



THE 1937-1948 CADILLAC AND LASALLE SACRIFICIAL BRONZE GEAR

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THERE ARE 500 WAYS TO DO IT WRONG AND ONLY ONE WAY TO DO IT RIGHT!

If your “bronze gear” is showing any amount of wear, it is telling you something. A few years ago I discovered that I could no longer rebuild a 346 cubic inch Cadillac or a 322 cubic inch LaSalle engine and keep it running for more than a few thousand miles without the bronze gear failing. Thanks to many club members I soon discovered I was not alone. This article includes many tips from members. The bronze gear is the idler gear that connects the oil pump and distributor to the cam shaft in 1937 – 1948 Cadillacs and LaSalles and, as the name suggests, it is made of bronze.



The straw that broke the camel’s back, so to speak, was the failure of the bronze gear in my 1946 Cadillac after only 8,700 miles of use. My wife Zona, Jan Gerecke, and I were on the 2005 CCCA ‘North To Alaska’ driving tour and when the gear failed we were 40 miles from the nearest phone.



Jan was driving when the engine suddenly backfired and then stopped running. We pulled over to the side of the road. Fortunately the caravan had a 'trouble truck' following so we did not feel stranded. When the truck arrived one and half hours later Jan and I had taken apart the engine and had all the pieces neatly laid out on the road shoulder. I had to work hard to temper my anger as to why I could not rebuild a 346 cubic inch Cadillac engine that would last. I have rebuilt more than twenty of them in the past 30 years with nary a problem until just a few years ago. Now I was sitting on the side of the road in "bear country" Alaska trying to figure out what had changed.

Bob Agnew, Earl Sejrup and I put the 1946 back together later that evening in Fairbanks, Alaska. Carl Steig looked in on what we were doing and said that it must be one of those Korean War bronze gears. The story had been going around for a few years that the gears made during the Korean War were softer than the WWII surplus gears and would last only about 10,000 miles. We had ten days left of the tour and Carl and I spent a lot of time talking about the bronze gear. He told me that he and some other people had done some studies on the metallurgical make-up of the original gear. He said he would pass this information to me along with the actual bronze formula from the Cadillac archives.

I had retired about six months before my trip to Alaska and thought it would be a great little retirement project to design and build a good bronze gear. I could make all of my Cadillacs more dependable cars, and the effort would also be a good club project.

DREAM ON!

When I got back home to Minneapolis I contacted my friends at Logic Product Development. Logic's business is taking your dreams and making working products out of them. They have a very fine in-house mechanical engineering department and my first meeting was with the vice president of this department, Pat Hamilton, and one of their senior mechanical engineers who has experience in gear design and construction, Chris Naujok. After one look at my collection of bronze gears, which includes 15 gears lent to me by Cadillac-LaSalle Club and CCCA

members, Chris said there was nothing wrong with the bronze gear but rather I was overloading it in operation. I said that was impossible because I was running 10-30 weight oil with 30 pounds of oil pressure and the distributor. Before I could get my foot out of my mouth, I started thinking.



REPLACEMENT GEAR



ORIGINAL GEAR

I always put in a new oil pump when I rebuild an engine. The whole pump was available, not a kit like now. The new oil pump kits don't look like the old. The new gears are straight cut while the old ones are helical cut.

There are very few WWII era parts left so people today have new oil pump kits made. Maybe the new kits are not built to the same standards to which Cadillac made them. I sent two sets back because of binding while turning them by hand. The red flag should have come up then. At that time, I didn't know there are at least seven different oil pump casings. One size does not fit all. More about gears and pressure on the gears, helical cut or straight cut gears, is found later in this article.

MEETING OVER!

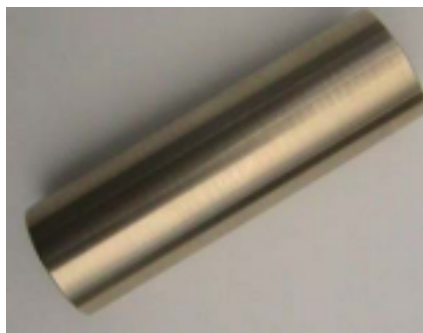
I went home, dropped the oil pan on my '46, and took out the oil pump. The gears were highly polished about 1/2" from the bottom across the full width of the gear tooth. I thought to myself, "There is only one way to polish steel and that's to rub parts together." I called my car club friends and asked them if they could get me the oil pump gears from their failed engines. I got six sets to examine. They all showed polishing, some on the gear surface and some on the casting. The more polished they were, the shorter the bronze gear life had been.

At my next meeting with the Logic engineers I was much more humble. My ears were open and my mouth was shut. I learned there was going to be only one way to make this project work. The oil pump gears and housings must have the original tight tolerance, be helical cut, and must be made of a good grade of steel so as not to expand under normal operating temperatures of the engine. There could be no friction. Next to the valve train the oil pump has the most pressure on its surface. A bad oil pump gear will cause a bronze gear to fail in a short time. I'd need a bronze gear of the similar hardness as the original and a new small polished and hardened gear that would drive the oil pump and distributor. All of the small steel gears I have seen have a pattern cut in them. This was a highly polished and hardened gear when new. This is so it will not cut the bronze gear.



SMALL DRIVE GEAR FOR DISTRIBUTOR AND OIL PUMP

The distributor tower needed new bushings. The bushings I checked had wear .005 to 0.025 of an inch out of round. The pressure is all one way. There are many ways to put extra pressure on the bronze gear and the gears must line up to run properly. It began to seem like the 'little retirement project' was never going to end.



REPLACEMENT
BUSHINGS



ORIGINAL
BUSHINGS

TESTING BEGINS

In January 2007 I set up a test bed that included a 1941 Cadillac engine block and gears, a distributor tower, oil pump and an electric motor to drive the cam shaft. I installed a variable speed control on the electric motor so that I could control the RPM very easily.

On February 16 I started the testing. I ran the engine at a speed equivalent to 70 mph with 40 lbs of oil pressure which is ten pounds more than Cadillac recommended. After the first week the engine had run the equivalent of 11,700 miles. I took everything apart and had the gears checked for wear. The bronze gear showed about 0.010 inch wear - not too good, not too bad. After the second week the equivalent travel was 23,200 miles and the gear showed 0.015 inch wear. At the end of the third week and 34,700 equivalent miles it showed about 0.025 inch wear. I had concerns at this point.



After the fourth week and 46,200 miles the gear still showed 0.025 inch wear. I felt better! After the fifth and sixth week and 57,700 miles and 69,200 miles respectively, the wear remained stable at 0.025 inch. With close to 70,000 miles completed on this test, I decided it was time to change the test to more typical operating parameters. I set the test bed to run at an equivalent speed of 55 mph with the oil pressure at 30 lbs -- the high side recommended by Cadillac.

Before beginning the new test I changed the oil and filter. This was the third oil change I had done on the test bed. But I didn't realize that the oil I had been using before was several years old. This time I went to the store and bought a case of the newer SM oil. I decided to use the same bronze gear to see if it continued showing 0.025 inch of wear for a two week test before starting over with all new parts.

After two days I took the gear out to check it and much to my surprise it showed 0.075 inch wear. I thought I must have left something under the distributor tower so that it was not mounted straight. Any piece of debris between the tower and block will cause major problems because if the tower is not perfectly straight the misalignment will cut the bronze gear very quickly. For this reason the bushings, shaft, and small gear should be replaced along with any bronze gear change.

I decided it was time to start with everything new and to be extra careful how I put it all together. I started up the engine and checked the gear after 24 hours. The bronze gear showed almost .030 inches wear; not a good sign. The gear was wearing much faster than during the first test. The next day there was over .060 inch wear. I stopped the test since something was obviously wrong. When I disassembled the engine I found that the oil was contaminated with large bronze pieces and not just the bronze powder I expected. This was not an oil problem. Something was seriously wrong.

I had five sets of gears (oil pump, bronze and small steel) made by a local gear shop, using a CNC machine. The oil pump gears were all the same size, and the small steel gears were not polished.

I had a meeting with Pat and Chris from Logic. I had asked Jeff Hunt, a retired tool and die maker and a member of the Northstar Region Cadillac-LaSalle Club with a 1939 LaSalle, to sit in on our meeting. After many questions and very few answers we decided Jeff should check all of the machine work we had done to see if the tolerances were kept.

MORE THAN ONE PROBLEM

Two weeks later I woke up at 3:30 AM remembering that I had read something about the reformulation of motor oil in late 2005. The next day I found the information I was looking for on the Internet. In 1996 the auto companies had cut the amount of Zinc dithiophosphate or ZDP phosphorous in motor oil from 1600 ppm to 800 ppm in response to an environmental law passed in 1993. By 2005 the ZDP phosphorous count had been cut to 400 ppm.

ZDP's are a family of chemicals that are manufactured using organic alcohols, phosphorus pentasulfide, and zinc oxide. The type of ZDP varies with the type of alcohol used in the manufacture of the product. For over 60 years ZDP has been used as an additive in engine oils to provide anti-wear agents for highly loaded rubbing surfaces and oxidation stability in an efficient and cost effective manner. However the phosphorus in ZDP contaminates catalytic converters when an engine burns oil.

Modern day automobiles all have catalytic converters and the switch to roller cams reduced the need for "anti wear" additives in the oil. Thus the auto industry, in order to meet EPA standards on highway emission standards for particulate and NO_x, has driven down the ZDP phosphorus content in modern day engine oils.¹ Unfortunately older engines still have parts under high pressure (i.e., flat tappets, oil pump, small steel gear and bronze gear) and a lack of ZDP phosphorus additives in the oil could be a real problem. Maybe the oil pump lubrication was breaking down because of the lack of ZPD. This would put extra pressure on the bronze gear.

¹"How Much ZDP is Enough?" SAE Technical Paper Series, 2004-01-2986 SAE International, Warrendale, PA

I called Jeff that morning to see if he had found anything unusual with the dimensions of the parts. He said several things could have closer tolerances, but found nothing that would cause the gear to wear out that fast. Jeff and I agreed that he would make a new set of gears to be tested. There would be 0.001 inch tolerance on all pieces, a new and improved bushing was designed for the distributor tower with a polished shaft, and improved oil flow for the tower and gears.



We soon discovered a CNC machine is good for production, but some of the older gear cutting equipment is better suited to our many problems. Because there are so many different oil pump casings, the oil pump gears have to be made to match the individual casings. Again, the answer was going to be that no one thing was going to be the answer.

Jeff started ordering materials he would need to make up new sets of gears. I was getting ready to go to Arizona for the spring CCCA tour and was going to take my 1946 Cadillac 60 Special which I use as a tour car. By this time it was over a year since the oil pump had been diagnosed as one of the problems.

I changed the oil pump gears to nos helical cut gears, not having a clue there were seven different casings, and found a good used bronze gear. I drove about 7,000 miles touring in it during 2006. When I took it apart and couldn't believe what I saw. The bronze gear was all worn out and the camshaft was ruined. Remember I put the '46 together by using a mixture of good used parts. After the tests I did, it was very clear to me that the rebuild was doomed from the start. The SM oil probably accelerated my problem, especially the camshaft wear.

I suppose by now you think this article will never end. I have explained this problem in detail because many of you are just like I was when I met with the Logic engineers. They did not tell me what I wanted to hear. I wanted a simple answer!

THE NOT SO SIMPLE ANSWER

Cadillac has been noted for precision tolerance since Henry Leland founded the company in 1902. This part of the engine driveline is very important and if all the pieces are not correct it will fail. I started the test using all new parts with tight tolerances, and SL oil. We have run three more tests, averaging 54,000 miles each, with only .002 to .008 wear on the bronze gear and not enough wear on the small steel or oil pump gears to detect. As you can see, changes in the method of oiling, tower, and gear, and much tighter tolerance on all parts is a big change from our first test that seemed OK.

METALLURGY

Many people have asked why not use steel or a stronger bronze when making the idler gear. Adding 2% or 3% beryllium to copper would make that stronger than steel. Chris Naujok from Logic warned me the first day that the bronze gear was something that has to take the abuse of the other parts wearing, including the oil pump gears, small steel gear, tower bushings, and cam gear. If I were to use a steel or a stronger bronze idler gear with other worn parts I would run the risk of everything seizing up due to the metallurgical makeup of other parts, or the possibility of wearing out the cam gear. Pieces of steel going through the engine will destroy it in just a very few miles. We learned that Cadillac and LaSalle cars, pre-1941, had mild steel cam shafts with the same part number as the replacement.

Anything but soft idler gears will shorten the life of the cam gears. Shop manuals recommend only 18-25 psi oil pressure in these cars because of the mild steel cam shafts. In our opinion, after running over 200,000 miles testing parts, adding a new part without replacing all components will not work.

It would take another article longer than this one to tell about failures people have had, from total destruction after 20 miles, to gear failures after anywhere from 300 to 8000 miles. The cost of our product may seem to be too expensive to some people but it is a whole lot cheaper than rebuilding the engine the second time. It would have been very easy to have the kit made overseas and charge \$500.00 for it. I would have made more money than I make now. But the only problem this would have solved is the price. Remember, anything worth doing is worth doing right!

CAUSE AND EFFECT

Problem:

Worn steel gear. The steel drive gear was originally case hardened and polished surface. Technology of that era probably gave you a .003 to .005 thousands of hard steel. Every steel gear that I have inspected has worn thru the hardening. Viewing through a magnifying glass the teeth are very rough

Effect:

Lack of a smooth surface soft steel will cause the bronze idler gear to wear at an accelerated rate.



Problem:

Oil pump gears that bind or run at more than 30 psi oil pressure or oil pump casings that are worn at the driveshaft.

Effect:

Bronze gear failure

As of now we have identified seven different casings that fit our Cadillac and LaSalle engines. All are different sizes. There can be as much as 11/1000" difference in casing sizes so we make our gears, one set at a time, to match the casing.

You can have a set of NOS helical gears but if they were not made for the casing you have, the best thing that can happen is that you lose oil pressure. The worst thing that can happen is bronze gear failure in 300 to 8000 miles.



OIL PUMP CASING

Problem:

Bushings in the distributor tower are worn.

Effect:

Worn bushings will cause the bronze gear to wear off-center. This will happen very fast, at less than 5,000 miles—depending on the wear for the two gears. (No longer on center as was original design.) This will affect the timing of your car, depending on the amount of wear.

Problem:

Over Parkerizing of the cam or Parkerizing the gear on the camshaft.

Effect:

Parkerizing is done when you have your cam reground. If it is done properly, it is a great break-in tool. If it's done wrong, it can be a catastrophe. It can ruin the tappets and bronze gear in a matter of a few hundred miles. In a few cases, we have seen where cam grinders have parkerized the cam gear. The cam is ruined. No gear will hold up. The bronze gear will have been destroyed any time after 30 to 1500 miles.

If the cam gear has pits in it from rust the bronze gear will self destruct. We discovered aluminum gear of like hardness will wear much better under not ideal conditions compared to the bronze gear.

Bronze is a porous material which needs a polished surface to run against.

MOVING FORWARD

You must send us the distributor tower and shaft, and complete oil pump from your car for exchange. Cores must be rebuildable and have no cracks in them.

OUR COMPONENT SYSTEM



You receive:

- New bronze or aluminum gear
- New steel drive gear
- New steel helical oil pump gears
- Distributor tower and new bushing installed in tower
- New distributor tower drive shaft
- New oil pump drive shaft
- New oil pump relief spring at 28-32 psi
- Rebuilt oil pump housing for proper fit of drive shaft
- ALL PARTS ARE MADE IN THE US

Thanks for letting us share our story with you!

- Jerry Steelman, Past director of the UMR-CCCA and NSR Cadillac LaSalle Club

Please write us, visit our website: hq-ma.com, call us at: (612) 568-0068, send us an email: info@hq-ma.com, or download an order form <here>, get it to us, and we'll get the process going!

If you're in the area, call us and we'll be happy to give you a brief tour of our shop.

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