Westinghouse Gapless Metal Oxide Arresters

Metal Oxide as a Voltage Limiter

Basic Characteristics of Metal Oxide Ceramics.
The Westinghouse metal oxide disc, MOXIDE, is a Westinghouse exclusive development. This MOXIDE disc is made up of zinc oxide which is mixed with other metal oxides, pressed to the desired shape, and fired in a high temperature kiln. The result is a very dense ceramic non-linear resistor which has a high exponent of non-linearity.

Figure 1 gives a relative comparison of the non-linearity of metal oxide to silicon carbide (which is presently used in conventional arresters) and to a linear resistor. The greater non-linearity of metal oxide allows for the design of an arrester with **NO GAPS IN SERIES OR PARALLEL WITH THE MOXIDE DISCS.**

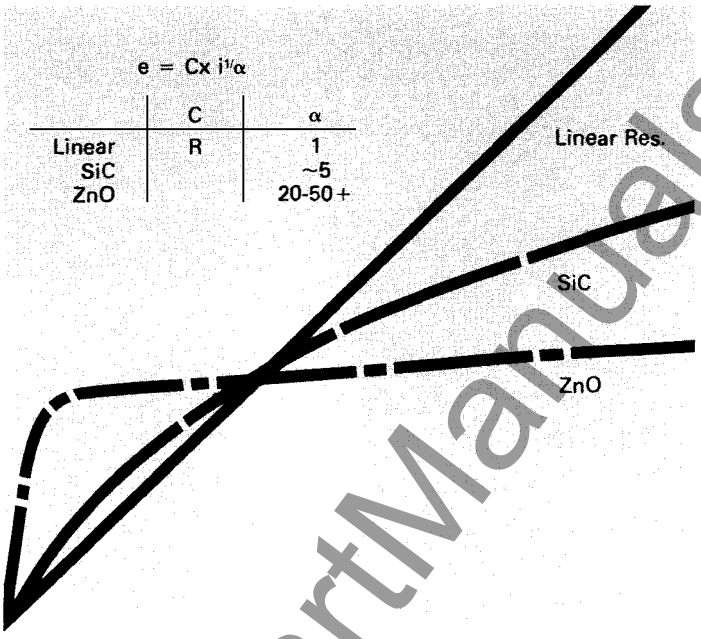


Figure 1

Advantages of Solid State Design

The totally solid state Westinghouse Metal oxide arresters have many advantages over conventional designs using series gaps or even other metal oxide arrester designs using series or parallel gaps.

Smaller
The volume of the Westinghouse metal oxide arresters is significantly less than equivalent conventional arresters. This is because the MOXIDE disc functionally replaces the gap, silicon carbide block and grading components used in conventional arresters. The result is less space required for installation.

Lighter
Due to the elimination of gap assemblies as well as possible grading components, the weights of the SMX and IMX Arresters are substantially lighter than equivalent conventional arresters. This provides for easier handling during shipment and installation.

Better Contamination Performance
The ability of an arrester to survive contamination on the external porcelain surface is affected by its internal grading circuit arrangement. The gapped conventional arrester is susceptible to random gap sparkovers and the possibility of damage due to extended power follow current if the contamination affects the ability of the internal grading system to evenly divide the line-to-ground voltage. In the SMX and IMX Arresters there are no gaps and the MOXIDE discs are capacitive when subjected to steady state voltage conditions. The highly capacitive discs effectively divide the line-to-ground voltage and compensate for the abnormal currents associated with external porcelain contamination. These MOXIDE discs change from capacitive devices to resistive devices depending upon the applied voltage. This characteristic provides good voltage distribution continuously and automatically. There are no gaps to sparkover and there is no power follow current.

Quick Response
Since the Westinghouse Arrester has no gaps, the energy of the incoming surge is absorbed immediately. When subjected to fast rising voltage surges, there is no need to consider the volt-time gap sparkover characteristic. The solid state metal oxide arrester has a much quicker transition associated with its turn on as compared to the conventional design.

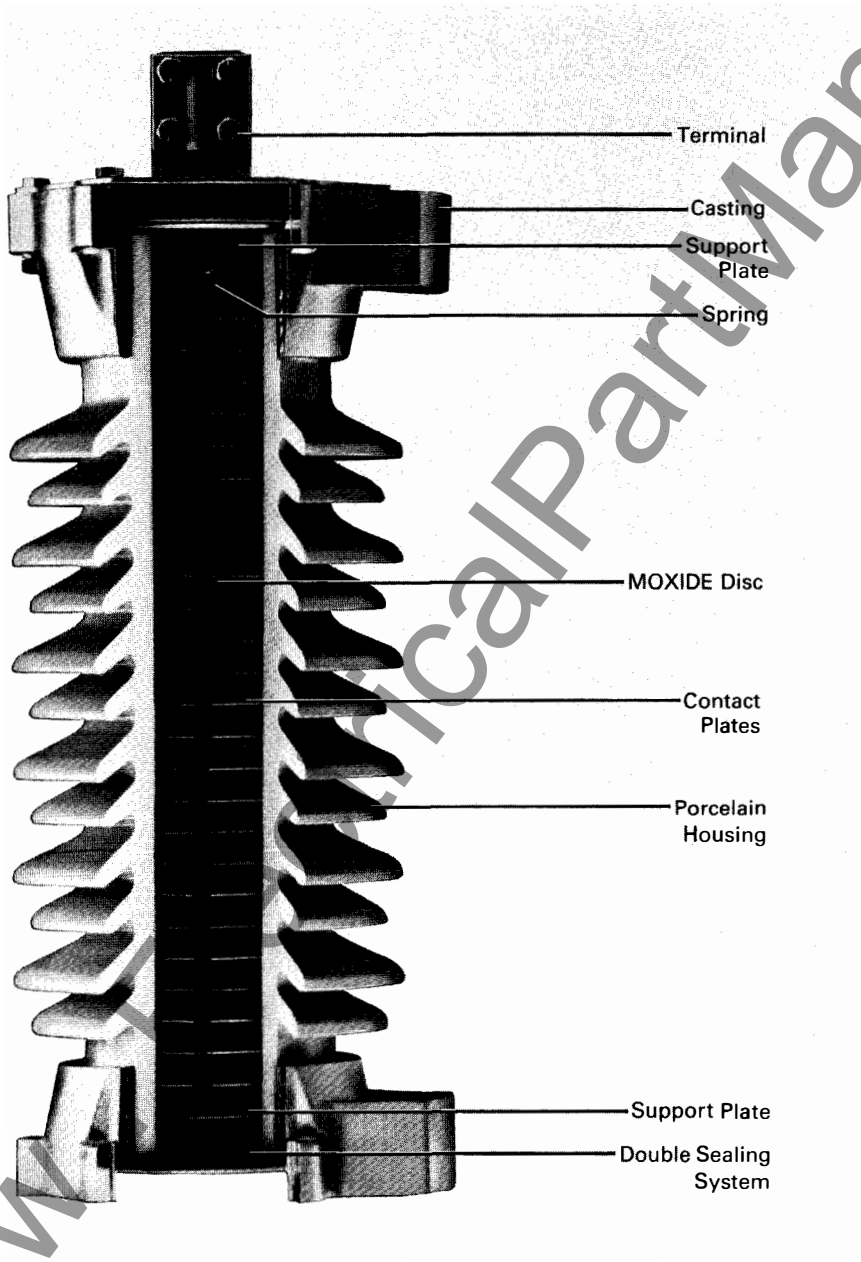
Field Testing
With a gapped arrester, the measurement of grading current at rated voltage provides information on the integrity of the grading components only. It does not provide a check of the gapped assemblies or the silicon carbide blocks. This limitation makes it extremely difficult to test conventional arresters in a field environment. Since the SMX and IMX Arresters have no gaps or grading components (other than the MOXIDE discs themselves), the leakage current can be used as an integrity check. The grading current can be monitored at the time the metal oxide arrester is installed. Since this grading current is established by the characteristics of the metal oxide disc, a significant change in the grading current at a later date would indicate that the arrester is potentially bad.

Simple, Rugged, Reliable
The Westinghouse Gapless Metal Oxide Arrester is much less complicated from a mechanical design standpoint as compared to a conventional gapped arrester. Elimination of the gaps, magnetic blowout coils, grading resistor, grading components, and control gap result in a much simpler arrester design. This simplicity results in an inherently more rugged and reliable arrester.

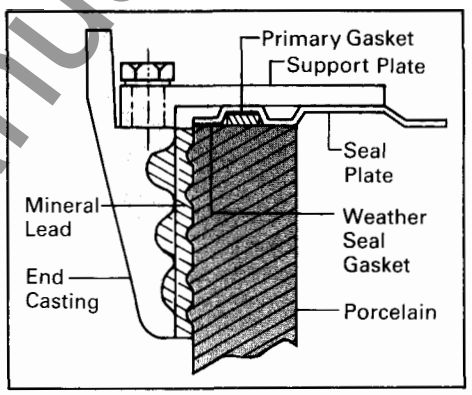
Construction

As this cutaway view shows, the internal arrangement of the Westinghouse Metal Oxide Arrester consists mainly of a stack of MOXIDE discs. In addition to the discs, special attention has been given to the internal suspension system, the sealing system, and pressure relief provisions.

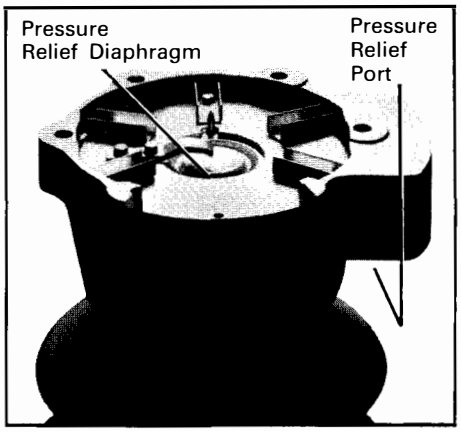
Internal Suspension System
A spring suspension system is used on the vertical axis of the arrester internal assembly to absorb shocks and vibrations caused by shipping and handling. In addition, spacer plates between each disc are designed to incorporate wall supports which protect the internal assembly against side thrusts.



Double Sealing System
A double sealing system prevents moisture from entering the arrester. First a weather seal gasket is used to protect the primary sealing gasket from the environment. The primary gasket seals the end plates to the arrester Porcelain. This neoprene gasket is confined in restraining channels and held under pressure to insure an effective seal for the life of the arrester.



Pressure Relief System
An arrester must be designed to protect equipment as well as itself. When the arrester sees more energy than it can physically handle, it must have a fail-safe method of protecting itself from catastrophic failure. The SMX and IMX Arresters are equipped with diaphragms which, in the event of an internal failure or extreme energy, expand and are punctured by a sharp object located close to each diaphragm. The gasses are then directed out of the pressure relief ports on both top and bottom allowing the arc to be established external to the porcelain. Each arrester has a diaphragm and port on both top and bottom to insure a reliable pressure relief system.



Testing Gapless Metal Oxide Arresters

The invention of gapless metal oxide arrester creates the need for changes in arrester testing procedures and provides for significant benefits to customers who wish to field test arresters to insure their ability to protect as originally designed.

Field Testing
The gapless design of the Westinghouse metal oxide arrester results in significant improvements for in-service testing. Since there are no gaps, monitoring of grading current results in a value that relates to the condition of the metal oxide disk. Figure 2 shows that the metal oxide disk has three distinct regions when subject to AC voltages.

Since the arrester should be operating in region 1 under steady state conditions, a variety of measurements can be performed in the field to verify the condition of the metal oxide disk. These include, but are not limited to, the following:

Method 1: Resistive Current Measurement at Operating Voltage

Methaod 2: Doble Testing

Method 3: Watts Loss at Operating Voltage

Method 4: Leakage Current Wave Shape

For more details of these suggested test methods the following paper is available from Westinghouse:

''Characteristics, Application & Field Testing of Westinghouse Gapless Metal Oxide Arresters, Andrew Sweetana, 1982 Doble Conference.''

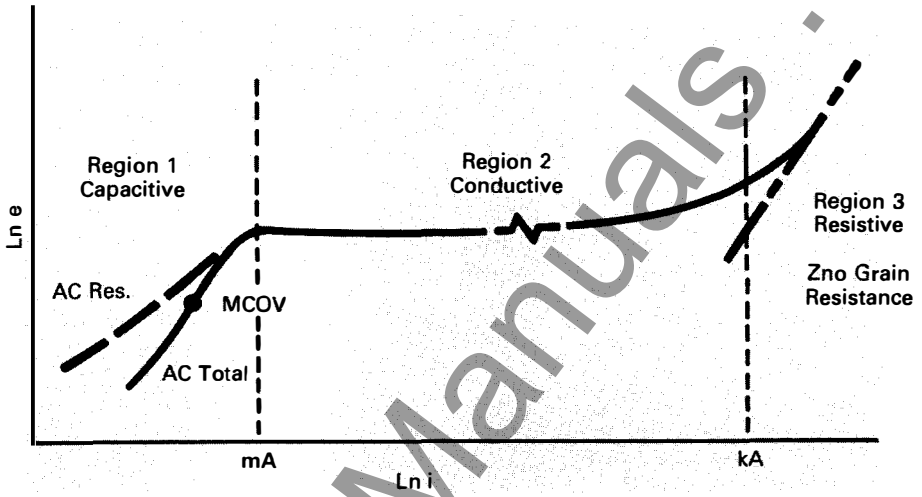


Figure 2: Typical Voltampere Characteristic of a Metal Oxide Disk

Production Tests
Each metal oxide arrester is subjected to a series of production tests to insure that it meets the required performance levels.

Seal Test:
A leak test insures the integrity of the arrester sealing system before the arrester is shipped from the factory. Every Westinghouse metal oxide arrester is evacuated and backfilled with dry air which contains trace quantities of helium. The fill tube is pinched off completing the seal of the arrester unit. The completed unit is then placed in a vacuum chamber where a sensitive helium detection system will find even the smallest leak.

Performance Tests:
All metal oxide arresters must pass the following electrical tests:

Current Impulse
Turn On Voltage
Grading Current at MCOV (Maximum Continuous Operating Voltage)
Watts Loss
Radio Influence Voltage

Design Verification Tests
The SMX and IMX Arresters were subjected to extensive testing per ANSI C62.1-1981. Certain sections of this standard have been modified by working group 3.3.11 of the IEEE Surge Protective Device Committee, to address the requirements of this standard to metal oxide arresters. The following is a list of tests conducted.

Voltage Withstand of Insulation
Discharge-Voltage-Time Characteristics
Discharge Current Withstand
Duty Cycle
Voltage Stability/Accelerated Life
Contamination Performance
Pressure Relief Capability
Mechanical Vibration
Cantilever Strength

For additional information, design test reports are available for all ratings.

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Printed in USA