



TOYING WITH YOUR TOYOTA

STORY NINO D'MONTARN + PHOTOS GUY BOWDEN

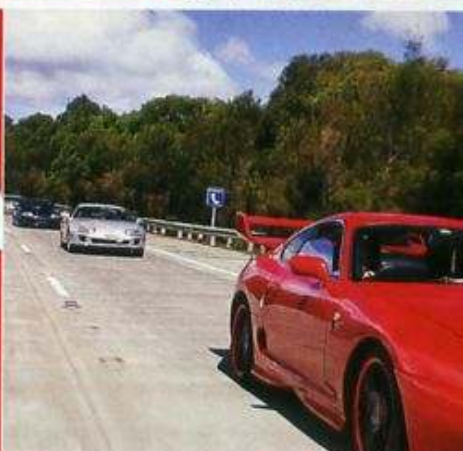
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TOYOTA 1JZ/2JZ

TUNING GUIDE

For factory bolt-on upgrades, few power plants outgun Toyota's 1JZ and 2JZ twin-turbo engines



IT'S a close run and oft fought argument: which Japanese hero engine has the most grunt, gives the best value, and can take the most power-up potential in stock form? Is it Skyline's RB26DETT or Toyota's 2JZ-GTE? While the Skyline has the numbers in Australia, further north across the Pacific, very few performance cars can keep up with a 2JZ-GTE-powered Supra, under either bolt-on or full-tilt modifications.

Such is the potency of the Supra's three-litre straight-six engine that it's possible to generate 10-second 0-400m runs from a correctly massaged Supra without touching engine internals. It's this bulletproof construction and responsiveness to enhancement that has not only established the Supra in the US, but has also seen a recent groundswell in Australian support.

A close relation to the three-litre 2JZ is the twin-turbo 1JZ found in Toyota/Lexus Soarer and Chaser series of

sedans and coupés. With near identical internals and design, the 1JZ gives away 500cc of capacity to the 2JZ, bringing its total to 2500cc, via a shorter-stroke crankshaft, while retaining enough output potential to be regarded as one of Japan's best. Wringing 450kW from an internally stock 1JZ is not ruled out.

Why is the 2JZ so good?

WHAT, then, makes these factory Toyota engines so durable? It's a case of everything being done right straight from the drawing board, during a period in Japanese car making when performance road engines were over-engineered for strength and durability, therefore providing key raw material for either competition use or modification potential. With their turbocharged straight sixes during the '90s, Toyota refused to cut corners at any stage of their development.



The basic 2JZ engine has a square layout, with a bore/stroke ratio of exactly 1:1. Its measurements are 86x86mm, giving 3000cc capacity, with a geometry identical to the much revered and super-expensive OS Giken three-litre race GT-R engine. The block casting itself bears no inherent weaknesses and, being made of cast iron, is superbly strong, if a little heavy.

Toyota have compromised the ability of the 2JZ engine to rev much beyond 9000rpm with this layout, endowing it instead with potential for excellent low-rev torque. This may well have been a requirement of the US market, used to driving large-capacity V8s, and one that Toyota was eyeing off when it first designed the 2JZ.

Comparing the 2JZ to its firmest competitor, the RB26DETT, we spoke to Peter Hall from Willall Racing, who are behind Kier Wilson's record-breaking B.84-second three-litre RB-powered GT-R. "[In a 2JZ] everything

looks like a bigger version of a GT-R part. Especially the con rods. I was impressed, but feel that the 2JZ pistons might suffer under high loads as they don't have a [built-in] cooling channel like an RB26DETT.

"Some of the 2JZ layout makes more initial sense, like having the shims for the solid lifter valve actuation on the top of the bucket [makes adjustment a comparative breeze]. Then, there's the cylinder head itself. Initially, it probably [looks] not as good as a GT-R head, but there seems to be plenty of porting potential," Peter explains. He is correct, as some Japanese tuners use the Yamaha-designed 1JZ cylinder head on the 2JZ [resulting in a 1.5JZ] due to the latter's better overall flow capabilities.

"Other really good things about these Toyota six-cylinders are the small touches, like having a steel-shim head gasket from the factory. I can't see any way that you could blow one and, when you upgrade the engine,

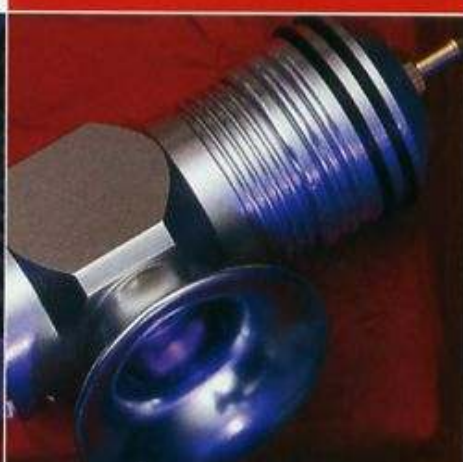
it's really something you wouldn't need to change. Then, there's the fasteners: typical high-quality Japanese ones, very similar to the Nissan stuff." Time for a change of camps over to Toyotas then, Peter? "Not at this stage. In my opinion, the RB26 still shows a more focussed race engineering approach, with the Toyota is closer to a conventional but extremely good road engine."

Who knows?

EXPLORING the limits of Australian 2JZ and 1JZ development led us to talk to the following tuning companies [in alphabetical order]: Advan Performance Centre, BD4s Motorsport, Boostworx, Croydon Racing Developments and Morpowa Auto & Dyno. Each of them has parts to improve either of the Toyota power plants, with most offering solutions ranging from a simple part upgrade through to full-house engine development.



Toyota's 1JZ and 2JZ straight-sixes respond instantly to tried and true filter-and-exhaust upgrade. As a base entry level, a couple of grand buys you around 15-20 kilowatts for a cheap and easy instant gain. Add ECU/boost control mods to up the boost from 0.5-0.6bar to around 1bar, yielding up to 50kW extra at the tyres over stock



STAGE

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UP TO \$5000

GETTING the basics right on the Toyota six-cylinders will net some decent gains as all of the tuners here show. Stage one development centres on the bolt-on performance areas of management, filters, and exhausts. However, all of the tuners are wary of putting too much boost through the factory Toyota turbochargers, as they are prone to failure above 1.0bar of boost (1JZ and 2JZ engines run 0.48bar and 0.62bar maximum boost respectively as standard).

Avan Performance Centre: \$1450 incl. labour

Rationale: "It's a simple upgrade," Peter Hopkins from Avan explains. "We address the stock issues of restriction with a pair of tried and tested TRUST parts that give a guaranteed power gain."

Parts: TRUST cat-back exhaust system, TRUST air filter

Time: While you wait

Performance gain: 15-20 rear-wheel kilowatts on either 1JZ or 2JZ

BD4s: \$5000 incl. labour

Rationale: "Improving the intake volume with reduced restriction in the exhaust" is what Toyota six-cylinder upgrades are all about to Tony Dunn from BD4s. "Combine our parts with an HKS EVC electronic boost controller to stabilise the stock boost curve (and give scope for further modification at stage two level), and the power increase will be exceptional."

Parts: HKS SPF Air Filter Kit, HKS front pipes, HKS Silen Hyper Exhaust system, HKS EVC boost controller

Time: One day

Performance gain: BD4s are confident that, with these modifications, anywhere up to 220 rear-wheel kilowatts from the 2JZ and 200kW from the 1JZ is achievable.

Croydon Racing Developments: \$4800 incl. labour

Rationale: "The 2JZ is heavily restricted in stock form," Jim Souvas from Croydon tells us. "The secret for good numbers comes from removing these restrictions, but not over-stressing the stock turbochargers and inter-cooler. Our stage one should see a manual 2JZ into the high 12-second zone, and the 1JZ not far behind."

Parts: CRD full stainless cat-back exhaust system, CRD pod filter assembly, turbo boost pressure upgrade (1.0bar), Unichip piggyback computer

Time: Two days

Performance gain: Jim reckons the 2JZ can give varying power in stock form, but says that "a decent manual 2JZ should give 180 rear-wheel kilowatts and, with our stage one in place, the power should climb closer to 230kW."

Morpowa: \$4950 incl. labour

Rationale: Morpowa's Simon Podlewski believes these engines' biggest let-down is their management system. "You just can't chip them from factory. So, for the manual cars, we use an A'PEXi Power FC plug-in computer for full tuning control, upgrade the exhaust system, and modify the stock cold air box. It's all in the fine-tuning as, if you run too much boost, the ceramic turbine wheels delaminate and fall off into the exhaust system. Not good."

Parts: A'PEXi Power FC engine management system, cat-back stainless steel exhaust system, cold air box modifications, panel filter insert

Time: Two days

Performance gain: "We have seen anything up to 225 rear-wheel kilowatts from a stage one upgrade on a 2JZ Supra, and 210kW from a manual 1JZ-equipped Soarer." But Simon tells us "both of these cars were kept on below 1.0bar boost to keep the stock turbos alive."

Hot links

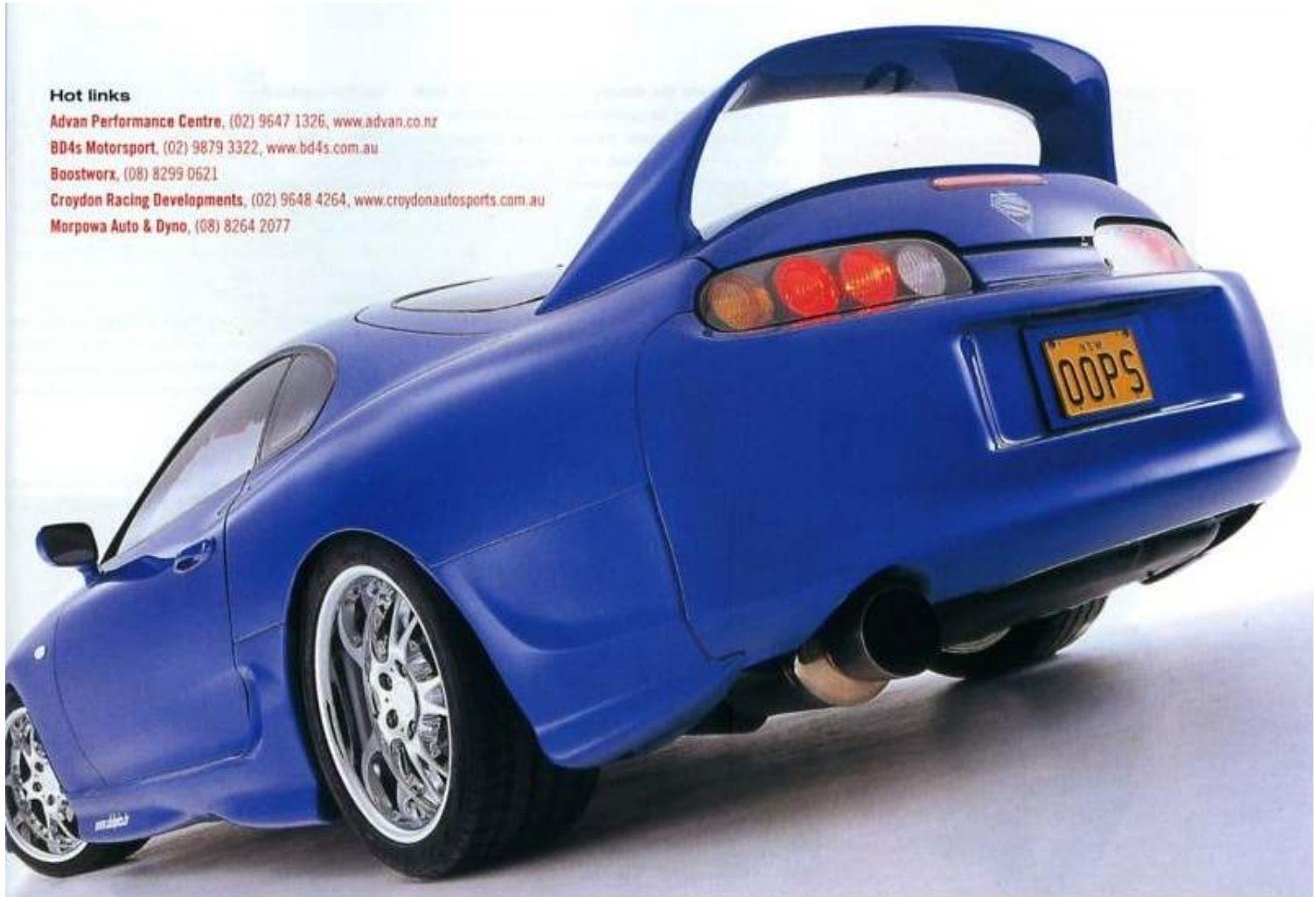
Advan Performance Centre, (02) 9647 1326, www.advan.co.nz

BD4s Motorsport, (02) 9879 3322, www.bd4s.com.au

Boostworx, (08) 8299 0621

Croydon Racing Developments, (02) 9648 4264, www.croydonautosports.com.au

Morpowa Auto & Dyno, (08) 8264 2077



Single vs twin

A LOT of aftermarket turbocharger upgrade kits for the 2JZ and 1JZ engines replace the stock twin turbocharger system with a big single one. Sounds odd, really, going back from two turbos to one, but the reality is that there are some very good reasons to go the single turbo route with these engines.

Reduced parts count is the first and most important reason. Twin-turbocharger kits require two of everything, from turbochargers through to wastegates, and all of the associated plumbing and fluid feeds. They are way more expensive than their single-turbo counterparts but, in a lot of cases, can offer a substantial performance increase due to smaller overall size, which helps the twin-turbo kit come onto boost lower in the rpm range.

Having excellent exhaust flow properties, the 2JZ and 1JZ can overcome some of the inherent lag of a single turbocharger, and give even big turbines a sprightly boost response. A good example of this is the massive turbochargers chosen by Japanese tuning shops as street turbos. It's nothing to see a TRUST T88 single-turbo strapped to the side of a 2JZ in a daily-drive situation. It's bloody surprising, though, when you drive the car, and its boost response is perfectly acceptable.

Being smaller in capacity, such a large single turbocharger on the 1JZ might not be an entirely recommendable idea. The HKS 3040, TRUST T67, and Apex RX6 all become popular turbocharger choices, then, but power remains firmly capped at no more than 350 rear-wheel kilowatts, which is plenty for most applications.

STAGE

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UP TO \$10,000

THIS is where the factory turbochargers on both engines need to be replaced with more durable and power-productive units. It's not a cheap process, due to the hardware involved, but it's here, in stage-two form, that the Toyota engines can really start to show their true potential.

BD4s: up to \$10,000 incl. labour

Rationale: "Once we have the foundations of stage one in place, there is plenty of scope for further development," Tony tells us. "We get colder air into the engine with an uprated intercooler, install an additional HKS engine management computer, then improve total throughput of the engine with a set of camshafts, complete with adjustable cam gears." While there is an HKS turbo kit for the 1JZ-equipped Chaser, Tony said the 2JZ units were more expensive and BD4s would need customer consultation before starting work. "It's up to what the customer wants," he explains. "We can fit US turbos or re-work local turbos to suit, but the HKS Supra kits are over \$10,000 to buy."

Parts: HKS Type S intercooler kit, HKS Step I camshafts with HKS adjustable camshaft gears, HKS F-CON SZ computer

Time: Two to three days

Performance gain: "We will see around 260-280kW at the wheels from a typical stage two," says Tony. "Obviously, the 1JZ makes a little less, but either of these engines is now a really good thing to drive with our stage two in place."

Croydon Racing Developments: \$9800 incl. labour

Rationale: Jim is adamant that you need "more boost, for more power and better management of the thermal side of the engine. Cooling becomes important, here, but

fuel flow needs to be looked at as well. In stage two guise, the big Toyotas start going strong and are capable of low 12-second timecards. That's pretty good from these big, heavy cars."

Parts (assuming stage one already in place): CRD Front-Mount Intercooler Kit (13cm thick), Toyota high-flowed CT12/CT12A (US-spec) turbochargers fitted with steel turbine wheels, Unichip boost control upgrade, uprated fuel pump assembly

Time: One week

Performance gain: "I would like to think that, with our stage two, the 2JZ engine power would be close to 400kW. They make 280-290 rear-wheel kilowatts, which is enough to give them pretty severe traction problems. Good fun to drive, though."

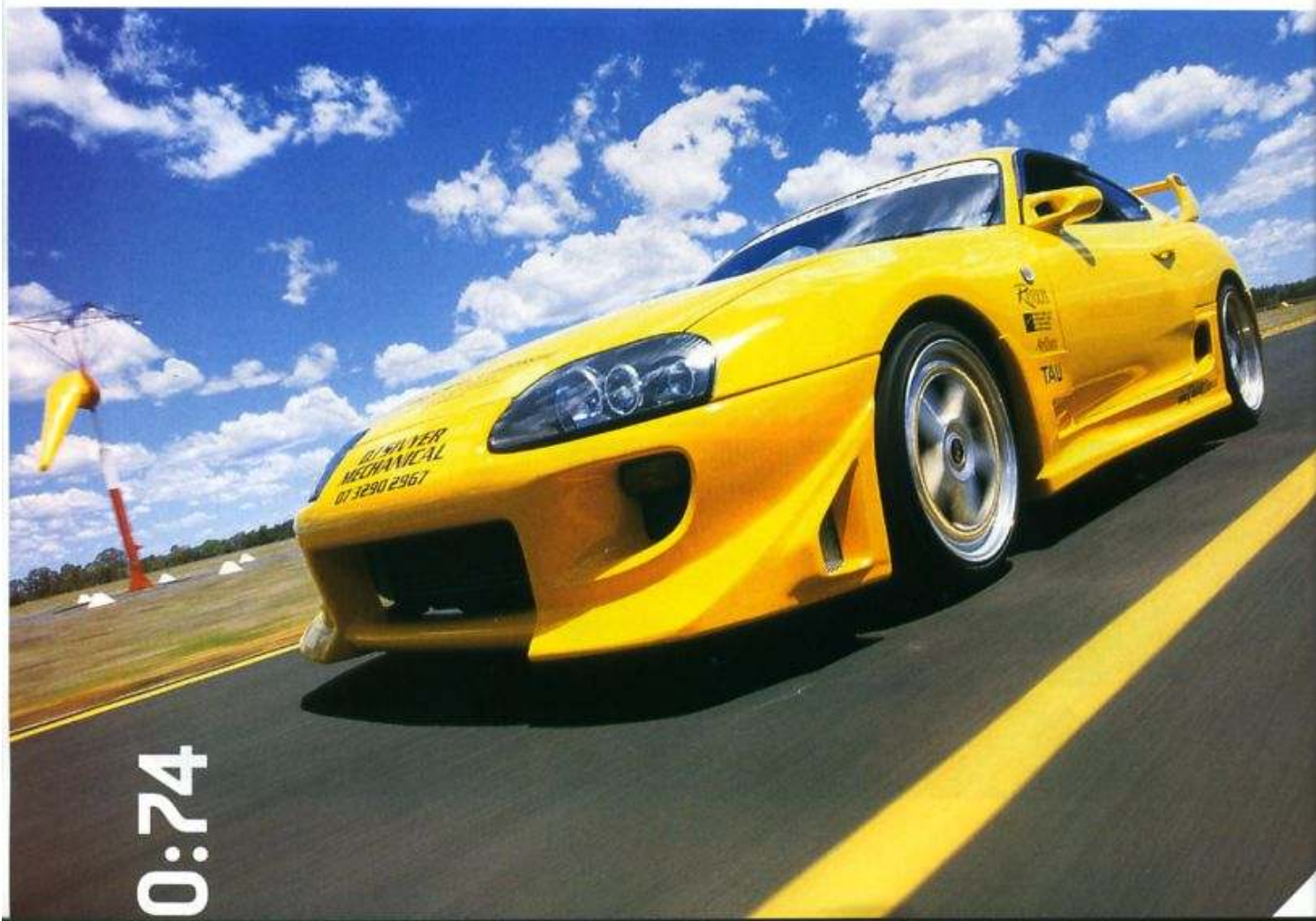
Morpowa: \$9500 incl. labour

Rationale: "The Americans had a better 2JZ package than us," Simon reckons. "They had better steel-wheel turbochargers with bigger exhaust housings, and larger fuel injectors. A lot of our stage-two power upgrade then consists of getting the American parts on the engine, plus some of our own, to give the gains. We also change the 1JZ turbochargers over to the steel-wheel type."

Parts (assuming stage one already in place): High-flowed US-spec steel-turbine factory turbochargers, US-spec 550cc fuel injectors, uprated fuel pump assembly, front-mount bar-and-plate intercooler

Time: Two weeks

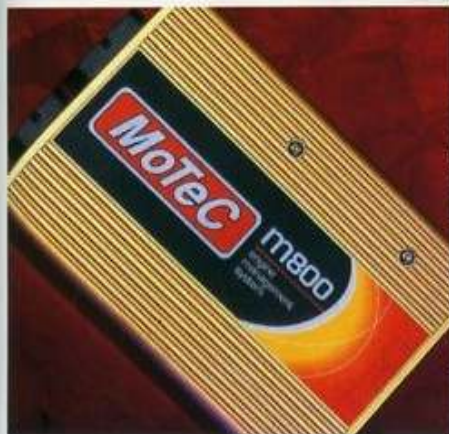
Performance Gain: Simon is enthusiastic about the power gains of his stage two with near-stock underbonnet performance. "Lifting the lid on our stage two car, you won't notice it's modified. Give it some throttle, though, and the 2JZ should make 280 rear-wheel kilowatts at 1.4bar boost, with the 1JZ close to 240kW"



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Left: The difference between stage one (200-220 rear-wheel kilowatts) and stage two (approx. 280 rear-wheel kilowatts) is largely down to intercooler, fuel and turbocharger upgrading. While aftermarket turbochargers have boosted many internally stock 1JZ/2JZ engines, it's worth noting that BDAs, CRD and Morpowa all recommend US-spec (bigger steel-turbine) factory Supra turbos for their stage-two packages



STAGE

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\$10,000 AND OVER

SERIOUS power, jaw-dropping 0-400m times, and high-level excitement live up here in stage three zone. While retaining the stock internals is quite possible at power outputs close to 500kW, most of the tuners recommend a full hard-tuned rebuild when chasing extreme horsepower, with both Boostworx and Croydon Racing Developments replacing the highly durable factory pistons and con rods.

Of course, if you're chasing 500-plus kilowatts of output, engine costs are not the only thing that skyrocket. Making proper use of such power – while keeping you and your Supra in one piece – will require an open-chequebook approach to chassis, driveline and safety upgrades, in preparation for the most insane Supra package.

Advan Performance Centre: \$18,280 incl. labour

Rationale: "Big turbochargers make these Toyota engines come alive," according to Peter. "But we don't go overly huge, as a stage three package should still be perfectly street-driveable. The customer has an option with us: either go the T78 smaller TRUST turbo for bottom-end grunt, or the big-mother T88 for all-out power. Both options work really well."

Parts [additional to stage one]: TRUST T78 or T88 complete turbocharger assembly, including turbo, manifold and wastegate, TRUST front-mount intercooler kit, TRUST fuel injectors, TRUST E-Manage engine management computer, TRUST fuel pump and regulator, TRUST oil cooler kit

Time: One week

Performance gain: "The T78 will make plenty of torque and top the engine out at around 350 rear-wheel kilowatts, which is plenty. The T88 will go well beyond that. At this stage, we believe the stock engine internals to be

well strong. The 1JZ engine is my favourite and most durable while the 2JZ can make good power, but you should not rev over 8000rpm unless you can afford it. A top engine can make in excess of 550kW at the wheels but this package would cost more than \$40,000."

Boostworx: \$35,000 incl. labour

Rationale: Sean Duns from Boostworx doesn't need to say too much. He has already put together a Supra with 500kW of power, and put it down the quarter-mile in a staggering 10.8 seconds. But he does give us some comment. "These engines are really excellent but, at these power levels, it pays to have some experience with them. We believe our stage three to be virtually bulletproof and, as you can already see, it's run some impressive numbers," he says.

Parts: Garrett GT42/45 600kW turbocharger assembly, high-lift camshafts, 950cc injectors, Boostworx competition camshafts, full cylinder head porting – complete with new valves, springs, retainers, forged pistons with custom I-beam rods, prepared crankshaft, TRUST head gasket, uprated fuel system with two Bosch D44 fuel pumps and surge tank, front-mount intercooler, straight-through exhaust system, Microtech engine management, and wiring

Time: Four weeks

Performance gain: "In testing, we have found it's very easy to get 400kW at the wheels from these engines. There is still plenty more left in our stage three, and we know that, with the levels we have gone to, we can get over 100kW more power reliably."

Croydon Racing Developments: \$20,000+ (POA)

Rationale: Being a JUN authorised importer, CRD unsurprisingly use a lot of this Japanese hardware in their big-

gun 2JZ engines. Jim is very fussy about turbocharger selection, though. "When switching to a big single turbocharger, I use either the HKS T51R SPL or the TRUST T88H-34D. Both of these will give our anticipated power levels of 600kW plus, while still remaining driveable. We change the factory internals once the customer decides that over 600kW at the engine (around 480 rear-wheel kilowatts) are required."

Parts: HKS T51R or TRUST T88H-34D single turbocharger system including turbo, manifold and external wastegate, 1000cc fuel injectors, complete fuel system, custom intake manifold, JUN camshafts, springs, retainers, CRD cylinder head porting, 100mm single-exhaust system, oil pump upgrade, CRD forged pistons and upgraded con rods, remote oil cooler assembly, MoTeC engine management system

Performance gain: "It really depends on what you want," Jim says. "If you put one of our stage three engines into a well set-up drag race car, then very easy nine-second passes are there for the taking. With boost being the limiting factor in regards to power, there should be upwards of 600 rear-wheel kilowatts on offer before the big TRUST turbo runs out of power."



Left: Above 400kW at the flywheel (or roughly 300 rear-wheel kilowatts), internals will need replacing and costs skyrocket. With most companies here, about \$20K gets you 350 big ones, and add another ten grand for 400kW at the tyres, or shell out a cool \$40K for a whopping 550kW+! None of this accounts for upgrades required for the transmission, driveline, brakes, wheels/tyres, rollcage, consumables, life insurance...



Driveline strength

LIKE most other parts, the drivelines in Supras and Soarers running 2JZ and 1JZ engines are well engineered and reliable. Not to say that you can't break them with too much power or too much abuse (or both). But treated kindly, they are sure to last.

The weakest point in these cars would have to be the automatic transmission. Like most production autos, the Toyota (Aisan) transmission doesn't like being overheated or over-torqued. Clutch failure and general internal calamity are the result. Kits are offered in the US from sites such as www.suprastore.com that allow additional torque

loading and extend transmission life. But shop wisely and look for customer testimonials before spending.

Manual 'boxes last a tad longer, unless you have a 1JZ engine with the R154A five-speed behind it — prone to sudden failure at anything over 250 rear-wheel kilowatts. The best, if you can afford a \$5000+ second-hand one or if you're lucky enough to have one fitted from the factory (RZ Supra only), is the Getrag six-speeder. Only a clutch upgrade is needed for it to handle 400 rear-tread kilowatts and beyond.

The factory Torsen-style limited-slip differential found in these cars is also fairly durable, but will not stand the abuse of constant drag strip launches.

If running good times is the order of the day, then invest in a mechanical differential centre, available from OS Giken, TRD or KAAZ. They aren't cheap (around \$2000, depending on brand and model) but they do provide peace of mind.

Stopping all your newfound power can be a problem, even with the factory four-piston Supra RZ brakes. There are plenty of aftermarket kits available, though, with Brembo, AP, and Alcon all having straight-fit upgrade kits for the JZA80 Supra. If you drive one of those Soarers with tiny rotors and discs, a conversion to RZ four-spotters is simple. All you have to do is find some.