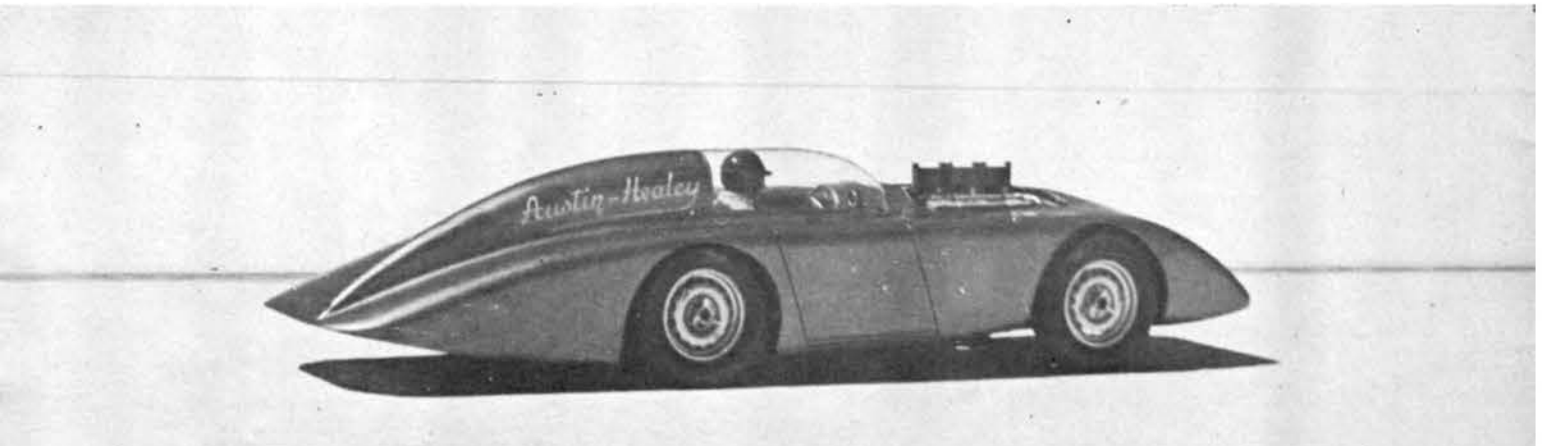
# 200 MPH In A Sports Car?

***The 200 mph barrier has been cracked officially by a sports car only twice. It can and will be broken again but not by brute power alone. The problems are many but they can be solved. Here is Roger Huntington's blueprint for all-out speed.***

*Donald Healey's supercharged 100-6 at Bonneville, 1956, had a tapered nose and tail section welded to a stock shell, with a faired canopy and small radiator cooling slit in the leading edge. It did 203 mph with only about 300 to 320 hp.*




If you're a real sports car enthusiast the sensation of *brute speed* probably holds much appeal to you—though chances are you won't admit it. You've probably dreamed more than once of driving a thoroughbred sports job at better than 150 mph down the Mulsanne straight at LeMans . . . or maybe you were tearing off 200 mph at Daytona or on the Bonneville flats. Any way you cut it, this has just about got to be auto sport at its very best — the physical thrill of extreme speeds on the ground, plus a chance to warp the factory boys under official timing!

Of course, we all know it's been done. Modified sports cars have been officially timed at better than 200 mph on two occasions. There was Joe Mabee's two-way average of 203.11 mph in a home-built Chrysler-powered sports roadster during the 1953 Bonneville Nationals; and Donald Healey turned 203 mph one way in a special super-charged Austin-Healey 1006 during Bonneville record trials in 1956.

So — (just for you dreamers, now) — what did it take to do it, and how easy will it be to do it again?

### THE INGREDIENTS OF SPEED

Mother Nature has written a simple equation for ultimate speed. Any body or vehicle in motion has a certain amount of *drag* acting on it to retard its forward motion. On a car this total drag is composed of wind resistance, the rolling resistance of the tires, and friction in the running gear, wheel bearings, etc. The engine power must provide the forward thrust on the tires to overcome this drag. When drag is equal to the maximum horsepower available . . . well, that's it. Top speed.

A simple example will illustrate: Suppose your total drag at, say, 140 mph is 600 lbs. One U. S. horsepower is equivalent to 550 foot-pounds of work per second. Since 140 mph is equal to 205 feet per second, our total power required is $600 \times 205 = 123{,}000$ foot pounds per second. And the horsepower required would be $123{,}000/550 = 224$. What if we've only got 210 hp available? Then we can't go 140 mph —except downhill or with the wind. This is the meat of the problem. That is, to go faster we either have to reduce drag or increase horsepower, or both. Fifty years ago, if you could find a few more horses somewhere, you could usually go out and break a speed record. Today you've got to do some pretty fabulous things in *both* departments to make a dent anywhere. To do 200 mph with any existing basic sports car . . . well, let's see how this drag problem stacks up:

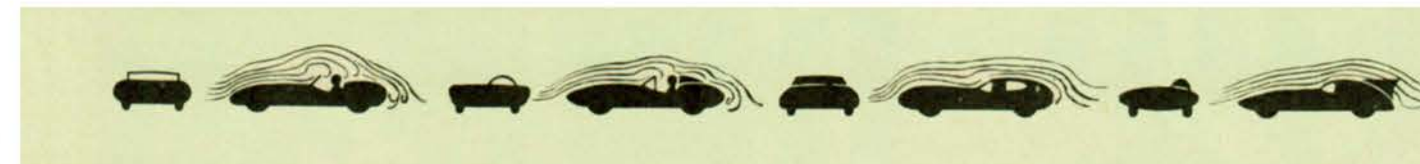
### CUTTING THE DRAG

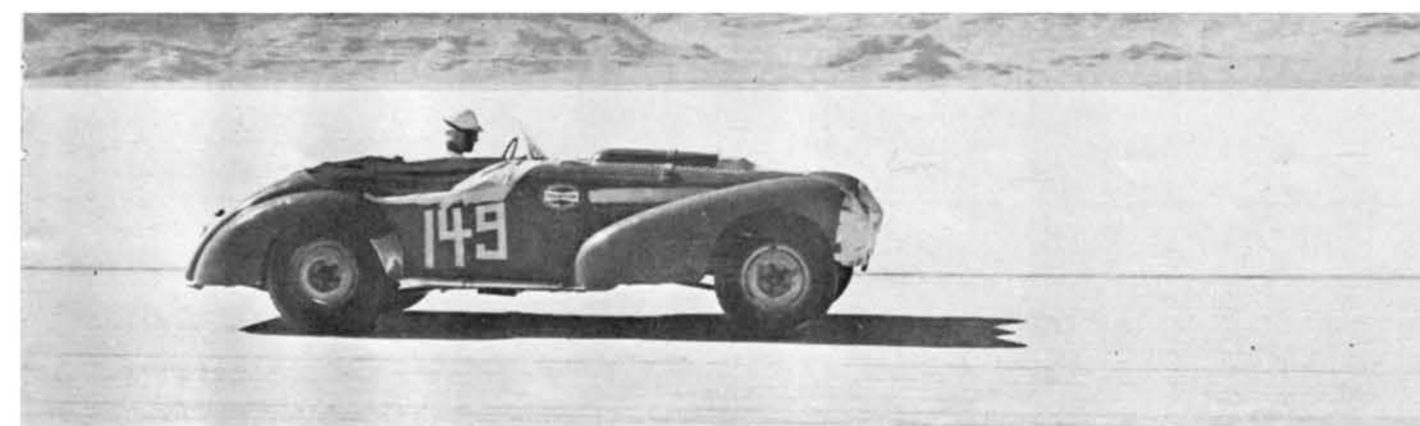
More than one would-be record-breaker has eaten dust because he didn't appreciate the relative importance of the three types of drag (wind resistance, tire rolling resistance, and friction) at the car speed he was aiming for. These relationships vary, and are not constant over a wide speed range; you can easily end up cutting drag that isn't hurting you much anyway.

Chassis friction won't be far off 10% of the total drag under all conditions. Reductions here are the least important. But the way the remainder of the drag is divided up between wind and rolling resistance is very important. Take a typical 2000-lb. sports coupe with reasonably clean body lines and running standard tires at 30 pounds pressure. At 100 mph the horsepower required at the clutch to move the car on a level road would be about 90; the total drag would be divided up with about 10% friction, 65% air drag, and 25% rolling resistance. But get this: At 200 mph the wind and rolling resistance proportions would change to about 50 and 40% respectively — and the horsepower requirement would be over *900!!* The tires could not run more than a few seconds without flying apart.

So the first rule for the super-speed enthusiast: Tire rolling resistance must be cut radically on any car expected to exceed about 130 mph.

How do we fight it? Essentially, tire rolling resistance represents the work expended in *flexing* of the casing and tread; this work is converted into heat, and is dissipated over the surface of the tire. This flexing is caused by the natural deflection of the casing under the vertical load, and —at higher speeds — centrifugal force steps in and tries to distort the tread just behind the flat spot where it contacts the road. What happens is that centrifugal force momentarily overcomes the elastic force of the tire, setting up a violent oscillation or "traction wave" on the rear of the tread. This eats up an enormous amount of power, and will quickly tear the tread off.





*And that's the way it shouldn't be done. This Allard has gobs of brute power, but poor aerodynamics. Grille opening has been partially taped; but tremendous horsepower is required to overcome drag of the windscreen and the suction areas.*

The obvious answer to all this is to stiffen the tires' resistance against deflection. There are several ways to do it: A lighter, thinner tread layer; stiffer rubber compounds; a stiffer casing structure, with more plies (generally six) and a steeper cord weave angle; and more inflation pressure. You'll recognize these features right away as those of our various special "high-performance" sports tires — like the Firestone Super Sports, Goodyear Blue Streak series, Dunlop Road Speed, Pirelli Sports, etc. At a given speed, load, and inflation pressure, these tires will have *less than half* the rolling resistance of a standard passenger car skin, even in the 100-mph range. At speeds over 150 . . . well, the passenger tire just disintegrates.

Actually, even the above high-speed production tires are not entirely suitable for speeds as high as 200 mph. The treads are pretty thick and heavy (to give long life in road racing) The special Firestone "Bonneville" tires would be much better; or a set of 200-mph tires could be made up on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*Here's a better way to do it. All projections, seams, and grille opening are taped, and flat areas faired. Tires are inflated to 80 psi.*

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special order by any of the European companies that make sports casings. (I see where Dunlop have made up a set for the coming M.G. Class F record attempts in the 240-mph range, with practically no tread layer at all.) Inflation pressure can run 60 to 80 pounds on all these tires.

The general problem of wind resistance, or air drag, is a little easier to picture. The whole idea here is to get your car to slip through the air mass with just as little disturbance of the mass as possible. You're all familiar with the terms "drag coefficient" and "frontal area." The former is a measure of the relative aerodynamic *cleanness* of a body, while frontal area gives us a yardstick for the relative *size* of the body presented to the air mass (it is actually the maximum cross-sectional area of the vehicle viewed from the front). Total air drag is directly proportional to both drag coefficient and frontal area—so a reduction in either, or both, will cut the drag proportionally.

Space won't permit any detailed discussion of aerodynamic design here; but the major tricks are well known. At any speed event you'll see cars with the headlight openings taped up, door handles masked off, windscreens stripped off, underpans, skirted wheel openings, radiator grilles partially blanked off, etc. Every little bit helps when you're struggling for that last mph. Two tricks are especially effective, however: Removal of the windscreen on open cars, and masking off part of the grille opening. An upright windscreen sets up a huge "suction area" behind it where the air flow is swept up over the top and then swirls and eddies down behind the screen. Sometimes you can reduce air drag to less than half by merely ripping off the whole windscreen and getting rid of the suction area (this also reduces frontal area). Some of the later super-speed cars are going to bubble canopies over the driver's head; this increases the frontal area a little, but the drag coefficient is reduced enough to more than compensate. (In fact, this is the reasoning behind the theory that a well-designed coupe body will have less air drag than a well-designed open car. It has never been conclusively proved, however.)

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arms which pivot around the center rear sprocket shaft bearings. The purpose of this design was to put all torque reactions and engine shock at the back axle instead of on the frame. It also permits sprockets to be changed quickly.

Herb felt that the conventional foot shift was undesirable in that during the stress of a race a gear might not be completely engaged. Then when the accelerator was tromped on, it would pop out of gear and allow the engine to overrev dangerously. Time would also be lost while attempting to reengage the gear. He therefore designed a gate shift with positive stops to prevent this contingency.

An interesting feature of the shift linkage was the very ingenious bell crank. Herb had to deal with two arcs in this case so he designed the end which carries the universal ball bearing on a stem which is a sliding fit inside the tube. A coil spring is used to return this arm to its shortest position.

Herb used half-hard sheet aluminum .040 thick for making the body. To form the aluminum to the desired shape, he built a simple metal forming device in his cellar patterned after a wheeling and raising machine. It consists of a flat pulley which is free to turn on a shaft. This shaft is supported on a wooden framework built down from the joist. Another small diameter pulley having a crowned or convex surface is free to turn on a shaft which is supported by adjusting screws, which in turn are held by a wooden framework built up from the cellar floor. To use the machine, the metal is placed between the rollers and the lower roller is raised by means of the adjusting screws until there is a light pressure on the metal. The metal is then slid back and forth between the pulleys and is thus made thinner, the idea being to thin the metal in from the edge itself. In this way, as the metal inside becomes thinner, it has to bow out.

With this machine, it is possible to get an absolutely smooth surface on the metal. Herb did no sanding or other smoothing on the body. As the metal is worked in the machine, it tends to become work hardened. Therefore, Herb annealed the metal once during the forming process, after he had worked the metal to about half the required curve. To anneal it, he used a torch operating on ordinary kitchen gas. He would heat an area and test it with an ordinary kitchen match. When aluminum is hot enough to char a pine splinter or match, it is hot enough for annealing. When one area reached this temperature, he moved to another and so on until the entire piece had been annealed. The body sections were welded together by a man experienced in aircraft welding.

Herb has had the satisfaction of building a car which is a prize winner for workmanship and appearance and I am sure he will soon have the added satisfaction of winning many trophies.

*Ed Monroe*

## 200 mph

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"Cooling drag" is another item that can cost you plenty. The Bonneville boys have been learning never to let anymore air through the radiator core than is absolutely needed to keep water and oil temperatures within limits. At speeds of 150 mph and more a huge amount of air will go through a very small opening, and drag is high when this air is rammed through the core and into the engine compartment. Only a small opening is actually needed to cool the powerplant.

Then there's chassis friction. The tricks here are well-known, too—like increasing bearing clearances, using thin, pre-heated lubricants, only half-filling the transmission and differential cases, etc. This stuff is not as important as your reduction in air drag and rolling resistance, of course . . . but chassis friction effects could easily be the difference between doing 197 mph and 200!

### SPEED VS. HORSEPOWER

So just how low can we get our HP requirements at 200 mph for the various basic body shells, using all the tricks? Let's let the slide rule talk here. Assuming sea level atmospheric conditions and a set of super-speed, light-tread tires at 80 pounds, I'd say you might look for these typical power requirements:

The larger open sports jobs—like the Corvette, T'bird, Jaguar, etc.—could do 200 mph on about 430 hp at the clutch. (This would be with windscreen stripped, headlights taped, underpan, cockpit cover, grille opening partially blocked, etc.) A nice, clean coupe in the larger size (like the Mercedes-Benz 300-SL) would have a lower drag coefficient; but the frontal area would be more . . . so it, too, would require over 400 hp at 200 mph. Both the 300-SLR open jobs and the one-of-a-kind coupe could get about 180 mph out of 290 hp, so this body type should be able to hit 200 on just about 400 horses. A D-Jaguar would want a hair more. Surprisingly enough, the power requirement at 200 mph for all these larger production-bodied cars appears to be in the range from maybe 390 to 440 hp.

Requirements for the smaller bodies are not as much lower as you might think. A stripped M.G. A, faired for speed and with super-speed tires at 80 pounds, would want around 370 hp to do 200 mph! The Porsche coupe is probably the most aerodynamically-clean production sports car out; it would still require some 350 hp for 200. When you get into the choppier bodies, like the Triumph, Austin-Healey, etc., your requirement is back up close to 400 hp again.

Obviously anything approaching 200 mph with a basic sports car body is going to require something very special in the engine room. In very few cases could the original engine be modified to provide the necessary punch. The above horsepower figures suggest "super-race" versions of engines ranging from 3.5 litres with high-pressure supercharging to 6.5 litres unblown.

The only other alternative, of course, would be a special streamlined body. I don't mean anything as radical as a typical Bonneville streamliner, but maybe something along the line of the '54 Austin-Healey record car. This had a stock body with long tapered nose and tail sections welded on, a faired canopy over the driver's head, and a separate ducted radiator in the nose section, fed by a small opening on the leading edge. The horsepower requirement at 200 mph appeared to be between 300 and 320. Nothing to it, really . . . and yet those few pieces of sheet metal were worth close to 100 horses at top speed. And, of course, if you wanted to go all the way—with a fully-streamlined shell of optimum shape and minimum frontal area over a 2000 pound car—you could probably reduce your total power requirement at 200 mph to less than 180 hp! You wouldn't have a "sports car" when you got done, though.

### THEORY VS. PRACTICE

Joe Mabee *did* go 200 mph with a sports car. In fact, the car was originally conceived and built (in 1953) for the sole purpose of blowing off some of the hotter European sports machinery on the California and Texas road courses. It never enjoyed any notable success along this line —but that speed mark of 203 mph could be a target for some time to come.

The design of the car was very simple and straightforward. The frame was fabricated of heavy-wall chrome moly tubing, with torsion bar suspension all around of the early Kurtis type (solid axles with trailing links in front and leading links on the rear). Axles, wheels, brakes, steering, and transmission were stock pre-'49 Ford. The body was a standard Victress fiberglass job—(but, of course, well stripped and shrouded for the record runs). Firestone Indianapolis tires, size 6.50/16, were used with treads shaved to a narrow strip down the center of the carcass. (This was before the special Bonneville tires were available.)

The '53 Chrysler V-8 engine was built up by Ray Brown. It featured a 1/8" bore job (to 354 cu. in.), ported heads, big valves, Herbert roller cam with a wild "rpm" grind, 11.5:1 compression ratio. Hilborn fuel injectors, and Harman-Collins magneto ignition. The engine was never put on a dyno; but the performance of the car would certainly suggest well over 400 hp at 5500 rpm on the methanol-nitro blend used at the Flats!

There's no denying that nitromethane had a big effect on the speed attained. When the Bonneville rulemakers put all sports car classes on pump gas in 1954, Mabee brought the car back for another try. In spite of the fact that the block had been bored another 1/16" and the crank stroked 1/4" (giving 389 cu. in. in all), the two-way average speed dropped off to 187.66 mph! (True, though, he did get 197-plus one way.) Assuming all other factors equal, this would suggest that the maximum available horsepower dropped 21%—or to probably less than 350. So I guess we should never forget the jiggle juice in our plans for super speed. (Incidentally, I should mention at this point that the 4200 feet of altitude and 90° air temperatures on the Bonneville flats are not conducive to ultimate speed. The air drag is less at a given speed, but the effective hp output of the engine drops a greater percentage—so the net effect is a loss of some 1-3% in top speed, as compared with a similar surface at sea level.)

### SO WHY NOT 200 MPH?

From all the above it would appear that the only practical way to get really super speeds (150-200 mph) out of a basic sports car would be to select one of the larger models to start with—then proceed to get more than 300 hp, either by modifying the original engine or installing a bigger plant. Unless you can get close to 400 extra horsepower, sheet metal fairing on the body will be necessary to approach 200 mph. There would seem to be no practical way to get these speeds out of the smaller, lighter models like the Porsche, M.G., etc.

This brings up another angle that is ever-present on any super-speed car—and that is *stability*. At these terrific speeds little things like aerodynamic lift on the body, "weathercocking" effect of the body shape, lateral torque reaction on the rear axle, etc. should be considered. These items are not nearly as critical at 200 mph as they are at 250, but they can get you in trouble if you aren't set up right. For instance, fore-and-aft weight distribution should fall between 55/45 and 45/55 for reasonable directional stability at 200 mph. (This would be critical if you tried to wedge a big engine in a light car like an M.G. or Porsche.) If you add sheet metal fairing on the body nose, be sure the lines are tapered down low at the leading edge to reduce lift (this shouldn't be too critical at 200 mph, though). I doubt if a tail fin is necessary; it will increase drag, and is not essential to directional stability. Even with all the precautions, though, anything approaching 200 mph with a basic production car calls for the wide open spaces of the Bonneville flats. The Germans' 1938 speed orgy, where the Mercedes-Benz and Auto-Union boys turned speeds up to 270 mph on a 24 foot concrete pavement was bound to end in tragedy.

But, given the right surface, a decent chassis, and a little space to spread out in . . . and top speed is pretty much a matter of horsepower vs. drag.

Incidentally, sports car owners are getting the red-carpet treatment at Bonneville. This year there were *four* major classes for you, all limited to pump gas. There were classes for American and foreign *production* sports cars, and two extra classes for American and foreign modified cars (the latter class also included commercial and home-built fabricated bodies). All American cars are limited to 368 cu. in. production and 425 cu. in. modified. The foreign production class was sub-divided on displacement at 0-91 cu. in., 92-170, and 171-305; foreign modified jobs divided at 0-91 cu. in., 92-183, 184-305, and 306-488.

Your chance is here. Come on out and try for that magic 200 in '58.

*Roger Huntington*