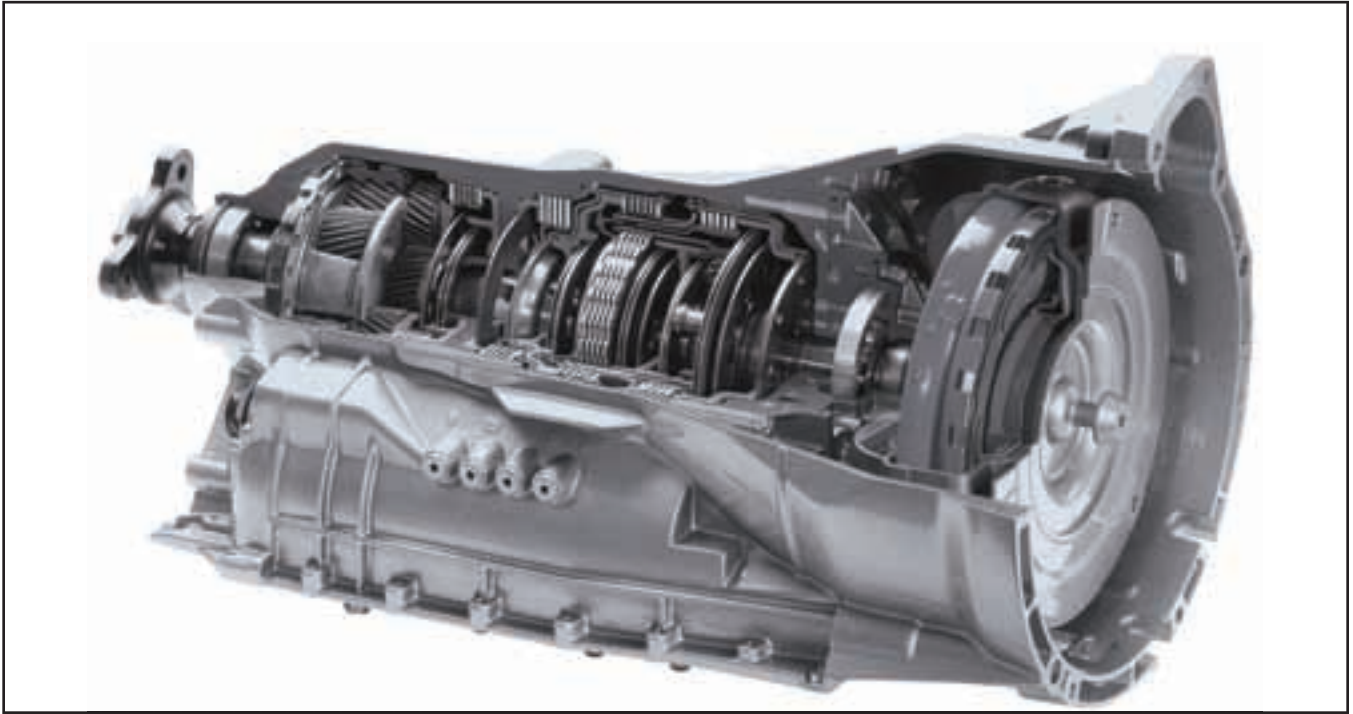


Trends in Automobile Transmissions

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With all the work in transmission development these days, the demand for automobile transmission gears should remain strong for several years, but because of the great variety of projects and variations, transmission manufacturers and their suppliers will have to be as flexible as possible to keep up with the changes.

Automobile transmissions have come a long way since the days of simply choosing between automatic and manual. Today's drivers have more transmission options than ever before. Automatics and manuals are still there, but they are now accompanied by automated manuals (AMTs), dual clutch transmissions (DCTs), continuously variable transmissions (CVTs) and hybrid drives.

Within those categories, there are several options as well, including 4-, 5-, 6-, and 7-speed automatic transmissions, along with five- and six-speed manuals.

ZF, the world's third largest producer of automobile transmissions, has been providing gearboxes since 1915, when Graf von Zeppelin founded the company

to provide gears and transmissions to his Zeppelin airships.

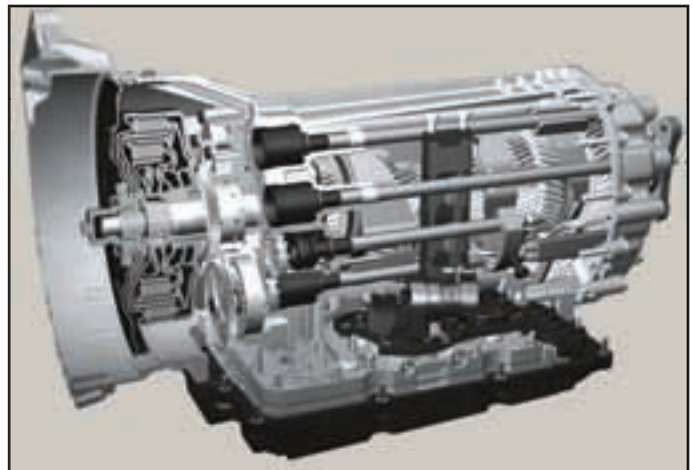
Today, ZF provides more than 1.2 million transmissions per year to automakers like Aston Martin, Audi, BMW, Ford, General Motors, Jaguar, Land Rover, Porsche, and Volkswagen and employs more than 6,300 in its car driveline technology division. In 2001, ZF introduced the world's first 6-speed stepped automatic transmission in the BMW 7-Series.

Dr. Harald Naunheimer, director of product development, car driveline technology at ZF, says that transmissions are highly individualized based on region and vehicle segment. "The models feature individual strengths, which, in turn, depend on the application conditions.

Therefore, each case has to be individually assessed because general statements are not applicable."

The type of transmission plays a key role in defining a vehicle's character, image, segment and brand, making it a major factor in competitiveness. Each vehicle features individual strengths, depending on application conditions.

AMTs—Also known as sequential manual gearboxes (SMGs), AMTs have their roots in Formula 1 racing, using computer-controlled actuators that are



prompted by paddle shifters mounted on the steering wheel. There is no clutch pedal. The system allows for both automatic and manual modes. SMGs are generally found on high-performance sports cars.

CVTs use a belt or chain to connect variable-diameter pulleys to provide an unlimited number of ratios. This allows for uninterrupted power to the wheels.

DCTs—Also called direct-shift gearboxes (DSGs), DCTs use two clutches instead of a single-sided clutch to transfer engine power through two sets of gears. The paths are set up similar to a manual transmission, with one path controlling gears 1, 3 and 5 and the other controlling 2, 4, and 6, but there is no clutch pedal. Also, there is constant power to the wheels.

Hybrids—With regard to hybrids, market share will depend on how the unit is used—mild or full-scale hybrid—and on regional legislation.

“North America and Japan are typically automatic transmission markets, with Japan using CVTs in the sub-compact market,” Naunheimer says. “Europeans still prefer manuals—but even that has dropped slightly.”

Since the introduction of the 6-speed automatic, several automakers have moved in this direction. At ZF’s automatic transmission plant in Saarbruecken, Germany, much of the production has shifted from 5-speed automatics to 6-speeds. Nearly all elements of the transmission are manufactured in-house. Based on application requirements, the plant can hone, shave, grind or match grind its gears.

Dr. Ludger Reckmann, vice president of manufacturing for automatic transmissions at ZF’s car driveline technology division, says the Saarbruecken facility will continue to increase capacity and finishing capability for its gear machining operations—a core technology of ZF. The company will also invest in quality-related processes, such as heat treating.

The average 6-speed automatic transmission contains 14 individual gears—ring, sun or planetary. These are inte-

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grated in several ways, depending on the vehicle.

Naunheimer says suppliers must be flexible, as the trend toward individual solutions will continue. "While the market share of manual transmissions in Europe is still around 80 percent, we expect that sub-compact cars (A/B segment) and light commercial vehicles will increase AMT use. Compact cars (C segment) and mid-size cars (D segment) can expect to see more DCTs. Mid-range and premium cars will continue to see auto-

matic transmissions with hydrodynamic torque converters up to 7-speeds."

Reckmann says increasing fuel efficiency is the most important development objective for transmission engineers. "The main goal is to improve overall powertrain efficiency by reducing drag losses. However, we also look for shift-time reduction, cost improvements and noise reduction."

Reckmann also says that within the transmission industry, manufacturers will have to make adjustments in the near

future based on limited floor space, corporate investment, cost and technology changes, adjustments that will lead to some outsourcing of non-critical components to low-cost countries.

"Suppliers will also have to create strategic partnerships for key components within the transmission—electronics and hybrids, for example—to develop new products," Reckmann adds.

The recent partnership formed by ZF and German-based supplier Continental-Teves to develop hybrid technology is one of several being formed within the industry. Continental-Teves brings electronics knowledge and expertise, while ZF provides the transmission, chassis and steering to create a complete hybrid driveline.

Gear manufacturing will see some changes as well. With more all-wheel drive vehicles on the road, demand for bevel and planetary gears—along with spur gear sets—will increase. And, with 8-speed automatic transmissions now hitting the market, the total number of gears necessary will also increase.

"With more gears needed, further improvements in gear quality, process costs and improvements will be required," Reckmann says. "Gear coating, heat treatment and finishing operations should remain the same, but more grinding, power honing and precision forging will be necessary." ⚙

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