

TechTopics No. 106

Arc-resistant equipment – exit of exhaust plenum from buildings

There are specific requirements for exhaust of gases produced during an internal arcing event that occurs in arc-resistant switchgear or controllers. These requirements are primarily imposed by the requirements of IEEE Std. C37.20.7, and the conditions of testing established in that standard. Our published selection and application guides, and instruction manuals, together with the drawings for a specific order, provide an overview of the requirements.

When an arcing event occurs inside electrical equipment, the arc produces extremely high temperatures, of the order of 20,000 K at the arc terminals. This high temperature is sufficient to vaporize materials in the vicinity of the arc, including steel, copper, aluminum, as well as insulating materials.

The hot vapor produced by the arcing event combines with the oxygen in the air, producing various metal-oxides. As these metal-oxides are expelled from the vicinity of the arc, they cool and become minute particles in the air. These materials appear as black smoke for copper and iron, and gray smoke for aluminum. These materials should be considered as hazardous and personnel should not be allowed in the area without special filtered breathing apparatus, as well as other appropriate personal protective equipment (PPE).

For these reasons, Siemens strongly recommends that the gases from an internal arcing event not be exhausted into an area in which personnel may be present, and further recommends that gases be exhausted to the outside environment and not to the inside of the building or enclosure housing the switchgear.

Figure 1: Typical horizontal exhaust plenum (duct) arrangement

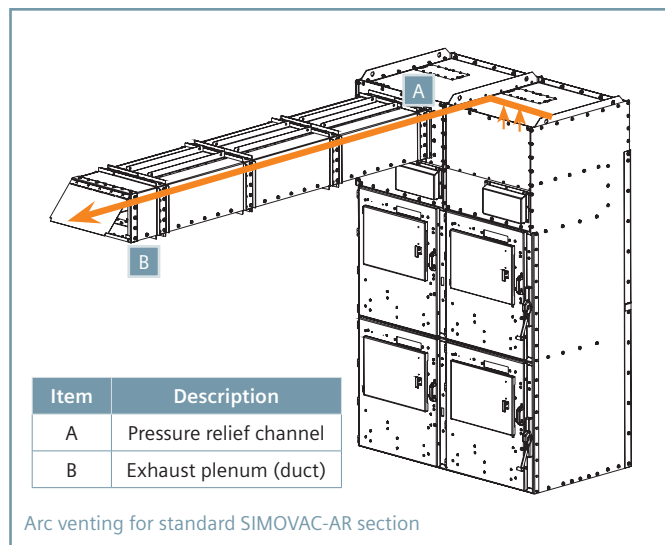


Figure 2: Exhaust area requirements

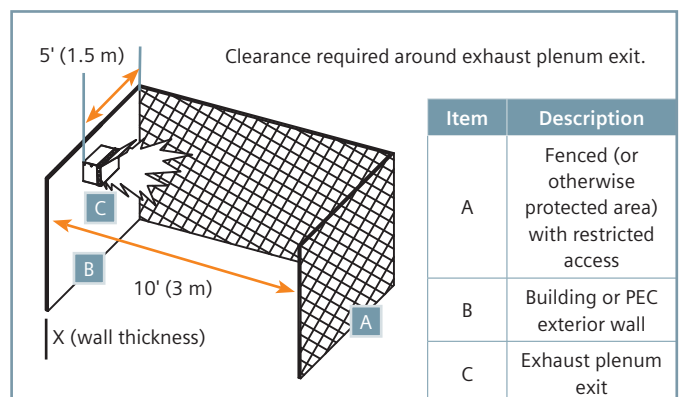


Figure 1 shows a typical exhaust system arrangement for SIMOVAC-AR arc-resistant, medium-voltage controllers, where the exhaust plenum extends horizontally from the front of the equipment. The exhaust plenum exits horizontally from the equipment, is routed through the interior space of the building or Power Equipment Center (PEC), and exits the building or PEC through an exterior wall (not shown) where the exhaust gases and arcing by-products are vented to the outside environment. In addition to allowing exhaust from the Pressure Relief Channel (PRC) in any of the four horizontal directions (front, rear, or either side), the PRC design allows for a vertically-oriented exhaust plenum.

Figure 2 shows the minimum requirements for the exhaust area in the vicinity of the exhaust plenum exit. When the equipment is energized, the area shown should be kept clear of personnel and/or combustible or flammable materials. This topic is covered in more detail in TechTopics no. 89.

Some users request that the exhaust plenum be arranged so that the exhaust outlet is above the roof of the outdoor enclosure, to reduce the horizontal space at ground level that must be left unobstructed around the enclosure.

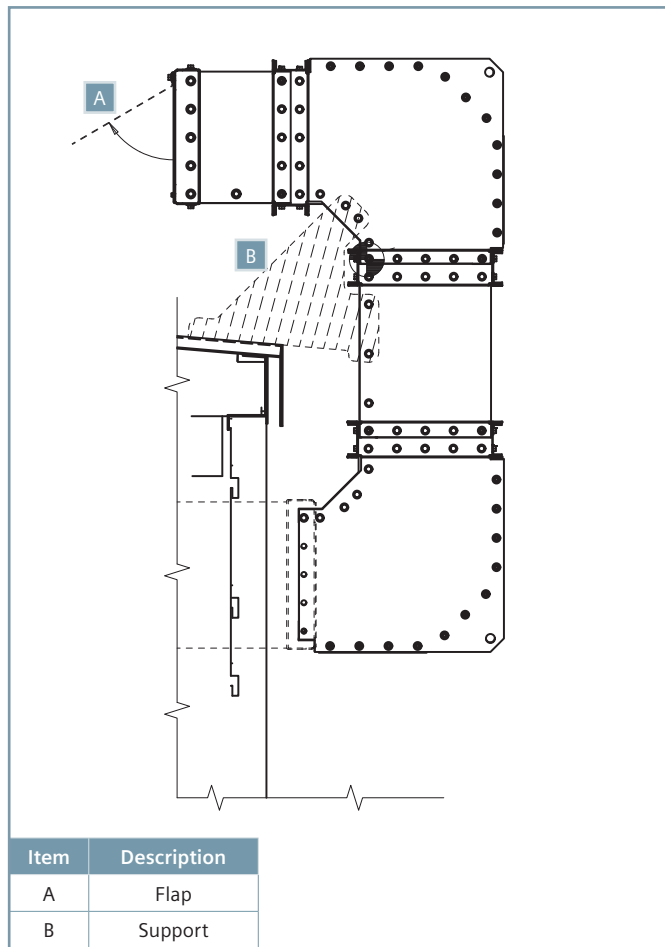


Figure 3: Typical exhaust arrangement above roof of PEC or building

Such an arrangement is shown in the Figure 3, where the exhaust plenum is connected to the PRC horizontally, extends through the exterior wall of the building or PEC, and then extends vertically to above the PEC building or roof, where the plenum transitions to horizontal so that exhaust of arcing gases is horizontally over the roof of the enclosure.

When exhausting over the roof of the enclosure, the roof area clearance around the exhaust plenum exit (flap) should approximate that shown in Figure 2, and the exhaust flap should be over the roof rather than simply being near the roof, so that personnel who may be at ground level in the vicinity of the flap are not directly exposed to the exhaust gases. The direction of exhaust exit must be chosen so that there is a generous distance from the end of the exhaust flap to the opposite edge of the building roof so that the clear space approximates that shown in Figure 2.

The roof structure of the PEC or building, and the members provided to support the exhaust plenum (duct) must be able to support the exhaust plenum, including consideration of seismic activity, snow or ice load, and appropriate wind loads. The manner of supporting the exhaust plenum must not compromise the weather-resistant integrity of the exhaust plenum.

The support system must also withstand forces that operate horizontally on the exhaust plenum (duct) that occur when an arcing fault occurs, since the reaction forces are opposite to the direction of exit.

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