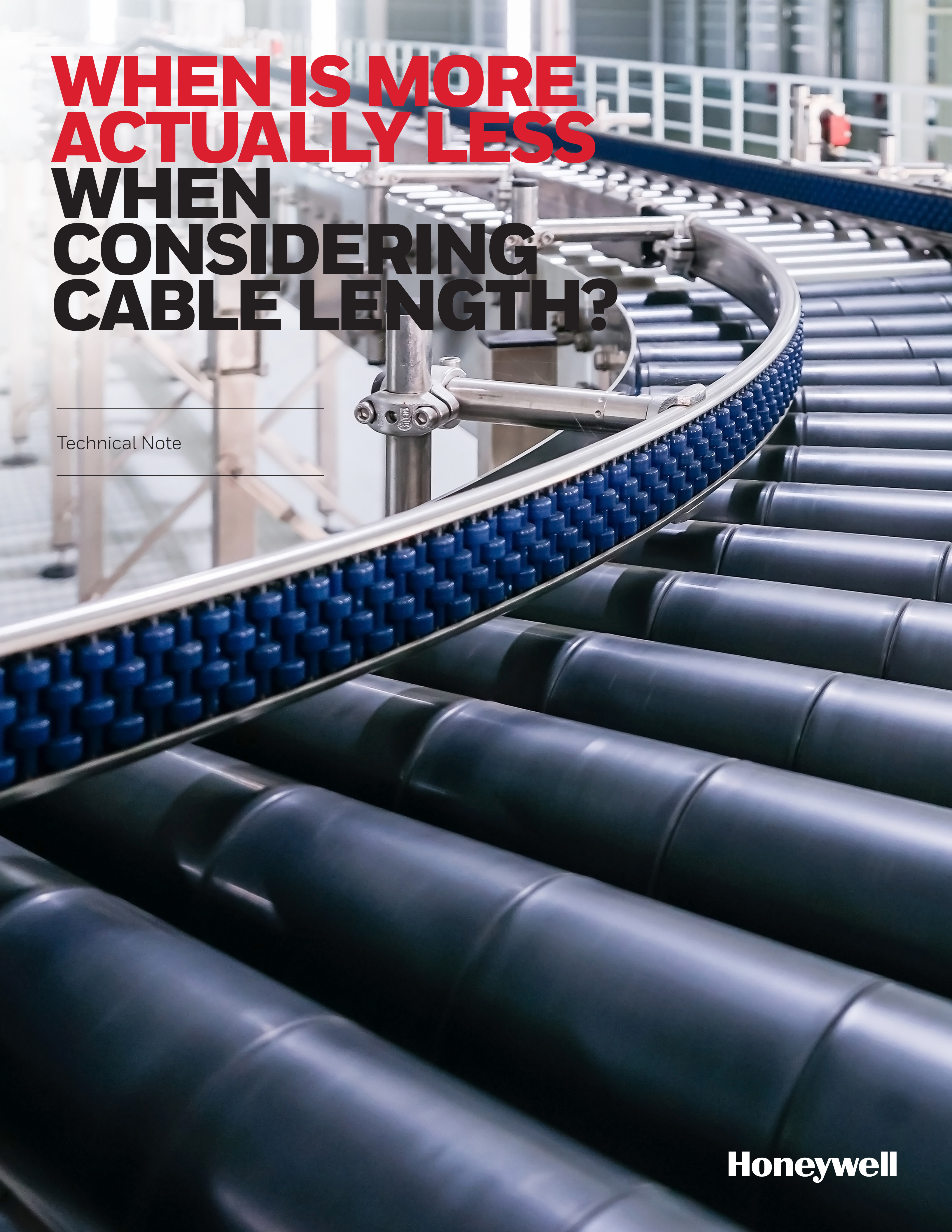
WHEN IS MORE ACTUALLY LESS WHEN CONSIDERING CABLE LENGTH?

Technical Note



Honeywell

WHEN IS MORE CABLE LENGTH ACTUALLY LESS?

Executive Summary

> Tension, friction, changes in elevation and fluctuations in temperature all impact cable-pull runs and the force required to trigger the switch.

JUST BECAUSE A SWITCH SPECIFIES A LONGER CABLE LENGTH, DOESN'T MEAN IT'S A BETTER APPLICATION OPTION

To prove this statement, Honeywell engineers went to work comparing the MICRO SWITCH 2CCP Cable Pull with *Competitor B's* cable pull using industry standards. The Honeywell switch specifies a cable span of 250 feet; whereas *Competitor B's* switch specifies a 328 feet usable span per their datasheet. At first glance, it appears *Competitor B's* switch can cover 78 more feet than the Honeywell 2CCP. But, does it actually do so and maintain the safety protocols necessary?

Most real-world cable-pull applications are not straight runs with no changes in direction and temperature. Each of these variables impacts the switch's performance. The relative expansion or contraction of the steel actuating cable when the ambient temperature or friction increases or decreases must be taken into account.

In four comparative tests (two with end spring, two without) that featured two cable length runs, the switches were properly installed and readings taken. *As evidenced by the diagrams and test data in the next pages, longer cable runs were not "better" and, ultimately, they proved to have safety concerns.*

Under certain circumstances, the use of longer cable lengths can potentially reduce the effectiveness of the cable switch and create questions concerning its usefulness and safety. The use of longer cable lengths can require additional manual effort to "pull" or trip the switch to allow shutdown of the conveyor – in some cases creating a safety issue – the kind of issue these products were meant to address. And once tripped, these longer cable runs do have the potential to require maintenance to manually retract the cable and reset the switch – ultimately resulting in increased downtime and additional cost.

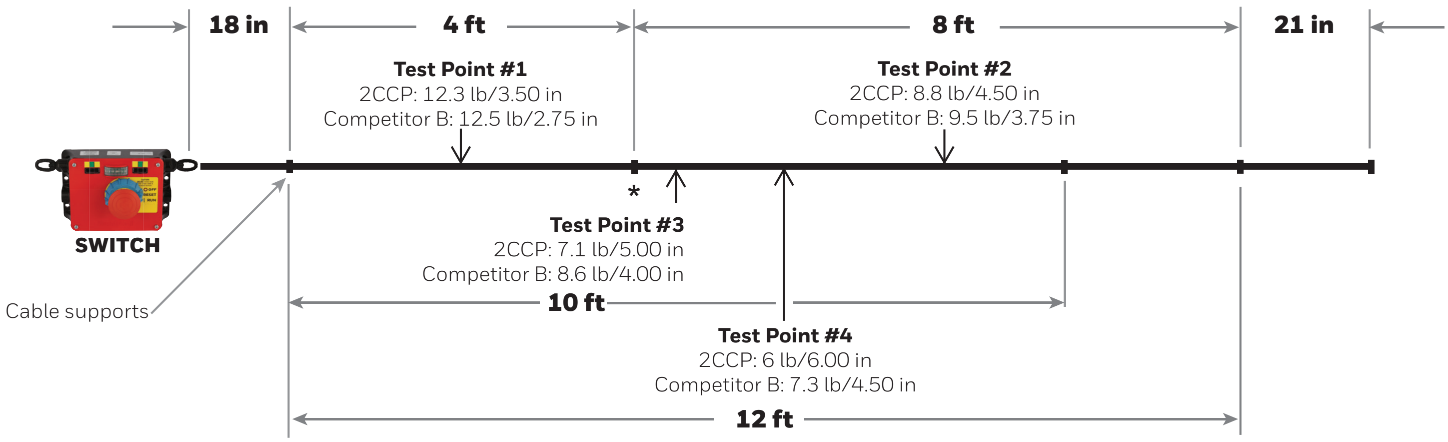
Each comparative test revealed the 2CCP offered several advantages based on actual performance data. Through the larger tension window, the increased viewing angle of the LED, the convenience of the rear conduit, the larger internal space for wiring, the functionality of the larger E-stop and the mechanical advantages of the cable length itself, the 2CCP product proved optimum in meeting industry standards while maintaining usefulness and convenience to the consumer.

Rather than providing another datasheet comparing products solely from specification values, Honeywell has taken a different approach. The purpose of this document is to assist in developing conclusions based on real data and not solely from published specifications. After reviewing the contents of this document, please contact your local Honeywell sales representative if you have any questions or would like to discuss these products in greater detail.

MICRO SWITCH 2CCP BENEFITS COMPARED TO THE COMPETITION

- The Honeywell 2CCP has a **larger proper tension zone** that is more forgiving for cable-length variation. This larger zone absorbs temperature variation which translates into **less nuisance trips**
- The LED viewing angle on the 2CCP features a **higher intensity and larger viewing angle** when compared with competitive switches. Visibility from a large distance makes it easier to identify which switch has been tripped
- Many installers add an accessory switch used as a PLC reset. The additional switch brackets, and junction boxes add cost to the installation. The MICRO SWITCH 2CCP **incorporates an accessory switch** into the 2CCP's housing, simplifying installation and reducing cost
- By adding a **rear conduit port** to the 2CCP, Honeywell engineers provided flexibility to the installation, as well as reducing the cable's exposure to damage
- The 2CCP's **E-stop is larger** than the competition's button – easier to halt the line in a panic setting

PULL FORCE/DISTANCE COMPARISON TEST #1
8’ vs. 10’ vs. 12’ CABLE SUPPORTS
(WITHOUT END SPRING)



** This cable support was removed for the 12 ft data collection.*
The first measure indicates the pull force applied; the second measure is the pull distances required to actuate the switch.

TEST NOTES/METHODOLOGY

1. Industry-leading requirements specify maximum cable support spans of 10 ft (3 meters). However, some installers attempt to reduce costs by exceeding this specification, often using up to 12 ft spans.
2. While “real world” cable-pull applications are rarely straight runs, this initial evaluation compares actual pull force and pull distance values as measured at 4 ft, 8 ft, 10 ft, and 12 ft straight distances respectively without using end springs.

OVERALL TEST NOTES/METHODOLOGY

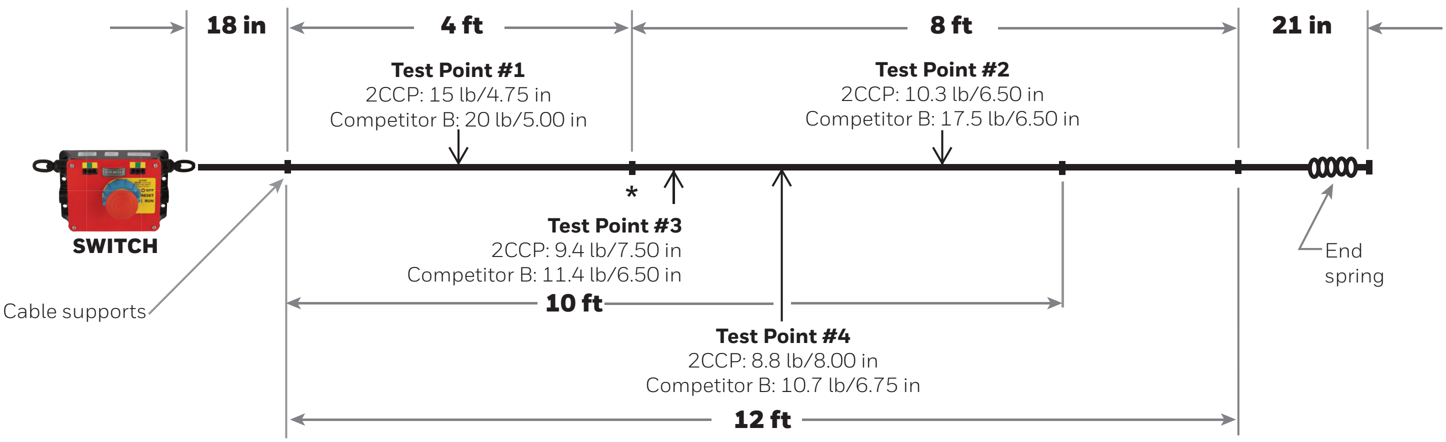
These notes apply to the four comparison examples included in this document. Where appropriate to a specific example, other testing constraints have been noted on the page.

1. All data was collected with Cable-Pull Switch in center of “Proper Tension” zone.
2. Force measurements were collected using a Nidec-Shimpo Instruments Series FGE-XY force gauge.
3. Cable supports spaced every 8 feet max.
4. All test points were in the center of two eye bolt cable supports.

CONCLUSIONS

1. Test data shows the amount of pull force required to activate the switch, regardless of manufacturer, decreases as the length of the cable span increases.
2. Conversely, the test data shows the amount of pull distance (the actual distance the cable needs to be pulled downward in order to actuate the switch) increases as the length of used cable span increases.
3. Honeywell recommends an 8 ft maximum cable span to provide the optimum pull force AND pull distance. The shorter cable span achieves a more manageable force to actuate the device. And due to the larger allowable tension zone, the higher pull distance of the Honeywell product minimizes the possibility of nuance trips. Combined, these factors provide a more robust solution for applications where convenience and safety are mandatory.

PULL FORCE/DISTANCE COMPARISON TEST #2 8' vs. 10' vs. 12' CABLE SUPPORTS (WITH END SPRING)



** This cable support was removed for the 12 ft data collection.*
The first measure indicates the pull force applied; the second measure is the pull distances required to actuate the switch.

TEST NOTES/METHODOLOGY

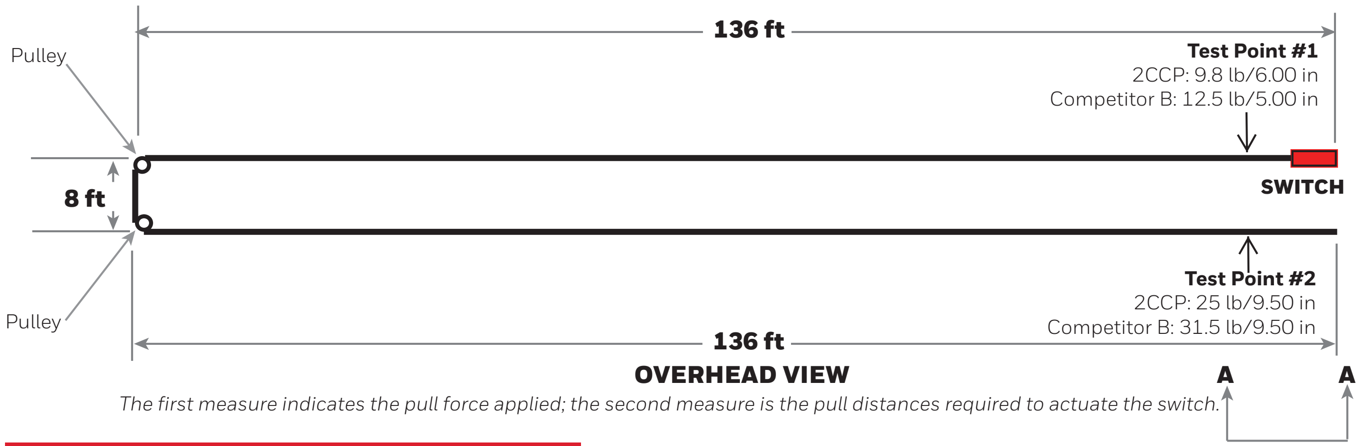
1. Test #2, similar to Test #1, utilizes a straight cable run to establish baseline pull force and pull distance values before introducing changes in the cable direction. The test set-up is the same as Test #1, with the exception of incorporating an end spring as shown above.
2. This evaluation utilized a zinc-plated carbon steel draw-bar style end spring with a spring rate of 25 lb/in (Honeywell part number CPSZ1S). This spring rate is matched to Honeywell's 2CCP's internal spring force. See note below

*Note: By utilizing an end spring that is matched to the force required to pull the shaft of the Honeywell 2CCP product, it effectively doubles the amount of application temperature variation the product can tolerate as both ends of the cable are now allow to expand and contract. This, coupled with the larger allowable tension zone, is just another example of how the Honeywell 2CCP product offers a more complete and robust solution for the most challenging applications.

CONCLUSIONS

1. On average, utilization of the end spring increased the amount of pull force needed to activate the switches. The Honeywell product required 2.3 lb more force, while the force needed to actuate Competitor B's product increased 6.3 lb.
2. Similar to the data without the end spring, test data with the end spring shows the amount of pull force required to activate the switch, regardless of manufacturer, decreases as the length of the cable span increases.
3. Similar to Test #1, as the length of the cable span increased, the amount of pull distance required to actuate the switch also increased. By incorporating an end spring, the average pull distance required increased by 1.7 in for the Honeywell product and 2.3 in for the competitive product.
4. Incorporating an end spring increases both the force and distance needed to actuate the switch. But the Honeywell 2CCP product experiences less impact which allows for a more consistent designer, installer and user experience.

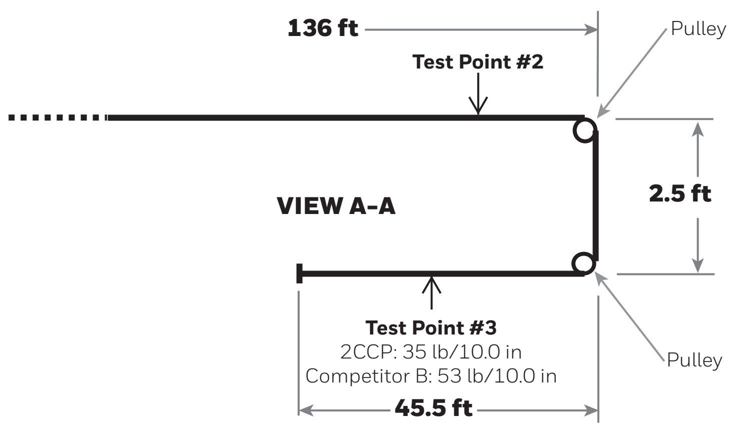
PULL FORCE/DISTANCE COMPARISON TEST #3 328' SPAN (WITHOUT END SPRING)



The first measure indicates the pull force applied; the second measure is the pull distances required to actuate the switch.

CONCLUSIONS

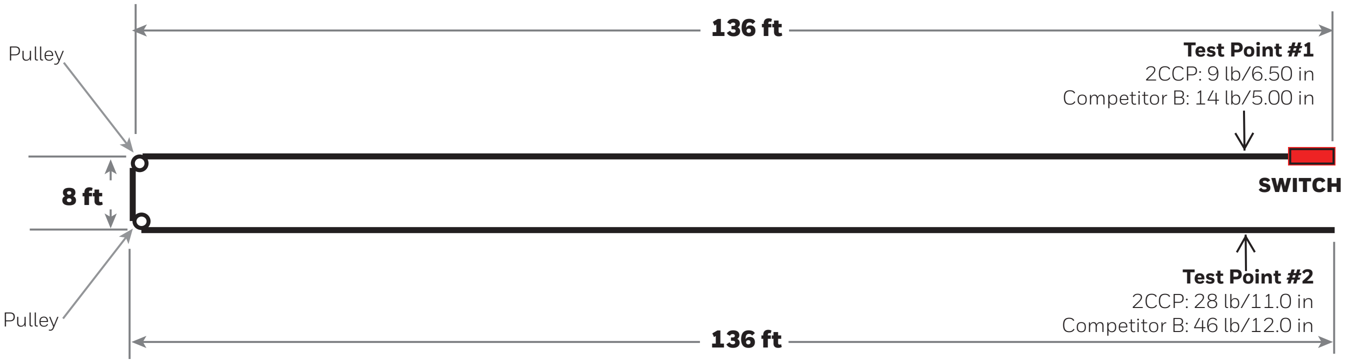
1. Unlike straight runs of cable, when friction is introduced into longer spans through changes in cable direction via pulleys, eye-bolts, etc., the pull force needed to actuate the switches increase significantly.
2. At Test Point #2, pull distances continue to increase as the length of cable increase. However, with only two pulleys influencing the cable direction, at a cable span of approximately 276 ft, the pull forces begin to reach or exceed the maximum industry standard of 28 lb.
3. At Test Point #3, by adding approximately 19 ft of cable length (295 ft total approx.) and two additional pulleys into the set-up, the necessary pull force increases dramatically. Based on test values, the Honeywell product requires 35 lb of force to actuate, while Competitor B's product requires a staggering 53 lb to actuate!
4. With pull forces exceeding 50 lb, this could easily exceed someone's ability to pull the cable in an emergency situation, ultimately defeating the purpose of the safety switch.



TEST NOTES/METHODOLOGY

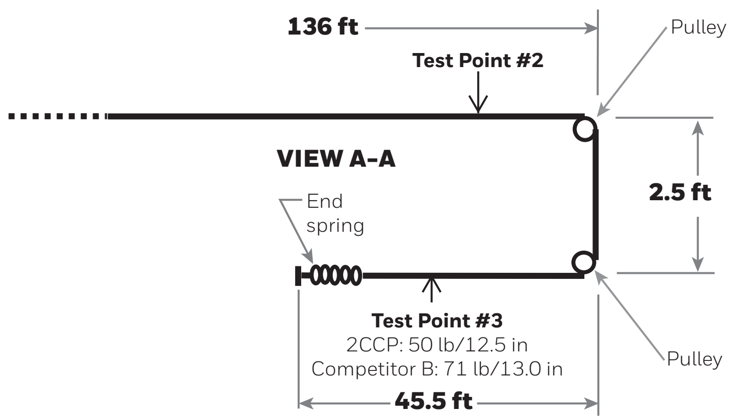
1. Test Points occurred at the following approximate cable lengths: Test Point #1 at 5.5 ft, Test Point #2 at 276 ft, Test Point #3 at 294.5 ft.
2. With the cable span approximately 136 ft, two pulleys were introduced into the set-up creating 90° turns, effectively changing the direction of the cable twice and changing elevation by 8 ft. Two additional pulleys were installed between Test Points #2 and #3 at approximately 280 ft of cable expansion. This again created 90° turns changing the direction of the cable twice and the elevation by approximately 2.5 ft.
3. To reset the switch after trip at Test Points #2 and #3, the cable had to be manually retracted back towards the switch to return the switch to the center of the proper tension zone.

PULL FORCE/DISTANCE COMPARISON TEST #4 328' SPAN (WITH END SPRING)



OVERHEAD VIEW

The first measure indicates the pull force applied; the second measure is the pull distances required to actuate the switch.



CONCLUSIONS

1. Similar to the results of adding an end spring to a straight cable run, adding an end spring to layouts incorporating multiple direction changes via pulleys and eye-bolts, also increases the pull forces and pull distances required for actuation as the cable span increases.
2. On average, the Honeywell product required 6.3 lb more pull force due to the end spring, while Competitor B's product required 11.3 lb. more pull force.
3. With only two cable direction changes via two pulleys, at Test Point #2 (approximately 276 ft span), the Honeywell product has reached the maximum industry force specification of 28 lb. At this same point, Competitor B's product has reach 46 lb of pull force!
4. With two additional direction changes added to the set-up via two pulleys, at approximately 295 ft of cable span, the Honeywell product reaches a necessary pull force of 50 lb! But Competitor B's product reaches a necessary force of 71 lb at the same point. Effectively rendering the competitive product unusable!

TEST NOTES/METHODOLOGY

1. The test set-up is the same as Test #3, with the exception of incorporating an end spring as shown above.
2. To reset the switch after trip at Test Points #2 and #3, the cable had to be manually retracted back towards the switch to return the switch to the center of the proper tension zone.
3. Similar to Test #2, this evaluation again utilized a zinc plated carbon steel draw-bar style end spring with a spring rate of 25 lb/in (Honeywell part number CPSZ1S). This spring rate is matched to Honeywell's 2CCP's internal spring force.

THE FINAL WORD

1. Adequately evaluating similar products goes beyond values seen on a specification sheet. It takes real-world application and actual data from those applications to fully determine which product provides the most value based on quality, usability, price point and support after the sale.
2. Through these simple evaluations, Honeywell has taken a competitive product that specifies a longer cable length, and shown, under real-world circumstances, ***the longer length doesn't necessarily yield more value.*** In fact, in typical layouts requiring changes in cable direction through the use of pulleys and eye-bolts, the use of longer cable lengths can quickly become a safety hazard by creating a situation where it may be extremely difficult to activate the product when it is needed the most.
3. These evaluations clearly show the importance of evaluating all features of the assembly to understand the total value of Cable-Pull Safety products. Additional options for the Honeywell 2CCP products that weren't addressed in this report are:
   - The intensity of the light and wide viewing angle of the 2CCP product assists in identifying which switch assembly has been tripped within large warehouse facilities – reducing down time.
   - The Honeywell 2CCP products offers an accessory switch option that, in many cases, is used as a PLC reset, thus eliminating the need for additional peripheral equipment and lowering the total install cost.

Making the Honeywell product the more robust solution.

HONEYWELL RESOURCES FOR CABLE-PULL SWITCHES

[Test Report: Cable-Pull Switch Force Testing]

[Application Note: MICRO SWITCH Switches in Conveyor Applications]

[Application Note: Maintaining Equipment Safeguards in Varying Operating Temperatures]

[Application Note: Limit Switches with Positive-Opening Contacts]

[White Paper: Safety in the Factory/Distribution Center • The Need for Cable-Pull Safety Switches]

[Range Guide: MICRO SWITCH Safety Switches Comparison]

[Datasheet: MICRO SWITCH CPS Cable-Pull Switches]

[Datasheet: MICRO SWITCH 2CCP Cable-Pull Switches]

⚠ 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.

⚠ WARNING
MISUSE OF DOCUMENTATION

- The information presented in this document is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

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

⚠ NOTICE

- All force and dimension values noted in this document are approximate values with no tolerance implied or stated.

FOR MORE INFORMATION

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004797-1-EN | 1 | 03/21

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