Guides

Monday, June 26, 2023 8:24 PM

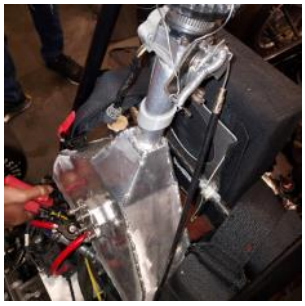
Designing a Press Fit Part

Monday, May 20, 2024 7:04 PM

Engine Removal Guide

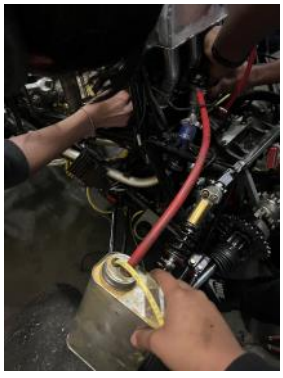
Thursday, November 30, 2023 1:10 AM

Intake and Fuel



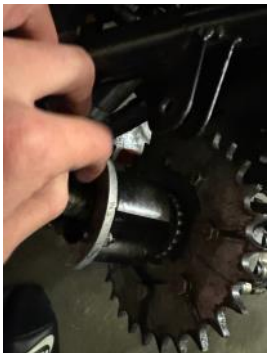
Exhaust

Cooling



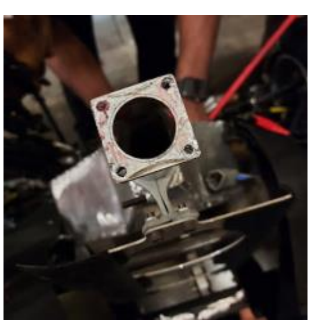
Pneumatic Shifting

Driveline





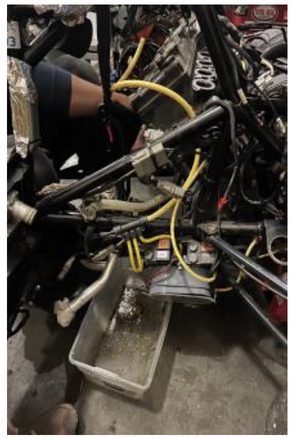


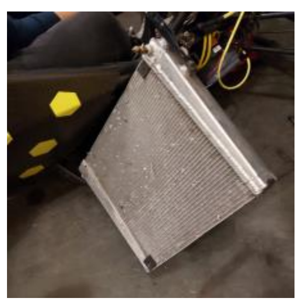


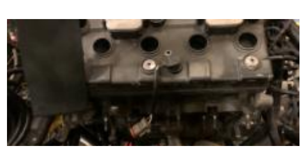


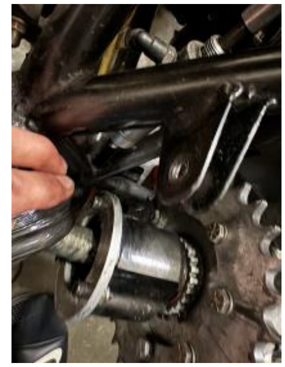




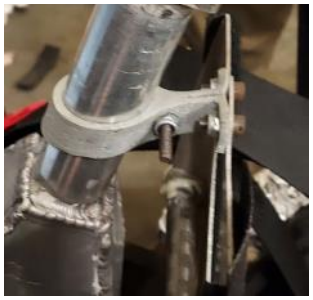


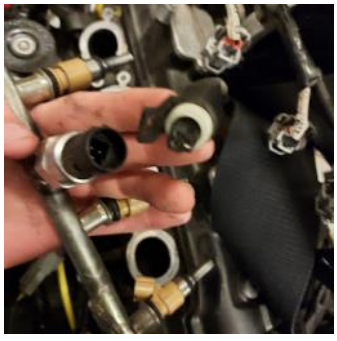












Yamaha R6 Engine Rebuild

Friday, July 28, 2023 7:37 PM

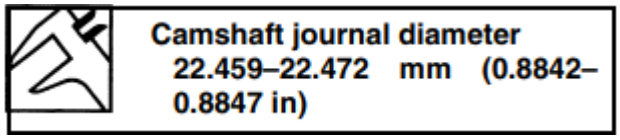
*Please refer to the appropriate service manual if you don't know what you are doing. If you do, I'll save you time and post the important numbers below.

Note: We use 2008 R6 not R6S

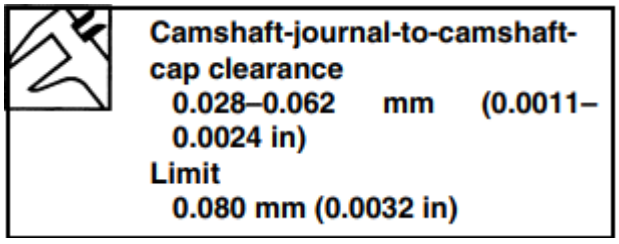
yzfr6xc_2008 Servic...

Clearances:

Camshaft:

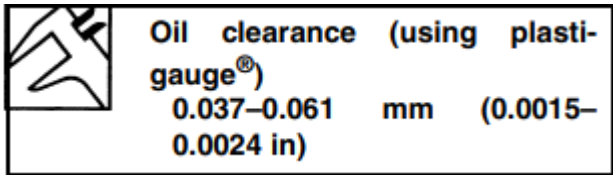


Camshaft journal diameter
22.459–22.472 mm (0.8842–0.8847 in)



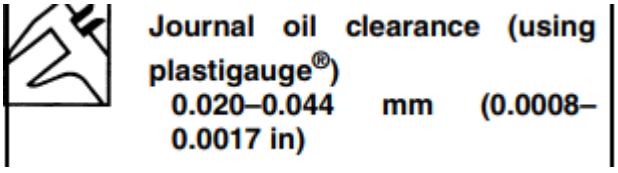
Camshaft-journal-to-camshaft-cap clearance
0.028–0.062 mm (0.0011–0.0024 in)
Limit
0.080 mm (0.0032 in)

Crankshaft:



Oil clearance (using plastigauge®)
0.037–0.061 mm (0.0015–0.0024 in)

*note this is rod bearing clearance



Journal oil clearance (using plastigauge®)
0.020–0.044 mm (0.0008–0.0017 in)

*note this is crank bearing clearance

Cylinder:

*Note this is the piston skirt diameter

Bore
67.000–67.010 mm (2.6378–2.6382 in)
Taper limit
0.050 mm (0.0020 in)
Out of round limit
0.050 mm (0.0020 in)

Piston
Diameter D
66.975–66.990 mm (2.6368–2.6374 in)

Piston-to-cylinder clearance
0.010–0.035 mm (0.0004–0.0014 in)
Limit
0.05 mm (0.0022 in)

Piston ring
Top ring
Ring side clearance
0.030–0.065 mm (0.0012–0.0026 in)
2nd ring
Ring side clearance
0.020–0.055 mm (0.0008–0.0022 in)

Piston ring
Top ring
End gap (installed)
0.25–0.35 mm (0.0098–0.0138 in)
Limit
0.60 mm (0.0236 in)
2nd ring
End gap (installed)
0.70–0.80 mm (0.0276–0.0315 in)
Limit
1.15 mm (0.0453 in)
Oil ring
End gap (installed)
0.10–0.35 mm (0.0039–0.0138 in)

Piston pin outside diameter
14.991–15.000 mm (0.5902–

Piston pin outside diameter
14.991–15.000 mm (0.5902–0.5906 in)
Limit
14.971 mm (0.5894 in)

Piston pin bore inside diameter
15.002–15.013 mm (0.5906–0.5911 in)
Limit
15.043 mm (0.5922 in)

Dyno Basics

Monday, February 8, 2021 7:53 PM

What is a dyno meter?

A dyno uses two drums to create a rolling resistance against the tires of a car. The weight and acceleration of the drums can then be used to calculate the amount of power that an engine produces.

How to set up the dyno:

Hopefully the first time you are trying to dyno a car someone has shown you but if not then this should help.

First you need to get the WinPEP7 software off dynojet's website:

https://www.dynojet.com/downloads/dynamometer/software-firmware/

After you download that you need to go and place this config file in the Program files (x86)>WinPEP7 directory

If you use the data7 (new).cfg rename it to data 7.cfg

data7 (new)

data7

This will allow your computer to connect with the towers that power some of the dyno components.

Next you need to power on those towers.

Then plug the computer in.

To read AFR through WinPEP7 you need to put the O2 sensor connected to the tower in the exhaust

To read RPM on the software you will want to take the clamp that is also connected to the towers and clamp it around the coil wires and clamp the other on the cars ground.

Putting a car on the dyno:

This should seem easy but if you mess up it would be a real bad day.

First roll the car STRAIGHT on the dyno then start ratcheting back till the car is in about the middle of the drum.

Then ratchet the front and back at the same time.

Most importantly roll the dyno with your foot in the direction the car will turn it and ensure that the car tracks straight.

This last step insures the car wont crab walk off.

Getting a graph:

Make sure no one is around the tires or behind the dyno and that the exhaust gasses have proper ventilation.

The driver also needs to understand that he should not slam on the breaks after the run to eliminate extra stress on the straps.

Next get someone in the car and wearing the proper equipment (full racing suit, shoes, helmet, gloves, etc).

Once the driver gets the wheels turning give them a signal to give it the beans.

When you give this signal press the green button on the control connected to the towers to start a sample.

They will need to make sure to give it full throttle.

The most accurate results will be the gear ratio closet to 1:1. However, you can rip through all the gears if you want.

After the driver hits redline or lets off press the green button to end the sample.

The graph will then be displayed on the laptop and saved in the directory mentioned earlier.

The previous style of run is a normal dyno that gives an accurate dyno graph

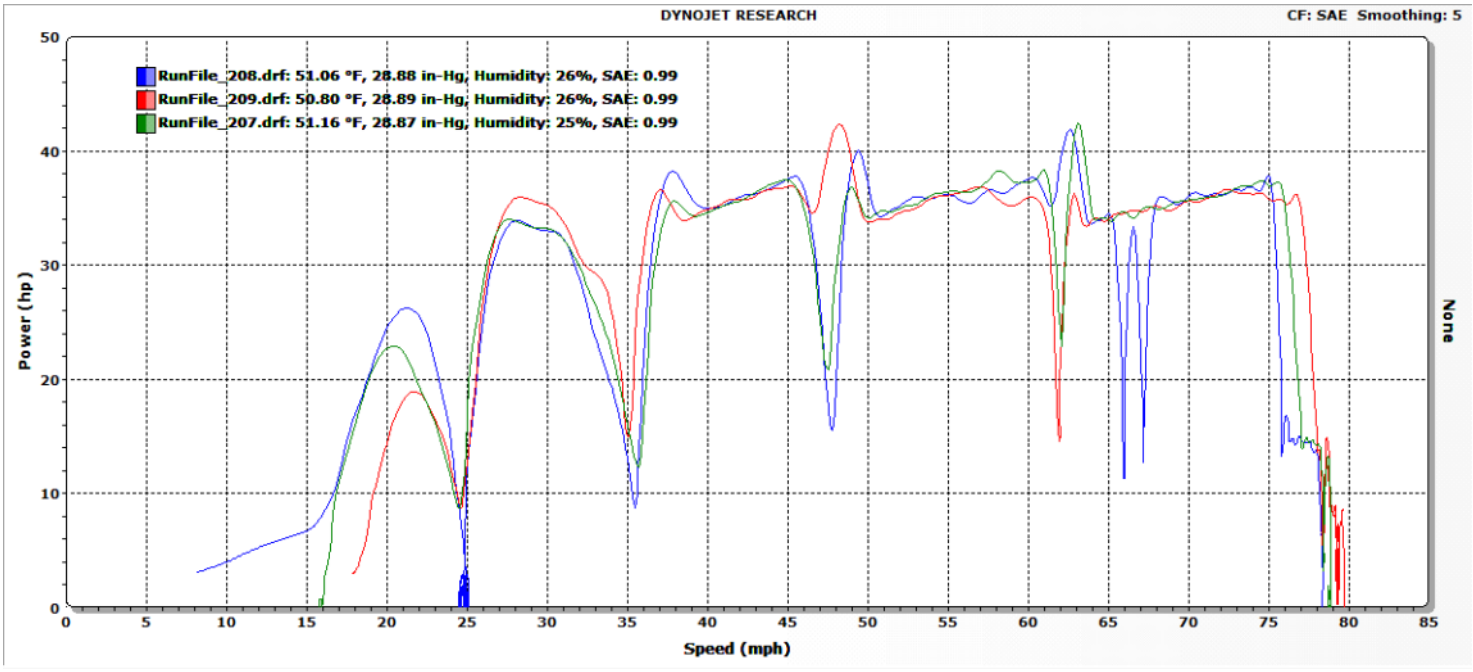
The other kind of run you can do is steady state.

This run will just put load on the engine with the brake and keep the engine at a specific RPM allowing for more tuning precision.

ADDED 12-16-22

The load can be enabled through the pendent by holding the green button while rolling. The amount can then be set in the software by either the value in the bottom left, or by dragging the white arrow on the outside of the load gauge.

Reading a graph:



This is a dyno graph of the 700cc Raptor that was in KS4-R
As you can see we took these graphs going through each gear.
Also you can see the Power (Y-axis) and Speed (X-axis).
So what are you looking for in this graph.
You want to look for highest power but also a graph that keeps that high power pretty uniformly.
If you have a design that makes 5 more horsepower but only at a small range where the other makes 4 more horsepower through the whole graph then the later design is clearly better.
You also want to run the car until you acquire consistent results.
The graphs used in design decisions should also be recorded and clearly documented.

Troubleshooting

If you are having trouble connecting to the dyno, and have followed all the steps above, check the lights that are on the tower. If there are not two yellow blinking lights, the battery in the bottom stack may be dead. If you were unaware that the tower blinked yellow lights the photo bellow should help.

If the yellow lights are not flashing then this PDF attached below should also help you change the battery.

EX_Battery
_Replace...

beans

Tuning Basics - To be updated

Monday, February 8, 2021 7:52 PM

What is a tune
- A tune is a reference for the engine control unit (ECU)
- The ECU controls almost everything on the engine
  - When fuel or spark events should happen
  - Where are the sensor data is sent to and processed
  - How much fuel should be injected for certain parameters
- This is essential to any electronic fuel injected (EFI) engine since most everything is done electronically.
- This also helps insure that you are achieving a good volumetric efficiency (VE)

How to tune
- The ECU uses a software called tuner studio.
- This software has a premium version to allow for some auto tune features I will get into later.
- First there are a few things you should check.
  - What is the firing order for that engine.
  - What is the size of the fuel injectors and engine.
  - What is the redline set at and how comfortable are you with the current tune if you are unsure bring the redline down anyways.
  - What is the trigger wheel settings for that engine and is there any reason those would be wrong
  - What timing are you on for an initial startup try running a fixed timing instead of the table
  - Do you have a cam, map, TPS, or O2 sensor.
  - Are the injectors and coils in the right order (check this with the test mode)
  - Are your sensors calibrated correctly do those values make sense for what the car is doing when not running.
  - If the engine is not hitting check to see if the cam and crank are logging in the high speed logger.
- Tuning fundamentals
  - Once the car is running you should check your AFR (air to fuel ratio) if this is not within 12.7-14.8 after warming up you should adjust the VE table until the AFR is within those ranges. (this can be done with auto tune).
  - After this you will want to let the car cool down and see if the WUE (warm up enrichment) looks like a gradual slope and that the AFR offset goals look adequate.
  - Assuming you are running a fixed timing you will want to start implementing the timing table. You will have to make an educated guess on what the timing should be and keep bellow 6k until the timing values are worked out well.
  - After that you will want to up the rev limit 1k at a time this gives you a little more safety from damaging the motor. To start you will want to duplicate the timing from the column to the left to the new column. Then edit according to sound again. At some point you will need to stop and get nock sensors because once you can here the knock something is already damaged. So progress at your own risk and level of knowledge.
- More advanced tuning
  - Run the car with sequential injection and spark, this will require a CAM sensor so the ECU know the exact events to do these rather than just wasted spark and fuel.
  - To achieve more accuracy you should also run the car off the MAP (mass airflow pressure) this will tell the ECU exactly how much air it can get rather than how open the throttle is.
  - The AFR will very per each cylinder so at some point you should put an O2 in each runner.

Jesse D. Notes and possible stuff to add

Tuning Basics add-

Set up and searching for port aka connection problems, making new project, concept of "Burning", saving tunes

Specific parameters of motors we have aka firing order, injector size, etc.

Where key setup parameters are stored, which situations call for which settings etc

Which Key parameters and systems should be turned off to avoid problems?

Setting up and calibrating sensors inputs, values, displaying them on gauge cluster

Testing sensors aka Composite logger for cam and crank, Logging to MegaLog viewer

Possible troubleshooting process for if car will not run on initial startup

KS7-Design Notes

Friday, July 21, 2023 4:58 AM

Cooling Code

Thursday, September 14, 2023 11:51 PM

- Repurpose Omni code to read temps from thermocouples
- Reading/Logging temp data
- Read four thermocouple inputs -> log to SD card
- Serial communication
- Logging in .csv
- Assign chip select to each pin (data will constantly shit out so this is necessary)
- Constantly read data-in
- Ask chance/matty about switch statement (switch between thermocouples to log them)

Rad Characterization

Tuesday, July 2, 2024 5:36 PM

Primary design goals:
Correctly categorize the radiator size according to accurate flow rates and temperature deltas. We would like to downsize the rad core size to drop some weight off the car, as we understand that ours is oversized to some degree. There was previously no validation/analysis done for the selection of the radiator nor the size of it. At some point in the past one of the IC cars kept blowing heads, so previous members just put a huge radiator on it so it wouldn't blow up.

Still need:
- Get thermometers
- Thermocouples with bungs

Notes:
Currently the mounting of the thermocouples will be placed underneath the hose secured by only the friction of the hose and the clamp against it. Ideas of cutting a hole into the tube and adding bungs might be incorporated, but since we already have most of the items we need now, we can proceed with the current solution.

Current OD of ideal hose is 1.375"

Water pump is EWP 80
https://daviescraig.com.au/electric-water-pumps

Good Radiator Document:
https://www.irjet.net/archives/V6/i3/IRJET-V6I318.pdf

Radiator Website:
https://www.pwrna.com/product-category/aluminum-radiators/universal-radiators

Bungs:
https://pittsburghpower.com/products/bung?srsltid=AfmBOopdC3rcJKgzYrf0esPoKlzTgv8zNqRZvp-N-vSctqey1WRV2TJL

Thermometer:
https://www.amazon.com/Laboratory-Thermometer-305MM-Scientific-Home/dp/B01ND4CARX/ref=sr_1_9?crid=2SIIA4UI3XD2N&dib=eyJ2IjoiMSJ9.A1TNaJ1rH4NVVwQI-IvWh8S-YxUligcQyaI5aCfIKGmFqwTD4js3E1aXKtIlC45MopeCxmjUf1akXVUu-a24Hu1nBvDB_7tO5QrjQCstfzYJCr9EOLRB2jgA013ai8-VvnzlkN2zkDY9P2B9QOVJ5IZUPW2zDrKje1wlyhMccnDcjgmpmikq2Sv_IWInYmtE6piP7cQyIbu2a-MgmNnQ4U-zKutDNJ1YUm59aeXM6js.7YtYxkf7VHSWw5jRNfAZEFjvS89qvy_Dx-_pQbjLnJk&dib_tag=se&keywords=thermometer+lab&qid=1719972988&sprefix=thermometer+lab%2Caps%2C96&sr=8-9

Thermocouples:
https://www.amazon.com/dp/B07W6PFCXF?ref=cm_sw_r_cso_cp_apin_dp_5WM1J21HVAPRX10FTPAH&ref_=cm_sw_r_cso_cp_apin_dp_5WM1J21HVAPRX10FTPAH&social_share=cm_sw_r_cso_cp_apin_dp_5WM1J21HVAPRX10FTPAH&starsLeft=1&skipTwisterOG=1

EV 6 AN fittings:
https://www.summitracing.com/parts/fra-498303-bl

https://www.summitracing.com/parts/rus-614405

(will look for cheaper options later)

TO-DO LIST:
1. Complete BOM
2. Start finding radiators & speccs
3. Test DAQ system
   a. Mini k-type thermocouples might not be an option and will cause an inaccurate analysis of the radiator
   b. Look for standard K-types and figure out bungs (they will work with the four-channel logger as long as they are k-types)

How can we do this:

If we can determine the heat rejection of the radiator, we can then determine whether the radiator surface area/core size can be downsized. To determine the heat rejection of the radiator, you need to measure six values:
1. Mass flow rate of water coming out of the water pump
2. Radiator Inlet Temperature
3. Radiator Outlet temperature
4. Ambient Temperature (Temperature going into the radiator)
5. Exit temperature of the air going through radiator
6. Specific heat capacity of water

Using these six factors you can calculate heat rejection of the radiator:

Required Items:
1. Freddy gizmo (four channel k-type thermocouple logger) with four k-type thermocouples (if it logs to an sd), or we can use the gizmo I made at the start of the year if it can be properly calibrated. We adapted the omni code to read temperature off the sensors but could not seem to get them to read the correct temperature
   a. The gizmo should be somewhere on the LV bench, it is just four adafruit modules soldered onto a protoboard with some displays on it.
   b. If we need more k-types I should have them at home, and if we need another teensy I do also have a few at home, idk if the one from my gizmo ever got colonized for some other daq gizmo.
2. Bungs/AN hardware fittings for the thermocouples to sit in.
   a. These can either be purchased (something like this https://www.amazon.com/Aluminum-Fitting-Female-Swivel-Adaptor/dp/B07NSJF2X8 and then the tops can be sealed with silicone)
3. Hall effect flow meter, I purchased one myself previously but it was far too large.
   a. Figure out the flow rate of the water pump on ic to purchase a properly sized flow meter

Possible concerns:
1. The thermocouples will kind of just be flying around in the liquid, which might affect the accuracy of the readings we're trying to get (I think).

1st Make sure that the thermocouples placed on the inlet and outlet of the radiator are measuring accurate readings.
2nd Place thermometers in front and behind the radiator. Infront of the radiator should just be the ambient temperature, and when measuring the exit air temperature of the radiator, try to measure at different distances ex; 5 cm, 10cm, 15cm, and 20cm. See if there is much of a discrepancy between these values. Ideally you do not want to be too close where you get the radiation off the radiator but you can't be too far where you do not get an accurate temperature reading. The exit temperature of the radiator will be used for calculations.
3rd Once all four temperatures have been collected it is time to do some math. First we find the rate of heat transfer (Qdot)

$$\dot{Q} = \dot{m} C_p (\Delta T)$$

$\dot{Q}$ Rate of Heat Transfer

$\dot{m}$ Mass flow rate

C_p Specific Heat of Water

$\Delta T = (T_{ow} - T_{iw})$ Temperature of Water

The temperature of the inlet and outlet of the radiator are being used for this initial calculation only.
We are able to find the mass flow rate from the specifications of the water pump (no need for sensors). Specific heat hardly ever changes its value but would be useful to know it will slightly vary at different temperatures.
4th After solving for the rate of heat transfer, we will use this next equation that solves for the logarithmic mean temperature difference:

$\Delta T = (T_{ow} - T_{iw})$ Temperature of Water

T_{ow} Temperature Outlet Water

T_{iw} Temperature Inlet Water

T_{oa} Temperature Outlet Air

T_{ia} Temperature Inlet Air

$$\Delta T_1 = T_{iw} - T_{oa}$$

$$\Delta T_2 = T_{ow} - T_{ia}$$

$$T_{lm} = \frac{\Delta T_1 - \Delta T_2}{ln(\frac{\Delta T_1}{\Delta T_2})}$$

- Temperature being overdefined?
- Close off a section of the radiator, perhaps tape off a section of the radiator and conduct the test.

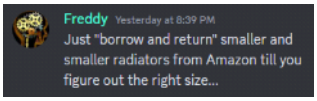
5th Now you should have both Tlm and Qdot, with this information we will plug it into our final equation where we can find the overall heat transfer coefficient (U).

$$\dot{Q} = UA_s\Delta T_{lm}$$

U Overall Heat Transfer Coefficient

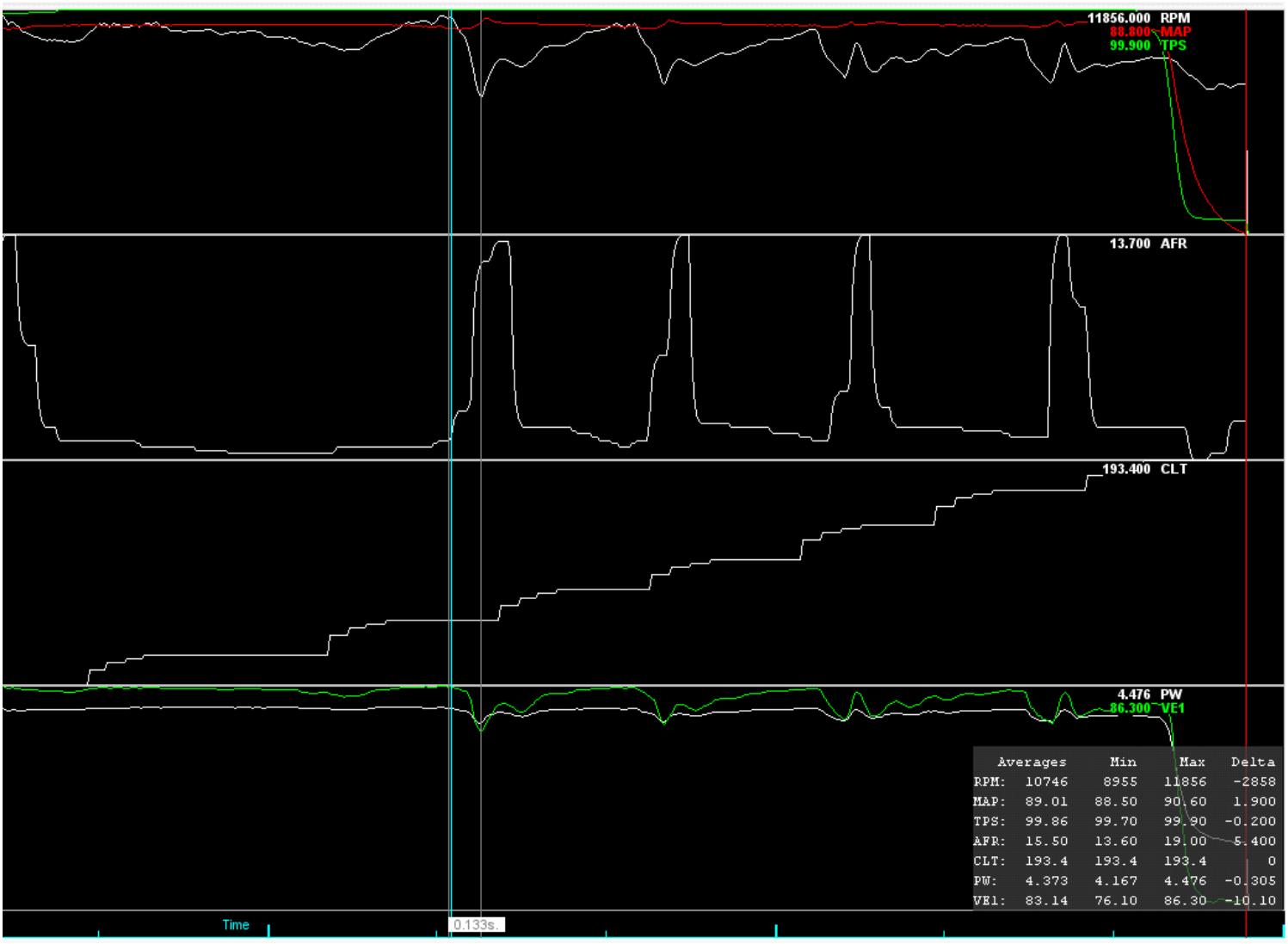
A_s Surface Area of Radiator

(PS another option to test this could be just doing this lol)



Launch Control

Wednesday, August 23, 2023 9:35 PM



.133 seconds of launch

Goal is to be 20 percent faster during launch which is .1064

Headers

Friday, July 21, 2023 4:57 AM

Primary Design Goals:

- Increase peak HP and Torque
  - Increase Exhaust scavenging by increasing negative pressure in cylinder during valve overlap
    - Achieved by proper exhaust runner length
    - We can't measure the pressure in the cylinder, but we can be conscious of the order of the exhaust pulse(Firing Order)
      - This can help in the thought process of how to run the tubes
  - Decrease backpressure
    - Do not want the negative pressure wave to have the fight back pressure on the way back to exhaust port
    - Achieved by proper exhaust runner diameter, equal length runners, and maximizing velocity of the air moving through runners.

Secondary Design Goals

- Easier Installation

Design Constraints:

- Packaging
  - Need to get dimensions and make a sketch of the box headers can fit in
- Sound
  - Probably more of a problem at speed rather than idle

Thoughts and Questions:

- Based on the VE table we can use data we have to generate a rough idea of volume of air in and out.
  - Maybe write a script to solve this in matlab
  - What could we do with this data
  - Based off this we should be able to get a diameter of tube
- The BSFC test will also help in this.
- How would we get a length?
- When does the Valve overlap occur

Reference Material:

EQUAL LENGTH tubular vs. LOG manifolds (headers) - SCAVENGING and EXHAUST BACK PRESSURE EXPLAINED

VIT Formula SAE exha...

UGM FSAE exhaust h...

CAD Notes:
Distance from cylinder 2 port to right plane: 1.5152in

Cylinder 1 to 2 :
in
Cylinder 2 to 3 : 2.8561in
Cylinder 3 to 4 : 2.8525in

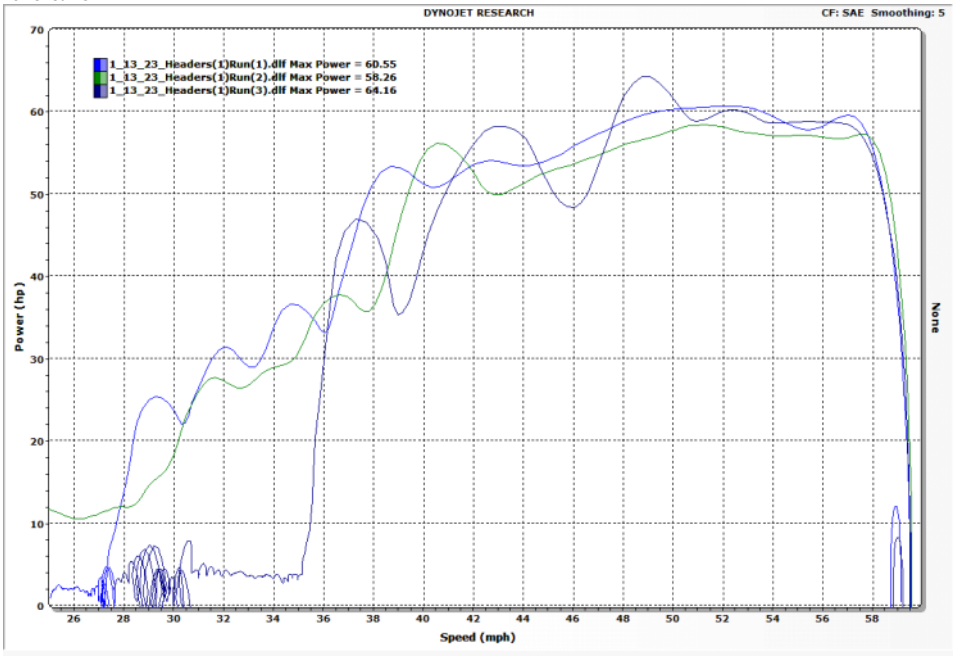
Headers Testing 1/13/23

Friday, January 13, 2023 9:46 AM

Problems encountered:
See google photos for failures

- Spark plug snapped off in cylinder head
- Spark plugs fouled
- Engine in car had clutch/oil starvation issues, swapped engine from car to ETS
- Engine had cam gear slip & mess up timing and scored cam gears due to loss of oil pressure
- Put stand originally on ETS back onto ETS
- Battery kept dying & required tender
- Wiring for switches was incorrect
- Oil & fuel pressure sensor broke
- Flex in the stand
  - Cut out bad support
  - Welded in better support for the stand itself
  - Welded the Engine Mounting Plate to the stand
- Torque snapped the two bottom "Engine Mounts"
  - Welded 3/4in x 2in steel bars onto the stand to connect to the upper engine mounts
- Electronic throttle body
  - Mounting bracket was not manufactured correctly
  - Initial setup used DC power from ETS battery with buck converter for 5V Supply, controlled with Arduino
  - ETB servo voltage would drop during crank, causing it to reset and close along with other funky behavior
  - Switched power supply to a separate 5V power supply which fixed the issues with the ETB
  - Had issues with servo & calibrating the range of motion
  - Tried a 9G servo from microcenter, but the gears had too much slop & would cause the idle to surge 10% up and down
    - https://www.microcenter.com/product/647077/leo-sales-ltd-plastic-gear-servo-180
  - New proper servo from HobbytownUSA fixed the sloppiness and should help remedy most of the other issues with the ETB. A proper bracket should be made in the future
- Chain jumped and the sprocket between engine and dyno on the dyno side was destroyed. This marks the end of Headers testing on ETS.
- Log manifold would not fit due to the supports added to brace the engine
- USB to Serial adapter originally on dyno kept messing up, so we replaced & duct taped the new adapter in (because it would fall out otherwise)
- Dyno software kept crashing randomly (fix computer)

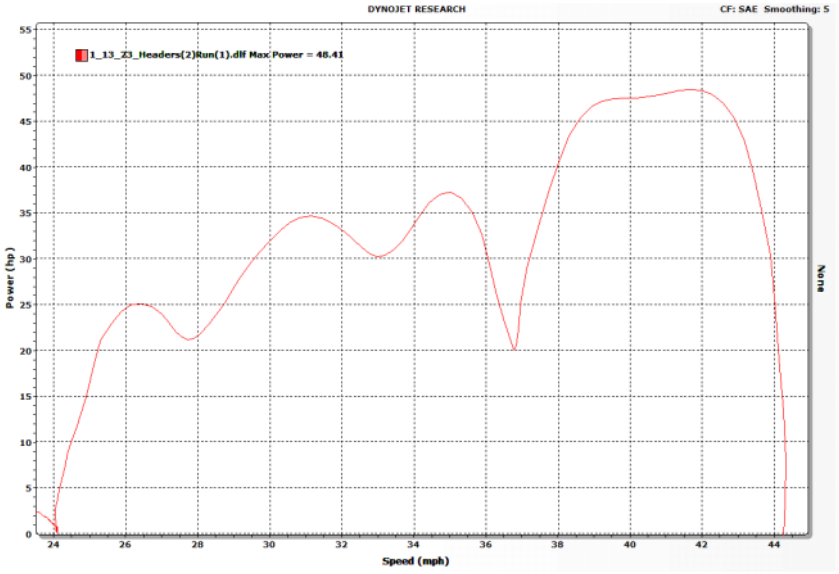
Power Curve



Headers 1:

Headers 2:

Power Curve:



Notes:
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Final notes on test:
The VEAL and afr aspect of the test was negated as there were no mufflers which would fit each set of headers. The sound recording was omitted as each header went beyond the limits of the sound meter's measuring device. Data was collected on the two sets of headers, with the second set of headers only having one run. We attempted to test the log, but the reinforced mounts we added prevented the headers from being mounted. All in all, some useful data was collected from the runs and can be used to design the new sets of headers. It would have been good to test more sets of headers, but considering the situation of the test we are satisfied with the testing.

Dyno Graph Files:

1_12_23_Pretesting(...

1_12_23_Pretesting(...

1_13_23_Headers(1)...

1_13_23_Headers(1...

1_13_23_Headers(1)...

1_13_23_Headers(1)...

1_13_23_Headers(2)...

Datalog Files

run

Header 1 Run 1

Header 1 Run 2

Header 1 Run 3

Header 2 Run 1

Tune Used

2023-01-13_Headers

Engine Test Stand

Friday, July 21, 2023 5:05 AM

BSFC Testing

Wednesday, August 9, 2023 12:55 AM

Calculating BSFC using MEP:

$$BSFC = \frac{\dot{m}_f}{P_e} \quad (1)$$

where:

$\dot{m}_f$ *[kg/s]* – fuel mass flow rate (measured on the engine dynamometer)

P_e *[W]* – effective (brake) engine power

BSFC [kg/J] – brake specific fuel consumption

Usually, the fuel mass flow rate is measured in *[g/s]*, the engine power in *[kW]*, which gives the brake specific fuel consumption in *[g/kW·h]*:

$$BSFC = \frac{\dot{m}_f}{P_e} \cdot 3600 \quad (2)$$

Engine power is the product between engine speed and torque. Therefore, we can express the BSFC function of engine speed and torque.

$$BSFC = \frac{\dot{m}_f}{\omega_e \cdot T_e} \quad (3)$$

where:

T_e *[Nm]* – effective (brake) engine torque

ω_e *[rad/s]* – engine speed

Engine torque *[Nm]* can also be defined function of the mean effective pressure (MEP) of the engine.

$$T_e = \frac{n_c V_d p_{me}}{2\pi n_r} \quad (4)$$

where:

n_c *[-]* – number of cylinders

V_d *[m^3]* – cylinder displacement (volume)

p_{me} *[Pa]* – mean effective pressure

n_r *[-]* – number of crankshaft rotations for a complete engine cycle (for 4-stroke engine $n_r = 2$)

Replacing (4) in (3), we can write the formula of the brake specific fuel consumption function of the mean effective pressure of the engine:

$$BSFC = \frac{2\pi n_r \dot{m}_f}{n_c V_d p_{me} \omega_e} \quad (5)$$

*

1. Gather Torque and RPM data of stock r6
2. Use torque data to gather MEP
3. Use MEP to gather BSFC while varying mass flow data
    a. Mass flow data should start with our current mass flow and vary it in 5 percent increments in both directions
4. Plot MEP and Torque on Y, Rpm on X, and BSFC on Z
5.

Fuel injector characterization

Wednesday, August 2, 2023 12:52 AM

https://ls1tech.com/forums/tools-fabrication/1951876-diy-fuel-injector-test-calibration-arduino-2.html

https://ls1tech.com/forums/fueling-injection/1961598-fuel-injector-characterization-testing.html

http://injectordynamics.com/articles/gm-injector-characterization/

Min 1x of each, 4x would be better so can do all set at once

Mosfet driver
Load cell min 1kg
ADC converter (we have these)
2L soda bottle
Arduino
Fuel rail

Need to assemble physical load cell platform, soda bottle, fuel rail, injector guy
Control circuit to pulse injector and see
Code for datalogging and control loop

EV Spool

Tuesday, October 10, 2023 9:41 PM

Design Features:

- ~~Sprocket on the Axel Side~~
- ~~True sin splien(Continues Cut)~~
- ~~C Clip2~~
- ~~Thinner Flange or No Flange~~
- Dip for Bearings to slide over (post-engineer it)
- ~~Change spool holes to 10-32~~

C clip vs Bolts
Torque= f*d
Torque 170 ft*lbs
Mracts 228, 220 nm

Justifications:

Lightweight
Manufacturability
- Ease of bearing Installation

Changing sprockets
Failure Prevention
- Bolt Grinding

@brendon these are not well detailed justifications for this component, you should also put some of the parts reqs and boundaries on here

Test Plans

Tuesday, June 25, 2024 9:10 PM

Intake Redesign

Tuesday, June 25, 2024 9:10 PM

Objective:

An intake redesign can be beneficial to the overall performance of an internal combustion engine. It is important to design a system that inputs laminar flow into each of your engine cylinders through a wide RPM range. The more air that goes in, the more power comes out. Specifically, it is important that the intake of air is equal in all cylinders to provide the highest efficiency. Maximizing air velocity will decrease the time it takes to start our power band. Computational Fluid Dynamics (CFD) can be performed on a Computer Aided Design (CAD) to prove that the flow into each intake cylinder is equal.

Launch Control Testing

Tuesday, August 6, 2024 7:55 PM

Goals:

Test the ECU LC function to see if it can be used with or without pneumatic LC to produce a fast car in accel

Deliverables:

Raw Accel Times for:

- No LC
- Pneumatic LC
- ECU LC
- Combination Pneumatic LC and ECU LC

60Ft times for:

- No LC
- Pneumatic LC
- ECU LC
- Combination Pneumatic LC and ECU LC

Determine the Best Launch Control Setup for Accel

Test Pre-Checks:

- [ ] Do we have LCOs
- [ ] Does Launch Control Trigger work
- [ ] Do we have Wheel Speed Sensors
- [ ] Do we have a charged co2 tank
- [ ] Have Fluids Been Checked
- [ ] Have bolts Been Checked
- [ ] Do we have ECU cable
- [ ] Do we have Micro USB cable
- [ ] Have we saved a copy of tune before Testing
- [ ] Have we cleared old logs in ECU
- [ ] Have we set-up appropriate Logging parameters
- [ ] Do we have someone writing shit down in car log

Test Procedure:

- [ ] Set up timing gates to measure 60 ft times and raw accel runs
- [ ] Perform 6 accel runs with no launch control to have a control variable
- [ ] Set the Pneumatic LC to dump the clutch
- [ ] Perform one run with pneumatic LC
- [ ] Increase the amount of clutch slip in the pneumatic LC system until the times start going up instead of down.
- [ ] When the pneumatic LC starts decreasing performance, revert to the last best position
- [ ] Enable ECU LC
- [ ] Set up initial parameters
- [ ] Run once with initial parameters
- [ ] Decrease the launch Hard Limit by 1000 and perform a run
- [ ] Do the previous step again
- [ ] Set the launch Hard Limit to the value that produced the best time
- [ ] Increment the soft Limit Zone TBD
- [ ] Change The limiter Method from Spark Cut To Spark and Fuel Cut and Perform a run
- [ ] Blend the settings together and allow for 2 or 3 runs for the tuner to experiment and blend the

settings together

- [ ] Set Pneumatic LC to Best Settings and ECU LC to best settings and Perform at least 6 runs
- [ ] Analyze the results

Test Data

Friday, July 21, 2023 5:33 AM

Testing Plan Before Comp

Wednesday, April 17, 2024 8:59 PM

-

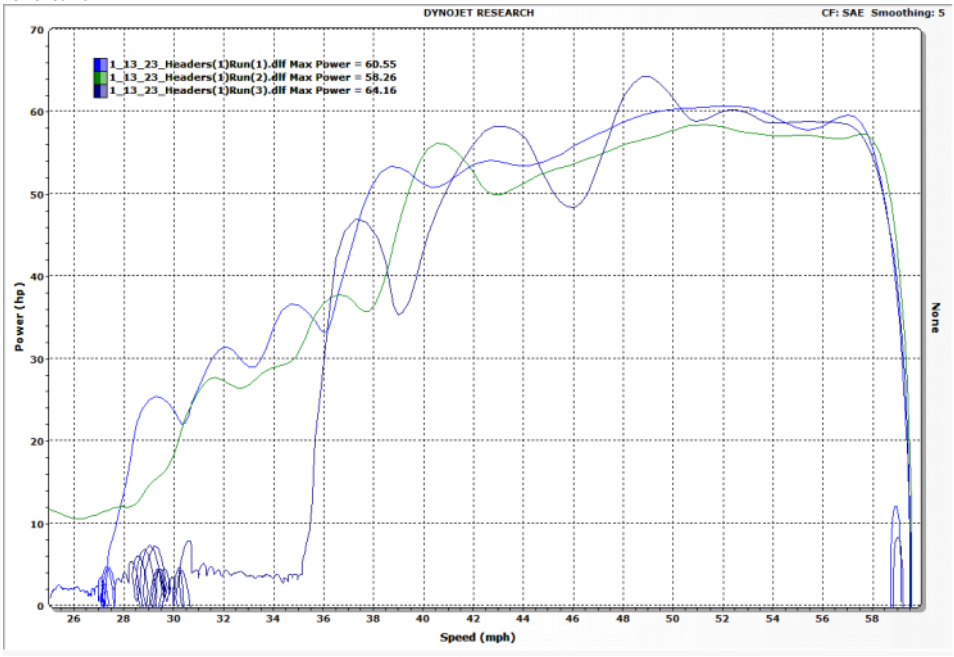
Headers Testing 1/13/23

Friday, January 13, 2023 9:46 AM

Problems encountered:
See google photos for failures

- Spark plug snapped off in cylinder head
- Spark plugs fouled
- Engine in car had clutch/oil starvation issues, swapped engine from car to ETS
- Engine had cam gear slip & mess up timing and scored cam gears due to loss of oil pressure
- Put stand originally on ETS back onto ETS
- Battery kept dying & required tender
- Wiring for switches was incorrect
- Oil & fuel pressure sensor broke
- Flex in the stand
  - Cut out bad support
  - Welded in better support for the stand itself
  - Welded the Engine Mounting Plate to the stand
- Torque snapped the two bottom "Engine Mounts"
  - Welded 3/4in x 2in steel bars onto the stand to connect to the upper engine mounts
- Electronic throttle body
  - Mounting bracket was not manufactured correctly
  - Initial setup used DC power from ETS battery with buck converter for 5V Supply, controlled with Arduino
  - ETB servo voltage would drop during crank, causing it to reset and close along with other funky behavior
  - Switched power supply to a separate 5V power supply which fixed the issues with the ETB
  - Had issues with servo & calibrating the range of motion
  - Tried a 9G servo from microcenter, but the gears had too much slop & would cause the idle to surge 10% up and down
    - https://www.microcenter.com/product/647077/leo-sales-ltd-plastic-gear-servo-180
  - New proper servo from HobbytownUSA fixed the sloppiness and should help remedy most of the other issues with the ETB. A proper bracket should be made in the future
- Chain jumped and the sprocket between engine and dyno on the dyno side was destroyed. This marks the end of Headers testing on ETS.
- Log manifold would not fit due to the supports added to brace the engine
- USB to Serial adapter originally on dyno kept messing up, so we replaced & duct taped the new adapter in (because it would fall out otherwise)
- Dyno software kept crashing randomly (fix computer)

Power Curve



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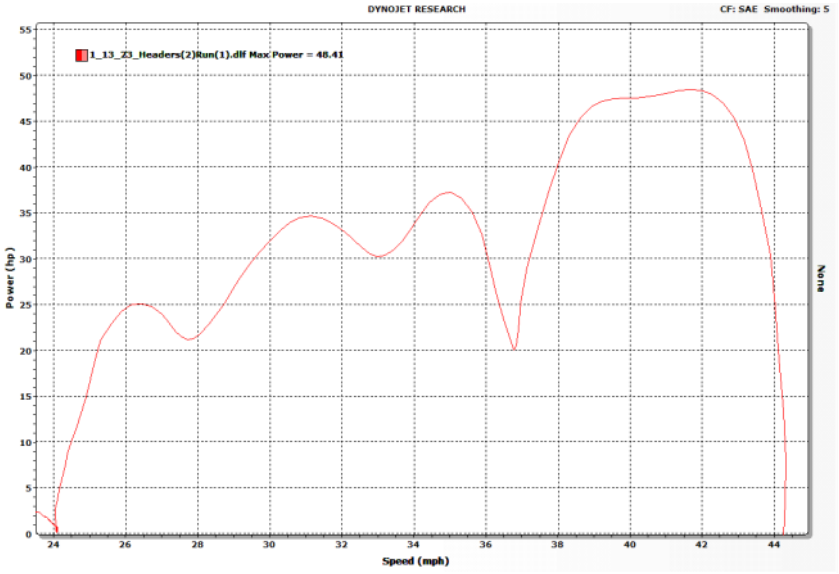

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1_13_23_Headers(2)...

Datalog Files

run

Header 1 Run 1

Header 1 Run 2

Header 1 Run 3

Header 2 Run 1

Tune Used

2023-01-13_Headers

Pneumatic Shifting Test 2-28-24

Thursday, February 29, 2024 7:34 PM

Tested number of shifts we were able to get out of a CO2 Tank & one of our standard air tanks on the KS8-C Pneumatic shifting system (not with chance's new code don't think it should make a difference though)

- Procedure
  - Repeat shifting up and down in sequence repeatedly until tank is empty & count number of shifts
  - Swap tanks
  - Repeat
- Tank Details
  - 12 oz CO2 Tank, no regulator on tank to check pressure (I believe it was freshly charged)
  - Standard air tank filled with 1900 psi
  - Results
    - CO2 Tank – 478 shifts
    - Air tank – 248 shifts @ 1900 psi

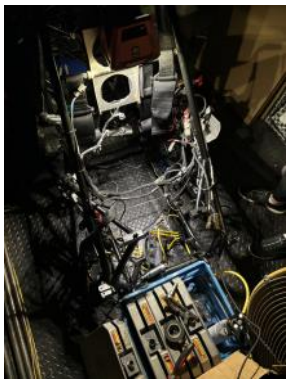
Air Tank

248 shifts / 1900 psi = x shifts / 3500 psi
X = 456.842105263 shifts

So @ 3500 psi theoretically we should have ~456 shifts which is less than the CO2 tank. If we could fully charge the tank to ~4500-5000psi we would get more out of air tank

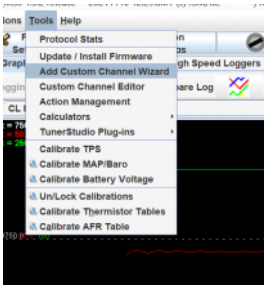
Additionally, we did not notice any major cooling of pneumatic components from the CO2 tank, only the main line directly after the regulator had a noticeable change in temperature and even so it was not freezing, however the regulator did get pretty cold (should have probably measured the temp lol but it was not a CO2 regulator).

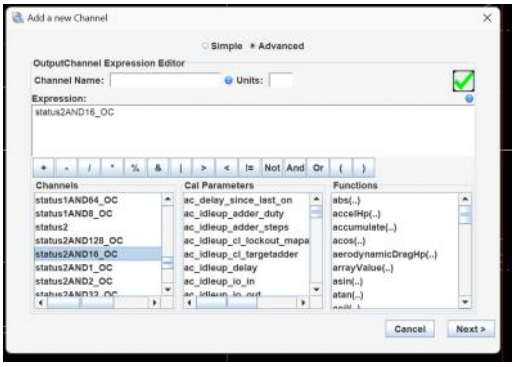
(if someone knows how to do psi calc for pressurized CO2 tank given max volume please put in here)

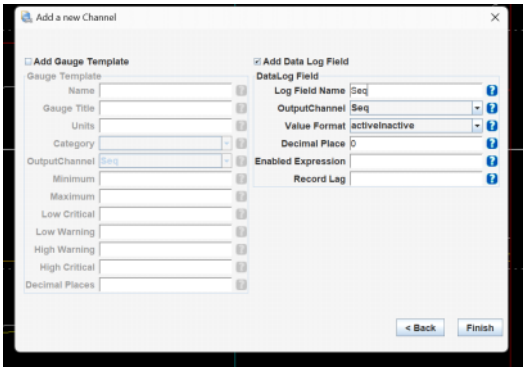


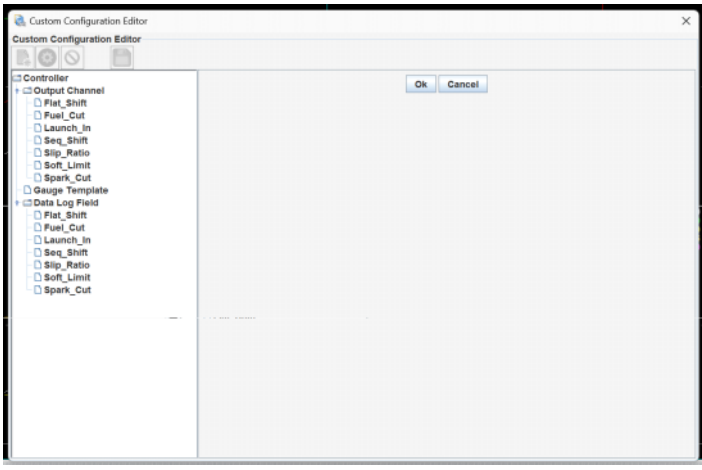
Tags: spark cut megasquirt ms3 shifting log megalogviewer how to view shifting spark cut

5/4/23
I added custom channels which read the status 2 & 3 bits to show the status of spark cut and seq. shift. See the manual for decoding them, this should? Be programmed into the ECU and carry over ms3 projects but idk lol so maybe not, either way going to see if it logs







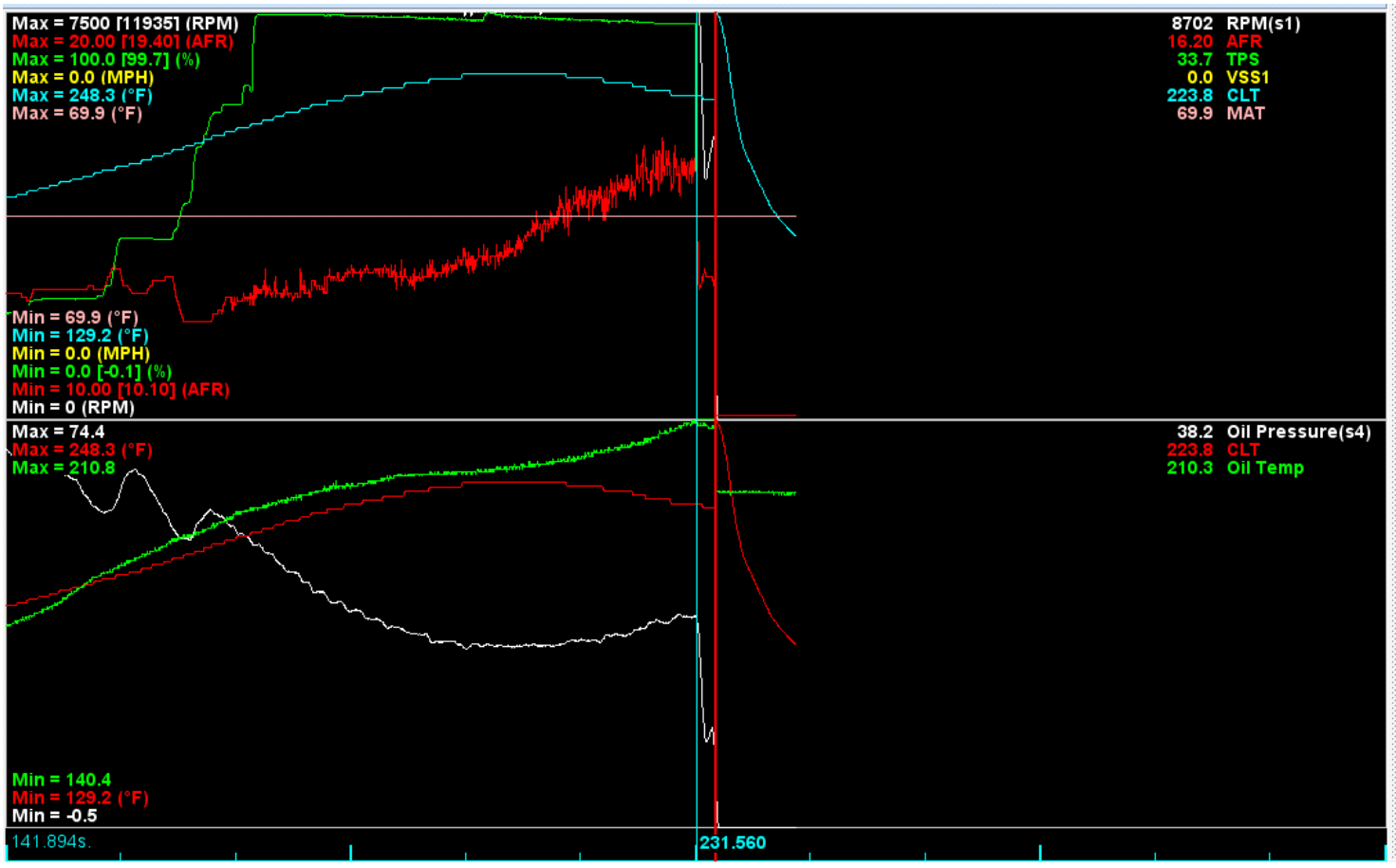


Oil Cooler test 12/16/22

Monday, December 19, 2022 2:40 PM

Put car on dyno to complete oil cooler test as per procedure. Took a bit to get running as noted in the car log, but we were able to get it going on the dyno. The following logs were taken while figuring out the dyno brake and other factors. The first log, _On, has a recorded event of the burst place popping near the end of the log at the small RPM spike. The final log, _On3, is the final and actual test run we conducted. We were able to get 57.6 seconds into the test under 100% TPS before the muffler started shooting sparks/cat material all over dyno, and then the test was stopped. The video below shows the aftermath of the muffler immediately after. The current theory is the built in cat in the muffler got super heated and started burning. It may have been possible to continue running, but it was decided to stop the run.

<u>With such a short run time, the test is inconclusive and thus the oil cooler should be kept on until further testing is done.</u> The oil temps did reach 210°F by the end of the 57.6 seconds, with coolant at 225°F, however this does not mean too much as the CLT temps were still higher than the oil, and thus the oil was still coming up to temperature.



2022-12-16 _Oil Coole...

2022-12-16 _Oil Coole...

2022-12-16 _Oil Coole...

2022-12-16
_Oil Coole...

Meetings

Tuesday, October 10, 2023 8:54 PM

8/27/24

Tuesday, August 27, 2024 6:33 PM

Agenda:

Discuss Responsibilities of Project Roles
Discuss the finalized Projects

Meeting Deliverables:

- [ ] Every project group should have a hour or 2 a week to discuss project tasking And every member should be able to go to the meeting.
- [ ] This Schedule should be documented in this meetings.
- [ ] Schedule meetings with EnD Leads to discuss the ins and outs of the project.

Projects:

Headers:
- Manager- Brenden
- Member- Carter Brown
- Manufacturing Advisor - Marco

Intake:
- Manger - Paddy
- Plenum - Aneila and Liz and bryson D
- Runner Lengths - Aneila and Liz and bryson D
- Restrictor and venturi - Letythe
- Manufacturing Advisor - Marco

Muffler:
- Manger - Carter Harrell
- Member - Rowan

Cooling Iteration:
- Manager - Liz
- Test Procedure - Matthew D
- Rad Selection - Liz
- Cooling Curve - Justin
- Electronics Integration - Justin

Axels and Tripods(IC and EV):
- Manager-
- Member- ed
- Member- edd
- Member- eddie

BSFC:
- Manager-
- Member-Alexander
- Member-John Williams
- Member- Matthew D

Chain Selection:
- Manager-
- Member
- Member

8/6/24

Tuesday, August 6, 2024 8:38 PM

Meeting Agenda:

Wenesday Shakedown
- Test wheel speed sensor and dial in
- Test initial LC Setup
- Make sure car don break
  - Need to check chain tension

Thursday :
- Check and see if bray and mihai are avaible

7-9-24

Tuesday, July 9, 2024 8:08 PM

Pedal Box:
- [ ] Find the soft lines
  - [ ] Missing the soft line from master cylinder to the front brakes
- [x] Find the right angle barb fitting into master cylinder
- [x] Install master cylinder into pedal box
- [x] Install pedal box in the car
- [ ] Connect soft lines to hard lines
- [x] Ensure pedals are attached to master cylinders
- [ ] Install Throttle cable into pedal

Driveline:
- [x] Locate axels
- [x] Locate tripods
- [x] Install axels with tripods in the car
- [ ] Install tension caps with safety wire
  - [x] Need the 10-32 safety wire bolts

Front Suspension :
- [x] Studs in new hub
- [x] 2x Press hubs into old upright
- [x] Find brass insert for bellcrank - Front right
- [x] Bolt in old control arms
- [x] Bolt on upright with hubs
- [x] Ensure steering rack is bolted on
- [ ] Install toe rod
  - [ ] Need to find the left toe rod
- [ ] Install Calipers
- [ ] Bolt check and safety wire

Updates:

Rad Characterization:
- [ ]

Headers:
- [ ] Change the header bung cad
- [ ] Water jet header clamp
- [ ] Finish welding jig
- [ ] Cut tube sections
- [ ]

Test	Manager	Team	Next Steps
Radiator Characterization	Emil	Liz, Mathew, Rowan	7/18 BOM, Manufacturing Plan, Go over proposal, DAQ
Modular Intake	Liz	Paddy, Carter, Anelia, leyth	7/18 Finish ETS, Develop Test Plan, Establish CAD
Headers Validation	Brenden	John, Marco, Abri	7/18 Manufacturing, Review Proposal header bung and primaries done
Launch Control	Jonathon/Brenden	Rowan, Anelia,Leyth	7/18 Develop Test Plan
Traction Control	Jonathon	Brenden, Chance,Rowan, Anelia	Develop Test Plan, Establish DAQ, Hall Effects Gear
Diff Characterization	Marco	Brendon, Emil, Sam,leyth	7/18 Develop Test Plan, DAQ (WSS, SAS, Accel, Shock Pots)
Injector Characterization	Jonathon	Justin	7/18 Get Test Stand Together

Injector Characterization:
- Stand is together
- Needs to debugged
- Test to be ran

7-3-24

Wednesday, July 3, 2024 3:35 AM

Driveline:

- [x] Locate axels
- [x] Locate tripods
- [x] Install axels with tripods in the car
- [ ] Install tension caps with safety wire

Front Suspension :

- [x] Studs in new hub
- [x] 2x Press hubs into old upright
- [ ] Find brass insert for bellcrank - Front right
- [x] Bolt in old control arms
- [x] Bolt on upright with hubs
- [x] Ensure steering rack is bolted on
- [ ] Install toe rod
- [ ] Bolt check and safety wire

Pedal Box:

- [ ] Find the soft lines
  - [ ] Missing the soft line from master cylinder to the front brakes
- [x] Find the right angle barb fitting into master cylinder
- [x] Install master cylinder into pedal box
- [x] Install pedal box in the car
- [ ] Connect soft lines to hard lines
- [x] Ensure pedals are attached to master cylinders
- [ ] Install Throttle cable into pedal

Shifting:

Charge 12oz C02 tank

Immediate Action Items: 7/3/24

Front suspensions items above

Test	Manager	Team	Next Steps
Radiator Characterization	Emil	Liz, Mathew, Rowan	7/18 BOM, Manufacturing Plan, Go over proposal, DAQ
Modular Intake	Liz	Paddy, Carter, Anelia, leyth	7/18 Finish ETS, Develop Test Plan, Establish CAD
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Injector Characterization	Jonathon	Justin	7/18 Get Test Stand Together

Injector Characterization:

- Stand is together
- Needs to debugged
- Test to be ran

6-25-24 Summer Plan

Wednesday, June 19, 2024 1:17 AM

Brendens Agenda:

- Car Update
- ETS Update
- Manufacturing Update
  - Outboard if Abri is here
  - Headers Jig
- Ask if anyone
- Discuss how to establish test plans
  - Talk about what a good test plan has
    - What are the goals of the test
    - What are the deliverables of the test
    - Variables
    - What kind of DAQ is needed
      - How do you calibrate said DAQ
    - What is needed to happen before the test
      - Is there any kind of cad
      - Or manufacturing
      - Or anything that is needed for the test
      - What is stopping us from doing the test right now
    - Should establish what the data should look like and what valid results look like.
      - Graphics are nice
    - A step-by-step break down of how to set up the test
    - List out how if there is anyone that needs to be informed about their territroy on the car
      - Are we going to have to remove something
      - Are we interfering anything on the car
      - Etc
      - The test would then require approval from that lead
    - Generate a BOM for the test if it requires one and receive appropriate approval from the leads
      - If you have to buy something, talk to your subgroup lead
      - If you have to manufacture something talk to abri
    - Develop a list and inform the chief mechanic if there is anything that needs to be setup on the car or modified and get approval that the car is read
    - Receive approval of the test plan from the subgroup lead
  - Groups breakdown
  - Who wants to be a test manager
- If time permits establish the purpose and deliverables of each test
- Talk to carter about Engine Rebuild
- If time really permits we can Yap a little about Design

Meeting deliverables:

- [x] Test teams established
- [ ] Goals and deliverables established for each test

No more than 2-3 test per person

Test	Manager	Team	Next Steps
Radiator Characterization	Emil	Liz, Mathew	7/2 BOM, Manufacturing Plan, Go over proposal, DAQ
Modular Intake	Liz	Paddy, Carter	7/9 Finish ETS, Develop Test Plan, Establish CAD
Headers Validation	Brenden	John, Marco, Abri	7/9 Manufacturing, Review Proposal header bung and primaries done
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Injector Characterization	Jonathon	Justin	7/9 Get Test Stand Together

IC Car Running:

Steering rack:
- [x] Fix the borked hole in tie rod
- [ ] Or run the third rack with no safety wire

Outboard:
- We have Stock
- Will check priority

Driveline:
- [ ] Axles in
- [ ] Locate tripods
- Flip drexler
- [ ] Chain masterlinks

Headers (Lower priority):
- [x] Alex needs the cad
- [x] Alex wants metal jigs
- [ ] Marco is finishing up runners
- [ ] Primaries done by end of next week
- [ ] Bung Cad needs to change
- [ ] Bungs made

Daq
- Shockpots
  - Does aero want it?
  - Are the new mounts good? - Jonathon
  - Update
- Wheelspeed sensors
  - Better mounting for better data?
  - New gear guys cut?
- VN back on IC / Adafruit GPS and IMU
  - Need to send email to see if we can get some more 200s or 300s
- Break pressures
  - Amazon chineasium sensors???
  - Spare CANnode or yoink from EV
- Pnuematic Shift
  - Possibly bodge CAN transceiver to the board?
  - Could test auto-shift
  - For now just use EEPROM to log

ETS:
- [ ] Get baseplate and frame members cut & welded
  - [x] Baseplate layout
  - [x] Baseplate cuts
  - [x] Frame member cuts
  - [x] Lathe down steel stock to 1" for one of the frame member attachments
  - [ ] Weld frame members to baseplate
- [ ] Cutout chain tensioner components
  - [x] Cut outline on bandsaw
  - [ ] Flatten edges on mill
  - [x] Layout holes on bottom edges
  - [x] Create holes and pockets on mill
  - [x] Lathe down aluminum stock to .625"
- [ ] Install anchor bolts
  - [ ] Source bolts and drill bits
  - [ ] Drill into concrete
  - [ ] Install anchors

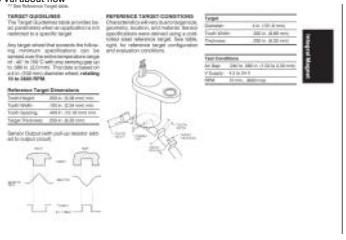
- [ ] Check inventory and put together elec. throttle body
- [ ] Need to install PDU
- [ ] Need to get the ECU Repaired
  - MS3 Megasquirt EVO ECU Repair
- [ ] Need to locate the pneumatic shifting board
- [ ] Need to clean up the wiring harness
- [ ] Diagnose dyno stack
- [ ] Possibly order new pendent
- [ ] Talk to steven about ordering parts
- [ ] Rebuild Spare engine

"Brenden loves head" - Johnathan
"you know how to suck good" - Marco

WTF- Brenden
Lol, Lmao even- Peter

To Do Today

- [ ] Pedal Box Install
  - [ ] Master Cylinder Install-
  - [ ] Reassemble
- [ ] Rod end for RR toe- John
- [ ] Press in Sphericals-
- [ ] Put on Wheel Speed Sensors
  - [ ] Figure out appropriate gear sizing
  - [x] Talk to Val about how



- [ ]

6-19-24 summer plan

Wednesday, June 19, 2024 1:17 AM

IC Car Running:

- Steering rack:
  - Fix the borked hole in tie rod
  - Or run the third rack with no safety wire
- Outboard:
  - We have Stock
  - Will check priority
- Driveline:
  - Locate tripods
  - Flip drexler
  - Chain masterlinks
- Headers (Lower priority):
  - Alex needs the cad
  - Alex wants metal jigs
  - Marco is finishing up runners
  - Primaries done by end of next week
  - Bung Cad needs to change
  - Bungs made
- Daq
  - Shockpots
    - Does aero want it?
    - Are the new mounts good?
  - Wheelspeed sensors
    - Better mounting for better data?
    - New gear guys cut?
  - VN back on IC / Adafruit GPS and IMU
    - Need to send email to see if we can get some more 200s or 300s
  - Break pressures
    - Amazon chineasium sensors???
    - Spare CANnode or yoink from EV
  - Pnuematic Shift
    - Possibly bodge CAN transceiver to the board?
    - Could test auto-shift
    - For now just use EEPROM to log

ETS:

Get baseplate and frame members cut
Cutout chain tensioner base
Install anchor bolts
Check inventory and put together elec.
throttle body
Need to install PDU
Need to get the ECU Repaired
MS3 Megasquirt EVO ECU Repair
Need to locate the pneumatic shifting board
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Diagnose dyno stack
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T

Test:

Rad Characterization (3-4 person task)	Matthew, emil, liz,

Determine which car to characterize rad
Gather IC temp data
Put a potentiometer on the water pump

Modular intake (2-3 People)	Liz,paddy, matthew, carter

Headers test(2 people)

Launch control(2-3)	Jonathan, chance,
Traction Control(1-2)	Jonathan, chance
Diff characterizations(3-4 people)	Brenden, emil, sam
Injector Characterization()	Jonathan

How to rank what to do:

- Performance 15
- Complexity 15
- Cost 15
- Time 30
- Risk 15

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"you know how to suck good" - Marco

4-16-24 : Fix the Car

Tuesday, April 16, 2024 8:36 PM

- Tuesday:
  - Pedal Box out: -carter and alexander and alex
  - Throttle Spring: Alex
  - Uprights: Sam Liz
  - Check diff Carriers to cad: Pete

- Wednesday
  - Motor Mount insert - Matthew
  - Pie cuts - Alexander and Alex
  - Toe rod inserts - Matthew
  - Diff carriers - car
  - Lock tight motor bolts
  - Uprights
- Thursday:
  - Bleeding brakes
  - Brake lines
  - Pedal box

Stuff to do before Dyno 4-24-2024

Tuesday, April 23, 2024 3:23 PM

- [ ] Fix Exhaust Leaks
  - [x] Add double nuts
- [ ] Change new diff carriers
- [ ] Shorten the chain by a link
- [ ] Swap for Dyno Tires
- [ ] Point Go Pro at driveline
- [ ] Fix gear ratios for wheel speed
- [ ] Fix Fuel leaks

EnD Meeting One

Tuesday, October 10, 2023 8:55 PM

Bore out intake restrictor for barnsville

Cooling testing: (Emil)
- ~~Need Components:~~
- Figure out wiring
- ~~Finish code~~

Intake testing: (Patty has been taken over by Dean)
- ID of Runners – 1.125 in
- ID of intake inlet pass throttle body – 1.063in
- Volume of sheet metal plenum (fill that bih up w water, and measure) - 81.1 cubic inches from solidworks
- Volume of carbon fiber plenum -
- OD of Runner – 1.36in
- OD of m18 washer

Diff Carriers: (Alex)
- Redo CAD

Fuel Injection Characterization: (Jonathan)
- Code?
- Slap that wood shit together
- Order parts from Mouser
- Min 1x of each, 4x would be better so can do all set at once
- Mosfet driver
- Load cell min 1kg
- ADC converter (we have these)
- 2L soda bottle
- Arduino
- Fuel rail

ETC Rebuild: (Pete)
- Welding
- Waterjet
- Relabel and clean up the harness
- Add wiring for ETB, shifting, E stop
- Order MacMaster parts (when money comes in)

Per Cylinder Tuning: (Dean)
- Answers to questions
- What 2 sensors do we have rn? Innovate LC 2 wide band controller and Bosch O2 sensor
- Putting in the header? Screw into bone (not bad)
- Decide your own cost, estimated cost. (~400 dollars)
- Do we have enough analog inputs to run every wire? Or do it through cam?
- Review
- Present proposal

Axil End Caps: (Britton)
- ~~Calculat load of weight of part * 2g's~~
- ~~Teach him how to make a FBD (Pete)~~
- ~~Gravity don't give a shit it cancels out~~

Throttle Body: (Carter)
- ~~Find the CAD, if not measure and make from scratch~~ (perhaps google drive)
- Waterjet or mill

Rear sprocket and Spool EV: (Liz)
- ~~CAD, add groove for c clip~~
- Drawings
- Start proposal
- Order MacMaster part

Headers:

Headers Update

Intake Iteration: (von):
- Cad Ribs on the intake

Redesign water pump bracket (Britton) no proposal

Final Drive: (Liz)
- Look up a gear ration, top speed vs. torque, based on dino information test what final drive would be the best for driving,
- Base off of IC final drive proposal

10-24-23

Tuesday, October 24, 2023 8:04 PM

•

01-09-24

Tuesday, January 9, 2024 7:46 PM

Schmeeting

Bolts List:
Bolts
- Size
- Sockets
- Allen keys

Location

Engine Rebuild:
- Main bearing
- Rod Bearings
- Head gasket

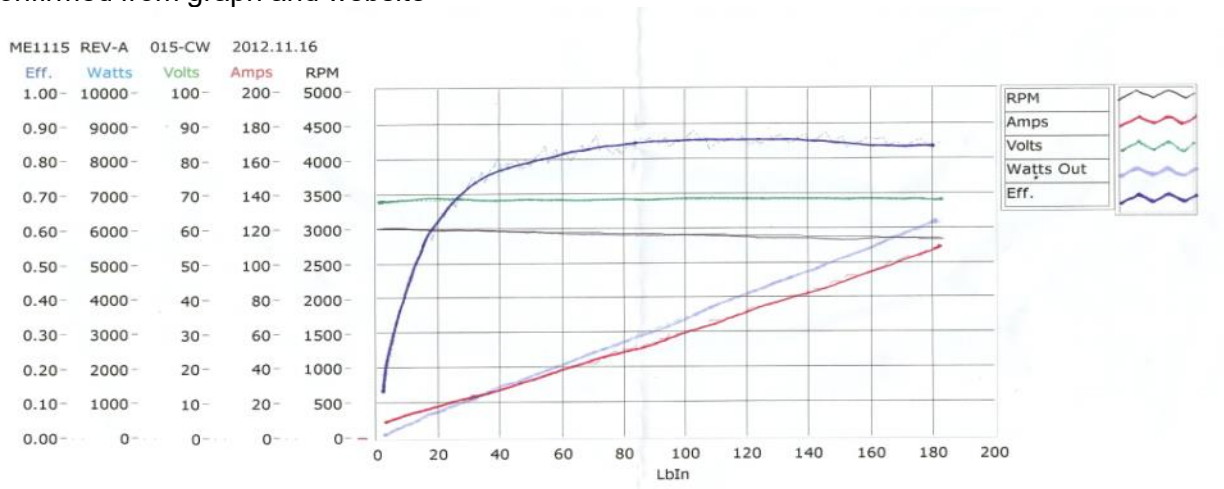
Dyno Testing With EVT

Monday, February 8, 2021 5:07 PM

Link to drive https://docs.google.com/document/d/1T-TF2vI-NGyTpBtPx4aurg_8mM_NhH8l4f7jzXFJWyg/edit?usp=sharing

JESSE DAVIS WORKING NOTES 2/7/21

Torque constant of ME1115 =.15
Confirmed from graph and website



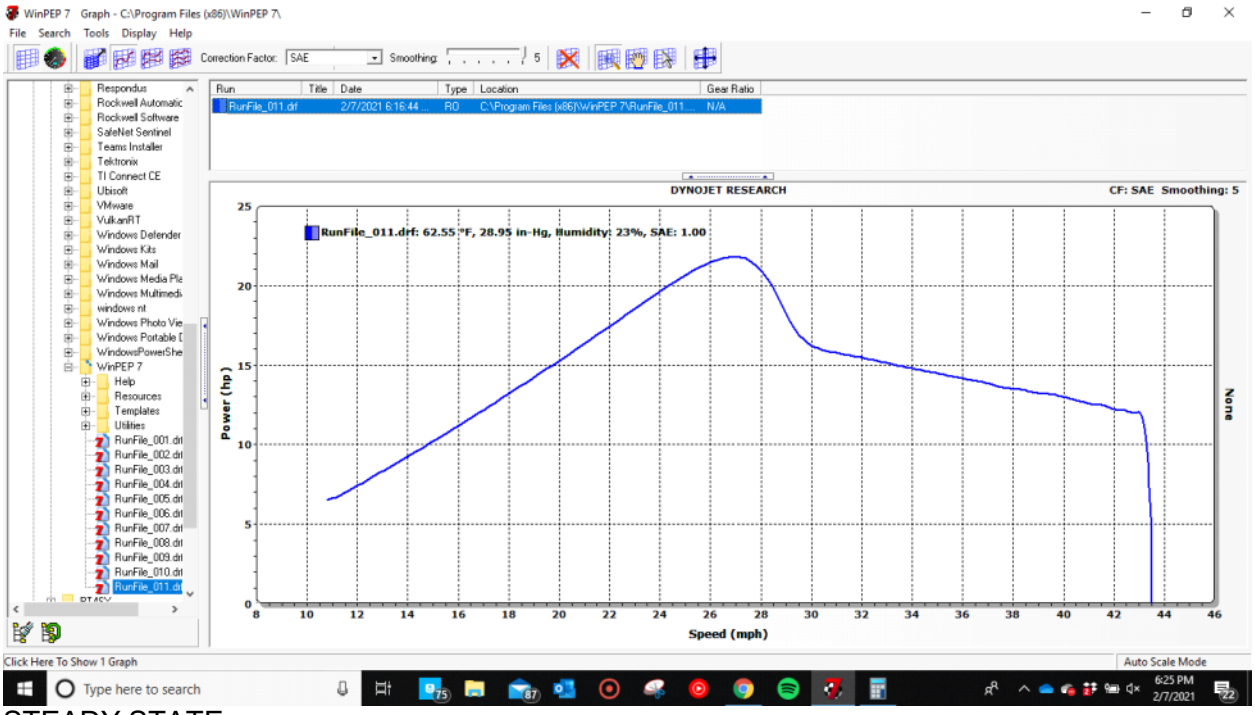
Peak Motor Current RMS(watched live on laptop)=476A
Motor RPM @ 476A on Run=3130 RPM
Dynojet Peak Power=21.9hp

MOTOR CALCS

Calc NM=.15*476=71.4NM
RPM @3130RPM
AT MOTOR CALC POWER =31.39HP

GEARING CALCS

GEARING OF CART 11TEETH TO 46TEETH
.239:1
MOTOR @3130RPM→ SPROCKET@748RPM
MOTOR TORQUE =71.4 NM → SPROCKET @ 298.74 NM
POWER CALC AT WHEELS= 31.38 HP
File Name on Dynojet= Runfile 11
43.33% DIFFERENCE



STEADY STATE
800rpm
500a
50%
Torque=98.75NM
kW=8.27

Header tube flairs

Thursday, April 25, 2024 12:50 PM

Made a die with mandral, it worked used up to 10 tons.

See pic we stoped as long tube started to buckle, we could likely do a larger flair with a shorter tube.

The flair was still not up to the OD we require.

When using the tool please use slot of lube to keep the tool from deforming or catching the stainless.
The die is 2 part, ensure both parts are present before use.

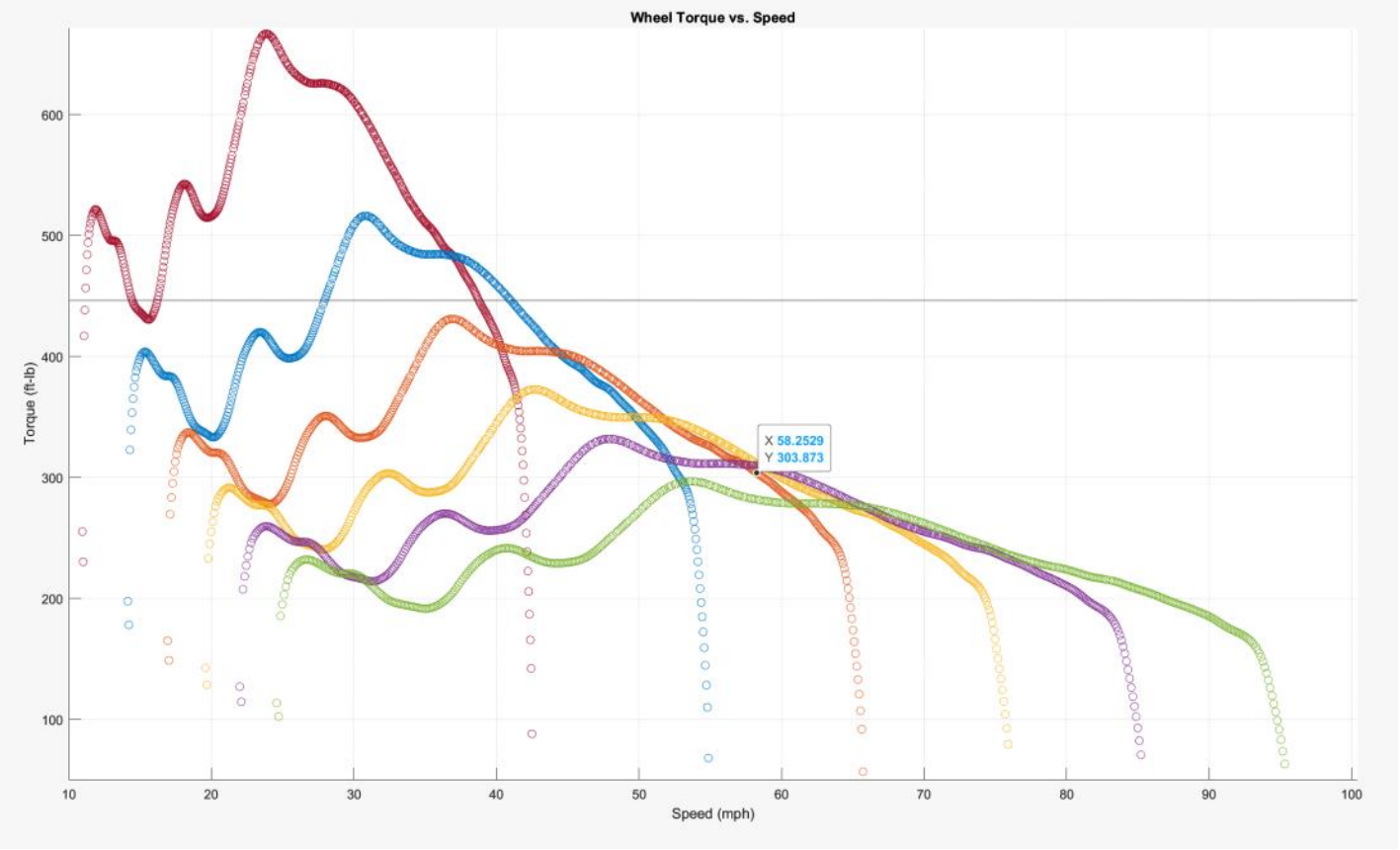

SmartFlow

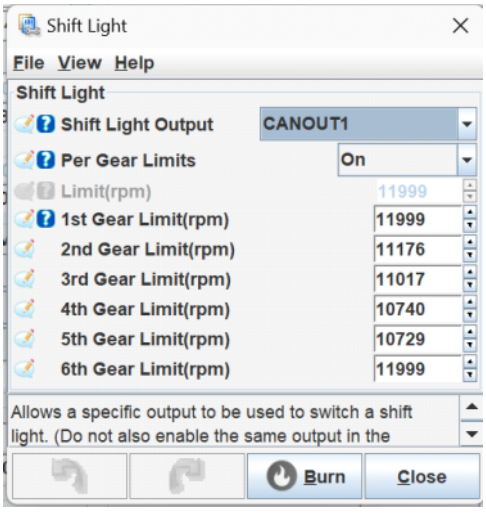
Torque curve per gear shift

Friday, May 3, 2024 12:00 AM

Tags: dash torque curve shift light shift point shift time when to shift how to drive car

When to shift for shift light torque curve per gear matlab guy





Command Window

```
g1f =
   17.8916
g2f =
   13.8533
g3f =
   11.5675
g4f =
   10.0021
g5f =
    8.9077
g6f =
    7.9657

ShiftRPM_G1C =
   1.2529e+04
ShiftRPM_G2C =
   1.1667e+04
ShiftRPM_G3C =
   1.1406e+04
ShiftRPM_G4C =
   1.1207e+04
ShiftRPM_G5C =
   1.1228e+04
ShiftRPM_G6C =
   1.0041e+04
```

fx >>