

A Chain Is Only As Strong As Its Weakest Link

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Contributing Editor

There is an endless variety of parts that we inspect, reuse or replace on a daily basis as we repair and rebuild transmissions and transfer cases. We know how the parts function, we know a lot about their specifications, and we take a lot for granted. Consider for a minute that which we assume – that the part is just a hunk of steel, iron, aluminum, plastic, rubber etc., shaped and machined to perform a specific function in the gearbox.

What we routinely take for granted is the amount of research, development, testing and quality control that goes into an OEM part. Even the simplest parts must undergo extremely rigorous testing and certification before they find their way into a motor vehicle. Sure, parts fail prematurely because of design or manufacturing defect (thank God, because I am way too old to learn a new trade), but in case you haven't noticed, the units are getting more complex and they

are lasting longer than ever before. The subject of this article is the ubiquitous drive chain. Don't be deceived by the apparent simplicity



of its design, because if we had half the money invested in the research and development of transmission drive chain, we would be playing 18 holes on our own private golf course.

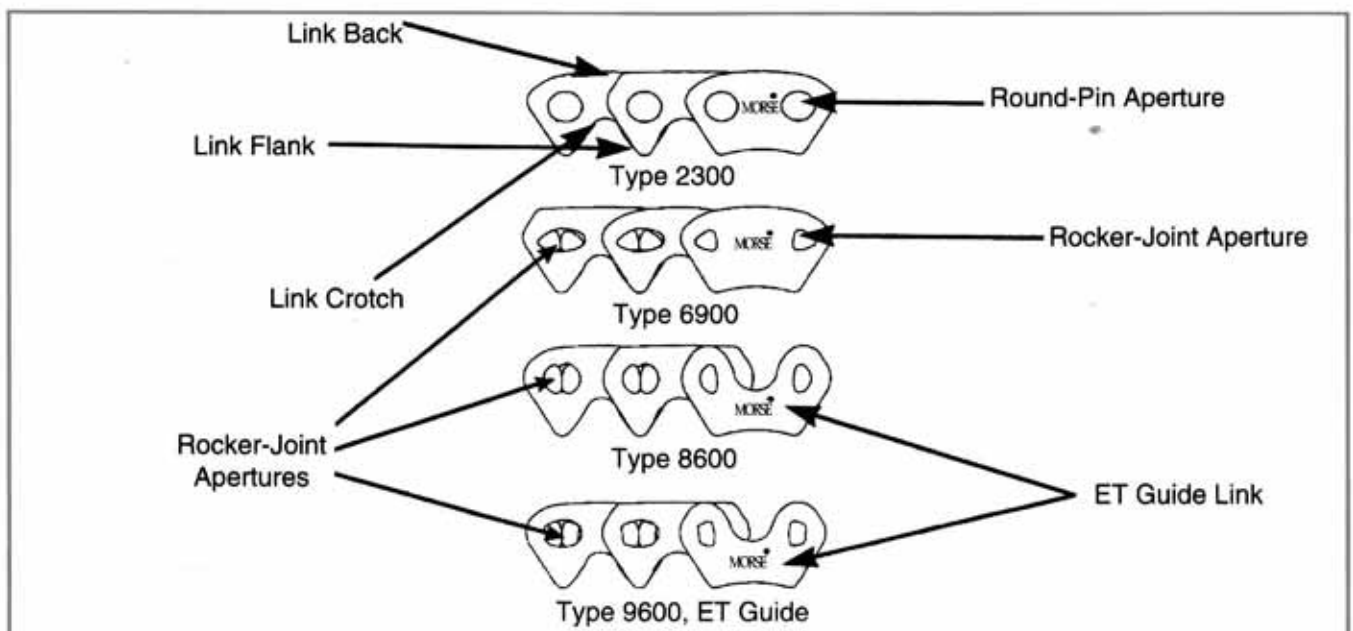
Years ago the main market for drive chain was on the engine side,

where timing chains were a big business. With the advent of front-wheel drive, chains were designed into the transaxle and the transfer case. The premier manufacturer of drive chain is Morse TEC Corp., a division of BorgWarner Automotive. The pictures and technical information provided here are through the kindness of Morse Chain. Since the primary purpose of this column is manual transmissions and transfer cases, I will concentrate on the transfer-case drive chain, but all the information here applies to the chains that transfer power in so many automatic transaxles.

The illustration here will help you to understand the various names and functions of the individual components of the chain.

LINK APERTURES (openings) are the holes in the links that are round or rocker joint (triangular)

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and match the connecting pins. This is the area of articulation (movement) in the chain

The GUIDE LINK is the link plate positioned on the outside of the chain. It holds the chain in position on the sprocket.

The LINK FLANK is the lower portion of the link that engages the sprocket teeth.

The LINK CROTCH is the space between the link flanks that clears the sprocket-tooth tip.

The LINK BACK is the outside curvature of the link design to provide strength. Some designs are flat rather than curved.

ROUND PINS are single-row pins used at each joint to articulate the chain. Round-pin designs have great impact resistance, and the load is distributed over a larger area because of the increased size of the opening.

ROCKER-JOINT PINS create a rolling motion as the chain articulates, have a high speed capacity and operate at lower friction levels for better wear. The rocker-joint-style chain is designed to operate at the specific load rating and speed of the application. A note of caution: Rocker-joint chains must be used only with OEM rocker-joint sprockets. Swapping one chain type for another will cause an early, expensive failure.

Chain Operating And Measurement Terms

Pitch – the effective length between the center points of the apertures, which are the points where the joint articulates.

Width – the approximate dimension between the outside guide links.

Random Chain – Certain patterns are interlaced in a random link pattern using two different link styles in rows across the chain.

Chordal Action – radial or transverse motion of the chain strand caused by sprocket engagement. This motion contributes to the noise associated with drive-chain systems.

Chain Quality Parameters

Tensile strength – The ability of the chain to endure loads that are applied during sprocket engagement and operation. It is measured as the ultimate strength of the chain; that is, the load at which the chain will break or fail. Centrifugal forces generated by high-speed operation create loads in the application. The quality of steel in the links and pins and the chain design are important factors in high tensile strength.

Fatigue strength – the ability of the chain to endure the loads and operating conditions repeatedly over time.

Wear – The amount of elongation (stretch) that occurs during operation.

Noise produced by the operating components of a transmission or transfer case is a major problem that must be addressed by the manufacturer in order to have a high level of customer satisfaction. With the high cost of new cars and trucks, we have a proportionally higher level of expectation from the customer for smooth, quiet operation. Through research and development, Morse has created a patented design for randomization of the links to create a chain that eliminates the whine of high-speed operation. This is done by varying the chain rows to break down any harmonic vibrations from the engine pulses or the engagement and power flow of the unit.

Chain wear is an issue that must be addressed every time we take a unit apart. Measuring stretch accurately is almost impossible. The measurement standards given in the repair manuals to measure chain deflection by marking the chain position as it sits on the sprockets and then pushing the center of the chain toward the sprockets and measuring the deflection will be correct about 50% of the time. A good rule of thumb is that if the chain is discolored or is in a unit that has run out of oil or has 60,000-plus miles on it, for the sake of your wallet it should be replaced.

How many times have you drained a transfer case to have only a shot glass of oil come out? The customer will never check the lube level in a transfer case on his own. If the customer is average, he will pay slightly less attention to preventive maintenance than to his unwanted stepchild. Some late-model 4X4 vehicles have eliminated the front-axle disconnect, so the chain is turning any time the vehicle is in motion. In many cases you will find these chains to have a light-brown color that is caused by baked-on lube. Sell the customer a new chain along with the other parts, such as bearings and seals, needed to restore the vehicle to proper running condition and protect your reputation. Remember, once you touch the unit, you have automatically accepted responsibility for its well-being – no matter how much or how little you charged.

The simple-looking chain turns out to be a lot more complicated than it first appeared. If you have ever seen the destruction done by a failed chain, you don't need me to tell you to skip the shortcuts. There are plenty of bargain chains around at cheap prices, but how much of a bargain was it when the third-world "will-fit" chain is noisy or lets go at speed, littering the highway with chunks of transfer case? Successful people never substitute quality for price. **TD**



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