3M

795-kcmil, 3M Brand Composite Conductor
Mechanical Properties
Breaking Strength

Principal Investigator: Dr. Kamal Amin

Reviewed by: Dr. Colin McCullough

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Summary

The load to failure of 3M Brand Composite Conductor was measured from tension tests. Tested samples produced loads to failure in the conductor above 100% RBS (Rated Breaking Strength).

Samples

Samples of 795-kcmil 3M Brand Composite Conductor were cut to lengths of 10ft (3.05m) and 20ft (6.1m), and fitted with resin terminations at both ends. The shorter samples were tested in September 2002, and the longer one in August 2002.

Equipment Used

The shorter 10ft samples were tested at the Xcel Energy test laboratories in Minneapolis, MN, in a horizontal tensile machine with a Sheffer Hydraulic ram. The load cell was a BLH Type T2P1 load cell with a maximum capacity of 50,000 lbs. The digital readout was a Daytronics Model 3270P, accurate to 10 Lbs. One longer sample was tested at NEETRAC (National Electric Energy Testing Research and Applications Center) in Atlanta, GA, and was terminated using resin terminations. In this case an MTS Servo-hydraulic tensile machine, Control # CQ 0195 was used, with a Dynamics Research Corporation (DRC)/NEETRAC cable extensometer, Control # CQ 3002, and a National Instruments AT-MIO-16XE-50 computer data acquisition interface.

Conductor Spec

See Appendix A

Procedure

795-kcmil 3M Composite Conductor samples of length 10ft (3.05m) were cut from a spool supply and terminated at each end using a resin wire-lock system cast into cast iron spelter-sockets. Hose clamps were applied 11in from each end and the aluminum strands were cut about 3in from the end to expose the core. The aluminum strands over the remaining 8in were flared open (moving both layers in a direction opposite to the stranding direction). Next the tape was removed from the core over the 8in length and the aluminum strands moved back in the stranding direction but left flared to allow for cleaning. The cables were hung vertically and the ends submerged in an ultrasonic bath containing MEK (Methyl Ethyl Ketone) as the cleaning solution. Samples were removed from the ultrasonic bath after 20 minutes, dried using an air blower and then hung vertically in the spelter-socket using a fixture. Resin (wire-lock compound) was prepared and poured into the metal ends. Samples were left to allow the resin to cure prior to testing. The longer length samples were prepared using a similar procedure, and required ring clamps around the conductor free ends during handling, cutting, and end

preparation. This preserves the "as-manufactured" placement of the conductor components, and ensures each layer is loaded realistically during testing

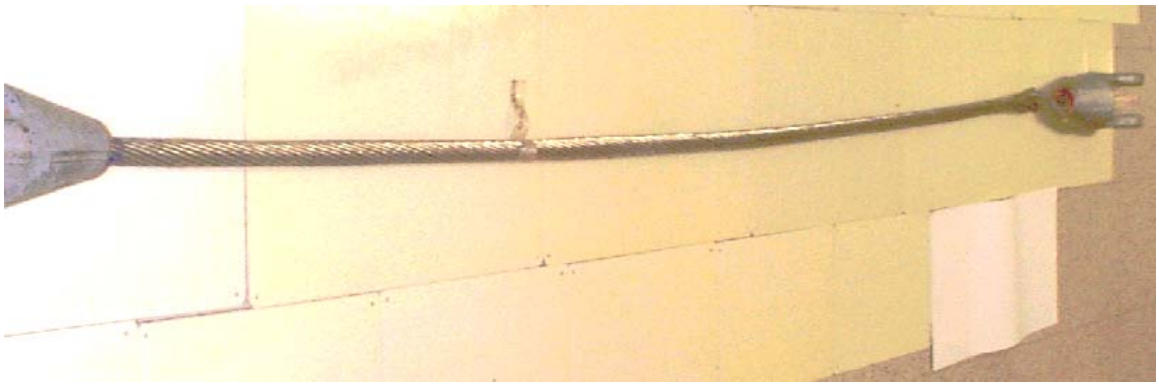
Testing of the 10ft long samples utilized a preload to 25% RBS and then holding the load for 10 minutes, followed by reloading at a rate of 5000 Lbs/minute to failure. The load was displayed on a counter and recorded manually along with any details of acoustic cracking noise or other observations. After testing, the failure location was recorded and the aluminum strands were removed and the core examined. The longer 20ft sample was initially used in a stress-strain test and afterward was used to obtain a breaking load. This was loaded uniformly at a rate of 10,000 Lbs/min to failure, with the free-span conductor length of 19 feet (5.6m).

Test Results

The following table summarizes load to failure, failure location and comments:

Failure Load, (Lbs)	Failure Load, (kN)	%RBS	Gauge Length (ft)	Comments
30720	136.6	99	10	At resin termination
31040	138.1	100	10	In gage 26" from termination
31480	140.0	101	10	In gage 40" from termination
31870	141.8	102	20	Failed in mid span (after stress-strain test)

RBS = 31,134 Lbs



An example of conductor failure at an epoxy termination. Failure is at the termination at the right hand-side.

All but one sample failed at loads > 100% RBS. The one test sample that failed below 100% RBS, did so at a resin termination, rather than in the gauge length. Thus, the test is affected by the resin termination. ANSI C119.4 (1998) – section 4.4.3 for full tension connectors, gives some guidance to the acceptance criteria. Recognizing that failure is often within the termination, the connector should hold at least 95% of the conductor's rated breaking strength when failure occurs in the termination. Thus, the test that failed at 99% RBS suggests the conductor strength is, with high probability, satisfactory.

Conclusions

Tensile tests performed on 795-kcmil 3M Composite Conductor indicate the conductor meets the Rated Breaking Strength.

Acknowledgement

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Disclaimer

Appendix A: 795-kcmil, 3M Composite Conductor Specification
(see Product Data and Specification at www.3M.com/accr)