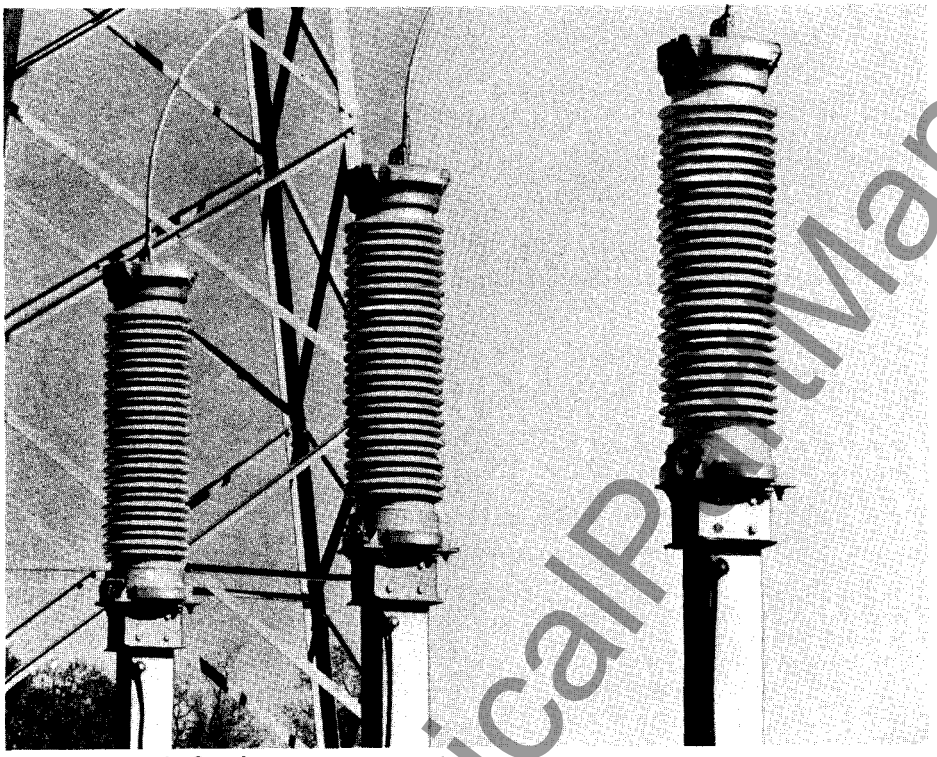
Westinghouse Electric Corporation
Distribution Apparatus Division
Bloomington, Indiana 47401

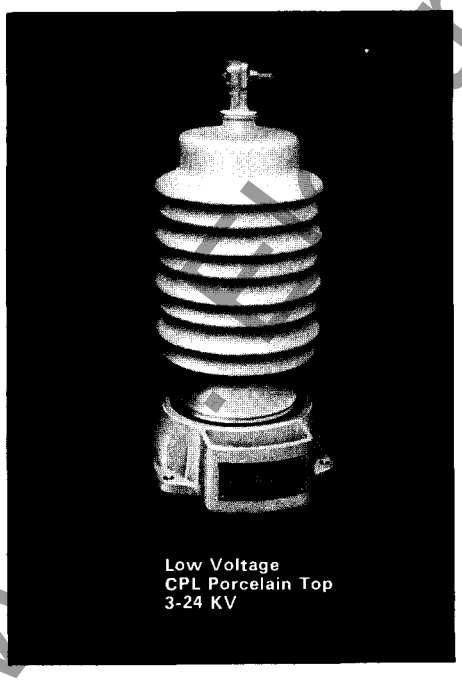
December, 1975
New Information
and Supersedes DB 38-131
Pages 1-4, dated May 1972, and 38-121
D WE A, Pages 1-4, dated April 1974
E, D, C/1981/DB

Indoor-Outdoor
Altitude 0-10,000 feet
3-468 KV

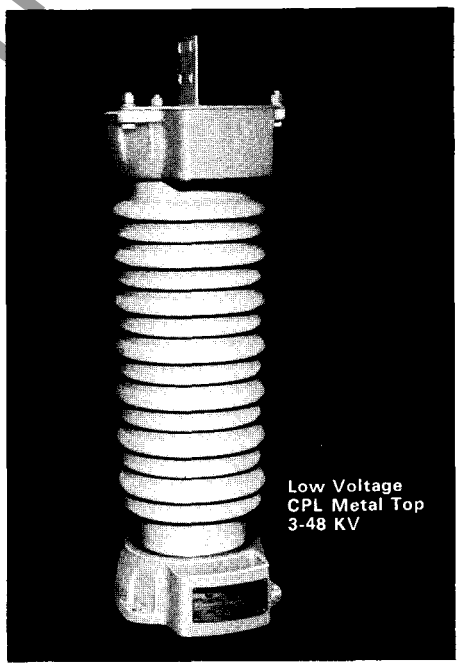
CPL Station Arrester Controlled Protective Level



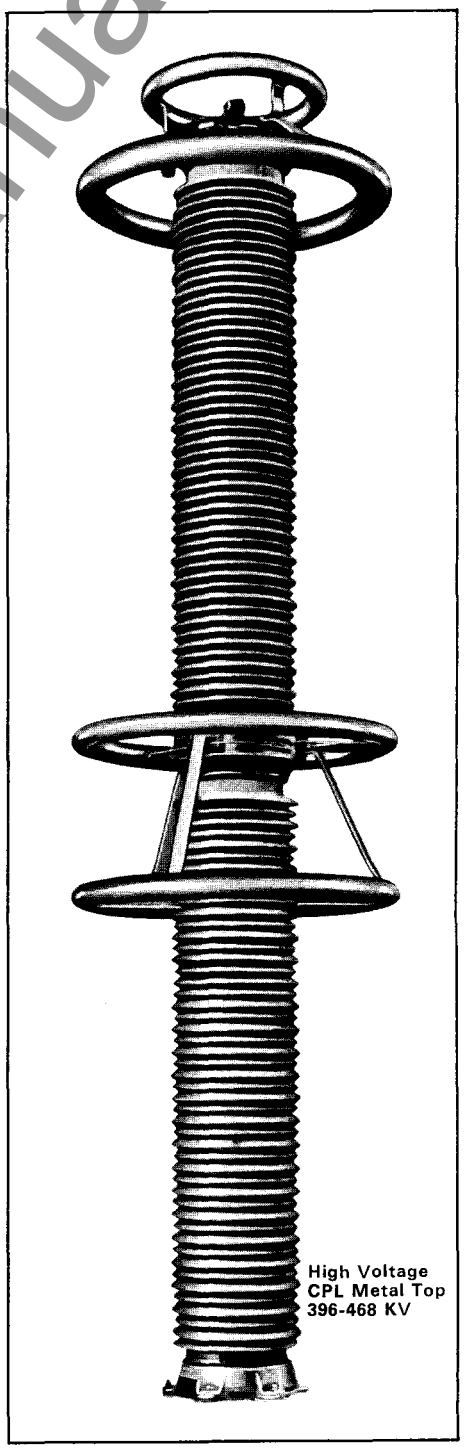
CPL Arresters in Service



Low Voltage
CPL Porcelain Top
3-24 KV



Low Voltage
CPL Metal Top
3-48 KV



High Voltage
CPL Metal Top
396-468 KV

CPL Means Protection

The CPL arrester is designed as a protective device. Its primary purpose is to protect the system insulation from damaging overvoltage surges. The secondary protective function of the CPL arrester is to protect itself from the surge currents it must discharge. The quality components and design of the CPL Station Class Arrester allow it to perform both of these functions.

Matched Components Protect a Modern System

Utilizing matched components and expert design, the new generation of Westinghouse CPL Station Class Arresters have low protective characteristics for standard ratings 3 KV through 468 KV.

Voltage control of all sparkover and discharge voltages guarantees Controlled Protective Levels to safeguard electrical insulation from lightning and switching surge transients while at the same time assuring that the switching surge discharge voltage does not exceed the switching surge sparkover voltage. Also the characteristics of the CPL Arrester make it suitable for protecting rotating machines and dry type insulation. Controlled Protective Levels make significant savings possible by reduction in transformer basic impulse insulation levels up to 3 steps reduced for systems with an effectively shielded substation and a low coefficient of grounding.

The Major Matched Components of the CPL Station Arrester are:

- Control Gap
- Interrupter Gap
- Grading Components
- Valve Elements

Control Gap

The high voltage CPL Arrester (60-468 KV) has parallel path gaps which separate the voltage sensing and current interruption functions of an arrester's gaps. This technology results in a level of arrester sparkover and reliability formerly unattainable with conventional arresters. Conventional arresters have gaps which perform the dual role of voltage sensing and current interruption while the high voltage CPL uses a separate control gap and interrupter gaps. The control gap serves as the voltage sensing, measuring, and triggering device and is located out of the power interruption path. It is connected in parallel with an interrupter gap and is not involved in the energy dissipating and current extinguishing duty.

The interrupter gap serves as the energy dissipation and power follow current interruption device.

The control gap is the key element in controlling switching surge sparkover.

The parallel path circuit of the high voltage CPL assures that the control gap will retain its precise sparkover characteristics. The control gap is made with planar electrodes hermetically sealed to the ends of an alumina ceramic tube and filled with a tritium preionizing agent.

The large electrodes produce a uniform electric field that is not polarity sensitive. The electrode to ceramic hermetic seal assures a precision control gap for the life of the arrester.

The low voltage CPL Arrester (3-48 KV) uses conventional gap circuitry with the interrupter gap preforming both the voltage sensing and current extinguishing duties.

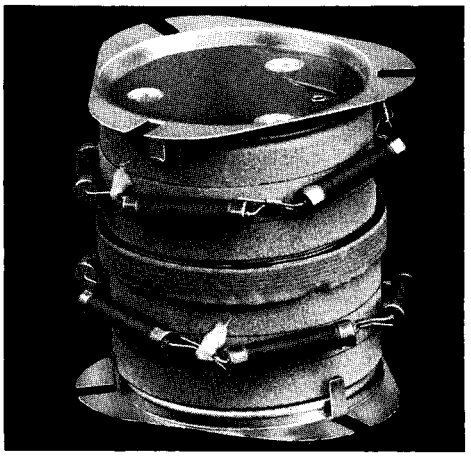
Control Gap

Interrupter Gap Assemblies

The current-limiting interrupter gap coordinates with the valve element to assure that the total arrester voltage does not exceed the maximum switching surge sparkover voltage even when producing back voltage to reduce the amount of energy that the arrester is required to absorb.

The interrupter gap assembly consists of permeable ceramic gap plates that cool and assist in the interruption of the arc which is extended between horn shaped copper electrodes. The interrupter gap assembly also includes ceramic slab preionizers to insure consistent sparkover levels. The self-bonded magnetic drive coil stretches the arc between the ceramic gap plates, and the interruption of the power follow current is accomplished within a fraction of a half cycle.

Interrupter Gap Assembly
High Voltage CPL (60-468 KV)



Interrupter Gap Assembly
Low Voltage CPL (3-48 KV)

The interrupter gap assembly for the low voltage CPL includes grading resistors as well as gap sections and a magnetic blowout coil. In the high voltage CPL the interrupter gap assembly includes only the gap sections and magnetic blowout coil.

Grading Capacitor
High Voltage CPL

Grading Resistor
High Voltage CPL

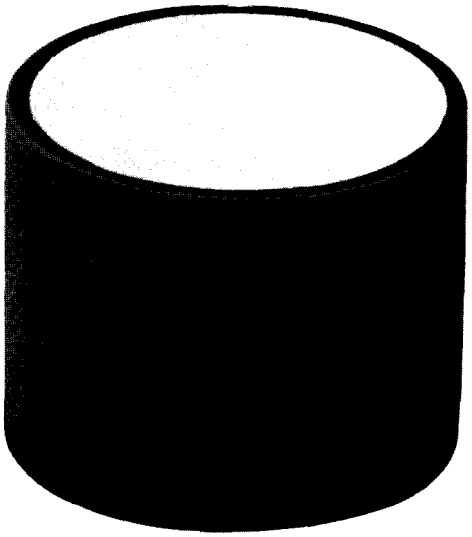
Grading Resistor
Low Voltage CPL

Grading Components
The voltage distribution of the CPL is precisely controlled by the frequency and voltage responsive grading elements.

The non-linear grading resistors are made of high quality silicon carbide and the grading capacitors are solid ceramic body fixed capacitors.

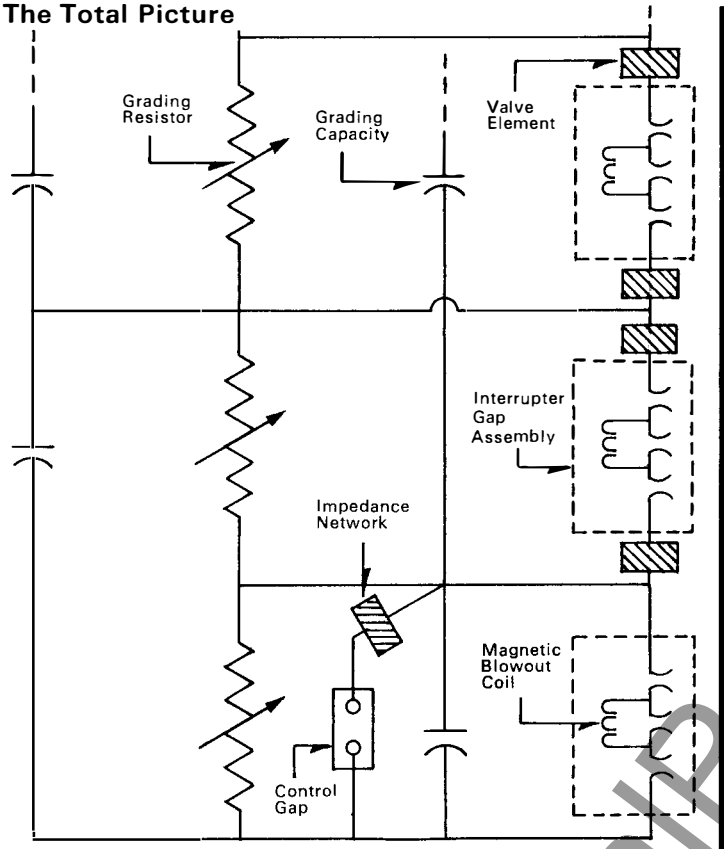
The high voltage CPL utilizes resistors and capacitors in its grading scheme. The low voltage CPL uses nonlinear resistor grading only.

Valve Elements
The non-linear resistance elements (blocks) are made of high quality silicon carbide which is a semi-conductor exhibiting a non-linear voltage-current relationship. The resistance elements are ceramic bonded with a special composition to obtain low discharge voltages and high thermal capability.

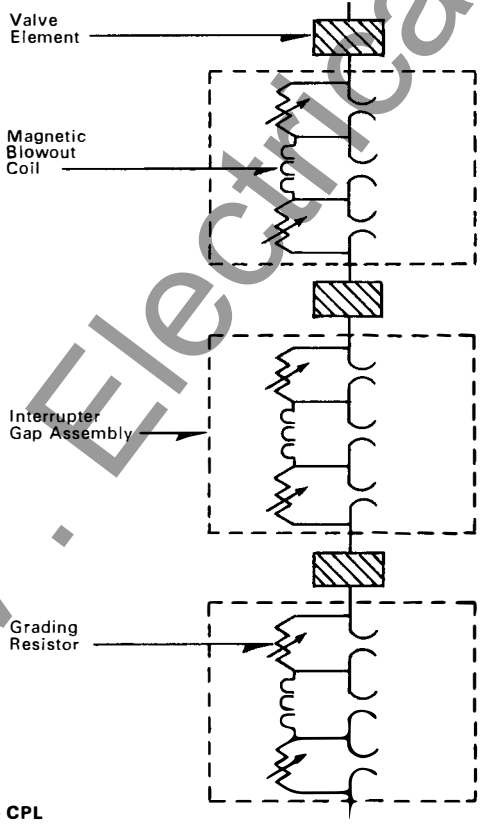


Valve Element

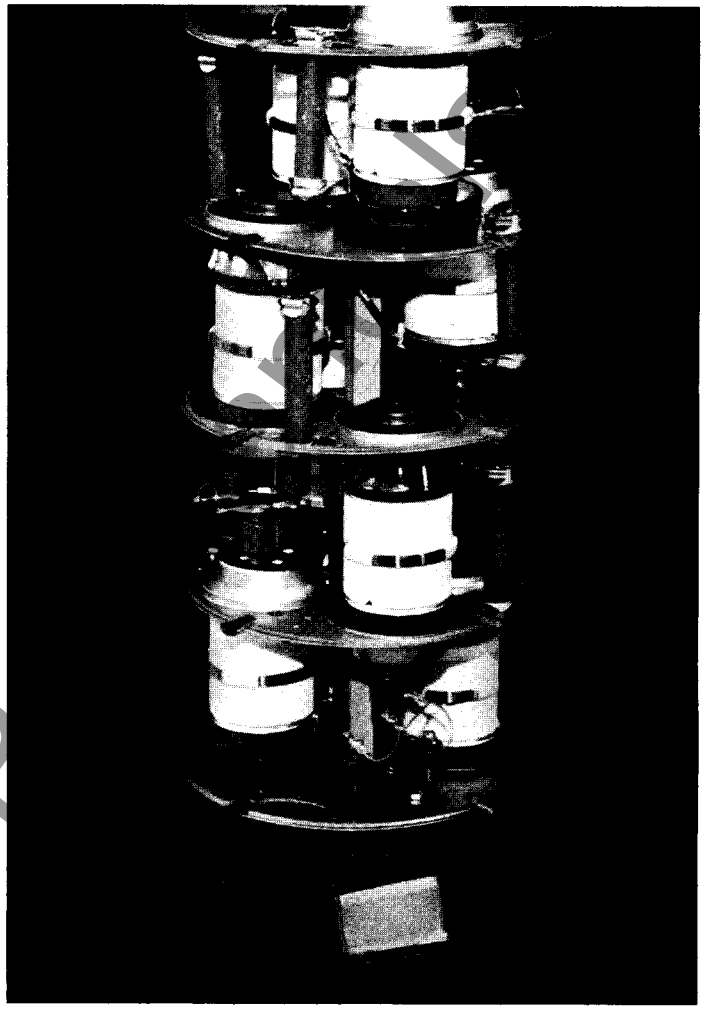
The Total Picture



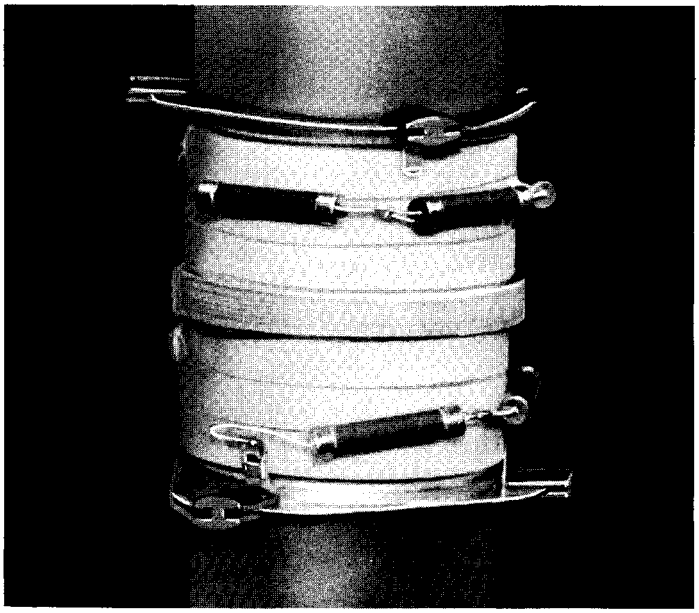
Schematic High Voltage CPL



Schematic Low Voltage CPL



High Voltage CPL (60-468 KV)
Physical Construction



Low Voltage CPL (3-48 KV)
Physical Construction

Critically-Tested Construction Protects The CPL Arrester

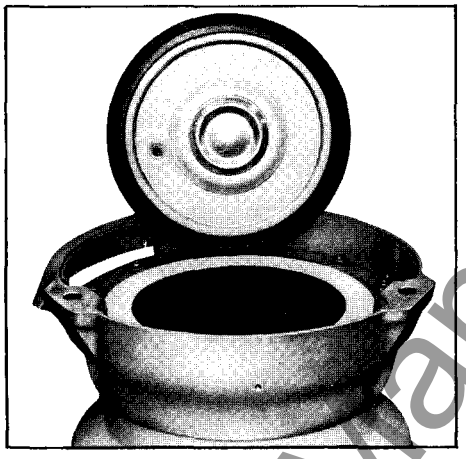
Special attention is given to the following major construction components of the CPL Station Arrester:

- Sealing System
- Internal Suspension System
- Porcelain Housing
- Fault Withstand Capability

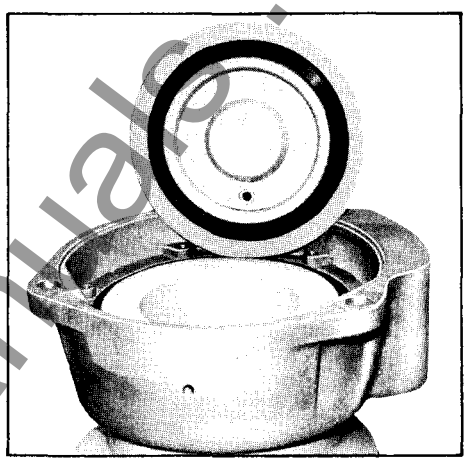
Sealing System

The CPL arrester is the only station arrester with double sealing; a primary sealing gasket and the backup protection of a weather seal gasket. The end plates are sealed to the arrester porcelain with a neoprene gasket confined in restraining channels and held under pressure to maintain the effectiveness of the seal.

To protect the primary sealing gasket from the effects of the environment a weather seal of asbestos neoprene is used. This seal is actually the front line defense against potentially damaging effects of the atmosphere on the arrester's primary sealing gasket.



Sealing System High Voltage CPL

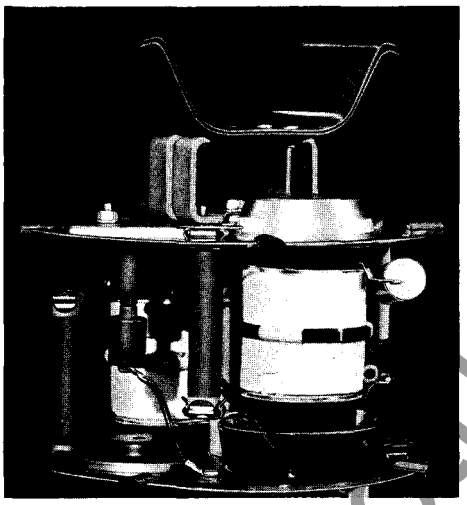


Sealing System Low Voltage CPL

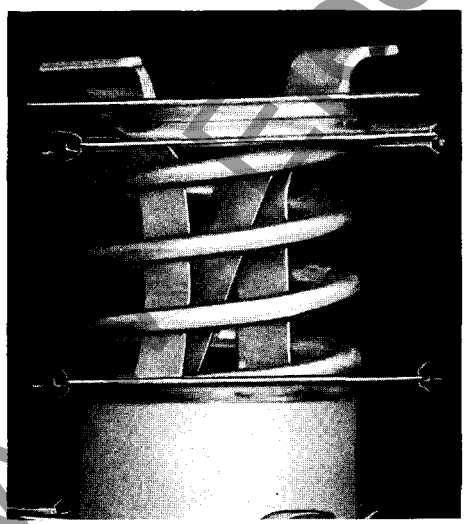
Internal Suspension Systems

The high voltage CPL uses a leaf spring suspension on the vertical axis of the arrester internal assembly to absorb shocks and vibrations caused by shipping and handling. The internal arrester structure is protected from side thrust by side wall supports positioned at every 5" of the arrester's height to absorb shocks.

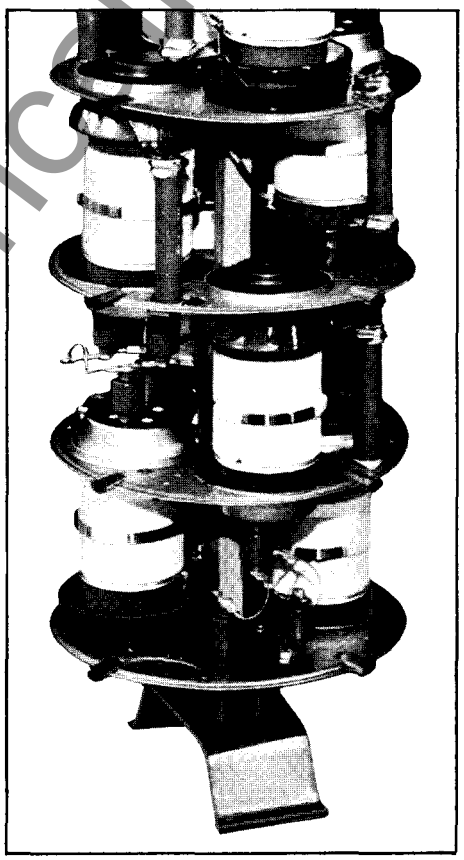
The vertical axis of the low voltage CPL internal assembly is supported by coil springs. Side wall supports for side thrust protection are positioned between every block and gap assembly.



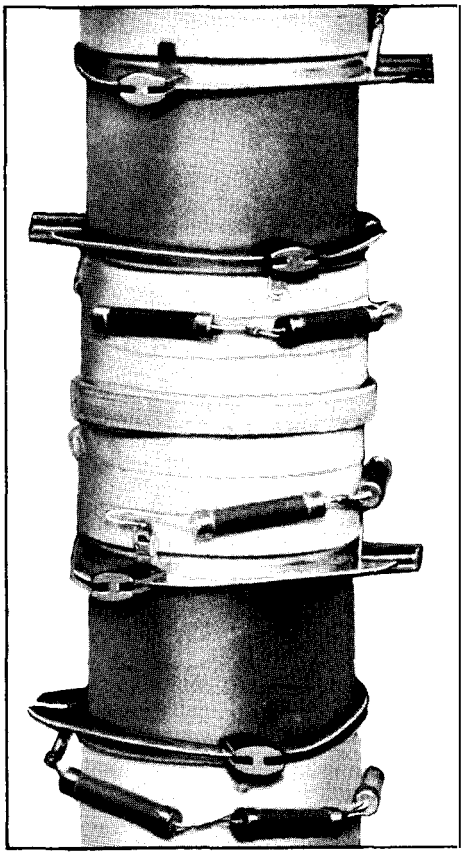
Spring Suspension High Voltage CPL



Spring Suspension Low Voltage CPL



Side Wall Supports High Voltage CPL



Side Wall Supports Low Voltage CPL

High Strength Wet Process Porcelain
All CPL arresters are constructed using high strength wet process porcelain. The porcelain of the CPL arrester passes all insulation withstand tests per ANSI C62.1. The coordination of the porcelain height and high standard creep distance with the internal grading scheme of the arrester provides excellent contamination resistance, insuring that the arrester passes the contamination test cycle of ANSI C62.1.

CPL Porcelain Cantilever Strength

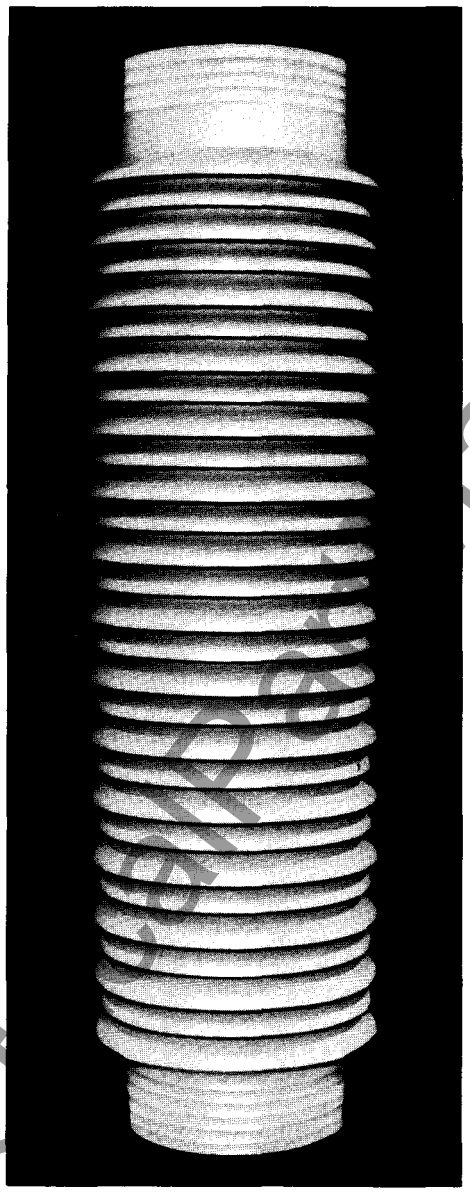
Voltage	Ft. lbs.
3-48 Kv	5800
60-312 Kv	17000
396-468 Kv	25000

Pressure Relief Capabilities
CPL arresters have been sucessfully tested in accordance with the pressure relief test requirements of ANSI C62.1. CPL's have published "safe fault current" pressure relief capabilities in excess of standards as shown in the table below.

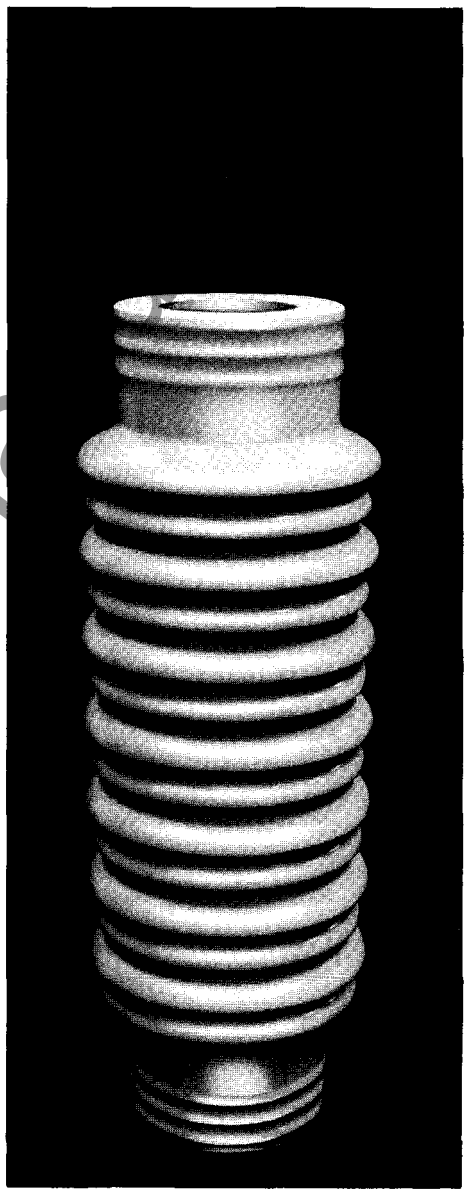
Arrester Rating① (KV)	ANSI C62.1 Class I High Current Test (RMS Symmetrical Amperes)	CPL (RMS Symmetrical Amperes)
3 - 15	65000	66000
21 - 48②	40000	44000
60 - 192	40000	63000
240 - 294③	25000	63000
300 - 312	Not Given	63000
396 - 468	Not Given	63000

① Pressure relief ratings for porcelain top arresters are not standardized.
② 18 KV arrester included with these ratings.
③ Includes 204, 216, and 228

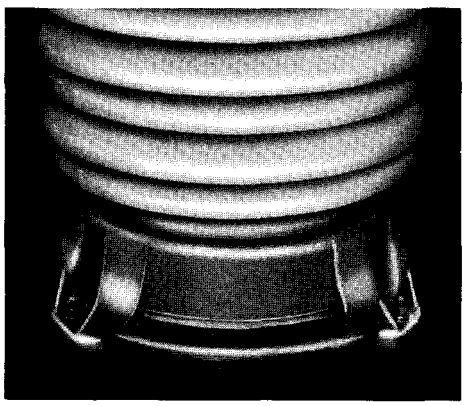
CPL arresters 3-312 KV have exhaust ports that provide directional venting in the remote event of a pressure relief operation. Directing the hot ionized gases away from the protected equipment minimizes the possibility of flashover of close-by arresters, bushings, or bus supports. CPL arresters 396-468 KV do not have directional venting.



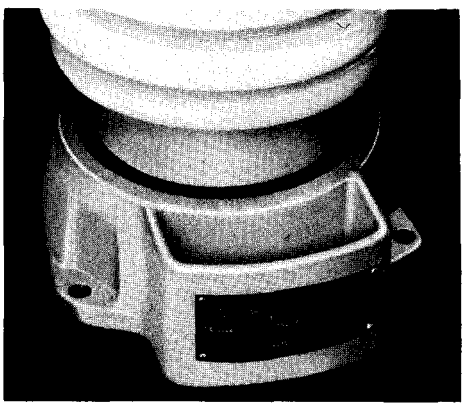
Typical Porcelain High Voltage CPL



Typical Porcelain Low Voltage CPL



Exhaust Port High Voltage CPL (60-312 Kv)



Exhaust Port Low Voltage CPL (3-48 Kv)

Built in Quality Verified Through Production Testing

CPL arresters are tested at each of the various stages of manufacturing to insure that the final product offers continued protection for the modern system.

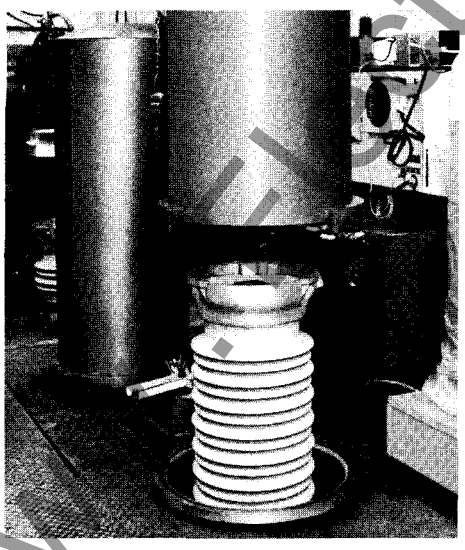
- Seal Test
- Valve Element Test
- Interrupter Gap Test
- Grading Component Test
- Control Gap Test
- Final Unit Test

Seal Tests
The CPL sealing system is leak tested after the arrester is completely sealed and ready for shipment.

Each arrester unit is evacuated and back filled with dry nitrogen and trace quantities of helium. The filling tube is then pinched off (cold weld) completing the seal of the arrester unit.

The arrester unit is then placed in a vacuum chamber which is evacuated. As gas is evacuated, it is passed through lines to sensitive helium detection equipment capable of recording a leak rate as small as 5×10^{13} atmosphere-cc/second.

The Leak Detection System Tests the Complete Arrester-End Plates, Seals, Castings, and Porcelain – Unlike Other Arrester Testing Methods That Require the Gas Fill Hole To Be Plugged After the Seal Test Is Completed. The CPL Is Completely Sealed Prior To Seal Testing – Not Afterwards.

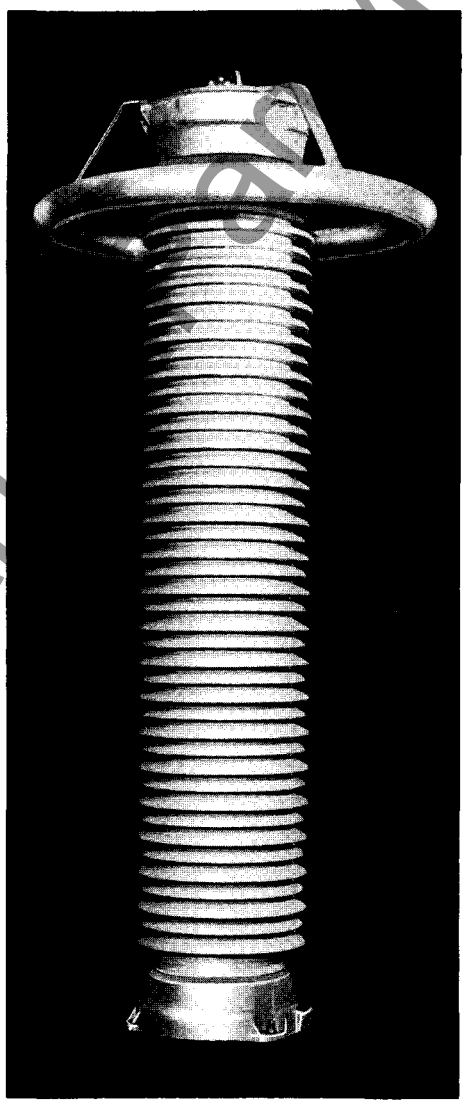


Seal Testing Of a High Voltage CPL Arrester

Valve Element Testing
Valve elements are seasoned then tested for discharge voltage and thermal capability.

Interrupter Gap Tests
Each gap is placed in a test cell which is evacuated and then filled with arrester atmosphere. The gap must then sucessfully pass three electrical performance tests:
- 60 Hz
- Radio influence test
- Repetitive sparkover tests

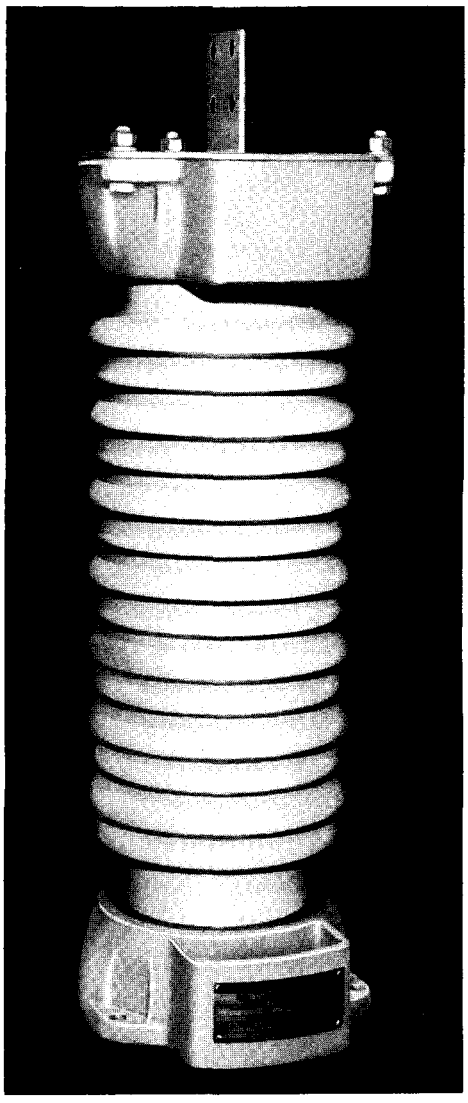
Performance Testing
To verify that CPL arresters provide low and consistent protective characteristics, each unit is tested for the following electrical values:



High Voltage CPL (60-468 KV)
- Radio influence voltage.
- Grading current at 60 Hz rated voltage
- 60 Hz sparkover
- Switching surge sparkover

Grading Components Testing
High accuracy equipment is used to test each ceramic capacitor and non-linear resistor. The tests are made in a controlled atmosphere environment.

Control Gap Testing
Each control gap is subject to ten sparkover applications of each polarity of a ramp voltage and then categorized for use with other arrester components.
Control gaps are energized above rating and given a radio influence voltage test.



Low Voltage CPL (3-48 KV)
- Radio influence voltage
- Grading current at 60 Hz rated voltage
- 60 Hz sparkover

Printed in U.S.A.

Further Information
38-140 P WE A
38-146 T WE A
38-142 F WE A

Westinghouse Electric Corporation
Distribution Apparatus Division
Bloomington, Indiana 47401