High-Performance Expectations at Navistar's IEP and ICC Operations in Indianapolis, IN

Culture change and Integrated Quality Assurance.

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t's cleaner, it's more reliable and quieter, and it meets the customer and government demands for reduced emissions. Also marked by more exacting requirements for production/ assembly, Navistar's new 6.4 liter diesel engine debuted early this year. This engine and related production/assembly processes, and production were among the topics discussed during a recent AME workshop at the International Truck and Engine Corporation's Indianapolis Engine Plant (IEP) and the adjacent Indianapolis Casting Corporation (ICC), both in Indianapolis, IN. Navistar International is the parent firm for these operations. Event participants toured both facilities.

Stringent Cleanliness Standards and Process Change

Cleanliness is a crucial element of the engine plant's production of the new 6.4-liter engine, according to Kent Hoffman, AME Group — Engine Test Resource Leader. The Indianapolis Engine Plant's three clean rooms where the high-pressure common rail fuel system is assembled and tested for this unit represents a significant change for processes employed in producing the 6.4-liter engines at the site, Hoffman said. For example, they are using an advanced, high-pressure,

In Brief

A more stringent assembly process, including critical cleanliness standards, marks the assembly of the new 6.4-liter diesel engines at International Truck and Engine Corporation's Indianapolis Engine Plant (IEP). AME workshop participants recently toured this operation as well as the adjacent Indianapolis Casting Corporation (ICC) in Indianapolis, IN. Their Integrated Quality Assurance (IQA) approach helps to minimize potential errors in the new engines.

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About IEP and ICC in Indianapolis, IN

Navistar International is the parent firm for International Truck and Engine Corporation's Indianapolis Engine Plant and the Indianapolis Casting Corporation, both in Indianapolis, IN. Employees at the Indianapolis Engine Plant had produced the 6.0-liter mid-range diesel engine for Ford Motor Company's Louisville, KY Truck Plant. The 6.4-liter diesel engine (named the Power Stroke by Ford) produced by IEP is now used in the Ford F-Series Super-Duty pickup trucks.

The Indianapolis Engine Plant encompasses approximately 1.1 million square feet of manufacturing space. They machine the five major components of the engine: camshaft, crankshaft, connecting rod, cylinder head, and cylinder block. After engines are assembled here, they are tested for quality before shipment to the customer. This plant was named one of the top ten North American manufacturing plants by *IndustryWeek* in 1998. The facility also received the Indianapolis Mayor's Eagle Award for setting and achieving high performance goals.

The 6.4-liter cylinder blocks and heads for the Indianapolis Engine Plant as well as International's diesel engine plant in Huntsville, AL are cast at ICC, a grey-iron foundry. Blocks and heads for the inline-6 diesel engine produced at International's Melrose Park, IL plant are made by ICC workers. They also cast blocks and heads for AM General's 6.5-liter diesel that goes in the military HUMVEE military vehicle and a racing block for Ford Motor Company.

ICC is a wholly-owned subsidiary of International Truck and Engine Corporation. It covers about 500,000 sq. ft. of manufacturing space and is adjacent to the Indianapolis Engine Plant. This plant has a capacity of 1000 tons a day. The foundry has molding units, metallurgical and sand laboratories, tooling and design, and a cleaning room.



Figure 1. Indianapolis Engine Plant manufactures the 6.4-liter Power Stroke^(R) diesel engine for Ford. Pictured is the assembly line, representing a fraction of the 1.1 million sq. ft. of manufacturing space in the facility.

common rail fuel system (with piezo injectors, a Siemens product). "This has been a big a culture change for us," said Hoffman. "We constantly need to monitor cleanliness standards. Cleanliness is critical, as we work with clearances of microns (thousandths of a millimeter) on the fuel system for the 6.4-liter engine." Employees were trained in methods for keeping assembly areas cleaner than hospital rooms, he said. The employees wear gloves, booties, hats, and other gear needed to ensure that these standards are met during assembly and test.

"There is a very stringent assembly process associated with this system — a complex series of steps," Hoffman continued. "To minimize potential error, we automated the critical rundown of fasteners with this system. Tooling includes two fully-automated stations with electronically-controlled rundown equipment. We worked through a long development process with Siemens and Ford to understand the requirements of this system — over two years."

The Indianapolis operations reflect the corporation's Integrated Quality Assurance (IQA) approach, according to Hoffman. The objectives are to improve product quality and reliability, improve the ability to detect assembly defects and reduce repair time, and eliminate the need to hot test engines 100 percent. The idea is to verify engines throughout the assembly process. Waveform and signature analysis are among the tools used by operators as they incorporate error-proofing and feedback systems.

Various types of test stations are in place. Among the factors they check are part presence (vision systems and mechanical probes), measurement of print dimensions, leak checks, and function performance of assembled components. Through IQA, they assure quality in shortblock assembly, piston subassembly, cylinder head subassembly, longblock assembly, etc.

Among these stations are Cold Test and Start-ability stations. The Cold Test method monitors the engine with an external drive at various RPMs and monitoring waveforms to detect defects. This system enables the operators to check pressure, torque, mechanical attributes of the engine, and operating sensors without operating the engine.

In the Audit Hot Test Cell, viewed by workshop participants, one percent of the engines are tested for any quality issues that could have been missed at the IQA stations. At this station, the engine is warmed up for three minutes and tested for 30 minutes.

Workshop attendees visited the automated piston stuffing machine. Employees used to manually stuff pistons into engines. They also viewed the Crankshaft Line, with two advanced technology heat treat machines that were installed for the 6.4. The operator can monitor and control the heat treat machines, another change from traditional operations.

An updated Crankshaft Line is a more streamlined, flexible process. Hoffman said stronger and more durable parts for the 6.4-liter engine are produced on this line. It features increased precision, allowing better geometry of the crankshaft.

Error-proofing, Employee Involvement

Error-proofing the new processes is a continuing effort. Production employees went through a familiarity class for the new engine. Process changes and the importance of completing process steps in the right order were discussed during these sessions. "The new process has been embraced very well," according to Hoffman.

The skilled trades learned various error-proofing techniques that rolled over from the company's Huntsville, AL plant. Hoffman said that employee involvement at Indianapolis enables them to adapt and improve these techniques, such as priming of the fuel system for better start times. Design for Manufacturing (DFM) improvements noted by Hoffman range from modified tube routing that enables access for auto rundown tooling, to the addition of a hex drive feature to the shaft of a pump to assist in driving the pump without the drive gear attached.

"It's an iterative process, ongoing as we look for process improvements," Hoffman continued. "As we ramp up production we are pushing to reduce cycle times and increase first time yield (now at 98-99 percent). We are constantly looking at ways to improve at each station. There are two new stations



Figure 2. An ICC employee removes slag, the impurities that surface when iron is melted, from an Ajax medium frequency melt furnace.

to test check for the functionality of the fuel system — checking for leaks and automated black light checks, for example."

Customers have high expectations for the performance of the new 6.4-liter engines. Compared to the competition, said Hoffman, they are quieter, more easily pull heavy loads, and deliver more reliable performance. The 6.4-liter engine is billed as Ford's cleanest and quietest diesel engine on a pickup sold in America. It meets U.S. EPA requirements for reduced emissions. Next on the agenda: Decrease emissions another 50 percent by 2010, per the EPA.

Foundry Operations

Operators at the adjacent ICC foundry make cylinder blocks and heads for IEP's 6.4 engine and for their sister plant in Melrose Park, IL and other markets such as the military HUMVEEs. Tour participants watched start-to-finish operations here. Cast iron scrap, pig iron, and scrap steel materials come in and then are melted at 3000 degrees F and transferred to ladles and poured into an overhead crane. which pours the molten material into holding furnaces. Then the material is transferred to ladles and the molten material is poured into sand molds to form castings. After a 45-minute cooling period, the castings then move on the "shakers" that shake them from the molds. A two-hour cooling period follows on conveyors. Next, a shot-blast machine cleans castings with steel shot. After cleaning and inspection, the castings are sent on pallets to a local company to remove the rough edges, and they come back to the customer for assembly.

The foundry's processes are fairly stable, though employees are mindful of the need to look for continuing improvements. Tom Smith, plant manager at ICC, noted that they have achieved TS-16949 (quality) and ISO 14001 (environmental) certifications. The facility annually recycles 165,000 tons of scrap metal and 2400 tons of internal scrap metal. They also recycle or provide for beneficial use more than 98,000 tons of sand each year. One hundred percent of house dust is recycled (it is sent to a cement kiln).

A challenge shared by Navistar and its customers is that new technology for the new engine drives a large amount of cost into the product, said Hoffman. Consumers don't want to pay for that upgrade, however. Alternate sourcing opportunities, the continuing reduction of the supply base, effective supplier partnerships, and other means are among their coping strategies. "Improvement in quality and other areas is a continuing process that goes on forever," Hoffman said.

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