

Treatment of Failed Material



1. Scope

This work practice identifies the types of failed-in-service material that shall be retained for forensic analysis. Procedures for the handling of failed^a material are also included.

The following items are outside the scope of this practice:

- Most tools
- Transmission cable and accessories
- Major equipment (transformers, breakers, switches)

^aUntil a failure analysis report presents a final determination, a problematic material item should only be considered suspect; however, for practical reasons, it is common and acceptable for field personnel and engineers to use the terms **failed** and **suspect** interchangeably.

2. Application

This work practice is directed at field personnel who are first on the scene of an outage incident to repair damaged infrastructure and restore service.

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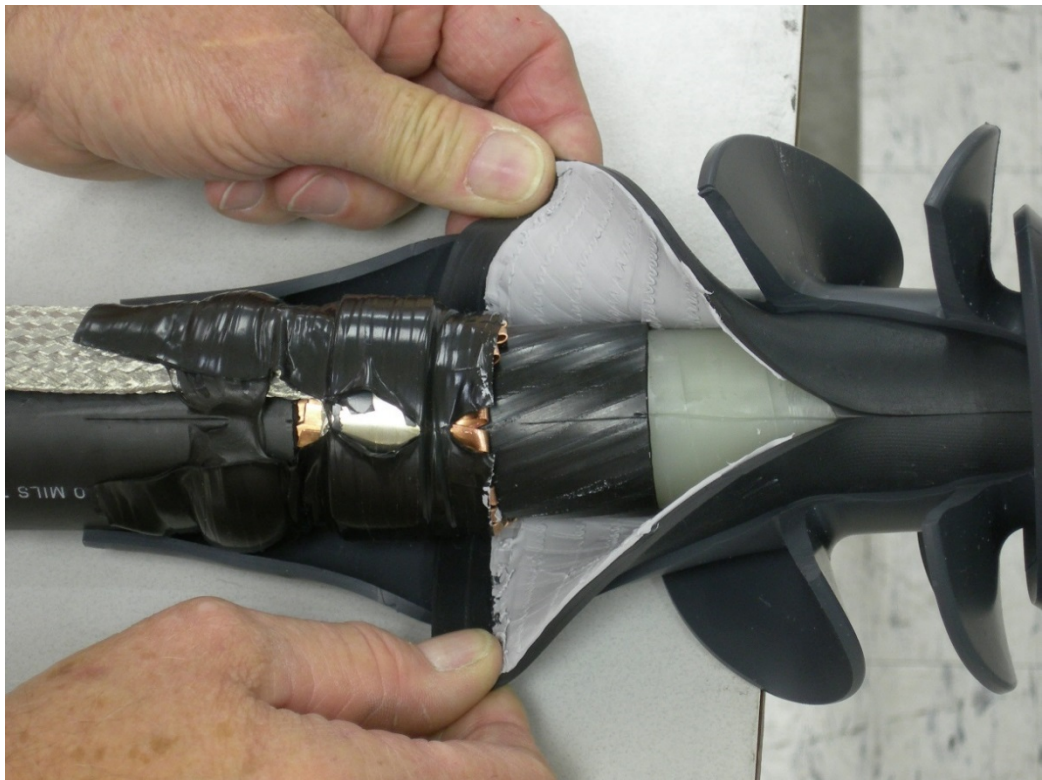
3. Discussion

The central question to be answered by a failure investigation is whether the problem was the result of normal wearout, a manufacturing quality (or design) defect, or a utility-side error. The solutions to each are very different. It is acknowledged that in some cases a failure investigation may not be able to identify a root cause.

Root Cause Analysis (RCA) is a class of problem-solving methods aimed at identifying the root causes of problems or events. The practice of RCA is predicated on the belief that problems are best solved by attempting to address, correct, or eliminate root causes, as opposed to merely addressing the immediately obvious symptoms. By directing corrective measures at root causes, it is more probable that problem recurrence will be prevented.

In 2006, five 28 kV, cold shrink cable terminations failed in service within a period of about a month. The manufacturer performed failure analysis and determined all failures were similar and were due to improper installation (there were also other factors). See Figure 3.

Figure 3. Cold Shrink Cable Terminator Undergoing Dissection



This leads to the most important point of this discussion: root cause analysis is impossible to conduct if the failed material does not arrive safely and in uncompromised condition at the Seattle City Light Quality Assurance office, located at the South Service Center.

4. Requirements

4.1 General

Treat with care any failed material that will be retained for analysis, both when removing from service and when transporting to the QA office.

Do not subject any failed material to destructive inspection or otherwise permanently alter it without the approval of the Supervisor of Standards Engineering.

For failed primary cable, try to preserve at least 2 inches of cable on either side of the fault.

For failed primary terminations, try to preserve at least 2 inches of cable below the termination.

For failed primary splices, try to preserve at least 2 inches of cable on either side of the splice.

Pay special attention to any material item that could possibly be involved in a customer claim. If questions arise, contact your local supervisor or Standards Engineering.

Use references to assist in material identification. References are provided for the material items cited in Sections 4.2 through 4.7.

4.2 Overhead Secondary

Material Type	Stock Catalog Section	Action Code(s)
Connectors, compression and wedge	6700	B

4.3 Overhead Primary

Material Type	Stock Catalog Section	Action Code(s)
Interrupter assemblies, Inertia	4500	C
Interrupter assemblies, S&C	4500	C
Deadend clamps	5800	B
Deadend automatic, guy feed-through	5800	B
Connectors, aluminum and copper	6500, 6600, and 6700	B
Arresters, polymer and porcelain	6800	B
Cutouts, polymer and porcelain	6800	B
Fuses, links and other	6800	B
Insulators	6900	B
Guy strain insulators	6900	B
Conductor clamps	6900	B

4.4 Overhead Transmission

Material Type	Stock Catalog Section	Action Code(s)
Connectors, deadend and lugs	6500	B
Insulators	6900	B, D

4.5 Underground Secondary

Material Type	Stock Catalog Section	Action Code(s)
Connectors	6700	B

4.6 Underground Primary

Material Type	Stock Catalog Section	Action Code(s)
Cable	600	B
Connectors	6700	B
Arresters, polymer and porcelain	6800	C
Fuses and holders	6800	B
200 A deadbreak elbows & accessories	6800	B
200 A loadbreak elbows & accessories	6800	B
600 A deadbreak elbows & accessories	6800	B
Cable splices, all types	6800	B
Cable terminations	6800	B
Fault indicators, PDP type	6800	B
Fault indicators, all other types	6800	A

4.7 Streetlight

Material Type	Stock Catalog Page	Action Code(s)
Streetlight luminaires, HPS	5700	A
Streetlight luminaires, HPS	5700	A
Streetlight luminaires, LED	5700	B
Streetlight ballasts and starters	5700	B
Streetlight photoelectric control	5700	A
Streetlight photoelectric control, 20-year design	5700	B

4.8 Action Code Legend

Action Code	Interpretation
A	Failed item may be disposed of.
B	Failed item shall be tagged and delivered to the QA office. Undamaged, adjacent items of same circuit should be left in service.
C	Failed item shall be tagged and delivered to the QA office. With the approval of local supervision, undamaged items of same circuit but of the opposite phase(s) should also be removed from service, tagged, and delivered to the QA office.
D	The failed material item and the surrounding area shall be photographed and the images provided to Standards Engineering. Images shall be checked in the field for focus and lighting before sharing.

4.9 Tagging

Use a method of tagging that is best suited to the material. Tagging may consist of writing with a permanent marker on the material item itself or writing in permanent ink on a tag securely attached to the material item.

Tag shall include the following minimum information:

- Brief description of failure
- Failure date (or date removed from service)
- Physical location of failure
- Electrical location of failure
- Whether a customer outage resulted
- Name of responsible crew chief

Tag should include the following information, if available:

- Name of manufacturer
- Stock number
- How long item had been in service prior to failure
- Whether a protective device operated
- Complete nameplate data, catalog number, and/or other special markings
- Date of manufacture
- Names of individuals who would like to receive the results of the failure analysis
- Any other relevant information

5. Next Steps

After the failed material reaches the Quality Assurance office located at the South Service Center, Standards Engineering personnel will evaluate the facts surrounding the reported failure and, if appropriate, implement the process detailed in SCL 9606.71.

Some items, such as molded current limiting fuses, are returned to the manufacturer for refurbishment.

Some items are under warranty and are returned to the manufacturer for credit.

6. References

SCL Design Standard 9606.71; "Requirements for Failure Analysis Reports"

7. Sources

Albergine, Dave; Strategic Advisor and subject matter expert for 0015.40

ASM Handbook, Volume 11: Failure Analysis and Prevention, Engineering Aspects of Failure and Prevention

Shipek, John; SCL Standards Engineering Supervisor; subject matter expert and originator of 0015.40

Wang, Quan; SCL Standards Engineer and subject matter expert for 0015.40