Mitigating risks in hydraulic hose applications

Eaton Aeroquip® Dynamax EC881 two braided hydraulic hose article

Ensure the risks are addressed or face potential hose failure

In this article,
Dimitar Atanasov
of Eaton Hydraulics looks at some common causes of hose failure and offers practical advice on how to mitigate against.

Introduction:

Just as the human body contains veins for transporting blood to vital organs, many mobile machines contain hydraulic hoses that deliver vital fluid to system components to ensure efficient machine operation. The hydraulic hose is a critical component, if it fails then the whole system can come to a grinding halt. The service life of the hose can be severely impacted by the environment that the machine operates in and globally you will find mobile machines working in some very hostile conditions.

For operators the number one priority is to ensure that equipment is utilised to deliver productivity, and to ensure the system stays functional. Continuous uptime is extremely critical, since unscheduled downtime can result in huge operating losses being incurred. What's more studies show that 31 percent of hose failure are what is called 'inside out' primarily due to aging.

Take for example mining, a typical hydraulic hose assembly in a mining application lasts anywhere between 3000 to 6000 hours (typically one to two years). Following this stated service time, the inner tube becomes brittle and loses its original rubber form. This means for operators that they have to be on top of their maintenance schedules. However, OEMs within this field should be looking at incorporating hoses that offer more in terms of reliability. Customers are demanding that manufacturers evolve the design and manufacture of hydraulic hoses in response to changing market forces.

Consider the Impulse cycles:

At some point in a mobile machines operational life, system components will degrade and eventually wear out. With a preventative maintenance schedule, downtime can be mitigated for and system component life times, which can be extended to maintain operational capabilities. However, despite such a programme hoses will need to be replaced as their lifetimes are not infinite. When it comes to hydraulic hoses the qualification of expected service life usually follows impulse cycle testing to established industry standards. Standard EN857 Type 2SC hoses are qualified up to 200,000 impulse cycles and whilst this is significant, hose manufacturers should be actively looking to offer hoses that extend this significantly. It's not uncommon at Eaton for our engineers to be working on hose lifetimes that significantly enhance performance. Indeed, Eaton's EC881 hose has a specified impulse life of one million cycles, achieved through next generation inner tubes that offer extreme protection and reinforcement. For OEM's this enables them to gain competitive advantage by offering their customers longevity on machines, and for operators one million cycle hoses deliver extended uptime and operational efficiencies.

Consider the bend radius:

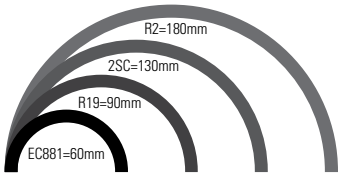
When it comes to specifying the hydraulic hoses that are needed on a mobile machine, the minimum bend radius is an important factor. If the hose does not have the required bend

EATON
Powering Business Worldwide

radius it could become unduly stressed or distorted thereby shortening the service life. We are increasingly dealing with customers who are designing mobile machines to be more compact, indeed the market trend is pushing for this. As these machines get smaller there is a need for systems components to be more compact in order to be installed in less available space.

Standard EN857 Type 2SC hoses are proving to be unsuitable in this new environment as they have to travel a greater distance in order to be routed around the spaces where they simply won't fit due to restrictive bend. For the OEM this means that the amount of hose needed for the work around is greater - this increases build cost as a greater quantity of hose is required. This extra cost has to be passed on to the end customer and the price of the machines may well rise. Increasing the cost of a capital purchase can prove to be prohibitive.

If more hose is required then the weight of the machine will increase, this is a key factor that directly correlates to operating costs. Many industries across the world are looking to 'lighten' machines in order to improve efficiency. The equation is quite simple – the greater the weight of the machine - the harder the internal combustion engine has to work - the harder the engine has to work - the harder the engine has to work the greater the fuel needed - the more fuel needed the higher the operating costs will be. It's obvious that more weight is not acceptable. Standard hoses that can cope with high pressures need more levels of reinforcement and when more levels are added, hoses become stiff with a large bend radius. Our engineers are constantly looking to respond to this challenge and the latest evolution namely the two wire Dynamax EC881 has been designed to offer a 50% better bending radius (1/3 SAE 100R2 bend radius at 100°C).



Consider the pressure:

Here at Eaton we have seen a market need over the last few years for increased operating pressures. This is mostly aligned with the OEM trend to offer compact machines, but with the same power and operating capabilities of their larger equivalents. During discussions with OEM customers they are increasingly telling us that their order books are changing to reflect huge growth in compact machines.

However, for OEMs this mean that they are actively seeking components that can cope with the higher pressures. Typically standard EN857 Type 2SC size 8 hoses are qualified for working pressures up to 275 bar, this means that they are not ideal for deployment on higher pressure compact mobile machine applications, underspecified hoses are a severe risk to machine uptime and indeed operator safety. The solution has been to specify four spiral hoses that offer more reinforcement, however they are less flexible, which is a problem with compact machines due to smaller installation space, and as stated above more hoses are needed to route around, which means more cost. The solution here is to work with a manufacturer who is evolving hose technology to cope with the higher pressure demand. In response to customer demand we are releasing two wire braided hoses (more flexibility) such as EC881 that are qualified up to 360 bars. Essentially, we have responded to the changing market dynamics and have worked closely with customers to design product that can cope.

Consider and minimise the abrasion risk:

An obvious cause for this is the improper routing of hoses, essentially placing hoses in areas where they can chaff against a surface which has the potential to abrade. It can cause the outside cover of the hose to wear away, thus exposing the hose reinforcement to the outside environment. It then becomes prone to rust, which will eventually penetrate the hose thus causing it to leak. For OEMs it is imperative that the hose path is critically examined in the design phase to ensure the rub risk is minimised. Where this isn't possible isolators should always be used. However, there are instances where abrasion is unavoidable. In this case the best practice should be to specify hoses that feature abrasion resistant covers, such as Dura-Tuff covers. These, if utilised properly, can deliver eight times more protection when compared to synthetic hose covers. The key message here is reroute or respecify hoses that mitigate the risk!

Consider the temperature:

Temperature ratings are a critical factor when it comes to selecting a hose that is right for the job. Hot fluids that are conveyed beyond the recommended temperature limits can have a detrimental effect. Exposure to continuous high temperatures can accelerate aging leading to hoses losing their flexibility, thus accelerating the potential for failure. It is therefore imperative that hoses that can cope with high temperatures are specified. Here at Eaton we would always insist that customers closely examine manufacturer's data to ensure that the correct hose is utilised: specifically look at the stated upper limits. But it's not only the fluid temperature that should be addressed. As machines are utilised all over the world, ambient operating temperatures can vary tremendously. In certain regions day time temperatures can be very hot, therefore the hose specified needs again to be able to withstand the ambient. Essentially it's a twofold approach – specify for both the fluid and ambient temperatures in combination, or risk hose failure. Take for example Eaton's GH681 and the EC881 hoses. Both have been engineered to outperform the current standards and offer capabilities up to 126°C. We should also consider low temperature threats as this also can have risks, that's why both the GH681 and EC881 are specified to -46°C.

Conclusion:

Hydraulic hoses have been utilised in mobile machines for decades and in their traditional form have served the industry well. However, 21st century applications are challenging and demand innovation. OEMs need to challenge their current suppliers to offer hydraulic solutions that will deliver real in application benefits. Ultimately look for an innovative supplier that is focused on continual improvement for the right reasons ie: to improve machine uptime and provide benefits in operating costs.

Eaton
Hydraulics Group Europe
Route de la Longeraie 7
1110 Morges
Switzerland
Tel: +41 (0) 21 811 4600
Fax: +41 (0) 21 811 4601

Eaton
Hydraulics Group USA
14615 Lone Oak Road
Eden Prairie, MN 55344
USA
Tel: 952-937-9800
Fax: 952-294-7722

Powering Business Worldwide

Follow us on social media to get the latest product and support information.