COMMENTS ON AN IMPORTANT MESSAGE FROM THE HEALEY "LISTERS" RE: MODERN FORMULATED OILS (see The Resonator, December 2006)

PERSPECTIVE ON COMMON ADDITIVES

To achieve an informed understanding of the importance of ZDDP (zinc dialkyl dithio phosphate) one should appreciate the role of some common doping agents added to mineral oils. Such agents are designed to improve the properties of the base oil in a particular direction: increase in the adhesive properties and the ability to withstand pressure, reduce temperature dependence of viscosity, improve aging stability and anti- redeposition power.

VI improvers (Ref. 1): Oils are classified by such institutions as the Society of Automotive Engineers (SAE) according to their viscosities. It is a characteristic of oil viscosity to decrease with rising temperature and in doing so the oil becomes less able to withstand pressure. Multigrade oils are designed to cover more than one SAE viscosity number and their short designations are made up from the designations of two viscosity numbers, the requirement of which are met with respect to dynamic viscosity at -17.8 deg.C and a kinematic viscosity at +98.9 deg.C. For example, an SAE 10W30 oil features a viscosity number of an SAE 10 oil at -17.8 deg.C, and one of a SAE 30 oil at +98.9deg.C Thus, the SAE 10W30 oil is designed to withstand higher pressures at elevated temperature than the SAE 10 oil.

Dispersants (Ref.2): In most oil formulations, the additives present in the highest concentrations are dispersants (between 3 and 6% by weight range). They are designed to hold in suspension sludge and other contaminants such as soot or dirt, until they can be filtered out or removed through an oil change.

Detergents (Ref.2): The next common additive is the detergent (from 2 to 3%, typically). Detergents are used primarily to neutralize acids formed by the combustion of impurities found in the fuel and that enter the oil during use.

Anti-oxidants (Ref.2): These are used to control the oxidation of the base oil and other additives during the oil's service life. They are present in fairly low concentrations (typically 1%, or less).

ZDDP (anti-wear with anti-oxidant and anti-corrosion properties) (Ref.3): To date this has been the dominant anti- wear agent, present in most machine and motor oil in amounts of about 1%. As an after market additive the percentage of ZDDP ranges from approximately 2 - 15%.

PERSPECTIVE ON HOW ZDDP WORKS (Ref.4)

ZDDP motor oil additive decomposes under engine conditions to form protective zinc phosphate (ZP) films. The decomposition occurs through oxidation at high temperature and results in removable alkyl groups and sulphur atoms, and the generation of long linear ZP molecules composed of Zn, P and O. These decomposition products transform then into ZP films at

elevated temperature and collect across the metal surfaces as evenly distributed films. The role of phosphorus is limited to affecting only the basic structural and mechanical properties of the film. Under rubbing conditions the ZP films are rapidly transformed into anti-wear film as follows.

As surfaces slide one relative to another under pressure, the pressure induces the formation of cross-links through the zinc atoms of the ZP system. Cross-linking transforms a viscoelastic fluid of loosely interacting linear ZP molecules into a fully connected chemical network with extended bonding in all three spatial directions from the zinc atoms, i.e. a very stiff 3-D structure. But this formation occurred only when the pressure level rises to about 80% of the underlying iron surface yield strength. Of course these high pressures are attained only momentarily during collision at the tops of the asperities during sliding contact. These collisions are of very short duration and create a local time-dependent pressure field with peaks well in excess of mean values. Such pressure pulses are sufficiently fast to cause the relevant chemical processes to compress the film, yet prevent the flow from leaking out of the contact area. During the pressure rise the greatest degree of cross-linking is induced among zinc atoms, and a much stiffer (harder) film results. Away from such high pressures the system remains in a weaker state.

The much strengthened film improves its capacity to accommodate and redistribute applied loads to which an underlying surface is exposed. This, depending on the hardness of the substrate, reduces wear. Additionally, the film prevents it from abrading the surface. Thus, the mechanical properties of the AW film play an important role in wear inhibition.

ZDDP is a family of zinc salts of dithio organophosphates and easily dissolves in mineral and synthetic lubricant oils. It does deplete early in the oil's life cycle; but, several intermediate thermal and oxidative decomposition by-products are formed that exhibit the original anti-wear and anti-oxidant properties of the original additive.

PERSPECTIVE ON WHAT TO DO

Those of us who have visited Bud Krueger's web site at www.ttalk.info and consulted the said ZDDP link and some of the associated references are now wondering what motor oil to use during our next oil change.

Because zinc and phosphorus emissions damage catalytic converters the amount of ZDDP in volume-manufactured motor oils has been minimized, if not eliminated (Ref.6). Zinc-free alternatives are being substituted, but so far do not present nearly the same measure of anti-wear protection. After market ZDDP products find useful application in older engines functioning with increased clearances and/or for "bedding in" procedures involving sliding surface replacements.

At present only a small fraction of the N.American car population use Diesel power and are not subject to the same emission standards imposed on spark ignition engines. Consequently, Diesel lubricating oils still include many additives such as ZDDP; but, this picture is changing rapidly: new fuel economy measures soon to be imposed on all modes of transportation - such as reducing N.American fuel dependency by 20% in 10 years time - will soon increase the sales of

Diesel powered cars. These will then be required to meet new emission caps. Choosing a Diesel-rated motor oil (which still contains ZDDP additives) for use in our Healeys is therefore only a stop-gap solution. Selecting a niche market motor oil formulated to contain adequate concentrations of ZDDP, such as Valvoline VR1 or an after market engine oil supplement containing ZDDP, such as General Motors(Chevrolet) EOS (in Canada: ACDelco EOS Part # 992869, available at any GM dealership parts department) as suggested in Ref. 6, seems to be a more appropriate choice. But do consult Bud Krueger's web site and its links, particularly "ZDDP", and then form your own opinion.

References Used

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5. Important Message from the Healey "Listers" Re: Modern formulated oils, The Resonator, Dec. 2006
6. Http://www,ttalk.info/Zddp.htm

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