DANIELS MANUFACTURING CORPORATION
A Veteran-Owned Small Business Manufacturer

Process Improvements by Using Safe-T-Cable Instead of Safety Wire

Introduction and Background

There will always be a need to install constraining (safety) devices to threaded fasteners in applications where vibration, extreme temperature cycling, and the need for high reliability is needed. Their purpose is to restrict (to a minimum) the unintentional rotation of the fastener. The traditional method for fastener security (devised in the early 1900's) is through the use of Hand Twisted Safety Wire (often called Lock Wire).

The only changes which have occurred since the early uses of Safety Wire are the tremendous costs in the installation of this material, and the levels of sophistication in the systems on which Safety Wire is being installed. It is used in Jet Engine systems, Airframes, Electronics, Space Vehicles, and Land/Sea based Systems.

The process of installing Safety Wire remains awkward and costly, and the inspection process is demanding. The removal and rework of installed Safety Wire is a common occurrence on production lines.

In 1989, GE Aircraft Engine Company (GEAE) invented and patented Safety Cable for use on its Commercial Aircraft Engines. Considerable amounts of time and expense were dedicated to refining this product and testing its performance. Very exact standards were written to control the materials, configuration, installation and testing process.

Safe-T-Cable® was invented to address these problems in modern Airframe and Engine Systems. The Safe-T-Cable® Kits are consistent in their construction/application, and the user-friendly tooling guarantees a secure and reliable installation each time it is used. Operator training is simple, inspection is objective and rework is virtually eliminated. This results in fewer demands on the Operators, Inspectors, and Maintenance personnel.

Cable Construction

Safe-T-Cable® is constructed of high tensile pre-twisted cable. It is more flexible than its Safety Wire counterpart, although the working diameters are equivalent. This provides a stronger assembly which has greater strength and lighter weight. The cable ends are electrically fused to form an easy threading end.

The pre-twisted cable is cut to various lengths, and is supplied with a square formed end cap attached to one end. Safe-T-Cable® is available in four nominal diameters. The .040 inch diameter cable is constructed of 7X7 stranded rope lay material. Rope lay construction is also used for the 3X7, .032 inch diameter cable while the .022 inch diameter cable is made of 1X7 unilay material. The

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ferrules are precisely manufactured to a size and hardness which assures their compatibility with the cable and ergonomic application tooling. They are supplied (50 pieces each) in an easy dispensing cartridge, which provides orderly containment of individual ferrules, and the easy release of individual ferrules as they are required. This feature minimizes the possibility of loose ferrules being dropped into areas where safe-t-cable is being installed.

Materials

The high performance alloys of safe-t-cable were selected by tenured aerospace engineers in the aircraft engine industry to provide strength and corrosion resistance that is required for durability and long life. All components (End Fitting, Cable, and user applied Ferrule) are made of the same material. 321 Stainless Steel (AS3510) is the most common Safe-T-Cable® material. It is used for most engine and airframe applications. Inconel 600 (AS3509) is appropriate for high temperature and/or non-magnetic applications, and the Inconel 625 (AS3655) has superior corrosion resistant properties

Time vs Cost

Numerous time studies have been completed by several users of Safe-T-Cable while qualifying the product for use within their aerospace systems. The percentage (%) of employee-hours saved ranged from 52%-75% and was determined to be **2-3 times faster** installation than conventional safety wire. A value engineering study conducted by the Corpus Christi Army Depot concluded that Safe-T-Cable would provide CCAD with full year (FY) total savings of $628,872.32 on the UH-60, AH-64, and CH-47 airframes and components.

Weight Savings

DMC performed an engineering study to determine the weight savings achieved by using Safe-T-Cable.

Scope: This test covered Ø.040 Safe-T-Cable and lock wire, in 3” and 5.5” spans.

Test Description: Bolts were set into a plate, which was then placed into a vice so the Safe-T-Cable and lock wire could be installed securely. The plate would then be removed from the vice and weighed, the weight was recorded and the test material stored. This procedure was repeated across both products and both lengths, 5 times each.

Test Equipment: A DMC SCTR403 was used to install the Safe-T-Cable, and a Milbar No. 31W was used to install the lock wire. An Ohaus GT2100 was used to weigh each sample.

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Test Results/Data:

	Ø.040 Safe-T-Cable 3"	Ø.040 Lock wire 3"
Sample 1	0.72g	1.71g
Sample 2	0.72g	1.67g
Sample 3	0.72g	1.77g
Sample 4	0.73g	1.71g
Sample 5	0.72g	1.84g
	Ø.040 Safe-T-Cable 5.5"	Ø.040 Lock wire 5.5"
Sample 1	0.98g	2.64g
Sample 2	0.98g	2.59g
Sample 3	0.98g	2.66g
Sample 4	0.98g	2.75g
Sample 5	0.98g	2.60g

Safe-T-Cable 3” Average: 0.722g, Lock wire 3” Average: 1.74g
58.50% Decrease
Safe-T-Cable 5.5” Average: 0.98g, Lock wire 5.5” Average: 2.648g
62.99% Decrease

Photo Gallery:

Safe-T-Cable 3”

Lock Wire 3”

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Safe-T-Cable 5.5”

Lock Wire 5.5”

Conclusion: Through the tests performed, it is evident that Ø.040 Safe-T-Cable has a significant weight advantage to Ø.040 Lock wire. We expect to find similar results in further testing with different size cable and wire.

Safety of User

Safe-T-Cable provides a safe and consistent method for securing threaded fasteners. Traditional safety wire exhibits sharp ends that can cause harm to the operator. Safe-T-Cable does not exhibit these same characteristics and requires less manual labor and skill to install.

Conclusion

Safe-T-Cable successfully completed all tests demonstrating enhanced weight savings and decreased labor hours during installation. Safe-T-Cable is also included in NASM33540, this National Aerospace Standard is the primary Standard which controls the selection, use, and installation of Safety Wire, Safety Cable, and other Safety devices for threaded fasteners. NASM33540 is adopted for use by DoD, and is listed in the Department of Defense Index of Standards & Specifications (DODISS)

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