

HOW TO AVOID & ANALYZE SUPERCHARGER PROBLEMS

The Kenne Bell BIG BORE™ Twin Screw is the most reliable, durable and trouble free supercharger available. If properly cared for with regular oil changes, it will give many years of trouble free service. Bearings are lubricated for life. And it's billet case, huge bearings and shafts, precision gears and rotors make it virtually indestructible. It far exceeds OEM standards. However, as with any mechanical device, it can be made to fail by overheating or over revving which is responsible for 99% of supercharger problems. It's all about basic physics. Would you install a 300° thermostat and then blame the engine when it burned up? Or overfill your engine with oil and raise the oil temp to 400°? Not good for the seals - any seals. Kenne Bell has many years of experience with the Twin Screw. We know their limitations. We have destruction tested / purposely destroyed superchargers under every possible condition so we can determine the true cause of ANY Kenne Bell supercharger failure. So let's talk failures and how to avoid them.

HEAT - For the most part, component failures are the result of excessive heat, boost and/or rpm, overfilling with oil, "hot air" systems from the brain dead, an inoperative bypass valve and low vacuum cams. Just as an overheated engine seizes pistons in the cylinder bores, the spinning rotors expand and can seize in the billet case. We've never seen a rotor case or bearing actually fail (crack, chip, break, etc.) in a Kenne Bell kit. Heat is what kills the parts. Heat. The same is true for oil starved gears. They become hot, discolor from the heat and burn up from lack of oil. Note: The Twin Screw bearings (supercharger and drive) are lubricated for life so don't need outside lubrication. The rotors rotate or "float" on these huge bearings and never contact the case unless distorted from excess heat and/or rpm.

HOT AIR UNDERHOOD FILTER KITS - Let's take a look at the #1 cause of supercharger overheating and the resultant seal and even rotor failure - "Hot Air" (Underhood Filter Kits) are sold deceptively as "Cold Air Kits." These cheapie "filters on a stick" have been promoted by mail order companies for years. Never once saw one of them pay for a supercharger rebuild. Why are they such a problem? The higher 100° inlet air temp from hot underhood air (approx. 200° vs. 100°) equates to the heat of an additional 10 psi boost! 1 psi boost = 10° rise in supercharger air charge temp. Now you know why all these cars are dyno tested with the hood OPEN. So, if you're running what you were led to believe was a safe 10 psi, the heat is that of 15 psi! Your "safe" 15 psi is really 25 psi, and 25 psi is 35 psi. And our 18 psi recommended max for street is like running 28 psi with a "hot air kit." Finally, our max recommended 25 psi (for competition ONLY) suffers from the heat of 35 psi - all because of these "hot air" kits. Again, regardless of supercharger type - or turbocharger - count on 10° per 1 psi boost - and toss the "hot air" kit in the dumpster.

OVERFILLING - Overfilling is the most frequent cause of supercharger failure. NEVER overfill a Kenne Bell supercharger with oil. NEVER. You wouldn't overfill your engine, rear end or trans - unless your goal is to heat up and boil the lubricant. Overfilling a Kenne Bell dramatically increases the oil temperature which hardens the front case seals resulting in high oil consumption. The excessively high oil temperature (400°+) can also melt and dissolve the plastic coupler which "cushions" the drive from the supercharger. With the coupler gone, there is now a 1/2" gap and metal to metal contact and, of course, audible noise (clacking) from the front of the supercharger, particularly at idle or when on and off the gas. A melted coupler can be verified by removing the belt and checking the lash by rotating the pulley back and forth. There should be very little lash. 1/2" of lash indicates the coupler is gone and the supercharger needs to be rebuilt as the seals will also be hardened allowing the oil to now pass from the oil reservoir into the case and rotor assembly. A partially heat destroyed or worn coupler with abnormal gap can emit a slight clacking sound which is accentuated by a rough idling engine. This is NOT a problem.

See "Supercharger Gear Noise" (<http://www.kennebell.net/techinfo/ford-techinfo/Lightning54only/GearNoise.pdf>).

NO OIL / LOW OIL SUPPLY - This is easy to diagnose because the gears discolor. As with any metal to metal parts contact, a lack of oil results in excess heat which turns the gears black or blue black. The gear teeth will then wear off from lack of oil. And if the heat from the gears running without oil is sufficient, the green coupler can also melt. Any residue oil splash or spray that contacts the gears will "fry" (burn and turn black).

RACE APPLICATIONS - SEVERE USE - Let there be no mistake about this. High rpm or high boost racing conditions ALWAYS create more heat in any supercharger. "Hot Air Kits" (see "Warning: Hot Air Underhood Exposed Filters & Kits" <http://www.kennebell.net/techinfo/general-info/HotAirWARNING.pdf>) and overfilling must be avoided for severe use. An overfilled reservoir with 400°+ boiling oil often overheats the front of the supercharger sufficiently to result in damaged seals, and in some cases, rotor to case or rotor to rotor contact and a ruined supercharger. A tell tale sign is that only the front (hottest) area of the rotors will be scored. Also, the air is hottest at the front of the supercharger. Scuffing the full length of the rotors indicates LOTS OF HEAT from oil, boost and inoperative bypass valve. The same is true for "Hot Air" (underhood exposed filters) which can elevate supercharger temp a whopping 100°. That's the equivalent heat generated by an additional 10 psi of boost. Does anyone really believe sucking hot underhood air helps the engine or supercharger life? For high rpm/boost applications, lower oil level to 1/4" BELOW the bottom notch on dipstick with dipstick screwed in.

BYPASS VALVE - The bypass valve lowers the supercharger temperature at idle and part throttle/cruise. They seldom, if ever fail, but if it does, the supercharger will run dangerously hotter at idle, cruise and all non boost conditions. Periodically check it's operation. Always check the vacuum/boost control line to the bypass valve for leaks. The valve will be "open" at idle (vacuum) and closed under boost (pressure).

CAMS - When a cam is too "big" to generate enough vacuum to open the bypass valve or keep it open driving under non boost normal driving, do we blame the cam company, engine builder or mail order company that sold it? Nope, the damaged supercharger is returned to us. Only too often we blame the poor supercharger or it's design. And if the rotors aren't damaged but the abuse from heat damages the seals and the supercharger burns some oil, everyone seems to discount or forget about all the legitimate causes of the issue (overfilling, bypass valve, "hot air" kit, street overboost). *Note: For low vacuum cams, Kenne Bell now offers a unique LOW VACUUM Bypass Valve that is full open at 2" vs. 11". Solves cam problem. Cams also create issues at idle and cruise where it may idle at 11" but cruise at 6" (NOT GOOD). If in doubt, use the LOW VACUUM Bypass Valve.*

ANALYSIS - Analysis of problems is easy. Depending on the rpm and run time, an overfilled supercharger will reek of burned oil when disassembled. The oil may appear "jelled" or as sludge. Also present may be the smell of the dissolved plastic coupler. Draining the above and filling with fresh oil may look good on the dipstick, but the tell tale damage remains. The seals didn't just decide to harden, the oil doesn't boil all by itself, nor does the coupler decide it's time for a melt down. It got HOT! Conversely, a lack of oil will always result in discolored (blue and black) gears, worn out teeth and metal shavings. Gears don't "fail." They merely burn up from lack of oil. Defective or worn gears don't turn blue or black. These extremely hot rotating gears also transfer heat to the front of the rotors, causing them to overheat, expand and seize in the case. Not much different than an engine that melts down from a lack of oil.

ROTOR FLEX - Rev anything high enough to exceed it's design limits and you introduce excessive stress, load and flex. When rotors are revved beyond the manufacturers safe rpm, they can flex - enough to contact the case and seize the rotors. This condition is evidenced by end and center rotor contact. The new Kenne Bell BIG BORE™ series utilizes larger diameter rotors that resist flex more than early design 1.5, 2.2, 2.4 models

NOISE	CAUSE & CURE
Growling	Debris in rotors or slight rotor to case contact. It'll NEVER be a bearing. Rebuild supercharger if case and rotors are useable.
Clacking	Coupler melted. Coupler worn. If clacking at idle, rev engine. If noise goes away, it's rough engine idle from cam or poor tune (see "Supercharger Gear Noise" http://www.kennebell.net/techinfo/ford-techinfo/Lightning54only/GearNoise.pdf). If supercharger isn't using oil, front seals are O.K. New coupler can be installed with supercharger on car. A melted coupler creates debris that usually damages front seals.
Whistling	Normal air flow through supercharger and inlet tract can make a slight whistling noise. That is normal. The rotors and bearings are silent since there is no rotor to case contact and the bearings ride on oil. Whistling may also be from a vacuum leak.
Gear Whine	Worn gears. Rare unless run low on oil or out of oil. Supercharger must be rebuilt. Gear shavings will damage front seals.
Noise Increase w/ Smaller Pulley	HP/air flow is noisy. Can't be avoided. Smaller pulley - more boost - more HP - greater air flow (noise) - more noise.
Just Noisy	Remove belt and rotate supercharger. If free and quiet, check alternator, water pump, idler pulley etc. Supercharger often gets blamed for other worn engine parts.
Vibration	Supercharger is balanced. Vibration is from engine or drive.

RUNNING HOT - It's an air compressor or air tank, even at idle. Compressing air creates heat. It's unavoidable in any supercharger. There is NOTHING else in the supercharger that will make it run "hot" or "hotter" except 1) overfilled oil, 2) excess boost 3) disabled bypass - and, of course, 4) "HotAir" underhood exposed filters.

LEAKING OIL - An oil leak can only occur between the front cover and billet case, but is extremely rare. This area is factory sealed. If front cover has been removed, it must be indexed with an alignment tool and resealed.

USES OIL - Unless there is a leak in the front cover, the oil can only escape 1) by damaged or worn front seals (won't harm the supercharger) or 2) old case or drive vent (old style '90-'05) or pulley bolt vent (new style '06 up).

BLOWING OIL OUT VENTS OR DRIVE FRONT SEAL LEAKING OR BLOWN OUT - Racing only. Indicates extreme pressure in front oil cover from high rpm/boost racing and 1) overfilled with oil, 2) drive or front cover vent plugged off (old style) or 3) "catch can" (old style) line is not teed into drive vent line and/or front seals damaged. Install as per Kenne Bell instructions or convert to new vent bolt drive.

CASES - There has NEVER been a Kenne Bell billet case failure - NEVER. Yes, we experienced some Lightning cast aluminum case failures. The cases distorted and contacted the rotors. All units were warrantied no charge. We learned our lesson. Any and all Kenne Bell superchargers will be offered with ONLY billet cases.

SUPERCHARGER OIL CONSUMPTION EXPLAINED

OIL LEAKS - Oil typically doesn't "leak" out of a twin screw any more than oil leaks out of your engine oil pan. So where does the oil go - and is using a little oil a big concern? Engines hold 6-8 quarts, whereas a supercharger carries a mere 5-6 oz (1/6 quart), so there is a big difference in being "1 quart low (23 oz) or "1-2 oz low." A mere 1 quart of oil would cover 6 supercharger fill ups. Higher engine and supercharger rpm increase the internal air pressure in both. The pressure and oil must exit somewhere. The engine simply blows it out the breather or burns it in the combustion chamber via the PCV system. The supercharger can lose a relatively small amount of oil by its front seals at higher racing/high boost applications. Again, 1/3 of its oil capacity is a measly 2 ounces. The older design 1.5-2.4 Kenne Bell/Autorotor superchargers vented air pressure out a breather on top of the front gear case or the drive snout, similar to an engine. At high boost and/or supercharger rpm with this elevated internal pressure - as during a 1/4 mile run - the air would carry some oil with it out the breather and onto the supercharger and engine. Five years ago, we solved this problem with an orifice, a tube and a catch can. Same principle used on the new Shelby KR differential for high speed cornering. You vent the oil to a container. It works! Anyone who experienced a problem with our Kenne Bell/Autorotor superchargers was sent the vent kit at no charge. We learned quickly that many of our superchargers were being used both for street (low boost normal driving) and for competition (high boost) on weekends. In many cases, VERY high boost (up to 26 psi). We also realized that more and more of our customers were running higher boost levels for the street "normal" driving on a full time basis. This, of course, meant the supercharger is spinning faster and developing higher boost and heat ALL OF THE TIME. Still other failures were due to street "DEATH TUNES" by the tuners e.g. 20+ psi with 13° timing instead of 17 psi and 23°. SAME PEAK HP except the supercharger runs HOTTER (+60°) at 23 psi than 17 psi. Oops! I'm running lots of boost on the street but abusing my supercharger. Finally, since we've been selling Ford Twin Screws at least 3X's longer than any other company, we have more units and more applications out there than any other company. To solve the problem, around 5 years ago, we redesigned new drives for the previous Kenne Bell/Autorotor 2.4, 2.2 using a new stronger 12mm "vented" pulley bolt. The new Kenne Bell BIG BORE™ 2.8, 2.6 and 2.1 also incorporated this new "vent bolt" design from the beginning (2005 and later). The cross drilled hole now vented the excess air pressure from the high boost/rpm harmlessly and cleanly out through the pulley bolt. The centrifugal force of the air in the hole prevented the oil from entering the hole and exiting the supercharger, but relieved the air pressure in the oil reservoir. Now there was no need for a catch can. Problem solved. Better product.

ROTOR SEALS - Yes, if the rotor seals are doing their job, this pressurized oil doesn't get sucked back into the rotors on decel. And if they're sealing, boost pressure in the rotor pac doesn't blow by the seals and into the oil reservoir. All Twin Screws and Eatons use the same basic seals. Contrary to what you may have heard, there is no better one. If there was, we would be using it.

SEAL DAMAGE - Seals will last a long, long time. We have many superchargers out there with 100-250,000 miles on them with the original oil seals and minimum oil use. But we don't all drive our Kenne Bell superchargers around at low rpm and low boost. OK, so what goes wrong? Why do the seals not hold back 100% of the oil? How can we prevent our supercharger from using oil? Any seals efficiency can be compromised by:

1. Heat (excess boost or rpm).
2. Lack of oil.
3. Oil contaminants.
4. Abnormally high vacuum on decels.
5. "Death Tunes" (high boost / retarded timing).
6. HEAT (overfilling). The big one. Overfilling is the number one cause of seal damage. Heat hardens the seal and causes them to leak. That's why there is a big red tag on the dipstick of any new Kenne Bell supercharger that says "NEVER OVERFILL." When overfilled, the oil can actually "boil." At 440°, the green plastic coupler in the oil case will shred and/or melt. Overfill an engine or transmission and oil WILL overheat and even blow out the dipstick hole vent. Same condition as the supercharger.

HEAT (High RPM) - To reduce windage and oil heating at higher rpm and in competition, we have specific oil level recommendations. It's all about controlling oil windage (same as in engines, transmissions and differentials). Instructions are included in every kit.

HEAT (From Boost) - The air charge temp of a twin screw or turbocharger is approx 10° per psi of boost. Eatons are much higher. Example: Raise the boost 5 psi and you increase air charge temp by 50°. 10 psi is 100°. The oil reservoir is located at the discharge port so it sees the higher boost temps. We recommend 18 psi max for the street (18 psi x 10° = 180° + supercharger "in temp" = discharge temp e.g. 100° day = 180°+100° = 280°

HEAT (Exposed Hot Air Underhood Filters) - I wish we could all charge the idiots who sell these "air charge heaters" for supercharger damage they've caused over the years. However, not one has ever reimbursed an owner. They create problems for Kenne Bell and our customers. Again, refer to the 280° example above, but instead of 100°, use the 200° air (+100°) from the underhood exposed filter. Now the air discharge temp is 380°. Oops! The absolute worst cars to use an exposed filter on is the '03-'04 Cobra and '96-'04 Mustangs. Our Shelby is the lone exception, but there was nowhere else to mount the filter and there are some openings that allow some cooler air to the filter. NOT as good as our '96-'04 Mustang, '03-'04 Cobra and '05 up Mustang kits which pull 100% of the air from the fenderwell or under the front valance. Always remember that what reduces seal life is not high speed wide open throttle - cool air rushing into the supercharger. It's instead the idling and cruising with the inlet sucking in hot 200° underhood air with the throttle body almost shut. There is very little cool air entering the supercharger during these conditions. Throw that hot underhood exposed filter in the dumpster and suck out of the fenderwell or in front of the valance. A hot air underhood exposed filter warning is included with every kit.

CONTAMINATES - A shredded coupler or melted plastic from overfilling contaminates the and may damage seals. And overfilling can damage seals with only one overfill. Keep that in mind when buying a used or abused supercharger. And if the supercharger is run without oil, the gear shavings and heat will obviously damage the seals.

BYPASS VALVE - We use a Mercedes Benz bypass valve - an extremely reliable component. It has to be. We've never had a failure that wasn't related to 1) supply tube fitting leaking or 2) external damage. All problems we've seen are the result of compromising the supply line with gauges. NEVER tie into a bypass feed line. The #2 cause of a bypass valve staying closed (not good) is low vacuum cams. Ever see a cam company or engine builder pay for a supercharger damaged by a cam that didn't generate enough vacuum to open the bypass valve? Our standard bypass valves open at 2" less vacuum than others. And we have a special no spring model that opens at a mere 2"Hg. These are all examples of how superchargers are damaged and blamed for problems that weren't their fault.

EXTERNAL OIL LEAKS (BIG BORE™ Series) - Our records clearly show that as of 9/'09 and thousands of kits, there has been only ONE - a 2.1 - returned to us for an actual leak. Our fault. We pressure test all the gear cases, but left the bottom case plug loose. We missed one. The gear case is sealed to the supercharger housing so oil leaks there are non-existent.

DRIVE LEAKS - The only place for oil to leak out the drive is by the front seal. As of '/'08, we've had 3 BIG BOY™ drives returned. All 3 had "seal shred." The drive seal rides on a hardened bushing (seal ring) that holds the pulley. Reinstall it without an oil film (as recommended) between the bushing and seal, and the seal immediately shreds/wears from lack of oil. Replace the seal and properly oil the seal surface and the problem goes away. We've sent out 6 BIG BOY™ seals in years. All no charge. No questions asked. Instructions for oiling the seal are included with every kit, but they're sometimes overlooked. Since 1990, we've sold tens of thousands of these superchargers. No one has ever been screwed by Kenne Bell. Many superchargers are run hard and often abused. Like any product, a twin screw supercharger has it's limitations. We never run from a problem and do our best to help prevent them. We listen to our customers. We have records of every supercharger sent in for warranty and repair and what the problem was. And we answer questions honestly and to the best of our ability. We try very hard to inform and educate our customers in all aspects of supercharging, including preventive maintenance.

RELIABILITY - We believe that Kenne Bell now has the most knowledgeable Technical Department in the industry and the most honest and straightforward website. And after 18 years in the supercharger business, we've seen it all and feel qualified in our analysis of any supercharger issue, including tuning. Hopefully, we have answered any questions or concerns you may have had about "oil leaks." Feel free to contact us anytime you have further questions.

LOWER OIL LEVEL (20-26 PSI)

The recommended oil level (with the dipstick screwed in) covers a wide range from the top mark (maximum) to 3/8" below the bottom mark. For higher boost levels (20-26 psi) lower the oil to 1/4" below bottom mark on the dipstick as shown. Air temperature also has an effect on your supercharger oil temp i.e. those "hot air" exposed underhood filters we continually warn about. Remember to CHECK LEVEL FREQUENTLY. 3/8" below bottom mark is MINIMUM oil level. Keep oil in this - 1/4" to -3/8" range with 20-26 psi boost.

We hope this information will help you to better understand the limitations of your supercharger and avoid any problems.

TECH NOTE:

Higher rpm and boost will increase oil temperature in any supercharger or engine. For competition and especially high boost street applications, dropping the oil level reduces oil turbulence from the gears and lowers oil temperature and internal pressure.

NOTE: Setting oil level at RACE LEVEL will reduce supercharger PC (power consumption) by 15HP with a substantial reduction in oil temperature at maximum recommended RPM (18,000).

OIL LEVEL GUIDE

- 6-15 PSI Between 2 marks
- 16-19 PSI Between bottom mark and 1/4" below
- 20-26 PSI 1/4" below bottom mark

Fill with small funnel until oil reaches correct level (DO NOT OVERFILL).

DIPSTICK CAP
Check level with dipstick screwed in all the way.

SUPERCHARGER

