

# CERTIFICATE OF ACCREDITATION

## Hyosung Heavy Industries Corporation

Accreditation No. : KT940

Corporation Registration No. : 110111-6770154

Address of (Branch site) 171, Yeondeok-ro, Seongsan-gu, Changwon-si,  
Laboratory : Gyeongsangnam-do, Republic of Korea

Date of Initial Accreditation : April 01, 2021

Validity of Accreditation : April 01, 2021 ~ March 31, 2025

Scope of Accreditation : Attached Annex

Date of issue : April 01, 2021

This testing laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025 : 2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to Joint ISO-ILAC-IAF Communiqué).



*Sanghoon Lee*

**Head**

**Korea Laboratory Accreditation Scheme**

# Korea Laboratory Accreditation Scheme

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## 03. Electrical Testing

### 03.003 High Power, High Voltage Test

Test method	Standard designation	Test range	Site	Field testing
IEC 60060-1:2010	High-voltage test techniques - Part 1: General definitions and test requirements 6. Tests with alternating voltage 7. Tests with lightning-impulse voltage 8. Tests with switching-impulse voltage	6. Max. 1 400 kV 7. Max. 2 475 kV 8. Max. 1 800 kV	BS	N
IEC 60076-10:2016	Power transformers Part 10: Determination of sound levels	(25 ~ 140) dB(A)	BS	N
IEC 60076-18:2012	Power transformer Part 18: Measurement of frequency response	10V, 10 Hz ~ 2 MHz	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEC 60076-1:2011	Power transformers Part 1: General 11.1.3.e) Measurement of no-load loss and current at 90 % and 110 % of rated voltage 11.1.4) - Measurement of dissipation factor (tan $\delta$ ) of the insulation system capacitances - Measurement of d.c. insulation resistance each winding to earth and between windings - Special tests - Sweep Frequency Response Analysis 11.1.4.b) Winding hot-spot temperature-rise measurements 11.2) Measurement of winding resistance 11.3) Measurement of voltage ratio and check of phase displacement 11.4) Measurement of short-circuit impedance and load loss 11.5) Measurement of no-load loss and current 11.6) Measurement of zero-sequence impedance(s) on three-phase transformers 11.7) Tests on on-load tap-changers - Operation test 11.12) Check of core and frame insulation	11.1.3.e) Max. 4 000 A, 100 kV 11.1.4) P.F : Max. 10 kV, (0 ~ 5) % Insulation Resistance : D.C (250 ~ 5 000) V, 10 M $\Omega$ ~ 1 T $\Omega$ SFRA : 10 Hz to 2 MHz 11.1.4.b) Max. 4 000 A, 100 kV 11.2) 1 m $\Omega$ ~ 10 $\Omega$ 11.3) 1/1 ~ 700/1 (Ratio), Max. 600V (Phase displacement) 11.4) Max. 4 000 A, 100 kV 11.5) Max. 4 000 A, 100 kV 11.6) Max. 4 000 A, 100 kV 11.7) Max. 4 000 A, 1 200 kV 11.12) D.C (250 ~ 5 000) V, 10 M $\Omega$ ~ 1 T $\Omega$	BS	N
IEC 60076-2:2011	Power transformers Part 2: Temperature rise for liquid-immersed transformers	Max. 4 000 A, 100 kV, 200 $^{\circ}$ C	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEC 60076-3:2013	Power transformers Part 3: Insulation levels, dielectric tests and external clearances in air 10) Applied voltage test (AV) 11) Induced voltage tests (IVW and IVPD) 12) Line terminal AC withstand test (LTAC) 13) Lightning impulse tests (LI, LIC, LIN, LIMT) 14) Switching impulse test (SI)	10) Max. 570 kV 11) Max. 1 386 kV, Min. 0.1 pC 12) Max. 570 kV (P-G) 13) Max. 2 475 kV 14) Max. 1 800kV	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEC 60076-6:2007	Power transformers Part 6: Reactors 7.8.2) - Routine tests -Measurement of dissipation factor ( $\tan \delta$ ) of the insulation system capacitances -Measurement of d.c. insulation resistance each winding to earth and between windings -Measurement of winding resistance 7.8.5) Determination of reactance and linearity of reactance 7.8.6) Measurement of loss 7.8.7) Measurement of harmonics of the current 7.8.8) Measurement of zero-sequence reactance on three-phase reactors 7.8.9) Measurement of mutual reactance on three-phase reactors 7.8.10.2) Separate source a.c. withstand voltage test 7.8.10.3) Induced a.c. withstand voltage test 7.8.10.4) Lightning impulse test 7.8.10.6) Switching impulse test 7.8.12) Measurement of acoustic sound level 7.8.13) Measurement of vibration 7.8.14) Temperature rise test	7.8.2) P.F : Max. 10 kV, (0 ~ 5) % Insulation Resistance : D.C (250 ~ 5 000) V, 10 M $\Omega$ ~ 1 T $\Omega$ Winding Resistance : 1 m $\Omega$ ~ 10 $\Omega$ 7.8.5) Max. 500 A, Max. 300 kV 7.8.6) Max. 500 A, Max. 300 kV 7.8.7) Max. 500 A, Max. 300 kV 7.8.8) Max. 4 000 A, 100 kV 7.8.9) Max. 500 A, Max. 300 kV 7.8.10.2) Max. 570 kV 7.8.10.3) Max. 1 386 kV, Min. 0.1 pC 7.8.10.4) Max. 2 475 kV 7.8.10.6) Max. 1 800 kV 7.8.12) (25 ~ 140) dB(A) 7.8.13) Max 200 mm 7.8.14) Max. 500 A, Max. 300 kV	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEC 62271-100:2017	High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers 6.2.6.1 Power-frequency voltage tests 6.2.6.2 Lightning impulse voltage tests 6.2.7.1 Power-frequency voltage tests 6.2.7.2 Switching impulse voltage tests 6.2.7.3 Lightning impulse voltage tests 6.4 Measurement of the resistance of the main circuits 6.101 Mechanical and environmental tests 7.1 Dielectric test on the main circuit 7.3 Measurement of the resistance of the main circuit 7.101 Mechanical operation tests	6.2.6.1 Max. 530 kV 6.2.6.2 Max. 1 200 kV 6.2.7.1 Max. 1 270 kV 6.2.7.2 Max. 2 420 kV 6.2.7.3 Max. 2 555 kV 6.4. 1 $\mu\Omega$ ~ 1 k $\Omega$ 6.101 Temperature : -50 °C ~ +50 °C, Humidity : (30 ~ 95) % R.H. 7.1 Max. 960 kV 7.3 1 $\mu\Omega$ ~ 1 k $\Omega$ 7.101 (10 ~ 10 000) ms	BS	N
IEC 62271-102:2018	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches 7.2.7 Power-frequency voltage tests Lightning impulse voltage tests 7.2.8 Power-frequency voltage tests Switching impulse voltage tests Lightning impulse voltage tests 7.4 Resistance measurement 7.104 Low- and high-temperature tests 8.2 Dielectric test on the main circuit 8.4 Measurement of the resistance of the main circuit 8.101 Mechanical operation tests	7.2.7 Power-frequency : Max. 530 kV Lightning impulse : Max. 1 200 kV 7.2.8 Power-frequency : Max. 1 270 kV Switching impulse : Max. 2 420 kV Lightning impulse : Max. 2 555 kV 7.4 1 $\mu\Omega$ ~ 1 k $\Omega$ 7.104 Temperature : -50 °C ~ +50 °C, Humidity : (30 ~ 95) % R.H. 8.2 Max. 960 kV 8.4 1 $\mu\Omega$ ~ 1 k $\Omega$ 8.101 (10 ~ 10 000) ms	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEC 62271-1:2017	High-voltage switchgear and controlgear - Part 1: Common specifications for alternating current switchgear and controlgear 7.2.7.2 Power-frequency voltage tests 7.2.7.3 Lightning impulse voltage tests 7.2.8.2 Power-frequency voltage tests 7.2.8.3 Switching impulse voltage tests 7.2.8.4 Lightning impulse voltage tests 7.4.4 Resistance measurement of contacts and connections in the main circuit as a condition check 8.2 Dielectric test on the main circuit 8.4 Measurement of the resistance of the main circuit	7.2.7.2 Max. 530 kV 7.2.7.3 Max. 1 200 kV 7.2.8.2 Max. 1 270 kV 7.2.8.3 Max. 2 420 kV 7.2.8.4 Max. 2 555 kV 7.4.4 1 $\mu\Omega$ ~1 k $\Omega$ 8.2 Max. 960 kV 8.4 1 $\mu\Omega$ ~1 k $\Omega$	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEC 62271-203:2011	High-voltage switchgear and controlgear - Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV 6.2.6.1 Power-frequency voltage tests 6.2.6.2 Lightning impulse voltage tests 6.2.7.1 Power-frequency voltage tests 6.2.7.2 Switching impulse voltage tests 6.2.7.3 Lightning impulse voltage tests 6.4.1 Measurement of the resistance of circuits - main circuit 6.102 Mechanical and environmental tests 7.1.101 Power-frequency voltage tests on the main circuit 7.3 Measurement of the resistance of the main circuit 7.102 Mechanical operation tests	6.2.6.1 Max. 530 kV 6.2.6.2 Max. 1 200 kV 6.2.7.1 Max. 1 270 kV 6.2.7.2 Max. 2 420 kV 6.2.7.3 Max. 2 555 kV 6.4.1 1 $\mu\Omega$ ~1 k $\Omega$ 6.102 Temperature : -50 °C ~ +50 °C, Humidity : (30 ~ 95) % R.H. 7.1.101 Max. 960 kV 7.3 1 $\mu\Omega$ ~1 k $\Omega$ 7.102 (10 ~ 10 000) ms	BS	N
IEC 62501:2017	Voltage sourced converter (VSC) valves for high-voltage direct current (HVDC) power transmission - Electrical testing 7.3.3) Dielectric test on valve support structure(Switching impulse voltage tests) 7.3.4) Dielectric test on valve support structure(Lightning impulse voltage tests)	7.3.3) Max 1 550 kV 7.3.4) Max 2 100 kV	BS	N
IEC 62927:2017	Voltage sourced converter (VSC) valves for static synchronous compensator (STATCOM) - Electrical testing 7.3.3) Dielectric test on valve support structure(Lightning impulse voltage tests)	7.3.3) Max 2 100 kV	BS	N



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Test method	Standard designation	Test range	Site	Field testing
IEEE Std C37.09:2018	IEEE Standard Test Procedures for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V 4.4.7 Measurement of the resistance of the main circuit 4.5.4.1 Power-frequency withstand voltage test - Dry test procedure 4.5.5 Full-wave lightning impulse withstand voltage tests 4.5.8 Switching impulse voltage withstand tests 4.13 Mechanical endurance and environmental tests 5.11 Mechanical operation tests 5.12 Timing tests 5.14 Electrical resistance of current path test 5.15 Power-frequency withstand voltage tests on major insulation components	4.4.7 1 $\mu\Omega$ ~1 k $\Omega$ 4.5.4.1 Max. 1 270 kV 4.5.5 Max. 2 555 kV 4.5.8 Max. 2 420 kV 4.13 Temperature : -50 $^{\circ}$ C ~ +50 $^{\circ}$ C, Humidity : (30 ~ 95) % R.H. 5.11 (20 ~ 300) V 5.12 (10 ~ 10 000) ms 5.14 1 $\mu\Omega$ ~1 k $\Omega$ 5.15 Max. 960 kV	BS	N
IEEE Std C37.100.1:2018	IEEE Standard of Common Requirements for High Voltage Power Switchgear Rated Above 1000 V 7.3.7.2 Power-frequency voltage tests 7.3.7.3 Lightning impulse voltage tests 7.3.8.2 Power-frequency voltage tests 7.3.8.3 Switching impulse voltage tests 7.3.8.4 Lightning impulse voltage tests 7.5.1 Measurement of the resistance of circuits - main circuit 8.2 Dielectric test on the main circuit 8.4 Measurement of the resistance of the main circuit	7.3.7.2 Max. 530 kV 7.3.7.3 Max. 1 200 kV 7.3.8.2 Max. 1 270 kV 7.3.8.3 Max. 2 420 kV 7.3.8.4 Max. 2 555 kV 7.5.1 1 $\mu\Omega$ ~1 k $\Omega$ 8.2 Max. 960 kV 8.4 1 $\mu\Omega$ ~1 k $\Omega$	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEEE Std C37.122:2010	IEEE Standard for High Voltage Gas-Insulated Substations Rated Above 52 kV 6.2.6.1 Power-frequency voltage tests 6.2.6.2 Lightning impulse voltage tests 6.2.7.1 Power-frequency voltage tests 6.2.7.2 Switching impulse voltage tests 6.2.7.4 Lightning impulse voltage tests 6.4 Measurement of the resistance of circuits 6.11 Mechanical and environmental tests 7.1.1 Power-frequency withstand voltage test 7.3 Measurement of the resistance of the main circuit 7.6 Mechanical operation tests	6.2.6.1 Max. 530 kV 6.2.6.2 Max. 1 200 kV 6.2.7.1 Max. 1 270 kV 6.2.7.2 Max. 2 420 kV 6.2.7.4 Max. 2 555 kV 6.4. 1 $\mu\Omega$ ~ 1 k $\Omega$ 6.11 Temperature : -50 °C ~ +50 °C, Humidity : (30 ~ 95) % R.H. 7.1.1 Max. 960 kV 7.3 1 $\mu\Omega$ ~ 1 k $\Omega$ 7.6 (10 ~ 10 000) ms	BS	N
IEEE Std C57.12.00:2015	IEEE Standard for General Requirement for Liquid-Immersed Distribution, Power, and Regulating Transformers 5.11) Temperature-rise tests Table17) Check of core and frame insulation	5.11) Max. 4 000 A, 100 kV, 200 °C D.C (250 ~ 5 000) V, 10 M $\Omega$ ~ 1 T $\Omega$	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEEE Std C57.12.90:2015	IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers 5) Resistance measurements 5.11) Temperature rise and loading conditions 6) Polarity and phase-relation tests 7) Ratio tests 8) No-load losses and excitation current 9) Load losses and impedance voltage 9.5) Zero-phase-sequence impedance 10.2) Switching Impulse Test 10.3) Lightning impulse test procedures 10.6) Applied voltage tests 10.8) Induced-voltage test for Class II power transformers 10.9) Partial discharge measurement 10.10) Insulation power-factor tests 10.11) Insulation resistance tests 11) Temperature-rise tests 13) Determination of sound levels	5) 1 mΩ ~ 10 Ω 5.11) Max. 4 000 A, 100 kV 6) Max. 600 V (Phase displacement) 7) 1/1 ~ 700/1 (Ratio) 8) Max. 4 000 A, 100 kV 9) Max. 4 000 A, 100 kV 9.5) Max. 4 000 A, 100 kV 10.2) Max. 1 700 kV 10.3) Max. 2 255 kV 10.6) Max. 518 kV 10.8) Max. 885 kV (P-G) 10.9) Min. 0.1 pC 10.10) Max. 10 kV, (0 ~ 5) % 10.11) D.C (250 ~ 5 000) V, 10 MΩ ~ 1 TΩ 11) Max. 4 000 A, 100 kV, 200 °C 13) (25 ~ 140) dB(A)	BS	N
IEEE Std C57.149:2012	IEEE Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers	10 V, 10 Hz ~ 2 MHz	BS	N

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Test method	Standard designation	Test range	Site	Field testing
IEEE Std C57.21:2008	IEEE Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA 3.4.1) Impedance 3.4.2) Total losses 7) Losses and impedance 7.2.3) Zero-sequence impedance 8) Temperature rise 9.1.1.h) Routine tests- Measurement of d.c. insulation resistance each winding to earth and between windings 9.1.2) Applied-voltage test 9.1.3.1) Low-frequency overvoltage test for oil-immersed shunt reactors 9.1.4) Lightning impulse test 9.1.5) Insulation power factor test 9.2.4) Switching impulse test 10.1) General- Measurement of mutual reactance on three-phase reactors 10.2.4) Conversion of resistance measurements 10.3.10) Insulation power factor tests 10.5) Temperature rise test 10.6) Measurement of acoustic sound level 10.7) Measurement of vibration	3.4.1) Max. 500 A, Max. 300 kV 3.4.2) Max. 500 A, Max. 300 kV 7) Max. 500 A, Max. 300 kV 7.2.3) Max. 4 000 A, 100 kV 8) Max. 500 A, Max. 300 kV 9.1.1.h) D.C (250 ~ 5 000) V, 10 MΩ ~ 1 TΩ 9.1.2) Max. 518 kV 9.1.3.1) Max. 885 kV (P-G), Min 0.1 pC 9.1.4) Max. 2 255 kV 9.1.5) Max. 10 kV, (0 ~ 5) % 9.2.4) Max. 1 700 kV 10.1) Max. 500 A, Max. 300 kV 10.2.4) 1 mΩ ~ 10 Ω 10.3.10) Max. 10 kV, (0 ~ 5) % 10.5) Max. 500 A, Max. 300 kV, 200 °C 10.6) 25 ~ 140 dB(A) 10.7) Max 200 μm	BS	N

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Test method	Standard designation	Test range	Site	Field testing
KS C IEC 60076-1:2013	Power transformers Part 1: General 11.2) Measurement of winding resistance 11.3) Measurement of voltage ratio and check of phase displacement 11.4) Measurement of short-circuit impedance and load loss 11.5) Measurement of no-load loss and current 11.6) Measurement of zero-sequence impedance(s) on three-phase transformers 11.7) Tests on on-load tap-changers - Operation test 11.12) Check of core and frame insulation	11.2) 1 mΩ ~ 10 Ω 11.3) 1/1 ~ 700/1 (Ratio), Max. 600 V (Phase displacement) 11.4) Max. 4 000 A, 100 kV 11.5) Max. 4 000 A, 100 kV 11.6) Max. 4 000 A, 100 kV 11.7) Max. 4 000 A, 1 200 kV 11.12) D.C (250 ~ 5 000) V, 10 MΩ ~ 1 TΩ	BS	N

End.