ROAD TEST:

Yamaha XJ650LJ Seca Turbo

The styling might be from outer space but the hardware is down to earth.

BY PAUL DEAN

Somebody has to say it, so it might as well be us: What this world doesn't need is another frightfully complicated turbocharged motorcycle. There already is one of those in production, with more apparently to follow. What this world could use instead is an *un*complicated turbo. One that won't intimidate potential buyers with sheer complexity. One that doesn't require a degree in engineering and a fortune in diagnostic equipment to troubleshoot and tune. One that allows the repair/replacement of individual components in the engine's support systems rather than forcing the installation of whole new systems. One, in fact, not unlike Yamaha's XJ650LJ Seca Turbo—the "simple" turbobike.

Trouble is, few people would ever figure this motorcycle to be simple based solely on its looks. It's a slice of the future as Yamaha sees it, a bike that wouldn't look any more out of place in the Star Trek prop room than in a Yamaha dealer's showroom. And its rocket-man styling all but sweats with high technology, as if to suggest that every inch of space behind all of those body panels is crammed with intricate mechanical workings.

In truth, that's not how the Seca Turbo is at all. But by the same token, neither does "simple" constitute a completely accurate description of this Yamaha—a four-cylinder, shaft-drive, fully faired motorcycle with computerized instrumentation and a complete, EPA-appeasing turbocharger system. Perhaps *simpler,*

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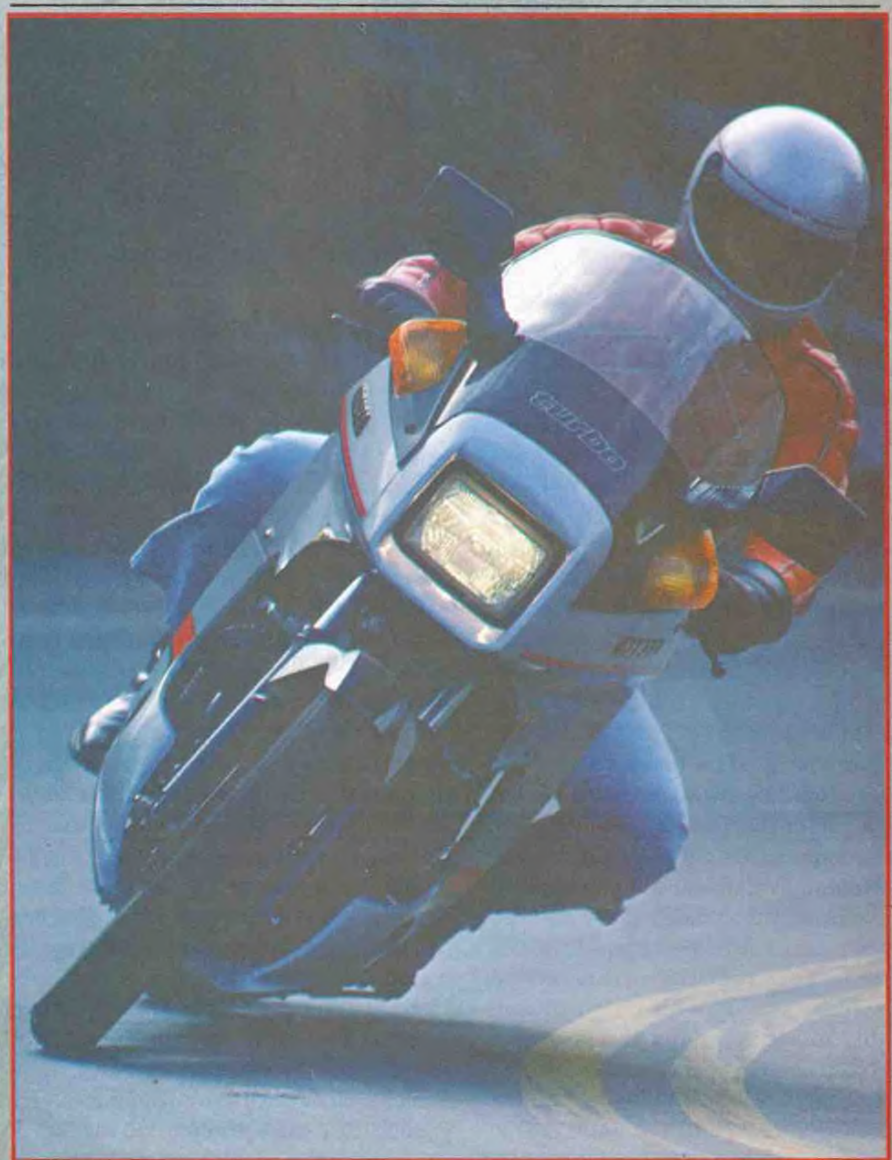
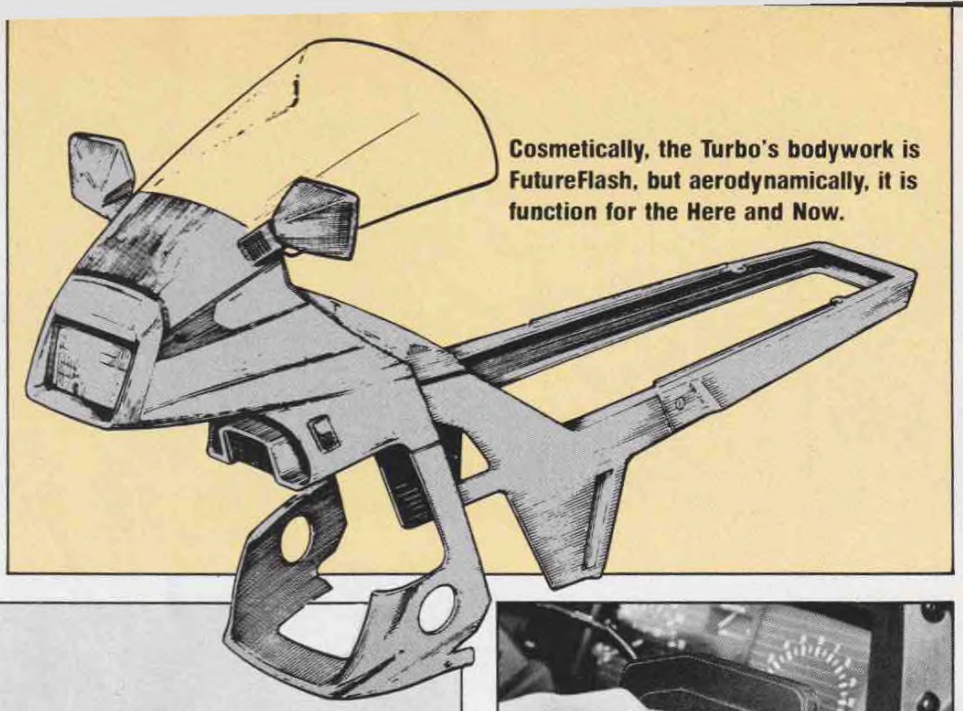


PHOTOGRAPHY © 1982 DAVID DEWHURST

Rear view shows integrated seat/light

And an autograph for your followers.



Cosmetically, the Turbo's bodywork is FutureFlash, but aerodynamically, it is function for the Here and Now.

Nose-heavy styling and semi-enclosed body surround normal-appearing engine

Only you and your insurance agent know better.

Fairing has two lockable compartments

Gloveboxes is a fitting description.

then, says it better. Because the Yamaha is infinitely simpler than Honda's awesomely complex CX500 Turbo, and—based on what's known about them at this point - it's not as complicated as the fuel-injected, computer-controlled turbos soon to be released by both Kawasaki and Suzuki.

Indeed, once you peel back the Seca Turbo's future-shock bodywork, you're left with what looks like, and in fact *is*, pretty much a standard XJ650 Eurobike. There's no trace of the Mitsubishi-built turbocharger itself, since it's tucked down behind the engine cases, just below the swingarm pivot. The black-chrome exhaust system has the appearance of (but isn't) a run-of-the-mill four-into-two, and there's even a conventional-looking bank of four Mikuni CV carbs lined up behind the cylinder head. If you didn't know any better, you'd probably never guess that you were looking at a turbocharged motorcycle.

Obviously, there's a lot on unconventionality in the plumbing and hardware that's hidden from plain view, but it's all done in a straightforward, simple way. The carburetors offer a perfect example of that simplicity: They meter fuel mechanically, not electronically, are conventional in location and typical in design. That alone ought to win the Turbo a vote of confidence from every fuel-injection-fearing Yamaha mechanic in the country.

Locating the carbs downstream of the turbocharger (as opposed to the conventional practice of mixing the fuel upstream on carbureted turbo engines) not only helps the LJ's simplicity quotient, it is instrumental in allowing the engine to do what most other turboed engines cannot: have normal power and response when not "on the boost." Any time the turbocharger is not spinning fast enough to provide boost pressure in the intake tract, the 30mm Mikunis simply function as they would in a normally aspirated engine. Intake-manifold vacuum causes air to be drawn into the air-filter box and through a one-way reed valve connecting the airbox to the big air chamber at the rear of the carbs, then into the engine. So when not under boost, the intake system operates as though the turbocharger weren't there. But as soon as the turbo is spinning quickly enough to replace the partial vacuum in the intake tract with boost, the reed valve is forced closed and the intake becomes pressurized—turbocharged, if you will.

There are a few support mechanisms necessary to render this system operational (see "Inside The Rational Turbo," pg. 48), but it's still an elegantly simple arrangement. And one that works. In roll-on acceleration in all gears and at all rpm, the Turbo is *exactly* as fast as the unblown Euro 650. And that's doubly impressive when you consider that the Turbo's effective gearing is a smidgen taller than the Euro's (all the ratios are identical but the LJ's rear tire is about half an inch taller) and that it weighs 65 pounds more.

Any acceleration similarities end, however, once the Turbo is on the boost. In the lower gears this 650 pulls like a strong 750, and in the taller ones it sprints down the highway like a literbike stuck on fast-forward. As with most turbo machines, the LJ's quarter-mile numbers are not a true measure of the bike's peak acceleration, since there's a bit of delay—turbo lag—before that peak is reached. Moreover, the Turbo's maximum boost (7 psi) isn't high enough to deliver astronomical horsepower figures, and full boost doesn't kick in until

the engine is revving up near 5000 rpm. Nevertheless, the amount of turbo lag on the Yamaha *seems* unusually low simply because the engine performs so well when it's off boost. That's why there are seldom any sudden bursts of power as the engine makes the transition from off the boost to on it, especially in the higher gears. The rate of acceleration just gradually and smoothly changes from ordinary to omigod, much like what you feel in a jetliner during takeoff.

Yamaha's decision to keep boost pressure on the conservative side meant that the basic double-cam, eight-valve engine, borrowed from the Euro and Maxim 650 models, didn't need extensive remodeling to make it turbo-worthy. There were the usual sort of unblown-to-blown tuning adjustments (lower compression ratio, 2mm smaller carbs, less-radical cam timing and slightly reduced cam lift) as well as a few structural changes (stronger pistons, higher-grade main and con-rod plain bearings, increased cooling-fin area on the exhaust side of the cylinders, stiffer clutch springs) to cope with the effects of the added power. And the lubrication system was upgraded to include an oil cooler, a second oil pump (to scavenge the engine oil fed to the turbocharger's high-speed center bearing) and a small hole in each con rod to direct a stream of oil to the underside of the piston to help dissipate heat. Otherwise, the Euro and Turbo 650 engines, transmissions and drivelines are carbon-copies.

For the most part, so are the bikes' two chassis. Except for differences in bracketry, the frames are identical, right down to

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COMPARATIVE TEST DATA:

Make and Model	Quarter-Mile, sec/mph	Top Speed, mph	Weight, lbs	Stopping Distance From 60 mph, ft.
Yamaha XJ650LJ-'82	12.61/104.7	126	541	145
Honda CX500 Turbo-'81	NA	136	549	NA
Suzuki XN85-'82	NA	135	492	NA
BMW R65 LS-'82	14.15/92.4	110	417	138
Suzuki GS650E-'81	12.89/101.4	128	462	115
Yamaha XJ650 Seca-'82	12.83/103.4	125	469	135

Inside The Rational Turbo

• To say that the XJ650LJ is a turbocharged motorcycle is only half-right—or, depending on your point of view, half-wrong. Because technically, it is every bit as much a normally aspirated motorcycle as it is a turbocharged one.

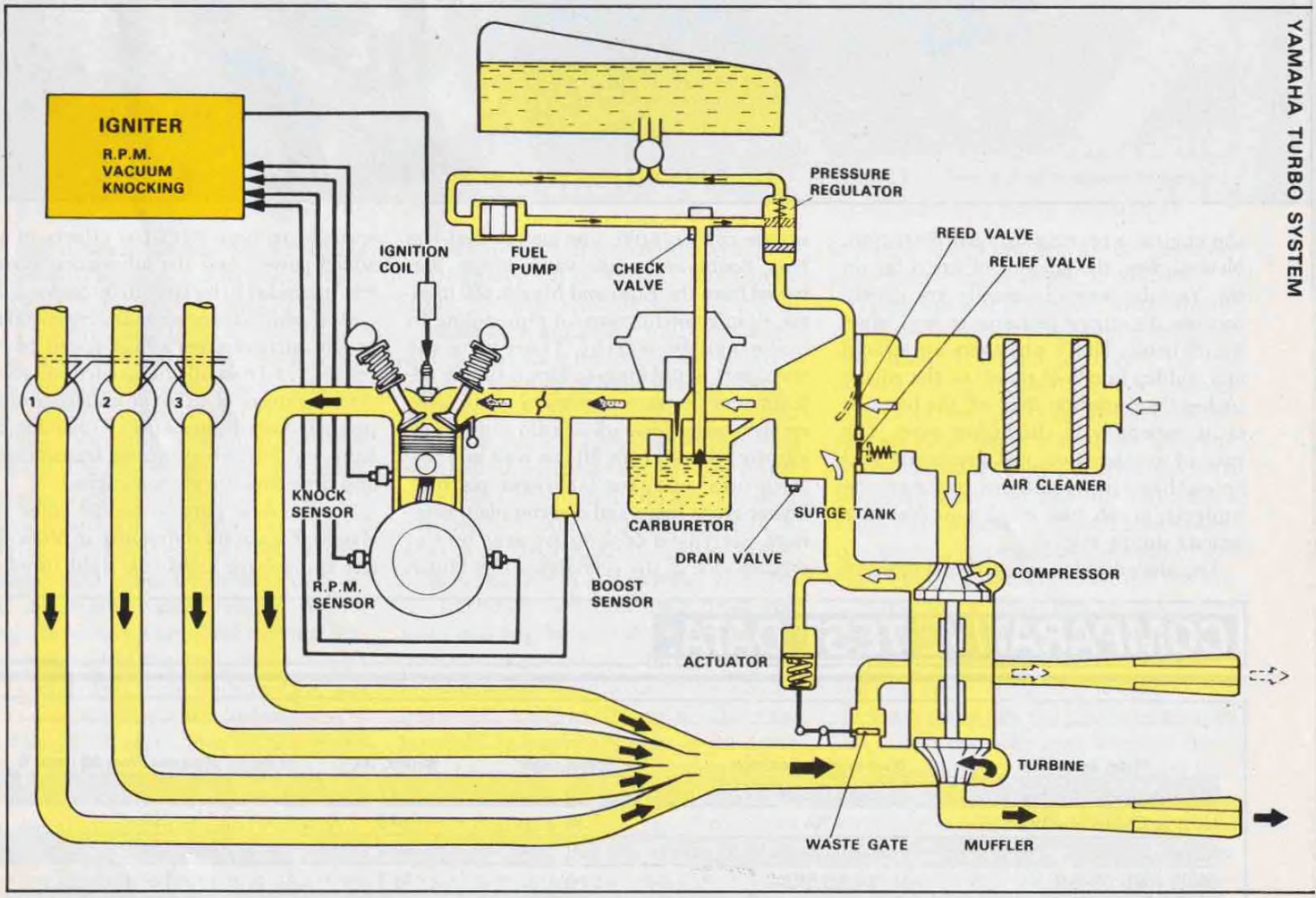
This two-bikes-in-one situation is a result of the way in which Yamaha dealt with a problem as old as turbocharging itself—the fact that when they're not on the boost, turboed motors don't perform anywhere near as well as their unblown counterparts. To a large extent, that's because in virtually every turbo system prior to this one, all intake air must first pass through the turbocharger's compressor wheel before entering the engine. Meaning that any time the compressor isn't spinning fast enough to pressurize the intake system, it is simply an obstruction that adversely affects the flow of incoming air. Thus the engine cannot perform at sub-boost rpm as well as it could were the compressor not in the way.

The Seca Turbo, however, is different in that its turbocharger isn't even a part of the intake tract until it produces boost. The intake system is similar to that of an unblown engine, with four conventionally located CV carburetors plumbed into a "surge tank" (a plenum-type chamber), behind which is a separate airbox that houses the air-filter element. The trick is that air can get from the airbox to the carbs in one of two ways: through a large reed valve that connects the airbox to the surge tank; or through the turbocharger, first via a long duct linking the under-seat airbox to the turbo unit below the swingarm pivot, then through a second duct connecting the turbo to the surge tank.

Any time the turbocharger is being spun too slowly to pump boost pressure into the surge tank, the intake system still can aspirate (and the engine perform) normally without any interference from the compressor wheel. Intake vacuum creates a low pressure in the surge tank, which sucks the reed valve open, allowing air to flow from the airbox, through the carbs and into the engine, bypassing the turbocharger altogether. But as soon as the turbo speeds up sufficiently, the negative pressure in the surge tank is supplanted with positive pressure (boost) that closes the reed valve and, consequently, turbocharges the intake tract.

Aside from the performance benefits of this arrangement, there are numerous other advantages. It's simpler and less expensive to manufacture than the electronically fuel-injected turbo systems that Yamaha's competition favors. That means easier, less-costly servicing, particularly since most shop mechanics should already be familiar with CV carburetion. And an invaluable bonus with this kind of turbo system is that the turbocharger can be mounted almost anywhere on the motorcycle.

Yamaha opted for a highly unusual turbo location, but for good reasons. For one, it positions much of the system's weight below the bike's center of gravity, where it has the least negative effects on



LJ's intake layout cures the off-boost performance blahs simply and effectively:

If the turbocharger can't supply any pressure, merely bypass it.

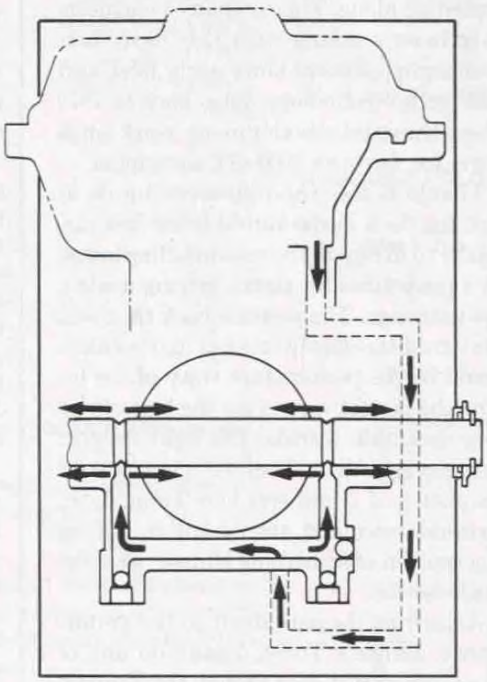
handling. And it keeps the extreme heat radiated by the turbo and the exhaust system far away from both rider and carburetion, at the same time virtually eliminating the need for any added exhaust plumbing. The turbo location also allows the LJ's external mechanicals to look quite conventional, which Yamaha hopes will allay any potential buyer's fears about owning an overly complex motorcycle.

Despite those numerous blessings, however, the turbo's remote location does have the disadvantage of being too far away from the engine to minimize turbo lag—the delay between the opening of the throttle and the arrival of boost. But Yamaha attempted to limit the amount of lag by: 1) using the world's smallest turbo unit, a Mitsubishi TC03-06A with 39mm turbine/compressor wheels; and 2) developing an exhaust collector that joins together header pipes Nos. 1 and 4 separate from Nos. 2 and 3, thereby directing exhaust pulses at the turbocharger that are evenly spaced. Futhermore, since the compressor wheel in this system pumps only plain air rather than air/fuel mix, it needn't have any mechanical seals to speak of. And that absence of seal friction permits the compressor to turn more freely and thus be easier to speed up at lower revs.

Some problems had to be ironed out of the carburetion, as well. Their location downstream of the turbo means that they are pressurized—that is, have greater-than-atmospheric (rather than less-than-atmospheric) pressure in their throttle bores—any time the system is under boost. This would have prevented fuel from being drawn up into the venturis during boosted operation; therefore, the electric fuel pump was linked to a special regulator (which senses the pressure changes in the surge tank) to insure that the pressure exerted on the fuel in the float bowls *always* is 0.2 kg/cm^2 (approximately 3 psi) higher than the pressure in the throttle bores so that boost or no boost, fuel will consistently be drawn up into the airstream.

Having pressurized carbs also means that they must be sealed wherever they might allow fuel to escape. But rather than installing mechanical seals around the throttle shafts and cold-start enrichener plungers (two areas where freedom of movement is important), Yamaha used a unique system of air seals. Air enters each carb body through an opening back near the surge tank, then is routed through passages to the aforementioned areas, where it flows around the parts to be sealed before simply leaking out to the atmosphere. Since the pressure in the air-seal system always is at least equal to that inside the carburetor (both get their pressure from the same source), the flow of air prevents any fuel/air mixture from leaking past.

Other unique aspects of the LJ's turbo system include the right-side muffler, which is used only as an exhaust dump for the wastegate once it opens at 7 psi of boost. All of the regular exhaust gases are routed through the left-side muffler only. Should the wastegate ever stick closed, there's a separate blow-off valve in the surge tank that won't let intake pressure exceed 14 psi. And to further prevent engine damage, a special electronically controlled spark advance regulates the ignition timing to achieve the best balance between power and reliability. A sensor in the intake system calculates the amount of tubo boost and advances the timing accordingly for optimum performance; but at the same time a knock sensor installed in the cylinder block retards the timing the instant it detects any detonation.



Non-mechanical carburetor seals

Letting air seep out keeps fuel in.

All of this sounds rather complicated and contradictory to any claims of simplicity, but it's really quite straightforward. So much so that the Turbo can be fully serviced with the very same special tools needed for the unblown Euro 650. And that's the kind of simplicity that hits you in the seat of the pants—right about where you keep your wallet. —*Paul Dean*

steering geometry and wheelbase. The Turbo has air-assisted front and rear suspension, and its shocks offer four-way-adjustable rebound damping—all features that the Eurobike doesn't have. The LJ's four-spoke cast wheels are of a different design than the Euro's "veg-a-matics," and although both bikes use the same-size tires, only the Turbo's are V-rated.

This means that the Seca Turbo is the only turbobike from Japan not to have a special one-shock chassis built expressly for it. But that's not necessarily a bad thing, given that the Euro 650 has been hailed as one of motorcycling's finest-handling sportbikes. And once again, it's a simpler approach to the problem. The location of the turbocharger and its attendant plumbing would have made designing a single-shocker a genuine nightmare.

Despite the unoriginality of its chassis, the Seca Turbo handles quite nicely, thank you. Understand, of course, that it is not a bike meant to fulfill the peg-dragging fantasies of 18-year-old canyon-crazies; no indeed, this is something more along the lines of a sport-tourer, a bike that you can ride fast, lean far and profile to your heart's content, but that's not the ticket for ten-tenths corner berserking.

For one thing, the nature of the power delivery gives flat-out cornering an abnormally high degree of difficulty. Using high rpm in the turns can unleash more acceleration than you want, while lower revs can deliver less than you need. And then there's the added weight that has transformed the mid-size Eurobike into a liter-class heavyweight. Fortunately, a lot of that additional weight is low, meaning that the center of gravity hasn't been noticeably raised. So the Yamaha doesn't resist leaning or sit up while braking in a turn the way Honda's 549-pound, high-*cg* Turbo does. But side-to-side transitions are more sluggish on the LJ than on the plain-Jane 650, and you can't bank the blown Yamaha into any kind of turn as easily. Full-on cornering also causes the tires to squirm a bit, letting you know that they're nearing their limits.

Overall, the best handling comes when the fork and shocks are set near the upper ends of their air-pressure ranges and the shock damping is adjusted to position 3 or 4. The chassis is then free of any wobbles or twitches—although when the suspension is in its cushier modes you can provoke a mild rear-end wiggle by snapping the throttle closed or dabbing the rear brake.

Those soft settings yield a comfortable ride, though, that's at least as good as you'll get on any other Yamaha but not quite state-of-the-art like, say, on one of the bigger Suzukis. There's some choppiness

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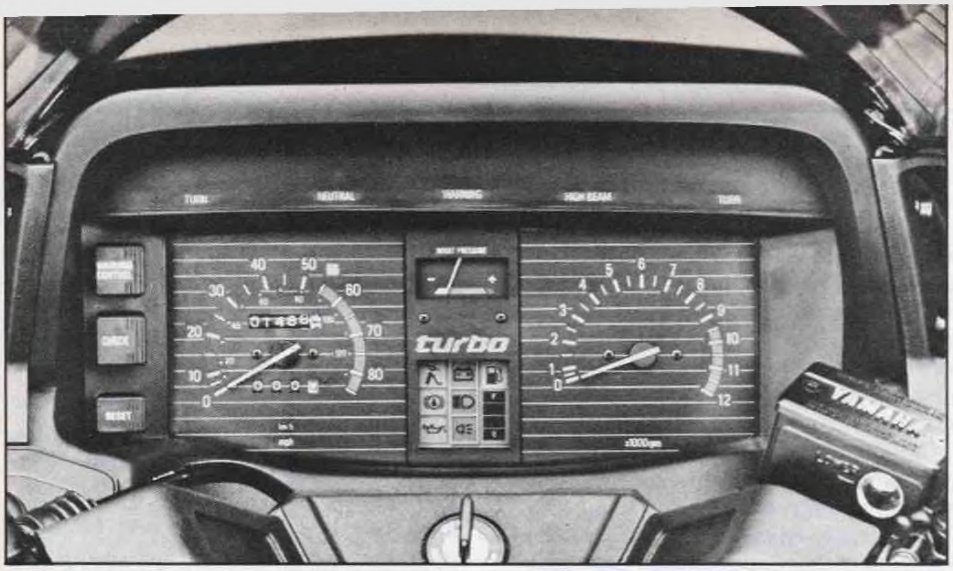

Instrumentation includes analog boost gauge and LCD systems-monitoring panel

Cozy cockpit for the Turbo's chief pilot.

evident when passing over uneven concrete-slab highways, expansion joints and other small-but-abrupt irregularities. Otherwise, the ride is smooth, non-fatiguing and complementary to the Turbo's role as a medium-range sport-touring device.

Neither is there much to snivel about with the riding position, particularly if you're less than six-feet tall. The elaborately styled seat is surprisingly comfortable and supportive on lengthy rides, and the all-important seat/peg/grip relationship feels as ergonomically right on this bike as it does on the Euro 650 from which it was lifted. Our longer-legged riders continually banged their knees into the rear of the full fairing, however, primarily when braking hard or riding two-up.

Aside from that complaint, and an annoying buzz that sneaks into the footpegs around 5000 rpm, there's little to intrude into the enjoyment of life aboard the Turbo. The wind-tunnel-designed fairing seems to part the air efficiently, evidenced by the bike's rock-steadiness in crosswinds and the rider's unawareness of any turbulence. The fairing is too narrow to offer any hand protection and too low to shield much of the rider's head, but there is no buffeting in those areas, just a steady stream of undisturbed air.

All in all, the ambience behind the fairing is cozy and cockpit-like, which seems to go hand-in-hand with the Turbo's starship styling treatment. Instrumentation includes a color-coded analog turbo boost gauge and an LCD systems-monitoring panel between the conventional tach and speedo. And two small, lockable compartments in the fairing provide storage space for gloves, maps, etc.

What subtracts from that cockpit coziness is that some of the fairing's numerous little pieces don't fit together well at all. And certain of those pieces—as well as some segments of the main bodywork—are inexcusably flimsy. Functionally, none of this is damaging; but it has led some people to believe that the Seca Turbo merely is Yamaha's quick-and-dirty reaction to Honda's Turbo. But that's not the case. For while it *is* likely that once the Honda hit the streets, the LJ's bodywork was rushed just to get the bike into production, the mechanicals are precisely what Yamaha intended all along. The company's engineers have been working with this basic turbocharging concept since early 1980, and their turbo technology dates back to 1970 when they did development work on a turbo for Toyota's 2000 GT car engine.

Thanks to those no-frills mechanicals, in fact, the Seca Turbo almost is the first turbobike to live up to the motorcycling industry's predictions for turbocharging made a few years ago. The promise back then was that middle-displacement turbobikes would be the performance wave of the future, the perfect way to get the best of two very desirable worlds—the light weight, maneuverability, fuel efficiency and simplicity of a mid-size bike along with, upon rider demand, the eyeball-squashing acceleration of something almost twice the displacement.

Aside from the part about go-fast performance, Honda's Turbo doesn't do any of those things. But even though the Yamaha isn't quite as fast as the CX, it handles much more nimbly, is just as fuel-efficient as the mid-size (and unblown) Euro 650 (our LJ got between 38 and 57 mpg) and, as we have seen, is demonstrably simpler than all of its competition.

That might not be a letter-perfect execution of the industry's projected One True Turbobike, but it's the closest so far. And until something else comes along that offers even less complexity, the Seca Turbo will stand as the industry's most *sensible* turbocharged motorcycle. One that also happens to be thrilling to ride, as well. •

Ride Review

• I appreciate simplicity in machinery. I've spent too many years turning wrenches not to. So for me, the real attraction of Yamaha's pressurized LJ is the clever way the turbo is used. The blend of naturally aspirated/boosted engine is a stroke of pure genius. From a maintenance and reliability standpoint, I can't help but applaud Yamaha's decision to retain, and work with, CV carburetion. The way I see it, just what we *don't* need is another computer-controlled technomarvel that forces you to choose between a mechanic or a TV repairman should trouble arise.

But this isn't to say that the LJ is perfect, because while I value simplicity I also value performance. Which means that I expect a turbobike to hit with a punch that would stun a mule. And this one doesn't. So simplicity aside, the bottom line is that this turbo isn't for me.

—Joe Kress

• I'll admit it. I love flash bikes as much for the flash as for the bike. And the Yamaha XJ650LJ Turbo is pure flash on wheels. Plus it has a bonus: It performs.

So with both flash and function, the Yamaha should be the perfect machine for me. But it isn't. And I'm not sure why. Maybe it's because I keep comparing the flash side of the LJ with the ultimate in dazzle—a Honda Turbo. When matched up close with the CX, the Yamaha looks plastic-shelled and dull. And when I think of the LJ as a performance machine, I compare it to a standard XJ650. The Turbo 650 may outrun an XJ on top, but the lighter non-hyperventilated 650 will tear the LJ a new exhaust when the road gets twisty.

I still can have fun on the Turbo, but when I see a Honda Turbo or a standard XJ on the road, I'll wish I had a lot of flash or a lot of bike—not a touch of both.

—Ron Lawson

• By all rights, the Seca Turbo should be up near the top of my list, since it's based on one of my favorites, the XJ650 Seca. But it's not. The Turbo is appealing in its own way, but any resemblance between the Turbo's Rocket Boy looks and the smooth, balanced styling of the XJ ends at the fact that each bike has two wheels and four cylinders.

Beyond that, how each 650 approaches street duty is as different as night and day. The normally aspirated Seca makes up speed in corners, while the Turbo—though not as top-heavy as the Honda CX Turbo—feels somewhat ponderous in the twisties. Not enough to keep you from going fast; just enough to make the straights seem more attractive. Call it plain pigheadedness, I won't argue. But a real turbocharged Seca, one without the slab-sided plastic, would suit me to a T.

—Larry Works

CYCLE GUIDE SPECIFICATIONS

Yamaha XJ650LJ Turbo — street

IMPORTER: Yamaha Motor Corporation USA, 6555 Katella Avenue, Cypress, California 90630

SUGGESTED RETAIL PRICE: $4999

ENGINE

Type . . . . . turbocharged four-stroke transverse vertical four
Valve arrangement . . . . . double overhead camshafts
Bore and stroke . . . . . 63.0mm x 52.4mm
Displacement 653.4cc
Compression ratio 8.2:1
Engine redline . . . . . 9500 rpm
Carburetion . . . . . four 30mm Mikuni constant-vacuum
Air filter . . . . . disposable pleated paper element
Lubrication . . . . . wet sump
Starting system . . . . . electric only
Ignition . . . . . transistorized breakerless
Charging system . . . . . 12-volt; 260-watt alternator, voltage regulator/rectifier

DRIVETRAIN

Primary drive . . . . . straight-cut gears; 1.672:1 ratio
Clutch . . . . . wet, multi-plate
Transmission-to-jackshaft drive . . . . . straight-cut gears; 1.361:1 ratio
Jackshaft-to-driveshaft drive . . . . . spiral-bevel gears; 1.056:1 ratio
Driveshaft-to-rear-wheel drive . . . . . spiral-bevel gears; 2.909:1 ratio

Gear	Internal gear ratio	Overall gear ratio	MPH per 1000 RPM
I	2.188	15.291	6.0
II	1.500	10.485	7.3
III	1.154	8.065	9.5
IV	0.933	6.524	11.8
V	0.813	5.679	13.5

SUSPENSION/WHEEL TRAVEL

Front . . Kayaba air-spring, 36mm stanchion tube diameter/5.6 in. (142mm)
Rear . . . . . dual Kayaba air-spring shocks, 4-way adjustable rebound damping/3.8 in. (97mm)

BRAKES

Front . . . . . dual single-action hydraulic calipers, 10.5-in. (267mm) discs
Rear . . . . . drum, single-leading shoe, rod-operated

TIRES

Front . . . . 3.25V19 Bridgestone Mag Mopus L303 tubeless
Rear . . . . . 120/90V18 Bridgestone Mag Mopus G508 tubeless

DIMENSIONS AND CAPACITIES

Weight . . . . . 541 lbs. (245kg)
Weight distribution . . . . . 46.6% front, 53.4% rear
Gross vehicle weight rating (GVWR) . . . . . 915 lbs. (415kg)
Load capacity (with full fuel tank) . . . . . 348 lbs. (158kg)
Wheelbase . . . . . 56.7 in. (1440mm)
Seat height . . . . . 30.9 in. (786mm)
Handlebar width . . . . . 27.5 in. (699mm)
Footpeg height . . . . . 12.8 in. (325mm)
Ground clearance . . . . . 5.4 in. (136mm), at turbocharger shroud
Steering head angle . . . . . 27.8 degrees from vertical
Front wheel trail . . . . . 4.53 in. (115mm)
Frame . . . . . tubular mild steel, double front downtubes
Oil capacity . . . . . 3.7 qt. (3.5*l*)
Fuel tank . . . . . steel, 4.2 gal. (16.0*l*), including 0.5 gal. (1.9*l*) reserve
Instrumentation . . . . . speedometer, odometer, tripmeter resettable to zero, tachometer, turbo boost gauge, LCD fuel gauge, LCD monitoring system

PERFORMANCE

Fuel consumption range . . . 38 to 57 mpg (16 to 24 km/*l*)
Average fuel consumption . . . . . 48 mpg (20 km/*l*)
Cruising range, maximum . . . . . 160 to 239 miles (257 to 389km)
Cruising range, reserve only . . 19 to 29 miles (31 to 47km)
Speedometer error, 30 mph indicated . . . . . 28 mph actual
Speedometer error, 55 mph indicated . . . . . 51 mph actual
Best 1/4-mile acceleration . . . . . 12.610 sec., 104.65 mph (168 kph)
Top speed (observed) . . . . . 126 mph (203 kph)
Stopping distance from 30 mph . . . . . 34 ft. (10m)
Stopping distance from 60 mph . . . . . 145 ft. (44m)

WARRANTY: 6 months unlimited mileage

AVAILABLE COLOR: silver only