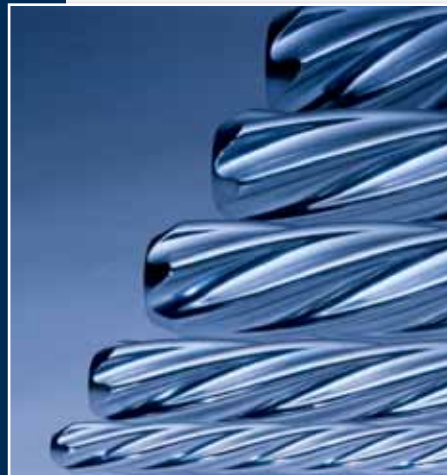


PV Fluid Products

The **PROGRESSIVE**
rotor and stator company



**Product
Service
Quality
Manufacturing**

POWER SECTION ROTORS

PV Fluid Products is dedicated to providing customers with the quality power sections.

Our rotors are top quality, technically advanced components that form a critical part of the downhole motor. This publication provides information to assist users in getting the best from their rotor fleet and so help optimize motor performance and service life.

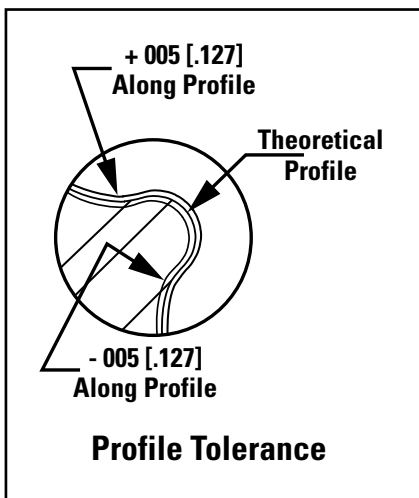
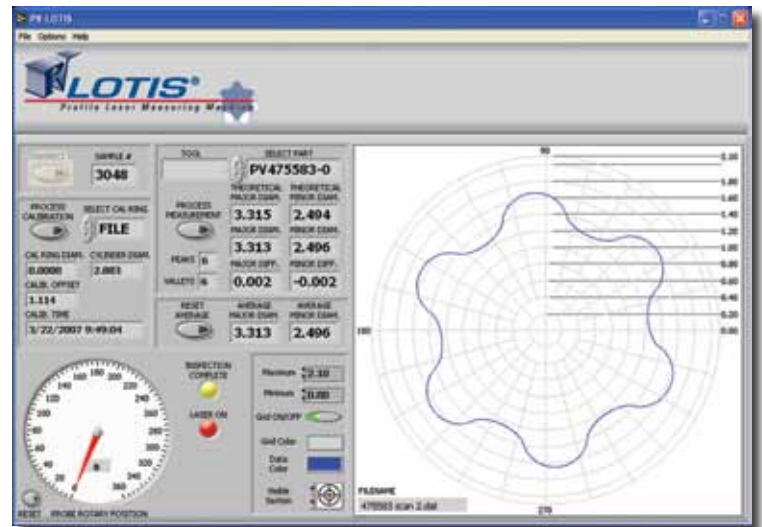
Power Section Rotors



The rotor is designed to mesh with the stator and to achieve the correct rotor/stator fit. If the fit is too tight, the stator elastomer will overheat, leading to an early failure, and if the fit is too loose, the drilling fluid will bypass the seal line as the differential pressure increases. This will reduce the rpm and power and the motor will be seen as weak. Maintaining an accurate rotor profile shape and the integrity of the surface condition are critical to obtaining the expected performance and service life from the power section.

Rotor Design and Manufacture

Rotors are manufactured from corrosion resistant stainless steel (e.g. 17.4PH stainless steel) and then coated. They can be supplied solid or with a gunbore to allow the rotor to be jetted. The additional benefit of a gunbore is that it reduces the rotating rotor mass and vibration, which reduces elastomer fatigue and helps prolong stator life.



PV rotors are accurately manufactured on specialized CNC machines and then CNC polished to achieve the target design to a manufacturing tolerance of +/- 0.005" (0.127mm) on radius around the entire profile. Specially designed laser measuring equipment (PV Lotis ®) is used throughout the manufacturing, quality control and inspection processes to ensure that this tight tolerance is achieved.

The base metal profile shape is engineered to accommodate the surface coating that will be later applied and to ensure that the finished rotor will comply with the specified dimensions.

Note: A rotor intended for one coating is not generally suitable for an alternative coating because the base metal profiles will be different.

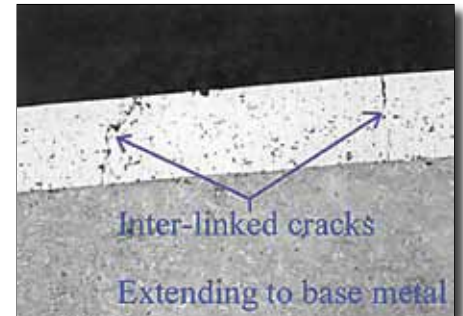
Rotor Coatings

As the rotor and stator heat up downhole, thermal expansion takes place which changes the fit. The elastomer has a higher rate of thermal expansion than the rotor. Rotor coatings are applied to the base metal to provide a hard wearing and corrosion resistant surface. The main cause of corrosion is the chloride content of the drilling fluid. While the severity and rate of corrosion can also be affected by temperature, pH level and pressure, the chloride content is the main factor used when determining what type of coating to select.

Current rotor coatings are:

Hard Chrome Plating

A hard wearing, engineered coating that gives good service life and is successfully used in many applications. It is applied by an electro-plating process to the surface of the rotor base material. Chrome plating is a naturally micro cracked coating. Any cracks that permeate right through the coating layer can allow the drilling fluid to reach the base metal. In corrosive (high chloride) applications, this can result in pitting the base metal and the chrome plating flaking off. The chrome flakes and the resulting damaged rotor surface will tear the stator elastomer and lead to failure.



Courtesy of Swinton Electroplating

Tungsten Carbide

This is a thermal sprayed coating that is generally applied using an HVOF process. Once polished to the specified surface finish, the hard coating is stator friendly and provides a hard wearing and corrosion resistant surface. Any remaining porosity in the sprayed and polished coating is reduced by a sealing process which further protects the base metal from the drilling fluid and gives good operating life.

Where to use' Coating Guidelines

Chloride Content of Drilling Fluid	Hard Chrome Plating	Tungsten Carbide
Up to 30,000 ppm	Good	Good
30,000 to 50,000 ppm	Corrosion can occur	Good
Above 50,000 ppm	Not recommended	Good

Rotor Handling

The rotor coatings are hard wearing but can be chipped or cracked if the rotor is roughly handled. This damage can initiate localised coating failure and lead to subsequent rotor and stator damage. Fabric slings are recommended when picking up rotors and care should be taken when moving rotors around so that they do not bang into other equipment. The use of chains will damage the coating. Also, the rotor profile should not be held in the jaws of the break-out unit as this could damage both the coating and the rotor profile.

Rotor Storage

Rotors can be stored inside or outside without any specific protection from the weather. The use of racks is recommended and a protective layer (e.g. timber, rubber, plastic, etc) should be placed on the rack arms so that the rotor surface is not damaged when rotors are placed on the rack. Take care to ensure the rotors don't bang against each other during movement to minimize impact damage.

Assembling a rotor in to a stator

It is recommended that a non-hydrocarbon based lubricant is applied to the rotor prior to its insertion into the stator. This can be a simple soap and water solution or a lubricant such as a silicon or Teflon based grease. The rotor/stator fit will be looser at workshop temperature and will tighten up downhole because of thermal expansion.



Rotor Service Issues

Typical rotor service issues include:-

- Abrasive wear (high sand content, cuttings recirculation, etc.)
- Poor handling issues – shop dents and cracks
- Foreign Object damage – hard objects pumped down the drill string and through the power section.
- Fishing Damage – severe damage caused by fishing tools
- Corrosion – high chloride attack, acid damage, etc.

Repairing Rotors

Both chrome plating and tungsten carbide coatings can be removed from the rotor base material and re-applied. This means that if the damage is not too severe, the rotor can be repaired and taken back into service.

After the coating has been stripped from the rotor, the base metal is typically weld repaired (if required), pre-polished to a surface finish that is suitable for the coating and also cleaned to produce a contaminant free surface. The new coating is then applied. The base material should be weld repaired using welding rods that are compatible with the base metal and the appropriate welding procedure should be used.

Removing the worn coating and pre-polishing removes some base material so the rotor will need a thicker coating in order to bring it back to size.

Note: If the power section performance is to be maintained, it is strongly recommended that the finished sizes of a repaired rotor are the same as the manufacturer's original specification.

For more information on PV rotors and information on the PV power section range, please visit our website at www.pvfluid.com or contact your local PV sales office



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