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Data Sheet 9.41/2

Shielded Rooms, Type Indoor Self-Supporting Construction (SSC)

Application

Partial-discharge (PD) measurement is a major issue of quality assurance (e.g. routine or type tests) or development tests of any high-voltage (HV) component. A partial-discharge measurement can only provide reasonable results in an environment of sufficiently low background noise level (BNL).
Since PD tests in the framework of routine testing are typically integrated into production work flows, radiated and line-conducted interferences may interfere the measuring circuit and distort the measuring signal.
Depending on the closer environment around the high-voltage test laboratory a shielded room based on the principle of a Faraday cage is required. Especially if the high-voltage laboratory is housed in the same building as the manufacturing area and close to machines with power electronic controls (e.g. power transformer or cable industry) the disturbing electromagnetic signals have to be damped by a shielded room.
While radiated interferences are attenuated thanks to the shielding effect of the shielding elements, line-conducted interferences are attenuated by a specially designed filter system. Thereby the grounding system of the shielded room including all related testing equipment plays an important role to achieve an overall low PD BNL. The electromagnetic interferences are damped by a certain damping factor but cannot be reduced to zero due to economic reasons. Therefore the performance of shielding and other components is designed to the requirements of sensitive PD measurement according to the relevant standards. A damping factor of 60 dB in the frequency range between 30 kHz and 1 MHz (e.g. according to standards IEEE 299:2006 and DIN EN 61000-5-7:2012) guarantees sufficient low BNL. For example: If a source outside the shielding would emit a signal equivalent to 1000 nC the damping of 60 dB leads to a signal of 1 pC inside the shielded room.

Principle of the HIGHVOLT shielded room

The HIGHVOLT shielded room damps radiated and line-conducted disturbing signals and provides a very low BNL over the long lifetime of the shielded room by the following provisions:

- pre-fabricated shielding and structure components well treated and preserved against corrosion
- use of special fixing parts keeping low contact resistance over very long time
- proper earthing for the shielded room to avoid disturbances coming from the soil of the factory or the building grounding system
- well-suited filter system for the line-conducted disturbing signals
- adapted cabling layout inside the shielded room to avoid any interference between power, control and measuring cables
- selection of auxiliary equipment (illumination, emergency device, air conditioning, ...) which do not spoil the low BNL

HIGHVOLT offers standardized shielded rooms complying with the typical international test standards and testing parameters. In addition customized shielded rooms are available in different dimensions with individual equipment.

Figure 1: HIGHVOLT-made shielded room

Main components of a shielded room

- galvanized steel structure
- special-coated steel shielding panels
- control room inside the shielding with personnel door toward the outside and to the testing area
- shielded sectional door for access of test objects
- shielded personnel/emergency door toward the outside
- wave guides for various media, e.g. water, air or oil
- shielded ventilation panels for test room and control room
- air conditioning of the control room
- electrical installation

Description of the main components of a shielded room

The test objects can be moved on air cushions or with forklifts into the shielded test room. HIGHVOLT supplies and installs the complete floor shielding and the necessary cable duct. The customer has to prepare the pit under instructions of HIGHVOLT where the shielded room is located before the beginning of installation. After installation the customer cares for the last floor layer inside (finish floor design). HIGHVOLT delivers instructions for preparation of both the pit and the floor timely.
The shielded sectional door for a fast test object access operates full-automatically controlled. The door threshold is suitable for any means of transportation up to 80 t load capacity.
The electrical installation includes all parts for safe operation in shielded rooms as cable ducts, earth boxes, lighting, wall sockets, emergency shut-off, door limit contacts, etc. The shielded room has natural ventilation (without motor-driven fan) by shielded ventilation panels (honeycomb) at floor level and on the ceiling.
The air conditioned **control room** is equipped with normally two personnel doors, one shielded toward the outside and one unshielded to the test room and a window for visual observation during carried out tests. The control room is equipped with interference-free lighting, an emergency light, wall sockets, and all necessary devices for safe operation (e.g. emergency shut-off, door limit contacts).

Structure of the shielded room

A galvanized self-supporting steel construction carries the shielded room which fulfills the following design standards:

- DIN EN ISO 1461:2009 and DIN EN ISO 10684:2004 (galvanization)
- DIN 18807:2001
- DIN 1990:2010, DIN 1991:2010 and DIN 1995:2010 (statics)
- DIN 1025-3:1994 and EN 10210:2006 (steel elements)
- DIN 1013-1:1976 (tolerances)

HIGHVOLT's manufacturing standard ensures a long lifetime of the shielded room amongst others due to the extremely low production tolerances. No later adaptation of steel construction is necessary on site. The protective galvanic and special-coated layer is not destroyed by drilling or cutting processes on site and any corrosion is prevented.

The electromagnetic shielding itself is made by special-coated trapezoidal steel sheets of 1 mm thickness. The sheets are overlapped and screwed together. This overlapping guarantees the high damping efficiency. In general, the usage of non-organic material (e.g. sandwich structure incl. wood) prevents any kind of deformation in case of occurrence of high moisture or high humidity.
The entire shielded room including its supporting structure is insulated against the surrounding building. The earthing is realized by one or more defined buried earth electrodes depending on the actual soil conditions on site.

Table 1: Main parameters

Type	Preferred test application Maximum test voltage	Location of the high voltage generator	Shielded room Length x Width x Height m x m x m	Control room Length x Width x Height m x m x m
SSC 8x6x4	Routine test for cables, insulators or transformers 100 kV	inside/outside	8 x 6 x 4	3.6 x 2.6 x 2.5
SSC 12x7x4	Routine test for cables 200 kV	outside	12 x 7 x 4	3.6 x 2.6 x 2.5
SSC 18x10x6	Routine test for cables 350 kV	outside	18 x 10 x 6	3.6 x 2.6 x 2.5
SSC 25x12x12	Routine test for cables 500 kV	inside	25 x 12 x 12	3.6 x 2.6 x 2.5
SSC 35x26x17	Type and routine test for cables 700 kV	inside	35 x 26 x 17	6.5 x 2.6 x 3

Table 2: Components and their dimensions (approx.)

Type	Shielded sectional door Number Width x Height m x m	Shielded personnel door toward outside Number Width x Height 0.9 m x 2.1 m	Unshielded personnel door to test room Number Width x Height 1.1 m x 2.1 m	Shielded ventilation panels of test room Number Width x Height 0.6 m x 0.6 m	Shielded ventilation panel of control room Number Width x Height 0.3 m x 0.3 m	Wave guide for water hose Number
SSC 8x6x4	1 3 x 3	1	1	2	2	-
SSC 12x7x4	1 4 x 4	1	1	6	2	4
SSC 18x10x6	1 5 x 5	1	1	4	2	4
SSC 25x12x12	1 6 x 6	2	1	8	2	4
SSC 35x26x17	1 6 x 6	2	1	12	2	4

Installation and erection

The installation of the shielded room is a major issue to ensure quality and performance. It has to be coordinated in line with the installation and preparation of the surrounding building and area. Some requirements are:

- separate installed earth system with a resulting earth resistance less than 1 Ohm
- prepared pit for installation of shielded room in accordance with HIGHVOLT's instructions
- completion of surrounding building, concrete floor and pit must be dry and capable to withstand appropriate mechanical stresses
- sufficient working space around the pit and for opening and unpacking material boxes

Latest two month before installation of a shielded room HIGHVOLT sends a detailed Site Survey Checklist with all requirements to be fulfilled from customer side. The customer has to fill in all relevant activities and measured values e.g. as the value of the measured earth resistance and completes the checklist by pictures of the prepared pit. The complete filled in Site Survey Checklist is mandatory for HIGHVOLT`s decision to start installation.
The installation is supervised by an experienced HIGHVOLT supervisor. He leads the installation team provided by the customer. The Site Survey Checklist specifies necessary numbers and qualifications of customer's staff and describes their necessary hand tools.
The supervisor checks the insulation resistance of the shielded room (>10 kOhm) day-to-day and collects all information in a protocol. The working progress is regularly documented by pictures.

In addition, the customer has to provide following tools and preconditions:

- site lighting (approx. 200 Lux)
- electrical power supply (minimum 4 sockets) for tools, chargers, etc. 110V/230V
- liquid for cleaning contact surfaces (approx. 4 liter e.g. isopropyl alcohol or similar oil free cleaning liquid)
- cleaning brush and industrial vacuum cleaner
- worktable for preparation of panels (approx. 2 pieces, height 700-1000 mm, width approx. 1200 mm)
- 1 fork lift of minimum capacity 5 t
- hand tools for customer's installation team

Table 3: Further requirements dependent on room size

Type	1 Wheel type loader Height m	Working platform (scissors lift) min. lifting capacity 500 kg Number / min. height m	1 Mobile crane Hoisting capacity t
SSC 8x6x4	-	1 / 5	5
SSC 12x7x4	-	1 / 5	10
SSC 18x10x6	10	1 / 8	10
SSC 25x12x12	15	2 / 15	20
SSC 35x26x17	20	2 / 20	20

Please note:

The scope of delivery includes hints, recommendations and sketches for:

- design and installation of the steel reinforced concrete floor within and around the test room
  (REMARK: HIGHVOLT does not carry out any kind of civil work!)
- earthing and installation of floor boxes, cable ducts
- safety operation of HV test fields
- design of the air conditioning system for the control room
  (REMARK: HIGHVOLT suggests installing the air conditioning and providing after sales service by a local company)

Please note that following items are not included:

- pit for installation of the shielded room
- earth system and its precise earth resistance measurement
- installation of the steel reinforced concrete floor
- electrical power supply
- compressed air supply for air cushion system

Optional equipment

Table 1 and table 2 show standard shielded rooms designed to meet common requirements. If the dimensions of an existing surrounding building differ from the standard or for any other reason, a customized solution with deviating dimensions or other performance can be provided.

Following items can optionally be ordered:

- additional shielded personnel door toward the outside for entrance into the test field or a further shielded emergency door
- additional sectional door
- crane adapter for bridge crane up to 1 t
  HIGHVOLT provides only the crane adapter for a 1 t crane. The customer procures the crane and is responsible for its installation.
- crash protection of shielded walls inside the shielded room
  A crash protection of the shielded walls is occasionally recommended. It protects the wall elements against possible damages e.g. by fork lift transportation or in case of unintentional mishandling of test object by additional steel plates with a height of up to 3 m or 6 m respectively.
- tool package
  The installation team works with its own hand tools.
- consultancy for the planning of the shielded room design
  Normally the customer plans the surrounding building and the ambient floor using the general plan of the shielded room which is provided at the beginning of the project. An additional consultancy is advised for complex building situations on site with the following planning items
  additional grounding
  work flow
  power supply
  planning of non-standard shielded rooms
  HIGHVOLT assists the planning procedure by 2 or 3 consultancy visits on site and provides drawings for coordination of the planning procedure.
- electrical installation
  The customer can chose between basic and advanced electrical installation package.

Table 4: Basic and advanced packages for electrical installation

Type	Advanced											
	Basic											
	Filter 4 x 36 A	Full lighting density lamp	Lamps for control room	Emergency shut-off	Signal warning lamps	Emergency lamps	Door contacts	Low light density lamps	Sockets 1 phase	Sockets 3 phase	Air conditioning	Horn
	pcs.	pcs.	pcs.	pcs.	pcs.	pcs.	pcs.	pcs.	pcs.	pcs.	pcs.	pcs.
SSC 8x6x4	1	4	3	3	4	2	4	4	2	2	1	1
SSC 12x7x4	1	6	3	4	4	3	4	6	4	2	1	1
SSC 18x10x6	1	6	3	5	4	4	4	6	6	2	1	1
SSC 25x12x12	1	8	3	5	4	5	6	8	8	2	1	1
SSC 35x26x17	1	10	6	6	10	6	6	10	10	2	1	1

Type designation

SSC a/b/c
a = length in m
b = width in m
c = height in m