Circle Track Crate Engine
Technical Manual

88958604

88958602/19258602

88958603

p/n 88958668

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This Technical Manual is dedicated to the memory of
Robert E. (Bob) Cross

1957-2010

Revised May – 2010

Introduction

GM Performance Parts is committed to providing proven, innovative performance technology that is truly "More than just Power." GM Performance Parts are engineered, developed and tested by the factory to exceed your expectations for fit and function. To contact us call 1-800-577-6888 for the GM Performance Parts authorized Center near you or visit our website at www.gmperformanceparts.com.

This book provides general information on components and procedures that may be useful for technical inspection of the engines. It is also intended as a guide for rebuilding specifications.

Refer to service manual for comprehensive and detailed service practices. Observe all safety precautions and warnings in the service manual for installation in the vehicle. Wear eye protection and appropriate protective clothing. When working under or around the vehicle support it securely with jack-stands. Use only the proper tools. Exercise extreme caution when working with flammable, corrosive, and hazardous liquids and materials. Some procedures require special equipment and skills. If you do not have the appropriate training, expertise, and tools to perform any part of the installation then contact a professional.

Legal Information

This publication is intended to provide information about your circle track engine and related components. The publication also describes procedures and modifications that may be useful during the installation. It is not intended to replace the comprehensive service manuals or parts catalogs which cover General Motors engines and components. Rather, it is designed to provide supplemental information in areas of interest and to "do-it-yourself" enthusiasts and mechanics.

This publication pertains to engines and vehicles which are used off the public highways except where specifically noted otherwise. Federal law restricts the removal of any part of a federally required emission control system on motor vehicles. Further, many states have enacted laws which prohibit tampering with or modifying any required emission or noise control system. Vehicles which are not operated on public highways are generally exempt from most regulations. As are some special interest and pre-emission vehicles. The reader is strongly urged to check all applicable local and state laws.

History

GM has a long history of providing the engine of choice for circle track racing. The introduction of the small block Chevy in 1955 started it all. Production parts were durable, and the engines were plentiful. In the 1960's, GM started producing HD parts for racing activities and a whole industry was started.

Over time, the competitive nature of racing drove costs increasingly higher and sanctioning bodies found it increasingly difficult to police the competitors. In the 1990's, several tracks and individuals took GM's successful crate engines designed for the street and adapted them for circle track applications. The potential for cost savings was tremendous.

Based on the success of those racers, GM Racing and GM Performance Parts engineers spent time in 2001 developing several circle track engine packages based on their proven small block Chevy crate engines. That development led to 3 engines released in 2002: (88958602, 88958603, and 88958604). Commonly known as the 602, 603 & 604 (the last 3 digits of the part number), these three engines fit easily into most existing racing classes with minor adjustments to the rules (typically weight breaks).

Each engine is assembled with all new parts on a production line to keep costs down. The engines then are up-fitted with special oil pans, valve covers and sealing bolts. Factory sealing of the engines are one of the keys to the success of the program as this makes it difficult to tamper with the engine and helps maintain equality among the competitors. If used as directed, the engines should provide several seasons of use with minimal maintenance.

Where to Buy

Circle track crate engines can be purchased from any GM Dealer in the USA, Canada and other countries. Our recommendation is to contact an authorized GM Performance Parts dealer which is more familiar with GM's high-performance parts line. Contact 1 (800) 468-7387 or www.gmperformanceparts.com to find a dealer near you.

Warranty

Circle track crate engines have no warranty. They are sold for off-road racing activities.

Sealing Bolts

The Circle Track Crate engines are sealed from the factory with 8 bolts in key locations. The locations are such that tampering with the engine is unlikely without destroying or damaging the bolt head. Each bolt has the familiar GM logo laser etched on the head as a quick identifier (Note: the GM logo is trademarked and there are penalties for copying the trademark). In 2005, GM started using a clear zinc coating on the bolts and added an additional anti-counterfeiting process called "Info-Glyph". This process allows information to be encoded into a "square of dots" laser etched on the bolt.

The 8 bolt locations are: 2 bolts in the intake manifold, 2 bolts in the front cover, 2 bolts in the oil pan & one bolt in each cylinder head.. The valve covers are not sealed as it is important to properly lash the valves. ***(See valve lash procedure on page 9)***

The bolts are designed so that during installation, the head breaks off at the proper torque. ***(Example: On the sealed cylinder head bolt, the hex head portion of the bolt breaks away at 65 ft*** **lbs.) Each bolt is designed specifically for that location and torque. The head is "rounded off" so it difficult to remove without damaging the head and sending up a "red flag" that the engine has been tampered with.**

Replacement bolts are not sold to the public. This ensures the integrity of the program. See the Rebuild section to understand repairs, rebuilds and replacement bolts.

This photo shows the GM Logo and Info-Glyph dot-matrix.

GM Circle Track Engines

This section is a brief overview of the 3 engine packages that are available from GM. The following pages outline the highlights of each engine including torque and horsepower figures. The final page has a chart that covers the technical specifications of each engine.

P/N 88958602 and 19258602 (602)

88958602 and 19258602 are rated at 350 hp @ 5000 rpm. The 602 makes 390 ft lbs torque @ 3800 rpm. It fits well in lower level introductory classes that are looking for affordable horsepower, such as factory stock, modified, and truck. It comes complete intake to pan and includes an HEI distributor. It does not include a flywheel or water pump. The engine uses a 4 bolt block, cast iron crank, powder metal rods, and cast pistons. The 9.1:1 compression ratio with iron Vortec heads offer a good balance of power and durability. The 8 1/2" deep oil pan holds 8 quarts including the filter. The engine has a dual-plane, high-rise, aluminum intake. This engine weighs 434 lbs as delivered.

P/N 88959603 (603)

88958603 is rated at 355 hp @ 5250 rpm. It makes 405 ft lbs torque@ 3500 rpm. It fits well in mid level classes such as limited late model and late models. The engine comes complete intake to pan and includes water pump, HEI distributor, and a flywheel. The 4 bolt block, steel crank, powder metal rods, and high-silicon pistons make a great foundation. The 10.1:1 compression ratio from the aluminum heads makes good power. The 7" deep oil pan holds 8 quarts including the filter. The engine has a dual-plane, medium-rise aluminum intake. This engine weighs 400 lbs. as delivered.

P/N 88959604 "604"

88958604 is rated at 400 hp @ 5500 rpm. It makes 400 ft lbs torque @ 4500 rpm. It fits well in late models and other classes that run on longer tracks. The engine comes complete intake to pan. It does not include distributor, flywheel, or water pump. The 4 bolt block, steel crank, powder metal rods, and high-silicon pistons make a great foundation. The 9.6:1 compression ratio with "Fast Burn" aluminum heads and roller rockers make great power and lots of torque. The 7" deep oil pan holds 8 quarts including the filter. This engine has a high-rise, single plane, aluminum intake manifold. This engine weighs 375 lbs as delivered.

Notes

Installation Instructions

Each engine comes with detailed instruction sheets. This section includes some of the information that is included in those instruction sheets. It is imperative that the startup procedures are followed before starting the engine. Failure to do so may result in catastrophic engine failure. These procedures are designed to ensure engines are properly broke in for maximum engine life. Two key factors affect engine life; proper valve lash and keeping rpm's within specified limits.

Valve Lash

Valve lash is critical. Read the procedures closely. All three engines do not have oil restrictors. This insures ample oil is available to cool the valve springs and pull heat from the valves.

Break-In Procedures

GM has detailed break-in procedures to ensure the life of your engine is maximized. Failure to follow these break-in procedures will shorten the life of the engine. Make sure you read this page completely before attempting to start your new engine.

Tune Up Specifications

Tune up specifications are provided for each engine to insure that they are tuned to factory specifications. Altitude, humidity, and other factors will affect performance. Do not increase timing more than factory recommendations. All three engines have had extensive dyno & track testing to maximize horsepower using these parameters. Maximum performance will be achieved if you keep the tune-up within factory recommendations.

RPM Limits

RPM limits are critical to engine life. Catastrophic engine failure can occur if the engines are run above the factory recommended limits. Extensive dyno & track testing has determined the limits of the engine. Under no circumstances is it recommended to exceed these limits. GM recommends that all sanctioning bodies, track operators or promoters have rev-limits written in their rule book.

Maximum limit for 602 engine is 5500 rpm.

Maximum limit for 603 engine is 5800 rpm.

Maximum limit for 604 engine is 5800 rpm.

Valve Lash Procedure

This page covers the proper procedure to lash the valves. It is imperative to set the valve lifter lash properly on each of the engines. All three engines use the same procedure. It is also critical that the rocker arm nuts are properly secured so they do not loosen during operation. The 602 & 603 engines use "Kool-Nuts" and the 604 uses aluminum roller rockers. Each has a locking nut with set screw. The set screw is the only way to keep valve lash secured. Refer to Tune-up section for photo of cool nut and set screw.

Recommended Lash is Zero to ¼" turn Hot.

To properly set the valve lash, warm up the engine to normal operating temperature (180 – 190 degrees F water temp) and follow the procedure below.

Remove the valve covers and disconnect power to distributor.

Important: When lashing valves, it is best to loosen the rocker arm nut slightly while rotating the pushrod with your other hand between two fingers until the pushrod rotates easily. Then set the valve lash by tightening the rocker arm nut while rotating the push rod between your fingers until you feel it stop rotating. When it stops rotating you are at zero lash. Next, tighten the set screw in the rocker arm nut against the rocker arm stud. Then rotate the rocker arm nut and the set screw at the same time ¼ turn maximum. This will allow the set screw to lock properly and hold the valve lash at ¼ turn. Use the sequence below for each rocker arm.

Valve Lash Adjustment:

1. Position engine at TDC on # 1 cylinder in firing position.
   Adjust Intake valves on # 2 & # 7 cylinders.
   Adjust Exhaust valve on # 4 & # 8 cylinders.

2. Rotate Crankshaft ½ Revolution Clockwise.
   Adjust Intake Valves on # 1 & # 8 cylinders.
   Adjust Exhaust Valves on # 3 & # 6 cylinders.

3. Rotate Crankshaft ½ Revolution Clockwise.
   Adjust Intake Valves on # 3 & # 4 cylinders.
   Adjust Exhaust Valves on # 5 & # 7 cylinders.

4. Rotate Crankshaft ½ Revolution Clockwise.
   Adjust Intake Valves on # 5 & # 6 cylinders.
   Adjust Exhaust Valves on # 1 & # 2 cylinders.

Reinstall valve covers, connect distributor and start engine to check for loose valve lash.

Recommended Break-In Procedure

Start-up is critical to ensure engine life. This procedure was written with the intent to provide a quick reference and guideline to starting a new or rebuilt engine if a dyno is not available. If you are using a dyno, refer to the dyno operator's guidelines for start up and initial break in of the engine.

1. **Safety First! Make sure you have proper tools as well as eye protection. If the car is on the ground, be sure the wheels are chocked and the transmission is in neutral.**
2. **Be sure to check the oil level in the engine and prime the oil system.**
3. **Run the engine between 2,000 and 2,500 rpm, with no-load for first 30 minutes.**
4. **Refer to valve lash procedure and lash valves.**
5. **Adjust the distributor timing to recommended specifications.**
6. **Adjust Carburetor settings. Idle mixture screws, base idle, floats, etc.**
7. **After first 30 minutes of the engine running, re-set ignition timing and carb adjustments.**
8. **Drive the vehicle at varying speeds and loads for first 30 laps. Be sure not to use a lot of throttle or high rpm's.**
9. **Run 5-6 medium-throttle accelerations to about 4500 rpm and letting off in gear and coasting back down to 2000 rpm.**
10. **Run a couple of hard-throttle acceleration to about 5000 rpm then letting off in gear and coasting back down to 2000 rpm.**
11. **Change the oil and filter, a PF1218 AC Delco oil filter (P/N 25160561) or PF45 (P/N 25324052) and Mobil 1 Synthetic oil (P/N 12347284) are recommended.**
12. **Drive the next 25 laps without high rpm's (below 5000 rpm), hard use, or extended periods of high loading.**
13. **Change the oil and filter again.**
14. **Your engine is now ready for racing.**

Tune Up Specifications

Tune Up Specifications			
Description (Engine)	**8602**	**8603**	**8604**
Firing Order:	**1 - 8 - 4 - 3 - 6 - 5 - 7 - 2**		
Recommended Fuel:	**92-93 Unleaded**		
Timing: (set @ 4000 rpm)	**32 degrees**	**34 degress**	**32 degrees**
Recommended Carburetor:	**Holley 650 HP p/n 80541-1**		
Jetting: Front / Rear	**73 / 73**	**73 / 73**	**73 / 73**
Spark Plugs:	**MR43LTS**	**MR43LTS**	**MR43LTS**
Spark Plug Gap:	**.045"**	**.045"**	**.045"**
Recommended Oil:	**15W-50 Synthetic Mobil 1**		
Recommended Filters:	**AC PF-35 or PF35L**		
Recommended Valve Lash:	**See Valve Lash Proceedure**		
Distributor Advance Settings:	**See Below**		
	Mechanical Advance:	**0 degrees @ 1100 RPM**	
		12 degrees @ 1600 RPM	
		16 degrees @ 2400 RPM	
		22 degrees @ 4600 RPM	
	Vacuum Advance:	**Not Used.**	
Recommended Header Size:	**1 5/8" to 1 3/4" stepped header with 3 1/2"**		
	collector 33" total length.		

NOTES

Tune Up Specifications *Continued*

Carburetor & Adjustments

The Holley 80541-1 carburetor is rated at 650 cfm. Track testing showed the 650 HP series was the best carburetor choice for all three applications. A 750 cfm HP series carb was also tested. It didn't make any more horsepower on the dyno and when it was track tested it was too rich and loaded up in the corners.

Because all three engines make power well before 5500 rpm, the larger carburetor can actually hurt performance. The Holley HP series is designed with most racing modifications done. There are other very good high performance aftermarket carburetors available as well that may be used with proper testing and tuning.

After installing your carburetor, make sure the float levels are set properly, the idle mixtures adjusted, and idle rpm set. Depending on the weather and altitude you may have to change the jet size up or down. Do not make large jumps in jet sizes without consulting the carburetor manufacturer or an engine builder. Most of the time only a couple of jet sizes is all that is necessary for proper performance. Make sure you take care of the carburetor when the season ends. Drain the fuel and put the carburetor in a plastic bag or sealed container. Do not leave it on the engine, the fuel will evaporate and leave a residue in the metering galleries.

Engine Timing

32-34 degrees of advance should be all that is needed. The combustion chambers are very efficient so it doesn't take much timing to make power. Don't run more than 34 degrees as detonation can occur.

Fuel Requirements

91-93 Octane Unleaded fuel is recommended. No need to run leaded fuel or 101-104 octane. Leaded fuel contaminates the oil and can foul the spark plugs. All three engines have compression ratios of 10:1 or less, so the higher octane is of little value. The valve seats are designed to run on unleaded fuel, plus unleaded fuel cost less and saves money each night. Some of the tracks & sanctioning bodies add traces of lead for "Off Road Use" which should not affect performance.

Headers

In GM testing, the engines were tested with stepped headers. The headers were 1 5/8" primary tubes 10" long, and then stepped to a 1 3/4" tube. The total length was 33" with a 3 1/2" collector. All three engines have efficient combustion chambers and exhaust ports. Therefore, it's normal to see flames out the back of the car during deceleration. The more efficient the headers the worse the flames will be. Most 2bbl classes need headers that are designed to scavenge the exhaust to make power and this pulls more fuel through the engine. That is not necessary when using the recommended 4 bbl carburetor on GM engines.

Recommended Oil

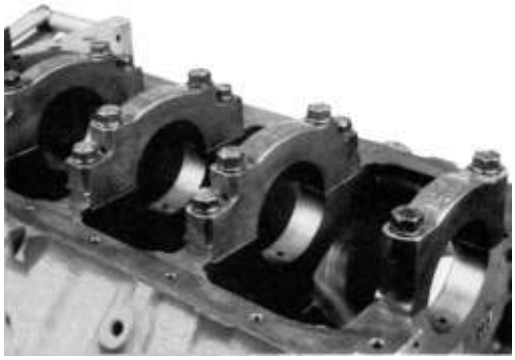
GM recommended Mobil 1 synthetic oil for all three engines. Extensive testing has proved that synthetic oil provides better lubrication qualities under extreme conditions and lasts longer.

Engine Components

A lot of engineering & extensive testing goes into each component in the GM circle track engines. The parts are tested to production standards and pass hundreds of thousands of miles before being released. Quality control standards are maintained during assembly of each engine. This section covers some of the differences between the major components in the three engines.

Engine Blocks

All three engines are assembled with brand new 4 bolt main blocks with cast iron caps. The main caps are straight bolts. They are machined to factory specifications. The blocks are designed to use 1 pc rear seal crankshafts. Photo to the right shows the 1 pc rear seal adapter which reduces oil leaks. It does require a special flywheel that is balanced correctly for these applications.



p/n 14088556 rear seal retainer

Pistons

The piston on the far left (below) is installed in 19258602 engines. This piston has a grafal coating on the skirt. The piston in the center (below) does not have a skirt coating and is installed in 88958602 engines. They both are a cast aluminum dished piston with 4 valve reliefs.
The piston on the right (below) is installed in 603 & 604 engines. It's a flat top piston with 4 valve reliefs made from high-silicon aluminum.

Piston in 19258602

Piston in 88958602

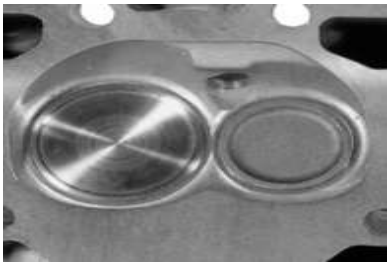
Piston in 88958603/604

Engine Components *Continued*

Cylinder Heads.

P/N 12558060. Photo's show the cast iron cylinder head & combustion chamber used on the 602 engine. Head casting number is 10239906 or 12558062. Valve sizes are 1.94" intake & 1.50" exhaust.

P/N 12556463. Photo's show the aluminum cylinder head & combustion chamber used on the 603 engine. Head casting number is 10088113. Valve sizes are 1.94" intake & 1.50" exhaust.



P/N 12464298. Photo's show aluminum "fast burn" cylinder head and combustion chamber used on the 604 engines. Head casting number is 12367712. Valve sizes are 2.00" intake & 1.55" exhaust.

Push Rods.

GM uses part number 14044874 HD .075" wall pushrods in the 88958602 engines. The pushrod is 7.724" long and 5/16" diameter.
P/N 10241740 is used in 88958603 & 88958604 engines. It is a HD pushrod that has a .060" wall and 7.122" long and 5/16" diameter.

Engine Components *Continued*

Intake Manifolds

P/N 12366573 intake on the left is used on 602 engines. It's a dual plane, high rise intake. It has the 8 bolt Vortec mounting pattern.

P/N 10185063 intake on the right is used on 603 engines. It is a dual plane medium rise style. It uses 12 bolt traditional mounting.

P/N 12496822 intake pictured to the left is used on 604 engines. It's single plane, high rise intake. It has the 8 bolt Vortec mounting pattern.

Front Covers

GM uses two different types of front covers on the 3 engines. The photo on the left shows a stamped steel cover that is installed on 602 engines. The photo on the right shows the plastic cover that is installed on 603 & 604 engines.

12342089 steel cover

12562818 plastic cover

Engine Components *Continued*

Rocker Arms

The photo at far left show the stamped steel rockers and kool nuts that are installed on the 88958602 & 88958603 engines. The photo on the immediate left shows the kool nut used on all 19258602 engines and any 88958603 engine built after May 1, 2010. Rocker arm adjustment is critical. (See page 9)

This photo shows the aluminum roller rocker arms that are installed on 604 engines.

602 & 603 engines use stamped steel rocker arms.

Rocker arm adjustment is critical. (See page 9)

Oil Pans

The 602 engine uses an 8 quart pan (including filter) that is 8" deep. The sump is 9 ½" long and 11" wide. It fits stock front sub cars (with stock engine location). The right side of the pan is kicked out 3 ¼" and has 3 trap doors to control oil. It has a built-in crankshaft scraper and comes with a louvered windage tray.

The 603 & 604 engines use an 8 quart pan (including filter) that is 7" deep. The sump is 12" long and 14" wide. It fits stock Camaro front subs and most fabricated subs (with stock engine location). It has 6 trap doors for oil control, 3 crankshaft scrapers, oil temp fitting and a louvered windage tray. Below is a photo of the louvered windage tray.

Photo of the 603 & 604 oil pan.

Photo of the louvered windage tray.

Engine Specifications

This section covers recommended rebuild specifications. All three engines are assembled with brand new parts. Each engine will be within a tight horsepower range from the factory. Customers typically get 2 seasons of service from each new engine.

GM does not recommend rebuilding engines. We recommend purchasing a new engine and selling the used engine to the hot-rod, street rod or drag racing community. This will ensure 100% integrity of the program.

If rebuilds are allowed, It is up to the track owner or sanctioning body to manage the rebuilders and closely monitor the rebuilt engines.

The key to maintaining close competition between new engines and rebuilt engines is to make sure rebuild specifications are kept close to factory tolerances. These specifications are only guidelines. If the engine is rebuilt to these specifications minimal horsepower differences should be noticed. These specifications also provide a reference point for inspection of suspected modifications to the factory engine.

Valve angles and depths are critical to valve life and horsepower levels. The valve seat width and angle affects airflow. It's also a crucial part of removing heat from the valve and extending valve life. The balance of keeping good air flow in all the lift ranges, as well as getting the heat out of the valve is necessary to extend the life of the valve and seat. Engine rpm's also affect the valve and seat life. When the harmonics of the valvetrain overcomes the valve spring, the valve bounces off the seat and the valvetrain becomes unstable, this reduces the amount of time the valve contacts the seat and transfers heat. Every millisecond the valve is bouncing it reduces the seat contact and heat transfer.

RPM recommendations need to be strictly enforced to prolong valve life. These recommendations were tested and designed to extend the life of the valve train components as well as the complete engine. Do not exceed the recommended rpm limits.

The following page covers the details of the valve seat area. These are the factory machining specifications. Anytime the valve seat and valve is "touched up" it may affect the height of the valve in the combustion chamber. This will have a negative effect on the compression ratio but not enough to make a large horsepower difference.

Reference the page on valve springs for factory specifications when new. Valve springs lose strength during the life of an engine. The major factor in reducing valve spring life is heat, therefore no oil restrictors are installed in the engine. Oil restrictors are not necessary when the rpm's are kept within factory recommendations. All three engines have excellent drain back to the oil pan. As long as the breathers are functioning properly and the engine has minimal ring blow-by, oil drainage to the pan will be good.

Some engine builders have learned from experience the negative effects that improper valve seat machining has on the engine. Make sure your engine re-builder follows these specifications.

Engine Specifications *Continued*

Factory Engine Specifications - New			
Description	**88958602 / 19258602***	**88958603**	**88958604**
Engine Weight (As Sold)	434 Lbs	400 Lbs	375 Lbs
HP & Torque	350 @ 5000 rpm	355 @ 5250 rpm	400 @ 4500 rpm
Torque	390 @ 4000 rpm	405 @ 3500 rpm	400 @ 5500 rpm
Bore	3.998" - 4.001"	3.998" - 4.001"	3.991" - 4.001"
Compression Ratio	9.1-1	10.1-1	9.6-1
Block Casting Number	10243880 or 14093638	10243880	10243880
Deck Height	9.025" +/- .001"	9.025" +/- .001"	9.025" +/- .001"
Crankshaft Type	Cast Iron	Forged Steel	Forged Steel
Crankshaft Casting Number	14082586	14088532	14088532
Piston Type	Cast Aluminum	Hi-Silicon Alum	Hi-Silicon Alum
Diameter	3.996"	3.998" - 3.999"	3.998" - 3.999"
Valve Relief Type	4 reliefs	4 reliefs	4 reliefs
Dished or Dome	Dished	Flat	Flat
Piston Weight (Piston Only)	598 / 512 * grams	533 grams	533 grams
Piston Pin Weight	144 / 159 * grams		
Connecting Rod Length	5.7"	5.7"	5.7"
Connecting Rod total wt +/- 10.0 grm	604.15 Grams	604.15 Grams	604.15 Grams
Connecting Rod Upper End	180.3 Grams	180.3 Grams	180.3 Grams
Connecting Rod Lower End	424.1 Grams	424.1 Grams	424.1 Grams
Camshaft Type	Hyd	Hyd Roller	Hyd Roller
Camshaft Lift (int / exh measured @ valve)	.435" / .460"	.474" / .510"	.474" / .510"
Camshaft Lobe Lift: (int / exh)	.290" / 306"	.316" / 340"	.316" / .340"
Duration @ .050" (int / exh)	212 / 222	208 / 221	208 / 221
Camshaft Lobe Centerline	112.5 degrees	112 degrees	112 degrees
Rocker Arm Type	Stamped Steel	Stamped Steel	Roller Rocker
Rocker Arm Ratio	1.5	1.5	1.5
Head Gasket Type	Composite / Steel	Composite	Composite
Thickness	.028"	.051"	.051"
Cylinder Head Type	Iron Vortec	Aluminum	Aluminum
Casting Number	12558062	10088113	12367712
Valve Sizes	1.94" / 1.50"	1.94" / 1.50"	2.00" / 1.55"
Combustion Chamber CC's (+/- 1-2 cc)	64	56	62
Intake Port CC's (+/- 1-2 cc)	170	163	205
Exhaust Port CC's (+/- 1-2 cc)			77
Normal Oil Pressures	40 psi @ 2000 rpm	40 psi @ 2000 rpm	40 psi @ 2000 rpm
*Note: * signifies 19258602 engine part specification*			
No Deck Surfacing after 1st Rebuild			
No Angle Milling of Cylinder Heads to Increase Compression Ratio.			
No Modifications to: Crank, Rods or Pistons.			

Engine Specifications *Continued*

Recommended Rebuild Specifications & Tolerances

Description	88958602 / 19258602	88958603	88958604
Maximum Bore Allowed:	Maximum of .008" all Bores		
	Otherwise new block required		
Standard Block Deck Height +/-.001"	9.025"	9.025"	9.025"
Maximum Deck Surfacing of Block	.005"	.005"	.005"
Minimum Block Deck Height +/- .001"	9.020"	9.020"	9.020"
Minimum Crank Bearing Size:	.010" under	.010 under	.010" under
Minimum Rod Bearing Size:	.010" under	.010 under	.010" under
Minimun Rod Weight:	595 grams	595 grams	595 grams
Crankshaft Balancing:	Factory External	Factory External	Factory External
Maximum / Minimum Crank Stroke:	3.48"	3.48"	3.48"
	No offset grinding of crank during rebuild		
No Modifications Allowed to:	Crank, Rods or Pistons		
Maximum Deck Surfacing of Head:	.005" to Square Surface During 1st rebuild		
	No Deck Surfacing After 1st Rebuild.		

Throughout the book we have tried to define "minimal allowable modifications" recommended. This common theme is intended to be strong. The industry is where it's at today because of lax rules enforcement, increased costs of components and the pressure to win. The competitors are shelling out lots of money to purchase parts that may not be necessary for close competition. In some cases those parts hurt performance.

The short track industry needs to keep costs under control. Rebuilding of engines seems like the least expensive way to go. In some cases that maybe true depending on the class and allowable rules, but in most cases it allows purchase of parts that are expensive and that drives up the cost of the engines. It is imperative that tracks do not relax the rules. Increased inspections and checks must be part of the program. Crate engines were born out of a need to make racing affordable again. It's in the hands of the tracks to contain the modifications to engines.

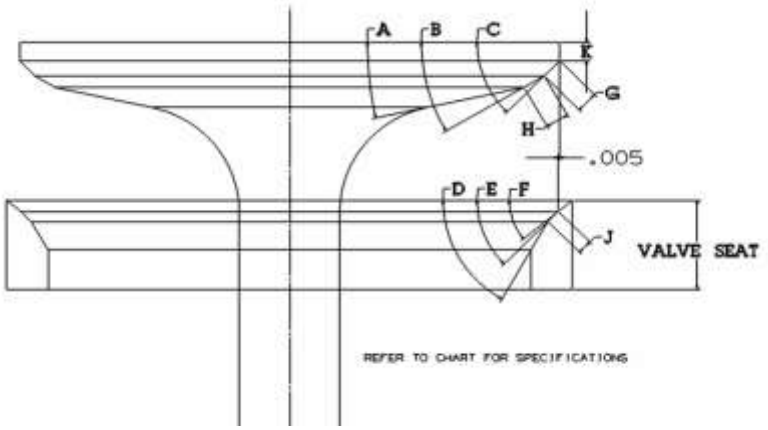
If the track allows any of these specifications to be relaxed then costs will begin to increase. Keep tight checks on your "approved re-builder." It might be a good idea to stop in and check on your "approved re-builder" from time to time when an engine is in his shop. GM engines are designed to be reliable and withstand normal racing use. Following these guidelines will ensure that horsepower gains will be minimal on rebuilds.

Rebuild Sealing Bolts: **Contact your local track and/or the track's authorized rebuilder when you need to have your engine serviced. They will be responsible for resealing the engine for competition and may wish to incorporate their own sealing methods.**
NOTE: Effective June 1, 2008 GM will no longer provide RM bolts for resealing rebuilt engines. If your track is going to continue to allow rebuilds, they should use an alternate sealing method as described later in this manual on page 30.

Engine Specifications *Continued*

Valve seat Machining.

This drawing covers the valve & valve seat machining angles & widths as well as factory valve margin. **Note: No modifications should be allowed to factory valve seat machining angles to increase flow.**



1. Refer to the chart "A, B, C" for proper valve angles.

2. Refer to the chart "D, E, F" for seat machining angles.

3. Refer to the chart "H, G, J" for valve & seat widths.

5. Refer to chart "K" for valve margin.

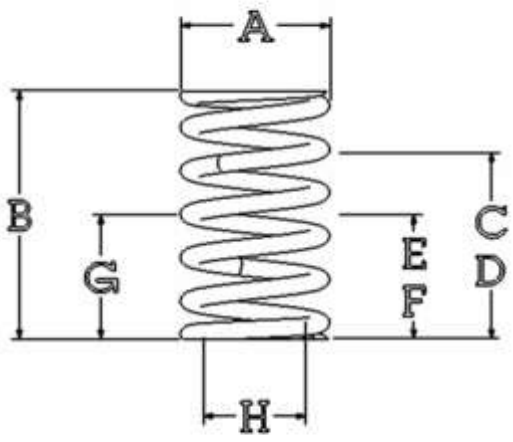
Factory Valve Angle Specifications

Description		88958602 / 19258602	88958603	88958604
Notes: No modifications allowed to factory valve seat machining angles to increase flow. No angle milling of cylinder heads to increase compression ratio.				
Valve Angle (from deck to valve C/L)		23 degrees	23 degrees	23 degrees
Intake Valve Stem Clearance		.0009".001"	.0009"-.0027"	.0009"-.0027"
Exhaust Valve Stem Clearance		.001" - .0012"	.0009"-.0027"	.0009"-.0027"
Intake Valve Angle Backcut #2	(A)	N/A	N/A	N/A
Exhaust Valve Angle Backcut #2	(A)	N/A	N/A	N/A
Intake Valve Angle Backcut #1	(B)	20 degrees	20 degrees	30 degrees
Exhaust Valve Angle Backcut #1	(B)	25 degrees	25 degrees	30 degrees
Intake Valve Angle	(C)	45 degrees	45 degrees	45 degrees
Exhaust Valve Angle	(C)	45 degrees	45degrees	45 degrees
Valve Angle Width (Intake / Exhaust)	(G)	.100" / .140"	.100" / .140"	.090" / .125"
Intake / Exhaust Backcut Width	(H)	Blend out	Blend out	Blend out
Margin Width, Intake / Exhaust Valve	(K)	.040" / .080"	.040" / .080"	.050" / .060"
Intake Valve Seat Width	(J)	.045"	.040"	.035"
Intake Valve Seat Angles	(F)	46 degrees	46 degrees	45 degrees
(M) Not shown. Factory chamfer at seat land	(M)	30 degrees	30 degrees	30 degrees
Valve Seat Insert Angles above Seat Land	(D)	65 degrees	65 degrees	60 degrees
2nd Valve Seat Angle to Seat Land	(E)	75 degrees	75 degrees	radius seat
Exhaust Valve Seat Width	(J)	.060"	.070"	.060"
Exhaust Valve Seat Angles	(F)	46 degrees	46 degrees	45 degrees
(M) Not shown. Factory chamfer at seat land	(M)	30 degrees	30 degrees	30 degrees
Valve Seat Insert Angles above Seat Land	(E)	55 degrees	65 degrees	60 degrees
2nd Valve Seat Angle To Seat Land	(D)	82 degrees	82 degrees	radius seat
Minimum Valve Seat ID Intake (see note below)		N/A	1.720"-1.745"	1.785"- 1.810"
Minimum Valve Seat ID Exhaust (see note below)		N/A	1.241"-1.266"	1.305"-1.330"
Note: Minimum Valve Seat I.D is measured at the center point of steel valve seat where seat is smallest.				
No Modifications are Allowed Below Valve Seat Land, in Bowl Area or Any part of the Ports.				

Engine Specifications *Continued*

Valve Spring Specifications

Below is illustration of a typical valve spring. Match up the locations and engine part number with the chart below for the correct specification.



REFER TO CHART FOR SPECIFICATIONS

Note: These specifications are for new valve springs.
The specification chart shows free height, installed height, spring o.d., installed pressure, open pressure, etc.

Keep in mind that new spring pressures have some variances. The chart notes the two important variances. Installed pressure & open pressure.

Valve spring pressures will change depending on length of time engine is in service, temperature during that period, and if the engine has been excessively over-revved. It is acceptable to add maximum of a .020" shim when valve seats are recut or to get spring pressures back to proper factory specifications. Care must be taken to make sure retainer to guide clearance is adequate. No Titanium Retainers Allowed.

Valve Spring Specifications - New

Description	88958602 / 19258602		88958603	88958604
Valve Spring P/N		10212811	12551483	12551483
Diameter	(A)	1.250"	1.32"	1.32"
Free Height	(B)	2.021"	2.145"	2.154"
Installed Height	(C)	1.70"	1.78"	1.78"
Lbs @ Installed Height (+/- 4 lbs)	(D)	80 lbs	101 lbs	101 lbs
Open Height	(E)	1.270"	1.300"	1.300"
Open Pressure (+/- 8 lbs)	(F)	195 lbs	260 lbs	260 lbs
Coil Bind	(G)	1.20"	1.21"	1.21"
Wire Diameter		.177"	.178"	.178"

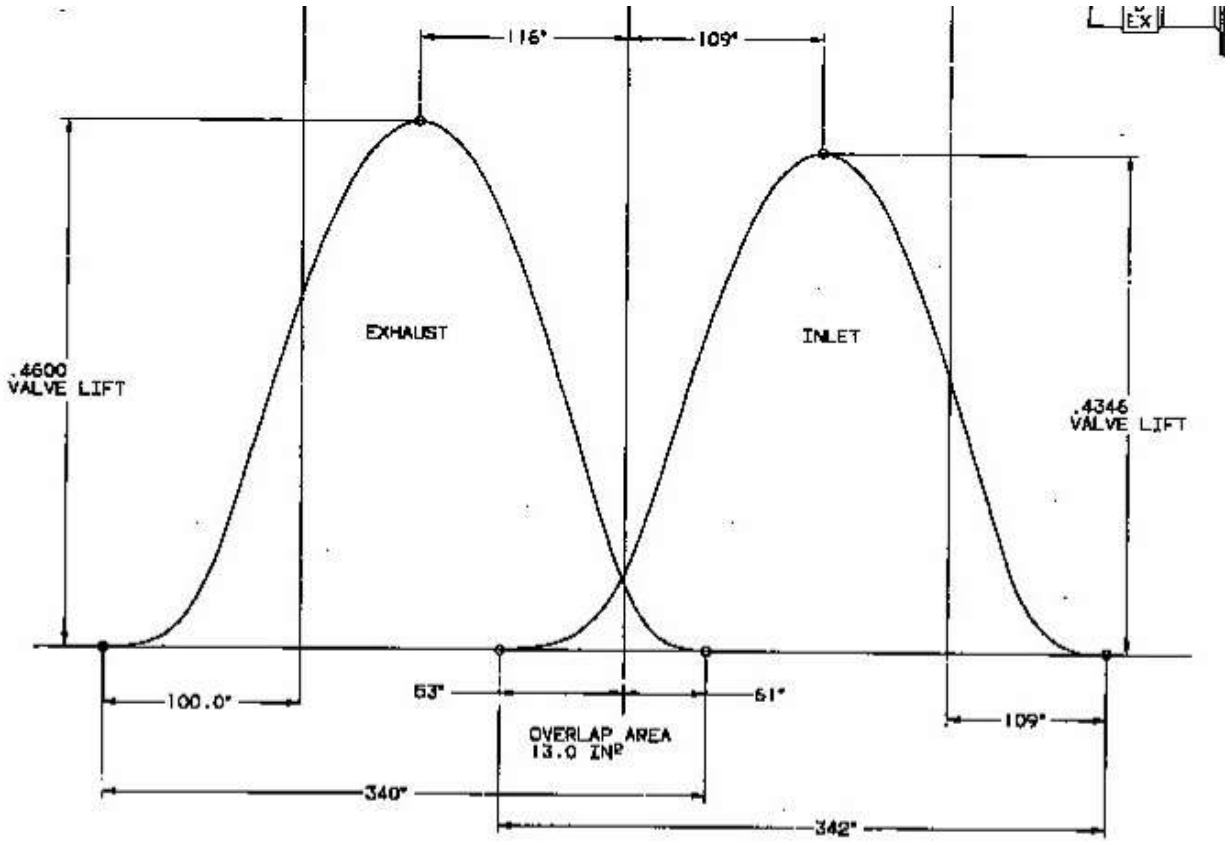
Engine Specifications *Continued*

88958602 / 19258602 Engine Camshaft Specifications

P/N 24502476 camshaft is installed in a 602 engines. It is a flat tappet camshaft and uses standard hydraulic lifters. See section on valve lash for proper lash procedure.

Valve Lift: .435 intake and .460 exhaust.
Duration @ .050": 212 degrees intake and 222 degrees exhaust.
Cam lobe centerline is: 112.5 degrees.
Intake lobe lift .290". Exhaust lobe lift .307"
Intake base circle radius: .633" Exhaust base circle radius: .616"
Dowel pin hole: Retarded 5 degrees from centerline of # 1 cylinder exhaust lobe, advanced 107.5 degrees from centerline of # 1 cylinder intake lobe. (107.5 +5 = 112.5 degrees lobe separation.)
Note: +/- .010" all dimensions and +/- 5 degrees angularity.

Shown below is a graph of the cam profile for cam p/n 24502476 as used in 88958602 and 19258602 engines.



24502476 camshaft specifications

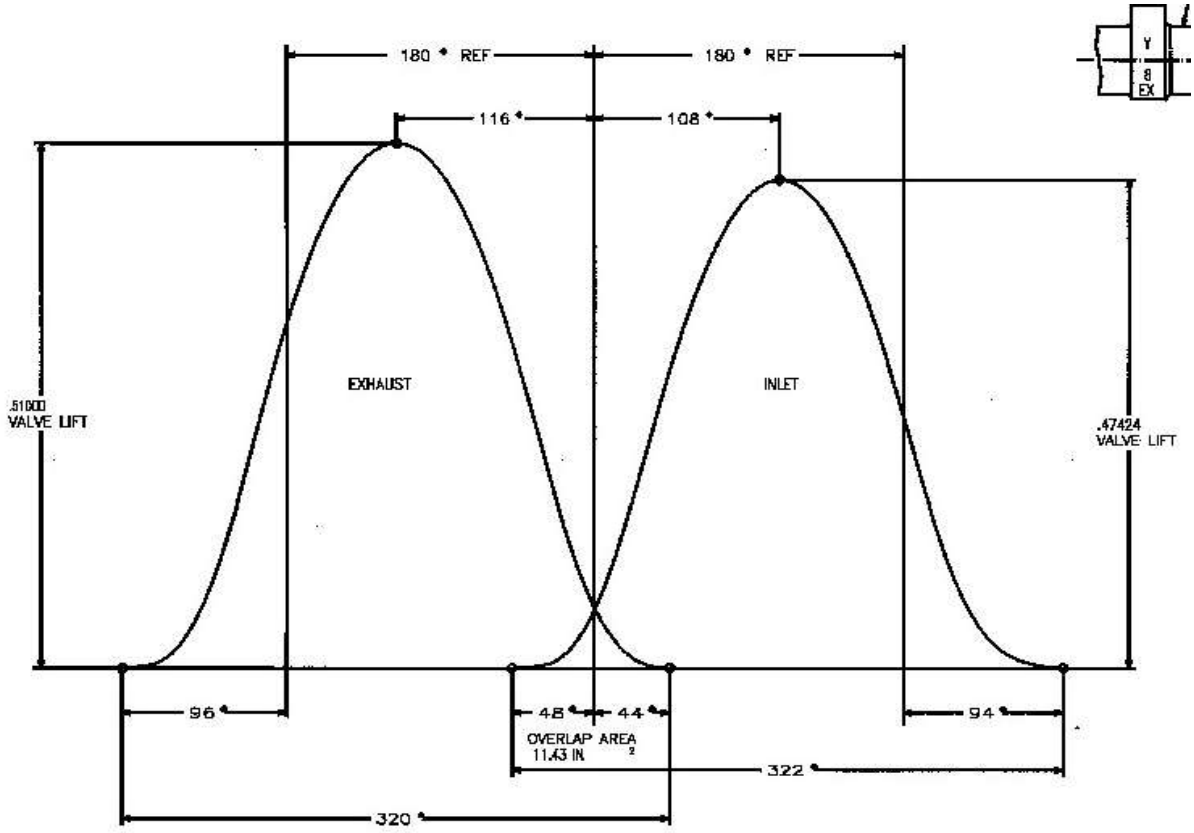
Engine Specifications *Continued*

88958603 & 604 Engine Camshaft Specifications.

P/N 10185071 camshaft is installed in both the 603 & 604 engines. It is a roller camshaft design and uses hydraulic roller lifters. This camshaft has a red dab of paint located near the camshaft gear for identification. See section on valve lash for proper lash and procedure.

Valve Lift: .474" intake and .510" exhaust.
Duration @ .050": 208 degrees intake and 221 degrees exhaust.
Cam lobe centerline is: 112 degrees.
Intake lobe lift .316". Exhaust lobe lift .340".
Intake base circle radius: .60684". Exhaust base circle radius: .583".
Dowel pin hole: Retarded 5 degrees from centerline of # 1 cylinder exhaust lobe, advanced 107 degrees from centerline of # 1 cylinder intake lobe. (107 +5 = 112 degrees lobe separation)
Note: +/- .010" all dimensions and +/- 5 degrees angularity.

Shown below is a graph of the cam profile for cam p/n 10185071 as used in 88958603 and 88958604 engines.



10185071 camshaft specifications

Torque Specifications & Sealers

All of the torque specifications are in one location to be used as a "Quick Guide" during rebuilds. Also included in this section are proper torque sequence guidelines. GM has spent extensive time on engineering, metallurgy, and physical testing to achieve proper clamping loads on bolts. Any deviation of these specifications will affect the life of the engine.

Sealers also affect clamp loads. The proper sealer should be used for each bolt where applicable. It is imperative that torque specifications and sealer recommendations be followed closely. All surfaces must be clean and free of debris. All tapped holes should have thread chasers run through them to clean old residue from the threads before re-assembly. Make sure you wear proper eye protection at all times.

Because the cylinder block does not have blind head bolts, all the head bolts will require sealer. Factory new head bolts come with the proper sealer applied. Break-off sealing bolts installed from the factory have sealer applied. Replacement sealing bolts do not have sealer factory applied.

Main Cap Bolts & Engine Galley Plugs

Use light engine oil or CMD #3 on all main cap bolts during assembly.
Use P/N 12346004 Teflon sealer on all oil passageway galley plugs. Do not over apply as it may clog lifters and other engine components. See next page for torque specifications.

Head and Intake Bolts.

1. **Use P/N 12346004 Teflon sealer on head bolts and intake bolts.**
2. **Use P/N 12346192 in tube form or 12346193 in cartridge form for intake china rails. A bead 3/8" wide and 3/8" tall should be all that is necessary to seal the intake rails. The sealer should be applied slightly up the cylinder head to "encase" the intake gasket and seal the corner where the intake/head and block come together. Make sure intake is clean.**

Camshaft Retainer & Gear Bolts

When tightening camshaft bolts we recommend you use Blue Loctite on the threads.

Oil Pan Bolts & Oil Pan Gasket

No sealer is needed on oil pan bolts. They should be installed with light engine oil on threads.
All three engines use one-piece oil pan gaskets. No sealer is necessary except in 3 areas.

1. **Add a slight amount of sealer to the 4 corners of the pan where at the 5/16 bolt holes.**
2. **After pan is installed put silicon sealer around the front of the pan where it meets the timing cover. The sealer should "encapsulate" the gasket between the pan and the timing cover.**
3. **Add sealer at the rear of the pan where it meets the seal adapter. This should also "encapsulate" the gasket between the pan and the aluminum part of the rear seal adapter.**

Front Cover

1. **The "602" engine uses a paper style gasket and will require a dab of P/N 12346192 silicon sealer at the bottom where the steel cover meets the block and oil pan.**
2. **The "603 & 604" engines have plastic covers with a built-in seal. They too require a dab of silicon sealer in the area where block, front cover and pan meet.**

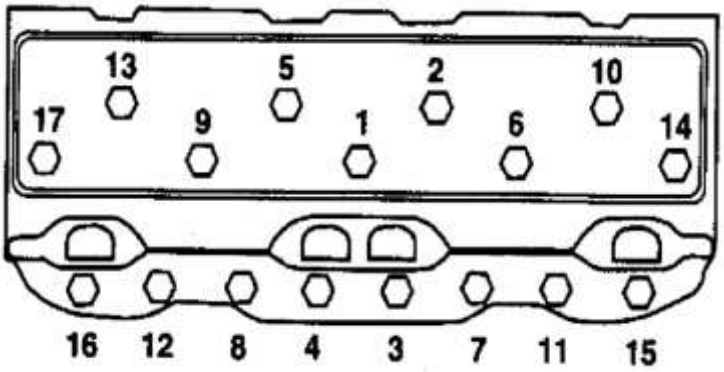
Torque Specifications & Sealers *Continued*

Torque Specifications			
Description	**88958602 / 19258602**	**88958603**	**88958604**
Main Bearing Bolt - Inner	70 ft lbs	70 ft lbs	70 ft lbs
Main Bearing Bolt - Outer	65 ft lbs	65 ft lbs	65 ft lbs
Connecting Rod Bolts	.006" bolt stretch preferred 20 ft. lbs + additional 55 degree		
Angle Gauge Required	(45 ft lbs if no angle gauge is available) / 27 N-m + additional		
Note: use CMD#3 on rod bolts @ 45 ft lbs	55 degrees (61 N-m if no angle gauge is available)		
Oil Galley Plugs	15 ft lbs	15 ft lbs	15 ft lbs
Oil Pump Bolt	66 ft lbs	66 ft lbs	66 ft lbs
Oil Pump Cover Bolts	80 inch lbs	80 inch lbs	80 inch lbs
Balancer Bolt	63 ft Lbs	63 ft Lbs	63 ft Lbs
Balancer Pulley Bolt 3/8" x 24	35 ft lbs	35 ft lbs	35 ft lbs
Rear Seal Adapter nut / bolt / screw	11 ft lbs	11 ft lbs	11 ft lbs
Camshaft Sprocket Bolts	18 ft lbs	18 ft lbs	18 ft lbs
Valve Lifter Retainer Bolt	N/A	18 ft lbs	18 ft lbs
Cylinder Head Bolts	65 ft lbs	65 ft lbs	65 ft lbs
Rocker Arm Stud	N/A	60 ft lbs	60 ft lbs
Front Cover Steel	97 inch lbs	97 inch lbs	97 inch lbs
Front Cover Plastic	97 inch lbs	97 inch lbs	97 inch lbs
Intake Bolts, (602 & 604 engines)	11 ft lbs	11 ft lbs	11 ft lbs
Intake Bolts, (603 engine)	15 ft lbs first round, 35 ft lbs final torque.		
Distributor Holddown Bolt	25 ft lbs	25 ft lbs	25 ft lbs
Oil Filter Adapter	18 ft lbs	18 ft lbs	18 ft lbs
Oil Pan			
Nut or Bolt @ Corner of pan	15 ft lbs	15 ft lbs	15 ft lbs
Side Rail Bolt	97 inch lbs	97 inch lbs	97 inch lbs
Oil Baffel Nut	100 inch lbs	100 inch lbs	100 inch lbs
Oil Drain Plug	15 ft lbs	15 ft lbs	15 ft lbs
Flywheel Bolts	65-70 ft lbs	65-70 ft lbs	65-70 ft lbs
Starter Bolts	35 ft lbs	35 ft lbs	35 ft lbs
Spark Plug	15 ft lbs	15 ft lbs	15 ft lbs
Valve Cover Bolts	100 inch lbs	100 inch lbs	100 inch lbs
Water Pump Bolts	30 ft lbs	30 ft lbs	30 ft lbs
Fuel Pump Cover Bolts	100 inch lbs	100 inch lbs	100 inch lbs
Fuel Pump Bolts	25 ft lbs	25 ft lbs	25 ft lbs

Torque Specifications & Sealers *Continued*

Sealing bolt installation: Torque heads, intakes, front cover and oil pan with stock bolts in all locations prior to installing sealing bolts. After final torque is done, remove stock bolt and install sealing bolt and tighten until head breaks off. Do not install sealing bolt first.

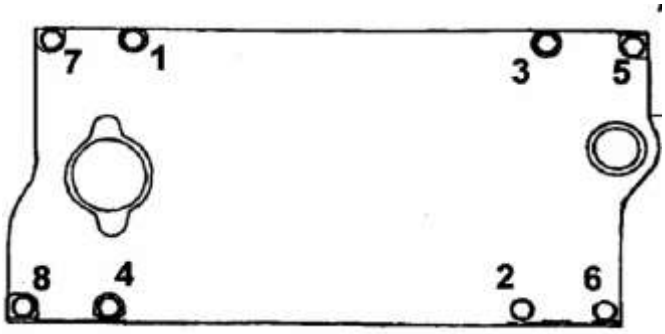
Cylinder Head Torque Sequence.



The diagram to the left shows the proper torque sequence for all three engines.

Torque bolts to 65 ft lbs. (Torque @ 40 ft lbs, then 50 ft lbs and 65 ft lbs final pass.) Use 12346004 Teflon sealer on all bolts unless new.

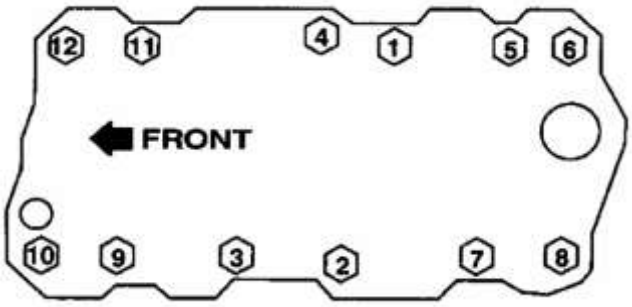
Intake Torque Sequence for 88958602, 19258602 & 88958604 Engines.



The torque sequence to the left is for intakes used on 8602 & 8604 engines

Torque to 11 ft lbs all bolts. Use 12346004 Teflon sealer on bolts unless new. Let intake set a short period and re-torque.

Intake Torque Sequence for 88958603.



The torque sequence to the left is for intake manifolds used on 8603 engines.

Torque to 35 ft lbs. (torque to 15 ft lbs first pass then 35 ft lbs final pass) Use 12346004 Teflon sealer on all bolts unless new.

Flywheel & Transmission Components

This section is intended to identify the flywheel components that GM recommends. The aftermarket has designed small clutch packs that fit smaller bell housings used in some applications. This section will also will help clarify the confusion between 1-pc & 2pc rear seals and flywheel balance.

All three circle track crate engines use 1pc rear seals. It's a much better seal and was introduced in production engines in 1986. When using a 1pc rear seal, the flywheel must have a counterbalance. All three engines are "internal/external" balanced. It's not like the old 400 engines. They had both a counterbalanced flywheel and balancer. You cannot use a 400 flywheel on circle track engines. The balance is in a different location and the bolt pattern is different. You must use the correct, balanced flywheel.

The front balancers on the circle track crate engines are zero balanced. Therefore the internal components of the engine are zero balanced like a pre 1986 engine. The only difference is the rear flywheel has a counterbalance. This is because the rear of the crankshaft is machined for the 1pc seal. One-piece rear seal engines do not have the counterbalanced flange like pre 1986 engines.

Photo to the left shows a flexplate that fits all three engines.

The counterweight is shown in the 10 o'clock area of the photo. It is welded in the proper location which makes sure the engine balance is correct.

Make sure whatever flywheel you use has a counterbalance on it or the engine will have a vibration.

This photo shows an aftermarket drive hub.

It combines the ring gear, transmission input spline and proper counterbalance location.

This is a great photo of how one aftermarket manufacturer address's the external balance required at the rear of the engine.

When the one piece seal was introduced, GM implemented a change to the bolt pattern diameter. The bolt pattern diameter changed from 3 ¼" to 3". This was done to insure that older flexplates would not be installed by mistake and cause imbalance issues. Make sure if you are using an aftermarket component, it has the correct balance.

Flywheel & Transmission Components

Transmission Installation Components			
Description	**88958602 / 19258602**	**88958603**	**88958604**
Flexplate 12-3/4" 153 tooth Automatic	14088765	14088765	14088765
Flexplate 14" 168 tooth Automatic HD	12554824	12554824	12554824
Flexplate 14" 168 tooth Automatic	14088761	14088761	14088761
Flywheel 12-3/4" 153 tooth standard	14088650	14088650	14088650
Flywheel 14" 168 tooth Std	14088648	14088648	14088648
Flywheel 14" 168 tooth lightweight	14088646	14088646	14088646
	Note: 14088646 weighs approximately 15 lbs.		
Pilot Bearing	14061685	14061685	14061685
Pilot Bushing	3752487	3752487	3752487
Dowel Pin, Bellhousing	(2) - 12338119	(2) - 12338119	(2) - 12338119
Starter, Standard Duty	1876552	1876552	1876552
Starter, Corvette 153 tooth	10475702	10475702	10475702
Bolt, Starter Long (fits 14095702)	14097278	14097278	14097278
Bolt, Starter Short (fits 14095702)	14097279	14097279	14097279
Bolt, Flywheel	(6) - 12337973	(6) - 12337973	(6) - 12337973
Bolt, Flexplate (Automatic)	(6) - 372707	(6) - 372707	(6) - 372707
Torque Specifications			
Flywheel Bolts	65-70 ft lbs	65-70 ft lbs	65-70 ft lbs
Starter Bolts	35 ft lbs	35 ft lbs	35 ft lbs

The photo to the left shows a p/n 14061685 crankshaft bushing. Install this roller bearing bushing in the rear of the crankshaft to minimize friction losses.

Tech Inspection Procedures

This section covers technical procedures. To keep competition equal, tracks must put proper procedures in place to police their engines. If track owners or promoters do not keep a close watch on engine modifications, then competitors will exploit every opportunity to make modifications and the savings from the crate engine program will be lost. Every track must take seriously the integrity of the program and be willing to implement strong penalties for those caught tampering with bolts or modifying engines.

Study these procedures closely. Take time to practice the tests on a known engine. Make sure you are familiar with the test and the equipment before testing in the field. Any signs of inexperience or lack of confidence may cause the tech inspector and track to lose credibility.

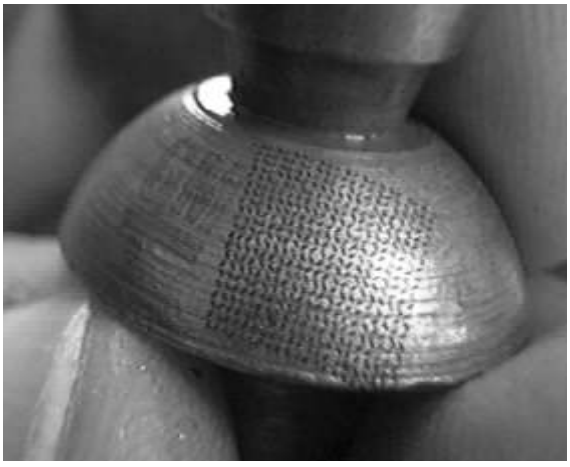
As you review the tests, you will find one common theme: Engine Temperature, it is the most critical item with most of the tests. One mistake here and your numbers will be off.

Sealing Bolts

Sealing bolts are the area of most concern for everyone. Every engine GM sells is fully sealed from the factory. Each engine is built to the same standards and specifications. After it leaves the factory it is up to the tracks to police them. GM is not responsible for engines that have been tampered, repaired or rebuilt.

GM Factory Sealing Bolt Inspection Procedures:

Inspection of the sealing bolts is simple. All 8 bolts in each engine have the GM logo laser etched on the head of the bolt. In May of 2005, GM started installing bolts with a zinc coating on them. This makes the "GM" logo easier to read and reduces rusting of the bolt.



The photo on the left shows: (1)The GM logo to the left of the square of dots. (2)The square of dots which is the Info-Glyph encrypted message. Info-Glyph encrypting is described next. The photo on the right shows a head bolt installed on an engine.

Additional Sealing & Tracking Methods.:

There are several other ways to seal and track engines. Some are simple, and some are more complex. By adding another level of seals, this reduces chances the engine is modified.

Tracking engines by serial numbers is the best way to understand who has what engine and when it is serviced. The local track can issue serial numbers and stamp them on the block and heads. That engine will be required to be registered on the track web site. This will allow the track to determine how long an engine is in service and who owns it. A registration fee maybe required to cover overhead costs.

Drilled bolt seals. You can install additional seals by installing a couple of drilled bolts in key locations (intake, front cover & oil pan) then run a stainless wire between the bolts and use a crimp seal. The crimp seal can be as simple as the track logo on a pair of vice-grips where you crimp a large fishing sinker. Some bolts can be purchase off the shelf already drilled, making installation easier.

Shown is Drill bolt fixture, stainless wire & safety wire pliers.

Wire Lock Seals. One of the major sanctioning bodies uses seals that involve a seal that locks the wire inside preventing removal. It also has enough area on the lock to serialize and/or add a logo. This sanctioning body has tough rules regarding rebuilds does extensive tech inspections. There resealed engines are monitored closely. They also use the cup plug as shown below as a secondary seal. Both seals are marked, serialized and registered.

Shown is a Wire lock seal. www.vmsproducts.net www.stoffel.com

Cup plug seals. This method uses a special base that is secured by the bolt. A cap is pressed on to the base and encapsulates the bolt head. Fingers on the base grab the outer rim of the cup and prevent removal without signs of damage. These seals can be serialized and/or a logo added. They are simple to use when a standard size bolt is required. It is more difficult when you have specialty bolts or in tight areas. www.americancasting.com

Cup plug system that can be serialized and track logo installed.

Tech Inspection Procedures *Continued*

One of the earliest series to embrace the circle track crate engine program was the USPRO Series, now known as the ASA Late Model Series. GM Racing and GM Performance Parts has worked with them to provide some of the procedures listed below. Refer to the actual instructions from each manufacture for 100% accuracy of the test procedures. These are only guidelines.

P&G Procedure: www.precisionmeasure.com

The P&G tester is one of the best "on site checks" of checking engine displacement. It provides a means to check engine displacement without tearing down the engine.
Note: Engine temperature is critical with this test.

Whistler Procedure: www.katechengines.com

The Whistler is used to check compression ratio. It's a tool used to check compression ratio of completely assembled engines at the track.
Note: Engine temperature is critical with this test.

Valve Spring Inspection: www.moroso.com

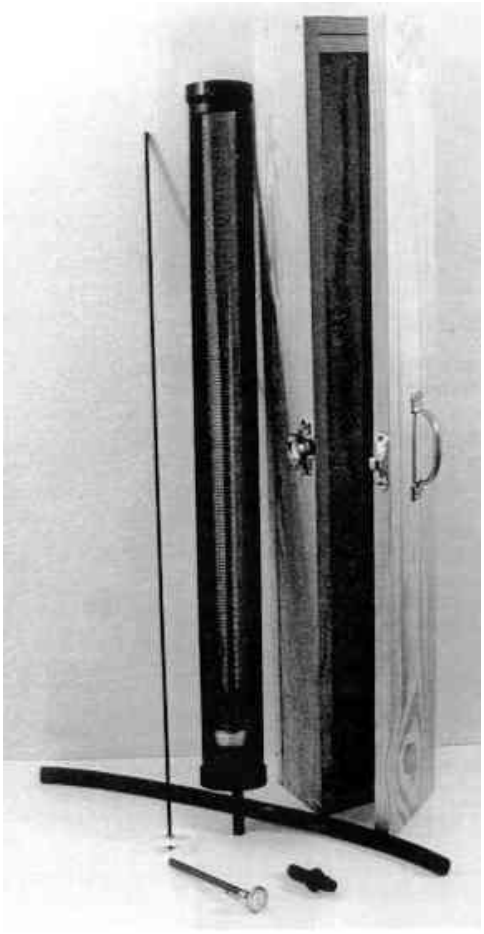
Valve springs are an area that teams try and increase the spring pressure to increase PRM limits of the engine. This sheet covers a quick way to check spring pressures on the engine. Refer to the spring chart for proper specifications. Moroso P/N 62391 spring rate checker.

Rocker Arm Testing: *604 engine only*. Contact local GM dealer

GM sells a rocker arm checking fixture. It's a simple fixture for testing the roller rockers on the 604 engine. This page covers how to check for correct rocker ratio. The p/n for the fixture is 88958663.

P&G Test Procedure

The P/G tester is used to check engine displacement. This is a quick on-site tool for checking displacement to determine if it is in the allowable cubic inch range.



Important Information

The P/G tester must be kept clean. Before each use, lubricate the nylon piston, tube and o-ring with fine oil. If tester is to be used for continuous testing, it should be oiled after every tenth (10th) engine is checked.

Engine Preparation

- **Remove <u>all</u> spark plugs.**
- **Select the cylinder number to be checked.**
- **Have the crew chief remove the both rocker arms and both push rods from selected cylinder.**

Testing Procedures

- **Insert the spark plug screw adapter into the selected cylinder. If this operation is done by the crew chief, make sure that no washers or spacers are added to the adapter.**
- **Make sure that the nylon piston is bottomed out in the tester tube. Insert the push rod gently into the tube and slide the piston to the bottom of the tube.**
- **Note the engine temperature as this will be needed to determine the total cubic inch displacement and for the Whistler Test.**
- **Important – If the engine is cold, use the same temperature as the outdoor temperature to read the listed cubic inch number adjacent to the temperature. If the engine temperature is warmer than the outdoor temperature read the % correction factor on the chart.**
- **With the ignition off, crank the engine, at cranking speed for approximately 2 seconds or until the engine has been spun at cranking speed approximately 10 times.**
- **Read the number where the nylon piston stops. Convert this number to cubic inch displacement using the P&G Conversion Chart.**
- **Maximum allowable cubic inch displacement for Chevy is: 350.0**
    - **If on conversion from P&G Conversion Chart is larger than maximum allowable reading, retest immediately. If reading is still over the legal maximum allowable limit, the Whistler Test or cc testing of the heads is necessary.**

Whistler Procedure

The Whistler measures combustion chamber volume. Using the volume achieved with the tester along with the chart provided by the company, you will know the correct engine displacement.

Measuring Combustion Chamber Volume for Engine Displacement

Requirements

- **110v Power supply**
- **Portable Air Tank or Compressor**

Engine Preparation

- **Remove spark plug**
- **With ignition off and distributor unplugged, crank engine to locate Top Dead Center (TDC) of piston in selected cylinder.**
- **Purge any remaining gas vapors from selected cylinder using compressed air.**
- **Insert Whistler adapter into spark plug hole.**
    - **When selecting cylinder to test, be aware that some engines require the removal of the header to accommodate the insertion of the whistler probe.**
- **Check water temperature via gauge or thermometer.**

Testing Procedures

- **Plug Whistler into 110 volt power supply.**
- **Turn on Whistler –**
- **Adjust display as follows:**
    - **Re-Set the 3 switches as follows.**
        - **Left hand switch – set for numbers 4-6-8.**
        - **Center switch has 3 functions.**
            - **Center position – Set Temperature of engine.**
            - **Bottom position – Set displacement as determined by P&G test.**
                - **Maximum Reading for Chevy: 350.0**
        - **Top Position – this is where the actual reading will appear.**
    - **Right hand switch is used to set reading – either up or down to change readings.**
- **Once the engine temperature and engine cubic inches have been entered – move the center switch to top.**
- **Insert whistler probe into adapter in selected cylinder.**
- **Make sure that the piston is at TDC.**
- **Hook up air line to portable air tank.**
- **Adjust air flow to 20 SCFH.**
- **Rotate engine slowly in either direction to determine if TDC has been reached.**
- **At TDC note the highest compression ration reading. Rotate the engine slowly in the other direction to determine the highest reading. Maximum allowable static reading is 10:1 as shown on the readout. If the reading is larger, cc the heads to determine the legality of the engine.**

Valve Spring Inspection Procedure

This section helps identify those teams that have changed valve springs in an effort to gain additional rpm's. It is important to keep rpm's within GM recommended numbers. Engine life and wear is severely reduced for every 100 rpm's that an engine is over-revved.

Purpose

Check for proper stock valve spring specifications. Use Moroso p/n 62390.

Step 1. Have the crew chief remove all debris in and around the engine

Step 2. Have the crew chief remove the valve cover being careful not to contaminate the cylinder head

Step 3. Have the crew chief remove both rocker arms from the selected cylinder & make sure piston is at BDC.

Step 4. Slide the Moroso valve spring tester into position so that intake valve spring sits in tester pocket

Step 5. Pull the handle to compress the valve spring to full compression and note the reading. Repeat the test for the exhaust valve spring and note the reading

Step 6. Refer to chart in rebuild section for correct valve spring pressures for the intake & exhaust. Use the space below to reference the numbers for your application.
Int._____ Exh._____

Rocker Arm Check Procedure

GM Racing designed a checking fixture for the aluminum roller rockers used on 604 engines. It can be purchased at your local dealer. The p/n is 88958663.

The GM P/N 88958663 roller rocker inspection fixture is designed as a quick Go-No Go gauge for verifying roller rocker arm ratios. It does not include rocker arms.

Both Sides of the fixture are marked for easy identification of a 1.5 or 1.6 rocker arm ratio.

The fixture is designed to check a GM roller rocker arm by placing the rocker arm on the stud and seating the roller tip on the pedestal, then checking the pushrod to the rocker arm cup seat.

The bottom photos show the difference between the 2 sides of the fixture using a 1.5 roller rocker arm. The left photo shows proper fit for the GM 1.5 roller rocker arm on the fixture. The pushrod seats into the rocker arm cup properly. The right photo shows the same 1.5 roller rocker arm sitting on the 1.6 side of the fixture, as you can see the pushrod does not fit the rocker arm cup properly. The reverse would be true for a 1.6 rocker arm. The pushrod cup will not fit properly on the 1.5 side.

Correct Pushrod Fit 1.5 ratio Rocker

Incorrect Pushrod Fit for 1.5 Rocker

***Please note*: There is only a .050" difference between the center stud and the pushrod cup center on a 1.5 and 1.6 rocker arm. The 1.6 rocker arm distance being shorter.**

Engine Parts List

Engine Block Components				
Description	**88958602**	**19258602**	**88958603**	**88958604**
Short Block Assembly	Not Serviced	Not Serviced	12561723	12561723
Cylinder Block	10105123	10105123	10105123	10105123
Main Caps	Not Serviced	Not Serviced	Not Serviced	Not Serviced
Rear Seal Housing	14088556	14088556	14088556	14088556
Dowel Pin, Rear Crank Seal Housing	9441003	9441003	9441003	9441003
Dowel Pin, Front Cover	(2) - 12554553	(2) - 12554553	(2) - 12554553	(2) - 12554553
Stud, Rear Adap.	(2) - 14101058	(2) - 14101058	(2) - 14101058	(2) - 14101058
Nut, Rear Adap	9439915	9439915	9439915	9439915
Bolt, Rear Adap.	(2) - 14088561	(2) - 14088561	(2) - 14088561	(2) - 14088561
Bolt, Rear Adap.	14088561	14088561	14088561	14088561
Rear Cam Plug	10241154	10241154	10241154	10241154
Cam Bearings	Use p/n 12453170 for 1 &4. P/n 12453171 for #2,3,5			
Dowel Pin, Bellhousing	(2) - 12338119	(2) - 12338119	(2) - 12338119	(2) - 12338119
Crankshaft	14088526	10243068	12556307	12556307
Connecting Rod. Powdered Metal	10108688	10108688	10108688	10108688
Piston (Std)	12514101	88894280	10159436	10159436
Balancer, 8" diameter	88960604	88960604	88960604	88960604
Cylinder Head Components				
Cylinder Head Assembly	12558060	12558060	12556463	12464298
Cylinder Head Bare	12529093	12529093	N/S	N/S
Intake Valve	10241743	10241743	10241743	12555331
Exhaust Valve	12550909	12550909	12550909	12551313
Valve Spring	10212811	10212811	12551483	12551483
Retainer, Valve Spring	10241744	10241744	10212808	10212808
Key, Valve Retainer	24503856	24503856	24503856	24503856
Shim, Valve Spring	N/A	N/A	10212809	10212809
Stud, Rocker Arm	N/S	N/S	12552126	12552126
Rocker Arm (1 per package)	10089648	10089648	10089648	19210724
Kool Nut Kit	88961233	88961233	88961233	N/A
Push Rod	14095256	14095256	10241740	10241740
Dowel Pin, Cylinder Head	(4) - 585927	(4) - 585927	(4) - 585927	(4) - 585927
Intake Manifold Components				
Intake Manifold	12366573	12366573	10185063	12496822
Distributor	93440806	93440806	93440806	N/A
Distributor Hold Down	10096197	10096197	10096197	10096197

Engine Parts Lists *Continued*

Description	88958602 / 19258602	88958603	88958604
Camshaft Components			
Camshaft	24502476	10185071	10185071
Lifter	5232720	17120735	17120735
Camshaft Gear	340235	12552129	12552129
Timing Chain	14088783	14088783	14088783
Crankshaft Gear	10128346	14088784	14088784
Camshaft Thrust Retainer	N/A	10168501	10168501
Timing Cover	12342089	12562818	12562818
Timing Tab 8" Balancer	3991436	3991436	3991436
Timing Tab 6 3/4" Balancer	3991435	3991435	3991435
Oil Pan Components			
Oil Pan	N/A	N/A	N/A
Oil Pan Gasket One Piece Design	10108676	10108676	10108676
Oil Pump	93442037	14044872	14044872
Shaft, Oil Pump Drive	3998287	3998287	3998287
Retainer, Nylon oil pump drive	3764554	3764554	3764554
Oil Pan & Screen	25534353	25534354	25534354
Reinforcement, Oil Pan LH	12553058	12553058	12553058
Reinforcement, Oil Pan RH	12553059	12553059	12553059
Adapter, Oil Filter	3952301	3952301	3952301
Bolt, Oil Filter Adapter	3951644	3951644	3951644
Engine Dress Items			
Rod, Fuel Pump	3704817	3704817	3704817
Cover, Fuel Pump Opening	14094069	14094069	14094069
Water Pump Cast Iron (Long)	88894341	88894341	88894341
Water Pump Alum (Long)	N/A	N/A	N/A
Water Pump Alum (Short)	19168604	19168604	19168604
Valve Cover Kit	25534359	25534359	25534359
Valve Cover Breather Kit	25534355	25534355	25534355
Miscellaneous Parts			
Balancer, 8" Diameter	88960604	88960604	88960604
Balancer, 6 3/4" Diameter	12551537	12551537	12551537
Key, Crankshaft Woodruff	(2) - 106751	(2) - 106751	(2) - 106751
Key, Balancer Woodruff	(2) - 106751	(2) - 106751	(2) - 106751
Thermostat 180 degree	12555290	12555290	12555290
Spark Plug Wires, 135 degree boot	N/A	N/A	N/A
Spark Plug Wires, 90 degree boot	12361051	12361051	12361051
Spark Plug MR43LTS	5614210	5614210	5614210

Engine Parts Lists *Continued*

Factory Rebuild Components - In Kit Form				
Description	**88958602**	**19258602**	**88958603**	**88958604**
Main Bearing 1-4 STD	89060460	12594874	89060460	89060460
Main Bearing Rear (.001 U/S)	89060460	12594873	89060460	89060460
Main Bearings 1-4 (.001 U/S)	12531215	12531215	12531215	12531215
Rod Bearings (Std) (16 req)	12523924	12561341	12523924	12523924
Ring Package	(8) - 88894219	12522848	(8) - 12528817	(8) - 12528817
Ring Package Set (.005" O/S)	(8) - 12507985	12524205	(8) - 12528818	(8) - 12528818
Piston Set (8 pcs)	N/S	N/S	N/S	N/S
Piston High limit (1 pc)	12514102	88894280	10159437	10159437
Connecting Rod Set (8 pcs)	12495071	10108688	12495071	12495071
Valve, Intake (8 req)	10241743	10241743	10241743	12555331
Valve, Exhaust (8 req)	12550909	12550909	12550909	12551313
Valve Spring Set	19154761	19154761	12495494 (note 1)	12495494 (Note 1)
Valve Spring Retainer	(16) - 10241744	(16) 10241744	12495492	19169661 (Note 2)
Push Rod Kit (16 pcs)	12495491	14095256	12371041	12371041
Lifter Kit (16 pcs)	12371044	12371044	12371042	12371042
Rocker Arm Kit	12495490 (note 3)	12495490 (note 3)	12495490 (note 3)	19210738 (note 4)
Cylinder Head Bolt Kit	12495499	12495499	12495499	12495499
Factory Rebuild Gasket List				
Description	**88958602**	**19258602**	**88958603**	**88958604**
Rebuild Gasket Kit	**19201171**	**19201171**	**19201172**	**19201172**
Head Gasket (each)	10105117	10105117	12557236	12557236
Intake Gasket Set	89017465	89017465	10147994	89017465
Oil Pan Gasket One piece gasket	10108676	19212594	10108676	10108676
Oil Drain Plug Gasket	N/S	N/S	N/S	N/S
Rear Main Seal	12554314	12554314	12554314	12554314
Optional Rear Main Seal	10088158	10088158	10088158	10088158
Rear Crank Adapter Gasket	12555771	12555771	12555771	12555771
Front Timing Cover Seal	14090906	14090906	14090906	14090906
Valve Cover Gasket	10046089	10046089	10046089	10046089
Front Timing Cover Gasket	10108435	10108435	RTV	RTV
Seal, Intake Valve	10212810	10212810	10212810	10212810
Seal, Exhaust Valve	12564852	12564852	10212810	10212810
Distributor Gasket	10108445	10108445	10108445	10108445
Water Outlet Gasket	10105135	10105135	10105135	10105135
Water Pump Gasket	3754587	3754587	3754587	3754587
Gasket, Fuel Pump Cover Opening	12560223	12560223	12560223	12560223
Gasket, Fuel Pump	10114141	10114141	10114141	10114141
Oil Filter PF-25	25324052	25324052	25324052	25324052

Note 1. 12495494 contains 16 of 12551483 springs

Note 2. Requires 16 pcs of 1916961 HD retainers or 1pc 19171528 kit.

Note 3. 12495490 contains 16 of 10089648 rocker arms

Note 4. 19210728 contains 16 of 19210724 rocker arms.

Engine Parts Lists *Continued*

Factory Service Bolt List

Description	88958602 / 19258602	88958603	88958604
Factory Sealed Bolt Kit	N/S	N/S	N/S
Rebuild Sealed Bolt Kit	N/S	N/S	N/S
Bolt, Main Cap Inner	12561388	12561388	12561388
Bolt, Main Cap Outer	3877669	3877669	3877669
Windage Tray Stud	12561389	12561389	12561389
Bolt, Oil Pump	10046007	10046007	10046007
Bolt, Oil Pan	(14) - 9440033	(14) - 9440033	(14) - 9440033
Stud, Oil Pan	(2) - 9424877	(2) - 9424877	(2) - 9424877
Nut, Oil Pan Stud	(2) - 12338130	(2) - 12338130	(2) - 12338130
Bolt, Oil Filter Adapter	(2) - 3951644	(2) - 3951644	(2) - 3951644
Bolt, Timing Cover Kit (8 bolts)	12497980	N/A	N/A
Bolt, Timing Cover Plastic Cover Short	N/A	(6) - 10213293	(6) - 10213293
Bolt, Timing Cover Plastic cover Long	N/A	(2) - 12551135	(2) - 12551135
Bolt, Head (short)	(16) -10168527	(16) -10168527	(16) -10168527
Bolt, Head, (medium)	(4) - 10168526	(4) - 10168526	(4) - 10168526
Bolt, Head (long)	(14) - 10168525	(14) - 10168525	(14) - 10168525

Factory Service Bolt List - Continued

Description	88958602 / 19258602	88958603	88958604
Bolt, Cam Retainer	N/A	(2) - 14093637	(2) - 14093637
Bolt, Valve Cover each	12338092	12338092	12338092
Bolt, Flywheel	12337973	12337973	12337973
Bolt, Flexplate (automatic)	373707	373707	373707
Bolt, Intake	(8) - 12550027	(4) - 14091544	(8) - 12550027
Bolts, Intake 88958603 continued		(4) - 88891769	
Bolts, Intake 88958603 continued		(4) - 9439918	
Bolt, Distributor Hold Down	14091544	14091544	14091544
Bolt, Water Outlet	(2) - 10198997	(2) - 10198997	(2) - 10198997
Bolt, Fuel Pump Cover	(2) - 9440033	(2) - 9440033	(2) - 9440033
Bolt, Fuel Pump Holddown	(2) - 14081295	(2) - 14081295	(2) - 14081295
Bolt, Balancer	3815833	3815933	3815933
Washer, Balancer	14001829	14001829	14001829
Bolt, Water Pump (Short Pump)	(4) - 9424877	(4) - 9424877	(4) - 9424877
Bolt, Water Pump (Long Pump)	(4) - 9442012	(4) - 9442012	(4) - 9442012

Notes

Catalog Changes.
10-19-09 changes to page 45 part numbers. Main and rod bearings.

3-1-10 changes.

1. **Page 18 corrected crank forging number on 603 & 604 engines from 10243880 to 14088532.**
2. **Page 43. Changed crankshaft service number from 12566307 to 12556307 (typo)**

4-27-10 changes.

3. **Added engine 19258602 throughout manual**
4. **Page 18. Corrected 8603 Chamber Volume.**
5. **Add 19258602 story to last page.**
6. **Add crankshaft bob weights to last page.**
7. **Page 13. Picture of piston added and description modified.**
8. **Page 16. Picture of kool nut added and description modified.**
9. **Pages 36-39 update all part numbers to current.**
10. **Remove references to fuel testing, noise testing, and carburetor tech procedures**
11. **Updated table of contents pages**

Crankshaft Weight (grams)					
Engine	Crankshaft Part Number	Bob Weight Pin 1	Bob Weight Pin 2	Bob Weight Pin 3	Bob Weight Pin 4
19258602	10243068	1657.3	1835.5	1835.5	1269.1
88958602	14088526	1742.2	1932.8	1932.8	1362.6
88958603	12556307	1803.5	1963.6	1963.6	1414.8
88958604	12556307	1803.5	1963.6	1963.6	1414.8

8602 Engines Crank and Piston Changes

General Motors has taken great pride in the crate engine program since its inception in 2002 by being able to provide proven, reliable, and affordable engine packages to grass roots racers. The main goal always has been to produce a line of engines that were all built with the exact same parts to keep a level playing field for all competitors. Over the years, the parts content of these engines have remained the same with no significant changes in content.

However, in the summer of 2009 the piston supplier for the 8602 engine approached General Motors and explained that they were no longer able to continue to produce the piston. This was a business decision based on the material availability and process used in manufacturing the piston. General Motors (and the supplier) were aware of the implications to the circle track engine program and tried to find an alternative method to make this piston. The results of the investigation soon boiled down to one of two choices: Either change the piston to a more commonly available material or increase the cost of the engine significantly.

Cost is a major factor in the success of the engine program so the only real choice was to change the piston material and leave the cost of the engine unchanged. Due to the piston change, the crankshaft balance also had to change. There was initially a concern that there would be a possible power difference or advantage between the two piston designs so GM began some extensive testing to find out. The results of this testing proved that no perceivable advantage or disadvantage could be measured between engines equipped with either piston design.

General Motors decided that since parts in the engine are slightly different and that these parts of the engine will not interchange with each other, there had to be a part number change to the engine itself. Since the history of the crate engine program has shown that "8602" (the last 4 digits of the original 88958602 GM part number) was so entrenched in the racing community, the decision was made to search for an available part number that used the same last 4 digits. Thus the new part number became 19258602.

So no matter what "8602" engine you or your competitor may have under the hood, be certain that the playing field is still as level as it always was.

This technical manual has been modified to show where this change designates a physical difference between the two engine part numbers.