

5.0 MUSTANG & SUPER FORDS

Rise of the Machines

Lentech boss Len Bertrand leans on one of his new AODE Strip Terminators. You can too—with up to 700 hp—without fear. Once you surpass that power level, Len can set you up with one of his many AOD variants, including the new AOD Strip Terminator Lockup Stage II.



Text and Photos by Dale Amy

As the brainchild behind Lentech Automatics, Len Bertrand probably knows as much about the hydraulic, mechanical, and electronic goings-on inside a Mustang's overdrive automatic transmission as anyone on the planet. For years, Len has been a staunch advocate of the high-performance potential of the AOD—an overdrive that is often criticized in stock form, but which is magically converted

from frog to prince with the simple kiss of some of Len's vast tranny know-how.

Recently, Lentech upped the AOD ante once again, with a new nonoverdrive version of the transmission—called the AOD Strip Terminator Lockup Stage II—which can swallow a steady diet of up to 1,100 hp while still offering the benefit of a lockup power flow in Third gear.

On a separate front, Lentech has been further strengthening the AOD's modern electronic cousin, the AODE (also known as the 4R70W)—the EEC-controlled tranny that replaced the AOD in Mustang use beginning in 1994. The firm recently introduced the AODE Strip Terminator, a stronger,

Horse Sense: The NMRA apparently recognizes the drag-racing capabilities of the AOD/AODE, since it no longer gives these automatics a weight break versus a manual gearbox in either Factory Stock or Pure Street.

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Street Terminator model, for applications up to 700 hp.

The Same, Only Different

Before scrutinizing Lentech's new AOD and AODE offerings, it's worth looking at the similarities and dissimilarities of these two generations of FoMoCo overdrives. In factory form, both are four-speed automatics having provision for lockup operation—that is, the ability to bypass the torque-converter's fluid coupling and provide a direct, no-slip, mechanical connection between crankshaft and the compound planetary gearsets (two sets of spiders mounted on a common planetary carrier) that both transmissions share.

In terms of their actual geartrains, the AOD and AODE are virtually identical. However, one major difference between them is the way in which lockup is achieved. Unlike the AODE, which uses a more traditional torque-converter lockup clutch, the older AOD achieved lockup in somewhat unconventional fashion inside the gearbox, through the use of two concentric input shafts. A hollow outer shaft was driven

Unlike older sibling AOD, the Mustang's current AODE transmission doesn't use dual concentric input shafts, relying instead on a torque-converter clutch to achieve lockup. However, for reasons known only to Ford, the stock AOD input (top) is divided lengthwise into main and stub shafts (split at the forward clutch). In the AODE Strip Terminator, these are replaced by the same hardened, 4340 chrome-moly, one-piece input shaft as used in the firm's highly regarded nonlockup AODs. ▼

off the torque-converter turbine to power First and Second (and Reverse) gears, while the inner shaft took engine rpm directly off the converter front cover—driven right off the flexplate—to engage both Third and OD in permanent lockup. This small-diameter inner shaft was always a weak spot in the AOD's power flow until Lentech turned it into a tactical advantage.

Having a torque converter clutch to perform lockup duty, the newer AODE does not use this concentric shaft arrangement—instead, the EEC programming tells the converter clutch when to go into lockup. But when faced with elevated power levels, the limited strength of the converter clutch itself becomes a potential Achilles' heel.

The other major distinction between AOD and AODE is in their valvebodies. The AODE's is electronically overseen, taking its marching orders from the EEC processor for control of shift points, line pressure, and converter-clutch operation. While quite competent in stock duty, the EEC can be thrown way out of whack by engine modifications. And this temporary electron insanity can negatively—even destructively—affect transmission



The AODE's stock pump stator is on the right. To improve lubrication and cooling flow, Lentech modifies AOD stators for use in the AODE Strip Terminator.



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operation, especially when it comes to its hydraulic line pressures.

Because of these differences, Lentech has had to adapt different strategies for beefing up each of the two generations of transmissions. Here's a brief overview of the company's latest high-performance AOD and AODE automatics.

Strip Terminator

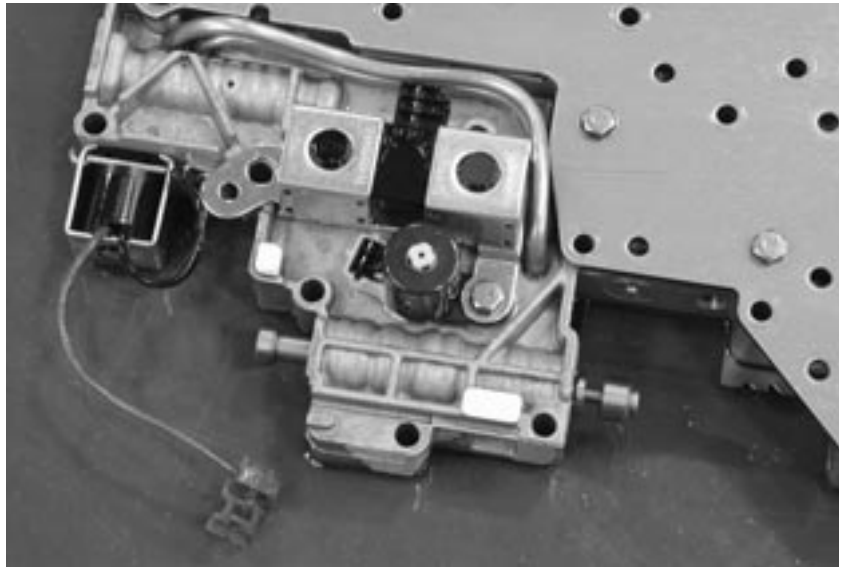
This new pumped-up AODE is great news, particularly for owners of heavily modified modulares with an eye on the quarter-mile. Lentech already makes an AODE Street Terminator transmission that is rated for up to 400 hp—a power ceiling principally resulting from the strength limitations of the E tranny's converter lockup clutch and factory input shaft, but also to some extent from the EEC's programming control of line pressures. Until now, for higher-power applications or more serious race use, Len had to recommend retro-swapping to one of his many AOD variants. This could become a bit expensive on late-model Mustangs since it also involved buying a modular-specific bellhousing (the AOD was never built with a modular bolt pattern) and various other accessories necessary to make an AOD function in an AODE environment.

Now there's an alternative. The company's new 700hp-rated, transbrake-equipped AODE Strip Terminator is aimed at the more serious street/strip modulares, bypassing the limitations of the Street Terminator by getting rid of both converter lockup and electronic control of line pressures altogether. According to Len, "The AODE Street Terminator is designed for mildly modified Mustangs. Where the AODE Strip Terminator comes in is for the more heavily modified combinations. It's for the guy who wants to put a blower on his car, change the heads, change the cams."

Automatic transmissions live or die by their line pressures. Instead of line pressures that vary at the whim of the EEC, the Strip Terminator's transbrake valvebody ("Give Yourself a 'Brake," Sept. '02, p.138) is modified to operate at a fairly high, fixed line pressure. While a knowledgeable tuner might be able to program safe line-pressure values into the EEC's lookup tables, going to constant line pressure in the valvebody eliminates that potentially dangerous variable. "We could technically make a fully electronically controlled E transmission work for these applications," Len says, "but how many transmissions is a guy going



A factory 12-inch, clutch-equipped AODE converter (about 51 pounds) is shown at the rear, an aftermarket clutch-equipped 10-incher (31.5 pounds) is on the left, and a 10-inch nonclutched version (26 pounds) as fitted to the AODE Strip Terminator is on the right. Going with a nonlockup converter greatly decreases rotating mass, for better response and acceleration, as well as eliminates the strength limitations of a lockup clutch.



The importance of Lentech's valvebody modifications cannot be overstated. The AODE Strip Terminator's transbrake valvebody uses fixed line pressure to eliminate the slippage potential caused by delayed line-pressure rise in an EEC-controlled valvebody. Despite having a transbrake, it will still shift automatically under control of stock, or custom, EEC shift programming. This valvebody has been yielding excellent results in the Paul's High Performance DragPak race car.

to go through before he gets the [line pressure] programming right?"

So, in the AODE Strip Terminator, the EEC IV or V is no longer responsible for controlling either line pressures or converter clutch operation, but the processor is still useful in controlling shift points for fully automatic shifting. Yes, that's right—despite having a transbrake, the Strip Terminator will still shift automatically,

making it convenient for occasional street use. Should you not care about—or want—auto shifting, a fully manual valvebody is optionally available.

On the mechanical side, the Strip Terminator receives various internal upgrades, including revised clutch packs, and gets the same one-piece, induction-hardened, SAE 4340 steel input shaft as used in Lentech's nonlockup AOD

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race variants. It is also converted to a nonlockup torque converter. Eliminating the lockup hardware not only takes the strength-limited converter clutch out of the equation, but it also allows the use of a much lighter converter, meaning notably less rotating mass to accelerate.



Among its many internal strength mods, the AODE Strip Terminator receives three intermediate clutches, five forward clutches, four reverse clutches, and no fewer than seven three-four clutches, all of high-performance Redline materials, and in some cases requiring clutch-cylinder modification to fit. Ford's latest and strongest design of intermediate one-way clutch, or mechanical diode, is also fitted.



As with all Lentech transmissions, each AODE Strip Terminator is assembled with new seals, gaskets, and filter, and with all critical clearances adjusted for high-performance use. Valvebodies are individually tested for correct function on Lentech's valvebody dyno before being installed.

In summary, the AODE Strip Terminator is a tough hombre that can handle 700 hp and bolt right in place of a factory AODE. But Len wants us to point out that it's not for everybody. This is a transmission optimized for competition more than for a daily 100-mile commute—it is called the Strip Terminator, after all. Running at constant full line pressure is a double-edged sword. Yes, it allows reliable handling of more power while offering crisp and precise shifts,

but those firm shifts may become tiresome in everyday use. More importantly, full pressure also generates more heat and will accelerate wear on seals. This is certainly not to say the Strip Terminator can't be used for the sort of limited street use that a 700hp modular might reasonably expect to see, but for any regular diet of street driving, Len highly recommends an upgraded transmission cooler and periodic fluid changes. And let's be clear—these comments hold for full line pressure valvebodies from any manufacturer.

Stage II

We now move to the nonelectronic portion of our program. For some time, Lentech has offered an impressive array of muscular, AOD-based transmissions in both lockup and nonlockup configurations, nearly all of which feature the company's bull-strong and patented Reverse-clutch, Third-gear power flow. Until now, the strongest lockup variant available—a three-speed aptly named the AOD Strip Terminator Lockup—was capable of handling as much as 800 hp. But now, Lentech's brand-new AOD Strip Terminator Lockup Stage II can corral herds of up to 1,100 hp while still offering the efficiency benefits of a lockup power flow.

Why might lockup be desirable in a drag racing tranny? Simple: It delivers more power to the ground in high gear. Len tells us that, on average, you lose (to heat) about 10 percent of power through a torque-converter's fluid coupling, so if you can have a high-gear lockup power flow without incurring a strength penalty, you get the best of both worlds. "And," Len says, "having three speeds with a lockup is just the ticket for a heavy car like a Mustang."

So Lentech puts to good use the AOD's unique ability to achieve lockup in the gearbox rather than via a traditional converter clutch. By avoiding the weight and complexity of a typical converter clutch, Len feels the AOD can have real advantages in terms of rotating mass and efficiency. "We can engineer a small, lightweight torque converter that doesn't take much power to drive," he says. He has converters in successful race use as small as 7 inches and weighing only 19 pounds. Len—a drag racer himself—is utterly adamant that no other auto transmission—no Powerglide, no Turbo 350 or 400, no C4—is capable of the efficiency of a lockup AOD.

To add the additional 300hp-handling ability to the Stage II's résumé, Len reengineered the inner and outer input shafts to a strength level even beyond the stout shafts used in his original AOD Strip Terminator Lockup. The original's

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production-splined input shafts are both whittled from chrome-moly 4340 steel, while the inner shaft on the Stage II goes a step beyond by being carved from Vasco tool steel. Len says it's now of the same diameter as a C4 input shaft and, mechanically, more than 50 percent



These Herculean concentric input shafts are the secret of the AOD Strip Terminator Lockup Stage II's 1,100hp power-handling capability. The outer shaft is 4340 chrome-moly, and the inner is even tougher Vasco tool steel. Being larger in diameter and higher in spline count (26 versus 23) than stock, a revised three-four clutch drum is required, likewise crafted from 4340 chrome-moly. This rather telling photo compares Lentech's new 26-spline inner shaft to its stock 23-spline counterpart. By our unofficial measurement, outer diameter at the spline increases from 19 to 21 mm.



Prior to shipment, all Lentech transmissions are run through a barrage of tests on Len's tranny dynamometer, powered by a good, old Trick Flow-headed small-block. And, yes, that is an E4OD (or 4R100) sitting on the dyno in this photo—Len is starting to work his magic on these heavy-duty autos as well. Lightning owners, stay tuned.

stronger than before. This beefy new inner shaft boasts a 26-tooth spline as opposed to the 23-tooth found on the production and Stage I variants. The larger spline naturally requires modification of the three-four clutch drum to which it meshes, so the drum's center-

section is cut out and replaced with a 4340 chrome-moly center of matching tooth count. The new outer input shaft is not forgotten either, as it benefits from more spline teeth on the converter end, meaning the converter configuration is also exclusive to the Stage II.

By the way, Lentech plans to offer a one-piece input shaft using this stronger spline configuration. This will permit his four-speed nonlockup AODs to swallow up to 700 hp in Overdrive, rather than the current limit of about 400 hp. Silver State Classic guys, are you listening?

Getting back to the AOD Strip Terminator Lockup Stage II, it features the same internal upgrades and manual, three-speed valvebody with transbrake as the original Strip Terminator Lockup. And, as with all Lentech automatics, it is fully dyno-tested before shipment. The Stage II is not meant to replace the Stage I, but it's a nice option to have for those packing more than 800 ponies.

So there you have an all-too-brief look at the latest in high-performance AOD and AODE offerings from Lentech. We've really just hit upon the major highlights of these two new models. A more complete description of the components used in each can be found at the company's Web site (www.lentechautomatics.com). With all their available converter and valvebody options, the guys at Lentech practically custom build each transmission anyway, so perhaps the best way to find out what's right for your particular application is with a phone call. **5.0**

Lifetime Warranty?

Lentech has always stood firmly behind its products by providing a full year of unconditional parts and labor coverage on all transmissions—in either street or race use. But now the firm has gone to the next level by offering a limited lifetime warranty on its transmissions. Beyond this first year of unlimited coverage, beginning in the second year and for as long as the original owner owns a Lentech transmission, all transmission repairs will be completed by Lentech at a cost ceiling of \$995 per occurrence (exclusive of shipping/brokerage/duties). Now that's confidence.

SOURCE

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