Instructions for Weld-On, Cast Resin Bushing, Type CRW (for Indoor or Enclosure Type Bushings)

I. L. 47-061-8A

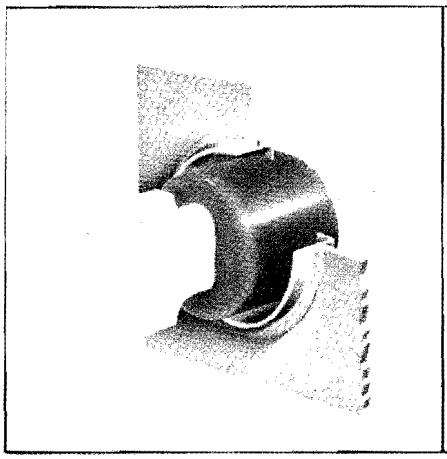

Fig. 1 Weld-On Cast Resin Bushing, Type CRW

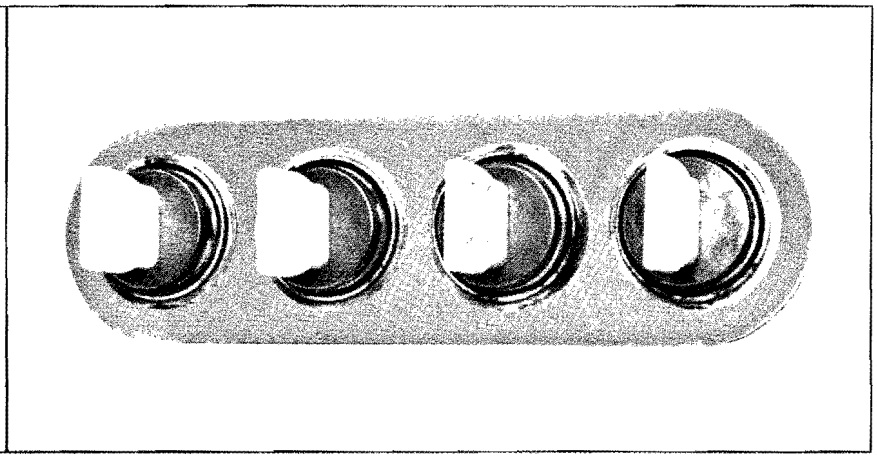

Fig. 2 Four Type CRW Bushings Welded into a Single Plate

The Westinghouse indoor (or in an enclosure) type CRW bushing is a cast resin, hermetically sealed bushing with an embedded copper flange for welding to a mating copper mounting ring. See Figure 1. Resin is cast around the conductor and a portion of the flange to form a weldable, gasketless bushing. The mounting ring is brazed to a non-magnetic steel plate on the transformer tank.

The type CRW bushing can be installed as a separate item into a tank wall, or for larger units the bushing is available prewelded into small non-magnetic steel plates. Bushings can be prewelded individually in a small plate, or in groups of two, three, or four to a plate. Figure 2 shows a group of four type CRW bushings welded into a single plate, which can then be welded directly to the tank wall. Gas tungsten arc welding is used to weld the bushing flange to its mounting ring. Gas tungsten arc welding (often called TIG welding) is an arc welding process in which the heat is produced between a non-consumable electrode and the work metal. The electrode, the weld puddle, the arc, and adjacent heated areas of the work piece are protected from atmospheric contamination by a gaseous shield. This shield is provided by a stream of gas (usually an inert gas) or a mixture of gases. The gas shield must provide full protection; even a small amount of entrained air can contaminate the weld.

This method of welding is ideally suited for mounting of type CRW bushings as its high concentration of localized heating provides a fast weld which in combination with adequate bushing cooling methods prevents excessive heating of the copper-to-resin seal.

MECHANICAL INSTALLATION DESIGN OF TYPE CRW BUSHINGS

The bushing conductor should not be used as a structural member. As a rule, flexible connections should be made to the air or liquid ends of the bushing conductor. If, however, a "dead weight" connector load is to be supported by the bushing, a maximum moment of 1200 in-pounds, as determined by a moment arm from the center of gravity of the load, perpendicular to a plane passing through the underside of the metal flange, should be considered a maximum. Rigid connections between the bushing and other bus supports are to be avoided as this will apply thermal expansion forces to the bushing.

As a general rule, if moment forces are not calculated, a maximum bushing conductor lateral load of 100 pounds acting at the end of the bushing conductor should not be exceeded.

For axial loads applied to the bushing connector, a maximum loading of 100 pounds is recommended.

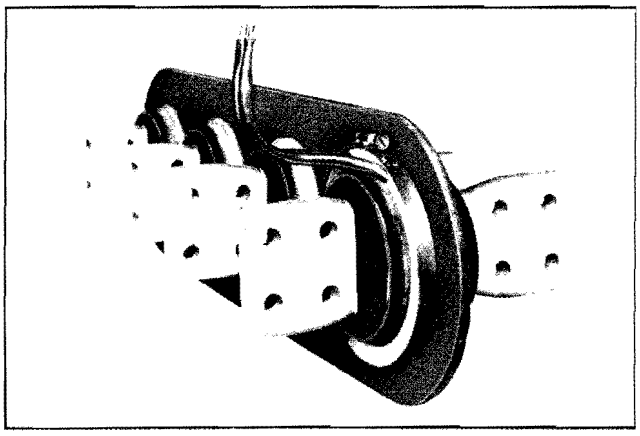

Fig. 3 Cooling Coil Positioned over the Bushing Flange

METHODS OF COOLING A BUSHING DURING WELDING

During welding of a type CRW bushing into its mounting ring, the following cooling methods are recommended:

Water Bath Method of Cooling Bushings (In Shop Use)

This method is practical for bushings to be welded into a small plate not yet attached to the transformer tank. Cooling of the bushings during welding is accomplished by an agitated container of water. The agitated water bath method simply consists of a small open container of water over which the bushing plate, complete with mounting rings, is placed with the ring upwards toward the operator. The bushing is inserted into its ring until the edge of the bushing flange is flush with the edge of the ring. (Depth of the water container must be sufficient to accommodate the bottom length of the bushing.) A snug fit should exist between the ring and the bushing flange which is sufficient to hold the bushing in place during welding. If the ring does not support the bushing, the ring may be tapped lightly to cause it to deform slightly to restrain the bushing. The water level in the container should be maintained to the top to assure that the underside of the bushing copper flange is immersed in water. During welding, the water in the container should be agitated with a small mixer blade.

Cooling Coil Method of Cooling Bushings During Welding (In Shop Use)

This method of cooling the bushings is practical for bushings being welded into small plates, or for bushings being welded directly into a tank wall when access to the liquid side of the bushing is available. The cooling coil is a brass collar which has been designed to slip over the liquid side of the bushing flange. During welding of the bushing, the cooling coil is positioned over the bushing flange and water is circulated through the coil. Figure 3 shows a cooling coil positioned on a bushing. Cooling coil Part No. 273C855 is used for 2000 amp bushings and cooling coil Part No. 273C856 is used for 3000 amp and above bushings.

Wet Asbestos Method of Cooling Bushings During Welding (For Field Replacement)

The wet asbestos method of cooling bushings during welding is recommended for bushing installation when the agitated bath or the cooling coil methods are not practical, such as may occur in field replacement of bushings. The wet asbestos method is as follows:

1) Wrap two full turns of 3/16 inch diameter water-soaked asbestos cord around the bushing resin body and force it into the space between the resin and copper flange so that it is in intimate contact with the bottom surface of the flange. Wrap one turn of dry 3/16 inch diameter asbestos cord around the bushing and force it down over the water-soaked cord to minimize steaming. Place a wrap of

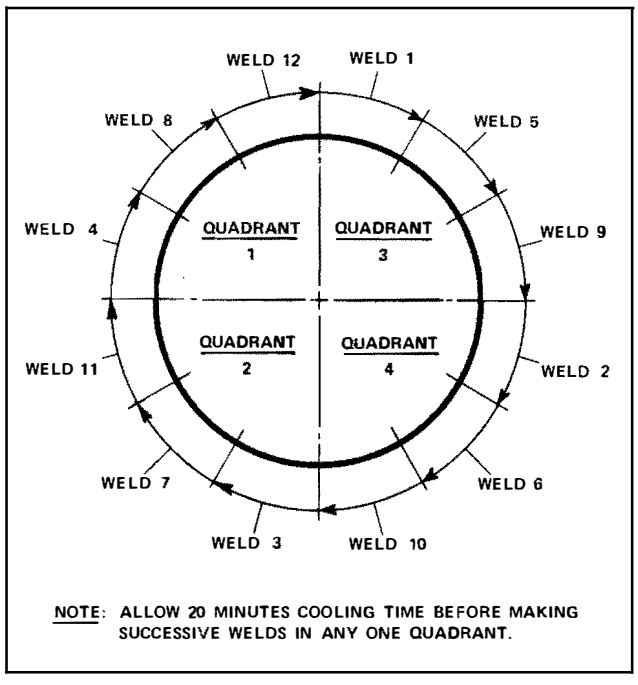

Fig. 4 CRW Bushing Installation Welding Procedure When Using the Wet Asbestos Method of Cooling Bushings

water-soaked asbestos tape around the resin body (airside) to protect it from weld flame.

2) Proceed to weld the bushing flange in approximately one inch segments, as shown in Figure 4. (Each segment shall not exceed 10 seconds to weld.) To prevent overheating of the bushing during welding of the flange, 20 minutes should elapse before successive weld passes are made **in the same quadrant.** Figure 4 shows a bushing flange divided into four quadrants, with each quadrant having three weld passes. Weld passes are numbered in the order of recommended completion.

INSTALLATION WELDING OF BUSHINGS

In conjunction with one of the previously defined methods of cooling, the following method of welding a bushing into its mounting ring is recommended:

NOTE: FOR COPPER TO COPPER (BUSHING FLANGE TO MOUNTING RING)

The current recommended for welding copper by the Gas Tungsten Arc Welding Process is direct current straight polarity (DCSP). Helium gas shielding is recommended for copper, but a mixture of shielding gas may be used.

1) Insert the bushing into the mounting ring. Rotate the bushing until the external terminal of bushing is properly oriented (refer to other low voltage bushings on unit or to transformer outline drawing).

2) The bushing should fit snugly in the mounting ring. If necessary, to insure this, tap the ring against the bushing flange with a small hammer.

3) If necessary, place a metal cylindrical shield or asbestos wrap over the exposed resin to prevent accidental damage from the arc during welding.

4) Weld the bushing to the mounting ring by the gas tungsten arc method using helium gas and a 200 ampere D.C. welder. No filler rod or flux is necessary. Weld parts together in accordance with Figure 4, moving as quickly as possible along the weld. Deep weld penetration is not necessary or desirable. Less time consumed in making the weld will afford better protection to the resin-to-metal seal.

5) After the welded joint has cooled, test the weld for tightness by applying 5 psi pressure to the transformer tank and brushing leak detector solution over the weld.

6) If there is a leak in the welded joint, close leak by rewelding the joint at the leak.

7) Connect the lead to the bushing inside the transformer.

CAUTION: During welding of a bushing into its mounting ring, the maximum temperature of the bushing resin should not exceed 120° centigrade (248° Fahrenheit), or bushing internal seal damage may result. To assist the operator in determining maximum temperatures, it is suggested that a melt-type or color-changing temperature indicating marking material be applied to the bushing **resin** body (not to metal parts).

FIELD REPAIR OF BUSHING LEAKS

If due to damage or other reasons a bushing is found to be leaking transformer coolant, the following methods of repairing the bushing on the transformer are approved, providing major damage is not present.

Repair of Bushing Weld Leaks

In cases where a leak has occurred in the weld between the bushing flange and mounting ring, the following solder seal method may be used to seal pinhole type leaks.

1) Cool the bushing as described in the wet asbestos method of cooling.

2) If the transformer tank is properly braced (check nameplate pull slight vacuum to temporarily stop leak.

3) Clean around the leak with a wire brush, Scotch-Bright or sandpaper.

4) Preheat the welded joint around the leak to approximately 350° F with a torch.

5) Apply (60% tin — 40% lead) solder and acid flux to joint at point of leak.

6) Allow to cool and rinse thoroughly to remove residual flux. Test repaired leak applying 5 psi pressure to the transformer tank and by brushing a chalk-alcohol solution over the repaired area.

Field Repair of Bushings Leaking at the Flange-to-Resin Seal

Leaking of a bushing at the flange-to-resin seal can be identified by seepage of the transformer coolant from the annular space between the resin body of the bushing and the bushing flange. Repair of this type of leak is accomplished by use of an epoxy sealant per the instructions outline in Westinghouse procedure identified as "South Boston Division Repair Manual Procedure No. 24."

FIELD REMOVAL AND REPLACEMENT OF TYPE CRW BUSHINGS

If for any reason a bushing must be replaced, the following procedure is to be followed after the unit has been de-energized and unit drained.

Removal of Bushing

1) Disconnect the lead to the bushing inside the transformer. (This will require removal of welded-on or bolted-on access or bushing plates on the transformer cover or wall.)

2) The gas tungsten arc weld between the flange and mounting ring is approximately 1/16 inch thick and can be broken by cutting or grinding. To reduce the possibility of metal chips or dust, the recommended method is to cut the weld. To cut the weld, use a 3/16 inch wide sharp chisel or screwdriver. Place the cutting edge of the tool on the edge of the weld and with sufficient hammer force, drive the blade through the weld so as to split the weld and force the bushing flange inward away from the plate mounting ring. Once the split has started, with the cutting tool edge held at an angle, continue cutting around the entire weld. Care must be taken so as not to damage or cut into the mounting ring.

   The grinding method of removing a bushing utilizes a highspeed rotary file, size 3/16"x1/2", shape C with radius end. Using the file, remove 3/32" to 1/8" of weld. A strong tug on the bushing will usually then free it from the mounting ring.

3) After the weld is broken, remove the bushing from the tank wall.

NOTE: If the bushing being removed has been repaired by a solder seal, be sure that all traces of solder are removed from the surface of the copper mounting ring before rewelding a new bushing in place.

Replacement of Bushing

Since the seal between the cast resin insulation and the copper flange of the bushing can be damaged by excessive heat during the welding process, it is important to use care during bushing replacement welding. If the operator is not familiar with the gas tungsten arc welding process, it is recommended that practice on similar pieces of copper be made before attempting to install a bushing.

The following bushing installation procedure is recommended:

1) Clean the mounting ring on the tank wall free of burrs, etc. Straighten any bends in the mounting ring. (Use care to avoid getting metal particles into the tank.)

2) Cooling and installation welding of the bushing is to be done in accordance with "Wet Asbestos Method of Cooling Bushings During Welding (For Field Replacement)," page 2, and "INSTALLATION WELDING OF BUSHINGS," page 3.

RENEWAL PARTS

When renewal parts are required, order from the nearest Westinghouse Office, giving description of parts wanted, with transformer serial number and rating as stamped on the transformer instruction plate. If the transformer is non-Westinghouse, contact the nearest office of the supplier.

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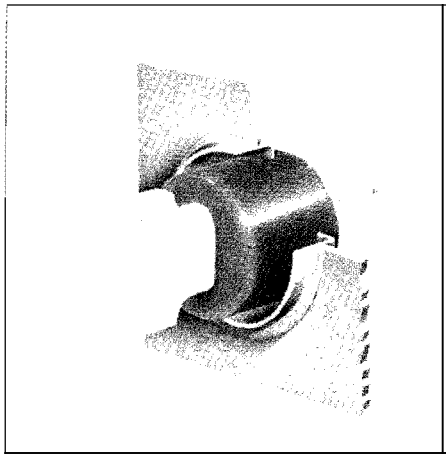

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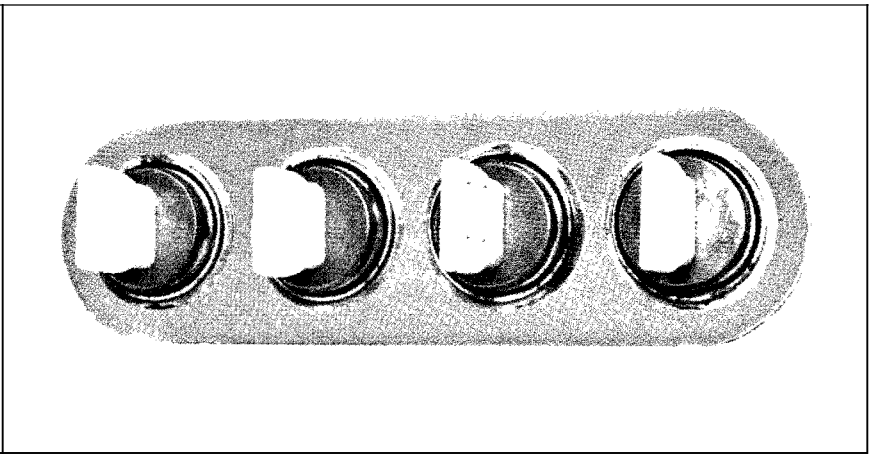

Fig. 2 Four Type CRW Bushings Welded into a Single Plate

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The type CRW bushing can be installed as a separate item into a tank wall, or for larger units the bushing is available prewelded into small non-magnetic steel plates. Bushings can be prewelded individually in a small plate, or in groups of two, three, or four to a plate. Figure 2 shows a group of four type CRW bushings welded into a single plate, which can then be welded directly to the tank wall. Gas tungsten arc welding is used to weld the bushing flange to its mounting ring. Gas tungsten arc welding (often called TIG welding) is an arc welding process in which the heat is produced between a non-consumable electrode and the work metal. The electrode, the weld puddle, the arc, and adjacent heated areas of the work piece are protected from atmospheric contamination by a gaseous shield. This shield is provided by a stream of gas (usually an inert gas) or a mixture of gases. The gas shield must provide full protection; even a small amount of entrained air can contaminate the weld.

This method of welding is ideally suited for mounting of type CRW bushings as its high concentration of localized heating provides a fast weld which in combination with adequate bushing cooling methods prevents excessive heating of the copper-to-resin seal.

MECHANICAL INSTALLATION DESIGN OF TYPE CRW BUSHINGS

The bushing conductor should not be used as a structural member. As a rule, flexible connections should be made to the air or liquid ends of the bushing conductor. If, however, a "dead weight" connector load is to be supported by the bushing, a maximum moment of 1200 in-pounds, as determined by a moment arm from the center of gravity of the load, perpendicular to a plane passing through the underside of the metal flange, should be considered a maximum. Rigid connections between the bushing and other bus supports are to be avoided as this will apply thermal expansion forces to the bushing.

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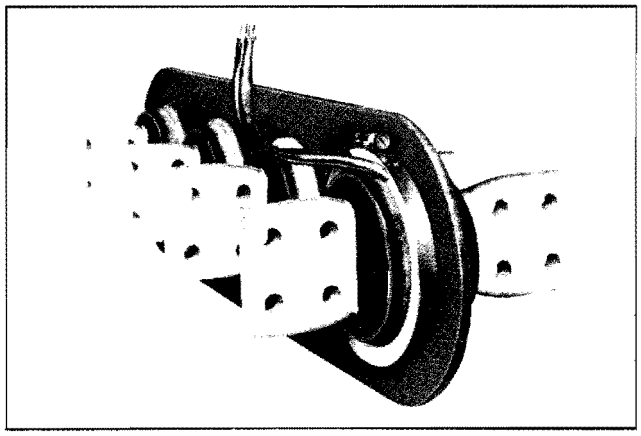

Fig. 3 Cooling Coil Positioned Over the Bushing Flange

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Wet Asbestos Method of Cooling Bushings During Welding (For Field Replacement)

The wet asbestos method of cooling bushings during welding is recommended for bushing installation when the agitated bath or the cooling coil methods are not practical, such as may occur in field replacement of bushings. The wet asbestos method is as follows:

1) Wrap two full turns of 3/16 inch diameter water-soaked asbestos cord around the bushing resin body and force it into the space between the resin and copper flange so that it is in intimate contact with the bottom surface of the flange. Wrap one turn of dry 3/16 inch diameter asbestos cord around the bushing and force it down over the water-soaked cord to minimize steaming. Place a wrap of

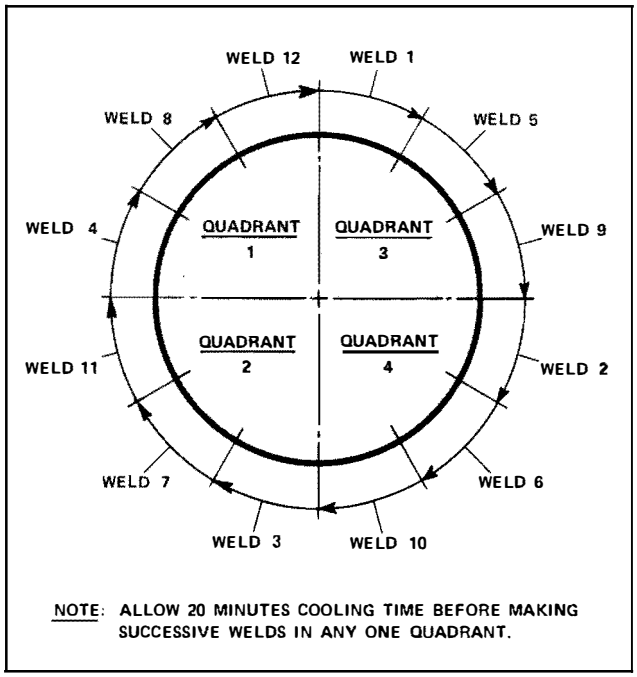

Fig. 4 CRW Bushing Installation Welding Procedure When Using the Wet Asbestos Method of Cooling Bushings

water-soaked asbestos tape around the resin body (airside) to protect it from weld flame.

2) Proceed to weld the bushing flange in approximately one inch segments, as shown in Figure 4. (Each segment shall not exceed 10 seconds to weld.) To prevent overheating of the bushing during welding of the flange, 20 minutes should elapse before successive weld passes are made **in the same quadrant.** Figure 4 shows a bushing flange divided into four quadrants, with each quadrant having three weld passes. Weld passes are numbered in the order of recommended completion.

INSTALLATION WELDING OF BUSHINGS

In conjunction with one of the previously defined methods of cooling, the following method of welding a bushing into its mounting ring is recommended:

NOTE: FOR COPPER TO COPPER (BUSHING FLANGE TO MOUNTING RING)

The current recommended for welding copper by the Gas Tungsten Arc Welding Process is direct current straight polarity (DCSP). Helium gas shielding is recommended for copper, but a mixture of shielding gas may be used.

1) Insert the bushing into the mounting ring. Rotate the bushing until the external terminal of bushing is properly oriented (refer to other low voltage bushings on unit or to transformer outline drawing).

2) The bushing should fit snugly in the mounting ring. If necessary, to insure this, tap the ring against the bushing flange with a small hammer.

3) If necessary, place a metal cylindrical shield or asbestos wrap over the exposed resin to prevent accidental damage from the arc during welding.

4) Weld the bushing to the mounting ring by the gas tungsten arc method using helium gas and a 200 ampere D.C. welder. No filler rod or flux is necessary. Weld parts together in accordance with Figure 4, moving as quickly as possible along the weld. Deep weld penetration is not necessary or desirable. Less time consumed in making the weld will afford better protection to the resin-to-metal seal.

5) After the welded joint has cooled, test the weld for tightness by applying 5 psi pressure to the transformer tank and brushing leak detector solution over the weld.

6) If there is a leak in the welded joint, close leak by rewelding the joint at the leak.

7) Connect the lead to the bushing inside the transformer.

CAUTION: During welding of a bushing into its mounting ring, the maximum temperature of the bushing resin should not exceed 120° centigrade (248° Fahrenheit), or bushing internal seal damage may result. To assist the operator in determining maximum temperatures, it is suggested that a melt-type or color-changing temperature indicating marking material be applied to the bushing **resin** body (not to metal parts).

FIELD REPAIR OF BUSHING LEAKS

If due to damage or other reasons a bushing is found to be leaking transformer coolant, the following methods of repairing the bushing on the transformer are approved, providing major damage is not present.

Repair of Bushing Weld Leaks

In cases where a leak has occurred in the weld between the bushing flange and mounting ring, the following solder seal method may be used to seal pinhole type leaks.

1) Cool the bushing as described in the wet asbestos method of cooling.

2) If the transformer tank is properly braced (check nameplate pull slight vacuum to temporarily stop leak.

3) Clean around the leak with a wire brush, Scotch-Bright or sandpaper.

4) Preheat the welded joint around the leak to approximately 350°F with a torch.

5) Apply (60% tin — 40% lead) solder and acid flux to joint at point of leak.

6) Allow to cool and rinse thoroughly to remove residual flux. Test repaired leak applying 5 psi pressure to the transformer tank and by brushing a chalk-alcohol solution over the repaired area.

Field Repair of Bushings Leaking at the Flange-to-Resin Seal

Leaking of a bushing at the flange-to-resin seal can be identified by seepage of the transformer coolant from the annular space between the resin body of the bushing and the bushing flange. Repair of this type of leak is accomplished by use of an epoxy sealant per the instructions outline in Westinghouse procedure identified as "South Boston Division Repair Manual Procedure No. 24."

FIELD REMOVAL AND REPLACEMENT OF TYPE CRW BUSHINGS

If for any reason a bushing must be replaced, the following procedure is to be followed after the unit has been de-energized and unit drained.

Removal of Bushing

1) Disconnect the lead to the bushing inside the transformer. (This will require removal of welded-on or bolted-on access or bushing plates on the transformer cover or wall.)

2) The gas tungsten arc weld between the flange and mounting ring is approximately 1/16 inch thick and can be broken by cutting or grinding. To reduce the possibility of metal chips or dust, the recommended method is to cut the weld. To cut the weld, use a 3/16 inch wide sharp chisel or screwdriver. Place the cutting edge of the tool on the edge of the weld and with sufficient hammer force, drive the blade through the weld so as to split the weld and force the bushing flange inward away from the plate mounting ring. Once the split has started, with the cutting tool edge held at an angle, continue cutting around the entire weld. Care must be taken so as not to damage or cut into the mounting ring.

   The grinding method of removing a bushing utilizes a highspeed rotary file, size 3/16"x1/2", shape C with radius end. Using the file, remove 3/32" to 1/8" of weld. A strong tug on the bushing will usually then free it from the mounting ring.

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NOTE: If the bushing being removed has been repaired by a solder seal, be sure that all traces of solder are removed from the surface of the copper mounting ring before rewelding a new bushing in place.

Replacement of Bushing

Since the seal between the cast resin insulation and the copper flange of the bushing can be damaged by excessive heat during the welding process, it is important to use care during bushing replacement welding. If the operator is not familiar with the gas tungsten arc welding process, it is recommended that practice on similar pieces of copper be made before attempting to install a bushing.

The following bushing installation procedure is recommended:

1) Clean the mounting ring on the tank wall free of burrs, etc. Straighten any bends in the mounting ring. (Use care to avoid getting metal particles into the tank.)

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