# Harley engine modification.

# Performance and Technical information on modifying engines for Harley-Davidson motorcycles.

Looking for high performance engine specifications for your Harley-Davidson motorcycle? Need to know what high performance equipment provides the best performance at the lowest costs for your H-D. Here you can look at performance modifications with the dyno runs of many different engine combinations, so you can pick your own equipment, horsepower rating and dollars to spend. An incremental approach to engine development has provided some good results on many engines. Find out what combination of carburetor, camshaft, exhaust systems, ignition systems, head work, pistons and the other high performance components work well. There are tests of some equipment that did not work well. Know what works and what does not. Compare the results of your current bike to those seen here. Are you getting the performance you paid for?

If you have had success in your engine development program, send a picture of the bike and your performance results (dyno sheets or time slips) to the **V-Twin Café** for publication. The **V-Twin Café** is always looking for good articles on motorcycle performance work. If you write performance oriented articles, contact us.

Twin Cam 88 and 95 cubic inches	Twin Cam Engines from Harley-Davidson have a good design and some nice upgrades available from the local Dealer including a 95 cubic inch big bore kit. What can you expect from this engine? Here are some engine configurations that have been tested.
45 to 50 HP	Stock Evolution Engines are the starting point for all the modifications. The only way to validate what the performance gain was for any change is to have dyno runs before and after. These are the before runs of several bikes.
55 to 65 HP Up to \$750	Stage One Evolution Harley-Davidson engines involve no internal changes made to the engine. All modifications are made by changing or modifications to external components on the engine. These components include air cleaners, carburetors, exhaust systems and ignition systems. No special tools or training is required to perform stage one modifications.
	wheel of a late model 80 CID Harley-Davidson big twin Evolution engine. If you want to <u>build your own Stage 1 engine</u> , here are the parts used to create a 64 HP engine.

60 to 80 HP Up to \$1,500	Stage Two Evolution Harley-Davidson engines involve any stage one changes plus changes to some internal "bolt-on" engine components. These "bolt-on" modifications include camshafts and milling of the heads to increase compression. Some special tools and knowledge of engines is required to perform stage two modifications. These modifications will provide from 60 to 80 horsepower at the rear wheel of a late model 80 CID Harley-Davidson big twin Evolution engine.
	If you want to <u>build your own Stage 2 engine</u> , here are the parts used to create a 74 HP engine.
70 to 120 HP \$2,000+	<b>Stage Three Evolution</b> Harley-Davidson engines involve any change to any component in the engine. These modifications should only be performed by experienced mechanics with knowledge of performance modifications and engine "blue printing". Special tools are required to perform stage three modifications. <i>V</i> -Twin Café will limit its Stage Three engine information to those combinations that are mostly streetable. These modifications will provide from 80 to 120 horsepower at the rear wheel of a late model 80 CID Harley-Davidson big twin Evolution engine.
	If you want to <u>build your own Stage 3 engine</u> , here are the part used to create an 82 HP engine that can be assembled over a weekend.
120 HP and more \$5,000+	Stage Four Harley-Davidson engines are "anything goes". If it can be stuffed into a motorcycle chassis, it is worth trying. Time, expert knowledge, special tools and lots of money are required to build stage four engines. The ability to run on the street is not a criteria when designing these engines. These are all out race engines, designed for drag racing and other forms of competition. These modifications can provide 120+ horsepower at the rear wheel of a late model 80 CID Harley-Davidson motorcycle. For these engines, the
Chaucilland	horsepower is only limited by the available money and engineering skills.
Snovelhead Engines	combustion chamber design is not as good as the Twin Cam and Evolution designs, there is still good power potential available in these engines. A good Shovel engine should make about 10% less power than a comparable Evo. This means your 80 CID Shovel can make 70-80 horsepower without to much trouble.
	The <u>Horsepower Gallery</u> provides an extensive list of bikes , the power they produced and the major engine components. This list covers Evolution, Twin Cam 88/95 and Shovelhead engines.

## **Harley-Davidson Evolution**

### **Stage 1 Engine Development and Modification**

# Performance and Technical information on stock engines for Harley-Davidson motorcycles.

**Stage One** Harley-Davidson engines involve no internal changes to be made. All modifications are made by bolt-on changes or modifications to external components on the engine. These components include air cleaners, carburetors, exhaust systems and ignition systems. No special tools or training is required to perform Stage One modifications. These modifications will provide from 55 to 66 horsepower at the rear wheel of a late model 80 CID Harley-Davidson big twin Evolution engine.

Motorcycle Performance Guide is now providing tuning information for Harley-Davidson Twin Cam 88 and EVOLUTION engines. For Twin Cam 88 engine information, look for the TC88 label next to the horsepower number.

All the parts listed below are traditional Stage One

components. The components listed have all been tested on Harley-Davidson engines. When installed and tuned properly, these components will improve the rear wheel horsepower of your big twin engine. Some popular, traditional items are not listed here. Components that have not been tested or did not improve the rear-wheel horsepower in testing various Big Twin engines are not listed. An example of components not being listed are drag pipes. Drag pipes, even when properly tuned, will not improve the street performance of your Harley-Davidson.

#### **Recommended Parts List for Bolt On Performance**

#### Air Cleaners

Screamin' Eagle Air Cleaner Kit K&N Air Filer

#### Carburetors

Stock Keihin CV (Modified by one of the following methods)

- Harley jets with 'do-it-yourself' modifications

- DynoJet carburetor re-calibration Kit
- DynoJet ThunderSlide Kit
- Yost Power Tube

Mikuni HSR-42 Screamin Eagle 44mm CV

#### **Exhaust Systems**

Screamin' Eagle Slip Ons SuperTrapp 2-1 Cycle Shack 2-2 Slash Cuts ThunderHeader Hooker 2-1 Python III

#### **Ignition Systems**

Screamin' Eagle Crane HI-4E Dyna 2000

#### **Ignition Coils**

Screamin' Eagle Crane DynaTech

#### **Plug Wires**

Magnecor Screamin' Eagle Accel

# **Stage 1 Modifications Build a 64 horsepower 1340 Evolution engine**

Performance and Technical information on basic modifications to a stock Harley-Davidson 1340 Evolution motorcycle engine.

Build the ultimate in a stock bike engine

or

How to get 64HP from your 1340 Evolution engine.

One of the first things most people do shortly after they get their new motorcycle is start to modify the engine. In the time honor tradition of Harley-Davidson, the first thing to go on most bikes are the stock mufflers in an effort to improve the sound. This is usually the first in a long list of changes to the engine. Changes to the carburetor and ignition system also rank very high on the first to change list. These



changes are done to improve the performance of the bike.

There are many companies out there that are competing for the dollars that Harley owners are willing to spend on their bikes. As an owner, you will be bombarded with a vast array of promises, claims and inaccuracies in an effort to get your money. Reading between the lines on many of the performance claims can be bewildering.

**Does the Harley-Davidson world** need another stock engine modification article? I decided it does, since the results obtained by the engine upgrades listed here provided significantly better results than those documented by the popular magazines aimed at the V-Twin crowd.

#### How to build your own Stage One engine

**Stage One engines involve no internal changes to the engine.** All modifications are made by bolt-on changes to external components on the engine. These components include air cleaners, carburetors, exhaust systems and ignition systems. No special tools or training is required to perform these modifications, although it is recommended you are comfortable working on your own motorcycle.

**Over the past several years we have installed and tested many manufacturers components**. The list of parts used in building the ultimate 'bolt-on parts' engine is the end result of this testing. The best and least expensive of the individual components was selected and tested as a single package. The fact that virtually all the parts used for the project are from Harley-Davidson is a coincidence. There was no plan or idea to use mostly Screamin' Eagle parts for this project. **All the parts used are readily available** through your Harley-Davidson Dealer except for the spark plug wires, which can be ordered directly through Magnecor. The components were installed and tested on a 1997 FXD Dyna Super Glide. No special tuning was performed to achieve the results listed. <u>All components were installed</u> according to the manufacturer instructions supplied.

#### Building the ultimate 'bolt-on parts' engine

Install the mufflers Install the air cleaner kit Re-jet the carburetor Install the ignition module Install the ignition coil Install the spark plug wires Road test the bike Dyno Tune the bike

The results of the Dyno testing simply astounded us. The test results showed the engine producing 63.8 horsepower @ 5350 RPM and 72.5 ft. lbs. of torque @ 3650 RPM. Three separate runs provide identical results. These performance numbers produced where real. The results were so surprising that additional research was done to make sure that Harley-Davidson hadn't come up with new cam design since 1996. The stock cam is still the same Harley "N" grind that has been around since 1992.

The Dyno Run Sheet show the improvement in power.

The results are due to a well matched set of parts being bolted-on to the engine. Seems that a little of that money the Dealers send back to Milwaukee is going into engine performance research.

The ability to create the same results with other manufacturers parts is a distinct possibility. There is an optional parts list of components that should perform as well as the parts tested. Please be aware that the parts listed in the Optional Stage 1 parts list have not been dyno tested unless otherwise noted.



**Still not enough power for your needs?** We decided to find out what happens when you take the Ultimate Stock Engine and make it a Stage 2 bike. There are more surprises ahead as we continue to step up the power in our "Ultimate

Engine" modifications series of articles. <u>Need a little more power?</u>

#### The Parts List for Bolt On Performance

New parts cost \$488.65 plus tax. Maintenance parts cost \$51.00 plus tax. Dyno Tuning costs estimated at \$200.00 plus tax.

#### Air Cleaner

Screamin' Eagle Evolution 1340 High-Flow Air Cleaner Kit Harley-Davidson Part Number 29008-90A \$69.95 Evolution 1340 Breather Manifold Kit Harley-Davidson Part Number 29310-93 \$29.95

#### **Carburetor Parts**

Stock Keihin CV\* modified using a DynoJet Re-calibration Kit Harley-Davidson Part Number 29045-97 \$74.95 .045 Slow Jet Harley-Davidson Part Number 27170-89 \$4.95

\*The carburetor used on the 97 FXD was a previously dyno tuned carburetor from a 94 bike. This carburetor had been modified using a standard DynoJet re-calibration kit. DynoJet supplies several kits depending upon the year of the bike. Similar results have been produced using a Yost Power Tube and tuner kit.

#### **Exhaust System**

Screamin' Eagle Slip On Baloney Cut Muffler Kit Harley-Davidson Part Number 80067-95A \$119.00

#### **Ignition System**

Screamin' Eagle Street Legal Performance Ignition Module Harley-Davidson Part Number 32630-96 \$114.95

#### **Ignition Coil**

Screamin' Eagle Performance Coil Harley-Davidson Part Number 31653-97 \$49.95

#### **Plug Wires**

Magnecor 8.5 mm Harley-Davidson Plug wire set \$24.95

#### **Other Items**

Harley-Davidson Double Platinum Spark Plugs or H-D Gold Spark Plugs Harley-Davidson Oil Filter Mobil 1 15-50w Synthetic Motor Oil (3 quarts) Royal Purple 75w-90 Synthetic Transmission Oil (1 quart) Harley-Davidson Chaincase Lube (1 quart)

#### Other riders have been able to produce similar results:

A 1998 FXD produced 66 HP and 78 ft. lbs. of torque with a stock engine. The only noticeable difference over the recommendations listed above is that the 98 bike used a Yost Tuners Kit in place of the DynoJet Re-calibration Kit and time was spent tuning the bike on the dyno. The ignition module had not been updated on this bike either. A 1998 FXSFB produced 62 HP with a stock engine, K&N OEM replacement air cleaner element, drilled out air box and stock mufflers with the baffles drilled out.

The <u>Horsepower Gallery</u> provides an extensive list of bikes , the power they produced and the major engine components.

### **Harley-Davidson**

# **Stage 2 Engine Development and Modification**

Performance and Technical information on modified engines for Harley-Davidson motorcycles.

**Stage Two Harley-Davidson engines involve Stage 1 changes** plus changes to some internal "bolt-in" engine components. These "bolt-in" modifications include camshafts and milling of the heads to increase compression. Some special tools and knowledge of engines is required to perform stage two modifications. These modifications will provide from 60 to 80 horsepower at the rear wheel of a late model 80 CID Harley-Davidson big twin Evolution engine, depending upon the condition of the engine and the components used.

All the <u>Stage One parts</u> plus the parts listed below can go into a Stage Two engine. The components listed have all been tested on Harley-Davidson engines. When installed and tuned properly, these components will improve the rear wheel horsepower of your big twin engine. Items that are not listed here have not been tested or do not improve rear-wheel horsepower of your motorcycle. An example of not being listed are drag pipes. Drag pipes, even properly tuned, will not improve the street performance of your H-D.

#### Camshafts

Some of the most popular cams for use in Stage 2 engine are listed below with an approximate grouping of cams with similar specifications and performance.

Bike and riding	Heavy Bike Touring	Heavy Bike Performance or	Light Bike Performance
RPM Range	Idle to 4500	1500 to 5000	2000 to 5500
Andrews	EV-13 EV-23	EV-27	EV-3 EV-46
Crane	Fireball 300	Fireball 310	Fireball 316
Screamin Eagle	SE-3	SE-4	SE-1 SE-11

#### Bolt-in Camshaft Selector EVOLUTION

Screamin Eagle	SE-3	SE-4	SE-1 SE-11
V-Thunder	EVL-3000	EVL-3010	EVL-3020 EVL-3040

#### Bolt-in Camshaft Selector TWIN-CAM 88/95

Bike and riding Style	Heavy Bike Touring	Heavy Bike Performance or Light Bike Touring	Light Bike Performance
RPM Range	Idle to 4500	1500 to 5000	2000 to 5500
Andrews	TW-21 TW-26	TW-37 TW-44	TW-44
Crane	HTC 300	HTC 310	HTC 316
Screamin Eagle	SE-203	SE-203 SE-204	SE-204 SE-211

Any camshaft with with a duration under 250 degrees and lifts below .500 can be considered bolt in. Extensive testing by Jerry Branch (Branch Flowmetrics) indicates that any group of camshafts with similar lift, duration and lobe separation angles tend to perform in similar fashion. To attempt to identify and test every bolt-in camshaft would be time consuming and expensive. The Motorcycle Performance Guide staff has reviewed J. Branch's results and agrees with the results. In practical terms, this means that the Crane 300 and EV-13 will provide about the same power, so goes the Crane 316 and EV-46. This also means that you will see only minor differences between the EV-13 and EV-27.

Need to find a cam to meet your specifications? Look through the Motorcycle Performance Guides <u>complete list of Harley-Davidson</u> <u>camshafts</u> for BIg Twin, Sportster and Twin Cam 88 engines.

### **Stage 2 Modifications**

### Building a 74 horsepower 1340

### **Evolution engine**

Performance and Technical information on Stage 2 modifications to a Harley-Davidson 1340 Evolution motorcycle engine.

Building the ultimate street bike engine or How to get 74HP from your 1340 Evolution engine. Your carburetor is re-jetted, a free flowing air cleaner is in place, you have the perfect exhaust system, and the ignition system has been upgraded. If you have made these Stage 1 changes to your bike and are still looking for more power, you may be ready for a Stage 2 engine, a performance camshaft. You must limit your choice to "bolt-in" cams unless you are willing to change pistons, change valve springs or



otherwise modify your heads. Those changes require significant time and money.

There are many companies out there that are competing for the dollars that Harley owners are willing to spend on their bikes. As an owner, you will be bombarded with a vast array of promises, claims and inaccuracies in an effort to get your money. Reading between the lines on many of the performance claims can be bewildering.

**Does the Harley-Davidson world** need another bolt-in camshaft engine modification article? We decided it does, since the results obtained by the engine upgrades listed here provided significantly better results than those documented by the popular magazines aimed at the V-Twin crowd. The Motorcycle Performance Guide staff continues to obtain better results than the "experts" in the press.

#### How to build your own Stage Two engine

**Stage Two engines do not involve any internal changes to the engine other than replacing the camshaft and camshaft bearing.** All modifications are made by bolt-in changes. Some special tools and training is required to perform these modifications. Unless you are a very good mechanic, it is recommended you find a competent shop to install the camshaft and bearing. For those of you that want to install the camshaft yourself, Motorcycle Performance Guide has created the <u>step-by-step instructions</u> for installing a camshaft.

Over the past several years we have installed and tested many manufacturers components. The list of parts used in building the ultimate 'bolt-on parts' engine is the end result of this testing. The best and least expensive of the individual components was selected an tested as a single package. The fact that virtually all the parts used for the project are from Harley-Davidson is a coincidence. There was no plan or idea to use mostly Screamin' Eagle parts for this project. All the parts used are readily available through your Harley-Davidson Dealer. The components were installed and tested on a 1997 FXD Dyna Super Glide. No special tuning was performed to achieve the results listed. <u>All components were installed according to</u> the manufacturer instructions supplied.

#### Building your Stage 2 engine

<u>Stage 1 improvements</u> must be in place Install the camshaft and new Torrington cam bearing Change Oil and Filter Install new spark plugs Road test the bike Dyno Tune the bike

The results of the Dyno testing are excellent as this bike's performance continues to improve. The test results showed the engine producing 73.9 horsepower @ 5950 RPM and 78.1 ft. lbs. of torque @ 4100 RPM. This was another 10 horsepower increase over the Stage 1 results. This engine is now producing 20 horsepower more than a stock bike. Not bad for the small investment required to get these results.

#### The Dyno Run Sheet

The results are due to a well matched set of parts being bolted-on to the engine. Seems that a little of that money the Dealers send back to Milwaukee is going into engine performance research.

The ability to create the same results with other manufacturers parts is a distinct possibility. There is an optional parts list of components that should perform as well as the parts tested. Please be aware that the parts listed in the Optional Stage 2 parts list have not been dyno tested unless otherwise noted.



**Still not enough power for your needs?** We decided to find out what happens when you take the Ultimate Stock Engine and make it a Stage 3 bike. There are more surprises ahead as we continue to step up the power in our "Ultimate Engine" modifications series of articles. In the next upgrade,

we bolt on a set of the new Screamin' Eagle 1340 EVO performance heads.

#### The Parts List for Bolt In Stage 2 Performance New parts cost \$252.95 plus tax. Maintenance parts cost \$51.00 plus tax.

### Dyno Tuning costs estimated at \$200.00 plus tax.

#### Camshaft

Andrews EV-46 camshaft \$158.00 list price - Street price is around \$120.00 Torrington B-138 cam bearing \$10.00 Street price Nose-Cone gasket \$8.00 from your local dealer Other Items

Harley-Davidson Double Platinum Spark Plugs or H-D Gold Spark Plugs Harley-Davidson Oil Filter Mobil 1 15-50w Synthetic Motor Oil (3 quarts) Royal Purple 75w-90 Synthetic Transmission Oil (1 quart) Harley-Davidson Chaincase Lube (1 quart)

The <u>Horsepower Gallery</u> provides an extensive list of bikes , the power they produced and the major engine components.

#### **Harley-Davidson**

#### **Stage 3 Engine Development and Modification**

Performance and Technical information on highly modifed engines for Harley-Davidson motorcycles.

**Stage Three** Harley-Davidson engines involve any change to any component in the engine. These modifications should only be performed by experienced mechanics with knowledge of performance modifications and engine "blue printing". Special tools are required to perform stage three modifications. *V*-Twin Café will limit its Stage Three engine information to those combinations that are mostly streetable.

These modifications will provide from 80 to 120 horsepower at the rear wheel of a late model 80 CID Harley-Davidson big twin Evolution engine.

The major difference between Stage Two and Stage Three engines is in the heads. A set of 'ported' heads and higher compression rations are considered essential to reaching Horsepower figures in excess of 80. A successful stage three engine will be well thought out, with all components determined prior to rebuilding the engine. As you view the Stage Three dyno sheets, notice the differences in the power bands. Specifically note where peak torque and horsepower occur. The lower the RPM's are on these figures, the more 'streetable' the engine will normally be.

### **Stage 3 Modifications**

### **Building a 82 horsepower 1340**

### **Evolution engine**

Performance and Technical information on Stage 3 modifications to a Harley-Davidson 1340 Evolution motorcycle engine.

Building the ultimate street bike engine or How to get 82HP from your 1340 Evolution engine. The camshaft in your bike has been upgraded. If you have made these Stage 2 changes to your bike and are still looking for more power, you may be ready for a Stage 3 engine where modifications can begin to get a little more complicated. Better flowing heads and increased compression ratios are the way that this is usually done.



#### There are many companies out

there that are competing for the dollars that Harley-Davidson owners are willing to spend on their bikes. As an owner, you will be bombarded with a vast array of promises, claims and inaccuracies in an effort to separate you from your money. Reading between the lines on many of the performance claims can be bewildering.

**Does the Harley-Davidson world** need another bolt together engine modification article? We decided it does, since the results obtained by the engine upgrades listed here provided significantly better results than those documented by the popular magazines aimed at the V-Twin crowd. The Motorcycle Performance Guide staff continues to obtain better results than the "experts" in the press.

#### How to build your own Stage Three engine



This Stage Three engine did not involve any internal changes to the engine other than replacing the OEM heads with the Screamin Eagle 1340 EVO heads. All modifications are made by bolt-on changes. Some special tools and training is required to perform these modifications. Unless

you are a very good mechanic, it is recommended you find a competent shop to install the heads. For those of you that want to install the heads yourself, Motorcycle Performance Guide recommends you obtain the proper service manual for your bike.

Over the past several years we have installed and tested many manufacturers components. The list of parts used in building the ultimate 'bolt-on parts' engine is the end result of this testing. The best and least expensive of the individual components was selected an tested as a single package. The fact that virtually all the parts used for the project are from Harley-Davidson is a coincidence. There was no plan or idea to use mostly Screamin' Eagle parts for this project. All the parts used are readily available through your Harley-Davidson Dealer. The components were installed and tested on a 1997 FXD Dyna Super Glide. No special tuning was performed to achieve the results listed. <u>All components were installed according to the manufacturer instructions supplied.</u>

#### Building your Stage 3 engine

<u>Stage 1 improvements</u> must be in place <u>Stage 2 improvements</u> must be in place Replace the OEM heads with the new Screamin Eagle Evolution heads Change Oil and Filter Install new spark plugs Road test the bike Dyno Tune the bike

**The results of the Dyno testing are excellent** as this bike's performance continues to improve. The test results showed the engine producing 81.7 horsepower @ 5700 RPM and 87.1 ft. lbs. of torque @ 3900 RPM. The long, flat power curve on this engine is ideal for street riding. There was an 18 horsepower increase over the Stage 1 results and an 8 horsepower increase over the Stage 2 engine. The engine is producing 28 horsepower more than a stock bike. Not bad for the relatively investment in time and money required to get these results.

**Just how fast is fast enough** is a matter of opinion. This 97 FXD was taken to the local drag strip in order to establish what sort of 1/4 mile times could be turned with this bike. The bike proved to be a potent Harley drag race bike by turning times in the 12:40 range with 105 MPH speeds. Considering the rider for this test is relatively inexperienced, it is expected that in the hands of an experienced racer, times in the 12:20 is quite possible.

#### The Dyno Run Sheet

The results are due to a well matched set of parts being bolted-on to the engine. Seems that a little of that money the Dealers send back to Milwaukee is going into engine performance research.

The ability to create similar results with other manufacturers parts is a distinct possibility. Motorcycle Performance Guide chose to work with parts that had proven ability to provide increased horsepower and torque. If you use the parts listed in the "Ultimate Street Engine" series of articles, there is little doubt in our minds that your can duplicate our results, provided the engine is in good mechanical shape and properly tuned. Optional parts that have similar specifications to the components used in our engine should provide very similar results. A matched set of engine components, careful assembly and dyno tuning are the keys to building a killer street engine. May your results be a successful as those we have documented.

The Parts List for Bolt On Stage 3 Performance New parts cost \$799.00 plus tax. Maintenance parts cost about \$80 plus tax. Dyno Tuning costs estimated at \$200.00 plus tax.

**New Heads** 

Screamin Eagle 1340 EVO heads \$799 list price (silver) complete with valves and springs

#### **Other Items**

Top End gasket set from James Gasket Harley-Davidson Double Platinum Spark Plugs or H-D Gold Spark Plugs Harley-Davidson Oil Filter Mobil 1 15-50w Synthetic Motor Oil (3 quarts)

The <u>Horsepower Gallery</u> provides an extensive list of bikes , the power they produced and the major engine components.

### **Harley-Davidson**

### **Stage 4 Engine Development and**

### **Modification**

Performance and Technical information on competition engines for Harley-Davidson motorcycles.

**Stage Four** Harley-Davidson engines are "anything goes". If it can be stuffed into a motorcycle chassis, its worth trying. Time, expert knowledge, special tools and lots of money are required to build a stage four engine. These are all out race engines, designed for drag racing and other forms of competition.

These modifications can provide from 120+ horsepower at the rear wheel of a late model Harley-Davidson motorcycle. For these engines, the horsepower is only limited by the available money and engineering skills.

Stage 4 engine development means. Accelerate till you see God, then brake. The best of everything.

**Stage 3 Modifications** 

**Building a 95 horsepower 1340** 

### **Evolution engine**

Performance and Technical information on Stage 3 modifications to a Harley-Davidson 1340 Evolution motorcycle engine.

Build low cost, maximum performance street engine or How to get 95HP from your 1340 Evolution engine. You have decided that your current engine isn't getting the job done. You have made Stage 2 changes to your bike and are still looking for more power. You are ready for a series Stage 3 engine. These modifications are a little more complicated than the <u>bolt-on Stage 3</u> <u>engine</u>.

Better flowing heads and increased compression ratios are the usual way to make 90+ horsepower.



**Motorcycle Performance Guide** is about to blow the lid off this idea. We achieved **95.4 horsepower** at the rear wheels using <u>un-ported</u> <u>Harley-Davidson 1340 heads</u> and increasing the compression with domed pistons. Contrary to what many performance shops try to tell you, we were able to break the 90 horsepower mark without larger valves, porting and polishing the Evolution heads.

There are many companies out there that are competing for the dollars that Harley-Davidson owners are willing to spend on their bikes. As an owner, you will be bombarded with a vast array of promises, claims and inaccuracies in an effort to separate you from your money. Reading between the lines on many of the performance claims can be bewildering.

**Does the Harley-Davidson world** need another engine modification article? We decided it does, since the results obtained by the engine upgrades listed here provided significantly better results than those documented by the popular magazines aimed at the V-Twin crowd. The Motorcycle Performance Guide staff continues to obtain better results than the "experts" in the press and most performance shops.

#### How to build your own Stage Three engine



This Stage Three engine requires internal changes to the engine. Disassembly of the top end of the engine is required. Some special tools and training is required to perform these upgrades. Unless you are a very good mechanic and have access to a machine shop, it is recommended you find a competent shop

to perform these modifications. For those of you that want to assemble the engine yourself, Motorcycle Performance Guide recommends you obtain the proper service manual for your bike. **Over the past several years we have installed and tested many manufacturers components**. The list of parts used in building this engine is the end result of this testing. The best and least expensive of the components were selected and tested as a single package. The horsepower your bike produces may vary from the results produced here. If you use different parts or do not properly tune your engine, power may change significantly. Motorcycle Performance Guide assures you that the parts list and results are presented as accurately as possible.

All the <u>parts used</u> in this engine are readily available through local shops, after-market parts companies and your Harley-Davidson Dealer. The components were installed and tested on a 1994 FXD Dyna Low Rider. Dyno tuning is required to achieve the results listed. All components were installed according to the manufacturer instructions supplied.

**Building your Stage 3 engine** Disconnect battery Drain gasoline from tank Remove gas tank Disassemble the engine top end Remove heads, cylinders and pistons Remove cam, lifters and lifter blocks Remove old cam bearing Remove stock clutch Send heads to machine shop to install parts and do valve job Send cylinders to machine shop to fit new pistons Install cylinders with new pistons Install upgraded cylinder heads Install new cam bearing Install new cam Install ignition module Install lifter blocks with new lifters Install adjustable pushrods Install intake manifold and carburetor Install new clutch Install exhaust system Remove exhaust system baffles Change engine oil and filter Change transmission oil Add primary chaincase oil Install new spark plugs Set static ignition timing Road test the bike Dyno Tune the bike Enjoy the ride

**The results of the Dyno testing were excellent**. The test results showed the engine producing 95.4 horsepower @ 5600 RPM and 95.3 ft. lbs. of torque @ 4600 RPM. While the power curve on this engine was optimized for drag racing and dyno shootouts, it still manages to produce over 80 ft.lbs.. of torque from 3900 to 6000 RPMs. That is some serious power to the rear wheels.

This engine is producing 40 horsepower more than a stock bike. Not bad for the relatively low investment in time and money required to get these results.

**Just how fast is fast enough** is a matter of opinion. This 94 FXDL was taken to the drag strip in order to establish what 1/4 mile times could be done.

The bike proved to be a very potent H-D drag race bike by turning times in the 11.80 range with 114 MPH speeds. The bike will accelerate to 90+ MPH in 1/8 of a mile.

#### The Dyno Run Sheet

**The results are due to a well matched set of parts** being installed in the engine. This is an engine combination that many Harley shops do not want you to know about. Who would believe stock Evolution heads could make over 90 horsepower.

Just because the heads were not ported and polished, don't think that you can achieve the high horsepower numbers without making some changes to the heads. The Manley performance valves and the 5 angle valve job provide big improvements in air flow through the ports. This is an important part of making good horsepower. Don't forget to have the spring clearance set for .600" lift cams. The SE-57 has a .575" bump on it. The JE 10.5:1 pistons are machined to accept a high lift cam.

The performance of the Screamin Eagle SE-57 camshaft was impressive, producing strong torque to match the horsepower potential. Past experience indicated that cams with 252 degrees of duration make excellent street cams. This Harley-Davidson camshaft did not disappoint.

The SuperTrapp 2-1 exhaust system with the internal baffles removed was an important component in creating this high horsepower. Installation of the baffles and use of 18 disks results in a 5-7 horsepower drop, but the torque remains the same. The horsepower curve peaks drops to 5700 RPM and the torque peak drops to 3900 RPM. This change in power curve makes the engine very potent on the street.

If don't have the money to purchase all the parts listed for this engine, we recommend you make the following changes

- Use your re-jetted CV carburetor in place of the Mikuni HSR-42.
  The CV is capable of supporting a 90 HP engine. Just keep your Screamin Eagle air filter clean and make sure the carburetor is well tune.
- The Cycle Shack Slash-cut exhaust system or Slip-on mufflers on stock header pipes are a low cost alternative to the SuperTrapp 2-1. While the maximum power of the 2-2 exhaust system is not going to match the 2-1 system, expect only a small horsepower drop.
- The Barnett Extra Plate clutch is a good alternative to the Rivera Pro Clutch. With the extra power available from the engine, the stock clutch will not last very long if your riding style is aggressive. While the Barnett upgrade will not last like the Rivera, the cost difference is significant.

**The ability to create similar results** with other manufacturers parts is a distinct possibility. Motorcycle Performance Guide choose to work with parts that had proven ability to provide increased horsepower and torque. If you use the parts listed in the "Ultimate Street Engine" series of articles, there is little doubt in our minds that your can duplicate our results, provided the engine is in good mechanical shape and properly tuned. Optional parts that have similar specifications to the components used in our engine should provide very similar results. A matched set of engine components, careful assembly and dyno tuning are the keys to building a killer street engine. May your results be a successful as those we have documented.

The Parts List for Stage 3 Maximum Performance New parts cost estimated at \$2,924 plus tax. New parts cost assumes the purchase of all parts listed. Using optional parts list, cost estimated at \$1,680. Machine Work cost estimated at \$400 plus tax. Maintenance parts cost estimated at \$200 plus tax. Dyno Tuning costs estimated at \$200 plus tax.

#### **Upgraded Heads**

Stock 1340 EVO heads Manley Stainless Steel Performance Valves - cost \$160.00 Crane 155# Valve springs - cost \$115.00 5 angle valve job Set spring height for .600" cam lift

#### Pistons

JE 10.5:1 compression pistons - Cost \$250.00 Perfect Seal Piston Ring set - Cost \$50.00

#### Camshaft and valve train

Screamin Eagle SE-57 camshaft - Cost \$200.00 Torrington B-138 cam bearing - cost \$6.00 Screamin Eagle Chrome-Moly Adjustable Pushrods -Cost \$90.00 Use 97 or later Harley-Davidson lifters - cost \$25.00 each

#### **Exhaust System**

SuperTrapp 2-1 with baffle removed - cost \$450.00 option: Cycle Shack 2-2 Slash-cut exhaust - cost \$175.00

#### Carburetor

Mikuni HSR-42 - cost \$550.00 Mikuni Intake Manifold - included above option: CV with DynoJet kit and SE air cleaner

#### **Ignition System**

Crane HI-4 Ignition - cost \$231.00 (We do not recommend using the Dyna 2000 ignition module.) Crane Single Fire Coil - cost \$127.00 Magnecor Spark Plug Wires - cost \$25.00

#### Clutch

Rivera Heavy Duty racing clutch - cost \$570.00 option: Barnett Extra Disk Clutch - cost \$150.00

#### **Other Items**

Top End gasket set from James Gasket Primary chaincase gasket Autolite 4265 Spark Plugs Harley-Davidson Oil Filter Mobil 1 15-50w Synthetic Motor Oil (3 quarts) Royal Purple 75w-90 Synthetic Transmission Oil (1 quart) Harley-Davidson Chaincase Lubricant (1 quart)

# **Stage 3 Modifications Building a 128 horsepower 95CID**

### **Twin Cam engine**

Performance and Technical information on Stage 3 modifications to a Harley-Davidson TC95 motorcycle engine.

How to get 128HP from your Twin Cam engine.

You have decided that your current engine isn't getting the job done. You have made Stage 2 changes to your bike and are still looking for more power. Maybe your bolt-on Harley parts aren't getting you down the road as quickly as you want? This this is the case, you are ready for a series Stage 3 engine.

Better flowing heads and increased compression ratios are the usual way to break the 100 horsepower mark with your Twin Cam engine. *Motorcycle Performance Guide* is about to blow the lid off this idea. We achieved **128 horsepower** at the rear wheels by using a carefully matched set of components and a lot of tuning.

There are many companies out there that are competing for the dollars that Harley-Davidson owners are willing to spend on their

bikes. As an owner, you will be bombarded with a vast array of promises, claims and inaccuracies in an effort to separate you from your money. Reading between the lines on many of the performance claims can be bewildering.

**Does the Harley-Davidson world** need another engine modification article? We decided it does, since the results obtained by the engine upgrades listed here provided significantly better results than those documented by the popular magazines aimed at the V-Twin crowd. The Motorcycle Performance Guide staff and a select group of performance shops continue to obtain better results than the "experts" in the press and what you can get by bolting on Harley-Davidson engine parts.

How to build your own Stage Three engine

#### This Stage Three engine requires internal changes to the

**engine.** Disassembly of the top end of the engine is required. Some special tools and training is required to perform these upgrades. Unless you are a very good mechanic and have access to a machine shop, it is recommended you find a competent shop to perform these modifications. For those of you that want to assemble the engine yourself, Motorcycle Performance Guide recommends you obtain the proper service manual for your bike.

**Over the past several years we have installed and tested many manufacturers components**. The list of parts used in building this engine is the end result of this testing. The best and least expensive of the components were selected and tested as a single package. The horsepower your bike produces may vary from the results produced here. If you use different parts or do not properly tune your engine, power may change significantly. Motorcycle Performance Guide assures you that the parts list and results are presented as accurately as possible.

**The <u>parts used</u> in this engine are available** through CycleRama (727-546-0889), after-market parts companies and your Harley-Davidson Dealer. The components were installed and tested in CycleRama's shop. Dyno tuning is required to achieve the results listed. <u>All components were installed according to the manufacturer instructions supplied.</u>

Building your Stage 3 engine Disconnect battery Drain gasoline from tank Remove gas tank Install upgraded cylinder heads Install new cams Install ignition module Install lifter blocks with new lifters Install adjustable pushrods Install intake manifold and carburetor Install new clutch Install exhaust system Change engine oil and filter Change transmission oil Add primary chaincase oil Install new spark plugs Set static ignition timing Road test the bike Dyno Tune the bike Enjoy the ride

**The results of the Dyno testing were excellent**. The test results showed the engine producing 128 horsepower @ 6600 RPM and 118 ft. lbs. of torque @ 4300 RPM. The power curve on this engine is suitable for street riding. It produces over 100 ft.lbs. of torque from 3200 to 6600 RPMs. That is some serious power to the rear wheels. This engine is producing 60 horsepower more than a stock Twin Cam engine. Not bad for the relatively low investment in time and money required to get these results.

#### The Dyno Run Sheet

**The results are due to a well matched set of parts** being installed in the engine. This is an engine combination that many Harley shops do not want you to know about. Who would believe a TC95 could make over 120 horsepower.

The heart of this upgrade is a set of CycleRama (727-546-0889) CNC Ported heads. The folks at CycleRama spent a lot of time optimizing the ports on the Twin Cam heads before committing to the current design. These heads will increase the power of your engine significantly.

The performance of the CycleRama designed cam is matched to the flow characteristics of the cylinder heads. This cam produced a wide power band.

The Thunderheader exhaust system was an important component in creating this high horsepower. 2-1 exhaust systems are known for their strong mid-range power and the Thunderheader did not disappoint us.

Other components used in this engine

- Screamin Eagle 44mm CV carburetor.
- Screamin Eagle Pistons.
- A performance clutch like the Barnett Scorpion is required to control this much power.

The ability to create similar results with other manufacturers parts is a distinct possibility. Motorcycle Performance Guide choose to work with parts that had proven ability to provide increased horsepower and torque. If you use the parts listed in the "Ultimate Street Engine" series of articles, there is little doubt in our minds that your can duplicate our results, provided the engine is in good mechanical shape and properly tuned. Optional parts that have similar specifications to the components used in our engine should provide very similar results. A matched set of engine components, careful assembly and dyno tuning are the keys to building a killer street engine. May your results be a successful as those we have documented.

#### The Parts List for Stage 3 Maximum Performance

#### **Upgraded Heads**

CycleRama CNC ported heads for Twin Cam

#### **Pistons**

Screamin Eagle Pistons

#### Camshaft and valve train

CycleRama special grind for Twin Cam

#### **Exhaust System**

Thunderheader

#### Carburetor

Screamin Eagle 44mm CV

#### **Ignition System**

Crane HTC Ignition moduleMagnecor Spark Plug Wires - cost \$25.00

#### Clutch

**Barnett Scorpion** 

#### **Other Items**

Top End gasket set from Cometic Gasket Primary chaincase gasket Spark Plugs Harley-Davidson Oil Filter AMSOIL 20-50w Synthetic Motor Oil (3 quarts) AMSOIL 20-50w motorcycle oil for Transmission Oil (1 quart) AMSOIL 20-50w motorcycle oil for Chaincase Lubricant (1 quart)

#### Sportster 883 to 1200 Upgrade

by Rick 'Rickko' Eliopoulos

Many riders have asked about how to upgrade the Sportster 883 engine to a 1200. Rickko sent us step-bystep instructions on his experience in performing his own upgrade. The attention to detail in this article is excellent. If you want to perform this upgrade yourself, these instructions are the starting point you'll need. Especially helpful is the reference list of parts required and the estimated cost.

#### PREFACE

The sections below describe the way to perform an 883 to 1200 upgrade. It can be done differently but my take on this is the more you read and familiarize yourself with information such as this the better prepared you are to tackle the task yourself so reading this should be a helpful guide into what you will experience.

This rebuild consists of choosing Wiseco dished 9.5:1 pistons, X-Hasting rings, Harley-Davidson base gaskets, Bartel's .027 head gasket kit, Andrews N2 Cams, Yost Power Tube and normal Stage I modifications (i.e. Screamin' Eagle (SE) air cleaner, slip-ons, 45/180 re-jet, SE coil, SE 1200 Ignition module and the Vance & Hines SS2R racing exhaust system).

#### The steps needed to upgrade an 883 to 1200

#### The Preparation

#### WHAT DO YOU DO ON RAINY WEEKENDS IF YOU DON'T WANT TO GET YOUR SCOOT WET?

It was one of those normal NW Oregon kind of days; ugly gray and rainy on and off. The only difference between Oregon rainfall and San Diego rainfall is that between wettings, in San Diego the streets and sidewalks dry out. If you had been in San Diego this weekend and had an 883 sitting in your garage, you might have done what I'm about to tell ya' too.

Saturday, I moved my cage out of the garage to make room to begin my performance upgrade on my 49state Victory Red '94 883. The plan on the performance side: Wiseco dished pistons, James base gaskets, Bartel's .027" head gaskets, Andrews N2 cams, Yost Power tube, SE Ignition module. On the poseur points side: Black H-D mirrors, black K&N Super Bars, Vance & Hines SS2r racing exhaust, black shocks (Progressive or Koni's), rear sets and much more (of course). I've already done Stage I modifications (i.e. SE air cleaner kit, re-jet carburetor, slip-ons, SE fork brace, etc.).

As the 883 sits, with its trademark classic H-D peanut tank and only 6,200 miles on the odometer, its perfect! Good power, nary a cough through its re-jetted CV, nimble handling, and narrow enough to split the tightest lanes in freeway stop and go traffic. But perfection can always be improved on, right?

After making a lot of room in the garage and laying an old white sheet down to put all the parts upon, I began stripping the scoot. I logged each step as I went along, for one reason, I'm kind of anal-retentive, for another, so I remember how to put it all back together again , and lastly, to type this story up so that some future 'wrench' can find it archived here for reference.

The good news is, I had every tool I needed to strip the scoot down and remove the jugs except a 12 pt 1/2" socket for the head bolts. The bad news, none really. Well, I was a little nervous when I came into the garage Sunday morning and found the scoot leaning over on its jiffy stand. No biggie you might be thinking' but when I left it Saturday night it was sitting on a Dunwel Lift about 6" off the ground! I'll elaborate on that in a later article.

Now its Monday. The heads and cylinders have been removed. All the parts are labeled and laying on that old sheet. Tomorrow I'm taking the cylinders in to be bored and honed and the heads to be ported and valves & seats reground a little for improved flow.

While I'm waiting to get 'them back I'll be doing the Yost Power Tube upgrade. Then, on another free night, I'll be pulling off the cam gear cover and begin swapping my stock cams with the Andrews N2 high torque cams.

While doing the Yost Power Tube upgrade I'll bump my main jet up to a #180 from the #170 I'm running now. The slow jet is a #45. If I notice pinging or poor higher RPM performance after the upgrade is done, I'll swap the #180 with a #185.

I just thought back and realize its been 38 years since me and my high school bud first tore into an old '50 Ford flathead. That was my first experience working on engines. Since then I've completely torn an old Renault 4CV down to its block replacing its innards. And along the way, fooled around with VW's and Mercedes engines and carburetors for many years. The only thing that's changed from those days is, I've got a creeper seat and a lift. In the old days I did all my work while the cars sat jacked up on the street at the curb.

It wasn't until home computers became popular that I realized you could have just as much fun tearing into them, modifying 'them (making' 'them go faster), then buttoning 'them up and never get your hands dirty. That's when I stopped working on cars but I must confess, I am enjoying getting a little dirty again working on this project.

It's always amazing to me to think as you see all the individual parts laying on the floor, that when put together (the right way), these inanimate pieces of metal and rubber can come to life creating that famous Harley sound, motion, and big grin on my face as I head into the wind!

# **CV** Carburetor Modifications For EVO and Twin Cam engines

#### Changes to improve the performance of your Keihin CV carburetor are easy to perform.

Do not under-estimate the ability of the stock Keihin CV carburetor Note: If your engine does to produce good horsepower. The stock CV carburetor has a venturi diameter of 40mm (1.575 inch). Properly tuned, a CV carburetor is capable of supporting 80+ horse power in modified engines. A stock bike 1340cc (80 CID) can develop up to 64 horse power with a well tuned and modified CV carburetor. Click here to see dyno testing on the CV against other carburetors.

not start or idle properly now, you should attempt determine the cause and repair it prior to making these carburetor modifications.

With a few parts from your local Harley-Davidson Dealer and some tools, you can re-jet a CV carburetor and improve the performance of your bike.

- Parts List
- **Tools Needed**

# Step 1. REMOVE THE CARBURETOR

Remove the carburetor as described the service manual for your model bike. You might get away with leaving the throttle cables connected. It is much easier to remove the carburetor and use a work bench. Leave the choke cable hooked to the carburetor and disconnect the pull-handle end, taking the entire choke cable/carburetor assembly with the carburetor. It is faster to cut the fuel line hose off rather than trying to save it.

#### Tricks of the trade

If you take out the rear fuel tank bolts and loosen the front bolts, the fuel tank can be raised a few inches. The extra room gained by raising the tank is the difference between struggling with the job and making it easy.

# Step 2: MODIFY THE IDLE MIXTURE ADJUSTMENT:

The aluminum plug covering the idle mixture adjusting screw needs to be removed. Turn the carburetor over and locate the plug toward the rear of the carburetor, in back of the float bowl. Using about a 1/16" drill bit, carefully drill a hole through the small plug (CV Carburetor Cutaway item #9). If the plug does not fall out while drilling, remove

### **CV Carburetor Cutaway**



- 1. Slide Spring
- 2. Slide Diaphragm
- 3. Vacuum Slide
- 4. Vacuum Port
- 5. Needle Jet
- 6. Main Air Jet
- 7. *Main Jet*
- 8. Slow Jet

9. Idle Mixture Adjustment Screw

10. Throttle Plate

the drill bit. Carefully insert a small self-tapping sheet metal screw into the plug. This will allow enough grip to remove the plug by pulling on the self-tapping screw with a pair of pliers.

Underneath you will find a slotted screw. Turn this screw clockwise until it is GENTLY seated. Over tightening this screw can damage the carburetor and needle. Back the idle mixture screw 2 1/2 full turns. This provides a starting point for tuning.

#### Step 3: SLIDE MODIFICATIONS:

Remove the top of the carburetor (slide vacuum chamber cover) being careful to loosen the throttle linkage stop plate. There is a spring under the top cover, so hold it with a finger until all screws are loose. Holding the carburetor upright, remove the cover and spring. The slide/diaphragm assembly can now be removed. Inside the slide you will see the plastic spring seat. Under the spring seat is the jet needle. These two items can be removed by turning the slide over and pouring the parts into you hand. These parts are needed for reassembly of the carburetor.

#### Slide Detail



On the bottom of the slide are two holes. The center hole is for the jet needle. The second hole is off center. This is the vacuum port (CV Carburetor Cutaway #4). This hole needs to be drilled to 1/8". Make sure this hole is a clean straight hole. Keep the shavings away from the rest of the carburetor. Remove any burrs that exist and clean the slide. Set the slide aside for now.

#### Step 4: REPLACE JETS:

Turn the carburetor over so the bottom is facing upward. Remove the float bowl by removing the four screws. Carefully remove the fuel bowl. Using a flat blade screwdriver, replace the stock #42 slow jet with a #45 jet (CV Carburetor Cutaway 8). If you use the OEM needle, the main jet will be replaced with a jet 10 larger than the OEM. If you use the XL needle, the main jet will be replaced with a 165 jet(CV Carburetor Cutaway 7). The jets are brass parts that are screwed into an aluminum body. Do not over-tighten the new jets when installing them.

Replace the float bowl, carefully placing the accelerator pump rod into

1. Slide Spring

2. Spring Seat

3. Jet Needle

Jetting Notes:

its rubber boot.

Be sure to use jets numbered for the CV carburetor, and the older butterfly carburetors. The HD part numbers listed are correct. Additional jet sizes and jet needles are listed on the <u>CV Carburetor Parts appendix.</u>

#### Step 5: RE-ASSEMBLE THE CARBURETOR:

If you use the OEM needle, place 1 (approx. .050" or 1/16" thick) of the small brass washers over the long end of the needle jet <u>(Slide Detail 3)</u>. These washers will raise the jet needle taper, richening the low RPM fuel mixture. Place the jet needle into the slide, making sure the washers remain in place. If you did not get thin brass washers, a single small washer of up to 1/8" thick can be used. Make sure the washer is the smallest that can be found.

If you are using the XLH needle, place the jet needle into the slide without using any washers.

Replace the spring seat into the slide and over the jet needle. Place the carburetor slide into the carburetor body. Carefully place the edges of the diaphragm into the grove around the top of the carburetor. Install the slide spring and the carburetor top being careful not to mis-align or pinch the diaphragm.

Assembly Tricks for the diaphragm

The diaphragm is easily mis-aligned or pinched. This is a common source of problems after carburetor modifications are performed. The diaphragm frequently has the appearance of being too large to fit into the groove. The repeated up and down movement of the diaphragm causes it to stretch, making re-assembly tricky. Try using the cap to position the diaphragm. It will allow you to evenly push the diaphragm into the groove. You can "wiggle" the top and feel when the diaphragm is properly located. A damaged diaphragm will have the symptoms of the engine being able to idle, but will not accept any throttle. If you think the diaphragm is damaged, check for any pinholes with a bright light behind the rubber, pulling on the edges to stretch the diaphragm a bit. If you find any, the

entire slide/diaphragm assembly must be replaced.

#### Step 6: PUT THE CARBURETOR BACK ON THE BIKE

The carburetor is now ready to be installed back on the engine. Place the fuel line on the carburetor before you place it on the bike. Replace the carburetor, directing the fuel line and choke cable into position as you move the carburetor into place. Remember to replace the vacuum hose from the VOES to the top rear of the carburetor. Checking all the work to make sure screws and hoses are properly installed. Be careful not to over-tighten the choke cable mounting nut as the plastic will break fairly easily.

Lower the fuel tank back into place. Connect the fuel line hose to the fuel petcock. If you have a late model bike with the vacuum line connected to the fuel petcock, make sure the hose is connected.

#### Step 7: WARMING UP THE BIKE:

Warm the bike up to full operating temperature. Prior to final adjustments the engine may not idle properly. The carburetor is not as lean as the factory settings. DO NOT follow the owner's manual directions for cold starting.

The new procedure is as follows: If the engine is cold, pull choke out all the way. If the engine is warm, use half or no choke at all. Start the bike, adjusting choke to reduce the fast idle to a reasonable speed. About 30 seconds later, push the choke all the way in and use the throttle to keep the bike idling while warming up. The throttle lock can be used for this purpose during initial adjustments.

Letting the bike idle for 15 minutes to warm up is not desirable. The modifications made to your bike should allow it to run well enough for a sedate test run around the block. This speeds up the warm-up time and also allows a feel for the improvement to throttle response from the modifications. As the bike comes up to proper operating temperature, adjustments to the idle mixture and idle speed can be performed.

#### Tricks of the trade

A small, flat blade screwdriver about 3" long should be used to adjust the idle mixture screw. Fumbling around with the wrong screwdriver usually results in burned knuckles. Make sure the screwdriver works before the engine is started.

To adjust the idle speed, a long, flat blade or #1 Phillips screw driver should be used. This allows the screwdriver to get past the various obstructions that exist between you and the idle mixture screw.

#### Step 8: ADJUSTING IDLE MIXTURE:

With engine warmed up and at idle, turn the idle mixture screw inward (clockwise) slowly until the engine starts to stumble. If the engine will not idle on its own during this procedure, raise the idle by adjusting the idle set screw until it does. Make a mental note of the position of the clock position of the screwdriver. Now turn the idle mixture screw outwards until the engine begins to run smoothly, adjusting the idle stop screw as necessary to maintain proper idle speed. Blip the throttle a time or two and observe the results. If the engine responds quickly with a gratifying blast and no backfiring through the carburetor, you have your idle mixture right. If backfiring occurs through the carburetor then adjust the idle mixture screw out another 1/8 to 1/4 turn. <u>Under normal circumstances, the idle mixture screw should be between 2 and 3 turns out.</u> Adjusting the idle mixture leading to poor gas mileage and carbon buildup in the combustion chamber.



The CCP idle mixture screw allows fine tuning without a screwdriver. Click For Info.

#### **Big Twin Idle Speed**

The proper idle speed for Big Twin engines is 900-1000 RPMs. EVO oiling systems need better than 700 RPM to work properly. Resist the temptation to lower the idle excessively. It may sound good, but improper oiling will contribute to engine overheating while idling in traffic and premature engine failures.

#### Step 9: FINE TUNING:

The details of carburetor tweaking and plug reading is a very involved subject, so you may want to refer to a higher authority after this. If you do not have access to a Dyno facility, here is a very basic guide that will get the adjustments close.

To test the main jetting, you must be in fourth or fifth gear and running fairly high RPM (4000+) then open the throttle all the way to the throttle stop, noting the feel of the bike. Immediately let off the throttle about 1/8 turn and note the feel of the bike. If it seems to accelerate some when you let off the 1/8, your main jet is too lean. If it hesitates or the top speed is poor (i.e. less than 80 MPH) you are too rich. Adjust your main jetting accordingly by increasing or decreasing the jet size by 5. Use your common sense and seat of the pants feel and you will get close enough to do plug reads.

Plug reading is as much an art as a science, taking years of experience to understand what the plugs are really telling us about the engine. For most street riders, making sure the plugs are a nice light tan color is good enough. Don't read the plugs until the fine tuning has been done and then make sure you use new plugs. Do some riding which exercises either low speed or main jetting, then stop immediately shutting down the engine before it is at idle speed. Checking the plugs this way will provide the most accurate reading. If your plugs are black you are too rich, which decreases your gas and performance but will not harm your engine. Too light or worse yet bone white you are too lean, and engine damage will soon follow if proper steps are not taken richen the mixture.

#### Parts needed:

#### CV Modification using the OEM jet needle jet

- Use OEM Main needle
- 27114-88 Main jet (#180) or 10 larger than the stock jet.

- 27114-88 Main jet (#180) or 10 larger than the stock jet.
- 27170-89 Pilot or slow jet (#45) or next size larger (42>45>48)
- 5 Small, thin brass washers approx. .050 thick (optional for fine tuning)
- 2 feet fuel line hose (1/4" ID)
- 2 small hose clamps for fuel line

#### OR

#### CV Modifications replacing the OEM jet needle

- 27094-88 Main needle ('88 XLH part)
- 27116-88 Main jet (#165)
- 27170-89 Pilot or "Low speed" jet (#45) or next size larger (42>45>48)
- 5 Small, thin brass washers approx. .050 thick (optional for fine tuning)
- 2 feet fuel line hose (1/4" ID)
- 2 small hose clamps for fuel line

Having a copy of the Harley-Davidson Service Manual for your model bike is always extremely helpful. The Service Manual will provide valuable information on repairs and maintenance of your bike.

#### **Tools needed:**

- Electric Drill
- 1/8" bit (.125 inches)
- 1/16" (or approximate) bit
- Hand tools for removing and disassembling carburetor

Phillips Head Screwdriver Flat Blade Screwdrivers 1/2",9/16" open end wrench Small Adjustable wrench Sharp knife

Good quality fine flat metal file

Disclaimer:

## Carburetor Adjustments and Re-jetting your Carburetor

After modifications to an existing carburetor or the installation of a new carburetor, final adjustments and jetting changes are required to get the most power from the modifications. Without a dynamometer and air fuel mixture test equipment, making jetting changes to your carburetor can be very difficult. Here are a set of procedures that will work with most carburetors, without regard to the type of carburetor nor the type of motorcycle. (These procedures are most effective for



(These procedures are most effective for single carburetor motorcycles) jet a carburetor has been so overwhelming that the following article was written.

#### Check your work:

Whether you are tuning a carburetor on a stock street bike or a modified race bike, the procedures are essentially the same. Start by making sure the carburetor's jets, adjustable settings and float levels are at a reasonable starting point. These would be the recommended setting that came with the installation instructions for the carburetor or re-jetting kit. While checking the carburetor look for fuel leaks, signs of air leaks, make sure the throttle works smoothly and opens to the proper full throttle position. Often overlooked is fuel tank ventilation, fuel line and shut-off valve operations. All these items are required to ensure maximum fuel flow from the tank to the carburetor.

#### Starting the Engine:

Assuming everything is OK, you are now ready to test your handy work. Warm the bike up to full operating temperature. You may have a little trouble keeping her idling, but one thing to remember is you now have a carburetor which is not running as lean out as the factory setup, so DO NOT follow the owner's manual directions for cold starting. Here is a new starting procedure to use: If the temperature is below 70°, pull the choke out all the way, above 70° pull the choke out half way. If the bike has been run in the past two hours and the engine is still warm, the engine should start without using the choke. After starting the bike, quickly adjust the choke to reduce fast idle to a reasonable level. After 30 seconds, push the choke in all the way, use the throttle to keep the engine idling. Warm the engine up for 8-10 minutes by riding a few miles at a slow pace. The Evolution engine is sensitive to the warm-up time. The engine must be up to operating temperature before setting the idle and idle mixture. A word of advice, find a small screwdriver that can be used to adjust the idle speed and mixture screws BEFORE the engine is hot. Fumbling around trying to determine the correct screwdrivers will probably result in burned knuckles if you are not careful.

#### Preliminary IDLE MIXTURE Adjustment:

With the engine at proper operating temperature and at idle speed, turn the idle mixture screw inward (clockwise) SLOWLY until the motor starts to falter. If the engine will not idle on its own when you begin this procedure, turn the idle speed adjustment screw until it does. Throughout this procedure try to keep the RPMs at 900-1000 RPMs.

Having turned the idle mixture screw inward until the bike falters, now back it out slowly, keeping count of the number of turns outwards until the motor begins to run smoothly. Re-adjust the idle speed set screw as necessary to maintain the RPMs about 900-1000 RPMs. The Harley-Davidson engine oiling systems needs 700 RPMs or greater to deliver proper lubrication. Blip the throttle a time or two, and observe the results. If the motor responds with a gratifying blast without backfiring through the carburetor, the idle mixture is correct. If it backfires through the carburetor, back the idle mixture screw out another 1/4 turn. Do not go too far, as too rich an idle mixture can cause problems and poor gas mileage. This sets the idle mixture and idle speed for initial testing.

#### FINE TUNING:

#### Adjusting Idle Mixture Adjusting Low Speed Circuit(s)

The details of carburetor tweaking and plug reading is a very involved subject, so you may want to refer to a higher authority after this. If you do not have access to a Dyno facility, here is a very basic guide that will get the adjustments close.

You will need to perform these tests while the engine is at proper operating temperature. Accelerate through the gears at full throttle. The bike should accelerate smoothly, without spitting or hesitating. If at low RPMs, backfires through the carburetor above 1500 RPMs, increase the size of your low speed jetting (slow speed or intermediate jet) a couple of notches and try again. If the engine feels sluggish, sounds flat, blubbers or emits black smoke from the exhaust, turn the idle mixture adjustment screw in 1/4 turn or reduce the size of the low speed jetting. You will find the part numbers for the Harley-Davidson CV carburetor on another page in this section of the Performance Guide. **Adjusting Intermediate Circuit(s)** 

#### Adjusting High Speed Circuit(s)

Adjusting the main jetting requires a long stretch of open road with no traffic. You must be in fourth or fifth gear and running at 3500-4000-4500 RPM. then open the throttle all the way to the stop, noting the feel of the bike. Immediately let off about 1/8 turn and note the feel of the bike. If the engine just slows a little, the jetting is very close. If it seems to accelerate some when you let off the 1/8, your main jet is too lean. If it hesitates or the top speed is poor (i.e. less than 80 MPH) you are too rich. Adjust the main jetting accordingly. Use your common sense and seat of the pants feel and you will get close enough to do plug reads.

Plug reading is as much an art as a science for most people. Lots of experience is needed to REALLY do it up right. For most street riders, making sure your plugs are a nice tan color is usually good enough. Don't bother reading the plugs until you have done preliminary fine tuning. You will need several sets of new plugs, gapped and ready to use. After your bike is properly warmed up, after installing a fresh set of plugs, you will need to do a full throttle acceleration test, making sure the bike gets to full RPMs in 4th gear.

(The Motorcycle Performance Guide staff recommends you take the bike your local drag strip for this testing. Your local sheriff usually has no sense of humor about a motorcycle running down his roads in excess on 90 MPH). At the peak RPMs, you will need to shut down the engine before you let off the throttle, and coast to a stop. Remove the plugs and look at the general color of the porcelain. If the porcelain is black, the engine is running rich, requiring the installation of a smaller jet. If the porcelain is bone white or a very light tan the engine is running lean, requiring the installation of a larger jet. If the porcelain is tan to light brown, the jetting is close. If additional tuning runs are required to adjust the carburetor, make sure you install a fresh set of plugs before each run. You can not read the condition of the plugs unless the plug is fresh.

If you are in doubt as to the jetting, make sure you jet on the rich side (tan>brown>black). Because of potential engine damage, you are better off slightly rich rather than lean. A lean engine can detonate, causing permanent damage.

#### FINAL NOTES:

Large changes to the low speed jetting may require additional adjustment of the idle mixture again. You should expect to end up with a richer setup if your bike is light and/or you are running exceptionally good flowing pipes (i.e. Thunderheader). There are so many variations here it is hard to predict, but the ranges listed here are for most normal applications. If you try these and your bike still runs like hell you may have some other problem (clogged fuel screen/filter, bad petcock, ignition trouble/electrical malfunction, timing wrong, fouled plugs, bad gas, etc. etc.) You may want to get a seasoned wrench involved if you are in doubt.

#### The 5 second overview:

When you are limited to street riding, take note on how easily and quickly the engine reaches the proper RPM for shifting gears. The engine should accelerate smoothly and quickly through all gears. When the main jetting is to rich, the engine will feel sluggish and acceleration will 'feel' slow.

You can check the main jet by quickly closing the throttle from wide open to 7/8 position when the engine's RPM is greater than 4500. If the engine accelerates slightly, the main jet is to lean. A larger main jet is needed. If the engine hesitates or misses slightly, the main jet is to rich. A smaller main jet is needed. If the engine just slows a slight amount, the jetting is very close to correct.

Another test is to accelerate through the gears at full throttle. If the engine backfires through the carburetor, misses, cuts out or quits running, the main jet is lean. Increase the size of the main jet. If the engine acceleration seems sluggish, does not react to the throttle or sounds flat, the main jet is rich. Decrease the size of the main jet.

The main jetting can be set quickly at a 1/4 mile drag strip. For this test, you can ignore the ET (elapsed time). Making sure the engine is warmed up, make your run down the strip making note of your final MPH. Keep increasing the size of the main jet until MPH begins to drop. Then drop back one jet size. Your jetting should now be correct.

# Selecting a Performance Camshaft for you Harley-Davidson

Selecting the correct camshaft for you bike can be confusing and frustrating. The more popular cams available may not be the right cam for the way you ride or the type of bike you have. A cam that is installed in a show bike featured by the 'biker' magazines may not be part of a proven engine performance combination. When it comes to improving your bike's performance by installing a cam, you should deal with a reputable performance shop and a proven record on improving power.



A stock cam is on the left, a 268 degree duration cam with a .600" lift is on the right.

In order to get the best performance, the camshaft must be matched to all the other engine components. The combination of carburetor, intake manifold, head design, flow characteristics, valve size, bore, stroke, compression ratio, ignition system, exhaust system and the way you are going to ride the bike all have an impact upon the best cam to select.

If head work or pistons are not in your budget,

then your choices are limited to bolt-in cams. Even limiting your cam selection to a boltin cam provides you with a wide choice of options. Most bolt-in camshafts are intended for use with bikes and engines that have few modifications. The minimum requirements for a bolt-in cam is usually a re-jetted carburetor, a high-flow air cleaner and a less restrictive exhaust system.

Make sure you match your riding style or needs to the the horse power and torque characteristics of the cam. The biggest mistake made in cam selection is getting to much cam for the bike, the way it is ridden or the components on the bike. A good set of pipes, some minor upgrades to the CV carburetor, a good ignition system and the right cam can produce around 75 HP when properly tuned.

If you ride a heavy bike like a Road King or always ride Bolt-in Cam Selector two up, you should place more emphasis on having the engine produce good low end torque. If you have a light bike like an FXR or Dyna, and you want a lot of top end power, a mid-range power cam can be used. If you usually ride your bike in town, choose a camshaft for low end torque. If you have your choice between horsepower or torque for engine characteristics, the best decision is to go for the torque cam.

In order to simplify your selection of a camshaft, the Motorcycle Performance Guide created a list of the most bolt-in camshafts for Harley-Davidsons. Find the type of bike, the riding style and your favorite cam manufacturer. A list of recommended camshafts is given.

As a general rule, cams with 220-235 degrees of duration tend to produce good low end torgue. Cams with 235-250 degrees of duration tend to work best in the mid-ranges and cams over 260 degrees work best for top end power. Camshaft overlap duration less than 30 degrees tends to produce good low end power. Lobe Separation Angles (LSA) of 100-103 degrees tend to produce power at the low end.

Cams with valve lifts .500 inches and under, with a duration under 250 degrees are generally considered bolt-in. Cams over .500 inches lift and 250 degrees duration require increased compression and head work to work best.

**Don't think you are going to take your stock bike** and turn it into a 100 HP monster by adding a cam, replacing the carburetor and putting on straight pipes. Getting an 80 inch Big Twin engine to produce 100 horsepower at the rear wheel is difficult, time consuming and quite expensive. You are much better off bolting in a Crane Fireball 310, an Andrews EV-27 or a V-Thunder EVL-3010 in your street bike than trying to find a long duration cam because you have been told 'bigger' cams makes more horsepower. A well designed and tuned engine combination, using a mild bolt-in cam is quite capable of embarrassing most other Harley's between stoplights. 100 horsepower is not very useful if the engine does not make power until 6000 RPM. Harley-Davidson Big Twin engines were not designed to take that kind of abuse. An engine with 70 HP at 4800 RPM and 85 foot pounds of torque at 3200 RPM can be a real thrill compared to a stock EVO motors.

http://www.nightrider.com/biketech/hdengines.htm

**Harley-Davidson** 

# **Engine Performance Dyno Runs** 63.8 HP

Performance and Technical information on Stage 1 engines for Harley-Davidson motorcycles.

#### **Basic Stage one Engine Design**

The Stage One Basic engine represents a simple approach to improve engine performance with bolt-on componentst. Most people can perform these modifications themselves. Modifications over stock engine are underlined in the list below. The estimated cost for these modifications ranges from \$700 to \$1000. The performance return for these changes can be large for the dollars spent. Increases up to 10 HP and 10 Ft.Lbs of torque can be seen on some bikes.

A maximum of 63.8 HP occured at 5350 RPMs, with maximum torque of 72.5 ft. lbs. at 3650 RPMs. The HP and torque curves for this engine combination was very smooth, with a broad torque curve over 60 ft. lbs. starting at uder 2300 RPMs and extending to 5500 RPMs.

Year: 1997 Model: EVO Bore: Stock Stroke: Stock Displacement: 1340cc Cases: H-D Assembly: H-D Crankshaft and Flywheel: H-D Heads: H-D Intake Valves: Stock Diameter Exhaust Valves: Stock Diameter Valve Springs: H-D Porting: None Compression Ratio: 8.5:1 Pistons: H-D Cam: H-D Pushrods: H-D Carb: Stock Keihin CV with <u>DynoJet recalibration kit</u> installed Carb Jetting Information: 180 main jet, 45 slow jet installed Manifold: Stock Air Cleaner: <u>Screamin Eagle K&N</u> Ignition: <u>Screamin Eagle 6000 RPM street module</u> Ignition Timing: 32° BTDC Coil: <u>Screamin Eagle Dual Fire</u> Plug Wires: <u>Magnecor 8.8mm</u> Pipes: Stock headers with HD Slip-on Baloney cuts Dyno Tuning Facilities: <u>CycleRama</u>, Pinellas Park, FL. (813) 546-0889

63.8 HP @ 5350 RPM 72.5 ft. lbs. Torque @ 3650 RPM



### **Harley-Davidson**

# **Engine Performance Dyno Runs** 68.0 HP

Performance and Technical information on Stage 2 engines for Harley-Davidson motorcycles.

#### **Stage Two Engine Basic**

The Stage Two Basic engine represents a more extensive approach to improve engine performance with bolt-on components and a bolt-in camshaft. Most people can perform these modifications themselves. Modifications over stock engine are underlined in the list below. The estimated cost for these modifications ranges from \$700 to \$1000. The performance return for these changes can be large for the dollars spent. Increases up to 30 HP and 20 Ft.Lbs of torque can be seen on some bikes.

This particular engine combination uses 3 very popular components: The Andrews EV-27 cam, a Crane HI-4E ignition module and a Thunderheader.

Year: 1997 FXDWG Model: EVO Bore: Stock Stroke: Stock Displacement: 1340cc Cases: H-D Assembly: Don Anderson Ignition: Stock H-D Crankshaft and Flywheel: H-D Heads: H-D Intake Valves: Stock Diameter Exhaust Valves: Stock Diameter Valve Springs: H-D Porting: None Compression Ratio: 8.5:1 Pistons: H-D Cam: Andrews EV-27 Pushrods: H-D Stock Carb: Stock CV w/Yost Power Tube Kit Carb Jetting Information: 170 main jet 45 slow jet Manifold: Stock Air Cleaner: Screamin Eagle K&N filter element Ignition: Crane HI-4E Ignition Timing: Coil: Crane Single Fire Pipes: Thunderheader Dyno Tuning Facilities: R&R Cycles, Manchester, NH



# Harley-Davidson

*Engine Performance Dyno Runs 70.0 HP* 

#### Performance and Technical information on Stage 2 engines for Harley-Davidson motorcycles.

#### **Stage Two Engine Basic**

The Stage Two Basic engine represents a more extensive approach to improve engine performance with bolt-on components and a bolt-in camshaft. Most people can perform these modifications themselves. Modifications over stock engine are underlined in the list below. The estimated cost for these modifications ranges from \$700 to \$1000. The performance return for these changes can be large for the dollars spent. Increases up to 30 HP and 20 Ft.Lbs of torque can be seen on some bikes. The major changes for a Stage Two Basic engine over the Stage One Advanced is the addition of a Crane Fireball 310 camshaft. The original cam bearing was removed and replaced with a Torrington. To speed the installation of the cam, Crane Time-Saver push rods were used. These push rods allow you to cut out the old push rods and install the new ones without removing the rocker boxes. Testing on the Stage One engine with a Dyna 2000 ignition module produced very poor results. The addition of the Crane HI-4 ignition module was used. The HI-4 allows complete tuning of the advance curve andlet the engine take advantage of the higher

RPM range of the new cam. The rev limiter on the ignition module was set to a very conservative 5800 RPM. The maximum RPM range for a Stage II is 6200. A maximum of 70 HP occured at 5500 RPMs, with maximum torque of 78 ft. lbs. at 2600 RPMs. The dip in the HP and torque curves is likely due to the CV carburetor. A different needle or changing to an after-market carb should smooth the curves. A basic stage two engine does not include the additional \$350 to \$600 it would cost to buy the carb.

Year: 1997 Model: EVO Bore: Stock Stroke: Stock Displacement: 1340cc Cases: H-D Assembly: H-D Ignition: Stock H-D Crankshaft and Flywheel: H-D Heads: H-D Intake Valves: Stock Diameter Exhaust Valves: Stock Diameter Valve Springs: H-D Porting: None Compression Ratio: 8.5:1 Pistons: H-D Cam: Crane Fireball 310 Pushrods: Crane Time Savers Carb: Stock CV w/ThunderSlidet Kit- Idle Mixture out 3.5 turns Carb Jetting Information: Slow Jet 48 Manifold: Stock Air Cleaner: UniFlow with modified HD air box Ignition: Crane HI-4 Ignition Timing: 32° BTDC Coil: Stock H-D Dual File Pipes: Stock H-D header pipes with modified Cycle Shack Slip-Ons Dyno Tuning Facilities: CycleRama, Pinellas Park, FL. (813) 546-0889



#### DYNORUN.022 - 4th gear roll on stock module. RO

# **Harley-Davidson**

# **Engine Performance Dyno Runs**

### 73.9 HP

Performance and Technical information on Stage 2 engines for Harley-Davidson motorcycles.

#### **Basic Stage Two Engine Design**

The Stage Two Basic engine represents a more extensive approach to improve engine performance with bolt-on components and a bolt-in camshaft. Most people can perform these modifications themselves. Modifications over stock engine are underlined in the list below. The estimated cost for these modifications ranges from \$700 to \$1000. The performance return for these changes can be large for the dollars spent. Increases up to 30 HP and 20 Ft.Lbs of torque can be seen on some bikes. The major changes for a Stage Two Basic engine over the Stage One Advanced is the addition of an Andrews EV-46 camshaft. The original cam bearing was removed and replaced with a Torrington. The stock Harley-Davidson push rods were used.

Prior testing with the Screamin Eagle 6000 RPM street ignition module had already produced excellent. No reason was seen to change from the SE ingition module. A maximum of 73.9 HP occured at 5950 RPMs, with maximum torque of 78.1 ft. lbs. at 4100 RPMs.

The HP and torque curves for this engine combination was very smooth, with a broad torque curve over 70 ft. lbs. starting at 2500 RPMs and extending to 5400 RPMs.

Year: 1997 Model: EVO Bore: Stock Stroke: Stock Displacement: 1340cc Cases: H-D Assembly: H-D Crankshaft and Flywheel: H-D Heads: H-D Intake Valves: Stock Diameter Exhaust Valves: Stock Diameter Valve Springs: H-D Porting: None Compression Ratio: 8.5:1 Pistons: H-D Cam: Andrew EV-46 Pushrods: H-D Carb: Stock Keihin CV with DvnoJet recalibration kit installed Carb Jetting Information: 180 main jet, 45 slow jet installed Manifold: Stock Air Cleaner: Screamin Eagle K&N Ignition: Screamin Eagle 6000 RPM street module Ignition Timing: 32° BTDC Coil: Screamin Eagle Dual Fire Plug Wires: Magnecor 8.8mm Pipes: Stock headers with HD Slip-on Baloney cuts



73.9 HP @ 5950 RPM 78.1 ft. lbs. Torque @ 4100 RPM

### **Engine Performance Dyno Runs**

### 74 HP Fuel Injected

Performance and Technical information on Stage 2 fuel injected Evolution engines for Harley-Davidson motorcycles.

#### **Basic Stage 2 Engine Design**

Don't underestimate the ability of Harley-Davidson fuel injected bikes to make power. Here is a Stage 2 EFI bike making 74 horsepower and 89 foot pounds of torque. Considering this engine is on a FLHRC-I, it can use all the torque it can get. With torque like this, who needs horsepower.

Year: 1998 Model: EVO **Owner: Glen Phillips** Bore: Stock Stroke: Stock Displacement: 1340cc Cases: H-D Assembly: H-D Crankshaft and Flywheel: H-D Heads: H-D Intake Valves: Stock Diameter Exhaust Valves: Stock Diameter Valve Springs: H-D Porting: None Compression Ratio: 8.5:1 Pistons: H-D Cam: H-D Stage 1 EFI Pushrods: H-D Carburetor: H-D Fuel Injection

Carburetor Jetting Information: EFI Stage 1 kit Manifold: Stock Air Cleaner: <u>EFI Stage 1 kit</u> Ignition: Ignition Timing: Coil: Plug Wires: <u>Magnecor 8.8mm</u> Pipes: Stock headers with HD Slip-on Touring Muffler Dyno Tuning Facilities: Harley-Davidson of Reno



# **Harley-Davidson**

# Sportster

# **Engine Performance Dyno Runs**

### 82 HP

Performance and Technical information on Stage 2 engines for Harley-Davidson motorcycles.

Year: 1996 Model: XL Bore: stock Stroke: stock Displacement: 1200 cc Cases: H-D Assembly: owner Crankshaft and Flywheel: H-D Heads: Buell White Lightning Intake Valves: stock Exhaust Valves: stock Valve Springs: stock Porting: none Compression Ratio:stock Pistons: H-D Cam: Screamin Eagle Pushrods: H-D Carb: CV w/DynoJet Kit Carb Jetting Information: Manifold: H-D Air Cleaner: Kuryakn Hypercharger Ignition: Dyna 2000 Ignition Timing: Coil: Pipes:SuperTrapp 2-1 Dyno Tuning Facilities: Kit Moto, France



KET MOTO RUE DES TULLERLES 67460 SOUFFELHEVERSHEIM 03.88.20.20.04.

# **Harley-Davidson**

**Sport**ster

# **Engine Performance Dyno Runs**

# 84 HP XL

Performance and Technical information on Stage 2 engines for Harley-Davidson motorcycles.

How to classify a Sportster engine with Buell heads? We are going to consider it a Stage Two engine because they are standard equipment on the Buell and a bolt on component for other Sportster based engines.

These results are impressive for a street 1200. If you are looking for a fast way to bolt on power, the Buell heads are the way to go. If you look at the specifications closely, you will see that with the carburetor was modified to the CV carburetor specifications listed on this WEB site. The bike also uses nothing but Screamin Eagle slip ons for an exhaust system. All things considered, this is an excellent example of a set of conservative components installed and properly tuned giving above average results.

#### **Stage Two Engine Specifications**

Owner: David Reed, Osage Beach, Mo. Year: 1994 Model: XL Bore: stock Stroke: stock Displacement: 1200 cc Cases: H-D Assembly: owner Crankshaft and Flywheel: H-D Heads: Buell Thunderstorm Intake Valves: stock Exhaust Valves: stock Valve Springs: stock Porting: none Compression Ratio:Stock Pistons: H-D Cam: Screamin' Eagle Pushrods: H-D Carb: CV w/Bike Tech Modifications Manifold: H-D Air Cleaner: Ignition: Ignition Timing: Coil: Pipes: OEM with Screamin' Eagle Slip Ons Dyno Tuning Facilities: Worth Harley Davidson..Belton Mo.(816)331-2222

> 84 Horsepower 74 Foot Lbs. Torque 1200 XL



## **Harley-Davidson**

# **Engine Performance Dyno Runs** 82 HP

Performance and Technical information on Stage 3 engines for Harley-Davidson motorcycles.

#### Stage Three Engine Design'

The Stage Three Basic engine represents a more extensive approach to improve engine performance with bolt-on components and a bolt-in camshaft. Most people can perform these modifications themselves. Modifications over stock engine are underlined in the list below. The estimated cost for these modifications ranges from \$1500 to \$1800. The performance of this type of engine provides dramatic improvements over a stock engine. An increases of 30 HP and 20 Ft.Lbs of torque was seen over the stock bike.

Development of this engine has been a carefully documented series of changes with the specific intent of creating a Stage Three engine that anyone with reasonably good mechanical skills could do over a weekend. The 82 horsepower obtained by bolting this engine combination together created an excellent performing bike.

In moving this bike from a Stage Two engine to a Stage Three engine, a set of Screamin Eagle Evolution heads were added.

The major changes in making a Stage Two Basic engine over the Stage One Advanced is the addition of an Andrews EV-46 camshaft. The original cam bearing was removed and replaced with a Torrington. The stock Harley-Davidson push rods were used.

Prior testing with the Screamin Eagle 6000 RPM street ignition module had already produced excellent. No reason was seen to change from the SE ingition module. A maximum of 73.9 HP occured at 5950 RPMs, with maximum torque of 78.1 ft. lbs. at 4100 RPMs.

The HP and torque curves for this engine combination was very smooth, with a broad torque curve over 70 ft. lbs. starting at 2500 RPMs and extending to 5400 RPMs.

Year: 1997 Model: EVO Bore: Stock Stroke: Stock Displacement: 1340cc Cases: H-D

Assembly: Stephen Mullen Crankshaft and Flywheel: H-D Heads: Screamin Eagle Intake Valves: 1.90" Exhaust Valves: 1.62" Valve Springs: H-D Porting: None Compression Ratio: 9.5:1 Pistons: H-D Stock Cam: Andrew EV-46 Pushrods: H-D Carb: Stock Keihin CV with DynoJet recalibration kit installed Carb Jetting Information: 175 main jet, 45 slow jet installed needle clip in highest position Carb Idle mixture screw: CCP replacement Manifold: Stock Air Cleaner: Screamin Eagle K&N Ignition: Screamin Eagle 6000 RPM street module Ignition Timing: 34° BTDC Coil: Screamin Eagle Dual Fire Plug Wires: Magnecor 8.5mm Pipes: Stock headers with HD Slip-on Baloney cuts Gaskets: James Gaskets Dyno Tuning Facilities: CycleRama, Pinellas Park, FL. (813) 546-0889





#### Build a 95 Horsepower Stage 3 bike

You can get over 90 horsepower from your 80 CID Harley-Davidson Evolution engine without porting and polishing the heads. Here is the dyno information that proves it can be

done. With the proper engine components and some good tuning, you can build the same engine.

