Iron Lung

Griggs Racing gives us an inside look at the engines that make its road-racing rockets breathe

Text and Photos by Tom Wilson

Above all, Bruce Griggs is a racer. While the Mustang world knows him as a suspension specialist—the originator and most successful campaigner of the torque-arm replacement suspension system—Bruce has always been more than that. He's a racer, doing whatever is necessary to get his cars to the front.

That's how the Mustang torque arm came about—Bruce needed it for racing back in the '80s. It's also how numerous other nonsuspension parts Griggs Racing sells landed in its catalog, such as the company's SN-95 front bumper cap with larger foglight and radiator openings, for example. Griggs also offers brake systems using Sierra components, and it has always had quite a few engine offerings. Replacement accessory drives, pulleys, dry-sump systems, whole engines—pushrod or modular—are all available through Griggs.

In fact, it was a NASA American Iron engine that had Bruce calling us to come and take a look. With two American Iron championships to Griggs Racing's credit—in fact, a perfect season last year—why not take a look at the company's latest ideas in American Iron racing engines? Besides offering insight to the racing world, these engines resonate well with performance street needs, so you don't have to trailer your car to learn something from these powerplants.

Tuning for Torque

What makes American Iron engines interesting is the AI power-to-weight rule. Cars are limited by having to carry 9.5 pounds per rear-wheel horsepower. The typical American Iron Mustang, stripped of the easy-to-get-rid-of stuff

Horse Sense: **Not your average racer, and more complex than a two-time-zone Swiss watch with auto-wind, Bruce Griggs is full of surprises. He told us that when he was young, he played percussion and even stood in a couple of nights with the Los Angeles Philharmonic when they were short-handed.**

and carrying the necessary safety gear, weighs between 2,900 and 3,200 pounds. That means 305-336 hp is allowed at the rear tires, which roughly translates into 355-390 hp at the flywheel, depending on a host of variables. That's a nice number for road-racing fun (you can go well over 160 mph on this sort of power) and typical of many street engines.

What's more, the tough on-again, off-again duty cycle of road racing, along with its need for part-throttle driveability and all-around good manners, is also similar to street needs.

Where AI engines spin off on their own is their torque-to-horsepower relationship. American Iron rules may limit horsepower, but they don't say anything about torque. Thus, the holy grail is to build just enough power, but all the torque possible.

With torque at a premium, several facts dominate. Primarily, torque is a function of displacement and cylinder pressure. So, large engines with plenty of squeeze in the combustion chamber make torque. Secondly, while American Iron rules allow carburetors or fuel injection, the long-intake runners of fuel-injection manifolds are more torque-friendly than the stubby-runner stuff of performance-carburetor intakes.

Griggs uses Scat's profiled, 4340 forged-steel crankshaft, with slightly knifed edges, reduced metal around the flanges, and other niceties. These are Chinese forgings that are machined and nitrited at Scat's Los Angeles shop. Bruce says they're straight and well machined as-delivered by Scat, which is what we're showing here.

Once Griggs gets done with the Scat crank, it looks more like this one we found in the engine room (curious how it has a gear-drive timing gear, huh?). Griggs insists on internally balancing AI cranks and finds the latest Scat cranks need only 8 pieces of Mallory rather than the previous 13. The balance job alone is $800, but Bruce says you'll put this crank "in your next engine, unless you do something stupid to it." Griggs also runs a plain, one-piece pilot bearing, as Ford's roller-bearing design is difficult to service and occasionally fails on-track.

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Besides building torque, the savvy American Iron engine builder is looking for ways to restrict horsepower. That way, an engine can be built with plenty of torque and a little too much horsepower, then the horsepower can be squelched somehow. Initial attempts at this by AI competitors were fairly lame, including pinching the exhaust-pipe tips (doesn't help) and fitting cheap, low-profile air filters (kills 20 hp). Now the wet rag is applied electronically by tuning the engine management to pull timing at higher rpm. This is more accurate, allowing maximum torque and allowable horsepower in a broad, flat powerband.

More Scat stuff is found in the 5.400-inch length, 4340 H-beam connecting rods. "For the rpm and the load, they're the best bang for the buck," Bruce says. Forged in China but machined in the United States, these Scat rods are a bit more expensive than comparable offshore parts, but Bruce likes their fully machined surfaces and close quality control. Plenty of rod for AI, Scat's higher-dollar, American-made rods are required for AIX engines.

Ross forgings with a Griggs design number for the dome shape, ring height, and other details compose the Griggs AI piston. The Grigg's dome uses a flame trough to get a flame kernel across the dome to the "hot" side of the combustion chamber and thus suppress detonation. There's not much of a valve pocket in these tall domes, which is a good clue valve lift is moderate.

The Griggs Approach

Obviously, the facts point to EFI as the logical American Iron induction solution, so Griggs Racing has gone the EEC IV route. The company has also done the displacement thing, using a stock 4.00-inch bore and a 3.250-inch stroker crank to arrive at 327 cubic inches. That's a nice compromise

Dyno Results

Once it was installed in owner Keith Videtto's AI race car, our subject engine was run both on Grigg's Racing in-house engine dyno and a chassis dyno. As expected, it made a bit too much horsepower to work with Keith's car weight, so the engine was restricted by pulling ignition timing and fuel via the engine management and a chip using Autologic software. Furthermore, Keith added about 10 pounds of ballast—just to make sure—for the first race he ran with the new engine.

Most importantly, the engine made 369 lb-ft of torque and just 340 hp to the rear tires, after approximately 65 percent of the airbox inlet area was plated off and the engine-management restrictions were in place. This worked great at the track, as Keith was running in a podium position at Willow Springs before spinning off in the only race run before our deadline. And, yes, Bruce Griggs won that race.

Unrestricted on the engine dyno, Keith's engine was nearly perfectly square, hovering right around 400 lb-ft of torque and 400 hp, give or take a few numbers. This is on Griggs' Dynamic Test Systems dyno, which reads about 8 percent lower at 6,000 rpm than the commonly used SuperFlow 901 (Bruce verified this by running the same engine on his and a 901 SF back-to-back).

Playing with a calculator (and apples and oranges input), we noted Griggs was able to retain 92.25 percent of the unrestricted flywheel torque in the car, while keeping only 85 percent of the unrestricted flywheel horsepower. Put another way, restricting horsepower allowed 7.25 percent more torque than would have been possible without restricting horsepower. Due mainly to the different dynos used, the percentage of power at the rear tires compared to the flywheel readings is clearly optimistic when figured this way, but the percentage difference of torque and horsepower retained after restricting the horsepower output would be the same. And that a restricted engine made 7 percent more torque is what really matters.

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between working area and revability.

Plenty of compression is another definite attribute of the Griggs' AI engine, although exactly what the compression ratio is was not divulged. Bruce's only comment on compression is, "People wouldn't believe what we run in these things." We'd guess something near 13:1.

Big compression mandates small combustion chambers and pop-up piston domes, thus driving head and piston design. Griggs takes care of this by milling the heads and specifying a custom dome on its Ross pistons.

Of course, the camshaft, the intake, and the porting combination has to be torque-friendly. Griggs camming specs are secret, but they must be barely in the low-0.500-inch lift range, combined with short duration, as there just isn't that much power being made here. Word was that Griggs was playing with moving the lobe centers around, but then, racers are always moving everything around.

And speaking of playing around, at press time an induction experiment was being built from a hermaphrodite Trick Flow intake pairing (see the photos).

The good news is, there is only so much power of any kind that can be made with a 9.5:1 power-to-weight rule. Thus, stress builders such as high rpm and excessive heat aren't overpowering considerations, so the durability requirements are not excessive (this is

Drag racers go for sexy, thin-waisted piston pins, but road racers are in for the long haul and prefer a more voluptuous slathering of material in the pin wall. To better package the oil ring, these suitably thick units measure 0.912 inch in diameter rather than the common 0.927-inch option. Griggs wants the pin out of the oil-ring groove.

Griggs' standard cylinder head is the Trick Flow Track Heat. This head has little trouble spooling up 400 hp, so it needs minimal preparation from Griggs. This includes running Trick Flow swirl-polished, stainless-steel valves and 10-degree locks, Trick Flow chrome-moly retainers, and Trick Flow springs. The spring pressures are checked, of course, and occasional adjustments are made. Bruce says they check their valvesprings after every race, but find they're typically good for one season.

There are no tricks in the Griggs AI engines' "packaged parts," such as rings and bearings. These Childs & Albert plasma-moly rings are the standard fitment (Griggs has run Total Seal but doesn't insist on them). Naturally, they are file fit. Bearings are Clevite HP bearings, occasionally with extra clearance on the mains, depending on how the crankshaft measures.

While the Track Heat already has a compact combustion chamber, Griggs mills the heads to raise the compression ratio. Bruce is also considering cutting a small eyebrow in the deck face to provide a steam bleed in the cooling system. That passage, which is present in some aftermarket aluminum heads, seems to deliver slightly cooler water temperatures.

somewhat offset by the brutal on-and-off duty cycle road-racing engines must endure). Aside from a strong Ford Racing Performance Parts R block—the stock 5.0 engine case won't last too many races before splitting through the number-two main bearing web—going wild on exotic materials or extra beefy parts isn't necessary.

Furthermore, exotic cylinder heads, zoomie exhaust, and all that aren't what make torque. That means more affordable, mainly streetable hardware is all that's required. This is especially helpful in the simple roller-rocker valvetrains, and well illustrated by Griggs' use of Air Flow Research 185 or Trick Flow Track Heat heads at most—not race stuff.

In fact, Bruce jokes that this is Griggs' "Summit engine" because it uses Summit gear for the heads, the valvetrain, and much of the rotating assembly. So, if not cheap, at least the basic engine bits are reasonably priced.

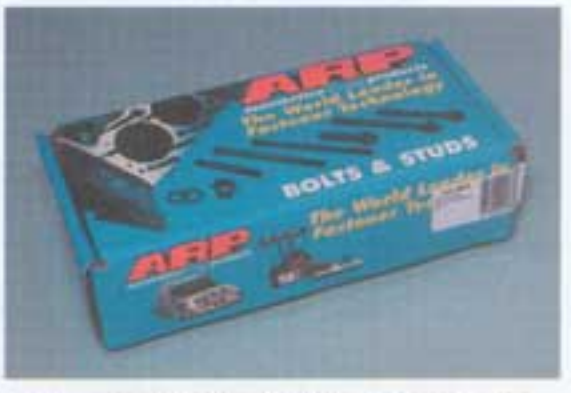
Of course, there are plenty of places money must be spent. We already noted the major exception—the FRPP block. Not only is there the price of the block, but also Griggs thoroughly details this beefy piece. Sharp edges are chamfered in the webbing and valley, the whole thing is deburred, and the rod bolt clearance is notched into the bottom of the cylinders, followed by a decking pass in the milling machine. Dodge Reidy, the engine specialist at Griggs, says decking is mandatory both to achieve a desirable gasket sealing surface texture (Fel-Pro's 1011-2 gasket with preflattened copper fire ring is used to keep from tearing up the aluminum heads), along with a zero deck height and block squaring. Griggs checks the blocks for bearing alignment and align-hones as necessary.

Oil improvements are restrictors to the cam bearings to increase main bearing flow and reduce camshaft flow

What Griggs does chase on its heads is core shift and how the bowl/valve seat relationship works out. Some heads need little work, while others require a definite touch with the cutter to align the bowl/seat interface. Naturally, while we were visiting, all the heads in the shop had little core shift. Although we don't have much to show you in this as-cast example, the eyebrow of material at one o'clock to the seat in this photo, and the area just to the left of it, are where the action occurs. A quick port match and knocking off any obvious casting imperfections completes the minor Griggs AI engine port job.

Mainly to get rid of the stock lifter retainers, Griggs runs Crane tie-bar roller lifters, which are happier at high rpm.

Those looking for speed secrets in the Griggs valvetrain will be disappointed. The company uses the full Trick Flow treatment, from pushrods to roller rockers, while the timing chain is typically an FRPP piece, so no unobtanium there, either.



As do most engine builders, Griggs runs ARP hardware wherever the budget allows. For AI engines, this is at least the head bolts.

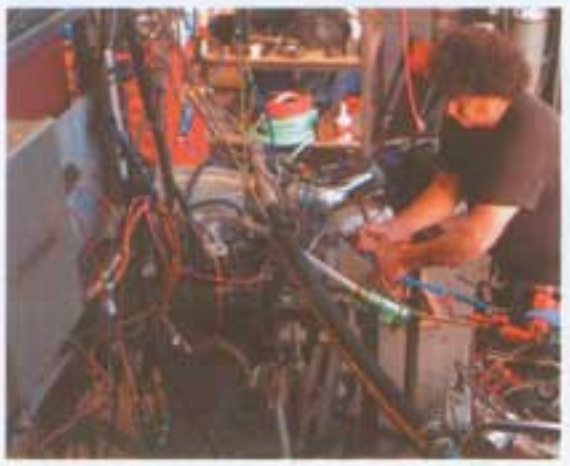
(not much is needed with roller lifters). Oil drainback is helped with lifter galley smoothing and grinding a radius to the passages at the oil filter. Asked if there were any trash screens in the valley, Dodge said no, but they were a good idea. Then Bruce chimed in with, "Nah, they don't go fast enough to hurt themselves."

Kidding aside, these engines are quite durable. Bruce says they'll go the entire racing season before needing rings and bearings. Given the cost of around $11,000 per engine, that's enough time to find another grand or so for the engine-freshening budget.

See the photos and captions for more details, and the sidebar for dyno results. And for track-winning power, see Griggs Racing.

On the fuel and engine-management side, there's nothing exceptional in the intake tract—far from it, due to the horsepower limitations. An off-the-shelf BBK 70mm throttle body and intake tube are the norm. The injectors were 30-lb/hr FRPP units on the test engine (Griggs aims for as much FRPP and Trick Flow gear as possible to aid commonality and reduce servicing headaches). The fuel rails are most often stock. Griggs nominally supplies its engine with valve covers, but often the customer already has a preferred set. The important point is to increase breather area to compensate for the extra 30 ci of displacement. Typically, stock covers with additional breathers welded on are the Griggs solution.

Griggs' next trick induction idea is to run the Trick Flow Track Heat upper intake on a Street Heat lower, along with a thick spacer with the transitions blended and radiused, not tapered. The idea is to have more plenum area and plenty of velocity, although Bruce notes it takes a good valve bowl to accelerate the air in such a combination. Unfortunately we didn't get to try this combination during our testing (ours had a straight Street intake). Bruce also noted that even with matched upper and lower intakes, there is a fair amount of port mismatch on these parts, so port matching is always part of the job.



Yeah, there's an engine somewhere in this EFI dyno wiring mess. Just what wires each engine has depends on the customer as ignition choices vary. Plug wires are typically from FRPP because they're inexpensive, they fit, and they're numbered, which helps at the track when things get hectic. Bruce prefers Champion spark plugs, while main engine main Dodge Reidy, seen here making an adjustment, has a penchant for NGKs.

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Restricting top-end power is a fact of American Iron life. Griggs prefers the stock air-filter box because it breathes cool air and doesn't cost any money. He often covers half or more of the inlet to restrict horsepower.

Headers are not normally part of the Griggs engine package and are supplied by the car owner. On his cars, Bruce uses BBK exhaust parts because they fit, and BBK is an American Iron series sponsor (Bruce is an unashamed American Iron booster). Griggs' dyno headers are these old 1⅝-inch MACs that were lying around the shop.

In the greater San Francisco Bay area, everything is regulated to an inch of its life, including engine noise that might offend the miles of nearby marshlands and vineyards surrounding the Infineon Raceway (read Sears Point). Griggs' dyno mufflers do the job with straight-through efficiency. Al cars are lightly muffled on the track too, so the arrangement is appropriate.

Canton's road-race oil pan covers the bottom end. Aside from occasional massaging for fitment, Griggs runs the pan stock. A Melling M68 standard-volume, standard-pressure oil pump is used because the high-volume pump chews up the cam gear and distributor, says Dodge. Besides, with the rpm and bearing clearances in an Al engine, more oiling isn't necessary. If extra coolers, lines, and fittings are on the chassis, then Griggs would use a standard-pressure, high-volume pump.

Bruce really likes the fluid-filled Innovators West harmonic damper (which, naturally enough, the subject engine was the only engine in the shop that didn't have one). Bruce says he's never had a crankshaft or block fail that's had this lightweight, turbine-smooth damper installed. No matter what the aftermarket damper, the bottom portion of the water pump must be lightly clearanced to fit, which is what you're looking at here.

Griggs Racing has its own late-model Front Engine Accessory Drive (FEAD) replacement kit to simplify dressing the myriad of engine combinations that land on its doorstep. The company uses Edelbrock's 8840 water pump with slight clearancing on the bottom to clear the harmonic damper, a '94-or-later alternator with a slightly modified bracket, the Innovators West damper, an FRPP AC-delete kit, and underdrive pulleys. All brackets are stock Ford, the belt tensioner is '85-'93 Ford ('94 and later uses the SN-95 tensioner), and the power-steering pulley is a non-Mustang-but-stock-Ford part (probably a truck piece). The system fits all Fox bodies.

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Not part of the Griggs Al engine package but commonly run by the company is this dual-disc McLeod clutch and flywheel. These are available with race or streetable friction material, so that makes a new trick for the ultrastreet performance and open-track guys to try. The light weight and small diameter really allow the engine to zing, and it all fits inside a stock bellhousing using a stock starter. **5.0**

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