

## **Tigershark Engine Family, New Transmissions Mark Turning Point for Chrysler Group**

- Model-year 2013 marks debut of Tigershark family of clean, fuel-efficient four-cylinder engines
- North American debut of MultiAir 2 valve-actuation technology
- Three new transmissions, including a sporty dual dry clutch transmission (DDCT), launch with all-new 2013 Dodge Dart – further evidence of Chrysler Group’s commitment to 25 percent fuel-economy improvement by 2014
- Availability of award-winning Pentastar V-6 expands to 13 nameplates with launch of 2013 Ram 1500 – also the first full-size light-duty pickup to feature an 8-speed automatic transmission and stop-start technology
- Pentastar’s output jumps to 300 horsepower in applications of Chrysler Group’s full-size sedans, while still delivering 31 mpg

August 31, 2012, Auburn Hills, Mich. - Engineers got the green light to develop the Tigershark in May 2010. At that time, Chrysler Group’s shortest interval between program approval and production launch was about 115 weeks (for the 6.1-liter HEMI® V-8).

Ninety-five weeks later, the company produced the first Tigershark engine, the company’s most refined 4-cylinder powerplant ever.

How was this accomplished? With sheer will, says Glen Macfarlane, the program’s chief engineer.

“The extremely compressed timing required shrinking the window allotted for dynamometer calibration,” he notes.

Because Chrysler Group had no protocol to accommodate the tighter deadlines, engineers had to develop one. The result: a method of synchronizing multiple test cells via a complex design of experiments.

This discovery shaved weeks off the development cycle – and created The Tigershark Effect.

The new test continues to be used on other programs, Macfarlane says, adding the word Tigershark now is used as a verb by engineers. When faced with a seemingly insurmountable task, they say: “Let’s Tigershark it.”

The Tigershark I-4, which powers the all-new 2013 Dodge Dart compact sedan, heralds a new era for Chrysler Group powertrain engineering – one inspired by a game-changing collaboration with Fiat.

“Our partnership with Fiat redefines the competitive landscape,” says Bob Lee, Vice President and Head of Engine and Electrified Propulsion Engineering. “The stage is set for us to once again demonstrate that Chrysler Group designs and produces world-class engines that deliver engaging functionality and superior value.”

Engineers started with an essentially clean sheet of paper. The Tigershark shares a fraction of its part numbers with the World Gas Engine, most of which are of the fastener/sealant variety.

The dual-overhead-cam (DOHC) 2.0-liter Tigershark, which debuts first, is 88 percent new, while the single-overhead-cam (SOHC) 2.4-liter version is 89 percent fresh.

Both start with a lightweight, high-pressure, die-cast aluminum block (with cast-iron bore liners) and a four-valve aluminum head. Both feature an 88-mm bore, but their strokes are 82 mm for the 2.0-liter and 97 mm for the 2.4-liter.

Central to the Tigershark’s fuel-efficient character and low-emissions performance are elements such as roller finger follower rocker arms, wide-range dual independent exhaust and intake variable valve timing.

Further testament to the no-holds-barred attitude that inspired the development process, engineers demanded enhancements such as:

- A diamond-like carbon-coated floating piston pin
- Electric thermostat
- Variable-displacement A/C compressor
- Two-stage oil pump
- Low-tension piston rings
- Precious-metal spark plugs that promise 100,000-mile service life

Whether the customer seeks smooth cruising or more robust performance, the Tigershark delivers. The 160-hp 2.0-liter engine generates peak torque of 148 lb.-ft. at 4,600 rpm, while its 184-hp big brother puts out 174 lb.-ft. at 3,900 rpm.

Both also exhibit superior refinement, an essential bogey for this engine whose Tigershark moniker was inspired by the fighter jet of the same name. A primary building block to achieve such refinement: the cylinder block.

Engineers added a structural cast-iron bearing beam to the bottom of the cylinder-block assembly, as well as integrated accessory mounts. A unique three-point powertrain mount system also was developed. It features an integrated front mount.

Other contributors to Tigershark's elevated refinement are:

- An aluminum isolated head cover
- Acoustic covers for intake and exhaust manifolds
- Thicker forged-steel crankshaft for increased stiffness
- A relocated crankshaft thrust bearing
- Unique front-exhaust architecture
- Balance shaft module
- Select fit rod and main bearings
- And a dual-layer acoustic damped steel oil pan

### **MultiAir 2**

The 2.4-liter Tigershark ups the ante on valve-actuation. The optional Dodge Dart I-4 features just the second application, worldwide, of MultiAir 2 – a new and improved version of Fiat's breakthrough MultiAir technology, which increases power and torque as much as 10 percent and 15 percent, respectively, while reducing carbon-dioxide emissions and improving fuel economy by up to 7.5 percent.

The acclaimed electro-hydraulic fully variable valve-lift system uses a column of oil in place of the traditional mechanical link between the camshaft and intake valves. The resulting precision reduces engine pumping losses and increases volumetric efficiency.

However, MultiAir intervenes only at the start or end of the valve event. MultiAir 2, which made its debut on Fiat's award-winning TwinAir engine, accommodates an extended opening inlet event for greater internal exhaust-gas recirculation and additional fuel-economy improvement.

### **Geared Up**

An auto-industry platitude declares there has never been a great car that did not have a great engine. Chrysler Group goes this one better: There has never been a great car that did not have great engine and a superior transmission.

"Chrysler Group is intensely focused on delivering unmatched value and performance in its transmissions," says Mircea Gradu, Vice President Transmission Powertrain and Driveline Engineering, Head of Powertrain Virtual Analysis Tools.

This is evidenced by recent investments in manufacturing that total more than \$1.2 billion.

"Excellence is the hallmark of our engineering team's efforts," Gradu adds. "That is plainly evident in our products."

None more so than Chrysler Group's first dual dry clutch transmission (DDCT), set to debut in the 2013 Dodge Dart.

The 6-speed DDCT's dual-mass flywheel accommodates operation at lower rpm, a condition that complements the unit's low-viscosity synthetic oil for enhanced fuel economy and CO2 emissions reduction.

From the driver's perspective, the transmission's 6.68 gear-ratio spread and 4.43 final-drive ratio deliver smooth launch performance and affords lower rpm at highway speed for greater refinement.

Mated exclusively to the Fiat-inspired 1.4-liter turbocharged FIRE I-4, the DDCT promises spirited driving – especially if actuated by the console shifter – thanks to an 18.4:1 first-gear launch ratio.

It also exhibits that most desirable of all behaviors: "The DDCT provides quicker, crisper shifts," says Ed Perosky, Chrysler Group director of automatic transmissions.

Two new transmissions enhance the Tigershark's performance: a 6-speed manual and a 6-speed automatic.

The Powertech AT features a shift schedule tailored to deliver superior fuel economy. Its 5.46 gear-ratio spread and 3.19 final-drive ratio contribute to smooth launch and reduced RPM in highway driving.

These attributes combine to reward Dart owners with outstanding value and a satisfying experience behind the wheel.

The 6-speed manual transmission, available with all three Dart engine choices, also features a dual-mass flywheel to accommodate operation at lower RPM. It boasts a gear-ratio spread of 6.68 when mated with the 1.4-liter FIRE I-4 and 6.27 when channeling power from the Tigershark engines.

Consistent with Chrysler Group's focus on refinement, significant measures were undertaken to mitigate noise, vibration and harshness. They include a synchronized reverse gear and utilization of an isolated shifter and shift cable bracket.

### **TorqueFlite Takes Flight**

Last used in 2007, Chrysler Group revives the legendary TorqueFlite name to mark an industry-first: the new TorqueFlite 8-speed automatic transmission becomes available in a full-size pickup, the 2013 Ram 1500.

Activated by an innovative rotary e-shift dial, the state-of-the-art gearbox features a thermal management system designed to quickly raise engine and transmission-fluid temperatures.

Raising fluid temperatures mitigates parasitic losses, improving fuel efficiency by 1.7 percent.

As the engine temperature increases to pre-determined levels, warm engine coolant is circulated through a thermal-exchange unit, which also contains dedicated pathways for transmission fluid. As the thermal-exchange unit heats up, it also heats up the transmission fluid.

This action dramatically reduces transmission warm-up time, improving not only fuel economy, but drivability and shift quality.

In most powertrain configurations, the transmission heats up independently of the engine, delaying warm-up time and reducing efficiency.

### **More Milestones**

Adding to industry-firsts in the pickup-truck segment is the application of stop-start, another fuel-saving feature available on select 2013 Ram 1500 models. This new system improves fuel economy by up to 3.3 percent, an increase of about one mile-per-gallon to the truck's city drive cycle.

Stop-start improves fuel efficiency by shutting the engine off when the truck comes to a complete stop. Amenities (radio, gauges, heating or air conditioning, etc.) continue to operate, making the feature's operation transparent to the driver. The engine restarts automatically when the driver releases the brake, allowing seamless acceleration.

Chrysler Group's award-winning 3.6-liter Pentastar V-6 (twice listed among Ward's 10 Best Engines) is being offered for the first time in the Ram 1500. There it delivers 42 percent more horsepower,

13 percent more torque and fuel economy that is at least 20 percent better when compared with the 3.7-liter V-6 previously available in the truck.

Meanwhile, in select models of the Chrysler 300 and Dodge Charger full-size sedans, the Pentastar's output jumps to 300 horsepower from 292 in model-year 2012.

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