

Agenda: De-energized Tapchangers

- Introductions
- Membership
- Old Minutes
- **Mission-Develop Functional Life Test Guide and Report for De-energized Tap-changers**
- PAR Document
- Assignments
- Future Work

- ☐ **P.J.H. Proposed Life Test**
- ☐ **PJH Proposed Report**
- Adjourn

Agenda: Off Circuit Tapchangers

Meeting Minutes from Houston, TX

IEEE/PES TRANSFORMERS COMMITTEE

TF TAP CHANGERS FOR DE-ENERGIZED OPERATION

MEETING MINUTES

Catamaran Resort Hotel, San Diego, California – April 12, 2011

Chairman: Phil Hopkinson

Secretary: Scott Choinski

The Task Force on Life Tests, De-energized Tap Changers was called to order at 8:05 AM on April 12, 2011. There were 72 attendees, 19 members, and 53 guests with 1 requesting membership.

This TF has been in existence for a number of years. According to the roster there are 113 members. Regular attendance at meetings has been much lower – approx 25 members and 25 guests. A show of hands revealed 30 members were present, which would not be enough for a quorum. Secretary sent an email to the listserv asking all to confirm their membership on the TF, and responses were being recorded.

Tom Lundquist stated that the intention was to form a WG at this meeting and to disband the TF. Membership on the WG would be reset to those attending the first meeting. Membership will require attendance of at least 1 meeting per year. Missing 2 meetings in a row is grounds for removal as a member, at the discretion of the chair. It was noted that a TF cannot become a WG without an approved PAR. The Subcommittee Chair can exercise discretion in granting waivers for certain circumstances. Corresponding members would count as official members when determining quorum.

This group was designated as a TF to explore developing a PAR, and a quorum was present.

There were no patents to disclose. Reviewed the Agenda for the meeting, and the Minutes from the October 26, 2010, meeting in Toronto, Canada, were approved.

Agenda: Off Circuit Tapchangers

Meeting Minutes from Toronto, Canada, October 26, 2010

This group was designated as a TF to explore developing a PAR, and a quorum was present.

There were no patents to disclose. Reviewed the Agenda for the meeting, and the Minutes from the October 26, 2010, meeting in Toronto, Canada, were approved.

1. Discussion to develop PAR

After a few false starts, a decision was reached unanimously to move forward to make this test into a guide.

TF approved the following Title:

Guide for Performing Conducting Accelerated Life Tests of liquid immersed contact assemblies while stationary in electrical apparatus

TF approved the following Scope:

This Guide provides the requirements and recommended testing methods for performing an accelerated life test for contact assemblies used in de-energized tap changers, dual voltage switches, reversing switches of on-load-tap-changers and other products for distribution and power transformers, containing electrical contacts in liquid filled chambers, where the contacts are moved infrequently.

TF approved the following Purpose:

Agenda: Off Circuit Tapchangers

Meeting Minutes from Toronto, Canada, October 26, 2010

Identify test conditions, instrumentation, data collection and calculations that are essential to be able to establish pass or fail conditions for the manufacture of contact assemblies.

TF approved the following Need For Document:

De-energized tap-changers and reversing switches of on-load tap-changer contact designs may be susceptible to thermal run-a-way and coking due to certain factors. Reliable test methods to identify stable and unstable material combinations are described in this guide and provide repeatable conditions to simulate accelerated life conditions for C57.12.00 and associated product standards.

2. New Business

There was no new business.

The meeting adjourned at 9:17 AM.

Reported by: Scott Choinski, April 12, 2011

Working Group for De-Energized Tapchangers by Philip J. Hopkinson

Mission:

Develop Functional Life Test and Report for De-energized tapchangers that recognizes transformer applications

Reference Documents:

C57.12.00 - General Requirements for Liquid Filled Transformers

C57.12.01 - General Requirements for Dry-Type Transformers

C57.91 - Guide for Loading Mineral Oil Immerse Transformers

C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers

Working Group for De-Energized Tapchangers by Philip J. Hopkinson

Title: Guide for Conducting Functional Life Tests for De-energized Tap-changer Contacts

SCOPE:

This Guide provides the requirements and recommended testing methods for performing an accelerated life test for de-energized tap changers, dual voltage switches, reversing switches of on-load-tap-changers and other products for distribution and power transformers, containing electrical contacts in liquid filled chambers.

Purpose:

Identify test conditions, instrumentation, data collection and calculations that are essential to be able to establish pass or fail conditions for the manufacture of de-energized tap-changers such that they can be expected to have long and stable life.

Working Group for De-Energized Tapchangers by Philip J. Hopkinson

Need for Document:

De-energized tap-changers and reversing switches of on-load tap-changers are susceptible to thermal run-a-way and coking when unstable materials are used in the electrical contacts and fluids. Reliable test methods to identify stable and unstable materials are described in this guide and provide repeatable conditions to simulate accelerated life conditions for C57.12.00 and associated product standards. Important Elements:

1. Test is on complete tap-changers and not on just the contacts.
2. Test is based on accelerated aging and can be conducted in 30 days to represent 30 years of normal service.
3. Test has been verified by millions of products that have remained stable over a 40 year period.

Working Group for De-Energized Tapchangers by Philip J. Hopkinson

4. Test is not overly complicated and can be replicated.
5. Multiple manufacturers have had similar results.
6. Setups, instrumentation, test conduct, and data collection are important elements that need to be defined to avoid incorrect conclusions.

Interested Parties:

Currently a task force exists with a steady membership of about 60 members. This task force has met continuously since 1998 and has developed a large volume of test results. All of the major manufacturers of tap-changers belong to the task force. We expect to have sufficient interest and participation to complete the work within a 2-3 year period.

Submitted by Philip J Hopkinson, PE and Task Force Leader April 3, 2011

1. We have a title.
2. We should have an introduction
3. Working Group membership
4. We should have a scope.
5. Definitions
6. Test Objective
7. Test pieces
8. Test Preparation
9. Test set
10. Procedures
11. Pass/fail
12. Normative References
13. Other references

Working Group for Off-Circuit Tapchangers by Philip J. Hopkinson

Accomplished:

- Mission objective
- Tentative paper
- General conditions for test
 - **30 Cycles of test**
 - **On for 8 hrs in 130 C oil at 2XN current**
 - **Off for 16 hrs at normal ambient**
 - **Pass if Resistance change <25% and stability reached**

Missing

- Verify acceleration factor of 1000:1
- Repeatable tests at lower oil temperature and higher current

• Complete description of test details

Working Group for Off-Circuit Tapchangers by Philip J. Hopkinson

Agenda items for October 26, 2010 Meeting:

- The updated Dix slides on Test issues and results
- The test thoughts and issues
- Paper review of Comments by Bengt-Olof Stenestam
- Comments by Reinhausen and others
- Tentative paper
 - Authors
 - Venue: Panel Session or Transaction
 - Timing

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Summary of the test:

1.2 times rated current for 8 hrs. on in 130 C fluid followed by 16 hrs. off with no heat to bath.

2.30 days of replications

3.Monitors:

- a. Current
- b. Fluid temperature
- c. Bulk temperature
- d. Contact voltage
- e. Maybe generated gases

4.Calculations:

- a. Bulk temperature rise
- b. Super temperature increment
- c. Super temperature
- d. Resistance

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Variables in the test:

- 1.Fluid stability
- 2.Contact materials
- 3.Contact pressure
- 4.Gases I the fluid
- 5.Current density
- 6.Contact substrates
- 7.Lead size
- 8.Contaminants in the fluid
- 9.Fluid volume
- 10.Initial super temperature

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Aging relates to Corrosion:

1. Proportional to time at temperature
2. Basis of test is 155 C super temperature for 30 days *8 hrs or 240 hrs.
3. Aging follows 10 C rule:
 - a. Each 10 C lower doubles life expectancy
 - b. Each 10 C higher cuts life in half.
4. RMS equivalent load for most transformers assumed at 50% of nameplate kVA
 - a. Transformer rise at 50% load ~35 C over ambient.
 - b. Ambient assumed at 20 C
 - c. Net expected contact super temperature at 50% load is 55 C.
5. Item 2 of 155 C temperature –item 4 temperature of 55 C is 100 C
6. 100 C is (10) multiples of 10 C
7. This implies 2^{10} times 240 hrs. or 245,760 hrs. of expected life at 55 C
8. Hence the 30 day test relates to about 28 years at normal use.

Testimonial: No reported failures for contacts that pass over 4 decades of time

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Other Combinations of time and temperature OK with constraints:

1. Choose desired current between 2 and 4 times rated current.
2. Contact rise over fluid varies with current^{1.6}.
3. Contact voltage drop varies directly with Current.
4. Contact voltage drop is not the same for every contact pair and must be determined by test.
5. 155 C hot spot initial super temperature is the objective for each life test.
6. Fluid temperature is determined by subtracting the contact bulk rise and contact super temperature rises from 155 C Super temperature.
7. 30 days at 8 hrs. on each day with fluid heated to proper temperature (determined from item 5 above) and current from item 1 above (the chosen current) , followed by 16 hours off each day with no heat to bath.
8. Pass-fail criteria on basis of:
 - a. Resistance increase no greater than 25%
 - b. Resistance change has stabilized in the 30 days.

**Examples of current XN and fluid temperature: 2.0 and 130 C, 3.0 and 110 C
4.0 and 84 C**

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The Test object needs to be a real tapchanger:

- 1.Fluid needs to be the one to be certified.
- 2.Fluid volume needs to be large (>5 gallons).
- 3.Fluid must not be mechanically stirred.
- 4.The tapchanger needs to be submerged in the fluid.
- 5.The contacts need to be new for the start of the test.

Contacts alone without a real tapchanger are meaningless

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Heavily loaded transformers may need extended test:

1. Identified test structured for 30 year simulation of 50% rms equivalent load.
2. Fits most transformers.
3. Transformers loaded more heavily may need added considerations.
4. One consideration could be extended time for the test.
5. An objective may be to equate contact life to theoretical electrical insulation life.
6. For example if 180,000 hours of cellulose life at 110 C is the mission then contact aging may need to be conducted for 120 days instead of 30 days.

Factual Observation: Contacts that pass the 30 day test have no reported failure in 4 decades of time.

Working Group for Off-Circuit Tapchangers by Philip J. Hopkinson

Other Agenda Items:

1. Comments by Bengt-Olof Stenestam.
2. Next steps for the test document.
 - a. Written Guide.
 - b. Written Standard
 - c. Power Points
 - d. Panel Session
 - e. Other
3. The Technical Paper:
 - a. Issue as is
 - b. Subgroup to revise
4. Call to Adjourn

General requirements for Off-Circuit Tapchangers

Transformer loading guides allow up to 2 times rated current for up to ½ hr. daily, dependent on ambient temperature and loss of life considerations. This is consistent with Section 9.2.1 of IEEE Loading Guide C57.91-1995. In addition, cold-load pickup of up to 3 times load is permissible as well as inrush current.

The thermal environment for off-circuit tap-changers is normally in or near the top-oil for liquid-filled transformers. Hence the tap-changer must be designed to operate satisfactorily in this environment. For liquid-filled transformers, the sustained rated liquid temperature shall be assumed to be as follows:

$$T_{oil} = T_{tor} + T_{amb}$$

Where T_{oil} is the oil temperature for the tap-changer
 T_{tor} is the top oil rise of the transformer
 The rated rise occurs at rated steady-state load
 The maximum rise occurs at the highest allowable overload
 T_{amb} is the outside ambient for the transformer

Insulation System	T tor		T amb		T oil	
	Rated	Max	Rated	Max	Rated	Max
55 C	45	60	20	40	65	100
65 C	55	70	20	40	75	110

Note that the 110 Max oil temperature is consistent with Section 9.2.1 of IEEE Loading Guide C57.91-1995

Life Considerations

Life expectancy is commonly addressed in terms of thermal life. Transformer thermal life is assumed to be 20 years. In IEEE's Liquid-filled transformer loading guide (IEEE 57.91-1995), uses 180,000 hours at rated load and ambient as the thermal index. Thermal life is a parameter that is both dependent on temperature and material composition. Both insulation and contact deterioration by oxidation have been found to obey the 10°C rule. Under the rule, each 10°C above or below the reference temperature causes life to change by 2 to 1.

Tapchanger Suitability for Synthetic Insulating Liquids

Synthetic insulating liquids may behave quite differently than mineral oil. Some of the more pronounced differences that have been observed are oxidation-stability, lubricity, heat transfer, dielectric integrity, flammability, and viscosity. Tap-changer ratings for use in synthetic insulating fluids must be established by the manufacturer.

Stability in Natural Ester Fluid

Natural ester fluid has proven to be stable in testing to date for a wide variety on contact pairs. It is still recommended that manufacturers test any proposed combinations of fluids and contact pairs to develop stability considerations before establishing switch ratings.

Routine and Type Test Requirements

Test	Routine	Type
a. Contact Resistance	X	
b. Contact spring pressure	X	
c. Dielectric Integrity	X	
d. Functional Life		X
e. Short Circuit		X
f. Mechanical endurance		X
g. Operating torque (manual)		X
h. Gland seal (Vacuum)	X	

Temperature Rise of Contacts

Tests shall be performed to verify that the temperature rise above the medium surrounding each type of contact, which carries current continuously in service, does not exceed the values given in table 6. This test shall be performed when the contacts have reached a steady temperature when carrying the through-currents in accordance with table 6, with tap-changer ambient in accordance with the rated values in section 7.1. The test is performed by measurements with thermocouples or other devices capable of measuring bulk temperature, and ambient liquid or air. The bulk rise is the difference between the bulk temperature and the temperature of the tap-changer environment (liquid or air).

It is important to note that the temperature rises in table 6 are limit values. The manufacturer must recognize that stable materials must be used so that aging does not result in thermal runaway. Time shall not result in higher temperature rises at the table 6 currents.

Table 6- Contact temperature-rise for off-circuit tap-changers

Style	Rated Current	2X Rated Current
Liquid	10	30
Dry	25	75

Functional Life Tests

A functional life test shall be performed as a Type Test to demonstrate the adequacy of the contact design to achieve long stable thermal life. The test consists of thermal cycling at accelerated current and temperature, with daily cool-down cycles. The original test depends on an acceleration factor of 1000:1. A successful test is completed if contact resistance remains within 25% of the original value and stability is achieved.

The test is conducted by passing twice rated current through the contacts for 8 hours per cycle at ambient temperatures of 130°C

A total of 30 cycles (days) of the 8-hour on 16 hour off 2XN current are required to complete the functional life test.

2 Criteria of success:

1. Resistance change <25%
2. Stability reached

Functional Life Tests

What about the 2 Criteria of success?:

1. Resistance change $<25\%$
2. Stability reached

1. Test claims to be a 1000:1 Acceleration of normal use
2. No known field failures from tapchangers that pass test.
3. If test truly represents 30 years then:
 - **Resistance change $>25\%$ may be OK**
 - **Some oxidation may be OK**

Functional Life Tests-Issues

Issues for test

1. **Validity of acceleration factor**
2. **Sample that should be a real tapchanger.**
3. **Sample Preparation.**
4. **Connections to tapchanger for current, voltage and temperature**
5. **Oil volume for the test**
6. **Oil temperature**
7. **Current in multiples of rating**
8. **Data collection**

2 Criteria of success:

1. Resistance change $<25\%$
2. Stability reached

Functional Life Tests-Issues

Issue 1: **Test Validity**

10 C rule a factor

1. RMS Equivalent Load normally 50%
2. Average ambient of 20 C
3. Normal tapchanger sees average temperature of 20C + 25C oil +2C Tapchanger = 47 C
4. For 1000 Times acceleration: $2^X = 1000$
5. $X \sim 10 = (T_{test} - T_{avg}) / 10$
6. $T_{test} = 100 + 50 = 150 \text{ C}$
7. T_{test} is indeed 151C and is OK.

2 Criteria of success:

1. Resistance change <25%
2. Stability reached

Suppose we wanted to define life as equivalent to Cellulose life

Functional Life Tests-Issues

Issue 1: Test Validity

1. IEEE C57.12.00 defines life as 180,000 at 110 C
 2. $180,000 \text{ hours} / 8,760 \text{ hrs/year} = 20.5 \text{ years at } 110 \text{ C}$
 3. 110 C = sum of 3 parameters
 - Avg ambient of 30 C
 - Avg wdg rise/ambient of 65 C
 - HS increment over avg wdg 15C
 1. But normal avg wdg/avg oil 12C
 2. Avg oil/amb 53C
 3. Avg tapchanger contact/oil 8C
 4. Super temperature/avg 2C
 5. Tapchanger ambient 30C
- Diagram showing temperature summation:
65 C + 15 C = 80 C (winding)
80 C + 12 C = 92 C (oil)
92 C + 2 C = 94 C (super)
94 C + 30 C = 124 C (tapchanger)
124 C + 30 C = 154 C (total)
154 C - 65 C = 89 C (effective)
89 C - 30 C = 59 C (effective)
59 C + 30 C = 89 C (effective)
89 C + 30 C = 119 C (effective)
119 C + 1 C = 120 C (effective)
6. Tapchanger contacts see 93 C when winding sees 110 C
 7. Years required at 93 C 20.5 or 180,000 hours
 8. Days for 20.5 years = $20.5 * 365 = 7500$ at 93 C

Suppose we wanted to define life as equal to oil-Cellulose

Functional Life Tests-Issues

Issue 1: Test Validity- - What time and temperature to have equal life as oil-cellulose (110 C for 180,000 hrs)?

1. For 93 C, 180,000 hours (20.5 years) 7500 days
2. 10 C rule applies to contact aging.
3. For 103 C 3750 days
4. For 113 C 1875 days
5. For 123 C 938 days
6. For 133 C 469 days
7. For 143 C 234 days
8. For 153 C 117 days 30 days now
9. For 163 C 58 days
10. For 173 C 29 days

Conclusion: Test to date not equivalent to insulation life

Functional Life Tests-Issues

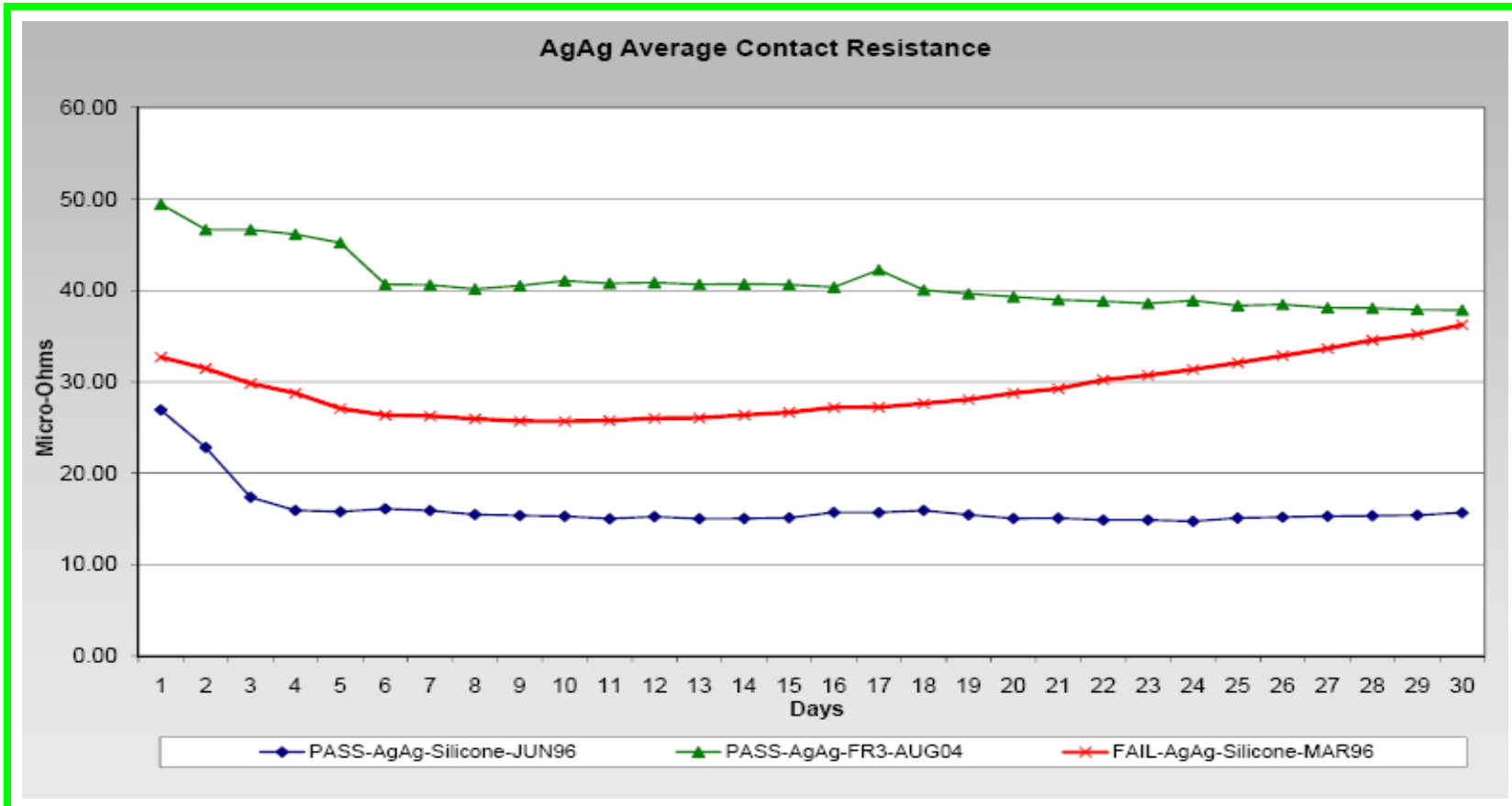
Issue 1: **Test Validity**

- 1. Test valid for typical use as no field failures reported.**
- 2. More time or higher temperature needed to test equivalent life as oil-cellulose.**
- 3. Conservative approach has proven successful to**
 - <25% resistance increase**
 - Stability.**
- 4. Extended time or higher temperature could allow more resistance change than 25% and be OK.**

Conclusions:

- Conservatism good**
- Present test works.**
- New criteria needed if test lengthened**

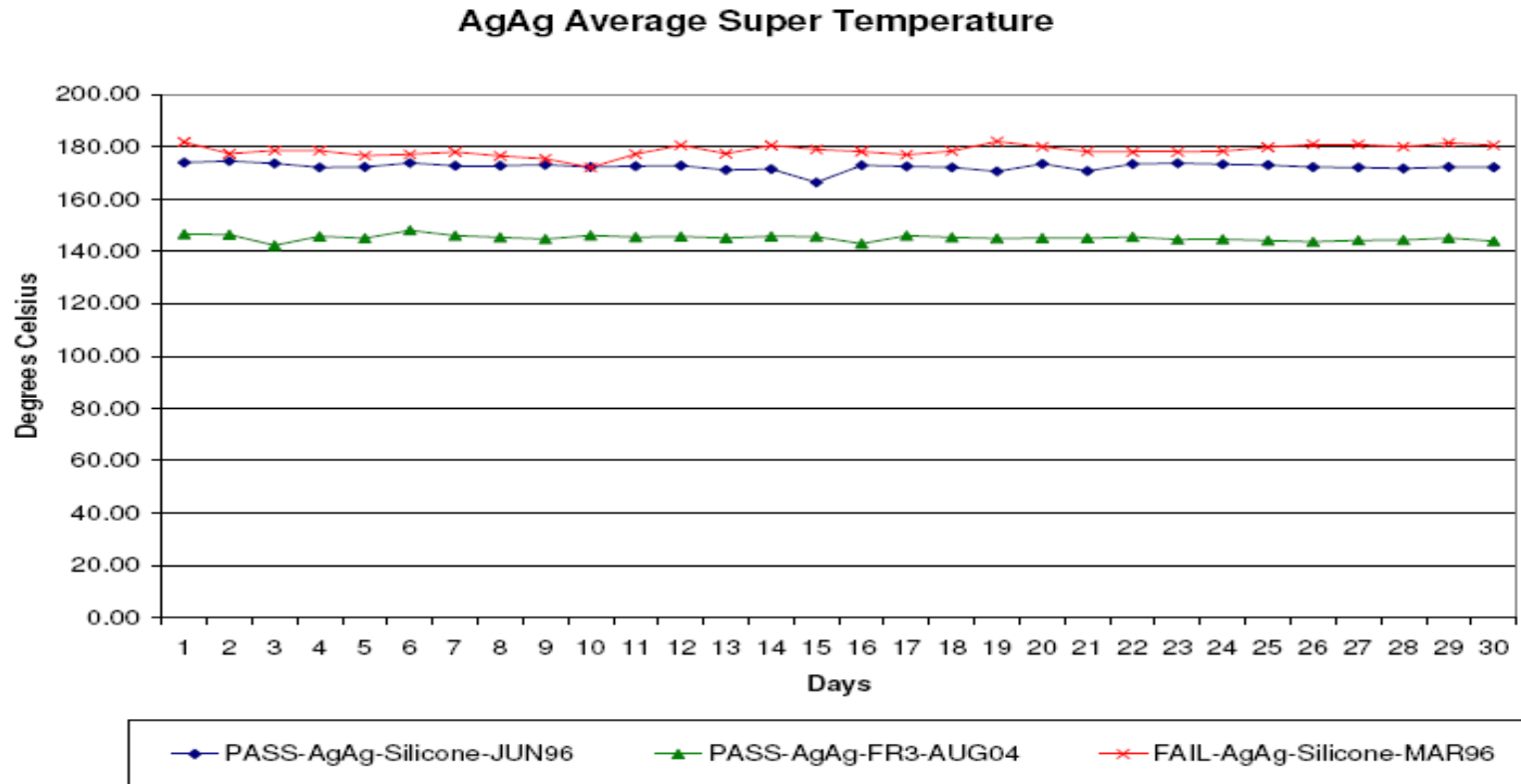
Functional Life Tests-Issues



Observations:

- Ag-Ag Silicone March 1996 is not apparently stable and probably failed
- Ag-Ag Silicone August 2004 clearly passed
- Ag-Ag FR3 August 2004 passed

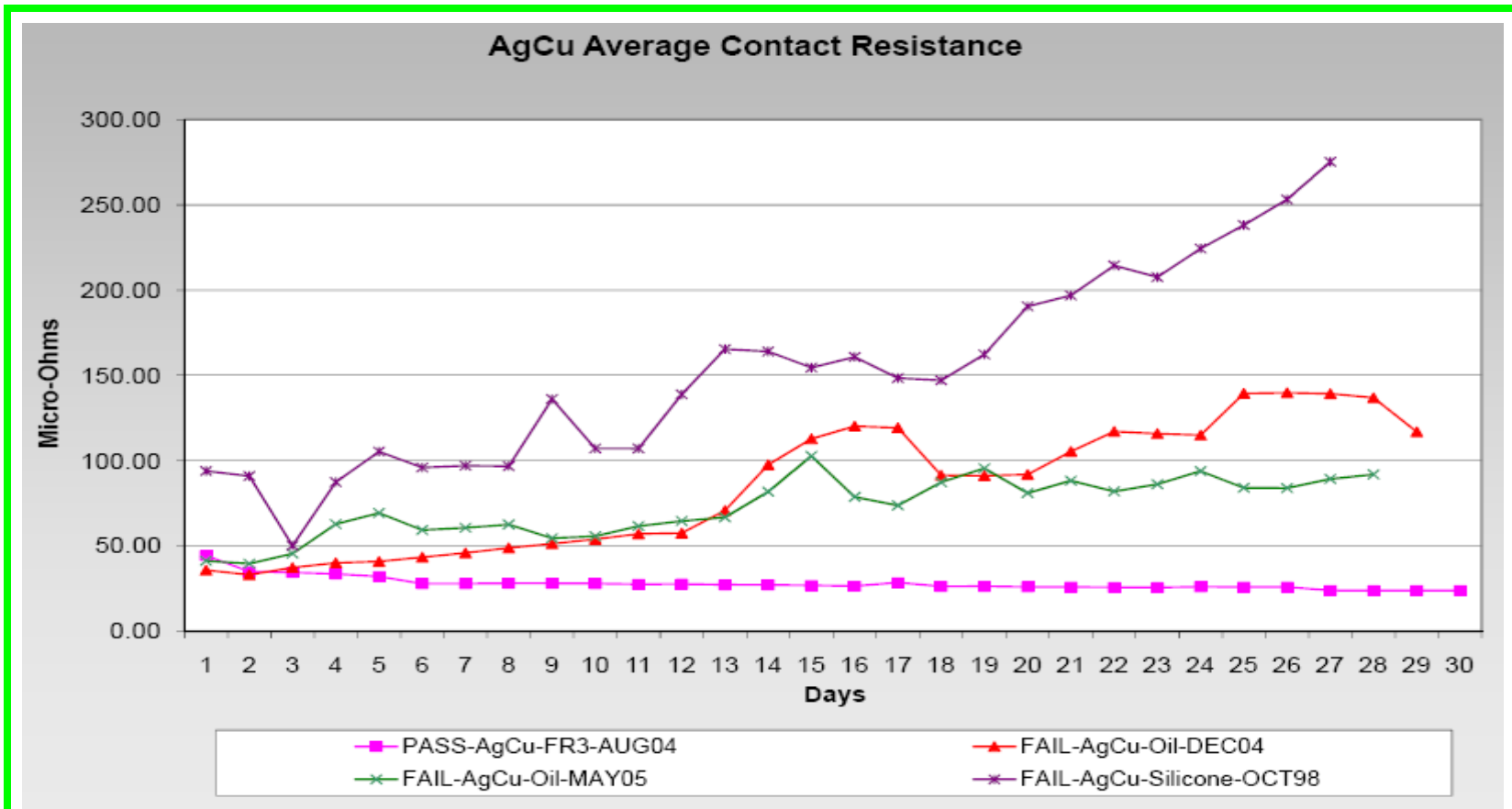
Functional Life Tests-Issues



Observations: Normally super temperature reflects stability or lack thereof

- Ag-Ag Silicone March 1996 is not apparently stable and may be OK
- Ag-Ag Silicone August 2004 clearly passed
- Ag-Ag FR3 August 2004 passed with flying colors

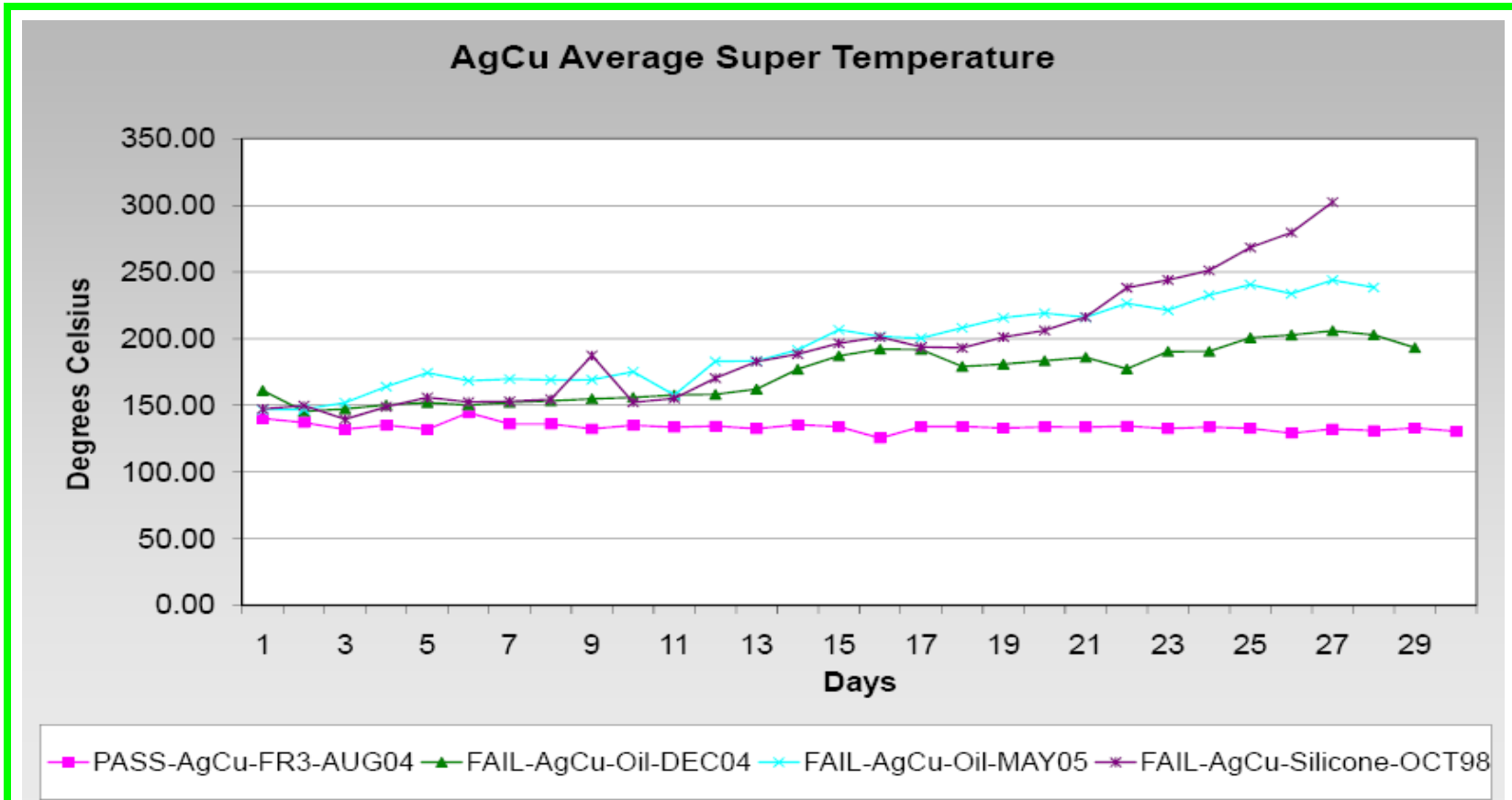
Functional Life Tests-Issues



Observations:

- Ag-Cu Silicone October 1998 clearly failed
- Ag-Cu Oil also failed
- Ag-Cu FR3 August 2004 passed

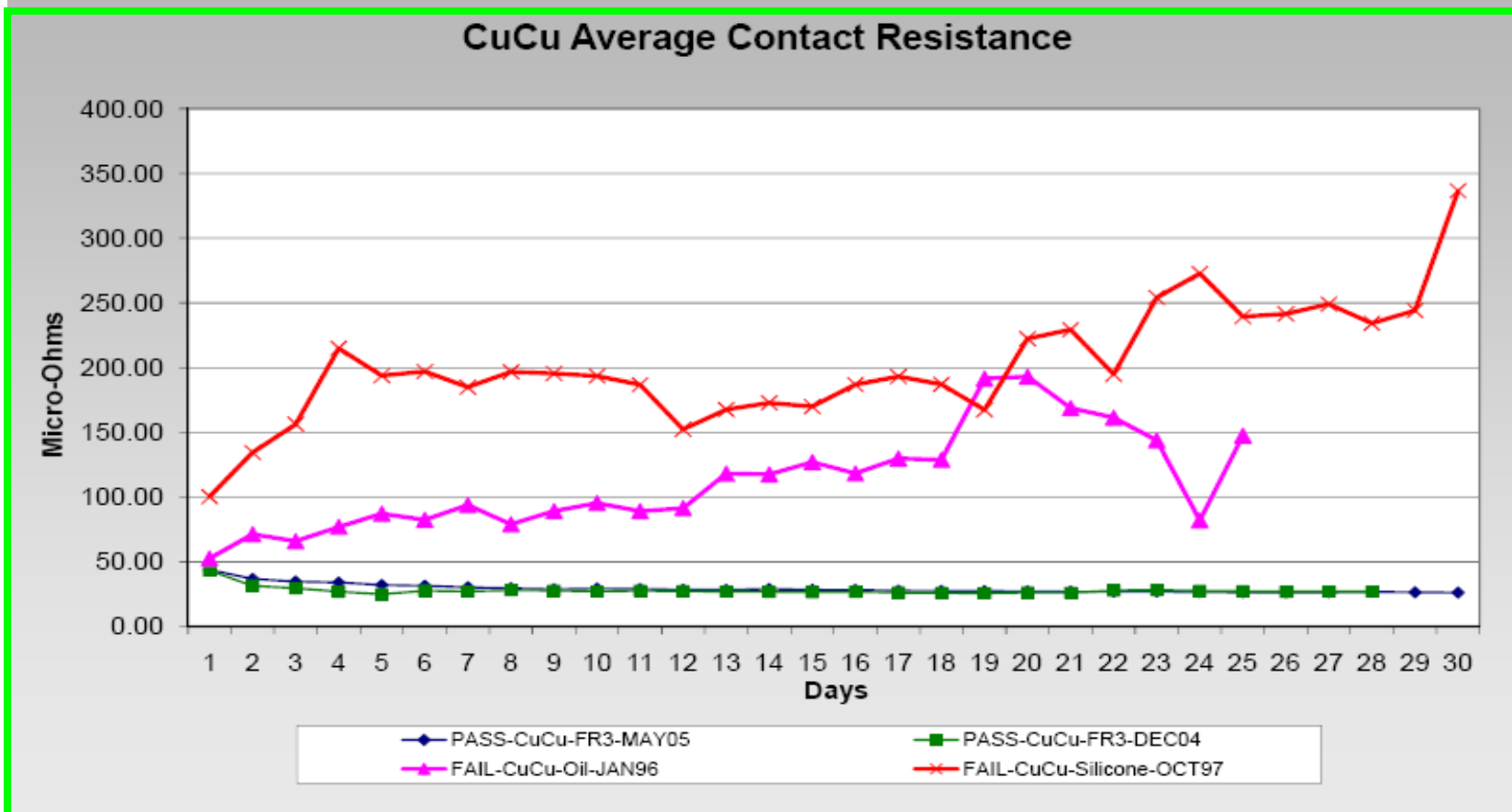
Functional Life Tests-Issues



Observations: Super Temperature indicates

- Ag-Cu Silicone October 1998 clearly failed
- Ag-Cu Oil also failed
- Ag-Cu FR3 August 2004 passed with clear stability.

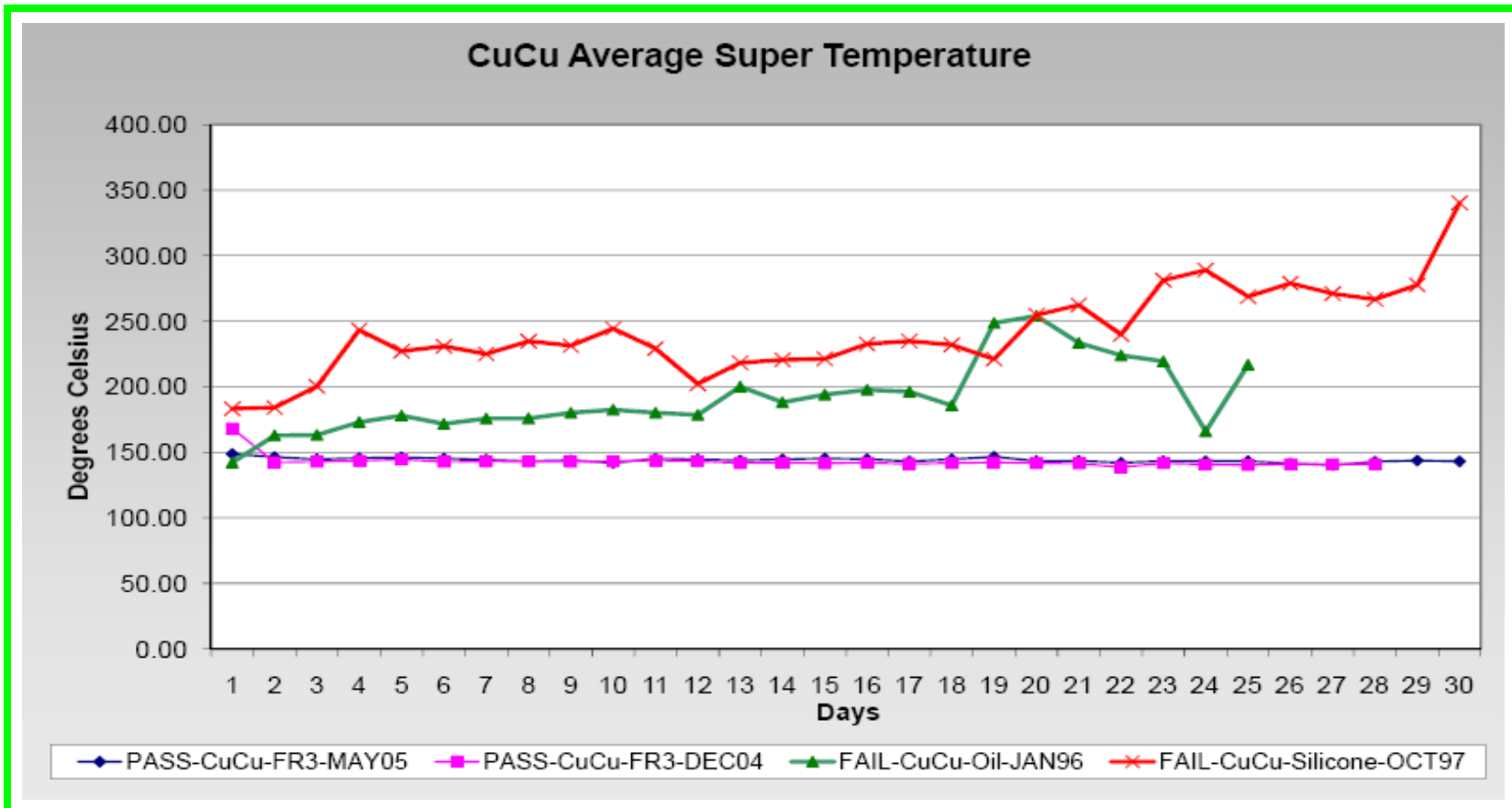
Functional Life Tests-Issues



Observations:

- Cu-Cu Silicone clearly failed
- Cu-Cu Mineral oil also failed
- Cu-Cu FR3 clearly passed

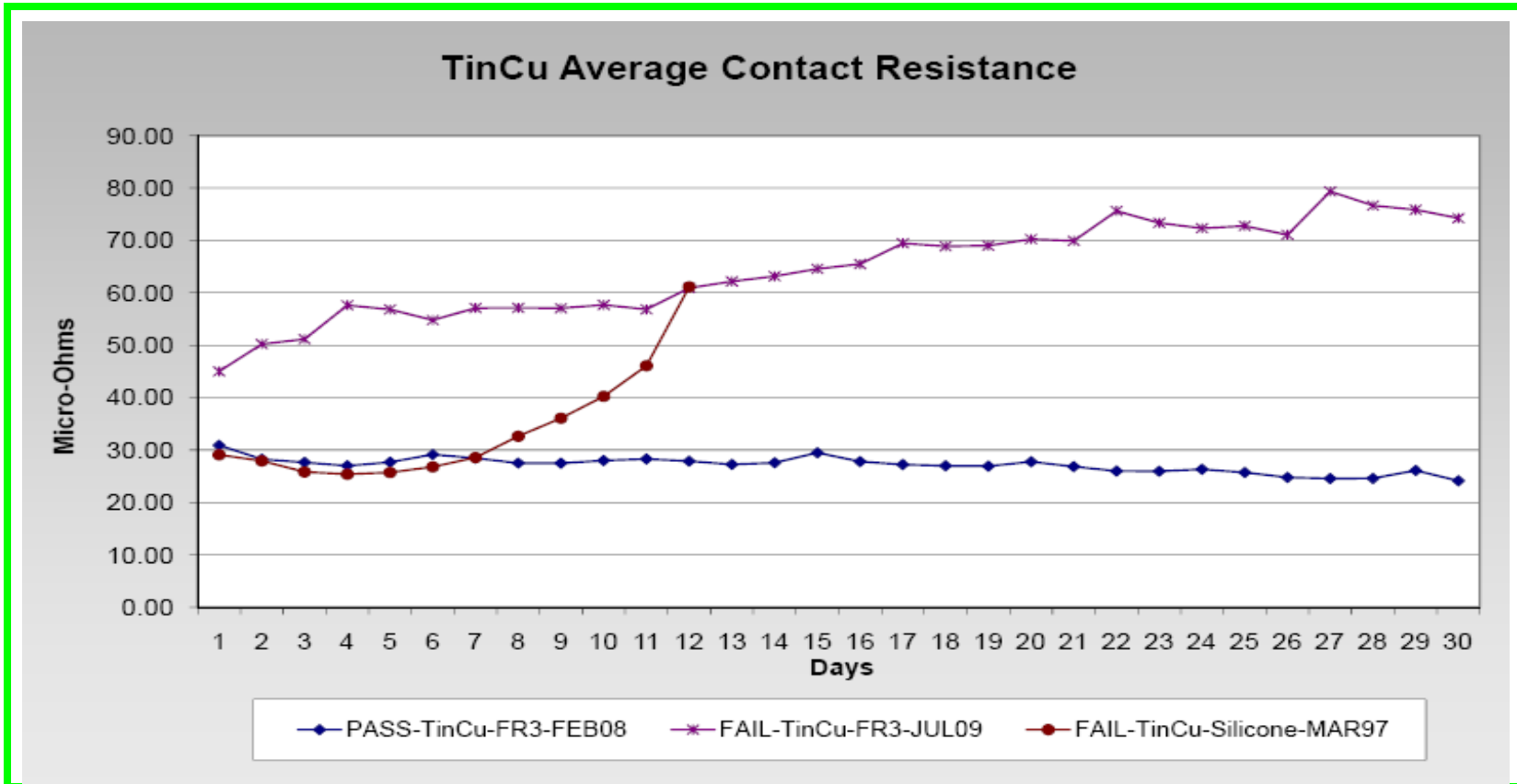
Functional Life Tests-Issues



Observations: Stability is only seen with one of the contact sets

- Cu-Cu Silicone clearly failed
- Cu-Cu Mineral oil also failed
- Cu-Cu FR3 clearly passed

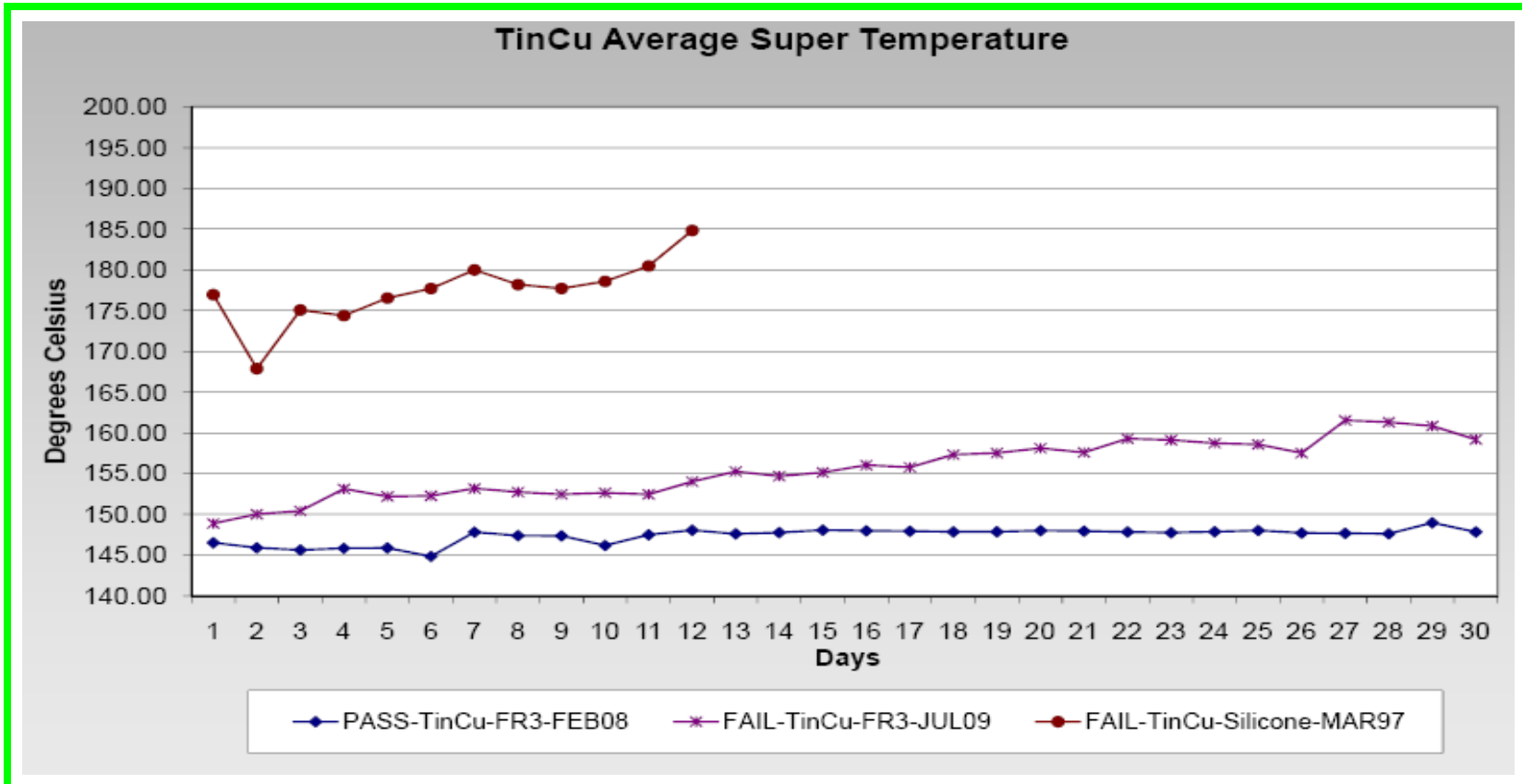
Functional Life Tests-Issues



Observations:

- Tin-CU Silicone clearly failed
- Tin-CU FR3 Feb 2008 passed
- Tin-CU FR3 July 2009 appears to have failed

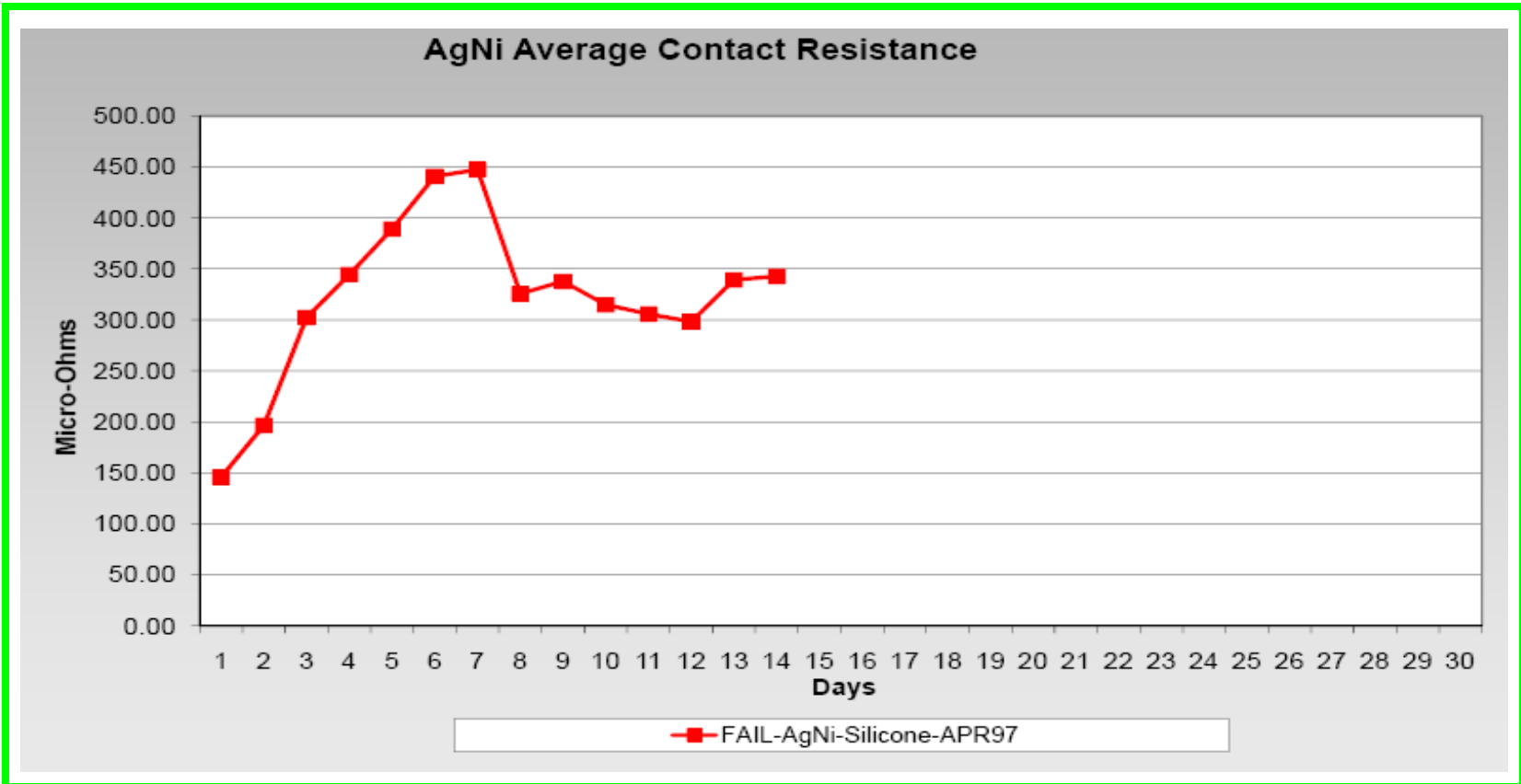
Functional Life Tests-Issues



Observations: This one has one clear failure and one uncertainty

- Tin-CU Silicone clearly failed
- Tin-CU FR3 Feb 2008 passed
- Tin-CU FR3 July 2009 appears to have failed but a longer test may be needed to be certain.

Functional Life Tests-Issues



Observations:

- Ag Silicone clearly failed

Functional Life Tests-Issues

Several Important factors for Pass-Fail

1. Average performance of 6 pairs of contacts
2. Worst case actor
3. Absolute resistance test
4. Super temperature performance as sensitive test of stability

Conclusion:

Pass-Fail Criteria can be improved by factoring in Super Temperature with resistance

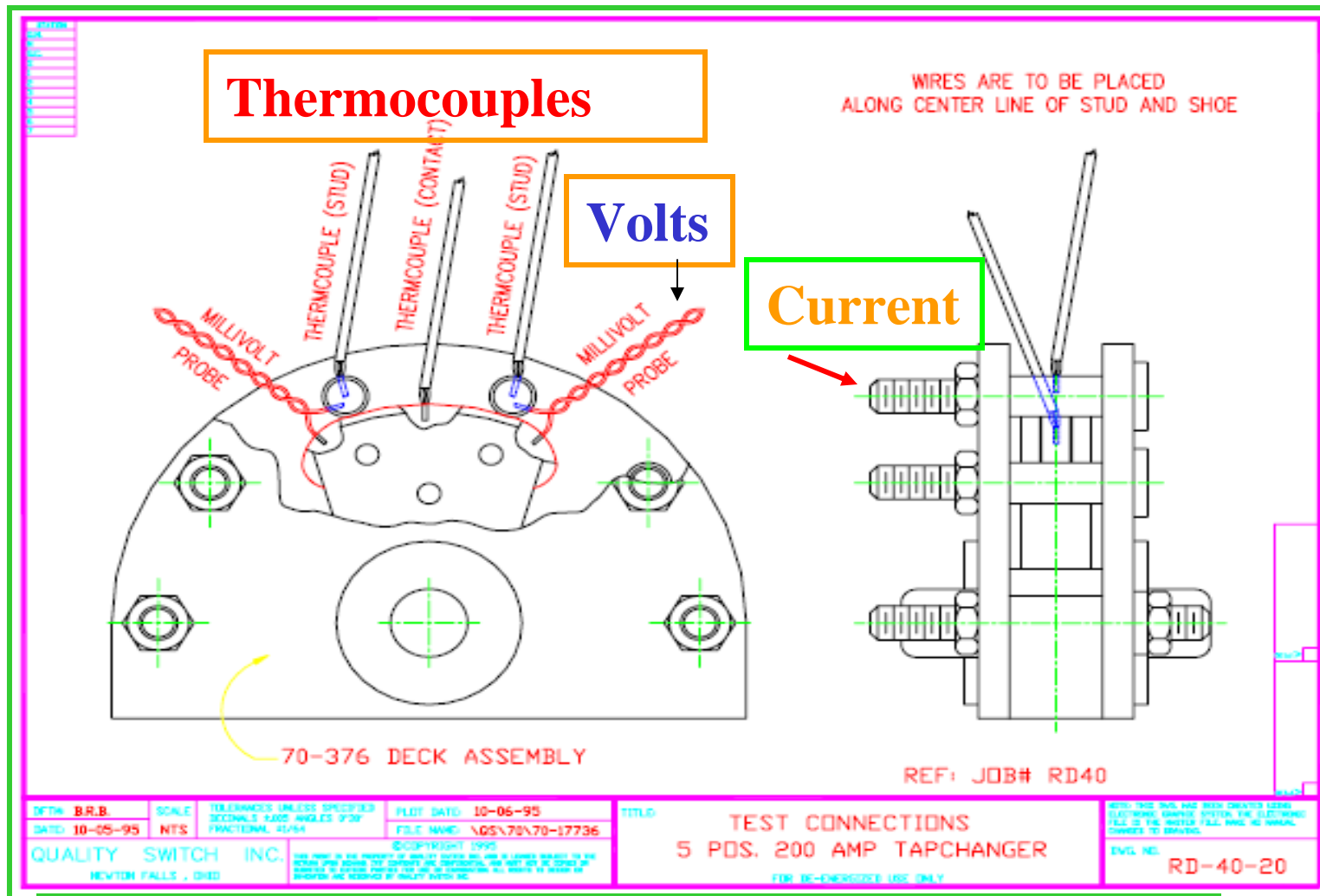
Functional Life Tests-Issues

A look at test setup

1. Use real 3-phase tapchangers
2. One tapchanger gives 6 contact pairs
3. Make sure that thermocouples get accurate bulk temperatures
4. Contact voltage requires minimal loops

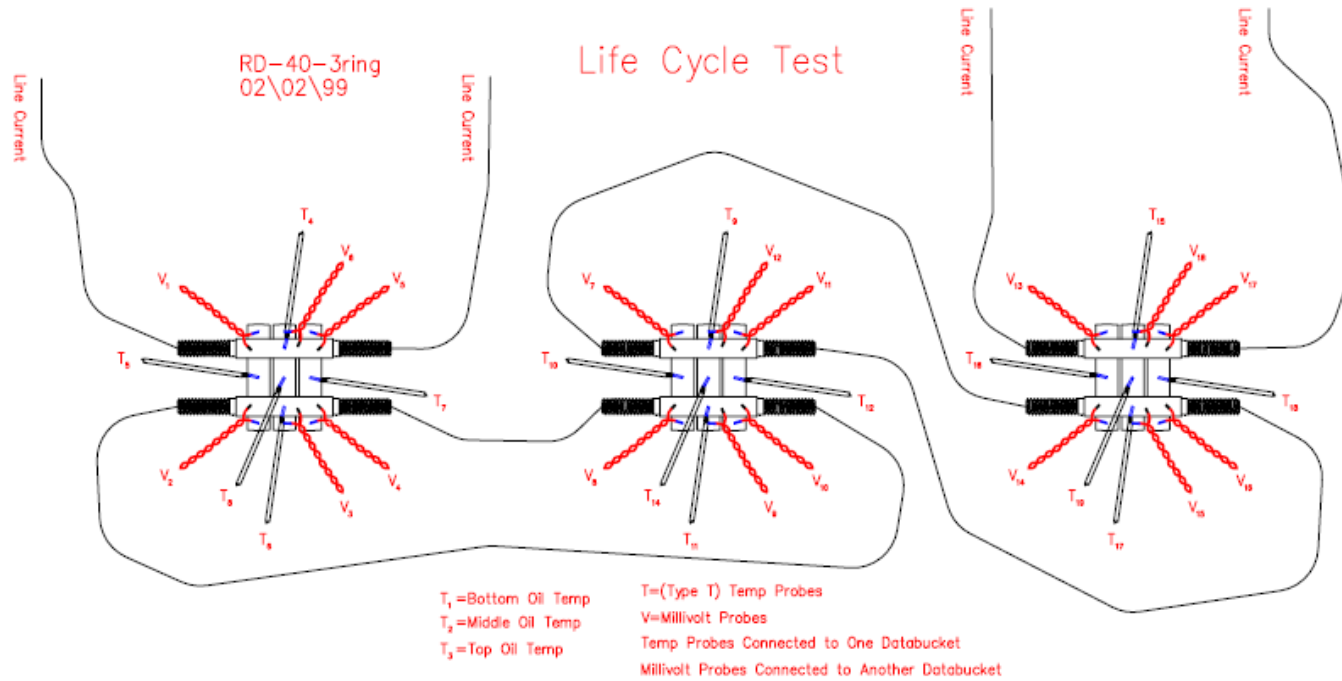
Most important to use complete tapchangers and not just contact pairs.

Functional Life Tests-Connections



**Tapchanger thermocouple and voltage measurements,
courtesy of Quality Switch**

Functional Life Tests-Multiple decks in series



**Hi gh Current Tapchanger (>500 amp rated)
Connections, courtesy of Quality Switch**

Functional Life Tests-Issue of Oil Volume

Large liquid volume important for test validity

1. Most representative of real transformer environment
2. Will contain dissolved gases
3. Provides opportunity for replacement of oxidized liquid
4. Should slow down thermal runaway

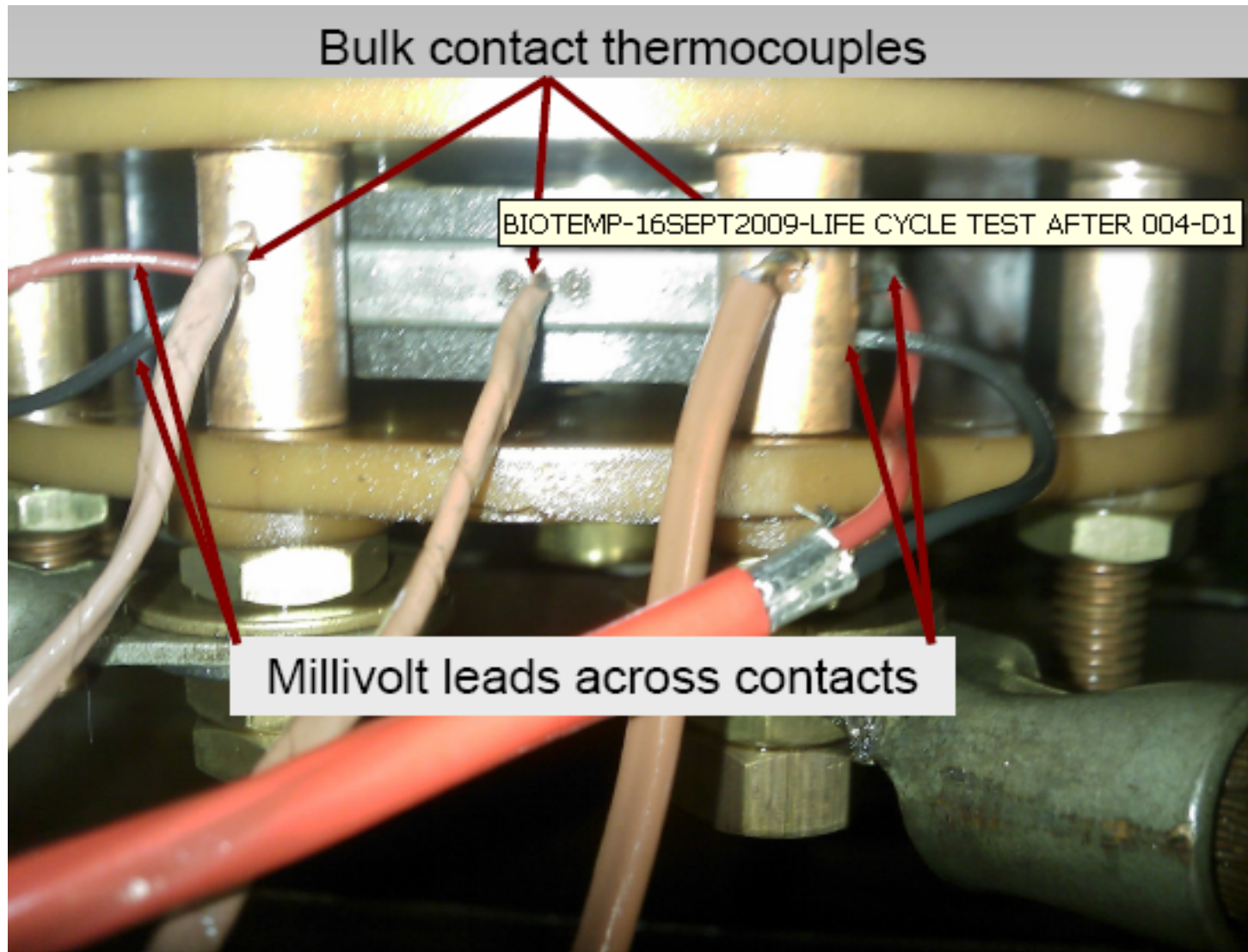
Important to replicate real environment

Functional Life Tests-Issue of Oil Volume



Important to replicate real environment

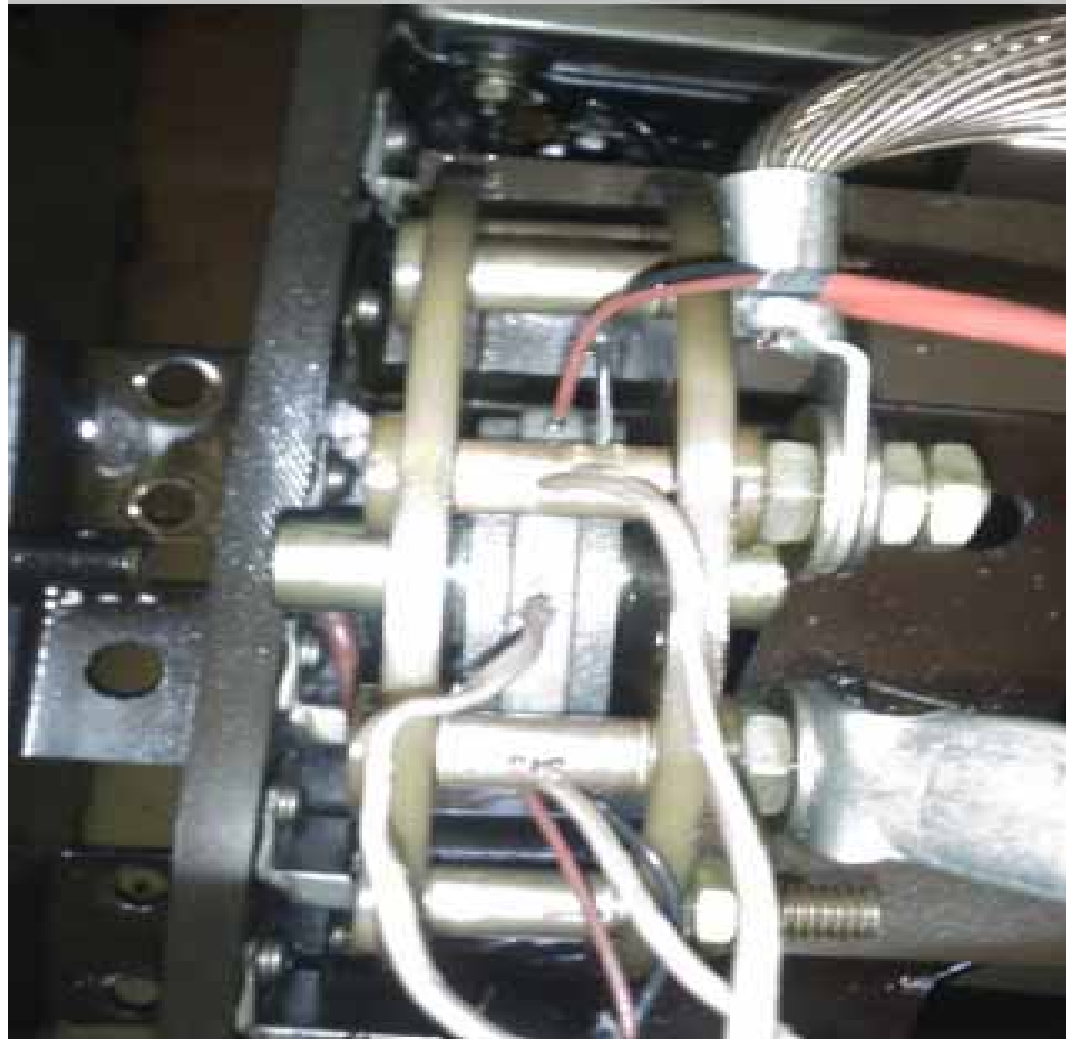
Functional Life Tests-Issue of Oil Volume



Important to replicate real environment

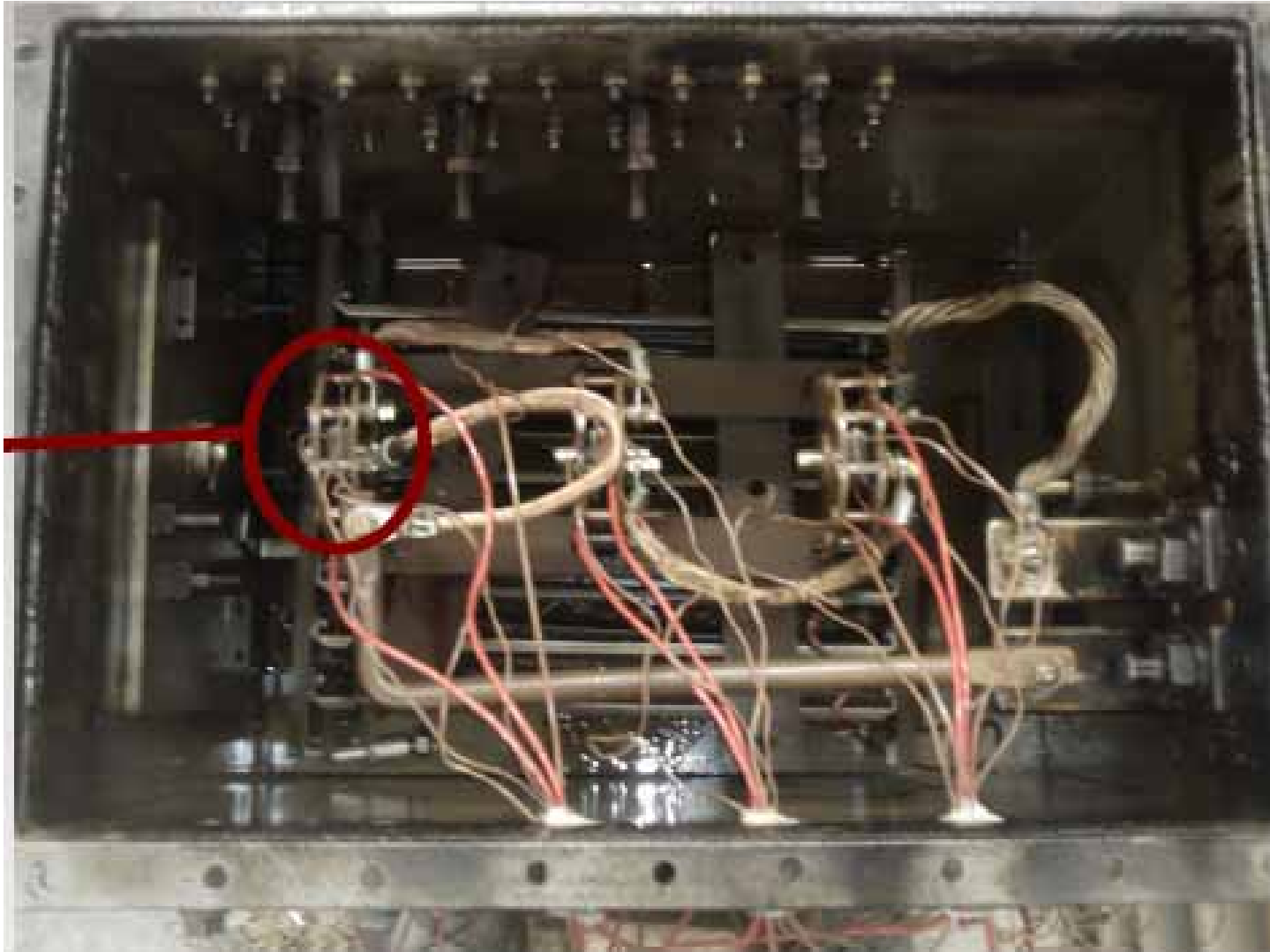
Functional Life Tests-Issue of Oil Volume

Double nut with flat and Bellville washer



Important to replicate real environment

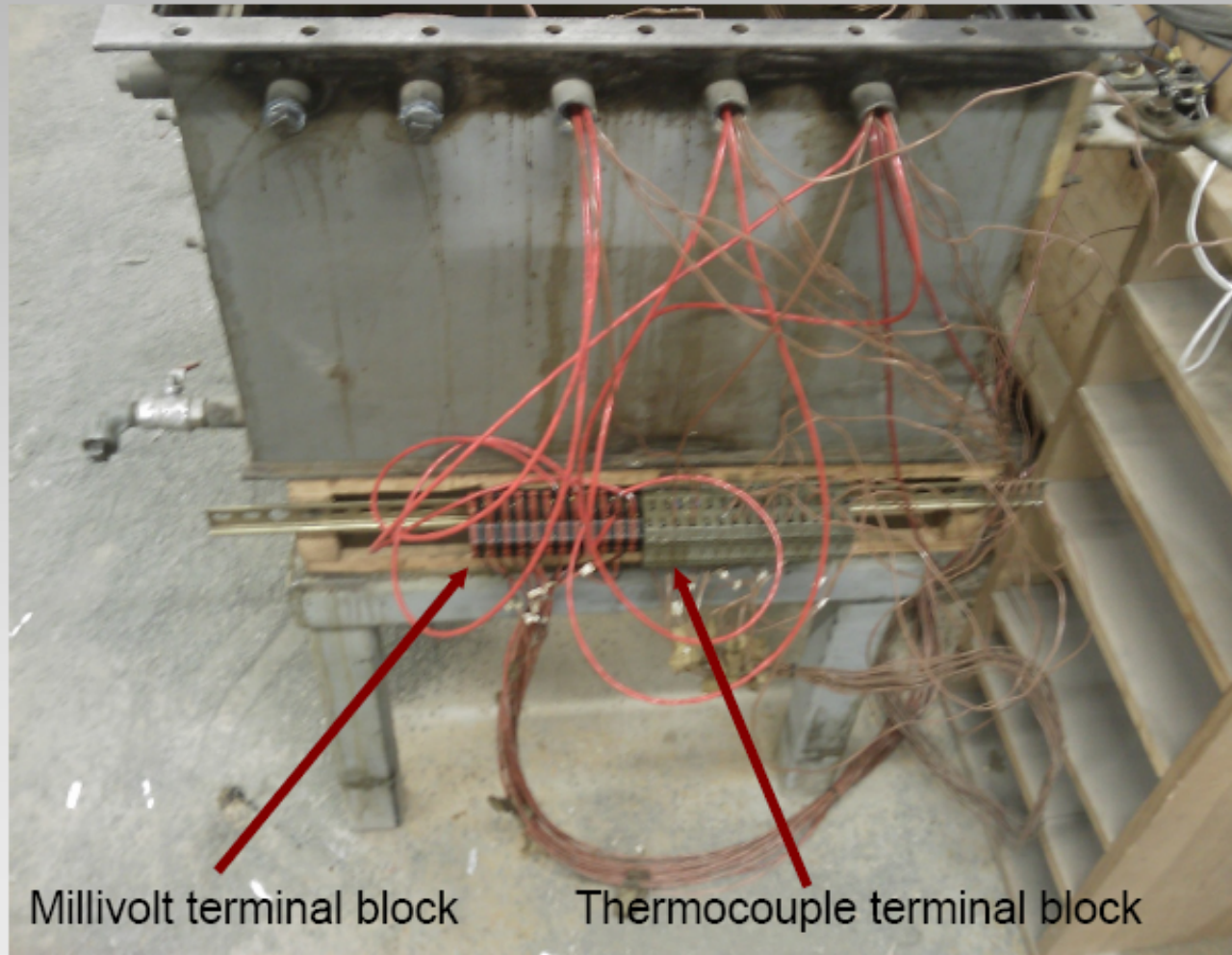
Functional Life Tests-Issue of Oil Volume



Important to replicate real environment

Functional Life Tests-Issue of Oil Volume

Terminal blocks on outside of tank. Connect inner tank wires to data logger.



Important to replicate real environment

Functional Life Tests-Issue of Oil Volume

130 C Liquid Temperature a good selection

1. Possible in real transformer at 2XN load for ½ hour in 30-40 C ambient.
2. Reflects IEEE C57.91 Loading Guide
3. Provides representative viscosity and activity
4. Provides sufficient acceleration to be reproducible

Important to replicate real environment

Assessment Time De-energized Tapchangers

Completed Work

- Functional Life Test Defined
- (5) Manufacturers have performed test
- **Test correlates with Harsh Duty field experience- switches that pass do well.** Example transformers – rolling mills

Limitation: General Purpose Transformers with light duty work OK with unstable contacts

Assessment Time De-energized Tapchangers

Completed Work-2

- Draft Technical Report issued

Limitation: To date: Only two authors on paper

Assessment Time De-energized Tapchangers

Derivation-oil temperature versus current

- Basic relationships
- Super temperature = Oil temp + bulk temp + super/bulk
- Hold super temp constant:

For Stable Silver-Silver Contacts		Avg of Method 1 and 2		
Current, times normal		2	3	4
Tbulk rise		18	35	55
T super rise over bulk		3	7	12
T super + bulk		21	42	67
Tgoal		151	151	151
Toil		130	110	84
Case		Base	Alt1	Alt2

Conclusions; Alternative currents and oil temperatures should work and give consistent results

Assessment Time De-energized Tapchangers

Derivation-oil temperature versus current

$$T \text{ super} = T \text{ oil} + T \text{ bulk/oil} + T \text{ super rise/bulk}$$

T Bulk/oil at rated current = 6

Current XN	Toil	T Bulk/oil	Toil+Tb/oil	Tbulk'	V	Method 1		
						Tsuper/Tbulk	Tsuper C/Toil	
1	144	6	1	6	0.008	1	7	
2	130	18	1	18	0.016	3	21	
3	110	35	1	35	0.024	7	42	
4	84	55	1	55	0.032	12	67	
Difference between 4XN and 2XN								46

Method 1				
Current, times normal		2	3	4
Tbulk rise		18	35	55
T super rise over bulk		3	7	12
T super + bulk		21	42	67
Super Temperature = Tgoal		151	151	151
Toil		130	110	84
Case		Base	Alt1	Alt 2

Contacts	Super Temp, C
Silver-Silver	151
Copper-Copper	167
Tin-Copper	163
Ag-Ni	223

Conclusions; Alternative currents and oil temperatures should work and give consistent results

Assessment Time De-energized Tapchangers

Remaining Work

- **Modified tests for other currents and bath temperatures**
- **Unified definition of the Functional Life Test**
- **Apply for PAR as a Working Group to write a Guide**
- **Agree on wording for the PAR**
- **Assign work elements**
- **Agree on Technical paper**
- **Assemble Guide**

Assessment Time De-energized Tapchangers

Recommendations

1. Title:

Guide for performing accelerated life tests of liquid immersed contact assemblies while stationary in electrical apparatus

Assessment Time De-energized Tapchangers

Recommendations

2. Scope:

This Guide provides the requirements and recommended testing methods for performing an accelerated life test for contact assemblies used in de-energized tap changers, dual voltage switches, reversing switches of on-load-tap-changers and other products for distribution and power transformers, containing electrical contacts in liquid filled chambers, where the contacts are moved infrequently.

Assessment Time De-energized Tapchangers

Recommendations

3. Purpose:

Identify test conditions, instrumentation, data collection and calculations that are essential to be able to establish pass or fail conditions for the manufacture of contact assemblies.

Assessment Time De-energized Tapchangers

Recommendations

3. Need For Document:

De-energized tap-changers and reversing switches of on-load tap-changers contact designs may be susceptible to thermal run-a-way and coking due to certain factors. Reliable test methods to identify stable and unstable material combinations are described in this guide and provide repeatable conditions to simulate accelerated life conditions for C57.12.00 and associated product standards.

Assessment Time De-energized Tapchangers

Recommendations

3a. Important Elements:

- **Test is on complete tap-changers and not on just the contacts.**
- **Test is based on accelerated aging and can be conducted in 30 days to represent 30 years of normal service.**
- **Test has been verified by millions of products that have remained stable over a 40 year period.**
- **Test is not overly complicated and can be replicated.**
- **Multiple manufacturers have had similar results.**
- **Setups, instrumentation, test conduct, and data collection are important elements that need to be defined to avoid incorrect conclusions.**

Assessment Time De-energized Tapchangers

Recommendations

Interested Parties:

Currently a task force exists with a steady membership of about 60 members. This taskforce has met continuously since 1998 and has developed a large volume of test results. All of the major manufacturers of tap-changers belong to the task force. We expect to have sufficient interest and participation to complete the work within a 2-3 year period.