Data Logger

Model: 9301, 9305

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1. PRO STREET LENCO 5 SPEED, BIG BLOCK, 2 STAGE NITROUS
1/8th Mile Passes

PSL 1A
Upper Graph
Dark Blue - Engine RPM (ERPM)
Light Blue - Drive RPM (DRPM)

Lower Graph
Red - Engine/Drive Ration (E/D Ratio)

The launch graph of a pro street, pro stock, or pro mod car differs greatly from other cars. In these classes, slight tire spin at launch is good. Lower 60 foot times can be achieved when the tires spin instead of the clutch slipping.

Initially, the launch on this graph looks good. The slight increase in engine RPM at launch shows the two step switch on the clutch was set correctly. The base setting for the clutch looks good because the engine did not pull down very far and the tire spin did not build too quickly. Further examination of the graph does show a problem at 5 tenths into the run. The tire speed (DRPM) is too high. This has two effects that will increase the ET. First, the car has passed the point where it pulls best. If you're asking how we know this, that is a good question (we don't have enough information to determine that yet, it will be pointed out on the next graph). Second, the engine RPM has exceeded the shift point. This did not allow the car to pull hard in first, and caused a short shift into second.

Take a close look at the E/D Ratio graph. It shows the clutch slipping some in first gear, half way through second and some in third and fourth. Notice the first to second shift, the clutch tried to lock-up. When the engine RPM came down, reducing the effectiveness of the counter weight, the clutch started slipping.

The rest of the pass looks normal, with a little tire spin at the shift points. The ET was off by over two tenths because of the poor launch.

PSL 1B
Upper Graph
Dark Blue - Engine RPM (ERPM)
Light Blue - Drive RPM (DRPM)
Red - Regulated Fuel Pressure

Lower Graph
Blue - Acceleration

Look at the acceleration graph from 0.0 to 1.0 second. Here you will see how we determined the best tire speed had been exceeded for launch. There is a large dip in acceleration where the DRPM exceeded 2500. An average of .3 G's was lost for six tenths of a second. This means that at one second into the pass the car was already traveling 4 miles an hour less than it could have been.

The regulated fuel pressure shows the typical dip in pressure at launch associated with the engagement of the fogger system. Although there are several factors that determine how large and how long this dip is, the primary factor is the total volume of the lines to be filled before the fuel reaches all the nozzles. An interesting comparison on this graph is the relationship of the DRPM to the fuel pressure. At launch, the DRPM (and tire spin) builds to about 1800 RPM then starts to level off. Once the fuel pressure starts recovering, the DRPM builds up to 2600. This is simple to explain. Until the fuel reached the nozzles, there was no power from the nitrous system, and the car actually ran the first four tenths on motor only.

This fuel pressure graph also points out another problem. The second stage of the nitrous system was supposed to be delayed until eight tenths of a second into the run. If it had come on at this time there would have been another dip in the fuel pressure. Since it wasn't there, one of two things happened. Either the second stage didn't come on at all, or it came on at launch with the first stage. Since a sensor was monitoring nitrous nozzle pressure for the second stage (graph PSL 1C), it was easy to determine that the second stage did come on at launch. A full system check revealed an error in the delay timer wiring.
The fuel pressure graph also points out that the flowing pressure is different from the static pressure. This has appeared in every regulator we have tested. This regulator shows a static pressure of 8 PSI and a flowing pressure of 6 PSI. A 25% drop is typical, but some regulators can drop up to 50%. The bottom line is that the only way to know what the fuel pressure is during a run is to measure it.

Graph PSL 1D shows the EGT’s for this pass.

**PSL 2A**

**Upper Graph**
- Dark Blue - Engine RPM (ERPM)
- Light Blue - Drive RPM (DRPM)

**Lower Graph**
- Red - Engine/Drive Ratio (E/D Ratio)

After reviewing the printouts of the previous pass, some changes were made to hopefully improve the ET. Additional base was added to the clutch, and larger tires were installed to help reduce tire spin.

The overall results from the changes were good. The ET dropped over two tenths with one minor drawback from the changes.

The first four tenths of the pass are not pretty. The clutch and tire change pulled the motor down to 4000 RPM. Once the nitrous came in, things got better. The larger tires reduced tire spin, holding the engine RPM below the shift point and allowing the car to hook up during first gear. If you compare this pass to graph PSL 1A you will notice that the first to second shift occurred at 1.6 seconds instead of 0.9 seconds. You can also see how the clutch change reduced the slip in second gear.

From these results, it looks like the clutch needs to be changed the other direction. The larger tires will allow the base to be reduced so the motor can stay up at launch, and adding counter will help prevent the slippage down track.

**PSL 2B**

**Upper Graph**
- Dark Blue - Engine RPM (ERPM)
- Light Blue - Drive RPM (DRPM)
- Red - Regulated Fuel Pressure

**Lower Graph**
- Blue - Acceleration

Comparing this graph to PSL 1B shows the dip in fuel pressure was a little worse on this pass and took a little longer to recover. That, and pulling the motor down accounts for the dip in the acceleration at 0.2 seconds. However, from four tenths to one second, acceleration improved from the PSL 1A pass.

The EGT’s in graph PSL 2C show a 200 degree spread with a 1300 degree max.
2. PRO MOD 4 SPEED LENCO, BIG BLOCK, 2 STAGE NITROUS SYSTEM

1/8 Mile passes

PM 1A
Upper Graph  Dark Blue - Engine RPM (ERPM)
             Light Blue - Drive RPM (DRPM)

Lower Graph  Red - Engine/Drive Ratio (E/D Ratio)

The first eight tenths of a second into this run are very good. The ERPM at launch shows the setting of the clutch's two step switch is correct. The clutch slipped in nicely over the first four tenths, allowing the ERPM to stay up. The DRPM built up smoothly to about 2700 RPM. Although 2700 RPM may be a little too high, it is not too bad.

Unfortunately, at about .85 seconds into the run, a problem occurred. When the second stage nitrous came on at .8 seconds, the tires spun up too far. This caused the clutch to slip too much in second gear and the spin got worse down track. The drive RPM shows some tire shake from the 2-3 shift on.

The E/D Ratio graph is typical of too little clutch. Although the clutch did just what we wanted at launch, it took over half a second for it to lock-up in second gear. Then from the 2-3 shift on, the car drove through the clutch. With too little clutch, the slip typically gets worse with each gear change due to the increasing load on the clutch.

PM 1B
Upper Graph  Dark Blue - Engine RPM (ERPM)
             Light Blue - Drive RPM (DRPM)

Lower Graph  Violet - Regulated Fuel Pressure

The regulated fuel pressure shows the characteristic dip as each of the nitrous stages is activated. From a static pressure of 8.75 PSI, the pressure drops to a flowing pressure of 6.25 PSI on the first stage. When the second stage is activated, the pressure drops to about 6 PSI. In graph PM 1C, the fuel pump pressure is shown in red on the upper graph (the PSI scale is on the right).

PM 1D
Upper Graph  Dark Blue - Engine RPM (ERPM)
             Light Blue - Drive RPM (DRPM)
             Yellow - 2nd Stage Nitrous PSI

Lower Graph  Yellow - 1st Stage Nitrous PSI

The nitrous pressures shown here are measured at the output of the solenoid. This provides an accurate measurement of the actual pressure at the motor and clearly identifies when the system was activated.

PM 1E
Upper Graph  Dark Blue - Engine RPM (ERPM)
             Light Blue - Drive RPM (DRPM)

Lower Graph  8 EGT probes

The EGT's show a very well balanced system with the exception of one cylinder (#5). Also, with only one cylinder over 1100 degrees, this system is set up very rich.

PM 2A
Upper Graph  Dark Blue - Engine RPM (ERPM)
             Light Blue - Drive RPM (DRPM)

Lower Graph  Red - E/D Ratio
Prior to this pass, more counter was added to the clutch to reduce slippage down track. The launch data indicates the added counter did not hurt the launch profile. The clutch still slipped in at about .5 seconds and tire speed wasn't built too quickly. The DRPM from .5 to 1.0 second is a little higher than the previous pass. This is expected when the air gets better and no tune up changes are made.

Again we see the increase in tire spin after the second stage came in at .8 seconds. The engine RPM is pretty strange from 1.5 to 2.0 seconds, but it is explainable. At 1.4 seconds, second gear was pulled, which would normally cause the ERPM to drop by about 1000. Here we see a drop of about 500. If the shift had caused substantial tire spin we could understand the motor staying up, but the DRPM shows very little tire spin on the shaft. To understand what happened, we need to look at the E/D Ratio. It shows major slippage (clutch or transmission) from 1.4 to 2.3 seconds. This explains why the ERPM looks strange during that interval. There is another problem between 2.2 and 2.4 seconds. The ERPM has a strange dip, the DRPM goes a little flat, and the E/D Ratio actually goes below the ratio for 2nd gear. This is where the engine backfired and shot fire out of the headers. (Unfortunately we are unable to determine what caused this with the data we collected.) From 2.5 seconds on, everything looks normal. The only exception is the driver dragging the shifts out past the 7400 RPM shift point (we will see the effects of this later).

The first guess of what caused the slip in second gear would be clutch, but that would be wrong. If the clutch had been too loose, the slip would have become worse with the 2-3 shift. A check of the tower pressure on the lenco verified that the transmission had slipped and wore on the clutch pack.

(Graphs PM 2B, 2C and 2D are similar to what we saw in pass PM1.)

**PM 2E**

**Upper Graph**

- Dark Blue - Engine RPM (ERPM)
- Light Blue - Drive RPM (DRPM)

**Lower Graph**

- Blue - Acceleration

The acceleration graph shows two distinct areas of lost acceleration. First, from 1.5 to 2.0 seconds, (when the transmission was slipping) and second, from 2.5 to 3.2 seconds (when second gear was strung out past the normal 7400 RPM shift point).

**PM 3A**

**Upper Graph**

- Dark Blue - Engine RPM (ERPM)
- Light Blue - Drive RPM (DRPM)

**Lower Graph**

- Red - Engine/Drive Ratio (E/D Ratio)

Before this pass, three things changed.
1. The tower pressure on second gear was set.
2. The second stage timer was changed from 0.8 to 1.0 second.
3. The air density altitude went up.

These three items combined to produce the best pass of the day.

The E/D Ratio graph indicates the tower pressure adjustment on second gear solved the transmission slip problem. The clutch still needs a little attention as indicated by the slippage in 3rd and most of 4th gear.

The engine RPM shows the 1-2 shift was a little late and the 3-4 shift was a little early. When looking at the Acceleration graph (PM 3E) you can see effect of the bad shifts.

One of the problems with the first two passes was too much tire spin (DRPM) at launch. The DRPM during the 1st stage dropped by about 200, due to a change in the air quality. At about 1.1 seconds, the ground speed caught up with the tires making the second stage timing almost perfect. There is a little tire shake and spin from 2.2 to 3.0 seconds and some shake from 3.5 seconds on.
PM 3B
Upper Graph  Dark Blue - Engine RPM
Light Blue - Drive RPM
Red - Fuel Pump Pressure

Lower Graph  Violet - Regulated Fuel PSI

Graphs PM3B, 3C and 3D are similar to the previous pass.

PM 3E
Upper Graph  Dark Blue - Engine RPM (ERPM)
Light Blue - Drive RPM (DRPM)

Lower Graph  Blue - Acceleration

Some interesting points appear when comparing this pass's acceleration to the acceleration in PM 2E. This pass shows an improvement in acceleration from launch to 1.0 second. PM 2E shows a loss of acceleration from 1.3 to 1.6 seconds. For this pass a correction was made to the 2nd gear slip, and the improvement is shown in PM 3E from 1.5 to 2 seconds. PM 3E also shows two dips in acceleration caused by tire slippage from 2.2 to 2.9 seconds. The short shift to fourth didn't appear to have much effect.

It is interesting to compare the EGT readings from the three passes. The tune up was not changed. The only difference between the three runs was air quality. The best density altitude was during the second pass, and the worst was during the third pass. Look closely at the average EGT readings and you will see the changes in mixture resulting from the different density altitudes.
3. C SUPER MODIFIED COMPETITION ELIMINATOR 5 SPEED LIBERTY, SMALL BLOCK

1/4 Mile passes

CSM 1A
Upper Graph Dark Blue - Engine RPM (ERPM)
Light Blue - Drive RPM (DRPM)

Lower Graph Red - Engine/Drive Ratio (E/D Ratio)
Green - Engine/Input Shaft Ratio (E/S Ratio)

From -0.6 to 0.0 seconds, the Engine RPM was limited to 8800 by the two step chip. Since the two step is controlled by a switch on the clutch pedal, the switch setting is critical to a clean launch. Insuring the switch releases the two step prior to clutch engagement allows the engine to clear before being loaded. Notice the slight increase in ERPM at launch. This shows that the two step was released just prior to clutch engagement. In this case, the actual launch RPM was 9000 when the clutch was engaged. The engine was then pulled down to 7900 RPM at launch. 0.8 seconds into the run, the initial tire spin was over and the car was hooked up.

Since this is a liberty transmission, clutch slippage can be evaluated by looking at either of the two ratio curves (E/D Ratio-Engine RPM/Drive RPM or E/S Ratio-Engine RPM/Input Shaft RPM). Looking at the E/D Ratio shows the clutch to be locked up 0.1 second into the run. The clean, sharp steps at each shift show there was almost no slippage between gears. The E/S Ratio verifies this. If this had been a Lenco transmission, the E/D Ratio would have shown if there was any slip in the clutch or transmission. The E/S Ratio would indicate which one was slipping.

About 1.4 seconds into the run there is a problem. Both the ERPM and DRPM flat lined. Since the launch tire spin has finished and the flat line appeared again at the top of second gear (2.6 seconds), we suspect these were late shifts and the high side rev limiter was reached. Knowing which RPM chip was installed would help clarify this problem. There is additional information in the next graphs (Acceleration and EGT's) that will tell us for sure.

The DRPM shows tire spin at each shift, and the ERPM identifies the shift RPM and drop for each gear. 10.4 seconds into the run, the throttle was closed. Remembering that the track clock will be 0.15 to 0.3 seconds behind our recorded ET we know the driver did not shut off early on this 9.98 pass.

CSM 1B
Upper Graph Dark Blue - Engine RPM (ERPM)
Light Blue - Drive RPM (DRPM)

Lower Graph Medium Blue - Acceleration

8 EGT Probes

On this graph, we can verify that the rev limiter was activated at the top of first and second gears. Notice that the acceleration drops sharply at the same point the engine flat lines. A close examination of the EGT graphs at the same point in time, indicate several cylinders are cooling from the misfires of the rev limiter.

The EGT graph also indicates that seven of the cylinder temps are tightly grouped, and one cylinder (#1) is 150 degrees above the rest. 1450°F is about as high as you want to go for cylinder temperature. Since #1 is already there, the mixture can't be leaned out to get the additional power from the rest of the cylinders. A little work on the head/manifold to get #1's temperature down with the rest will allow leaning of the mixture to get that additional power.
The acceleration graph also tells you if the shift points are right for your combination. Figuring out how to get the lowest ET for any combination directly relates to keeping the acceleration at the highest level possible. Since the "Accelerometer" reading is a direct measurement of acceleration, it is ideal for the task. Whatever you can do to keep that line high, will lower your ET. When looking at the graph, you will notice a sharp increase in acceleration at each shift, which lasts for a relatively short time. The additional torque applied to the driveline by pulling the motor down gives an additional kick of acceleration. Once those effects are over (about 4 tenths on this car) the acceleration should be just slightly lower than it was before the shift. If that is the case, the shift RPM is what it needed to be. If the acceleration before the shift is lower than after the shift, the shift point was too high. This means you need to short shift to keep the average acceleration higher, and lower the ET. On this pass we can't check the 1-2 or 2-3 shift because of the effects of the rev limiter, but looking at the 3-4 and 4-5 shifts we can see that a lower shift point is needed.

CSM 2A
Upper Graph
Dark Blue - Engine RPM (ERPM)
Light Blue - Drive RPM (DRPM)

Lower Graph
Red - Engine/Drive Ratio (E/D Ratio)

On this graph the clutch switch for the two step did not let the motor clear before the clutch started to engage. This caused the engine to pull down off of the two step so the effective launch RPM was only 8000. This meant the launch chip change from 8800 (CSM 1) to 9000 had no effect. The motor pulled down to 7000 RPM at launch while the previous pass only went down to 8000.

The rev limiter chip was lowered to 9800, and you can see on the graphs that the rev limiter was hit in the first three gears. The engine was on the limiter for 2 tenths in first and third and about 4 tenths in second.

For this pass, a little base was taken out of the clutch with little effect. The E/D Ratio shows very small "points" shortly after the start of the first three gears and a slight curve to the step into fourth and fifth. On this particular car, setting the clutch to "slip" into the next gear is not important, but to a pro mod it can make a major difference.

CSM 2B
Upper Graph
Dark Blue - Engine RPM (ERPM)
Light Blue - Drive RPM (DRPM)

Lower Graph
Medium Blue - Acceleration

8 EGT probes

From the EGT's and the Accelerometer, we see the rev limiter came in at about 9700 RPM at the top of first, second and third gears. The RPM's increase so quickly on this car that a lower shift chip needs to be installed to make up for the drivers reaction time. The rev limiter cost about 2 tenths in ET on this pass.

Again we see the #1 cylinder (pink line) prevents us from getting everything the motor has to offer.
4. NITRO FUNNY CAR

1/4 Mile passes

Upper Graph  
Dark Blue - Engine RPM (ERPM)  
Light Blue - Drive RPM (DRPM)  
Red - Blower Pressure  
Yellow - Timer Air Pressure

Lower Graph  
Yellow - Clutch Travel  
Violet - Clutch Control Pressure

FC 1A, 1B
Clean pass, 5.14 ET. Drove through the clutch a little at the big end. Minor tire shake from 3.6 seconds on.

FC 2
Hurt a piston. Clutch locked up at 3.5 seconds.

FC 3
1.0 to 1.5 seconds - Major tire shake.  
1.6 to 2.5 seconds - Driver in and out of the throttle.  
3.0 seconds - Back in the throttle hard.  
3.0 to 3.6 - More tire shake.

FC 4
Good launch.  
1.0 to 2.0 seconds - Tried to drive through the clutch because of a mechanical problem in the clutch. The throwout bearing did not move until 1.8 seconds into the run, even though the timers show normal operation.  
2.8 seconds - Broke blower belt.

FC 5
0.4 seconds - Smoked the tires.
Timer Air Pressure
Got Out of It Broke Blower Belt
Clutch Lock-Up
Throwout bearing starts to move
SERVICE

For service send your product to Auto Meter in a well packed shipping carton. Please include a note explaining what the problem is along with your phone number. Please specify when you need the product back. If you are sending product back for Warranty adjustment, you must include a copy (or original) of your sales receipt from the place of purchase.

12 MONTH LIMITED WARRANTY

Auto Meter warrants to the consumer that this product will be free from defects in materials and workmanship for a period of twelve (12) months from the date of the original purchase. Products that fail within this 12 month warranty period will be repaired or replaced at the manufacturer's option to the consumer, when determined by the manufacturer that the product failed because of defects in material or workmanship. This warranty is limited to the repair or replacement of parts in the instrument and the necessary labor done by the manufacturer to affect the repair or replacement of the instrument. In no event shall this warranty exceed the original purchase price of the instrument, nor shall the manufacturer be responsible for special, incidental or consequential damages or costs incurred due to failure of this product. Warranty claims to the manufacturer must be accompanied with a dated proof of purchase. This warranty applies only to the original purchaser of product and is non-transferable. All implied warranties shall be limited in duration to the said 12 month warranty period. Breaking the case seal, improper use or installation, accident, water damage, abuse, unauthorized repairs or alterations voids this warranty. The manufacturer disclaims any liability for consequential damages due to breach of any written or implied warranty on all products made by the manufacturer.

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