ROBOTICS

Arm - RX series 60B family

Instruction manual

D28045004E - 02/2008

STÄUBLI

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CHAPTER 1

INTRODUCTION

1.1. FOREWORD

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If any difficulties are met with during operation or servicing of the robot that are not referred to in this document, or if further information is required, please contact the **STÄUBLI** After Sales Department, "Robot Division".

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1.1.1. OBJECTIVE OF THIS MANUAL

The objective of this manual is to provide information concerning the installation, operation and maintenance of **STÄUBLI** robots. It provides help for the persons working on the equipment, for reference purposes only. Indeed, in order to understand the present document and the use of **STÄUBLI** robots, it is necessary for staff to acquire the corresponding knowledge by following a "robots" training course as provided by **STÄUBLI**.

1.1.2. SPECIAL MESSAGES CONCERNING WARNINGS, ALERTS, AND INFORMATION

In this document, there are two formats for warnings and alerts. The messages contained in the boxes inform staff of the potential risks involved in carrying out an action.

These boxes are as follows (they are shown in decreasing order of importance):

Danger message

DANGER:

Instructions drawing the reader's attention to the risks of accidents that could lead to serious bodily harm if the steps shown are not complied with. In general, this type of indication describes the potential danger, its possible effects and the steps necessary to reduce the danger. It is essential to comply with the instructions to ensure personal safety.

Warning message

CAUTION:

Instructions drawing the reader's attention to the risks of material damage if the steps shown are not complied with. It is essential to comply with these instructions to ensure equipment reliability and performance levels.

Notes
Paragraphs of the "note" type provide very important information to help the reader to understand a description or a procedure.

> **Note:**
> *Supplies further information, or underlines a point or an important procedure. This information must be memorized to make it easier to apply and ensure correct sequencing of the operations described.*

1.2. DEFINITION OF THE ELEMENTS AROUND THE ROBOT CELL

Person: general term identifying all individuals likely to come close to the **STÄUBLI** robot cell.

Staff: identifies the persons specifically employed and trained to install, operate, and service the **STÄUBLI** robot cell.

User: refers to the persons or the company responsible for operating the **STÄUBLI** robot cell.

Operator: refers to the person who starts or stops the robot, or controls its operation.

1.3. REMINDER CONCERNING THE SAFETY STANDARDS

DANGER:

The robot is a fast moving machine. These movements can be dangerous. Always comply with the safety standards recommended for robot use and inform operators about the dangers faced.

The robot is a sub-assembly designed for integration in a robot cell. It has been designed and built to enable the "robot cell" unit to comply with regulatory provisions. Compliance of the robot cell is the responsibility of the prime contractor who very frequently is the owner.

The user must make sure that the staff programming, operating, maintaining or repairing the robot or the robot cell are correctly trained and show the skills necessary to carry out these tasks in full safety.

In France, for example, posters isued by the CRAM are available to remind operators of the safety rules applicable in the vicinity of robot stations.

The electrical equipment of the robot and the robot cell must comply with standard EN 60204-1.

The characteristics of the power supply and the grounding terminals must comply with the manufacturers' specifications.

The robot and its controller are designed to meet a "Category III" safety level.

Standards applicable
Installation of the robot must be planned in accordance with the standard instructions.

• ISO 10218-1, 2006	Robots for industrial environment - Safety
• EEC 98 / 37 "Machine Safety" Directive	European Directive
• Standard EN 292	General principles
• Standard EN 294	Safety distances
• Standard EN 418	Emergency stop equipment
• Standard EN 953	Protective elements
• Standard EN 954-1	Machine safety
• Standard EN 349	Minimum clearances
• Standard EN 1050	Risk assessment
• Standard EN 1088	Locking devices
• Standard EN 60204-1	Electrical equipment on machines
• Standard EN 999	Speed on approach towards the human body
• Standard EN 61 000-6-4	Electromagnetic compatibility - Emission
• Standard EN 61 000-6-2	Electromagnetic compatibility - Immunity
• Standard CEI 34-1	Electrical rotating machines

1.4. SAFETY DIRECTIVES CONCERNING TO THE WORK ENVIRONMENT

1.4.1. ANALYSIS OF SAFETY AROUND THE ROBOT CELL

Safety must be taken into account for the robot cell from the design and development stage on.
Before planning the installation of the robot cell, it is necessary to study the following points:

- Plan the safety strategies that reduce risks to an acceptable level.
- Define the tasks required for the foreseeable applications and assess the access and/or approach requirements.
- Identify the sources of risks including the failures and the failure modes associated with each of the tasks. The risks can involve:
    - the cell itself
    - its association with other items of equipment
    - the interactions between persons and the cell.
- Assess and estimate the risks stemming from cell operation:
    - programming risks
    - operating risks
    - risks during use
    - maintenance risks for the robot cell.
- Select the protective methods:
    - use of protective devices
    - installation of signalling means
    - compliance with safe working procedures.

These points are taken from the standards applicable to robots.

Note:
This list is not exhaustive. Above all, it is necessary to comply with the standards in force in your country.

DANGER:

To ensure reliability and precision in the robot's movements, the robot cell environment must comply with the levels of disturbance set out in the safety standards.

1.4.2. RULES CONCERNING THE ROBOT'S WORK AREA

The controlled area or isolation area in which the robot moves must be determined using protective devices (protective elements).

Note:
Protective elements are devices protecting persons from a dangerous area. See the standards currently in force concerning safety for industrial handling equipment.

DANGER:

At the time of an emergency stop, the final position of the arm can never be determined precisely because of the kinetic energy involved. It is thus necessary to make sure that no persons or obstructions are present in the robot's work area when the arm is powered up.

1.5. SAFETY DIRECTIVES CONCERNING TO STAFF PROTECTION

Stäubli robots work with computer controlled mechanisms, capable of moving at high speed and exerting considerable force. Like all robots and most industrial equipment, they must be controlled with great care by the user of the robot cell. All staff using **Stäubli** robots must be familiar with the warnings and recommendations given in this manual.

1.5.1. MECHANICAL AND ELECTRICAL DANGERS.

DANGER:

Disconnect all the electrical and pneumatic power supplies before carrying out any work on the controller or the arm.

To turn of power, set the CS8C main switch to the "0" position.

To prevent inadvertent during the service operation, the main switch must be locked in 0 position using a padlock whose key is to be kept by the person carrying out the service operation. The locked status must be shown by a sign. For example, put a "Do not operate" sign in place.

Before powering up the system, make sure that all the electrical protection systems have been fitted and that there is no risk of electric shocks.

Note:
When the main switch is set to 0, voltage remains present between the input terminals (mains supply filter) and the main switch input.

DANGER:

Each time the arm is powered on, keep one hand close to the "Emergency stop" button in order to be able to press it as quickly as possible in the event of a problem.

- Do not connect or disconnect components while the unit is under power. The connection between the controller and the robot arm can only be made if the controller has been switched off.
- The arm must not be loaded during maintenance operations.
- If unusual sounds or vibrations are noted on the robot arm, especially following a shock or some other incident, it is necessary to inspect the tool and gripper fastenings carefully and make diagnoses at low speed.

Note:
If a crash of the arm occurs, all safety components involved in the safety have to be checked carefully to verify they are still operating and not damaged: hard stop devices on the arm, electrical limit switches, calibration of the robot. Don't hesitate to call Stäubli service for any doubt.
Each time a calibration, adjustment or recovery procedure is done, the calibration of the arm has to be controlled carefully to verify that the robot is able to move in its expected angular range and not more. This verification has to be done at slow speed.

DANGER:

All persons are prohibited from remaining in the isolation area in which the robot arm operates. Certain robot working modes such as the "brake release" mode can lead to unforeseeable arm movements.

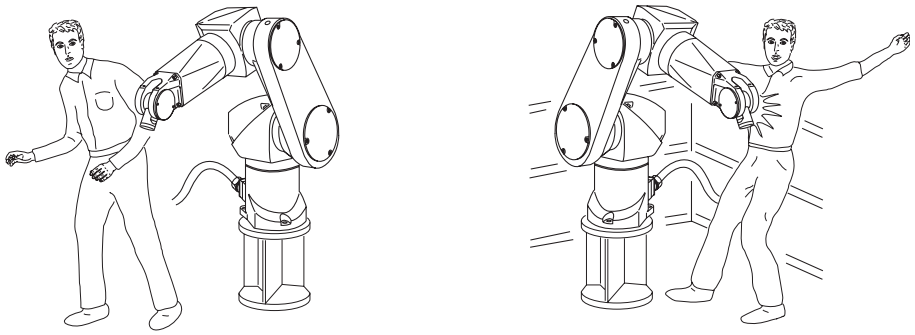


Figure 1.1

Following maintenance work, whether it involves mechanical, electrical, pneumatic or software operations, it is advisable to make sure that the robot functions correctly, first at low speed while the person stays outside the cell, and then under the normal conditions of use. In particular, make sure that all the protective and safety systems are correctly in place, and that calibration of the robot is correct.

1.5.2. ROBOT CELL SAFETY DEVICES

The safety devices must form an integral part of the design and installation of the robot cell. Operator training and compliance with the operating procedures constitute a major element in setting up the safety devices and systems.

Stäubli robots are equipped with various communication functions, helping the user to develop safety devices for the robot cell. These functions include the emergency stop circuits, the digital Input/Output lines, and the display system for error and warning messages (see the "Integration" chapter). When the system is used without the MCP, these messages/warnings can only be consulted via the application program.

1.5.3. SAFETY DIRECTIVES CONCERNING TO PROTECTION OF THE EQUIPMENT

1.5.3.1. CONNECTIONS

- Before connecting the controller to the power supply, make sure that its nominal voltage does indeed correspond to the network voltage.
- When connecting the controller, use a cable whose cross-section corresponds to the power rating shown on the manufacturer's plate.
- Before removing or inserting an electronic component, switch off arm power and then switch off controller power and comply with the procedure.
- Take care to avoid blocking the air inlets and outlets for the controller airflow path.
- Never use the emergency stop to power down the arm under normal conditions of use.

1.5.3.2. INFORMATION ON ELECTROSTATIC DISCHARGES

What is an electrostatic discharge?

Everyone has felt the effects of static electricity on their clothes or when they touch a metal object, without being aware of the damage that can be done to electronic components by static electricity.

Our desire to integrate the notions of quality and reliability in our products makes it necessary to prevent electrostatic discharges from causing damage to them. This means that all the staff and login users must be informed.

Storage of a charge
An electric charge is created simply by combining a conductor, a dielectric and the ground (lowest reference potential, usually the ground in the case of an electrostatic charge).
Example: people, printed circuits, integrated circuits, components, conducting mats when separated from the ground by a dielectric.

Electrostatic discharges or ESD
Most people have experienced ESD by receiving an electric shock when walking on a carpet and touching a doorknob or when getting out of a car.
In most case, the following is true:
- To feel an ESD, a charge of at least 3500 V is required.
- To hear one, a charge of at least 5000 V is required.
- To see a spark, a charge of at least 10 000 V is required.

This shows that it is possible to develop charges of over 10 000 V before noticing an electrostatic discharge!

Risks created by an electrostatic discharge

A high ESD voltage (several thousand volts) creates danger for electronic components. A semi-conductor must be handled carefully to prevent destruction by ESD. ESD are truly dangerous. It is estimated that they destroy only 10% of the components that they effect. The other 90% of components fall into the "deteriorated" category. A component may be damaged with simply 25% of the voltage required to destroy it.

These hidden faults can lead to problems that appear several days, weeks or even months after the incident. Components may also undergo a change in their operating characteristics. Initial tests are successfully passed but an intermittent error occurs under vibration or temperature constraints. The same components will pass the "on/off" test successfully, as carried out during repairs, but the problem will reappear again once on site.

Typical ESD voltages

SOURCE	LOW RELATIVE HUMIDITY 10 - 20%	AVERAGE RELATIVE HUMIDITY 40%	HIGH RELATIVE HUMIDITY 65 - 90%
Walking on carpet	35 kV	15 kV	1,5 kV
Walking on vinyl	12 kV	5 kV	0,3 kV
Working at the workstation	6 kV	2,5 kV	0,1 kV
Plastified instructions	7 kV	2,6 kV	0,6 kV
Polyethylene bags	20 kV	2 kV	1,2 kV
Cellular polyurethane	18 kV	11 kV	1,5 kV

CHARGE SOURCES	
Work surfaces	Packaging
Floors	Handling
Chairs	Assembly
Carriages	Cleaning
Clothes	Repairing

PARTS SENSITIVE TO STATIC CHARGES
Electronic cards Power supplies Encoders etc

1.5.3.3. PREVENTION OF DAMAGE DUE TO ELECTROSTATIC DISCHARGES

It is essential to guard against electrostatic discharges during an intervention concerning electronic components, sub-assemblies and complete systems.

Elimination of the danger due to ESD requires a combined team effort. By complying with the following instructions, you can substantially reduce the potential damage caused by ESD and ensure long-term reliability for the robot.

- Inform the staff of the risks stemming from ESD.
- Know the critical zones sensitive to ESD.
- Know the rules and procedures to deal with ESD.
- Always carry components and boards in a tray to protect them from electrostatic charges.
- Always ground yourself before working on a workstation.
- Keep non-conducting equipment (static charge generators) away from components and boards.
- Use tools providing protection from ESD.

STÄUBLI workstation
To handle electronic cards, **STÄUBLI** workstations are given a grounded coating that dissipates static electricity. An anti-static bracelet is required to handle boards or electronic components.

Work zones
Remove objects that generate static electricity charges from the work area, such as:

- plastic cups
- polystyrene
- notebooks
- plastic files and document holders.

Printed circuits, boards and electronic components must be kept in anti-static bags.

Anti-static wrist strap
Use an electrostatic wrist strap connected to the frame of the controller or to the frame of the arm and the ground during all handling of boards or components. The wrist straps are supplied as part of the standard equipment for the robot.

> **CAUTION:**
> **Use an anti-static wrist strap and an anti-static mat connected to the controller for all work involving handling of boards or components.**

CHAPTER 2

DESCRIPTION

2.1. IDENTIFICATION

Manufacturer's plate on each robot.

There is a plate riveted on the controller and arm (see figure 2.1).

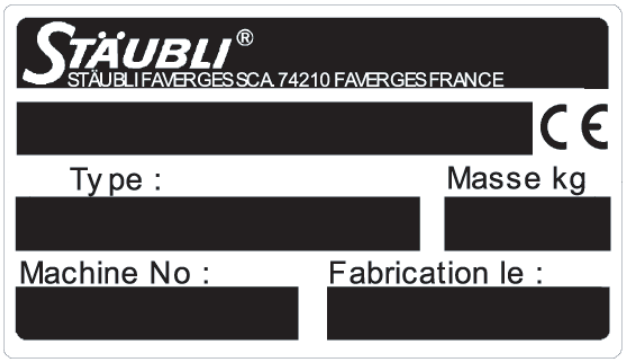


Figure 2.1

For all requests concerning information, replacement part orders, or requests for intervention, please state the type and the serial number of the machine concerned, as set out on the manufacturer's plate.

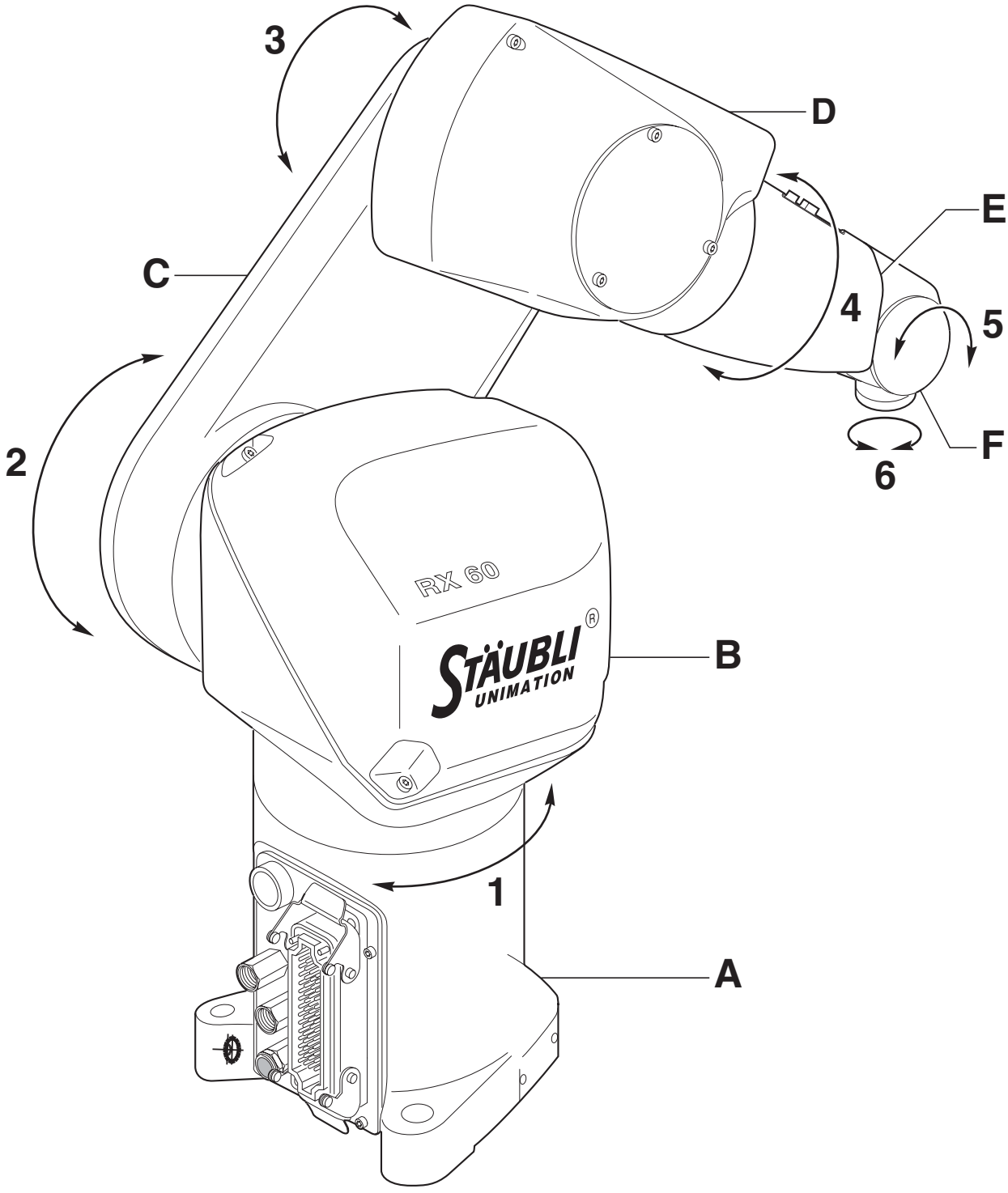


Figure 2.2

2.2. GENERAL PRESENTATION

The arm consists of segments or members interconnected by joints**.**

Each joint comprises an axis around which two members pivot.

The movements of the robot's joints are generated by brushless motors coupled to resolvers.

This reliable, robust assembly is linked to an innovative counting system that provides data concerning the absolute position of the robot at all times.

The arm assembly is flexible and is able to perform a great variety of applications.

Example: Handling of loads, assembly, process, application of adhesive beads, control/check and clean room applications. This list is not exhaustive: for further information, please consult us.

The various elements of the robot's arm are: the base **(A)**, the shoulder **(B)**, the arm **(C)**, the elbow **(D)**, the forearm **(E)** and the wrist **(F) (figure 2.2)**.

The arm assembly thus contains the drive, the brakes, the movement transmission mechanisms, the cable harness, the pneumatic and electrical circuits for the user.

Of simple construction, the RX60B arm assembly consists of a rigid and encased structure (protection IP65 to standard NF EN 60529) to protect it against external aggressions. Its concept is based on the JCS transmission modules (STÄUBLI Combined Joint) used on axes 1, 2 and 3 and on a belt, wheel and worm gear drive on axis 4 **(figure 2.2)**.

The wrist consists of axis 5 and 6 **(figure 2.2)**.

The RX60B can be mounted on the floor, a wall or the ceiling**.**

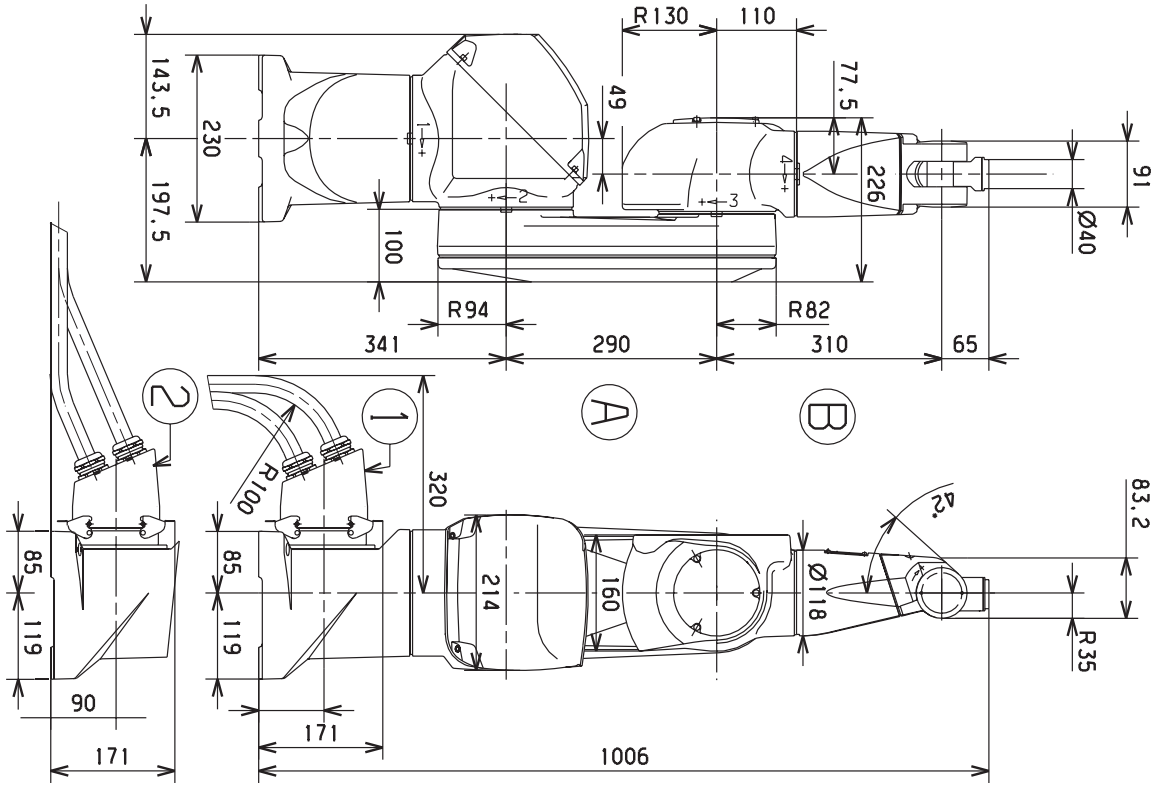


Figure 2.3

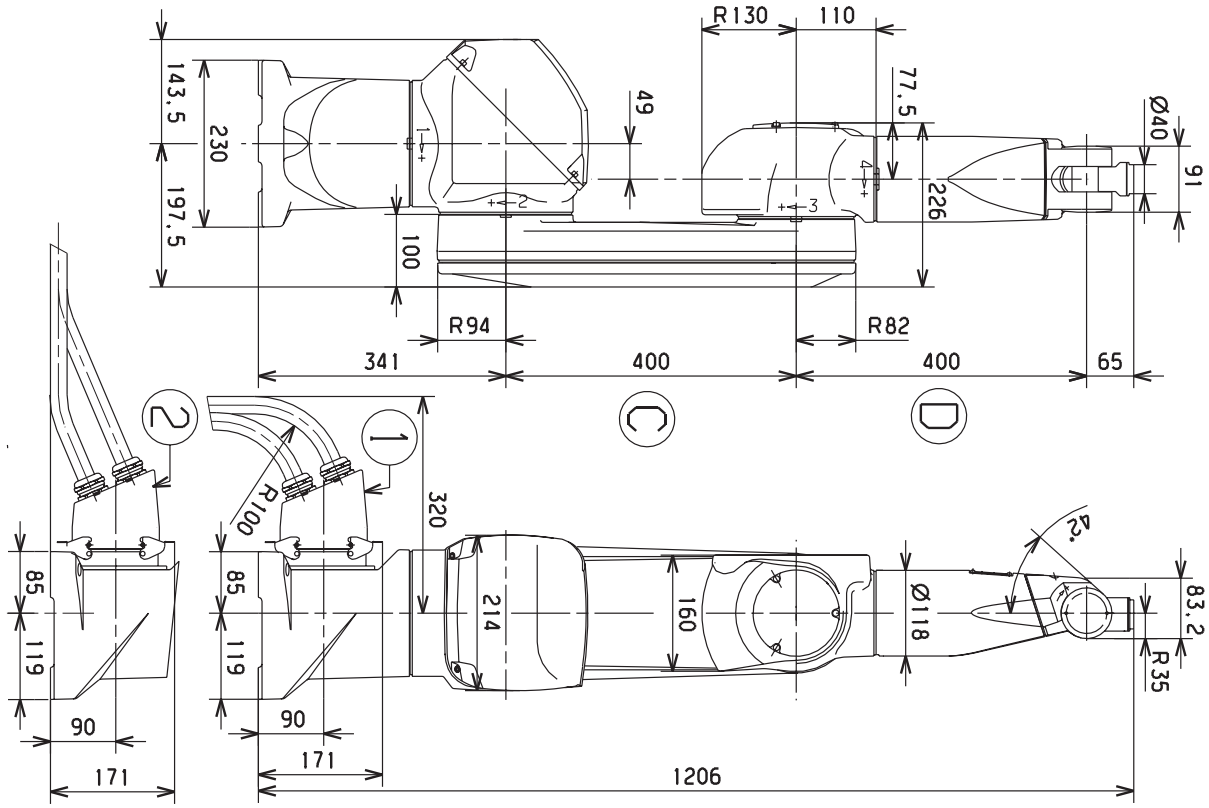


Figure 2.4

2.3. DESIGNATION OF ROBOTS OF THE RX SERIES 60 FAMILY

RX	6	0	B		CR
(1)	(2)	(3)	(4)		(5)

(1) RX family arm

(2) Maximum reach between axes 2 and 5 expressed in decimeters:
- dimension (A) + dimension (B) **(figure 2.3)**.
- dimension (C) + dimension (D) **(figure 2.4)**.

(3) Number of active axes:
- 0 = 6 active axes.
- 5 = 5 active axis, geometry being conserved.

(4) RX family changed to "B".

(5) Upper case letters to indicate an option.
Example:
- L = extended forearm: dimension (C) + dimension (D) **(figure 2.4)**.
- CR = clean room application.

These letters can be combined.
Example: LCR = extended forearm clean room application.

In the manual, the following terminology is used:

Standard arm: for arm with standard geometry **(figure 2.3)**.
Long arm: arm with a different shape where the forearm and the arm are longer **(figure 2.4)**.
5-axis arm: for arm with 5 active axis.

2.4. GENERAL CHARACTERISTICS

2.4.1. OVERALL DIMENSIONS **(figures 2.3 and 2.4)**

(1) Vertical cable outlet

(2) Horizontal cable outlet

2.4.2. WORK ENVIRONMENT

- Working temperature: + 5°C to + 40°C (according to standard(s) and/or directive(s): NF EN 60 204-1)

CAUTION:

It may be necessary to perform a warm-up cycle before nominal performances are obtained.

- Humidity: 30% to 95% max. non-condensing (according to standard(s) and/or directive(s): NF EN 60 204-1)
- Altitude: 2000 m max
- Vibrations: please consult us
- Clean room application: Cleanliness class ISO 4 according to standard ISO 14644-1

CAUTION:

If the robot is used in dusty surroundings or in the presence of spattered liquids, we strongly recommend use of the pressurization system as described in chapter 2.10, page 39.

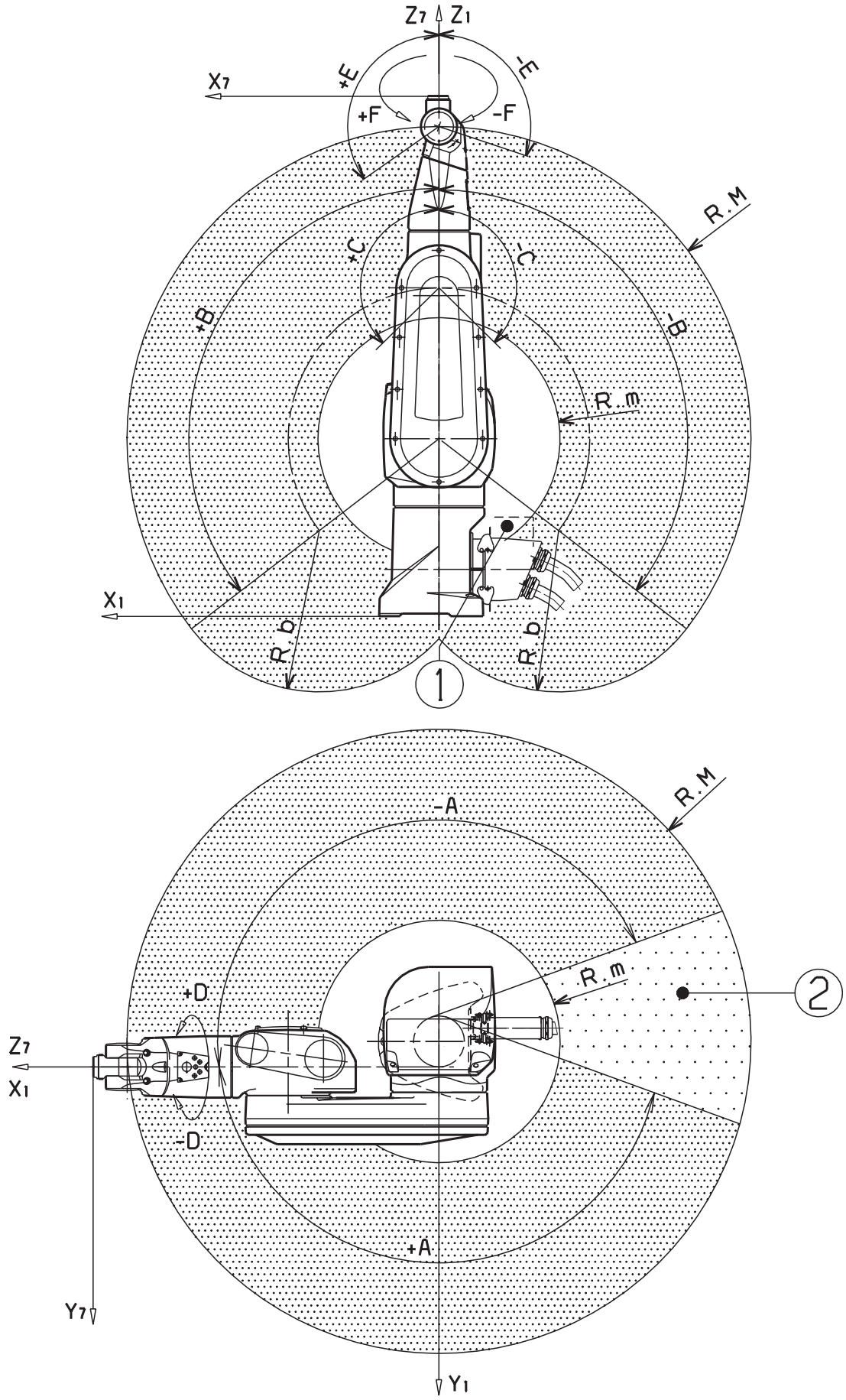


Figure 2.5

2.4.3. WEIGHT

STANDARD ARM	LONG ARM	5-AXIS ARM	LONG 5-AXIS ARM
44 kg	45 kg	42 kg	43 kg

2.5. PERFORMANCE

See **figure 2.5**

(1) Brake release access area

(2) Area accessible in righty configuration

	STANDARD ARM	LONG ARM
Work envelope		
R.M max. reach between axis 2 and 5	600 mm	800 mm
R.m min. reach between axis 2 and 5	233 mm	309 mm
R.b reach between axis 3 and 5	310 mm	400 mm
Maximum speed at load center of gravity	8 m/s	12.5 m/s
Repeatability at constant temperature	± 0.02 mm	± 0.033 mm

2.5.1. TORQUE LIMITS

	REFERENCE AXIS		
	AXIS 5 (Z_6)		AXIS 6 (Z_7)
Static torque (Nm)	7.2 (1)	3.7 (2)	3.5
Peak torque (Nm)	36 (1)	21.5 (2)	14.5

(1) If axis 6 torque = 0

(2) For maximum torque on axis 6

2.5.2. AMPLITUDE, SPEED AND RESOLUTION

Axis	1	2	3	4 (1)	5	6
Amplitude (°)	320	255	269	540	230	540 (2)
Working range distribution (°)	A ± 160	B ± 127.5	C ± 134.5	D ± 270	E +120.5 -109.5	F ± 270
Nominal speed (°/s)	287	287	319	410	320	700
Angular resolution ($°.10^{-3}$)	0.724	0.724	0.806	1.177	1.953	2.747

(1) For 5-axis arms, axis 4 is fixed. Joint 5 corresponds to joint 4 and joint 6 to joint 5 of the software.

(2) Can be configured by software up to ±18 000°. See the "Software configuration" chapter in the "Controller" documentation.

Low speed in manual mode: 250 mm/s at tool centre point and 45°/s on each axis.
Maximum Cartesian speed: 1.8 m/s

2.5.3. MODIFICATION OF AMPLITUDES

The arm is installed to obtain maximum angular amplitudes.

The amplitude of the joints can be voluntarily limited by the "software" (see chapter on programming). Furthermore, on axes 1 and 2 the position of the mechanical travel stops can be placed in several different positions (for modification, please consult STÄUBLI).

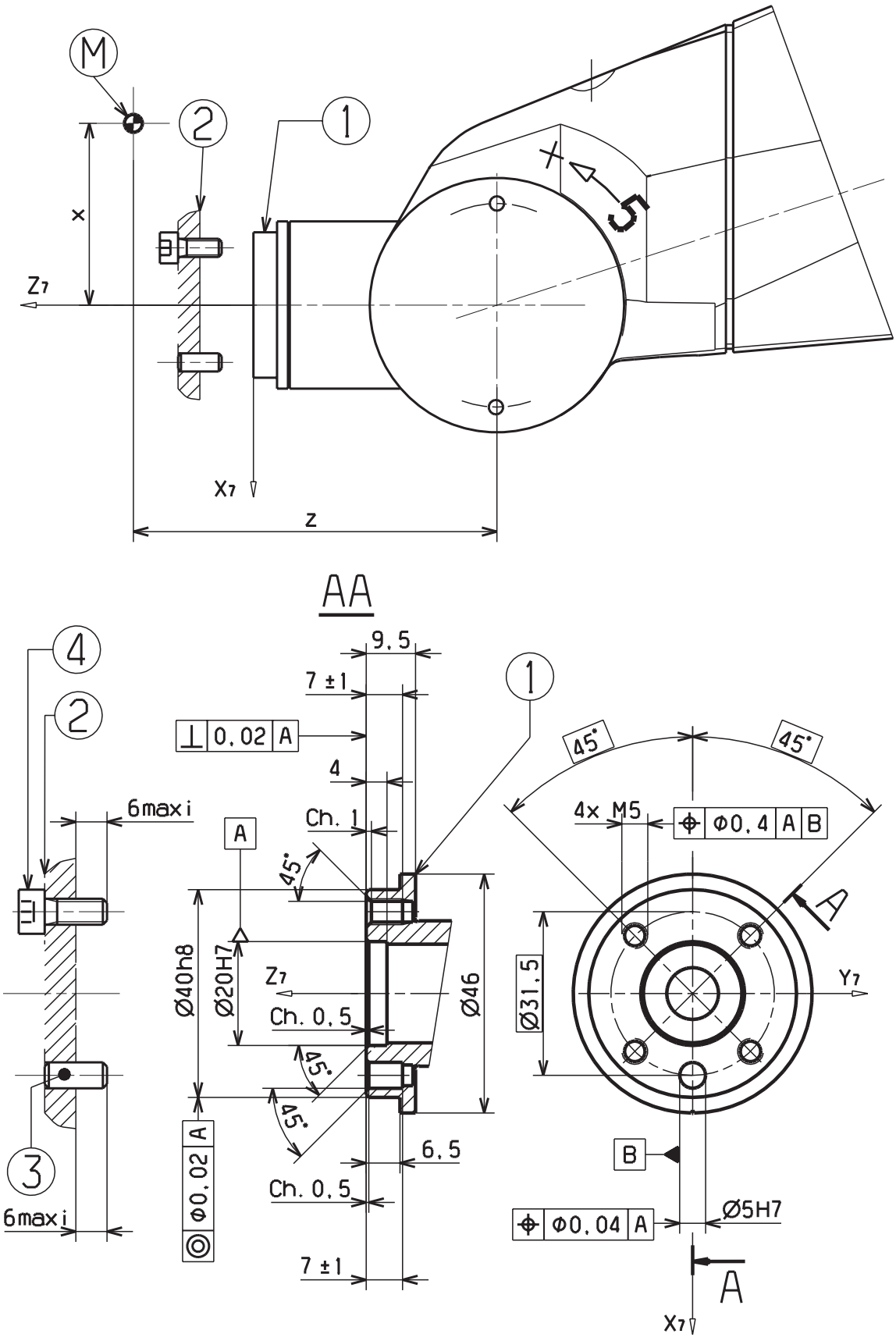


Figure 2.6

2.6. LOAD CAPACITY – MECHANICAL INTERFACE

(1) Mechanical interface

(2) End-effector

The robot hand is not supplied with the arm assembly; its design depends on the robot's specific applications. All studies can be undertaken in cooperation with STÄUBLI to obtain optimum performance without exceeding the robot arm assembly load limits.

The robot hand is mounted on the wrist's login user flange whose dimensions are given in figure **2.6**.

Attachment by 4 M5 screws frame (4), Class 12-9, torque 9.5 Nm ± 0.7 Nm.

Indexing by pin frame (3), diameter 5.

Mechanical interface designation:
ISO 9409 - 1 - A31.5 as per Standard ISO 9409 - 1 : 1996 (F)
(except the localization of the 4 M5 threaded holes)

CAUTION:
The installation length of the screws attaching the terminal is limited to 6 mm (figure 2.6).

Load capacity

Load characteristics:

Load center of gravity position (M): z = 100 mm from centerline of joint 5 and x = 50 mm from centerline of joint 6 **(figure 2.6).**

Load capacity	**Standard arm**	**Long arm**
At nominal speed (1)	2.5 kg	1.5 kg
At reduced speed (1)	4.5 kg	2.5 kg
Refer to us if:	Load > 4.5 kg	Load > 2.5 kg

(1) In all configurations.

	NOMINAL INERTIAS (kg.m²)		**MAXIMAL INERTIAS (kg.m²) (2)**	
	STANDARD ARM	**LONG ARM**	**STANDARD ARM**	**LONG ARM**
For axis 5	0.0250	0.0150	0.125	0.075
For axis 6	0.0063	0.0038	0.032	0.019

(2) Under reduced speed and acceleration conditions:
For CS7B: SP60, ACC(8) 50, 50
For CS8: VEL = 60%, ACC = 30%, DEC = 30%

CAUTION:
The nominal values can be exceeded to a certain extent but imply a limitation to the speed and the acceleration of the arm. If these limits are to be exceeded, please consult STÄUBLI.

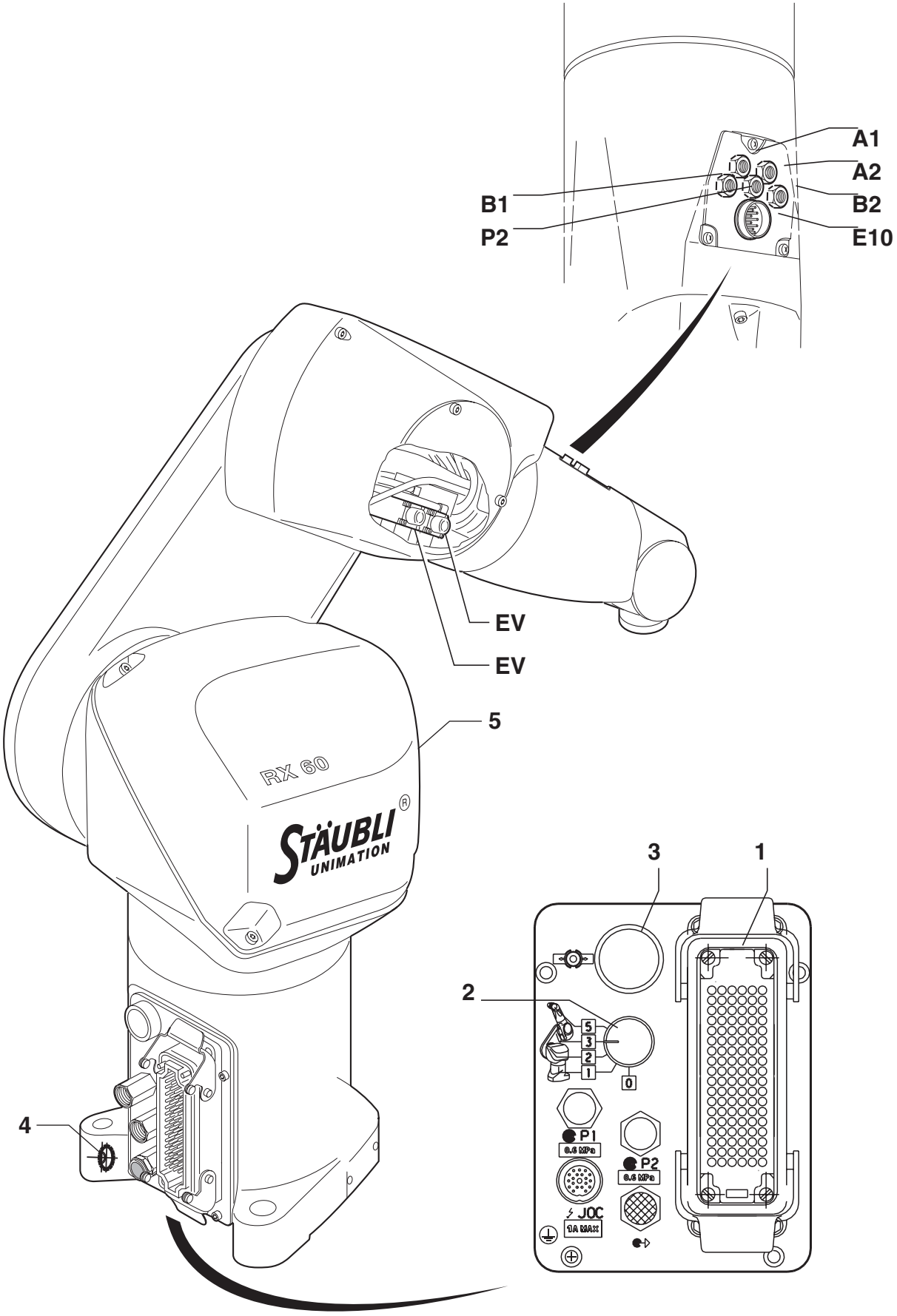


Figure 2.7

2.7. USER CIRCUIT

The arm's electrical wiring consists of a harness of several cables designed to power the servomotors (power, brakes, encoders), servovalves, login user connector. These components are connected by means of removable connectors.

The harness also includes pneumatic hoses which supply air to the solenoid valves (**EV1** and **EV2**). The arm also provides a pneumatic hose **P2** that directly links the base to the forearm **(figure 2.7)**.

The wiring is inside the structure and routed through the centre of the joints. It is connected to the arm base on a plate which includes several electrical and pneumatic components such as:

Figure 2.7:

- Arm/**(1)** controller interconnection socket.
- Binder connector intended for the user for possible electrical connection of grip (**JOC**).

> **CAUTION:**
> **When a connector is plugged to E10, there may be a risk of collision with the cover (5) in some arm configurations.**

- Arm ground connection **(4)**.
- Brake release selector **(2)**.
- Brake release pushbutton **(3)**.
- Compressed air network pneumatic (or vacuum) connections **P1** and **P2**.
- Pneumatic (or vacuum) exhaust muffler ⟶ .

> **CAUTION:**
> **Do not add wires or cables to arm wiring as this may cause premature wear of the arm electrical wiring and lead to loss of the warranty.**

2.8. RELEASING JOINT BRAKE

The controller must be connected to the power supply.

Place the brake release selector in position corresponding to the joint to be released.

> **CAUTION:**
> **Make sure that the arm and load relevant to this joint are suitably supported.**

Press the brake release pushbutton, the selected joint is totally free. When the pushbutton is released, the brakes will then be engaged and the corresponding joint locked.

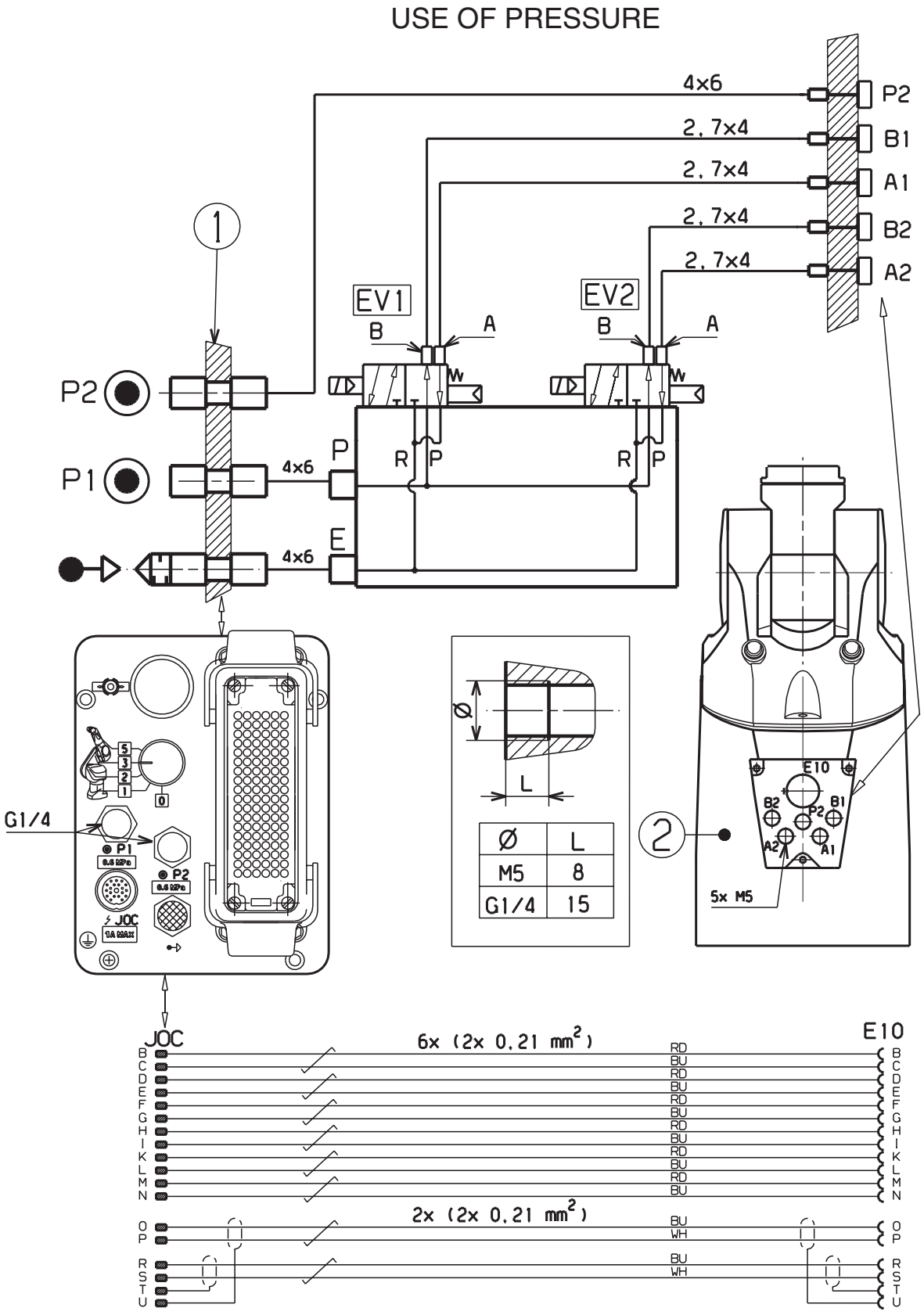


Figure 2.8

2.9. PNEUMATIC AND ELECTRIC CIRCUITS

(1) Plate attached to base

(2) Forearm

2.9.1. DESCRIPTION **(figure 2.8)**

- The arm is connected to the air system, whether lubricated or not, via the base of the arm (**P1**).
- There is a direct line between the base and the forearm (**P2**).
- The centralized solenoid valve exhaust is directed to the base and through a muffler ⟶ .
- The outlets of the solenoid valves **EV1** and **EV2** are on the forearm:
    - **A1** and **B1** for solenoid valve **EV1**.
    - **A2** and **B2** for solenoid valve **EV2**.

2.9.2. PNEUMATIC SYSTEM, STANDARD APPLICATION

Solenoid valves (EV1 and EV2):

- 5/2-way monostable.
- Electrically controlled (24 VDC).
- Max. working pressure: 1.5 to 7 bar MAX.
- Flow coefficient K_V = 2.86 S = 3.6 mm².
- Clip-on connector.
- Overvoltage protective circuit and indicator diode.

CAUTION:
The air must be filtered by a 10 µm filter.

2.9.3. PNEUMATIC SYSTEM, CLEAN ROOM APPLICATION

Solenoid valves (EV1 and EV2):

- 5/2-way monostable.
- Electrically controlled (24 VDC) by direct delivery.
- Max. working pressure: 6 bar vacuum.
- Flow coefficient K_V = 0.013 C_V = 0.18.
- Clip-on connector.

CAUTION:
The air must be filtered by a 5 µm filter.

USE OF VACUUM

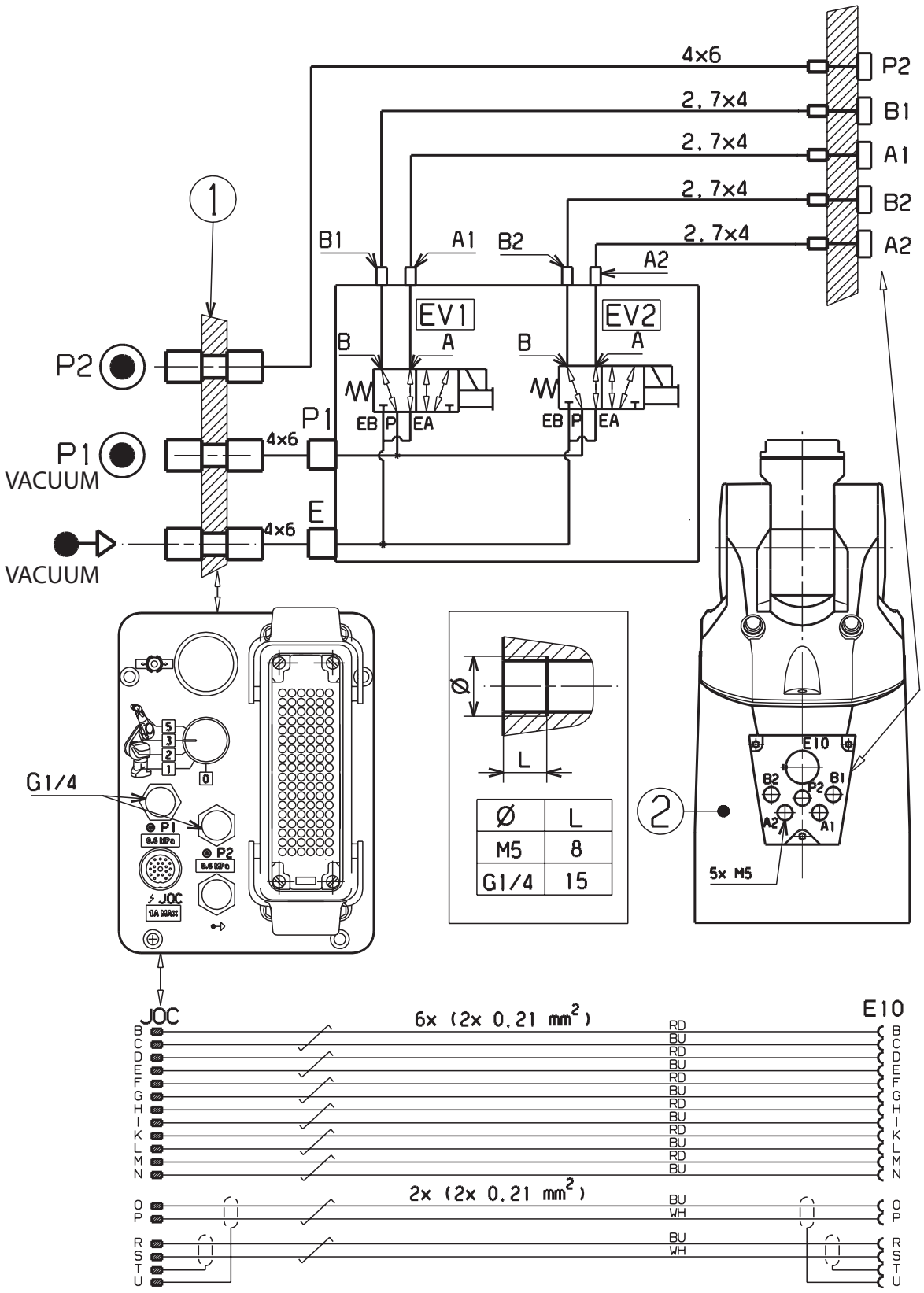


Figure 2.9

2.9.4. ELECTRIC CIRCUIT **(figures 2.8 and 2.9)**

- 13 0.21 mm^2 conductors (1 A max. and 60 VDC max. or 25 VAC) plus 2 0.21 mm^2 twisted shielded pairs (1 A max. and 60 VDC max. or 25 VAC).

> **CAUTION:**
> **Do not use the shields as a conductive cable.**

- Connection to forearm (**E10**) by Binder elbow male cylindrical connector.
- Connection to base (**JOC**) by Binder straight female cylindrical connector.

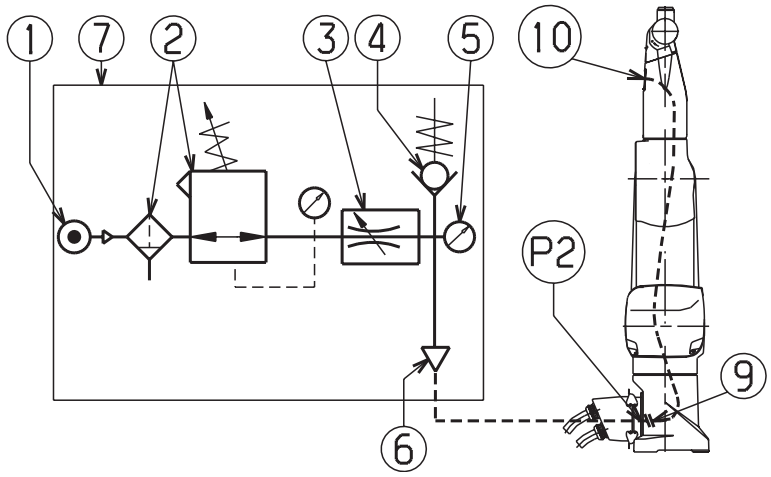


Figure 2.10

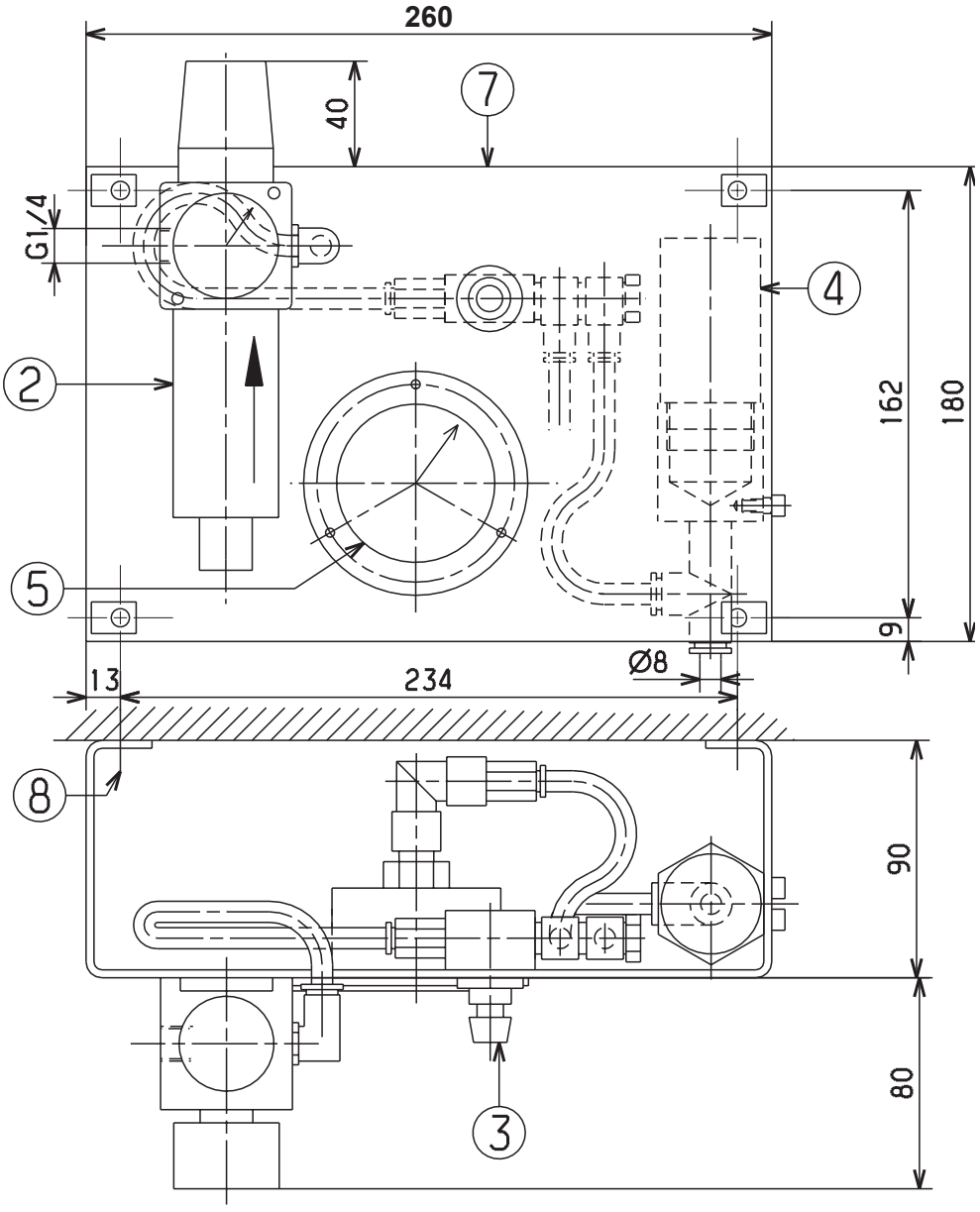


Figure 2.11

2.10. PRESSURIZATION SYSTEM FOR DUSTY SURROUNDINGS OR SPATTERING WITH LIQUIDS

2.10.1. PURPOSE

For very severe applications in dusty surroundings or with spattered liquids, the objective is to keep the pressure inside the arm above atmospheric pressure in order to avoid migration of dust and liquids.

> **CAUTION:**
> **The overpressure must never exceed 20 mbar.**

2.10.2. INSTALLATION

a) Plate with pneumatic system P3:

- Use this fitting to connect the unit.

b) Plate without pneumatic system P3:

- If the hose **(P2)** between **(9)** and **(10)** is not used, cut the pipe **(P2)** at **(9)** and plug **(P2)** at **(10)**.
- If **(P2)** is used for another function, add a pressure sealed union to the connector mount (black plate at base of arm to which the electrical connector is attached).
- Attach the unit with 4 screws (Ø 6 max.) at item **(8)** (screws not supplied) to a rigid vertical wall in direction shown by arrow; the air inlet **(1)** being to the left of the regulator **(2)**.
- Provide for air inlet at **(1)**, this is a G1/4 tapped hole; the air pressure is 10 bar maximum. Before the pressure arrives at **(1)**, make sure that the regulator **(2)** is completely screwed out and that the valve **(3)** is completely screwed in. Before pressurizing the arm, also make sure that the arm is correctly connected and correctly sealed (covers closed, plugs in hoisting ring tapped hole, pipe connected at **(6)** and at **(9)**, etc.).
- Install a pipe with an outside Ø 8 between the unit (output **6**) and the arm (input **P2**). Provide a male G1/4 union for the pipe with an outside Ø 8. At **(P2)**, the hole is a G1/4 tapped hole for the complete RX range.
- Pressurize the arm.

  1) Slowly screw in the regulator. First adjust the pressure to 1 bar max. (pressure shown on pressure gage **11**).

     Note:
     *At this stage, the low pressure gage **(5)** must remain at 0 mbar.*

  2) Very slowly screw out the valve **(3)**; the value on the pressure gage **(5)** must increase progressively. When this value reaches 5 to 10 mbar and remains stable, adjustment is considered as correct.

> **CAUTION:**
> **An excessive value (above 40 mbar) will make the pressure gage (5) unusable.**

- If however the valve **(3)** is completely screwed out and it is impossible to reach 5 mbar, check that:

  a) The circuit is tight (unit, arm, pipe, etc.)

  b) The pressure gage **(5)** is not unserviceable (damaged by a pressure greater than 40 mbar).

If the 2 points a and b are correct, the pressure can be increased by means of the **(2)** regulator without however exceeding 2 bar.

> **CAUTION:**
> **It is preferable for safety reasons (valve opens between 15 and 25 mbars) and consumption reasons to work with minimum pressures (high and low pressures).**

2.11. SAFETY

2.11.1. FLOOR OR CEILING CONFIGURATION

Releasing the brakes on joints 2 - 3 - 5 will cause the arm or load to fall.

2.11.2. WALL CONFIGURATION

Releasing the brakes on joints 1 - 2 - 3 - 5 will cause the arm or load to fall.

CHAPTER 3

ON-SITE PREPARATION

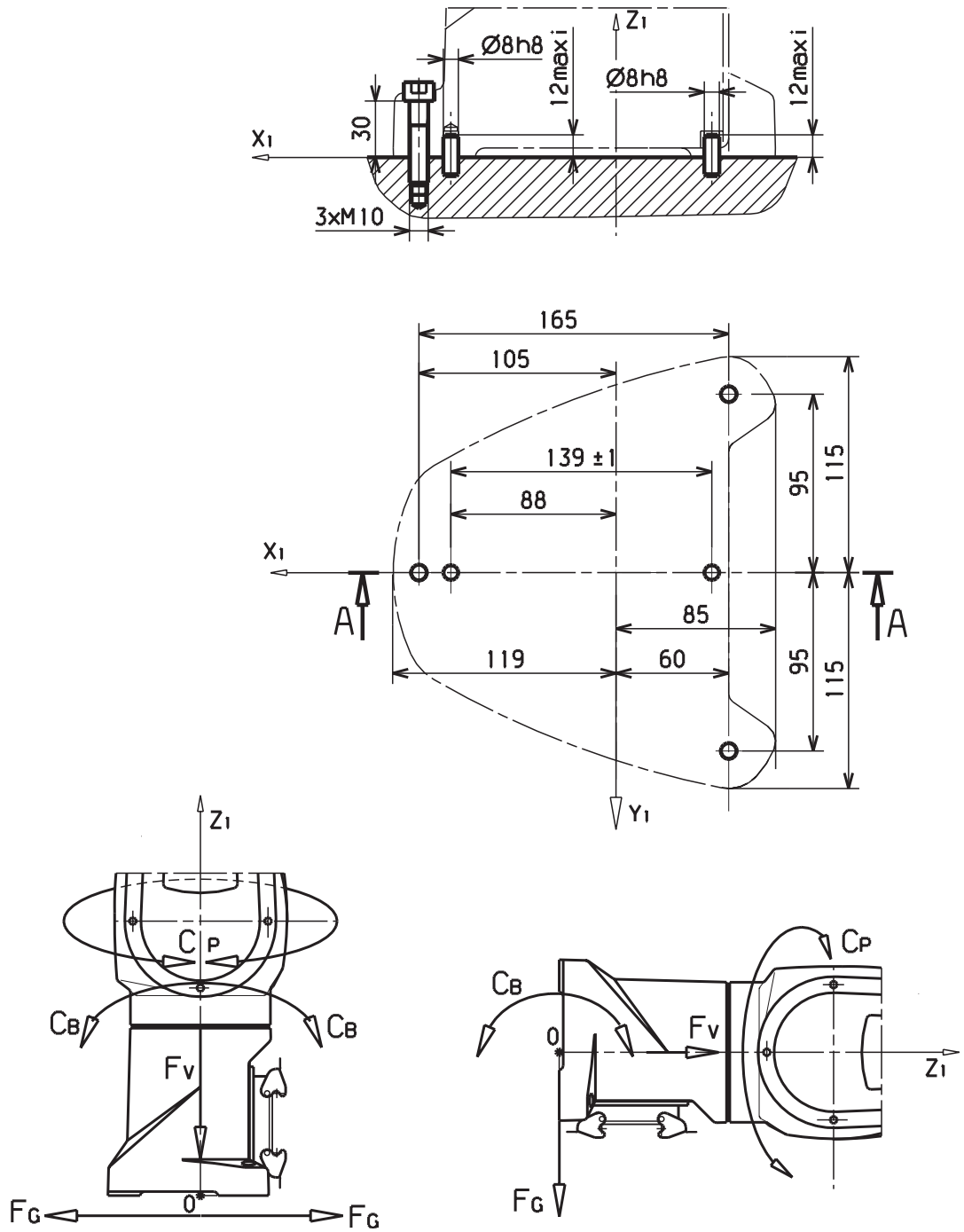


Figure 3.1

3.1. WORKING SPACE

The user is responsible for performing all preparatory work required to complete the on-site installation of the robot. Working space must be sufficient, installation surface appropriate; the power supplies must be available (for the electric power supplies, see the characteristics of the controller).

DANGER:

The arm's working area must be surrounded by a closed safety enclosure in compliance with the country's safety legislation preventing personnel accessing the dangerous area.

International standard: ISO 10218-1, 2006.

European Directive: machine directive CEE 89-392.

DANGER:

There must be no obstacles within the robot work envelope.

3.2. ATTACHMENT (figure 3.1)

The arm can be installed in the upright position with the stand pointing downwards (floor mounted version), upwards (ceiling mounted version) or horizontally (wall mounted version). In all cases, it must be securely attached by **3** class **12.9 M10** hex. socket head screws.

Attachment surface shall be flat and metallic.

To dimension the support, take into account the maximum loads generated by the arm in motion at point 0 which are:

ATTACHMENT	FLOOR CEILING	WALL
F_V	950 N	530 N
F_G	804 N	1374 N
C_B	640 Nm	702 Nm
C_P	317 Nm	385 Nm

Under following load conditions:

		LOAD POSITION (mm)	
	LOAD (kg)	AXIS 5	AXIS 6
Standard arm	2.5	100	50
Long arm	1.5	100	50

The user can accurately position the robot by means of two 8h8 diameter centering pins.

CHAPTER 4

INSTALLATION

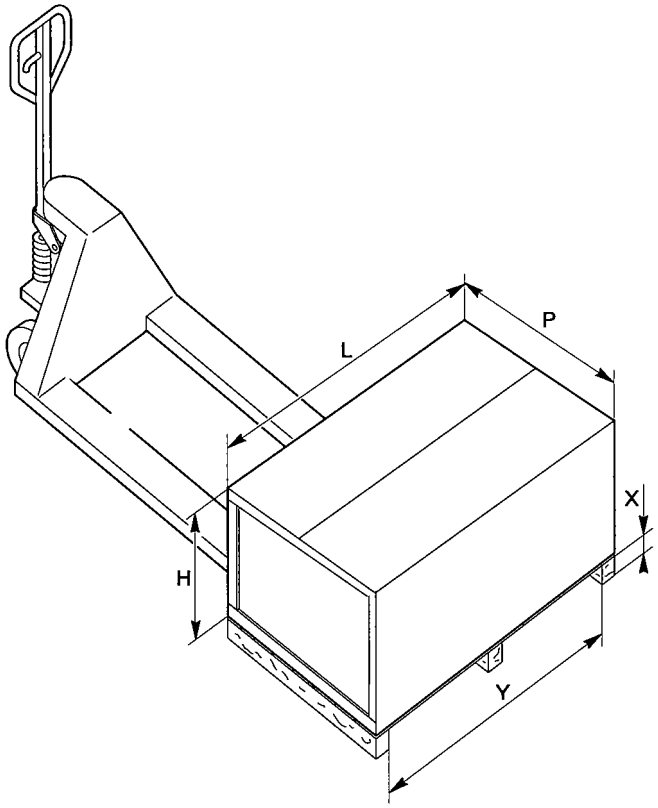


Figure 4.1

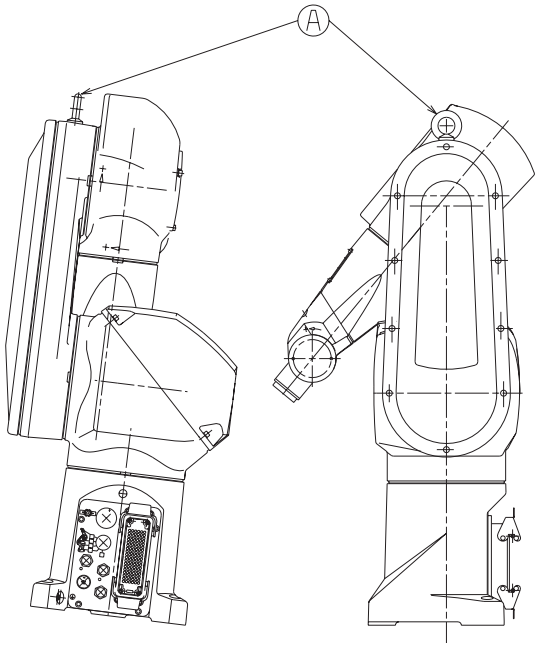


Figure 4.2

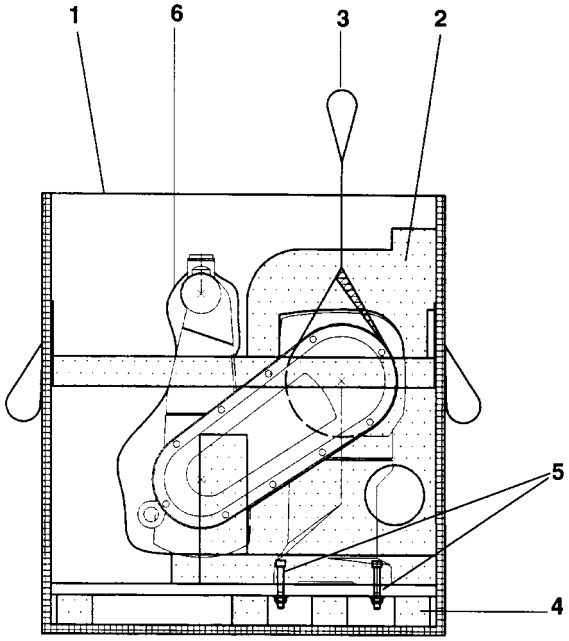


Figure 4.3

4.1. ARM PACKAGING (figure 4.1)

Standard packaging:

Case: L x H x D = 680 x 720 x 470 mm

	GROSS WEIGHT	NET WEIGHT
RX60B	64 kg	44 kg
RX60B L	65 kg	45 kg

International packaging:

Case: L x H x D = 800 x 855 x 500 mm

	GROSS WEIGHT	NET WEIGHT
RX60B	75 kg	44 kg
RX60B L	76 kg	45 kg

The arm is packed in the vertical position.

Transport condition:
- Minimum temperature -20°C
- Maximum temperature +60°C

4.2. HANDLING OF PACKING (figure 4.1)

By pallet truck under base.
- X = 100 mm
- Y = 600 mm

4.3. UNPACKING AND INSTALLATION OF THE ARM

CAUTION:

According to European Directive CEE 89-392, the hoisting ring's (A) threaded hole (M10) used for the robot hoisting is defined according to the ISO 262 standard.

Ⓐ Attachment point

- Move the packing case as near as possible to the installation site.
- Open the case **(1)**.
- Remove the wedging **(2)**.
- Using the sling **(3)**, remove the arm from the case.
- Open the slip cover **(6)**.
- The arm is attached to the support **(4)** by 3 M10 screws **(5)**.
- Place the arm + support assembly on the floor.
- Connect the controller to the arm.
- Put the arm in the position shown in **figure 4.2** after having released the brake.
- Disconnect the connector from the arm.
- Unscrew the 3 screws and remove the support **(4)** and the slip cover.
- Install the arm on its definitive support.

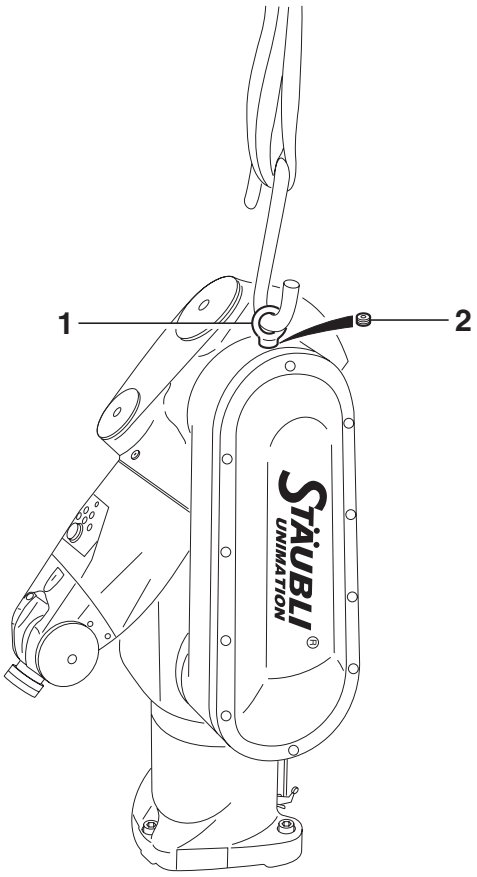


Figure 4.4

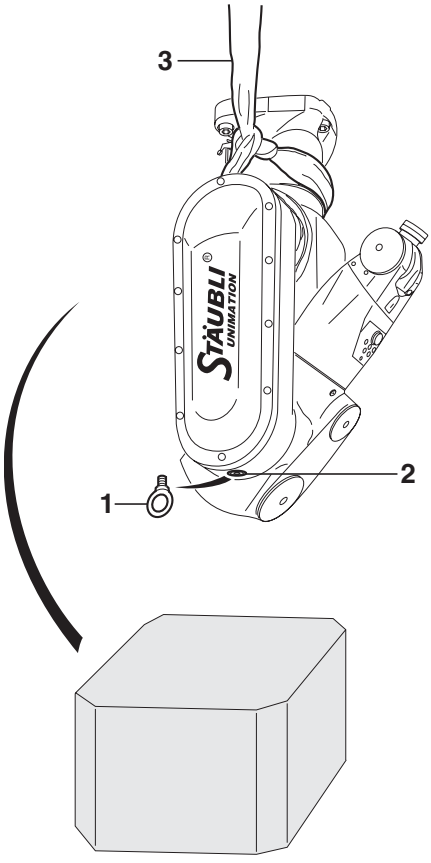


Figure 4.5

4.4. INSTALLATION OF ARM

CAUTION:
The arm must be attached on a solid base, with the stand either on the floor, on the ceiling or on the wall.

4.4.1. INSTALLATION OF ARM ON FLOOR **(figure 4.4)**

- Position the arm on the support at its final attachment points.
- Attach the arm with 3 M10 x 45 CHc screw class 12.9.
- Unscrew the hoisting ring **(1)** and install the plug **(2)**.

DANGER:
For safety's sake, keep the sling slightly taut until the arm is definitively mounted on the floor.

4.4.2. INSTALLATION OF ARM ON CEILING **(figure 4.5)**

- Carefully lay the arm on a flexible support.
- Unscrew the hoisting ring **(1)** and install the plug **(2)**.
- Place the fabric sling **(3)** around joint 1 as shown on figure **4.5**.

CAUTION:
500 kg fabric sling.

- Position the arm on the support at its final attachment points.
- Attach the arm with 3 M10 x 45 CHc screw class 12.9.

DANGER:
For safety reasons, hold the sling slightly tensioned until arm is securely attached to the ceiling.

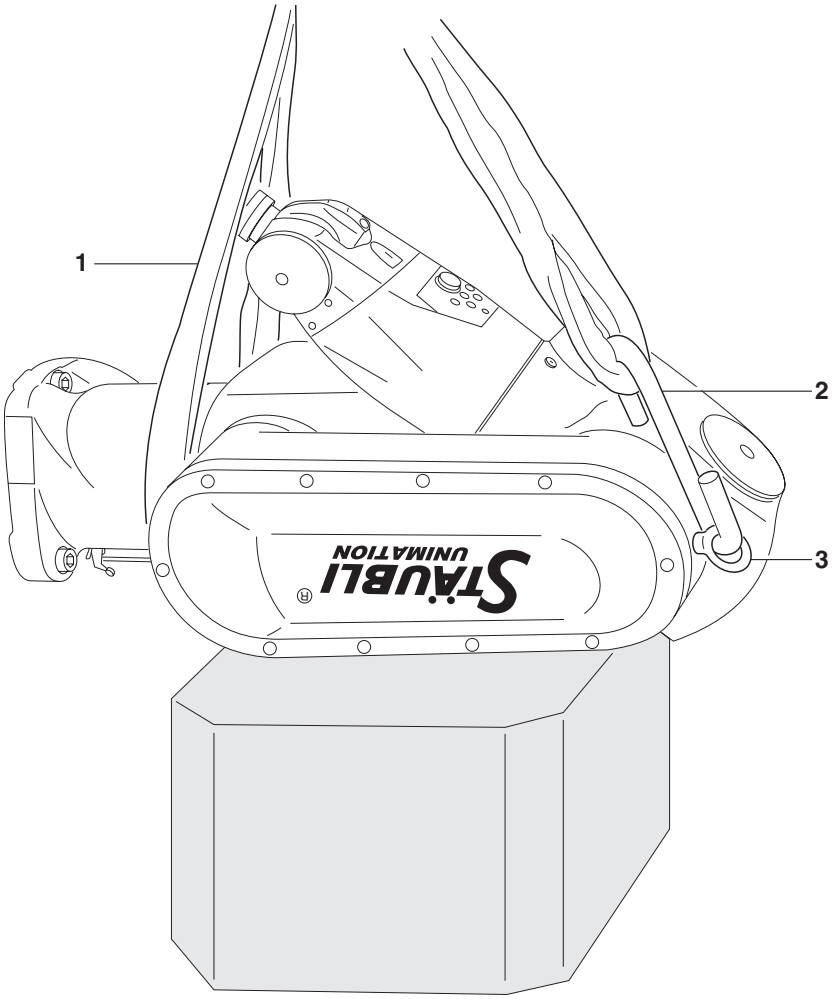


Figure 4.6

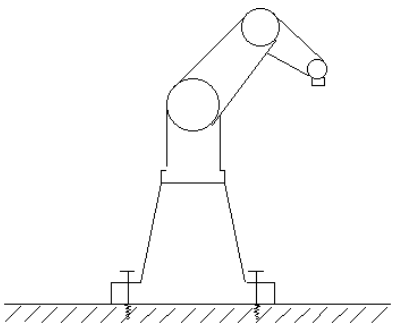


Figure 4.7

4.4.3. ARM INSTALLATION ON THE WALL **(figure 4.6)**

- Carefully lay the arm on a flexible support.
- Place the fabric sling **(1)** around joint 1 as shown on figure **4.6**.

> **CAUTION:**
> **500 kg fabric sling.**

- Place the hook **(2)** in the hoisting ring **(3)**.
- Position the arm on the support at its final attachment points.
- Attach the arm with 3 M10 x 45 CHc screw class 12.9.

> **DANGER:**
> **For safety's sake, keep the sling slightly taut until the arm is definitively attached to the wall.**

4.4.4. MOUNTING FLOOR QUALITY **(figure 4.7)**

The user has to make sure that the mechanical caracteristics of the floor and the means of fixture allow to hold up the maximum forces caused by the moving arm *(see chapter **3**).*

Note:
The height of the robot support can strongly influence the forces on the floor.

CHAPTER 5

TRANSMISSION CASING OIL CHANGE

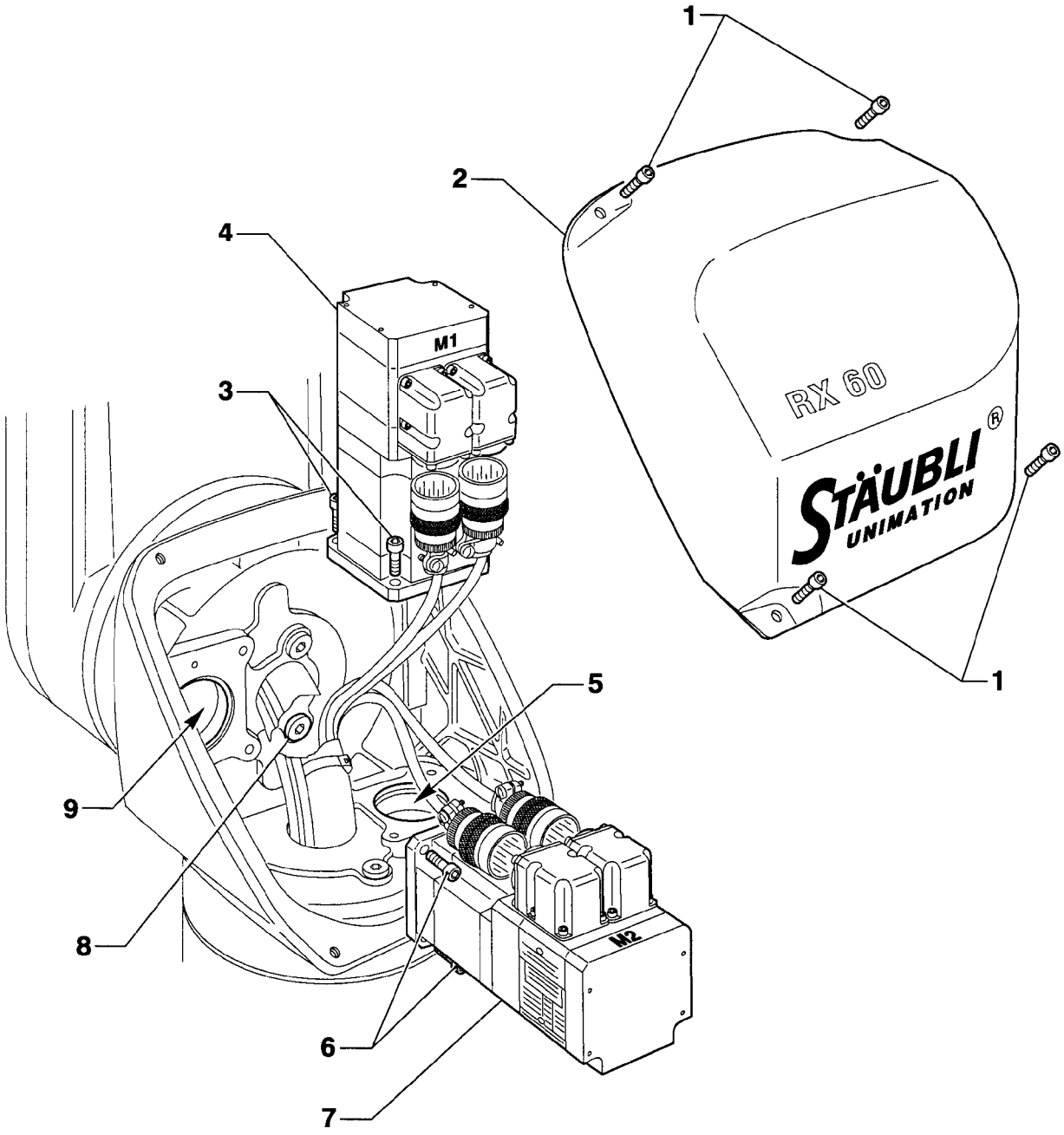


Figure 5.1

5.1. STANDARD VERSION

5.1.1. JOINT 1 TRANSMISSION CASING **(figure 5.1)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- Unscrew the 4 M5 screws **(3)** attaching motor **(4)**.
- Remove motor **(4)**.
- Use a pumping system to remove as much of the oil as possible from the casing, via the motor gear passageway **(5)**.
- Top up with oil* through the engine gear passageway. Fill up to the lower level of the crown gear (indicative quantity: 180 cm³).
- Put the motor **(4)** in place.
- Tighten the 4 M5 screws **(3)** attaching the motor to 9.5 Nm ± 0.7 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install shoulder cover **(2)**.
- Tighten the 4 M5 screws **(1)** attaching the cover **(2)** to 5.7 Nm ± 0.4 Nm.
- Calibrate axis 1.

5.1.2. JOINT 2 TRANSMISSION CASING **(figure 5.1)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Position axis 2 at the mechanical stop.
- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- Unscrew the 4 M5 screws **(6)** attaching motor **(7)**.
- Remove motor **(7)**.
- Unscrew the plug **(8)**.
- Use a pumping system to remove as much of the oil as possible from the casing, via the motor gear passageway **(9)**.
- Top up with oil* through the engine gear passageway. Fill up to the lower level of the hole from which the plug has been removed (indicative quantity: 90 cm^3).
- Put the motor **(7)** in place.
- Tighten the 4 M5 screws **(6)** attaching the motor to 9.5 Nm ± 0.7 Nm.
- Tighten the plug **(8)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install shoulder cover **(2)**.
- Tighten the 4 M5 screws **(1)** attaching the cover **(2)** to 5.7 Nm ± 0.4 Nm.
- Calibrate axis 2.

(*) Recommended oil: see spare parts.

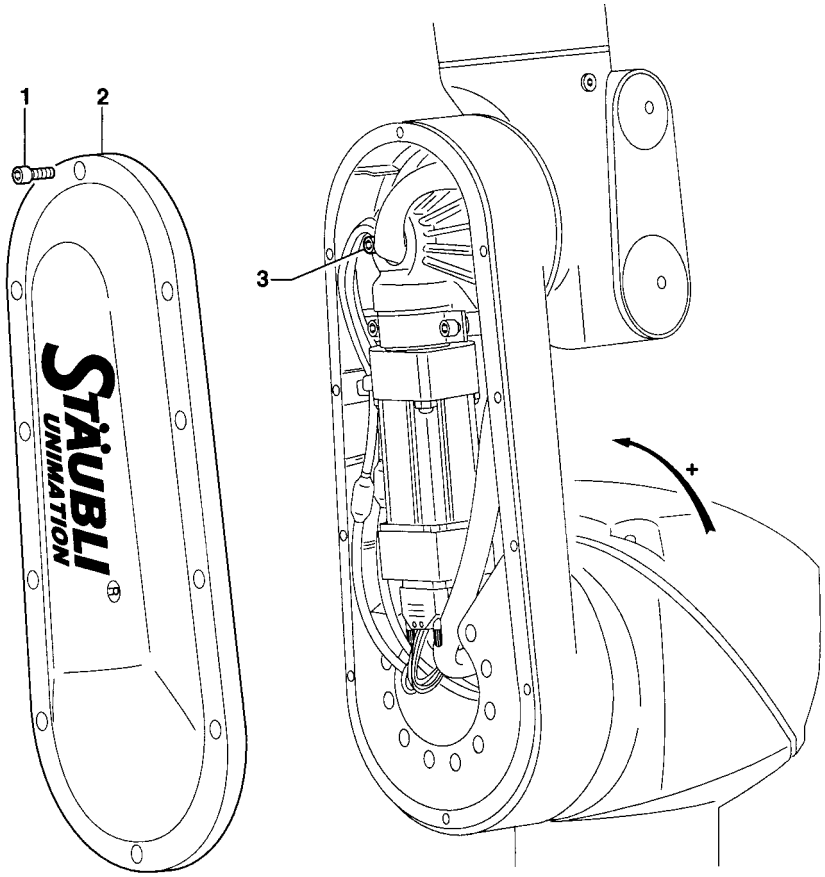


Figure 5.2

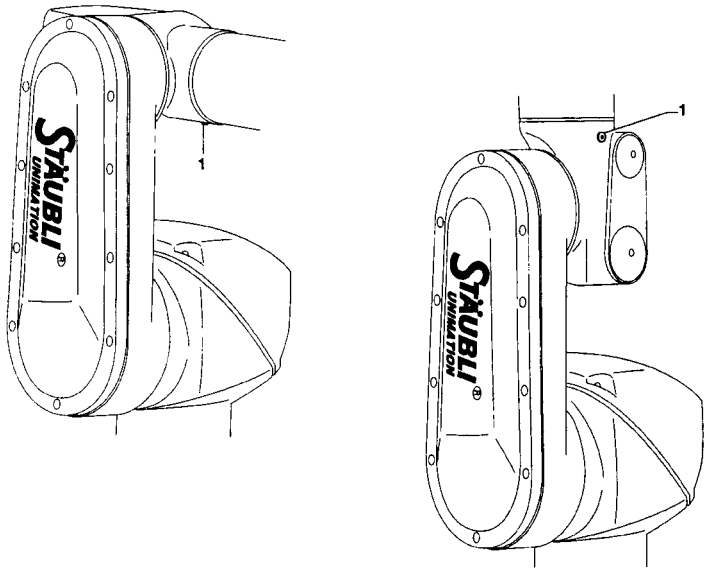


Figure 5.3

5.1.3. JOINT 3 TRANSMISSION CASING **(figure 5.2)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Tilt the arm by 15° in the positive direction with respect to the Ready position.
- Unscrew the 10 M5 screws **(1)** attaching cover **(2)**.
- Remove the cover **(2)** from the arm.
- Unscrew the plug **(3)**.
- Use a pumping system to remove as much of the oil as possible from the casing, via the plug hole.
- Top up with oil* through the same hole. Fill up to the lower level of the hole from which the plug has been removed (indicative quantity: 85 cm^3).
- Tighten the plug to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install the cover **(2)** on the arm.
- Tighten the 10 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

5.1.4. JOINT 4 TRANSMISSION CASING **(figure 5.3)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Place the forearm in the horizontal position, with the drain plug **(1)** positioned underneath.
- Unscrew the plug **(1)**.
- Wait approximately 15 minutes for oil to flow out.
- Place the forearm in the upright position.
- Top up with oil* through the drain hole. Fill up to the lower level of the hole from which the plug has been removed (indicative quantity: 50 cm^3).
- Tighten the plug **(1)** to torque value 4 Nm ± 0.3 Nm.

(*) Recommended oil: see spare parts.

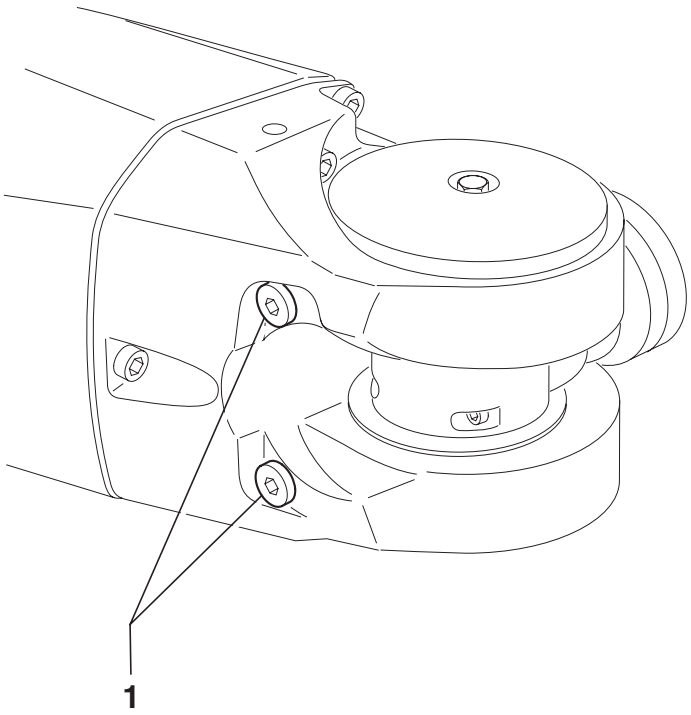


Figure 5.4

5.1.5. TRANSMISSION CASING OF JOINTS 5 AND 6 **(figure 5.4)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Turn the articulations so that the forearm is horizontal, with the **(1)** caps facing down and vertical axle 6 upwards.
- Remove caps **(1)**.
- Wait approximately 10 minutes for oil to flow out.
- Using the brake releases, move the robot so as to have the caps **(1)** aimed upwards (by rotating axis 4).
- Top up the oil* through the fillers covered by caps **(1)**. Fill until the level is flush with the thread root of the worm screw (indicative quantity: 80 cm^3).
- Screw down the caps **(1)**, with a torque of 4 Nm ± 0.3 Nm.

(*) Recommended oil: see spare parts.

5.2. MOUNT ON CEILING VERSION

5.2.1. JOINT 1 TRANSMISSION CASING

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Remove the arm from its support by proceeding in the reverse order to installation.
- Place the arm in position on the floor.
- Follow the arm on floor procedure.
- Calibrate axis 1.

5.2.2. JOINT 2 TRANSMISSION CASING

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Remove the arm from its support by proceeding in the reverse order to installation.
- Place the arm in position on the floor.
- Follow the arm on floor procedure.
- Calibrate axis 2.

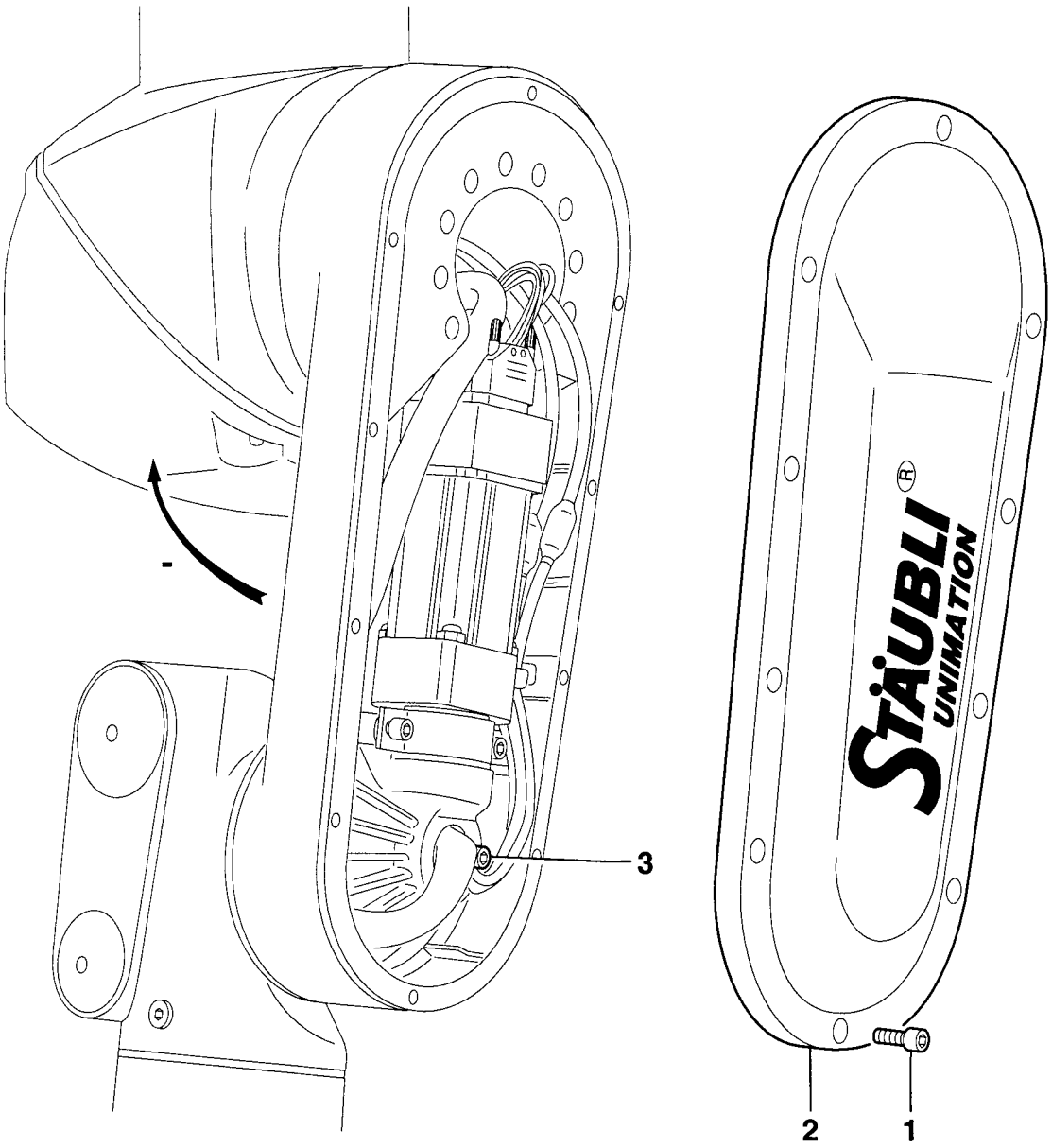


Figure 5.5

5.2.3. JOINT 3 TRANSMISSION CASING **(figure 5.5)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Tilt the arm by 15° in the negative direction with respect to the Ready position.
- Unscrew the 10 M5 screws **(1)** attaching cover **(2)**.
- Remove the cover **(2)** from the arm.
- Unscrew the plug **(3)**.
- Use a pumping system to remove as much of the oil as possible from the casing, via the plug hole.
- Top up with oil* through the same hole. Fill up to the lower level of the hole from which the plug has been removed.
- Tighten the plug **(3)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install the cover **(2)** on the arm.
- Tighten the 10 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

5.2.4. JOINT 4 TRANSMISSION CASING

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

Follow the arm on floor procedure.

5.2.5. TRANSMISSION CASING OF JOINTS 5 AND 6

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

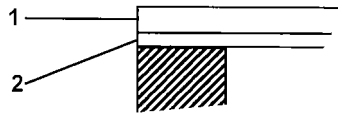
Follow the arm on floor procedure.

(*) Recommended oil: see spare parts.

5.3. PROCEDURE FOR REPLACING THE FLAT SEAL

The flat seal is made up of 2 sections:

- A section made of foam **(1)**,
- An adhesive section **(2)**.



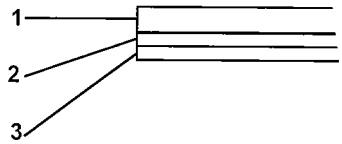
5.3.1. REMOVING THE SEAL

- To remove the flat seal, peel off a corner of the seal and pull it towards you.
  If the adhesive section **(2)** remains stuck to the cover, use "C" fluid (ethyl acetate) to remove it.
- Clean the surface, remove all paint and all other particles present on the surface, without scratching it.
- Clean the whole surface using "C" fluid (ethyl acetate).

5.3.2. FITTING A NEW SEAL

The new seal is made up of 3 sections:

- A section made of foam **(1)**,
- An adhesive section **(2)**,
- A protective paper covering the adhesive **(3)**.



- Remove the cut-out sections such as screw holes.
- Present the seal. Line the contour of the seal up with that of the surface.
- Apply the new seal to the surface. Remove a corner of the protective paper covering, apply that part to the surface, and then continue to remove the paper and put the seal into contact with the surface.

CHAPTER 6

OPERATIONS ON MOTORS

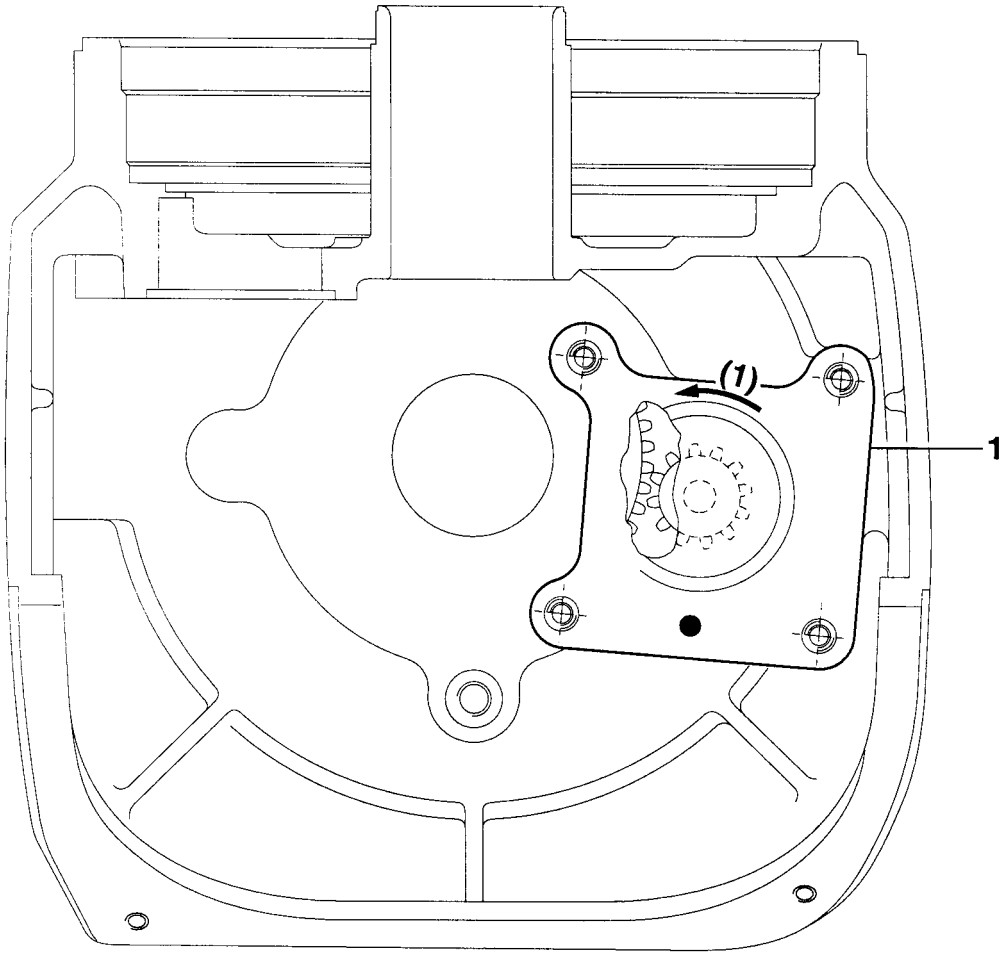


Figure 6.1

6.1. MOTOR PLAY ADJUSTMENT PROCEDURE

DANGER:
Follow the safety rules! See chapter 1.3.

Motor play is adjusted by moving the motor gear wheel towards the crown gear of the JCS transmission module:

- Unscrew the 4 screws of the motor of the joint concerned by 1/4 to 1/2 of a turn.
- Push the motor **(1)** in the counter-clockwise direction **(figure 6.1)**. The arrow indicates less play.
- Progressively tighten the 4 motor screws, working diagonally.

CAUTION:
Do not hold the motor pressed against the crown gear when tightening its 4 attachment screws.

- Check the adjustment using the "check motor play" procedure described in paragraph 6.1.4.

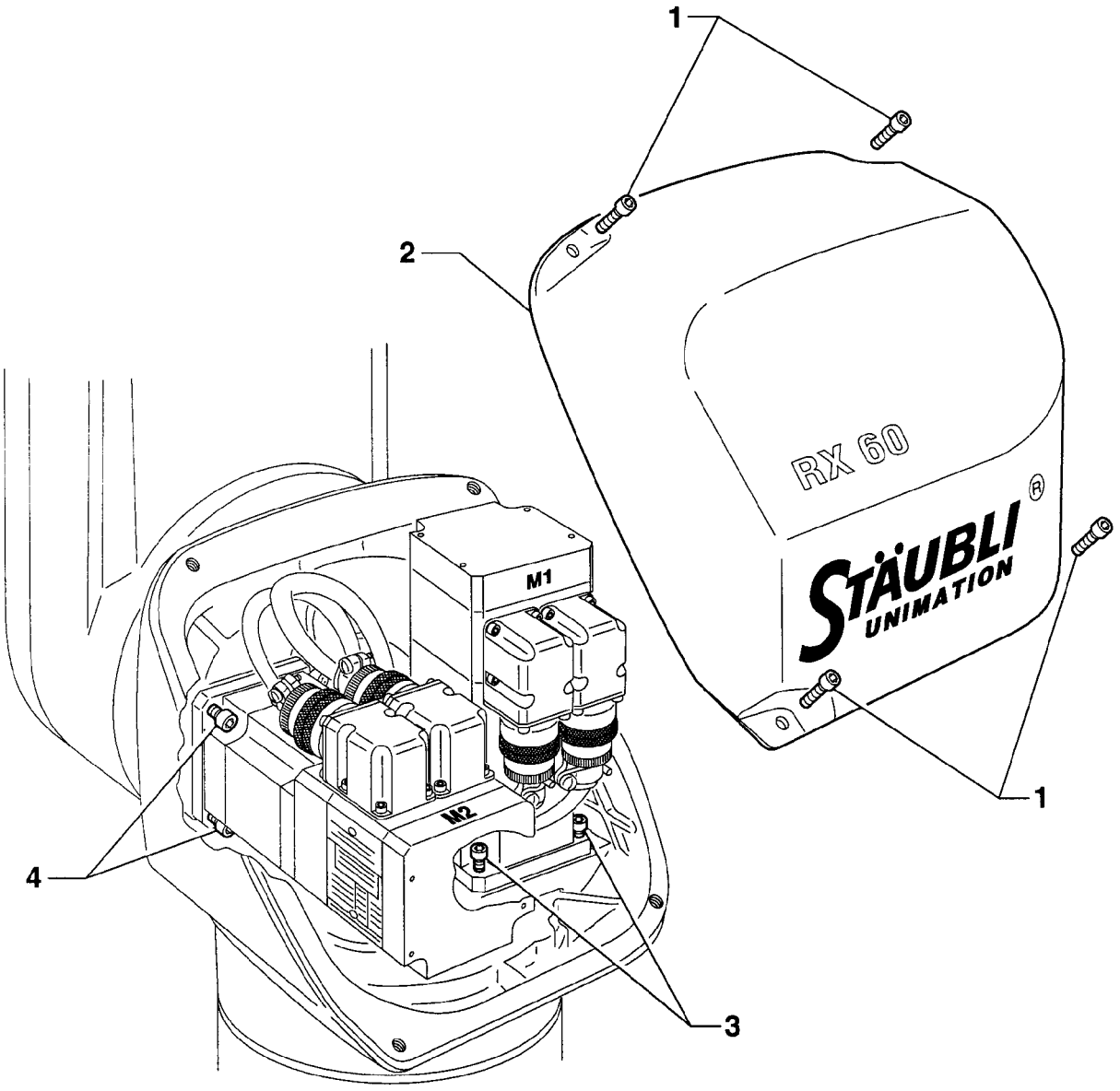


Figure 6.2

6.1.1. JOINT 1 **(figure 6.2)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- Loosen the 4 M5 screws **(3)** attaching the M1 motor.
- Perform the motor play adjustment procedure.
- Tighten the 4 M5 screws **(3)** attaching motor M1 to 9.5 Nm ± 0.6 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install cover **(2)**.
- Tighten the 4 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

6.1.2. JOINT 2 **(figure 6.2)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- The arm is in "Ready" position.
- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- Release the 4 M5 **(4)** motor mounting screws M2.
- Perform the motor play adjustment procedure.
- Tighten the 4 M5 screws **(4)** attaching motor M2 to 9.5 Nm ± 0.6 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install cover **(2)**.
- Tighten the 4 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

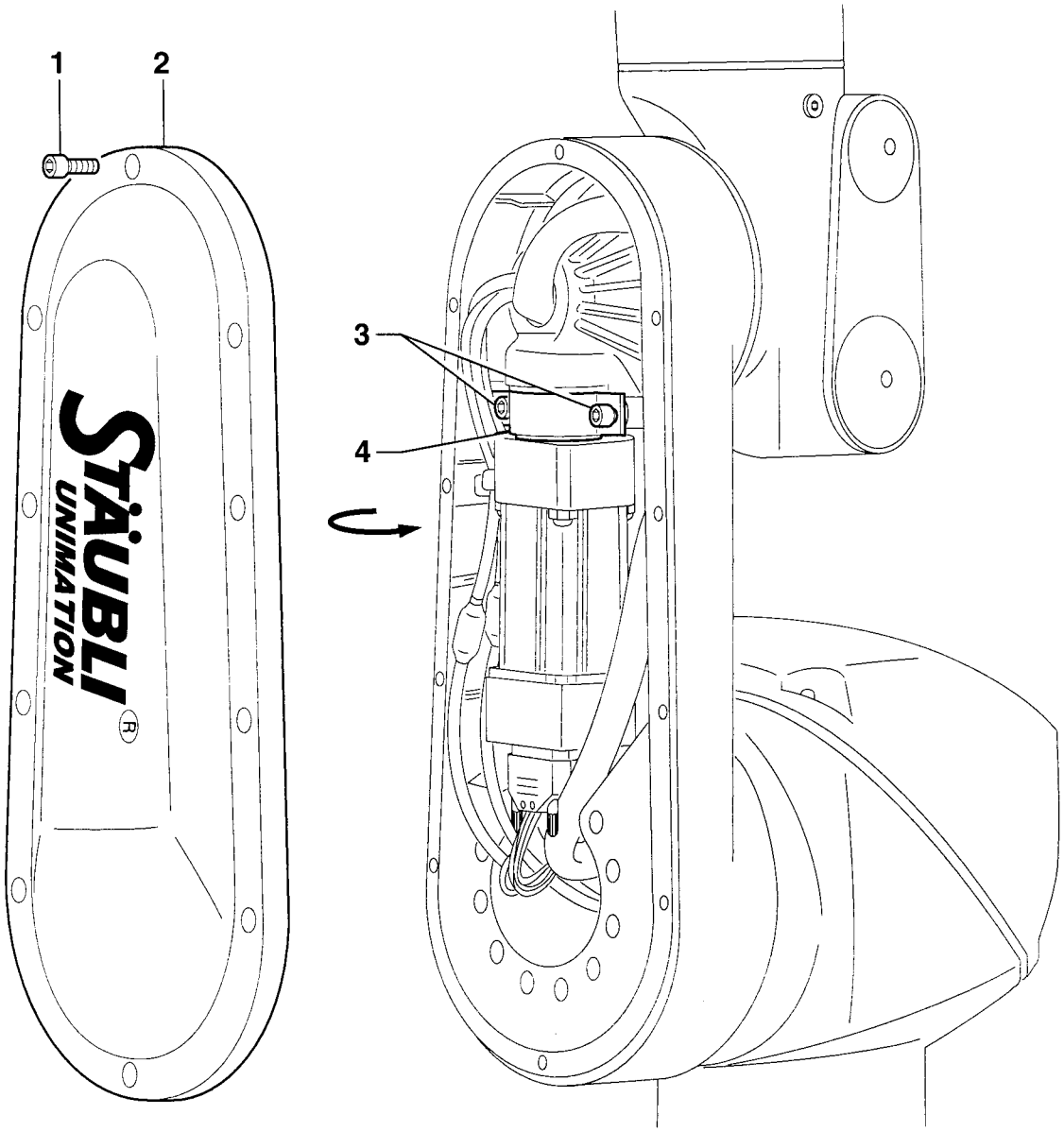


Figure 6.3

6.1.3. JOINT 3 **(figure 6.3)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

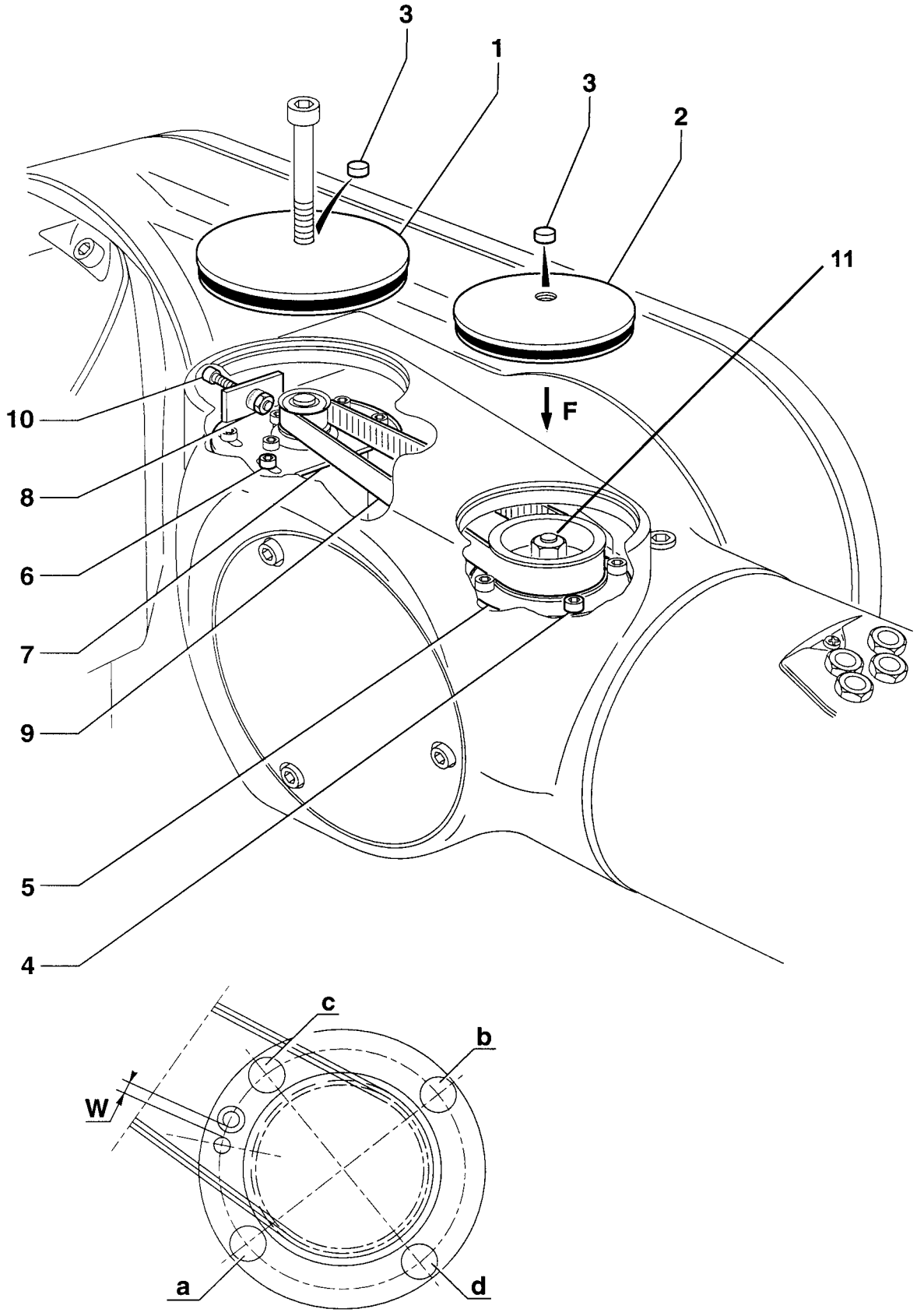
- The arm is in "Ready" position.
- Unscrew the 10 M5 screws **(1)** attaching cover **(2)**.
- Remove the cover **(2)** from the arm.
- Loosen the 2 M5 screws **(3)** attaching the motor flange **(4)**.
- Turn the motor in the direction of the arrow to reduce the play.
- Take care to keep the motor perfectly pressed on its contact face.
- Tighten the 2 M5 screws **(3)** attaching the flange to torque value 9.5 Nm ± 0.7 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install cover **(2)**.
- Tighten the 10 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

6.1.4. CHECK MOTOR PLAY

To check for play in a join:

- Release the brake of the joint concerned.
- Move the joint to both sides in movement direction.
- If there is play in the joint, a characteristic noise will be heard when direction of movement is reversed.

For the robot to work under the best conditions, transmission play must tend towards zero without this jamming the gearing or creating a friction point in the transmission or significant operating noise.



View according to F

Figure 6.4

6.1.5. JOINT 4 **(figure 6.4)**

DANGER:
Follow the safety rules! See chapter 1.3.

6.1.5.1. ADJUSTING THE PLAY OF THE GEAR WHEEL AND WORM SCREW

- Place the arm and the forearm in the horizontal position, with the 2 plugs providing access to the motor **(1)** and to the axis 4 cartridge **(2)** on the top **(figure 6.4).**
- Remove the plastic plugs **(3)** from the center of plugs **(1)** and **(2)**.
- Install 2 M6 screws or 2 threaded rods at least 50 mm long in the holes provided for that purpose.
- Remove the 2 screws by pulling on the threaded rods.
- Loosen the 4 M4 screws **(4)** attaching the axle 4 cartridge **(5)**.
- Adjust the play of the wheel and of the worm screw according to the following procedure:
    - Bring the worm screw close to the wheel so as to obtain a screw drive torque equal to 0.18 Nm ± 0.02 Nm. Use the nut **(11)** to drive the screw in rotation and check the torque. The drive torque is adjusted in the hard zone, with the cartridge attachment 4 screws tightened.
    - The torque is adjusted by means of slip gauges. Proceed by adding 0.01 mm to dimension W between each measurement of the torque until you obtain the required value.
- Tighten the M4 screws **(4) (a - b - c - d)** attaching the cartridge **(5)** to a torque value of 4.8 Nm ± 0.34 Nm in the following order: screw **a** then screw **b** then screw **c** and end with screw **d**.
- Install the plugs **(1)** and **(2)**.
- Install the 2 plastic plugs **(3)**.

6.1.5.2. ADJUSTING THE BELT TENSION

- Place the arm and the forearm in the horizontal position, with the 2 plugs providing access to the motor **(1)** and to the axis 4 cartridge **(2)** on the top.
- Remove the plastic plugs **(3)** from the center of plugs **(1)** and **(2)**.
- Install 2 M6 screws or 2 threaded rods at least 50 mm long in the holes provided for that purpose.
- Remove the 2 screws by pulling on the threaded rods.
- Loosen the 4 M4 screws **(6)** attaching the motor support **(7)**.
- Loosen the M4 locknut **(8)**.
- Retighten the belt **(9)** using the screw **(10)**: Measure the tension with the BINDER TSM3 vibration frequency between 125 and 155 Hz.
- Tighten the 4 M4 screws **(6)** attaching the motor support to a torque value of 4.8 Nm ± 0.34 Nm.
- Tighten the M4 locknut **(8)** while holding the M4 screw **(10)** immobilized.
- Check the tension of the belt.
- Install the plugs **(1)** and **(2)**.
- Install the 2 plastic plugs **(3)**.

6.1.6. JOINTS 5 AND 6

CAUTION:
Play of joints 5 and 6 must be adjusted in the factory or by a qualified technician.

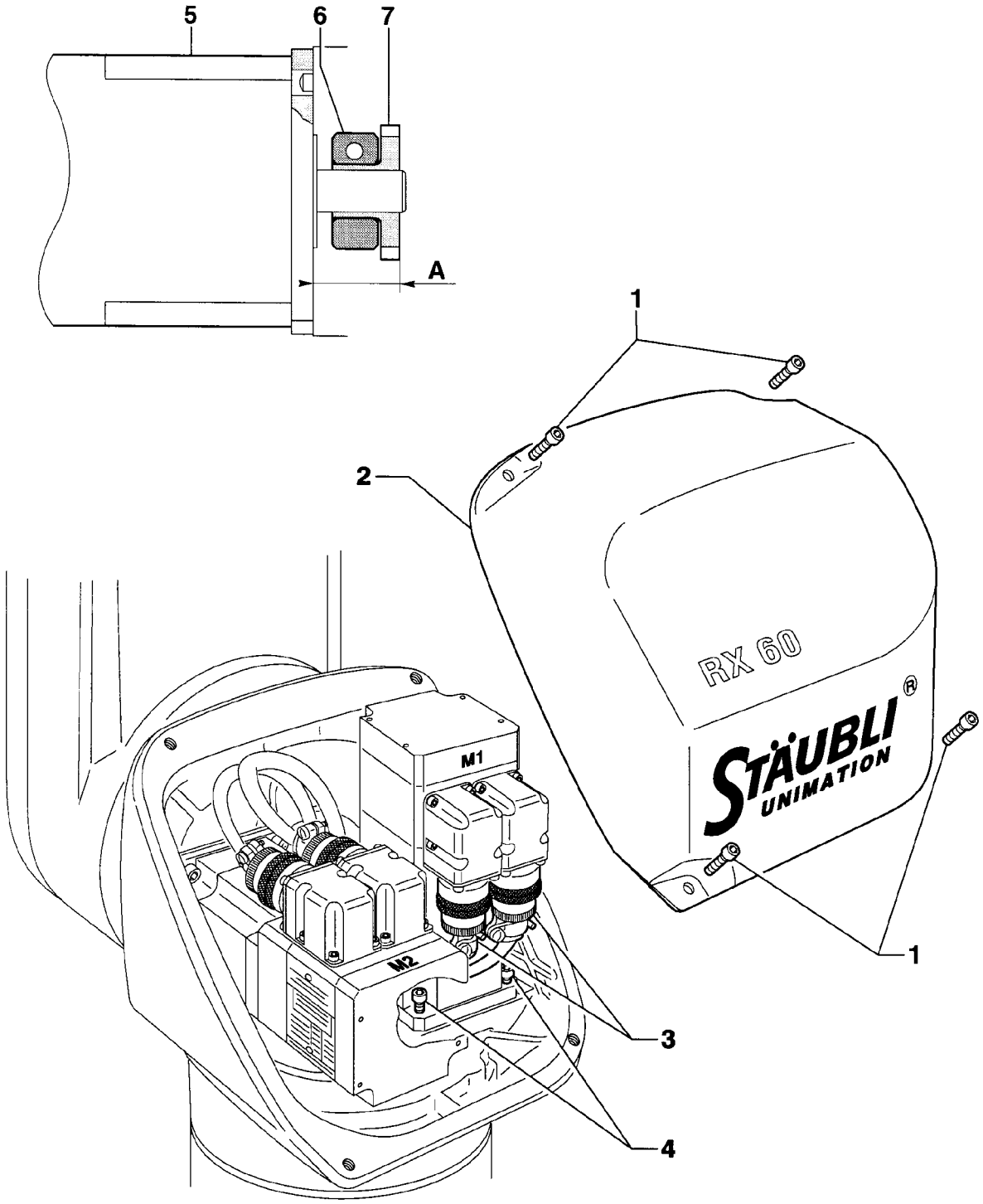


Figure 6.5

6.2. REPLACEMENT OF A MOTOR – STANDARD VERSION

DANGER:

Follow the safety rules! See chapter 1.3.

Before carrying out any work on the motors, the DAPS board backup supply switch MUST be set to OFF (0).
If an item is replaced or joint transmission uncoupled, an arm adjustment procedure must be performed.

6.2.1. JOINT 1 (figure **6.5**)

- Align the joint position frames.
- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- Disconnect connectors **(3)** from motor M1.
- Unscrew the 4 M5 screws **(4)** attaching motor M1.
- Remove motor M1.

CAUTION:

Hold the joint in position.
Check for good condition and positioning of the joint under the motor.
Make sure that no impurities enter the joint JCS casing.

Figure 6.5

- Untighten the M6 screw of bushing **(6)**.
- Remove gear wheel **(7)** from motor **(5)**.
- Return the defective motor to the after sales service department STÄUBLI.

On the new motor:

- Install the gear wheel **(7)** and bushing **(6)** assembly on motor **(5)**.
  Dimension **(A)** is 23 mm ± 0.1 mm.
- Tighten the M6 screw of bushing **(6)** to 16.7 Nm ± 1.2 Nm.
- Install motor M1 on joint 1 casing.

CAUTION:

Do not damage the joint under the motor.
Correctly position motor M1 on the locating stud.
Keep the articulation frames aligned.

- Install the 4 M5 screws **(4)** attaching motor M1, do not tighten down.
- Connect connectors **(3)** to motor M1.

- Perform the motor play adjustment procedure.
- Tighten the 4 M5 screws **(4)** attaching motor M1 to 9.5 Nm ± 0.7 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install shoulder cover **(2)**.
- Tighten the 4 M5 screws **(1)** attaching the cover **(2)** to 5.7 Nm ± 0.4 Nm.

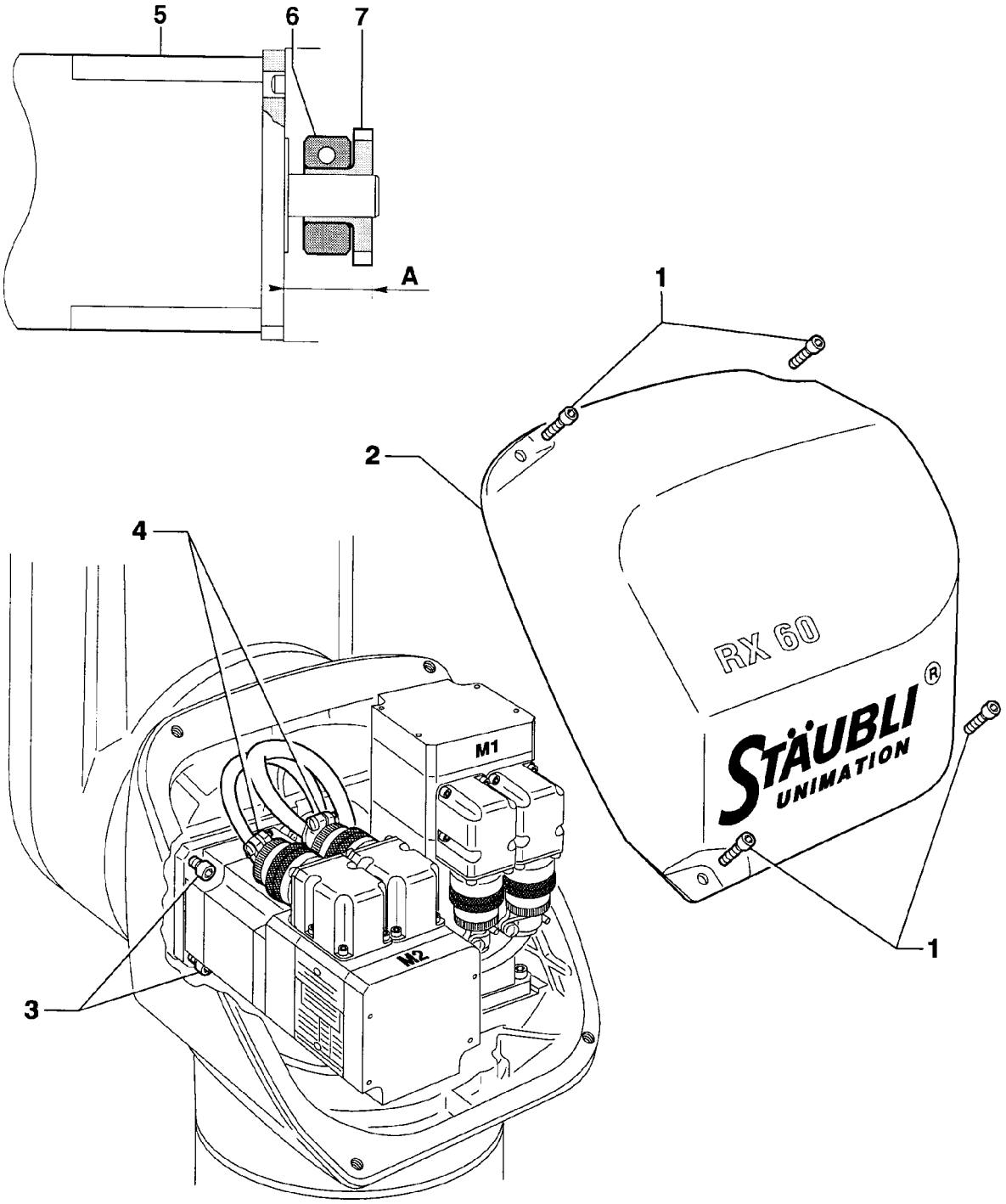


Figure 6.6

6.2.2. JOINT 2 **(figure 6.6)**

DANGER:
Follow the safety rules! See chapter 1.3.

- Align the joint position frames.
- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- Disconnect connectors **(4)** from motor M2.
- Unscrew the 4 M5 screws **(3)** attaching motor M2.
- Remove motor M2.

CAUTION:
Hold the joint in position.
Check for good condition and positioning of the joint under the motor.
Make sure that no impurities enter the joint JCS casing.

Figure 6.6

- Untighten the M6 screw of bushing **(6)**.
- Remove gear wheel **(7)** from motor **(5)**.
- Return the defective motor to the after sales service department STÄUBLI.

On the new motor:

- Install the gear wheel **(7)** and bushing **(6)** assembly on motor **(5)**.
  Dimension **(A)** is 23 mm ± 0.1 mm.
- Tighten the M6 screw of bushing **(6)** to 16.7 Nm ± 1.2 Nm.
- Install motor M2 on joint 2 casing.

CAUTION:
Do not damage the joint under the motor.
Correctly position motor M2 on the locating stud.
Keep the articulation frames aligned.

- Install the 4 M5 screws **(3)** attaching motor M2, do not tighten down.
- Connect connectors **(4)** to motor M2.

- Perform the motor play adjustment procedure.
- Tighten the 4 M5 screws **(3)** attaching motor M2 to 9.5 Nm ± 0.7 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install shoulder cover **(2)**.
- Tighten the 4 M5 screws **(1)** attaching the cover **(2)** to 5.7 Nm ± 0.4 Nm.

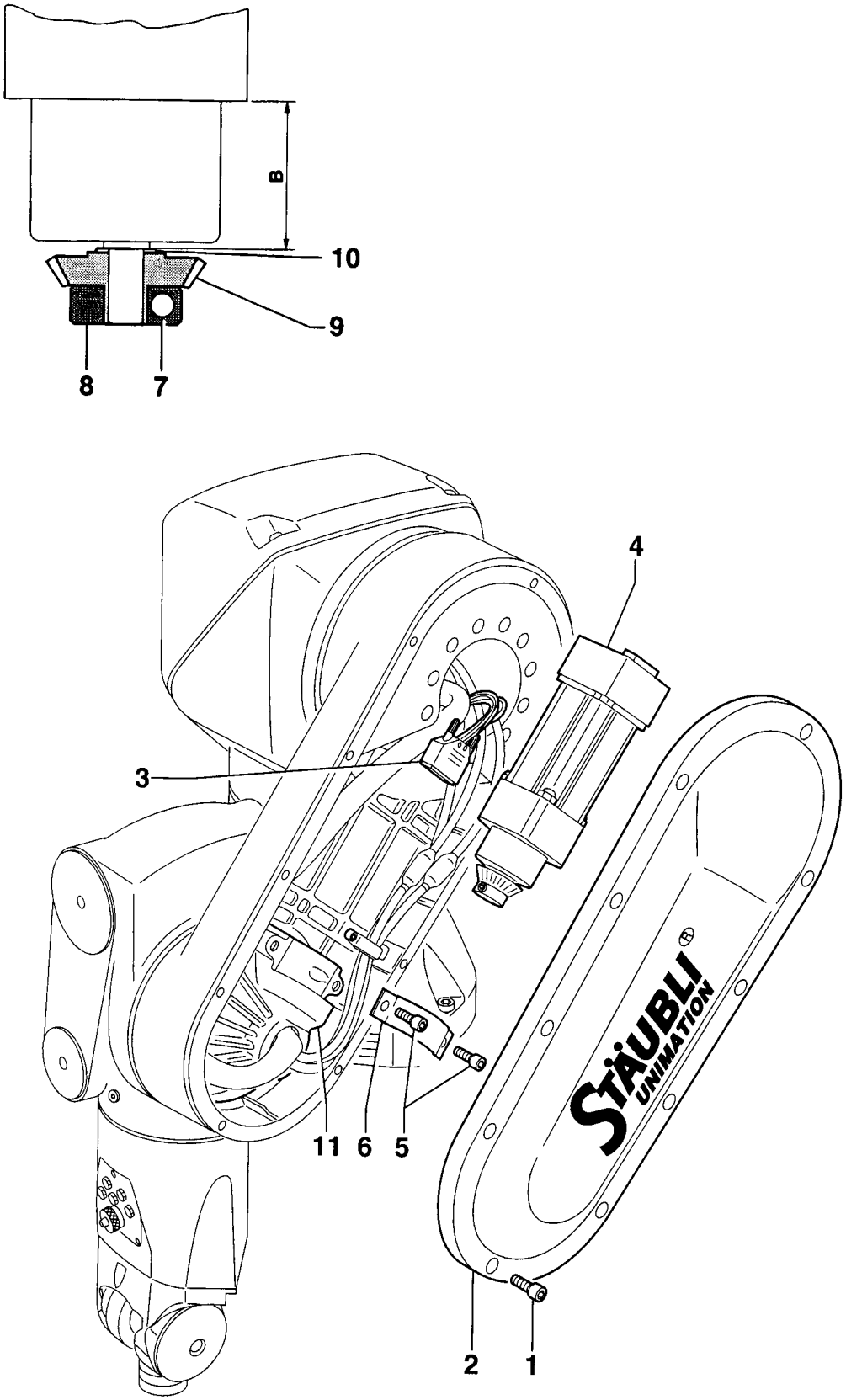


Figure 6.7

6.2.3. JOINT 3 **(figure 6.7)**

- The arm is at the software limit position, the forearm in the upright position and the wrist pointing downwards.
- Unscrew the 10 M5 screws **(1)** attaching cover **(2)**.
- Remove the cover **(2)** from the arm.
- Disconnect the motor **(4)** power supply connector **(3)**.
- Unscrew the 2 M5 screws **(5)** attaching the motor flange **(6)**.
- Remove the motor flange **(6)** and the motor **(4)**.
- Untighten the M5 screw **(7)** of bushing **(8)**.
- Remove the motor gear **(9)** and the setting shim **(10)**.

> **CAUTION:**
> **Hold the joint in position.**
> **Check the correct condition and positioning of the joint in the axis 3 casing.**
> **Make sure that no impurities enter the axle casing 3.**

- Return the defective motor to the after sales service department STÄUBLI.

On the new motor:

- Using a 1/50 depth caliper gauge, measure the distance between the shoulder on the motor shaft and the motor's contact face: dimension B.
- Note the dimension A engraved on the axis 3 casing **(11)**.
- Note the dimension C engraved on the gear **(9)**.
- Calculate the shim **(10)** thickness dimension E as follows: E = A - B - C.
- Adjust the shim if necessary or replace it.
- Install the shim **(10)**, gear **(9)**, clamping ring **(8)** assembly on the motor shaft.
- Tighten the M5 screw **(7)** of bushing **(8)** to 9.5 Nm ± 0.7 Nm.
- Install the M3 motor on the axis 3 casing **(11)**, taking care not to damage the joint.
- Put the M3 motor's attachment flange **(6)** in place.
- Tighten the 2 M5 screws **(5)** attaching the flange to torque value 9.5 Nm ± 0.7 Nm.

- Perform the motor play adjustment procedure.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install the cover **(2)** on the arm.
- Tighten the 10 M5 screws **(1)** attaching the cover **(2)** to 5.7 Nm ± 0.4 Nm.

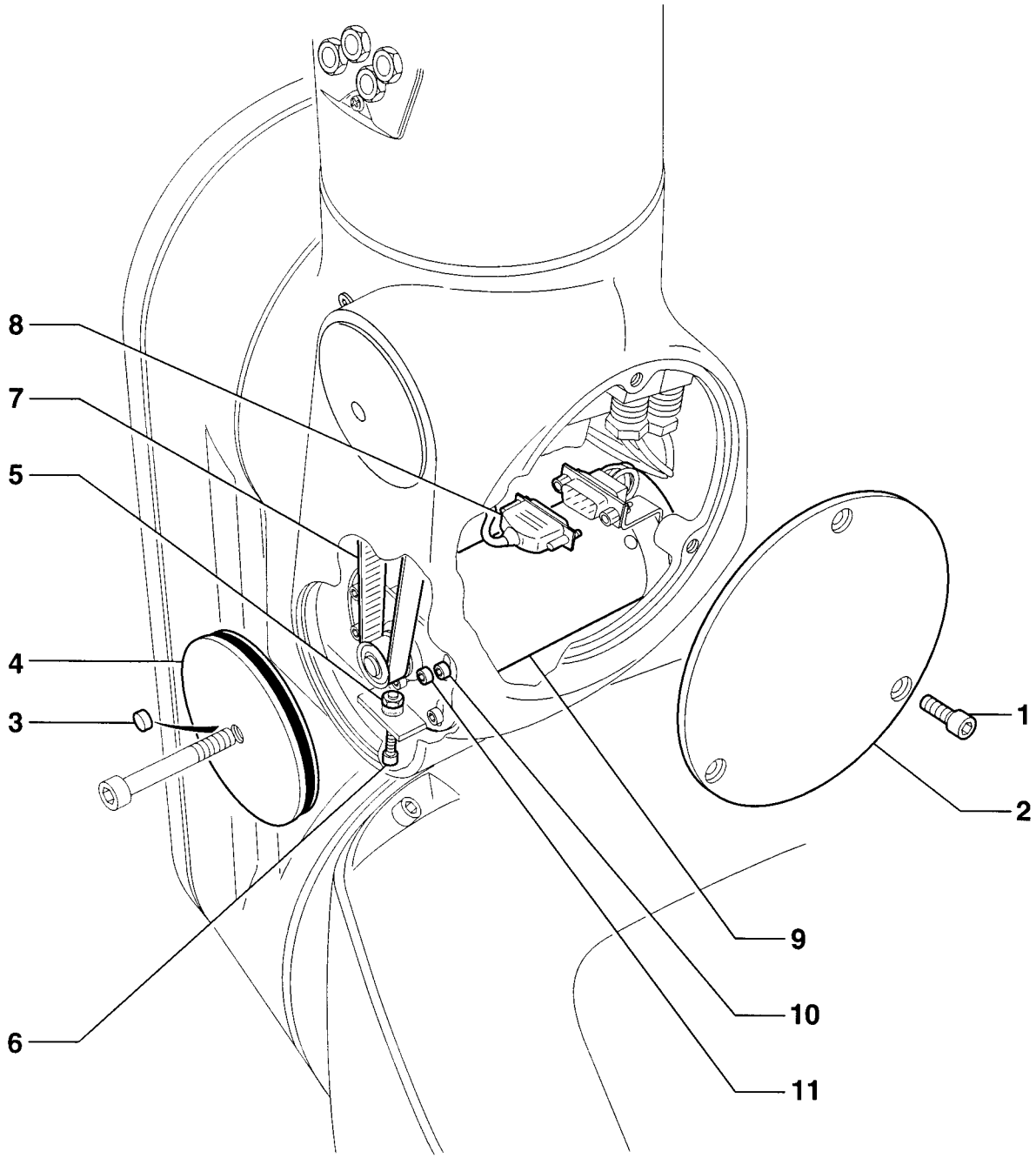
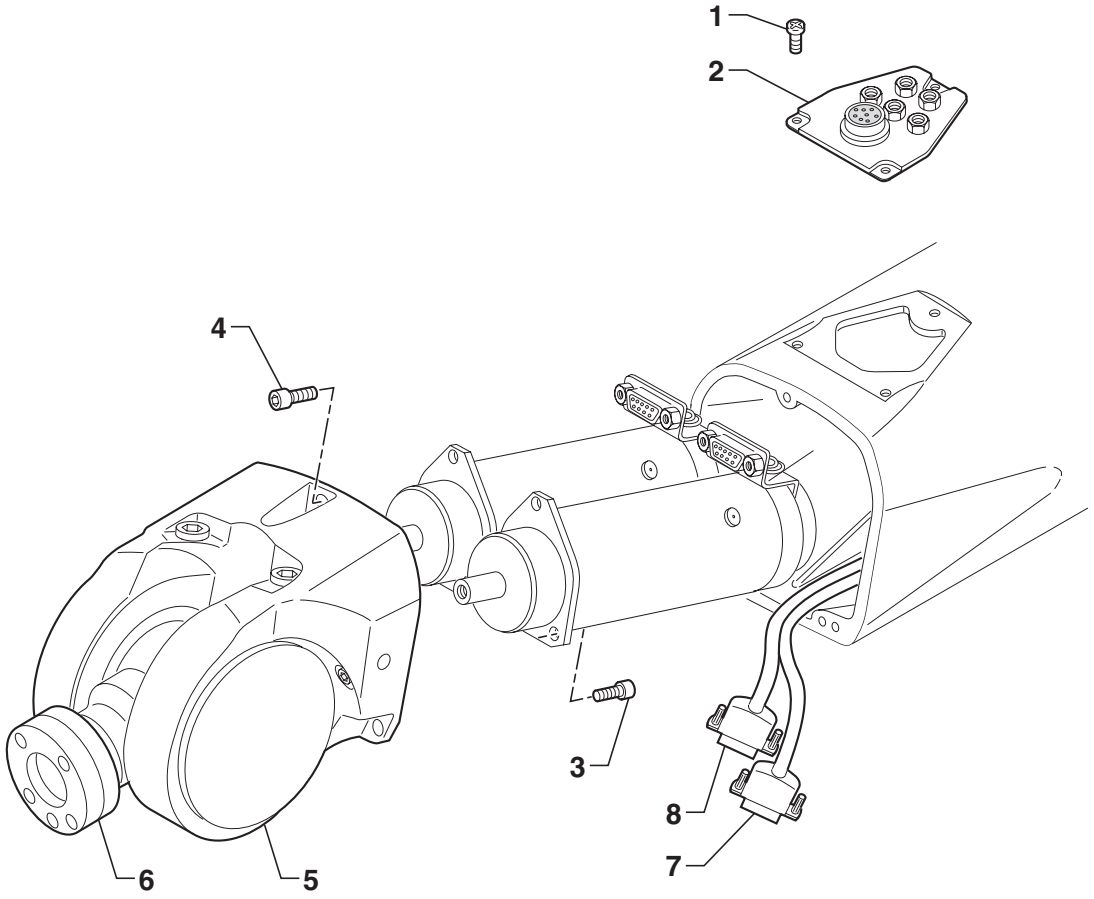


Figure 6.8

6.2.4. JOINT 4 **(figure 6.8)**

- Put the arm in the "Ready" position.
- Unscrew the 3 M5 screws **(1)** attaching cover **(2)**.
- Remove the cover **(2)** from the arm.
- Remove the plastic plug **(3)** at the center of plug **(4)**.
- Install an M6 screw or threaded rod at least 50 mm long in the holes provided for that purpose.
- Remove the plug by pulling on the threaded rod.
- Loosen the M4 locknut **(5)**.
- Unscrew the belt **(7)** tensioner M4 screw **(6)**.
- Remove the belt **(7)** from the pulley.
- Disconnect the motor **(9)** power supply connector **(8)**.
- Loosen the 4 M4 screws **(10)** attaching the motor support.
- Remove the motor support and motor assembly.
- Unscrew the 4 M3 screws **(11)** attaching the motor.
- Return the defective motor to the after sales service department STÄUBLI.
- Attach the new motor to its support with 4 M3 screws **(11)** tightened to a torque value of 2.1 Nm ± 0.14 Nm.
- Put the motor and motor support assembly in place.
- Put the belt **(7)** in place on the motor pulley.
- Install the 4 M4 screws **(10)** attaching motor , do not tighten down.
- Retighten the belt **(7)** using the screw **(6)**: Measure the tension with the BINDER TSM3 vibration frequency between 125 and 155 Hz.
- Tighten the 4 M4 screws **(10)** attaching the motor support to a torque value of 4.8 Nm ± 0.34 Nm.
- Connect the M4 motor power supply connector **(8)**.
- Put the plug **(4)** fitted with its plastic plug **(3)** back in place.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install the cover **(2)** on the arm.
- Tighten the 3 M5 screws **(1)** attaching the cover **(2)** to 5.7 Nm ± 0.4 Nm.



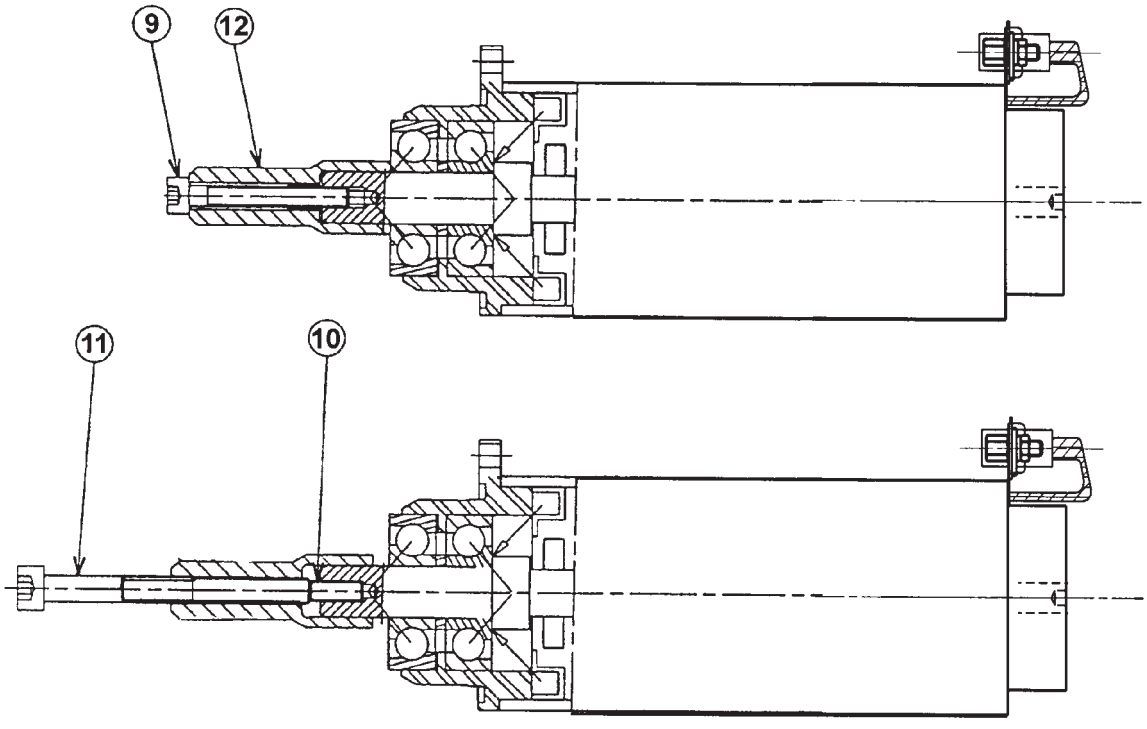


Figure 6.9

6.2.5. JOINTS 5 AND 6 **(figure 6.9)**

DANGER:

Follow the safety rules! See chapter 1.3.

CAUTION:

The replacement of joints 5 and 6 must be carried out at the factory or by a qualified technician.

- Remove the robot hand installed on the wrist **(5)** flange **(6)**.
- Unscrew the 3 M4 screws **(1)** attaching cover **(2)**.
- Unscrew the 3 M4 screws **(4)** attaching wrist **(5)**.
- Remove the motor wrist assembly to access the connectors **(7)** and **(8)**.
- Disconnect connectors **(7)** and **(8)**.
- Remove the handle/motor assembly.

Replacement of a motor

1) Unscrew the 3 M3 screws **(3)** attaching the motor.
2) Remove the defective motor.
3) Disassemble the worm screw. Proceed as follows:
    - Unscrew the CHc screw M4x30 **(9)**.
    - Screw a Hc grub-screw M4x12 **(10)** into the motor shaft.
    - Make sure that the screw does not protrude by more than 3 mm out of the end of the shaft.
    - Screw an M5x50 screw **(11)** into the worm screw and use it to extract the worm screw **(12)**.
    - Remove the worm screw.
4) Return the defective motor to the after sales service department STÄUBLI.
5) Install the screw on the new motor. Proceed as follows:
    - Perfectly clean the bore of screw **(12)** taking care not to damage the bore and to ensure that there are no traces of *Loctite* remaining at the bottom and on the walls of the bore.
    - Perfectly degrease the motor axle and the bore in the worm screw **(12)**.
    - Lightly apply ***Loctite 601*** inside the bore of the worm screw **(12)**.
    - Screw an M4x70 threaded rod into the motor shaft.
    - Install the worm screw **(12)** on the motor shaft.
    - Fit the worm screw **(12)** using an M4 nut that you screw on to the threaded rod.
    - Remove the threaded rod.
    - Tighten the CHc M4x30 screw **(9)** to a torque value of 4.8 Nm.
    - The motor can be handled after 45 mn.
6) Install the new motor.
7) Adjust the wheel and worm screw play. This adjustment must be carried out at the factory or by a qualified technician.
8) Tighten the 3 M3 screws **(3)** attaching motor to 2.1 Nm ± 0.14 Nm.
9) Plug in the connectors **(7)** and **(8)**.
10) Raise the motor handle assembly.
11) Tighten the 3 M4 screws **(4)** attaching the wrist to 3.6 Nm ± 0.25 Nm.

CAUTION:

Check that connector frames correspond to motors.

- Replace the joint on the cover **(2)**.See chapter 5.3
- Install cover **(2)**.
- Tighten the 3 M3 screws **(1)** to 1.6 Nm ± 0.11 Nm.

6.3. REPLACEMENT OF A MOTOR – MOUNT ON CEILING VERSION

DANGER:

Follow the safety rules! See chapter 1.3.

Before carrying out any work on the motors, the DAPS board backup supply switch MUST be set to OFF (0).

6.3.1. JOINT 1

- Place the arm in position on the floor.
- Replace the joint 1 motor, follow the procedure in paragraph 6.2.1.

6.3.2. JOINT 2

Replace the joint 2 motor, follow the procedure in paragraph 6.2.2.

6.3.3. JOINT 3

Replace the joint 3 motor, follow the procedure in paragraph 6.2.3.

6.3.4. JOINT 4

Replace the joint 4 motor, follow the procedure in paragraph 6.2.4.

6.3.5. JOINTS 5 AND 6

Replace the joint 5 and 6 motor, follow the procedure in paragraph 6.2.5.

CHAPTER 7

PREVENTIVE MAINTENANCE

To keep the performance of the arm at an optimal level the arm requires preventive maintenance.

The maintenance operations must be carried out by persons who have followed the appropriate course given by STÄUBLI.

CAUTION:
To ensure a correct seal, the joint must be replaced each time a cover is removed (see chapter 5.3).

7.1. MAINTENANCE FREQUENCY

After 5000 hours (or once a year):

- Check the general condition of the arm.
- Check the oil level for each seal.
- Check the condition of the harness (visible parts).

After 20 000 hours:

- Change the oil in joints 4, 5 and 6.

CAUTION:
Consult STÄUBLI to define a preventive maintenance programme adapted to the use you make of the arm.

After 40 000 hours:

- Change the oil in all the joints.

CAUTION:
Consult STÄUBLI to define a preventive maintenance programme adapted to the use you make of the arm.

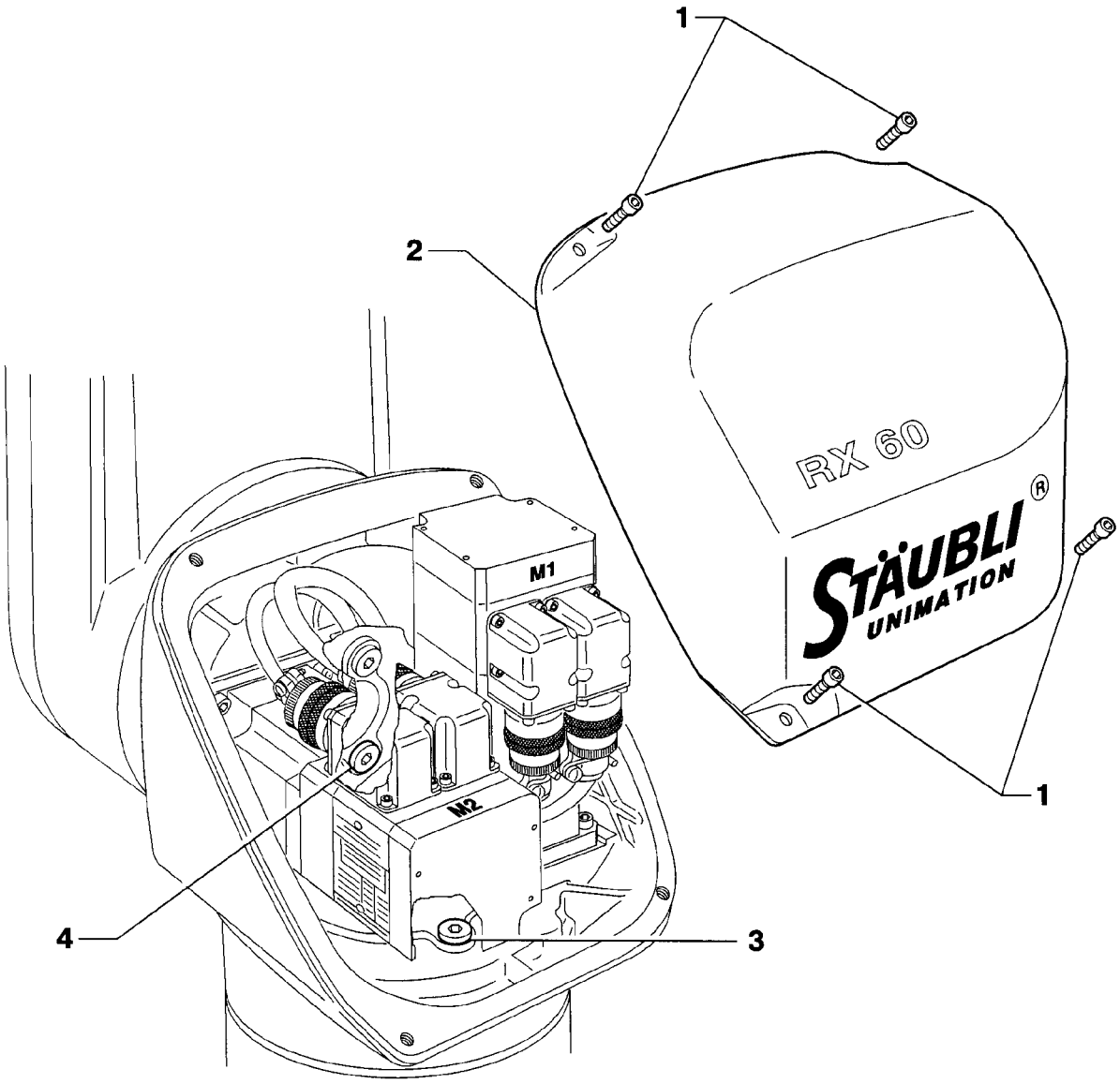


Figure 7.1

7.2. CHECKING OIL LEVELS – STANDARD VERSION

7.2.1. JOINT 1 **(figure 7.1)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- Unscrew the plug **(3)**.
- Check that the oil level is flush with the lower face of the crown gear.
- Top up with oil*, if necessary, through the hole from which the plug **(3)** has been removed.
- Tighten the plug **(3)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install cover **(2)**.
- Tighten the 4 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

7.2.2. JOINT 2 **(figure 7.1)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- The arm is in "Ready" position.
- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- Unscrew the plug **(4)**.
- Check that the oil level is flush with the lower part of the tapped hole.
- Top up with oil*, if necessary, through the hole from which the plug **(4)** has been removed.
- Tighten the plug **(4)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install cover **(2)**.
- Tighten the 4 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

(*) Recommended oil: see spare parts.

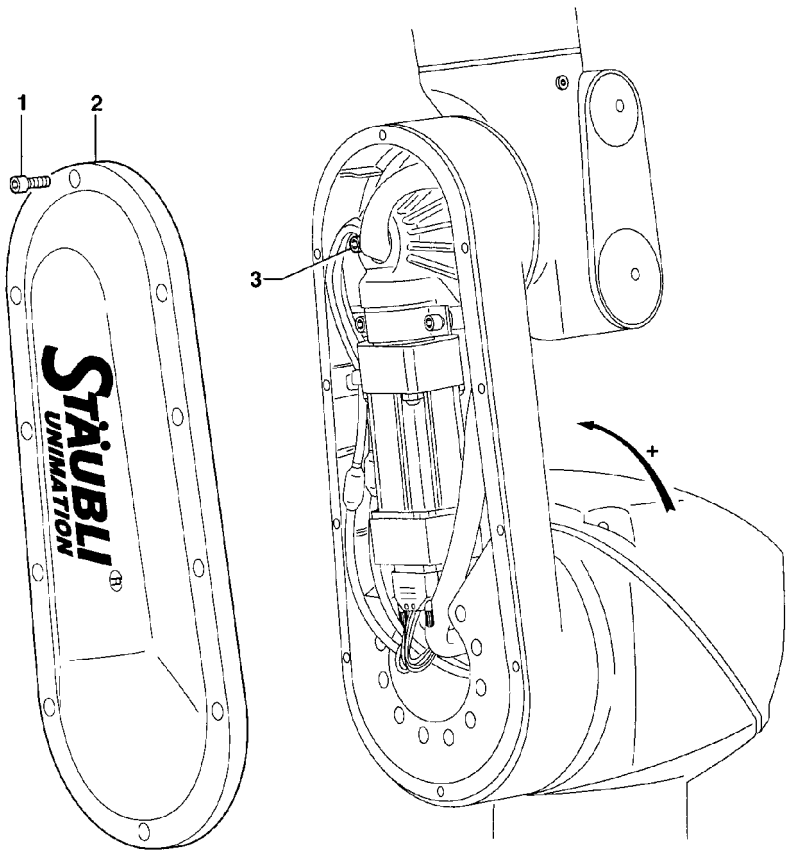


Figure 7.2

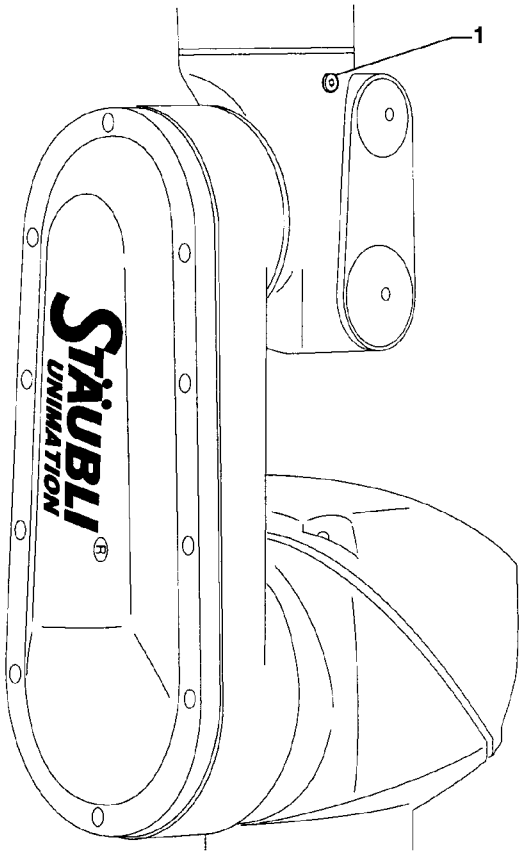


Figure 7.3

7.2.3. JOINT 3 **(figure 7.2)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Tilt the arm by 15° in the positive direction with respect to the Ready position.
- Unscrew the 10 M5 screws **(1)** attaching cover **(2)**.
- Remove the cover **(2)** from the arm.
- Unscrew the plug **(3)**.
- Check that the oil level is flush with the lower part of the tapped hole.
- Top up with oil*, if necessary, through the hole from which the plug **(3)** has been removed.
- Tighten the plug **(3)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install cover **(2)**.
- Tighten the 10 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

7.2.4. JOINT 4 **(figure 7.3)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Put the arm in the "Ready" position.
- Unscrew the plug **(1)**.
- Check that the oil level is flush with the lower part of the hole from which the plug has been removed.
- Top up with oil* through the same hole.
- Tighten the plug **(1)** to torque value 4 Nm ± 0.3 Nm.

(*) Recommended oil: see spare parts.

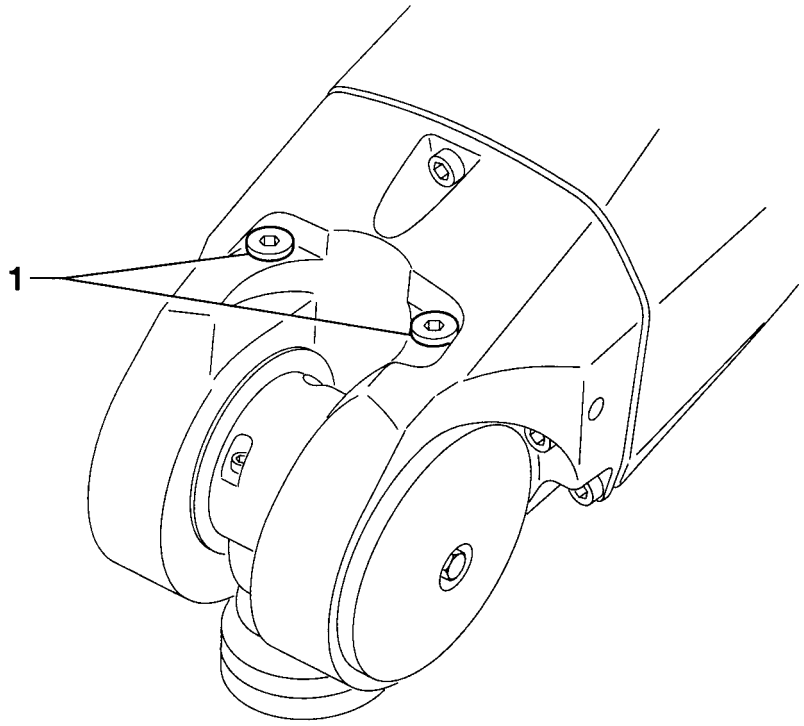


Figure 7.4

7.2.5. JOINTS 5 AND 6 **(figure 7.4)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Position the robot in such a way that the forearm is horizontal, with the plugs **(1)** facing upwards and the axis 6 upright.
- Unscrew the **(1)** caps.
- Check that the oil level is flush with the worm screw's thread roots.
- Top up with oil*, if necessary, through the hole from which the plug **(1)** has been removed.
- Screw down the caps **(1)**, with a torque of 4 Nm ± 0.3 Nm.

(*) Recommended oil: see spare parts.

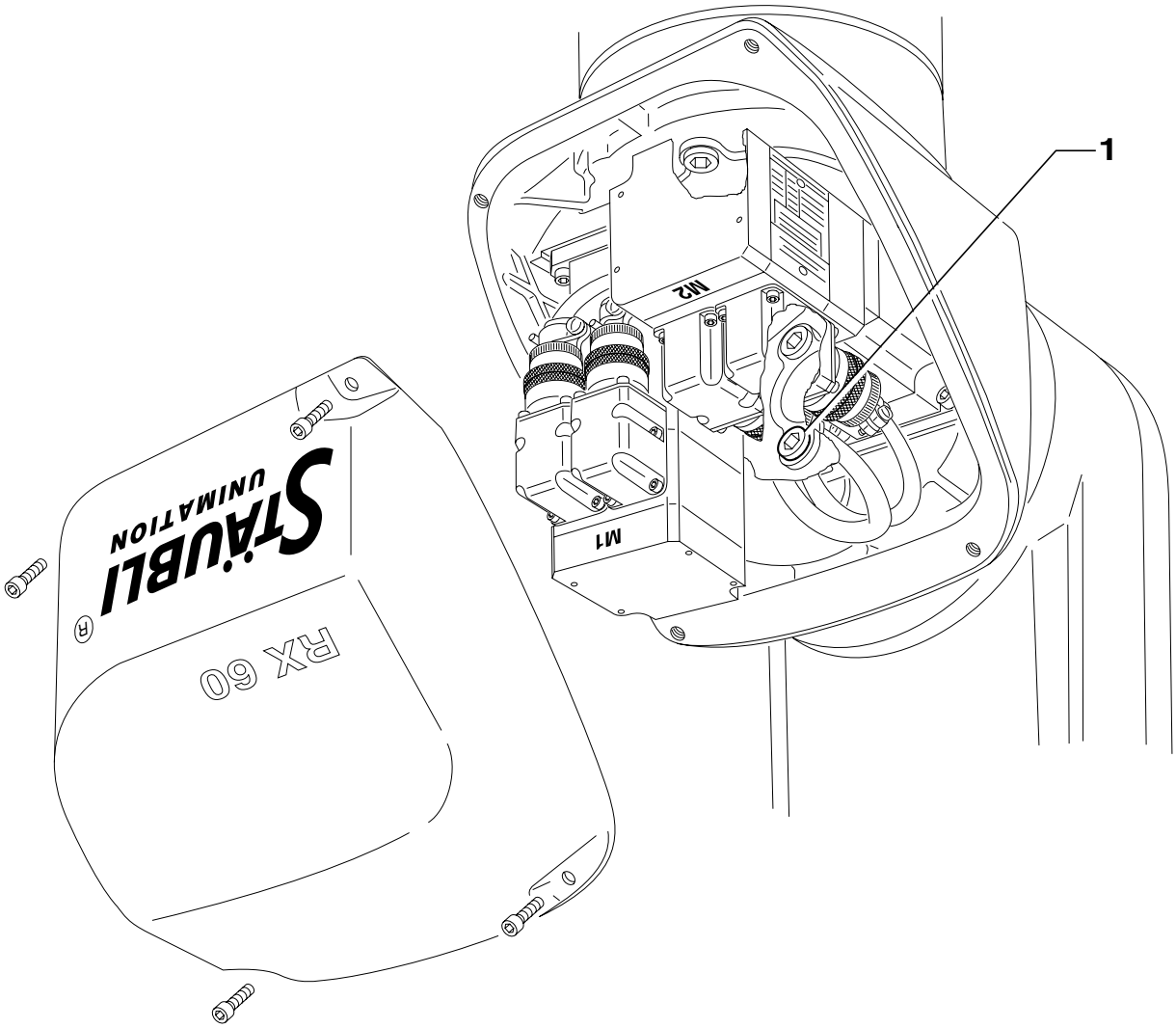


Figure 7.5

7.3. CHECKING OIL LEVELS – MOUNT ON CEILING VERSION

7.3.1. JOINT 1

DANGER:
Follow the safety rules! See chapter 1.3.

- Remove the arm from its support by proceeding in the reverse order to installation.
- Place the arm in position on the floor.
- Follow the arm on floor procedure.

7.3.2. JOINT 2 **(figure 7.5)**

DANGER:
Follow the safety rules! See chapter 1.3.

Follow the same procedure as for the floor mounted robot version using plug **(1)**.

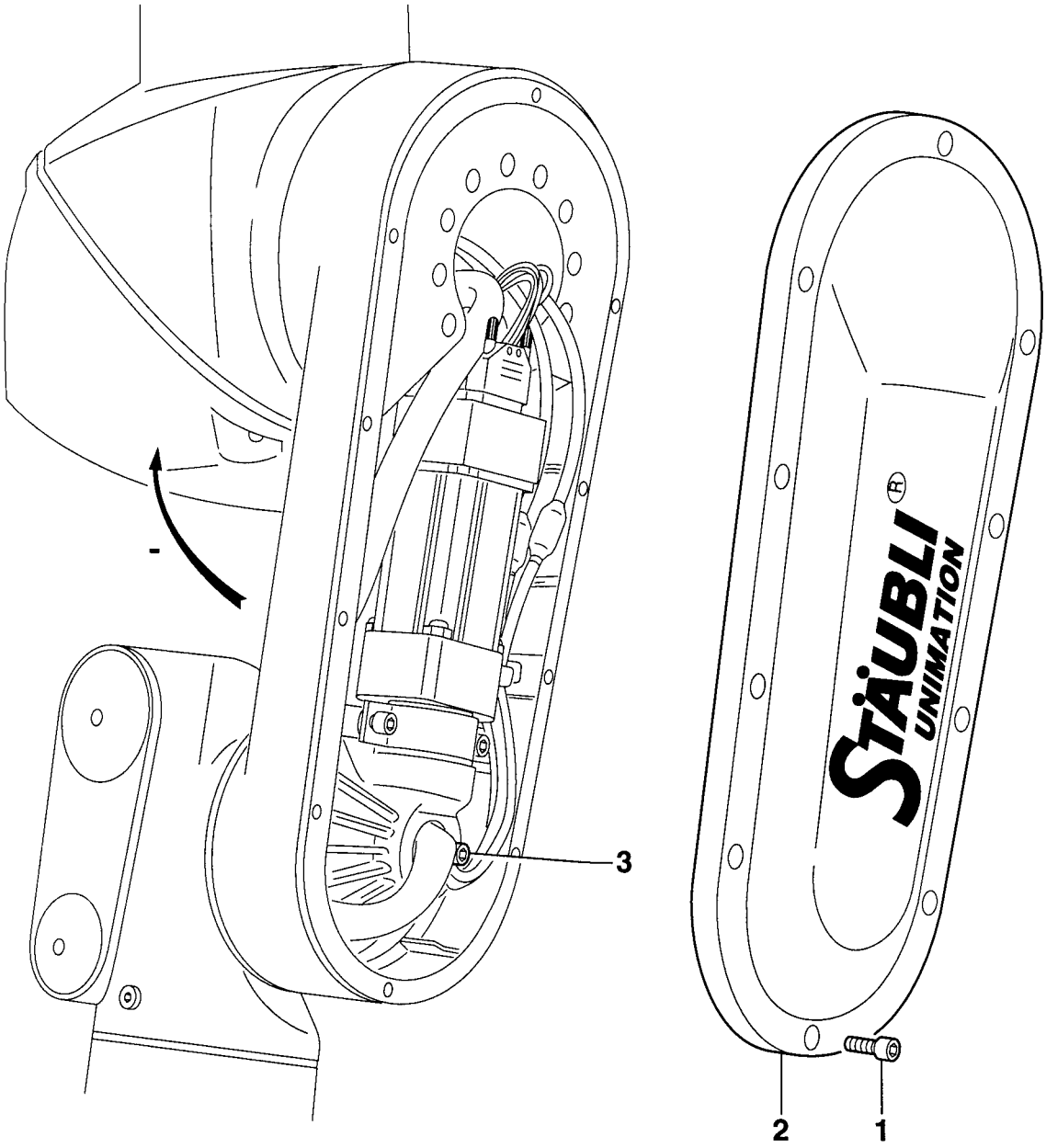


Figure 7.6

7.3.3. JOINT 3 **(figure 7.6)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Tilt the arm by 15° in the negative direction with respect to the Ready position.
- Unscrew the 10 M5 screws **(1)** attaching cover **(2)**.
- Remove the cover **(2)** from the arm.
- Unscrew the plug **(3)**.
- Check that the oil level is flush with the lower part of the hole from which the plug has been removed.
- Top up with oil* through the same hole.
- Fill up to the lower level of the hole from which the plug has been removed.
- Tighten the plug **(3)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- **Install the cover (2) on the arm.**
- Tighten the 10 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

7.3.4. JOINT 4 **(figure 7.6)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

Follow the arm on floor procedure.

7.3.5. JOINTS 5 AND 6

Resume the procedure for verifying the wrist casing levels (see paragraph 7.2.5).

(*) Recommended oil: see spare parts.

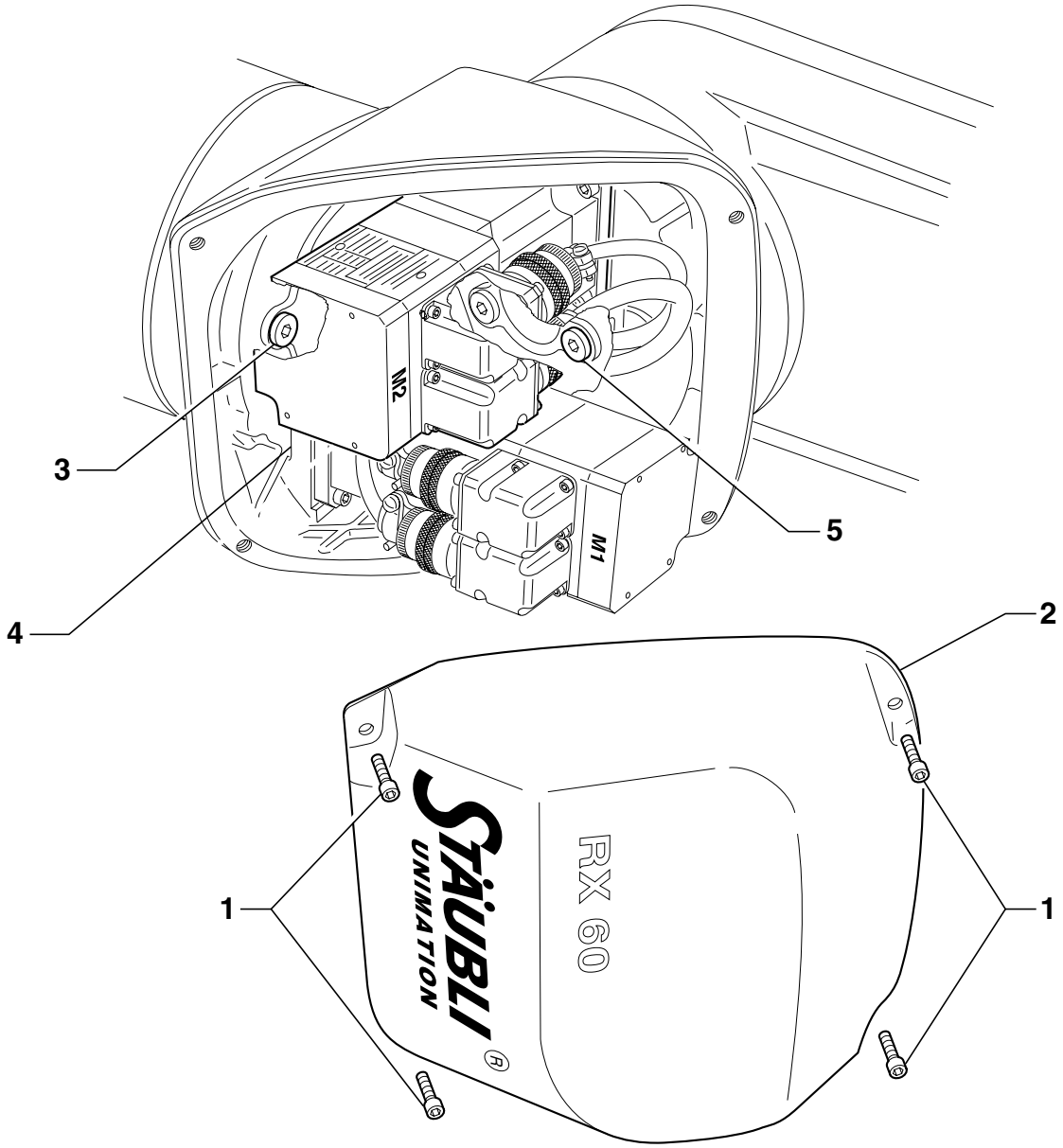


Figure 7.7

7.4. CHECKING OIL LEVELS – WALL VERSION

7.4.1. JOINT 1 **(figure 7.7)**

DANGER:
Follow the safety rules! See chapter 1.3.

- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- By acting on axis 1, tilt the plug **(3)** by 15° downwards starting from the Ready position (axis 2 horizontal).
- Unscrew the plug **(3)**.
- Check that the oil level is flush with the lower part of the hole from which the plug has been removed.
- Top up with oil* through the same hole.
- Fill up to the lower level of the hole from which the plug has been removed.
- Tighten the plug **(3)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install shoulder cover **(2)**.
- Tighten the 4 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

7.4.2. JOINT 2 **(figure 7.7)**

DANGER:
Follow the safety rules! See chapter 1.3.

- Unscrew the 4 M5 screws **(1)** attaching cover **(2)**.
- Remove shoulder cover **(2)**.
- By acting on axis 1, position the axis 2 motor **(4)** towards the top.
- Unscrew the plug **(5)**.
- Check that the oil level is flush with the lower part of the hole from which the plug has been removed.
- Top up with oil* through the same hole.
- Fill up to the lower level of the hole from which the plug has been removed.
- Tighten the plug **(5)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install shoulder cover **(2)**.
- Tighten the 4 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

(*) Recommended oil: see spare parts.

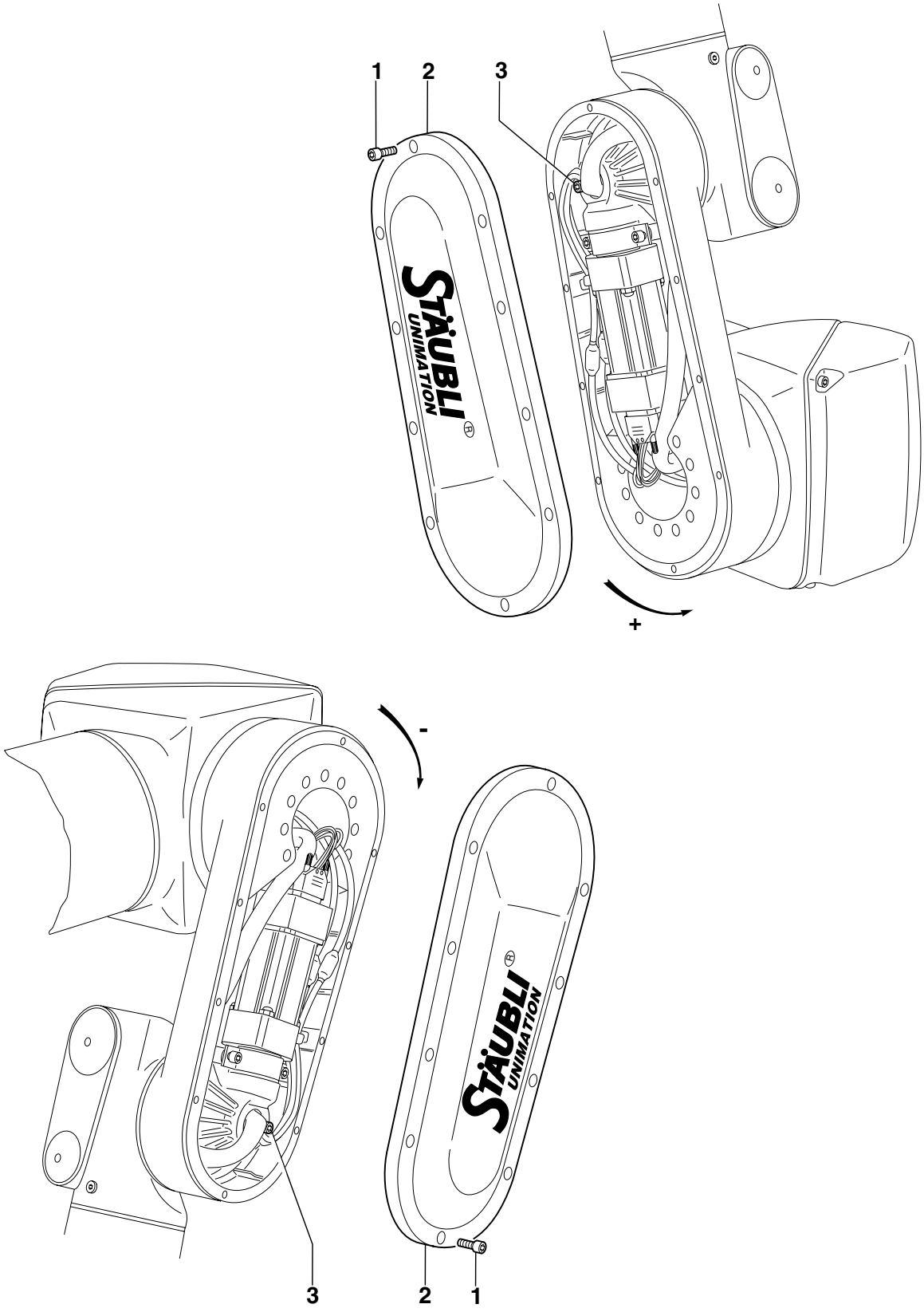


Figure 7.8

7.4.3. JOINT 3 **(figure 7.8)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

- Tilt the arm by ±105° with respect to the Ready position according to the desired position (high or low).
- Unscrew the 10 M5 screws **(1)** attaching cover **(2)**.
- Remove the cover **(2)** from the arm.
- Unscrew the plug **(3)**.
- Check that the oil level is flush with the lower part of the hole from which the plug has been removed.
- Top up with oil* through the same hole.
- Fill up to the lower level of the hole from which the plug has been removed.
- Tighten the plug **(3)** to torque value 4 Nm ± 0.3 Nm.
- Replace the joint on the cover **(2)**.See chapter 5.3.
- Install the cover **(2)** on the arm.
- Tighten the 10 M5 screws **(1)** to 5.7 Nm ± 0.4 Nm.

7.4.4. JOINT 4 **(figure 7.8)**

> **DANGER:**
> **Follow the safety rules! See chapter 1.3.**

Follow the arm on floor procedure.

7.4.5. JOINTS 5 AND 6

Resume the procedure for verifying the wrist casing levels (see paragraph 7.2.5).

(*) Recommended oil: see spare parts.

CHAPTER 8

RECOMMENDED SPARE PARTS

- Mobil SHC 626 oil*
- Mobil SHC 634 oil* for the wrist and axis 4)
- Mobil SHC 639 oil* for the wrist and axis 4) (Consult STÄUBLI)
- Solenoid valve
- Pneumatic harness
- Motor, axis 1 and 2
- Motor, axis 3
- Motor, axis 4
- Motor, axis 5
- Motor, axis 6
- O-ring for motor, axis 1 and 2
- O-ring for motor, axis 3
- Electrical harness
- Brake selection board
- Cover seal kit

* Maximum oil quantity

SHC 634 :	Wrist	80 cm^3
(or SHC 639)	Axis 4	50 cm^3
SHC 626 :	Axis 1, 2, 3	355 cm^3