Six Costly Mistakes Most Hydraulics Users Make… And **How YOU Can Avoid Them**!

A special advisory report by Brendan Casey - www.hydraulicsupermarket.com

The information contained in this report could save you or the business you work for a LOT of money.

But before I explain the six mistakes and how to avoid them (there's eight actually), I thought I'd better answer a question that's probably on your mind right now, namely:

Who the hell am I and why should you listen to me?

My name is Brendan Casey and I've spent the better part of 25 years working in and running hydraulic repair shops. In other words, rebuilding hydraulic components. During this time I kept seeing the same pattern repeat itself over and over:

1. Failed hydraulic component comes into shop along with concerned owner who wants to know why it has failed after only a short time in service.

2. Based on what I saw after tear-down, I would explain the cause of failure - and how it could have been prevented.

3. Customer leaves thousands of dollars poorer with repaired component and a hard-learned lesson on hydraulic equipment maintenance.

For as long as there are hydraulic equipment owners, mechanics and maintenance people out there who believe that hydraulic equipment doesn't require any special kind of attention, this vicious circle will continue.

In an effort to bridge the knowledge gap on what needs to be done to get maximum life from hydraulic equipment, I've written several books on the subject, including: The Hydraulic Maintenance Handbook, The Hydraulic Troubleshooting Handbook, The Industrial Hydraulics Handbook and The Mobile Hydraulics Handbook.

I've also written over 100 maintenance-related articles for *Machinery Lubrication* magazine, *Hydraulics & Pneumatics* magazine and the *Fluid Power Journal*. And I've presented technical papers and workshops at international conferences such as Lubrication Excellence, National Conference on Fluid Power and Reliability World.

As you've probably gathered, the maintenance and reliability of hydraulic equipment is a subject I'm passionate about. And one I'm considered by my peers to be a leading authority on. BUT you didn't request this report to read about me.

So here are the six costly mistakes – at least one of which you're probably making right now …

Mistake #1 - Changing the oil.

There are only two conditions that necessitate a hydraulic oil change. And they are: degradation of the base oil or depletion of the additive package. Because there are so many variables that determine the rate at which oil degrades and additives get used up, changing hydraulic oil on hours in service - without any reference to the actual condition of the oil - is like shooting in the dark.

Given the current high price of oil, dumping oil which doesn't need to be changed is the last thing you want to do. And the larger the reservoir the more expensive this mistake. On the other hand, if you continue to operate with the base oil degraded or additives depleted, you compromise the service life of every other component in the hydraulic system. And that's the last thing you want.

As you can see, changing hydraulic oil on a fixed number of hours in service is a bad idea - for all but the smallest of hydraulic systems. And the only way to know when the oil *does* need to be changed is through oil analysis.

Oh, and contamination by particles or water doesn't mandate an oil change either. Both these contaminants can usually be economically removed using offline filtration.

<u>So to avoid mistake #1</u>, don't change hydraulic oil on hours in service. Change the oil when its additives are used up or the base oil is shot. And the only way to know when this point is reached is to do regular oil analysis.

Mistake #2 - Changing the filters.

A similar situation applies to hydraulic filters. If you change them on hours, you're either changing them too early or too late. If you change them early – before all their dirt holding capacity is used up, you're wasting money on unnecessary filter changes. If you change them late – after the filter has gone on bypass, the increase in particles in the oil quietly reduces the service life of every component in the hydraulic system - costing a lot more in the long run.

The solution is to change your filters when **all** their dirt-holding capacity is used up - but before the bypass valve opens. This requires a mechanism to monitor the restriction to flow (pressure drop) across the filter element and alert you when this point is reached. A clogging indicator is the crudest form of this device – and although better than nothing, continuous monitoring of pressure drop across the filter using a differential pressure gauge or transducer is the better solution.

<u>So to avoid mistake #2</u>, don't change hydraulic filters on hours in service. Change the filters when all their dirt holding capacity is used up, but BEFORE they go on bypass. And the only way to know when this point is reached is to monitor the pressure drop across the filter element using a clogging indicator (that works!), or <u>better</u> still, a differential pressure gauge.

Mistake #3 - Running too hot.

There are not too many equipment owners or operators out there who would continue to operate an engine that was overheating. Unfortunately, the same can't be said when the hydraulic system gets too hot. But like an engine, the fastest way to destroy hydraulic components, seals, hoses and the oil itself is high-temperature operation.

But how hot is too hot for a hydraulic system? Well it mainly depends on the viscosity – and viscosity index (rate of change in viscosity with temperature) of the oil used, and the type of hydraulic components in the system.

As the oil's temperature increases its viscosity decreases. And so a hydraulic system is operating too hot when it reaches the temperature at which oil viscosity falls below that required for adequate lubrication.

A vane pump requires a higher minimum viscosity than a piston pump, for example. And this is why the type of hydraulic components used also influences the system's safe maximum operating temperature.

If your hydraulic system contains a vane pump, the minimum viscosity you should be looking to maintain is 25 centistokes (cSt or mm^2/s). For mineral oils with a viscosity index of around 100, this equates to a maximum allowable operating temperature of 35°C if you're using ISO VG22 oil or 65°C for ISO VG68.

Apart from the lubrication issue – the importance of which can't be overstated - operating **temperatures above 82°C damage most seal and hose compounds and accelerate degradation of the oil**. But for the reasons explained above, a hydraulic system can be running too hot well below this temperature.

So to avoid mistake #3, do the little exercise at the end of mistake #4, below. And never let your hydraulic equipment operate above 82°C or the temperature at which viscosity falls to 10 cSt, whichever is the lower of the two (you'll see what I mean in a moment).

Mistake #4 - Using the wrong oil.

The oil is THE most important component of any hydraulic system. Not only is hydraulic oil a lubricant, it's also the means by which power is transferred throughout the hydraulic system. It's this dual role which makes viscosity the most important property of the oil - because **it affects both machine performance and service life**.

Expanding on what I said about *Mistake #3 – Running too hot*, the viscosity of the oil largely determines the maximum and minimum oil temperatures within which the hydraulic system can safely operate. This is sometimes referred to as the temperature operating window (TOW).

If you use oil with a viscosity that's too high for the climate the machine has to operate in, the oil won't flow properly or lubricate adequately during cold start. If you use oil with a viscosity that's too low for the prevailing climate, it won't maintain the required minimum viscosity, and therefore adequate lubrication, on the hottest days of the year.

But that's not the end of it. Within the allowable extremes of viscosity required for adequate lubrication, there's a narrower viscosity band where **power losses are minimized**. If operating oil viscosity is higher than ideal, more power is lost to fluid friction. If operating viscosity is lower than ideal, more power is lost to mechanical friction and internal leakage.

So using the wrong viscosity oil not only results in lubrication damage and premature failure of major components - it also **increases power consumption** (diesel or electricity) – two things you don't want.

And despite what you might think, you won't always get this right by blindly following the machine manufacturer's oil recommendation. It's not the machine manufacturer who needs to sweat about this though – because they aren't the one who's going to pay dearly if the oil selection is wrong.

The only way to be certain is to check your machine's ***actual*** temperature operating window lies within the ***allowable*** temperature operating window – and ideally - within the ***optimum*** temperature operating window for the oil you're using.

So to avoid mistake #4 (and #3), you must define the temperature operating window for the viscosity grade and the viscosity index of the hydraulic oil you're currently using. And then make sure your machine operates within it at all times! The procedure for doing this is a bit involved, which is why I dedicate an entire chapter to explaining it in *The Hydraulic Maintenance Handbook*.

Mistake #5 - Wrong filter locations.

Any filter is a good filter, right? Wrong! There are two hydraulic filter locations that do more harm than good, and can rapidly destroy the very components they were installed to protect.

These to-be-avoided filter locations are the pump inlet, and piston pump and motor case drain lines.

At this point, it wouldn't surprise me if you're shaking your head in disagreement. After all, this flies in the face of conventional wisdom doesn't it? That you have to have a strainer on the pump inlet to protect it from 'trash'.

Well firstly, the pump draws its oil from a dedicated reservoir not a garbage can. Secondly, if you believe it's normal or acceptable for trash to get into the hydraulic tank, then you're probably wasting your time reading this report.

If getting maximum pump life is the primary concern here – and it should be, then it's far more important for the oil to freely and completely fill the pumping chambers during every intake, than it is to protect the pump from nuts, bolts and 9/16" combination spanners – which pose no danger in a properly designed reservoir, where the pump inlet penetration is a least two inches off the bottom.

Research has shown that a restricted intake can reduce the service life of a gear pump by 56%. And it's worse for vane and piston pumps because these designs are less able to withstand the vacuum-induced forces caused by a restricted intake. Hydraulic pumps are NOT designed to 'suck'.

A different set of problems arise from filters installed on the drain lines of piston pumps and motors – but the result is the same as suction strainers – they can reduce service life and cause catastrophic failures in these expensive components.

If these filters are fitted to any of your hydraulic machines and you don't get rid of 'em, there's a very good chance they'll end up costing you serious money.

And if you're still not convinced or are nervous about discarding a filter the machine manufacturer thought was wise to install in the first place, there's no need to take my word for it. Ask the pump or motor manufacturer. And if you do manage to find a hydraulic pump or motor manufacturer who recommends the use of suction strainers and/or conventional depth filters on case drain lines, I'd like to hear about it.

<u>So to avoid mistake #5</u>, check each of your hydraulic machines and if there's a suction strainer on the pump inlet, or a *depth* filter on any piston pump or motor case drain line, remove and discard them – or at the very least, get a second opinion from the pump or machine manufacturer.

Mistake #6 - Believing hydraulic components are self-priming and self-lubricating.

You wouldn't start an engine with no oil in the sump – not knowingly anyway. And yet I've seen what amounts to the same thing happen to a LOT of pricey hydraulic components.

Fact is, if the right steps aren't followed during initial start-up, hydraulic components can be seriously damaged. In some cases they may work OK for a while, but the harm done at start-up dooms them to premature failure.

You'd be amazed at the number of these types of failures which wrongly end up as warranty claims by hydraulic equipment owners. And it's frustrating for everyone concerned – because they're **totally preventable**.

There's two parts to getting this right: **knowing** what to do; and **remembering** to do it. If you don't know what to do that's one thing. However if you do know, but forget to do it, well that's soul destroying. You can't pat yourself on the back for filling the pump housing with clean oil when you forgot to open the intake isolation valve before starting the engine!

This sort of mistake is easily prevented by using a start-up procedure and check list. I don't know about you, but these days I don't like relying too much on memory – not for important stuff anyway. So even after 25+ years working on hydraulic equipment, I would never attempt to commission or re-commission a hydraulic system, without having a piece of paper to remind me of what I need to do and the order I need to do it in. This simple technique eliminates all possibility of error.

So to avoid the consequences of mistake #6, never attempt (or allow anyone else to attempt) to re-start a hydraulic machine after changing components without a written checklist which tells you exactly what to do, and the order in which to do it in. And I can't tell you precisely what that is here. Because to be effective, it must be machine specific. The pre-flight check list for a Boeing 767 is no use at all to a pilot flying an Airbus A380!

Mistake #7 - Assuming the machine manufacturer knows best.

This can be a fatal mistake. After all, if the machine manufacturer always knew best, and assuming you're following the machine's manual to the letter, you wouldn't be making any of the above mistakes, would you?

Mistake #8 – Not getting an education in hydraulics.

As I hope this report has shown, if you own, operate, repair or maintain hydraulic equipment, and you aren't 'clued up' on hydraulics, a lot of money can slip through your fingers – yours or somebody else's.

So keep an eye on your inbox, because in a couple of days time I'm going to share some more hydraulic maintenance tips and insights, which I know you'll find invaluable.

Yours for better hydraulics knowledge,

Brendan Casey

