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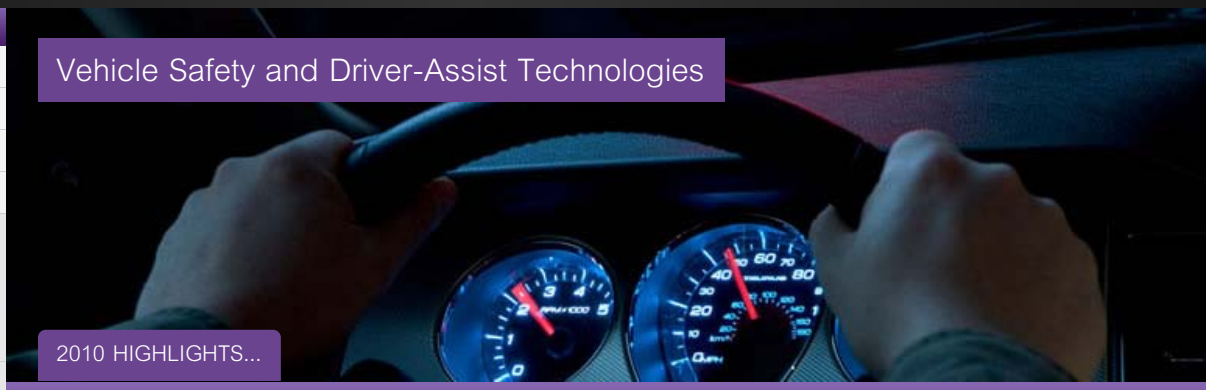
Vehicle Safety and Driver-Assist Technologies



2010 HIGHLIGHTS...

- Achieved IIHS Top Safety Pick for 2011 Fiesta – first vehicle in its class to do so
- Invested $1 million to expand Ford Driving Skills for Life to 15 states
- Launched research to create digital human body model of a child
- Expanded our investment in "intelligent vehicles"

Ford is a global leader in vehicle safety, and vehicle safety is a critical part of our company identity and reputation. We work to develop innovative technologies and to build in safety from the very beginning of each product development process. Indeed, safety is one of four principles that guide our every design and engineering effort.[1]

In 2010, the three major public domain ratings systems were revised – and made much tougher. Vehicle safety has continued to improve over the years, and the ratings agencies wanted to make it harder to achieve top ratings. The systems that changed include the New Car Assessment Program (NCAP) implemented by the U.S. National Highway Traffic Safety Administration (NHTSA), the Top Safety Pick program run by the Insurance Institute for Highway Safety (IIHS), and the EuroNCAP system sponsored by seven European governments as well as motoring and consumer organizations. (See How We Manage Vehicle Safety for an overview of the changes.)

Because of these changes, our ratings results this year cannot be meaningfully compared to previous years, although our vehicles are safer than ever. A comparison to other automotive companies' results reveals that we remain an industry leader in motor vehicle safety.

In fact, Ford has the most top U.S. safety ratings of any automaker ever. This includes more IIHS "Top Safety Picks" than any other manufacturer in the six-year history of this crash testing program and more NHTSA five-star ratings than any other manufacturer during 30 years of government testing. (To earn a Top Safety Pick, a vehicle must receive a rating of "good" in offset frontal impact, side impact and rear impact evaluations, and offer electronic stability control. Under the new testing scheme, Top Safety Picks also must earn a "good" rating in roof strength tests.)

Our recent safety highlights include the following:

- The 2011 Ford Taurus is one of the safest-rated large sedans sold in America, with NCAP ratings among the industry leaders for front impact and five-star NCAP crash ratings for side impact. The Taurus also earned a Top Safety Pick designation from IIHS and boasts a comprehensive list of segment-leading safety features.
- The all-new 2011 Ford Explorer, Edge and F-150 as well as the 2011 Lincoln MKX also earned Top Safety Pick designations.
- The 2011 Fiesta is the first vehicle in its class to achieve a Top Safety Pick, and also leads its segment for NCAP ratings. The Fiesta also was the first car in its segment to earn top crash test ratings in each of the world's largest auto markets that perform safety testing – the U.S., China and Europe.
- For the 2011 model year, the IIHS awarded 18 Ford vehicles with "good" ratings for frontal offset performance and 15 Ford vehicles with "good" ratings for side impact performance.
- In Ford's most recent EuroNCAP assessments, using their new testing and rating system, the 2010 Ford C-MAX and Grand C-MAX earned five-star safety ratings.
- Under the previous EuroNCAP system, the Ford Kuga and Fiesta achieved Ford's first three-star ratings for pedestrian protection. These cars also joined the Focus, Mondeo, S-MAX and Galaxy in having best-in-class, five-star adult protection and four-star child protection ratings.
- The Ford Fiesta and Mondeo were the second and third Ford cars (after the Focus) to be awarded five-star ratings in the Chinese NCAP.

Perspectives on Sustainability

Scott Belcher

President and CEO, Intelligent Transportation Society of America (ITS America)

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Related Links

Vehicle Websites:
- Ford Fiesta
- Ford Taurus
- Ford Edge
- Ford Explorer
- Ford F-150
- Lincoln MKX

Ford.co.uk:
- Ford Kuga
- Ford Fiesta
- Ford Focus
- Ford Mondeo
- Ford C-Max
- Ford Grand C-Max
- Ford S-Max
- Ford Galaxy

Ford.com.au:
- Ford Falcon

External Websites:
- National Highway Traffic Safety Administration
- Insurance Institute for

- The Ford Falcon was the first Australian-built car to be awarded five stars in the Australasian NCAP.

This section outlines our vehicle safety performance over the past year. It includes a discussion of current vehicle safety challenges and opportunities globally, how we manage vehicle safety within the Company, and our efforts to support and promote driver education. The section then discusses the advanced technologies that can be found on our vehicles. These technologies are organized into four categories: accident avoidance technologies, driver-assist technologies, occupant protection technologies and post-crash/injury mitigation technologies. We then discuss the various collaborative efforts we are undertaking with other organizations related to vehicle safety. The section concludes with two case studies: one looks in depth at the issue of driver distraction, while the other discusses developments in the realm of "intelligent vehicles."

For a discussion of Ford's positions on U.S. public policy issues relating to vehicle safety, please see the Governance section.

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1. The other principles are quality, fuel efficiency and smart technologies.

Highway Safety
- European New Car Assessment Programme
- Australasian New Car Assessment Program

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Challenges and Opportunities

As we at Ford implement our global "ONE Ford" strategy, we are mindful that countries with different levels of economic and infrastructure development face different traffic safety challenges.

In the U.S. and other developed countries, traffic safety has significantly improved in recent years. Although the U.S. population has continued to increase, the number of traffic fatalities in the U.S. in 2009 reached its lowest level in 55 years, according to the National Highway Traffic Safety Administration (NHTSA). If early projections from NHTSA for 2010 prove accurate, the number of traffic fatalities in the U.S. in 2010 will also decline. In fact, the fatality rate per 100 million vehicle miles traveled has declined steadily since the late 1960s, and is now at the lowest level ever recorded. It declined to 1.13 deaths per 100 million miles in 2009, compared with 1.26 the year before. In the first half of 2010, the rate was 1.02.

Other developed countries have also seen improvements. The nonprofit Resources for the Future looked at traffic fatality data in 32 high-income countries between 1970 and 1999, and found that traffic fatalities declined in these countries by an average of 35 percent.

These improvements can be attributed to a combination of factors, including higher safety belt usage, advancements in vehicle safety technology, greater enforcement, better traffic infrastructure and increased cultural disapproval of driving under the influence.

Of course, traffic safety remains a significant challenge in these countries, with room for improvement. In the U.S. in 2009, more than 30,000 people died in motor vehicle crashes. Traffic crashes are the leading cause of death among U.S. teens. And, as discussed in depth in our case study, distracted driving is an important safety issue.

In developing countries, traffic safety is an acute public health problem. The World Bank reports that fatality rates in developing countries are 25 to 30 per 10,000 vehicles, compared to 1 to 2 per 10,000 vehicles in mature markets. Globally, nearly 1.3 million people die in traffic accidents. More than 1 million of those fatalities occur in countries with low- and middle-income economies. The World Health Organization estimates that deaths due to road traffic accidents will increase to 2.4 million in 2030, primarily owing to increased motor vehicle ownership and use associated with economic growth in low- and middle-income countries.

Many of the traffic deaths in developing nations involve pedestrians, cyclists and motor-driven cycles. As mobility increases in developing markets, people initially use two-wheeled motor vehicles, and the incidence of traffic accidents rises. As people migrate to automobiles, traffic accidents and injury levels generally decrease. During this transition, holistic solutions are required, including infrastructure improvements, the modification of road user behavior and the enforcement of traffic laws. One critical task is to educate drivers about the most important primary safety feature – safety belts.

In both developed and emerging markets, continued improvements in vehicle safety are also very important, and we at Ford continue to take seriously our responsibility to build safe vehicles.

Everywhere in the world, it is increasingly important for road safety stakeholders to work together using an integrated approach to any given safety initiative. To support this approach, we at Ford seek ways to partner with governments, nongovernmental organizations and other stakeholders to identify the best opportunities to promote safety based on real-world data. We have become more involved in encouraging new and innovative ways to modify road user behavior (for example, through new technologies, driver education efforts and working with government agencies such as the UK Driving Standards Agency) and encouraging infrastructure and enforcement improvements in the communities in which we operate.

Related Links

This Report:

- Case Study: Driver Distraction

External Websites:

- National Highway Traffic Safety Administration
- Resources for the Future
- The World Bank
- World Health Organization
- UK Driving Standards Agency

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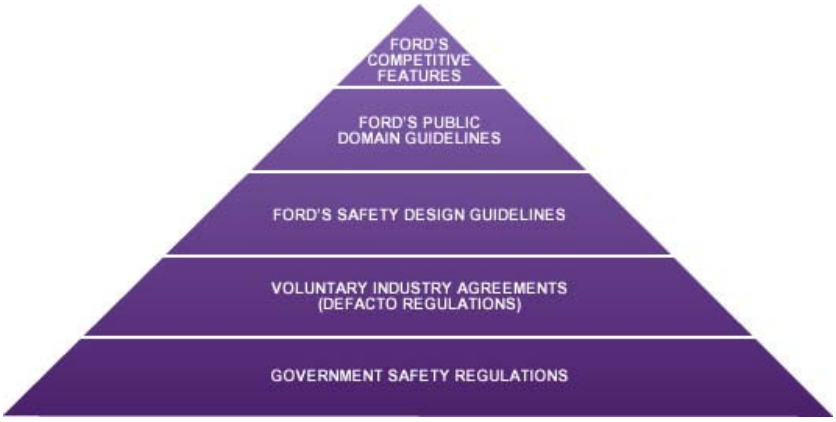
How We Manage Vehicle Safety

Here at Ford, our objective is to design and manufacture vehicles that achieve high levels of vehicle safety for a wide range of people over the broad spectrum of real-world conditions. Real-world safety data, driver behavior, research, regulatory requirements and voluntary agreements provide much of the input into our safety processes, including our Safety Design Guidelines (SDGs) and Public Domain Guidelines (PDGs). (See graphic below.) The SDGs are Ford's stringent internal engineering design targets that exceed regulatory requirements and define many additional requirements that are not regulated. The PDGs are Ford guidelines that focus specifically on helping to ensure that our vehicles earn top marks in relevant public domain assessments.



Our PDGs have been revised over the past few years to take into account significant changes in public vehicle testing programs. Globally, the public domain tests have become significantly more stringent. In the U.S., for example, the New Car Assessment Program (NCAP), run by the National Highway Traffic Safety Administration (NHTSA), has added a "rigid pole impact test" to assess side-impact safety (in addition to an existing side-impact test); implemented the use of a smaller dummy in the passenger seat in frontal impact tests; and made significant changes to the injury criteria. In addition, NHTSA will now provide an overall vehicle score (a "star" rating, from one to five stars) representing a combination of the vehicle's front, side and rollover ratings. To earn a Top Safety Pick from the Insurance Institute for Highway Safety (IIHS), a vehicle must now receive a "good" rating for a new roof strength test, in addition to "good" ratings in front, side and head restraint assessments. EuroNCAP has added a test for whiplash neck injury protection in rear impact, and also now rewards speed limiters and the inclusion of electronic stability control technologies as a standard feature. Like NHTSA, EuroNCAP also now gives each vehicle an overall star rating representing a combination of individual ratings. (EuroNCAP made this change in 2009.)

Internally, Ford utilizes engineering analyses, extensive computer modeling and crash and sled testing to evaluate the performance of vehicles and individual components. These rigorous evaluations help to confirm that our vehicles meet or exceed regulatory requirements and our even more stringent internal guidelines. Our state-of-the-art crash-test facilities include the Safety Innovation Laboratory in Dearborn, Michigan, and the extensive crash-test facilities in Merkenich, Germany, and Dunton, England.

Global Technical Regulations

The automotive industry is highly regulated, and two systems of vehicle regulation predominate globally: the United Nations Economic Commission for Europe Regulations and the U.S. Federal Motor Vehicle Safety Standards. To meet the relevant regulations of each market in which it sells, a manufacturer must modify its vehicle designs and features. This is a particular challenge for Ford, given our increased focus on producing vehicles with the same platforms globally. It can increase vehicle complexity and cost, often without demonstrated, incremental real-world safety benefit.

With the aim of harmonizing world vehicle regulations, 31 countries are working together to develop Global Technical Regulations (GTRs). Ford actively participates in the GTR development process.

Thus far, 11 GTRs have been developed (though not all relate to motor vehicle types relevant to Ford). Progress has been slow due to the difficulty of reconciling varied national requirements and the historical differences of existing regulations. Despite these challenges, Ford continues to believe that true harmonization has the potential to significantly reduce complexity while maintaining high levels of vehicle safety, security and environmental performance, and we plan to

Related Links

External Websites:

- National Highway Traffic Safety Administration
- Insurance Institute for Highway Safety
- European New Car Assessment Programme
- Global Technical Regulations

continue supporting global harmonization efforts.

Haddon Safety Matrix

Vehicle safety is the product of complex interactions among the driver, the vehicle and the driving environment. We use the Haddon Safety Matrix (developed by William Haddon, a former NHTSA administrator and IIHS president) to take a holistic view of the factors that affect vehicle safety.

The Haddon Matrix looks at injuries in terms of causal and contributing factors, including human behavior, vehicle safety and the driving environment. Each factor is then considered in the pre-crash, crash and post-crash phases. In the pre-crash phase, the focus is to help avoid the crash. In the crash and post-crash phases, the primary objective is to help reduce the risk of injury to occupants during and after a collision. Another goal is to minimize the amount of time that elapses between the crash and when help arrives.

	Human Behavior	Vehicle Safety	Environment
			
Pre-Crash (accident avoidance)	• Research • Education • Advocacy	• Crash avoidance technologies • Security	• Road design for accident avoidance • Traffic control
Crash (occupant protection)	• Technology and proper use	• Restraints • Structures that absorb and reduce crash energy and intrusion	• Road design for injury mitigation • Research
Post-Crash (injury mitigation)	• Telematics	• Post-crash notification	• Emergency medical services
Examples of Ford Actions	• SYNC® technology • MyFord Touch™ driver connect technology • MyKey™ • Ford Driving Skills for Life	• Accident avoidance features • Inflatable safety belts • Roll Stability Control®	• Accident research • Development of “vehicle-to-infrastructure” communication systems

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Driver Education

According to the U.S. Department of Transportation, human factors cause or contribute to more than 90 percent of serious crashes. And, traffic accidents are the number-one cause of death of teens in the U.S. More than 3,000 teenagers (aged 15–19) die on American roads each year.

Ford Driving Skills for Life (FDSFL), Ford's driver education program, demonstrates our commitment to educating teens about safer driving. FDSFL provides outstanding learning tools, including an award-winning curriculum with hands-on training and web-based learning, a teacher and parent educational kit, a teaching DVD designed for interactive learning, and printed materials to help young drivers improve their ability behind the wheel. Both the FDSFL website and "ride and drives" for teen drivers include modules on the importance of avoiding distracted driving. In addition, the program includes information about eco-driving, car care tips and information for mature drivers.

Ford Driving Skills for Life

In early 2011, the Ford Motor Company Fund invested an additional $1 million to expand the FDSFL program in the U.S. from 9 to 15 states. Students at a total of 30 high schools will take part in the new expanded program.

The FDSFL program is also being implemented outside the U.S. In 2008, Ford launched FDSFL in our Asia Pacific and Africa region, and in 2010 continued with the successful rollout of the program in Australia and South Africa. (In addition, FDSFL is in Indonesia, the Philippines, Thailand, Vietnam, China, Taiwan and India.) Ford has now provided training for thousands of licensed drivers in these markets.

In South Africa in 2010, Ford brought special attention to the FDSFL program by involving seven performers from the South African Idols singing competition in a ride-and-drive event. The performers learned new skills designed to make them safer and more fuel-efficient drivers, and also got to compete in a tough "skidpan" challenge testing their braking and steering skills. The event was featured in a subsequent edition of the Idols show.

Beginning in 2007, Ford partnered with the Illinois Department of Transportation, secretary of state and state police to launch a statewide effort – modeled on Ford Driving Skills for Life – designed to reduce teen crashes and fatalities. Called **Operation Teen Safe Driving**, this campaign was the first of its kind and got high school students directly involved by challenging them to develop and implement a teen safe driving community awareness campaign using FDSFL resources. This seven-month statewide effort – which now takes place annually – involves 778 schools in 102 Illinois counties, and has the support of the governor, the secretary of state and the Chicago board of education. In 2010 alone, the state estimates that the program touched 3.2 million Illinois residents.

The results have been remarkable: Illinois has seen a 45 percent reduction in teen fatalities over the last four years.

In recent years, distracted driving has received increased national attention as a contributing factor in motor vehicle crashes. We at Ford have been working for years to research the issue and develop voluntary guidelines, in addition to providing teen driver education and appropriate technologies to help reduce the risk of crashes due to distracted driving. Over the past two years our sustainability report has included a case study on distracted driving; the case has been updated for this year's report.

Related Links

This Report:

- Case Study: Driver Distraction

Ford Websites:

- Ford Driving Skills for Life

External Websites:

- Operation Teen Safe Driving

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Accident Avoidance Technologies

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Curve Control


Active City Stop


Adaptive Front Lighting System


Auto High-Beam Controller


MyKey™


AdvanceTrac® with Roll Stability Control®

A variety of Ford technologies, in addition to each vehicle's handling and braking capabilities, can help drivers to avoid accidents.

Curve Control

For example, Curve Control is a new technology launched on the all-new 2011 Ford Explorer. Curve Control is designed to sense when a driver is taking a curve too quickly. In those situations, it rapidly reduces engine torque and can apply four-wheel braking, slowing the vehicle by up to 10 mph in about one second. The technology is designed to be effective on wet or dry pavement, and is expected to be helpful when drivers are entering or exiting freeway ramps with too much speed. Curve Control will roll out in the majority of Ford products by 2015.

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Active City Stop

In Europe, Ford's Active City Stop can help the driver avoid low-speed collisions. The system uses a forward-facing infra-red laser, mounted next to the rearview mirror, to detect reflective objects in front of the car. The system continuously (100 times per second) monitors the distance to the vehicle in front and the closing speed, to determine the risk of a collision. If, for example, the car in front brakes suddenly, and the system considers that a collision is imminent, it pre-charges the brakes. If the driver does not react, the brakes are automatically applied and the throttle is released. Active City Stop is only active at speeds below 30 km/h (about 19 mph). If the relative speed difference between the two vehicles is less than 15 km/h, then the system may help the driver avoid the collision entirely. For relative speeds between 15 and 30 km/h, the objective is to reduce speed as much as possible prior to impact. Active City Stop is available on the new Ford Focus in Europe.

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Adaptive Front Lighting System

Another important Ford safety innovation is the next generation of adaptive headlamps. Our Adaptive Front Lighting System (AFLS) can help drivers to see better at night around curves in the road. The system allows drivers to take corners and curves more safely, and to consume less energy while doing so. The AFLS is available on all newer MK-designated Lincolns and on a number of vehicles across the Ford fleet in Europe.

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Auto High-Beam Controller

Auto High-Beam Controller is a new feature that strives to maximize visibility at night by automatically actuating the high-beam lamps when ambient lighting conditions and traffic conditions permit. A forward-looking camera senses the headlamps of oncoming vehicles and the taillamps of leading vehicles, upon which the system automatically switches to the low-beam lamps. Auto High-Beam is offered as an option on the Ford Taurus in North America and on the Ford Mondeo, S-MAX, Galaxy and new Focus in Europe. It is standard on the Lincoln MKS and

Related Links

Vehicle Websites:
- Ford Focus
- Ford Fusion
- Ford Taurus
- Ford Escape
- Ford Escape Hybrid
- Ford Explorer
- Ford Flex
- Ford Expedition
- Ford E-Series
- Ford F-150
- Ford SuperDuty
- Lincoln MKZ
- Lincoln MKS
- Lincoln MKX
- Lincoln MKT
- Lincoln Navigator

Ford.co.uk:
- Ford Focus (Europe)
- Ford Mondeo
- Ford S-MAX
- Ford Galaxy

Ford Websites:
- MyKey™

MKT.

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MyKey™

Ford's MyKey™ system is an innovative technology designed to help parents encourage their teenagers to drive more safely. MyKey allows owners to program a key that can limit the vehicle's top speed to 80 mph and the audio volume to 44 percent of total volume. MyKey encourages safety-belt usage by enabling Ford's Beltminder™ to chime every minute indefinitely until the safety belt is buckled, rather than ceasing after five minutes, and also by muting the audio system until the belt is buckled. In addition, MyKey provides an earlier low-fuel warning (at 75 miles to empty rather than 50); sounds speed-alert chimes at 45, 55 or 65 mph; and will not allow manual override of other safety systems. For the 2011 model year, MyKey is available on nearly all retail vehicles – including the Ford F-150, SuperDuty, Taurus, Fusion, Mustang, Focus, Explorer, Flex, Escape and Expedition, as well as all Lincolns (the Navigator, MKS, MKX, MKZ and MKT).

Late in 2011 on the Ford Taurus and Explorer, Ford will upgrade MyKey with a world-first technology that allows parents to block explicit radio programming while their teens are driving. The upgraded technology also will allow parents to limit a vehicle's top speed at any of four different settings – 65, 70, 75 or 80 mph. These upgrades will quickly be offered across a variety of Ford and Lincoln models.

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AdvanceTrac® with Roll Stability Control®

Finally, Ford's industry-leading innovation known as AdvanceTrac® with Roll Stability Control® (RSC) continues to give drivers more driving confidence. RSC actively measures and helps control both yaw and roll movements. It uses two gyroscopic sensors to detect when a driver corners too fast or swerves sharply to avoid an obstacle. It then applies pressure to select brake(s) to help the driver maintain control and thus reduce the risk of a rollover event.

Roll Stability Control is standard equipment on the Ford Flex, Explorer, Expedition, Edge, Escape and F-150, as well as E-Series wagons and vans and the 2011 SuperDuty with single rear-wheel configurations. It is also standard equipment on the Lincoln Navigator, MKX and MKT. Ford developed a next-generation regenerative braking system for the 2009 and 2010 Escape Hybrid that is compatible with RSC. For the 2011 model year, 84 percent of all Ford vehicles offered either RSC or our standard electronic stability control system; all 2012 models will offer standard stability control systems.

Percent of North American Nameplates with Standard Offering of Electronic Stability Control or Roll Stability Control

	Percent
2012 Model Year	100%
2011 Model Year	84%
2010 Model Year	77%
2009 Model Year	62%
2008 Model Year	40%
2007 Model Year	27%

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Driver-Assist Technologies

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SYNC®


MyFord Touch™


Rearview Camera


Adaptive Cruise Control


Collision Warning with Brake Support


Blind Spot Information System


Cross Traffic Alert


Lane Keeping Alert


Lane Keeping Aid


Driver Alert

Traffic Sign Recognition


Active Park Assist

Ford vehicles feature an array of new driver-assist and convenience technologies.

SYNC®

Ford's popular and award-winning SYNC® system, powered by Microsoft®, is one such technology. Numerous studies show that hands-free multimedia devices offer benefits compared to hand-held devices. The benefits are seen in driving performance as well as object and event detection. Ford SYNC provides a way for drivers to use cell phones and MP3 players through voice commands alone, while keeping their eyes on the road and their hands on the wheel. Ford SYNC is now available with "Traffic, Directions and Information," a subscription service that allows drivers to access traffic reports and turn-by-turn directions, all via voice command. Ford SYNC was launched in late 2007 and is now available on nearly every vehicle from Ford and Lincoln in North America. Please see the case study for more on how SYNC helps to further reduce driver distraction.

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MyFord Touch™

In 2010, Ford introduced the new MyFord Touch™ driver connect technology – an all-new user interface that delivers a smarter and simpler way to connect drivers with in-car technologies and their digital lives. MyFord Touch, along with MyLincoln Touch™, was developed after a thorough review of current interior design – and its limitations – considering the abundance of new and emerging technologies. After studying vehicle communications trends and the ways drivers were using technology inside their vehicles, it was evident that the current way of interacting with car and truck technology was rapidly becoming obsolete.

The MyFord Touch user interface replaces many of the traditional vehicle buttons, knobs and gauges, and is designed to increase focus on driving while providing access to information, entertainment and connectivity features. The system includes a next-generation, state-of-the-art voice recognition system with nearly 10,000 available commands, and clear, large, color LCD displays, along with two five-way controllers on the steering wheel. These features encourage drivers to maximize the time their eyes are on the road and their hands are on the wheel. And although the user interface is all new, it should not feel unfamiliar, as it is based on the fundamentals of Ford's award-winning navigation system, as well as the SYNC user interface.

MyFord Touch launched on the 2011 Ford Edge and goes global with availability on the 2012 Focus. MyLincoln Touch will be standard equipment on new Lincolns beginning with the 2011 MKX.

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Related Links

Vehicle Websites:
- Ford Focus
- Ford Fusion
- Ford Taurus
- Ford Edge
- Ford Escape
- Ford Explorer
- Ford Flex
- Lincoln MKZ
- Lincoln MKS
- Lincoln MKX
- Lincoln MKT

Ford.co.uk:
- Ford Focus (Europe)
- Ford Mondeo
- Ford S-MAX
- Ford Galaxy
- Ford C-MAX

Ford Websites:
- SYNC®
- MyFord Touch™

Rearview Camera

Ford's Rearview Camera can enhance rear visibility, as well as assist with actions that require reverse maneuverability such as parallel parking and hitching trailers. The system uses an exterior camera embedded in the rear of the vehicle that sends images to a video display in the rearview mirror or the navigation system screen. These images can help improve visibility directly behind the vehicle when the vehicle is in reverse. The camera image is overlaid with lines that mark the width of the vehicle, which makes it easier to gauge distance and navigate in reverse. The system also increases visibility in low light by using a low-light-capable camera and high-intensity reverse taillights. The Rearview Camera is offered on most of Ford's vehicles. The National Highway Traffic Safety Administration recently published a Notice of Proposed Rulemaking mandating rearview cameras and displays meeting specified criteria by September 1, 2014, on all vehicles with less than a 10,000 lb. gross vehicle weight rating.

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Adaptive Cruise Control

Adaptive Cruise Control (ACC) helps drivers maintain a pre-set distance from the vehicle in front of them. It is one of the innovations now available on the 2011 Ford Taurus, Explorer and Edge; the Lincoln MKS, MKX and MKT; and the Ford Mondeo, S-MAX, Galaxy and new Focus in Europe. While primarily a comfort and convenience feature, Adaptive Cruise Control also contributes to more controlled driving when traffic flow is uneven. The ACC module is mounted at the front of the vehicle and uses radar to measure the gap and closing speed to the vehicle ahead. The system automatically adjusts the speed of the car to help maintain a pre-set distance from the vehicle in front. Ford was the first manufacturer to launch radar-based ACC several years ago.

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Collision Warning with Brake Support

In driving situations that present a high risk of collision with the vehicle in front, Ford's Collision Warning with Brake Support technology activates a visual and audible warning. In addition, the brake system is pre-tensioned and the "servo boost" assistance system is modulated to provide faster brake performance, if required by the driver. Range and speed information is sensed with long-range radar mounted on the front of the vehicle. Collision Warning with Brake Support can be activated or deactivated as the driver wishes, and it may alert the driver if the sensor becomes blocked by snow, ice or mist. This technology is available in the U.S. on the Ford Taurus, Edge and Explorer and the Lincoln MKS, MKX and MKT, and in Europe on the Ford Mondeo, S-MAX, Galaxy and Focus.

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Blind Spot Information System

Blind Spot Information System (BLIS) is designed to help inform the driver when a vehicle is detected in the "blind spot zone." The system uses two radar sensor modules that are mounted behind the left- and right-hand side of the rear bumper. BLIS is active above 10 km/h (about 6 mph) and is even capable of detecting motorcycles in some cases.

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Cross Traffic Alert

Cross Traffic Alert is designed to assist the driver when other parked vehicles may obscure the driver's view of traffic while backing out of a parking space. To assist the driver while slowly backing up, the BLIS sensors in the corners of the rear bumper can detect approaching vehicles. A warning chime will sound, an amber light will display in the outside mirror on the appropriate side of the vehicle and a text message will inform the driver of the situation.

In North America, both BLIS and Cross Traffic Alert are available on the Ford Fusion, Taurus, Edge and Explorer, as well as on the Lincoln MKZ, MKX and MKT. In Europe, BLIS is available on the Ford Mondeo, S-MAX and Galaxy as well as the new Ford Focus and C-MAX.

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Lane Keeping Alert

Lane Keeping Alert (previously called Lane Departure Warning) is designed to warn the driver, via a vibration in the steering wheel, when the front-view camera detects that an unintentional lane departure is likely to happen. The front-view camera continuously monitors the road ahead and evaluates where the car is in relation to the lane markings. If the driver uses the turn indicator, or the driving situation suggests an intended lane change, the warning is suppressed. Lane Keeping Alert is deactivated at speeds below 38 mph, so as not to interfere in urban stop-and-go conditions. The system can be activated and deactivated via a switch on the turn indicator stalk.

Lane Keeping Alert is available in Europe on the Ford Mondeo, S-MAX and Galaxy, as well as on the new Focus.

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Lane Keeping Aid

Lane Keeping Aid goes a step further. In addition to vibrating the steering wheel, it undertakes a temporary steering intervention to steer the vehicle back into the lane, when the front-view camera detects that an unintentional lane departure is likely to happen. Like Lane Keeping Alert, Lane Keeping Aid can be activated and deactivated via a switch on the turn indicator stalk and is automatically deactivated below 38 mph. Lane Keeping Aid was introduced in Europe on the new Ford Focus, and its availability will be expanded to other vehicles.

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Driver Alert

Driver Alert computes a “vigilance level” for the driver and displays it in the cluster upon request. The vigilance judgment is based on statistical analysis of lane information collected by the forward-looking camera and the vehicle’s yaw behavior. If the driver vigilance level falls below a certain level (i.e., if the driver gets tired), a warning is given. Driver Alert is available in Europe on the Ford Focus, Mondeo, S-MAX and Galaxy.

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Traffic Sign Recognition

Our new Traffic Sign Recognition technology uses a forward-looking camera to recognize speed limit signs next to the road; it then shows them in the information display. Traffic Sign Recognition is available on the Ford Focus in Europe.

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Active Park Assist

Finally, Active Park Assist, a semi-automatic parallel parking system, is another new driver-assist technology. After activating the system by pressing the “parking” button, sensors detect a parking space by scanning. As the car passes the space, sensors measure the length. The system then defines the optimum point from which the vehicle can start parking and gives audible and visual warnings advising the driver to stop. From there the driver has to engage reverse and operate the accelerator and brakes, but the car controls the steering angle. When in the space, the vehicle continues to control the steering, with the driver engaging forward and reverse gears as necessary until the system gives a finish signal. Active Park Assist is available on the Ford Focus and C-MAX in Europe and the Ford Flex, Escape, Focus, Taurus and Explorer and the Lincoln MKT in the U.S.

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Occupant Protection Technologies

Many factors influence a vehicle's crash performance, including the design of the vehicle's structure to absorb impact energy and the use of passive safety equipment such as air bags and safety belts. To help protect drivers and passengers in the event of a crash, a variety of Ford technologies have been designed to enhance the performance of safety belts and air bags and provide additional occupant protection in side crashes and rollovers.

The next-generation Ford Focus, which went on sale in North America and Europe in early 2011, features a new standard **driver-side air bag**. The new air bag, which will be used on other future Ford models as well, is designed to further reduce loading on the driver's chest. It uses a curved tether, which resembles a smile when inflated. The new air bag was designed to address new, more stringent federal regulations and five-star New Car Assessment Program (NCAP) requirements, which were directly influenced, in part, by Ford's biomechanical research. The new NCAP uses a mathematical equation published by Ford researchers to estimate the probability of crash-related chest injuries, depending on age and chest deflection. Accordingly, lower chest deflections will be rewarded in the revised star-rating system.

Older drivers, in particular, can benefit from the air bag's redesign, because they are more susceptible to rib injuries due to weaker bones. According to Ford safety researchers, the typical 65-year-old has one-quarter the ability of a 16-year-old to withstand crash-related forces on their chest during a forward collision.

Safety belts remain the most important vehicle safety technology available. For the 2011 model year, Ford brought to market the world's first automotive inflatable safety belts – a brand-new technology that won Popular Science magazine's "Best of What's New" award in late 2010. These belts combine the attributes of traditional safety belt and air bag technologies to help reduce head, neck and chest injuries for rear-seat passengers. Ford introduced the inflatable rear safety belts on the new 2011 Ford Explorer in North America.

The inflatable belts are designed to deploy over a vehicle occupant's torso and shoulder in less than 40 milliseconds in the event of a crash. Each belt's tubular air bag inflates with cold compressed gas. The inflatable belt distributes crash force energy across five times more of the occupant's torso than a traditional belt, helping to further reduce the risk of injury.

In everyday use, the inflatable belts operate like conventional safety belts and are safe and compatible with infant and child safety car and booster seats. In Ford's research, more than 90 percent of those who tested the inflatable safety belts found them to be similar to or more comfortable than a conventional belt, because they feel padded and softer. Ford will monitor real-world effectiveness and customer acceptance of this new technology as it begins the phase-in into the Ford fleet.

Ford Escape 2010 with Safety Canopy

Ford was the first in the industry to offer rollover-activated side-curtain air bags, known as the **Safety Canopy®**, beginning with the Ford Explorer and Mercury Mountaineer in 2002. The Safety Canopy with rollover sensors, combined with safety belts, helps to further reduce the risk of injury to vehicle occupants during side-impact collisions and rollover crashes. For the 2011 model year, the Safety Canopy is available on the Ford Explorer, Expedition, Edge, Flex, Escape, Taurus, F-150 and Super Duty, and the Lincoln MKX, MKT, Navigator and MKS.

Ford has recently implemented a **new strategy** for deploying side-curtain air bags in frontal impacts – specifically in the 40 mph/40 percent offset deformable barrier crash test conducted by

Related Links

Vehicle Websites:

- Ford Fiesta
- Ford Focus
- Ford Fusion
- Ford Fusion Hybrid
- Ford Taurus
- Ford Edge
- Ford Escape
- Ford Explorer
- Ford Flex
- Ford Expedition
- Ford F-150
- Ford SuperDuty
- Lincoln MKZ Hybrid
- Lincoln MKS
- Lincoln MKX
- Lincoln MKT
- Lincoln Navigator

Ford.co.uk:

- Ford Mondeo
- Ford S-MAX
- Ford Galaxy

External Websites:

- National Highway Traffic Safety Administration
- Insurance Institute for Highway Safety

the Insurance Institute for Highway Safety. This strategy helps to reduce the risk of occupant contact with the roof rail, A-pillar and B-pillar and reduces containment concerns during frontal offset and angular impacts.

Ford is also advancing the state of the art in crash sensing. Specifically, we are phasing in new pressure-based sensors on new side air bag systems to deploy side air bags and curtains earlier in a crash as compared to state-of-the-art acceleration-based sensors. In a side collision, the pressure sensors are designed to detect a change in air pressure inside the front doors as the doors deform and send an electrical signal to deploy the side air bag system. Pressure-based sensors have increased accuracy to measure the severity of a side impact crash than acceleration-based sensors, which makes them better able to differentiate between a life-threatening, air-bag-deployable crash and relatively harmless daily abuse that should not require air bag protection. The system also enhances performance in new federal side-impact tests.

In Europe, the Ford Mondeo, S-MAX and Galaxy are equipped with an Inflatable Knee Bolster, designed to help reduce the driver's forward motion in the event of a severe frontal crash and reduce the risk of injury to lower limbs. This technology is also available in the U.S. on the 2011 Fusion Hybrid and MKZ Hybrid and the 2011 Ford Fiesta.

Ford vehicles are engineered with advanced structures designed to direct crash energy around the passenger compartment. For example, Ford's Side Protection And Cabin Enhancement architecture – known as SPACE™ Architecture – utilizes crash energy management techniques to help channel impact forces around and away from the passenger cabin in side collisions. The SPACE system integrates a high-strength steel structure in the floor that runs the width of the vehicle, as well as reinforcements along the rocker panels to help protect passengers in side-impact incidents. In addition, many new Ford vehicles are built with the company's Trinity Front Crash Body Architecture. This energy-absorbing body structure is optimized for strength and stiffness, and it's designed to absorb and redirect crash forces away from the passenger compartment.

As smaller and more fuel-efficient vehicles become more popular, the safety of smaller cars is sometimes raised as a concern. Ford continues to make small cars even safer while building larger vehicles that are more crash compatible with smaller vehicles. The 2011 Ford Fiesta, for example, was the first mini-car to earn a 2010 Top Safety Pick from the Insurance Institute for Highway Safety since the IIHS's introduction of the new roof-strength test. The Fiesta's extensive use of high-strength steels, our Trinity front crash structure, SPACE Architecture and advanced air bag technologies (including a segment-exclusive driver's knee air bag) helped the car perform well in IIHS testing. In our larger vehicles, we've already lowered the front bumper structures on most of our crossovers, SUVs and pickups to help them better match up with small vehicle crash structures.

Finally, Ford is using more advanced and ultra-high-strength steels than ever as part of our continuing effort to enhance the safety and fuel efficiency of our vehicles. Increased use of these types of steels helps us design vehicle structures with enhanced crash energy management, while balancing overall vehicle weight – even as we add more features, equipment and safety devices.

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Post-Crash/Injury Mitigation Technologies

One method of assisting emergency responders to reach the scene of a vehicle crash quickly is through in-vehicle emergency call systems, also called post-crash notification. These systems enable a driver to summon assistance in an urgent situation.

In the U.S., Ford SYNC® is an award-winning, in-car connectivity system that was introduced on certain 2007 model year vehicles. Beginning with the 2009 model year, SYNC-equipped vehicles come with an occupant communications capability called SYNC 911 Assist. In the event of a severe crash, the ability to directly contact the local 911 emergency operator could be critical, for both the vehicle occupants and first responders. While any cell phone alone could be used in an emergency situation, SYNC can assist in placing a call to a local 911 emergency operator – when a phone is properly paired, turned on and connected to SYNC and where the system and cell phone remain powered and undamaged – should a crash with an air bag deployment or fuel shutoff switch activation occur. The key advantage of SYNC 911 Assist is speed, as calls are placed directly to local 911 operators and do not have to be routed through a call center (as in competitors' versions), which can delay the time it takes to get help on the way. SYNC 911 Assist gives the occupants a choice as to whether or not to make the emergency call, and places the call if the occupant does not respond after a short time.

This voice-activated feature is available to customers with 2008 and beyond model year SYNC-equipped vehicles through a dealer-installed software update. Ford recently announced that we will offer a system similar to SYNC 911 Assist in Ford's European product range beginning in 2012. We are working with the various stakeholders in Europe to ensure that this type of solution is supportive of the eCall initiative, a pan-European, in-vehicle emergency call system.

The SOS-Post Crash Alert System, which is standard equipment on most Ford, Lincoln and Mercury vehicles, is another advance in post-crash safety technology. The SOS-Post Crash Alert System automatically activates the horn and emergency flashers in the event of an air bag deployment or safety belt pre-tensioner activation. The second-generation system – which was added to the 2011 Ford F-150, SuperDuty, Explorer and Edge and the Lincoln MKX – also is designed to automatically unlock vehicle doors subsequent to an air bag deployment or safety belt pre-tensioner activation, to aid in rescue. The system is designed to alert passersby and emergency services to the vehicle's location.

Related Links

Vehicle Websites:

- Ford Edge
- Ford Explorer
- Ford F-150
- Ford SuperDuty
- Lincoln MKX

Ford Websites:

- SYNC®

External Websites:

- European Automobile Manufacturers' Association

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Research

Ford is undertaking a number of research efforts to assess and verify the effectiveness of new active safety technologies, such as those using forward-looking radar and vision sensors. (Research regarding vehicle-to-vehicle and vehicle-to-infrastructure communication technologies is discussed in the "intelligent vehicles" case study.)

In January 2010, a consortium of 29 partners – led by the Ford European Research Center in Aachen, Germany – joined forces in the Accident Avoidance by Active Intervention of Intelligent Vehicles (interactIVe) European research project. The consortium seeks to support the development and implementation of active safety systems, and consists of seven automotive manufacturers, six suppliers, 14 research institutes and three other stakeholders. The European Commission will cover more than half of the €30 million budget.

During the planned 42-month duration of interactIVe, the partners will test the performance of implemented safety systems through active intervention, including autonomous braking and steering in critical situations, with the aim of avoiding collisions or at least mitigating impact severity in accidents.

In 2008, Ford launched a major European research project (called EuroFOT) to deliver a large-scale field operational test of the real-world impact of active safety systems. Under the EU's Seventh Framework Program (FP7) for research and technological development, this project joins together 28 partners – including vehicle manufacturers, suppliers, universities and research centers – and will run until August 2011. More than 1,500 cars and trucks will be equipped with eight new active safety technologies, along with advanced data-collection capabilities. This will allow a thorough evaluation of the new technologies for safety, efficiency and driver comfort, in real-world scenarios and with ordinary drivers. The project has a total budget of €22 million and is led by the Ford research center in Aachen, Germany. It includes 100 Ford vehicles.

In another area of research, Ford announced in March 2011 that we launched research aimed to create one of the world's first digital human body models of a child. The model could someday serve as a digital "dummy" for computer crash testing. A child's body is very different from an adult's, and building a digital human body model of a child will help Ford design future systems that offer better protection for our young passengers.

Digital models are painstakingly detailed; Ford's current adult digital human body model took more than a decade to create. It was also one of the first full human body digital models ever created. It contains digital representations of the human body, the skeleton and the internal organs in great detail. In addition to the geometrical information, the Ford adult human body model includes accurate mechanical properties, so that in "virtual" or simulated crashes it deforms like a real human would in a real crash. The model has been extensively validated by comparing its response in simulated tests to data from publicly available data in the scientific literature.

Such models are used in research, not vehicle development. They do not take the place of crash dummies, which measure the effects of forces on the body, but instead are used to better understand injury mechanisms, so as to further improve restraint system effectiveness.

For the new digital human body model of a child, Ford researchers have contracted with Tianjin University of Science and Technology and Tianjin Children's Hospital to obtain child geometry and basic body information from sources like MRIs and CT scans provided by volunteers. Most other information for the project will be obtained from public domain literature.

Finally, a particularly creative research technique Ford has been using involves driving cars with Collision Warning with Brake Support into large "balloons" nearly the size and shape of real cars. The purpose of these tests is to assess the accuracy of the radar and the timing of the warning signals and braking pre-charge. The balloons play the role of a "target" vehicle, allowing Ford engineers to assess the radar and braking features without endangering test drivers or damaging real cars. The balloons offer enough "give" to allow impact without injury. Ford uses about a dozen balloon cars in different sizes, each made from tarp-like material and weighing more than 40 pounds.

Related Links

External Websites:
- interactIVe
- EuroFOT

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Collaborative Efforts

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Related Links

External Websites:
- National Fire Protection Association
- Society of Automotive Engineers
- U.S. Council for Automotive Research

Ford Motor Company continues to be involved with a number of partners to enhance the safety of the driving experience and develop future technologies.

Crash Avoidance Metrics Partnership

In 1995, Ford and General Motors launched the Crash Avoidance Metrics Partnership (CAMP) to conduct pre-competitive active safety research with other OEMs, suppliers and the U.S. government. Within CAMP, the Vehicle Safety Communications Two (VSC-2) Consortium, which included Ford, GM, Toyota, Daimler and Honda, worked with the U.S. Department of Transportation on projects to develop safety applications that utilize vehicle communications. Their efforts focused on developing a communication system whereby vehicles can “talk” to each other and to the roadway. This would be analogous to a wireless internet system or a cellular telephone for cars. CAMP VSC-2 successfully completed projects that demonstrated the basic feasibility of this technology and evaluated several applications.

CAMP has now formed a VSC-3 Consortium with Ford, GM, Honda, Hyundai-Kia, Mercedes, Nissan, Toyota and VW-Audi to continue work on vehicle-to-vehicle communications for safety applications. This consortium is being funded by the U.S. Department of Transportation to complete all of the pre-competitive work necessary for a deployment decision for vehicle safety communications in 2013. In addition, the consortium is being funded to conduct driver clinics of vehicle-to-vehicle (V2V) safety systems around the U.S. in 2011 and is preparing to participate in a model deployment of V2V systems in 2012. (See the case study for more on Ford’s work regarding “intelligent vehicle” systems.)

CAMP completed two projects with the U.S. National Highway Traffic Safety Administration in 2010. The Crash Imminent Braking Project (involving Ford, GM, Mercedes, Continental and Delphi) developed minimum performance requirements and objective test procedures for systems that automatically apply the brakes to avoid crashes or mitigate the severity of a crash. The Advanced Restraint Systems Project (involving Ford, GM and Mercedes) developed and evaluated restraint systems that utilize pre-crash and occupant sensing information. In 2011, a CAMP consortium will work with NHTSA on a project to develop performance requirements and test procedures for systems to avoid or mitigate vehicle crashes with pedestrians.

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First Responder Training

For decades, Ford has supplied vehicles to fire departments so they can train on the latest technologies and materials using their increasingly advanced extrication tools. The increased use of stronger steels (e.g., boron steel, tubular hydroform steel and high-strength steel) in motor vehicles, as well as the introduction of new technologies such as advanced safety features and hybrid powertrains, have raised some questions by first responders regarding gaining access to vehicle occupants who have been involved in a severe accident. As a result, Ford has provided more than 2,000 training vehicles to first responders since 1990.

In addition, following the introduction of our first hybrid model (the 2006 Ford Escape Hybrid), Ford began publishing emergency responder hybrid vehicle guides with instructions on how to quickly and safely disable the vehicle’s electrical and battery systems before attempting to rescue occupants. In June 2009, Ford’s training efforts included working with the Regional Alliance for Firefighter Training, which is made up of nearly 35 fire departments in Michigan. For this event, we provided 10 hybrid vehicles to facilitate the first-known emergency responder training event specifically focused on hybrid vehicles.

In 2010, Ford provided more than 70 vehicles to first responders for training purposes, including 12 vehicles to the Dearborn (Michigan) Fire Department. These vehicles gave more than 100 firefighters the opportunity to train on advanced vehicles using their new extrication equipment,

commonly known as “the jaws of life,” which the city of Dearborn obtained with the aid of an “Assistance for Firefighters” federal grant program.

Ford also is working to take this training to the national level. In October 2010 we partnered with PennWell Publishing, the publisher of ***Fire Engineering*** magazine, to develop a three-part training video on advanced vehicle technologies and extrication techniques. This training video was released at the annual Fire Department Instructors Conference, held in Indianapolis, Indiana, in March 2011.

Ford is also working with the National Fire Protection Association (NFPA) to provide electric vehicle safety training to first responders. The NFPA’s training program, which was announced last year as part of a $4.4 million grant from the U.S. Department of Energy, will provide firefighters and first responders with information about how to safely handle emergency situations involving new technologies found in electric vehicles.

Ford’s efforts and training events have been well received by the first responder community, and should help their important efforts in the future.

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University Partnerships

Ford increasingly collaborates with university partners on a wide range of research projects, including research into advanced safety technologies. In recent years, we have fine-tuned the objectives of our grant-providing University Research Program (URP), moving away from exploratory, long-term research to highly collaborative projects focused on innovations with more near- and mid-term implementation potential.

In 2010, Ford awarded 13 new URP grants to 12 universities around the globe. Recipient schools include, for example, Wayne State University in Detroit, Michigan; Stanford University in Palo Alto, California; RWTH Aachen University in Aachen, Germany; and Tsinghua University in Beijing, China. These new Ford URP projects add to an active research portfolio that now comprises 30 studies in partnership with 26 universities globally.

In addition to the URP projects, Ford has major research alliances with the Massachusetts Institute of Technology (MIT), the University of Michigan and Northwestern University.

Safety is a central thrust in many of these collaborative university programs. The following are some examples of current projects:

- Projects within the Ford–MIT alliance are yielding progress in areas of vehicle autonomy and active safety, including computer vision, lane keeping, vehicle controls, obstacle detection and avoidance, and accurately assessing the driver’s interaction with the vehicle. One project aims to assess the role of active safety technologies, features and functions in reducing driving-related stresses and enhancing driver wellness.
- At Auburn University, Ford has an ongoing project to conduct “sensor fusion” – that is, to coordinate between Global Positioning System sensors and the motion sensors in a vehicle’s stability control systems, to predict when a driver is about to lose control. The ultimate goal is to use satellites to feed data to a vehicle’s electronic stability control system, allowing it to adjust and prevent a loss-of-control accident.
- At the University of Michigan, safety work includes a portfolio of projects on 360° sensing and developing more robust and capable active vehicle control and enhanced collision avoidance systems, utilizing both onboard sensors and offboard information sources.
- A project at the State University of New York’s Downstate Medical Center should yield an improved understanding of human tolerance to pelvis injury.
- Collaborative work is ongoing with Purdue University investigating enhanced vehicle dynamics and stability control.
- As part of its accident research projects in Germany, the UK and Australia, Ford works closely with internationally acknowledged safety experts from the Universities of Hannover, Loughborough, Dresden, Birmingham and Monash.

Collaborative university work catalyzes innovation at Ford by providing access to leading researchers at the cutting edge of vehicle dynamics and stability control, accident avoidance and driver-assist safety technology, to name just a few. Ford will continue to integrate these collaborative innovations, driving continuous improvement in real-world safety and sustainability for all Ford Motor Company products.

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Alcolock Blue Ribbon Panel

Reducing the incidence of impaired driving would go a long way toward improving road traffic safety. In the EU, 25–30 percent of all car accidents involve alcohol. In the U.S., approximately 40 percent of all traffic fatalities are alcohol-related (as reported by NHTSA).

The Automotive Coalition for Traffic Safety formed a Blue Ribbon Panel (BRP) in 2007 for the

development of advanced alcohol detection technology, often called “alcolocks.” The panel consists of vehicle manufacturers, including Ford, alcohol detection technology suppliers, Mothers Against Drunk Driving, the Insurance Institute for Highway Safety, government representatives and other experts.

The BRP and its research are being funded jointly by NHTSA and the Alliance of Automobile Manufacturers. The purpose of the research is to “...engage major automakers in cooperative research that advances the state of alcohol detection technology... to promote the standardization of the technology, its widespread deployment, and acceptance by the general public.”

Ford continues to participate in the work of the Blue Ribbon Panel through the Alliance. Phase I of the research has been completed, though some of the system targets were not achieved and remain to be addressed. Phase II has nonetheless begun, and will include demonstrating the technology in a test vehicle and with human subjects over the next two years.

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New Crash-Test Dummies

Crash-test dummies are essential research tools that aid in the development of passive safety technologies, and Ford Motor Company continues to develop, often in partnership with other parties, more advanced test dummies.

From 2005 through 2010, Ford partnered with the Children’s Hospital of Philadelphia (CHOP), the University of Virginia, Virginia Tech and the Takata Corporation in a multi-year project to develop a new abdominal insert and sensor for a crash-test dummy representing a six-year-old child.

A “family” of crash test dummies

CHOP studies have shown that, in vehicle crashes, significant abdominal injury in four- to eight-year-old children is second in frequency of occurrence only to head and facial injuries. Abdominal injuries may occur when children who are too young (i.e., the four- to eight-year-old range) utilize adult restraint systems without a booster seat. The abdominal insert and sensor will allow restraint engineers industry-wide to test the potential for abdominal injuries in children and ultimately improve the development of in-vehicle restraint systems for younger children.

In February 2008, the Society of Automotive Engineers established a task force to perform “round robin” testing of the new dummy component. More than 20 organizations from around the globe have signed up to participate. Tests will be performed by dummy manufacturers, other OEMs and NHTSA’s Vehicle Research and Test Center. Testing is scheduled to begin in the summer of 2011.

In another effort, Ford, GM and Chrysler have been working together under the auspices of the Occupant Safety Research Partnership (OSRP), a group within the U.S. Council for Automotive Research, to research, develop, test and evaluate advanced crash-test dummies and other pre-competitive safety systems. A number of years ago, the OSRP initiated development of WorldSID, a male side-impact dummy that is recognized as the most advanced crash-test dummy ever created. From 2006 through 2008, the OSRP worked with NHTSA to help them evaluate WorldSID for potential use in the federal government’s new side-impact crash-test standard. NHTSA concluded that the biofidelity of WorldSID is better than that of the dummy in the current side-impact regulation. WorldSID is the first side-impact dummy with the potential to be commonly used in side-impact regulations around the world.

To that end, since 2009, an informal working group under the UN’s Working Party on Passive Safety has been working to fully develop WorldSID dummies for use in government regulations globally. In 2010, OSRP developed a new test fixture to simulate the front end of a generic car or truck. Work is underway using that fixture to assess a new “dummy” leg, called FLEX-PLI, which has been proposed for inclusion in a new Global Technical Regulation for pedestrian testing.

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Data

The data relating to vehicle safety is included in the Society section of this report.

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Case Studies

IN THIS SECTION

Case Study: Driver Distraction

Over the past two decades, cellular phones have gone from clunky novelties to ubiquitous must-haves. The public has become accustomed to using cell phones everywhere – at home, on the street, in restaurants, at the office, while shopping and – of most interest to Ford's safety researchers – while driving. The ubiquity of cell phones has heightened concerns about driver distraction. We at Ford agree that this is an important safety issue, and we have taken steps to address it.

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Case Study: Intelligent Vehicles

In recent years, Ford has unveiled numerous safety and driver-assist technologies that rely on radars and cameras to warn the driver of an impending dangerous situation and even intervene if necessary. At the same time, we have been undertaking research – both on our own and in partnership with others – to take these technologies to the next level. This "next level" involves improving the performance of these systems such that they can be used in onboard vehicle-to-vehicle and even vehicle-to-infrastructure communications.

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Case Study: Driver Distraction

Over the past two decades, cellular phones have gone from clunky novelties to ubiquitous must-haves. Wireless subscriptions in the U.S. have grown from about 28 million in 1995 to about 280 million by 2010 – a tenfold increase. The public has become accustomed to using cell phones everywhere – at home, on the street, in restaurants, at the office, while shopping and – of most interest to Ford's safety researchers – while driving.

The ubiquity of cell phones – coupled with the proliferation of portable music players in vehicles – has heightened concerns about driver distraction. We at Ford agree that this is an important safety issue and we have taken steps to address it. We also believe that continued research is needed to better understand the complex interactions involved in this issue, and we are actively participating in that research.

In 2009 and again in 2010, the National Safety Council (NSC) called for a total ban on the use of cell phones, both handheld and hands-free, while driving. The NSC stated that cell phone use while driving is "...a very high-risk behavior with significant impact on crashes...." And indeed, some studies have concluded that there's no difference in driver behavior whether using handheld or hands-free phones. In many of those laboratory studies, participants in simulated driving situations were observed while being asked to engage in in-depth conversations on challenging or emotional subjects, such as the latest political scandal or a near-death experience. Such intense and lengthy discussions can indeed be distracting.

Naturalistic driving studies – in which study participants' driving performance, "eye glance behavior," driving environment and in-vehicle activities are observed and recorded over weeks or months in real-world situations – have revealed different results. For example, naturalistic studies completed by the University of Michigan's Transportation Research Institute reveal that, when immersed in real traffic conditions, drivers using cell phones by and large exhibit prudent driving behavior.

In addition, the landmark 100-Car Naturalistic Driving Study conducted by the Virginia Tech Transportation Institute (VTTI) found that almost 80 percent of all crashes and 65 percent of all near-crashes involved the driver looking away from the forward roadway just prior to the onset of the incident. In 2008, the study's authors summarized their findings in this way: "...it is a rare case that a crash occurs while the driver's eyes are on the forward roadway, regardless of any other 'cognitive demand' that they might be engaged in."

In 2009, the VTTI published a new naturalistic driving study based on commercial vehicle operator experience. This study suggested that there is a 23-fold increase in risk when commercial operators send text messages while driving, and that some behaviors like checking gauges and talking on the cell phone can have protective benefits.

Beyond the VTTI and University of Michigan studies, there exists a considerable body of published research that indicates the superiority of hands-free voice interfaces as compared to handheld or visual–manual interfaces for the same tasks of command or data entry. These studies show advantages in driver performance, eye glance behavior toward the roadway, and object and event detection when the driver can keep eyes on the road and hands on the wheel. It is also interesting to note that, despite the significant increase in cell phone use in recent years, crash rates have fallen over the same time period (specifically, in both the categories of "fatal crashes" and "police-reported crashes"). (See graph below.)

Related Links

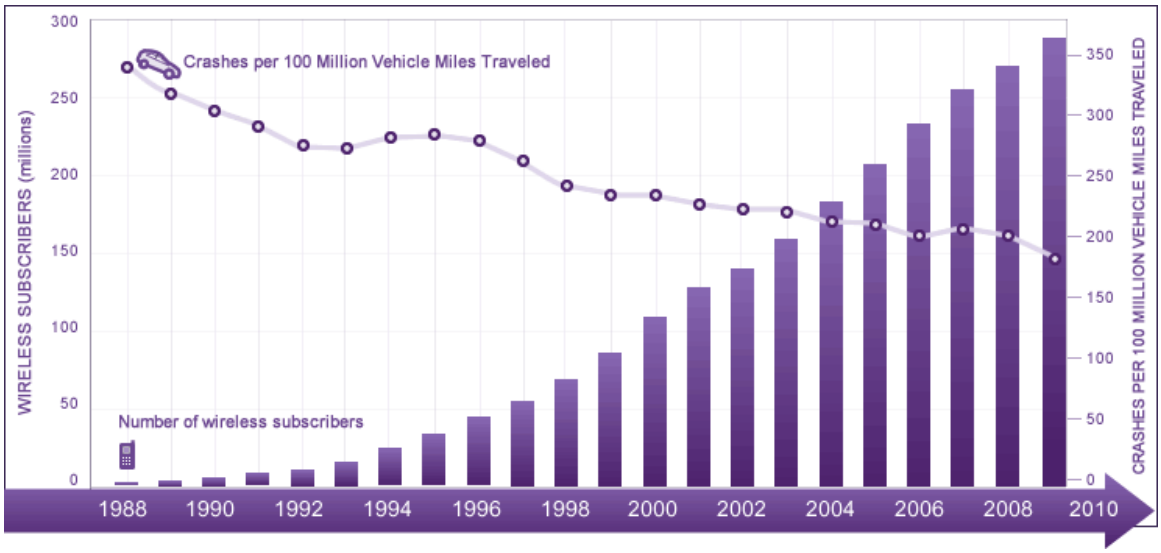
Ford Websites:

- SYNC®
- Ford Driving Skills for Life

External Websites:

- National Safety Council
- University of Michigan Transportation Research Institute
- Virginia Tech Transportation Institute
- U.S. Department of Transportation
- Alliance of Automobile Manufacturers
- Insurance Institute for Highway Safety

Police Reported Crash Rates and Wireless Subscription Growth 1988–2009



Recently, the VTTI 100-Car study has been criticized because only a handful of crashes were recorded, near-miss events were analyzed as surrogates for crashes without empirical justification, and there were only 107 primary drivers (and 132 occasional drivers). In 2010, the U.S. Department of Transportation (DOT) released several important reports that address these issues. One study of commercial truck and bus drivers was based on a data set collected and coded by DriveCam®, a vendor of onboard safety monitoring systems (OBMS). This data set was obtained from 13,306 vehicles and included 1,085 crashes, as well as many times that number of near-crashes, safety-critical events and baseline events. The results, highly consistent with the 100-Car findings, were that activities that take drivers' eyes off the road were associated with crash and near-crash involvement, but listening and talking tasks were not. A separate study conducted by VTTI on the relationship between near-misses and crashes revealed that (a) there was no evidence of different causal mechanisms between the two; (b) the near-misses underestimate risk ratios associated with crashes; but (c) the use of near-misses as surrogates for crashes greatly increases the likelihood of detecting statistically significant differences (when present) because of the much larger sample size of near-misses obtainable in naturalistic driving studies.

Another U.S. DOT-sponsored research study released in 2010 lends new insights into the case-crossover method which produced estimates of "over four-times greater risk of being in a crash" when using a cell phone. (This risk level has been cited by the IIHS, as discussed below.) Unlike the epidemiological studies, the 100-Car data set of video and engineering data has no uncertainty about exact crash times, cell phone use vs. non-use during the hazard interval leading up to the crash or near-crash, whether or not the driver was actually driving during the control day, and so forth. The researchers reported that the case-crossover odds ratios were lower, not higher, than the two-cohort odds ratios, strongly suggesting that the fourfold figure from the non-naturalistic epidemiological studies is inflated. Finally, it is noteworthy that the Strategic Highway Research Program II naturalistic driving study was launched in 2010. This study, which Ford supports with technical advice and information provided on Ford vehicle on-board information channels, will collect data for up to two years each on some 4,000 drivers.

In 2009, the IIHS evaluated insurance data to see if there were demonstrable benefits to bans on handheld cellphone use. As noted above, the IIHS had previously claimed that driving while using a cell phone causes a four-fold increase in risk, thus it was expected that insurance data would show a drop in claims after the enactment of handheld bans. However, the data showed no observable drop in claims as expected. In addition, the IIHS has published studies indicating that handheld phone bans in New York, Washington, DC, and Finland led to an initial decline in the banned behavior followed by a return to pre-ban levels of handheld phone use within roughly one year. The IIHS is now re-evaluating its position on distracted driving and cell phone use risks.

For several years now, Ford has been focused on the issue of driver distraction and has taken steps to enhance driving safety for those who use cell phones and other telematics devices while driving. Through its work with the Alliance of Automobile Manufacturers, for example, Ford helped lead the development of an industry-wide Driver Distraction Voluntary Agreement, and Ford designs its telematics systems to meet that agreement. In addition, Ford was the first automotive manufacturer to support the Schumer Bill, the first bill in Congress to propose a ban on handheld texting while driving. Ford also clarified its employee policies to explicitly ban the practice. Ford Driving Skills for Life, Ford's driver education program, includes modules on the importance of avoiding distracted driving. In 2010 the U.S. Secretary of Transportation convened a two-day Distracted Driving Summit to open a dialogue between the various stakeholders interested in this issue. Ford took part by sending representatives to attend the Summit as well as leading the development of the Alliance of Automobile Manufacturers' presentation for the Advanced Technologies Panel.

Ford SYNC®, our voice-activated in-car connectivity system, has been shown to enhance the ability of drivers to keep their eyes on the road and hands on the wheel while using cell phones and music players. Simulator research at Ford has shown that SYNC substantially reduces drivers' eyes-off-road time and improves lane-keeping, speed maintenance, and object and event detection response times, when compared to handheld devices for the same tasks. (See the above video for an example. It shows how long it takes a driver to find a song on an MP3 player manually vs. using SYNC's voice-activated system.) This study evaluated driver performance, not

driver behavior in the real world. However, these performance effects are consistent with the 100-Car VTTI Study, and strongly suggest that SYNC can reduce driver distraction in situations where a hand-held device would otherwise be used. In addition, these findings were recently confirmed by independent, on-road testing performed by the VTTI and published at the SAE Congress.

Ford customers reinforce the array of compelling research discussed above, as a large majority say they believe voice-controlled systems such as SYNC provide benefits and that they take other responsible measures while using electronics. According to a new survey of Ford owners of vehicles equipped with SYNC, 88 percent use the system's hands-free features, and 74 percent use the unique voice-control functions to use electronics while driving. A large majority of these customers also take other safety measures, such as increasing following distances while using electronics, and 77 percent say they don't use them in hectic driving conditions.

Ford recognizes that drivers will use cell phones and music players while driving, and that evolving technologies like text messaging are growing increasingly popular. Text messaging is a particular concern, as it requires significant time looking away from the roadway to operate. Ford's SYNC system addresses this concern as well: when a text message arrives, it does not display that message but instead reads it aloud through text-to-speech technology, and then provides a list of canned replies for the driver to select rather than key-in or compose manually. SYNC also locks out certain features (such as adding or editing a phone book contact) while driving.

We believe that further education is needed to help drivers understand the importance of focusing on the driving task and keeping their hands on the wheel and eyes on the road. Ford plans to continue to work with the government and other safety-related groups to discuss measures that can effectively reduce driver distraction and improve driving safety. We also plan to participate in continued research that can further our understanding of safe driving and help spread the message of safe driving.

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Case Study: Intelligent Vehicles

In recent years, Ford has unveiled numerous safety and driver-assist technologies that rely on radars and cameras to warn the driver of an impending dangerous situation and even intervene if necessary. These technologies include, for example, Lane Keeping Alert, Collision Warning with Brake Support, Adaptive Cruise Control and other features discussed in our Accident Avoidance Technologies and Driver-Assist Technologies sections. At the same time, we have been undertaking research – both on our own and in partnership with others – to take these technologies to the next level.

This "next level" involves improving the performance of these systems such that they can be used in onboard vehicle-to-vehicle (V2V) and even vehicle-to-infrastructure (V2I) communications. In addition to the radar and cameras in use today, advanced Wi-Fi, cellular technologies (GSM/3G or 4G/LTE) and global positioning systems will provide the foundation to build an entirely new landscape of features for the purpose of safety, convenience and eco-mobility.

Ford is rapidly expanding its commitment to "intelligent vehicles" that can wirelessly talk to each other, warning each other of potential dangers to enhance safety and flag impending traffic congestion for more efficient driving. Such systems could potentially help in 81 percent of all police-reported vehicle-to-vehicle crashes involving unimpaired drivers, according to a National Highway Traffic Safety Administration (NHTSA) report. In 2011 we are doubling our investment in intelligent vehicles, forming a new 20-member task force of scientists and engineers to explore the technology's broader possibilities and becoming the first automaker to build prototype vehicles for demonstrations across the U.S.

Ford's vehicle communications technology will allow cars to talk wirelessly with one another using advanced Wi-Fi signals, or dedicated short-range communications, on a secured channel allocated by the Federal Communications Commission. The Wi-Fi-based radio system allows 360 degrees of detection and can "look" around corners for potentially dangerous situations, such as when a driver's vision is obstructed.

Intelligent vehicles could warn drivers if there is a risk of collision when changing lanes, approaching a stationary or parked vehicle, or if another driver loses control. Drivers also could be alerted if their vehicle is on a path to collide with another vehicle at an intersection, when a vehicle ahead stops or slows suddenly, or when a traffic pattern changes on a busy highway. If vehicles approaching from opposite directions were communicating with each other, they could warn the drivers of oncoming vehicles, potentially avoiding head-on crashes.

By reducing crashes, intelligent vehicles could also ease traffic delays, which would save drivers both time and fuel costs. Congestion also could be avoided through a network of intelligent vehicles and infrastructure that processes traffic and road information. A traffic management center would send this information to intelligent vehicles, which could then suggest less-congested routes to drivers.

Ford has initiated a series of research and advanced projects to begin the rollout of intelligent vehicle technologies into our product lineup. Much of our work builds on the research conducted by the Crash Avoidance Metrics Partnership (CAMP), discussed in the Collaborative Efforts section.

In Europe, the "Safe Intelligent Mobility – Test Field Germany" (known as "sim^{TD}" for short) is investigating V2V and V2I communication under everyday conditions in a large-scale field operational test. In sim^{TD}, 400 vehicles are outfitted with V2V and V2I communications systems, and roadside units are set up in select locations around the test area. Both are also linked up to traffic control centers. During the test, participating drivers may, for example, receive information

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External Websites:

- National Highway Traffic Safety Administration

about a traffic jam or road accident, so they can choose an alternate route. One hundred drivers are actively participating and collecting data by completing specific driving tasks, while 300 drivers are passively taking part by driving where they would normally go. Ford is providing test vehicles for the project, as well as leading the development of the Electronic Emergency Brake Light system, which warns the driver of a heavily braking vehicle ahead.

The sim^{TD} project will run through 2012 around Frankfurt, Germany. It is a joint effort with other OEMs, suppliers, telecommunication providers and research institutes, as well as public authorities. It receives funding from the German government.

Ford is also contributing to the European harmonization and standardization of wireless communication systems and applications within the framework of the DRIVE C2X project, which is co-funded by the European Commission. DRIVE C2X is the acronym for "DRIVing implementation and Evaluation of C2X communication technology in Europe." (C2X stands for "car-to-infrastructure," and means the same as V2I.) This project kicked off in January 2011 and brings together more than 40 stakeholders, such as OEMs, suppliers, universities and public authorities from all over Europe. Within the framework of DRIVE C2X, field operational tests in a real-world environment will be conducted in seven test sites in Europe.

Both sim^{TD} and DRIVE C2X are also targeted to pave the way for full deployment of V2V and V2I systems in Europe and provide Ford with relevant data needed as a basis for the development of next-generation safety and efficiency features.

In the U.S., NHTSA will decide in 2013 whether to initiate a rulemaking process for V2V technologies that could require these systems in new vehicles starting in some future model year. As seen in the examples above, Ford's goal is not to just wait for governmental action in this area, but to accelerate the vehicle connectivity landscape to be a leader in smart, safety and eco-friendly customer solutions.