45-163-99

RECEIVING • TESTING • RECONDITIONING

INSTRUCTIONS

SUPERSEDED BY 45-163-99

INERTEEN®

INSULATING FLUID

P.D.S. 7336-9

for

Electrical Apparatus

WESTINGHOUSE ELECTRIC CORPORATION
SHARON PLANT • TRANSFORMER DIVISION • SHARON, PA.

NEW INFORMATION

MONS 080564

FEBRUARY, 1966

RECEIVING, HANDLING, STORING

SHIPMENT

Inerteen is shipped in tank cars, drums, or cans. The modern tank cars are usually lagged to prevent rapid fluctuations in temperature during transit and thus reduce the amount of expansion and contraction of Inerteen. Changes in the volume of the Inerteen due to temperature changes tend to cause breathing in of moist air resulting in condensation of moisture inside the container, and lowering of the dielectric strength of the Inerteen.

When shipped in drums, the Inerteen and the drums are both heated above room temperature while the drums are being filled, and the bungs are tightened immediately after filling. After cooling to normal temperature, the bungs are again tightened. The drums are provided with screw bungs having gaskets to prevent admission of water.

When shipped in cans, the cans as well as the Inerteen are heated above room temperature while being filled and are hermetically sealed immediately after filling.

STORING

Drums. As soon as a drum of Inerteen has been unloaded, the bung should be examined and tightened if it is loose. It is possible for bungs to become loosened by change in temperature or rough handling in transit. If loosened, be sure Inerteen is tested before using, or combining it with good Inerteen.

It is very desirable that Inerteen in drums be stored in a closed room. Outdoor storage of Inerteen is always hazardous to the Inerteen and should be avoided if at all possible. If it is necessary to store Inerteen outside, protection against direct contact of rain and snow should be provided. Drums stored outdoors should be placed so that bungs will be protected from moisture. It is desirable to cover the drums with a tarpaulin.

Cans. Cans containing Inerteen must not be exposed to the weather. Seals should be kept intact until the Inerteen is actually needed.

Screw caps are provided on the cans to use when the Inerteen is only partially removed after hermetic seal has been broken. By replacing the screw caps contamination by moisture and dirt will be retarded, but the Inerteen must be tested just before using.

Storage Tank. The storage tank should be mounted on piers so that it will not touch the ground, and will be accessible to all points for inspection for leakage.

It is desirable to maintain the temperature of the Inerteen and tank a little above the temperature of the surrounding air as this prevents condensation of moisture in the tank which would affect the dielectric strength of the Inerteen.

The tank should preferably have a convex bottom, allowing for the installation of a drain cock at the lowest point for removing dirt or tank scale which might settle out. As Inerteen is heavier than water, most all of any water present will, in time, rise to the top of the Inerteen. A valve somewhere near the normal top level of the Inerteen should be provided for drawing off water-contaminated Inerteen. Provision for drawing off the Inerteen should also be made near the bottom of the tank.

HANDLING

Caution: Inerteen is a skin irritant. Unnecessary contact with the liquid or its vapor, particularly when it is hot, should be avoided. Especially the eyes, nose, and lips are effected when Inerteen comes in contact with them. Certain safety precautions must be observed when handling Inerteen.

In case Inerteen comes in contact with the skin, the parts affected should be thoroughly washed in soapy water and followed by an application of cold cream. A supply of these materials should be kept available at all times where personnel are working with Inerteen. Continued exposure may cause eruptions on certain individuals due to the absorption of Inerteen through the pores

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Caution: Do not use a steel pipe because of the danger of a spark igniting the gasoline or benzine vapor.

Next, heat the drum with bunghole down, in a ventilated oven at a temperature of at least 88°C. (190°F.) for sixteen hours. (A simple oven for this purpose may be made from sheet metal and heated with steam or an electric heater.) Blow out the drum with dry nitrogen or dry air to remove any lingering explosive vapors. Screw the bung on tightly before removing the drum from the oven. Use a new washer with the bung to insure a tight seal.

Caution: Open flames must always be kept away from the oven to prevent igniting inflammable gases which might be remaining in drum when placed in the oven.

Refilling Drums. The practice of refilling drums with Inerteen is undesirable and should be avoided whenever possible, for unless the utmost precautions are taken, the Inerteen is likely to become contaminated.

If it is necessary to refill them for storage, drums which have been used only for clean, dry Inerteen should be reserved for this purpose. They should be closed immediately after being emptied, to exclude dirt and water. After refilling, they should be examined to see that they do not leak.

Whenever a drum is to be filled with Inerteen, the temperature of the drum and of the Inerteen should be at least 5.5°C. (10°F.) higher than the air, but the temperature of the drum need not be the same as that of the Inerteen.

A new washer should be used with the bung each time the drum is refilled, to insure a tight seal. These washers may be obtained from the nearest Westinghouse Office and it is recommended that a supply be kept on hand. Natural rubber composition washers should never be used as they would be attacked by the Inerteen.

Drums to be refilled with Inerteen for storage should be plainly marked with paint for identification.

SAMPLING AND INSPECTION

A good fireproof insulating liquid is one that will act as an insulating liquid, will carry the heat away from the apparatus, and is fireproof. Westinghouse Inerteen meets these requirements with the following characteristics:

1. High dielectric strength.
2. Freedom from inorganic acid, alkali, and corrosive sulphur. (To prevent injury to insulation and conductors)
3. Low viscosity. (To provide good heat transfer)
4. Low pour point.
5. Fireproof.

CAUSES OF DETERIORATION

The principal causes of deterioration of Inerteen are:

1. Presence of water.
2. Arcing.

Condensation from moist air due to breathing of the apparatus, especially when the apparatus is not continuously in service, may injure the Inerteen. (The moist air drawn into the apparatus condenses moisture on the surface of the Inerteen and inside of the tank.) The Inerteen may also be contaminated with water through leakage such as from leaky cooling coils or covers.

Arcing or burning in Inerteen produces finely divided carbon and gases which are mostly hydrogen chloride. Hydrogen chloride in the presence of moisture forms hydrochloric acid which may soon damage the insulation in the apparatus and cause rusting of ferrous materials.

Since hydrogen chloride is formed quickly after the arcing occurs, neither the Inerteen nor the apparatus should be exposed to the atmosphere (which always contains more or less moisture) until an attempt has been made to remove the hydrogen chloride. See Reconditioning, Page 7, for the method of purification.

SAMPLING INERTEEN

The dielectric strength of Inerteen is affected by the most minute traces of certain impurities, particularly water. It is important that the greatest care be taken in obtaining the samples and in handling them to avoid contamination. There have been low dielectric test results reported from the field which, upon investigation, have been found to be largely a matter of carelessness in handling.

All sampling and testing equipment must be thoroughly dry and clean. It is recommended that sampling and testing equipment used for handling Inerteen and servicing Inerteen be used for no other purpose. Care must be used in taking samples of Inerteen and sealing them prior to testing. It is

The physical and chemical examination consists of an examination of the Inerteen by a competent chemist. Recommendations will be made as to the suitability of the Inerteen for continued use, whether it would be desirable and economical to clean it, and in a general way, the preferred method of cleaning. In submitting samples for this service, the history of the Inerteen represented should be given as completely as possible.

Power factor test of Inerteen at 60 cycles can be made.

(For details refer to the nearest Westinghouse Office.)

CHARACTERISTICS AND RECONDITIONING

CHARACTERISTICS

Inerteen is chemically stable. It is straw-yellow in color. It is not affected by reaction with other materials regularly used in the manufacture of Inerteen apparatus. It is non-oxidizing and non-corrosive at temperatures considerably above those normally obtained in Inerteen apparatus. Inerteen will not sludge under any operating condition.

The dielectric strength of Inerteen will compare favorably with that of insulating oil when tested under the same conditions. Quality samples of Inerteen tested under laboratory conditions may show a dielectric strength in excess of 40kv. Care must be exercised in handling and testing Inerteen. Inerteen must be kept in clean, sealed containers to prevent loss by evaporation or contamination by moisture or dirt.

Inerteen exerts a strong solvent action on most varnishes, gums, and paints. Such materials are not used in the construction of Inerteen apparatus. No materials should be used in Inerteen apparatus except those approved by the Westinghouse Electric Corporation.

Inerteen has an irritating effect upon the skin. If it is necessary to handle it, see the caution note under Receiving, Storing, and Handling. (See Page 3.) It should be remembered that mineral oil is completely miscible with Inerteen; in fact, it is practically impossible to separate mineral oil and Inerteen.

Inerteen P.D.S. 7336-9 has an improved characteristic so that, when arcing occurs, the insulating materials are not so quickly or so greatly impaired as a result of the liberation of hydrogen chloride. Inerteen 7336-7, which was supplied in Inerteen transformers previous to September 1, 1946, can easily be converted to 7336-9 Inerteen. For complete information on this conversion, request Engineering Data Letter No. 1337-A from any Westinghouse Electric Corporation Office.

Specific Characteristics of Inerteen. As outlined in "Method of Testing Asharels A.S.T.M. D801-46T", the specific characteristics of Inerteen are:

1. Burn point: None
2. Chemical stability: No generation of free chlorides under normal operating conditions
3. Color: (Maximum) 130 A.P.H.
4. Condition: Clear
5. Dielectric constant:
   At 1000 cycles 77°F (25°C), 4.0 to 4.3
   At 1000 cycles 212°F (100°C), 3.8 to 3.9
6. Dielectric strength: (Minimum) 77°F (25°C)
   At point of shipment, 35 kv
   At point of receipt, 30 kv
7. Electrical resistivity: (Minimum)
   100 x 10^9 ohms/cm³ (212°F (100°C) at 500 volts d-c)
8. Fixed chlorine content: (Minimum) 99.1 percent
9. Free chlorides: Less than 0.10 ppm
10. Neutralization number: Less than 0.010 mg. of NaOH/gram.
11. Pour Point: (Maximum) minus 25.6°F (minus 32°C)
12. Refractive index:
    At 77°F (25°C), 1.6137 to 1.6157
13. Specific gravity: (Minimum)
    At 60°F/60°F (15.5°C/15.5°C), 1.560
14. Viscosity: (Maximum)
    At 100°F (37.8°C), 54 seconds

RECONDITIONING

Reconditioning will be necessary to remove water, dirt and hydrogen chloride which may be present and contaminating the Inerteen.

The blotter filter press and the Inerteen conditioner (both of which will be explained later in this book under "Apparatus for Reconditioning") will remove water and dirt deposits which may be present. Of the two methods, the Inerteen conditioner is the most effective in removing these two contaminating agents. Any equipment used for filtering

The temperature of the test cup and of the Inerteen when tested shall be the same as that of the room, which should be between 68°F and 86°F. (20°C and 30°C.) Testing at lower temperatures is likely to give variable results which may be misleading.

The sample in the container shall be agitated with a swirling motion (to avoid introducing air) so as to mix the Inerteen thoroughly before filling the test cup. This is even more important with used Inerteen than with new Inerteen as the impurities may be precipitated and the test may be misleading.

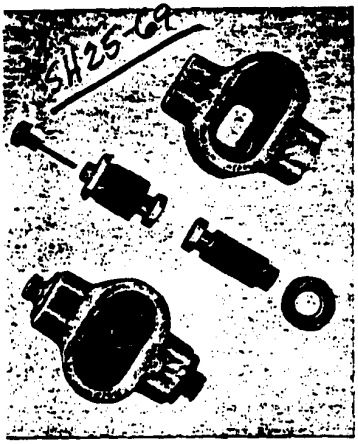

FIG. 1. Fluid Test Cup for Dielectric Test

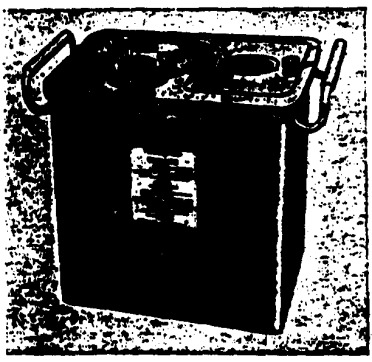

FIG. 2. Portable Oil Testing Set, ½ Kva. 25,000 Volts

The cup shall be filled with Inerteen to a height of no less than 0.79 in. (20 mm) above the top of the electrodes.

The Inerteen shall be gently agitated by rocking the cup and allowing it to stand in the cup for three minutes before the first and one minute before each succeeding puncture. This will allow air bubbles to escape.

Voltages shall be applied and increased uniformly at a rate of approximately 3000 volts (rms) per second until breakdown occurs as indicated by a continuous discharge across the gap. (Occasional momentary discharges which do not result in a permanent arc may occur; these should be disregarded).

TESTS

a. Except as specified in (b) one breakdown test shall be made on each of five fillings of the test cup. If the average deviation from the mean exceeds 10 percent or if any individual test deviates more than 25 percent from the average, additional tests shall be made. The dielectric strength shall be determined by averaging the first five tests that conform to the allowable variations.

b. When Inerteen is tested in considerable quantity, so that the time required for testing is excessive and when it is merely desired to determine whether the breakdown safely exceeds the limit specified, or in those cases where the amount of Inerteen available for test may be very limited, one breakdown test shall be made on each of two fillings of the test cup. If neither breakdown is below this value, the Inerteen may be considered satisfactory and no further tests shall be required. If either of the breakdowns is less than the specified value a breakdown shall be made on each of three additional fillings and test results analyzed in accordance with (a).

Report. The report shall include the volts (rms value) at each breakdown and the average of the two or five breakdowns and the temperature of the Inerteen at the time of the test.

POUR TEST

Note: The procedures covered by the following instructions for the pour test, and especially the neutralization test, require special equip-

During the cooling of the Inertoxen, care shall be taken not to disturb the mass of the Inertoxen nor to permit the thermometer to shift in the Inertoxen.

The temperature of the cooling bath shall be adjusted so that it is below the pour point—approximately -25.6°F (-32°C)—of the Inertoxen by not less than 18°F. (9.3°C) nor more than 30°F. (16.7°C), and the cooling bath shall be maintained at this temperature throughout the test. The jacket containing the test jar shall be supported firmly in a vertical position in the cooling bath so that not more than 1 in. of the jacket projects out of the cooling medium.

Beginning at a temperature 20°F. (11.1°C.) above the expected pour point, at each lower test-thermometer reading which is a multiple of 5°F. (2.8°C), the test jar shall be removed from the jacket carefully and shall be tilted just sufficiently to ascertain whether there is a movement of the Inertoxen in the test jar. The complete operation of removal and replacement shall require not more than three seconds. As soon as the Inertoxen in the test jar does not flow when the jar is tilted, the test jar shall be held in a horizontal position for exactly five seconds, as noted by a stop watch or other accurate timing device, and observed carefully. If the Inertoxen shows any movement under these conditions, the test jar shall be immediately replaced in the jacket and the same procedure repeated at the next temperature reading 5°F. (2.8°C.) below the previous reading.

FIG. 4. Apparatus for Pour Test

The test shall be continued in this manner until a point is reached at which the Inertoxen in the test jar shows no movement when the test jar is held in a horizontal position for exactly five seconds. The reading of the test thermometer at this temperature, corrected for error if necessary, shall be recorded. The pour point shall be taken as the temperature 5 F. (2.8 C.) above this solid point.

NEUTRALIZATION [illegible]

The Neutralization Number is the number of milligrams of potassium hydroxide required to neutralize the acid in one gram of Inertoxen.

Solutions Required.

a. Standard Potassium Hydroxide Solution (alcoholic, 0.1 N)—add 6 g. of c.p. solid KOH to 1 liter of c.p. anhydrous isopropyl alcohol. Boil, add 2 g. of c.p. Ba (OH)2 and boil again. Cool, filter and store in a chemically resistant bottle protected by a guard tube containing soda lime and soda asbestos (Ascarite). Standardize against pure potassium acid phthalate using phenolphthalein as an indicator.

b. Titration Solvent—Add 500 ml. of c.p. benzene and 5 ml of water to 495 ml of c.p. anhydrous isopropyl alcohol.

c. Alpha-Naphtholbenzein Indicator Solution—Prepare a solution containing 10 g. of alpha-naphtholbenzein per liter of c.p. anhydrous isopropyl alcohol.

Procedure. Into a 250 ml Erlenmeyer flask introduce 40 g. of Inertoxen weighed accurately. Add 100 ml of the titration solvent and 3 ml of the indicator solution. Titrate immediately at a temperature below 30°C. Consider the end point definite if the color change to green persists for 15 seconds. A blank shall be determined on the solvent.

Calculations. The neutralization number or mg. KOH per g. of Inertoxen = $\frac{(A-B)(N) \times 56.1}{W}$

A = ml KOH solution required for sample.
B = ml KOH solution required for blank.
N = normality of KOH solution.
W = grams of sample used.

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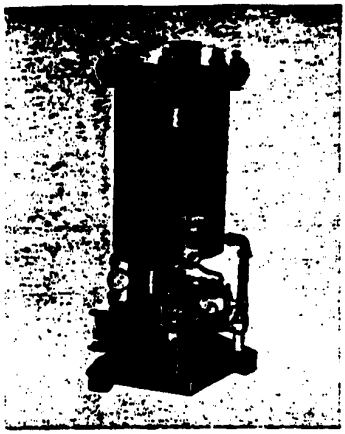

FIG. 5. Three Gallon-per-Minute Conditioner

depending on the condition of the paper and the spacing of the sheets in the oven. Both paper and clay should be placed directly in the filter after the drying process as either, if exposed, will absorb considerable moisture from the atmosphere in a very short time.

Each fresh charge of clay will absorb about three gallons of Inerteen. This should be provided for to prevent depleting the supply in the apparatus, but most of this Inerteen may be recovered when changing clay.

This can be accomplished most effectively by removing the used clay from the filter and placing it in a tank of approximately 30 gallons capacity containing about 5 gallons of water. The tank should have a drain valve at its bottom edge and should be tilted somewhat toward this valve. The clay thus placed in water, having a greater affinity for water, will give up the Inerteen it has absorbed and become saturated with water. The Inerteen being heavier than water will sink to the bottom; the clay and water will float on top. After settling for several hours, most of the Inerteen may be drawn off through the valve. This Inerteen may be reconditioned and used again in recharging the conditioner. The used clay should be discarded.

To Prepare the 7 GPM Conditioner for Operation. Remove the cover and screen from the clay tank and fill the tank with activated clay, 4440-3, to within four inches of the bottom edge of the inner flange. Replace screen and cover. Release the pressure-screw of the filter press and loosen plates and frames. Place one sheet of "F" size blotting paper between the face of each frame and plate. Care should be used to see that the holes thru the plates, frames and paper are in proper alignment before the pressure screw is tightened. Close the discharge, tank by-pass, tank drain, suction and suction-test valves. Open the air discharge valve. Pour sufficient Inerteen into the drip pan to fill the clay tank and wet the clay. This will require approximately eight gallons of Inerteen. Start the motor and open the drip pan valve a small amount so that not less than 5 minutes are required to fill the clay tank, saturating the clay with Inerteen. (If Inerteen is admitted too rapidly, it will tend to pack the clay into the top of the tank.) With the valve at the apparatus closed, open the suction-test valve to subject the suction line to pressure and thus check it for leaks. Stop motor and close suction-test, air discharge, and drip pan valves.

To begin conditioning Inerteen in Inerteen filled apparatus, open the apparatus valves. Open the conditioner discharge and suction valves. At intervals open air discharge valve to allow trapped air to escape and close when Inerteen starts to flow through valve. Open drip pan valve at intervals too, to remove Inerteen which may have dripped into the drip pan.

When it is necessary to change the clay, first close the valve in the suction line, close the tank

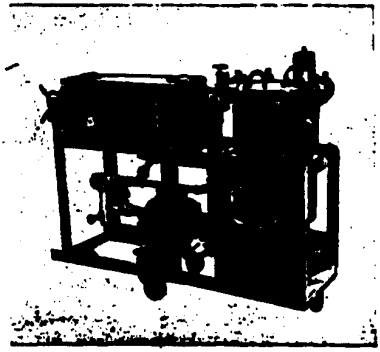

FIG. 6. Seven Gallon-per-Minute Conditioner

the escape of Inerteen, the plates are cast with small pyramids on both surfaces.

The plates and frames have holes in two corners and supporting lugs at the sides. The plates have handles cast on the top edge. When the plates and frames are assembled with the filter papers between, the holes form the inlet and outlet. The frames have the holes in the upper corner connected by small ducts to the middle of the frame. The plates have ducts leading from the surface of the plate to the hole in the lower corner. (See Fig. 8).

The Inerteen enters under pressure at the top corner through the inlet formed by the holes in the frames, plates, and filter papers, flows into the frames through the same ducts, and completely fills the chamber formed by the frame and two sets of filter paper. As there are no outlet ducts in the frame, the Inerteen is forced through the paper and flows along the grooves between the rows of pyramids and out through the ducts provided at the lower corner of the plates. The dry filter paper takes up the moisture and removes the sediment from the Inerteen.

Operation. The filter press is made ready for operation by placing a set of five sheets of filter paper (that have been thoroughly dried in an electric oven) between each filter plate and frame. The holes in the filter paper must line up with the holes in the plates and frames. The sediment is strained out by the first layer of paper and the moisture is taken up by the capillary action of the paper.

If any moisture remains, it indicates that the filter papers are saturated with moisture and should be renewed. No rule can be given as to how often the papers must be changed, as this depends entirely on the condition of the Inerteen. The usual procedure is to run the machine for about half an hour (if the Inerteen is not in very bad condition) and then shut down; remove one sheet from the inlet side of each set and put in a new sheet on the outlet side of each set. (The frame is the inlet side and the plate is the outlet side.) Frequent dielectric tests should be made during this procedure as wet Inerteen may necessitate recharging the filter press with a full set of papers before the five sheets have been removed in succession.

The quickest method of filtering a quantity of Inerteen is to pump all the Inerteen through the filter and into another tank which is clean and dry. If care is taken to change the filter papers before they become saturated, the Inerteen will be clean and dry. If a second tank for holding the Inerteen

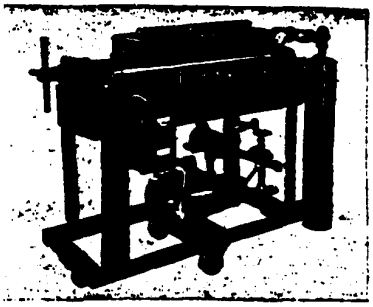

FIG. 7. B-10 Blotter Filter Press

is not available, or if it is desired to filter the Inerteen of apparatus while it is in service, the Inerteen may be pumped from the top of the apparatus tank through the filter and returned to the bottom of the same tank under the surface of the Inerteen. This operation should be continued until the Inerteen in the apparatus tank shows a sufficiently high dielectric strength.

When a large quantity of Inerteen is to be filtered, time may be saved by using two filter presses, one of which may be operated while the other is being recharged.

Filtering through blotter filter papers does not materially reduce organic acidity or improve resistance to emulsification, although the dielectric strength may be restored to a satisfactory value.

The capacity of the filter press is much reduced when operating at low temperatures.

When the Inerteen has to be filtered at low temperatures, an additional pump in the pipe line is desirable.

Inerteen in apparatus contaminated by only a small amount of moisture may be reconditioned by drawing the Inerteen from the top of the apparatus tank, passing it through the filter press, and pumping it back into the bottom of the apparatus. The Inerteen should be put through the system until a sample drawn from the top of the apparatus gives satisfactory dielectric values.

Blotter Filter Paper. The filter paper used is a special grade of blotting paper about .025 in. thick; it contains no coloring matter or chemicals which might injure the Inerteen. Five sheets cut to