Reflections on “First Experiences” with IEEE 400

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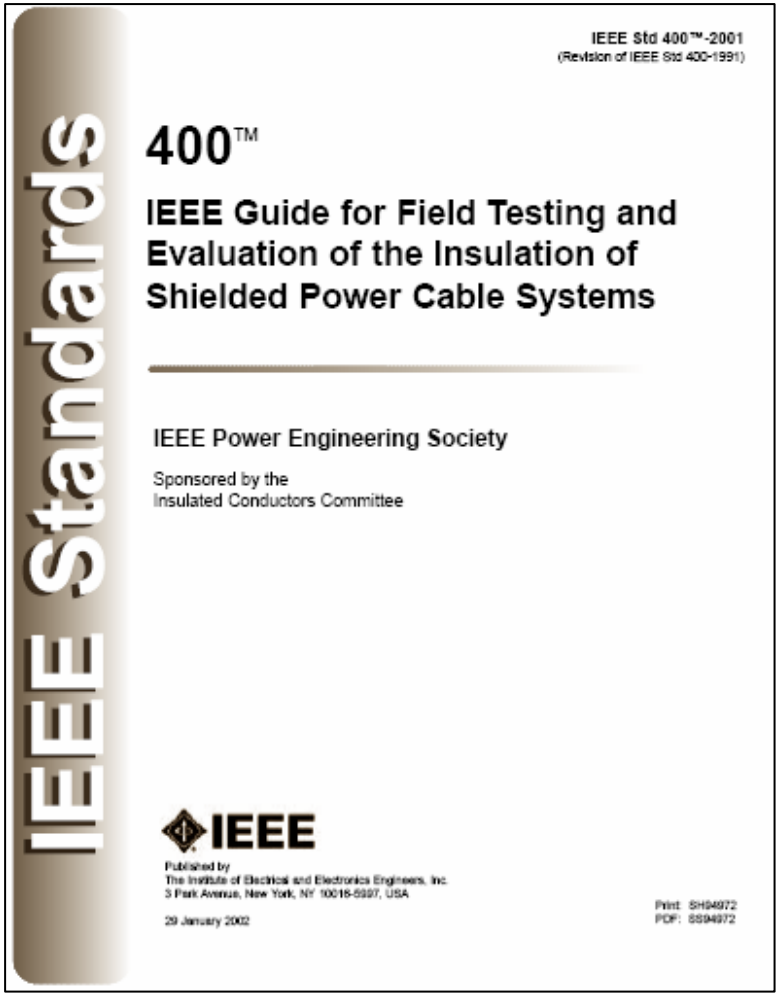
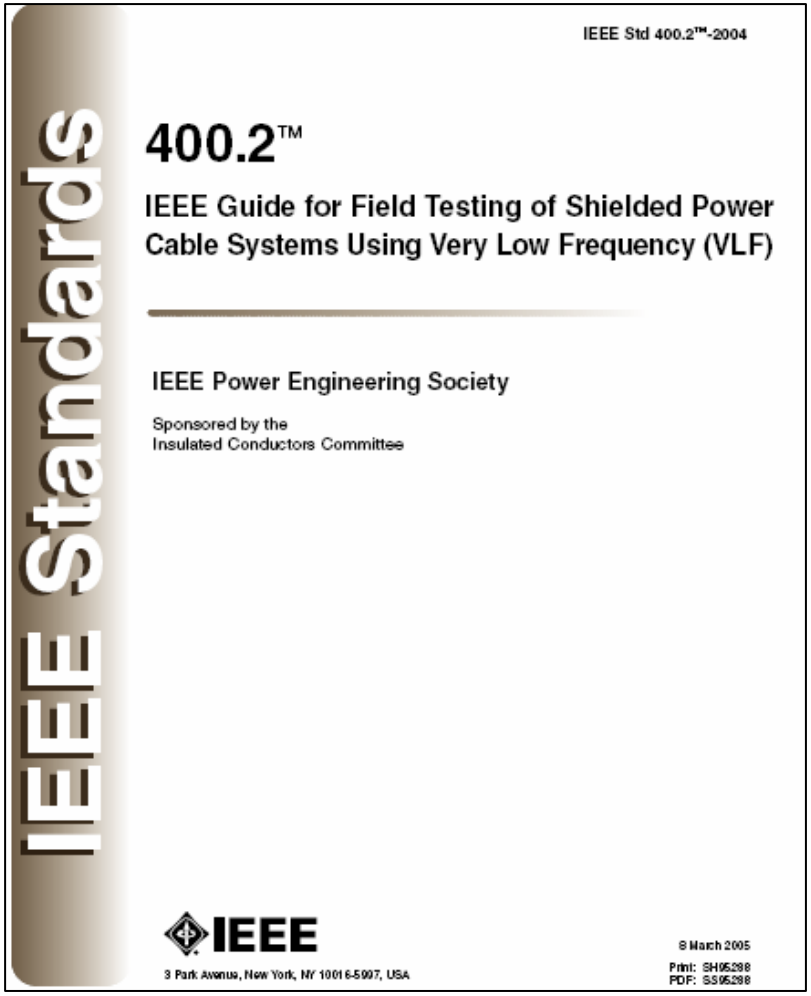
Issues

- **Document Structure**
- **Practical Guidance**
- **Confusing and contradictory criteria**
- **What are the sources of the criteria that are quoted?**
- **Are the criteria specific to cable designs and local operating conditions?**
- **A better treatment of the Risks associated with VLF and any test.**

Document Structure

Why 2 documents?





Practical Guidance

- Test arrangement
- Terminations
- Retest
- Times
- Voltages
- Criteria

Withstand
Dielectric
PD

Voltages and Times

Table 4—VLF test voltages for cosine-rectangular waveform (see Note 1)

Cable rating phase to phase	Installation (see Note 2) phase to ground	Acceptance (see Note 2) phase to ground	Maintenance (see Note 3) phase to ground
rms voltage in kV	rms voltage/peak voltage	rms voltage/peak voltage	rms voltage/peak voltage
5	12	14	10
8	16	18	14
15	25	28	22
25	38	44	33
35	55	62	47

NOTES

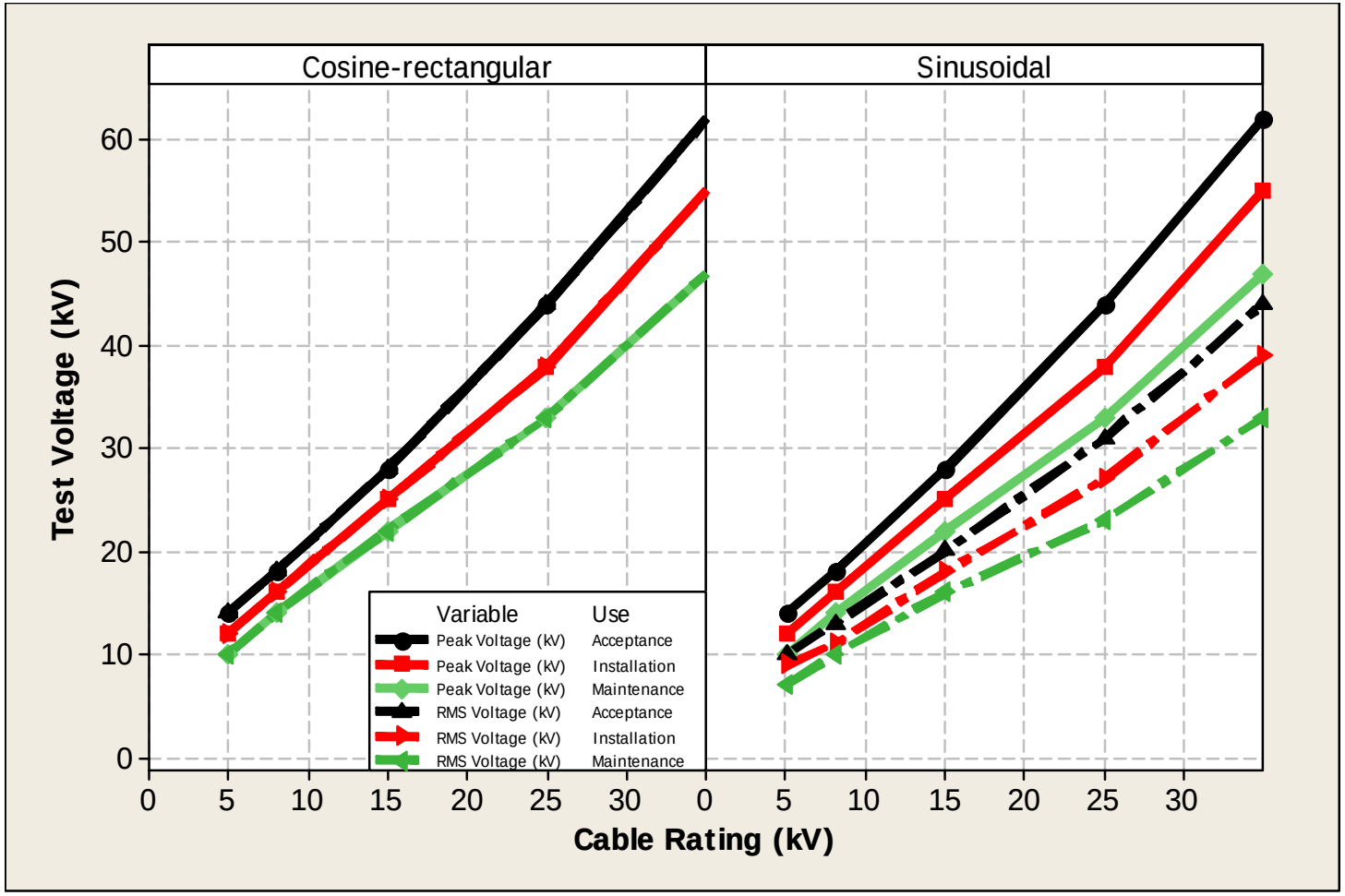
1—For cosine-rectangular waveform the rms is assumed to be equal to the peak value.

2—The results of field tests on over 15000 XLPE cable circuits tested showed that ~68% of the recorded failures occurred within 12 minutes, ~89% within 30 minutes, ~95% after 45 minutes, and 100% after 60 minutes (Mch [B17]). **The recommended testing time varies between 15 and 60 minutes, although the data in Mch [B17] suggest a testing time of 30 minutes.** The actual testing time and voltage may be defined by the supplier and user and depend on the testing philosophy, cable system, insulation condition, how frequently the test is conducted, and the selected test method. Testing databases or Eager et al. [B7] may be consulted when choosing a preferred testing time. When a VLF test is interrupted, it is recommended that the testing timer be reset to the original time when the VLF test is restarted.

3—For a 0.1 Hz VLF test voltage, the suggested maintenance voltage duration is 15 minutes (Eager et al. [B7]).

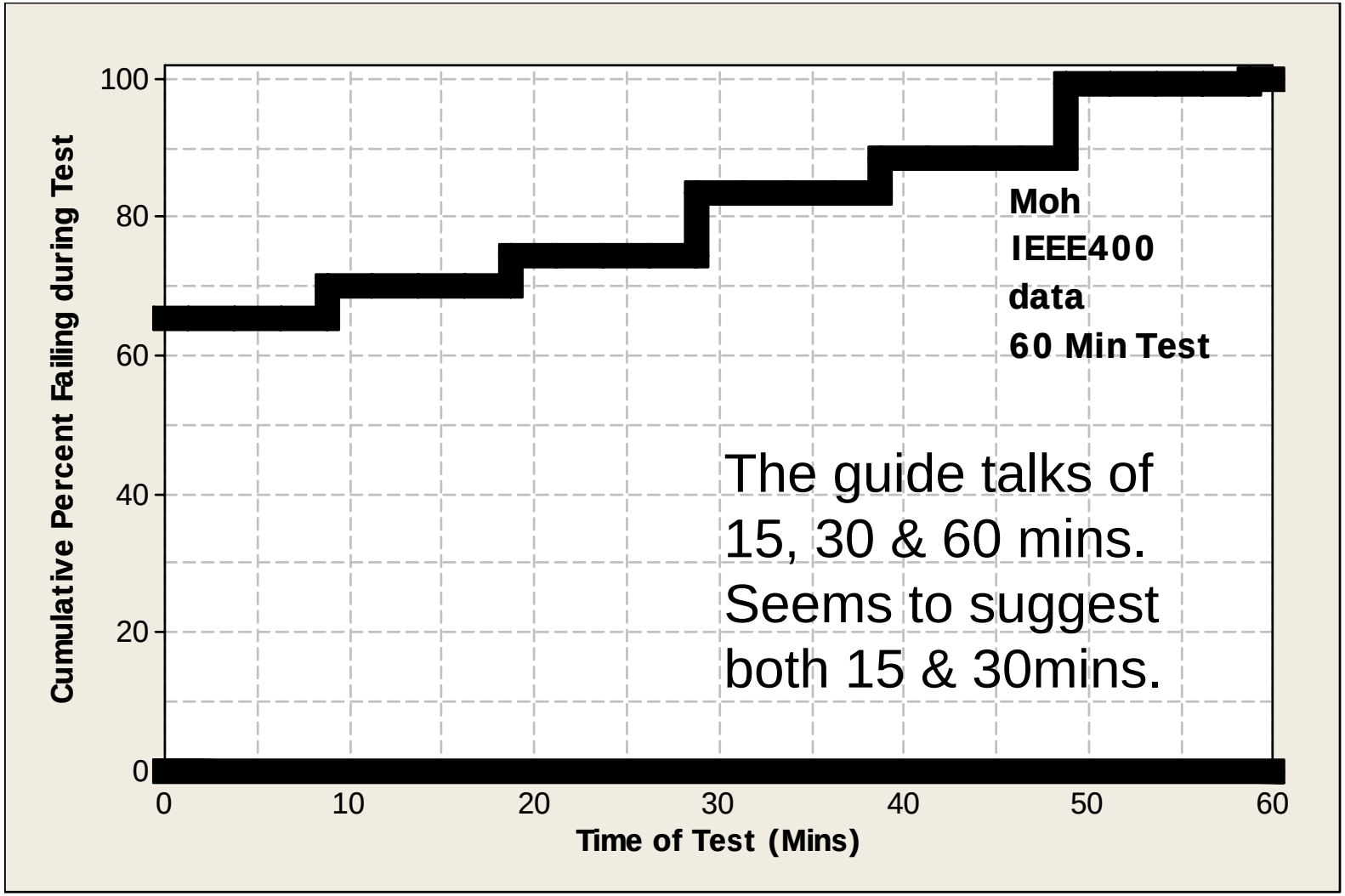
Voltages

Voltage are un wieldy but clear



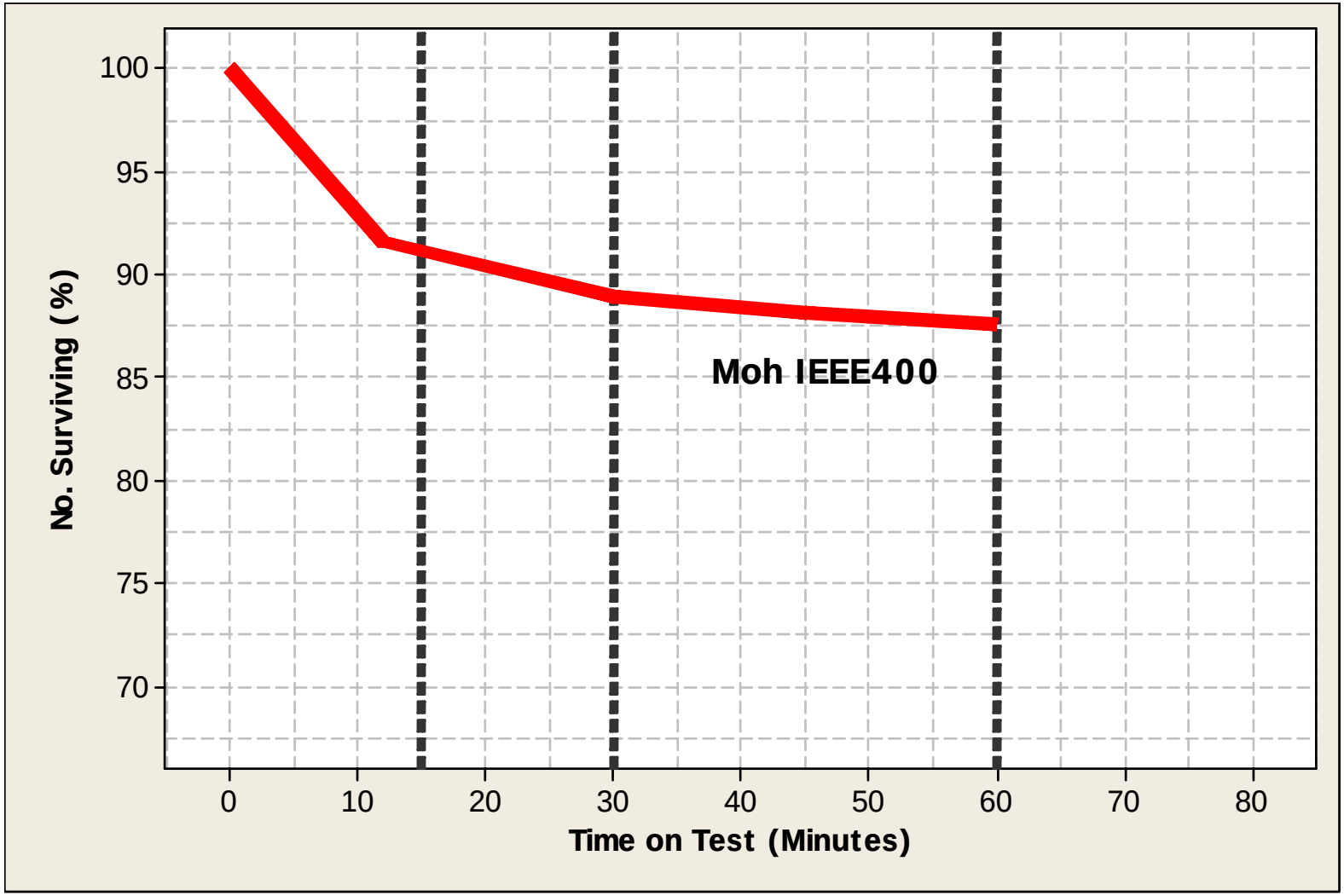
We normally talk about multiples of Uo

Times 1

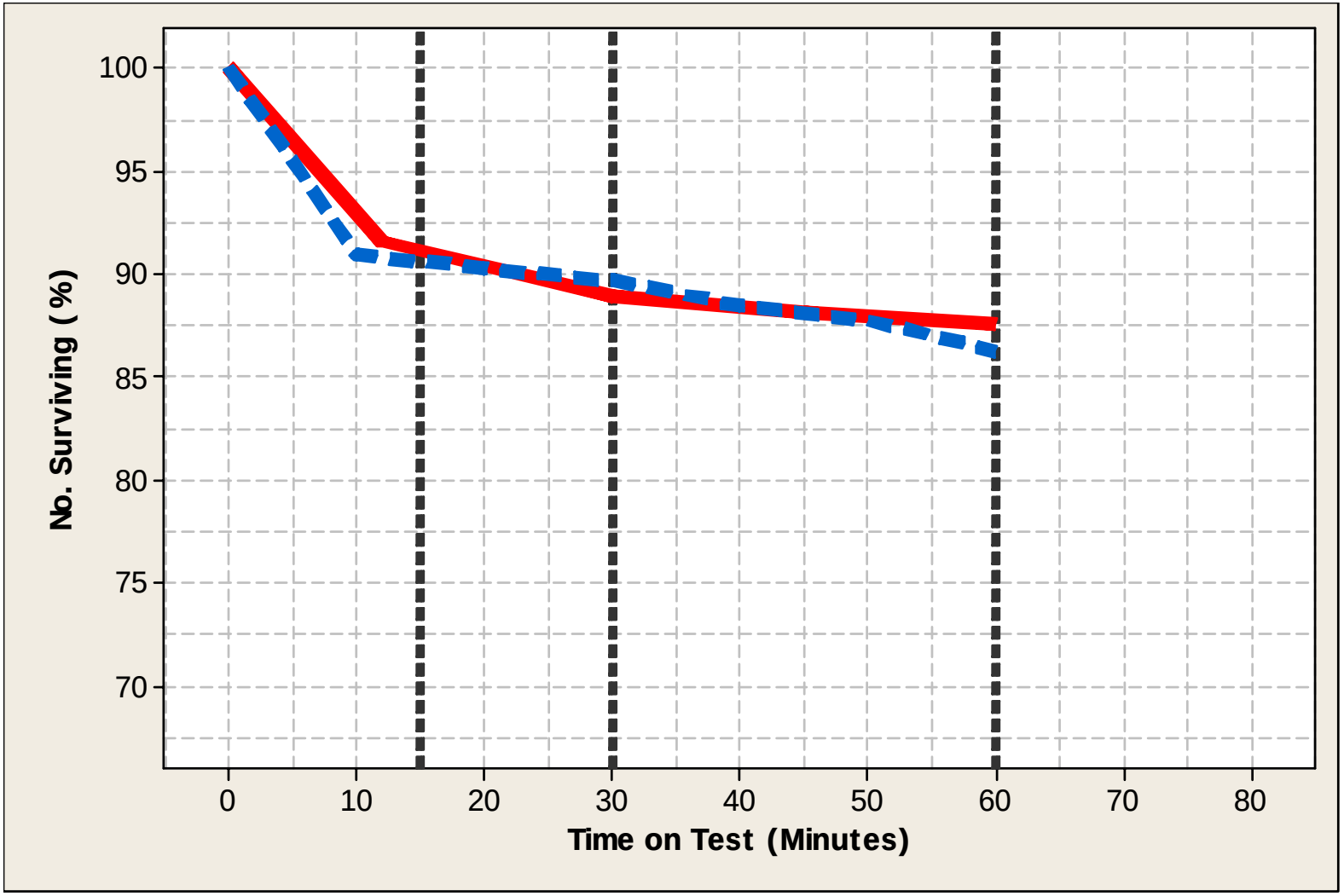


Perhaps more useful to look at survival of cables?

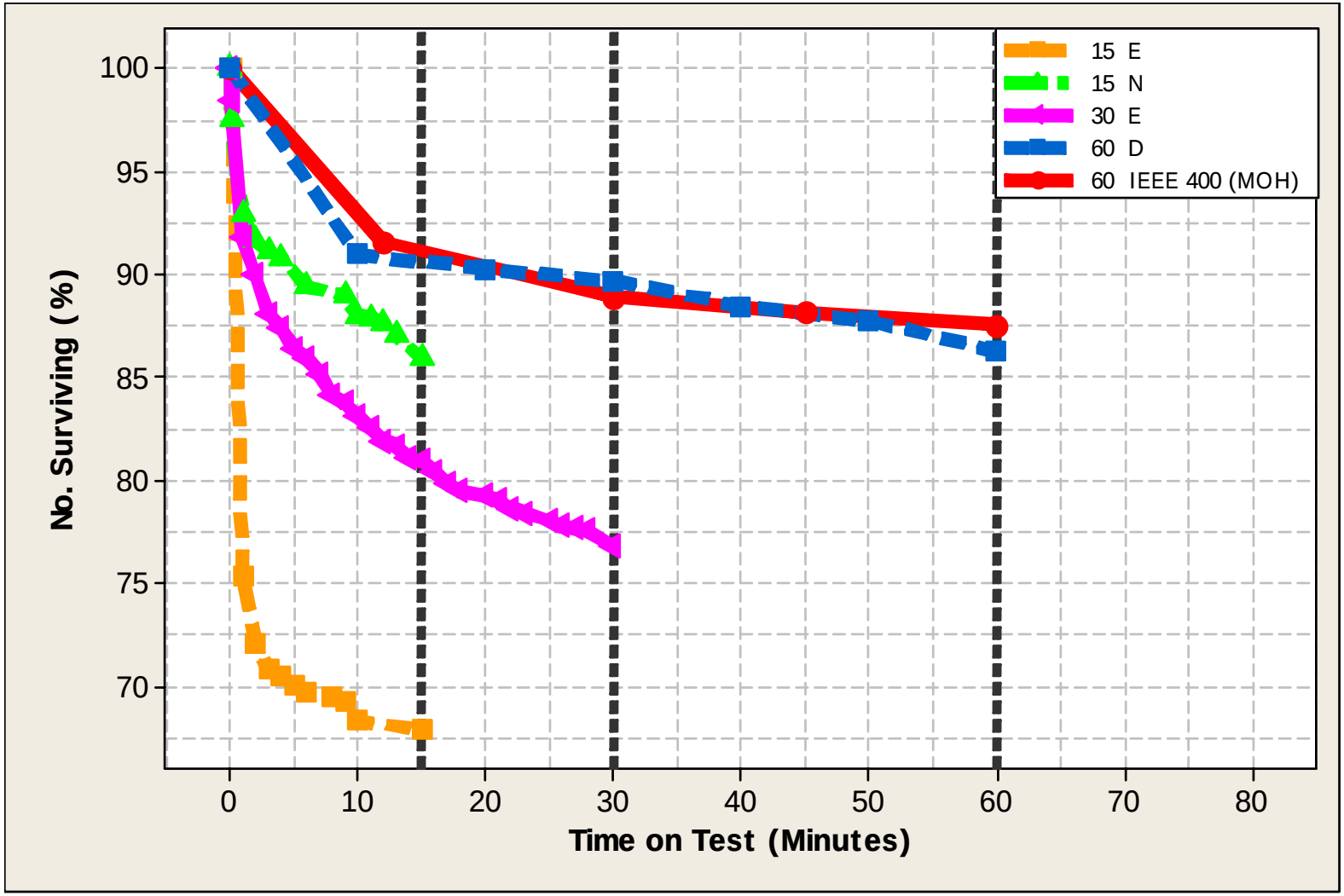
Times 2


100
95
90
85
80
75
70
No. Surviving (%)
Moh IEEE400
0
10
20
30
40
50
60
70
80
Time on Test (Minutes)

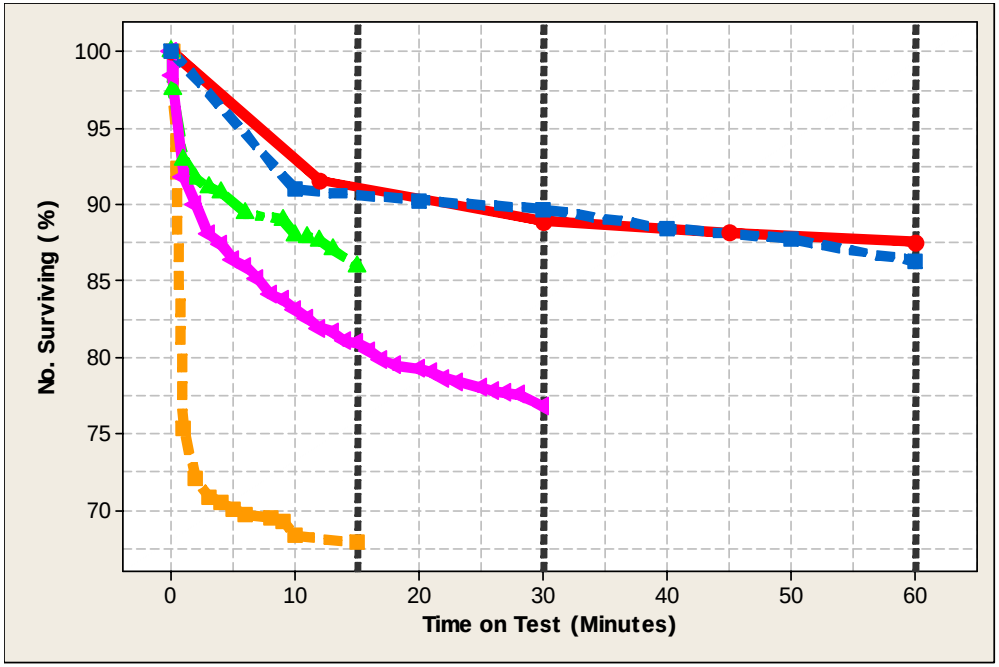
Times 2


No. Surviving (%)
100
95
90
85
80
75
70
0
10
20
30
40
50
60
70
80
Time on Test (Minutes)

Times 2


15 E
15 N
30 E
60 D
60 IEEE 400 (MOH)
No. Surviving (%)
100
95
90
85
80
75
70
0
10
20
30
40
50
60
70
80
Time on Test (Minutes)

This leaves a number of issues



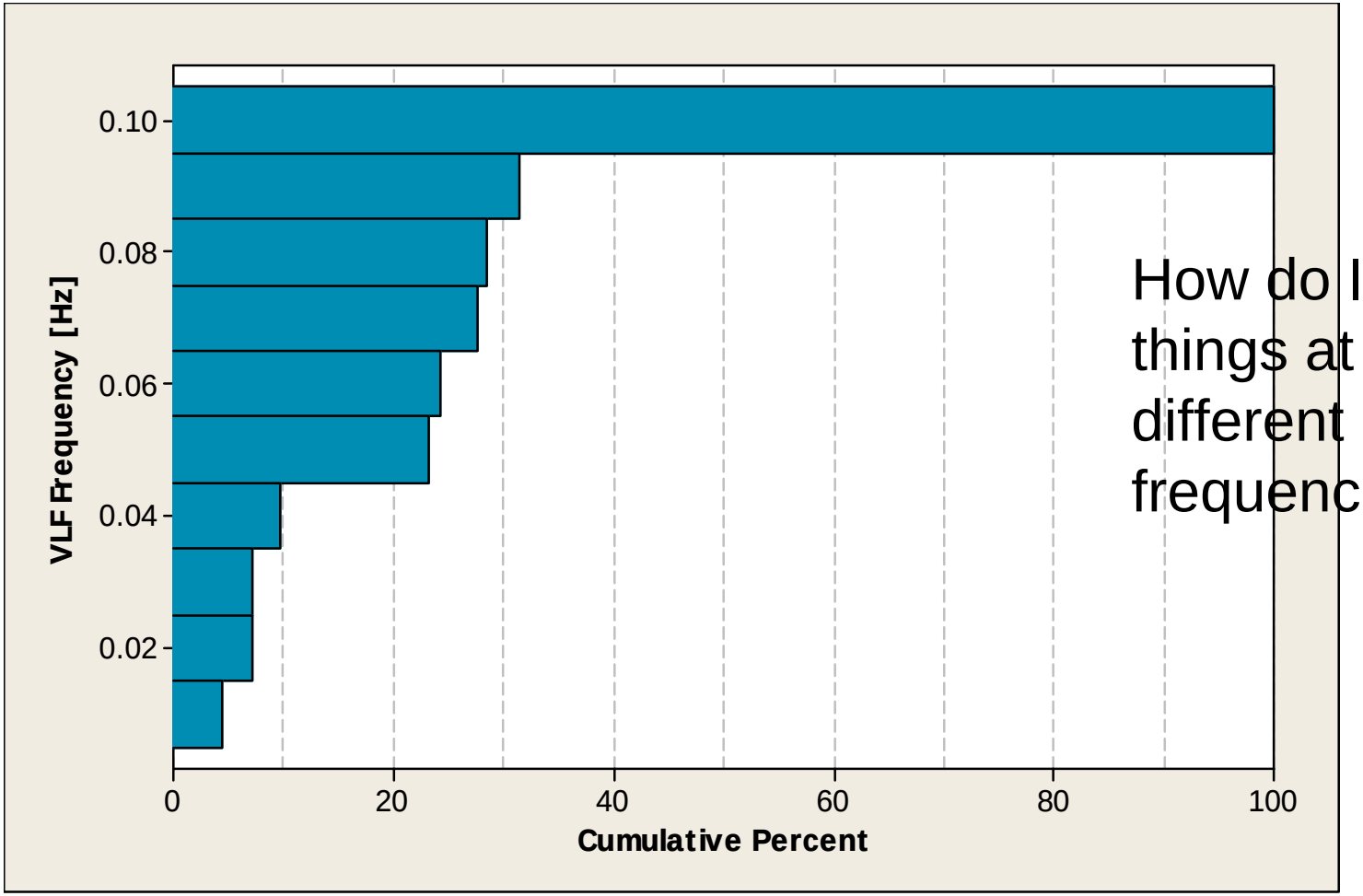
Much of the recommendation is supported by the data set of Moh.

- Perhaps 60 mins is not long enough if you want to be exceptionally cautious?
- 15 mins is certainly too short.
- If you use time between 15 & 60 mins then you need to be very aware of the risks

The attrition in these data is very different from that in the US. Are we comfortable in basing recommendations on a single & very different data set??

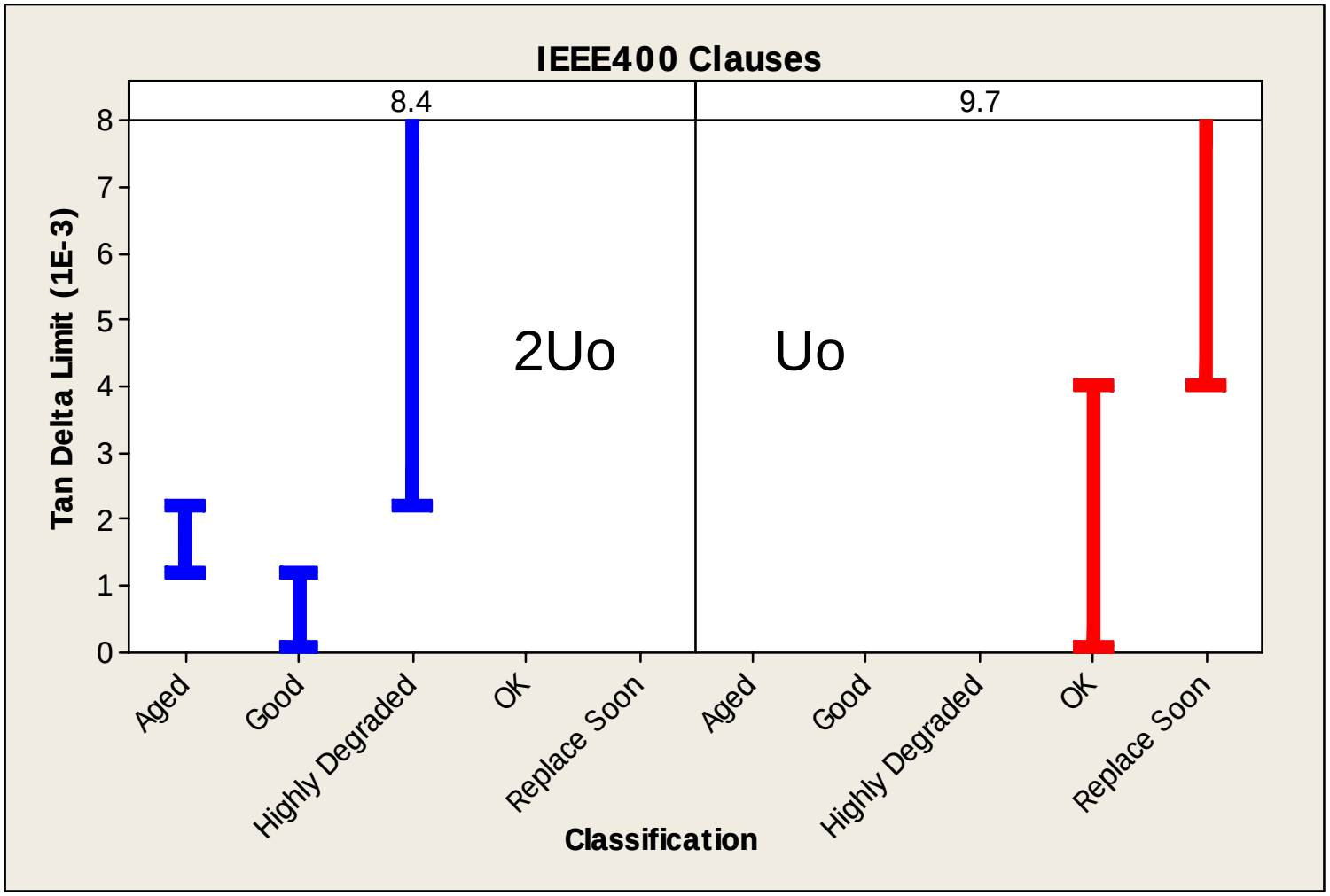
Times 4

Times are not clear



How do I change things at different frequencies?

Confusion with the “Odd Couple”



Source and Specificy

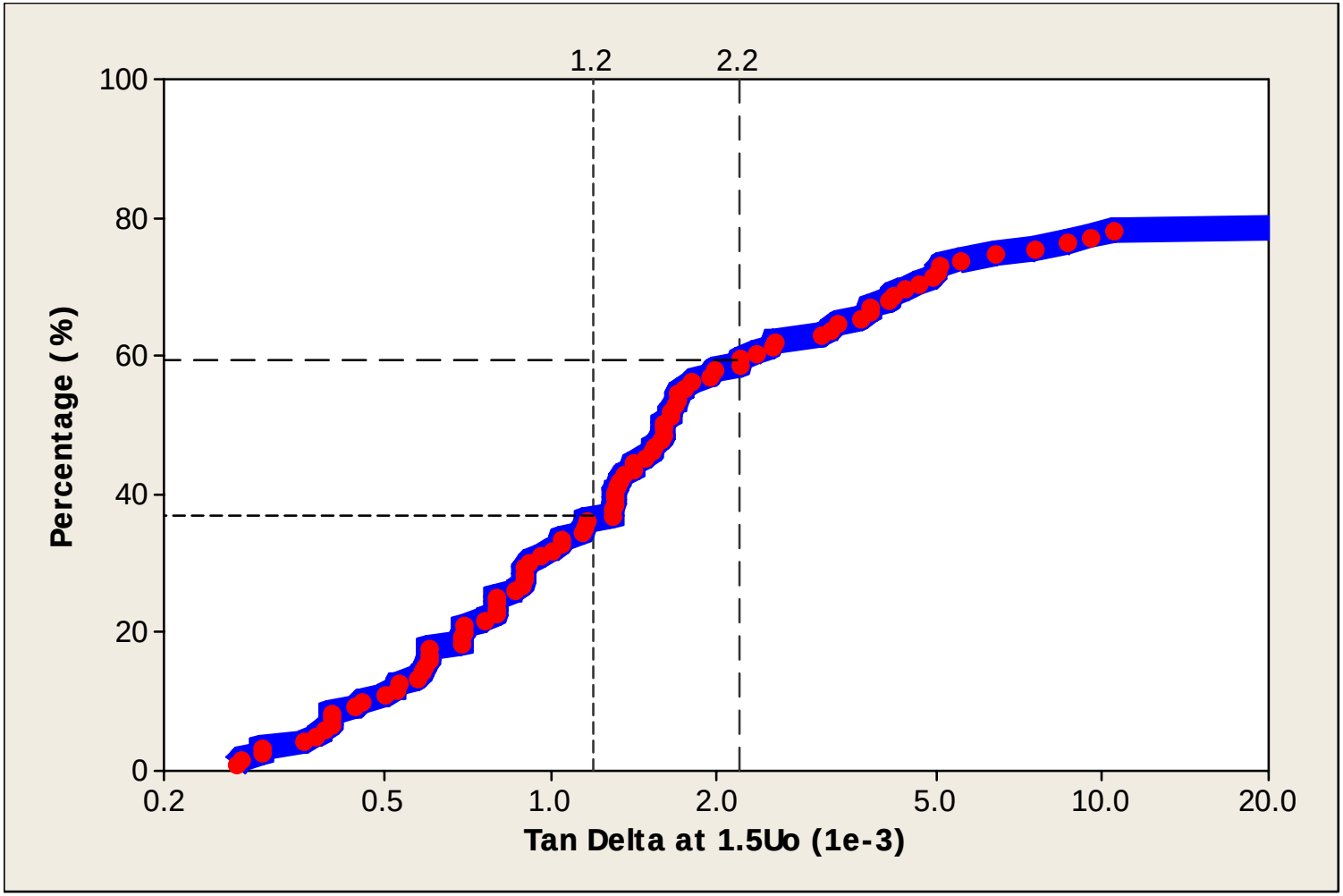
Table 2—Table of criterion

Tan δ at $2V_o$	Differential of Tan δ tan δ $2V_o$ – tan δV_o	Assessment
Less than 1.2×10^{-3}	Less than 0.6×10^{-3}	Good
Greater than or = 1.2×10^{-3}	Greater than or = 0.6×10^{-3}	Aged
Greater than or = 2.2×10^{-3}	Greater than or = 1.0×10^{-3}	Highly degraded
NOTE—It has been found that copolymer dielectric materials such as TR-XLPE or silicon fluid-treated insulations exhibit different tan δ characteristics; therefore, other criteria are valid.		

Table from IEEE400

Where do these come from?
How do I know that they are appropriate?
What do I use for HMWPE, TRXLPE, PILC, EPR?
Are they correct?

Source and Specificy



Are they correct?

What are the Risks?

- What is the Risk associated with Voltages and Times when using Diagnostic Mode? – too much

- What are the Risks in withstand? – not enough

What is the route for a Low Impact approach?

- Most comprehensive Criteria are at Uo & 2Uo
- What guidance is there for lower voltage approaches?