

Integrated Visible Break Switch Discussion

Report to RODE Spring 2017 meeting



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Background:

The intent of the task force is to generate a definition, intent and testing scheme which will be included in relevant equipment standards as needed.

The task force recommends keeping the definition and intent together to avoid misunderstandings.

The standards listed in the tables below for the various tests are for reference only. Other applicable relevant standards can be referenced based on application.

Definition:

Visible Break - An insulating gap between conductors that can be visually verified.

Intent:

The intent of a visible break is to allow workers to see an insulating gap in the conducting path, typically between an energized source and a de-energized load, before grounding the line and beginning work on the de-energized circuit. The visual aspect of a visible break is important because it gives greater confidence that a circuit has been isolated than a secondary indication mechanism (for example, a mechanical or electrical position indicator) which indicates the position of a concealed interrupter. Establishment of a visible break is often the first line of defense against unintended energization of a de-energized conductor.

In order to achieve this intent, a visible break should withstand some level of steady-state and transient voltage. The dielectric ratings of a visible break are typically coordinated with the ratings of the associated switchgear in one of two ways. First, a visible break may provide an insulating distance which is coordinated with the line-to-ground insulation such that a flashover will likely occur across other insulating media in the gear and not across the visible break. Second, the dielectric rating of the visible break may be equal to the rating of the switchgear. In all cases, the line would not be considered de-energized unless it is grounded in addition to the visible break.

In the special case of an integrated visible break (without phase barriers), users should note that the integrity of a visible break inside a piece of gear could be compromised in the event of an internal flashover of that gear. This is because in many types of switchgear, if a line-to-ground flashover occurs even with a good dielectric in the tank, it often migrates to all phases and could easily compromise the visible break. This possibility accentuates the need to properly ground the de-energized line prior to work being performed.

Draft Testing:

Table 1: Applicable testing for integrated visible break systems developed by the task force

Line No.	Test	Notes	Reference Standard (for RODE only)
1	Dielectrics (BIL, Power frequency withstand, DC withstand and Partial discharge)	If integrated, the visible break dielectrics can be rated together with the main interrupter. If insulation coordination is required, refer to the relevant equipment standard. (e.g. IEC 62271-1)	IEEE C37.74-2014
2	Contact resistance (Circuit resistance)		IEEE C37.74-2014
3	Temperature rise		IEEE C37.74-2014
4	Short time current withstand		IEEE C37.74-2014
5	Peak current withstand		IEEE C37.74-2014
6	Interlocking (as part of mechanical endurance)	Only applicable if the visible break does not have load breaking capability.	IEC 62271-102
7	Mechanical endurance	How many operations? IEC says 5 for interlocked devices, 1,000 for general disconnectors	IEEE C37.74-2014
8	Extreme temperature	Functional mechanical tests at temperature extremes.	

Standards referenced for testing requirements:

- **IEEE 37.74 – 2014: Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV**
- **IEC 62271-102 – 2013: High-Voltage Switchgear and Controlgear – Alternating current disconnectors and earthing switches.**
- **IEC 62271- 201 – 2012: High-voltage switchgear and controlgear –AC solid insulated enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV**

Other Considerations:

1. What are the visibility requirements of the view port and applicable testing?
2. How many operations will suffice for mechanical endurance of the disconnect switch in an integrated system?
3. Should the visibility of the gap be considered (example: should both contact of the disconnect switch be visible)?
4. If the main interrupter (such as vacuum interrupter) in an integrated system fails, what should the dielectric requirements of the disconnect switch (visible break) be? Example: should it be able to withstand 110% system voltage for at least 15 minutes (indefinitely)?

ANNEX

Table 2: IEC 62271-102 testing protocol also referencing IEC 60694 reviewed by the task force in creating table 1

Line No.	Test	Notes	Section of IEC 62271-102:2003
1	Dielectrics (BIL, Power frequency withstand and DC withstand partial discharge)	Applicable. Test to IEEE C37.74. There are portions that differ from IEEE standard because of the outdoor applications covered in the standard	6.2
2	Radio interference voltage (riv)	Not applicable. RIV applies to controlgear rated 123kV and above. Refer to relevant IEC standard.	6.3
3	Measurement of Contact resistance	Applicable. Test to IEEE C37.74. Made for a comparison between switchgear types. Also made during temperature rise test.	6.4
4	Temperature rise	Applicable. Test to IEEE C37.74.	6.5
5	Short time withstand current and Peak withstand current	Applicable. Test to IEEE C37.74.	6.6
6	Verification of protection	Not applicable – covered by relevant apparatus standard. Impact testing of enclosure	6.7
7	Tightness	Not applicable – covered by relevant apparatus standard. Verification of acceptable leakage rate. Applicable of visible break is part of a sealed system.	6.8
8	Electromagnetic compatibility	Not applicable.	6.9
9	Test to prove the short-circuit making performance of earthing switches	Not applicable to visible break disconnectors	6.101
10	Operating and mechanical endurance tests	Terminal loading test is not applicable to integrated disconnectors Mechanical endurance tests applicable - 5 operations to check function of interlocks	E.6.102.3
11	Operation at the temperature limits	Not applicable? Three operating cycles each at min and max ambient temp	E.6.104
12	Bus-charging switching tests	Not applicable	E.6.108
13	Pressure withstand test for enclosures	Not applicable – covered by relevant apparatus standard.	E.6.109
14	Test under conditions of arcing due to an internal fault	Not applicable?	E.6.110

Table 3: IEC 62271-201 testing protocol also referencing IEC 60694 reviewed by the task force in creating table 1

Line No.	Test	Notes	Section of IEC 62271-102:2003
1	Dielectrics (BIL, Power frequency withstand and DC withstand partial discharge)	Applicable. Test to IEEE C37.74. There are portions that differ from IEEE standard because of the outdoor applications covered in the standard	6.2
2	Radio interference voltage (riv)	Not applicable. RIV applies to controlgear rated 123kV and above. Refer to relevant IEC standard.	6.3
3	Measurement of Contact resistance	Applicable. Test to IEEE C37.74. Made for a comparison between switchgear types. Also made during temperature rise test.	6.4
4	Temperature rise	Applicable. Test to IEEE C37.74.	6.5
5	Short time withstand current and Peak withstand current	Applicable. Test to IEEE C37.74.	6.6
6	Verification of protection	Not applicable – covered by relevant apparatus standard. Impact testing of enclosure	6.7
7	Tightness	Not applicable – covered by relevant apparatus standard. Verification of acceptable leakage rate. Applicable of visible break is part of a sealed system.	6.8
8	Electromagnetic compatibility	Not applicable.	6.9
9	Test to prove the short-circuit making performance of earthing switches	Not applicable to visible break disconnectors	6.101
10	Operating and mechanical endurance tests	Terminal loading test is not applicable to integrated disconnectors Mechanical endurance tests applicable - 5 operations to check function of interlocks	E.6.102.3
11	Interlocks	- 25 attempts to open any interlocked door or cover; - 50 attempts to access or engage the operation interface, when access or engagement is prevented due to an interlocking device (shutter, selector lever, etc.); - 50 attempts to operate the switching devices manually, when the operation interface is accessible; - 10 attempts to operate the switching device manually in the wrong direction shall be - carried out in addition to, but anywhere in, the above sequence of 50 attempts; - 25 attempts to insert and 25 attempts to withdraw the removable parts.	E.6.102.2
12	Operation at the temperature	Not applicable? Three operating cycles	E.6.104

	limits	each at min and max ambient temp	
13	Bus-charging switching tests	Not applicable	E.6.108
14	Pressure withstand test for enclosures	Not applicable – covered by relevant apparatus standard.	E.6.109
15	Test under conditions of arcing due to an internal fault	Not applicable?	E.6.110