (lip seal) or with spring (oil seal). The WEG standard for IP-56 is the Lip Seal.



#### **Application:**

Used to avoid entrance of liquids through the motor's shaft.

#### **Installation:**

D.E. and N.D.E. end shields.

#### **Cares:**

Do not compress the lip/oil seal before installation, since it can cause oval form;

Do not touch the internal lip, avoiding contamination and deformation;

Install with proper tool to obtain centering with end shield / shaft;

Use lip/oil seal with proper material for the application:

Poliacrilic: Normal temperatures of operation;

Nitrilic Rubber: up to 120°C;

Viton: Extreme temperatures. Ex.: Kilns.

Apply a thin layer of oil or grease over the lip before the assembly;

Observe the correct position of assembly. Spring side installed at the opposite side of the motor;



Check if there are sharp-edged or wearing in the shaft: In affirmative case, repair the shaft before installing the lip/oil seal;

For all maintenance of the motor, always replace it.

#### 4.4.3. Labyrinth Taconite:

Used in motors to avoid entrance of solid and abrasive contaminants. Standard for degree of protection IP-65.



#### Application:

These components prevent the entrance of dust inside the motor when required by the environment;

Available from frame 90L up to 355M/L;

Sealing ensured by existent grease between the labyrinth (mobile part) and end shield of the motor (stationary part).

#### For its installation, there are two points to be observed:

Frame 90 up to 200 – Change the end shields from standard by special;

Frame 225 up to 355 – Change the external bearing caps only;

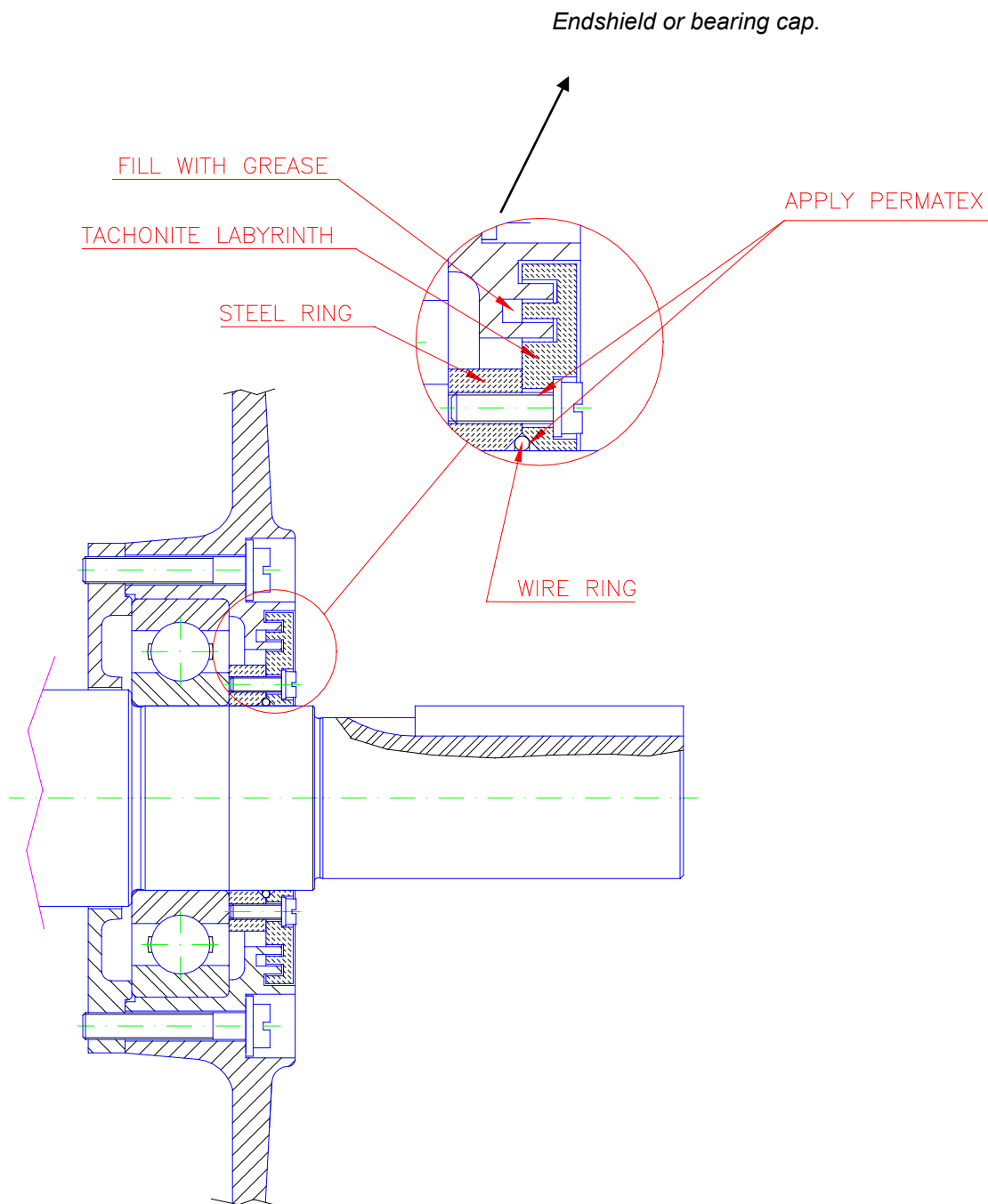
**! Always assemble with grease between the labyrinth and end shield.**

#### Advantages:



Built of brass material, without friction among parts;  
IP65.

Schematic drawing of labyrinth taconite's assembling and functioning:



FRAME 213/5T to 324/6T



## 5. ALIGNMENT

### 5.1. ALIGNMENT INFORMATION

A proper alignment of the driver shaft and the driven shaft:

- Eliminates vibration;
- Maximizes bearings life;
- Extends the overall life of the machinery;
- Improves the efficiency of the driver;
- Reduces power consumption.

Ideally, the shaft axes should form a continuous line.

### SUGGESTED ALIGNMENT TOLERANCES

These suggested alignment tolerances are the desired values, whether such values are zero or a targeted offset. They should be used if machinery manufacturer alignment tolerances are not available.

		RPM	INSTALLATION	IN SERVICE
<b>Soft Foot (mills)*</b>		all	± 1.0	± 1.5
<b>Short Couplings</b>	Parallel offset (mils)	1200	± 1.25	± 2.0
		1800	± 1.0	± 1.0
		3600	± 0.5	± 1.0
	Angular Misalignment (mils/inch)**	1200	0.5	0.8
		1800	0.3	0.5
		3600	0.2	0.3
<b>Coupling With Spacers</b>	Parallel Offset Per Inch or Spacer Length (mils/inch)	1200	0.9	1.5
		1800	0.6	1.0
		3600	0.3	0.5

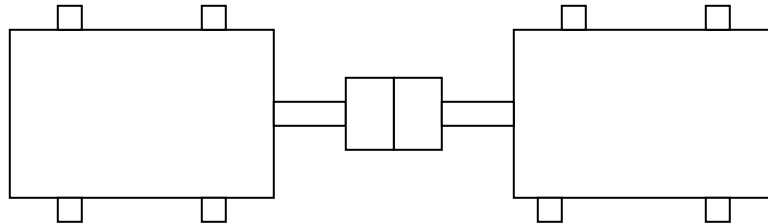
**\*Soft foot describes the condition where the four mounting feet are not in the same plane. Measured in mils (1 mils = 0,001 inches).**

**\*\*To find angular misalignment in mils/inch of coupling diameter, measure widest opening in mils, then subtract narrowest opening in mils, and divide by diameter of coupling in inches.**

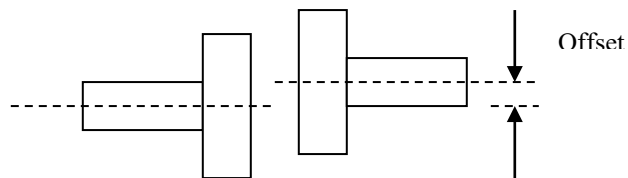
**Note: Up and down motion of driving and drives shafts with temperature may be in either direction.**



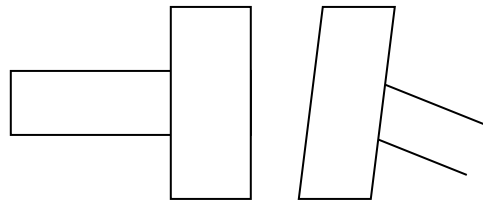
**SHORT COUPLINGS:**



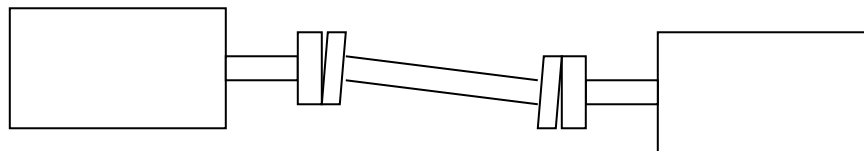
**PARALLEL OFFSET:**



**ANGULAR MISALIGNMENT:**



**COUPLING WITH SPACERS:**





## 5.2. GEAR COUPLINGS

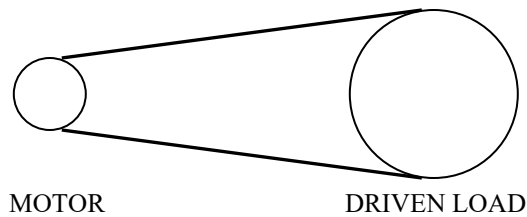
A mechanical system used to reduce or increase the speed of the driven machine. It is indispensable the shafts stay in perfect alignment, severely parallels for rectum gears, and, in right angle for conic or helix gears. The perfect coupling can be controlled with an insertion of one trip of paper, which will appear after one turn, the tracing of all jags.

This type of coupling when not well done, due to the gears stay bad aligned, causes bumps that causes vibration on its own transmission and motor.

When a relation of speed is necessary, the transmission by gears is frequently used.

## 7.3. BELTS AND SHEAVES:

### PULLEY FORMULAS FOR CALCULATING DIAMETERS AND SPEED:



$$\text{Driven Load RPM} = \frac{\text{Motor Pulley Diameter}}{\text{Driven Pulley Diameter}} \times \text{Motor RPM}$$

$$\text{Motor RPM} = \frac{\text{Driven Pulley Diameter}}{\text{Motor Pulley Diameter}} \times \text{Driven Load RPM}$$

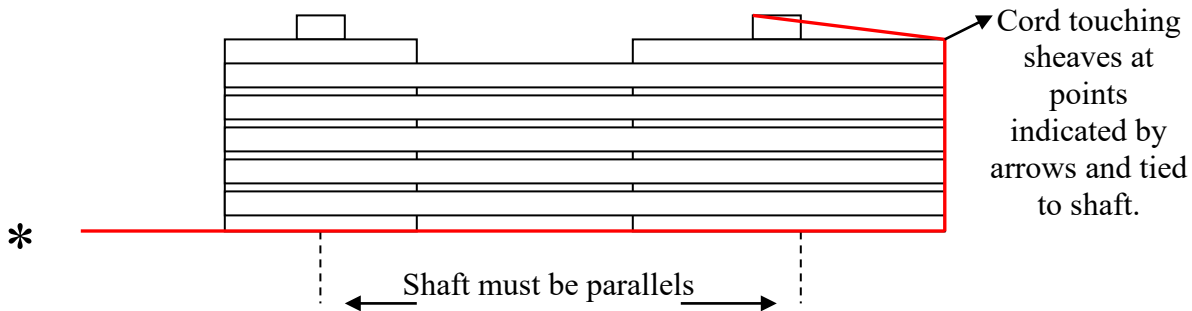
$$\text{Motor Pulley Dia.} = \frac{\text{Driven Load RPM}}{\text{Motor RPM}} \times \text{Driven Pulley Dia.}$$



Pulley diameter equals pitch diameter;  
 When gears and sprockets are used in place of pulleys, the number of teeth may be substituted for pitch diameter.

**BELT INSTALATION:**

Make sure the power is locked out and tagged out;  
 Replace sheaves that show more than 1/16" wear along one side of grove;  
 Don't pry belts over the sheave groove;  
 Check alignment using a cord. When the sheaves are correctly aligned, the cord will be in contact with the outside faces of both sheaves, without a gap between them.



**BELT TENSIONING:**

**Step 1:** Calculate the deflection amount (DA):

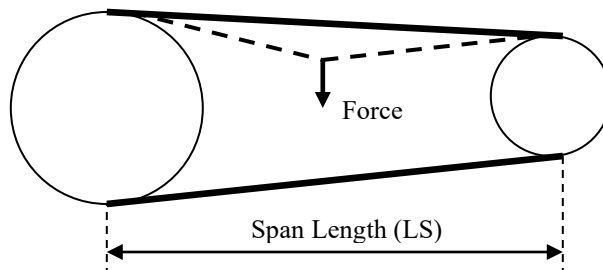
$$D.A. = LS/64$$

Where:

DA: deflection amount (inches)

LS: span length (inches)

**Step 2:** At midspan, deflect the belt to the required deflection amount (DA) and record the force required.



**Step 3:** Check the force required for the deflection above.



## ANNEX I

<b>MAINTENANCE PLAN – THREE PHASE INDUCTION MOTOR</b>					
Part	Daily	Every Week	Each 3 months	Every year	Each 3 years
<b>Full Motor</b>	Noise, vibration, temperature	Noise, vibration, temperature, frame cleaning	Remove condensate water	Relock screws and connections	Disassembly the motor, check all the parts.
<b>Stator/Rotor Coils</b>				Visual inspections and/or insulation resistance evaluation.	
<b>Bearings</b>	Noise, Vibration	Regrease in order to the nameplate			Clean the bearing, change if it's necessary, clean the inner ring.
<b>Terminal Box</b>				Keep clean. Relock the screws and connections. Check the insulation cables.	Keep clean. Relock the screws and connections. Check the insulation cables
<b>Monitoring Systems (PT-100, PTC)</b>		Write down the values.			If possible, disassemble / test the systems.
<b>Source</b>		Check the current and voltage levels.			
<b>Fan / Cooling System</b>		Keep the fan cover and cooling system clean.	Check the fan blades		
<b>Ground</b>				Check and relock the connections.	Check and relock the connections.
<b>Coupling</b>		Check the alignment/pulley and belt tension; Check the base screws.		Check the alignment/pulley and belts tension; Check the base screws.	Check the alignment/pulley and belts tension; Check the base screws.
<b>Balancing</b>					Check the balance of the rotor.



## ANNEX II

### Vibration in Rotate Equipments

All rotating equipment (motor, pump, compressor, fan, etc.) presents a determinate vibration level when it is in operation. To determine if an equipment is having vibration problems or not, the vibration level must be measured and compared with the vibration values defined in the standard. If the vibration problem is confirmed, the cause must be investigated in order to eliminate it. For the hints we are informing below, it was considered the maximum vibration values indicated in the table below. This table was obtained at ISO 10816-1, Standard, edited in 1995.

Output power	Vibration Limits
Smaller than 20HP	1,8mm/s
20HP until 100HP	2,8mm/s
100HP until 500HP	4,5mm/s

#### Hints to investigate vibration in electrical motors:

To investigate occurrence of vibration in electrical motor, it is necessary to analyze the motor on its own site. A technician must go to the customer's plant to inspect the motor in normal operating conditions to identify if the vibration is caused by motor itself, or not. The motor can be removed from its site if the cause of vibration is the motor.

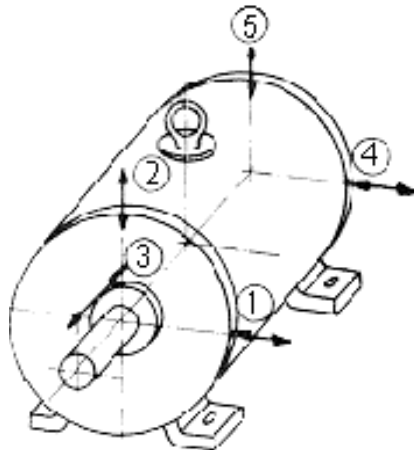
The investigation begins with the measurement of the vibration level on the motor. For this, the technician must have an equipment to register global values of vibration, in millimeters per second (mm/s), RMS value. The vibration must be measured in five points on the motor frame, according to the picture bellow. The measured values must be registered.

Point 1: horizontal front

Point 2: vertical front



- Point 3: axial front
- Point 4: horizontal rear
- Point 5: vertical rear



To define what's the vibration level of the motor, it must be considered the highest value found among the five measurements. The highest value must be compared with the table values to define if the motor really has high vibration levels.

**Example:** Suppose a vibration analysis on a 100cv electric motor, that is coupled in a fan. The measured values are:

- Point 1: 2,4 mm/s
- Point 2: 2,0 mm/s
- Point 3: 1,2 mm/s
- Point 4: 2,1 mm/s
- Point 5: 2,2 mm/s

For this example the measured vibration is 2,4 mm/s (the highest of all measured values). Comparing with the table value, that 2,4 mm/s is under the limit, that is 2,8 mm/s. Thus, in the example, the electrical motor is operating satisfactory.

If the measured vibration is over the table limit, it must be checked if this high vibration cause is the electric motor or the load coupling. This is very important because even if the vibration is happening at the electric motor, it is possible that it's caused by the **load** (unbalanced, bearing defects, ...)



or even by the **coupling** between the electric motor and the load machine (coupling defects, misalignment, cracked pulley, wear belts, etc.).

But, how to check if the origin of vibration is the electric motor or the loaded machine? To check this, it must be proceeded by the following way:

Uncouple the electrical motor;

Turn on the electrical motor;

To measure the vibration on five points of the frame, according the previous procedure;

To register in a report the measured values.

If the obtained values, if the electric motor is uncoupled, are expressive less then the obtained values if the motor is coupled, it can be concluded that the cause of vibration is not the motor. Otherwise, if the values obtained with the uncoupled motor are similar the values obtained with the coupled motor, we can conclude that the cause is on the motor side. **Nevertheless we can't say that the cause of vibration is on the motor**, because even the motor is coupled, there is other external factors that can cause the vibration. Those external factors must be checked before removing the electrical motor from its site.

How to check if the origin of vibration is at the electric motor or not?

Below there are some hints about how to check and how to do?

Motor is not fixed on its base: Are the fixing bolts well screwed?

Motor bad sustained on its base: Are the motors feet well fixed or "Is there a rest of foot"?

Base equalized wrong or irregular: To check this, keep the vibration sensor at the highest spot already measured; loose one of the motor fixing bolts on its site and check if there were any change on its vibration levels. Screw that bolt and repeat the test with another one, and so on. If there were a reduction on the vibration level caused by loosening some bolts, it is probable that the site is incorrect. In this case the customer must check the site and provide the correction of that irregularity. After correcting the site and the motor had been installed, measure again the vibration with the motor running with no load.



Vibration caused by other machines installed near the analyzed motor: measure the vibration with the motor stopped and register in the report.

Key excess: if the motors coupling (or pulley) is shorter than the key, the key excess can cause unbalancing and vibration, mainly in two pole motors. In this case would be necessary to cut the key excess, to repeat the measures and to compare with the values already obtained.

Coupling (or pulley) unbalanced: remove the coupling (or pulley) and repeat the measures. Register in a report and compare with the other values already obtained. The measure of vibration must be done with the key channel fulfilled only into the middle.

Defective Site: perform a visual inspection at the metallic site in order to verify if there is some trines, cracks, crushes, or some kind of defects possible to prejudice the base rigidity. Supervise the concrete base, mostly in the fixing points of the metallic base (**fixers**).

### **It's the motor:**

If at the end of the previous checking, stays evident that the motor is really the responsible for the vibration, it must taken to the repair shop to be analyzed. The motor analysis must be done checking as follow:

- Rotor balancing;
- Feathering and/or eccentricity of the shaft;
- Rests between ball bearings and end shields;
- State of the bearings (noise, lack or excess of grease, marks on the balls and/or bearing rings, etc.);
- Assembling of the bearing cap – to check if there was not inversion in any maintenance done before (frame 225 S/M and higher);
- Correct assembling of springs on the ball bearing cap (frame 225 S/M and higher) or wave washer (frame 200 and smaller);



## ANNEX III Bearing Evaluation Check List

**Designation:**

<b>Customer:</b>	<b>Date:</b>
<b>Bearing type:</b>	

**2. Application:**

<b>Equipment:</b>			
<b>Coupling:</b>	Direct:	Pulley:	Other:
<b>Assembling:</b>	Vertical:	Horizontal:	
<b>Load:</b>	Axial:	Radial:	Effort loads: ..... kgf
<b>Degree of protection:</b>			
<b>Duty (hours/day):</b>			
<b>Rotation (rpm):</b>			

**LUBRICATION:**

<b>Grease Mark:</b>					
<b>Quantity of grease used in the lubrications:</b>					
<b>Lubrication period:</b>					
<b>Was the lubricant contaminated?</b>					
<b>Bearing work Temperature:</b>			<b>Environment Temperature at failure moment:</b>		
<b>Are there any heating signals ?</b>	No:	Yes:	Lubricant:	Shaft:	Covers:

**ADJUSTMENTS:**

<b>Which is the bearing seat condition / Endshield's groove / bearing caps:</b>		
<b>Is there any friction signs between bearing caps or endshields and shaft:</b>		
<b>What the alignment deviation between Motor and Load?</b>	Parallel:	Concentricity:

**Description:**

<b>How long was the motor stayed on duty?:</b>					
<b>How long was the motor stayed stocked?/Stopped before to get on duty:</b>					
<b>Which are the stock Conditions?:</b>	Moisture:	Yes	No	Temperature:	Yes No
	Vibration:	Yes	No	Dust:	Yes No
<b>Were the storage procedures followed during the stock period? (to move the shaft every month):</b>					
<b>Confirm if others motors had bearing failures.</b>					
<b>When was done the last maintenance?</b>					
<b>Was there any monitoring before the failure:</b>			Temperature (°C):	Vibration (mm/s):	
<b>When was the last event:</b>			<b>Cause:</b>		
<b>Environment conditions in the work place:</b>			Temperature(°C): .....		
Moisture:	Yes	No	Vibration:	Yes	No
			Dust:	Yes	No
<b>Are there any mechanical parts missing:</b> No: Yes: Fan propeller blade: balancing weight:					
Others:					

**Observations:**



Judice Electric

No.:

Date: 11-APR-2013

### DATA SHEET Three-phase induction motor - Squirrel cage rotor

Customer : Del corp  
Product line : Three-Phase : Explosion Proof - NEMA Premium

Frame : 215T  
Output : 10 HP  
Frequency : 60 Hz  
Poles : 4  
Full load speed : 1765  
Slip : 1.94 %  
Voltage : 575 V  
Rated current : 10.2 A  
Locked rotor current : 76.2 A  
Locked rotor current (I<sub>L</sub>/I<sub>n</sub>) : 7.5  
No-load current : 5.04 A  
Full load torque : 29.4 lb.ft  
Locked rotor torque : 250 %  
Breakdown torque : 300 %  
Design : B  
Insulation class : F  
Temperature rise : 80 K  
Locked rotor time : 15 s (hot)  
Service factor : 1.15  
Duty cycle : S1  
Ambient temperature : -20°C - +40°C  
Altitude : 1000  
Degree of Protection : IP54  
Approximate weight : 207 lb  
Moment of inertia : 1.3362 sq.ft.lb  
Noise level : 58 dB(A)

	D.E.	N.D.E.	Load	Power factor	Efficiency (%)
Bearings	6308 ZZ	6207 ZZ	100%	0.81	91.7
Regreasing interval	---	---	75%	0.75	91.0
Grease amount	---	---	50%	0.62	90.2

Notes:  
01018XT3H215TC

Performed by

Checked



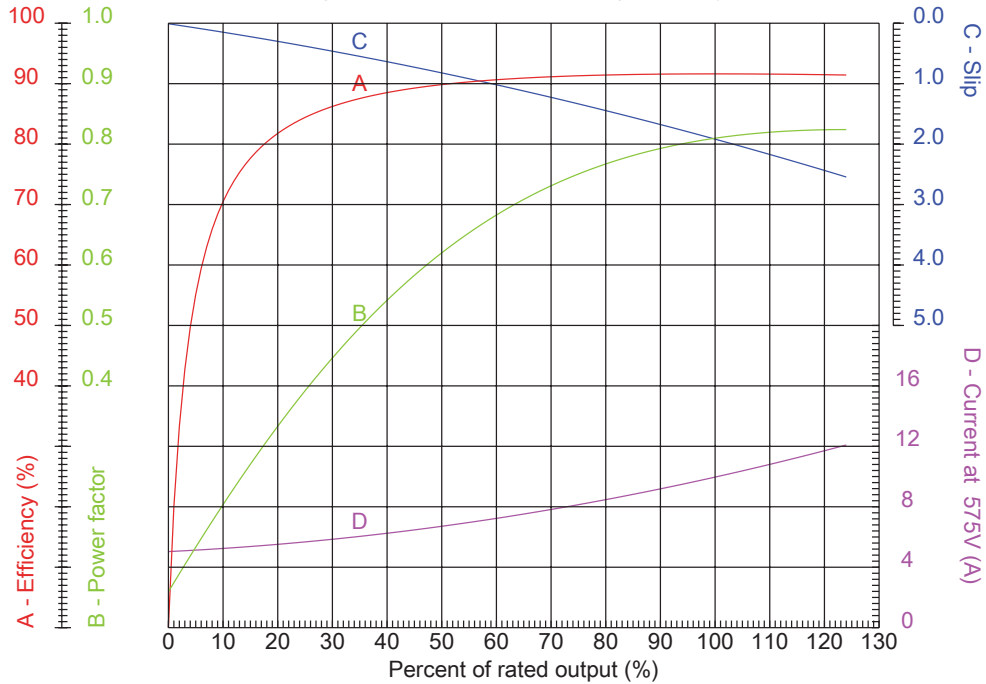
# Judice Electric

No.:

Date: 11-APR-2013

## PERFORMANCE CURVES RELATED TO RATED OUTPUT

Three-phase induction motor - Squirrel cage rotor



Customer : Del corp  
Product line : Three-Phase : Explosion Proof - NEMA Premium

Frame : 215T	Locked rotor current (I <sub>L</sub> /I <sub>n</sub> ) : 7.5
Output : 10 HP	Duty cycle : S1
Frequency : 60 Hz	Service factor : 1.15
Full load speed : 1765	Design : B
Voltage : 575 V	Locked rotor torque : 250 %
Rated current : 10.2 A	Breakdown torque : 300 %
Insulation class : F	

Notes:  
01018XT3H215TC

Performed by

Checked



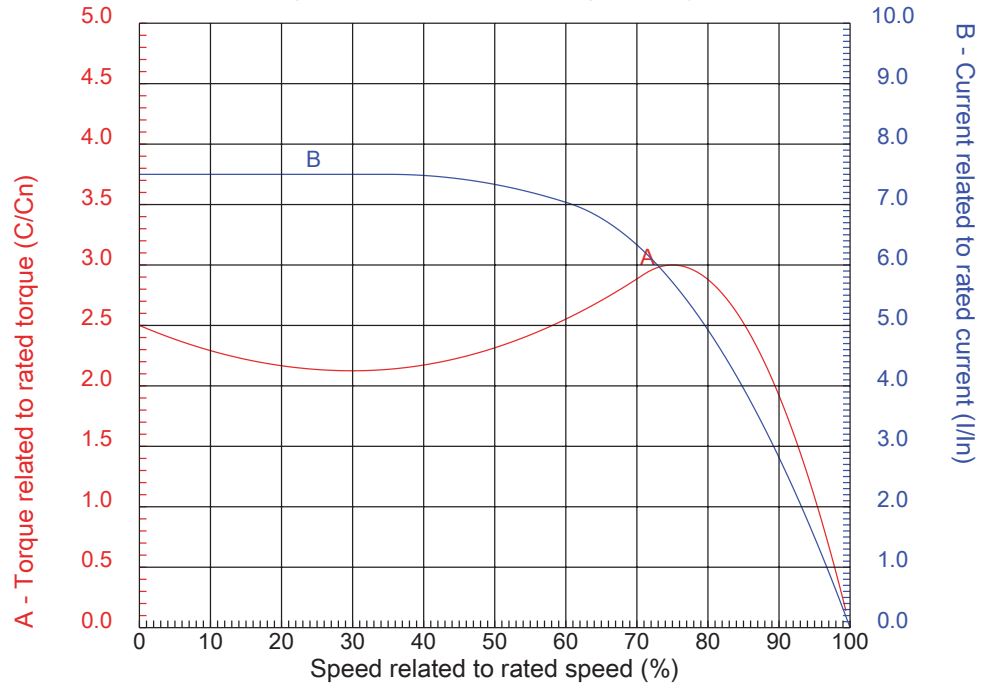
# Judice Electric

No.:

Date: 11-APR-2013

## CHARACTERISTIC CURVES RELATED TO SPEED

Three-phase induction motor - Squirrel cage rotor



Customer : Del corp  
Product line : Three-Phase : Explosion Proof - NEMA Premium

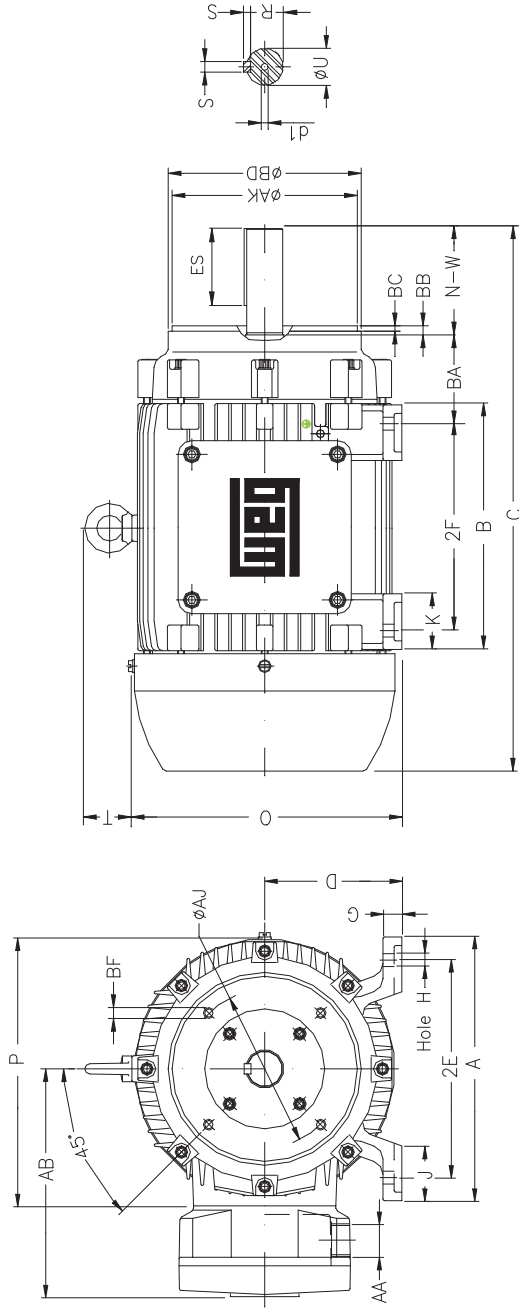
Frame	: 215T	Locked rotor current (I <sub>L</sub> /I <sub>n</sub> )	: 7.5
Output	: 10 HP	Duty cycle	: S1
Frequency	: 60 Hz	Service factor	: 1.15
Full load speed	: 1765	Design	: B
Voltage	: 575 V	Locked rotor torque	: 250 %
Rated current	: 10.2 A	Breakdown torque	: 300 %
Insulation class	: F		

Notes:  
01018XT3H215TC

Performed by

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1 2 3 4 5 6 7 8



Notes: 01018XT3H215TC

2E	8.500	A	9.764	2F	7.000	B	8.898	BA	3.500
J	2.008	K	2.165	P	10.709	ES	2.480	depth	0.313
S	0.313	N-W	3.375	U	1.375	R	1.203	AB	9.252
D	5.250	G	0.827	O	11.156	T	1.772	H	0.406
C	19.450	AA	NPT 1"	d1	A4	d2	A4	Flange	FC-184
AJ	7.250	AK	8.500	BD	8.875	BF	UNC 1/2"x13	BB	0.250
BC	0.250	AH	3.125						

Performed by:

Checked:

Customer: Del corp

Three-Phase : Explosion Proof - NEMA Premium

Three-phase induction motor  
Frame 215T - IP54

11-APR-2013

