KATECH CADDY

1,000hp V-16 Buildup

The GM XV-16 went through many conceptual phases within GM before Katech Engine Development became involved with the project. From the official kickoff meeting at Katech to the first fire-up on dyno, this ambitious project spanned only seven months. The fully calibrated engine was delivered to GM for installation into a mule vehicle, a stretched Yukon, in less than eight months. With details such as beauty covers and a stylized power steering reservoir to follow, the engine was unveiled in the Cadillac Sixteen concept car at the North American International Auto Show.

Katech was awarded the job of building this engine because it was the only company who wanted to do it right: to cast real heads, a new block, and inlet manifold. Starting with Gen III architecture, Katech and GM performed torsional studies, design iterations, and solid-modeled the entire engine in CAD software. Three master's-degreed engineers, a full-time designer, and Katech's technical director worked nearly around the clock in conjunction with GM HPVO and Styling Studio to complete the design work. These designs were transferred directly to prototype casting source Becker CCC for cylinder head, block, and inlet castings. Katech also contracted ACTech GmBH to cast its V-16 specifically designed integrated main-cap, eight-stage dry-sump.

Katech then CAM-programmed directly from the solid model and machined parts from billet for a majority of the remaining pieces. This includes the eight scavenge-section dry-sump pump bodies, throttle bodies, the upper inlet plenum, valve covers, and beauty covers. Much of the front drive, including the harmonic balancer, oil pump drive, and belt tensioner were also purpose-built for this engine.

The heads were machined completely in-house and then hand-ported (the long heads wouldn't fit the five-axis CNC head-porting machine) the LS6-style head to achieve 320 cfm. While most of the block was machined by Katech, some expert help (such as line-boring the mains and cam) came from Schwartz Machine.

Machining 8 Stage Dry Sump.

For a refined, smooth V-16 engine, it shook the foundation when running W.O.T., making 980 lb-ft at 3,600 rpm. At only 50 percent throttle and 2,000 rpm it still made 640 lb-ft of torque.

The crank design, completed in conjunction with Ricardo's torsional analysis, was manufactured by Dearborn Crankshaft. The crank was machined from billet steel, as was the camshaft, which was manufactured by LSM. As these parts came in and Katech finished machining everything else, the engine build proceeded with great caution. Every tolerance had to be inspected to ensure that one small oversight did not destroy the one-of-a-kind engine. Some insurance was taken out, however: GM and Katech decided a display engine was a must. This display engine had real parts ready to stand in if any catastrophic failures occurred

As with the machining, engine assembly was a task based purely on the size of the engine. At more than 38 inches front to back, the block weighed almost 200 pounds. Much of it was built on a rolling cart versus the traditional engine stand. The crank and sump each required two engine builders to install. The short-block utilized forged-steel connecting rods, racing alloy forged pistons, oversized main journals for crank rigidity, and pressed-in ductile iron liners. Departing from its Gen III origins, the block was split at the crank centerline, allowing the one-piece integrated main-cap sump to replace the steel mains. The sump had cast-in scavenge oil pickups and allowed complete sealing of the bays to reduce pumping losses. This rigid bottom end helped reduce torsional vibrations in the crank even further. GM's Displacement On Demand and cam-phasing technologies were utilized to showcase the possibility of blending power and fuel economy in a single package.

The upper end of this engine also utilized the best technology and materials known to production and racing. Lightweight titanium valves were closed by titanium valve springs, which had a much higher natural frequency. This combination allowed for better valve control required for high-speed operation of an engine with a 36-inch-long camshaft. Assembly details were completed as the engine was being prepared for testing on the dynamometer.

Time was running short, so everyone got to work. The scavenge pumps and inlet manifold were installed while other technicians rerouted the water and oil-cooling systems to fit the monster in the dyno. Some parts came off the CNC machines minutes before the first attempt to start the engine. A near all-night thrash and some good luck allowed for the first fire-up and troubleshooting to occur just hours before more than 40 GM engineers and executives including Tom Stephens and Wayne Cherry arrived for the ceremonial running of the engine. *Newsweek* was on hand to document the sheer determination it took to arrive at that point.

A successful first demonstration took a lot of pressure off Katech's shoulders.

Torsional testing showed the engine to be well within acceptable production levels, illustrating a high level of refinement for a prototype project. With data to show the crank wouldn't tear itself in two, real calibration commenced on Katech's Cell 2 engine dynamometer. The engine tested the upper limits of the dyno as real numbers within 2 percent of the target were actually recorded, even limiting the engine speed to reduce the likelihood of failure or runaway on the dyno. For a refined, smooth V-16 engine, it shook the foundation when running W.O.T., making 980 lb-ft at 3,600 rpm. At only 50 percent throttle and 2,000 rpm it still made 640 lb-ft of torque.

As the engine came off the dyno and was being installed into the Yukon mule, the program manager and calibration engineer began to wonder how driveable this engine would be with that much torque and power. The first roll off the driveway onto the street almost shocked them both ... it was as smooth as butter. Rolling into the throttle as one would under normal driving simply started a smooth acceleration. But as they became more comfortable, these two quickly found it was the rate of throttle opening acceleration that made the difference. A light foot meant easy-mannered (yet still quick acceleration) driving. A faster foot meant lighting up the tires—through as many gears as they had the guts to go through over the short street they drove it on. The response was phenomenal. It seemed a direct linear response to the foot; as it pushed forward, the 6,500-pound Yukon propelled with equal ease.

After refining the calibration under driving and cold-start conditions, Katech shipped the engine to GM for good. The stories continue beyond that, but the guys at Katech will only smile about them. It was a fun project, it was a crazy project, it was the chance of a lifetime—and they lost themselves in the moment. ●

V16 CADILLAC FIGURES PAST & PRESENT

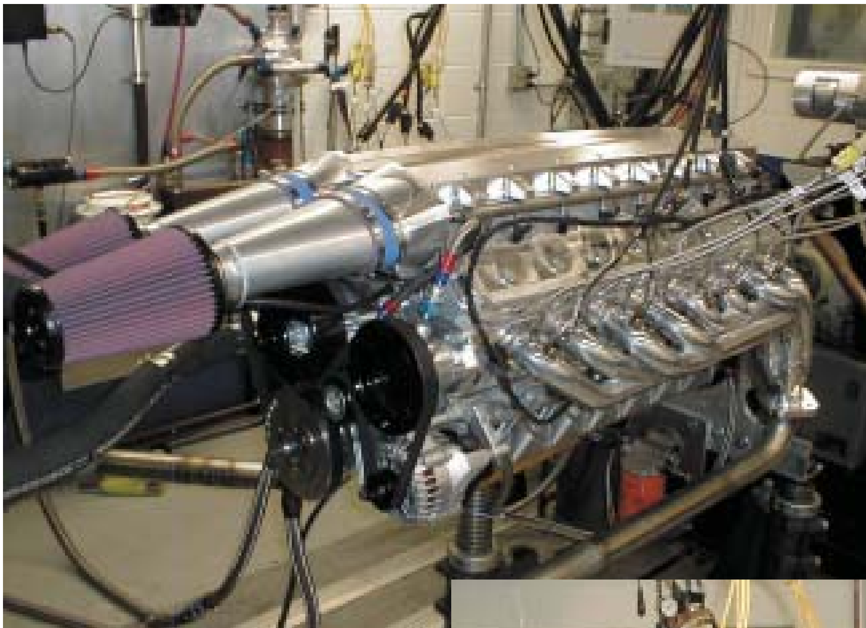
	1930s V-16	2002 V-16
Cubic Inch	452 ci	827 ci
Torque	320 lb-ft	980 lb-ft
Horsepower	175 bhp	1,000 bhp
RPM redline	3,600 rpm max	6,000 rpm max
Engine Weight	1,500 lbs	695 lbs

Bottom end assembly.

Torquing the crankshaft in place.

Valve spring installation.

Flow bench test of cylinder heads.



Ready to make 1000hp!

Spare crankshafts.

Dyno test cell.

Test-fitting the engine in place.

Yukon test bed.