

Maintaining Equipment Safeguards in Varying Operating Temperatures

A Technical Note

Factories, warehouses, and distribution centers often encounter temperature variations due to the number of machines running and the weather conditions outside. Workers as well as the equipment they use must adjust for these temperature variations in order to maintain safe and efficient operations. A cost effective and reliable safety mechanism to consider for a conveyor system is a Honeywell MICRO SWITCH CPS Series Cable-Pull Safety Switch.

Effect of Temperature on a Cable-Pull Safety Switch

The relative expansion or contraction of the steel actuating cable when the ambient temperature increases or decreases must be taken into account when pre-tensioning a CPS. This phenomenon is called the coefficient of linear expansion.

This change of cable length with variation in temperature, although very small on short cable runs, can cause significant nuisance shutdowns on much longer runs. Fortunately, this change can be calculated and steps taken to minimize its effect (see Table 1). The table can help in calculating the change in cable length depending on the total span of the cable and the temperature variation in a facility.

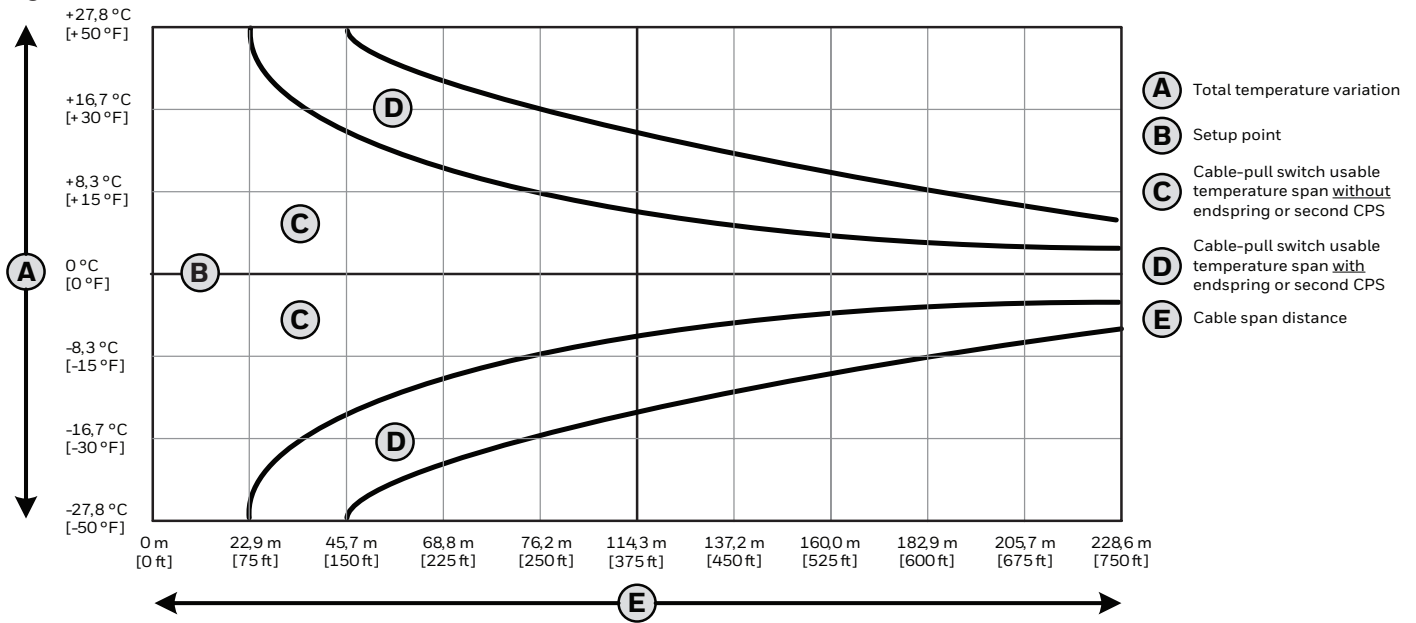
Table 1. Formula Table

VARIABLE	DEFINITION	IMPERIAL	SI
T	CHANGE IN TEMPERATURE	°F	°C
K	COEFFICIENT OF EXPANSION FOR STEEL CABLE	6.89×10^{-6} °F	1.24×10^{-6} °C
D	CABLE SPAN	ft	m
L	CHANGE IN LENGTH	in	mm
FORMULAS			
		$L = TxKxDx12$	$L = TxKxDx1000$
		$T = L / (KxDx12)$	$T = L / (KxDx1000)$
		$D = L / (TxKx12)$	$D = L / (TxKx1000)$



Each CPS switch has travel specifications. The distance between “trip on slack” and “trip on pull” is the usable travel. The lesser the travel, the lower the temperature tolerance a CPS will have. With 0 °C [0 °F] change in temperature, only the weight and friction of the cable are factors in its correct operation and very long runs are theoretically possible. Real world applications have temperature variations for which planning is needed.

Figure 1. Effect of Temperature on Cable-Pull Switch Operation



Select a switch with the greatest usable travel distance as this determines the temperature tolerance.

- If possible, install the system when the temperature is at the midpoint of the extremes. If a warehouse has a low of 15.6 °C [60 °F] and a high of 32.2 °C [90 °F], set up the system at the midpoint, 23.9 °C [75 °F]. If the system is installed at an extreme temperature, the tensioning should be fine-tuned when the temperature is at the midpoint.
- Use an end-spring, or another CPS, at the opposite end of the cable span to double the temperature tolerance (see Figures 1 & 2).

Upon using an end-spring or a second CPS switch, the usable temperature variation increases to $\pm 30\text{ }^{\circ}\text{F}$. Hence, the conveyor system now will be less vulnerable to temperature variations when equipped with an end-spring or a second CPS switch.

How to Determine Usable Temperature Variation for a CPS Switch

Example: Factory A is using a 1CPS Series switch in a conveyor belt system for emergency shutdown situations. The cable length of the 1CPS switch is 250 feet and the perimeter of the conveyor belt is 125 feet. The cable of the 1CPS switch is being used to cover the perimeter of the conveyor belt so a worker anywhere within the perimeter of the conveyor can pull the cable to stop the conveyor during an emergency.

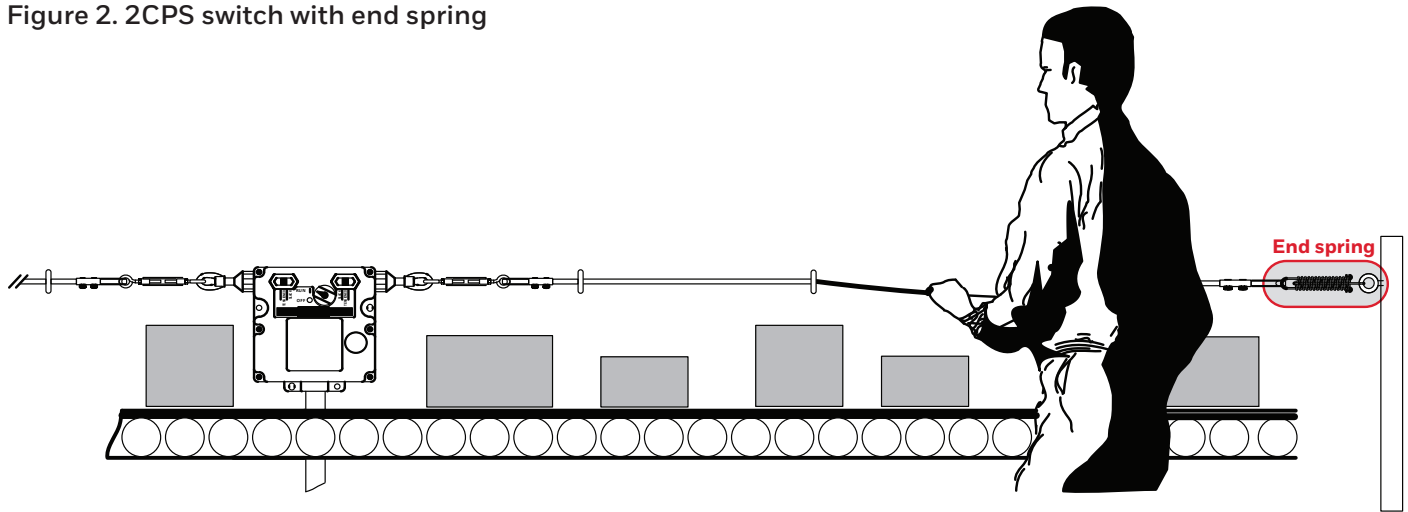
During the installation of the cable-pull safety switch, one key parameter that Factory A needs to determine the temperature tolerance of a switch with a cable span of 250 feet. Let's assume that the temperature variation in Factory A when all the machineries and equipment are running versus not running is around $\pm 22\text{ }^{\circ}\text{F}$.

Using Tables 1 and 2, it is understood that for a 250 feet cable, the usable temperature variation is $\pm 15\text{ }^{\circ}\text{F}$ without using an end-spring or a second CPS switch. Clearly, the usable temperature variation is well below Factory A's required temperature tolerance. Factory A needs to have a temperature tolerance of around $\pm 22\text{ }^{\circ}\text{F}$ or higher for the cable-pull safety switch to functional properly, avoid nuisance tripping due to temperature variations, or continuous stretching of the cable.

Table 2. Usable Temperature Variation vs. Cable Span

WITHOUT END-SPRING OR SECOND CPS SWITCH		WITH END-SPRING OR SECOND CPS SWITCH	
75 FT	$\pm 50\text{ }^{\circ}\text{F}$	75 FT	$\pm 80\text{ }^{\circ}\text{F}$
100 FT	$\pm 27\text{ }^{\circ}\text{F}$	100 FT	$\pm 50\text{ }^{\circ}\text{F}$
225 FT	$\pm 20\text{ }^{\circ}\text{F}$	225 FT	$\pm 36\text{ }^{\circ}\text{F}$
250 FT	$\pm 15\text{ }^{\circ}\text{F}$	250 FT	$\pm 30\text{ }^{\circ}\text{F}$
375 FT	$\pm 13\text{ }^{\circ}\text{F}$	375 FT	$\pm 25\text{ }^{\circ}\text{F}$
450 FT	$\pm 8\text{ }^{\circ}\text{F}$	450 FT	$\pm 21\text{ }^{\circ}\text{F}$
525 FT	$\pm 7\text{ }^{\circ}\text{F}$	525 FT	$\pm 18\text{ }^{\circ}\text{F}$
600 FT	$\pm 6\text{ }^{\circ}\text{F}$	600 FT	$\pm 15\text{ }^{\circ}\text{F}$
675 FT	$\pm 5\text{ }^{\circ}\text{F}$	675 FT	$\pm 12\text{ }^{\circ}\text{F}$
700 FT	$\pm 5\text{ }^{\circ}\text{F}$	700 FT	$\pm 9\text{ }^{\circ}\text{F}$

Figure 2. 2CPS switch with end spring



Honeywell MICRO SWITCH Cable Pull Switches

Honeywell’s cable-pull safety switches are playing a major role in helping to keep workers safe in manufacturing and distribution centers by providing consistent, predictable, fail-safe control response.

Cable-pull switches (CPS) provide a readily accessible emergency stop (E-stop) signal and is a cost-effective alternative to using multiple E-stop pushbuttons. A single CPS can span hundreds of feet, whereas an E-stop pushbutton is needed every five or six feet. The savings in hardware, especially wiring junctions, can be substantial.

Honeywell’s switch design offers the greatest usage travel distance in the industry.

The cable-pull safety switch comes in two versions – 1CPS series and 2CPS series. The 1CPS is intended for use in applications where the cable span is 76 m [250 ft] or shorter. It is an economical solution for shorter runs or zone protection typical to automated systems. The 2CPS Series is intended for use in very long cable runs of 152 m [500 ft].

Our switch design features the widest range of pre-tensioning in the cable pull safety switch industry. This distance is what determines the temperature tolerance available in the switch. This is a significant benefit for any factory floor or warehouse application since temperature variations will cause cable length changes and pre-tensioning mitigates false safety signals. Honeywell’s CPS minimizes nuisance tripping or shutting down of a conveyor belt due to temperature variations.

There are many cable pull safety switches available in the market. Honeywell’s cable pull safety switches often perform reliably and effectively in a wide range of operating temperatures.

For more detailed product specification of the 1CPS and 2CPS Series switches, please refer to the [CPS datasheet](#).

CPS Switch Cable Type – Red Vinyl Coated, Galvanized Steel, Aircraft Grade Cable

The following are the advantages of using a vinyl coated, galvanized steel, aircraft grade cable –

- Superior combination of strength and flexibility
- Galvanized coating provides corrosion protection
- Higher temperature tolerance
- Vinyl coating adds an extra layer of protection

Warranty/Remedy

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items that Honeywell, in its sole discretion, finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

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Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, Honeywell assumes no responsibility for its use.

WARNING **IMPROPER INSTALLATION**

- Consult with local safety agencies and their requirements when designing a machine control link, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

Failure to comply with these instructions could result in death or serious injury.

For more information

To learn more about Honeywell's sensing and switching products, call 1.800.537.6945, visit sensing.honeywell.com, or e-mail inquiries to info.sc@honeywell.com

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