

# TechTopics No. 80

## Special tests-type SDV7 distribution circuit breaker gearbox lubrication

The type SDV7 outdoor substation distribution vacuum circuit breaker recently introduced in the marketplace is an evolution of the SDV family of circuit breakers, first introduced in the early 1980s. The type SDV7 circuit breaker features very compact dimensions, allowing use of the type SDV7 to replace many older outdoor circuit breakers used in substations. Many older circuit breakers were of the bulk oil type and were quite compact. As a result, today's modern air-insulated circuit breakers are often too large to fit in the available space.

The redesign of the outdoor distribution circuit breaker was undertaken to decrease the overall size of the circuit breaker. The decrease in size of the type SDV7 enclosure, compared to earlier designs, comes about because the circuit breaker operating mechanism and the vacuum interrupter poles have been completely reoriented.

The new circuit breaker has the vacuum interrupter pole units arranged horizontally, above the operating mechanism, which positions the connection pads on the vacuum interrupter poles quite close to the bushing connection pads. The section view of the type SDV7 circuit breaker (Figure 1) shows the short current path from the connection pads on the vacuum interrupter poles to the roof-mounted bushings.

The stored-energy operating mechanism for the circuit breaker is below the vacuum interrupter poles, accessible through the door on the right side of the enclosure as shown in Figure 1.

The user's protective relays and other instrumentation elements are installed in the low-voltage control compartment, accessible through the door on the left side in the illustration.

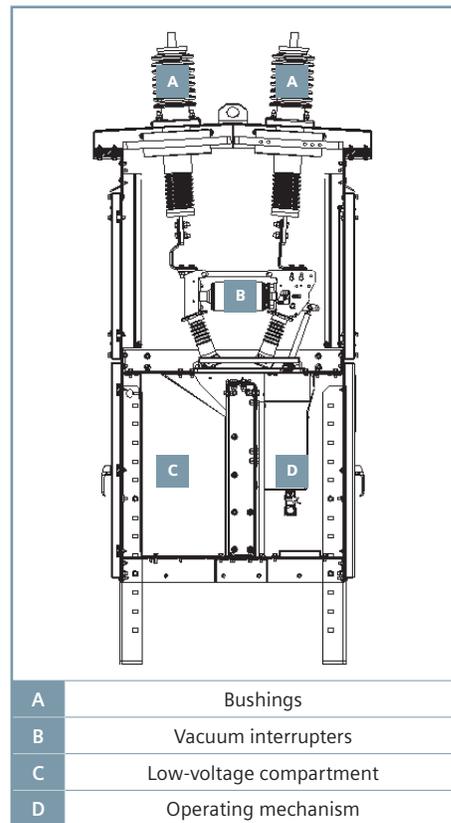


Figure 1: Type SDV7 distribution circuit breaker - section view

Figure 2 shows a view of the operating mechanism (at bottom) in relation to the vacuum interrupter poles (at top). As shown, this arrangement is possible as the operating mechanism has been inverted from the orientation as used in the type SDV6 distribution circuit breakers and in the type GMSG indoor drawout circuit breakers for use in metal-clad switchgear.

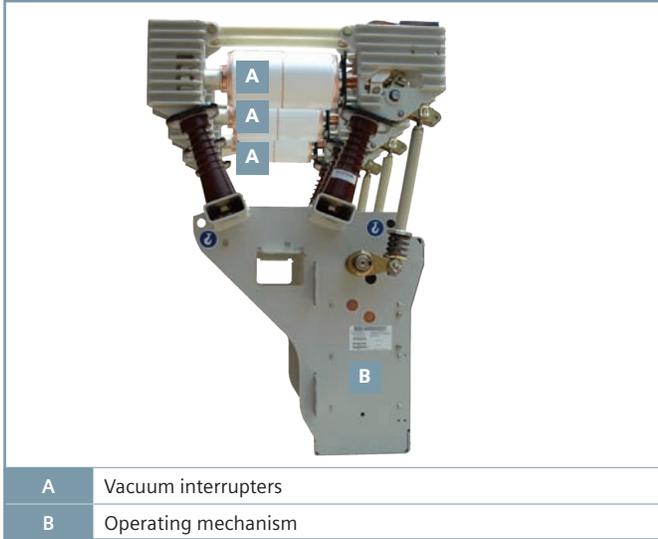


Figure 2: Type 3AH35 operating mechanism

The heart of the operating mechanism is the enclosed gearbox, which allows for manual and electrical charging of closing springs, and serves as a mounting platform for many of the elements important to the closing and opening functions.

In most of our earlier designs, the operating mechanism is oriented with the main rotating shaft near the bottom and the gearbox drive located in the upper portion of the operator. In the type SDV7 distribution circuit breaker design, as shown in the illustration, the main rotating shaft is located near the top and the gearbox drive is located near the bottom.

We have applied the gearbox in other orientations for many years in certain special applications, such as high continuous current generator circuit breakers and in special circuit breakers for mining application where space is highly restricted.

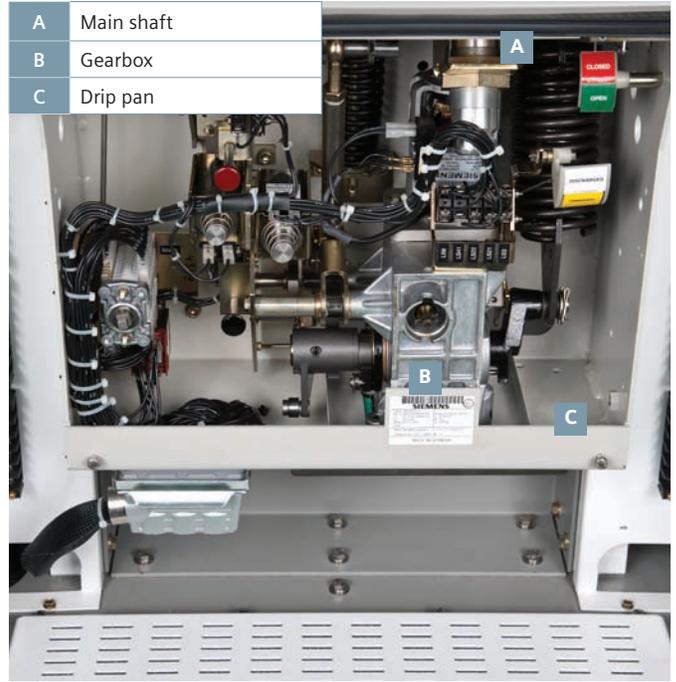
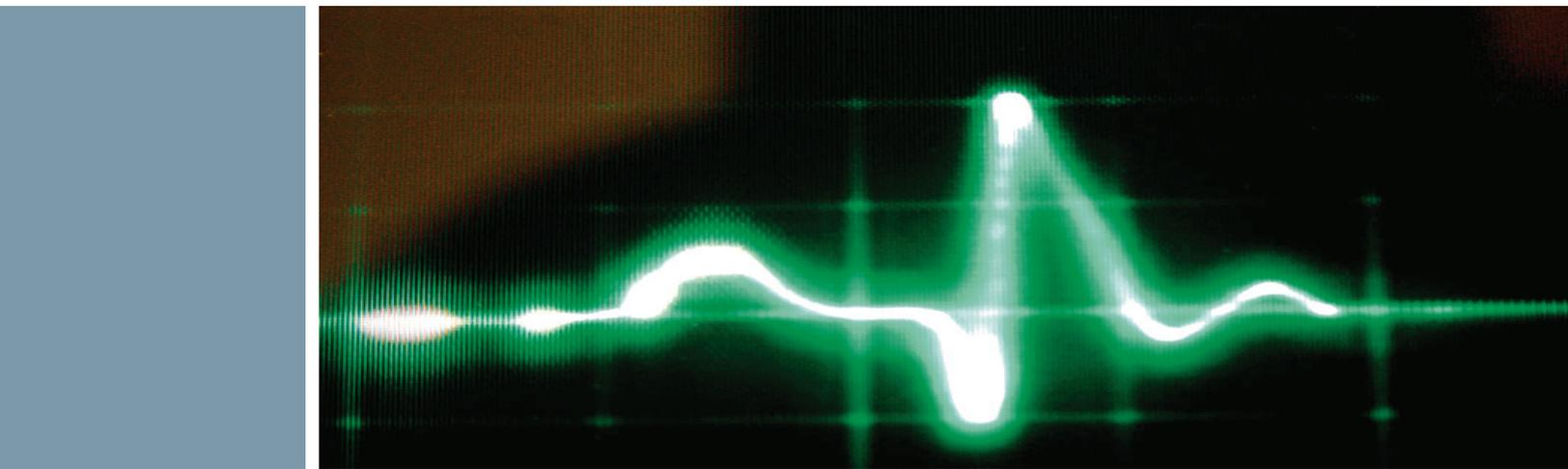


Figure 3: Type SDV7 with type 3AH35 operating mechanism visible

Because the gearbox in the type SDV7 distribution circuit breaker is used in an inverted mode, special tests were undertaken to assure that the functionality of the gearbox drive would be unimpaired by this unusual mounting and by the high ambient temperatures common in outdoor circuit breaker applications. Figure 3 shows the gearbox, as installed in the lower portion of the operating mechanism of a type SDV7 distribution circuit breaker.

The gearbox is mounted directly to the bottom plate of the mechanism housing. The mounting incorporates special purpose gasket material, in combination with a gasket sealant compound, to assure long-term resistance to leakage. The gasket material consists of aramid fibers bonded together with nitrile butadiene rubber (NBR) or nitrile rubber.

The gasket material is used in combination with a silicone rubber sealant to further assure long-term sealing and bonding of the gasket system to the gearbox flange and the mounting plate. This gasket/sealant combination provides an oil-resistant seal suitable for applications from minus 50 °C to beyond 150 °C.



Since the gearbox operates at atmospheric pressure, the application of the gasket and sealant imposes relatively modest stresses on the system.

To confirm the suitability of the system, an endurance test was conducted on the gearbox and mounting in a chamber at elevated temperature. The gearbox was held at an elevated temperature of 70 °C, and the spring-charging motor was operated at irregular intervals to simulate circuit breaker operations and to avoid stagnation in the grease. It was felt that allowing the grease to remain in one condition for long periods of time would be a less severe test case, so operations at irregular intervals were employed to avoid this occurrence. The elevated temperature was chosen as leakage of grease would be more likely at higher temperatures, and high-internal ambient temperatures are common in outdoor circuit breaker enclosures on sunny summer days.

After a period of weeks under these conditions, only very minor leakage of grease from the gearbox was observed, thus demonstrating the validity of the gasket/sealing system. The leakage of grease occurred at the rotating crank shaft bearings, and leakage from this location is normal for other applications of the gearbox. No leakage occurred at the mounting location where the gasket/sealant system is used.

During other tests on various distribution circuit breakers in the type SDV family, it has been observed that a small amount of lubricant is disbursed around the enclosure as various cranks, bearings and the like move at high speed during the closing operation. Some users may find this objectionable but this is completely normal.

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