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Our M3's motor is alive





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ON THE COVER: One of Les Bidrawn's favorite hangouts, the Streets of Willow Springs, hosted our überGolf Challenge, and he was there to catch the hot hatch action.

or Con 1995 at 1995 64799, October 2004 VM, 25, No. 11, Corposite 2004 to PRINCEIA Specialty Group, Inc. All rights received, Published monthly by PRINCEIA Specialty Group, Inc. 6420 Whitein Bridg. Los Ampeires Co. 450040. Periodical PrinceInc. CA 1995 VM of a statistical making place for 1 year (12 countries) and a statistical making place for the countries of the countries of

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ong before the first Honda was fitted with a 4-in. tailpipe, cut springs and questionable aerodynamics, Volkswagen's Golf was the weapon of choice. The whole thing actually started when a group of German engineers started tinkering with a Rabbit after hours, giving it a tighter suspension, more powerful engine and more aggressive gears. Thus was born the Rabbit GTL

More than three decades have passed since a whole new category of car was formed—that's a lot of tire smoke under the wheelwell—and Volkswagen has continuously developed the Golf, culminating in the R32, the zenith of the badge's development. Although the R32 is a far cry from the first 81-bhp GTI, its heart is in the same place—a car built by enthusiasts for enthusiasts. european car has seen thousands of modified Golfs in guises too numerous to enumerate. Here

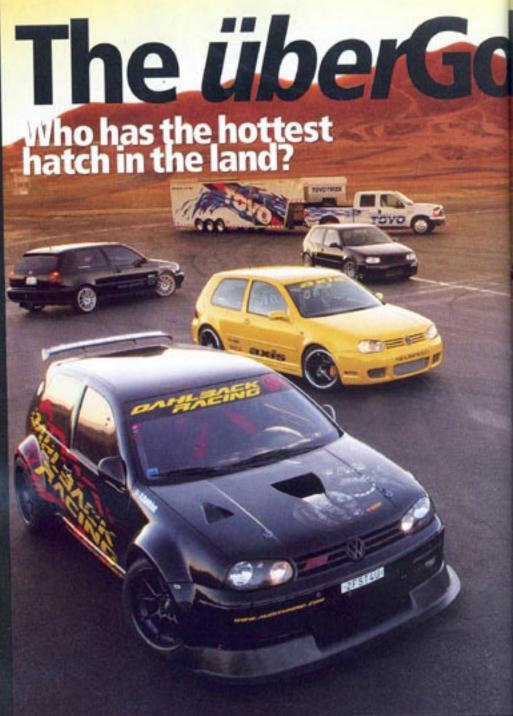


in the U.S., it pretty much started with Neuspeed and its Thunder Bunny project car, followed by our own "Millionizing the Rabbit" turbo series put together by James Sly. The bar was set incredibly high early on, ensuring there would be a demand for high-quality parts to make Volkswagens more fun to drive for years to come.

It begs the question, though: Why the Golf? What makes this car so special, and why do folks spend countless time and money modifying them?

Perhaps it's the fact the Golf is something of an "everyman's" car, a vehicle for the masses that is nevertheless far better than the average commutermobile. Its utility has made it one of the world's most ubiquitous cars—several million on the road serve as rolling testaments. And transforming the common into the extraordinary is a big lure. Who doesn't like trouncing the occasional BMW or Porsche in a so-called econo-box?

We thought it might be fun to throw a



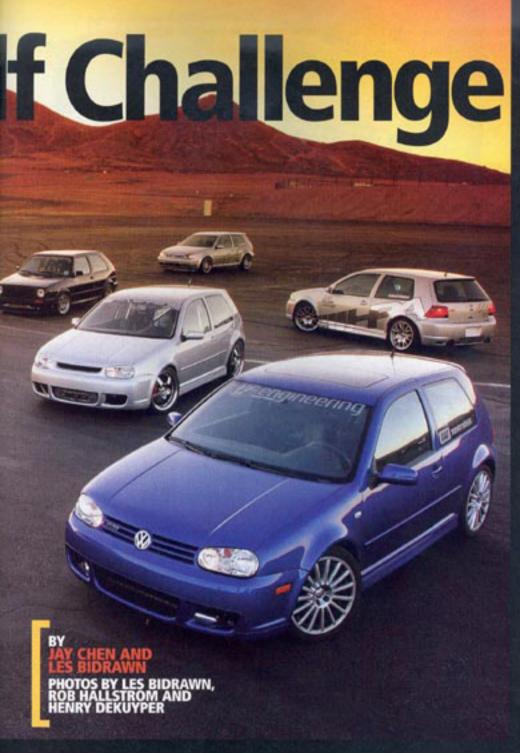
few Golfs in the ring and see what happened. Is the R32 the *über*Golf, king of the hatches, or will some lightweight, fwd upstart assume the throne?

For those who caught our 911 twinturbo shootout in the April issue, this was basically the same program. Four tests, each test awarded a specific number of points. Points were awarded based on a car's performance relative to the best and worst performances, so no matter how close the field really is, it spreads out in the scoring system.

Like most connected VW fans, we scan the forums at www.vwvortex.com. Lots of guys have really big "virtual muscles" on the Vortex, so we thought it might be prudent to call them on it. We started with 18 cars, a few of which promised to be in excess of 700 bhp and capable of 11-sec. 1/4-mile times. A week before the competition, that number was halved, victims of their own excesses —or they were always just mere figments of overactive imaginations. Maybe a few of these cars don't even exist. In any case, the lot you see here is a tough bunch and went through hell—almost literally.

Drag Strip

Unlike our previous challenges, we hit the pavement running and did our drag and track testing first. The inferno started at 7 a.m. Tuesday morning at a place called Los Angeles County Raceway, a pit so ghastly the devil himself won't run



his car there. Despite numerous phone calls and e-mails, the gate to LACR was locked upon our arrival, leaving 40 guys choking on diesel fumes from the trucks climbing out of a nearby gravel pit. As

UBER

temperatures rose to the mid 80s, we jumped the fence to find "Frank," an employee of LACR. Frank lives in a container with his dog Happy, a pit bull with an affinity for human flesh, and as we approached Frank's digs, Happy charged, causing engineering editor Chen to drop into the fetal position with both hands on his jewels. A little small talk and a piece of beef jerky for Happy, and Frank unlocked the gate so we could get started—sort of.

Vik Kazanjian of Eurosport drew first in the testing order and after a few quick burnouts was ready to roll. By now it was 9:45 a.m. and 89°F. Vik's first run was brilliant, what we could see of it anyway. At the 100-ft mark, the car was completely lost in a cloud of dust. We were worried he might not find his way back. Calling LACR a hellhole is an insult to hell. Yeah, it's hot in Hades, but I'll bet the pavement is better and the gates are always open. We won't be back.

In an effort to reduce outside variables, we enlisted Toyo and its vaunted RA-1 as the spec rubber. The RA-1 resides in the upper echelon of the tire



world and has few peers in terms of performance. Moreover, it's readily available in popular VW sizes. See the sidebar for details on the Toyo RA-1.

Once again we called on the services of pro-driver Kevin Schrantz, who offered his formidable skills to interested contestants. If you were to design a race-car driver from the ground up, chances are you'd wind up with something that resembles Kevin Schrantz. Standing about 5 ft, 9 in, tall and whip-cord lean, Schrantz resembles a model in the Orvis Outdoor catalog (that's actually not too far from the truth; Schrantz is also a seasoned fly-fishing guide). Schrantz has driven both Audis and Volkswagens in touring car series and has recently been driving for VW's Haagestad Racing Team, and his feedback during our testing was invaluable to our challenge.

Road Course

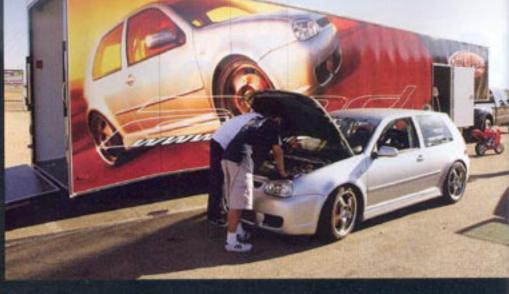
The Streets of Willow Springs (Rosamond, Calif.) was chosen for the road course section of the competition. It's a technically challenging track with lots of elevation changes, a high-speed front straight, decreasing-radius turns and series of tight curves. The Streets would be a challenging test of chassis balance, brakes and the engine, especially as the temperature eventually rose to an unbalmy 102°F. Because of the dreadful conditions at LACR, we added an additional 1/4-mile straight to the course, the idea to perhaps salvage the accelerative part of the testing. By the end of the additional section, a few cars were hitting 150 mph before hard braking for a tight right turn.

There's no doubt Kevin is fast. A few drivers tried piloting their own cars but were seconds off Kevin's blistering pace. But what is especially impressive was his machine-like consistency. Kevin's times for each car were all within tenths of a second of each other, and his lines as recorded on the Racepac system were virtually identical. We had this guy out there in the heat and dust for 6 hours straight. He did not sweat, complain or request a lunch break. You'd swear he's a racing cyborg—only a machine performs like this.

Dyno

The dyno portion of the testing was performed at GIAC (Irvine, Calif.), where its four-wheel Mustang chassis dyno was prepped and ready. The GIAC dyno uses a combination of inertia (inescapable due to the mass of the rollers) and electrical resistance loading. The time required for a pass and the resistance offered by the dyno are determined by the Mustang's software, partly using factors entered by the operator. Unlike most four-wheel-drive dynos, the Mustang's front and rear rollers are mechanically linked, so they turn at the same speed. There was no problem managing front-to-rear torque splits even with electronic traction aids.

Garrett and Andrew of GIAC did all



the hard work of strapping each car to the dyno but left its operation to us; that way no one could claim bias, as GIAC had tuned several of the competitors. We like the GIAC facility for several reasons, the most significant being the folks who work there. Although Garrett



is a certified medical physician, he's chosen cars as a career path. These guys love what they do, and it shows. Plus, GIAC software kicks ass. Just ask Bidrawn what he thinks of his Stage II VFE supercharger and GIAC ECU.

A new record was set at GIAC in terms of horsepower when Dahlback Racing's SuperGolf turned the big wheels to produce an earth-turning 586.9 whp. Not too bad for a Golf.

Despite the heat, dust, sweat and heat, not a single car malfunctioned. No blown turbos, no boiling radiators, just a dogged determination to soldier on. We consider each of these cars champions, not just for showing up but also reminding us just how good the Golf is. Read on to see how the chips fell.

Toyo RA-1: A Special Spec Tire

Known for its use as the official spec tire for the Speed World Challenge Series, the RA-1 has been a favored choice for weekend racers. The RA-1 is designed

racers. The RA-1 is design for touring and autocross racing and comes with a directional 8/32-in-deep tread pattern, which can be shaved down to 4/32 in. A two-ply rayon casing construction is used along with steel wire-reinforced sidewalls to improve handling characteristics and also increase the thermal stability and heat resistance of the tire. A large range of sizes is available between 13-and 18-in, wheel diameters with an UTQG

treadwear rating of 40/A/A.



überGolf Acceleration and

To help keep all of our contestants in the running for as long as possible, we conducted the überGolf dragstrip and track competition before the dyno day. We still had our share of breakdowns, but thankfully nothing catastrophic occurred.

The track day started bright and early at Los Angeles County Raceway (LACR) in Palmdale, Calif. At 2,700 ft. above sea level, the quarter-mile times posted would ill reflect what each car is truly capable of



1.0229 for trap speed and is derived from a linear relationship based on altitude. It makes sense, since the ideal gas law is linear.

To add to the frustration, LACR is in middle nowhere desert and is perpetually covered in dust. It also concrete a launch surface for the first 100 ft and is not consistent with the rest of the asphalt on the strip. By the time each car reached the actual asphalt, they were well into second gear, but you still could hear the engines bog from the sudden increase

in traction. From there on, the rest of the run was pretty good. Of course, this was after the Eurosport car had the misfortune of clearing off the track dust since it was the first to run.

gave each group the option to drive their own cars or to have Kevin Schrantz do the driving for the 1/4-mile. Most opted to do their own driving. Each driver was given a chance to acquaint themselves with the launch surface with a practice pass, and then perform only

three measured passes in a row regardless of how well the vehicle was launched. There were no do-overs.

Without doubt, the R32s launched the best, but the surprise came from the MkII: It set the highest trap speed of 122.6 mph with a launch that more resembled a burnout. The 1/4-mile scoring was allocated between the fastest and slowest e.t., with 100 points assigned to the fastest and 10 to the slowest. All other scores were rated proportionately according to that scale. Since this was not an all-out horsepower war, no scoring was given to the trap speeds nor to the 0 -to-60-mph times because of the inconsistent surface.

All 80-to-0-mph braking was performed with Kevin Schrantz at the wheel. We allowed each vehicle to brings its tires up to temperature and then performed the brake testing with three back-to-back passes. Usually the first or second pass vielded the shortest distances; brake temperatures started creating fade by the third



run. The shortest distance for each car was given points distributed in the same way as the acceleration run, with 100 points going to the shortest distance and 10 to the longest. In the case of the Billy Tylaska and Eurosport cars, the lack of ABS made for some squirrely and smoky stops, even on the RA-1s. Dahlback, not to be outdone, decided to start the breaking from 130 mph. Getting there was not a problem. The initial bite from the banquet plate-size rotors and Alcon calipers made the car look more like it was doing a burn-out off in the distance instead trying to stop as it barreled toward us at 130+ mph. Surprisingly, the VF Engineering

HPA R32	12.65	
/F Engineering	13.29	
Eurosport Accessories	13.67	
Tylaska	13.75	
APR Global Motorsport	13.99	
Dahiback Racing	14.09	
AXIS	14.54	
ABD	14.74	
HPA GTI	14.9	

lylaska	122.6	
Dahlback Racing	120.6	
HPA R32	112.6	
Eurosport Accessories	106.2	
APR Global Motorsport	104.9	
VF Engineering	193.3	
AX05	98.9	
ABO	98.4	
HPA GTI	98.3	

at sea level. Considering that all the cars were force inducted with either a turbocharger or centrifugal supercharger, we felt it fair to apply the NHRA correction factor for altitude compensation. This way, there would be no correction dis-

crepancies between NA and positive-displacement contestants, since all of the cars were equally affected. Time slips that you might have acquired at a dragstrip usually use these NHRA correction factors, a coefficient multiplied to the measured e.t. and trap speed to get the equivalent sea-level values. Palmdale's correction coefficient is 0.9761 for e.t and

VF Engineering	204.6	
HPA R32	205.7	
AX05	209.5	
APR Global Motorsport	217.6	
ABD	221.8	
Eurosport Accessories	233.0	
Dahlback Racing	243.4	
HPA GTI	250.9	
Tyleska	252.7	

überGolf Dyno

Day two, at the dyno: Everyone arrived tired and roasted from the sun. We arranged to perform the dyno runs on GIAC's facility in Irvine and to use its Mustang dyno model MD-AWD-500. This is an eddy-current all-wheel-drive dyno that features a drive belt to link the front and rear rollers. This is one of the few dynos that can simulate wheel rotation on all wheels and not cause traction control issues on some of the more complicated cars.

All the power is fed to a massive power absorption unit (PAU) directly connected to the primary drive rollers. The PAU is like a large electric motor that runs on eddy current instead of direct current and generates mechanical resistance on the rollers. This PAU is capable of absorbing more than 900 whp.

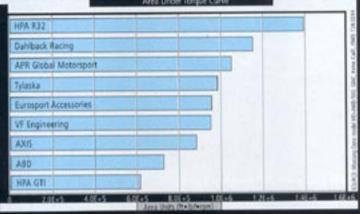
The rules were simple: three pulls, intercoolers could be hosed down before the first run, and coolant temperatures had to be at normal at the start of the run. Between pulls, the car was left to idle and circulate coolant for 5 minutes with the fans pulling away as much heat as possible.

On the Mustang dyno system, the vehicle rpm was calculated from the roller rpm and a "learned" complete driveline ratio. Based on the known ratio, the operator sets the vehicle speed from which to start and stop the power pull. The upper speed limit is set

on the track, it did cross our not the minds that dyno experience would have been as wild as it turned out to be. Being on an open track with nothing to run into really takes away your perspective of speed and power. Everything gone so smoothly that our guard was down, and so after strapping the R32 down and setting the inertial corrections to awd mode,

We proceeded to make the power pull. What was not engaged was the clutch that connects the front wheel rollers to the primary rear wheel

\$86.8 Dahlback Racing 428.0 HPA R32 418.7 Tylaska APR Global Metorspor 351.7 294.4 VF Engineering 285.7 Eurosport Accessorie HPA GTI 254.7 AXI5 244.9 ABD 228.4 Area Under Torque Curv HPA R32 Dahlback Racing



rollers that were connected to the PAU. Basically, we pulled the R32 with the front wheels free rolling.

What the VW Haldex awd system does when it senses a difference in load or wheel speed is redirect the power to the appropriate wheels to maintain traction. And that's exactly what it did—all 400+ ft-lb of torque went straight into the rear wheels. Because the rear wheels sit in a trough between the two rear rollers, any redirection of the force against the rollers other than in the direction of rotation causes the car to

want to climb up onto the rollers, if there is sufficient torque.

The HPA car had plenty, and that's precisely what the rear wheels did when the boost built at roughly 80 mph on the dyno. There was enough yaw to bring the car into an intensifying yaw-and-pitch oscillation. We can't show you what a car doing the bucking bronco on the dyno looked like. No one in the dyno room seemed to have stuck around to get a picture. The trouble is that when you're on a dyno, you can't use the brakes, and it takes a long time to coast down from 80 mph even after letting off the throttle.

After engaging the front roller clutch, everything else proceeded smoothly, even the GIAC record-setting run by the Dalhback car. The real surprise came from Billy Tylaska's MkII turbo 12V VR6 with a whopping 418 whp at the end of the day. Even the AXIS Super K04-powered 1.8T pulled an unanticipated 244.9 whp with

mostly bolt-on modifications.

Scoring for the horsepower contest was broken into two groups of 50 points for the highest score and 5 points for the lowest score in each group. Scoring for everything in between was assigned proportionately to where they fell in the range. The first category is for peak horsepower value and the second category is for the "area under the torque curve," from 40% of the redline rpm. The area was approximated by numerical integration (midpoint approximation) from 40% of the redline all the way to redline rpm in 100-rpm increments. This scoring not only gives advantage to cars with more torque but also to cars with wider powerbands, since the calculated area is based on a percentage of the total range of useable rpm.



to be just shy of each vehicle's redline speed. The pull is then recorded over the speed range so as to avoid hitting the rev limiter.

The first couple of front-drive entries were dynoed without much spectacle, but then came the horsepower and torque leader, the twin-turbo HPA R32. We just didn't know it at the time. Having driven the car the previous day

Seventh Place **HPA Motorsports**

(Grass Roots VR6 Single Turbo)

ver the last 12 months, VR6 geeks (Bidrawn's among them) have been screaming for love-hot, force-fed love. HPA responded with its Grass Roots Turbo System for VW's narrow-angle six-pot engine. Designed to be affordable and efficient, we thought it might be a good idea to bring one down and put it to task.

Producing 255 whp and 258 lb-ft of



twist at 5000 rpm, it lent roughly an extra 100 whp and torque to the 24V VR6 mill. Given the modest entry price,

the HPA Grass Roots turbo system has all the makings of a good deal.

A mix-up in tires left this GTI with Toyo T1-S rubber, which ain't bad but lacks the grip of the vaunted Toyo RA-1s. Hook-up problems limited this car to an unremarkable 14.9 sec. at 98.3 mph, still better than a stock car but a far cry from the other competitors. Its braking, however, was impressive with a 217-ft stop from 80 to 0 mph, the fourth best in the group. On the road course, the HPA single turbo took dead last with 68.9 sec., almost 5 sec. off the lead car. Again, we think tires could have made a big difference here. Still, for what the Grass Roots system is, it's capable of kicking the hell out of a stock car any day.

Driver's View

"Good suspension balance and setupnot too soft, not too stiff. The shocks









ENGINE DISPLACEMENT 2800cc INTERNAL MODIFICATIONS None **EXTERNAL MODIFICATIONS** HPA Grass Roots single turbo
wintercooler, T3/T4 Garret
turbo (11 psi), 70mm downpipe,
75mm GHL exhaust
ENGINE MANAGEMENT
MODIFICATIONS DRIVETRAIN MODIFICATIONS HPA short shifter SUSPENSION KW Variant III coilovers Hyperformance slotted rotors and sport pads CR7, 9x18, fr; CR7, 9.5x18, r TIRES Toyo T1-5, 225/40ZR-18

rebound control, though. The motor had a nice balance of torque and horsepower.



First Place HPA R32 Bi-turbo

In many ways, the R32 modified by HPA was somewhat responsible for this little shindig. A year ago, Marcel and crew brought a car like this to our offices, and it left an indelible impression on our psyches. You don't easily forget a car this fast. We always knew great things would happen with the R32, and HPA merely confirmed it. Not only did HPA take the prize, it took it by more than 100 total points.



HPA's hardware has proven itself to be virtually indestructible. A week before our challenge, this R32 was tested for a high-perform-

ance TV program. A day later it competed in sister publication Sport Compact Car's "Ultimate Street Car Challenge." Two after that, it was in Detroit, where Car and Driver put it through its extremely rigorous testing procedures (not for nothing is that magazine known as Car and Destruction). Despite the copious abuse, the HPA R32 performed flawlessly, besting cars with twice the displacement.

This R32 began its domination at LACR with a first run of 12.6 sec. at 112.5 mph. It would turn out to be nearly a full second faster than the next closest time. Following a full track cleaning and treatment with VHT (thanks to Sport Compact Car), the R32 ran a slower 12.8. Seems the crappier the pavement, the better it performed.

Like the other R32, this one stopped exceptionally well, netting a 209-ft distance from 80 to 0 mph, 5 ft longer than the leading car. On the road course, the bi-turbo R32 behaved with all the dexterity of a great sports car, causing driver Schrantz to utter long strings of profanity-laced praise, Although the HPA car bested the VFE R32 by a significant 2-





sec. margin (and cut the quickest time of the day), the GTI of CMG was only 6/10ths off its blistering pace. There's the whole "weight versus horsepower" issue in action once again.

On the GIAC dyno, the HPA R32 produced a winning 427 whp and scored the most points for usable torque. The car is actually capable of more power—perhaps as high as 495 whp—but it was dialed back given the heat and activity it would see over the following few weeks. When the dust cleared and the last photo was snapped, the HPA R32 bi-turbo quietly drove away as the King of all Golfs, an exhausted but very happy Marcel Horn behind the wheel.

Congratulations to Marcel and his crew. We have found the world's *iiber*Golf, and it wears an HPA badge.

Driver's View

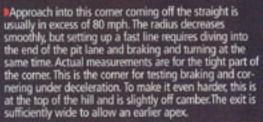
"It's fast...super fast...but very easy to drive. I never felt I was going to lose it. You push this car over the edge, though, and you fight like hell to bring it back. The suspension was nicely dialed ENGINE
DISPLACEMENT
3189cc
INTERNAL MODIFICATIONS
HGP head spacer (8.0:1 compression), high-flow injectors, Black race bearings
EXTERNAL MODIFICATIONS
Dual hybrid K04 turbochargers with oversized exhaust housings (17 psi), HGP exhaust manifolds with dual 70mm downpipes, HGP cast-aluminum intake manifold, dual side-mount intercoolers, high-flow formed silicon and stainless piping, high-flow mass airflow sensor, high-flow secondary fuel pump, proprietary electronic boost controller, twin high-flow race catalytic converters, 3.5-in, stainless-steel exhaust system, EDS override controller (turns off traction aids during track usage)
ENGINE MANAGEMENT
MODIFICATIONS
HGP ECU
DRIVETRAIN MODIFICATIONS
Hardened and enlarged flywheel, single-disc metal clutch disc with sport pressure plate, HPA short shifter
SUSPENSION
KW Variant III coilovers
BRAKES
HPA Stage IIIR brakes: front, RS6 six-piston calipers and 360mm rotors; rear, four-piston calipers w/312mm rotors
WHEELS
BBS CH, 8x18

and the brakes were big enough to stop the car all day long. I did notice a bit of push when exiting the corners. A few more clicks on the rear dampers and a few less on the fronts might help. The short shifter was truly a short throw and was a "must" with this car. Things happen very fast when you're on the throttle and you don't want to mess with long, sloppy shifts. Clutch is pretty stiff-it feels like you're hitting the brake. After a few shifts, though, it makes perfect sense."

Toyo T1-S, 225/40ZR-18



Duhlback Racing			62,158
HPA R32			53.064
APR Global Motorsport			64.586
Eurosport Accessories			65.531
VF Engineering			65.546
AXIS			66,840
Tyleska			67.650
HPA GR	THE RESIDENCE		68.598





	RIGHT CORNER				
6		D			
MAX	LATG	AVERAGE MPH			
1.30	Dahlbac	k • 43.54			
1.16	APR	41.82			
1.15	AXIS	41.48			
1.09	Eurospo	ort 41.03			
1.11	HPA R3	32 40.77			
1.04	VF End	40.61			
0.97	Tylask	a 39.31			
1.01	HPA G	TI 38.95			
1.01	Audi S	38.92			

SEGMENT 2

The main straight of The Streets of Willow is where the higher horsepower, and lag-free, cars excelled. At the exit of the go-kart turns, it's a wide-open throttle race through the finish line and by the tower where we were stationed. This is an uphill climb right into turn one.

ACCELERATION				
Δ.		В		
MAX ACCEL G MAX MPH				
0.65	Dahlback •	110.43		
0.62	HPA R32	98.73		
0.43	VF Eng	93.57		
0.51	Tylaska	93.23		
0.44	APR	92.63		
0.40	Eurosport	90.40		
0.37	HPA GTI	88.72		
0.36	Audi S4	88.50		
0.33	AXIS	84.42		

CECMENIT

STREETS
OF WILLOW:
SHORT COURSE
0.96 MILES

The Numbers Game: Scoring a Winner

With each event scored, on a scale of 100 points with at least 10 points to be awarded to entries that managed to finish. Zero points are assigned to those that did not finish. In this case, only the ABD car did not manage to finish on the track due to a loose intake pipe holding boost. The Dahlback entry was not used for the scoring scale since the car is really in its own league. If it were to be scored, in this case it would have 114 points for horsepower, with roughly 327 points overall. The street car conditions really put the RSI in a position that it was never meant to be in. As expected, the contrasting R32s cleaned house with their awd and awesome performance, even when close to stock. The surprise performance from the all-out lightweight Mk II, from a privateer no less, verified the benefits of speed through lightness. But, overall, the HPA R32 won simply by the fact that it consistently did well in all categories. Verdict? Awd and turbos (the more the merrier) rock.



At the Track

Additional illustrations and plots by Kim Reynolds

We picked the Streets of Willow because of its technical nature, putting suspension and chassis tuning to severe tests. This would not be a horsepower race, because points for power would be reflected by the dyno scoring. As for driving and tires, most of the entries ran R-compound street tires such as the Toyo RA-1 and Pilot Sport Cup, which leveled the playing field in terms of traction. Kevin Schrantz did all the driving, and after

several hot laps with him and watching his telemetry and time data, I have to admit he is just a machine. His lines never varied by more than a foot, and lap times were so consistent that there was never any thought to re-driving the course.

New to our shoot-out was the use of the RacePak data acquisition and race telemetry system. The unit uses on-board accelerometers along with a GPS antenna to derive real-time telemetry, which is broadcasted to the offboard operator via a radio modem. This unit outputs and records everything from spatial position and velocity to acceleration data, all relative to the car's frame of motion.

The modular unit was mounted in the car and Kevin was given five laps, three hot in between the warm-up and cool-down. Critical corners are marked off, and some data is presented below. The final go-kart-sized corners were used more to slow down the vehicles so that the high-powered cars had a little advantage on the straight. Dahlback used them for drifting exhibition. Just for reference a stock 2004 Audi S4 on UHP tires ran a 67.368 lap.

Editor's Note: The red lines shown in each each segment are the velocity profiles for the fastest car through each section.

