HIGH VOLTAGE REACTORS

Product Spectrum
Air Core Reactors

With more than 60 years of successful field experience, Trench is the recognized world leader in the design and manufacture of air-core dry-type power reactors for all utility and industrial applications.

A unique customer design approach, along with fully integrated engineering and manufacturing facilities in North America, South America and Europe, has enabled Trench to become the technical leader for high-voltage inductors worldwide.

PROVEN RELIABILITY
• Trench developed today’s air-core reactor technology
• Trench is the largest reactor manufacturer in the world
• Over 250,000 units in service worldwide
• Product lifetime of 30+ years
• All units are custom designed based on:
  • Over 6 decades of experience
  • Continuous R&D and product improvement
  • Three competence centers around the world
  • Management system certified to ISO 9001, 14001 and 45001
Design Features

- Epoxy impregnated with fiberglass-encapsulated construction
- Aluminum construction with welded current carrying connections
- High mechanical and short-circuit strength
- Low noise levels maintained throughout the life of the reactor
- Weatherproof construction with minimum maintenance requirements
- Designed with a service life of 30+ years

Construction

Trench air-core dry-type reactors consist of a number of parallel-connected, individually insulated aluminum conductors (copper available upon request). These conductors can be small wire or proprietary cables which are custom-designed and custom-manufactured. The size and type of conductor used in each reactor is dependent on the reactor specification. The various styles and sizes of conductors available ensure optimum performance at the most economical cost.
Reactors connected in series with the line or feeder.

**CURRENT-LIMITING REACTORS**
reduce the short-circuit current to levels within the rating of the equipment on the load side of the reactor (up to 765 kV/2100 kV BIL)

**CAPACITOR REACTORS**
are installed in series with a shunt-connected capacitor bank to limit inrush currents due to switching, to limit outrush currents due to close-in faults, and to control the resonant frequency of the system due to the addition of the capacitor banks (up to 765 kV/2100 kV BIL)

**BUFFER REACTORS FOR ELECTRIC ARC FURNACES**
stabilize the arc when operated at low electrode current and long arc length for the highest possible efficiency of the furnace

**DUPLEX REACTORS**
are current-limiting reactors that consist of two half coils magnetizing against each other. These reactors provide a desirable low reactance under normal conditions and a high reactance under fault conditions

**LOAD-FLOW CONTROL REACTORS**
are series-connected on transmission lines up to 765 kV. The reactors change the line impedance characteristic so that load flow can be controlled, thus ensuring maximum power transfer over adjacent transmission lines
Shunt Reactors

Shunt reactors are used to compensate for capacitive reactive power generated by lightly loaded transmission lines or underground cables. They can either be connected to the tertiary of the power transformer or directly to the line up to 500kV.

configurations
Filter reactors are used in conjunction with capacitor banks to form tuned harmonic filter circuits, or with capacitor banks and resistors to form broadband harmonic filter circuits.

If inductance adjustment for fine-tuning is required, the tapping range and tolerances must be specified.

Many filter applications require a Q factor that is much lower than the natural Q of the reactor. This is often achieved by connecting a resistor in the circuit.

An economical alternative is the addition of a de-Qing ring structure on a reactor. This can reduce the Q factor of the reactor by as much as one tenth without the necessity of installing additional damping resistors. These rings, mounted on the reactor, are easily coupled to the magnetic field of the reactor. This eliminates the concern of space, connection and reliability of additional components such as resistors.
Reactors for FACTS

Flexible AC Transmission Systems (FACTS) increase the reliability of AC grids and reduce power delivery costs. They improve quality and efficiency of power transmission by supplying inductive and capacitive reactive power to the grid. Depending on the technology of the FACTS device, different types of reactors are used. For example:

For Conventional Static Var Systems (SVCS):
- Thyristor-controlled shunt reactors (TCR) - the compensating power is changed by controlling the current through the reactor using the thyristor valves
- Thyristor-switched capacitor reactors (TSC)
- Filter reactors

For Static Synchronous Compensators using IGBT Valves (VSC) For Power Control:
- Line / phase reactors

For MSC (On) Circuits:
- Filter reactors
- Damping reactors

For SC:
- Damping reactors

For TCSC:
- Thyristor-controlled parallel reactors

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Reactors for HVDC

HVDC lines are used for long distance bulk power transmission up to 1,100 kV, as well as back-to-back interconnections between different transmission networks.
HVDC systems with line commutated converters normally include:

- **SMOOTHING REACTORS**
  which are used to reduce the magnitude of the ripple current in the HVDC system

- **AC AND DC HARMONIC FILTER REACTORS**

- **AC AND DC PLC NOISE FILTER REACTORS**

Self-commutated HVDC (VSC) schemes usually include
converter reactors and smoothing reactors
(depending on the HVDC scheme)
Line traps are connected in series with HV transmission lines. The main function of the line trap is to provide a high impedance at power-line-carrier frequencies (30-500 kHz) while introducing negligible impedance at the power frequency (50 or 60 Hz). The high impedance limits the attenuation of the carrier signal within the power system by preventing the carrier signal from being:

- Dissipated in the substation
- Grounded in the event of a fault outside the carrier transmission path
- Dissipated in a tap line or a branch of the main transmission path
Other Products

- **Test lab reactors** are installed in high-voltage and high-power test laboratories. Typical applications include current-limiting, synthetic testing of circuit-breakers, inductive energy storage and artificial lines.

- **Neutral earthing reactors** limit the line-to-earth fault to specified levels. Specification should include unbalanced condition, continuous current duration and short-circuit current duration.
CPR 500

The capacitor filter protection relay (CPR 500) is specifically designed to provide comprehensive protection of medium and high voltage capacitor banks and filter installations.

**PROTECTION FUNCTIONS:**
- Peak repetitive overvoltage protection to the 50th harmonic
- Overcurrent, undervoltage & earth fault protection
- Neutral unbalance protection with residual compensation
- Line unbalance protection
- Thermal protection for capacitor, inductor & resistor elements
- Dual breaker fail protection with programmable logic
- Capacitor re-switching protection
Single-phase neutral earthing reactors (arc-suppression coils, or ASC) are designed to compensate for the capacitive line-to-earth current during a 1-phase earth fault. Because the electric system is subject to changes, the inductance of the ASC used for neutral earthing must be variable. Trench utilizes the plunger core coil, or the moveable-core design. Based on extensive experience in design, construction and application of ASCs, Trench products meet the most stringent requirements for earth-fault compensating techniques. The arc-suppression coil represents the central element of the Trench earth-fault protection system.

In addition to the ASC, Trench offers a variety of advanced electronic earth-fault compensation controllers and earth-fault detection systems.
Innovation
and bridge to the future

A deep commitment to the power industry with extensive investments in engineering, manufacturing and testing capabilities, gives Trench customers the utmost high-quality and reliable products that are individually designed for each application. Reactor applications have grown to c10V-applied reactors surpassing 300 MVA per phase. Highly developed research and development programs constantly address new technologies and their potential in reactor products.
Global footprint and technologies

“Our partners are utilities, contractors and power-intensive industries worldwide. We support them with our technical expertise, extensive experience, competitiveness of our products and a global network of factories.”