

OPERATION & MAINTENANCE MANUAL

MS Unit

PROJECT No. 49104

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Scope of Document

To provide a concise detailed Operation & Maintenance Manual for use by the facility operators and facility personnel. The document will provide a reference to drawings, manufactured item, propriety item and lubrication and service schedules.

Document Approval

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Use of this Manual

This manual has been divided into a number of logical sections, with each section dealing with a specific aspect of the MS Units for the Reel S.A.S project.

A brief description of the sections is given below:-

Section 1 - General Information

This section outlines the purpose and use of the manual, provides details of key personnel and gives notes on life expectancies.

Section 2 - Emergency Procedures and Health & Safety

This section describes the procedures involved in an emergency, including contact details. It also houses pertinent health and safety information to the work package, including significant hazards, significant weights and safe access.

Section 3 - Technical Information

This section contains design criteria and a detailed as built specification for the work package; warranties and guarantees; a master equipment schedule including details such as supplier / manufacturers name, address and telephone number; order number, item / equipment type and model, performance details, etc.; This section should be read in conjunction with the as built drawings contained in section 8 of this manual.

Section 4 - Testing

This section contains test certificates and records of commissioning data for all relevant systems.

Section 5 - Operating Instructions

This section describes the procedures involved in system start-up, normal operation, shut-down and emergency; and training requirements.

Section 6 - Maintenance Information

This section contains general notes on maintenance and gives recommended preventive procedures, inspections, servicing and cleaning requirements covering major plant and equipment items. This section also contains fault finding and spares information. This section should be read in conjunction with the manufacturer's literature given in section 7 and also any other manuals within the suite covering related systems / services.

Section 7 - Manufacturers and Suppliers Information

This section contains a directory of manufacturers and suppliers plus manufacturers specific technical literature for all relevant major items associated with the work package.

Section 8 – As Built Drawings

This section contains a schedule of the As Built drawings for the installation.

1 GENERAL INFORMATION

1.1 Foreword

1.1.1 Introduction

The MS unit is a failsafe mechanical hoist arrester, designed by Siguren and manufactured under license by SCX Special Projects. The MS unit protects against failures in hoist drive trains that would otherwise lead to dropped loads or overloads.

The MS consists of an irreversible worm and wheel gearbox mounted directly to the hoist drum. It is a permissive system which allows the drum to rotate at any speed within the hoist's normal operating parameters. Under fault conditions a differential speed between the worm and wheel will cause the system to mechanically lock and the damping system safely arrests the load. This provides mechanical failsafe protection in the event of any electro-mechanical failure of the hoist drive train. In addition to the unit, a torque limiter is put in the drive-train to limit the maximum load into the MS unit. The MS units are available in multiple variants; hydraulic damping or friction plate arresting, shaft mounted or foot mounted each with various load capacities. The units are available in sizes 0 to 8 which equate to increasing equivalent drum loads. The subject of this document is the MS size 3 (hydraulic version), which is capable of braking torques of 32.0 kNm and the MS size 6 (hydraulic version), which is capable of a braking torque of 148kNm.

1.2 Notes & Limitations

- 1 The owners and users of this manual shall ensure that any modifications carried out to the installations described in this manual or any amendments made to the manual are recorded for future reference on the revision sheet given.**
- 2 It is strongly advised that the owners and users of this manual utilise the training record log sheet given in section 6.6 to record details of all relevant training courses carried out by the maintenance / operating staff for future reference.**
- 3 It is incumbent upon the operators of the premises to ensure that all relevant acts, particularly the Health and Safety at Work Act, are fully complied with.**
- 4 To ensure that manufacturer's guarantees will be honoured, a maintenance programme must be formulated immediately after handover of the services installation. The programme must take into consideration the periods of time that plant and equipment may have been operated or installed prior to Handover. The installing contractors Contractual Defects Liability Period obligations DO NOT include for the regular servicing and maintenance of the installation.**

1.3 Abbreviations

The following abbreviations have been used in the production of this manual.

| Meaning | Abbreviations |
|-------------------------------|---------------|
| Communication Port | COMM |
| Factory Acceptance Test | FAT |
| Human Machine Interface | HMI |
| Lifetime Quality Record | LTQR |
| Lifetime Quality Record | LTQR |
| Motosuiveur | MS |
| Personal Protective Equipment | PPE |
| Programmable Logic Controller | PLC |
| Safe Working Load | SWL |
| SCX Special Projects Ltd | SCX |
| Site Acceptance Test | SAT |
| Universal Serial Bus | USB |

Table 1.3-1

1.4 Warnings, Cautions & Notes

Warnings, Cautions and Notes are used in the main body of text and are used to emphasise important points. The instructions contained within these highlighted areas must be adhered to.

WARNING



WARNINGS CALL ATTENTION TO INSTRUCTIONS, WHICH MUST BE FOLLOWED PRECISELY TO AVOID INCREASING THE RISK OF INJURY OR DEATH. BE SURE TO ACT UPON EVERY ITEM LABELLED IN THIS WAY

CAUTION



CAUTIONS CALL ATTENTION TO INSTRUCTIONS, WHICH MUST BE FOLLOWED PRECISELY IN ORDER TO AVOID DAMAGE TO THE PRODUCT, THE PROCESS, OR ITS ENVIRONMENT.

Note



Notes are used to provide supplementary information to the text.

1.5 System Description

The MS unit comprises of the following components.

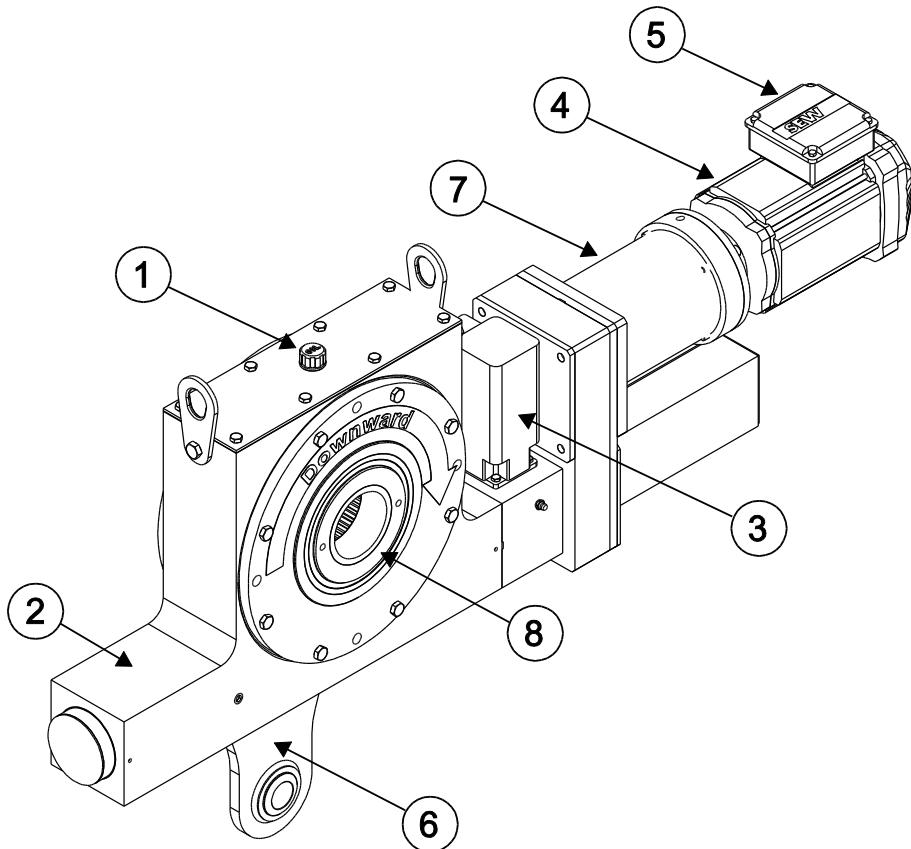


Figure 1.5-1– MS Unit

| No. | Description | No. | Description |
|----------|-------------------|----------|-----------------|
| 1 | Breather cap | 2 | Damping chamber |
| 3 | Servo motor | 4 | Motor |
| 5 | Electrical supply | 6 | Reaction arm |
| 7 | Reducer | 8 | Worm gear |

Table 1.5-1

1.5.1 Functioning Principle

Typically, the MS unit attaches to the drum via a stub shaft beyond the bearing and torque is restrained via a torque arm. This arrangement is shown in Figure 1.5.1-1.

The MS consists of a machined steel casing within which resides a worm gear and associated wheel both of steel. Also within the casing are numerous other components which allow the unit to function. The wheel is splined internally and is connected to an equivalently splined shaft attached to the crane drive train to transmit torque and via plain bearings between the shaft and wheel to support the interface radially. The wheel interface consists of a plain bearing mounted between the wheel and casing for radial support where the wheel interacts directly with the casing for lateral and axial loads. The worm and wheel interact in a standard manner, with the mesh such that nominal clearance is achieved and that the wheel cannot force rotation on to the worm. The worm bears onto the casing directly and is thus supported laterally and radially. Axial restraint is provided by a small indent plunger which holds the worm in place where the normal servo motor torque is applied (i.e. under normal conditions). Extending from the worm in one direction is a shaft with a splined surface, this interfaces with a bevel gear with an internal spline and is axially free to translate along the worm shaft. Meshing with the bevel gear is its reciprocal gear which is rigidly fixed to a servo motor, itself mounted to the casing. This motor provides rotation to the worm via the bevel gear arrangement at a pre-set torque. The worm conveys this torque onto the wheel through its mesh. The motor is actuated when the hoist operation is requested at the Human-Mechanical Interface (HMI) for the crane. When the servo motor actuates it allows the worm to convey the torque onto the wheel but this torque is insufficient to allow the crane drive to actuate, instead allowing the wheel to rotate with the drum shaft through the normal crane drive. Finally, to complete the moment couple between the drum shaft and the MS unit, a steel torque arm mounts between the unit and the crane body.

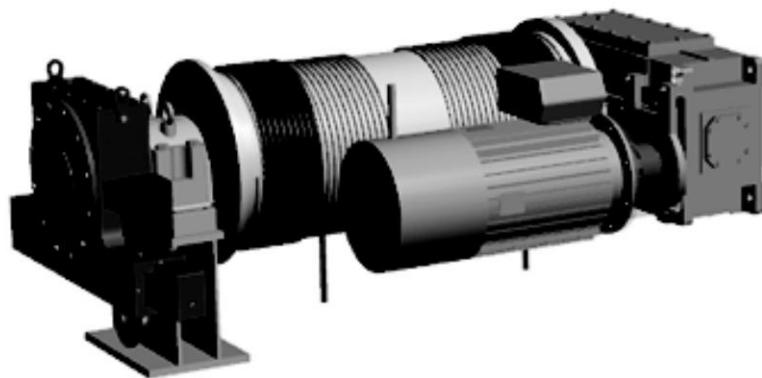


Figure 1.5.1-1-MS Unit

1.5.2 Mechanical Description

A classic winch equipped with a Motosuiveur® is typically made up of the following main parts:

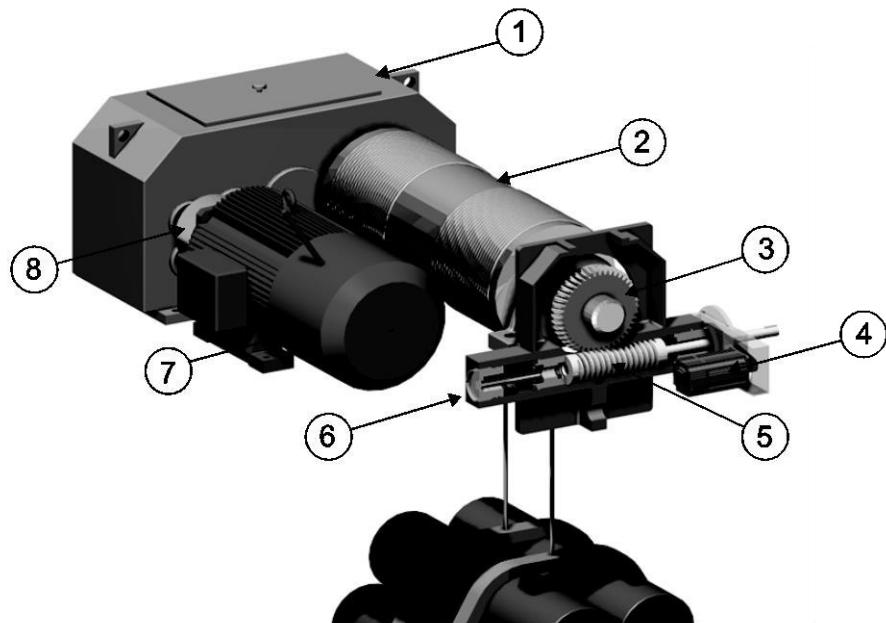


Figure 1.5.2-1—Mechanical Description

| No. | Description | No. | Description |
|----------|-------------|----------|---------------------------|
| 1 | Gearbox | 2 | Drum |
| 3 | Worm wheel | 4 | Motor |
| 5 | Worm Screw | 6 | Hydraulic Damping Chamber |
| 7 | Motor Brake | 8 | Torque Limiter |

Table 1.5.2-1

1.5.3 Electrical Description

The MS unit is electrically controlled using typical components as shown in the diagram below.

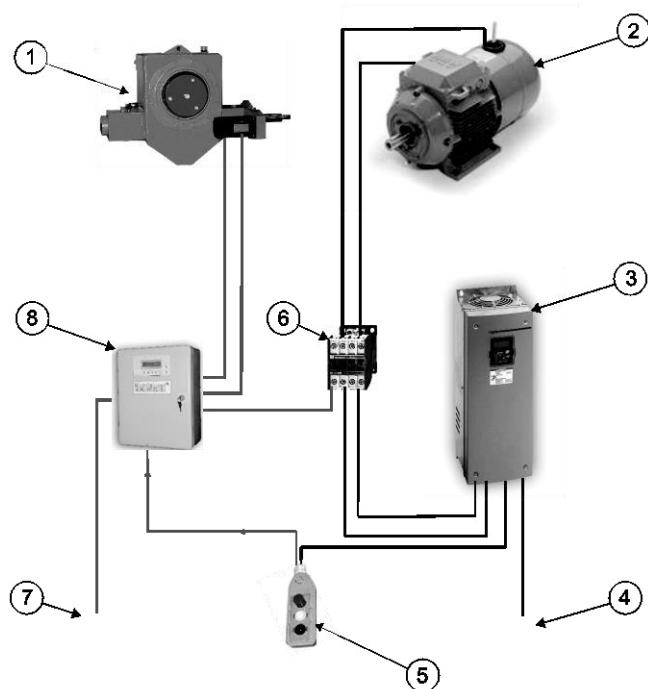


Figure 1.5.3-1– Electrical Control System

| No. | Description | No. | Description |
|-----|------------------------|-----|-------------------|
| 1 | Motosuiveur | 2 | Brake & Motor |
| 3 | Drive Speed Controller | 4 | Main Power Supply |
| 5 | Control | 6 | Contactor |
| 7 | Power Supply | 8 | Controller Box |

Table 1.5.3-1

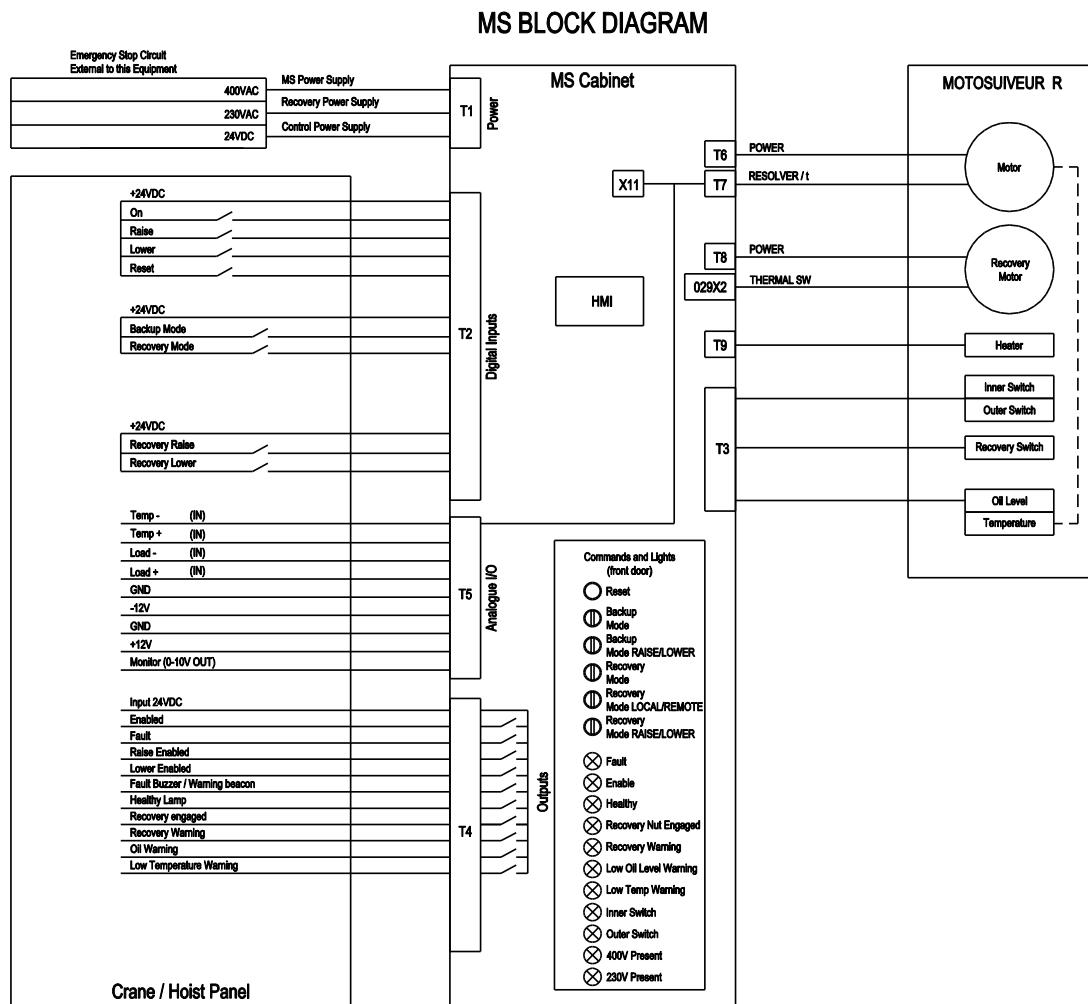


Figure 1.5.3-2– Electrical Control System Block Diagram

2 HEALTH & SAFETY INFORMATION

WARNING



READ HEALTH AND SAFETY PRECAUTIONS BEFORE YOU START ANY SERVICE WORK. SERVICING OF THE EQUIPMENT MUST ONLY BE CARRIED-OUT BY AUTHORISED PERSONS FULLY TRAINED AND COMPETENT IN THE MAINTENANCE OF THIS EQUIPMENT. THEY MUST FULLY UNDERSTAND AND ADOPT CORRECT AND SAFE WORKING PRACTICES.

If you are unable to carry out the work safely in the required manner then contact SCX Special Projects Ltd for advice. Only routine servicing procedures are detailed in this handbook. Do not attempt more complex work without reference to SCX Special Projects Ltd.

2.1 Safety for Maintenance

On commencing any maintenance work on the crane:

1. Obtain the necessary authorisation / permit to work on the equipment.
2. Follow the appropriate health and safety regulations and procedures.
3. Remove any loads or attachments from the equipment.
4. Regular planned maintenance should only be carried out by SQEP.
5. Only genuine SCX Special Projects spare parts should be used.
6. No modifications should be carried out to equipment without written approval from SCX Special Projects Limited.
7. Do not wear loose clothing or jewellery etc. while operating, installing or maintaining equipment, which could be caught in moving parts.
8. Pay strict attention to all caution, warning and danger labels.
9. Never operate the equipment unless all the guards (if fitted) are in place.
10. Do not operate, install or maintain equipment when taking any kind of drug or medicine which may cause drowsiness, or when over fatigued or under the influence of alcohol. Consult your pharmacist if in doubt.
11. Never operate the equipment unless all the safety devices/interlocks are working.
12. Never perform maintenance, cleaning or repair work while the equipment is running.

2.2 Handling

All Motosuiveur® are controlled after assembly, set and tested on bench. During those tests, the oil fill is adjusted and the hydraulic system is drained. To prevent draining the system on activation, the Motosuiveur® must be carried in horizontal position, with the breather cap in top position.

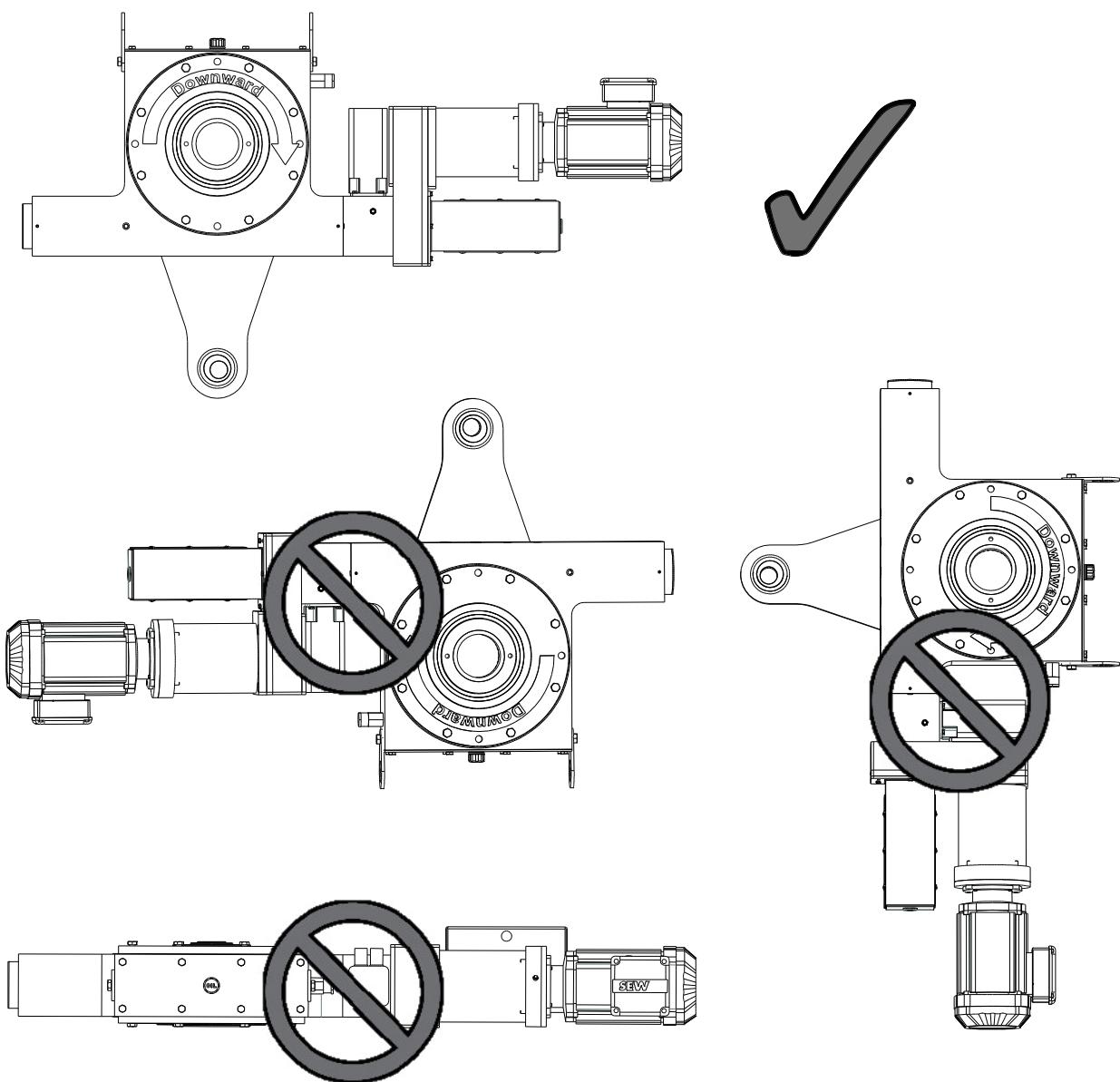


Figure 2.2-1 Handling Arrangements

2.3 Safety Instructions

- The Motosuiveur® is designed to resist the dynamic force of a defined application; so before the device is put into operation, make sure that the installation complies entirely with the application which the Motosuiveur® has been designed for.
- Before any operation on the equipment, switch off the electrical supply and ensure that the load cannot move.
- Never place your hands inside the Motosuiveur®, unless you are sure that it is impossible to rotate the shaft.
- Never rotate the Motosuiveur® if the maintenance door is open or/and if the protection cover of the torque limiter is removed.
- Do not modify the machine. Any modification of the kinematic chain increasing the inertias, the limiter adjustments or the maximum speeds can be dangerous.
- All work must be carried out by competent staff with appropriate training.

Siguren declines any responsibility if the safety instructions are not followed correctly!

WARNING



RISK OF DEATH OR INJURY MAY OCCUR IF THE EQUIPMENT IS IN CONTACT WITH HIGH VOLTAGE POWER LINES AND WIRED COMPONENTS.
TO PREVENT PHYSICAL INJURY OR MATERIAL DAMAGE, ONLY TRAINED AND QUALIFIED STAFF ARE AUTHORIZED TO WORK ON THE EQUIPMENT.

CAUTION



DAMAGE MAY OCCUR IF:
THE MOTOSUIVEUR® IS NOT USED COMPLYING WITH THE APPLICATION IT HAS BEEN DESIGNED FOR,
IF THE MOTOSUIVEUR® HAS BEEN MODIFIED
IF THE SAFETY STANDARDS AND THE INSTRUCTIONS ARE NOT OBSERVED.

CAUTION



DO NOT UNPLUG ELECTRIC FUNCTIONS, DO NOT PERFORM MAINTENANCE, REPAIR OR ASSEMBLE ANYTHING ON THE EQUIPMENT WHEN IT IS SWITCHED ON.
THE LINKING CABLES MUST NOT BE SUBJECT TO MECHANICAL EFFORTS.

2.3.1 Correct Use of the Equipment

The Motosuiveur® is designed to work with lifting equipment and must only be used with the applications they have been ordered and designed for.

Using the device beyond its technical capabilities will cause the device to fail or malfunction.

The following scenarios should be avoided as this may invalidate the warranty.

(See section 3.3 Warranties and Guarantees for further information)

- Incorrect use of the Motosuiveur
- An unapproved modification of the Motosuiveur
- Incorrect handling or work on the Motosuiveur

2.3.2 Hydraulic Unit Size

| MS size | Maximal braking torque : Hydraulic Damping MS C _{MS_hyd} | Recovery option : Lifting capacity C _{MS_rec} |
|---------|--|---|
| Units | Nm | Nm |
| MS0 | 4 000 | 1 600 |
| MS1 | 9 500 | 3 800 |
| MS2 | 18 500 | 7 400 |
| MS3 | 32 000 | 12 800 |
| MS4 | 50 750 | 20 300 |
| MS5 | 75 750 | 30 300 |
| MS6 | 148 000 | 59 200 |

Table 2.3.2-1

2.4 Weights

| Component | Drawing No. / Item | Weight (kg) |
|-----------|--------------------|-------------|
| MS3 | GA MSL-03-10 | 201 |
| MS6 | GA-MSL-06-10 | 897 |

Table 2.4-1

2.5 Control of Substances Hazardous to Health (COSHH)

The following table lists only one supplier of the recommended lubricants for each item. Refer to manufacturer's literature for additional suppliers of lubricants.

| Index | Item | Description MSDS |
|-------|------|------------------|
| A | Oil | SIGUREN SW15 |

Table 2.5-1

2.6 Nameplate

The nameplate of the Motosuiveur® indicates the maximum rotating speed and the corresponding braking torque.

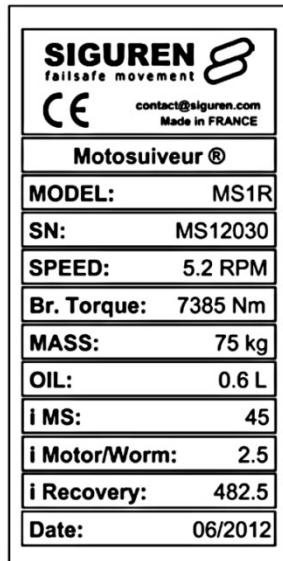


Figure 2.6-1

CAUTION

THE MOTOSUIVEUR® IS FACTORY SET TAKING INTO ACCOUNT THE SPEED, LOAD AND INERTIA OF THE EQUIPMENT. INCREASING THE SPEED / INERTIA OF THE EQUIPMENT ON WHICH THE MOTOSUIVEUR® IS INSTALLED IS NOT ALLOWED AND MAY LEAD TO SERIOUS DAMAGE.

2.7 Contact Details

| Address | Contact Details |
|---|--|
| SCX Special Projects Ltd Roman Ridge Road Sheffield S9 1GA | Tel: 0114 243 1142 Fax: 0114 256 1739 |
| Email | info@scx.co.uk |

Table 2.7-1

3 TECHNICAL INFORMATION

3.1 Design Criteria and Standards

- 2006/42/EC – The Machinery Directive
- BS EN ISO 12100:2010 – Safety of Machinery
- BS EN 82079-1:2012 Technical Manuals

As stipulated by Annex V of the EC machinery Directive.

- CE symbol affixed to equipment
- Technical documentation filed in manufacture's works

3.2 Warranties and Guarantees

- a) The Company undertakes subject to sub Clauses (b) and (d) hereof at its discretion either to replace or repair without charge the Machinery or any part or parts thereof which shall be provided to the satisfaction of the Company to be defective by reason of faulty materials or workmanship supplied or performed by the Company provided such defect appears within 12 months from the date of commissioning or within 15 months of the date when the Purchaser was first advised that the Machinery was ready for despatch, whichever is the earlier. The Company shall not be liable for the cost, including labour, of removing a defective part or parts of the machinery or the cost of fitting new part or parts. Any defective parts replaced shall become the sole property of the Company.

- b) The Company's liability under Sub-Clause (a) hereof is conditional upon:
 - 1. Written notice of the defect, with full details thereof, being received by the Company within 7 days of the discovery of the defect. Such notice may be given by fax or email confirmed by letter of the same date.

 - 2. The defective Machinery or part or parts thereof being returned, securely packed, at the risk of the Purchaser and carriage paid by the Purchaser, to the Company or to such persons as the Company may direct.

 - 3. The defect not being due to carelessness, improper treatment or any wilful or negligent act or omission including lack of maintenance, inadequate lubrication, or any failure to comply with any instruction given by the Company or any use of the machinery with any part or parts which do not comply with the Company's specifications.

 - 4. The Machinery having been operated within the classification for which it was designed.

- c) Where the machinery is installed outside the UK, the Machinery or parts replaced under this guarantee will be delivered by the Company UK port.

- d) In the case of parts not manufactured by the Company, the Purchaser shall only be entitled to the benefit, insofar as it may be passed on to the Purchaser, of any rights the Company may have against the supplier of such parts and the Company's liability in such cases as is limited to making the benefit of such rights available to the Purchaser.

- e) Save for the undertakings as to the title all other conditions or warranties expressed or implied, statutory or otherwise are hereby expressly excluded.
- f) If it should be held in relation to any particular contract that Sub-Clause (e) hereof is not fair and reasonable then any breach of any condition or warranty in relation to that contract shall not entitle the Purchaser to reject the Machinery, but shall entitle the Purchaser to damages only, and these damages shall be limited to the reasonable cost of remedying the defect or other matter constituting such breach (provided that the Company shall first be afforded the opportunity of carrying out the remedial work) and any liability for death or personal injury resulting from such breach.

4 TESTING

Testing has been covered in detail during the commissioning phase by means of a setting to work document. This has been produced as part of the manufacturing phase and forms part of the Lifetime Quality Records 49104-20-012A/014A.

As part of the continued validation of the safety circuit, periodic testing of the unit and its operation is required and at intervals identified and listed below. As a minimum this should be prior to a lifting campaign.

MS3

Factory Acceptance Tests (FAT) SCX Doc Ref; 49104-16-002A

All test documentation enclosed within the following:

Lifetime Quality Records (LTQR) SCX Doc Ref; 49104-20-012A

MS6

Factory Acceptance Tests (FAT) SCX Doc Ref; 49104-16-001B

All test documentation enclosed within the following:

Lifetime Quality Records (LTQR) SCX Doc Ref; 49104-20-014A

5 INSTALATION OF THE TORQUE LIMITERS

The installation is equipped with a RIMOSTAT®- RSC Torque Limiter (Ringspan).

- The torque limiter is mounted between the hoist motor and the High Speed shaft of the gear box
- Assembly must be done by qualified operators.
- The torque limiter is delivered factory rated to the value necessary to the application. In case of doubt, check the application data on the assembly drawing.
- The limiter assembly direction is defined on the layout.
- The torque limiter coupling is made of:
- The permanent spring limiter
- The driving hub

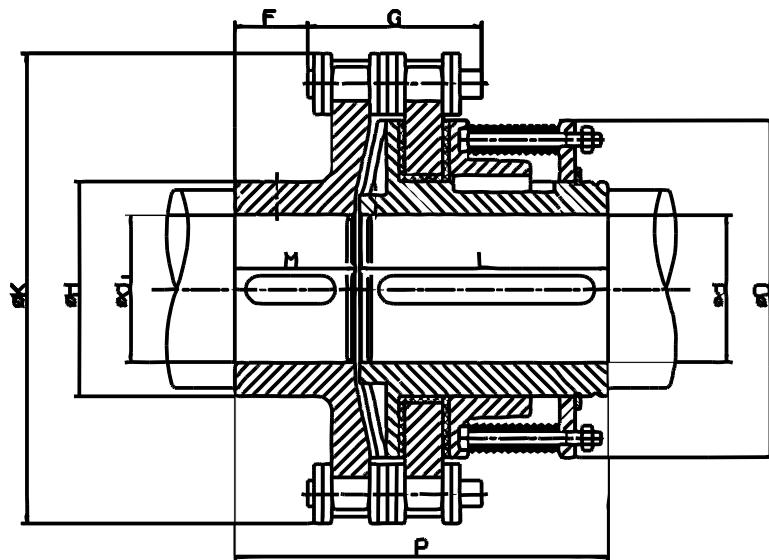


Figure 5.1-1-Torque Limiter

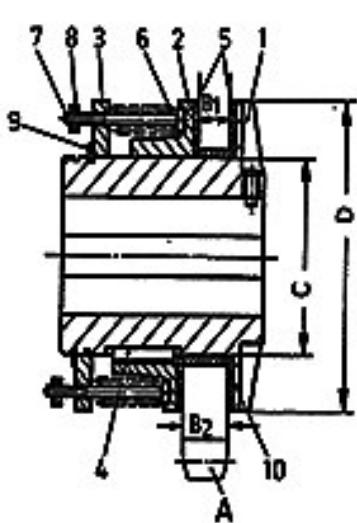
The response curve of the helical springs is maintained and the pressure force applied to the linings is constant regardless of the degree of wear. Any fluctuation of the pre-set torque is insignificant and it is the number of springs which defines the rating torque.



THE LIMITER SUPPLIED IS RATED SPECIFICALLY FOR THE APPLICATION IT IS INTENDED TO BE USED; THE LIMITER PART SHOULD NEVER BE DISMANTLED. NEVER ADD OR WITHDRAW A SPRING DURING NORMAL FUNCTIONING OF THE WINCH. YOU WOULD BE TAKING AN IMPORTANT RISK OF DAMAGING THE EQUIPMENT AND ALL GUARANTIES WOULD BE LOST. ANY MAINTENANCE OPERATION SHOULD BE DONE BY SIGUREN OR AN AUTHORIZED REPRESENTATIVE.

5.1 Torque Limiter Variations

5.1.1 Torque Limiter RSC125 (MS6 set to 441Nm)



- A Machine Part
- 1 Hub
- 2 Pressure ring
- 3 Spring Holder
- 4 Key
- 5 Friction Lining
- 6 Spring
- 7 Hexagon head screw
- 8 Hexagon nut
- 9 Guard ring
- 10 Bush

Figure 5.1.1-1-RSC125*

Supplier RINGSPANN

| Type RS + RSC | No. of springs | D mm | C mm | B1 mm | B2 mm | Operating key for Part 7 or 8 |
|------------------|----------------------|---------|---------|----------|----------|--|
| 125 | 30 | 125 | 80 | 15,3 | 23 | Button die of tools * 2741.011.601 / SW 10 |
| 160 | 30 | 160 | 100 | 15,3 | 28 | Button die of tools * 2741.015.602 / SW 13 |
| 200 | 30 | 200 | 125 | 23 | 34 | Socket wrench for hexagon nut M 8 |
| 250 | 30 | 250 | 160 | 28 | 41 | Socket wrench for hexagon nut M 10 |

Table 3.1.1-1

1. Insertion of Machine Part A

If a bush 10 is to be used, then it is recommended that this be done with the aid of a press acc. to Figure 5.1.1-2.

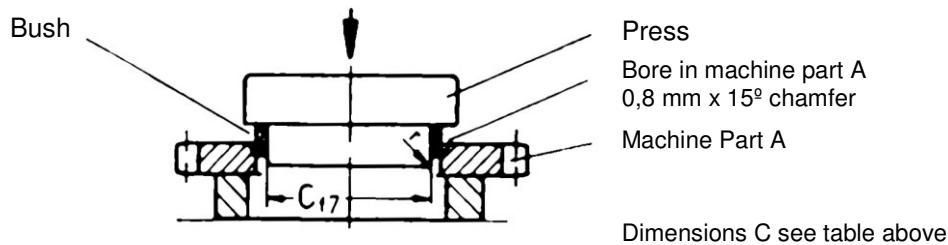


Figure 5.1.1-2

Pressing the bush into the machine part A using a press (lightly oil the bore of the machine part).

All of the springs 6 are made inactive by tightening the nuts on the screws.

| Type RS + RSC | Active springs | Driving speed | Driving time |
|------------------|----------------|----------------------|--------------|
| 125.1+ 160- | 30 | 60 min ⁻¹ | 0,5 min |
| 125.2 | 30 | 30 min ⁻¹ | 0,5 min |
| 160.2 | 30 | 25 min ⁻¹ | 0,5 min |
| 200.1 | 30 | 25 min ⁻¹ | 0,8 min |
| 200.2 | 15 | 25 min ⁻¹ | 0,8 min |
| 250.1 | 20 | 25 min ⁻¹ | 1,0 min |
| 250.2 | 10 | 25 min ⁻¹ | 1,0 min |

Table 3.1.1-2

Attention! Guard ring 9 not to dislodge from the hub 1 before the springs inactive. Spring holder 3 and pressure ring 2 to draw off. Key 4 and front friction lining 5 to be taken off. Machine part A can now be fitted.

2. Lubrication

For the bush only no other lubrication is required.

3. Running In

Constant operating torque can be guaranteed if the torque limiter with blockaded machine part A has done slip rotations according to table below.

The "running in" is not necessary when the torque limiter was supplied with machine part A and torque set by RINGSPANN.

4. Setting of Torque

After running let the torque limiter cool down. It is not necessary to dismount the parts. The torque limiters are always equipped by 30 springs 6, which are taken on hexagon head screws 7. The torque is determined by the number of thrust springs to be in function. Springs are to be stopped by tightening the nut 8 which is fitted at the screw end, and hereby the springs are made inactive. The number of springs which are in function for a determined torque, are shown in the diagram beside. A more accurate setting of the torque is possible by using a lever (see fig. 5.1.1-4). This is connected with the machine part A, on which weights can be hung.

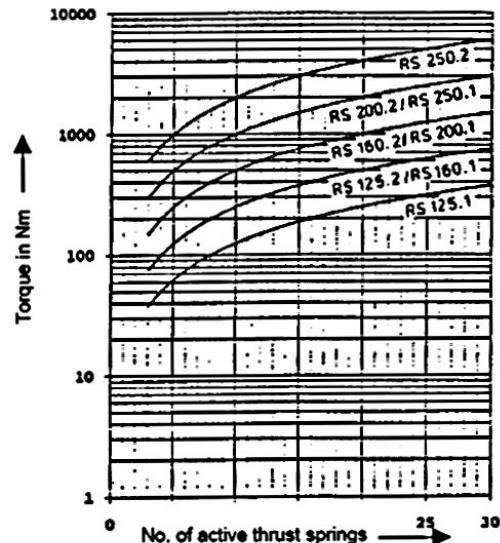


Figure 5.1.1-3

With the torque limiter running slowly, the lever has to be brought into balance by adjusting the weight and the calculating the transmissible torque.

A more accurate setting of the torque is possible by using a lever (see fig. 5.1.1-4). This is connected with the machine part A, on which weights can be hung. With the torque limiter running slowly, the lever has to be brought into balance by adjusting the weight and the calculating the transmissible torque.

$$M = L \cdot 9,81 (P + 0,5 G)$$

M = Required torque in [Nm]

L = Lever length in [m]

P = Weight in [kg]

G = Lever weight in [kg]

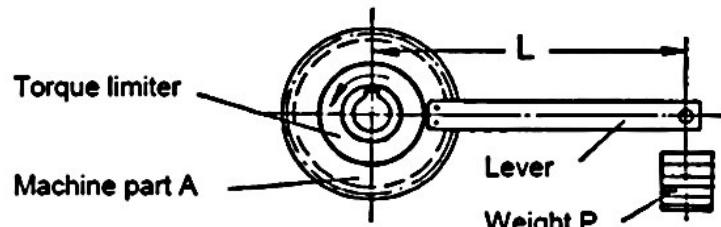


Figure 5.1.1-4

Only with symmetrically mounted spring balanced arrangements are possible.

5.1.2 Torque Limiter RSC100 (MS3 set to 134Nm)

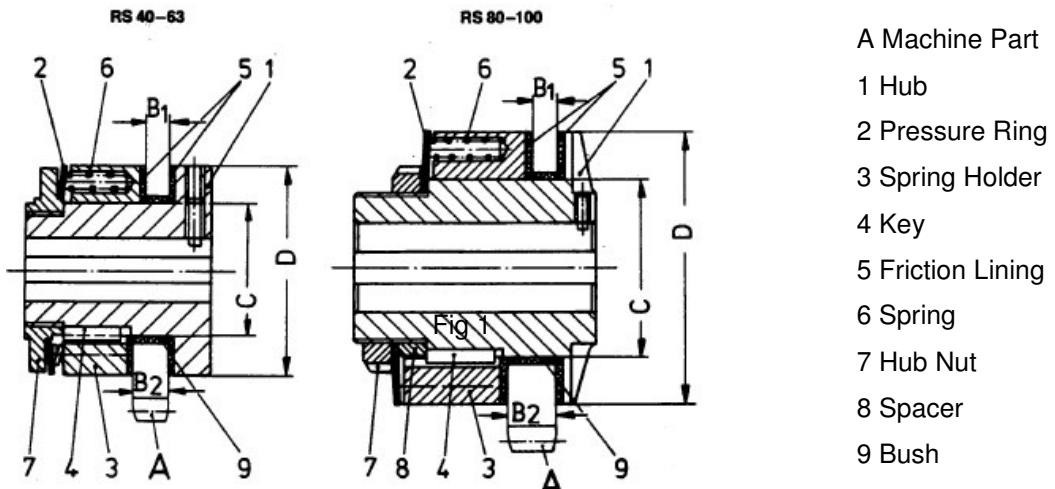


Figure 5.1.2-1

1. Insertion of Machine Part A

If a bush 10 is to be used, then it is recommended that this be done with the aid of a press acc. to Fig. 5.1.2-2

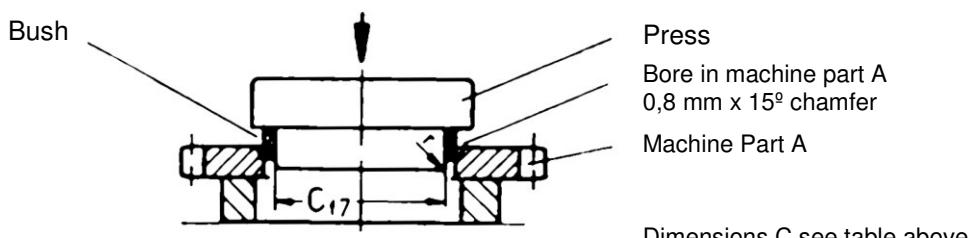


Figure 5.1.2-2

Pressing the bush into the machine part A using a press (lightly oil the bore of the machine part). All of the springs 6 are made inactive by tightening the nuts on the screws.

Unscrew the hub nut (7) with the correct key or spanner (see above table). Withdraw the pressure ring (2) and spring holder (3) with springs (6). Key (4) and front friction lining (5), part A can now be fitted.

| Size D mm | No. of springs | C mm | B1 mm | B2 mm | Operating key for part 7 | tight. torque for part 7 |
|--------------|----------------------|---------|----------|----------|--------------------------|--------------------------|
| 40 | 18 | 25 | 4,4 | 7 | Wrench SW 36 | 40Nm |
| 50 | 18 | 32 | 5,2 | 8,7 | Wrench SW 36 | 80Nm |
| 63 | 18 | 40 | 5,8 | 10,5 | Wrench SW 50 | 120Nm |
| 80 | 30 | 50 | 5,8 | 15,3 | 'C' spanner A58-62 | 300Nm |
| 100 | 30 | 65 | 8,7 | 18 | 'C' spanner A58-75 | 500Nm |

Table 5.1.2-1

Torque limiter should be reassembled in opposite sequence. Pressure Rings (2), lightly plate shaped, to be mounted as shown in picture. Hub nut (7) must be tightened hard, dependent on whether correcting part B₁ or B₂ is being used with sizes 40 - 63. you should note carefully which way round the hub nut (7) is put in, see RS drawing above, . For the sizes 80-100 a built in bearing spacer (pos 8) is supplied which has to be detached when assembling a connecting part with width.

2. Lubrication

With the type using the bush no other lubrication is required.

3. Running In

Constant operating torque can be guaranteed if the torque limiter is run in with a locked connecting part according to the table below.

The "running in" is not necessary for the sizes 40-63 and also if the torque limiter was supplied with machine part A and torque set by RINGSPANN.

4. Setting of Torque

After running, let the torque limiter cool down and

As described in paragraph 1 remove the springs (6).

The necessary number of springs requires to give a certain torque can be calculated approximately with the help of the diagram.

An exact torque setting is only possible by measuring the torque. For this for instance, a lever to which weights can be attached,(see fig 5.1.2-4) is connected with machine part A

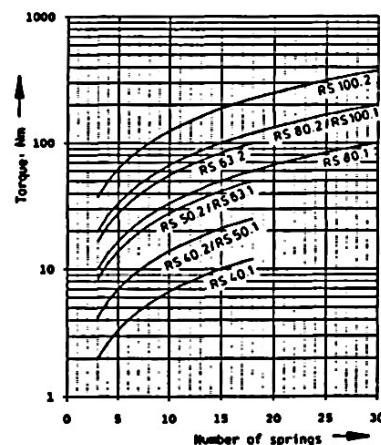


Figure 5.1.2-3

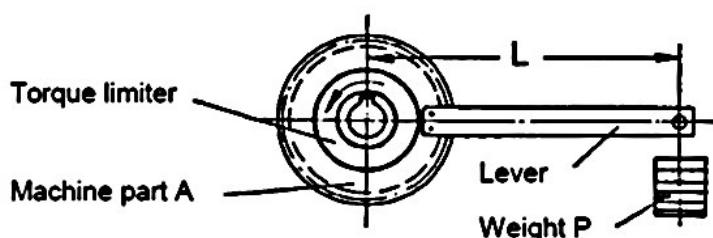


Figure 5.1.2-4

With the torque limiter running slowly, the lever has to be brought into balance by adjusting the weight and the calculating the transmissible torque.

$$M = L \cdot 9,81 (P + 0,5 G)$$

M = Required torque in [Nm]

L = Lever length in [m]

P = Weight in [kg]

G = Lever weight in [kg]

For use with high torque the springs have to be symmetrically placed.

5. Setting and Tests on the Drives

It is preferable that before the Motosuiveur® is assembled, the following settings and tests are performed on the hoist drives:

- The acceleration ramps
- The deceleration ramps
- The opening of the service brake of the main hoist motor against the motor torque
- The closing of the service brake of the main hoist motor against the motor speed
- The thresholds of the fixed speeds
- The minimum and maximum speeds
- The Motosuiveur® is programmed to brake as soon as the maximum and minimum thresholds are exceeded for each of these values.

If when engaged, the drive is not correctly set, the Motosuiveur® will automatically brake, until the correct value is obtained.

5.2 Setting-up on the Drum

To avoid having to do a new drain of system before putting it in service, the Motosuiveur® must be transported in the authorised positions shown above. See Section 2.2 *Handling*.

WARNING



**BEFORE SETTING IT UP, CHECK THAT THE MOTOSUIVEUR® IS POSITIONED THE
CORRECT WAY. A WRONGLY POSITIONED MOTOSUIVEUR® WILL INVALIDATE THE
WARRANTY.**
**THE RIGHT WAY IS INDICATED BY AN ARROW ON THE SIDE OF THE
MOTOSUIVEUR®..**

The arrow indicates the direction of spin of the Motosuiveur® during the lowering of the load.

6 OPERATING INSTRUCTIONS

6.1 Front Panel Layout

The Front Panel is the main source for power and recovery functions.

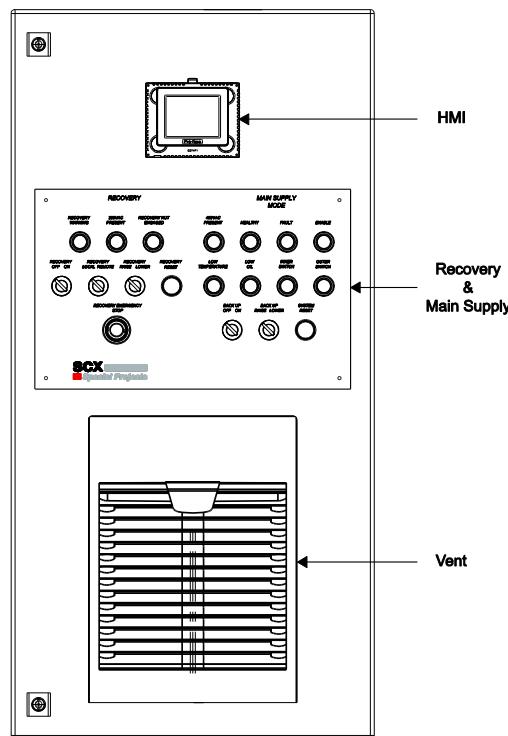


Figure 6.1-1—Main Front Panel

Before any operations can commence a system reset is required. The reset pushbutton is located on the main supply mode section of the panel. This will only be achieved if the following conditions are true

- Power supply is on and healthy
- E-Stop Circuit is healthy
- No faults are present

This reset is required after the activation of any emergency stops, electrical faults, or any isolation of power.

The operator has the facility to use the controls on the HMI and the controls on the Recovery and Main Supply Panel as shown on below.

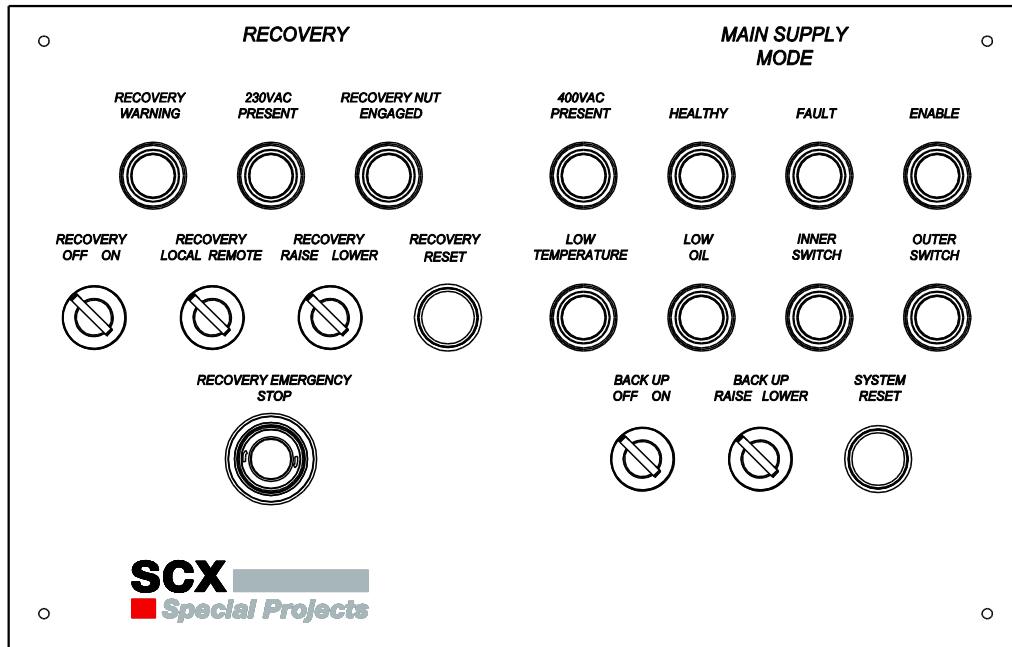


Figure 6.1-2-Recovery and Main Supply

The panel allows the operator to do the following:

- Reset the system
- Utilise the recovery functions
- Utilise the Backup system
- Monitor the status of the Motosuiveurs supply, health, switch, temperature and oil levels
- Provide emergency stop operation if required

6.2 HMI Touch Screen Operations

6.2.1 Main Screen

The Motosuiveur® control system uses a touchscreen attached to the logics controller.

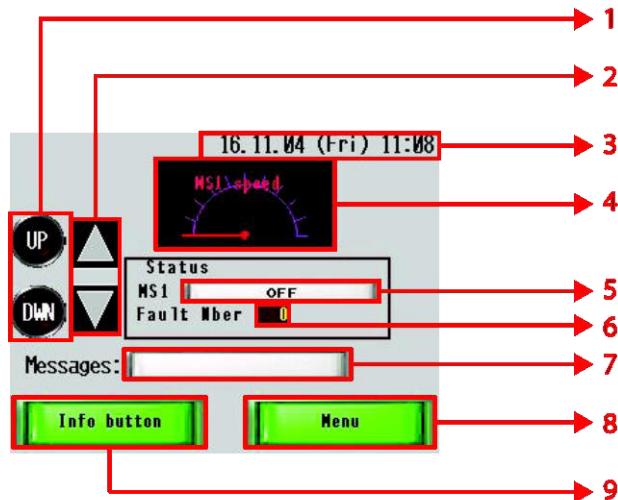


Figure 6.2.1-1-Main Screen Components

| No: | Function: | Description: |
|-----|--------------------------------|--|
| 1 | UP/DOWN buttons | When the system is in Backup or Recovery mode pressing one of the buttons drives the motor respectively in UP and DOWN directions. |
| 2 | UP/DOWN motor status indicator | Shows actual motor's status based on Arrow illumination.(See table 6-5) |
| 3 | Date/Day/Time | Shows actual date, day of week and time. |
| 4 | Speed indicator | Displays actual motor speed. |
| 5 | Status indicator | Displays system status (See Status Table 6-2 1-3). |
| 6 | Fault number indicator | Displays fault number (See Fault Table 6.2 1-5). |
| 7 | Messages bar | Displays warning messages (See Warning Table 6.2 1-2). |
| 8 | Menu button | Redirects to Menu screen. |
| 9 | Info button | Redirects to Fault text window with further clarification of received fault and possible solution. |

Table 6.2.1-1

| Warning Table | | Description |
|----------------------|---------------------------|---|
| 0 | OFF | No warning |
| 4 | Simultaneous | Both 'Raise' and 'Lower' signals are on |
| 5 | Power output off | The MS controller power stage is off |
| 10 | Blocked | Unsuccessful centering (worm not free at the end of the movement) |
| 11 | Inner switch not centered | Inner switch not correctly set |
| 12 | Outer switch not centered | Outer switch not correctly set |
| 13 | No inner switch | Inner switch not responding |
| 14 | No outer switch | Outer switch not responding |
| 28 | Check Sum | Unexpected variable change |
| 40 | Slope too long | The hoist motor deceleration slope is too long |
| 41 | Power Loss | Power loss during movement |
| 42 | Movement Stopped | ON signal turned off during movement |

Table 6.2.1-2

| Status Table | | |
|---------------------|-----------------------|-----------------------|
| Value | Text Displayed | Description |
| 0 | OFF | OFF, I1 |
| 1 | Self Check A | Soft self check |
| 2 | Self Check B | Electrical self check |
| 3 | Self Check C | Damping self check |
| 4 | Self Check D | Air self check |
| 5 | Self Check E | Play self check |
| 6 | Ready | Ready |
| 7 | Fault | Fault |
| 8 | Backup | |
| 9 | Recovery | |

Table 6.2.1-3

| Arrow Colour | Status |
|---------------------|---------------|
| Grey | Resting |
| Grey | Other |
| Green | Executing |
| Yellow | Waiting |
| Orange | Stopping |
| Red | Inversing |
| Brown | Impossible |
| Black | Impossible |

Table 6.2.1-4

| Fault Table | | Description |
|--------------------|-----------------------|---|
| 0 | OFF | No fault |
| 15 | Play too big | Worm backlash too big detected |
| 17 | Play too small | Worm backlash too small detected |
| 20 | Air detected | Air in the damping chamber detected |
| 22 | Damping too soft | Hydraulic resistance out of tolerance (too small) |
| 23 | Damping too hard | Hydraulic resistance out of tolerance (too big) |
| 25 | Piston not in place | Hydraulic piston stuck in the bottom |
| 27 | Transmission lost | Motor to worm transmission broken |
| 33 | Unscrewing Overspeed | 'overspeed' detected during lowering |
| 34 | Screwing Overspeed | 'overspeed' detected during raising |
| 35 | Unscrewing Underspeed | 'underspeed' detected during lowering |
| 36 | Screwing Underspeed | 'underspeed' detected during raising |
| 37 | Max Speed | to be removed from the table for this project |
| 39 | Abnormal movement | movement won't start (starting timeout detected) |
| 44 | Sudden Stop | MS physical activation detected |

Table 6.2.1-5

6.2.2 Fault Screen

Shows status of fault once 'Info' button has been pressed.

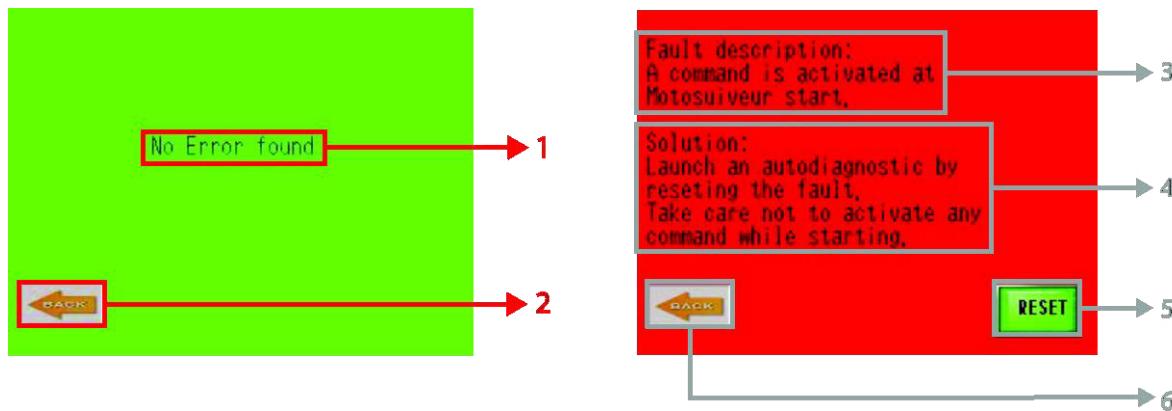


Figure 6.2.2-1—Fault Screen Components

| No: | Function: | Description: |
|-----|-------------------------|---|
| 1 | No error message | Indicates absence of fault. |
| 2,6 | Back button | Returns to previous screen. |
| 3 | Fault description field | Describes generated fault. |
| 4 | Solution field | Describes possible solutions to remove generated fault. |
| 5 | Reset button | Pressing the key sends request to the PLC unit for Reset of the PLC unit. If the PLC unit returns acknowledge it will reset itself. |

Table 6.2.2-1

6.2.3 Communication Failure Screen



Figure 6.2.3-1—Communication Failure Screen

| No: | Function: | Description: |
|-----|----------------------|--|
| 1 | COMM Failure message | If the communication between PLC unit and HMI display is lost the Communication failure screen pop-ups automatically. Once the cause is removed the screen hides itself automatically. |

Table 6.2.3-1

6.2.4 Menu Screen

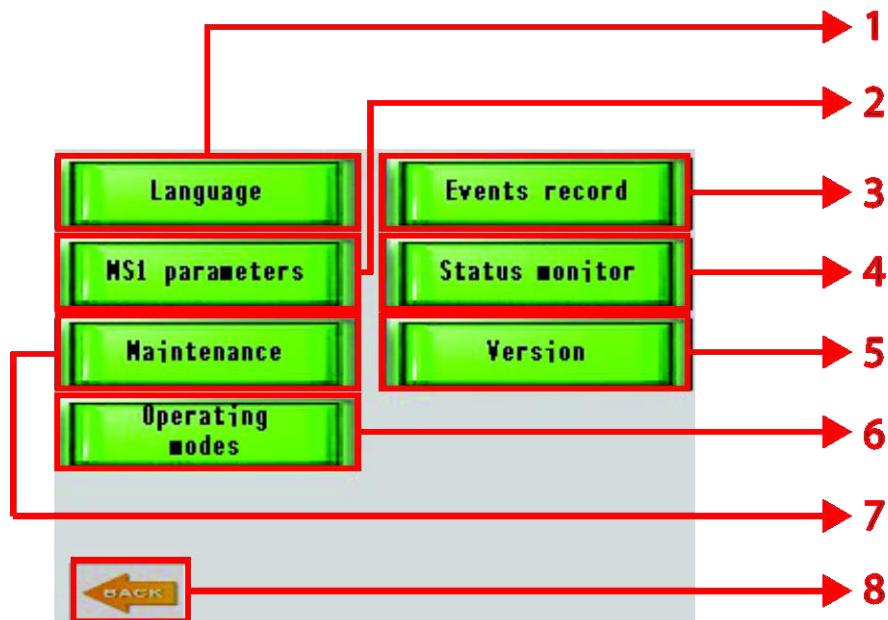


Figure 6.2.4-1—Menu Screen Components

| No: | Function: | Description: |
|-----|------------------------|--|
| 1 | Language button | Redirects to the screen for language selection. |
| 2 | Events record | Redirects to the screen with history event records. |
| 3 | MS1 parameters button | Redirects to the screen for selection a group of parameters for changing. |
| 4 | Status monitor button | Redirects to the screen Status monitor. |
| 5 | Maintenance button | Redirects to the screen with additional maintenance information. |
| 6 | Version button | Redirects to the screen with information about current firmware and software versions. |
| 7 | Operating modes button | Redirects to the screen for operating mode selection. |
| 8 | Back button | Returns to the previous screen. |

Table 6.2.4-1

Note



All re-directions use the internal Pro-face3 logic

6.2.5 Language Selection Screen

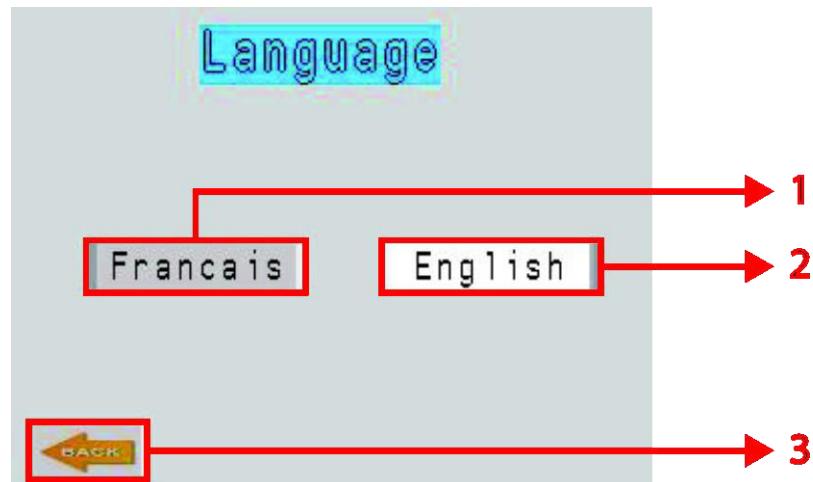


Figure 6.2.5-1—Language Selection Screen Components

| No: | Function: | Description: |
|-----|--------------------------|--|
| 1 | French selection button | Button to select French language. (Not selected in Fig.6.2.5-1) |
| 2 | English selection button | Button to select English language. Selected in Fig 6.2.5-1 |
| 3 | Back button | Returns to the previous screen. |

Table 6.2.5-1

6.2.6 Events Record Screen

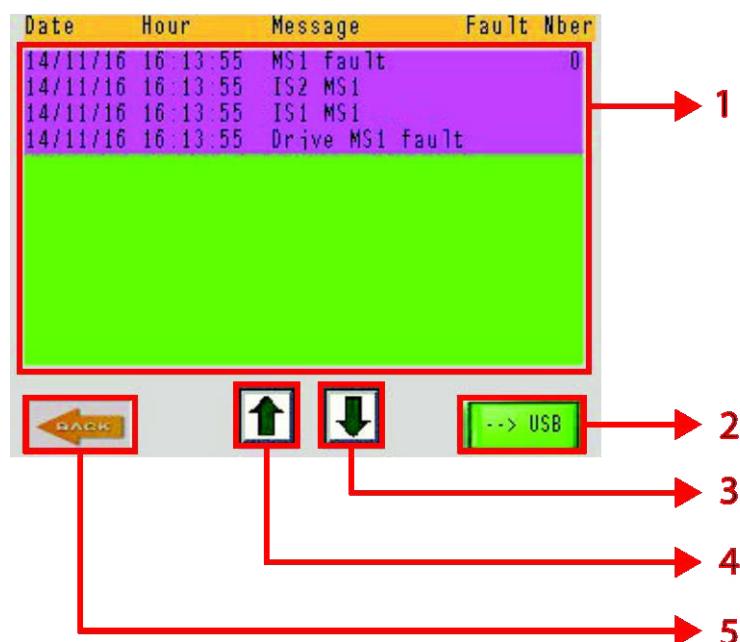


Figure 6.2.6-1—Events record Screen

| No: | Function: | Description: |
|-----|-------------|---------------------|
| 1 | Screen | Fault description |
| 2 | USB | Export to USB. |
| 3 | Scroll down | Scroll down |
| 4 | Scroll up | Scroll down |
| 5 | Back button | Returns to previous |

Table 6.2.6-1

Note



All Motosuiveur® faults are logged in the event record.

6.2.7 MS1 Parameters Screen

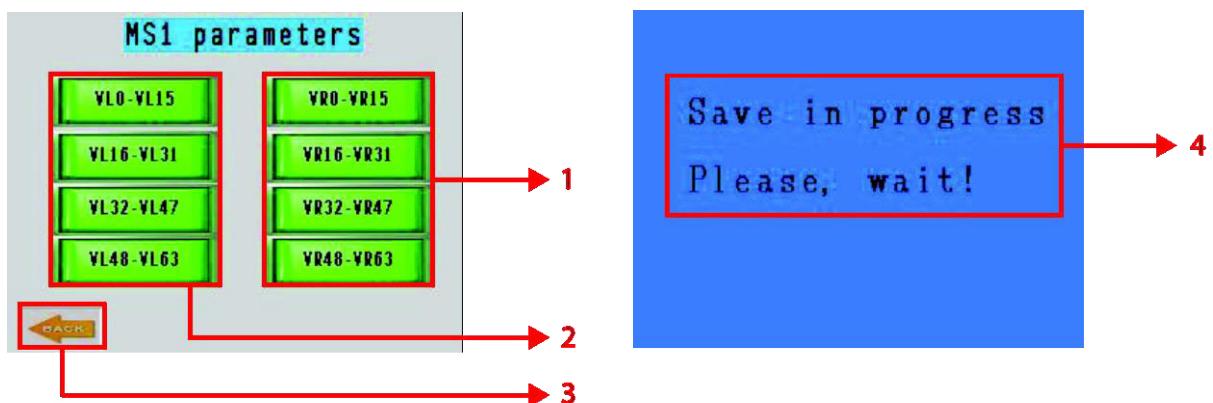


Figure 6.2.7-1 –MS1 parameters screen components

| No: | Function: | Description: |
|-----|--------------------------|---|
| 1 | VR buttons group | Buttons group for editing VR parameters respectively: - VR0-VR15 – from VR0 to VR15; - VR16-VR31 – from VR16 to VR31; - VR32-VR47 – from VR32 to VR47; - VR48-VR63 – from VR48 to VR63; |
| 2 | VL buttons group | Buttons group for editing VL parameters respectively: - VL0-VL15 – from VL0 to VL15; - VL16-VL31 – from VL16 to VL31; - VL32-VL47 – from VL32 to VL47; - VL48-VL63 – from VL48 to VL63; |
| 3 | Back button | Returns to previous screen and set request save flag. |
| 4 | Save in progress message | Once the PLC unit returns acknowledge the Save in progress screen (right picture in Fig. 6-7) pop-ups and hides itself automatically when the saving process finished. |

Table 6.2.7-1

Note



The term "MS1" is not related to the MS size.

6.2.8 MS1 VR Parameters Screen

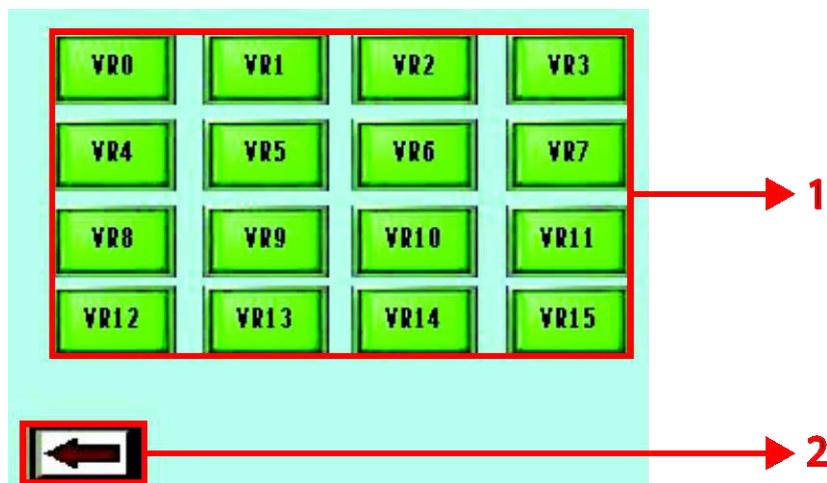


Figure 6.2.8-1 MS1 VR parameters screen

| No: | Function: | Description: |
|-----|---------------------------------|--|
| 1 | VR buttons group for range 0-15 | Buttons group for editing VR parameters respectively from 0 to 15. |
| 2 | Back button | Returns to previous screen. |

Table 6.2.8-1

Note



The following description is also valid for ranges of parameters VR16-VR31, VR32-VR47 and VR48-VR63 with respect to their values.

6.2.9 MS1 VL Parameters Screen

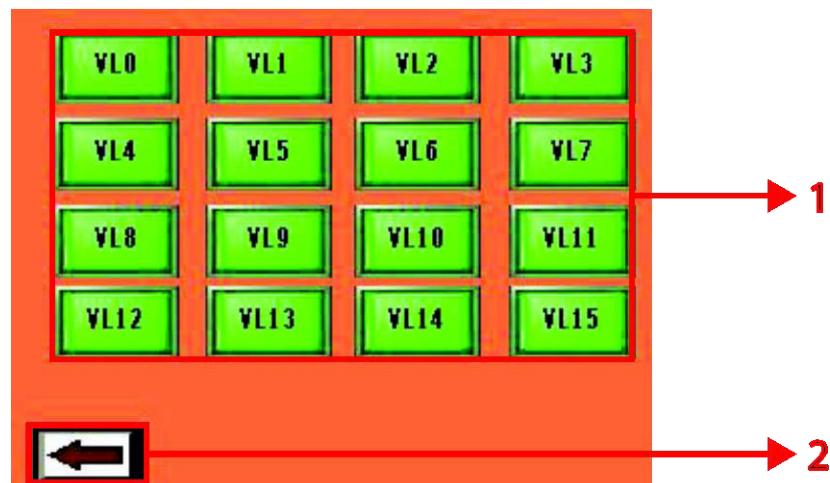


Figure 6.2.9-1 MS1 VL parameters screen components

| No: | Function: | Description |
|-----|---------------------------------|--|
| 1 | VL buttons group for range 0-15 | Buttons group for editing VL parameters respectively from 0 to 15. |
| 2 | Back button | Returns to previous screen. |

Table 6.2.9-1

Note



The following description is also valid for ranges of parameters VR16-VR31, VR32-VR47 and VR48-VR63 with respect to their values.

6.2.10 MS1 Parameter Setting Screen

Following description is valid for all VR and VL parameters.

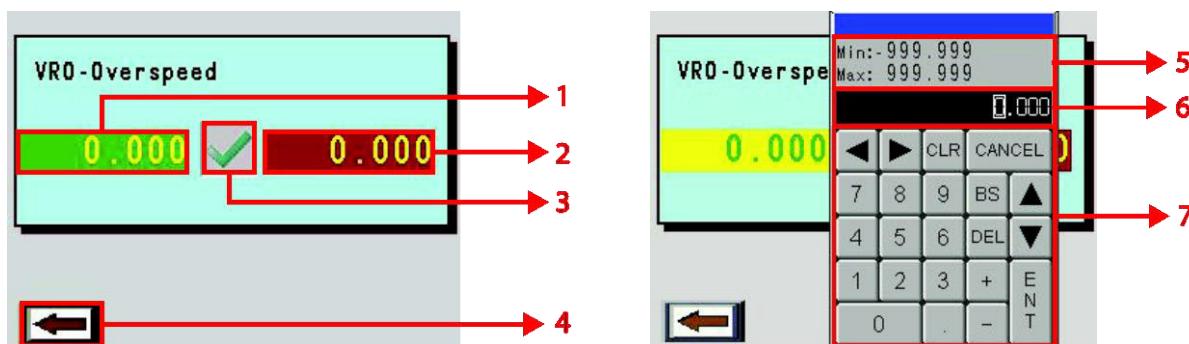


Figure 6.2.10-1—MS1 parameter setting screen components

| No: | Function: | Description: |
|-----|-----------------|---|
| 1 | Entry field | When pressing on it input keyboard (right picture on Fig.6-10) appears. |
| 2 | Actual field | Shows current value for the given parameter. |
| 3 | Confirm button | When pressing on it the entered new value will be corrected directly in the PLC unit. |
| 4 | Back button | Returns to previous screen. |
| 5 | Available range | Shows available range of values which may be entered. |
| 6 | Display | Shows entered value. |
| 7 | Keyboard | Keyboard buttons for entering the desired value. |

Table 6.2.10-1

Note



For all functionality the Internal Pro-face logic is used for direct access to the PLC unit memory (SDO instructions);

6.2.11 Status Monitor Screen

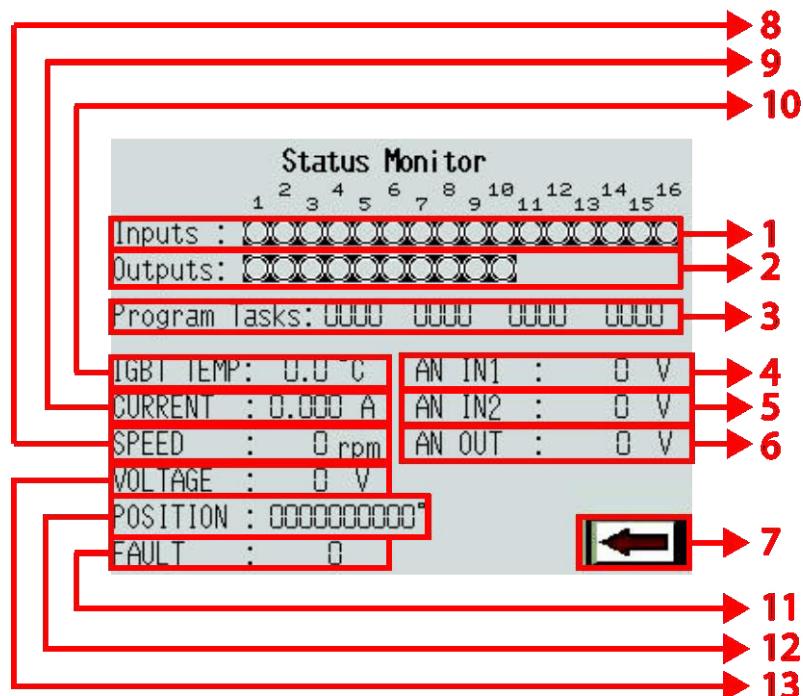


Figure 6.2.11-1—Status monitor screen components

| No: | Function: | Description: |
|-----|----------------------------|--------------------------------------|
| 1 | Digital inputs indicator | Shows actual digital inputs states. |
| 2 | Digital outputs indicator | Shows actual digital outputs states. |
| 3 | Program tasks indicator | Shows actual program tasks states. |
| 4 | Analog input 1 indicator | Shows actual analog input 1 value. |
| 5 | Analog input 2 indicator | Shows actual analog input 2 value. |
| 6 | Analog output indicator | Shows actual analog output value. |
| 7 | Back button | Returns to previous screen. |
| 8 | Speed indicator | Shows actual motor speed. |
| 9 | Current indicator | Shows actual current value. |
| 10 | IGBT temperature indicator | Shows actual IGBT temperature. |
| 11 | Fault status indicator | Shows actual fault status. |
| 12 | Position indicator | Shows actual position. |
| 13 | Voltage indicator | Shows actual DC BUS voltage. |

Table 6.2.11-1

6.2.12 Maintenance Screen

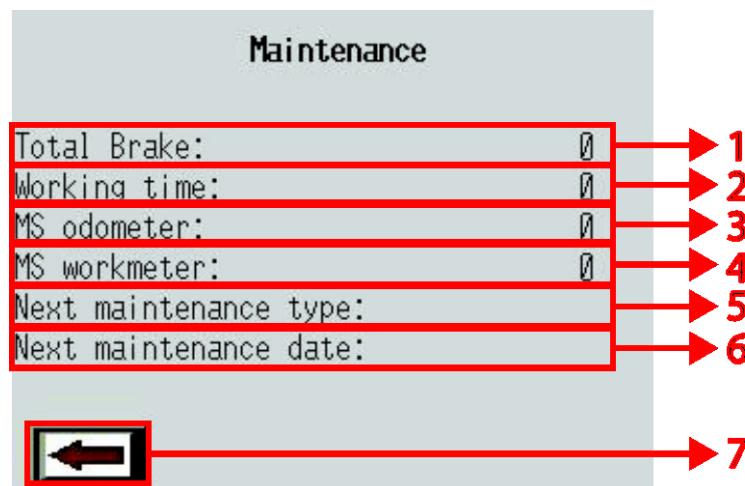


Figure 6.2.12-1—Maintenance screen components

| No: | Function: | Description: |
|-----|-----------------------|--|
| 1 | Total brake counter | Shows total brakes. |
| 2 | Working time | Shows total working time. |
| 3 | MS odometer | Shows overall distance travelled by the motor. |
| 4 | MS workmeter | Shows overall performed work. |
| 5 | Next maintenance type | Currently not used. |
| 6 | Next maintenance date | Currently not used. |
| 7 | Back button | Returns to previous screen. |

Table 6.2.12-1

6.2.13 Version Screen

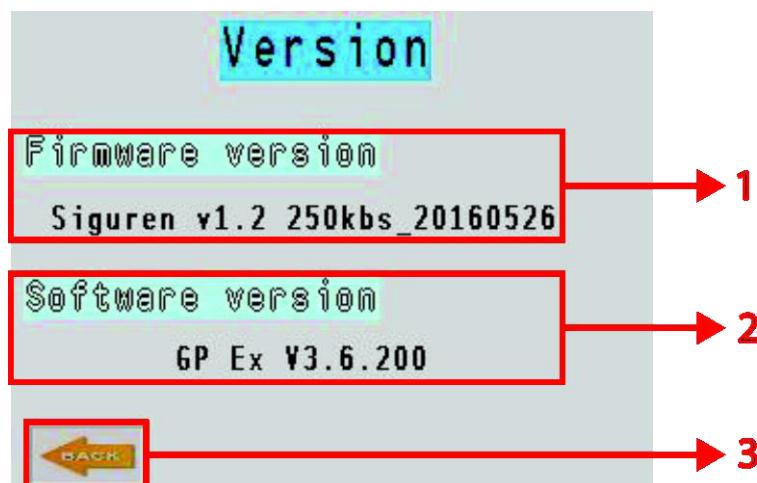


Figure 6.2.13-1-Version screen components

| No: | Function: | Description: |
|-----|------------------------|---|
| 1 | Firmware version field | Shows current project firmware version. |
| 2 | Software version field | Shows current GP-PRO software version. |
| 3 | Back button | Returns to previous screen. |

Table 6.2.13-1

6.2.14 Controller Display Codes

| Self Test | Description |
|-----------|-----------------------|
| | Homing |
| | Waiting piston return |
| | Checking software |
| | Electrical Test |
| | Outer switch test |
| | Inner switch test |
| | Damping |
| | Air Test |
| | Play Test |
| | Error |

Table 6.2.14-1

| At Rest | Description |
|---------|-------------------------|
| | Oil level low |
| | Inner Switch Activated |
| | Outer switch Activated |
| | Both Commands Activated |
| | Maintenance "D" |
| | Maintenance "C" |
| | Maintenance "B" |
| | Maintenance "A" |
| | Rest (normal) |

Table 6.2.14-2

| During Movement | Description | Explanation |
|-----------------|----------------------|--|
| | Centering | The worm is positioned to the centre of its backlash, to prepare for the next movement |
| | Screwing Tackling | Upward movement start |
| | Unscrewing Tackling | Downward movement start |
| | Screwing Following | Upward movement following |
| | Unscrewing Following | Downward movement following |
| | Near Overspeed | Starts blinking the more and more rapidly as the speed approaches the 'overspeed' threshold setting |
| | Near Underspeed | Starts blinking the more and more rapidly as the speed approaches the 'underspeed' threshold setting |
| | Fault | Fault detected |

Table 6.2.14-3

| During Recovery | Description |
|---|----------------|
|  | Pre engagement |
|  | Engaged |

Table 6.2.14-4

6.3 Recovery Procedure

The MotoSuiveur unit is a proprietary system for protection of the main hoist load from over-speed and load path failures, and for recovery of the load in the event of a failure. The MotoSuiveur unit is supplied with a proprietary control panel from the equipment manufacturers. The crane hardwired controls are interfaced to this panel to control the MotoSuiveur in normal operation.

A separate operator panel, the MS remote panel, is provided, located adjacent the crane operator panel, which houses the MotoSuiveur recovery controls and MotoSuiveur HMI. In the event of a protection system trip, caused by main hoist over-height or main hoist over-load, the crane operator will require the use of the recovery procedure.

Prior to any recovery operations commencing, the cause of the fault should be identified. The following procedure below explains the recovery procedure process.

1. Isolate the MotoSuiveur Panel using the isolator.
2. Plug the 230v recovery plug into the front of the left hand door.
3. Using the isolator enable the 230v on the panel.
4. Wait for the HMI to fully complete its start-up procedure.
5. Depress the blue '**Recovery Reset Button**' to reset the recovery VSD.
6. Switch on the recovery mode to start the recovery nut engagement process. The engagement will cycle the recovery motor forward approx. 10s then reverse approx. 1 s. This will cycle until the engagement is completed.
7. On completion of the engagement process the '**Recovery Nut Engage Lamp**' will be illuminated.
8. Open the hoist brake to lower the load. If the weight of the load is insufficient to make the hoist lower by gravity then the "pushing down" function must be used.
9. Using the recovery direction switch make a small (5 second) movement in the raise direction to ensure the teeth of the recovery nut is fully engaged.
10. Complete a recovery lower movement to lower the load and maintain the switch in the lower position until the '**Inner Switch Lamp**' has switched off. (MS Worm Screw has moved into the normal position)
11. Complete a recovery raise movement to disengage the recovery nut indicated by the changing state of the '**Recovery Nut Engaged Lamp**' to NOT illuminated.

12. Once the nut is disengaged the '**Recovery Raised Switch**' can be released to the central position.

Note

The recovery drive will begin to run on the release of the switch to the central position. This is normal.

13. Switch the recovery mode to the '**Off**' position using the switch.
14. Switch the isolator to the central '**Off**' position and wait for 2 minutes.
15. Remove the 230v recovery plug from the front of the panel door.
16. Using the isolator move this into the normal positon by applying 400v to the panel.
17. As soon as the panel is energised the drive will initiate a self-test and start the HMI software.
18. The self-test will complete and the '**Enable Lamp**' will be illuminated.

Note**Recovery Limitations:**

Downward direction-Full SWL and locked service brake only. Service brake should be opened during recovery.

Upward direction-Limited to 3.5t hook block only without load applied and brake operable. Upward movement with SWL and Hoist brake closed is not permitted.

6.4 Backup Procedure

This switch allows the user to lower or raise the load with the MS unit ensuring no braking occurs. It does this via the MotoSuiveur servo motor following the hoist movement whilst maintaining the normal position for the worm.

Raise signal- This replicates the raise signal from the main hoist unit control panel without movement. This is to prime the MotoSuiveur following motor in the raise direction. The raise movement is via the hoist motor so in this case is not be isolated. Therefore any hoist movement will be required to be initiated by some means but prior to the initiation the backup mode should enabled.

Lower signal- This replicates the lower signal from the main hoist unit control panel without movement.

In the event of a fault on the hoist the hoist drive mechanism can be isolated, the MotoSuiveur backup mode enabled, lower direction switch applied and through the release of the service brake by 'fethering the brake' the MotoSuiveur will follow the rotation of the hoist without arresting. However if the hoist achieves an over speed condition then the MotoSuiveur will arrest the load.

The following conditions apply to the control system when the backup procedure is initiated.

- The MotoSuiveur motor speed is physically limited to 110% during normal operation
- Hoist enable signals are ignored
- MotoSuiveur switches are inhibited

6.5 Memory Card

6.5.1 IMD Drive PC Loading / Saving procedure

An application developed with an IMD drive must be saved on a PC in order to be able to load it later, for either modification or maintenance.

6.5.1.1 Saving an application on a PC :

- Connect the drive to the PC with the CIMDP cable.
- Launch the iDPL software with the Start menu.

If you don't have the source project :

- In the welcome window, select **New Project**
- If the software asks you to overwrite the default project, click on Yes
- For multi-drives projects :
 - With the **Project \ Setup window**, declare the drives in the application (with their node number)
 - Select the drive you have to save
- In the **Communication** menu, click on **Receive drive**
- In the selection window, tick **All**
- Click on **Receive** to start the drive save in the PC
- In the **Project menu**, click on **Save as**
- In the window «Save project as», go to the save folder and enter the name of the project (e.g. : MyProject.IDW).

If you have the source project :

- In the welcome window, select **Open project**
- In the window «Open», go to the save folder
- Double click on the project (e.g. : MyProject.IDW).
- For multi drives projects : select the drive you have to save
- Go into **Communication \ Receive drive**
- In the selection window, tick **Parameters, Variables, Saved data and Cams.**
- Click on **Receive** to start saving the drive in the PC project.

6.5.1.2 Application loading in the drive

- Connect the drive to the PC with the CIMDP cable.
- Launch the iDPL software with the Start menu.
- In the welcome window, select **Open project**
- In the window «Open project», go to the save folder
- Double click on the iDPL project (e.g. : MyProject.IDW).
- For multi-drives projects: select the drive you have to load
- Go to **Communication \ Send drive**
- In the selection window, tick **All**
- Click on **Send** to start the project PC restoring data to the drive.

6.5.2 MEMORY STICK Loading / Saving procedure

This optional module 'Memory Stick' provides a quick and simple way of saving of the whole drive data: Parameters, Saved data, Cam profiles, Tasks and Operating System. When it is switched on, the IMD compares its data content with the Memory Stick data. If they are different, the IMD is automatically reloaded with the Memory Stick data.

In case of empty Memory Stick at power on, the data's of the IMD are loaded inside the Memory Stick.

The Memory Stick is automatically updated during a PC loading to an IMD :

- The Parameters
- The saved data or trajectories
- The cams or saved data
- The tasks
- The Operating System

6.5.3 Status Display



Data transfer from the Memory Stick to the Drive



Data transfer from the Drive to the Memory Stick



Error 18 : a write operation to the Memory Stick has failed : Removed or defective Memory stick.



Error 19 : the Memory Stick transfer to the drive has not been done correctly because the data are incoherent. The Memory Stick has been erased and updated with the drive contents.

6.6 Training Requirements

The following training record log sheet should be used to record all training given in the operation, maintenance and use of the various elements of this work package.

6.6.1 Training Record Log Sheet

| | |
|--|--|
| Name: | |
| Position: | |
| Signature: | |
| Date: | |
| Details of Training Given: | |
| Comments: | |
| By signing this sheet, the above named person agrees that he / she has been given the training detailed and fully understand the implications of the training e.g. if training has been given on the mechanical services installation, the person understands the working of the installation including its' day to day operation and routine maintenance. | |

This page is to be used as the basis of a log of all training given in the use of the various elements of the equipment and any associated equipment / systems / services. Please photocopy this page, fill in the photocopy and insert it in this manual.

7 MAINTENANCE INFORMATION

7.1 Health and Safety

WARNING

READ HEALTH AND SAFETY PRECAUTIONS BEFORE YOU START ANY SERVICE WORK. SERVICING OF THE EQUIPMENT MUST ONLY BE CARRIED-OUT BY AUTHORISED PERSONS FULLY TRAINED AND COMPETENT IN THE MAINTENANCE OF SCX SPECIAL PROJECTS EQUIPMENT. THEY MUST FULLY UNDERSTAND AND ADOPT CORRECT AND SAFE WORKING PRACTICES.

If you are unable to carry out the work safely in the required manner then contact SCX Special Projects Ltd for advice. Only routine servicing procedures are detailed in this handbook. Do not attempt more complex work without reference to SCX Special Projects Ltd.

WARNING

PLEASE READ THE HEALTH AND SAFETY INSTRUCTIONS IN SECTION 2 BEFORE CARRYING OUT ANY WORK ON THE HHS.

There is no single factor more important than minimising the possibility of personal injury to the Operator and/or those working in the area, or damage to property, equipment and/or materials.

No Operator should be permitted to use the equipment unless they are familiar with its operations. They should be physically and mentally fit and trained in Safe Hoisting Practices. Hazards can only be minimised by, care, common sense and the operator being alert at all times.

7.2 Electrical Maintenance and Testing

Due to inherent dangers in the maintenance and testing of electrical equipment, special attention should be paid to safety, not only to the personnel working the immediate area but also to equipment under test, maintenance and repair.

All personnel operating in the relevant area should observe these procedures and pay due regard to safety Local Safety Rules and Regulations.

It is advisable that at least two fully trained engineers be present at all times when the equipment is being tested, maintained or serviced.

All equipment under electrical test should have WARNING NOTICES displayed saying that equipment tests are in progress. Any ancillary equipment, for example, test equipment and instruments, should be safe and prominent notices around the equipment should advertise any danger, which may exist. Any notices displayed in pursuing these procedures should be removed as soon as they are no longer applicable, to emphasise the special significance of their presence.

If it becomes necessary to carry out maintenance, testing or setting up to work on the equipment requiring access by opening doors, removing covers etc., then safety hazards may arise. Then risk assessments should be carried out and safe-working practices followed.

A duty holder should be responsible for ensuring that the equipment is made accessible only to authorised personnel to carry out specific tasks after receiving permission.

The user should ensure that maintenance setting up and authorised and competent persons only carry out testing of the equipment. The following basic rules should be adhered to: -

1. Before commencing maintenance works, the supply to the equipment must be isolated, locked off and the appropriate safety documents issued.
2. Comply with safe working conditions.
3. Do not work on the equipment when it is energised.
4. Ensure that all persons working on the equipment are familiar with instructions and information provided in this manual.
5. Providing that the equipment is functioning correctly and all personnel responsible for operating it are complying with the conditions specified, the electrical equipment may be deemed to be "properly used" and should be safe and free from health hazards.

7.3 Planned Maintenance Schedule

The reliability of the Motosuiveur® will depend if the maintenance procedure is strictly adhered to.

Maintenance operations are to be done based either on the number of revolutions given by the servo-motor drive display or on a time basis wherever the smallest value applies.

Maintenance Intervals: - A= Weekly, B= Monthly, C= 3 Monthly, D= 6 Monthly E= Annually, F= 2 Years
G=5 Years, H=10 Years

| Mechanical | A | B | C | D | E | F | G | H | Worm Rotation Count on servo motor | Controller Display |
|---|---|---|---|---|---|---|---|---|--|--------------------|
| TORQUE LIMITER : Visual inspection (no oxidation marks) Drawings 49104-02-003 49104-02-004 | | | | | • | | | | - | |
| REACTION ARM : (fixation, welds, cracks, etc) Drawings MSL-06-10 MSL-03-10 Replace Part No 123 | | | | | • | | | | - | |
| SERVO MOTOR WORM TRANSMISSION : Grease - LGMT2 | | | | | • | | | | 75E+6 | R |
| BELT (IF APPLICABLE) : Check for wear | | | | | | • | | | 75E+6 | R |
| WORM SHAFT LIP SEAL : Drawings MSL-06-10 MSL-03-10 Replace Part No 53 | | | | | | • | | | 150E+6 | B |
| WHEEL LIP SEAL : Drawings MSL-06-10 MSL-03-10 Replace Part No 28 | | | | | | | • | | 450E+6 | D |
| | | | | | | | | | Replace earlier if leaks are present and maintenance history is unknown. | |

| | | | |
|---|---|--------|---|
| O RINGS : Drawings MSL-06-10 MSL-03-10 Replace Part No's 27,37,38,52,103-106,116 | • | 900E+6 |  |
| | | | |
| ELECTRICAL CABINET AIR FILTER (if applies) : Replace or clean | • | - | |
| | | | |

Table 7.3-1

| Electrical | A | B | C | D | E | F | G | H | Worm Rotation Count on servo motor |
|---|---|---|---|---|---|---|---|---|------------------------------------|
| TOUCHSCREEN DISPLAY : Visual inspection | | | | • | | | | | - |
| | | | | | | | | | |
| TOUCHSCREEN DISPLAY BATTERY: Replace | | | | | | | • | | - |
| | | | | | | | | | |

Table 7.3-2

7.4 Torque Limiter

7.4.1 RSC-100

Maintenance Intervals: - A= Weekly, B= Monthly, C= 3 Monthly, D= 6 Monthly E= Annually, F= 2 Years

| Mechanical | A | B | C | D | E | F |
|--|---|---|---|---|---|---|
| GENERAL INSTALLATION: General inspection, signs of movement on shafts, condition of link chain (corrosion), wear of tooth profile where the link chain interfaces with the hubs. | • | | | | | |
| FRICITION LININGS : The TL friction linings have a minimum thickness of 2mm. Replacement is necessary if this limit is reached. | | | | • | | |
| OPERATING AREA : The operating area should be examined for contamination such as dust and fibres which may indicate the TL has been subject to forces which are causing the TL to slip and slipping will lead to the wear of the linings. The TL should be examined to assess if the unit is clean, dry and without signs of any possible contamination which may alter the performance through the contamination of the friction linings. | • | | | | | |
| TORQUE SLIP TEST : To ensure torque limiter slips when specified torque setting is exceeded. | | | | | • | |

Table 7.4.1-1

7.4.2 RSC-125

Maintenance Intervals: - A= Weekly, B= Monthly, C= 3 Monthly, D= 6 Monthly E= Annually, F= 2 Years

| Mechanical | A | B | C | D | E | F |
|--|---|---|---|---|---|---|
| GENERAL INSTALLATION: General inspection, signs of movement on shafts, condition of link chain (corrosion), wear of tooth profile where the link chain interfaces with the hubs. | • | | | | | |
| FRICITION LININGS : The TL friction linings have a minimum thickness of 2mm. Replacement is necessary if this limit is reached. | | | | • | | |
| OPERATING AREA : The operating area should be examined for contamination such as dust and fibres which may indicate the TL has been subject to forces which are causing the TL to slip and slipping will lead to the wear of the linings. The TL should be examined to assess if the unit is clean, dry and without signs of any possible contamination which may alter the performance through the contamination of the friction linings. | • | | | | | |
| TORQUE SLIP TEST : To ensure torque limiter slips when specified torque setting is exceeded. | | | | | • | |

Table 7.4.2-1

7.5 Lubrication

All Motosuiveur® units, are checked after assembly, set and tested on a bench at Siguren. During these tests, the oil tank is filled, the level is adjusted and the hydraulic system is drained.

| Version | Oil Capacity l |
|---------|----------------|
| MS3 | 2 |
| MS6 | 8.5 |

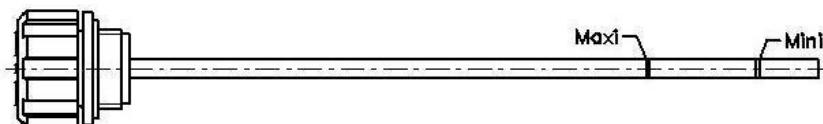


Figure 7.5-1

After the torque arm is set-up:

- If necessary clean the upper side of the Motosuiveur®.
- Unscrew the breather cap and check the oil level.
- Replace the breather cap and screw back tightly.

WARNING



DURING THIS OPERATION, MAKE SURE YOU DO NOT INTRODUCE ANY FOREIGN PARTICLES INTO THE MOTOSUIVEUR® USE ONLY THE SW15 OIL. USING OIL OTHER THAN SPECIFIED CAN CAUSE THE UNIT TO MALFUNCTION.

Maintenance Intervals: - A= Weekly, B= Monthly, C= 3 Monthly, D= 6 Monthly E= Annually, F= 2 Years
 G=5 Years, H=10 Years

| Lubrication | A | B | C | D | E | F | G | H | Worm Rotation Count on servo motor | Controller Display |
|---|---|---|---|---|---|---|---|---|------------------------------------|--------------------|
| OIL LEVEL : Visual inspection | | | | • | | | | | - | |
| OIL: Replace | | | | | | | | • | 450E+6 | |
| | | | | | | | | | | |

Table 7.5.1-Lubrication Chart

7.5.1 Oil Change

The following sketch shows the locations of holes for oil changing and filling.

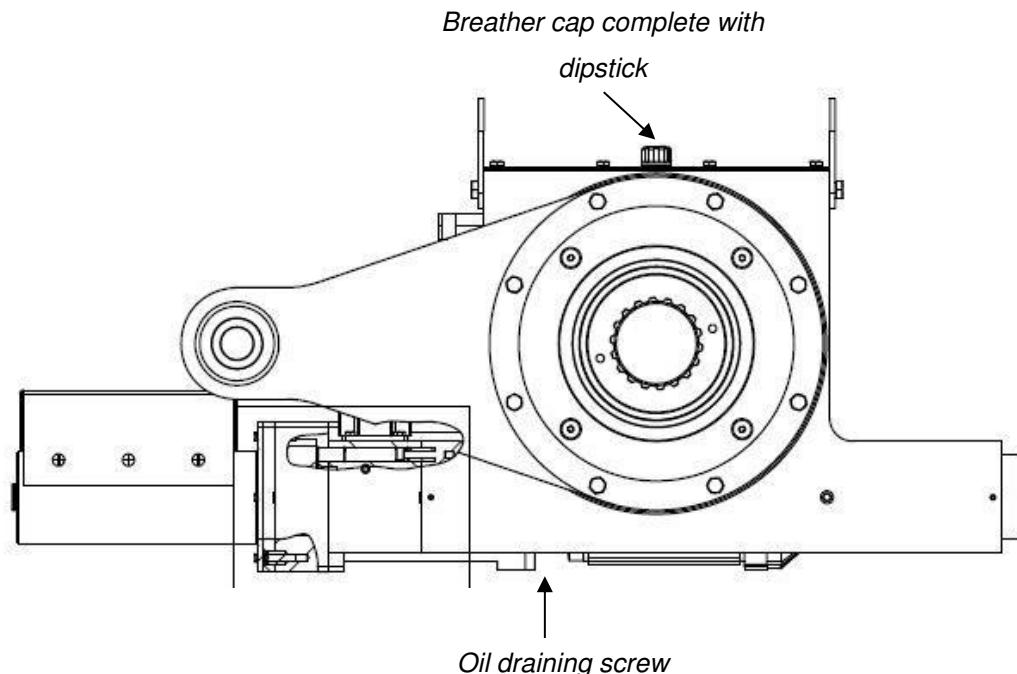


Figure 7.5.1-1

Whilst completing maintenance and during the oil change procedure care must be taken not to introduce any particles inside the Motosuiveur® as this will cause the unit to malfunction.

CAUTION

ONLY USE SIGUREN SW15 OR SQ32 OIL. THE USE OF ANY OTHER OIL MAY LEAD TO A SERIOUS MALFUNCTION.

7.5.2 Drain of the Hydraulic System

After each operation of the Motosuiveur® an auto diagnostic programme is run to check that there is no air within the damping chamber. If air is detected, the damping chamber has to be drained. This operation must be carried out by a qualified operator.

Procedure:

- Make sure the hoist is empty
- Make sure the oil level is sufficient
- Make a movement down at slow speed until the movement stops (the torque limiter is slipping)
- Make a movement up at slow speed until the movement stops (the torque limiter is slipping)
- Repeat these two operations seven times
- Power on the Motosuiveur® (an automatic auto diagnostic is launched)
- If the auto diagnostic ends with a fault, repeat the procedure

7.6 Storage

In order to ensure good preservation conditions the following storage recommendations should be observed:

(In case of ship transportation, the packaging must be waterproof and have a humidity absorbing properties). The equipment must also be stored in a dry place, away from adverse weather conditions and any temperature variation ensuring it is placed on an insulated paper covered wooden base.

Short Period Storage (Less Than 3 Months)

After the tests and the final checks, the manufactured parts of the Motosuiveur® must be protected with a long term corrosion preventative coating. The oil fill up must be adjusted to the level indicator. In this condition, they can be stored in vertical position, without any intervention during 3 months. Beware not to damage the protected finish.

Medium Period Storage (Less Than 1 Year)

For a storage period of 3 to 12 months, the Motosuiveur® must be completely filled with the oil designed for the required application.

This oil will be drained off to the level indicator before use. There will be no need to rinse it. During emptying, beware not to go under the level indicator otherwise the system may need to be drained.

Long Period Storage (Less Than 5 Years)

For a storage period longer than 12 months, to 5 years, it is recommended to drain the Motosuiveur® then pour or spray ARDROX IV 2 (supplier Brent) into the machine (5 % of the total volume).

- This is a volatile corrosion inhibitor additive for standard lubricating oils.
- Its vapour phase protects surfaces which are not in contact with the liquid phase.
- Its liquid phase increases the corrosion protection properties of the oil in which it is dissolved.

For A Medium or a Long Period of Storage

With the corrosion inhibitors being volatile during the storage period make sure the inside of the Motosuiveur® is insulated/protected against any atmospheric. In particular, the breather caps must be replaced by hermetic caps. The maintenance door must be hermetically closed.

Every 3 months:

- Rotate the PV wheel (at least 1 turn) manually.
- Check the protective long term corrosion protective surface.

Protection of the Manufactured Parts

The manufactured surfaces are delivered protected by a long term corrosion preventative coating (standard casing). Except if there is some deterioration to the surface, there is no need for another protective coating application.

Prior to coating the product has been Grit Blast cleaned in accordance with ISO 8501-1:2007 to grade Sa2½.

Products used: One coat Sherwin Williams Epigrip C400V4 epoxy primer @ 150µ

One coat Sherwin Williams Epigrip C400V4 epoxy primer @ 150µ

One coat Sherwin Williams C750 urethane acrylic special finish @ 50µ

Colour – RAL 3020

7.7 Recommended Spares

Mechanical Spares MS6

| Qty | Description | Ref |
|-----|-------------------------------------|------------------|
| 1 | Piston front washer (safety washer) | MSL-06-10-A01-09 |
| 2 | Piston Seal | MSL-06-10-A01-11 |
| 2 | O ring 490mm x 5mm | MSL-06-10-B01-03 |
| 2 | Lip seal 280x250x15 | MSL-06-10-B01-04 |
| 2 | O ring 30mm x 3mm | MSL-06-10-B02-08 |
| 2 | O ring 130mm x 3mm | MSL-06-10-B02-09 |
| 1 | O ring 140mm x 10mm | MSL-06-10-B05-02 |
| 1 | Rod Seal 80x65mm x8mm | MSL-06-10-B05-03 |
| 1 | O ring 420mm x 3mm | MSL-06-10-B07-25 |
| 1 | O ring 185mm x 3mm | MSL-06-10-B07-26 |
| 1 | O ring 200mm x 3mm | MSL-06-10-B07-27 |
| 1 | O ring 230mm x 3mm | MSL-06-10-B07-28 |
| 1 | Roller limit switch | MSL-06-00-B08-01 |
| 1 | MS Motor & Servo Drive | MSL-06-00-B06-02 |
| 1 | Case | MSL-06-10-A01-01 |
| 1 | Wheel | MSL-06-10-A01-13 |
| 1 | Worm | MSL-06-10-A01-03 |
| 1 | Recovery motor | ATV312HU22M2 |

Table 7.7.1-MS6 Mechanical Spares

Mechanical Spares MS3

| Qty | Description | Ref |
|-----|-------------------------------------|------------------|
| 1 | Piston front washer (safety washer) | MSL-03-10-A01-09 |
| 2 | Piston Seal | MSL-03-10-A01-11 |
| 2 | O ring 295mm x 4mm | MSL-03-10-B01-03 |
| 2 | Lip seal 150x180x8.5 | MSL-03-10-B01-04 |
| 2 | O ring 24mm x 3mm | MSL-03-10-B02-08 |
| 2 | O ring 78mm x 3.6mm | MSL-03-10-B02-09 |
| 1 | O ring 72mm x 6mm | MSL-03-10-B05-02 |
| 1 | Lip Seal 40x52mm x6mm | MSL-03-10-B05-03 |
| 1 | O ring 260mm x 2mm | MSL-03-10-B07-25 |
| 1 | O ring 185mm x 3mm | MSL-03-10-B07-26 |
| 1 | O ring 200mm x 3mm | MSL-03-10-B07-27 |
| 1 | O ring 140mm x 2mm | MSL-03-10-B07-28 |
| 1 | Roller limit switch | MSL-03-00-B08-01 |
| 1 | MS Motor & Servo Drive | MSL-03-00-B06-02 |
| 1 | Case | MSL-03-10-A01-01 |
| 1 | Wheel | MSL-03-10-A01-13 |
| 1 | Worm | MSL-03-10-A01-03 |
| 1 | Recovery Motor | ATV31H075M2 |

Table 7.7.2-MS3 Mechanical Spares

Electrical Spares

| Qty | MFG | Catalog | Description | MS # |
|-----|--------------------|---------------|--|-------|
| 1 | SCHNEIDER ELECTRIC | A9F53102 | MINIATURE CIRCUIT BREAKER, ACTI9 IC60H SERIES, B CURVE, DIN RAIL MOUNTING | 3 & 6 |
| 1 | SCHNEIDER ELECTRIC | A9F53302 | MINIATURE CIRCUIT BREAKER, ACTI9 IC60H SERIES, B CURVE, DIN RAIL MOUNTING | 3 & 6 |
| 1 | SCHNEIDER ELECTRIC | A9F54102 | MINIATURE CIRCUIT BREAKER, ACTI9 IC60H SERIES, C CURVE, DIN RAIL MOUNTING | 3 & 6 |
| 1 | SCHNEIDER ELECTRIC | A9F54204 | MINIATURE CIRCUIT BREAKER, ACTI9 IC60H SERIES, C CURVE, DIN RAIL MOUNTING | 3 & 6 |
| 1 | SCHNEIDER ELECTRIC | A9F55102 | MINIATURE CIRCUIT BREAKER, ACTI9 IC60H SERIES, D CURVE, DIN RAIL MOUNTING | 3 & 6 |
| 2 | TELEMECANIQUE | CA3KN22BD3 | CONTACTOR CA3-K - 2 NO + 2 NC - INSTANTANEOUS - 10A - 24VDC | 3 & 6 |
| 2 | TELEMECANIQUE | CA4KN22BW3 | CONTACTOR CA4-K - 2 NO + 2 NC - INSTANTANEOUS - 10A - 24VDC LOW CONSUMPTION | 3 & 6 |
| 1 | MEANWELL | EDR-120-24 | 24VDC POWER SUPPLY SINGLE PHASE | 3 & 6 |
| 1 | TELEMECANIQUE | GV2L14 | MOTOR CIRCUIT BREAKER GV2-L - 25 A - 3P 3D - MAGNETIC TRIP UNIT | 3 |
| 1 | TELEMECANIQUE | GV2L22 | MOTOR CIRCUIT BREAKER GV2-L - 25 A - 3P 3D - MAGNETIC TRIP UNIT | 6 |
| 1 | TELEMECANIQUE | LC1D09BD | CONTACTOR TESYS LC1-D - 3P - AC-3 440V 9A - COIL 24VDC | 3 & 6 |
| 1 | PROFACE | PFXLM4201TADD | TOUCH SCREEN 3.5" HMI | 3 & 6 |
| 1 | SCHNEIDER ELECTRIC | RM17TG20 | ZELIO CONTROL THREE PHASE MONITORING RELAY | 3 & 6 |
| 1 | LINKWELL | TSNO 060 | COOLING THERMOSTAT (BLUE) | 3 & 6 |
| 1 | TELEMECANIQUE | XB4BA61 | BLUE PUSHBUTTON Ø22 - FLUSH SPRING RETURN - 1NO | 3 & 6 |
| 1 | TELEMECANIQUE | XB4BD21 | XB4 BLACK SELECTOR SWITCH Ø22 STANDARD HANDLE 2 POSITIONS - 1NO | 3 & 6 |
| 1 | TELEMECANIQUE | XB4BD33 | XB4 BLACK SELECTOR SWITCH Ø22 STANDARD HANDLE 3 POSITIONS - 2NO | 3 & 6 |
| 1 | TELEMECANIQUE | XB4BD53 | XB4 BLACK SELECTOR SWITCH Ø22 STANDARD HANDLE 3 POSITIONS - 2NO, SPRING RETURN TO CENTRE | 3 & 6 |
| 1 | TELEMECANIQUE | XB4BS8444 | RED EMERGENCY STOP Ø22 - MUSHROOM HEAD Ø40 - TURN TO RELEASE | 3 & 6 |

| | | | | |
|---|--------------------|-----------|--|-------|
| 1 | TELEMECANIQUE | XB4BVB1 | ROUND PILOT LIGHT Ø22 - IP 65 - WHITE - INTEGRAL LED - 24V - LUGS | 3 & 6 |
| 1 | TELEMECANIQUE | XB4BVB3 | ROUND PILOT LIGHT Ø22 - IP 65 - GREEN - INTEGRAL LED - 24V - LUGS | 3 & 6 |
| 1 | TELEMECANIQUE | XB4BVB4 | ROUND PILOT LIGHT Ø22 - IP 65 - RED - INTEGRAL LED - 24V - LUGS | 3 & 6 |
| 1 | TELEMECANIQUE | XB4BVB5 | ROUND PILOT LIGHT Ø22 - IP 65 - YELLOW - INTEGRAL LED - 24V - LUGS | 3 & 6 |
| 1 | SCHNEIDER ELECTRIC | XPSAF5130 | XPS AF CONFIGURABLE SAFETY RELAY SINGLE/DULE CHANNEL | 3 & 6 |
| 1 | TELEMECANIQUE | ZB4BD2 | SELECTOR SWITCH HEAD - 2 POSITIONS - Ø22 - BLACK, STAY PUT | 3 & 6 |
| 1 | OMRON | H3DE-F | SOLID-STATE TWIN TIMER | 3 & 6 |
| 1 | SOCOMECA | 22003003 | 32A 3 POLE LOAD BREAK SWITCH | 3 & 6 |
| 1 | SOCOMECA | 22005005 | SOLID NEUTRAL LINK UNSWITCHED | 3 & 6 |
| 1 | SOCOMECA | 22990011 | AUXILIARY CONTACT 2NO | 3 & 6 |
| 1 | IMO CONTROLS LTD | MKV11D15 | SCREW SENSOR | 3&6 |
| 1 | IMO CONTROLS LTD | VF MKCV22 | TERMINAL COVER | 3&6 |

Table 7.7.3- MS3/MS6 Electrical Spares

8 MANUFACTURERS AND SUPPLIERS INFORMATION

8.1 Directory of Manufacturers and Suppliers Information



= Data Sheet



= Operation & Maintenance Manual

| Manufacturer | Contact Details |
|--|--|
| SCX Special Projects Ltd 30 Roman Ridge Road Sheffield S9 1GA | Tel No. 01142 431142 Fax No. 01142 561739 |

| Index | Supplier | Contact Details | Description / Reference | PDF |
|-------|---|--|---|-----|
| A | Siguren ZI de la Tuilli  re. Rue de la Traille. 01700 Miribel | Tel No. +33 (0)4 72 25 71 12 | MS3 & MS6 Units | |
| B | Ringspann (U.K.) Ltd. 3, Napier Road Bedford MK41 0QS Great Britain | Tel No. 01234 34 25 11 info@ringspann.co.uk www.ringspan.co.uk | RSC100.1 RSC125.2 | |
| C | Sew-Eurodrive Ltd. DeVilliers Way Trident Park Normanton West Yorkshire WF6 1GX | Tel. 01924 893855 Fax. 01924 893855 | MS3 Recovery Motor- DRN80MS2/FF/TH MS6 Recovery Motor- DRN100LS4/FF/TH | |
| D | PROFACE Schneider Electric Ltd/ TELEMECANIQUE University of Warwick Science Park Sir William Lyons Road Coventry, CV4 7EZ United Kingdom | Tel: +44 (0)2476 847655 Fax: +44 (0)2476 847660 | Touch screen – PLC PFXLM4201TADD | |

| | | | | |
|---|--|--|--|---|
| E | Serad 271 route des Crêtes 44440 TEILLE - FRANCE | Tel: +33 (0) 240972454 Fax +33(0) 240972704 | MS motor B36E8 I3 H6 A05 2033 |  |
| F | KTR U.K. Ltd. Unit 7, Robert House, Acorn Business Park, Woodseats Close, Sheffield, England, S8 0TB | Tel: +44 (0) 114 258 7757 Fax: +44(0)114 258 7740 | RUFLEX Torque Limiter ROTEX Coupler |  |

Table 8.1-1



8.2 Safety Data Sheets

SAFETY DATA SHEET

according to Regulation (EC) N°. 1907/2006

Date of the previous version: None Revision Date: June 10th, 2015 Version A

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product name : SW15
Number : SW15-0001
Substance/mixture : Mixture

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Oil bathing dedicated for SIGURENT MotosuiveurTM

1.3. Details of the supplier of the safety data sheet

Supplier : SIGUREN INGENIERIE SAS
ZI DE LA TUILLIERE
Rue de la Traille
01700 MIRIBEL

For further information, please contact:

Contact Point: Mr Yavor PACHOV

Tel: +33 6 12 32 44 43
Fax: +33 9 52 71 75 68
Email : contact@siguren.com

1.4. Emergency telephone number

SIGUREN Tel : +33 6 12 32 44 43

**SECTION 2: HAZARDS IDENTIFICATION****2.1. Classification of the substance or mixture****REGULATION (EC) No 1272/2008**

For the full text of the H-Statements mentioned in this Section, see Section 2.2.

Classification

The product is classified as dangerous in accordance with Regulation (EC) No. 1272/2008

Serious eye damage/eye irritation - Category 2 - (H319)

Chronic aquatic toxicity - Category 3 - (H412)

DIRECTIVE 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16.

The substance/mixture is classified as dangerous in accordance with Directive(s) 67/548/EEC with amendments and/or 1999/45/EC with amendments

Classification

R52/53

2.2. Label elements**Labelled according to REGULATION (EC) No 1272/2008****Signal Word :**

WARNING

Hazard Statements:

H319- Causes serious eye irritation

H412 - Harmful to aquatic life with long lasting effects

Precautionary statements :

P280 - Wear eye protection/ face protection

P501 - Dispose of contents/container to an approved waste disposal plant

Contains Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12-14- tert-alkyl. May produce an allergic reaction.

2.3. Other hazards

Environmental properties:

Contaminated surfaces will be extremely slippery. Should not be released into the environment.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Mixture

Chemical nature The product is made from refined mineral base oils and synthetic oils.

Hazardous components

| Chemical Name | EC-No | REACH Registration Number | CAS -No | Weight % | Classification (Dir. 67/548) | GHS Classification |
|---|-----------|---------------------------|------------|----------|--|---|
| zinc bis[O,O-bis(2-ethylhexyl)] bis(dithiophosphate) | 224-235-5 | 01-2119493635-27 | 4259-15-8 | < 2.9 | Xi;R41 N;R51-53 | Aquatic Chronic 2 (H411) Eye Dam. 1 (H318) |
| Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12-14- tert-alkyl | 931-384-6 | 01-2119493620-38 | ^ | < 2.9 | Xn;R22 Xi;R41 R43 N;R51-53 | Acute Tox. 4 (H302) Aquatic Chronic 2 (H411) Eye Dam. 1 (H318) Flam. Liq. 3 (H226) Skin Sens. 1 (H317) |
| 2-hydroxy-4-tetradecyl-1,3,2-dioxaborolane | 284-222-5 | no data available | 84819-41-0 | < 0.9 | R43 | Skin Sens. 1 (H317) |
| Triphenyl phosphite | 202-908-4 | no data available | 101-02-0 | < 0.19 | Xn;R22 Xi;R36/38 N;R50-53 R43 | Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Aquatic Acute 1 (H400) Aquatic Chronic 1 (H410) Skin Sens. 1 (H317) |

Additional information :

Product containing mineral oil with less than 3% DMSO extract as measured by IP 346.

**For the full text of the R-phrases mentioned in this Section, see Section 16.
For the full text of the H-Statements mentioned in this Section, see Section 16.**

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

General advice :

IN CASE OF SERIOUS OR PERSISTENT CONDITIONS, CALL A DOCTOR OR EMERGENCY MEDICAL CARE.

Eye contact :

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician immediately.

Skin contact :

Remove contaminated clothing and shoes. Wash skin with soap and water. Wash contaminated clothing before reuse. In the case of skin irritation or allergic reactions see a physician.

Inhalation :

Move to fresh air.

Ingestion:

Do not induce vomiting. Never give anything by mouth to an unconscious person. Call a physician or poison control centre immediately.

4.2. Most important symptoms and effects, both acute and delayed

Eye contact :

Causes serious eye irritation.

Skin contact:

Not classified. May produce an allergic reaction

Inhalation:

Not classified. Inhalation of vapours in high concentration may cause irritation of respiratory system.

Ingestion:

Not classified. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea.

4.3. Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician :

Treat symptomatically.

SECTION 5: FIRE-FIGHTING MEASURES

5.1. Extinguishing media

Suitable extinguishing media :

Carbon dioxide (CO 2). ABC powder. Foam. Water spray or fog.

Unsuitable Extinguishing Media :

Do not use a solid water stream as it may scatter and spread fire.

5.2. Special hazards arising from the substance or mixture

Special hazard :

Incomplete combustion and thermolysis produces potentially toxic gases such as carbon monoxide and carbon dioxide, Sulphur oxides, Phosphorous oxides, Nitrogen oxides (NOx), Zinc oxides, Mercaptans, Hydrogen sulphide.

5.3. Precautions for fire-fighters

Special protective equipment for fire-fighters :

Wear self-contained breathing apparatus and protective suit.

Other information :

Cool containers / tanks with water spray. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

General Information :

Do not touch or walk through spilled material. Contaminated surfaces will be extremely slippery. Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition.

6.2. Environmental precautions

General Information :

Do not allow material to contaminate ground water system. Try to prevent the material from entering drains or water courses. Local authorities should be advised if significant spillages cannot be contained.

6.3. Methods and materials for containment and cleaning up

Methods for cleaning up

Dam up. Contain spillage, and then collect with non-combustable absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Keep in suitable, closed containers for disposal.

6.4. Reference to other sections**Personal protective equipment :**

See Section 8 for more detail.

Waste treatment :

See section 13.

SECTION 7: HANDLING AND STORAGE**7.1. Precautions for safe handling****Advice on safe handling :**

When using, do not eat, drink or smoke. For personal protection see section 8. Use only in well-ventilated areas. Do not breathe vapours or spray mist. Avoid contact with skin, eyes and clothing.

Prevention of fire and explosion :

Take precautionary measures against static discharges: Ground/bond containers, tanks and transfer/receiving equipment.

Hygiene measures :

Ensure the application of strict rules of hygiene by the personnel exposed to the risk of contact with the product. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product. Do not use abrasives, solvents or fuels. Do not dry hands with rags that have been contaminated with product. Do not put product contaminated rags into workwear pockets.

7.2. Conditions for safe storage, including any incompatibilities**Technical measures/Storage conditions :**

Keep away from food, drink and animal feeding stuffs. Keep in a bunded area. Keep container tightly closed. Preferably keep in the original container. Otherwise, reproduce all the statutory information from the labels onto the new container. Do not remove the hazard labels of the containers (even if they are empty). Design the installations in order to avoid accidental

emissions of product (due to seal breakage, for example) onto hot casings or electrical contacts. Protect from frost, heat and sunlight. Protect from moisture.

Materials to avoid :

Acids. Oxidizing agents.

7.3. Specific use(s)

Specific use(s) :

No information available.

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1. Control parameters

Exposure limits :

Components with workplace control parameters

DNEL Worker (Industrial/Professional)

| Chemical Name | Short term, systemic effects | Short term, local effects | Long term, systemic effects | Long term, local effects |
|--|------------------------------|-------------------------------------|--|-------------------------------------|
| zinc bis[O,O-bis(2-ethylhexyl)] bis(dithiophosphate) 4259-15-8 | | | 9.6 mg/kg bw/day Dermal 6.6 mg/m ³ Inhalation | |
| Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12-14-tert-alkyl ^A | | | 12.5 mg/kg/8h (dermal) 8.56 mg/m ³ / 8h (inhalati on) (ECHA CHEM) | |
| Triphenyl phosphite 101-02-0 | | 0.0117 mg/cm ² Dermal | 0.3 mg/kg bw/day Dermal 1.06 mg/m ³ Inhalation | 0.0117 mg/cm ² Dermal |

DNEL Consumer

| Chemical Name | Short term, systemic effects | Short term, local effects | Long term, systemic effects | Long term, local effects |
|--|------------------------------|-------------------------------------|--|-------------------------------------|
| zinc bis[O,O-bis(2-ethylhexyl)] bis(dithiophosphate) 4259-15-8 | | | 4.8 mg/kg bw/day Dermal 1.67 mg/m ³ Inhalation 0.19 mg/kg/bw/day Oral | |
| Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12-14-tert-alkyl | | | 6.25 mg/kg/24h (dermal) 2.2 mg/m ³ /24h (inhalation) 0.25 mg/kg/24h (oral) (ECHA CHEM) | |
| Triphenyl phosphite 101-02-0 | | 0.0117 mg/cm ² Dermal | 0.15 mg/kg bw/day Dermal 0.53 mg/m ³ Inhalation 0.075 mg/kg bw/day Oral | 0.0117 mg/cm ² Dermal |

Predicted No Effect Concentration (PNEC): Predicted No Effect Concentration (PNEC)

| Chemical Name | Water | Sediment | Soil | Air | STP | Oral |
|--|---|---------------------------------------|--------------------|-----|------------|-----------------|
| zinc bis[O,O-bis(2-ethylhexyl)] bis(dithiophosphate) 4259-15-8 | 0.004 mg/1 fw 0.0046 mg/1 mw 0.044 mg/1 ir | 0.0701 mg/kg dw 0.00701 mg/kg dwmw | 0.0548 mg/kg dw | | 3.8 mg/1 | 8.33 mg/kg food |
| Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12-14-tert-alkyl | 0.0012 mg/1 fw 0.00012 mg/1 mw 0.064 mg/ or | 3.13 mg/kg fw 0.313 mg/kg mw | 2.54 mg/kg soil dw | | 24.33 mg/1 | 10 mg/kg food |

8.2. Exposure controls

Occupational Exposure Controls

Engineering measures :

Apply technical measures to comply with the occupational exposure limits. When working in confined spaces (tanks, containers, etc.), ensure that there is a supply of air suitable for breathing and wear the recommended equipment.

Personal protective equipment

General Information :

If the product is used in mixtures, it is recommended that you contact the appropriate protective equipment suppliers. These recommendations apply to the product as supplied.

Respiratory protection :

When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Respirator with combination filter for vapour/particulate (EN 14387), Type A/P2. The use of breathing apparatus must comply strictly with the manufacturer's instructions and the regulations governing their choices and uses.

Eye protection :

Tightly fitting safety goggles. Safety glasses with side-shields. Face-shield.

Skin and body protection :

Wear suitable protective clothing. Protective shoes or boots. Long sleeved clothing.

Hydrocarbon-proof gloves, Fluorinated rubber. Nitrile rubber. Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. Also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion, and the contact time. If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the EC approved gloves.

Environmental exposure controls :

General Information :

The product should not be allowed to enter drains, water courses or the soil.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Cloudy
 Colour : Grey
 Physical state 20°C: Liquid
 Odour : No information available

| Property | Values | Remarks | Method |
|------------------------------------|--------------------------|--------------------------|-----------|
| pH | | Not applicable | |
| Boiling_point/boiling range | 260 0C | | |
| Flash point | > 125 0C > 257 0F | | |
| Evaporation rate | | No information available | |
| Flammability Limits in Air | | No information available | |
| Vapour pressure | | No information available | |
| Vapour density | | No information available | |
| Density | 890 kg/m3 | 15 0C | ISO 12185 |
| Water solubility | | Insoluble | |
| Solubility in other solvents | | No information available | |
| logPow | | No information available | |
| Autoignition temperature | | No information available | |
| Viscosity, kinematic | 13.5 mm ² / s | 40 0C | ISO 3104 |
| Explosive properties | Not explosive | | |
| Oxidising properties | Not applicable | | |
| Possibility of hazardous reactions | Not applicable | | |

9.2. Other information

No information available.

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

General Information :

No information available.

10.2. Chemical stability

Stability:

Stable under recommended storage conditions.

10.3. Possibility of hazardous reactions

Hazardous reactions :

None under normal processing

10.4. Conditions to Avoid

Conditions to Avoid :

Heat (temperatures above flash point), sparks, ignition points, flames, static electricity.

10.5. Incompatible materials

Materials to avoid :

Acids. Oxidizing agents.

10.6. Hazardous Decomposition Products

Hazardous Decomposition Products :

None under normal use. Incomplete combustion and thermolysis may produce gases of varying toxicity such as carbon monoxide, carbon dioxide, various hydrocarbons, aldehydes and soot, Mercaptans, Nitrogen oxides (NOx), Sulphur oxides, Phosphorous oxides, Calcium oxides, Hydrogen sulphide.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Acute toxicity Local effects Product Information

Skin contact :

Not classified. May produce an allergic reaction.

Eye contact :

Causes serious eye irritation.

Inhalation:

Not classified. Inhalation of vapours in high concentration may cause irritation of respiratory system.

Ingestion:

Not classified. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea.

Acute toxicity- Component Information

| Chemical Name | LD50 Oral | LD50 Dermal | LC50 Inhalation |
|---|---------------------------------------|---|---|
| zinc bis[O,O-bis(2-ethylhexyl)] bis(dithiophosphate) 4259-15-8 | LD50 3100 mg/kg (Rat- OECD 401) | LD50 > 5000 mg/kg (Rabbit- OECD402) | |
| Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12- 14- tert-alkyl // | LD50 2000 mg/kg bw (Rat- OECD TG 401) | | |
| Triphenyl phosphite 101-02-0 | LD50 1590 mg/kg (Rat - OECD 401) | 2000 mg/kg (Rabbit) = 1180 mg/kg (Rat) | LC50 (1h) > 6.7 mg/l (Rat - aerosol - OECD 403) |

Sensitisation :

Contains sensitizer(s). May produce an allergic reaction. The supplier of one of the components contained within this formulation has indicated that they have data, which confirms that at the concentration used, no sensitisation classification is required.

Specific effects

Carcinogenicity:

This product is not classified carcinogenic

Mutagenicity :

This product is not classified as mutagenic.

Reproductive toxicity :

This product does not present any known or suspected reproductive hazards.

Repeated Dose Toxicity

Subchronic Toxicity :

No information available.

Target Organ Effects (STOT)Target Organ

Effects (STOT): No information available.

Other information

Other adverse effects :

Characteristic skin lesions (oil blisters) may develop following prolonged and repeated exposures (contact with contaminated clothing).

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Harmful to aquatic life with long lasting effects.

Acute aquatic toxicity - Product Information

| Chemical Name | Toxicity to algae | Toxicity to daphnia and other aquatic invertebrates. | Toxicity to fish | Toxicity to micro organisms |
|---|--|---|--|-----------------------------|
| zinc bis[O,O-bis(2-ethylhexyl)] bis(dithiophosphate) 4259-15-8 | EC50 (72h) > 240 mg/L (Desmodesmus subspicatus) | EC50 (48h) > 1 - < 10 mg/L (Daphnia magna – OECD 202) | LC50 (96h) > 1 - 2 mg/L (Oncorhynchus mykiss-OECD 203) | |
| Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12-14-tert-alkyl II | EL50 (96h) > 15 mg (Selenastrum capricornutum - OECD 201) EC50 (96h) 6.4 mg/1 Pseudokirchnerella subcapitata – OECD 201) EC50 (96h) 15 mg/1 (Pseudokirchnerella subcapitata – OECD 201) EC50 (96h) 6.4 mg/1 (Selenastrum capricornutum- OECD TG 201) (ECHA CHEM) | EL50 (48h) ca. 91.4 mg/1 (Daphnia magna – OECD 202) | LL50 (96h) ca. 24 mg/1 (Oncorhynchus mykiss-OECD 203) | |

Chronic aquatic toxicity - Product Information

No information available.

Chronic aquatic toxicity - Component Information

| Chemical Name | Toxicity to algae | Toxicity to daphnia and other aquatic invertebrates. | Toxicity to fish | Toxicity to microorganisms |
|---|---|--|------------------|--|
| Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12-14-tert-alkyl II | NOEC (96h) 1.7 mg/1 (Pseudokirchnerella subcapitata - OECD 201) par NOEC (96h) 3.3 mg/1 (Pseudokirchnerella subcapitata - OECD 201) | EL50 (21d) 0.91 mg/1 (Daphnia magna – OECD 211) NOEL (21d) 0.12 mg/1 (Daphnia magna – OECD 211) EL50 (21d) 0.66 mg/1 | | EC50 (3h) ca. 2433 mg/L (Activated Sludge, domestic - OECD TG 209) (ECHA CHEM) |

| Chemical Name | Toxicity to algae | Toxicity to daphnia and other aquatic invertebrates. | Toxicity to fish | Toxicity to microorganisms |
|---------------------------------------|-------------------|--|------------------|----------------------------|
| salted by amines, C12-14-tert-alkyl A | | (Daphnia magna – OECD 211) | | |

Effects on terrestrial organisms :

No information available.

12.2. Persistence and Degradability

General Information :

No information available.

12.3. Bioaccumulative potential

Product Information :

No information available.

logPow:

No information available

Component Information

| Chemical Name | log Pow |
|---|---|
| zinc bis(O,O-bis(2-ethylhexyl)] bis(dithiophosphate) 4259-15-8 | 3.59 |
| Reaction products of 4-methyl-2-pentanol and diphosphorus pentasulfide, propoxylated, esterified with diphosphorus pentaoxide, and salted by amines, C12-14-tert-alkyl II | < 0.30 to >7.10 (OECD TG 117) (ECHA CHEM) |
| Triphenyl phosphite 101-02-0 | 5 |

12.4. Mobility in soil

Soil:

Given its physical and chemical characteristics, the product generally shows low soil mobility.

Air:

Loss by evaporation is limited.

Water:

Insoluble. The product spreads on the surface of the water.

12.5. Results of PBT and vPvB assessment

PBT and vPvB assessment : No information available.

12.6. Other adverse effects

General Information : No information available

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from residues / unused products:

Should not be released into the environment. Dispose of in accordance with the European Directives on waste and hazardous waste. Dispose of in accordance with local regulations. Where possible recycling is preferred to disposal or incineration. After use, this oil must be sent to a licensed waste oil facility. Incorrect disposal of used oil poses a risk to the environment. Mixture with other waste types such as solvents, brake- and cooling liquids is forbidden.

Contaminated packaging :

Empty containers should be taken to an approved waste handling site for recycling or disposal.

EWC Waste Disposal N):

The following Waste Codes are only suggestions:.. 13 02 05, 13 02 06. According to the European Waste Catalogue, Waste Codes are not product specific, but application specific. Waste codes should be assigned by the user based on the application for which the product was used.

Section 14: TRANSPORT INFORMATION

ADR/ RID:

Not
regulated

IMDG/IMO:

Not
regulated

ICAO/IATA:

No regulated

ADN:

Not
regulated

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

European Union International

Inventories: No information available

Further information :

No information available

15.2. Chemical Safety Assessment

Chemical Safety Assessment:

No information available

15.3. National regulatory information

The United Kingdom

- Avoid exceeding occupational exposure limits (see section 8).

Ireland

- Avoid exceeding occupational exposure limits (see section 8)

SECTION 16: OTHER INFORMATION

Full text of R-phrases referred to under sections 2 and 3

R11 -Highly flammable

R22 - Harmful if swallowed

R41 - Risk of serious damage to eyes

R43 - May cause sensitisation by skin contact

R36/38 - Irritating to eyes and skin

R37/38- Irritating to respiratory system and skin

RS0/53 - Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

R51/53 - Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

R52/53 - Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Full text of H-Statements referred to under sections 2 and 3

H224 - Extremely flammable liquid and vapour

H226 - Flammable liquid and vapour

H302 - Harmful if swallowed

H315- Causes skin irritation

H317 - May cause an allergic skin reaction

H318- Causes serious eye damage

H319 - Causes serious eye irritation

H335 - May cause respiratory

irritation H400 - Very toxic to aquatic life

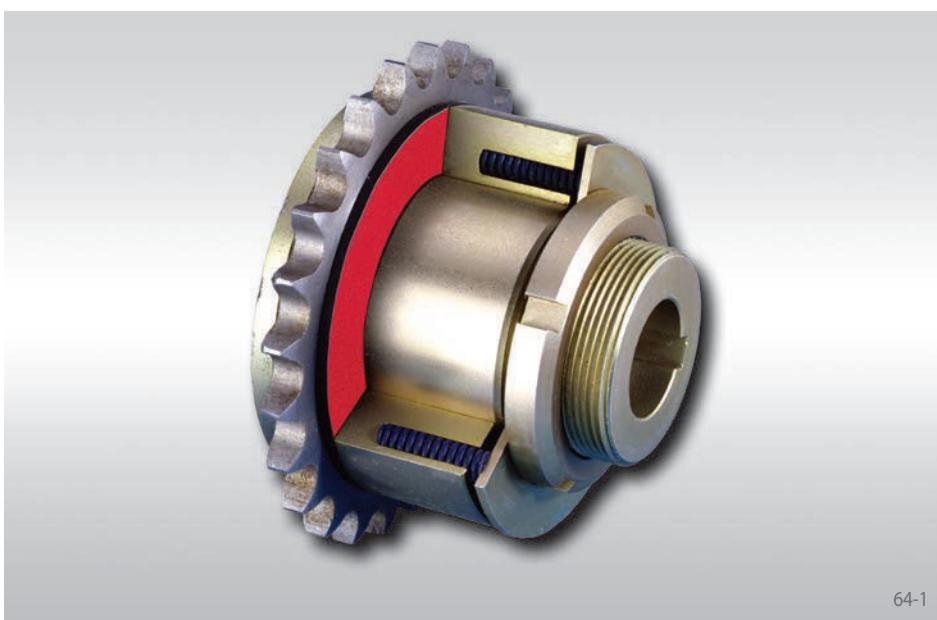
H410 -Very toxic to aquatic life with long lasting effects

H411 -Toxic to aquatic life with long lasting effects

This safety data sheet complies with the requirements of Regulation (EC) N°. 1907/2006

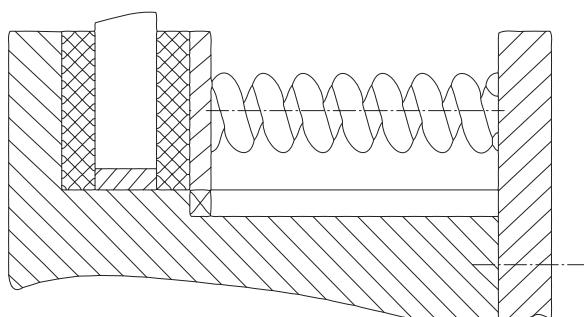
This safety data sheet serves to complete but not to replace the technical product sheets. The information contained herein is given in good faith and is accurate to the best of knowledge at the date indicated above. It is understood by the user that any use of the product for purposes other than those for which it was designed entails potential risk. The information given herein in no way dispenses the user from knowing and applying all provisions regulating his activity. The user bears sole liability for the precautions required when using the product. The regulatory texts indicated herein are intended to aid the user to fulfil his obligations. This list is not to be considered complete and exhaustive. It is the user's responsibility to ensure that he is subject to no other obligations than those mentioned.

End of Safety Data
Sheet



Advantages

- Particularly suitable in applications with frequent slipping
- Better stability of slipping torque than Belleville spring torque limiters over duration of the operating period
- Adjustment of slipping torque setting according to the number of active springs – not through modification of spring pressure

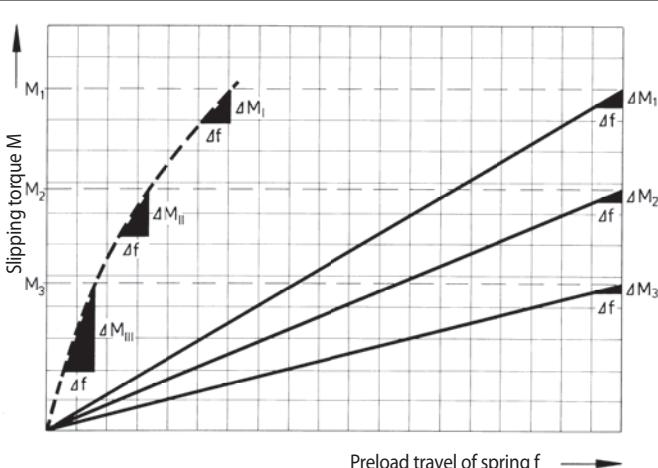


Function

64-2

The RIMOSTAT® Principle

The contact pressure on the friction surfaces is produced by long coil springs. Because of the RIMOSTAT® Torque Limiter's linear, flat-angle characteristic of the pressure force, practically no reduction of the slipping torque occurs even when friction linings are subjected to wear. As the diagram 64-3 shows, compared with Belleville spring torque limiters, assuming a friction wear of Δf the reduction of the slipping torque ΔM is negligible.

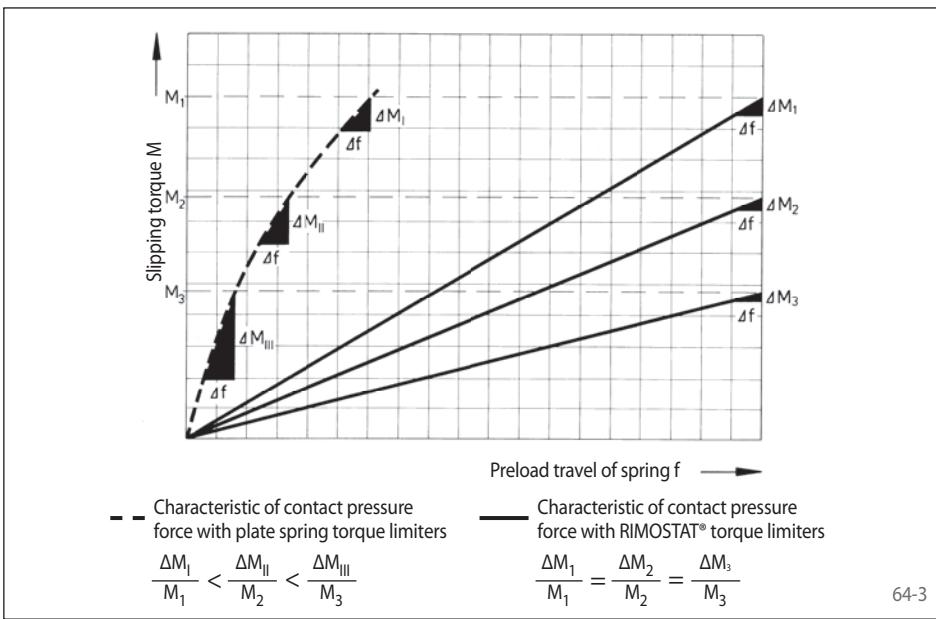


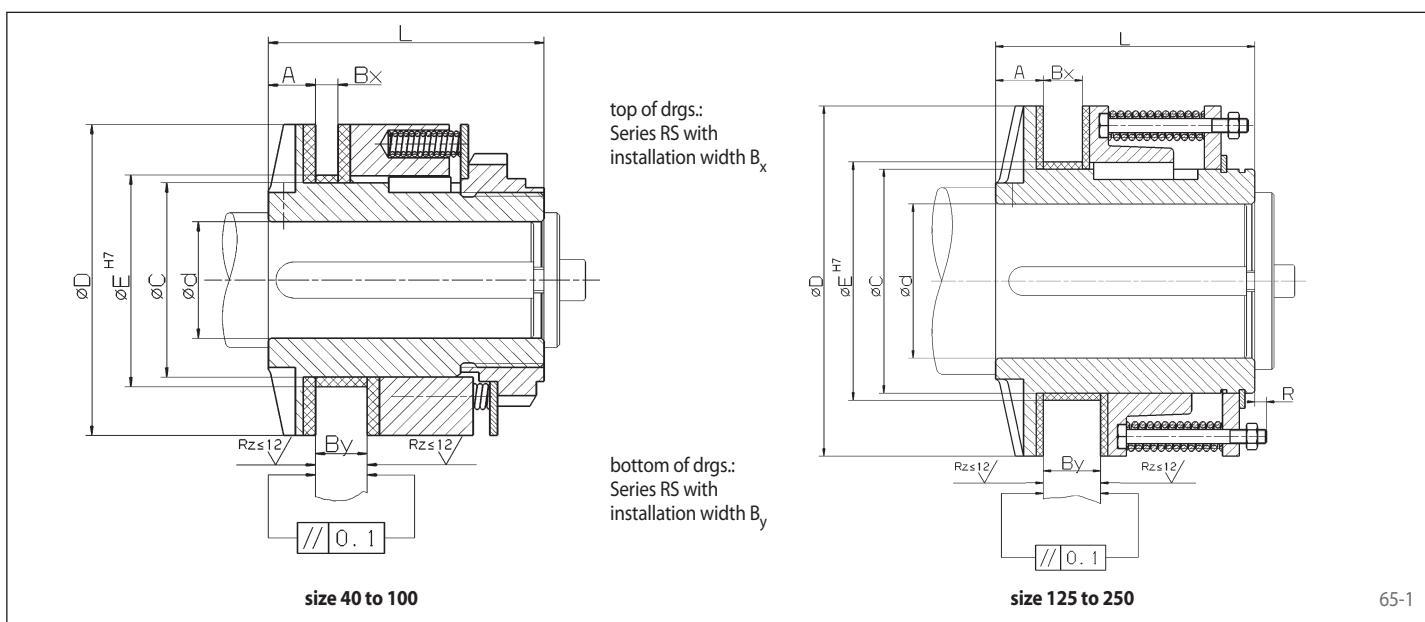
$$\frac{\Delta M_1}{M_1} < \frac{\Delta M_{II}}{M_2} < \frac{\Delta M_{III}}{M_3}$$

$$\frac{\Delta M_1}{M_1} = \frac{\Delta M_2}{M_2} = \frac{\Delta M_3}{M_3}$$

Function

- When the preset slipping torque has been reached the built-in component (e. g. chain wheel) slips
- During the slipping process, input and output rotate relative to each other and the preset slipping torque continues to be transmitted
- Inherent in the slipping process is a high energy consumption
- Re-engagement is not necessary





Technical Data and Dimensions

| Type | Art.-No. | Slipping torque | Max. speed ¹⁾ | Bore $dH7$ | | A | B_x | B_y | $C^2)$ | D | $E^2)$ | L | R |
|----------|-------------|-----------------|--------------------------|------------|------|----|-------|-------|--------|-----|--------|------|-----|
| | | Nm | min ⁻¹ | min. | max. | mm | mm | mm | mm | mm | mm | mm | mm |
| RS 40.1 | 4474-040820 | 2 - 12 | 13 000 | 8 | 16 | 8 | 4,4 | 7,0 | 25 | 40 | 28 | 35,5 | - |
| RS 40.2 | 4474-040920 | 4 - 25 | 13 000 | 8 | 16 | 8 | 4,4 | 7,0 | 25 | 40 | 28 | 35,5 | - |
| RS 50.1 | 4474-050820 | 4 - 25 | 10 500 | 9 | 20 | 8 | 5,2 | 8,7 | 32 | 50 | 36 | 45 | - |
| RS 50.2 | 4474-050920 | 8 - 50 | 10 500 | 9 | 20 | 8 | 5,2 | 8,7 | 32 | 50 | 36 | 45 | - |
| RS 63.1 | 4474-063820 | 8 - 50 | 8 500 | 9 | 25 | 10 | 5,8 | 10,5 | 40 | 63 | 44 | 56 | - |
| RS 63.2 | 4474-063920 | 16 - 100 | 8 500 | 9 | 25 | 10 | 5,8 | 10,5 | 40 | 63 | 44 | 56 | - |
| RS 80.1 | 4474-080820 | 10 - 100 | 6 700 | 15 | 32 | 12 | 5,8 | 15,3 | 50 | 80 | 55 | 71 | - |
| RS 80.2 | 4474-080920 | 20 - 200 | 6 700 | 15 | 32 | 12 | 5,8 | 15,3 | 50 | 80 | 55 | 71 | - |
| RS 100.1 | 4474-081820 | 20 - 200 | 5 350 | 25 | 40 | 15 | 8,7 | 18,0 | 65 | 100 | 70 | 90 | - |
| RS 100.2 | 4474-081920 | 40 - 375 | 5 350 | 25 | 40 | 15 | 8,7 | 18,0 | 65 | 100 | 70 | 90 | - |
| RS 125.1 | 4474-082820 | 40 - 375 | 4 300 | 22 | 55 | 17 | 15,3 | 23,0 | 80 | 125 | 85 | 105 | 2,5 |
| RS 125.2 | 4474-082920 | 75 - 750 | 4 300 | 22 | 55 | 17 | 15,3 | 23,0 | 80 | 125 | 85 | 105 | 2,5 |
| RS 160.1 | 4474-083820 | 75 - 750 | 3 350 | 40 | 70 | 22 | 15,3 | 28,0 | 100 | 160 | 105 | 130 | 5,5 |
| RS 160.2 | 4474-083920 | 150 - 1 500 | 3 350 | 40 | 70 | 22 | 15,3 | 28,0 | 100 | 160 | 105 | 130 | 5,5 |
| RS 200.1 | 4474-084820 | 150 - 1 500 | 2 700 | 50 | 90 | 27 | 23 | 34,0 | 125 | 200 | 130 | 160 | 7,5 |
| RS 200.2 | 4474-084920 | 300 - 3 000 | 2 700 | 50 | 90 | 27 | 23 | 34,0 | 125 | 200 | 130 | 160 | 7,5 |
| RS 250.1 | 4474-085820 | 300 - 3 000 | 2 100 | 55 | 115 | 34 | 28 | 41,0 | 160 | 250 | 165 | 185 | 9,0 |
| RS 250.2 | 4474-085920 | 600 - 6 000 | 2 100 | 55 | 115 | 34 | 28 | 41,0 | 160 | 250 | 165 | 185 | 9,0 |

¹⁾ The max. speed relates to the design straight of the Torque Limiter; the max. permissible speed differential Δn should be checked according to the heat calculation on page 73.

²⁾ If the part to be coupled is used without bearing bush, the bore should be made to dimension C (tolerance F8).

Keyway as per DIN 6885, page 1 · Tolerance of keyway width P9. Further sizes available on request.

Width of parts to be connected

Components may be connected with either width B_x or B_y .

Supply

Unless requested otherwise, the Torque Limiters are supplied pilot bored, a full complement of springs, without slipping torque setting and without bearing bush. Factory slipping torque setting is only possible when the order includes a finish bore.

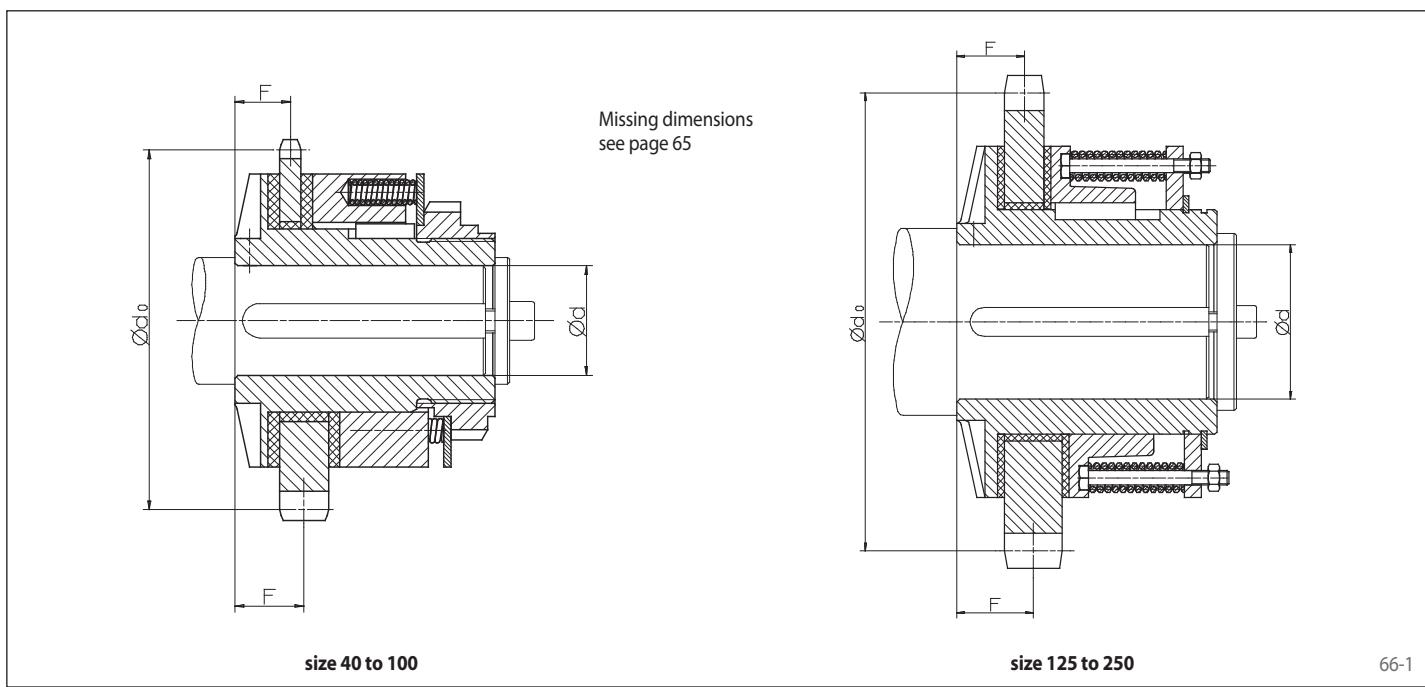
Accessories

- Width B_x or B_y bearing bushes
- Standard tools are normally sufficient for adjusting the slipping torque. Only sizes 125 and 160 require a tool adapter which can be ordered from us.

Please specify when ordering

- Type of Torque Limiter
- Diameter d , if finish bore is requested
- Width of bearing bush B_x or B_y
- Slipping torque to be preset, if required

with chain wheel



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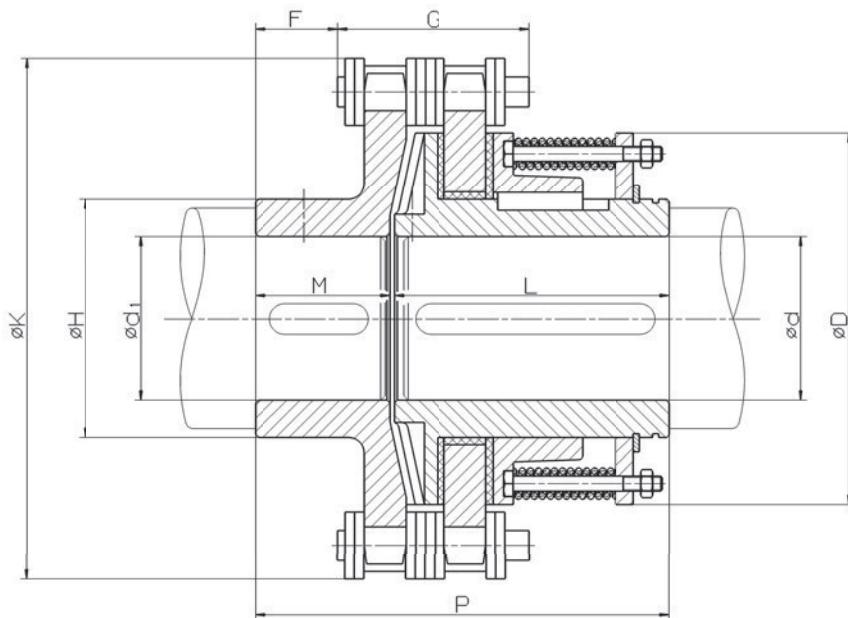
Technical Data and Dimensions

| Type | Art.-No. | Slipping torque Nm | Bore d^{H7} | | Chainwheel suitable for simple roller chain as per DIN 8154 or DIN 8187 | | | | | F mm | | | |
|-----------|-------------|-----------------------|---------------|------------|---|-------------------|----------------|------------------------|-------------------------------|--------------------------|-------|------|------|
| | | | min. mm | max. mm | Pitch mm | Inner width mm | Roller-ø mm | Nº of teeth Z mm | Pitch circle-ø d_0 mm | Chainwheel-width B mm | | | |
| RSK 40.1 | 4474-040822 | 2 - 12 | 8 | 16 | 9,525 | x | 4,77 | x | 5,08 | 17 | 51,8 | 4,4 | 10,2 |
| RSK 40.2 | 4474-040922 | 4 - 25 | 8 | 16 | 9,525 | x | 4,77 | x | 5,08 | 17 | 51,8 | 4,4 | 10,2 |
| RSK 40.1 | 4474-040823 | 2 - 12 | 8 | 16 | 12,70 | x | 7,75 | x | 8,51 | 14 | 57,1 | 7,0 | 11,5 |
| RSK 40.2 | 4474-040923 | 4 - 25 | 8 | 16 | 12,70 | x | 7,75 | x | 8,51 | 14 | 57,1 | 7,0 | 11,5 |
| RSK 50.1 | 4474-050821 | 4 - 25 | 9 | 20 | 9,525 | x | 5,72 | x | 6,35 | 20 | 60,9 | 5,2 | 10,6 |
| RSK 50.2 | 4474-050921 | 8 - 50 | 9 | 20 | 9,525 | x | 5,72 | x | 6,35 | 20 | 60,9 | 5,2 | 10,6 |
| RSK 50.1 | 4474-050823 | 4 - 25 | 9 | 20 | 15,87 | x | 9,65 | x | 10,16 | 14 | 71,3 | 8,7 | 12,4 |
| RSK 50.2 | 4474-050923 | 8 - 50 | 9 | 20 | 15,87 | x | 9,65 | x | 10,16 | 14 | 71,3 | 8,7 | 12,4 |
| RSK 63.1 | 4474-063822 | 8 - 50 | 9 | 25 | 12,70 | x | 6,40 | x | 8,51 | 20 | 81,2 | 5,8 | 12,9 |
| RSK 63.2 | 4474-063922 | 16 - 100 | 9 | 25 | 12,70 | x | 6,40 | x | 8,51 | 20 | 81,2 | 5,8 | 12,9 |
| RSK 63.1 | 4474-063823 | 8 - 50 | 9 | 25 | 19,05 | x | 11,68 | x | 12,07 | 14 | 85,6 | 10,5 | 15,0 |
| RSK 63.2 | 4474-063923 | 16 - 100 | 9 | 25 | 19,05 | x | 11,68 | x | 12,07 | 14 | 85,6 | 10,5 | 15,0 |
| RSK 80.1 | 4474-080822 | 10 - 100 | 15 | 32 | 12,70 | x | 6,40 | x | 8,51 | 23 | 93,3 | 5,8 | 15,0 |
| RSK 80.2 | 4474-080922 | 20 - 200 | 15 | 32 | 12,70 | x | 6,40 | x | 8,51 | 23 | 93,3 | 5,8 | 15,0 |
| RSK 80.1 | 4474-080823 | 10 - 100 | 15 | 32 | 25,40 | x | 17,02 | x | 15,88 | 13 | 106,1 | 15,3 | 19,8 |
| RSK 80.2 | 4474-080923 | 20 - 200 | 15 | 32 | 25,40 | x | 17,02 | x | 15,88 | 13 | 106,1 | 15,3 | 19,8 |
| RSK 100.1 | 4474-081821 | 20 - 200 | 25 | 40 | 15,87 | x | 9,65 | x | 10,16 | 24 | 121,6 | 8,7 | 19,5 |
| RSK 100.2 | 4474-081921 | 40 - 375 | 25 | 40 | 15,87 | x | 9,65 | x | 10,16 | 24 | 121,6 | 8,7 | 19,5 |
| RSK 100.1 | 4474-081823 | 20 - 200 | 25 | 40 | 31,75 | x | 19,56 | x | 19,05 | 13 | 132,7 | 18,0 | 24,1 |
| RSK 100.2 | 4474-081923 | 40 - 375 | 25 | 40 | 31,75 | x | 19,56 | x | 19,05 | 13 | 132,7 | 18,0 | 24,1 |
| RSK 125.1 | 4474-082821 | 40 - 375 | 22 | 55 | 25,40 | x | 17,02 | x | 15,88 | 19 | 154,3 | 15,3 | 24,8 |
| RSK 125.2 | 4474-082921 | 75 - 750 | 22 | 55 | 25,40 | x | 17,02 | x | 15,88 | 19 | 154,3 | 15,3 | 24,8 |
| RSK 125.1 | 4474-082823 | 40 - 375 | 22 | 55 | 38,10 | x | 25,40 | x | 25,40 | 14 | 171,2 | 23,0 | 28,7 |
| RSK 125.2 | 4474-082923 | 75 - 750 | 22 | 55 | 38,10 | x | 25,40 | x | 25,40 | 14 | 171,2 | 23,0 | 28,7 |
| RSK 160.1 | 4474-083821 | 75 - 750 | 40 | 70 | 25,40 | x | 17,02 | x | 15,88 | 23 | 186,5 | 15,3 | 29,7 |
| RSK 160.2 | 4474-083921 | 150 - 1500 | 40 | 70 | 25,40 | x | 17,02 | x | 15,88 | 23 | 186,5 | 15,3 | 29,7 |
| RSK 160.1 | 4474-083823 | 75 - 750 | 40 | 70 | 50,80 | x | 30,99 | x | 29,21 | 13 | 212,3 | 28,0 | 36,0 |
| RSK 160.2 | 4474-083923 | 150 - 1500 | 40 | 70 | 50,80 | x | 30,99 | x | 29,21 | 13 | 212,3 | 28,0 | 36,0 |
| RSK 200.1 | 4474-084821 | 150 - 1500 | 50 | 90 | 38,10 | x | 25,40 | x | 25,40 | 20 | 243,6 | 23,0 | 38,5 |
| RSK 200.2 | 4474-084921 | 300 - 3000 | 50 | 90 | 38,10 | x | 25,40 | x | 25,40 | 20 | 243,6 | 23,0 | 38,5 |
| RSK 200.1 | 4474-084823 | 150 - 1500 | 50 | 90 | 63,50 | x | 38,10 | x | 39,37 | 13 | 265,4 | 34,0 | 44,0 |
| RSK 200.2 | 4474-084923 | 300 - 3000 | 50 | 90 | 63,50 | x | 38,10 | x | 39,37 | 13 | 265,4 | 34,0 | 44,0 |
| RSK 250.1 | 4474-085821 | 300 - 3000 | 55 | 115 | 44,45 | x | 30,99 | x | 27,94 | 21 | 298,3 | 28,0 | 48,0 |
| RSK 250.2 | 4474-085921 | 600 - 6000 | 55 | 115 | 44,45 | x | 30,99 | x | 27,94 | 21 | 298,3 | 28,0 | 48,0 |
| RSK 250.1 | 4474-085823 | 300 - 3000 | 55 | 115 | 76,20 | x | 45,72 | x | 48,26 | 14 | 342,4 | 41,0 | 54,5 |
| RSK 250.2 | 4474-085923 | 600 - 6000 | 55 | 115 | 76,20 | x | 45,72 | x | 48,26 | 14 | 342,4 | 41,0 | 54,5 |

Keyway as per DIN 6885, page 1 - Tolerance of keyway width P9

The glidebush is incorporated as standard. Further chainwheels available on request. Factory slipping torque setting only possible for orders incl. finished bore. Further notes please refer to page 65.

with flexible chain coupling



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Technical Data and Dimensions

| Type | Art.-No. | Slipping torque Nm | Max. speed min ⁻¹ | Bore d ^{H7} | | Bore d ₁ ¹⁾ | | D mm | F mm | G mm | H mm | K mm | L mm | M mm | P mm |
|-----------|-------------|-----------------------|---------------------------------|----------------------|------------|-----------------------------------|------------|---------|---------|---------|---------|---------|---------|---------|---------|
| | | | | min. mm | max. mm | min. mm | max. mm | | | | | | | | |
| RSC 40.1 | 4474-240820 | 2 - 12 | 6300 | 8 | 16 | 10 | 24 | 40 | 15 | 23 | 35 | 61 | 35,5 | 19,0 | 55,5 |
| RSC 40.2 | 4474-240920 | 4 - 25 | 6300 | 8 | 16 | 10 | 24 | 40 | 15 | 23 | 35 | 61 | 35,5 | 19,0 | 55,5 |
| RSC 50.1 | 4474-250820 | 4 - 25 | 5300 | 9 | 20 | 13 | 30 | 50 | 16 | 25 | 45 | 70 | 45 | 21,5 | 67,5 |
| RSC 50.2 | 4474-250920 | 8 - 50 | 5300 | 9 | 20 | 13 | 30 | 50 | 16 | 25 | 45 | 70 | 45 | 21,5 | 67,5 |
| RSC 63.1 | 4474-263820 | 8 - 50 | 4250 | 9 | 25 | 17 | 44 | 63 | 17 | 33 | 60 | 94 | 56 | 25,5 | 83,0 |
| RSC 63.2 | 4474-263920 | 16 - 100 | 4250 | 9 | 25 | 17 | 44 | 63 | 17 | 33 | 60 | 94 | 56 | 25,5 | 83,0 |
| RSC 80.1 | 4474-280820 | 10 - 100 | 3350 | 15 | 32 | 17 | 50 | 80 | 19 | 33 | 70 | 106 | 71 | 24,0 | 97,0 |
| RSC 80.2 | 4474-280920 | 20 - 200 | 3350 | 15 | 32 | 17 | 50 | 80 | 19 | 33 | 70 | 106 | 71 | 24,0 | 97,0 |
| RSC 100.1 | 4474-281820 | 20 - 200 | 2650 | 25 | 40 | 17 | 58 | 100 | 25 | 38 | 80 | 137 | 90 | 30,0 | 123,0 |
| RSC 100.2 | 4474-281920 | 40 - 375 | 2650 | 25 | 40 | 17 | 58 | 100 | 25 | 38 | 80 | 137 | 90 | 30,0 | 123,0 |
| RSC 125.1 | 4474-282820 | 40 - 375 | 2120 | 22 | 55 | 26 | 75 | 125 | 25 | 75 | 100 | 180 | 105 | 46,5 | 154,5 |
| RSC 125.2 | 4474-282920 | 75 - 750 | 2120 | 22 | 55 | 26 | 75 | 125 | 25 | 75 | 100 | 180 | 105 | 46,5 | 154,5 |
| RSC 160.1 | 4474-283820 | 75 - 750 | 1700 | 40 | 70 | 26 | 82 | 160 | 35 | 75 | 110 | 211 | 130 | 51,5 | 184,5 |
| RSC 160.2 | 4474-283920 | 150 - 1500 | 1700 | 40 | 70 | 26 | 82 | 160 | 35 | 75 | 110 | 211 | 130 | 51,5 | 184,5 |
| RSC 200.1 | 4474-284820 | 150 - 1500 | 1320 | 50 | 90 | 26 | 105 | 200 | 37 | 113 | 140 | 280 | 160 | 70,0 | 233,0 |
| RSC 200.2 | 4474-284920 | 300 - 3000 | 1320 | 50 | 90 | 26 | 105 | 200 | 37 | 113 | 140 | 280 | 160 | 70,0 | 233,0 |
| RSC 250.1 | 4474-285820 | 300 - 3000 | 1120 | 55 | 115 | 26 | 120 | 250 | 55 | 129 | 160 | 336 | 185 | 90,0 | 280,0 |
| RSC 250.2 | 4474-285920 | 600 - 6000 | 1120 | 55 | 115 | 26 | 120 | 250 | 55 | 129 | 160 | 336 | 185 | 90,0 | 280,0 |

¹⁾ Check the stress of the keyway in the case of smaller finish bores d₁ and high slipping torques.

Keyway according to DIN 6885, p. 1 · Tolerance of keyway width P9

Application

As slipping shaft coupling to compensate for minor misalignments.

Supply

Unless specified otherwise, the Torque Limiters are supplied with a pilot bore, a full complement of springs and without slipping torque setting. Factory slipping torque setting is only possible when the order includes a finish bore.

Accessories

- Standard tools are normally sufficient for adjusting the slipping torque. Only sizes 125 and 160 require a tool adapter which can be ordered from us.

Please specify when ordering

- Type of Torque Limiting chain coupling
- Diameter d and d₁, if finish bore is requested
- Slipping torque to be preset, if required

4 Technical data of the motors

4.1 Key to the data tables

The following table lists the short symbols used in the "Technical data" tables:

| | |
|----------------|--|
| P_N | Rated power |
| M_N | Rated torque |
| n_N | Rated speed |
| I_N | Rated current |
| $\cos\varphi$ | Power factor |
| $\eta_{50\%}$ | Efficiency at 50% of the rated power |
| $\eta_{75\%}$ | Efficiency at 75% of the rated power |
| $\eta_{100\%}$ | Efficiency at 100% of the rated power |
| I_A/I_N | Starting current ratio |
| M_A/M_N | Starting torque ratio |
| M_H/M_N | Ramp-up torque ratio |
| M_K/M_N | Breakdown torque ratio |
| m_{Mot} | Mass of the motor |
| J_{Mot} | Mass moment of inertia of the motor |
| BE.. | Brake used |
| $Z_0 BG$ | Switching frequency for operation with BG brake control |
| $Z_0 BGE$ | Switching frequency for operation with BGE brake control |
| M_B | Braking torque |
| m_{Bmot} | Mass of the brakemotor |
| J_{BMot} | Mass moment of inertia of the brakemotor |

4.2 IE3 DRN.. motors, 380 V, 50 Hz, 2-pole

4.2.1 Information for motors

| DRN.. motor type | P _N kW | M _N Nm | n _N min ⁻¹ | I _N 380 V A | cosφ | η _{50%} % | η _{75%} % | η _{100%} % | I _A /I _N | M _A /M _N M _H /M _N | M _K /M _N |
|------------------|----------------------|----------------------|-------------------------------------|------------------------------|------|-----------------------|-----------------------|------------------------|--------------------------------|--|--------------------------------|
| DRN 80MS 2 | 0.75 | 2.5 | 2855 | 1.66 | 0.84 | 80.2 | 82.0 | 81.4 | 5.9 | 2.8 2.5 | 2.9 |
| DRN 80M 2 | 1.1 | 3.65 | 2860 | 2.35 | 0.85 | 83.1 | 84.1 | 83.0 | 6.6 | 3.0 2.5 | 2.9 |
| DRN 90S 2 | 1.5 | 4.95 | 2886 | 3.25 | 0.83 | 83.7 | 85.0 | 84.2 | 6.6 | 2.7 2.5 | 2.9 |
| DRN 90L 2 | 2.2 | 7.2 | 2905 | 4.55 | 0.85 | 86.1 | 86.7 | 85.9 | 7.4 | 2.5 2.1 | 3.0 |
| DRN 100LM 2 | 3 | 9.9 | 2894 | 6.1 | 0.85 | 88.9 | 88.7 | 87.2 | 7.7 | 3.3 2.6 | 3.5 |
| DRN 112M 2 | 4 | 13 | 2948 | 7.9 | 0.86 | 88.1 | 88.7 | 88.1 | 10.6 | 2.9 1.3 | 3.3 |
| DRN 132S 2 | 5.5 | 17.9 | 2935 | 9.9 | 0.92 | 90.3 | 90.2 | 89.2 | 10.0 | 3.0 2.1 | 3.7 |
| DRN 132S 2 | 7.5 | 24.5 | 2936 | 14.8 | 0.85 | 90.6 | 90.8 | 90.1 | 9.6 | 3.3 2.0 | 3.4 |

4.2.2 Further information for motors and brakemotors

| DRN.. motor type | P _N kW | M _N Nm | n _N min ⁻¹ | m _{Mot} kg | J _{Mot} 10 ⁻⁴ kgm ² | BE.. | Z ₀ BG BGE h ⁻¹ | M _B Nm | m _{BMot} kg | J _{BMot} 10 ⁻⁴ kgm ² |
|------------------|----------------------|----------------------|-------------------------------------|------------------------|---|------|--|----------------------|-------------------------|--|
| DRN 80MS 2 | 0.75 | 2.5 | 2855 | 11 | 18.5 | BE05 | 1200 3400 | 5 | 15 | 20 |
| DRN 80M 2 | 1.1 | 3.65 | 2860 | 14 | 24.1 | BE1 | 1000 2600 | 7 | 18 | 25.6 |
| DRN 90S 2 | 1.5 | 4.95 | 2886 | 20 | 53.1 | BE1 | 600 1300 | 10 | 22 | 54.7 |
| DRN 90L 2 | 2.2 | 7.2 | 2905 | 23 | 66.3 | BE2 | - 1000 | 14 | 27 | 71 |
| DRN 100LM 2 | 3 | 9.9 | 2894 | 33 | 89.7 | BE2 | - 750 | 20 | 37 | 94.4 |
| DRN 112M 2 | 4 | 13 | 2948 | 45 | 178 | BE5 | - 400 | 28 | 52 | 183 |
| DRN 132S 2 | 5.5 | 17.9 | 2935 | 56 | 241 | BE5 | - 300 | 40 | 64 | 246 |
| DRN 132S 2 | 7.5 | 24.5 | 2936 | 56 | 241 | BE5 | - 300 | 55 | 64 | 246 |

4.3 IE3 DRN.. motors, 380 V, 50 Hz, 6-pole

4.3.1 Information for motors

| DRN.. motor type | P _N kW | M _N Nm | n _N min ⁻¹ | I _N 380 V A | cosφ | η _{50%} % | η _{75%} % | η _{100%} % | I _A /I _N | M _A /M _N M _H /M _N | M _K /M _N |
|------------------|----------------------|----------------------|-------------------------------------|------------------------------|------|-----------------------|-----------------------|------------------------|--------------------------------|--|--------------------------------|
| DRN 90S 6 | 0.75 | 7.5 | 957 | 2.1 | 0.68 | 77.4 | 79.8 | 78.9 | 4.8 | 2.0 2.0 | 2.4 |
| DRN 90L 6 | 1.1 | 11 | 957 | 3.1 | 0.67 | 78.8 | 81.3 | 81.0 | 5.0 | 2.4 2.3 | 2.8 |
| DRN 100L 6 | 1.5 | 14.9 | 961 | 4.3 | 0.63 | 80.7 | 82.8 | 82.5 | 4.7 | 2.2 2.2 | 2.9 |
| DRN 112M 6 | 2.2 | 21.5 | 973 | 5.7 | 0.66 | 83.6 | 85.0 | 84.3 | 6.5 | 2.4 1.9 | 3.2 |
| DRN 132S 6 | 3 | 29.5 | 974 | 7.8 | 0.66 | 84.8 | 86.0 | 85.6 | 6.2 | 2.6 2.5 | 3.4 |
| DRN 132S 6 | 4 | 39.5 | 968 | 10.2 | 0.68 | 86.4 | 87.5 | 86.8 | 5.5 | 2.5 2.5 | 3.2 |
| DRN 132L 6 | 5.5 | 54 | 975 | 14.5 | 0.64 | 86.9 | 88.3 | 88.0 | 5.6 | 2.7 2.5 | 2.8 |
| DRN 160M 6 | 7.5 | 73 | 979 | 16.6 | 0.74 | 88.4 | 89.4 | 89.1 | 8.2 | 2.7 1.6 | 4.0 |

4.3.2 Further information for motors and brakemotors

| DRN.. motor type | P _N kW | M _N Nm | n _N min ⁻¹ | m _{Mot} kg | J _{Mot} 10 ⁻⁴ kgm ² | BE.. | Z ₀ BG BGE h ⁻¹ | M _B Nm | m _{BMot} kg | J _{BMot} 10 ⁻⁴ kgm ² |
|------------------|----------------------|----------------------|-------------------------------------|------------------------|---|------|--|----------------------|-------------------------|--|
| DRN 90S 6 | 0.75 | 7.5 | 957 | 20 | 54 | BE2 | 2400 5000 | 20 | 24 | 58.7 |
| DRN 90L 6 | 1.1 | 11 | 957 | 23 | 67.4 | BE5 | 2200 4400 | 28 | 29 | 73.4 |
| DRN 100L 6 | 1.5 | 14.9 | 961 | 34 | 112 | BE5 | 3400 | 40 | 40 | 118 |
| DRN 112M 6 | 2.2 | 21.5 | 973 | 45 | 178 | BE5 | 2500 | 55 | 52 | 183 |
| DRN 132S 6 | 3 | 29.5 | 974 | 56 | 245 | BE11 | 2300 | 80 | 71 | 256 |
| DRN 132S 6 | 4 | 39.5 | 968 | 56 | 245 | BE11 | 2100 | 80 | 71 | 256 |
| DRN 132L 6 | 5.5 | 54 | 975 | 81 | 439 | BE11 | 1700 | 110 | 100 | 461 |
| DRN 160M 6 | 7.5 | 73 | 979 | 115 | 1290 | BE20 | 1200 | 150 | 145 | 1350 |

4.4 IE3 DRN.. motors, 400 V, 50 Hz, 2-pole

4.4.1 Information for motors

| DRN.. motor type | P _N kW | M _N Nm | n _N min ⁻¹ | I _N 400 V A | cosφ | η _{50%} % | η _{75%} % | η _{100%} % | I _A /I _N | M _A /M _N M _H /M _N | M _K /M _N |
|------------------|----------------------|----------------------|-------------------------------------|------------------------------|------|-----------------------|-----------------------|------------------------|--------------------------------|--|--------------------------------|
| DRN 80MS 2 | 0.75 | 2.5 | 2855 | 1.58 | 0.84 | 80.2 | 82.0 | 81.4 | 5.9 | 2.8 2.5 | 2.9 |
| DRN 80M 2 | 1.1 | 3.65 | 2860 | 2.2 | 0.85 | 83.1 | 84.1 | 83.0 | 6.6 | 3.0 2.5 | 2.9 |
| DRN 90S 2 | 1.5 | 4.95 | 2886 | 3.1 | 0.83 | 83.7 | 85.0 | 84.2 | 6.6 | 2.7 2.5 | 2.9 |
| DRN 90L 2 | 2.2 | 7.2 | 2905 | 4.3 | 0.85 | 86.1 | 86.7 | 85.9 | 7.4 | 2.5 2.1 | 3.0 |
| DRN 100LM 2 | 3 | 9.9 | 2894 | 5.8 | 0.85 | 88.9 | 88.7 | 87.2 | 7.7 | 3.3 2.6 | 3.5 |
| DRN 112M 2 | 4 | 13 | 2948 | 7.5 | 0.86 | 88.1 | 88.7 | 88.1 | 10.6 | 2.9 1.3 | 3.3 |
| DRN 132S 2 | 5.5 | 17.9 | 2935 | 9.4 | 0.92 | 90.3 | 90.2 | 89.2 | 10.0 | 3.0 2.1 | 3.7 |
| DRN 132S 2 | 7.5 | 24.5 | 2936 | 14.1 | 0.85 | 90.6 | 90.8 | 90.1 | 9.6 | 3.3 2.0 | 3.4 |

4.4.2 Further information for motors and brakemotors

| DRN.. motor type | P _N kW | M _N Nm | n _N min ⁻¹ | m _{Mot} kg | J _{Mot} 10 ⁻⁴ kgm ² | BE.. | Z ₀ BG BGE h ⁻¹ | M _B Nm | m _{BMot} kg | J _{BMot} 10 ⁻⁴ kgm ² |
|------------------|----------------------|----------------------|-------------------------------------|------------------------|---|------|--|----------------------|-------------------------|--|
| DRN 80MS 2 | 0.75 | 2.5 | 2855 | 11 | 18.5 | BE05 | 1200 3400 | 5 | 15 | 20 |
| DRN 80M 2 | 1.1 | 3.65 | 2860 | 14 | 24.1 | BE1 | 1000 2600 | 7 | 18 | 25.6 |
| DRN 90S 2 | 1.5 | 4.95 | 2886 | 20 | 53.1 | BE1 | 600 1300 | 10 | 22 | 54.7 |
| DRN 90L 2 | 2.2 | 7.2 | 2905 | 23 | 66.3 | BE2 | - 1000 | 14 | 27 | 71 |
| DRN 100LM 2 | 3 | 9.9 | 2894 | 33 | 89.7 | BE2 | - 750 | 20 | 37 | 94.4 |
| DRN 112M 2 | 4 | 13 | 2948 | 45 | 178 | BE5 | - 400 | 28 | 52 | 183 |
| DRN 132S 2 | 5.5 | 17.9 | 2935 | 56 | 241 | BE5 | - 300 | 40 | 64 | 246 |
| DRN 132S 2 | 7.5 | 24.5 | 2936 | 56 | 241 | BE5 | - 300 | 55 | 64 | 246 |

13 Technical data of the motors

13.1 Key to the data tables

The following table lists the short symbols used in the "Technical data" tables:

| | |
|----------------|--|
| P_N | Rated power |
| M_N | Rated torque |
| n_N | Rated speed |
| I_N | Rated current |
| $\cos\phi$ | Power factor |
| IE | International energy efficiency class |
| $\eta_{50\%}$ | Efficiency at 50% of the rated power |
| $\eta_{75\%}$ | Efficiency at 75% of the rated power |
| $\eta_{100\%}$ | Efficiency at 100% of the rated power |
| I_A/I_N | Starting current ratio |
| M_A/M_N | Starting torque ratio |
| M_H/M_N | Ramp-up torque ratio |
| m | Mass of the motor |
| J_{Mot} | Mass moment of inertia of the motor |
| BE.. | Brake used |
| $Z_0 BG$ | Switching frequency for operation with BG brake control |
| $Z_0 BGE$ | Switching frequency for operation with BGE brake control |
| M_B | Braking torque |
| m_B | Mass of the brakemotor |
| J_{MOT_BE} | Mass moment of inertia of the brakemotor |

13

13.2 DT.., DR.., DRS.. motors, 50 Hz, 4-pole, S1

4-pole DT.., DR.., DRS.. motors for 400 V (380 – 420 V), 50 Hz

| DT../DR../ DRS.. motor type | P _N kW | M _N Nm | n _N rpm | I _N 400 V A | I _N 380-420 V A | cosφ | IE | η _{50%} % | η _{75%} % | η _{100%} % | I _A /I _N | M _A /M _N M _H /M _N |
|-----------------------------------|----------------------|----------------------|-----------------------|------------------------------|----------------------------------|------|-----|-----------------------|-----------------------|------------------------|--------------------------------|--|
| DT56M4 | 0.09 | 0.66 | 1300 | 0.29 | 0.31 | 0.68 | - | - | - | - | 2.6 | 2.1 1.8 |
| DT56L4 | 0.12 | 0.88 | 1300 | 0.42 | 0.46 | 0.68 | - | - | - | - | 2.6 | 2.2 1.9 |
| DR63S4 | 0.12 | 0.83 | 1380 | 0.39 | 0.39 | 0.69 | - | - | - | - | 3.3 | 2.4 2.2 |
| DR63M4 | 0.18 | 1.3 | 1320 | 0.55 | 0.55 | 0.78 | - | - | - | - | 2.9 | 1.8 1.7 |
| DR63L4 | 0.25 | 1.8 | 1300 | 0.68 | 0.73 | 0.81 | - | - | - | - | 2.8 | 1.8 1.7 |
| DRS71S4 | 0.18 | 1.25 | 1380 | 0.64 | 0.66 | 0.70 | IE1 | 59.1 | 65.3 | 66.6 | 3.5 | 1.8 1.8 |
| DRS71S4 | 0.25 | 1.72 | 1390 | 0.67 | 0.69 | 0.75 | IE1 | 68.6 | 72.6 | 72.6 | 4.1 | 1.9 1.9 |
| DRS71S4 | 0.37 | 2.55 | 1380 | 1.14 | 1.24 | 0.70 | IE1 | 59.1 | 65.3 | 66.6 | 3.5 | 1.8 1.8 |
| DRS71M4 | 0.55 | 3.85 | 1360 | 1.55 | 1.62 | 0.72 | IE1 | 69.1 | 71.9 | 70.6 | 3.6 | 2.1 2.1 |

4-pole DT.., DR.., DRS.. motors/brakemotors for 400 V (380 – 420 V), 50 Hz

| DT../DR../ DRS.. motor type | P _N kW | M _N Nm | n _N rpm | m kg | J _{Mot} 10 ⁻⁴ kgm ² | BE.. | Z ₀ BG / BGE 1/h | M _B Nm | m _B kg | J _{Mot_BE} 10 ⁻⁴ kgm ² |
|-----------------------------------|----------------------|----------------------|-----------------------|-----------------|---|-------|-----------------------------------|----------------------|----------------------|--|
| DT56M4 | 0.09 | 0.66 | 1300 | - ¹⁾ | 1.1 | BMG02 | 10000 - | 0.8 | - | 1.2 |
| DT56L4 | 0.12 | 0.88 | 1300 | - ¹⁾ | 1.1 | BMG02 | 10000 - | 1.2 | - | 1.2 |
| DR63S4 | 0.12 | 0.83 | 1380 | 6.1 | 3.6 | BR03 | 10000 - | 2.4 | 7.6 | 4.8 |
| DR63M4 | 0.18 | 1.3 | 1320 | 6.1 | 3.6 | BR03 | 10000 - | 3.2 | 7.6 | 4.8 |
| DR63L4 | 0.25 | 1.8 | 1300 | 6.7 | 4.4 | BR03 | 10000 - | 3.2 | 8.2 | 5.6 |
| DRS71S4 | 0.18 | 1.25 | 1380 | 7.8 | 5.13 | BE05 | 6000 9500 | 5 | 10 | 6.43 |
| DRS71S4 | 0.25 | 1.72 | 1390 | 7.8 | 5.13 | BE05 | 6000 9500 | 5 | 10 | 6.43 |
| DRS71S4 | 0.37 | 2.55 | 1380 | 7.8 | 5.13 | BE05 | 6000 9500 | 5 | 10 | 6.43 |
| DRS71M4 | 0.55 | 3.85 | 1360 | 9.1 | 7.21 | BE1 | 4100 11000 | 10 | 12 | 8.51 |

1) only available as gearmotor

13.3 DRN.. motors, 50 Hz, 4-pole, S1

4-pole DRN.. motors for 400 V, 50 Hz, IE3

| DRN.. motor type | P _N kW | M _N Nm | n _N rpm | I _N 400 V A | cosφ | IE | η _{50%} % | η _{75%} % | η _{100%} % | I _A /I _N | M _A /M _N M _H /M _N | M _K /M _N |
|------------------|----------------------|----------------------|-----------------------|------------------------------|------|-----|-----------------------|-----------------------|------------------------|--------------------------------|--|--------------------------------|
| DRN 80M 4 | 0.75 | 4.95 | 1440 | 1.75 | 0.74 | IE3 | 80.7 | 82.9 | 82.9 | 6.7 | 3.1 2.7 | 3.4 |
| DRN 90S 4 | 1.1 | 7.2 | 1455 | 2.55 | 0.73 | IE3 | 83.5 | 85.0 | 84.5 | 6.9 | 2.7 2.1 | 3.3 |
| DRN 90L 4 | 1.5 | 9.8 | 1461 | 3.4 | 0.74 | IE3 | 84.6 | 86.1 | 85.6 | 7.5 | 2.7 2.0 | 3.3 |
| DRN 100LS 4 | 2.2 | 14.5 | 1450 | 4.75 | 0.76 | IE3 | 86.4 | 87.5 | 86.9 | 7.1 | 2.9 2.2 | 3.3 |
| DRN 100L 4 | 3 | 19.7 | 1456 | 6.4 | 0.76 | IE3 | 87.3 | 88.3 | 87.8 | 8.2 | 3.4 2.3 | 3.7 |
| DRN 112M 4 | 4 | 26 | 1464 | 7.9 | 0.81 | IE3 | 88.6 | 89.4 | 88.7 | 8.2 | 2.4 1.6 | 3.6 |
| DRN 132S 4 | 5.5 | 36 | 1461 | 10.5 | 0.84 | IE3 | 90.6 | 90.6 | 89.6 | 8.3 | 2.5 2.8 | 3.5 |
| DRN 132M 4 | 7.5 | 49 | 1468 | 15.2 | 0.78 | IE3 | 90.8 | 91.1 | 90.4 | 7.8 | 3.1 2.4 | 3.3 |
| DRN 132L 4 | 9.2 | 60 | 1470 | 18.7 | 0.77 | IE3 | 90.8 | 91.6 | 91.0 | 8.4 | 3.7 1.8 | 3.7 |
| DRN 160M 4 | 11 | 71 | 1473 | 21 | 0.81 | IE3 | 91.1 | 91.7 | 91.4 | 7.3 | 2.6 2.2 | 3.0 |
| DRN 160L 4 | 15 | 97 | 1474 | 29 | 0.80 | IE3 | 91.9 | 92.5 | 92.1 | 8.0 | 3.0 2.0 | 3.4 |
| DRN 180M 4 | 18.5 | 120 | 1478 | 33.5 | 0.85 | IE3 | 92.8 | 93.1 | 92.6 | 9.5 | 3.6 2.9 | 3.6 |
| DRN 180L 4 | 22 | 142 | 1477 | 38.5 | 0.87 | IE3 | 93.4 | 93.6 | 93.0 | 9.6 | 3.5 2.1 | 3.4 |
| DRN 200L 4 | 30 | 194 | 1480 | 56 | 0.82 | IE3 | 93.3 | 93.9 | 93.6 | 8.2 | 2.9 2.5 | 3.3 |
| DRN 225S 4 | 37 | 240 | 1482 | 64 | 0.88 | IE3 | 94.3 | 94.4 | 93.9 | 8.4 | 3.0 1.9 | 2.5 |
| DRN 225M 4 | 45 | 290 | 1482 | 81 | 0.85 | IE3 | 94.1 | 94.5 | 94.2 | 8.8 | 3.5 2.4 | 2.8 |
| DRN 250M 4 | 55 | 355 | 1482 | 105 | 0.80 | IE3 | 94.4 | 94.8 | 94.6 | 7.6 | 3.3 2.5 | 2.9 |
| DRN 280S 4 | 75 | 485 | 1482 | 143 | 0.79 | IE3 | 94.9 | 95.3 | 95.0 | 7.6 | 3.7 2.6 | 2.9 |
| DRN 280M 4 | 90 | 580 | 1481 | 161 | 0.84 | IE3 | 95.4 | 95.6 | 95.2 | 7.7 | 3.6 2.0 | 2.7 |
| DRN 315S 4 | 110 | 710 | 1488 | 189 | 0.87 | IE3 | 95.3 | 95.6 | 95.4 | 6.7 | 2.9 2.1 | 3.1 |
| DRN 315M 4 | 132 | 850 | 1488 | 230 | 0.86 | IE3 | 95.6 | 95.9 | 95.6 | 7.9 | 3.0 2.2 | 3.5 |
| DRN 315L 4 | 160 | 1030 | 1486 | 275 | 0.87 | IE3 | 95.8 | 96.0 | 95.8 | 7.7 | 3.0 2.1 | 3.3 |
| DRN 315H 4 | 200 | 1280 | 1489 | 360 | 0.84 | IE3 | 95.4 | 96.0 | 96.0 | 8.1 | 3.7 2.8 | 3.8 |

4-pole DRN.. motors/brakemotors for 400 V, 50 Hz, IE3

| DRN.. motor type | P _N kW | M _N Nm | n _N rpm | m kg | J _{Mot} 10 ⁻⁴ kgm ² | BE.. | Z ₀ BG BGE 1/h | M _B Nm | m _B kg | J _{Mot_BE} 10 ⁻⁴ kgm ² |
|------------------|----------------------|----------------------|-----------------------|---------|---|-------|------------------------------------|----------------------|----------------------|--|
| DRN 80M 4 | 0.75 | 4.95 | 1440 | 14 | 24.7 | BE1 | 3200 8200 | 10 | 18 | 26.2 |
| DRN 90S 4 | 1.1 | 7.2 | 1455 | 20 | 54 | BE2 | 2300 6000 | 14 | 24 | 58.7 |
| DRN 90L 4 | 1.5 | 9.8 | 1461 | 23 | 67.2 | BE2 | 2200 5800 | 20 | 27 | 71.9 |
| DRN 100LS 4 | 2.2 | 14.5 | 1450 | 27 | 81.4 | BE5 | - 6100 | 28 | 33 | 87.4 |
| DRN 100L 4 | 3 | 19.7 | 1456 | 34 | 112 | BE5 | - 3700 | 40 | 40 | 118 |
| DRN 112M 4 | 4 | 26 | 1464 | 45 | 178 | BE5 | - 2900 | 55 | 52 | 183 |
| DRN 132S 4 | 5.5 | 36 | 1461 | 56 | 241 | BE11 | - 2100 | 80 | 71 | 251 |
| DRN 132M 4 | 7.5 | 49 | 1468 | 73 | 381 | BE11 | - 1100 | 110 | 91 | 403 |
| DRN 132L 4 | 9.2 | 60 | 1470 | 81 | 439 | BE20 | - 980 | 150 | 110 | 490 |
| DRN 160M 4 | 11 | 71 | 1473 | 115 | 817 | BE20 | - 900 | 150 | 145 | 877 |
| DRN 160L 4 | 15 | 97 | 1474 | 130 | 1040 | BE20 | - 800 | 200 | 165 | 1100 |
| DRN 180M 4 | 18.5 | 120 | 1478 | 155 | 1630 | BE30 | - 510 | 300 | 195 | 1770 |
| DRN 180L 4 | 22 | 142 | 1477 | 170 | 1950 | BE30 | - 470 | 300 | 210 | 2090 |
| DRN 200L 4 | 30 | 194 | 1480 | 280 | 2660 | BE32 | - 500 | 400 | 335 | 2890 |
| DRN 225S 4 | 37 | 240 | 1482 | 310 | 4350 | BE32 | - 230 | 500 | 365 | 4580 |
| DRN 225M 4 | 45 | 290 | 1482 | 310 | 4350 | BE32 | - 200 | 600 | 365 | 4580 |
| DRN 250M 4 | 55 | 355 | 1482 | 460 | 7400 | BE62 | - 180 | 800 | 550 | 7990 |
| DRN 280S 4 | 75 | 485 | 1482 | 520 | 8970 | BE62 | - 150 | 1000 | 600 | 9570 |
| DRN 280M 4 | 90 | 580 | 1481 | 630 | 12000 | BE62 | - 79 | 1200 | 720 | 12600 |
| DRN 315S 4 | 110 | 710 | 1488 | 880 | 23400 | BE122 | - 53 | 1600 | 1000 | 24500 |
| DRN 315M 4 | 132 | 850 | 1488 | 900 | 24800 | BE122 | - 46 | 2000 | 1020 | 25900 |
| DRN 315L 4 | 160 | 1030 | 1486 | 1030 | 28600 | BE122 | - 34 | 2000 | 1150 | 29700 |
| DRN 315H 4 | 200 | 1280 | 1489 | 1150 | 35200 | BE122 | - 23 | 2000 | 1270 | 36300 |



LT-4201TM

Model : PFXLM4201TADDK
PFXLM4201TADD
PFXLM4201TADAK
PFXLM4201TADAC



Model Name Indication

PFXLM4201TAD * *

| | | | |
|-----|----------------------------|-----------------|----------------------|
| (1) | (2) | (3) | (4) |
| 2 | 3.5 in. | T TFT Color LCD | A Analog Touch Panel |
| (5) | | | (6) |
| D | Digital I/O | K | Sink Output Type |
| A | Analog I/O and Digital I/O | C | Source Output Type |

Display Specifications

| | | LT-4201TM | | | |
|-----------------------------|---|---|--|--|--|
| | | DIO | AIO and DIO | | |
| Models | | PFXLM4201TADDK : Sink Output Type PFXLM4201TADD : Source Output Type | PFXLM4201TADAK : Sink Output Type PFXLM4201TADAC : Source Output Type | | |
| Type | | TFT Color LCD | | | |
| Resolution (pixels) | | 320 x 240 (QVGA) | | | |
| Active display area (W x H) | | 70.56 x 52.92 mm (2.78 x 2.08 in.) | | | |
| Display Colors | | 65,536 colors | | | |
| Backlight | | White LED | | | |
| Brightness adjustment | | Non-exchangeable | | | |
| Language Fonts *1 | | LED ON / OFF control, adjustable screen saver activation time | | | |
| Character sizes | | 16 levels of adjustment available via touch panel in the configuration menu | | | |
| Font sizes | | Japanese, ASCII, Chinese (Simplified), Chinese (Traditional), Korean, Cyrillic, Thai | | | |
| 8 x 8 pixels | | 8 x 8, 8 x 16, 16 x 16 and 32 x 32 pixel fonts | | | |
| 8 x 16 pixels | | Width can be expanded 1 to 8 times. Height can be expanded 1/2 and 1 to 8 times. | | | |
| 16 x 16 pixels | | 40 characters per row x 30 rows | | | |
| 32 x 32 pixels | | 40 characters per row x 15 rows | | | |
| 32 x 32 pixels | | 20 characters per row x 15 rows | | | |
| Application memory *2 | | 10 characters per row x 7 rows | | | |
| Memory | FLASH EPROM 16 MB (includes screen editing program and extended logic program) | | | | |
| | FLASH EPROM 132 KB *3 (equivalent to 15,000 steps) | | | | |
| | Font area | | FLASH EPROM 8 MB (when limit exceeded, uses application memory) | | |
| | Data backup | | nvSRAM 128 KB (rechargeable lithium battery for data backup) | | |
| Variable area | | Variable area | | | |
| Touch Panel | Type | nvSRAM 64 KB (rechargeable lithium battery for data backup) | | | |
| | Lifetime | Resistive Film (analog) 1 million touches or more | | | |
| Interface | RS-232C (Connector type: RJ45, Isolation: None, Maximum baud rate: 115,200 bps, Cable Type: Shielded, Cable Maximum length: 15 m (49 ft), 5 Vdc power supply for RS-232C: None) | | | | |
| | RS-485 (Connector type: RJ45, Isolation: None, Maximum baud rate: 115,200 bps, Cable Type: Shielded, Cable Maximum length: 200 m (656 ft), Polarization: Setting is required via software when connecting Multiple LTs. Refer to the "GP-Pro EX Device / PLC Manual" for the setting. 5 Vdc power supply for RS-485: None) *4 | | | | |
| | CANopen (master) | | USB 2.0 (Type A) x 1 | | |
| | CAN-CIA (ISO 11898-2:2002 Part 2), Connector: D-sub9 (plug) | | IEEE802.3 compliant Ethernet x 1 | | |
| | Ethernet | | (Connector type: RJ45, Driver: 10 M half duplex (auto negotiation)/ 100 M full duplex (auto negotiation), Cable type: Shielded, Automatic cross-over detection: Yes) | | |
| | USB (Type A) | | USB 2.0 (Type A) x 1 | | |
| | (Power Supply Voltage: 5Vdc +/- 5%, Maximum Current Supplied: 500mA, Maximum Transmission Distance: 5m (16.4 ft.)) | | USB 2.0 (Type A) x 1 | | |
| | USB (mini B) | | USB 2.0 (Mini-B) x 1 | | |
| | DIO (Sink Type) | 20 Points Standard Input (including 2 Points for Fast Input) 10 Points Standard Output, 2 Points for Fast Output | 12 Points Standard Input (including 2 Points for Fast Input) 6 Points Standard Output and 2 Points Fast Output | | |
| | DIO (Source Type) | 20 Points Standard Input (including 2 Points for Fast Input) 10 Points Standard Output and 2 Points Fast Output | 12 Points Standard Input (including 2 Points for Fast Input) 6 Points Standard Output and 2 Points Fast Output | | |
| | AIO | — | 2 ch analog inputs (13-bit) and 2 ch analog inputs (16-bit) for Thermocouple 2 ch analog outputs (12-bit) | | |

*1: Please refer to the GP-Pro EX Reference Manual for details on font types and character codes.

*2: Capacity available for user application.

*3: Up to 60,000 steps can be converted in software. However, this reduces application memory capacity (for screen data) by 1 MB.

*4: 2-wire connection is available for RS-485. When a Device/PLC supports 2-wire connection, 4 wires (RXD+, TXD+, RXD-, and TXD-) can be short-circuited to be 2 wires (RXD+ and TXD+ = D1, RXD- and TXD- = D0). For details on the connection, refer to the connection manual.

General Specifications

| | LT-4201TM | | | |
|--|----------------------------|---|--------------|--|
| | DIO | AIO and DIO | | |
| Supported Standards and Regulations | | UL508 cUL508 UL508 cUL508 ANSI/ISA 12.12.01 | | |
| Rated Input Voltage | 24 Vdc | | | |
| Input Voltage Limits | 20 to 28.8 Vdc | | | |
| Acceptable Voltage Drop | 10 ms or less at 20.4 Vdc | | | |
| Power Consumption | 9 W or less | | 12 W or less | |
| In-Rush Current | 30 A or less at 28.8 Vdc | | | |
| Voltage Endurance between power terminal and frame ground (FG) | 500 Vdc for 1 minute | | | |
| Insulation Resistance between power terminal and FG | 10 MΩ or higher at 500 Vdc | | | |

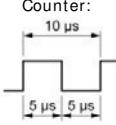
Environmental Specifications

| | LT-4201TM | | | |
|---|-------------------------|--|-----------------|--|
| | DIO | AIO and DIO | | |
| Standard compliance | | IEC61131-2 | | |
| Ambient operating temperature for the display and the rear module | Horizontal installation | 0 to 50°C (32 to 122°F) | | |
| | Vertical installation | 0 to 40°C (32 to 104°F) | | |
| Storage temperature | | -20 to 60°C (-4 to 140°F) | | |
| Storage altitude | | 0 to 10,000 m (0 to 32,808 ft) | | |
| Operating altitude | | 0 to 2,000 m (0 to 6,560 ft) | | |
| Surrounding Air and Strage Humidity | | 5 to 85% w/o condensation (non-condensing, wet bulb temperature 39°C (102.2°F) or less) | | |
| Degree of pollution | IEC60664 | 2 | | |
| Degree of protection | IEC61131-2 | IP20 with protective covers in place | | |
| Corrosive gases | | Free of corrosive gases | | |
| Dust | | $\leq 0.1 \text{ mg/m}^3 (10^{-7} \text{ oz/ft}^3)$ (non-conductive levels) | | |
| Atmospheric pressure (Operating Altitude) | | 800 to 1,114 hPa (2000 m (6,561 ft) or lower) | | |
| Vibration resistance | Mounted on a DIN rail | 3.5 mm (0.138 in.) fixed amplitude from 5 to 8.4 Hz 9.8 m/s² (1 gn) fixed acceleration from 8.4 to 150 Hz | | |
| | Mounted on a panel | 3.5 mm (0.138 in.) fixed amplitude from 5 to 8.6 Hz 9.8 m/s² (1 gn) fixed acceleration from 8.6 to 150 Hz | | |
| Mechanical shock resistance | Mounted on a DIN rail | 147 m/s² (15 gn) for a duration of 11 ms | | |
| | Mounted on a panel | 147 m/s² (15 gn) for a duration of 6 ms | | |
| Electrostatic discharge | IEC/EN61000-4-2 | 8 kV (air discharge) 6 kV (contact discharge) | | |
| Radiated radio frequency electromagnetic fields | IEC/EN61000-4-3 | 10 V/m (80 MHz to 3 GHz) | | |
| Fast transients / Burst noise | IEC/EN61000-4-4 | Power lines: 2 kV Digital I/O: 1 kV Relay outputs: 2 kV Ethernet line: 1 kV COM line: 1 kV CAN line: 1 kV | | |
| Surge immunity | IEC/EN61000-4-5 | Power supply: CM: 1 kV; DM: 0.5 kV Digital I/O: CM: 1 kV; DM: 0.5 kV Shielded cable: 1 kV CM = line-earth DM = line-line | | |
| Conducted disturbances induced by radio-frequency fields | IEC/EN61000-4-6 | 10 Veff (0.15 to 80 MHz) | | |
| Mains terminal disturbance voltage | EN55011 (IEC/CISPR11) | 150 to 500 kHz, quasi peak 79 dBµV 500 kHz to 30 MHz, quasi peak 73 dBµV | | |
| Electric field strength | EN55011 (IEC/CISPR11) | 30 to 230 MHz, quasi peak 10 m @40 dBµV/m 230 MHz to 1 GHz, quasi peak 10 m @47 dBµV/m | | |
| Vibration immunity (operating) | | IEC61131-2 | | |
| Protection structure | | NEMA TYPE 4X (indoors, with panel embedded) | | |
| Protection (front module) | | IP65f - (IEC60529) | | |
| Protection (rear module) | | IP20 - (IEC60529) | | |
| Shock immunity (operating) | | IEC61131-2 15gn 11ms | | |
| Cooling method | | Natural air circulation | | |
| Weight | 496 g (17.49 oz) | | 531g (18.73 oz) | |
| Color | | Front module: PT404 Rear module: RAL 7032 | | |
| Material | | Front module: PC/PBT Rear module: PC/PBT | | |

Digital Input Characteristics

| | | LT-4201TM |
|---------------------------|------------------------|---|
| Rated Current | Voltage | 5 mA |
| Inrush Values | Current | 30 Vdc 6.29 mA max. |
| Input impedance | | 4.9 kΩ |
| Input type | | Sink/Source |
| Rated voltage | | 24 Vdc |
| Maximum Allowable Voltage | | 28.8 Vdc |
| Input limit values | ON Voltage | 15 Vdc or more (15 to 28.8 Vdc) |
| | OFF Voltage | 5 Vdc or less (0 to 5 Vdc) |
| | ON Current | 2.5 mA or more |
| | OFF Current | 1.0 mA or less |
| Isolation | Method | Photocoupler Isolation |
| | Between internal logic | 500 Vdc |
| Filtering | | 0.5 ms to 30.0 ms |
| IEC61131-2 edition 3 type | | Type 1 |
| Compatibility | | Supports 2 wire and 3 wire sensors |
| Cable type and length | | Shielded: Maximum 100 m (328 ft) Non-shielded: 50 m (164 ft) |
| Terminal blocks | | Type: 3.5 mm (0.137 in.) pitch Terminal blocks are removable |
| Input paralleling | | No |

High Speed Counter Input Characteristics

| | | LT-4201TM |
|-------------------------------|------------------------|--|
| Rated Current | Voltage | 24 Vdc |
| | Current | 7.83 mA |
| Inrush values | Voltage | 30 Vdc |
| | Current | 9.99 mA |
| Input impedance | | 3.2 kΩ |
| Input type | | Sink/Source |
| Rated voltage | | 24 Vdc |
| Maximum Allowable Voltage | | 28.8 Vdc |
| Input limit values | ON Voltage | 15 Vdc or more |
| | OFF Voltage | 5 Vdc or less |
| | ON Current | 5 mA or more |
| | OFF Current | 1.5 mA or less |
| Isolation | Method | Photo coupler Isolation |
| | Between channels logic | 500 Vdc |
| Filtering | | None, 4 µs, 40 µs |
| IEC61131-2 edition 3 type | | Type 1 |
| Compatibility | | Supports 2 wire and 3 wire sensors |
| Cable | Type | Shielded |
| | Length | Maximum 10 m (33 ft) |
| Terminal blocks | | Type: 3.5 mm (0.137 in.) pitch Terminal blocks are removable |
| Maximum frequency | | <ul style="list-style-type: none"> · 100 kHz is the maximum frequency for Single-phase · 50 kHz is the maximum frequency for 2-phase · Duty Rate: 45 to 55% |
| Phase Counting Mode | | <ul style="list-style-type: none"> · Single phase · 2 Phase x2 · 2 Phase x4 · 2 Phase x2 Reverse · 2 Phase x4 Reverse |
| Response time | Marker | 1 ms |
| | Preload | 1 ms |
| | Prestrobet | 1 ms |
| | Synchronize output | 2 ms |
| Min. Pulse Width(Pulse input) | Counter: |  |
| | | Pulse Catch Input signal ON width |
| Input paralleling | | No |

Transistor Output Characteristics

| | | LT-4201TM |
|----------------------------------|------------------------|---|
| Rated Voltage | | 24Vdc |
| Output range | | 19.2 to 28.8 Vdc |
| Output type | | Sink/Source |
| Rated current | | DIO: 0.3 A/point, 3.0 A/common AIO and DIO: 0.3 A/point, 1.8 A/common |
| Residual voltage | | 1.5 Vdc or less for I= 0.1A |
| Delay | | Off to on (0.3 A load): 1.1ms On to off (0.3 A load): 2ms NOTE: The delay is not including the cable delay. |
| Isolation | Method | Photocoupler Isolation |
| | Between internal logic | 500 Vdc |
| Minimum resistor load | | 80 Ω at 24 Vdc |
| Cable length | | Non-shielded: 150 m (492 ft) |
| Protection against short circuit | | No |
| Terminal blocks | | Type: 3.5 mm (0.137 in.) pitch Terminal blocks are removable |

NOTE: Refer to LT4201TM/4301TM Hardware Manual about Protecting Outputs from Inductive Load Damage for additional information on this topic.

Pulse Output/PWM Output/High-speed Counter (Synchronize Output) Characteristics

| | | LT-4201TM |
|-----------------------------------|--|---|
| Output type | | Sink/Source |
| Rated voltage | | 24 Vdc |
| Power supply input range | | 19.2 to 28.8 Vdc |
| Power supply reverse protection | | Yes |
| Pulse Output/PWM output current | | 50 mA/point, 100 mA/common |
| Response time for original input | | 2 ms |
| Isolation resistance | Between fast outputs and internal logic | 10 MΩ or more |
| | Between power supply port and protective earth ground (PE) = 500 Vdc | 10 MΩ or more |
| Residual voltage | for I = 0, 1 A | 1.5 Vdc or less |
| Delay | | Off to on (50 mA load): 1.1ms On to off (50 mA load): 1.1ms NOTE: The delay is not including the cable delay. |
| Minimum load impedance | | 80 Ω |
| Maximum Pulse output frequency | | 50 KHz |
| Maximum Pulse output frequency | | 65 kHz |
| Accuracy Pulse Output/ PWM Output | Frequency | Accuracy |
| | 10~1000Hz | 1% |
| | 1.001~20kHz | 5% |
| | 20.001~45kHz | 10% |
| | 45.001~65kHz | 15% |
| Duty rate range | | 1 to 99% |
| Cable | Type | Shielded, including 24 Vdc power supply |
| | Length | Maximum 5 m (16 ft) |
| Terminal blocks | | Type: 3.5 mm (0.137 in.) pitch Terminal blocks are removable |

NOTE: When using the acceleration/deceleration pulse output, there is a 1% maximum error for the frequency.

Analog Input Characteristics

| | | |
|---------------------------------------|--|---|
| | | LT-4201TM |
| | | AIO and DIO |
| Characteristics | Voltage input | Current input |
| Number of maximum input | 2 | |
| Input type | Single-ended | |
| Input range | -10 to 10 Vdc/0 to 10 Vdc | 0 to 20 mA/4 to 20 mA |
| Input impedance | 1 MΩ or more | 250 ± 0.11% Ω |
| Sample duration time | 10 ms per channel + 1 scan time | |
| Total input system transfer time | 20 ms + 1 scan time | |
| Input tolerance | Maximum deviation at 25°C (77°F) without electromagnetic disturbance | ± 1% of the full scale |
| | Maximum deviation | ± 2.5% of the full scale |
| Digital resolution | 13 bits | |
| Temperature drift | ± 0.06% of the full scale | |
| Common mode characteristics | Cross talk | 80 dB |
| | Non-linearity | 60 dB |
| Input value of LSB | 5 mV | 10 μA |
| Maximum allowed overload (no damages) | ± 30 Vdc (less than 5 minutes) ± 15 Vdc (No damage) | ± 30 mA dc |
| Protection type | Photo coupler between input and internal circuit | |
| Cable | Type | Shielded |
| | Length | Must be less than 3 m for IEC61131-2 conformance. Maximum transmission distance is 10m. |
| Terminal blocks | Type: 3.5 mm (0.137 in.) pitch Terminal blocks are removable | |
| Isolation | External input | Photo-coupler isolation |
| | Between channels | Non-isolated |

Temperature Input (Temperature Probes) Characteristics

| | | |
|--------------------------------|--|---|
| | | LT-4201TM |
| | | AIO and DIO |
| Input sensor type | Pt100/Pt1000/Ni100/Ni1000 | |
| Input temperature range | Pt100/Pt1000: -200 to 600°C (-328 to 1112°F) Ni100/Ni1000: -20 to 200°C (-4 to 392°F) | |
| Measuring current | Pt100/Ni100 Pt1000/Ni1000 | 1.12 mA ± 3.5% 0.242 μA ± 3.5% |
| Input impedance | | Typically 10 MΩ |
| Sample duration time | | 10 ms+1 cycle time |
| Wiring type | | 2-wire or 3-wire connection configured by software for all inputs |
| Conversion mode | | Sigma delta type |
| Input filter | | Low pass |
| Resolution temperature value | | 0.1°C (0.18°F) |
| Detection type | Open circuit (detection on each channel) | |
| Input tolerance *1 | Maximum deviation at 25°C (77°F) without electromagnetic disturbance | ± 5°C (41°F) |
| | Maximum deviation at 25 to 50°C (77 to 122°F) | Pt type: ± 5.6°C (42.08°F) Ni type: ± 5.2°C (41.36°F) |
| Temperature drift | | 30 ppm/°C |
| Digital resolution | | 16 bits |
| Rejection in differential mode | 50/60 Hz | Typically 60 dB |
| Common mode rejection | | Typically 80 dB |
| Isolation Method | | Photocoupler Isolation |
| Permitted input signal | | ± 5 Vdc max. |
| Cable length | Pt100/Ni100 Pt1000/Ni1000 | 20Ω以下 200Ω以下 |
| Terminal blocks | | Type: 3.5 mm (0.137 in.) pitch Terminal blocks are removable |
| Noise resistance - cable | | Shielded cable is necessary |

* 1: Excluding errors caused by the wiring

Temperature Input (Thermocouple) Characteristics

| | | LT-4201TM AIO and DIO | |
|---|--|--|--|
| Input sensor type | | Thermocouple | |
| Input type range *1 | | J (-200 to 760°C) (-328 to 1400°F) K (-240 to 1370°C) (-400 to 2498°F) R (0 to 1600°C) (32 to 2912°F) B (200 to 1800°C) (392 to 3272°F) S (0°C to 1600°C) (32 to 2912°F) T (-200 to 400°C) (-328 to 752°F) E (-200 to 900°C) (-328 to 1652°F) N (-200 to 1300°C) (-328 to 2372°F) | |
| Input impedance | | Typically 10 MΩ | |
| Sample duration time | | 10 ms + 1 cycle time | |
| Conversion mode | | Sigma delta type | |
| Digital resolution | | 16 bits | |
| Input filter | | Low pass | |
| Resolution temperature value | | 0.1°C (0.18°F) (Type J) | |
| Detection type | | Open circuit (detection on each channel) | |
| Input tolerance | Maximum deviation at 25°C (77°F) without electromagnetic disturbance | 0.2 % of the full scale, plus standard point of compensation precision at +/- 6°C. | |
| | Maximum deviation | 0.28 % of full scale range | |
| Temperature drift | | 30 ppm/°C | |
| Input tolerance - terminal temperature compensation | | ± 5°C (41°F) after 10 min. | |
| Cold junction compensation in the temperature range (0 to 50°C (122°F)) | | Internal cold junction error: +/- 6°C (42.8°F) after operating 45 minutes. | |
| Rejection in differential mode | 50/60Hz | Typically 60 dB | |
| | | Typically 80 dB | |
| Isolation Method | | Photocoupler Isolation | |
| Permitted input signal | | ± 5 Vdc max. | |
| Warm up time | | 45 minutes | |
| Terminal blocks | | Type: 3.5 mm (0.137 in.) pitch Terminal blocks are removable | |
| Noise resistance - cable | | Shielded cable is necessary | |

*1: Temperature measurement on PCB at terminal block for cold junction compensation.

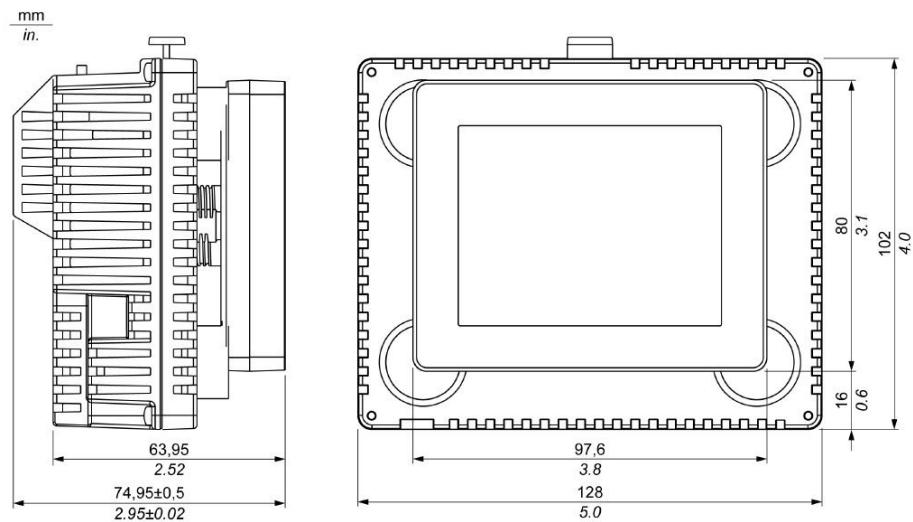
Analog Output Characteristics

| | | LT-4201TM AIO and DIO | |
|---|--|---|---------------------------|
| Characteristics | | Voltage Output | Current Output |
| Maximum number of outputs | | 2 | |
| Output range | | -10 to 10 Vdc/0 to 10 Vdc | 0 to 20 mA / 4 to 20 mA |
| Load impedance | | 2 kΩ or more | 300 Ω or more |
| Application load type | | | Resistive load |
| Setting time | | | 10 ms |
| Total output system transfer time | | | 10 ms + 1 scan time |
| Input tolerance | Maximum deviation at 25°C (77°F) without electromagnetic disturbance | | ± 1% of the full scale |
| | Maximum deviation | | ± 2.5% of the full scale |
| Digital resolution | | | 12 bits |
| Temperature drift | | | ± 0.06% of the full scale |
| Output ripple | | | ± 50mV |
| Cross talk | | | 60 db |
| Non-linearity | | | ± 0.5% of full scale |
| Output value of LSB | | 6 mV | 12 μA |
| Protection type | | Photo coupler between input and internal circuit | |
| Output protection | | Short circuit protection: Yes Open circuit protection: Yes | |
| Output behavior if input power supply is less than the power failed threshold | | Set to 0 | |
| Cable | Type | Shielded | |
| | Length | Must be less than 3 m for IEC61131-2 conformance. Maximum transmission distance is 10m. | |
| Terminal blocks | | Type: 3.5 mm (0.137 in.) pitch Terminal blocks are removable | |
| Isolation | External input | Photo-coupler isolation | |
| | Between channels | Non-isolated | |

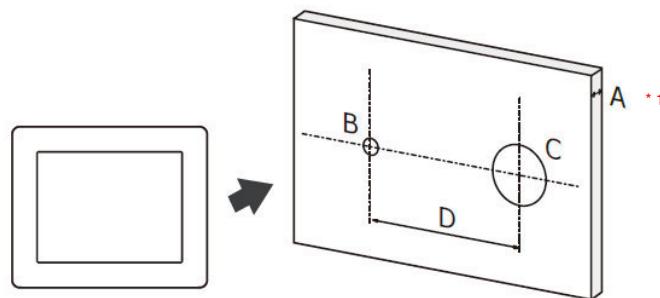
External Dimensions/ Panel Cut-out

3.5 Inches Display Module

<External Dimensions>



<Panel Cut-out>

mm
in.

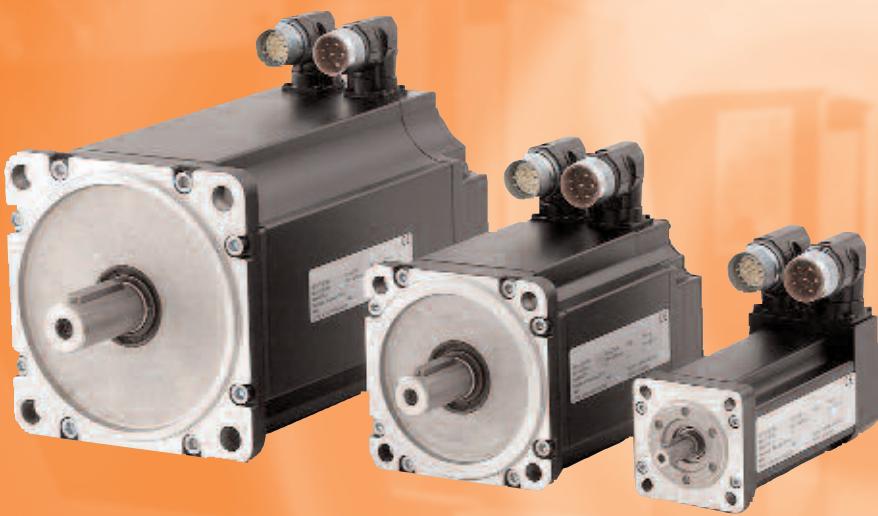
| A | B | C | D |
|----------------------------|----------------|-----------------|-----------------|
| 1.5 to 6 [0.06 to 0.23] | 4.00 [0.15] | 22.50 [0.88] | 30.00 [1.18] |

*1 If rotating torque acted on a display module is 2.5 N.m (22.12 in-lb) or more, use an anti-rotation tee which is supplied with a LT unit. The anti-rotation tee supports up to 6 N.m (53.10 in-lb).

Brushless Servo motors

BS Series

Product range



- 6 sizes available**
- From 0,2 to 54 Nm**
- From 2000 to 6000 rpm**
- Sinusoïdale Commutation**
- Standard Inertia**
- Resolver feedback**
- Integrated thermal sensor**
- Plug connectors**
- IP65 protection**

Options

- Encoder feedback**
- Parking brake**
- Reinforced inertia**
- Terminal box**



**Flange from standard DIN 42955R
Keyway from standard DIN 6885**

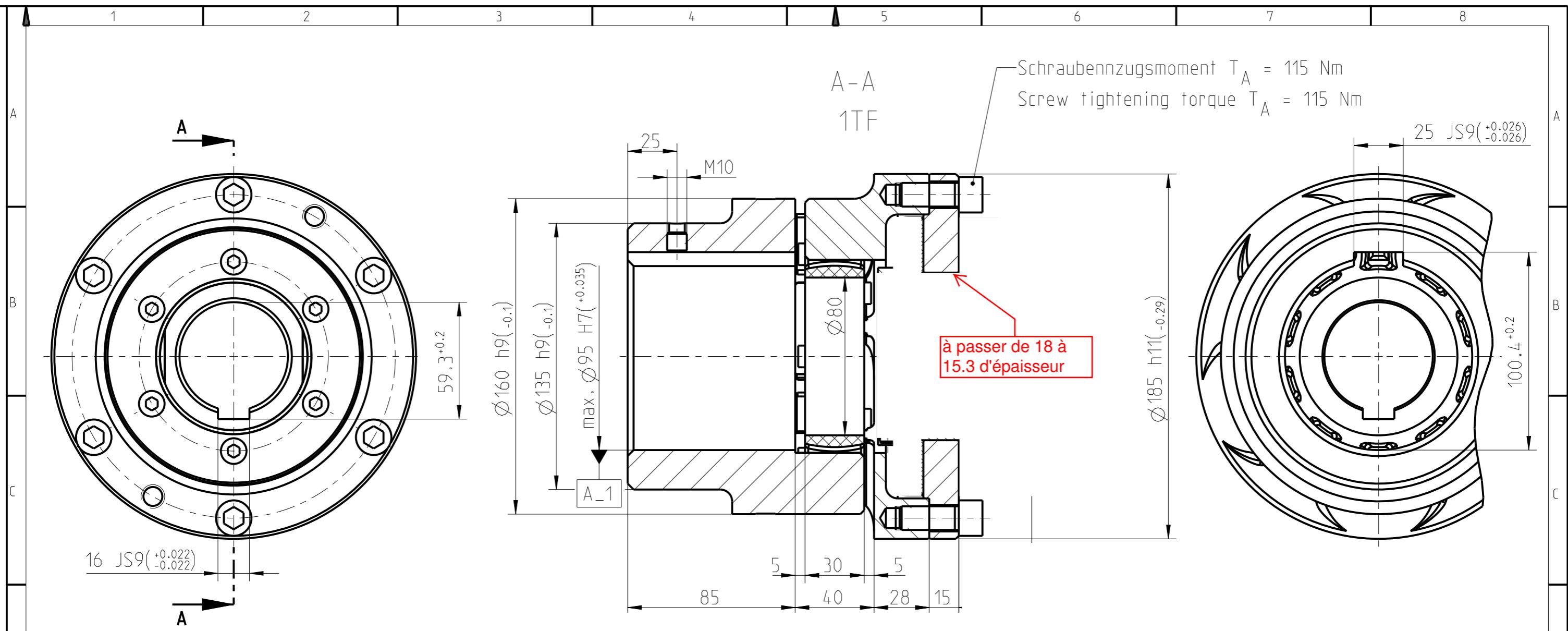
The solution for your motion control applications

Technical data

| Type | Stall torque | Rated torque | Rated power | Rated speed | Rated current | Moment of inertia | Pole number | Length* without brake | Length* with brake | Weight without brake | Weight with brake |
|----------------------|--------------|--------------|-------------|-------------|---------------|-------------------|-------------|-----------------------|--------------------|----------------------|-------------------|
| | M0 (Nm) | Mn (Nm) | Pn (Kw) | n (Rpm) | In(A) 230v | In(A) 400v | J (kg.cm²) | (mm) | (mm) | (Kg) | (Kg) |
| B28D2I3 | 0,2 | 0,19 | 0,006 | 3000 | 0,23 | 0,13 | 0,07 | 4 | 118 | 146 | 1,5 |
| B28D4I3 | 0,4 | 0,38 | 0,119 | 3000 | 0,45 | 0,26 | 0,13 | 4 | 133 | 161 | 1,7 |
| B28D6I3 | 0,6 | 0,57 | 0,179 | 3000 | 0,68 | 0,39 | 0,18 | 4 | 148 | 176 | 1,9 |
| B28D8I3 | 0,8 | 0,76 | 0,239 | 3000 | 0,91 | 0,52 | 0,23 | 4 | 163 | 191 | 2,1 |
| B2801I3 | 1,0 | 0,95 | 0,298 | 3000 | 1,13 | 0,66 | 0,28 | 4 | 178 | 206 | 2,3 |
| B36D6I3 | 0,6 | 0,55 | 0,173 | 3000 | 0,65 | 0,38 | 0,45 | 4 | 126 | 173 | 1,4 |
| B36E2I3 | 1,2 | 1,1 | 0,346 | 3000 | 1,31 | 0,76 | 0,60 | 4 | 151 | 198 | 2,2 |
| B36E8I3 | 1,8 | 1,65 | 0,518 | 3000 | 1,96 | 1,13 | 0,75 | 4 | 176 | 223 | 3,1 |
| B36F5I3 | 2,5 | 2,2 | 0,691 | 3000 | 2,62 | 1,51 | 0,90 | 4 | 201 | 248 | 4 |
| B3603I3 | 3,0 | 2,75 | 0,864 | 3000 | 3,27 | 1,89 | 1,10 | 4 | 226 | 273 | 4,9 |
| B56D6I3 | 0,6 | 0,50 | 0,16 | 3000 | 0,6 | 0,3 | 0,73 | 4 | 185 | 212,5 | 3,7 |
| B5601I3 | 1,3 | 1,0 | 0,31 | 3000 | 1,2 | 0,7 | 1,40 | 4 | 210 | 237,5 | 4,6 |
| B5602I3 | 1,9 | 1,6 | 0,5 | 3000 | 1,9 | 1,1 | 1,84 | 4 | 235 | 262,5 | 5,6 |
| B5603I3 | 2,8 | 2,2 | 0,69 | 3000 | 2,6 | 1,5 | 2,28 | 4 | 265 | 287,5 | 6,5 |
| B6304I3 | 4,0 | 3,50 | 1,1 | 3000 | 3,7 | 2,1 | 5,8 / 8,6 | 6 | 224 | 254,5 | 7,1 |
| B6306I3 | 6,0 | 5,30 | 1,67 | 3000 | 5,6 | 3,3 | 8,55 / 13,3 | 6 | 249 | 279,5 | 9 |
| B6308I3 | 8,0 | 7,10 | 2,23 | 3000 | 7,5 | 4,4 | 11,2 / 18 | 6 | 274 | 304,5 | 10,1 |
| B6310I3 | 10,0 | 8,80 | 2,76 | 3000 | 9,3 | 5,4 | 13,6 / 22,7 | 6 | 299 | 329,5 | 12 |
| B7108I3 | 7,8 | 7,0 | 2,2 | 3000 | 7,4 | 4,3 | 15,7 / 32,3 | 6 | 234 | 264 | 12 |
| B7112I3 | 11,7 | 10,5 | 3,3 | 3000 | 11,1 | 6,4 | 23,6 / 39,9 | 6 | 259 | 288 | 14,1 |
| B7116I3 | 15,6 | 14,1 | 4,4 | 3000 | 15,0 | 8,6 | 31,5 / 47,5 | 6 | 284 | 314 | 16,4 |
| B7120I3 | 19,5 | 17,6 | 5,5 | 3000 | 18,7 | 10,8 | 38,4 / 55,2 | 6 | 309 | 339 | 18,6 |
| B7124I3 | 23,4 | 21,1 | 6,6 | 3000 | 22,4 | 12,9 | 45,3 / 62,8 | 6 | 334 | 364 | 20,8 |
| B7128I3 | 27,3 | 23,5 | 7,7 | 3000 | 26,1 | 15,1 | 52,3 / 70,5 | 6 | 369 | 389 | 23 |
| B1024I3 | 24 | 20,9 | 6,6 | 3000 | 22,2 | 12,8 | 136 | 6 | 301 | 365 | 26 |
| B1030I3 | 30 | 26,2 | 8,2 | 3000 | 27,9 | 16,0 | 170 | 6 | 326 | 390 | 30 |
| B1043I3 | 43 | 37,0 | 11,6 | 3000 | 39,4 | 22,7 | 238 | 6 | 376 | 440 | 38 |
| B1054I3 | 54 | 47,0 | 14,8 | 3000 | 49,9 | 28,8 | 300 | 6 | 426 | 490 | 46 |
| * Type with resolver | | | | | | | | | | | |

Flange

| Type | Square flange (mm) | Bolt circle Ø / 4 holes Ø (mm) | Centering Ø (mm) | Shaft Ø x L (mm) |
|-------------|-----------------------|-----------------------------------|---------------------|---------------------|
| B28I | 58 | 63 / 5,5 | 40 | 9 x 20 |
| B36I | 70 | 75 / 5,8 | 60 | 11 x 23 |
| B56I | 91,5 | 100 / 6,5 | 80 | 14 x 30 |
| B63I | 115 | 115 / 9 | 95 | 19 x 40 |
| B71I | 142 | 165 / 12,5 | 130 | 24 x 50 |
| B10I | 190 | 215 / 13 | 180 | 35 x 58 |



ROTEX 75

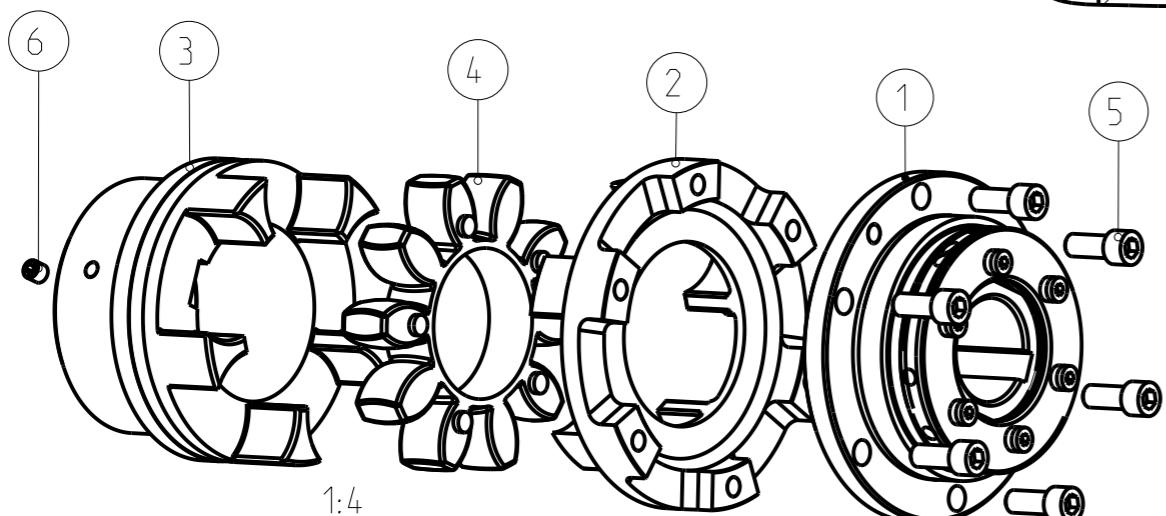
Drehmoment / Torque
Zahnkranz / spider 98 Sh-A T-PUR

$T_{KN} = 1920 \text{ Nm}$

$T_{Kmax} = 3840 \text{ Nm}$

2TF

3TF



1:4

| Drehmomente / Torques (Nm) | | |
|----------------------------|------------|-------------|
| 1TF | 2TF | 3TF |
| 90 - 600 | 180 - 1200 | 1100 - 1600 |

Oberflächenqualität nach DIN EN ISO 1302 Reihe 2
Surface quality acc. to DIN EN ISO 1302 Line 2

Allgemeintoleranzen nach
General tolerances acc. to
DIN ISO 2768 - mH

Schutzvermerk ISO 16016 beachten
Note protection mark acc. to ISO 16016

Massstab
Scale 1:2 Format
Size A3

RUFLEX 4- XTF-55-95 (max.)
with ROTEX

RUFLEX 4- XTF-55-95 (max.)
mit ROTEX

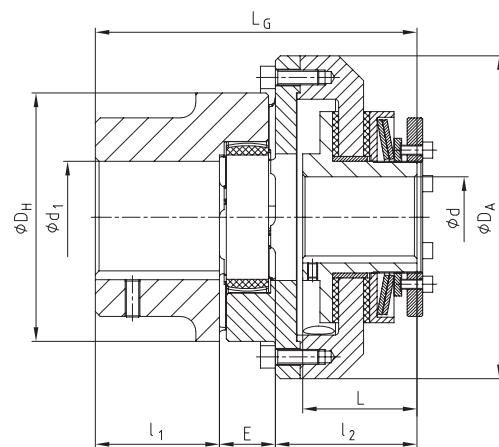
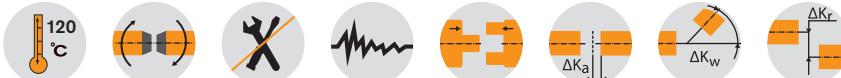
| | gezeichnet drawn | Werkstoff Material | Kz | Lfd.-Nr. Current number | Index Rev. |
|---------------|---------------------|-----------------------|-----------|----------------------------|---------------|
| Datum Date | 16.03.16 | Norm Standard | M | 660107 | 0 |
| Name | FE | Gewicht Weight | 20.127 kg | | |

KTR

RUFLEX®

Torque limiters

With torsionally flexible ROTEX®



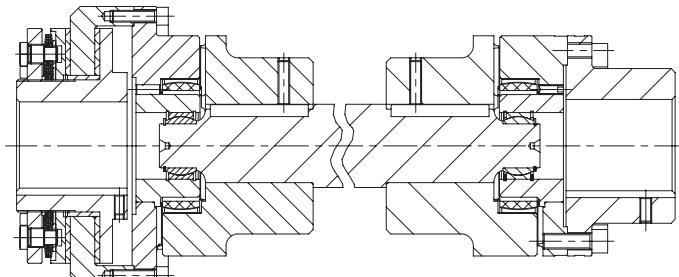
Technical data – Dimensions

| RUFLEX® size | ROTEX® size | RUFLEX® torques [Nm] | | | ROTEX® torques [Nm] ³⁾ | | | Dimensions [mm] | | | | | | | | | |
|--------------|-------------|----------------------|-----------|-------------------|-----------------------------------|-------------------|----------|------------------|----------------|----------------|----------------|----------------|----------------|----------------|-----|----------------|----------------|
| | | | | | 98 Shore-A | | Bore d | | Max. bore | | D _H | D _A | I ₁ | I ₂ | E | L | L _G |
| | | 1TF | 2TF | 3TF ²⁾ | T _{KN} | T _{Kmax} | pilot b. | max. | d ₁ | D _H | D _A | I ₁ | I ₂ | E | L | L _G | |
| 00 | 14 | 0,5-3 | 1-5 | – | 12,5 | 25 | – | 10 | 16 | 30 | 44 | 11 | 35 | 13 | 31 | 59 | |
| 0 | 19 | 2-10 | 4-20 | – | 17 | 34 | – | 20 ¹⁾ | 25 | 40 | 63 | 25 | 37 | 16 | 33 | 78 | |
| 01 | 24 | 5-35 | 10-70 | – | 60 | 120 | – | 22 | 35 | 55 | 80 | 30 | 50 | 18 | 45 | 98 | |
| 1 | 28 | 20-75 | 40-150 | 130-200 | 160 | 320 | – | 25 | 40 | 65 | 98 | 35 | 58 | 20 | 52 | 113 | |
| 2 | 38 | 25-140 | 50-280 | 250-400 | 325 | 650 | – | 35 | 48 | 80 | 120 | 45 | 64 | 24 | 57 | 133 | |
| 3 | 48 | 50-300 | 100-600 | 550-800 | 525 | 1050 | – | 45 | 62 | 105 | 162 | 56 | 82 | 28 | 68 | 166 | |
| 4 | 75 | 90-600 | 180-1200 | 1100-1600 | 1920 | 3840 | – | 55 | 95 | 160 | 185 | 85 | 80 | 40 | 78 | 205 | |
| 5 | 90 | 400-800 | 800-1600 | 1400-2100 | 3600 | 7200 | – | 65 | 110 | 200 | 260 | 100 | 114 | 45 | 92 | 259 | |
| 6 | 100 | 300-1200 | 600-2400 | – | 4950 | 9900 | 38 | 80 | 115 | 225 | 285 | 110 | 130 | 50 | 102 | 290 | |
| 7 | 110 | 600-2200 | 1200-4400 | – | 7200 | 14400 | 45 | 100 | 125 | 255 | 330 | 120 | 142 | 55 | 113 | 317 | |
| 8 | 140 | 900-3400 | 1800-6800 | – | 12800 | 25600 | 58 | 120 | 160 | 372 | 410 | 115 | 65 | 155 | 152 | 372 | |

¹⁾ Finish bore exceeding Ø19, feather keyway acc. to DIN 6885 sheet 3

²⁾ With clamping setting nut, to use only for designs with limited dimensions

³⁾ See selection of ROTEX couplings on page 10 et seqq.



Special type:

- RUFLEX® as intermediate shaft coupling
- For large shaft distance dimensions
- Available in combination with ROTEX® or RADEX®-N steel lamina coupling

Ordering example:

| RUFLEX® 1 | 2TF | d Ø20 | ROTEX® 28 | 98 Sh-A | d ₁ Ø25 | 100 Nm |
|-------------|-------------------|---------------|-------------|---------|--------------------|------------|
| Type / size | Disk spring layer | ROUFLEX® bore | Type / size | Spider | ROTEX® bore | Torque set |
| | | | | | | |

RUFLEX®

Torque limiters

Structure and operation

- Overload protection up to 12000 Nm (standard)
- Available with integrated sprocket
- Asbestos-free and rust-proof friction lining for dry running (ATEX available on request 
- High wear capacity, long service life
- High-quality slide bush with dry-film lubricant
- Torque setting while in place



- Securing of the nut by locking in 12 different positions
- Easy assembly and torque setting
- Coupling components made of steel, high safety reserves
- Corrosion protection by zinc-coated and passivated surfaces
- Rust-proof and acid-proof type on request
- High power density due to high-quality disk springs and frictions linings

The RUFLEX® modular system provides solutions for your drive, too.

The combination with the approved KTR couplings and the integration of customer-specific drive components (e. g. sprockets) allows for an overload protection optimally adapted to every application.

Various layers of disk springs and high-quality friction linings ensure a high power density even with only few mounting space.

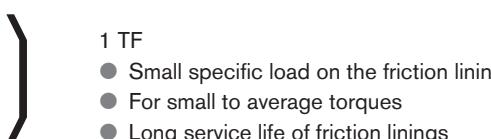
RUFLEX® consists of the following components:



List of components:

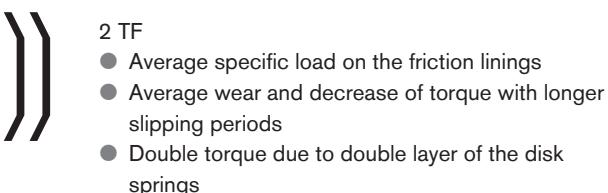
- | | | | |
|---|-----------------------|----|---------------------------------|
| 1 | Hub | 6 | Friction lining |
| 2 | Thrust washer | 7 | Slide bush |
| 3 | Setting nut | 8 | Setscrew |
| 4 | Torque setting screws | 9 | Locking washer |
| 5 | Disk spring | 10 | Drive component (e.g. sprocket) |

Layers of disk springs:



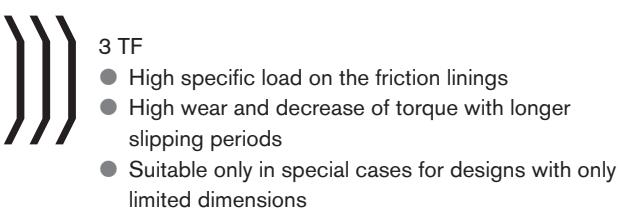
1 TFD

- Small specific load on the friction linings
- Torques like with type 1 TF
- Only small decrease of the torque even with longer period of friction
- Precision torque adjustment due to a double spring excursion



2 TFD

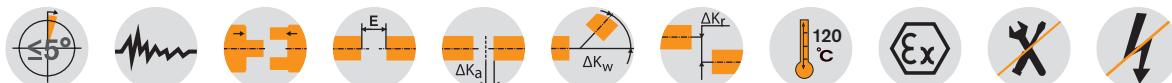
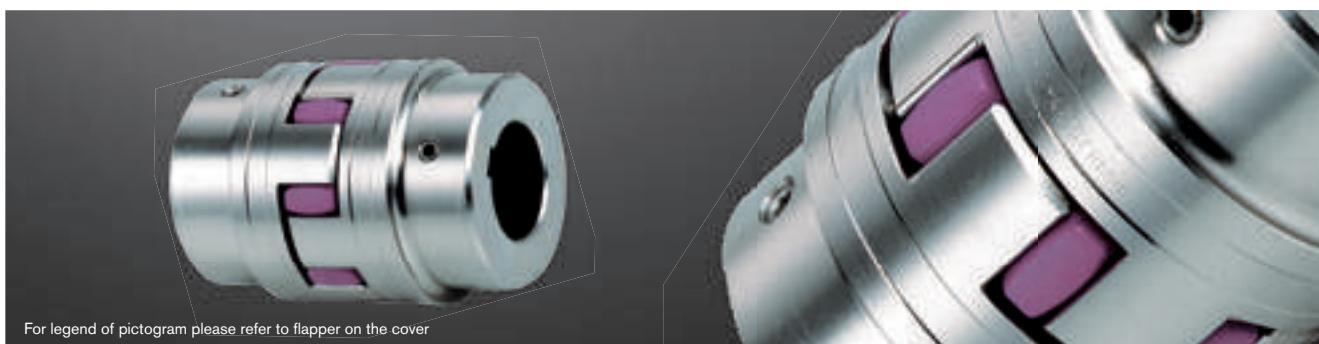
- Average specific load on the friction linings
- Torques like with type 2 TF
- Only small decrease of the torque even with longer period of friction
- Precision torque adjustment due to a double spring excursion



ROTEX® Standard

Flexible jaw couplings

Material steel



| ROTEX® Steel (St) | | | | | | | | | | | | | | | | | |
|-------------------|-----------|--------------------------------------|---------|---------|-----------------|---------------------------------|------|----|----|----------------|----------------|---------------------|-----|-----|-----|---------------------|-----|
| Size | Component | Spider (part 2) rated torque [Nm] | | | Dimensions [mm] | | | | | | | | | | | | |
| | | Finish bore d (min-max) | | General | | | | | | | | Thread for setscrew | | | | | |
| | | 92 Sh-A | 98 Sh-A | 64 Sh-D | L | I ₁ ; I ₂ | E | b | s | D _H | d _H | D | N | G | t | T _A [Nm] | |
| 14 | 1a | 7,5 | 12,5 | 16 | 0-16 | 35 | 11 | 13 | 10 | 1,5 | 30 | 10 | 30 | — | M4 | 5 | 1,5 |
| | 1b | | | | | 50 | 18,5 | | | | | | | | | | |
| 19 | 1a | 10 | 17 | 21 | 0-25 | 66 | 25 | 16 | 12 | 2 | 40 | 18 | 40 | — | M5 | 10 | 2 |
| | 1b | | | | | 90 | 37 | | | | | | | | | | |
| 24 | 1a | 35 | 60 | 75 | 0-35 | 78 | 30 | 18 | 14 | 2 | 55 | 27 | 55 | — | M5 | 10 | 2 |
| | 1b | | | | | 118 | 50 | | | | | | | | | | |
| 28 | 1a | 95 | 160 | 200 | 0-40 | 90 | 35 | 20 | 15 | 2,5 | 65 | 30 | 65 | — | M8 | 15 | 10 |
| | 1b | | | | | 140 | 60 | | | | | | | | | | |
| 38 | 1 | 190 | 325 | 405 | 0-48 | 114 | 45 | 24 | 18 | 3 | 80 | 38 | 70 | 27 | M8 | 15 | 10 |
| | 1b | | | | | 164 | 70 | | | | | | 80 | — | | | |
| 42 | 1 | 265 | 450 | 560 | 0-55 | 126 | 50 | 26 | 20 | 3 | 95 | 46 | 85 | 28 | M8 | 20 | 10 |
| | 1b | | | | | 176 | 75 | | | | | | 95 | — | | | |
| 48 | 1 | 310 | 525 | 655 | 0-62 | 140 | 56 | 28 | 21 | 3,5 | 105 | 51 | 95 | 32 | M8 | 20 | 10 |
| | 1b | | | | | 188 | 80 | | | | | | 105 | — | | | |
| 55 | 1 | 410 | 685 | 825 | 0-74 | 160 | 65 | 30 | 22 | 4 | 120 | 60 | 110 | 37 | M10 | 20 | 17 |
| | 1b | | | | | 210 | 90 | | | | | | 120 | — | | | |
| 65 | 1 | 625 | 940 | 1175 | 0-80 | 185 | 75 | 35 | 26 | 4,5 | 135 | 68 | 115 | 47 | M10 | 20 | 17 |
| | 1b | | | | | 235 | 100 | | | | | | 135 | — | | | |
| 75 | 1 | 1280 | 1920 | 2400 | 0-95 | 210 | 85 | 40 | 30 | 5 | 160 | 80 | 135 | 53 | M10 | 25 | 17 |
| | 1b | | | | | 260 | 110 | | | | | | 160 | — | | | |
| 90 | 1 | 2400 | 3600 | 4500 | 0-110 | 245 | 100 | 45 | 34 | 5,5 | 200 | 100 | 160 | 62 | M12 | 30 | 40 |
| | 1b | | | | | 295 | 125 | | | | | | 200 | — | | | |
| 100 | 1 | 3300 | 4950 | 6185 | 0-115 | 270 | 110 | 50 | 38 | 6 | 225 | 113 | 180 | 89 | M12 | 30 | 40 |
| 110 | 1 | 4800 | 7200 | 9000 | 0-125 | 295 | 120 | 55 | 42 | 6,5 | 255 | 127 | 200 | 96 | M16 | 35 | 80 |
| 125 | 1 | 6650 | 10000 | 12500 | 60-145 | 340 | 140 | 60 | 46 | 7 | 290 | 147 | 230 | 112 | M16 | 40 | 80 |
| 140 | 1 | 8550 | 12800 | 16000 | 60-160 | 375 | 155 | 65 | 50 | 7,5 | 320 | 165 | 255 | 124 | M20 | 45 | 140 |
| 160 | 1 | 12800 | 19200 | 24000 | 80-185 | 425 | 175 | 75 | 57 | 9 | 370 | 190 | 290 | 140 | M20 | 50 | 140 |
| 180 | 1 | 18650 | 28000 | 35000 | 85-200 | 475 | 195 | 85 | 64 | 10,5 | 420 | 220 | 325 | 156 | M20 | 50 | 140 |

= If no material is specified in the order, it is stipulated in the calculation/order.

¹⁾ Maximum torque of coupling T_{Kmax.} = rated torque of coupling T_K rated x 2. For selection see page 10 et seqq.



Use in fire extinguisher pumps

ROTEX® couplings comply with the specifications of NFPA 20 standard for the installation of stationary pumps for fire protection and on completion of the necessary permanent tests they also comply with the specifications of UL 448A, flexible couplings and connection shafts for stationary fire extinguisher pumps.

Sizes available:



| Size | Compo- nent | Material | Spider (part 2) Rated torque [Nm] | Dimensions [mm] | | | | |
|------|----------------|----------|--------------------------------------|-------------------------|----------------|-----|---------------------------------|-----|
| | | | | Finish bore d (min-max) | | L | I ₁ ; I ₂ | E |
| | | | 92 Sh-A | D _H | d _H | | | |
| 42 | 1 | St | 265 | 18-55 | 126 | 50 | 26 | 95 |
| 55 | 1 | St | 410 | 24-74 | 160 | 65 | 30 | 120 |
| 65 | 1 | St | 625 | 24-80 | 185 | 75 | 35 | 135 |
| 75 | 1 | St | 1280 | 24-95 | 210 | 85 | 40 | 160 |
| 90 | 1 | St | 2400 | 30-110 | 245 | 100 | 45 | 200 |

* For complete dimensions see table on page 36

| Ordering example: | ROTEX® 38 | St | 92 Sh-A | 1 - Ø 45 | | 1 - Ø 25 | |
|-------------------|---------------|----------|-----------------|-----------|-------------|-----------|-------------|
| | Coupling size | Material | Spider hardness | Component | Finish bore | Component | Finish bore |



The **RUFLEX® torque limiter** is an overload system which operates as frictionally engaged connection. It protects the following components in the drive lane against destruction.

General Hints

Please read through these mounting instructions carefully before you set the torque limiter into operation. Please pay special attention to the safety instructions!

The mounting instructions are part of your product. Please keep them carefully and close to the torque limiter.

The copyright for these mounting instructions remains with **KTR Kupplungstechnik GmbH**.

Safety and Advice Hints



DANGER !

Danger of injury to persons.



CAUTION !

Damages on the machine possible.



ATTENTION !

Pointing to important items.

General Hints to Danger



DANGER !

With assembly, operation and maintenance of the torque limiter it has to be made sure that the entire drive train is secured against unintentional engagement. You can be seriously hurt by rotating parts. Please make absolutely sure to read through and observe the following safety instructions.

- All operations on and with the torque limiter have to be performed taking into account "safety first".
- Please make sure to disengage the drive unit and the power packs in service before you perform your work.
- Secure the drive unit against unintentional engagement, e. g. by providing hints at the place of engagement or removing the fuse for current supply.
- Do not touch the operation area of the torque limiter as long as it is in operation.
- Please secure the torque limiter against unintentional touch. Please arrange for the corresponding protection devices and caps.

Proper Use

You may only assemble, operate and maintain the torque limiter if you

- carefully read through the mounting instructions and understood them
- had technical training
- are authorized to do so by your company

The torque limiter may only be used in accordance with the technical data (see **RUFLEX®**- catalogue). Unauthorized modifications on the torque limiter design are not admissible. We do not take any warranty for resulting damages. To further develop the product we reserve the right for technical modifications.

The **RUFLEX®** described in here corresponds to the technical status at the time of printing of these mounting instructions.

| | | |
|--------------------------------------|---|---|
| Schutzvermerk ISO 16016 beachten. | Gezeichnet: 24.05.11 Pz/Koh Geprüft: 24.05.11 Pz | Ersatz für: KTR-N vom 25.08.09 Ersetzt durch: |
|--------------------------------------|---|---|

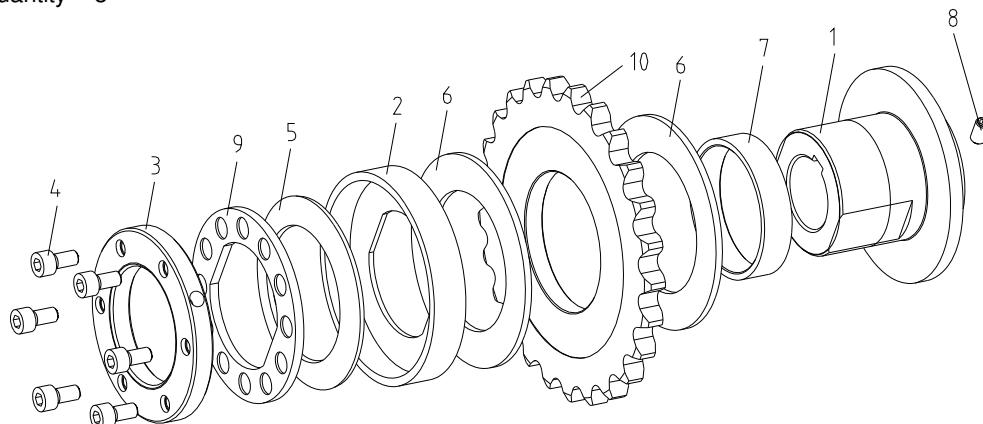


The **RUFLEX® torque limiter** is delivered in assembled condition.

Components RUFLEX® Torque Limiter Size 00 - 5

| Component | Quantity | Designation | Component | Quantity | Designation |
|-----------|-------------|-------------------------|-----------|----------|------------------------------------|
| 1 | 1 | Hub | 6 | 2 | Friction lining |
| 2 | 1 | Pressure ring | 7 | 1 | Slide bush |
| 3 | 1 | Setting nut | 8 | 1 | Set screw |
| 4 | 6* | Torque adjusting screws | 9 | 1 | Safety disk |
| 5 | see table 3 | Disk spring | 10 | 1 | Driving component (e. g. sprocket) |

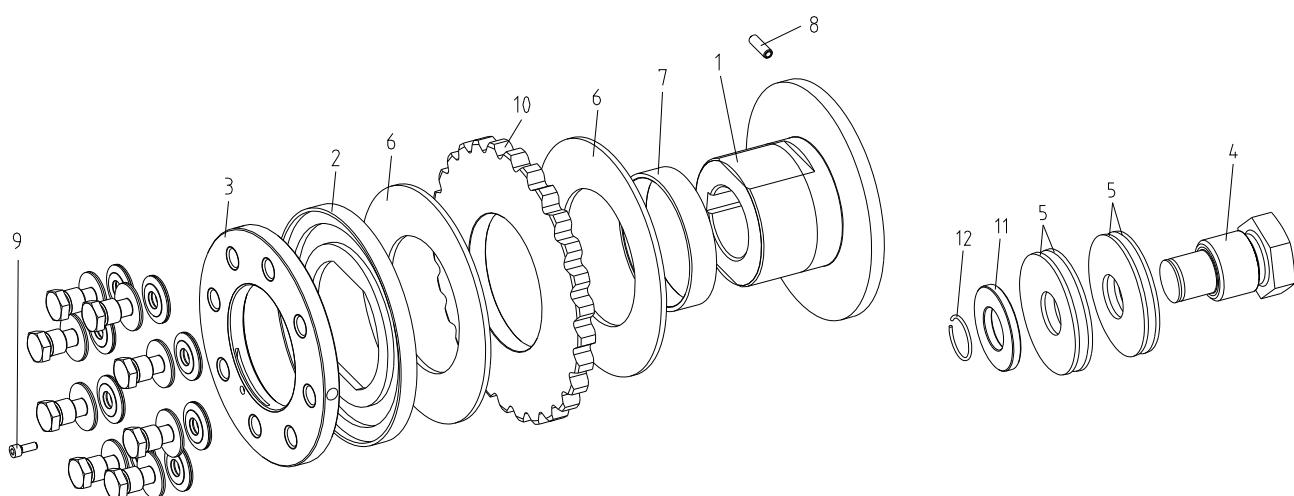
* with size 00 quantity = 3



picture 1: RUFLEX® size 00 - 5

Components RUFLEX® Torque Limiter Size 6 - 8

| Component | Quantity | Designation | Component | Quantity | Designation |
|-----------|-------------|------------------------------|-----------|-------------|------------------------------------|
| 1 | 1 | Hub | 7 | 1 | Slide bush |
| 2 | 1 | Pressure ring | 8 | 1 | Set screw |
| 3 | 1 | Setting nut | 9 | 1 | Cap screw DIN EN ISO 4762 |
| 4 | see table 1 | Disk spring adjusting screws | 10 | 1 | Driving component (e. g. sprocket) |
| 5 | see table 3 | Disk spring | 11 | see table 1 | Disk DIN 1440 |
| 6 | 2 | Friction lining | 12 | see table 1 | Spring ring DIN 7993 |



picture 2: RUFLEX® size 6 - 8

Table 1:

| RUFLEX® size | 6 | 7 | 8 |
|--|---|----|----|
| Number of disk spring adjusting screws | 8 | 12 | 16 |
| Number of disks | 8 | 12 | 16 |
| Number of spring rings | 8 | 12 | 16 |

| | | |
|--------------------------------------|--------------------------------|-----------------------------------|
| Schutzvermerk ISO 16016 beachten. | Gezeichnet: 24.05.11 Pz/Koh | Ersatz für: KTR-N vom 25.08.09 |
| | Geprüft: 24.05.11 Pz | Ersetzt durch: |



General Hints of Assembly

- Please make sure that the **RUFLEX® torque limiter** is in a technically excellent condition.
- Clean the sliding surfaces of the hub, the driving component, the pressure disk and the friction linings concerning dirt, oil and grease.
- Protect the torque limiter against any axial displacement on the shaft by a grub screw DIN EN ISO 4029 with toothed cup point or end disk.



CAUTION!

Dirty sliding surfaces affect the function of the torque limiter.

Centering Slide Bush

- Check the width of the centering slide bush.

$$\text{ZenBu} = 1,5 \times s_1 + b_1$$

Example:

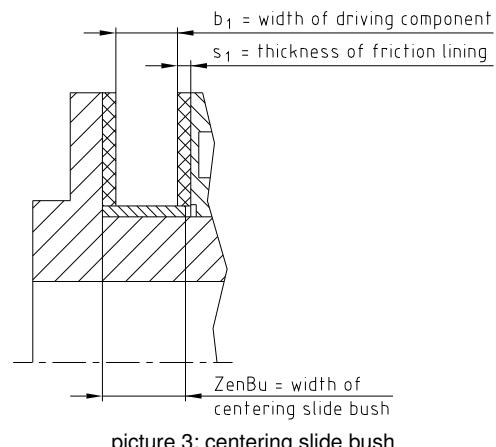
RUFLEX® torque limiter size 1

Width of driving component e. g. $b_1 = 8 \text{ mm}$

Width of friction lining $s_1 = 3 \text{ mm}$

$$1,5 \times 3 + 8 = \underline{12,5 \text{ mm}}$$

ZenBu = If you do not indicate the width of the driving component when placing your order, the centering slide bush is delivered in max. length.



CAUTION!

If you do not observe the stipulated width of the centering slide bush, the function of the torque limiter is not guaranteed.

Table 2:

| RUFLEX® size | 00 | 0 | 01 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--|-----|----|----|----|----|------|------|----|----|----|----|
| Max. width of the centering slide bush | 4,2 | 10 | 13 | 15 | 17 | 21,5 | 24,5 | 28 | 31 | 33 | 33 |

Disk Spring Layer

single layer (standard)

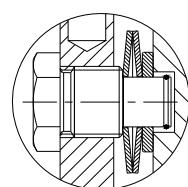
1TF
size 0 - 5



1TFD
size 00



1TFD
size 6 - 8



2TF
size 0 - 5

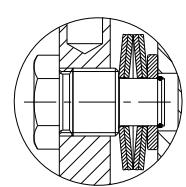


double layer

2TFD
size 00



2TFD
size 6 - 8



triple layer

3TF
size 1 - 5



picture 4: disk spring layers

| | | |
|--------------------------------------|--------------------------------|-----------------------------------|
| Schutzvermerk ISO 16016 beachten. | Gezeichnet: 24.05.11 Pz/Koh | Ersatz für: KTR-N vom 25.08.09 |
| Geprüft: 24.05.11 Pz | | Ersetzt durch: |

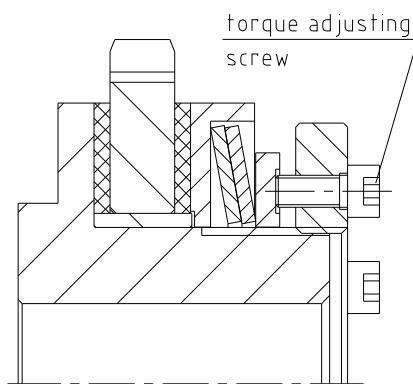


Disk Spring Layer

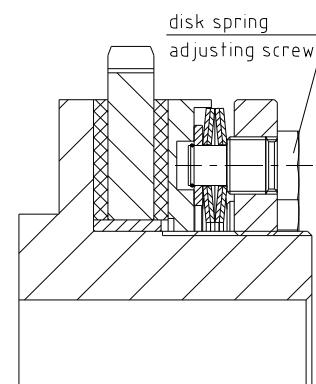
Table 3:

| RUFLEX® size | 00 | 0 | 01 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|------------------------|----|---|----|---|---|---|---|---|----|----|----|
| Number of disk springs | | | | | | | | | | | |
| 1TF | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - | - |
| 1TFD | 2 | - | - | - | - | - | - | - | 16 | 24 | 32 |
| 2TF | - | 2 | 2 | 2 | 2 | 2 | 2 | 2 | - | - | - |
| 2TFD | 4 | - | - | - | - | - | - | - | 32 | 48 | 64 |
| 3TF | - | - | - | 3 | 3 | 3 | 3 | 3 | - | - | - |

Torque Adjustment



picture 5: torque adjustment



RUFLEX® size 00 - 5

1. Turn back the adjusting screws (until the complete shaft of the screw is in the setting nut).
2. Manually tighten the setting nut until the stop.
3. Now screw in the adjusting screws completely for max. torque setting.
4. For a lower torque setting, please unscrew the setting nut before step 3 acc. to the diagrams of adjustment (see diagrams 1 to 8) by the indicated setting angle. Afterwards, screw in the adjusting screws completely (tightening torque T_A see table 4).

RUFLEX® size 6 - 8

1. Turn back the adjusting screws until the disk springs are situated at the internal side of the nut.
2. Manually tighten the setting nut until the stop.
3. Now screw in the adjusting screws completely for max. torque setting.
4. For a lower torque setting, please unscrew the setting nut before step 3 acc. to the diagrams of adjustment (see diagrams 9 - 11) by the indicated setting angle. Afterwards, screw in the adjusting screws completely (tightening torque T_A see table 4).



CAUTION!

The torque settings indicated in the diagrams refer to the drive parts of steel or cast iron!

The height of the slipping torque set depends on several factors and may vary considerably. That is why we would recommend to inspect the slipping torque of the coupling set by means of suitable devices.

During the running-in period (adaptation to the friction partner) and subject to environmental influences, operating conditions or wear, higher deviations may arise during the operation.

| | | |
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|--------------------------------------|---|---|

Diagrams of Adjustment

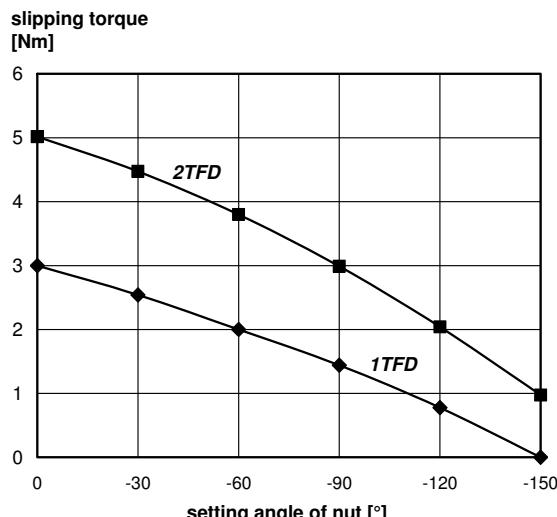


diagram 1: RUFLEX® size 00

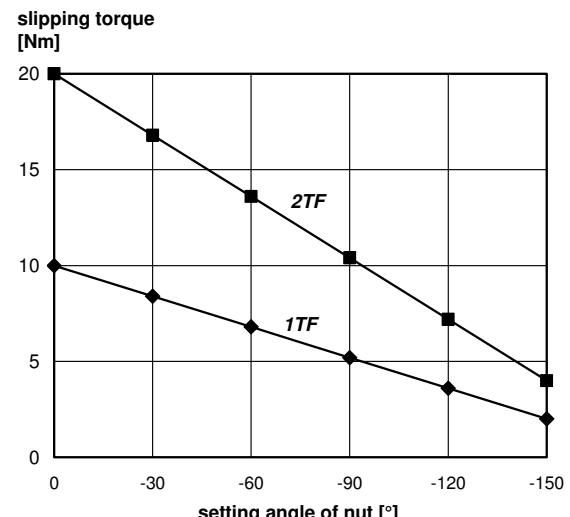


diagram 2: RUFLEX® size 0

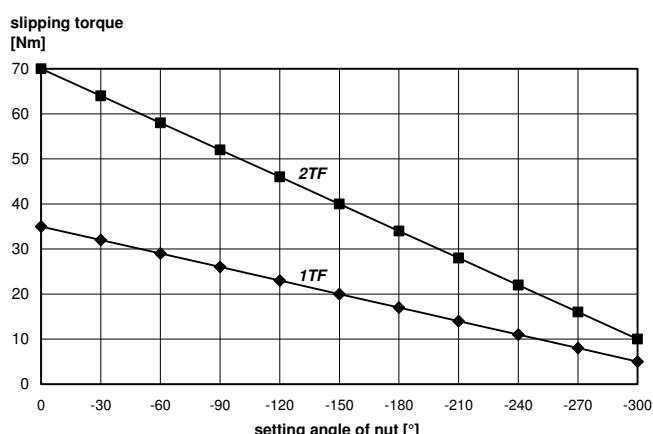


diagram 3: RUFLEX® size 01

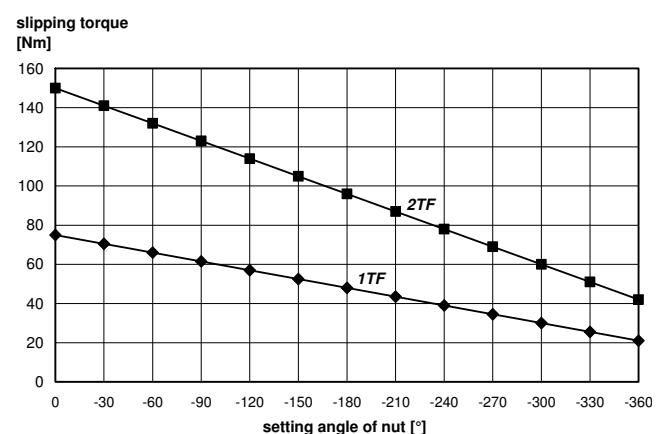


diagram 4: RUFLEX® size 1

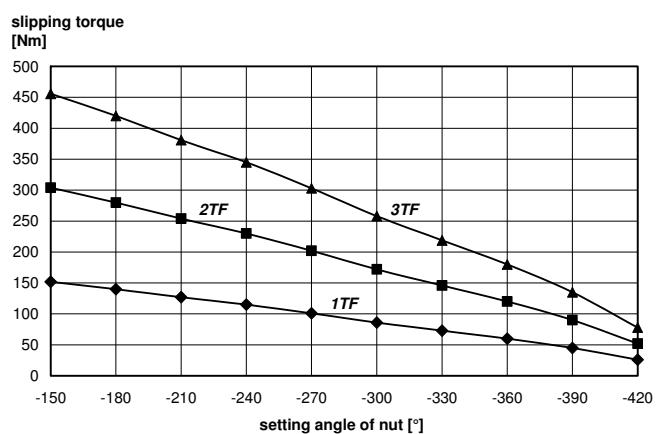


diagram 5: RUFLEX® size 2

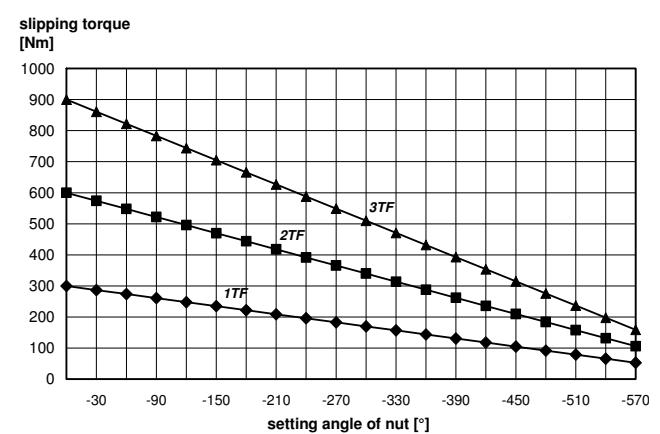


diagram 6: RUFLEX® size 3



Diagrams of Adjustment

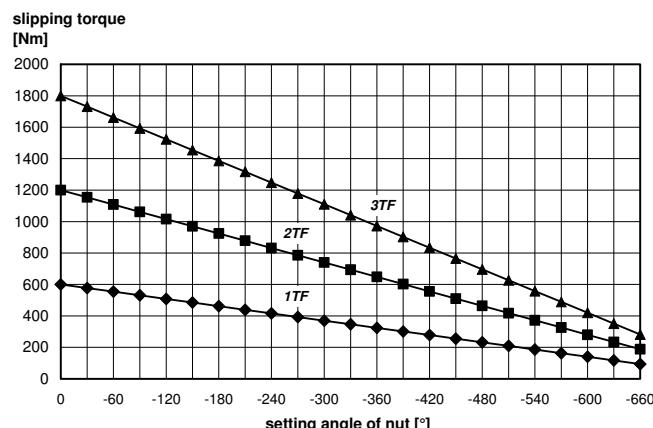


diagram 7: RUFLEX® size 4

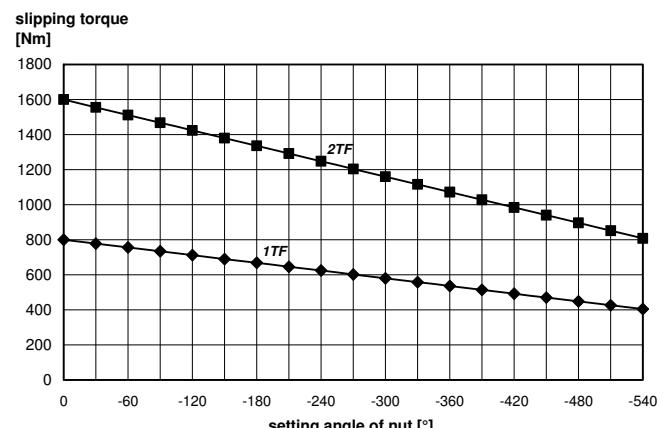


diagram 8: RUFLEX® size 5

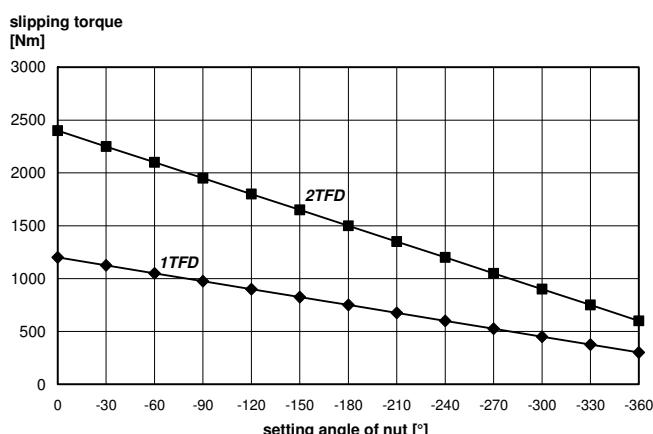


diagram 9: RUFLEX® size 6

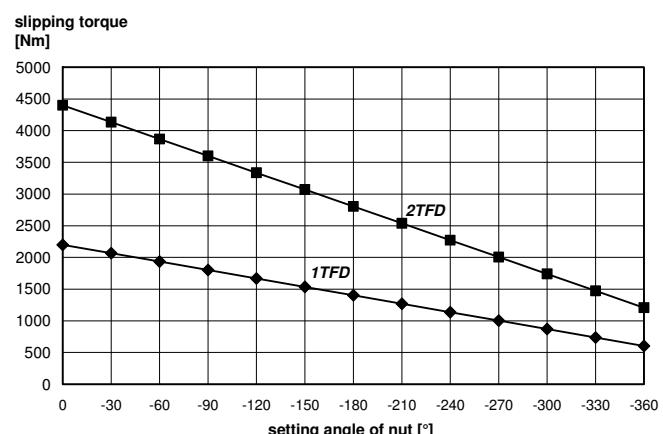


diagram 10: RUFLEX® size 7

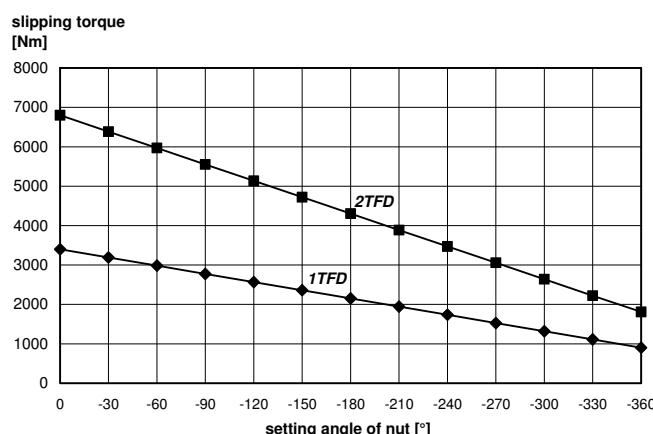
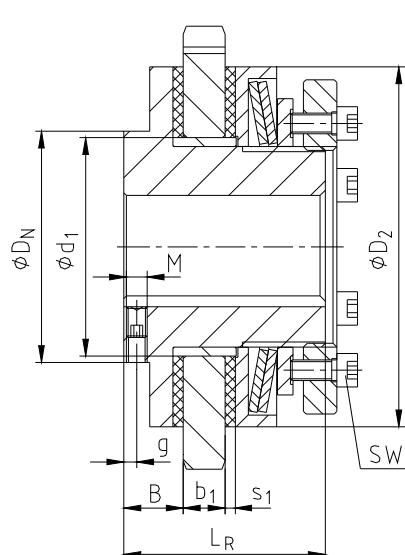


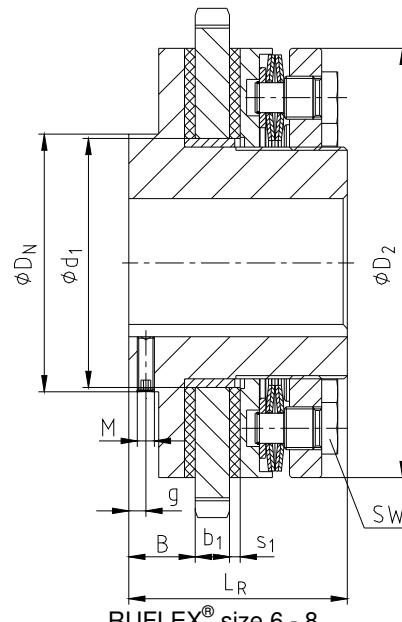
diagram 11: RUFLEX® size 8



Technical Data



RUFLEX® size 00 - 5



RUFLEX® size 6 - 8

picture 6: dimensions

Table 4:

| RUFLEX® size | 00 | 0 | 01 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| Dimensions | | | | | | | | | | | |
| Dimension b ₁ | min. | 2 | 2 | 3 | 3 | 4 | 5 | 6 | 8 | 8 | 8 |
| | max. | 6 | 6 | 8 | 10 | 12 | 15 | 18 | 20 | 23 | 25 |
| Dimension B | | 9 | 8,5 | 16 | 17 | 19 | 21 | 23 | 29 | 31 | 33 |
| Dimension d ₁ | | 21 ¹⁾ | 35 ¹⁾ | 40 ¹⁾ | 44 ¹⁾ | 58 ¹⁾ | 72 ¹⁾ | 85 ¹⁾ | 98 ²⁾ | 116 ¹⁾ | 144 ²⁾ |
| Dimension D ₂ | | 30 | 45 | 58 | 68 | 88 | 115 | 140 | 170 | 200 | 240 |
| Dimension D _N | | 30 | 45 | 40 | 45 | 58 | 75 | 90 | 102 | 120 | 150 |
| Dimension L _R | | 31 | 33 | 45 | 52 | 57 | 68 | 78 | 92 | 102 | 113 |
| Dimension s ₁ | | 2,5 | 2,5 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 5 |
| Technical data of the adjusting screws | | | | | | | | | | | |
| SW | | 3 | 3 | 3 | 4 | 5 | 6 | 6 | 6 | 24 | 24 |
| T _A [Nm] | | 2,5 | 2,5 | 2,5 | 5 | 8,5 | 21 | 21 | 21 | 200 | 200 |
| Threads for setscrews | | | | | | | | | | | |
| Dimension M | | M4 | M4 | M5 | M5 | M6 | M6 | M8 | M8 | M10 | M10 |
| Dimension g | | 3 | 3 | 4 | 6 | 6 | 6 | 8 | 8 | 8 | 8 |

1) d₁ dimensions manufactured with fit F8

2) d₁ dimensions manufactured with fit H8

| | | |
|--------------------------------------|--------------------------------|-----------------------------------|
| Schutzvermerk ISO 16016 beachten. | Gezeichnet: 24.05.11 Pz/Koh | Ersatz für: KTR-N vom 25.08.09 |
| | Geprüft: 24.05.11 Pz | Ersetzt durch: |

9 AS BUILT DRAWINGS

9.1 MS3 Drawing Register

| Drawing No. | Title | Item | Rev |
|------------------|------------------------------|------|-----|
| MSL-03-10 | General layout | - | A |
| MSL-03-10-B01-02 | Bearing Bush 150 x155 x 26,5 | 26 | A |
| MSL-03-10-B05-04 | Bearing Bush Ø40 x Ø44 x 9 | 54 | A |
| MSL-03-00-B06-04 | Bearing Bush Ø40 x Ø44 x 23 | 58 | A |
| MSL-03-10-B07-08 | Bearing Bush Ø45 x Ø50 x 12 | 86 | A |
| MSL-03-10-B07-09 | Bearing Bush Ø90 x Ø95 x 12 | 87 | A |
| MSL-03-10-A01-01 | Casing | 1 | A |
| MSL-03-10-A01-02 | Inspection Cover | 2 | A |
| MSL-03-10-A01-03 | Ms3 Worm | 3 | A |
| MSL-03-10-A01-04 | Outward Backing Plug | 4 | A |
| MSL-03-10-A01-05 | Spring washer | 5 | A |
| MSL-03-10-A01-06 | Backing Plug Spring | 6 | A |
| MSL-03-10-A01-07 | Inspection Cover Gasket | 7 | A |
| MSL-03-10-A01-08 | Inward Plug Cover | 8 | A |
| MSL-03-10-A01-09 | Piston Front Washer | 9 | A |
| MSL-03-10-A01-10 | Plunger Gate | 10 | A |
| MSL-03-10-A01-11 | Piston Seal | 11 | A |
| MSL-03-10-A01-12 | Lifting Plug | 12 | A |
| MSL-03-10-A01-13 | MS3 Worm Wheel | 13 | A |
| MSL-03-10-A01-17 | MS3 Switch Collar | 17 | A |
| MSL-03-10-A01-25 | Seal Washer | 133 | B |
| MSL-03-10-B01-01 | Wormgear plug type 1 | 25 | A |
| MSL-03-10-B02-01 | Lower MS casing Plug | 30 | B |
| MSL-03-10-B02-02 | Lock Washer | 31 | A |
| MSL-03-10-B02-03 | Plunger | 32 | A |
| MSL-03-10-B02-04 | Control Rod | 33 | A |
| MSL-03-10-B02-05 | Spring | 34 | A |
| MSL-03-10-B02-06 | Spring | 35 | A |
| MSL-03-10-B03 | Elastic Buffer | 40 | A |
| MSL-03-10-B04-01 | Lowering Piston | 43 | A |
| MSL-03-10-B04-02 | Piston Worm Spacer | 44 | A |
| MSL-03-10-B05-01 | Lifting Piston | 51 | A |

| Drawing No. | Title | Item | Rev |
|------------------|-------------------------|------|-----|
| MSL-03-10-B06-01 | MS3 Transition Casing | 55 | B |
| MSL-03-10-B06-03 | Centering Bush | 57 | A |
| MSL-03-10-B06-11 | Plain Washer | 65 | B |
| MSL-03-10-B06-12 | Parallel Key | 66 | A |
| MSL-03-10-B06-13 | Filling Collar | 67 | A |
| MSL-03-10-B07-01 | Casing Recovery Box | 79 | A |
| MSL-03-10-B07-02 | Recovery Box Main Cover | 80 | A |
| MSL-03-10-B07-03 | Recovery Box Cover 1 | 81 | B |
| MSL-03-10-B07-04 | Recovery Box Cover 2 | 82 | B |
| MSL-03-10-B07-05 | Spur Gear z14 | 83 | A |
| MSL-03-10-B07-06 | Spur Gear z17 | 84 | A |
| MSL-03-10-B07-07 | Spur Gear z36 | 85 | B |
| MSL-03-10-B07-10 | Dowel pin | 92 | A |
| MSL-03-10-B07-16 | Locking Nut | 94 | B |
| MSL-03-10-B07-18 | Plain Washer | 96 | A |
| MSL-03-10-B07-19 | Recovery Switch collar | 97 | A |
| MSL-03-10-B07-20 | Recovery spring | 98 | A |
| MSL-03-10-B08-02 | Switch Fixing Plate | 108 | A |
| MSL-03-10-B10-01 | Switch Box | 113 | A |
| MSL-03-10-B10-03 | Switch Cover | 115 | A |
| MSL-03-10-B10-07 | Switch Cover Gasket | 119 | A |
| MSL-03-10-C01-01 | MS3 Reaction Arm | 123 | B |
| MSL-03-10-C01-02 | Pin Blocking Washer | 124 | A |
| MSL-03-10-C01-03 | Spacer Reaction Arm | 125 | A |
| MSL-03-10-C01-04 | Wormgear plug type 2 | 126 | A |
| MSL-03-10-C01-05 | Dowell pin | 127 | A |
| MSL-03-10-C01-06 | Sleeve | 128 | A |
| MSL-03-10-C01-09 | Eccentric Boss | 131 | A |
| MSL-03-10-A01-25 | Seal Washer | 133 | B |

Table 9.1-1 MS3 Drawing Register

9.2 MS6 Drawing Register

| Drawing No. | Title | Item | Rev |
|------------------|-------------------------------|------|-----|
| MSL-06-10 | General layout | - | A |
| MSL-06-10-A01-01 | Casing | 1 | A |
| MSL-06-10-A01-02 | Inspection Cover | 2 | A |
| MSL-06-10-A01-03 | MS6 Worm | 3 | D |
| MSL-06-10-A01-04 | Shaft Casing Plug | 4 | A |
| MSL-06-10-A01-05 | Outward plug bush | 5 | A |
| MSL 06-10-B01-02 | Bearing Bush 250 x255 x 42 | 26 | A |
| MSL 06-10-B05-04 | Bearing Bush Ø65 x Ø70 x 17,7 | 54 | A |
| MSL 06-00-B06-04 | Bearing Bush Ø65 x Ø70 x 30 | 58 | A |
| MSL 06-10-B07-08 | Bearing Bush Ø75 x Ø80 x 20 | 86 | A |
| MSL 06-10-B07-09 | Bearing Bush Ø150 x Ø155 x 20 | 87 | A |
| MSL-06-10-A01-07 | Inspection Cover Gasket | 7 | A |
| MSL-06-10-A01-08 | Inward Plug Cover | 8 | A |
| MSL-06-10-A01-09 | Piston Front Washer | 9 | A |
| MSL-06-10-A01-10 | Plunger Gate | 10 | A |
| MSL-06-10-A01-11 | Piston Seal | 11 | A |
| MSL-06-10-A01-12 | Lifting Plug | 12 | A |
| MSL-06-10-A01-13 | MS6 Worm Wheel | 13 | C |
| MSL-06-10-A01-17 | MS6 Switch Collar | 17 | A |
| MSL-03-10-A01-25 | Seal Washer | - | B |
| MSL-06-10-B01-01 | Wormgear plug type 1 | 25 | C |
| MSL-06-10-B02-01 | Lower MS casing Plug | 30 | B |
| MSL-06-10-B02-02 | Lock Washer | 31 | A |
| MSL-06-10-B02-03 | Plunger | 32 | A |
| MSL-06-10-B02-04 | Control Rod | 33 | B |
| MSL-06-10-B03 | Elastic Buffer | | A |
| MSL-06-10-B04-01 | Lowering Piston | 43 | A |
| MSL-06-10-B04-02 | Piston Worm Spacer | 44 | A |
| MSL-06-10-B05-01 | Lifting Piston | 51 | A |
| MSL-06-00-B06-01 | MS6 Transition Casing | 55 | B |
| MSL-06-00-B06-03 | Centering Bush | 57 | A |
| MSL-06-00-B06-11 | Plain Washer | 65 | A |
| MSL-06-00-B06-12 | Parallel Pin | 66 | A |

| Drawing No. | Title | Item | Rev |
|------------------|----------------------------|------|-----|
| MSL-06-00-B06-13 | Filling Collar | 67 | A |
| MSL-06-10-B07-01 | Casing Recovery Box | 79 | B |
| MSL-06-10-B07-02 | Recovery Box Main Cover | 80 | A |
| MSL-06-10-B07-03 | Recovery Box Cover 1 | 81 | A |
| MSL-06-10-B07-04 | Recovery Box Cover 2 | 82 | A |
| MSL-06-10-B07-05 | Spur Gear z14 | 83 | A |
| MSL-06-10-B07-06 | Spur Gear z17 | 84 | A |
| MSL-06-10-B07-07 | Spur Gear z36 | 85 | A |
| MSL-06-10-B07-10 | Dowel pin | 88 | A |
| MSL-06-10-B07-16 | Locking Nut | 94 | A |
| MSL-06-10-B07-18 | Plain Washer | 96 | A |
| MSL-06-10-B07-19 | MS6 Recovery Switch collar | 97 | A |
| MSL-06-10-B07-20 | Locking Nut Spring | 98 | A |
| MSL-06-10-B08-02 | Switch Fixing Plate | 108 | A |
| MSL-06-10-B10-01 | Switch Box | 113 | A |
| MSL-06-10-B10-03 | Switch Cover | 115 | A |
| MSL-06-10-B10-07 | Switch Cover Gasket | 119 | A |
| MSL-06-10-C01-01 | MS6 Reaction Arm | 123 | B |
| MSL-06-10-C01-02 | Pin Blocking Washer | 124 | A |
| MSL-06-10-C01-03 | Spacer Reaction Arm | 125 | A |
| MSL-06-10-C01-04 | Wormgear plug type 2 | 126 | A |
| MSL-06-10-C01-05 | Dowell pin | 127 | A |
| MSL-06-10-C01-06 | Sleeve | 128 | A |

Table 9.2-1 MS6 Drawing Register