



# Review of IEEE C57.32, Standard Requirements, Terminology and Test Procedures for Neutral Grounding Devices

-- Technical Presentation --  
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By Sheldon Kennedy, Michael Sharp, Donald Ayers, Klaus Pointner, and Thomas Melle

## 1. Abstract

The tutorial will cover the following topics:

- History of IEEE 32 and the path forward with the migration / update to IEEE PC57.32 Standard Requirements, Terminology and Test Procedures for Neutral Grounding Devices.
- Overview of standard updates, tests and requirements.
- Grounding Reactors
- Grounding Transformers
- Ground Fault Neutralizers
- Grounding Resistors
- Combination Devices
- An explanation of the Test Annex section of the newly updated IEEE PC32 Draft Standard for Neutral Grounding Devices.

In the first part, Sheldon Kennedy from Niagara Transformer Corp will present a brief review of the history of IEEE 32 and the updating to IEEE C57.32 -- Standard Requirements, Terminology and Test Procedures for Neutral Grounding Devices. Requirements and challenges in designing these devices will be discussed. Sheldon will present an overview of grounding resistors and combination devices. Requirements of the devices and updates of the Grounding Resistor section and Combination Devices section will be discussed.

Michael Sharp from Trench Limited in Canada will present a brief overview of grounding reactors. Requirements of the devices and updates to the Grounding Reactor section will be discussed.

Donald Ayers, of Ayers Transformer Consulting, LLC, will provide a review of the changes made to the grounding transformer section. Standards updates and requirements will be discussed.

Klaus Pointner from Trench Group in Austria will present a brief overview of ground fault neutralizers. Requirements of the devices and updates of the ground fault neutralizer section will be discussed.

Thomas Melle from HIGHVOLT USA will present a brief review of Annex A to discuss the old test procedures and temperature rise calculations.

## 2. Learning Objectives

This presentation will help engineers understand the purpose and variety of neutral grounding devices that may be used. The presentation will also help engineers understand how the standards have evolved from the 1930's to the present.

## 3. Learning Outcomes

As a result of attending this tutorial session, members will gain an understanding of the following:

- The history and evolution of the standard for neutral grounding devices.
- Overview of the different devices available for neutral grounding.
- Potential pros and cons of each device.

## 4. Presenters' Biographies

**Sheldon P. Kennedy** has 42 years of electrical engineering experience. He has been Vice President Engineering since 1988 with Niagara Transformer Corp., a small power and medium power liquid filled transformer manufacturer, as well as for special application transformers, including grounding transformers, motor drive transformers, rectifier transformers and furnace transformers. He was Engineering Manager at Niagara Transformer from 1985 to 1988. Prior to that he had been Chief Electrical Engineer at R.E.Uptegraff Manufacturing for four years. He has also been a Transmission Substation Engineer and Rate Engineer for four years with Allegheny Power. Prior to that he was in Division Distribution Engineering with West Penn Power Company for four years. He was also an electrical engineering trainee for six months with the US Steel Corporation in the coal mining division. He was also a part time lecturer in Electrical Engineering at the Penn State Fayette Campus for four years. He is a Senior Member of IEEE, an IEEE Transformers Committee member, serving on many subcommittees, working groups, task forces, and as Chair of C57.32 Neutral Grounding Devices, past Chair of C57.52 Sealed Dry Type Transformers and past and current Chair of C57.18.10 Rectifier Transformers. He has been Chairman of the NEMA Transformer Section and Chairman of Accredited Standards Committee C57-Transformers, Regulators and Reactors. Also, as a member of the IEEE Industry Applications Society (IAS), Petroleum and Chemical Industry Conference (PCIC), he has served as Chairman of the Electrochemical Subcommittee. He is also the Converter Transformer Expert for the ANSI US National Committee, TC 14, to IEC, the International Electrotechnical Commission. He has authored several IEEE papers, a Doble conference paper, and the chapter on rectifier transformers in the CRC book, "Electric Power Transformer Engineering". He received a BSEE from the Pennsylvania State University and is a registered Professional Engineer.

**Michael R. Sharp** was born in Oshawa, Ontario, Canada, October 23, 1956. He obtained his B.A.Sc. degree in Electrical Engineering at the University of Toronto in 1979. Two years later he became a Registered Professional Engineer in the Province of Ontario.

Immediately after graduating he joined Trench Electric as an air-core reactor design engineer. He became Technical Leader of the Shunt and Filter Reactor design group in 1982, and in 1987 assumed the role of Engineering Manager responsible for the design and manufacture of all air-core reactors. In 2010, Mr. Sharp's responsibility was broadened to include directing Trench Limited's Reactor Research and Development programs in Toronto and in 2012 all Coil Project Management activities were added to his portfolio.

Mr. Sharp has written and presented several papers concerning the design and application of air-core reactors for power transmission and distribution systems and industry applications. He has also contributed to a number of industry standard power engineering and power transformer applications books.

As an IEEE committee member he actively participated in the update of the IEEE C57.21 -2008 Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA, IEEE C57.16 -2011 Standard Requirements, Terminology and Test Code for Dry-Type Air-Core Series-Connected Reactors and IEEE 1277 -2010 Standard General Requirements and Test Code for Dry-Type and Oil-Immersed Smoothing Reactors for DC Power Transmission. Mr. Sharp is currently chairman of the IEEE HVDC Converter Transformers and Smoothing Reactors Subcommittee.

**Donald E. Ayers** is President of Ayers Transformer Consulting LLC that provides technical consulting services to users and manufacturers of power transformers used in the utility, industrial, construction and transit industries. Mr. Ayers has over 35 years working in the power transformer field with expanding responsibilities in the fields of engineering, manufacturing, quality and field service. Mr. Ayers was most recently Vice President of Engineering and Manufacturing for Pacific Crest Transformers between 2005 and 2011. PCT is a manufacturer of medium power oil-filled transformers including grounding transformers. Previously Mr. Ayers worked for Virginia Transformer Corp. as Quality and Field Service Manager and then as transitional Plant Manager of their Pocatello, Idaho Plant. VTC manufactures and repairs power transformers in the medium to large sizes. Mr. Ayers started his career as a transformer design engineer for Westinghouse Electric Corp. and held a variety of technical and managerial assignments. He has also worked for Smit Transformers of The Netherlands and Delta Star Transformers. Mr. Ayers received his BS in Electrical Engineering from Oregon State University and his Masters of Business Administration from the University of Pittsburgh. He is a Senior Life Member of the Institute of Electrical and Electronic Engineers (IEEE) and is an active member of the IEEE Transformer Committee.

**Klaus Pointner** was born in Wels, Austria, April 2, 1968. He obtained his Dipl.Ing (equal to MSc) degree at the University of Applied Science in Wels in 2001. Klaus started his career immediately after graduation at the Higher Institute of Technical Education for Electrical Engineering in 1988 as a design engineer for air-core dry-type reactors at Spezialektra the predecessor of Trench Austria. After leading the engineering group he was head of R&D from 2006 to the end of 2013. In both functions he was heavily involved in the evolution of the air-core dry-type technology to higher voltage levels and higher rated power levels up to 800kV UHVDC Smoothing reactors and 150MVAr Transmission Class High Voltage Series Reactors.

Since beginning of 2014 he is Senior Executive Sales Manager, Marketing and Sales for Trench Group in Austria.

As an IEEE committee member he actively participated in the update of the IEEE C57.21 -2008 Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA, IEEE C57.16 -2011 Standard Requirements, Terminology and Test Code for Dry-Type Air-Core Series-Connected Reactors and IEEE 1277-2010 Standard General Requirements and Test Code for Dry-Type and Oil-Immersed Smoothing Reactors for DC Power Transmission

**Thomas R. Melle** is Sales and Service Manager for HIGHVOLT USA and Canada, a global leader in high voltage test systems and measurement equipment. Previously Tom was Project Manager for HV/EHV transformer installations with Siemens. Prior to that he was a transformer test engineer with SPX/Waukesha. He has also been a Project Engineer and Electrical Test Engineer with IBM. Tom is an IEEE Transformers Committee Member, serving on three Subcommittees and many Working Groups, Task Forces, most recently as Vice-Chair of PC57.125 and PC57.32. He currently leads the PC57.162 Task Force on *Measurement and Evaluation of moisture-in-gas Insulation Parameters* and is Secretary of the Task Force to *Investigate the Interaction between Substation Transients and Transformers in HV and EHV Applications*. He is also liaison to Cigré WG A2-45 *Transformer Failure Investigation and Post-Mortem Analysis*. Tom has presented at the Double Life of a Transformer seminar and various regional technical seminars. He is originally from the Pittsburgh, PA area, a U.S. Army Veteran, and received a BSEE from North Carolina State University in Raleigh where he continues to reside.