

Arm - TX series 60 family

Characteristics



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CHAPTER 1

DESCRIPTION

1.1. IDENTIFICATION

Manufacturer's plate on each robot.

There is a plate riveted on the controller and arm (see figure 1.2).

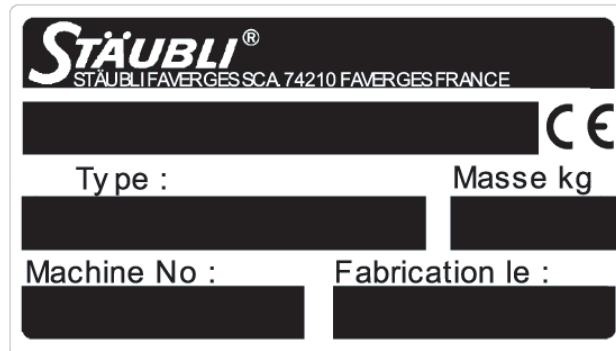


Figure 1.2

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.

1.2. GENERAL PRESENTATION

The arm consists of segments or members interconnected by joints (**figure 1.1**).

Movements on the arm joints are generated by servomotors coupled with position sensors. Each of these motors is equipped with a parking break.

This reliable and robust assembly associated with an innovative counting system allows the absolute position of the robot to be known at all times.

The arm assembly is sufficiently 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 restrictive: 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 1.1**).

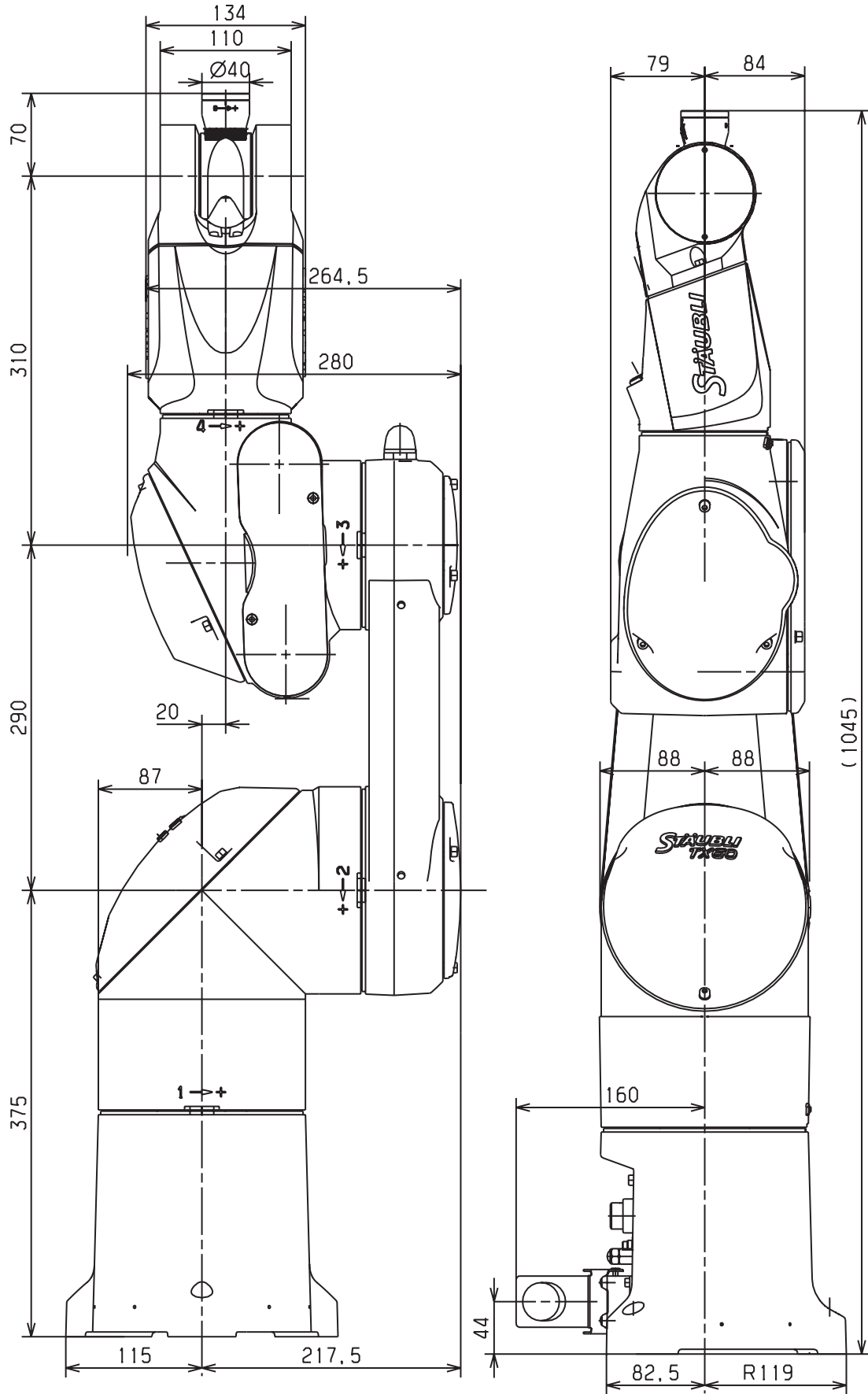


Figure 1.3 - Standard arm

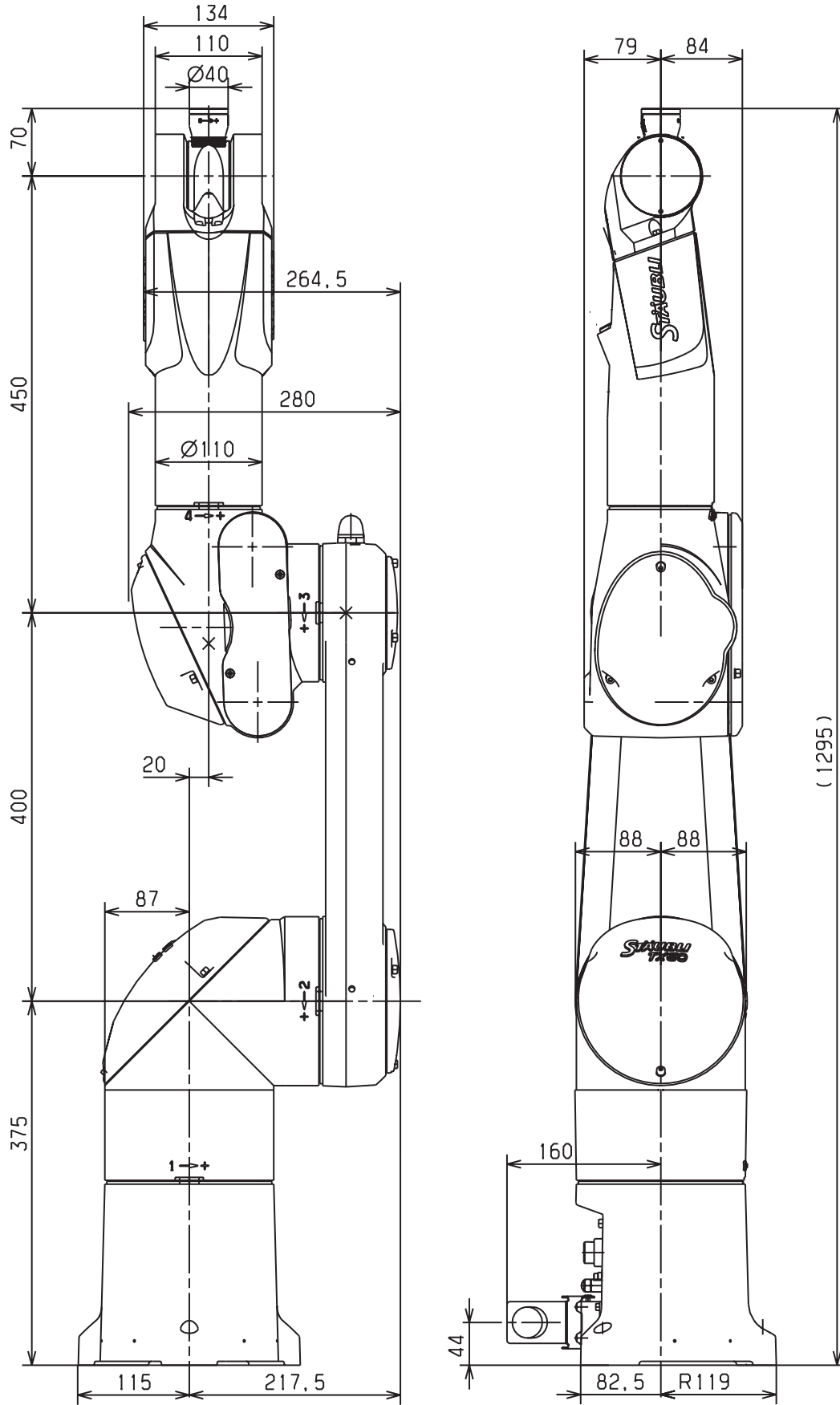
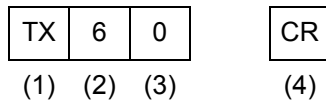


Figure 1.4 - Long arm

1.3. DESIGNATION OF ROBOTS OF THE TX SERIES 60 FAMILY



- (1) TX family arm
- (2) Maximum reach between joints 1 and 5 expressed in decimeters:
dimension (A) + dimension (B).
- (3) Number of active joints:
• 0 = 6 active axis.
- Upper case letters to indicate an option.
- L = long version.
 - CR = clean room application.
- (4) • SCR = ultra-clean room application.

These letters can be combined.

Example: LCR = Long arm for clean room applications.

In the manual, the following terminology is used:

Standard arm: for arm with standard geometry **(figure 1.3)**.

Arm L: arm with a different shape where the forearm and the arm are longer **(figure 1.4)**.

1.4. GENERAL CHARACTERISTICS

1.4.1. DIMENSIONS

See figures 1.3, 1.4 and 1.5.

1.4.2. WORK ENVIRONMENT

- Working temperature: + 5°C to + 40°C (in accordance with standard directive 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 (in accordance with standard directive NF EN 60 204-1).
- Altitude: 2000 m max.
- Vibrations: please consult us.

Clean room application:

- CR: cleanliness class 4 in accordance with standard 14644-1.
- SCR: cleanliness class 3 in accordance with standard 14644-1.

IP65 arm protection and IP67 wrist protection in accordance with standard NF EN 60529 with electric connectors or plugs in place.

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 1.10, page 31.

1.4.3. WEIGHT

Standard arm	Long arm
51.4 kg	52.5 kg

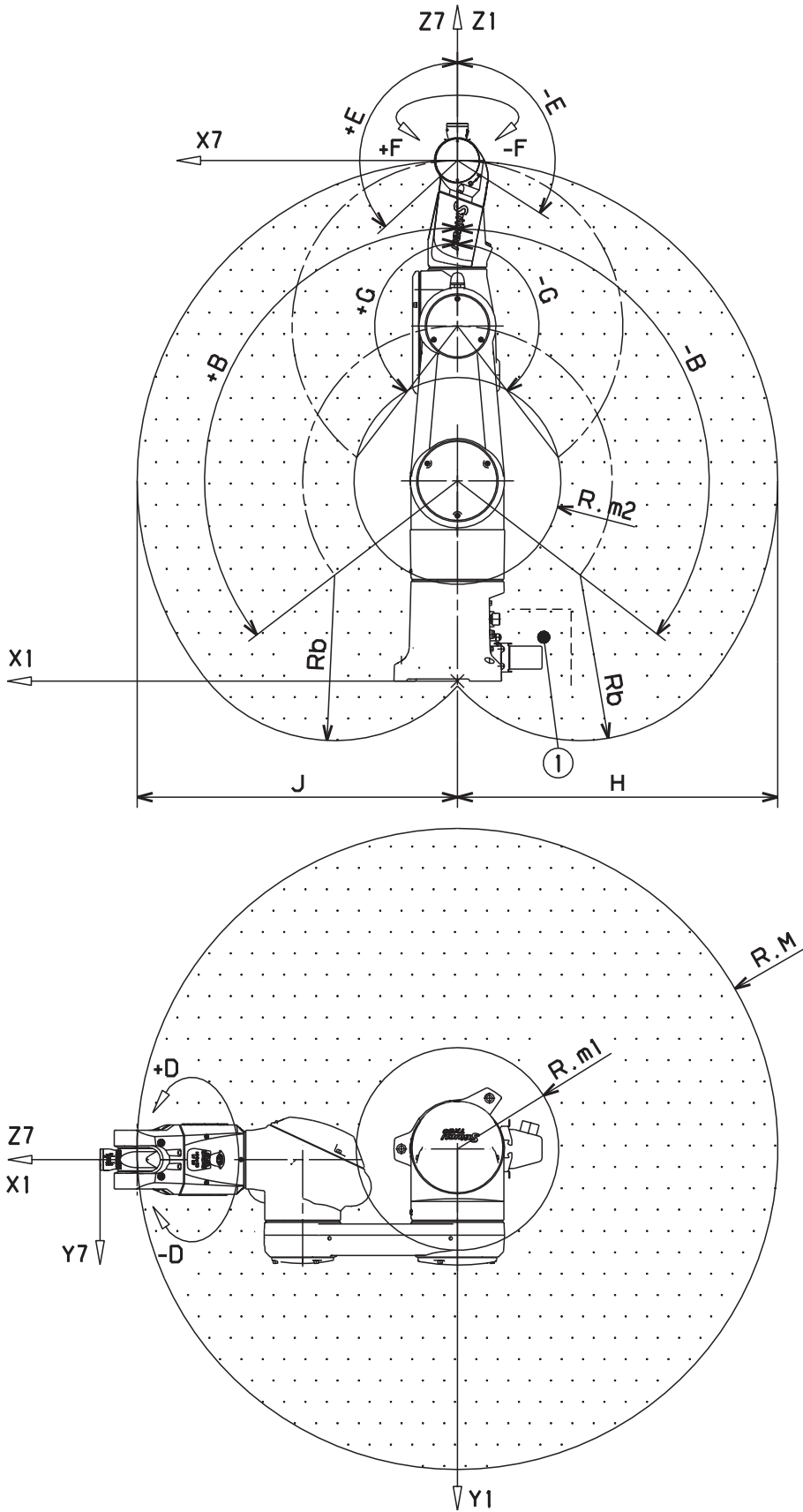


Figure 1.5

1.5. PERFORMANCE

See figure 1.5 1 Brake release access area

	Standard arm	Long arm
Work envelope		
R.M max. reach between axis 1 and 5	600 mm	850 mm
R.M max. reach between axis 2 and 5	600 mm	850 mm
R.m1 min. reach between axis 1 and 5	190 mm	209 mm
R.m2 min. reach between axis 2 and 5	189 mm	208 mm
R.b reach between axis 3 and 5	310 mm	450 mm
Maximum speed at load center of gravity	8 m/s	10.6 m/s
Repeatability at constant temperature	± 0.02 mm	± 0.03 mm

1.5.1. AMPLITUDE, SPEED, RESOLUTION, REPEATABILITY

axis	1	2	3		4	5	6
			TX60	TX60L			
Amplitude (°)	360	255	285	305	540	255	540 ⁽¹⁾
Working range distribution (°)	A ± 180	B ± 127.5	C ± 142.5	C ± 152.5	D ± 270	E + 133.5 - 122.5	F ± 270
Nominal speed (°/s) TX60	287	287	431		410	320	700
Maximum speed (°/s) ⁽²⁾	373	373	500		968	800	1125
Angular resolution (°.10 ⁻³)	0.057	0.057	0.057		0.114	0.122	0.172

(1) Can be configured by software up to 18 000°.

(2) Maximum speed for reduced conditions of load and inertia.

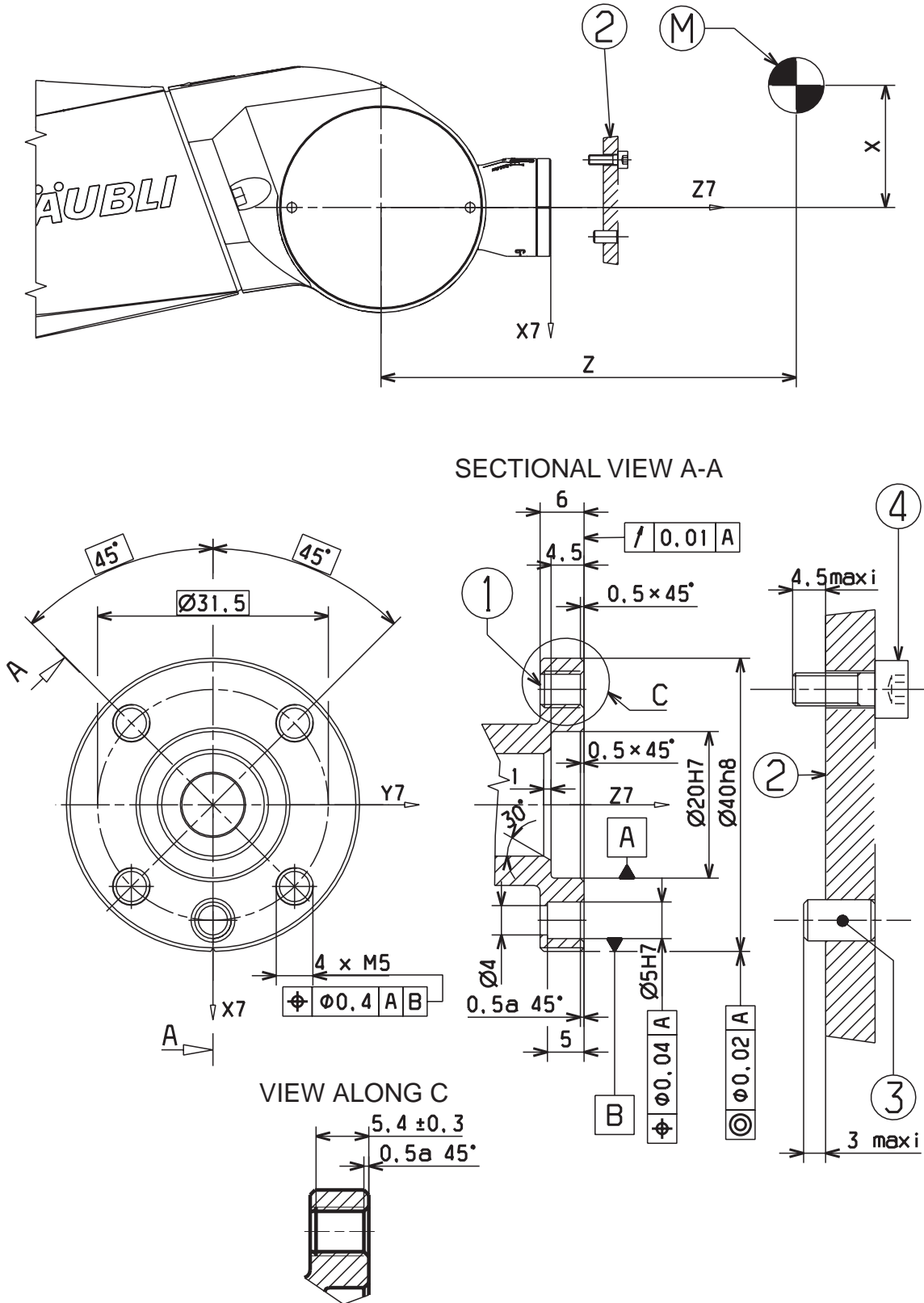


Figure 1.6

- ① Mechanical interface
- ② End-effector

1.6. LOAD CAPACITY – MECHANICAL INTERFACE

See **figure 1.6**.

The end-effector is not supplied with the robot 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 end-effector is installed on the mechanical interface of the wrist dimensions of which are given on **figure 1.6**.

Secured by 4 class 12-9 screws M5 **(4)**, tightening torque 9.5 Nm ± 0.7 Nm.

Indexing via pin **(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:

Length of end-effector attaching screws is limited to avoid all interference with the wrist (figure 1.6).

1.6.1. LOAD CAPACITY (figure 1.6)

Load characteristics:

- ① Load center of gravity position : z = 100 mm as compared with axis 5 and x = 50 mm.

Load capacity	Standard arm		Long arm	
	Floor or ceiling configuration	Wall configuration	Floor or ceiling configuration	Wall configuration
At nominal speed	3.5 kg		2 kg	
At reduced speed ⁽¹⁾	4.5 kg		3.7 kg	

(1) in all configurations and taking maximum inertias into account. See table below.

	Nominal inertias (kg.m ²)		Maximal inertias (kg.m ²) ⁽²⁾	
	Standard arm	Long arm	Standard arm	Long arm
For joint 5	0.045	0.025	0.325	0.2
For joint 6	0.009	0.005	0.1	0.05

(2) under reduced speed and acceleration conditions.

Generally: VEL = 60%, ACC = 30%, DEC = 30% (consult us)

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.

VIEW ALONG G

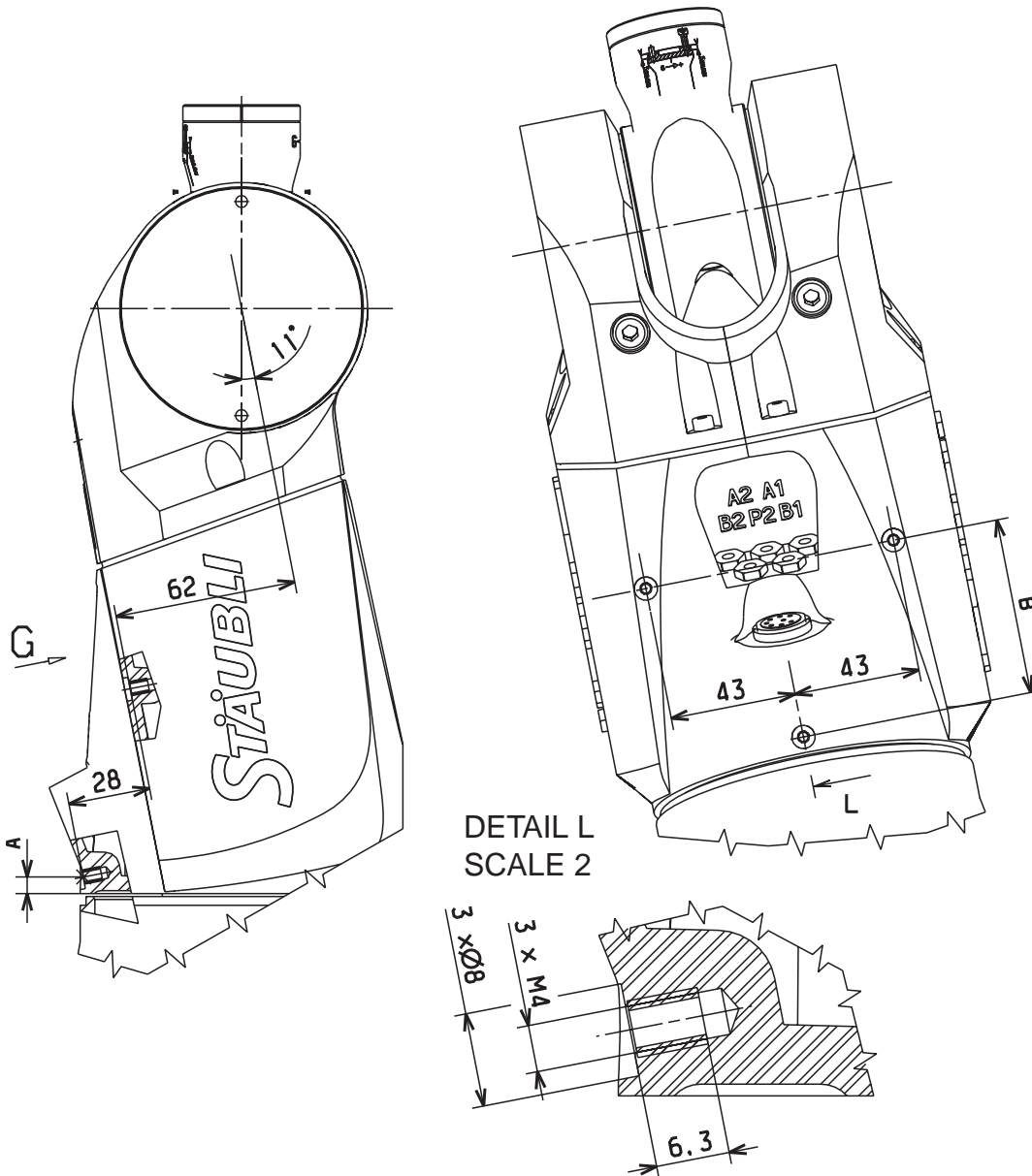


Figure 1.7

1.6.2. TORQUE LIMITS

	Reference axis			
	axis 4	axis 5 (Z6)		axis 6 (Z7)
		With torque / joint 6	With torque / joint 6	
Static torque (Nm)	7	10	8	2

Note:

These pairs are available for a load carried equal to 0 kg.

1.6.3. ATTACHMENT OF ADDITIONAL LOAD ON FOREARM

See **figure 1.7**.

An additional load can be attached to the forearm using 3 M4 screws; maximum torque is 3 Nm.

Position of 3 M4 tapped holes: See **figure 1.7**.

Dimensions	Standard arm	Long arm
A	5.6 mm	117.4 mm
B	60 mm	88 mm

CAUTION:

The additional load depends on nominal load (see next page). In all cases, do not exceed load characteristics.

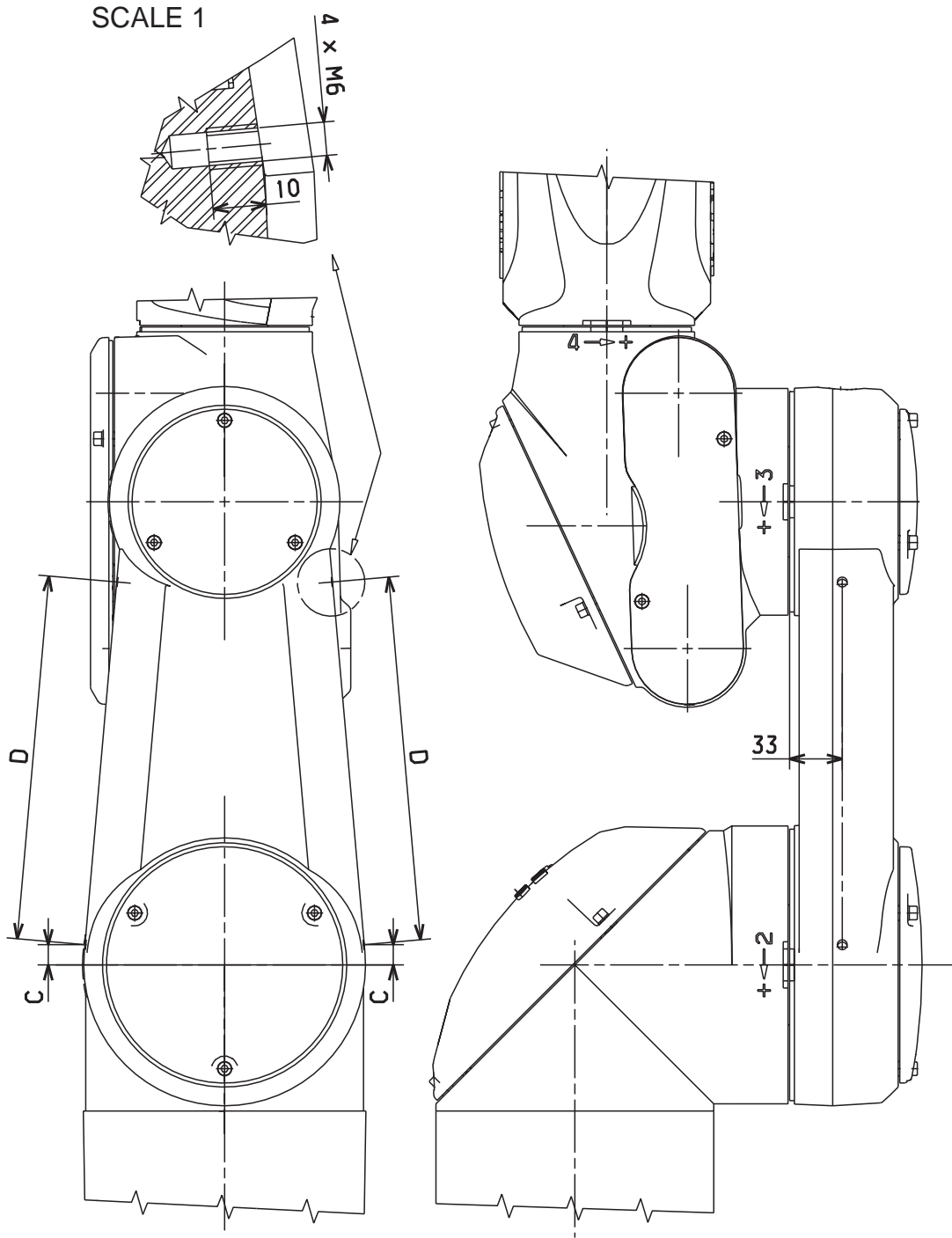


Figure 1.8

1.6.4. FIXING THE AUXILIARY HARNESS ON THE ARM CASING

See **figure 1.8**.

Dimensions	Standard arm	Long arm
D	228 mm	337.5 mm
C	33 mm	33 mm

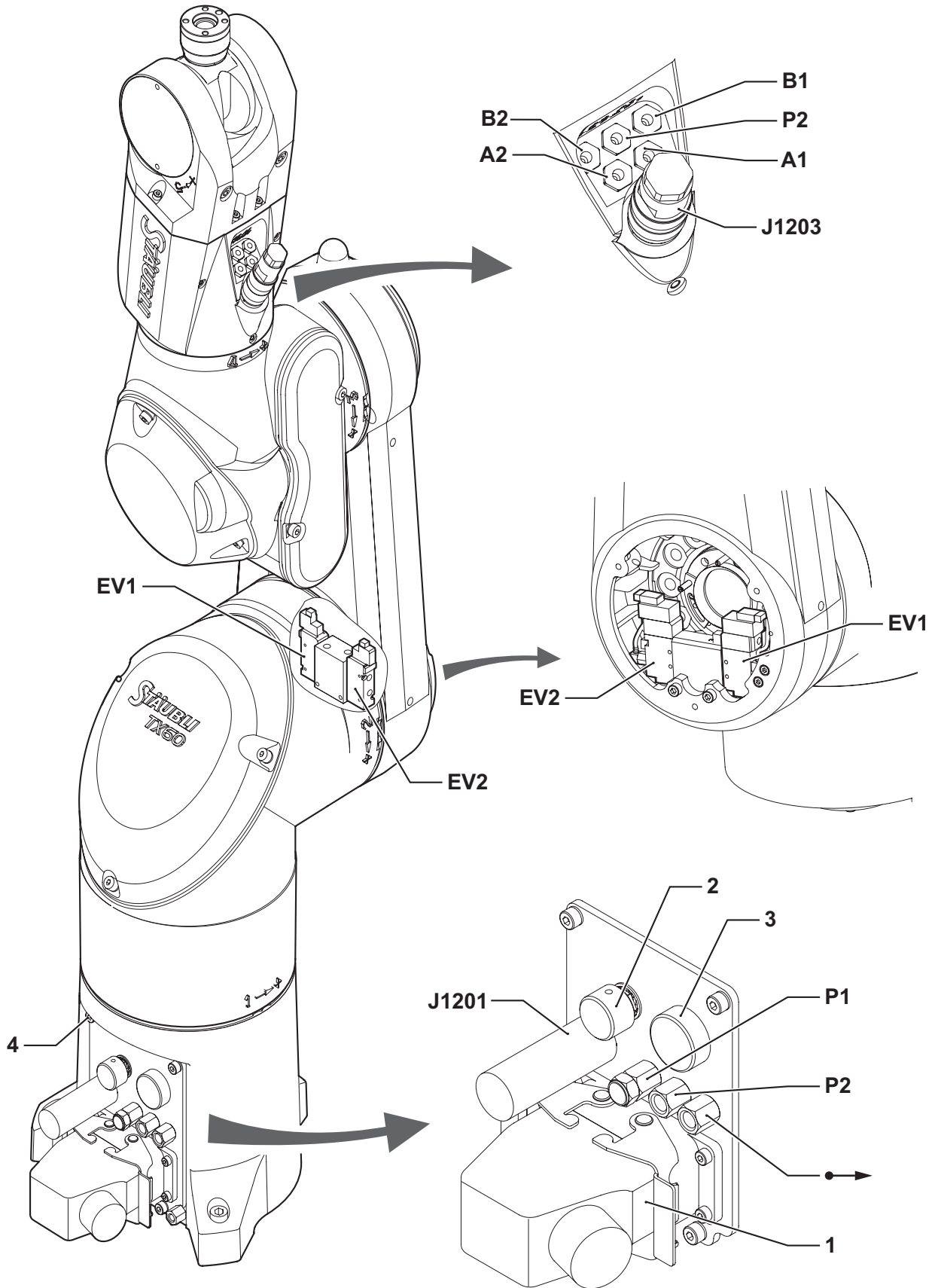


Figure 1.9

1.7. LOGIN USER

See **figure 1.9**.

The electric wiring of the arm is assembled into a harness including several cables supplying the motors (power, brakes, resolvers), the solenoid valves, the limit switches and login user. 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 robot also has a pressure source (**P2**) close to the tool clamp.


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**.

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 1.9) :

- Arm/(1) controller interconnection socket.
- Binder connector intended for the user for possible electrical connection of grip (**J1201**).
- Brake release selector (**2**).
- Brake release pushbutton (**3**).
- Pneumatic connections to the **P1** and **P2** compressed air networks.
- Connection for creating overpressure in the **P3** arm.

CAUTION:
The overpressure must never exceed 20 mbar.

- Pneumatic exhaust muffler  .
- Arm ground connection (**4**).

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.

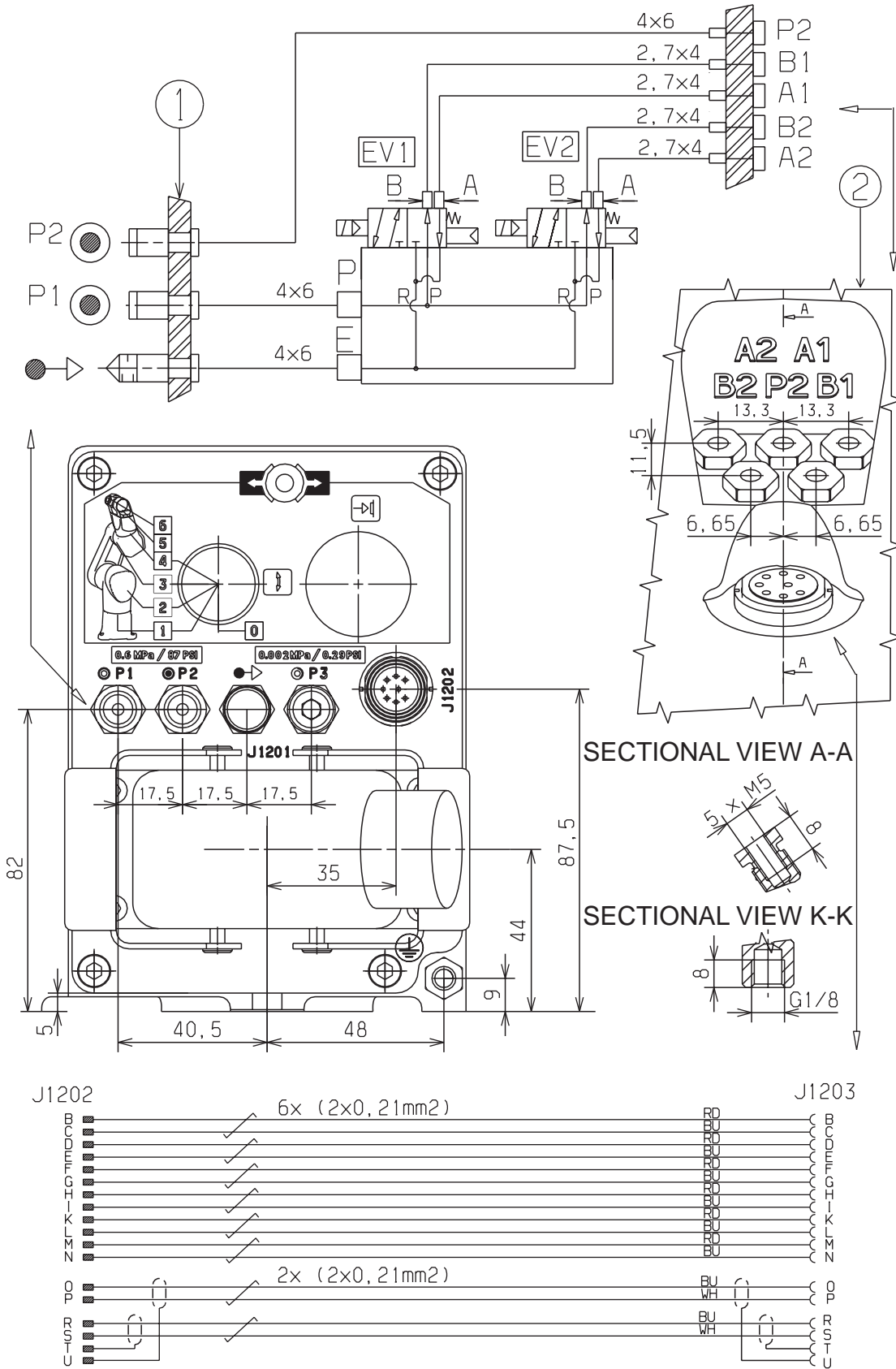


Figure 1.10

1.8. PNEUMATIC CIRCUITS (USING COMPRESSED AIR) AND ELECTRIC CIRCUITS WITH STANDARD ROBOT EQUIPMENT (OR CLEAN ROOM AS AN OPTIONAL EXTRA)

1.8.1. PNEUMATIC CIRCUIT

- ① Plate attached to base
- ② Forearm


Solenoid valves (EV1 and EV2):

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

Description (figure 1.10):

- The arm is connected to the compressed air network (7 bars max., lubricated or not) via the base **P1**.

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

- 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 .
- An orifice (**P3**) is provided to connect the pressurization system, if used, to the base of the robot.

CAUTION:
Do not use this orifice for other purposes.

1.8.2. ELECTRIC CIRCUIT

The electrical circuit consists of:

- A male 19-contact socket at the bottom of the arm.
- A female 19-contact socket on the forearm.

The contacts are connected in the following way:

- 2 shielded twisted pairs, cross-section AWG24.
- 6 twisted pairs, cross-section AWG24.

Supply voltage: 75 VDC - 60 VAC.

Permissible current:

- Pairs and shielded pairs AWG24: 1 A per contact.

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

- Connection to the forearm (**J1203**) via a Binder straight male cylindrical connector.
- Connection to base (**J1202**) by Binder straight female cylindrical connector.

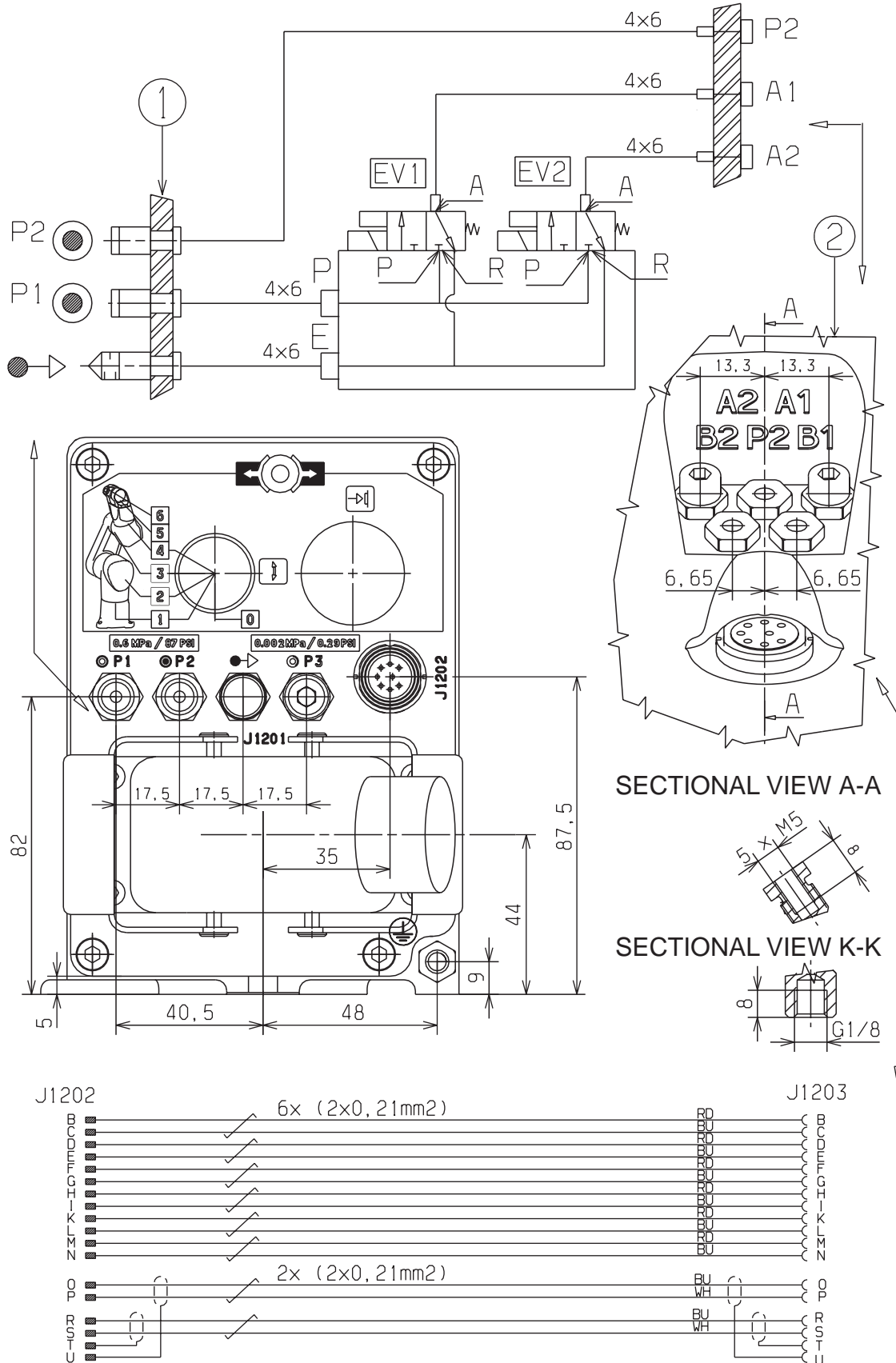


Figure 1.11

1.9. PNEUMATIC CIRCUITS (USING VACUUM) AND ELECTRIC CIRCUITS WITH CLEAN ROOM ROBOT EQUIPMENT (OR STANDARD EQUIPMENT AS AN OPTION)

1.9.1. PNEUMATIC CIRCUIT

- ① Plate attached to base
- ② Forearm

Solenoid valves (EV1 and EV2):

- 3/2-way monostable.
- Electrically controlled (24 VDC).
- Max. working pressure: vacuum only ~ - 0.8 bar.
- Flow coefficient Kv: 2.86 S = 3.6 mm².
- Clip-on connector.

Description (figure 1.11):

- The arm is connected to the vacuum network via the base (**P1**).
- There is a direct line between the base and the forearm (**P2**).
- Max. working pressure: vacuum only.

CAUTION:

Cleanliness of sucked in air must be equivalent to 10 µm filtered air.

1.9.2. ELECTRIC CIRCUIT

The electrical circuit consists of:

- A male 8-contact socket at the bottom of the arm.
- A female 8-contact socket on the forearm.

The contacts are connected in the following way:

- 2 shielded twisted pairs, cross-section AWG24.
- 6 twisted pairs, cross-section AWG24.

Supply voltage: 75 VDC - 60 VAC.

Permissible current:

- Pairs and shielded pairs AWG24: 1 A per contact.

CAUTION:

Do not use the shields as a conductive cable.

- Connection to the forearm (**J1203**) via a Binder straight male cylindrical connector.
- Connection to base (**J1202**) by Binder straight female cylindrical connector.

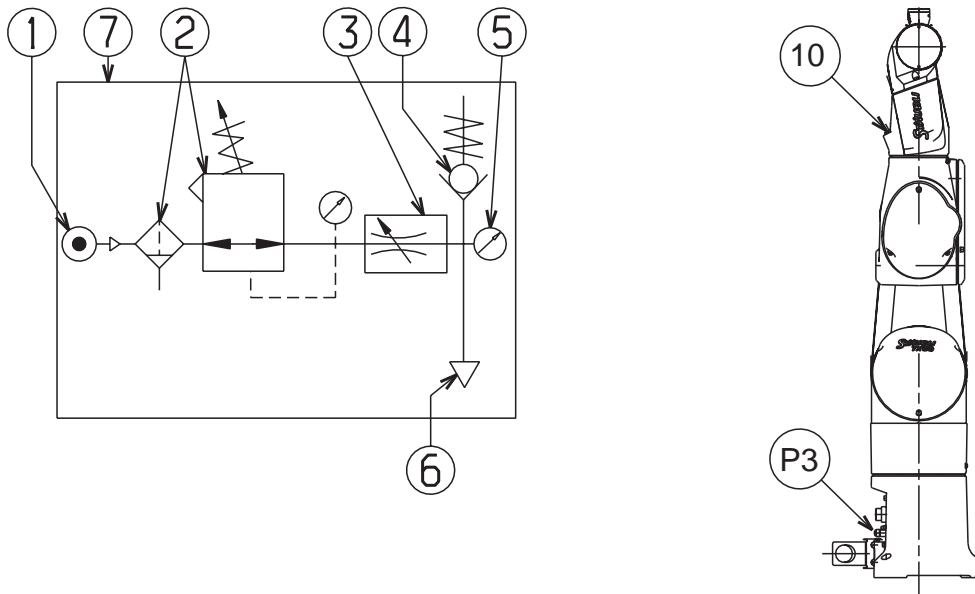


Figure 1.12

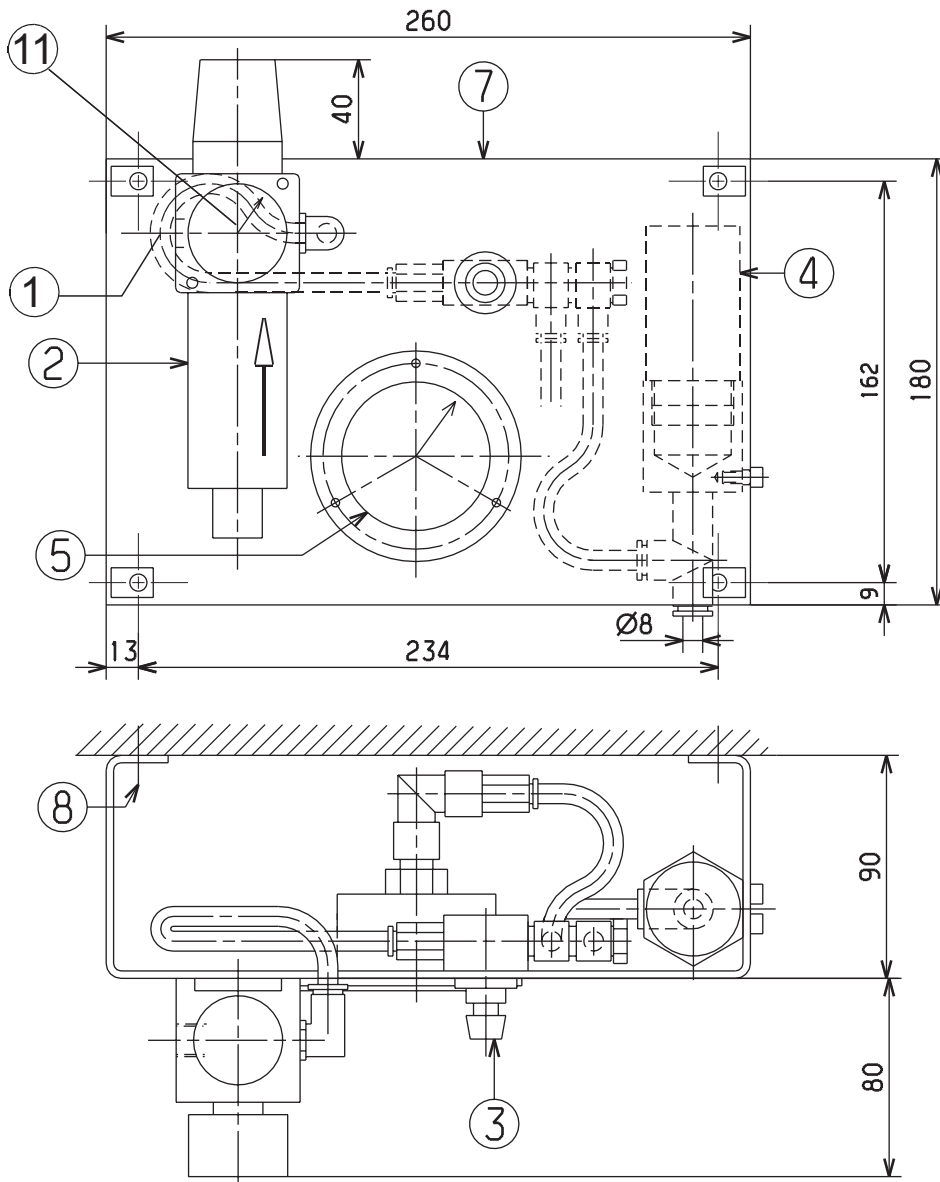


Figure 1.13

1.10. PRESSURIZATION SYSTEM FOR DUSTY SURROUNDINGS OR SPATTERING WITH LIQUIDS

1.10.1. 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.

1.10.2. INSTALLATION (figures 1.12 and 1.13)

- Use orifice (**P3**) to connect the pressurization system to the base of the robot.
- 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 (**P3**), etc.).
- Install a pipe with an outside Ø 8 between the unit (output **6**) and the arm (input **P3**). At (**P3**), the hole is a G1/8 tapped hole.
- 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 mbars) 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.

Note:

It is preferable for safety reasons (valve 4 opens between 15 and 25 mbars) and consumption reasons to work with minimum pressures (high and low pressures).

1.11. RELEASING JOINT BRAKE

CAUTION:

Make sure that the arm and load relevant to this joint are suitably supported.

The controller must be connected to the power supply.

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

When the pushbutton is pressed to free the brakes, the brake on the joint under consideration is freed and the motor is put into short-circuit on the amplifier to brake the arm drop speed.

1.12. SAFETY

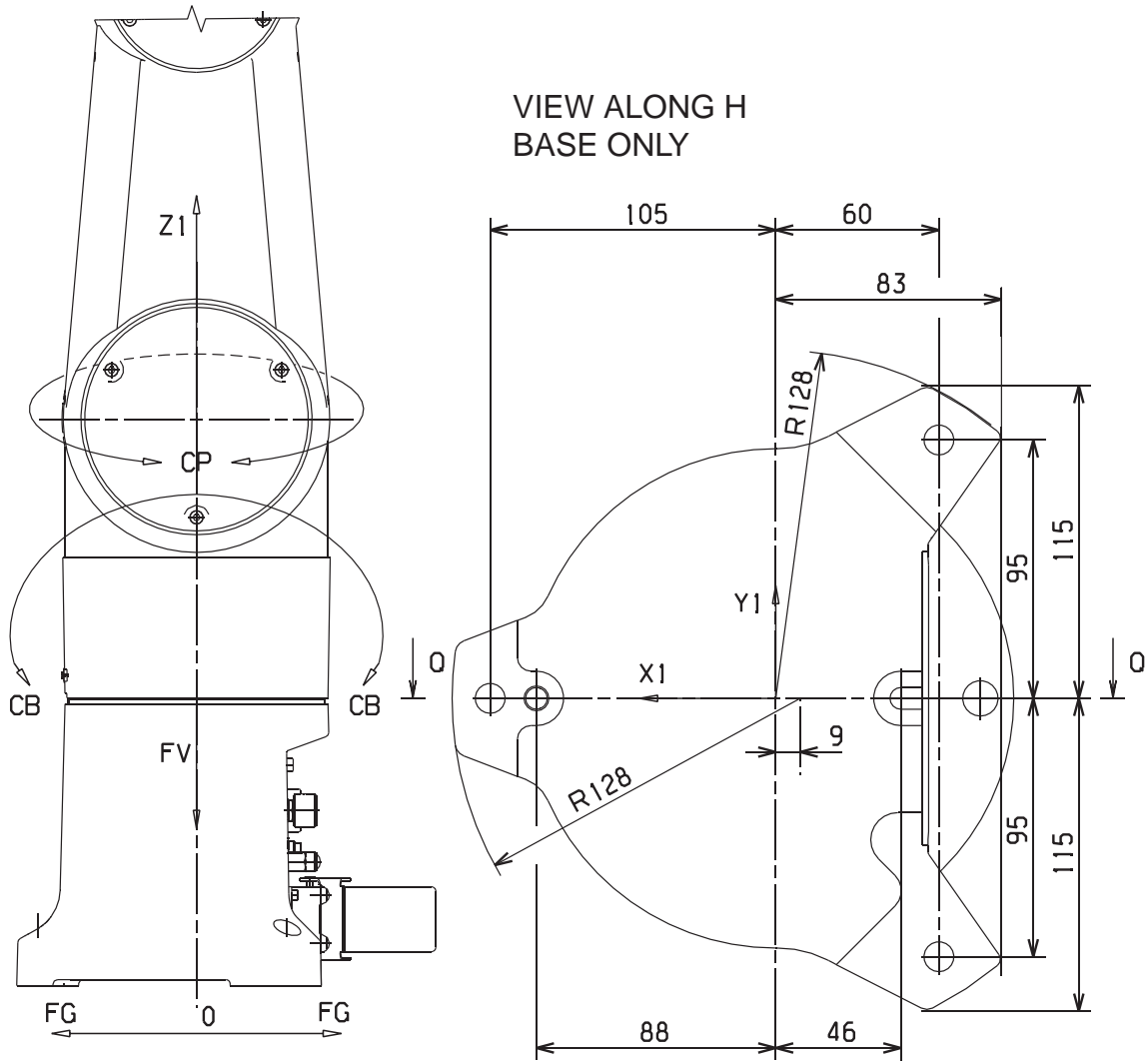


DANGER:

None of the joints are equipped with a balancing system. Short-circuiting of the motors is the only system used to limit the drop speed.

CHAPTER 2

ON-SITE PREPARATION



H ↑

SECTIONAL VIEW Q-Q

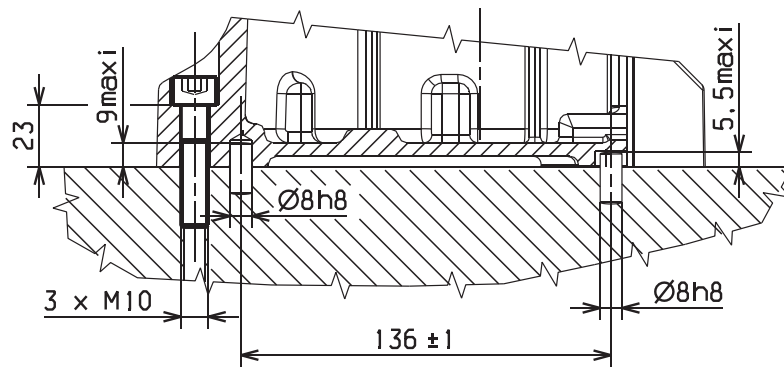



Figure 2.1

2.1. 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).

	<p>DANGER:</p> <p>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.</p> <p>International standard: ISO 10218 (1992).</p> <p>French standard: NF EN 775 (1993).</p> <p>European Directive: machine directive CEE 89-392.</p>
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<p>CAUTION:</p> <p>There must be no obstacles within the robot work envelope.</p>
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2.2. ATTACHMENT (figure 2.1)

The arm must be installed vertically, with the base underneath (floor-mounted configuration), the base uppermost (ceiling-mounted configuration), or the base horizontal (wall-mounted configuration). 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. A deformable support will greatly reduce robot's performance in speed and accuracy.

When calculating the size of the support, it is necessary to take into account the maximum forces transmitted by the arm in movement at point 0, which are as follows for the standard arm:

Floor or ceiling mounted arm

- $F_V = 923 \text{ N}$
- $F_G = 523 \text{ N}$
- $C_B = 524 \text{ Nm}$
- $C_P = 150 \text{ Nm}$

under following load conditions:

	Load (kg)	Load position (mm)	
		axis 5	axis 6
Standard arm	3.5	100	50
Long arm	2	100	50

The user can accurately position the robot by means of two 10h8 diameter centering pins (not supplied).

CHAPTER 3

STORAGE, TRANSPORT AND INSTALLATION



Figure 3.1

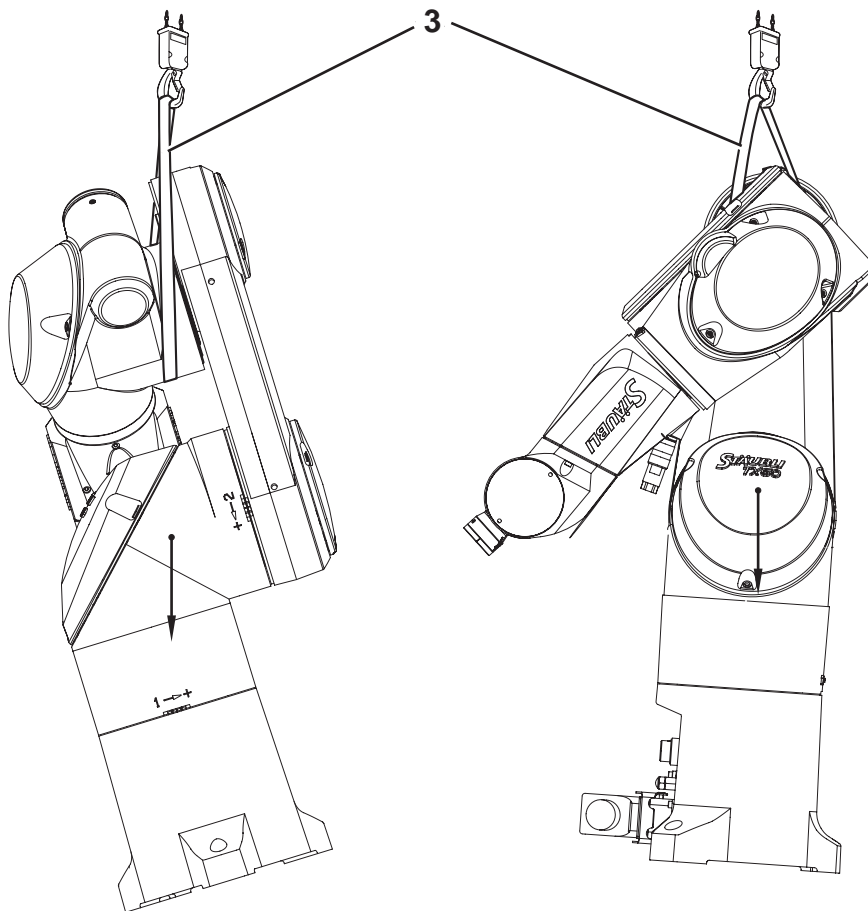


Figure 3.2

3.1. ARM PACKAGING (figure 3.1)

Packaging position of the arm:

	axis 1	axis 2	axis 3	axis 4	axis 5	axis 6
Angular position	0°	-120°	+120°	0°	+90°	0°

Standard packaging:

	Standard arm	Long arm
Case (1) L x H x D (mm)	900 x 820 x 570	900 x 900 x 570
Gross weight (kg)	72	73

International packaging:

	Standard arm	Long arm
Case (1) L x H x D (mm)	970 x 935 x 610	970 x 1000 x 610
Gross weight (kg)	86	87

The arm is packed in the vertical position. It is attached to the pallet (2) by 3 M10 bolts.

3.1.1. CONDITIONS OF STORAGE AND TRANSPORT

- Temperature for storage and transport : -20°C to +60°C

3.2. HANDLING OF PACKING

Figure 3.1

By pallet truck under base (2):

- X = 100 mm
- Y = 840 mm

3.3. UNPACKING AND INSTALLATION OF ARM

- Move the packing case as near as possible to the installation site (figure 3.1).
- Remove the cardboard packaging, remove the packing material and the plastic cover.
- Remove the 3 M10 bolts from the arm.
- Place the fabric sling (3) around joint 3 as shown on figure 3.2.
- Slowly raise the arm using the hoist.

CAUTION:

The robot will swing when raised and moved (see figure 3.2).

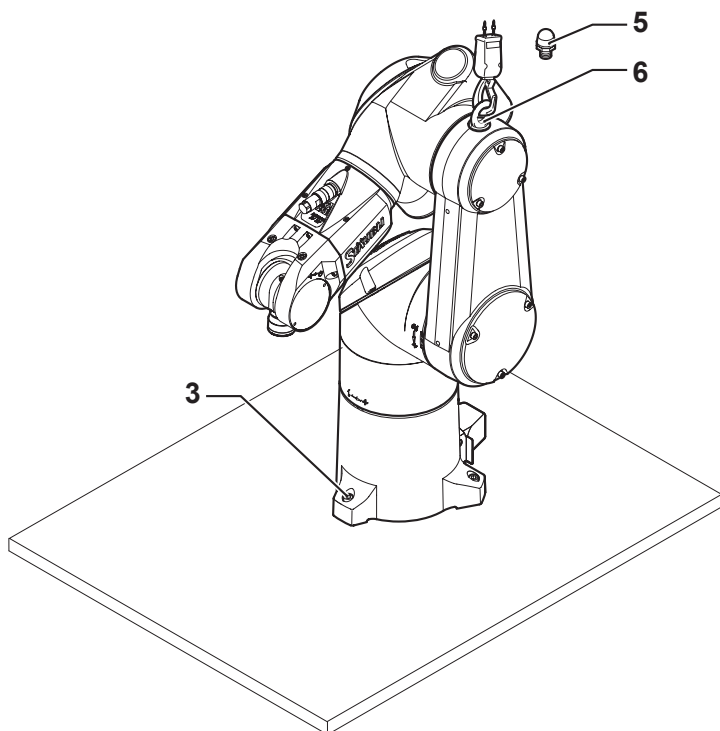


Figure 3.3

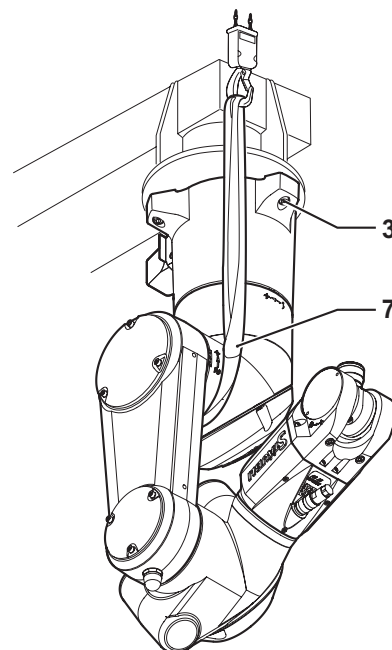


Figure 3.4

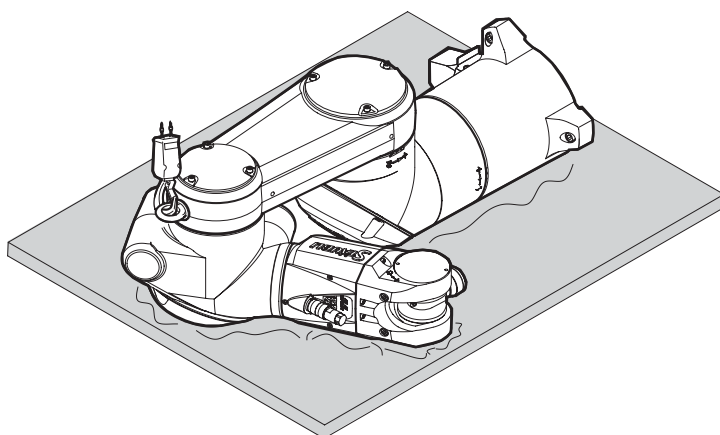


Figure 3.5

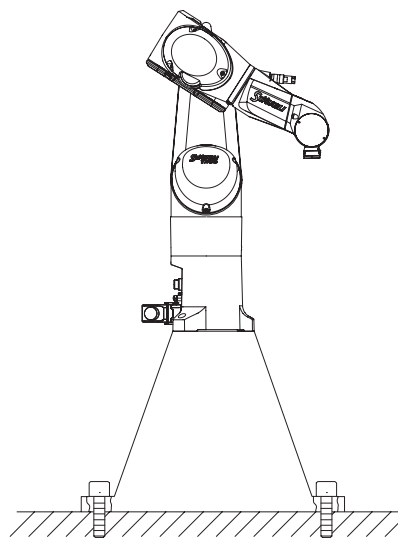


Figure 3.6

3.4. INSTALLATION OF ARM

CAUTION:

The arm can be fixed with its base facing downwards (floor-mounted version), upwards (ceiling-mounted version), or against a wall, without requiring any mechanical modifications. However, it is necessary to configure the controller accordingly. To do so, see the "Software configuration" chapter in the controller manual.

CAUTION:

Throughout all handling and installation operations concerning the arm, it is essential to keep the protection on the main connector at the foot of the robot in place at all times to avoid damaging and soiling the electrical and optical contacts.

3.4.1. INSTALLATION OF ARM ON FLOOR (figure 3.3)

- Position the arm on the support at its final attachment points.
- Attach the arm with 3 class 12.9 M10 hex. socket head screws (3), tightened to 77 Nm ± 5 Nm.
- Unscrew the hoisting ring (6) and install the plug (5).



DANGER:

For safety reasons, keep the sling slightly tensioned until the arm is securely attached to the floor.

3.4.2. INSTALLATION OF ARM ON CEILING (figure 3.4)

CAUTION:

Do not rotate joint 2.

- Carefully lay down the arm on a flexible support as shown on figure 3.5.
- Place the fabric sling (7) around joint 2 as shown on figure 3.4.

CAUTION:

500 kg fabric sling.

- Position the arm on the support at its final attachment points.
- Attach the arm with 3 class 12.9 M10 hex. socket head screws (3), tightened to 77 Nm ± 5 Nm.



DANGER:

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

3.4.3. MOUNTING FLOOR QUALITY

The user has to make sure that the mechanical characteristics of the floor and the means of fixture allow to hold up the maximum forces caused by the moving arm (see *chapter 2*).

CAUTION:

The height of the robot support can strongly influence the forces on the floor (figure 3.6).

3.4.4. 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, the electric limit stops on axis 1, 2 and 3 can be placed in a certain number of different positions.

Note:

The angular values shown in the drawings are software values and they can thus be reached.

The angular value between the software limit and the electric limit is 2.5°.

References of the limit stop screws:

- Axis 1 and 2: D60016100, tightening torque 2.8 Nm.

3.4.4.1. AXIS 1

See figure 3.7.

Factory settings:

- No limit stop screws are fitted, it is the lever that activates the electric limit if the arm moves outside the envelope.

Modification of the envelope:

- Select the positions suitable for the application.

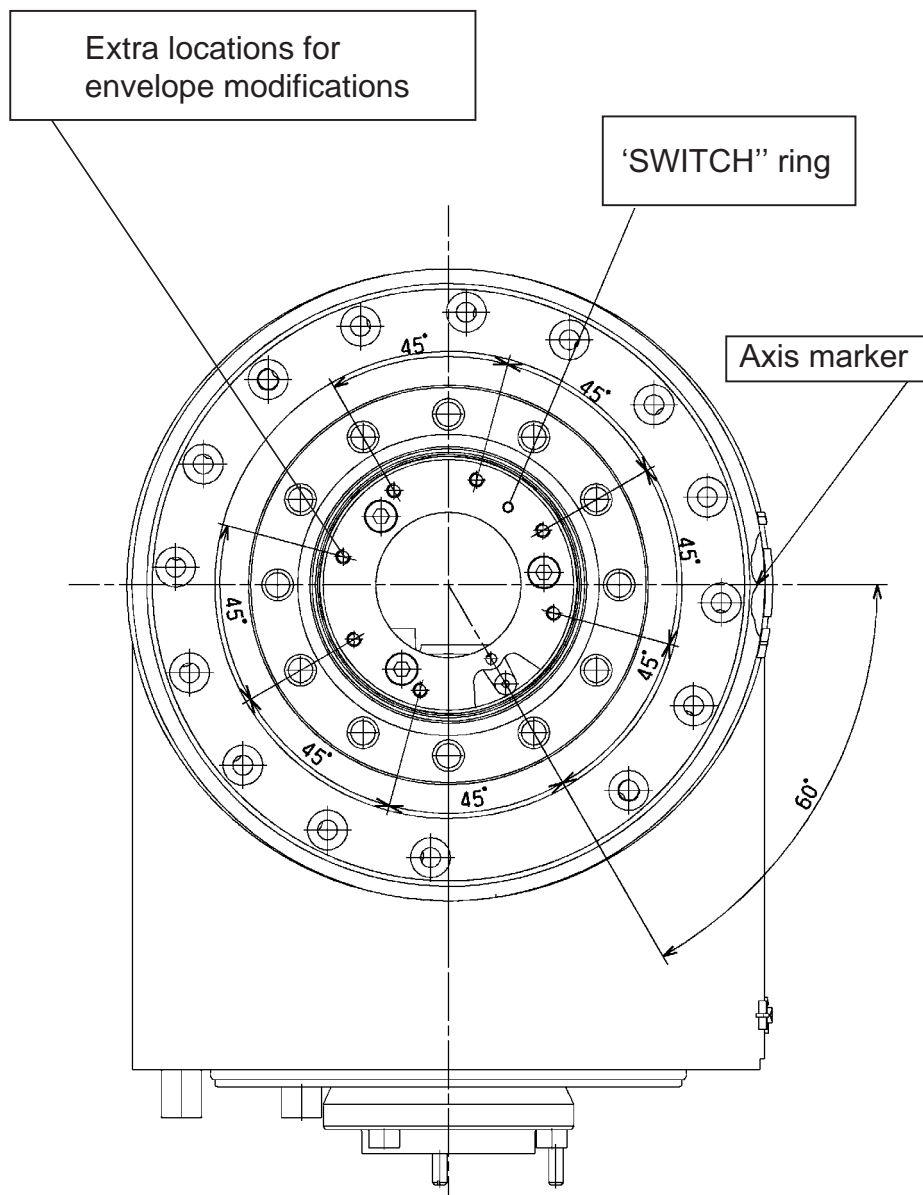


Figure 3.7

3.4.4.2. AXIS 2

See figure 3.8.

Factory settings:

- A limit stop screw is fitted in position $+ 127.5^\circ$.
- Another limit stop screw is fitted in position $- 127.5^\circ$.

Modification of the envelope:

- Select the positions suitable for the application.

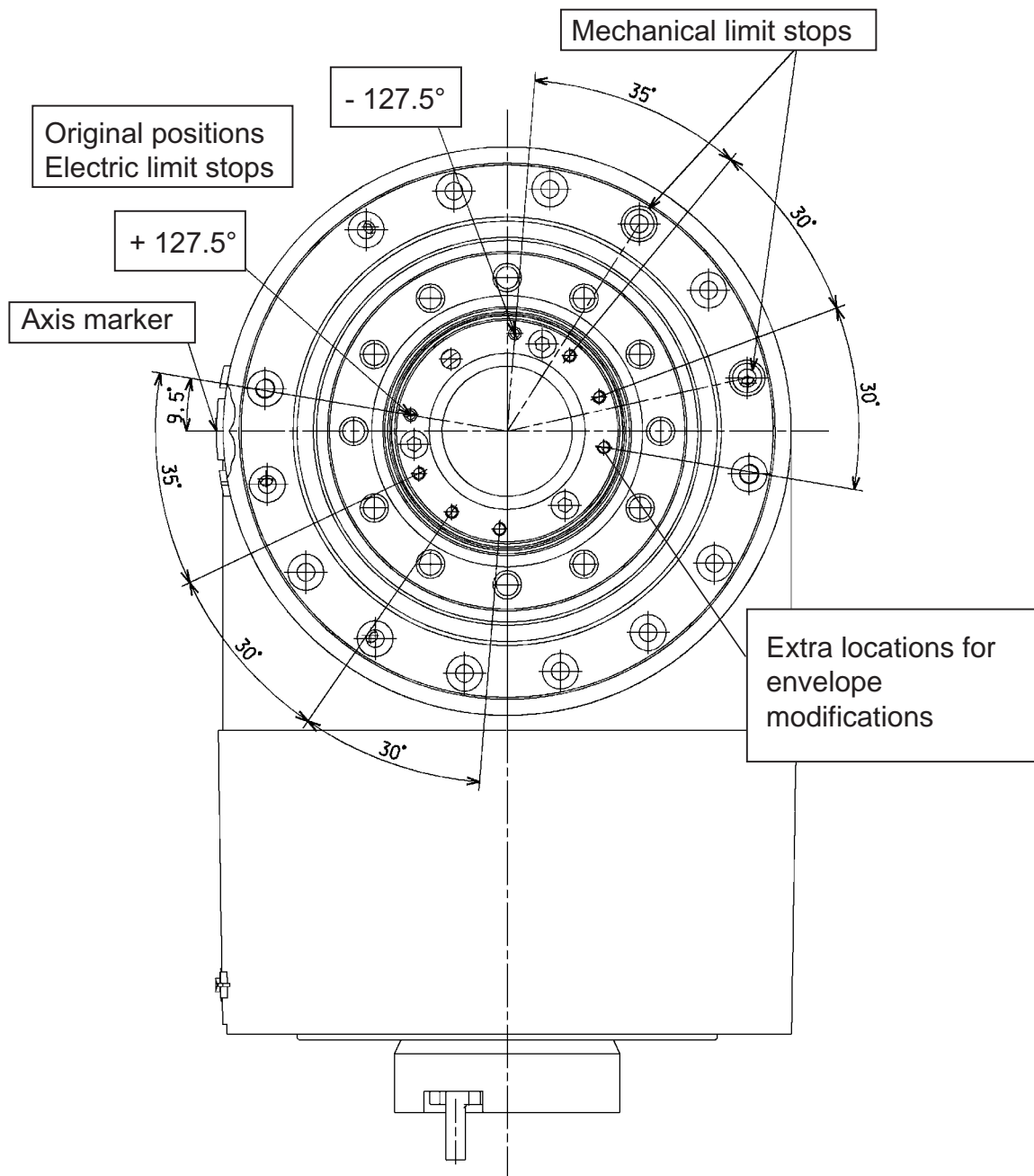


Figure 3.8

3.4.4.3. AXIS 3

See figure 3.9.

Factory settings:

- A limit stop screw and a cam are fitted in their basic position at the factory.

Modification of the envelope:

- Remove the cam and the screw from their original position.
- Select the positions suitable for the application.
- Put a round headed CHc M6x8 screw (D60012100) and a \varnothing 6.5x10x1.5 washer (C13301410) in place in the threaded holes selected.

Note:

These screws and washers are not supplied with the robot.

- Lock the screws in place using loctite 242.

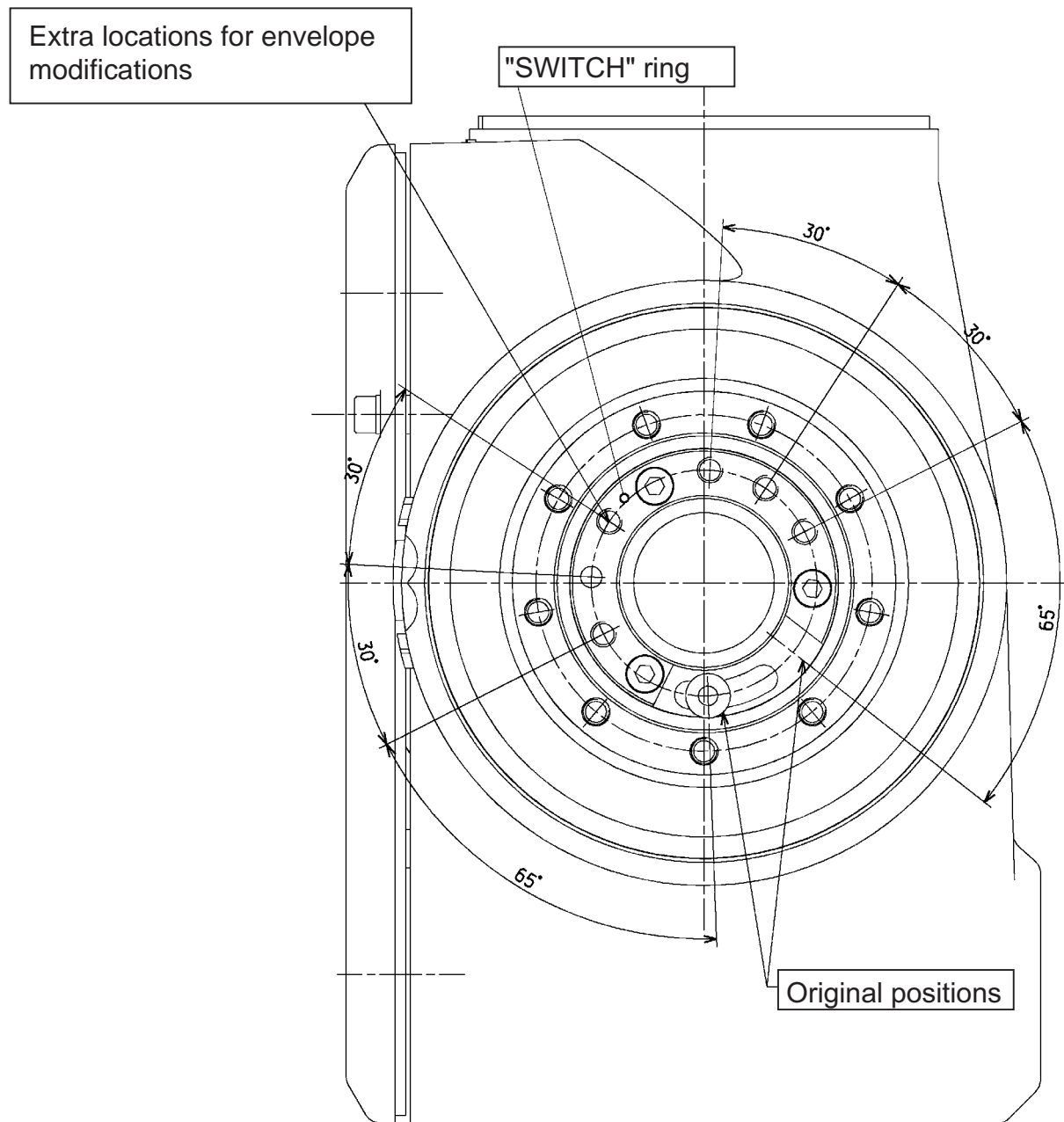


Figure 3.9

