

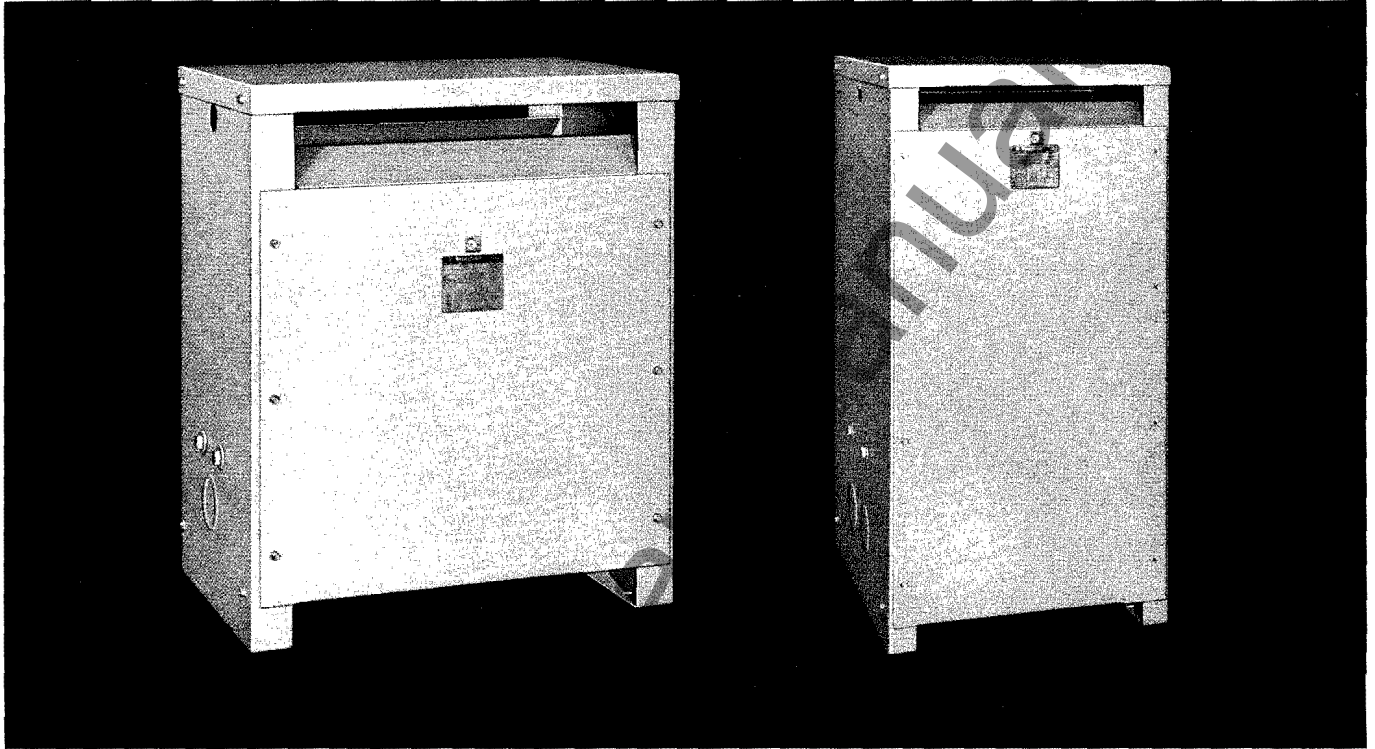
Westinghouse



Dry Type Transformers

37½-500 Kva, Single Phase, DS-3
45-1500 Kva, Three Phase, DT-3

General Purpose
5000 Volts and Below, 60 Hertz
220°C Insulation System, 150°C Rise



Advantages and Application

Dry type distribution transformers are ideally suited for indoor application and offer many advantages over liquid-filled transformers. They may be installed in practically any indoor location not subject to submersion or to a high concentration of destructive fumes.

Air insulated and cooled by natural convection of air, they are safe and cannot explode, no toxic gases can be released, and fire hazards are negligible. Elimination of these principal liquid-filled transformer potential hazards makes them especially desirable for installation in hospitals, hotels, theaters, schools, factories, and other working areas where large groups of people are present.

Where space limitations and insurance regulations prohibit the use of liquid-filled transformers, the dry type transformer is the answer.

The DT-3 and DS-3 designs offer the ultimate in low sound level dry type transformer performance. Built-in vibration dampening system makes extra vibration mounts unnecessary. The 220°C insulation system packs maximum kva in the smallest possible space.

Westinghouse sound levels are lower than

ANSI-NEMA standards. The many thousand applications during the past eighteen years of manufacturing super quiet transformers show why sound level problems are eliminated with DS-3 and DT-3 transformers. See page 3 for table of values.

Highest Testing Standards in the Industry:

Westinghouse testing standards are the highest in the industry. New designs are given complete and exhaustive load, short circuit and insulation tests to prove methods and materials used in manufacture. Verified production line models receive standard quality control inspections and tests. Certified test reports on routine tests can be obtained on all units, and special tests or reports can be obtained on special order.

Underwriters Laboratories

All standard rating 600 Volt Class DS-3 and DT-3 Transformers 1000 KVA and Below Three Phase, 167 KVA and Below Single Phase are UL listed and bear the UL Label. These transformers are designed and have been tested in strict accordance with UL-506 transformer standards.

Standards

These transformers are designed and manufactured in accordance with NEMA ST 20 and NEMA TR 27 where applicable.

Insulation Class

Types DT-3 and DS-3 transformers are insulated with a Westinghouse 220°C System with temperature ratings as follows:

| Insulation System | Ambient | Average Rise | Hottest Spot Winding Temperature Rise | Reference Temperature for Performance |
|-------------------|---------|--------------|---------------------------------------|---------------------------------------|
| 220°C | 40°C | 150°C | 180°C | 170°C |

Maintenance

Dry type transformers are practically maintenance free, except for periodic inspection of the connections. Any accumulation of dust or dirt should be removed by brushing or blowing dry air on the unit. See IL-46-060-901.

Further Information

Prices: PL 46-920, 46-921, 46-922, 46-923, 46-926, 46-927

Description: DB 46-951 (TENV)
DB 46-956 (Marine Design)
DB 46-957 (Saturable Core Reactors)

Technical Data: TD 46-960

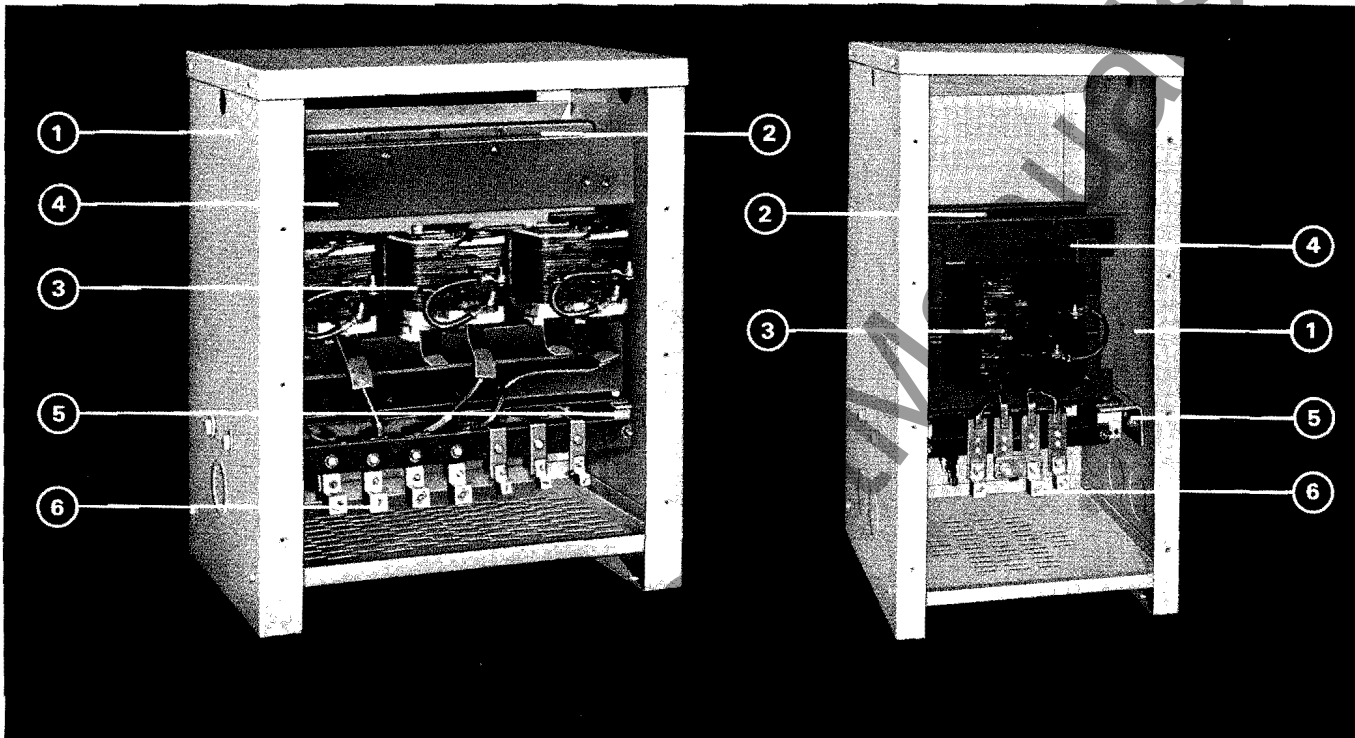
Dimensions: DS 46-970

October, 1973
Supersedes Descriptive Bulletin 46-950, pages 1-4,
dated July, 1971
E. D. C/2076/DB

Westinghouse



Design Features



1 Case

Self-bracing case is provided with lifting holes to facilitate handling and installation.

2 Core

Low loss core construction using stacked laminations assures quiet operation throughout transformer life with minimum size and weight.

3 Coils

Coils are insulated with a Westinghouse 220°C insulation system which prevents deterioration under heat. Westinghouse uses DuPont's new high-temperature-resistant NOMEX paper as layer insulation, as well as for section insulation. NOMEX is the insulating material – UL rated at 220°C – with the toughness and flexibility required for economical use in essentially all transformer applications. Westinghouse craftsmen prefer NOMEX because it is easy to bend and form, it resists damage and results in fewer rejects. In addition, the excellent high-temperature, high-humidity endurance of NOMEX assures long transformer life and reliability, even under the most severe conditions.

4 End Frame

Rigid end frame provides strength against short circuit stresses to assure dependability.

5 Mounting Frame

The DT-3 transformer rated 45-300 kva, and DS-3 transformer rated 37½-250 kva, are designed such that the core and coil assembly is supported on two angle brackets which are bolted to the sides of the enclosure. To absorb sound vibrations, the assembly utilizes rubber vibration dampeners between the core and coil assembly and the mounting bracket. Ratings 500-1500 kva three phase and 333-500 kva single phase are designed such that the core and coil assembly is mounted on a channel frame base.

6 Terminal Arrangement

Solderless connectors are furnished only on DS-3, 50 kva and below and DT-3, 112½ kva and below. Larger ratings are furnished with terminal straps only. They are located in the terminal compartment below the core and coil assembly where cooling air is at room ambient temperature with a maxi-

mum rise of 5°C. No high temperature or oversized cables are required.

Primary taps are changed by the following methods:

(1) A manual no load tap changer located on the terminal board below the core and coil is furnished on the following ratings:

| Type | Rating | Voltage Class |
|------|------------|---------------|
| DS-3 | 37½ | 5,000 Volt |
| DT-3 | 45-500 Kva | 5,000 Volt |

(2) Taps are changed by means of coil-face taps on the following ratings:

| Type | Rating | Voltage Class |
|------|--------------|---------------|
| DS-3 | 37.5-100 Kva | 600 Volt |
| DS-3 | 50-500 Kva | 5,000 Volt |
| DT-3 | 45-150 Kva | 600 Volt |
| DT-3 | 750-1500 Kva | 5,000 Volt |

(3) Taps are changed by means of a link-type connector located above the core and coil on the following ratings:

| Type | Rating | Voltage Class |
|------|--------------|---------------|
| DS-3 | 333-500 Kva | 600 Volt |
| DT-3 | 500-1500 Kva | 600 Volt |

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Enclosure

Drip-proof enclosure has conduit knockouts on both sides for high and low voltage cable entrance. Front and rear cover panels are removable for easy access to terminal compartment.

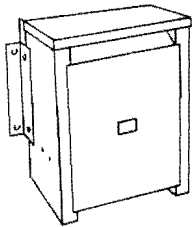
Accessories

Externally Mounted Circuit Breakers

Types DS-3 and DT-3 can be supplied with AB-I enclosed circuit breakers mounted externally on the side of the transformer enclosure. We strongly recommend this application for indoor use only. The breaker is connected to the transformer terminal board at the factory. Caution must be taken that the breaker enclosure is not larger than the side of the transformer enclosure. This is often the case when the breaker is a secondary breaker.

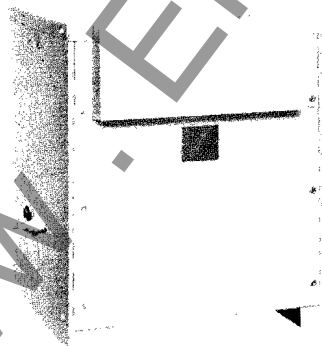
Mounting Brackets

Mounting brackets (in pairs) are available for DS-3 types up to 100 kva. The DT-3 has the universal mounting brackets which can be used for ceiling, wall or trapeze mounting through 112½ kva. Mounting brackets are available in stock and shown by style number in Price List 46-920.



Outdoor Applications

Types DS-3 and DT-3 can be made suitable for outdoor use by the addition of ventilation covers (weathershields) to the standard enclosure. These covers (in pairs) are supplied as separate items for field installation by the customer.



DS-3 and DT-3
with Weathershields

Any unit which is used outdoors should either be kept energized at all times or space heaters installed by customer for use when transformer is deenergized to eliminate atmospheric moisture. For units above 600 volts, lightning arresters are recommended; and they should be located as close to the transformer terminals as possible.

General Notes

Sound Levels

Years of outstanding performance in the manufacture and application of ultra-quiet dry type transformers are the result of extensive sound level testing, both in the laboratory and in the field by Westinghouse engineers. Extensive records have been compiled from testing many production line units. The tabulation of averages below compares present NEMA standards for general purpose transformers (NEMA ST 20) with Westinghouse averages.

| Kva 600 Volts and Below [Ⓢ] | Sound Level in DB40 | |
|---|---------------------|------|
| | Westinghouse | NEMA |
| 25-50 | 42 | 45 |
| 51-150 | 42 | 50 |
| 151-300 | 46 | 55 |
| 301-500 | 50 | 60 |

[Ⓢ] For 5 kv class the average sound level is about 5 DB higher than in the above table (NEMA TR27-1965 TR27-5-09, Table 5-6).

When transformers are manufactured and tested to fall within NEMA standard values, and when proper consideration is given to installation practices, highly satisfactory sound levels are achieved. No manufacturer can or does guarantee sound level at the installation due to variations in conditions (shipment, handling, building structures, installation practices in the industry, etc.). Observance of factors covered below will minimize installation problems and assure that transformers built to proper specifications will meet performance expectations when installed.

How to Measure Audible Sound

Sound level tests should be made in a laboratory with anechoic characteristics. The ambient sound level of this room should not exceed 24 db, to provide a true measurement, unaffected by unrelated sources.

NEMA standards state measurements shall be taken opposite each major sound producing surface at a distance one foot from the surface. Surface, in this case, means the surface of the enclosure of the completed unit.

How to Minimize Sound Amplification

Sound amplification can be greatly reduced by using the following suggestions in installation:

- The transformers should be installed in an area where the sound would be the least objectionable.
- Nearby reflecting objects or enclosures which will resonate, or echo, should be avoided. Avoid mounting units in areas which tend to amplify voice noises, such as stairways and hall areas.
- Tile, brick, concrete, masonry, or steel walls, as well as floors and ceilings, are excellent sounding boards and should be avoided whenever possible. Acoustic absorbing materials may be used when they cannot be avoided.
- Avoid mounting on walls, partitions, balconies, floors, etc., having a light mass. If the weight of the mounting surface, corresponding to the projected area of the transformer were greater than or equal to the weight of the transformer, the possibility of amplifying the sound waves in the structure would be greatly reduced.

Lightning Arresters

In general, dry type transformers, 600 volts and below, are not exposed to the effects of voltage surges. They are normally protected adequately by substation and/or power center protective devices and, as such, do not require lightning arresters.

For dry type transformers in the 5000 volt class, some consideration should be given to surge voltage protection. As in the 600 volt class, these transformers are usually protected by substation devices. Caution should be exercised when transformers are separated from the protective devices by long cables spans, either exposed or sheltered. Naturally, exposed lines are subject to direct lightning strokes and RM valve type arresters should be applied at the transformer terminals even where valve type station arresters or expulsion arresters are used. Even on sheltered cable spans, care should be used to protect the transformer from excessive surge voltages which occur when terminating impedances do not match the surge impedance of the cable.

If the line between transformers is not cable, there is usually enough attenuation of surge voltage so that arresters are not required.

In all cases where doubt occurs, Westinghouse engineers should be consulted. They have the necessary information for safe, practical and economical application, based on years of research and development on transformers and protective devices.

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220°C Insulation System, 150°C Rise

Test Data

Westinghouse transformers are tested in accordance with NEMA ST-20, for ratings 600 volts and below and NEMA ST-20 and NEMA TR-27 for 601 to 5000 volts.

Routine commercial tests performed on production line models are as follows:

1. Ratio
2. Polarity
3. No load (core loss)
4. Applied and induced over-potential tests

Ratio and polarity tests are given to insure that proper voltage ratio is maintained and that the winding polarity is either additive or subtractive as required by the design and shown on the transformer nameplate. No-load losses are checked to assure proper core assembly.

Applied voltage tests are made to check major insulation between windings and between windings and ground.

Induced over-potential tests are performed to check again turn-to-turn and layer-to-layer insulation.

Dry type distribution transformers are required to withstand impulse tests according to NEMA standards – demonstrated by prototype tests. Each Westinghouse dry type transformer has an established basic impulse level as required by NEMA standards. The basic impulse levels (BIL) are as follows:

600 volts and below – 10 kv BIL
2400 volts-5000 volts – 25 kv BIL

Test Reports: Certified test data on duplicate units of a production line model is obtainable from the factory at no additional charge.

Special tests not called for in routine commercial procedure must be negotiated with the factory.

Cooling

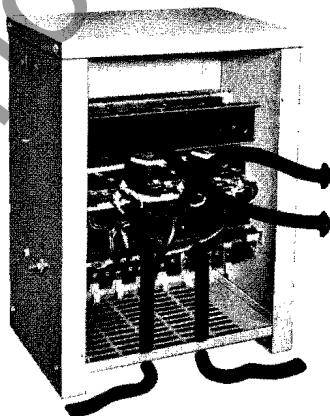
The insulation system is rated to withstand an average temperature rise of 150°C above a 30°C average or 40°C maximum ambient in a 24 hour period. The 150° figure is based on the rise of the winding temperature as measured by the change in resistance from cold start to maximum temperature at full load. The 150°C average rise is achieved without exceeding a 180°C hot spot rise. Adding the 40° maximum ambient to 180°C hot spot totals 220°C which is the rating of the insulation system.

The DT-3 and DS-3 transformers are so designed as to retain case characteristics of previous 80°C rise designs. In order to retain these characteristics, total losses at

operating temperatures have been kept approximately the same as on other 80°C rise units. Since total heat dissipation is a result of losses in the transformer, no greater amount of BTU/min are dissipated in the 150°C rise units than on the 80°C rise units. The winding temperatures are higher only due to the fact that core and coil utilize less cooling area and therefore become physically smaller.

Case design and terminal configurations prevent the higher temperatures within the coils from producing temperature problems in installation. The ventilated case design provides free air flow from the bottom louvers. In this way, heat is removed from the transformer, preventing the enclosure from excessive heat rise. No direct limitations are placed on case temperatures of this type transformer by the insulation; however, case temperature rises of 30° to 35°C are considered practical and acceptable and have given customer satisfaction in many DT-3 and DS-3 installations.

The location of terminals, when supplied in the bottom portion of the transformer case places them in the area where cool ambient air enters the case. Terminal compartment temperatures are generally less than 5°C rise in this area; therefore, high temperature cable insulation or oversize cables are not required for safe, long-life operation.



Coil Cooling

Terminal
Compartment
Cooling

Nomenclature

Series-Multiple and Three-Wire

A single phase winding designed for multiple, series and three-wire connections is designated by the multiple voltage rating followed by a (/) and then the series voltage rating

Example: 120/240 – a winding designed for 120-volt multiple connection, 240-volt series connection, or 240/120-volt, three-, wire connection.

Series-Multiple Only

A single or polyphase winding for both multiple and series connection, but not for three-wire connection, shall be designated by the multiple voltage rating followed by an (x) and the series-voltage rating.

Example: 240 x 480 – a voltage designed for 240-volt multiple connection or 480-volt series connection but not 240/480-volt, three-wire connection.

Three Phase Wye (Fully Insulated Neutral)

A three phase winding designed for wye connection, with fully insulated neutral brought out for four-wire operation, is designated by the Y-voltage rating, followed by a (/) and the voltage from line to neutral.

Example: 208Y/120 – a winding designed for 208-volt wye connection with 120 volts available from line to neutral.

Delta or Wye

A single or three phase winding for both delta or wye operation shall be designated by the delta voltage rating followed by a (/) and the wye voltage rating.

Example: 120/208 wye – windings to be connected for operation at 120 volts delta or 208 volts wye.

Transformers for Special Applications

Motor Starting Autotransformers

Motor starting autotransformer for reduced voltage starting of large ac motors. See Price List 46-923.

Saturable Core Reactors

Saturable core reactors for use with associated equipment in controlling heating power to electrical furnaces and for speed control of ac and dc motors. See Descriptive Bulletin 46-957.

Marine Applications

DS-3 transformers are designed specifically to meet the rigid requirements of AIEE-45, ABS and United States Coast Guard Rules for commercial marine shipboard application. See Descriptive Bulletin 46-956.

Our line of DT-3 three phase transformers are also designed to meet these same specifications; and in the event that three phase transformers are approved, these units will be applicable.

The Westinghouse policy of continuous improvement of its products may result in changes of these specifications without notice.