Going green

the implications for hoses

Protecting the environment and controlling pollution are gaining importance in our changing industrial world. The hydraulics industry is no exception

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It has always been man's characteristic to want to go faster, be bigger, exceed expectations, do less but achieve more. These factors have taken new guises in recent times that are common in all industrial markets – shorter development times, larger output volumes, higher productivity, higher efficiency and lower energy inputs. These factors are crucial to the survival of a modern business.

Each market segment adapts these factors to suit. In the hydraulics industry, higher output can be defined as the efficient use of high-pressure oil to move, or control the movement of, ever-larger loads in ever-smaller time frames and with an ever-higher demand for precision. This trend can only be materialised when the components of a hydraulic system are of high standard, low weight, excellent quality, high precision and are reliable.

The necessity for high precision valves, good quality metals, powerful pumps and compressors is often recognised. However, it is often the case that little or no thought is given to the quality and capability of the hydraulic hoses.

The hoses within a hydraulic system must be accepted as a crucial factor affecting the overall performance and reliability of that system and as such it is

Typical hydraulic applications

important that the selection criteria for a hydraulic hose be known and carefully considered when designing or maintaining a hydraulic system.

Rubber hydraulic hose: selection

Selection of the hose fittings to match the ports to which the hose must be attached is relatively simple but hose selection itself can, however, be far more complex.

A few of the important factors influencing the choice of hose type are:

- System working pressure and possible pressure peaks;
- Environmental temperature;
- Layout of the hose (avoiding sharp edges, restrictive positional clamping, staying within minimal bending radii, etc);
- Temperature of the oil medium;
- Exposure to mechanically destructive influences leading to hose cover wear;
- Weather and ozone resistance.

Oil selection

Until fairly recently, when engineers have designed hydraulic systems, these and other mechanical factors have led the selection process of finding a suitable hydraulic rubber hose. One factor that has gained importance recently however, is the selection of the type of oil.

Over the past few years, the awareness of the need to protect our environment has gained significance both in the minds of the common man but, more importantly, in industry and in politics. What once was a political minority supporting environmental issues is now becoming a majority and as such, the pressure being exerted on industry to produce environmentally friendlier products is increasing.

The industrial trend and mindset that is forming is being followed by the hydraulics industry. While having to match the economical requirements of constantly better output with less and less input, modern engineers also have to take the environmental factor into consideration in their designs. This is further increasing the technical specification of the components of a system.

One of the improvements being seen in the hydraulics market that goes toward implementing environmentally-friendly products is the gradual but consistent move toward the use of biodegradable oils in hydraulic systems.

Mineral oils, the future?

Until recently the hydraulics world's medium has been mineral-based oils – this is changing!

Mineral oils have numerous advantages, from their chemical compatibility with the seals, filters and rubber hoses in a hydraulic system to their worldwide availability. They all, however, share one common property; they are not environmentally friendly and as such cannot be broken down by the environment. Biodegradable oils on the other hand are based on plant extracts that can be broken down over a relatively short period of time and therefore present less of a problem to the environment should they leak or spill from a system.

In applications such as forestry, farming, lawn care or local municipal vehicles where leaks or spillages could be catastrophic to the environment, to say nothing of the financial consequences involved, biodegradable oils are gaining popularity. To further promote the use of biodegradable oils, many national and provincial regulations are being passed requiring equipment used within urban areas to use biodegradable oils.

Table 1: Parker ECO-DESIGN hose range

Parker hose type	Hose construction	Fulfils or exceeds industry specifications
481	One-wire braided EN853-1SN	DIN 20022-1SN/EN853-1SN/ISO1436/I
381	Two-wire braided EN853-2SN	DIN 20022-2SN/EN853-2SN/ISO1436/II
492	One-wire braided EN857-2SC compact	EN 857 1SC
462	Two-wire braided EN857-2SC compact	EN 857 2SC
372	Three-wire braided compact	Meets requirements of EN856-4SP
702	Four-layer multispiral EN 856-4SP	DIN 20023-4SP/EN 856-4SP
732	Four-layer multispiral EN 856-4SH	DIN 20023-4SH/EN 856-4SH
772	Four-layer multispiral	SAE 100R12
782	Four/Six-layer multispiral	SAE 100R13
792	Six-layer multispiral	SAE 100R15

Eco-design hoses

Biodegradable oil types

There are two main categories into which biodegradable oils can be placed; vegetable-based oils and synthetic ester-based oils.

Vegetable-based oils are mainly used in applications where no large temperature extremes are encountered. The oils tend to cook at high temperatures, creating a tar-like substance, and break down at high pressures, releasing acids into the hydraulic system. They also tend to form a thick gel at low temperatures, increasing the wear in the system during start up.

Synthetic esters perform better at low and high temperatures than vegetable-based oils, but when heated above a critical temperature (normally around 100°C), can be absorbed by hose linings, causing the linings to swell and reduce the inside diameter of the hose.

Biodegradable oil selection and respective implications

The exact type, location and parameters of the hydraulic system determine the type of oil required.

An example that clearly describes this issue is the hydraulic system of small construction equipment. In order to pack more power into this compact equipment, the hydraulic systems often run with higher operating pressures and smaller oil coolers than systems on their bigger brothers. The system's requirements have led to the selection of a synthetic ester-based oil, since the vegetable-based oils would coagulate and break down too quickly, causing blockages and the need for expensive maintenance.

Economically sound to use

Aside of the pure environmental aspects involved in the use of biodegradable oils, two other major advantages should be mentioned that could influence the decision to change to using these oil types:

- Longer service life between oil changes. With some modern oils, tests have proven the ageing of the biodegradable oil to be so negligible that the service life between changes is increased. Not only ecologically, but also economically sound;
- Many governments are offering incentives to promote the use of biodegradable oils, which can balance out the extra cost of the biodegradable oil and the necessary system changes.

Using biodegradable oil has a massive effect on the selection of the filters, seals and hoses within a hydraulic system.

The differences in the properties of the two types of oil – bio and mineral – present important selection criteria for

The complete range of products

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the components of a hydraulic system. As biodegradable oil is generally more aggressive towards rubber components, the entire hydraulic system must be considered before simply changing to biodegradable oil.

Which hose quality to select?

Hydraulic hoses or rubber seals made of standard compounds such as NBR/SBR show good resistance to mineral oils but they do not show the same level of resistance to biodegradable oils. The use of bio-oils can cause swelling of the rubber, reducing the inside diameter of the hose, or the rubbers can become so porous that rubber particles are released into the oil, which when not trapped in the filters, can lead to costly repairs of valves or cylinders.

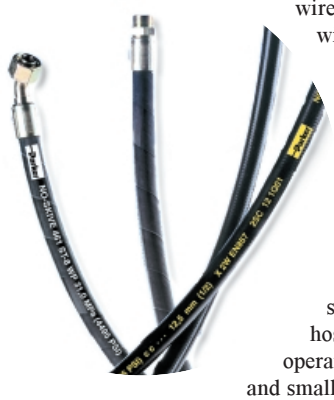
In order to solve these potential problems, Parker Hannifin's Hose Products Division offer a complete range of hydraulic rubber hoses with pressureresistant pure nitrile (NBR) inner tubes – the Eco-Design hose line. These hoses offer excellent biodegradable oil compatibility up to 100°C, while further improving compatibility with standard mineral oils.

The Eco-Design hose line covers the full range of hoses from the one-wire DIN/SAE hose up to the six-layer SAE100R15 multispiral hose. The latest addition to complete the Eco-Design hose range for the European market is the addition of the 1SC, 2SC and three-wire braided compact hoses. Table 1 shows the full range of hoses available.

Compact hydraulic hoses

The market has been generally been traditional in its selection of hose types.

One- and two-layer construction SAE and DIN hoses are usually wire-braided products, with specifications dating back over 40 years with very little change up to the present day.



New technology in hydraulic hose development has allowed progress from DIN and SAE standards towards hoses that are able to operate at higher pressures and smaller bend radii but which also exhibit excellent ozone and abrasion wear properties. This new generation of hose is Parker's No-Skive Compact Hose range. (Hoses meet or exceed the EN specification EN857.)

Due to the thin rubber walls associated with the construction of a compact hose and the disadvantageous compression and elastomeric properties of NBR, the successful introduction of a pure NBR hose inner tube was only possible after intensive development. This development has paid off with the completion of the compact hose range with products that match the growing hydraulic trend.

Connection hose – hose fitting

The hose itself is not the only important factor that determines the lifespan of a hydraulic rubber hose assembly in the field, no matter what sort of oil is in the system. The hose-to-hose connection fitting is vital.

There are two main methods to connect hose fittings to hydraulic rubber hoses; using a crimp fitting or a screw reusable fitting.

This article concentrates on the crimped fitting, as it is by far the most popular and widely used of these two methods. A crimp fitting achieves two things:

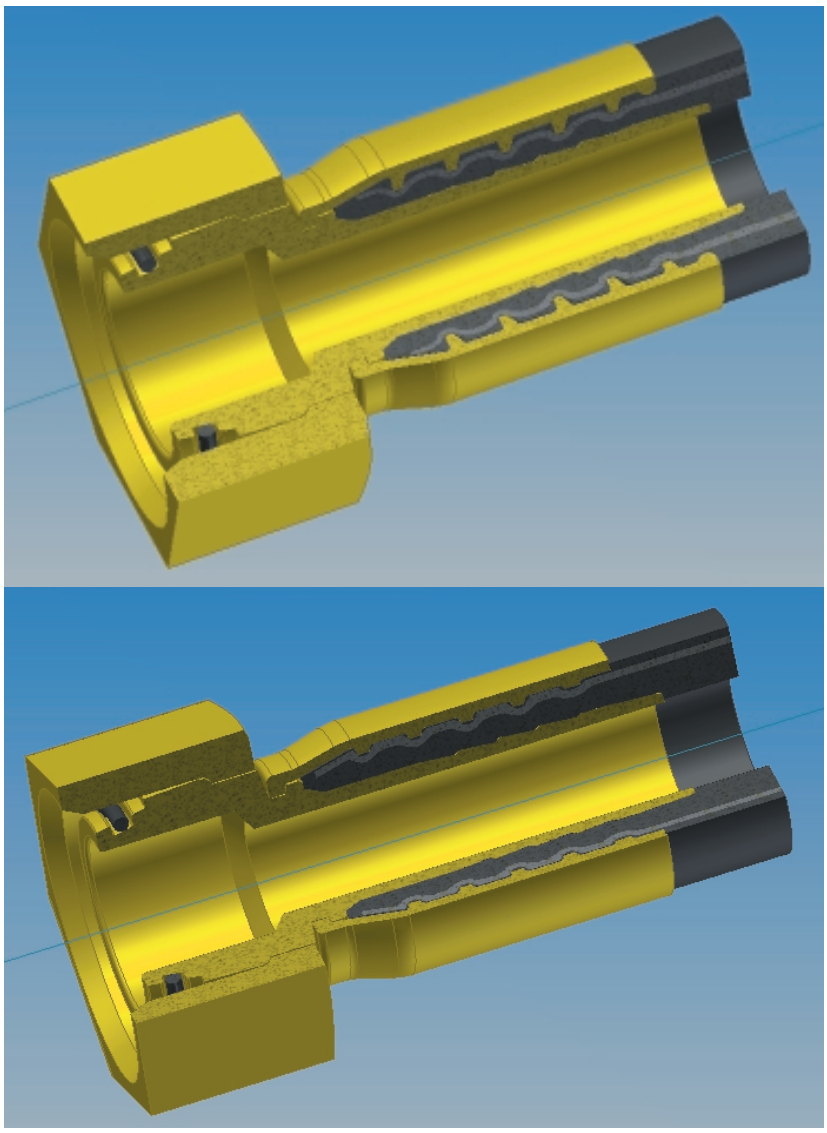
- First, it connects the shell and nipple with their matching contours, leaving some space behind the nut for swivelling and easier mounting;
- Second, it creates compression forces between the shell and nipple to seal and fix the hose. The pressing forces needed to generate a sufficient compression can be as large as 180 tonnes on 2 inch hoses. Consequently, highquality equipment has to be used to guarantee precision.

No-Skive fittings

Standard crimp fittings require skiving. This means that the cover of the hose has to be removed in order to guarantee the metal-to-metal grip necessary to withstand the forces incurred by high operating pressures. The process of skiving must be accurate due to the possible danger of damaging the wire-braided layer. Most skive-type fittings are produced in two pieces, with the nipple having to be pushed into the hose after the shell is positioned. Skive-type fittings require adjustable crimpers.

The standard crimp fitting, if used with larger sizes of multispiral hose, often requires additional internal skiving. In this case the shell and nipple are extended in length, leaving space to form a matching crimparea. The end of the hose is completely rubber-free and is clamped under full metal contact. Assemblies of this type require the highest precision and should only be made by specialists.

The major problem with skive-type fittings arises from the manufacturing tolerances of the assembled components. If the tolerances on nipple diameter, wall thickness of hose and wall thickness of the shells are all high, the assembly will



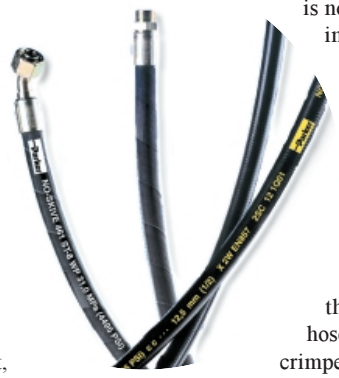
Hose fittings – Skive ((above)and No-Skive (top)

fail due to overcrimp. This problem is exaggerated when the components are all from different manufacturers.

Because of the thickwalled construction of the shell, a standard crimp fitting is not forgiving. Components produced at the lower end of the accepted tolerance-band can lead to blow-off and leakages. Professional assemblers check the degree of nipple collapse with two-piece skive fittings to confirm a successful joint, but this is successful only if it is done as a 100% check. Measuring nipple collapse on elbows is difficult.

Parker No-Skive fittings

Parker Hannifin offers No-Skive fittings as a part of its package that consists of quality hose, No-Skive fittings, hose crimpers and tooling.



Much easier handling and a high level of safety are available with the No-Skive crimp fitting. Using this fitting, skiving of the hose, including six-layer multispiral hose types, is not required. Due to the internal profile, the shell is of a lightweight construction with a thinner wall than the skive-type shell. The advanced design of the No-Skive shell consists of a number of internal ribs that are designed to cut through the cover of the hose when the shell is crimped.

Accepting the slightly higher manufacturing costs resulting from the sophisticated shell design, the package guarantees much easier handling, with no specific skills being required for hose assembly. The performance of an assembly is guaranteed when the crimp diameter is within the tolerances defined by Parker specifications.

This can easily be checked from the outside of the shell.

In order to make the No-Skive fitting concept work, the tolerances on both fitting and hose are controlled closely and the dimensions are restricted to within a narrower band than that generally given by the accepted DIN and SAE standards. Parker No-Skive means:

- Assembly of No-Skive hose and fittings does not require removal of the outer cover of the hose. It eliminates premature hose failure caused by skiving too long or short;
- Use of No-Skive hose and fittings keeps the outer cover intact, protecting the vulnerable wire braided layer during fitting assembly;
- Cushioned grip increases hose life for the user – the supporting cushion of compressed rubber between the gripping teeth on the fitting reduces wire movement, thus minimising stress;
- Corrosion protection – the steel wire braid of No-Skive hose is never exposed since the outer rubber cover is not removed before assembly;
- No-Skive fittings are designed to allow the shell teeth to bite down to the wire to give a metal-to-metal grip. The fitting teeth grip the wire for maximum retention;
- Keeping the cover in place provides better protection against corrosion and the No-Skive crimp assembly gives a perfect seal. Where stainless steel fittings are being used, the importance of leaving the wire braid protected by the rubber outer layer is imperative. Removal of this would contradict the advantage gained through the stainless steel fittings – a rust-proof hose assembly.

Leak-free systems

Whether with mineral oil or environmentally conscious biodegradable oils, there is an everincreasing demand for leak-free systems, which has driven fitting design towards soft seal configurations. It is now possible to guarantee leak-free systems by providing hose fittings and adapters as compatible components with connectors and hoses that have been tried and tested together under the most severe conditions (pressure, flexing, impulsing and abrasion tests, etc). Parker Hannifin offers guaranteed leak-free solutions with its Fluid Connector Group range and a worldwide three-year warranty on request.