



## ***Van Diemen DP08 ZR55 Brake System Handbook***

The purpose of this document is to offer guidelines for the care and maintenance of the Van Diemen DP08-Mazda fitted with USF2000 Series approved PFC ZR55 brake system.

### **DP08 brake pedal set-up baseline**

#### **DP08 Pedal ratio= 3.8:1**

Under compression, brake pedal must get firm before it reaches vertical to the pedal's pivot so as to not over-center.

#### **Front m/c= 17.8mm (.70")**

Front push rod at rest, must be 4-5.0mm longer than the rear push rod to compensate for fill rate difference and ensure proper balance bar geometry. This geometry will help minimize bias migration as well.

#### **Rear m/c= 17.8mm (.70")**

Once system is bled, check dynamic brake engagement and release (as outlined in this document.) The brake pedal will be firm with these sizes. There are 1 size smaller bore, and 6 sizes, larger bores readily available.

#### **Balance Bar=Van Diemen**

Bulkhead mounted, push type, articulating with spherical bearing in pedal tube. Set 51/49% pressure bias. This is your starting point. Average air gap of clevis to pedal tube clearance should be 1.5mm (.060")

## **Balance bar set-up and technical notes**

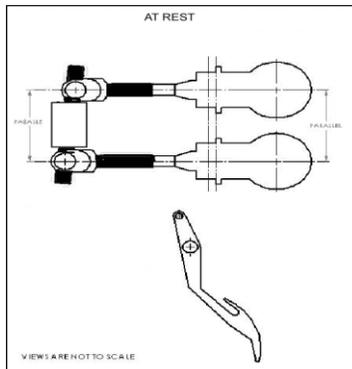
Purpose:

The function of a balance bar is to allow the adjustment of brake line pressure distribution between two master cylinders. This is accomplished through moving the balance bar pivot towards one master cylinder 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 master cylinder or the other, then the master cylinders will receive differential forces that are inversely proportional to the distance between the balance bar pivot point and master cylinder center lines. Being able to move the pivot point allows the driver to make incremental adjustments to the braking characteristics of the car (front-to-rear brake bias) and to alter those characteristics to account for changes in fuel load, track conditions and handling of the car.

### **Pedal Assembly**

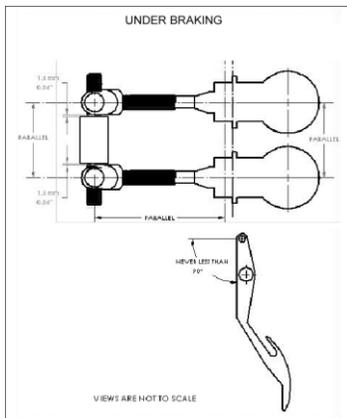
The DP08 is fitted with a “push-type” or “compression” pedal assembly. In this type of pedal, pushing the piston into the body of the master cylinder is actuated by the brake master cylinder pushrods. The pressure outlet is mounted on the opposite end of the master cylinder body from the pushrod.

### **Setting up the Brake Balance Bar: Articulating Push Type**



The brake balance bar is one of the most over looked, and least understood, components on a racecar. As with all aspects of racecar assembly and preparation, careful attention to the geometry of the brake balance bar and brake pedal will yield great benefits. To start with, look for proper installation of the brake balance bar bias adjuster and ensure that the brake balance bar pivot bearing is free to move within the pedal tube. There are important installation and maintenance considerations for the push type pedal assembly. The articulating push type pedal assembly (wherein the master cylinder is mounted

through a spherical joint), there are numerous spherical bearings, rod ends, clevises and needle bearings in these systems. These components must be in proper working order and clean of debris and dirt to function properly. Any excess play in these components will adversely affect the control and release of the brake system, and should be avoided at all costs.



Next, find the distance between the centerlines of the front and rear master cylinders. Typically, this could be 2½ inches, but this value is not critical. What’s critical is whatever this measurement is; it must be exactly duplicated in the center-to-center distance of the clevises threaded onto the bias adjuster. This ensures the master cylinder pushrods are actuated properly, minimizing any side loads applied to the master cylinder piston and bore. With the clevises set on the bias adjuster, measure the distance between each clevis and the

pedal tube. The air gap should not exceed 1.5mm per side. Because of tolerance stack it may require shims to maintain this gap. This will prevent the balance bar from shifting while on the track and causing unpredictable change in the brake bias of the car.

With the balance bar connected to the master cylinders, and brake lines connected, the brakes should be bled. It is critical that front and rear brake circuits be bled simultaneously so that both master cylinders are allowed to use their full travel, and prevent binding or distortion of the bias adjuster.

Once satisfied that the clevises and pedal tube clearances have been properly set, now look at master cylinder pushrod length. The key is to have the balance bar pivot rod perpendicular to the master cylinder mounting when the brake pedal is under pressure.

Typically, this means that the front master cylinder pushrod will be 0.120"–0.200" (3mm-5mm) longer than the rear master cylinder pushrod when at rest. This is due to the front braking circuit having either larger fluid volume needed to feed the larger piston diameters of the front calipers or a smaller front master cylinder to augment the higher pressure requirements. As a result the front master cylinder requires a higher feed rate than does the rear. If the pushrod lengths are equal then the feed rate of the rear master cylinder is too high relative to the front and that would result in the rear circuit "hitting" before the front. So, with the pushrod lengths adjusted properly, the balance bar will be square with the pedal frame under compression, with the front and rear circuits engaging and releasing at the same moment.

### **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") then the mechanical advantage of the pedal, over the pushrods, will be lost. That would result in a loss of pedal feel and braking force efficiency. Adjust the pedal "over center" position with a separate pedal height adjuster, if available, or by lengthening both master cylinder pushrods by the same amount and until the desired pedal height is achieved. When tall drivers are being fitted, this may require that pedal pivot be moved forward or the brake pedal cluster to be moved forward. As a result, the throttle pedal may need to be adjusted to restore the proper heel-and-toe pedal relationship. If there is insufficient adjustment available then this can be accomplished by attaching a simple spacer to the throttle pedal.

### **Brake Pressure Bias**

For the USF2000-Mazda, **51/49%** pressure bias is a good starting point, checked at the master cylinders or at the calipers. This will produce **54.5/45.5%** dynamic torque bias at the wheels.

## **Brake system bleeding procedures**

Purpose:

Proper bleeding of the brake system is critical to the performance of any racecar. Without good quality, clean, fresh brake fluid and a properly bled brake system, the brake system cannot function properly. There are many misconceptions about bleeding brakes and brake fluid in general. The purpose of this article is to help dispel some of these myths and outline a reliable and repeatable method for bleeding the brake system.

### **Brake Fluid 101**

There are 2 types of brake fluids commonly available today. Glycol-ester blends (“glycol-based”) and high percentage ester content blends (“ester-based”). More common are the glycol-based. These glycol-based fluids normally have low compressibility but are “hygroscopic” in nature. This means they are able to absorb water from the atmosphere. This contamination process occurs whenever brake fluids are exposed to the atmosphere, and even occurs somewhat through the plastic bottles most brake fluids are packaged in. *This is the reason that all brake fluids must be used fresh.* The susceptibility of brake fluids to hygroscopic contamination can be judged by comparing the “dry boiling point” and “wet boiling point” of the fluid: the greater the difference is between these two ratings, the more hygroscopic is the nature of that fluid. This concept is important, as it is the absorbed water that gasses off (boils) first inside the brake system and adds to the “spongy/soft/long pedal” effect. Pay no attention to the large numbers used by the marketers to describe the product, as they can be very misleading. The dry boiling point of glycol-based brake fluids seldom exceeds 580F (304c), even though you’ll see 600, 610 and 660 as a label description. The use of PFC caliper temperature stickers, PN **032.0007** is highly recommended to monitor brake fluid and caliper seal condition. If the calipers exceed 430f (210c) for an extend period, the brake fluid and or caliper seals will deteriorate. High percentage ester blends have the promise of higher dry and wet boiling points. The ester base used in manufacturing these fluids is not hygroscopic at all. However, they are blended with a percentage of glycol for several reasons including cost (ester is more expensive to manufacture than glycol), pedal feel (ester is by nature more compressible than glycol), lubricity and seal conditioning. The most common ester-based brake fluid on the market, and the established standard in the racing industry, is Castrol SRF. It has a proprietary formulation and effectively combines the best properties of the ester base (stability at elevated temperatures and low hygroscopic characteristics) with compressibility near that of glycol-based fluids. PFC recommends Castrol SRF racing brake fluid because of decades of proven consistency and performance. However, not all high ester blends are equal. In many cases, although they may have less water content to boil, compressibility is not as good at elevated temperatures, and the soft/spongy/long pedal effect is the same. Regardless of which brake fluid is used, frequent and correct bleeding should be considered part of proper race preparation.

### **Brake Bleeding How To**

As with any system on a racecar, the brake system must be inspected and found to be in good working order before beginning. Inspect the entire brake system for leaks or damaged parts including the pedal assembly (refer to the Balance Bar setup guide). Inspect the master cylinder reservoir cap(s) to see that they are venting properly, as this is an overlooked and common cause for poor pedal feel. Once all of the components in the

system have been inspected and serviced as necessary, begin the bleeding process by filling the master cylinder reservoir with clean, fresh, high quality brake fluid. Depending on the type of master cylinder arrangement, follow the instructions below:

**Notes on Bleed Bottles:**

There are many brake bleed bottles commercially available for a reasonable price. It is helpful for the bleed bottle to be clear so a visual inspection of the fluid being purged is possible. The use of clear hose that fits tightly around the bleed screws adds a visual aid to bleeding then just relying on what is seen through the bleeder bottle. For PFC calipers, this hose should have a 3/16" ID to fit the PFC bleed screws properly. Ensure that the bleed hose is inserted deeply enough into the bottle so that the end is always submerged in brake fluid to help close the loop. Bleed bottles should be vented as well. Discard spent brake fluid in an approved manner.

**Notes on Master Cylinder Fluid Reservoirs**

The master cylinder **fluid level must be higher than the caliper bleed screws** to insure proper bleeding. This means when a floor-mounted pedal used, the fluid reservoirs should be remote mounted above the level of the caliper bleeders. You should always take into consideration dynamic wheel movement, so placement of the reservoirs is important. The fluid volume required for a master cylinder reservoir is based upon the maximum piston displacement of the calipers being used. For the ZR55, maximum fluid volume required is **133cc per circuit.**

If there is insufficient fluid volume in the reservoir for the piston displacement required, the master cylinder will be empty before the pads are worn to their maximum. Total brake failure will result in that circuit.

**Vehicle with Dual Master Cylinder and Racing Calipers**

Supplies needed:

- 3 people
- Supply of high quality brake fluid from an unopened container
- 2 brake bleed bottles
- 2 6 point box end or line wrenches for bleed screws on calipers

**Important Notes**

It is imperative that both ends of the car be bled simultaneously when using dual master cylinders. If this is not done, the master cylinders will not be adequately purged of contaminated brake fluid. Further, the balance bar assembly may be severely damaged, leading to a failure of the brake system.

With the car on jack stands and a person sitting in the driver's seat:

- Place a wrench over the inboard bleed screw on one front and one rear caliper.
- Place the bleed hose attached to the bleed bottle over the bleed nipple with the wrenches.
- Open the bleed screws.
- With the bleed screw is open, have the "driver" slowly depress the brake pedal to the floor. With the driver holding the pedal down, gently close the bleed screws. With the bleeder closed, the driver can release the brake pedal.
- Repeat this process until the fluid coming from the calipers is clear and free of all air bubbles.
- Repeat this process for the outboard bleeders.
- Monitor the fluid level in the reservoirs and refill as necessary during the process.

When finished torque bleeders to factory recommended settings Torque PFC bleed screws 48-60 in-lbs. Repeat these steps for the remaining calipers, bleeding the front and rear circuits simultaneously. At times it is helpful to tap the caliper body with a soft mallet to release any small air bubbles trapped inside the caliper. At this point, the brake pedal should be checked for firmness and consistency. If the fluid is free of air bubbles and the pedal is still soft or spongy, there may be further issues that need to be addressed with the brake system. When finished, fill the fluid reservoir to the “full” line, but not over.

#### **Alternate Bleeding Methods**

The methods outlined above are not intended to be the sole methods approved for bleeding brake systems. However, they are reliable and repeatable techniques designed to minimize the cavitations that occur when fluids move too rapidly through small passages and orifices. Bleeding brakes is not a pressure dependent process; it is a flow dependent process. All that is required is the slow and steady evacuation of contaminated fluid and air from the system.

#### **Power Brake Bleeders**

Power brake bleeders operate through applying external pressure to the brake fluid reservoir (pressure bleeders). If a power bleeder system is used, be sure a bellows or rubber diaphragm is used where the power bleeder applies its pressure to the reservoir area. This reduces water or other contaminants from affecting the brake fluid. Vacuum Bleeders apply a vacuum to the bleed screw at the calipers and draw the fluid out the system. These are typically used in car repair shops and are not generally considered acceptable for racing applications.

#### **Closed Loop System Bleeding**

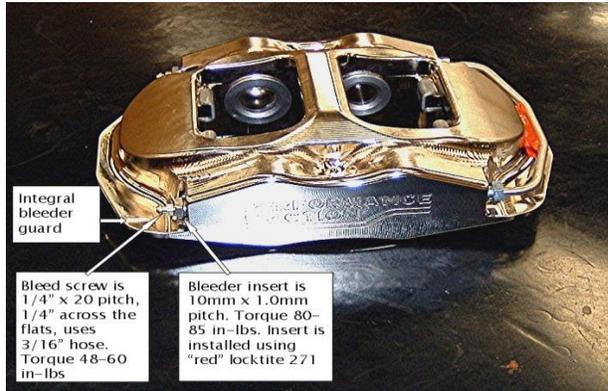
Closed loop systems circulate the brake fluid from the calipers back to front of the master cylinders via a series of check valves when the brake pedal is depressed and released and displace a the small amount of fluid from brake wear. These types of systems add a tremendous amount of brake drag as well as poor release characteristics. PFC strongly discourages the use of these systems.

This does not obviate the need to bleed the brakes, as the brake fluid becomes contaminated, just as in a conventional brake system. If a closed loop system is used, then 100% of the old fluid must be removed before bleeding these types of systems. If the fluid is not replaced frequently, the entire system will become contaminated and failure will result.

#### **Brake Fluid Disposal**

All brake fluids must be disposed of properly. Their ability to combine with water means they can very easily contaminate ground water supplies if disposed of improperly.

**2-Piece Bleeder Assembly**



PFC's 2-piece bleeder assembly may look a bit "agricultural", but it is extremely effective. Once tightened, it won't vibrate out. If the bleed screw is broken, it won't leak. The bleed screws are inexpensive and so ordering spares are highly encouraged. The 1/4 wrench needed should have a narrow head to clear the 3/16" recommend clear hose. Bleed screws have a 5.5mm nipple. Torque bleed screw torque is 48-60 in-lbs.

**900.900.100.03 Series Seal Kit (8pcs, services 4 calipers)**

PFC seals are of a high tension, square "O" ring design. The seals along with the seal groove and caliper stiffness are designed for just right amount of "piston pull" back for low drag and quick release. When re-sealing PFC calipers, it is highly recommended that a small amount of high temperature rubber grease is used such as Dow, Tilton's RG-17 or Castrol's SRF is used as an assembly lubricant. Remove any excess lubricant as it may attract wear debris deposits on the pistons.

**900.900.104.01– Bleeder screw kit (4pcs, services 2 calipers)**

The PFC 2-piece bleeder assemblies require very little maintenance. Be sure the seat and bleed screws are clean of debris. Replace as needed.

**900.900.106.01 – anti-knockback spring kit (4pcs, services one caliper)**

The PFC pistons have been modified to accept anti-knock back springs. The PFC anti-knock back springs are made from stainless steel wire and are rated at 6.5lbs. The tapered coil of the springs pilots around a nub on the backside of piston. If installed properly, the pistons can be retracted completely. If the springs are not piloted properly, the piston will stand proud of the caliper bore and not allow pads to be loaded easily.

Part Number	description
55.255.440.000.11	Zr55 RH Front Trailing w44.0mm pistons/heat caps and insulators
55.255.440.000.12	Zr55 LH Front Trailing w44.0mm pistons/heat caps and insulators
55.255.410.000.01	Zr55 LH Leading rear w41.0mm pistons/heat caps and insulators
55.255.410.000.02	Zr55 RH Leading rear w41.0mm pistons/heat caps and insulators
255.10.0042.03	255mm F2000 single plane discs for Van Diemen/Citation
255.10.0042.04	255mm F2000 single plane discs for Van Diemen/Citation
7832.01.14.44	Race Pads, 01 compound for Zr29/Zr55 PFC calipers
7832.07.14.44	Race Pads, 01 compound for Zr29/Zr55 PFC calipers

**Brown & Miller**

BJB-03-2-7S -2 banjo assembly for –2 fittings

**PFC refurbishing service**

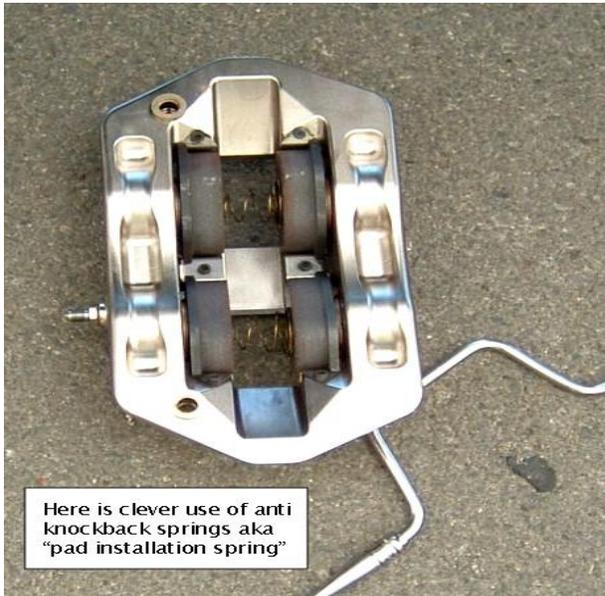
Should there be any questions about the service condition of the PFC ZR55 billet calipers, PFC has refurbishment services. Refurbishment service includes CMM measuring, replacement of all worn items, and 100% pressure checked. Simply contact PFC's customer service dept at **1-800-521-8874** and follow the prompts.

**Shipping address**

Performance Friction Corp. Inc  
Caliper rebuilding dept.  
83 Carbon Metallic Hwy  
Clover, SC 29710

**PFC Brake Pad Notes**

**7832.01.14.44** pads are the baseline compounds. PFC Z55 calipers by design require the brake pads to be installed by removing the calipers and loading the brake pads from within. This can be a tricky proposition especially when hot so heavy duty heat-resistant gloves are highly recommended.



Over the years, PFC has found a simple method to aid with brake pad installation. Using PFC anti-knock back spring kit PN **900.900.106.01**, place pads inside the caliper's throat, piloting the pads on PFC's low drag "C" channel abutments. Place large knock-back springs between brake pads to hold pads in place. This will then free up your hands from having to hold the pads in place. When you reinstall the calipers, the springs simply pop out of the top of caliper.

Torque caliper mounting bolts 40-50 ft lbs. Be sure to use either nickel or copper anti seize as a lubricant.

**7832.07.14.44** brake pad set is PFC's high bite, high torque compound. It has 32% more average bite and torque than PFC 01 compound and when hot, will have excellent release and modulation. 07 pads are highly recommended for right foot brakers, high down force, higher grip tracks. If rear control is an issue on bumpy track conditions but the drivers still wants the higher bite, using 07 front pads with 01 rear pads is a possible solution.

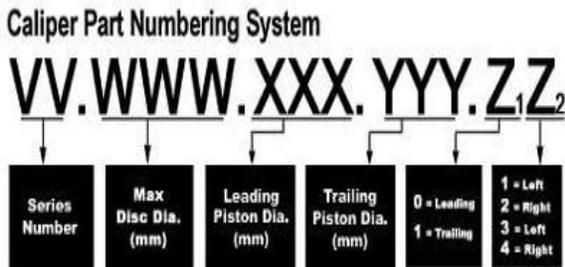
**Bedding New PFC Pads**

If the PFC discs are already used and are in good condition bedding new PFC pads will be a very simple procedure. Brake cooling ducts should be open and fully functional, perform the following procedures. On the out lap, perform a dozen brake snubs with progressively higher pedal pressure and braking force from slow to higher speeds. You will feel the effectiveness of the brakes increase with each successive snub. First the fronts will come in then the rears. The new brake burnishing is typically completed in one or two laps. As soon as the brakes become more responsive the car can be driven normally and at increased speeds. Be sure to check your mirrors for any oncoming cars. Running the car at speed for one or two more laps will allow the disc

to achieve the desired core temperature. If three-color rotor paints are used, the green paint should be fully oxidized and the orange paint beginning to oxidize to white. A transfer layer of pad material will deposit on the disc; this transfer layer is from a slate-gray to a highly polished coloration on the disc friction surface. This is a good indication that the disc and pads have been bedded properly.

## **PFC Buildsheet and Disc assembly instructions**

<b>Part Number</b>	<b>description</b>
55.255.440.000.11	Zr55 RH Front Trailing w44.0mm pistons/heat caps and insulators
55.255.440.000.12	Zr55 LH Front Trailing w44.0mm pistons/heat caps and insulators
55.255.410.000.01	Zr55 LH Leading rear w41.0mm pistons/heat caps and insulators
55.255.410.000.02	Zr55 RH Leading rear w41.0mm pistons/heat caps and insulators
255.10.0042.03	255mm F2000 single plane discs for Van Diemen/Citation
255.10.0042.04	255mm F2000 single plane discs for Van Diemen/Citation
7832.01.14.44	Race Pads, 01 compound for Zr55 PFC calipers
7832.07.14.44	Race Pads, 07 compound for Zr55 PFC calipers



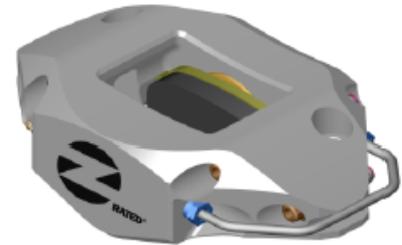
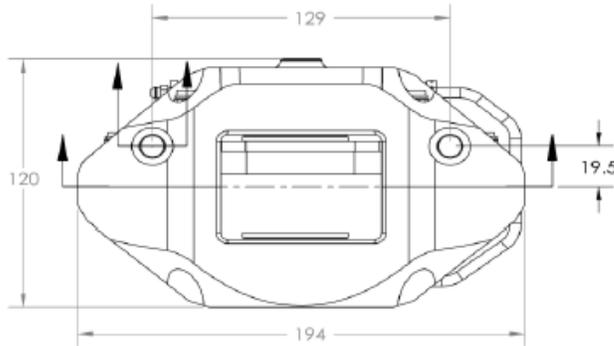
## ZR55 Series Caliper

### Two Piece - 2 piston

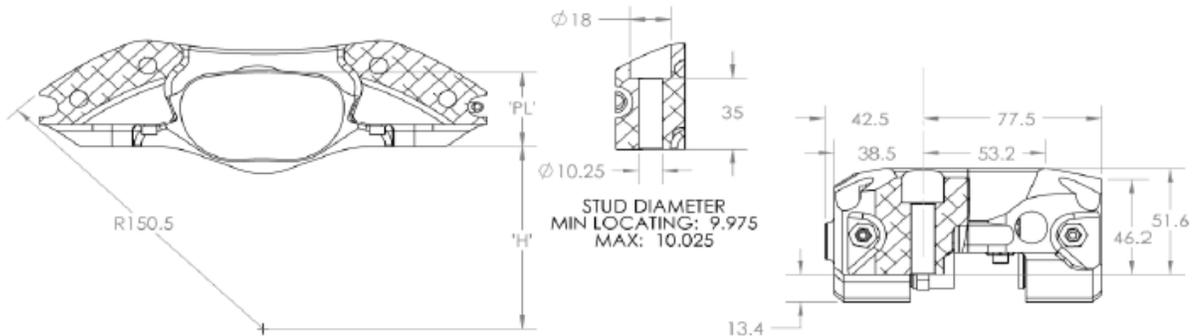
Application	F2000	F2000
Mount Dim. (mm)	129 x 19.5	129 x 19.5
Piston sizes (mm)	44	41
Piston area per side (mm <sup>2</sup> )	1520.5	1320.3
Max disc dia (mm)	255	255
Max disc thickness (mm)	10	10
Min disc thickness (mm)	8	8
Max pad thickness (mm)	14	14
Fluid capacity (cm <sup>3</sup> )	21.3	18.5
Max operating pressure	103bar/1500psi	103bar/1500psi
Pad shape	7832	7832
Pad area per side (cm <sup>2</sup> )	26	26
Caliper weight	1.61kg/3.5lbs	1.61kg/3.5lbs

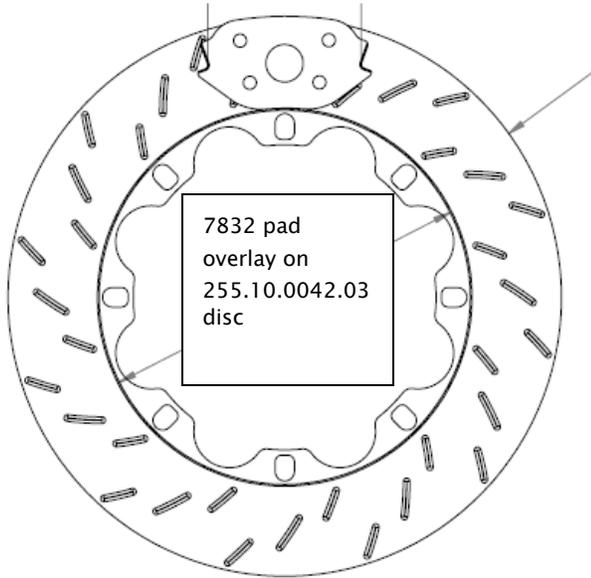
  

Handing	Caliper Part #	Caliper Part #
Leading Left	55.255.440.000.01	55.255.410.000.01
Leading Right	55.255.440.000.02	55.255.410.000.02
Trailing Left	55.255.440.000.11	55.255.410.000.11
Trailing Right	55.255.440.000.12	55.255.410.000.12



55 Series Caliper				
Rotor OD(mm)	Pad Shape	Eff. Radius (mm)	H' Dimm (mm)	'PL' Dim(mm)
255	7832	105	88.8	36.1





#### **Disc-Hub Assembly Instructions**

The Élan bobbins **PN 95J0001 DP08** attachment system has been used successfully for a number of years, worldwide. Before installing new PFC discs, check the **Front and Rear hubs** for flatness and inspect the mounting holes for roundness. If the hubs mounting holes are elongated from wear, then replace. True position, true flatness and uniform torque take-out is the desired result as a system.

When installing new discs, it is highly recommended that new bobbins be installed as well or get into the habit of changing orientation of the flats of the bobbins when changing discs. Assemble using a very small amount of nickel anti-seize on the flats of the direct-drive bobbins and threads.

Torque 70-80 in-lbs in a star-like sequence. Check for float by using a soft blow hammer and listen for the “rattle”. Lateral float

is held at .012-.018”.

#### **PFC disc conditioning**

Thermal fatigue of iron discs is a common wear factor. Ideal temperatures for a single plane disc are about 500c (900f). Using temperature sensitive paints is highly recommended. PFC recommends the 50-100% of the orange paint be oxidized from the brake disc cheeks through the disc’s cores. This will reduce temperature variation and help minimize disc face fatigue. When the disc face has tension cracks in excess of 6-8.0mm long, the discs are done and it’s time to replace. The PFC discs incorporate a patented slot pattern. The unique slot pattern aids to removal pad material debris without disrupting the pad’s interface with the disc’s surface for increased bite. It is not unusual to see a “rippled” look to disc’s transfer layer from the PFC pads. This rippling is simply the debris path of the friction material. It has little or no effect to the braking performance. The 01 pad transfer has a “grey slate” color to it, the 07 has more of a “polished” look to it. Both feature a fine micronic conditioning of the disc’s surface.

#### **Bedding New Performance Friction Brake Discs**

Ensure that the brake discs are clean and free of grease or other contaminants. Once the discs and pads are installed perform the following procedure with brake cooling ducts fully open and functional—no tape! Best results are achieved using new Performance Friction brake pads. It is not necessary to bed in new PFC discs with used PFC pads.

On the out lap, perform a dozen brake snubs with progressively higher pedal pressure and braking force from slow to higher speeds. You will feel the effectiveness of the brakes increase with each successive snub. First the fronts will come in then the rears. This should take six to ten brake snubs and is typically completed in one

or two laps. As soon as the brakes become more responsive the car can be driven normally and at increased speeds. Be sure to check your mirrors for any oncoming cars.

Running the car at speed for one or two more laps will allow the disc to achieve the desired core temperature. If three-color rotor paints are used, the green paint should be fully oxidized and the orange paint beginning to oxidize to white. A transfer layer of pad material will deposit on the disc; this transfer layer is from a slate-gray to a highly polished coloration on the disc friction surface. This is a good indication that the disc and pads have been bedded properly.

Note: Sanding/machine grinding the discs will not decrease the bedding time. Whenever new Performance Friction pads are installed, the pads require very little cool down time. Usually the time spent taking tire temperatures and a debriefing with the driver is sufficient.

In closing, Performance Friction Corporation, Inc has produced a robust brake system with many features to address the most severe brake conditions. The PFC brake package has also addressed dynamic brake balance with proper piston sizing and has incorporated unique torque take strategies to greatly reduce brake drag.

PFC has open wheel racing in its corporate DNA and we openly invite inquiries. Please feel free to call 800-521-8874 should you any questions and ask for the race department.