WHAT MAKES A PTT CLUTCH BETTER THAN THE COMPETITION?

Competitive Edge - Highly Engineered; Extreme levels of Performance; Ease of Use; Quality; Dependability. These are the terms that have come to be associated with products from PowerTrain Technology
Low Moment of Inertia - Critical weight is removed from the largest diameters of rotating parts, where it reduces MOI the most. Low MOI means more of your engine's horsepower gets to the drive wheels. This results in quicker acceleration and better fuel economy.
Size - Fits into a smaller work envelope due to improved design and flush mounted fasteners. Approximately .250" shorter overall than other competitors' clutches.
Better control - Optimized clutch cover design, means lower pedal effort, better modulation or drivability and better control.
Cooler running - Open housing design means improved cooling and dust evacuation.
Better balance - Power-V clutch leg design offers a level of performance that is superior to other competitor's designs. Power-V makes the clutch components self centering and therefore self balancing under load.
Proprietary friction materials - State-of-the-art clutch friction materials feature smoother engagement characteristics and longer life.
Micro-finishing - PTT clutch discs are ground to an extremely fine finish. This eliminates excessive clutch wear and any bedding-in requirement.
Alignment - Clutch positively locates with a stepped flywheel register. This results in improved actuation, and improved balance.
Precision - CNC machined to very tight tolerances using state-of-the-art machines, materials, and finishes.

HOW TO SELECT A RACING CLUTCH

Circle track racing clutches are designed to be as light in moment of inertia (MOI) as absolutely possible. You always want to select the lightest clutch and drivetrain components that you can for your type of racing. The only exception to this has to do with durability. In order to finish first, first you must finish! The clutch you select will be a fine balance of lightweight performance combined with rugged durability. Which clutch you ultimately select is based upon several other factors as well.

1. Insure the clutch you are considering conforms to any rules set forth by the sanctioning body which governs your type of racing.

2. The peak torque capacity of the clutch you select is based upon how much peak torque your engine makes (not horsepower). The torque capacity for a clutch is the clutch's highest ultimate torque rating. To properly size a PTT clutch to your application you should multiply the engine's peak torque by 1.25 (minimum) and select a clutch that has at least as much or more, torque capacity. For instance, if your engine has a peak torque of 400 lb. ft. multiply 400 by 1.25 (400 x 1.25 = 500). Therefore, in this example, you would select a clutch that has a torque capacity rating of at least 500 lb. ft. For all wheel drive (AWD) cars, you should use a 1.5 multiplier.

Engines that have unusually high harmonic vibration, such as inline 4 cylinders, or inline 6 cylinders or extremely light rotating assemblies (light cranks and pistons, Ti rods, no harmonic damper, etc.) should be rated using a 1.5 multiplier.

When selecting a multi-disc racing clutch, the number of discs in the clutch assembly usually determines the torque capacity of the clutch. For instance a two disc clutch has twice as many friction surfaces, so it has twice as much torque capacity as it's similarly sized one disc variant. Likewise a three disc clutch has three times the torque capacity, and so on.

Remember it is important to always specify a clutch with more torque capacity than needed. Always round up when it comes to selecting a clutch with the proper torque capacity. This avoids the possibility of slippage, which will quickly destroy a racing clutch due to excessive heat buildup. Avoid using a clutch with a torque capacity of 2.0 or more times the engine's peak torque rating (see PTT Clutch Facts: Too much clutch torque capacity?).

3. Heat is a racing clutch's mortal enemy. Every time you slip the clutch, the clutch friction surfaces generate heat. You should always try to conserve your equipment by keeping the heat build-up in a racing clutch to an absolute minimum. This is best accomplished by using the minimum engine RPM necessary to get the car launched, and/or slipping the clutch for the shortest amount of time, needed to get the car moving. Matching engine RPM on downshifts also helps reduce clutch heat build-up (and excessive wear) immensely. You should NEVER slide or 'fan' the clutch coming off a slow corner to make up for a wrong gear ratio, resulting in the engine being too low in its powerband. The amount of heat generated doing this to a small multi-disc clutch will damage it in a short time.

HOW TO SELECT A RACING CLUTCH (continued)

4. Select a size clutch that matches your racecar weight. Lightweight cars (formula cars, small 4 cylinder cars, etc.) can use the smallest clutches. (4.5") Heavier cars will need to go up in clutch diameter. If your racecar has a tall fist gear, or a tall final drive ratio, you might want to consider going to a larger diameter clutch than you would normally install. The highest weight, highest horsepower cars will need to be on larger diameter clutches, with multiple discs.

The primary consideration in selecting the diameter of the clutch comes down to balancing durability against performance. A smaller clutch will give the car better performance. The bigger clutch will give you the durability to finish the race. All things being equal, a 4.5" clutch has approximately half the MOI of a 5.5" clutch. A 5.5" clutch has about half the MOI of a 7.25" clutch. The performance benefits with a clutch that has half (or one fourth!) the MOI of larger clutches are tremendous.

It is important to understand that a smaller clutch is much more sensitive to heat build-up. As a result, the driver must be careful to drive the smaller clutch within its limits. Just as conserving your tires is important, so is conserving your clutch. To help you understand how critical this is, think of a 4.5" clutch as a cup of water, and think of a 5.5" clutch as a gallon of water. Now put both containers of water on the stove to boil. Which one boils sooner? Obviously the cup of water boils sooner, due to its lower mass. Think of slipping the clutch as being equivalent to putting the water on the hot stove. Lower mass can be a great help in getting around the race track faster due to lower MOI, BUT you have to be careful to not overheat the clutch! With a small clutch you should always push your car around in the pits, never drive the car on the trailer, and avoid slipping the clutch. In the heat of the battle, it is always better to break the tires loose to get the car going, rather than excessively slip the clutch.

5. Getting maximum life out of your clutch is an acquired skill. First you must ask yourself, "How good is my driver?" Does he/she have multi-disc racing clutch experience? Can he/she make a racing clutch pack last a full season or more? If the answer is yes, select the smallest clutch you can afford that meets the torque requirements, vehicle weight, and gear ratio guidelines specified above.

If you have a newer, less experienced driver you may want to add an extra disc to your clutch assembly. This will help the clutch withstand more heat abuse, while still improving the racecar's performance over a larger clutch with fewer clutch discs. If you have the choice of adding a disc to a small diameter clutch or going to the next size larger clutch, adding the disc is a much better performance and durability decision. Generally the next bigger size clutch roughly doubles the clutch MOI. As the driver's performance (skill with the racing clutch) improves, it is inexpensive to get a shorter clutch cover, and remove one clutch disc and floater plate.

PTT CLUTCH FACTS

Clutch torque improvement. The torque capacity of all PTT clutches increase as the clutch wears. As the clutch wears, the clutch will transmit more torque! Once you understand this little known fact, you can rest easy in the knowledge that if the clutch does not slip when it is initially installed then, like a fine wine, it will only get better with age.

Too much clutch torque capacity? Sizing the clutch torque capacity to your application is covered elsewhere (see How to select a clutch) however it should be noted that it is possible to have too much clutch torque capacity. You should avoid having more than twice the engine torque for the clutch torque capacity. You want the clutch to slip if a sharp torque spike is transmitted back up the drivetrain from the drive wheels, such as if a driver experiences wheel-to-wheel contact with another competitor, the wall, or upon impact with a stationary object that suddenly stops the drive wheels. This helps avoid expensive engine or gearbox damage.

Custom torque capacity. PTT clutches can be custom tailored for a lower release load by installing a diaphragm spring with a lighter clamp load. This is frequently done for two reasons. It reduces pedal effort to the driver, and it reduces the force imposed on the engine's crank thrust bearing. This helps reduce driver fatigue in longer endurance events, while improving engine durability. A lot of smaller 4 cylinder engines cannot withstand the excessively high release loads imparted from some aftermarket racing clutches. PTT's clutches with lower release loads reduce the chance of expensive engine rebuild costs due to 'crank walk'.

PTT CLUTCH FACTS (continued)

The torque capacity of a PTT clutch can be changed in three ways:
1. Install a high-torque pressure plate instead of a regular pressure plate. This pressure plate has a reduced diameter fulcrum. Installing a high-torque pressure plate will increase the torque capacity of a clutch with NO increase in spring clamp load or pedal effort.
2. Select a different diaphragm spring. PTT diaphragm springs are rated from 'AA' to 'C'. Standard clutches come with 'A' rated springs. Changing from an 'A' spring to a 'AA' spring will increase the torque capacity. Conversely, changing from an 'A' spring to a 'B' spring will reduce the torque capacity. Typically springs are changed to accommodate pedal effort requirements just as much as for peak torque capacity.
3. Select a different friction material. PTT offers bronze metallic, organic and iron metallic based friction materials. Different friction materials offer different coefficients of friction (Cf). A different friction material could be selected for its drivability as well as its ultimate torque capacity.

Maximum clutch release load limits. All PTT clutches are designed to not exceed 800 pounds of force during release. Some unknowledgeable clutch manufacturers will install two standard diaphragm springs into a clutch cover and call it high performance. This is irresponsible, and demonstrates a lack of good engineering judgment (or no engineering at all!). Although it will double the torque capacity of the clutch, it also doubles the load to the engine's thrust bearing, causing its early failure, and expensive replacement.

FRICTION MATERIALS

SINTERED BRONZE METALLIC - PTT's standard friction material is a proprietary sintered metallic material that has been custom blended to meet a variety of different requirements. It is also ground to an extremely fine surface finish. This eliminates excessive clutch wear the first time the clutch is used. It also requires no bedding-in when first installed. Standard thicknesses available in this material are .105", .200", or .250" thick. The thickness of the disc for use in your clutch is determined by the type of use it is put to. Generally speaking, a thicker disc would be selected if the clutch is going to be consistently subjected to higher operating temperatures brought about by lots of slippage.

For the most part, you can plan on approximately 300 lb.ft. of torque capacity per 7.25" disc. PTT metallic friction materials stand up to extreme heat abuse better than organic friction materials do.

ORGANIC - Organic friction materials have a softer, more forgiving engagement characteristic. PTT organic discs have a higher coefficient of friction (Cf) than some metallic linings offered. Using a clutch cover with the same clamp load (diaphragm spring), the organic material will deliver a higher clutch torque capacity. GENERALLY, you can plan on approximately 400 lb. ft. of torque per 7.25" disc. Organic friction materials lose Cf as the lining temperature goes up. If you get an organic clutch hot, and it slips, let the clutch cool down to avoid costly damage to the rest of the clutch components due to excessive heat.

SINTERED IRON METALLIC - PTT's highest Cf friction material. If you have a difficult application, and need every last lb.ft. of torque capacity then this is the material for you! When used in a single disc, 7-1/4" clutch this iron material has a torque rating in excess of 600 lb. ft. In many situations, this clutch will allow you to go from a standard 2 disc clutch to a 1 disc clutch in order to reduce static weight and MOI This material drops Cf moderately with increased lining temperature. It is also 'grabbier' than our velvety smooth bronze material, which most drivers will find more difficult to initially learn how to drive.

MOMENT OF INERTIA

Moment of inertia, (MOI) or more properly called angular moment of inertia as it applies to rotating (racecar drivetrain) parts deserves important consideration. The reduction of MOI in your racecar's drivetrain will pay big dividends in your car's performance. First let's consider how MOI is calculated. The MOI of rotating parts can be solved by the formula $\frac{1}{2} MR^2$ where M = mass and R = radius. This means that one half the mass of a rotating part times the radius (squared) of the rotating part will give us the MOI of the part expressed in lb./in.^{2}. Let's solve for the MOI of a simple flywheel:

Let's say we have a flywheel that weighs 12 pounds and is 10" in diameter.

Mass (M) = 12 and Radius (R) = 5

$\frac{1}{2} \times 12 \times 5^2 = 150$ lb./in.^{2}

MOMENT OF INERTIA (continued)

Now let's take our 12" flywheel and put it on a diet. Let's turn 4 pounds off of it to reduce its weight down to 8 pounds. (That is a full 1/3 reduction in weight!)

Now, M = 8 and R = 5

$\frac{1}{2} \times 8 \times 5^2 = 100$ lb./in.^{2}

This shows that a 1/3 reduction in weight results in a 33% reduction in MOI.

Now, let's reduce the size of the flywheel to a 6" diameter but for comparison sake we will say that it still weighs 12 pounds.

Now, M = 12 and R = 3

$\frac{1}{2} \times 12 \times 3^2 = 54$ lb./in.^{2}

This shows that a 50% reduction in size results in a 64% reduction in MOI, even though it still weighs the same!

If you reduce the size of the flywheel to a 6" diameter **and** reduce the weight to 6 pounds you have ½ x 6 x 32 = 27 lb./in.^{2}, a full **82% reduction in MOI**.

Low MOI shows up as a benefit in your race car in several different ways:

Low MOI Advantage #1

On acceleration the engine's horsepower is more efficiently transmitted to the drive wheels. Due to the fact that this extra power is not being absorbed by having to spin up the excess inertia of the heavier clutch and flywheel the racecar with the lower MOI driveline parts will out-accelerate a racecar with heavier MOI driveline parts.

Low MOI Advantage #2

On braking when coming up to a turn, the racecar with the lower MOI driveline parts decelerates harder, with less braking. This is due to the fact that the engine has much less 'flywheel' effect due to the lighter clutch and flywheel. This increased braking from the engine will result in less brake pad wear and less stress on the rest of the racecar.

Low MOI Advantage #3

Lower MOI parts take less horsepower to accelerate. This can result in lower fuel consumption. In an endurance event this can add up to a substantial fuel savings. Perhaps enough to alter your pit stop strategy.

Low MOI Advantage #4

Low MOI rotating parts usually also have lower static weight. This allows the racecar designer to reduce the car's weight. If the class has a minimum weight and the car is already under that weight, it allows the designer to put the ballast where it will help the car's handling the most.

Q. Is it more important to reduce the static weight of your racecar, or reduce the MOI of your car's rotating parts?

A. It is generally recognized that there is about a ten to one advantage in favor of reducing rotating MOI over static weight reduction of the racecar. Let's face it, if you have the chance to remove just one pound of rotating weight from your flywheel, you will see an immediate and noticeable improvement in the racecars acceleration. On the other hand if we put a ten pound brick in your racecar without your knowledge, you probably would not even realize it was there.

Every spinning part PTT engineers is built with an eye towards low MOI, while still paying critical attention to rugged reliability. It is this low MOI that gives you the unfair advantage over your competition.

You may be fast, but PTT racing products will make you go faster!

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