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Safety equipment
1 General

In order to avoid personal danger when entering supervised areas demands continuous supervision of:

- the status of safety components
- operator communication
- moving machine parts.

This is provided by a circuit board for safety supervision, which includes functions to immediately cut the control system’s operating stop loop when a course of events occur that can result in personal danger.

Examples of events are:

- hardware failure in the safety equipment
- incorrect operation
- carelessness
- machine fault

Safety equipment is designed according to category 4 described in EN 954-1, doubled and self-supervision.

The equipment can be adapted for optimal handling in each individual case by connecting different accessories to the circuit board.

General stop (G-stop)

A general stop occurs:

- If the light barriers are broken during station switching.
- If the light barriers are broken when the motor on the operator's work station (the positioner's loading side) is engaged. Does not apply to the positioner type C and the Fixed table.
- If the light barriers are broken for the station where the robot is located, applies to positioner types A/L and the Fixed table.

An auto stop occurs (A-stop)

- If the gate is opened during an ongoing working cycle

Station switching during an ongoing working cycle may only be performed with the key switch in the “Manual” position. Only applies to positioners with the station switching unit.
The following safety components are available as standard options for

All station types:
- Operator panel
- Light barriers
- Roller door (FlexArc)
- Gate supervision
- Timer resetting

For station types S/L/A/T there are also the functions:
- Home position/transport position indication
- Station indication with the service position
- Activation from extended programming area
1.1 System solutions

1.1.1 Traditional welding robot station

Figure 2 Traditional welding robot station

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<table>
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<td>Positioner</td>
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<td>Operator panel</td>
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<td>Light barriers</td>
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<td>Supervised area station 1</td>
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<td>Supervised area station 2</td>
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<td>Supervised programming area</td>
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<td>8</td>
<td>Barrier</td>
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<td>9</td>
<td>Service door</td>
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</table>
1.1.2 FlexArc

FlexArc is a complete welding robot station built on a base plate including walls. The total solution gives easy connection and rapid start-up. FlexArc always incorporates safety with a light barrier or roller door.

Figure 3 FlexArc 250R with light barriers

<table>
<thead>
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<th>1</th>
<th>Robot</th>
<th>5</th>
<th>Supervised area</th>
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<tr>
<td>4</td>
<td>Light barriers</td>
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<td>Service door</td>
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</table>
2 Operator panel

2.1 One working area

This variant applies to stations with one working area for operator.

![Operator’s panel 1 station](image)

**Figure 4** Operator’s panel 1 station

1. **Emergency stop**

   Pressing the emergency stop button immediately stops the entire welding robot system.

   The emergency stop button is connected in series with the other emergency stop buttons in the system.

2. **Entry permitted indication**

   Lamp, when green, indicates to the operator that the station is ready for loading the next workpiece.
3. Start Process, Resetting - (toggle function)

Pressing the push-button after loading the workpiece in station 1:

The status lamp in the push-button comes on:

1. Gives the ready signal to the robot system that loading of the workpiece in the station is complete.
2. Resets the personal safety protection around the station’s working area.
3. Starts the process

Pressing the push-button once again:

The status lamp in the push-button goes out:

4. Cancel button for operator ready. Stops the process

4. Program start

Starts the execution of the robot program.

5. Program stop

 Stops the execution of the robot program.

6. Menu

Push-button to access the main menu (Applies if the GPP function is included).

7. Error indication

Lamp that indicates an error.
2.2 Two working areas

This variant applies to stations with two working areas for the operator.

![Operator's panel 2 stations](image)

Figure 5  Operator's panel 2 stations

1. **Emergency stop**

Pressing the emergency stop button immediately stops the entire welding robot system.

The emergency stop button is connected in series with the other emergency stop buttons in the system.

2. **Entry permitted indication - station 1**

Lamp, when green, indicates to the operator that station 1 is ready for loading the next workpiece.

3. **Entry permitted indication - station 2**

Lamp, when green, indicates to the operator that station 2 is ready for loading the next workpiece.
4. **Start Process, Resetting** - (toggle function) - station 1

Pressing the push-button after loading the workpiece in station 1:

1. Gives the ready signal to the robot system that loading of the workpiece in station 1 is complete.

2. Reset personal safety protection around the working area for station 1.

3. Starts the process

*Pressing the push-button once again:*

The status lamp in the push-button goes out:

4. Cancel button for operator ready. Stops the process

5. **Start Process, Resetting** - (toggle function) - station 2

Pressing the push-button after loading the workpiece in station 2:

1. Gives the ready signal to the robot system that loading of the workpiece in station 2 is complete.

2. Reset personal safety protection around the working area for station 2.

3. Starts the process

*Pressing the push-button once again:*

The status lamp in the push-button goes out:

4. Cancel button for operator ready. Stops the process

6. **Program start**

Starts the execution of the robot program.

7. **Program stop**

Stops the execution of the robot program.

8. **Menu**

Push-button to access the main menu (Applies if the GPP function is included).

9. **Error indication**

Lamp that indicates an error.
3 Working area supervision

3.1 Light barriers

Light barriers are an opto-electronic protective device intended to protect dangerous areas.

The light barriers in the robot system are used to stop the robot and positioner if anyone enters the risk zone where moving parts are activated.

![Figure 6 Light barrier](image)

Light barriers can, where appropriate, be replaced by hatches, sliding doors or gates.

**Example:**

![Figure 7 FlexArc 250R Standard, right, with light barrier](image)

The light barrier equipment is connected directly to the circuit card for safety supervision without any further safety components.
3.2 Roller door

The roller door in the robot system is used to prevent access to the risk zone where moving parts are activated.

A light curtain is used with the roller door to assure that no personnel remain in the cell when the door closes and goes down.

Example:

*FlexArccell 250R Standard, right, with the roller door*
3.3 Gate interlock unit

The protective barrier that surrounds the robot system can be supplemented with one or more service gates to increase accessibility to the robot’s working area, for example, during programming. Such a gate should be fitted with a positive opening gate switch (interlock contact).

If a service gate is opened during an ongoing working cycle:

- the system is automatically switched to standby mode and
- the motors are shutdown.

To restart the system:

- the gate be must closed and
- the gate interlock reset.

This can be done in two ways depending on where the control cabinet is located.

1 Resetting, option 1. See “Resetting, option 1” on page 16.
2 Resetting, option 2. See “Resetting, option 2” on page 17.
3.3.1 Resetting, option 1

When the control cabinet is located close to the service gate giving a good view of the risk zone resetting can be done using the controller on the control cabinet’s control panel.

The gate switch (the interlock contact) is directly connected with the Auto-stop circuits. Resetting for operation after closing the gate, takes place using the controller on the control cabinet’s or from the teach pendant.

The gate switch consists of:

- positive opening interlock contact, which is secured to the door frame.
- coded key, which is fitted on the gate.

The gate switch (Figure 8) is connected to the control cabinet’s safety interface and is supplied with a 7 m cable.

1 Gate switch
2 Control Cabinet
3 Service door

Example:

![Diagram of gate switch used for resetting, option 1.](image)

*Figure 8  Gate switch used for resetting, option 1.*
3.3.2 Resetting, option 2

When the control cabinet is located far from the service gate where you cannot see over the risk zone, an external push-button should be fitted in order to reset the gate interlock. The push-button should be located outside of the risk zone.

- Resetting can only be done when the gate is closed.

The push-button and gate switch are connected to an option card in the control cabinet’s safety equipment.

The option card’s safety relays are connected with the AUTO-stop circuits.

Components according to Figure 9:

1. Push-button outside of the gate
2. Option card for external gate interlock (control cabinet)
3. Gate switch (service door)

Example

![Figure 9 Gate switch with resetting, option 2.](image-url)
3.4 Timer resetting unit

The timer resetting unit is a device used in connection with resetting light barriers. It is connected to the light barriers’ sensing circuits.

The timer resetting unit prevents unintentional starting when the operator is inside the restricted service area.

The timer resetting unit consists of:

- A timer resetting button located inside the service area.
- Timer resetting unit placed on the safety card in the control cabinet.

The timer resetting button must first be pressed in to reset the light barriers, this gives the operator 10 seconds to reset the light barriers using Process button on the operator’s panel.

1 Timer resetting unit (control cabinet)
2 Timer resetting button
3 Operator’s panel - Process button

The timer resetting button should be placed inside the service area so that it is not accessible to anyone outside of the light barriers that monitor this area.

The timer resetting button is connected to the control cabinet’s safety equipment and is supplied with a 17 m cable.

If the light barriers’ sensing circuits have not been reset within 10 seconds after the timer resetting unit (push-button) has been activated, this function must be reactivated in order for resetting to take place.
3.5 Activation from the supervised area

It can sometimes be desirable to program equipment of the type A/L/Fixed table from the Unloading/Loading side.

This can be done by allowing the operator to activate light barriers from the inside of the supervised area.

Activation is performed using a separate push-button inside the supervised area and can only be done in manual operating mode.

- MANUAL REDUCED SPEED (<250 mm/s)
- MANUAL FULL SPEED 100%

Components according to Figur 11:

1 Push-buttons for activation of light barriers
2 Safety card in the control cabinet
3 Supervised area
4 Light barriers

Figur 11 Activation unit.
Safety equipment
4 Positionsindikering

4.1 Station indication

The station indication function is used to monitor the system’s work stations. The positive opening limit switches are used for this function.

The limit switches are located in different positions depending on the station layout.

Example 1:

Station indication on a manipulator with a station switching unit and two stations.

The limit switches are placed on the station switching unit.

The limit switches have the task of:

- Monitor unpermitted movement on the station switching unit.
- Indicate which station side is facing the robot.
**Example 2:**

Station indication on the robot with two work stations.

The limit switches, which are located on the base of the robot, indicate which station side the robot faces.

**Example 3:**

Station indication on the conveyor for the robot with two work stations.

The limit switches, which are located on the carriage, indicate which station side the robot is next to.
4.2 Service position

The service position is a limited area (position) between two work stations where the robot can perform tool cleaning (e.g. the weld gun). When the robot is in this area the operator can enter both work stations without the robot shutting down.

NOTE! If the work stations are made up of manipulators, the motors for these must be shut off before the operator can enter the working area.

The limit switches are used in the service position function for station indication. See “Station indication” on page 21.

Example:

Service position for a robot with two work stations.

The limit switches, which are located on the base of the robot, indicate when the robot is in the service position.

NOTE! Systems that include a conveyor with a gun service unit as illustrated cannot provide a service position for the robot between the two work stations.

To clean the tool in this case use another function called Home position, see Home position on page 24.
4.3 Home position

The home position is a position where the robot is run to a safe position out of reach for the operator. Positive opening limit switches are used for this function and are located on the base of the robot.

The home position function is used in station solutions that only include one work station, which is common to the robot and operator.

When the robot is in the home position the operator is permitted to enter the working area.

Example:

Home position for the robot with one work station.

The limit switches, which are located on the base of the robot, indicate when the robot is in the home position.
4.4 Transport position

The transport position is a safe position out of reach for the operator that the robot, fitted on a conveyor, is put into pass a work station where the operator is present.

Positive opening limit switches are used for this function and are located on the base of the robot, the same limit switches as in the home position function on page 24.

Example:

Transport position for the robot.

The limit switches, which are located on the base of the robot, indicate when the robot is in the transport position. When the robot is in the transport position:

1. The operator can enter both work stations.

The robot can pass the work station that the operator is in.

4.4.1 Fixtures

If the fixture is not fitted, or if the shape and size of the fixture does not prevent access to the danger zone, applies for the L-type manipulators that a fence or similar must be put up to prevent access.
Safety equipment

Positionsindikering
5 Installation and set-up

This work may only be carried out by persons trained in the use of the complete equipment and who are aware of the special risks involved with these different parts.

5.1 Transport and unpacking

The safety instructions and other instructions should be studied carefully before starting transport and unpacking of the safety equipment. These can be found under a separate tab in the System manual.

- Check that the equipment is not damaged in any way.
- Report any visible transport damage immediately.

5.2 Lifting instructions

Lifting of the safety equipment may only:

- be carried out using equipment that corresponds with applicable lifting standards.
- be carried out by authorised personnel.

Do not walk under a suspended load!

Weight:

- Roller door, standard kg
5.3 Installation of the light barrier

Applicable regulations for machine safety are to be observed during installation and usage. Consult with the relevant local authorities concerning technical safety issues, if necessary.

- Follow the instructions for the supplied light barrier.

Safety instructions

In general the following conditions are to be satisfied:

- The light barriers are to be installed so that the risk zone cannot be passed from behind. If this cannot be guaranteed, further safety devices must be installed.
- During all phases of the work it must be possible to check the control of the machine electrical, so that a dangerous machine movement can be averted immediately.
- The safety distance between the risk zone and the light field must be so high that a dangerous movement is interrupted, before a person can reach the risk zone.
- The mechanical and electrical installations are to be carried out by trained and qualified personnel.
- Installation and commissioning of the equipment may only be carried out by trained and qualified personnel.
- Repairs, in particular with regard to optics and circuit cards, may only be carried out by the manufacturer or by persons appointed by the manufacturer.
- Interference or modifications to equipment must not take place, except for that described in these instructions.

Connection, see page 30:

- Connection of the light barrier to the system is done through the two-piece cable glands to the jackable terminal X 41

Set up

1 Transmitter/receiver unit
2 Deflection mirror

Figure 12 Light barrier
5.4 Installation of the roller door

The roller door is supplied with all essential cables for connection to the safety system.

A light curtain is used with the roller door to assure that no personnel remain in the cell when the door closes and goes down.

General

Observe the general safety instructions.

In principle all units are to be installed so that you cannot reach the risk area without breaking the light field and so that sufficient distance is maintained between the risk area and light field.

Connection, see page 30:

- Connection of the roller door to the system is done via outputs XS 41.1 and XS 41.2.
- Connect the light curtain using the two-piece cable gland to the jackable terminal blocks XS 81 and XS 81.1.

Example:

![Figure 13  FlexArc with roller door.](image-url)
5.5 Connections

5.5.1 External safety components

- Connected to the jackable terminal blocks fitted internally by the two-piece cable glands on the left-hand side of the top cabinet.

5.5.2 General

Figure 14  General connections

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<td>9</td>
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<td>Gate reset</td>
<td>Home position/transport indication</td>
<td>Position indication for robot/conveyor</td>
<td>Roller door station 1</td>
<td>Roller door station 2</td>
<td>Operator panel</td>
<td>Timer resetting station 2/Light curtain station 2</td>
<td>Light curtain (resetting protection) station 2</td>
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<td>11</td>
<td>12</td>
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<td>Activation unit working area 1</td>
<td>Timer resetting station 1/Light curtain station 1</td>
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<td>Light barrier 1</td>
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5.6 Inspection before start up

NOTE! Keep the doors to the control cabinet and top cabinet closed to prevent dust and dirt from entering.

Before switching on the voltage check that the following has been done:

- Check that all component equipment is connected correctly.
- The main voltage is according to the identification plate on the control cabinet.
- The teach pendant is connected.
- **The operating mode selector** on the control cabinet’s control panel is in the - MANUAL position.
- Check that the safety equipment is installed.

Light barriers

*Satisfactory protection for the operator/operating personnel and machines can only be guaranteed if the protective equipment is used correctly.

![Figure 15 Light barrier](image_url)

1 Transmitter/receiver unit  2 Deflection mirror

- The electrical connections should be inspected before the light barrier is connected. The transmitter’s LEDs come on when the system is activated.
- Check that the receiver unit has been adjusted correctly.
- Adjust the position if necessary so that it is optimal.
- Loosen the assembly screws and then move the optical centre point horizontally and vertically.
5.7 Start up

All requisite system software is installed on delivery.

- Switch on the main power switch on the control cabinet and the main power switch on the welding power source if fitted. The main power switch on the control cabinet normally controls the power supply to all component modules in the cabinet.

Note! Some power sources supply the process control card with an external reference voltage, which is why some parts of the control cabinet can be voltage fed even when the main power switch is in the "OFF" position.

- The robot makes a self-test on the hardware and software. This test takes about 1 minute.
- Wait until the message “Welcome to....” is shown on the teach pendant's display.

The system is now ready for use.
6 Maintenance

The wrist strap, provided in the cabinet, must be worn when handling the circuit cards and other electronics in the control cabinet to prevent ESD damage.

- The control system is fully enclosed and the electronics are thereby protected in a normal workshop environment. However, in very dusty and powdery environments the inside of cabinet should be checked regularly. If necessary use a vacuum cleaner.
- Check that the cables/connectors are not damaged. Damaged components must be replaced immediately.

At the start of each shift:

- An operating test is to be made on the safety equipment.
Safety equipment

Maintenance
7 Reservdelsförteckning/Spare Parts List

Reservdelar beställs genom ABB Automation Technology Products AB. Vid beställning var vänlig uppge typ och tillverkningsnummer samt benämningar och beställningsnummer enligt reservdelsförteckningen.

Rätt till ändring av specifikationer utan aviserings förbehålles.

Spare parts are to be ordered from ABB Automation Technology Products AB. Kindly indicate type of unit, serial number, denominations and ordering number according to the spare parts list.

Rights to reserved to alter specifications without notice.
<table>
<thead>
<tr>
<th>Positionsnummer</th>
<th>Antal</th>
<th>Beställningsnummer</th>
<th>Benämning</th>
<th>Denomination</th>
<th>Anmärkningar</th>
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<td>Op-panel 1 Op-ready komplett</td>
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Säkerhetsutrustning/ Safety equipment
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