American Polywater's

# TechnicalTalk

ROUTE TO:

A PUBLICATION FOR ENGINEERS INVOLVED IN ELECTRICAL CABLE INSTALLATION

**Volume 13**

## Cable Compatibility Standard

Can the pulling compound you use ruin your cable? How do you know? P1210 is a draft standard being developed by the Insulated Conductors Committee of IEEE. The draft is titled "Standard Tests for Determining Compatibility of Cable Lubricants with Wire and Cable."

### What & Why?

P1210 was developed at the request of both cable manufacturers and cable end-users. With the variety of materials being used in cable pulling lubricants, there were no accepted methods to determine if these materials adversely affected cable. Potential interaction of lubricants with cable was a major concern. History had shown that certain wax emulsion lubricants can negatively affect semi-conducting jacket; that some soaps and waxes can "stress crack" polyethylene jacket; and that petroleum greases and oils can wreck havoc with a great many cable jacket materials.

P1210 provides a basis for evaluation of a specific lubricant's "compatibility" with a specific cable jacket. While P1210 is a draft standard, it has been finalized for submission to the IEEE standards board. At the time this was written, please be aware that P1210 is an "unapproved" draft, subject to change. To really understand the P1210 standard, we need to know the test procedures, how they were developed, and what the tests show about compatibility.

### Physical Versus Electrical

P1210 breaks the evaluation of lubricant/jacket into physical and electrical effects. The lubricant effect on physical properties must be measured for all cable jackets. The effect on dielectric properties is required when the jacket is also the insulation (600V building wire). Volume resistivity measurements are required when the jacket or exposed cable covering is "semi-conducting."

### Physical Testing

The primary function of medium and high voltage cable jacket is physical protection. Jacket physical properties (tensile and elongation) are a primary focus in P1210.

The standard requires physical testing at three different aging conditions (versus a control sample). The first condition is jacket-specific, and is based on NEMA/ICEA time and temperature requirements for aging of the particular jacket material. In the first test, the "aged-in-lubricant" sample is compared to a *non-aged* and *non-lubricated* sample. The second condition is identical in time and temperature, but the comparison is between two "aged" samples, one exposed to lubricant and one not. The third condition is a longer term, lower temperature comparison, again between two aged samples, one exposed to lubricant and the other not.

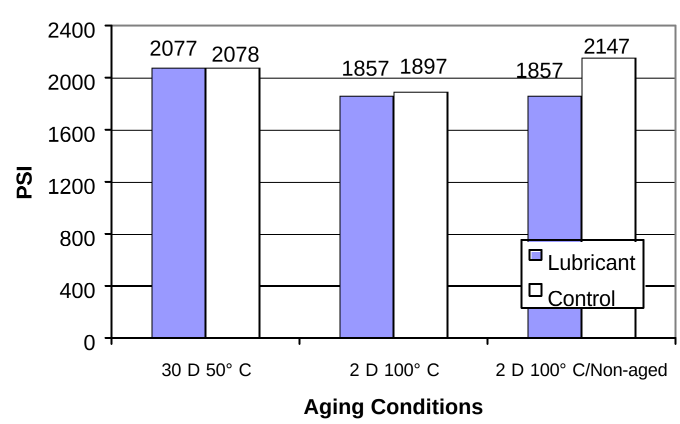
It's easiest to understand testing detail by looking at some P1210 test data we have for Polywater® J on the common 6425 LLDPE power cable jacket.

| | **P1210 Testing Polywater® J on 6425 PE** | | | |
|---|---|---|---|---|
| | **Minimum % Required** | | **Results** | |
| **Test Description** | **Tensile** | **Elongation** | **Tensile** | **Elongation** |
| 2-day 100° C vs. non-aged control | 75% | 75% | Passed (86%) | Passed (102%) |
| 2-day 100° C vs. aged control | 85% | 85% | Passed (98%) | Passed (98%) |
| 30-day 50° C vs. aged control | 85% | 85% | Passed (100%) | Passed (100%) |

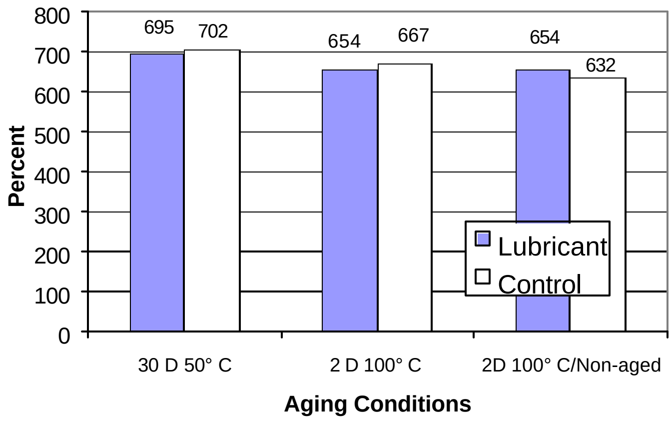
Note that the NEMA/ICEA aging test for PE jackets is 2 days at 100°C with 75% retention required for both tensile and elongation. The test is modified to include lubricant immersion of the aged sample. In #1, the lubricant-immersed and aged sample is compared with a non-aged sample. #2 and #3 compare to an "aged" control sample, but one not exposed to lubricant. The minimum retention for comparisons #2 and #3 is 85% in P1210.

The table shows that Polywater® J met the standard on LLDPE. Retention (as a percentage) is compared to the requirements, but specific test detail is not presented. For a detailed analysis, you need actual tension and elongation data from the tests. The graphs below present this data. Note there is a tensile graph and an elongation graph, both with the three aging conditions.

**TENSILE TESTING**
**Polywater® J Lubricant**
**DFDA-6425 PE**



**ELONGATION TESTING**
**Polywater® J Lubricant**
**DFDA 6425 PE**

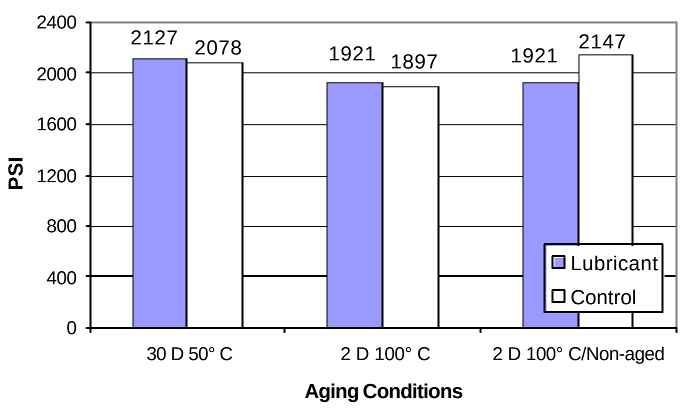



A complete presentation of P1210 test data should include both the table and graph data above.

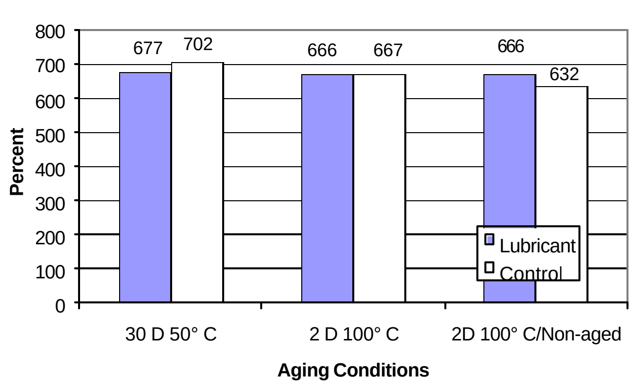
Polywater® J has been extensively used and tested, and it's no surprise that it's compatible with cable jacket. P1210 is useful on a newer product, Polywater® Plus Silicone™, a lubricant which contains "silicone" (polydimethyl siloxane). P1210 test data on the same PE jacket with Polywater® Plus Silicone™ Lubricant are shown below:

| | P1210 Testing Polywater® Plus Silicone ä on 6425 PE | | | |
|---|---|---|---|---|
| | Minimum % Required | | Results | |
| Test Description | Tensile | Elongation | Tensile | Elongation |
| 2-day 100° C vs. non-aged control | 75% | 75% | Passed (89%) | Passed (105%) |
| 2-day 100° C vs. aged control | 85% | 85% | Passed (101%) | Passed (100%) |
| 30-day 50° C vs. aged control | 85% | 85% | Passed (102%) | Passed (96%) |

**TENSILE TESTING**
**Polywater® Plus Silicone ä NN Lubricant**
**DFDA 6425 PE**




**ELONGATION TESTING**
**Polywater® Plus Silicone ä NN Lubricant**
**DFDA 6425 PE**




The utility of P1210 is obvious. The standard has provided a way to evaluate the new lube, Polywater® Plus Silicone™, and its interaction with cable jackets. We see that Polywater® Plus Silicone™ passes the tests, and is compatible with this power cable jacket.

## Test Limits

P1210 does not show whether a pulling lubricant is "effective." Water or library paste would both pass P1210, both neither make very good pulling lubricants.

While it's critical that lubricants are compatible with cable, it's equally important that they're functional and efficient. Key properties in a lubricant are:

(1) **Coefficient of Friction** -- (How "slippery" is the lubricant?--By jacket type and conduit type?)

(2) **Coefficient of Friction "Dry"** -- (Can cable be adjusted and is lubricant effective for long pulls?)

(3) **Amount and Nature of Residue** -- (Does residue "cement" in cable over time--block conduits?)

(4) **Combustion Properties of Residue** -- (Does residue affect flame propagation character of fire-retardant cables?)

(5) **Coating and Cling Character During Application** -- (Will lubricant cover jacket?--Does it stay on for long runs?)

(6) **Stability** -- (What are effects during cold and/or warm storage?)

(7) **Environmental** -- (Is lube toxic, hazardous waste, etc?)

This list is not intended to be all-inclusive, but it does show what several decades of making and using pulling lubricants has taught us. Polywater® Lubricants offer real end-user benefits based on superior performance in all of the properties highlighted.

## Summary

Space limits this discussion to only the physical properties part of P1210. Electrical evaluation will be discussed in a future issue.

Be aware that this draft IEEE specification is reaching a final approval level. The standard will offer guidance needed in the interaction of lubricant with cable. American Polywater continues to lead the way with both product and evaluation technology.

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