

STAHL HEADERS/CAMS
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May 1993

STAHL HEADERS/CAMS NEWSLETTER ISSUE #11

SCAVENGING

After 29 years of being unable to understand how there can be any such thing as scavenging in a 4 cycle engine, I finally found some information to pass on. In the past 12 months I have re-read "The High Speed Internal Combustion Engine" by Sir Harry Ricardo and J.G.G Hempson. I also glanced through Charles Taylors, "The Internal Combustion Engine in Theory and Practice". Recently an acquaintance loaned me MIT professor John B. Heywoods book "Internal Combustion Engine Fundamentals". On page 216 he presents instantaneous pressure diagrams for 1200 rpm and 4800 rpm measured at 2 distances from the cylinder. One being 200 mm and the other is 700 mm. There are a few points where there is sub atmosphere pressure in the exhaust pipe at the 1200 test. However at 4800 there is not one point that appears less than 1.01 atmospheres at 200 mm which showed 2 distinct wave forms whereas the measurement 700 mm away shows 2 major and 4 minor peaks with none less than about 1.3 atmospheres. Heywood specifically says on pg 205 "this chapter deals with the fundamentals of the gas exchange process, intake and exhaust in four stroke cycle engines and scavenging in two stroke cycle engines." The book is available through Classic Motorbooks at

800-826-6600. Heywood's book also points out a condition that I had never considered over the past 30 years nor have I heard anyone else discuss the fact that when the intake and exhaust are both open in overlap with the piston going down on intake stroke that exhaust gets pulled back into the cyl. In fact now that I think about it..there has to be more exhaust pulled back into the cyl when the piston is going down during overlap than intake due to the exhaust system backpressure being much higher than a normally aspirated engines intake tract pressure. I personally have felt shudders go up my back whenever I hear engine people talking about an engine "over scavenging". If you're one of those people who isn't sure what's going on and you hear someone use the term "scavenging" in reference to a 4 cycle engine... tell them Stahl says "bull shit." I think the condition they are describing is too much overlap area combined with poor intake port/bowel fuel atomization. One thing for sure, its all verbal diarrhea until someone takes the time to document port flow in both directions and runs a series of camshafts through 2 engines that are the same other than cyl head flow characteristics in overlap... and does some valid dyno testing... Which brings up another subject.

STAHL HEADERS/CAMS NEWSLETTER QUESTIONNAIRE

Your Name: _____	Specialty: _____
Company _____	Drag Race: _____
Address: _____	Oval Track: _____
_____	Road Race: _____
_____	Other: _____
Phone: _____	Cams Used Most: _____
_____	Flat Tappet: _____
Flow Bench: _____	Roller: _____
Brand _____ Model _____	<i>Please complete & return to:</i>
Dyno: _____	STAHL HEADERS/CAMS
Brand _____ Model _____	1515 Mt. Rose Ave.
Computer: _____	York, PA 17403
	(717) 846-1632 or 846-3123

ATTENTION!

DO YOU WANT TO CONTINUE TO RECEIVE THIS NEWSLETTER?

Check you mailing label!

????? Return above questionnaire to remain on our mailing list for future issues.

XXXXX This will be your last issue unless you return your questionnaire. Those that do not respond are either not reading our newsletter or don't care and, in any event, we don't need to waste. Previous issues are available upon written request only.

EXHAUST SYSTEM TESTING

The following was recently written to the editor of a automotive magazine. References to testing apply to race engines.

As per your request I would really like to write about exhaust systems for street torque/MPG. It is a subject that I have already consumed 450 gallons of fuel chasing. However, based on what I know today about testing exhaust systems, I do not have any facts to write about. The work I have done in the past is not conclusive because we have all been testing wrong for 20 years. The requirements are simple. Run the total vehicle exhaust system in the same configuration as it will be in the vehicle relative to tubing size, length and location of mufflers/components. This engine exhaust system normally has to terminate into a dyno exhaust system. The engine system must not be sealed to the dyno system. The dyno system must have at least 4 times the cross-sectional area of the engine system. Then data acquisition must be used to permit sweep testing the engine and gathering data in 100 RPM increments. Each combination must be run 3 times to ensure data validity. Thus, today I do not know enough

to write an article on the exhaust systems for street cars. But then probably no one else does either. I did see some muffler tests in Hot Rod magazine that were done at McFarland's that appear to be getting closer to being valid (lacked 100 rpm data points). From the pictures I see in most magazine articles of tests being done on engines other people are continuing to make the same mistakes we've made for 20 years.

INERTIAL WHEEL DYNO UPDATE

Nothing to report...almost no progress. However we have made design changes to the Stahl water brake and there's a chance we may be willing to build a few if it passes all the tests over the next 90 days. The brake is a bolt on replacement for a Stuska.

NEW STAHL HEADER MODELS

55-57 SB Chevy chassis exit (2 heights available)
Bush Grand National 180 V6 Chevy
82-92 SB Camaro SCCA American Sedan
82-92 SB Camaro NHRA Super Stock
82-92 SB Camaro (stock eng. loc w/solid mts)

ENGINE WATER FILLING

It is my opinion that most small block Chevs are being raced with inadequate cooling systems. The bottom line is that between the air pockets and lack of water pump output/block/cyl head pressure, that there is a definite lack of cooling ability to pull heat out of the combustion chamber. As soon as slight detonation occurs and elevates the combustion chamber temperature, the cylinder quickly goes into damage causing detonation. With some engines, such as methanol fueled engines, the range between detonation and pre-ignition is very narrow. Pre-ignition is the condition that torches cyl heads, tulips valves and burns holes in pistons. Keep in mind that most SB Chev over heating problems are caused by a combination of incorrect filling of the cooling system, water pump cavitation and/or inadequate air flow through the radiator and lack of use of a surge tank. Pump cavitation is usually caused by insufficient inlet flow capability relative to the outlet flow. The usual methods of controlling pump cavitation are to reduce pump speed via pulley diameters (I started the small crank pulleys), use of restrictors at the thermostat housing or other outlet restriction techniques. Through the years I've seen people create problems by reducing the inlet dia, or having flow inefficient outlets on the radiator. The majority of non-Nascar race cars I've looked at were very negligent in good airflow practice through the radiator.

Banjo Matthews told me in 1976 it cost him over \$50,000 to learn how to fill a cooling system with water. The following is Banjo's method.

- 1) Disconnect the upper radiator hose at the radiator.
- 2) Insert water hose into the radiator hose so you are back filling the engine and radiator.
- 3) When water starts to run out the radiator, connect the hose and start filling the surge tank.
- 4) When the surge tank appears full, start the engine.
- 5) Run at approximately 2500 rpm's until all sign of air bubbles is gone from the water being pumped through the surge tank.
- 6) Cap the surge tank with the engine at 2500 rpm. Do not ever remove the radiator cap unless the engine is at 2500 rpm or you will lose coolant.

Howard Stewart has built a water pump dyno and has done some interesting research.

I predict eventually everyone will run reverse flow cooling systems as it will be the easiest way to get the most pressure in the cyl head water passages. Apparently the drag racing method of using an electric motor to rotate the water pump is the greatest offender. Keep the detonation going gang... the parts suppliers love it.

HUMBLE PIE

We got to eat some humble pie last year thanks to Daniel Brewer from Mercruiser. It appears Stewart Matthews and I did not really invent the honing plate idea after all. Daniel was kind enough to send me a copy of a picture showing an old Chrysler 332 Hemi block being honed with a honing plate back in the days of the Kiekhaefer Chrysler hemi's of the 55-56 era. I saw those cars race at Syracuse and Darlington in 1955 and they put on a show. They certainly were the first team that I would call professionals in American racing. Perhaps there are those that will argue that Briggs Cunningham was the first to form a professional racing team but I don't see it that way. It is my understanding that the IRS forced Kiekhaefer to stop racing because it was set up as a separate business and the IRS used to have a cap on the number of years a business could exist and lose money. Please don't get upset if I've stated this incorrectly. I'll have to buy a copy of Kiekhaefer's book to get the facts straight. Anyway, thanks Daniel, it never hurts to eat some humble pie. It sure swallows easier than seeing a competitor copy one of your products that you've spent a great deal of time developing. Its too bad we don't have more ethical manufacturers in this country. It never ceases to amaze me how many people copy a competitors product and think they've done nothing wrong. They certainly don't perceive themselves as being a thief and that they are stealing. Imitation may be a form of flattery, but you sure can't spend it, eat it, or xxxx it...so what good is it?

STAHL DYNO DEMO PROGRAM

In Issue we announced our new dyno software which we believe to be the most powerful software intended for dyno data analysis in existence. We started shipping Tutorial Demos (\$25) in February and plan to ship the complete working version in April. Call for information.

MEASURING ENGINE AIR CONSUMPTION

Based on the talk that Brian Wolfe from Ford gave at the Superflow conference in Dec. of 91 it appears the only reliable way to measure air consumption of an engine is to measure fuel consumption with a realistic LABORATORY QUALITY fuel flow transducer and measure air fuel ratio with a laboratory grade oxygen sensor and then calculate the air/fuel ratio. As of this date the good sensors are sold by NTK for around \$600. We are currently trying to get spec sheets on some Bosch units that are reported to be as good for the range we are interested in that are less than 1/3 the cost. However, keep in mind that all oxygen sensors will die much quicker if exposed to leaded fuel. I can assure you that attempting to use any OEM production auto sensors is a joke when trying to measure air/fuel ratio on full throttle engines. They will work well at part throttle in the immediate range of 14.7 to 1. The problem with trying to use a production car unit as in (3 or 4 wire) sensor is it has a narrow range of use which is near stoichiometric (14.7 to 1). Thus when it gets out to the 12--12.5 area that we need race engines to be in...the output of the sensor is not linear and has too small a voltage change for a large change in A/F ratio. Don't even bother trying to use one of the old single wire transducers. For information purposes among other things they need a hose to be plumbed from the carb air blower duct (engine air supply is a better label) and that air be carefully blown across the oxygen sensor. The 3 and 4 wire units do not need the air I am told.

I don't know if Superflow has the tapes from previous conferences available, but I highly urge you to call and find out. The tapes have not been expensive for the attendees who have purchased them (around \$100 p/set) and from a seminar standpoint offer even more advantage than attending. If you're one of those who doesn't fly, or just can't afford to attend, buy the tapes. They are not a substitute for attending.

Special thanks to Bill Clemmens of the EPA lab for helping with the understanding of using oxygen sensors.

The MIND is like the stomach. It is not how much you put into it that counts, but how much it digests. *Jay Neck*

COMPUTERS

For some of us, they are as addictive as race cars. For others they represent some black magic box that is to be feared. For those of you who still choose not to touch them.... let me pass on a few words. It's not like any other piece of equipment you have worked with. You can't break it... it is helpless until you and a program tell it what to do. It can be the most frustrating object you have ever tried to co-exist with because it will only do what you and a program tell it to do. If you don't know what the program wants you to do... it will do nothing. BUT YOU AIN'T GOT NO CHOICE if you want to go forward and learn. I know too many that are leaving the interaction of computers up to other people. They will sit along side someone and say... make it do this or that... HEAR MY WORDS TAKE A DOS CLASS...LEARN TO TYPE because you will not be able to go forward at the same pace as your competitors. Hire a high school or college kid to learn the program you want to use and have them sit along side you and every time you want to do something ask them how until you have learned it. You don't have to become a speed typist... 10 or 15 words per minute is enough. You only need to learn instinctively where the keys are... just like you know what knobs to turn which way on your balance machine, or lathe, or mill or whatever....its only another damn tool except you can't break this one like the others when you don't know what you're doing. The majority of Depac owners I talk to, are utilizing no more than 75% of the programs capability. My ego permits me to hire a college kid at minimum wage to come in to learn to use a program and then teach one of us how to use it. If it works for me, it'll work for you. The Depac program is so easy to use, that a high school kid can probably learn it all in 4 or 5 hours. Then have them come in every Sat or whenever you have time to spend 30 minutes to 1 hour at a crack and teach you. It's not important who or how old the teacher is... it's only important to learn. Art Bennett says "being closed minded is fatal."

The average person puts only 25% of his energy and ability into his work. The world takes off its hat to those who put in more than 50% of their capacity, and stands on its head for those few and far between souls who devote 100%.

Andrew Carnegie