WATEROUS

Talking Points

Flame Plated Impellers

Did you know that one of the major causes of worn, inefficient pumps in the fire service is common sand. To quote an article written by Chief Jackson in the Pacific Fire Coast Journal, “types of sand causing this damage may range from coarse, sharp–edged, fast–cutting grains, down to fine, soft soap–like material that causes as much damage by clogging small passages as it does by direct wear. Needless to say, any of these can cause major problems in the maintenance of fire pumps, with their extremely close tolerances used in impellers, wear rings, relief valves, pressure governors, gauges and other close–fitting parts.”

If you haven’t had a chance to read Chief Jackson’s article, “Watch that sand,” then why not take the time to do so–before reading on. (A reprint of the article is attached, we’ll wait. Although it is dated. The sand affects have not changed.)

It is because of this wear problem that Waterous introduced a unique flame plating process to the fire service more than 30 years ago and to our knowledge, it is still a Waterous exclusive! The method used to accomplish this is most interesting and extremely unique, please read on...

Much to the surprise of most people, approximately 75% of the pump wear due to pumping sand, as described by Chief Jackson, occurs on the impeller hubs. Because the hubs are moving at a speed of around 60mph while the wear rings are stationary, the sand impinges on the hubs at a much higher velocity than on the wear rings. For this reason, Waterous Company adopted the policy of offering flame plated impellers as an option (standard on CMU and CSU pumps). The flame plating process consists of adding tungsten carbide to the surfaces to be protected from wear.

This unique process produces extremely hard, well–bonded, wear–resistant coatings which consistently outwear hard chrome plating, tool steel and solid tungsten carbide.

A specially constructed gun is used to blast tiny particles of tungsten carbide onto and into the base metal. This gun resembles a large–caliber machine gun. When measured quantities of oxygen, acetylene and particles of coating material are metered into the firing chamber, a timed spark detonates the mixture. This creates a hot, high–speed gas stream which instantly heats the particles to a plastic state and hurls them at supersonic velocity (2500 fps) from the gun barrel. The near molten particles impinge onto the surface of the work piece where a microscopic welding action produces a tenacious bond. Rapid–fire detonations, during automatically controlled passes across the work piece, build up the coating to a specified thickness.

Although temperatures above 6,000°F are reached inside the gun, the work piece remains below 300°F. Thus, metallurgical properties of the base material are not changed during the coating process. Low temperatures in the substrate also eliminate the possibility of warpage, distortion or other physical change in precision parts.

The impeller hub surface, when flame plated, is approximately twice the hardness of the hardest tool steel. An attempt to score the surface with a good metal file would prove harmful to the file, not the flame plated hub. This feature may be specified as follows... The impeller hubs to be flame plated with tungsten carbide to assure longer pump life and lower maintenance costs.

Wear Rings

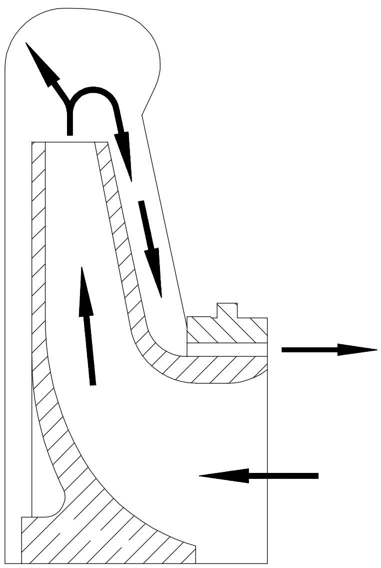
As it is impossible to avoid pumping water containing some sand or other abrasive material occasionally, it’s a good idea to adopt as many measures as you can to minimize the effect of impeller hub wear on pump performance. Ordinary construction consists merely of a close running fit between the impeller hubs and the body bores; wear rings are commonly added to fit between an enlarged bore in the body and the hubs so that when wear occurs the original clearance can be restored by replacing the wear rings.

The amount of leakage between the wear rings and the hubs depends mainly on three things: the pressure difference, the clearance and the leakage path. We can’t do much about the pressure difference, but we can certainly do something about the clearance by rigidly supporting the impeller shaft and by flame plating the hubs to keep wear to a minimum and we can also do something about the leakage path.

Every firefighter knows that the longer the hose the greater the friction loss and also that adding elbows to a piping system increases the friction loss through the system.

Plain Wear Rings

With ordinary wear rings the path is short and straight, so the friction loss is low and the leakage rate high. There are two ways to add to the length and to make the path crooked, one is called the “wrap–around” wear ring and the other is the “labyrinth” wear ring.



PLAIN
WEAR RINGS

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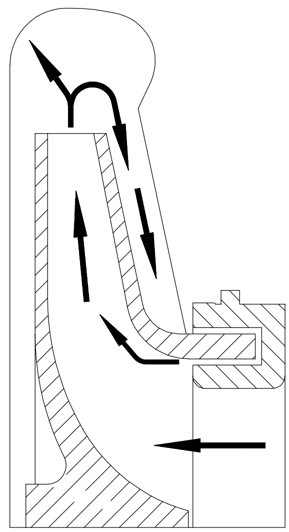
Wrap–Around Wear Rings

In the wrap–around design the wear ring extends into the eye of the impeller as well as fitting closely around the hub. With this design, water under discharge pressure in the volute tending to return to intake through the clearance between the wear ring and the impeller hub is forced to change direction and flow toward the impeller eye before it exits from the clearance; the leakage then flows with the water entering the impeller from intake.



WRAP–AROUND
WEAR RINGS

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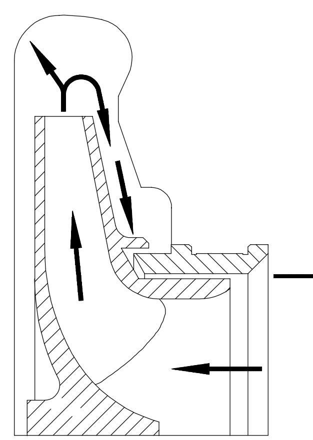
Labyrinth Wear Rings

In the labyrinth reverse flow design, the wear ring extends into an annular groove just outside the hub. With this design, water under discharge pressure in the volute tending to return to intake is first forced to flow back toward the impeller, then forced to change direction again and flow outward away from the impeller as it exits from the clearance; the leakage then flows against the water entering the impeller from intake.

Tests made with both designs indicate that with the same amount of radial clearance, the labyrinth design allowed less leakage. With the original close clearance, a pump will have pretty much the same efficiency even with plain, simple, old style wear rings as with either the wrap–around or labyrinth designs, but with the same amount of excessive clearance, as will result from operation with sandy water, the wrap–around design is better than the plain, but the labyrinth design is best, by an appreciable amount.

Of course, with reduced leakage the wear will be less, so the impeller life will be increased in two ways, it will take longer for a given amount of wear to occur and there will be less leakage when the wear is the same. And, of course, if the hubs are flame–plated, it will take much, much longer for a given amount of wear to take place.



LABYRINTH STYLE
WEAR RINGS

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Watch That Sand

by Chief Jackson

One of the major causes of worn, inefficient pumps in the fire service is nothing but common sand. Types of sand causing this damage may range from coarse, sharp edged, fast–cutting grains, down to a fine, soft silt–like material, that causes as much damage by clogging small passages as it does by direct wear. Needless to say, any of these can cause major problems in the maintenance of fire pumps, with their extremely close tolerances used in impellers, wear rings, relief valves, pressure governors, gauges and other close fitting parts.

The sources of sand are many. Even though one of the major causes of sand damage is carelessness in drafting from canals, lakes and rivers, many pumps are damaged by sand that are never used for drafting. Water systems originating from sandy wells or from silt–laden water sources and poorly filtered, may well force large quantities of sand into your booster tanks with it.

The amount of sand that may be carried by water is amazing, as is the amount of damage that may be caused in short time by heavily sand–laden water. Pumps may very well fail their first annual condition test after being in service only a year or less, if you are unfortunate enough to have pumped even relatively small gallonages of sand–laden water. More common though, is the gradual lessening of efficiency and eventual failure to meet test standards caused by wear ring and impeller clearances becoming excessive over a few years of pumping even small percentages of sand. Many times an engine has been blamed for excessive loss of power, when the main trouble was in these excessive pump clearances, with the resulting bypassing of water to the extent where the engine actually was overloaded by poor pump condition.

To one unfamiliar with the tolerances of fire pumps, the clearance between impeller hub and wear ring may not appear to be a great deal, even in an excessively worn pump. However, when you stop to consider that new tolerances may be as close as 10 to 12 thousandths of diametrical clearance, a clearance of 25 to 30 thousandths is obviously less than desirable and as we find many times, 40 to 50 thousandths can well mean total inability to meet performance standards.

Another effect of sand shows up in the sticking and scoring of relief valves, sometimes damaging or sticking them to the point of causing pump failure through the by–passing of water through the relief valve itself. Still more damage may be found in sticking pressure governors, sand–clogged gauges and worse yet, in damage to seals, packing and impeller shafts. The pump shaft with grooves cut in it where the packing or seal rides, does not seal properly for very long and with excessive vacuum loss at this critical point, we may well get total failure to draft water.

How then to safeguard ourselves against this enemy? Unfortunately, it is not possible to completely eliminate these hazards. We can, however, lessen the probabilities of damage. If we must draft from streams or other places where sand is present, then the teaching of proper procedures in securing intake screens well off the bottom can mean a tremendous saving in the amount of sand ingested by our pumps. The use of a floating pick-up screens on intake hoses, though fairly expensive, may pay for their cost many times over in reduced pump wear.

Correct design and maintenance of sump traps in booster tanks can aid greatly in stopping sand from this source, although it is impossible to screen or trap all of it and still maintain the desired water flows. Possibly the hardest source of sand to guard against, is the water system that delivers sand bearing water from the hydrants directly into your pumps. Here, the best than can be done is periodic flushing to prevent excessive sand pocket buildups in the mains and most important, the avoiding of use of known sand bearing water systems except for emergency purposes only. Drill elsewhere, or use other water sources, rather than needlessly wear out the pumps with sand! The cost in repairs is bad enough, but the lack of dependability that results is much too series not to use any means possible to avoid. Damage to packing glands can be lessened by keeping a correct adjustment of the glands at all times. A properly adjusted gland will not admit as much sand between it and the shaft as will a loose adjustment. Screens can be utilized to protect relief valves, governors and gauges, but must be serviced periodically to prevent total clogging of the screen itself.

In closing, I repeat, watch that sand. While we cannot completely avoid damage from it, we can greatly lessen the changes of major damage occurring, by understanding the danger and taking the steps available to us to avoid it.

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