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Reassuringly expensive

John Coxon visits Millers Oils to find out why its competition lubricants command a premium price

Mention the town of Brighouse in West Yorkshire to anyone familiar with British culture and I imagine the image conjured would be of brass bands and cloth caps. Yet tucked away in the hustle of this north of England town straddling the river Calder, on the site of a former piggery, is a small company supplying world-class specialist engine and transmission oils.

Millers Oils does so in the no-nonsense way one associates with northern folk, as I discovered when I travelled to Brighouse earlier this year. I had come to discuss the subject of engine oils and in particular to pose the question: "Why should I pay £35 (\$50) or more for a specialist competition oil when I can go to my local motor accessory store and get any number of superficially similar products all of which are cheaper?"

As is often the case the answer is in the question and it revolves around the word “specialist”. I got the full explanation from talking to Technical Director, Martyn Mann and his Motorsport Manager, Robin Longdon.

“Millers Oils was established in 1887,” begins Mann, “to supply lubricants to a range of industries, which today includes automotive, industrial and textiles. Today we employ around 80 at the plant here in Brighouse and another 30 or so nationwide. The company is still family owned and we pride ourselves in supplying world class, quality products.

“We are a technology led organisation, not a marketing led one and we work at the high end of the automotive market giving both the professional and the amateur racer the best possible oil for the price.”

Perhaps indicative of the origins of the company, Mann continued to say that last year Millers Oils supplied over four million litres of lubricant to the textile industry and that only 40% of the company's overall business is automotive.

“It was in the 1990s that we saw the potential to use our lubricant expertise to expand into the motorsports sector,” remarks Mann. “We did this under the stewardship of initially, Graham Lord, now Robin Longdon. Since 1999 this sector has grown to around 10% of our total business and it culminated in us winning the ‘Motorsport Company of

the Year’ award at the recent Historic Motorsports Show at Stoneleigh, Warwickshire in February 2006.

“This is a time of increasing pressure on the lubricant supply business with the increasing cost of crude oil, increasing demand for diesel fuel, fires in certain refineries and supply issues in the oil additives business. We see an increasing demand for products specifically designed for motorsport as mainstream automotive lubricants move towards more ‘catalyst friendly’ and fuel economy orientated formulations.”

Perhaps the main reason why competition oils are seemingly expensive relative to some other automotive oils is in the quality of the basestock. Millers Oil supplies full synthetic oil for motorsport applications, using POA/ester blend basestock (see sidebar: Lubricant Basestock).

Although the amount of ester varies according to the particular formulation, Millers uses “more than ten percent” in its CFS (Competition Full Synthetic) blends of motorsport oils. With PAO sourced from the UK and France and esters from UK and Germany, the two provide 70-75% of the overall volume of the finished product, which ensures that the retail cost is “Reassuringly Expensive,” as Mann and Longdon remark in unison.

A motorsport lubricant made purely from a mixture of PAO ▶

LUBRICANT BASESTOCK

In general base oils can be categorised by family type:

- **Mineral oil** – conventional oils derived directly from refining of crude oils
- **Hydrocracked (also referred to as Group III)** – extra highly refined base stocks
- **Polyalphaolefines (PAO, sometimes referred to as Group IV)** – pure synthesized hydrocarbons
- **Esters (Group V)** – manufactured from a reaction between acids and alcohols

While mineral oils are undoubtedly the cheapest type to manufacture, they can have serious limitations for motorsport use. Poor thermal stability resulting in a loss of viscosity and high oxidation degradation as well as low film strength are surely good enough reasons to steer away from these types of oils for competition use.

Hydrocracked products fall somewhere between the mineral and PAO/Esters in terms of both price and performance. Still having some light and volatile components, as well as a degree of wax (causing thickening at sub zero temperatures), they contain a wide range of chemical types. Frequently referred to, confusingly, as ‘synthetic’, they are not to be confused with true synthetic lubricants. The latter, more correctly labelled ‘full synthetic’ lubricants are oils made from Groups IV and V products.

Full synthetic PAO basestock oils on the other hand are generally highly paraffinic (of the generic formula $C_n H_{(2n+2)}$) and have a high resistance to oxidation and very high viscosity indices (the viscosity changes less with temperature). This makes them much better suited to motorsport applications.

These PAO basestock oils also have lower volatility – which reduce oil consumption – and a higher film strength, which gives them a load bearing capacity less than six-times that of an equivalent mineral oil although Millers Oils’ Martyn Mann is prepared to admit, “that does depend on the test procedure”.

Perhaps even more important is that they don’t ‘shear down’ easily maintaining full film strength in the bearings and the cam/tappet interface.

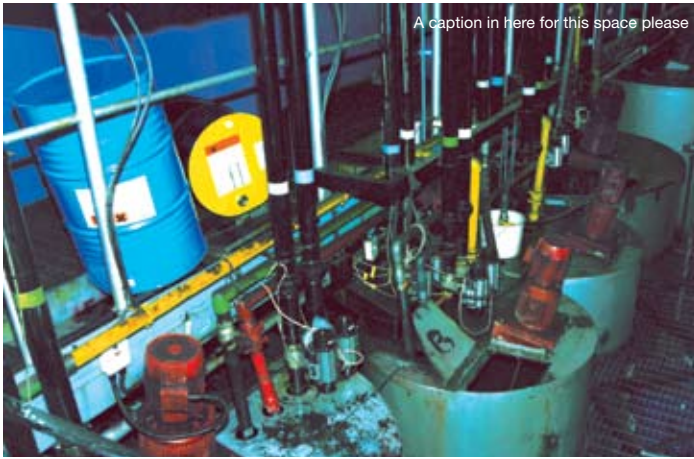
While mineral oils will be the cheapest to manufacture, Group 4 PAO basestock is around five times more expensive and in very short supply.

Alongside these, the other constituent of the full synthetic oil will be a blend of carefully selected esters. Esters are not derived from crude oil unlike many other base oils. Formed from a reaction between acids and alcohols they are used widely in gas turbine aircraft engines. Although on the whole generally unsuited to engine lubricant applications, selected products (for example carboxylic acid esters) can be synthesized to give unique characteristics.

Esters have what is known as a ‘synergistic’ response and in a balanced blend with PAO, provide extra load bearing capacity. A definite case of the whole (that is the blend) being greater than the sum of the parts. In so doing, this enables the amount of polymer or viscosity modifier (VM) to be reduced. The practical result to this will be reduced wear on highly loaded bearings, cams and so forth.

The high molecular polarity of esters when combined with PAO can also enhance the ability of the engine lubricant to soften or dissolve engine deposits improving internal engine cleanliness. Finally the seal swell characteristics of the ester can be used to counteract the propensity of PAO products to attack and harden elastomers in the engine.

Early full synthetic PAO/ester blends often introduced crankshaft oil seal leaks after a short period of use following an oil change. Replacing a mineral oil with one of these new oils caused the crankshaft oil seals, which had swollen as a result of chemical action from the Group I product, to shrink and harden through an inadequate balance of PAO and ester. Increasing the amount of ester and re-balancing the formulation quickly solved the issues and although anecdotal stories still abound, full synthetic lubricant formulations no longer have sealing issues.



and esters would have very good oxidative stability but would not have the viscometric capabilities demanded by modern engines. You could either select the products to satisfy the viscosity requirements of the engine when hot, suffering the consequences of poor cold flow, or formulate to the cold engine condition and risk possible bearing damage when hot. Fortunately technology invented in the early sixties produced the idea of the viscosity index improver (now more commonly known as VM, Viscosity Modifiers or just 'Polymers') and with it the concept of multigrade oils.

Robin Longdon takes up the story. "The objective with race engines is to maximize protection, with the minimum loss of power. To achieve this we set out to reduce the amount of polymer in the lubricant.

"Polymers are long molecular chains, which when added to an oil give it multigrade capability. They coil up like a spring when cold but gradually open out as the temperature increases, taking up more space and increasing (or maintaining) the oil pressure. However, these molecules don't like the high 'shear' forces found in journal bearings, in the cam and tappet interface and between the gear teeth in a transmission application. In these areas of high shear these long molecules are chopped up reducing both the oil pressure and the life of the oil.

"It follows that a 10W60 oil will contain more polymer than a 10W40 in order to give the wider viscosity range. However, in order to reduce



this shearing effect on the oil, we use very high viscosity index base oils and we minimize the addition of VM in all our competition oils. In this way our lubricant is much more likely to stay in grade for longer."

Longdon goes on to emphasize something that is often misunderstood by many: that high oil pressure in an engine is not necessarily a good thing. The oil pump is absorbing power in trying to push the oil through a small hole whereas the actual requirement is to have just enough pressure to maintain a continuous flow of oil to the surfaces being lubricated and in particular to overcome centrifugal forces in the crankshaft. It is this minimal continuous flow of oil that separates the metal surfaces reducing both wear and power absorbed.

"By using only the most advanced chemicals and having direct contact with our customers, Millers Oils can offer superior products and service to the amateur or professional racer alike. Where the bigger oil companies will only respond to the influences of Formula One or factory teams, a specialist company such as ours can react quickly to the demands of its customers introducing new additive technology if necessary, as soon as it becomes available."

With the basestock blend and VM taking up around 85% of the oil volume, the remaining 15% or so is down to the 'additive pack.' This is the cocktail of chemicals that is designed to enhance the properties of the oil under certain circumstances. Generally it will include things like anti-wear additives, detergents/dispersants, corrosion inhibitors and friction modifiers, to name but a few. As befits the demands of a race engine, Millers includes its standard high quality "DI" (Detergent – Inhibitor) package, which includes detergents/dispersants, a corrosion inhibitor and an anti-wear package sourced from the traditional suppliers in this technology.

Over to Robin Longdon again.

"Road car lubricants are not necessarily suitable for race cars. Road car lubricants are now being designed with two criteria in mind, which have no bearing on their use in motorsport: exhaust emissions and fuel economy. The introduction of engine exhaust catalysts and government legislation on fuel economy, have dictated that certain substances



RUNNING-IN OILS

At one time oils for running-in an engine were readily available. A requirement of the engine manufacturer, they were introduced on the road engine build line and replaced after the first 500 miles or so, at the vehicle's first service. Today of course, with pressures on cost-of-ownership, this first vehicle short service has, in all but exceptional cases been consigned to the history books. Road car engines are today filled with factory fill specifications designed to survive to the first major service interval, often 15,000 miles or more.

In the competition world, however, there is still a very real need for the continued use of running-in oils. Modern oils are so very good in reducing wear that if placed in a 'green' (new) engine, the process of bedding-in the critical areas of rings and cams can take many thousands of miles to achieve peak performance. In the case of a competition engine and in particular an older, rebuilt unit, it is therefore desirable not to use the best oils initially. It is preferable to use a slightly lesser quality multigrade basestock product with a similar detergent/dispersant treat rate but a lower level of anti-wear additives. Used for a maximum of 500 miles on the road or on the dynamometer for break-in and test these running-in oils encourage rapid bedding in the critical areas before draining and filling with a full synthetic blend.

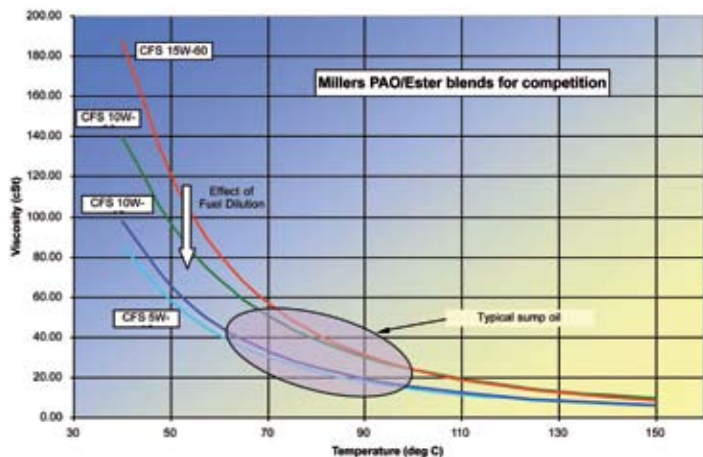


Figure 1: Effect of fuel dilution

need to be controlled. Limitations on compounds containing sulphur and phosphorus, generally considered to be damaging to catalysts, are gradually being brought in. Unfortunately zinc dialkyldithiophosphate, containing both sulphur and phosphorus, is a very good and inexpensive anti-wear agent but it is now steadily being replaced in road car engine oils.

“In the United States, Corporate Average Fuel Economy (CAFE) regulations essentially require engine oils to shear down to combat inevitable thickening due to oxidation. For a race car lubricant maximum performance and maximum wear resistance at high engine loads are the main design factors and so formulations do not need to be compromised by emissions or CAFE fuel economy regulations.”

A good example of where a small company can innovate where others might find it difficult is in the development of unusual grades. The 15W60 from Millers Oils is a perfect example of this. It was developed specifically for the increasing number of 12-24 hour endurance races. In addition to the shearing effect on oils, another of the biggest enemies is fuel dilution of the crankcase oil. Whereas a road car under normal circumstances will see a contamination of 1% or so fuel, a race engine running at wide open throttle for long periods can typically see over 10% after only a few hours racing!

“This has the effect,” says Longdon, “of reducing the viscosity to that of a 15W40 or even less.”

A quick look at Figure One shows this in more detail. The natural conclusion to all this for the average club racer is although it is not necessary to change the oil filter after every race meeting, changing the oil should be very high on your list of preparation for the next event.

“At the other end of the viscosity scale is our CFS 5W40”, continues Longdon. “This is suitable for smaller power units or shorter race distances where the benefit of the 15W is not required.”

Further innovation of late is the introduction by Millers Oils of its ZFS 10W40 (the Z denotes karts or motorcycles) full synthetic oil for motorcycle-engined cars with a wet clutch. This shows how the company is in tune with modern motorsport at the grass roots level. In such applications the oil has to protect the engine and the gearbox but not interfere with the performance of the multiplate clutch surfaces.

While extreme pressure additives (EP) are included to reduce wear in the gear teeth, anything that operates as a friction modifier (reducing the level of friction on a surface), would have a detrimental effect on

THE MILLERS OILS FILE

PRODUCTS

Engine and transmission lubricants with specialist motorsport product range

RACING MARKET

All forms of racing from karting to Top Fuel

HEADQUARTERS

Brighouse, West Yorkshire, England

KEY PEOPLE

Managing Director: Robert Miller

Personnel Director: Sarah Miller

Finance Director: Nevil Hall

Sales/Marketing Director: Steve Woolven

Technical Director: Martyn Mann

Motorsport Manager: Robin Longdon

Motorsport Consultant: Graham Lord

SCALE OF OPERATION

110 employees. Competition is around 10% of business

BACKGROUND

Miller family-owned company since established in Brighouse in 1887. Involved in motorsport since Graham Lord joined as Technical Director in 1990 (a post from which he has now retired)

GLOBAL DISTRIBUTION

Distributors in a number of European countries and Australia. Elite transmission distributes its gear oils to the West Coast racing community through its Los Angeles base

the clutch performance. Since esters (a constituent of car engine full synthetic formulations – see sidebar) have this friction reducing effect it is consequently imperative that they are not be used in motorcycle wet clutch applications. The PAO tendency to shrink the oil seals is therefore counterbalanced by the addition of a small amount of Group III product. Proven in motorcycle-engined vehicles (such as Radicals) where larger tyre footprints cause higher clutch shock loads, this innovative lube shows more resistance to clutch slip.

In my opinion, however, the best reason to use such high quality product is in having direct access to the Millers Oils technical advisory service where immediate help is often available over the telephone. The company also has a fully equipped analysis laboratory, which is designed not only to support its internal quality assurance system but also to provide its MillerCare Oil Analysis System for the testing of oils in service.

With a range of equipment, which includes viscometers and a rather useful 19 element ICP analysis machine (which can tell you more about the mechanical state of your engine than you would probably care to know), engine faults can often be diagnosed long before the problem manifests itself.

Above all Martyn and Robin are enthusiasts themselves. Mann is a former karter while Longdon is currently a competitor in historic racing. If they don't know what you, their customer is looking for, I cannot imagine who does!

Perhaps the last word I should leave to Mann. “At Millers Oils, we pride ourselves on providing lubricants which provide maximum performance along with maximum life. This in turn leads to reduced rebuild costs and a happy customer”

Says it all in my opinion. ■