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TR #15-0002

Industrial Ethernet Torsion Test

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1. Introduction

Continuous movement applications that force a cable to flex repeatedly will subject the cable to various types of stress that can degrade performance and cause failure in the field. The most commonly recognized type of flex stress is the act of repeatedly bending a cable back and forth. This back and forth flexing is detailed under separate cover in the *Quabbin, Rolling Bend Flex test report*. However, a rolling bend isn't the only type of flex stress. A second lesser known stress called torsional stress can also be at work in a continuous movement application. The focus of this report is torsional stress and the impact on the Quabbin Industrial Ethernet products.

As previously explained in the *Quabbin, Rolling Bend Flex test report*, the testing has been designed to simulate the movement of a robotic arm. If we can use an analogy, the rolling bend flex cycle represents the bending and reaching of the robotic arm as it emulates a human arm bending at the elbow and possibly straightening to extend and grasp something. The scenario covers two of the three types of flex stress yet still leaves us to account for the third, torsional stress. Using the same analogy as above, we would see torsional (or rotational) stress come into play as wrist rotation. Just as a human arm includes a wrist capable of rotation, a robotic arm also needs to accommodate wrist like motion for positioning tools and/or to grasp objects. As the "wrist" rotates through the full field of motion, it can twist a control cable up to 360 degrees, similar to the visual picture of wringing out a wet towel. Obviously these torsional forces must be considered during cable development in order to have a design robust enough to survive the intended purpose. Hence we arrive at the Quabbin Industrial Ethernet Torsion Test.

Torsion tests were performed on Quabbin industrial Ethernet cables. The test is a 360 degree twist total per cycle (180° in each direction) over 34" of cable at 71 cycles per minute.

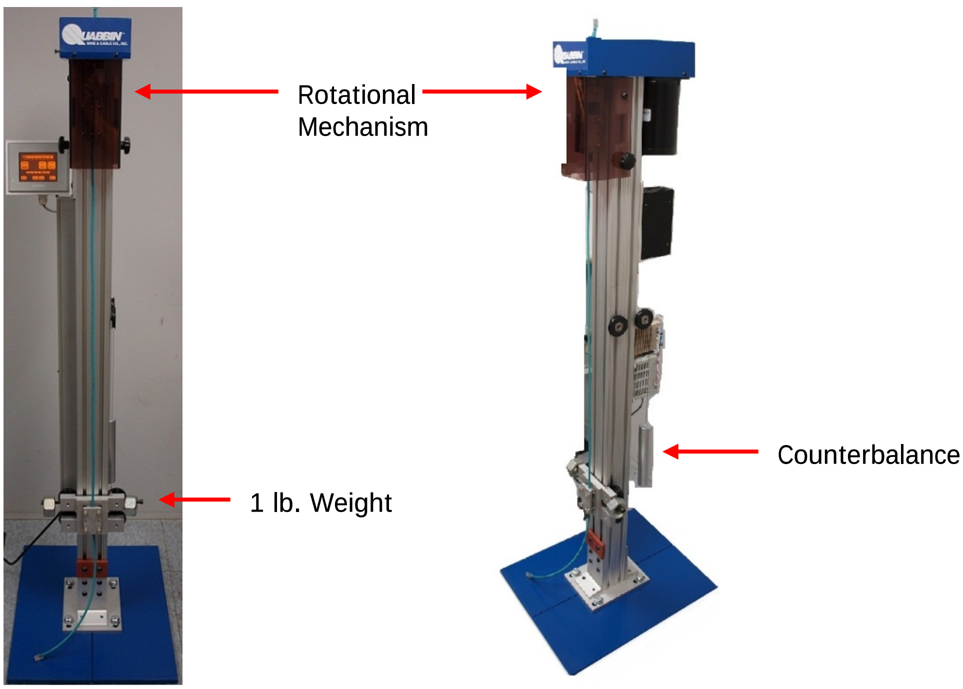
2. Testing Equipment

- 8753E Network Analyser
- DTX-1800 Portable tester
- Quabbin torsion testing machine

3. Resources

Torsion testing is done on the following Quabbin cables: 5025, 5026, and 5083. Additional cables will be added to this report as they complete testing.

4. Setup

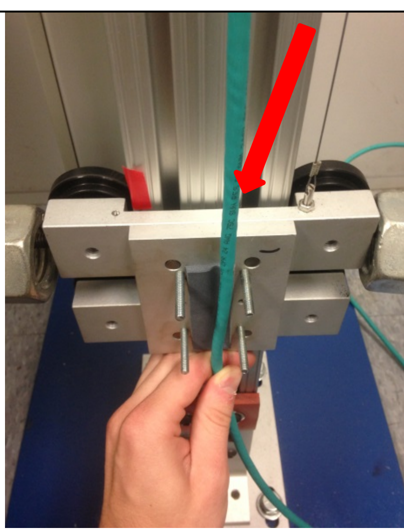


1. The cable is fed through the top hole. A short length of about 1 inch of cable is exposed at the rotating end to avoid unintended flexing of the cable as the rotation reversed.

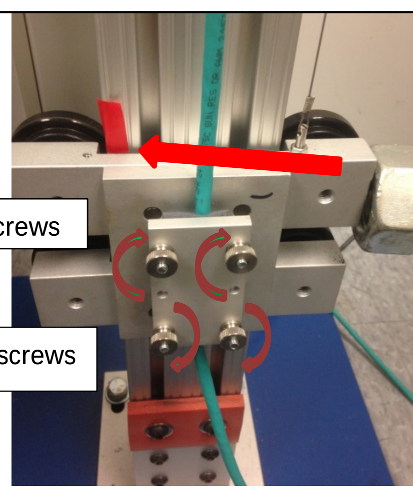
2. The top plate is secured and screwed on. The 2 top screws were screwed on simultaneously insuring that the plate is clamped on evenly. Foam is added between the plates to insure that the cable is not crushed. The same went for the bottom screws. It is recommended to go back and forth between the top screws and bottom screws making sure the clamp is secure. When a small resistance is given by the screws we stopped because it is essential not to crush the cable when screwing on the top clamp.

3. The rotation end could be dangerous and harmful so it is important to close the rotating top with the plastic shield

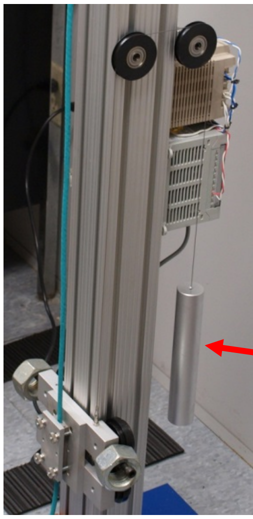
4. The bottom part of the cable is fed through the bottom clamp. The foam is located between the screws.



5. The bottom plate can is secured and screwed on. The 2 top screws were screwed on simultaneously insuring that the plate is clamped on evenly. The same went for the bottom screws. It is recommended to go back and forth between the top screws and bottom screws making sure the clamp is secure. When a small resistance is given by the screws, we stopped because it is essential not to crush the cable when screwing on the top clamp. It is also important that the top of the clamp met with the bottom of the red tape insuring a 34” distance between the top and bottom clamps.



Weight is added to the lower carriage to keep the cable taut. The lower carriage can move as the cable is twisted and becomes shorter to avoid breaking the cable. The test is set to a 360 degree twist total per cycle (180 in each direction).



5. Test Description

In order to insure that the cables were able to withhold continuous 360 degree rotation, data is recorded before, during, and after the torsion test. The halfway point is 1.5 Million cycles and the final is 3.25 Million cycles. All testing is done while the torsion machine is running insuring that the cable can perform while being rotated in real time. The testing of the cable follows Quabbin standard procedures.

6. **Results** 5025, 5026, and 5083.

5025:

	1.5 million cycles	3.25 million cycles
Jacket cracks	None	None
Tape cracks	None	None
Braid strands broken	None	None
Abrasion of insulation	None	None
Conductor Failure	None	None
Return Loss	Pass	Pass
Cross Talk	Pass	Pass

5026:

	1.5 million cycles	3.25 million cycles
Jacket cracks	None	None
Tape cracks	None	None
Braid strands broken	None	None
Abrasion of insulation	None	None
Conductor Failure	None	None
Return Loss	Pass	Pass
Cross Talk	Pass	Pass

5083:

	1.5 million cycles	3.25 million cycles
Jacket cracks	None	None
Tape cracks	None	None
Braid strands broken	None	None
Abrasion of insulation	None	None
Conductor Failure	None	None
Return Loss	Pass	Pass
Cross Talk	Pass	Pass