

Safety Distance Formulas

Use of the following formulas assumes familiarity with the relevant standards.

U.S. Applications

The Safety Distance formula, as provided in ANSI B11.19:

$$D_s = K \times (T_s + T_r) + D_{pf}$$

D_s

the Safety Distance (in inches)

K

the OSHA/ANSI recommended hand-speed constant (in inches per second), in most cases is calculated at 63 in/s, but may vary between 63 in/s to 100 in/s based on the application circumstances;

not a conclusive determination; consider all factors, including the physical ability of the operator, when determining the value of K to be used.

T_s

the overall stop time of the machine (in seconds) from the initial stop signal to the final ceasing of all motion, including stop times of all relevant control elements and measured at maximum machine velocity.

T_s is usually measured by a stop-time measuring device. If the specified machine stop time is used, add at least 20% as a safety factor to account for brake system deterioration. If the stop-time of the two redundant machine control elements is unequal, the slower of the two times must be used for calculating the separation distance.

T_r

the response time of the safety device

D_{pf}

the added distance due to the penetration depth factor equals 48 in, per ANSI B11.19

D_{pf}

the added distance due to the penetration depth factor
For light curtains, D_{pf} is based on the resolution of the light curtain.

For safety mats, D_{pf} equals 48 inches per ANSI B11.19.

For two-hand control applications where encroachment towards the hazard is not restricted, D_{pf} equals 550 mm (21.65 in). When encroachment is obstructed (for example, shrouding the two-hand actuating controls, orientation of the workstation, etc.), the reaching distance (d_{ds}) may be reduced to zero. D_{pf} is also known as "d_{ds}".

There are two other U.S. formulas for two-hand control applications:

Part-Revolution Clutch Machinery

$$D_s = K \times (T_s + T_r + T_h) + D_{pf}$$

Where T_h =

the response time of the slowest hand control from the time when a hand disengages that control until the switch opens; T_h is usually insignificant for purely mechanical switches. However, T_h should be considered for safety distance calculation when using electronic or electromechanical (powered) hand controls. For Banner Engineering Corp. Self-checking Touch Buttons (STBs), see the de-actuate time listed in the specification section of the STB Manual, p/n 64136.

Full-Revolution Clutch Machinery

$$D_s = K \times (T_m + T_r + T_h) + D_{pf}$$

Where T_m =

the maximum time (in seconds) the machine takes to cease all motion after it has been tripped. For full revolution clutch presses with only one engaging point, T_m is equal to the time necessary for one and one-half revolutions of the crankshaft. For full revolution clutch presses with more than one engaging point, T_m is calculated as follows:

$$T_m = (1/2 + 1/N) \times T_{cy}$$

N = number of clutch engaging points per revolution

T_{cy} = time (in seconds) necessary to complete one revolution of the crankshaft

European Applications

The Minimum Distance Formula, as provided in EN 13855:

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

S

the Minimum Distance (in millimeters)

K

the EN 13855 recommended hand-speed constant (in millimeters per second), in most cases is calculated at 1600 mm/s, but may vary between 1600 mm/s to 2500 mm/s based on the application circumstances;

not a conclusive determination; consider all factors, including the physical ability of the operator, when determining the value of K to be used.

T

the overall machine stopping response time (in seconds), from the physical initiation of the safety device to the final ceasing of all motion.

C

the added distance due to the depth penetration factor
For light curtains, C is based on the resolution of the light curtain.

For safety mats, C equals 1200 mm, per EN 13855.

For two-hand control applications C equals 250 mm, per EN 13855. ISO/DIS 13855:2022 increases the C factor (d_{ds}) to 550 mm. The EN 13855 C factor may be reduced to 0 if the risk of encroachment is eliminated, but the safety distance must always be 100 mm or greater.