RELIABILITY & H.V. EQUIPMENT DEPARTMENT

Main Technical Requirements

For 170 kV

DISCONNECTORS

AUGUST 2025

	Name	Signature	Date
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The purchase of equipment, its installation, or its integration into the electricity sector in Israel shall be permitted solely upon receipt of prior written approval from NOGA-ISO (for private customers, within the framework of the technical coordination process, and, with respect to the Israel Electric Corporation - written approval), confirming that the System Requirements Document - as published and updated from time to time on NOGA's-ISO official website - has been fully complied with by the purchaser, and further subject to the submission, in full, of all required technical materials, information, and accompanying documents, as detailed in the System Requirements Document, and upon completion of a formal, full, and final examination and approval, to the sole satisfaction of NOGA-ISO.

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Appendices

SYSTEM REQUIREMENTS FOR 170 kV DISCONNECTORS

1 GENERAL

1.1 Applicable Standards

IEC 62271-1/2017- HV switchgear – Common specification.

IEC 62271-102/2018-Alternating current disconnectors and earthing switches

IEC TR 62271-207/2012 - High-voltage switchgear and control gear: Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV.

IEC TR 62271-300/2006 - High-voltage switchgear and control gear - Part 300: Seismic qualification of alternating current circuit-breakers.

IEC 62271-305/2009-Capacitive current switching capacity of air-insulated disconnectors for rated voltage above 52 kV.

IEC 60721 -3-4/2019- Classification of environmental conditions.

IEC 60273/1990 – Characteristic of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V

IEC 60529/2013 - Degrees of protection provided by enclosures (IP Code).

IEC 62262/2021 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).

IEC 60168/2001 – Tests on indoor and outdoor post insulators of ceramic material with nominal voltage above greater than 1000 V.

IEC TS 60815-1/2008 - Selection and dimensioning of high-voltage insulators intended for use in polluted conditions. Part 1: Definitions, information of general principles.

IEC 60815-2/2008 - Selection and dimensioning of high-voltage insulators intended for use in polluted conditions. Part 2: Ceramic and glass insulators for AC systems.

IEEE 693/2018 - Seismic Design of Substations

ISO 9001/2015 - Quality management systems — Requirements

ISO/IEC 17025/2017- General requirements for the competence of testing and calibration laboratories

ISO 14001/2015- Environmental management systems

ISO 2409 – Paints and varnishes - Crosscut test

ISO 9223 - Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation

1.2 Definitions

All definitions are as specified in applicable standards

2 SERVICE CONDITIONS

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
The design shall be according to the following		
2.1.	Permissible ambient air temperature:	
2.1.1.	Maximum	+50°C
2.1.2.	Minimum	-5°C
2.1.3.	Average, measured over a period of 24 hours	+35°C
2.2.	Permissible humidity:	
2.2.1.	Low relative / absolute humidity	4% / 0.9 g/m^3
2.2.2.	High relative / absolute humidity	100% / 27 g/m^3
2.3.	Rain intensity	15 mm/min
2.4.	No-rain, dry period (months).....	7
2.5.	Site Pollution Severity (SPS, for dimensioning purposes)	Class E, IEC TS 60815-1 – 2008, Clause 8.3
2.6.	Site Pollution Characterization	High Pollution/High NSDD site
2.7.	Type of Pollution: Desert-Coastal, high inert content	mixed A+B, A - prevalent IEC TS 60815-1 - 2008
2.8.	Prevalent Pollution Type:	Saharan Blowing Dust
2.9.	Low / High air pressure	84 kPa / 106 kPa
2.10.	Heating effects of solar radiation W/m^2	1120 W/m^2
2.11.	Maximum wind velocity measured 10 m above ground (bare area) at 3 sec duration	4Z5 (50 m/sec)
2.12.	Environmental parameters according to IEC 60721-3-4/2019, par.5.2	4K26
2.13.	Chemically active substances according to	ISO 9223 (C5)
2.14.	Mechanically active substances:	IEC 60721-3-4/2019, ed.3, Table 4, CLASS 4S13
2.14.1	Sand	18 mg/m^3
2.14.2	Dust (suspension)	18 mg/m^3
2.14.3	Dust particles size range, (μm) …	1-100
2.15.	Seismicity of site:	
2.15.1	Peak horizontal (x, y directions) ground acceleration with an 85% probability not to be exceeded over a 50 year period	0.5g
2.16.	Permissible altitude over the sea level	1000 m
2.17.	The equipment shall be vermin proof	

3 Technical Proposal

The technical proposal must be filled in entirely and signed by the manufacturer plant representatives.

The Manufacturer plant Company should also sign the proposal.

The Bidder and the Manufacturer are required to fill in and to sign the attached declaration concerning requirement for technical English fluent speaking engineer:

To: NOGA - Israel Independent System Operator

SUBJECT: Declaration for language communication conformance

We the undersigned below, _____ undertake to provide at least one technical English or fluent speaking engineer, during all the entire 170 kV disconnectors and earthing switches life duration, on each of the following teams, involved in the under discussion of 170 kV disconnectors and earthing switches project:

Design, supervising, operation, maintenance, after sale services and Subcontractors.

	Bidder	Manufacturer
Company name:	_____	_____
Name of signing officer	_____	_____
Title of signing officer	_____	_____
Signature:	_____	_____
Date:	_____	_____

Stamp:

4 RATINGS

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
6.1	Rated voltage U_r	170 kV
6.1.1	Rated lightning impulse withstand voltage:	
6.1.1.1	Phase to earth and between poles	750 kV peak
6.1.1.2	Across isolating distance	860 kV peak
6.1.2	Rated 1 minute power frequency withstand voltage in wet conditions:	
6.1.2.1	Phase to earth and between poles	325 kV r.m.s.
6.1.2.2	Across isolating distance	375 kV r.m.s.
6.1.2.3	Rated frequency f_r	50 Hz
6.1.3	Rated continuous current I_r at maximum ambient temperature 50°C shall be according to relevant Single Line Diagrams approved by Israel Independent System operator (taking into account the temperature rises in IEC 62271-1 Table 14 reduced by 10°C):	
6.1.3.1	Rated short-time withstand current for disconnector and earthing switches I_k	50 kA r.m.s.
6.1.3.2	Rated duration of short circuit t_k	1 sec
6.1.3.3	Rated peak withstands current for disconnector and earthing switches I_p kA peak	125 kA
6.1.3.4	Rated bus transfer current	1600 A
6.1.3.5	Rated bus transfer voltage	100 V r.m.s.
6.1.4	Classification of earthing switches for induced current switching:	
6.1.4.1	Earthing switch to be used in circuits having relatively short sections of line or low coupling to adjacent energized circuits	Class A
6.1.4.2	Earthing switch to be used in circuits having relatively long sections of lines or high coupling to adjacent energized circuits	Class B
6.1.4.3	Classification of disconnectors for mechanical endurance	M2
6.1.4.4	Classification of earthing switches for mechanical endurance	M1
6.1.4.5	Classification of earthing switches for electrical endurance	E1

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
6.1.5	Rated mechanical terminal load:	
6.1.5.1	Rated static mechanical terminal load	2700 N
6.1.5.2	Rated dynamic mechanical terminal load	6700 N

5 DESIGN

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
7.1	**General**	
7.1.1	The disconnectors and their accessories shall be constructed as to comply with the ratings and to meet all test requirements laid down herein with respect to insulation strength, current arraying capacity and mechanical operation	
7.1.2	Disconnectors and earthing switches shall be such that they cannot come out of their open or closed position by rated static stresses (gravity, wind, pressure, vibrations, etc.) reasonable shocks or accidental touching of the connecting rods of the operation mechanism	
7.1.3	The rated peak withstands current, and the rated short-time withstand current, carried by the disconnectors or earthing switches in closed position shall not cause separation of contacts, contact welding, material mechanical damage and a temperature rise likely to damage the insulation	
7.1.4	The auxiliary and control equipment shall be designed acc. to	IEC 62271-102 subcl. 6.4 and 6.104
7.1.5	The graphical symbols used in drawings and diagrams shall be according to	IEC 60617
7.2	**Main contacts and blades**	
7.2.1	Contacts shall be of the high-pressure contact type, and shall open and close with sufficient positive action to remove any film or oxide but shall not cause galling of the contact surface	
7.2.2	The design of disconnectors shall take into account that higher voltages than rated may appear between their contacts during synchronization	

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
7.2.3	The contact system shall be provided with adjusting facilities for current path length by means of which an excessive pull-on terminal can be compensated	
7.2.4	Disconnector's blades shall be provided with appropriate rings to prevent corona discharges	
7.2.5	Full contact and current carrying capacity shall be secured during over travel and under travel of the operating mechanism	
7.2.6	All contact surfaces shall be silver plated with minimum thickness of	20 µm
7.2.7	The main system contact shall be maintenance free	
7.2.8	Material of blades of centre-break disconnector shall be	aluminum
7.3	**Terminals**	
7.3.1	Disconnectors should be so designed that no dangerous leakage currents can pass from the terminals of one side to any of the terminals of the other side of the disconnector	
7.4	**Earthing Terminals**	
7.4.1	Earthing terminal for disconnectors shall be according to	IEC 62271-102 subcl. 6.3
7.4.2	Each disconnector frame shall be equipped with	two terminals for earthing
7.4.3	Each earthing terminal shall be marked with appropriate graphical symbols acc. to	IEC 60417
7.4.4	The earthing terminals shall be designed to withstand for 1 sec a short-time current of	50 kA
7.5	**Insulators**	

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
7.5.1	***Porcelain Insulators***	
7.5.1.1	Porcelain insulators shall be designed according to	IEC 60273 type C figure 4
7.5.1.2	Mechanical strength class according to	IEC 60273 clause 4
7.5.1.3	Insulators shall be suitable for installations on sites with site pollution severity (SPS) class E as defined by See also Chapter 2 above.	IEC 60815-1/2008
7.5.1.4	Withstand Pollution Stress ESDD, mg/cm2 NSDD, mg/cm2 Annual number of dangerous wetting events	 0.45 2.0 200
7.5.1.5	The insulator shall be of alternate sheds type	See Appendix 1.
7.5.1.6	Voltage test values for insulator:	
7.5.1.6.1	Dry lightning impulse withstand voltage – 1.2/50 μs wave according to	IEC 60168 subcl. 4.5: 750 kV peak
7.5.1.6.2	Power frequency withstands voltage, 1 min wet conditions according	IEC 60168 subcl. 4.8: 325 kV r.m.s.
7.5.1.7	Minimum Reference unified specific creepage distance (RUSCD)[1]	53.7 mm/$kV_{phase\_to\_earth}$
7.5.1.8	Minimum creepage distance phase to ground not less than	5270 mm
7.5.1.9	Corrected unified specific creepage distance USCD for insulator diameter (K_{ad}):	
7.5.1.9.1	Arcing distance not less than	1500 mm
7.5.1.9.2	Failing load-bending (F) not less than	10000 N

[1] The required value is for insulator with average diameter Da < 300 mm

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
7.5.1.10	The insulators shall be subject to the tests specified in IEC 60168	IEC 60168
7.5.1.11	Type, sample and routine test reports shall be supplied for offered insulators	
7.6	**Stresses on mounted disconnectors**	
7.6.1	Permissible values of loading for terminals connected to other equipment by rigid or flexible conductors:	
7.6.1.1	Static terminal load (sum of all loads occurring simultaneously in service: conductor pull, conductor weight and wind, short-circuit excepted) in any direction in space not less than	2700 N
7.6.1.2	Testing load for 60 sec, applied to the midpoint of the terminal perpendicularly to the insulator axis	4700 N
7.6.1.3	Short-time load (sum of all loads occurring simultaneously in case of short-circuit) in any direction in space not less than	6700 N
7.6.2	Dynamic seismic withstand capability (simultaneous earthquake acceleration applied at the base of the support disconnector):	Moderate level
7.6.2.1	Horizontal	0.5 g
7.6.2.2	Testing methods acc. to	IEEE 693-2018
7.7	**Accessories and fittings**	
7.7.1	Each disconnector and its operating mechanism shall be complete with all necessary shafts, cranks, links, bearings and fittings required for operation	
7.8	**Motor operating mechanism**	

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
7.8.1	The disconnector and earthing switches shall have individual electrical operating mechanism	
7.8.2	The motor drive cabinet will include the motor drive, position indicator device, auxiliary switches, local/remote selector switch, command push buttons for local opening and closing, heating elements, motor relays, interlocking relays, etc.	
7.8.3	The three phases of each disconnector or earthing switch shall be operated simultaneously	
7.8.4	Operating mechanism shall be designed to absorb any shock incident to the operation of disconnector and earthing switch and to ensure a smooth, quiet and continuous transmission of motion to main contacts	
7.8.5	The design shall be such that minimum energy is required for operation and one man shall be able to operate the isolators without undue effort	
7.8.6	Crank(s) for emergency manual operation of disconnector main blades and earthing switches shall be provided	
7.8.7	The connection of hand crank to operating mechanism shall ensure safe interruption of the central energy to the operating mechanism	
7.8.8	Maximum force required for manual operation shall be less than	120 N
7.8.9	Linkage system shall have the following properties:	
7.8.9.1	Easily adjustable with possibility of reliable fixing of set position	
7.8.9.2	Simple readjustment of previously set and fixed position	

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
7.8.9.3	Linkage system shall be drilled to accurate fit so as to maintain the minimum amount of slack and lost motion in the entire mechanism	
7.8.9.4	Linkage system parts shall be manufactured so as to withstand all mechanical stresses appearing in normal operation	
7.8.10	Motor drive mechanism, auxiliary switches, auxiliary contactors and other auxiliary equipment shall be accommodated in a vermin proof cabinet having a degree of protection	IP 54
7.8.11	The degree of protection of the above cabinet against mechanical impact shall be	IK 07
7.8.12	The motor drive shall be protected with a thermal-magnetic type overload protection	
7.8.13	Rating of motor drive:	
7.8.13.1	Rated & control voltage – system standard, other values pending NOGA's permission.	220 V DC.
7.8.14	Heaters shall be provided in each motor drive cabinet to prevent condensation:	
7.8.14.1	Rated voltage of heater	230 V AC
7.8.15	Locking devices and interlocks:	
7.8.15.1	Locking devices shall be designed according to	IEC 62271-102 subcl. 6.12
7.8.15.2	Disconnectors and earthing switches shall have provision for locking mechanically and electrically, in both the open and closed positions	
7.8.15.3	When the disconnector is locked in either the open or closed position, the external influence of wind, short circuit or other cause shall not bring it out of this position	

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
7.8.15.4	Disconnector and associated earthing switches shall be electrically and mechanically interlocked to prevent either of them closing unless the other is open	
7.8.15.5	The mechanical interlock shall be independent and additional to the electrical interlock	
7.8.15.6	Disconnector blades and earthing switches shall each have their own separate electrical and mechanical interlocking devices	
7.8.15.7	In case of loss of auxiliary DC voltage for interlocking purposes, the manual operation of the disconnector shall be avoided	
7.8.15.8	Remote control switch, push buttons for clothing and tripping shall not be installed in the disconnector's local cubicle	Appendix 3
7.9	**Earthing switches**	
7.9.1	Design of the Centre Break Disconnector with one set of earthing switches should permit the addition of a set of earthing switches in the future on the other side	
7.10	**Spare parts**	
7.10.1	Spare parts for disconnectors and earthing switches shall be available for the period of life duration of disconnectors	

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
8	**Nameplates**	
8.1	Each disconnector, earthing switch and its operating device shall be provided with a weather and corrosion-proof nameplate, made of suitable material, including the mandatory markings according to (see example in Appendix 2)	IEC 62271-102
9	**Tests**	
9.1	**Type tests**	
9.1.1	***General***	
9.1.1.1	Type tests shall be performed on disconnector; linkage system and operating mechanism of the same design as will be provided by the contractor	
9.1.1.2	Type test shall be performed together on the disconnector, linkage system and operating mechanism as a single unit	
9.1.1.3	Type tests reports of offered type of disconnectors and insulators shall be performed by a laboratory accredited to the last applicable accreditation requirements of ***ISO/IEC 17025*** by an Accreditation body which is a member of ILACMRA (e.g. APLAC, EA, IAAC, A2LA). Furthermore, the Laboratory scope of accreditation must include the required specific test methods used for the above mentioned type tests	
9.1.2	***Scope***	
9.1.2.1	All compulsory type tests on disconnectors and earthing switches as per	IEC 62271-102
9.1.2.1.1	Standard lighting impulse withstand voltage test 1.2/50msec	sub clause 7.2
9.1.2.1.1.1	To earth and phase to phase (kV peak)	750
9.1.2.1.1.2	Across the isolating distance (kV r.m.s.)	860

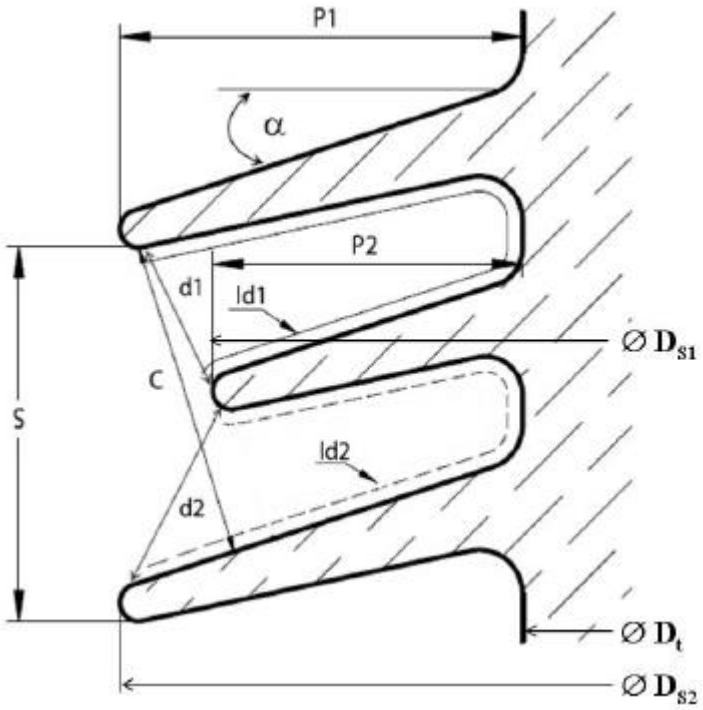
	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
9.1.2.1.2	Power frequency (50 Hz) withstand voltage test 1 min dry and wet conditions, according to:	Sub clause 7.2
9.1.2.1.2.1	To earth and phase-to-phase (kV r.m.s.)	325
9.1.2.1.2.2	Across the isolating distance (kV r.m.s.)	375
9.1.2.1.3	Dielectric tests on auxiliary and control circuits according to:	sub clause 7.2.11
9.1.2.1.3.1	Power frequency (50 Hz) withstand voltage test, 1 minute (kV r.m.s.)	2
9.1.2.1.4	Radio Interference Voltage test (R.I.V):	sub clause 7.3
9.1.2.1.4.1	Radio interference level at 1.1x170/ $\sqrt{3}$ kV shall not exceed (mV)	2500
9.1.2.1.5	Measurement of the resistance of circuits	sub clause 7.4
9.1.2.1.6	Temperature - rise tests	sub clause 7.5
9.1.2.1.7	Short-time withstand current and peak withstand current tests	sub clause 7.6
9.1.2.1.8	Verification of the protection:	sub clause 7.7
9.1.2.1.8.1	Verification of IP coding according to **IEC 60529**	IP54
9.1.2.1.8.2	Mechanical impact test according to **IEC 62262**	IK07
9.1.2.1.9	Operating and mechanical endurance tests	sub clause 7.102
9.1.2.1.10	Mechanical endurance test for disconnector class M2 and earthing switch class M1 (10000 operating cycles for M2 class. 2000 operating cycles for M1 class)	sub clause 7.102.5
9.1.2.1.11	Operating test of disconnectors during application of terminal load	sub clause 7.102.4
9.1.2.1.11.1	Number of operating cycles	20
9.1.2.1.11.2	Rated static terminal load (N)	2700
9.1.2.1.12	Operation at minimum and maximum ambient temperature	sub clause 7.104
9.1.2.1.13	Tests to verify the proper function of the position indicating device	sub clause 7.105

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
9.1.2.1.14	Bus - transfer current switching tests on disconnectors	sub clause 7.106
9.1.2.1.15	Induced current switching tests for earthing switches	sub clause 7.107
9.1.2.1.16	Additional tests on auxiliary and control circuits	sub clause 7.10
9.1.2.2	Capacitive current switching capability test of disconnector according to	IEC 62271-305/2009
9.1.2.3	All compulsory type tests on porcelain insulators as per	IEC 60168 sub clause 6.1 & Tables 3,4
9.1.2.4	Seismic qualification test shall prove that the disconnector including all accessories will operate fully satisfactory during and after the earthquake with ground acceleration indicated according to	IEEE 693
9.1.2.5	Cross cut test of painting according to	ISO 2409
9.1.2.6	Test report or dynamic analysis which shall prove that the disconnector including all accessories will operate fully satisfactory during and after earthquake with ground acceleration as required in clause	
9.2	**Routine and sample tests**	
9.2.1	***General***	
9.2.1.1	Routine test report shall be issued for each disconnector and earthing switch	
9.2.2	***Scope***	
9.2.2.1	All routine tests on disconnectors and earthing switches as per	IEC 62271-102
9.2.2.2	All routine tests on porcelain insulators as per	IEC 60168
9.2.2.3	Sample tests porcelain insulators as per	IEC 60168
10	**Documentation**	
10.1	**General**	
10.1.1	All data and descriptive materials shall be in English	
10.1.2	All documents shall be submitted in doc or pdf formats	

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	**Required Value or Applicable Standard**
10.1.3	All drawings shall be submitted in dwg or pdf formats	
10.2	**Technical documents for approval of the specific type**	
10.2.1	Description and schematic drawing of completely assembled disconnector and earthing switches	
10.2.2	Description and drawing of post insulator from insulator Manufacturer	
10.2.3	Description and detail drawings of the operating mechanism	
10.2.4	Drawing of nameplate	
10.2.5	Type test reports according to the requirements in clause 9.2.2	
10.2.6	Example of routine test report for disconnector	
10.2.7	Example of routine test report for porcelain insulator	
10.2.9	A valid certificate demonstrating certification to	ISO 9001:2015
10.2.10	Details about environmental management system (EMS) according to	ISO 14001 and ISO 50001
10.2.11	Seismic qualification test report or dynamic analysis as per clause 2.16	
10.3	**Technical documents for each item**	
10.3.1	All technical documents as listed below shall be provided before shipping the equipment to Israel	
10.3.2	Routine and sample test reports according to requirements in clause 9.1.3.1	

Appendix 1. Aero-dynamic Open Profile: Alternating Sheds

	Required Data and Documentation	
	Flat Alternating Sheds	
	The profile parameters shall be according to the following values	



P_1-P_2	> 15 mm
S/P_1	> 0.75
C	> 40 mm
α	7° ≤ α ≤ 14°
D_a	< 300 mm
K_{ad}	1
USCD	53.7 mm/kV
A	> 1500 mm
CF = L/A	3.0 < CF < 4.5
l_1/d_1	2.5 ÷ 4.5
l_2/d_2	2.5 ÷ 4.5

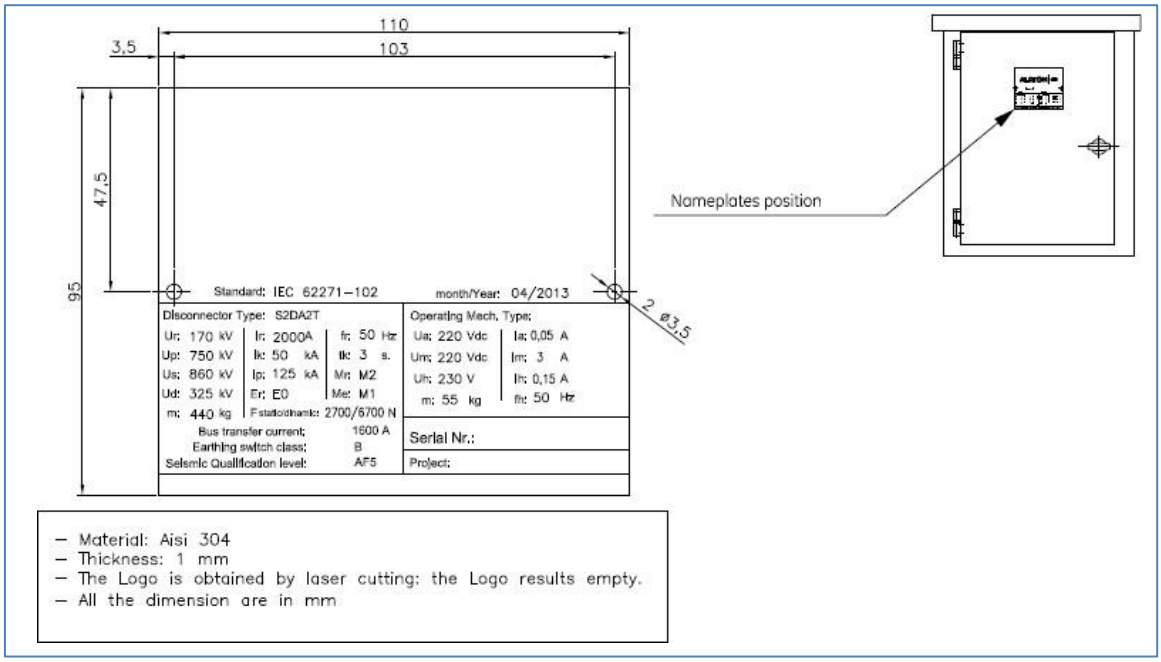
P_1, P_2, S, C, α, ld_1, d_1, ld_2, d_2, D_{s1}, D_{s2}, D_t: see drawing.

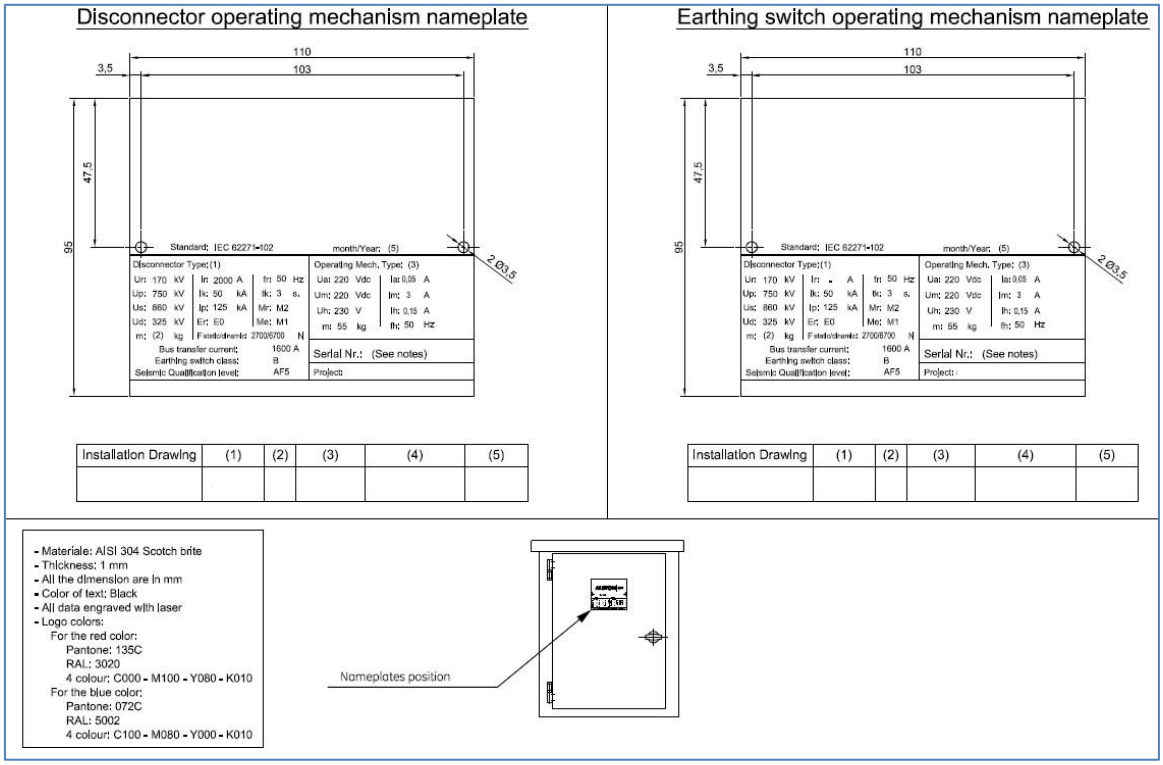
$$D_a = \frac{D_{s1} + D_{s2} + 2D_t}{4}$$

L: creepage distance.

A: arcing distance.

Appendix 2. Nameplates example





Appendix 3. Local control cubicle configuration