Transmission & Bearing Corp.

Technical Notes by Dr. Mel

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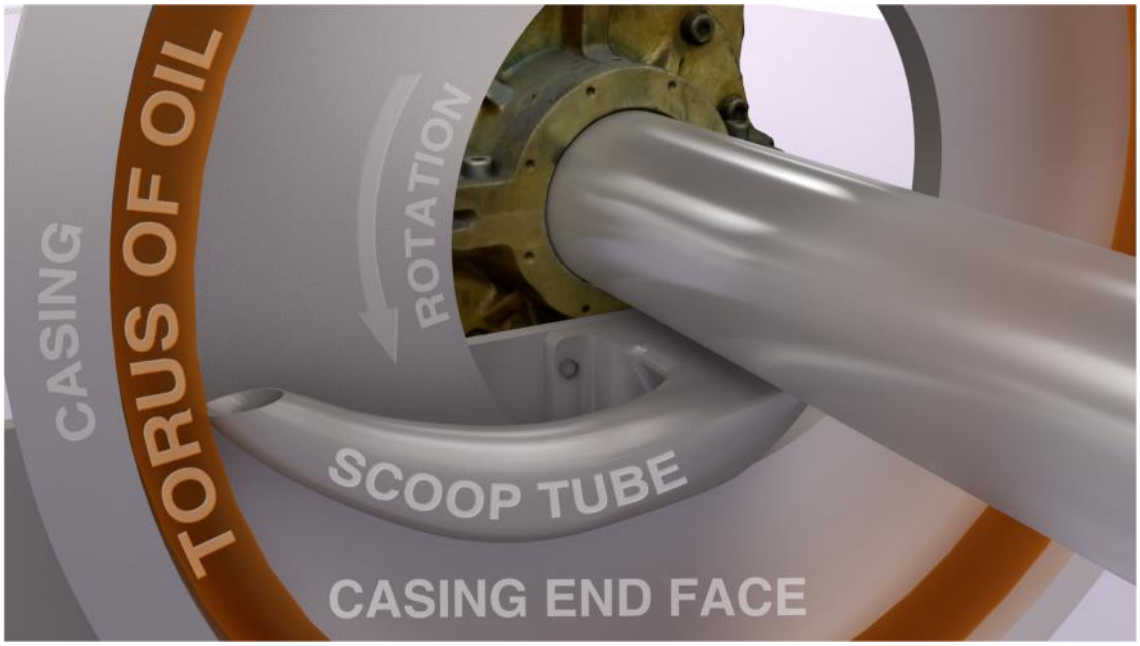
Improving a Critical Component of a Fluid Drive: The Scoop Tube

The speed of almost every variable speed fluid drive is controlled by a moving scoop tube, the heart of a fluid drive. When the fluid element rotates, a torus of oil forms within the rotating shell that surrounds the impeller and runner. The diameter of the inside surface of this torus of oil is controlled by a "scoop tube" that scoops oil from the surface and discharges it outside of the shell so that it can recirculate. In almost all fluid drives, the flowrate of circuit oil (working oil) through the fluid drive element is constant, driven by positive displacement pumps. The scoop tube does not change the amount of oil flowing through the element, it simply changes the inside radius of the torus of circuit oil in the fluid drive element.



Call TRI at (800) 363-8571 for more information about Fluid Drives.

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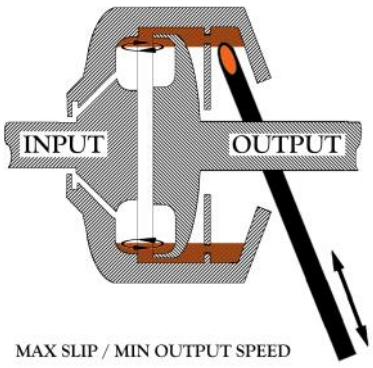
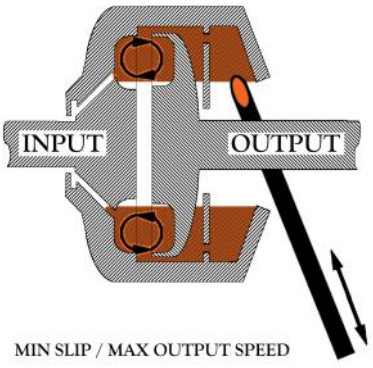
TRI was Founded in 1961

The output speed and torque of a fluid drive are determined by the amount of oil in the torus: as the thickness of the ring of oil increases, so does the speed and torque increases as a general rule. Typically there are two types of scoop tubes:

One is shaped much like a sheep's horn and is mounted on a sliding plate that slides back and forth perpendicular to the shaft line in guide blocks.



MAX SLIP / MIN OUTPUT SPEED



MIN SLIP / MAX OUTPUT SPEED

One is a straight tube with a scoop shaped tip that goes directly in and out and is mounted on an angle of roughly 20 degrees. Sketch of assembly from top.

These items are subject to severe duty. At 3600 rpm, the inside diameter of the torus of oil in a size 270 fluid drive is around 14 inches, and at minimum speed, it is around 26 inches. With a circuit oil flow of 400 gpm and at minimum speed, the cross-sectional area of the oil that is scooped up is around 0.31 sq in (.55in x .55in) and the speed that it is going into the scoop tube is 280 miles per hour.

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TRI designs and builds new Variable Speed Fluid Drives for fan, compressor, and boiler feed pump service, as well as upgrading them to suit customers' needs.

Upgrade Lube Oil Systems: Some units overheat when used in ways different from the original design intentions. TRI can inspect your oil system and develop and install solutions that will eliminate overheating.

TRI takes items off your maintenance list. Send your rotor vibration, bearing damage and fluid drive problems to us.

Due to the change in direction of the flow through the tip, a substantial downward force is applied bending the scoop tube.

When a second circuit oil pump starts, which it can do for various reasons, or when the scoop tube is rammed at a high speed into the torus of oil which might be done at the same time in response to some unusual event, now the flow immediately multiplies, and the scoop tip is bent even more. Many standard design scoop tubes cannot handle this increase in bending force and the tip stretches and yields and remains in a severely bent shape. Sometimes they have bent to the point of closing off the flow, and the speed control is lost. Other times, it is only partially bent and its effectiveness drops. Then, at some time, when the fluid drive is next shut down, the scoop tube goes all the way out to the minimum speed position (from the actuators point of view) and the tip rams into the rotating scoop tube eroding the tip away, so that it no longer works at all, or will only work in certain speed ranges.

The scoop tube is a complex geometry, both on the outside, and more so, on the inside. With considerable effort, TRI redesigned the scoop tube, including the manufacturing process, to be able to withstand an extreme bending force. Several of these have been in service for a few years and none of them have been bent in fluid drives, including those fluid drives in which standard scoop tubes had been bent from time to time in the past.

In the early fluid drives, the straight scoop tubes had brass tips brazed to a straight tube. Because brass has a thermal coefficient of expansion that is about 1.5 times that of steel, the brass tip would expand and contract at a different rate when subjected to the normal temperature range that fluid drives experience (70 deg to 210 deg F), and after a number of cycles, the brass tips would come loose, sometimes falling out of the tube and then the fluid drive would lose speed control.

TRI developed a replacement straight scoop tube that has the tip and tube made integral using one piece of alloy steel rod. The tip is made via a CNC process. Being integral to the tube, the tip will not fall off and it will not break.

This Technical Note was written by Dr. Melbourne F. Giberson, P.E., President of TRI Transmission & Bearing Corp., Turbo Research, Inc. The objectives of Technical Notes are to disseminate information and experience on understanding problems and how to solve them. We attempt to send this Technical Note only to those people for whom the information might be useful. Over the years, many people have asked to be added to the distribution list (see our website). Occasionally, a few individuals inform us that they do not wish to receive the information. Should you desire not to receive future Technical Notes, please advise TRI by info@turboresearch.com or click visit the removal page on the TRI web site MFG 02/2015