TECHNICAL NOTE

Type C arc-resistant construction
How does this benefit me?

We are often asked what additional benefits Type C construction provides to the customer. This is usually followed directly with the additional question: Can't we work in one frame of switchgear with the other frames still energized if we have type C switchgear?

To properly answer these questions, we need to first understand the definition of, application of and intended use of arc-resistant switchgear.

Arc-resistant medium voltage metal-clad switchgear is tested to the requirements set forth in the ANSI/IEEE C37.20.7 testing guide. It is important to note that this is a guide and not a standard and therefore will not define design or construction requirements, but only defines the performance and testing requirements for the equipment to be qualified as arc-resistant switchgear.

Qualifications to this guide are only applicable to arcing faults occurring entirely in air within the enclosure when the doors and covers are secured in accordance with the rated accessibility type and does not apply to arcing faults that occur within components of the switchgear, such as instrument transformers, sealed interrupting devices, surge arresters, fuses and so on.

The intended use of switchgear that is qualified to the C37.20.7 guide is to provide an additional degree of protection to the personnel performing normal operating duties near the switchgear while it is within normal operating conditions as defined by the guide. The guide defines normal operating conditions and duties related to operating the switchgear throughout many clauses within the guide.

The normal operating condition of the switchgear is with all enclosure doors and/or covers properly installed and all breakers and auxiliary units in either the disconnect or connect position. When type 2B construction is provided, the low voltage compartment door can be open.

[1]IEEE C37.20.7-2017 – IEEE Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults
[2]Ref. C37.20.7-2017, clause 1.2.2 and 5.4.2

Normal operating duties include operations such as opening or closing of breakers or switching devices, connecting and disconnecting of withdrawable units, e.g. racking breakers in and out with doors closed, reading of measuring instruments and monitoring equipment and similar activities that do not require opening doors or removing cover plates.

Removing or replacing active primary components such as breakers or fuses, or any other primary component and activities required to carry out maintenance work are not considered normal operations or duties. When compartment doors, other than low voltage compartment doors for type 2B accessibility, or barriers and cover plates are removed, the equipment is no longer qualified by the testing guide.

Access areas above or below the switchgear are not included in the additional degree of protection either. Some examples of installation conditions or activities that are not covered by this guide include, but are not limited to:

1. Personnel on top of or above the switchgear, such as during maintenance or cleaning
2. Personnel on ladders, catwalks or other structures that elevates them above the base level of the switchgear
3. Switchgear installed on an open grating
4. Cable vaults below the switchgear – especially those that are sized sufficiently enough for personnel access.

So where are personnel protected when performing normal operations and duties on switchgear that is qualified to the IEEE C37.20.7 guide? These areas are defined as Accessibility Types, which are defined in section 4.2 of the guide. There are two types of accessibility defined. These levels correspond directly to the burn indicator placement.

> **Type 1** - Switchgear with arc-resistant designs or features at the freely accessible front of the equipment only
>
> **Type 2** - Switchgear with arc-resistant designs or features at the freely accessible exterior (front, back, and sides) of the equipment only

Accessibility is further defined using suffixes as found in Annex C of the guide. These suffixes define additional performance features beyond that of the Type designations. The suffixes are:

> **Accessibility Suffix A –** This is the base rating. It indicates the equipment has met the requirements of the Type assigned with no additional performance features. The inclusion of A in the designation is not necessary. So, an accessibility type 1A is the same as type 1.
>
> **Accessibility Suffix B –** This suffix is applicable to any equipment that has a designated compartment for low voltage control or instrumentation. The guide requires that arc fault testing be performed with the LV compartment door opened or removed and cotton indicators placed 4 inches from the opening of the LV compartment. Equipment is considered to be qualified to

this suffix if arc faults within compartments adjacent to the LV compartment do not ignite the indicators and meet all additional performance requirements set by the standard. Based on this, it is clear to see that personnel protection is provided for those who are 4 inches or further from the opening only. Personnel accessing the interior of the LV compartment are not offered the additional degree of protection by suffix B.

Per clause C.2.2, the application of suffix B does not imply that working on energized equipment is safe, nor does it imply that the equipment may be continuously operated with the LV doors opened or removed. Also, this suffix does not apply to doors, covers, or panels for any primary circuit component. The equipment cannot maintain its intended degree of protection if such doors are opened or covers or panels are removed, or latches or fasteners improperly secured.

Accessibility Suffix C - is designated for equipment where isolation from the effects of an internal arcing fault is desired between all adjacent compartments within a switchgear assembly. It does not imply that the equipment may be operated with doors, covers, or panels opened or removed and maintain its intended degree of protection.

The suffix C feature is only applicable to equipment manufactured to the IEEE C37.20.2 metal-clad switchgear standard as this equipment is compartmentalized.

Equipment qualified to suffix C may also be qualified for suffix B, but only if the testing was performed with the LV door either opened or removed and cotton indicators placed as required by the guide.

The use of a combined suffixes, such as 2BC is acceptable per the testing guide if the equipment is qualified for both suffixes.

This suffix does not provide any additional degree of protection to personnel than what is provided by the Type 2 performance. It is not intended for personnel protection but may improve equipment survivability when applied with electrical protection devices that are properly coordinated with the ratings of the switchgear.

Accessibility Suffix D – is applicable to equipment specifically designed for installation where there is restricted access to specific sides or surfaces created by the installation. The equipment cannot exhaust gases into an area designated by the Accessibility Type 2 requirements. ABB does not offer equipment with suffix D so we will not venture further into the definition of this suffix.

ABB currently offers only Accessibility Types 2, 2B and 2BC for the SafeGear product, and only Types 2 and 2B for the SafeGear HD product.

There are other aspects to arc-resistant switchgear, such as the arc duration, which can influence the application of the equipment. These will be the subject of other documents.

Users, specifiers and operators are encouraged to read and understand the application guide in Annex B. This annex addresses important topics such as physical considerations, electrical considerations, installation of the switchgear, site conditions, outdoor installations, clearances for venting and many others.

Summary

As clearly defined in the IEEE C37.20.7 arc fault testing guide, equipment that is under maintenance where a door or panel is removed for access is no longer qualified to the arc-resistant test guide. There is no condition where the guide infers that personnel have any additional degree of protection when working within the switchgear. In fact, there are several other results of arcing faults that can cause injury to personnel besides burns, such as projectiles, pressure waves, damaging sound levels and toxic fumes. Both the testing guide and ABB highly recommend that personnel do not work on energized equipment. In short, Accessibility Suffix C does not provide any additional personnel protection.

However, when the electrical protection and control is properly coordinated with the switchgear ratings, and the switchgear is qualified to Type 2BC or 2C accessibility ratings, there can be an additional degree of protection to equipment located within adjacent compartments, specifically in the manner of preventing heat damage or the prevention of secondary arcing faults within the equipment. This could result in less damage, less downtime and lower repair costs should an arcing fault occur. The use of active arc mitigation systems can also reduce the incident energy levels which can result in further reductions of damage, downtime and repair costs.

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