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# Improvement on Mechanical Power Transmitter to Meet the API 610 and API 671 Standards in the Petrol Industry

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***Abstract: -*** *The Petroleum Industry is one of the largest and broadest entrepreneurs of the world, and it grows each year, with new technologies and new innovation perspectives. The hydrocarbon exploration is a risk-filled activity, requiring dangerous tasks involving very high pressures and the manipulation of gigantic amounts of gas. Therefore, all equipment need to meet security standards. This paper was based on improving a machine component to meet the requirements on the API 610/671 Standards. The coupling used in the past could cause sparking, creating dangerous explosions, and if there were severe vibrations, their blades could come loose, becoming a danger for operators In order to meet the API 610/671 Standards, a change was made to the coupling design, where a study was carried out to select a new material with more adequate mechanical characteristics for the work, phosphatizing thermal treatment and salt spray tests to analyze the material life time.*

***Keywords: -*** *Blade coupling, API 610/671 Standards, Petroleum, Security*

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## I. INTRODUCTION

The Petroleum Industry in Brazil is historically one of the most subject to international standards and codes of manufacture, inspection and maintenance, such as API (American Petroleum Institute), ASME (American Society of Mechanical Engineers) and others, for process operation among safety, environment and health acceptable conditions. Additionally, this segment makes use of internal regulations to maintain the products and process quality assurance. All these procedures contribute to the increase of reliability and operational continuity.

This case study is about improving a coupling and modifying to meet the API Standard referred to "Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries". It was demanded by the Oil Industry that for classified areas, where there could be gas leakage, constant temperature oscillations and high pressures, that the couplings should be differentiated.

On this, research and development of a new coupling that would meet the standards were carried out. The couplings shouldn't have the polymer damping element, because this material doesn't support areas with high temperatures and high pressures and the performance and durability were getting lower, yielding to risks, such as explosions caused by sparkling.

On the first modifying study, hubs made by cast iron and stainless steel blades were created. The work temperature could vary between -40ºC and 280ºC. A field test was carried out in conditions similar to the oil company, but not yet in accordance with the standards. The elements were made by materials with different properties and they would still generate sparkling. The Standard demanded internal bolts, anti-fly mechanism on couplings, avoiding blades, projections towards workers and equipment, and interchangeable parts alongside the whole coupling.

After many studies, material testing and chamber testing, to simulate real field conditions, an ideal prototype was obtained, made by stainless steel.

## II. BLADE COUPLINGS

The formerly used blade coupling was composed of blades and rubber damping elements. These elements, made of nitril rubber, experiment reduced life time due to high temperatures, releasing the blades and causing possible accidents.

The coupling material used to cause sparkling that could create explosions due to dispersed gases, present on site.

Their lifetime was around 2 years, causing large expenditures with spare parts

This way, the coupling didn't meet the API 610 (Machinery Protection) and API 671 (flexible Components) Standards.

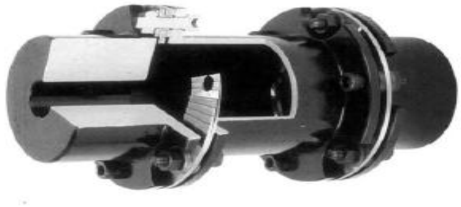

**Figure 1 – Blade couplings**

## III. Materials Of The New Coupling Prototype

The stainless steels are, basically, iron-chromium alloys, their oxidation resistance is mainly due to the presence of chrome, that from a certain value and in contact with hydrogen, it allows formation of a very thin chromium oxide film on the steel's surface, which is impermeable and insoluble in the usual corrosive media.

Austenitic stainless steels present the biggest corrosion resistance. They combine low yield stress and high tensile strength and good elongation, offering the best properties for cold work.

For this reason, the 301 austenitic stainless steel was used to create the coupling prototype.

The hub, flange and spacer are made of steel, with phosphatizing superficial finishing.


**Figure 2 – Hub, flange and spacer**

The blades are made of Stainless steel, AISI 301 corrugated alloy, as demanded in API 610 standard.

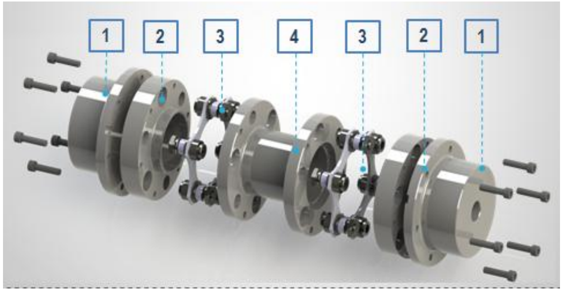


**Figure 3 – New coupling meeting the API 610/671 standards**

The rectified screw and threaded bush are manufactured from high strength steel equivalent to class 10.9 (DIN 20.898). All of them present phosphatizing superficial finishing.

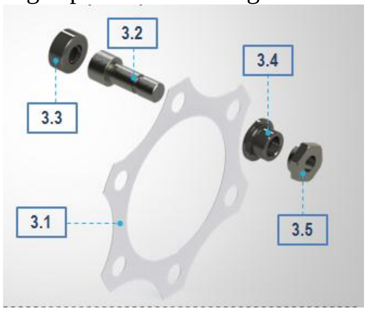


**Figure 4 - Blade, screw and nut.**

The new prototype featured an Anti-fly system, which is an internal protection in the spacer to avoid accidents in case of a brakeage of the membranes or spare parts.
This coupling has protection in all parts with anti-spark treatment. It avoids the risk pf sparkling in case of physical contact with another material in a workspace with high gas index in a closed place.

## IV. Phosphatizing Thermal Treatment

The phosphatizing process, the thermal treatment used in the prototype, is used to protect metals by coating them with monoacid phosphates and neutrals of zinc, iron, manganese or chromium, increasing the porosity and allowing a good penetration of the in, increasing its adhesion and surface corrosion resistance.
Being poorly soluble in water, the phosphates are deposited on the metallic surface in contact with the solutions, in the form of thin crystal layers.
The main advantages of the phosphate layer are:

- low porosity;
- High insulating power, preventing the propagation of galvanic currents (causes of corrosion);
- great adherence to the metallic surface;
- good affinity for oils and inks,
- low applying cost
- excellent corrosion resistance
- prevent oxidation to spreading to areas where the painting has been destroyed

For these reasons, the phosphatizing thermal treatment was chosen for the new prototype.

## V. Salty Mist Chamber Test

The coupling operates in an area where great oxidation occurs due to salinity. After changing the material and thermal treatment, a test was carried out in a salty mist chamber (salt spray test). It is a very important comparative test, used to evaluate the corrosion process in multiple materials. To execute this test, it was used a chamber that simulates the severe marine environment, with controlled salt concentration and temperature.

The result was satisfactory increasing the lifetime of the coupling from 3 to 5 years acting in the area with high salinity.

## VI. CONCLUSION

A study was carried out to modify a coupling that served the Petroleum industry area, it should meet the API 610 and 671 standards.
In this way its physical structure and manufacture material were changed
In its structure, the elastic elements made by nitrile rubber and the blades that cause accidents were removed.
The chosen material for the new coupling was the austenitic stainless steel 301, with phosphatizing thermal treatment and anti-sparkling.
Through the salty mist chamber test, it was confirmed that the lifetime of the coupling increased 2 years.

It is concluded that the new coupling perfectly complies with the API 610 and 671, becoming safer, with greater lifetime and totally interchangeable.

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