



Replacement Inflatable Packers & Elements

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By John Misson – Replacement Inflatable Packers and Elements Pty Ltd. August 2007

A brief introduction to Rubber and manufacture of Inflatable Packers

Rubber once solely produced from the sap of the Para Rubber Tree (*Hevea braziliensis*) and still in wide use today, initially presents as a milky colloidal suspension, or latex. In this state it is a naturally occurring hydrocarbon that may be called a polyterpene. This elastic hydrocarbon polymer was greeted upon its arrival in Europe, with an admixture of amazement and horror (some thinking its properties the work of the devil!).

Following significant research and experimentation during the nineteenth century, we come today to nearly two dozen rubber types, some fully synthetic, others less so.

Generally, rubber compounds can be thought of as long, dense chains of randomly oriented molecules, with properties subject to their degree of molecular cross linking and entanglement. This molecular cross linking and entanglement contribute to rubbers elasticity; hence rubbers are also referred to as elastomers (elastic polymers). The term 'elastomer' once referred to synthetic rubber compounds, it is now extended to natural rubber as well.

The addition of certain substances to base rubber can significantly influence its response to many factors. The use of carbon black as a filler and pigment, is widespread and well documented, while sulphur, peroxide, acrylonitrile and many other agents are used to enhance rubber behaviour for various end uses.

Nevertheless, only a few of the many rubber types are employed in the manufacture of inflatable packer elements (also called glands or membranes). Choice is usually dependent on the chemical and thermal environment that the inflatable packer element is expected to operate within.

Typical rubber types suitable for inflatable packer elements include:

- Natural rubber (NR), such as polyisoprene which couples economy with high strength and reasonable temperature resistance. NR is a preferred rubber for diverse engineering applications, despite poor oil resistance and is prone to oxidize and react with ozone.
- Nitrile Butadiene Rubber (NBR) covers a range of compounds dependent upon the acrylonitrile (ACN) content, with higher ACN content rubbers having greater resistance to oil. NBR offers high resilience and wear resistance, offset by limited strength and weather resistance. A good choice for temperatures up to 100C.
- Hydrogenated Nitrile Butadiene Rubber (HNBR) covers many grades based on both the level of hydrogenation and ACN content. Overall HNBR offers

higher temperature resistance and strength than regular nitrile rubbers, together with good abrasion and wear resistance.

- Worthy of mention is the fluoroelastomer Viton® (DuPont), which has many excellent properties including very strong resistance to many environmental degradants. Its use in building inflatable packer elements however, is limited to specific applications, principally inflatable packers employed in water well development, where statutory concerns about potential contamination of potable water mandate its use.
- Although other rubbers, such as neoprene can be used for inflatable packer elements, NR, NBR, and HNBR rubber types under discussion are those generally encountered.

In addition, inflatable packer elements can be mechanically strengthened by the inclusion of reinforcing fibres such as Kevlar® (DuPont) or aircraft grade wires. The addition of such mechanical strengthening is not universal, and depends on specific end use applications.

It is a fact of life that rubber wears in service and deteriorates over time. As rubber is subjected to stress/ strain and wear the inevitable changes to its resting occur, with forces increasing with rising temperature.

Rubber performance degrades over time, even if not subjected to stress. At Replacement Inflatable Packers and Elements we have observed some fully vulcanized rubbers 'shrinking' by as much as twenty two thousandths of an inch, per inch over time. Factors influencing rubber longevity have been documented, though poorly explained outside the industry. Such factors include oxidation, ozone attack, temperature, sunlight ageing and out gassing. These non mechanical stressors thus affect fundamental rubber properties resulting in loss of flexibility, abrasion resistance and elasticity due to changes in polymer chain lengths and crosslinking.

As a result, inflatable packer vulcanite's typically have a shelf life not exceeding ten years, depending on both specific product characteristics and relevant ageing processes, with actual service life being shorter than that.

Many additional factors influence the service life of inflatable packer elements, chiefly related to down bore conditions. Bore holes are not smooth and raising and lowering an inflatable packer subjects the rubber to abrasion. In addition, a packer element inflated to its working pressure is subject to both extrusion and compression as the packer plugs the bore, and long term compression set is not uncommon, particularly at high operating pressures over time.

As well, dramatic rubber failure down bore can occur where a packer element inflates in an area where the bore hole has a 'wash out' section, allowing part of the packer element to out bulge excessively and rupture.

Down bore exposure to heat, oil, amines, aromatic hydrocarbons, acids, alkalis and strongly polar fluids and gases also affect rubber life. While, as already noted, rubber selection for inflatable packer elements is generally dependent on a rubber's ability to cope with hostile chemical and thermal environments (rather than mere linearity with strain), no one rubber is completely impervious to these factors. Thus, rubber qualities are expressed qualitatively rather than quantitatively, with merits in terms of 'poor', 'fair', 'good', 'excellent' and so forth.

Considering the multitude of factors affecting rubber life, it is almost impossible to accurately predict mean time between failure of inflatable packer elements, despite rigorous quality control, from initial rubber selection, through to the fully vulcanized product.

Inflatable packer elements have to work hard in hostile conditions.

Replacement Inflatable Packers and Elements Pty Ltd manufactures and services standard and custom designed OEM inflatable packers.

We modify OEM inflatable packers to suit new or different applications and supply associated equipment such as fittings, inflation lines and gauge boards etc as required.

We also offer the economic options of repairs and rebuilds of deteriorated or damaged OEM inflatable packers

We pride ourselves not only on the world standard quality of our work, but also our ongoing technical support, and fast turnaround.

We understand that time is money and we understand inflatable packers.