Power Control P PRODUCTS
ABN 38 009 121 260

P.O. Box 4022, Myaree WA 6960
Unit 3, 8 Hayden Court, Myaree WA 6154
phone (08) 9317 4322, fax (08) 9317 4465
email: sales@powercontrol.com.au

The Effect of Temperature Variations on Safe-T-Pull Switch Operation

Changes in Cable Length due to Temperature

Temperature changes cause small variations in the length of steel pull wire (lanyard) cable.

Increases in temperature will cause the cable to lengthen, while temperature decreases will cause the cable to shorten. The result of this thermal expansion and contraction is not normally noticeable, but under some conditions may cause nuisance tripping of the pull wire switch.

Published data reveals that steel pull wire cable has a typical thermal coefficient of 12.5 parts per million per degree Celsius. The length of a steel pull wire cable will increase or decrease by that amount for every one-degree change in temperature. Longer cables and larger changes in temperatures will result in the biggest changes in cable length.

Mathematically this effect is expressed as follows:

$$\Delta L = \Delta T * k_T * L \qquad \text{general form}$$

$$L_{T_1} - L_{T_0} = (T_1 - T_0) * k_T * L_{T_0} \qquad \text{specific form}$$

ΔL = change in length ΔT = change in temperature

L_{T1} = length @ T_1 T_1 = final temperature

L_{T0} = length @ T_0 T_0 = initial temperature

k_T = coefficient expansion (12.5 ppm or 12.5 x 10^{-6})

Using the equation it is easy to calculate the exact effect of and interaction between cable length, temperature and cable expansion or contraction.

For example, a temperature change of 45°C will cause a 100m cable to change by 56.25mm.

Switch Design

The WA made Safe-T-Pull switches have been purposely designed to accommodate up to 60mm of cable movement before tripping. This "deadband" is comprised of 30mm allowance on either side of a central shaft position, and prevents small movements of the cable from causing nuisance trips.

When correctly installed, a Safe-T-Pull switch uses a specially manufactured compensating spring to terminate the fixed end of each pull wire cable. The cable is therefore suspended between two matched springs, one inside the switch and one fixed externally. The result is that only HALF of the total change in length is apparent at each end of the cable.

Referring to the above equation, we can then calculate the maximum possible cable length that can be used when the annual temperature range is known.

For example, the maximum length of cable that could be used on a site with a 50°C annual temperature span is 192m. (giving a total change of 120mm, or 60mm at each end)

In practice however, it is better to take a more conservative approach to the calculation of maximum cable length to allow for the effects of incorrect installation, vibration, and cable path obstruction.

We recommend that for the most reliable switch operation, the installed cable length be limited to approximately half of the maximum calculated value. In the example above, a cable length of 100m would provide reliable operation with the Safe-T-Pull switch when properly installed.

Other Factors affecting Switch Reliability

Excluding the effects of temperature, the most common causes of nuisance trips are due to the incorrect switch installation. Various possible causes of nuisance trips are described below. Note that one or more problems may jointly contribute to nuisance trips

Cable Path Obstruction arises when the cable path is neither straight nor incorrectly aligned, resulting in cable drawn tight against mechanical obstructions or its own cable supports. Attempting to route the cable around obstacles or curves without the use of suitable pulleys or low friction cable guides can also restrict the free movement of the cable and impaired protection or nuisance tripping can result.

Excessive Vibration can cause cable wear and sticking against eyebolts. Cable movement due to vibration can also contribute to nuisance trips, especially where long cable runs are installed.

Installation Errors or inappropriate cost saving measures include too few cable supports, incorrect compensation springs, failure to correctly pre-tension the switch shaft, and excessive pull wire cable length.

Ageing Cables may stretch slightly over time and should be retensioned if necessary.

Uneven Temperatures along the length of a pull wire cable can result from various combinations of full sun and shade, proximity ho sources of heat or cold,

Note: Older style eyebolts or pigtail cable guides can now be replaced with new self-aligning nylon cable guides. The new guides address two problems: the wearing of the pull wire cable at point of contact and the cumulative friction of many guides on a single length of cable.

The new nylon guides feature an extended and tapered tubular throat to eliminate sharp wear points, causing less cable wear. Despite the greater contact surface, the overall cable friction is dramatically lower due to the specially selected "slippery" or low friction characteristics of the nylon. The self aligning guide is easily included in new projects or retrofitted to existing equipment.

Comparisons with Competitive Products

In order to compare the Safe-T-Pull with any competing product, it is necessary to know the guaranteed switching deadband and linear tension span of the other product. It is also important to determine that non deforming matched compensation springs are available in order to comply AS1755. Only when this information is known can a valid comparison be made.