

# B-Series Ultimate Builder's Guide

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Building an engine can be a daunting process. So we've taken the time to break down what we've learned in over 20 years of engine building and racing experience to help users new and old alike have an understanding of what common combinations of engines are capable of as well as create a list of stepping stones for someone wondering what their next modification should be.

Keep in mind when reading this guide: **everyone has opinions and different experiences. The horsepower numbers that we give are not hard rules, but a general guideline. Your mileage may vary, but hopefully we can put your expectations in the right realm of thinking.**

## INTRODUCTION

The biggest draw to a honda powerplant is the wide breadth of customization and build options. That being said, this guide is not the hard and fast rule on how to build an engine, but rather a general guideline of what we've used successfully for over 2 decades. Each part we list is available to purchase on our webstore, and we also offer packages in conjunction with this guide to make your shopping experience easier. If you want to show appreciation for this walkthrough, please be sure to check out our store for all your performance needs.

## 1.0 ENGINE BLOCK

### *1.1 QUICK AND DIRTY GOAL SETTING*

The first part of any build should start with a general idea or goal of your ultimate outcome.

Below is a quick and dirty guide on what power modified B-Series typically can hold safely.

#### ***Stock Engine B-Series***

B18 LS: 250-300WHP

B18 VTEC: 300-350WHP

B16: 250-300WHP

B20: 225-250WHP

#### ***Stock Sleeve + Aftermarket Rod/Piston/Spring/Retainer B-Series***

B18 LS: 400-500WHP

B18 VTEC: 500-550WHP



B16: 450-500WHP

B20: Don't.

### **CSS B-Series**

B18 LS: 500-600WHP

B18 VTEC: 700-900WHP

B16: 700-900WHP

### **Sleeved B-Series**

B18/B16/B20: 1000+WHP

Seeing those numbers should allow you to put an idea in your head of what you can build to. The average streetable horsepower in our experience is in the realm of 400-500WHP, anything past 500HP typically results in nothing but spinning. To put 400-500WHP in perspective, a full weight civic at that power range will run a low 11 to a high 10 second pass on the 1/4 mile.

## **1.2 Stock Sleeves vs. CSS**

We've proven it time and time again. A stock sleeve B-Series engine can hold power. We've made upwards of 700HP on stock GSR sleeves and made multiple 9 second passes, over 200 dyno passes and never cracked a sleeve. That being said, it should be noted: a stock sleeve B18 over 500HP is a **timebomb**. If you are on a budget and want to make the most power, pushing the limit on stock sleeves is **not** a good idea. If you're wanting to make 500+HP on a limited budget, you are better off buying a CSS for the extra \$350 insurance, because that initial \$350 investment will save you the labor and parts that cost more than \$350 to replace your broken engine. If you're building an engine for 500+HP nowadays, unless you're going for BIG power, CSS should be a no brainer.

## **1.3 Sleeves vs. CSS**

In our experience, we get a lot of phone calls from people asking about a sleeved engines for higher power street cars. While sleeves offer an extremely robust and pretty much bulletproof block, for a street car, we typically err on the side of a CSS (Cylinder Support System). The major benefit being cost. You're saving about \$1000 vs. sleeves to run a CSS, and for 90% of our customers, a CSS is perfectly adequate. CSS is limited to 81-82mm bore, and we recommend running a .020 over piston in a CSS block to ensure cylinder roundness. If your plan is to mainly be a high power track oriented car that needs to eek out every inch of power on a big bore engines, sleeves take priority.

## **1.4 B20 Turbo Problems**

The B20V is a great setup for a budget N/A car, but due to a poor sleeve design, we do not recommend a B20 for turbo applications. The sleeves are so weak that breakage is never a matter of if, but when. There is no way to reinforce the sleeves adequately to alleviate the breakages, your only option is to sleeve the

engine. After sleeving, the engine can hold whatever you throw at it. On average, B20 sleeves break around 300HP like clockwork.

### **1.5 LS/VTEC vs. VTEC**

Optimally, you would find a full VTEC B18, but the LS/V is still a great option. There are several design differences, but for the average street car, the differences are miniscule. High power LS/Vs are just as reliable as GSR/ITR engines. Compared to a full LS engine, The LS VTEC is a drastic improvement due to head design and VTEC. We tend to stay away from non-vtec B18 engines due to their lack of capability compared to the LS/V due to head flow and design. The LS/V is a cost effective way to make the most potential out of your build.

## **2.0 INTERNALS**

Now it's time to get to the nitty gritty of selecting parts for the engine. We're going to start from the bottom up.

### **2.1 Bearings**

ACL Race Bearings are our go to bearing. When assembling, make sure you check or have your machine shop inspect your journals for the appropriate oversized over undersized bearing.

### **2.2 Connecting Rods/Pistons**

Rods/Pistons should always be one of the first items you think about. For the average street car, we recommend our Humble Performance Bottom End Kit. We offer several stages for street to strip. Our Street Kit is our go-to setup for all sub 700HP cars. A good piston/rod package is probably one of the most important items in a performance build and should never be skimped on.

### **2.3 Oil Pump**

The oil pump is the lifeblood of your engine. Honda OEM is the best pump, period. For higher horsepower/higher revving applications, we always recommend the 4Piston Ported Oil Pump. As stated earlier, for a street car we recommend up to 500HP, because anything past 500HP typically results in excessive tire spin. The result of excess tire spin is a broken oil pump, there are several ways to combat breaking oil pumps, reducing tires spin and installing an aftermarket harmonic balancer like an ATI Fluidampr.

### **2.4 Water Pump**

OEM.

### **2.5 Head Gasket**

A multi-layer steel head gasket is a necessity for turbo applications. We run Cometic headgaskets on every car. Usually a .040 thickness, but thickness should be determined by your cylinder head and engine block deck measurements.

## **2.6 Head Studs**

Standard ARP or SpeedFactory 4130 head studs are perfect for almost all street builds. If your goal is over 700WHP, we recommend the ARP L19 head studs to prevent head lift.

## **2.7 Springs/Retainers**

Springs and Retainers should be addressed for any B-Series engine trying to make over 300HP. Valves will hold power up to 500 safely, but the OEM Springs and retainers should be replaced to avoid dropping a valve and catastrophically destroying your engine. Check out our head packages for more information on selecting the appropriate parts for your cylinder head.

## **2.8 Valves**

For valves, we solely use Ferrea products. Ferrea 6000 valves are our go-to for every street car. For a track oriented car making upwards of 600HP we recommend the Competition Plus valves on the exhaust side. After 800HP we started bending 6000s like clockwork, but the Comp Pluses are built to sustain heat and are used in engines of upwards of 1200WHP.

## **2.9 Lost Motion Assembly**

Replace the OEM LMA for Skunk2 Lost Motion Assembly and never look back. The OEM LMAs are prone to failure.

## **2.10 Camshafts**

OEM Camshafts can take you a long ways. If you're running a bigger turbo and need to start picking up power, we've seen massive gains of over 70+HP in the midrange using the Skunk2 Pro1 Camshafts. For our high horsepower applications, we've worked with a manufacture to develop a custom camshaft that you can purchase here.

# **3.0 PERFORMANCE MODIFICATIONS**

After all the parts for the engine have been selected, it's time to start buying parts like the turbo manifold, intake, turbocharger etc.

## **3.1 Turbocharger**

Sizing a turbocharger is a balancing act of peak power and usable power. Here's our general guide to selecting a turbocharger for your application.

400-600HP **5858** Fast Spool/Broad Powerband Great Street Turbo

600-700HP **6062** Fast Spool/Broad Powerband Great High HP Street/Strip Turbo

700-800HP **6266** Moderate Spool/Good Powerband Great High HP Street/Strip Turbo

800-900HP **6466** Moderate Spool/Peaky Powerband Great Strip Turbo/Moderate Street Turbo  
900-1100HP **6870** Long Spool/Peaky Powerband Great Strip Turbo

### 3.1.1 Ball Bearing vs. Journal Bearing

Should you select a ball bearing or a journal bearing turbo? Ball bearing carries several benefits over journal bearing including spool time and reliability. But comes at the added prices. If you have the money to buy a ball bearing, it's a good idea to run a ball bearing turbo, but not a necessity. Some turbos, like the 6466 only come in ball bearing. Gen 1 Precision Turbos did carry some reliability issues, but since the release of the Gen 2 turbos, we've seen some really impressive numbers and reliability has been dead on.

### 3.2 Wastegate

There are two major contributors to boost control issues. The turbo manifold, and the wastegate. When looking for a wastegate, sizing is crucial to proper low boost control. If you size the gate too small on a bigger turbo, the exhaust gasses will overcome the wastegate and commanding low boost will become impossible. Anything bigger than a 6266 we always suggest a 60mm gate or twin 44 setup, a single gate can be used on a larger turbo if the turbo manifold design is up to the task, but these numbers are for a general idea.

5858	38mm Wastegate
6062-6266	44mm Wastegate
6466 and Up	Twin 44mm Wastegates or 60mm Wastegate

### 3.3 Turbo Manifold

If there's any part I cannot stress enough, it is **do not cheap out on the turbo manifold**. Many people will buy the cheaper, thin walled ebay ramhorn manifolds and run into cracking issues. We've seen everything from runners breaking to wastegates blowing off the manifold. Make sure you buy a high quality manifold. It might hurt in the beginning, but most reputable builders carry lifetime warranties in the event of cracking whereas you'll spend a lot of downtime pulling your turbo and rewelding poorly constructed manifolds. Our two favorite brands for manifolds are Go-Autowerks and KLM. Both companies are staples in the Honda industry and carry great craftsmanship.

#### 3.3.1 Ramhorn vs. Top Mount

There are many great manifold options available for the B-Series and several designs, but the two most common designs are the ramhorn and the top mount. Both come with pros and cons, and you honestly can't go wrong with either of them. A ramhorn offers faster spool but can limit top end power, whereas a topmount manifold won't have the same response as a ramhorn, but it makes up in top end power. For a smaller street setup, pairing with a ramhorn for quick usable power is a great idea. For a strip focused car, a top mount allows you to get the most of a big turbo. Ramhorns are great for people wanting to retain A/C

and power steering as most options allow for it. There are top mounts that are a/c p/s compatible as well, but they are not quite as common. Both can work great on the street, just be conscious of your turbo sizing and overall goals.

### **3.4 Intercooler + Piping**

The intercooler is pretty straightforward. There are many options available on the market. Many people will cheap out on intercoolers for street setups and do fine sizing will just be crucial. When selecting your intercooler, be sure to read the specs and flow rate to see what it supports. When running over 600+WHP higher end intercoolers become more crucial. We suggest selecting the appropriate KLM or Go Autowerks Intercooler for your setup.

#### **3.4.1 Intercooler Piping Sizing Guide**

2.5" Intercooler Piping to 600HP

3.0" Intercooler Piping to 800HP

3.5"+ for 900+HP

2.5" Piping is effective to more than 600HP, but as a general rule of thumb, when sizing piping for a customer car, if we know they want to make 600HP off the bat, they're going to want to make more power later. Consider it future proofing.

#### **3.4.2 Blow Off Valves**

Blow off valves are recommended to prolong the life of your turbocharger. There's no real guide to them, most will work. Cheap ebay ones tend to leak and can cause the turbo to go into an overspeed condition. Be sure to buy a quality valve like a Tial, genuine HKS, Turbosmart, etc.

### **3.5 Intake Manifolds**

The stock intake is plenty capable for power for a street car, but when you start making 500+, it's worth looking into breathing mods. There are several intakes that work great for every application.

The Skunk2 Pro Intake holds plenty of power and has been a goto for quite a while. We recommend the Pro for mild street builds under 500HP.

The Skunk2 Ultra Street is a great street/strip intake manifold, it's paired well with a good 6062 to 6466 turbo setup and will allow for plenty of power to be made. 500-700HP

The Skunk2 Ultra Drag is the big daddy manifold. A big plenum for big power, on a 6466+ Setup there are some large gains to be made. If you're shooting for 700+HP The Ultra Drag should definitely be on your list. Notable mention: The Edelbrock Victor X is a great manifold for a budget. If you're looking for 500-800HP, the Victor X is a good budget alternative.

#### **3.5.1 Skunk2 Ultra Drag Accessories**

For the Ultra Drag Manifold, paired with a 2L Plenum Spacer and a 90mm throttle body, we've seen some massive horsepower gains when compared to an Edelbrock Victor X setup. For a strip only car, the Ultra Drag is our 100% go to manifold. For added power, 4Piston also offers CNC porting for the manifold for maximum output.

### **3.6 Engine Mounts**

Your engine mounts hold the engine in place. Don't cheap out. Hasport mounts are the best mounts on the market and have been a mainstay forever.

60A - 100-400HP Minimal vibration, easy Driver

70A - 500-600HP Some vibration but not teeth shattering

88A - 600+HP Heavy Vibration, but still driveable

94A - 900+HP Strip priority car, streetability is not a priority.

6061 Solid - 900+HP Extreme Vibration recommended for racecars only.

## **4.0 DRIVELINE**

### **4.1 OEM Transmission Selection**

For a turbo car, the best stock gearset is a GSR Transmission with a 4.4 final drive. This transmission works well on the street and is geared almost perfectly for the 1/4. We typically take stock GSR gearsets to ~500-600WHP and have run multiple 9 second passes on them.

#### **4.1.1 Highway Cruising LS 5th Gear**

Many people looking for a street/strip car will install the 5th gear from a B18 LS transmission into a GSR for a nice low RPM cruising gear for highway driving. This is a great modification for someone not wanting to cruise on the highway at 4000RPM for hours on end.

#### **4.1.2 Strengthening the Case**

When pushing the power limits of the car 800+ on the dragstrip, many people have run into the issue of cracking transmission cases. There are several remedies, many weld reinforcements into the transmission case to keep it together. The other solution is running a Libert Billet Bellhousing.

### **4.2 Axles**

For a street and street strip car, the best cheap axle you can run is OEM or Autozone Lifetime warranty axles. We regularly take stock axles to 500+HP and have made multiple 9 second passes on OEM axles. If you're looking to make more passes at the track, there are a couple options. The Driveshaft Shop makes several great options that are guaranteed to get you A to B reliably without worrying about breakages. The second option is a lesser known option. OEM 36mm RSX Axles. We replace the hubs with Karcepts 36mm Hubs and

run 36mm OEM axles without worry in several cars. Most notably, our 900HP SFWD build 'La Y'Axiel' went 9.0 on 36mm Axles without breaking a sweat on countless launches. If you're looking to get serious, Driveshaft Shop 5.9s are borderline unbreakable, but come with a pricetag.

#### 4.2.1 A Tip For Not Breaking Axles

One of the biggest issues we see with axle breakages is driver error. I cannot stress this enough. **PRELOAD**. Preloading is the act of lightly engaging the clutch while holding the car in place with the parking or staging brake. This removes shock load from the axles, and gearset and will make the driveline last much longer. If you can properly preload, your axles will thank you.

#### 4.3 Clutch

For up to 600HP we recommend the Competition Clutch Stage 4 for a street driven car. If you plan on tracking your car more, we recommend the Competition Clutch Super Single. Both clutches have roughly the same torque capacity, but the super single shifts at high RPMs with more ease than a Stage 4 at the cost of some driveability. Over 600HP is twin disk territory. A twin disk does not have anywhere near the driveability of a single plate full face disc, but it has significantly more torque capacity. There are some twin discs on the market with street/strip in mind like the Clutchmasters 750. 1000+ Becomes Triple Disk territory.

### 5.0 FUELING

There are many ways to approach a fuel system, so we're going to break down some of the basic concepts for you.

#### 5.1 Fuel Type

For a street car, there are typically 2 options. Gasoline or E85. We strongly recommend E85 for any 500+HP Street cars. E85 is a robust fuel with high detonation resistance. It's a great fuel and in our area, we only see roughly E68 and have regularly made 700+HP with zero knock. The only reason I would err on the side of gasoline would be availability and if you plan on making long trips regularly (but Flex-Fuel is an option!). E85 does come at the cost of increased maintenance and worse fuel economy, but the upsides are tremendous in terms of reliability and power. This fueling guide will carry information for both E85 and Gasoline

##### 5.1.1 E85 MAINTENANCE

With E85 comes increased maintenance. Here are some quick tips to make sure your ethanol based fuel system stays in tact.

- 1.) Drive the car regularly. If you are going to let the car sit for more than 3 weeks, you need to pickle the fuel system with gasoline to remove the corrosive ethanol from the system.
- 2.) Any time you're about to do maintenance that involves removing injectors from the engine or fuel rail, either pickle the system or **IMMEDIATELY** have the injectors cleaned, if injectors are out of the fuel rail for



more than a few days, the potential for them to seize is extremely high. This is especially true for injectors without stainless internals like most 2000cc injectors.

3.) If you are running aftermarket fuel lines, make sure they are E85 compatible, PTFE lines preferable.

4.) Make sure you run an adequate fuel filter system. Injector manufacturers call for a certain micron filter for injectors.

## 5.2 Fuel Pressure

Before jumping into injector and fuel pump sizing, one must understand fuel demand. Your standard fuel system will run a base fuel pressure of 43.5psi. As your car comes onto boost, fuel pressure will rise. So at 30psi of boost with a 43.5psi base pressure, your fuel system will be running at 73.5psi.

Why is that number important? Injector flow rates and fuel pump flow rates change as fuel pressure changes. A '450lph' Walbro pump doesn't ALWAYS flow 450lph. In fact, Walbro fuel pumps are rated at 0psi pressure, whereas the pump we recommend, the Deatschwerks DW400 flows 400lph at 40psi of pressure. Why is that important? Because as fuel pressure goes up, flow goes down. Don't be confused by the nomenclature, calculate your fuel pump and injector demands based on how much boost and base pressure you're going to run.

***Adjusting your fuel pressure using an aftermarket fuel pressure regulator is a must on 400+HP street cars.***

Our standard turbo street cars are usually set at 60psi base pressure and will see boost levels of 30-35psi on average on the dyno. That means we need a pump that flows enough volume for a 90-95psi of fuel pressure, and that's why we choose the DW400 as our standard turbocharged streetcar fuel pump.

## 5.3 Fuel Lines

The standard EG/DC/EK fuel lines are pretty adequate up to 600-700WHP dependent upon your fuel pump/injector setup. OEM lines are roughly -6an. If your plan is mostly track duty at 600+ we recommend upgrading your feed line to a -8an line. On a DW400, we've made 840WHP on stock EG fuel lines using a DW400 fuel and DW2000 injectors.

Why upgrade the lines? Think of fueling the same way you drink through a straw. A smaller, more restrictive straw requires more effort to move fluid, whereas a bigger straw allows more fluid to pass with less effort. The same applies to fuel lines. Opening up the lines allows the pump to move more fuel with less effort. As you start reaching higher power, and as fuel demand increases, a large drop in fuel pressure at high RPM indicates undersized fuel lines or an undersized pump which can cause an engine to lean out and fail. Refer to the guide below on sizing fuel lines and pumps for your application.

## 5.4 Fuel Pumps

Calculate your fuel pump demand using the **DW Fuel Pump Calculator**

(<https://www.deatschwerks.com/fuel-calculators/fuel-pump-calculator>) Easy rule of thumb sizing your fuel

*pumps:*

0-400HP DW200

400-600 DW300

600-800 DW400

800+ Multiple Pumps or High Flow Weldon/Magnafuel

We utilize the DW400 on 90% of our builds form 400+.

## **5.5 Fuel Injectors**

EV14 Body injectors are the latest and greatest. When searching for an injector, make sure it's a Bosch EV14 core. Most modern injectors are flow-matched Bosch EV14 Injectors to make fueling even across all cylinders and high quality idle.

Easy rule of thumb sizing for your injectors:

### ***Gasoline:***

550cc Injectors up to 300HP

850cc Injectors up to 400HP

1000cc Injectors up to 500HP

### ***E85 (4 Injectors):***

1000cc Injectors up to 400HP

1300cc Injectors up to 600HP

1650cc Injectors up to 700HP

2200cc Injectors up to 900HP

K Kenny is the author of this solution article.