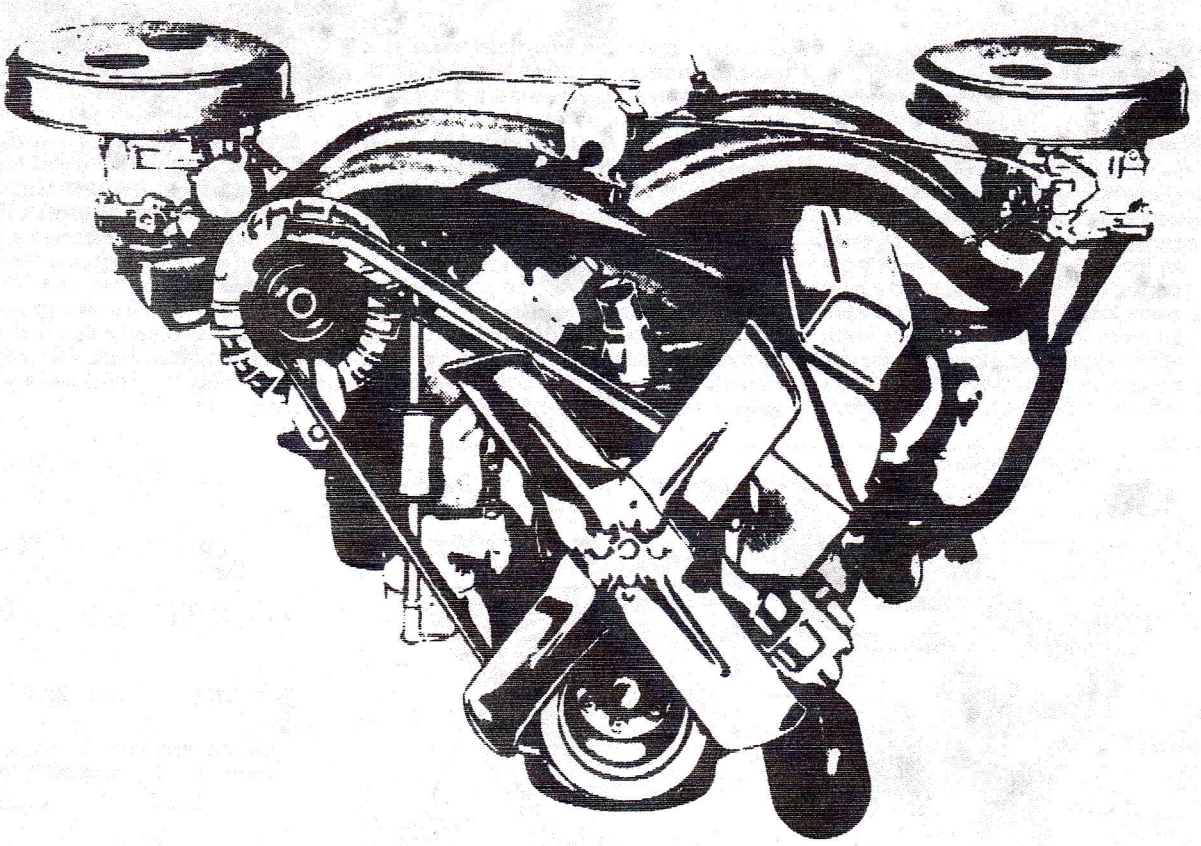


The "Ramifications" of Chrysler Engineering

By John Veatch

Upon the demise of the 392 HEMI at the end of 1958, the Chrysler 300-E came under much criticism as being just another semi-high performance automobile. The car, after all, was indeed dull and run of the mill to a public who had just experienced supercharged Fords. Packards, and Studebakers; mechanically fuel injected Chevrolets and Pontiacs; electronically fuel injected Ramblers and Chrysler HEMIs; and a host of other multi-carburated iron from Detroit.

What the motoring public did not realize was that, in spite of Chrysler's impending bleak financial and sales future of the late '50's, their engineering department was working full bore on one of the biggest performance bombshells to ever hit the automotive industry.

Enter the 1960 Chrysler 300-F. Suddenly, the racing world again took notice of the 300's performance. Although the 300-E was rated at 5 more horsepower than the standard 300-F (380 vs 375) the real performance difference was the way the 300-F felt on the road. The car would pass with ease and climb hills without the high RPM "threshing machine" sound generated by so many other designs which needed to downshift to pass or climb.

How, you may ask, was a car which produced less power than previous models able to produce these results? The answer is low speed torque. The 300-E was rated at 450 foot pounds of torque at 3600 RPM. The 300-F was rated at a stump pulling 495 pounds at 2800 RPM. Yes, you may say , that is only a 10% increase, how can that produce such a dramatic difference?

The answer to that is two fold. First, very few cars would see the 300-E's 3600 RPM required for peak torque output in everyday driving. However, the F's 2800 RPM max torque output is right in the neighborhood of highway speeds required for passing and cruising. Secondly, consider the range of the increased torque (see graphs). Not only did the F produce more torque, but produced it over a wider RPM range as compared to the rather peaky torque curve of the 300-E.

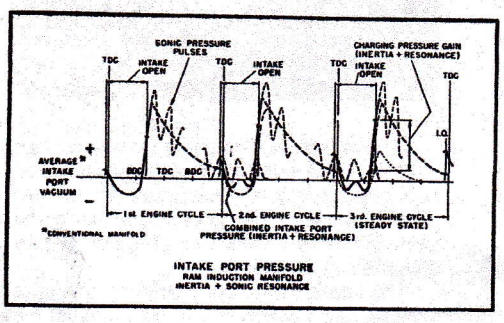
The 300-F was rated at a stump pulling 495 pounds at 2800 RPM.

Your next question should be, how then did Chrysler engineers effect such a dramatic improvement to two engines which were basically the same? Enter Ram Induction. Even the name evokes visions of tires smoking, carbs growling, and competition cowering in fear.

Chrysler introduced Ram Induction to the American Public in 1960 and offered it on all models except the Imperial. It was known as "Ram Induction" on the Chryslers, "Power Charge" when installed on the De Sotos, "Red Ram" on the Dodges (usually D-500) and "Sono Ramic" when Plymouths were so equipped.

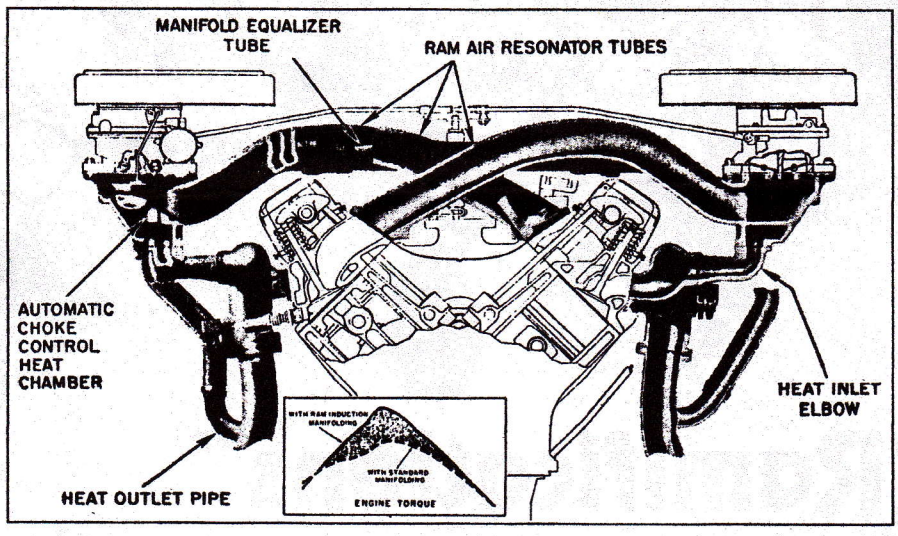
Most anyone associated with the Chrysler 300 knows what ram induction looks like, but very few realized where it came from or how it works, This may also include engineers who work with Ram Induction since the mechanics of this induction is not completely understood.

Although the high performance effects of long intake runners leading to the valves were known as early as the 1930's, the knowledge was not applied in a scientific manner since the design of such systems was a hit and miss proposition. The actual effects of a particular ram system design was not known until it was bolted to the engine and actually tried.



"Ramifications"

When Chrysler entered the high performance marked it 1951 with the HEMI, considerable engineering interest was immediately generated toward any method which demonstrated a promise of winning the ensuing horsepower race. As the Chrysler 300 was rewriting the record books, Chrysler engineers were busy at their backroom dyno's attempting to ensure the 300's place in history. One item which deserved investigation was the ram tubes fuel injection setups used on many of the early 50's racing engines. Could such a system be built and sold to the public? Could it use carburetors instead of fuel injection? How could the performance of such a system be predicted?



To answer some of these questions, Chrysler set up a test engine at their labs. Attached to this engine was a set of adjustable intake manifold runners. By adjusting these runners for maximum power at any given RPM, a glimpse of the mechanics of ram induction was obtained. The outcome of this investigation was the formula:

$$L = \frac{72C}{N} \pm 3"$$

which was detailed in the patent application submitted by Chrysler. This formula is used to find the length (L) in inches required between the inlet valve and the end of the ram tube for a particular application. The variables are defines as follows:

N = RPM at which maximum torque is desired.
C = The velocity of sound (ft/sec) at the expected pressure and temperature (approx. 1,100 ft/sec in a typical engine intake manifold at wide open throttle.)

The variable (C) contains the key for ram induction. The velocity of sound is what makes ram induction work (remember Plymouth's "Sono Ramic"). The explanation as to the workings of ram induction, although greatly simplified, is as follows:

The intake valve, upon opening sets up a vacuum pulse which, due to the inertia of the air column in the ram tube, must travel as a pulse, toward the carburetors at the velocity of sound. Upon reaching the end of the ram tube, an important event occurs due to a strange phenomenon. As most people realize, sound waves will reflect off of solid objects or a closed end tube. What many do not know is that sound waves will also reflect off of the open end of a tube. When sound waves reflect in this manner, they are inverted upon reflection. Thus, a negative or vacuum pulse will be converted to a pressure pulse and reflected down the ram tube in the other direction. Upon reaching the intake valve, assuming the valve happens to be open, this pulse assists the intake charge in filling the cylinder. The trick is getting the pulse at the intake valve when it is open. Looking back at the previous formula, it can be seen that the only two controllable variables are ram tube length and RPM. As one increases the other decreases. This ram effect occurs in all inlet ports of all reciprocating engines, but under most circumstances, the tube length is too short to be useful. Thus Chrysler had to go to great lengths, so to speak, to get a useful ram effect under the hood of their cars.

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In addition to the formula, there are certain rules which are also required in designing an effective ram induction system, some are as follows:

1. Ram tubes should be of a uniform cross sectional area.
2. There should be minimum obstructions in the ram tube (venturi, throttle valves, etc.)
3. The formula gives the minimum length tube for a given rpm. The boost can be effected by using multiples of the minimum length. Conversely, a fixed length tube will work on multiples of RPM increases.
4. There can be no "Siamesing" of ports or runners as this will dampen the pulses and kill the ram effect.

Chrysler quickly took their new found information and designed two styles of ram tubes and bolted them on their 1960 model cars. The first set, the so-called 30" rams was the most common type. If you measure a set of 30" rams, you will quickly discover that they are really closer to 25 inches long. The 30 inch ram is so called because there is also approximately 6 inches of port in the head which must also be taken into account. Plugging this information into our formula to find the maximum torque we find,

$$(25" + 6") = \frac{72(1100)}{N} \pm 3$$

$$(31" \pm 3") = \frac{79200}{N}$$

$$28 = \frac{79200}{N} \qquad 34 = \frac{79200}{N}$$

$$N = 2828 \qquad N = 2329$$

Maximum torque is obtained between 2329 and 2828 rpm.

This is very close to the 2800 RPM as specified by Chrysler. But many other engine characteristics determine the RPM for maximum torque. Using a very similar casting, Chrysler modified it to make a 15" ram tube (sometimes called 16" tubes). Again, this length includes the 6" for the port in the head. Chrysler also offered a 14" ram in 1962 (before the stage I super stocks were introduced) these rams are very, very rare and only seven 300-H's were supposedly equipped with these rams.

The 1960 and 1961 long rams can be readily identified from their "short" brothers by comparing the center crease and casting numbers.

They are as follows:

30" right 1947162
30" left 1947163
15" right 2129986
15" left 2129987

Long ram casting numbers can be found near the center pivot of the carburetor linkage.

After introducing ram induction on production vehicles in 1960, Chrysler was a quantum leap ahead of the competition and the racing results showed the large gap the MoPars had put between themselves and the others.

Next came the 10" rams on the Super Stock Dodges and Plymouths starting in 1962. Additionally, the same principle which had been found to work on the intake manifold was also found to work on the exhaust and Chrysler redesigned the exhaust manifold on the stage II and III Super Stocks to reflect this. The 1964 model year was the last one that saw Chrysler offer "rams for the street". The 300-K and the stage III Super Stocks were the last production cars to wear this high performance accessory. Although the 1964 and 1965 race HEMI got a cross ram manifold, the 1966 street version did not.

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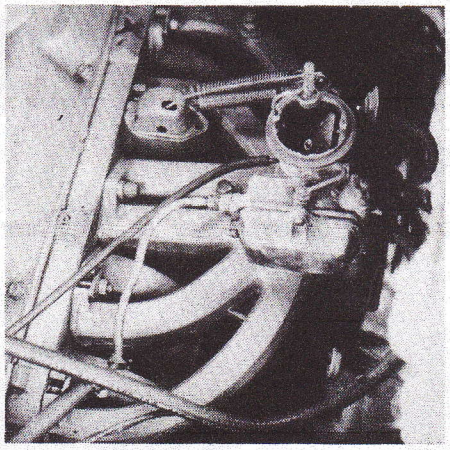
The after market suppliers and the competition were quick to take up where Chrysler had left off. Soon, Chevrolet had a cross ram Corvette.

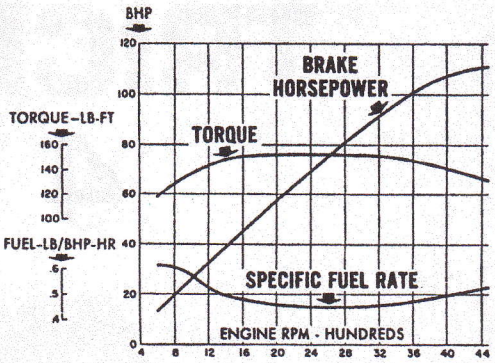
A myriad of "over the counter" ram manifolds could be purchased.

So what became of Chrysler's own ram manifold plans? Well, glad you asked. If you think back, you will remember that Chrysler was pretty busy designing a revolutionary new six cylinder engine at about the time all of this ram research was going on. Introduced in 1960, the slant six was heralded by most all auto publications as being "extremely responsive", "torquey", and "hard to believe it's not a V-8". Just one look at the slant six's broad flat torque curve and the multi length individual runners on its intake manifold and it's not too hard to put 2 and 2 together. The runners are, despite the lack of Chrysler claims, in effect ram manifolds. Since their lengths vary, they are operating in pairs. The longer ones ramming at lower RPMs and the shortest ones at the top end with the middle length runners working in the mid range of these RPM scales. And if that was not enough of an achievement, don't forget the "hyper pack" slant six's that used a four barrel and equal length ram tubes to boost the slant six horsepower to 195 in the 225 cid version.

If the reviews you read on Chrysler's new 2.2 four cylinder sound familiar, look at the intake manifold. Believe it or not, it looks like Chrysler is a leader again. The ram style design is obvious. Who said Chrysler engineering is now dull, unimaginative, and no longer the leader? Maybe they're just not wasting as much time on these so called transition engines and going directly to the power plant of the future. A ram inducted four cylinder.

CPM

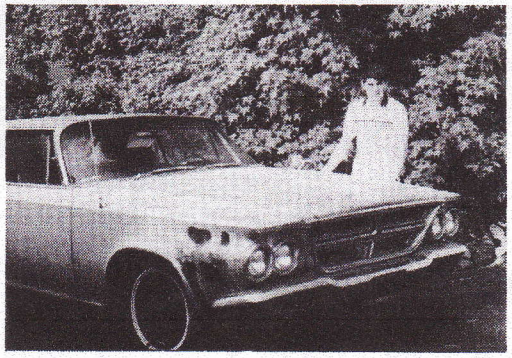


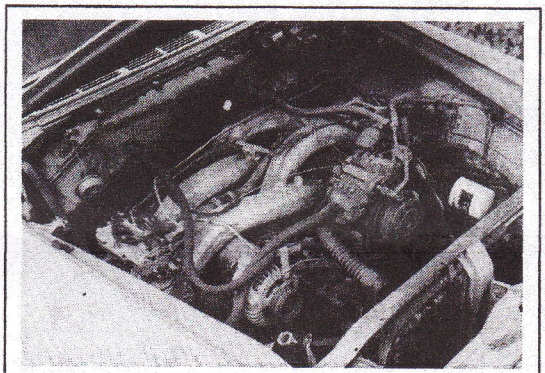


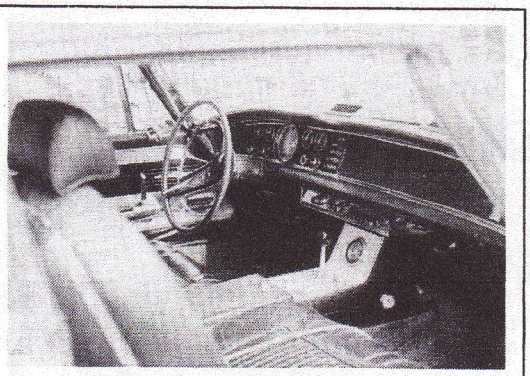
Slant Six performance curve.

Even Chrysler's slant six engine benefited from ram induction research. Note the unequal intake runners in the photo and the broad, flat torque curve on the graph.

PROJECT 300K







The Chrysler 300K was the last year for the 413 Long Ram performance package. Not long ago, Mr. and Mrs. Staph of Oroville, CA purchased a 300K in the condition you see here. It was pulled from a field where it sat for 10+ years. The interior was in astonishing good condition. Later it was discovered that the windows had been cleaned long ago with an S.O.S. abrasive pad but the damage to the windows helped to diffuse the sunlight. The options included tilt wheel, air conditioning, power brakes (an interesting design due to the Rams), power windows, power seats, leather seats, a vacuum gauge, and so forth. The engine was pretty much there with pieces coming along the way. Look for the 300K restoration project in upcoming issues of Chrysler Power.