whitepaper

Automatic lines of assemblage

Protection of benches of assemblage and automations with different levels of interaction with operator.

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Request

Protecting the operator gate of a series of automatic benches pedal assembling mounting (clutch and brakes) the in the automotive sector. Manufactured by DeD Automation Srl.

The operator must enter the work pieces and start the machine using a start command. During the machine cycle the operator gate is protected by light curtains.

Automatic benches of assemblage

Request

All the other sides of the bench are protected by transparent panels that prevent uncontrolled access.

Safety light curtains, start, stop and reset buttons are managed by the Mosaic safety controller.

The production process phases and the assembly instructions of the components are displayed on the display of the operating panel that integrates: reset for the light curtains, operator controls, alarm reset, manual or automatic operation selector and command to see on the display of the waste during processing.

Operator Panel

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As you can notice in below sequence of images, each stage of processing is provided with the appropriate assembly bench.

Bushings assembly

Pivot brake assembly

Brake assembly

Clutch assembly

Final Assembly

The height of the light curtains protects the entire working areas.

The height of the light curtains prevents from reaching the dangerous point also if leaning above the last beam of vertical lght curtain.

The height of the light curtain and its position are in relation to the minimum safety distance: $(S = K \times T + C)$.

Please refer to the Safety Guide on ReeR Website for more information.

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Achievement

The protection system has been completed with:

- 2 **EOS4 903 X** light curtain 30 mm resolution (hands), protected height 910 mm
- MOSAIC **M1** safety controller(cod. 110000). This guarantees a high level of flexibility of the safety system and reduces the number of components and therefore footprint and wiring. Promotes faster electrical cabinet construction.
- M12 5 poles female connectors with different cable lengths - type CD5, CD10, etc..

Mosaic iside the electrical cabinet

Determination of the safety distance and the relationship with the height of the light curtain

General formula for the determination of the minimum safety distance:

$$S = K \times T + C$$

Where: **S** - minimum safety distance between the protection and hazardous point, expressed in mm.

K - speed of approach of the body or parts of the body, expressed in mm / sec.

K = 2000 mm/sec. for safety distance up to 500 mm (for arm movement speed)
K = 1600 mm/sec. for safety distance higher than 500 mm (body movement speed)

T - total stopping time of the machine, consisting of:

t1 reaction time of the protective device in seconds
t2 reaction time of the machine in seconds, until it stops the hazardous action.

C - additional distance in mm.

Option C, takes into account:

1. Possible intrusion of parts of the body in the sensitive area before they are detected.
   In this case:
   C = 8 x (d-14) If d (light curtain resolution) <= 40 mm
   C = 850 If d (light curtain resolution) > 40 mm and for 2 - 3 - 4-beam light curtains
   C = 1200 - (0,4 x H) for horizontal light curtains
   In our case, the light curtains have resolution 30 mm so: C = 8 x (30-14); C = 128 mm.

2. The possbility that the dangerous point is reached by leaning over the upper edge of the sensitive area of a vertical light curtain, passing in the space between the mechanical protection and the protected area as shown.
   In this case C is obtained from Table 2 of ISO 13855 / EN 999 in the next page. This table relates the height of the hazardous area (a) with the height of the upper edge of the light curtain protected area (b).
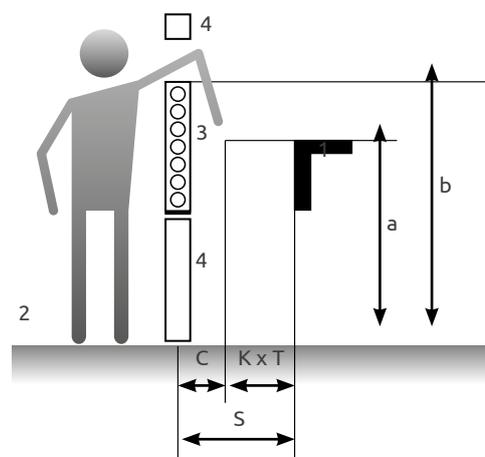
1 = Dangerous area 2 = Reference plane
3 = Light curtain 4 = Mechanical protection

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Height of Hazard zone "a"	Height "b" of upper edge of area protected by photoelectric curtain											
	900	1000	1100	1200	1300	1400	1600	1800	2000	2200	2400	2600
	Alternative distance C											
2600	0	0	0	0	0	0	0	0	0	0	0	0
2500	400	400	350	300	300	300	300	300	250	150	100	-
2400	550	550	550	500	450	450	400	400	300	250	100	-
2200	800	750	750	700	650	650	600	550	400	250	-	-
2000	950	950	850	850	800	750	700	550	400	-	-	-
1800	1100	1100	950	950	850	800	750	550	-	-	-	-
1600	1150	1150	1100	1000	900	800	750	450	-	-	-	-
1400	1200	1200	1100	1000	900	850	650	-	-	-	-	-
1200	1200	1200	1100	1000	850	800	-	-	-	-	-	-
1000	1200	1150	1050	950	750	700	-	-	-	-	-	-
800	1150	1050	950	800	500	450	-	-	-	-	-	-
600	1050	950	750	550	-	-	-	-	-	-	-	-
400	900	700	-	-	-	-	-	-	-	-	-	-
200	600	-	-	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-	-	-	-

Note: C (reaching over) calculated using Table 2 of EN ISO 13855 / EN 999 must be compared to C as conventionally calculated (see paragraph 1).
Please always select the higher value.

In our case:

- for ergonomic reasons the operational area is very large and the mechanical protection is not in contact with the upper edge of the protected area. We must therefore take into account the second point for the calculation of C;

- the safety distance is imposed by the kind of production. The operator cannot be too far from the assembly bench.

Therefore, in order to reduce the safety distance S, without changing the other two parameters K and T, reducing the C value is necessary, increasing the height of the light curtain.

- Height of Hazard zone (a) = 1200 mm

- Height of upper edge of area protected by photoelectric curtain (b) = 2200 mm

- C according to the previous table = (-).
  C as conventionally calculated: $C = 8 \times (30-14)$; $C = 128$ mm

- Assuming that T = 100 ms, the minimum safety distance is: $S = 2000 \times 0{,}1 + 128 = 328$ mm

In the next pages some companies operating in this busines sector.

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Founded in Turin (Italy) in 1959, ReeR distinguished itself for its strong commitment to innovation and technology.

A steady growth throughout the years allowed ReeR to become a point of reference in the safety automation industry at a worldwide level.

The Safety Division is in fact today a world leader in the development and manufacturing of safety optoelectronic sensors and controllers.

ReeR is ISO 9001, ISO 14001 and ISO 45001 certified.

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Object	Protection of benches of assemblage and automations with different levels of interaction with operator