



C2/113

**Homologation procedure for HV switchgear
according to the technical prescription C2/112**

Part 7

Internal arc withstand and associated AA categories of HV switchgear

Edition 2 (03.2024)

Version management

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1 Object and scope

Several AAxx categories of switchgear are defined, corresponding to different levels of behavior in case of an internal arc and probability of occurrence of an internal arc.

The purpose of this document is to define the criteria by which an internal arc category AAxx can be assigned to switchgear

The Applicant for the homologation of switchgear shall consult, prior to the pre-classification stage, this document to determine the category of the switchgear he applies for.

The methodology described in this document (process flow) shall also be used by the Synergrid reviewer.

2 General

Every assembly shall be metal-enclosed and conform to EN 62271-200¹.

In derogation from the EN 62271-200, for the Belgian market:

- All external connections (e.g. external busbars), are considered to be part of the switchgear and shall be included in the metal enclosure. The distance between two adjacent above-mentioned metal-enclosures shall never exceed 12.5 mm.
- a component containing active parts of the 3 phases in a single volume and included in the metallic enclosure is considered as an HV compartment. Such components shall also be assigned an internal arc classification (IAC).

The AA category shall be assigned by Synergrid based on the criteria defined here after.

The categories listed below can be assigned:

- AA10
- AA11
- AA13
- AA15
- AA20
- AA30
- AA31
- AA33

The flow charts hereafter allow to assign the AAxx category based on a number of questions.

The drawings or examples illustrate the principle of the gas exhaust path. Hence, they are not restricting the design of the HV switchgear to achieve the gas evacuation requirements.

¹ Please contact Synergrid in case of solid-insulation enclosed switchgear according to EN 62271-201

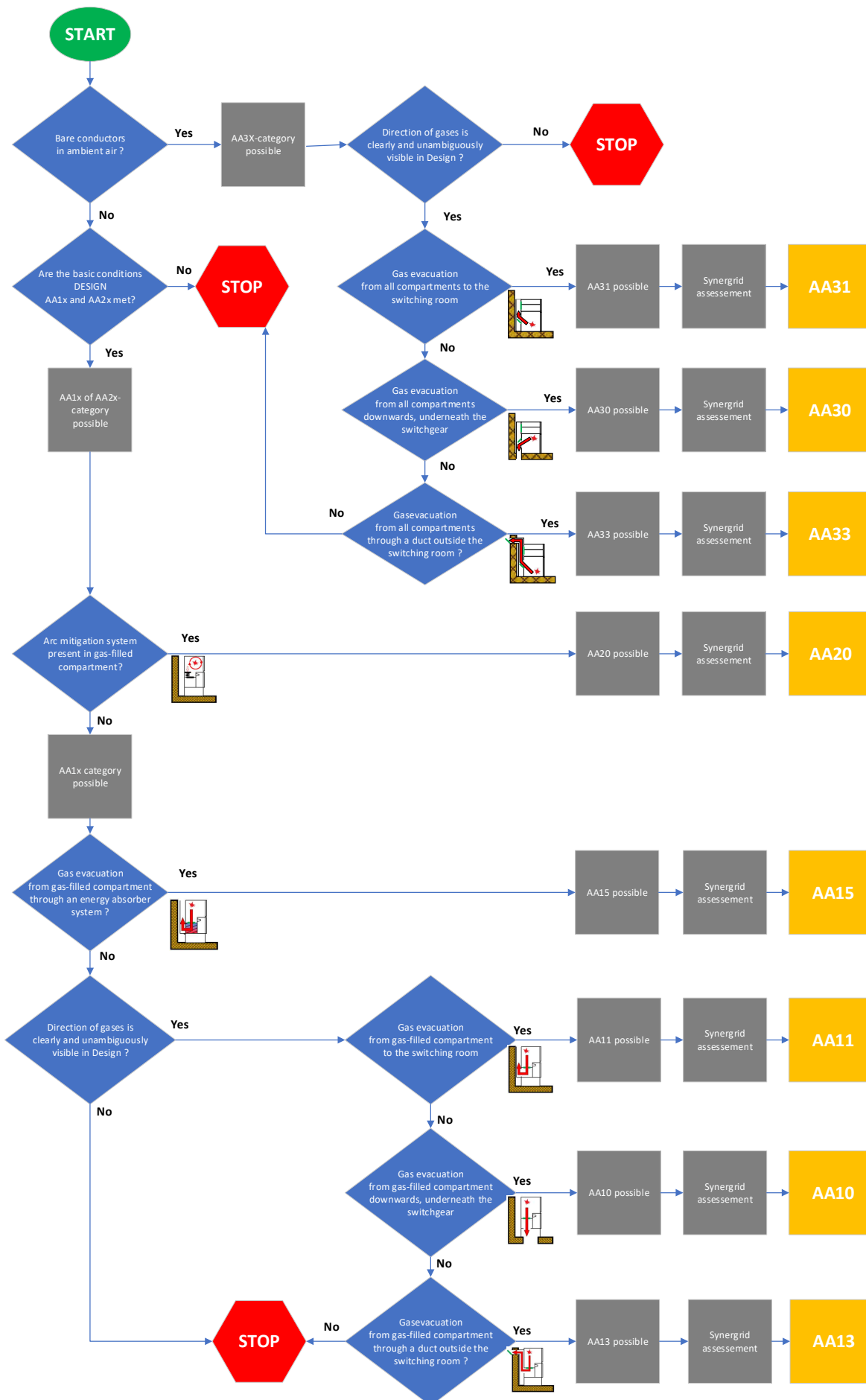


Figure 1: Flowchart for the assignment of an AA category of the switchgear

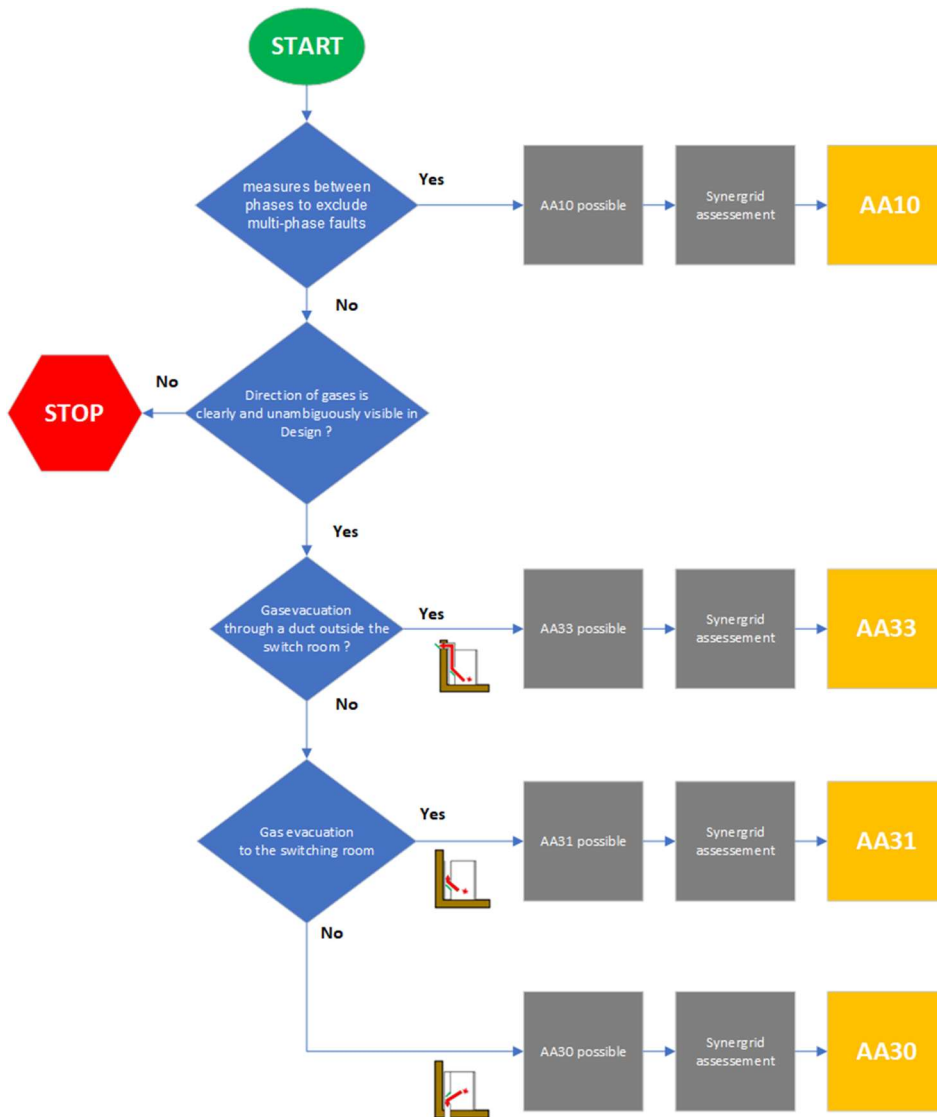


Figure 2: Flowchart for the assignment of an AA category of the HV metering functional units

3 AA1x and AA2x categories

3.1 Common criteria for AA1x and AA2x category

This switchgear shall be designed to minimize the probability of occurrence and/or the severity of the effects of an internal arc.

All active HV-parts of the switchgear shall be protected in a way that they cannot be influenced by service conditions:

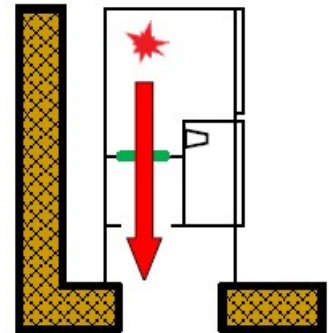
- Switching devices and all unscreened active HV-parts shall be enclosed in a sealed pressurised gas-filled compartment equipped with a pressure relief device, except for the fuse canisters and HV metering compartment.
- The dielectric withstand ability of the insulating gas can be checked in service. The control device shall not be influenced by ambient conditions (e.g. temperature)
- The design of the insulation system of the assembly including the busbar connections, and of the cable connection system shall be such that neither a breakthrough in one solid insulation nor a disruptive discharge in self-restoring insulation can generate a fault between phases in ambient air (outside of the sealed pressure system). A single-phase internal arc fault will not lead to a multiphase fault.
- The fuse canisters consist of single-phase insulating tubes and their design ensures the full insulation level withstand in each single phase.

Raising baseframes shall be designed and supplied by the switchgear manufacturer. They shall be available and cover all dimensions corresponding to the range of blocs of FU's within a switchgear family.

3.2 AA10 category: minimized risk switchgear with gas evacuation downwards with an arc in the gas-filled compartment

Switchgear AA10 shall comply with the following **additional** criteria:

- The hot gases resulting from an internal arc in the sealed pressure gas-filled compartment shall expand downwards, underneath the switchgear:
 - The design of the switchgear shall prevent the hot gases from evacuating directly in the room.
 - Every duct, possible present raising base frame AA10-R or other compartment part of the gas evacuation path shall withstand the overpressure due to the internal arc. Their design prevents the hot gases resulting from an internal arc in the sealed pressurised gas-filled compartment evacuating directly into the switching room.

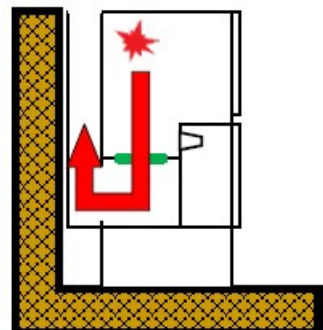


Baseframes, alone constituting the gas expansion volume under the switchgear in case of an arc in the sealed pressurised gas-filled compartment, fitted with an opening to the switching room (old AA10-B), are not allowed.

3.3 AA11 category: minimized risk switchgear with gas evacuation in the switching room with an arc in the gas-filled compartment

Switchgear AA11 shall comply with the following **additional** criteria :

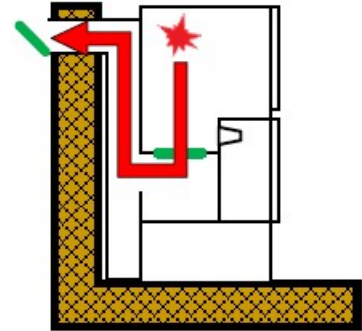
- The hot gases resulting from an internal arc in the sealed pressure gas-filled compartment shall only expand upwards through a chimney directly into the switching room. This evacuation chimney is part of the switchgear:
 - The design of the switchgear shall prevent the hot gases from evacuating by another way than the chimney.
 - Every duct, possible present raising base frame AA11-R or other compartment part of the gas evacuation path shall withstand the overpressure due to the internal arc. Their design prevents the hot gases resulting from an internal arc in the sealed pressurised gas-filled compartment to evacuate by another way than the chimney to the switching room.



3.4 **AA13 category: minimized risk switchgear with gas evacuation duct out of the switching room with an arc in the gas-filled compartment**

Switchgear AA13 shall comply with the following **additional** criteria :

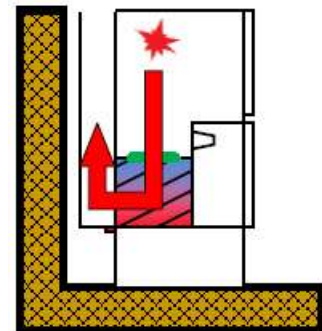
- The hot gases resulting from an internal arc in the sealed pressurised gas-filled compartment shall be evacuated only towards an evacuation duct leading them out of the switching room.
- The gas evacuation duct shall comprise an end element equipped with a pressure relief device, evacuating the gases due to an internal arc fault out of the room. The pressure relief device shall be closed in normal service.
- The switchgear, the gas evacuation duct and the accessories involved in the evacuation path of the hot gases (duct, possible present raising base frame AA13-R), shall be designed by the switchgear manufacturer and shall be integral part of the switchgear. They shall:
 - prevent gas exhaust through other ways than the evacuation duct,
 - not negatively impact the internal arc withstand of the switchgear.



3.5 **AA15 category: minimized risk switchgear with energy absorption with an arc in the gas-filled compartment**

Switchgear AA15 shall comply with the following **additional** criteria :

- It is equipped with an energy absorber.
- The hot gases resulting from an internal arc in the sealed pressure gas-filled compartment are first cooled by the energy absorber integrated in the switchgear. Thereafter, they will expand upwards at the rear of the switchgear in the switching room. The switchgear, the energy absorber and all the accessories involved in the evacuation path of the hot gases, shall be designed by the switchgear manufacturer and shall be part of the switchgear. They shall prevent gas evacuation through other ways than through the exit of the energy absorption system.



Energy absorbing base frames type AA15-A

A baseframe including the energy absorbing device is acceptable. It shall be treated as part of the switchgear.

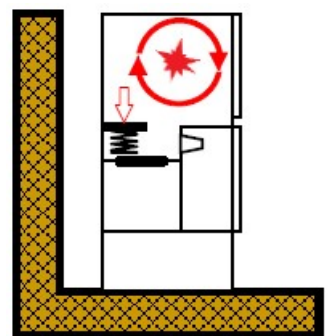
Raising base frames type AA15-R

AA15-R raising baseframes cannot be involved in the evacuation path of the hot gases resulting from an internal arc in the sealed pressure gas-filled compartment.

3.6 **AA20 category: minimized risk switchgear without external phenomena with an arc in the gas-filled compartment**

Switchgear AA20 shall comply with the following **additional** criteria:

- It is at least equipped with arc mitigation systems in the gas-filled compartment
- In case of an arc in the gas-filled compartment, the arc is detected and automatically suppressed by means of galvanic short-circuiting and earthing all possible sources of supply. This is done:
 - without the need of auxiliary power-supply,
 - regardless of the infeed,
 - regardless of the value of the arc fault current, limited to the maximum rated value I_A
 - regardless of the position of any switch.
- The hot gases resulting from an arc in the gas-filled compartment remain inside the sealed pressurised gas-filled compartment in which the arc ignited itself (the pressure relief device of the sealed pressurised gas-filled compartment does not open).
- The switchgear AA20 shall be equipped with a local indicator and a device for remote signalling of operation of the arc mitigation system



- The arc detecting and suppressing device is integrally part of the switchgear and designed by the switchgear manufacturer.

3.7 HV metering functional units AA10 category

The general requirements mentioned in §3.1 are applicable, with the following additional criteria:

- The design of the insulation system of the assembly and of the cable connection system shall be such that neither a breakthrough in one solid insulation nor a disruptive discharge in self-restoring insulation can generate a fault between phases in ambient air. A single-phase internal arc fault shall not lead to a multiphase fault.
- If the metering function comprises HV compartments other than the HV metering compartment, those compartments shall fulfill the requirements of the AA10 category.

4 AA3x Categories

4.1 Common criteria for AA3x category

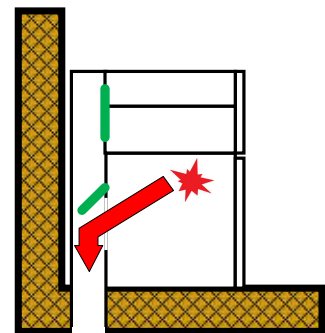
This switchgear shall be designed to limit the probability of occurrence and/or the severity of an internal arc:

- The design of the insulation system of the assembly including the busbar connections, and of the cable connection system is such that a breakthrough in one solid insulation or a disruptive discharge in ambient air can generate a fault between phases.
- The switchgear shall be equipped with pressure relief devices in every compartment, including the possible sealed pressure gas filled HV component(s) with the 3 phases in one single volume. These pressure relief devices open in order to limit the overpressure in the switchgear in case of an internal arc. They only open in the direction of the gas flow (out of the compartment in which the arc can occur).
- In presence of (a) sealed pressurised gas filled HV component(s), the dielectric withstand ability of the insulating gas can be checked in service. The control device shall not be influenced by ambient conditions (e.g. temperature)

4.2 AA30 category: limited risk switchgear with gas evacuation downwards

Switchgear AA30 shall comply with the following **additional** criteria:

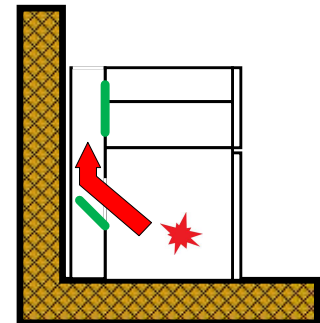
- The hot gases resulting from an internal arc in any compartment shall expand downwards, underneath the switchgear:
 - The design of the switchgear shall prevent the hot gases from evacuating to expand, directly in the room
 - Every duct or accessory part of the gas evacuation path shall be designed by the switchgear manufacturer and shall be integral part of the switchgear. They shall withstand the overpressure. Their design prevents the hot gases resulting from the internal arc in any compartment evacuating directly into the switching room.



4.3 AA31 category: limited risk switchgear with gas evacuation upwards in the room

Switchgear AA31 shall comply with the following **additional** criteria:

- The hot gases resulting from an internal arc in any compartment shall only expand upwards through a rear chimney directly into the switching room. This evacuation chimney is part of the switchgear.
- Every duct or accessory part of the gas evacuation path shall be designed by the switchgear manufacturer and shall be integral part of the switchgear. They shall withstand the overpressure. The design shall prevent the hot gases from evacuating by another way than the rear chimney.



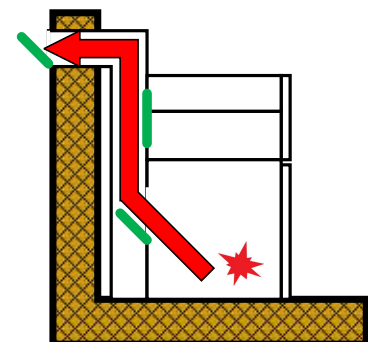
4.4 AA33 category: limited risk switchgear with gas evacuation duct out of the room

Switchgear AA33 shall comply with the following **additional** criteria:

- The hot gases resulting from an internal arc in any compartment shall be evacuated only towards an evacuation duct leading them out of the switching room.
- The gas evacuation duct shall comprise an end element equipped with a pressure relief device, evacuating the gases due to an internal arc fault out of the room. The pressure relief device shall be closed in normal service
- The switchgear, the gas evacuation duct and the accessories possibly involved in the evacuation path of the hot gases, shall be designed by the switchgear manufacturer and shall be integral part of the switchgear,

They shall:

- prevent gas exhaust through other ways than the evacuation duct,
- not negatively impact the internal arc withstand of the switchgear



4.5 HV metering functional units AA3x category

The HV metering function with an internal category AA3x shall fulfill the requirements for this category of switchgear.