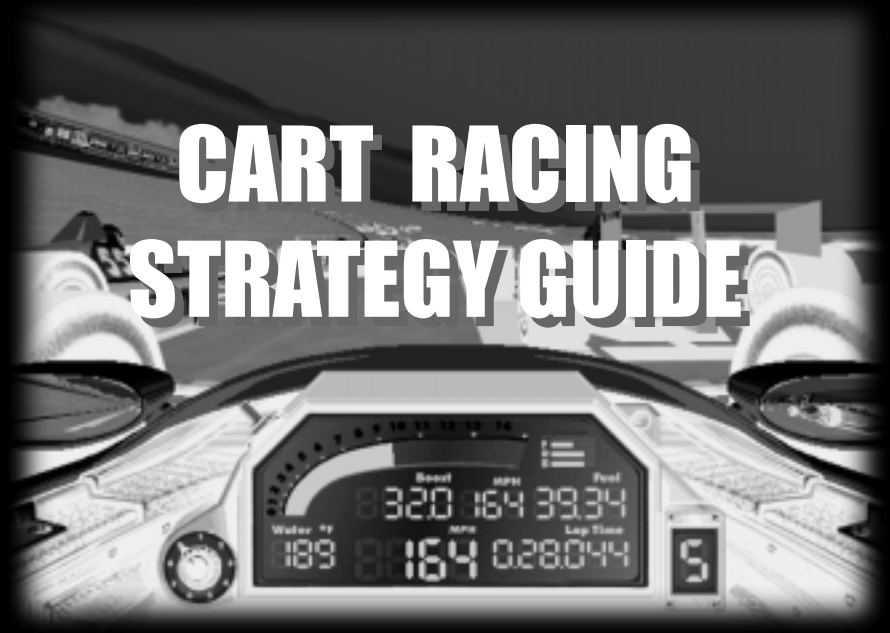
CART™

WINNING



CART RACING STRATEGY GUIDE

By Steven Smith

All American Sports Series

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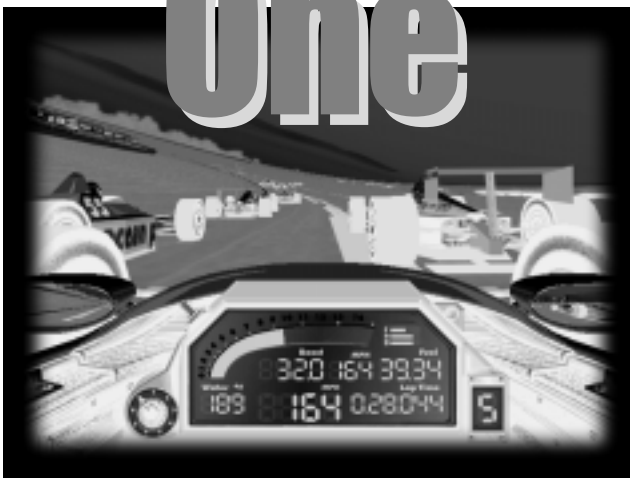
Chapter One



CART Racing and *CART Racing*


C·A·R·T
™

The Joys of Desktop Auto Racing

Almost everybody who tries one of Papyrus' sims wants to get them all*.

**The suite is currently comprised of* CART Racing, NASCAR Racing 2 *(an enormously popular stock-car racing simulation), and is soon to be joined by* Grand Prix Legends, *an historical Formula One sim.*

Starting in 1990 with five employees, gifted lead programmer David Kaemmer authored *Indianapolis 500: The Simulation*. It was, by any standard, the best desktop auto-racing game of its day. Only "game" doesn't begin to cover it. *It* provided its fans with unlimited hours of interactive "virtual reality;" some of the sim's more rabid enthusiasts probably logged more time at the Speedway than the entire Unser clan, as I later noted in a review written for my alma mater, *Car and Driver*.

The 500 indulged every racer-wannabe's fantasy of being strapped into the cockpit of a million-dollar race car and turned loose on the legendary Indianapolis Motor Speedway, reeling off 2-1/2-mile laps every 40 seconds or so. *The 500* let's you let you choose from among three different cars, and fiddle with chassis adjustments in the cockpit (and your garage in Gasoline Alley) to make the car faster...or at least to suit your particular driving style. The sim was shown on national television coverage of the real Indianapolis 500.

The game's most startling innovation was the introduction of a random number "seed." That is, unlike virtually every other computer simulation at that time, the opposition didn't behave in a completely predictable fashion every time you launched the game. As in real life, the fast cars were always fast, and the slow cars were always slow, but no two races were ever the same. You could park your car beside the track and marvel at the way the CC cars completed the race in real time, with unexpected lead changes, spectacular crashes, mechanical failures, and unscheduled pitstops;, fighting fiercely all the way to the checkered flag.

In that game, you could compete in 10-, 30-, or 60-lap sprint races, or devote over three hours behind the wheel racing against 32 computer-controlled cars for the entire 200 laps...including agonizing yellow-flag "caution" periods when you or the other cars suffered accidents. Sometimes, if the damage wasn't too bad, you could limp back to your pit, change a flat tire, splash in some fuel, and continue. More often, a split-second lapse in concentration would earn you no more than a DNF (did not finish) for your efforts. If you could hang tough for the whole race, by the time you took the checkered flag, you were usually drenched in sweat. I went the full distance 11 times—out of hundreds of starts—winning ten times (and finishing a humiliating third once when I got overconfident).

The Best Gets Better

Four years later, Kaemmer and crew released *CART car Racing*, which improved on the original by including all 16 races then comprising the PPG CART car Championship. *CART car* also tuned up the driving model (more realistic...and harder to drive), the graphics (for the first time, a Paint Kit allowed you to create cars of your own design...or duplicate real-world cars), improved the sound, and offered the chance not to race against not only CC cars but also head-to-head against human opponents either via a direct computer-to-computer hookup or over ordinary phone lines via a modem.

Again, you could drive a variety of cars in solo practice sessions, run short races (anything from 1% to 100% of the real race distance), and play by the real-world rules or make up your own. You could make your car invulnerable, you could bump other cars off the track, you could even—if you were really juvenile—race around the track in the opposite direction to traffic and try to take out all your competitors (okay, so I've done it, too). Or you could assume the daunting task of competing in all 16 races and scoring enough points (20 for first place, 16 for second, and so on; down to tenth place, with an extra point for qualifying on the pole, and/or leading the most laps) to win the highly-prized PPG Cup.

The game was an instant success, selling 100,000 copies in its first hundred days on the market (it went on to sell at least three times that many). It's also won two "Codies" (the computer-game industry's

equivalent of filmdom's Oscars) and was given *Computer Gaming World*'s highest award: five stars.

The sim was further refined in *CART car Racing II* (1995-1997), with an even more realistic physics model. The graphics were upgraded to high-resolution Super VGA (640 x 480 pixels and 256 colors; although the lower-res VGA graphics were still available for older computer systems). And in 1996, a special enhanced version of the game was bundled with several "3-D" video accelerator cards based on the Rendition Verite chip, resulting in the best graphics of any auto-racing simulation to date.

Legal issues in real-world auto racing forced a name-change to *CART Racing* this year, although the current title still represents the 15 CART-sanctioned races of 1995, missing only the USAC-sanctioned 500 in that year's PPG World Series of CART car Racing. Subsequent additions to the CART season, such as the events at Homestead (FL), Fontana (CA), and Rio (Brazil) are not represented in the game.

On the other hand, neither does the game represent the subsequent loss of Phoenix (AZ) and Louden (NH) to the rival the racing league's fledgling schedule. Later, I will show those of you lucky enough to have purchased the optional Paint Kit for the original *CART car Racing* a way to convert the add-on's Indianapolis Motor Speedway for use in *CART Racing* (or *CART car II*). And ways of "editing" the Championship to approximate the schedule of either club. I can even show you how to win the PPG Championship in a single evening. Honest.

Variety is the Spice of CART Racing

While the Formula One cars in international Grand Prix competition have specifications roughly comparable to those for CART cars (the latter have more brute horsepower; the former are more technically sophisticated), the challenges you'll face in CART cars are considerably more varied than those in F1, where—according to a Formula One chassis designer—the "average" corner is taken at a mere 75 mph in second gear.

In *CART Racing*, you have to master the cars' hair-trigger response on high-banked superspeedways; the simple "stab-it-and-steer-it" tech-

nique of flogging the cars around pancake-flat bullrings; the delicate ballet of circumnavigating crazy, twisted Phoenix (or narrow, scary Nazareth); and the wall-to-wall claustrophobia of "round-the-houses" street races...as well as the 200-mph straightaways and 40-mph hairpins of road courses. Nobody said life in *this* fast lane was going to be easy...and it isn't.

CART Racing also simulates the rules that prevailed in 1994. That is, no passing under full-course yellow-flag conditions (there are no "local" yellows as in F1), an 80-mph speed limit in the pits, etc. Neither the current 1.85-miles-per-gallon minimum fuel-mileage, nor the 35-gallon maximum fuel load, nor the lower turbo boost (now 40 inches), is implemented in *CART Racing*...although you could impose these rules yourself...if you're a stickler for accuracy or a glutton for punishment. I'll show you how.

The rules governing the design of real CART cars have been stable for some time: a flounder-shaped (15-ft. long, 7-ft. wide, 3-ft. high) open-wheeled single-seater weighing just about a ton ("wet" as they say, i.e., fueled and ready to go, with driver aboard); powered by a methanol-burning, 2.65-liter turbocharged V-8 engine that can make nearly 1,000 horsepower; and capable of straightaway speeds in excess of 250 mph. In the sim (as in real life), the race track starts to look very narrow as your speed rises above the double-century mark...never mind if you're on an open road circuit or you're three-abreast on a high-banked superspeedway. The speed may be simulated, but the thrill is real.

You drive with your view split horizontally in front of you. At the bottom of your computer screen is a pitch-perfect reproduction of an CART car's digital instrument panel: rpm, speed, oil-pressure warning light, water temp, etc. You may also call up a readout of your tire temperatures—not only for all four tires at any point anywhere on the track; it will also show any variation between the inner, middle, and outer edge of each tread—an invaluable tool for perfecting your setup, as we shall see. You may also call up displays of your fuel consumption, race position, and fastest lap. And every time you cross the S/F (start/finish) line, you'll see a pitboard with information on how many laps remain in the race...and how close your nearest competitors are.

Occupying the entire top of your screen is a swiftly- and colorfully-rendered representation of the outside world rushing past your race car. You can see the hood of your car (well, the cowl anyway), as well as the front tires, the racing surface itself (realistically textured or not, at your option), a wealth of trackside detail (more choices: you can turn on—or off—anything from reflections of the sky in high-rise buildings to trackside billboards), the cars ahead of you, and—in your rearview mirrors—the cars behind (or alongside) you.

Cockpit Workload

From the cockpit, while you're on the track (or in your pit), you can adjust the front and rear anti-sway bars (they're like trim tabs on a sailboat; the correct minor "push" and "loose" conditions) and move the brake balance fore and aft. Before pitstops, you can "radio" your pit crew (via your keyboard's function keys) with requests for specific amounts of fuel, fresh tires (you can swap tire compounds, even change your tire "stagger"), wing-angle adjustments (which affect traction as well as aerodynamic drag), and repairs to collision damage (or not, if you don't want to lose track position making purely cosmetic repairs). I'll explain all this as we go along.

In the Garage, you'll learn not only which way to tweak such arcane adjustments as camber angle, gear splits, and shock absorber calibrations, but why. I won't dwell on theory, but will attempt to explain—in plain English—the complex interactions between all these variables, how they affect your on-track performance, and how they change the way the car will feel to you.

You can vary your own engine's horsepower only from the cockpit, but if you can edit a simple ASCII text file, you can also stipulate specific horsepower figures for each of your CC opponents. You can assign each of them a range (and let the computer choose a number at random from within that range); say 850-950 horsepower for a consistent driver, and 400-800 for an erratic one. You can edit the files to make the whole field faster or slower in qualifying runs, as well as fine-tuning the speed of the entire field for each individual race. You can even adjust the aggression levels of each driver, to make him (or her) more or less likely to choose off with you for a corner, or to dispute your right-of-way when you're both traveling the length of two football fields each and every second. In other words, you have a God-like ability to bend "reality" to your will...or whim. You can make the game do almost anything you want...to make it easy in the

beginning...and to make it tougher as you get better.

You can also customize the way each of the cars look. Using the game's built-in paint facility (Paint Kit in the DOS version of the sim, and Paint Shop within Windows 9*x*), you can replace some or all of the car designs that come with *CART Racing* with paint jobs that resemble real-world race cars, driver- or team-specific, and correct down to the last decal. You can't change the *shape* of the cars, but you can emblazon them with any graphic scheme you can devise, or download designs from online services like CompuServe. In fact, you can collect whole fields of race cars (they're called "car sets" in the game), all in the latest livery—they look exactly like what you might see on TV race broadcasts that very same day. The drivers in the game may be ranked up-to-the-minute in the order they appear in the real-world Championship, and their performance may be adjusted to reflect their real-world performance. This book will show you where to find all this stuff.

Probably the most advanced (if least used) feature of this game's predecessor, *CART car Racing II* was its "interoperability," computer jargon for "It runs on a PC, it runs on a Macintosh, and you can play on a PC *against* a Mac, or vice versa. *ICR2* was probably the only game in the universe where you could hook up a PC to a Mac on a serial or modem connection and both be playing exactly the same game, racing against each other. The Mac version has been discontinued, but with a little help, you should still be able to connect that game with the current PC version.

The current game has three separate versions on the CD-ROM: the DOS version, the (3-D enhanced) Rendition version, and the Windows 9*x* version. Which one you use will depend on what you've got "under the hood."

Speaking of which, let's discuss hardware.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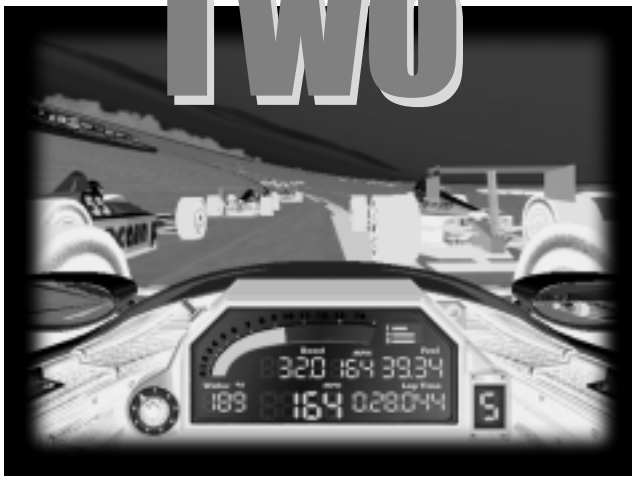
Chapter Two



Hardware Considerations

You Can Never Have Too Much Hardware

There are two ways to get the best hardware for running games (from *CART Racing* to *Outpost II* to *The Incredible Machine 3.0*): buy it off the rack...or build it yourself. I'm going to assume that most of you have store-bought units...and that you're disinclined to pop the lid and start tampering with internal components. However, for those brave souls who are willing to mix 'n' match parts, I'll provide guidelines for which upgrades I think are worthwhile...and which are not. In any case, there are some choices you're going to have to ponder no matter what (unless you bought one of those dedicated "gaming" computers that come equipped with a steering wheel and foot pedals).

You can never have too much hardware (you can only buy it too soon, as the old computer adage has it). Not because it looks cool sitting on your desktop, or because its marquee value will knock your peers' Argyles off, or because it enhances the eye-candy on your computer screen, but because ultimately it can make you a better driver.

Let me explain.

Eadweard Muybridge discovered the "persistence of vision" in the middle of the 19th century, and "moving pictures"—everything from early zoetropes to silent films to Cinerama to HDTV to the stupendous impact of IMAX theaters—have depended on it ever since. That is, when you look at a "flip book" of sequential still pictures (like those from a motor drive camera) at a rate of anything less than about 10 pages per second, the effect is more like a high-speed slide show of separate images than a fully animated scene. Silent films, shot at about 14 frames per second, are usually shown at 24 frames per second, making the motion look comically sped up. Shown at the original speed, the action unfolds in real time, but it looks jittery. It's only when a scene is shot and projected at close to 30 fps (the TV standard) that the individual images are perceived as continuous, seamless "motion," because each new image flashes onto the screen before the old one has fully faded from the viewer's retina.

In computer games, the "smoother" (more fluid) the animation, the tighter the player's potential control loop (hand/eye coordination). If you saw only one new image per second (like videos from the Martian Rover), playing chess would be no problem, but controlling a race car at 200 mph would be almost impossible. You'd get a glimpse of where your car was on the track, maybe just enough to suggest where you ought to aim it for the next frame, but—traveling at a couple hundred yards per second—if your guess was off by only a fraction of a degree, you'd probably be off the road in the next frame. So the higher the frame rate, the more timely the visual updates that the driver needs to make accurate mid-course corrections: steering, braking, and accelerating. Driving a race car is all about "flow," and a decent frame rate is the key.

What Price Eye-Candy

There are three ways to get an acceptable frame-rate (anything more than 30 fps is overkill, cybernetics-wise) in a computer game. One, simplify the image. I'll get back to this, but basically, you don't need to waste precious CPU cycles drawing pretty clouds in the sky, or detailed motorhomes in the infield, or rubber dust-bunnies up in the "marbles." Two, get a faster CPU. Traditionally, this has been the path most taken *Cart* ran fine on a 16-Mhz 286 with EGA graphics, but if you wanted higher-resolution VGA graphics, you had to go out and buy a 33-Mhz 386). The problem is that it gets harder and harder to eke out another few fps from the same-old CPU-centric architecture. Three, take some of the video load off the CPU and let a separate (dedicated) graphics chip handle it, so that all the already-overburdened CPU has to worry about is where the cars are, not how to draw them on the screen (SVGA puts over 300,000 pixels on the screen, one at a time, then moves them all to new locations 1/30th of a second later). As usual, Steve Jobs was there first--his original Next computer branched off the video computations from the CPU ten years ago.

Starting with the obvious, most gamers make their CPU choice based on clock speed—a 200-MHz Pentium is better than a 166-MHz Pentium. Fair enough...as far as it goes. But no matter what is says on *CART Racing*'s box, I'd say a 133-MHz Pentium is the minimum clock-speed benchmark to run *CART Racing* successfully, all other factors being equal. And if you like what you see at 133 MHz, you're gonna love a 166-MHz Pentium (or its equivalent, although I tend to stick with

Intel CPUs simply to avoid compatibility issues, never mind the hype about competing products' performance claims).

In Verite Veritas

But other factors are not equal. If instead of spending an extra $150 to $250 for a faster CPU...if you spent the same money on a Rendition-based video card, I think you'd be happier with the end-result: better graphics, smoother animation, more bang for your buck. Not only do the Rendition Verite boards (there are four that I know of—see the "Resources" section at the back of the book) give you a rock-solid 30 fps *even with a lowly 133-MHz Pentium* (most other boards slow to a crawl when the CPU is overwhelmed with other tasks, such as the AI-load at the beginning of a race, or tracking the positions of every car at a big, complicated circuit like Elkhart Lake), but several of the tracks in the Rendition version of the game have also been enhanced with breathtaking artwork, like a sky full of threatening weather at Elkhart...plus nicely textured 3-D walls, more detailed objects around the track, even subtle "anti-aliasing," smoothing out the typical computer "jaggies" (which break up diagonal and curved lines into annoying stair-step patterns). Overall, the effect of Verite video is almost as photorealistic as a live feed from ESPN.

The only problem is that *no* computer I know of comes with a Rendition board; you have to go out and buy one and install it yourself. The "street" prices range from $150 to $250, and—wouldn't you know it—the best of these is the most expensive (it comes with 3-D glasses—a feature not implemented in *CART Racing*, unfortunately), nor is installation as simple as its Plug 'n' Play appellation would indicate. But this puppy is definitely worth a look. The visual improvement is tremendous, the price is right, and I've been able to drive faster with less effort at every track in the game.

Raising the Frame Rate

If you can afford neither a fast CPU nor a Rendition video board, all is not lost. Going back to Square One, you always have the option of easing the graphics overhead. Here's what Brian, one of the customer support guys at Sierra Online (which bought Papyrus in 1996) recommends, in order:

"One, turn graphics options off. We usually suggest that people start turning off road and grass textures. Next, turn off wall textures and

possibly grandstands. Next, continue to turn off graphic options (car textures, horizon, etc.) until the frame rate improves to an acceptable level.

"Two, reduce the number of opponents you compete against. Reducing opponents from the default 32 [*sic; it's 31*] to 15-to-20 can have a dramatic effect on frame rates.

"Three, reduce the number of opponents drawn in front and behind. Reducing these numbers from 5-to-6 in front and 1-to-2 behind can also have a great effect on the frame rate.

"Four, reduce the number of opponents that can be heard simultaneously to 2-to-3. This will reduce the strain on the CPU and improve the frame rate slightly.

"Five, use FM sound instead of digital sound. To do this, launch the game with the '-F' switch. That is, type "CART -F" at the system prompt (or from a DOS 'shortcut' in Windows 9*x*). The sound quality will not be as high as the digital sound, but it is much less memory-intensive and can improve frame rate.

"Six, run the game in VGA, not Super VGA (SVGA). To do this, launch the game without the '-H' (for High Resolution) switch. The graphics quality will not be as high as SVGA, but the frame rate will improve considerably."

Thanks, Brian. I can only add that, for Windows 9*x* users, given the choice between running the Windows executable or running the game from a DOS shortcut, I'll take the DOS mode every time. *CART Racing* is the lineal descendent of a pure DOS game, and its performance under DOS is noticeably better (even the sound). The sole advantages of the Windows version (in my opinion), are that its menus are far more logical, and the setup screen is a paradigm of legibility and usability.

If you do choose VGA graphics, you may find you can turn back on all the stuff you reduced or turned off altogether in SVGA: objects, textures, number of opponents drawn and heard, and digital sound. In my view, you should drop back to VGA if you have anything less than a 100-MHz CPU and/or local-bus video (VESA or PCI). You only need

eight megs of RAM to run the game; anything beyond that will mainly affect the length of the replays. As a rule of thumb, every additional meg of RAM can store about two minutes of replay. (Thus, 12 megs of RAM = eight-minute replays, 16 megs = 16 minutes, and 32 megs = 48 minutes...roughly. A Rendition board will considerably reduce the initial replay capacity, I suspect because this chip uses some RAM to store object textures.)

The Big Picture

No matter what video circuitry you've got, you'll want the biggest color monitor you can afford. The larger the image in front of you, the deeper you're drawn into the sim. While a microfine dot-pitch (anything finer than .028-in.) will make the picture look sharper, you don't actually need any higher resolution than *CART Racing*'s maximum (SVGA's 640 x 480 pixels). Because there are no reliable objective specifications for subjective qualities like color richness, I'd take a long, hard look at any monitor you have under consideration. Are the colors vibrant without bleeding? (Red smears the worst.) Are the whites pure? Are the blacks deep? This may sound more appropriate for a laundry-detergent commercial, but do your homework—you may be spending more time than you ever imagined staring at this screen. I like the Trinitron tubes the best, but my tertiary awareness of those two irritating horizontal lines never quite goes away.

If you can afford it (ca. $600), a 17-inch monitor gives a much more convincing picture than anything smaller; and a 21-inch display is even more impressive (providing you don't sit too close to the screen), albeit at huge expense—they can cost $2,000...and up. The best compromise might just be one of the new crop of 19- and 20-inch monitors ($900 to $1,100) just now becoming popular again.

Now Hear This

Other than your video gear, the next most important contributor to your "willful suspension of disbelief" is your audio setup...from the sound board to the speakers. I always recommend Creative Labs' tried-and-true Sound Blaster series because they are compatible with more games than any other, although most of the brands supported by the game will also give satisfactory results: MediaVision, Microsoft, Advanced Gravis, etc. *CART Racing* is programmed with full 16-bit

stereo, so you'd be well advised to set up the speakers equidistant from each ear, and angled directly toward the player's head.

You can use self-powered speakers like the Advent corner speakers or Bose Roommates, or route the output from the sound card through a stand-alone stereo (even a boom-box in a pinch), with or without a powered subwoofer. I've also used high-quality headphones and find the sound "stage" (the spread and depth of the sound) is better than any speaker placement I've tried, although there is no "surround sound" as such.

The most fun you can have with your hi-fi setup is to get a ThunderSeat, which is a thinly-padded fiberglass racing seat with a subwoofer cunningly concealed in its base. When you gun the engine or smack the wall, you get a realistic jolt up your spine. I can't say it simulates exotica like the effects of flat-spotting a tire, but it's positively *tectonic* with air combat sims, and it did cure a nasty case of hemorrhoids. Highly recommended. (A low-buck substitute: so-called "Bass Shakers," which are little more than woofer voice-coils—you screw them to a chair, floor, or table to make the surfaces vibrate. I've seen these for about $50 each.

Is Everything Under Control?

The most important peripheral hardware you'll have to choose is whatever you use to control the car: steering, brakes, and throttle. My background is in flight simulations, where your right hand "steers" the plane with a joystick (roll, pitch, and yaw), while your left controls the throttle. Thus, it was natural for me to continue to steer (although in only two directions) with a joystick in my right hand, and use another joystick in my left hand to control the throttle (push forward) and brakes (pull back).

Indeed, this is how many of the world's most competitive sim drivers (and hottest "factory" drivers) set their fastest laps—its advantage is most apparent on quick-twitch road courses—but it lacks the sense of rightness you get with a steering wheel and a pair of foot pedals. There are a number of products to choose from here: ThrustMaster's T2 is a popular and inexpensive choice (I've seen the T2 on sale for under $100 at discount chains), although overenthusiastic driving may

eventually lead to broken springs and worn-out pots (potentiometers). Not to worry; ThrustMaster's customer service is legendary—they will promptly ship replacements, often overnight, and usually for free.

Considerably more sturdy is the TSW, or Thomas Steering Wheel (available direct; see "Resources"), which looks as dowdy as the steering wheel from a 1963 Plymouth Valiant, but which claims legions of enthusiastic fans on CompuServe's hyperactive sim-racing Forum. Recent additions to the TSW include F1-style gearshift paddles, and its use of readily-available parts makes it a tinkerer's delight.

At the high end of the price spectrum is the Extreme Competition Controls setup, which looks like it was swiped from the cockpit of a real F1 car (or an exhibit at the Museum of Modern Art). Designed by architect Andy Cers (who sounds uncannily like ex-pol Robert Dole), the ECC is made of aircraft-grade materials and assembled like a Swiss watch. It's heavy enough that it's the only steering wheel that doesn't need to be clamped to your desk—its heft alone is sufficient to hold it in place. And the wheel rim is not only thickly padded, it's covered with sexy black suede, just like a real Momo wheel. The pedals are also spot on, with a stronger resistance for the brake pedal than the accelerator, for example. I own an ECC and I've never had a moment's regret at having spent more than Burkina Faso's Gross Domestic Product for it. (Would you believe $645 to $1,660...and worth every penny?)

Somewhere in between are CH Products' steering wheels (Virtual Pilot and Virtual Pilot Pro) and foot pedals. Their "butterfly" wheel was designed as a cockpit yoke for civilian flight sims, so it seems a

Getting By With a Little Help From Your Friends

*One obscure piece of hardware you might want to consider is a so-called scan converter; a "black box" which allows you to view (or record) computer graphics on a TV set or VCR. It plugs in between your video card and your monitor and has a separate output for standard NTSC (American) or PAL (European) television signals. The picture you get on the TV is nowhere as high-res as what you see on your computer monitor (it has only about a third as many pixels), but it will display—and more importantly—*record *game play from the cockpit view, something you can't get from* CART Racing*'s otherwise unimpeachable replay function. This is invaluable when you want to review what you've*

been doing; not just how swashbuckling you look zooming around the track, but noting all the data on the instrument panel that you've been too busy to look at while you've been driving. You can slo-mo your VCR and get precise information on tire temps, Vmax (top speed) at the end of the straights, turn-in points, speed in the turns, etc. Of course, you could accomplish the same thing with a friend looking over your shoulder while you drive, telling you what you need to know, but a scan converter allows a more detailed look...and at your leisure. These gizmos can cost as little as $100 (with a blurry picture and a lot of flicker) or as much as $2,000 for near-broadcast quality TV.

little out of place in a driving sim (the in-and-out wheel stroke has no conceivable application for desktop auto racing, and in fact is distracting). The CH pedals may be rigged for either throttle and brakes or an airplane's rudder.

The arguments rage over whether a wheel and pedals are better than a pair of joysticks (one oddball alternative is a joystick and a pair of pedals), but regardless of the on-track performance—which I believe evens out over time—most players will feel a lot more at home with a wheel and pedals. And have a lot less explaining to do when friends drop over and start asking pointy questions.

Theoretically, you could drive the car with a game pad or a mouse (or even the keyboard), but that would make you a weenie in my book...and this *is* my book.

Further down the road, when you get into online activities, your choice of a modem may become important. The game supports only 9,600 baud, but you'll want something capable of handling something more (28.8K is common nowadays) so it isn't straining at its limit at 9.6K. Almost any modem is as good as any other here (fancy error-correction algorithms are turned off for multi-play), but U.S. Robotics is the de facto standard simply because it's cornered the lion's share of the market for home-computing modems. One caution: if your computer is more than a year or two old, it may not have the newer 16550 UART chips in the serial ports' path. If you have a copy of Microsoft's *Diagnostics* (it comes with Windows; look for "msd.exe"), run the utility and check the COM ports. If it says you've got 8250 UARTS, disable the on-board I/O and get an add-on I/O card with 16550 UARTS, preferably an I/O card with a game port on it as well.

DSVD (simultaneous voice and data) modems are all the rage at the moment...despite the fact that there are no universal standards for this feature. In fact, I've got one, but haven't been able to try it out because I don't know anybody else who has an identical model (a necessity in the absence of standards). The idea of being able to taunt your opponent (or even engage in polite online banter) has some appeal, but if I want to speak to anybody during a race, it will probably be my pit crew. On a "secure" channel.

Two Game Ports are Not Better Than One

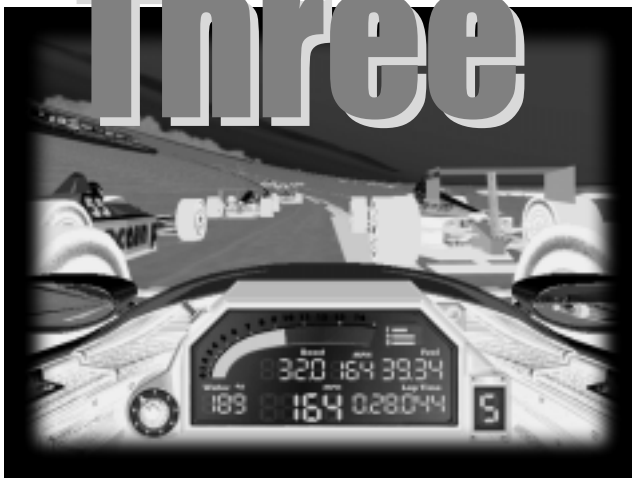
You should have only one game port enabled at a time, or you'll get extremely erratic performance from your controls. But just because you can't find a game port's D-shaped 15-pin connector (a "form factor" it shares with MIDI music connectors) doesn't mean the electrical circuitry isn't present and active, nor will any diagnostic software I know of irrefutably detect the presence of unwanted extra game ports. Many sound cards also have game ports, and some computers have game ports on the motherboard which cannot be disabled (most often those with the Vibra sound chip). If you suspect a second port is messing up your game controls, you will have to ferret it out manually.

If you want to add a discrete game port, the two I'd recommend are CH's Gamecard III Automatic and ThrustMaster's ACM. Both will handle the high-speed buses in today's computers. The CH adjusts its response automatically, while the ACM has a "volume control" at the end of a 3-foot cable which allows you to adjust its sensitivity to match your machine's, a feature that *appears* to be disabled in Windows 9*x*...but isn't. Go figure.

Okay, now that your equipment is up to speed, let's get *you* up to speed.


C·A·R·T
TM

Chapter Three



Race-Car Driving 101

Getting in the Groove

Welcome to Camp Papyrus—boot camp for future *CART Racing* winners. No, this isn't one of those skinhead paramilitary operations where recruits are called "Maggot," forced to eat live rattlesnakes, and consigned to peeling potatoes and swabbing latrines. You'll be treated with respect, but if you enlist for the duration, you'll be guided through a series of simple-minded but character-building exercises involving many lonely laps of an empty race track. We'll start off with some "chalk talk," followed by on-track instruction, and culminating with a full-blown Rookie Orientation Program, where your goal will be—for the nonce—consistency, not speed.

And just so you don't think I'm one of those armchair generals who wouldn't stoop to do what he demands of his troops, I'm going to be going through Basic Training right along with you. Not that I haven't passed most of these tests before, but I'll be doing it all over again, starting from Square One. Along the way, I'll share my results with you, but if my numbers don't tally precisely with yours, don't sweat it. Racing is still more art than science, and even the experts can't always duplicate results. Ballpark figures count for more than metronomic accuracy. Keep your eye on which way your figures are trending; where you're going is more important than where you are.

However, just so we're all singing from the same hymnal, let's make sure we're all starting from a "clean" (i.e., unmodified) installation of *CART Racing*. That is, if you've already played the game a bit, and have altered any of the original files (particularly any of the setup files), or have deleted anything like the original car set, I strongly suggest you rename the default subdirectory (C:\CART) and reinstall the game, or install a fresh version under something other than the default subdir (like C:\BOOK). Later on, if you're handy with file-management utilities, you can combine the best setups, say, of both, and "recycle" the superfluous installation.

Finding the "Sweet Spot"

There's no real secret to going fast. If you just keep lashing around a circuit—*any* circuit—eventually it will come. So the first objective of these lessons is simply to put in enough "seat time" that you can drive comfortably (suggestion: drive in your stocking feet) and confidently, without having to make cognitive, left-brain decisions at every turn. That is, when your accumulated experience crosses a certain threshold and your driving becomes right-brained (i.e., instinctive), you'll find yourself going fast without any conscious effort. You'll have discovered the "sweet spot" common to every sport. If you play anything long enough (even the theramin), eventually you punch through all mental resistance and enter what athletes call "the Zone," performing better than you (or your detractors: hi, Dad!) ever imagined you could. It's as if—for a few laps, anyway—you can do no wrong. All it takes is practice, practice, practice.

Computers are patient instructors. They adjust themselves to your schedule, never get tired, and will cheerfully give you as many make-up classes as you want. There's no emotional component; you never have to feel bad about screwing up. Compared to real-world race-driving schools like Skip Barber's (where the guys from Papyrus polished their real-world driving chops; see "Resources"), your sessions never get rained out and you could buy a whole new computer for what you'd have to spend on a week's worth of pseudo-racing...never mind the motel bills and buying rounds after hours while "bench-racing" with your buds. Best of all, on your computer, you're encouraged to drive faster than you've ever dared, with no fear of speeding tickets, broken bones, or expensive repair bills for equipment you've trashed. Just hit "Shift-R" (reset) and the world is made right again.

The first mistake most newbies make is jumping from track to track trying to find one where they're instantly fast...which doesn't happen any more often than waking up one morning and discovering you've learned to play the piano in your sleep. *CART Racing* has a steep learning curve, so the first thing you'll need is the patience to match your computer's. It may seem insultingly obvious, but before you do anything else, you owe it to yourself to read the game's excellent instruction manual...from cover to cover. You may not understand everything in it, but it's as good a place as any to start. *This* book is not

a substitute for the manual, but it will cover many of the same points, albeit from a different point of view.

Basic Training at MIS

So, in part to avoid the sting of repeated disappointments, we're going to settle in at one track and learn it (so thoroughly that you could probably drive it with your eyes closed) before moving on to the next one. I've chosen Michigan International Speedway as our "home" track. Later on, we'll move to the other ovals, in ascending order of difficulty. Finally, we'll move the whole school to Laguna Seca and cover the basics of road racing before tackling the street circuits, which may not be the hardest tracks to learn, but are surely the easiest tracks to crash out of.

I've chosen MIS to begin your training despite the fact this so-called "superspeedway" is unlike any other track in the sim (although in the real world there are near-duplicates of MIS in Texas and California). MIS is a relatively easy track for novices to learn...and I'll show you a neat trick that makes it even easier to drive. MIS is a two-mile, D-shaped "tri-oval" set in the Irish Hills about an hour west of the Motor City (home of Belle Isle's Detroit Grand Prix), with a ruler-straight backstretch and a gently curving front "straight" connected by two high-banked turns at either end.

MIS is a big, open track. It's wide enough to race through the turns three abreast, so on an empty track there's enough room to sweep through the turns staying close to the racing line (or "groove"), which is clearly marked with pre-programmed tire skid-marks. This means there is also plenty of room to recover from minor mistakes without clouting the outside wall or spinning into the infield grass. Finally, the sight lines are long—you don't have to remember (or guess) where the road goes the way you do on tracks with big elevation changes (the approach to Laguna Seca's Corkscrew, for example, is completely blind; even on an oval like Nazareth, you can't quite see over the brow of the hill). At MIS, because of the banking, the road rises up to meet you, and you can see far, far ahead.

Eventually, you'll learn to lap MIS at average speeds approaching 240 mph, touching almost 250 mph on the back straight and taking the

turns at over 220 mph. (Just be glad you're not doing this in real life—the centrifugal forces are crushing; over four "G's" in the turn—a 175-lb. driver is pushed into the seat as if a 600-lb. weight has been dropped into his or her lap.)

We're going to start out a *lot* slower.

Let's assume you've successfully installed the game (if not, help from Papyrus' friendly customer-service reps is as near as your phone, fax, or modem; see "Resources"), have launched the game in VGA or SVGA mode, and after sitting through the opening "cut scene" are presented with the initial menu screen. This also assumes you've already calibrated your joystick(s) and/or wheel and pedals...if they're connected. If you haven't—or if the calibration has changed—the program will prompt you to do so and *then* present you with the Main Menu.

Choosing the Right Stuff

Select Driver Info and give yourself a moniker, nickname, hometown, and team name. Now you have to choose a chassis, an engine, and a tire brand. Papyrus has always been coy about the exact differences between the engines (Cosworth, lately rebadged Ford; Mercedes; and Honda), the chassis (Reynard, Lola, and Penske), and the tires (Goodyear and Firestone). In the absence of any hard information about these choices, my unsubstantiated opinion is as follows:

The Lola appears to be the fastest on the ovals, particularly at Michigan, where aerodynamics are a primary consideration. The Penske seems to be the easiest to drive on the natural-terrain road courses, although its handling is somewhat ungainly on the street circuits. The Reynard feels like the most nimble in the tight confines of the street circuits, but somewhat twitchy on high-speed sweeping bends.

Honda's V-8 has very strong acceleration, but a narrow band of usable power, making it suitable on ovals with little speed variation (Michigan, Milwaukee), or road racing setups with very close-ratio gears. The Mercedes seems to have a wide band of mid-range torque, but falls short on high-end horsepower, making it ideal for tracks which demand a lot of punch coming off the turns (Portland, Mid-Ohio), or

setups with wide gear-spacing. The Cosworth is at its best on ovals, with an exceptionally strong top end (although its power seems to max out at a lower rpm than the Honda's).

The Goodyear tires seem to take longer to get up to operating temperature (a factor at the start of a race, or after restarts, or tire changes), but have more ultimate grip than the Firestones...and they seem to last longer, a factor in full-length races.

You could choose a different combination for every track (and indeed, if you're trying to set lap records, this is the only way to fly*), but

*Purists will tell you that in real life, no Penske was ever powered by a Cosworth or a Honda (although they *have* raced on Firestones), so if historical accuracy is important to you, your Penske should always have a Mercedes in its engine bay.

but my recommendation—for now, at least—is to start off with one combination and stick with it until you can actually *feel* the differences in chassis, engines, and tires, and not attempt to judge by lap times alone. Reason: the differences may be too subtle to feel at first, but they could be enough to throw you off your game without your knowing why.

My choice for the best all-around beginners' combination would be Reynard/Cosworth/Goodyear. If the Reynard feels too "nervous," try Lola/Cosworth/Goodyear. But don't be deceived into thinking that any combination is a substitute for practice; the ultimate difference in the lap times of any combination at any track is probably less than one percent.

Wheel & Pedals vs. Joysticks

If you haven't already done so, go to the Controls menu from the Main Menu and set up your control devices. I'd avoid using the keyboard for steering, but if you have only one joystick, you're probably better off using it for steering only, and using two keys on the opposite side of the keyboard (the left side, assuming you're steering with your right hand) for throttle and brakes, rather than using the

joystick for both steering (left and right) and throttle/brakes (fore and aft), although a fair numbers of players make do with this arrangement.

The preferred method, as I say, is a steering wheel and pedals. This looks right and feels right for most players, although the argument has been advanced that because your hands almost certainly react faster than your feet, you're better off with two joysticks—one for steering and the other for throttle and brakes. If you're also a flight simulation fan, you may already be set up with a left-hand throttle and a right-hand joystick, and if you don't want to get hopelessly confused, you may want to stick with this.

For now, you don't have to worry about shifting (we'll choose an Automatic Transmission in a moment), but--thinking ahead—you may want to select shifter controls; usually the "Fire 1" and "Fire 2" buttons on Joystick 1. Some wheel and pedal setups (like the ThrustMaster T2) have a separate gear shifter, and some have buttons on the wheel spokes (like the ECC), or Formula One-style "paddles" behind the wheel. It's your call, but the obvious choice is the right side for upshifts and the leftside for downshifts (mimicking the positions of the right-foot "go pedal" and the left-foot "slow pedal").

If you've got a joystick, select Non-Linear Steering (vs. Linear Steering for a steering wheel). Reverse gear should be somewhere where you are not likely to hit it by mistake, but handy enough that you can get at it in a hurry (like when you spin into the path of the on-rushing pack). Now calibrate the controls according to the manual and you're all set. (If you're using the ThrustMaster ACM game card, you'll need to recalibrate the controls every time you move the speed-sensitivity dial, at least in DOS. The game will prompt you when you launch the program.)

Two more beginners' mistakes. If the menu highlight is scrolling like crazy, press the "J" key to make it stop. And when you want your pit crew to spring into action when you come into the pits, remember to use the *brake* to stop, not reverse gear.

Now go to the Realism menu and select "10%" for Race Length (although for now it doesn't matter; your first race is still far in the future); "Off" for Car Damage; "Off" for Breakdowns, Yellow Flags, and

Pace Lap; and "Constant" for Weather. (If someone has fiddled with the weather selection, you might want to reset the ambient temperature to 70-ish and the wind to zero.)

By the way, when you're finished with a menu, you don't have to press Done unless you want to; just hitting "Esc" (Escape) will safely save the settings *and* exit the menu, saving you a keystroke.

Since you won't be taking on any opponents just yet, you can ignore the Opponents menu. From the Driving Aids menu, select Automatic Shifting. I'd recommend Manual Braking for now, although you may want to try Automatic Braking when we move on to road racing. For the most part, I find Automatic Braking confusing; it cuts in and out unexpectedly...unlike Automatic Shifting, which shifts up at precisely 13,000 rpm (or 13,500 rpm, depending on which chassis/engine "package" you've chosen).

Avoiding "Auto" Graphics

The choices on the Graphics menu are critical because—as explained in the previous chapter—they have a huge effect on frame rate, and frame rate is the key to car control. I strongly recommend turning Skids/Paint on, because the tire marks on the track are essential for visualizing the groove. The tire tracks never change (in reality, they would get darker the more rubber is laid down by race traffic), so they are unvarying indicators of where to aim (and when to brake), even more so than the trackside graphics (advertising signage on the ovals and braking markers—"3," "2," and "1"—on the road courses), which may be obscured by competitors' cars once you're in a race.

The one thing you *don't* want to do with the Graphics menu is leave anything on Auto—you want each feature either on or off. Reason: Auto actually slows the frame rate because your computer has to make an extra calculation for each and every frame. That is, it has to ask itself, "Do I turn this feature on or off for this frame? and then repeat the calculation a fraction of a second later for the next frame, thus eating up even more CPU cycles. In any case, you don't have to make a final selection now; during game play, you can toggle through each feature with the number keys ("1" for grass texture, "2" for track texture, etc.; as explained in the manual).

The Increase/Decrease Min. Frame Rate numbers only come into play when you've selected Auto for any of the graphics features. Eventually, you may want to fine-tune the frame rate by setting all these features to Auto and playing with the Increase/Decrease Min. Frame Rate numbers, turning on the frame-rate counter ("Alt-F" for DOS and Windows; "Alt-R" for the Rendition version) and watching the features (like grass texture) pop on and off as the image complexity goes up and down (more detail slows the frame rate), and *then* deciding which features you can do without. But for now, permanently disable features you don't need until you get a frame rate that hovers around 15 fps or higher. In general, you need a fast Pentium to run the game with SVGA graphics (the "-H" switch from the command line or a Windows 9*x* shortcut). If you have an old Pentium or a 486-class PC, you're better off dropping back to VGA graphics and raising the detail level. Rendition users can turn on all the detail without suffering a performance "hit" with almost anything faster than a 120-MHz Pentium.

On the other hand, the levels in the Sound menu aren't mission critical...provided you can hear the onset of tire squeal (the best indicator of an incipient skid). Personally, I can do without the music altogether. [Beginner's mistake #4: "I only hear the announcer when I start the game." That's because "I'm So-and-So," and "From Papyrus, this is CART Racing" during the opening cut-scene is the only thing the announcer says in the game...period.]

Now we're almost ready to get going, but first I'm going to ask you to make a couple of small adjustments to your car. In the next chapter, we'll tackle the whole process of tuning the chassis for speed, but for now I want you to *detune* your car to make it more drivable. The idea of making the car one iota slower than the game allows will be met with shock, resistance, and outrage by any red-blooded American who grew up listening to Sammy Hagar's "I Can't Drive 55," but if you want to drive faster, first you've got to learn to drive slower. Or, as they say in NASCAR country, "The hurrier I go, the behinder I get."

K.I.S.S.

The ideal way to learn the racing line would be to slow the clock down and run the track in slow motion...and indeed, in real life, drivers often *walk* the track before practice begins. In the absence of these

options, the next best thing is to reduce your engine's maximum power, so driving the car is more like riding a pony at a petting zoo than being turned loose on an unfamiliar jumping horse at a steeplechase. I am deeply indebted to Lane Charnes, the genial sysop of CompuServe's auto-racing sim forums for this tip—its genius is in its simplicity: **turn down the boost!** Lowering the boost from "9" on the dash-mounted dial to "1" solves the rookie's most vexing problem: car control. With less power, you can practice far more enjoyably and productively than by stumbling through a fruitless cycle of crash and reset.

Normally, you would only down the boost during a long race to conserve fuel. (In real life, drivers nowadays leaves the boost alone and lean out the fuel-air mixture for economy, but that's another story.) Boost is measured in inches of mercury (Hg.) as measured by the top-left number on your digital instrument panel. Normal atmospheric pressure (i.e., without any boost) is about 30 inches of Hg. (equivalent to 14 pounds per square inch), as you can see when your car is at rest in the pits. As you accelerate, the exhaust-driven turbine spools up and pumps extra air into the engine, up to a maximum of about 45 inches (an extra eight psi, or about the same boost level as my old Saab Aero). The dash-mounted boost-control dial (just to the left of your digital LCD) is graduated from "1" to "9," with each click representing one inch of boost. At "1" (or 37 inches), your engine is producing only about 150 less horsepower than when it's at "9." At Michigan, when the boost is at "4," your lap speeds will drop by only about ten mph; so at 230 mph, you shouldn't exactly feel like you're tied to a post.

Something else that may make you feel better: in real life, since 1994, CART cars at MIS have been allowed only 40 inches of boost (equivalent to "4" on the dial), so practicing at "1" (37 inches), you're only giving away another 90 horsepower or so. In return, you get a car that you can drive flat-out all the way around the track, without lifting (although the "pucker factor" will incline you to feather the throttle during your first few practice sessions), thus allowing you to concentrate on learning the racing line, which is what this chapter is all about.

So, from the Main Menu, select Preseason Testing and then choose Michigan as the track. In addition to lowering the boost, I'm going to

ask you to make two other minor changes from the Garage menu. Under Options, go to Load and select the "EASY" setup if you haven't done so already. Next, go to Fuel and reduce the amount to 25 gallons. (With a full 40-gallon load, your car will feel sluggish and unresponsive.) Finally, go to Gears and increase the value shown for sixth gear (which should be at 4.4) to the value shown for fifth gear (which should be at 4.7) to compensate for the lower boost level. [N.B. This isn't critical. If you've accidentally altered the "EASY" setup, or you've downloaded a rookie setup from an online service; almost any setup with a top gear of 4.50 to 4.90 will do. Even if you wildly over-rev the engine, it probably won't burst, thanks to the lower boost.]

Now you shouldn't have to go back to the Garage (unless you need to adjust the steering sensitivity) until we get into chassis tuning in the next chapter. When you exit the track, the program remembers your last setup and reloads it when you return. If you want to be on the safe side, you can go back to the Garage/Options menu and Save your practice setup under a unique filename (like "PRACTICE" or "LOWBOOST"). Be careful here: if you save it as "EASY," you'll over-write the earlier "EASY" file and loose the original setup values—not a good idea.

Let's Rock 'n' Roll

It's show time! Hit "Esc," go to Testing (or Resume, if you've already snuck in a few laps), and you'll be sitting in your car, in your pit, engine idling, ready to roll. Press the "K" key five times until the boost dial reads "4" (if you overshoot, hitting the "L" key increases the boost). The boost shown on the dash display will remain at 30 in. until you've been under full throttle for a few seconds, when it should peak at 40 inches. If it goes higher, tap the "K" key again. If it never reaches 40 in., you're probably not getting full throttle and need to recalibrate the control.

Unlike the other settings, the program doesn't remember your boost level. As long as you stay in the game, the boost will remain where you set it, *even if you go to a different track.* However, when you exit the game, the boost setting is lost, so you have to remember to reset it to "4" (from the default of "9") every time you start the game. If you don't, and if you have shortened sixth gear (made it numerically

higher), you'll probably over-rev the engine and blow it. If so, hit "Shift-R" and reduce the boost to "4" the next time before you leave the pits.

To get out of the pits smoothly, squeeze on the power gently and turn the steering wheel gingerly, following the pit road as it curves around to the left, When the pit wall on your right ends, let the car's momentum carry you over the white line that divides the apron (or "warm-up lane") from the banking going into Turn 1. Your speed through the pits doesn't matter now, but during an actual race, you'll have to keep it under 80 mph or you'll be disqualified. If you've selected Auto Brakes, a speed governor will prevent you from exceeding 80 mph until the pit road becomes the warm-up lane, at which point (if you've got the pedal to the metal), your car will surge forward. If you want to see the effect of this, hit "Alt-B" to toggle Auto Brakes on and off (noting that it won't slow your speed entering the pits, only traversing Pit Road.

When you come up onto the banking, you'll see your car tilt. You should ease off the throttle for this transition—it can be discombobulating enough to throw the car into a skid—but once you're on the banking, gradually increase the throttle until it's wide open as you're going down the backstretch. Straighten the car out and take your hands off the wheel (or joystick). If it "pulls" to the right or left, you probably haven't calibrated your steering control properly.

Let's See Some ID

I'm loathe to even mention this, but if you press the "F10" function key, there are not one but two arcade views. These have no role in a serious sim; they belong in a video arcade, and if you think otherwise, you're age is in the single-digit range or you're a marketing wonk. Or both. How anybody can control a racing car from a bird's-eye view is beyond me, but every kid—including my own—seems to want to. I will grant you that it does allow you to see slightly farther down the road, an advantage when you're still trying to memorize a complicated circuit (like Detroit or Cleveland), but to me it feels like driving a stage coach, Moreover, just when you need it most—plunging down the Corkscrew at Laguna—your car momentarily disappears! (A well-known glitch that has eluded Papyrus' byte doctors for years.) My advice: stay in the cockpit; it's the preferred view of every race-car winner since the invention of the wheel. If you insist on an out-of-body experience, check out the Rear Chase View in the replays.

It's Your Turn

One of the stranger conventions of oval-track racing is the confusing nomenclature of the turns. Any casual observer eyeballing MIS will see only two actual turns. Real racers, however, count four. Turn 2 is merely a continuation of Turn 1. Turn 3 is the entrance to the turn at the end of the back straight, while Turn 4 is the same turn's exit, which blends imperceptibly with the curved front "straight." Note that Turns 1 and 2 comprise a decreasing radius turn (which gets tighter the deeper you get into it), while Turns 3 and 4 "open up" as you go through them.

As you approach the end of the backstretch, keep to the righthand side of the road, near the outside wall, and *roll* out of the throttle (don't simply let it slam shut) as you cautiously steer to the left, trying to follow the general mass of the black tire marks that sweep into Turn 3. As the solid white line at the bottom of the turn disappears behind your left front tire, *un*steer a bit (don't actually steer right; just unwind some steering lock), stabilize the car, and attempt to keep the white line in the same position relative to the LF tire until you sense that the turn is opening up, then let the car's momentum carry you back across the track toward the wall.

That's the ideal, anyway. Beginner's mistake Number 5: sawing away at the wheel in a demonic frenzy. Racing is all about smoothness, and if you watch the masters (real or virtual) at work, you'll be struck by their economy of motion. They make no unnecessary movements, and they're inclined to live with small mistakes rather than take wild swings at rectifying them. Take a small cut at the steering, observe the effect, then make a single, tiny correction (more or less lock). If you try to chase the car all over the track, you'll eventually run afoul of what the fly guys call "PIOs," or pilot-induced oscillations. That is, each attempt to second-guess yourself will make things worse until you spin or crash.

For now, don't worry about spinning or crashing. If you hit the wall and bounce off, keep going—again, with as little wasted motion as possible. Sometimes, though, the car won't bounce off; it will rub along the wall as if it was welded to it. This is unique to *CART Racing*;

the cognoscenti refer to it as “wall glue” and it won’t let go until your car is at an almost complete stop. Don’t fight it. Until you learn to avoid the dreaded wall-glue altogether, you’re better off hitting “Shift-R” and starting all over again.

If you spin (the most common cause: coming down too low in the groove and putting the LF wheel onto the grass), and if you’ve activated the Spin Recovery feature, just ride it out and the car will reorient itself pointed in the right direction after you’ve come to a stop. If you come to rest on the grass, use the throttle *very* judiciously until you’re back on the blacktop, or you’ll spin the wheels and loop the car again. If you get frustrated, simply hit “Shift-R” and you’ll be instantly back at the beginning of the session. Your mother was right: anger never got anybody anywhere.

Beginner’s mistake Number 6: Although at low boost levels you shouldn’t be going fast enough in the turns to induce oversteer (“loose”) or understeer (“push”) is the *technical* sense of the terms (see next chapter), in the popular vernacular, you may literally be “over steering” the car. That is, you may be turning the steering wheel too much or too fast or both, putting the car into a spin (or the grass, which amounts to the same thing—see above). Eventually, you’ll learn to feed in steering lock as delicately as “licking honey off the wings of a butterfly” (as somebody said in another context), but if you feel as if you are over-controlling the car, here’s a temporary cure: Go to the Garage, and under Suspension, reduce the value of the Steering Lock from 16 (the default for the “EASY” setup) to 10 or 12. This will make the steering “slower” (i.e., less sensitive); so slow in fact that your car won’t be nimble enough in traffic later on, but slow enough to keep you out of trouble while you’re learning. If this works for you, you may save it by overwriting your beginner’s setup, or—better—by saving it under a unique filename like “SLOSTEER.”

Ho-Hum, Guess I’ll Turn In

Let’s get back to the “groove.” Although slicing through Michigan’s wide turns—staying with the tire tracks that mark the racing line—looks like (and should feel like) one smooth, continuous motion, racers divide it—conceptually, at least—into three distinct phases: turn-in, the apex, and the exit...of which turn-in is by far the most critical for newbies.

Turn-in (which is also, confusingly, defined as how crisply the car responds to steering input) is defined here as the transition point between the straight and the corner. There are several ways to initiate the action. For now, you don't have to worry about braking first (you'll have to learn this later for road racing), but you still have some variables to consider. A fast, aggressive turn-in? A quick snap of the wheel? No, at MIS you turn in very gently. Do you come off the throttle...and *then* turn in...or storm through with the hammer down? Neither. The mere act of turning-in will scrub off some speed, so you turn in first, then "steer" with the throttle. Too much throttle and your car will run wide (without adding more steering lock, which would scrub off still more speed, which is self-defeating). Too little throttle and you won't carry enough speed through the turn (i.e., you'll exit low and slow), and your average speed will drop like a rock.

Doug Arnao, a real-world racer with a black belt in *CART Racing*, defines the apex as the point where you stop entering the corner and start exiting it. For most of us, it's simply the lowest point of our arc through the corner—where we're closest to the white line that separates the banking from the apron. The apex is also the earliest point where you get back on the throttle to power out of the turn...unless you've made a mistake in your entry and are still wrestling with the car for control. Either way, the apex is usually the slowest point in the corner. Finally—as a point of reference—the apex is also the boundary between Turns 1 and 2 and between Turns 3 and 4 (at MIS, anyway).

Getting the Power Down

The key to good lap times is how soon you can get back full-time on the power...without having to make major steering corrections, or running wide and scraping the wall. Thus, the first thing you need to learn is not how fast you can arrive at the corner and still survive, but rather the earliest moment at which you can start getting back on the throttle to maximize your exit speed. To practice this, just cruise around the corner low in the groove ("against the fence" in horse racing terms), and at the earliest moment—in your judgment—squeeze on the power and don't back off until you either smack the wall or shoot off down the straight under full power. If you do hit the wall, move your apex farther around the turn (i.e., delay the point at which you floor it). If you never come close to the wall, put the power down

sooner. When you get it right, make a mental note: that's your apex. (When you get it right, you'll know it: it feels great.)

The second part of this exercise: finding your turn-in point. Barrel down the preceding straight as fast as you can, and at the last possible moment—in your judgment—roll into the turn and out of the throttle. If no amount of steering lock can "pull" the car down low enough to connect with your apex, you're coming it too hot...in which case, back off sooner, back off more, turn in sooner, or any other combination of the above that results in hitting your mark (the apex). If you come down too low in the groove or too soon, you're not going fast enough. When you get it right, a light will go on over your head, bells will ring, the heavens will part, and the finger of God will point directly at you—it's Perrier-Jouet time.

[N.B. Don't assume there is any static steering wheel position that's just right for any given turn, even one with a constant radius. Most drivers make steady wheel corrections—in both directions and at variable rates—all the way through the turn. Just don't overdo it.]

The only difficult part of this is repeating it. MIS is so vast that it's hard to remember exactly where you did what. (Also, when you get one corner right, it will increase your arrival speed at the next one, necessitating further adjustments.) While the tire marks are the best indicators of your position on the track (in my opinion), you may also use trackside features like the trucks parked in the infield, irregularities in the wall, or the billboards around the track. Marc Nelson, another *CART Racing* expert, likens the turn-in point to a key-hole—it's always in the same place; the trick is memorizing its location. Let's take a closer look at how it's done at Michigan.

Michigan Under a Microscope

There are four "event horizons" around MIS: 1. The turn-in for Turn 1 (where your timing is more critical than your lateral position on the track), 2. the exit from T2 (where the wall looms up on the right), 3. the turn-in for T3 (where your line is more critical than your timing), and 4. the exit from T4 (there's an invisible "kink" here—just when your car should be aimed down the front "straight," it snaps to the left at the transition point between the steep (18 degrees) banking of T4 and the gentle slope (12 degrees) of the front "straight."

Of these, the turn-in for T3 is the most difficult...and the most important. It's on an especially featureless part of the track. If you have to err on one side or the other, I'd turn in sooner rather than later, if for no other reason than because later on, when you're racing in traffic, taking the tighter line will block competitors from trying to pass you on the inside (go wide and they'll pass you on the inside like a freight train). Here, I'd come in low, between the tire marks and inside white line. Conventional wisdom says you should back off first and then turn in, but I prefer to turn in first, let the car "settle" (as its weight shifts to its outside wheels), and *then* ease up on the throttle. It makes for a smoother transition, in my view.

The exit from T4 is difficult, too. First, your car has a tendency to run wide, so rather than losing speed by backing off, you crank in more steering. Beyond a certain point, the car simply stops responding to further steering input. Then, if you've avoided the wall, just when you've cranked in all your steering lock, you hit the kink, your front tires suddenly regain traction, and the car shoots across the road to the left, sometimes all the way across the apron and onto the grass. Grrrrr! You eventually learn to "spill" a little bit of steering lock here without devoting any conscious thought to the process.

Because the front straight is really a gentle bend, if you stray too far to the right, you'll find the wall keeps curving around to meet you, so you want to stay in about the middle of the road until you cross the Start/Finish line, then let your car drift toward the wall until you see the tire tracks building up going into T1. Your turn-in should be a bit more aggressive than for T3. As you swoop down off the banking, gravity will help prevent you from scrubbing off speed as you head for the apex, but as the banking flattens out coming off T4, your speed will drop, and your exit will tend to be inside and slow. If the turn-in for T3 is the first thing you learn at MIS, not losing speed coming off T2 will probably be the last.

Beginners mistake Number 7: Hugging the inside all the way around the track. True, it's the shortest distance (and it feels the safest, because you stay away from the big, bad walls), but it's not the fastest line. The whole point of following the groove is to "straighten out" the turns; that is, to keep your speed up the most by turning the steering

wheel the least. Your lap speeds would be even higher if you could go around without turning the wheel at all (as you could if the banking were parabolic rather than flat), but that's not an option.

Whatever Goes Around

It shouldn't take more than a couple-dozen laps of driving at this level to grasp the principles involved, so just keep on lapping the track until you feel like you could keep it up all day...or until you ran out of fuel. Once you get the hang of it, you'll be able to tear your eyes away from the road long enough to sneak a peek at the instruments. If you're doing it right, you should be seeing best laps of 214-216 on your pitboard (which unfortunately pops up just as you're setting up for T1) or about 34 seconds on the dash-mounted lap-timer. At the end of the back straight, you should be seeing a Vmax (top speed) of about 220 mph. Your Vmin (slowest speed) should be about 205 mph at the transition between T1 and T2 and between T3 and T4. Your speed as you cross the S/F line should be about 215 mph.

How the Good Ol' Boys Do It

Those of you fortunate enough to own Papyrus' other best-selling sim, NASCAR Racing 2, *may find your stock car experience will better prepare you for CArt cars at MIS...and vice versa. You'd think that after driving the single-seaters for a while, jumping into a stocker would seem as slow as driving underwater. Conversely, after flogging the big iron around the tri-oval, getting back into carbon fiber would seem as far out as the* Millennium Falcon *at warp speed (the stock cars are about 60 mph slower all the way around). But what you come away with is more than merely mutual admiration; you can benefit from the synergy of cross-*

[N.B. This is where having a friend looking over your shoulder and calling out the speeds at each point on the track is useful. Or having a scan converter (see previous chapter) if your friends don't have the patience. Looking at replays—particularly the overhead Blimp view—will tell you if you're following the groove indicated by the tire tracks...but it won't tell you what your speed is.]

So much for the Rookie Orientation Program. Now for your final exam.

Part 1. Hit "Shift-R." Pull out of the pits and take a couple of laps to work up to speed. Your tires will be cold for the first couple of laps, which will make them feel "greasy" until you put some heat into them.

training discipline. From stock cars, you learn the importance of getting the power down early. From CART cars, you learn to finesse your line coming into the turns. In slow, out fast. Check it out.

The only other comparisons between the two sims (unless you download the shareware that allows you to convert the one games' tracks for the other's use—see Chapter Ten: "Really Advanced Stuff") are at Louden (NH) and Phoenix (AZ), where both kinds of cars race. But at the shorter mile-ovals, the disparity between driving techniques for CART cars and stock cars is so great as to render comparisons meaningless. At MIS, though, it's a revelation.

(Leave the tire temps on the screen—hit "F4"—until they settle down.) Do 25 continuous laps, trying to keep your lap speeds between 210 and 212 mph (the "F1" key will show your last lap's speed, your best lap since you began the session, and how many laps you've completed since your last "Shift-R" reset). If you spin or crash, and can extricate yourself and continue, do so. If you get stuck, hit "Shift-R" and try again.

Part 2. By now you should be brimming with confidence. Touch the "L" key once to raise the boost to "2" (38 inches), and repeat the exercise: 25 continuous laps. Only now, try to maintain an average between 212 and 214 mph. You'll have to start your turn-in a little earlier, ease a little further off the throttle, and get back on it a little later. You'll feel a little more "push" coming off T4 (you have to turn the wheel a little more to keep the car away from the wall).

Part 3. Raise the boost another notch, to "3" (39 inches) and do another 25 laps. By now, you should start to feel the car get lighter, faster, and more responsive as the fuel load drops; your final laps should be a couple of mph faster than your first few—say between 214 and 216 mph. You should be able to hear some tire squeal; the quieter the tires, the less speed you're scrubbing off. Are we having fun yet?

Part 4. Yep—raise the boost to "4" (40 inches). You're now at the maximum boost allowed by the real-world rules. If you can sustain lap speeds of 216 to 218 mph, you're within a couple of mph of real-world racing speeds. If you have earlier reduced the Wheel Lock (under Suspension) below 16, you might want to go back to the Garage and raise it; a) because the faster you go, the faster you want the steering to

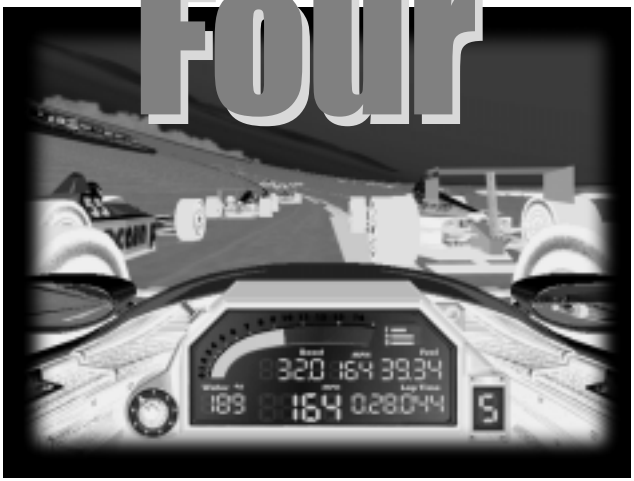
respond, and b) because the more laps you put in, the faster the steering you can handle.

Feels great, doesn't it? If you're one of those obsessive-compulsive types that delved into the Paint Kit (or Paint Shop) and painted the traditional rookie stripes on the back of your car, you can remove 'em, because you're not a rookie any more.

But you're not out of the twilight zone yet. Next stop: learning the secrets of chassis tuning.


C·A·R·T
TM

Chapter Four



Tuning for Speed

The Perfect Setup...As If!

The most valuable lesson you can learn about setups is that there is no such thing as the "perfect" setup. And even of you could find a perfect setup, it would only be perfect for *you*...unless there's somebody else in the world who drives *exactly* the way you do. Most novices assume what works for the experts will work for them, so they pester veterans for their "secret" setup parameters...and then can't understand why a combination that produces a 240-mph lap for a master of the game won't allow them to reach so much as a measly 225 mph.

How come? A perfectly legit question. Answer: mostly because of differences in driving styles...and, to a lesser degree, differences in experience. In real-world racing, drivers who come up through the ranks of karting, like Michael Schumacher (the 1995 F1 World Champion), tend to prefer setups that make their cars handle like go-karts (i.e., stiff as a buckboard), while a driver like Damon Hill (the 1996 F1 World Champion), who began on motorcycles and spent years as a development driver, tends to prefer setups that emphasize maximum mechanical grip and fluidity of line...even at the expense of responsive handling in close-in combat. A driver like Jacques Villeneuve, who came to Formula One from CART cars (where he was the 1995 PPG Champion), is comfortable with low downforce and asymmetrical setups (where each corner of the car is "tuned" individually, rather than in front and rear "pairs"). Needless to day, Villeneuve would probably be uncomfortable with Schumacher's favorite setup, just as Schui would be with Damon's. and as Hill would be with Jacques'. C'est la guerre, eh?

And maybe you think you could hop into Villeneuve's Williams and go fast...not as fast as he could, of course, but fast. Probably not. Chances are, you'd actually go faster with a "training-wheels" setup: high downforce, soft tires, stiff shocks, widely-spaced gears, and slow steering. You probably couldn't handle his favorite real-world setups any better than you could handle his game setups (he's a sim-racing fan), and neither could I.

You'll find, as you go along, that as your ability improves, your

preferences in setups will change, too—from the safe and sane setups we're going to begin with (rookie setups are more forgiving; expert setups become more demanding as they get closer to the bleeding edge), and toward setups customized for the driving style you will eventually embrace. As your driving becomes smoother, for example, you'll find you're easier on tires, allowing you to use either a softer compound for greater grip, or less wing angle for a higher top speed.

Here's what we're going to do in this chapter. I'll take you through each available adjustment; explain what it is, how it works, and what to look for; set up demonstrations to show you what the effects of changing it are; and tell you how to know when you've got it right (which is not as easy to determine as you might think). Then we'll put it all together on the track; once again at MIS. Some variables, like brake balance and gear ratios, don't apply to most ovals; they'll be examined in detail when we get to Laguna Seca.

While you're learning, you'll be mixing and matching these adjustments to build up your overall lap averages at MIS...until your rate of improvement levels off, as it inevitably will. Later, as you gain experience at other tracks, you'll find that when you return to MIS, you can raise the bar another notch (or two). But by the end of this chapter, you'll be plenty fast enough to take on cars in the next chapter, when you'll begin wheel-to-wheel competition.

Keeping Track of On-Track Keepers

The first thing I'm going to ask you to do is set up a database to keep track of all the significant chassis adjustments you'll make. The real-world teams call these "setup sheets" and they're kept for every car at every track and referred to over and over again. If you want to be fancy-schmancy, you can keep a computerized database, with programs like *Excel*, *Alpha Five*, or the old *Q&A*. (There is at least one utility available online which will convert *CART Racing* setup files—the ones with the .STG extension—into Microsoft's *Excel* format.) But unless you have a separate laptop to park alongside your gaming computer, you'll either have to shell out to your electronic database or print out the setup sheets. I prefer a "shoebox" database of 3x5 in. index cards, with 15 dividers to separate the setups by track. Another alternative is a looseleaf notebook, so you can pre-print an 8.5 x 11-in. sheet with blank fields, and fill in the numbers as you go along. The

advantage of a computerized database, of course, is that you're not limited to breaking out the information by tracks, you can compare all your rookie setups, or tire wear vs. tire compounds, or lap times vs. fuel consumption, or whatever. But however you do it, do keep a log. It will not only help you track important bits of hard information, it will also track your progress as a driver.

Here are some fields to make provision for (the essential ones are in boldface...but feel free to add more obtuse variables, such as "Personal Mental Acuity" on a scale of 1 to 10, "Favorable Alignment of the Planets," or whatever"

SETUP SHEET

Track name
Driver's name
Car-set name (if applicable)
Setting filename
Control(s) filename
Date recorded
Weather
RF: Tire **compound**, **inflation pressure** (cold/hot), **I/M/0 temps**, **max. temp.** (observed), **camber angle** (degrees, pos. or neg.), **shock value** (%)
RR: Tire **compound**, **inflation pressure** (cold/hot), **I/M/0 temps, max. temp.** (observed), **camber angle** (degrees, pos. or neg.), **shock value** (%)
LR: Tire **compound**, **inflation pressure** (cold/hot), **I/M/0 temps, max. temp.** (observed), **camber angle** (degrees, pos. or neg.), **shock value** (%)
LF: Tire **compound**, **inflation pressure** (cold/hot), **I/M/0 temps, max. temp.** (observed), **camber angle** (degrees, pos. or neg.), **shock value** (%)
Stagger (inches, pos. or neg.)
Front wing angle (degrees)
Rear wing angle (degrees)
Steering lock (degrees)
Linear/Non-Linear steering
Auto Shifting/Manual
Auto Brakes/Manual

Front sway-bar setting (1-8, from L to R, on the in-cockpit display)
Rear sway-bar setting (1-8, ditto)
Brake bias (1-8, ditto)
Fuel load (gallons)
Fuel consumption (observed)
Boost pressure (if anything other than "9")
Gear ratios (6th-1st, or v.v.)
Vmax (observed)
Vmin (observed)
Speed at S/F line (observed)
Number of laps completed in session
Best lap in session (observed)
Qualifying position (if applicable)
Race position (if applicable)
Race results "saved as" file name (if applicable)
Opposition level (if applicable)
Replay filename (if applicable)
Comments (where appropriate)

If you've got room (on an 8-1/2 x 11 looseleaf page, for example) you might want to double up the fields, making instant before-and-after comparisons possible. Such as: original FSB (front sway bar) setting, new FSB setting, and the changes that result. This is useful if you go "over center" on a setup and want to go back to an earlier, more successful adjustment. Either way, if I were you, I'd fill in the fields with a No. 2 (soft) pencil rather than with indelible ink.

Think Tire Temps

The most valuable tool for chassis tuning is available at the touch of the "F4" function key: tire temperatures. Most novices assume that a stopwatch is the best indication of how well you're doing; that if an adjustment makes you go faster, it must be better. Wrong on two counts. One, until you're a battle-hardened development driver, your lap times won't be consistent enough to draw any valid conclusions. Until they are, you won't be able to tell if a fast lap was because you just got lucky on your last go-around, or because you made the right adjustment. (A good development driver can put together a dozen laps that very by hundredths...or even thousandths...of a second, not

tenths.) Two, lap times don't tell you which way to go with your setup adjustments; tire temps do.

There are three broad components to tire temps. One, the absolute temp of each tire. Two, the relative temp of each tire to the other three. Three—and this is the key factor—the differences (if any) between the temperatures of each tread as measured on the inside, middle, and outer edge of the tire.

First, last, and always (with one or two really obscure exceptions), the result of every suspension change should include "zeroing out" any differences in temperature between the inner, middle, and outer edge of each tire tread. Each tire will be generating its maximum grip only when these differences are zero. Each tire has a so-called "footprint" (or "contact patch") which is the area of the tire that's in contact with the road at any given time. The bigger the contact patch, the greater the grip. To maximize the footprint, the tire must be perpendicular to the road...at that moment. Since the moment that counts is when the car is in the turn, it doesn't matter whether the tire is perpendicular to the road when the car is stationary in the pits...and it doesn't make much difference if the tire is straight up and down when the car is going in a straight line, either.

The Aero Package

The wings on a race car have the opposite intent of wings on an airplane. On a plane, they keep it airborne. On a car, they press down on the car to keep it glued to the road. On a track like MIS, where the turns are steeply banked and taken flat out, you don't need extra downforce so much as you want to eliminate the extra drag that a wing produces, so the wing angles are reduced to the bare minimum (three degrees, in this case), or nearly so. On street circuits with long straights and mostly slow corners, like Australia's Surfers Paradise, the wings can't help much (they provide little downforce below 80-100 mph) but they can hurt the top speed on the straights, so you don't run much wing there, either. But on tracks—ovals or road circuits—with critical high-speed bends and short straights (like Portland, Phoenix, Nazareth, and Cleveland), you might use

In fact, when the car is sitting still, the tires usually lean in slightly at the top. This is called "negative camber." (Positive camber is when the tires lean away from each other at the top.) When the car is cornering

wing angles closer to the maximum allowed (18 degrees). On a circuit like Road America, with long straights preceded by high-speed corners, the decision to go with a high- or low-downforce setup is a strategic choice.

[There is another component of aero, but it's not adjustable in the sim: tunnels, or tapered longitudinal grooves underneath the car. These take advantage of the venturi—or Bernoulli—effect (when you blow air between two balloons, they move toward each other) to just about double *the downforce provided by the wings. Taken together, these aero components provide more downforce (in lbs.) than the car weighs. That is, if you inverted the car at top speed (with, say, a spiral—or corkscrew—track), it would stay glued to the "ceiling," upside down, until it ran out of fuel, the driver passed out, or another spiral righted the car again.*

hard, the chassis itself will lean slightly (this is called roll), and the suspension geometry—if the setup is correct—will compensate by positioning the camber of the wheel so that the tire is perpendicular to the track surface at the tire's limit of adhesion. (Here's one reason why my setup won't work for you...and vice versa: if you don't drive the corner as fast as I do, your chassis won't roll as much, and its camber may never get to zero, so your car won't have as much grip, so you won't be able to drive the corner as fast as I do...and so on and so on.)

On the other hand, the faster you go, the more your car's wings (the inverted airfoils on either side of the nose cone and between the two rear wheels) press down on your car's chassis (unsprung weight), making the wheels splay out as the bottom (increasing negative camber). So too much "wing" in a high-speed corner will produce excessive negative camber, thus reducing the contact patch. Similarly, hard braking (something you won't encounter at MIS) will push down on the front suspension (more negative camber), but unload the rear suspension (more positive camber). Tricky, huh?

Taking Your Temperature

So how...and where...and when...do you measure tire temperatures? When you first go to the pits, all tire temps are at 150 degrees. This simulates the track temperature on a sunny day (unlike F1, there are no "tire warmers" in CART car racing). It will take anywhere from two to five laps to get the tires up to their optimum operating temps,

depending on the weather and how hard you're driving through the turns. If you continue to lap at the same speeds, the temps will stabilize within a few more laps, then start to drop as the fuel load lightens. (The temperature drop is more pronounced at the front tires because the fuel tank is ahead of the center of gravity, thus the fronts are more affected than the rears.)

If a camber setting is incorrect, you'll start to see a difference in temps across the affected tread within a few laps. Typically, three tires might be fine (that is, the temps across their treads are even), but the one with the wrong camber will show I/M/O (inner, middle, and outer) temps of, say, 235/240/240 degrees. This tells you that that tire has too much positive camber. If the inner edge is running *hotter* than the outer edge, this tells you that it's running too much *negative* camber. I'll explain the corrective procedures in a minute.

The other adjustment that can cause uneven temps across any given tread is tire pressure. Until the tire warms up to its proper operating range, the center temp will look too low. Or, if you overheat the tire (almost always the result of using too soft a compound), the center temp may appear way too high. So, if you're getting a readout of 240/235/240, either the tire hasn't warmed up enough yet or you need to increase the tire pressure. If you're getting 285/290/285, the camber and pressure are okay, but you're definitely running too soft a tire compound. I'll get to the proper operating range in a minute, too.

And of course, you could have the camber, the compound, *and* the pressure wrong, in which case you could see a reading like 275/295/285, or 285/310/280, or something equally unavailing. Hang in there; help is on the way.

That's why and how to read the temps. Here's where and when.

Eventually, when you're competing in races of more than just a few laps, you'll realize you want to husband your resources for the last quarter to one-third of the race distance. At the beginning of a race, your tires will be cold...but the tires of the CC cars are not (don't think of it as a bug; it's a *feature!*). Until you put some heat in your tires, you won't be able to show much speed. You'll spend another dozen laps

trying to establish a sustainable track position. Then you'll go into your maintenance mode, trying not to give anything away (in the sim, the race rarely "comes to you;" usually it's the other way around). Only toward the end of a race should you make the decision to keep what you've got...or gamble everything on a late-race sprint. That's when you want your car to be at its best. So you want to optimize your setup for a light fuel load (say 10-15 gallons of a full 40-gallon load...or 5-10 gallons of a 25-gallon load) for when you're ready to "go for it" in a mad dash for the checkered flag.

Racing vs. Qualifying Setups

That's the "when" of your *race* setup. For your *qualifying* setup, it depends on whether you're or not you're going for the best of two laps (qualifying for an oval-track race), or the best single lap of a 10-minute timed session (qualifying for a road race). For reasons I'll explain in detail later, you probably want your *first* lap of two on an oval (your tires may "go away" on your second hot lap), and your *last* lap in the in the road-racing session (when your fuel load is lightest) to be your best. For now, let's optimize your rookie setup at MIS for a *medium* fuel load, say 15-20 gallons (of 25), so that you'll have five laps to get used to your most recent adjustment, to concentrate your focus on the task at hand, and then go for a couple of hot laps*.

**There are hot laps...and then there are Hot Laps. The latter are semi-official* virtual *lap records for every track in the sim (most, but not all are quicker than the real-world records). These times are posted online (on CompuServe and various Web sites) by the drivers who set them, although there is no way to know if they're exaggerating or cheating. These are often set by players with no other interest in the sim—they don't race, they don't compete for the Championship, they don't go head-to-head via modem—they only go two laps in a row with no other cars on the track. They're one-trick specialists—like fly-by pilots at air shows; for them, public bragging rights are everything. Which is fine...as far as it goes. Problem is, considering everything else that* CART Racing *has to offer, it doesn't go very far. Still, the numbers they post are impressive. The Hot Lap record at MIS, for example, is well over 242 mph; way beyond my personal best.*

The "where" is easier: at the exit of the turn that puts the most heat in your tires. At Michigan, this is coming out of T2 rather than T4, because your tires cool off on the backstretch, but are kept slightly warmer by the curved front "straight." Of course, sneaking a peak at the "blue box" (upper righthand corner of your screen, where the Function-key readouts appear) while you're simultaneously struggling to keep from hitting the wall isn't all that easy, never mind remembering all that info (for tire temps—"F4"—there are twelve three-digit numbers: I/M/O temps x 4 tires). You *could* hit "P" to pause the game, but when you unpause ("P" again), you'll probably lose control of the car just long enough to crash, so you might as well hit "Esc" and proceed directly to the Garage, where you can not only check the temps but also make the appropriate adjustments.

Let's Go to the Videotape

If you've got a friend "spotting" for you (or a scan converter and a VCR), you should also watch the temps as they jump up when you enter the corners. If your camber and pressure are exactly right, you'll see all three temps (I/M/O) jump up together. If the outer temp increases first, you have a hair too much negative camber, etc.

Okay, let's put this to the test. Leaving the setup untouched from the end of the last chapter—that is the "EASY" setup, modified with a 4.7 top gear and a 25-gallon fuel load—go to Preseason Testing, then Testing (or Resume), then hit the "K" key five times to lower the boost to "4" and the "F4" key to bring up the "blue box" for the tire temps. Note that if you dawdle in the pits, the tires temps, which begin each session at 150 degrees, will start to drift toward the session's ambient temperature (as determined by the values specified in the Weather menu), so let's get going.

Ease out of the pits and up to speed. On the first lap, on the backstretch, the temps may actually go slightly lower...and may start to differ from tire to tire...and each tread may begin to show different temps for inner, middle, and outer. After a couple of laps (if you're taking it easy), the temps will stabilize—that is, they'll heat up in the turns and cool off on the straights, but they'll return to the same numbers when you're at the same point on the track each lap. As you come off T2, just as you approach the wall, hit "Esc" and go to the

Garage and select Tires. Grab a setup sheet, label it ("BOOST_4" or whatever) and enter the information. On a sample test, I got the following tire temperatures:

	Inner	Middle	Outer	TP/Cold/Hot	Compound
RF	200	200	202	35/43	Hard
RR	211	211	211	38/43	Medium
LR	195	195	195	38/46	Soft
LF	171	171	173	36/42	Soft

Ignoring "stagger" (the default for the "EASY" setup is .700-in.), this tells me that the RR and LR are nicely zeroed across their treads, but that the outside edges of the RF and LF are two degrees warmer than the middle and inner, meaning they have slightly too much positive camber. Exit Tires and go to Suspension, then Camber, and add two*

**Only a fool...or a grizzled veteran...changes anything two notches at a time. Change values one step at a time, then retest. And not even an old fool like me will change two values at once...because, for better or worse, you won't know which of the two values you changed was the operand, so you'll have to go back and change one, and then the other, to learn what you should have learned the first time around.*

clicks of negative camber to each front tire (from -1.70 to -1.90 for the RF, and from -.70 to -.90 to the LF...and notice the minus sign: these are *negative* values. Resume testing. Try to replicate your first session *exactly*—the same driving style, the same speed, the same number of laps—and hit "Esc" at the same spot coming off T2. This time, I got the following readout from the "F4" tire display:

	Inner	Middle	Outer	TP/Cold/Ho	Compound
RF	199	199	199	35/43	Hard
RR	210	210	210	38/43	Medium
LR	195	195	195	38/46	Soft
LF	169	169	169	36/42	Soft

It's not important that the temps are slightly lower (I guess I wasn't as consistent as I thought); it *is* important that the temps are even across each tread. Since this represents an improvement, you'd be wise to save this setup under the designated name (e.g., "BOOST_4" in this example).

Your Results May Vary

On the other hand, if your second test had come up with something like this....

	Inner	Middle	Outer	TP/Cold/Hot	Compound
RF	200	199	200	35/43	Hard
RR	210	210	210	38/43	Medium
LR	195	195	195	38/46	Soft
LF	171	169	171	36/42	Soft

...you'd note that the center of the RF tread was one degree cooler than the inner and outer edges, and that the center of the LF was two degrees cooler. This could indicate one of two things. One, that you should raise the pressure of the RF by maybe one lb. (pressure is measured in lbs./sq. in., or psi) and the pressure of the LF by maybe two lbs. Or two, that you hadn't done enough laps to bring the tires up to their operating temps. Before you start playing with the TPs, do at least one more session, either to replicate the results of the first, or to validate the questionable numbers by running a few more laps to stabilize the readout.

Tuning By the Numbers

There are three tire compounds available to you, and each has an "ideal" temperature range...different for each compound. The optimum temperature for the Soft compound is 200-240 degrees; the optimum for the Medium compound is 210-250 degrees; and the optimum for the Hard compound is 220-260 degrees. If you get the tires above or below these norms, they will get considerably more slippery. (Additionally, if you get them *way* above these temps, they will get slipperier than snot on a glass door knob, they could also blow out with no warning. The first time you blow a tire, you will be shocked, *shocked!* Don't say I didn't warn you.

The softer the rubber, the greater the grip. (The softer the rubber, the greater the tire wear, too; which will become a factor later when you run longer races.) So you want the softest compound that doesn't overheat. (Or later, that doesn't wear out.) In the example above, the default compounds are too hard to get the tires into the optimum range. Both tires on the left side are already Soft, so all you can do is change both rightside compounds to Soft, which in a subsequent test yielded the following results:

	Inner	Middle	Outer	TP/Cold/Hot	Compound
RF	269	269	269	38/44	Hard
RR	245	246	245	38/46	Soft
LR	198	198	198	38/46	Soft
LF	166	166	166	36/42	Soft

Uh-oh. Now the temps are mostly even across the treads, but 269 deg. is too hot for a RF*, the tire that takes the most abuse on oval tracks.

**See? I* told *you not to change more than one thing at a time.*

Two-forty-five for the RR is a touch high, but not outrageous. So, backtracking one step, I changed the RF to a Medium compound (and touched up the RR TP, lowering it one lb.) and got the following results:

	Inner	Middle	Outer	TP/Cold/Hot	Compound
RF	239	239	239	35/45	Medium
RR	245	245	245	37/42	Soft
LR	198	198	198	38/46	Soft
LF	169	169	169	36/42	Soft

Perfect. Congratulations; if you've been following this—and getting similar results—you've made your first major setup improvement. Save the new setup under the filename of the setup sheet (e.g., "BOOST_4," overwriting the old file), and go on to the next step.

By the way, you may notice your lap speeds improving as you get deeper into this process, but you won't know if it's simply because you've gotten in more practice (25 laps in this example alone; testing goes on and on...) or if the changes are objectively for the better. Also, trying to drive consistent laps to reduce driver error to a minimum is a completely different mindset from driving as fast as you can. When you're ready to "lock in" a setup (and to save any subsequent improvements under a different filename, e.g., "BOOST_4A"), you owe it to yourself to put in a couple of maximum-effort laps to prove to yourself that the changes you've made are indeed an improvement.

If there is a God in heaven, you should now be able to lap a *bunch* faster than you ever could before, but if you're looking for even *more* speed, you may want to pause here to review your options. You could...

1. Reduce the wing angles (front and rear) to reduce drag and increase top speed, at the expense of less downforce in the corners (and, hence, a slightly lower Vmin in the turns), or...

2. Try to further increase the mechanical grip, which incurs no penalty in the overall aero package, although it may make the car harder to drive (we'll return to this later).

Although the obvious answer would seem to be the latter, let's take a stab at the former for the simple reason that it's a whole lot easier to understand.

Friends Don't Let Friends Drive Loose

The default wing angles in the "EASY" setup are 3.50 degrees for both the front and rear wings. If you reduce the angle of the *rear* wing only, you not only reduce the rear downforce (and thus the overall grip), you alter the balance of the car. The ideal balance is "neutral;" that is, the rear wheels track around in the same part of the groove as the front wheels. If the rear wheels begin to "step out," that is, start to slide more than the front wheels, the car is said to be "tail happy" or "loose." (In technical parlance, this is "oversteer.") If you don't catch the resultant skid—either by slowing down or by counter-steering, i.e., turning in the direction of the slide—you'll hit the wall tail first.

If you reduce the angle of the *front* wing, the front wheels won't have as much grip, forcing you to turn the steering wheel more to get the car around the turn. This is called "push" (or "understeer"). Taken to its extreme, the front wheels will continue to plow straight ahead in a corner, and no amount of steering lock will force the car to turn enough to make it through the corner. Result: you'll hit the wall nose first.

In the sim, you can actually *hear* oversteer before you can "feel" it. (Well, you can't actually *feel* anything unless you have force-feedback controls and a "shake 'n' bake" cockpit mock-up...which you don't.) If you have the throttle wide open going through the turn, but the exhaust "note" keeps dropping, however subtly, you've got oversteer. There is nothing subtle about *under*steer, on the other hand; it is horribly apparent: you've cranked in all the steering lock your setup allows...and the wall is still looming closer and closer to your RF tire. You can "save" the car from either situation if you can slow it down (although often, taking your foot off the throttle will *cause* a spin), but if you back off, for even a fraction of a second, your lap times will suffer...and in a race, your competitors will seize the advantage in a heartbeat.

"Listening" to Your Tires

The other thing you can hear is tire squeal (although you can't tell which tire...or tires...are making the sound). If you don't hear any *tire noise, you're either not going nearly fast enough...or you've got way too much wing angle (which amounts to the same thing). A little tire noise tells you that you're approaching the limit of adhesion. A lot of tire noise tells you that you're about to lose it altogether. If you're exiting a turn, and you hear the engine rpm rising and the tire squeal decreasing, you're doing it about right. If the tire noise continues all the way until you get to the wall, you've probably cranked in too much steering lock (or have too much understeer, which also amounts to the same thing). If the tire noise disappears too soon after the apex, you're probably not coming off the turn fast enough.*

The ideal, as I say, is a car with neutral handling, neither loose nor pushing. There are a number of ways to alter the balance (we'll get to the others in a minute), but the obvious method is to adjust the wings until the car is balanced. If the front end is sliding and the rear end isn't, one solution is to make the rear end looser (less rear wing), so that it's sliding, too; but a better way is

to make the front end stick better. Conversely, with a car that's loose, you could either take some grip off the front end (less front wing), or add some to the rear. Note that while adding wing angles makes the car faster in the turns (more downforce), it makes it slower on the straights (more drag).

So you have to find an aerodynamic balance between four points. First you have to balance the car between front and rear grip, then you have to find the right balance between speed in the turns and speed on the straights. In the real world, CART teams work from push to loose, so we'll take the same approach.

Do Try This At Home

To see what effect the wing angle has on balance, speed in the corners, speed on the straight, and lap times, go to the Garage menu, and under Wings, reduce the angle of the *front* wing from the default 3.50 degrees to 3.00, go to the track, run five laps as fast as you can, and note the following values on your last lap: Vmax (on the back straight), Vmin (exiting T4*), and lap average (on Lap 5). Now go back

**Note that while you measure your tire temps coming off T2 because that's where they get the hottest, you measure your Vmin coming off T4 because that's where your car is the slowest.*

to the garage, put the front wing back to 3.50 and reduce the *rear* wing angle from the default 3.50 to 3.0 and repeat the test. Finally, reduce the value of *both* wings to 3.00 and repeat the test. Now see how your results compare with mine:

With less front wing, I noticed that I had to turn the steering wheel several degrees farther to achieve satisfactory turn-in...and to keep the car away from the wall exiting T4. My exit speed in T4 dropped from 213 mph to 212, my top speed increased from 229 mph to 230, and my lap times improved from 225 mph to 226. (This is typical for an oval: substantive changes in on-track performance are measured in increments of only one or two mph.)

With less rear wing, I got some oversteer exiting T4 on my third lap

(the engine rpm—and my lap average—dropped), but on the fifth lap, my T4 exit speed was 214 mph, my Vmax improved to 231 mph, and my average speed improved to 227 mph. Good.

With less front wing *and* less rear wing, my Vmin was still 214 mph, my Vmax was the fastest yet (232 mph), but my lap speed dropped back to 226 mph because I couldn't pull the car down to the apex in T3, ruining my line. I ran wide here on my fourth lap, so started my turn-in sooner on my fifth lap, but had to feather the throttle exiting T4 to avoid the wall, thus ruining that lap's average (the fourth lap was actually the better of the two).

Drawing Conclusions

What have we learned from this? One, that value-for-value, reducing the rear wing has a greater effect on top speed than reducing the front wing by a similar amount. Two, that unless you retain steering "authority," you need superhuman skill to maintain good lap averages. And three, that somewhere between reducing the rear wing and reducing both wings (3.00 is the minimum wing angle available), I'd reached the point of diminishing returns. Since you can change the wing angles in increments of .05 degrees, you could eventually "dial in" a satisfactory setup by trying every value from 3.00 to 3.50 for the front wing angle.

One other surprising revelation. Decreasing the wing angle makes the tires run hotter! Although a half-a-degree's change was not enough to change the dynamic camber (i.e., at speed) sufficiently to affect the difference between the inner, middle, and outer tread temps, it was enough to raise the overall temp of the RF tire to 261 degrees and the RR to 251 degrees. It may seem contrary to common sense, but increasing the downforce (the "virtual" weight on the tire—without the penalty of true mass, which would be subject to centrifugal force), makes it run cooler. The explanation is simple: tire "squirm" (technically, "hysteresis" or internal friction) is what causes a tire to heat up. Downforce reduces the squirming (defined as the angular difference between the wheel rim and the tire tread where it contacts the road), thus reducing internal friction...and friction equals heat. One practical result: tire temps just outside the optimum range can be sometimes be brought into range by raising or lowering the wing angle.

Big caveat: if you change the wing angle enough to affect the camber, you have to go back to the Suspension menu and readjust the camber to zero out the temps across the tread again.

Staggering facts

Two final tire issues. One: "stagger." This is the degree to which the RR tire must be larger in diameter than the LR tire. How come? Because on an oval, the outside tires have to travel a greater distance than the inside tires. CART cars don't have a differential, like a passenger car, to compensate for the difference in travel (most race cars have a "locked" rear end or "spool" axle), so if the outside tire isn't larger than the inside rear tire, the inside tire will be dragged around the corners, increasing the rolling resistance. The cars in *CART Racing* go around every oval in a counterclockwise direction (turning left), so the outside tire is the right tire, and it may be larger by any value from a tenth of an inch to an inch. The tighter the turns (or the less banked), the more stagger required. Theoretically, Michigan should require very little stagger, but values from half an inch to an inch seem appropriate. Also theoretically, you should know when you've got enough stagger when your car wants to turn left going down the back straight, but in the sim, you know when you've got enough stagger when your car suddenly and violently oversteers exiting T4...and sometimes T2. Ditto for all the other ovals. Scary but true.

[N.B. All the road courses in *CART Racing*—except Laguna Seca and Surfers Paradise—are run in a *clockwise* direction, i.e., with a preponderance of righthand turns, so theoretically you might be tempted to dial in some *negative* stagger, but in the sim as in real life, road courses are a complicated mix of left- and right-hand turns, and almost everybody uses symmetrical setups...or at least zero stagger.]

One last tire tip: a track like Michigan is basically a horsepower track, not a handling track. In other words, top speed counts for more than cornering speed when you're going flat out, and at MIS, with tons of experience and the right setup, you can go all the way around without lifting...at least for qualifying...even with the boost turned all the way up to "9." You can (slightly) decrease the rolling resistance by (slightly) overinflating the tires, just the way you can on a passenger car. You

increase the TP one lb. at a time until the center tread is one degree hotter than the inner and outer edges. Conversely, at tracks like Portland or Detroit, where grip is everything, you can gain a (slight) advantage in grip by *under*inflating the tires by one lb.

Macho Misconception: Stiffer is Better

So much for tires and aero. Now let's see what obtains when it comes to mechanical grip.

One of the most widely held misconceptions about handling is that the stiffer the suspension, the faster you go. Wrong-o! True, it *feels* faster, because the car responds faster, but in terms of actual traction, grip, cornering power...nope, sorry, no way. In fact, the exact opposite is true: the softer the suspension, the greater the cornering force generated by all four tires. This is not, as you might suspect, because a softer suspension is more supple, and thus keeps the tires more firmly in contact with the road over bumps, ripples, and irregularities...not in this sim, at any rate, where the track surfaces are as smooth as billiard tables. It has to do with weight transfer. An infinitely stiff suspension would instantly transfer *all* of the car's weight to the outside tires in a corner, not only overloading them, but leaving the inside tires with nothing to grab hold of—they would be making no contribution to the overall cornering grip. Conversely, an infinitely soft suspension would allow all the unsprung weight of the car (i.e., everything inboard of the suspension), to keep rolling freely and *never* unload the inside tires.

The problem with a soft suspension is that it also wallows like *Old Ironsides* heeling over in a storm. It takes time for the chassis to roll, so it takes time for the car to stabilize in the turn, and if the turn is just a brief kink, a chassis with a soft suspension will still be rolling even after the road straightens out. Even worse, if the road doesn't merely straighten out, but turns the other way, the chassis will still be rolling one way when the road starts to go the other. To the driver, this feels nauseating. The driver wants crisp—nearly instantaneous—steering response. This is particularly important in a race when you have to make sudden moves to pass a competitor...or stay out of the way of the CC cars. Alone on the track, in solo practice or qualifying sessions, a driver can afford to trade some responsiveness for higher ultimate

grip. It's a question of balance...too far in one direction and you'll have a hard time making mid-corner corrections in your line; too far the opposite way and the car will feel skittish.

[N.B. In *CART Racing*, the two most important components of the suspension—the springs and the shock absorbers—are combined into one value, simply called "shocks." If you wanted to be picky about it, this isn't totally realistic. Theoretically, you could have a contradictory condition like a soft spring and a stiff shock. You could even have a shock that is soft in jounce (when the wheel moves up) and stiff in rebound. But within the context of the game, it does a perfectly reasonable job of simulating real-life conditions.]

Anti-Sway Bars

*Sway bars (more properly, "*anti-*sway bars"), aka roll bars (more properly "*anti-*roll bars," and not to be confused with roll-*over *bars, which are those sturdy safety hoops just behind the driver's head) are not merely fine-tuning verniers for the shock absorbers (more properly "spring dampers"). True, they are used to make in-cockpit adjustments to compensate for minor push or loose conditions during a race (or test session), but unlike shock adjustments, which are made to only one corner of the car, sway bars affect both wheels at one end of the car. Thus, a stiff front sway bar will speed up weight transfer to the outside front wheel (the RF on an oval), putting more heat in that tire...and reducing the grip of the inside front tire.*

On oval tracks, the front bar is used to compensate for the changing fuel load during a race. That is, it's usually set one or two clicks softer than the mid-point to mitigate excessive weight transfer during the early stages of a race (or after a pit stop). Halfway through the fuel load, the driver stiffens the bar to the mid-point (4 of 8 clicks). At the two-thirds or three-quarters mark, the driver stiffens it another notch or two. The rear bar is usually left at the mid-point and changed during a race only if the driver changes tire types (or pressures) during a pit stop.

On road courses, bars are used in conjunction with the shocks to tune the suspension. On tight, twisty street circuits, for example, real-world teams literally disconnect the roll bars and let the chassis roll freely to minimize the effects of weight transfer (which are more pronounced in low-speed hairpin corners than in high-speed bends). The front shocks are stiffened proportion-

ately to reclaim steering "authority" (crisp turn-in). In the sim, if you apply Doug Arnao's heretical "weight jacking" theory (see below), you may use the bars to compensate diagonally.

Of course, sometimes you use the sway bars just because you "missed" the setup during practice, qualifying, and the warm-up, and you find yourself in the middle of a 200-lap race with a dangerously ill-handling car. There you go....

Wanna See Something Really Scary?

Let's test out some of these theories on the track.

Starting with the most successful setup we've developed thus far (the adaptation of the "EASY" setup, modified to include a shorter top gear, less rear wing angle, more negative camber at the front, less fuel on board, and lower boost; and saved under the filename "BOOST_4"), let's make up a new chart, substituting our new camber values and the default shock absorber and sway bar setting (from the original "EASY" setup) in the columns where we previously showed the tire pressure and compound info. Your baseline chart should look something like this:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	239	239	239	-1.90	65%	4/8
RR	245	245	245	-1.30	65%	(Front)
LR	198	198	198	+0.10	70%	6/8
LF	169	169	169	-0.90	85%	(Rear)

The around-the-track measurements (you may remember) were: Vmax = 231 mph, Vmin = 214 mph, Lap = 227 mph.

Now we're going to run a series of tests to see the effects of suspension stiffness. To exaggerate the results to the shock settings, we're going to thrown in another variable: the anti-sway bars. (I know what you're about to say; that I should separate the shock settings from the bar settings, but that would run up the number of permutations unconscionably, so I'll lump them all together, just this once). So....

1. Run the shocks up to 100% stiff all the way around and set the bars full stiff at either end, Then do five moderate (*not* banzai) laps, hit "Esc" as you exit T2 on L5 and record the results. Mine looked like this:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	251	251	251	-1.90	100%	8/8
RR	256	256	256	-1.30	100%	(Front)
LR	204	204	204	+0.10	100%	8/8
LF	174	174	174	-0.90	100%	(Rear)

Comments: Car seemed nervous, "darty." Good turn-in...but then understeered toward wall coming off T4. RR hotter than RF (*too* hot, in fact for a Soft compound). Vmax: 230 mph. Vmin: 206 mph. Lap average: 225 mph. Conclusion: Requires the reflexes of a hummingbird on a caffeine jag to control.

2. Full stiff shocks and bars at the front, dead soft shocks and bars at the back:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	260	260	260	-1.90	100%	8/8
RR	242	242	242	-1.30	0%	(Front)
LR	211	208	205	+0.10	0%	1/8
LF	169	169	169	-0.90	100%	(Rear)

Comments: Unpleasant. Had to chase the car all over the road with the steering; slewing and bobbing. Uneven temps across LR tread; don't know why—could be "pucker factor" with scary setup. Vmax: 226 mph. Vmin: 200-205. Lap average: 218. Conclusion: Forget about this one.

3. Full stiff shocks and bars at the back, dead soft shocks and bars at the front:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	209	201	201	-1.90	0%	1/8
RR	238	238	238	-1.30	100%	(Front)
LR	176	176	176	+0.10	00%	8/8
LF	179	177	177	-0.90	0%	(Rear)

Comments: Undriveable! Terminal "exit oversteer." Spun on every lap. Less weight transfer at the front, but very uneven temps across RF. Vmax: 226. Vmin: 198. Lap: DNF Conclusion: No way!

4. Dead soft shocks and bars all the way around:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	202	202	202	-1.90	0%	1/8
RR	217	217	217	-1.30	0%	(Front)
LR	179	179	179	+0.10	0%	1/8
LF	153	153	153	-0.90	100%	(Rear)

Comments: The worst yet. Sloppy. Lack of shock control leads to a terrible yaw oscillation, as if a steering damper were adrift. Ironically: nice even temps across all treads. Vmax: 222. Vmin: 188. Lap: sub-200. Conclusion: Can I go home now?

Aren't You Glad That's Over?

What immutable conclusions may we draw from all this?

1. The combination of roll stiffness and shock settings has an effect on both the absolute tire temps and on the temperature differentials across the treads.

2. The stiffer the suspension, the greater the weight transfer. That is, the outer tires tends to get overloaded, while the inner tires are under-utilized. Therefore, stiffness, per se, is not a good thing. [N.B. Okay, so the numbers don't fully support this. I could have fudged the figures, but the anomalies are due to driver inconsistencies, not because the theory is flawed. Trust me—I'm a professional.]

3. But...if you have to err on one side or the other, go stiff. Stiffer *feels* better...or at least racier. Too soft not only feels lousy; the car is in fact lurching around like a drunken journey tacking up Fleet Street after a heavy night.

4. If you soften the suspension at one end of the car, it has the same effect as adding positive camber to the outside tire at that end of the car. Therefore, changes to the roll stiffness should *always* be accompanied by readjustments to the camber...just as you should double-check the effect of every change to wing angle on camber/tire temps.

5. The "EASY" setup (at least in terms of shock and sway-bar stiffness) is pretty good as is. To see just how good it is, we'll try one last test.

The Home Stretch

Go back and load your modified "EASY" setup ("BOOST_4"). Now change the shock settings from 65/65/70/85% to 40/60/80/100%. The theory under test is that shock stiffness should be inversely proportional to the weight transfer at each corner of the car. That is, in order: the RF takes the heaviest beating, the LR also takes a lot of punishment (even though it's a larger tire, it's fighting the weight of the engine), while the RR is lightly loaded, and the RF takes the least load of all, as may be deduced by the fact that it heats up the least. (The 20% increments are more or less at random; proportioned for actual weight transfer, they'd probably come out more like 25-35% for the RF; 45-55% for the RR; 65-75% for the LR; and 85-95% for the LF...but I'm on my soapbox here, so don't interrupt until I'm finished.)

The results look like this:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	254	251	251	-1.90	40%	4/8
RR	259	260	259	-1.30	60%	(Front)
LR	204	204	204	+0.10	80%	6/8
LF	177	177	177	-0.90	100%	(Rear)

Comments: Okay, but not quite as comfortable (nor quite as quick) as the baseline. Vmax: 230. Vmin: 213. Lap: 226.

As you can see, the RF looks like it wants a click or two more positive camber. You could try that, or, as an alternative, you could soften the RF shock a further 20%, for values of 20/40/80/100%, which yields results that look like this:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	253	253	253	-1.90	20%	4/8
RR	258	258	258	-1.30	40%	(Front)
LR	204	204	204	+0.10	80%	6/8
LF	176	176	176	-0.90	100%	(Rear)

Comments: Turn-in not as crisp, but held line better through T4. Vmax: 321. Vmin: 213. Lap: 227.

Now we've got even temps across the RF tread...but the speeds around the track are very little changed from the modified "EASY" setup (i.e., "BOOST_4") we started out with. O.E.D.

What shock and bar stiffness comes down to then, is largely a matter of personal preference. There's a trade-off between the quicker response of a stiff setup, and the slightly better grip and longer tire wear of a soft setup. Check it out both ways before you make your final choice. (As I said, testing goes on and on....).

And Now for Something Completely Different

Many paragraphs ago, I promised a discussion of the temps of each tire relative to the other three, and here it is. But if you though the previous discussion was arcane as how many tech-support guys can dance on the head of a pin, this one is even more obscure. However, it was proposed by Doug Arnao, whose expertise I respect...mainly because he goes much faster than I do on every track in *CART Racing*...and because he's driven much faster than I've ever even hoped to go in some very hairy-chested Porsche racing cars.

Doug is also an expert at *NASCAR Racing* and after switching back and forth between the two sims, he started to wonder what would happen if you applied the stock cars' "weight jacking" effects to CART cars. In *NASCAR Racing*, you can not only control the roll stiffness from side to side, you can also shift the weight at each corner of the car to its opposite corner (RF to LR; LF to RR), something like sticking a matchbook cover under the shortest leg of a wobbly table in a restaurant. There is no comparable adjustment in *CART Racing*, so Doug decided to see what would happen if he used shock stiffness to affect weight transfer at the *opposite* corners of the car.

If I understand Doug's argument correctly (and I'm not at all sure I do), if your RF is overloaded—as indicated by the heat going above the optimum range—rather than softening the suspension at that corner (and losing some steering authority), you might reduce the load on the RF by softening the shock at the opposite (LR) corner. So Doug winds up with a lot of setups for ovals that look something like 50/60/40/90% (i.e., the value for the LR shock looks suspiciously soft). Conversely, if you want to put *more* heat into a tire, say the RR; rather than stiffening the rear sway bar (which can result in the much-feared exit oversteer), a better alternative might be to stiffen the LF shock. Bizarre. I'll be damned if I can unequivocally prove (or disprove) the benefits Doug claims for this regimen, but it works like crazy for him, and the guy is so smart at this stuff that I felt I'd be remiss if I didn't pass it on. Try it out for yourself and let me know what you think.

That's it. Everything I can think of that relates to setups for ovals. Road racing demands altogether different setups, but for now let's stop arguing physics and metaphysics and kick some asphalt (as they say in the ads).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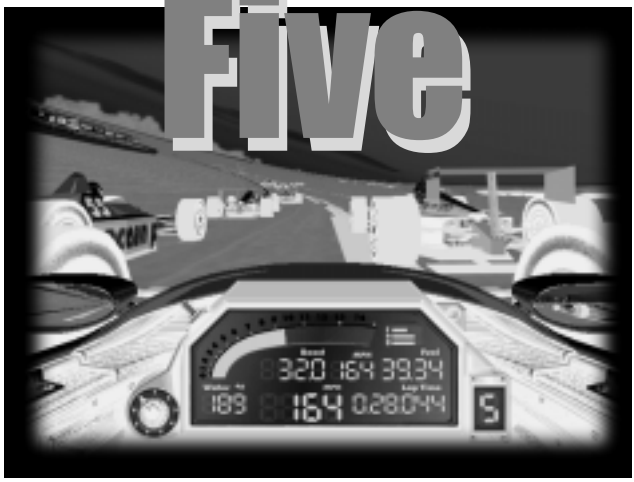
TM

Chapter Five



Your First Race

Drivers...Start Your Engines

Now that you've learned how to drive like a thing possessed when you're all alone on the track, you're going to have to accomplish the same feat while surrounded by dozens of competitors, all trying to outdrive you (or, in your paranoia, trying to drive you off the road), claiming choice real estate for themselves, taking advantage of each and every mistake you make, pursuing you relentlessly, never tiring, never letting up. This is more than disconcerting; it's discouraging. But unless you're content to claim nothing more than bragging rights for the Hot Laps you'll have set as a solo development driver, you've got to get the knack of performing brain surgery in the middle of an air raid...so to speak.

This chapter nominally consists of lessons in technique and procedures, but it is also an ongoing exercise in sustaining focus and concentration. You'll discover that maneuvers you can perform with grace and precision when there's no one else around are so confoundingly difficult in a crowd as to make you feel like a complete klutz. Your lap times will suffer, you'll unaccountably find yourself banging into immovable objects again, and your ability to keep your eye on the prize will be seriously (if temporarily) compromised.

There are two key objectives to be achieved. One, as Roger Penske says, "To finish first, first you must finish." That is, to beat the other drivers (up to now, you've only practiced beating the clock), your immediate priority must be to survive in race traffic. But beyond that, rather than merely driving defensively (just to stay out of harm's way), you must embrace the means to *prevail*. You must drive pro-actively. Instead of just responding to your competitors' moves, you must seize control of the race; make the opposition dance to your tune.

Racing rewards initiative, enterprise, and aggression. It's not a team sport, like basketball—it's always a one-against-many battle...and the only consolation is that the CC cars do not cooperate with each other to thwart you. (Your paranoia is well founded, however: they *are* out to get you...only not collectively.) You can't intimidate the CC cars by

lurking in their wake, trying to psych them into making mistakes (they drive like robots because they *are* robots). The CC cars' mistakes occur seldom...and totally at random. On the other hand, you *can* force the CC cars into reacting to your attempts to pass...and it is fair game to move over on an opponent to protect your position. Don't "just do it;" do it *con brio*.

Go Play In Traffic

Races are not won by who's fastest in practice, but by who's fastest in traffic. So the objective of this chapter will be to get you used to traffic in graduated stages. First, we'll set up some mock races, pitting you against a single, well-matched competitor. Then we'll increase the pace and the number of opponents, practicing standing starts (true-to-life rolling starts will come later), staying in contact with the leaders, passing and being passed, lapping backmarkers, drafting etiquette, and coping with the quirks and foibles of AI (artificial intelligence—the oxymoron behind the wheel).

To begin, go to the Main Menu, select Opponents, then reduce the number of opponents to one. In the car set that ships with the game, this will be the mythical "Fred Jones," who drives a car that looks remarkably like yours, only his is number "00" and has a blue rear wing; yours is number "95" and has a red rear wing. While you're at it, set the Opponent *Strength* (OPPS) to 100%, the number of cars *drawn* to three ahead and two behind, and the number of cars *heard* to two (this is mostly for later, when we'll increase the number of opponents).

Now go to Single Race, select MIS (this will be your last visit to this by-now-familiar venue...until you're ready for the PPG Championship), and proceed to the Garage. Load your rookie setup ("BOOST_4" or whatever), then go to Next Session and press it three times (you have to move the highlighted bar down twice) to bring up Race. We're not going to bother with qualifying—much less practice and the warm-up—because you're going to be starting at the back of the grid for now...and qualifying is an entirely separate discipline that we'll get to later.

When you hit Enter (with the highlight centered on Race), the race will start immediately, with you in the second position on the grid at the S/F

line (not in the pits), just to the right of Fred Jones' number #00 car. Let him go. Your boost will be at "9" (if you've just relaunched the program), so just sit there and do nothing but hit the "K" key five times to reduce the boost to "4."

Now push the throttle wide open, and as your car starts to gather momentum, hit "Shift-R" (reset) and the race will restart immediately, only this time get ready to rock 'n' roll. If your reflexes are good, you may be able to stay with Fast Freddy as he rockets away from you, but the chances are you'll be struggling to keep him in sight as he disappears around T1/T2 and becomes a dot on the backstretch. Don't be disheartened. Hit "Shift-R" and try again. And again. And again.

And They're Off!

You'll notice you're probably getting some wheelspin (listen for tire squeal) as you get under way, which will make your car "fishtail," but don't back off. If you do, you'll lose too much time. Don't both trying to make steering corrections, either. If you do, you'll probably either steer right into Jones' #00 car or bounce off the wall on your right. Just keep hitting "Shift-R" until you can keep your car in a straight line as both cars accelerate from a standing start. This could take several dozen tries, but if you don't get it right, abandon the attempt after a couple of seconds...and when you finally *do* get it right, just keep going, flat out, until you can keep your car on the track all the way from the S/F line, through T1/T2, and onto the backstretch,

If, for some reason, you find you're beating Mr. Jones into T1, check your lefthand mirror. If you can see anything much more than the nose of his car (that is, if you can see any of his righthand side-pod), he's probably abreast of you, and you won't be able to slice left toward your normal T1 apex; you'll have to stay wide (i.e., high). If this happens more than a couple of times, exit the track, go to the Opposition menu, and raise the Strength to 105%. There is no point in your getting ahead of your opponent in this lesson; being ahead of the only other car on the track is no different that being alone. The idea is to follow #00 around the track as closely as you dare.

The first time you make it all the way to T3, you'll probably be so jubilant that you'll forget your tires are still cold, and you'll spin or crash

(probably the latter—understeering into the wall coming off T4). So don't forget to back off a little here...and turn in a little earlier...for your first couple of laps.

Ideally, you should be able to lap the track exactly as fast as the #00 car, to tuck your nose right up under its gearbox, and chase it around the track in close proximity. If it starts to get too far ahead, you could tap the "L" key to bring up the boost to close the gap, but until you go back and restore the taller sixth gear from the original "EASY" setup, you'll run the danger of blowing the engine if the boost gets much above 42 inches. If you consistently get ahead at the start, you could back off temporarily and let #00 pass (the CC cars are curiously reluctant to pass *when you want them to!*), or reduce the boost to "3" (or "2" or "1"), but a better, if more long-winded solution is to exit the track, go back to the Opposition menu, and raise or lower the strength until the #00 is just about as fast as your own. (Remember, with the program's random number seed, #00's speed will very...slightly...from race to race, so don't expect Mr. Jones to be 100% consistent. He won't be.)

If you bobble and the #00 car gets way ahead of you despite your best efforts to close the gap, reset. There's no way (short of upping the boost) to catch #00 once it's gone...assuming you've achieved a modicum of consistency. But if you can stay "in contact," just keep chasing and restarting until you can stay within a second in arrears for the duration of the race (25 laps, if you haven't changed the 10% race distance).

Feeling the Draft

If you can get within a car length or two on the backstretch, and position your car directly behind the #00 car, you'll feel the effect of "drafting" (or "slipstreaming," as it's called in Europe). That is, the car head pushes the air aside so you don't have to. Additionally, the car ahead tows a partial vacuum in its wake, and if you're close enough, it will suck your car along at a slightly higher speed than you're used to seeing on the back straight. The difference is usually no more than two or three mph, but later, in a race, you'll learn to "hook up" with another car (or cars) to form a "drafting pack" that can pull both of you ahead of the rest of the field. It can also pull you faster by just enough to

over-rev your engine, so the technique has to be used sparingly. (It can also rob your radiator and front wing of air, causing your engine to overheat and your front tires to lose grip.) And, when you learn to master the "slingshot" pass, you'll learn to take advantage of the "tow" to build up so much momentum that you can blow by the other car at the end of the straight.

For now, position your car just behind and to the left (inside, or "underneath") #00. You'll probably find you can pull up alongside in two places at MIS: going into T1 (if he backs off before you have to), and transiting T3/T4. Beware of a classic mistake: you can probably build up enough speed to overtake #00 going into T3 (the towing effect "helps"), but anybody who's driven *NASCAR Racing*'s stock cars on this track knows what happens next: if you go "low" (inside), your apex is too early, then you understeer through T4, scrubbing off so much speed that your opponent(s) will repass you on the inside line while you're still struggling to avoid the wall. If you go high, you may never connect with your apex, forcing you to stay high, and slow enough that the competition, once again, dives underneath you and sails by you coming off T4.

But do try passing. You won't begin to get a sense of the actual size of your car, and—more importantly—where your wheels are relative to the other car's wheels until you've tried (and failed) a bunch of times. You'll also see that *where* to pass is obvious; it's *when*—the timing—that counts. Once you've picked a sport to pass #00, spend a couple of laps deciding when to attempt the maneuver, and when you do go for it, back off a little beforehand, then try to "rush" your opponent to maximize the speed differential.

And let him try to pass you. You can easily block him, but usually for only so long before he gets up a head of steam and passes you...decisively. You can anticipate his moves by keeping an eye on him in your rearview mirror, but remember the mirror's perspective isn't realistic. [This came about after months of discussion at Papyrus. With the original version of *CART car Racing*, newbies complained that the mirrors had a blind spot, which is true-to-life; you could see cars *preparing* to overtake, but then they vanished...until they suddenly burst into view right alongside you. Purists like me pointed out that in

the interval during which the overtaking car was out of sight, you could still hear his* engine, and if his engine rpm was rising, you knew

**Forgive me; I'm really not misogynistic (although defiantly politically incorrect), it's just that the overwhelming number of real...and most of the virtual...members of this community are of the male persuasion. Some of my best friends...oh well, never mind.*

he was gaining on you. Papy didn't buy that argument. The current cockpit views show the overtaking car alongside you and in the rearview mirror at the same time. Unrealistic...but I've learned to live with it...and so will you.]

The point about hearing a competitor is well taken, however. You can clearly hear when another car is going as fast as you are. When there's a difference in pitch, only experience will tell you which car is faster, but if you can hear the other guy bearing inexorably down on you, you'd better move over and let him by.

Artificial Intelligence: Your Sim Dollars At Work

I'll deal with the rest of the AI later, but for now, take note of this difference between passing and being passed. The AI seems much more sensitive when you're the one doing the passing. If you make an aggressive move on a competitor—either trying to force your way by on the inside, or coming up fast on the outside as you both exit a corner—the CC car will suddenly give up and move over...sometimes so suddenly that you can't avoid hitting him. On the other hand, the CC cars are far less courteous when they're passing you. Once they're *committed* to a pass, nothing will make them back off again or let you block them. If you don't get out of their way, they're likely to shunt you up the arse and put you both out.

You'll also notice that you can probably give the #00 car a gentle tap without any dire consequences. A bump from straight behind won't have much effect. A bump to his left rear wheel will sometimes send him spinning...sometimes send you spinning...and sometimes send both of you spinning (often locked together in an awkward mechanical

embrace). Experienced sim racers know exactly where and how hard to administer a *coup de grace* to a slower car, but I've never mastered this black art.

A word about accident avoidance. According to an old racing adage, if another car spins in front of you, aim right at 'em...because by the time your car gets there, they'll be gone. *Mirabile dictu*, it works! Well, sometimes it works.

Eventually, you may be able to keep this match race with #00 going for the full 25 laps. At a boost level of "4," the winner should average about 223-224 mph. You can check the standings at any point during the race (hit "Esc" and select from the on-screen menu), or the results after the race is over. If you want to save the standings or results (or a replay), do so then and there, because once you exit the "race weekend," the opportunity is gone. (Even so, you can't access the text later on from within the game; you have to print it or exit the program and view the text with an editor capable of displaying an ASCII file.)

Going For a Spin

The physics model isn't dead accurate about what happens when you *get into a spin...but it's pretty close. If the rear end starts to get away from you, you can catch it by countersteering (steering into the skid), if your reflexes are quick...and the slide hasn't gone too far. But beyond a certain angular momentum, nothing you can do will make any difference because a sliding tire has no "directional integrity." That is, it doesn't know which way it's pointed, so steering and braking input have no effect. The tires still have friction, but it's as if you were sliding on rubber bumpers, not steerable wheels.*

Real CART car drivers never try to catch a spin on an oval because once they countersteer to the right and the tires regain traction, the car will whip around and into the wall before the driver can steer left again. Indeed, real drivers do the opposite; cranking in full left lock, to tighten the spin, and pull the car down off the track, into the infield and out of harm's way. Sometimes this works, too.

As you get more comfortable during a race, you can again use "F4" to check your tire temps. I recently discovered a limitation on the methodology employed in the previous chapter, where tire temps were checked only after five laps. Ten laps into a 25-lap race, the center of the RF was running about three degrees hotter than the edges. At 15 laps, the differences had returned to zero, but at 20 laps, the center of the RR

started to rise, and it finished the race three degrees hotter than the edges. At no time did the values shown in the "blue box" get into the "danger zone" (first they turn yellow—then red—if you're really over-cooking the rubber), but I resolved *next time* to run a full a full 25 laps in solo Preseason Testing and note the results on my setup sheet.

Wake Up and Small the Testosterone

Next lesson: go to the Opponents menu and raise the Number to five*,

**The next four drivers in the default car set were real-world participants in the 1995 PPG Championship season: Stefan Johannson (now a car owner), Mauricio Gugelmin, Danny Sullivan (now a TV commentator), and Gil de Ferran. Any time they take to the track, they are a* lot *faster than the mythical Mr. Jones, so be prepared to reduce the Opposition Strength as much as five percent...or be prepared to have them walk all over you.*

and repeat the previous lesson until you can stay alive for 25 laps in mixed traffic. Now you're likely to find yourself somewhere between first and sixth place. If you're outdistancing everybody—or falling hopelessly behind—go back and readjust the OPPS (Opposition Strength). Run as many races as you can stand...because it's never going to be this easy again. In the next segment, you're going to get some testosterone flowing by raising the boost to 45 inches ('9" on the dial), and thereafter, you're going to be racing in earnest. However, you need a break here...and I'll explain why.

Never mind what anybody else tells you: when you're ready to go racing for real, you don't want to practice with your stable setups and then attempt to qualify with your hairiest setups, because it's a lot easier to go from fast to slow than vice versa. If you practice with your qualifying setup, you'll be razor-sharp when it's time to qualify. You can then use the so-called pre-race Warm-Up session to dial in your race setup, which will seem like a walk in the park by comparison (and allow you to segue gracefully into the rhythm of the race itself).

[Later on, you'll see why qualifying setups for road racing are much closer to the setups you'll be using during the race...but at the ovals,

qualifying setups are little different from your Hot Lap setups, i.e., as wild as you wanna be.]

Your grid position in oval races is determined by the fastest of two qualifying laps. You're allowed an "out" lap (from the pits), a warm-up lap, then two timed laps (i.e., laps three and four). The trick here (it is *not* a cheat) is to run tires which are not only too soft to last a whole race distance, but tires that may actually overheat after your third (first timed) lap. If you use compounds hard enough to last through four flat-out laps, you'll get two good Q laps out of them, instead of the one great lap and one lousy lap you'll get out of the softer rubber...and one great lap is all you need.

As luck would have it, the compounds we've been using to run 25 laps at 40 inches of boost (Medium/Soft/Soft/Soft) are just about right for a two-lap Q session at 45 inches, which will be your next test. Here's what you're going to do (after you've taken that breather):

Setting the Track on Fire

Go to Preseason Testing (you *could* work on your Q setups during race Practice, but having the other cars around is an unnecessary distraction). Go to the Garage and change your sixth gear ratio back to its initial value (4.4 in the original "EASY" setup). Reduce the fuel load from 25 to five gallons and the front wing angle from 3.50 to 3.25 degrees (leave the RWA at 3.00 degrees and the other values untouched from your "BOOST_4" setup). Save this setup under a new (unique) filename, like "QUAL_1" or whatever.

Go to the track, and as you ease out of the pits, hit the "L" key several times to make sure the boost dial is at "9" (which should produce a reading of 45 inches on the boost gauge after a few seconds at full throttle). As you get up to speed, you'll notice the light fuel-load and low wing-angles make the car feel very responsive. If, after a couple of laps, the steering feels too touchy, go to the Garage and lower the Steering Lock (if you haven't already done so) from the default 16 degrees to 10 or 12 degrees. If, on the other hand, you feel you have to turn the steering wheel too much to pull the car down off the high side of the track and close to your apex, go to the Garage and increase the value a couple of degrees. And if the car *still* doesn't turn in

sufficiently to hook up with your chosen apex, it isn't the steering angle, it's front-end grip. In this case, increase the front wing angle back to something closer to its original 3.50 degrees.

Now let's establish a baseline. With a FWA of 3.25 degrees and a full 45 inches of boost, I did one cautious lap, one more aggressive lap (not rolling completely out of the throttle for T1 and T3...and getting tire-squeal and push, but no oversteer), and one lap as fast as I dared, pausing the game exiting T2 on the beginning of my fourth lap. Here are the results:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	267	267	267	-1.90	65%	4/8
RR	266	266	267	-1.30	65%	Front)
LR	210	210	210	+0.10	70%	6/8
LF	181	181	181	-0.90	85%	(Rear)

The observed on-track measurements were: Vmax = 243, Vmin = 222, Lap = 238.

Unlike our previous tests, I then unpaused ("P" again) and tried to sustain the same speeds for one more lap. Disaster! The rear end broke away completely going into T1. By the time I had paused the game, the RF was into the red (over 290) and the RR values had turned yellow (over 270). Had I backed off after the fourth lap and coasted around for my fifth lap, I could have qualified at over 238...not bad, considering the real-world track record (for 45 inches of boost) is only 234 mph.

However, I saw that the outer edge of the RR was one degree hotter than the middle and inner edge. I could have changed the camber at that wheel to -1.40, but instead I decided to soften both the front and rear bars one notch. (That is, the balance was fine. If I had noticed push, I might have softened the front bar only, or the front bar one more notch than the rear bar. Or, if I wanted to try Doug Arnao's theory, I would have softened the *LF* a couple of notches. Or tried the opposite, if I was trying to cure a loose condition. But the K.I.S.S.

principle prevailed. I re-ran the test with this result:

	I*nner*	*Middle*	*Outer*	*Camber*	*Shocks*	*Sway Bars*
RF	*262*	*262*	*262*	*-1.90*	*65%*	*3/8*
RR	*266*	*266*	*266*	*-1.30*	*65%*	*(Front)*
LR	*213*	*213*	*213*	*+0.10*	*70%*	*5/8*
LF	*183*	*183*	*183*	*-0.90*	*85%*	*(Rear)*

The observed on-track measurements were: Vmax = 244, Vmin = 222, Lap = 239. Excellent, as they say in Brooklyn.

Unpausing again, I fared no better than the first time; spinning in T1 on the next lap, with the outside tire temps heading for the stratosphere. Still, this setup had gained me a mph on the first lap, slightly reduced the temps of both rightside tires, and (for reasons I cannot readily explain) zeroed out the tread-temp differences on the RR tire. I saved this setup as "QUAL_1" (overwriting the original "QUAL_1"), and moved on to develop a viable race setup.

Oh yeah—one other thing. In each of the two sessions, even before terminal oversteer blew me away at the beginning of the fourth laps, I felt the rear end twitch going into T3 on the second laps (before the tires were up to snuff) and again going into T3 on the third laps (when the tire temps were *au point*). On a hunch, I reduced the stagger from the default .700 inches to .600 in., and while the on-track numbers didn't change, the car did feel a bit more stable. (If I were going to follow another hunch, I'd probably shorten sixth gear one step, to 4.5, but I decided to save that complication for another day.)

Why Your Race Setup is Different

You've undoubtedly noticed that the car is now a lot harder to drive smoothly than when we were practicing with the boost at 40 inches. Get used to it. However, you may heave a sigh of relief once you've locked in your Q setups; your R setups are a whole lot easier to drive. Save in one respect: you will need to speed up the steering to make the car responsive enough to avoid other traffic in a race. With a field of only five other cars, this won't be a problem, but by the end of this

chapter, you'll be surrounded by 31 other cars...and you'll need all the agility your car can muster.

So go to the Garage and increase the Wheel Lock from the slow (10 to 12 degrees) Steering Lock you've been using until now (the lower value will still be part of your traffic-free Q setup) and choose a value of 14 to 16 degrees (16 is the default...and it's a bit too high, in my opinion) for your R setup.

You already know that a Medium RF and a Soft RR will overheat within four laps, so change them back to the "EASY" default of Hard and Medium (if the leftside compounds need changing, we'll get to that later). You'll want more wing than your Q setup for two reasons. One, more wing = lower tire temps. Two, more wing = more grip. Ideally, you want to be able to run the entire track flat out for the entire race, because when you have to lift, even momentarily, the boost drops...and it takes a couple of seconds to spool the turbine back up to full boost when you get back on the throttle (this is the infamous turbo "lag"). So to ensure that your car sticks to the track like Krazy Glue, we'll increase the wings one-half a degree (above the original "EASY" default of 3.50 degrees) to 4.00 degrees, front and rear.

The downside to this much wing is not just slower lap times; the extra drag will also increase fuel consumption, so you'll need more than 25 gallons for 25 laps. For now, we'll leave the slightly softer sway bars (they're easy enough to change from the cockpit) and the other values from the Q setup and save the whole kit and kaboodle under a new (unique) filename, say "RACE_1."

Going All the Way

This time, we're going to run a full 25-lap test, pausing after five laps to record info for the database...and again at 20 laps, to see how the setup looks near the end of the simulated race. You should also modify your driving style; a 25-lap test isn't do-or-die on every lap, so you don't have to be quite as swashbuckling as you do for a qualifying run.

Here's how my test looked over five laps:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	222	222	222	-1.90	65%	3/8
RR	236	236	236	-1.30	65%	(Front)
LR	219	219	219	+0.10	70%	5/8
LF	187	187	187	-0.90	85%	(Rear)

The observed on-track measurements: Vmax = 238, Vmin = 219, Lap = 231.

Comments: Despite my expectations, the car felt loose slicing down off the banking going into T1 and again coming off the banking in T4, so I chickened out and rolled out of the throttle just enough to help the turn-in, but never letting the boost fall below 44 inches. (This is called "foot shrinkage," "the pucker factor," or a "confidence lift.") The car also felt line sensitive; that is, working a low groove, it felt more twitchy than staying high. I stayed high.

And here are the numbers I got after 20 laps:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	217	217	217	-1.90	65%	3/8
RR	236	236	236	-1.30	65%	(Front)
LR	218	218	218	+0.10	70%	5/8
LF	185	185	185	-0.90	85%	(Rear)

The observed on-track measurements: Vmax = 240, Vmin = 222, Lap = 233, with a best lap of 234.

Comments: Note the dramatic increase in observed measurements as the fuel load lightens. The only other change was the RF, which cooled off five degrees. Starting at about 15 laps, I could skip the "confidence lift" and not have to worry about the rear end stepping out. The red warning-light on the upper right of the dashboard came on in about the middle of both straights, indicating too many rpm (and the water temp rose to 224--a scosh too high). I could reduce this with either slightly more rear wing or (as a somewhat more coarse adjustment) a slightly taller sixth gear.

Scoping Out, Zeroing In, and Turning Yellow

Although these numbers look okay, I was reluctant to start my first race with a car that was going to be loose for the first few laps (when I'd be concentrating more on what the cars around me were doing than what my car was doing), so I decided to add another half-degree to the rear wing (for a total of 4.50), which should also cure the over-revving/high water-temp problem...albeit at the expense of even more fuel consumption and lower lap speeds.

Here are the results of the second test (after five laps):

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	220	220	220	-1.90	65%	3/8
RR	236	236	236	-1.30	65%	(Front)
LR	224	224	224	+0.10	70%	5/8
LF	189	189	189	-0.90	85%	(Rear)

The observed on-track measurements: Vmax = 236, Vmin = 216, Lap = 229.

Comments: Hmmmn...stuff happens. Theoretically, the rear tires should be running cooler, but the RR is unchanged and the LR is actually five degrees hotter! Contrarily, the *front* tires are two degrees cooler. The speed in T3 should be higher (more aero grip), but in fact it's three mph slower. (What am I doing wrong? Is it just my inconsistent driving style?) Plus, my top speed—you want as much as you can get to keep from being passed on the straights—and my lap speeds are both slower by two mph. This isn't looking good.

After 20 laps, I got these numbers:

	Inner	Middle	Outer	Cambe	Shocks	Sway Bars
RF	216	216	216	-1.90	65%	3/8
RR	234	234	234	-1.30	65%	(Front)
LR	220	220	220	+0.10	70%	5/8
LF	184	184	184	-0.90	85%	(Rear)

The observed on-track measurements: Vmax = 238,

Vmin = 220, Lap = 233, with a best lap of 234. The fuel mileage dropped from 1.90 mpg on the first test to 1.88 this time around.

On paper, this setup (4.50 RWA) looks worse than the previous (4.00 RWA) setup, but I decided to use it in my first race because the car felt a lot more stable (I still rolled partially out of the throttle for the fist ten laps), and because although the lap times after five laps looked pretty lame (I may have been puckering too much), the lap times after 20 laps, when I could stay on the throttle all the way around, were as good as with the looser setup. I saved the last setup as "RACE_1," overwriting the first "RACE_1."

The Moment of Truth

Drop your socks and grab your joystick: it's time to go racing. Exit Preseason Testing and go to Single Race. Go to the Garage and load your "QUAL_1" setup. Go to Practice and practice with your Q setup. Note that while you're only able to do five laps at a time, the other cars will go a dozen or more laps, then make a pit stop, then go out again. They're practicing with their race setups, which should put them in the 227-228 mph range (you can check the standings by punching "F2" after the CC cars have been practicing for a while).

If you want to go by the book, you could pull into your pit every four or five laps, but if you do, you have to "radio" your pit (with the "F3" key) and instruct your crew to fill the tank to five gallons; unless otherwise instructed, they'll put in the full 40 gallons. If you repeat this procedure more than a dozen times, you'll probably wear out a rightside tire...so you might want to check its status ("F5") and radio in for fresh rightside rubber. Or you can make it easy on yourself and just hit reset ("Shift-R") every four of five laps. I must admit that's what I do.

Once you think you're ready, go to Qualifying, then check the Standings (from the menu or "F2" from the track). If the Q speeds of the field are radically different from yours, exit the track and adjust the OPPS (Opposition Strength) from the menu. At 100%, the five-car field should qualify in the 237-239 mpg range (except for the hapless Mr. Jones).

On your qualifying run, take it easy the first time around (your "out" lap), but get on it pretty hard for your second (warm-up) lap. One, to

put some heat into your tires, and two, because you want to get psychologically ready to rip off a fast one the next time around. As you begin your third lap, you'll get a green flag at the Start/Finish line. Don't get crazy here, but this is the lap that counts. As you cross the S/F line again, you'll see your lap speed and grid position displayed in the upper left corner of your screen...and the white flag (one lap to go) in the upper right.

If your lap speed is really disappointing, you might as well go flat-out one more time. You might overheat a tire and spin, but you've got nothing to lose. On the other hand, if it's a good time (and/or grid position), you've got it in the bag—ease off the throttle and just cruise around for your second lap.

The game doesn't allow you another shot at qualifying once you've started your Q run (not strictly realistic; in real life, you can "wave off" the attempt and try again later), so if you're desperately unhappy, exit the track, and either return immediately if you think your aborted attempt was a fluke, or go to the Opposition menu and reduce the OPPS even more if you suspect your best just isn't good enough.

Holding On to What You've Got

Once you're happy with your grid position, exit Qualifying, go to the Warm-Up, enter the Garage, load your "RACE_1" setup and then—**this is important**—exit the track. As you do so, you'll get a menu that asks you if you want to "Save Race Weekend?" Answer "Yes,"* exit the

**Actually, you'll be asked this question any time you exit a track after you've finished qualifying, but until you've got a grid—or race—position you want to save, don't answer "Yes."*

track and immediately return. Now you'll see a menu asking you to choose "Previous Race" or "New Race." Choose "Previous Race." You'll be sent not to Practice or Qualifying, but straight to the Warm-Up, with your "RACE_1" setup already loaded. (What you've done here is saved a good grid position that you can use over and over again...if you want to skip the bother of qualifying. If you want to go back to qualifying anew for the next race, skip these steps, or answer "New Race" when you return to the track.)

Practice with your "RACE_1" setup, concentrating on standing starts (from your pit is fine...if the pit ahead of you is empty; if you like to live dangerously, you can halt at the S/F line—the other cars will whiz past you on the high side of the track—and practice starts on the banking, noting that your car wants to slew to the left). You can check your fuel consumption at any time with the "F3" key or by hitting "D" twice (it cycles the dash display through mph, rpm, and laps-'til-empty), so you can make sure you've got enough fuel for 25 laps. It's the first 10-15 laps you'll have trouble with, however, so don't bother running a full 25-lap test. Check your TPs every so often; actual racing conditions have a way of pumping up your adrenaline...increasing the stress on you and your "skins" (car-guy jargon for tires).

When you're ready, go to Next Session and start your Race. If you're in mid-pack, you'll have to concentrate on not blundering into the car next to you. If you're toward the back of the grid, you may find yourself overrunning the car ahead. If you're on the front row, your problem will be getting carried away going into T1 or over your head going into T3.

Here's a cheat: If you blow the start and crash out, don't take your foot off the "gas" (it's actually methanol, Wilbur) before you restart. Why? Note that when you restart, if the pedal is still to the metal (even if you're in the middle of an accident), the boost is already at 45 inches. If you back off before you restart, your boost is reset to 30 inches...and you'll lose power until your turbo spools back up.

Here's another cheat. When you're ready to call it a day, answer "Yes" to "Save Race Weekend?" but "Cancel" to the next question ("Overwrite Previous Race?"). That way, even if you've been having a miserable race, when you return to the event, you're not struggling along in last place or something equally disheartening, you're back at the Warm-Up, after having set a Q time you can be proud of. Cool, huh?

Eventually, of course, you will finish a 25-lap race. Remember, you'll learn a lot more by setting the OPPS high enough to finish in a respectable third place than by setting it so low that you run off with the lead and never see another living soul.

My First Race

Here's what happened in my first race. I qualified second on the grid at 238 mph, and thanks to having practiced my standing starts, got the jump on everybody...for the first four laps. By then, Stefan Johannson was nipping at my heels, and rather than getting into a dogfight with him, I moved over...only to have "Big Mo" (Mauricio Gugelmin) slip past as well. I kept within two seconds of this duo...and barely ahead of Danny Sullivan...until a few laps from the end, when I came upon a lapped car. It was Fred Jones, poor devil, running alone in last place. I managed to pass him easily*, but Sully was momentarily "boxed" and

**The best way to deal with backmarkers is ruthlessly. Their AI doesn't recognize that they're a lap or more behind; they'll be as contentious as if they were fighting you for a podium position. Don't be polite; they'll put a big dent in your average speed. Dispose of them at once.*

slipped 1.2 seconds behind my third-place finish. The leaders averaged about 230 mph. I ran out of fuel on the cool-off lap and made a mental note to increase the fuel load in my "RACE_1" setup from 26 to 27 gallons.

During the race, I was still bothered by a slightly loose condition. After five laps, I softened the rear bar one notch and stiffened the front bar one notch and that seemed to fix the problem. Toward the end of the race, I stiffened the front bar another notch to compensate for the lighter fuel load. I was too busy fending off Sullivan's advances to check my tire temps. Note that if you change anything during the race (in the cockpit or the pits), when you do a "Shift-R" reset, the changes will remain in effect. However, if you exit the track ("Save Race Weekend?"/"Yes"/"Overwrite Previous Race?"/"Cancel") and return to the event later, your settings will be exactly where you left them when you *first* saved the race weekend; in this example, with the "RACE_1" setup you had when you exited the first Warm-Up.

Here's one last cheat: If you start a race and find that you are hopelessly outclassed, exit the race ("Save Race Weekend?"/"Yes"/"Overwrite Previous Race?"/"Cancel"), go to the Opposition menu and reduce the Strength by a couple of percentage points, and return to the

event. Although you can't change your setup once you've started and saved a race (although you can return and change them at any time up to the start of the race), you can change the OPPS at any time before you re-enter the event. This will allow you to qualify against a low OPPS (to get a good grid position), but run against a higher OPPS (to get practice in strong race traffic). Or vice versa. Later on, I'll show you how to edit the track files, so that you can adjust the qualifying and race speeds separately (from each other and independently for each track), so you won't ever have to mess with the Opposition Strength settings ever again.

That's about it for racing at MIS. If you find you're getting too fast for the CC cars, you can speed them up from the OPPS menu, or you can increase your aero downforce to make your car more stable (or just turn down the boost to make your car slower...but that's not much fun in a sprint race). Once you get comfortable with five opponents, increase the number to 10 or so, then 20, and finally 31 (traditionally, superspeedway fields have been filled out to 33 cars—the 500 usually starts 11 rows of three—I don't know why *CART Racing* stopped one short (well, I do; but I'll leave it to you to see if you can figure that one out).

Don't get cocky. You've spent so much time at MIS that the natural tendency is to think that all tracks—or at least, all ovals—are this easy. They're not...as you'll find out in the next chapter.


C·A·R·T
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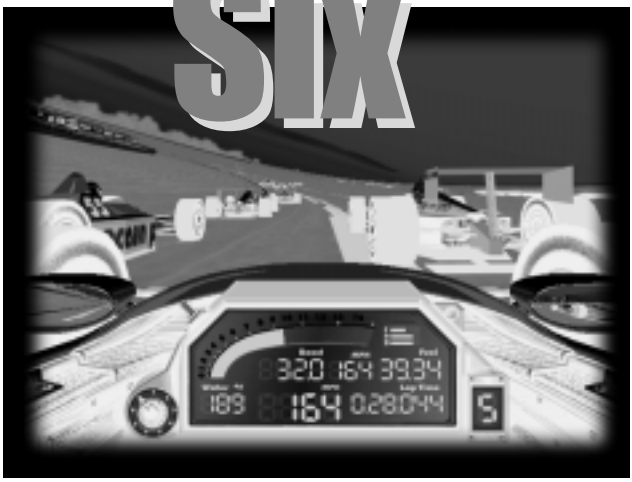
Chapter Six



Oval-Track Racing

Macarena, Hell; I Came Down Here to Twist!

It's time to leave the comfort and security of Michigan International Speedway. In trying to find a logical progression through the bewildering variety of tracks in *CART Racing*, the closest thing to a large, kind-of-symmetrical oval like MIS is a small, kind-of-symmetrical oval, like Milwaukee's so-called Miracle Mile (one of the oldest tracks in the U.S.), or Louden, NH's, one-mile oval (one of the newest).

There are considerable differences between these two tracks...apart from the fact that Louden measures .058-of-a-mile more in length. Milwaukee is shaped like dozens of other classic one-mile "bullrings" (both paved and dirt) that once formed the backbone of American auto racing; the same approximate proportions as your basic horse-racing track, with wide, flat turns, and relatively short straights. Loudon, on the other hand, is shaped more like a foot-long hot dog; that is—short, sharp turns, and relatively long straights.

There are two other mile-ovals in *CART Racing*...but they are as different as cheese and chalk. Phoenix (AZ) and Nazareth (PA) are "ovals" in name only. Neither is symmetrical, neither is round, no two turns are the same, and both have distinct elevation changes. Indeed, if it weren't for the fact that both have only lefthand turns, they would be classified as natural-terrain road circuits. Preparing for these amoeba-shaped venues is more akin to girding your loins for road-racing (next chapter), so we'll deal with the symmetrical ovals first.

By now, you'll probably agree that the most critical element of a decent lap of MIS is getting on the power early coming off T4; if you can't get this part right, you might as well keep your day job. You'll soon learn that every race track in *CART Racing* has one problematic choke-point...one basic keystone...which must be mastered before you can start turning competitive lap times (i.e., before you can make a good account of yourself at 100% OPPS).

In real life, as in this sim, you'll find that you don't improve everywhere around the track equally; you learn the easy stuff first (usually the slowest turns), and the hard stuff (fast turns, particularly the ones with tricky entries) last. The most critical component of any given track may not be the most difficult part to learn, but it's almost always pretty easy to identify. Not so at Milwaukee, which seems deceptively easy to learn, and easy to get a handle on. But don't be fooled; the Miracle Mile's demons are lurking farther down the road.

You're Only as Rookie As You Think

At Milwaukee, as elsewhere, the "EASY" setups are as good a place to start (each track in *CART Racing* has an "EASY" setup filed away in its particular Garage). As a second choice, I recommend the "rookie" setups developed by the experts on CompuServe's Sports Simulation forum (GO SPRTSIMS) and available online. Also recommended: an extensive set of descriptions of each track, written by Joachim Trensz, and also available from CompuServe's sports sim library; recommended even though Achim's views are frequently at variance with my own.

The "QUALEASY" setups available for each track within the game are, for the ovals at least, much like the "QUAL_1" setup we developed for MIS; that is, almost identical to the "EASY" setup, only with a lighter fuel load, and the Hard/Medium/Soft/Soft (RF/RR/LR/LF) tire compounds of the "EASY" setup changed to Medium/Soft/Soft/Soft, which gives just enough grip for a brief qualifying run before your rubber starts to "go away."

I loaded Milwaukee's "QUALEASY" setup and after a few laps, decided that I'd like slightly faster steering, and changed the Wheel Lock from 15 to 16. I also reduced the fuel load from four gallons to three because Milwaukee is a mile—compared to MIS' two—and three gallons is plenty for an out-lap, a warm-up lap, and two timed laps. All the other default values seemed pretty good, so I saved the setup as "QUAL_1."

Here's what my first qualifying run yielded (measured at the end of the third—or first qualifying—lap):

	Inner	Middle	Outer	Camber	Shocks	Sway	Bars
RF	240	240	240	-1.90	50%	5/8
RR	260	260	260	-1.30	70%	(Front)
LR	210	210	210	-0.10	75%	5/8
LF	165	165	165	-0.60	95%	(Rear)

The observed on-track measurements: Vmax = 187 (end of front straight), Vmin = 161 (apex of T4), Lap = 180. (At the end of the fourth lap—second timed lap—the RR was in the 275-degree range, i.e., going away.) So far, I wouldn't change a thing.

Switching to the "EASY" setup to practice for a 10% (20-lap) race, I found that I was getting 1.7 mpg, so I reduced the fuel load from 40 gallons to 12. The other "EASY" defaults, however, seemed to be causing oversteer, particularly diving into T1. Again, I suspected excessive stagger (the default is the maximum: 1.00 in.), but reducing the value to everything from .900 to .500 inch didn't significantly alter the condition...nor did anything else in my bag of tricks...so I finally decided I was simply "overdriving;" that is, trying too hard. Like every other sport, you have good days, and days when you can't get arrested. I packed it in, and came back to it the next day, fully rested, and trying not to picture myself as a "victim" of oversteer.

[N.B. Once you start playing with setups, you may unknowingly wander far afield, trying this and trying that, and getting further and further away from where you want to be. You have to learn to recognize these *cul de sacs* and know when it's time to go back to where you started. As many real-life teams have found out, once you've lost the thread, it's gone. (More than one team has been known to buy back a car they sold a year ago, just to reacquaint themselves with a setup they know works.) Know when to fold 'em. Give it up and start afresh from a known departure point...which is another reason why it's important to keep accurate setup sheets.]

It's the Handling, Stupid

I also discovered that subtle changes in driving style have a big effect on the way the car seems to handle. A track as wide as Milwaukee offers the opportunity to try several different lines. Realizing that Milwaukee's T1 and T3 are not anything alike, I experimented with two radically different grooves. At the approach to T3, I swooped in low for an early apex, not backing off, and not touching the brakes until I was riding the yellow line at the bottom of the track, and then only giving the brakes a short, sharp jab, and getting right back on the power again.

At the end of the front straight, on the other hand, I rolled partially out of the throttle rather than hitting the brakes at all, coasted in (on a slightly trailing throttle) to a very late apex, gradually squeezing the power back on late in the corner. What seemed to count almost as much as the lines I was trying was controlling the turn-in transients: when, how fast, in which order (and how hard) to turn the wheel, feather the throttle, and hammer the brakes. What had seemed easy with three gallons on board became fiendishly difficult with 12 gallons. (Other than fuel load and tire compounds, the "EASY" and "QUALEASY" setups at most tracks are identical.)

This resulted in lap times within one mph of my qualifying setup, but I had reservations about using these techniques during a race. An early apex in T3 is very protective of your line, but a late apex going into T1 leaves the door wide open for any competitor near enough to dive inside of you at the end of the front straight. Also, there are merits to *either* braking for these two corners *or* backing off (it's easier to be consistent backing off than to brake by exactly the same amount every time),

*I left the brake balance unchanged from the "EASY" default of 6/8. If I'd biased the brakes more toward the front (say 7/8), the car would have been inclined to get loose if I was turning in *and* braking at the same time. If I'd biased the brakes more toward the rear, it would have enhanced directional integrity...at the expense of overall stopping power. I'll discuss this anomaly later in greater detail at Laguna Seca *in re* trail-braking on road courses.

but it's confusing (and tiring...which usually amounts to the same thing) to brake for one and back off for the other. Still, stabbing the brakes for T3 got the oversteer under control* at *that* end of the track, and a gentle turn-in for T1 helped control oversteer at the other end. I decided to try this technique for my first race.

Here are the results of the modified (12-gallon) "EASY" setup after 10 laps (half the 10% race distance):

Inner	Middle	Outer	Camber	Shocks	Sway	Bars
RF	225	225	225	-1.90	50%	5/8
RR	250	250	250	-1.30	70%	(Front)
LR	242	242	242	-0.10	75%	5/8
LF	194	194	194	-0.60	95%	(Rear)

The observed on-track measurements: Vmax = 186, Vmin = 158, Lap = 178. Note that both leftside tires are considerably hotter than during the Q attempt, even though they're both Soft compounds. This is because they've had a lot longer to warm up. The RF is a little cool. It ran several degrees warmer in the earlier laps, but if I'd tried a Medium, it would have overheated after as few as five laps.

Earth to Fred: Go Home!

Leaving the Opposition Strength and Number where they had been at MIS (100% and 5), I found the field of CC cars qualified at 179-181 mph (except for poor Fred Jones, who limped around at a pathetic 173...where did they get this guy?). I posted a 180-mph lap, started fourth on the grid, and shot between the two cars ahead of me on the grid (definitely not recommended) before we got to T1, and was never headed. I never saw anybody but Jonesy, whom I lapped toward the end of the race. I averaged 174 mph and won by five-and-a-half seconds. Considering my reckless start, I was lucky. Very lucky.

So what is the key to Milwaukee? It's got nothing to do with your car or your setup or the track. It's traffic...as you discover when you increase the number of opponents to 10 or more (the maximum at a one-mile track is 26 or 27), and/or run a race closer to 100% of the full distance (200 laps). On a mile oval, you're in traffic *all the time*. There's so much traffic that you lose track of where the guys are who

are on the same lap as you. You find yourself taking wild chances to get by backmarkers, because if you don't, your nearest competitors will gang up on you, and you'll frequently be shoved out of the way by guys who have nothing at all to gain by it.

And you start a new lap every twenty seconds....

Fortunately, the AI is very good at Milwaukee, and you've got plenty of room to stay out of harm's way and still be able to circulate rapidly. You need a stable setup to be able to change your line to suit traffic conditions, but if you screw your car so tightly to the track that you can't run consistent 174-176 mph laps, you won't be able to keep up with the CC cars at 100% OPPS.

Final word of caution: in practice and longer races, there's a lot of traffic in and out of the pits. Here the AI is clueless; the CC cars will cut in front of you as they peel into the pits, and if you make a habit of occupying the area inside the yellow lines (delineating the pit-in and pit-out lanes), sooner or later, you'll be S.O.L.

Have fun.

I Love the Smell of Methanol in the Morning

Louden, as I say, is altogether different. The straights are long enough that you may eventually want to shift down a gear for the corners, but the sim won't allow you to do this if you've selected Auto Transmission; you have to go to Manual Transmission. Like braking vs. lifting at Milwaukee, keeping it simple has a lot to recommend it, and for now I'd suggest leaving it in sixth gear all the way around.

The straights are also long enough that you can catch a "tow" by slipstreaming the car ahead. The effect is not as pronounced as it is at MIS (it's worth one or two mph, not two or three), but in a long race, it's worth taking into consideration (i.e., keep your race gears tall enough that you don't quite get the "over-rev" warning light blinking at the end of the straights...*unless* you've caught a draft).

[N.B. In a long race at Louden, you may even want to use sixth as a fuel-saver, shifting down to fourth for the turns, and back to fifth for the straights as you work your way through traffic, but this constitutes a significantly heavier cockpit work load.]

The track at Louden is also narrower than Milwaukee, and the turns are slightly banked. When you turn into T1, the banking rises on your right, but when you turn into T3, you dive down to the apex, then climb out of the "hole" as you exit T4, which makes it a horsepower track, like Dover is for stock cars (and horses).

I loaded the "QUALEASY" setup, but it wasn't as effective "out of the box" as the "QUALEASY" setup at Milwaukee. The outside of the RF ran two degrees hotter than the inside edge, and the center of the tread was three degrees cooler. I added two clicks of negative camber and two lbs. of air. The inside edge of the RR was slightly hotter than the outside, so I added one click of positive camber there. I also reduced the fuel load to three gallons, and saved the setup as "QUAL_1."

Pausing coming out of T2 on the third lap, I recorded the following data:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	214	214	214	-2.00	65%	5/8
RR	248	248	248	-1.20	60%	(Front)
LR	212	212	212	+0.10	70%	5/8
LF	156	156	156	-0.90	95%	(Rear)

The observed on-track measurements: Vmax = 184 (on the back straight), Vmin = 160 (T4), Lap = 178. The RF looks too cool, but it seemed unlikely that a Soft compound wouldn't overheat, so I decided not to change it. This may have been a mistake.

Taming the Demon Oversteer

Once again, I experimented with line and turn-in technique. I discovered that backing off and taking a late apex at both ends of the track worked better for me than the asymmetrical technique I'd tried out at Milwaukee. And once again, the car seemed quite loose, particularly exiting T4. I started trying different settings to see if I could tame the oversteer, such as stiffening the front bar, lowering the front wing, raising the rear wing, softening both rear shocks, and working a high groove, and felt I was making some progress in the way the car handled, but the lap speeds failed to show any improvement. I entered a Single Race just to check the qualifying speeds. Bad news:

with the leaders turning 182s, my 178-mph run would have put me fifth on the grid in a field of six, ahead of only the sorrowful Mr. Jones.

I decided to check out the "QUALACE" setup (passing over the intermediate "QUALFAST" setup). After making the same adjustments (more TP and negative camber at the RF; more positive camber at the RR; fuel load reduced by one gallon, etc.), I saved the result as "QUAL_2" and took the car out for a spin. Literally. The only difference in the setups is the wing angles: 11.00 degrees front and rear for "QUALACE" vs. 16.20 (FWA) and 17.60 (RWA) for "QUALEASY"...but what a difference! Although you need a much more delicate touch, the improvement in lap speeds is dramatic. Here are the results:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	229	229	229	-2.00	65%	5/8
RR	208	208	208	-1.20	60%	(Front)
LR	211	211	211	+0.10	70%	5/8
LF	160	160	160	-0.90	95%	(Rear)

The observed on-track measurements: Vmax = 194 (ten mph faster than with the "QUALEASY" setup!), Vmin = 160 (curiously, about the same), Lap = 182 (four mph faster than with "QUALEASY").

The new setup also worked better when I braked going into T1 and T3 rather than just backing off. However, a forceful (if brief) jab at the brakes would hook the car into a spin if I didn't angle the car toward the apex, straighten it out, brake in a straight line, then jerk the car to the left again. Too untidy for me. But by moving the brake bias rearward three clicks (to 3/8), I could really stomp on the binders without losing the rear end...and without giving up too much momentum.

If you're good enough to control the car with the "QUALACE" setup, use it. If not (or if you just don't need the aggravation right now), go to the Opposition menu and reduce the OPPS to 96%.

How Much Is That in Gallons Per Mile?

Moving on to a race setup, I made the same changes to Louden's "EASY" setup (more TP and negative camber at the RF; more positive camber at the RR), reduced the fuel load to 13 gallons (enough for a 10%, or 20-lap, race at 1.6 mpg; the consumption is worse than Milwaukee's because the wing angles are greater), changed the brake bias to 3/8, and ran a benchmark. After a few laps, I made one further change: softening the rear bar to 4/8). Here are the results after 10 laps:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	181	181	181	-2.00	65%	5/8
RR	229	229	229	-1.20	60%	(Front)
LR	232	232	232	+0.10	70%	4/8
LF	161	161	161	-0.90	95%	(Rear)

The observed on-track measurements: Vmax = 183, Vmin = 156, Lap = 175. Running out the full 20 laps (to make sure 13 gallons would be enough), I turned a 178 on my penultimate lap. Note the Hard RF tire is stone cold. I could have stiffened the front bar (or lowered the front wing) to put more heat into it. Could've. Should've. Would've. Didn't.

At the end of the test, running against a full field of 26 cars at 100% OPPS. I had the fastest practice time, but I decided to cheat on qualifying...just to get in some practice in lapped traffic, you understand...not that I would ever do such a thing in real competition. I set the OPPS at 96%, qualified on the pole at 178 mph with my "QUAL_1" setup, saved the Race Weekend, and then raised the OPPS to 100% for the event.

It was fairly easy to lead from the pole, but after a few laps I was passed by Bobby Rahal and Scott Pruett. At the halfway point, I was four seconds behind the leaders, when Jimmy Vassar (the 1996 CART car Champion) put me into the wall when I failed to yield (he had the right-of-way). Serves me right for cheating. I had been averaging about 172, which would have put me pretty far behind had I lasted the distance (you can hit the "A" key to accelerate time if you crash out of the race but want to know how it turned out). Rahal won at an

average of 175 mph.

When you do crash out of a race, it doesn't make much sense to get your car pointed in the right direction and reenter the fray. You're hopelessly behind at that point, and if you'd been running with Realistic Damage on, you'd be toast anyway. (BTW, unless you're a Generation-Z Nintendo chauffeur, don't tell anybody you've even considered *Arcade* Damage. Sheesh!)

Before my crash, at 100% OPPS with the modified "EASY" setup, I was definitely quicker than the CC cars coming off T2 and T4, but losing ground to them on both straights. This tells me that I've got too much wing. With a low-drag setup like "FAST," I'd probably be evenly matched all the way around the track. So many permutations, so little time. If I had it to do all over again, I'd have set the OPPS at 97%. My 178-mph Q speed (with the "QUAL_1" setup) would have put me in the first couple of rows on the grid (the leaders qualify at 179 mph at 97% and 176 mph at 96%, which shows you what a difference a one percent difference in OPPS can make), and allowed me to run with the pack all day. But until you can handle the "FAST" setup (14.40/14.00; FWA/RWA) at 100% OPPS, you can't claim you've mastered Louden.

Hurry! Hurry! Hurry!

Phoenix. Let's cut right to the chase. Phoenix is fast, fun, and furious. An amusement-park ride. Thrills! Chills! Spills! Mostly spills. It's a crash-fest! I crashed out of at least eight races before I finished one...in second place, at 97% OPPS, against a full-field of 26 other cars. In qualifying, 97% OPPS had gridded me well down in the pack, so I cheated...again. Dropped back to 95%, grabbed the pole at a lowly 178 mph, saved the Weekend, cranked the OPPS back up to 97%, and ran a number of spectacularly unsuccessful 10% (20-lap) races. The usual scenario: I would run with...or ahead of...the leaders until we got into lapped traffic after a dozen or so laps, then I'd collide with a backmarker, usually putting us both out. Is it me? Or the AI?

Admittedly, the race-ending "incident" was usually my fault...for running afoul of what *CART Racing* fans call "the stop sign at Turn One" at Phoenix: the CC cars suddenly jam on the brakes after they're committed to the corner. Even when you know it's coming, it's hard to avoid "Death From Ahead." When the CC cars "brake test" you, be prepared to go high or go low...because they don't leave you with time

to brake. But sometimes, it's the CC cars that crash out, and you're the survivor. The few races I did manage to finish—races where everything that could go wrong *didn't*—were usually the ones where I'd taken out several other cars (as many as five in one race), but was able to soldier around. This isn't my idea of fun.

The only "fix" (other than getting really nimble at avoiding the CC cars) is to reduce the number of Opponents to nine or ten. Then the CC cars you *do* encounter are not only fewer and farther between, they're "smarter" because the AI has fewer cars to deal with. So, until further notice, we'll restrict all fields to nine other cars. I think we can all live with that. I know I can.

Phoenix is flat out almost all the way around. You want setups with a lot of downforce, and the "EASY" setup variants fill the bill. You know the drill by now: load the "QUALEASY" setup, reduce the fuel load to three gallons, and establish a baseline. I paused the game coming off T4 after three laps. This is what I got:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	181	183	185	-1.80	45%	3/8
RR	211	211	211	-1.40	60%	(Front)
LR	184	184	184	-0.10	65%	3/8
LF	146	146	146	-0.60	85%	(Rear)

The observed on-track measurements: Vmax = 185, Vmin = 145 (in T2), Lap = 176. Car felt fine; some push is T2. The 5.4 top gear is way off, but it doesn't matter—the car stays stuck in fifth (a 5.7 gear), turning up 13,000 rpm only at the end of the straight. (You'd have to fix this once you get the aero drag low enough that the car automatically shifts into sixth gear.)

Are You a 98-lb. Weakling?

It's obvious from the baseline that the RF can take a softer compound and at least one more click of negative camber. Yet even with push from a cold RF tire, I could feel oversteer lurking, so I backed off the stagger three whole tenths (to .700 in.) and moved the brake balance back one notch (to 3/8) to soften the effect of hard braking. I tested again and got the following results:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	255	255	255	-1.90	45%	3/8
RR	245	245	245	-1.40	60%	(Front)
LR	207	207	207	-0.10	65%	3/8
LF	147	147	147	-0.60	85%	(Rear)

The observed on-track measurements: Vmax = 186, Vmin = 148, Lap = 178. Car very easy to drive. Too easy? To see how this would stack up on the grid, I went to Single Race/Qualifying, and saw that at 97% everybody was outrunning me, so that's when I decided to "cheat" by qualifying at 95% and saving the race for later running at higher OPPS.

For the race setup, I took "EASY" and reduced the fuel to 12 gallons, reduced the stagger to .900 in. (vs. .700 for my Q setup), and took a chance on substituting a Medium for a Hard compound—and adding one click of negative camber—at the RF, lowering the front wing (to 16.20 deg.) and raising the rear wing (to 15.80 deg.). Bingo! The results:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	265	265	265	-1.90	45%	4/8
RR	232	232	232	-1.40	60%	(Front)
LR	235	235	235	-0.10	65%	3/8
LF	160	160	160	-0.60	85%	(Rear)

The observed on-track measurements (pausing coming out of T4, which seemed to show about the same temps as coming out of T2) after 10 laps: Vmax = 184, Vmin = 140, Lap = 174, with a best lap of 176. The RF is hot, but not hellishly so. The speeds are good for a race setup. I saved it as "RACE_1."

Running in traffic (practice and race) showed me that with "RACE_1," I can run in the 172-174 range, or about what the CC cars do at 97%. Again, you have to split the Q and R OPPS (although you can easily edit the track files once you decide on the exact speeds you want—see the "Really Advanced Stuff" chapter later on). I chose 95/97%. In retrospect, I should have tried harder...maybe 96/98%.

The Joy of Driving

Phoenix is a joy-of-driving track. You swoop down into T1 like a fighter plane, swing wide as you enter T2, then swoop down twice again: for the T2 apex at the end of the pit-lane exit, and for the "dogleg" in the back "straight." The final corner, T3/T4, is a classic bullring shape...although the pedestrian bridge almost touching your nose is always a *frisson*. Brake too hard and your nose points right at the bridge abutment; not hard enough and you sail around the rim o' the bowl, nowhere near your apex.

Once you get comfortable at Phoenix, it's possible to skitter around like a water bug, barely breaking the surface tension. The fastest laps seem to come from taking a high, fast line, rather than keeping it tucked in against the rail all the way around. The key at Phoenix is your turn-in to T1; you want to carve down toward your apex, but not so sharply as to cut across the grass at the bottom (which will get you sideways). You have to learn to do this by instinct; you cannot see the apex from where you must initiate your turn-in.

The only time you're likely to be unpleasantly surprised at Phoenix is when you get exit oversteer coming out of T4. This is invariably a result of having come down too early on your apex for T3, forcing you to make one tug too many on the steering wheel to complete the turn, thus pitching your car into a skid. Try for a later, smoother entry. If hitting the brakes is pulling your car into a loose attitude, move the brake bias even more to the rear (to, say 2/8).

For me, the easiest place to pass was on the outside going into T1. The CC cars' slow-down is so dramatic (and predictable) that you can pick them off, one by one, if you stay one lane higher then they do as they traverse the home straight. When they brake for T1, you nip around them on the outside before hitting your brakes. However, this is predicated on your having been able to stay right with them coming off T4. Note that you cannot gain on them on the front straight (not much of a draft here), but if you're in position, just wait for the CC cars to slam on the brakes, then go for, uh, broke.

[The other passing "opp" is going into T3. This is risky business. Again, you have to set up the target car coming off T2: you come off a little faster and outside. Going into the dogleg, you get under his (or her) LR wheel, keep it there, then grab an early turn-in and apex for T3.

This gives you a pathetic exit speed from T4, but if you've passed decisively enough, you can make it stick the length of the front straight on the inside, then you're home free.]

You can circumnavigate Phoenix entirely without touching the brakes. If you find yourself alone in the race, with nobody to pursue or escape from, you'll probably cruise around, backing off for T1 and T3, although you've gotta be smooth (watch that T4 exit oversteer!). If you're chasing a competitor (or in qualifying), most likely you'll be working the brakes. FWIW, I've watched *CART Racing* maestros like Matt Sentell (the chief test pilot for Papyrus) at speed, and note that they work the brakes and throttle in many short, sharp, alternating jabs...often so close together I wonder if they aren't using them both at the same time. I feel like an old fuddy-duddy by comparison.

[Also FWIW (for what it's worth), on television, watch every race at every track you ever intend to run on in the game. You can learn about economy of line from watching stock cars at Phoenix and Nazareth (see below). The in-car cameras at CART car races will give you an idea of the cockpit workload (the steering looks heavy and unresponsive...in comparison to the sim), and of the tremendous G-loads (particularly under braking) that sim players will never feel. Movies like "Days of Thunder" and the remake of "The Getaway" with Alec Baldwin and Kim Basinger give some indication of the earth-shaking rumble of the stock cars at Phoenix, but the most recent Hollywood take on CART cars is the hopelessly out-of-date "Winning" (with real-life racer Paul Newman and *ueber*-cad Bob Wagner as his rival, from way back in 1969.]

The Naz Wants You

If Milwaukee is the Miracle Mile, then Nazareth must be the Nazareth Nightmare. The Naz will keep you up late at night, chasing the perfect setup, trying to get hooked up for the race. The track is so narrow that there's only one groove...and it's *not* two cars wide. The Naz is yet another pretzelated oval, but contrary to the usual roundy-round hypertrophy—what I see as six turns is here officially counted as only three! Turn 1 is a trifle, a kink that's more of a nuisance (like the dogleg at Phoenix) than a major annoyance...unless you attack it from *completely* the wrong angle (e.g., if a CC car is passing you on the outside, BACK OFF, BUSTER!).

T2 is usually what would be called the T1/T2 complex at most ovals—a long, flat, constant-radius turn (called a "wait-a-minute" because it requires gobs of patience), followed by a ruler-straight (but slightly downhill) run to T3, which I see as two distinct turns (one downhill, one uphill) with separate apexes and different radii, then—fighting push and energy hemorrhage—you stagger up over the brow of a hill and across the S/F line. Whew!

The conundrum of Nazareth, in a long race: how *not* to overheat the RF tire. Your car spends more time "cornering" (T2 seems to go on forever) at Nazareth than at any other track, so you want to keep an eye on your RF tire. Hard is the usual compound, although for a 10% race a Medium will suffice.

First, we'll establish a benchmark with Nazareth's "QUALEASY" setup, sticking with the default wing angles (17.40 and 15.00 degrees; front and rear), and modified only by one less gallon of fuel. The results (from L3/T2):

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	204	205	206	-1.70	35%	4/8
RR	240	240	243	-1.50	75%	Front)
LR	195	195	195	-0.10	85%	4/8
LF	155	155	155	-0.90	95%	(Rear)

The observed on-track measurements: Vmax = 186, Vmin = 158, Lap = 175. Now I'm becoming *really* paranoid: it's getting to where I can *smell* oversteer...and what I'm getting a whiff of here isn't Starbucks wafting across T3. Desperate drivers demand desperate measures...and what I'm considering is Draconian.

"Waiter! What's This Car Doing in My Soup" "About 185?"

The numbers tell you to substitute a Medium-compound RF for the Soft, and to add a little negative camber to the right side of the car. Instinct told me to test out Doug Arnao's "matchbook-under-the-table-leg" theory here, so I reduced the RR shock four clicks to 65% and stiffened up the rear bar one notch so the back end wouldn't go all squishy on my. Huzzah! This worked like crazy. The results:

	Inner	Middle	Oute	Camber	Shocks	Sway Bars
RF	255	255	255	-1.80	35%	4/8
RR	250	250	250	-1.40	75%	(Front)
LR	205	205	205	-0.10	65%	5/8
LF	150	150	150	-0.90	95%	(Rear)

The observed on-track measurements: Vmax = 186, Vmin = 160, Lap = 176, with a best lap of 178. To tell the truth, I'm not at all sure about that Vmin; it comes in the middle of T3 when I'm at my busiest. A better indication is my speed through the constant-radius T2, which has gone up from 169 to 171. This feels good. I save this setup as "QUAL_1."

Loading the "EASY" race setup, reducing the fuel to 13 gallons, running 10 laps, and pausing coming off T2, I establish the following benchmark for a 10% race setup:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	176	176	176	-1.70	35%	4/8
RR	226	225	224	-1.50	75%	Front)
LR	221	221	221	-0.10	85%	4/8
LF	165	165	165	-0.90	95%	(Rear)

The observed on-track measurements: Vmax = 184, Vmin = 154, Lap = 174.

I made a couple of obvious changes (touch up the RR camber, substitute a Medium RF for the default Hard), one subtle change (softening up the LR shock to ease up of the RF), and—to err on the side of caution—reduced the FWA from 17.40 to 16.80 *and* increased the RWA from 15.00 to 16.20. That old devil-oversteer ain't gonna get me! Indeed, it's under control:

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	255	255	255	-1.70	35%	4/8
RR	235	235	235	-1.40	75%	Front)
LR	235	235	235	-0.10	65%	4/8
LF	155	155	155	-0.90	95%	Rear)

The observed on-track measurements: Vmax = 184, Vmin = 156, Lap = 176.

Putting Theory into Practice...and Qualifying

A trial race-start or two demonstrated the importance of qualifying in the front third of the field. Although I had turned 176s often enough in testing, the first time I went to a Single Race (at 97%), wouldn't you know, I got butterflies and barely squeaked through for sixth on the grid.

If you're willing to live with the results you get from starting in the third row, you're probably going to go home hungry more often than not. I just kept hitting "Shift-R" until I got a start I could live with through the first couple of corners. The CC cars quickly bunch up on the left going through T1, so you can make great strides from an outside row (even-numbered) grid positions, if you don't tangle with another car.

At Nazareth, 97% seemed just right for both qualifying and racing. I found I could move up easily from sixth place on the grid (polishing my chops in traffic) to third or second or even first, effortlessly running with the leaders, and often running in the lead. However, if I made the tiniest mistake, my pursuers would be all over me like cheap perfume, so it's a great confidence- and concentration-builder to practice staying out of their clutches. With fields of 10 cars, there aren't too many

backmarkers to deal with, and I even assayed a few races with Realistic Damage on (talk about your “pucker factor”!). Now I *am* having fun.

The setup still needs work, though. I’m significantly faster than the CC cars through the long, long T2...and slower down the ensuing straight...indicating that I’ve got too much wing, and too high an OPPS. But 100% is several mph higher...and in this game, every mile-per-hour is a whole order of magnitude.

Tired of going in circles? Me too. Why don’t we do it in the road?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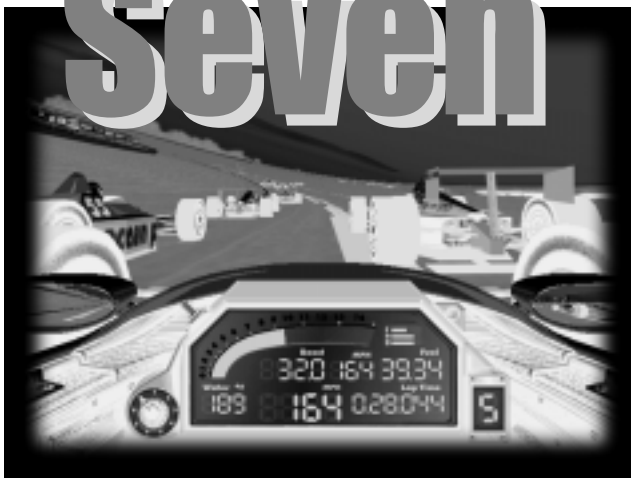
TM

Chapter Seven



Road-Racing 101

Wherein We Move "Camp Papyrus" to Laguna Seca

Now that you've learned how to stab it and steer it (left!), it's time to learn the other side of CART car racing, generically called "road racing," a term which includes temporary circuits like Long Beach and Surfers Paradise in Australia (where you race on what are ordinary city streets 51 weeks of the year); the meandering country lanes of "natural terrain" road courses like Laguna Seca and Elkhart Lake; a circuit laid out on airport runways a stone's throw from bustling downtown Cleveland, Ohio; and Detroit's Belle Isle, a temporary track winding through a sylvan park on an island in the middle of the Detroit River.

Road racing is much harder to master than oval-track racing, in my opinion. The most obvious differences are that road-racing tracks are longer (up to four miles per lap); have more turns (up to a dozen or more); and the turns go left and right, fast and slow, and up and down (the downhill plunge at Laguna Seca is equivalent to a fall from a 17-story building). You're going to have to learn two whole new skills: braking and accelerating...and neither is as simple as you might imagine.

One other profound difference: traffic. Thankfully, there's quite a lot less of it to deal with. Not only do road races start out with smaller fields (for instance, 23 at Detroit), but they're also spread out over longer tracks, and they don't seem to bunch up as much. Plus the number of laps is less (a 10% race at Laguna is only eight laps), so you lap the other cars—or they lap you—less often. And when you're ready for longer races, you'll be pleased to discover that it's easier to fake out the CC cars on the road circuits (particularly under braking) than it is on the ovals.

Road racing also demands a different mindset. While ovals require patience and precision, road racing rewards aggression, and favors decisiveness over finesse. You need confidence, experience—or both—to lunge immoderately into the controlled chaos of road racing. If ovals are a Baroque minuet, road racing is slam-dancing (the street

circuits more resemble a knife fight in a telephone booth). You've got to put a lot of hustle into road racing, a lot of body English.

Road racing can be very frustrating. You'll find it's a lot easier to come up with satisfactory *setups* than it is to come up with satisfactory *laps*, because there are so many chances for error each lap. While you can scorch around a mile-oval in less than 20 seconds, one lap of a big circuit like Elkhart Lake can take *five times* as long. And while messing up one corner won't affect you for the next couple of laps the way it can on an oval, it will almost certainly screw up the next several *corners*, so if you blow one of the early turns on any given lap, you may have quite a wait until you get a shot at another lap. You have to think farther down the road...literally and figuratively.

This limited perfectibility extends to driving techniques as well as setups. On an oval, there's basically one correct way to drive a lap...and everything else is either a compromise or a mistake. In road racing, there are as many acceptable ways to attack the circuit as there are driving styles. You can come closer to perfection on an oval (kind of a "technical" sport, like rock-climbing with pitons) than you can with the more "interpretive" art of road racing. Lap times are no indication of *how* you're driving on a road circuit, only how *well*.

Road Racing: It's Out There

And while there are near-perfect setups for the ovals (all the theories tend to converge on a single point), road racing setups are far more nebulous. Thus, hard numbers start to lose their helpfulness. For one thing, tires on a road course almost never get hot enough to warrant anything other than a Soft compound, so tire temps no longer carry as much import (other than getting them even across their treads). For another, Wheel Lock values lose their meaning when a joystick player opts for the quick-twitch response of Linear Steering (you have to flick the car from side to side more than you do on the ovals), and then buffers it with a much lower Wheel Lock number.

On the other hand, setups become even more critical than on ovals because road-racing setups may be better "tuned" to your personal driving style. You can go with high- or low-downforce settings with less prejudice toward either lap speeds or track position than you'd get

on an oval if you wandered as far from the beaten path. Likewise, you can "tilt" towards either fast reaction or maximum grip without compromising your lap times (although, to win races, you're better off being fast on the straights than in the corners). In any case, you'll be working within fuzzy ranges of what *might* work (like a wing angle of anywhere from 12 to 18 degrees), rather than splitting hairs (like trying to discern any appreciable difference between a wing angle of 12.9 degrees and one of 13.1 degrees). I'll do my best not to lose sight of the fact that you, dear reader, may prefer exactly the opposite "feel" of a road-racing setup than I do.

In this chapter, we're going to start off with some chalk-talk about braking and acceleration. Then, as promised, it's on to Laguna Seca to test out some of these theories in the crucible of one of the most challenging tracks anywhere in the world. Then we'll concentrate on finding road-racing setups that work for you. In the next chapter: track descriptions and helpful hints for the nine remaining venues in *CART Racing*: Road America, Mid-Ohio, Portland, Cleveland, Australia, Long Beach, Toronto, Vancouver, and Detroit...in that order.

It's All In the Approach

Most casual observers assume that the hardest part of road racing is learning how to *go around* the corners. Nope. It's how to approach the corners. Your corner entry isn't as much of a choice in oval-track racing because there's less variation: you either fling the car into the corner with a "confidence lift" or you jab the brakes and *then* fling the car into the corner. Each corner in road racing is unique, and demands close attention as to how, exactly, you wrestle your car into the curve. This has mainly to do with braking, and there are basically two kinds of braking you may employ as you close in on the turn.

I've already mentioned "trail-braking," wherein you're still applying the brakes as you initiate your turn-in, and don't fully release them until you've reached your apex. In order to brake and turn at the same time, you have to move the brake balance forward of most of the default settings. You can move the brake balance (or bias) forward only from the cockpit (*not* from the Garage, although the value is always saved with the setup) by pressing the comma ("‘") key...and backward with the semi-colon (";") key...and observing the bar graph

in the upper righthand corner of your instrument panel. If the balance is too far aft, the front tires can't supply enough traction for maximum braking (although the car will be very stable in a straight line), nor will there be enough weight transferred to the front tires to provide maximum steering response. With too much rearward brake balance, you'll loop the car is you try braking and turning at the same time. (Used judiciously, rearward brake bias may be employed on ovals to "help" the car into the turn. Used promiscuously, it will snap the car into a spin.)

Getting the brake balance just right is a vital part of your road-racing setups, because it has a dramatic effect on your turn-in...if you're trail-braking. Too much forward brake bias will increase push, forcing you to miss your apex and run wide. To much rear bias will spin you out. Just the right amount will improve your turn-in. Brake bias also affects your car's attitude when you *release* the brakes, as we shall see.

In practical terms, there are eight "clicks" of brake adjustment from front to rear. To work from push to loose, you'll probably want to start with 7/8 (the bar graph almost all the way to the right), and move the bias rearward (to the left) until the car starts to feel unstable under trail-braking. If the rest of your setup is right, you probably won't go much below 5/8, except for straight line braking on ovals.

Trail-braking has three benefits. One, even though it provides less stable braking than straight-line braking, you can apply the brakes closer to the apex, so you can delay braking until later. Two, because you don't have to keep to an outside line while you're applying the brakes, you're not leaving the door open for a trail-braking competitor to sneak inside your line and pass you under braking. (On the downside, with less stable deceleration, trail-braking makes it dicier for you to outbrake your human opponents—CC cars don't trail-brake.) Three, in corners with a late apex, like T1 at Mid-Ohio or T3 at Toronto, you don't waste time the way you would if you had to brake in a straight line, coast around the corner to your apex, and then get back on the power. With trail-braking, it's a struggle, but you're always either on the brakes or the throttle.

Laguna Seca is one of those rare tracks where you can try it both

ways and see which works best for you. I prefer trail-braking here, but a case can be made for conventional straight-line braking for almost every turn*. Cleveland is an example of a track where trail-braking is the

only approach that makes any sense. OTOH, Australia is an example where the straights are so long and the turns so tight that maximum straight-line braking is preferable. (Besides, those kinky chicanes also mean it's harder for an opponent to get "under" you, and even if he or she does, the zig-zag nature of the chicanes Down Under are such that you can almost always re-pass the challenger at the exit.

**There is one bizarre alternative I mention here mainly for its amusement value. If your reflexes are unusually quick and your fingers preternaturally agile, you could employ* both techniques on the same lap, *readjusting the brake balance just before braking for each turn. Don't scoff. In the old game, maniacal players would adjust the wing angles on the fly; shifting from a low-drag position on the straights to high-downforce for the turns. Hey, it worked for the Chaparral 2E.*

Toss This Off!

Turn-in raises the issue of "tossability." When a driver talks about "tossing" a car into a turn, it's not braggadocio, it's a technique. At turn-in, you can either ease the car off its straight line and into the groove...or you can pitch it violently sideways by suddenly snapping the steering wheel, like a rally driver in the dirt. As a rule of thumb, the slower the corner, the more aggressively you can hurl the car into it. You can even induce oversteer with this technique to "help" the car around the turn.

Tossability is the way a car responds to this kind of treatment. The most tossable (aka "chuckable") cars are those with a low polar moment of inertia. (Low polar moment is the reason most race cars are

Once you reach the apex, the natural tendency is to punch the throttle to maximize your exit speed. But road racing has many first-gear hairpin turns where there's so much torque available that if you bang open the throttle, you'll spin the wheels...and maybe the car. If you're getting wheelspin coming off low-speed turns, you have three choices. One, go to a taller gear and forego maximum acceleration. Two, soften the inside rear shock (which will also, if Doug Arnao is right, reduce weight transfer at the front of the car). Or three, ease up on the loud

mid-engined.) The Reynard is such a car. I'll give you a demonstration of low polar moment: try to balance a broom on the palm of your hand with the straw-side down. Almost impossible—all the weight is at the "wrong" end, so the broom topples over before you can catch it. Invert the broom and it's easy—the mass at the top of the broom takes much longer to start falling...giving you plenty of time to catch it. The Lola has a higher polar moment; it's harder to haul off a straight line, so it feels more stable (which is better suited to oval-track racing). So, if you've been using the Lola on the ovals, I suggest it's time to switch to the Reynard chassis (or the Penske, which is somewhere in between...and fairly comfortable on the road circuits.)

pedal, dummy! The problem with trying to feather the throttle is that, sooner or later, in the heat of competition, you will forget...and loop the car. I'd rather make every effort to ensure that it doesn't happen in the first place.

Finding the Right Gear

The most significant component of acceleration (not just out of hairpin turns, but all around the track) is gearing. On the ovals—at least until you get into pace-car starts and long-distance races—the only gear you have to worry about is top gear (usually sixth), chosen to make sure the warning light just blinks on at the end of the straights. In road racing, you use all the gears each and every lap (even more so than in real racing, where the fragile first gear is used sparingly; there are only five forward gears available in real-world road-racing setups), and your choice of ratios will determine where on the track your car's acceleration is the strongest.

The considerations for top gear remain the same: you juggle the trade-off between high downforce in the turns and low drag on the straights. Your choice of a first gear depends in part on whether you're going for standing start (in which case you'll probably want the shortest gear available in the game: 11.9), or a rolling start (in which case you need the maximum acceleration not from rest but from 80 mph). It's which gears to use in between that needs concern us here.

On some tracks, like Cleveland, there's only one really slow corner, so you don't need a lot of grunt down low in the speed range. Others, like Vancouver, demand plenty of torque coming off the many tight turns.

(A gearbox is basically a torque multiplier, giving you either speed or acceleration in each gear.) Some tracks, like Laguna, consist mainly of low-speed corners, with one or two high-speed bends. Your choice of gears should be tailored to the needs of each track.

There are several ways of arriving at appropriate gear "splits;" the ratios you choose will determine your gearbox type. You can have a "close-ratio" gearbox where there is little rpm difference between the gears, or a "wide-ratio" gearbox, which is suited to tracks with big speed differentials between the slowest and the fastest parts of the track. Or you can choose gears to suit critical corners, so that in the middle of the turn (the apex), you are just coming on the power band, which will give you the best acceleration coming off that turn. At Laguna, for example, you want to optimize acceleration coming off T2, T3, T5, up the hill after T6, and particularly digging out of the hairpin (T11).

There are even reasons to choose ratios based on your selection of Automatic or Manual Transmission. With the former, the sim will sometimes leave you lugging in a higher gear than you would choose if you were shifting manually (going up the hill at Laguna, or between T1 and T2 at Mid-Ohio or Elkhart Lake). That is, you may have to *force* a shift with the Automatic Transmission by installing a lower gear than the optimum. With a Manual Transmission, you may sometimes choose a slightly taller gear than the optimum, to avoid having to shift up and then immediately back down again, as, for example, between T2 and T3 at Laguna, or again between T3 and T4. (If this intermediate gear is too short, you risk over-revving the engine, which can cause it to go off song for the remainder of the race...or blow altogether). In the epiphany I described in the preface to this book, I mentioned that you can emulate real-world teams with an extra-tall "economy" gear, for which a manual transmission is absolutely necessary.

A Treasure Hunt Without a Treasure

Finding the right gear splits (or "stack") is a tiresome procedure with little to show for your efforts. Your lap averages won't increase dramatically, and your ability to pass competitors won't magically improve. The way I do it is a compromise...but it works for me. I'll start off with whatever stack is in the "EASY" setup, and make my first adjustment to

top (or sixth) gear, bearing in mind the "tail-wind" effects of weather (if activated) and "drafting." Next, I'll determine what first gear I want. Then I'll work down from the top and up from the bottom to pick my intermediate gears. In general, you want to drop three or four clicks (each click is a tenth of an integer) from sixth to fifth, five to seven or eight clicks from fifth to fourth, and so on. If you're lucky, this progression will land on exactly the gear you've chosen for first.

If not, I'll accelerate out of the pits (during a Preseason test session so mine will be the only car I'll hear) and *listen* to the rpm drop between the gears, a technique which is usually more reliable than trying to read the rapidly moving tachometer tape. If you have any musical ability, you can *hear* when you've got it right. (If you have perfect pitch, watch a video of a real-world CART car race and try to match your splits to their engines' exhaust notes.) Portland is a great track to "audition" gear splits; the main straight is actually a drag strip. In fact, you can even use a stop-watch (or a scan converter and a VCR...or even a camcorder on a tripod) to measure your acceleration times precisely. Braking distances, too, if you're in an empirical frame of mind. Lastly, I'll make fine-tuning adjustments during practice to tailor specific splits for critical corners.

There's one more piece of advice about road racing that I should pass on (once again from race instructor Arnao) before we continue: Never find yourself *pointing away* from a turn. Between T2 and T3 at Laguna, for example, you have to *aim* the car from the righthand verge exiting T2 to the lefthand verge to set up for T3, then steer the car to the right; so if you find yourself still "crossing the road" when its time to dive into T3, you'll be pointing in the wrong direction. Another classic example (also from Laguna, although the worst track for leaving you aimed the wrong way is surely Mid-Ohio): you have to cross the road again, this time from left to right, between T8A and T9, and even if you don't spin, having to re-orient your car will bust your rhythm, break your concentration, and wreak havoc with your lap times.

Welcome Back to Camp Papyrus

After all your oval-track experience, you should be comfortable with the car at speed, so we don't have to start all over again from scratch, but since there's so much new stuff to learn, we'll go back to the Drivers' School approach we used at MIS, only this time the classroom will be at Laguna Seca. Why Laguna? It's not an easy track to get right, but once you do, it'll probably become your favorite road course (you can gain some cachet by simply declaring Laguna as your personal favorite, the way Stirling Moss used to psych his rivals by claiming he *loved* to race in the rain). If you can make it here, you can make it anywhere. That is, it incorporates all the elements that make road racing different from ovals. And unlike, say, Detroit, if you put a wheel off, there's enough room to gather the car up and continue without feeling like a fool (or worse, if you've chosen Realistic Damage on) bouncing off the walls.

Also, Laguna is great fun...a great place to show off what you've learned. You arrive at its most famous corner, the storied Corkscrew, at the top of a steep hill under heavy braking, drive over what looks like a cliff, then try to control the car as it tumbles down an even steeper hill in what feels like free-fall. Exhilarating, to put it mildly. (Even the game seems to get dizzy here: in the Arcade views, your car disappears altogether, albeit momentarily.) In short, this is as good as road racing gets (maybe except for the time Masten Gregory walked away unscathed after stepping out of his crashing Maserati 450S in the Gran Premio de Caracas in 1957).

Let's grab a setup and go for an "orientation tour" of the track. Simply learning which way the road goes is one of the most formidable challenges you'll face in committing all the road-racing circuits in *CART Racing* to memory. It's a great help if you've attended races at any of these tracks or observed them carefully on ESPN. And it's of even greater benefit if you've actually *driven* on any of these circuits, even if only in a street car, or at a drivers' school. Happily, it works both ways—if you ever intend to take up *real* racing, your experience with the sim will give you a leg up on driving the real tracks. (Or, if you already are a real racer, the sim can help you stay sharp during the off season.) And your appreciation of watching real racing on TV will be greatly enhanced by your having driven the track in the sim.

Although I'm no fan of the "QUALEASY" setup for this track, it will serve well enough for an orientation tour (we'll work on a better setup after you're familiar with the layout). With a bow once again to Lane Charnes, you can make your life a lot easier by reducing the boost from "9" to "1" on the dial (37 in. Hg.), which will make the car a lot easier to drive and eliminate wheelspin entirely. Another useful option is to toggle the Auto Brakes on by hitting 'Alt-B." Now you've got a car that's easy enough for your mother to drive, so you can concentrate on learning the course.

A Word on Methodology

Before we leave the pits, a word on methodology. I'd like you to run ten laps (which is what you'll get with the "QUALEASY" default fuel-load of 13 gallons with the boost reduced to "1"), concentrating on following the groove: keep your car in the middle of the tire marks in the corners, particularly T5 and the Corkscrew (T8 and T8A). Once you get the hang of it, you should be able to turn laps of 1:16-1:18 or so. When you run out of fuel, hit "Shift-R" and do it again, only this time note that the Auto Brakes only release once you have the car pointed in the right direction, so try to get the Auto Brakes to release earlier each lap by getting the car squared away earlier each time you repeat a turn.

Repeat the exercise, this time making mental notes of your track position when the AI *applies* the brakes. The AI is pretty good at this, with one exception: it brakes much too late for the hairpin (T11), so you should apply the brakes yourself when you see the number "2" brake marker disappear off the righthand edge of your screen. The hairpin aside, you should now be able to lap the entire circuit without lifting.

Then toggle off the Auto Brakes ("Alt-B") and repeat the exercise again, only this time *you* apply the brakes instead of the AI. This will take considerable getting used to, so I won't be handing out any demerits for switching the Auto Brakes on again for a lap or two (or part of a lap) until you've got a handle on it. Keep this up until you can get through a full 13 gallons with the Auto Brakes off.

When you feel ready, hit the "L" key to raise the boost to "2" on the dial (38 in. Hg). Your lap times should improve by about a second per

lap. Again, when you're comfortable, raise the boost another notch; you should pick up about another second per lap. Also check the tire temps, and notice that they are rising with every increase in boost pressure. Once you've raised the boost all the way up to "9" (45 in. Hg), the car will be very difficult to control, and it'll be time to make some changes in the setup.

On the Road Again

There's nothing flat or straight about any of this track—even the pits run uphill. The front "straight" is a sinewy trail up over the crest of a hill (officially labeled as Turn 1, although nobody has ever slowed down for it; not even in a Can-Am car). Avoid the temptation to hug the inside wall here, however. It's part of the pit-out road (clearly marked with white lines), and if you get in the habit of straying too far to the left, sooner or later, you'll come up unexpectedly on a car rejoining the track. (The pit-out extends all the way around the inside of T2, where you can see if it's occupied by traffic looking to merge, but this isn't the quick way around T2 so don't be tempted to use it...except in an emergency.)

Once you top the rise, you'll have to move over to the righthand side of the track to brake from 180 mph (at full boost...with a good setup) for T2, a long, long lefthander which has two apexes and assumes a reverse-camber tilt upon its exit. This is another "wait-a-minute" turn; there's a prolonged (and frustrating) period when you're just maintaining about 60 mph in first gear before you can start accelerating again.

Finally, when you *can* apply full throttle, you'll shoot across the road to the righthand verge...but don't straighten the car out—just let its natural arc carry you back across the road to the lefthand verge to start (straight-line) braking for T3, one of the most irritating turns in motor racing. Turn 3 looks as if you should be able to take it a lot faster than 75 mph, but it's usually a struggle just to connect with your apex. The tendency is to turn in too soon, catch too early an apex, and get the car straightened out before the road has quit turning; thus putting you off on the outside halfway through. If you turn in too much, you hook your RF wheel in the dirt and spin out. Until you learn to slow down and get it right, this turn will cause you more trouble than any other, especially on the first lap of a race when your tires are cold. The

Serenity Prayer works wonders here.

On the short straight between T3 and T4 you'll probably get up to fifth gear before coming back down again to third or fourth. If you're running with Auto Transmission on, you don't have to worry about it, but with a manual setup, you may want to lengthen fourth gear so you can eliminate the two extra shifts.

Float Like a Butterfly; Schwing Like a Flea

There's no real trick to T4 (a righthander taken at about 110 mph), but it is critical, because it leads to a series of three fast straights which will determine the majority of your lap time. Just tap the brakes, crank in some right lock, and stand on it. If you're going fast enough, you can "float" the RF over the grass inside the apex, but if you're not cornering hard enough (watch for a puff of dust in the replays), putting the RF in the grass will hook you into a spin.

You'll get up a surprising turn of speed (about 175 mph*) in the short straight after T4 before you go under a bridge and brake for T5 (a fourth-gear lefthander with an apex speed of about 105 mph). Turn 5, the Eau Rouge of American road racing, is the key turn at Laguna, because it connects the previous (downhill) straight with the next two straights, which go increasingly uphill...so if you don't carry your speed through T5, you're losing heaps of time all the way to the Corkscrew, just past the top of the hill, almost a mile away.

By my count, you get up over 165 mph five times at Lauguna (from exit speeds of 100-plus mph, except for the hairpin), which is why high-end acceleration is so important here.

You have the charge at T5, attack it, chucking the car into the turn with complete confidence that the tires will bite; then get back on the gas before you have any assurance that the car will make it. This takes tons of practice...and brass balls. There are no defining marks about where, exactly, to brake...and T5 is fast enough that you don't want to throw away your momentum with too much braking...just a quick jab to settle the car, then turn in. Again, if you do it right, you can float the inside front tire (the LF this time) over the apex...a fairly early apex if you're turning in aggressively. There are no half measures; if you're not going fast enough, the LF will catch and you'll spin. If you don't

"float" the LF, you have to take a much wider line—about 10 mph slower—and a later apex. After hundreds of laps, this will become second nature. Until then, do the John Wayne thing only in qualifying...and pussyfoot around the turn during actual races.

Now you start to climb the hill, gently at first. You reach about 165 mph before you have to punch the brakes for T6 (a fifth gear turn with an early apex, taken at almost 120 mph). Turn 6 is gentle enough that you *can't* float the LF tire over the apex while turning; first you square up the car, then brake, then drive straight across the grass, which is a lot easier to do. (If you're beginning to think road-racing has a lot in common with lawn-mowing, you're right. Cutting corners takes more bravery than skill; once you've tried it with sufficient gusto, you won't believe how easy it is.) If you do it wrong, you'll loop the car at the exit.

Next you start climbing the steepest part of the hill (one of the tire marks unaccountably floats serenely in mid-air here), and start braking for the Corkscrew just before the summit. Having been passed on the inside more than once under braking for T8*, I now brake in a straight

**Like T1, T7 doesn't really exist; it's more of an aiming point for the Corkscrew. You certainly don't have to brake for it.*

line *diagonally* across the road from just before the number "2" brake marker on the right to just before where the road drops away on the left.

Monster? Or Pussycat?

Although the Corkscrew looks like a monster, it's really a pussycat. Your car can get light enough to spin as you tip into T8, and if you carry too much speed from T8 (the lefthand part, taken at about 50 mph) into T8A (the immediately-following righthander, taken at about 55 mph), you'll spin the other way, so you have to gently "motivate" your car through these undulations at speeds that seem less than heroic. I find a series of pokes at the throttle works better here than steady pressure—it makes it easier to sense when the car is about to break loose.

[By the way, don't bother counter-steering to catch a slide in the Corkscrew. It's all downhill, and gravity—accurately modeled in the sim—is accelerating the spin. Conversely, gravity is why you can catch slides so easily going *uphill* into T6.]

The one to watch out for is T9. Surviving the Corkscrew is initially such a rush that you're too busy congratulating yourself to get ready for T9 (a steeply-downhill, third-gear lefthander taken at about 100 mph), which is more dangerous than it looks. It requires only a quick stab at the brakes, just enough to steady the car. Brake too much, and you usually put a wheel off on the inside and spin. Not enough braking, and you'll understeer off on the outside.

There follows another downhill run, not quite as steep (and not so accurately modeled; in real life it's much shorter). Once again, let the natural arc of the car carry you across the road to set up for T10 (taken in fourth gear at about 115 mph). The entry to T10 is banked, so you can enter it faster than you might think...but this changes to reverse camber at the exit, so you have to come out of it more slowly than is immediately apparent. If you get into trouble here, you can usually run wide, straighten the car out, and use the pit-entrance lane to get the car back under control before you have to cross the road to the right to set up for T11.

Turn 11, the last (and, at about 45 mph in first gear, the slowest) turn, is also very simple, but if you think you're on a hot lap, you may be tempted to get back on the throttle too early and you can easily loop the car at the exit. This is largely a function of your setup and first-gear ratio, but the sooner you can get the power down, the better —it's a long straightaway...and you're starting another uphill climb.

[If you have occasion to come into the pits (the pit-in lane starts between T10 and T11) be advised that the "elbow" here is even sharper than the radius of T11...and your pit follows immediately thereafter...so don't come in "hot," and don't fail to leave yourself enough Wheel Lock to make this turn without scraping the wall.]

Let's Work on Your Setups

When you think you know the track well enough to start feeling racy, you'll probably want to start working on some setups more attuned to the way you drive. I'll outline some general principles, then tell you what I've found that works for me.

Road-racing setups may be either asymmetrical (separate values for each corner of the car, the way it's done for oval tracks), which usually means very slightly biased toward righthand turns (every road-racing circuit has a preponderance of righthand turns except Laguna and Australia, which are run the "wrong" way), or just plain symmetrical, if you'd rather keep it simple. Nominal values would be 14-16 degrees of front wing angle (except at Detroit), 12-14 degrees of rear wing angle (except at Detroit), one-and-a-half to two degrees of negative camber at the front, zero to one degree of negative camber at the rear, front shocks fairly stiff (50-100%), and rear shocks much softer (25-50%).

The tuning procedure is much like that for ovals: pick a setup, run a few laps, use camber and TP adjustments to zero the temp differences across the tread (pause at the exit of the corner that puts the most heat, total, in all four tires), run in concert with the CC cars to get an idea of what RWA you need to match their Vmax, juggle the front wing angle and shocks and bars to balance the car and retain steering authority (you may want to adjust the Wheel Lock), double-check the tire temps, fiddle with the rear shock values and the first-gear ratio to control wheelspin, and—if you're happy with the the result—save it under a unique file name.

For now, there doesn't have to be any difference between your Q and R setups because the number of laps for qualifying won't be much different from the number of laps in a 10% race (i.e., at Laguna, eight laps for each). Eventually, you'll want to develop a lower-drag setup for qualifying, and an easier-to-drive, higher-downforce setup for the race, although you may find you're turning faster laps with the latter setup in the race.

A word about qualifying. Unlike the ovals, where you qualify alone on the track for two laps, you qualify for road races *in traffic* for ten minutes. If Lady Luck is with you, each and every lap will be better

than the last as the tires warm up, the fuel load lightens, and your concentration improves...so your last lap *should* be your best. More often, just when you think you're on a killer lap, you come up behind a slower car (or a faster car comes up on you), inevitably ruining your lap*. If you're really good, you could load a banzai setup with a

**Okay; one rare exception. At a track with long, high-speed straights, like Elkhart Lake, you might get* really *lucky and catch a tow, slipstreaming a faster car, and marginally improving your Q time...but don't bet the farm on it.*

light fuel load, take one lap to warm up, and set your best time on your second lap...before the CC cars come out of the pits to join you (you almost always get a couple of traffic-free laps at the beginning of the session, at least at Laguna). The one thing you *don't* want is to have any fuel left in the tank at the end of your best Q session—or lap—because its extra weight can only make you slower.

Setting Up for Laguna

For Laguna, specifically, you want a setup that gives you pinpoint steering authority. It's far more important to be able to aim the car precisely than it is to go for maximum cornering speed. It's one of the few tracks where I'm inclined to use the maximum available front wing angle—18 degrees—*and* use stiff front shocks (in the 80-100% range) *and* a fairly stiff front anti-sway bar (a couple-three clicks off full stiff). For qualifying, you may want to take a degree or two off the front wing angle and a click or two off the front bar. Or maybe not.

Once you've got the front end planted firmly on the road, the rear will more or less follow. I usually set the rear wing angle from 12 to 14 degrees, the shocks in the 25-35% range, and the rear bar a click softer than the front. I set the rear shocks soft to control wheelspin coming off the slow corners, but if they're too soft, you'll get wallowing (sort of a queasy yawing, like porpoising, only from side to side) if you bang open the throttle. You have to learn to caress the throttle, like the trigger of a hunting rifle (i.e., between the heartbeats; or, less martially, like a camera release).

You use the rear wing angle basically to control your Vmax. If, at any

given Opposition Strength, you find the CC cars are blasting by you on the straights and you're catching them up in the turns, you need less aero and more mechanical grip. OTOH, if you're blowing them off on the straights and they're eating your lunch in the corners, it's vice versa. If the former, reduce the rear wing angle and soften the rear suspension. The tire compounds in almost every road-racing setup will be Soft (the only exception that springs to mind is the LR at Cleveland), but you might increase their stiction marginally by lowering the pressure until the center tread temp is down by one degree, then increase the pressure by one lb.

You might also be tempted to play with a small amount of *positive* stagger at Laguna (a counterclockwise track), but the slight advantage that might accrue in the important lefthand turns (T2, T5, T9, and T11) probably isn't worth the hassle of asymmetrical handling characteristics in T3, T8A, and T10. I think you'd be better advised to confine asymmetry to camber (more negative on the right side) and shocks (5-10% stiffer on the left side). As always, let the tire temps be your guide.

[BTW, as with most road courses, the tire temps will seem low—the LF may run 150 degrees or less, and the rears will rarely get over 225—unless you're running very little wing and/or driving like a maniac.]

What I Did On My Summer Vacation

Here's how I arrived at my setup. I loaded Laguna's "QUALEASY" setup, ran seven laps, and paused coming off the hairpin (T11). The results looked like this:

Inner	Middle	Outer	Camber	Shocks	Sway	Bars
RF	195	195	195	-2.00	75%	4/8
RR	220	220	220	-1.10	20%	(Front)
LR	210	210	210	-0.90	20%	5/8
LF	160	160	160	-1.70	75%	(Rear)

The observed on-track measurements: Vmax = 174, Vmin = 42 (in T11), Lap = 1:10 (with a best of 1:09). Note that Vmin doesn't mean much in road racing. If you were going to modify your database fields,

you'd probably want to keep track of the speeds at the apex of every turn at every road circuit.

Although it's not apparent from the numbers, the 5.7 sixth gear was much too tall; I was in it for only a few yards and could only pull 12,900 rpm. However, the 11.9 first gear seemed a bit too short; I was getting serious wheelspin in T11. In between, the default gear splits (11.9/9.6/8.3/7.1/6.2/5.8; 1st-6th) seem, mmm, ill-chosen. After a lot of experimentation, I arrived at 11.8/9.7/8.3/7.4/6.7/6.2, which gives maximum speeds in the lower gears of about 90, 110, 130, 145, and 160 (at a 13,500-rpm shift-point), 180 mph at 14,000 rpm in top gear, and emphasizes acceleration in the 110-160 mph range.

Before I finalized the gear stack (knowing that I couldn't keep up with the CC cars at any self-respecting OPPS with a Vmax of anything less than 180 mph), I decided the default RWA of 18 degrees was way too high, so I lowered it to 12. On the other hand, I didn't feel the front tires were getting nearly enough bite, so I raised the FWA from 16.8 degrees to 18 degrees (the max). Of course, wing changes this radical necessitated some camber changes: two clicks more negative on the RF, none (surprisingly) on the RR, one click more negative one the LR, and four full clicks more negative on the LF.

Seeking even more steering authority (if oversteer is my *bete noire* on the ovals, it's understeer on the road circuits), I stiffened the front shocks to 85% (and later increased the LF to 95%), and softened the front bar one click (to 3/8) to reduce weight transfer. I also raised the stagger from zero to a tenth of an inch (positive).

Now it was the rear end that was feeling sloppy, so I stiffened the rear shocks to 30% (and later increased the LR to 35%). Finally, after more furious experimentation, I moved the brake bias forward from 5/8 to 6/8. You'd think all these changes would result in a *huge* difference in lap times. Not at all—my times improved by only one second. The tire temps, however, looked much better (that is, the RF, RR, and LR were 20 deg. warmer; and the LF was 30 deg. warmer...mainly because I could now drive the car a lot harder):

	Inner	Middle	Outer	Camber	Shocks	Sway Bars
RF	215	215	215	-2.20	85%	3/8
RR	240	240	240	-1.10	30%	(Front)
LR	230	230	230	-1.00	35%	6/8
LF	190	190	190	-2.10	95%	(Rear)

The observed on-track measurements: Vmax = 180, Vmin = 46 (in T11), Lap = 1:09 (with a best of 1:08). Good.

The Test of Time

This is a far cry from Hot Lap territory (the HL specialists claim 1:06 or better) but it's good enough to run with the CC cars under normal circumstances. The pole-sitter's Q time at 97% OPPS is usually around 1:10; at 98% it's around 1:09; at 99% it's around 1:08; and at 100% it's around 1:07.

This setup may or may not work for you, but by now you should have the experience and understanding to fiddle with the values until you find something you can live with for eight laps. From here on in, I won't give detailed setup information for each and every track. You can load the "EASY"/"QUALEASY" setups yourself and work with them until the car feels right.

I ran a sample race or two without learning anything startling. At Laguna, if you're not on the front row, it's a long way from the S/F line to T2 before you have to brake, so you have ample opportunity to pass the CC cars in front of you. And if you're not on the pole, you probably want an odd-numbered grid position so that you can keep to the left of the pack as it queues up for T2. If you have an even-numbered position and are "frozen out" of the pack as it lines up for T2, you might want to consider using the tighter radius of the pit-out lane on your left...just this once...but not if you haven't perfected this particular maneuver in practice.

My best finish was a first place (at an average of 114 mph, with a best lap of 1:09, against 97% OPPS), but my most *instructive* race was a third-place finish (at 99% OPPS), because I could observe where I was gaining on—or losing to—the leaders. The best place for passing is going into T2 or T11*. Between T2 and the Corkscrew, the CC cars *always*

**Long braking distances are typically where you can gain the most yardage on road courses. Not because you're such a fine driver (indeed, in this sim you don't even have to worry about locking the brakes and flat-spotting the tires: you can't), but because the CC cars' braking ability is compromised so as not to embarrass drivers using Auto Brakes.*

pulled away from me. I could catch them up under braking for the Corkscrew, but there was no way in hell I was going to pull off the Zanardi Maneuver (so brilliantly executed on the last lap of the last race of the 1996 CART season, when Alessandro Z. blasted past Bryan Herta between T8 and T8A...in the dirt!...and won the race). No way at all.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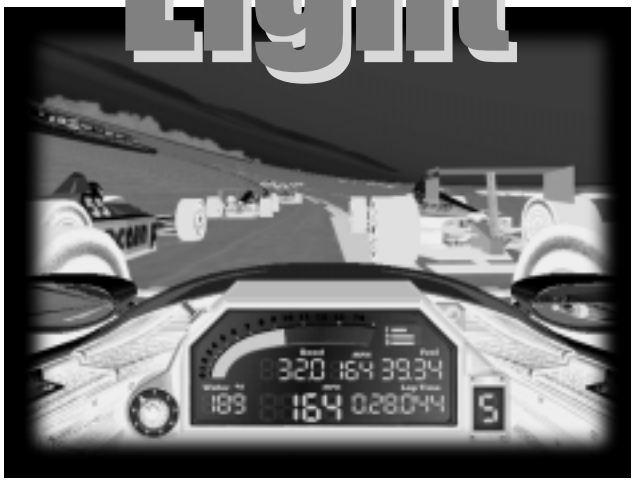
Chapter Eight



Road-Racing Notes from All Over

The Best of the Rest

The easiest of the road-racing venues to learn are probably the street circuits like Long Beach, because they're the simplest—Long Beach, for example, is only 1.59-miles around and its lap times are well under a minute—but while they're short, they're anything but sweet. The frustration levels are over the moon because they're so claustrophobic; you're hemmed in by walls right next to the track all the way around. The experience has been likened to "marbles in a chute." You feel no more in control of your fate than the early astronauts who were basically just along for the ride, like Laika, the dog in the early Sputnik; or "Spam in a can," as Tom Wolfe put it in "The Right Stuff." Also, you're so pressed for elbow room that passing is a Big Deal, and you're all too frequently jostled by the CC cars, usually just as you're preparing to make some inspired move.

The "natural terrain" road courses are longer in length and lap times (four miles in a minute-and-three-quarters at Elkhart Lake, for example), and you've got plenty of run-off room for when you make mistakes; the longer track distances spread out the traffic; and the more open "form factor" (a detestable piece of compu-jargon that happens to fit nicely here) makes overtaking less problematic. On the other hand, a layout like Cleveland's Burke Lakefront Airport is wide open...but so featureless that it's impossible to get your bearings without spending half your life just chasing the CC cars around trying to commit the layout to memory.

We'll start with Elkhart Lake (aka "Road America"), because it's the most natural progression from Laguna Seca, and segue on to Mid-Ohio, Portland, and Cleveland, before we get back to the street circuits.

Elkhart Lake: High-Speed Heaven

Like Laguna, Elkhart Lake is a great place to strut your stuff. It has three very long straights (the longest is 7/10ths of a mile), some nice elevation changes (but nothing as drastic as Laguna's), fast turns, slow turns, and one corner almost as distinctive as Laguna's Corkscrew: the Carousel, a seemingly endless, 180-degree merry-go-round that separates the once and future Jedi knights from the puerile wannabes.

The key to Elkhart Lake is learning to live with very little downforce so that you can make haste covering those three long straights. You need only enough wing to prevent your car from getting loose in T11, a fast sweeper after the Carousel, which should be taken flat out, without lifting. If you can control your car here with a RWA of 10 degrees or less, you should see speeds of over 200 mph between T11 and T12; the uphill straight between T14 and T1; and again between T3 and T5...and you need a Vmax of 200-plus mph if you ever hope to see lap times under 1:45 (the current Hot Lap is under 1:42).

The most critical turns at Elkhart are T1 and T3, because they connect at both ends to high-speed straights. Turn 1 is the more conventional of the two; a simple brake-and-turn exercise leading to a short straight. The sharper T3 can benefit from judicious "lawn mowing" (but if you're not going fast enough to "float" the RF over the apex, don't put a wheel off on the inside), and leads to a much longer downhill straight. Turn 3 has a late apex, and the most common mistake is getting back on the power too soon, realizing you're running wide, then having to back off, which leaves you entering a long straight with the throttle closed. Bad idea.

Like T2, T11, and T13, T4 is a kink in the road, not a real turn (although all four turns can—and should—be employed to block other cars from passing you). Your best opportunity for passing-under-braking is T5, which even if you're having trouble making the pass stick leaves you on the inside going up the short hill (under the Corvette bridge) toward T6.

If you can make it through T7 without lifting, you've definitely got too much wing. Turn 8—the slowest on the course—is deceiving because it's downhill; don't leave your braking too late (you want to trim the grass here, too, but not on the *outside* of the turn). The entry to T9 (the beginning of the Carousel) is much easier: turn in, then lift. As you circumnavigate the Carousel, you'll find its radius keeps changing; you learn to "steer" as much with the throttle as with the steering wheel. Be patient until it begins to open up at T10 (the exit of the Carousel), gradually applying full throttle. Steering precision through the pedal-to-the-metal T11 requires the steadiness of a brain surgeon, so I reduced the Wheel Lock to 13 degrees to prevent my over-caffeinated nerves from twitching me into the boonies.

Turn 12 might benefit from trail-braking, one of the few turns at Road America that would, but I prefer the security of straight-line braking everywhere else on this track. My favorite is T13 because you can attack it with great gusto (the CC cars scatter here when they see me coming) and draw a good bead on T14, an important turn because it exits onto the long, uphill front straight. If you have a choice between push and loose in T14, take the former—you can run wide on the grass and never have to let up on the throttle; just ease the car back toward the pavement. Don't get greedy and blow a good lap time here.

One other thing: use all the road. This may seem obvious, but at 200 mph (or anything close to it), the road looks so narrow that I wouldn't blame you if you clung tenaciously to the middle of the track. But don't.

For beginners, I'd recommend wing angles of about 16/14 (FWA/RWA), and gradually work your way down to 13/9, with shock values of around 70/50/50/70, although this track will benefit from asymmetry in everything but stagger. Strive for stability in the Carousel; you can't afford an "off" here, especially not during a race. The long straight-aways cool off the rubber, so you may want to experiment with slightly higher-than-normal tire pressures.

As at Laguna Seca, there's a long stretch between the S/F line and where you first have to stand on the brakes, so grid position isn't absolutely critical (given a choice, take an odd-numbered grid position to place you on the inside line).

Mid-Ohio: Why Do You Suppose They Call It Madness?

Mid-Ohio is everybody's idea of what a road-racing track should be like: plenty of tire-screeching corners, roller-coaster elevation changes, and sizzling high-speed straights. It's also one of the easiest of all the road circuits to learn...and not too tough to master. It's relatively non-taxing, stress-wise, making it a good choice for long-distance (100%) races. It's also an enormously pleasant place to visit in real-life as well (as all those campers and motorhomes along the backstretch attest, it's a great "family" track).

The secret to good laps here is carrying plenty of speed through T1, a

lefthander with a late apex just beyond the pits (mind the pit-out traffic!) that connects the S/F straight with a long-ish straight leading to the Keyhole. Turn 1 is iffy, requiring many repetitions to perfect it. Fortunately, there's a trick you can use to get in extra practice without having to go all the way around the rest of the 2.25-mile circuit: reverse out of your pit, steer right, accelerate the length of the S/F straight, and attack T1 from every angle you can think of. The universal tendency is to run wide at the exit. Like T14 at Elkhart Lake, if you do go off, you can usually coax the car back onto the pavement without hitting anything (the wall is quite far back from the track), although you will lose eons of time. Also, backing out of the pits will give you plenty of experience with making it around T1 with cold tires (a real Achilles heel during the start or restart of a race.)

Turn 2, the Keyhole, is like Elkhart's Carousel, only tighter, more even, and considerably easier. It's preceded by a flat plateau for braking in a straight line, a diving entry, and a climbing exit. This is another "patience" turn; you have to mark the spot where you can get back on the throttle full bore. Like Elkhart's T3, if you're early, you have to back off to avoid running out of road...just when the throttle should be wide open.

There follows a long, long downhill straight where you don't want to give away any speed to your opposition. Mid-O is a low-drag circuit (there are no high-speed bends that would benefit from a lot of rear wing angle), but you definitely want plenty of front wing to help your car turn in smartly (this is called high "wing stagger"). I always run with the maximum FWA: 18 degrees—there's little drag penalty—but I'm probably just lazy. You might start with the RWA at 15 degrees and work on getting it down to 13 or so.

Since there are a lot of slow corners, you want to keep wheelspin under control, so I'd recommend moderately soft rear shocks (buffered with a stiff-ish rear bar), and a wide-ratio gearbox that emphasizes mid-range acceleration.

With its many late-apex turns, Mid-O is a great place to try out different BB (brake bias) settings. Not only can you move the apexes from early to late (or v.v.), you can also observe the effect that *releasing* the

brakes has on your car's balance. If you have the bias pretty far forward (7/8 or 8/8), note that taking your foot off the brakes has the same effect as cranking in more steering (because it shifts the front wheels' traction from braking to steering). At first, this is disconcerting—just when you think your car has settled into the groove, releasing the brakes puts the inside front wheel onto the grass. However, once you learn to anticipate it, you can use this phenomenon to assist turn-in (in effect, steering with the brakes...or, more accurately, but *ceasing* to use them). Until it becomes instinctive, this approach may be a little too theoretical to use in traffic (race instructor Arnao won't allow any but the most experienced drivers do it in *his* race car); if you find it unsettling, move the BB aft a click or two.

The end of the long straight is a great place to outbrake the CC cars, particularly if you've been able to draft them from at least T3 (another "phantom" turn that's really just a kink in the road). Then you swoop up a short, steep hill, over the crest (T4, where your car will get *really* light), and a brief blast slightly downhill into the Esses (T6, T7, and T8), also known—affectionately—as "Madness."

"Madness" is a textbook case of never, ever letting yourself get pointed the wrong way. If you do, coming off T6 you'll find yourself too far over to the left to set up properly for T7, meaning you'll come off T7 aimed in *entirely* the wrong direction for T8, meaning you'll come off T8 (if you make it around T8 at all), with insufficient speed to carry through T9 for the important straight that follows. If you get angry, you'll just whack the wall coming off T9. Getting messed up in this section of the track is racing's equivalent of a gutter ball. You have to "back it in" from T9, where it's important to get the power down early. That is, sacrifice whatever you have to in T6, T7, and T8 in order to get a good entry into T9. "Madness" requires rhythm, pure and simple. If you don't got it, get it.

The straight between T9 and T10 ends in a right kink followed by a climbing lefthand sweeper (T11). You have to decide how much of the apex of T10 (which you don't brake for) you want to eliminate. If you're really brave, you can put *all four* wheels off at the apex of T10, and nail the brakes for T11 the instant they're back on the pavement. This is more like off-road racing than a simple shortcut, but it can be

done (but only in the sim; in real life there's a hefty guard rail). The trick is to use gravity to help your braking going uphill into T11, and to release the brakes early enough to assist turn-in and ensure that your car doesn't run wide as it gets light going over the top.

Another short blast brings you to a flat braking zone for the "wait-a-minute" T12, a reprise of the Keyhole complex, only not as interesting, and convex instead of concave. You have to be careful not to have an "off" here when you think you're on a hot lap...and careful not to hit the butt-end of the pit wall as you swoop down the hill through T13 onto the S/F straight. (Like sticking your finger into a spinning propeller, you usually only make this mistake once.)

The high priests of *CART Racing* Hot Laps have turned close to 1:10 at Mid-Ohio (the real-world record is around 1:06), but I've never even come close. At 97% OPPS, the CC cars qualify at around 1:15; at 98% 1:14; at 99% 1:13; and at 100% 1:12. Let's just say that I've struggled to qualify toward the front of the grid at 97% and run well at 98%.

Portland: "P" As In "Patience"

What can I say about Portland? An exception to the rule, it's a road-racing circuit that rewards patience, not aggression. It's chockablock with frustrating "wait-a-minutes" where you can't crack the throttle without inviting disaster. It's definitely a rhythm track, and if you succumb to the temptation to stand on it, you'll still be paying for your impudence many turns down the road. Its chicane is so slow it doesn't even have a number—I believe it's the slowest corner in the sim, maybe in all of racing. Can you tell it isn't my favorite track?

Portland is a typical "multiple-use" track, like Sears Point (my favorite track of all...only it's in *NASCAR Racing*), where the front half is a drag strip and the back half is a bunch of squiggles to get you back to where the Christmas tree shines. Portland's first two turns resemble an anti-terrorist road-block. The next couple of corners are interesting, as are the last couple, but in between are a tedious series of vertigo-inducing switchbacks. As Doug Arnao says, there's nothing to be gained in the Esses (T2, T3, T4, T5, and T5A), but everything to lose.

The numberless Chicane is much like the first two turns at Long Beach (see below): a sharp right followed by a left so tight that I doubt that a Lotus 11, with its enclosed front wheels, would have enough steering lock to make it through unscathed. (In *CART Racing*, you need all the Steering Lock the game offers: 18 degrees.) Even with Realistic Damage off, you can't afford to tap the wall at the apex, because jumping even a teensy bit out of the groove will put you off the road—*way* off the road—at the exit.

Turn 1 has a "fuzzy" (read: ill-defined) entry and not one but two apexes, followed by a brief burst of acceleration before you angle into T2. Almost every turn until you get to the curving back "straight" leads immediately into another turn, often off-camber and usually in the opposite direction, and whose only distinction is a variety of entries and radii. To me, this is about as much fun as parallel parking...and requires almost as much twirling of the steering wheel. By the time I get out of T4, all I want to do is nail it, so I invariably come into T5 too hot and run wide. I spend a lot of time filling the air with blue language at this track...and I don't mean shouting "Periwinkle!"

The backstretch is walled in on your right (there's a lake down there), so your approach to T7 is blind, and with a high Wheel Lock, you may find yourself repeatedly banging into the wall. Happily, T7 and T8 are as interesting as any in motor racing (never mind what the CC cars do here; it's a great place to stick it to human opponents in head-to-head racing; see Chapter Ten). Think rhythm.

Finally, you barely have time to stabilize the car before braking for T9, which leads back to the S/F straight. You cannot trail-brake here (although you can frequently get inside the CC cars), and you can't attack T9 too vigorously without spinning. Think patience.

Needless to say, Portland demands as much grip as you can devise. Start with at least 16 or 17 degrees of front wing angle, and 15 or 16 at the rear. Also lower the tire pressures until the center tread-temp is one degree cooler. Then spend a lot of time measuring tire temps through the Esses and getting the camber exactly right here. Try both positive and negative stagger. I've never had much problem with wheelspin; my shock values have been around 85/30/40/85, but Doug Arnao insists that 75/80/40/95 (note the unusual shock "stagger") is the

way to go. By contrast, the "EASY" default is 50/25/20/50, so there's no slavish unanimity of opinion here. Most tracks are about 75% driver (i.e., practice) and maybe 25% car setup. Here, I'd say it's the other way around.

The best thing I can say about Portland is that I could qualify and run well at 100% OPPS (where the CC cars qualify at about 1:03), but don't get cocky if you can, too—the Hot Lap record is well under a minute.

Cleveland: Lost On Runway 24R

Cleveland has the distinction of being the fastest "road circuit" in North America (by a couple of mph). Of course, it's not a road course at all; it's laid out on the runways a commuter airport on the shore of Lake Erie (you can see sailboats...and what looks like an aircraft carrier from your cockpit...nah, can't be). Like the airport circuits that dominated American road racing in the 1950s before many natural-terrain circuits were built, it is flat, affectless, almost entirely without any visual reference points. You even start to wonder if the tire tracks you're following were laid down by race cars...or aircraft touching down.

Thus, it's a "memory" track. The trick here is simply to know which way the road goes...and the best way to commit this to memory is to set the OPPS pretty low (say around 96%) and run endless Practice sessions with the CC cars, just following them around and around.

As anyone who's watched real CART car racing here knows, there are a vast number of possible lines (one commentator called them "creative" lines) around T1, and the only thing they all have in common is that they intersect at its apex. It's the slowest turn on the track, and surrounded by acres of runways, so you can turn in almost anywhere, only taking care not to run too wide on the exit, where the track tightens up. (The only brake markers for this corner are in the pit lane*, fer

*For cheaters only: certain unscrupulous individuals have been known to use Pit Road during qualifying, which "opens up" T1...but don't try this during a race: not only are you liable to T-bone your competitors, you'll also get black-flagged for exceeding 80 mph in the pit lane.

chrissake, so you're *forced* to use tire skid-marks for your shut-off point

You don't brake again until T3 (T2 is another kink), at the apex of which is one of *CART Racing*'s few onlookers—a guy with a video camera—although I did spot a corner worker emerging from a Port-a-Potty between T6 and T7. There's a nice "S" bend between T3 and T4, the only place on the track that calls for rhythm. The rest of the track consists of 90-degree "elbows" ripe for cheating—it's easy to turn in early and cut across the grass at the apex (putting all four wheels off), making it easy to pass CC cars (which follow the rules...or at least the road). I wouldn't try this with a human opponent, except on the end of a very long phone line.

The best thing about Cleveland is that it's a great place to prove (or disprove) theories, precisely because it is so flat. There are no elevation or camber changes to complicate the equation, so you can get hard and fast answers. For example, like Nazareth, you spend a lot of time "cornering," which would seem to point to a high-downforce setup, but on the other hand, the fast straights would seem to demand a low-drag setup. Here, you can try it both way and let the numbers speak for themselves.

However, the sheer width of the track means that the CC cars can pass you at will if your Vmax has been compromised by too much wing, so no matter what the numbers tell you, you'll eventually have to opt for less aero if you want to win races. At first, you might want to try a RWA as high as 16 degrees...and then work on generating enough mechanical grip to be able to reduce this to around 12 degrees.

I started with the preconception that I could get away with very soft shocks, and use fairly stiff bars to keep the car from wallowing. Indeed, the default "EASY"/"QUALEASY" setups seemed to support this (and are very easy to drive), but in my zeal to conquer the dreaded understeer, I kept softening the bars as well. My final choice (for a 13-gallon fuel load): 50/25/20/55, with the FSB at 4/8 and the RSB at 3/8.

I also started with the max FWA (18 degrees) and never saw any reason to change. The understeer is pretty fierce in the turns at either end of the pits (T1 and T10); the only place I ever got any oversteer

was in T6, for some unaccountable reason. I tried tire stagger both ways and abandoned it. As mentioned, you need trail-braking often (T1, T3, T4, T5, definitely *not* T6, but again in T7, T8, and T9), and I eventually decided on a BB of 6/8.

The default TPs seem too high (I finally zeroed in on 34/32/31/33), and the gears also seemed too tall (I chose 11.8/9.3/8.0/7.0/6.3/5.9). What really gave me fits were the camber settings (I settled on -2.20/-1.30/-1.15/-2.20), because the tire temps were all over the lot. Eventually, I realized that my driving technique was having a profound effect on the heat of the tires here, and driving too hard can overheat the LR. If you're not monitoring the temps ("F4"), the overheated LR can cause the rear end to slide around even more...and then you'll *really* toast the LR. In a longer race (10% is only eight laps), you'd have to decide whether to raise the RWA or go to a Medium compound to make the LR last the distance.

All in all, not my favorite track, but there's lots of room to stay out of the way of faster cars during a race, and—just like the real thing—you can safely engage in some terrific passing battles. Once again, I was just barely competitive at 98% OPPS (the best Q times were around 1:05), not because my setups weren't good enough, but because my driving wasn't good enough. The Hot Lap record here is around 1:02, or about 102% OPPS.

Street Circuits: The Walls Want You

After Cleveland's wide-open spaces, the street circuits will come as a shock. Detroit is the most claustrophobic, so we'll leave that for last. As mentioned, Long Beach is the easiest, but we'll start with Australia, because that's the most like what you've become accustomed to: it's a bit like Mid-Ohio, long and willowy, with a couple of switchbacks and a "patience" turn or two.

Surfers Paradise is unlike any other street circuit because of the three chicanes planted in the middle of two long straights. Most street circuits have closely-coupled right-left turns, but the chicanes at Surfers are unique. The first one, T3/T4, may be taken almost flat out; you just burp the throttle and bull your way through, barely flicking the wheel from side to side. It's also the easiest to master. The next one, T7/T8,

is more defined, and requires sharp braking, but is fairly conventional. The last, T11, is an almost straight shot...if your entry is perfect (you don't brake on the outside going in because it would require too much steering; ditto the exit—you arrive and depart more or less on the "wrong" side of the road). If you're just the tiniest bit off, your car becomes a battering ram...or you have to scrub off almost 20 more mph to steer through it in the conventional dull-normal manner.

The remainder of the turns are unexceptional but for the close proximity of the walls. At first, you'll slam into the wall at the apex (and again at the exit) of almost every single right-angle turn—you just cannot believe your car is that wide. Patience is required exiting the tight turns, particularly the last one (T16); if you jump on the throttle here, you'll bury the nose in the wall (which should make you fear for the results once you finally get good enough to assay Realistic Damage on). The only way to avoid the carnage is to get extremely precise about steering (make sure releasing the brakes doesn't affect your line here). Some good news: if you want to get a leg up on the next chapter, Australia is a good place to practice manual shifting.

The setup strategy I'd hoped would work at fast, open Cleveland worked instead at tight, closed-in Surfers: extremely soft bars (2/8, front and rear), with stiffer front shocks to control the inevitable wallowing. As I say, real-world teams disconnect the anti-sway bars altogether at street circuits, letting the chassis roll freely, to minimize weight transfer. With my Surfers' setup, I came pretty close to that.

Once again, I was unable to get crisp turn-in with a FWA of anything less than the full 18 degrees. In theory, the majority of turns are so slow as to render wing angles meaningless, but I found I was getting oversteer here and there with a RWA of anything less than 14 degrees. This combination (and a 5.9 top gear) produced a Vmax of 186 mph at 13,750 rpm. I was reluctant to use the shortest first gear (11.9) for fear of getting wheelspin coming off the tightest corners, but with really soft shocks at the rear, this wasn't a problem. The final settings: 60/25/20/55 (shocks), 11.9/9.6/8.1/7.0/6.3/5.9 (gears), -2.20/-1.30/-1.20/-2.10 (camber), and 6/8 or 7/8 brake bias (I was getting shorter stopping distances with the latter, but also some unpleasant yaw when the brakes were released, so I settled for 6/8). Oh

yeah, like Laguna (and whirlpools), down-under Surfers goes the "wrong" way—counterclockwise—so if you try any tire stagger, make it *positive*. (It didn't work for me.)

As at Cleveland, drastically reducing the tire pressures did wonders for the mechanical grip (I wound up with 34/32/30/32), but the car did seem a little sloppy. Makes you wonder if the bit-twiddlers at Papyrus have actually modeled the tires' sidewall stiffness. Amazing.

The setup *felt* wonderful, but I was dismayed to find that my times—around 1:36, with a best of 1:35—were not only nowhere near the real-world times (of around 1:34), much less the Hot Lap record (under 1:30), but even worse, weren't competitive at any OPPS much higher than 94%. Embarrassing.

A couple of quick races also demonstrated how few opportunities there are to pass. Turn 5 is good because it leaves you unassailably on the inside track for T6. Turn 6 is not so good, because if you lose any speed exiting, the CC cars will pass you right back on the following straight. The other pair of 90-degree lefthanders, T12 and T13, offer similar opps...but that's about it.

You don't dare tangle with the CC cars in any of the chicanes—their lines (and speeds) defy the laws of physics. My suggestion: start off with very small fields (five or six CC cars), and work up slowly and carefully to full fields (26 at Surfers).

Long Beach: Everybody's Favorite Street Circuit...Except Mine

Long Beach is the most famous "round the houses" street race in the world, except for the Formula One race at Monte Carlo, after which it was modeled. Its extensive TV coverage has meant that nearly every auto-racing enthusiast is intimately familiar with it (its configuration has changed over the years...and continues to evolve). It's a bog-simple layout—basically two straights with a couple-three turns at either end.

Shoreline Drive, the main straight, is curved along almost its entire length, and ends with a simple pair of right-left 90-degree turns (T1 and T2), followed by a short blast to a pair of 90-degree right turns (T3 and T4). You saw through an "S" bend (T5 and T6) without lifting or

sliding, beat it up the back straight, followed by the only fast sweeper on the course (T7), another short straight, and another pair of left-right 90-degree turns (T8 and T9). That's it. The real-life and Hot Lap times are both down around 52 seconds. I've never been able to get below :55, despite having tried dozens of setups from mild to wild.

Feel free to sample—or concoct—your own setups. The one I'm most comfortable with has your basic street-circuit parameters: a FWA of 12 or 13 (T7 aside, the turns here are too slow to generate much aero), a RWA of 10 or 12 (ditto); shocks set at 70/35/25/60; camber at -2.00/-1.20/1.30/-2.10); gears at 11.9/9.3/7.9/7.0/6.3/5.8 (which emphasizes grunt coming off the slow turns; the Vmax is 190 at 13,750); soft-ish tires (34/32/31/33 lbs.); two clicks (-.200) of negative stagger; medium bars (4/8 front; 3/8 rear); and brakes biased *slightly* to the front (5/8), both to shorten the braking distances and to slightly assist turn-in.

As TV reporters have often noted, Al Unser, Jr. (who's won the real-world event a half-dozen times) seems to have the knack of getting the power down coming off T9 onto Shoreline Drive just a teench earlier than his competitors...giving him just enough of an edge going into T1 to outbrake them. Indeed, this is also the key to success in *CART Racing*. Turn 9 is another "patience" turn; you have to approach it wide, and memorize the exit, because you can't see it from the spot where you have to squeeze on full power. You can tell how well you're doing by pausing your car at the S/F line and noting your speed. Your terminal velocity (the Vmax) will remain about the same, as measured at the shut-off point for T1, but the sooner you get back on the throttle in T9, the higher your speed will be at the S/F line.

The AI is pretty good here, but run with small fields until you feel comfortable mixing it up with the CC cars—it feels like getting on a crowded elevator at first. (*CART Racing* will start a full 31 cars at Long Beach, as opposed to only 23 at Detroit, a longer track.) With my less-than-impressive lap times, I've limited my racing here to OPPS of 96% or 97%, and I'm none too proud of it either, thank you very much.

Toronto: Oh! Canada!

Toronto is another street circuit that keeps changing. The fast, scary, right-left "S" bend across the wall from the pits (where Brian Herta had an horrific crash a few years ago) no longer looks like it does in *CART Racing*. In the sim, however, it's the key to good lap times, because if you can't hustle here, you lose time on the straights that precede and follow the complex. If everything else were equal, you'd want a high-downforce setup just for these two turns (T10 and T11), but there's a very long straight to contend with, and your Vmax is unusually sensitive to high wing angles here.

The corner at the end of Lakeshore Boulevard, T3, has a very late apex, favoring trail-braking. After you make a left onto Princess Boulevard from Ontario Drive (sounds like Holly Hunter giving the cabdriver instructions in "Broadcast News"), you have to deal with T6, which is like the turns you remember from oval-track racing: do you turn and brake...or brake and turn? Actually, your entry here is unimportant. Instead, you do whatever will maximize your exit velocity so as to carry as much speed as you can onto the following curved "straight" (Manitoba Drive, as if you had the time to read the damn street signs).

You're still turning slightly when you have to brake for T8, and if you wait until your car is perfectly straight, it may be too late (I can't count how many times I've smote the wall head-on here). Turn 9 is really satisfying; you can charge it like an angry bull, power-slide through, throw on a dab of opposite lock for the fans in the cheap seats, and hurry on toward the terrifying T10/T11 complex. Other than these two nightmare turns, the only corner that needs a lot of practice is T1, which is also your best opportunity for passing (other than the right-angle T3 at the end of the main straight).

No special setup advice is needed here; just enough forward brake bias to permit trail-braking...and a soft enough RR shock to control wheelspin coming off the slow righthanders. (Doug Arnao's alternative approach is a taller—11.6—first gear.) Your gear stack should lean toward mid- to high-end acceleration to make as much of the Lakeshore Boulevard straight as you can. Set your FWA for enough grip through T10/T11 and your RWA low enough to pull 190 mph (or

better) on Lakeshore Boulevard.

The track looks more open and the traffic less of a problem in the sim than in real life. Once again, the AI does a good job of leaving you enough room to do your stuff without interference from the CC cars. The one exception is in T2, where the CC cars act as territorial as commuters on a Japanese subway at rush hour.

With any luck you should be able to break a minute (lap time), and compete successfully at 97% or 98% OPPS.

Vancouver: Like Racing in a Parking Garage

Despite being situated in one of the most beautiful parts of the world, the CART race in downtown Vancouver has been likened to a race in an underground parking garage because a big chunk of the track is under the eaves of a giant sports stadium. Like Toronto, Vancouver has a very long straight with a bend in it, but unlike its counterpart in eastern Canada, Vancouver's bend (T2) is not at the beginning of the straight but at the end. And like Elkhart's T11, it's possible to get the car sideways **at top speed** with the wrong setup (or a nervous tic). You can't afford so much as a bobble here, because you have to smear the brakes immediately thereafter for the hairpin (T3).

Vancouver always seems to be compared to other tracks. Like Toronto, you have to use just enough rear wing to keep the car from getting loose in T2...and like Long Beach, it's essential to get a good "hole shot" coming off the last turn onto the S/F straight. The entry into this last turn (T10) is as difficult as jockeying the car into position for Long Beach's T9; you're braking and turning and it's a struggle to have any grip left over for a very tight exit...and if you can't control the push, you come onto the main straight with the throttle closed and your momentum ebbing away.

Other than that, Vancouver's a hoot. You can really fling the car through the rest of the corners...aside from a rhythm chicane (T5), and an iffy high-speed bend (T8; like Toronto's T6, turn in, then brake). Like Toronto's T2, the CC cars get shirty about their space in the flat-out T1 kink (and again in T9), but are otherwise models of decorum. Your lap times should be a couple of seconds faster than Toronto (my best

was a :56), and you should practice short races with small fields at 96% or 97% OPPS.

Movin' 'n' Groovin' 'n the Motor City

Which brings us to bad, bad Detroit. This is, hands down, the hardest track in *CART Racing*. There are no straights where you get a shot at passing (much less reflect on the meaning of life), it's narrower than a bolo string-tie, the turns are as fiendishly complicated as quantum mechanics, and it's as dangerous as ordering fugu in a Romanian restaurant. Nonetheless, I've had some wonderful races here, and it's the duelists' venue of choice when you get into head-to-head grudge matches against human opponents later in your career. In short, you gotta get it right.

Just learning the layout is a job-and-a-half. Fourteen turns in a little over two miles. They never let up; it's one turn after another—asymmetrical switchbacks, decreasing-radius hooks, unmarked turns (i.e., no brake markers), "wait-a-minute" roundabouts, walled-in hairpins, flat-out sweepers...every nightmare you ever had about learning how to race CART cars. And everything happens *sooooo* fast....

Worse, there is no one key to the place; you have to get everything more or less right...'cuz there's no room for mistakes. Doug Arnao says it's a "rhythm and anticipation" track. That is, you need rhythm to get you to where you are at any given moment on the track, but you've got to be thinking about—and setting up for—turns that lie way ahead. To give you an idea of how tough it is, Arnao, who drives with as much economy of line and motion as Pablo Picasso tossing off a pencil sketch, uses the maximum wing angle (18 degrees), front *and* rear. Be afraid. Be very afraid.

There's only one thing for it: practice. And only one helpful hint: if it's driving you nuts, go back to 37 inches of boost ("1" on the dial); even use Auto Brakes; until you get a handle on the place. (One other tip from the experts: make good use of the grass.) The CC cars lunge and thrust spastically, but are reasonably polite everywhere but T12, where they act near-suicidal.

As to the setup—you want to make sure you don't lose control of the car near the end of the meandering back "straight" before braking for

T8. If you're already using the maximum wing, about all you can do is ease up on the rear shocks (and the rear bar) so the back end doesn't get away from you; I've gone as low as 10% on the LR shock. This will also help get the power to the ground digging out of the many slow turns. You need plenty of steering authority to keep cris-crossing back and forth, so the front bar should be pretty stiff. Also: lower the TPs to maximize the mechanical grip.

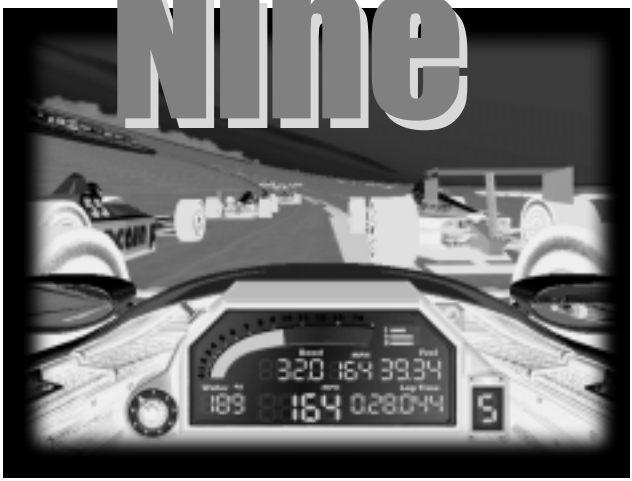
At 100% OPPS, the CC cars qualify around 1:14. The Hot Lap record stands at around 1:10. My best Q lap was a wee dram short of 1:17, and I've had some crackerjack races at 96% and 97%. If you can compete at 98% or higher, my helmet's off to you.

You're on you're own. I wish I could be with you men at the front today (cough, cough), but I can't seem to shake this nagging chest congestion.

Any questions?


C·A·R·T
TM

Chapter Nine



Going All the Way

Learning to Love Making It Hard on Yourself

This is where it all comes together. By now, presumably you've been able to win races at every track in the game...or at least make a good account of yourself...well, okay, at least not embarrass yourself. You may be better on the ovals than on the road circuits (or v.v.), but if you're able to consistently finish in the top five, you're ready for a shot at the PPG CART Word Series, *CART Racing*'s highest challenge.

You know you're good to go when options like these don't make you wake up screaming:

Races at...

100% distance...
100% opposition...
Full fields...
Yellow Flags on...
Realistic Damage on...
Pace Lap starts...
Manual Transmission...

That is...

...staying alive in races ten times as long as anything you've survived to date...

...running against the strongest competition you've ever tackled...and against as many opponents as you've ever encountered at any time...

...without the artificial driving aids that have protected you from yourself (and others) until now...

...having to endure the agony of inopportune caution periods and the ecstasy of sudden-death rolling starts...

...and then having to do it all over again...and again...and again.

Fifteen races in a row—two thousand laps altogether; almost three thousand miles of racing. If you can survive this, you will have earned the right to be called a Champion...no matter how many points you've earned.

Gentlepersons, it's nail-biting time!

Here's what you're going to do. First, you'll practice with 40-gallon fuel loads (including some races at 33%, which usually consumes about one full tank). Next, you'll practice your pit-in and pit-out laps—the key to any long-distance race strategies. Then we'll introduce Pace Car starts, then races with Realistic Damage and Yellow Flags on. Finally, you'll go for the Championship, with any mix of other options that you think you can handle.

"Heavy" Strategies

Let's go back to Michigan International Speedway and look at the difference between partial and full fuel-loads. Up until now, your top fuel loads have been about a dozen gallons, or about 72 lbs. (at six lbs./gallon). Full, at 40 gallons, the weight of the fuel rises by just about that of a passenger (168 lbs.), which doesn't sound like it would have much effect on a one-ton vehicle with almost a thousand horse-power. Wrong! It will feel like you're dragging a boat anchor. Not only is the acceleration sluggish, but the steering is unresponsive, and the car handles like a Teflon-coated pig. Most of the extra weight is on the front wheels (the fuel tank is behind the driver, but ahead of the car's center of gravity), and the car won't begin to feel good again until you've burned off about half the load. The difference between full and almost-empty tanks can be a couple of seconds on a road course or up to five mph on an oval.

Let's skip the intermediate steps (like 20 gallons) and go straight to a full fuel-load race. From the Options menu, go to Realism menu and change the Race Length to 16% (40 laps at MIS; a single fuel-load is 33% almost everywhere else). Select Preseason Testing, go to the Garage, load your previous race setup, raise the Fuel value to 40 gallons, and save the setup under a unique filename like "40_GAL." (Or just load "EASY.")

Check it out. Right away, you'll notice that the car feels like the tires are cold and the boost is down...even when they're not. You'll have some push at the front, and your Vmax will be down by several mph. You *could* optimize your 40-gallon setup by increasing the front wing angle (to add grip at the front), by adding some positive camber at the front wheels (the added wing angle and fuel loads will press down on the nose, slightly splaying the wheels), and by softening the front shocks and/or anti-sway bar. However, I don't recommend this approach,

Racing, like so many things in life, responds better to enhancing your assets than trying to offset your liabilities. That is, no matter what you do, you're going to have to stroke it when your car is "heavy." During a multi-stop race, you'll be set back to your full-load condition several times (up to six times during a 500-mile race), and since you can't change this, I humbly suggest you learn to live with it.

On the other hand, when your car is light, it will feel rarin' to go; you will have had half-an-hour to get used to it when it feels heavy...and to anticipate driving the wheels off it once it finally feels light. If this situation coincides with the end of a long race, you'll be at your peak of concentration and motivation for a big finish. Psychologically, there's nothing more satisfying than taking the lead on the last turn of the last lap. Thus, I suggest optimizing your setup for the last third of a tank, rather than for the start or middle of a fuel load.

Setup Strategies

Still, a couple of compromises are in order. On the road courses, the effect of the fuel's extra weight will be felt most strongly in slower acceleration coming off the tighter turns. And, if you have a setup where the rear wheels are almost breaking traction on a third of a tank (T8 at Detroit, for example), a full fuel-load will make its weight felt at the back end, as well. Or, if a Soft tire is close to overheating (like the LR at Cleveland), you'll have to go to a Medium.

On the ovals, you'll definitely need harder rubber. In long races, the RF takes a beating, and if you've been getting away with a Medium, you'll have to go to a Hard. Likewise, if your RR has been a Soft, you'll have to go to a Medium. However, don't optimize your TP, shock, and

wing settings for your new rubber with a full tank, but with a dozen gallons.

About the only other change you need to make is to move your front anti-sway bar setting a click or two to the left of its light-load fuel condition for the first third of a tank (this holds true for both ovals and road courses). After a third of the fuel is gone, move it one notch to the right, and after two thirds is gone, make it another notch stiffer. If you think the fuel load is making your car loose, you might try softening the rear bar a notch or two at the beginning, then back again as the fuel burns off. Just don't forget to reset the bars during your pit stops.

From your earlier experience at MIS, pick an OPPS you think you can do well against, and run a 16% race. If you want to compete against a full field (31 opponents), you owe it to yourself to qualify as well as you can (i.e., not with 40 gallons, but with your best full-boost, 4-lap Q setup). If the field is small—say, nine other cars—just start at the back of the grid and see what happens.

Note that your race starts (either standing starts or Pace Lap starts) are a lot slower; you'll lose ground to the CC cars like you're running on three cylinders. Note also that it's really hard to set up a pass with full tanks—not only is your car woefully lacking in acceleration and top speed, but it's also less nimble when you try to maneuver around competitors, particularly if they're "stealing your air" (i.e., if you're drafting them, you'll be sucked into the corners...only to discover that the reduced airflow over your front wing can lead to disastrous understeer).

Finally, note that 40 gallons will not be enough to complete a 40-lap race at MIS unless you're getting at least two miles per gallon. You can stretch your fuel mileage in the cockpit by lowering your boost, shifting into overdrive, or stroking it ("feather-footing"), or—from the Garage—running a taller top gear and/or less RWA.

Once you get beyond the range of a single, 40-gallon race, you'll need to develop pit-stop strategies, but before we get into that, let's look at fuel- and tire-conservation strategies (which will apply to both full-load and multi-stop races).

Boost Strategies

I wouldn't blame you if you thought that lowering the boost would have a bigger effect on fuel mileage than on lap times, but it just isn't true. Lowering the boost will send your lap averages straight to hell without a concomitant increase in fuel economy, so normally this isn't a viable alternative. Even in a really long race, you couldn't lower the boost enough to save a stop unless you also backed off the OPPS to the point where you'd all be creeping around at speeds that would foul the plugs of a Formula Junior.

The only time I'd recommend lowering the boost is if, at the end of a long race, you realize you're not going to make it without an extra (unscheduled) pit stop...*and* you've got a big enough lead that you can afford to stroke it. You don't have to be a rocket scientist to figure this out; the game does it for you. Just hit "F3" (or "D" twice) to see your DTE (distance to empty, in laps), and keep lowering the boost (the "K" key) until the DTE matches the number of laps remaining in the race. This is almost always preferable to making an extra stop, which can put you a lap down at the bullrings (a big consideration if the yellow flag comes out *after* you stop). The number of laps left is also a major concern at Elkhart Lake, which has a very narrow pit-stop "window" due to its extreme track length.

Sidebar: The CC Cars Are Sandbagging

Well, there is one other time to consider running less than full boost...but it has nothing to do with fuel economy. At the drags, they have what's called "bracket" races, where two grossly mismatched cars compete by handicapping the faster car. The slower car gets the green light first, and may be halfway down the strip before the faster car is turned loose. Unfortunately, this sometimes happens in CART Racing, *albeit unintentionally. As I've mentioned, the race seldom "comes to you." Usually, it's the other way around—toward the end of the race, you see your hard-earned race position evaporate in the final laps. There is no worse feeling in racing, real or simulated. In the sim, however, you can do something about it...and I don't mean dialing 911.*

It's not a bug, exactly; the CC cars also go faster as their fuel-load lightens, just as yours does; and it doesn't happen every time, nor at every track. It seems to depend on a combination of your track speeds and the

OPPS you've selected (and, to the game's credit, it happens less frequently when the OPPS is closest to 100%), and the effect appears to be less the longer the race lasts. If this "bugs" you (little compu-pun there), this would be about the only condition under which I'd recommend running less than the maximum turbo boost: 45 in. Hg. ("9" on the control knob), at any race except at Michigan (see MIS sidebar).

In such a case, just load your normal race setup, then back off the boost to, say, "5" or "6," and run a short race to establish a baseline average speed at this boost level, then adjust the OPPS to match it. Run the race at the lower boost (it wouldn't be quite fair to start the race at "9" but, hey, you wouldn't be doing this if the CC cars weren't sandbagging in the first place), and if you find the demon CC cars creeping up on you toward the end of the race, hit "L" to raise your boost. Just make sure your fuel strategy leaves you with enough go-juice to run hard at the end.

Fuel Strategies

The best way to stretch your fuel mileage—particularly if you're on the bubble between having to make an extra stop, or not—is with lower wing angles (which your crew can adjust during pit stops, although during a race is a bad time to be trying out new setups). If you can make do with less aero, not only will your fuel economy rise dramatically, but you'll be able to lap faster (or not have to drive so hard to stay with your opponents, which will benefit your tire mileage as well). Conversely, more wing will make your tires last longer (at the expense of fuel consumed), even if you're going like stink. You can also make marginal adjustments to the shocks and bars to reduce weight transfer (typically, to the RF on an oval) to preserve rubber.

The other fuel-conservation measures include the afore-mentioned "economy" overdrive top gear...or simply taking it easy on the throttle...but this is subjective and imprecise. The real-world teams usually use their econo gears at ovals and road-racing circuits like Elkhart Lake, where fuel-mileage is a consideration—and you can too, provided you've selected Manual Transmission (it won't work with Automatic Transmission). This is dead easy, provided you've learned to use a "stick shift." You take your normal race setup, make sixth gear two or three clicks taller (use "F3" in practice to check your fuel mileage), then give fifth gear the value of your old sixth gear,

then readjust the splits between first through fourth gears,

At the start of the race, you only shift as high as fifth. Once the race order shakes out, you shift into sixth and cruise until you need some extra power to pass a lapped car or go toe-to-toe with another car for position. The advantage that an econo gear has over simply taking it easy is that it incurs no "turbo lag." That is, when you need instant power, you get it—no waiting for the turbo to spool up to maximum boost; just a speed-shift down to fifth (something you may have already noticed: there's no clutch in *CART Racing*).

At 100% distance, most *CART Racing* events are 200 miles, requiring between 110 and 120 gallons of fuel (at 1.8 mpg...or thereabouts). If you start with a full load, you'll have to stop after 70 or 80 miles, and again after 140 to 160 miles, so on your second stop, you should take on a short load: about 30 gallons. One alternative would be to *start* with a short load, and take on 40 gallons at each stop. This has a couple of advantages, One, during the critical opening laps of the race, you car will handle better and go faster, helping you stay out of trouble and establish track position. Two, you'll be making your two stops about 10 laps earlier than the CC cars, thus avoiding pit-lane traffic. Another alternative: start with about 35 gallons, and take on similar amounts at each stop. Benefit: you never have to

Strategic Thinking at MIS

The 500-mile race at Michigan International Speedway is the only event where fuel strategy can play a huge *role, because—in the absence of the other 500—it's the only 500-mile race in the game. The others are 200 miles, more or less; "sprint" races, completed in under two hours.*

Let's do the math. At the sim's normal boost, "9" on the dashboard control knob (or 45 in. Hg.), your fuel mileage (depending on wing angles and gearing) should be around 1.8 miles per gallon at Michigan, requiring seven tanks of fuel (280 gallons), or six pit stops, assuming you start with a full tank. Your pit-in lap (including slowing down, entering the pits, stopping, refueling, pulling back onto the pit road, and keeping your speed under 80 mph until you cross the S/F line) will take about 40 seconds longer than a normal 30-second lap. Your pit-out lap (from crossing the S/F line at 80 mph, re-entering the track, accelerating back up to speed, and completing the lap) will take about 20 seconds longer than a normal 30-second lap. Time lost, total, is roughly a minute per stop, not

counting tire changes, wing or stagger adjustments, and/or car repairs, if any, which can add another 15 seconds or so).

Let's say you devise a strategy that eliminates one stop, so you have 240 gallons to go 500 miles (or about 2.1 miles per gallon). In order to accomplish this, you'd have to back the boost off to about "6" on the dial (42. inches on the dashboard read-out); or run a really tall top gear, possibly an "economy" overdrive gear. Whichever, your lap averages will drop by about four mph, meaning you lose two laps for every hour of the race, or at least *four laps by the end of 500 miles. Is this worth it? Not only if you only gained one minute (or two laps at racing speed) by eliminating one pit stop. That is, you'd be down two laps to the leaders at the end of 500 miles.*

Of course, this doesn't take into account imponderables like accidents or yellow-flag caution periods—if this feature is activated—which can work as easily against you as in your favor, depending on the breaks. In my experience, full-field 500-mile races average four to seven caution periods, lasting an average of four or five laps each, and each lap under yellow can save about a gallon per lap; so you might save a total of about 30 gallons if you got really lucky...but that's still not quite enough to eliminate a whole 'nother stop.

Finally, slicing the margins that thin locks you into a rigid game plan, with little room to alter your strategy to take advantage of changing race conditions, like scooting into the pits as soon as the course goes yellow, or—better—fueling up just before the course goes green.

On the other hand, if you do decide to abide by CART's real-world restrictions (40 inches of boost, a minimum or 1.85 miles per gallon—or a total of 270 gallons for a 500-mile race—and a maximum of 35 gallons per tank), you can make life a little more interesting...or at least more complicated. It also gives you the moral justification to lower the OPPS (to about 95-97%) so that the CC cars are running slower, as they would be if their boost was limited to 40 inches, too. With 40 inches of boost, you and the CC cars should be running MIS at about 220-225 mph during a 500-mile race, as opposed to 225-230 mph with the full 45 inches. Unfortunately, the CC cars at 40 inches also seem to be getting better fuel mileage, but at least you could realistically toy with the possibilities of a five-stop race. (P.S. Your tire wear will dramatically improve as well.)

*Bottom line: Running 250 laps at MIS is usually a bore. Why not spice it up by playing with the real-world rules, and seeing if you can't out-*think *the CC cars instead of out-driving them? Just this once....*

Pit-Stop Strategies

The most-often repeated truism in motor racing is, "The widest part of the track is Pit Road." Meaning that mastering quick pit stops, a science in itself, is a much better way to improve your race position than by dicing wheel-to-wheel on the race track. Whereas the CC cars' stops are as regular as clockwork, yours can either be faster...or a disaster. The only way to get good at it is to practice...and practice pit stops as religiously as you practice going fast.

Despite the obviousness of this, most players don't even *think* about pit stops until they run out of fuel for the first time, then rush into the pits too fast or too slow, stop short or overshoot (and remember, to get any service from your pit crew, you must stop with the brakes, not Reverse), or fail to alert the pit crew of their needs (via the "radio" Function keys), and then come roaring out of the pits at full throttle...only to get black-flagged for exceeding the 80-mph pit-road speed limit.

You have to know where on the track—exactly—to spike the brakes to haul your speed down to 80 mph at the pit entrance. Then you have to know where on the pit road—exactly—to haul the car down from 80 mph to stop smack-dab in the middle of your pit (you have a leeway of less than five feet, as near as I can tell). While your crew is working on your car, you have to remember to reset your bars, and hit "Alt-B" (Auto Brakes, which works like a rev limiter leaving the pits; it won't slow you down soon enough when you're entering the pits). You can tell your pit crew to ignore minor repairs (to, say, body damage, or a spoiler late in a street race), and specify a precise amount of fuel for a "splash 'n' go" (otherwise they'll top you off to the default 40 gallons). When the pit-stop timer goes green and your car comes off the jacks, you have to check your mirrors before you blast out of your pit, and remember to toggle "Alt-B" off again as the Auto Brakes release when you reach the pit-out "blend line." Your pit is always the first stall, but every pit entry, pit road, and pit exit is different, so you need plenty of practice for each track.

Even knowing *when* to stop isn't just a matter of coming in when you're out of fuel. The point has been made *ad nauseam* on TV: if you're about due for a pit stop anyway, and you find yourself stuck

behind a competitor or a group of truculent backmarkers, you're probably better off coming in early. This avoids the dangers of risking life and limb on the track, and you probably weren't going to be turning any fast laps in traffic anyway. Hopefully, when you come out of the pits, you'll have a clear track ahead of you. If not, at least you won't be any worse off than you were before.

The CC cars are extremely dangerous when entering, leaving, or driving in the pits. You'll get very little warning that they're about to pit. Eventually, you'll learn to read the signals: they slow only slightly, but their line changes when they're about to come in. You can usually see (or hear) them when they're leaving the pits; the danger comes when they transition from pit-out AI to racing AI—they suddenly swerve across the track from the warm-up lane onto the racing line. If you're coming up on them fast, you have a split-second to decide which side to pass them on. If there's room, always take the inside line. Hurling salty epithets and giving them the finger doesn't seem to have much effect, I'm afraid.

On Pit Road, there are three hazardous conditions. One, if a car is ahead of you on the pit road, it may suddenly brake and swerve into its pit; so fast that you won't be able to avoid a collision if you're following closely. Two, if you hang back to give the car ahead of you more room, you'd better be sure there isn't another car *behind* you, because it will nerf you if you're not going fast enough (that is, 80 mph). Three, if you are on the pit road and see a car stopped ahead of you, assume he (or she) is about to pull out right in front of you without checking the mirrors...because there seems to be no collision-avoidance AI in this situation. If there is also a car behind you at this point, you're doomed...unless there are enough empty pits to duck around the car ahead on the *inside*. This alone is a great reason why your pit-stop strategy should include bringing you in for fuel and tires when you know the CC cars are likely to still be out on the race track.

Yellow-Flag Strategies

Two more reasons to come in early...and one reason not to. The minute the yellow flag comes out after an accident, most of the field will dive into the pits to refuel (just as they used to in real life...until they changed the rules). But if experience tells you that the track will

stay yellow for, say, four laps, you should come in on the fourth lap, not the first, both to avoid pit-lane traffic (see above), but also to move your next fuel "window" farther forward. Two, if you must pit under green, come in *before* the rest of the field (the CC cars get terrific mileage, but usually not the leaders, who can generally manage no better than about two miles per gallon), because when they come out after your stop, they'll be on full tanks, while you'll have a lighter load, giving you a performance advantage.

Of course, unless you're willing to risk causing a yellow flag incident (not recommended), you never know when you're going to encounter a caution period. If you stay out until you're running on empty, you might get lucky and catch a yellow, meaning that you'll lose less time (and track position) than if you have to pit under green while everybody else continues to circulate at full speed. The worst thing is if you have to stop under green, but the minute you're back in the race, the yellow comes out, and the CC cars get to pit at their leisure. I hate when that happens.

There's one good reason for *not* stopping under a yellow: you can make a much better account of yourself if you can start with a nearly empty tank. Of course, you might have to throw out your pit-stop strategy and improvise. Such as: you're in about fifth or sixth place, with 100 miles to go (so you *know* the leaders are going to have to make at least one more stop, possibly under green). You've got a light load; say 10 gallons. Whether the CC cars pit now or later, if you restart "light," you might be able to get the jump on the cars ahead of you until your tires warm up, and be able to maintain track position for the next 20 miles, and then pit for 40 gallons, which will almost certainly leave you better off than if you had to restart "heavy," struggle to stay with the leaders, then pit for a "splash 'n' go" from fifth or sixth place, under green, just before the checkered flag.

For both Pace Lap starts and Yellow Flag conditions, you'll have to practice something antithetical to the whole idea of an auto-racing simulation: driving slowly. That is, at a steady 80 mph, which is the speed of the pace car. Surprisingly, your car is much harder to control at slow speeds than at speed. In the real world, drivers saw back and forth on the steering wheel to put some heat in the tires during slow,

yellow-flag laps. But if you try this in the game, you'll spin the car instanter. Car control is even more difficult during the pace lap, because instead of being in-line astern (as during a yellow-flag period or the re-start of a saved race), you're lined up two-abreast, effectively halving the width of the track.

Pace-Lap Strategies

Let's look at Pace Lap starts. If you're on the pole, or are second-fastest, all you have to worry about is not hitting the pace car or the car next to you. (Likewise, at the back of the pack, you have to avoid only the next-to-last car.) At the end of the "formation" lap, the pace car heads for the pits, and after it's out of the way, the course goes green and the race starts. If you pass the pace car before they throw the green (this is called "screwing the pooch"), you'll be black-flagged, although you can often get away with passing the CC cars between the time the pace car pulls off and the course goes green, if you don't do it before the S/F line.

If you're on the pole, *you* control the field (the CC cars won't pass you until the course goes green). Basically, what you want to do is fake 'em out. Not by speeding up (they'll match their speed to yours), but by slowing down. This will bunch up the field behind you, so when the course goes green, half of them will be on the brakes, and the other half on the throttle, like a Three Stooges comedy. However, this depends on your knowing *exactly* where the course goes green. Fortunately, this is always at the same spot (hint: it's not at the S/F line), so once you've memorized its location, you can anticipate the start, slowing down just before the pace car pulls off, then speeding up just before the green flag comes out. This can gain you two or three car lengths by the end of the first lap.

The AI is overloaded during full-field starts, so you can almost always get a clean start from anywhere toward the front of the grid. For the same reason, if you're stuck in the middle of the pack, you have to contend with the CC cars responding very slowly. Chaos. Confusion. The "fog of war." This is why a good qualifying position is essential to getting a good start. Otherwise, your goal must be merely to survive the start. The best place to be (other than the pole) is on the inside line going into the first turn, because the CC cars will initially queue up on

the outside. *In extremis*, you may be able to seek refuge in a pit-out (warm-up) lane, or on the apron inside the white line.

You have to be wary of cold tires for at least a lap, sometimes more, after any start or restart. This condition is exacerbated with full tanks, and is at its absolute worst when you've come in under yellow to refuel. You have to drive on tip-toe, preferably with the tire-temp "blue box" ("F4") engaged, and don't even *think* about getting racy until you see the temps edge up toward 200 degrees. The CC cars, lucky devils, *always* start (and restart) on warm tires, so be prepared to yield if they challenge you at this time.

You could combine Yellow Flags on with Realistic Damage off, which means *you* won't suffer any damage after a collision, but any car you tangle with will probably be toast, the Yellow Flag will come out, and you'll have to creep around at 80 mph for several laps until the debris is cleared and the course goes green. During a race, this is agony. You get "velocitized" (as my friend Denise says) in the heat of competition, and your timing and judgment go to hell when you suddenly have to drive in slow motion. When an accident happens nowhere near you (all by themselves, two or three CC cars will crash all by themselves for each hundred miles of racing), the yellow flag may catch you unawares. Often the first inkling you get of trouble is when the CC cars, for no apparent reason, spike the brakes, even though the accident may be half a lap ahead.

Qualifying Strategies

Since you can adjust the Q speeds of the CC cars, there's nothing to stop you from slowing them down until you can easily take the pole...except that if you raise the bar just a notch higher than you can reach, you may find it within yourself to go just a little bit deeper than you thought you could, raising your personal best, imparting a warm rush of personal satisfaction and self-esteem, and a feeling of accomplishment. Isn't that what sporting competition is all about?

Whether in a Single Race or the Championship, when you first get to the track, load your best Q setup, go to Practice, concentrate on driving at *qualifying*—not racing—speeds. Once you feel you're as good as you're going to get on that particular day, go to Qualifying and check

the Standings. If you're significantly faster or slower than the field, exit the track and go to the Options/Opponents menu and adjust the OPPS. Return to the track, go directly to Qualifying, give it your best shot, and exit, saving the Race Weekend. Return again, go to the Garage, load the appropriate Race setup, and take as much time as you need during the Warm-Up to get comfortable with cold tires and as much fuel as you're going to be carrying at the beginning of the race.

Race Strategies

Your overall race strategy: use the beginning of the race to establish the pecking order (i.e., to see who got lucky with the random number seed), the middle of the race to establish a sustainable race position, and don't make a determination to go for a do-or-die finish until you get close to the checkered flag ("the dash for cash" as the commentators invariably intone). In the opening laps, use "F2" to check if there's anybody moving rapidly up through the field or stealthily closing in on you. If anybody is overhauling you, don't fight with them for position; get out of their way. In the middle of a race, particularly after a round of pit stops, the race order will stabilize, and unless you've been holding back, you have nothing to gain at this point by driving over your head. Only toward the end of the race (when you're down to, say 10 or 15 gallons) should you determine if there's any point in risking a DNF to improve your position. If you're in the hunt for the Championship (see below), note carefully which of your closest competitors *in the points battle* are close to you on the race track. Often, the smartest thing to do is to get ahead of only whoever you need to for the points, and forego the glory of a podium finish.

Weather Strategies

You do have the option of setting the weather yourself, or letting the game choose the ambient temperature, and wind velocity and direction at random. Although CART cars do not race on ovals in the rain (too dangerous), they do race in the wet on road circuits. [Once upon a time, this was a feature in *CART car Racing*, but Papyrus felt it was poorly implemented (basically, traction was proportionately reduced, and there was a misty overlay, but no real spray, much less any blinding rooster-tails from the cars ahead), so it was dropped from *CART car Racing II* and has not been resuscitated for *CART Racing*, more's the pity.]

The question is: do you really *want* random weather in the game? Unless you're an obsessive-compulsive type, probably not. In practical terms, weather means you have to spend a lot of extra time fiddling with setups on the race weekend that split the difference between a headwind on one part of the track (which will slow you down, obviously) and a tailwind on another part (which will speed you up, often so much that it will blow your engine if you don't go to a taller gear, which will slow you down even more going upwind...never mind the effects of catching a tow going downwind). Even though the effect is the same for everybody, it's a complication that I, for one, don't need. Ditto for Random Breakdowns. Yeah, sure, in real life CART cars suffer breakdowns (like the failure of a 25-cent part that stopped Parnelli Jones from winning in a turbine car years ago), but this is one particular werewolf I won't invite into my house. It's all downside risk, with no potential upside (the CC cars suffer no greater failure/accident rate with this feature turned on than off.)

Also once upon a time, raising the ambient temperature to the max (a searing 120 degrees) also raised your Vmax, because hot air is thinner and creates less drag, a factor at a high-speed oval like MIS. Papyrus closed that "loophole" by also modeling the effect of hot air on your engine's horsepower (it lowers it), so the advantage was nullified. (*More* than nullified—your top speed now drops by several mph on a scorching hot day.)

The only reason I can think of to alter the ambient temperature is that it will affect tire temps. That is, if you aren't getting enough heat in your tires during a qualifying attempt, you might raise the ambient. Conversely, if your tires are overheating during a long race, a lower ambient could help. Unlike the effect of ambient on top speed, it seems to have no effect on the CC cars' tires, so you might eke out a tiny advantage here under the right circumstances.

Personally, I would leave the weather settings alone.

The One Percent Solution

Are you ready for the Big Time? So am I...but first, it's spring break! Let's have a little fun with the Championship; an easy-to-swallow degustation I call the "One Percent Solution." This is a walk in the park;

you can run the entire 15-race season in a single evening; become PPG Champion in a day!

Under the Options/Realism menu, reduce the Race Length to 1%, then return to the Main Menu and Choose Championship Season. You'll be presented with a slate of the whole calendar. (If you'd like to change it—make it all road races, or all oval tracks; run twice at the same track; or shorten the season; or anything that doesn't add up to more than 16 events—check out how to edit *CART Racing*'s text files in the next chapter.)

The One Percent Solution has a number of advantages, not the least of which is the fact that while it's easy, it isn't boring. For one thing, it means you can run your Q setups in the races (most are three laps). For another, there's no lapped traffic to contend with. Similarly, there need be no pit stops, no pace laps, no yellow flags, no restarts. Once you get good at standing starts, you can almost always get the jump on the field for at least the first lap or two. And last but not least, it leaves you with more time for home and hearth,

If you want to make it more challenging, there's always the *Two* Percent Solution (*et seq*.). This will mean you can't always use your Q setups on the ovals (even at one percent, you can fry a tire), so you'll have to come up with more appropriate setups; and it will double the time the CC cars have to catch up with you after you run off with the lead, but many of the other advantages of nano-term racing will still apply.

The best part is that you can change your options from race to race *within* the Championship: different chassis, engines, and tires; OPPS and number, Pace Lap on or off, Yellow Flags on or off, Weather...well, you get the idea. You can also save races, or—if you're dissatisfied with the results—re-run them, *provided* you exit the track before the game records the results (i.e., hit "Esc" before the last car crosses the Start/Finish line).

More importantly, the One Percent Solution will give you a taste of what a serious run at the Championship would be like (very few players have even attempted a full Championship season, much less

completed one...at any level). If you have any intentions of *ever* playing with any or all of the sim's options stacked against you, this is a great way to practice your chops, and enjoy yourself at the same time.

I've tried this and—surprise!—won the title 274 points (seven poles and ten wins) to Little Al's 201 points (one pole and three wins), even though I made a good-faith effort to level the playing field. Really. Okay, so I had to make several mid-course corrections in OPPS, but I'm pleased to report I won the last two events at 100% OPPS, in both qualifying and the (1%) races.

Okay, you've had your fun. Now back to work.

Championship Strategies

The beauty of the One Percent Solution is that it demystifies the full-boat Championship, which differs from the One Percent version only in the race distances you select. As we've seen, you're not locked into any of the variables you can choose from the Options or Opponents menus. During the season, you can adjust the opposition strength, number of opponents (although this will screw up the points tally), race distance, vulnerability, etc., to make it as easy or hard on yourself as you want to be.

One important thing obtains, however. The more time and effort you put into a full season, the less of it you will want to place at risk by doing anything reckless. Just like at the end of a long race, you'll be driving very cautiously, and thinking very conservatively. The thrill of devil-may-care driving will be replaced by flinty-eyed driving only as fast as you need to to stay ahead of who ever is chasing you for the title.

You may even—horrors!—be willing to bend the rules a little. For example, when I found myself down on points two-thirds of the way through the Championship, I decided that that was sufficient justification to swap my chassis and engine for the 500-miler at Michigan (although but a Roger Penske would even *think* of doing this in real life). I went from my usual combo, a Reynard-Cosworth, to the higher-power, lower-drag Lola-Honda, and picked up nearly two mph over my previous best lap.

[N.B. One other little cheat: if you find yourself about to go down a lap (that is, once the race leaders are closing in on you from behind), one dubious move is to exit and save the Race Weekend. At the restart, the field is single file behind the leader, so you regain almost a full lap of track position. Needless to say, purists frown on antics like this. Winning isn't the main thing, etc. Not me. Usually.]

The only hard decision you have to make is whether you are finally good enough to run with Realistic Damage turned on, and risk crashing out of a race every now and then. By now, you've probably noticed (particularly during replays), that you rarely hear the awful sound of your car scraping along the wall anymore. Even if you're brave enough to race with Realistic Damage on, you still have the option of re-running a race, either by simply by restarting it ("Shift-R"), or—if you're having a really ghastly day—by Saving the Race Weekend, exiting, going to the Options/Realism menu and reinstating Realistic Damage off. Vote your conscience.

A word to the wise: bad things happen even to the best drivers, and if you've invested a sizable portion of your free time in trying to win the PPG Championship, you will be one unhappy camper if some computer glitch throws it all away. Just as if you were writing the Great American Novel, you'd be a fool not to save your work after completing every "chapter." Thus, after *each* race, find the file called "SEASON.BIN" (in the default directory C:\CART) and save a copy under a different name, like "SEASON.B_N," so that you can restore the season if any disaster befalls your precious data. If you're really paranoid, you'll save it to a floppy, so that even if your whole hard disk goes t.u., you can reinstall the game and reinstate the season-to-date totals.

Really Advanced Strategies

If I were you, I would defer going for the full Championship season until you've learned to edit the track text files (next chapter), which will allow you to dial in the CC cars' Q times and race speeds, independently, at each track, to match your own abilities. That way, you can leave the OPPS in the game's menu at 100%, but at each track, you will be competitive with the CC cars in qualifying, and in the same league (so to speak) during each race. However, you can accomplish

more or less the same thing within the game...with a little extra work. To wit: select Preseason Testing from the Main Menu. Go to Australia and work on your Q setup. Once you're happy, exit and select Single Race. Go immediately to Qualifying. Check the Standings for the Q times of the CC cars. Exit and adjust the OPPS from the Opponents/ Strength menu until the CC cars' times are in the same range as yours. Now select Championship Season. The first race is Australia. Qualify. Save the Race Weekend. Return and start a Single Race. Exit and adjust the OPPS to match your race speed. Go back to Australia under the Championship Season, start (or restart) as many times as you like until you're happy with the result (bearing in mind that real racers get only one shot at each track per season; everything else is a form of cheating), then finish the race (wait until the last car running crosses the S/F line), when the results will be recorded toward the Championship. Repeat for each race in the Championship...but don't call me in the morning.

You don't have to win every race to win the Championship. Indeed, depending on how consistent the CC cars are, you don't have to win *any* races to win the Championship, You get the same number of points (20 for first, 16 for second, etc.) irrespective of the other factors (such as race length, number of opponents, OPPS, saves and restarts, etc.). However, it's likely that as the season progresses, the same guys will be fast in every race, and they will be the guys who are chasing you in the points battle. (One really dirty trick: pull a Senna and nerf your closest rival off the track...if you can get close enough to feel his last breath on your cheek. You didn't hear this from me.)

If you manage to make it through an entire 15-race season, you'd think the game would throw some kind of victory celebration...when, and, as, and if you finally do win the PPG CART car World Series...but noooooo, all you get is another laconic "You won!" and a splash screen of your crew jumping for joy. No kiss from the race queen, no keys to the city, no champagne (not even the "traditional" bottle of milk, no keys to a new Mercedes-Benz, not even an interview on "RPM-2-Nite." But *you'll* know you're the Champion...and that's what counts.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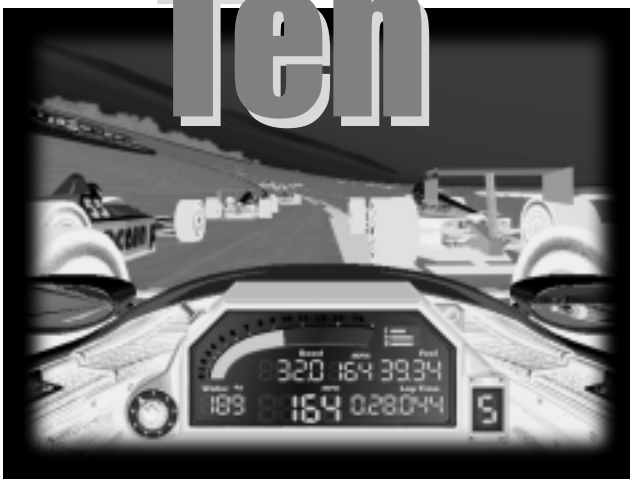
Chapter Ten



Really Advanced Stuff

Everything You Need to Know...About Everything Else

I've segregated this chapter all by itself at the end of the book, because it contains a lot of material that many players simply won't want to bother with. You can spend months or years with *CART Racing* without ever messing with the information presented here...or you can start using it from the very beginning.

What you're about to learn may be applied at any time during your education in desktop auto racing, but it presumes a willingness—and ability—to delve into the mysteries of computer files... and modems. If the thought of mucking around with your computer's innards—or connecting two computers together—makes your stomach churn, I wouldn't blame you from shying away from these arcane topics, or for seeking "professional" help, but I think you'll find the results worthwhile.

"Professional" help needn't set you back $75 a hour (which is what a lot of teenage computer gurus charge for house calls these days); a ton of expert help is available for the asking, online, for no more than the cost of a subscription to CompuServe, America Online, or your basic Internet connection.

My immediate recommendation: get a CompuServe account. As this is written, the cost of a monthly subscription is only about ten bucks a month, which plugs you into more useful computer intelligence than you could possibly access any other way...plus a library full of FAQs, "secret" setups, car sets, utility files, hardware recommendations, and meticulously compiled lists of applicable URLs, not to mention a couple of fascinating discussion groups debating the merits of any related topic you could possibly imagine, and a couple of off-line racing groups you may have fun participating in...in short, hours of harmless amusement, as my friend Weaz says.

There are three CompuServe divisions which are germane here. Papyrus' parent corporation, Sierra Online, maintains a Papyrus section

within the Sierra "forum" (GO SIER) staffed by technical-assistance boffins and customer-service wonks who are standing by, ready to help you with *CART Racing* (and *NASCAR Racing 2* and the Papyrus-distributed *SODA*). If you're having trouble installing the game, say, or getting a sound card or gamepad (ugh!) to work, you post a message, and one of the reps will get back to you, usually within 24 hours (they've been known to come in on Sundays...even during the holidays!), with an official answer. Additionally, private individuals are allowed to kibitz, informally, so you will often get a second (and third, etc.) opinion of whatever steps are necessary to resolve the issue. This is a veritable goldmine of priceless information.

Private Dance Lessons

Then there's the "Sports Simulation" (GO SPRTSIMS), presided over by the jolly mailman (his real day job), Lane Charnes, which contains two sections you ought to know about: "Motorsports" and "Racing Circuits." The former is of general interest to players of Papyrus' (and others') auto-racing simulations, and consists chiefly of lively "threads" (discussions) of topics of interest to desktop auto-racing fans, such as which video card to buy, how to create "shortcuts" for DOS games running under Windows 9*x* (even how to run *CART Racing* under *OS/2*...there are those who claim it *can* be done!), how to obtain free upgrades and apply for rebates, and rumors about what hardware and software offerings are in the pipeline.

These posts and ripostes are blissfully free (more or less) from the witless cant, unmitigated screeds, and vituperative blather common on Internet newsgroups typically found at such sites as rec.auto.sims. I don't have anything against the Net or the Web *per se*, but neither do I have the time to sift the few useful nuggets from the overflowing cauldrons of bile-saturated dross.

CompuServe's "Racing Circuits" is devoted to the curious phenomenon of offline racing leagues, like ICR2A (the "CART car Racing II Racing Association," which may by now be renamed the "CART Racing Racing Association"). At first glance, this seems to make little sense for any game, such as *CART Racing*, that has built-in *on*line capabilities. Rather than connecting CompuServe members in real-time for some head-to-head racing, the offline leagues disseminate parameters for members to run races all by their lonesomes, offline, at their leisure.

You are given a race length, opposition strength, weather factors, etc. You load the options, run the race, and post the results on the forum (earning the usual 20 points for first place, 16 for second, etc.). Although this would seem like a license to lie (to claim you won, at a record-breaking average speed, against withering opposition, in a howling monsoon, etc.), it's on the honor system, seems to work pretty well, and everybody—by all accounts—has a good time.

In general, these offline races are run around the same time of year as the real-world events, when interest in, say, the race at Laguna Seca is at its peak. There's a class system so that newbies don't have to compete against experienced "car sharks," and various handicapping formulae so that novices can run with Auto Brakes on against, say, the trade-off of a lower OPPS level. With any diligence at all, you can find a compatible group to run with, where you can be proud of your standing at the end of the season. The cost is a lot less than intercontinental online racing, too. Some of the best sim racers are in Germany, Portugal, Hawaii, Brazil, Japan, etc., but you only pay for the local call.

Make Room in Your Garage

However, far and away the best of what's available on CompuServe are the "patches," utilities, and car sets found in the Sierra and Sports Simulation "libraries." Patches are files, usually supplied by the original producers of the software, which when applied to the game, will eliminate bugs that somehow slipped through the original beta-testing program. The utilities are "freeware" (the politically- correct term is "shareware"); you pay only for the connect-time to download them. Some are "workarounds" that address niggling deficiencies in, say, the Paint Kit. Some are third-party enhancements that bring something entirely new to the party (one such program generates a detailed lap-by-lap account of each race, with lap times, elapsed times, car-to-car intervals, and race position). Some are more mundane: one tiny program allows you to set the refresh rate of your monitor, if you're using the Rendition card, which doesn't come with any such utility. But the best of the best are car sets and individual cars which you can download and add to your copy of *CART Racing*.

The individual car files available online (in the .PCX graphics format) are cars...well, *virtual* cars...which have been painted (or repainted) with the Paint Kit (or Paint Shop in the Windows 9*x* versions) in any

color scheme you can imagine. You can download accurate representations of every CART car in recent memory, plus "fantasy" cars derived from real-world imagery (an "IBM," "Gulf," or "Coke" sponsored car, say, or a variation on BMW's "Art Cars," or an CART car version of Kodak's famed #4 Winston Cup stock car), or concocted from whole cloth (a car painted like a log cabin or a killer whale...I'm making this up), etc. Imaginations run wild, wacky, and wonderful here.

Car *sets* are 32-car collections, which may mix 'n' match the individual (officially licensed) cars which shipped with the game with cars created (by individual artists) with the Paint Kit/Paint Shop, or which may be all-new sets. Some car sets are historically accurate, like the cars from the cars that ran in the '97 CART season; and some are total fabrications, like an "All Stars" set (including greats from past and present eras); or a set painted to look like Grand Prix or stock cars or America's Cup yachts. One of my favorites incorporates the logos of America's great railroading past: B&O, Pennsy, Southern Pacific, etc. (Note that all the cars are the same *shape*; what you get are different paint jobs, color schemes, car numbers, and sponsor decals.)

Of course, if you have infinite amounts of free time, the dedication necessary to master the intricacies of Paint Kit/Paint Shop (a subject worthy of a book in itself), the patience of a saint, the artistic talent of Robert Bechtle (the well-known photorealist painter and car fetishist), and the resources of *Road & Track*'s art department...not to mention several hundred megabytes worth of corporate logotypes...there's nothing available online you couldn't create yourself, but downloading this cornucopia of gorgeous graphics is *sooooo* much easier!

You need to create separate subdirectories for each car set (the path would be C:\CART\CARS), and you have to make sure the name of the subdirectory is *exactly* the same as the car set's binary file name (viz., the car-set filename CART97.DAT and the associated DRIVERS.TXT and DRIVERS2.TXT files would go into C:\CART\CARS\CART97), after which you load the car set from *within* the game (from the Driver Info menu).

Nothing I have undertaken in *CART Racing* has added as much realism and value to the game, nor provided as much enjoyment and satisfaction with the experience, as putting together collections of car sets and individual cars. (No more toy soldiers like "Fred Jones;" I

have *real* drivers now!) It's like having a trophy case of beautifully-detailed model cars...and they're free!

How to Stop Playing With OPPS

If you're willing to roll up your sleeves and edit some simple ASCII (plain text) files, I can show you some more tricks. We'll start with the easy stuff. In the path C:\CART\TRACKS, you'll find the subdirectories for each of the 15 tracks that come with the game (and for those you've added, if any). Within each subdir, there are a couple of files you may want to experiment with, [TRACK].TXT (the actual filename depends on which track, like AUSTRAL.TXT, CLEVLAND.TXT, NWENGLND.TXT, etc.) and another always named RECORDS.TXT within each track's subdir.

Before you mess with anything, make copies of the original files under slightly different names (such as AUSTRAL.T_T or RECORDZ.TXT), so that if something goes hideously awry, you don't have to reinstall the game from scratch (actually, you could copy these files from the CD). And modifying *any* file is at your peril; I make no warranty as to suitability for *any* cause. That is, don't call me if this results in an aneurism.

Open the [TRACK.TXT] and scan down the individual lines that begin with arcane collections of capital letters, like TNAME, SNAME, PIT, SPEEDW, and LENGT, etc. There are only a couple of lines you can change without inviting Armageddon. The first of these is line 6, LAPS. In the case of Australia, the number following is "65." If you'd like to run a longer race—say, 100 laps—change it to "100." (It doesn't make much sense to choose a lower number, since you can more easily change this from within the game, by lowering the percentage of the race distance.) Longer races are *really* nice at Elkhart Lake—100 laps would be 400 miles; twice as long as the normal race—where you can get fancy with fuel strategies. [One bunch of zealots decided that Elkhart looked enough like Le Mans to run a 24-hour race here—the appropriate number of laps was 720! The problem was that there were no CC cars left running at the end; they had all crashed out. And if you close your eyes and squint, you can imagine Cleveland's airport circuit a close enough facsimile of Sebring to host a 12-hour enduro there.]

Another line that's safe to alter is 11, QUAL, followed by two numbers

(in the case of Surfers, it's "0" and "10," indicating a single 10-minute Q session. If you'd like more time—a half-hour, say—change the "10" to "30." In real life, on the road courses, CART splits the field into two half-hour Q sessions, but the game won't let you do this. You have to run with the entire field circulating on the course, but you may extend the single session to an hour...starting with a light fuel load, then pitting several times for a splash 'n' go until you see a clear track ahead...then take your best shot unimpeded by traffic, and exit before anybody else racks up a better Q time (although no Q battles, a la F1, are designed to be a factor in *CART Racing*).

The first digit after QUAL determines the Q format. "0" means you take your best lap from a single Q session, the length of which (in minutes) is determined by the second number. On the ovals, the default "QUAL 2 2" means the *best* of two timed laps. If you change the first digit to a "1," it means your Q position will be determined by the *average* speed of the next number of laps. This is a holdover from *CART car Racing*, where qualifying for the 500 is traditionally the average of four timed Q laps (e.g., "QUAL 1 4"). Unless you're a confirmed masochist, I'd skip this particular Q format; it's not for nothing that qualifying for a major race has often been described as "the longest ten miles in auto racing."

Taking Qualifying By the Horns

I promised to show you how to adjust the CC cars' Q times and race speeds to more closely match your own, without having to keep readjusting the OPPS, and this is where you do it—line 21 is BLAP and line 22 is RELS. Here's what they mean:

RELS (relative strength) is the same thing as OPPS (opposition strength) from the Options/Opponents menu within the game, only its set individually for each track from the [TRACK].TXT file. If you've been keeping a record of your OPPS for each track, you can use these values for the RELS at each track and leave the OPPS set at 100% in the menu (note that there is no "%" sign after the value in RELS). Of course, if you had *both* the RELS and the OPPS set at, say, 97, presumably you'd get 97% of 97%, or 94% at that track.

The preceding line, BLAP, is the "base" (median or average) Q lap for

the fastest CC cars at that track (their actual Q time will vary, thanks to the random number seed), expressed in seconds x 1,000. That is, for Australia, the BLAP value is 88573, or 88.573 seconds, or 1:28.573. If your qualifying times there are around 1:34, you'd want to change the BLAP to 94000 or thereabouts (no commas, please). Note that your RELS and BLAP have no effect on each other. You can set the BLAP dead slow, put yourself on the pole, and run against 120% OPPS...if you want.

You may also want to take a look at (or edit) one other file: RECORDS.TXT (the name of this file is the same for every track, but its contents aren't). The first two lines tell you who holds the lap record, as shipped with the game, and the time (in seconds x 1,000). At Australia, the first line reads "FASTN Nigel_Mansell," and the second "FASTN 94877" (or 1:34.877)*. You can substitute anything you want,

**Traditionally, speeds on the ovals are given in mph, not minutes and seconds, as on the road circuits; but the game's math is a little off here: it should be 7272/mph=time in seconds, not 7200/mph=time in seconds.*

like a new real-world record, or the current Hot Lap posted on CompuServe, or your personal best. The next two lines tell you what the player's best lap has been (if you've completed at least one lap); viz. "RACEN Your_Name," and "RACET 94652" (or 1:34.652). If you want to raise the bar a peg or so, use this value for the BLAP (see above) and the fastest CC cars will qualify about as fast...or a little faster...as your best-ever lap.

Playing God With Cars and Drivers

Now we get into the heavy-duty stuff: editing the DRIVERS2.TXT files. Again, back 'em up...and whatever you do, don't get 'em confused with the DRIVERS.TXT files, which look similar, but are actually tactical nuclear devices set to go off if you attempt to alter them. In fact, I'd advise leaving the original CARS95 sub-directory alone altogether (modifications to which can also play hob with your ability to use the Paint Shop/Paint Kit utilities), and instead *clone* it under a different name, like NEWCARS, meaning the path would be

C:\CART\CARS\NEWCARS and that you will have to rename the copy of the CARS95.DAT file therein to NEWCARS.DAT.

So, in your new subdir, NEWCARS, you should have the files NEWCARS.DAT, DRIVERS.TXT, and DRIVERS2.TXT. The last one is the only one you should even *look* at, much less edit.

Scanning down through DRIVERS2.TXT, you come to 33 lines that begin with DINFO, followed by a bunch of meaningless (to the untrained eye) numbers, aligned vertically in columns, followed by drivers names, nicknames, hometowns, team names, etc. These columns of numbers are the key to customizing the performance of the individual cars and drivers in the game (or at least those in that particular car set).

Reading the columns from left to right, this is what the numbers mean (ignore the top two lines, the first of which relates to the pace car, which doesn't matter; and the second of which relates to the player's car, which doesn't matter because changing the numbers won't affect your car's performance one iota):

Column 1: the number of the car whose characteristics follow (to the right). These numbers should match the numbers painted on the cars (from the car-set's .PCX graphics files, like those in the NEWCARS.DAT file in this example) or the written text won't match the cars you see on the screen. This is also true for all the remaining cars in the set.

Column 2: the chassis of the car (0 for Lola, 1 for Penske, and 2 for Reynard).

Column 3: the engine (0 for Cosworth, 1 for Mercedes-Benz, 2 for Honda).

Column 4: the tires (0 for Goodyear, 1 for Firestone).

Column 5: the minimum power of the engine (in a range of 1 to 375 in the original car set; a typical value is 350; these numbers are relative, but arbitrary (i.e., 375 is *not* a horsepower figure, but it is more powerful than a value of 350).

Column 6: the maximum power (250 to 562; typically 500), which

will affect acceleration and top speed. Even though the default maximum only goes as high as 562, you may set this at any value up to 999, as you may with any of the following.

Column 7: the minimum co-efficient of traction assigned to the car (the lower the number, the slower the car will go around the corners). [N.B. With an absurdly low number, the tires will have so little grip that the cars will slide down off the banking of the superspeedways, *even when they're parked!*]

Column 8: the maximum traction (the higher the number, the faster the car will go around the corners).

Column 9: the minimum aerodynamic drag co-efficient (the higher the number, the slower the car on the straightaways); although this number doesn't seem inversely proportionate to the aerodynamic grip (i.e., downforce).

Column 10: the maximum aero drag (the lower the number, the faster the top speed; other factors—like power—being equal).

Column 11: the minimum aggression level of the driver (the lower the number, the less aggressive the driver will be).

Column 12: the maximum aggression level (the higher the number, the less likely the driver will be to yield when challenged).

With the Driver Info menu within the game, it's easy to change all the data to the right of these numbers (i.e., the driver's name, etc., as well as the chassis, engine, and tires specified in columns 2, 3, and 4) in the DRIVERS2.TXT file), but it's a lot more rewarding to shuffle the numbers in the middle columns of the file itself with an ASCII editor.

For example, you might not agree with the aggression levels assigned in the game. I note that some competitive juices run the gamut from 998 to 999. But I wholeheartedly disagree with the values assigned to Al Unser, Jr. (800-900) and Hiro Matsushita (600-800).

Little Al, while not quite the choir-boy his freckle-faced demeanor suggests, is not an aggressive driver. He wins races by driving smarter

than anybody else, not by bumping egos. And “King” Hero, who was once the terror of Formula Atlantic, has been painfully slow in CART cars, despite having machinery reputedly as good as anybody else’s; suggesting that he is almost totally devoid of aggression these days.

But that’s the beauty of this deal. You can download a car set (or assemble one of your own) of, say, the CART car season, go through the DRIVERS2.TXT file, and make each driver as aggressive or as timid as you think he (or she...if you’re a Lyn St. James fan, as I am) is in real life.

Likewise, if you think Bobby Rahal deserves to get his Honda engine back, you can give it to him. Or if you think that Greg Moore is the hottest thing since Toad in the Hole, as I do, you can make him faster through the corners than anybody else (he should at least inherit an over-the-top aggression level, in my opinion). Or if you think somebody else is overrated, you can slow him or her down on the straightaways.

The permutations are virtually endless. If you’re happy with your setups at certain OPPS levels, but you think the CC cars have too much straightaway speed, for example, you can assign a higher drag value to the whole field, then speed up their lap times with higher horsepower levels, or—if you think that would give them too much acceleration—with faster cornering speeds.

As mentioned, the random-number “seed” (a computer algorithm) chooses exact values within each assigned range at the beginning of each race weekend...providing there is some variation to work with. For instance, Little Al will get a number between 800 and 900, and Hiro’s will be somewhere between 600 and 800.

In the example above, Unser has a range of about 10%, and Matsushita’s is about 20%. If you assign your own values, you can make each car and driver as regular as rain, or wildly inconsistent, based on any criteria you feel are relevant...or just to make the game play more interesting.

Many of the car sets you can download have already been tweaked to

represent the *auteur*'s idea of who should be quick and who should be slow (some even based on complicated formulas derived from season-to-date on-track performance), so you may not want to change a thing. Or, if you feel the CC cars are too often bunching up into drafting "wolf packs" on the ovals (groups are harder to pass than individual cars), you can spread the field out by dialing in more divergent numbers. [Bear in mind that lack of aggression tends to be cumulative; that is, a less aggressive driver, no matter how powerful his car, will tend to tuck in behind a more aggressive driver...and so on...and if you're not careful you can wind up with milk-trains of 'fraidy-cat drivers if you've turn down the aggression too much.]

Needless to say, you should not only back up the original DRIVERS2.TXT, but you should also keep a copy of the immediately previous iteration of DRIVERS2.TXT in case you get hopelessly muddled and need to go back one step. Testing out changes in DRIVERS2.TXT is tedious because you have to save the file, close the ASCII editor, relaunch the game, and run a race (or at least several laps of practice) before the changes you've wrought become apparent. The results are frequently amusing.

I keep meaning to run a race at Laguna Seca, giving all the cars 999 "horsepower," a 999 traction figure, 1 for drag, aggression levels of 999, and a RELS of 150%, just to see what happens (hell, maybe even run a whole Championship season that way), but I've just been too darn busy writing this book....

Let's review. As we've learned, you can exercise enormous control over the game at almost any level: you can speed up or slow down the individual cars at any point on any track (the DRIVERS2.TXT files); you can speed up or slow down the entire field on any track, in both qualifying (the BLAP figure) and the race itself (the RELS value), independent of each other; and speed up or slow down the entire field in both qualifying and the race (the opposition strength) from a menu within the game itself. *Plus*, of course, tune your own car to go faster or slower at any track, and adjust each setup to suit your individual driving style, talent, and predilections. *Plus* paint your own car (and/or any or every other car in the race) in any livery you fancy. I don't know of any other computer simulation (not even *NASCAR Racing 2*)

that gives you this degree of freedom.

What more could you possibly want?

The Deadliest Enemy

Oh yeah—one more little thing. Going up against the deadliest enemy of all: another human being. I mean, beating the pants off the computer's artificial intelligence is all very well and good, but if you're a real competitor, you want to beat Boris Spasky at chess, not some silicone-based pseudo-lifeform.

To take on one of your own kind, you've got two choices here: a direct, computer-to-computer hookup, or over the telephone with a modem. The first method is less problematical—all it requires is two computers of roughly equal performance, each running identical versions of *CART Racing*, and a serial-port-to-serial-port cable usually called a "null modem" (the cable that came with my copy of *LapLink IV* works fine). I'm honor-bound to point out that legally, if there are two players, each should have his or her own copy of the game, but if there's a knock at the door, you might escape the hangman's noose by claiming that one of you is simultaneously driving both cars. More seriously, you should also make sure both of you are using identical car sets, particularly the crucial DRIVERS2.TXT file.

The same ground rules apply to modem-linked games over the phone (don't bother with Internet connections; they're too slow). It may help—but isn't strictly necessary—for both of you to have the same make and model modem...unless they're DSVD modems (for simultaneous chat and chase sessions), in which case it *is* strictly necessary. There are an enormous number of arcane technical flubs that can diddle modem-linked play, and trouble-shooting the problems can drive you nuts. (Stuff like parsing the init strings and remembering to hit "*-80" to disable call-waiting.) Read the instructions carefully...and practice witchcraft...if you know any. Once again, I cannot recommend CompuServe's eager experts too highly here (they even have their own forum, Modem Games; GO MODEMG). Phone connections seem to work better the more computer power you can pile on the problem (a pair of Pentium 133s with 16650 UARTs would

be my idea of the bare minimum), although the maximum speed supported by CART Racing is an antediluvian 9,600 bps, so you don't have to go wild on modem speed.

With either method of connecting, in the beginning, you should eliminate all the CC cars and race against the other human player alone. Head-to-head racing is iffy enough without any spurious complications, so eliminate those variables before you mix in the CC cars. With full fields, all the cars will tend to look alike at a distance, but you will soon learn to spot your human opponent by his or her, eccentricities (during the pace lap, for instance, the CC cars will align themselves like a Praetorian guard; the one car that is out of line is the one being driven by your human opponent).

It's important to practice against someone of equal driving skill, because there's no way to speed up or slow down the HC (human-controlled) cars, other than by raising or lowering the boost, which, at extremes, will get you into "reciprocity failure;" i.e., the faster driver will be screaming around the corners and crawling down the straights in order to turn the same lap times. No fun for anybody. That is, you can't simply edit a text file to make two flesh-and-blood players equal.

Leisure Suit Larry Meets Leadfoot Harry

Unless you live in an urban neighborhood blessed with a plenitude of equally gifted leadfoots willing to lug their computers over to your house (or unless you own a couple yourself), the lack thereof will eventually force you to seek modem partners. Again, CompuServe has a "ready room" full of able-bodied chauffeurs willing to meet you any time, any place, for some *mano a mano* competition...particularly if you're willing to pay for the phone call. (A good enough reason in itself to sign up for one of those dime-a-minute telco rates.) However, if some complete stranger with a 266-MHz Pentiun II and a T1 line tells you he's "never done anything like this before," make sure you're not racing for pink slips.

There's only one thing that you need to remember about playing against a human opponent. Just ask yourself how a HC car's behavior differs from a CC car's. Right—the CC cars *never make mistakes*. Or almost never. Silicone never sleeps. Never gets tired, or angry, or

suffers brain fade. The CC cars just drone around the track like little robots, and your job is basically to stay out of their way. Competing against human drivers, on the other hand, your job is basically *to get in their face*. Well, not exactly; more like getting right on their tail and clinging there like flypaper. Nothing drives another driver nuts like some fool (that's you) tailgating them...unless they've got ice water in their veins (some do; most don't). Better to be the hunter than the hunted.

So even if you think you *could* pass them, don't. Stay stuck to their gearbox as long as you can, both to put pressure on them, and to study their mistakes, like Sun Tsu sizing up his enemy. Spend the race harrying your opponent and planning your move, not trying to lock horns. The ideal time to put him or her away (if bird-dogging him or her for the entire race hasn't caused him or her to lose his or her cool) is the last turn of the last lap.

[N.B. Bear in mind, too, that the jack-rabbit starts you've perfected for gaining track position at the *beginning* of a race against the CC cars won't faze human opponents, who suffer no AI overload at the drop of the green flag. Don't sweat it. Behind the HC car is where you want to be...at this point in the race.]

Of course, if your carbon-based opponent has done this before, he (or she; do I have to keep reiterating this gender disclaimer?) will know this trick, so may try to get on *your* tail. Then the only thing for it is the Ken Miles Move, named after the great British driver who perfected this gambit in the 1950s: lull the guy—male or female—behind you into a false sense of security by slightly stretching your lap times. On the last lap, turn up the wick all the way and go hell-bent-for-leather to the Finish Line.

Or, if the guy behind you is particularly aggressive, make note of the corner where he's trying to set you up—usually by feinting a passing attempt for a couple of laps—knowing that the real move, when it comes, will almost certainly be on the opposite side of the track from where he's been trying to con you into expecting it. Just don't expect him to roll over and quit once he knows you're on to him.

Or, if you can't shake him by outdriving him, you can frequently sucker him into following *you* too deep into a corner (moving the brake- bias forward a notch just before you try this will do wonders to confound your nemesis' expectations and break his rhythm). That is, you "throw away" a corner by going in so deep that about all you can do is save your car from sliding off the far edge. Your line will be all wrong, and your exit speed will be pathetic, but if the guy behind you isn't ready for it, he probably won't be able to make the corner at all, much less with enough speed to capitalize on your deliberate faux pas. The danger here is that if his intention was to outbrake you on the *inside*, when you finally do have to turn in, he will probably have to T-bone you. This maneuver works like gangbusters, however, when his intent was to try to take you on the outside.

If you insist on trying a pass for position, the best place to do it is in an "S" bend, suckering your opponent into going off his line (to pass you or block you) in the first part of the turn, putting him on the wrong side of the road to defend his position in the second part of the turn. This is another great place to move the brake-bias forward a notch, because releasing the pedal after heavy trail-braking will assist your turn-in, helping you stay to the inside in the first part of the turn, and not be forced into running wide (i.e., avoiding a "tank slapper," in F1 parlance).

Give 'Em a Brake? Puh-leeze!

The one thing I *don't* recommend is "brake testing" your opponent. If it catches him unawares, he may be momentarily taken aback, and if he doesn't hit you, he'll soon be on your tail again...somewhat wiser...and madder than a wet Puma. More likely, he will rear-end you if you brake unexpectedly early, possibly putting you both out. The object of the exercise here is not to get him riled up or to prang your car, but to get him to put himself off the road.

There is a kinder, gentler approach (borrowed, strangely enough from those ruffians in stock-car racing) that you might try with two HC cars against a full field of CC cars: a drafting "pact," where you and the other living, breathing driver agree to help each other out by forming a drafting "train" on the long straights (Michigan is ideal for this), which will increase both of your lap speeds by a couple of mph and may help

pull you clear of the rest of the field. Do I have to mention that the pact is null and void as of the last lap of the race?

If you ever do run out of things to do in *CART Racing*, you could always run the tracks the wrong way around. The ovals are pretty boring, but for a real thrill try Laguna backwards (clockwise). Getting up through the Corkscrew is hard enough, but accelerating downhill from T7 to T6 is death-defying. Similarly, counterclockwise at Elkhart Lake is hair-raising, particularly coming down the hill from the S/F line toward T14. (Unfortunately, the lap timer doesn't work backwards, and I'm still waiting for somebody to hack the code so the CC cars can circulate in the wrong direction...and I don't mean in reverse.

For me, *CART Racing* falls short of perfection only in its inability to link more than two players over a local network, or an online gaming network. For that kind of action, you have to start all over again, learning to rub fenders with the good ol' boys in *NASCAR Racing 2*. I might just give it a try.

Any questions? You can e-mail me at 76172.340@compuserve.com. Terse eloquence will be more likely to get you a response than fulminating diatribes. And please, extinguish all flaming materials.

—Steve Smith

Where to Find It

Stuff That's Mentioned in the Book...and More

America Online
(www.aol.com; 800-827-6364).

Canopus Total 3D
(www.total3d.com; 888-868-2533).

Carly Brayton Memorial Trust
c/o Bank One
14801 U.S. 31 North, Carmel IN 46032

CART (Championship Auto Racing Teams;
www.cart.com; 810-362-8800).

CH Products (
www.chproducts.com; 619-598-2518).

Classic Motorbooks (www.mbibks@win.bright.net; 800-826-6600). Legend has it that David Kaemmer jump-started his career as a sim-racing programmer by maxing out his credit card at this ultimate car buff's emporium, then gorging on technicalia until *Indianapolis 500: The Simulation* sprung full-blown from his brow. All the books mentioned here are available, uh, here. Classic's backlist is thin-ish and they're not very computer hip, but if it's current and if it's about cars, they've got it. (Specifically as to archival material on Cart cars—for authentic car sets and such—there's not a lot of depth, but the section is well stocked with "fan" guides and up-to-date annuals.)

CompuServe
(www.compuserve.com; 800-769-6747).

Creative Labs
(www.soundblaster.com; 408-434-5700).
"Drive to Win" and **"Tune to Win"** (Carroll Smith, 1236 Via Landetta, Palos Verdes Estates CA 90274). These two books are ground-level, Master Sergeant's views of auto racing. Smith (no relation) has been in the trenches for many years and knows all the tricks. He covers everything deadpan, from the sublime (an explanation of the much-touted "traction circle") to the mundane ("Big Feet, Little Cockpit"), and does it with a gritty, funny, cinema-verite voice. A good read. And nicely illustrated (the call-outs on a sketch of Road Atlanta will make your mouth dry with fear). A lot of what he covers, I've covered (e.g., "The Cornering Sequence"), and guess what? Most of what Mr. Smith describes here applies to *CART Racing*.

Extreme Competition Controls
(71204.503@compuserve.com; 612-824-6733).

ESPN
(www.games-espnet.sportszone.com).

Intergraph Intense 3D
(www.intergraph.com; 800-763-0242).

Jeff Krosnoff Memorial Fund
c/o Arciero-Wells Racing
30212 Tomas, Rancho Santa Margarita CA 92688

National Speed Sport News (704-455-2531). Forget about wimpy weeklies writing as though they were afraid of losing their press passes, *NSSN* (which has been around since 1926 and still looks like a horse-racing tout-sheet of that era) tells it like it is...about CART, IRL, F1, SCCA, the series formerly known as IMSA, NHRA, USAC, WoO, ASA...you name it. About $37 a year. If you're a real racer, you won't be able to live without it.

Papyrus Design Group
(www.papy.com; 617-926-0700).

"Principles of Race Driving," (Ayrton Senna; $20; available from Classic Motorbooks). A lot of people believe Senna was the greatest driver who ever was. I thought he was a reckless bully. Whichever, when he talks, you listen. His book is a lot more passionate —or at least more tactile—than this book; Senna reaches out with his emotions a lot, talking about how his car *feels* to him. This isn't about setups or theories, this is about the mythical, mystical, magical seat-of-the-pants connection that all great drivers make with their machines. The Zen of auto racing, if not *desktop* auto racing.

"Race Car Engineering & Mechanics" (Paul van Valkenburg, P.O. Box 3611, Seal Beach CA 90740). Although a lot has changed since reporter/racer van Valkenburg wrote this (originally in 1986; my edition is corrected as far as 1992), most of the technology he describes...and explains...applies to *CART Racing* today. Terse eloquence, technically speaking. A single example: wheel camber, mass, and weight distribution are handled more adroitly in a single diagram than in my entire chapter on the topic. Paul's book may tell you more about race-car physics than you want to know (helpful suggestions for NACA-duct sizes), but it will answer every question you have about auto racing. Guaranteed.

"Race Car Vehicle Dynamics" (William F. & Douglas I. Milliken; $85; available from Classic Motorbooks). The ultimate coffee-table tome, this thousand-and-one-page opus is the be-all and end-all of race-car physics...expiated in excruciating detail. If you can understand this gobbledegook, you're probably already employed by Reynard. (No, I didn't read it; Doug Arnao gave me the "executive summary.")

Rendition
(www.rendition.com).
This is OEM territory, but you might score some tech help.

Sierra On-line
(www.sierra.com; 800-757-7707); *CART Racing* and **Screamin' 3D.**

Skip Barber Racing School
(www.skipbarber.com; 800-221-1131).
These are the guys who taught David Kaemmer and his crew how to drive *real* race cars! Okay, so they're not Cart cars, but the Barber Dodge single-seaters would give you more than a taste of what racing feels like; more like a four-course meal. What you've learned in the sim will help you here. And vice versa.
ThrustMaster, Inc.
(www.thrustmaster.com; 503-615-3200).

ThunderSeat Technologies
(www.new-kewl.com/spots/spot-thunderseat; 800-848-6337).

TSW
(Thomas Steering Wheel; www.soli.inav.net/~thomas; 319-462-2396).

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