

Arm - RX series I60 family

Characteristics



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CHAPTER 1

DESCRIPTION

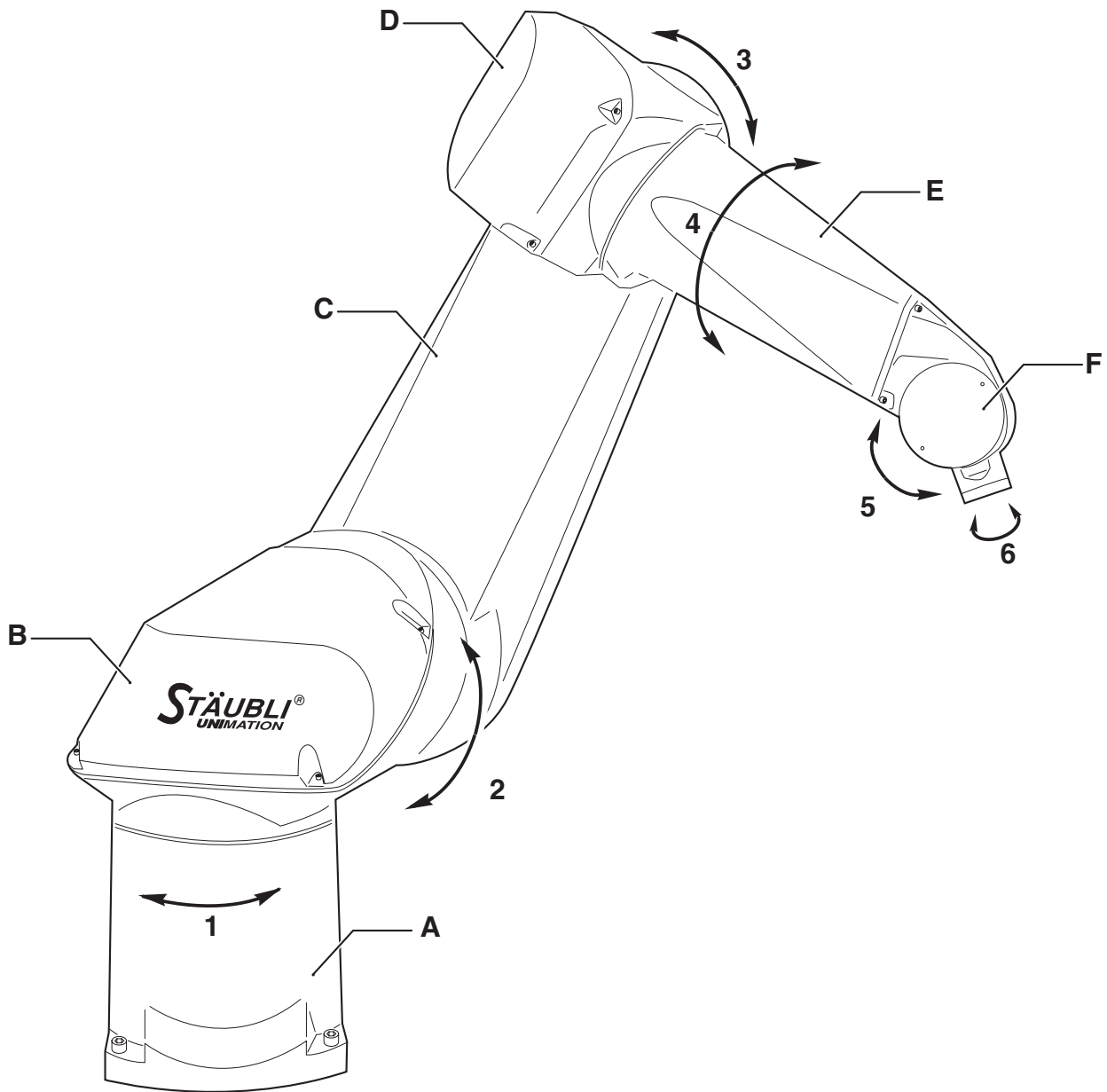


Figure 1.1

1.1. GENERAL DESCRIPTION

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

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. 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**).

The robot arm assembly thus contains the motorization, brakes, motion transmission mechanisms, cable bundles, pneumatic and electric circuits for the user and the counterbalance system.

Of simple construction, the RX160 arm assembly consists of a rigid and encased structure (protection IP65 to standard NF EN 60529) to protect it against external aggressions. Its design is based on transmission modules: JCS (STÄUBLI Combined Joint) used on axis 1, 2, 3 and 4 (**figure 1.1**).

The wrist consists of axis 5 and 6.

Arm balance is performed by an integrated spring system. The arm has a built-in spring counterbalance system giving an attractive low weight system.

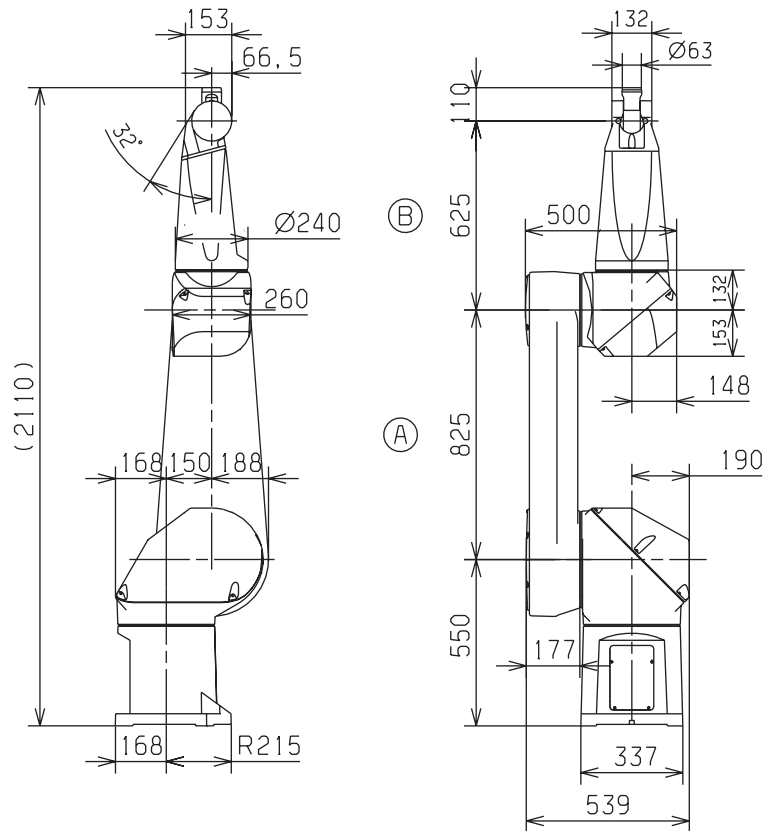


Figure 1.2 (RX160)

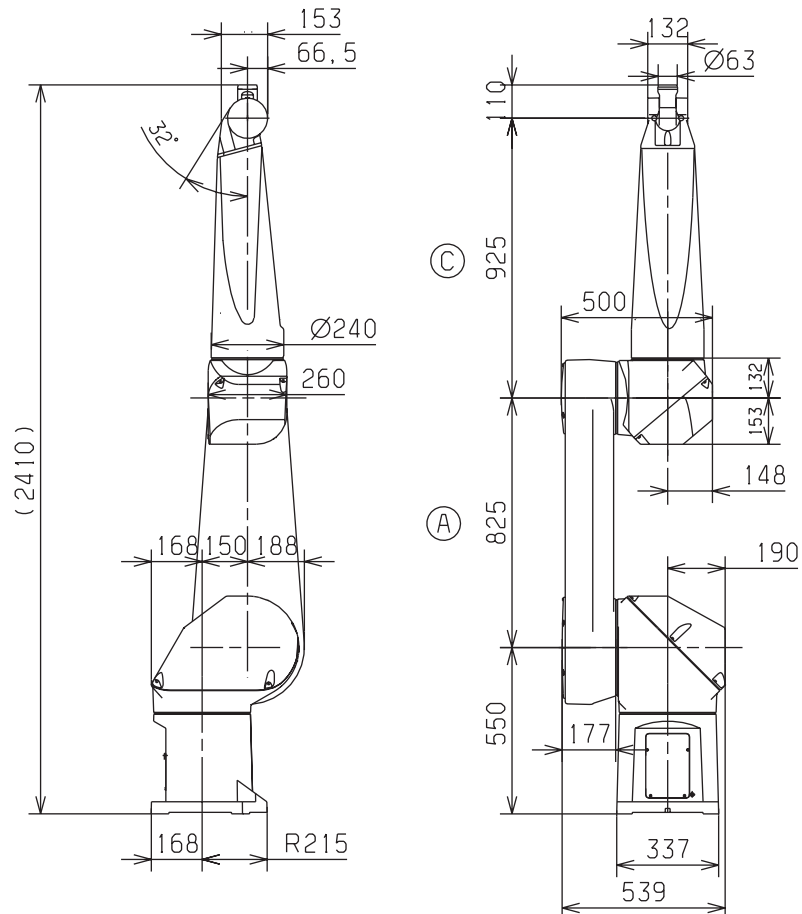
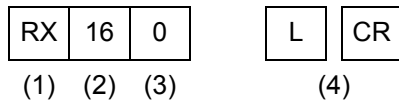


Figure 1.3 (RX160 L)

1.2. DESIGNATION OF ROBOTS OF THE RX SERIES 160 FAMILY



- (1) RX family arm
- (2) Maximum reach between joints 2 and 5 expressed in decimeters:
 - dimension (A) + dimension (B) **(figure 1.2).**
 - dimension (A) + dimension (C) **(figure 1.3).**
- (3) Number of active joints:
 - 0 = 6 active axis.
 - 5 = 5 active axis, geometry being conserved.
- (4) Upper case letters to indicate an option.
Example:
 - L = extended forearm: dimension (A) + dimension (C) **(figure 1.3).**
 - 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 1.2).**

Arm L: for arm with different geometry where forearm is extended **(figure 1.3).**

5-axis arm: for arm with 5 active axis.

1.3. GENERAL CHARACTERISTICS

1.3.1. OVERALL DIMENSIONS (figures 1.2 and 1.3)

1.3.2. 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

1.3.3. WEIGHT

STANDARD ARM	ARM L
248 kg	250 kg

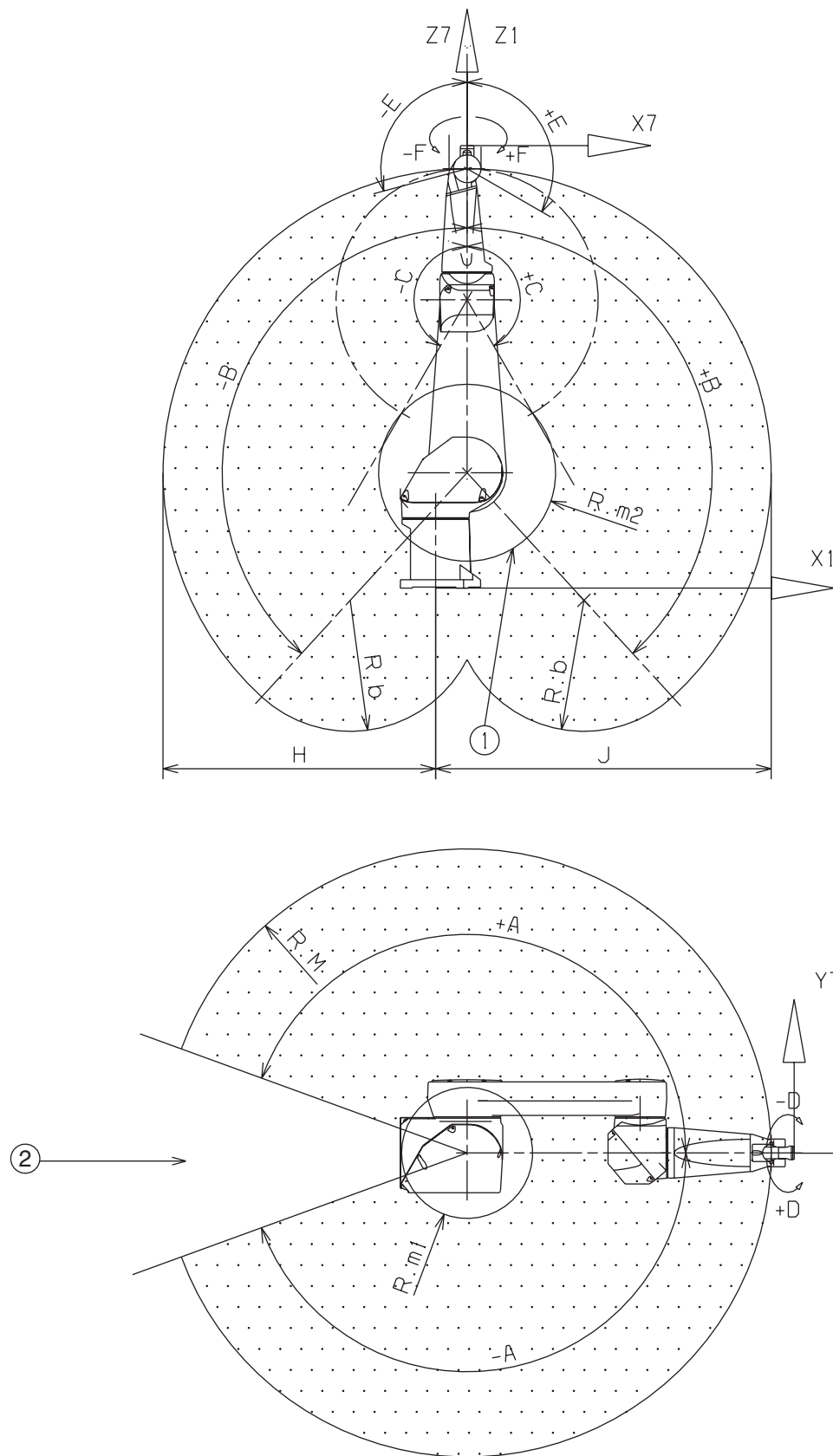


Figure 1.4

1.4. PERFORMANCE

Figure 1.4

- ① Brake release access area
- ② Area accessible in righty configuration

	STANDARD ARM	ARM L
Work envelope		
R.M max. reach between axis 1 and 5	1600 mm	1900 mm
R.m1 min. reach between axis 1 and 5	422 mm	463 mm
R.m2 min. reach between axis 2 and 5	312 mm	462 mm
R.b reach between axis 3 and 5	625 mm	925 mm
H	1300 mm	1600 mm
J	1600 mm	1900 mm
Maximum speed at load center of gravity	18.9 m/s	
Repeatability at constant temperature	± 0.05 mm	

1.4.1. TORQUE LIMITS

	REFERENCE AXIS		
	AXIS 5 (Z ₆)		AXIS 6 (Z ₇)
Static torque (Nm)	89 ⁽¹⁾	66 ⁽²⁾	30
Peak torque (Nm)	269 ⁽¹⁾	210 ⁽²⁾	91

(1) if axis6 torque = 0

(2) for maximum torque on axis 6

1.4.2. AMPLITUDE, SPEED AND RESOLUTION

Axis	1	2	3	4	5	6
Amplitude (°)	320	275	300	540	225	540 ⁽¹⁾
Working range distribution (°)	A ± 160	B ± 137.5	C ± 150	D ± 270	E +120 ; -105	F ± 270
Nominal speed (°/s)	165	150	190	295	260	440
Maximum speed (°/s) ⁽²⁾	278	278	356	409	800	1125
Angular resolution (°.10 ⁻³)	0.68	0.68	0.87	1.0	1.95	2.75

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

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

Low speed in manual mode: 250 mm/s at tool centre point and 45 °/s on each joint.

Maximum Cartesian speed: 2.5 m/s.

CAUTION:

In some arm configurations, the maximum joint speeds can be reached only if payloads and inertias are reduced.

1.4.3. 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). Also, the position of the mechanical travel limiters on axis 1, 2 and 3 and of the electrical travel limiters on joints 1 and 2 can be modified in a certain number of positions (for modification, please consult STÄUBLI).

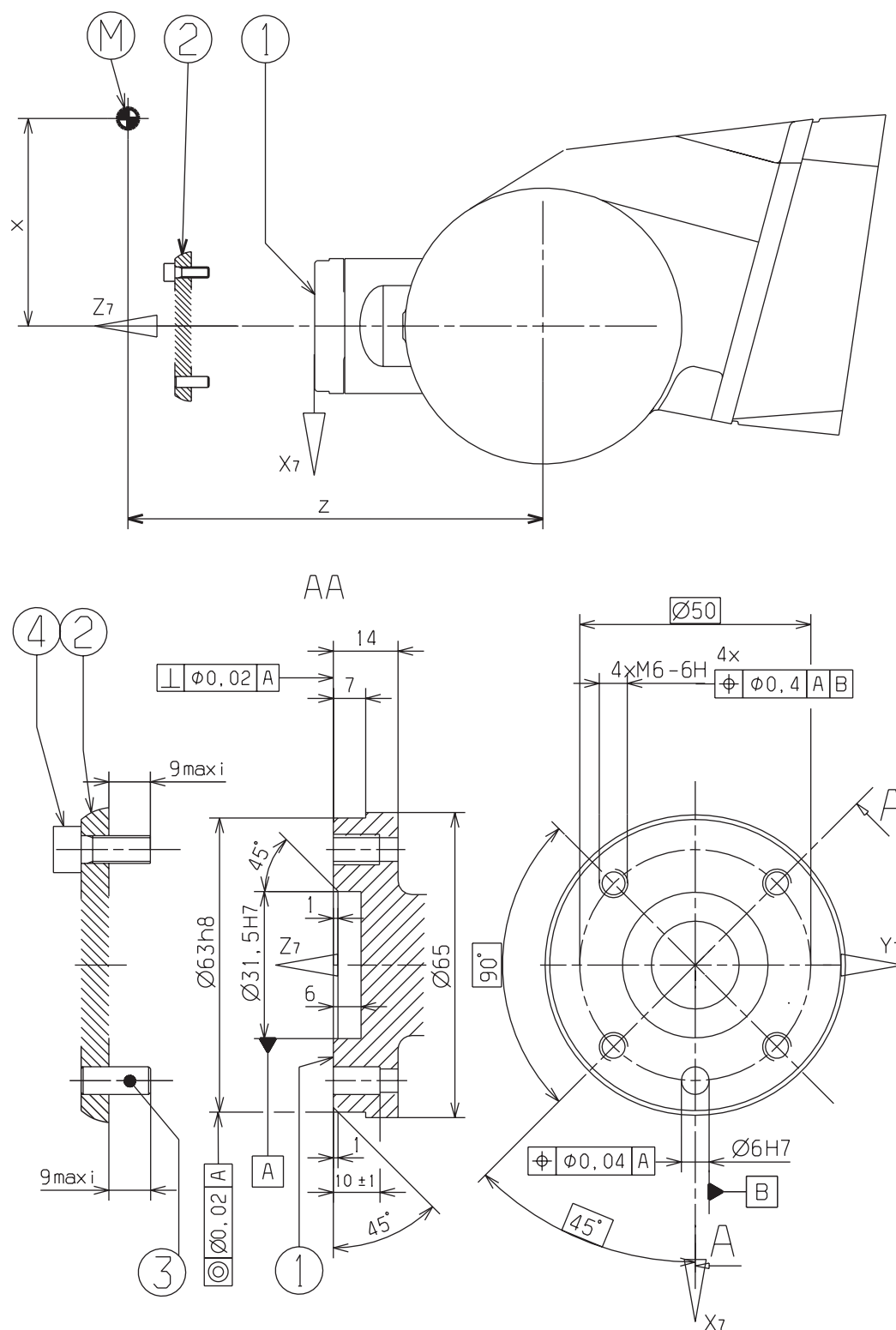


Figure 1.5

1.5. LOAD CAPACITY – MECHANICAL INTERFACE

- ① Mechanical interface
- ② End-effector

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 1.5.

Attachment by 4 M6 screws frame ④ , Class 12-9, torque 16.7 Nm \pm 1.2 Nm.

Indexing by pin frame ③, diameter 6.

Mechanical interface designation:

ISO 9409 - 1 - A50 as per Standard ISO 9409 - 1 : 1996 (F) (Standard and L arms)
(except the localization of the 4 M6 threaded holes)

CAUTION:

Length of end-effector attaching screws is limited to avoid all interference with the wrist (figure 1.5).

1.5.1. LOAD CAPACITY

Figure 1.5

Load characteristics:

Load center of gravity position (M): $z = 200$ mm from centerline of joint 5 and $x = 100$ mm from centerline of joint 6.

Load capacity	Standard arm	Arm L
At nominal speed ⁽¹⁾	20 kg	14 kg
At reduced speed ⁽¹⁾	30 kg	20 kg
Maximum load capacity (see figure 1.6)	34 kg	28 kg

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

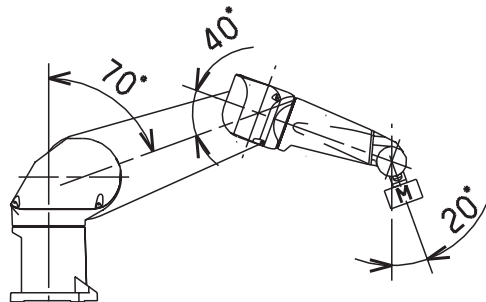


Figure 1.6

	NOMINAL INERTIAS (kg.m ²)		MAXIMAL INERTIAS (kg.m ²) ⁽²⁾	
	STANDARD ARM	ARM L	STANDARD ARM	ARM L
For joint 5	0.8	0.56	4	2.8
For joint 6	0.2	0.14	1	0.7

(2) under reduced speed and acceleration conditions:

For CS8C: 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.

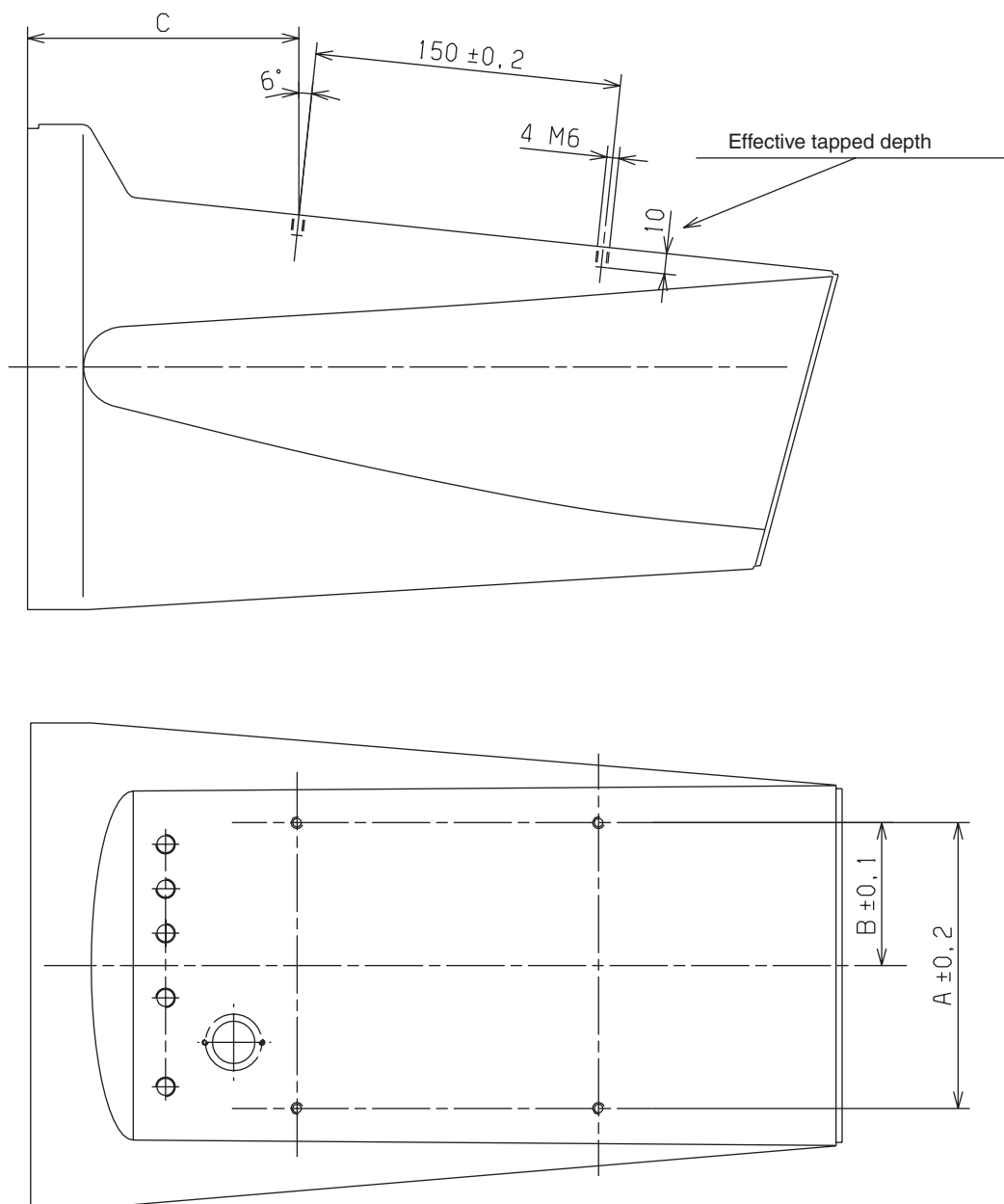


Figure 1.7

1.5.2. ATTACHMENT OF ADDITIONAL LOAD ON FOREARM

An additional load can be attached to the forearm using screws.

	STANDARD AND L ARMS
Screw	4 M6
Tightening torque	12 Nm

Position of tapped holes: See figure 1.7.

DIMENSIONS	STANDARD ARM	ARM L
A	140	110
B	70	55
C	133	185

CAUTION:

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

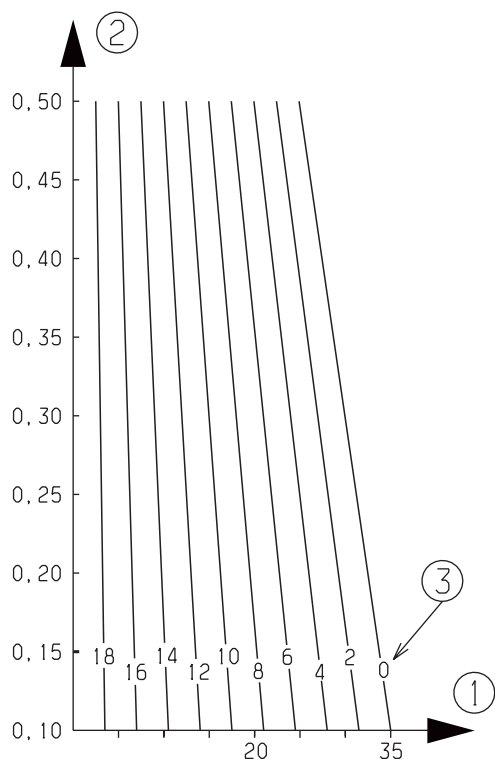


Figure 1.8

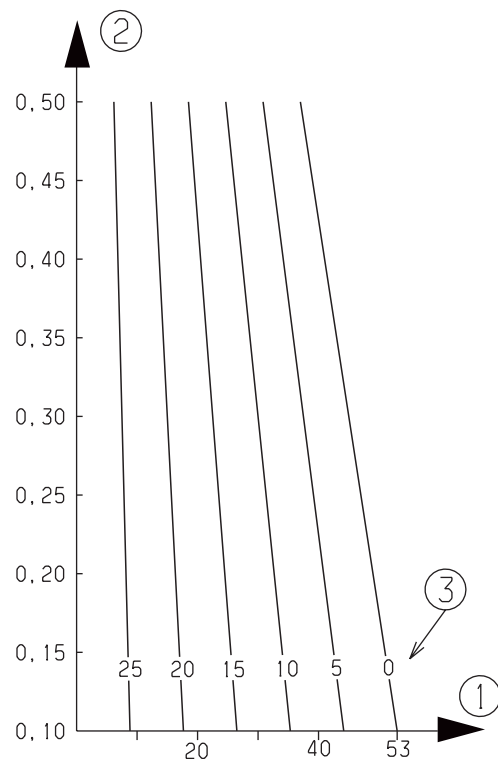


Figure 1.9

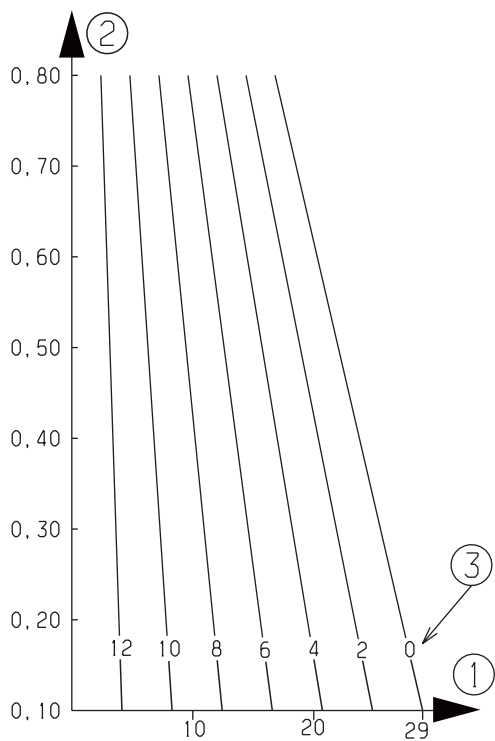


Figure 1.10

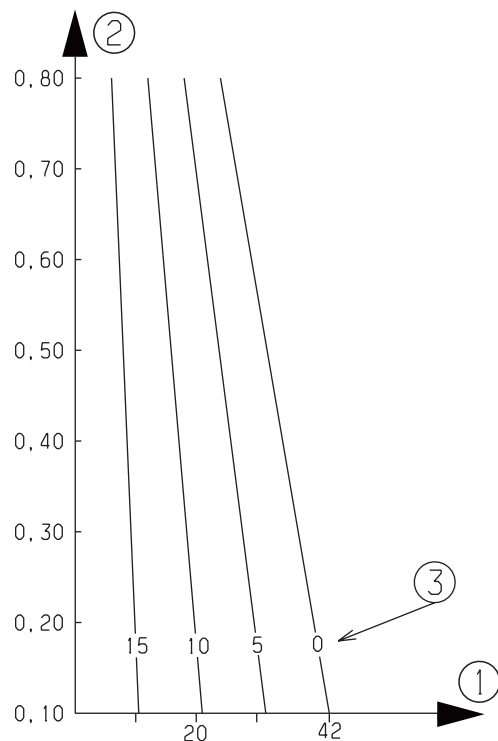


Figure 1.11

1.5.3. ADDITIONAL LOAD DIAGRAMS

These diagrams can be used to determine the additional load which can be attached to the forearm depending on its center of gravity position from joint 3 and the load attached to the mechanical interface of the wrist.

- ① Additional load (kg)
- ② Additional load center of gravity position (m) from centerline of joint 3.
The additional load center of gravity position is at 0.20 m max. from the centerline of joint 4.
- ③ Load attached to the mechanical interface of the wrist.
200 mm from centerline of joint 5 and 100 mm from centerline of joint 6.

Figure 1.8: for standard RX160

Figure 1.9: for standard RX160 with reduced speeds ⁽¹⁾

Figure 1.10: for RX160 with L arm

Figure 1.11: for RX160 with an L arm at reduced speeds ⁽¹⁾

(1) Reduced speeds:

For CS8C: VEL = 60%, ACC = 30%, DEC = 30%

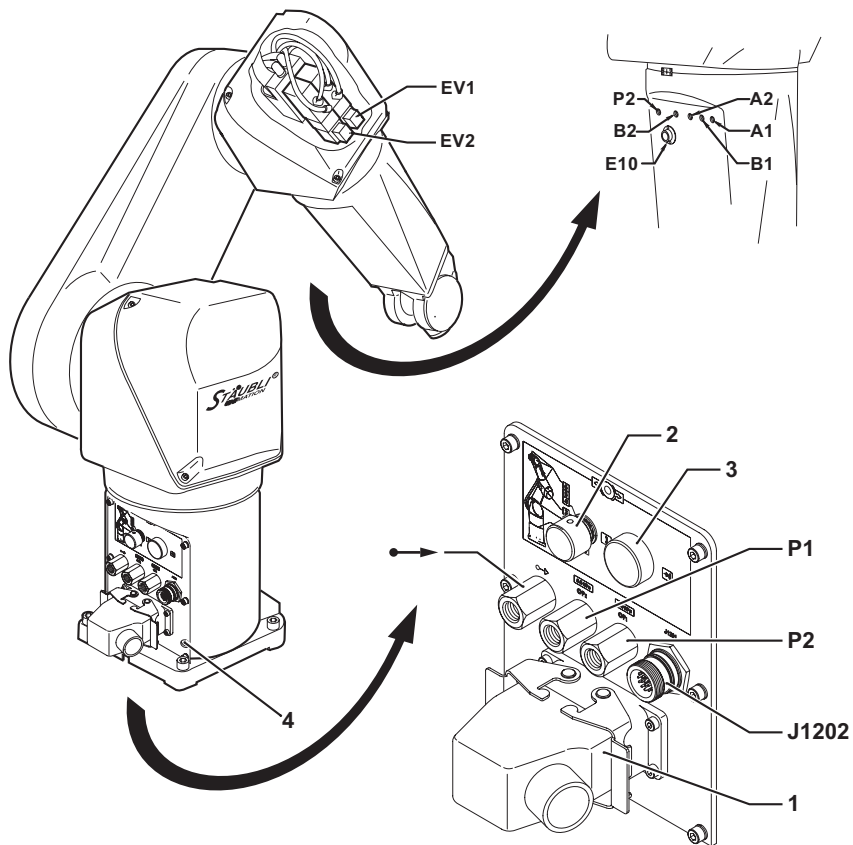


Figure 1.12 (RX160)

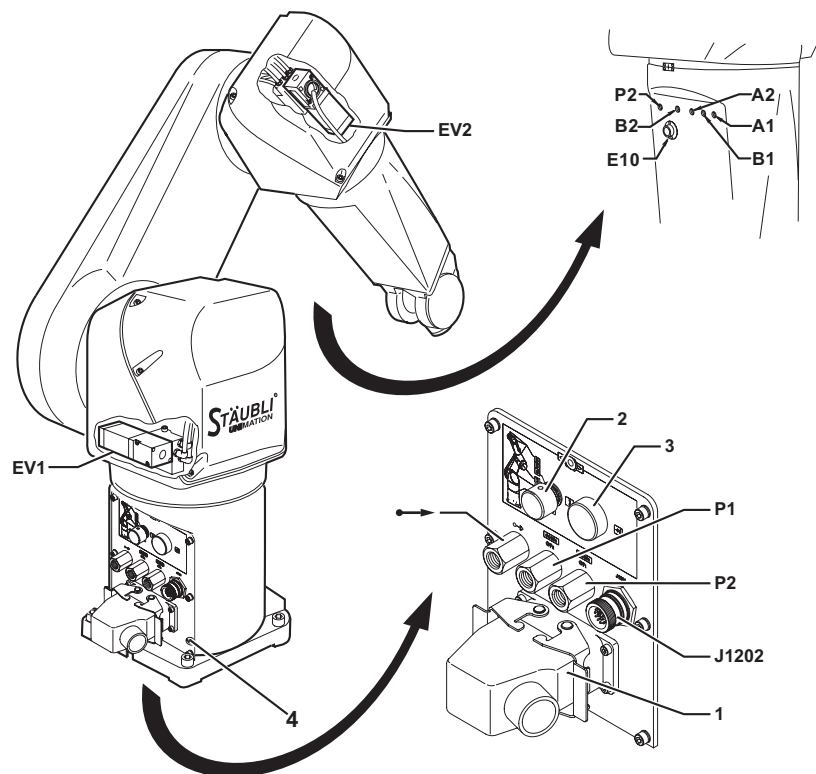


Figure 1.13 (RX160 CR)

1.6. LOGIN USER

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**.

Figure 1.12 is for all robots except the clean room application.

Figure 1.13 is for clean room application robots.

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:

Figures 1.12 and 1.13:

- Arm/(1) controller interconnection socket.
- R23 connector intended for the user for possible electrical connection of grip (**J1202**).
- Brake release selector (**2**).
- Brake release pushbutton (**3**).
- Compressed air network pneumatic (or vacuum) connections **P1** and **P2**.
- Pneumatic (or vacuum) 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.

1.7. RELEASING JOINT BRAKE

The controller must be switched on.

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.

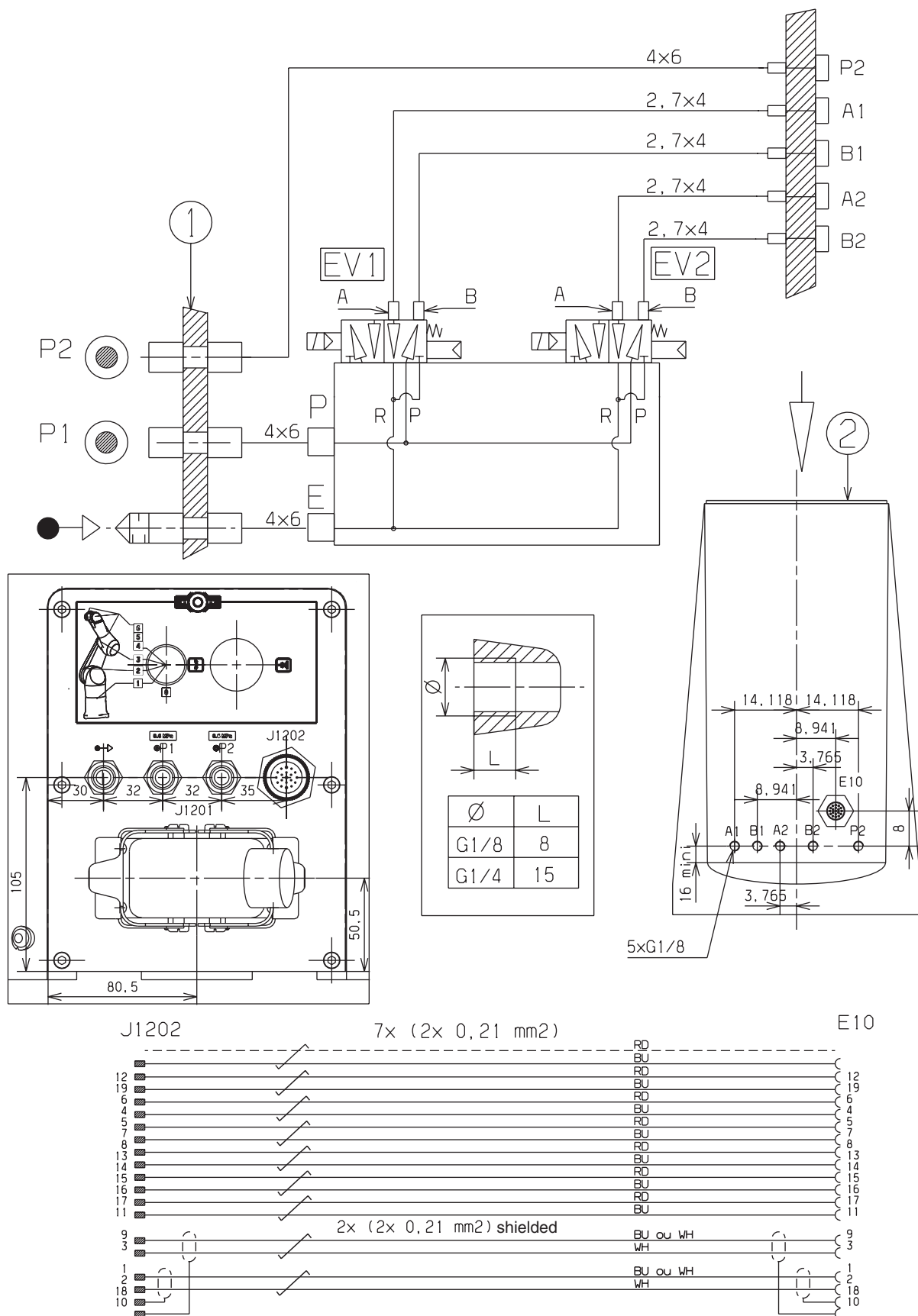


Figure 1.14

1.8. PNEUMATIC AND ELECTRIC CIRCUITS (EXCEPT FOR CLEAN ROOM APPLICATION)

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 = 8.6.
- Clip-on connector.
- Overvoltage protective circuit and indicator diode.

Description (figure 1.14):

- 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  .

1.8.2. ELECTRIC CIRCUIT

Figure 1.14

The electrical circuit consists of:

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

These 19 contacts include 3 power contacts and 16 command contacts.

- The 3 power contacts in each socket are connected by a 3-wire conductor with cross-section AWG18 (contacts 6-12-19).
- The 16 command contacts in each socket are connected in the following way:
 - 2 shielded twisted pairs, cross-section AWG24 connecting contacts 3-9-10 and 1-2-18 in each socket.
 - 5 twisted pairs, cross-section AWG24 for the other contacts.

Supply voltage: 60 VDC - 25 VAC.

Permissible current:

- 3-wire conductor AWG18: 4.5 A per contact.
- Pairs and shielded pairs AWG24: 2 A per contact.

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

- Connection to forearm (**E10**) by R23 elbow male cylindrical connector.
- Connection to base (**J1202**) by R23 straight female cylindrical connector.

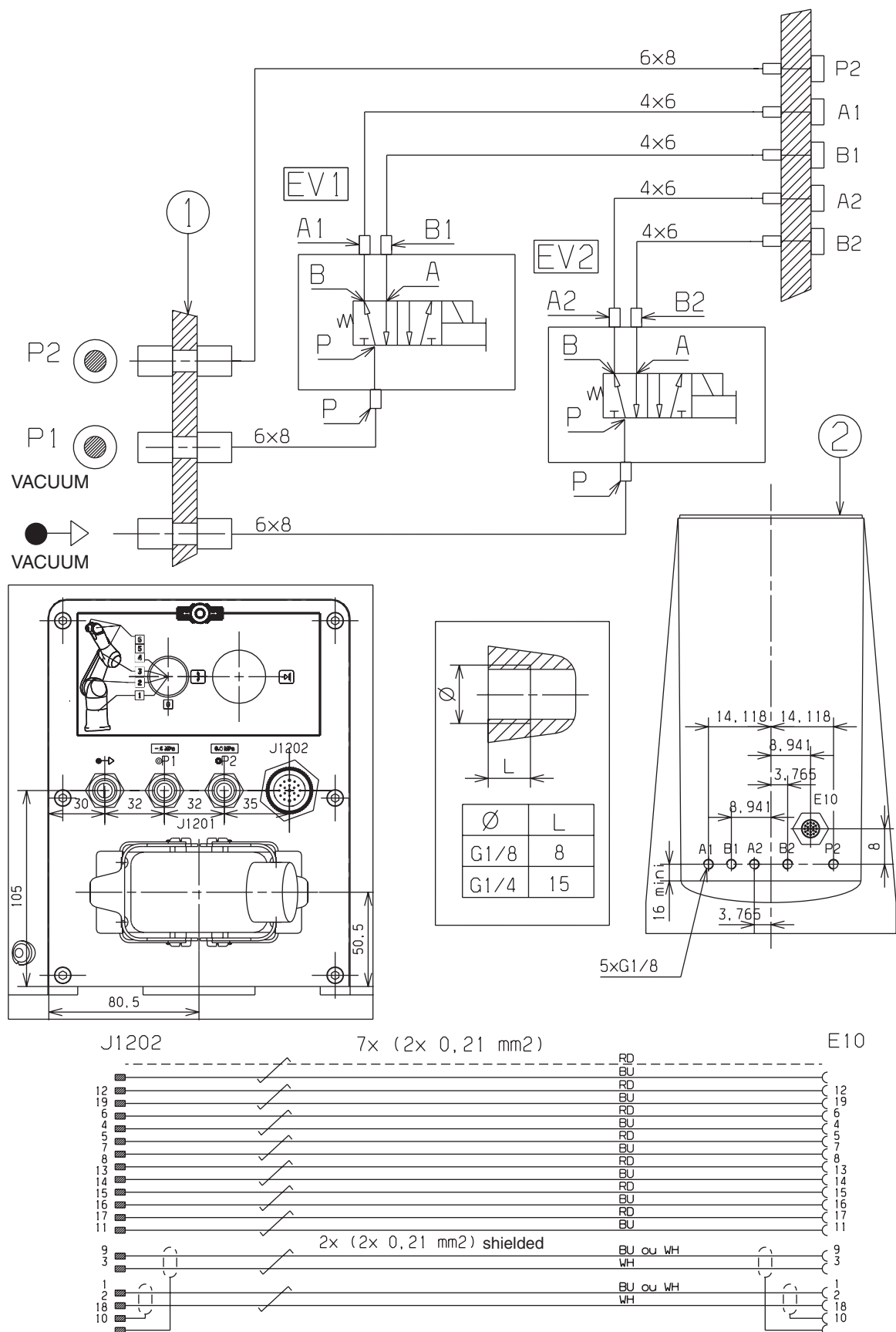


Figure 1.15

1.9. PNEUMATIC AND ELECTRIC CIRCUITS CLEAN ROOM APPLICATION


1.9.1. PNEUMATIC CIRCUIT

- ① Plate attached to base
- ② Forearm

Solenoid valves (EV1 and EV2):

- 5/2-way monostable.
- Electrically controlled (24 VDC).
- Max. working pressure: vacuum only.
- Flow coefficient Kv = 5.72.
- Clip-on connector.

Description (figure 1.15):

- The arm is connected to the vacuum network via the base (**P1** and ).
- There is a direct line between the base and the forearm (**P2**).
- Max. working pressure: vacuum only.
- There is no exhaust to the outside of the arm for the solenoid valves controlling the vacuum circuit.

CAUTION:

Cleanliness of sucked in air must be equivalent to 5 µm filtered air.

1.9.2. ELECTRIC CIRCUIT

Figure 1.15

The electrical circuit consists of:

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

These 19 contacts include 3 power contacts and 16 command contacts.

- The 3 power contacts in each socket are connected by a 3-wire conductor with cross-section AWG18 (contacts 6-12-19).
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Supply voltage: 60 VDC - 25 VAC.

Permissible current:

- 3-wire conductor AWG18: 4.5 A per contact.
- Pairs and shielded pairs AWG24: 2 A per contact.

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

- Connection to forearm (**E10**) by R23 elbow male cylindrical connector.
- Connection to base (**J1202**) by R23 straight female cylindrical connector.

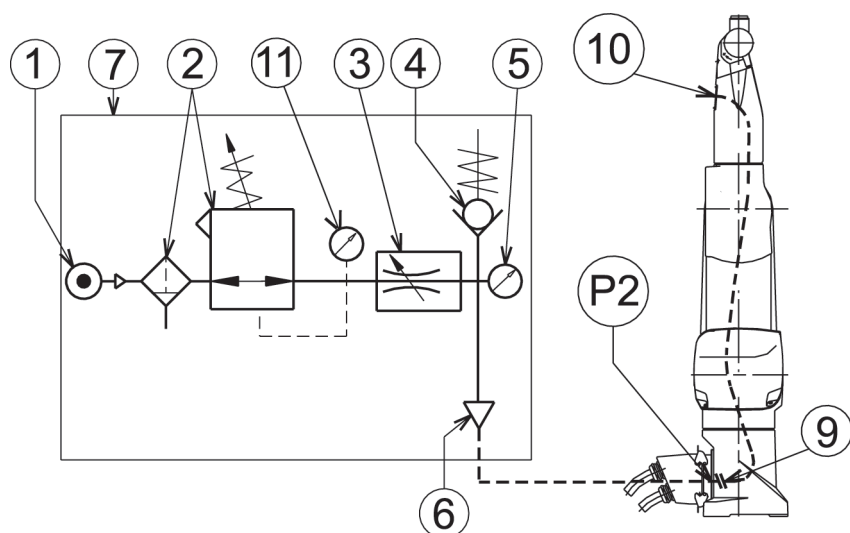


Figure 1.16

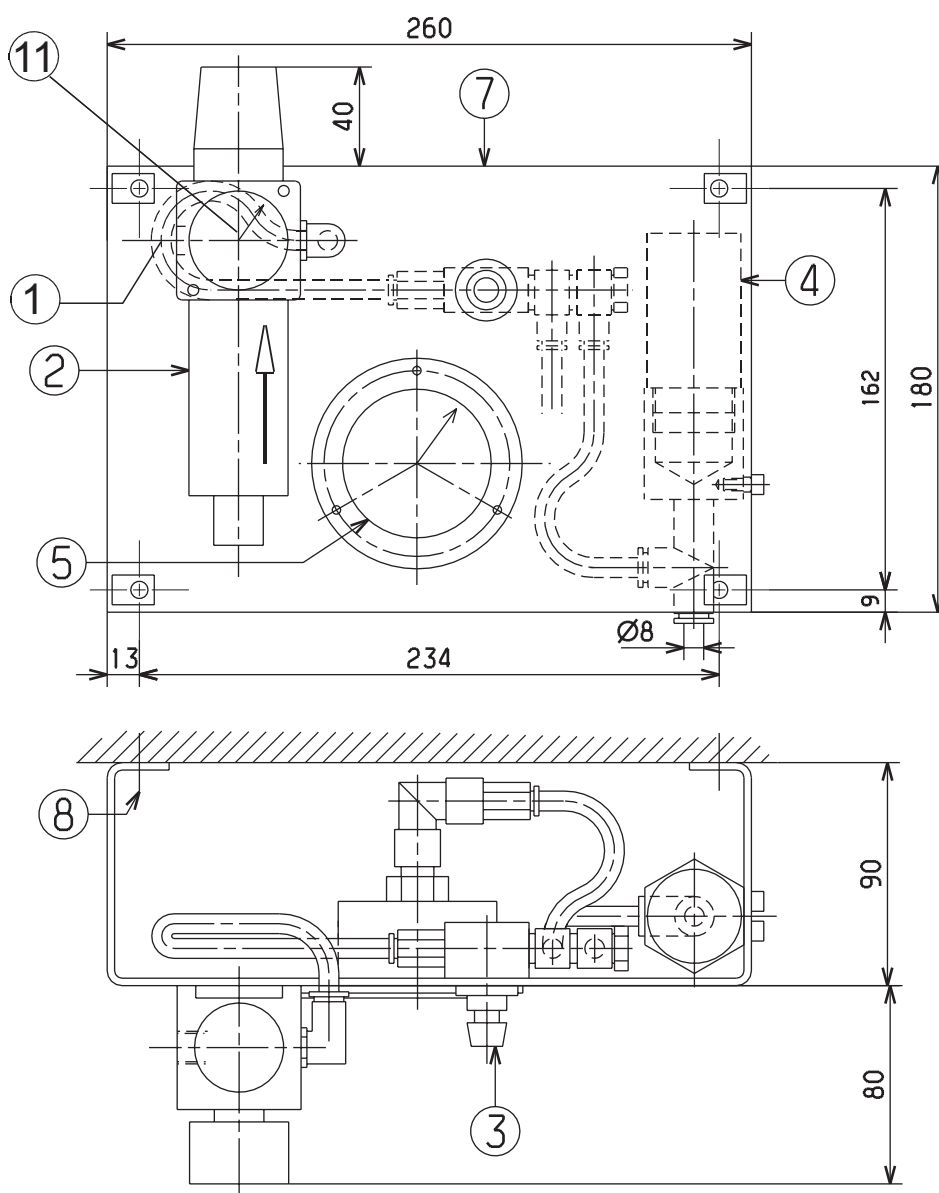


Figure 1.17

1.10. PRESSURIZATION UNIT FOR DUSTY ENVIRONMENTS

1.10.1. PURPOSE

For very severe applications in dusty environment, to maintain the inside of the arm at a pressure greater than the atmospheric pressure to avoid migration of dust.

1.10.2. INSTALLATION

- 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.

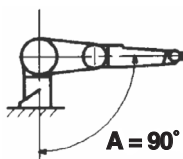
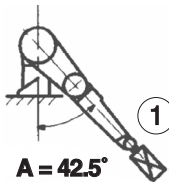
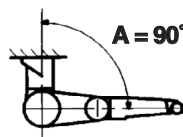
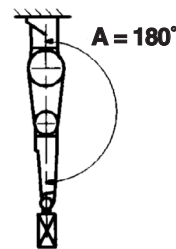
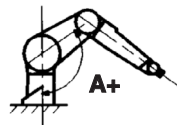
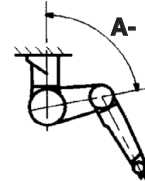
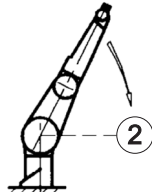
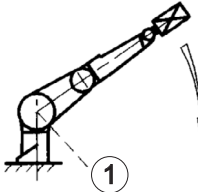
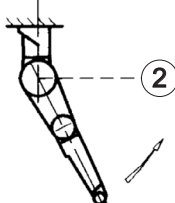
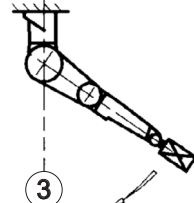
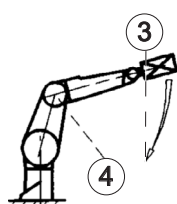
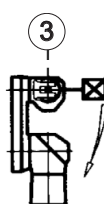
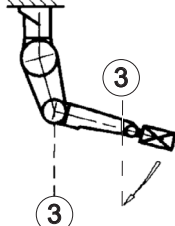
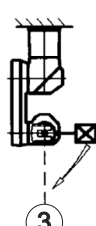

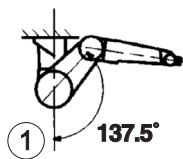
CAUTION:

An excessive value (above 40 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).

FLOOR CONFIGURATION		CEILING CONFIGURATION	
1) Balanced position (joint 2 brake released) is as follows:			
without load:	with nominal load:	without load:	with nominal load:
			
Rotating joint 3 modifies angle A:			
			
2) When arm is in a position other than balanced position, releasing joint 2 brake causes arm to return to balanced position.			
without load:	with nominal load:	without load:	with nominal load:
			
3) Releasing brakes of joints 3, 4, 5 and 6 (standard arm) or joints 3, 4 and 5 (5 axis arm) causes arm to move down whether loaded or not.			
<ul style="list-style-type: none">• Joints 3 and 5 (standard arm)• Joints 3 and 4 (5 axis arm)	<ul style="list-style-type: none">• Joints 4 and 6 (standard arm)• Joint 5 (5 axis arm)	<ul style="list-style-type: none">• Joints 3 and 5 (standard arm)• Joints 3 and 4 (5 axis arm)	<ul style="list-style-type: none">• Joints 4 and 6 (standard arm)• Joint 5 (5 axis arm)
			
4) Before all operations on arm (especially for removal), springs must be released and arm placed in following position:			
			

- ① against stop
② balanced position

- ③ vertical
④ position of axis 3

1.11. SAFETY

The robot arm's energy is that accumulated by the springs.

Indeed, joint 2 is equipped with a spring balance system. Releasing joint 2 discharges the accumulated energy. This energy label is attached on the arm and must remain in place.

The brake release movements are described on the opposite page according to arm configuration (floor or ceiling).

CHAPTER 2

ON-SITE PREPARATION

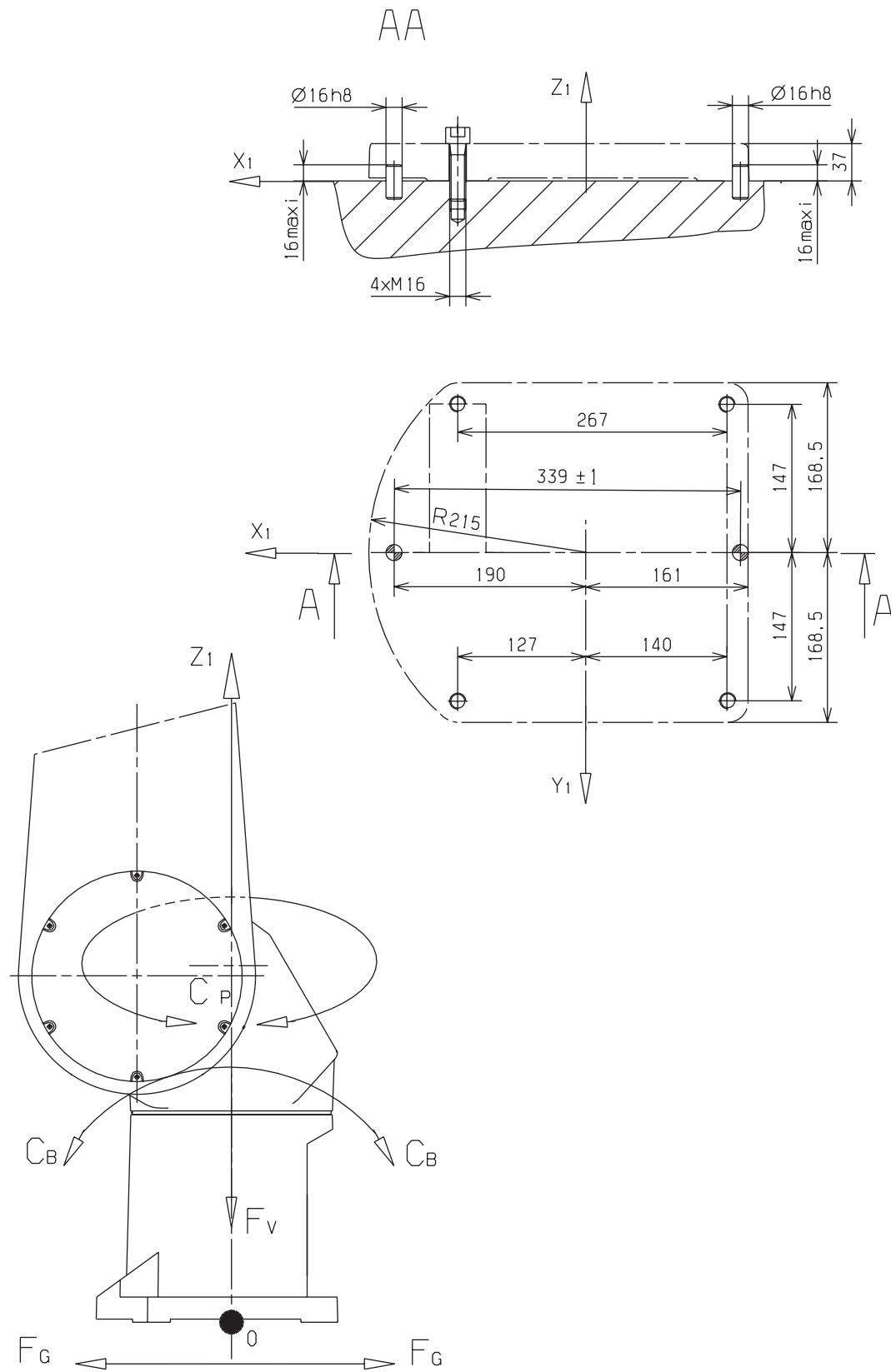



Figure 2.1


2.1. WORKING SPACE

The robot like any fast moving machine, may be dangerous. Always comply with the safety standards recommended for robot use and inform operators about the dangers faced.

"Users must ensure that personnel who program, operate, maintain or repair the robot or the robot equipped cell are properly trained and have the skills required to perform these tasks safely" (excerpt from standard NF EN 775).



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 (1992).
 French standard: NF EN 775 (1993).
 European Directive: machine directive CEE 98-37.



DANGER:
 There must be no obstacles within the robot work envelope.

2.2. ATTACHMENT (figure 2.1)

The robot arm can be installed vertically, base downwards (floor-mounted version) or base upwards (ceiling-mounted version). In all cases, it must be securely attached by 4 class **12.9 M16** hex. socket head screws.

Attachment surface shall be flat and metallic. A deformable support will greatly reduce robot's performance in speed and accuracy.

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

	STANDARD AND L ARMS
F_V	4067 N
F_G	2456 N
C_B	3706 Nm
C_P	2012 Nm

under following load conditions:

	LOAD (kg)	LOAD POSITION (mm)	
		AXIS 5	AXIS 6
Standard arm	20	200	100
Arm L	14		

The user can accurately position the robot by means of two 16h8 diameter centering pins.

CHAPTER 3

INSTALLATION

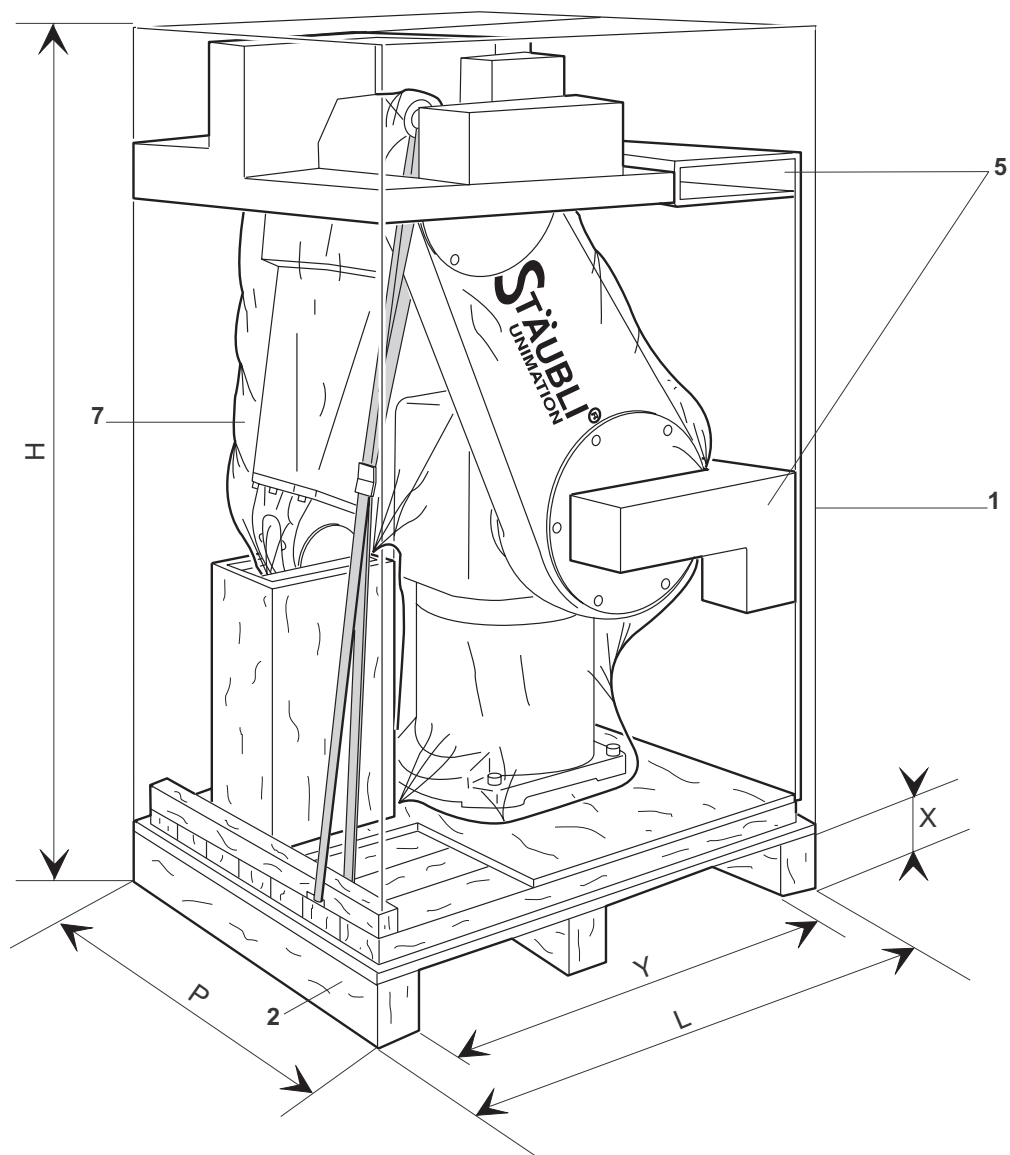


Figure 3.1

3.1. ARM PACKAGING (figure 3.1)

Standard packaging:

	STANDARD ARM	ARM L
Case (1) L x H x D	1200 x 1570 x 1000 mm	
Gross weight	323 kg	325 kg

International packaging:

	STANDARD ARM	ARM L
Case (1) L x H x D	1290 x 1570 x 1000 mm	
Gross weight	391 kg	393 kg

The arm is packed in the vertical position. It is attached to the pallet (2) by 4 M16 bolts (3).

Transport condition:

- Minimum temperature -20°C
- Maximum temperature +60°C

3.2. HANDLING OF PACKING (figure 3.1)

By pallet truck under base (2).

	STANDARD AND L ARMS
X	100 mm
Y	1040 mm

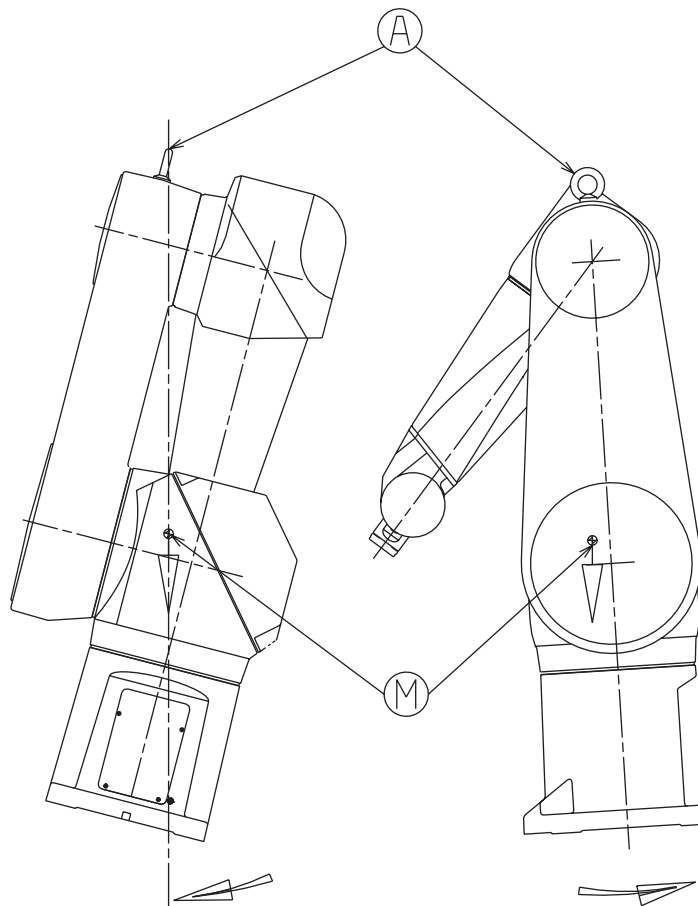


Figure 3.2

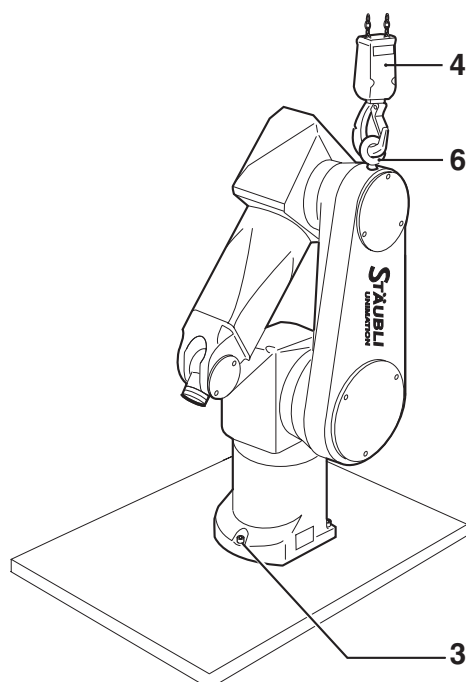


Figure 3.3

3.3. UNPACKING AND INSTALLATION OF ARM

CAUTION:

According to European Directive CEE 98-37, the hoisting ring's (6) threaded hole (M20) used for the robot hoisting is defined according to the ISO 262 standard.

- Move the packing case as near as possible to the installation site.
- Remove the cardboard packaging (1), remove the packing material (5) and the plastic cover (7) (figure 3.1).
- Pass the hook (4) of the hoist through the hoisting ring (6) and hold slightly tensioned to stop the arm from tipping (figure 3.3).
- Remove the (3) bolts from the arm (figure 3.3).
- Slowly raise the arm using the hoist.

CAUTION:

The robot will swing when raised and moved (figures 3.2 and 3.3).

- Ⓐ Attachment point
- Ⓜ Center of gravity

CAUTION:

For ceiling-mounted version robots (balance springs of joint 2 released), do not rotate joint 2.

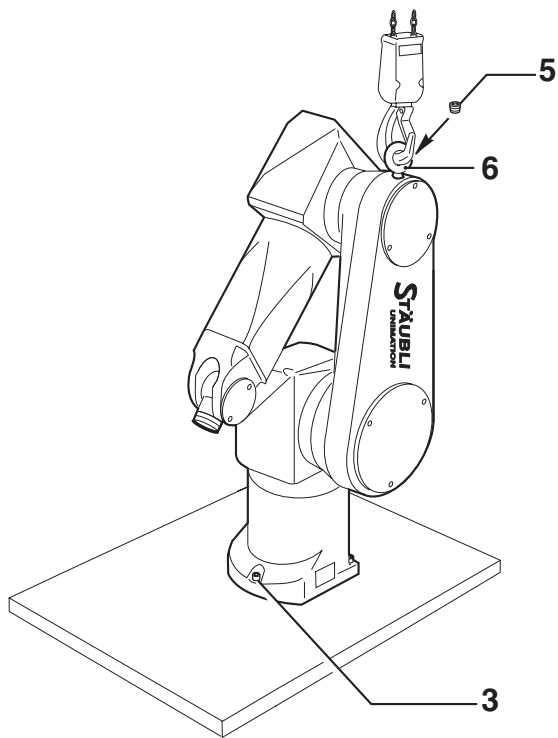


Figure 3.4

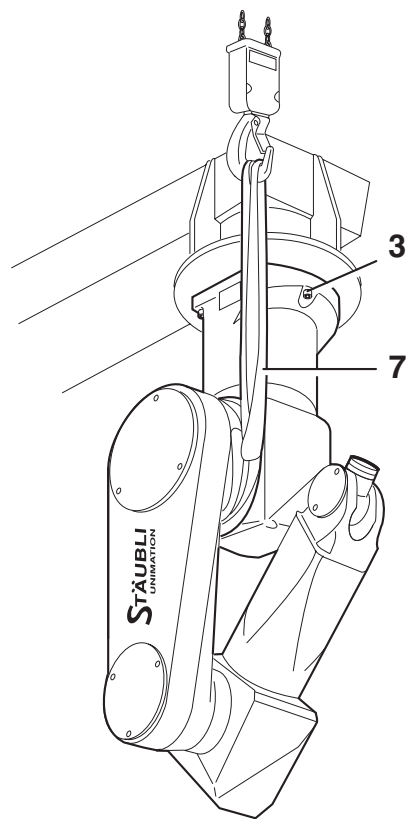


Figure 3.5

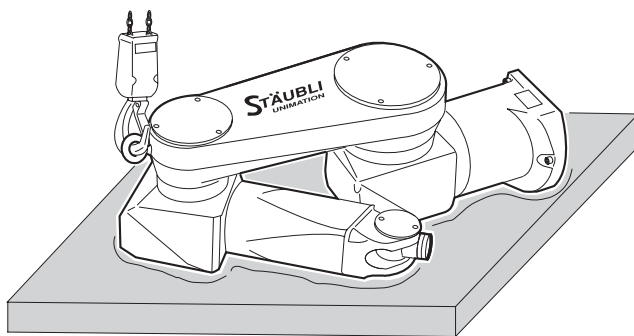


Figure 3.6

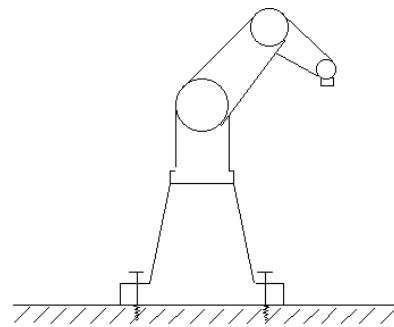


Figure 3.7

3.4. INSTALLATION OF ARM

CAUTION:

The arm can be attached with the base downwards (floor-mounted version) or with base upwards (ceiling-mounted version). Caution: the balance system is installed in the factory for one OR the other of these versions. Conversion from a floor-mounted version to a ceiling-mounted version requires a mechanical operation on the balance system.

3.4.1. INSTALLATION OF ARM ON FLOOR (figure 3.4)

- Position the arm on the support at its final attachment points.
- Attach the arm with 4 class 12.9 M16 hex. socket head screws (3), tightened to 325 Nm ± 23 Nm.
- Unscrew the hoisting ring (6) and install the plug (5).



DANGER:

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

3.4.2. INSTALLATION OF ARM ON CEILING

CAUTION:

Do not rotate joint 2.

- Carefully lay down the arm on a flexible support as shown on figure 3.6.
- Place the fabric sling (7) around joint 2 as shown on figure 3.5.

CAUTION:

500 kg fabric sling.

- Position the arm on the support at its final attachment points.
- Attach the arm with 4 class 12.9 M16 hex. socket head screws (3), tightened to 325 Nm ± 23 Nm.
- Tension the springs for robots delivered in ceiling-mounted version using the tool supplied with the robot (see chapter 3.5).



DANGER:

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

3.4.3. MOUNTING FLOOR QUALITY

(figure 3.7)

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 3).

CAUTION:

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

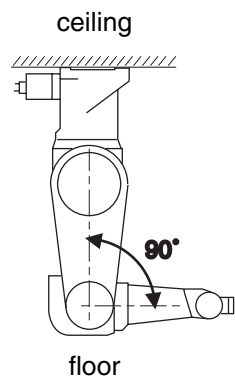


Figure 3.8

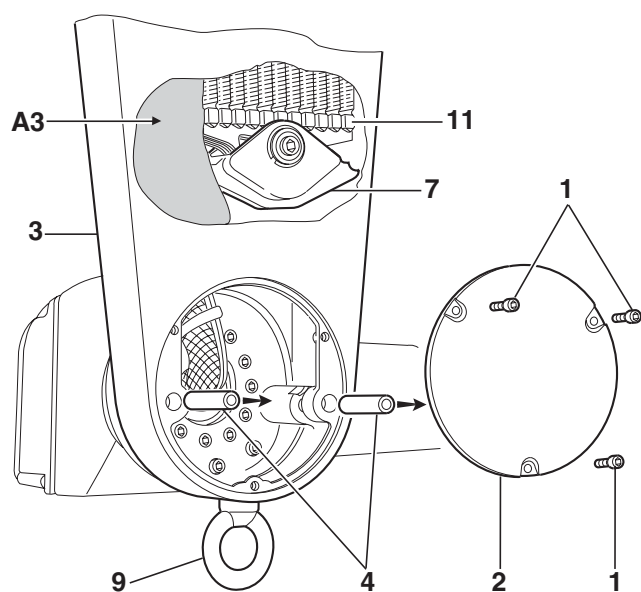


Figure 3.9

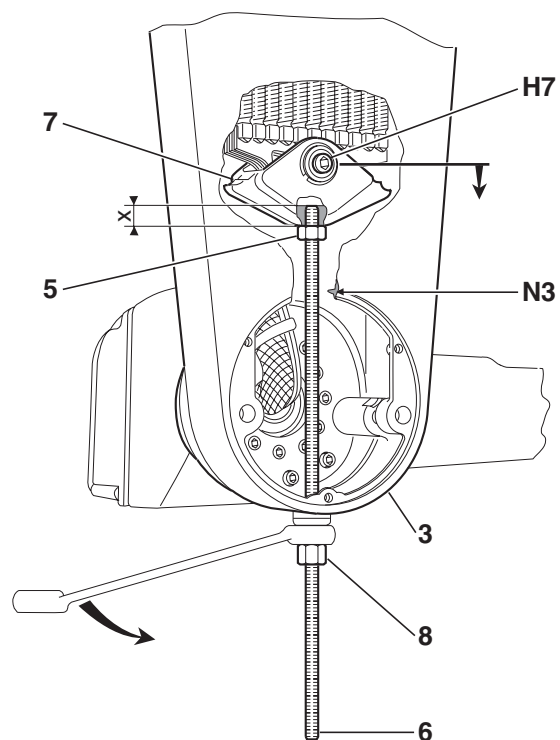


Figure 3.10

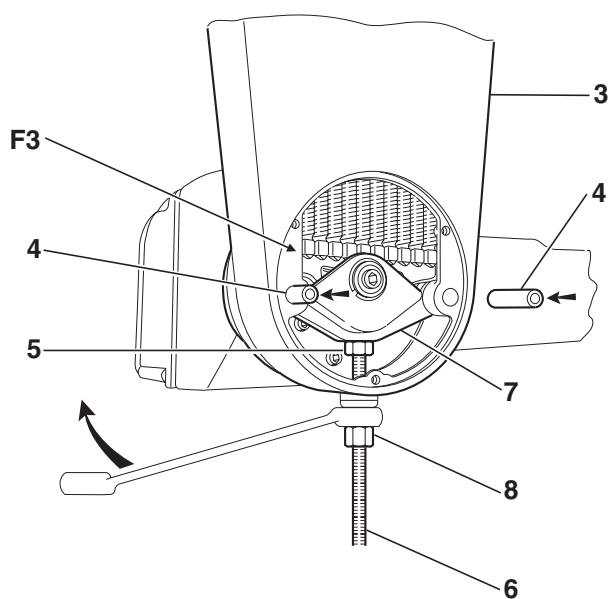


Figure 3.11

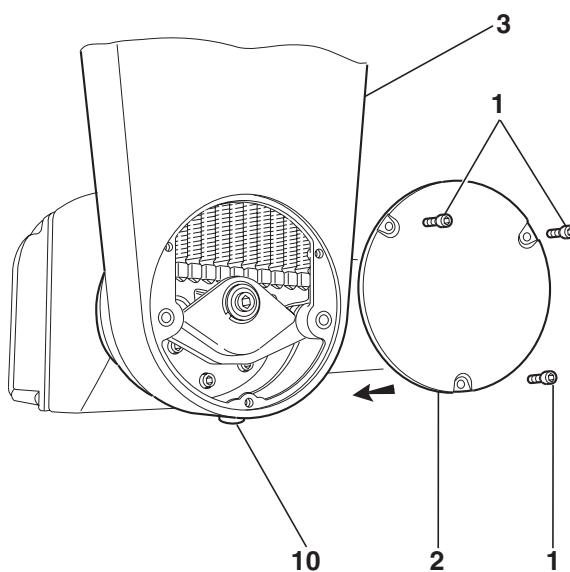


Figure 3.12

3.5. SPRING TENSION

CAUTION:

The robot must be attached to the ceiling. Do not rotate joint 2.

Figure 3.9

- Remove hoisting ring **(9)** from the arm.
- Unscrew the M5 screws **(1)** attaching cover **(2)**.
- Remove cover **(2)** from arm **(3)**.
- Remove the 2 pins **(4)** from arm **(3)**.
- Remove foam **(A3)** wedging beam **(7)** against arm **(3)**.
- Check that beam **(7)** and its springs **(11)** are not jammed in arm **(3)**.
- Place the robot in position **(figure 3.8)**.

Figure 3.10

- Unscrew the M12 nut **(5)** from the M12 threaded rod **(6)**.
- Insert threaded rod **(6)** into arm **(3)** (polyamide washer in contact with arm).
- Screw nut **(5)** onto threaded rod **(6)**.
- Screw the end of threaded rod **(6)** into beam **(7)**.
Grip length $X = 15 \text{ mm} \pm 1 \text{ mm}$
- Tighten nut **(5)** against beam **(7)**.
- Using an 18 mm ring spanner (not supplied), tighten nut **(8)** until the pin holes of beam **(7)** coincide and pass beyond ($\pm 1 \text{ mm}$) those on the arm.

Figure 3.11

- When beam **(7)** is in position, insert the pins **(4)** in arm **(3)** (pin threads on outside). The pins must be inside face **(F3)** of arm **(3)**.
- Unscrew nut **(8)** so that beam **(7)** bears on pins **(4)**.
- Unlock nut **(5)**.
- Unscrew threaded rod **(6)**.
- Unscrew the M12 nut **(5)** from the M12 threaded rod **(6)**.
- Remove threaded rod **(6)** from the arm.

Figure 3.12

- Install cover **(2)** on arm **(3)**.
- Tighten the 3 screws **(1)**.
- Install plug **(10)** in arm **(3)**.

