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Test Lab Reactors

Test Lab Reactors are installed in high voltage and high power test laboratories. Some typical applications include current limiting, synthetic testing of circuit breakers, inductive energy storage, artificial lines, etc.

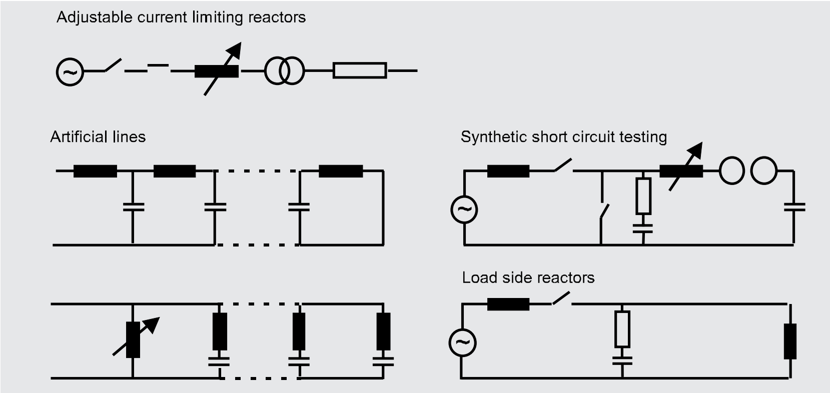
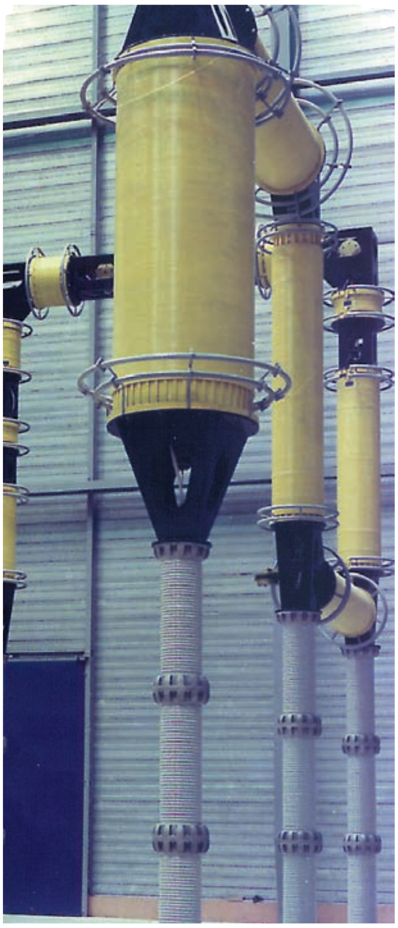


Fig. 22
Schematic diagram



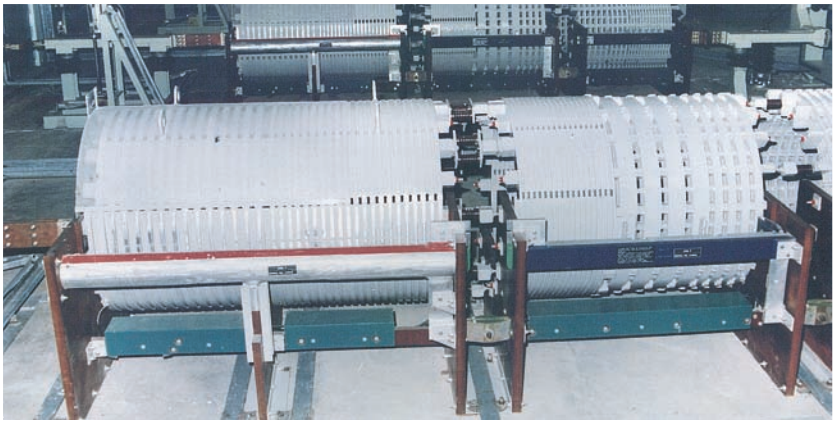


Fig. 24
Adjustable
current limiting reactor

Fig. 25
Short circuit
test reactor

Fig. 23
Reactor bank for the
voltage circuit for synthetic testing
of circuit breakers;
32 kA peak to peak,
0,318 mH to 353,6 mH,
up to 1600 kV BIL

Neutral Grounding Reactors

Neutral Grounding Reactors limit the line to ground fault current to specified levels. Specification should also include unbalanced condition continuous current and duration.

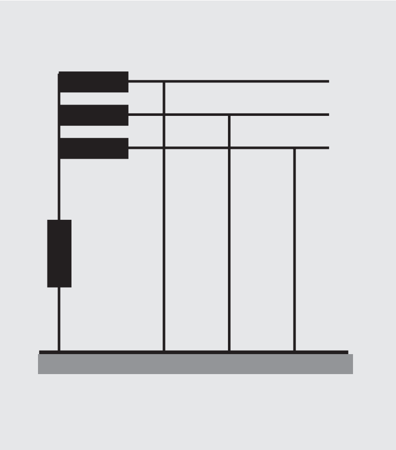


Fig. 26
Schematic diagram

Arc Suppression Coils

Single-phase neutral grounding (earthing) reactors (arc suppression coils) are intended to compensate for the capacitive line-to-ground current during to a single phase ground-fault.
The arc suppression coil (ASC) represents the central element of the Trench earth fault protection system.

Since the electric system is subject to changes, the inductance of the ASC used for neutral earthing must be variable.

The earth fault detection system developed by Trench utilizes the plunger core coil (moveable core design). Based on extensive experience in design, construction and application of ASCs, Trench products can meet the most stringent requirements for earth fault compensating techniques.

Fig. 27
Arc suppression coil 110 kV

Fig. 28
Standard arc suppression coil

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Construction

A Trench air core dry type reactor consists of a number of parallel connected, individually insulated, aluminum (copper on request) conductors. These conductors can be small wire or proprietary cables custom designed and manufactured.

The size and type of conductor used in each reactor is dependant on the reactor specification. The various styles and sizes of conductors available ensure optimum performance at the most economical cost. The windings are mechanically reinforced with epoxy resin impregnated fibreglass, which after a carefully defined oven cure cycle produces an encapsulated coil. A network of horizontal and vertical fibreglass ties coupled with the encapsulation minimizes vibration in the reactor and achieves the highest available mechanical strength.

The windings are terminated at each end to a set of aluminum bars called a spider. This construction results in a very rigid unit capable of withstanding the stresses developed under the most severe short circuit conditions.

Exceptionally high levels of terminal pull, tensile strength, wind loading and seismic withstand can be accommodated with the reactor. See Fig. 29 for details on construction.

This unique design can be installed in all types of climates and environments and still offer optimum performance.

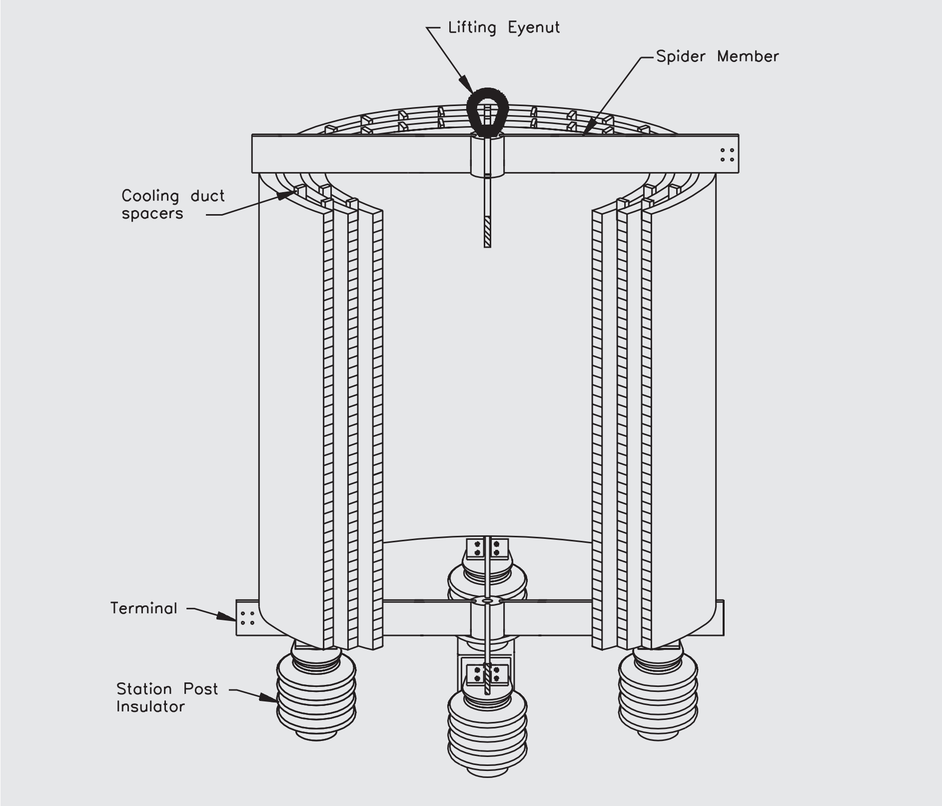

Fig. 29
Typical Trench air core dry type reactor construction

Trench air core dry type reactors are installed in polluted and corrosive areas supplying trouble free operation. In addition to the standard fixed reactance type of coil, units can be supplied with taps for variable inductance. A number of methods are available to vary inductance for fine tuning or to provide a range of larger inductance steps.

Trench utilizes various other designs for reactors (eg. iron core, water cooled, etc.) which are described in other sections of this catalogue.

Terminals/ Magnetic Clearance

Terminals

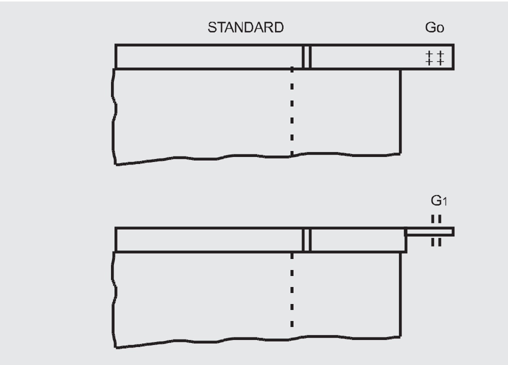

Fig. 30
Terminal orientation

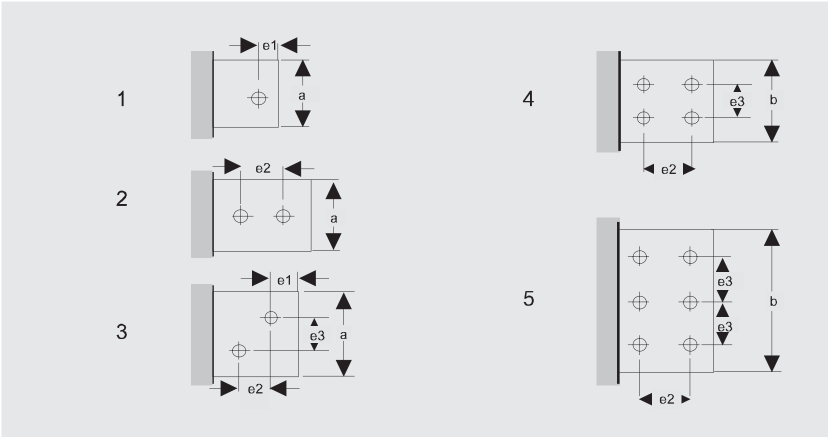

Fig. 31
Terminal details

Magnetic Clearence

Minimum clearances to metallic parts, and between coils, must be maintained as indicated by Figs. 32 and 33. The values shown are only guidelines. Each specific reactor design will specify magnetic clearance requirements.

It is the customer's responsibility to consider these minimum clearances, especially if steel reinforcing in concrete foundations or floors, or structural steel is involved in the building or station design. It is important, even outside these minimum magnetic clearances, to avoid closed electrical loops with metallic parts.

If required, non-magnetic extension brackets can be supplied by Trench to maintain the necessary magnetic clearance below the reactor. Trench can provide additional details on space requirements and recommended reinforcing steel (rebar) design, if requested.

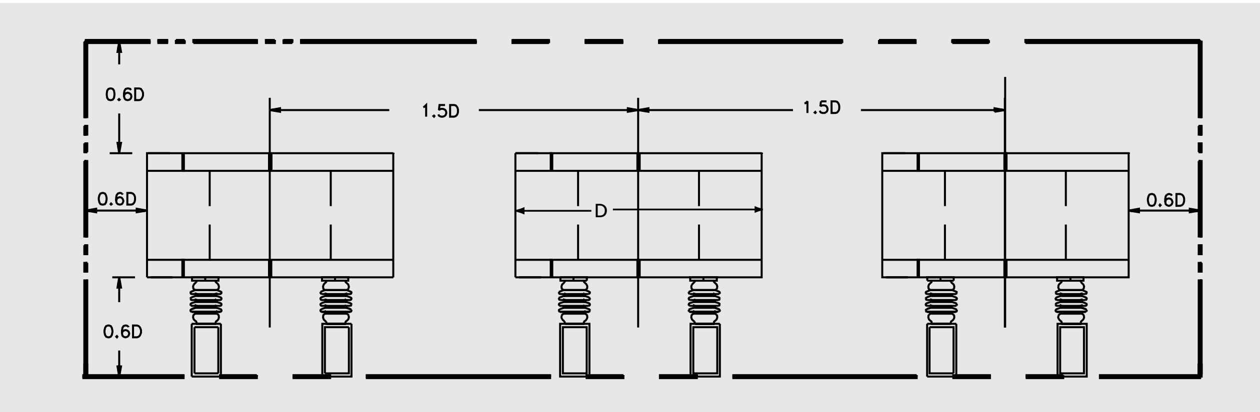

Fig. 32
Minimum magnetic clearance to other reactors and metallic parts not forming closed loops (approximate values only)

Installation

Generally, air core, dry type reactors can be installed in either side by side or vertically stacked configurations and are often added to existing substations or locations where space limitations exist. With its highly developed computer design expertise, Trench can design reactors with optimized dimensions, to suit limited space requirements. The multi-spider construction allows flexibility in terminal location, which minimizes connection problems (see Fig. 35).

Number of spider arms to be obtained from the actual quotation design.

Installation assembly is minimal and typically requires only that brackets and insulators be bolted to the main coil. Installation instructions are provided with each reactor order.

Trench takes into consideration all aspects of the reactor installation. These include requirements of ventilation, reactor supports, connections and busbar arrangements.

Trench can also provide detailed information regarding:

- magnetic field distribution analysis for mounting pads and foundations, grounding grids, fences and adjacent structures
- Force calculations on adjacent coil installations, bus and cable connections
- Seismic analysis on entire reactor assemblies, including support insulators and mounting pedestals, when furnished.

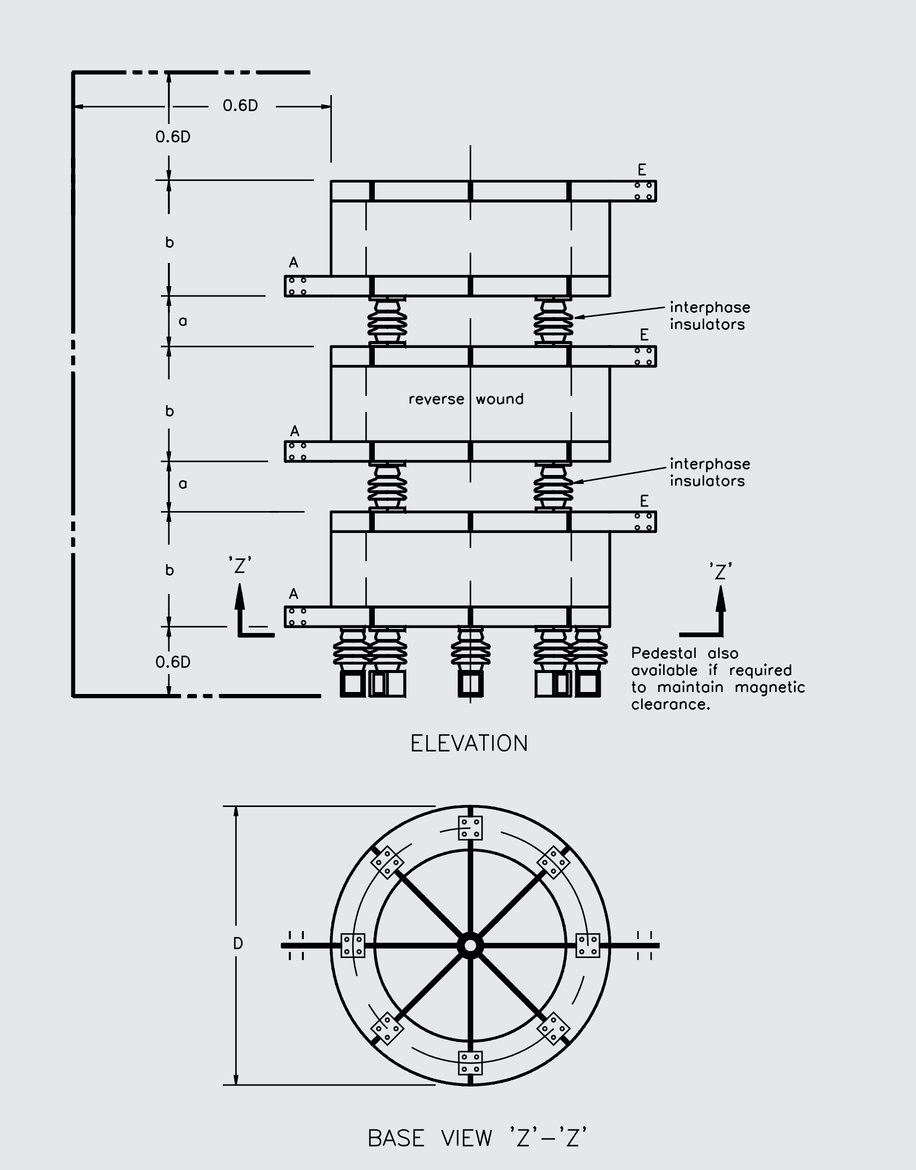

Fig. 33
Three-phase stacked arrangement

Testing/ Losses

Fig. 34
High voltage test laboratory

Testing

At Trench each reactor manufactured is subjected to a rigorous test and inspection program. In addition to the routine testing required by ANSI/IEEE or IEC a number of in-process tests are performed on each unit during production to ensure maximum in-service reliability. Each reactor is supplied with a certified test report with the results from all tests performed.

In addition to routine testing we have the capability in our High Voltage and Power labs to perform most of the design tests described in the applicable standards. Design tests can be performed at an additional cost or test reports on similar units can be supplied upon request.

The materials used in the manufacture of the reactor are also subject to a strict test program. Cooling duct spacers and the fibreglass epoxy resin composite encapsulation are subject to routine mechanical strength and tracking resistance testing. Accelerated thermal and multifactor aging studies are carried out which help to verify performance of the reactor components over their full service life.

This testing coupled with our Quality Assurance program enables us to ensure the continuous performance of our reactors throughout the design service life.

Losses

The custom design approach used by Trench allows optimum use of materials to control reactor losses. If a loss evaluation is not indicated in the specification, the reactor will be designed to meet the applicable standards at a most economical initial cost.

All customers are aware of the advantages in minimizing system losses and are applying loss evaluation techniques for reactor purchases. In the cases where loss evaluations are included in the reactor specifications, Trench optimizes the initial cost of the reactor plus the cost of operating losses, to ensure the most economical balance. Generally, a loss optimized reactor will operate at a lower temperature rise and will thus extend the reactor overload capability.

Trench's ability to design and manufacture low loss reactors allow many electric power utilities to economically justify the replacement of older, inefficient reactor installations. The low loss reactors can usually be installed on existing mounting pads.

Losses can also be influenced for other purposes. In some applications it is important to control the Q factor (X/R ratio) of the reactor. This may be important at the fundamental frequency or at specific harmonic frequencies where additional losses are advantageous, for example capacitor switching reactors and certain filter applications.

Enclosures and Pedestals

Fig. 35
Filter reactor with sound shield

Fig. 36
Filter reactor with top-hat and pedestal

Trench designs and manufactures enclosures and support pedestals specifically for air core, dry type reactors.

Enclosures, depending on the requirement, are made of steel or fibreglass and can be designed for indoor or outdoor installations. Trench enclosure design minimizes circulating current loops and optimizes the size by defining ventilation area and acceptable temperature rise. Enclosures have been qualified as complete assemblies by short circuit testing of the enclosed reactor.

Trench can supply support pedestals to elevate reactor live parts to a height commensurate with personnel safety standards. Pedestals also provide proper magnetic clearance below the reactor.
Various pedestal designs are available and include fibreglass, braced aluminum and non-magnetic steel designs.

Trench can recommend the most practical pedestal for each reactor application. Additional information on enclosures and pedestals is available on request.

Sound shields can be provided to reduce the reactor noise level for special applications (HVDC).

Data required with order

- Reactor application
- Indoor or outdoor installation
- System voltage, impulse insulation level (BIL)
- Rated and maximum continuous current (fundamental and harmonics)
- Short circuit current level and duration
- Rated inductance/impedance
- Mounting arrangement (side by side or vertical stack)
- Detailed accessory requirements (connectors, buswork, etc.)
- Location of installation and site conditions
- Ambient temperature range

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04.09

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