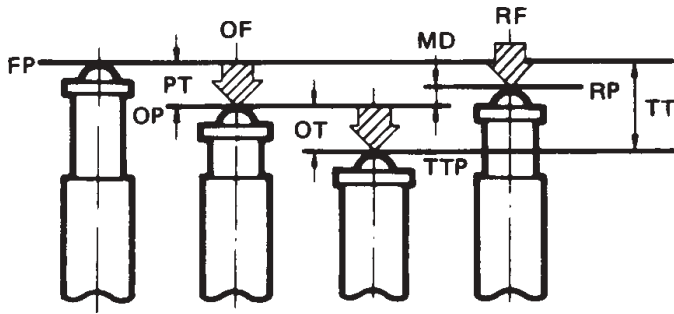
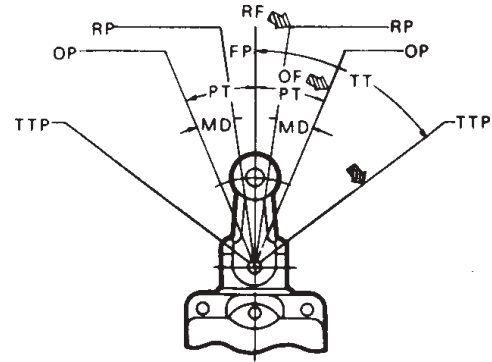


Limit Switches

■ LINEAR MOVEMENT



■ ROTARY MOVEMENT



■ LEGEND

- | | |
|-------------------------------|-----------------------------------|
| OF: Operating force | TTP: Total travel position |
| RF: Releasing force | PT: Pretravel |
| FP: Free position | OT: Overtravel |
| OP: Operating position | MD: Movement differential |
| RP: Releasing position | TT: Total travel |

■ GLOSSARY

Operating force (OF)
The force applied to the actuator required to operate the switch contacts.

Releasing force (RF)
The value to which the force on the actuator must be reduced to allow the contacts to return to the normal position.

Free position (FP)
The initial position of the actuator when there is no external force.

Operating position (OP)
The position of the actuator at which the contacts snap to the operated contact position.

Releasing position (RP)
The position of the actuator at which the contacts snap from the operated contact position to their normal position.

Total travel position (TTP)
The position of the actuator when it reaches the stopper.

Pretravel (PT)
The distance or angle through which the actuator moves from the free position to the operating position.

Overtravel (OT)
The distance or angle of the actuator movement beyond the operating position.

Movement differential (MD)
The distance or angle from the operating position to the releasing position.

Total travel (TT)
The sum of the pretravel and the total overtravel expressed by distance or angle.

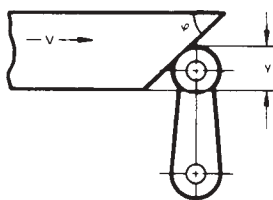
■ PROPER DESIGN FOR CAMS

Roller Lever Actuators

Non-overtravel type cams

Velocity: less than or equal to 0.25 m/sec (0.82 ft/sec)

If velocity (V) does not exceed 0.25 m/sec (0.82 ft/sec), the lever can be set vertically. As operating speed increases, the cam angle decreases.

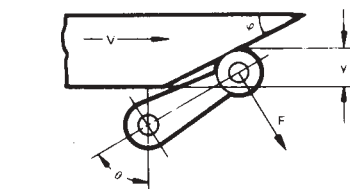


Cam angle (φ)	Velocity (V) max.
30°	0.4 m/sec (1.31 ft/sec)
45°	0.25 m/sec (0.82 ft/sec)
60°	0.1 m/sec (0.33 ft/sec)
60° to 90°	0.05 m/sec (0.16 ft/sec)

Cam stroke (y) may be up to 80% of total travel.

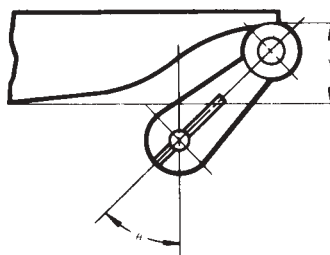
Velocity: greater than or equal to 0.25 m/sec (0.82 ft/sec) but less than or equal to 2 m/sec (6.56 ft/sec)

In higher-speed operations, the lever angle (θ) may be required to change according to the cam angle (φ). It is appropriate to set the lever angle within a range of 45° to 75°. See table top of next column.



Lever angle (θ)	Cam angle (φ)	Velocity m/sec (ft/sec)	Cam stroke (y)
45°	45°	0.5 (1.64)	0
50°	40°	0.6 (1.97)	50% to 80% TT
55° to 60°	30° to 35°	1.3 (4.26)	50% to 70% TT
65° to 75°	15° to 25°	2 (6.56)	50% to 70% TT

Velocity: greater than or equal to 2 m/sec (6.56 ft/sec) but less than or equal to 3 m/sec (9.84 ft/sec)

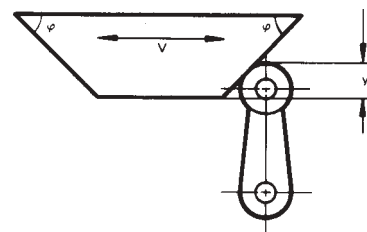


Lever angle (θ)	Cam angle (φ)	Velocity m/sec (ft/sec)	Cam stroke (y)
45°	Cam has smooth cubic curve	3 (9.84)	Up to 50% TT

Overtravel type cams

Velocity: less than or equal to 0.25 m/sec (0.82 ft/sec)

If velocity (V) does not exceed 0.25 m/sec (0.82 ft/sec), the lever can be set vertically. As operating speed increases, the cam angle decreases.

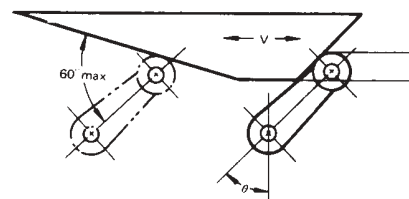


Cam angle (φ)	Velocity (V) max.
30°	0.4 m/sec (1.31 ft/sec)
45°	0.25 m/sec (0.82 ft/sec)
60°	0.1 m/sec (0.33 ft/sec)
60° to 90°	0.05 m/sec (0.16 ft/sec)

Cam stroke (y) may be up to 80% of total travel.

Velocity: greater than or equal to 0.5 m/sec (1.64 ft/sec)

In higher-speed operations, the cam angle (φ) of the rear edge should be in a range of 15° to 30°. Otherwise, make the cam acting surface straight in order to reduce lever shaking.



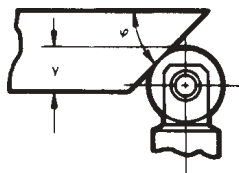
Plunger Type Actuators

Cams that override the actuator may have the same shape for both forward and backward directions. Avoid cam shapes that leave the actuator abruptly.

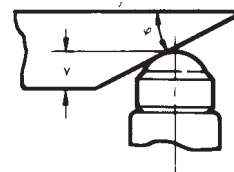
Refer to the illustrations at right for reference locations. Appropriate values are shown in the table below.

Cam angle (φ)	Velocity m/sec (ft/sec)	Cam stroke (y)
30°	0.25 (0.82)	60% to 80% TT
20°	0.5 (1.64)	50% to 70% TT

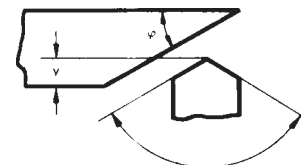
Roller plunger type



Ball plunger type



Bevel plunger type



■ INSTALLATION DESIGN TIPS

Correct Actuation of Limit Switches

With rotary actuator limit switches, the cam or piece (dog) encountering the actuator should be shaped to prevent the roller lever from snapping back freely. Use a cam tapered to allow a slow release of the lever. This reduces contact bounce and switch wear, and improves repeat accuracy.

In installations where the limit switch actuator encounters a fast-moving cam or piece, make sure the limit switch's lever does not receive a severe impact. Taper the cam to extend the time electrical contacts are engaged. These precautions assure the circuit is completed and prevents excessive wear on the switch.



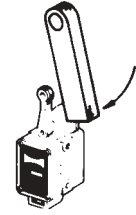
RIGHT



WRONG



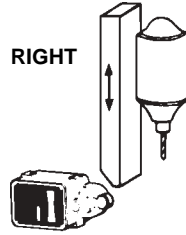
RIGHT



WRONG

Protecting the Limit Switch

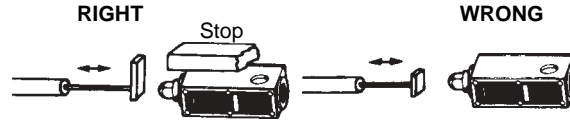
Where an overtravel situation may occur, as in emergency stop applications, choose a rotary actuator lever limit switch instead of pin- or roller-plunger type switches. Plunger type switches are not designed for use beyond the normal travel length, and would be damaged if the switch was used as a stop without protection. To use a plunger type switch, a stop plate should be added to protect the limit switch and its mounting from damaged due to overtravel.



RIGHT



WRONG

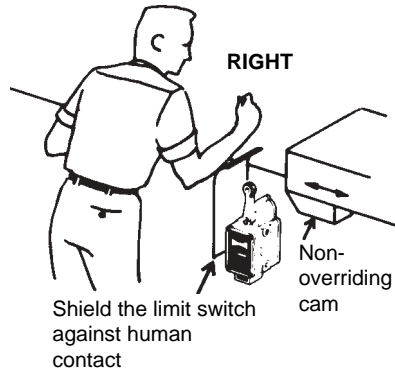


RIGHT

WRONG

Protecting Operations Personnel

Operator safety should always be considered in installing limit switches. The switch is designed for mechanical activation in automatic control. Prevent accidental activation due to operator error by installing a shield to protect the limit switch. Also use a non-overriding cam or dog.



RIGHT

Shield the limit switch against human contact

Non-overriding cam



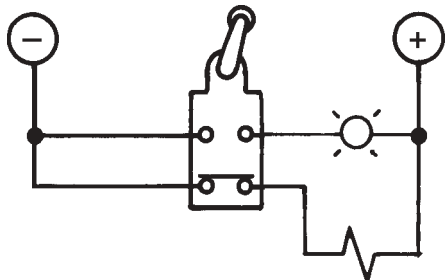
WRONG

■ GENERAL WIRING GUIDELINES

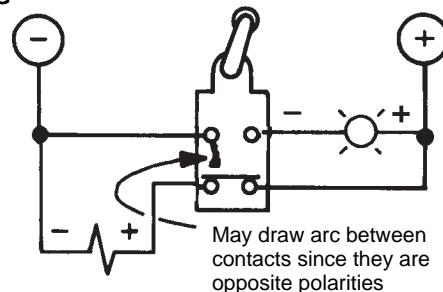
Prevent Arcing by Observing Polarity

Polarity must be observed when wiring limit switches. Failure to observe polarity may result in arcing between contacts.

RIGHT



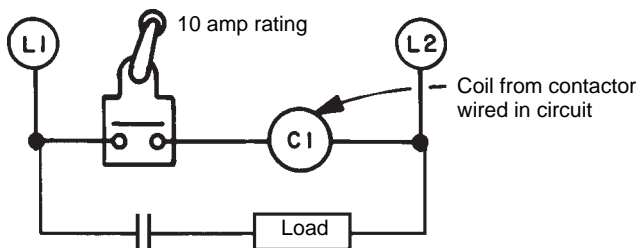
WRONG



Connections to Contactors

Use of a contactor in the control circuit when the rating of the limit switch contacts cannot directly handle the load.

RIGHT



WRONG

