

Astoria II GIS

INSTALLATION AND COMMISSIONING MANUAL

345kV Gas Insulated Switchgear

Buyer: **ABB US PP Astoria LLC**

Consultant: **SNC Lavalin**

Project: **Astoria II**

Contract: **62000050**

Supplier: **ABB SWITZERLAND LTD
HIGH VOLTAGE PRODUCTS**

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SECTION 1

WORK DESCRIPTION

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Document No

➤ Installation and Commissioning Procedure

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1 Installation General

1.1 Scope

This manual covers the requirements for the installation of gas insulated switchgear.

The manual is based on the following documents:

- Customers contract
- Approved drawings, latest revision
- Approved Installation Processes on Site (Test Reports)

Abbreviations: ABB; ABB Switzerland Ltd

1.2 Site Organization

To assure correct installation, in accordance to drawings and specification, at the minimum one installation supervisor from ABB is required

1.3 Site Meetings

Regular meetings shall be held with the following main topics:

- Progress and quality of installation
- Installation instruction / training for next installation sequence
- N° of personnel required
- Special equipment required (cranes, lifters etc.)
- Material required for the next installation sequence

The results of the meeting are to be fixed in a minutes of meeting, signed by the present parties.

No contractually binding agreements may be entered into during site meetings without knowledge and written approval of ABB's project manager in Switzerland.

1.4 Sequence of Installation

The sequence of installation will be determined by ABB based on the Installation and Commissioning Schedule and assembly drawings.

If due to transportation damages, climatic conditions, incomplete civil works, etc., the installation cannot be carried out in the foreseen sequence, a new sequence may be determined on site by ABB's supervisor. If necessary the engineering department of ABB shall be consulted.

1.5 Installation and Commissioning Schedule

The Installation and Commissioning Schedule shows the overall estimated installation/commissioning duration as well as the durations of the main installation/commissioning activities.

It also states the number of installation personnel required.

All estimated durations of the planned tasks are based on standard required skill of employed local personnel.

1.6 Installation Personnel

Installation personnel shall be at the disposal of the ABB Supervisors according to the relevant contracts. The number of personnel is stated in the Installation and Commissioning Schedule or will be agreed during the site meetings. In case of insufficient skills and quality of the installation personnel, the effected personnel shall be replaced at the request of ABB's supervisor.

1.7 Installation Tools and Instruments

GIS special tools, equipments and instruments required for the installation will normally be supplied by ABB on temporary importation basis.

Normal hand tools for fitters and electricians shall be available with the required installation personnel.

1.8 Quality Control

Quality procedures to be observed during installation are prescribed in the Quality Plan latest revision.

Checks and tests to be carried out in accordance with the progress of the installation.

Results to be recorded on the corresponding report and test sheets.

In order to allow to attend the tests, all checks and tests to be announced in advance, on request of the customer/engineer.

The report sheets shall be signed progressively.

Copies of the complete set of signed report sheets may be handed over to the customer/engineer.

The original set of signed report sheets stays with ABB.

1.9 Marked up Drawings

Modifications carried out during installation/ commissioning to be marked up on the appropriate drawings, lists, etc.

The marked up drawings stays with ABB for the issue of the final drawings.

1.10 List of outstanding work

Outstanding work what could not be rectified during the installation/ commissioning to be noted on a punch list.

1.11 Site Variation Orders

Extra works or tests requested by the customer shall be carried out only against written authorized site variation orders.

1.12 Safety Requirements

All general site safety requirements shall apply to installation. Suitable warning signs shall be placed to ensure that personnel not involved with the installation are aware that additional hazards may exist. All personnel involved in the installation shall be aware of all safety requirements.

Report: 251 01010 / 251 02010

1.13 Non Conformances

Any non conformances, such as damages, rectifications, deviations, etc. to be reported with a "Non Conformance Report".

1.14 Submittal of Documents

Reports will be submitted to the client.

In general, the submission of detailed installation instructions towards the client is not foreseen. However, clients have the possibility to refer to these instructions on site.

2 Acceptance of Site

2.1 General

2.1.1 Switchgear Building

The construction of the SF6 switchgear room /building must be finished.

All work of tradesmen such as bricklayers, painters, fitters and electricians must be completed.

Tools, fixtures and installation material of the tradesmen mentioned, must be removed from the switchgear room.

The crane facility must be installed/cleaned/tested and ready for operation.

Prior to installation, the power supply (light, electrical power) required for the installation must be available.

A lockable tool store close to the switchgear room is to be provided.

A storage room or storage area of adequate size outside the switchgear room must be made available for the purpose of unpacking and cleaning the assembly units.

The entire switchgear room must be thoroughly cleaned and largely free of dust.

Test Report: 221 01010

2.1.2 Switchyard

The construction work of the installation switchyard must be completed. Foundations, cable trenches, lay down areas, roadways etc.

The switchyard (installation area) shall be effectively protected by means of a fence, to prevent the access of unauthorized persons.

The crane installation (mobile or gantry) provided for the installation work must be available and in operation.

The storage room, or storage area must be available for unpacking, cleaning and preparing the assembly units. The transport to the installation area must be assured.

A lockable shelter/room/container (or similar) for office, tools and instruments must be available at the installation site.

Test Report: 221 01020

2.2 Checking of Civil Works

To be checked with reference to the drawing "Civil Work Requirements".

X – Y-axis

Circuit breakers – axis

Floor and wall openings

Outdoor foundations

Test Report: 221 01010 / 221 01020

2.3 Earthing

To be checked with reference to the drawing "Earthing Layout".

Connection flags

Report: 221 01010 / 221 01020

3 Common Instruction

Following items to be observed until the completion of installation.

3.1 Conditions during Installation

During the installation of the SF6 switchgear, no rework of construction in the building/switchyard should be permitted. In the event that such work is unavoidable, the chief supervisor should coordinate this work with the local construction management. In such a case, installation of the SF6 switchgear shall have first priority.

The switchgear room must be lockable, and if necessary equipped with a suitable material transfer compartment.

All breakthroughs, cable ducts etc. leading to the outside must be fitted with appropriate covers.

During the installation, the switchgear room must be kept in a high state of cleanliness. In case of a dirty environment, suitable measures such as vacuum cleaning, wet wiping of floors and installation of covers/ doors have to be taken.

Remark: The crane facility must be examined on cleanliness.

3.2 Access to Switchgear Installation

During installation of the SF₆ switchgear, access to the switchgear room is prohibited generally to unauthorized persons.

Every visitor shall report to the site manager/supervisor.

3.3 Installation Instructions

Coupling works that are carried out at site, have to be handled according to the specification.

The individual components are to be cleaned according to the specification.

While coupling the assembly units, make sure that the enclosures are only opened shortly before the coupling is carried out. If that is not possible, the opened parts are to be covered with plastic foil or protective hoods to limit the danger to a minimum of extraneous materials (dust, chips etc.) getting into them.

The protective hoods may never be used to cover insulators. Zinc dust abrasion from the stud bolts could get caught in the hoods.

The insulators of the units may not be touched with bare hands. For such works plastic gloves are required.

For each connecting point (between two assembly units), new O-rings are delivered and shall be installed.

All assembly units are shipped and stored with Nitrogen or SF₆-gas filling. If the enclosure is opened for any reason (installation or inspection), the Nitrogen will escape. If this gas compartment cannot be filled with SF₆ gas or nitrogen within the next day,

it must be first evacuated to min. «1 mbar» for 2 hours and then filled with nitrogen to a pressure «pabs» of approx. «120 kPa».

If an assembly unit has been found during unpacking or inspection without gas overpressure, greater attention is to be paid to this unit during the evacuation period. The unit has to be checked concerning leakage and possible moisture inside the gas compartment.

The gas valves are always to be covered with caps.

Only the thread and the shoulder surfaces may be lubricated with a fine film of grease.

The screws and nuts must be tightened to the prescribed torque with torque wrenches according to specification.

Very important: To prevent oil getting inside the gas compartments:
Do not use two vacuum pumps at the same time to evacuate one gas compartment.
Do not calibrate and retest the pressure gauges with oil or similar mediums, but only with air.

3.4 Dust and Weather Protection

If necessary, particular in windy locations, suitable protective devices have to be installed.

For protection against dust, rain etc. during installation of the assembly units, one of the following possibilities for covering is to be used:

- Completely covered installation site: mobile tent with lightweight structure
- Partly covering of the installation site with a tent
- Local protection during installation of the assembly units (only the connection points are covered with an umbrella, a raincoat etc.)

Whichever version is used, the selection of the most appropriate method should be discussed with our installation division in any case.

3.5 Handling of SF6 Gas

Instruction: 1HC0028659

3.6 Tightening Torque of Screws

For screws and nuts, different torques values according to the specification/instruction have to be used.

Instruction: HASV 600416

3.7 Treatment of Flanges

For outdoor switchgear installations, flanges have to be treated with grease.

Instruction: HASV600824

3.8 Lifting Equipment

To lift the Assembly Units, use always "SPANSET SLINGS" or special lifting devices.

4 Identification of Equipment

Equipment and materials for installation are defined in the drawing "Assembly Layout" including the belonging material lists.

The allocations of equipments and loose materials are stated by "Unit-N°" e.g. 001, 002, etc.

These Equipment Allocations have to be strictly observed!

5 Transport and Receiving of Equipment

5.1 Transportation of unpacked Equipment

At every site meeting ABB's supervisor will hand over to customer a case list, indicating the equipment necessary for the coming installation sequence.

Remark: It is customer's responsibility that the transportation of goods between storage place and GIS building will take place in accordance with the site regulations under consideration of the transportation markings on the cases. ABB will not be responsible for damages occurred during transportation or due to wrong handling!

5.2 Receiving and Unpacking of Equipment

Following items to be checked:

- Condition of cases
- Quantity of content according to packing list
- Condition of content
- Overpressure in gas compartments (to be checked during preparation for coupling work)

Test Report: 221 02010

6 Installation Procedure GIS

6.1 Fixing Points of Circuit Breaker Units

Mark fixing points of circuit breaker units according to drawing "Civil Work Requirements".
Measure and record elevation of fixing points.

6.2 Installation of Circuit Breaker Units

6.2.1 Setup of Circuit Breaker Units

Lift unit and move it to it's setup place.
Put necessary spacers to fixing points in accordance to the elevation control list.
Line up units to axis and put it down.

6.3 Installation of Connection Units Circuit Breaker - Circuit Breaker

Fit contacts and small parts and clean units
Top up SF6 Gas
Treatment of flanges, where required.

Instruction: 1HC0072978

Test Report: 221 02010

6.3.1 Preparation of Coupling Points at the relevant Circuit Breaker Units

Clean coupling points.

Instruction: 1HC0072978

6.3.2 Installation of Connection-Units to the Circuit Breakers

Treatment of flanges, where required.

Instruction: HASV600824

Test Report: 221 02010

6.4 Installation of Bus bars

Sequence phase by phase.

Remark: If the exit units are situated below the bus bar, it may be an advantage to install these units before the busbars. It's on the decision of ABB's supervisor which sequence is preferable.

6.4.1 Installation of Connection Units Circuit Breaker – Busbar

Check for overpressure in gas compartments.
Clean units.
Fit contacts and small parts.

Instruction: 1HC0072978

Test Report: 221 02010

Preparation of Coupling Points at the relevant Circuit Breaker Units

Clean coupling points.

Instruction: 1HC0072978

Installation of Connection-Units to the Circuit Breakers

Treatment of flanges, where required.

Instruction: HASV600824

Test Report: 221 02010

6.4.2 Installation of 1st Busbar Unit

Check for overpressure in gas compartments.
Clean units.
Fit contacts and small parts.

Instruction: 1HC0072978

Test Report: 221 02010

Preparation of Coupling Points at the Connection Units

Clean coupling points.

Instruction: 1HC0072978

Installation of Busbar Unit to the prepared Connections

Treatment of flanges, where required.

Instruction: HASV600824

Test Report: 221 02010

6.4.3 Installation of Supports

Assemble and fit supports according to drawing "Support Layout".
Set anchor bolts.

Remark: Supports to be installed in accordance with the installation progress on decision of ABB's supervisor. During the installation it may be necessary to support the GIS with temporary supports. Such supports can be made of wood from the cases in which the GIS equipment has been transported. All temporary supports to be approved by ABB's supervisor and to be checked for safety!

Instruction: HASV601046

6.4.4 Completion of Busbar Installation

Complete installation of busbar by repeating steps 6.4.1 to 6.4.3.

6.4.5 Primary Resistance Measurements

Measurement of contact resistance at all 3 phases of couplings made

Instruction: HASV601049

Test Report: 221 03010

6.4.6 Humidity Absorbers

Fit humidity absorbers, where required.

Treatment of flanges, where required.

Instruction: HASV600016 / HASV600824

Test Report: 221 02010

6.4.7 Evacuation and SF6 Gas filling

Evacuate Air and fill SF6 Gas.

Instruction: 1HC0028659

Test Report: 221 03020

Remark: Circuit breakers and voltage transformers are already filled with SF6 gas at the factory and therefore not to be evacuated.

6.4.8 Setting of Anchor Bolts on Circuit Breaker Units

Re-check and re-adjust, where required, line up of circuit breaker units to axis.

Set anchor bolts.

Instruction: HASV601046

Remark: These activities can also be carried out later on.

6.5 Installation of Exit Feeders

6.5.1 Installation of Units adjacent to CB - CB Connection

Sequence phase by phase.
Check for overpressure in gas compartments.
Clean units.
Fit contacts and small parts.

Instruction: 1HC0072978

Test Report: 221 02010

Preparation of Coupling Points at CB - CB Connection

Clean coupling points.

Instruction: 1HC0072978

Coupling of Units to CB - CB Connection

Treatment of flanges, where required.

Instruction: HASV600824

Test Report: 221 02010

6.5.2 Installation of following Units

Sequence phase by phase.
Check for overpressure in gas compartments.
Clean units.
Fit contacts and small parts.

Instruction: 1HC0072978

Test Report: 221 02010

Preparation of Coupling Points at preceding Units

Clean coupling points.

Instruction: 1HC0072978

Coupling of Units to preceding Units

Treatment of flanges, where required.

Instruction: HASV600824

Test Report: 221 02010

Remark: It may be more convenient to pre-assemble several units on the floor before lifting up and coupling. It's the decision of ABB's supervisor whether pre-assembly will take place or not.

6.5.3 Installation of Supports

Assemble and fit supports according to drawing "Support Layout".
Set anchor bolts.

Remark: Supports to be installed in accordance with the installation progress on decision of ABB's supervisor. During the installation it may be necessary to support the GIS with temporary supports. Such supports can be made of wood from the cases in which the GIS equipment has been transported. All temporary supports to be approved by ABB's supervisor and to be checked for safety!

Instruction: HASV601046

6.5.4 Installation of Interface Units to the Exit Feeders

Remark: The exit feeders may be fitted out either with bushings or cable connections or may end on transformers.

Installation of Bushings

Sequence phase by phase.
Check for overpressure in gas compartments.
Clean units.
Fit contacts and small parts.

Instruction: 1HC0072978

Test Report: 221 02010

Preparation of Coupling Points at preceding Units

Clean coupling points.

Instruction: 1HC0072978

Coupling of Bushings to preceding Units

Treatment of flanges, where required.

Instruction: HASV600824

Test Report: 221 02010

6.5.5 Primary Resistance Measurements

Measure contact resistance in all 3 phases of couplings. It must be observed that the entire GIS is measured where possible.

Instruction: HASV601049

Test Report: 221 03010

6.5.6 Humidity Absorbers

Fit humidity absorbers, where required.
Treatment of flanges, where required.

Instruction: HASV600016 / HASV600824
Test Report: 221 02010

6.5.7 Evacuation and SF6 Gas filling

Evacuate Air and fill SF6 Gas.

Instruction: 1HC0028659
Test Report: 221 03020

6.6 Density Monitor and - Sensor

Compare values of operating points on the nameplate of the monitor / sensor with the values stated in the "Single Line & Gas Diagram".
Check of functioning.

Instruction: 1HC0017413
Test Report: 221 03030 or 221 03031

6.7 Driving Shafts for Isolators and Earthing Switches

Install driving shafts according to the drawings

6.8 Voltage Transformers

Sequence phase by phase.
Clean units.
Fit contacts and small parts.

Instruction: 1HC0072978 / HAGS 30193
Test Report: 221 02010

6.8.1 Preparation of Coupling Points at preceding Units

Clean coupling points.

Instruction: 1HC0072978

6.8.2 Coupling of Voltage Transformers

Fit contacts and small parts.
Top up SF6 Gas
Treatment of flanges, where required.

Instruction: HASV600824 / 1HC0028659
Test Report: 221 02010

Remark: Voltage transformers are already filled with SF6 gas at the factory and therefore not to be evacuated.

6.9 Final Activities

6.9.1 Installation of Surge Arresters

Remark: If surge arresters are equipped with removable links, the arresters can be installed prior to the high voltage test.
Clean units.
Fit contacts and small parts.
Treatment of flanges, where required.

Instruction: 1HC0072978 / HASV600824

Test Report: 221 02010

Remark: Surge arresters are already filled with SF6 gas at the factory and therefore not to be evacuated.

Wall Sealing

Fit the wall sealing according the drawing or customers requirement.

6.9.2 SF6 Gas Filling Pressure

Check filling pressure in all gas compartments and top up if necessary to nominal pressure.

Instruction: 1HC0028659

Test Report: 221 03020

6.9.3 Dew point and Purity measurement of SF6

Check the dew point and purity content on all gas compartments of the installation.

Instruction: 1HC0028659 / 1HC0016974

Test Report: 221 04010E

6.9.4 SF6 Gas Balance

The amount of SF6-gas, delivered with the product must be verified during the assembling time.

This means, that all gas bottles and -tanks must be weighed before taking out gas from it. Same procedure must be done after finishing the job.

Instruction: 1HC0070163

Test Report: 1HC0070163

6.9.5 Name Plates

Fit name plates to the corresponding equipments.

7 Earthing

GIS earthing to be installed according to drawing "Earthing Layout".

Remark: Activities as per Installation and Commissioning Schedule (file directory 2), respective in accordance with the installation progress.

8 Local Control Panels and Secondary Cabling

8.1 Placement of Local Control Panels

Set panels according to allocations in drawing "Assembly Layout"

8.2 Cable Trays

Install cable trays, where required.

8.3 Cable Laying

Cables to be laid according to cable lists.

8.4 Cable Connections

Cables to be connected according to connection diagrams.

Remark: Activities as per Installation and Commissioning Schedule, respective in accordance with the installation progress.

9 Commissioning

9.1 Introduction

The purpose of the "Site Inspection and Test Plan for Testing & Commissioning" is to set a guide to the way site testing & commissioning has to be carried out.

9.1.1 General Aspects

The site testing & commissioning of a transmission or distribution plant are the final activities to confirm that the plant operates correctly and fulfills specified requirements. Normally, the equipment is already factory tested and it is the duty and responsibility of the commissioning engineers to make sure that the equipment is assembled / installed correctly. The main objectives of the "Site Inspection and Test Plan for Testing & Commissioning" are:

- That the specified equipment has been correctly installed.

- That the equipment operates correctly and has not been damaged during transportation or installation.
- That the required operations / functions are obtained with chosen design.
- To obtain a set of as-built drawings and test records as reference for future modifications and periodic maintenance.

In order to be able to perform the testing & commissioning systematically and professionally it is a pre-requirement that the test procedures and test records have been agreed with the client and that the commissioning engineer has got the correct mental approach to execute the activities.

9.1.2 Personnel and Responsibilities

Commissioning Coordinator:

A Commissioning Coordinator is responsible to organize all works related to testing & commissioning and to implement the "Site Inspection and Test Plan for Testing and Commissioning".

Testing & Commissioning Engineer:

A Testing & Commissioning Engineer is responsible for the testing & commissioning of equipment and to ensure that the correct procedures are followed. Upon completion of each test he will sign the appropriate test record and request any witnessing representative to do the same.

9.1.3 Safety Requirements

All general site requirements shall apply to testing & commissioning. Suitable warning signs shall be placed to ensure that personnel not involved with the testing & commissioning are aware that additional hazards may exist. All personnel involved in the testing & commissioning shall be aware of all safety requirements.

9.1.4 Documentation

Prior to any testing & commissioning work the following documentation is mandatory:

- Approved drawings
- Approved "Site Inspection and Test Plan for Testing & Commissioning"

9.1.5 Site Inspection and Test Plan

The Site Inspection and Test Plan deals with inspections and tests on site before and during energization of the substation.

The Site Inspection and Test Plan is listing the inspections and tests which are planned to be done on site.

The Site Inspection and Test Plan refers to test descriptions and test reports, from these it is possible to follow the planned tests more in detail.

9.1.6 Test Procedure

A test description is a guideline on how to perform a test.

9.1.7 Test Record

A test report is a document where all test results are recorded.

9.1.8 Test Equipment

ABB Switzerland Ltd normally owns test equipment used at sites. But occasionally it may be necessary to rent from third party. All test equipment used will be calibrated and have a valid calibration certificate.

9.2 Tests

9.2.1 Isolator & Earth Switch

Visual check of the various equipment

Designation

Tightening of screws

Terminals

Operation of the equipment by hand

Check of free movement

Check of end positions (Endoscope)

Automatic operation

Check of supply of the motor, phase rotation

Check of the blocking device (if available)

Check of the blocking interlocking

If drive is blocked by removed cover.

Check of the position indicator

Local control panel

Test Report: 211 02061

9.2.2 Circuit Breaker drive

General control

Screws and terminals
Oil level and leak

Check of the running time controller

Measurement of the pump running time

Function check

ON and OFF functions of local command work correctly (without controller, direct function)

Antipumping (hindrance of reclosing)

Pole discrepancy, (Trip at unequal pole positions)

Pump relay switch ON and OFF

Signal "OFF-ON-OFF"

Blockings for "Switch ON"

Blockings for "Trip 1" and "Trip 2"

Gas blockings

Check of the panel heater

Check of the counter functions

Test Report: 211 02020

9.2.3 Circuit Breaker Timing Test

Measurement

Recording of the breaker switching times:

ON, OFF and ON-OFF

Test Report: 211 02030

9.2.4 Circuit Breaker Pump Start Control

To check the tightness of seals in the CB pump, the amount of pump charges during 24 hours have to be recorded. Important are the pump starts due to pressure loss without any switching operations.

Test Report: 211 02050

9.2.5 Density Monitors

General control

Visual control of the monitor

Electrical connections

Conformity of mounting place

Check of all alarms and functions with the simulation device

Test Report: 211 02070

9.2.6 Local Alarms

Check and simulation

Simulation of each local alarm to alarm unit in LCP
Each tested circuit has to be marked yellow in the drawings

Test Report: 211 04060

9.2.7 Interlocking

Checks

All interlocking requirements must be fulfilled for:

Circuit Breaker
Earthing Switch
Isolator

Test Report: 211 04010

9.2.8 VT Secondary Insulation

Measurement of the insulation values:

- between each secondary core and earth
- between the secondary cores

Test Report: 211 03010

9.2.9 VT DC Resistance

Measurement of the primary resistance on each voltage transformer

Test Report: 211 03030

9.2.10 VT Ratio and Polarity

Checks

All polarities and wiring connections
Measurement of the ratio of each core

Remark: Will be done during high voltage test

Test Report: 211 03070

9.2.11 CT Secondary Insulation

Measurement of the insulation values:

- between each secondary core and earth
- between the secondary cores

Test Report: 211 03080

9.2.12 CT Analyzer

Measurement of winding resistance for each core.

Recording of core magnetisation curve

Check polarity of each core and wiring connections

Check ratio of each core (voltage injection on secondary side)

Test Report: 211 03150

9.2.13 Commissioning Acceptance

"AS BUILT" Documents

Handing over the copy of a complete set of electrical drawings containing the handwritten definitive corrections and changes that are made during the commissioning.

Commissioning "TEST REPORTS"

Handing over the copy of a complete set of commissioning Test Reports undersigned by the customer and the ABB representative.

Acceptance Certificate

Written confirmation of the completion of commissioning activities, undersigned by the customer and the ABB representative.
List of possible pending items.

Test Report: 211 07050

10 High Voltage Test

10.1 Preparation for High Voltage Test

Check and complete, if necessary all items according to checklist "Preparation for High Voltage Test" prior to high voltage test.

10.2 High Voltage Test

According to test procedure.

Test Report: 211 08010

11 Spare Parts inclusive Operation and Maintenance Equipment

Handing over of spare parts according to "Assembly Material List".

Test Report: 221 05010

12 Final Inspection

Check all items for completeness according to final inspection check lists.

Test Report: 221 04030

SECTION 2

INSTRUCTIONS

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➤	SF6 Gas Balance	<u>1HC0070163</u>
➤	SF6 Gas Balance Calculation Sheet	<u>1HC0070163</u>

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GIS + LTB SF₆ GAS HANDLING ON SITE

Instructions for evacuating, filling, reclaiming, measuring of SF₆ gas in gas compartments

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1 Document determination

1.1 Purpose

Instructions and recommendations for the correct handling of insulating and arc quenching gas SF₆ (sulfur hexafluoride), used in switchgear from ABB Switzerland Ltd.

This document refers to

- SF₆ self-obligation CH
- ABB position statement on sulfur hexafluoride (SF₆)
- Directive (EC) No. 842/2006 on certain fluorinated greenhouse gases including labelling and certification

and to the relevant guidelines on the **responsibilities and objectives on handling SF₆** which are prescribed for the prevention of SF₆ emissions, wherever possible.

1.2 Area of Application

All departments and persons who install, repair, service and maintain gas insulated switchgear (GIS), LTB and PASS systems / switches manufactured by ABB Switzerland Ltd.

These instructions apply for the evacuation, filling and reclaiming of SF₆ gas from gas compartments, and in addition for leak tests, leak tests of the connections in control systems fitted on site, GIS / PASS and LTB circuit breakers.

These instructions are applicable exclusively for all GIS / PASS and LTB products manufactured and in the technical responsibility of ABB Switzerland Ltd.

1.3 Terms and abbreviations

SF ₆	:	sulfur hexafluoride
Technical grade SF ₆ gas (IEC 60 376)	:	here often also called "new" SF ₆ gas for filling into electrical equipment
Used SF ₆ gas (IEC 60 480)	:	SF ₆ gas as used in electrical equipment
Re-use SF ₆ gas (IEC 60 480)	:	re-use quality of SF ₆ gas after removal from switchgear
Gas compartments	:	are these ones under work, resp. which will be lowered in pressure
MPL	:	Project Manager Site Installation (Montageprojektleiter)
LTB	:	Live tank breaker (Outdoor)
DAP	:	pressure rise test (D ruck a nstiegs p robe)
gas cylinders	:	gas bottles
gas containers	:	gas tanks

1.4 Responsible department

SF₆ gas specialist team, manager of SF₆ gas handling PTHS-F, (GIS) Field Operation.

1.5 Derived from

1HC0028659 mod. AF

2 Description

2.1 GIS / PASS

When building a new system on site and during checks and overhauls of GIS systems various work processes take place in connection with filling gas into ELK and PASS switchgear filled with SF₆ gas.

These work processes and test must be carried out on all switchgear.

- Evacuation (air)
- Filling (SF₆ gas)
- Reclaiming (SF₆ gas)
- Leak test / searching for leaks (SF₆ gas)
- SF₆ gas quality measurements (SF₆ gas)

The work processes, tests and rated test values to be used are described here.

2.2 LTB

The work processes described apply analogous also for LTB products, with the exception of the processes described in chapter 8.

In case of special questions, ambiguities, it is imperative to consult the competent technical department.

3 Safety

3.1 Assembling instructions

SF₆ gas is about five times heavier than air and can accumulate in lower lying rooms where it will displace oxygen. There must be paid respective attention for.

Each person, who is assigned with the assembling, commissioning, operation, maintenance or repair of the switchgear installation, must have read and understood the chapter "Safety" of the Operation Instructions for Handling SF₆ Gas 1HC0028459.

The ABB - CH - GIS and the local assembly regulations must be stringently adhered to.

During work on open parts of the installation, the operating instructions for the appropriate installations and components must be consulted and followed.

3.2 Differential pressures at insulators in different types of switchgear

Barrier insulators of adjacent gas compartments must not be subjected to high differential pressure when filling and evacuating gas. The permissible values have been defined.

See the various technical instructions in chapter 10, References

4 Environmental aspects

As SF₆ gas is a very strong greenhouse gas, it must therefore be handled with care; please refer also to regulation 1HC0028459 (User manual on handling sulfur hexafluoride SF₆).

"SF₆ gas must not be released into the environment"!

5 Material and equipment

Instruments, apparatus and auxiliary materials required in relation with document 1HC0025668

- Service cart (evacuation and filling system, reclaimer), gas replenishment cart
- Instruments for measuring dew point, percentage and decomposition products
- Precision manometer class 0.6 or better
- Leak detector
- PE film
- Adhesive tape
- SF₆ gas
- The equipment/instruments must be operated in accordance with the relevant operating instructions.
- The **quantities of gas** in the bottles / tanks are measured by **weight in kg or lbs**. See also the details on the bottle / container.

6 Work processes

6.1 Transports of SF₆ gas / decomposition products

Cylinders with gas content classified as being toxic, deleterious or inflammable by exposure to air must not be transported in “closed up vehicles”, such as motorcars, estate cars and delivery vans or must not be handed over to the said for transport.

6.1.1 Gas in cylinders in keeping with UN 1080 (good gas)

The following rules shall apply for **ABB staff members (inclusive co-workers ordered by ABB)**:

A maximum of 200 kg of SF₆ gas is permitted in a motorcar or delivery van, which is steered by a staff member of ABB. Care for appropriate and sufficient air ventilation !

Example:

Four full, four empty cylinders

- | | |
|--|--------|
| - four cylinders of 40 kg each full | 160 kg |
| - four cylinders of 10 kg each (empty) | 40 kg |

The cylinders must be transported correctly.

The gas volume filled in and the substance must be readable at all times.

The cylinders or the volume of gas must be carried for “own consumption” only, and must not constitute a delivery to a customer.

6.1.2 Gas in cylinders in keeping with UN 3308 (toxic, corrosive)

Cylinders with SF₆ gas in keeping with UN 3308 (toxic and corrosive) are considered hazardous freight with high hazard potential.

Hazardous freight with a high hazard potential must not be transported without a safety plan.

These cylinders must therefore not be transported by ABB staff.

Solid decomposition products

These solid decomposition products are also “hazardous freight with high hazard potential” and must be transported with special approval only and must not be transported by members of the ABB staff.

You can get further detailed information by the appropriate transport companies.

6.2 To be followed in general terms

According to the regulations on "Differential pressure in ELK insulators" (see chapter 10), only certain pressure differences may occur when evacuating, filling and reclaiming SF₆ gas from gas compartments. These must be stringently complied with.

The respectively current protocol sheets have to be used.

State of the art gas treatment units (reclaimers) as well as measuring instruments must be used.

Caution:

New installations:

In order to prevent potentially increasing humidity values in gas compartments, opened at site, the maximum exposal time to air shall not exceed

36 hours

If this time is prior to evacuation and subsequent filling with SF₆ gas, the gas compartments must be evacuated or even better evacuated and filled intermediately with 120 kPa abs nitrogen (N₂).

Covering of gas areas with PVC - foil as a humidity protection, without masking with tape and without adding desiccator, is insufficient and inadmissible.

Overhauls, repairs:

In case of overhauls and repairs, the required times should be kept as short as possible.

6.3 Evacuation (air)

6.3.1 All gas compartments (except cable and transformer connection gas compartments)

Note: The vacuummeter is directly connected to the service unit. The values rendered below must be achieved and kept continuously in the gas compartment, however. This requires that for a correct reading of the vacuum in the gas compartment the vacuum pump has to be switched off briefly to achieve a pressure adjustment.

Connect the reclaimer (evacuation and filling device) to the gas compartment, start the vacuum pump and evacuate the gas compartment up to a final vacuum of < 3 mbar. When this value has been reached, the gas compartment must be evacuated for another 2 hours at least.

If the gas compartment was exposed to high atmospheric humidity or had been open for a long time, (> 4 hours), it must be evacuated for longer, i.e. for up to 24 hours.

Pressure rise test: No standard testing required, see chapter 7.3

Humidity in general:

Humidity present in gas compartments can be deposited or stored at varying depths on surfaces or in insulation materials.

Surface humidity can only be partially removed by evacuation and temporarily filling the gas compartment with dry nitrogen N₂ (< 20 ppm_v H₂O).

The change in the humidity of the nitrogen can be measured with the combined measuring instrument 973-ABB.

The admissibility of the resulting humidity balance must be checked with SF₆.

Humidity deposited in insulation materials cannot be removed by evacuation and nitrogen since it diffuses only very slowly. This process can take months or more.

In any cases of uncertainty, please consult the relevant technical department immediately.

6.3.2 Gas compartments with connection to HV cables or transformer bushings

High importance of the humidity in connection with cable – and bushing cones:

Cable terminations and also transformer bushings, with insulating bodies made from casting resin, are hygroscopic and can absorb and store large amounts of humidity as a result **if wrongly handled and stored** (see comment 1).

This humidity would then be given off later to the SF₆ gas of the GIS. The connection compartments are relative small gas compartments, in contrast the hygroscopic cast resin surfaces are big. Therefore problems arise if the following work instructions are neglected. To prevent this type of problem longer evacuation times must be applied here.

Work instructions :

Connect the reclaimer (evacuation and filling device) to the gas compartment, start the vacuum pump and evacuate the gas compartment up to a final vacuum of < 3 mbar. When this value has been reached, the gas compartment must be evacuated for another **24 hours** at least.

The assembly staff is obliged :

- **to impose the technical instructions given on the relevant drawings and delivery regulations to the staff of the cable- and bushing or transformer suppliers.**
- **to pay special attention to the evacuation times during assembly.**

In any case of uncertainty or problems, please consult the relevant technical department immediately.

Comments :

1. The effects of **wrong treatment and storage** of the cast resin parts can only be corrected with a big effort, if ever. These cast resin parts are 3rd party products, see the ABB information to the treatment and storage on the drawings to the delivery scope.
2. Gas compartments which have been filled with SF₆ gas already, and have to be opened for a brief period only, can be evacuated like “normal” gas compartments, i.e. within 2 hours.
3. The above mentioned extended evacuation times do not apply to cable terminations and transformer bushings made from porcelain (not hygroscopic). The evacuation times given under point 6.3.1 are to be used here.

6.3.3 Voltage transformers:

These components are products supplied by third parties and thus require special attention.

Voltage transformers are 3rd products and are supplied filled with 120 kPa abs of SF₆ gas. Consequently, they need only to be filled up to the nominal filling pressure on site.

They can be energized at the earliest 24 hours after the last gas handling under voltage.

Voltage transformers must **not be opened** by ABB staff without **specific** written instructions of the manufacturer as well as of the competent technical ABB departments. The staff of the customer must be informed of the fact!

For work on and in voltage transformers, SF₆ gas handling processes are required which may deviate from the conventional methods applied at ABB. Thus, these processes have to be enquired about and must be applied strictly on site. Any separate rules of the manufacturer must be observed by all means !

In case of uncertainty or problems, please consult the relevant technical department immediately. The special written instructions must be obtained from the competent technical department, if and when required.

6.3.4 Surge arresters:

Surge arrester are 3rd party products und need therefore special attention.

Surge arresters are individual closed gas compartments and are supplied filled with 120 kPa abs SF₆ gas. They need only to be filled up to the nominal filling pressure on site.

Without written instructions of the competent technical department, the surge arresters must not be opened by ABB employees. The staff of the customer must be informed of the fact as well !

All necessary gas handling processes and measuring values of the surge arresters are identical with those of GIS.

The operating instructions have to be observed.

In case of uncertainties or problems, please consult the relevant technical department immediately.

6.4 Leak test / pressure rise test (DAP)

According to the revised regulation 1HC0028728 Chapter 6.2, only disproportionately big leaks can be discovered in a usable time with a pressure rise test (DAP = Druckanstiegsprobe). As a result, a DAP is not required.

Consequently, no general pressure rise tests (DAP) are to be carried out on gas insulated switchgear and PASS components.

Exceptions:

If there is any doubt that a leak may be present, a pressure rise test (DAP) can be carried out nevertheless. It is recommended that at least 24 hours are set aside for this test.

Carrying out a pressure rise test:

After reaching the final vacuum required of < 3 mbar, such a test may be performed. By switching off the vacuum pump, keeping open the connection to the gas compartment resp. hose, a gas compartment or a hose only can be checked for a potential (vacuum) pressure loss using the vacuummeter of the reclaimer (evacuating and filling device). If possible, a separate vacuummeter can be fitted directly to the gas compartment.

The value of < 3 mbar reached during evacuation must not exceed 3 mbar within the specified time (such as 24 h).

It must be ensured that the (vacuum) pressure rises are not taken for (internal) pressure losses of SF₆ gas pressure. Gas compartments must be tight under pressure.

For information on leak testing please refer to Chapter 7.1

6.5 Filling with SF₆ gas

SF₆ gas specification in accordance with IEC 60376 or IEC 60480.

Please note that the temperature of fast filled SF₆ gas is relatively low, i.e. in the range of 3 - 10° C.

For the leak test as prescribed by chapter 7.1, the gas compartments must be filled with an "intermediate filling pressure" of about 300 kPa (p abs at 20° C) normally. The test should be carried out as late as possible after filling.

To achieve a correct filling pressure in accordance with the prevailing compartment or enclosure temperature, the gas compartment must not be filled immediately to nominal filling pressure, but only to a pressure about 20 - 30 kPa abs below this value.

After between 6 and 12 hours the gas temperature can be adjusted to the compartment or enclosure temperature. The gas compartment can be then filled to nominal filling temperature in accordance with the temperature.

In order to guarantee a correct fill of the switchgear and thus the correct operation of all devices, the gas compartments must be filled with the nominal filling pressure with a tolerance of **0 / +5 kPa**.

6.6 Reclaiming the gas

Connect the gas compartment with a hose, if necessary via pre-filter unit, to the reclaimer and to a storage tank or gas bottle.

Before starting the reclaimer it must be ensured that there is enough capacity to store the gas.

Reclaim the SF₆ gas up to < 1 mbar and store, then ventilate the gas compartment for internal work.

See also chapter 3, Safety

If the SF₆ gas is to be returned from the gas compartment to a bottle/tank, it must be ensured that the reclaimer, the hoses used and the storage tanks/bottles as well are always filled with SF₆ gas.

If the quality of the gas is not clear, then a pre-filter unit is to be installed between the gas compartment and the reclaimer in order to keep any potential contamination away from the reclaimer.

Reclaimers, fitted with compressor and vacuum pump, create a vacuum of < 1 mbar during gas evacuation. This means that 100 % of the SF₆ gas in the gas compartment is evacuated and stored.

But it is a prerequisite that enough time is scheduled and allowed for this process.

Please refer to the details in the overview of "SF₆ Gas Handling Equipment 1HC0025668".

In order to prevent the SF₆ gas cylinder from being overfilled, the process must always be monitored and the bottles / tanks to be filled acc. to its weight.

Attention: The compressor is only switched off when a pressure of ~46-48 bar is reached.

6.7 Labeling the gas cylinders (bottles) / gas containers (tanks)

Every gas bottle, every tank, every service equipment must be fitted with a label (1HC0017417 or the like) by the **assembly staff** and be clearly and unambiguously labeled as regards content. This means that the contents of every gas bottle can be unambiguously identified at all times.

Scotch tape and marking pens shall not be used directly on the bottle / tank.

This is necessary for correct storage on site, transport on public roads and the continued use of the gas.

Definitions for bottle or tank „empty“:

- | | | |
|---------------|--------|--------------------------------|
| - 20 to 54 kg | bottle | remaining gas quantity 1.5 kg |
| - 600 kg | tank | remaining gas quantity 10.0 kg |

Requirements for the recycling:

- | | | |
|---------------|--------|--|
| - 20 to 54 kg | bottle | remaining gas quantity not less than 1.5 kg |
| - 600 kg | tank | remaining gas quantity not less than 10.0 kg |

6.7.1 Gas cylinders (bottles) / gas containers (tanks)

For various gases or their qualities, different containers are required.

In Europe, **new gas** according with IEC 60376 is usually supplied in green cylinders with sealed valves (Solvay Company). In case of sealed gas cylinders, the manufacturer guarantees the quality of the gas and the cylinder.

The same cylinders can be used for used gases in keeping with IEC 60480. But here has to be ensured that gas quality in the cylinders correspond to the requirements, code UN 1080

6.7.2 Used gas, contaminated gas

Used gas which is not used again or cannot be used again must be filled in special cylinders, if the value of the decomposition product is > 50 ppm_v. They are also used for special transport.

Specification of the gas: Toxic and corrosive, code UN 3308

SF₆ gas with too high share of different gases, such as air or nitrogen, is not toxic and/or corrosive and can be transported in both types of cylinders.

Cylinder color: Grey with yellow shoulder, connecting thread G1"

Detailed information to be obtained from the competent technical department or from every shipping agent for transport.

6.8 SF₆ gas balance

In case of every on site gas handling, be it new installation, repair or maintenance, the gas balance must be prepared in keeping with 1HC0070163 D01+E01. The appertaining form with instructions 1HC0070163 D02+E02 must be used.

The filled-in form must be forwarded to the Project Manager Site Installation (MPL) with all protocol sheets and the installation report.

7 Tests

7.1 Leak test / searching for leaks

All flange connections assembled on site must be leak tested according to Instructions "1HC0072875, Leakage searching at gas compartments on site", as required in IEC. This should be done at a "intermediate pressure" of about 300 kPa abs.

These connections must be checked with the leakage detector. These tests shall be done as late as possible after the filling with gas accomplished.

The results must be reported by appropriate protocol form "Evacuation und SF₆ gas filling". If leakages are found, they must be located and eliminated according to the procedure below.

If leaks are suspected or measured, the gas compartment should be filled with SF₆ gas to a slight overpressure of 150 - 200 kPa abs. It can then be scanned with any commercially available leak detector. Leak detector spray or soapy water can also be used.

When searching for leaks in the open air where the wind can make locating the leak difficult, and also with very small leaks, the suspected leak spot must be wrapped loosely in PE film and then sealed with adhesive tape. After a few hours waiting time any SF₆ gas present and the leak can be located and indicated with the leak detector passing through a small hole.

Before any repairs are made, all the SF₆ gas must be reclaimed and stored.

An additional leak test can also be run with a precision manometer permanently installed in the gas compartment for an extended period of time.

7.1.1 Leak test / searching for leaks after repair / overhauls

After each repair resp. overhaul a leak test must be performed and logged. Detailed procedure as in chapter 7.1

7.2 Measurements (pressure, humidity, SF₆ percentage, decomposition products)

All gas compartments must have their pressure, humidity and SF₆ percentage checked after being re-filled. These values must be logged. (See also chapter 7.3)

The responsible technical department is to be consulted if any deviations occur or values are exceeded.

7.2.1 Dew point / humidity in °C / ppm_w

ABB - CH - GIS measures the dew point of the gas in °C with the instruments available to us. Since the limit values have been defined in regulations and operating instructions and also in humidity values like ppm_w, the humidity value in ppm_w is to be derived by means of the available tables and graphs.

Newer devices indicate these different values directly on screen. Since any humidity present in insulation materials diffuses only very slowly and is absorbed by the SF₆ gas, this measurement should be taken as late as possible after the gas filling so that the most realistic values possible are measured.

Ideally, this is 2 - 3 weeks after filling to nominal filling pressure.

If the humidity value is above the limit values, the SF₆ gas must be dried and then re-measured after 2 - 3 weeks.

This is to be done in accordance with the instructions from ABB's responsible technical departments.

Preferably, the measuring instruments ABB – CH has should also be used for this test.

In general it must be ensured: that the humidity present in individual materials is not removed by an SF₆ gas exchange or by drying the gas via filters.

(See values section 7.8)

7.2.2 Percentage of SF₆ gas

In contrast to IEC and CIGRE, ABB does not measure and define the percentage share of foreign gases, but the percentage share of SF₆ gas in the gas compartment.

(Measured values in chapters 7.6 to 7.9)

7.2.3 Decomposition products in ppm_v

In general, this measurement is done in accordance with the details in chapter 7.9. But in special cases, and also at the request of the customer, all gas compartments can be measured.

Most instruments measure the decomposition products with chemical reaction tubes.

7.3 Measurements when assembling switchgear

The measured values to be collected can be used both as reference values for later measurements during checks, diagnostics and also as guarantee values for the new product.

The following measurements are to be made and logged:

- Dew point and humidity measurements	100%	in all gas compartments
- SF ₆ gas percentage measurements	100%	in all gas compartments
- Decomposition products measurements		no measurements required
- Gas pressure measurements	100%	in all gas compartments

7.4 Measurements during checks, diagnostics

(Gas compartments which are **not** opened)

Attention:

It must be ensured **in advance** that if any of the customers' own instruments are to be used, they are in perfect working order.

The following measurements are to be made and logged:

- | | | |
|---|------|-------------------------|
| - Dew point and humidity measurements | 100% | in all gas compartments |
| - SF ₆ gas percentage measurements | 100% | in all gas compartments |
| - Gas pressure measurements | 100% | in all gas compartments |

We recommend to perform and to log the following measurements in addition:

(According to the clients wish or the results of the measurements, also more measurements may be performed.)

- | | | |
|---------------------------------------|------|--|
| - Decomposition products measurements | 10 % | at circuit breaker gas compartments |
| - | 5 % | at disconnector gas compartments |
| - | 5 % | at fast earthing switch gas compartments |
| - | 5 % | all other gas compartments |

If, however, measurements are to be done that are **fewer in number than or different from those** required, this must be agreed beforehand with the responsible technical department.

Requirements must not be changed without positive feedback from the respective department.

Gascompartments which will not be measured regularly, we recommend to measure a certain of on alternating basis (see above) e.g. every 2 - 5 years.

This means that all gas compartments of a complete switchgear installation can be covered sooner or later.

In addition, all gas compartments with diverging measured values of the gas quality shall be monitored specifically.

Suspect devices, like density monitors or contact manometers, must be monitored or replaced.

7.5 Measurements during overhaul / repair work

All following measurements are to be performed, logged on the given protocol forms and always to be counter-signed by the client :

- before the gaswork starts
- as soon as gas compartments are opened
- as soon as pressure is lowered in gas compartments

For definition in the following text :

The gas compartments “involved” are those being worked on or also where only the pressure is lowered.

7.5.1 Measurements before reclaiming the gas

The gas quality measurements, as also defined in IEC, are to be made on **ALL** gas compartments **INVOLVED** and logged **BEFORE** the start of the assembly work, i.e. before reclaiming the SF₆ gas

- Dew point resp. humidity measurements in all gas compartments involved
- SF₆ gas percentage measurements in all gas compartments involved
- Decomposition products measurements in all gas compartments involved

- Gas pressure measurements in all gas compartments involved

These measurement results are used

- to identify at an early stage any technical problems in the gas compartments due to gas quality
- to make technical and operational proposed solutions to the customer and ABB
- in order not to allow any explanation problems to arise in the event of poor gas quality in gas compartments or bottles after overhaul or repair work

Assure absolutely :

It must be ensured **in advance** that if any of the customers' own reclaimers and / or instruments are to be used, they are in perfect working order. Please check according to the manual.

It must be ensured that the gas quality measurements are made **before and after** start / completion of the proper gas handling work. This ensures that the clear responsibilities of the customer and ABB are set out.

Pay attention to the duty to inform :

If deviations occur in the **percentage of SF₆** (ABB internal limit values at new fillings, resp. IEC limit values at gas analysis) during the gas quality measurements **before** the start of work, the **customer and technical department** are to be informed immediately in order to be able to take the appropriate measures.

(Reason: On site the percentage of SF₆ cannot be improved, probably a new gas filling may be necessary).

If deviations occur of any of the values during the gas quality measurements after completion of the work, the **technical department** is to be informed immediately in order to be able to take the appropriate measures.

7.5.2 Measurements after replenishing the gas compartment with gas

Gas quality and pressure measurements are to be made on completion of the assembly work, too :

- Dew point and humidity measurements in all gas compartments involved
- SF₆ gas percentage measurements in all gas compartments involved
- Decomposition products measurements 5 % of the gas compartments involved

- Gas pressure measurements in all gas compartments involved

7.6 Desired values of new SF₆ gas in accordance with IEC 60376
(bottles sealed)

Table 1

Measurements	Limit values
Percentage of SF ₆	> 99.90 %
Decomposition products (total)	< 7.3 ppm _v
Dew point	≤ - 36° C (100 kPa abs, 20° C)

Conversion: ppm_v : ppm_w = 8.1:1

7.7 Desired values of used SF₆ gas in accordance with IEC 60480
(prior to re-use in a gas compartment)

Table 2

Measurements	Limit values
Percentage of SF ₆	> 97 %
Decomposition products (SO ₂ & SOF ₂)	< 12 ppm _v
Dew point (recommended value)	≤ - 23° C (100 kPa abs, 20° C)

Conversion: ppm_v : ppm_w = 8.1:1

7.8 Humidity + percentage limits

For new systems / overhaul / repair of switchgear

For all GIS and PASS products

On completion of the assembly work on switchgear, lower dew point and humidity values are to be complied with in order to be able to comply with the values required for new systems / overhauls / repairs of switchgear, even after the warranty period and in the subsequent operation of the system.

Table 3

Measurements	ABB - CH - GIS / PASS limit values for new build systems	
	Gas compartments with nominal filling pressure 680 and 700 kPa abs	Gas compartments with nominal filling pressure 420, 460, 480, 530 kPa abs
Percentage of SF ₆	> 97 %	> 97 %
Decomposition products (SO ₂ & SOF ₂)	< 12 ppm _v	< 12 ppm _v
Values for humidity at new installed switch- gear respective filling with new SF ₆ gas	< 37 ppm _w	< 60 ppm _w

Conversion: ppm_v : ppm_w = 8.1:1

Test values for dual pressure bushings used earlier are to be requested from the responsible technical department.

7.9 Limits humidity, percentage + decomposition products

on switchgear in service

(Limit values for SF₆ gas that does not need to be reclaimed from the gas compartment)

For all GIS and PASS products

Table 4

Measurements	Limit values (used gas)	
	Gas compartments with nominal filling pressure 680 and 700 kPa abs	Gas compartments with nominal filling pressure 420, 460, 480, 530 kPa abs
Percentage of SF ₆	> 97 %	> 97 %
Decomposition products (SO ₂ & SOF ₂) ¹	< 250 ppm _v Exception: Voltage transformer: 25 ppm _v	< 25 ppm _v
Values for humidity in operation ²	< 50 ppm _w	< 90 ppm _w

Conversion: ppm_v : ppm_w = 8.1:1

Test values for dual pressure bushings used earlier are to be requested from the responsible technical department.

Comment:

If the SF₆ gas remains in the gas compartment, 100 ppm_v counts as the limit value of the total of **all** reactive gaseous decomposition products in the gas compartment of GIS or PASS. (Exept CB) This is double the value of used gas under IEC 60480. A maximum value of **250 ppm_v for SO₂ + SOF₂** applies to the gas compartment of a switchgear, measured with standard instruments.

¹ Reference: Cigre Task Force B03.02.01, SF₆ Recycling Guide (Revision 2003), Table 9

< 12 ppm_v is warranted to the client for new build systems / overhauls / repairs

² These values are warranted to the client for new switchgear / overhauls / repairs

8 SF₆ Gas Handling at LTB Products

Transport

For the transport of ELF circuit-breakers the pressure in the SF₆ gas compartment must be lowered to 120 kPa abs (\approx 0,2 bar over pressure).

Disassembly

Before the disassembly the SF₆ gas compartment pressure must be lowered up to a value smaller than 20 mbar.

Subsequently, flood the gas area with air.

IEC 62271-303, Table 13, Item 4, Page 32

Evacuating

Evacuate until $p_{\text{abs}} = 300 \text{ Pa}$ ($< 3 \text{ mbar}$) is reached. The vacuum pump must keep running at least 2 hours. Subsequently, supervise the vacuum during 2 further hours.

The vacuum may not change within this time. With a found leak, fill the circuit-breaker with $p_{\text{abs}} = 200 \text{ kPa}$ ($\approx 2 \text{ bar}$) SF₆ gas, look for leakage (Leakdetector) and repair.

Gas bottle

With new SF₆ gas the dew point must be equal or lower than -41°C ($\approx 5 \text{ ppm}_w$).

Gas from gas compartments

Gas from a gas compartment, that after overhaul respectively repair work is filled into the same gas compartment again, must correspond to IEC 60480. (See table in section 7.8)

New filled in SF₆ gas must have in the gas compartment a SF₆ percentage of min. 97 as well as a dew point equal or lower than -29°C ($\approx 50 \text{ ppm}_w$).

The decomposition products must be equivalent or less than 12 ppm_v .

In circuit-breakers in service, (without SF₆ gas handling) the decomposition products may reach maximally 250 ppm_v .

9 Tables

9.1 Nominal filling pressures in relation to the ambient temperature

Table 5

Temperature in °C	Nominal filling pressures in kPa abs							
-20	572	556	533	440	400	384	352	128
-18	578	563	539	444	404	388	355	129
-16	585	569	545	449	408	392	359	130
-14	591	575	551	453	412	395	362	131
-12	598	582	557	458	416	399	365	133
-10	605	588	563	463	420	403	369	134
-8	611	594	569	467	424	407	372	135
-6	618	601	575	472	428	411	376	136
-4	624	607	581	476	432	415	379	137
-2	631	613	587	481	436	419	383	138
0	637	619	593	485	440	422	386	139
2	643	625	598	490	444	426	390	140
4	650	632	604	494	448	430	393	141
6	656	638	610	499	452	434	396	142
8	662	644	616	503	456	438	400	144
+10	669	650	622	508	460	441	403	145
12	675	656	627	512	464	445	407	146
14	681	662	633	517	468	449	410	147
16	688	668	639	521	472	453	413	148
18	694	674	644	526	476	456	417	149
+20	700	680	650	530	480	460	420	150
22	706	686	656	534	484	464	423	151
24	712	692	661	539	488	467	427	152
26	719	698	667	543	492	471	430	153
28	725	704	672	548	496	475	433	154
+30	731	710	678	552	499	479	437	155
32	737	716	684	556	503	482	440	156
34	743	722	689	561	507	486	443	158
36	749	727	695	565	511	490	447	159
38	755	733	700	569	515	493	450	160
+40	761	739	706	574	519	497	453	161
42	767	745	711	578	523	501	456	162
44	773	751	717	582	526	504	460	163
46	779	757	722	586	530	508	463	164
48	785	762	728	591	534	511	466	165
+50	791	768	733	595	538	515	470	166

Acc. to :
Döring

9.2 Conversion of dew point °C into humidity ppm_w

Table 6

SF ₆ gas dew point in °C / Humidity values in ppm _w					
Dew point °C	Humidity ppm _w	Dew point °C	Humidity ppm _w	Dew point °C	Humidity ppm _w
-60	1.3	-32	37	-4	539
-59	1.5	-31	42	-3	586
-58	1.7	-30	47	-2	637
-57	2	-29	52	-1	693
-56	2.2	-28	56	0	753
-55	2.5	-27	64	1	809
-54	2.9	-26	71	2	869
-53	3.3	-25	79	3	934
-52	3.6	-24	86	4	1002
-51	4.2	-23	95	5	1074
-50	4.8	-22	104	6	1155
-49	5.4	-21	115	7	1236
-48	6.1	-20	127	8	1317
-47	6.9	-19	140	9	1418
-46	7.8	-18	154	10	1509
-45	8.7	-17	169	11	1621
-44	10	-16	185	12	1722
-43	11	-15	204	13	1844
-42	12	-14	224	14	1965
-41	14	-13	243	15	2097
-40	16	-12	267	16	2239
-39	17	-11	293	17	2391
-38	20	-10	320	18	2543
-37	22	-9	348	19	2705
-36	24	-8	381	20	2877
-35	27	-7	415		
-34	30	-6	454		
-33	34	-5	494		

Symbols: °C = degrees Celsius
 ppm = parts per million
 wt or _w = weight, mass
 v = volume

Conversion: ppm_v in ppm_w = 8.1 : 1

10 References

Basic documents	SF ₆ self-obligation CH		
	ABB position statement on sulfur hexafluoride (SF ₆)		
	Directive (EC) No. 842/2006 on certain fluorinated greenhouse gases including labelling and certification		
Directive	ABB SF ₆ Gas Handling Guide		1HC0018511
	Overview SF ₆ Gas Handling Equipment		1HC0025668
SF ₆ Operating Instruction (OI)	OI on handling sulfur hexafluoride SF6		1HC0028459
	ABB - CH - GIS project specific Health & Safety - Plan		project specific
Standards	IEC 60376 Rev. 2 (new gas)		
	IEC 60480 Rev. 2 (used gas)		
	IEC 62271-303 / 2007		
Technical Instructions	Differential pressures at insulators	ELK3 (ISPESL)	1HC0041561
		ELK-14 / 362 SS 550	1HC0041562
		ELK-14 / 245	1HC0041563
		ELK14 to ELK-14 / 300	1HC0041564
		ELK-3 / 420	1HC0041565
		ELK3 to ELK-3 / 550	1HC0041566
		ELK1	1HC0041568
		ELK2	1HC0041569
	Pressure coordination	ELK-5	1HC0046369
		All these instructions for differential pressures consist of two parts :	
	- Text for clients of the Operating Instruction (OI)		project specific
	- Comments for staff and deduction		
	Fundamental principles of revising SF ₆ Gas Handling		1HC0028728
	Instructions "Leakage detection at gas compartments on site"		1HC0072875
	Protocol form "Evacuating and SF ₆ gas filling"		221 02030
	Protocol form "Gas measurements"		22104010

Table 7

11 IEC 60376, New gas

“Table from IEC 60376 - Maximum acceptable impurity levels

Content	Specification	Analytical methods (for indication only, not exhaustive)	Precision
Air	2 g/kg [note 1]	Infrared absorption method	35 mg/kg
		Gas-chromatographic method	3 – 10 mg/kg
		Density method	10 mg/kg
CF ₄	2 400 mg/kg [note 2]	Gas-chromatographic method	9 mg/kg
H ₂ O	25 mg/kg [note 3]	Gravimetric method	0,5 mg/kg[note 5]
		Electrolytic method	2 – 15 mg/kg
		Dew point method	1 °C
Mineral oil	10 mg/kg	Photometric method	< 2 mg/kg
		Gravimetric method	0,5 mg/kg [note 5]
Total acidity expressed in HF	1 mg/kg [note 4]	Titration	0,2 mg/kg
<p>NOTE 1 2 g/kg is equivalent to 1 % vol under ambient conditions (100 kPa and 20 °C [1]).</p> <p>NOTE 2 2 400 mg/kg is equivalent to 4 000 µl/l under ambient conditions (100 kPa and 20 °C [1]).</p> <p>NOTE 3 25 mg/kg (25 mg/kg) is equivalent to 200 µl/l and to a dew point of –36 °C, measured at ambient conditions (100 kPa and 20 °C [1]).</p> <p>NOTE 4 1 mg/kg is equivalent to 7,3 µl/l under ambient conditions (100 kPa and 20 °C [1]).</p> <p>NOTE 5 Depending on the sample size.</p>			

.....”

Table 8

12 IEC 60480, Used gas

“Table from IEC 60480 - Maximum acceptable impurity levels

Impurity	Maximum acceptable levels	
	Rated absolute pressure <200 kPa ^a	Rated absolute pressure >200 kPa ^a
Air and/or CF ₄	3 % volume ^b	3 % volume ^b
H ₂ O	95 mg/kg ^{c,d}	25 mg/kg ^{d,e}
Mineral oil	10 mg/kg ^f	
Total reactive gaseous decomposition products	50 µl/l total or 12 µl/l for (SO ₂ +SOF ₂) or 25 µl/l HF	

^a Within the complete range of re-use pressures, covering all possible applications (both HV and MV insulation systems as well as all circuit-breakers), the low re-use pressure range $p < 200$ kPa has been defined to highlight low pressure insulation systems (typically applied in MV distribution).

^b In the case of SF₆ mixtures, the levels for these gases shall be specified by the equipment manufacturer.

^c 95 mg/kg (95 ppmw) is equivalent to 750 ppmv (750 µl/l) and to a dew point of -23 °C, measured at 100 kPa and 20 °C.

^d Converted to ppmv these levels shall also apply to mixtures until a suitable standard becomes available.

^e 25 mg/kg (25 ppmw) is equivalent to 200 ppmv (200 µl/l) and to a dew point of -36 °C, measured at 100 kPa and 20 °C.

^f If gas handling equipment (pump, compressor) containing oil is used, it may be necessary to measure the oil content of the SF₆. If all equipment in contact with the SF₆ is oil-free, then it is not necessary to measure oil content.

.....“

ABB		ABB Switzerland Ltd		Document number 1HC0016974
Unit High Voltage Products	Created Kyburz Theo	Version AC	Document part E01	Document type ANW
Status Released	Last change Zimmer Klaus-Detlef		30.07.2009	

DEW POINT MEASUREMENT INSTRUCTIONS

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1 Document determination

1.1 Purpose

All gascompartments in the installation are to be checked for moisture and purity (%-SF₆)
To furnish proof that the SF₆-gas insulated equipment will not exceed the maximum admissible humidity in operation.

1.2 Applicability

SF₆-Gas Insulated Switchgear of ABB Switzerland Ltd. and associated components.
Site Manager, Erection-Supervisor

1.3 Terms and abbreviations

1.4 Responsible department

PTHS-F, Field Operation

1.5 Derived from

1HC0016974 Vers. AB Dew Point Measurement Instructions

2. Procedure

2.1. Scope of test

The measurement should be done during the commissioning after the filling of the components with gas after a balance of eventual equalisation phenomena in the distribution of moisture in the gas compartment.

2.2. Acceptability criterion (see table 3 and 4)

In this commissioning measurement the measured moisture content (in ppm mass, ppm_w) may not be higher than 75% of the limit value specified for the installation. Compartments with excessive moisture content are to be dried and measured after 2 to 3 weeks.

Note: For the initial commissioning measurement more stringent values apply to account for eventual equalisation phenomena in the distribution of moisture in the gas compartment.

3 Further applicable documents

IEC 60480 and IEC 60376
ABB 1HC0007414
ABB 1HC0028659 SF₆-Gas Handling On-Site

5. Responsibility

6. General

The dew point measuring instruments, Model DP19 as well as 973-ABB, manufactured by MBW Electronic AG, Wettingen, Switzerland is preferably to be used.
For Purity Measurements only the DILO Instrument 3-027 R002 shall preferably be used.

7. Measurements

For the purpose of avoiding contradictions, as a general rule the measurement is always carried out with the gas depressurised means atmospheric pressure.

- With Model DP19, the gas flows through the hygrometer in pressureless condition. This state is achieved by completely opening the shutoff valve on the flowmeter as well as by regulating the gas flow rate with the inlet regulating valve. With the flowmeter set at 30l/h this will result in a measurement pressure of 100 kpa abs in the measuring chamber.

- With Model 973-ABB no further pressure regulations have to be done because this instrument is regulating the pressure automatically.

7.2. Measurements with Instrument Model DP19

7.2.1. Preparation

Attention:

Do not close the control valve and the flow meter by force! Both are needle valves and there is danger of deformation and leakage.
See also manual of the instrument

7.2.2. Connecting the Instrument

First make the necessary connections between sampling point and instrument. Close control valve and flow meter completely.

Plug in the mains lead and switch the instrument on (press the MAINS-button). Then press the MODE-button. Both buttons are now illuminated. After 5 min. warm-up mirror check indicator should in the centre of the red zone.

7.2.3. Measurement at Atmospheric Pressure (100kPa abs.)

Close control valve completely.

Open flow meter valve completely.

Open control valve slowly until the required gas flow of 30 to 40 l/h is indicated.

7.2.4. Measurement

Before releasing the MODE-button, check dew-point mirror condition. The indicator needle must be approx. in the middle of the red field.

Release MODE-switch (light is off). Instrument starts cooling down to the dew point and the needle of mirror check indicator moves into the green field.

Wait until the indication of the digital display is stable.

Read dew point.

Important

When measuring more than one point, make shure that the inlet valve at the hose is closed during changing the measurement point.

It is not necessary to thaw off the instrument between measurements.

7.2.5. Terminating the Measurement

Close control valve and flow meter completely.

Press MODE-button (now illuminated)

Switch instrument off (release MAINS-switch, light is off).

Disconnect sample gas line from instrument and measuring point.

7.3 Measurements with Instrument Model 973-ABB

The instrument 973-ABB is a fully automatic instrument. It is capable to measure Dew Point, calculating the respective Humidity, is measuring the purity (% of SF₆), is feeding back the measured gas into the connected gas-compartment and is measuring the SF₆-Gas pressure in the gasroom.

Detailed informations regarding handling see manual.

Table 2: Limit values for admissible moisture content on GIS Type ELK 1-4

Component	Filling pressure at 20°C kpa abs	Moisture Limit during service ppm _w	Moisture Limit at commissioning ppm _w
Gascompartement	680	50	37
Gascompartement	700	50	37
Gascompartement	420	90	60
Gascompartement	460	90	60
Gascompartement	530	90	60

ABB	ABB Switzerland Ltd			Document number 1HC0017413
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DENSITY MONITOR TEST INSTRUCTION

1

Contents:

1. Purpose
2. Applicability
3. Standards
4. Procedure
5. Responsibility
6. General
7. Test procedure

1. Purpose

To furnish proof that keep the density monitors for the SF6 gas insulated Switchgear the prescribed and adjusted values, supplied by the company trafag, Switzerland.

2. Applicability

SF6 gas insulated Switchgear of ABB High Voltage Technologies Ltd. and appendant components.

3. Standards

IEC 60157 cl. 7.107.3

4. Procedure

The check of function during the commissioning is to be performed on random basis (10%).

Checking of set points in service to be made as per station manual at 5-year intervals.

4.1. Check of function of density monitor

The functioning and the adjustment of each density monitor must be checked for:

Adjustment of switching contacts

Hysteresis of switching contacts

Tripping of required signals

Resetting of the signals

All measured values are to be recorded in the commissioning report.

(HAEM 822210 and HAEM 824250)

Note: With density monitors (electronic) the operation check is not necessary, as the density monitors comprise self-checking function.

4.2. Checks setting values

With Switchgear installations see table and diagrams on the instructions manual of installation.

5. Responsibility

Site Manager, Erection-Supervisor

6. General

The density controller test box, SK-509-R002, made by DILO Babenhausen, Germany is preferably to be used.

7. Test procedure:

Using the rating plate values on the density monitor check whether the switching points of the micro switch or the pressure values on the pressure gauge are identical with the set point values of the reference value tables.

When checking always takes into account the ambient temperature, i.e. establish the desired tripping value. If the read pressure value is not within the tolerance of the tabulated value, the entire density monitor is to be sent to trafag for overhaul.

Attention: Since without the appropriate equipment adjustment of the micro switches in the plant is very difficult, the manufacturer should do the adjustments only.

7.1. Description:

The switch point of the density controller can be checked with the density controller test unit.

For testing the density controllers are mounted on the buffer container.

The test pressure is indicated at the gauge. The indicator lamp in the indicating unit lights up when the corresponding switch contact is closed.

SF6-gas over the coupling or compressed air, which is generated by means of the air pump, is used as testing medium.

The indicating unit is supplied by 4 batteries of 1.5V each, which are commercially available.

All parts are easy to locate and easily accessible.

A transport box is included to store the density controller test unit with its accessories.

Connecting cables are necessary in order to connect the density controller test unit with the density controller. These connecting cables are equipped with a plug for the indicating unit and for the density controller, which are delivered with the unit.

Table 1: Nominal filling pressure (Pabs) by SF6-Switchgear of Type ELK 1 till 4 in function of ambient temperature

Symbols: °C = degree centigrade
 kPa = 1000 Pascal
 100 kPa = 1 bar

Temperature	Components			Circuit breaker
°C	kPa	kPa	kPa	kPa
0	388	425	570	640
2	391	428	575	646
4	394	432	580	652
6	397	436	585	658
8	400	439	590	664
10	404	443	595	670
12	407	446	600	676
14	410	450	605	682
16	413	453	610	688
18	417	457	615	694
20	420	460	620	700
22	423	464	625	706
24	426	468	630	712
26	430	471	635	718
28	433	475	640	724
30	436	478	645	730
32	440	481	650	736
34	443	485	655	742
36	446	488	660	748
38	449	492	665	754
40	452	495	670	760

Table 2: Nominal filling pressure (Pabs) by SF6-Switchgear of type ELK14 in function of ambient temperature

Symbols: °C = degree centigrade
 kPa = 1000 Pascal
 100 kPa = 1 bar

Temperature	Components	Circuit breaker Potential transformer	Bushing (Low pressure gas space)
°C	kPa	kPa	kPa
0	480	620	135
2	485	626	
4	490	632	
6	495	638	
8	500	644	
10	505	650	145
12	510	656	
14	515	662	
16	520	668	
18	525	674	
20	530	680	150
22	535	686	
24	540	692	
26	545	698	
28	550	704	
30	555	710	155
32	560	716	
34	565	722	
36	570	728	
38	575	734	
40	580	740	160

ABB	ABB Switzerland Ltd				Document No.: HAGS 30193
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ASSEMBLY AND COMMISSIONING ELK PI

SF6 Switchgear ELK

1 Transport

The voltage transformer is delivered prepared for use. It is filled with SF₆ to 120...130 kPa absolute pressure. Transport is carried out in the vertical position (axis vertical) with the apparatus insulator above. The latter is protected by a cover for transport, which must be removed only briefly before assembly of the voltage transformer.

Important note - observe without fail

(Data and requirements differ according to make and year of manufacture.)

The voltage transformers may be tilted and lifted only in the plane shown by an arrow on the plate on the jacket of the pressure vessel. The direction of transport must also be that shown by the arrow.

Attention : Every voltage transformer must be checked before assembly for transport damage.
(for procedure, see separate instruction)

2 Assembly

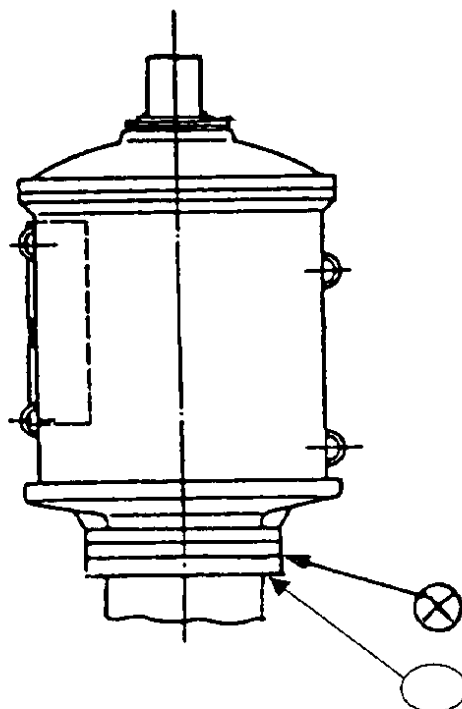
- Remove protective transport cover from the apparatus insulator.
- Check flange surface, sealing groove, contact surfaces and the other surfaces of the apparatus insulator for transport damage and clean with a white, lint-free cloth.
- Mount contact with shield on the apparatus insulator.
- For outdoor installations, apply corrosion protection as in Section 3.
- Insert sealing ring and mount on the SF₆ installation.
- Be sure to observe direction of tilt and position of attachment
(marked by an arrow on the enclosure)
- Make secondary connections in the terminal box of the voltage transformer.
With devices whose secondary connections can be changed: check the connection against the circuit diagram or instructions (in the terminal box) and change if necessary.
- Attention : Before the voltage transformer is put under tension (test or operating voltage), all short circuits (in the transformer and the switching cabinet) must be removed.
- Connect and adjust the ferromagnetic resonance protection, if present.
- The terminal box has ventilation openings. The closing plugs supplied must be inserted according to the orientation of installation such that water cannot penetrate from above (rain) and any condensation can run off (differs according to make, type of transformer and year of manufacture).
- Prepare SF₆ gas space of switchgear for gas filling and carry out filling.
- Connect the voltage transformer with the bypass tube ELK RR provided to the switchgear gas space, if the latter is not monitored as a separate gas space with density monitor.
(Take care that the voltage transformer is filled only with pure SF₆ gas to IEC Publ. 376)
- In the case of voltage transformers with rupture disc attachment, the deflection device provided must be adjusted, if necessary, to a direction determined by the installation conditions pertaining.

3 Section to be observed for OUTDOOR ERECTION

On mounting the voltage transformer on the installation, the flange connections must be protected against corrosion.

⊗ Corrosion protection No. 1 HAGS 30 074

○ Corrosion protection HATH 600 355



4 Remark

- As a rule, the voltage transformer is attached to the installation only after the latter has been tested. The voltage transformer must be separately tested if required in the technical documents.

Furthermore, the supplier's operating instructions apply for the voltage transformer concerned.

ABB		ABB Switzerland Ltd		Document number HASV600016
Unit High Voltage Products	Created Rodrigo Miguel	Version AG	Document part 002	Document type ANW
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ASSEMBLY FILTER WITH MOLECULAR SIEVE 5A

Chapter	<u>CONTENTS</u>	Page
1	Material properties and general indications	2
2	Packing (State of delivery).....	2
3	Storage	2
4	Inspection, Test	2
5	Handling, Installation, Transport	2

Chapter Number	A	B	C	D	E	Used for :
1	1, 2	1, 3	1, 2	1	-	Delivery Instructions Filter bag HATH410311
2	-	1, 3	1, 2	2	1, 4	Assembly of filter at apparatus flange and circuit - breaker
3	1	2, 3	2	-	-	Delivery Instructions Filter complete HASV301185
4	-	2, 3	1, 2	2	5, 6	Assembly of filter at flange with normal rupture disk
5	-	2, 3	1, 2	2	5, 7	Assembly of filter at flange of earthing switch and flange with reverse rupture disk

1 Material properties and general indications

- 1.1 Material of filter :** Molecular sieve 5A - 501, grain size 1 - 3
- 1.2 Filter bags :** Polyesters (Spezifikation according to drawing)

2 Packing (State of delivery)

- 2.1 Filter bag filled with molecular sieve vacuum-packed shrink-wrapped individually into PE foil by min. 0.3 mm of thickness with 8% card indicator. Individual filter bags packed in all side stuck together boxes.
Packing size 12 pieces each box**
- 2.2 1 piece filter completely vacuum-packed shrink-wrapped into PE foil by min. 0.3 mm thickness with 8% card indicator. Additional packing for storage and transport :
Pack 12 bags in all side stuck together cardboard boxes.**
- 2.3 Additional packing for spare part see drawing**

3 Storage

- 3.1 Storage of filter bags filled with molecular sieve in dry place in the delivered state (see B1 or B2) at ambient temperature.**
- 3.2 To be stored during max. 6 months in the indicated packing in dry place.**

4 Inspection, Test

- 4.1 Incoming goods check :** Enclosed humidity indicator must be blue.
- 4.2 Gas tightness test :**
The leakage of the mounting of filters is tested at the entire assembly unit or installation

5 Handling, Installation, Transport

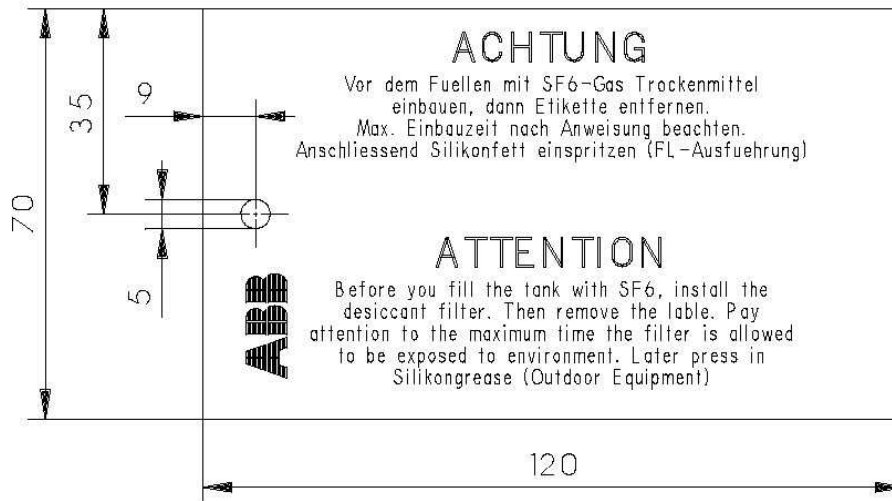
5.1 Mounting of filter at circuit - breakers

- a) On site assembly
With all circuit - breakers of the size 1+3 without own insulator the filter bag will be mounted on site. Supply as loose piece.
Packing according to B1. Work procedures according to variant 0 (see table page 4)
- b) Factory - assembly
With all circuit-breakers of the size 1+3 with own insulator the filter bag will be mounted by the assembly crew at the test place. Work procedures according to variant 1 (see table page 4)

For the variants of mounting of filter the cover with the empty filter pot is already installed to the breaker at the begin in the assembly department. Outside at the flange with the empty filter cover a label HAFA413494P0001 has to be attached.

HAFA413494

P1



5.2 Mounting of the filter at assembly units (components)

- The filter pot will be installed during the assembly unit assembly.
- Outside at the flange with the empty filter cover a label HAFA413494P0001 has to be attached.
- Supply of filter bag as loose piece on site (packing according to B1)

5.3 Filter assembly

- The filter is correct, if the enclosed humidity indicator is blue.
- Unpack filter from the PE foil and insert it into the filter cover.
Fasten filter pot with the inserted filter bag as rapidly as possible to the cover.
- Install cover, remove label at the cover.
- Evacuate assembly unit with the inserted filter within 2 h after unpacking of the filter bag from the PE foil.
Fill gas compartment with dry SF₆ .

5.4 Filter material

- If a gas compartment will be opened, in which a filter is built, the filter must be replaced. A regeneration of the filter is not intended.
- Back - up filters with O - ring see table.

Size	Spare material
1	HASV402864R0003
2	HASV402864R0004
3	HASV402864R0005

Filter change of old filter generation bags to new status see HASV201097.

5.5 Filter assembly

- The filter is correct, if the enclosed humidity indicator is blue
- Unpack the filter from the PE foil and install it with the rupture disk.
- Evacuate assembly unit with the inserted filter within 2 h after unpacking of the filter bag from the PE foil.
Fill gas compartment with dry SF₆ .

5.6 Filter material

- After opening of a gas compartment, in which an filter is built in, the filter has to be replaced. A regeneration of the filter is not intended. Back - up filter with O - ring see table.

Rupture pressure of disk	Spare material
$p_e = 750 \text{ kPa}$	HASV402864R0006
$p_e = 1150 \text{ kPa}$	HASV402864R0007

5.7 Filter material

- After opening of a gas compartment, in which an filter is built in, the filter has to be replaced. A regeneration of the filter is not intended. Back - up filter with O - ring see table.

Place of assembly	Spare material
below rupture disk	HASV402864R0001
below cover of earthing flange	HASV402864R0002

Mounting of a filter at the circuit - breaker

Place of assembly	Var. 0 :	Var. 1 :
	- all circuit-breakers size 1 + 3 (EL*, ED*, ACI) <u>without</u> insulator - circuit-breakers size 4	- all circuit-breakers size 1 + 3 (EL*, ED*, ACI) with insulator
Factory	1 Evacuating < 1 mbar *) 2 Filling with SF ₆ 3 Mechanical Tests 4 Reclaiming SF ₆ into SF ₆ tank 5 Cleaning 6 Evacuating < 1 mbar *) 7 Filling with SF ₆ 8 Dielectrical Tests 9 Reclaiming SF ₆ into SF ₆ tank 10 Evacuating to about 1 mbar *) 11 Filling with N ₂ to $p_{abs} = 120 \text{ kPa}$	1 Evacuating < 1 mbar *) 2 Filling with SF ₆ 3 Mechanical Tests 4 Reclaiming SF ₆ into SF ₆ tank 5 Cleaning, assembly of filter bags 6 Evacuating < 1 mbar *) 7 Filling with SF ₆ 8 Dielectrical Tests 9 Reclaiming SF ₆ into SF ₆ tank up to $p_{abs} = 120 \text{ kPa}$
On site	12 Reclaiming 13 Cleaning, <u>assembly of filter bags</u> 14 Evacuating < 1 mbar *) 15 Filling with SF ₆	15 Filling with SF ₆

*) 1 mbar = 100 Pa

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Valid for: CH-PTHS	Derived from:	Replaces:	Classification no./Project name/Assembly		

WORKING INSTRUCTION TIGHTENING TORQUES

These instruction contain the tightening torques in Nm (kp) for joints with screws of a strength of 8.8 (or of materials of at least the same strength), which are screwed into a nut thread of steel or aluminium. For below tightening torques the DIN-instruction 13 applies. Values based on experience were also taken into account.

	Nut thread in aluminium		Nut thread in steel	
	kp	Nm	kp	Nm
M 4	0.2	2	0.3	3
M 5	0.4	4	0.6	6
M 6	0.5	5.5	1.0	10
M 8	1.3	13	2.2	22
M 10	2.4	24	4.2	42
M 12	4.2	42	7.0	70
M 16	9.0	90	16.0	160
M 20	16.0	160	30.0	300

Deviating from our screw standard quality "8.8", screws in the so-called „ASTM quality“ for pressurized enclosures must be tightened with the torques of the following Table :


	Steel ASTM	
	kp	Nm
M 8	1.8	18
M 10	3.5	35
M 12	6.0	60
M 16	13.0	130
M 20	25.0	250
Flange of rupture disk	4.8	48

Tightening torques for nut threads in aluminium in the outer fittings of app. insulators and intermediate rings.

	kp	Nm
M 12 (size 14, insulators and intermediate rings)	7	70
M 16 (size 3, insulators and intermediate rings)	16	160
M 16 (size 3/420, insulators)	9	90
M 16 (size 3/420, intermediate rings)	16	160

Tightening torques for screw plugs and Dilo couplings in aluminium

3/8 " thread in housing	-	50 Nm
1 " thread in housing	-	110 Nm
Coupling tongue part or cover	NW 8 →	60 Nm
cap on coupling groove part	NW 20 →	70 Nm

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				Deplaces: 	
				Classify no.: 	

SF6 Switchgear ELK

Shock- and Toggle Indicators

Procedure to be followed on discovering that indicators have tripped during transport

- Tripping of indicators by no means shows that the packed goods have been damaged.
- It merely shows that the freight has been subjected to a certain acceleration between application of the indicator (packing) and inspection.
- Before using the goods, a close inspection must be carried out.
- **The recipient of the goods must record the fact in writing. (Inspection sheet for assemblies KMW 400 684 -> Page 3 of this regulation).**

Procedure:

- Examine crate (packing) for damage. The direction of the blow may be able to be deduced from the damage.
- Which shock indicators have tripped?
- Examine goods (assembly unit) for external damage.
- Record defects by photos and record KMW 400 684.
- If the assembly unit is to be opened (remove transport cover), the accessible parts should be checked visually.
- If no visible defects can be discerned, then the goods are to be regarded as undamaged.

Note:

Depending on the construction and type of the assembly unit, the permissible shock loading can vary strongly. For this reason the completed documents must be sent to the supplying works for final release.

The assembly units busbar and voltage transformer may not be opened. Prior to release, the completed record KVM 400684 must always be sent to the supplying works. The indicators of the voltage transformer should not be taken away (at least by the clomp chest).

- The example below shows how little is needed for freight to experience an acceleration of 10g.

Example:

A piece of freight, upon loading, is put down from a height of 10 cm practically in free fall, whereby the package can give way by 1 cm (crushable zone).

How great is the acceleration?

Velocity attained by falling goods :

$$v = \sqrt{2 \times g \times h}$$

where

g = acceleration due to gravity 10 m/s²

h = free fall height = 10 cm = 0.1 m

Acceleration suffered by goods :

$$a = v^2 / 2s$$

where

s = deceleration distance = 1 cm = 0.01 m

Hence

$$a = \frac{2gh}{2s} = \frac{2 \times 0.1 \times g}{2 \times 0.1} = \underline{10g}$$

ABB High Voltage Technologies Ltd.



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Übernehmende Stelle/Receiv. dept.:

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PREPARATIONS FOR THE HIGH VOLTAGE TESTING OF A GIS INSTALLATION AT THE SITE

1. Applicability of the instructions

These instructions are applicable where the HV test of a GIS installation is performed with a Series Resonance Test Kit, and where the (pre-calculated) frequency of the power frequency voltage is above 100 Hz; this is generally the case where the GIS outgoing feeders do not exceed lengths of a few tens of meters.

These instructions can be supplemented or replaced by installation-specific testing instructions (HASQ ...).

2. Preparation of the GIS installation

The SF⁶ installation must be finish-erected. The voltage transformers are installed before the HV test is carried out. In cable outgoing feeders or in transformer connections the connection link must be removed, the necessary screens must be fitted and the transformer bushing or the cable must be securely earthed.

The installation is to be filled with SF⁶ gas to nominal filling pressure.

The earth connections within the SF⁶ installation, as well as between this installation and the building earthing system, are to be made in accordance with the regulations.

Every switching element (every circuit breaker, disconnector, earthing switch) of the GIS installation has to be switched at least 10 times. Thereafter, all circuit breakers and disconnectors are to be closed. For the HV test the GIS installation will be split up into individual sections according to the technical conditions of the installation by the test engineer at the site. The GIS HV test will be carried out phase by phase, with an entire phase or parts of a phase as a test section. Test sections to which high voltage is not to be applied at the respective time must earthed at least one point.

2.1 Current transformers

The (secondary) terminals of the current transformers with the designations "S1", "S2", "S3" or "1S1", "1S2", "2S1", "2S2" etc. have to be connected with one another and with the plant earthing system (on delivery of an erection unit with built-on current transformer from the factory this is assured by a contact conductor with an earthing connection on the terminal strip).

2.2 Voltage transformer

The primary or HV winding of voltage transformers is located between phase and ground, meaning that when the transformer is installed (coupled) the high-voltage end of the winding (designated as "A") is solidly connected with the inside conductor of the GIS installation. The low-voltage end ("N") has to be earthed in the terminal box.

The secondary winding connections with the designations "n", "dn", "1n" or "2n" etc. also have to be connected to the plant earthing system. The connections with the designations "1a", "2a", "da", "a1" or "a2" etc. have to be insulated from ground. The isolation can be provided in the control cubicle, or by releasing the relevant connections in the voltage transformer terminal box. With simultaneous grounding in the terminal box and in the control cubicle it must also be checked whether the same connections, i.e. 2 x the secondary winding on the "n", "dn", "1n" or "2n" side etc. where earthed in both cases.

Attention: Short circuiting of a voltage transformer secondary winding would cause the transformer to be destroyed in the HV test!

3. Preparations for the setup / connection of the test kit

After the delivery of the test kit to the site at least the converter should be stored indoors. If this is not possible, the converter (and to the extent possible the entire test kit) have to be covered and the converter heater must be turned on after having been connected to a 220 V power outlet by means of a power cable.

A surface area of approx. 15 - 20 m² capable of carrying a load of several tons should be available for setting up the test kit. A crane is required with a lifting capacity of at least 1,000 - 1,500 kg. 2 double ladders with a height of 2 - 3 m meters are also required.

For the connection of the test kit to the three-phase consumer current network a power of approx. 25 kW is required. With a 380 V system the current circuit would consequently have to be protected with a fuse capacity of 40 A. This power is to be supplied to the test kit via a cable with a cross section of at least 4 x 6 mm². For the connection of the test kit (on the isolation transformer) the cable should have open ends (without connectors).

Attention: The test kit consumer current circuit may not be protected by a fault current (FI) protection switch!

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				Classification no./Project name/Assembly	

Standard anchor rods – setting instruction

1) Drill hole

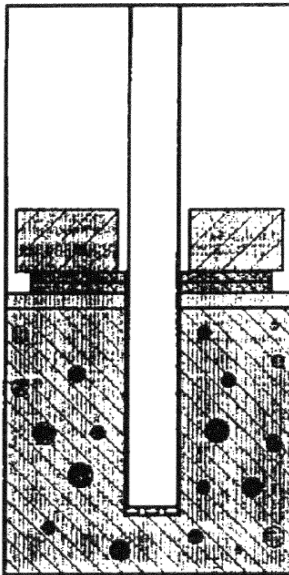


Fig. 1/1

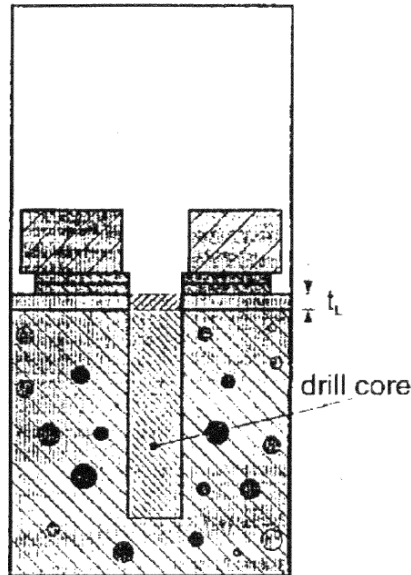


Fig. 1/2

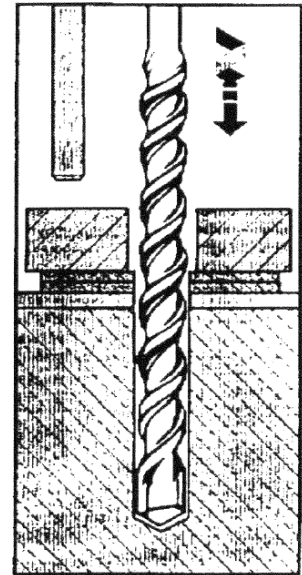


Fig. 1/3

- 1.1) Hole in foundation to be drilled through the hole in the base plate of the steel structure.
- 1.2) Check thickness of finishing layer.
Drill hole with drill. Check thickness t_L (Fig. 8/1) by measuring drill core sample (Fig 1/2).
If the thickness exceed 30mm, fill out a Non conformance Report (NCR) and do not proceed until the problem is clarified by the ABB Engineering Dept.

- 1.3) Type of drill to be used:

Fig. 1/1 for reinforced concrete: use HILTI DD 100 with diamond drill bit and use special vacuum support or equivalent.

Fig. 1/3 for plain concrete: only if decided on site by ABB-CHHOS supervisor, use HILTI Hammer drill TE52 or equivalent.

1.4) Drill to required hole depth h_1 (Fig. 8/1). Do not exceed hole depth h_1 .

Important:

- The full specified hole depth must be drilled.
- Anchor rods may not be set with a depth less than specified.

2) Clean hole

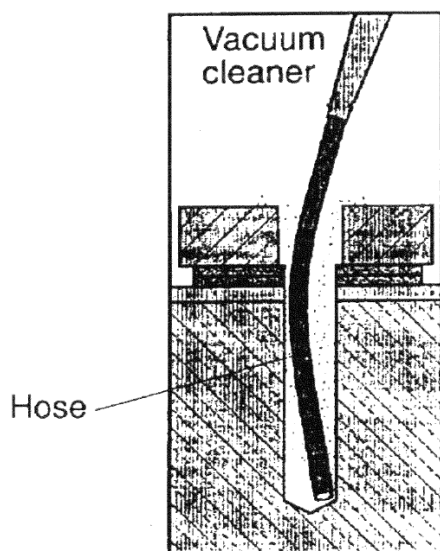


Fig. 2/1

Clean hole with a thin hose attached to vacuum cleaner (hose supplied together with drilling tool).

The hole must not contain standing water, but can be damp (Fig. 2/1).

3) Insert adhesive cartridge

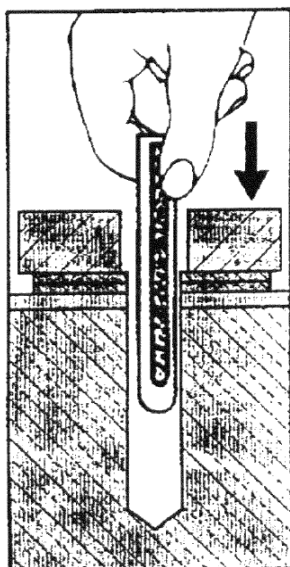


Fig. 3/1

Check expiry date of cartridge. Discard if expired or if resin is no longer free flowing (Fig. 3/1).

Type	ABB-CHHOS Article No.
M16 x 125	HASV403263P0026
M20 x 170	HASV403263P0030
M24 x 210	HASV403263P0034

4) Drive in anchor rod

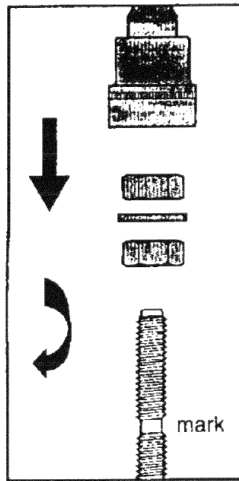


Fig. 4/1

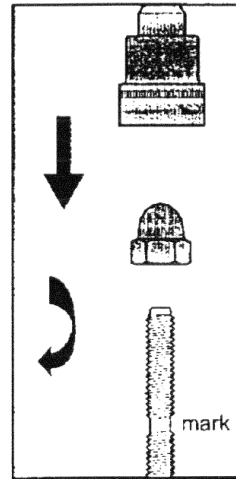


Fig. 4/2

- 1) Remove all grease and dirt from anchor rod with a solvent
- 2) Fit double locked nuts (Fig. 4/1) or cap nut to top of rod (Fig. 4/2).
- 3) Drive in anchor rod with slow speed hammer drill fitted with socket attachment.

Important:

- Feed in the anchor rod slowly while it is turning until the mark (hole depth h_1 is reached to allow the resin to mix properly.
- In the final position, don't exceed 5 turns to avoid extrusion of resin.

5) Wait for adhesive to harden

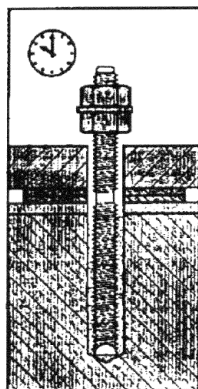


Fig. 5/1

Important:

Setting time (=curing time until full loading capacity) must be followed.

Temperature when setting	Setting time
-5°C to 0°C	5 hrs
0°C to 10°C	1hr
10°C to 20°C	30 min.
20°C and above	20 min.

- 1) Double setting times when hole is damp.
- 2) Do not proceed with drilling or erection work on the same structure until the adhesive is fully hardened.

6) Tighten nut to specified torque

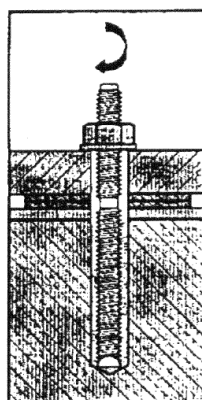


Fig. 6/1

Rods that cannot sustain the required torque have to be removed and re-set.

M16	100 Nm
M20	160 Nm
M24	240 Nm

7) Retighten the nuts after at least

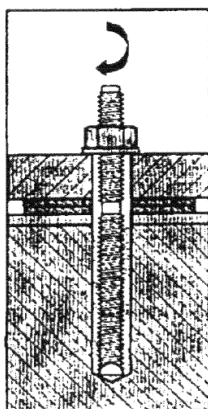


Fig. 7/1

- 1) All anchor rods must be checked and retightened to the required torque.
- 2) Rods that have lost more than 10% of the torque must be noted on a Non Conformance Report (NCR).

8) Definitions

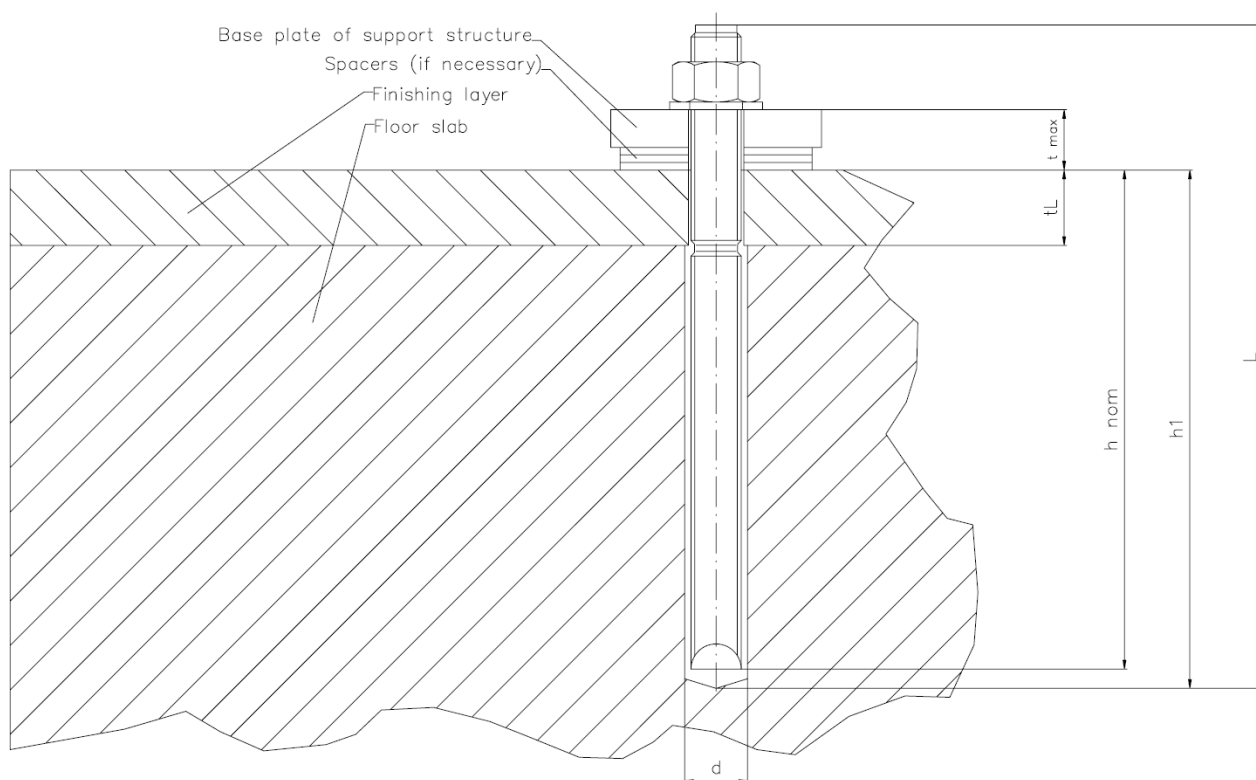


Fig. 8/1

Anchor rod	h_{nom}	h_1	t_{max}	d	L
	mm	mm	mm	mm	mm
M16	125	130	38	18	190
M20	170	175	48	24	240
M24	210	215	54	28	300

Definitions:

- h_1 = hole depth = $h_{nom} \pm 5$ mm
 h_{nom} = embedment depth
 t_{max} = maximum thickness of base plate of structure + spacers
 t_L = thickness of finishing layer max. 30mm
 d = drilling diameter
 L = length of anchor rod

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Zuständige Stelle: PTHS-Q	Übernehmende Stelle:	Änderung/Version: AD 2007.11.16	Dok-Art.: ANW	Einordnungs-Nr.:	
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Gültig für:	Entstand aus:	Ersatz für:	Klassifikations-Nr./Projektname/Baugruppe: -		

TEST SPECIFICATION

Primary Resistance Measurement of the Main Circuit on Gas Insulated Switchgear (Type ELK)

Content:	1. Test object
	2. Standards
	3. Test conditions
	4. Test procedure
	5. Test equipment
	6. Test report
	7. Annex

1. Test object

SF6 gas insulated Switchgear type ELK during and after site assembly.

2. Standards

IEC 62271-203 cl. 10.2.101.3

3. Test conditions

Prescribed nominal values refer to ambient temperature of +20°C. If higher/lower ambient temperatures prevail during the tests a correction-factor is applicable, according to IEC 60694 cl. 7.3, IEC 62271-203 cl. 7.3 and cl. 10.2.101.3 and according to temperature coefficient of electric resistance of Aluminium of 3.9E-03
This factor is ±2.0% of nominal value per 5°C deviation.

Example:	Nominal value (at 20°C)	100 μΩ
	Permissible resistance at 35°C	106 μΩ

The ambient temperature is to be noted on the test report.

4. Test procedure

4.1 General

The resistance of the main circuit is determined by measuring the voltage drop along a conductor through which a defined current is flowing. The current value is normally 300A d.c but in no case less than 100A d.c.

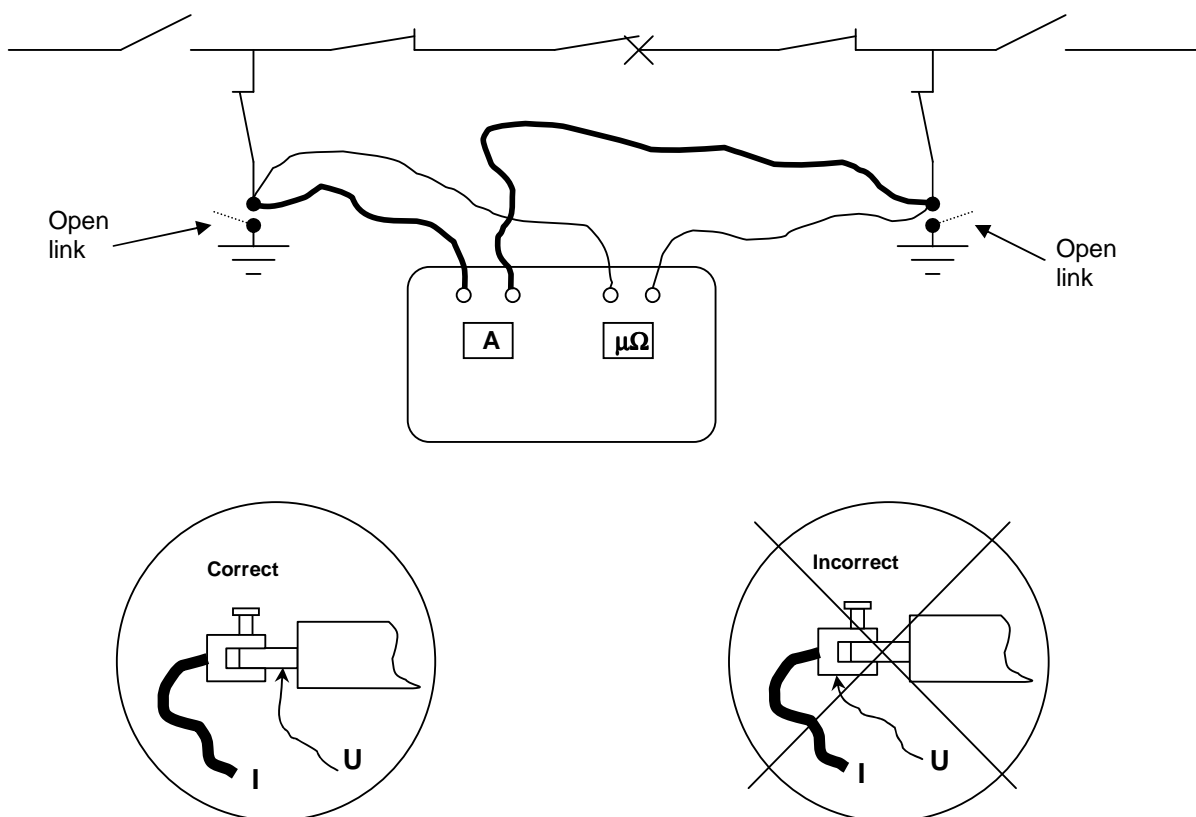
Test sections are predetermined by the engineering department taking into account switchgear layout and envisaged assembly sequence. Corresponding maximal allowed limits of resistance values are obtained by cumulation of values of type tests plus 20%. In case of need of individual values refer to Annex 1.

4.2 Test procedure

Injection of test current is applied generally via (insulated) grounding switches and via open accessible contacts, conductor tubes, HV bushings, transformer and cable terminations respectively. In the latter two cases the barrier insulator base is to be used for current connection. If measurements are made between insulated grounding switch and (insulated) grounding switch, the earth connection of the insulated grounding switch must be open. The same applies to the shielding of secondary cables.

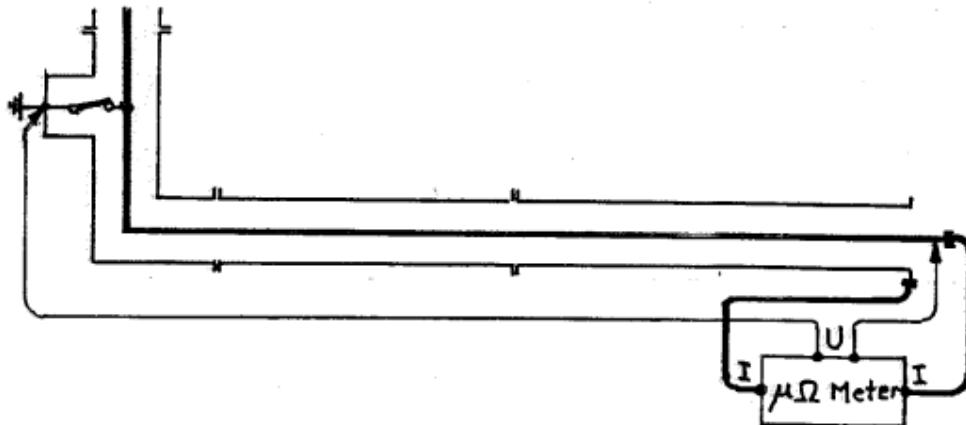
If test sections begin/end at grounding switches, the measuring lead is to be connected to the corresponding coax.-plug socket.

In all other cases attention must be paid that measuring leads are connected directly to the main conductor. Test current connection-clamps must not be included in the metering circuit.



4.3 Test arrangement for long feeder connections.

In such cases an arrangement as shown in below example may be selected for injection of the test current.



5. Test equipment

For efficient measurement of low ohmic resistances a direct indicating micro-ohmmeter is preferably being used, e.g. programme type 600 A or similar. Regarding measuring procedure refer to user's manual of instrument.



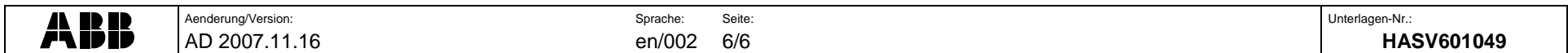
6. **Test report**

Conditions of tests and respective results are to be recorded in a suitable manner.

Extent of data shall be as per test report specimen in annex 2 below. Duly signed reports (client's signature optional) shall be archived according to pertinent instructions.

GIS ELK Nominal resistance values for contacts and single elements Annex 1

	ELK 14 ($\mu\Omega$)	ELK 1 ($\mu\Omega$)	ELK 3 ($\mu\Omega$)	ELK 4 ($\mu\Omega$)
Conductor tube, without contacts per meter	8.2		4000A: 11.0 5000A: 4.8	
Contact with spiral springs	3.1	n. a.	5000A: 4.0 6300A: 3.0	n. a.
Contact with fingers	n. a.		3.0	
Insulator	1.3		1.2	
Grounding switch	16.0		13.0	
HV Bushing Haefeli Type SEF 1050/2000	34		n. a.	
HV Bushing ABB Type AB3 (incl. spacer insulator)	n. a.		47.5	



Aenderung/Version:
AD 2007.11.16

Sprache: en/002 Seite: 6/6

Unterlagen-Nr.: **HASV601049**

ABB

Client: .	Project name: .	Contract: .
Consultant: .	Installation Report:	Order No.: .
Form No.: .		Template No.: HASV601049 ANW 002 AD
Start of Test:	Feeder/Diameter:	Page: 6/6

To Procedure: HASV601049 Gas schematic diagram No.: _____ Measurement equipment No.: _____

[illegible]

Remarks: _____

For or on behalf of ABB Switzerland Ltd.

For or on behalf of the Client

Date: _____

Date: _____

Name:

Name: _____

Signature: _____

Signature: _____

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Valid for:		Derived from:	Replaces:	Classification no./Project name/Assembly	

CORROSION PROTECTION AND SEALING ELK-14,ELK-3,ELK-3/420

Applicability

This instruction applies to indoor-extreme, outdoor-normal und outdoor-extreme installations.

(Pictures donated with ELK14 / ELK3 also apply to ELK-14/ELK-3)

The treatments for the earthing- and back current conducts are specified in the instruction HASV600941.

Selection of corrosion protection index

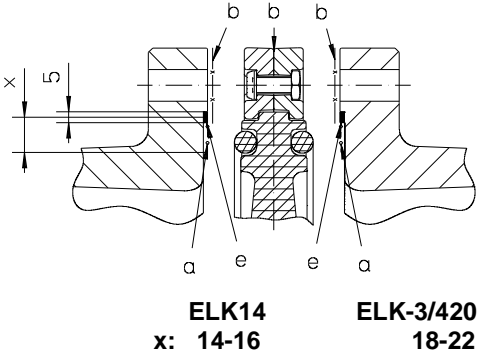
The appropriate index must be selected from the Items on sheets 2-14.

Type of treatment

Type of treatment	Area of appliance and Grease-/Silicon bulge	accomplishment	Corrosion protection agent
a	Sealing surface	Dab sealing surface with grease pad so that when touched with the finger a weak fingerprint will form.	B1
b	Current connection surface	Dab current connection surface with grease pad so that when the flanges are assembled a small grease bulge will form.	B1
c	Screws, threads, Rubber sleeves	Brush thin coat of grease onto screws.	B1
d	Sealing point	Seal sealing point with appropriate sealing compound according to the drawing.	B2
e	Grease bulge	Apply a grease bulge with appropriate grease only for OD and OD extreme.	B1
f	Covers, crevices	Seal sealing point with appropriate sealing compound according to the drawing against penetration of splash water.	B5
g	Silicone bulge	Bulge of silicone 744 RTV according to the drawing.	B3
h	Screws, Threads	Screws must have a thick coating of grease covering all threads	B1
i	Cavity	Fill cavity with grease	B2
k	Current straps, bypass strips	Contact surfaces plane off with Bear-Tex and immediately after it grease.	B1
l	Mounting case, plug enclosure	On the whole contact area of the gear case, plug base and plug housing (inclusive O-ring) grease with grease roller apply, so that after assembly a small grease bulge results.	B1

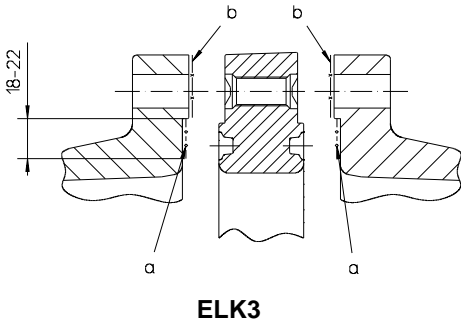
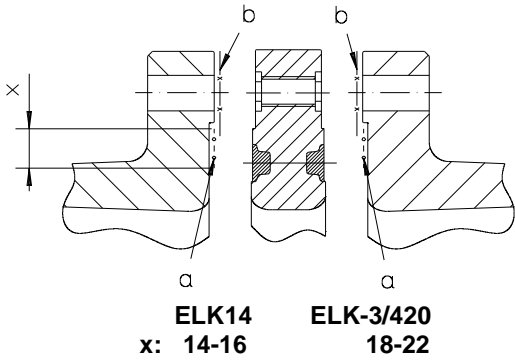
Item 1

Flange cover with insulator

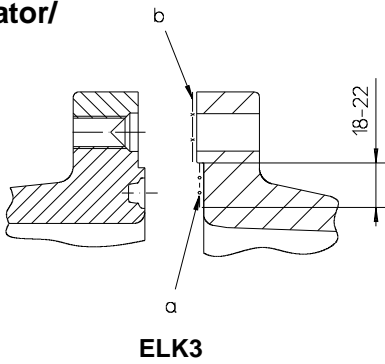
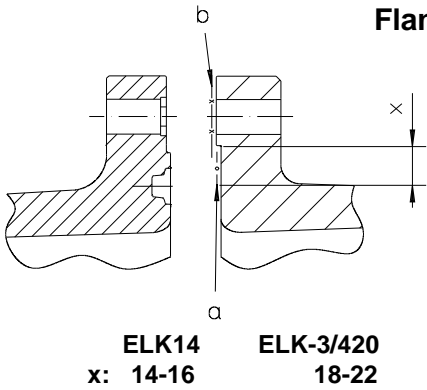


ELK3

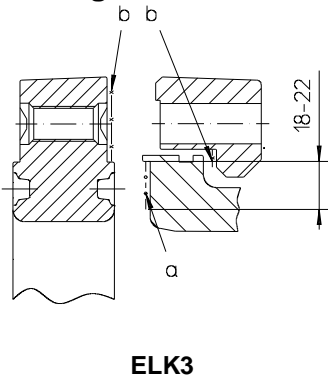
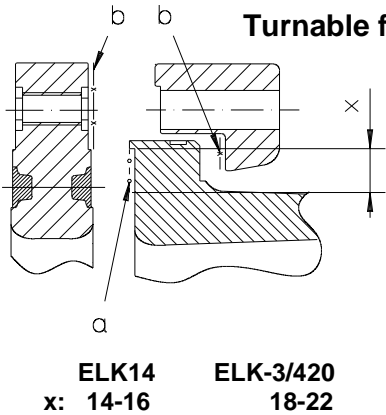
Flange cover with intermediate ring



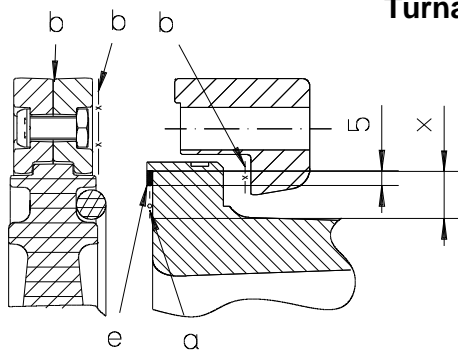
Flange cover without insulator/ intermediate ring



Turnable flange with intermediate ring

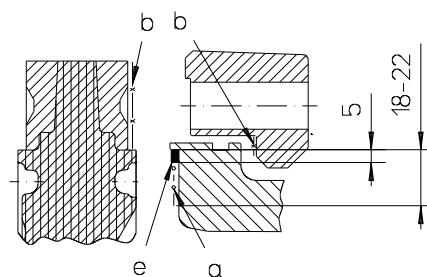


Turnable flange insulator



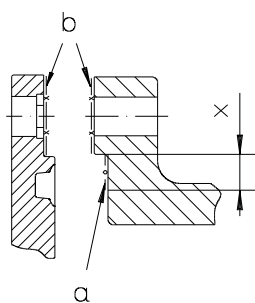
ELK14
x: 14-16

ELK-3/420
18-22



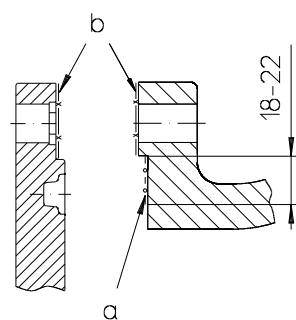
ELK3

Earthing flange



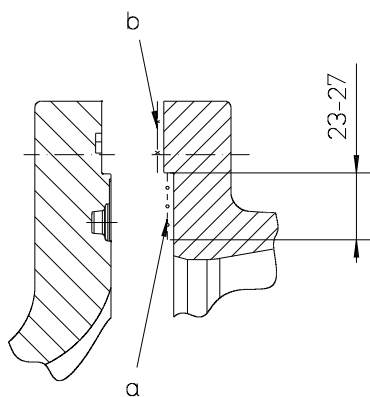
ELK14
x: 12-14

ELK-3/420
18-22



ELK3

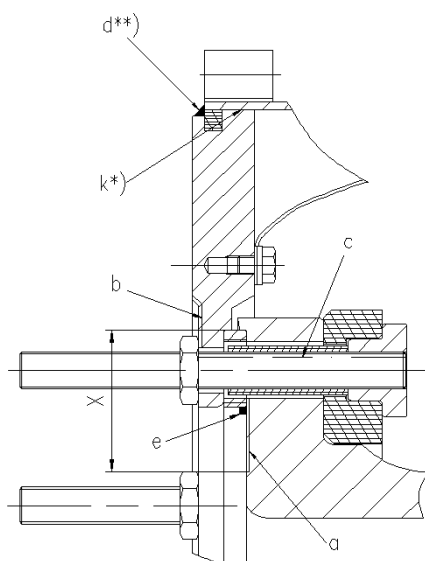
Engine cover



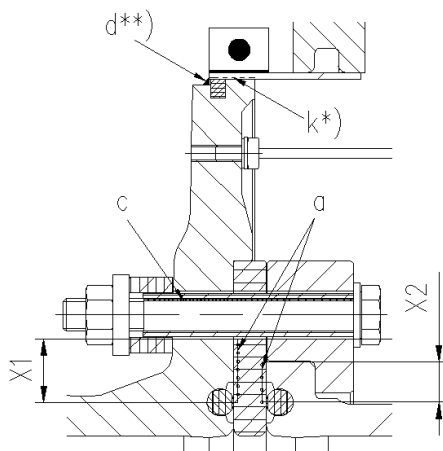
ELK-TK14

Item 2

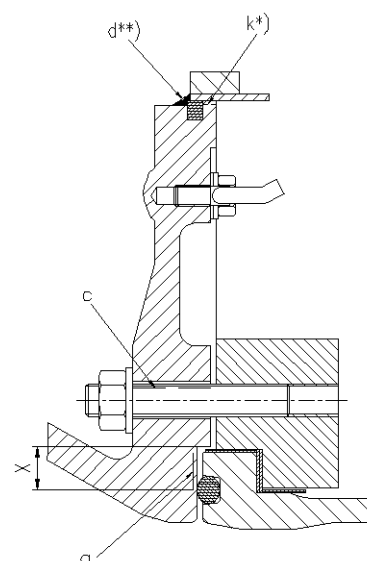
Current transformer



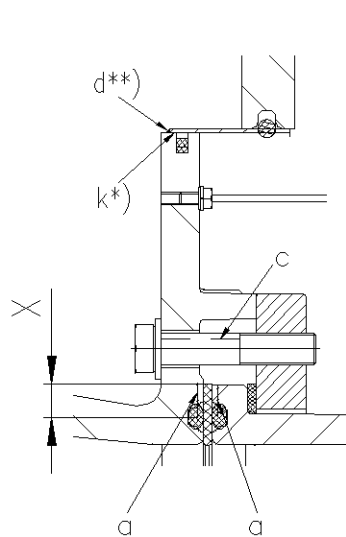
CN14 (old, SD)
X = 43-47



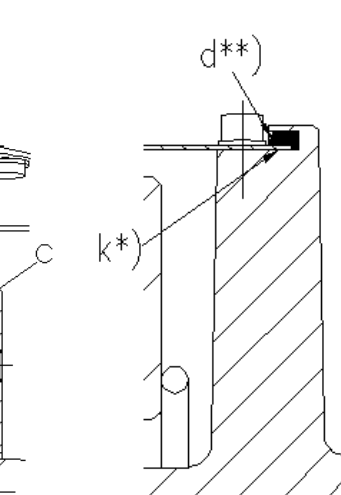
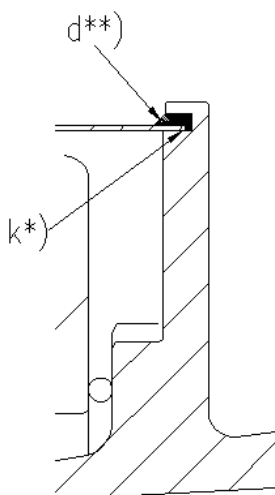
CN14 (old)
X1 = 16-18
X2 = 8-10



CB3 (new)
X = 16-18



CN3/420
X = 16-18



CN14/300
X = 16-18

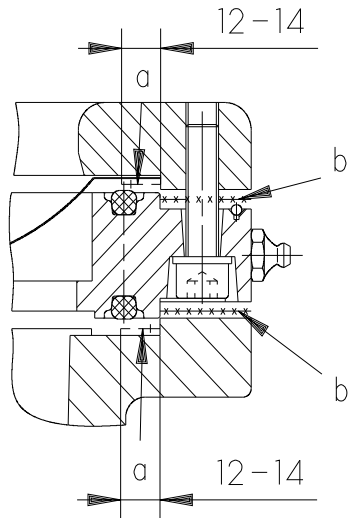
*) pretreatment, Cleaning and Corrosion protection, is necessary for the sheet casing, for the core support flange and the core support housing

**) only for outdoor-normal and outdoor-extrem installation

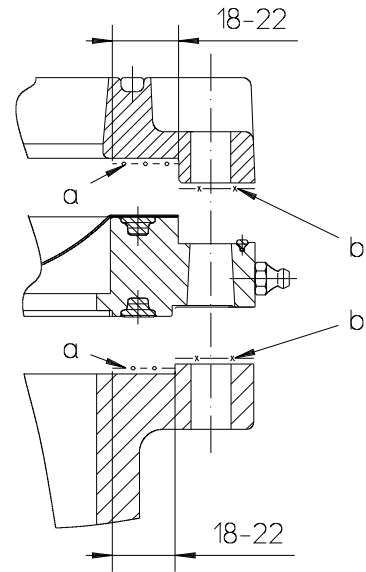
Item 3

Rupture disk

ELK14, EIK-3/420

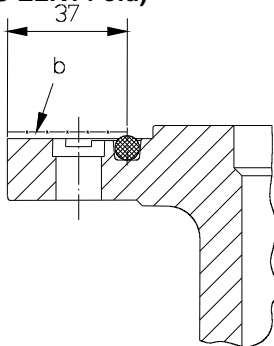


ELK3



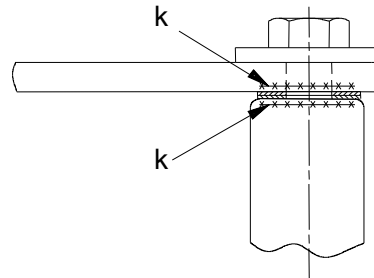
Item 4

Driving side disconnecting switch, earthing switch
(BAC ELK14 old)



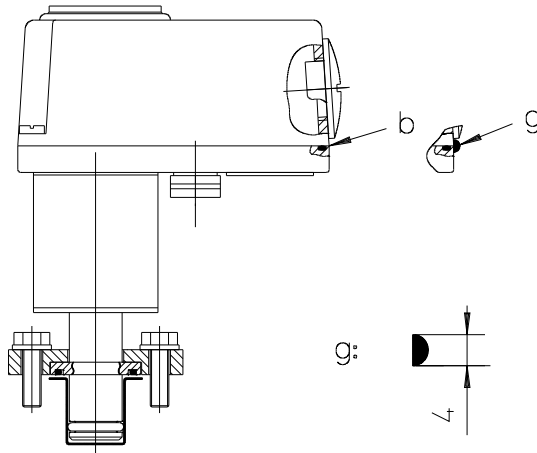
Item 5

Current straps, bypass strips

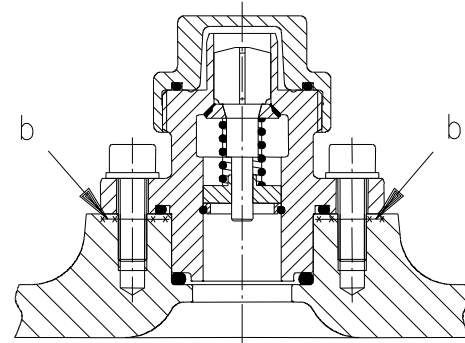


Item 6

Gas connection, blank cover, LBU-additional cover, sight glass, plug-in coupling, density sensor, density monitor,

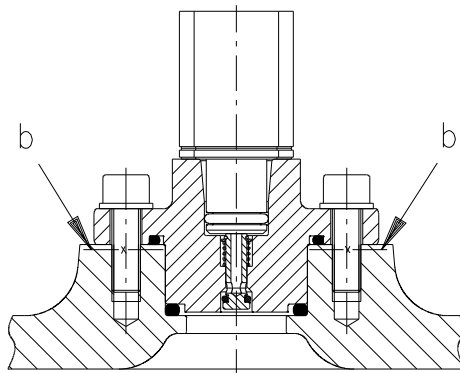


- Apply bulge g only on outdoor and outdoor extreme.
Density monitor (Trafag Typ 87X0)

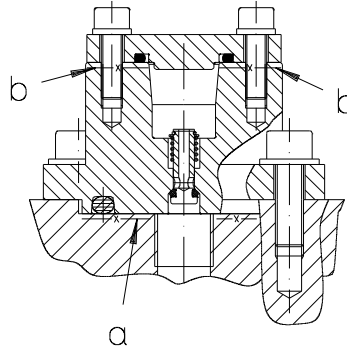


ELK14

density monitor, density sensor ELK14



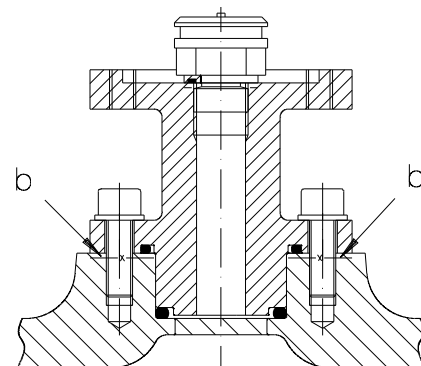
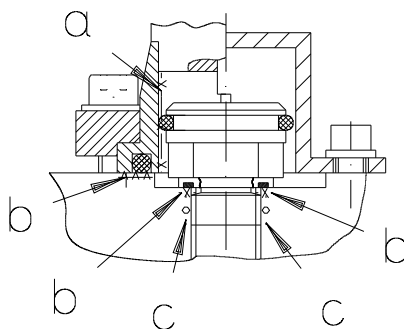
ELK14, PASS M1/M2

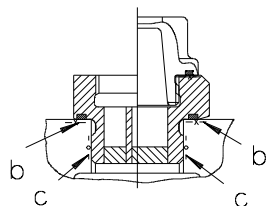
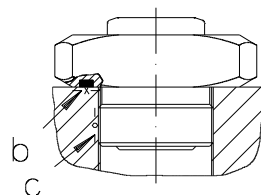
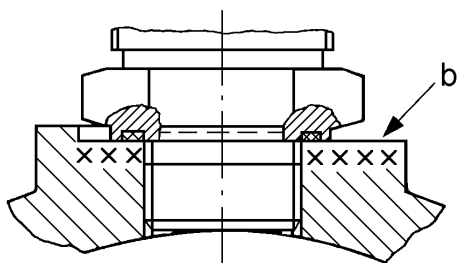
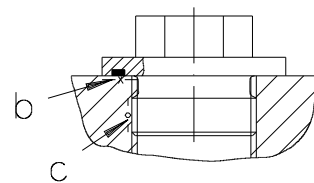
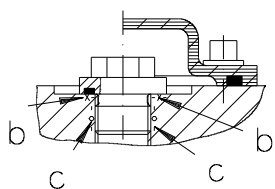
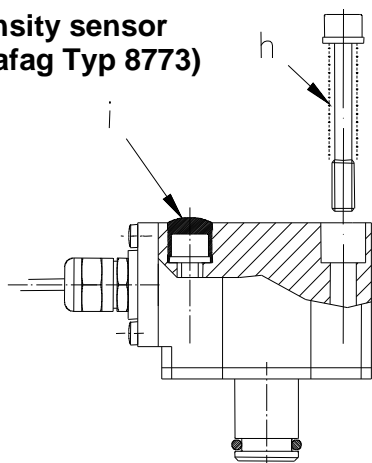


ELK3

Adapter to density monitor

Density monitor coupling

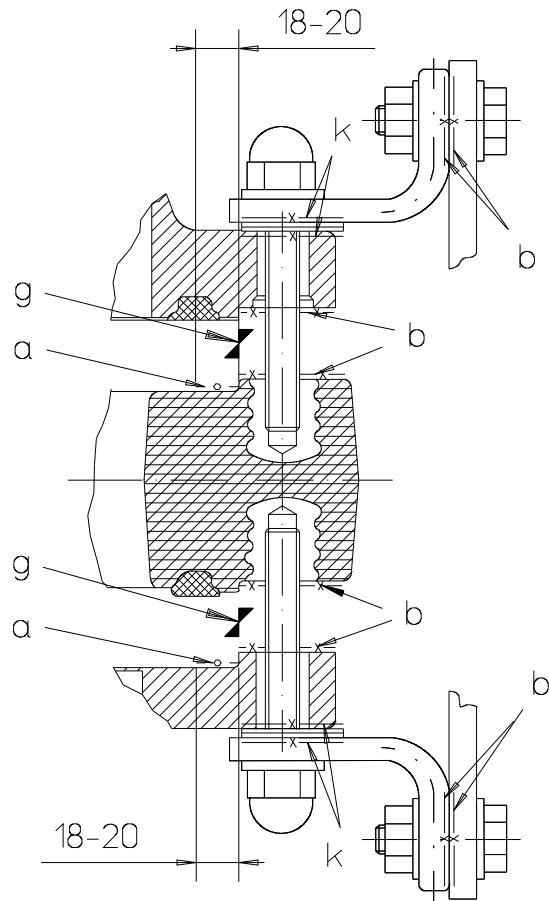
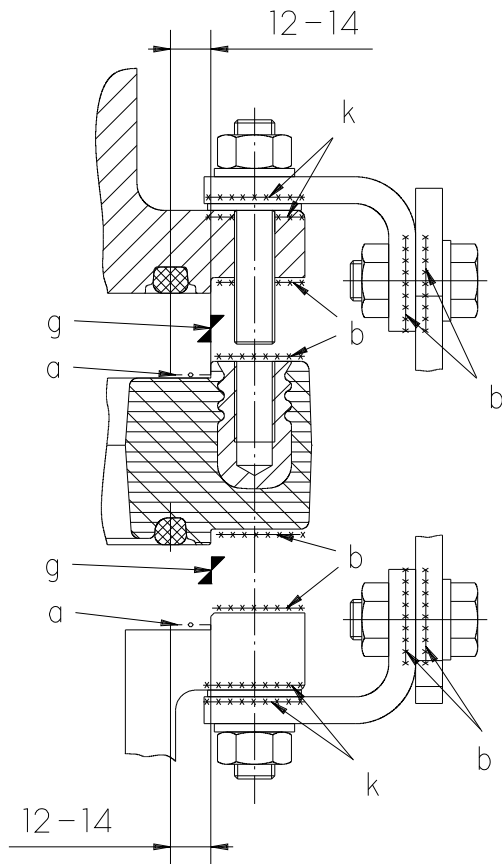


ELK3
Sight glass flange

LBU

Sealing screw

Gas connection
Item 7
**Density sensor
(Trafag Typ 8773)**


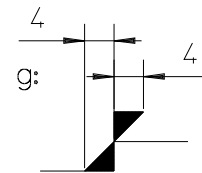
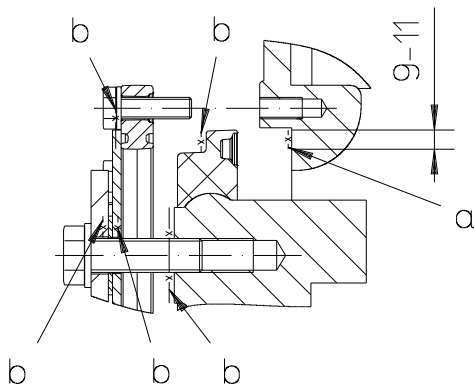
Item 8

Isolated earthing switch

ELK14 (old)



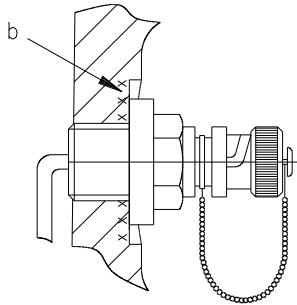
ELK-14 ELK-3/420



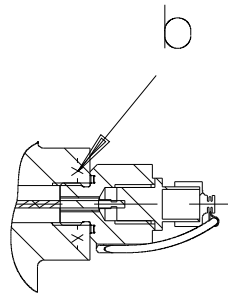
- Apply bulge g on b
- Apply bulge g only on outdoor normal and outdoor extreme.

Item 9

Coaxial connector / earthing switch

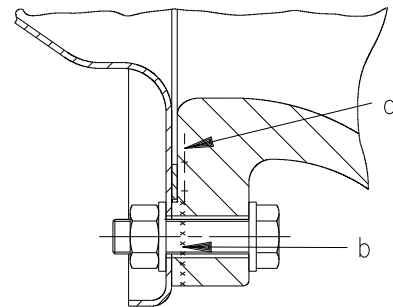
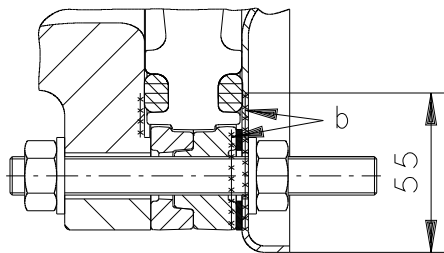


Coaxial connector BAE/TK-14



Item 10

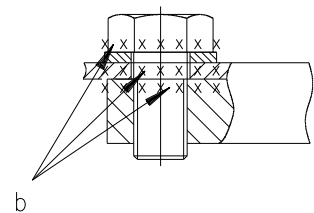
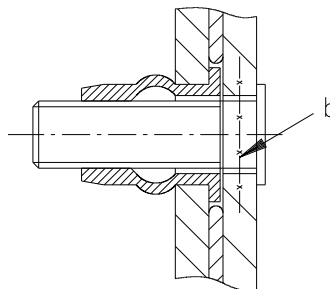
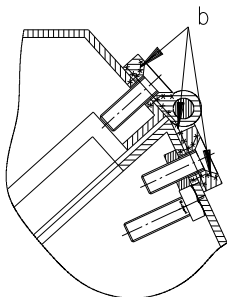
Transportation protection cap



Item 11

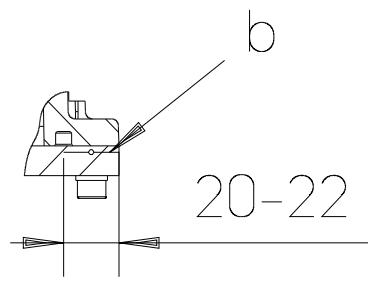
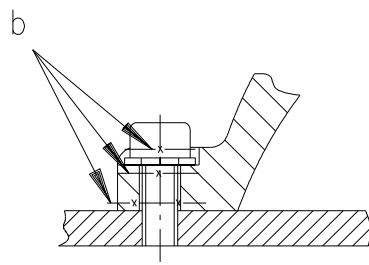
Only grease support surfaces

Circuit Breaker drive HMB1

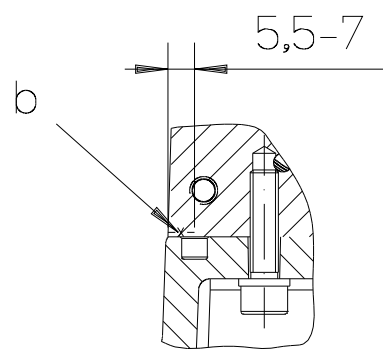
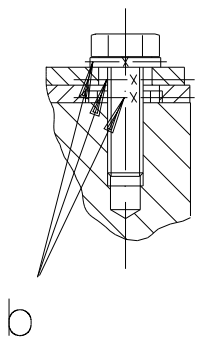


position indicator BAC, BAE

BAC, BAE, DA, DM ELK-14, ELK-3/420

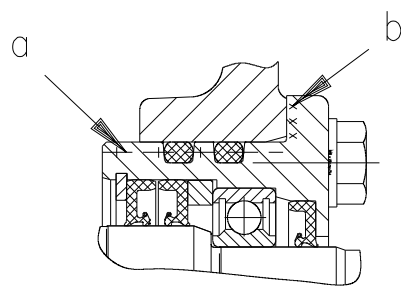
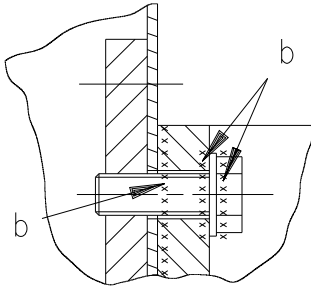


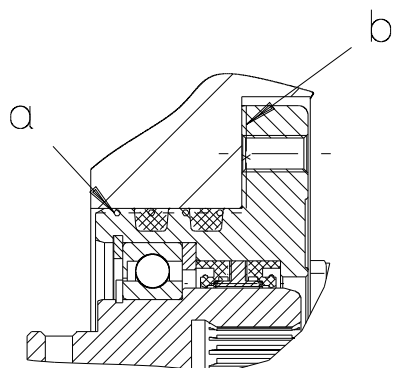
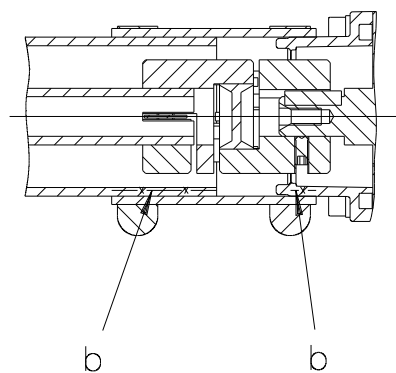
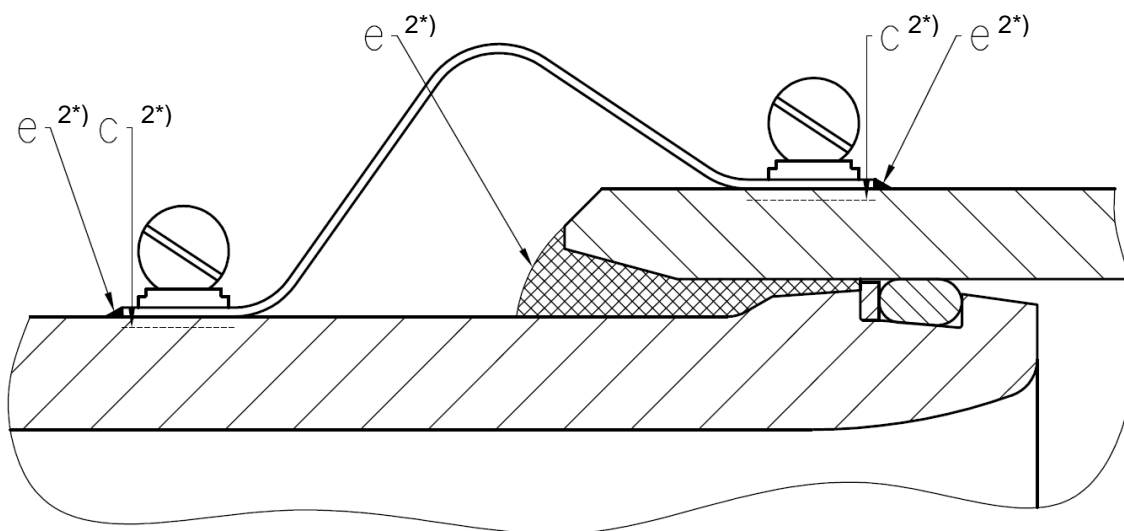
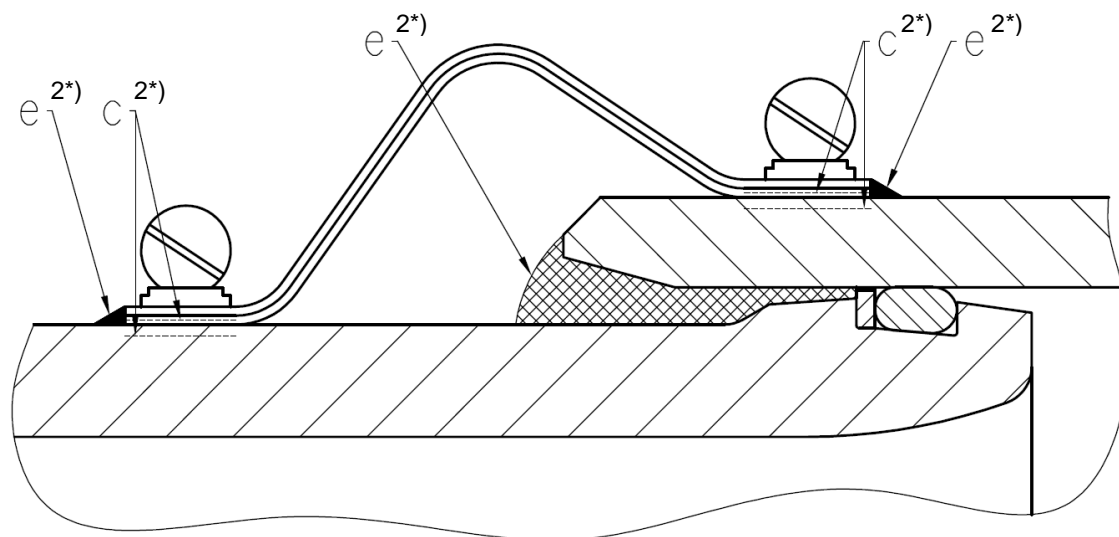
DA/DM ELK-14, ELK-3/420



Item 12

Circuit Breaker SD14

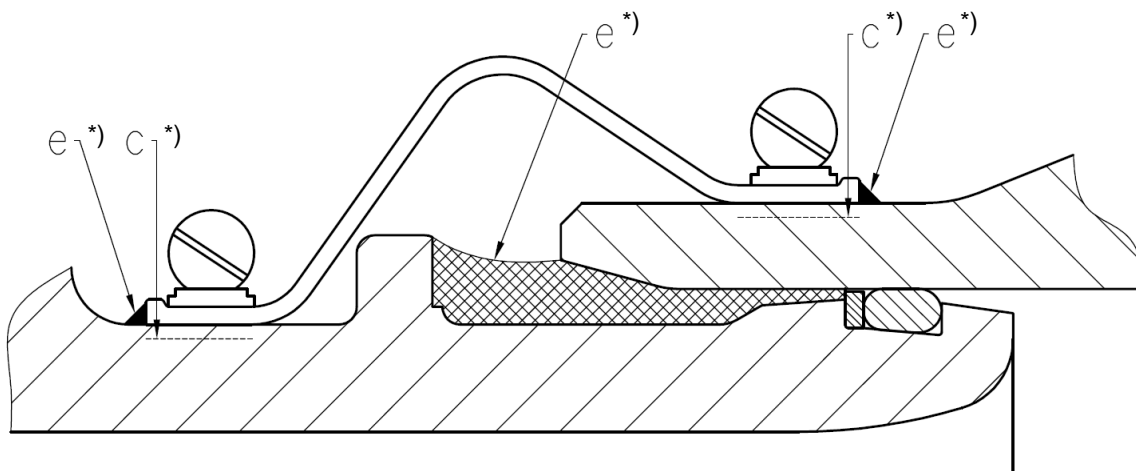


ELK-TK14

ELK-DV14

Item 13
Lateral dismantling unit

2x rubber bellow if outdoor extreme


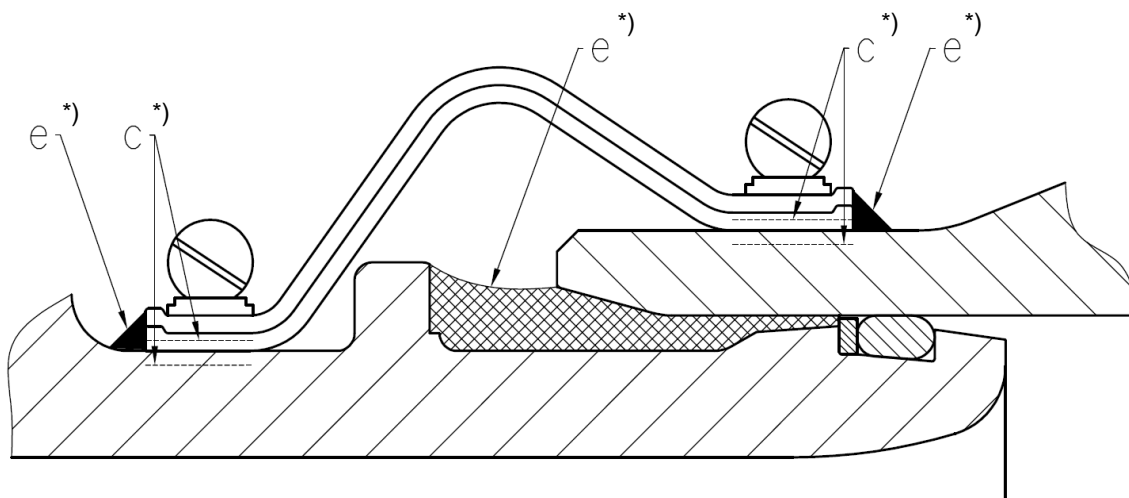
2*) primal on site

Item 14

Parallel compensator



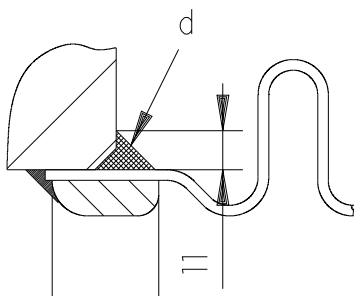
2x rubber bellow if outdoor extreme



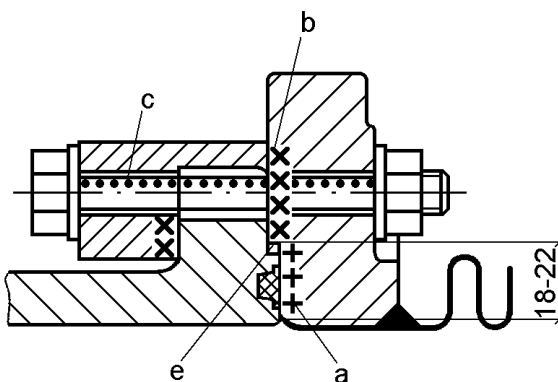
$^{*})$ during the assembly in factory

Item 15

Compensator ELK HT

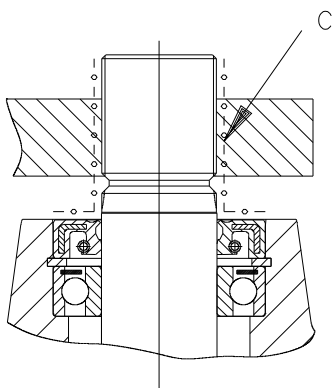


Enclosure ELK HT-14 with flange-Segment

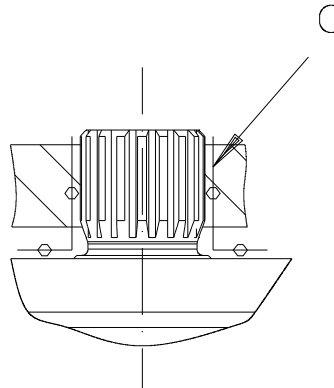


Item 16

Earthing switch- / disconnecting switch drive, connecting rod, secondary gear DA/DM



ELK14



ELK-14

Item 17.1

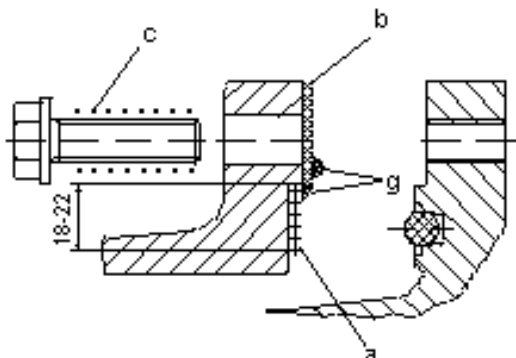
Item 17.2

Drive BAC / BAE (Schilling-ELK14) Secondary gear DA/DM

The Items 17.1; 17.2 are described in the drawing sets, and the application is defined.

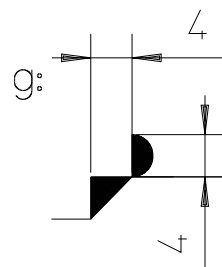
Item 20

Window blind flange



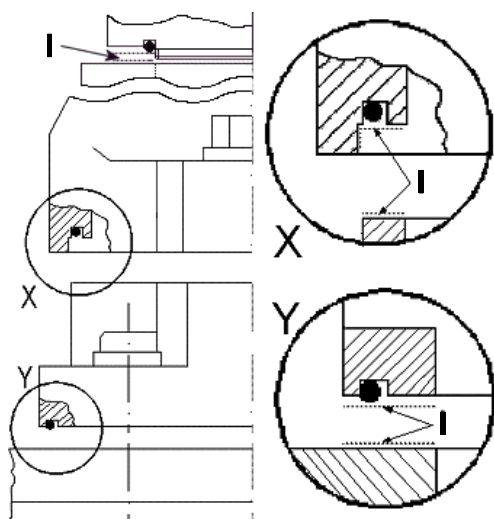
Bem.: Bulge g only on OD

Apply g on b



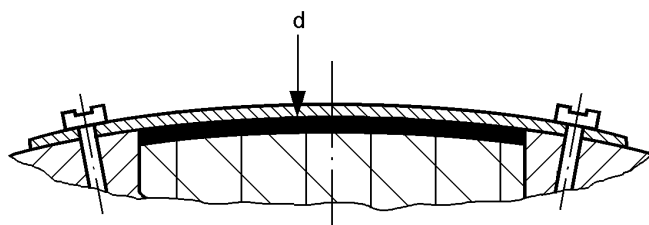
Item 21

Attachment case, plug connection case



Item 22

Insulator filling port ELK3



Item 23

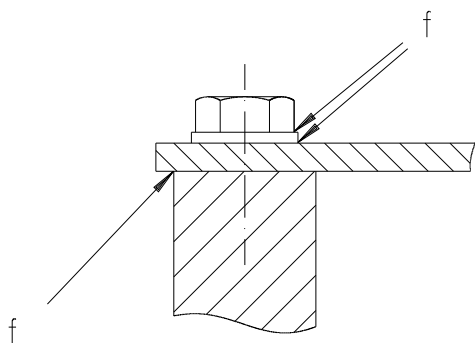
Treatment of whole structural components (e.g. CB drive, disconnecting switch drive, earthing switch drive).

Corrosion protection:

Dip components to be treated into material B4 and let drip off. Spray components not treated in assemblies and the assemblies themselves with material according to B4.

Attention:

Cover motor, on- off- magnets, heating resistors and all plastic components in the devices before spraying.

Item 24

Seal hoods, caps, boardings with larger unevenness (raw surfaces) etc. and its connectors against penetration of splash-water (Use flat gaskets, If necessary, if repeated dismantling).

treatment like	A Cleaning				B Sealing agents					C Time of application							D After- treatment					E Remarks					F Pretreatm ent		
	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6	7	1	2	3	4	5	1	2	3	4	5	1		
Item 1	x				x					x							x					x							Flange with sealing surface and current connection surface
Item 2	x	x			x	x				x							x					x							Current transformer
Item 3	x				x					x							x					x							Rupture disk
Item 4	x				x					x							x					x							Disconnecting switch- earthing switch drive BAC
Item 5		x			x								x				x					x							Current straps, bypass strips
Item 6	x				x					x							x					x							Gas connection, blank cover, sight glass and so on.
Item 7	x				x	x				x	x						x					x							Density sensor
Item 8		x	x		x		x			x							x							x					Isolated earthing switch
Item 9	x				x					x							x												Coaxial connector, earthing switch
Item 10	x				x										x		x												Transportation cap
Item 11	x				x					x							x					x							Circuit breaker drive
Item 12	x				x					x							x					x							Circuit breaker SD14
Item 13				x	x								x				x					x							Lateral dismantling unit (VQ)
Item 14				x	x								x							x		x							Parallel compensator (VP)
Item 15				x		x									x		x												Elongation compensator (BD)
Item 16	x				x					x	x						x												Earthing switch- / disconnecting switch drive, connecting rod
Item 17.1	x				x																								BAE, BAC, DA, DM (ELK14)
Item 17.2	x						x			x							x					x	x						BAE, BAC, DA, DM (ELK14)
Item 20	x				x		x								x	x										x			Crank flange
Item 21	x				x											x	x												Attachment case, connection case
Item 22	x					x									x				x										Insulator filling port
Item 23	x							x			x					x													Circuit breaker drive, disconnecting switch drive, earthing switch drive
Item 24	x								x		x	x	x									x	x						Hoods, Cap, Boardings

C Time of application

- C1** Before fitting
- C2** After erection
- C3** After routine inspection
- C4** In the plant
- C5** The silicon grease on the flange surfaces must be evenly distributed, e.g. using a foam rubber pad.
Before fitting the cover
- C6** According to drawing (OP)
- C7** Housing of operating mechanism at factory assembly
Plug socket – plug housing at assembly on site

D After-treatment

- D1** Wipe dripping and excess agent with cleaning cloth.
- D2** Even out material well, the surface should be smooth.
- D3** Fill out filling port, fit cover plate, carefully remove emitting material, clean surface.
- D4** None
- D5** Apply material and allow solvent to evaporate 10...20 min.
Then assemble parts and remove emitting material with putty knife.

E Remarks

- E1** Treatment when assembling
- E2** On refinishing work on the installation remnant material must be removed and the surfaces must be cleaned with suitable cleaning agents.
- E3** Etch off paint, remove with brushes or special tools.
- E5** Treatment to be carried on during assembly (as indicated on the drawing) if during or after the routine inspection the cover remains **unopened**.
Treatment to be carried on the consignment unit (despite drawing calls up "treatment for individual components) if the cover will be **opened** during routine inspection.

F Pretreatment

All fig. of this instruction are taken from the drawing HATE000540-AE and ASRP001058-A1/A2.

<div>ABB</div>	ABB Switzerland Ltd			Document No.: HASV600824	
Responsible department: PTHS-TO		Take over department:	Revision: AG 2005.10.12	Doc.-type: ANW	File no.:
Prepared: 2005.10.12 WAELCHLI		Checked: 2005.10.13 VRANA	Approved: 2005.10.14 KRETZ		Language: Page: en/002 1/7
Valid for:	Derived from:	Replaces:	Classification no./Project name/Assembly -		

TREATMENT OF FLANGES ELK-14/3/PASS M1/M2

1. Applicability

This instruction applies to outdoor switchgear. Prior to installation, all flange surfaces must be greased according to the instructions in HASV 600715.

2. Time at which the grease injection is carried out

The shipping units are injected with grease in the ABB-CH factory in an non-pressurised condition, with the exception of the end flanges, which are closed off with a transport cover.

Injected flanges must be marked next to the grease nipple using a stamp or a water resistant felt-tip pen. Marking "F" black, size approx. 10mm.

Before the coupling of the assembly units on site, all flanges marked with "F" must be re-treated with grease, and be supplemented with the marking "N" (Report 221 02010E).

The ME - ME connections / couplings made on-site must be immediately injected with grease and have the marking "M" applied to them (Report 221 02010E).

If the installation is interrupted, for example, overnight, flanges that have not been treated with grease must be covered to protect them from the direct effects of the weather.

After completion of the installation, it must be ensured that all flanges are treated with grease in accordance with the above-mentioned instructions, and that they are correspondingly marked (with F/N and M).

3. Material and quantity for the injection

Sealant (Grease Spec. 4) HASV 404392 R1 (Supplier designation G661)

Supplier: Chemische Fabrik Schweizerhalle (Schweizerhalle Chemical Factory Ltd, Basle)

Grease requirement:

- **Support insulator between two flanges**

ELK-14	115 g
ELK-3	350 g
ELK-3/420	200 g

- **Flange with sealing groove - Flange with sealing surface**

ELK-14	70 g
ELK-3	200 g
ELK-3/420	190 g

- **Other flanges**

ELK-14	100 g
ELK-3	100 g
ELK-3/420	100 g

4. Location of the grease nipples

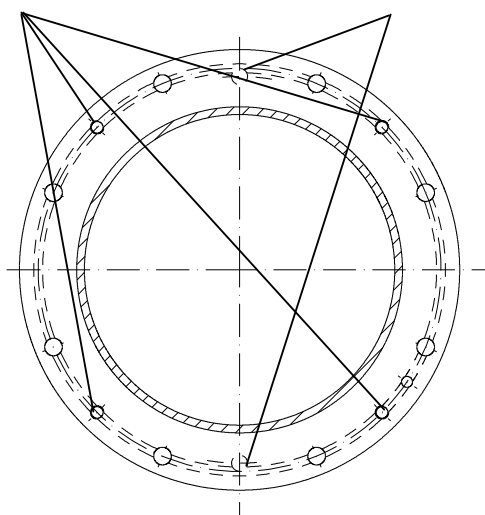
There are 4 or 8 support fixation holes on the large flanges, with a grease nipple mounted on each.
On the small flanges, one grease nipple is located on the fitted PE.

ELK-14: EB, EM, WE, XA, ZX

ELK-3 : EB, EM, WB, XC, ZX

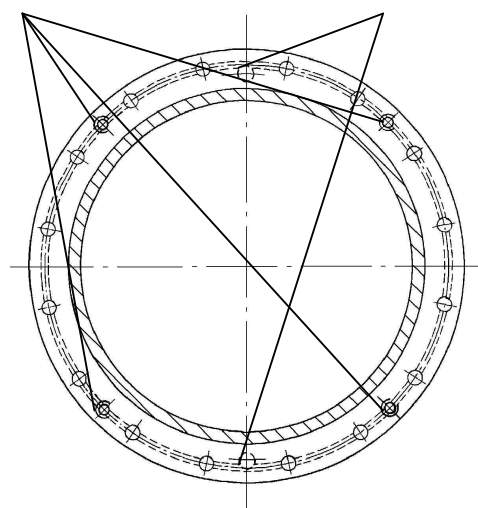
ELK-14
connection holes

support fixation holes connection holes



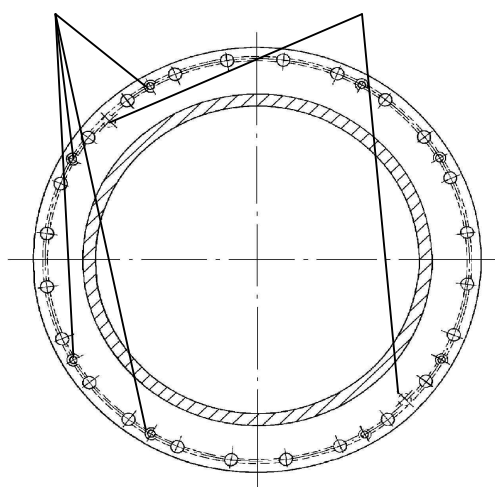
ELK-3/420
connection holes

support fixation holes connection holes



ELK-3
connection holes

support fixation holes connection holes



5. Injection of the grease

A barrel or mini pump is used for the injection of the grease.

5.1 Barrel pump

- Delivery pump for barrels with capacity up to 20 litres (Ø285 mm) for low to high viscosity media, pressure transmission ratio 35:1 consisting of:
 - Pump jack with two pneumatic lifting cylinders 505.03.05
 - Piston pump Ø26 mm 505.03.06
 - Drive cylinder Ø100 mm 505.03.15
 - Switch-over valve 430.10.27
 - Air conditioning unit 430.10.33
 - Pressure plate T-266
 - 505.306.6
- Teflon hose with kinking protection LW 13mm, L=3m 28.09.516
- Pressure reduction valve 30-100 bar 400.25.38
- Diaphragm pressure gauge 0-150 bar
- Hydraulic gripper head R1/4"
- ARO spray gun 651-500
- Adapter
- Pressure gauge 0-100 bar
- Connection block 505.10.06

5.2 Mini pump

- Delivery pump for containers with a capacity of up to 20 litres (Ø285 mm), with pressure transmission ratio 20:1 505.10.05
- With large frame 400.25.50
- Pressure controller
- Pressure reduction valve
- Diaphragm pressure gauge 0-150 bar
- ARO spray gun 651-500
- Adapter
- Pressure gauge 0-100 bar

Supplier for the above-mentioned pumps:

Dopag AG
Langackerstrasse 25
6330 Cham - Zug

5.3 Abnox el. pump AX400C

The accessories must be defined in the order.

The pump is only designed for on-site assembly.

5.4 If only a few flange connections need to be injected, it is practical to use a hand pump according to HATH305693R0001 (available from the installation store under the number HS 97953 kpl. / Muralt).

6. Injection procedure

6.1 The screw lying 180° opposite the grease nipple (or the 2 grease nipples) must first be loosened. The grease is then pumped in at 70 - 75 bar until it begins to flow out at the loosened screw. The screw must then be tightened, and the pumping continued until grease appears at all screws / nuts / flat washers.

6.2 The screw lying approximately 180° opposite the grease nipple must be loosened first.

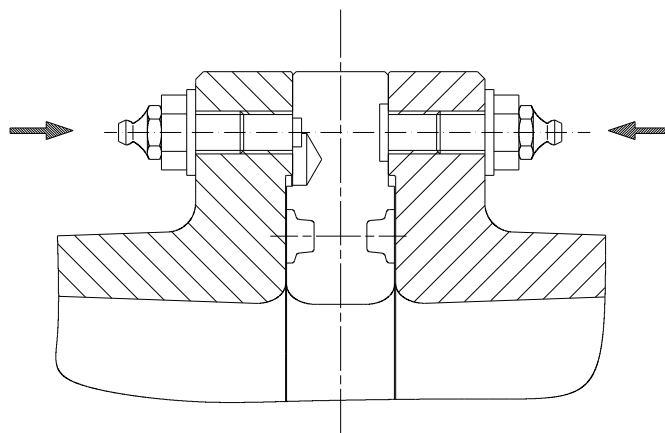
The grease is then pumped in at 70 - 75 bar until it begins to flow out at the loosened screw. The screw must then be tightened. Continue pumping until escaping grease appears.

7. General notes

- 7.1 All grease nipples remain installed.
- 7.2 Remove any outflowing grease
- 7.3 Illustrations from Drawing ASRP000154-AA

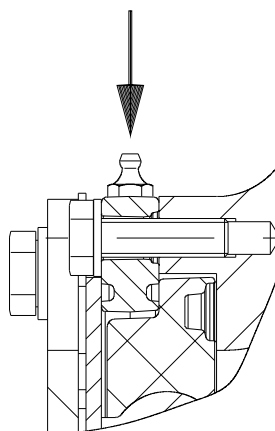
Support flange with intermediate ring

Inject according to 6.1



Isolated earthing ELK-14 BAE/TK

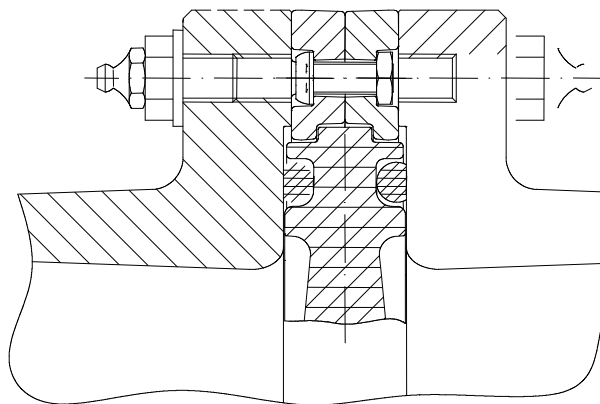
Inject grease until grease is flowing out at the
grease nipple lying 180° opposite.



Support flange with insulator

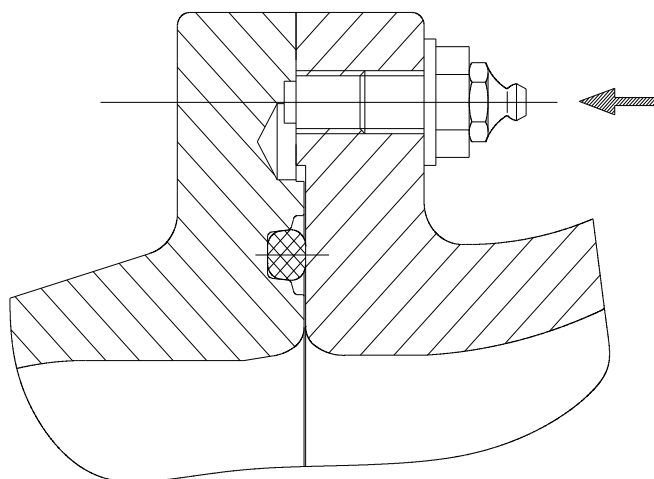
Inject according to 6.1.

Before installation, apply grease bead according to HASV600715



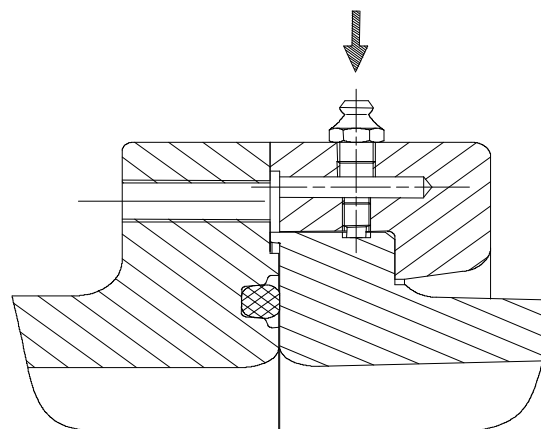
Support flange without insulator/ intermediate ring

Inject according to 6.1



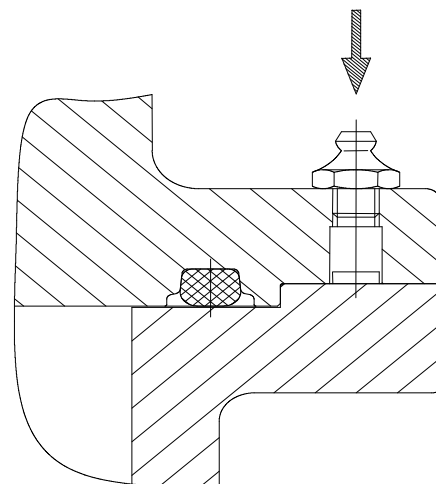
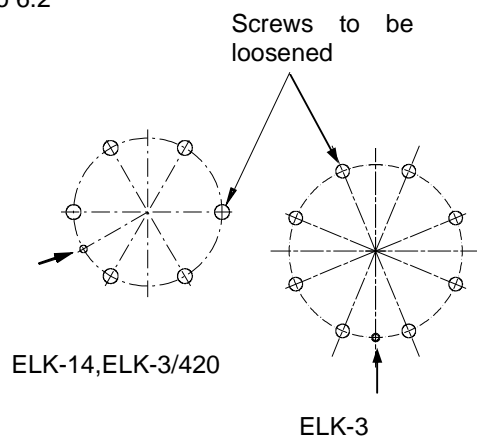
Rotating flange

Inject according to 6.1



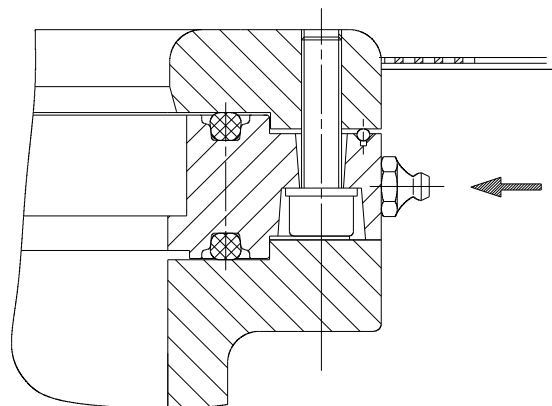
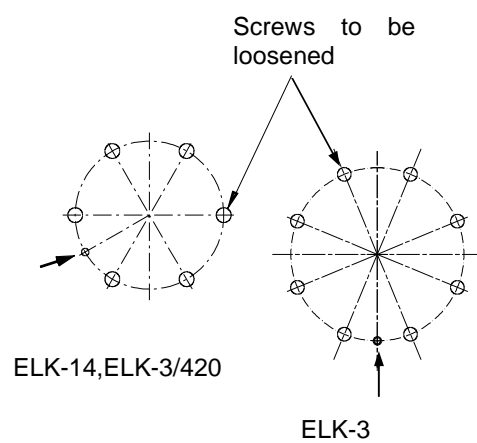
Earther and BAC, BAE, DA, DM

Inject according to 6.2



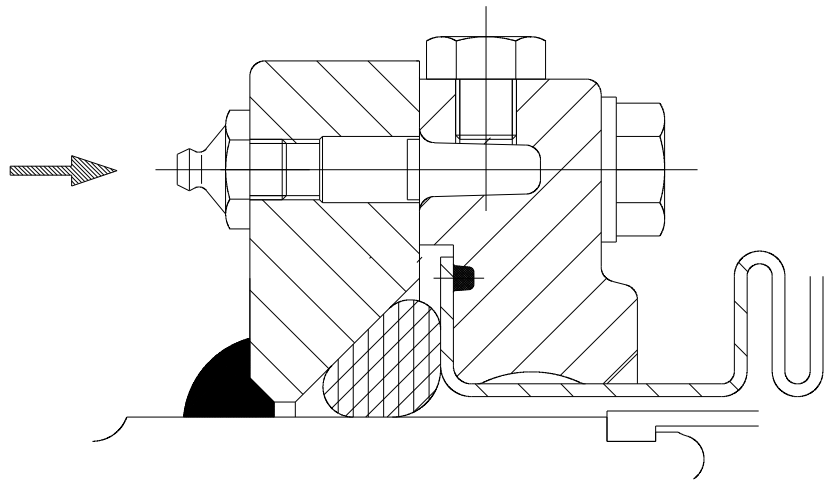
Rupture disk

Inject according to 6.2



Pressure flange

Inject according to 6.1



Encapsulation, Adapter ring

Inject according to 6.1

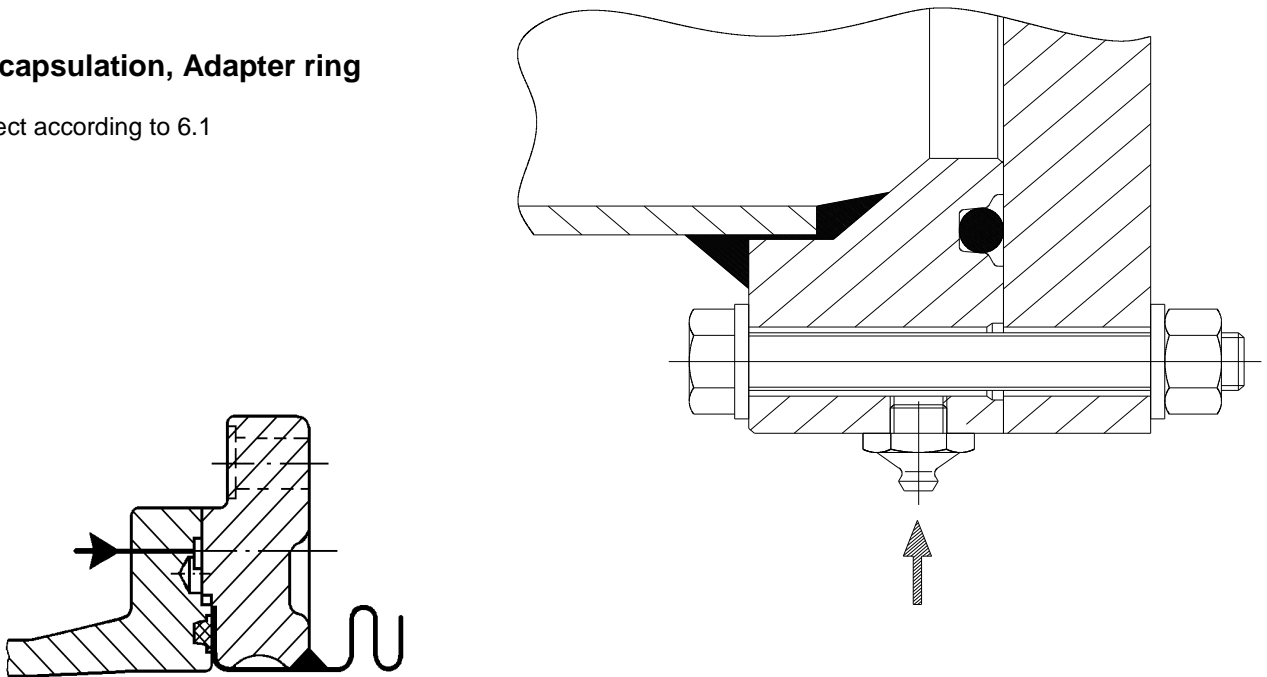


ABB		ABB Switzerland Ltd		Document number 1HC0072978
Unit High Voltage Products	Created Kyburz Theo	Version AA	Document part E01	Document type ANW
Status Released	Last change Lienhard Arthur		16.12.2009	

Cleaning Instruction for GIS components

Components	Cleaning Agent	Alternative
Insulators	Ethanol "F 25 K"	Isopropyl alcohol
Sealing surfaces, grooves	Ethanol "F 25 K"	Isopropyl alcohol
O-rings (sealing rings)	wipe with dry cloth, if hard to clean Ethanol is acceptable; before insert to be dried well	
Tubular Parts Conductor Tubes Corona Shields Plastic Parts	Ethanol "F 25 K"	Isopropyl alcohol
Outer Parts	Soapy Water	Ethanol "F 25 K" Pay attention to Coating!

Use non-fibrous or special paper cloths (see agent below), for cleaning the inner parts.

Delta Werke AG, Zofingen
Politex 640/45 K white Art. No. 5135

Identity No.: VM73125

Moisten the cloth with cleaning agent by using a spray bottle.

Please note that when cleaning the insulators or coated (painted) current-carrying conductor parts (corona shields, conductor tubes), **never** use a dry or partly dry cloth. Danger of static charge (shock).

Ethanol "F 25 K" is a 96 Vol.% Ethyl alcohol, denatured with 2% Methyl-Ethyl-Kenton. It corresponds to the "*Eidg. Alkoholverwaltung, Bern*", under the trade mark "*Industriefeinsprit*" with 2% Kenton denatured.
Trade market quality and with the grade labeling F 25 K" guaranteed degree of purity.

As a substitute, Propanol or Isopropyl alcohol is permissible.

ABB		ABB Switzerland Ltd		Document number 1HC0070163
Unit High Voltage Products	Created Lienhard Arthur	Version AA	Document part E01	Document type ANW
Status Released	Last change Kyburz Theo	11.12.2009		

SF6-Gas Balance on Site

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1 Document determination

1.1 Scope

Description of Data Sheet for On-Site SF₆-Gas Balance

1.2 Area of application

For all Field Operation Staff, working under order of ABB Switzerland Ltd. or under order of any other ABB company on ABB Switzerland Ltd. - Products, such as Gas Insulated Switchgear (GIS), PASS as well as LTB Products.

1.3 Terms and abbreviations

1.4 Responsible department

PTHS-F, Manager SF₆-Gas Handling, Field Operation

1.5 Derived from

Gasbalance old

2 Procedure

3 Further applicable documents

Excel-File „ On Site SF₆-Gasbalance 1HC0070163“

4 Description to SF₆-Gas Balance Data Sheet

All SF₆-gas has to be monitored und its position must be known at any time. This wether the gas is in a bottle/tank, a gas room in a GIS or similar or in the atmosphere.

During and after each On-Site SF₆-gas handling job, the document „On-Site SF₆-Gasbalance 1HC0070163“ has to be filled out and handed over uncalled to the Project Manager Site Installation.

Further on data will be collected for process improving.

Page 1, Titelsheet:

General informations about the substation resp. the place where gashandling takes place, equipment in service and its condition.

Any remarks, informations etc. related to SF₆-Gas shall be noted as well.

Page 2, Balance:

Descriptions of input fields in the table:

The amount of SF₆-gas, delivered with the product must be verified during the assembling time.

This means, that all gas bottles and -tanks must be weighed before taking out gas from it.

Same procedure must be done after finishing the job.

All fields, marked „grey“ are „Input-Fields“

- | | | |
|-----|------------|---|
| 1.) | Field CDE1 | Name of substation acc. to official documents |
| 2.) | Field CDE2 | Order-Nr. |
| 3.) | Field CDE3 | Name of country |

- 4.) Field C6 Amount of SF₆-Gas delivered according to packing list from SAP
- 5.) Field C8 Amount of SF₆-Gas according the datas from engineering departement in „SF₆-Gas Volumen Table“
- 6.) Field C12 Total amount of SF₆-Gas, measured, filled in on site through ABB-Staff.
- 7.) Field C18 Emissions into the atmosphere, caused by people and/or defective equipment
- 8.) Field E18 Numbers of gascompartment evacuated from air and filled with SF₆-Gas. This including gascompartmentes evacuated more then one time.
(Cable- and transformer-terminals, any gascompartmentes to be handled during tests such as HV-test)
- 9.) Field C20 This field is NOT a „inputfield“:
The total value from field 6a and 6b will be added to a total value of emissions and will be communicated further in ABB and to the government.
- 9.) Field CDE22/23 Honest, detailed description of reasons why emissions happened.
There must always be a statement according to.
- 10.) Field C31 - C35 Amount of SF₆-Gas, to be handed over to client according to tool- and spare parts list in order to follow project management request.
Numbers of bottles still full and sealed, acc. to IEC60376
- 11.) Field D39 - D43 Amount of SF₆-Gas, to be handed over to client according to tool- and spare parts list in order to follow project management request.
Gas, which is stored in already opened bottles/tanks, acc. to IEC60480
- 12.) Field C51 - C55 SF₆-Gas, either to be handed over to client or to remain on ABB- or client site for further activities.
This SF₆-Gas shall, when ever possible, be sent back to ABB Switzerland Ltd.
Name numbers of bottles/tanks still full and sealed, acc. IEC60376
- 13.) Field D59 - D63 SF₆-Gas, either to be handed over to client or to be remain on ABB-site for further activities.
This SF₆-Gas shall, when ever possible, be sent back to ABB Switzerland Ltd.
Gas, which is stored in already opened bottles/tanks, acc. to IEC60480
- 14.) Field DE67 Information about planned further use of gas
- 15.) Field CDE69 Place
- 16.) Field CDE70 Date
- 17.) Field CDE71 Family name, First name (write out)
- 18.) Field CDE72 Signature (write out)

On Site SF₆-Gasbalance



Name of Substation:

Order-Nr.:

Type/Size:

New Installation

GIS

other

Repair, Revision

GIS

other

Owner of SF₆-Gas Handling Equipment

Client

ABB

pls. name

other

Condition of SF₆-Gas Handling Equipment

with technical defects and/or tightness deficiency

if defects, pls. name

Further Remarks, Informations:

On-site SF₆-Gasbalance



Name of Substation			
Order / Contract Nr.			
Country			

Nr.	kg		
1 Total amount of gas delivered (acc. packing list SAP)		Difference kg	0.000
2 Amount of gas acc. to "Gas volume table"		Spare Gas delivered %	#DIV/0!
3 Amount of gas calculated plus reserve	0.000		Further Informations
4 Amount of gas filled on site (measured)			Handling-Emmissions
5 Amount of gas left over on site	0.000		Nr. of evac. processes
6a Emmissions (Handling losses)	0.000		(excl. CB, Arrester, VT)
6b Emmissions (Leckages, Failures)			
6 Total Emmissions	0.000	kg	0.000
7 Reason/s for Emission/s			
8 Amount of SF ₆ -gas to be balanced	0.000		0.00076

9 Gas handed over to client (ordered by client)		0.000	
9a Bottles, Tanks			
Nr. of bottles 20 kg SF ₆ -gas (full, sealed)	Numbers	kg	
Nr. of bottles 40 kg SF ₆ -gas (full, sealed)			0
Nr. of bottles 52 kg SF ₆ -gas (full, sealed)			0
Nr. of bottles 54 kg SF ₆ -gas (full, sealed)			0
Nr. of tanks 600 kg SF ₆ -gas (full, sealed)			0
	Sub-Total		0.000
9b Amount of SF ₆ -Gas			
kg SF ₆ -gas in bottles (20kg; open)		kg	
kg SF ₆ -gas in bottles (40kg; open)			
kg SF ₆ -gas in bottles (52kg; open)			
kg SF ₆ -gas in bottles (54kg; open)			
kg SF ₆ -gas in tanks (600kg; open)			
	Sub-Total		0.000
	Total		0.000

10 SF ₆ -gas left over on site (for further disposition)		0.000		Important Information	
10a Bottles, Tanks					
Nr. of bottles 20 kg SF ₆ -gas (full, sealed)	Numbers	kg			
Nr. of bottles 40 kg SF ₆ -gas (full, sealed)			0		
Nr. of bottles 52 kg SF ₆ -gas (full, sealed)			0		
Nr. of bottles 54 kg SF ₆ -gas (full, sealed)			0		
Nr. of tanks 600 kg SF ₆ -gas (full, sealed)			0		
	Sub-Total		0.000		
10b Amount of SF ₆ -Gas					
kg SF ₆ -gas in bottles (20kg; open)		kg			
kg SF ₆ -gas in bottles (40kg; open)					
kg SF ₆ -gas in bottles (52kg; open)					
kg SF ₆ -gas in bottles (54kg; open)					
kg SF ₆ -gas in tanks (600kg; open)					
	Sub-Total		0.000		
	Total		0.000		

11 Gas to be used for (Nr. 10)	0.000	
--------------------------------	-------	--

Place	
Date	
Familynname, Firstname (write out)	
Signature, Visa	

SECTION 3

HEALTH & SAFETY MAPPING

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	H&S Description: SAFETY PROCEDURE	Order No.: 10898
Form No.: 151 01010 E		Template No.: 151 01010 E ANW 001 AA
		Page: 1/6

1. General

From the safety point of view, the testing & commissioning of distribution and transmission plants is often done under hazardous conditions. The risk of accidents must always be taken into consideration and the testing & commissioning personnel have to be fully aware of the dangers that exist and should know how to conduct their work to avoid such hazards.

Protocol

251 01010 E

2. Electric shock

Without any doubt, the greatest risk associated with the testing & commissioning of electric plant is that of electric shock. Accidents due to electric shock occupy an exclusive position since the persons involved seldom receive any forewarning as the danger cannot be apprehended by the human senses. For example, brief contact with a "live" part of an installation, which neither by sound or movement shows any signs of being dangerous, is all that is necessary to cause a serious accident.

„The 5 Safety Roules“



1. Disconnecting
2. Securing against reclosing
3. Testing for absence of voltage
4. Earthing and short-circuiting
5. Covering or fencing off adjacent live parts

3. Working method

The testing & commissioning of plant quite often has to be accomplished within a very short space of time and with many people from different companies involved.

There are two potential reasons for accidents which testing & commissioning personnel must take into consideration:

⇒ Stressful situations where action goes before methodic thinking.

⇒ Stressful situation during the energizing sequence etc. when one party is unaware of the actions taken by the other.

The testing & commissioning personnel must never allow themselves to be influenced by customer demands (economic pressure) etc. which can jeopardize the safety of personnel.

During all energizing procedures, all orders and instructions regarding operations, connections, temporary earthing etc. are to be given by the person (customer/consulting engineer) responsible for the operation of the plant. All contacts between the latter person and ABB's testing & commissioning personnel are, during the energizing sequence, to be made via one person only (the chief commissioning engineer) to prevent fatal misunderstanding.

Directives regarding the taking of measurements and any required fault-finding procedures in energized equipment, are to be given by ABB's chief commissioning engineer in order to minimize the risk of accidents which can occur when uncertainty arise as to who does what.

All personnel in the vicinity of the plant must be fully informed of the risks, which are present when auxiliary circuits of the plant are energised.

4. Customer's and third party personnel

Quite often, ABB's testing & commissioning personnel are assisted by personnel employed by the customer and third party, e.g. during supervisory engagement. In such cases, the testing & commissioning personnel must be well aware of the fact that they are also responsible for the safety of such personnel since they personally take charge of the daily work. This responsibility implies that the testing & commissioning personnel must ensure that assisting personnel are well aware of the risks involved and of how they should act to avoid such risks.

A suitable way of informing assisting personnel of the hazards associated with testing & commissioning work is, in addition to oral instructions, to give them the opportunity of studying this document.

5. Work and operational verifications

To ensure the utmost safety when working on or wiring up electrical equipment in energized stations, some form of written verification is used. This verification gives the status of a particular section of the equipment. The two most common issues are:

Work verification: A verification that a particular section of a plant is completely isolated from the power supply, that it is earthed and short circuited to an extent as stated in the verification. This also implies that the specified status of the section will be maintained until the holder of the work verification issues an operational verification.

Operational verification: A verification that a particular section of the plant, on which the issuer of the mentioned verification has been working, is ready for operation. This implies that the section in question is in a condition as stated in the verification and that all earth connections and short circuits, made by the issuer of the verification, have been removed.

The work and operational verifications are often combined to one document, a Work Permit. A Work Permit is issued as a work verification by the person in charge of operations and is retained by the commissioning personnel until such time as the requisite work has been completed and the applicable section of the plant is ready for operation.. The commissioning personnel then signs the document (Operational Verification) and returns it to the person in charge of operations.

IF THE CUSTOMER USES THE WORK PERMIT SYSTEM, SUCH A PERMIT HAS TO BE OBTAINED BEFORE COMMENCING WORK ON A SECTION OF THE PLANT THAT HAS PREVIOUSLY BEEN IN OPERATION.

6. Operational responsibility

The person responsible for the operation of a new plant, and thus he who is responsible for the safety of personnel, during the time from the commencement of plant energization to when the customer takes over the plant, is not always clearly defined. The fundamental principle is that the customer is always responsible for plant operation and safety as soon as energization has commenced.

The above implies that the customer is responsible for ensuring that, among other things, energized section are cordoned off, locks are fitted to control room doors, cautionary signs are placed in position and that all other precautionary measures are immediately taken.

Prior to plant energization, the customer/consulting engineer is to be informed that ABB's plant/plant section is ready for operation and that the customer, as soon as energization is commenced, is solely responsible for the operation and safety of the plant. This may be in contradiction to any contract agreement but nevertheless should be observed to make all parties aware of the prevailing situation.

Despite this, ABB's testing & commissioning personnel must ensure that reasonable safety measures have been taken by the customer. If the customer lacks a functional organization and the safety measures are considered as being inadequate, ABB's testing & commissioning personnel must ensure that reasonable measures are taken, considering at least their own safety. Example of such measures are:

- ⇒ The cordoning off of energized bays in the substation.
- ⇒ The cordoning off of energized transformers.
- ⇒ The cordoning off of sections of indoor switchgear that have been energized.
- ⇒ The installation of locks for energized areas, e.g. padlocks for the fence around capacitor banks. (Keys are always to be handed over to the customer's operating personnel).

7. Disconnection, temporary safety earthing

7.1 General

Prior to commencing work on a plant section, e.g. a substation, where there is the slightest risk that the equipment is, or can be, energized, the testing & commissioning personnel is always responsible for ensuring that the equipment is "dead". This can be determined in different ways:

- ⇒ With the aid of a voltmeter. Always used for low voltage but not normally for high voltage.
- ⇒ By making a visual inspection to ensure that the plant section is completely isolated from the supply and that all temporary earthing measures have been taken.

If the plant is in operation, the customer is normally responsible for such and for ensuring that sections are isolated and temporarily earthed. In other cases, it is to the testing & commissioning personnel interest to ensure that necessary measures have been taken to ensure their own safety and that of other personnel.

7.2 Disconnection

A plant section is considered as being completely isolated only when all the conductors, that can supply power to the section, are disconnected. This is accomplished by means of disconnectors incorporating visible break points or reliable position indicators, or by the extraction of fuses, truck-type circuit breakers, etc.

When isolating a plant section, certain items must be given special consideration:

- ⇒ Reverse supply. A great deal of accidents have occurred in cases when the persons involved were unaware of the fact that the plant was being supplied in the reverse direction from ring circuits, local auxiliary power generators, etc.
- ⇒ Erroneous action. Always make a careful check to ensure that the correct disconnectors are opened.
- ⇒ Inadvertent breaks. Before operating a disconnector, always ensure that the load current (if any) has been interrupted since conventional disconnectors are not designed to break heavy current.

Disconnectors, truck type circuit breakers, etc. are to be locked in their open positions to prevent them from being closed by mistake.

7.3 Temporary safety earthing

Temporary safety earthing means the earthing and short circuiting at the place of work to ensure that the plant section in question will not be subject to any voltages which can be of danger to the personnel.

Prior to commencing work on a high-voltage installation, the latter must always be temporarily earthed. If fixed earthing switches, earthing trucks, etc. are incorporated, these are to be used. If portable earthing equipment is used, this must first be connected to earth and then to the phase conductors. If the plant is "live" by mistake, a powerful arc can develop when making earth connections. For this reasons, appropriate tools such as insulated rods are always to be used. Portable earthing equipment must be capable of withstanding the highest short circuit current for a period of 1 second.

7.4 Barriers

If testing & commissioning work is to be done on a partially energized "hot" plant where the testing & commissioning personnel may inadvertently come in contact with a "live" plant section, barriers, are to be set up to give warning of the "live" plant sections that are located in the vicinity of the place of work. Example of such sections are:

- Near-lying energized bays in indoor and outdoor substations.
- Energized transformers, thyristor stacks etc.

Even when high-voltage tests are being made on plant sections, the equipment being tested and the test equipment must be cordoned off to prevent accidents.

Special barriers ropes, fitted with appropriate warning signs are suitable for this purpose. The ropes should be removed immediately after they have served their purpose.

7.5 Clothing

To reduce the risk of accidents and to minimize the effects of accidents which may occur, the commissioning engineer should not wear rings, necklaces, wrist-watch straps, etc. of metal when making tests in which he may come in contact with "live" parts.

Clothes of synthetic material should not be worn if there is any risk that arcs can develop. Synthetic material melts and penetrates the skin resulting in severe burnings and other injuries.

8. Measuring equipment and tools

8.1 Fuses

When measuring voltages on distribution busbars (high short-circuit power/powerful arcs), great care must be exercised in order to avoid short circuits. The inputs of the instruments being used must incorporate fuses. If an output is connected between the phases of a busbar a fatal accident may be the result.

8.2 Insulated tools

If works has to be done in energized low-voltage switchgear etc., the handles of the tools used must be adequately insulated. If screwdrivers are used, their shank must also be insulated. One of the most common accidents occurs when a screwdriver slips and its shank causes an undesired short circuit/arc.

9. Induced voltages

Non-energized plant sections, such as lines and busbars in outdoor substations, which are not earthed, can often assume dangerous potential due to induction from near-lying "live" parts. The risk of dangerous induction voltages is greatest in the vicinity of high-voltage (> 200 kV) substations. The shock received by a person who inadvertently comes in contact with a part energized by means of induction, for example in an outdoor apparatus, can be sufficient to throw him off a ladder. Induction voltages in non-operating plants can be prevented by sufficient earthing, e.g. with normal copper wire.

10. Current transformers

Secondary circuits of current transformers must never be opened while the latter are energized. If a secondary circuit is opened, the entire primary current will become magnetizing current and the core will saturate resulting in very high voltage (tenfold kV) across the secondary circuit. Great care should always be exercised when measuring the load current in secondary circuits. If a test switch is incorporated in the circuit, a current metering plug with built-in overvoltage protection is preferred to be used.

11. Voltage transformers

When making injection tests on protective relays etc. which are connected to voltage transformers, there is always a risk of the latter being supplied from the reverse direction in which case they produce high voltage which is fed to equipment connected to the primary. When connecting test equipment to voltage circuits, the secondary windings must therefore always be checked to ensure that they are disconnected in order to prevent any reverse supply to the transformers.

12. Power capacitors and high voltage cables

Due to their capacitive characteristics, capacitors and cables are capable of storing considerable amounts of electricity energy for lengthy periods of time. Before touching a previously energized power capacitor or a high-voltage cable, care must be taken to ensure that it is really in the discharged state, i.e. short circuited and earthed (via a discharge resistor if such is included).

13. Low voltage switchgear

The short-circuit power in large low-voltage switchgear is often relatively high. The high power and the relatively long tripping times of the “incoming” short-circuit protections, during a short circuit, result in a very high current (powerful arcs) for a relatively long time.

If work has to be carried out on an energized substation, the tools used must therefore be adequately insulated to prevent inadvertent short circuiting.

Voltage measuring instruments such as voltmeter or phase-sequence indicators, which are used during the testing & commissioning work, are to be connected to the external side of an apparatus group, i.e. on the fused side. Furthermore, the instruments used should, where possible, be provided with fuses.

14. Batteries

For operational reasons, the station battery of a plant is normally connected directly to the DC-distribution board without any intermediate fuses. The high short-circuit current from the battery is therefore not limited by any fuse and great care must be exercised when taking measurements and when working on the battery circuit.

15. Convertor

The output current of a convertor is, normally, limited only by the convertor's current limiter which often has a relatively high setting. As is the case with the battery, great care must be taken to ensure that the convertor's output port is not short-circuited by mistake.

16. Fuses

When removing/inserting high-rated fuses, such as blade fuses in low-voltage switchgear, or high-voltage fuses, insulated fuse tongs are always to be used.

Where such is possible, fuses should always be replaced in the “dead” state, i.e. with the fuse-switch in the “Off” position. If, for any reasons, the fuseholder cannot be de-energized (e.g. battery fuses), one should always make a habit of ensuring that no short circuit occurs when large-size low-voltage fuses are inserted in their holders. The best way of doing this, is to check that the voltage across the other fuseholders is zero after inserting the first fuse.

17. Electrically operated equipment

During testing & commissioning when personnel is working on the equipment, great care must always be exercised to ensure that outdoor circuit-breakers, SF6 circuit-breakers, disconnectors, motors, etc. are not operated by mistake. Tensioned springs which are released, rotating shafts, levers and the like, can cause serious injury. The risk of shocks, and injuries due to falling from ladders, etc, must also be taken into consideration.

Accidents of this type can be prevented by disconnecting the control circuits to electrically operated equipment and, if possible, by securing such equipment mechanically.

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	H&S Description: HEALTH & SAFETY ACTION PLAN	Order No.: 10898
Form No.: 151 02010 E		Template No.: 151 02010 E KOR 001 AA
		Page: 1/1

1. Purpose of Performance

Check for the performance of pending deficiencies from the Health & Safety Checklist.

The H&S Action Plan has to be used for pending deficiencies from the Safety Checklist and shall be issued with the date when the deficiencies has to be completed.

After completion of the deficiencies from the person in charge (client or contractor), a ABB's representative has to sign with date and signature.

Protocol

251 02010 E

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	H&S Report: HEALTH & SAFETY CHECKLIST	Order No.: 10898
Form No.: 251 01010 E		Template No.: 251 01010 E KOR 001 AA
Start of Test:	Feeder/Diameter:	Page: 1/14

1. Requirements for the Health & Safety Checklist

The ABB Supervisor is obliged to perform a general evaluation regarding health & safety of the working area. Therefore he fills in the health & safety checklist for installation.
For subjects where deficiencies are detected the detailed checklist must be completed. If no deficiencies are detected the completion of the detailed checklists is not mandatory. The completed checklist must be signed by the ABB Supervisor and returned to his ABB home office

2. Health & Safety Checklist for installation

Subject	Deficiencies?		Comments
	Yes	No	
2.1 Regulations, Instruction, Info			
2.2 Organization Planning			
2.3 Help in an Emergency			
2.4 Fire Prevention			
2.5 Traffic and pedestrian routes			
2.6 Electrical installations			
2.7 Working at heights			
2.8 Suspension Devices			
2.9 Hand tools			
2.10 Equipment and Machines			
2.11 Scaffolding			
2.12 Ladders			
2.13 Material Storage			

ABB Switzerland Ltd.	Client	Consultant
Date: .....	.....	.....
Name: .....	.....	.....
Signature: .....	.....	.....

2.1 “Regulations, Instruction, Info” checklist

Date:_____ checked by:_____

Yes

No

Inspection of the working area (5+2 Safety Rules)

- 1) Clear identification of the working area
- 2) Disconnect the relevant HV-Equipment
- 3) Secure against reconnection
- 4) Check the installation is dead
- 5) Carry out earthing and short circuiting
- 6) Protect against other live parts
- 7) Obtain working permission

Are the relevant building site foremen familiar with the pertinent regulations?

Are operational based safety regulations available and known?

Are customer based safety regulations available and known?

Is information on safety and hygiene systematically publicized?

Are “new arrivals” systematically introduced to hazards, conduct and responsibilities?

Is the staff informed about the property damage, accident situations and accidents, their consequences and measures to prevent them?

Remarks:
ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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2.2 "Organisation Planning" checklist

Date: _____ checked by: _____

Yes

No

Have the responsibility and competencies for industrial safety been properly arranged on the building site?

Is industrial safety a regular agenda item during visits and at conferences of the responsible site supervisors?

Are there planning mistakes that may adversely affect the safety of the assembly personnel?

Is the relevant specialist for industrial safety involved if there are special hazards or risks?

Are there contacts with the relevant authorities?
e.g. industrial inspectorates, accident insurance companies.

Are the relevant laws, directives and provisions known?

Have employees been informed about the status of organisation and planning?

Remarks:
ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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2.3 Help in an Emergency

Date: _____ checked by: _____

Yes

No

Have matters relating to providing help in an emergency been properly arranged on the building site?

Do the staff know what is to be done in serious accidents?

Are the emergency service numbers written on the telephones?

Are the emergency service numbers programmed into mobiles?
!! Attention: not all emergency numbers can be dialled from mobiles !!

Is there a reliable medical service on site?

Has the staff been trained in life saving first-aid?

Is there medical material for first aid and for treating small injuries on site?

Is there an obligation for reporting accident injuries on the building site?

Are the necessary formalities for reporting accidents known?

Remarks:

ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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2.4 Fire Prevention checklist

Date: _____ checked by: _____

Yes

No

Does the management know if and how a fire brigade can be called out for bigger fires?

Is the function of the permanently installed automatic extinguishing equipment known?

Has the use of permanent fire-fighting water lines, hydrants, etc. been regulated?

Small fire-fighting equipment, bucket sprays, hand-held fire extinguishers
Have they been usefully positioned? Accessible at all times? Periodically checked?

Has the staff been trained in the use of small fire-fighting equipment?

Are the relevant laws, directives and provisions on fire prevention known?

Have mobile heaters, hot plates or cookers been installed safely in terms of fire?

Are combustible, highly inflammable materials or waste stored safely in terms of fire?

Are combustible, highly inflammable materials or waste regularly and correctly disposed of?

Remarks:
ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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2.5 Traffic and pedestrian routes checklist

Date: _____ checked by: _____

Yes

No

Space problems

Is material stored in such a way that "pedestrian routes" are at least 60 cm wide? Are the "traffic and pedestrian routes" free of surrounding hoses, cables and other "bits and pieces"?

Route markings

Are the route markings in order and appropriate? Are they respected?

Slippage hazard

Are the "traffic and pedestrian routes" non-slip and stable? Is waste immediately cleaned up?

Tripping hazard

Are trip hazards, ground unevenness and steps recognised as hazards and refurbished or adequately marked?

Danger from vehicles

Are there blind spots where people are at risk from vehicles? Do reversing vehicles receive the necessary attention from both "parties"?

Are "temporary hazards" immediately and adequately marked?

Remarks:

ABB Switzerland Ltd.

Client

Consultant

Date:

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Name:

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Signature:

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2.6 Electrical installations checklist

Date: _____ checked by: _____

Yes

No

Has the part of the electrical installed used by your staff been installed or checked by a qualified expert?

Are electrical devices and mobile lighting connected using a residual current breaker?

Are the electric cables and plug connectors in a good condition?
Connecting plugs must not come into direct contact with the floor.

Are only double-insulated electrical hand machines used?

Are the building site installations changed only by experts?

Are the building site installations checked periodically?
(Cables, plug connections, RCB, etc.)

Remarks:

ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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2.7 Working at heights checklist

Date: _____ checked by: _____

Yes

No

Is there a risk of people falling?

Serious accidents can occur even at low heights! The risk of falling is especially great when working at heights with hand tools or hand machines!

Working on ladders!

Ladders are makeshift solutions! Are they used only in those places where no gantry or scaffolding can be used for time or space reasons?

Fixed gantries

Are the climbing and passage coverings made of non-slip materials?
Are the handrails in order (even for fall heights of less than 2 metres)?

Mobile gantries and scaffolding

Are the climbing steps and passage coverings in order? Are the handrails in order and correctly installed (even for fall heights of less than 2 metres)?
(Do not forget the connecting struts and edging strips)

Personal fall-arrest equipment

If the possible fall height is 2 metres or more, the legislator demands appropriate safety devices. Where people are not secured by handrails or other permanent fittings, personal, mobile devices must be used. Is this type of equipment available and is it consistently used?

Instructions, training

Are your employees regularly informed of these particular accident risks and on the correct behaviour?

Remarks:

ABB Switzerland Ltd.

Client

Consultant

Date:

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Name:

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Signature:

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2.8 Suspension Devices checklist

Date: _____ checked by: _____

Yes

No

Do the suspension devices meet requirements in terms of type, shape and weight of work pieces? Load suspension devices should comply with requirements determined by the work pieces. Changes in assembly processes frequently lead to different requirements for auxiliary equipment.

Checking the suspension devices:

Chains

Worn, bent links and hooks, stress marks or firing pitting from welding electrodes?

Wire ropes

Wire break tangle, crushed spots, heavy kinking or bending, faulty crimping casings or split joints?

Plastic ropes

Tear, cut and burn marks, heavy pollution?

Round slings

(e.g. straps) cuts and burn holes in the cover, heavy pollution?

Lifting straps

Worn, damaged protective layer, damaged loops, heavy pollution?

S-hooks, shackles, ring bolts

Bent, faulty, thread damaged, load bearing designation?

Special equipment

Strength record, load-bearing designation, missing, faulty parts?

Storage

Are the suspension devices stored properly?

Training

Have employees been trained in the proper use of the suspension devices?

Remarks:

ABB Switzerland Ltd.

Client

Consultant

Date:

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Name:

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Signature:

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2.9 Hand tools checklist

Date : _____ checked by: _____

Yes

No

Hammers!

Cracking, splitting on hammer surfaces? Loose, faulty handles? Heavily worn lead or plastic bodies?

Chisels, punches, drifts, impact rates!

Bearding, splitting on impact surfaces? Blunt, split blades or tips?

Screwdrivers, files, scrapers, mortise chisels!

Handles split? Blunt, split blades? Scrapers not chamfered, or ground to a blunt point?

Adjustable spanners!

Open-ended spanner stretched? "Worn" hexagonal socket? Faulty special spanners? Improvised spanner extensions not fit for purpose?

Range of tools!

Is the range of tools suitable and adequate for your working area?

Use!

Do you regularly check that your employees are using the tools correctly?
(Prevention of accidents and material damage)

Remarks:

ABB Switzerland Ltd.

Client

Consultant

Date:

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Name:

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Signature:

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2.10 Equipment and Machines checklist

Date: _____ checked by: _____

Yes

No

Stationary metal/wood-working machines

Have the machines been installed by qualified staff?

Are the stipulated protective devices in order?

Can the switch-off devices be locked and have they been fitted with emergency stop arrows?

Are the required auxiliary devices in order?

Are periodic checks and servicing carried out?

Do only trained or well instructed staff work on these machines?

Drilling, grinding and other hand-operated machines

Are these machines registered?

Is a maintenance and repair service assured?

Are members of staff unfamiliar with these machines carefully trained before being allowed to use?

Risks due to external effects

Are there risks from sound emissions?

Are there risks from flying sparks?

(people, fire, firing of glass, ceramics, etc.)

Remarks:

ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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2.11 Scaffolding checklist

Date: _____ checked by: _____

Yes

No

Has the responsibility for erecting and maintaining scaffolding been laid down?

Does the scaffolding to be used by your staff comply with the relevant regulations?

Is “approval” given after erecting or modifying scaffolding?

Has fixed and rolling scaffolding been correctly erected in accordance with the supplier’s instructions? Instructions on site?

Has scaffolding in the vicinity of transit or transport routes been signposted?
e.g. by barriers or warnings, boards, etc.

If scaffolding has been erected in the vicinity of electrical cables, crane installations, or other hazards, have the necessary safety measures been taken?
e.g. by confirmation of safety measures and a list of actions taken.

Do ladders rising vertically over 5 m in height have a protective cage installed?
Protecting people from falling can also be achieved with personal fall arresting equipment.

Are the scaffold passages and platforms clear of waste and obstacles?

Have employees been properly trained in using scaffolding correctly?

Remarks:
ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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2.12 Ladders checklist

Date: _____ checked by: _____

Yes

No

Are enough ladders available?

Can the available ladders be used appropriately?

Are the ladders in good condition?
Poles, rungs, feet, extension catches, anti-expansion device for step-ladders?

Are the ladders stored correctly?
Dry, shaded location for wooden ladders

Are single ladders properly secured when being used?
e.g. by securing the ladder foot or attaching them.

Are ladders used only for short and light work?
Heavy work, or work lasting longer, needs the appropriate scaffolding.

Do ladders rising vertically over 5 m in height have a protective cage installed?
Protecting people from falling can also be achieved with personal fall arresting equipment.

Do "third party ladders, or ladders provided on the site" meet our requirements, even when used at our own responsibility?

Have employees been trained in the proper use of the ladders?

Remarks:
ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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2.13 Material Storage checklist

Date: _____ checked by: _____

Yes

No

Has the material to be used been stored properly?
Stable base, Intact support blocks, Limited stacking heights, Standing parts "secured against falling" Pipes, barrels, etc. secured against rolling away

Are the access roads to the storage sites in order?

Has the permissible ground load been complied with?

Is the stored material protected adequately against weather?

Is theft protection adequate?

Have appropriate fire prevention measures been taken?

Remarks:

ABB Switzerland Ltd.
Client
Consultant

Date:

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Name:

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Signature:

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	H&S Report:	Order No.: 10898
Form No.: 251 02010 E	HEALTH & SAFETY ACTION PLAN	Template No.: 251 02010 E KOR 001 AA
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No.	Action to be taken	Date	Person tasked	Completed		Remarks	Checked	
				Date	Signature		Date	Signature

ABB Switzerland Ltd.	Client	Consultant
Date: .....	.....	.....
Name: .....	.....	.....
Signature: .....	.....	.....

SECTION 4

INSTALLATION MAPPING

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Subject: GIS INSTALLATION	Order No.: 10898
Form No.: 021 00000 E		Template No.: 021 00000 E KOR 001 AA
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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: GENERAL INFORMATION	Order No.: 10898
Form No.: 121 00010 E		Template No.: 121 00010 E KOR 001 AA
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GENERAL INFORMATION

INTRODUCTION

The purpose of the "Site Test Program for Installation" is to set a guide to the way installation of SF6-GIS has to be carried out.

DOCUMENTATION

Prior to any installation work the following documentation is mandatory:

- Approved drawings
- Approved "Site Test Program for Installation"

SITE TEST PLAN FOR INSTALLATION

The Site Test Plan for Installation is listing the inspections and tests which are planned to be done on site.

The Site Test Plan for Installation refers to test procedures and test records, from these it is possible to follow the planned tests more in detail.

TEST EQUIPMENT

All test equipment used is registred and calibrated according our ISO 9001 quality certificate.

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: ACCEPTANCE OF BUILDING AND FOUNDATIONS	Order No.: 10898
Form No.: 121 01010 E		Template No.: 121 01010 E KOR 001 AA
		Page: 1/2

1. Purpose of inspection

This procedure is for acceptance of building and foundations.

2. General checks

- Completion of civil work
- Availability of cranes (Overhead / Mobile)
- AC availability and lighting
- Openings and cable ducts are closed
- Lockable doors, gates
- Availability of storage and office rooms
- Cleaness
- Earthing grid
- X and Y axis

3. Condition of building structure

The SF₆ switchgear room must be finish constructed.

All work of tradesmen such as bricklayers, painters, fitters, electricians must be completed.

Tools, fixtures and installation material of the tradesmen must be removed from the switchgear room.

The crane facility must be finish installed / cleaned and operational.

Prior to installation the power supply (light, electrical power) required for the installation should be available.

A lockable toolstore should be provided in the immediate vicinity of the switchgear room.

A storage room or storage area of adequate size must be available outside the switchgear room for the purpose of unpacking and cleaning the assembly units.

The entire switchgear room must be thoroughly cleaned and largely free of dust.

Earthing connection flags to be checked with reference to the drawing "Earthing Layout".

X and Y axis to be checked with reference to the drawing "Civil Work Requirements"

4. Conditions for GIS installation

During the installation of the SF₆ switchgear, no rework of construction in the building should be permitted. In the event that such work is unavoidable, the chief supervisor should coordinate this work with the local construction management. In such a case, installation of the SF₆ switchgear shall have first priority.

The switchgear room must be lockable.

All breakthroughs, cable ducts etc. leading to the outside must be fitted with appropriate covers.

During the installation, the switchgear room must be kept clean. Vacuum cleaning, wet wiping of floors if necessary.

Note: The crane facility must be examined periodic on cleanness.

Results to be recorded in:

Protocol

221 01010 E

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Report:	Order No.: 10898
Form No.: 221 01010 E	ACCEPTANCE OF BUILDING AND FOUNDATIONS	Template No.: 221 01010 E KOR 001 AB
Start of Test:		Feeder/Diameter:
		Page: 1/2

Before start of installation, following items are completed and available:

	completed, available	outstanding
1. All construction activities in the switchgear room are finished.	<input type="checkbox"/>	<input type="checkbox"/>
2. The entire switchgear room must be thoroughly cleaned.	<input type="checkbox"/>	<input type="checkbox"/>
3. Approach road to the GIS building is guaranteed.	<input type="checkbox"/>	<input type="checkbox"/>
4. The crane is installed, approved and ready for operation.	<input type="checkbox"/>	<input type="checkbox"/>
5. Power supply (220/380V) is available from at least two auxillary boards.	<input type="checkbox"/>	<input type="checkbox"/>
6. The lighting is installed and functioning. (200 Lux required)	<input type="checkbox"/>	<input type="checkbox"/>
7. All wall openings, cable trenches etc. are appropriately covered, transport-, lift shafts and galleries are secured with handrails.	<input type="checkbox"/>	<input type="checkbox"/>
8. All entrances to the switchgear room are equipped with locks and the keys are in possession of ABB Switzerland Ltd field supervisor.	<input type="checkbox"/>	<input type="checkbox"/>
9. For the duration of the GIS installation, following items have to be available to the ABB Switzerland Ltd field supervisor:		
-A lockable storage room with shelves for loose parts and tools.	<input type="checkbox"/>	<input type="checkbox"/>
-A lockable office room with phone / fax, desk, chairs and refrigerator.	<input type="checkbox"/>	<input type="checkbox"/>
-Sufficient storage and space for unpacking the cases outside the switchgear building.	<input type="checkbox"/>	<input type="checkbox"/>
10. Civil works according to the drawing "Civil Work Requirements".	<input type="checkbox"/>	<input type="checkbox"/>
11. Outdoor foundations according to the drawing "Civil Work Requirements".	<input type="checkbox"/>	<input type="checkbox"/>
12. Earthing grid in accordance to the drawing "GIS Earthing Plan".	<input type="checkbox"/>	<input type="checkbox"/>

The acceptance of building shall take place, if the above mentioned items are completed and to the satisfaction of the ABB Switzerland Ltd field supervisor. Minor outstandings / deviations shall be reported.

ABB Switzerland Ltd shall not be responsible for any delay of installation due to non acceptance of building and foundations.

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

Case 1

Inspection of site is satisfactory and installation of GIS can start.

Case 2

Inspection of site has show, that conditions at site do not comply with ABB requirements.

A
☐

Start of installation is postponed until all deficiencies are "solved" and conditions fullfill ABB requirements.

- ABB shall not be kept responsible for delay in schedule resulting from this action.
- ABB will claim for waiting period of supervisor and rental fee for tools.

B
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Customer insists on start of installation at own risk.

All couplings performed under conditions which do not fullfill ABB requirements are ex-
empted from warranty.

In case of flashover during HV-Test the resulting repair costs of such couplings will be
claimed.

Amount of couplings & extend of installation which do not fullfill ABB requirements shall
jointly be "traced".

proceed acc. to

Customers decision:

A) ☐
B) ☐

ABB Switzerland Ltd.

Client

Consultant

Date:

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Name:

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Signature:

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: ACCEPTANCE OF YARD AND FOUNDATIONS	Order No.: 10898
Form No.: 121 01020 E		Template No.: 121 01020 E KOR 001 AA
		Page: 1/2

1. Purpose of inspection

This procedure is for acceptance of building and foundations.

2. General checks

- Completion of civil work
- Availability of cranes
- AC availability and lighting
- Openings and cable ducts are closed
- Lockable doors, gates
- Availability of storage and office rooms
- Cleaness
- Earthing grid
- X and Y axis

3. Condition of building structure

The switchyard must be finished constructed.

All work of tradesmen such as bricklayers, painters, fitters, electricians must be completed.

Tools, fixtures and installation material of the tradesmen must be removed from the switchyard.

The crane facility must be finish installed / cleaned and operational.

Prior to installation the power supply (light, electrical power) required for the installation should be available.

A lockable toolstore should be provided in the immediate vicinity of the switchyard.

Earthing connection flags to be checked with reference to the drawing "Earthing Lay-out".

X and Y axis to be checked with reference to the drawing "Civil Work Requirements"

4. Conditions for control building installation

The building must be lockable.

All breakthroughs, cable ducts etc. leading to the outside must be fitted with appropriate covers.

Results to be recorded in:

Protocol

221 01020 E

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Report:	Order No.: 10898
Form No.: 221 01020 E	ACCEPTANCE OF YARD AND FOUNDATIONS	Template No.: 221 01020 E KOR 001 AB
Start of Test:		Feeder/Diameter:
		Page: 1/2

Before start of installation, following items are completed and available:

	completed, available	outstanding
1. All construction activities in the switchyard are finished.	<input type="checkbox"/>	<input type="checkbox"/>
2. Water drains functioning.	<input type="checkbox"/>	<input type="checkbox"/>
3. All floor openings, cable trenches etc. are appropriately covered.	<input type="checkbox"/>	<input type="checkbox"/>
4. The entire switchyard must be cleaned.	<input type="checkbox"/>	<input type="checkbox"/>
5. Approach road to the GIS installation is accessible. (Gates installed, no unnecessary traffic through the switchyard).	<input type="checkbox"/>	<input type="checkbox"/>
6. Mobil cranes available for GIS installation.	<input type="checkbox"/>	<input type="checkbox"/>
7. Power supply (220/380V) is available from at least four auxillary boards.	<input type="checkbox"/>	<input type="checkbox"/>
8. For the duration of the GIS installation, following items have to be available to the ABB Switzerland Ltd field supervisor:		
-Lockable storage / container for tools and instruments.	<input type="checkbox"/>	<input type="checkbox"/>
-Office room including desk, table, chairs, refrigerator. (phone, fax)	<input type="checkbox"/>	<input type="checkbox"/>
-Sufficient storage and space for unpacking the cases, cleaning and preparing the assembly units.	<input type="checkbox"/>	<input type="checkbox"/>
9. Civil works according to the drawing "Civil Work Requirements".	<input type="checkbox"/>	<input type="checkbox"/>
10. Foundations according to the drawing "Civil Work Requirements".	<input type="checkbox"/>	<input type="checkbox"/>
11. Earthing grid in accordance to the drawing "GIS Earthing Plan".	<input type="checkbox"/>	<input type="checkbox"/>

The acceptance of the installation yard shall take place, if the above mentioned items are completed and to the satisfaction of the ABB Switzerland Ltd field supervisor. Minor outstandings / deviations shall be reported.

ABB Switzerland Ltd shall not be responsible for any delay of installation due to non acceptance of yard and foundations.

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:
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Case 1

Inspection of site is satisfactory and installation of GIS can start.

Case 2

Inspection of site has show, that conditions at site do not comply with ABB requirements.

A
☐

Start of installation is postponed until all deficiencies are "solved" and conditions fullfill ABB requirements.

- ABB shall not be kept responsible for delay in schedule resulting from this action.
- ABB will claim for waiting period of supervisor and rental fee for tools.

B
☐

Customer insists on start of installation at own risk.

All couplings performed under conditions which do not fullfill ABB requirements are ex-
empted from warranty.

In case of flashover during HV-Test the resulting repair costs of such couplings will be
claimed.

Amount of couplings & extend of installation which do not fullfill ABB requirements shall
jointly be "traced".

proceed acc. to

Customers decision:

A) ☐
B) ☐

ABB Switzerland Ltd.

Client

Consultant

Date:

.....

.....

Name:

.....

.....

Signature:

.....

.....

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: CONTROL AND CONNECTION OF ASSEMBLY UNITS	Order No.: 10898
Form No.: 121 02010 E		Template No.: 121 02010 E KOR 001 AA
		Page: 1/2

1. Purpose of performance

This procedure is for control and connection of assembly units.

2. Registration of assembly units

- Identity number
- Registration of condition
- Mechanical condition
- Nitrogen remaining gas pressure
- Registration of flange treatment
- After coupling, treatment on site
- Damage report reference if necessary
- Location

3. Control

Equipment and materials for installation are defined in the drawing "Assembly Drawing" including the belonging material lists.

The allocations of equipment and loose materials are stated by "Unit-N°" e.g. 001, 002, etc.

After unpacking, each unit must be controlled to the corresponding report form and after to be installed in the determined location. (Assembly Drawing)

These equipment allocations have to be strictly observed

4. Connections

Cleaning of the individual components
Use non-fibrous or special paper cloths for cleaning the inner parts.

While coupling the assembly units, make sure that the enclosures are only opened shortly before the coupling is carried out. If that is not possible, the opened parts are to be covered with plastic foil or protective hoods to limit the danger to a minimum of foreign materials (dust, chips) getting into them.

The insulators may not be touched with the bare hands, plastic gloves required!

For each connection between two assembly units, new O-rings are delivered and shall be installed.

Results to be recorded in:

Protocol

221 02010 E

To Procedure: HASV600824	Assembly drawing No.: _____
--------------------------	-----------------------------

Remarks:

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: PRIMARY RESISTANCE MEASUREMENTS	Order No.: 10898
Form No.: 121 03010 E		Template No.: 121 03010 E KOR 001 AA
		Page: 1/2

1. Purpose of test

Measurement of DC-Resistance after installation by means of a current source and a micro ohmmeter.

2. Test equipment

Micro ohmmeter test set

3. Test conditions

Prescribed nominal values refer to ambient temperature of 20°C. If higher/lower ambient temperatures prevail during the tests, a correction factor is applicable.

This factor is $\pm 2.0\%$ of nominal value per 5°C deviation.

Example: Nominal value (at 20°C) 100 $\mu\Omega$

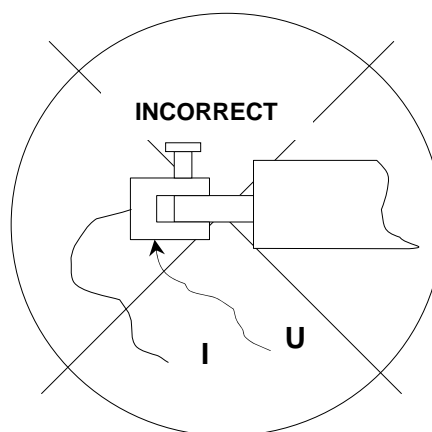
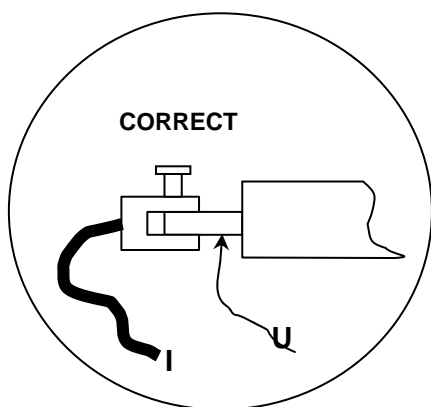
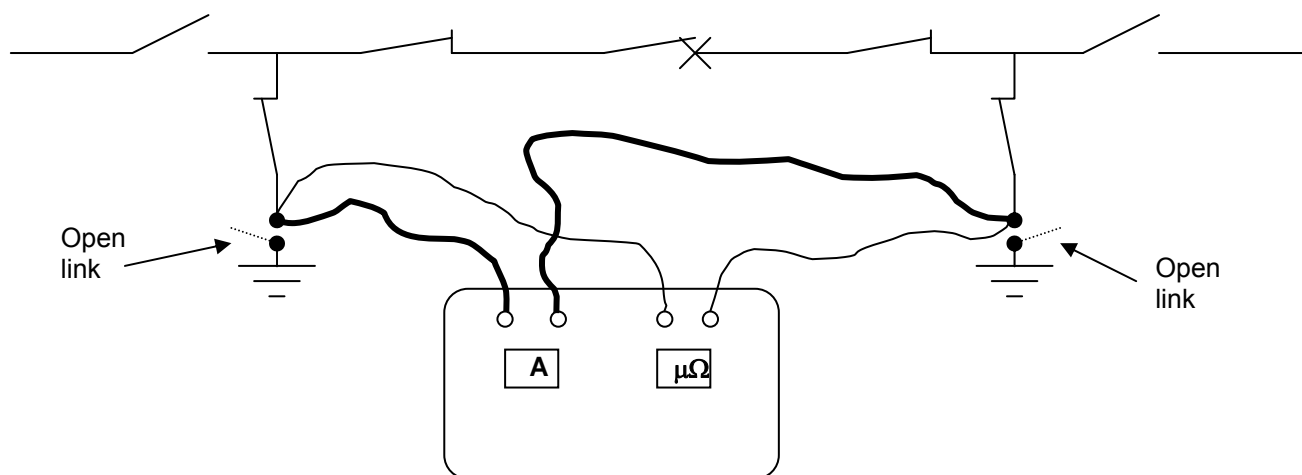
Permissible resistance at 35°C 106 $\mu\Omega$

If a correction factor is applied, the ambient temperature is to be noted in the test report form.

Protocol

221 03010 E

4. Test arrangement



To Procedure: HASV601049 Gas schematic diagram No.: _____ Measurement equipment No.: _____

Remarks:

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: EVACUATION AND FILLING	Order No.: 10898
Form No.: 121 03020 E		Template No.: 121 03020 E KOR 001 AA
		Page: 1/1

1. Purpose of test

Check of tightness of gas compartments during evacuation phase and after filling with SF₆-Gas.

The monitoring of the pressure continues during all the installation time until commissioning has finished. It consists of measurements of SF₆ gas pressure drop in gas compartments.

2. Test equipment

SF₆ gas (in pressurised bottles).
Service truck (evacuation and filling device)
Couplings and hoses
Leak detector
GIS special tools

3. Special precautions

SF₆ gas handling.

As a general rule it is recommended that the insulators must not be subjected to unnecessary mechanical stressing.

It is recommended that the gas compartments be filled (alternatively) such that the pressure differences acting on the barrier insulators during the filling procedure do not exceed approx. Pabs =350kPa.

Results to be recorded in:

Protocol

221 03020 E

To Procedure: 1HC0028659	Gas schematic diagram No.: _____ Pressure gauge No.: _____
--------------------------	---

Comments:	

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: DENSITY MONITORS OPERATING POINTS	Order No.: 10898
Form No.: 121 03030 E		Template No.: 121 03030 E KOR 001 AA
		Page: 1/1

1. Purpose of test

Check of operating points compare with the “Gas Schematic Diagram”

For testing, the density monitors are mounted on the buffer container (item 3). In case of firmly mounted density monitors, only the present switching condition can be indicated.

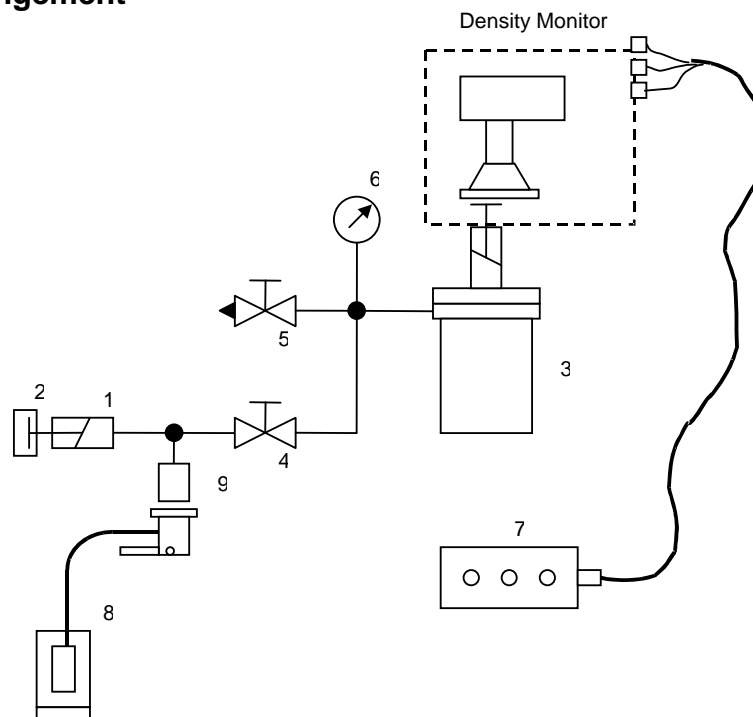
The test pressure is indicated at the gauge (item 6). The indicator lamp in the indicating unit (item 7) lights up when the corresponding switch contact is closed.

SF₆-gas over the coupling (item 1) or compressed air, which is generated by means of the air pump (item 8), is used as testing medium

Protocol

221 03030 E

2. Test arrangement



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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: GAS MEASUREMENTS	Order No.: 10898
Form No.: 121 04010 E		Template No.: 121 04010 E KOR 001 AA
		Page: 1/1

1. Objective

To proof that the gas insulated switchgear equipment will not exceed the maximum admissible humidity in operation.

2. Applicability

SF6 gas insulated switchgear of ABB Switzerland Ltd. and associated components.

3. Procedure

The measurement should be done during the commissioning after the filling of the components with gas after a balance of eventual equalisation phenomena in the distribution of moisture in the gas compartment.

4. Scope of test

All gas compartments in the installation are to be checked for moisture, SF6 percentage and pressure

5. Responsibility

Site Manager, Installation Supervisor

Protocol

221 04010 E

To Procedure: 1HC0028459 / 1HC0016974

Gas schematic diagram No.:_____ Measurement device No.:_____

Remarks:	
----------	--

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: FINAL INSPECTION GIS	Order No.: 10898
Form No.: 121 04030 E		Template No.: 121 04030 E KOR 001 AA
		Page: 1/1

1. Purpose of consistency check

Final control of installation and pre commissioning activities.
According to:

Protocol

221 04030 E
221 04040 E

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Report:	Order No.: 10898
Form No.: 221 04030 E	FINAL INSPECTION GIS	Template No.: 221 04030 E KOR 001 AB
Start of Test:		Feeder/Diameter:
		Page: 1/1

Assembly drawing No.: _____

1. High Voltage Switchgear:	Sign	3. Commissioning and HV-Test:	Sign
Check of gas tightness	-----	Commissioning processed by:	
Checking of screws:		Company:	-----
Switchgear, anchors, supports, earthing	-----	Name:	-----
Caps to be replaced on gas connections	-----	High voltage test processed by:	
Earthing complete	-----	Company:	-----
Earth strips mounted on compensators	-----	Name:	-----
Bypass tubes installed	-----		
Exhaust chambers installed	-----	4. As Built Drawings:	
Compensators are adjusted, locking pins removed and fastened at mating flange	-----	Modifications must be marked up “red” on the corresponding drawings and documented with photos	-----
End corona shields installed	-----	Reports according to documentation signed by client	-----
Insulated earth switches short circuited	-----		
Flange treatment accomplished	-----	4. Equipment of Client:	
Flange-,and apparatus shelters installed	-----	Spare parts of switchgear	-----
Covers on density monitors installed	-----	Installation devices	-----
Heaters switched on	-----	Maintenance facilities	-----
Secondary cable inlets acc. instruction	-----	Test equipments, measurement devices	-----
Corrosion noticed and eliminated	-----	Gas service units	-----
		SF6-Gas cylinders, hydraulic oil	-----
		-----	-----
		-----	-----
		-----	-----
2. Visual Check up:			
Cleanness in general, coat of paint	-----		
Wall-, and floor sealings	-----		
Sign-posting	-----		
-----	-----		

Remarks: _____

	ABB Switzerland Ltd.	Client	Consultant
Date:	.....	.....	.....
Name:	.....	.....	.....
Signature:	.....	.....	.....

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: FINAL INSPECTION GIS-OUTDOOR	Order No.: 10898
Form No.: 121 04060 E		Template No.: 121 04060 E KOR 001 AA
		Page: 1/1

General Control

Final control of Installation and pre commissioning activities.

Protocol

221 04060 E

Assembly drawing No.: _____

Sign

Remarks: _____

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: SPARE PARTS / SERVICE EQUIPMENT	Order No.: 10898
Form No.: 121 05010 E		Template No.: 121 05010 E KOR 001 AA
		Page: 1/1

General Control

The equipment is listed on the here attached sheet.

Protocol

221 05010 E

[illegible]

Remarks: _____

Consultant

.....

.....

.....

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Description: COMPLETION CERTIFICATE INSTALLATION	Order No.: 10898
Form No.: 121 05020 E		Template No.: 121 05020 E KOR 001 AA
		Page: 1/1

General Control

An acceptance protocol is written, in which the client and the ABB Supervisor confirm, that the installation of the GIS is completed.
A list of possible pending items is made.

Protocol

221 05020 E

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Installation Report:	Order No.: 10898
Form No.: 221 05020 E	COMPLETION CERTIFICATE INSTALLATION	Template No.: 221 05020 E KOR 001 AB
Start of Test:		Feeder/Diameter:
		Page: 1/1

INSTALLATION OF GIS

The installation and the tests of the switchgear have successfully been completed according to
 “INSTALLATION PROCESSES ON SITE (GIS)“.
 The results are reported on the here attached sheets.

PENDING ITEMS

None or following list:

ENCLOSURE

1 Set of “Installation Test Reports“(Copy for the Client)
 Spare Parts / Service Equipment 221 05010 E

REMARKS

	ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report:	Order No.: 10898
Form No.: 221 05060 E	DOCUMENT LIST	Template No.: 221 05060 E KOR 001 AB
Start of Test:	Feeder/Diameter: DOCUMENT LIST	Page: 1/1

Document No.	Name / Description	Quantity	Revision	Date

ABB Switzerland Ltd.	Client	Consultant
Date: .....	.....	.....
Name: .....	.....	.....
Signature: .....	.....	.....

SECTION 5

COMMISSIONING MAPPING

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Subject: GIS COMMISSIONING	Order No.: 10898
Form No.: 011 00000 E		Template No.: 011 00000 E KOR 001 AA
		Page: 1/2

Table of Contents

Switchgear, Apparatus, Supervision

CB ELK Drive HMB

<i>Description</i>	111 02020 E
<i>Test Report</i>	211 02020 E

CB Timing Test

<i>Description</i>	111 02030 E
<i>Test Report</i>	211 02030 E

CB Pump Start Control

<i>Description</i>	111 02050 E
<i>Test Report</i>	211 02050 E

Isolator and Earth Switch Function Check (electronic)

<i>Description</i>	111 02061 E
<i>Test Report</i>	211 02061 E

Density Monitors

<i>Description</i>	111 02070 E
<i>Test Report</i>	211 02070 E

Voltage and Current Transformers

VT Secondary Insulation

<i>Description</i>	111 03010 E
<i>Test Report</i>	211 03010 E

VT DC Resistance

<i>Description</i>	111 03030 E
<i>Test Report</i>	211 03030 E

VT Ratio und Polarity

<i>Description</i>	111 03070 E
<i>Test Report</i>	211 03070 E

CT Secondary Insulation

<i>Description</i>	111 03080 E
<i>Test Report</i>	211 03080 E

CT Analyzer

<i>Description</i>	111 03150 E
<i>Test Report</i>	211 03150 E

Local and Remote Control / Supervision

Interlocking

<i>Description</i>	111 04010 E
<i>Test Report</i>	211 04010 E

Local Alarms

<i>Description</i>	111 04060 E
<i>Test Report</i>	211 04060 E

Acceptance

Commissioning Acceptance

<i>Description</i>	111 07050 E
<i>Test Report</i>	211 07050 E

Document List

<i>Test Report</i>	211 07060 E
--------------------	-------------

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: CB ELK HMB	Order No.: 10898
Form No.: 111 02020 E		Template No.: 111 02020 E KOR 001 AA
		Page: 1/1

General Control

Screws and terminals
Gas and oil fillings

Check of the running time controller

Measurement of the pump running time

Function check

ON and OFF functions of local command work correctly
(without controller, direct function)
Pump hindrance (hindrance of reclosing)
Controller for pole discrepancy, (Trip at unequal pole positions)
Pump relay switch ON and OFF
Signal "OFF-ON-OFF"
Blockings for "Switch ON"
Blockings for "Trip 1" and "Trip 2"

Check of the panel heater

Check of the counter functions

Protocol

211 02020 E

ABB Switzerland Ltd

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report: CB ELK HMB FUNCTION CHECK	Order No.: 10898
Form No.: 211 02020 E		Template No.: 211 02020 E KOR 001 AC
Start of Test:	Feeder/Diameter:	Page: 1/1

Circuit breaker	Phase __	Phase __	Phase __
Breaker serial number HA			
Drive serial number			
Installation, overall control			
Oil level			
Oil leak			
Control circuit			
Pump running time from P = 0 [s]			
Running time supervision [s]			
Function: Close/Open			
Function: Antipumping			
Function: Pole Discrepancy t ₁ =.....[s]			
t ₂ =.....[s]			
Spring pressure switch	Contact:		
Pump ON/OFF			
Blocking OCO			
Blocking Close			
Blocking Trip 1			
Blocking Trip 2			
SF6 Pressure Low	Contact:		
Blocking Close			
Blocking Trip 1			
Blocking Trip 2			
Anticondensate heating			
Counter Pump starts:			
Breaker operations:			

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date: .....	.....	.....
Name: .....	.....	.....
Signature: .....	.....	.....

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: CB TIMING TEST	Order No.: 10898
Form No.: 111 02030 E		Template No.: 111 02030 E KOR 001 AA
		Page: 1/1

Measurement

Recording of the breaker switching times during switching:
ON, OFF and ON-OFF

Protocol

211 02030 E

ABB Switzerland Ltd

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report: CB TIMING TEST	Order No.: 10898
Form No.: 211 02030 E		Template No.: 211 02030 E KOR 001 AB
Start of Test:	Feeder/Diameter:	Page: 1/8

Function	Nom.values	Phase R	Phase S	Phase T	Δt
Close	$\leq 60\text{ms} / \Delta t 4\text{ms}$				
Trip 1	$\leq 18\text{ms} / \Delta t 2\text{ms}$				
Trip 2	$\leq 18\text{ms} / \Delta t 2\text{ms}$				
Close – Trip 1	$t_{on} \leq 40\text{ms}$				
Close – Trip 2	$t_{on} \leq 40\text{ms}$				
Close – Trip 1 After O+15s+CO+15s+CO+15s operation	$t_{on} \leq 40\text{ms}$				
Close – Trip 1 After O+0.75s+CO+15s operation	$t_{on} \leq 40\text{ms}$				

Test set No. : HS31363

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

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Close

Trip 1

Trip 2

Close – Trip 1

Close – Trip 2

Close – Trip 1

After O+15s+CO+15s+CO+15s operation

Close – Trip 1

After O+0.75s+CO+15s operation

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: CB PUMP START CONTROL	Order No.: 10898
Form No.: 111 02050 E		Template No.: 111 02050 E KOR 001 AA
		Page: 1/1

CB pump check

To check the tightness of seals in the CB pump, the ammount of pump charges during 24 hours have to be recorded. Important are the pump starts due to pressure loss without any switching operations.

Protocol

211 02050 E

[illegible]

	ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: ISOLATOR & EARTH SWITCH FUNKTION CHECK	Order No.: 10898
Form No.: 111 02061 E		Template No.: 111 02061 E KOR 001 AA
		Page: 1/1

Visual check of the various equipment

Localisation and designation
Tightening of screws
Terminals

Operation of the equipment by hand

Check of free movement
Check of end positions (Endoscope)

Automatic operation

Check of supply of the motor.
Check if ready signal is ok.

Check of the blocking device

Check if drive is blocked by removed hand crank cover

Check of the blocking interlocking

Check if its only possible to enter the crank handle when not interlocked (override)

Check of the position indicator

Check of the heaters

Protocol

211 02061 E

ABB Switzerland Ltd

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report:	Order No.: 10898
Form No.: 211 02061 E	ISOLATOR & EARTH SWITCH FUNCTION CHECK	Template No.: 211 02061 E KOR 001 AB
Start of Test:		Feeder/Diameter:
		Page: 1/1

Name			
Serial number	HA		
Visual			
Manual operation by handle			
Ready Signal			
Drive blocking by removed cover			
Crank handle release	Isolator		
	Earth		
Local position indication	Isolator		
	Earth		
Anticondensate heating			
Supply voltage [V]			

Name			
Serial number	HA		
Visual			
Manual operation by handle			
Ready Signal			
Drive blocking by removed cover			
Crank handle release	Isolator		
	Earth		
Local position indication	Isolator		
	Earth		
Anticondensate heating			
Supply voltage [V]			

V-Meter No.:

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: DENSITY MONITORS	Order No.: 10898
Form No.: 111 02070 E		Template No.: 111 02070 E KOR 001 AA
		Page: 1/1

General Control

Visual control of the monitor
Electrical connections
Conformity of erection place

Simulation

Check of all alarms and functions with the simulation device

Protocol

211 02070 E

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report: DENSITY MONITORS	Order No.: 10898
Form No.: 211 02070 E		Template No.: 211 02070 E KOR 001 AB
Start of Test:	Feeder/Diameter:	Page: 1/1

Name	Function / Alarm	Phase _	Phase _	Phase _
	Stage 1	[]	[]	[]
	CB Blocking 1	[]	[]	[]
	Blocking 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
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	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
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	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]
	Stage 1	[]	[]	[]
	Stage 2	[]	[]	[]

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date: .....	.....	.....
Name: .....	.....	.....
Signature: .....	.....	.....

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: VT SECONDARY INSULATION	Order No.: 10898
Form No.: 111 03010 E		Template No.: 111 03010 E KOR 001 AA
		Page: 1/1

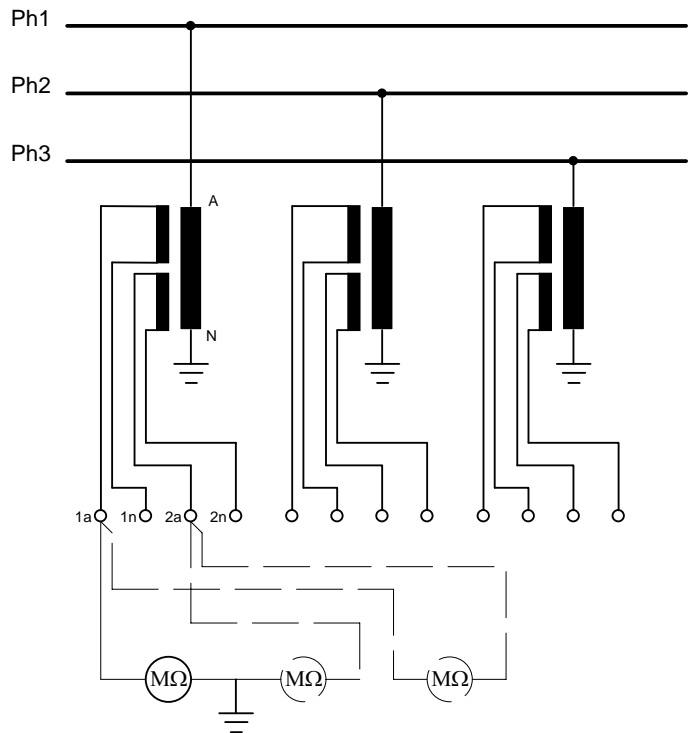
Secondary Insulation

Measurement of the insulation values:
between each secondary core and earth
between the secondary cores

Protocol

211 03010 E

TEST ARRANGEMENT :



Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report: VT SECONDARY INSULATION	Order No.: 10898
Form No.: 211 03010 E		Template No.: 211 03010 E KOR 001 AB
Start of Test:	Feeder/Diameter:	Page: 1/1

Applied voltage: _____ V

Time voltage applied: > 3 s

Name	Core	Phase ____ [MΩ]	Phase ____ [MΩ]	Phase ____ [MΩ]
T_____ ____ kV / ____ V	winding 1 to earth			
	winding 2 to earth			
	winding 3 to earth			
	winding 4 to earth			
	winding 5 to earth			
	winding 1 to winding 2			
	winding 1 to winding 3			
	winding 1 to winding 4			
	winding 1 to winding 5			
	winding 2 to winding 3			
	winding 2 to winding 4			
	winding 2 to winding 5			
	winding 3 to winding 4			
	winding 3 to winding 5			
	winding 4 to winding 5			

Test set No.:

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: VT DC RESISTANCE	Order No.: 10898
Form No.: 111 03030 E		Template No.: 111 03030 E KOR 001 AA
		Page: 1/1

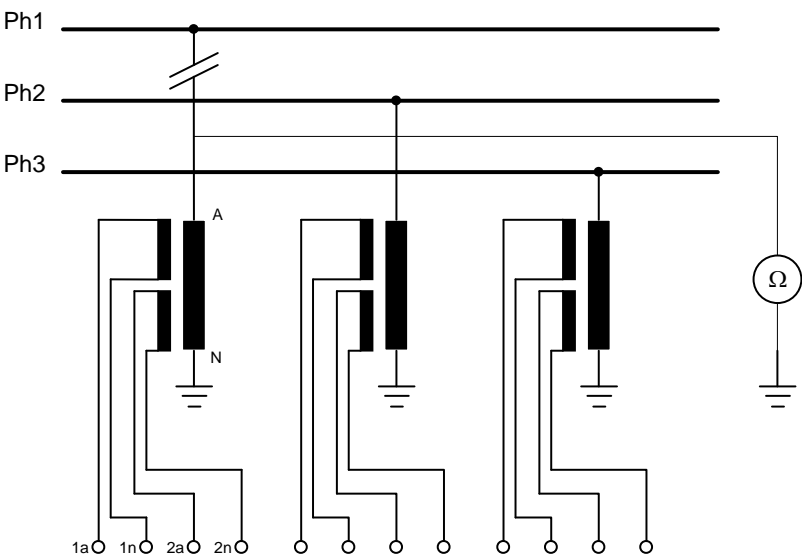
DC-Resistance

Measurement of the primary resistance with a Wheatstone Bridge on each voltage transformer.

Protocol

211 03030 E

TEST ARRANGEMENT :



Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report: VT DC RESISTANCE	Order No.: 10898
Form No.: 211 03030 E		Template No.: 211 03030 E KOR 001 AB
Start of Test:	Feeder/Diameter:	Page: 1/1

VT Name: _____

Ratio: _____

Primary:

Location	Phase ____ [kΩ]	Phase ____ [kΩ]	Phase ____ [kΩ]
GIS primary	A to N	A to N	A to N

Test set No.:

Test lead resistance:Ω

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: VT RATIO & POLARITY	Order No.: 10898
Form No.: 111 03070 E		Template No.: 111 03070 E KOR 001 AA
		Page: 1/1

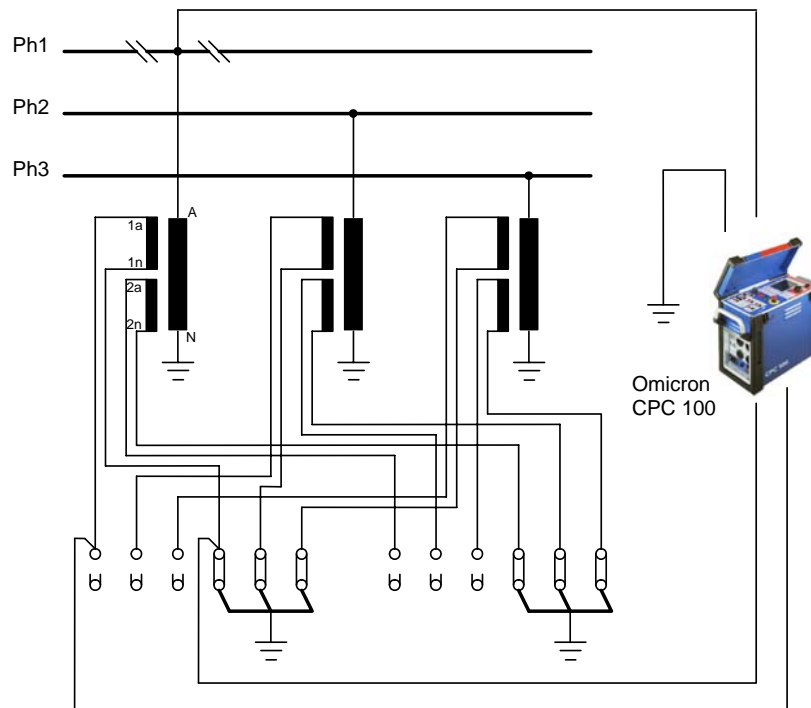
Ratio & Polarity

Measurement of the ratio and check of the polarity of each core with the help of Omicron CPC 100 (primary injection)

Protocol

211 03050 E

TEST ARRANGEMENT :



Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report: VT RATIO & POLARITY	Order No.: 10898
Form No.: 211 03070 E		Template No.: 211 03070 E KOR 001 AB
Start of Test:	Feeder/Diameter:	Page: 1/1

Danger: High voltage, see procedure

Injected voltage on primary side : kV

Name	Core	Location	Terminal Block	Phase ____ VT-#-_____	Pol. [√]	Phase ____ VT-#-_____	Pol. [√]	Phase ____ VT-#-_____	Pol. [√]
T____ ____kV / ____V	1		# _____	to		to		to	
			Result						
	2		# _____	to		to		to	
			Result						
	3		# _____	to		to		to	
			Result						
	4		# _____	to		to		to	
			Result						
	5		# _____	to		to		to	
			Result						

Test Set No.:

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: CT SECONDARY INSULATION	Order No.: 10898
Form No.: 111 03080 E		Template No.: 111 03080 E KOR 001 AA
		Page: 1/1

Secondary Insulation

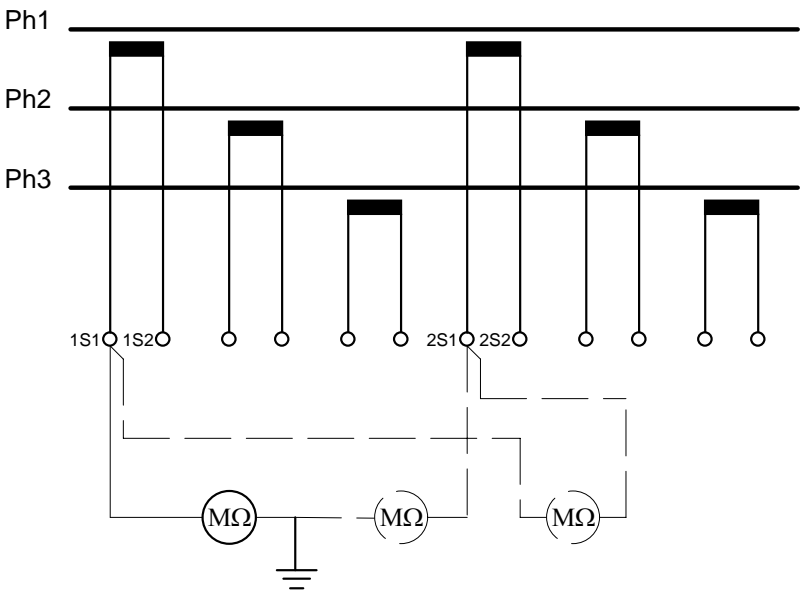
Measurement of the insulation values:

- between each secondary core and earth
- between the secondary cores

Protocol

211 03080 E

TEST ARRANGEMENT :



Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report: CT SECONDARY INSULATION	Order No.: 10898
Form No.: 211 03080 E		Template No.: 211 03080 E KOR 001 AB
Start of Test:	Feeder/Diameter:	Page: 1/1

Applied voltage: _____ V

Time voltage applied: > 3 s

Name	Core	Phase __ [MΩ]	Phase __ [MΩ]	Phase __ [MΩ]
T_____ ____ kA / ____ A	core 1 to earth			
	core 2 to earth			
	core 3 to earth			
	core 4 to earth			
	core 5 to earth			
	core 1 to core 2			
	core 1 to core 3			
	core 1 to core 4			
	core 1 to core 5			
	core 2 to core 3			
	core 2 to core 4			
	core 2 to core 5			
	core 3 to core 4			
	core 3 to core 5			
	core 4 to core 5			

Test set No.: _____

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: CT ANALYZER	Order No.: 10898
Form No.: 111 03150 E		Template No.: 111 03150 E KOR 001 AA
		Page: 1/1

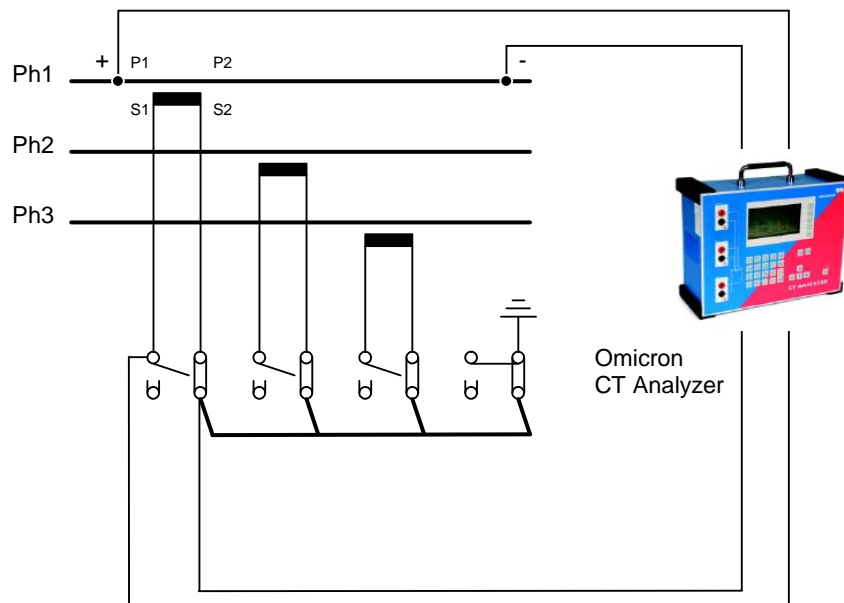
Measurements:

Recording of the core magnetisation curve
 Check polarity of each core and wiring connections
 Measure winding resistance of each core
 Check ratio of each core (voltage injection on secondary side)

Protocol

211 03150 E

TEST ARRANGEMENT :



Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Report: CT ANALYZER	Order No.: 10898
Form No.: 211 03150 E		Template No.: 211 03150 E KOR 001 AB
Start of Test:	Feeder/Diameter:	Page: 1/

CT Name	Phase	Core	Tap	Measurement from CT-Box [] or LCC []	Resistance	Mag.curve	Polarity	Ratio
T..... Serial No.....	R	1	1S1-1S2	-T11.X1 :1 / :2	[]	[]	[]	[]
			1S1-1S3	-T11.X1 :1 / :9	[]	[]	[]	[]
			1S1-1S4	-T11.X1 :1 / :10	[]	[]	[]	[]
			1S1-1S5	-T11.X1 :1 / :11	[]	[]	[]	[]
			1S1-1S6	-T11.X1 :1 / :12	[]	[]	[]	[]
		2	2S1-2S2	-T11.X2 :1 / :2	[]	[]	[]	[]
		3	3S1-3S2	-T11.X3 :1 / :2	[]	[]	[]	[]
		4	4S1-4S2	-T11.X4 :1 / :2	[]	[]	[]	[]
			4S1-4S3	-T11.X4 :1 / :9	[]	[]	[]	[]
			4S1-4S3	-T11.X4 :1 / :10	[]	[]	[]	[]
			4S1-4S4	-T11.X4 :1 / :11	[]	[]	[]	[]
			4S1-4S6	-T11.X4 :1 / :12	[]	[]	[]	[]
		5	5S1-5S2	-T11.X5 :1 / :2	[]	[]	[]	[]
			5S1-5S3	-T11.X5 :1 / :9	[]	[]	[]	[]
			5S1-5S3	-T11.X5 :1 / :10	[]	[]	[]	[]
			5S1-5S4	-T11.X5 :1 / :11	[]	[]	[]	[]
			5S1-5S6	-T11.X5 :1 / :12	[]	[]	[]	[]

Checked

Installation of CTs according to single line diagram: []

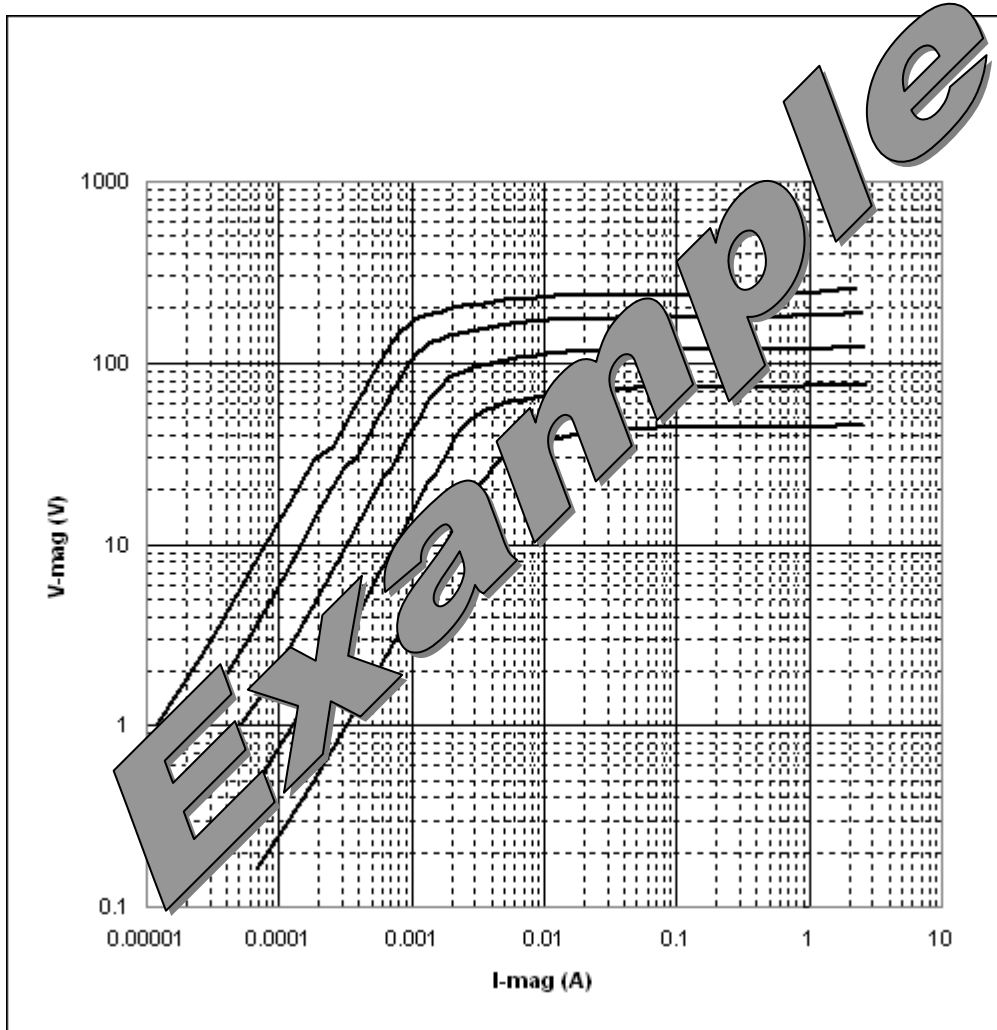
CT Analyzer No.:

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

Feeder/Bay	Bus Section 1	Bus Section 1	Bus Section 1	Bus Section 1	Bus Section 1
Phase:	R	R	R	R	R
Manufacturer:	0	0	0	0	0
Type:	0	0	0	0	0
Serial Number:	2008.1524.03/8	2008.1524.03/8	2008.1524.03/8	2008.1524.03/8	2008.1524.03/8
Core Number:	1	1	1	1	1
Tap:	1	2	3	4	5
Core Type (P/M):	M	M	M	M	M
Primary Current I-pn (A):	600	1000	1600	2400	3200
Secondary Current I-sn (A):	1	1	1	1	1
Applied Standard	IEC 60044-1	IEC 60044-1	IEC 60044-1	IEC 60044-1	IEC 60044-1
Class:	0.2	0.2	0.2	0.2	0.2
FS:	5	10	15	20	20
ALF:	0	0	0	0	0
Frequency (Hz):	50	50	50	50	50
Rated Burden (VA):	10	10	10	10	10
Operating Burden (VA)	10	10	10	10	10
Status Info:	Test successful	Test successful	Test successful	Test successful	Test successful
Resistance Test:					
Rmeas (Ω):	0.685	1.373	2.352	3.811	5.386
Rref/75°C (Ω):	0.817	1.590	2.805	4.545	6.423
Kneepoints with nominal burden:					
60044-1:					
V-kn (V):	30.53	55.37	88.43	133.17	176.36
I-kn (A):	0.0061	0.0037	0.0023	0.0015	0.0011
60044-6:					
V-kn (V):	30.53	50.89	81.29	122.33	161.93
I-kn (A):	0.0069	0.0042	0.0026	0.0017	0.0012
Ratio Test:					
Ratio:	600	1000	1600	2400	3200
	1.0003	1.0005	1.0005	1.0004	1.0004
Current ratio error:	0.034 %	0.055 %	0.049 %	0.039 %	0.036 %
Turns ratio error:	-0.226 %	-0.136 %	-0.086 %	-0.057 %	-0.047 %
Phase:	-0.524 min	0.215 min	0.243 min	0.152 min	0.074 min
Polarity:	OK	OK	OK	OK	OK

Magnetisation Curve for: Feeder: Bus Section 1
Phase: R
Core: 1
Serial Number: 2008.1524.03/8



Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: INTERLOCKING	Order No.: 10898
Form No.: 111 04010 E		Template No.: 111 04010 E KOR 001 AA
		Page: 1/1

Checks

All interlocking requirements must be fulfilled for:

Circuit Breaker
Earthing Switch
Isolator

Protocol

211 04010 E

Client: ABB US PP / Astoria LLC				Project name: Astoria II 345kV								Contract: 62000050			
Consultant: SNC Lavalin				INTERLOCKING								Order No.: 10898			
Form No.: 211 04010 E												Template No.: 211 04010 E KOR 001 AB			
Start of Test:				Feeder/Diameter:								Page: 1/1			

Apparatus	Operation close/open															

Tested: Hardware ☐ Software ☐ O = Open C = Close EMPTY = Not Relevant
 EP = End Position (O or C)

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

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Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: LOCAL ALARMS	Order No.: 10898
Form No.: 111 04060 E		Template No.: 111 04060 E KOR 001 AA
		Page: 1/1

Check and simulation

Simulation of each local alarm to alarm unit in LCP
Each tested circuit has to be marked yellow in the drawings

Protocol

211 04060 E

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050	
Consultant: SNC Lavalin	Commissioning Report: LOCAL ALARMS	Order No.: 10898	
Form No.: 211 04060 E		Template No.: 211 04060 E KOR 001 AB	
Start of Test:	Feeder/Diameter:		Page: 1/1

Alarm	Checked
<hr/>	[]
<hr/>	[]
<hr/>	[]
<hr/>	[]
<hr/>	[]
<hr/>	[]
<hr/>	[]
<hr/>	[]
<hr/>	[]
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<hr/>	[]
<hr/>	[]
<hr/>	[]
<hr/>	[]

Remarks:

ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050
Consultant: SNC Lavalin	Commissioning Description: COMMISSIONING ACCEPTANCE	Order No.: 10898
Form No.: 111 07050 E		Template No.: 111 07050 E KOR 001 AA
		Page: 1/1

"AS BUILT" Documents

Handing over the copy of a complete set of electrical drawings containing the handwritten definitive corrections and changes made during the commissioning.

Commissioning "TEST REPORTS"

Handing over the copy of a complete set of commissioning Test Reports undersigned by the customer and the ABB representative.

Acceptance Certificate

Written confirmation of the completion of commissioning activities, undersigned by the customer and the ABB representative.
List of possible pending items.

Protocol

211 07050 E

Client: ABB US PP / Astoria LLC	Project name: Astoria II 345kV	Contract: 62000050	
Consultant: SNC Lavalin	Commissioning Report: COMMISSIONING ACCEPTANCE	Order No.: 10898	
Form No.: 211 07050 E		Template No.: 211 07050 E KOR 001 AB	
Start of Test:	Feeder/Diameter:	Page: 1/1	

I Commissioning

- I.I The commissioning and function tests of the installations have successfully been completed.
- I.II The results are in accordance with the specifications delivered by ABB as well as per agreement object of meeting held on :
- I.III The results are reported on the here attached test sheets.

II Pending items

- II.I None or following list :
.

III Enclosure

Enclosed documents (copy for Client)

- 1 set "As Built" electrical drawings.
1 set of commissioning "Test Reports"

	ABB Switzerland Ltd.	Client	Consultant
Date:
Name:
Signature:

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Client: ABB US PP / Astoria LLC		Project name: Astoria II 345kV	Contract: 62000050				
Consultant: SNC Lavalin		Commissioning Report: DOCUMENT LIST	Order No.: 10898				
Form No.: 211 07060 E			Template No.: 211 07060 E KOR 001 AB				
Start of Test:		Feeder/Diameter: DOCUMENT LIST	Page: 1/1				
Document No.		Name / Description		Quantity	Revision	Date	
ABB Switzerland Ltd.		Client		Consultant			
Date:			
Name:			
Signature:			
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ABB		ABB Switzerland Ltd		Document number 1HC0075090
Unit High Voltage Products	Created Kunath Uwe	Version AC	Document part D01	Document type ANW
Status Released	Last change Bitter Thomas 23.04.2010			

Test Procedure 345kV Astoria

HIGH VOLTAGE TEST ON-SITE

Table of Content

1	High Voltage Test Procedure	2
1.1	AC HV-test.....	2
1.2	PD measurements	2
1.3	Test sequence	2
2	Preparations of the GIS	3
3	Preparations of the test set	3
4	Appendix	4
	Appendix 1: Possible place of encapsulated reactor from test section 1 & 2	4
	Appendix 2: Test section 1	5
	Appendix 3: Test section 2	6

This test procedure has been approved by the customer:

Date

Approved by

Signature

1 High Voltage Test Procedure

1.1 AC HV-test

For the high voltage test, a series resonant test set with variable frequency (30 to 300 Hz) will be used according to ANSI - IEEE Std C37.122-1993 and ABB standard. The test frequency is determined by the inductance of the reactor and the capacity of the GIS-test section. To include the voltage transformers into the test, the frequency must be higher than 65 Hz.

More detailed information is provided in the General Technical Information:

- GTI 1HC007011 High Voltage On-Site Testing

1.2 PD measurements

During the HV test, a partial discharge (PD) measurement will be performed as an UHF measurement. The duration of the PD measurements depends on the results of themselves.

More detailed information is provided in the General Technical Information:

- GTI 1HC0021804 PD Concepts for GIS
- GTI 1HC0021805 UHF PD Detection

1.3 Test sequence

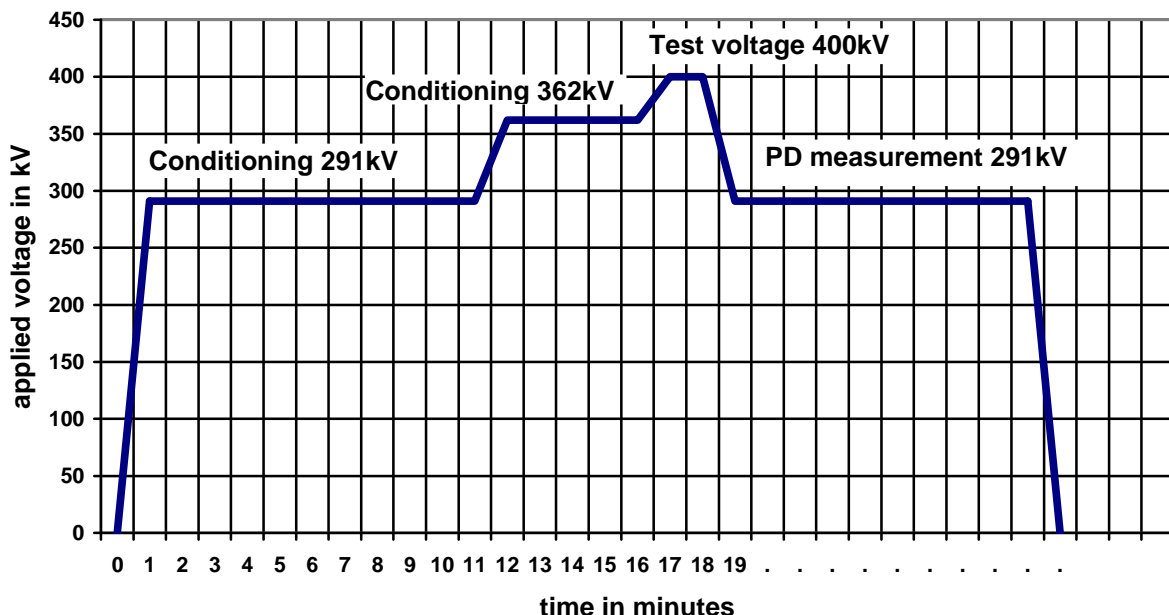
Each phase will be tested similar to the following sequence:

291kV_{rms} for 10minutes (PD measurements / conditioning $1.2 \cdot U_r \cdot \frac{1}{\sqrt{3}}$)

362kV_{rms} for 5minutes (conditioning)

400kV_{rms} for 1minute (test voltage, 80% of 500 kV_{rms} according to IEEE Std C37.122-1993)

291kV_{rms} for n minutes (PD measurements $1.2 \cdot U_r \cdot \frac{1}{\sqrt{3}}$)



The test engineer reserves the right to modify this test procedure in the interests of personnel and equipment safety as the site conditions dictate.

2 Preparations of the GIS

The erection of the GIS has to be completed, voltage transformers included.

The switchgear must be filled with SF₆-gas according to ABB requirements and Gasdiagramm 1HC0069572 Rev. AF.

Circuit breakers & VT's	680 kPa _{abs} at 20°C
All other gas compartments:	530 kPa _{abs} at 20°C

The earth connections within the switchgear and from the switchgear to the station earth must be installed in accordance with customer and ABB requirements.

The secondary windings of all current transformers must be short-circuited. Likewise, the secondary windings of any voltage transformers must be opened and one side of the windings must be grounded. Any ferroresonance damping circuit at the voltage transformer must be disconnected.

The overhead lines to the GIS have to be removed.

Each phase will be tested in two test sections. All breakers and disconnect switches within the test section must be closed and all earthing switches must be opened. The other two phases (not under test) and all other parts not under test must be earthed.

In case of a dielectric breakdown in the GIS, the procedure like pointed out in instruction HASV601084 revision AD will take effect.

3 Preparations of the test set

The injection of test voltage will be done via an encapsulated reactor (see Appendix). The distance between parts of the test set on high voltage and earthed or conducting objects (as ground, walls, pieces of installation, crane...) has to be $\geq 4\text{m}$.

The area around the test set will be marked with red-white tape. Any conducting object in the GIS –building and near the test set must be properly earthed.

To arrange the test set, the following aid is needed:

- 1 crane (load capacity $\geq 2\text{t}$)
- 1 step ladder (height $\geq 4\text{m}$)
- 1 skilled worker
- 1 gas- machine

To supply the equipment, a $4 \times 25\text{mm}^2$ (3 phases and earth) cable of $3 \times 208\text{ V AC}$; with $\geq 60\text{A}$; (without leakage current protection) has to be provided by the customer. The end of the supply cable should be without any terminals.

Safety instructions will be given by the test engineer on site.

Since the test sets are only partially qualified for outdoor use, they must be stored in a building

4 Appendix

- Appendix 1: Possible places of encapsulated reactor for Test section 1 & 2
- Appendix 2: HV-test section 1
- Appendix 3: HV-test section 2

Symbols meaning:



Overhead lines not connected



Part under test



Earthed parts

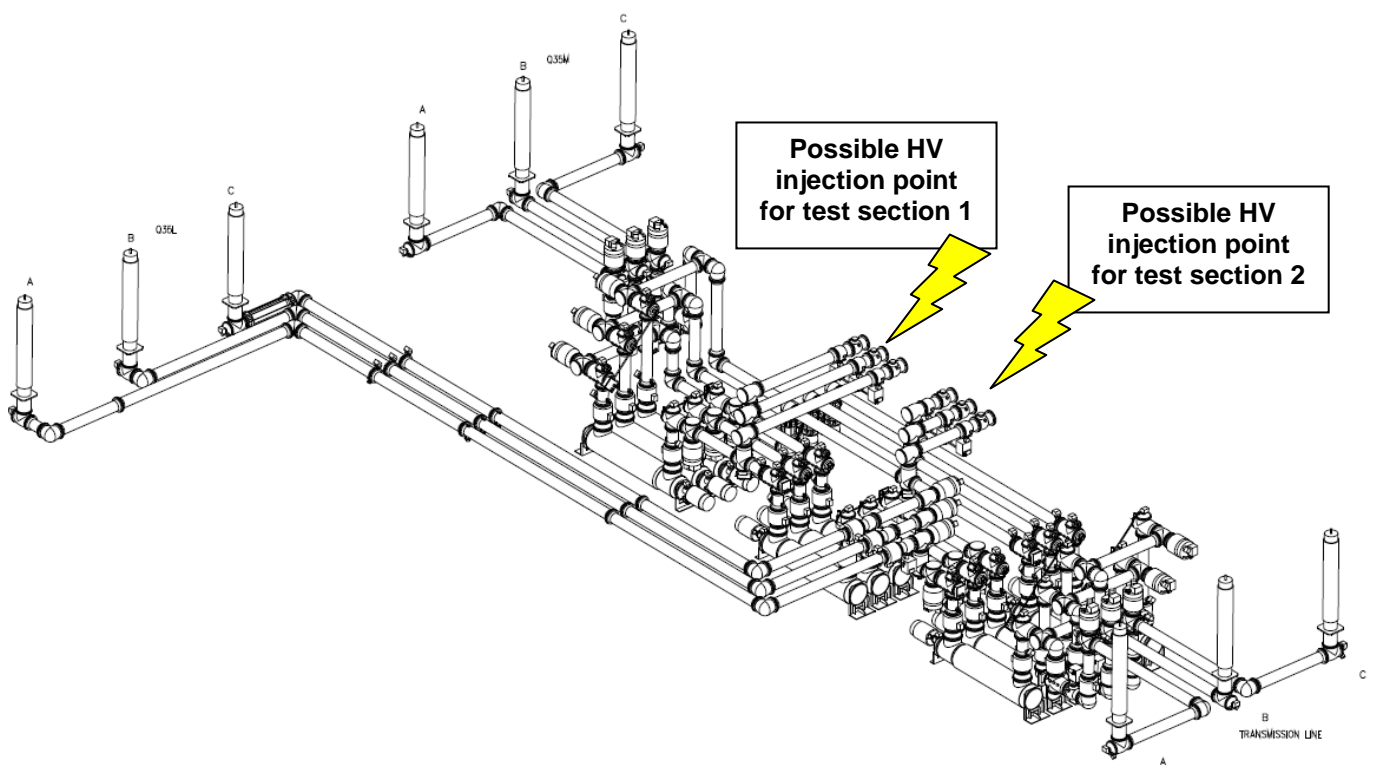


Pickup point for PD measurement

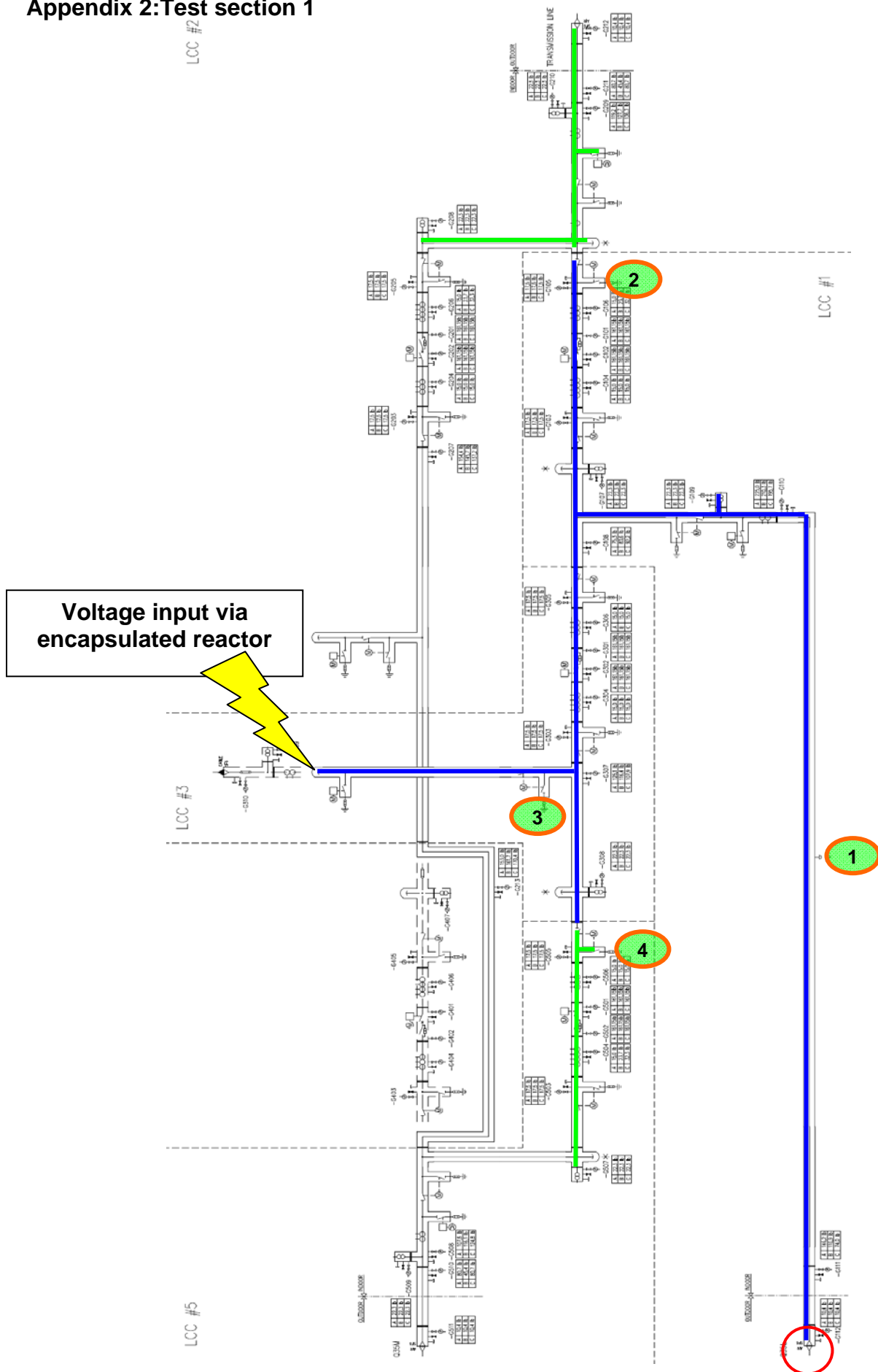


Voltage injection point

Appendix 1: Possible places of encapsulated reactor for Test section 1 & 2



Appendix 2: Test section 1



Appendix 3: Test section 2

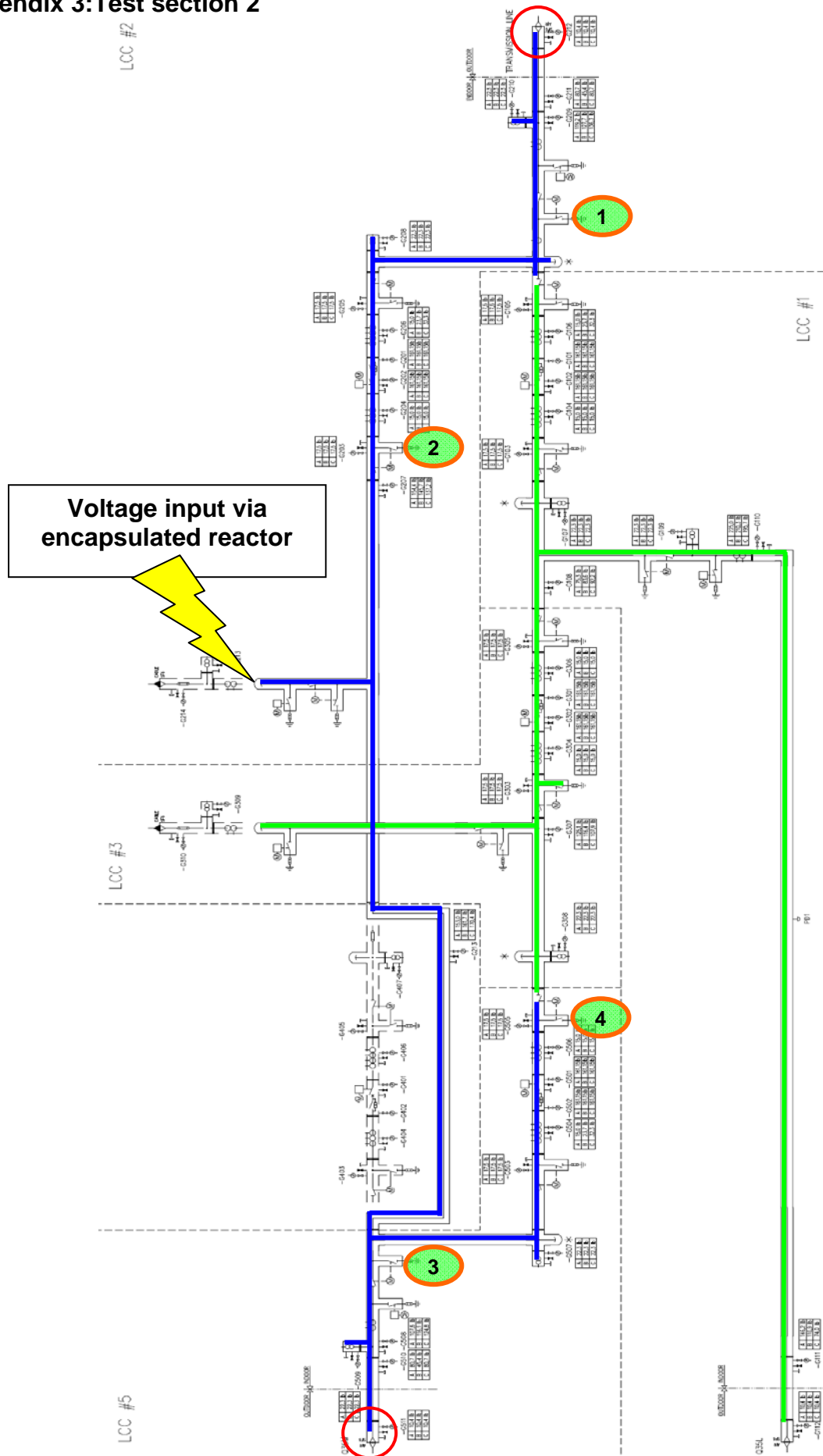


ABB		ABB Switzerland Ltd		Document number 1HC0075211
Unit High Voltage Products	Created Kunath Uwe	Version AB	Document part D01	Document type ANW
Status Released	Last change Bitter Thomas 23.04.2010			

Test Procedure 345kV Astoria Phase II Power Block

HIGH VOLTAGE TEST ON-SITE

Table of Content

1	High Voltage Test Procedure	2
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1.2	PD measurements	2
1.3	Test sequence	2
2	Preparations of the GIS / Power Block	3
3	Preparations of the test set	3
4	Appendix	4
	Appendix 1: Place of encapsulated reactor	4
	Appendix 2: Test section	5

This test procedure has been approved by the customer:

Date

Approved by

Signature

1 High Voltage Test Procedure

1.1 AC HV-test

For the high voltage test, a series resonant test set with variable frequency (30 to 300 Hz) will be used according to ANSI - IEEE Std C37.122-1993 and ABB standard. The test frequency is determined by the inductance of the reactor and the capacity of the GIS-test section. The capacity can be assumed as 65pF/m. The complete capacity of the switchgear / power block can be assumed around 6.5nF (three phases together). To include the voltage transformers into the test, the frequency must be higher than 65 Hz.

More detailed information is provided in the General Technical Information:

- GTI 1HC007011 High Voltage On-Site Testing

1.2 PD measurements

During the HV test, a partial discharge (PD) measurement will be performed as an UHF measurement. The duration of the PD measurements depends on the results of themselves.

More detailed information is provided in the General Technical Information:

- GTI 1HC0021804 PD Concepts for GIS
- GTI 1HC0021805 UHF PD Detection

1.3 Test sequence

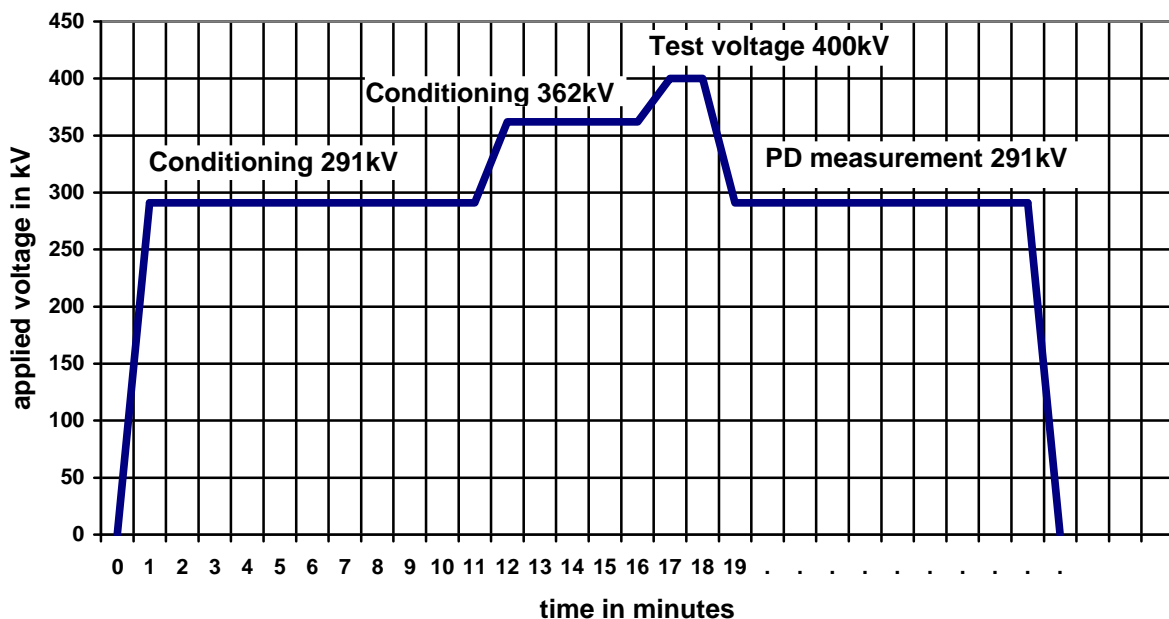
All three phases will be tested similar to the following sequence:

291kV_{rms} for 10minutes (PD measurements / conditioning $1.2 \cdot U_r \cdot \frac{1}{\sqrt{3}}$)

362kV_{rms} for 5minutes (conditioning)

400kV_{rms} for 1minute (test voltage, 80% of 500 kV_{rms} according to IEEE Std C37.122-1993)

291kV_{rms} for n minutes (PD measurements $1.2 \cdot U_r \cdot \frac{1}{\sqrt{3}}$)



The test engineer reserves the right to modify this test procedure in the interests of personnel and equipment safety as the site conditions dictate.

2 Preparations of the GIS / Power Block

The erection of the GIS / power block has to be completed, voltage transformers included.

The switchgear / power block must be filled with SF₆-gas according to ABB requirements and gasdiagramm 1HC0069571 Rev.AE.

Voltage transformer:	680 kPa _{abs} at 20°C
All other gas compartments:	530 kPa _{abs} at 20°C

The earth connections within the switchgear / power block and from the switchgear / power block to the station earth must be installed in accordance with customer and ABB requirements.

The secondary windings of all current transformers must be short- circuited. Likewise, the secondary windings of any voltage transformers must be opened and one side of the windings must be grounded. Any ferroresonance damping circuit at the voltage transformer must be disconnected.

All power cable / transformer links have to be removed and the corresponding shielding and earthing must be installed in accordance with the manufacturer's regulations. The overhead lines have to be removed.

All three phases will be tested together in one test section. All disconnect switches within the test section must be closed and all earthing switches must be opened. All parts not under test must be earthed.

In case of a dielectric breakdown in the GIS, the procedure like pointed out in instruction HASV601084 revision AD will take effect.

3 Preparations of the test set

The injection of test voltage will be done via an encapsulated reactor (see Appendix 1). The distance between parts of the test set on high voltage and earthed or conducting objects (as ground, walls, pieces of installation, crane...) has to be $\geq 4\text{m}$.

The area around the test set will be marked with red-white tape. Any conducting object in the GIS –building and near the test set must be properly earthed.

To arrange the test set, the following aid is needed:

- 1 crane (load capacity $\geq 2\text{t}$)
- 1 step ladder (height $\geq 4\text{m}$)
- 1 skilled worker
- 1 gas- machine

To supply the equipment, a $4 \times 25\text{mm}^2$ (3 phases and earth) cable of $3 \times 208\text{ V AC}$; with $\geq 60\text{A}$; (without leakage current protection) has to be provided by the customer. The end of the supply cable should be without any terminals.






Safety instructions will be given by the test engineer on site.

Since the test sets are only partially qualified for outdoor use, they must be stored in a building

4 Appendix

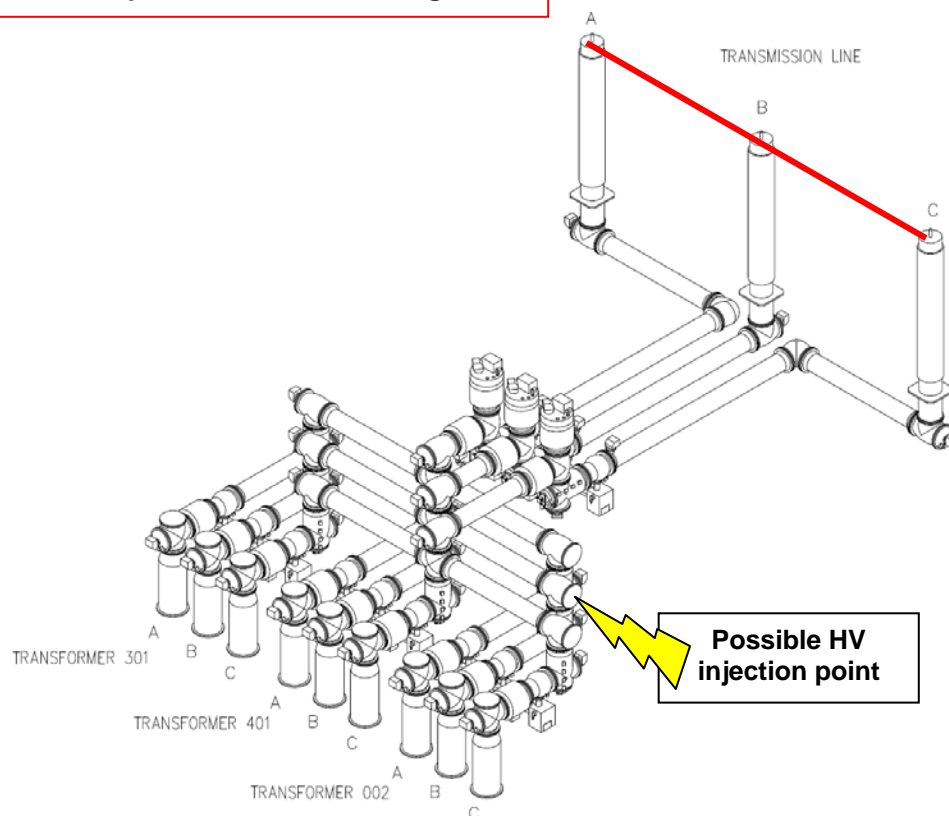
- Appendix 1: Place of encapsulated reactor
- Appendix 2: HV-test section

Symbols meaning:

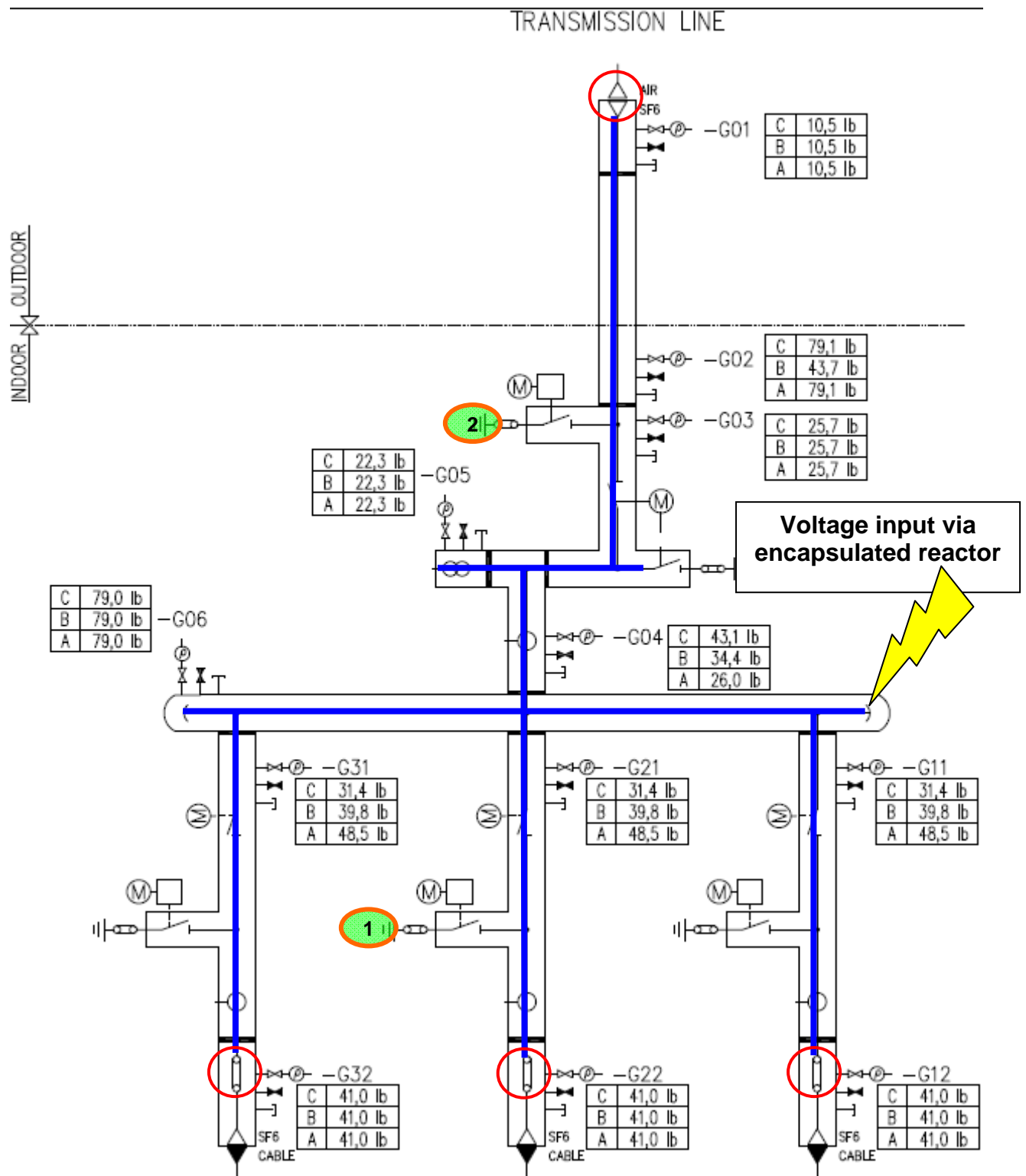
-  Overhead lines / power cable not connected
-  Part under test
-  Earthed parts
-  Pickup point for PD measurement
-  Voltage injection point

Appendix 1: Place of encapsulated reactor

Note: all 3 phases will be tested together.



Appendix 2: Test section











SECTION 6








TOOLS AND GENERAL EQUIPMENT

ABB Switzerland Ltd




TOOLS FOR GIS-INSTALLATION

Item	Art. No.	Article	Total	ABB CH	Customer	Subcontractor	Pic.
1	HS11235	POWER BOARD "7800	2				
2	HS11270	CABLE REEL "220V/20M"	2				
3	HS11284	CABLE REEL 30M/380V	1				
4	HS13791	EXTENSION LADDER "TS" 1.75 M	2				
5	HS13820	SAFETY BELT "GA"	1				
6	HS21404	LEAK-SEEKER "L-790A"	1				
7	HS21412	DENSITY MONITOR TEST SET	1				
8	HS21413	MICROOHMMETER "600A"	1				
13	HS21427	PRESSURE GAUGE 0-10 LEO"SF6"	1				
14	HS21429	PRESSURE GAUGE 0-1000 KPA "LEO2/EF"	1				
15	HS21432	PRESSURE REDUCING VALVE"SF6"	1				
16	HS21502	TOOL CAR GIS 02	1				
17	HS21508	CONNECTION-SET "DILO/DN8-20"	1				
18	HS22015	TORQUE WRENCH "730R/5" / 20-100	2				

							
19	HS22018	TORQUE WRENCH "730R/20" / 40-200	2				
20	HS22019	TORQUE WRENCH "730R/40" / 75-400	2				
21	HS22346	ROTARY/HAMMER DRILL "TE56"	1				
22	HS22354	SETTING TOOL FOR BOLTS	1				
23	HS22380	DIAMOND HEAD DRILL	1				
24	HS25222	BENDING DEVICE	1				
25	HS 36324	TRANSIT LEVEL "NA724"	1				
26	HS36386	LASER MEASURING INSTRUMENT "PD 20"	1				
27	HS41504	ADAPTER "DILO 3-244" to DN20 VALVE ON GIS	1				
28	HS41506	EXTENSION HOSE "DILO" NW20, 10m	3				
29	HS41511	EXTENSION HOSE NW20 10m, GASFILILNG	2				
30	HS41518	EXTENSION HOSE NW8 6M	1				
31	HS41404	GAS EVACUATING/REFILL DEVICE	1				
32	HS41621	SUCTIONING PLANT "SF6-ECO/99-2"	1				
33	HS45929	VACUUM CLEANER "RSV 200"	1				
34	HS46751	CRIMPING TOOL HYDRAULIC "HAT 51"	1				
35	HS46762	TOOL KIT HYDR. FOR GIS ERDING	1				

							
36	HS48508	LOCKING PLIERS "KT 9"	4				
37	HS48688	TRANSPORT-ROLLER F.SHIPP.-UNIT	6				
38	HS48737	TOOL SET "ELK-14"					
	HS48814	TOOL SET "ELK-420"					
	HS48855	TOOL SET "ELK-550"					
39	HS54235	PULLER 0.5T "LX005"	2				
40	HS54240	PULLER "1.5 TON"	2				
41	HS56433	DYNAMOMETER 0-1250 KG	1				

GENERAL EQUIPMENT FOR GIS-INSTALLATION

Item	Art. No.	Article	Total	ABB CH	Customer	Subcontractor	Pic.
1		COLLAPSIBLE WORKBENCH	1				
2		PORTABLE SCAFFOLD 6.9M	2				
3		STEPLADDER 1.7 M	2				
4		EXTENSION LADDER 6 M	2				
5		MECHANIC'S TOOL CHEST	4				
6		ELECTRICIANS' TOOL CHEST	4				
7		SOCKET WRENCH SET 1/2"8-34	2				
8		SOCKET WRENCH SET 1/4" DRIVE	2				
9		CABLE CUTTER	4				
10		CORDLESS DRILL	2				
11		ROTARY/HAMMER DRILL	1				
12		IMPACT WRENCH	1				
13		DISC GRINDER	1				
14		SABRE SAW	1				
15		CRIMPING TOOL	4				
16		SET OF ALLEN KEYS 1.5-10 MM (SHORT)	2				
17		SET OF ALLEN KEYS 1.5-10 MM (LONG)	2				









							
18		PULL AND PRY BAR "600"	2				
19		PULL AND PRY BAR "SUPERBAR"	2				
20		VACUUM CLEANER	2				
21		HAND PALLET TRUCK	2				

ABB Switzerland Ltd



CONSUMABLES FOR GIS-INSTALLATION

Item	Art. No.	Article	Total	ABB CH	Customer	Subcontractor	Pic.
1	VM25361	CRIMPING TOOL "PZ 4"	4				




2	VM28019	COMBINATION WRENCH 19	6				
3	VM28024	COMBINATION WRENCH 24	6				
4	VM28519	SOCKET WRENCH LONG 1/2" 19 mm	4				
5	VM28524	SOCKET WRENCH LONG 1/2" 24mm	4				
6	VM56501	POLYESTER ROUNDSLING "1M/V"	4				
7	VM56503	POLYESTER ROUNDSLING "2M/V"	4				
8	VM56516	POLYESTER ROUNDSLING "4M/G"	4				
9	VM56518	POLYESTER ROUNDSLING "6M/G"	4				
10	VM56528	POLYESTER ROUNDSLING "6M/Y"	4				
11	VM56605	SHACKLE 1.5 TO	4				
12	VM56607	SHACKLE 3.25 TO	4				
13	VM66322	POLYESTER STRAP 50MM / 5M	2				
14	VM66325	POLYESTER STRAP 50MM / 8MM	2				
15	VM70251	CORUNDUM CLOTH M120	2				













Item	Art. No.	Article	Total	ABB CH	Customer	Subcontractor	Pic.
16	VM70301	CORUNDUM CLOTH M280	2				
17	VM70372	BEARTEX-VLIES	2				




18	VM72012	GREASE "OKS VP 980"	2				
19	VM72021	GREASE MOLYKOTE D	1				
20	VM72991	LIQUID LEAK DETECTOR 59 ML	1				
21	VM73111	CLEANING CLOTH "WITH" (5KG)	2				
22	VM73125	CLEANING RAG (25 PIECE)	10				
23	VM73581	CARTRIDGE CASE 310 ML	5				
24	VM73590	SPRAYER 0.65L	4				
25	VM75100	THREADLOCKER "LOCTITE 241" 10 ML	2				
26	VM75121	THREADLOCKER "LOCTITE 270" 10 ML	2				
27	VM75140	DOSAGING NOZZLE	2				
28	VM75301	FD-PLAST (SILVER-GRIS)	2				
29	VM75504	SCOTCH TAPE 19MM/5.5M	1				
30	VM75523	SCOTCH TAPE 25MM	5				




Item	Art. No.	Article	Total	ABB CH	Customer	Subcontractor	Pic.
28	VM75525	SCOTCH TAPE 50MM	5				
29	VM75551	BARRICADE TAPE 200 RED/WITH	2				
30	VM75619	PLASTICFOLI LD-PE 3X50M	1				

31	VM76722	RUBBER COUPLING "TYP13"	1				
32	VM76997	THERMOMETER -30° - +50°	1				
33	VM78547	INDICATOR PLATE (DON'T SMOKE)	2				
34	VM78557	INDICATOR "ZV"	2				
35	VM78562	INDICATOR PLATE "F"	1				
36	VM78567	INDICATOR PLATE "EH"	1				
37	VM78703	ADHESIVE FILM "ELK-3-550" (200PIC)	1				
38	VM78717	LABEL "SF6- BOTTLE"	20				
39	VM79025	WORK GLOVES LG-M	5				
40	VM79041	GLOVES M "POLYÄTHYLEN" (1000PIC)	1				
41	VM79152	PROTECTIVE SAFETY CAP "ORANGE"	1				
42	VM79200	CAP "ABB" BLACK	5				
43	VM82942	RING NUT M12	4				


















Item	Art. No.	Article	Total	ABB CH	Customer	Subcontractor	Pic.
44	VM82946	RING NUT M16	4				
45	VM90011	SCREWDRIVER 1	4				
46	VM90012	SCREWDRIVER 2	4				

47	VM90153	SCREWDRIVER SZS 0.6 X2.5	4				
48	VM90164	SCREWDRIVER SZS 0.6 X 3.5	4				
49	VM91026	SIDE-CUTTING PIERS 160MM ISOL.	4				
50	VM91810	STRIPPING TONGS "STRIPAX"	4				
51	VM91902	CABLE KNIFE "2200"	5				
52	VM91904	CABLE KNIFE 180/60	4				
53	VM91912	CABLE KNIFE "JOKARI 28H/G"	4				
54	VM91931	SHEATING	4				
55	VM93085	PAINT ROLLER 60MM KPL.	2				
56	VM93086	SPARE ROLLER 60MM (2PIC)	2				
58	VM96012	MEASURING TAPE 2M	5				
59	VM97951	SQUEEZER PRESS CARTRIDGE CASE	2				
60	VM97953	LEVER GREASE GUN "MURALT"					
61	VM97962	FILLER GREASE GUN "MURALT&AX-400"	1				
Item	Art. No.	Article	Total	ABB CH	Customer	Subcontractor	Pic.


62	VM72105	OIL-HYDRAULIK (1L)	1				
63	VM72117	OIL "Corena V100" (1L)	1				
64	VM82912	RING SCREW M12	4				

65	VM82916	RING SCREW M16	4				
66	VM98818	DIAMOND HEAD DRILL 25/300 T2	4				
67	VM98820	DIAMOND HEAD DRILL 28/300 T2	4				

CONSUMABLES FOR GIS-INSTALLATION

Item	Art. No.	Article	Total	ABB CH	Customer	Subcontractor	Pic.
1	VM25361	CRIMPING TOOL "PZ 4"	4				
2	VM28019	COMBINATION WRENCH 19	6				
3	VM28024	COMBINATION WRENCH 24	6				
4	VM28519	SOCKET WRENCH LONG 1/2" 19 mm	4				
5	VM28524	SOCKET WRENCH LONG 1/2" 24mm	4				
6	VM56501	POLYESTER ROUNDSLING "1M/V"	4				
7	VM56503	POLYESTER ROUNDSLING "2M/V"	4				
8	VM56516	POLYESTER ROUNDSLING "4M/G"	4				
9	VM56518	POLYESTER ROUNDSLING "6M/G"	4				
10	VM56528	POLYESTER ROUNDSLING "6M/Y"	4				
11	VM56605	SHACKLE 1.5 TO	4				
12	VM56607	SHACKLE 3.25 TO	4				
13	VM66322	POLYESTER STRAP 50MM / 5M	2				
14	VM66325	POLYESTER STRAP 50MM / 8MM	2				
15	VM70251	CORUNDUM CLOTH M120	2				
16	VM70301	CORUNDUM CLOTH M280	2				
17	VM70372	BEARTEX-VLIES	2				

							
18	VM72012	GREASE "OKS VP 980"	2				
19	VM72021	GREASE MOLYKOTE D	1				
20	VM72991	LIQUID LEAK DETECTOR 59 ML	1				
21	VM73111	CLEANING CLOTH "WITH" (5KG)	2				
22	VM73125	CLEANING RAG (25 PIECE)	10				
23	VM73581	CARTRIDGE CASE 310 ML	5				
24	VM73590	SPRAYER 0.65L	4				
25	VM75100	THREADLOCKER "LOCTITE 241" 10 ML	2				
26	VM75121	THREADLOCKER "LOCTITE 270" 10 ML	2				
27	VM75140	DOSAGING NOZZLE	2				
28	VM75301	FD-PLAST (SILVER-GRIS)	2				
29	VM75504	SCOTCH TAPE 19MM/5.5M	1				
30	VM75523	SCOTCH TAPE 25MM	5				
28	VM75525	SCOTCH TAPE 50MM	5				
29	VM75551	BARRICADE TAPE 200 RED/WITH	2				
30	VM75619	PLASTICFOLI LD-PE 3X50M	1				
31	VM76722	RUBBER COUPLING "TYP13"	1				
32	VM76997	THERMOMETER -30° - +50°	1				

33	VM78547	INDICATOR PLATE (DON'T SMOKE)	2				
34	VM78557	INDICATOR "ZV"	2				
35	VM78562	INDICATOR PLATE "F"	1				
36	VM78567	INDICATOR PLATE "EH"	1				
37	VM78701	ADHESIVE FILM "ELK-14" (500PIC)					
	VM78702	ADHESIVE FILM "ELK-420" (250PIC)					
	VM78703	ADHESIVE FILM "ELK-3-550" (200PIC)					
38	VM78717	LABEL "SF6- BOTTLE"	20				
39	VM79025	WORK GLOVES LG-M	5				
40	VM79041	GLOVES M "POLYÄTHYLEN" (1000PIC)	1				
41	VM79152	PROTECTIVE SAFETY CAP "ORANGE"	1				
42	VM79200	CAP "ABB" BLACK	5				
43	VM82942	RING NUT M12	4				
44	VM82946	RING NUT M16	4				
45	VM90011	SCREWDRIVER 1	4				
46	VM90012	SCREWDRIVER 2	4				
47	VM90153	SCREWDRIVER SZS 0.6 X2.5	4				
48	VM90164	SCREWDRIVER SZS 0.6 X 3.5	4				
49	VM91026	SIDE-CUTTING PIERS 160MM ISOL.	4				
50	VM91810	STRIPPING TONGS "STRIPAX"	4				
51	VM91902	CABLE KNIFE "2200"	5				

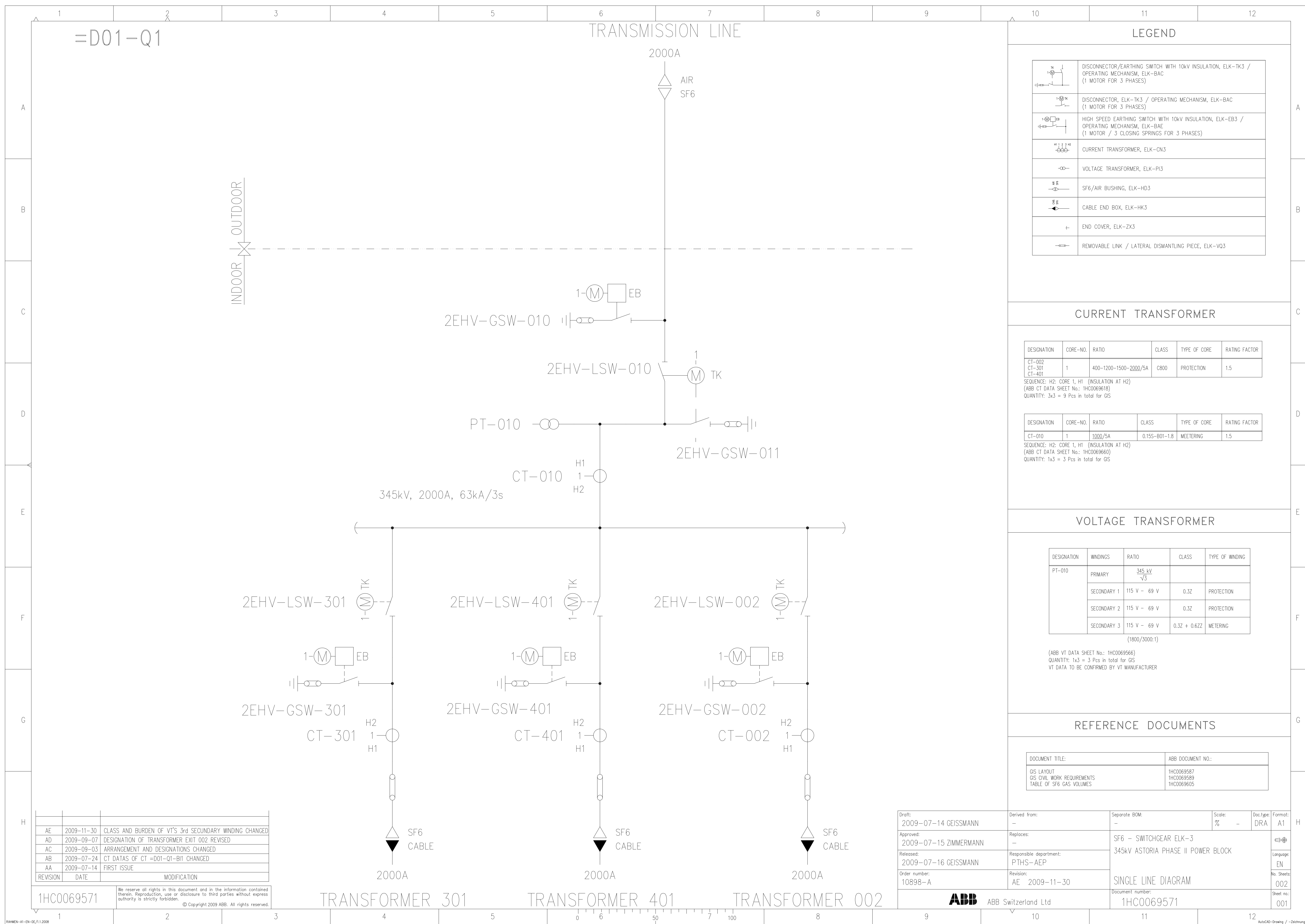
52	VM91904	CABLE KNIFE 180/60	4				
53	VM91912	CABLE KNIFE "JOKARI 28H/G"	4				
54	VM91931	SHEATING	4				
55	VM93085	PAINT ROLLER 60MM KPL.	2				
56	VM93086	SPARE ROLLER 60MM (2PIC)	2				
58	VM96012	MEASURING TAPE 2M	5				
59	VM97951	SQUEEZER PRESS CARTRIDGE CASE	2				
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61	VM97962	FILLER GREASE GUN "MURALT&AX-400"	1				
62	VM72105	OIL-HYDRAULIK (1L)	1				
63	VM72117	OIL "Corena V100" (1L)	1				
64	VM82912	RING SCREW M12	4				
65	VM82916	RING SCREW M16	4				
66	VM98818	DIAMOND HEAD DRILL 25/300 T2	4				
67	VM98820	DIAMOND HEAD DRILL 28/300 T2	4				

SECTION 7

DRAWINGS

Table of Contents

- Assembly Drawing
- Single Line & Gas Diagram
- GIS Layout
- Civil work requirements
- Earthing Layout
- Support Layout



=D01-Q1

TRANSMISSION LINE

LEGEND

	DISCONNECTOR/EARTHING SWITCH WITH 10kV INSULATION, ELK-TK3 / OPERATING MECHANISM, ELK-BAC (1 MOTOR FOR 3 PHASES)
	DISCONNECTOR, ELK-TK3 / OPERATING MECHANISM, ELK-BAC (1 MOTOR FOR 3 PHASES)
	HIGH SPEED EARTHING SWITCH WITH 10kV INSULATION, ELK-EB3 / OPERATING MECHANISM, ELK-BAE (1 MOTOR / 3 CLOSING SPRINGS FOR 3 PHASES)
	CURRENT TRANSFORMER, ELK-CN3
	VOLTAGE TRANSFORMER, ELK-PI3
	SF6/AIR BUSHING, ELK-HD3
	CABLE END BOX, ELK-HK3
	END COVER, ELK-ZX3
	REMOVABLE LINK / LATERAL DISMANTLING PIECE, ELK-VQ3

	BARRIER INSULATOR, ELK-IG3
	DENSITY MONITOR WITH OPEN RETURN VALVE
	SF6 CONNECTION WITH CLOSED RETURN VALVE
	PRESSURE RELIEF DEVICE WITH ADSORBENT

SF6 GAS PRESSURES

SF6 GAS PRESSURES ABSOLUTE AT 68°F		GAS ZONES / BUSHING	VOLTAGE TRANSFORMER
FILLING PRESSURE – FILLING DENSITY		76.87 psi – 2.14lb/ft³	98.63 psi – 2.81lb/ft³
MINIMUM PRESSURE – MINIMUM DENSITY		65.27 psi – 1.75lb/ft³	87.02 psi – 2.45lb/ft³
MINIMUM RESPONSE PRESSURES FOR DENSITY MONITOR	CONTACT 1: "SF6 GAS LOW"	68.17 psi	89.92 psi
	CONTACT 2: "URGENT ALARM"	65.27 psi	87.02 psi

REFERENCE DOCUMENTS

DOCUMENT TITLE:	ABB DOCUMENT NO.:
GIS LAYOUT GIS CIVIL WORK REQUIREMENTS TABLE OF SF6 GAS VOLUMES	1HC0069587 1HC0069589 1HC0069605

AE	2009-11-30	CLASS AND BURDEN OF VT'S 3rd SECONDARY WINDING CHANGED
AD	2009-09-07	DESIGNATION OF TRANSFORMER EXIT 002 REVISED
AC	2009-09-03	ARRANGEMENT AND DESIGNATIONS CHANGED
AB	2009-07-24	CT DATAS OF CT =D01-Q1-B11 CHANGED
AA	2009-07-14	FIRST ISSUE
REVISION	DATE	MODIFICATION

1HC0069571

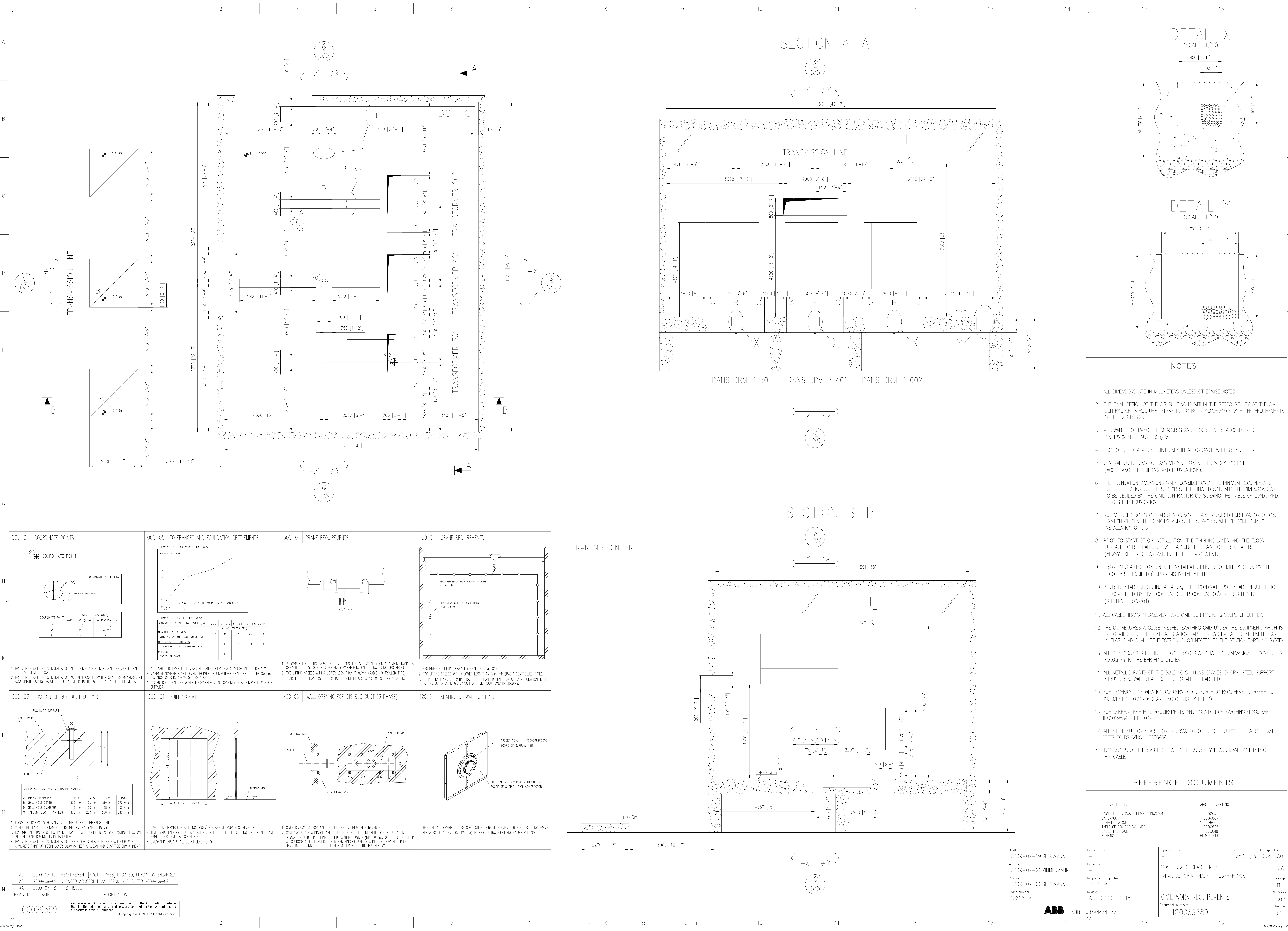
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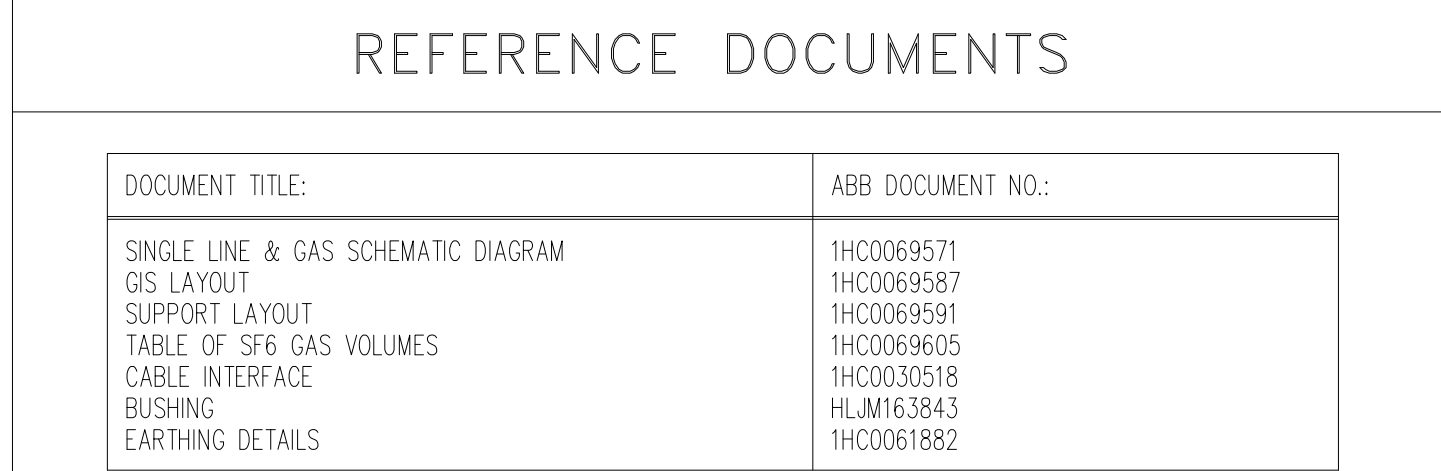
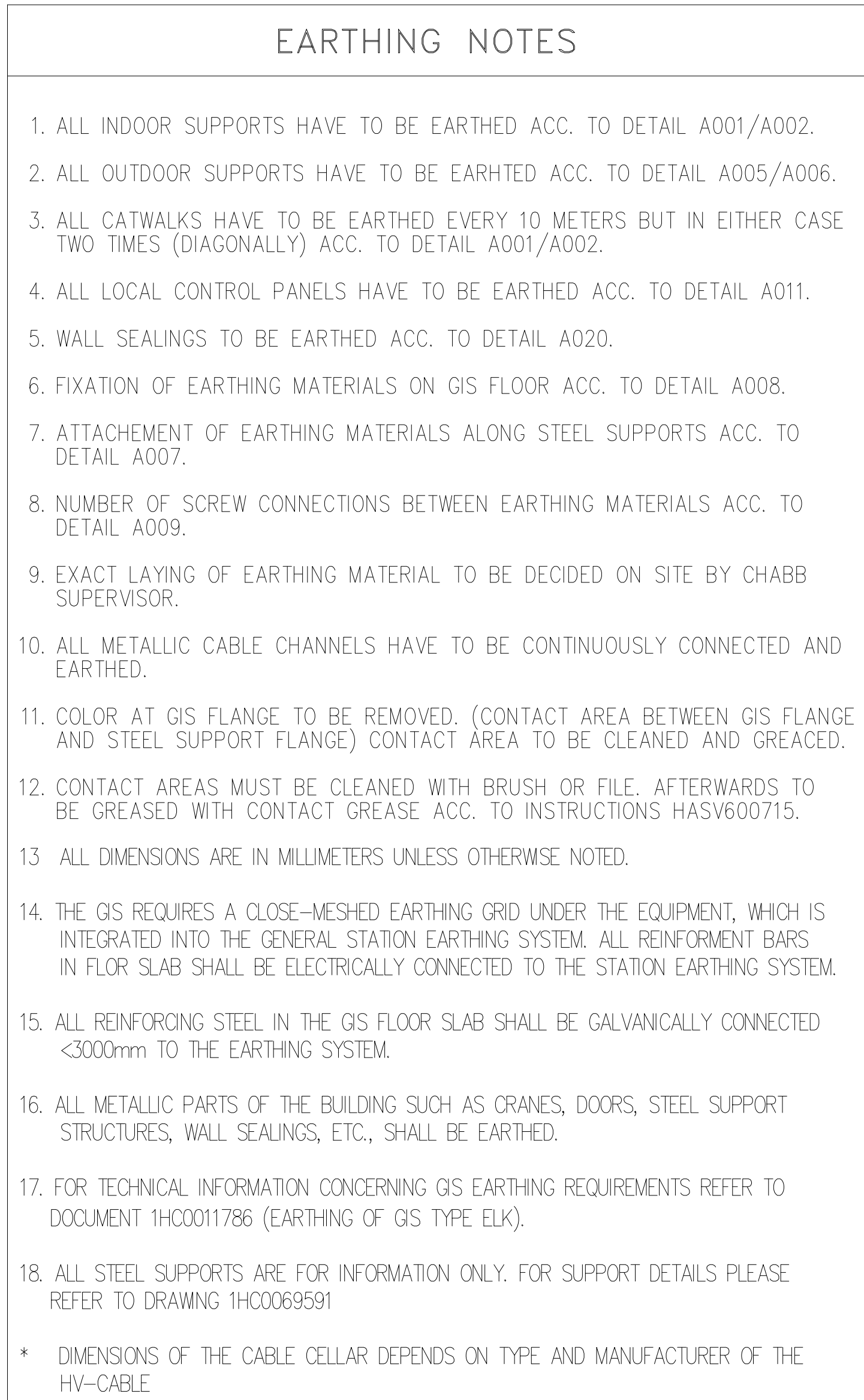
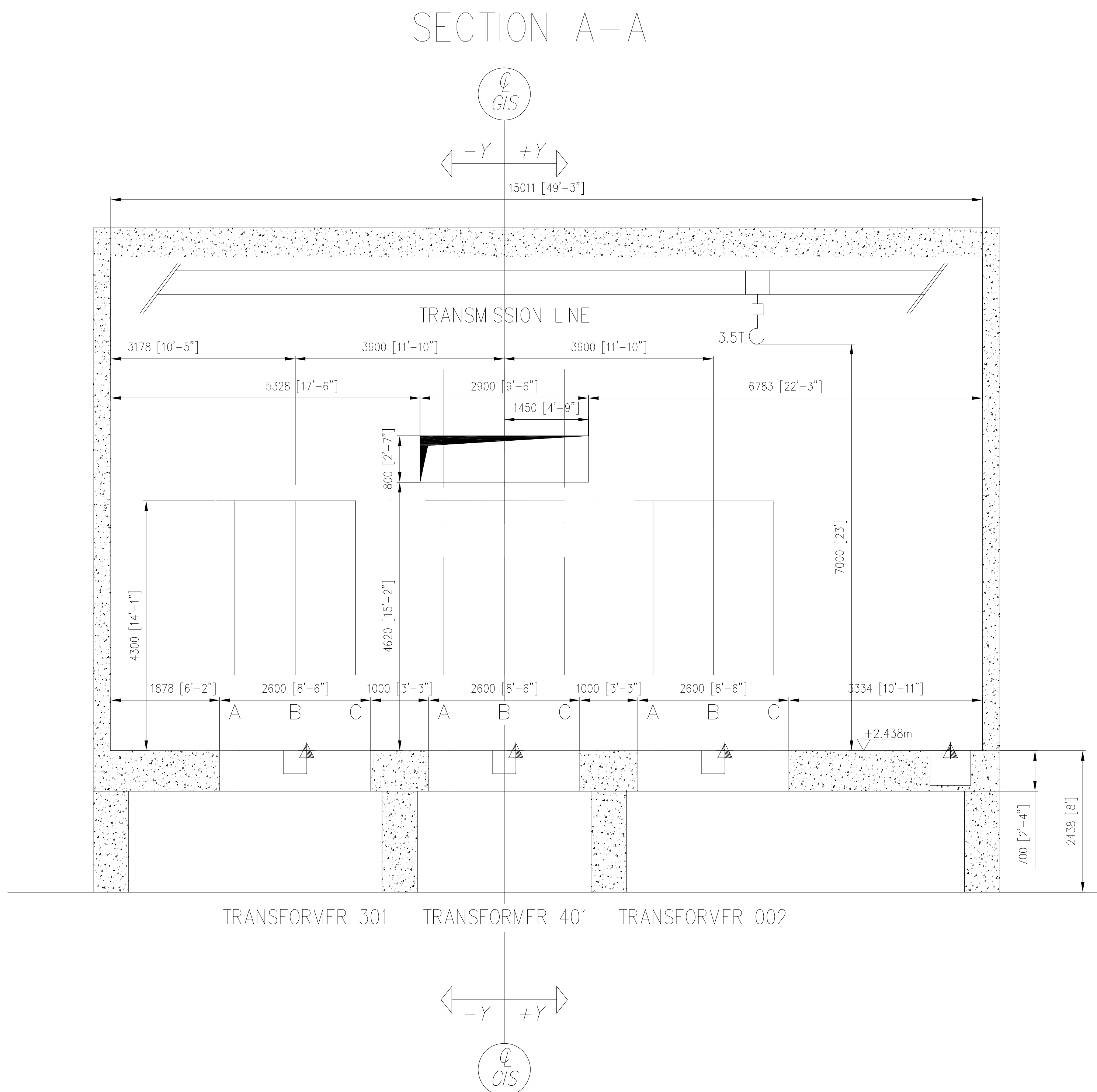
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

TRANSFORMER 401

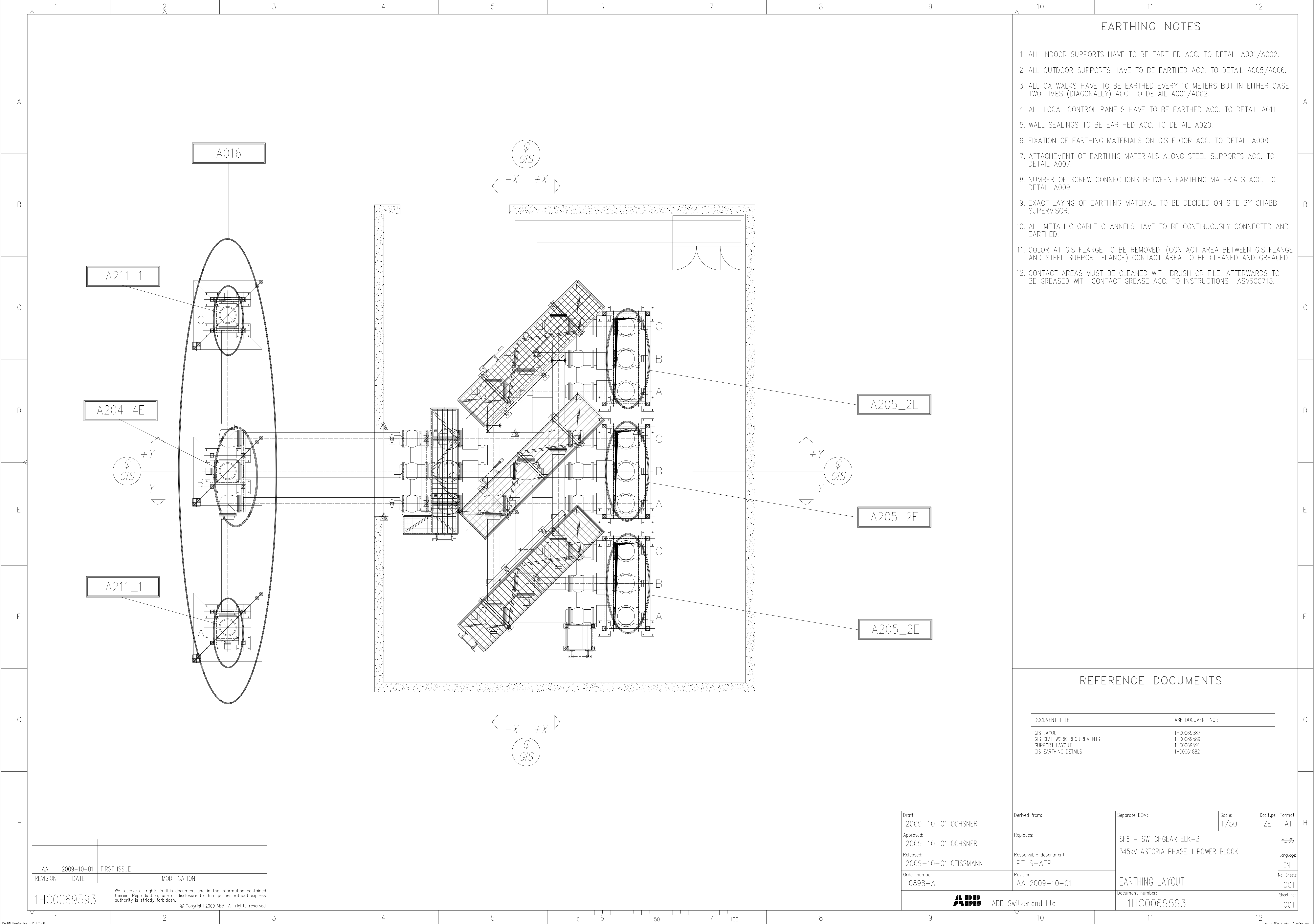
TRANSFORMER 002

Draft: 2009-07-14 GEISSMANN	Derived from: -	Separate BOM: -	Scale: % -	Doc-type: DRA	Format: A1
Approved: 2009-07-15 ZIMMERMANN	Replaces: -	SF6 - SWITCHGEAR ELK-3 345kV ASTORIA PHASE II POWER BLOCK			Language: EN
Released: 2009-07-16 GEISSMANN	Responsible department: PTHS-AEP	GAS SCHEMATIC DIAGRAM			No. Sheets: 002
Order number: 10898-A	Revision: AE 2009-11-30				Sheet no.: 002
ABB ABB Switzerland Ltd		Document number: 1HC0069571			





Draft:	Derived from:	Separate BOM:	Scale:	Doc type:	Format:
2009-07-19 GEISSMANN	—	—	1/50 x	DRA	A4
Approved:	Replaces:	Sf6 – SWITCHGEAR ELK-3 345kV ASTORIA PHASE II POWER BLOCK			
2009-07-20 ZIMMERMANN	—				Language: EN
Released:	Responsible department:	EARTHING REQUIREMENTS			No. Sheets: 002
2009-07-20 GEISSMANN	PTSHS-AEP				002
Order number:	Revision:	1HC0069589			Sheet no: 002
10898-A	AC 2009-10-15				002
 ABB Switzerland Ltd					



EARTHING NOTES

1. ALL INDOOR SUPPORTS HAVE TO BE EARTHED ACC. TO DETAIL A001/A002.
2. ALL OUTDOOR SUPPORTS HAVE TO BE EARTHED ACC. TO DETAIL A005/A006.
3. ALL CATWALKS HAVE TO BE EARTHED EVERY 10 METERS BUT IN EITHER CASE TWO TIMES (DIAGONALLY) ACC. TO DETAIL A001/A002.
4. ALL LOCAL CONTROL PANELS HAVE TO BE EARTHED ACC. TO DETAIL A011.
5. WALL SEALINGS TO BE EARTHED ACC. TO DETAIL A020.
6. FIXATION OF EARTHING MATERIALS ON GIS FLOOR ACC. TO DETAIL A008.
7. ATTACHEMENT OF EARTHING MATERIALS ALONG STEEL SUPPORTS ACC. TO DETAIL A007.
8. NUMBER OF SCREW CONNECTIONS BETWEEN EARTHING MATERIALS ACC. TO DETAIL A009.
9. EXACT LAYING OF EARTHING MATERIAL TO BE DECIDED ON SITE BY CHABB SUPERVISOR.
10. ALL METALLIC CABLE CHANNELS HAVE TO BE CONTINUOUSLY CONNECTED AND EARTHED.
11. COLOR AT GIS FLANGE TO BE REMOVED. (CONTACT AREA BETWEEN GIS FLANGE AND STEEL SUPPORT FLANGE) CONTACT AREA TO BE CLEANED AND GREACED.
12. CONTACT AREAS MUST BE CLEANED WITH BRUSH OR FILE. AFTERWARDS TO BE GREASED WITH CONTACT GREASE ACC. TO INSTRUCTIONS HASV600715.

REFERENCE DOCUMENTS

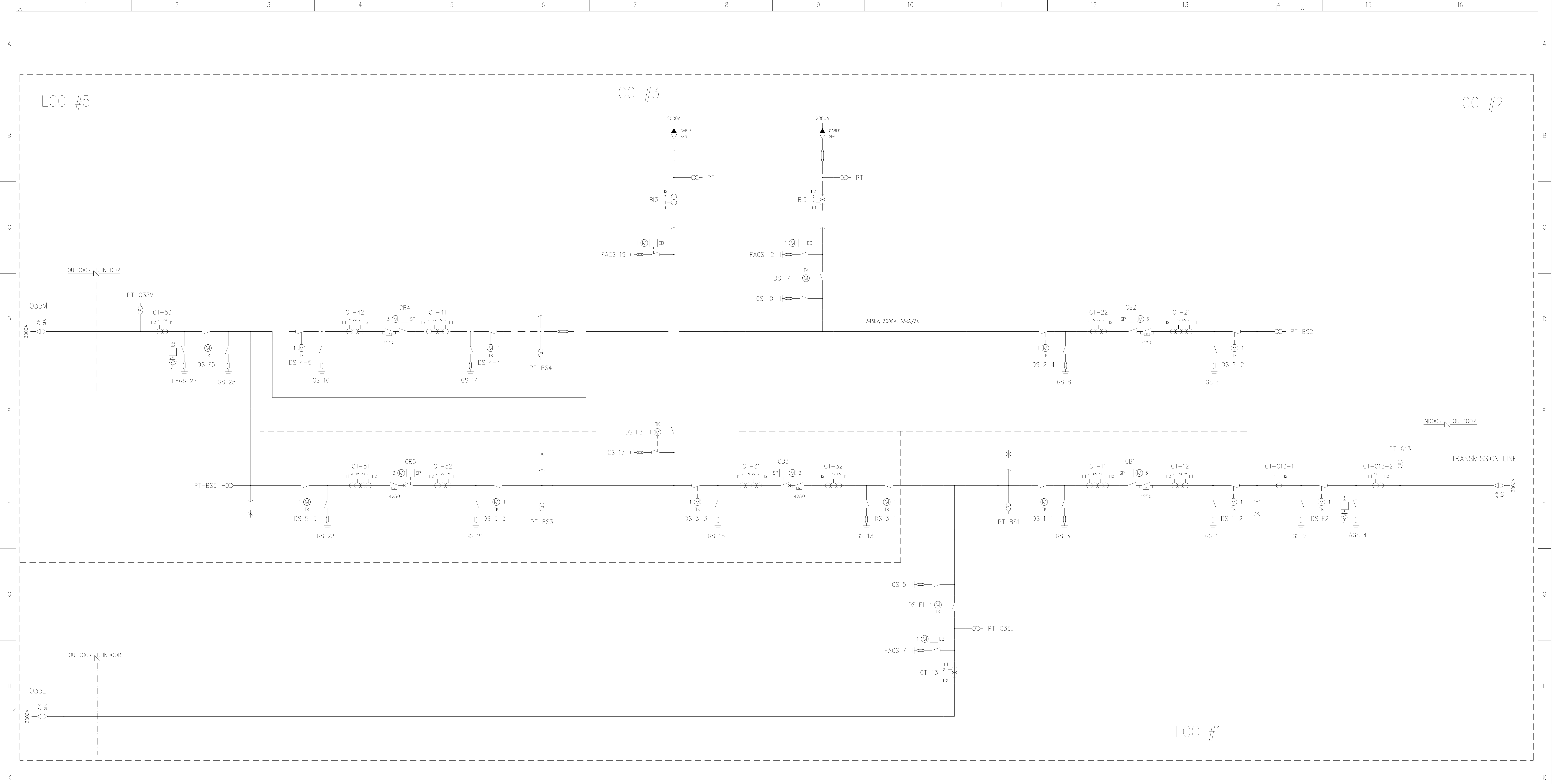
DOCUMENT TITLE:	ABB DOCUMENT NO.:
GIS LAYOUT GIS CIVIL WORK REQUIREMENTS SUPPORT LAYOUT GIS EARTHING DETAILS	1HC0069587 1HC0069589 1HC0069591 1HC0061882

REVISION	DATE	MODIFICATION
AA	2009-10-01	FIRST ISSUE

1HC0069593

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Draft: 2009-10-01 OCHSNER	Derived from:	Separate BOM: -	Scale: 1/50	Doc.type: ZEI	Format: A1
Approved: 2009-10-01 OCHSNER	Replaces:	SF6 - SWITCHGEAR ELK-3 345kV ASTORIA PHASE II POWER BLOCK			Language: EN
Released: 2009-10-01 GEISSMANN	Responsible department: PTHS-AEP	EARTHING LAYOUT			No. Sheets: 001
Order number: 10898-A	Revision: AA 2009-10-01				Sheet no.: 001
ABB ABB Switzerland Ltd			Document number: 1HC0069593		



LEGEND		CURRENT TRANSFORMER		VOLTAGE TRANSFORMER		REFERENCE DOCUMENTS	
	CIRCUIT BREAKER, ELK-SP-3 WITH CLOSING RESISTOR / OPERATING MECHANISM, ELK-HMBB (3 MOTORS FOR 3 PHASES)		DISCONNECTOR/EARTHING SWITCH WITH 10kV INSULATION, ELK-TK3 / OPERATING MECHANISM, ELK-BAC (1 MOTOR FOR 3 PHASES)		HIGH SPEED EARTHING SWITCH WITH 10kV INSULATION, ELK-EB3 / OPERATING MECHANISM, ELK-BAE (1 MOTOR / 3 CLOSING SPRINGS FOR 3 PHASES)		CURRENT TRANSFORMER, ELK-CN3
	VOLTAGE TRANSFORMER, ELK-PL3		SF6/AIR BUSHING, ELK-HD3		END COVER, ELK-ZX3 * TESTPOINT		END COVER, ELK-ZX3
	REMOVABLE LINK / LATERAL DISMANTLING PIECE, ELK-VQ3						

DESIGNATION	CORE-NO. (TAP)	RATIO	CLASS	TYPE OF CORE	RATING FACTOR
CT-11 CT-21 CT-31 CT-51	1 (X)	3000/5A MR	C800	PROTECTION	1.5
	2 (Y)	3000/5A MR	C800	PROTECTION	1.5
	3 (Z)	3000/5A MR	C800	PROTECTION	1.5
	4 (W)	1000-2000-3000/5A	0.3 B-2.0	METERING	1.5

SEQUENCE: H2: 1, 2, 3, 4, H1 (INSULATION AT H2; AT CB SIDE)
(ABB CT DATA SHEET No.: 1HC0069619)
QUANTITY: 4x3 = 12 Pcs in total for GS
ACC. IEEE C57.13, TABLE 8

DESIGNATION	CORE-NO. (TAP)	RATIO	CLASS	TYPE OF CORE	RATING FACTOR
CT-12 CT-22 CT-32 CT-52	1 (X)	3000/5A MR	C800	PROTECTION	1.5
	2 (Y)	3000/5A MR	C800	PROTECTION	1.5
	3 (Z)	3000/5A MR	C800	PROTECTION	1.5
	4 (W)	1000-2000-3000/5A	0.3 B-2.0	METERING	1.5

SEQUENCE: H2: 1, 2, 3, H1 (INSULATION AT H2; AT CB SIDE)
(ABB CT DATA SHEET No.: 1HC0069620)
QUANTITY: 4x3 = 12 Pcs in total for GS
ACC. IEEE C57.13, TABLE 8

DESIGNATION	CORE-NO. (TAP)	RATIO	CLASS	TYPE OF CORE	RATING FACTOR
CT-13 CT-13-2 CT-53	1 (X)	3000/5A MR	C800	PROTECTION	1.5
	2 (Y)	3000/5A MR	C800	PROTECTION	1.5
	3 (Z)	3000/5A MR	C800	PROTECTION	1.5

SEQUENCE: H2: 1, 2, H1 (INSULATION AT H2; AT LINE SIDE)
(ABB CT DATA SHEET No.: 1HC0069712)
QUANTITY: 3x3 = 9 Pcs in total for GS
ACC. IEEE C57.13, TABLE 8

DESIGNATION	CORE-NO. (TAP)	RATIO	CLASS	TYPE OF CORE	RATING FACTOR
CT-G13-1	1 (X)	1000/5A	0.155-B01-1.8	METERING	1.5

SEQUENCE: H2: 1, H1 (INSULATION AT H2; AT LINE SIDE)
(ABB CT DATA SHEET No.: 1HC0069714)
QUANTITY: 1x3 = 3 Pcs in total for GS

DESIGNATION	WINDINGS	RATIO	CLASS	TYPE OF WINDING
PT-B51 PT-B52 PT-B53 PT-B55 PT-G13 PT-Q35L PT-Q35M	PRIMARY	345 kV V3		
	SECONDARY 1	115 V - 69 V	0.3Z	PROTECTION
	SECONDARY 2	115 V - 69 V	0.3Z	PROTECTION
	SECONDARY 3	115 V - 69 V	0.3Z - 0.6ZZ	METERING

(1800/3000:1)

(ABB VT DATA SHEET No.: 1HC0069567)
QUANTITY: 7x3 = 21 Pcs in total for GS
VT DATA TO BE CONFIRMED BY VT MANUFACTURER

DOCUMENT TITLE:		ABB DOCUMENT NO.:	
GS LAYOUT GS CIVIL WORK REQUIREMENTS TABLE OF SF6 GAS VOLUMES		1HC0069588 1HC0069590 1HC0069606	

Draft:	2009-07-17 GEISSMANN	Derived from:	-	Separate BOM:	-	Scale:	%	-	Doc type:	DRA	Format:	A0
Approved:	2009-07-20 ZIMMERMANN	Replaces:	-		345kV SF6 - SWITCHGEAR ELK-3							
Released:	2009-07-20 GEISSMANN	Responsible department:	ASTORIA PHASE II CHARLES POLETTI SUBSTATION									
Order number:	10898-B	Revision:	AF 2009-12-21									
			SINGLE LINE DIAGRAM									
			Document number:				1HC0069572					
			ABB Switzerland Ltd				Sheet no.:				001	

AF	2009-12-21	CT-13, CT-G13-1, CT-G13-2, CT-53 TURNED (INSULATION SIDE)
AE	2009-11-30	CLASS AND BURDEN OF VTS 3rd SECONDARY WINDING CHANGED
AD	2009-09-03	BAY AND GAS ZONE DESIGNATIONS, BAY PARTITION CHANGED
AC	2009-07-24	CT DATAS OF CT =D01-01-BI3 CHANGED
AB	2009-07-23	CT DATAS CHANGED
AA	2009-07-17	FIRST ISSUE
REVISION	DATE	MODIFICATION

1HC0069572

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TO Q35 M

345kV GIS
BUILDING

TRANSMISSION LINE

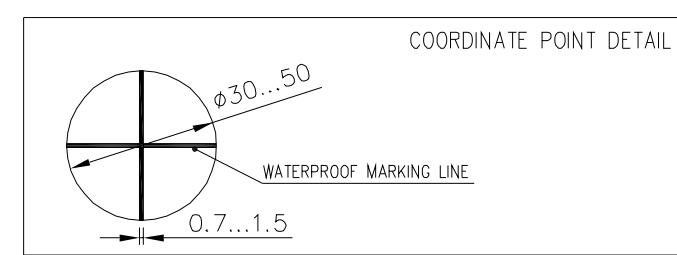
345KV CONTROL
BUILDING

NOTES

- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
- THE FINAL DESIGN OF THE GIS BUILDING IS WITHIN THE RESPONSIBILITY OF THE CIVIL CONTRACTOR. STRUCTURAL ELEMENTS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE GIS DESIGN.
- ALLOWABLE TOLERANCE OF MEASURES AND FLOOR LEVELS ACCORDING TO DIN 18202 SEE FIGURE 000/03.
- POSITION OF DILATATION JOINT ONLY IN ACCORDANCE WITH GIS SUPPLIER.
- GENERAL CONDITIONS FOR ASSEMBLY OF GIS SEE FORM 221 01010 E (ACCEPTANCE OF BUILDING AND FOUNDATIONS).
- THE FOUNDATION DIMENSIONS GIVEN CONSIDER ONLY THE MINIMUM REQUIREMENTS FOR THE FIXATION OF THE SUPPORTS. THE FINAL DESIGN AND THE DIMENSIONS ARE TO BE DECIDED BY THE CIVIL CONTRACTOR CONSIDERING THE TABLE OF LOADS AND FORCES FOR FOUNDATIONS.
- NO EMBEDDED BOLTS OR PARTS IN CONCRETE ARE REQUIRED FOR FIXATION OF GIS. FIXATION OF CIRCUIT BREAKERS AND STEEL SUPPORTS WILL BE DONE DURING INSTALLATION OF GIS.
- PRIOR TO START OF GIS INSTALLATION, THE FINISHING LAYER AND THE FLOOR SURFACE TO BE SEALED UP WITH A CONCRETE PAINT OR RESIN LAYER. (ALWAYS KEEP A CLEAN AND DUSTFREE ENVIRONMENT)
- PRIOR TO START OF GIS ON SITE INSTALLATION LIGHTS OF MIN. 200 LUX ON THE FLOOR ARE REQUIRED (DURING GIS INSTALLATION).
- PRIOR TO START OF GIS INSTALLATION, THE COORDINATE POINTS ARE REQUIRED TO BE COMPLETED BY CIVIL CONTRACTOR OR CONTRACTOR'S REPRESENTATIVE. (SEE FIGURE 000/04)
- ALL CABLE TRAYS IN BASEMENT ARE CIVIL CONTRACTOR'S SCOPE OF SUPPLY.
- THE GIS REQUIRES A CLOSE-MESHED EARTHING GRID UNDER THE EQUIPMENT, WHICH IS INTEGRATED INTO THE GENERAL STATION EARTHING SYSTEM. ALL REINFORCEMENT BARS IN FLOOR SLAB SHALL BE ELECTRICALLY CONNECTED TO THE STATION EARTHING SYSTEM.
- ALL REINFORCING STEEL IN THE GIS FLOOR SLAB SHALL BE GALVANICALLY CONNECTED <3000mm TO THE EARTHING SYSTEM
- ALL METALLIC PARTS OF THE BUILDING SUCH AS CRANES, DOORS, STEEL SUPPORT STRUCTURES, WALL SEALINGS, ETC., SHALL BE EARTHED.
- FOR TECHNICAL INFORMATION CONCERNING GIS EARTHING REQUIREMENTS REFER TO DOCUMENT 1HC0011786 (EARTHING OF GIS TYPE ELK).
- FOR GENERAL EARTHING REQUIREMENTS AND LOCATION OF EARTHING FLAGS SEE 1HC0069590 SHEET 002
- ALL STEEL SUPPORTS ARE FOR INFORMATION ONLY. FOR SUPPORT DETAILS PLEASE REFER TO DRAWING 1HC0069592
- DETAILS OF CIVIL WORK REQUIREMENTS SEE DRAWING 1HC0069590 SHEET 004
- OUTDOOR DENSITY MONITOR CABLES REQUIRE A PVC PIPE OF MIN. DIAMETER 100mm FOR THE CONNECTION BETWEEN OUTDOOR HAND-HOLES AND THE INDOOR CABLE TRENCH

000_04 COORDINATE POINTS

⊕ COORDINATE POINT



COORDINATE POINT	DISTANCE FROM GIS Ⓞ	
	X-DIRECTION (mm)	Y-DIRECTION (mm)
C1	0	0
C2	0	3614
C3	-15300	0
C4	-15300	3614

- PRIOR TO START OF GIS INSTALLATION ALL COORDINATE POINTS SHALL BE MARKED ON THE GIS BUILDING FLOOR.
- PRIOR TO START OF GIS INSTALLATION ACTUAL FLOOR ELEVATION SHALL BE MEASURED AT COORDINATE POINTS. VALUES TO BE PROVIDED TO THE GIS INSTALLATION SUPERVISOR.

REFERENCE DOCUMENTS

DOCUMENT TITLE:	ABB DOCUMENT NO.:
SINGLE LINE & GAS SCHEMATIC DIAGRAM	1HC0069572
GIS LAYOUT	1HC0069588
SUPPORT LAYOUT	1HC0069592
TABLE OF SFG GAS VOLUMES	1HC0069596
CABLE INTERFACE	1HC0030318
BUSHING	HLAM63843

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Revision:	AE 2009-12-21

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Separate BOM:	-

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Doc type:	DRA
Format:	A0

345kV SF6 - SWITCHGEAR ELK-3

ASTORIA PHASE II CHARLES POLETTI SUBSTATION

CIVIL WORK REQUIREMENTS

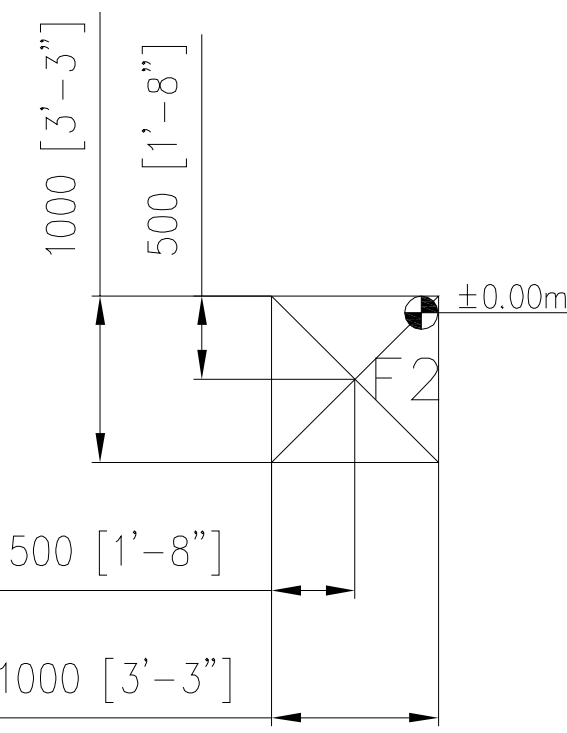
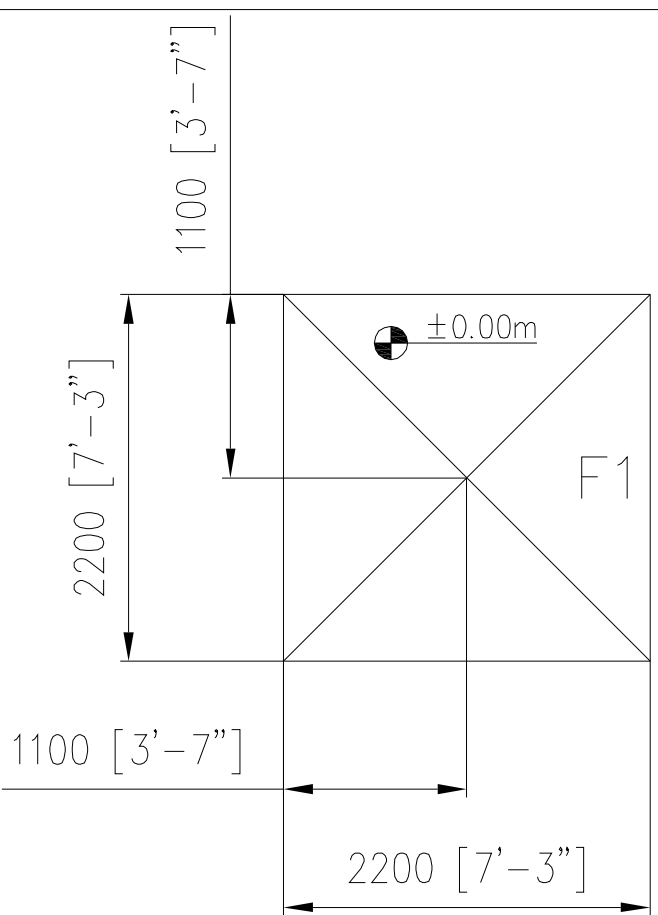
Document number:

1HC0069590

ABB

ABB Switzerland Ltd

TYPES OF FOUNDATION
(Outdoor)



AE	2009-12-21	CT-13, CT-23, CT-24, CT-53 TURNED, OUTDOOR CABLE PIPES
AD	2009-10-07	MEASUREMENT [FOOT-INCHES], FOUNDATION F1 AND BUILDING UPDATED
AC	2009-09-14	NEW BUILDING DRAWING (WALLS MOVED), GIS EXIT Q35L MOD.
AB	2009-08-04	LCC PHOENIX, GIS EXIT Q35L AND CABLE TRENCHES MODIFIED
AA	2009-07-21	FIRST ISSUE

1HC0069590

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TO Q35 M

345kV GIS BUILDING

TRANSMISSION LINE

345KV CONTROL BUILDING

GENERATOR DIESEL

EARTHING NOTES

1. ALL INDOOR SUPPORTS HAVE TO BE EARTHED ACC. TO DETAIL A001/A002.
2. ALL OUTDOOR SUPPORTS HAVE TO BE EARTHED ACC. TO DETAIL A005/A006.
3. ALL CATWALKS HAVE TO BE EARTHED EVERY 10 METERS BUT IN EITHER CASE TWO TIMES (DIAGONALLY) ACC. TO DETAIL A001/A002.
4. ALL LOCAL CONTROL PANELS HAVE TO BE EARTHED ACC. TO DETAIL A011.
5. WALL SEALINGS TO BE EARTHED ACC. TO DETAIL A020.
6. FIXATION OF EARTHING MATERIALS ON GIS FLOOR ACC. TO DETAIL A008.
7. ATTACHEMENT OF EARTHING MATERIALS ALONG STEEL SUPPORTS ACC. TO DETAIL A007.
8. NUMBER OF SCREW CONNECTIONS BETWEEN EARTHING MATERIALS ACC. TO DETAIL A009.
9. EXACT LAYING OF EARTHING MATERIAL TO BE DECIDED ON SITE BY CHABB SUPERVISOR.
10. ALL METALLIC CABLE CHANNELS HAVE TO BE CONTINUOUSLY CONNECTED AND EARTHED.
11. COLOR AT GIS FLANGE TO BE REMOVED. (CONTACT AREA BETWEEN GIS FLANGE AND STEEL SUPPORT FLANGE) CONTACT AREA TO BE CLEANED AND GREASED.
12. CONTACT AREAS MUST BE CLEANED WITH BRUSH OR FILE. AFTERWARDS TO BE GREASED WITH CONTACT GREASE ACC. TO INSTRUCTIONS HASV600715.
13. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
14. THE GIS REQUIRES A CLOSE-MESHED EARTHING GRID UNDER THE EQUIPMENT, WHICH IS INTEGRATED INTO THE GENERAL STATION EARTHING SYSTEM. ALL REINFORCING BARS IN FLOOR SLAB SHALL BE ELECTRICALLY CONNECTED TO THE STATION EARTHING SYSTEM.
15. ALL REINFORCING STEEL IN THE GIS FLOOR SLAB SHALL BE GALVANICALLY CONNECTED <3000mm TO THE EARTHING SYSTEM.
16. ALL METALLIC PARTS OF THE BUILDING SUCH AS CRANES, DOORS, STEEL SUPPORT STRUCTURES, WALL SEALINGS, ETC., SHALL BE EARTHED.
17. FOR TECHNICAL INFORMATION CONCERNING GIS EARTHING REQUIREMENTS REFER TO DOCUMENT 1HC0011786 (EARTHING OF GIS TYPE ELK).
18. ALL STEEL SUPPORTS ARE FOR INFORMATION ONLY. FOR SUPPORT DETAILS PLEASE REFER TO DRAWING 1HC0069590
19. DETAILS OF EARTHING REQUIREMENTS SEE DRAWING 1HC0069590 SHEET 004

REFERENCE DOCUMENTS

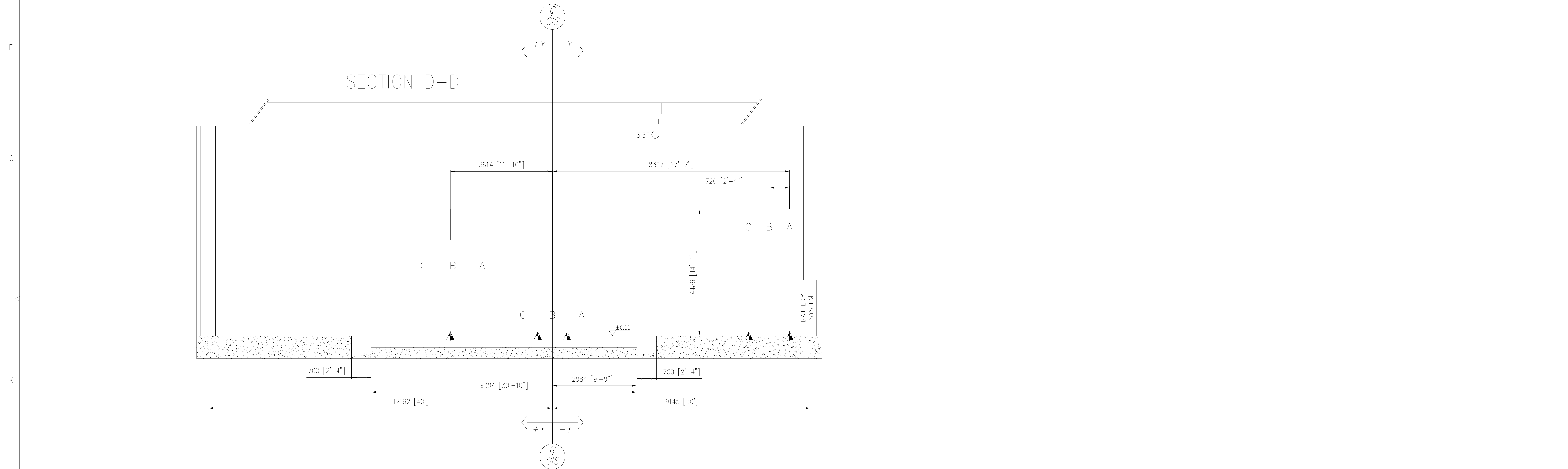
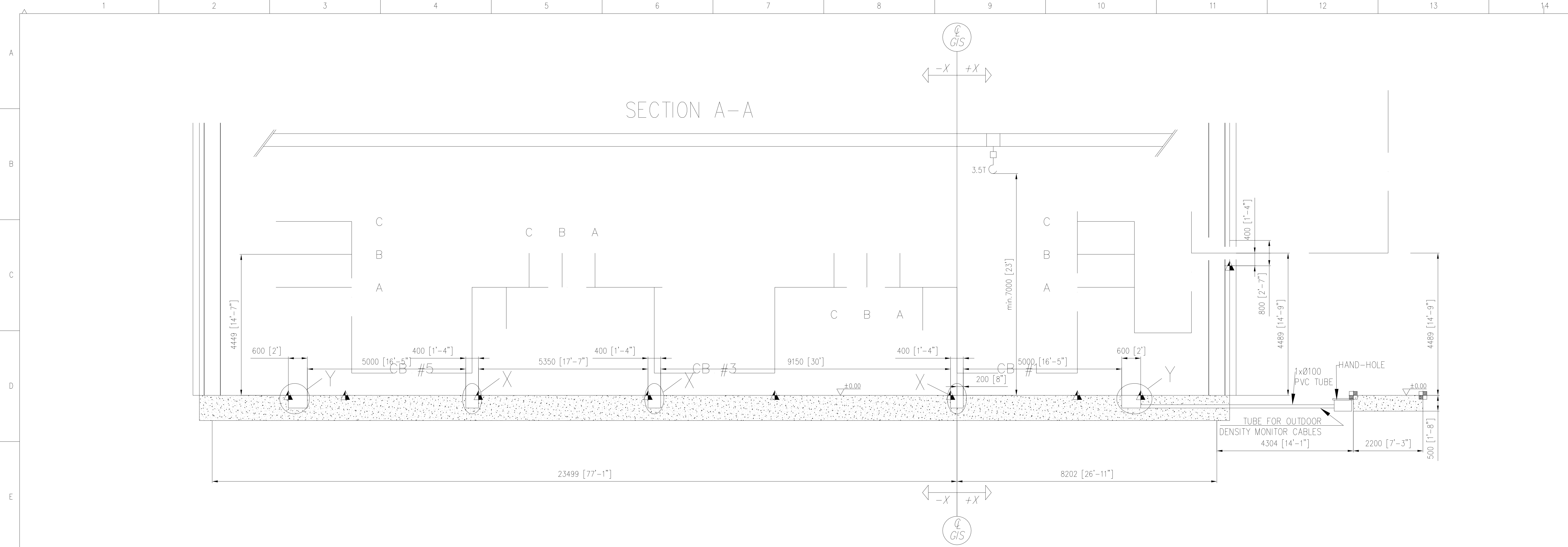
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SINGLE LINE & GAS SCHEMATIC DIAGRAM	1HC0069572
GIS LAYOUT	1HC0069588
SUPPORT LAYOUT	1HC0069592
TABLE OF SFG GAS VOLUMES	1HC0069608
CABLE INTERFACE	1HC0030516
BUSHING	HLMI163843
EARTHING DETAILS	1HC0061882

Draft: 2009-07-23 GEISSMANN	Derived from: -	Separate BOM: -	Scale: 1/50	Doc type: DRA	Format: A0
Approved: 2009-07-23 ZIMMERMANN	Replaces: -	Responsible department: PTHS-AEP			
Released: 2009-07-23 GEISSMANN	Revision: AE 2009-12-21				
Order number: 10898-B					
ABB Switzerland Ltd			EARTHING REQUIREMENTS		
1HC0069590			Sheet no.: 002		

REVISION	DATE	MODIFICATION
AE	2009-12-21	CT-13, CT-23, CT-24, CT-53 TURNED, OUTDOOR CABLE PIPES
AD	2009-10-07	MEASUREMENT [FOOT-INCHES], FOUNDATION F1 AND BUILDING UPDATED
AC	2009-09-14	NEW BUILDING DRAWING (WALLS MOVED), GIS EXIT Q35L MOD.
AB	2009-08-04	LCC PHOENIX, GIS EXIT Q35L AND CABLE TRENCHES MODIFIED
AA	2009-07-21	FIRST ISSUE

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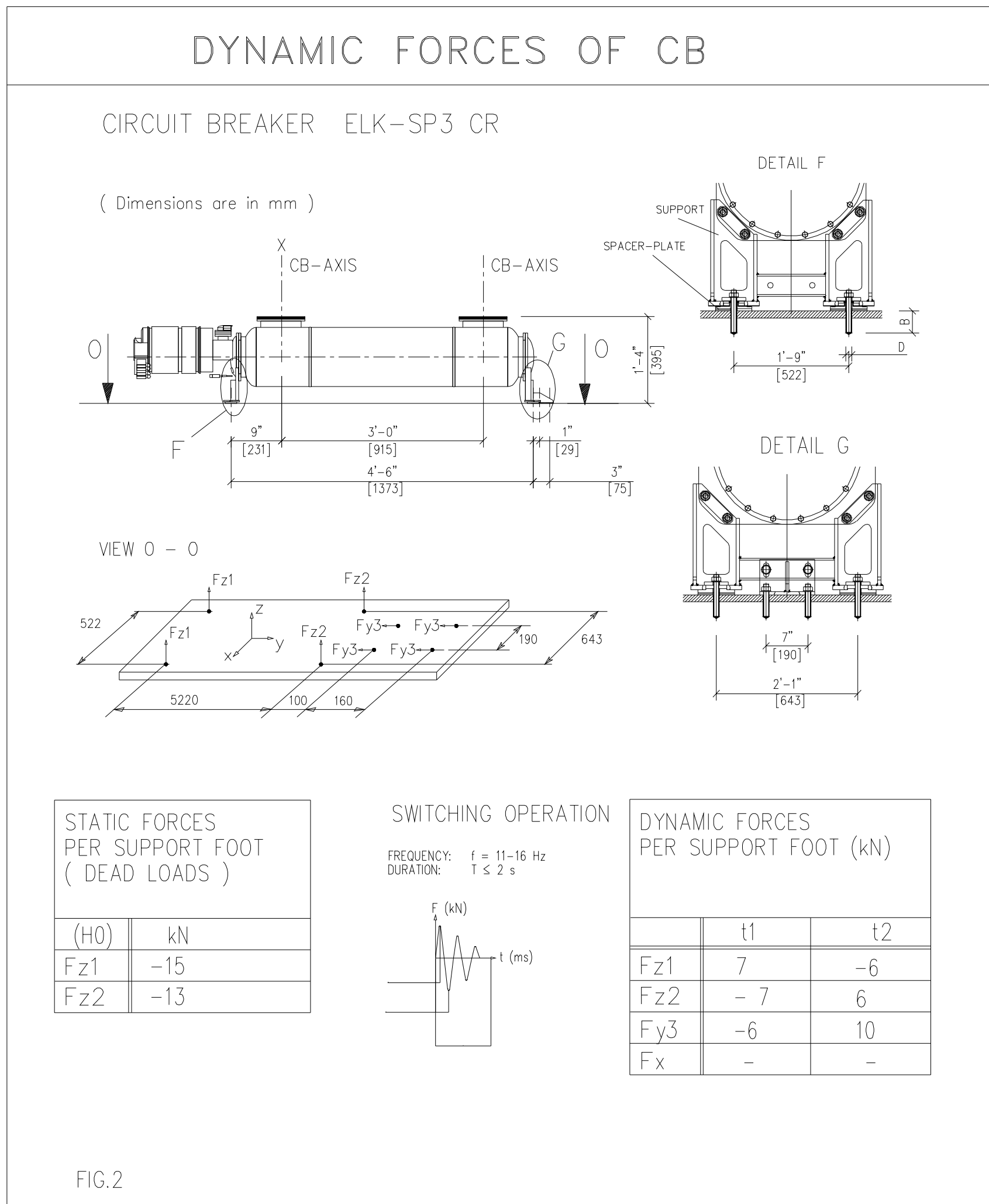
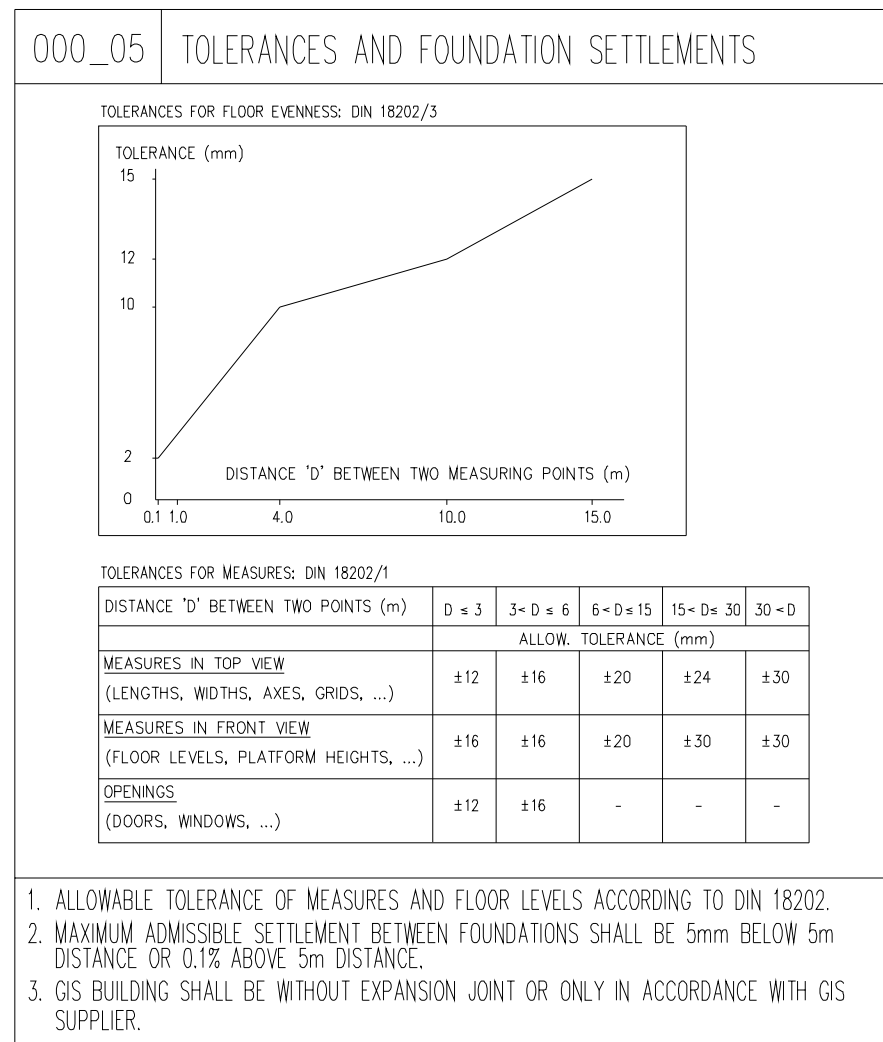
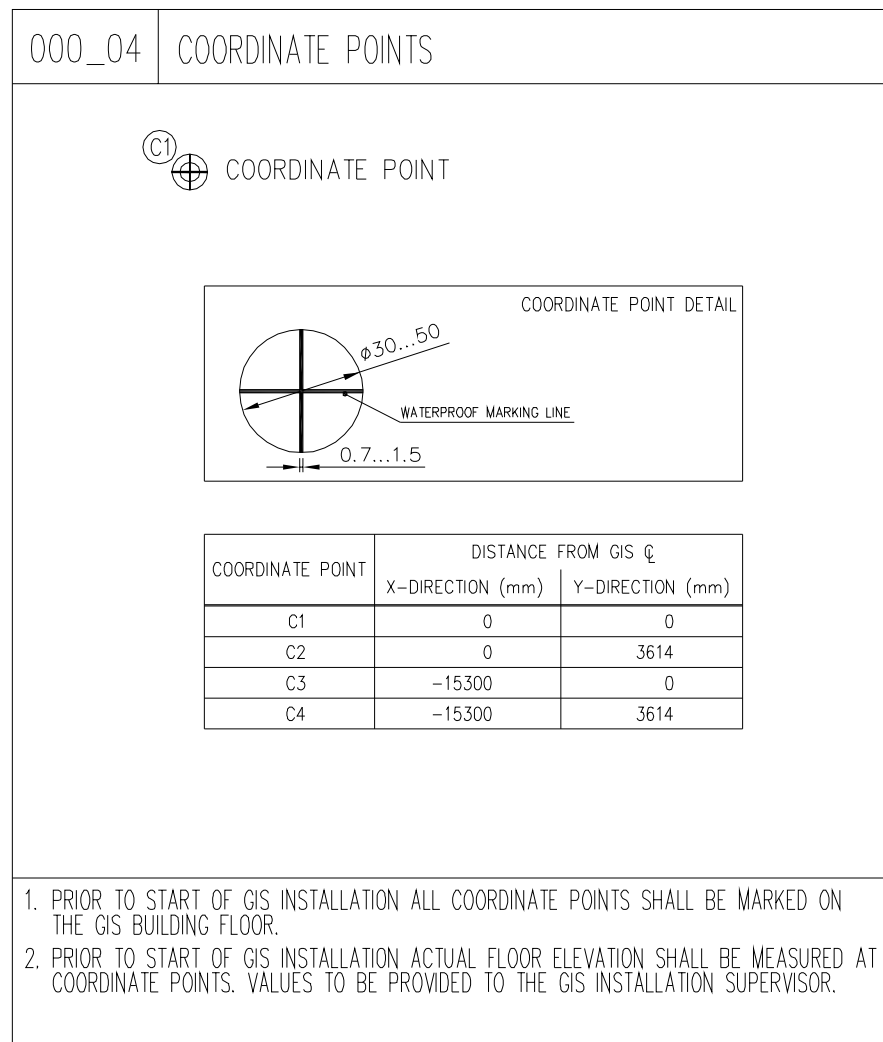
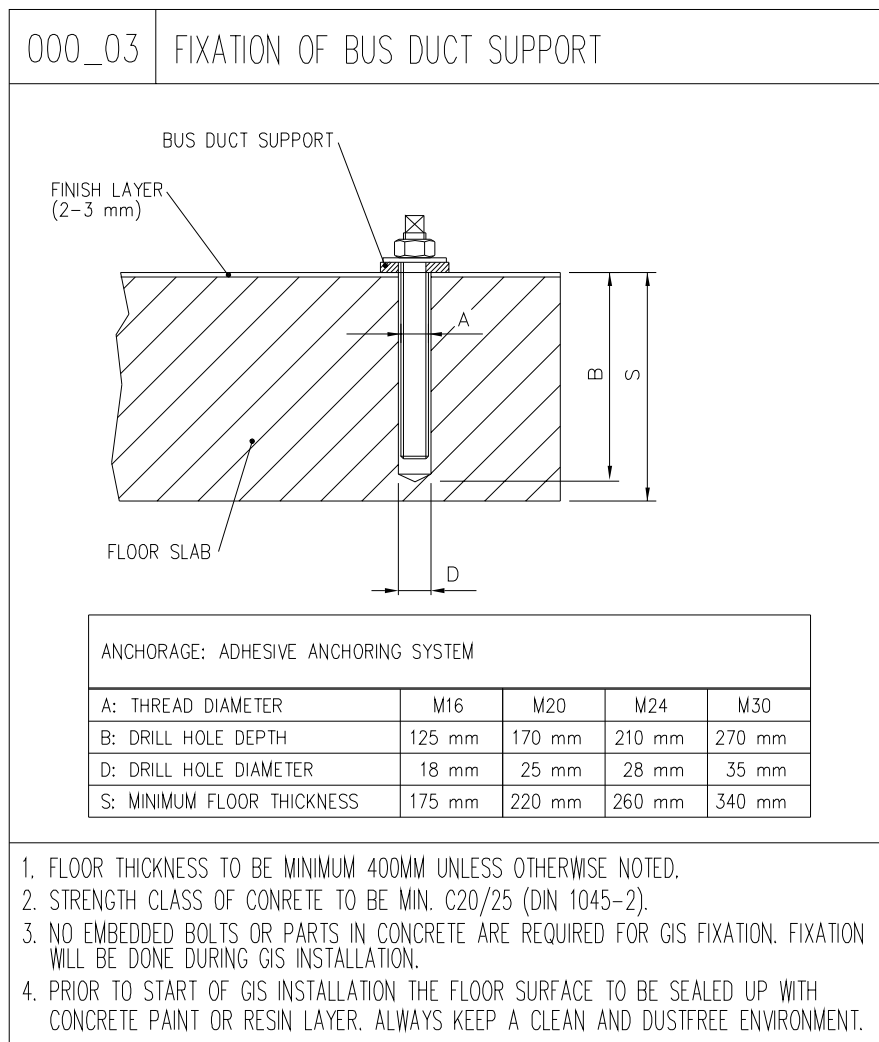
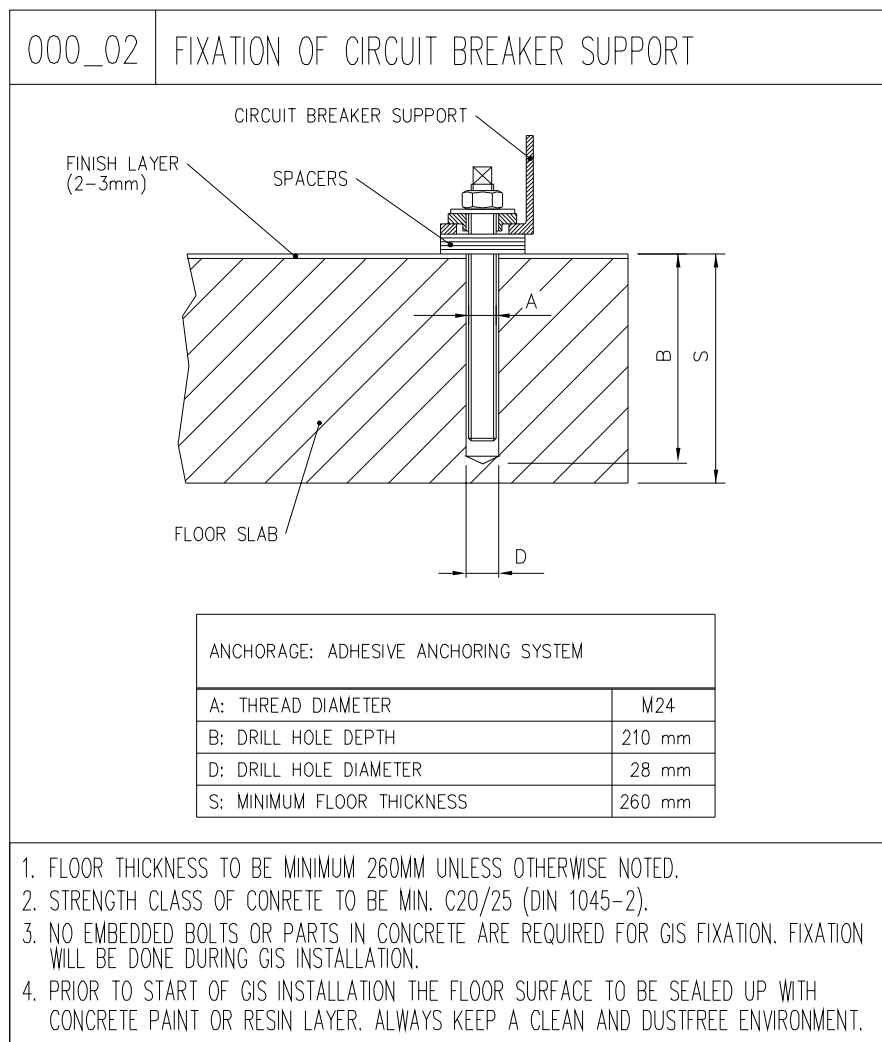
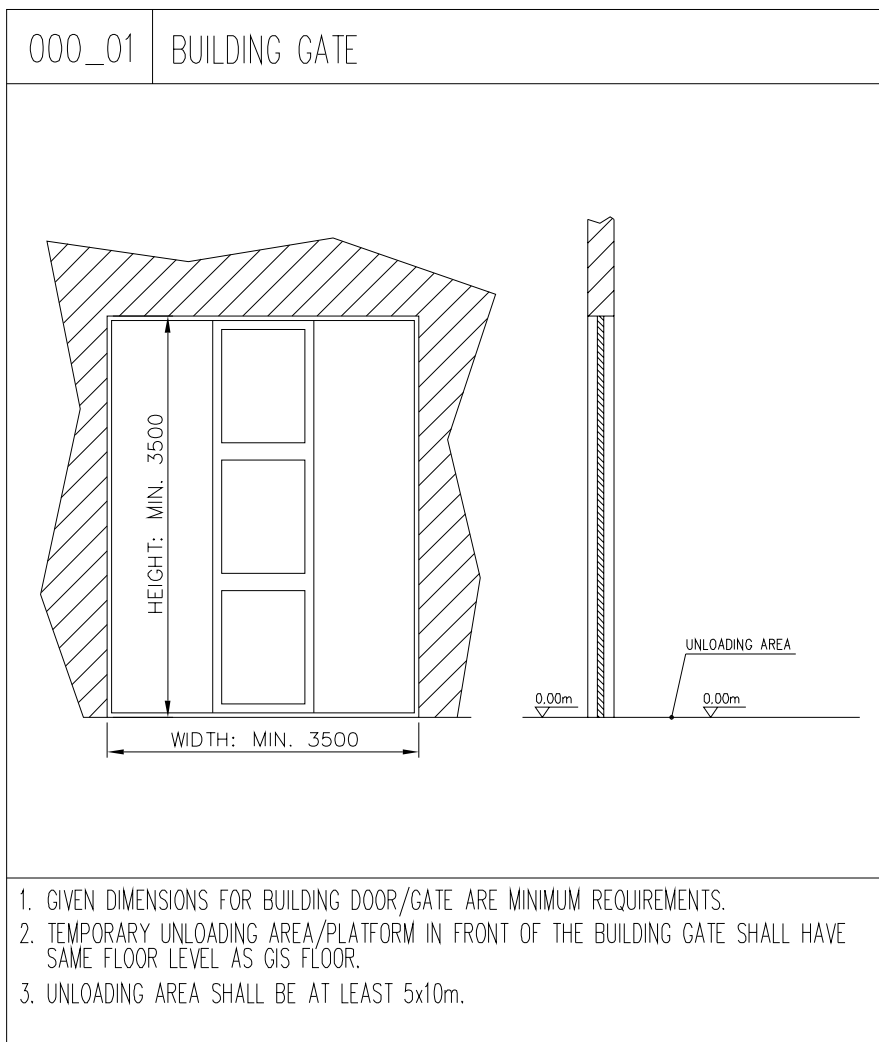
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 - DETAILS OF CIVIL WORK REQUIREMENTS SEE DRAWING 1HC0069590 SHEET 004
 - OUTDOOR DENSITY MONITOR CABLES REQUIRE A PVC PIPE OF MIN. DIAMETER 100mm FOR THE CONNECTION BETWEEN OUTDOOR HAND-HOLES AND THE INDOOR CABLE TRENCH

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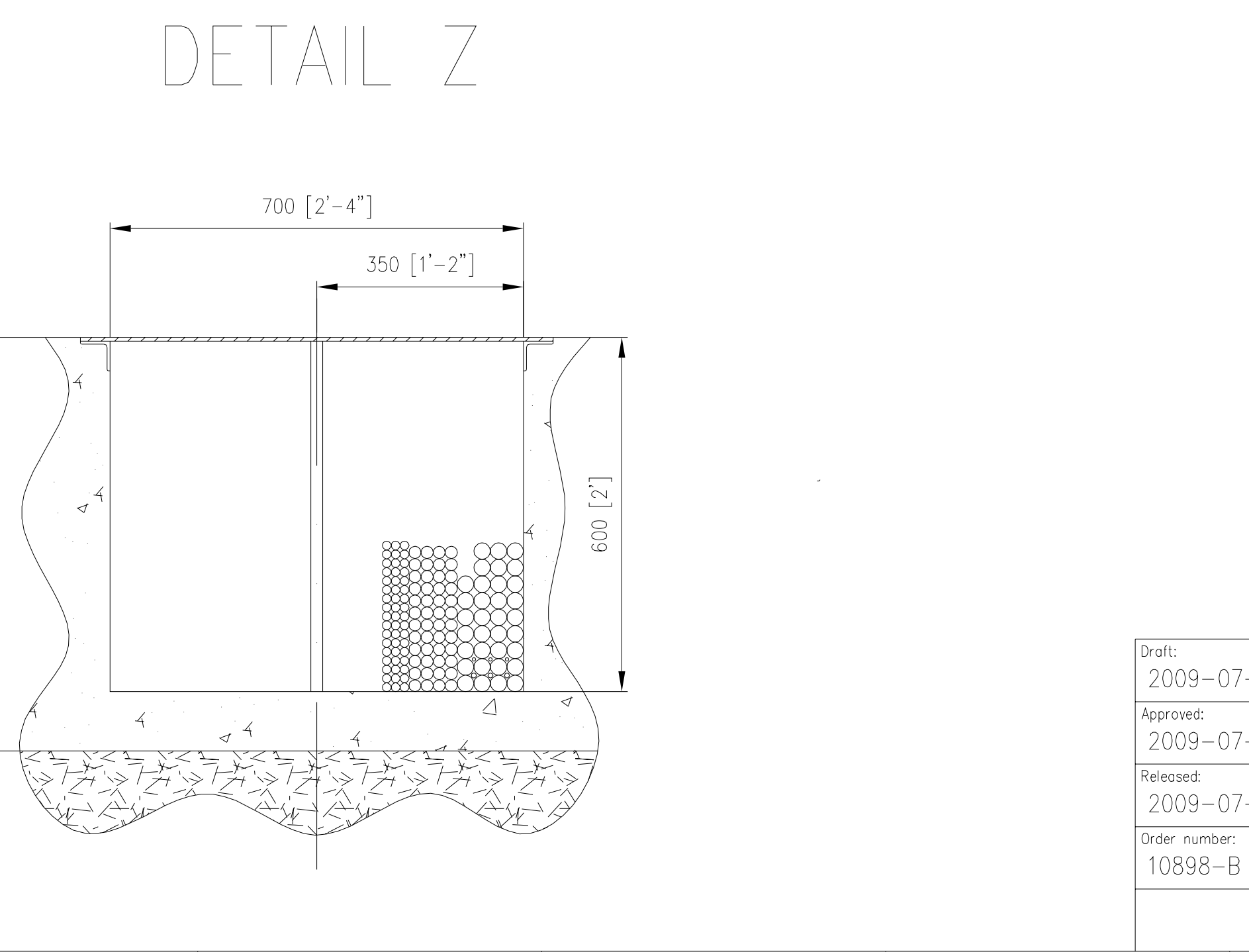
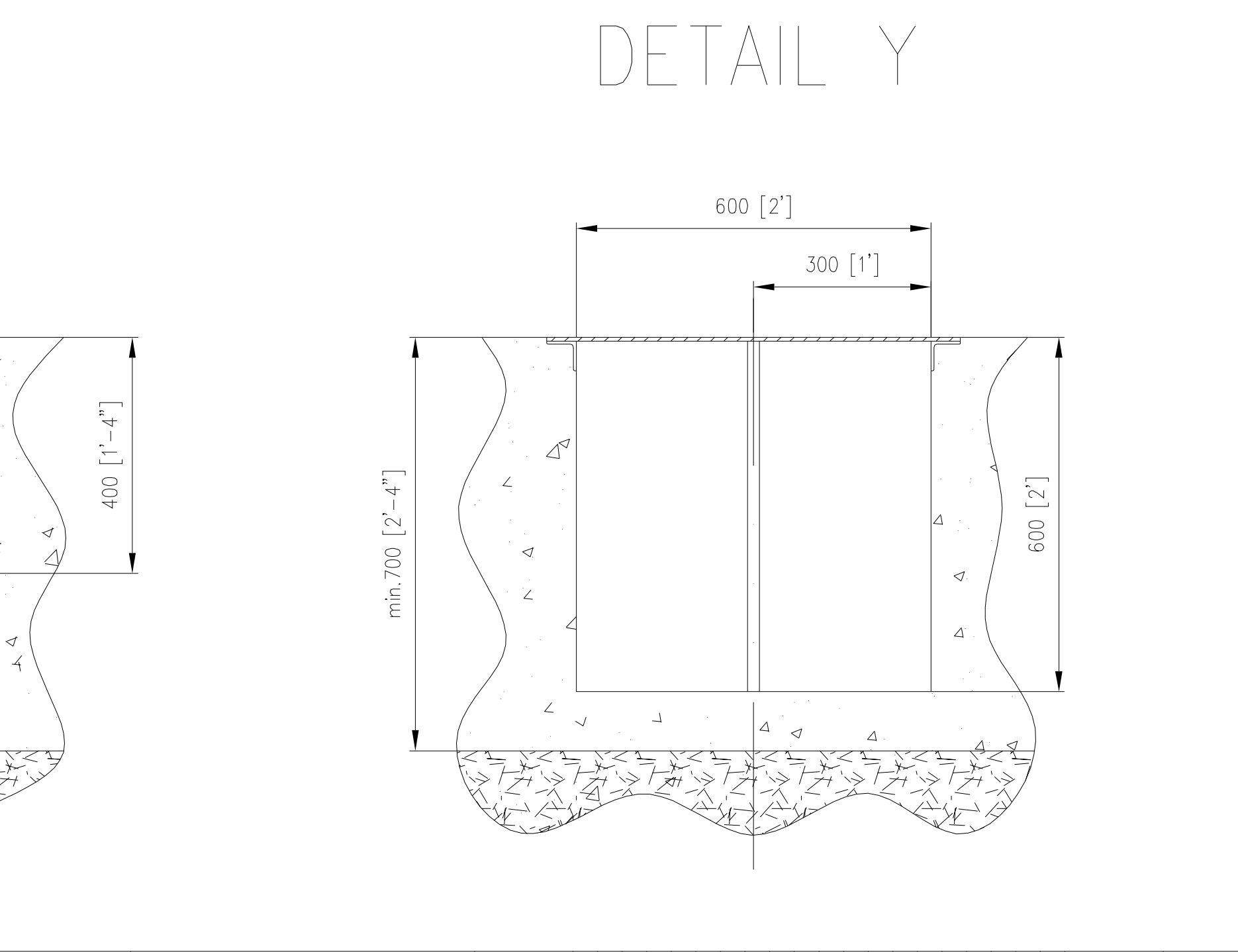
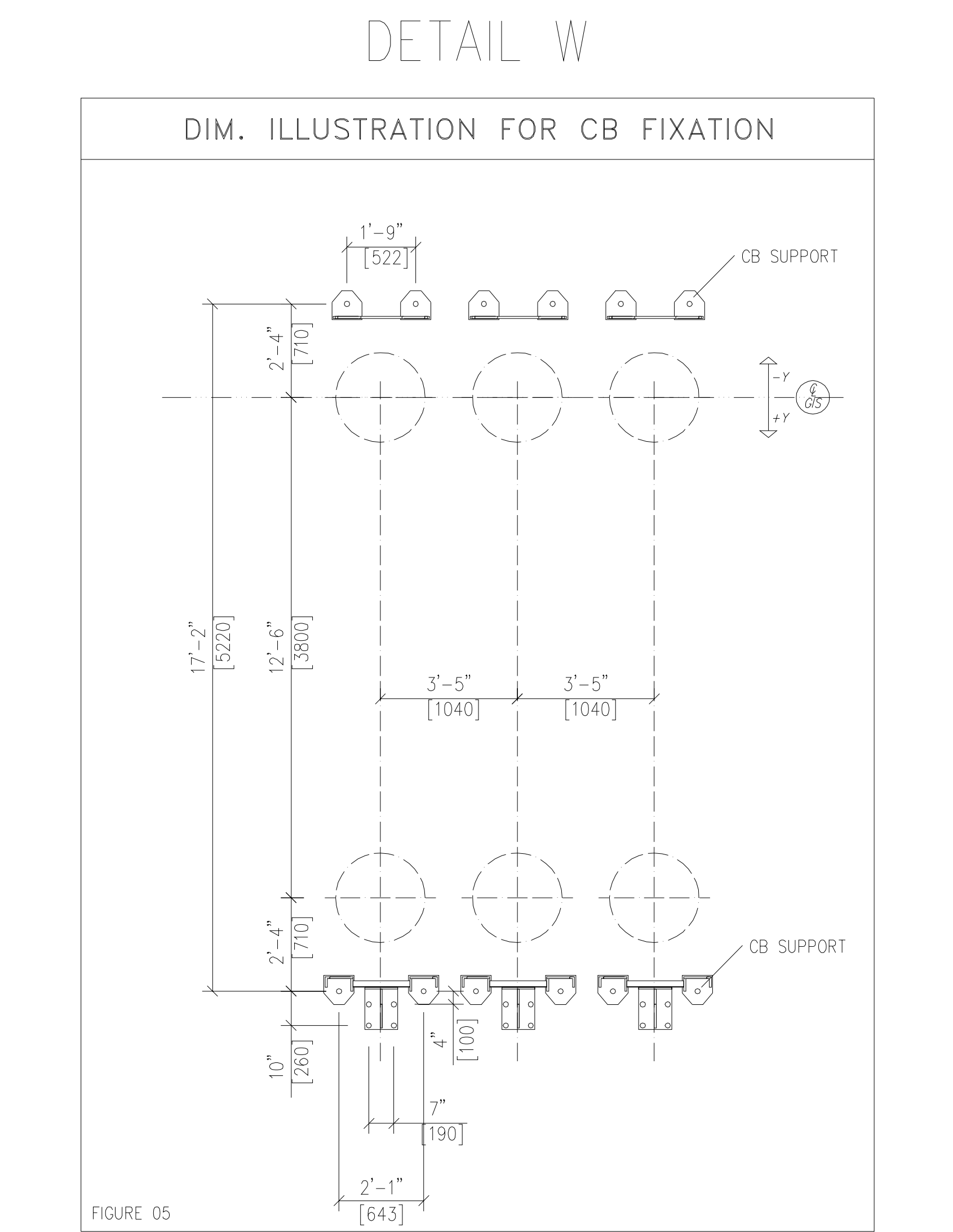
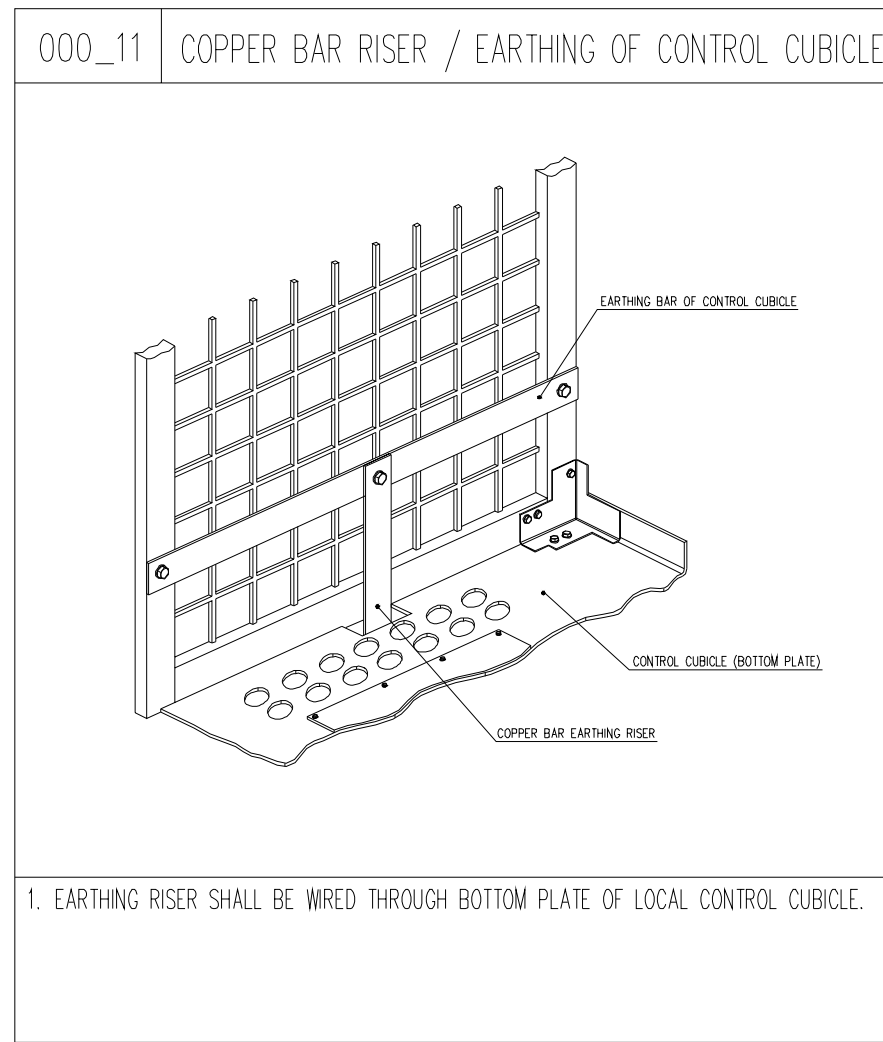
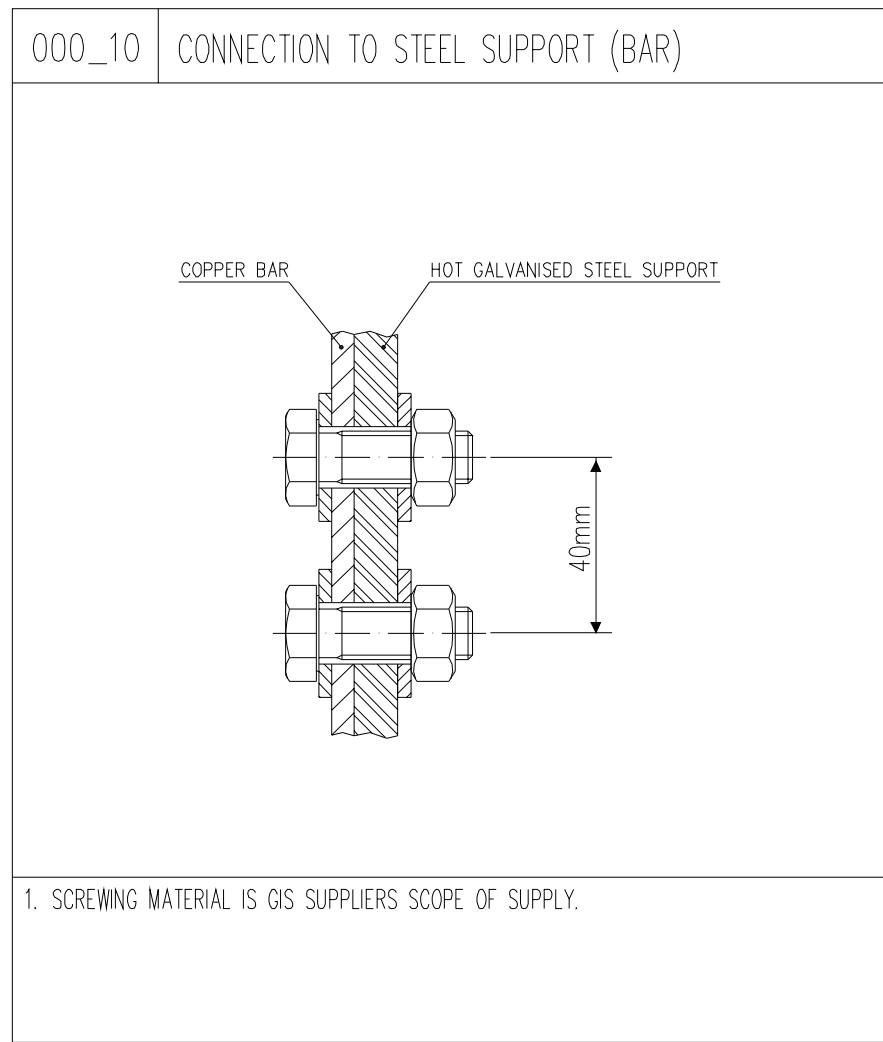
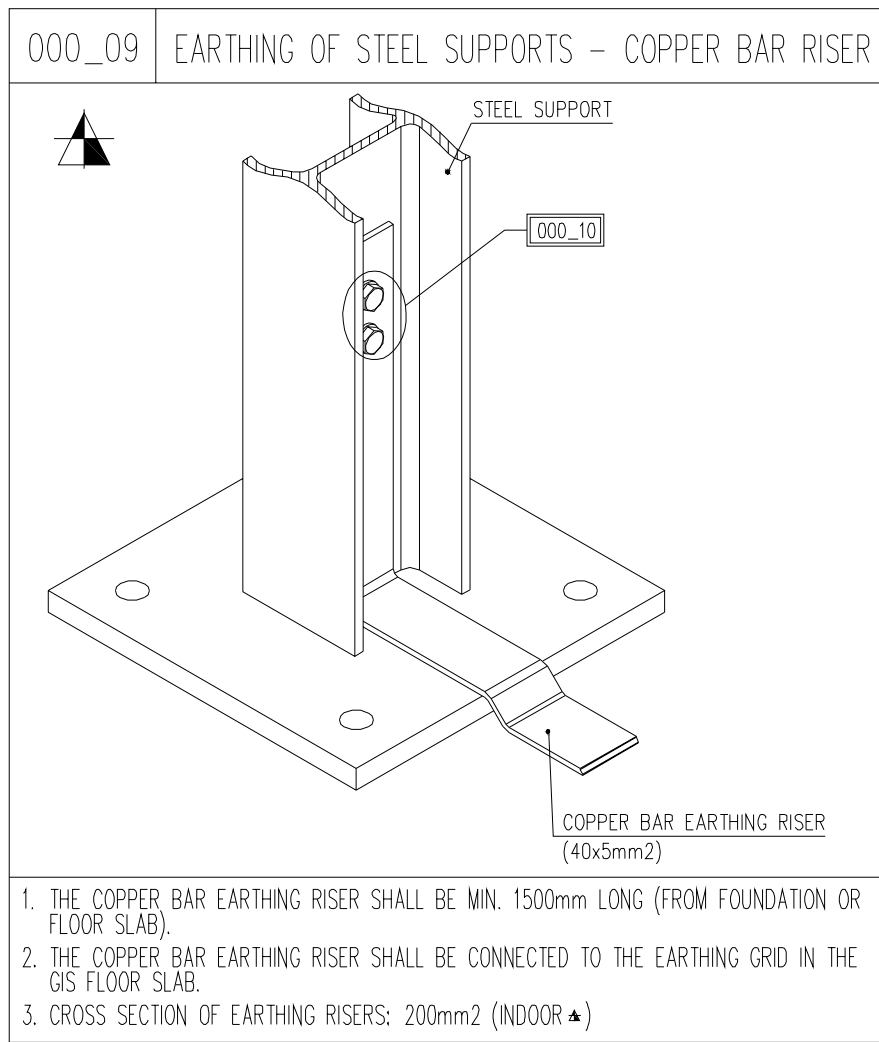
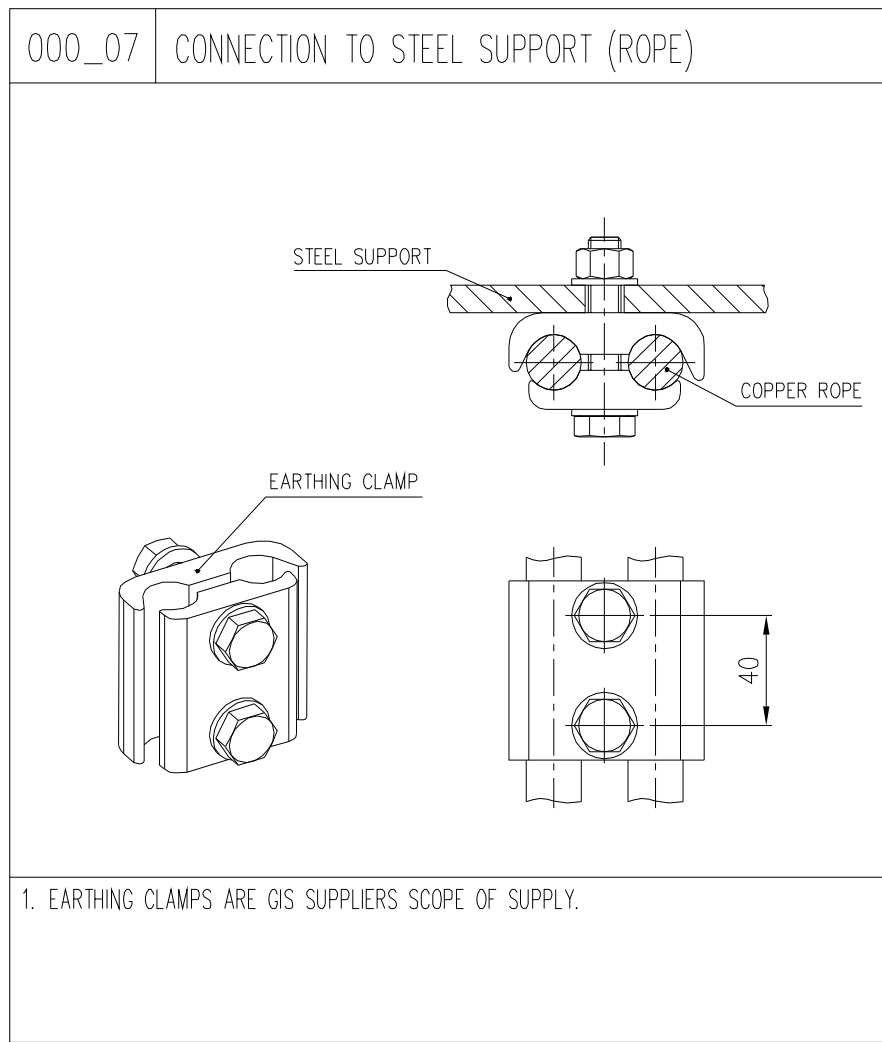
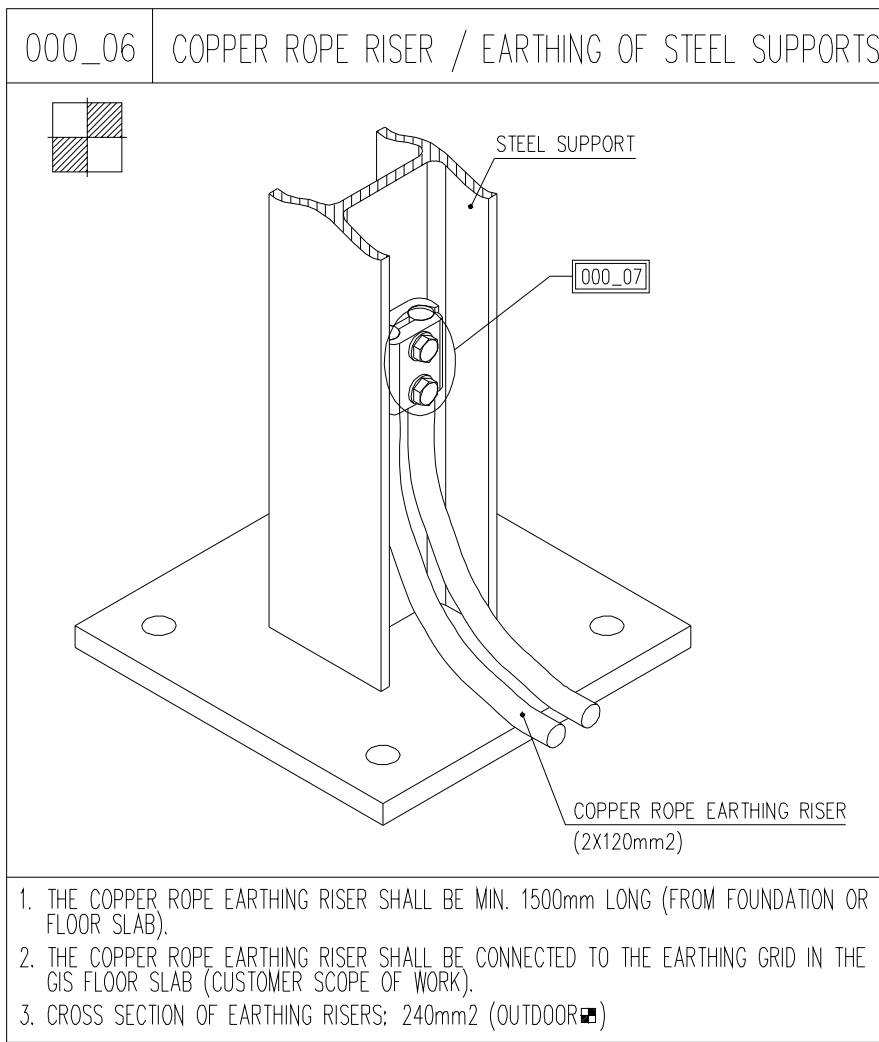
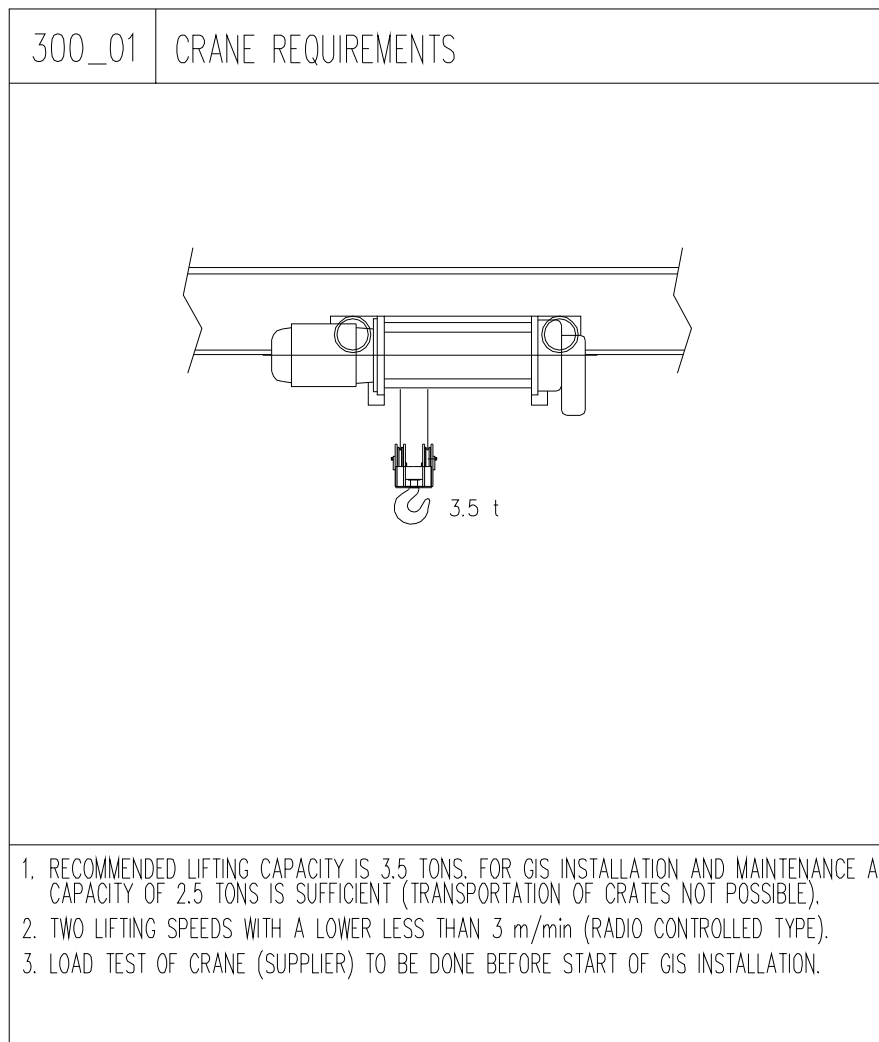
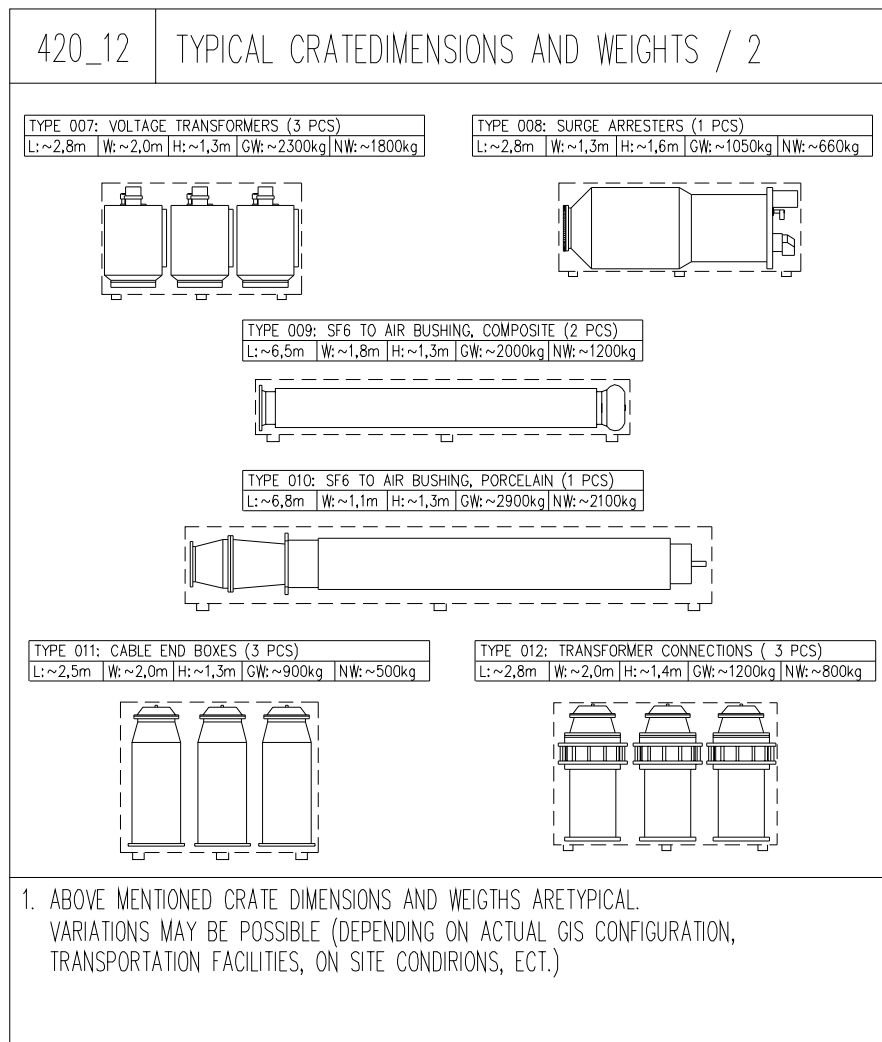
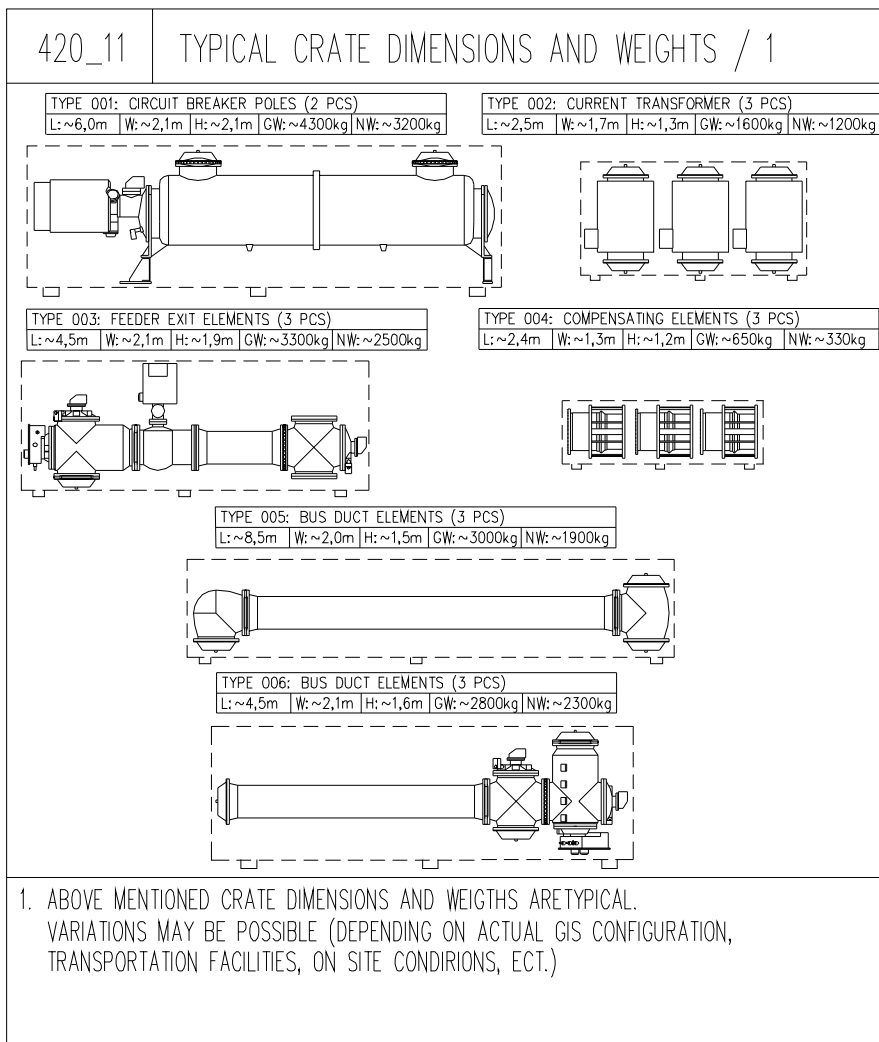
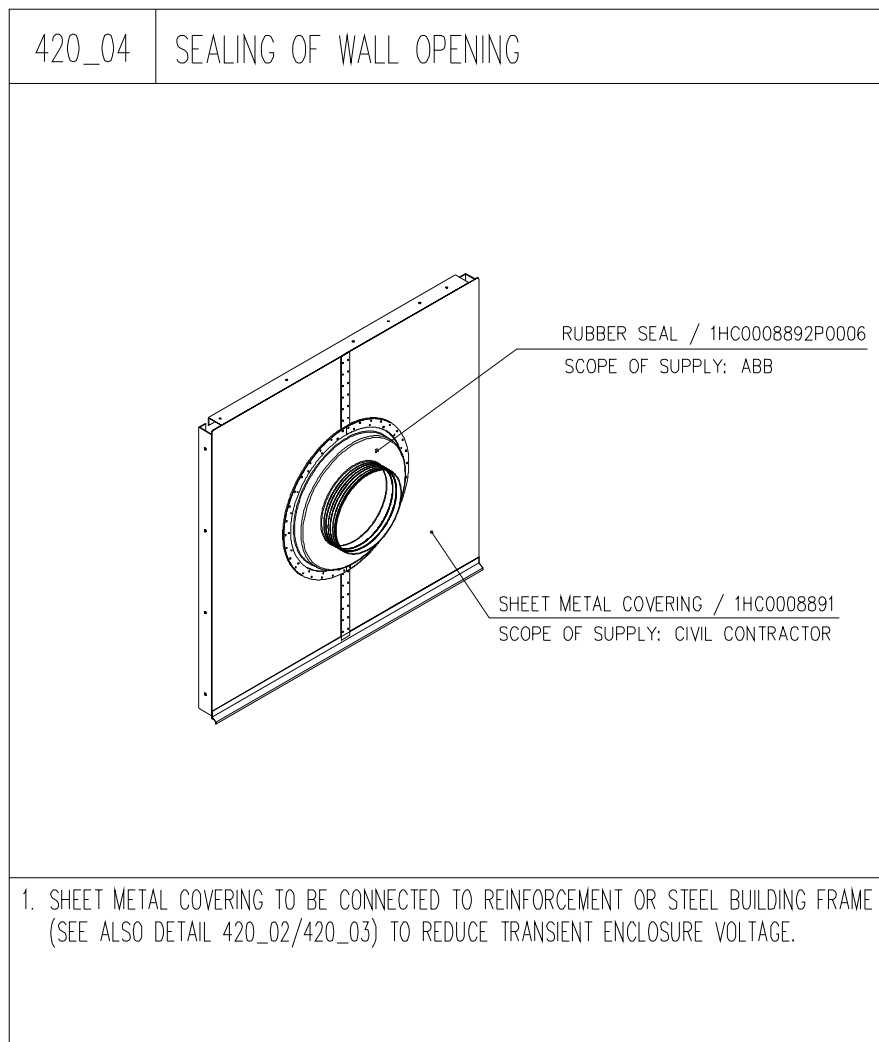
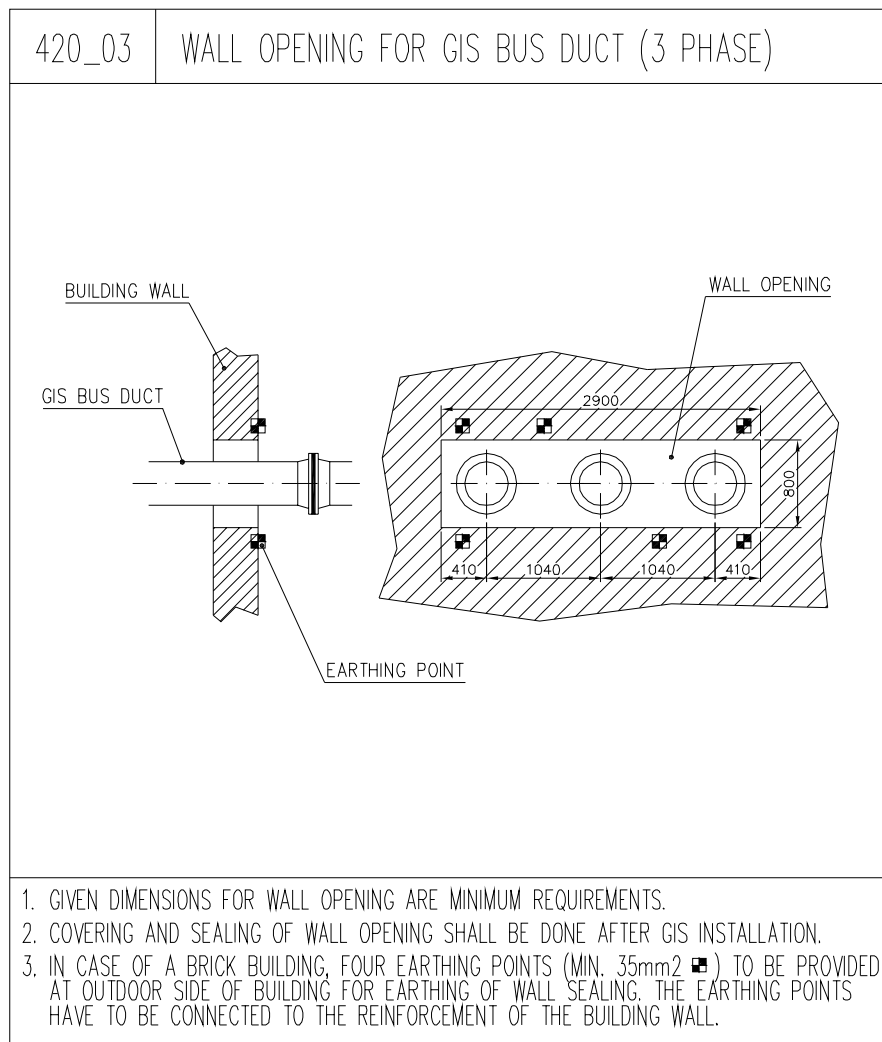
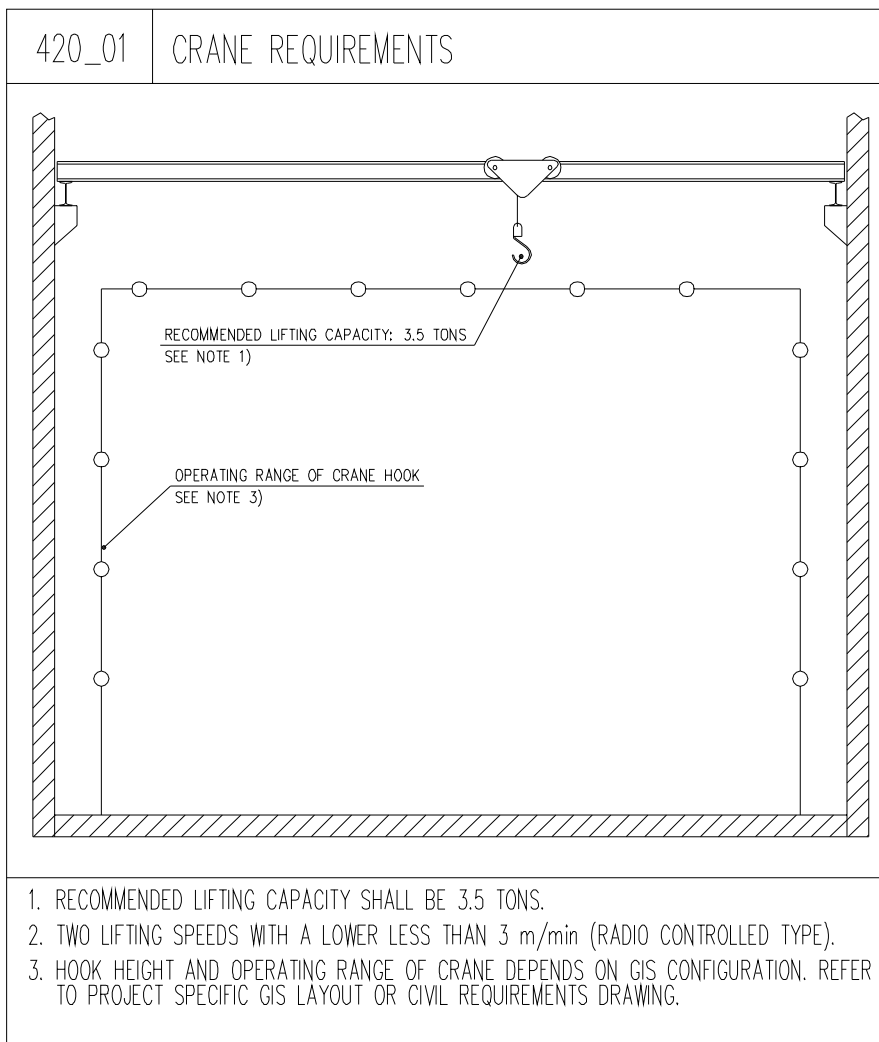
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SINGLE LINE & GAS SCHEMATIC DIAGRAM	1HC0069572
GIS LAYOUT	1HC0069588
SUPPORT LAYOUT	1HC0069592
TABLE OF SF6 GAS VOLUMES	1HC0069608
CABLE INTERFACE	1HC003018
BUSHING	HL/M163843
EARTHING DETAILS	1HC0061882

AE	2009-12-21	CT-13, CT-23, CT-24, CT-53 TURNED, OUTDOOR CABLE PIPES
AD	2009-10-07	MEASUREMENT [FOOT-INCHES], FOUNDATION F1 AND BUILDING UPDATED
AC	2009-09-14	NEW BUILDING DRAWING (WALLS MOVED), GIS EXIT Q35L MOD.
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1HC0069590		
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Approved:	Replaces:	345kV SF6 - SWITCHGEAR ELK-3			
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Released:	Responsible department:	SECTIONS			
2009-07-23 GEISSMANN	PTHS-AEP	Document number:			
Order number:	Revision:	1HC0069590			
10898-B	AE 2009-12-21	No. Sheets: 004			
ABB ABB Switzerland Ltd		Sheet no.: 003			



- CIVIL NOTES
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 - PRIOR TO START OF G/S INSTALLATION, THE FINISHING LAYER AND THE FLOOR SURFACE TO BE SEALED UP WITH A CONCRETE PAINT OR RESIN LAYER. (ALWAYS KEEP A CLEAN AND DUSTFREE ENVIRONMENT)
 - PRIOR TO START OF G/S ON SITE INSTALLATION LIGHTS OF MIN. 200 LUX ON THE FLOOR ARE REQUIRED (DURING G/S INSTALLATION).
 - PRIOR TO START OF G/S INSTALLATION, THE COORDINATE POINTS ARE REQUIRED TO BE COMPLETED BY CIVIL CONTRACTOR OR CONTRACTOR'S REPRESENTATIVE. (SEE FIGURE 000/04)
 - ALL CABLE TRAYS IN BASEMENT ARE CIVIL CONTRACTOR'S SCOPE OF SUPPLY.
 - THE G/S REQUIRES A CLOSE-MESHED EARTHING GRID UNDER THE EQUIPMENT, WHICH IS INTEGRATED INTO THE GENERAL STATION EARTHING SYSTEM. ALL REINFORCING BARS IN FLOOR SLAB SHALL BE ELECTRICALLY CONNECTED TO THE STATION EARTHING SYSTEM.
 - ALL REINFORCING STEEL IN THE G/S FLOOR SLAB SHALL BE GALVANICALLY CONNECTED <300mm TO THE EARTHING SYSTEM.
 - ALL METALLIC PARTS OF THE BUILDING SUCH AS CRANES, DOORS, STEEL SUPPORT STRUCTURES, WALL SEALINGS, ETC., SHALL BE EARTHED.
 - FOR TECHNICAL INFORMATION CONCERNING G/S EARTHING REQUIREMENTS REFER TO DOCUMENT 1HC0011786 (EARTHING OF G/S TYPE ELK).
 - FOR GENERAL EARTHING REQUIREMENTS AND LOCATION OF EARTHING FLAGS SEE 1HC0069590 SHEET 002
 - ALL STEEL SUPPORTS ARE FOR INFORMATION ONLY. FOR SUPPORT DETAILS PLEASE REFER TO DRAWING 1HC0069592
 - DETAILS OF CIVIL WORK REQUIREMENTS SEE DRAWING 1HC0069590 SHEET 004
 - OUTDOOR DENSITY MONITOR CABLES REQUIRE A PVC PIPE OF MIN. DIAMETER 100mm FOR THE CONNECTION BETWEEN OUTDOOR HAND-HOLES AND THE INDOOR CABLE TRENCH



- EARTHING NOTES
- ALL INDOOR SUPPORTS HAVE TO BE EARTHED ACC. TO DETAIL A001/A002.
 - ALL OUTDOOR SUPPORTS HAVE TO BE EARTHED ACC. TO DETAIL A005/A006.
 - ALL CATWALKS HAVE TO BE EARTHED EVERY 10 METERS BUT IN EITHER CASE TWO TIMES (DIAGONALLY) ACC. TO DETAIL A001/A002.
 - ALL LOCAL CONTROL PANELS HAVE TO BE EARTHED ACC. TO DETAIL A011.
 - WALL SEALINGS TO BE EARTHED ACC. TO DETAIL A020.
 - FIXATION OF EARTHING MATERIALS ON G/S FLOOR ACC. TO DETAIL A008.
 - ATTACHMENT OF EARTHING MATERIALS ALONG STEEL SUPPORTS ACC. TO DETAIL A007.
 - NUMBER OF SCREW CONNECTIONS BETWEEN EARTHING MATERIALS ACC. TO DETAIL A009.
 - EXACT LAYING OF EARTHING MATERIAL TO BE DECIDED ON SITE BY CHABB SUPERVISOR.
 - ALL METALLIC CABLE CHANNELS HAVE TO BE CONTINUOUSLY CONNECTED AND EARTHED.
 - COLOR AT G/S FLANGE TO BE REMOVED. (CONTACT AREA BETWEEN G/S FLANGE AND STEEL SUPPORT FLANGE) CONTACT AREA TO BE CLEANED AND GREASED.
 - CONTACT AREAS MUST BE CLEANED WITH BRUSH OR FILE. AFTERWARDS TO BE GREASED WITH CONTACT GREASE ACC. TO INSTRUCTIONS HASV600715.
 - ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
 - THE G/S REQUIRES A CLOSE-MESHED EARTHING GRID UNDER THE EQUIPMENT, WHICH IS INTEGRATED INTO THE GENERAL STATION EARTHING SYSTEM. ALL REINFORCING BARS IN FLOOR SLAB SHALL BE ELECTRICALLY CONNECTED TO THE STATION EARTHING SYSTEM.
 - ALL REINFORCING STEEL IN THE G/S FLOOR SLAB SHALL BE GALVANICALLY CONNECTED <300mm TO THE EARTHING SYSTEM.
 - ALL METALLIC PARTS OF THE BUILDING SUCH AS CRANES, DOORS, STEEL SUPPORT STRUCTURES, WALL SEALINGS, ETC., SHALL BE EARTHED.
 - FOR TECHNICAL INFORMATION CONCERNING G/S EARTHING REQUIREMENTS REFER TO DOCUMENT 1HC0011786 (EARTHING OF G/S TYPE ELK).
 - ALL STEEL SUPPORTS ARE FOR INFORMATION ONLY. FOR SUPPORT DETAILS PLEASE REFER TO DRAWING 1HC0069591
 - DETAILS OF EARTHING REQUIREMENTS SEE DRAWING 1HC0069590 SHEET 004

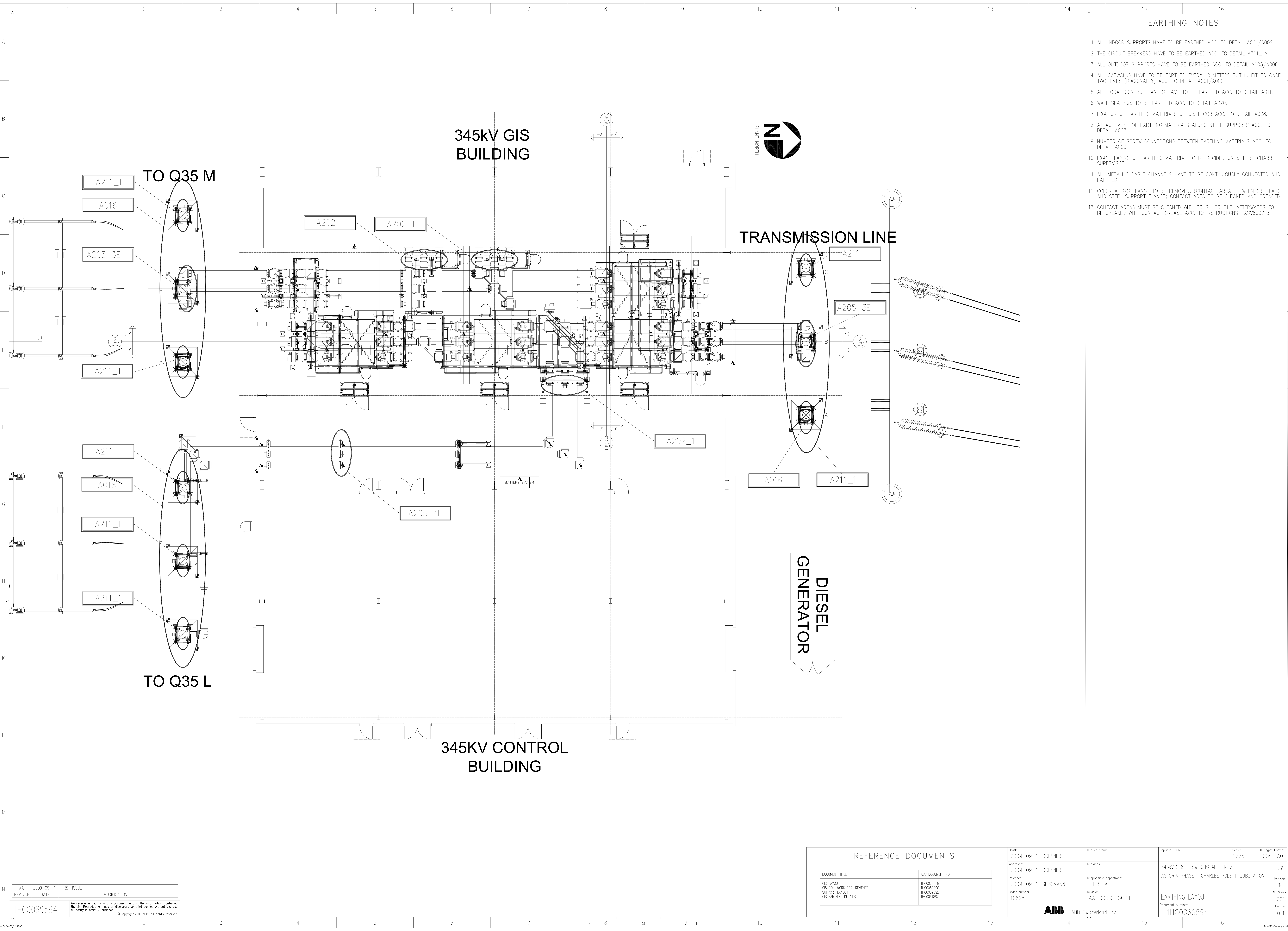
REFERENCE DOCUMENTS

DOCUMENT TITLE:	ABB DOCUMENT NO.:
SINGLE LINE & GAS SCHEMATIC DIAGRAM	1HC0069572
G/S LAYOUT	1HC0069588
SUPPORT LAYOUT	1HC0069592
TABLE OF STG GAS VOLUMES	1HC0069608
CABLE INTERFACE	1HC003018
BUSING	1H.M16.3843
EARTHING DETAILS	1HC0061882

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1HC0069590

ABB Switzerland Ltd



EARTHING NOTES

1. ALL INDOOR SUPPORTS HAVE TO BE EARTHED ACC. TO DETAIL A001/A002.
2. THE CIRCUIT BREAKERS HAVE TO BE EARTHED ACC. TO DETAIL A301_1A.
3. ALL OUTDOOR SUPPORTS HAVE TO BE EARTHED ACC. TO DETAIL A005/A006.
4. ALL CATWALKS HAVE TO BE EARTHED EVERY 10 METERS BUT IN EITHER CASE TWO TIMES (DIAGONALLY) ACC. TO DETAIL A001/A002.
5. ALL LOCAL CONTROL PANELS HAVE TO BE EARTHED ACC. TO DETAIL A011.
6. WALL SEALINGS TO BE EARTHED ACC. TO DETAIL A020.
7. FIXATION OF EARTHING MATERIALS ON GIS FLOOR ACC. TO DETAIL A008.
8. ATTACHEMENT OF EARTHING MATERIALS ALONG STEEL SUPPORTS ACC. TO DETAIL A007.
9. NUMBER OF SCREW CONNECTIONS BETWEEN EARTHING MATERIALS ACC. TO DETAIL A009.
10. EXACT LAYING OF EARTHING MATERIAL TO BE DECIDED ON SITE BY CHABB SUPERVISOR.
11. ALL METALLIC CABLE CHANNELS HAVE TO BE CONTINUOUSLY CONNECTED AND EARTHED.
12. COLOR AT GIS FLANGE TO BE REMOVED. (CONTACT AREA BETWEEN GIS FLANGE AND STEEL SUPPORT FLANGE) CONTACT AREA TO BE CLEANED AND GREASED.
13. CONTACT AREAS MUST BE CLEANED WITH BRUSH OR FILE. AFTERWARDS TO BE GREASED WITH CONTACT GREASE ACC. TO INSTRUCTIONS HASV600715.

REFERENCE DOCUMENTS

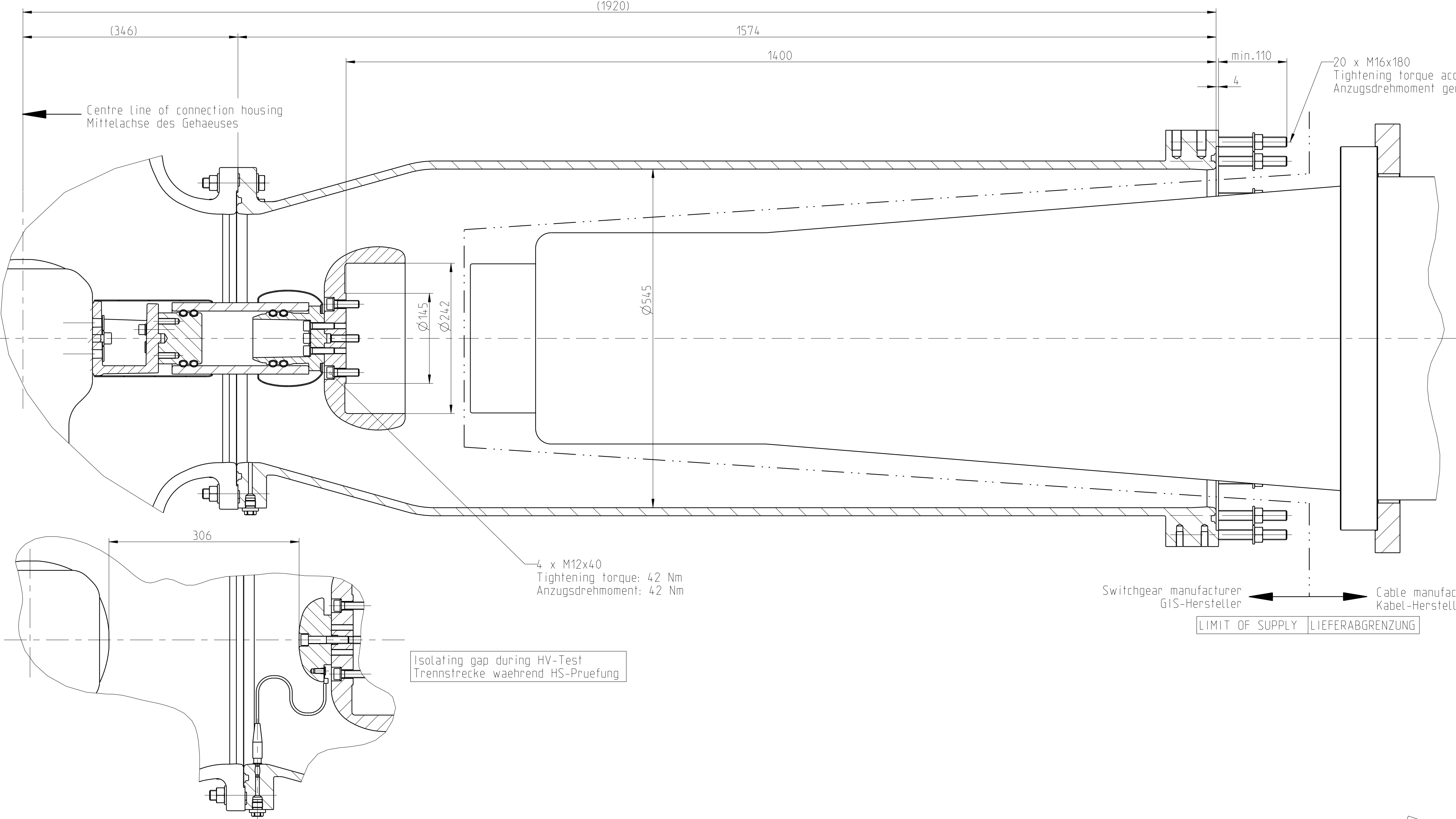
DOCUMENT TITLE:	ABB DOCUMENT NO.:
GIS LAYOUT	1HC0069594
GIS CIVIL WORK REQUIREMENTS	1HC0069590
SUPPORT LAYOUT	1HC0069592
GIS EARTHING DETAILS	1HC0061862

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Order number: 10898-B	Revision: AA 2009-09-11	EARTHING LAYOUT			
		Document number: 1HC0069594			

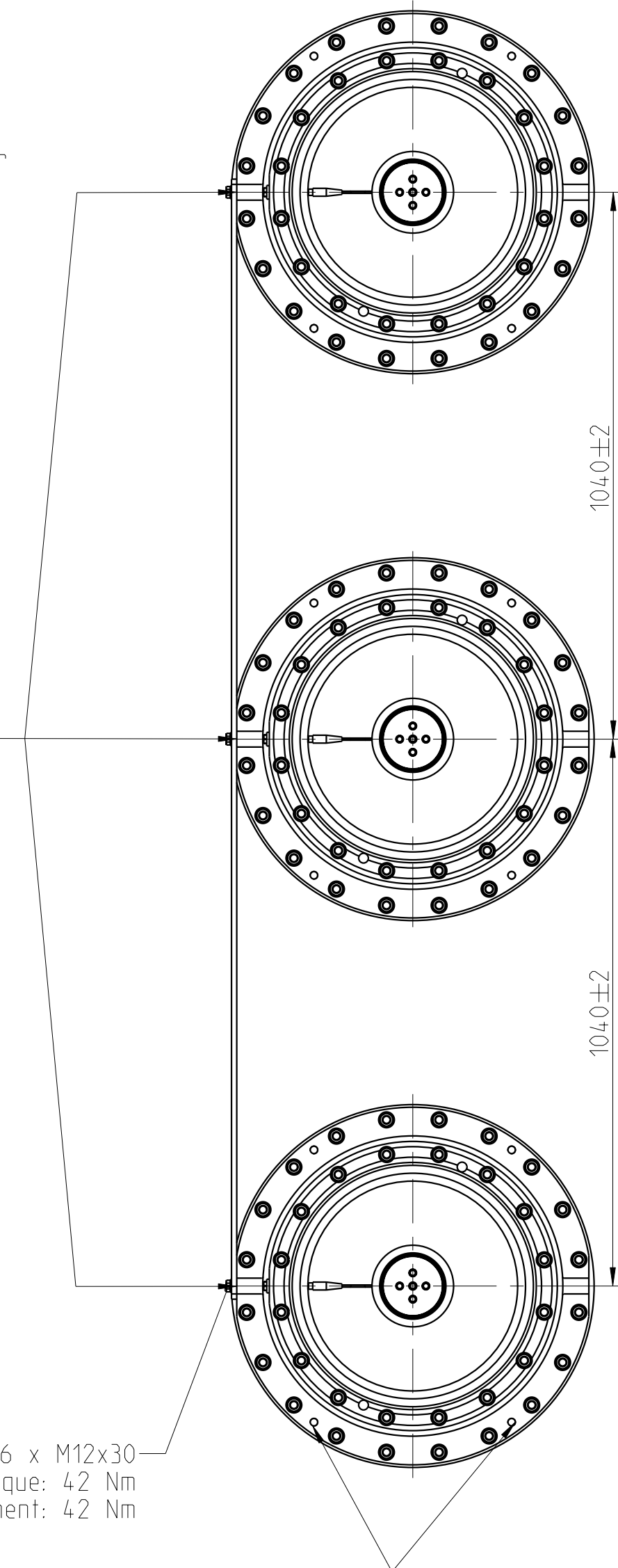
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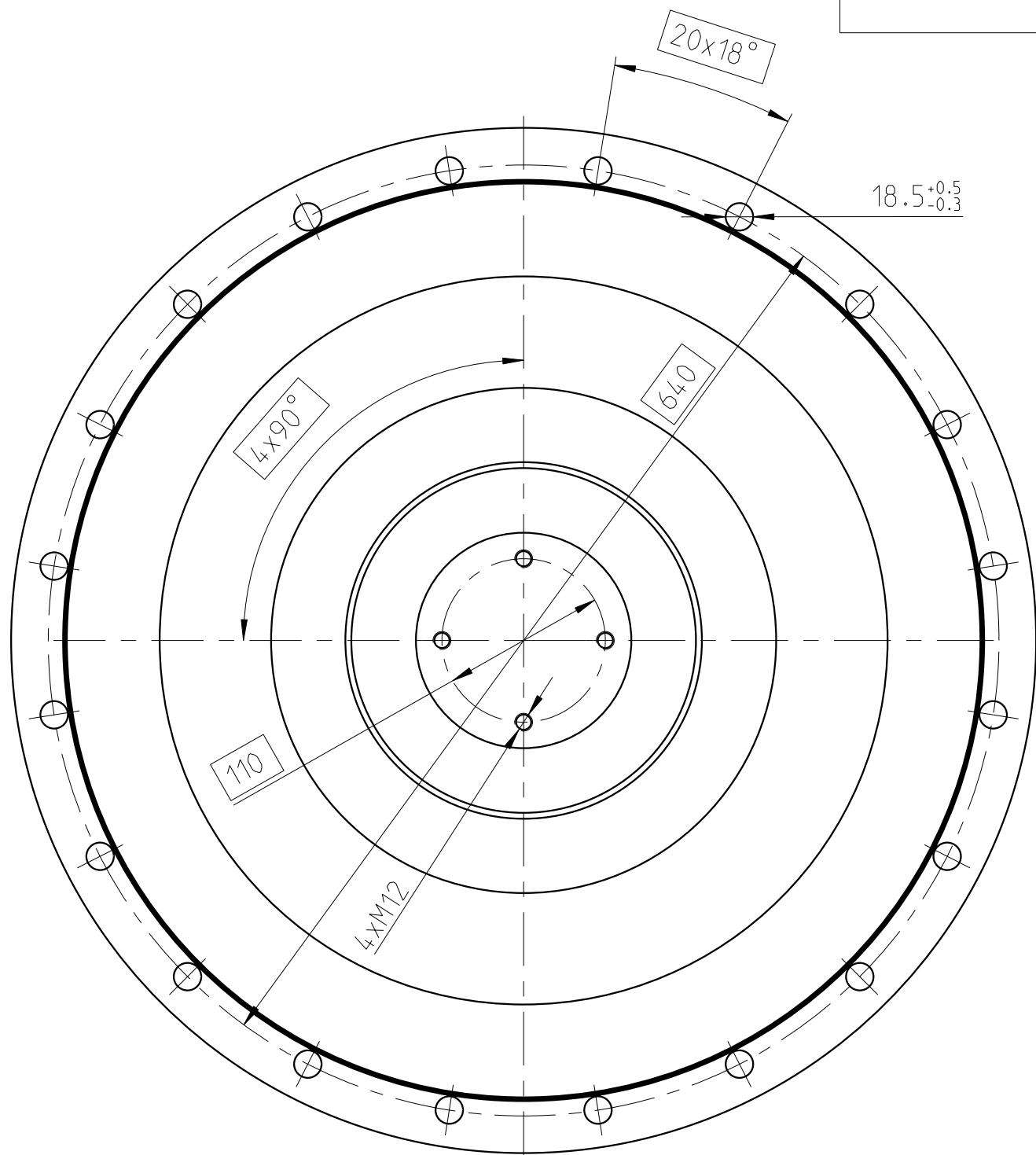
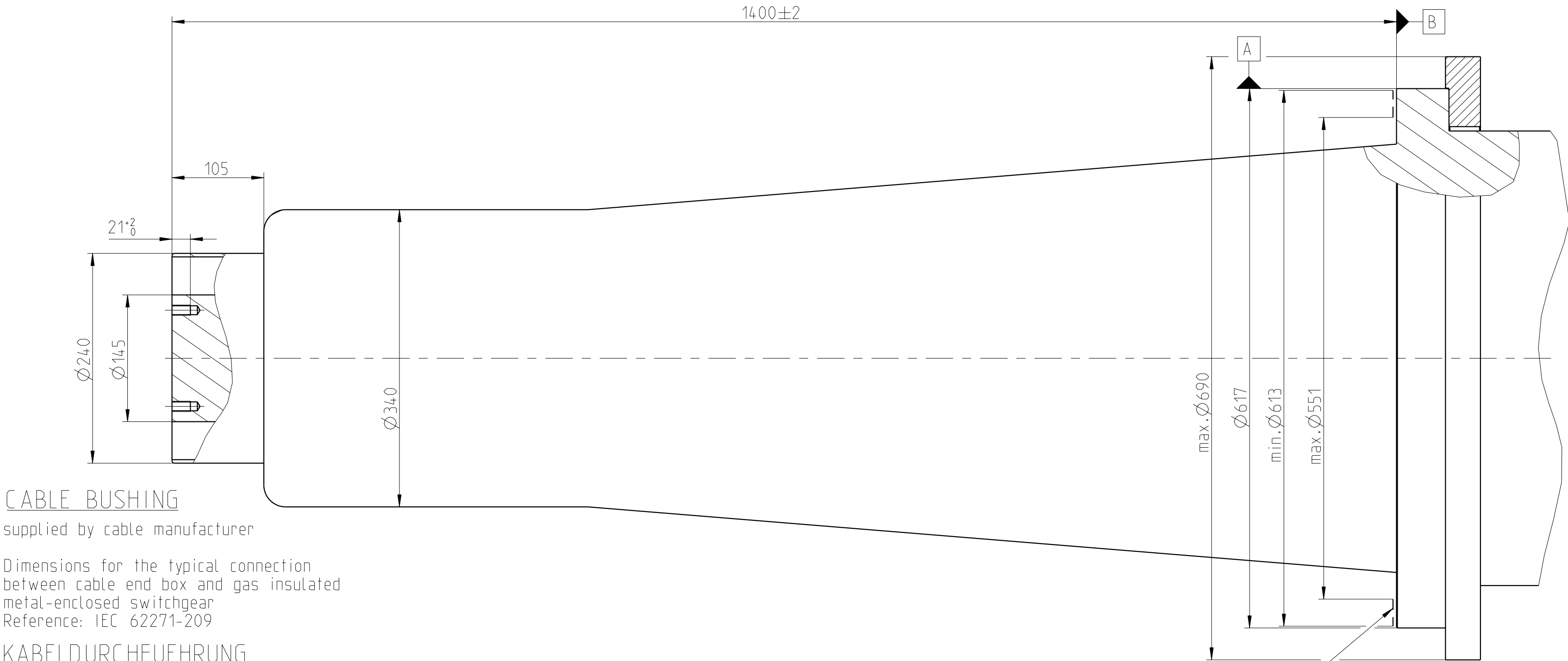
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Starpoint earthing for 3-phase cable connection
Sternpunkt Erdung fuer 3-phasigen Kabelanschluss



4 thread holes M16 for earthing of the cable screen or mounting of voltage arrestors
Contact surface: paint removed, cleaned and greased
4 Gewinde M16 vorgesehen fuer Anschluss von Kabelschirmerdung oder von nicht linearen Widerstaenden (Ueberspannungsableitern)
Kontaktflaeche: Farbschicht entfernen, reinigen und fetten



Notes for the cable manufacturer

- The SF6-side of the bushing has to be protected against absorption of moisture during fabrication, manufacture and storage until assembling into the gas-insulated, metal-enclosed switchgear.
- Gas pressure at 20°C
Filling pressure: 530 kPa (absolute)
Nominal insulation pressure (Pme): 450 kPa (absolute)
Rated voltage: 420 kV
- All dimensions are in millimeters.

Hinweis fuer Kabel-Hersteller

- Die SF6-Seite des Kabelendverschlusses ist waehrend der Fabrikation, Lagerung und Konfektionierung bis hin zur Montage in das Gehaeuse der gasisolierten, metallgekapseten Schaltanlage gegen Feuchtigkeitsaufnahme zu schuetzen.
- Gasdruecke bei 20°C:
- Fuelldruck: 530 kPa (absolut)
- Nennisolierungsdruck (Pme): 450 kPa (absolut)
Nennspannung: 420 kV
- Alle Masse in mm

CABLE BUSHING
supplied by cable manufacturer

Dimensions for the typical connection
between cable end box and gas insulated
metal-enclosed switchgear
Reference: IEC 62271-209

KABELDURCHFUEHRUNG

geliefert vom Kabel-Hersteller

Masse fuer die typische Verbindung
zwischen Kabeldurchfuehrung und Schaltanlage
Referenz: IEC 62271-209

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