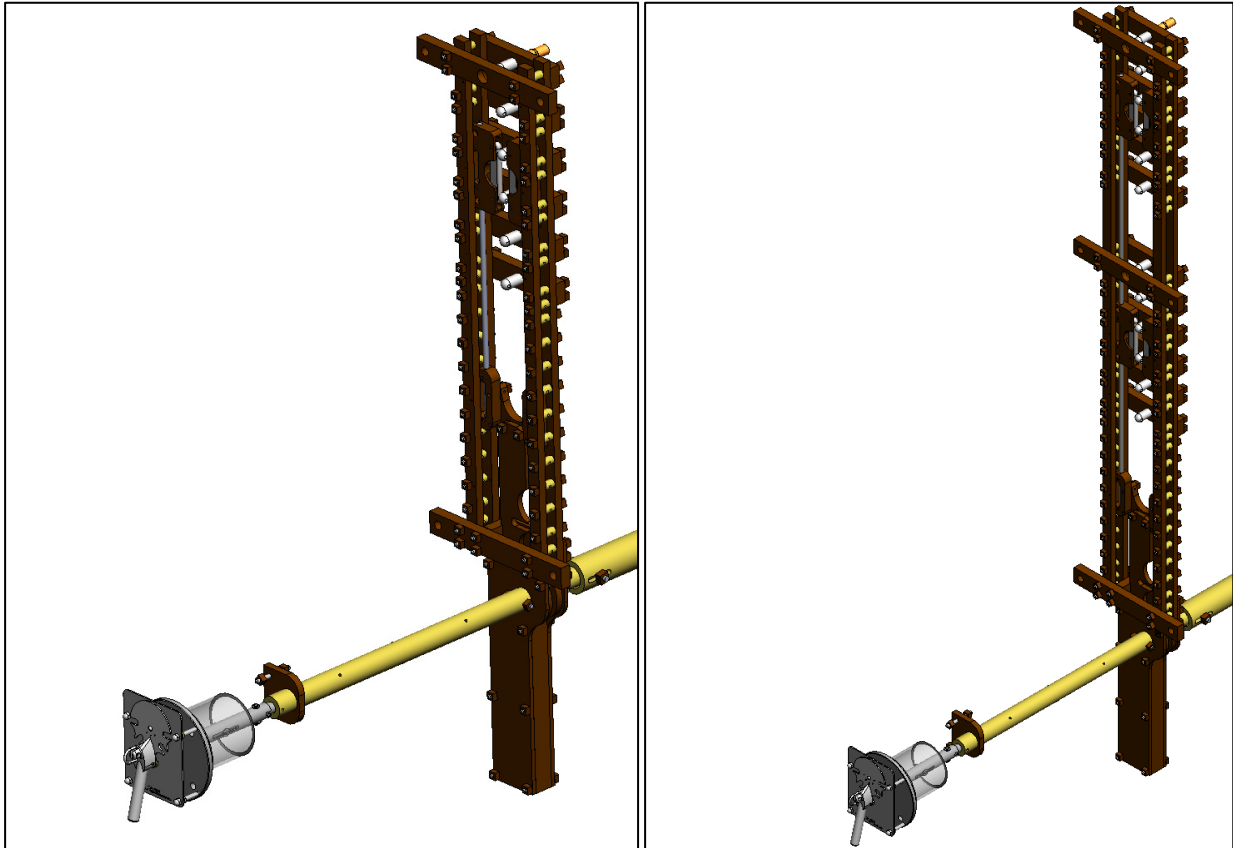


**TYPE QS-DLS™ EHV DETC (up to 1050 BIL):**



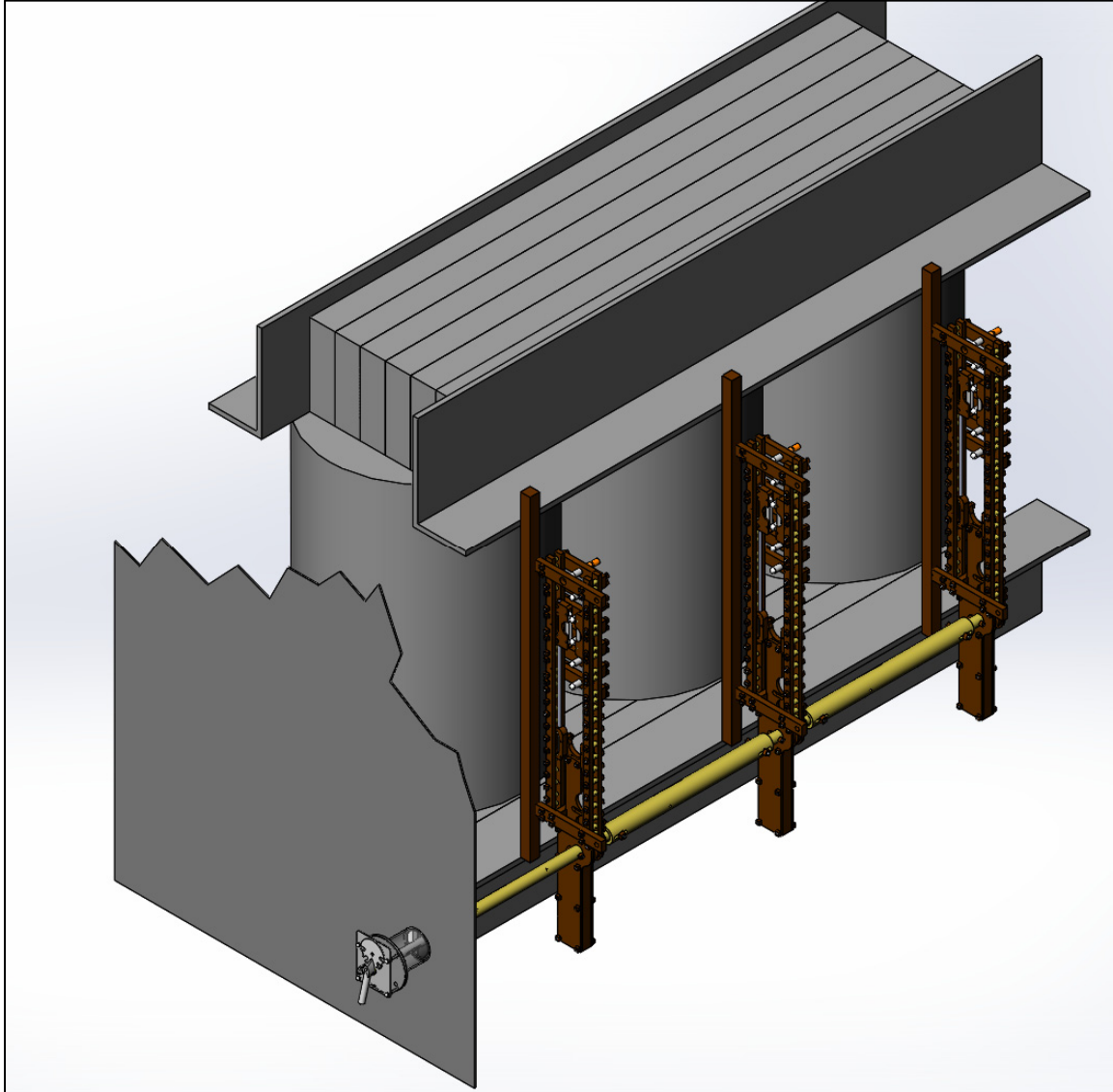
**SCOPE:**

This document contains general information about applying and installing the QS-DLS™ EHV non-metallic Geneva driven de-energized tap changer. These instructions do not describe all possible issues that may arise during installation, operation, or testing of the tap changer. It also does not describe all of the details and variations of the equipment. Consult the drawings supplied with the order for additional information. In addition, if there is a special application, the switch may be adaptable or customized in some aspects, so please contact Quality Switch for special requests.

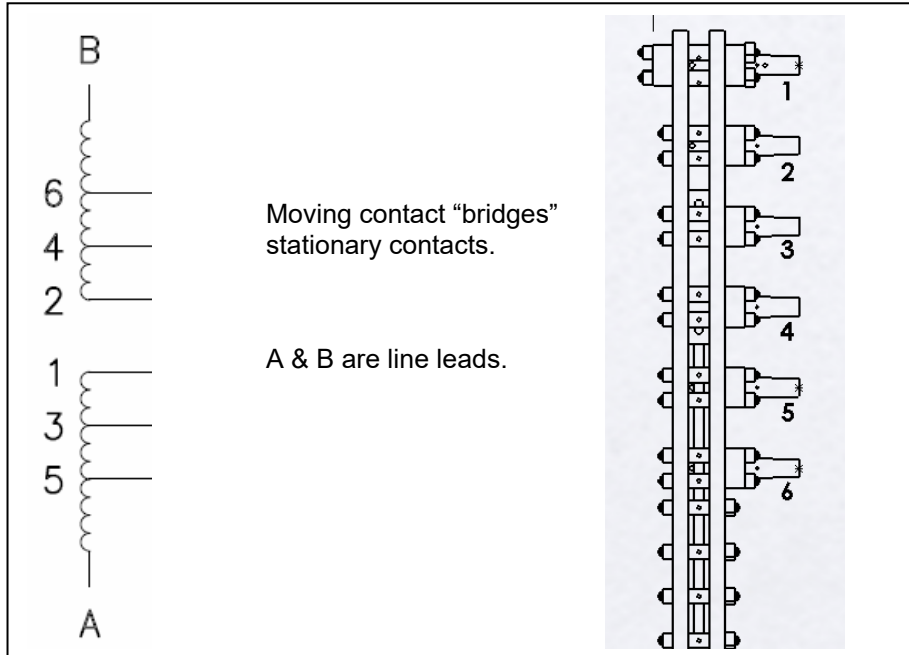
**INTRODUCTION:**

The type QS-DLS™ tap changer is one family of the Quality Switch tap changers that is designed for power transformers. A de-energized tap changer (DETC) is intended to be connected to the winding of the taps of a transformer. When the DETC is moved from one position to another, the amount of tap winding connected into the circuit is changed. The DETC is typically installed into the high voltage circuit and is generally used to adjust the primary voltage of the transformer within a 10 percent range in 5 steps. The QS-DLS™ EHV DETC is modular and designed as a bridging type DETC with an external operating mechanism. It is commonly used as a 5 position DETC and is made of individual tap decks (one group or two groups per tap deck). The switch is designed to be mounted and secured to super-structure (made of insulating wood or insulating pressboard) built up around the core and coil assembly of the transformer. Figure 1 shows a typical mounting arrangement. The tap decks can be mounted in the center of the core and coil assembly which allows the tap leads to be short and avoid long routing of the cable.

**Figure 1: Mounting Arrangement**



**Figure 1a: Bridging Contacts**



**RATINGS:**

The QS-DLS™ EHV tap changer is available with a current rating of 1000amps per group. A heat run done at 1000amps gave a 14°C rise in temperature above the oil. The switch is typically used on transformers rated up to 1050 kV BIL. The switch can be applied on a higher BIL transformer if a specific winding arrangement falls within the design limits of the tested values between contacts (typically wye connected with the taps located near the neutral of the winding). In addition, the ratings are dependent on how the DETC is applied to the transformer, i.e. distance to the tank wall and distance between phases. Consideration must be taken to provide adequate clearance to the live parts (see Figure 2).

Table 1:

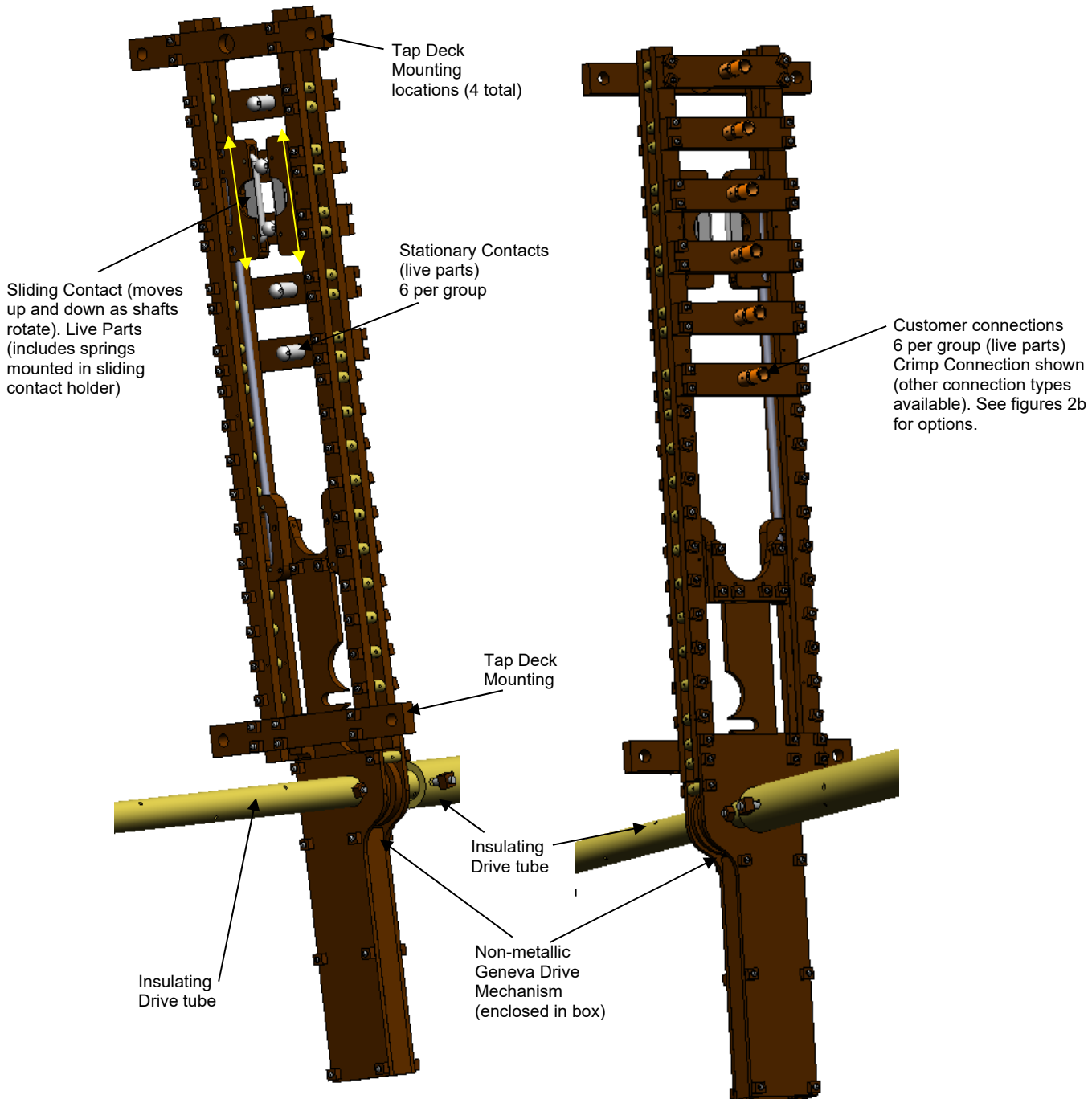
QS-DLS™ EHV DETC Tested values	
Test	Result
FW Impulse between contacts (1.2X50 μs)	Passed 6 tests at 391 kV
60 Hz. Applied Voltage between contacts	143 kV for 30 minutes
Temperature Rise in oil	14°C at 1000amps
*Typical Operating Torque	≤ 20 ft-lbs
Short Circuit Withstand	15 kA RMS 26.7 kA peak

\*Typical Operating torque listed is measured on a workbench. Mounting the switch assembly to a transformer structure may increase the operating torque measurement, but caution should be taken to avoid putting the switch mechanism in a bind due to mechanical mounting stresses.

**DESIGN FEATURES & DETAILS:**

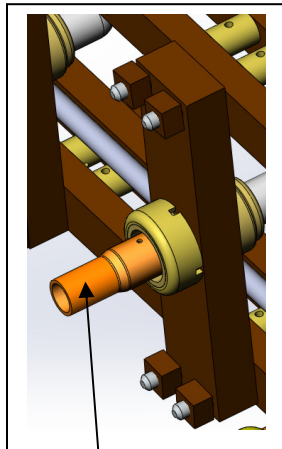
The QS-DLS™ EHV DETC is assembled with basic components shown in Figure 2.

**Figure 2: Tap deck features**

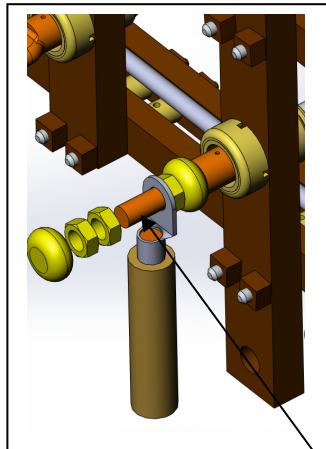


**Figure 2b: Switch features—Connection Options**

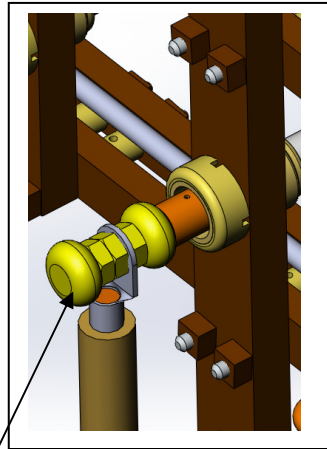
Customer connection points can be varied for ease of manufacturing and selected based on assembly preferences at the transformer facility.



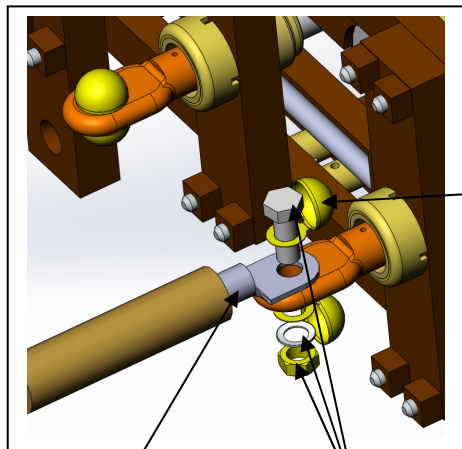
Crimp Connectors are available and made to match the cable size. Provide the bare OD of the cable and QS will match a crimp to your cable.



A 5/8"-11 threaded post is available with brass shields on each end for shaping the field. A terminal is secured using jam nuts as shown (terminal and cable only shown as reference and is not supplied by QS).



2-hole bolt-on lugs with 9/16" diameter holes spaced at NEMA 1-3/4" centers. Bolt-cap shields supplied and applied similarly to the 1-hole lugs shown below.



Cable Terminal is only a representation (not supplied by QS). Ensure leads are pre-formed and supported to minimize mechanical stress on the switch.

- 1/2"-13 Hex Bolt
- 1/2" Bellville washer
- 1/2"-13 Brass Jam nut (Not supplied unless specified with order)

Bolt-cap shield (2 per connection) folded over after connection is secured. CAUTION: Do not open and close bolt-cap more than 3 times as fatigue may cause it to break loose.

**NOTE:** All four options are assembled in a manner that does not constrain the rotational motion of the connection points. Care will need to be taken to ensure leads are run to the switch in a manner to minimize mechanical stress on the switch connection. It is recommended for these connections to then be wrapped in some form of insulation (crepe paper or aluminum backed crepe paper) to aide in shielding sharp edges. Each customer may have a preferred method they use within their transformer on crimped, bolted, or threaded connections appropriate to the voltage class. Specify the preferred connection option when ordering your switch.

**TAP DECK MOUNTING BOARD:**

The QS-DLS™ EHV tap changer contact supports and non-metallic Geneva drive mechanism are machined of a high-pressure laminate manufactured and specifically tested for high voltage applications. The stationary contacts are assembled onto the laminate board with the portion in contact with the moving contact being silver plated. This stationary contact is machined with a full radius on the end to provide a nice dielectric shape for shielding the contacts. The customer connection end can be crimp connections (size of crimp specified by customer), single hole bolt-on connection, two-hole bolt-on connections, or a 5/8"-11 threaded post with brass shields for the tap lead terminal. The rotational motion of these connectors is not constrained by the mounting support (see Figure 2b for representations of the connections). Each tap deck assembly is typically supplied with four mounting locations to fasten the tap deck to the transformer structure. Each tap deck assembly is then coupled together with insulating drive tubes to chain multiple phases together.

**SLIDING CONTACT:**

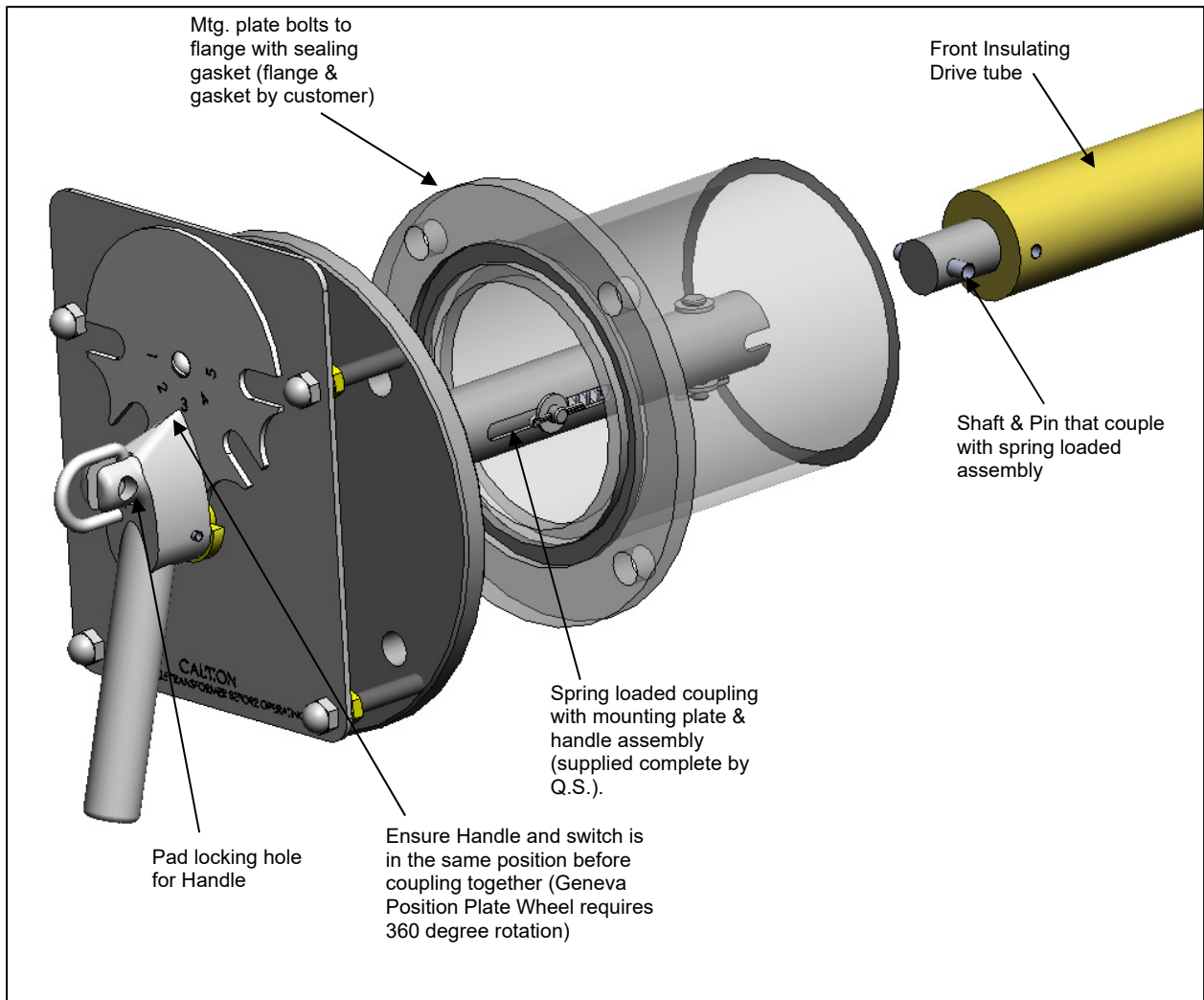
The QS-DLS™ EHV sliding contact is a solid copper contact that has a fully rounded contact edge to avoid sharp edges and provides a line type contact with the stationary terminal which in turn allows a relatively low operating torque. The sliding contact is spring loaded to provide ample contact pressure to withstand blow-off forces under fault conditions. The contact is fastened to the non-metallic Geneva drive using a fiber rod. The insulating drive shaft of the DETC will rotate 360 degrees for one tap change up or down. This operation of the tap changer creates a sliding action that wipes the contact surfaces of the moving and stationary contacts.

**OPERATING MECHANISM (main drive shaft and external mechanism):**

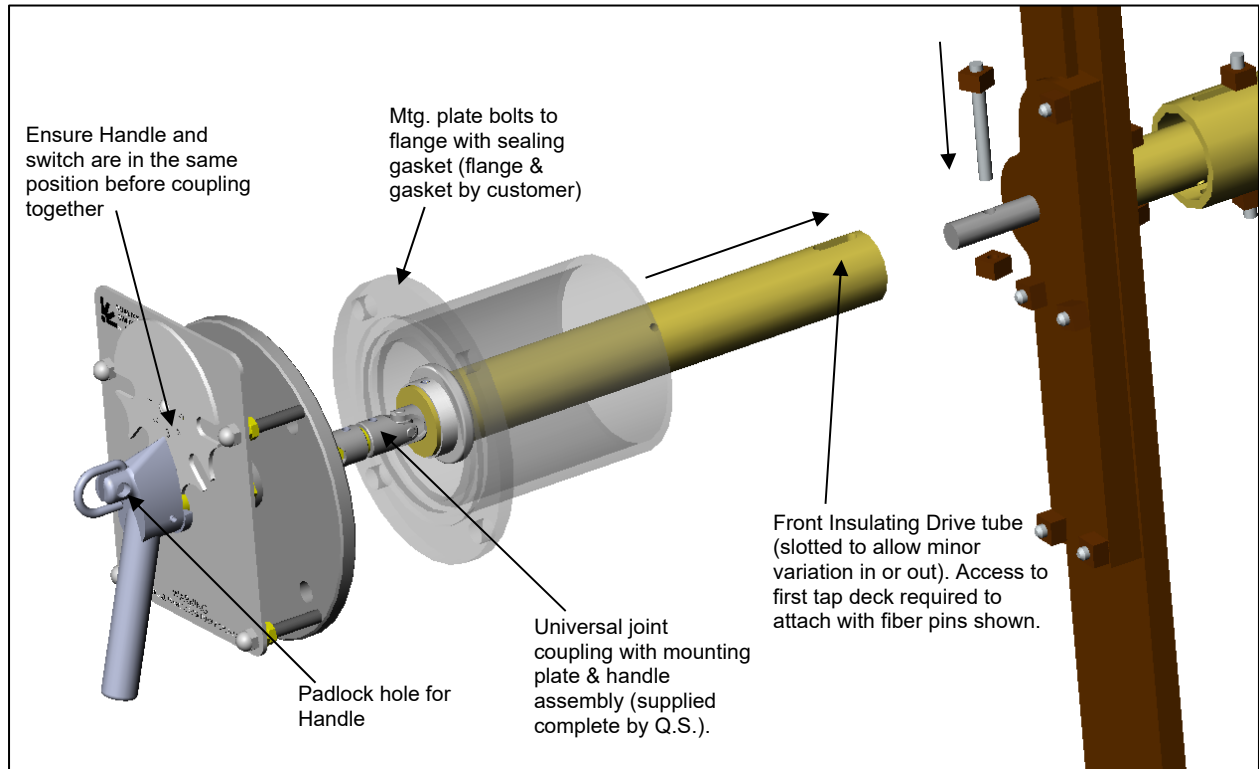
The external operating mechanism couples to an insulating tube that is attached to the non-metallic Geneva drive mechanism on the front tap deck. The Geneva mechanism is driven from a fiber shaft that extends from the tap deck that will have a hole to couple with the insulating tubes. The front insulating drive tube has a shaft and pin attached on the opposite end that attaches to the tap deck and is coupled with a spring-loaded coupling assembly. This coupling is supplied assembled to a mounting plate and handle assembly shown in Figure 3. This mounting flange will attach to a flange that is welded to the transformer tank (typically on top of a pipe header) and will require a gasket seal. This flange and gasket are not supplied by QS. The handle follows a Geneva index plate and rotates 360 degrees for each position change. Also, as an alternative option for coupling the insulating tube to the switch, a universal joint may be used in place of the spring-loaded coupling. The flange plate arrangement is the same, but access to the first tap deck is required with this option (see Figure 3a).



**Figure 3: Spring loaded operating mechanism**



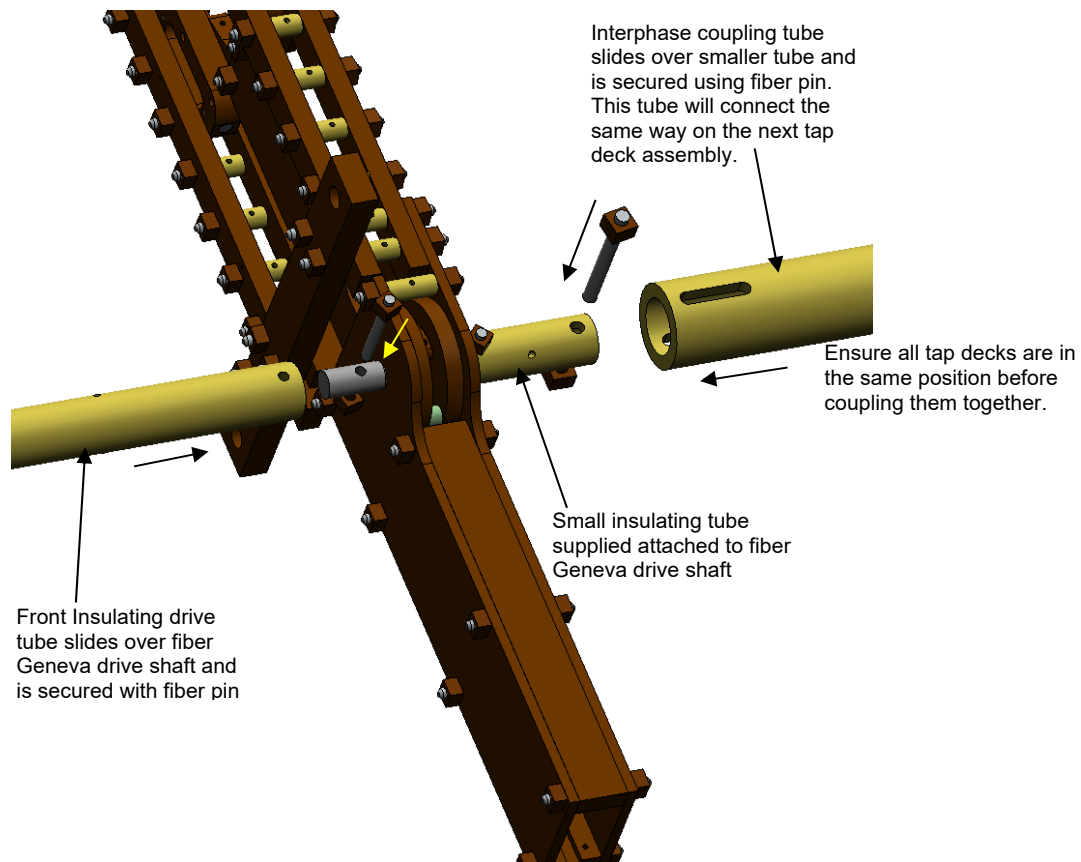
**Figure 3a: Universal Joint operating mechanism**



**OPERATING MECHANISM (interphase drive tubes and couplings):**

The operating mechanisms that attach the other tap decks together are done by connecting slotted insulated drive tube couplings to a smaller tube that is fastened to the fiber shaft on the non-metallic Geneva drive mechanism. This insulating tube is slotted and has an oversized inside diameter to accommodate some minor misalignment between each tap deck assembly. After the tubes are installed, they are fastened together using a non-metallic drive pin and nuts.

**Figure 4: Insulating tubes**



**HANDLING, INSTALLATION AND MOUNTING:**

**Receiving the Type QS-DLS™ EHV DETC:**

- Upon receiving the type QS-DLS™ EHV DETC, check for visible damage. Notify Quality Switch if any damage is found.
- All DETC tap decks are shipped with the contacts in the same position. These may shift during shipping, so ensure each tap deck sliding contacts are all in the same position before assembly.
- Verify that the shipment is complete and contains all loose components. Several smaller components (i.e. handle assembly, insulating drive tubes, bearing plate, fiber pins, nuts, etc.) will be wrapped individually for protection during shipping and marked with a yellow sticker that states 'Parts Enclosed', so take caution not to discard them with the packing material in container. These components will be listed in the description of the item on the packing list provided with the shipment.
- Check that the packing list matches the order numbers and part numbers included on the order acknowledgement. A serial number will be engraved on each tap deck mounting boards that should correspond with a sales order number found on the order information.

**Preparation required by Customer:**

- Prior to installing the DETC, appropriate mounting in the transformer tank is required. A mounting flange with the appropriate bolt pattern and gasket seal is required to be welded (gas tight) to the transformer. The mounting flange and pipe header are not supplied by QS. The appropriate dimensions and specifications will be included on the outline and/or detail drawings of the DETC.
- The transformer structure needs to be prepared with holes appropriate for mounting the type QS-DLS™ EHV tap deck. The hole patterns are also shown on the DETC outline drawing. Hardware to secure the switch to the structure is not supplied with the switch, but can be ordered separately if required. This must be non-metallic hardware.
- Only standard tools are required for installation.

**Mounting:**

- The type QS-DLS™ EHV DETC requires a support structure constructed of appropriate insulating material to secure the tap deck mounting boards. In most cases, the boards are mounted in a vertical manner and secured using the holes on each end of the tap deck. The structure is typically the same structure that supports the HV leads in the transformer design. Also, support is required for the front insulating tube using the bearing plate provided by QS. This bearing plate can be secured also to the same structure and is used to avoid the cantilevered load on the insulating tube from the front tap deck.
- Refer to the switch outline drawing for specific mounting dimensions for your switch.

**Installation Steps (in general):**

- 1) Make sure that all the tap decks are in the same position (the moving contact should align on all of the tap deck assemblies). The tap decks are typically shipped in the nominal position, but they may shift during transit. Rotate the drive shaft to align all the moving contacts if they have moved.
- 2) Install the first deck by inserting fiber threaded rod or bolts thru the supplied mounting holes in the tap deck and secure the tap deck to the transformer structure with non-metallic nuts. These holes need to be slightly oversized to avoid forcing the bolts into the holes.
- 3) To mount the second tap deck, also install the threaded bolts into the holes on the tap deck mounting boards and slide them thru the transformer structure. However, do not snug up the nuts that will secure the board to the transformer structure and allow it to be loosely held in place.
- 4) Install the insulating drive tube between the first and second tap deck by sliding the coupling tube over the insulating shaft already attached to the fiber Geneva drive shaft. Install the supplied threaded pin thru the slot and attach non-metallic nuts to each end of the pin to secure the coupling (see Figure 4.)
- 5) Repeat the process for the third tap deck.
- 6) To confirm that the installation has been done properly, after tightening all mounting hardware, turn the operating shaft and observe the movement of the sliding bridging contacts on all three tap deck assemblies. All three phases should move together from one end of the tap range to the other in a synchronized fashion.
- 7) Connecting tap leads to the tap deck assemblies is dependent on the connection method (specific to order). The tap leads should be pre-formed and arranged to not apply any mechanical stresses to the tap deck switch assembly.
- 8) It is recommended for these connections to then be wrapped in some form of insulation (crepe paper or aluminum backed crepe paper) to aide in eliminating sharp edges. Each customer may have a preferred method they use within their transformer on crimped, bolted, or threaded connections appropriate to the voltage class.

- 9) After the drying out process all non-metallic hardware will need to be re-tightened. Snug up nuts finger tight (5-8 ft-lbs) similar to all the other non-metallic hardware on the transformer structure. Then apply electrical epoxy (i.e. Glyptal or equivalent) to prevent them from vibrating loose.
  - a. Do not operate the DETC after drying out process until lubrication is applied to contacts (either petroleum jelly or transformer insulating fluid should be wiped on contacts to avoid sliding dry contacts).
  
- 10) When using the operating mechanism shown in Figure 3, the insulating shaft between the front tap deck and the handle operating mechanism external to the tank are coupled together after the core and coil assembly have been installed into the tank. A bearing support shall be provided by QS to be installed near the end of the tube to prevent deflection and keep the insulating tube aligned with the hole in the tank after tanking. The coupling is a spring loaded and slotted in order to compensate for minor variations in expansion and contraction (see Figure 3).
  
- 11) When using the operating mechanism shown in Figure 3a, the insulating shaft will be attached to the tap deck gear shaft after tanking (access is required to the first tap deck drive mechanism after tanking in order to secure the fiber pin). With the universal joint on the front end, the insulating tube will not require an additional bearing support.



# **TYPE QS-DLS™**

## **EHV DETC (up to 1050 BIL)**

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### **\*\*\*DISCLAIMER\*\*\***

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