Design and Use of the Throttle Bushing in
Armstrong Series 4300 Split Coupled Vertical In-Line pumps

The Split Coupled Vertical In-Line (SC-VIL) pump design was introduced into the HVAC market by Armstrong in 1969, as Series 4300. Similarly designed units, typically to ANSI and API 610 standards, had been manufactured by the larger industrial pump companies for a generation prior to Armstrong redesigning the unit to be more user friendly for the HVAC market.

Armstrong digressed from the ANSI and API standards applied to SC-VIL in the industrial and petrochemical markets to design more value into the unit. For instance: Armstrong designed the 4300 series with same size inlet and outlet, so that the installing contractor no longer needs to install a reducer after the pump to return to the system pipe size. (ANSI and API units require smaller sized discharge connections than suction). Armstrong also manufactures pump housings from cast iron and ductile iron, unlike the steel industrial housings, to reduce unit prices of pumps for HVAC pressure and temperature parameters.

One industrial design feature that is retained in the 4300 series is the isolated stuffing box or seal chamber. The isolated seal chamber is physically separated from the pumping chamber, by a throttle bushing, and houses the mechanical seal.

Mechanical seals prevent liquid in pumps from escaping where the rotating shaft exits the pump housing. Mechanical seals have proven to be reliable over the past 40 years and are the sealing arrangement of choice in the HVAC industry. Mechanical seals primarily operate by rotating very flat washers, or faces, together. One face is usually softer than the other (Carbon against Ceramic, as an example) and the seal works by a combination of spring and hydraulic pressures, to keep the faces together, along with rotational heat evaporation of the thin film of liquid passing through the seal faces.

As an HVAC seal usually rotates at 1800 rpm (30 times a second! …60 times a second on a typical 3600 rpm booster pump), the faces will wear with time and ease of service is desirable, as the mechanical seal is usually the first pump component to need replacing. An isolated seal chamber, when supplied in conjunction with a rigid split shaft coupling, allows all mechanical seal components to be removed for service without disturbing any other pump or motor component!

The Armstrong Series 4300 design incorporates all the above mentioned features!

Mechanical seals need cooling and lubricating to provide acceptable life. In an isolated seal chamber the seals are cooled and lubricated through flush line tubing piped in from the pump discharge connection. The isolated seal chamber and flush line allow the mechanical seal environment to be controlled to a greater extent than if the seal were installed in the pump housing, directly behind the impeller. With an isolated seal chamber the pumped liquid, recirculated through the area, may be filtered or cooled in the flush line before entering the seal area. (See Armstrong File No: 43.15) To derive maximum benefits from this flushing liquid, a throttle bushing, installed between the seal and pump chambers, allows a controlled flow of flushing liquid to re-enter the pump. This ensures that the seal chamber is always full of liquid and pressurized.
The throttle bushing, that the Armstrong 4300 series takes advantage of, is a **Lemon Journal** design. Two grooves are machined into the carbon compound bushing along the bore that, when viewed from the end, give the inside bore a ‘lemon’ shape. The Lemon Journal design has been used industrially, for many years, to ensure proper grease distribution on shafts as the journal rotates in lemon bore-shaped bushings. The grease would flow down each channel and be picked up by the shaft evenly, over the whole length of the bushing. This helped center the shaft in the bushing and prevented uneven wear.

The same beneficial feature effects the Series 4300 shaft and throttle bushing interaction. The grooves allow the required amount of flushing liquid to be re-circulated through the seal chamber and, also, ensure that water is distributed evenly around the shaft, along the entire length of the bushing.

The Lemon Journal effect provides the hidden benefit of being an excellent “water bearing” that is a critical added value in Armstrong premium quality Series 4300 pumps by helping maintain shaft alignment thus ensuring smooth and quiet operating for many years.

**Particulate size allowable:**

Note that the grooves in the throttle bushing are 3/32” deep so, theoretically, will “pass” particulate close to that size. Practically however, solids should be discouraged from entering the seal area. Small abrasives could enter the seal faces, or the shaft to throttle bushing clearances, and cause premature seal failure or shaft wear. Larger size particulate may collect in the seal chamber, building up there sufficiently to prevent the movable seal component, or “pusher”, from moving forward to compensate for seal face wear. This again promotes shorter seal life.

In short: For longest shaft and seal life, keep solids out of seal area by means of abrasive filters (50 micron) or separators in the seal flush line.