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Vacuum Potting Smart Waste Gate Valves

by

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The Mark III Command Valve, manufactured by Norgren – KIP Fluid Controls of Farmington CT, is a proportional valve used to provide Smart Waste Gate control in the Dodge Ram Diesel turbocharger. In this application it is subject to extreme temperatures, vibration, and moisture.

Void free potting is important to maintain the integrity of the valve coil when exposed to moisture. Voids in the potting material provide a direct path for ingression of moisture, which would in turn cause premature failure of the valve's coil.

With the valve mounted directly to the turbocharger located on the truck engine, the epoxy would need to survive at high temperatures and provide adequate heat dissipation. At the same time, due to the constraints of the valve body design, the material needed to be as free flowing as possible to completely penetrate the coil and related components.

A two-part, heat cure epoxy from MERECO Technologies in East Warwick RI was selected. It had the characteristics to meet the temperature extremes, vibration, thermal conductivity, and wet-out properties.

The dispense equipment requirements included an automatic, accurate, continuously operating, meter, mix system to dispense a precise and variable amount of potting material into the valve at different vacuum levels.

Working with KIP, Ashby Cross designed an automatic vacuum potting system to automatically encapsulate the valve.

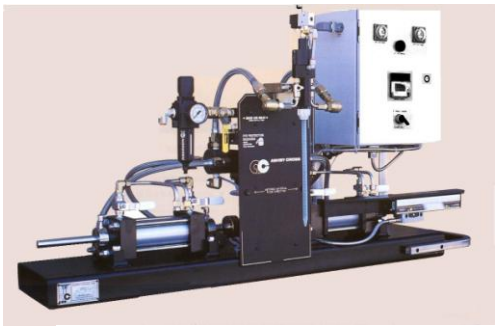
The system is composed of six basic functions, the feed system, the metering, controls, mix/dispense, vacuum chamber, and heating.

The feed system in a meter, mix may be tanks, totes, drums, or pails. In some applications the feed system also provides a means of preparing the material for processing. The material may be heated and degassed in the feed system prior to metering and dispensing to ensure void-free potting and proper wet out.
Several factors in this application made degassing, agitation, and heating the material necessary. Heating is needed to reduce the viscosity, which assists in degassing and also

reduces the time to penetrate the valve, thereby increasing throughput. In addition, vacuum is needed, as any entrained air in the material would defeat the purpose of dispensing into a vacuum. For this application vacuum tanks with heaters and electric motor driven agitators were provided. Agitation assists in the degas process as well as providing a uniform material temperature. In this case it also keeps the fillers in suspension.

Once prepared for processing the material travels through heated lines to the metering where the material is proportioned in the specified ratio. Two, in-line, positive displacement metering cylinders with volume ratios matching that of the material ensure that accurate repeatable ratio is achieved. In addition, piston metering will process a wide range of chemistry including heavily filled, abrasive materials. Piston metering is also excellent for wide ratio applications, and can be used with varying system backpressure.

The Ashby Cross 2500 Double Acting meter, mix system was chosen for this project. This system provided the needed double-acting (continuous) output and would work well with the wide ratio and significantly different material viscosities. Hardened cylinders designed for abrasive materials assured longevity.



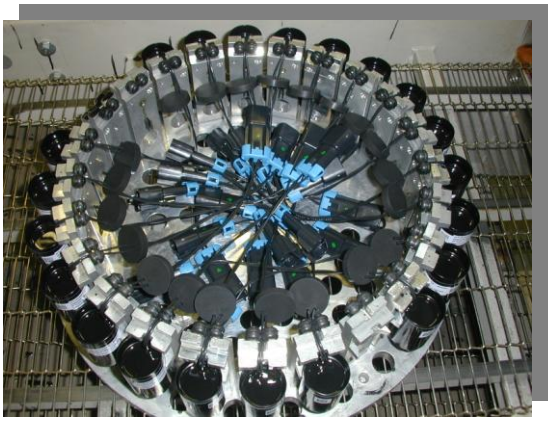
Ashby Cross 2500 Double Acting meter, mix and dispense system integrated to the automatic vacuum potting system.

Once proportioned in the cylinders, the material moves to the heated mix/dispense head. The static mixer is housed in a shroud that penetrates the vacuum chamber. At this point the temperature is elevated to the final design point for pouring into the valve.
By dispensing in a vacuum, elements within the valve, e.g., electric coil had no entrained air, providing for 100% penetration.

A vacuum chamber, capable of automatically processing 24 valves at varying vacuum levels was designed and integrated into metering system. The chamber was heated and incorporated a servo controlled rotary table and a vision system to detect the presence or misalignment of valves. If the system detected a misaligned or absent valve that shot would be aborted.

Vacuum potting at 150 Torr

Testing indicated that degassed and heated material and a preheated valve provided optimum potting. However testing also indicated at least two different pours at two different vacuum levels would be necessary to completely penetrate the components. The system was programmed to pump down to 150 Torr and begin dispensing once that level was achieved. After the initial pour, the chamber was vented to atmosphere and a final "top off" done.



Encapsulated valves enter the conveyor oven for curing

Complete penetration of the valve was achieved by sequencing the potting process. The first pour under vacuum ensured the valve and components were air-free. Following the first pour, the chamber is vented to atmosphere causing the material to collapse into the

valve body. A final top-off pour serves as a final seal and also brings the potting material to design level.

The automatic meter, mix, dispense, and vacuum system achieved the desired goals of reducing operator involvement, increasing production, reducing cost, and reducing defects. Overall the system is used in a 2-shift basis producing 24 valves in less than 3 minutes.