



# Type DTW, De-energized Tap Changer Technical and Installation Guide

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## 1 Scope

This guide contains general information for ordering and installing the type DTW de-energized tap changer. This guide does not describe all possible contingencies, which may arise during installation, operation or maintenance of the tap changer, nor does it describe all details and variations of the equipment. If you require additional information regarding the installation and the operation or maintenance of your equipment, please contact ABB.

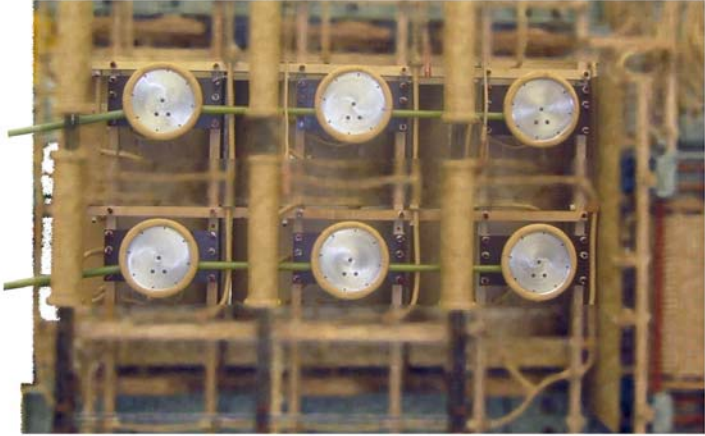


Figure 1: Double Bridging DTW, Installed

### 1.1 Safety Definitions

Safety notations are intended to alert personnel of possible conditions, which may cause personal injury, property damage or even death. They have been inserted into this instructional text prior to the step in which the condition is cited. The safety notations are headed by one of three hazard intensity levels, which are defined as follows:

**DANGER-** immediate hazard that will result in severe personal injury, property damage or death.

**WARNING-** hazard or unsafe practice that could result in personal injury, property damage or death.

**CAUTION-** hazard or unsafe practice, which could result in minor personal injury, or property damage.

## 2 Introduction

The type DTW de-energized tap changer is one of a family of ABB tap changers for power transformers. The Type DTW switch can also be configured to perform dual voltage switching and delta wye switching. This manual describes the tap changing features of the Type DTW switch. If you require information regarding other forms of switching, please contact ABB. A de-energized tap changer is a switch, which is connected to the winding taps of the transformer. When the

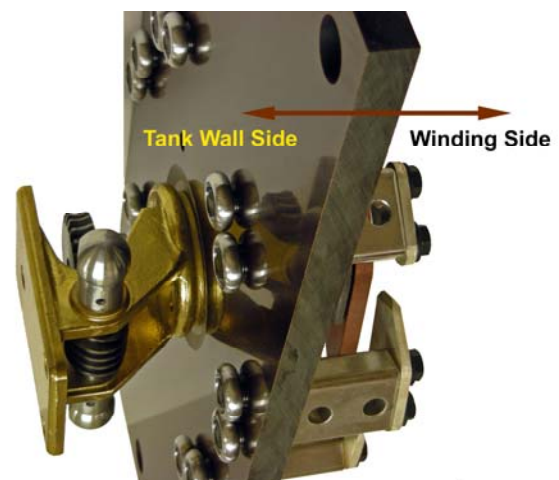


Figure 2: DTW Deck, Edge View

tap changer is a switch, which is connected to the winding taps of the transformer. When the

tap changer is moved from one position to another, the amount of the tap winding connected into the circuit is changed. This permits the adjustment of the voltage ratio of the transformer to best suit the voltage requirements at the transformer's installation site. The de-energized tap changer is usually installed into the high voltage circuit of the transformer and, most of the time, it is used to adjust the primary voltage of the transformer within a 10 percent range in five steps.

#### D A N G E R

The type DTW tap changer is a de-energized tap changer, and must, be operated only when the transformer is completely de-energized. Never operate this type of tap changer when the transformer is energized. Operation when the transformer is energized is dangerous and will result in severe personal injury, property damage or death.

The type DTW tap changer is a modular, bridging-type (zigzag) tap changer with external operating mechanism. It is most commonly available as a 5-position device. Other configurations are available or can be designed; for these, please contact ABB. The type DTW tap changer is made up of individual tap decks (one or more per phase). The tap deck is the fundamental component of the tap changer. The tap deck holds and orients both the moving and stationary contacts and provides the connection point for the tap leads from the winding. These components are mounted on the winding side of the tap deck. The phase tap decks are

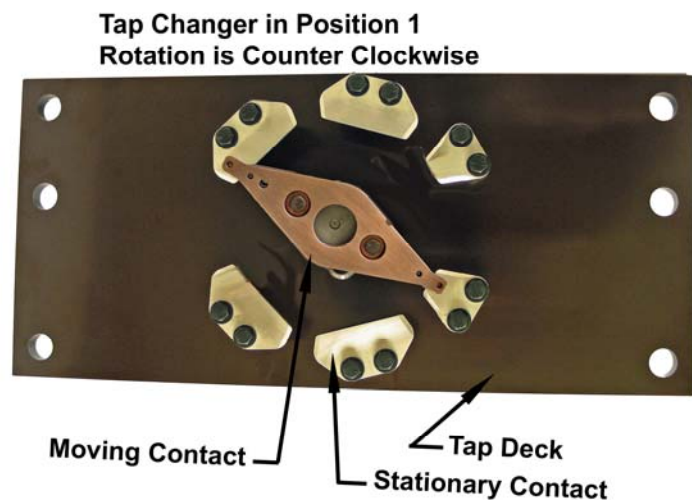


Figure 3, DTW Deck

connected to a common set of horizontal operating shafts through individual gear sets. The gear sets and operating shafts are mounted on the tank wall-side of the tap deck. The tap changer is mounted in front of each phase coil, parallel to the side of the transformer tank. The tap changer is supported by an insulating framework, which is part of and attached to the transformer superstructure. See Figure 1 for a general view of a type DTW tap changer installation. The ability to locate the type DTW tap changer on the side of each phase coil permits very direct tap lead routing with a minimum of bends.

All materials used in the construction of the type DTW tap changer have been chosen for their superior electrical properties, mechanical strength, temperature extremes capability, corrosion resistance, transformer oil compatibility and lightweight.

## **2.1 Direction of Rotation**

The ABB convention for describing the direction of rotation of the type DTW tap changer is to view the rotation from the tank wall side of the tap deck. See Figure 3, and Figure 11.

### 3 Ratings

The type DTW tap changer is available in one basic current rating and is offered with several different electrostatic shielding and insulation options. Table 1 presents the various rating options.

**Table 1: Type DTW Tap Changer Ratings**

Test Parameter	Rated Value	Reference Dimension on Tap Changer
Voltage Class	See note 4	N/A
Phase to ground and phase to phase Lightning Impulse 60 Hz, Power Frequency	See note 4	N/A
Between adjacent contacts Lightning Impulse 60 Hz, Power Frequency	180 kV 75 kV	(A-B, B-C D-E, E-F) <sup>1</sup>
With contacts B and E removed Lightning Impulse 60 Hz, Power Frequency	280 kV 110 kV	(A-C, C-D D-F, F-A) <sup>1</sup>
Short Circuit Current	10,000 A, rms	
Steady State Current	Current	Contact Temperature Rise <sup>2</sup>
	665 A	10°C
	845 A	15°C
	1015 A	20°C

- 1) See Figure 4: Schematic Diagram
- 2) Temperature rise over local oil temperature.
- 3) Historically, Westinghouse used this tap changer at 1,000 amperes.
- 4) The dielectric withstand from tap deck to ground and from phase to phase is very much dependent on the electrical clearance distances which are maintained by the transformer design. See also Electrostatic Shielding and Insulation in Section 4.1.5.

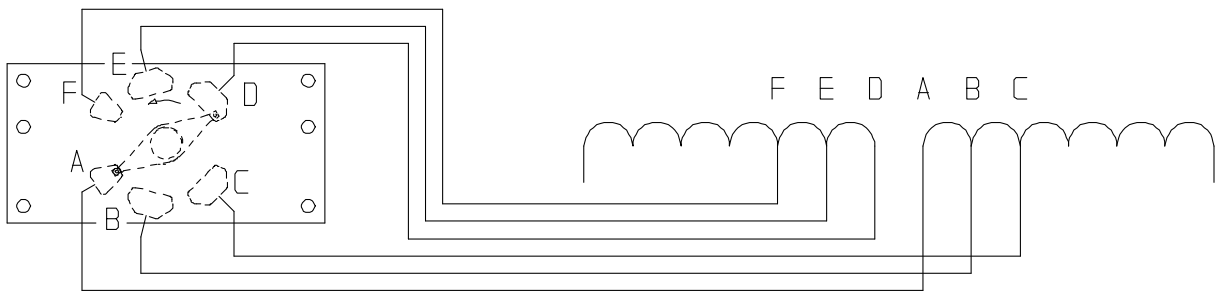


Figure 4: Schematic Diagram

## 4 Construction Details and Features

### 4.1 Basic Information

The major subcomponents that make up the type DTW, de-energized tap changer are: 1) tap deck, 2) worm gear set, 3) moving contacts, 4) stationary contacts, 5) mounting post 6) drive shaft and 7) external operating mechanism. Contact details are shown in Figure 5: Contact Structure. Drive details are shown in Figure 7: Gear Drive

#### 4.1.1 Tap Deck

The tap deck is a flat insulating plate. This plate serves as the base to which all of the other tap changer components are bolted. The tap deck is bolted to the transformer framework through the six bolt holes, which are located at each end of the tap deck. The flat insulating plate is fabricated from high strength, electrical grade, low power factor phenolic-paper board. This structure carries all of the mechanical loads created by the weight of the tap leads and the thrust and weight of the drive shafts.

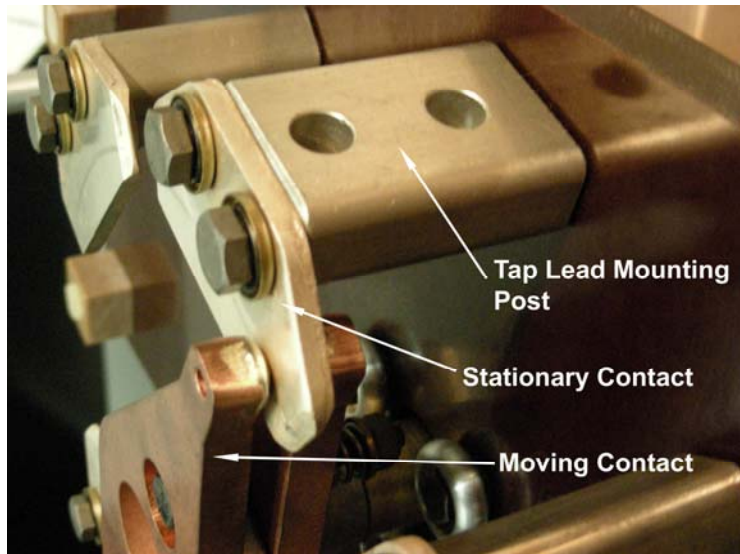


Figure 5: Contact Structure

#### 4.1.2 Contacts

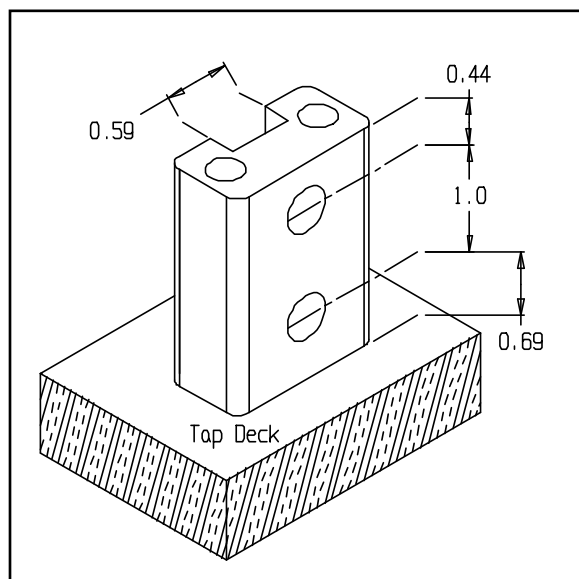


Figure 6: Mounting Post

The stationary contacts are copper flat 0.25 inches (6.4 mm) thick. The leading edges are chamfered to permit the moving contacts to easily slide up into position. These contacts are silver-plated. The stationary contacts are bolted to tin plated copper mounting posts, which in turn, are bolted to the phase deck. The stationary contacts are bolted to the mounting posts with two bolts. Special toroidal washers shield the bolt heads and washers to minimized electrical stress concentration.

The copper mounting posts serve as the connection point for the tap leads. The tap leads from the coil should be terminated with a two-hole flat connector.

The flat connector is bolted to the mounting post with two 0.375 bolt sets. The mounting posts “capture” the bolt head so that only the nut has to be turned to tighten the joint. See Figure 6: Mounting Post

The moving contact set is a “pincer” type of contact; the spring loaded contact plates slide over the stationary contacts. See Figure 5. Each contact plate is made from copper flat stock. The copper plates are tipped with semi-spherical, coined silver contact buttons. This alloy contact button assures a positive, low friction, low resistance current path at all times, even when taps are changed very infrequently. The sliding action of the contact button over the chamfered stationary contact plate creates a good wiping action during the tap change, which further guarantees a solid, low resistance electrical contact. Two coil springs precisely control the contact pressure, which is set and calibrated at the factory to provide uniform and consistent contact force. The combination of contoured interface surfaces between the moving and stationary contacts and the accurately calibrated spring-loaded pincer contacts minimizes the force needed to drive the tap changer from one position to another. The pincer type of contact takes advantage of the magnetic attractive forces created during through faults or current surges. These additional compression forces yield high fault current withstand capability by preventing contact bounce and arcing during faults. These features permit the tap changer to have a relatively low driving torque and yet maintain a high through fault current withstand capability.

#### 4.1.3 Worm Gear Set

This gear set is mounted on the main deck’s outboard face (Figure 7: Gear Drive). Its function is to convert the rotary action of the driving shaft 90 degrees in order to turn the moving contacts from position to position. This gear set is contained within a cast metal housing. The function of the housing is to position and hold the gear set and to provide a smooth, rounded corner enclosure in order to minimize electrical stress concentration. The nature of the gearing is such that one full turn of the drive shaft rotates the moving contacts from one set of stationary contacts to the next (a 30° rotation).

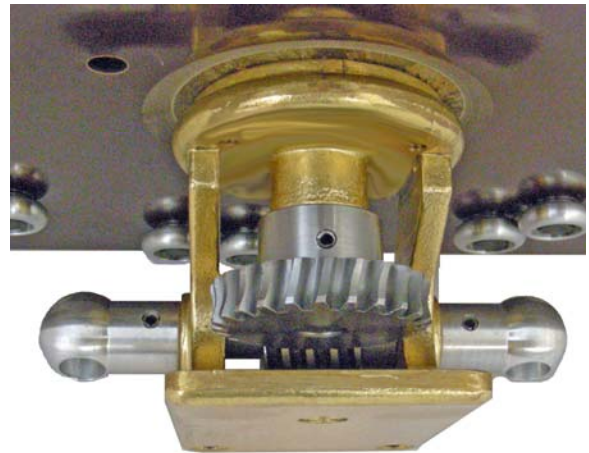


Figure 7: Gear Drive

#### 4.1.4 Driving System

The drive system consists of several parts: 1) the worm gear drive, 2) the inter-phase shafts, 3) the main drive shaft and 4) the external operating mechanism. See Figure 7: Gear Drive and Figure 8.

The worm gear rotates the moving contact shaft. This gear is meshed with the worm driver, which is attached to the drive shaft through ball joints. The entire worm driver assembly is designed to provide positive drive shaft engagement with a minimum of backlash and maximum forgiveness of shaft misalignment. The worm driver terminates in a ball-shaped, shaft end.

The inter-phase shafts are filament wound glass epoxy tubes. These shafts slide over the ball-ends of the worm drive shaft creating a ball and socket type of joint. Each inter-phase shaft consists of two pieces which telescope together. This telescoping action allows the tap changer to accommodate a range of phase-to-phase spacing and eliminates the need for precisely cut-to-length shafts. The telescoping action makes assembly easy, accommodates some misalignment and accommodates movement due to thermal expansion of the transformer.

The input drive shaft connects the operating mechanism to the first tap changer deck. This shaft is also a filament wound glass epoxy tube. A telescoping tube connects the main drive shaft to the external operating mechanism. The combination of ball joint connectors, telescoping and slip joint shaft tubes allows the drive mechanism to accommodate misalignments between tap changer decks or the operating mechanism and permits the shaft and drive mechanism to adjust to dimensional changes that occur as the transformer responds to temperature variations.

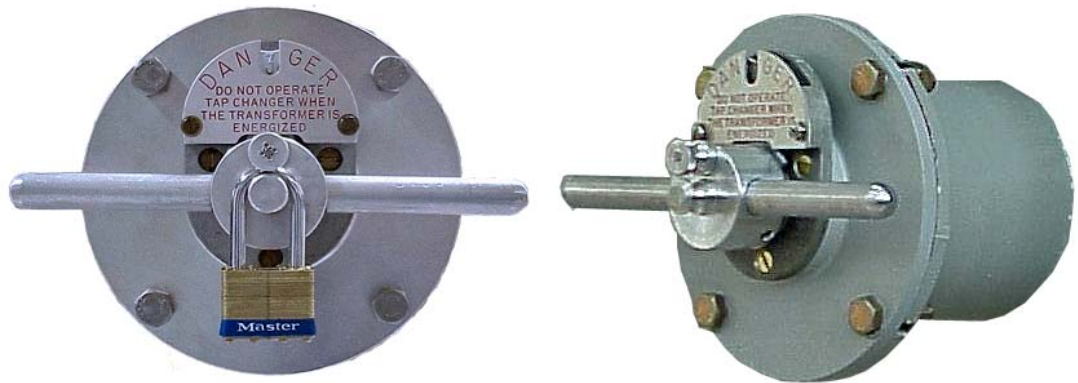


Figure 8: Operating Mechanism, External View

The operating mechanism (Figure 8: Operating Mechanism, External View) is sealed to the mounting boss by a flat gasket, which is retained by a machined groove in the flange of the mounting boss. The operating mechanism is bolted to the mounting boss. The external operating mechanism drives the tap changer's operating shaft. Generally, one revolution of the external mechanism moves the tap changer one position. However, there are applications, eg, 3-position tap changer where more than one revolution is required to advance to the next position. In any case, the tap changer is on position when the tap number shows fully in the view port and the locking pin can be engaged.

To make a tap change, the operator must perform two separate actions: 1) pull the locking pin, which frees the mechanism shaft and 2) turn the operating handle. There is a view port on the external mechanism. The Geneva tap indicator dial is visible in this view port. The Geneva tap indicator shows the number of the tap position. A position number is only fully visible when the tap changer is in position. The locking pin will not re-seat itself unless the tap changer is fixed on a position. The tap changing mechanism contains built-in positive

mechanical stops, which prevent turning past the lowest and highest positions. The external mechanism can be pad locked in any position (pad lock not supplied by ABB). Figure 8: Operating Mechanism, External View shows the location of the pad-lock. All external parts are made of non-corrosive materials.

#### 4.1.5 Electrostatic Shielding and Insulation

Electrical spacing requirements between the tap decks and the tank wall and between the tap decks and adjacent phases or other metallic objects are a complex subject. The transformer designer must calculate the required electrical clearance distances between phase decks and between phase decks and ground or other parts of the transformer. Three levels of shielding and insulation are available for the tap decks. See Figure 9

**Unshielded:** Tap decks do not have any electrostatic shields. This configuration is typically used for applications, which have an impulse voltage withstand requirement of 200 kV or less.

**Level 1 Electrostatic Shielding:** A cast-aluminum electrostatic shield ring is placed between the tap changer deck and the transformer tank wall. This ring is referred to as the “outer shield”. The ring is bolted to an aluminum mounting plate, which is, in turn, bolted to the worm gear housing. The ring portion of each shield is insulated with a layer of crepe paper wrap. This configuration is, typically, used for applications, which require an impulse voltage withstand of 650 kV or less.

**Level 2 Electrostatic Shielding:** Cast-aluminum, electrostatic shield rings are mounted on both the tank wall side and the coil side of each tap deck. The shield rings are wrapped with cotton tape. Both the inner and outer shield rings are bolted to the shield mounting plate, which was described above. The outer ring portion of each shield is a continuous ring. The inner shield consists of two half-circle rings. In addition to the aluminum rings, a pressboard disk is



Figure 9: Shield Levels

placed in front of the aluminum mounting plate and a pressboard box shield is added to the tank wall side of each tap deck. This box shield is attached to the transformer support structure with cotton tape. The pressboard disk is attached to the aluminum mounting plate with cotton tape. This configuration is, typically, used for applications which require an impulse voltage withstand greater than 650 kV; the upper limit of impulse withstand in this configuration is determined by the electrical clearances designed into the transformer.

#### 4.2 Standard Configurations & the Order Data Sheet

There are many configurations of the type DTW tap changer. Typically, the user must decide on one deck per phase or two decks per phase and the location of the external operating mechanism, ie, left side or right side – eye level or tap deck level. The Order Data Sheet describes these variations and allows the customer to select the combination that he requires. The Order Data Sheet also allows the customer to describe the technical requirements for any particular installation. Use the Order Data Sheet to specify configuration, mechanism location, important spacing dimensions and electrostatic shielding requirements. ABB cannot enter a complete order for this product without the complete Order Data Sheet.

## 5 Installation

### 5.1 Inspection upon Receiving

Before opening the shipping carton, check carton for any obvious signs of damage or poor handling. Open shipping crate and closely examine the tap changer components for any sign of damage.

ABB ships all DTW tap changers with the moving contacts as shown in the upper picture of Figure 10: Deck Rotation. Check to verify that the moving contacts are indeed in this position before continuing.

Verify that the shipment is complete and contains all components ordered.

Check that the type designation and shop order number agree with the delivery documents (i.e. the packing list or ABB's ordering acknowledgement). The shop order number is stamped on the rating plate.

### 5.2 Required Tools and Materials

Wrench with 9/16-inch hex socket (for connection of leads to the tap deck and for assembly of the aluminum shield casting)

Screwdriver with flat head (used together with 9/16-inch hex socket wrench in assembly of aluminum shield casting).



**Position 1,  
CW Rotation**



**Position 1,  
CCW Rotation**

Figure 10: Deck Rotation

Two wrenches with 3/4 inch (19 mm) hex socket (for tightening bolt and nut on external operating mechanism). Installation guide (this document).

### 5.3 Pre-installation Work Required by Customer

Make the appropriate size hole in the transformer tank according to the dimensions shown in the tap changer outline drawing.

In addition to the hole required to accept the mounting boss and tap changer-operating

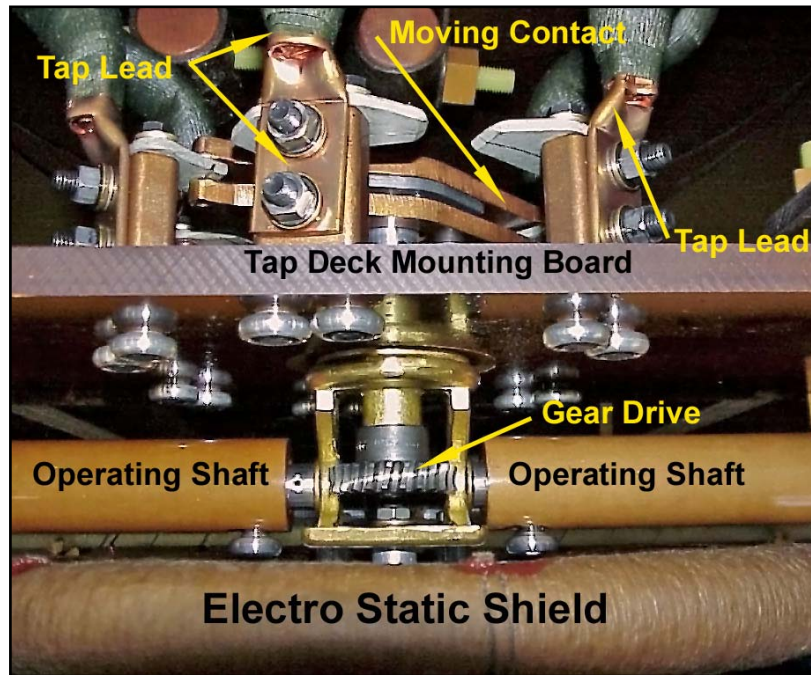


Figure 11

mechanism, a hand hole will may be required in this vicinity to allow the final mechanical connections to be made between the operating mechanism and the drive shaft.

Weld the mounting boss/bosses (not supplied by ABB) to the transformer wall. These welds must be gas-tight.

Prepare the transformer superstructure with holes for the assembly of each DTW deck. The common installation feature, regardless of other options chosen, is that each deck of the DTW tap changer mounts to the transformer superstructure with six glass-fiber bolts. There are usually one or two DTW decks installed per phase depending on the design of the transformer.

### 5.4 Deck Serialization

ABB assembles and mechanically tests all tap changers prior to shipment. You should install the tap changers in the same location sequence as these tests were performed. Each deck has three sets of numbers written on its top edge (see Figure 12: Deck Serialization). Mount the deck noted as number 1 in the first position closest to the external mechanism; mount the deck noted as number 2 in the next position and so on. If you are assembling a double deck tap changer, arrange the decks so that the decks numbers 1, 2 and 3 are all in the lower row

and the decks marked 4, 5 and 6 are in the upper position with deck 4 immediately below deck 1.

## 5.5 Installation

Following are the steps required to install a DTW tap changer:

1. Remove each tap deck from the shipping carton and verify that it is in position number -“1”.

Note: for Left Hand Drive, clockwise rotation of external operating handle rotates the moving contact in the clockwise direction when viewed from the tank wall side of the tap deck. For Right Hand Drive, the contacts rotate in the counter clockwise direction when viewed from the tank wall. See Figure 10: Deck Rotation and Figure 11 for correct contact position. ABB ships all DTW tap changers in position number 1.

2. Loosely bolt the tap deck onto the transformer superstructure once the transformer superstructure has been prepared with holes for the mounting bolts. Each tap deck requires six glass-fiber bolts and twelve glass-fiber nuts to attach the deck to the transformer superstructure. (ABB does not supply the glass-fiber mounting hardware).

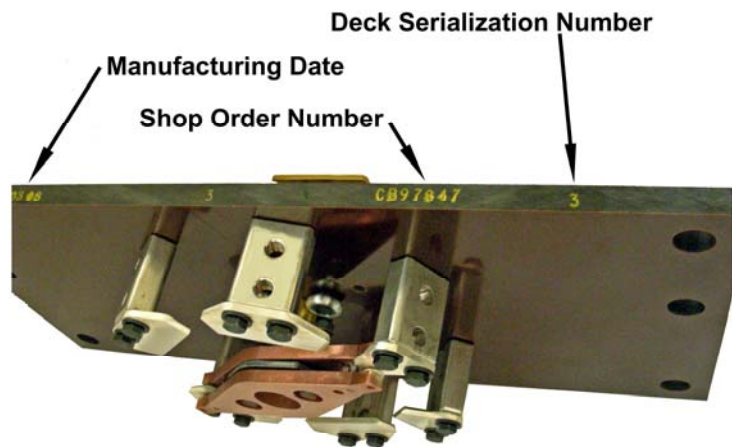


Figure 12: Deck Serialization

3. Prepare the ends of the tap leads from the coil. Bolt the tap leads to the appropriate mounting post on the tap deck (according to the transformer specification). This connection requires a flat connector on the end of the tap lead. The centerline spacing of the bolt holes on the tap deck mounting post is 1.0 inch (refer to the outline drawing for other dimensions). Fasten each lead to its mounting post with two bolts (not supplied). Locate the mounting bolt so that the bolt head (3/8 bolt) is on the inner side of the copper mounting post as shown in Figure 11. There is a recess on this side, which is sized to capture the head of a 3/8 bolt and prevents the bolt head from rotating during the tightening process (Figure 6: Mounting Post). Each tap lead requires two mounting bolts, two flat washers, two cup-washers, two lock-washers and two nuts. See Figure 11.

NOTE: If the number of leads from the coil is less than the number of mounting posts on the DTW deck, review the transformer specification to verify the application.

NOTE: It might be easier to prepare the tap leads from the coil if the DTW deck is not mounted to the superstructure.

4. If you did not mount the decks to the superstructure in Step 2, now is the time to do so.
5. Assemble the Inter-Phase Shafts to the worm gear ball end fitting. The Inter-Phase Shaft slides onto the ball end fitting. Align the slot in the shaft with the hole in the ball end fitting. When this is done, place a Spacer ring into the hole; this ring should ride in the groove of the ball end fitting. Bolt this assembly together using the prevailing torque bolt and hardware that is provided (see Figure 13: Mounting Bolt) Tighten the bolt.

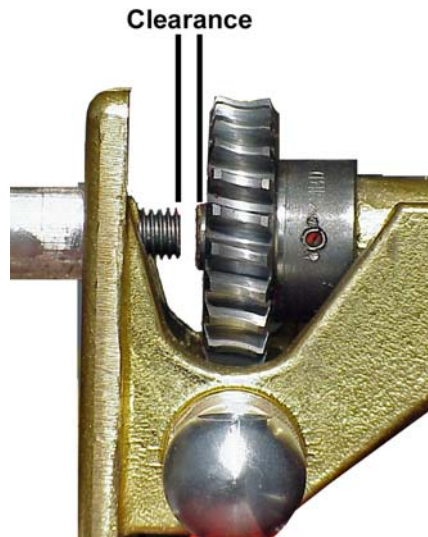


Figure 13: Mounting Bolt

NOTE: Make sure that the bolt has a Nylon patch near the bottom end (see Figure 13: Mounting Bolt). This patch provides anti rotational locking and prevents the bolt from becoming loose. If this bolt assembly is removed, a new bolt of similar construction should be used to insure this positive locking action is maintained.

NOTE: Make sure that the bolt has a Nylon patch near the bottom end (see Figure 13: Mounting Bolt). This patch provides anti rotational locking and prevents the bolt from becoming loose. If this bolt assembly is removed, a new bolt of similar construction should be used to insure this positive locking action is maintained.

6. Fit the second DTW deck to the Inter-phase shaft mounted in Step 5 and then repeat Steps 3, 4 and 5 for this deck.

7. Fit the third DTW deck to the Inter-Phase Shaft of the second deck and repeat Steps 3, 4 and 5 for this

deck.

NOTE: Make sure that the moving contact of the first, second and third decks are all in the number 1 position, when connecting this shaft.

8. Mount the Drive Shaft to the left end or right end tap deck as specified on the transformer drawings. Assemble the drive shaft to the ball end fitting in the same way as the Inter-Phase Shafts.

NOTE: Make sure that the two spring pins at the end of the Drive Shaft are undamaged. Proper operation of these pins is necessary for proper operation of the tap changer.

9. If electrostatic shielding kits are to be used, they should be mounted at this time.



Figure 14

### 5.5.1 Shield Kit Installation

**Level 1 Shield Kit:** To install a Level 1 shield kit, bolt the crepe paper wrapped aluminum shield casting and the aluminum-mounting disk to the worm gear housing with the three bolts provided in the kit.

NOTE: Make sure that the top mounting bolt holding the aluminum casting to the gear housing does not make contact with, nor interfere with the gear, See Figure 14.

**Level 2 Shield Kit:** To install a Level 2 shield kit, bolt the crepe paper wrapped aluminum shield casting and the aluminum-mounting disk to the worm gear housing with the three bolts provided in the kit as in Step 10. Place the outer continuous ring shield in position and, after that, place the inner half-circle ring shields in position. Both the outer ring and the inner half-circle rings are bolted to the cast aluminum-mounting disc with four bolts. See Figure 15.

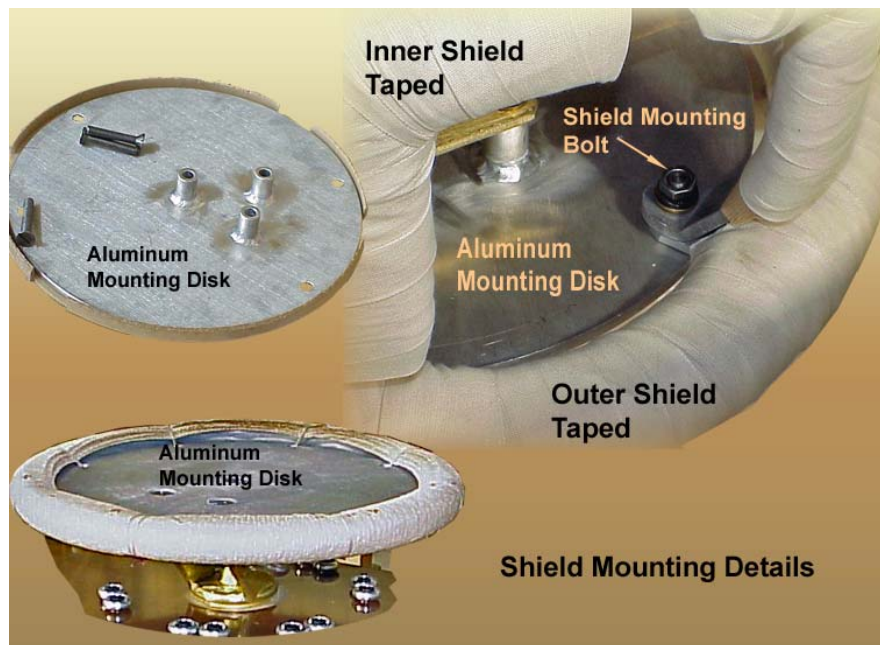


Figure 15

NOTE: Make sure that the top mounting bolt holding the aluminum casting to the gear housing does not make contact with, nor interfere with the gear, See Figure 14.

After the drying and impregnation process of the core and coil, make sure the glass fiber nuts holding the tap decks to the superstructure are tightened once again.

Before placing the core and coil into the tank, verify that all tap decks are set to Position “1”. Position the Main Drive shaft at the correct height so that it is aligned with the hole in the mounting boss. Use a length of cotton tape (or similar material) as a sling to assist in this alignment process. Once you have properly aligned the drive shaft, tie the cotton tape sling to the superstructure to hold the shaft in place temporarily.

Assemble the Connecting Tube to the ball-end fitting of the operating mechanism in the same way as the Inter-Phase Shafts were assembled to the individual DTW decks.

Slide the Operating Mechanism with the Connecting Tube through the mounting boss onto the Main Drive shaft.

NOTE: Make sure that the position shown on the External Operating Mechanism agrees with the position of each tap deck.

Make sure that the gasket in the groove of the Mounting Boss is undamaged and properly seated.

### 5.5.2 Double Mechanism Set-up

If this installation requires the use of the Upper Gear Box as shown in Figure 16, the following additional instructions are necessary.

The Upper Gear Box is needed when the transformer has two rows of tap decks, or if the height of the operating mechanism is to be different from the height of the tap decks.

When the Upper Gear Box is used, mount the internal Drive Shaft of the Upper Gear Box in the same manner as was described above for the Operating Mechanism.

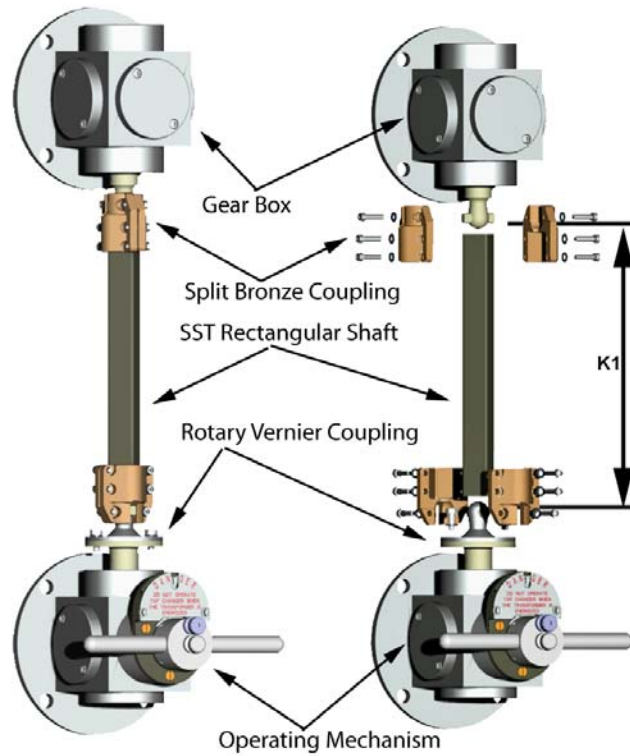


Figure 16

Mount the Upper Gear Box to the transformer tank in the same manner as the Operating Mechanism housing.

The vertical connecting shaft assembly between the operating mechanism box and the upper gearbox allows the external mechanical connections to be made without moving the position setting of the internal tap decks. The external shaft connections have enough “universal joint” movement to overcome about seven degrees of misalignment between the Upper Gear Box and the Operating Mechanism. The Vernier Coupling allows you install and adjust the vertical connecting shaft without disturbing the tap changer settings within the transformer.

With the Operating Mechanism and the Upper Gear Box installed onto the transformer and with reference to Figure 16 and the appropriate assembly drawing, proceed as follows:

Place the half of the Vernier Coupling with the spherical drive end on top of the other half.

Determine the dimension, K1, between the spherical drive ends.

Cut the square vertical drive shaft to a dimension that is 6 mm less than K1. Remove all burrs.

Fit the two halves of the bronze coupling onto one end of the square shaft with the six screws and washers provided.

Connect the square shaft end with the mounted bronze coupling to one of the spherical drive ends of the Operating Mechanism or the Gear Box.

Fit the two halves of the other bronze coupling onto one end of the square shaft with the six screws and washers provided and connect to other spherical drive shaft end.

At this point, the vertical drive assembly should be snug but with enough play to allow about 2 mm of vertical movement. Once you have the shaft properly aligned, fully tighten the bolts joining the Split Bronze Couplings.

Adjust the Vernier Coupling to maintain the correct rotational alignment between the Upper Gear Box and the Operating Mechanism.

NOTE: Make sure that the position shown on the External Operating Mechanism agrees with the position of each tap deck.

#### D A N G E R

The next step verifies that the tap changer mechanism is working properly, and should not be performed unless the transformer is de-energized. Failure to do so will result in severe personal injury, property damage or death.

### 5.6 Verifying Proper Operation

Check the tap changer for proper installation after you have fully installed it. To operate, pull out the locking pin until it disengages from the Geneva Indicator Dial and turn the operating mechanism handle one complete turn. All rotational movement should be smooth with no feeling of binding.

Verify that the tap changer is operating properly, electrically, by performing a Turns Ratio test in each tap position.

NOTE: All DTW tap changers have the same Geneva Indicator Dial (i.e., the dial has 7 indicator positions) but, depending on the actual tap changer ordered, the limits of operation will be controlled by mechanical stops placed at the proper position within the indicating mechanism.

### 5.7 Processing Temperatures

The type DTW tap changer is designed to operate properly in the transformer environment. However, the transformer manufacturer must not over stress the tap changer, thermally, during transformer manufacturing and processing. The maximum temperature that the type DTW tap changer can be exposed to during transformer manufacturing is 125°C. If the tap changer will be exposed to temperatures greater than 125°C, ABB should be consulted for technical guidance. Processing within the temperature range of 105°C to 125°C should not exceed 48 hours total exposure time. During processing make sure that the tap changer is subjected to thermal shock by the hot vacuum processing fluid.

## 6 Renewal Parts

If renewal parts are required, order them through the nearest ABB representative. Please provide the item description and the identification numbers (model, style, catalog number) from the unit's nameplate.

## 7 Repairs

In normal use, the DTW tap changer will not require repairs. We recommend that you contact the transformer manufacturer before making any repairs.

## 8 Maintenance

ABB de-energized tap changers require little or no maintenance to ensure proper mechanical and electrical operation of the switch. Always de-energize the transformer before operating the tap changer. Inspect the external operating mechanism for any damage. Lubricate the ball joint connector which is inside of the bronze split coupling (see Figure 16). Any time that you operate the tap changer, you should cycle it through its entire range a minimum of 20 times before setting it onto the desired tap position. The tap changer's operating mechanism housing and gear box housing (if present) is lubricated for life and should not be disturbed.

### W A R N I N G

Before attempting any disassembly or repairs, de-energize the transformer. Failure to do so could result in personal injury, property damage or death.

## 9 Technical Support

If a technical question arises regarding the product detailed in this document contact ABB.

# Contact us

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