Tips & Tabs is a free news letter for Private circulation to all our esteemed customers and friends in the industries. Forward it to all those who are involved in machine maintenance, design and interested in technical matters.

Hymat Services

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Your Friendly Partner in:

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Cool, clean and dry: if only it was that easy……

Maintaining your hydraulic oil starts with selecting the right one. Then you can worry about contamination, temperature and water control.

In order to maximize the service life of hydraulic equipment, all you need to do is keep the oil clean, cool and dry. It's an old adage. And a simple one. But like most things hydraulic once you scratch the surface, there's more to it than meets the eye.

Not only that, there's an important first-step missing. It should be: Use the right oil and *then* keep it clean, cool and dry.

Choose the right oil:

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 that makes *viscosity* and *viscosity index* (VI) the most important properties of the oil — because they affect both machine performance and service life. Viscosity is the measurement of a fluid's resistance to flow, whereas viscosity index is a measure of the oil's change in viscosity with change in temperature.

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.

If you use oil with a viscosity that's too high for the climate the machine operates 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 provide 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 an oil with an inappropriate viscosity or VI not only results in lubrication damage and premature failure of major components, it also increases power consumption.

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1. ***L&T (Defense & Aero Space Projects).***
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11. ***Yeoman Marine Services.***
12. ***Time Technoplast.***
13. ***Elley Electricals.***
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15. ***Many Plastic Item Manufacturers(Injection & Blow Molding Machines).***

Over All more than 200 satisfied and repeat Customers.

So how do you know if you're using the right oil? You won't necessarily get this right by simply following the machine manufacturer's oil recommendation. The only way to be certain is to check that a machine's *actual* temperature operating window lies within the allowable temperature operating window and, ideally, within the optimum temperature operating window for the oil. If the machine operates at temperatures outside these numbers, something has to change. And it's likely the oil!

Keep contamination out:

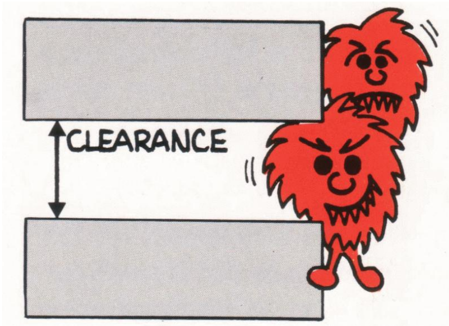

Figure 1. Particles larger than a component's internal clearances are not necessarily dangerous.

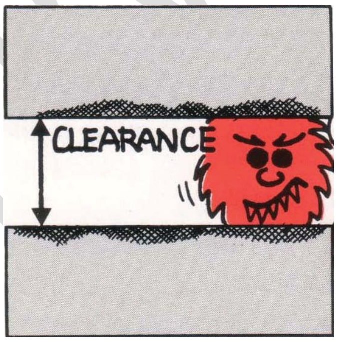

Figure 2. Particles the same size as the internal clearance cause three-body abrasion.

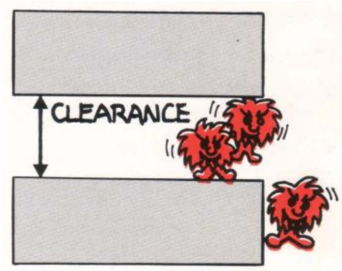

Figure 3. Particles smaller than the internal clearance are the most dangerous in the long run

Type of hydraulic system	Minimum recommended cleanliness level			Minimum recommended filtration level in microns ($\beta_X \geq 100$)
	ISO 4406	NAS 1638	SAE 749	
Silt sensitive	15/13/10	4	1	2
Servo	16/14/11	5	2	3-5
High pressure (250–400 bar)	17/15/12	6	3	5-10
Normal pressure (150-250 bar)	18/16/13	7	4	10-12
Medium pressure (50 -150 bar)	20/18/15	9	6	12-15
Low pressure (< 50 bar)	21/19/16	10	-	15-25
Large clearance	23/21/18	12	-	25-40

Typical oil cleanliness levels for different types of hydraulic systems and minimum level of filtration allowed in hydraulic fluids.

Our Track Record

So far Filtered more than 7,00,000 liters of oil for various applications….

Having established that we're using the right oil, we can now turn our attention to keeping it clean. More accurately, this means controlling particle contamination in the oil to an acceptable level. Particle contamination can be divided into hard particles, such as wear metals and dust, and soft particles, such as oxidation products and sludge. Be aware that soft particles can cause reliability problems — such as valve-spool stiction and filter clogging — even if hard particles are kept within acceptable levels.

Hard particles accelerate wear of hydraulic components. The rate at which damage occurs depends on the internal clearances of the components within the system, the size, shape and quantity of particles present in the oil, and operating pressure.

Particles larger than a component's internal clearances, Figure 1, are not necessarily dangerous — unless they cause interruption of hydrostatic balance, i.e. blockage of balance drillings. Particles the same size as the internal clearance, Figure 2, cause heavy friction and wear through a process known as three-body abrasion.

However, in the long run, the most dangerous particles to a hydraulic system are those that are smaller than the component's internal clearances, Figure 3. If present in sufficient quantities, these silt-sized particles cause erosive wear, leading to degradation failure of hydraulic components over time.

With the above understood, typical oil cleanliness levels for different types of hydraulic systems, and the minimum level of filtration generally required to achieve them, can be selected from the accompanying table, below.
Keep your cool

Keep Oil Cool : With an appropriate oil cleanliness level chosen and maintained, we can move on to keeping the oil cool. As already explained, adequate lubrication of hydraulic components and efficient power transmission both depend on appropriate oil viscosity. If system operating temperature is allowed to exceed that required to maintain viscosity at around 20 cSt, the likelihood that boundary lubrication will occur — resulting in friction and wear — increases dramatically.

The temperature at which this point is reached, depends on the viscosity of the oil used and its viscosity index. In other words, the critical temperature can be relatively low or high, depending on the oil used in the system.

But when it comes to oil, seal and hose life, it is the top-end danger temperature that must be considered. According to Arrhenius's Law, **for every 10°C increase in temperature, the rate of reaction doubles.** The chemical reaction we're concerned with for hydraulic oil life is oxidation — due to the presence of air; and hydrolysis — due the presence of water. So the hotter the oil, the faster the rate of these reactions, and exponentially so.

The elastomers used to make hydraulic seals and hoses are improving all the time. But oil temperatures above 82°C accelerate the degradation of most of these polymers. In fact, **according to seal manufacturer Parker Pradifa, operating temperatures 10°C above recommended limits can reduce seal life by 80% or more.**

Similarly, **according to hose manufacturer Gates Corp., exposing a hydraulic hose to an operating temperature 10°C above its recommended maximum cuts its expected service life by 50%.** Therefore, a single over-temperature event of significant magnitude, can damage all the hoses and seals, crack the oil and result in scuffing and wear of lubricated surfaces.

So **what *is* the operating temperature danger number for hydraulic systems?** To avoid compromising oil, hose and seal life, I always work on a maximum of 85°C (185°F). However, to avoid compromising viscosity, lubrication and efficiency, a much lower temperature may have to be respected; from 85°C (185°F) down to **around 50°C (122°F) or perhaps lower, depending on the grade and VI of oil being used, and by extension, the climatic conditions the machine operates in.** And if you own or are otherwise responsible for the upkeep of hydraulic equipment, you should know what this (lower) number is.

Keep water out: Last but not least, keep the oil dry. Water is a nasty contaminant and can be more damaging to hydraulic system reliability than hard particles. Water reduces lubricating film-strength, which leaves critical surfaces vulnerable to wear and corrosion. It also depletes some additives and reacts with others to form corrosive by-products that attack some metals, and it reduces filterability and clogs filters.

Water can be present in three forms: dissolved (in the oil's molecular structure); free (unstable suspension) and emulsified (stable suspension). Oil becomes cloudy when it is contaminated with water above its saturation level. The saturation level is the amount of water that can dissolve in the oil's molecular chemistry and is typically 200-300 ppm for mineral hydraulic oil.

Many references cite 1000 ppm (0.1%) as an acceptable water concentration for hydraulic oil. But according to bearing manufacturer Timken, with this level of water in the oil, expected bearing life will be only 30% of what it would be if water content was controlled at 100 ppm (0.01%). Even at 500 ppm (0.05%) water, bearing life is less than 50% of what it would be at 100 ppm of water. For this reason, I recommend water concentration is controlled as close as possible to 100 ppm and certainly no higher than the saturation level of the oil at 20°C, which is around 200-300 ppm for mineral hydraulic oil.

In summary, to minimize the MRO costs (Maintain, Repair & Operate) of your hydraulic equipment, make sure you're using the right oil. Then keep it clean, cool and dry. Do these four things correctly and most everything else will take care of itself.

Compiled by Mr. V.S.Dave
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Source : Feb. 7, 2013 By Brendan Casey, HydraulicSupermarket.com | *Hydraulics & Pneumatics. Brendan Casey has more than 20 years experience in the maintenance, repair, and overhaul of mobile and industrial hydraulic equipment.*

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