Impact assessment

We take an exclusive tour of Ford's Dearborn crash laboratories to discover the cutting-edge development work at this 'global center of excellence'

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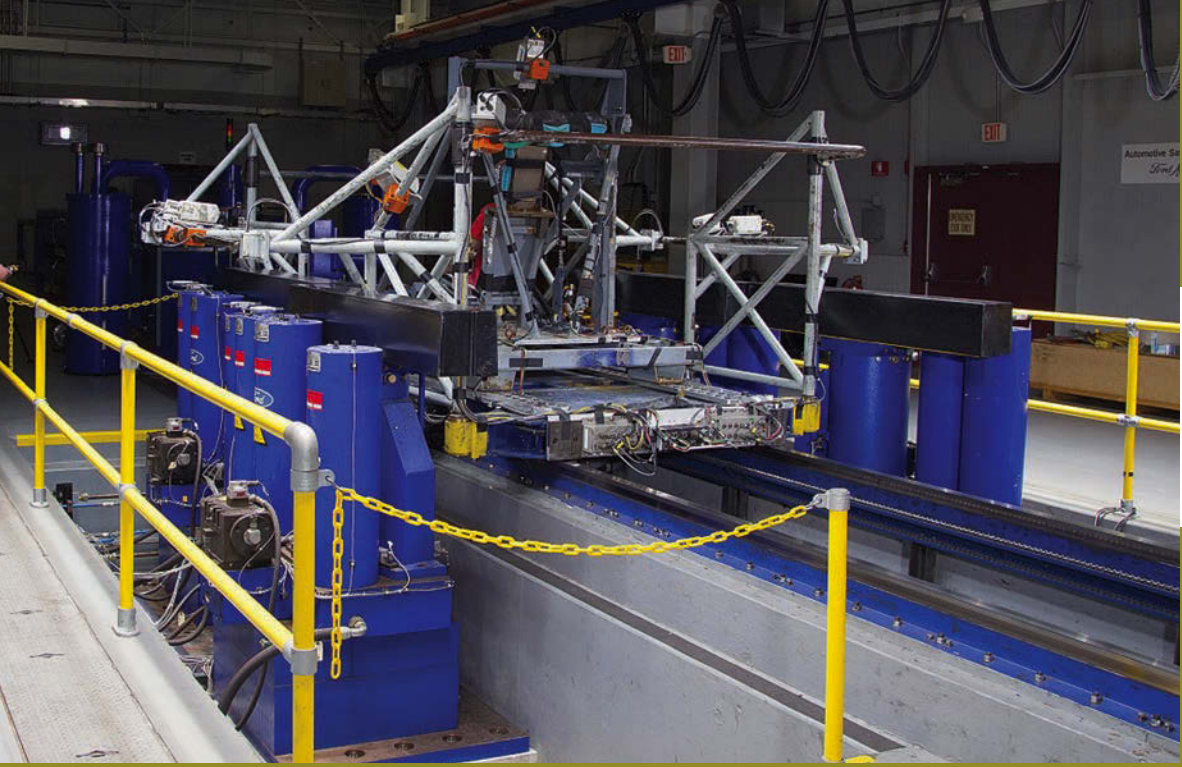
MAIN IMAGE: The view toward the crash wall at the Dearborn Crash Barrier Building. The adjacent ATD Lab (ABOVE) takes care of more than 100 dummies

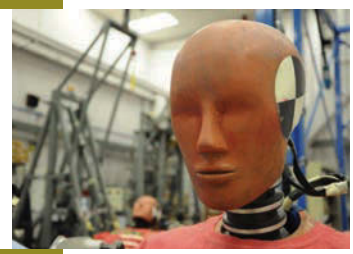
Ford has been crash testing at its Dearborn headquarters since the mid-1950s, when the first car-to-car impacts took place on the old Ford Airport. Today, rather more sophisticated impact testing is conducted on the exact same site in two major facilities: the Safety Innovation Laboratory (SIL), which handles subsystem, component and sled testing; and the Crash Barrier Building, where full-vehicle crash tests are performed. We were fortunate to be invited to tour them both.

SIL is located in a building next door to the historic Tri-Motor airplane assembly hall. The 100,000ft^2 facility has a number of test laboratories as well as a machine shop to create the considerable number of test fixtures required.

"Bringing two parts together in a three-dimensional space is typically what we do here, because we don't do full-vehicle deformation," summarizes Mike Rolling, operations engineering supervisor at SIL.

The tour begins in a component test lab where several versatile, linear impact stands handle a wide range of regulation testing (such as IP impact for FMVSS 201) and development testing (such as





LEFT: The Hyge/Seattle Safety servo sled in Ford Dearborn's Safety Innovation Laboratory has an Aicon system to position the dummies correctly for the test

simulated side-pole impacts for curtain airbag development).

"Most of it is filmed on high-speed video," says Rolling. "We typically run 1,000fps here."

Across the long, central corridor is IHI – the interior head impact testing area. Here the focus is on the upper interior of the vehicle, where a head might strike hard points such as coat hooks, grab handles and the like, as well as exterior pedestrian impact testing with head forms.

Two laboratories are dedicated to this work and, in line with the 'One Ford' global development philosophy, can test to regulations for North America, Europe, China and beyond. "We can design a car here that's going to pass in Europe," stresses Rolling.

The key pieces of test hardware in this area are two industrial robots for free-motion head-form launches (as opposed to the pendulum launches in the previous laboratory). They're similar to those used on vehicle production lines, but in this case the brakes on its movement axes are used to create inertia when the head is launched. "Its flexibility allows you to get into different areas of the vehicle, tight spaces," says Rolling. "It's a very convenient way to launch head forms."

Next stop is OOP – the occupant out of position lab. The focus here is on occupants sitting closer to an airbag than is desirable. As part of the development of ways to detect and manage the airbag's energy in such situations, test airbags are fired with a dummy close by, and data collected.

Back across the corridor is a versatile impact sled. It's used for tires and rims, fuel tanks and side-impact pole simulations, among other tasks. Rolling describes the latter as probably SIL's most complex test setup, requiring a seat, side airbag, door panel and seatbelt for the run into the pole. A complex test fixture has been designed to deform on impact so that it can be reused. A simpler test conducted in this area aims to prove that the steel frame of an F-series truck will crumple as designed in the event of a frontal impact; it's just another of the 4,500+ tests performed at SIL every year.

> "The robot's flexibility allows you to get into different areas of the vehicle. It's a convenient way to launch head forms"
>
> Mike Rolling, operations engineering supervisor, Ford SIL

Dummyville, Michigan

Ford's ATD Lab is adjacent to the full-vehicle crash facility and takes care of the dummies used there and at SIL. Here they are put through certification testing as per SAE procedures and the ATD makers' guidelines, assisted by test rigs from the likes of Denton and FTSS (both now part of Humanetics). Ford has over 100 active, instrumented dummies in the facility and does its own dummy build and certification.

"For certification testing we evaluate the dummy both before and after so that there's no question at all that the dummy has undergone any damage," says Ng.

The bulk of the dummies are a mix of Hybrid IIIs, EuroSIDs and SIDs (US), in a variety of sizes.

Another interesting area of the facility looks at fragmentation of the IP material – leather, vinyl or foam, for example – when an airbag deploys. Fragments of material can catch on the leading edge of the bag as it deploys; these need to be minimized so as to reduce the injury risk. At SIL, testing is carried out at low and high temperatures inside an ESPEC climate chamber. A catch box collects the fragments for weighing; by combining the mass information with velocity data derived from high-speed photography that tracks the fragments through space, the energy in the fragments can be calculated. Development is undertaken to keep that energy below a certain threshold.

The final stops on our tour of SIL take in three major pieces of test equipment. The first is a BIA rig that performs leg-form launches for pedestrian

ABOVE: Rows of dummies in the ATD Lab, where Ford performs all of its own certification testing

protection and ejection mitigation testing with a head launcher. Then there are the site's two biggest pieces of hardware, the crash simulators: a Hyge/Seattle Safety servo sled, and an Instron servohydraulic sled. Both use an Aicon dummy positioning system (DPS) to repeatably locate the dummy's head, knee, pelvis, etc. The latter is a 40mph sled with pitching capability that dates from 2005, a project instigated by Jackie Shuk – now Ford's overall head of testing – when she was in charge of crash testing.

It's time to move on to the Crash Barrier Building, which since the mid-1980s has been located on the infield of the Dearborn Proving Ground. Since then, the original 'North' crash runway has been decommissioned and given over to vehicle preparation. After a brief period of two-runway operation, the 'South' runway now handles full-vehicle impacts for North America and beyond – typically two to four crashes a day, 500-700 a year.

"Testing here is done to all the global requirements – we're a global center of excellence," explains our guide, test operations engineering supervisor Jerome Ng. "We test for North American and European requirements, and Latin NCAP too; we've also done a lot of work for Ford Australia. It's a busy area and it's been very important in supporting the One Ford plan at a time when the technology in crash testing has grown, too."

At one end of the runway is the crash mass weighing 454 metric tons. Made of steel-reinforced concrete, it sits 10ft above ground and 13ft below, and is roughly 18-20ft deep. The load cell-equipped crash wall itself can be pivoted ±30°.

High-intensity lights and a plexiglas-covered photography pit set the scene for crashes to be filmed.

"The high-speed digital cameras are from Vision," says Ng. "They've been a very important partner for us, with both the Miro cameras on board the vehicle and the larger cameras we have above, below and to the side." Kistler (formerly Kayser-Threde) data acquisition systems are used for sensor data recording, airbag triggering and CAN system recording.

At the time of our visit, setup was underway for a moving table/'flying floor' pole test for sensor development. The flying floor, guided by a shuttle on the crash rail, is used for all Ford pole tests to ensure the best alignment to the pole.

Everything in terms of the lighting, camera pit, etc is replicated at the other end of the 600ft rail. The difference there is that instead of a mass, there is a large, open area for vehicle-to-vehicle tests.

Around four years ago, the drive system for the rail was upgraded from a hydrostatic drive to an AC electric drive. Ng explains that this offers better speed control and extra capacity to handle the heavy masses involved in truck crash testing, and the 75mph impacts Ford requires for developing its police interceptor vehicles. ❮