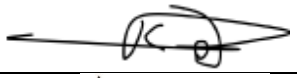
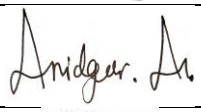
Main Technical Requirements

For 170 kV

AIS CURRENT TRANSFORMERS (OIL INSULATED)

December 2025

	Name	Signature	Date
Prepared by:	Pe'er Avraham		04/12/2025
Checked by:	Adir Anidgar		11/12/2025
Approved by:	Chen Marchini		18/12/2025

Requirements for purchase, installation and connection to the Israeli grid

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-ISO's 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.

MAIN TECHNICAL REQUIREMENTS FOR 170 kV AIS CURRENT TRANSFORMERS (OIL INSULATED)

Scope of work:

This document describes the System data and the main Current Transformer components, focusing on the threshold requirements.

Its primary purpose is to serve as a technical compulsory guideline for parties involved in preparing a detailed specification for a Current Transformer that complies with applicable local regulations and the Purchaser's requirements in the Israel grid.

Notes:

1. *This document adopts the IEC 61869 as the primary international standard governing Current transformers.*
2. *The technical data, procedures, and requirements specified herein shall be regarded as part of the System's Threshold Requirements.*
3. *The final Current Transformer Specification shall be jointly reviewed by the Customer and the Manufacturer to define the detailed design of each component, in accordance with the Israel Grid Code requirements* https://www.noga-iso.co.il/pdt/grid-code/*.*
4. *In cases where certain components lack the required documentation or fail to meet NOGA-ISO's technical requirements, the equipment or the affected parts may be disqualified for use.*
5. ***This document must be approved and signed by:***
   - *5.1. End Customer or his representative.*
   - *5.2. The entity is responsible for preparing the Current transformer specification (if applicable)**.***
   - *5.3. Current transformer manufacturer**.***

The Customer shall be responsible for providing all data and information requested in this document, and for ensuring that all technical requirements are fully met by the Manufacturer in the final supplied product.
The Customer is also responsible for verifying the accuracy and validity of all data submitted by the Manufacturer.

Project Name:				
Spec. No.				
No. of units:				
#	**Name**	**Company & country**	**Date**	**Sign**
End-Customer or his representative				
Entity responsible for preparing the power transformer spec.				
Manufacturer				

Table of Contents

1. GENERAL

- **Location:** This document covers the installation of Current transformers indoors or outdoors.
- The applicable standards are included in the respective clauses of this document.
- **Required Information and Documentation:** Requirements about documentation are in Clause 3.16.2.
- All clauses must be addressed. Only a specific ***data value***, confirmation of compliance with the requirement (***Complies***), or indication that the requirement is not applicable (***N/A***) will be accepted.

2. APPLICABLE STANDARDS

2.1 Unless otherwise specified all equipment shall be designed, constructed and tested in accordance with the requirements of the latest relevant published Recommendations of the International Electrotechnical Commission (IEC) as amended up to date.

2.2 All aspects, tests, etc. not covered by IEC Recommendations, should be executed according to the latest published issue of official, or otherwise approved standards of Manufacturer's country. In such cases, the standards themselves shall be supplied.

2.3 The terminology used in this SYSTEM REQUIREMENTS, except where otherwise indicated, in accordance with IEC Publications:

1. IEC 61869-1/2023 - Instrument transformers.
2. IEC 61869-2/2012 – Current transformers.
3. IEC 62155/2003 -Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V.
4. IEC 61462/2023- Composite hollow insulators.
5. IEC 60721 series - Classification of environmental conditions.
6. IEC 60529/2013 - Degrees of protection provided by enclosures (IP Code).
7. IEC 62262/2021- Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).
8. IEC 60137/2017- Insulated bushings for alternating voltages above 1000 V.
9. IEC TR 62039/2021 - Selection guide for polymeric materials for outdoor use under HV stress.
10. IEC 62217/2025- Polymeric HV insulators for indoor and outdoor use.
11. IEC 60085/2007 - Thermal evaluation and designation.
12. IEC 60815 series - Selection and dimensioning of high-voltage insulators intended for use in polluted conditions.
13. IEC 62073/2016 - Guidance on the measurement of wettability of insulator surfaces.
14. IEC 60417/2004 - Graphical symbols for use on equipment.
15. IEC 60296/2020- Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear.
16. IEEE 987/2001- Guide for Application of Composite Insulators.
17. IEEE 693-2018-2024- Seismic Design of Substations.
18. IEEE 57.13/2019- Standard Requirements for Instrument Transformers.

3. TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.1.	**SYSTEM DATA**	Grid Code	
3.1.1.	Rated system voltage (line to line)	161 [kV]	
3.1.2.	Highest system voltage (line to line)	170 [kV]	
3.1.3.	Neutral connection in the 170 kV systems	Effectively earthed	
3.1.4.	Earth fault factor	1.4	
3.1.5.	Frequency	50 [Hz]	
3.1.6.	Symmetrical short circuit current	50 [kA r.m.s]	
3.2.	**CLIMATIC CONDITIONS**		
3.2.1.	Permissible ambient air temperature:		
3.2.1.1.	Maximum	+50 [˚C]	
3.2.1.2.	Minimum	-5 [˚C]	
3.2.1.3.	Average measured over a period of 24 hours	+35 [˚C]	
3.2.2.	Permissible humidity:		
3.2.2.1.	Low relative/absolute humidity	4% / 0.9 [g/m3]	
3.2.2.2.	High relative/absolute humidity	100 [%] / 27 [g/m3]	
3.2.3.	Rain intensity	15 [mm/min]	
3.2.4.	Low/high air pressure	84 [kPa] / 106 [kPa]	
3.2.5.	Solar radiation: Heating effects of solar radiation	1120 [W/m2]	
3.2.6.	Maximum wind velocity measured 10m above grade (bare area) at 3 sec duration	44 [m/sec]	
3.3.	**ENVIRONMENTAL CONDITIONS**		
3.3.1.	Site Pollution Severity (SPS, for dimensioning purposes)	Class E (very heavy) • IEC TS 60815-1 2008, cl. 8.3	
3.3.2.	Site Pollution Characterization	High Pollution/High NSDD site	
3.3.3.	Type of Pollution: Desert-Coastal, high inert content	Mixed A+B, A - prevalent • IEC TS 60815-1 - 2008	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.3.4.	Prevalent Pollution Type:	Saharan Blowing Dust	
3.3.5.	Environmental parameters:	4K25 & 4K26 • IEC 60721-3-4/2019, par.5.2	
3.3.6.	Chemically active substances according to: Corrosively category according to:	• IEC 60721-3-4/2019, par. 5.5 • ISO 9223, C5	
3.3.7.	**Classification of mechanically active substances** according to:	• IEC 60721-3-4/2019 Table 4, 4S13	
3.3.8.	Permissible altitude over the sea level	1000 [m]	
3.3.9.	The CT shall be vermin proof		
3.3.10.	Electromagnetic Environment		
3.3.10.1.	Electromagnetic compatibility (EMC) according to:	• IEC 61869-1 cl. 6.11.2-5	
3.3.10.2.	Maximum induced electromagnetic disturbances in the secondary system for interface designed as "Normal EMC severity class"	1.6 [kV peak] • IEC: 61000-4-2	
3.4.	**SEISMICITY OF SITE**	• IEEE 693-2018-2024 • Israeli Standard 413	
3.4.1.	Seismic Qualification level:	Moderate Level	
3.4.1.1.	Peak horizontal (x, y directions) ground acceleration (PGA) with an 85% probability not to be exceeded over a 50-year period:	0.5g	
3.4.1.2.	Vertical severities (z direction) ground acceleration	0.25g	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.5.	**ELECTRICAL DATA**		
3.5.1.	The ratings of the CTs shall be in according to: * EXAMPLE OF COMONLY USED ITEMS of the CTs listed under:	• Individual project (need NOGA-ISO permission) • Appendix 1 – EXAMPLE OF COMONLY USED ITEMS	
3.5.2.	Highest voltage for equipment (Um)	170 [kV r.m.s]	
3.5.3.	Rated frequency	50 [Hz]	
3.5.4.	Rated primary current (I_1)	IEC 61869-2 cl. 5.201	
3.5.5.	Rated continuous thermal current $(I_{cth} = 1.2 \times I_1)$	120 [%] • IEC 61869-2 cl. 5.203	
3.5.6.	Extended current rating $(I_{\text{Ext}} = 1.2 \times I_1)$	120 [%] • IEC 618692 cl. 5.6.201.5	
3.5.7.	Rated secondary current	5 [A] • IEC 61869-2 cl.5.202	
3.5.8.	Rated output (burden) to be supplied to the secondary circuit shall have at a power factor (PF): * Except that, when the burden is less than 5 VA, a power-factor of 1,0 shall be used, with a minimum value of 1 VA.	0.8 lagging • IEC 61869-2 cl.5.6.201.3	
3.5.9.	Rated burden (VA) (Rated output for each ratio)	• According to individual project (need NOGA-ISO permission) • Burden calculations in worst case scenario shall be submitted to NOGA-ISO for examination and according to Grid Code	
3.5.10.	Core designations:	• Grid Code • IEC 61869-2	
3.5.10.1.	Number of cores for measuring, metering and protection	According to individual project parameters (need NOGA-ISO permission) and according to Grid Code	
3.5.10.2.	Accuracy class	• IEC 61869-2 cl. 5.6.203	
3.5.10.3.	**Measuring cores:**		
3.5.10.3.1.	Accuracy class	0.5	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.5.10.3.2.	Instrument security factor (Fs) for each ratio:	According to individual project parameters (need NOGA-ISO permission) and according to Grid Code	
3.5.10.3.3.	Current error at rated primary current both ratios (ε)	±0.5 [%]	
3.5.10.3.4.	Phase displacement at rated primary current at both ratios ($\Delta\emptyset$)	±30 [min]	
3.5.10.3.5.	Composite error at rated accuracy limit primary current for protection core and at rated instrument limit primary current for measuring core at both ratios	>10 [%]	
3.5.10.4.	**Metering cores:**		
3.6.9.4.1.	Accuracy class	0.2s	
3.6.9.4.2.	Instrument security factor (Fs) for each ratio:	2.5 - 5	
3.6.9.4.3.	Current error at rated primary current at both ratios (ε)	±0.2 [%]	
3.6.9.4.4.	Phase displacement at rated primary current at both ratios ($\Delta\emptyset$)	±10 [min]	
3.6.9.4.5.	Composite error at rated accuracy limit primary current for protection core and at rated instrument limit primary current for measuring core at both ratios	>10 [%]	
3.5.10.5.	**Protection cores:**		
3.6.10.5.1.	Accuracy class	5P	
3.6.10.5.2.	Accuracy limit factor (ALF) for each ratio:	30	
3.6.10.5.3.	Current error at rated primary current at both ratios (ε)	±1 [%]	
3.6.10.5.4.	Phase displacement at rated primary current at both ratios ($\Delta\emptyset$)	±60 [min]	
3.6.10.5.5.	Composite error at rated accuracy limit primary current for protection core and at rated instrument limit primary current for measuring core at both ratios	5 [%]	
3.5.11.	Rated short-time thermal current (I_{th})	50/1 [kA r.m.s./sec]	
3.5.12.	Rated dynamic current (I_{dyn})	125 [kA peak]	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.5.13.	Maximum permissible density current taking into consideration the rated short-time thermal current 50kA/1 sec and maximum winding temperature 200 ºC (aluminum) or 250 ºC (cooper)	Cu< value [A/mm2] Al< value [A/mm2] • IEC 60076-5: 2006, Table 3	
3.5.14.	The change in ratio of the CT shall be performed by secondary reconnection		
3.5.15.	Class of insulation	• IEC 60085/2007	
3.6.15.1.	For oil insulated CT with composite/porcelain insulator shall be at least:	A • According to cl. 3.2	
3.6.15.1.1.	Maximum temperature rise of winding	55 [°K]	
3.6.15.1.2.	The temperature rise of the oil at the top housing shall not exceed	45 [°K]	
3.5.16.	Rated insulation level:	• IEC 61869-1 • IEC 61869- 2 cl.5.3	
3.6.16.1.	Rated lightning impulse withstand voltage for primary terminal shall be at least:	750 [kV peak]	
3.6.16.2.	Rated power-frequency withstand voltage for primary terminal shall be at least:	325 [kV r.m.s.]	
3.6.	**OTHER REQUIREMENTS**		
3.7.1.	The partial discharge level shall not exceed	• IEC 61869-1 cl.5.4.3.1	
3.7.1.1.	At Um	10 [pC]	
3.7.1.2.	At 1.2 Um/√3 kV	5 [pC]	
3.7.2.	The dielectric dissipation factor, between primary conductor and capacitance tap, shall not exceed at Um/√3	0.005	
3.7.3.	The dielectric dissipation factor, between capacitance tap and earth, shall not exceed at 3 kV	0.005	
3.7.4.	The rated power frequency withstand voltage of the insulation between sections	3 [kV r.m.s]	
3.7.5.	The rated power frequency voltage for secondary windings insulation	3 [kV r.m.s]	
3.7.6.	The rated withstand voltage for inter-turn insulation	4.5 [kV peak]	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.7.	**DESIGN AND CONSTRUCTION**		
3.8.1.	GENERAL REQUIREMENTS:		
3.8.1.1.	CT shall be inverted type or tank type		
3.8.1.2.	The CTs, shall be provided with secondary reconnection (Not accepted CT designed for primary reconnection)		
3.8.1.3.	The CTs shall be with minimum four mounting holes on the transformer base		
3.8.1.4.	The CTs shall be provided with a clearly marked capacitance tap suitable for connection to tan φ measuring equipment		
3.8.1.5.	Indicate if steps should be taken (screening, special type of earthing) to reduce overvoltage between terminals of secondary windings and earth to safe values on switching the CT in and off at rated voltage and during atmospheric overvoltages		
3.9.	**INSULATING MEDIUM**		
3.9.1.	The CT oil shall meet the requirements indicated in:	• Appendix 4 • IEC 60296	
3.9.2.	The mixability between oils must be in accordance with:	• IEC 60296 • IEC 60422	
3.10.	**EARTHING TERMINALS**		
3.10.1.	Each CT shall be equipped with	Two terminals for earthing	
3.10.2.	The earthing terminals shall be marked with appropriate graphical symbols according to	IEC 60417	
3.10.3.	The earthing terminals for each transformer shall be designed to withstand for 1 sec a short-time current of	50 [kA]	
3.11.	**INSULATORS**		
3.11.1.	GENERAL INFORMATION:		
3.11.1.1.	Manufacturer		
3.11.1.2.	Type of insulator (Porcelain/Composite)		
3.11.1.3.	Rated voltage	170 [kV]	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.11.1.4.	Voltage test values for insulator: *HV Insulation levels must be at least the specified values		
3.11.1.4.1.	Dry lightning impulse 1.2/50 µs wave	750 [kV peak]	
3.11.1.4.2.	Power frequency voltage withstand test 1 min	325 [kV r.m.s.]	
3.11.1.5.	All other relevant tests shall be carried out, according to:	• IEC 62155	
3.11.1.6.	HOUSING:		
3.11.1.6.1.	Reference unified specific creepage distance (RUSCD):	53.7 [mm/kV]	
3.11.1.6.1.1.	Phase to ground (Creepage Distance) not less than:	5270 [mm]	
3.11.1.6.2.	Arcing distance not less than:	1500 [mm]	
3.11.1.6.3.	The insulators shall be only “wind formed” type not “drop shaped edge”		
3.11.1.6.4.	All dimensions shall be indicated in the dimension drawings		
3.11.1.6.5.	The insulators shall be "anti-fog" profiles of the alternate sheds	• Porcelain: IEC 60815-2, Fig. 5b • Composite: IEC 60815-3, Fig. 6	
3.11.1.6.6.	The insulator profile (Design and Construction) shall be according to:	• Appendix 2 • IEC 60815-2	
3.12.	**STRESSES ON MOUNTED CTs**		
3.12.1.	Permissible values of loading for terminals connected to other equipment by rigid or flexible conductors:		
3.12.1.1.	Static terminal load (sum of all loads occurring simultaneously in service: conductor pull, conductor weight and wind force on conductor) in any direction in space not less than	2700 [N]	
3.12.1.2.	Short - time load (sum of all loads occurring simultaneously in case of short-circuit) in any direction in space not less than:	6700 [N]	
3.12.1.3.	Static test load: Testing load for 60 sec. Applied to the midpoint of the terminal, perpendicular to the insulator axis	4700 [N]	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.12.2.	Safety factors of CT insulators taking into consideration the requirements under cluse 3.12 for each item of offered CT including steel pedestal		
3.12.2.1.	Condition 1– routinely expected load including: - design pressure 100% - mass 100%, -rated terminal load 100% (tensile force on conductors, weight of conductors and load due to wind on conductors) -load due to wind on CT 30%	> 2.1	
3.12.2.2.	Condition 2 – rarely occurring extreme loads including: -design pressure 100% - mass 100%, -rated terminal load 50% (tensile force on conductors, weight of conductors and load due to wind on conductors), -load do to wind on CT 100%, -short circuit load 100%	> 1.5	
3.12.2.3.	Condition 3 – rarely occurring extreme loads including: -design pressure 100% - mass 100%, -rated terminal load 70% (tensile force on conductors, weight of conductors and load due to wind on conductors), -load do to wind on CT 10%, -seismic load 100%	> 1.2	
3.12.3.	Seismic forces:	• IEEE 693-2018-2024 (Moderate Level)	
3.12.3.1.	Simultaneous earthquake acceleration applied at the base of each type of transformer taking into consideration seismicity of the site according to cl. 3.4 and mounting of each type of transformer on support at 2.5 m height and 100 kg weight.		
3.12.3.2.	Dynamic seismic withstand capability (simultaneous earthquake acceleration applied at the base of the support CT):	Moderate Level PGA: 0.5 [g]	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.12.3.2.1	The dynamic seismic analysis report shall be done for CT including support structure according to:	• IEEE 693-2018-2024	
3.13.	**SECONDARY TERMINAL BOX**		
3.13.1.	The entire control box which includes the coating must be designed to withstand the Climatic and Environmental Conditions according to:	Cl. 3.2 – 3.3	
3.13.2.	All wiring for connection to purchaser's cable shall be terminated at terminal blocks enclosed in a terminal box having environmental protection shall be at least:	IP 54 • IEC 60529	
3.13.3.	The protection against mechanical impact shall be at least:	IK 10 • IEC 62262	
3.13.4.	The terminal blocks shall be	• Spaced (to allow ample clearance on all sides) • Suitable for cross-section cable connected to CTs	
3.13.5.	The wires shall be	with XLPE insulation for 1000 [V] rated voltage	
3.13.6.	All wiring insulation and terminal blocks shall be flameproof protected, according to:	ASTM D635	
3.13.7.	The destination of each winding shall be	Clearly indicated at the terminals, the cores shall be denoted according to their destination	
3.13.8.	Electromagnetic Control box code shall be at least:	EM4677xx • IEC 61000-5-7	
3.13.9.	The control box shall be supported by suitable vibration damping device designed to withstand the seismic characteristics described in:	cl. 3.4	
3.13.10.	Thermal calculations of the control box must be performed according to:	• IEC 61439	

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.14.	**NAMEPLATE**		
3.14.1.	All CTs shall carry the markings specified in:	• IEC 61869-1 cl. 6.13 • IEC 61869-2 cl. 6.13 e.g. : Appendix 3	
3.14.2.	Rating plate (nameplate) drawings shall be written in English, with metric units, with the Data on the Nameplate must be engraved with any system that guarantees its readability throughout the CT service life.		
3.14.3.	The nameplates material shall be no corrosive stainless steel, and they shall be mounted with no corrosive type of stainless-steel screws, bolts or rivets. Mounting the nameplates with adhesive is not acceptable.		
3.14.4.	In addition, the following data shall be included:		
3.14.4.1.	Diagram showing the use of each secondary winding and its corresponding terminal markings		
3.14.4.2.	Mechanical requirements (static/ static + dynamic loads)	2700 / 6700 [N/N]	
3.14.4.3.	Temperature category	-5 / +50 [˚C]	
3.14.4.4.	Creepage distance	≥ 5270 (mm)	
3.14.4.5.	Name and number of standards	• IEC 61869-1 • IEC 61869-2	
3.14.4.6.	Rated voltage factor and the corresponding rated time	Continuous: ≥ 1.2 30 sec: ≥ 1.5	
3.14.4.7.	Seismic qualification	0.5 [g]	
3.14.4.8.	Value of tan δ	≤ 0.005	
3.15.	**TESTS**		
3.15.1.	GENERAL:		
3.15.1.1.	Contractor shall perform Production Tests to check the quality and uniformity of the workmanship and materials used in the manufacturer's CT.		
3.15.1.2.	Tests shall be carried out according to requirements further specified and the files of the relevant test reports for the proposed type of equipment.		

#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.15.1.3.	Contractor shall also submit test data to prove that the design has the capability to meet all the ratings as specified in this document.		
3.15.1.4.	The Contractor is required to submit type test reports of offered type of CT performed by a neutral 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 mentioned type tests.		
3.15.1.5.	Contractor shall submit a list of all tests to be performed on site, after mounting of the CT and during operation.		
3.15.1.6.	Contractor shall submit with the test reports a list of all measuring instruments, including their accuracy class and type, test equipment and test circuits.	• IEC 61869-1 • IEC 61869-2	
3.15.1.7.	Contractor shall indicate permissible tolerance for each test value.		
3.15.2.	**TYPE TESTS**		
3.15.2.1.	Type Test Reports for offered types according to the provision of the latest relevant issue of IEC recommendations according to:	• IEC 61869-1 Cl. 7.2 • IEC 61869-2 Cl. 7.2 Table 10	
3.15.2.2.	Temperature-rise test according to: The temperature rise values will be maximum values specified under cl. 3.2.	• IEC 61869-2 Cl. 7.2.2	
3.15.2.2.1.	Oil temperature rise at top of tank or housing not more than	45 [K]	
3.15.2.2.2.	Temperature rise of the windings under rated conditions not more than	55 [K]	
3.15.2.3.	Phase to ground test voltage: Lightning impulse voltage test on primary terminals according to:	750 [kV peak] • IEC 61869-2 Cl. 7.2.3.1 • IEC 61869-1 Cl.7.2.3.2.1,	

		Table 2	
#	Description	Required Value /Standard	Manufacturer's Confirmation or Proposal
3.15.2.4.	One-minute power frequency test on primary winding phase to ground: Wet test for outdoor transformers according to:	325 [kV r.m.s.] • IEC 61869-1 Cl.7.2.4	
3.15.2.5.	Electromagnetic compatibility (EMC) tests:	• IEC 61869-1 Cl. 7.2.5	
3.15.2.5.1.	RIV test at 108 kV (1.1xUm/ kV) shall not exceed: Um = highest system voltage	2500 [µV] • IEC 61869-1 Cl. 7.2.5.1	
3.15.2.6.	Test for accuracy according to:	• IEC 61869-2 Cl. 7.2.6	
3.15.2.6.1.	Type test for ratio error and phase displacement and determination if instrument security factor for measuring winding shall be performed according to:	• IEC 61869-2 Cl. 7.2.6.201&Cl. 7.2.6.202	
3.15.2.6.2.	Type test for limits of voltage error and phase displacement for protective winding shall be performed according to:	• IEC 61869-2 Cl.7.2.6.203	
3.15.2.7.	Verification of the degree of protection of secondary terminal box:	• IEC 61869-1 Cl.7.2.7	
3.15.2.7.1.	Verification of the IP coding	IP 54 Cl.7.2.7.1	
3.15.2.7.2.	Mechanical impact test	IK 10 Cl.7.2.7.2	
3.15.2.8.	Mechanical tests are carried out to demonstrate that the CT is capable to withstand the required values under cl. 3.12 according to	• IEC 61869-1 cl. 7.2.10	
3.15.2.9.	Short-circuit withstand capability test according to:	• IEC 61869-2 Cl. 7.2.201	
3.15.2.10.	Type tests of porcelain insulators acc. to:	• IEC 62155 • IEC 60137/2017	

3.15.2.11.	Type tests of composite insulators according to:	• IEC 61462/2023 • IEC 60137/2017 • IEC 62217/2025 • IEC 62073/2003 • IEEE 987/2001 • IEC TR 62039/2021	
#	**Description**	**Required Value /Standard**	**Manufacturer's Confirmation or Proposal**
3.15.3.	**ROUTINE TESTS**		
3.15.3.1.	General:		
3.15.3.1.1.	Manufacturer shall perform all Routine Tests for each CT according to the provisions of IEC Recommendations and submit all relevant test reports according to:	• IEC 61869-1 Cl. 7.3 &Table 10 • IEC 61869-2 Cl. 7.3	
3.15.3.1.2.	Manufacturer shall submit the routine test reports to NOGA-ISO for approval one month prior to delivery. The equipment can be delivered only after approval of routine test reports.		
3.15.3.2.	Routine test reports shall include:		
3.15.3.2.1.	Phase to ground: Power frequency voltage withstand tests on primary terminals for 1 min according to:	325 [kV r.m.s] • IEC 61869-2 Cl. 7.3.1	
3.15.3.2.2.	Partial discharge measurement test according to:	• IEC 61869-1 Cl. 7.3.2.2 Table 3	
3.15.3.2.2.1.	Pre-stress voltage/duration Indicate procedure A or B according to:	• IEC 61869-1 Cl. 7.3.2.2	
3.15.3.2.2.2.	Measuring PD level at specified voltage test		
3.15.3.2.2.2.1.	Partial discharge level at Um	<10 [pC]	
3.15.3.2.2.2.2.	Partial discharge level at 1.2 x Um/$\sqrt{3}$	< 5 [pC]	
3.15.3.2.3.	Power frequency voltage withstand tests between sections according to:	• IEC 61869-1 Cl.7.3.3	
3.15.3.2.3.1.	One-minute power frequency test between sections	3 [kV r.m.s]	
3.15.3.2.3.2.	One-minute power frequency test between capacitive tap and earth [kV r.m.s]		
3.15.3.2.4.	Power frequency voltage withstand tests on secondary terminals:	• IEC 61869-1 Cl. 7.3.4	

3.15.3.2.4.1.	One-minute power frequency test between secondary terminals of each winding and earth	3 [kV r.m.s.]	
3.15.3.2.5.	Tests for accuracy	• IEC 61869-1 Cl. 7.3.6 • IEC 61869-2 Cl. 7.3.5	
3.15.3.2.5.1.	Routine test for ratio error and phase displacement for measuring CTs according to:	• IEC 61869-2 Cl.7.3.5.201-203	
#	**Description**	**Required Value /Standard**	**Manufacturer's Confirmation or Proposal**
3.15.3.2.5.2.	Routine test for ratio error and phase displacement and test for composite error for protective CTs shall be performed according to:	• IEC 61869-2 Cl.7.3.5.202-203	
3.15.3.2.6.	Verification of polarity and terminal markings according to:	• IEC 61869-1 Cl. 7.3.6 • IEC 61869-2 Cl. 6.13	
3.15.3.2.7.	Oil-leakage test (Enclosure tightness test at ambient temperature)	• IEC 61869-1 cl. 7.3.8	
3.15.3.2.8.	Measurement of secondary resistance for each core and each ratio according	• IEC 61869-2 cl. 7.3.201	
3.15.3.2.9.	Test for verifying the knee-point voltage by measuring the exiting current and voltage for two points of the magnetization curve close to the knee-point according to:	• IEC 61869-2 cl. 7.3.203	
3.15.3.2.10.	Test of inter-turn insulations according to:	• IEC 61869-2 cl. 7.3.204	
3.15.3.2.10.1.	Procedure A - With the secondary winding open circuited and rated extended primary current applied for 1 min to primary winding. Indicate the voltage at the secondary terminals (kV peak], Frequency [Hz]		
3.15.3.2.10.2.	Procedure B - With the primary winding open circuited, and test voltage applied 1 min to secondary winding. Indicate the Frequency [Hz]	4.5 [kV peak]	
3.15.3.2.11.	Measurement of capacitance and dielectric dissipation factor (tan φ) test shall be performed for each CT, according to Manufacturer's Standard methods (a full description of the test method shall be supplied) and according to:	• IEC 61869-2 cl. 7.4.3	
3.15.3.2.11.1.	Capacitance and voltage measurement on capacitance tap		

3.15.3.2.11.1.1.	Capacitance between primary conductor and capacitance tap (pF)		
3.15.3.2.11.1.2.	Capacitance between capacitance tap and earth (Pf)		
3.15.3.2.11.1.3.	Voltage on capacitance tap at Um/√3 primary voltage [V]		
#	**Description**	**Required Value /Standard**	**Manufacturer's Confirmation or Proposal**
3.15.3.2.11.2.	The measurement of dielectric dissipation factor (tan δ) shall be between primary conductor and capacitance tap, performed at a voltage in the range from 10 kV to Um/$\sqrt{3}$		
3.15.3.2.11.3.	The measurement of dielectric dissipation factor (tan δ) shall be between capacitance tap and earth, performed at a voltage of 3kV		
3.15.3.2.12.	Measurement of insulation resistance (Indicate also the DC test voltage value for each of the following measurements)		
3.15.3.2.12.1.	Between the primary winding and capacitance tap	>16 [Ω]	
3.15.3.2.12.2.	Between the capacitance tap and earth	>200M [Ω]	
3.15.3.2.12.3.	Between the secondary windings	>200M [Ω]	
3.15.3.2.12.4.	Between the secondary windings and earth	>200M [Ω]	
3.15.3.2.13.	Test certificate (COT) of oil according to:	• IEC 60296 • Appendix 4	
3.15.3.2.14.	**Routine and sample tests for each <u>porcelain</u> insulator acc to:**	• IEC 62155 cl.:	
3.15.3.2.14.1.	**Sample tests:**	9.1	
3.15.3.2.14.1.1.	Verification of dimensions	7.1	
3.15.3.2.14.1.2.	Control of the roughness of the ground parts	7.1	
3.15.3.2.14.1.3.	Temperature cycle test	7.3	
3.15.3.2.14.1.4.	Porosity test:	7.4	
3.15.3.2.14.1.5.	Galvanizing test	7.5	
3.15.3.2.14.1.6.	Pressure test	8.2.1	
3.15.3.2.14.1.7.	Bending test	8.3.1	
3.15.3.2.14.2.	**Routine tests:**	10.1	

3.15.3.2.14.2.1.	Visual examination	10.3	
3.15.3.2.14.2.2.	Electrical test	10.4	
3.15.3.2.14.2.3.	Pressure test	10.5.1	
3.15.3.2.14.2.4.	Bending test	10.5.2	
3.15.3.2.14.2.5.	Other mechanical tests	10.5.3	
#	**Description**	**Required Value /Standard**	**Manufacturer's Confirmation or Proposal**
3.15.3.2.15.	**Routine and sample tests on composite insulators:**	• IEC 61462/2023 Subclause:	
3.15.3.2.15.1.	**Sample tests**	9	
3.15.3.2.15.1.1.	Verification of dimensions	9.3	
3.15.3.2.15.1.2.	Mechanical tests	9.4	
3.15.3.2.15.1.3.	Galvanizing test	9.5	
3.15.3.2.15.1.4.	Check of the interface between end fittings and the housing	9.6	
3.15.3.2.15.2.	**Routine tests**	10	
3.15.3.2.15.2.1.	Visual examination	10.2	
3.15.3.2.15.2.2.	Routine pressure test	10.3	
3.15.3.2.15.2.3.	Routine mechanical test	10.4	
3.15.3.2.15.2.4.	Routine tightness test	10.5	
3.15.4.	**SPECIAL TESTS**	• IEC 61869-1 • IEC 61869-2 Cl.7.4	
3.15.4.1.	General:		
3.15.4.1.1.	Manufacturer shall perform the following tests as a part of type test and in accordance with all type tests requirements above except where indicated otherwise, and supply test reports and curves accordingly:	• IEC 61869-1 Cl. 7.4 • IEC 61869-2 Cl. 7.4	
3.15.4.2.	Chopped lightning impulse test on primary windings, according to:	• IEC 61869-1 Cl.7.4.1	
3.15.4.2.1.	One 100% full impulse [kV peak]		
3.15.4.2.2.	Two 100% chopped impulses [kV peak]		
3.15.4.2.3.	Fourteen 100% full impulses [kV peak]		

3.15.4.2.4.	Differences in impulse shape of full wave before or after chopped impulses		
3.15.4.3.	Multiple chopped impulse test on primary terminals according to:	• IEC 61869-1 Cl.7.4.1	
#	**Description**	**Required Value /Standard**	**Manufacturer's Confirmation or Proposal**
3.15.4.4.	Transmitted overvoltage test according to: Transmitted overvoltage:	• IEC 61869-1 Cl. 7.4.2 <1.6 [kV peak]	
3.15.4.5.	Internal arc fault test according to:	• IEC 61869-1 Cl. 7.4.3 Class II	
3.15.4.6.1.	Internal arc fault current	50 [kA r.m.s.]	
3.15.4.6.2.	Arc fault duration in protection class:	IA2 (Table 16) 0.3 [sec]	
3.15.4.6.	Corrosion test according to:	• IEC 61869-1 Cl.7.4.6	
3.15.4.7.	Fire hazard test according to:	• IEC 61869-1 Cl. 7.4.7	
3.15.4.8.	Measurement of short circuit impedance according to:	• IEEE C57.13/2008 cl.8.3.1.3	
3.15.4.9.	Measurement of exiting current and voltage a t 50 Hz, with open primary winding and drawing of the magnetization curve for each core type according to:	• IEEE C57.13/2008 cl. 8.3.2	
3.15.4.10.	Seismic qualification test shall prove that the CT including all accessories will operate fully satisfactory during and after earthquake with ground acceleration indicated in cl. 3.4.	• IEEE 693-2018-2024	
3.15.5.	**SAMPLE TESTS**		
3.15.5.1.	Determination of the instrument security factor (FS) for one CT of each type in each batch according to	• IEC 61869-2 cl. 7.5.2	

3.16.	**TECHNICAL DOCUMENTAION**	Table in Cl. 3.16.2	
3.16.1.	General:		
#	**Description**	**Required Value /Standard**	**Manufacturer's Confirmation or Proposal**
3.16.1.1.	All data (documents, drawings) and descriptive material shall be in English or Hebrew doc/pdf/dwg formats.		
3.16.1.2.	Every document/drawing should include: Title document name, date, drawing number, revision number.		
3.16.2.	**REQUIRED DOCUMENTS**		
3.16.2.1.	**ISO certificates**		
3.16.2.1.1.	ISO 9001 for Quality management system (QMS)		
3.16.2.1.2.	ISO 14001 for environmental management system (EMS)		
3.16.2.1.3.	ISO 14025 for environmental product declaration (EPD)		
3.16.2.1.4.	ISO 17025 for testing and calibration laboratories		
3.16.2.2.	**Main technical data schedule /datasheet**		
3.16.2.2.1.	The document should include: all values that appear cl. 3.1, 3.2.1, 3.3.1, 3.4.1, 3.6, 3.12.2 and drawing numbers of Dimensional Insulator, Nameplate, Secondary terminal box, Insulator drawing.		
3.16.2.2.2.	Project Details: Manufacturer's factory address, Manufacturer name.		
3.16.2.3.	**Burden calculations in worst case scenario according to** 3.6.9		
3.16.2.4.	**Dimensional drawing**		

3.16.2.3.1.	The document shall include: Drawing of complete CT, showing all components, name of materials, HV & earth terminals, drawing number, revision number.		
3.16.2.5.	**Manufacturer's insulator drawing**		
3.16.2.4.1.	The document shall include: all values that appear in cl. 3.11, 3.12.		
#	**Description**	**Required Value /Standard**	**Manufacturer's Confirmation or Proposal**
3.16.2.6.	**Nameplate drawings**		
3.16.2.5.1.	The nameplates shall be provided with a weather and corrosion-proof nameplate, made of suitable material, including the mandatory markings: " All symbols and characters engraved by laser" and according to cl. 3.14.		
3.16.2.7.	**Stresses**		
3.16.2.6.1.	Calculations demonstrating that the CT complies with the Seismic Qualification Level (Static, dynamic and seismic calculation stresses) according to cl. 3.12.		
3.16.2.6.2.	Seismic qualification test report according to cl. 3.15.4.11.		
3.16.2.8.	**Tests**		
3.16.2.9.1.	INSPECTION AND TEST PLAN (ITP)		
3.16.2.9.2.	A plan, specifying all the inspections and tests (from its initialing through design, in process inspection, type tests, final inspection/s and test/s, packing, transportation and supply to the purchaser.		
3.16.2.9.3.	Measurement of capacitance and dielectric dissipation factor (tan δ) test according to cl. 3.15.3.2.11.		
3.16.2.9.4.	Test certificate (COT) of oil according to cl. 3.15.3.2.13.		
3.16.2.9.5.	TYPE TEST reports according to cl. 3.15.2.		

3.16.2.9.6.	ROUTINE TEST reports according to cl. 3.15.3.		
3.16.2.9.7.	SPECIAL TEST reports according to cl. 3.15.4.		
3.16.2.9.8.	Manufacturer's recommended SAT program shall be submitted.		

4. APPENDICES

4.1 APPENDIX 1 – EXAMPLE OF COMONLY USED ITEMS

CLARIFIACTION:

The CTs offer shall Include the relevant core designations (as per cl. 3.6.10) to be examined by NOGA-ISO per project.

Item 1:

170kV, 200 - 400/5/5/5/5A Current Transformer, with one measuring core with accuracy class 0.2S and three protection cores with accuracy class 5P.

Item 2:

170kV, 200 - 400/5/5/5/5/5A Current Transformer, with two measuring cores with accuracy class 0.2S / 0.2 and three protection cores with accuracy class 5P.

Item 3:

170kV, 750-1500/5/5/5/5A Current Transformer, with one measuring core with accuracy class 0.5 and three protection cores with accuracy class 5P.

Item 4:

170kV, 750-1500/5/5/5/5/5A Current Transformer, with two measuring cores with accuracy class 0.2S / 0.2 and three protection cores with accuracy class 5P.

Item 5:

170kV, 2000/5/5/5/5A Current Transformer, with one measuring core with accuracy class 0.5 and three protection cores with accuracy class 5P.

Item 6:

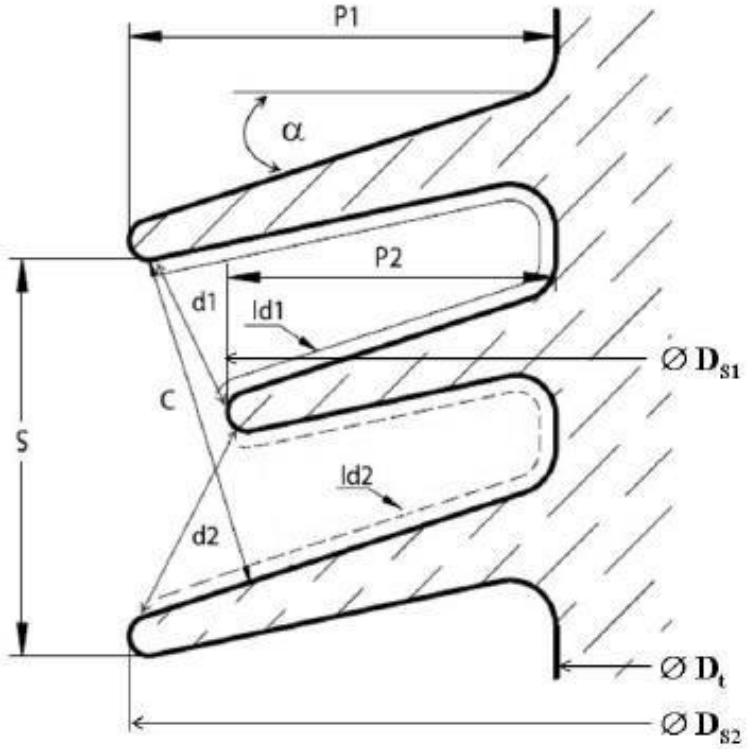
170kV, 3000/5/5/5/5A Current Transformer, with one measuring core with accuracy class 0.5 and three protection cores with accuracy class 5P.

4.2 APPENDIX 2 - DESIGN AND CONSTRUCTION

COMPOSITE &PORCELAIN INSULATOR - ALTERNATE-SHEDS

Flat Alternating Sheds

The profile parameters shall be according to the following values



P_1-P_2	> 15 mm
S/P_1	> 1
C	> 70 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.

K_{ad}: Correction factor for insulator diameter of the RUSCD.

USCD: Unified specific creepage distance phase to ground.

D_a: $(D_{s1} + D_{s2} + 2D_t)/4$.

L: Creepage Distance.

A: Arcing Distance.

4.3 APPENDIX 3 - NAMEPLATE EXAMPLE

Current Transformer

Product Year : Material no: Order no:

Um = 170 kV 50 Hz IEC 61869-2

170 / 325 /750 kV Ith = 50.0 kA / 1 s Idyn = 125 kA Icth = 120 %

-5 .... 50 °C

100	/	5	A	0.2SFS5 30VA	1S1...1S2
200	/	5	A	0.2SFS5 30VA	1S1...1S3
100	/	5	A	0.2SFS5 30VA	2S1...2S2
200	/	5	A	0.2SFS5 30VA	2S1...2S3
100	/	5	A	0.2SFS5 30VA	3S1...3S2
200	/	5	A	0.2SFS5 30VA	3S1...3S3
100	/	5	A	5P30 60VA	4S1...4S2
200	/	5	A	5P30 60VA	4S1...4S3

Transportation:

Static/ static+dynamic load: 2700/6700 N

Seismic qualification: 0.5 g

Tanδ value: ≤ 0.005

Specification:

Weight : Oil:

4.4 APPENDIX 4 - INSULATION OIL REQUIREMENTS

1.	The CT oil shall meet the requirements indicated in:		IEC 60296
1.1.	The mixability between oils must be in accordance with:		• IEC 60296 • IEC 60422
1.2.	**Requirements for Insulation Oil:**		
#	**Property**	**Test method**	**Limits**
1.2.1.	**Function**		
1.2.1.1.	Viscosity at 40 °C	ISO 3104	Max. 12 mm²/s
1.2.1.2.	Viscosity at -30 °C	ISO 3104	Max. 1 800 mm²/s
1.2.1.3.	Pour point	ISO 3016	Max. -40 °C
1.2.1.4.	Water content	IEC 60814	Max. 30 mg/kg [a]/40 mg/kg [b]
1.2.1.5.	Breakdown voltage	IEC 60156	Min. 30 kV/70 kV [c]
1.2.1.6.	Density at 20 °C	ISO 3675 or ISO 12185	Max. 0.895 g/ml
1.2.1.7.	DDF at 90 °C	IEC 60247 or IEC 61620	Max. 0.005
1.2.2.	**Refining/stability**		
1.2.2.1.	Appearance		Clear, free from sediment and suspended matter
1.2.2.2.	Acidity	IEC 62021-1	Max. 0.01 mg KOH/g
1.2.2.3.	Interfacial tension	EN 14210 or ASTM D971	Min. 40 mN/m
1.2.2.4.	Corrosive sulfur	DIN 51353	Not corrosive
1.2.2.5.	Anti-oxidant inhibitor	IEC 60666	0.08 - 0.40%
1.2.2.6.	Dibenzyl Disulfide (DBDS)	IEC 62697-1	Not detectable (<5 mg/kg)
1.2.2.7.	Metal passivators additives according to:	IEC 60666	Not detectable (<0.05 mg/kg)
1.2.2.8.	2-Furfural content	IEC 61198	Non-detectable (<0.05 mg/kg)
1.2.3.	**Performance**		
1.2.3.1.	Oxidation stability [f]	IEC 61125 (method C) Test duration: 500 h	
1.2.3.2.	Total acidity [f]	IEC 61125	Max. 1.2 mg KOH/g
1.2.3.3.	Sludge [f]	IEC 61125	Max. 0.8%
1.2.3.4.	DDF at 90 °C [f]	IEC 61125	Max. 0.5
1.2.4.	**Health, safety, and environment**		
1.2.4.1.	Flash point	ISO 2719	Min. 135 °C
1.2.4.2.	PCA content	BS 2000 Part 346	Max. 3%
1.2.4.3.	PCB content	IEC 61619	Not detectable (<2 mg/kg)

1.2.4.4	[a] For bulk supply, [b] For delivery in drums, [c] After laboratory treatment,	[d] Information must be provided [e] At the end of oxidation stability test [f] To be performed at the end of oxidation stability test.
1.3	**Requirements for Insulation Oil After Filling a New Electrical Equipment prior to Energization:**	
1.3.1.	Appearance	Clear, free from sediment and suspended matter
1.3.2.	Colour (on scale given in ISO 2049)	Max. 2.0
1.3.3.	Breakdown voltage [kV]	>60
1.3.4.	Water content [mg/kg] [g]	< 10
1.3.5.	Acidity [mg KOH/g]	Max. 0.03
1.3.6.	DDF at 90°C and 40 to 60 Hz	Max. 0.015
1.3.7.	Resistivity at 90°C [GΩm]	Min. 60
1.3.8.	Interfacial tension [mN/m]	Min. 35
1.3.9.	Total PCB content [mg/kg] [h]	Not detectable (< 2 total)
1.3.10.	Particles (counting, sizing)	Should be made as baseline for future comparation
1.3.11.	Inhibitor content [h]	0.25-0.4%
1.3.12.	Total gas content according to IEC 61181 [i]	< 1%
1.3.13.	DGA according to IEC 61181	-
1.3.14.	[g] The values should be without temperature correction. [h] Shall be similar to the value before first filling. [i] By vacuum extraction.	
1.3.15.	The CT oil COT shall be approved by Purchaser before delivery according:	IEC 60296