

# Panoz Esperante GTS

RVP – Reliability / Value / Performance

## Quaker State – Recommended fill for the GTS



The Power to Reduce Friction



Welcome to the Panoz family. We want to thank you for all of the time that you have taken and for placing your trust in us by purchasing a Panoz Esperante GTS Race Car. We look forward to working and playing with you at the race track.

This manual is meant to assist you in the care, tuning and enjoyment of your GTS. The information compiled in this book is from our own experience and that of your fellow racers. This manual will be constantly updated as components are upgraded and information is accumulated. We would also appreciate your input for future revisions to this book.

This manual will not provide specific race set-ups and strategies. We will explain how to tune your suspension but other than a neutral starting point we won't tell you how to set your suspension for individual events. For further information about race strategies, suspension tuning, car set-ups and driving techniques we recommend the following books:

- Tune to Win- Carroll Smith
- Drive to Win- Carroll Smith
- Prepare to Win- Carroll Smith

### ***Taking Delivery***

We have checked and double-checked the condition of the car. It should be in good condition, however, we strongly suggest going through the car with a torque wrench and a careful eye before you take it to the track. If anything is wrong or out of place please let us know, we want to make sure our system is working.

Please familiarize yourself with the basic layout of the car. Note the electrical shut-off switch, fire extinguisher equipment and the fuel system safety features. Pay attention to where the shipper tied the car down to the trailer. There are many choices for tying down the car. The primary consideration is for safety. Be sure to avoid damage to fuel lines, brake lines, suspension parts and electrical wires when you tie it down to your own trailer.

## IMPORTANT SAFETY NOTICE



**WARNING** *Indicates a strong possibility of severe personal injury or loss of life if instructions are not followed.*



**CAUTION:** *Indicates a possibility of personal injury or equipment damage if instructions are not followed.*

**NOTE:** Gives helpful information.

Detailed descriptions of standard workshop procedures, safety principles and service operations are NOT included. It is important to note that this manual contains *Some* warnings and cautions against some specific service methods which could cause PERSONAL INJURY to service personnel or could damage a vehicle or render it unsafe. Please understand that those warnings could not cover all conceivable ways in which service, whether or not recommended by Panoz, might be done or of the possibility hazardous consequences of each conceivable way, nor could Panoz investigate all such ways. Anyone using service procedures or tools, whether or not recommended by Panoz, *must satisfy himself thoroughly* that neither personal safety nor vehicle safety will be jeopardized by the service methods or tools selected.

### **WARNING:**

1. THIS VEHICLE IS INTENDED FOR USE AS A HIGH PERFORMANCE RACING VEHICLE. THERE ARE SIGNIFICANT RISKS AND DANGERS ASSOCIATED WITH THE OPERATION AND/OR RACING OF HIGH SPEED AND HIGH PERFORMANCE VEHICLES INCLUDING THE POSSIBILITY OF SERIOUS PHYSICAL INJURY OR DEATH.
2. THIS VEHICLE WILL NOT WITHSTAND ALL FORESEEABLE IMPACTS WHICH MAY OCCUR DURING IT'S NORMAL INTENDED USE AS A RACING VEHICLE WITHOUT POSSIBLE INJURY TO OR DEATH OF THE DRIVER OR DAMAGE TO THE VEHICLE WHICH MAY EFFECT IT'S PERFORMANCE AND SAFE USE.
3. OTHER RACE PARTICIPANTS, THEIR AUTOMOBILES, TRACK CONDITIONS AND OTHER FACTORS BEYOND THE CONTROL OF THE VEHICLE DESIGNER, MANUFACTURER, DISTRIBUTOR AND SELLER MAY CONTRIBUTE TO THE ABOVE DANGERS AND RISKS. THE OWNER AND DRIVER OF THIS VEHICLE HEREBY ACKNOWLEDGE THAT THERE MAY BE OTHER RISKS AND DANGERS WHICH ARE NOT REASONABLY FORESEEABLE TO THE VEHICLE DESIGNER, MANUFACTURER, DISTRIBUTOR AND SELLER.
4. THE OWNER AND DRIVER OF THIS VEHICLE HEREBY ACKNOWLEDGE THAT THEY HAVE READ THE WARNING STATED HEREIN AND THAT THEY VOLUNTARILY ACCEPT AND ASSUME ALL SUCH RISKS AND DANGERS, INCLUDING SERIOUS PHYSICAL INJURY OR DEATH AND ANY AND ALL RELATED DAMAGES, HOWEVER CAUSED AND WHETHER CAUSED IN WHOLE OR IN PART BY THE NEGLIGENCE OR FAULT OF THE VEHICLE DESIGNER, MANUFACTURER, DISTRIBUTOR OR SELLER.
5. DO NOT OPERATE THIS VEHICLE IF YOU ARE NOT FULLY TRAINED AND EXPERIENCED WITH SKILLS NECESSARY TO OPERATE A HIGH SPEED AND HIGH PERFORMANCE RACING VEHICLE OF THIS TYPE.

## **GENERAL SAFETY**

### **CARBON MONOXIDE**

If the engine must be running to do some work, make sure the area is well ventilated. Never run the engine in an enclosed area.

***The exhaust contains poisonous carbon monoxide gas that can cause loss of consciousness and may lead to death***

Run the engine in an open area or with an exhaust evacuation system in an enclosed area

### **GASOLINE**

Work in a well ventilated area, keep cigarettes, flames or sparks away from work area or where gasoline is stored.

***Gasoline is extremely flammable and is explosive under certain conditions.***

***KEEP OUT OF REACH OF CHILDREN!***

### **HOT COMPONENTS**

Engine and exhaust systems parts become very hot and remain hot for some time after the engine is run. Wear insulated gloves or wait until the engine and exhaust system have cooled before handling these parts.

### **USED ENGINE OIL**

Used engine oil may cause skin cancer if repeatedly left in contact with the skin for prolonged periods. Although this is unlikely unless you handle used oil on a daily basis, it is still advisable to thoroughly wash your hands with soap and water as soon as possible after handling used oil. ***KEEP OUT OF REACH OF CHILDREN!***

### **BRAKE DUST**

Wear a dust mask when dealing with brake assemblies or cleaning the rotors to minimize the hazard caused by airborne asbestos fibers.

### **BRAKE FLUID**

#### **CAUTION:**

Spilling fluid on painted, plastic or rubber parts will damage them.

***KEEP OUT OF REACH OF CHILDREN!***

## GET TO KNOW YOUR PANOZ GTS

### Driver's seat

We did not install the driver's seat. This allows you to position the seat as you see fit. All of the hardware is included. Installation instructions are on page **11**.

### Seat Belts

Seat belts have a shelf life of approximately 2 years. Take note of the date printed on the tag of your seat belts and plan to replace them every 2 years from the date printed on the tag.

### Jetting/Tuning

Your car is delivered with the following jets:

76 Fronts

81 Rears

This refers to the jetting guide (110 leaded racing gas). The jetting guide is to be used as a reference only. In most cases this is a good safe starting point. It is your responsibility to read the spark plugs and tailpipe color. Colder ambient temperatures require more fuel. It is a good idea to fit the the car with exhaust gas temperature (EGT) probes. The ignition timing is set to 36° total advance (rpm over 3000). We do not recommend advancing the timing further than that. You will not gain any more horsepower, and you could put the motor into a detonation condition. Detonation usually occurs at peak torque around 4000 RPMs. We recommend running leaded race fuel. Unleaded fuels are too difficult to tune (DO NOT USE). Reading a spark plug burning unleaded gas is very difficult. Detailed information can be found in the Engine tuning section on page **17**.

### Brakes

Your car is delivered with new brake rotors and pads. Your front rotors come pre-bedded. The rear rotors are not. Brembo has not found it necessary to pre-bed the rear rotors. They will get bedded when you bed your pads. You should bed the pads using the following procedure.

1. Drive the vehicle in an aggressive Sunday drive fashion (no threshold braking), for 3-4 laps.
2. return to the pits and let the brakes cool to the touch.

### IMPORTANT

The brakes require heat in them before they work to maximum performance. Drag the brakes on your warm up lap to add heat into the system.

### Fuel Cell

Your fuel cell should be serviced at least once a year. The fuel pick up screens should be replaced, the check valves should be checked for proper operation and the fuel cell gaskets and gas cap gasket should be replaced. Most importantly, the bladder should be inspected for any fuel leaks or blistering. Any damage or broken components should be replaced before use. Your fuel cell has a build date printed on a label located on the right side of the tank. You can see it through the right rear wheel well. Take note of the date and expect to test or replace the fuel cell after 3 years or if a leak is detected.

### Aircraft Rubber Manufacturing, Inc.

250 SE Timber Ave.

Redmond, Oregon 97756

(541) 923-6005 / (800) 433-6524

FAX (541) 923-6015

[www.fuelsafe.com](http://www.fuelsafe.com)

[www.aircraftrubber.com](http://www.aircraftrubber.com)

### Fire Bottles

Be sure to pull the pins and check the gauges of your fire bottles to ensure that they are full before and during each event.

### Fluids

- Check fluid levels after each time on the track.  
Engine oil is Quaker State Full Synthetic 5w50 or 5w40 (9 quarts total fill)
- Transmission Fluid is 2.5 quarts Quaker State Full Synthetic 75W-90 GL-4
- Differential is Quaker State Full Synthetic GL-5 (3 quarts total fill).
- Water is Red Line Water Wetter (one bottle)
- Brake Fluid (bleed after each race weekend/event)  
Brembo Racing LCF600 (Brembo does not recommend mixing brake fluids, if you are planning to use a different fluid you should flush the system completely).  
Hydraulic Clutch uses Quaker State DOT 3 (550°F).

## VEHICLE SPECIFICATIONS

### Dimensions

|                 |                             |
|-----------------|-----------------------------|
| Wheelbase:      | 107.6 in.(2690 mm)          |
| Track (f/r)     | 63.0/65.8 in.(1575/1645 mm) |
| Overall Length: | 170.0 in. (4250mm.)         |
| Overall Width:  | 78.0 in.(1950mm.)           |
| Overall Height: | 51.0 in.(1275mm.)           |
| Curb Weight:    | 2685 lbs.(1217kg.)          |
| Fuel Capacity:  | 32.0 gal.(121.6L)           |

### Body and Chassis

- BODY: Lightweight, damage-resistant ABS plastic with acrylic exterior layer 15 easily replaceable panel with standardized mounting points. Safety glass windshield; clear acrylic rear window.
- CHASSIS: 1.75(43.75mm) x 1.75, .090(2.25 mm) wall, mild steel space frame 1.75x .095 DOM 8-point roll cage w/triple tube side protection 18-gauge interior panels, welded in. Meets all SCCA tech and safety requirements

### Engine/Drivetrain

|                    |                                                                                           |
|--------------------|-------------------------------------------------------------------------------------------|
| Layout:            | Front mid-engine, rear drive                                                              |
| Engine:            | Ford Motorsports 5.8-liter, 16-valve V-8                                                  |
| Compression Ratio: | 10.5:1                                                                                    |
| Horsepower@RPM:    | 430bhp @ 5,850                                                                            |
| Torque @ RPM:      | 435 lb/ft @ 4,500                                                                         |
| Cylinder Heads:    | Edelbrock Performer                                                                       |
| Carburetion:       | Holley 4bbl., 750cfm Double Pump carburetor                                               |
| Ignition:          | MSD 6ALN Ignition Control                                                                 |
| Transmission:      | Tremec 5-speed manual                                                                     |
| Gear Ratios:       | 1st=2.87:1, 2nd=1.89:1, 3rd=1.28:1, 4th=1.00:1, 5th=0.82:1                                |
| Final Drive:       | 3.89:1, Ford 9-inch w/ TruTrac (.350:1 optional)<br>Differential cooler w/integrated pump |
| Clutch:            | QuarterMaster V-Extreme 8.5" aluminum flywheel and clutch assembly                        |
| Exhaust:           | Hedman Headers, Magnaflow Mufflers                                                        |

### Suspension, Brakes, Wheels, Steering

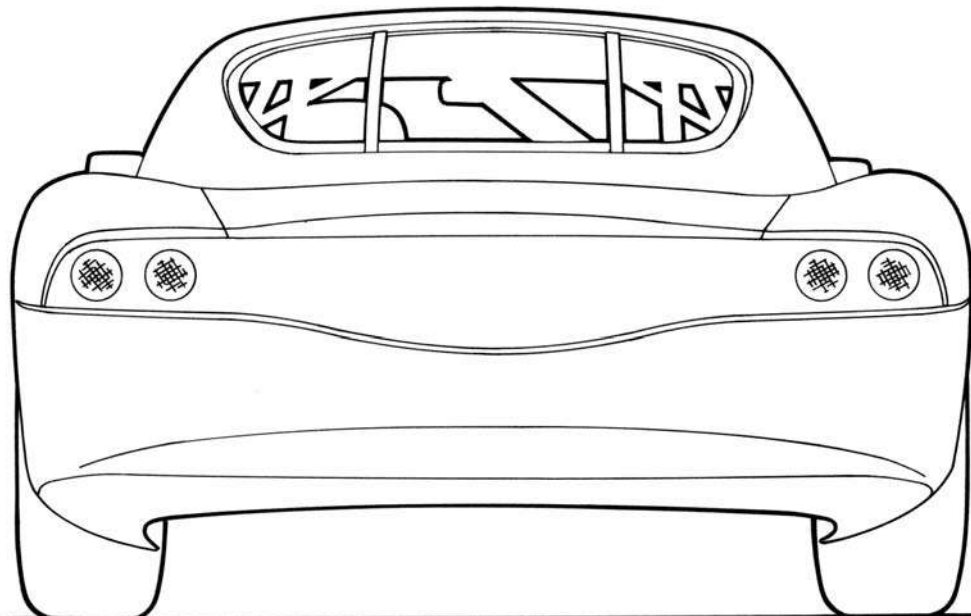
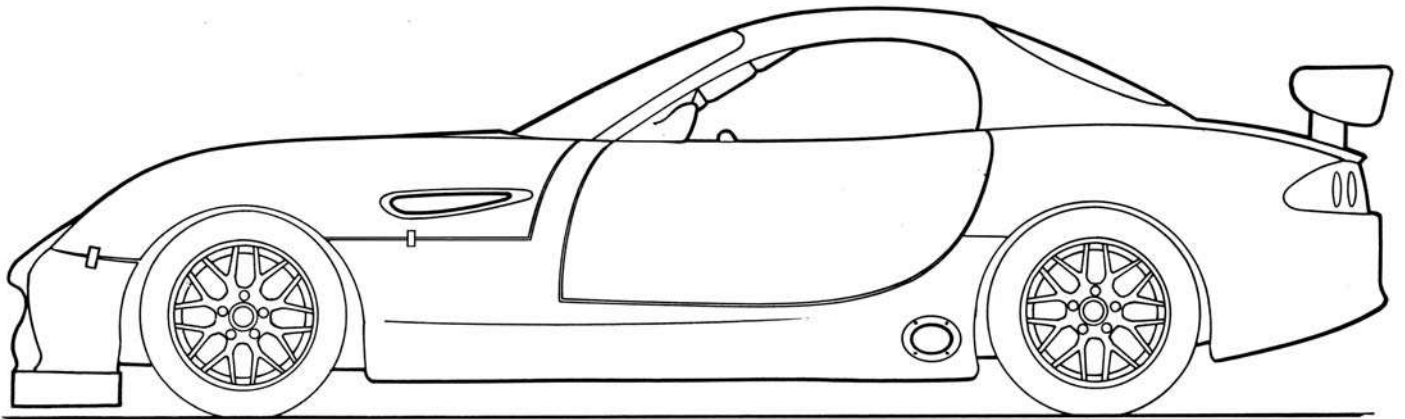
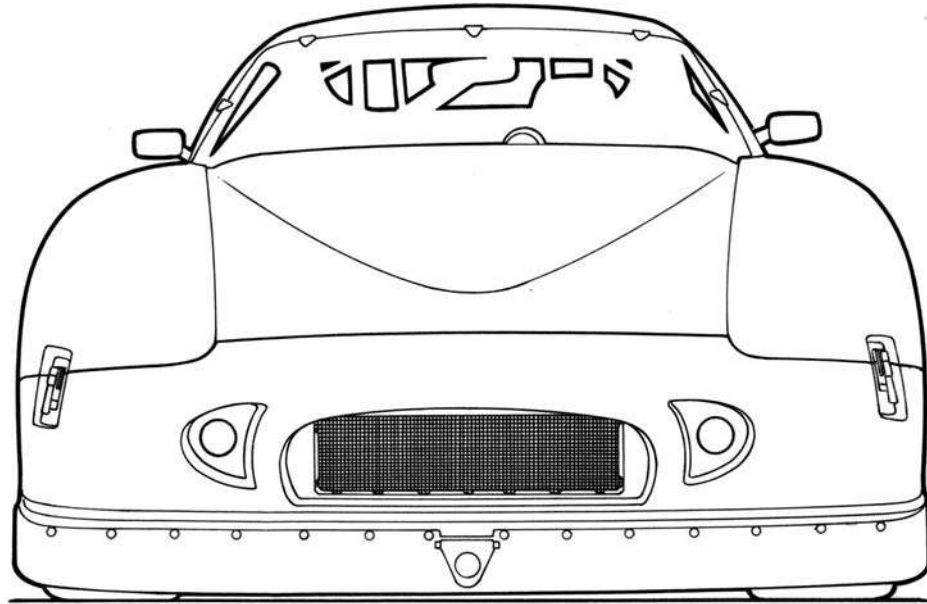
- SUSPENSION (F/R): Unequal length A Arm Penske single adjustable coil-over shock absorbers  
Two-position adjustable sway bar, 1.25" dia.  
Live axle located by trailing arms and Watts Link  
Penske single adjustable coil-over shock absorbers  
Three-position adjustable sway bar, 0.75" dia.
- BRAKES (F/R): Brembo 4-piston 40/44mm 328 mm slotted & vented, floating rotors (pre-bedded). Pads: Hawk HT-10 (black) or Performance Frictions 97  
Brembo 4-piston 36/40 hydraulic calipers. 320 mm slotted & vented, floating rotors. Pads: Hawk HT-10 (front) and Hawk 9012 (rear) or Performance Frictions 97
- WHEELS: BBS RX 18"x10" (457x254mm) aluminum
- TIRES: 285/640x18 Pirelli P-Zero Slicks
- STEERING: Rack and pinion 3 turns lock-to-lock, 15:1 steering ratio

### Equipment & Controls

Steel braided fuel and oil lines, Front brake cooling ducts, Aluminum high support one piece racing seat of various widths, Fittipaldi 3-spoke steering wheel with quick release, Autometer 2-5/8" Ultra Lite gauges and lighted 10k rpm Monster Tach with memory, Stack Dash Loggers (optional), Pi Research System2 digital instruments (optional), Wilwood brake bias control system (cockpit adjustable), Fuel Safe fuel cell with bladder located within chassis rails, 3-inch 5-Point safety harness, Driver's side window net, Manual Halon fire extinguisher system; driver and remote operated, Driver and remote battery kill key, Illuminating tail lights and brake lights, Remote battery boost connector, Left and right side mirrors (electric remote optional), Single electric wiper, Opening doors.

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# At The Track

**Fuel Mileage** .....9

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**Seat Installation** .....11

Even though we checked the torques, you should continue to check things while waiting for track time. Be sure to check all torques, specifically:

- Header bolts 3/8" 12 point wrench, must check after first 4 sessions.  
This should happen anytime that you change the engine.
- Header collector nuts and bolts - after every other session.
- Body bolts - check after each event.
- Use anti-seize on spark plugs (gap set to 0.045)

This list does not include everything,just the items that are a little out of the ordinary. Please see the GTS Torque Specification check list in this section.



## Fuel Mileage

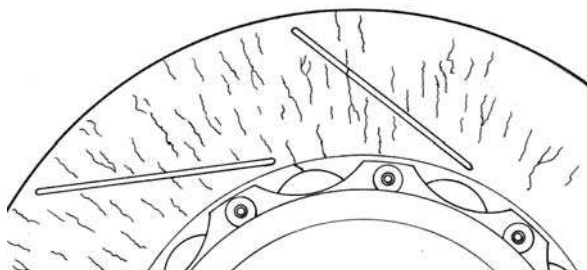
Typically the Panoz GTS cars get 4 miles per gallon. Panoz GTS cars have 32-gallon fuel cells. When measuring fuel; 7/8" equals 2 gallons. Panoz recommends using 110 octane, leaded racing fuel. If you are using a different fuel, be sure to jet the carburetor accordingly. Using the leaded fuel allows you to "read" the spark plugs and tail pipe much easier.

**HINT:** Purchase a wooden dowel rod and scribe it in 7/8" increments. This will allow you to measure your fuel level accurately.

## After On-Track Session

### NUT & BOLT CAR

- A:** Place car on jack stands.
- B:** Remove hood and rear deck lids.
- C:** Grab each wheel and tire, shaking and pulling it; checking for anything that may feel loose or worn out (wheel bearings, heims, etc); they should be very little, if any, play.
- D:** Remove wheels and tires and check over all suspension parts. You are checking for anything that may have loosened up, cracked or broken during the track session.
- E:** Re-Tighten all body fasteners after every race weekend (snug fasteners, do not over tighten).
- F:** Always look for not only loose fasteners, but any leaks or anything that looks out of place or not right (plug wires, electrical connections fluid levels, etc.).
- G:** Check brake pads for thickness and wear characteristics. Check the rotors for heat cracks - heat check cracks on the surface of the rotor are normal. They should extend over the top of the rotor or away from from any of the mounting locations. Also check the calipers.



**H:** This is also a good time to bleed the brake and clutch systems since the car is off the ground.

**I:** Bleed brakes at least once during and after each race/track event. For maximum performance, bleed brakes after each all out driving session. The brake pedal should not get soft during any track event. If a soft pedal condition occurs bleed brakes more frequently

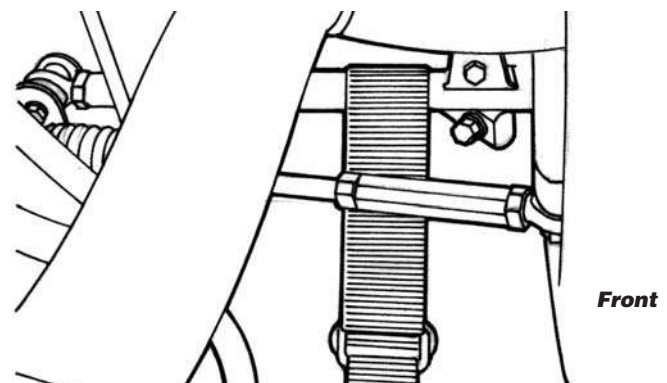
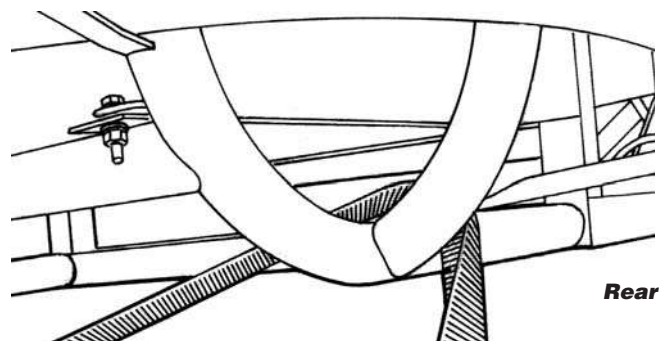
## Trailer Tie Down

When taking delivery of your Panoz GTS note where the shipper tied the car down. You can use the tow strap to winch your GTS onto the trailer.

**\* DO NOT TIE THE GTS DOWN USING THE FRONT TOW STRAP OR REAR TOW HOOK.**

**• DO NOT TIE DOWN OVER THE REAR TRAILING (RADIUS) ARMS.** Below you will see where we tie ours down. After tying the car down take the car out of gear to save on driveline wear. When figuring the wear on your shock absorbers remember that they are working while the car is in transit.

**Note:** Be careful that your tie down straps don't pinch or rub on the brake lines, fuel lines and electrical wires during transit.



## **GTS Torque Specifications** (CHECK BEFORE EACH RACE)

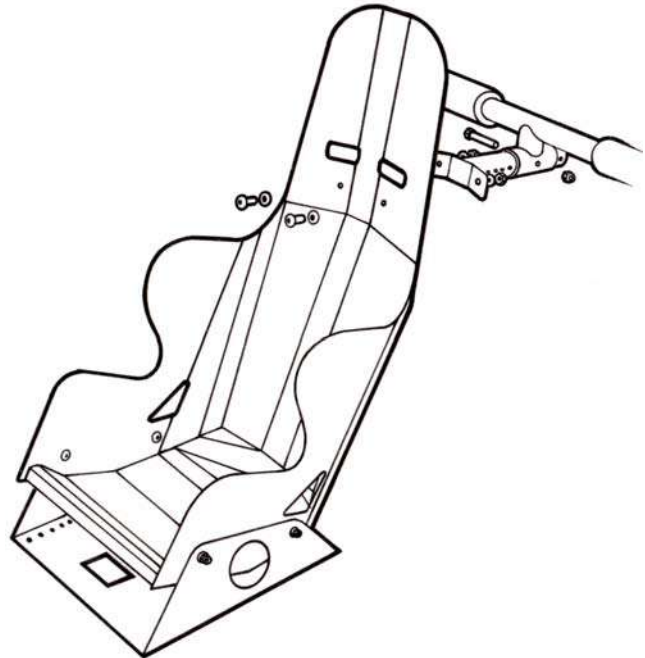
| <b>Part Description</b>                 | <b>Torque LBS.</b> | <b>Vehicle Quantity</b> |       |
|-----------------------------------------|--------------------|-------------------------|-------|
| Brake strut bar, rear                   | 45                 | 2                       | _____ |
| Brake strut bar, rear                   | 45                 | 2                       | _____ |
| Brake strut bar, front                  | 23                 | 2                       | _____ |
| Brake strut bar jamb-nuts               | 45                 | 4                       | _____ |
| Spindle mounting bolt, top              | 45                 | 2                       | _____ |
| Spindle mounting bolt, inside top       | 45                 | 2                       | _____ |
| Spindle mounting bolt, inside bottom    | 90                 | 2                       | _____ |
| Spindle mounting bolt, bottom           | 45                 | 2                       | _____ |
| Shock mounting bolt                     | 45                 | 8                       | _____ |
| Caliper bracket to spindle, front       | 50                 | 4                       | _____ |
| Front Caliper Mounting Nut & Stud       | 25                 | 4                       | _____ |
| Rear Caliper Mounting Nut & Stud        | 12                 | 4                       | _____ |
| Caliper hardware bolts                  | 10                 | 8                       | _____ |
| Rotor Disc to Rotor Hat (Brembo)        | 60 in. lbs.        | 10/wheel                | _____ |
| Rotor Hat to Hub (Brembo)               | 25                 | 20                      | _____ |
| Sway bar arm, front                     | 45                 | 2                       | _____ |
| Sway bar arm, rear                      | 23                 | 2                       | _____ |
| Steering shaft jamb-nuts                | 15                 | 6                       | _____ |
| Upper control arm mounting bolts        | 110                | 4                       | _____ |
| Tie-rod jamb nuts                       | 25                 | 4                       | _____ |
| Motor mount nuts                        | 90                 | 2                       | _____ |
| Transmission mount nuts                 | 35                 | 2                       | _____ |
| Transmission mount bolts                | 50                 | 2                       | _____ |
| Transmission crossmember bolts          | 35                 | 2                       | _____ |
| Front cross brace support               | 90                 | 2                       | _____ |
| Crush box bolts, upper & lower          | 45                 | 4                       | _____ |
| Swaybar heimjoint jamb-nut, front       | 35                 | 4                       | _____ |
| Trailing arms, rear                     | 120                | 4                       | _____ |
| Watts link arm bolts, inner & outer     | 80                 | 4                       | _____ |
| Brake rotor mounting bolts (Coleman/AP) | 20                 | 32                      | _____ |
| Drive shaft U bolts                     | 35                 | 2                       | _____ |
| Diff. Chunk mounting nuts               | 35                 | 10                      | _____ |
| Wheel lug nuts                          | 90                 | 20                      | _____ |

See maintenance section for torque specifications according to bolt grade.

## Seat Installation

Because of differences in driver's size these instructions should be used as a general guideline only.

- A:** Place seat tray inside of car.
- B:** Place a 2"x6" board inside the tray.
- C:** Set seat on top of 2"x6"
- D:** Sit in seat and using 1" and/or 2" boards to achieve a comfortable height and angle.
- E:** Once comfortable with seat location mark the seat so it's angle can be recreated outside the car.
- F:** Remove seat, boards and seat tray and recreate angle and height according to your markings.
- G:** Clamp seat to seat tray and using a 3/8" drill bit, drill bolt holes.
- H:** Install bolts from outside of seat to inside of seat. (Use spacers/washers as required)
- I:** Place seat back in the car. Now is a good time to route your lap belts through the seat.
- J:** Confirm seat location and fasten seat tray from the bottom up.
- K:** Don't forget to attach the fifth point of your harness.



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# Driver Feedback

|                                                    |                |
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| <b>Crew Chief's Communication Responsibilities</b> | <b>.....13</b> |
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## **Driver Feedback at the Track**

Often times, one of the most misunderstood practices at the track is proper communication. Some racers wear all the hats at the track; driver, crew chief and mechanic. In some cases these racers have an advantage, their communication is on a more personal level. This section deals with communicating what the race car is doing on the track, in order to make the proper adjustments to go fast. It is important for the driver and the crew chief to understand each other. For the “do all” racer this section may be helpful in bringing thoughts to the front of your mind to solve driveability or handling issues.

The first step in communication is understanding the personality of the other person. What are they telling me or how will they react to my comments. In all cases ego's must be put aside. It's not about who is right or wrong, it's about understanding the situation and making adjustments to fix it. Communication skills between the crew chief the driver are essential for proper adjustment of the suspension. They must create a comfortable language so that each understand what the other is describing.

## **The Crew Chief's Communication Responsibilities**

- A:** Make it easy for the driver to provide clear and informative feedback.
- B:** The driver must be comfortable and satisfied with the cornering of the car so the crew chief should accept the driver's feedback “as is” and try to understand the driver's interpretation of the car's actions. Simply put, if the driver doesn't like the way the car is cornering then something must be done to correct it.
- C:** Build the driver's confidence by accepting their comments and making the necessary changes to make the driver more comfortable.
- D:** The driver may have trouble communicating what the car is doing. It's the crew chief's job to interpret the driver's description and adjust the car even if the driver's description is different than the real problem. If the driver keeps repeating the same thing and you still don't understand, diplomatically ask him/her to re-word the feedback.

**E:** Ask the driver several questions about his/her feedback. Ignore any emotion or ego and intently listen for quality responses.

**F:** Suggest other optional chassis changes that address the driver's feedback.

**G:** Each driver has a personal style and a chassis set-up that works for one driver may not work for another. Adapt to your driver instead of making your driver adapt to the car.

**H:** Discuss and agree on the terminology of each part of the corners and straights so you're each talking about the same area.

## **Driver's Communication Responsibilities**

**A:** Pay attention to how the car feels in each part of each corner. Avoid using too much emotion. Be specific about the car's cornering characteristics — if your crew chief doesn't have detailed information they can't properly adjust the car.

**B:** Resist suggesting chassis changes before describing what the car is doing. Explaining the car's cornering characteristics provides the crew chief with the information they need. Making chassis suggestions may interfere with their assessment.

**C:** Be brief. Give the crew chief your feedback in short, detailed statements. Avoid telling stories or cluttering your information with scenery.

**D:** It is appropriate to offer chassis changes only after the crew chief has analyzed your feedback, tire pressure, tire temperature and related suspension settings.

**E:** Give your crew chief's advice priority. Avoid other people's advice.

## **Defining the Corner**

To help the driver and crew chief understand each other it is important that they use the same terminology. The car will do different things in different portions of a corner so here are common definitions of the corner.

### **A: Entry**

The entry is the area where the driver lifts off the throttle and begins braking. Steering input often begins at the end of braking (except in trail braking situations).

### **B: Apex**

The apex is the point when the car is at the innermost part of the corner. In road racing this is usually a little past the center of the corner (referred to as a late apex).

### **C: Exit**

The exit is where steering input is reduced and the car is at full throttle.

## **Corner Breakdown Feedback**

In order to communicate properly each section of the corner should be discussed in order. There is no benefit in worrying about the center of the corner if the car is unstable on entry. The preceding zone affects the next zone. Make sure that the car makes a good entry, hits the apex and then exits the corner well. Reconsider your adjustments if your corrective action adversely affects any preceding zone in the corner area you are addressing. There is more information on this in the Suspension section of this manual.

Again, whenever making any adjustment you must consider each corner area. Adjustments cannot upset the preceding section.

## **Common Feedback Traps**

Cars that are loose on entry nearly always push in the middle as the driver simply is unable aggressively turn the wheel at the right time. Basically, a loose entry causes the driver to miss the entire turn. There is no point making changes that deal with the middle when the car is loose at entry.

Cars that push in the middle of the turn are very likely to be loose on the corner exit. The angular momentum of the car is upset and the car travels off the exit on the wrong line due to the push in the middle. The car pushes and moves up. Upon exit the car runs out of room in the groove and often becomes loose on the late exit as the driver overturns to avoid running off the track. Many times when you loosen the car up to get a better run through the middle it will hook up better on exit.

A car that is loose on corner entry should be cured at all costs. A car that is loose on entry is uncomfortable for the driver and is very difficult to drive. The driver really has no way to adapt his line for a loose entry problem. Basically, the driver just has to slow down and ride. Cars that are loose on entry make for long day.







The Power to Reduce Friction



# Engine Tuning Guide

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## General Information

This section relays hours of track experience related to the proper tuning of your GTS engine. One of the most important things that we have learned is that the proper tuning for the engine and fuel delivery system is a critical part of engine performance and endurance. Deviating from the information presented can result in premature failure of your engine. The GTS engine is carbureted and therefore requires proper monitoring of the engine and weather conditions.

## Normal Operating Temperatures...

Water 180° F to 210° F

Oil 210° F to 240° F

These ranges depend on the ambient conditions. Temperatures higher than what is listed could indicate an improper engine tuning condition.

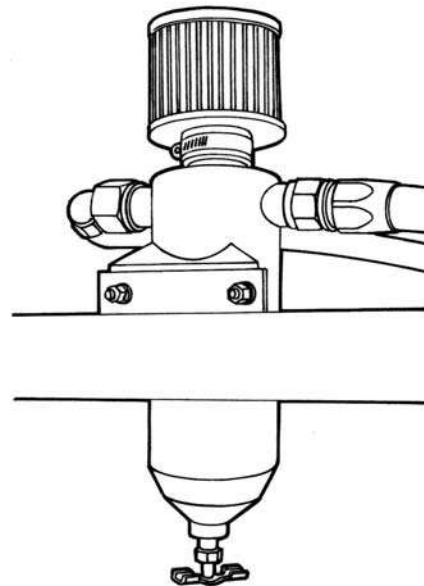
Panoz has found peak performance with the engine timing set at 34° to 36°, total advance. This must be checked with the engine RPM at 3000 or slightly above. Advancing the engine timing past 36° can create detonation. Another source for creating detonation is running the motor too lean, overheating the combustion chamber and creating a pre-ignition condition. This is not something that you can hear during a track session. It can be detected by reading the spark plug and watching oil temperatures on the track session. We contracted L&B Engine development to help us determine the proper operating conditions for the Ford 351 engine. All of the information listed in this section is related to an engine and fuel delivery system that comes with the GTS as it is delivered from the factory. The jetting information will not apply to a carburetor that has been blue printed\*. Be sure to follow the jetting guide and back up the adjustments with proper inspection. This information is presented in more detail later in this section.

Normal on-track water temperature should be 180° F to 210° F, Normal on-track oil temperature should be in the range of 210° F to 240° F, depending on the ambient condition. Temperatures higher than that could indicate an improper engine tuning condition.

\*Blue printing is allowed per SCCA A sedan rules (reference SCCA general competition rules ASCS-59D.1.a.B

## We strongly recommend the following:

- Run with leaded race gas. Most tracks have 110 leaded race fuel. You can also purchase drums to carry with you. We do NOT recommend using unleaded fuels. These fuels are oxygenated and differ from batch to batch and brand to brand. Also unleaded fuels make reading spark plugs very difficult. Even though the compression ratio is 9.5:1, we still recommend running 110 leaded race gas.
- Purchase a Holley Carburetor Jetting Kit and carburetor tools (Jet Driver and Float bowl drain cup).
- Exhaust Gas Temperature (EGT) Sensor Kit - there are a number of kits available or you can purchase unique temperature instrumentation equipment from Omega ([www.omega.com](http://www.omega.com)). EGT profiles are shown in the jetting guide listed in this document.
- Weather equipment - thermometer, barometer, altimeter and air density meter.
- Follow the tuning guide, checking it each time you run your GTS.
- Do not advance your timing more than 36° total advance.



Be sure to empty crank case breather catch can on a regular basis.

## Throttle Linkage Adjustment

Throttle linkage adjustment serves two purposes; setting the pedal height for most comfortable driving style and insuring that you are using 100% of the carburetor.

The throttle linkage includes the following parts:

- Throttle pedal
- Throttle pedal stop
- Accelerator bell crank
- Heim joint (LH thread)
- Accelerator Linkage Rod
- Heim joint (RH thread)

Anytime that the engine is removed or installed, you must check to see that your linkage is adjusted properly. Improper adjustment will cause a lack of performance (not getting full throttle) or damage to the carburetor throttle shaft due to excessive side loading.

**RECOMMENDATION: THE FUEL SHOULD BE DRAINED FROM THE FRONT AND REAR FLOAT BOWLS DURING THE THROTTLE INSPECTION PROCESS TO PREVENT FLOODING THE CYLINDERS.**

Before you adjust the throttle linkage you should first check that the secondary butterfly valves open 100% when the throttle is fully opened. Panoz does this adjustment before delivery, but it's a good idea to check it before you start racing or if you have purchased a replacement carburetor.

Begin by opening the throttle while looking into the venturies, if the secondary throttle blades don't open fully the secondary throttle linkage may need to be bent (see Figure 2 note the bent rod unlike Figure 1) to accomplish wide open throttle (throttle blades straight up and down).

## Inspection

The inspection process requires two people. It must be checked by depressing the accelerator pedal, until it hits the stop and looking into the carburetor venturies to see that the secondary throttle blades are opening 100% (straight up and down).

**NOTE: ONE PERSON INSPECTION BY PROCESS OF STROKING THE CARBURETOR LINKAGE ONLY WILL NOT ENSURE PROPER ADJUSTMENT OR OPERATION.**

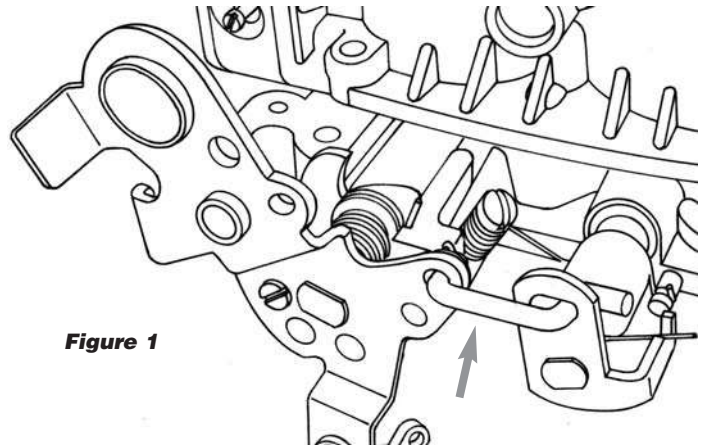


Figure 1

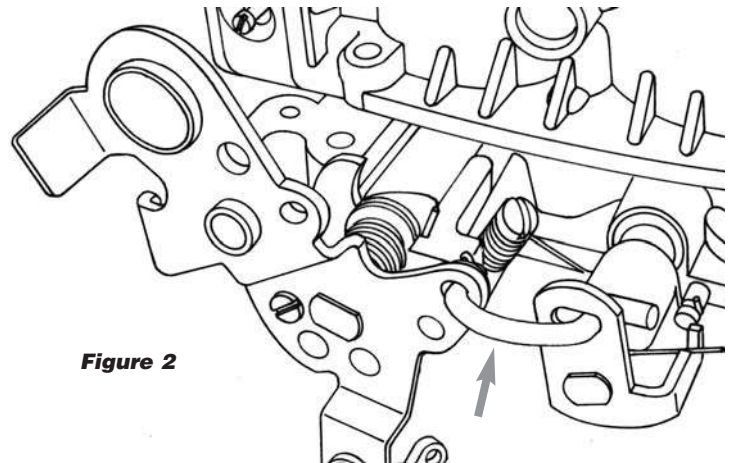


Figure 2

## Adjustment

The linkage adjustment process is a combination of lengthening or shortening the throttle rod (setting the pedal height) and adjusting the pedal stop to ensure that carburetor is not getting over stroked.

At the same time the pedal stop hits the firewall, the secondary throttle blades should just reach 100% open. Lengthen the rod and adjust the pedal stop unit you have 100% throttle valve open when when the pedal stop hits the floor

## Heel-toe pedal adjustment

In order to obtain optimum brake pedal to accelerator pedal relationship (for heel-toe braking) you may have to adjust the brake pedal height. Be sure to adjust both master cylinder push rods equally to avoid changing your brake bias. (Refer to the Brake System Chapter for more information.)



## **Tuning the Panoz GTS V-8**

The Panoz GTS engine was tested to determine operating parameters for best power and safe operation. We adjusted timing and jetting to find best power with three different fuels. The information was obtained through dyno testing and may vary from results on the track. Use this information as a guide, but watch your engine carefully (plugs, EGT and performance) while you learn exactly what your motor wants. We cannot assume responsibility for problems.

In general, more fuel and less spark advance are safer for your engine. WE STRONGLY RECOMMEND STANDARD 110 OCTANE LEADED RACE FUEL FOR BEST POWER AND ENGINE DURABILITY.

## **Test Conditions**

All tests were done with these components and settings:

- Ignition Timing - 36° BTDC @ 4000 RPM (best power with least advance)
- Spark Plugs- Motorcraft AGSF-32C
- Carb - Testing was conducted with a stock Holley 4779C carb. The choke assembly was removed, but the airhorn was left intact.

## **Carburetor Jetting**

Page 21 is a summary of how to use jetting charts. Three charts (pages 24-26) are provided, one for each fuel tested. The charts are intended for easy use with just a thermometer and the track altitude, or a barometer.

Barometer- If you have a barometer, you don't need track altitude. The barometer must be **UNCORRECTED**, that is it must be calibrated to read 29.92"Hg with standard conditions at sea level. The US Weather Service uses corrected barometer readings at weather stations, meaning the barometers are calibrated to read 29.92" for conditions standard to the weather station altitude.

**Vapor Pressure-** The chart is used to determine water vapor pressure. Estimate the relative humidity to select the proper row of the chart : Use 0% for crisp dry weather, 50% for average days and 100% for extremely humid, hazy or rainy day.s. Use the outside air temperature (not CAT) to select the column. Read the water vapor pressure from the chart, extrapolating as needed. Greater accuracy is possible with a portable weather station, but this simple chart works quite well with a little experience.

**Barometric Pressure-** Subtract the chart water vapor number from your barometer reading. Use this number in the “Barometric Pressure” row at the bottom of the jetting chart to find the proper column for jetting.

## **Barometric Pressure = Barometer Reading - Vapor Pressure**

### **Carburetor Jetting**

**A:** Using a weather station, determine barometric pressure and corrected altitude.

**B:** Refer to jetting chart provided.

### **Changing Carburetor Jets**

**A:** There are (4) 5/16” bolts on the front and (4) 5/16” bolts on the rear fuel bowls.

**B:** Remove front bowl using a jetting tool (a short large blade flat-head screwdriver will work) Remove existing jets.

**C:** Replace with desired jets.

**D:** Inspect float bowl gaskets for damage, or excessive wear. (Replace as required)

**E:** Re-Install fuel bowl, making sure accelerator pump operating lever is located under pump override spring.

**F:** Repeat steps on the secondary floats and jets.

**G:** DO NOT over tighten fuel bowls (This can crack or cut the gaskets).

**HINT:** Write jet numbers on top of fuel bowls with a paint pen for quick reference.

**H:** Check fuel pressure and set float level. See carburetor adjusting section on page 22.

### **Determining Jet Size**

Quick and easy method

**A:** Determine the altitude of the racetrack.

Topographical maps for the entire US are available free on the web at [www.topozone.com](http://www.topozone.com).

**B:** Measure the outside air temperature.

**C:** Read jetting chart for correct fuel. (Match column with track altitude. Match row with air temperature. Read the correct jets off the chart. Extrapolate as needed. Go richer when in doubt).

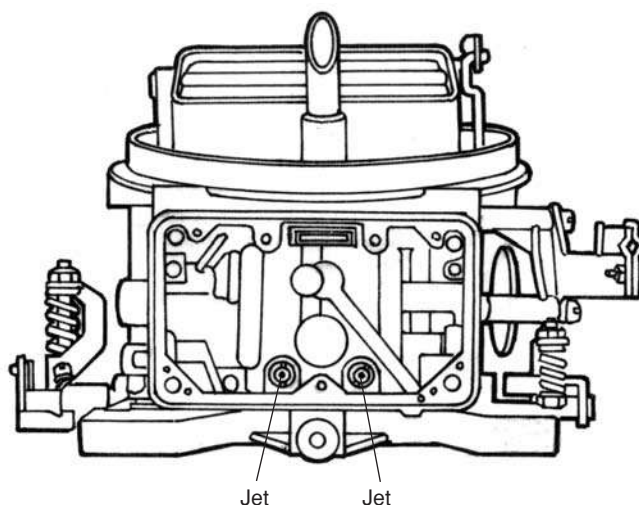
**D:** If it's over 80° and extremely humid, go one size smaller on all jets.

Example- It's 90° out, average humidity and the barometer reads 28.5”. We are using 110 leaded fuel.

Refer to Vapor Pressure chart below. Assume 50% humidity and 90°. By extrapolation, vapor pressure is 0.75” Barometric Pressure=28.5 - 0.75 = 27.75” Refer to 110LL jetting chart. Select 74 front jets and 79 rear jets.

### **Vapor Pressure (in. Hg)**

|                   |      | Temperature (F) |      |      |
|-------------------|------|-----------------|------|------|
|                   |      | 60°             | 80°  | 100° |
| Relative Humidity | 100% | 0.5"            | 1.0" | 2.0" |
|                   | 50%  | 0.25"           | 0.5" | 1.0" |
|                   | 0%   | 0"              | 0"   | 0"   |





## Exhaust Gas Temperature (EGT)

EGT was measured at the end of a long dyno pull, with three different fuels. Thermocouple probes were located in the exhaust primary tubes 1.5" from the heads. These numbers should be comparable to what you will see at the end of a long straight section of track. Note how the cylinders are numbered on the GTS Ford V8:

### Sunoco 94 Pump Fuel

Front of engine

|             |             |
|-------------|-------------|
|             | cyl 1 1386° |
| cyl 5 1092° | cyl 2 1235° |
| cyl 6 1320° | cyl 3 1195° |
| cyl 7 1319° | cyl 4 1290° |
| cyl 8 1232° |             |

### Sunoco Standard 110 Leaded Race Fuel

Front of engine

|             |             |
|-------------|-------------|
|             | cyl 1 1351° |
| cyl 5 1045° | cyl 2 1179° |
| cyl 6 1229° | cyl 3 1119° |
| cyl 7 1265° | cyl 4 1242° |
| cyl 8 1204° |             |

### 100LL Aviation Fuel

Front of engine

|             |             |
|-------------|-------------|
|             | cyl 1 1346° |
| cyl 5 1258° | cyl 2 1182° |
| cyl 6 1182° | cyl 3 1140° |
| cyl 7 1251° | cyl 4 1234° |
| cyl 8 1193° |             |

## Tools & Parts

The following jet kits and tools can be purchased at:

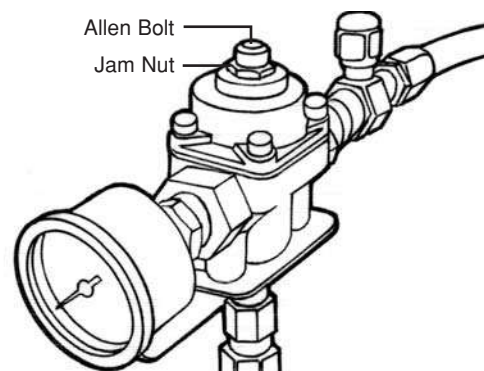
Jeg's High Performance  
751 East 11th Avenue  
Columbus, OH 43211  
(800) 345-4545

- Holley Jet Kit part# 510-36-181
- Moroso Drain Cup (float bowl) part# 710-65805
- Mr. Gasket Jet Driver part# 720-8016 or Jet Tool
- Jet Driver part# 710-62293

## Carburetor Adjusting

**A:** Check for wide open throttle (set pedal heights for proper heel/toe). Adjust for wide open throttle with throttle rod.

**B:** Adjust the fuel pressure regulator (while cold) using an allen wrench and a 5/8" wrench; adjust fuel pressure to 7 PSI. If pressure does not change with adjustment you may have a defective fuel pressure regulator. Start motor and let idle while making fuel pressure adjustment



**C:** Using a large blade flat head screwdriver, remove fuel bowl sights.

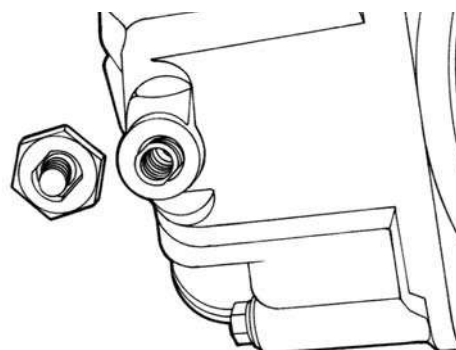
**D:** Place rags under fuel bowl sights.

**E:** Again, with a large blade flat head screwdriver and a 5/8" wrench, set fuel bowl level to the bottom of bowl sights.

**F:** Re-install bowl sight plugs.

**G:** Set idle at 900 - 1000 RPM's.

**Note:** If the levels are not changing with adjustments; turn the motor off and remove locking screws and lift adjusting nut. The bottom of the adjusting nut is D-shaped. If the float adjusting valve goes down too far, turn it back up enough to allow adjusting nut to catch (usually 1/8"). Replace locking screw and begin adjusting process again.

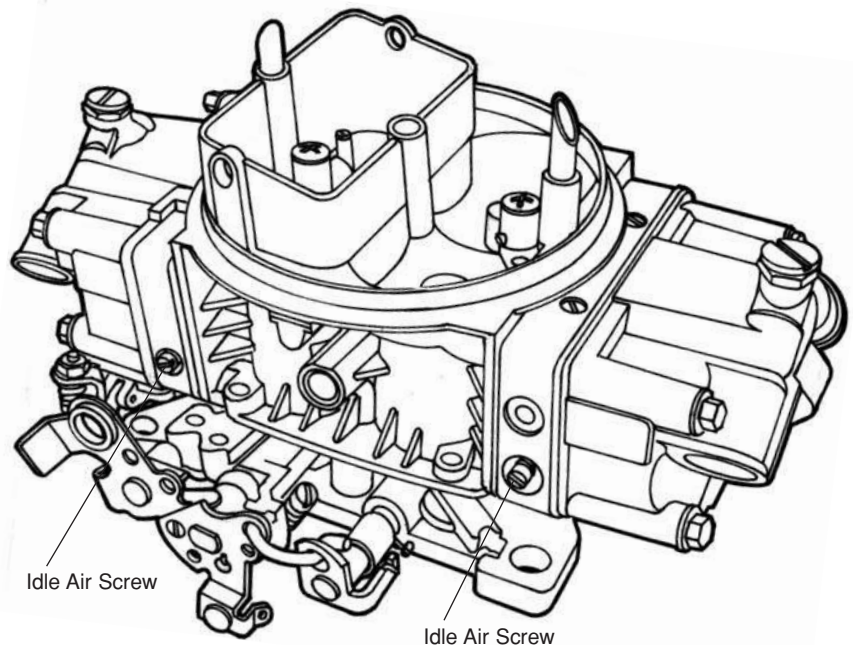
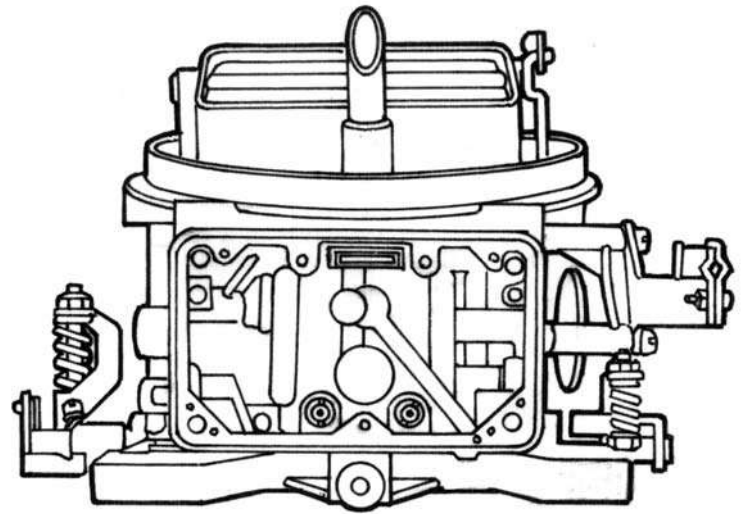
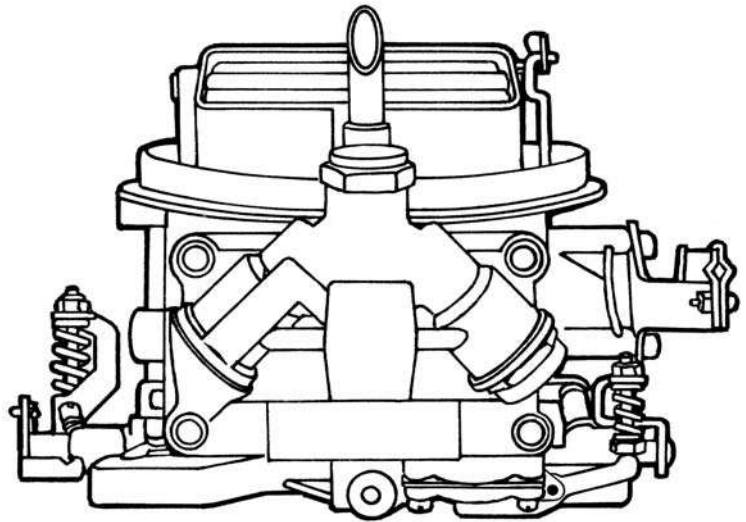




## **Idle Air and Air Screw Adjustment:**

The objective for adjusting the idle air mixture is to keep the car running properly and not load up during idle and low speed conditions. It can also effect on/off throttle operation on the track. The goal is to create the cleanest idle with the least amount of fuel. Some people are able to perform this adjustment by listening to the motor, while making adjustments. We will describe the process using a vacuum gauge. There are 4 air bleed screws on the carburetor. 2 on the front metering block and 2 on the back metering block.

- 1.** Remove the vacuum rubber plug from under the front float bowl, and install the vacuum gauge hose to the vacuum nipple.
- 2.** Warm engine up to operating temperature.
- 3.** If this is the first time that you have done this procedure or if it is a new carburetor, turn the rear air bleed screws all the way in (clockwise). Then turn them back out 1/2 turn.
- 4.** Read and know where the vacuum needle is reading. We are not so concerned with the exact numerical value, as we are with obtaining the maximum vacuum with the least amount of fuel.
- 5.** From either side, while watching the gauge, slowly turn the air bleed screw clockwise until the vacuum starts to go down. The engine may stumble a little. Then slowly turn the screw out until you have reached peak vacuum.
- 6.** Repeat for the other side.
- 7.** Go back and forth for fine adjustment.
- 8.** Move to the rear bleed screws and slowly turn them in (clockwise) until vacuum drops, then back out to peak vacuum. The rear is usually more sensitive than the front, requiring smaller adjustments.
- 9.** Repeat on other side.





Ambient Air Temp

## Quaker State – Recommended fill for the GTS

### Panoz GTS JETting – Sunoco 94 Octane Pump Gas (v.2) NOT RECOMMENDED

|       | Altitude                        |    |       |    |         |    |         |    |         |    |         |    |         |    |         |    |
|-------|---------------------------------|----|-------|----|---------|----|---------|----|---------|----|---------|----|---------|----|---------|----|
|       | -1000 ft                        |    | 0 ft  |    | 1000 ft |    | 2000 ft |    | 3000 ft |    | 4000 ft |    | 5000 ft |    | 6000 ft |    |
| 40°F  | 85                              | 85 | 84    | 84 | 82      | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 76      | 76 | 75      | 75 |
|       | 91                              | 91 | 89    | 89 | 87      | 87 | 86      | 86 | 84      | 84 | 83      | 83 | 81      | 81 | 80      | 80 |
| 50°F  | 85                              | 85 | 83    | 83 | 81      | 81 | 80      | 80 | 78      | 78 | 77      | 77 | 76      | 76 | 74      | 74 |
|       | 90                              | 90 | 88    | 88 | 86      | 86 | 85      | 85 | 83      | 83 | 82      | 82 | 80      | 80 | 79      | 79 |
| 60°F  | 84                              | 84 | 82    | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 76      | 76 | 74      | 74 | 73      | 73 |
|       | 89                              | 89 | 87    | 87 | 86      | 86 | 84      | 84 | 82      | 82 | 81      | 81 | 79      | 79 | 78      | 78 |
| 70°F  | 83                              | 83 | 81    | 81 | 80      | 80 | 78      | 78 | 77      | 77 | 76      | 76 | 74      | 74 | 73      | 73 |
|       | 88                              | 88 | 86    | 86 | 85      | 85 | 83      | 83 | 82      | 82 | 80      | 80 | 79      | 79 | 78      | 78 |
| 80°   | 82                              | 82 | 81    | 81 | 79      | 79 | 78      | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 73      | 73 |
|       | 87                              | 87 | 86    | 86 | 84      | 84 | 82      | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 77      | 77 |
| 90°F  | 81                              | 81 | 80    | 80 | 78      | 78 | 77      | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 72      | 72 |
|       | 86                              | 86 | 85    | 85 | 83      | 83 | 82      | 82 | 80      | 80 | 79      | 79 | 78      | 78 | 77      | 77 |
| 100°F | 81                              | 81 | 79    | 79 | 78      | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 73      | 73 | 72      | 72 |
|       | 86                              | 86 | 84    | 84 | 82      | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 77      | 77 | 77      | 77 |
| 110°F | 80                              | 80 | 78    | 78 | 77      | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 72      | 72 | 72      | 72 |
|       | 85                              | 85 | 83    | 83 | 82      | 82 | 80      | 80 | 79      | 79 | 78      | 78 | 77      | 77 | 76      | 76 |
| 120°F | 79                              | 79 | 78    | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 73      | 73 | 72      | 72 | 71      | 71 |
|       | 84                              | 84 | 83    | 83 | 81      | 81 | 80      | 80 | 79      | 79 | 77      | 77 | 77      | 77 | 76      | 76 |
| 130°F | 79                              | 79 | 77    | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 72      | 72 | 71      | 71 | 71      | 71 |
|       | 83                              | 83 | 82    | 82 | 80      | 80 | 79      | 79 | 78      | 78 | 77      | 77 | 76      | 76 | 76      | 76 |
| 140°F | 78                              | 78 | 76    | 76 | 75      | 75 | 74      | 74 | 73      | 73 | 72      | 72 | 71      | 71 | 71      | 71 |
|       | 83                              | 83 | 81    | 81 | 80      | 80 | 78      | 78 | 77      | 77 | 77      | 77 | 76      | 76 | 75      | 75 |
|       | 31.05                           |    | 29.92 |    | 28.83   |    | 27.79   |    | 26.78   |    | 25.81   |    | 24.87   |    | 23.97   |    |
|       | Barometric Pressure (inches Hg) |    |       |    |         |    |         |    |         |    |         |    |         |    |         |    |

#### Key:

|            |             |
|------------|-------------|
| Left Front | Right Front |
| Left Rear  | Right Rear  |

Left = Driver's Left

# Panoz Esperante GTS

RVP – Reliability / Value / Performance



The Power to Reduce Friction



Ambient Air Temp

## Quaker State – Recommended fill for the GTS

### Panoz GTS Jetting – 100LL Aviation Gas (v.2) NOT RECOMMENDED

|       | Altitude                        |    |       |    |         |    |         |    |         |    |         |    |         |    |         |    |
|-------|---------------------------------|----|-------|----|---------|----|---------|----|---------|----|---------|----|---------|----|---------|----|
|       | -1000 ft                        |    | 0 ft  |    | 1000 ft |    | 2000 ft |    | 3000 ft |    | 4000 ft |    | 5000 ft |    | 6000 ft |    |
| 40°F  | 85                              | 85 | 84    | 84 | 82      | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 77      | 77 | 75      | 75 |
|       | 89                              | 89 | 87    | 87 | 85      | 85 | 84      | 84 | 82      | 82 | 81      | 81 | 79      | 79 | 78      | 78 |
| 50°F  | 85                              | 85 | 83    | 83 | 82      | 82 | 80      | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 74      | 74 |
|       | 88                              | 88 | 86    | 86 | 85      | 85 | 83      | 83 | 82      | 82 | 80      | 80 | 79      | 79 | 77      | 77 |
| 60°F  | 84                              | 84 | 82    | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 76      | 76 | 75      | 75 | 74      | 74 |
|       | 87                              | 87 | 85    | 85 | 84      | 84 | 82      | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 77      | 77 |
| 70°F  | 83                              | 83 | 82    | 82 | 80      | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 74      | 74 | 73      | 73 |
|       | 86                              | 86 | 85    | 85 | 83      | 83 | 82      | 82 | 80      | 80 | 79      | 79 | 77      | 77 | 76      | 76 |
| 80°   | 82                              | 82 | 81    | 81 | 79      | 79 | 78      | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 73      | 73 |
|       | 85                              | 85 | 84    | 84 | 82      | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 77      | 77 | 76      | 76 |
| 90°F  | 82                              | 82 | 80    | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 73      | 73 |
|       | 85                              | 85 | 83    | 83 | 82      | 82 | 80      | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 75      | 75 |
| 100°F | 81                              | 81 | 79    | 79 | 78      | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 73      | 73 | 73      | 73 |
|       | 84                              | 84 | 82    | 82 | 81      | 81 | 79      | 79 | 78      | 78 | 77      | 77 | 76      | 76 | 75      | 75 |
| 110°F | 80                              | 80 | 79    | 79 | 77      | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 73      | 73 | 72      | 72 |
|       | 83                              | 83 | 82    | 82 | 80      | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 75      | 75 | 75      | 75 |
| 120°F | 79                              | 79 | 78    | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 73      | 73 | 73      | 73 | 72      | 72 |
|       | 82                              | 82 | 81    | 81 | 79      | 79 | 78      | 78 | 77      | 77 | 76      | 76 | 75      | 75 | 74      | 74 |
| 130°F | 79                              | 79 | 77    | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 73      | 73 | 72      | 72 | 72      | 72 |
|       | 82                              | 82 | 80    | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 75      | 75 | 75      | 75 | 74      | 74 |
| 140°F | 78                              | 78 | 77    | 77 | 75      | 75 | 74      | 74 | 73      | 73 | 73      | 73 | 72      | 72 | 71      | 71 |
|       | 81                              | 81 | 79    | 79 | 78      | 78 | 77      | 77 | 76      | 76 | 75      | 75 | 74      | 74 | 74      | 74 |
|       | 31.05                           |    | 29.92 |    | 28.83   |    | 27.79   |    | 26.78   |    | 25.81   |    | 24.87   |    | 23.97   |    |
|       | Barometric Pressure (inches Hg) |    |       |    |         |    |         |    |         |    |         |    |         |    |         |    |

#### Key:

|            |             |
|------------|-------------|
| Left Front | Right Front |
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# Panoz Esperante GTS

RVP – Reliability / Value / Performance



The Power to Reduce Friction



Ambient Air Temp

## Quaker State – Recommended fill for the GTS

### Panoz GTS Jetting – Sunoco Standard Leaded 110 Octane RECOMMENDED

|       | Altitude                        |    |       |    |         |    |         |    |         |    |         |    |         |    |         |    |
|-------|---------------------------------|----|-------|----|---------|----|---------|----|---------|----|---------|----|---------|----|---------|----|
|       | -1000 ft                        |    | 0 ft  |    | 1000 ft |    | 2000 ft |    | 3000 ft |    | 4000 ft |    | 5000 ft |    | 6000 ft |    |
| 40°F  | 82                              | 82 | 81    | 81 | 79      | 79 | 78      | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 72      | 72 |
|       | 87                              | 87 | 86    | 86 | 84      | 84 | 83      | 83 | 81      | 81 | 80      | 80 | 78      | 78 | 77      | 77 |
| 50°F  | 81                              | 81 | 80    | 80 | 78      | 78 | 77      | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 72      | 72 |
|       | 87                              | 87 | 85    | 85 | 83      | 83 | 82      | 82 | 80      | 80 | 78      | 78 | 77      | 77 | 76      | 76 |
| 60°F  | 81                              | 81 | 79    | 79 | 78      | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 72      | 72 | 71      | 71 |
|       | 86                              | 86 | 84    | 84 | 83      | 83 | 81      | 81 | 80      | 80 | 78      | 78 | 77      | 77 | 76      | 76 |
| 70°F  | 80                              | 80 | 78    | 78 | 77      | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 71      | 71 | 71      | 71 |
|       | 85                              | 85 | 83    | 83 | 82      | 82 | 80      | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 75      | 75 |
| 80°   | 79                              | 79 | 78    | 78 | 76      | 76 | 75      | 75 | 73      | 73 | 72      | 72 | 71      | 71 | 70      | 70 |
|       | 84                              | 84 | 83    | 83 | 81      | 81 | 80      | 80 | 78      | 78 | 77      | 77 | 76      | 76 | 75      | 75 |
| 90°F  | 78                              | 78 | 77    | 77 | 76      | 76 | 74      | 74 | 73      | 73 | 71      | 71 | 71      | 71 | 70      | 70 |
|       | 83                              | 83 | 82    | 82 | 80      | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 75      | 75 | 74      | 74 |
| 100°F | 78                              | 78 | 76    | 76 | 75      | 75 | 74      | 74 | 72      | 72 | 71      | 71 | 70      | 70 | 70      | 70 |
|       | 83                              | 83 | 81    | 81 | 80      | 80 | 78      | 78 | 77      | 77 | 76      | 76 | 75      | 75 | 74      | 74 |
| 110°F | 77                              | 77 | 76    | 76 | 74      | 74 | 73      | 73 | 72      | 72 | 71      | 71 | 70      | 70 | 69      | 69 |
|       | 82                              | 82 | 80    | 80 | 79      | 79 | 77      | 77 | 76      | 76 | 75      | 75 | 74      | 74 | 74      | 74 |
| 120°F | 76                              | 76 | 75    | 75 | 74      | 74 | 72      | 72 | 72      | 72 | 70      | 70 | 70      | 70 | 69      | 69 |
|       | 81                              | 81 | 80    | 80 | 78      | 78 | 77      | 77 | 76      | 76 | 75      | 75 | 74      | 74 | 73      | 73 |
| 130°F | 76                              | 76 | 74    | 74 | 73      | 73 | 72      | 72 | 71      | 71 | 70      | 70 | 69      | 69 | 69      | 69 |
|       | 80                              | 80 | 79    | 79 | 78      | 78 | 76      | 76 | 75      | 75 | 74      | 74 | 74      | 74 | 73      | 73 |
| 140°F | 75                              | 75 | 74    | 74 | 72      | 72 | 71      | 71 | 70      | 70 | 70      | 70 | 69      | 69 | 68      | 68 |
|       | 80                              | 80 | 78    | 78 | 77      | 77 | 76      | 76 | 75      | 75 | 74      | 74 | 73      | 73 | 73      | 73 |
|       | 31.05                           |    | 29.92 |    | 28.83   |    | 27.79   |    | 26.78   |    | 25.81   |    | 24.87   |    | 23.97   |    |
|       | Barometric Pressure (inches Hg) |    |       |    |         |    |         |    |         |    |         |    |         |    |         |    |

#### Key:

|            |             |
|------------|-------------|
| Left Front | Right Front |
| Left Rear  | Right Rear  |

Left = Driver's Left

## SPARK PLUG TECH TALK

Panoz recommends when installing spark plugs to use a torque wrench and the correct torque in ft.-lbs. listed below. If a torque wrench is not available, hand tighten the plug until it is seated in the cylinder head. Spark plugs with gaskets should be tightened an additional 90°. Spark plugs with tapered seats should be tightened an additional 15°.

**NOTE:** Avoid over tightening or under tightening as spark plug or engine damage may result.

### Thread Size

10MM WITH GASKET  
12MM WITH GASKET  
14MM WITH GASKET  
14MM TAPERED SEAT  
18MM WITH GASKET  
18MM TAPERED SEAT

### Torque FT.-LBS:

8-11  
12-15  
19-22  
12-15  
20-23  
14-17

(if anti-seize material is used, reduce the torque recommendations by 30%).

## IMPORTANT, PLEASE READ

Plugs must be tightened with a torque wrench. Failure to sufficiently seat the plug in the engine spark seat will likely result in one or more of the following:

Damaged spark plug (melting of electrodes, separation of the insulator from the shell, discoloration of shell and terminal nut), burnt spark plug wire and severe engine damage. Avoid over torquing of the spark plug which will result in plug damage (insulator can become loose and center electrode can melt).

Make sure cylinder head plug threads are free of carbon deposits — if necessary “chase” threads with a cleaning tool.

## INSTALLATION TIPS

To avoid problems later, it is always wise to check that the plug has the correct reach for the engine and that the gasket is in place during installation (see figure 1). However, some plugs do not require a gasket (see figure 2). These are usually plugs with a conical (or tapered) seat. When installing these plugs, it is important that the mating surfaces are clean and that you do not over torque the plug. If a plug is installed without a gasket, excessive heating and pre-ignition may occur due to poor heat transfer and blow-by of combustion gasses. Also, the threads will project in the combustion chamber and become filled with residue making removal difficult. On the other hand, if two gaskets are used, residue will collect in the exposed cylinder threads. This will make the next installation of the correct plug extremely difficult. The same conditions occur when installing a plug with incorrect reach.



Figure 1



Figure 2



## **Spark Plug Analysis**

(Reference plug image chart on page 29)

### **1-2: Normal**

This is a normal looking spark plug. The insulator tip is greyish white, but could also be greyish yellow to brown. This indicates that the engine is in good operating condition and that the heat range of the plug is correct.

### **3-4: Carbon Deposit**

The velvet-like, dull black carbon deposits on the insulator, electrodes and shell can be caused by any of the following: incorrect mixture, dirty air filter, faulty automatic choke, too cold of a spark plug or extreme stop-and-go driving conditions. To remedy this situation, make appropriate mixture adjustments, replace the air filter or use a hotter spark plug in the case of extreme stop-and-go driving conditions.

### **5-6: Oil Fouled**

The wet, shiny deposits are oil. This excessive quantity of oil can result from worn cylinders, piston rings or valves. In a two-stroke engine, it indicates an oil mixture that is too rich. To correct this problem, repair and/or replace the worn parts. In either case, new spark plugs should be installed.

### **7-8: Lead Deposit**

The yellow insulator deposits are from fuel additives containing lead. With higher loads the deposit will become conductive and can cause misfiring. New plugs should be installed, because cleaning is ineffective.

### **9-10: Severe Lead Deposit**

The brownish tint in the yellow glazed deposit is a combination of carbon and lead from fuel and oil additives. They accumulate on the insulator nose during slow driving conditions and then melt when the vehicle begins hard acceleration. As the plug cools, the deposits solidify. Once again, cleaning and sandblasting are useless; install new plugs.

### **11-12: Ash Deposits**

The brownish, cinder-like deposits on the electrodes and insulator are ash residues from oil and gas additives. The alloying additives leave an unburnable ash in the combustion chamber and on the spark plug. In serious cases, it may be necessary to decarbonize the combustion chamber before installing new spark plugs.

### **13: Partially Melted Center Electrode**

A melted electrode, with a white and/or blistered insulator tip indicates incorrect heat range or insufficient installation torque. Note: If the insulator has separated from the shell and the shell is discolored, insufficient installation torque is the cause. If the shell is not discolored over torquing is the cause. Spark plug misfiring will occur and engine damage can result. A thorough tune-up should be performed, and the appropriate plug application heat range should be verified before installing any new spark plugs.

### **14: Melted Center Electrodes**

The melting of the center electrode is the result of abnormal combustion; for example, knocking or over-advance ignition timing. Misfiring will occur. Power loss and possible engine damage can result. A thorough tune-up with new plugs is necessary.

### **15: Partially Melted Electrodes**

A melted ground electrode can be caused by pre-ignition. Pre-ignition can result from hot spots in the combustion chamber, over-advanced ignition timing, lean air/fuel mixtures, defective distributor advance mechanisms, deposits in the combustion chamber, defective cylinder head or manifold gaskets. To avoid pre-ignition, a thorough tune-up is required before installing new spark plugs.

### **16: Center Electrode Erosion**

This erosion is caused by not observing replacement intervals. Misfiring and poor starting behavior will result. Install new spark plugs.

### **17: Ground Electrode Erosion**

This electrode erosion was the result of aggressive fuel and oil additives. It was further aggravated by unfavorable gas turbulence in the combustion chamber caused by heavy deposits. This is not a heat range problem. Effects include hard starting and hesitation on acceleration. Install new spark plugs.

### **18: Insulator Nose Breakage**

This damage is from impact, drop or pressure on the center electrode. If the plug has been used for too long, the insulator nose can be cracked by deposits between the center electrode and the insulator and from corrosion of the center electrode. New spark plugs should be installed.





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# Maintenance

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**Service Maintenance Intervals .....32**  
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**Hardware and Torque Specifications .....34**  
**Radiator fill procedure .....35**

## ***Periodic Maintenance Schedule***

This schedule is meant to be a guide, and is not meant to replace regular inspection. All components should be inspected before and after EVERY race for signs of wear, fatigue or damage. We suggest you make copies of the torque checklist included in this book to help you establish a pre race checklist. A space will be provided throughout the maintenance schedule for you to list the type of service part or brand and weight of fluid to be used. There will also be a space for you to list an alternate schedule time if you find that this guide does not meet or exceeds the needs of your car and driving style.

### ***Part ; Service Life; Brand or Type***

- Engine oil; 10hrs. Quaker State - 5w 40 F/S or 5w 50 F/S
- Engine oil filter; 10hrs. Motorcraft FL-1HP
- Transmission fluid; 20 hrs. Quaker State F/S GLH
- Fuel filter; 10hrs. Disassemble and clean with carburetor cleaner (back of car— brass)
- Clean air filter; 10 hrs. Clean and recharge with K&N kit.
- Rear diff. fluid; 20 hrs. Quaker State F/S GLS
- Rear diff. filter; 20 hrs. Disassemble and clean with parts cleaner.
- Power steering fluid; 20 hrs. Red Line power steering fluid
- Belts and hoses; Inspect after every run
- Bleed brakes; Every race, use Brembo 600 or equivalent (Do not mix)
- Brake pads and rotors; Inspect after every run
- Shocks; 40 hrs. Shocks must be sent to Panoz/Penske to be rebuilt and resealed.
- Springs; No service life has been determined. Periodic inspection and testing recommended.
- Steering components; Check torques and inspect for wear after every race. Some components are spec. marked and must be obtained from Panoz Auto Development.
- Front suspension components; Check torques and inspect for wear after every track event. Some components are spec. marked and must be obtained from Panoz Auto Development.
- Bleed clutch hydraulics; DOT3 550° F every event
- Rear suspension components; Check torques and inspect for wear after every track event. Some components are spec. marked and must be obtained from Panoz Auto Development.
- Drive line; Motor, Transmission, Rear diff. Check all related components and hardware for your wear or damage and proper torques after every track event.
- Wheel bearings; 20-30 hours bearings should be repacked using a high temp. synthetic grease.
- Electrical connections; All electrical connections, both positive and negative should be checked before every race to be tight and free of corrosion.
- Body fasteners; Check all body hardware for tightness before every track event. Snug only- do not over tighten
- Accessories; Check lights, mirrors, wipers and additional components for proper operation before each track event
- Zerk fittings; Zerk fittings are provided on the upper control arms and universal joints, these fittings require greasing after each weekend of racing.

## Service Maintenance Intervals

● = Minimum    ◇ = Recommended    ◆ = Inspect

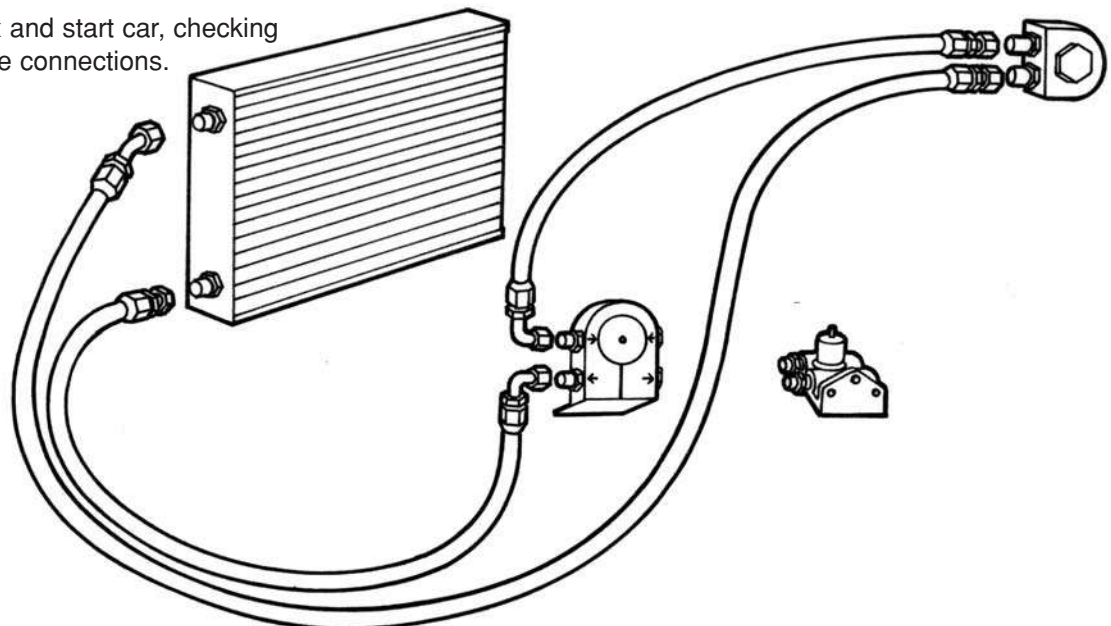
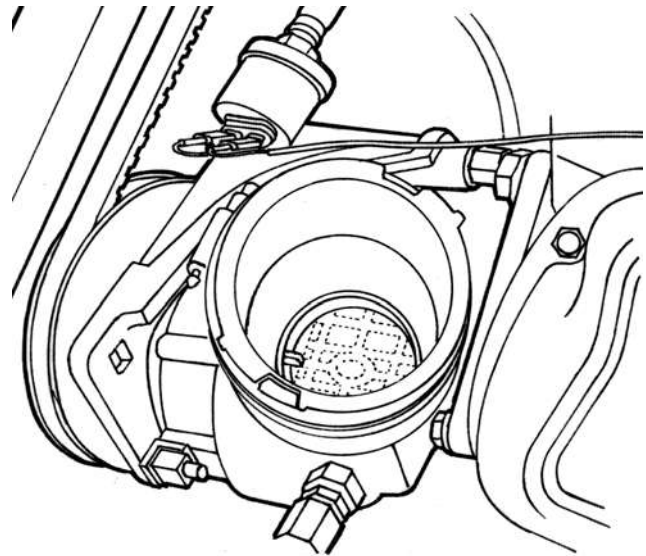
| Service Item                | Track Events |   |   |   |   |   |   | Hours of Operation |                                        |    |    |    |    |    |     |
|-----------------------------|--------------|---|---|---|---|---|---|--------------------|----------------------------------------|----|----|----|----|----|-----|
|                             | Every >>     | 1 | 2 | 3 | 4 | 5 | 6 | 10                 | 20                                     | 30 | 40 | 50 | 60 | 80 | 100 |
| <b>Brakes</b>               |              |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Bleed Brakes                | ◇            |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Caliper Rebuild             |              |   |   |   |   |   |   |                    |                                        |    |    |    | ●  |    |     |
| Brake Pads                  | ◆            |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Brake Rotors                | ◆            |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| <b>Driveline</b>            |              |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Engine Oil & Filter         |              | ● |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Transmission Oil            |              |   | ● |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Differential Oil            |              |   |   | ● |   |   |   |                    |                                        |    |    |    |    |    |     |
| Power Steering Fluid        |              |   |   |   |   | ● |   |                    |                                        |    |    |    |    |    |     |
| Cooling System              |              |   |   |   |   |   |   |                    |                                        |    |    |    | ●  |    |     |
| <b>Filters</b>              |              |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Air Filter                  |              | ◇ | ● |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Crank Case Breather         |              | ◇ | ● |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Differential Catch Can      |              | ◇ | ● |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Rebuild                     |              |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Engine Rebuild              |              |   |   |   |   |   |   |                    |                                        |    |    |    | ◇  |    |     |
| Transmission Rebuild        |              |   |   |   |   |   |   |                    |                                        |    |    |    | ◇  |    |     |
| Differential                |              |   |   |   |   |   |   |                    |                                        |    |    |    |    |    | ◆   |
| <b>Suspension</b>           |              |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Shock Rebuild*              |              |   |   |   |   |   |   |                    |                                        |    | ◇  |    |    |    |     |
| Suspension Link Connections | ◆            |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| <b>Body</b>                 |              |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Body Fasteners              | ◇            |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| <b>Safety</b>               |              |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |
| Seat Belts                  | ◆            |   |   |   |   |   |   |                    | Replace every two years                |    |    |    |    |    |     |
| Fuel Cell                   | ◆            |   |   |   |   |   |   |                    | Have tested every year after two years |    |    |    |    |    |     |
| Fire Bottle                 | ◆            |   |   |   |   |   |   |                    |                                        |    |    |    |    |    |     |

## Oil Change

- A:** Place car on jack stands.
- B:** Remove 2 (two) drain plugs from oil pan. (3/4"), front sump and rear sump.
- C:** Remove oil filter.
- D:** Remove lower oil cooler line from oil remote.
- E:** Allow system to completely empty.
- F:** Re-install drain plugs and reconnect lower oil cooler line.
- G:** Fill oil filter with oil; 3/4-1 full quart-Install filter (rub a thin film of oil over the filter gasket).
- H:** Remove upper oil cooler line from oil remote filter adapter.
- I:** The next step can be time consuming unless you have access to an oil pump system.
- J:** After removing line from remote; start pouring new oil back into cooler. You will need at least 1 1/2 quarts; ideally 2 full quarts.
- K:** Filling the oil filter and oil cooler will ensure proper lubrication throughout the system.
- L:** Now fill motor accordingly. Six more quarts of oil will take you to your nine quart total requirement.
- M:** Be sure the oil dipstick has a mark on it. Do not rely on the standard markings on the dipstick. You will want to mark the dipstick yourself.
- N:** Now prime motor by disconnecting MSD box and turning motor over until oil pressure comes up. (5 second intervals- do not overheat starter motor).
- O:** Reconnect MSD box and start car, checking for leaks and/or loose connections.

## Power Steering Fluid Level

Before delivery Panoz Auto Development modifies the power steering pump reservoir to increase expansion capacity. Fluid level should be just over the plastic filter screen. There is no dipstick to check the power steering fluid level so we use the screen as a reference. Over filling the power steering pump will cause the fluid to expand and leak out of the housing and causing a potential fire hazard or oiling your tires or brakes.



## Hardware and Torque Specifications

When working with the hardware (bolts, nuts, screws, etc...) it is important to know the proper use and torque specifications. Nyloc nuts cannot be re-used and should be replaced after use. All of the nuts and bolts on your GTS are US Standard sized with the exception of the Brembo brake system parts which uses Metric hardware. Bolts come in several grades depending on tensile strength needs. The bolt grade is indicated on the head using short lines pointing towards the center of the bolt head. Except for a grade 2 bolt (which has no such lines) the number of lines determines the bolt grade. Grade 5 bolts have 3 lines and grade 8 bolts have 6 lines. See the chart below for respective tensile strengths and torques.

## Torque Charts

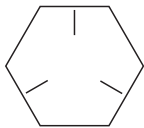
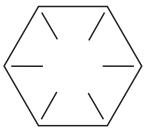
### NUT AND BOLT FASTENER ASSEMBLY

| Diameter<br>(inches) | Grade 5<br>lubricated |      | Grade 5<br>dry |      | Grade 8<br>lubricated |      | Grade 8<br>dry |      |
|----------------------|-----------------------|------|----------------|------|-----------------------|------|----------------|------|
|                      | Coarse                | Fine | Coarse         | Fine | Coarse                | Fine | Coarse         | Fine |
| 1/4                  | 5                     | 9    | 6              | 10   | 12                    | 14   | 12             | 14   |
| 5/16                 | 10                    | 17   | 12             | 20   | 24                    | 27   | 25             | 25   |
| 3/8                  | 19                    | 31   | 21             | 35   | 44                    | 49   | 45             | 50   |
| 7/16                 | 30                    | 50   | 33             | 56   | 70                    | 78   | 70             | 80   |
| 1/2                  | 45                    | 75   | 51             | 85   | 105                   | 120  | 110            | 120  |
| 9/16                 | 66                    | 110  | 72             | 120  | 155                   | 170  | 150            | 170  |
| 5/8                  | 90                    | 150  | 100            | 170  | 284                   | 323  | 220            | 240  |
| 3/4                  | 160                   | 265  | 180            | 300  | 510                   | 568  | 380            | 420  |
| 7/8                  | 260                   | 430  | 285            | 475  | 813                   | 902  | 600            | 660  |
| 1                    | 390                   | 645  | 435            | 720  | 905                   | 1030 | 900            | 1000 |
| 1-1/8                | 480                   | 800  | 540            | 900  |                       |      |                |      |
| 1-1/4                | 670                   | 1120 | 745            | 1240 |                       |      |                |      |
| 1-3/8                | 880                   | 1470 | 1000           | 1670 |                       |      |                |      |
| 1-1/2                | 1170                  | 1950 | 1320           | 2200 |                       |      |                |      |

\* Recommended torque foot-pounds for lubricated fastener assembly (waxed nuts, anti-seize lubricants, etc.).

\*\* Recommended torque foot-pounds for clean, dry, unlubricated fastener assembly.

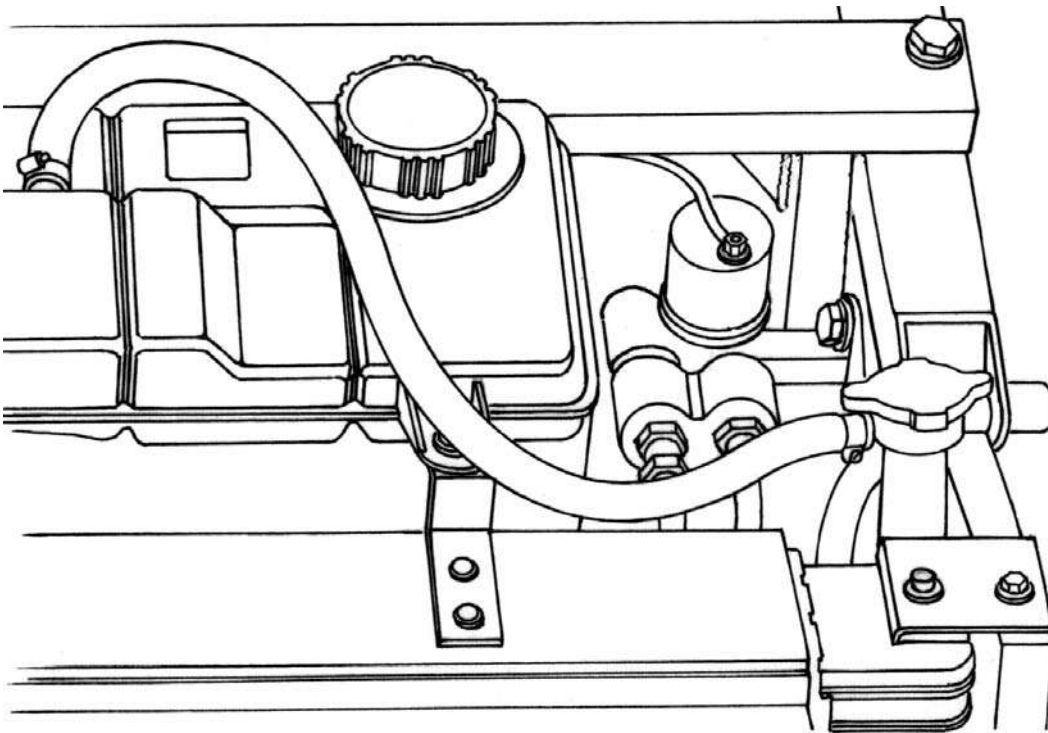
## Cap Screw Grade

|                                      |                                                                                     |                                                                                     |
|--------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                                      |  |  |
| Grade                                | <b>Grade 5</b>                                                                      | <b>Grade 8</b>                                                                      |
| P.S.I. Tensile Strength <sup>+</sup> | 120,000                                                                             | 150,000                                                                             |

<sup>+</sup> Pounds per square inch of holding power

## **Radiator Fill Procedure**

- 1.** Confirm all hose clamps and water jacket fittings are tight.
- 2.** Remove the radiator cap and coolant reservoir cap.
- 3.** First fill through radiator neck, letting it drain down.
- 4.** Once the radiator is full, continue filling through the coolant reservoir bottle (add Red Line Water Wetter).
- 5.** Start the motor and observe water temperature closely. **WATCH FOR AIR POCKETS IN THE COOLING SYSTEM.**
- 6.** After the motor has run for a period of time and there is no movement on the temperature gauge, feel the left (driver's side) of the radiator, if it is cold, turn the motor off and carefully open the cap on the radiator neck, more than likely there is an air pocket.
- 7.** When you remove the radiator cap, there may not be water in the neck.
- 8.** Slowly open the coolant reservoir cap, the water should start to flow up the radiator.
- 9.** Re-install the cap when the water reaches the top.
- 10.** Continue filling through the coolant reservoir bottle. **DO NOT OVER FILL - YOU MUST ALLOW ROOM FOR EXPANSION.**
- 11.** Restart the engine and continue observing the water temperature.
- 12.** Turn the cooling fan on when the water temperature reaches 200° F. Cycle fan operation between 180° F and 200° F.





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Engine

**Engine Removal .....37**  
**Engine Installation .....37**  
**Ignition Distributor .....38**  
**Oil Line Routing .....38**

## Engine Removal

- A:** Place car on jack stands.
- B:** Disconnect battery.
- C:** Drain oil, transmission fluid, water, and power steering fluid.
- D:** Disconnect oil lines, water lines, power steering lines, and brake ducts.
- E:** Remove water reservoir and upper chassis cross-brace, oil temperature sensor, water temperature sensor, and motor ground.
- F:** Remove front bumper/crush box clip (This is the four 5/8" nuts with the 5/16" allen-head bolts).
- G:** Once the front clip is out of the way, remove drive shaft, transmission tunnel, remote shifter, switch panel, and starter.
- H:** Disconnect crank case breather lines, fuel lines, air cleaner, and carburetor. (Tape over the intake so nothing can fall down into it).
- I:** Install intake plate.
- J:** Remove headers.
- K:** Remove 5/8" bolts from transmission crossmember.
- L:** Remove clutch line and clutch slave from motor.
- M:** Hook the engine lift to the intake plate.
- N:** Remove motor mount nuts.
- O:** Lift motor out of car (Be careful on the oil remote to power steering pump clearance).
- P:** Be careful, making sure not to damage anything.

## Engine Installation

- A:** When installing the engine, three people helping would be best: one person to operate the engine lift, one person to direct the engine into the bay and one person inside the car to guide the transmission into place.
- B:** Install accessories, fittings & sensors.
- C:** Power steering pump, belts (check for proper alignment), flywheel, clutch, throw-out bearing, refer to clutch torque specifications, clutch slave brackets, bell housing with clutch fork and adjustable pivot ball, transmission and oil filter remote.
- D:** Before installing engine into the car, write down all of your Panoz Seal Numbers: timing cover, intake, transmission and valve covers.

- E:** Once the engine and transmission are set into place, install the locknuts and washers onto the engine mounts.
- F:** Install transmission crossmember bolts, drive shaft and safety loop.
- G:** Install engine ground (to bellhousing), starter and clutch slave.
- H:** Remove intake plate and tape. Install carburetor spacer and carburetor and connect fuel line to carburetor.
- I:** Install headers and exhaust system.
- J:** Install crank case breathers (valve covers).
- K:** Install oil and water temperature sensors.
- L:** Connect wiring for the fan, distributor, and alternator.
- M:** Install plumbing, oil lines, power steering lines and water reservoir.
- N:** Be sure to re-check wide open throttle on carburetor. See page 18 for procedure
- O:** Fill fluids, transmission, water, power steering, and oil. When filling the oil, it may be necessary to mark the new oil dipstick. Put two quarts of oil in cooler, one quart in the oil filter and six quarts in the engine (Refer to oil change on page 33).
- P:** Install transmission tunnel, shifter and switch panel.
- Q:** Turn ignition on to energize fuel pump, set fuel pressure and float bowls on carburetor (refer to carburetor tuning section page 22).
- R:** Fill engine with coolant being careful not to overfill (Refer to page 35 for procedure).
- S:** Prime the engine (disconnect MSD box and turn the engine over in five second intervals until oil pressure is achieved).
- T:** While you are priming the engine you will need to continue to fill power steering fluid (fill to just above filler neck screen).
- U:** Before firing the engine double check all belts, hoses and fasteners to make sure nothing is leaking or rubbing, and coolant level.
- V:** Re-connect MSD box and fire engine.
- W:** While running you need to tune the carburetor (set idle, fuel pressure, etc refer to page 22-23 for carburetor adjustment procedure). Check timing.

## Ignition Distributor

The MSD 85805 distributor is legal for competition. The unit has given us reliable performance and durability.

**IMPORTANT:** Installation of this unit requires that you purchase a steel or bronze gear, which must be pressed on. This is required to work with material properties of the roller cam. Failure to install the proper gear will result in engine failure.

## Panoz part numbers

GTS2 - 3042 MSD Distributor MSD-85805

GTS2 - 3043 MSD Distributor Steel Gear

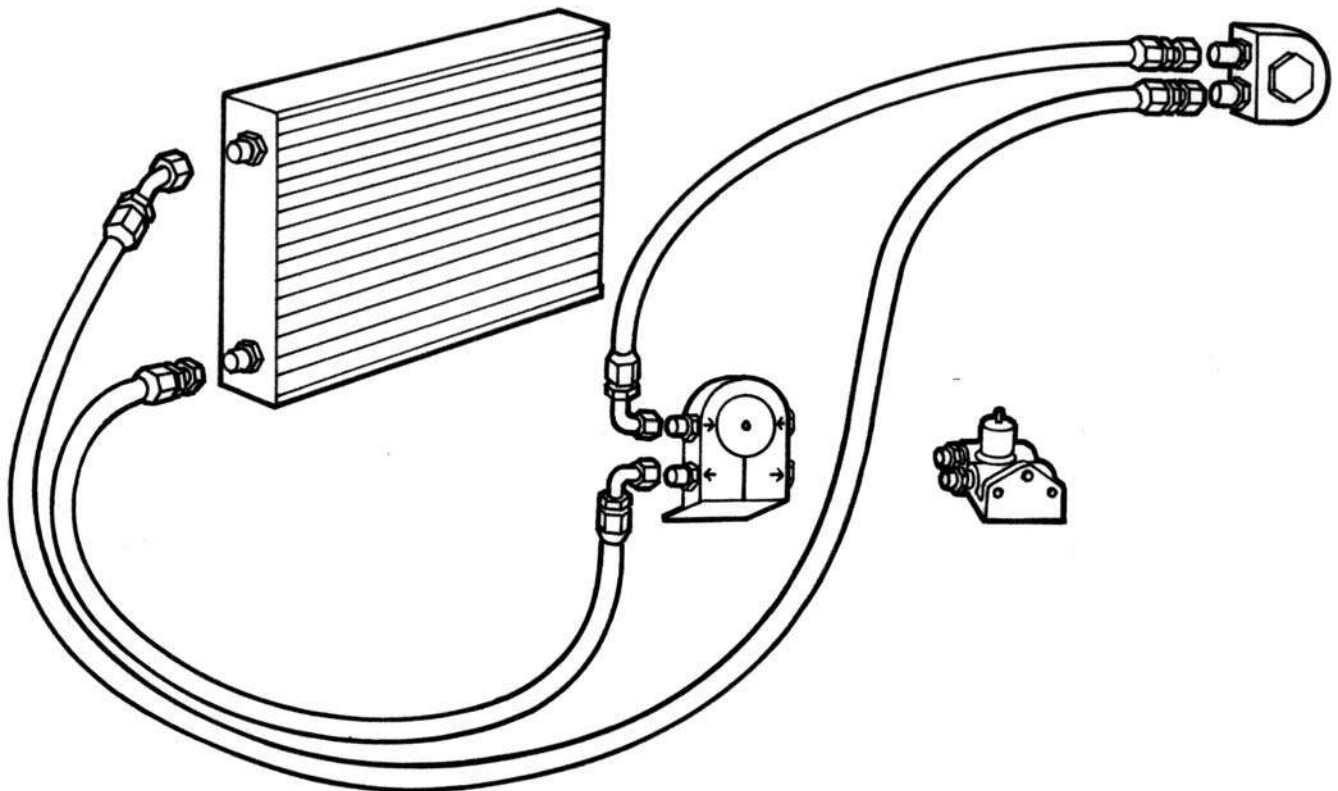
(Refer to MSD instructions for proper installation)  
IMPROPER INSTALLATION OF GEAR WILL CAUSE  
PREMATURE WEAR ON DISTRIBUTOR AND  
CAM GEAR.

If you have any questions or require additional information, please call your local CSR or Panoz Auto Development.

## Oil Line Routing

FOR THE SAFETY OF YOUR ENGINE it is important to plumb your oil system properly. The diagram below shows the proper oil line routing. Failure to plumb the system as described in this document will lead to premature failure of your motor. Improperly plumbed systems will show oil pressure on the gauge, because of the location of the sensor. Do not let this fool you.

THE ROUTING IS AS FOLLOWS: Oil exits the engine from the top port of the oil filler adapter (mounts to the engine) and goes to the inlet of the filter adapter (arrows show inlet direction). From the adapter the line goes to the bottom port of the oil cooler. The line from the top port of the oil cooler goes to the bottom port of the engine oil adapter.





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Driveline

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**Clutch Pedal Adjustment ..... 41**

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**Clutch Bleed ..... 45**

**Transmission Fluid Change ..... 46**

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## Clutch Slave Free Play Adjustment

This section is a caution to keep in mind when installing and adjusting the clutch slave, with the Quarter Master Clutch Assembly. It applies to you if you have the Quarter Master Aluminum Clutch and Flywheel Assembly and/or an external clutch slave.

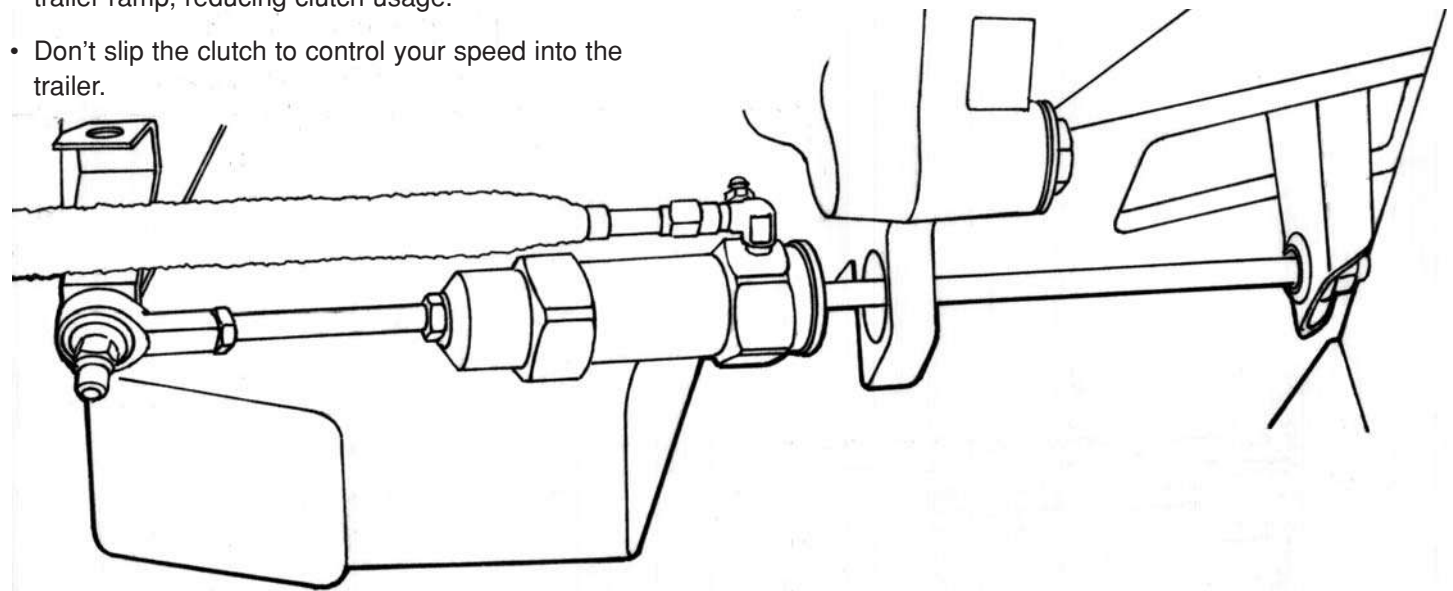
It is important to the life of your clutch that you install the clutch slave allowing 1/8" of clutch fork free play (fore and aft) travel. The adjustment is made at the clutch fork using the jam nut at the end of the clutch slave rod. This should relate to slightly less than the 0.100 gap between the pressure plate springs and throw out bearing that Quarter Master recommends. The up and down movement is irrelevant. A properly adjusted clutch will give hours of trouble free performance.

**WARNING:** THIS IS A CRITICAL ADJUSTMENT. IF THERE IS NO FORE AND AFT FREE PLAY IN THE CLUTCH FORK YOU WILL EXPERIENCE PREMATURE CLUTCH WEAR OR FAILURE AND POSSIBLE ENGINE WEAR (THIS WARNING COMES FROM EXPERIENCE)!

One more clutch saving tip...

Pulling your car into the trailer is usually the hardest part of a race weekend, as far as your clutch goes. If possible do the following;

- Winch it into the trailer
- Try to maintain slow constant speed while on the trailer ramp, reducing clutch usage.
- Don't slip the clutch to control your speed into the trailer.



## Clutch Pedal Adjustment

The GTS is equipped with a clutch pedal stop, mounted in the chassis firewall. This must be properly adjusted to prevent over stroking and over pressure on the clutch assembly. The best way to adjust this, after bleeding the clutch slave circuit, is...

1. Raise the car off the ground.
2. Put the car in gear (DO NOT START THE CAR)
3. Have someone try to turn the driveshaft, while you stroke the clutch pedal.
4. As soon as the driveshaft is allowed to spin, adjust the pedal stop to that point.
5. You can add up to 1/8" more if it is difficult to drive when cold or if you are having engagement or disengagement issues (the system will feel better as it is heated up from driving).



## Quarter Master Clutch Installation

Please familiarize yourself with the tools and procedures discussed in these instructions before beginning the clutch installation. Please remember that these instructions are only a guide for the person performing the repairs and should only be taken as a guide. There are many items which may change during the production cycle of an automobile that may change the tools needed or procedures required for this clutch installation. Quarter Master recommends this installation should take place at a professional installation/service shop.

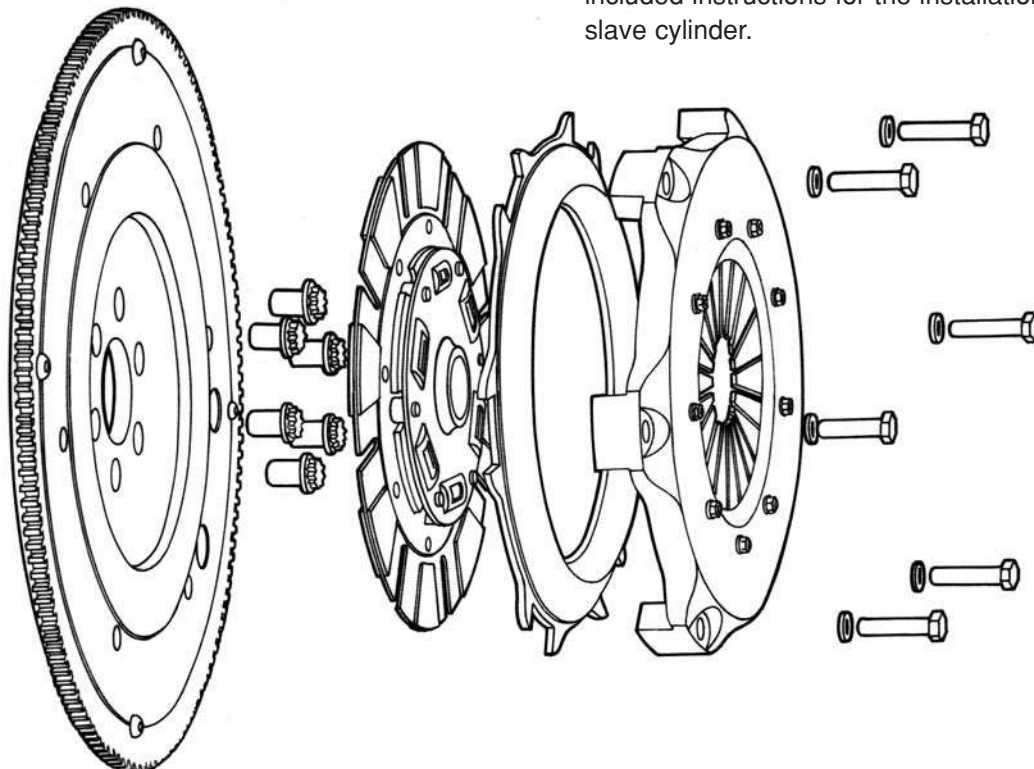
Tools needed for installation:

- Safety glasses
- 3/8" and/or 1/2" ratchet
- Socket set, metric and fractional ranging from 10mm-15mm and 3/8"-3/4"
- Combination wrench set, metric and fractional
- Air impact wrench preferably 1/2"
- Floor jack
- Transmission jack (if available)
- 3/8" or 1/2" torque wrench
- Several extensions for the ratchets/impacts
- Rubber mallet or dead blow hammer

- Screwdriver set
- Jack stands with a minimum rating of 2 tons each
- Drop light
- Scotch-brite or hand wire brush
- Lock-tite Blue (optional)
- Mechanic's creeper or equivalent
- Silicone spray lubricant
- High pressure or extreme pressure grease
- Optional items not included in kit:
- Transmission fluid
- Transmission end plug
- Anti-seize
- Hi-temp automotive grease

This clutch replacement should take approximately 3-4 hours to accomplish, preferably with two people to move around, and remove/replace the transmission. We strongly recommend using an impact wrench, many of the bolts may be stuck and an impact wrench will help enormously.

If the clutch installation is to be done by a service shop, please bring this set of instructions prior to installation, this will eliminate any potential problems during installation. This clutch is not compatible with the McCloud internal slave cylinder so we have included instructions for the installation of an external slave cylinder.



## Clutch/Bellhousing Removal

ALWAYS WEAR SAFETY GLASSES WHEN REMOVING/INSTALLING COMPONENTS UNDER THE VEHICLE

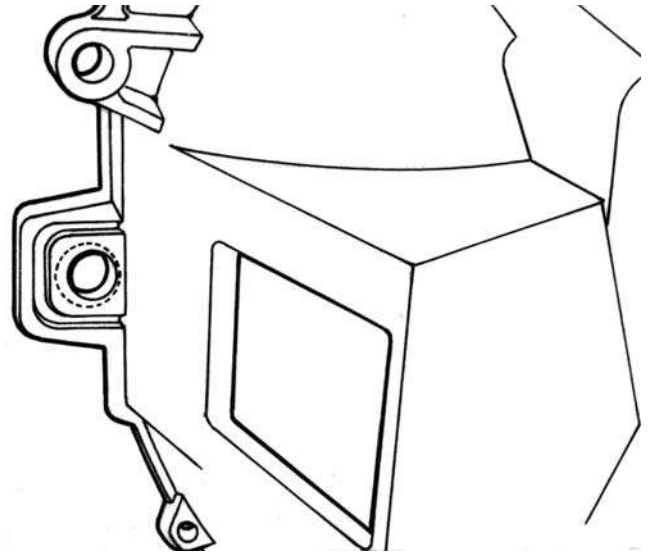
There are a couple of ways to remove the transmission. One is from the underside of the vehicle, the other is to remove it from inside the passenger compartment. This procedure describes the latter.

- 1.** Properly lift and support the front and rear of the car for clearance to all underside components.
- 2.** Disconnect the negative (-) cable from the battery. The battery can be easily accessed by removing the right rear wheel
- 3.** Once the vehicle is securely supported, remove switch panel. Make sure the shifter is in the neutral position. Remove two 1/2" bolts from remote shifter linkage
- 4.** Remove the transmission tunnel.
- 5.** Drain transmission fluid and properly discard the used fluid.
- 6.** Remove four 1/2" universal joint u-bolt nuts. Slide driveshaft back out of transmission and put it to the side.
- 7.** If you have an internal slave cylinder, remove hydraulic line at the bell housing.
- 8.** If you have an external clutch slave, remove the jam nuts from the end of the slave, at the clutch fork.
- 9.** Remove two 5/8" bolts where the transmission mounts to the cross member.
- 10.** Loosen four 5/8" bolts that hold transmission to bell housing. Do not remove them as they will hold the transmission in place so you can brace it. Take the transmission jack and properly place it under the transmission and slowly raise the jack to support the transmission, do not put a lot of pressure on the transmission, just enough to support it. If you do not have a transmission jack, then have your partner get in the passenger side of the car and slowly remove all four bolts, have you or your partner hold up the rear of the trans. When all bolts are removed, work together to slowly pull the transmission out of the bell housing. Have the person in the car set the transmission on the floor of the car.

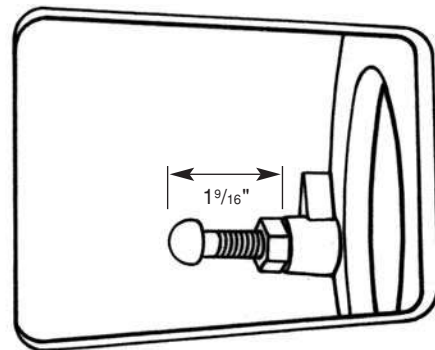
- 11.** Unbolt the starter on the lower right side of the bell housing (as you are facing the front of the car underneath). Remove the two 9/16" bolts holding the starter to the bell housing. Swing the starter out of the way and support it sufficiently.

- 12.** Remove six 5/8" bolts that hold bell housing to block, starting from the bottom to the top. If you are switching from an internal to external clutch-slave, do the follow steps 13-14 otherwise go to step 15 for internal slave removal.

- 13.** Enlarge hole in the cast tab in front of clutch fork opening to 7/8" to provide clearance for the slave cylinder rod.



- 14.** Install adjustable pivot ball to existing threaded boss inside the bell housing. Set the pivot ball to 1 9/16" from the TOP of the boss (not the bell housing surface) to the top of the ball. Any setting greater than 1 9/16 may cause hard contact between the clutch fork and the chassis firewall down tube.



## **Internal Clutch Slave:**

- 15.** If you have the internal slave cylinder, remove hydraulic throw out bearing and remove the collar from the input shaft. If it is stuck on the bearing housing, you may need to use WD-40 and pry bar to remove it.
- 16.** Remove six 1/2" bolts that hold the pressure plate and remove it and the clutch disk.
- 17.** Remove six 19mm 12 point bolts from flywheel.
- 18.** Remove pilot bearing with puller.

## **Installation:**

If you are installing a QuarterMaster aluminum clutch assembly, confirm that the flywheel counter weight is bolted to the back of the flywheel using Lock-tite blue on the supplied bolts (failure to do so can cause severe damage to engine and transmission).

- 19.** Install new pilot bearing, using a socket of the same diameter and tap it in with a hammer until seated.
- 20.** Confirm the engine separator plate/dust shield is installed. It must be installed before the flywheel. Make sure it is not bent and that it lays flat against the block.
- 21.** Re-install the new flywheel onto the crankshaft by lining up the six holes in the flywheel to the six holes on the crank. One hole is offset from the rest of the bolt pattern, so some rotation of the flywheel may be needed in order to line up all 6 holes. Apply blue (medium strength) loctite (thread lock) to the flywheel bolts and insert the bolts through the flywheel into the crankshaft and lightly tighten them down. Torque the bolts to 60-70 ft lbs, in a star pattern. Confirm that there is clearance between the flywheel counter weight bolts and the dust shield (rotate fly wheel).
- 22.** Place the clutch disc with the spring pack (taller portion) facing rearward, under the cover and pressure plate, then place the cover over the clutch disc. Rotate cover until bolt holes line up with the threaded hole in the flywheel.
- 23.** Using an alignment tool (contact Tremec or Quarter Master for tool) place the six 5/16" bolts into the holes and lightly tighten them down. In a motion similar to the installation of the flywheel, torque the cover bolts to 20 ft-lbs (use blue loc tite on bolts). Check to make sure that the alignment tool still moves in and out freely. Re-torque the bolts to insure proper torque (If the torque is not applied correctly, or the star pattern is not used, the clutch may not work properly and the life and performance will be drastically reduced.) Remove the alignment tool.
- 24.** Gently place the bell housing onto it's two alignment pins and push it until it is flush with the back of the engine. You may need to use a rubber mallet to properly seat it flush with the engine face. Then install the six 1/2" bolts and torque them to 28-38 ft lbs.
- 25.** Re-install the clutch fork by simply sliding it back over the ball stud; (make sure both sides of the fork clip are around the pivot ball back side) it should slide over with little effort. You will need to make sure that the throw-out bearing does not get knocked off of the clutch fork during this procedure.
- 26.** Re-install the transmission on the bell housing be sure the input shaft engages the clutch. Once the input shaft of the transmission has engaged the disc and is flush with the bell housing's face, replace the four bolts that hold the transmission to the bell housing. Simply hand-tighten the bolts, then torque the bolts to 28 – 38 ft lbs for Tremec TKO/3550 & 4617 transmissions.
- 27.** Re-install the starter. Tighten bolts to 15-19 ft lbs.
- 28.** Re-install the drive shaft and grease u-joints with grease gun.
- 29.** Re-install clutch slave actuating rod into clutch fork. Shim the slave cylinder mounting rod end as necessary for alignment and clearance between the rod and the bell housing through hole.
- 30.** Clutch fork should have 1/8" - 1/4" of fore and aft free play in it (Jam nuts on clutch slave should not pre-load the clutch).
- 31.** Re-fill transmission fluid (3 quarts).

- 32.** Re-install the transmission tunnel.
- 33.** Re-install the two 1/2" bolts to the remote shifter linkage.
- 34.** Follow external clutch slave installation steps.
- 35.** Set clutch pedal stop as follows
  - a.** With car Raised off the ground
  - b.** Put the car in gear (DO NOT START THE CAR)
  - c.** Have someone try to turn the driveshaft, while you stoke the clutch pedal.
  - d.** As soon as the drive shaft is allowed to spin, adjust the pedal stop to that point.
  - e.** You can add up to 1/8" more if it is difficult to drive when cold or if you are having engagement or disengagement issues (the system will feel better as it is heated up from driving).

## **External Clutch Slave Installation:**

- 1.** Install inside bracket on top of existing oil pan nuts with nyloc nuts.
- 2.** Remove rear motor mount bolt at the back of the mount.
- 3.** Re-install motor mount bolt with modified outer bracket in place.
- 4.** If you are converting from an internal slave; Modify stationary rod by shortening it by approximately 1" (adjust so clutch fork doesn't hit firewall). See illustration on page 41
- 5.** Using Teflon tape or liquid install 90° fitting to slave cylinder.
- 6.** Install bleeder valve.
- 7.** If you are converting from an internal slave; Replace hydraulic line with one from kit.
- 8.** Install slave cylinder to bracket making sure bleeder valve is pointing up.
- 9.** Install clutch rod ball behind clutch fork. Install nut and jamb nut to slider rod.
- 10.** If not already done, remove dzus fasteners and move dash out of the way.
- 11.** Loosen 1/2" bolt holding master cylinders.

- 12.** Remove two 1/2" nylocs holding clutch master cylinder.
- 13.** Unscrew push rod from clutch pedal.
- 14.** Remove hydraulic line.
- 15.** Remove master cylinder.
- 16.** Install push rod to clutch pedal.
- 17.** Install 1" master cylinder.
- 18.** Install hydraulic line.
- 19.** Re-adjust clutch stop so that pedal travels no more than 3.5".
- 20.** Bleed clutch master cylinder.
- 21.** Set pedal height and tighten jamb nut on push rod.
- 22.** Set clutch pedal stop as follows
  - f.** With car Raised off the ground
  - g.** Put the car in gear (DO NOT START THE CAR)
  - h.** Have someone try to turn the driveshaft, while you stoke the clutch pedal.
  - i.** As soon as the drive shaft is allowed to spin, adjust the pedal stop to that point.
  - j.** You can add up to 1/8" more if it is difficult to drive when cold or if you are having engagement or disengagement issues (the system will feel better as it is heated up from driving).

## **Clutch Bleed**

Very Similar to Brake Bleed Process

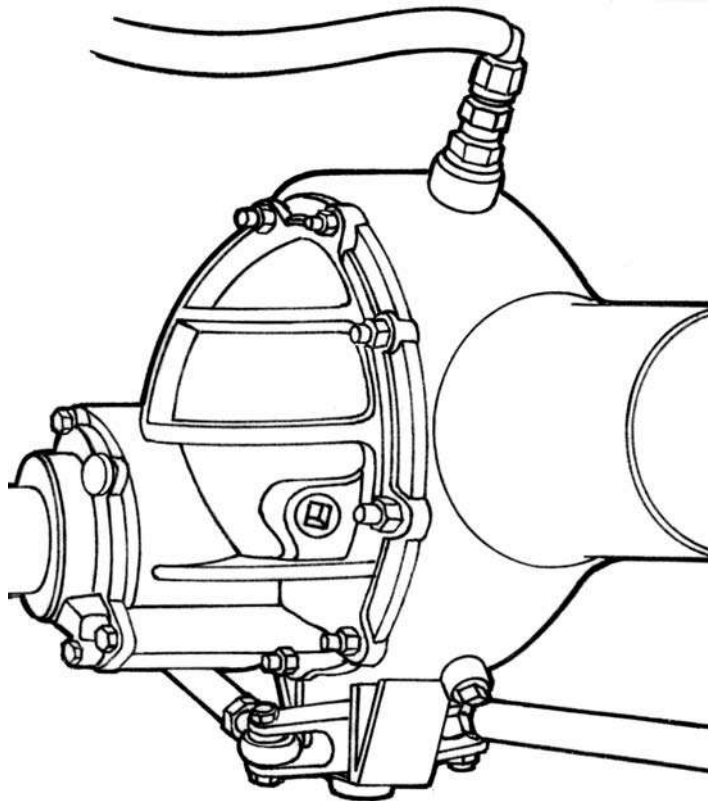
- A.** Using a 1/4" wrench, open bleeder valve while your helper pushes clutch pedal.
- B.** After fluid is flowing, close valve and have your helper continue pushing clutch full stroke.
- C.** Continue until all burnt fluid is removed from system.
- D.** After master cylinder is topped off; using a tape measure, check the amount of travel in clutch fork (1 1/8" - 1 1/4" is ideal).
- E.** Clutch fork should have 1/8" - 1/4" of free play in it (Jam nuts on clutch slave should not pre-load the clutch).

## **Transmission Fluid Change**

- 1.** Remove drain plug at the bottom of the transmission.
- 2.** Re-install drain plug.
- 3.** Loosen switch panel and move out of your way.
- 4.** Remove the two 1/2" bolts securing the shifter remote to the shifter.
- 5.** Remove the transmission tunnel.
- 6.** Remove the fill plug.
- 7.** Fill with 2.5 Quarts of Quaker State Full Synthetic 75W-90 GL-4.

## **Differential Fluid Change**

- 1.** Remove drain plug from the bottom of the differential and let fluid drain into pan.
- 2.** Re-install drain plug.
- 3.** Disconnect the differential cooler line at the top of the differential.
- 4.** Pour in three quarts of Quaker State Full Synthetic GL-5.
- 5.** Re-install cooler line.







Quaker State – Recommended fill for the GTS



The Power to Reduce Friction



# Brake System

**Brake Bleed .....49**  
**Brake Pedal Assembly & Balance Bar Adjustment .....49**  
**Bias Bar Set Up and Technical Notes .....50**  
**Setting Up the Balance Bar .....50**  
**Brake Pedal Geometry .....51**  
**Brembo Brake Disc Assembly .....51**  
**Replacing Rotors .....52**

## Brake Bleed

**A:** Set car on jack stands.

**B:** Remove wheels.

**C:** Starting with right rear; using 11mm wrench; open valve while your helper pushes brake pedal. When fluid starts to flow, close valve. Instruct your helper to NOT stroke the pedal past 1/2 of the master cylinder full stroke. When valve is closed your helper should release pedal and pull pedal up with toe. The objective is to limit brake pedal travel.

**Note:** Stroking the pedal past the normal operating range on a used master cylinder can cause premature failure of the master cylinder.

**D:** Continue until burnt fluid is gone.

**E:** Check master cylinder (top off fluid level).

**F:** Repeat process on left rear caliper.

**G:** Top off master cylinder again.

**H:** Repeat steps on front right and then front left.

**I:** Front calipers have two bleeder valves. Bleed outside valve first, then inside valve.

**J:** All cars leave the plant with Brembo Brake Fluid. If you are not using Brembo fluid, be sure to completely flush the system. DO NOT MIX FLUIDS.

**K:** From driver's seat; far left master cylinder is for the clutch, middle cylinder is for the rear brakes, and the far right cylinder is for the front brakes.

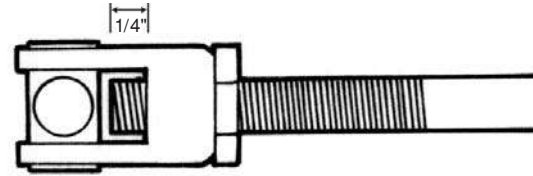
**Note:** Clutch Master cylinder size is 1", rear master cylinder size is 1", front master cylinder is 7/8"

## Brake Pedal Assembly & Balance Bar Adjustment Instructions

This specifically refers to the Panoz GTS with the Brembo Brake System (Calipers and Rotors). It does not apply to other brake configurations.

PANOZ GTS BRAKE BALANCE BAR SET UP BY PERFORMANCE FRICTION CORPORATION. SET-UP HAS BEEN OPTIMIZED FOR USE WITH PFC 97 COMPOUND PADS THROUGH EXTENSIVE TESTING.

1. Rear master cylinder pushrod length should be 1/4" shorter than the front master cylinder pushrod.

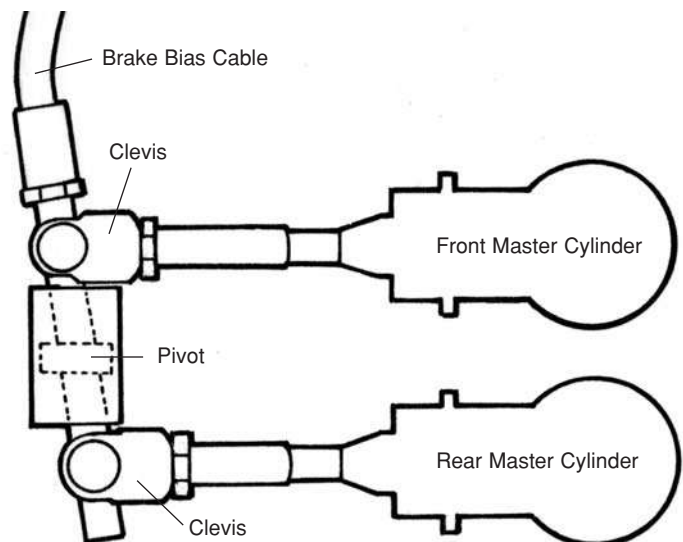


2. Rear master cylinder 1.0" (25.4mm)
3. Clevis air gap .125" (3.0mm) total
4. Brake pedal height 11.25" (286mm) measured from the apex between the floor and the footwell panels.
5. Center balance bar bearing position in brake pedal tube at rest, when using PFC 97 compound pads on current disc brand, +1.25 turns (5 clicks) of front brake.
6. Bleed front and rear circuits at the same time.

If you have a brake bias gauge set, here is a good setting to start with:

- Push the brake pedal to achieve 600 psi on the front circuit.
- The rear should read 400 psi.
- Each click of the bias control should give you approximately 20 psi change.

Make adjustments at the track for track conditions, weight distribution, and weather conditions.



### ***Bias Bar Set-up and Technical Notes***

The function of a bias bar is to allow the adjustment of brake line pressure distribution between two master cylinders. This is accomplished through moving the bias bar pivot towards one master cylinder pushrod or the other. If the pivot is perfectly centered between the pushrods, the force applied to each master cylinder will be equal. This is known as the “neutral position” of the bias adjuster. If the pivot is moved closer to one pushrod or the other then the master cylinders will receive different pressures (proportional to the distance between the bias bar pivot point and the master cylinder center lines). This adjustment gives the driver control over the braking characteristics of the car, and to alter those characteristics to account for changes in fuel load, track conditions and handling characteristics of the car.

### ***Setting Up the Balance Bar***

The balance bar is one of the most overlooked, and least understood components on almost any race car. As with all aspects of race car assembly and preparation, careful attention to geometry of the balance bar and brake pedal will yield great benefits. To start, we need to look at the proper installation of the bias bar adjuster.

First, we must insure that the bias bar pivot bearing is free to move within the pedal tube. Often this tube becomes distorted during installation. If this is the case, then the tube may be honed, until the bearing slides smoothly from one end of the tube to the other. The tube must be clean and may be lubricated with a light oil or dry Teflon spray.

Next we need to know the distance between the centerlines of the front and rear master cylinders. Typically, this is 2.5 inches, though this is not critical. What is critical is that this dimension, whatever it may be, is duplicated in the center-to center distance of the clevises threaded onto the bias bar adjuster rod. This insures that the master cylinder pushrods are actuated properly, minimizing any side loads applied the master cylinder piston and bore.

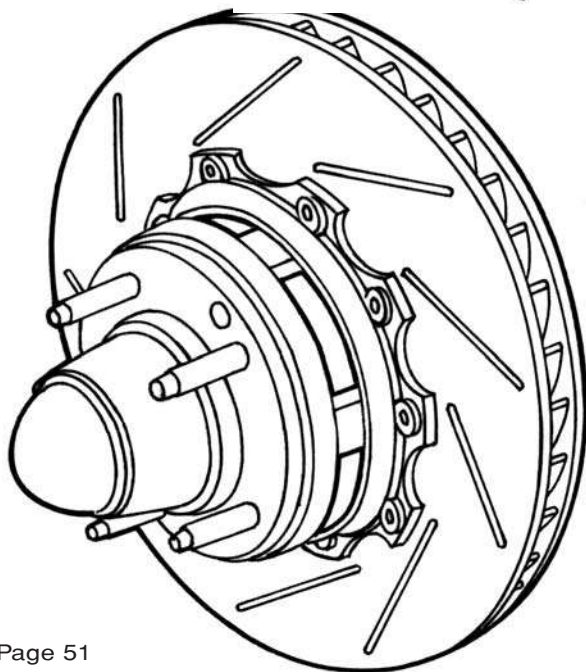
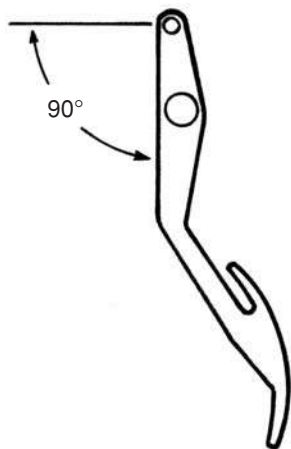
With the clevises set on the adjuster, measure the distance between them and the bias tube itself. If the clearance between each clevis and the bias tube is more than 1.5mm. then shims must be added until the proper airgap is achieved. This prevents the bias bar from shifting while on the track and altering, in an unpredictable manner, the brake bias of the car. With the bias bar connected to the master cylinders, and the brake lines connected, the brakes should be bled. It is ideal that front and rear brake circuits be bled simultaneously. This will allow both master cylinders to use their full travel and prevent binding the bias adjuster.

With the pedal tube and clevises squared away we now look at the master cylinder push rod length. The key is to set up the bias adjuster so that it is perpendicular to the master cylinder centerlines with the brake pedal under compression. Typically, this means that the front master cylinder push rod will be 3mm-5mm longer than the rear master cylinder push rod at rest. This is due to the fact that the front braking circuit has a larger fluid volume due the larger piston diameters in the front calipers. As a result, the front master cylinder requires a higher feed rate than does the rear. If push rod length is equal front and rear then the feed rate of the rear master cylinder is too high relative to the front. The result in this case is the rear circuit “hitting “ before the front. With the push rod lengths adjusted properly the bias bar will square under compression and the front and rear circuits will “hit” approximately at the same time.

There is more brake bleeding information at the beginning of this section.

## Brake Pedal Geometry

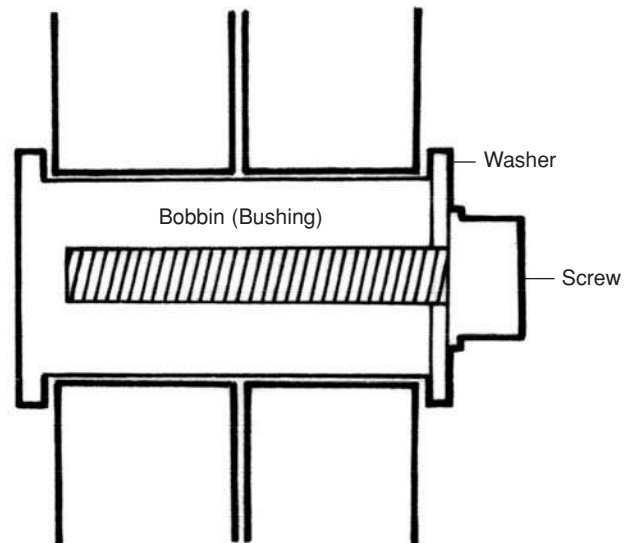
With the bias bar geometry correct we now turn our attention to the brake pedal geometry. In order for the brake system to work properly, it is important that the brake pedal get hard before it crosses the vertical plane of the brake pedal pivot. If the brake pedal crosses the vertical plane of the pedal pivot (goes “over center”) the mechanical advantage of the pedal over the push rods will be lost causing a loss of pedal feel and braking force. This can be adjusted with a separate pedal height adjuster (if available) or by lengthening both master cylinder push rods the same amount, until the desired pedal height is achieved. As a result, the throttle pedal may need to be adjusted to restore the proper “heel and toe” pedal relationship. If there is sufficient adjustment available this can be accomplished through attaching a simple spacer to the throttle pedal.



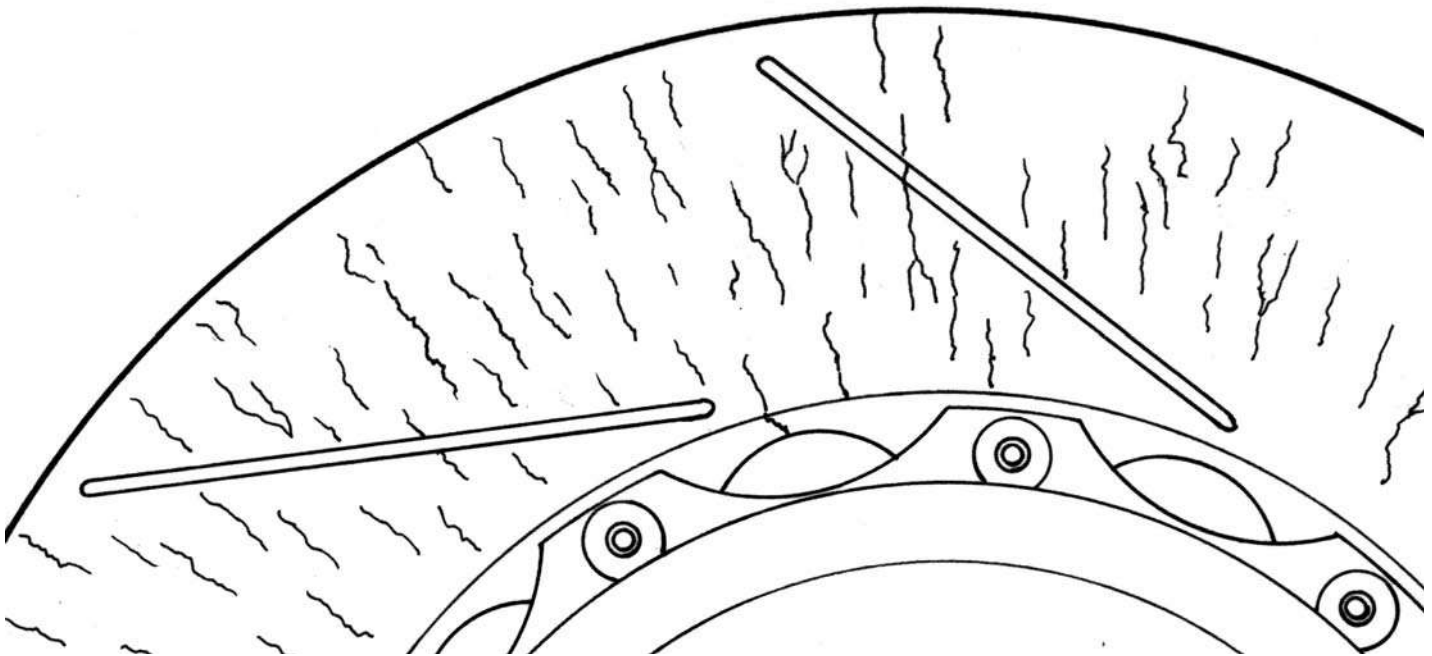
## Brembo Brake Disc Assembly

Insure that all the parts that are to be re-used are in good condition. This includes the Brembo supplied bushings, their hardware and Brembo supplied hats.

1. Brembo rotors are directional, the curved cooling slots rotate clockwise to draw hot air out of the rotor. With this in mind, GENTLY place the appropriate Brembo disc in a soft jawed vice, with the flange side facing outward (this can be done without holding the disc in a vice, but it's very difficult). Assemble two or three Brembo bushings to the Brembo front hat and disc, using the supplied AN washer under the head of the fastener. Brembo strongly recommends that that you use a dab of nickel based high temperature anti-seize compound on the threads of each fastener. This will make disassembly easier.

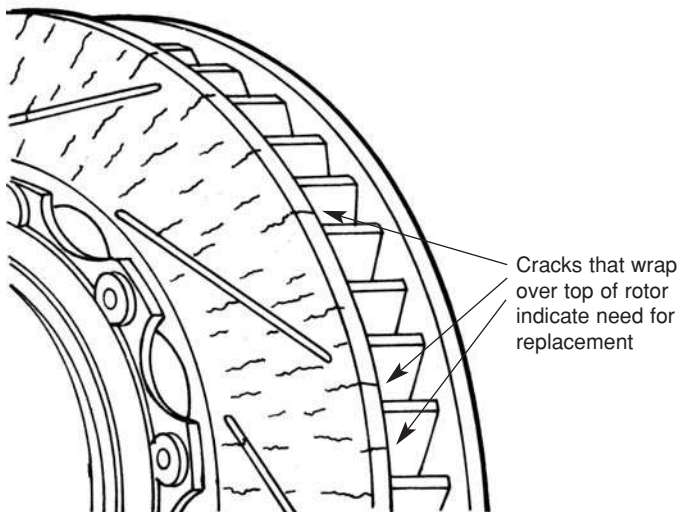


2. Next, continue assembling the remaining bobbins to the hat and disc, using the nickel anti-seize and Brembo supplied AN washers. Be sure the bushings are properly seated. The flat side of the bushing aligns with the ridge on the hat. With all 10 bushing fasteners assembled to the the hat and disc, it is time to torque the assembly. TORQUE EACH FASTENER TO 60 INCH POUNDS (5 foot puonds) USING A STAR PATTERN. After torquing the bushings check that the rotor still floats (there should be a small amount of play between the hat and the disc.



## Replacing Rotors

Brake rotors will crack; small cracks are normal. However any cracks that travel all the way to the edges should be noted. Cracks that you can run your fingernail over and feel may need to be replaced. Cracks that wrap over the top of the rotor and into the cooling fins indicate the need for immediate replacement. Please refer to the torque specifications on page 10 when replacing rotors.







Quaker State – Recommended fill for the GTS



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# Body Section

**Body Panel Care Guide .....55**

**Fastener Inspection .....55**

**Replacing Body Panels .....55**

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**Effects of Chemicals, Cleaners and Silicone Adhesives .....57**

**Compatibilities of Tapes and Weatherstrips .....58**

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## Body Panel Care Guide

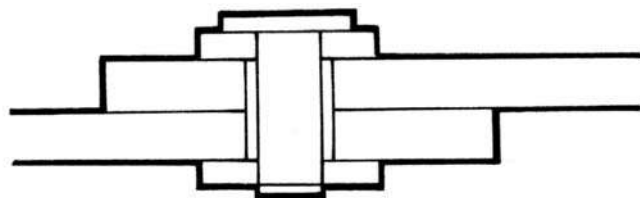
This section will give you information and tips for caring for your Panoz GTS body panels. It includes fastening information, approved cleaning products, chemical resistance, and effects of vinyl and tapes.

The Panoz GTS body panels are formed from a co-extruded ABS Plastic. The lower layer of material is ABS (Centrex®) and the upper layer is Lexan®. We choose this material for it's

- Toughness and durability
- Resistance to weather aging
- Good chemical resistance
- Good processability

The panels can be used in white as they are produced or painted. The painting procedure is listed in a later section of this manual. All of the body panel and related attachments are fastened using a nut and bolt assembly. This is done for a specific reason. The careless use of rivets will reduce the life of your panel. We do not recommend using rivets to fasten panels to each other or to mounting brackets. The expansion of the rivet body will put excessive pressure on the through hole of the rivet. This excess pressure will cause the panel to split, from the radius of the hole. If you are forced to repair the assembly with rivets, be sure to use the suggestions below.

Find a washer that has a smaller hole than the hole in the body panel. Use the rivet on both the top and bottom of the panel joint or mounting location. The rivet must expand against the inside radius of the washer and NOT the plastic body panel.



## Fastener Inspection

It is recommended that you inspect all of the body fasteners between each track event. Because of the nature of the plastic panels it is possible for the joints to become loose due to vibration and unfortunate car to car contact. Using an allen wrench and a 3/8" wrench, go round the vehicle and check the tightness of each fastener. Lightly torque each fastener to a snug condition. The locking will hold the assembly. DO NOT OVER TORQUE THE FASTENER.

## Replacing Body Panels

Body panels can be ordered trimmed or untrimmed. Even if you order trimmed panels, there could be some slight modifications needed to make the panels fit properly. If you order untrimmed panels, you will receive them marked with trim lines. A 90° grinder with roloc discs and a body saw are the basic tools needed to trim panels. Each car is a little different so final touches will most likely need to be done by car owner to ensure perfect body fit. DO NOT over tighten body screws (make them snug) Over tightening can cause bolt heads to pull through the plastic body panels or crack the body panels.

## Repair

The ABS panels can be repaired. If you get a small crack in your panel, we recommend drilling a small hole at the end of the crack. Be sure to find the end of the crack. Drilling the end of the crack will stop it from getting any bigger. The Quick and dirty fix for race rash...

If you get a large crack in your panel, a quick fix is to;

1. Drill the end of the crack.
2. Drill small holes down each side the crack, across from each other.
3. Use zip ties and stitch the crack

There are plastic welding kits that can be purchased. They use a combination of compressed air, heat and come with ABS welding rod.

## Paint Procedure

### Surface preparation

**A:** Clean the entire body with D846 degreasing agent for plastics, while constantly turning and changing clean lint free towels.

**B:** Scuff with #M 07447 Red Scotch Brite.

**C:** Air blow entire substrate thoroughly using a clean air supply.

**D:** Clean the entire body with D846 degreasing agent for plastics, while constantly turning and changing clean lint free towels.

**E:** Tack off entire panel.

**F:** Apply D820 Plastic Adhesion Promoter in one thin coat. Apply with uniform coverage.

1.3-1.5mm  
0.5-0.7/7-10 PSI  
4 bar/55 PSI  
1x

**G:** RTS (ready to spray)

**H:** Let air dry to 30 minutes

**I:** 30min @ 20°C (68°F) no more than 24 hours.

**J:** Tack off all panels

**K:** Mix 4 : 1 : 2

DG : D884 : D870 <18°C/65°F  
D887 : D871 18-25°C/65°-77°F  
D872 >25°C/77°F  
D873 >35°C/95°F

**L:** Pot life is 1-3 hours @20°C/68°F

**M:** Apply DG DirectGloss Color.2 normal coats

1.4-1.6 mm  
0.7 bar/10PSI  
3-4 bar/45-55PSI  
2x

**N:** Flash off - allow 5-10 minutes between coats  
@20° C/68°F

**O:** Dry - allow to dry minimum 50-70 minutes  
@20°C/68°F

**P:** Air dry <20hours @20°C/68°F

**Q:** Force dry 30 minutes @60°C/140°F

## HVLP Equipment

High volume low pressure (HVLP) uses higher volume of air at low pressures to atomize high solid low VOC coatings. By reducing the atomizing pressure "overspray" and "bounce back" are minimized. This will result in savings for coatings material and booth filters.

IMPORTANT: The above solvents and paint components contain materials that may be hazardous to your health. Read and be sure that you understand the warning messages on the labels of all components.

Follow instructions for positive airline respirator use. Wear eye and skin protection. Observe all applicable precautions.

**See Material Safety Data Sheet and labels for additional safety information and handling instructions.**

## Cleaning

The plastic material has good resistance to most chemicals and cleaners. It is not resistant to all chemicals. Below is a list of common known safe chemicals and cleaners. Please refer to the charts at the end of this section for anything beyond that list.

CLEANERS: Windex, Fantastic, 409, Simple Green

CHEMICALS: WD-40, 30W Motor Oil, Mineral Spirits

Gun Oil, Silicone Sealer/RTV (non-acid cured)

AVOID CONTACT OR USE OF THE FOLLOWING PRODUCTS: Citrus cleaning products, gasoline.

## EFFECT OF CHEMICALS FOUND IN SHOPS ON BAYER PLASTICS MATERIALS

|                                                  | NO ATTACK EXPECTED | MINIMUM ATTACK<br>GENERALLY USEABLE | MODERATE ATTACK<br>USEABLE ONLY WITH<br>NO STAIN ON PLASTIC | SEVERE ATTACK<br>NOT RECOMMENDED |
|--------------------------------------------------|--------------------|-------------------------------------|-------------------------------------------------------------|----------------------------------|
| <b>AGENT: CENTREX</b>                            |                    |                                     |                                                             |                                  |
| AJAX Expert Cleaner/Degreaser                    |                    |                                     |                                                             |                                  |
| BEAVER Terp-A-Klean Citrus Cleaner               |                    |                                     |                                                             |                                  |
| FANTASTIC                                        |                    |                                     |                                                             |                                  |
| FORD TAR & GREASE REMOVER                        |                    |                                     |                                                             |                                  |
| FORD ULTRACLEAR Window Wash Con                  | –                  | –                                   | –                                                           | –                                |
| FORMULA 409                                      |                    |                                     |                                                             |                                  |
| Krazy clean All Purpose Cleaner                  |                    |                                     |                                                             |                                  |
| MINERAL SPIRITS                                  |                    |                                     |                                                             |                                  |
| OLD TYME Lemon Oil                               |                    |                                     |                                                             |                                  |
| PPG-DX 330 Acrylic-Clean<br>(wax/grease remover) |                    |                                     |                                                             |                                  |
| PVC Foam Weatherstripping                        |                    |                                     |                                                             |                                  |
| Super UNLEADED GASOLINE                          |                    |                                     |                                                             |                                  |
| WD 40                                            |                    |                                     |                                                             |                                  |
| 3M SHARPSHOOTER Extra Strength                   |                    |                                     |                                                             |                                  |
| 30 W MOTOR OIL                                   |                    |                                     |                                                             |                                  |
| 303 PROTECTANT                                   |                    |                                     |                                                             |                                  |

## EFFECT OF CLEANERS ON BAYER PLASTICS MATERIALS

|                                             |   |   |   |   |
|---------------------------------------------|---|---|---|---|
| <b>CLEANER: CENTREX</b>                     |   |   |   |   |
| TEK 701 GLASS CLEANER                       |   |   |   |   |
| TEK 811 GRAFFITI REMOVER                    |   |   |   |   |
| TEK 969 BUG CLEANER                         |   |   |   |   |
| TERP-A-CLEAN DEGREASER<br>(Beaver Research) |   |   |   |   |
| TURPENTINE                                  | – | – | – | – |
| WINDEX GLASS CLEANER                        |   |   |   |   |
| ZEP FORMULA 50, diluted 1:4 w/water         |   |   |   |   |
| ZEP FORMULA 50, undiluted                   |   |   |   |   |
| 3M CITRUS BASE NATURAL                      |   |   |   |   |
| 3M DESK 7 OFFICE CLEANER                    |   |   |   |   |
| 3M SHARPSHOOTER Extra Strength              |   |   |   |   |
| 303 PROTECTANT                              |   |   |   |   |

## EFFECT OF SILICONE ADHESIVES AND SEALANTS ON BAYER PLASTICS

|                                                     |  |  |  |  |
|-----------------------------------------------------|--|--|--|--|
| <b>MATERIAL: CENTREX</b>                            |  |  |  |  |
| 5007 PLAS, SILICONES UNL                            |  |  |  |  |
| COLORIMETRIC (acetic acid cure) <sup>+</sup>        |  |  |  |  |
| COLORIMETRIC MS 101                                 |  |  |  |  |
| DOW 700 <sup>+</sup>                                |  |  |  |  |
| ECLECTIC PRODUCTS' E-6100                           |  |  |  |  |
| FLEXIPRENE 1000, POLYMERIC SYS.                     |  |  |  |  |
| FULAPRENE 303 <sup>+</sup>                          |  |  |  |  |
| GE 1000 RTV SILICONE, Acetic Acid Cure <sup>+</sup> |  |  |  |  |
| GE 2800 RTV SILICONE, Neutral Cure                  |  |  |  |  |
| GE SILICONE II                                      |  |  |  |  |
| GE SILPRUF 2000 SERIES SILICONE                     |  |  |  |  |
| PSI-631 RTV SILICONE, Moisture Cured                |  |  |  |  |
| SILICONE 5007, SILICONES UNL                        |  |  |  |  |
| SIR-O-SIL 50, Neutral Cure                          |  |  |  |  |

\* 3-5 mil film laminated on ABS

\*\*1 FOR CENTREX 401/833, 2 FOR CENTREX 825

<sup>+</sup>In general, acid cured RTV silicones do not attack the plastic if applied in a thin layer. If uncured silicone is trapped between two sheets of plastic, however, it will attack the plastic. Acid cured silicones smell like vinegar

**NOTES:** Do not use cleaners containing citrus oil. Dilute all cleaners according to directions.

## COMPATIBILITY OF TAPES AND WEATHERSTRIPS ON BAYER PLASTICS

|                                                       | NO ATTACK EXPECTED | MINIMUM ATTACK<br>GENERALLY USEABLE | MODERATE ATTACK<br>USEABLE ONLY WITH<br>NO STAIN ON PLASTIC | SEVERE ATTACK<br>NOT RECOMMENDED |
|-------------------------------------------------------|--------------------|-------------------------------------|-------------------------------------------------------------|----------------------------------|
| <b>MATERIAL: CENTREX</b>                              |                    |                                     |                                                             |                                  |
| Aliphatic TPU w/acrylic PSA, Patco Corp.              |                    |                                     |                                                             |                                  |
| Bowman Anti-seize Compound                            |                    |                                     |                                                             |                                  |
| Colorimetric Tape # 873304                            |                    |                                     |                                                             |                                  |
| EPDM Foam/Tape                                        |                    |                                     |                                                             |                                  |
| IPS Weld-On ABS 2773                                  | –                  | –                                   | –                                                           | –                                |
| Plasticized PVC Foam/Tape                             |                    |                                     |                                                             |                                  |
| Polyken Duct Tape                                     |                    |                                     |                                                             |                                  |
| Polyolefin Foam/Tape                                  |                    |                                     |                                                             |                                  |
| Polyurethane Foam/Tape                                |                    |                                     |                                                             |                                  |
| Scotch Brand 898 Reinforced Tape                      |                    |                                     |                                                             |                                  |
| Surebond SB-430 Quick Tack Tape                       |                    |                                     |                                                             |                                  |
| Thermoplastic Rubber Tape                             |                    |                                     |                                                             |                                  |
| Velcro Brand Tape                                     |                    |                                     |                                                             |                                  |
| Vinyl Cloth Tape                                      | –                  | –                                   | –                                                           | –                                |
| 3M VHB 4932                                           |                    |                                     |                                                             |                                  |
| 3M VHB 4941                                           |                    |                                     |                                                             |                                  |
| 3M VHB 4952                                           |                    |                                     |                                                             |                                  |
| 3M 05407-10828 Electrical Vinyl<br>(white or black)** |                    |                                     |                                                             |                                  |

## CHEMICAL RESISTANCE TO AUTOMOTIVE CHEMICALS

|                               |     |  |  |  |
|-------------------------------|-----|--|--|--|
| <b>CHEMICAL: CENTREX</b>      |     |  |  |  |
| Unleaded Gasoline             | 1-2 |  |  |  |
| Diesel Fuel                   | 1   |  |  |  |
| Wheel Bearing Grease          | 1   |  |  |  |
| Brake Fluid                   | 4   |  |  |  |
| WD-40                         | 1   |  |  |  |
| Mopar Anti-Freeze (undiluted) | 1   |  |  |  |
| Transmission Fluid            | 1   |  |  |  |
| Mineral Spirits               | 1   |  |  |  |
| Tar & Grease Remover          | 1-2 |  |  |  |
| 10W30 Motor Oil               | 1   |  |  |  |

\*\*1 FOR CENTREX 401, 2 FOR CENTREX 833, 3 FOR CENTREX 825

**NOTE:** In general, PVC materials attack the plastic. DO NOT USE.

## EFFECT OF CLEANERS ON BAYER PLASTIC MATERIALS

|                                         | NO ATTACK EXPECTED | MINIMUM ATTACK<br>GENERALLY USEABLE | MODERATE ATTACK<br>USEABLE ONLY WITH<br>NO STAIN ON PLASTIC | SEVERE ATTACK<br>NOT RECOMMENDED |
|-----------------------------------------|--------------------|-------------------------------------|-------------------------------------------------------------|----------------------------------|
| 25% ISOPROPANOL/WATER                   |                    |                                     |                                                             |                                  |
| 30% ACETONE/WATER                       |                    |                                     |                                                             |                                  |
| AJAX Expert Degreaser/Cleaner (Colgate) |                    |                                     |                                                             |                                  |
| AMMONIA DILUTED 1:3 WITH WATER          |                    |                                     |                                                             |                                  |
| ARMORALL CLEANER                        |                    |                                     |                                                             |                                  |
| ARMORALL PROTECTANT                     |                    |                                     |                                                             |                                  |
| BATHMATE NO ACID WASHROOM               | -                  | -                                   | -                                                           | -                                |
| BEAVER Terp-A-Klean Citrus Cleaner      |                    |                                     |                                                             |                                  |
| BIO T CITRUS OIL                        |                    |                                     |                                                             |                                  |
| BIO T MAX CITRUS OIL                    |                    |                                     |                                                             |                                  |
| Butyl Cellosolve                        |                    |                                     |                                                             |                                  |
| CLOROX CLEANUP                          |                    |                                     |                                                             |                                  |
| DO-IT-ALL                               |                    |                                     |                                                             |                                  |
| DRI-WASH N GUARD                        |                    |                                     |                                                             |                                  |
| FANTASTIC                               |                    |                                     |                                                             |                                  |
| FORD TAR & GREASE REMOVER               |                    |                                     |                                                             |                                  |
| FORD ULTRACLEAR WINDOW WASH CON.        | --                 | -                                   | -                                                           | -                                |
| FORMULA 409                             |                    |                                     |                                                             |                                  |
| GOO GONE CITRUS CLEANER                 |                    |                                     |                                                             |                                  |
| HYDROWASH A 300 DYCHEM INT'L.           |                    |                                     |                                                             |                                  |
| KRAZY CLEAN ALL PURPOSE                 |                    |                                     |                                                             |                                  |
| LOOK GLASS (conc) (Butcher)             |                    |                                     |                                                             |                                  |
| LYSOL BATH & TILE                       |                    |                                     |                                                             |                                  |
| MICROCLENE                              |                    |                                     |                                                             |                                  |
| MURPHY HOUSE. OIL SOAP (DILUTED)        |                    |                                     |                                                             |                                  |
| MURIATIC ACID 31.5% HCL**               |                    |                                     |                                                             |                                  |
| OASIS 255 GLASS CLEANER                 |                    |                                     |                                                             |                                  |
| OASIS 266 ALL PURPOSE                   |                    |                                     |                                                             |                                  |
| OASIS 277 AIR FRESHENER                 |                    |                                     |                                                             |                                  |
| OASIS 499 GERMICIDE                     |                    |                                     |                                                             |                                  |
| OLD TYME LEMON OIL                      |                    |                                     |                                                             |                                  |
| PPG DX-330 ACRYLIC CLEAN (Wax Remov.)   |                    |                                     |                                                             |                                  |
| PAINT THINNER                           | -                  | -                                   | -                                                           | -                                |
| PLEXUS PLASTIC CLEANER                  |                    |                                     |                                                             |                                  |
| PURPLE RAGE                             |                    |                                     |                                                             |                                  |
| RM-900 PRE-KLEAN                        |                    |                                     |                                                             |                                  |
| SIKA 205 CLEANER                        |                    |                                     |                                                             |                                  |
| SIMPLE GREEN, DILUTED                   |                    |                                     |                                                             |                                  |
| SPEEDBALL HD SPRAY                      | -                  | -                                   | -                                                           | -                                |
| SPEEDBALL POWER CLEANER                 |                    |                                     |                                                             |                                  |
| TEK 102 ALL PURPOSE                     |                    |                                     |                                                             |                                  |
| TEK 145 LIQUID WASH 7 WAX               |                    |                                     |                                                             |                                  |
| TEK 404 GENERAL PURPOSE                 |                    |                                     |                                                             |                                  |
| TEK 408 CREAM CLEANER                   |                    |                                     |                                                             |                                  |
| TEK 411 CONC. VEHICLE CLEANER           |                    |                                     |                                                             |                                  |
| TEK 412 HARD CARMABU WAX                |                    |                                     |                                                             |                                  |
| TEK 456 CLEAN 7 SHINE                   |                    |                                     |                                                             |                                  |
| TEK 555 TIRE GLOW                       |                    |                                     |                                                             |                                  |
| TEK 633 GLASS CLEANER                   |                    |                                     |                                                             |                                  |
| TEK 701 GLASS CLEANER                   |                    |                                     |                                                             |                                  |
| TEK 811 GRAFFITI REMOVER                |                    |                                     |                                                             |                                  |
| TEK 969 BUG CLEANER                     |                    |                                     |                                                             |                                  |
| TERP-A-CLEAN DEGREASER (Beaver Re)      |                    |                                     |                                                             |                                  |
| TURPENTINE                              | -                  | -                                   | -                                                           | -                                |
| WINDEX GLASS CLEANER                    |                    |                                     |                                                             |                                  |
| ZEP FORMULA 50, DILUTED 1:4             |                    |                                     |                                                             |                                  |
| ZEP FORMULA 50, UNDILUTED               |                    |                                     |                                                             |                                  |
| 3M CITRUS BASE NATURAL                  |                    |                                     |                                                             |                                  |
| 3M DESK 7 OFFICE CLEANER                |                    |                                     |                                                             |                                  |
| 3M SHARPSHOOTER X-STRENGTH              |                    |                                     |                                                             |                                  |
| 303 PROTECTANT                          |                    |                                     |                                                             |                                  |

\*\*1 FOR CENTREX 401/833, 2 FOR CENTREX 845

**NOTE:** Do not use cleaners containing citrus oil. Dilute all cleaners according to directions.



## Quaker State – Recommended fill for the GTS



The Power to Reduce Friction



# Suspension

|                                      |            |
|--------------------------------------|------------|
| <b>Ride Height</b>                   | <b>.61</b> |
| <b>Shock Settings</b>                | <b>.61</b> |
| <b>Square Rear End Housing</b>       | <b>.61</b> |
| <b>Brake Bias</b>                    | <b>.61</b> |
| <b>Sway Bar Adjustment</b>           | <b>.62</b> |
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## Introduction

The information in this section will help you with the suspension set of your car. Each driver will have a unique setting for his or her driving style and track conditions. The settings presented in this manual are primarily the setup as the car leaves the factory. You should confirm this baseline before going to the track. Knowing exactly how your car is before an event will help you make the proper changes to improve the feel of the car and your lap times.

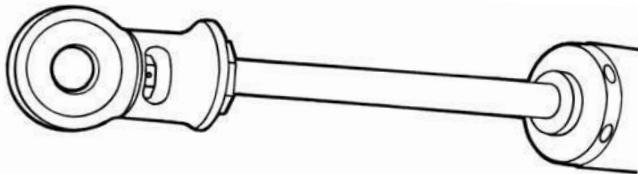
## Basic GTS Set-Up

### Ride Height

- 3 1/2" in front (from bottom of chassis to ground) at front axle center line.
- 4" in rear (from bottom of chassis to ground) at rear axle center line.

### Shock Settings

The shocks are sealed units and do not allow changes to the compression of the shock. The only adjustments with the shocks are rebound, and with the spring ride height.



- Shock rebound settings start from a full firm setting.
- The rebound adjuster window is labeled with a plus (+) and a minus sign (-).
- Turning the adjuster to the plus (+) direction makes the rebound more firm (slower).
- Turning the adjuster to the minus (-) direction makes the rebound softer (faster).

To set shock rebounds use a small punch, turn dial all the way +, then back off 6 holes (sweeps/clicks). This is a neutral setting to get started with.

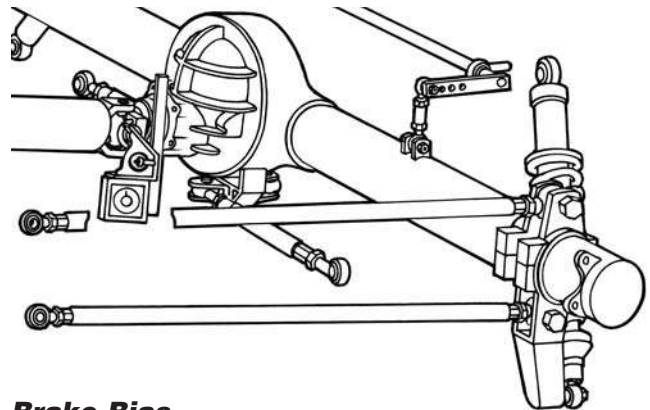
### Pinion Angle

Pinion angle measurement is an important part of getting tracking and controlling driveline vibration. Having too much or too little pinion angle will lead to a driveline vibration. Obtaining more pinion angle can help

improve traction, as the pinion will tend to rise during acceleration. Pinion angle must be set in the range of 3°-5°. Any less or any more may result in a vibration. You set pinion angle using the 4-link bars and an angle/degree gauge.

- First check angle on drive shaft, then check angle on differential housing (ref. figure 1).
- Add the absolute value of the two numbers together (i.e. Driveshaft angle = -2° & Pinion angle = 1.5° [ 2 + 1.5 = 3.5°] and adjust until it is in the range of 3°-5°.

**Note:** Pinion angle can be obtained by placing a 90° square against the front face of the yoke housing. (ref. figure 1)



### Brake Bias

This is a base line for setting the brake bias, it is only a safe baseline. This should be adjusted to driving style, track and weather conditions. The brake bias control knob adjusts the amount of pressure that is applied to the front and rear brake circuits during a brake application. Turning the control knob clockwise increases pressure the rear and counter clockwise increases pressure to the front. The initial brake bias setting is as follows; while pressing brake pedal, front gauge should read at 600 PSI and the rear should read 400 PSI. Always make sure brake bias cable is not in a bind when making adjustments. Turning the brake bias control to full front or full rear can cause the mechanism to get in a bind. To correct this, turn the control in the opposite direction while reaching behind the dash panel to free up the bound mechanism. If your car is not equipped with bias gauges, turn the bias knob until full front is achieved (turn counter-clockwise), then turn clockwise 10-12 turns, then test on track and adjust accordingly.

## Square Rear-end Housing

Rear-end housing should be 14"-14 1/4" from chassis to housing. Place string over axle housing at 4-link clamp, then measure both sides. Adjust using 4-link bars. (see illustration below.)

## Sway Bar Adjustments

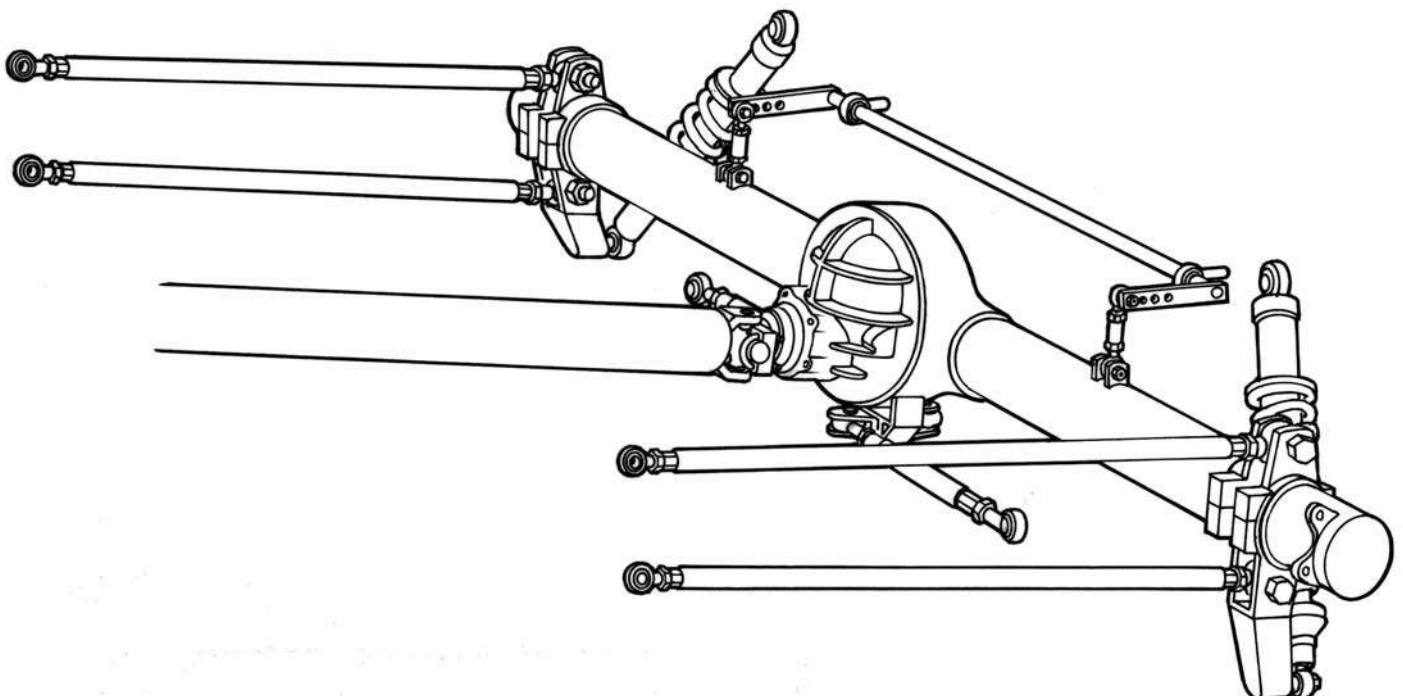
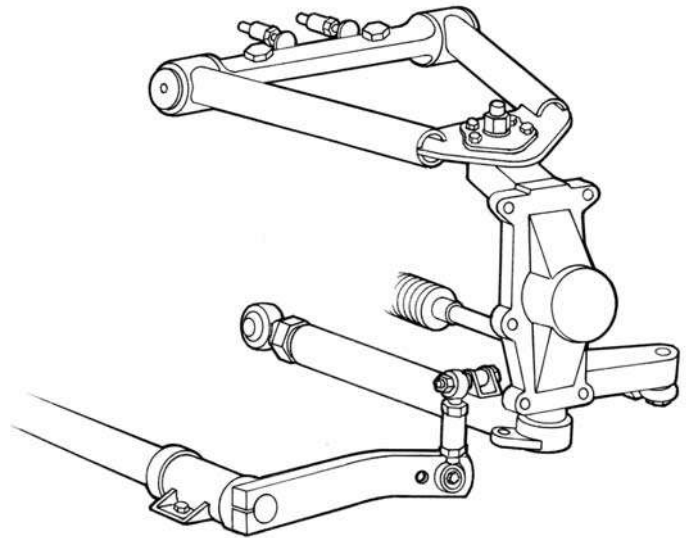
The sway bars are an important part in controlling weight distribution and traction. In order for the sway bar to work properly it must be neutralized. If it is not neutralized there can be an adverse transfer of weight, loading and unloading the wheels, in a cornering situation.

### Front

- A:** Front sway bar has two adjustments.
- B:** It is best to have the driver in the car for this adjustment.
- C:** Remove bolts from both sides of the sway bar.
- D:** With driver in the car, lengthen/shorten heim until bolts slide into sway bar holes easily.
- E:** Front hole (front of car) is soft; rear hole (closest to firewall) is stiff.

### Rear

- A:** Rear sway bar has three settings.
- B:** The hole to the rear of the car is full stiff.
- C:** The middle hole is medium.
- D:** The front hole is full soft.
- E:** This adjustment is also best done with the driver in the car
- F:** If your driver is not available try to find someone about the same weight, or if nobody is available, you can make all of your settings in a neutral manner.



## **Suspension Tips**

### **Controlling Under Steer**

This section is related to the correction of understeer. At this stage the scope of this document cannot cover all possible scenarios to correcting understeer conditions. The Panoz GTS is usually released from the factory with conservative alignment settings. These settings usually tend to create an understeer condition. The Design of the car is not such that it inherently has an understeer problem. There is more than enough adjustment possibilities to get the car to handle any way that you like.

There are a lot of things to consider when adjusting the handling characteristics of a car. One of the biggest things to consider when adjusting for understeer and oversteer is weight transfer and it's effect on the tire contact patch.

When talking about understeer, the first question we have to ask is "Does the car understeer going into the corner or coming out?"

### **Going into a corner**

If the car exhibits understeer going into corner (poor turn in), that can be related to 2 things; weight transfer and bump steer (assuming that tire pressures are correct and that the tires are not overly worn and have not been heat cycled too many times). More times than not it is related to bump steer.

Bump steer is refers to the amount of toe change that occurs as the wheel travels through the suspension limits. By nature the GTS tends to toe in during heavy brake (suspension compression). For that reason we specify an alignment setting of toe out (ranging from 1/16" to 1/8"). This can be adjusted out by going through a bump steer exercise and slightly modifying the geometry of the front suspension. If you have not performed that exercise adding a little more toe out will help you during turn in.

Weight transfer can be adjusted by driving style and by shock adjustment. Braking deep into a corner and turning while you have maximum weight on the front tire can help corner entrance understeer condition. The other option is to soften the rebound setting of the rear shock.

The Penske shocks have rebound adjusters. The adjustment is from soft (-) to firm (+). Note: before making any adjustments to the shocks, record where they currently are. All adjustments from Panoz Auto Development are referenced from a full firm setting.

By softening the rebound on the rear shock, you allow the rear of the car to raise, which in turn applies more weight to the front tires which can help you turn in and rotate the car.

Weight transfer can also be controlled by adjusting the rake in the car. Rake is the ride height difference from one end to the other. You need to know where you are at prior to making any adjustments.

## **Exiting a corner**

This is the area that starts at or just before the apex of the corner. It is usually the same point where you are starting to apply power. Again weight transfer is the key to applying power and maintaining grip while steering comfortably through the corner. In this situation wheel camber, shock and sway bar setting play a critical roll in controlling the weight transfer of the car (again we are assuming that the tire pressures are correct, and that the tires are not overly worn and have not been heat cycled too many times). The understeer condition exists because there is not enough grip from the front tires to change the direction of the car.

Front rebound adjustment is the easiest and most subtle. You will be surprised in the gains that can be made by adjusting the rebound just one or two clicks. If you adjust the front rebound to a more firm setting you will slow down the weight transfer of the car, thereby allowing the fronts tires to have a better contact patch with the track.

Sway bar settings will also yield high gains in controlling understeer. (IT IS IMPORTANT TO NOTE THAT THE SWAY BARS, BOTH FRONT AND REAR, NEED TO BE NEUTRALIZED BEFORE BEING ABLE TO MAKE ANY PROPER HANDLING ADJUSTMENTS NOTES BELOW). Adjusting the rear sway bar to a stiffer setting will help if not eliminate any exiting understeer condition. If adjusting the rear sway bar makes the car too loose, don't jump to the conclusion that you went the wrong way and move it back right away. Consider adjusting the front sway bar to a stiffer setting to put a little push back into the car.

Proper camber is important to controlling understeer conditions. Too much or not enough camber affects your contact patch.

The key is to find the proper balance of all these adjustments to match your driving style, track and weather conditions. Like anything else in life there are usually sacrifices that have to be made. You should always adjust your suspension for the most critical corner on the track. Usually, this is the one that leads onto the longest straight away, or the one that carries the most speed. Understand that some tracks will not let you have optimum handling everywhere.

Obtaining tire temperature and pressure information after each session is the key to making proper adjustments to the car. Tire temperature will tell you if you have too much or not enough camber, if the car is out of balance or if there is too much or too little pressure. Be careful to not adjust the car back to your driving style and speed. In other words, having the same front tire temp inside middle and out is a pretty thing, but it doesn't mean that it is fast.

Through weight transfer and balance you can maximize the contact patch of all the tires for the related track condition.

## **Alignment**

Alignment settings vary from track to track and tire to tire. Switching tire brands at the track is not recommended. Any time that you change tire brands, you will have to start from ground zero related to the alignment and overall setup of the car.



## **Shocks**

If your shocks have too many hours on them and they are worn out, you will never be able to adjust your car to run fast. Typically the shocks are good for about 40 hours of track time. That might not seem like a lot until you add in the number of hours that you car rides in or on a trailer. When your car bounces down the highway in the trailer it adds wear and tear on the shocks. Shocks don't necessarily have to be leaking to tell you that they are worn out. The only way to tell is to have them tested on a dyno. Usually, you will know when they are worn as you will be feeling weird handling characteristics that don't make sense.

## **Sway bars**

Sway bars do more than just control the sway or later weight transfer of the car. They also apply opposing forces to the inside wheel during a turn.

Neutralize the sway bars by disconnecting one side (break the adjusting jam nut loose first). Then adjust the link so that the bolt slides easily through the adjusting heim and the sway bar arm. The optimum situation is to neutralize them with the driver and his gear in the car.

If your sway bar is not in the neutral zone before adding dynamics to the cars attitude, you may drive through that neutral zone in a corner, making the car handle more poorly in one direction opposed to the other.

Stiffness plays a big part in controlling understeer and oversteer. It also plays a big part in how much force you can transfer to the inside tire, in a cornering situation.

If you have any questions about the information presented in this document, please contact Joel Grewett at Panoz Auto Development [888.467-2660 or [jgrewett@panozauto.com](mailto:jgrewett@panozauto.com)].

## **A Guide To Damper Tuning**

The ultimate purpose of a shock is to work together with the spring to keep the tire on the track. In compression(bump) to help control the movement of the wheel and in rebound to help absorb the stored energy of the compressed spring. Breaking down the shaft speeds to chassis movement can be done from the data taken from on board acquisition and/or actual test sessions. Where we find the biggest advantages with low speed adjusters is looking at the chassis in the plane of the four wheels in relation to the chassis movement in roll and pitch and how quickly weight is transferred to each corner in order to load the tire sooner or later, depending on track conditions.

Usually in rain or low grip situations, allowing more bleed or less low speed damping is desirable to delay tire loading upon initial roll. In dry high grip conditions, adding damping or restricting bleed will load the tire sooner upon initial roll increasing platform stability. In pitch situations on smooth surfaces under braking, increasing low speed damping or restricting bleed will help load the tires for entry or mid corner. If the tire begins bouncing under braking usually an increase in high speed compression will calm this down. Since the GTS does not have adjustable compression settings this is telling you it is time to have the shocks rebuilt.

We recommend that you have all 4 shocks rebuilt at the same time. Otherwise you will continue to chase handling problems at you next track session(s).

If the chassis feels like it is moving around too much between the plane of the wheels, increasing low speed damping or restricting bleed, will overall, firm up the chassis and give it a crisp feel or a better sense of feel in the car. A car with too much low speed damping will usually lack grip in change of directions, cannot put power down in slower corners (wheel spin) and lack overall grip after initial turn in. If traction is a problem coming off corners, reducing low speed damping or more bleed will help weight transfer at the rear thus increasing traction.



Rebound adjustments are usually indicated by the driver asking for more stability. By increasing low speed damping, stability will be enhanced; decreasing damping will allow more movement in the car, but will result in a little better tire wear. Also, the amount of rebound can have a great influence on weight transfer. Less front rebound allows weight transfer to the rear under acceleration. Less rebound in the rear allows for a greater amount of weight transfer to the front under braking and turn in. When a car is over damped in rebound it can pack down in a series of bumps and a driver will recognize this as too stiff and usually will think it is compression damping. Too much rebound can cause lack of grip on cornering. When making a spring change, keep in mind where the rebound adjuster is and do you have enough range to compensate. Sometimes a spring change will bring a better balance to the damping values after the spring change. If the spring/shock combination was balanced, the rule of thumb is a stiffer spring requires lower compression and higher rebound. A softer spring requires higher compression and lower rebound.

## **General Track Tuning Tips**

Bump in Front Usually Effects:

- Middle
- Entry

Rebound in Rear Usually Effects:

- Middle
- Entry

Rebound in Front Usually Effects:

- Middle
- Exit

Bump in Rear Usually Effects:

- Middle
- Exit

Push Off Exit of Corners

- Increase (firmer) Rebound Front

Loose Off Exit of Corners

- Decrease (softer) Rebound Front

Push in Middle of Corners

- Decrease Rebound (inside wheel)
- Increase Rebound (outside wheel)

Loose in Middle of Corners

- Decrease Rebound (outside front wheel)
- Decrease Rebound (inside rear wheel)

Push on Entry to Corners

- Increase Rebound Rear

Loose on Entry to Corners

- Decrease Rebound Rear

Keep in mind that your sway bars are a big factor in the adjustments listed above. Typically, if you cannot adjust the corner performance with rebound settings then you should consider a sway bar change.

## **Pirelli Tire Care and Feeding**

The Pirelli P-Zero slicks are considerably different than the Michelin slick or Hoosier race tire. The side wall is much stiffer. It is possible to spin the tire on the rim. The instructions below will help you eliminate this rotation. The rotation is somewhat normal. The only thing that this will affect is the balance of the wheel, if it spins too far. The tires have the capability of coming back should you cook them during a session. With one or two laps driving slightly off pace, the tires will return the performance that you lost. The outside of the tire has a "D3 arrow" label. Pirelli race tires have compound ratings from D1 to D5. The directional arrow is ignored in our application. Pirelli says the tires can be rotated to any corner of the car to increase tire life and maintain performance. Rule of thumb says that you shouldn't put right side radial tires on the left side of the car. This is related to the possibility of breaking tire construction belts. We are not challenging this theory. We have tested right side tires on the left side of the car and had no problems. We are not giving any guarantees that you will have the same experience. Use your own discretion.

## **Mounting Instructions**

- Tires should be mounted to the rim dry, if possible. If you use a mounting lubricant DO NOT use lubricants that are not designed to get tacky.
- Mount the tires with all the bar codes to the inside of the wheel. Ignore the directional arrows on the outside of the tire. They will look wrong on one side of the car.
- Mark your valve stem location on the tire, for rim to tire rotation reference.

## **Tire Pressures**

- Hot tire pressures should be approximately 31psi hot, all four corners. To get there cold pressures should be set (on an 80° ambient day) 23psi front and 21psi rear. Your driving style and preferences will dictate future settings.

## **Warm Up Suggestions**

Warming up Pirellis should be done in a straight line, during acceleration and deceleration. Use gradual applications of both acceleration and deceleration until you have generated some heat in the tires (be sure you have enough track space). Dumping the clutch out of the pits with cold tires will rotate the rear rims, excessive braking will rotate the front rims. Once the tires have heat in them, slight weaving can be done. We avoid weaving, when the tires are cold, so that we don't break the tire bead from the rim. Stay off the rumble strips (alligators) in the corners until tire temps are up.

## **Alignment Settings**

We can only give you general information to get you started. Typically the Pirelli tire requires 1.5° more camber on the outside tire and 1° more on the inside tire (inside and outside reference related to track direction). We have made no changes to caster and toe settings.