

*The A-B-C Conveyor Book*  
*No. 2*

*Electrical Controls for Conveyors*



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**THE PURPOSE OF THIS MANUAL**

ELECTRICAL CONTROLS are always needed when powered conveyors are used. The power is supplied through the conveyor drive (which is the motor and reducer). The motor must be turned ON and OFF. ELECTRICAL CONTROLS are used to turn the motors ON and OFF.

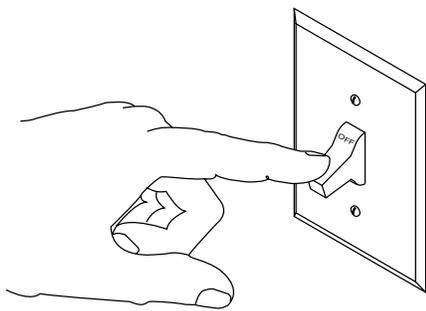
What controls are...how they are used...is the purpose of this Basic Training Manual No. 2. However, we will cover only those simple and basic types which are most commonly used.

The explanation of complicated and sophisticated electrical control setups can be obtained from your local Electrical Contractors.

**WHAT ARE ELECTRICAL CONTROLS?**

The most commonly known electrical control is found in the home...

**The Light Switch**

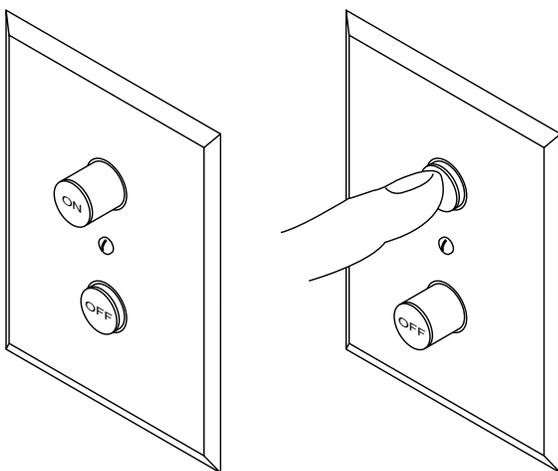


It controls the lights in each room. It turns the electric power to the lights ON and OFF.

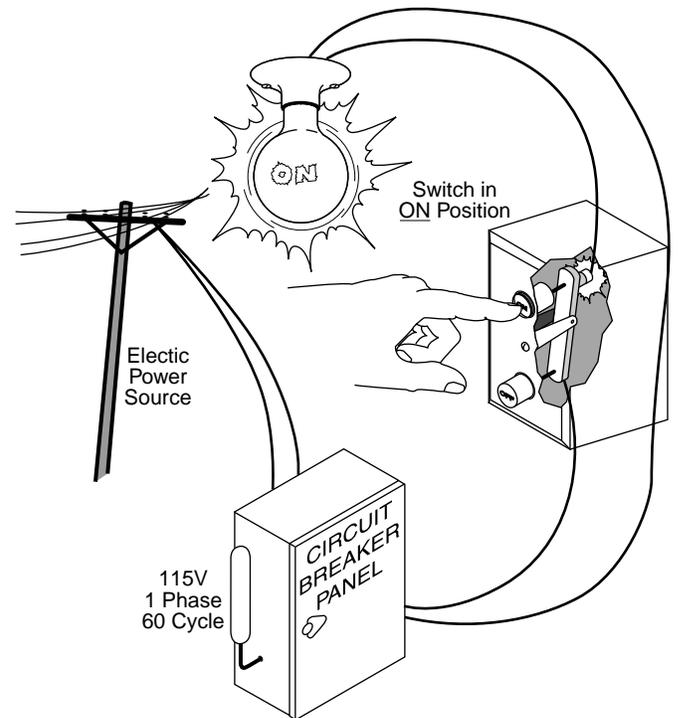
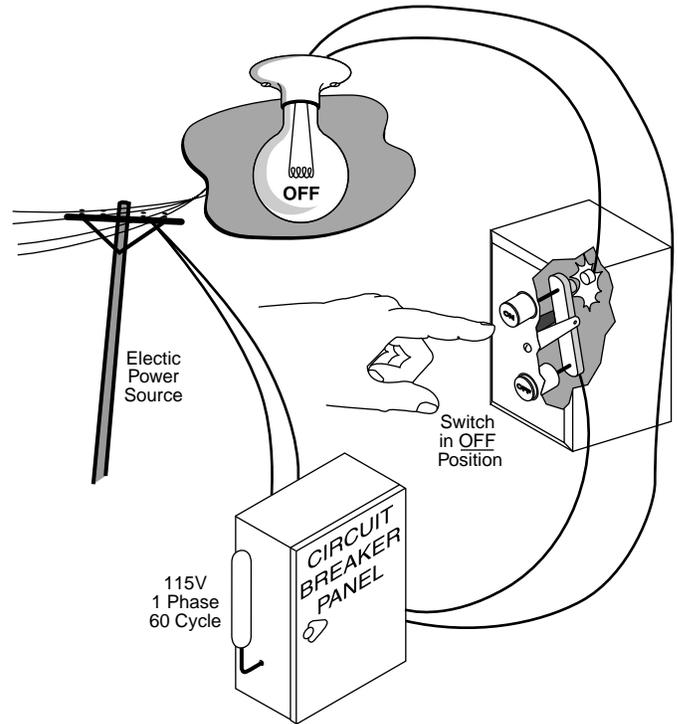
Some older type homes use a...

**"Pushbutton" Light Switch**

This also turns the electric power ON and OFF to control the lights in the room.



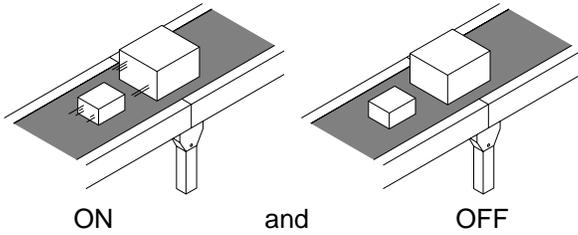
**HOW THE "LIGHT SWITCH"**



Now!...

Electrical controls (used on powered conveyors) do exactly the same thing as Light Switches.

Turn the conveyor...



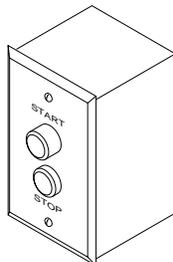
There are many different types of controls (or switches) used for different reasons.

The Most Common Types of Control Conveyors Are:

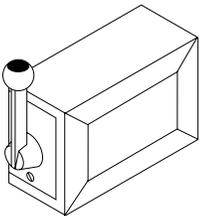
1. Manual Start Switches.
2. Reverse Drum Switches.
3. One direction Magnetic Starters used with one or more Pushbutton Stations (two button).
4. Reversible Magnetic Starters used with one or more Pushbutton Stations (three button).
5. Limit Switches.

Types of Conveyor

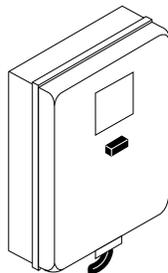
Manual Pushbutton



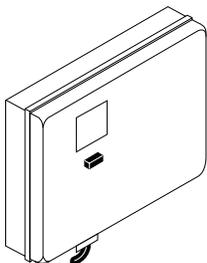
Manual Reversing Drum



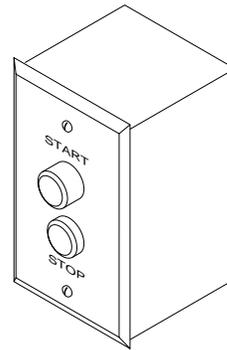
Non-reversing Magnetic



Reversing Magnetic



TYPE ONE  
Manual Pushbutton

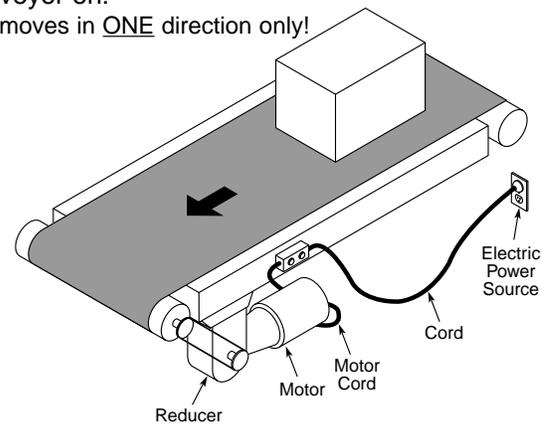


This is just like the light switch. It only turns the conveyor ON and OFF.

This switch is ideal for smaller motors at lower voltage. Motors up to and including 3/4 Horsepower (hp), 115 or 230V.

How a Manual Pushbutton Switch Is Used to Turn a Conveyor on:

Belt moves in ONE direction only!



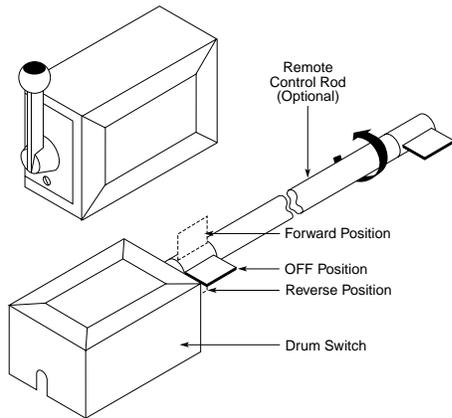
Advantages of a Manual Pushbutton Switch

- Easily available...usually in Cutler-Hammer stock.
- Small...can be mounted on most conveyors.
- Easy to install and operate.
- Plugs into wall outlets or can be connected permanently.
- Inexpensive.

Disadvantages of a Manual Pushbutton Switch

- No overload protection for motor (if too much weight is put on conveyor belt and conveyor is overloaded, motor could BURN OUT!)
- Maximum recommended — 230V, 3/4 hp.
- Only one switch can be used and in one location only.
- No high voltage protection to operator.
- Cannot be used for "automatic" control setup.
- No protection in hazardous atmosphere conditions (dust...water...etc.)

**TYPE TWO  
Manual Reversing Drum**

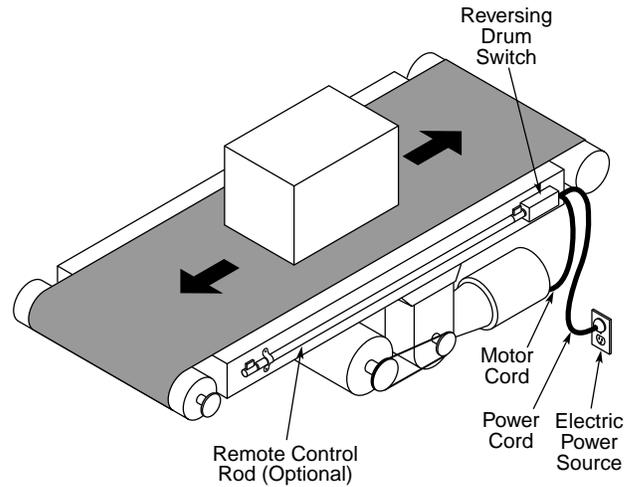


This type is most commonly used on all portable type belt conveyors...but can also be used with permanent belt conveyors.

**Advantages of a Manual Reversing Drum Switch**

- Readily available.
- Reversible.
- Can be mounted on most conveyors.
- Easy to install and operate.
- Plugs into wall outlet or can be wired permanently.
- Inexpensive.
- When used with remote control rod, conveyor can be controlled from either end.

**How a Manual Reversing Drum Switch Is Connected to a Powered Conveyor:**

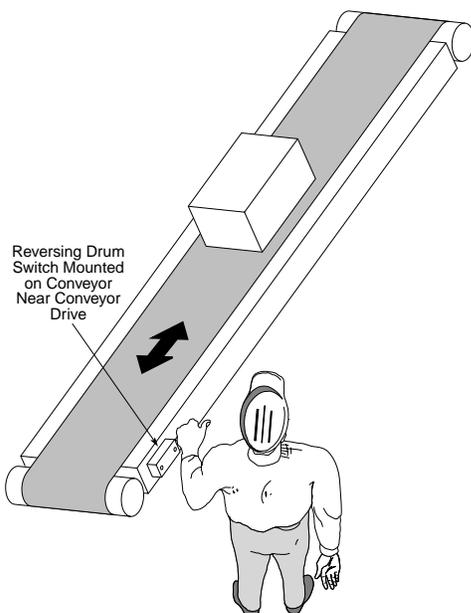


**Disadvantages of a Manual Reversing Drum Switch**

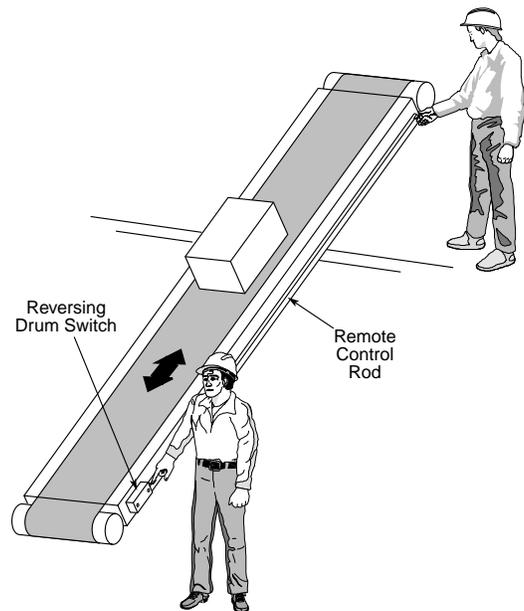
- No overload protection for motor (if conveyor is overloaded by user...motor could BURN OUT!).
- Maximum recommended...230V, 3/4 hp.
- No high voltage protection to operator.
- Cannot be used for "automatic".
- No protection from contaminants (dust...water...etc.).

**Typical Uses for Reversing Drum Switch**

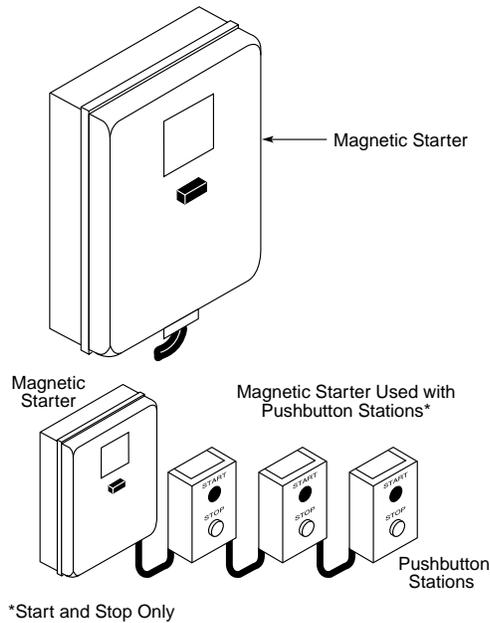
1. Operator can select Forward, OFF, or Reverse from one location only.



2. With remote control rod...conveyor can be controlled from EITHER end.



**TYPE THREE**  
**Non-reversing Magnetic**



**How the Non-reversing Magnetic Starter Works**

- Pushbutton stations CONTROL magnetic starter.
- Magnetic starter CONTROLS motor.
- If conveyor is overloaded, the magnetic starter will stop the conveyor.

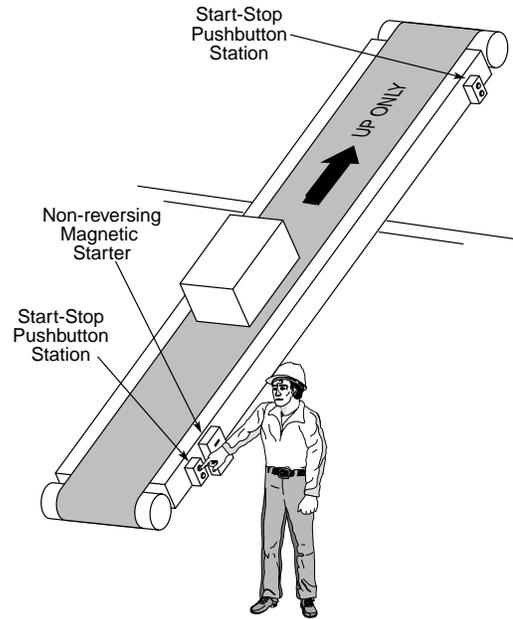
**Advantages of the Non-reversing Magnetic Starter**

- One or more pushbutton stations can be used, allowing conveyor to be "controlled" from many locations.
- Overload protection to conveyor...prevents motor burnout.
- Can be used with ALL Horsepower motors (must be used with 460V or more).
- Adaptable to automatic control setups. See page 7.

**Typical Uses of Non-reversing Magnetic Starters and Pushbutton Stations**

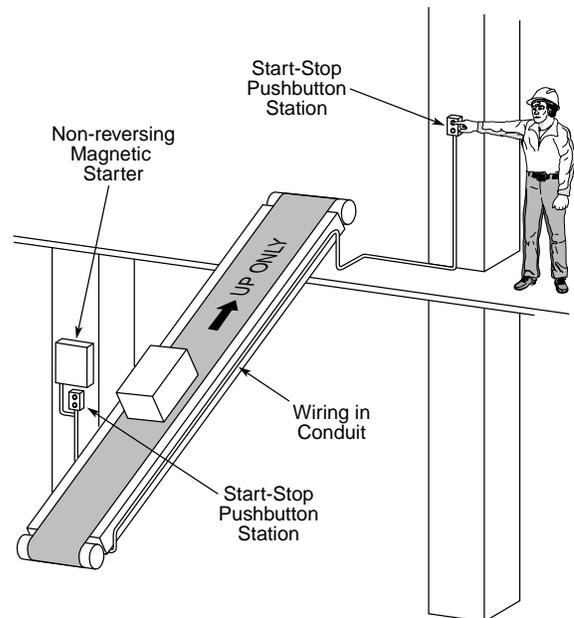
1. Controls mounted on conveyor.

Operator can turn conveyor ON or OFF at either end of conveyor.

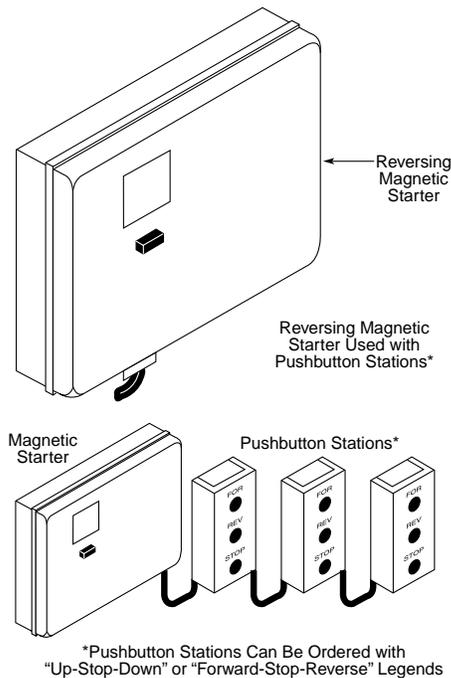


2. Controls mounted on building columns.

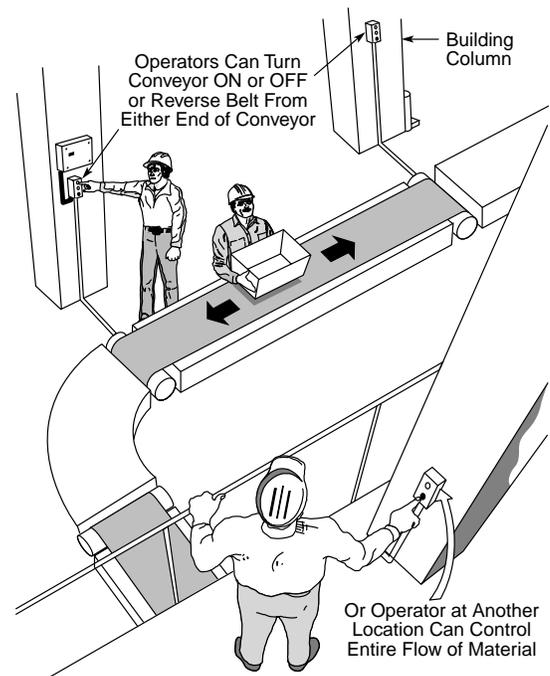
Conveyor can be turned ON or OFF at either location.



TYPE FOUR  
Reversing Magnetic



Typical Uses of Reversing Magnetic Starters and



How the Reversing Magnetic Starter Works

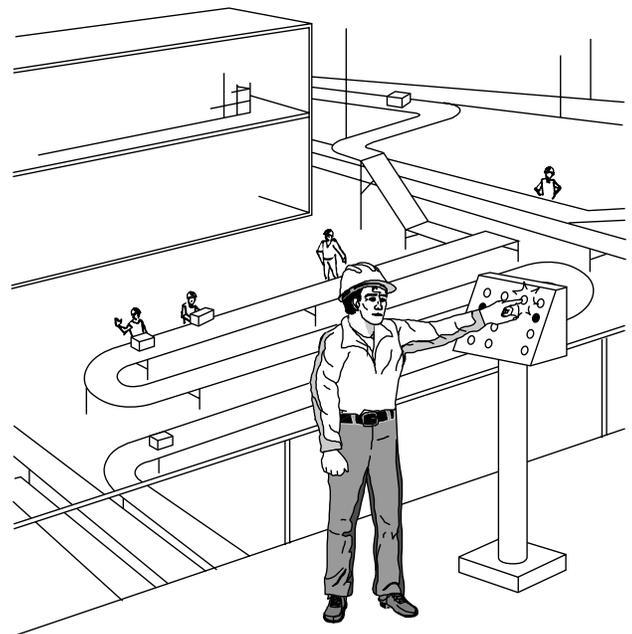
- Pushbutton stations CONTROL magnetic starter.
- Magnetic starter CONTROLS motor.
- Belt movement may be reversed by pushing "STOP" button and then pushing "REVERSE" button.
- If conveyor is overloaded, the magnetic starter will stop the conveyor.

Advantages of the Reversing Magnetic Starter

- One or more pushbutton stations can be used, allowing conveyor to be "controlled" from many locations.
- Overload protection prevents motor burn out.
- Can be used with ALL Horsepower motors (must be used with 460V or more).
- Adaptable to automatic control setups. See photo at right.

Can Be Adapted to Automatic Control Setup for a Large Conveyor System

Many conveyors can be controlled from a panel which houses many magnetic starters (one for each conveyor) and pushbutton stations. Each startup button energizes or deenergizes its respective starter.



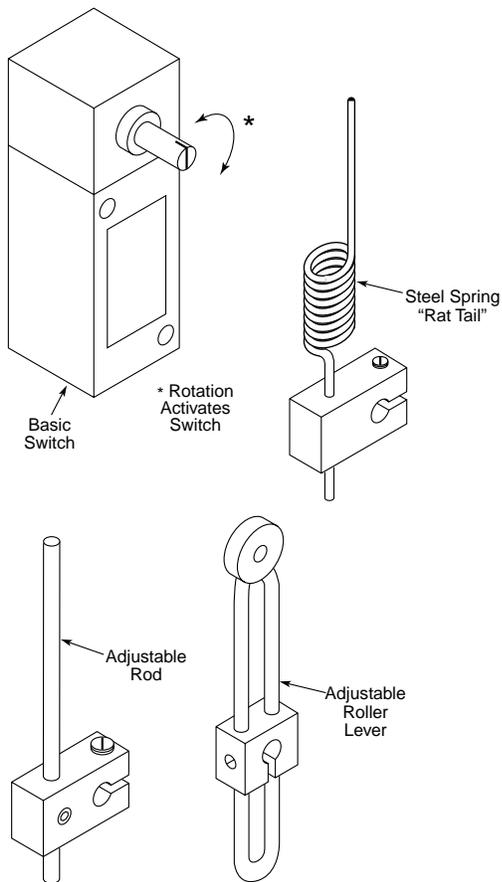
**TYPE FIVE**

**Limit Switches**

These must be used with Magnetic Starters but in addition to Pushbutton Controls. Limit Switches allow the material being moved to activate the switch and STOP the conveyor.

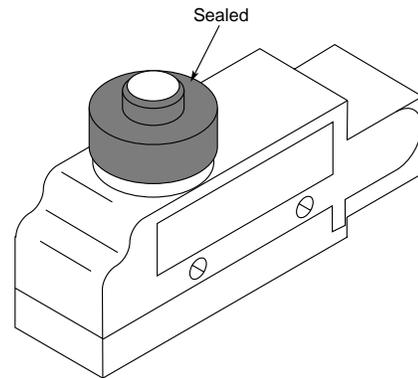
**Types of Limit Switches**

A. LEVER TYPE...can be used with several types of levers.

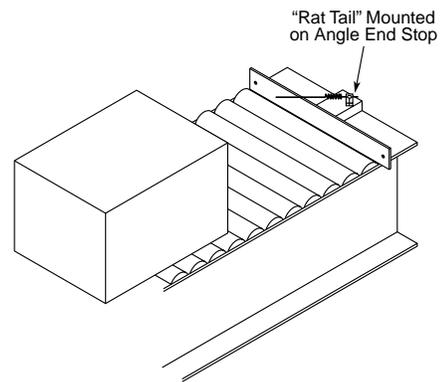


This type of switch can be supplied either as standard or with a time delay function.

B. PLUNGER OR PUSH TYPE...needs no lever... depression of "BUTTON" on top of switch activates magnetic motor starters.

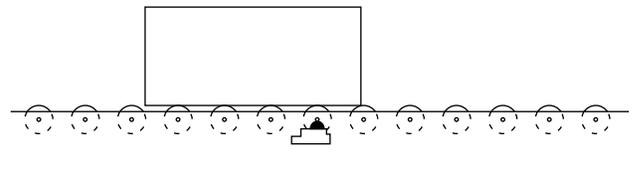


**Typical Limit Switch Applications**



**A. END STOP**

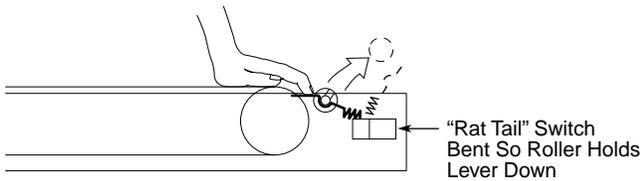
Limit switch connected to magnetic starter...when carton reaches end of unit, conveyor stops.



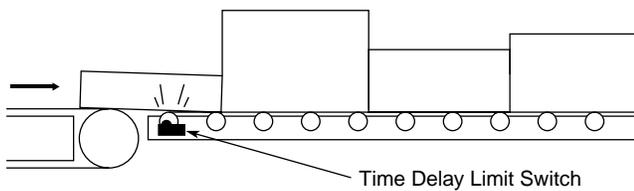
**B. DEPRESSED ROLLER**

When roller is depressed by carton...limit switch is activated, conveyor is stopped.

C. POP-OUT ROLLER



If a hand or objects gets caught between pulley and roller, roller POPS-OUT stopping conveyor.



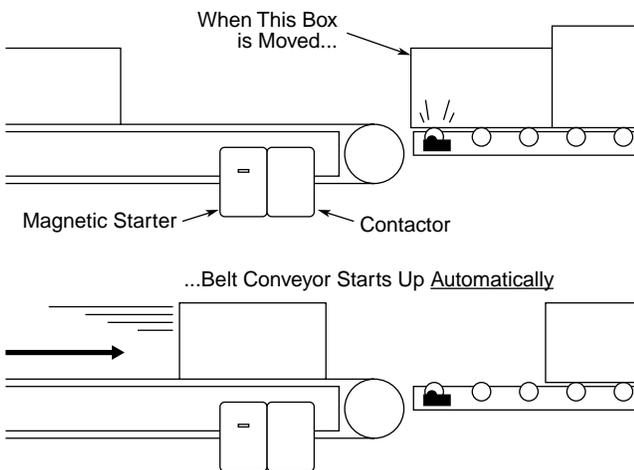
D. ACCUMULATION

Cartons passing over Limit Switch DO NOT stop conveyor, but when carton rests on Limit Switch for a period of time (usually several seconds) Limit Switch is activated and belt stops.

**IMPORTANT** — All Limit Switches can stop conveyors. Pushbutton switch **MUST** be pushed to turn power back on after Limit Switch is cleared.

E. AUTO RESTART

Belt conveyors can be re-started **AUTOMATICALLY ONLY** if contactor is used.



A contactor is another type of electrical control used with Limit Switches and Magnetic Starters.

TYPE SIX

Photo-electric Switches

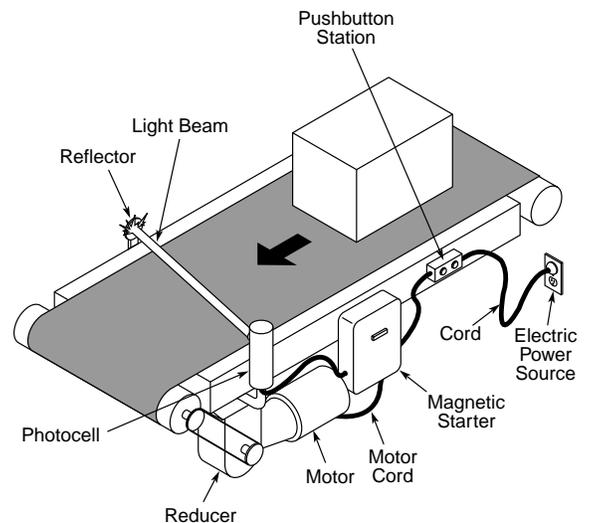
Photo-electric switches (or photocells as they are commonly called) are used exactly like limit switches, however, instead of moving or depressing a lever, the package blocks a light beam. When the beam is blocked, the switching part of the photocell is activated and the conveyor is stopped.

As with the limit switch, photocells are used in addition to magnetic starters and pushbutton stations. Photocells must also have a reflective disc to bounce back the light beam to the "eye."

Because there is no physical contact between the photocell and the packages being conveyed, the size and weight of the packages are NOT factors as with limit switches (a very light package may not activate a limit switch).

How a Photo-electric Switch Controls a Powered Conveyor:

When the beam is blocked, the switching part of the photocell is activated and the conveyor is stopped.



For additional Technical Reference see Photoelectric Sensors on page 10.

**TECHNICAL REFERENCE**

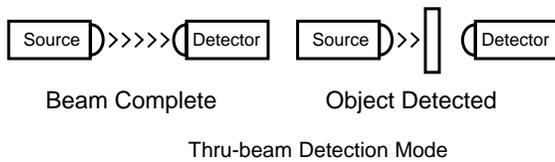
**Introduction — Photoelectric Sensors**

Photoelectric sensors use light to detect the presence or absence of an object. The main advantages of photoelectrics are:

- Object can be detected without direct contact.
- Sensor can be a great distance from the object being detected.

**Modes of Detection**

**Thru-beam:** Separate source and detector elements are aligned facing each other across an area which the target object crosses. Detection occurs when an object blocks the entire effective beam (the column of light that travels in a straight line between lenses).



**Thru-Beam Sensing**

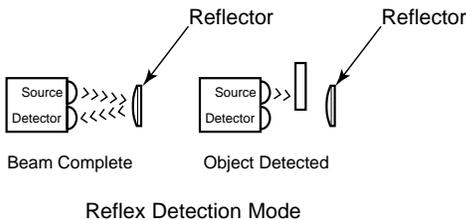
**FEATURES**

- Longest optical range
- Highest possible signal strength (excess gain)
- Greatest light/dark contrast ratio
- Surface reflectivity and color have little effect
- Best trip point repeatability

**LIMITATIONS**

- Two components to wire across detection zone
- Alignment can be difficult

**Reflex:** The source and detector are positioned parallel to each other on the same side of the object to be detected. The light beam is transmitted from the source to a retroreflector that returns the light to the detector. Detection occurs when the target object blocks the entire effective beam.



**Reflex Sensing**

Reflex photoelectric sensors (sometimes known as retro-reflective) position the source and detector parallel to each other on the same side of the object to be detected. The light source is directed at a retroreflector (a specially designed device that returns most of the light it receives back in the same direction from which it came, an example is a bicycle reflector.) The detector receives the light returned from the retroreflector. An output occurs when an object breaks the beam between the photoelectric sensor and the retroreflector.

Because the light must travel in 2 directions (to the retroreflector and back to the control), reflex controls will typically not sense as far, nor will they have the optical performance of a thru-beam control. Reflex controls do offer a powerful sensing system that does not require electrical wire to be run to both sides of the sensing area. This combination of high sensing power and ease of mounting has made reflex sensors the most popular choice of all sensing modes.

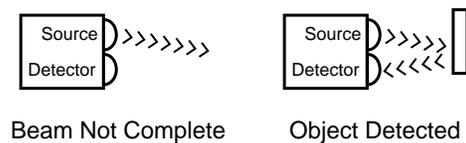
**FEATURES**

- Long range
- High light/dark contrast ratio
- Easy installation and alignment
- Only one component must be wired

**LIMITATIONS**

- Can be false triggered by shiny surfaced objects

**Diffuse Reflective:** The source and detector elements are positioned on the same side of the object to be detected and aligned so that their fields of view cross. When the target moves into this area, light from the source is reflected off the target surface back to the detector, and detection occurs.



**Diffuse Reflective Sensing**

**FEATURES**

- Simple installation and alignment. Wire only one side of sensing zone.
- Can detect differences in surface reflectivity.

**LIMITATIONS**

- Limited sensing range.
- Light/dark contrast and sensing range are dependent on object surface reflectivity.

## TECHNICAL REFERENCE

### Introduction — Inductive Proximity Sensors

These sensors detect the presence or absence of a metallic object without contact using an electromagnetic field.

A number of factors should be considered when applying proximity sensors. A detailed discussion of these factors can be found in the following section. Presented below are a few of the more important considerations for quick reference.

### FEATURES

- Immune to dirty, greasy, adverse environmental conditions
- Can detect lightweight or small objects that cannot be detected by mechanical limit switches
- High switching rate for rapid response to object counting application
- Can detect metallic targets through non-metallic barriers (i.e. glass, plastic, etc.)
- Long operational life with virtually unlimited operating cycles
- Solid state output provides a "bounce free" contact input signal to solid state logic devices

### LIMITATIONS

- Limited sensing range — up to 4" maximum
- Detects only metallic objects

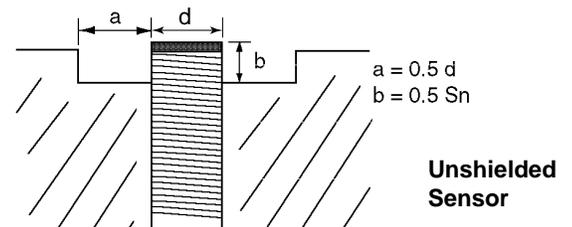
### GENERAL APPLICATION

- Part presence or absence detection
- Part counting
- Object position detection
- Object sorting

Different metallic material differentiation (i.e. ferrous vs. non-ferrous).

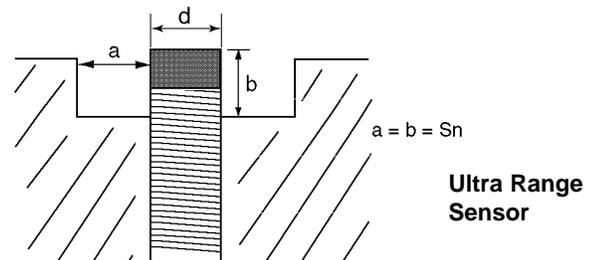
### Mounting

Proximity sensors are available in two classifications: shielded (also known as embeddable or flush mountable) and unshielded (non-embeddable or non-flush mountable). These terms refer to the proximity to surrounding metal that the device can be mounted. An embeddable or shielded sensor can be mounted with the sensor completely surrounded by metal.



A non-embeddable or unshielded sensor must have a metal free zone provided when mounting the sensor as shown above and below. The size of the metal free zone is dependent on both the size of the sensor and the type of sensing range, i.e., standard or extended.

Where  $a$  and  $b$  are the metal free dimensions.



### Ultra Range Sensors

Recently introduced "Ultra Range" proximity sensors — extended range devices offering sensing distances almost 3 times greater than conventional devices. They are available in semi-shielded designs — mounted similar to an embeddable sensor — and non-embeddable designs — requiring more metal free zone area than conventional unshielded sensors. All are available in a variety of circuits and terminations.

\* $S_n$ =rated sensing range of proximity sensor



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