

# TECH LINE *Coatings*

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## ANEALON

Anealon was developed from aerospace programs originally associated with NASA. The technology at that time was not developed in such a way as to apply to greases, pastes or liquid coatings. Over the last 17 years experimentation carried on at Tech Line led to the key elements needed to utilizing the technology in these forms, being established.

Anealon is a surface modification method that creates an extremely thin, self lubricating, ceramic film on any substrate that can handle the temperature and pressure needed to form the film, during part operation. This film forming process has the ability to be produced in a number of viscosities and formulations. Depending on application method, temperatures likely to be encountered, the ability to re-supply the material, environmental concerns, the pressures to be encountered, the material can be altered to meet specific needs.

One of the major advantages of Anealon is its ability to lubricate at temperatures and pressures well beyond the abilities of existing dry and liquid lubricants and greases to handle. Anealon can be formulated to provide lubrication at temperatures approaching 3000F. Most common lubricants will “burn” off at temperatures approaching 700F. At this point lubrication depends on being able to constantly re-supply such lubricants during the time period of greatest load. Unfortunately in many cases re-supply is not possible during the event. When any lubricating film fails on a metal surface, micro welding is likely to occur. Micro welding is caused by extremes of temperature that literally melt a portion of a metallic substrate to the point that a weld or joining of the two substrates occurs. The movement of the two surfaces immediately breaks the weld, leaving a remnant of the joined material on one surface or the other. This event is repeated many times in an extremely short period of time as the substrates slide or roll across each other. This lead to a pitting of the substrate that lost material. In addition the substrate gaining material becomes in effect a file and does additional damage to the next portion of the adjoining substrate that is encountered. Typically both surfaces, if of comparable hardness, will show both pitting and acquisition of material from the adjoining surface. This condition is typically referred to as “galling”. As the conditions leading to such lubrication failure is repeated, additional damage is incurred, accelerating the wear of both substrates. The heat generated can also over time affect the hardness of the substrates leading to additional potential for damage.

Anealon is designed to directly address this problem. At the point that such conditions become optimal for such wear Anealon forms a self lubricating film that will not burn off. This film forms in such a short period of time that insufficient heat is generated, for a sufficient length of time, to cause micro welding. The following will discuss several examples of the protective effect.

An initial test was conducted using a simple bench top lathe. A mild steel tube with a wall thickness of about .125” and a 1” diameter was spun in the lathe at 1500 RPM’s. The tool holder with a tool steel shaft was run against the tube at the maximum pressure possible to achieve, with the hand crank. The tube, which had been coated with Anealon, showed the formation of the film. No form of lubrication other than the Anealon coating was used. The test was run for 15 minutes with no wear on to the shaft. Then the test was repeated for an additional 15 minutes and oil was poured on the shaft. Immediately the oil burned off, indicating the temperature was high due to friction. The shaft continued to show the film formation. Uniquely the film was not

consistent as it formed only on the contact points between the two round metal pieces. This indicated a very narrow contact patch, increasing the actual load at the contact points. It should be noted that the uncoated tool steel shaft actually showed wear, where the coated tube had no wear, after the first test. In the second test the tool steel shaft was also coated and showed only a faint polished line at the contact point.

An additional test was performed using a camshaft, lifters and the distributor gear for a 350 cu in Chevrolet motor built for racing. These parts were coated with Anealon. The engine is used in NHRA stock eliminator drag racing competition. The test was designed to expose the coating to the worst possible conditions.

Only the cam was new. The lifters were used and had already developed a wear pattern that would match the original cam. It is not recommended to run used lifters with a new cam as the desired mating wear pattern is less likely to develop, leading to premature wear and failure of one or more lobes on the cam. When used lifters are employed they should be returned to the lifter bore they originated in. In this test the lifters were not returned to the original bores. This would further aggravate the mismatch between the new cam and the old lifters. To further stress the cam much heavier valve springs were utilized. The original springs had a closed pressure of 80 lbs and an open pressure of 160 lbs (static). The new springs had a closed pressure of 220 lbs and an open pressure of 440 lbs (static). Running such heavy springs, especially at start up when typically very soft springs are used, is extremely likely to lead to the failure of one or more lobes on the cam within minutes of start up. To further stress the coated cam the engine was simply allowed to idle while adjusting the valve clearance. Normally an engine will be run at 2000 RPM's during this process, which aids in break in and reduces the potential for excessive wear during the valve adjustment process. Oil pressure would be higher increasing the lubrication available to the parts at this RPM. The valves were also adjusted "cold", rather than when the engine temperature had risen to a normal level. Setting them when cold is also likely to create wear problems. As a final step an off the shelf, 0-20 weight synthetic motor oil was used that had no additional Zinc as a wear protectant. (Note; zinc loading in oil has been reduced and this reduction has led to severe cam failure as it reduces the high pressure lubrication properties of the oil). All in all the stage was set for cam failure in 5 to 10 minutes of running.

The valves were adjusted for proper clearance and the engine installed in the car. The car then entered competition. After every 4 – 5 runs down the drag strip, at full throttle, the valve adjustment was checked. Normally valves will need to be adjusted to compensate for normal break in wear. No adjustment was necessary. This was repeated several times and then the checking was done every 10 to 15 runs. After over 100 runs by the car, **NO ADJUSTMENT WAS NECESSARY**. This is unheard of after this many runs in competition. The cam was pulled and inspected and showed **NO** wear at all. The gear which normally will show wear from being run against a stock iron cam showed **NO** wear. The oil filter was checked for any wear debris and **NONE** was found. **NO** wear of any coated part was experienced, even with the assembly being done in such a way as to virtually guarantee, not simply wear, but failure of the components. To verify the test a second test was run using a new cam and lifters in the same engine. The car currently has over 120 passes in NHRA competition and still has needed **NO** valve adjustment at all. No wear is visible upon inspection, with the cam still in the car.

It should be noted that the first cam shows the typical wear pattern *in the coating*, which on the low wear areas of the cam still shows as a gray film. This wear pattern indicates that the lifters were functioning as designed, which includes a rotating action as they slide around the cam lobe, to maintain even wear pattern development for long life. This was with lifters that had a wear pattern adapted to a different cam.

An interesting development was that unlike on the mild steel tube, the cam like the tool steel shaft did not show a visible Anealon film formation at the high load points, just a very bright highly polished surface. This may be related to the type of metal involved. The absolute lack of wear on any coated part is evidence of the continuing functionality of the coating, though the Anealon film is not visible.

Anealon can be adapted to many surfaces and conditions. Anealon can be formulated using a variety of ingredients to satisfy most needs and conditions. Of special interest is the ability of Anealon to be formulated in such a way that it has minimal to no environmental issues. Several of the ingredients are actually FDA acceptable for food contact surfaces. This formulating ability means Anealon can aid customers in avoiding issues of contamination and the attendant expenses. Anealon is normally formulated as a thin film material but can also be formulated as a thick coating where spread ability is needed.

It should also be noted that the use of Anealon may reduce significantly the need for constant re lubrication, reducing the cost associated with long term lubrication needs. Various application methods can be utilized, though applying to a properly prepared surface and allowed to bond is the best. Anealon will function in a “wet” or uncured condition where necessary, however an initial application as a thin film coating could reduce the frequency of “wet” film application needed, where regular and frequent applications of a grease currently is typical.

This characteristic was noted in a racing application where the rearend had a damaged pinion seal and all the lubricating fluid drained out. This was unnoticed by the driver, who proceeded to drive the car in qualifying. The build up of heat due to a lack of a lubricating fluid, which is also a coolant, led to damage to peripheral items as well as the seizing of the rearend. When the rearend was inspected the damage was limited to the bearings. The ring and pinion showed no damage and were re-installed in the vehicle, with a new seal, and again raced. They won the next race using this same ring and pinion.