

# GM SPORT COMPACT PERFORMANCE BUILD BOOK

Part Number 88958728

**THIRD EDITION**



## Appendix

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GM

**RACING**

# INTRODUCTION

## GENERAL INFORMATION

This handbook describes parts and procedures used to prepare **ECOTEC** race engines used by GM Racing in professional Sport Compact Drag Racing and Drifting, as well as engine, transmission, and chassis modifications designed for sportsman-level drag racers.

This handbook is intended to be used by experienced and knowledgeable race engine and chassis builders. It does not cover all basic engine blueprinting and assembly procedures, since it is assumed that the reader is already familiar with machining, measuring, and inspecting the components. Some of the procedures described require specialized tools and skills. If you do not have the appropriate training and equipment to perform these modifications safely, this work should be performed by other professionals.

There are, of course, many other possible combinations of components and modifications that may produce equal or superior results. However, by using the combination of parts and procedures described in this handbook, an experienced engine builder can build a competitive and reliable **ECOTEC** Race Engine.

It is not the intent of this book to replace the comprehensive and detailed service practices explained in the GM service manuals. GM service manuals are available from:

Helm Incorporated      [www.helminc.com](http://www.helminc.com)  
PO Box 07130  
Detroit, MI 48207

Observe all safety precautions and warnings in the service manuals. 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.

## PROGRAM HISTORY

The General Motors Sport Compact Drag Racing Program was kicked off at the 2001 International Auto Salon (IAS) in Long Beach, CA. During IAS, GM identified Sport Compact Drag Racing as the highest opportunity to gain awareness in the sport compact market. The first Chevrolet Cavalier and Pontiac Sunfire front-wheel-drive drag race cars were unveiled at the 2001 SEMA show, and, in February of 2002, GM Racing made their competitive debut in Palmdale, CA. In 2003 and 2004 the GM Racing team won back-to-back championships in both the NHRA Hot Rod and ProFWD categories. In 2005, GM transitioned from a factory race team to factory support of independant teams.



Fig. 1

Gary Gardella earned the 2005 NDRA Pro 4 cylinder championship in his first year running an **ECOTEC** race engine. 2006 and 2007 brought more championships, records, and wins for Chevy and **ECOTEC**.

## WHY WE RACE

At GM, we race because it's where we came from and because it fuels our love for competition.

Racing has been part of the GM culture since auto pioneers like Louis Chevrolet relied on speed records and racing victories to launch his fledgling car company. GM has remained in racing for two basic reasons - to win on the track and win in the marketplace.

Racing is a compelling demonstration of the depth of GM's technical resources, the capabilities of its people and the performance, reliability, quality and safety of its products. The race track is the toughest of proving grounds to forge engineering, marketing and business skills into tangible results. Few, if any, environments can match racing's ability to build awareness and consideration of a manufacturer's products to new customers, while simultaneously solidifying the loyalty of current customers.

## FIVE PILLARS GUIDE GM RACING'S INTEGRATED STRATEGY

It provides a **dynamic training ground** for GM engineers. In racing, decisions must be made at a rapid rate. You must be ready at all times, on time, and solve problems quickly and effectively. Racing's demands are the perfect venue in which to exercise the mind and expand abilities, improve teamwork and communication - and do it all without making excuses.

This leads to **technology transfer**. Racing is well known to have introduced improvements in the auto production industry in areas such as suspensions, brakes, engines, aerodynamics and safety - but there's also a transfer in technology through people who work in racing, then take those improved skills and knowledge to the production process. Likewise, the advanced technology and people involved in the mass production of vehicles has enhanced the development of race cars.

Human nature dictates that **people want to compete** - and win. There is a strong competitive spirit within GM, and success in racing produces a vibrant esprit de corps. GM is not a sponsor of racing - we are an active, engaged participant who produces the cars and the components, and provides the technology essential to the sport.

If racing did not already exist, auto manufacturers would invent it as the **perfect marketing platform**. Racing is a sport that's all about the product and the people, followed with cult-like passionate fans who buy cars and trucks at a higher and more loyal rate than the average consumer.

Grass roots racers and enthusiasts demand the best, and have made **GM Performance Parts** the leader in over the counter components and engine assemblies. GM's

approach, as a participant in racing, is to take responsibility to support the sport. Someone else might even build a motor that beats the factory team. But it's this democratization of racing that sets GM apart, and is the cornerstone of GM's total business approach.

## LEGAL INFORMATION

This publication is intended to provide technical information on the GM **ECOTEC** engines, Hydra-Matic transmission, and Chevy Cobalt used in sport compact drag racing at the professional and sportsman level.

This handbook pertains exclusively to engines and vehicles which are used off the public highways. Federal law restricts the removal or modification 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, but the reader is strongly urged to check all applicable local and state laws.

Many of the parts described or listed in this handbook are merchandised for off-highway application only, and are tagged with the following "Special Parts Notice":

### SPECIAL PARTS NOTICE

This part has been specifically designed for Off-Highway application *only*. Since the installation of this part may either impair your vehicle's emission control performance or be uncertified under current Motor Vehicle Safety Standards, it should not be installed in a vehicle used on any street or highway. Additionally, any such application could adversely affect the warranty coverage of such an on-street or highway vehicle.

The information contained in this handbook is subject to change. General Motors also reserves the right to make changes at any time, without notice, in equipment, manufacturers, specifications, and materials, or to discontinue items.

The information in this publication is presented without any warranty. *All the risk for its use is entirely assumed by the user.* Specific component design, mechanical procedures, and the qualifications of individual readers are beyond the control of the publisher, and therefore the publisher disclaims all liability incurred in connection with the use of information contained in this publication.

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## ORDERING PARTS IN THIS BOOK

Parts described in this book are from several sources. Many parts are available from aftermarket suppliers. The contact information for these suppliers is listed in a separate section of this book. Note that some parts may be available from additional sources.

There are three types of General Motors parts listed in this book. First are parts used in regular production vehicles. These are regular service and replacement parts, denoted as 'GM' parts in this book. These parts are available through any GM dealer. See [www.gmgoodwrench.com](http://www.gmgoodwrench.com) for more information and to locate a dealer near you.

The second type of GM parts shown are GM Performance Parts. These parts are available only through authorized GM Performance Parts dealers. Not all GM dealers are authorized to sell GM Performance Parts. For more information or to locate an authorized dealer, visit [www.gmperformanceparts.com](http://www.gmperformanceparts.com). Please note that not all parts are listed on the GM Performance Parts website. Your authorized dealer has a more complete list. If your dealer is an authorized GM Performance Parts dealer and still cannot locate a GM Performance Part listed in this book, please e-mail GM Racing through our website [www.gmtunersource.com](http://www.gmtunersource.com).

The third type of parts listed in this book are available exclusively from GM Racing. These are typically low-volume parts for professional racing applications. All GM Racing Parts are for off-highway use only and are tagged with the "Special Parts Notice" shown previously in this book. GM Racing Parts are available only by e-mailing us through our website [www.gmtunersource.com](http://www.gmtunersource.com). Racing personnel will respond to you with additional ordering information and part availability. Please allow up to twelve weeks for delivery.

All part numbers are subject to change. Please contact the appropriate source for the most recent information.

## BASE ENGINE OVERVIEW

The engine is the heart of a competition car. It must be capable of delivering full power reliably run-after-run on race day, at engine and vehicle speeds far in excess of those encountered in normal driving. Every part of a competition engine must be as nearly perfect as possible – the slightest failure can put you out of the race.

Since 1955, the Small Block Chevy has proven its versatility, durability, and performance potential with automotive performance enthusiasts. The **ECOTEC** engine has all the basic mechanical components to repeat this success. A sound base engine structure, excellent airflow capability, easy serviceability, compact size and low weight. These qualities, along with the very successful race program, demonstrate the **ECOTEC** engine is a driving force in the sport compact segment. (Fig. 2)



Fig. 2

GM's **ECOTEC** engine has proven to be a reliable and competitive engine for use in Sport Compact Drag Racing. It has also proven its superior durability in grueling five mile runs at the Bonneville Salt Flats with speeds over 300 MPH and in showroom stock endurance road racing competition. The number of stock components utilized in the race engine demonstrates the robust design of the **ECOTEC** engine.

The **ECOTEC**'s outstanding feature to performance enthusiasts is its impressive strength. GM Racing dynamometer tests confirm that major horsepower gains are possible with minimal modifications. For instance, when building an **ECOTEC** engine to the 400 hp power level, no modifications to the cylinder head, block, main girdle or crankshaft are required.

The production **ECOTEC** engine block is manufactured out of aluminum using a lost-foam casting process. This process allows for both a stronger and lighter part. Flanged, thin-wall iron cylinder sleeves are press-fit into a semi-floating aluminum support structure. The **ECOTEC** block is supported by a massive die-cast aluminum girdle/main cap assembly and structural oil pan for noise and vibration suppression. The main-cap structures are each supported with six fasteners. Extra-thick main bearings resist the differential thermal expansion of the nodular iron crank and aluminum block.

All **ECOTEC** blocks are cast with passages for piston-cooling jets and an oil cooler for high-output turbocharged applications. The fully-boxed block requires no windage tray, even on applications up to 600 horsepower. An auxiliary chain drives the water pump and balance shafts from the crank.

To reduce the risk of hot spots, pressure-cast, non-squish dished pistons are manufactured without valve reliefs. The symmetrical, barrel-faced moly-coated top ring fits in an

anodized ring-groove below a super-thin 3 mm top ring land, creating a low crevice volume for reduced emissions. The pistons deliver power through full-floating piston pins and powder-metal or forged steel connecting rods.

The **ECOTEC** twin-cam cylinder head uses low-friction hydraulic roller finger-followers, which have been proven reliable and effective up to 11,000 rpm. Head fastener placement permits cylinder head removal and installation without removing the camshafts. The camshafts are driven directly off the crank by a chain. The design includes provisions for variable cam phasing now found on select **ECOTEC** variants. The finger-follower design permits a light-weight narrow profile and reduced valve angles (the intake valve is 18 degrees from vertical and the exhaust valve 16 degrees).

The design of the intake manifold eliminates the need for variable-length intake runners and some **ECOTEC** engines now include direct injection.

The **ECOTEC** engine management system uses a port-EFI design with cassette waste-spark ignition.

The next several sections of this publication focus on performance modifications for the 2.2L **ECOTEC** engine installed in a 2005 Chevy Cobalt. The modifications shown could be performed on a number of GM vehicles.

See your local GM dealer for more information on ordering a vehicle equipped with the **ECOTEC** engine.

## **ECOTEC ENGINE CODES**

<b>Engine Code</b>	<b>Usage</b>	<b>Displacement</b>	<b>Bore x Stroke</b>	<b>CR:1</b>	<b>Fuel</b>	<b>Induction</b>	<b>Hp @ rpm</b>	<b>Tq @ rpm</b>
L61	Saturn ION & VUE Chevy Malibu, Cobalt & HHR Pontiac G5	2.2L	86 x 94.6 mm	10	SFI	Naturally aspirated	148 @ 5600	152 @ 4200
LE5	Saturn ION & Sky Chevy Cobalt Sport & HHR Pontiac G5 GT, G6, & Solstice	2.4L	86 x 98 mm	10.4	SFI	Naturally aspirated with VVT	173 @ 6200	163 @ 4800
LSJ	Saturn ION Redline Chevy Cobalt SS S/C	2.0L	86 x 86 mm	9.5	SFI	Supercharged	205 @ 5600	200 @ 4400
LNF	Pontiac Solstice GXP Saturn Sky Redline Chevy HHR SS & Cobalt SS	2.0L	86 x 86 mm	9.2	DI	Turbocharged with VVT	260 @ 5300	260 @ 2500
LK9	Saab 9-3	2.0L	86 x 86 mm	9.5	MPFI	Turbocharged	210 @ 5300	221 @ 2500
LAT	Saturn Aura Green Line	2.4L	86 x 98 mm	10.4	SFI	Naturally aspirated hybrid	164 @ 6400	159 @ 5000

# APPENDIX

## 2007 PRODUCTION ECOTEC ENGINE SPECIFICATIONS

	L61	LE5	LSJ	LNF
Displacement	2.2L / 134CID	2.4L / 146CID	2.0L / 122CID	2.0L / 122CID
Compression	10.0:1	10:01	9.5:1	9.2:1
Horsepower @ rpm	148 @ 5600	177 @ 6600	205 @ 5600	260 @ 5300
Torque @ rpm	152 @ 4200	166 @ 4800	200 @ 4400	260 @ 2500-5250
<b>Block</b>				
Cylinder bore diameter	85.992-86.008mm 3.3855-3.3861in.	87.992-88.008mm 3.4668-3.4675in.	85.992-86.008mm 3.3855-3.3861in.	85.992-86.008mm 3.3880-3.3887in.
Main bearing bore diameter	64.068-64.082mm / 2.5224-2.5229in.	64.068-64.082mm 2.5224-2.5229in.	64.068-64.082mm / 2.5224-2.5229in.	64.068-64.082mm / 2.5224-2.5229in.
Block Material	Lost foam cast Aluminum	Lost foam cast Aluminum	Lost foam cast Aluminum	Lost foam cast Aluminum
<b>Crank</b>				
Stroke	94.6mm 3.727in.	98mm 3.861in	86mm 3.388in.	86mm 3.388in.
Rod Journal Diameter	49.000-49.014mm 1.9291-1.9297in.	49.000-49.014mm 1.9291-1.9297in.	49.000-49.014mm 1.9291-1.9297in.	49.000-49.014mm 1.9291-1.9297in.
Main Journal Diameter	55.994-56.008mm 2.2045-2.2050in.	55.994-56.008mm 2.2045-2.2050in.	55.994-56.008mm 2.2045-2.2050in.	55.994-56.008mm 2.2045-2.2050in.
Main Bearing Clearance	0.031-0.067mm 0.0012-0.0026in.	0.031-0.067mm 0.0012-0.0026in.	0.031-0.067mm 0.0012-0.0026in.	0.031-0.067mm 0.0012-0.0026in.
Bolt Pattern	6	6	8	8
Material	Cast	Cast	Forged Steel	Forged Steel
<b>Rods</b>				
Rod Bearing Clearance	0.029-0.073mm 0.0011-0.0029in.	0.029-0.073mm 0.0011-0.0029in.	0.029-0.073mm 0.0011-0.0029in.	0.029-0.073mm 0.0011-0.0029in.
Rod Bore Diameter-Bearing	52.118-52.134mm 2.0519-2.05252in.	52.118-52.134mm 2.0519-2.05252in.	52.118-52.134mm 2.0519-2.05252in.	52.118-52.134mm 2.0519-2.05252in.
Rod Bore Diameter-Pin	20.007-20.021mm 0.7877-0.7882in.	20.007-20.021mm 0.7877-0.7882in.	23.007-23.017mm 0.9058-0.9062in.	23.007-23.017mm 0.9058-0.9062in.
Material	1019 Steel	1019 Steel	5115 Steel	1019 Steel
<b>Piston Rings</b>				
Piston Ring Thickness - First Compression Ring	1.170-1.190mm 0.0461-0.0469 in	1.170-1.190mm 0.0461-0.0469 in	1.170-1.190mm 0.0461-0.0469 in	1.170-1.190mm 0.0461-0.0469 in
Piston Ring Thickness - Second Compression Ring	1.471-1.490mm 0.0579-0.0587 in	1.471-1.490mm 0.0579-0.0587 in	1.471-1.490mm 0.0579-0.0587 in	1.471-1.490mm 0.0579-0.0587 in
Piston Ring Thickness - Oil Control Ring - Rail - Maximum	0.40mm 0.0157 in	0.472mm 0.0186 in	0.43mm 0.0169 in	0.472mm 0.0186 in

	<b>L61</b>	<b>LE5</b>	<b>LSJ</b>	<b>LNF</b>
Piston Ring Thickness - Oil Control Ring - Spacer	1.613 mm 0.0635 in	.968 mm 0.0380 in	1.574-1.651 mm 0.0620-0.0650 in	1.765 mm 0.06940 in
<b>Pistons and Pins</b>				
Pin - Piston Pin Diameter	19.995-20.000 mm 0.7872-0.7874 in	19.995-20.000 mm 0.7872-0.7874 in	22.995-23.00 mm 0.9053-0.9055 in	22.995-23.00 mm 0.9053-0.9055 in
Piston - Piston Diameter - @14.5 mm up	85.967-85.982 mm 3.3845-3.3851 in	87.967-87.982 mm 3.4633-3.4638 in	85.967-85.982 mm 3.3845-3.3851 in	85.967-85.982 mm 3.3845-3.3851 in
Piston - Piston Pin Bore Diameter	20.002-20.007 mm 0.7875-0.7877 in	20.004-20.009 mm 0.7876-0.7878 in	23.004-23.010 mm 0.9057-0.9059 in	23.004-23.010 mm 0.9057-0.9059 in
Piston - Piston Ring Groove Width - Oil Control	2.52-2.54 mm 0.0992-0.1000 in	2.51-2.53 mm 0.0988-0.0996 in	2.52-2.54 mm 0.0992-0.1000 in	2.52-2.54 mm 0.0992-0.1000 in
Piston - Piston Ring Groove Width - Second	1.52-1.54 mm 0.0598-0.0606 in	1.52-1.54 mm 0.0598-0.0606 in	1.52-1.54 mm 0.0598-0.0606 in	1.52-1.54 mm 0.0598-0.0606 in
Piston - Piston Ring Groove Width - Top	1.23-1.25 mm 0.0484-0.0492 in	1.23-1.25 mm 0.0484-0.0492 in	1.23-1.25 mm 0.0484-0.0492 in	1.23-1.25 mm 0.0484-0.0492 in
Piston - Piston to Bore Clearance	0.010-0.041 mm 0.0004-0.0016 in	0.010-0.041 mm 0.0004-0.0016 in	0.013-0.047 mm 0.0005-0.0019 in	0.010-0.041 mm 0.0004-0.0016 in
<b>Valves</b>				
Valves - Valve Stem Diameter - Exhaust	5.935-5.950 mm 0.2337-0.2343 in	5.935-5.950 mm 0.2337-0.2343 in	5.935-5.950 mm 0.2337-0.2343 in	5.935-5.950 mm 0.2337-0.2343 in
Valves - Valve Stem Diameter - Intake	5.955-5.970 mm 0.2344-0.2355 in	5.955-5.970 mm 0.2344-0.2355 in	5.955-5.970 mm 0.2344-0.2355 in	5.955-5.970 mm 0.2344-0.2355 in
Valves - Valve Head Diameter - Exhaust	30.09 mm 1.185 in	30.09 mm 1.185 in	30.09 mm 1.185 in	30.09 mm 1.185 in
Valves - Valve Head Diameter - Intake	35.17 mm 1.385 in	35.17 mm 1.385 in	35.17 mm 1.385 in	35.17 mm 1.385 in
<b>Cam Shafts</b>				
Intake Cam Peak Lift	5.9804 mm	6.2551 mm	5.9557 mm	6.1112 mm
Intake Valve Peak Lift	10.0795 mm	10.5425 mm	10.0379 mm	10.3 mm
Intake Valve Timing	116°	135 °	100°	126°
Intake Duration @1mm lash	198.4°	210.3°	196.5°	203.6°
Intake Valve area @1mm lash	1112.9 mm <sup>2</sup>	1253.3 mm <sup>2</sup>	1117.7 mm <sup>2</sup>	1171.3 mm <sup>2</sup>
Exhaust Cam Peak Lift	5.9752 mm	5.9514 mm	5.9543 mm	6.1061 mm
Exhaust Valve Peak Lift	10.0792 mm	10.0391 mm	10.0439 mm	10.3 mm
Exhaust Valve Timing	-108°	-125°	-115°	-120°
Exhaust Duration @1mm lash	193.3°	195.4°	191.7°	194°
Exhaust Valve area @1mm lash	1078 mm <sup>2</sup>	1092.7 mm <sup>2</sup>	1076.4 mm <sup>2</sup>	1106 mm <sup>2</sup>

	<b>L61</b>	<b>LE5</b>	<b>LSJ</b>	<b>LNF</b>
Cam Signal Source	Through 2006 - none (waste spark) 2007 - wheel on on intake cam	wheel on both cams	hex bushing in exhaust cam	wheel on both cams
<b>Head</b>				
Valve Guide Bore - Exhaust	6.000-6.012 mm 0.2362-0.2367 in	6.000-6.012 mm 0.2362-0.2367 in	6.000-6.012 mm 0.2362-0.2367 in	6.000-6.012 mm 0.2362-0.2367 in
Valve Guide Bore - Intake	6.000-6.012 mm 0.2362-0.2367 in	6.000-6.012 mm 0.2362-0.2367 in	6.000-6.012 mm 0.2362-0.2367 in	6.000-6.012 mm 0.2362-0.2367 in
Valve Lifter Bore Diameter - Stationary Lash Adjusters	12.013-12.037 mm 0.4730-0.4739 in	12.013-12.037 mm 0.4730-0.4739 in	12.013-12.037 mm 0.4730-0.4739 in	12.013-12.037 mm 0.4730-0.4739 in
Material	Lost foam cast Aluminum	Lost foam cast Aluminum	Sand Cast Aluminum	Sand Cast Aluminum
<b>Injectors</b>				
Flow Rate	28 lbs/hr @ 58 PSI	28 lbs/hr @ 58 PSI	34 lbs/hr @ 58 PSI	20cc/min @ 1450 PSI
Brand	Delphi	Delphi	Siemens	Bosch
<b>Ignition System</b>				
Type	Through 2006: Waste spark, dual coil 2007:Coil-On-Plug	Coil-On-Plug	Coil-On-Plug	Coil-On-Plug
Firing Order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
Spark Plug	part number 12598004	part number 12598004	part number 12610757	part number 12590701
Spark Plug Gap	1.1-0.95 mm 0.043-0.037 in	1.1-0.95 mm 0.043-0.037 in	1.1-0.85 mm 0.043-0.033 in	0.9-0.75mm 0.035-0.030 in.
Rating	Heat Range 5	Heat Range 5	Heat Range 5	Heat Range 5
Brand	NGK	NGK	NGK-R	NGK

**ECOTEC COMPONENT UPGRADE MATRIX****UPGRADES BY HORSEPOWER**

Failure Mode	Fix	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400
L61/LE5 Rods	Upgrade to aftermarket or LSJ/LNF rods	X												
L61/LE5 Pistons	Upgrade to aftermarket piston set	X												
Spark Plugs	Upgrade to aftermarket spark plugs		X											
Fuel Injectors	Use high-flow injectors (and/or add injectors)		X											
Fuel Pump	Upgrade to aftermarket fuel pump		X											
LSJ/LNF Pistons	Upgrade to aftermarket piston set		X											
L61/LE5 Valves	Upgrade to aftermarket or LSJ/LNF valves		X											
Cylinder liners	Replace with solid iron liners			X										
LSJ/LNF Rods	Upgrade to aftermarket rods			X										
LSJ/LNF Valves	Upgrade to aftermarket valves			X										
Head gasket	Copper w/ O-rings or aftermarket multi-layer				X									
Crank	Upgrade to steel crank				X									
L61/LE5 combustion chamber seal	Stake combustion chamber or use LSJ head					X								
Exhaust rocker arm	Upgrade to billet rocker arm						X							
21mm wrist pin (including aftermarket)	Upgrade to 22mm wrist pin						X							
Multi-layer gasket (aftermarket)	Use copper headgasket with O-rings							X						
L61/LE5 Head casting	Use LSJ head casting								X					
Block Casting	Use uni-bolt block upgrade									X				
Aftermarket Rods	Upgrade to 300M Manley rods										X			
Aftermarket Rods	Upgrade to 300M 675 gram Manley rods												X	
Timing chain guide	Use billet timing chain guide & tensioner													X

**UPGRADES BY RPM**

<b>Failure Mode</b>	<b>Fix</b>	<b>7000</b>	<b>7500</b>	<b>Extended time on rev limiter</b>
Valve springs	Upgrade to aftermarket valve springs	X		
Balance shafts	Use neutral balance shafts or elimination kit		X	
Production Oil Pump (for wet sump)	Upgrade to billet pump gears			X
Front hub assembly	Upgrade to billet hub assembly			X

**TORQUE SPECIFICATIONS**

<b>Component Description</b>	<b>Ft.Lbs.</b>	<b>In.Lbs.</b>	<b>Lubrication</b>
Unibolt Stud Straps	Max Thread		609 Green Loctite
Piston Oil Squirters	15		242 Blue Loctite
Crankshaft Main Stud Nuts	65		#3 Extreme pressure lube CMD
Girdle to Block Peripheral Bolts	15		#3 Extreme pressure lube CMD
Connecting Rod Bolts	65		51609 Anti-Sieze Molly
Balance Shaft Chain Guide Bolts		89	242 Blue Loctite
Balance Shaft Drive Sprocket Bolts	41		271 Red Loctite
Balance Shaft Retaining Bolts		89	242 Blue Loctite
Head Strap Nuts	120		51609 Anti-Sieze Molly
Timing Chain Guide Bolts		89	242 Blue Loctite
Timing Chain Guide Bolts Access Plug	30		#3 Extreme pressure lube CMD
Timing Chain Guide Fixed Bolt		89	242 Blue Loctite
Timing Chain Oil Nozzle Bolt		89	242 Blue Loctite
Timing Chain Tensioner Bolts		89	242 Blue Loctite
Timing Chain Guide Adjustment Bolt	20		242 Blue Loctite
Water Pump Bolts	18		242 Blue Loctite
Water Pump Sprocket Bolts		89	242 Blue Loctite
Water Pump Cover Bolts		89	242 Blue Loctite
Intake Camshaft Rear Bearing Cap Bolt	18		#3 Extreme pressure lube CMD
Camshaft Bearing Cap Bolts		89	#3 Extreme pressure lube CMD
Camshaft Timing Chain Tensioner	44		#3 Extreme pressure lube CMD
Camshaft Sprocket Adjusting Bolts	15		271 Red Loctite
Camshaft Sprocket Center Bolt	70		271 Red Loctite
Camshaft Cover Bolts		89	#3 Extreme pressure lube CMD
Oil Pan Bolts	18		Grey Silicone
Oil Drain Plug (Wet Sump)	18		#3 Extreme pressure lube CMD
Oil Pump Gear Cover Plate Screws (Wet Sump)		53	242 Blue Loctite
Oil Pump Pressure Relief Valve Plug (Wet Sump)	35		242 Blue Loctite
Front Cover Bolts	22		242 Blue Loctite
Dry Sump Oil Pump Mount Bolts	20		242 Blue Loctite
Crankshaft Damper Bolt	150		271 Red Loctite
Trigger Wheel Bolts	25		271 Red Loctite
Mandrel Bolt	70		271 Red Loctite
Spark Plugs	15		51609 Anti-Sieze Molly
Flywheel and Flexplate Bolts	100		271 Red Loctite
Exhaust Manifold Studs to Head		89	Dry
Exhaust Manifold Nuts	13		Dry
Intake Manifold Bolts	22		242 Blue Loctite
Fuel Rail Bolts		89	242 Blue Loctite
Throttle Body Bolts/Nuts		89	242 Blue Loctite
Throttle Position Sensor Screws		25	242 Blue Loctite

**PROFESSIONAL ENGINE BUILDER INSTRUCTIONS****PREPARATION****Engine Block**

1. Using a 3.500" bore race block, (GM Racing part number XGB679), verify that the sleeves stand proud of the deck by 0.007" – 0.010". If not, machine aluminum deck surface to achieve this measurement.
2. Tap front oil galley holes to 9/16-18 thread.
3. Plug or weld factory crank sensor hole shut
4. Remove oil filter boss from block with a mill. Weld -10 O-ring boss fittings for oil in and oil out.
5. For dry sump engines utilizing an external pump, the alternator boss may need to be removed from the side of the block.
6. Drill and tap main girdle for -10 AN turbo oil drain back, depending on dry sump or wet sump.
7. Deburr block and sump as desired. Notch rear of block and sump for flywheel clearance. This varies with flywheel and clutch being used.
8. If not already complete, machine block for uni-bolt upgrade and weld plugs in place for #5 unibolt.
9. Wash block and sump thoroughly to clean out debris and machining chips.
10. Install engine block on engine stand, fill five center oil drain backs with aluminum Devcon (part number 10720). Pour from bottom side of engine to top of balance shaft tunnels. Ensure that block is level and let Devcon set up overnight.
11. Install main studs with blue Loctite and torque to 8 ft. lbs.
12. Install main girdle and torque to 20 ft. lbs. and let Loctite set up.
13. Install stainless steel 0.041" thick O-rings, by Bates Engineering (Available through GM Performance Parts part number XGH674). Ensure they are 0.009"-0.011" proud of sleeve surface
14. Install 3.540" head gasket (GM Racing P.N. XGH616).
15. Install main girdle and torque to 65 ft. lbs. with EPL #3 on studs and nuts.
16. Install torque plate and torque to 120 ft. lbs. with moly on threads of studs and nuts.
17. Re-torque mains to 65 ft. lbs.
18. Hone cylinder walls to meet piston manufacturer's specifications. With JE pistons we are currently at 0.0095" piston to wall.

19. Line hone crankshaft housing bore to 2.5230" – 2.5240"
20. Remove rear balance shaft bearings and install aluminum plugs.
21. Modify OEM balance shafts to use as plugs in front of block.
22. Tap water pump chain tensioner oil galley hole for 5/16" set screw, careful to not go too deep.
23. Add threaded hole for extra water pump blockoff plate support.
24. Mill down front water pump bolt hole 0.400" and use shorter bolt.
25. Tap & plug 1/8" NPT in deck surface to block off oil to tensioner, ensure plug is installed flush or below deck.

**Crankshaft**

1. Crankshaft is a 3.505" stroke, 4340 billet steel Bryant Racing (Available through GM Performance Parts part number 88958620).
2. Measure and record all main and rod journal diameters.
3. Look over all oil feed holes and deburr if necessary.
4. Polish crankshaft and wash for assembly.
5. Install freeze plug and snap ring in rear of crankshaft with epoxy or silicone (Hollow main only).
6. Slightly lap the four sides of the thrust bearings to deburr and achieve 0.003" of crankshaft end play.
7. Install the main bearings in the block and girdle, using production main bearings.
8. Install main girdle and torque to 65 ft. lbs. with EPL #3 on studs and nuts.
9. Install torque plate and torque to 120 ft. lbs. with moly on threads of studs and nuts.
10. Re-torque mains to 65 ft. lbs.
11. Check main bearing clearance (0.0028" – 0.0032").
12. Crankshaft fillet clearance must be checked on both sides of each journal.

**Connecting Rods**

1. Inspect and deburr as necessary ensuring to deburr inside oil hole in bushing on small end.
2. Chamfer both sides of rod bearings for crank fillet clearance. Clevite part number 1663H or 1663HX
3. Install bearings in clean connecting rods. Measure and record sizes. Rod bearing clearance should be 0.0028" – 0.0032".

- Current professional-level connecting rods used are Manley part number 15499GR-4 with larger section area and made from 300M material. Big end clearance is 0.0028" to 0.0032" and small end clearance is 0.0015" – 0.0017". Length is 5.888", big end width is 0.940", we are currently grinding 0.003" off each side to achieve this. Big end bore is 2.0150" – 2.0155".

#### Pistons and Wrist Pins

- Wrist pins (Precision Products part number MC-86622462005-TC).  
Specs: 0.866"/ 22mm diameter, 2.246" long, 0.200" wall thickness, Casidium coated, C-350 steel.
- Wrist pin clips are supplied with pistons (deburr before installation)
- Pistons are JE or Arias, 3.500" Bore, 1.055" Compression Height. Lay back valve reliefs for additional valve clearance. Deburr pistons and pin fit to 0.0016" clearance. Note: Pistons are commonly ordered as pop-ups to allow us to control compression ratio to around 10:1.
- Piston rings are JE, Arias, or Total Seal parts. For JE pistons, top ring end gap is 0.032", second ring is 0.035", Rails 0.020" minimum. File to fit and deburr both ends of each ring and rails. Also deburr both ends of groove loc spacers

#### Camshafts and Drive Components

- Water pump crank gear and cam drive crank gear are stock production parts.
- Surface grind or lap both sides of both gears to ensure good fit against one another to prevent galling under high rpm use.
- Chamfer back of water pump gear for clearance on crankshaft radius.
- Adjustable cam drive gears (GM Performance part number 88958613). Disassemble and deburr slots to ensure full range of adjustability. Wash for assembly.
- Grind heads of cam bolts flat for cam cover clearance.
- If not already done, install distributor hex drive in intake camshaft with 0.0005" to 0.010" press and weld a couple spots for reliability.
- Dry run distributor hex fit.
- Polish all cam journals and wash for assembly.

#### Head Gasket

- Current head gasket is a 0.043" thick, heat treated copper by SCE (Available through GM Performance Parts part number XGH616).
- Ensure that head gasket does not protrude into cylinders. Bore gasket out to 3.540" to ensure no overhang. Deburr both sides of cylinder bores, make sure gasket sits on deck properly. It will be tight on the dowels and will likely need to be relieved by hand with a grinder.
- If using an older design gasket create a bowtie shaped support piece and install in gasket between #4 cylinder and back edge of gasket (to prevent cylinder pressure from pushing gasket outward)

#### Miscellaneous

- For turbo oil feed, use a small side oil galley plug, remove aluminum washer, drill 11/64" hole from bottom of 6mm hex through the bottom of the plug. Weld a -4 AN fitting with 9/16" O.D. hex on to plug. A second one of these fittings could serve as oil pressure measurement point.
- Use LSJ Saab Valve Cover. Remove stock baffle (save). Determine where and what oil breather is to be located. Weld on, cut and fit stock baffle to mount over fitting. Drill and tap stock rivet pads for screws. Install baffle. Install screws with red Loctite. Silicone over screws so they cannot turn out. Weld oil fill hole shut or it can be hard capped with O-ring Pro Werks style cap if desired.
- Mechanical timing chain tensioner. Make one as described elsewhere in this publication. Use the Billet tensioner and guide as described elsewhere in this publication for applications exceeding 1400 hp.
- Bates or Stefs oil pan. Clearance rear of oil pan for flywheel bolts and possibly the front to clear front plate. Dry test pan on engine. Slot bolt holes if necessary.
- Front oil galley plugs. Either 9/16"x 18 set screws trimmed to 0.375" or 9/16" x 18 threaded rod cut approximately 0.375" with screwdriver slot machined in one end and radius the other end. Deburr and wire wheel threads.
- Make crankshaft keyway from 3/16" square key stock.

## ENGINE ASSEMBLY

### Block and Crankshaft

Now that all the components are prepped and washed for assembly, use a flashlight and inspect all of the oil galley holes for debris. Install the water galley, water pump chain tensioner elimination set screws and front oil galley plugs with epoxy. Install oil galley plugs, the oil feed to the turbo and the oil pressure gage fitting with thread sealant. Next, install the upper main bearings in the block and coat with Clevite Bearing Guard. Install the lower main bearings into the sump and coat with Clevite Bearing Guard. Use red gasket sealant on block surface and sump surface where O.D. of rear main seal is located. Oil the rear main seal where it rides on crankshaft and install onto crankshaft. Now lower the crankshaft with the seal on it into the block. Push rear main seal into block until it stops. Use grey silicone (Loctite #5699) between block and sump. Go around both square oil drain backs and both sides of oil pressure channels. Install sump on block. DO NOT hit sump onto block as this will dislodge the bearings. Instead, install uni-bolts and straps, being sure to apply silicone between the strap and the sump, and use the nuts for the main studs and washers with EPL #3 to draw sump down. Torque in two stages to 65 ft. lbs. Pay attention to the rear main seal as sometimes it will back out of its housing, to prevent this a washer can be made to bolt to the crank flange. Install peripheral bolts with EPL #3 and torque to 15 ft. lbs. Smear silicone on the outside of block if desired. Check crankshaft end play (spec is 0.003" – 0.008"). Install crankshaft key into end of crank. Inspect threaded holes in front of block, install screws in the ones which intersect the unbolt holes to prevent oil bleed off.

### Rods and Pistons

Assemble the rods and pistons with STP / LL55 Lube. Check and record wrist pin end play (0.025" – 0.035"). Install rings and groove loc spacers on pistons. Pay attention so that end gaps are not aligned. Next, install the rod bearings in the rods and also the rod caps. Coat with Clevite Bearing Guard and make sure there is rod bolt lube in the threads of the rods, on the threads of the bolts and under the heads of the bolts. Coat the piston skirts and rings, and cylinder walls with oil. Install rods and pistons, making sure your valve notches are on the correct sides. Look over bearings to make sure they are still in place. Install rod cap and bearings and torque to manufacturer's specification. Check rod side clearance (0.008" – 0.012"). Measure and record piston deck heights, sleeve to deck heights, steel o-ring to sleeve height, and stroke. Double check compression ratio at this point.

### Chains, Guides and Pumps

Install the water pump crankshaft gear, insure that it is clearanced for the crank chamfer, and the cam drive crank gear. Install the water pump plate onto block with silicone. Install the chain oil squirter to block with blue Loctite and torque to 89 in. lbs. Install balance shaft plugs in front journals making sure bolt doesn't run into uni-bolt stud torque with blue Loctite to 89 in. lbs.

### Deck Preparation and Head Installation

The next step is to install rubber o-rings in deck surfaces of block from bulk 0.070" rubber o-ring material. Install cylinder head dowels, either custom made or available from Bates Engineering, and apply a thin layer of grey silicone (Loctite #5699) to deck of block. Use some 0.005" thick sewing thread and lay it out in the silicone around both rear oil drain backs, around the rear oil pressure feed, around the square water hole and around center (6) unbolts. Set head gasket on block. Apply a thin layer of grey silicone on the deck of cylinder head. Be careful not to plug the oil pressure feed to the head or water passages. Place all cylinder head straps, with grey silicone on bottom side, in position and set the head on the block. Coat top of straps, washers, threads, and nuts with moly and torque in 3 stages to 120 ft. lbs. Install the 4 front chain case bolts with EPL #3 and torque to 18 ft. lbs. Install both chain guides and torque with blue Loctite to 89 in. lbs. Install the front plug into the cylinder head with thread sealant. When finished with head torques, re-torque main studs to 65 ft. lbs.

### Camshaft Installation & Timing

Set camshafts in saddles of cylinder head with lifters and followers. Set rough lash on base circle to 0.005" – 0.007" on all 16 valves. Lube saddles, cams, cam caps with STP / LL55 Lube. Install exhaust cam #1 lobe nose at approximately 8 o'clock. Install intake cam #1 lobe nose at approximately 4 o'clock. Run down the caps with a speed handle evenly, and then torque cam caps to 89 in. lbs. Install rear cam caps with sealant underneath and torque to 18 ft. lbs. Install cam chain on crank gear. Align mark on gear to pink link on chain. Align blue link of chain on mark of intake cam gear, and pink link on mark of exhaust cam gear. Install cam gear bolts. Red Loctite on threads, EPL #3 between head and washer. Torque to 70 ft. lbs. Install mechanical chain tensioner making sure that the end lines up with chain guide. Tighten to the cylinder head and adjust chain tension by laying straight edge over cam gears and chain. Rotate engine so chain slop is between gears, approximately 90 degrees after TDC of overlap. Adjust tensioner to about 0.200" of slack (measured from straightedge between cam gears). Run through lash 0.005"-0.007". Perform cam timing at 117 degrees intake and 117 degrees exhaust. Remove one bolt at a time, of the three in the adjustable cam gear, and torque with red Loctite to 15 ft. lbs. Re-verify cam timing. Rotate engine to #1 TDC of overlap and mark cams to caps for reference.

Install cylinder head chain guide. Torque bolts to 89 in. lbs. with blue Loctite. Install the valve cover.

#### **Front Cover and Drive Hub**

Apply a layer of grey silicone (Loctite #5699) to block where front plate seals to and install front plate and bolts using blue Loctite and torque to 18 ft. lbs. Lube front seal and seal area of front hub. Put anti-seize on I.D. of hub and put a dab of grey silicone in key-way slot. Install front hub with no more than 0.0008" press and install crank bolt with red Loctite on threads and EPL #3 between bolt head and washer. Torque to 160 ft. lbs. Install water pump block off plate bolt with grey silicone under head and blue Loctite on threads and torque to 18 ft. lbs.

#### **Oil Pan**

Double check rod, main and peripheral bolt torques. Lay grey silicone #5699 on oil pan rail and around pick up tube area. Install oil pan. Put grey silicone on oil pan bolt threads and under heads. Torque bolts to 18 ft. lbs. Install drain plug in oil pan with grey silicone and tighten up.

#### **Injectors and Covers**

Install water block off plate with grey silicone and blue Loctite on bolts. Install injectors in fuel rails with Parker O-ring lube. Install injector wiring harness. Next, put the rails and injectors into the head and intake manifold with Parker O-ring lube. Install bolts with blue Loctite and tighten up.

#### **Exhaust Header**

Before installation of exhaust header be sure to fill in holes in exhaust flange on the head with red high temp silicone, smear flush and let set up. Install exhaust header with red high temp silicone and tighten up.

#### **Flexplate**

Install Flexplate. Use EPL #3 under the heads and red Loctite on the threads. Torque bolts to 100 ft. lbs.

#### **Final Check and Peripherals**

Install front dress, pickup wheel, crank sensor, pointer, oil and fuel pumps and lines, turbo of choice, and alternator. Check and verify all oil and water passages are sealed. Verify all bolts are torqued to specification.

## **ECOTEC HIGH HP CYLINDER HEAD**

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1. Use cylinder head, GM Performance Parts part number XGH614.
2. Ensure O-ring groove is for a 3.500" bore block, Groove dimensions are 0.007" deep, 0.060" wide, and the inner and out radius are 3.650" & 3.770" respectively.
3. Run a spark plug tap through all of the spark plug holes and tap 1/8" NPT in water out for air bleed.
4. Deburr cylinder head and cam caps.
5. Wash entire cylinder head.
6. Install hat washers, available from either Bates Engineering or B&B.
7. Install cam caps and torque to 89 in. lbs. Measure guides, no more than 0.003" larger, and cam bores, 0.0016" – 0.0030" and document.
8. Install head on torque plate for valve job procedure, at 120 ft. lbs.
9. Using a SERDI 100 machine, cut the valve seats at 45 degree angle
10. Blend seats to port with a carbide grinder and blend the chamber to the 3.500" bore
11. Using Ferrea valves, 1.400" intake Valarz VV50 high temp nickel based material, and 1.200" exhaust, Neumonic 90 Nickel Vac 800 custom blend, touch grind the angles, on the intake use 30 degree (0.040"-0.060" backangle) and verify run-out numbers
12. Measure the valve stem diameters (6 mm).
13. Wash all of the valvetrain parts
14. Check spring pressure on all 16 springs at open, 250-260 lbs., and closed, 90-95 lbs., and record numbers. For the PSI 1530 spring, use 1.210" installation heights.
15. Using tip gage, measure the valve tip to spring pocket and record on each valve.
16. Measure from bottom of retainer to valve tip on each valve.
17. Calculate proper installation height.
18. Assemble all valves, springs etc, into the cylinder head.
19. Check the volume of all four combustion chambers and record.
20. Use Miller-Stephenson epoxy on all plugs in the cylinder head.
21. Measure camshaft journals to verify that they are within specification.
22. Rough lash the cylinder head. Use the stock Ecotec rocker arm on the intake and a Jesel Ecotec rocker arm part number OCF-8100 on the exhaust side.
23. Install cylinder head on engine.
24. Lash to 0.005"-0.007" Note: under lifter shims cannot be used with the LSJ/SAAB sand cast cylinder head.

**COBALT PRO RACING BODY COMPONENTS**

<b>PARTS LIST</b>		
<b>DESCRIPTION</b>	<b>PART NUMBER</b>	<b>SUPPLIER</b>
Cobalt Hotrod FWD Front Clip — Fiberglass	30-047-0092	Roush Industries (734) 779-7385
Cobalt Hotrod FWD Front Clip — Carbon Fiber	30-047-0093	Roush Industries (734) 779-7385
Cobalt Pro FWD Front Clip — Fiberglass	30-047-0094	Roush Industries (734) 779-7385
Cobalt Pro FWD Front Clip — Carbon Fiber	30-047-0095	Roush Industries (734) 779-7385
Cobalt Dashboard — Fiberglass	30-071-0049	Roush Industries (734) 779-7385
Cobalt Dashboard — Carbon Fiber	30-071-0050	Roush Industries (734) 779-7385
Cobalt Pro Stock Body	CCS-0591	GM Racing (810) 239-4122

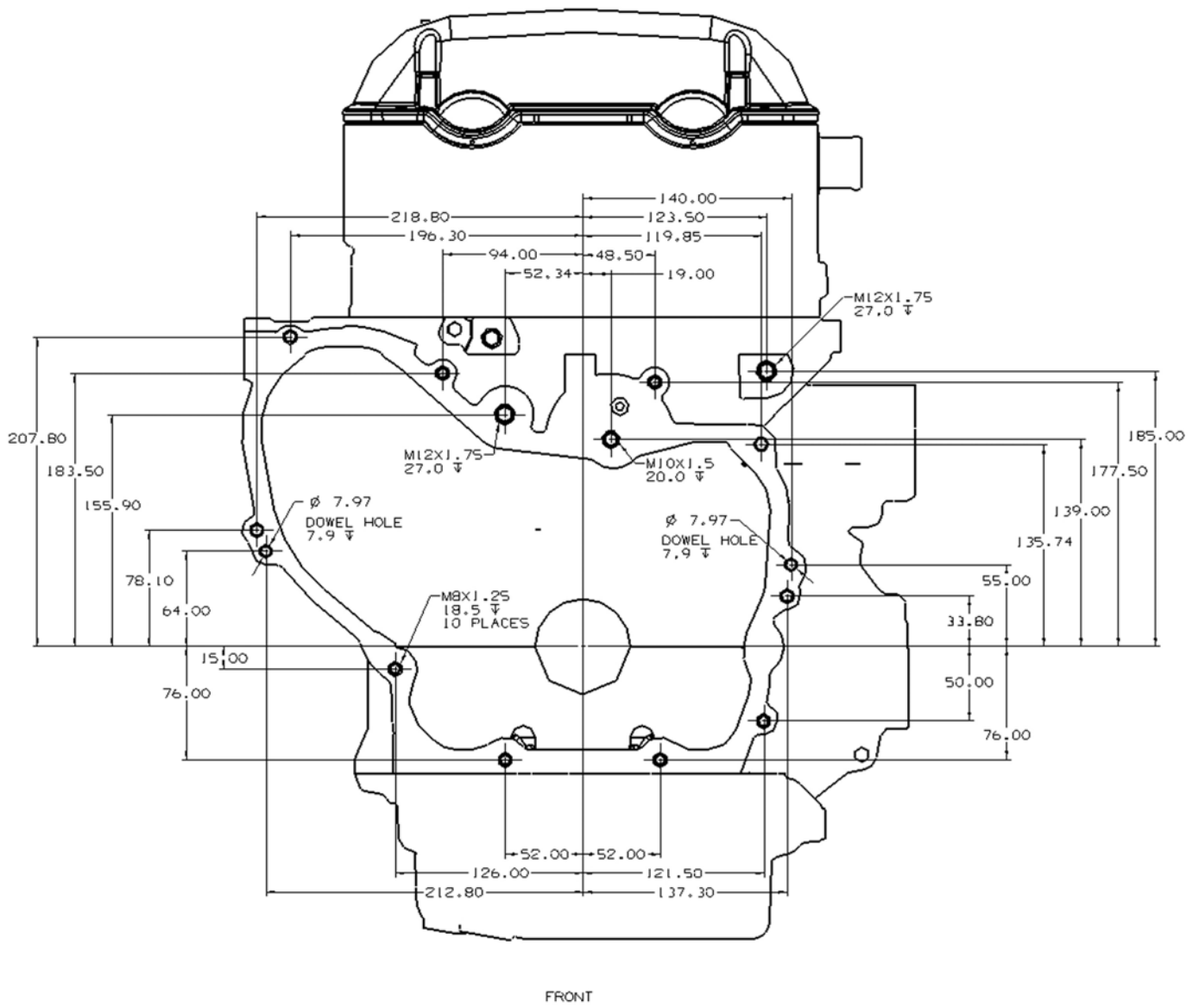
**SUPPLIER CONTACT LIST**

<b>SUPPLIERS LIST</b>			
<b>SUPPLIER</b>	<b>WEB ADDRESS</b>	<b>PHONE NUMBER</b>	<b>Component</b>
ACE Racing	www.ace-mfg.com	(800) 844-9294	Race Clutch
Arias Pistons	www.ariaspistons.com	(310) 532-9737	Pistons
Accufab	www.accufabracing.com	(909) 930-1753	Throttle Body
Aeromotive	www.aeromotiveinc.com	(913) 647-7300	Fuel Systems
Air Lift/Easy Street	www.airliftcompany.com	(800) 248-0892	Airbags
ARP	www.arp-bolts.com	(805) 339-2200	Fasteners
ATI	www.atiperformanceproducts.com	(800) 284-3433	Crank Dampers
Autometer	www.autometer.com	(815) 899-0801	Gauges
B&M	www.bmracing.com	(818) 882-6422	Shifter
Bates Engineering	www.batesengineering.info	(714) 545-0159	Engine and Suspension Components
Borg Warner	www.turbo driven.com	(828) 684-4000	Turbochargers
Bullseye Power	www.bullseyepower.com	(877) 784-0379	AirWerks Turbos
Carrillo	www.carrilloind.com	(949) 498-1800	Connecting Rods
Chapman Racing Heads	www.chapmanracingheads.com	(801) 292-3909	Cylinder Parts
Coan Converters	www.coanracing.com	(765) 456-3957	Torque Converters
Cometic	www.cometic.com	(800) 752-9850	Stock Crank Bolt
Comp Cams	www.compcams.com	(800) 999-0853	Cams
Compushift	www.compshift.com	(310) 465-0220	Transmission Controller
Corsa	www.corsaperf.com	(900) 486-0999	Exhaust
Crower	www.crower.com	(619) 661-6477	Connecting Rods
CV Products	www.cvproducts.com	(800) 448-1223	Valve Springs
DFI	www.accel-dfi.com	(248) 380-2780	Engine Management
Diamond Racing Pistons	www.diamondracing.net	(877) 552-2112	Pistons
Eagle	www.eaglerod.com	(662) 796-7373	Connecting Rods
Enginuity		(310) 901 0132	Xtrac Shift Controller
FAST	www.fuelairspark.com	(877) 334-8355	Engine Controllers
Ferrea	www.ferrea.com	(888) 733-2505	Valves and Valve train
Full Race	www.full-race.com	(866) full-race	Turbos and Turbo Manifolds
General Motors Performance Parts	www.gmperformanceparts.com	GM Performance Parts	GM Performance Parts
General Motors Racing	www.gmtunersource.com	—	GM Racing Parts and technical assistance
General Motors Goodwrench	www.gmgoodwrench.com	Local Dealer	Production Parts
Ground Control	www.ground-control.com	(530) 677-8600	Camber Caster Plates
Hahn Racecraft	www.hahnracecraft.com	(630) 553-6830	Turbochargers
HKS	www.hksusa.com	(310) 491-3300	Waste Gates

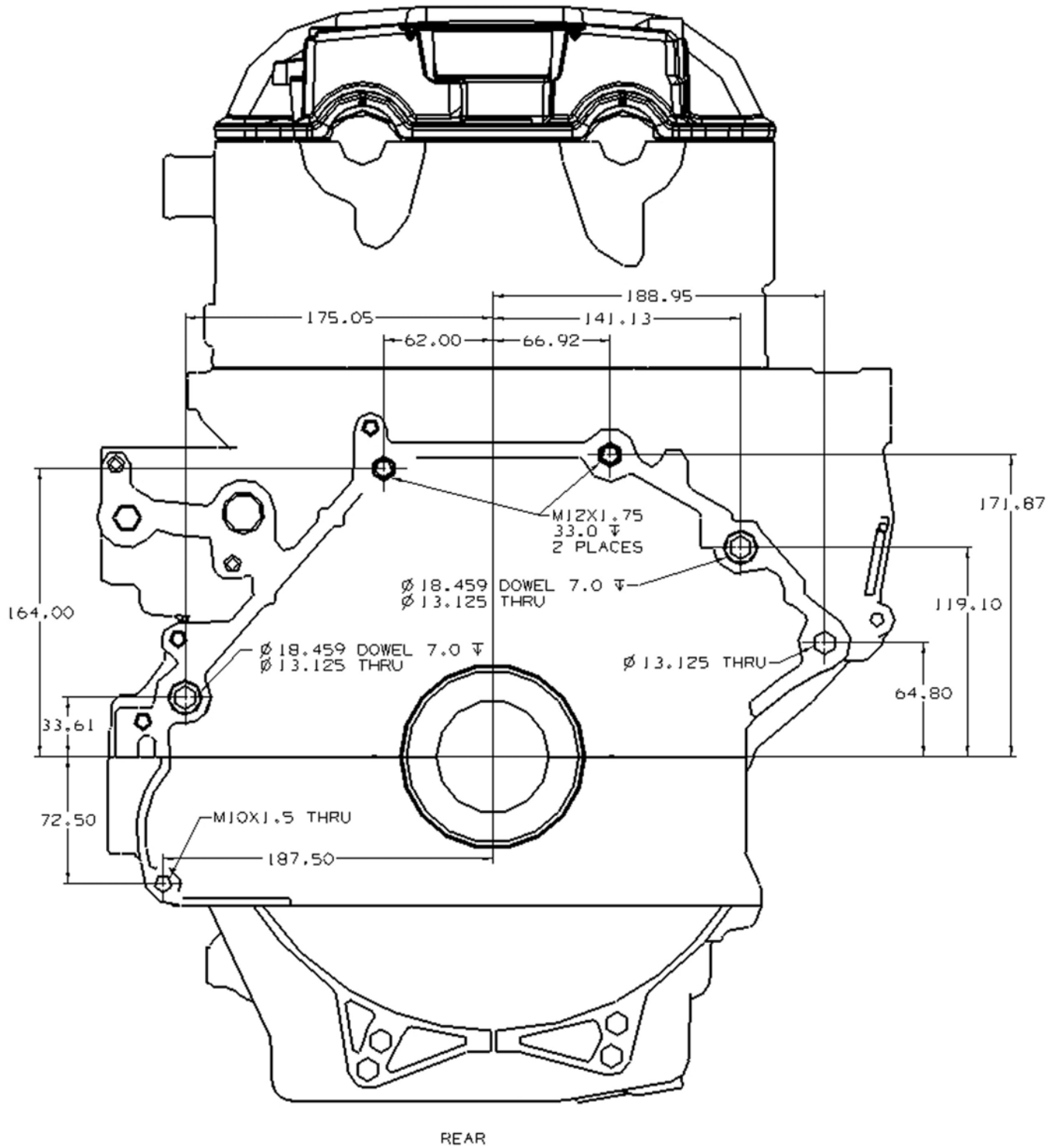
<b>SUPPLIERS LIST</b>			
<b>SUPPLIER</b>	<b>WEB ADDRESS</b>	<b>PHONE NUMBER</b>	<b>Component</b>
HP Tuners	www.hptuners.com	—	Production ECM reflash
Innovative	www.innovativeturbo.com	(805) 526-5400	Turbos, Waste Gates and Intercoolers
Intense	www.intense-racing.com	(614) 873-6499	4T65-E Transmission Upgrades, 2.0L LSJ Upgrades
JE	www.jepistons.com	(714) 898-9763	Pistons and Rings
Jesel	www.jesel.com	(732) 901-1800	Valvetrain Components
Justice Racing Engines	www.justiceracingengines.com	(301) 624-1000	Engine Building
Kroyer Racing Engines		(702) 651-2071	Engine Building
KYB	www.kyb.com	(630) 620-5555	Struts
Manley	www.manleyperformance.com	(732) 905-3366	Connecting Rods
Mickey Thompson East Coast	www.mickeythompson tires.com	(330) 928-9092	Tires
Mickey Thompson West Coast	www.mickeythompson tires.com	(951) 817-0101	Tires
Moroso	www.moroso.com	(203) 458-0542	Engine Components
Motegi Racing Wheels	www.motegiracing.com	(866) 466-8344	Wheels
MSD	www.msddignition.com	(915) 857-5200	Ignition, Shift Controller and Boost Controller
NGK	www.ngksparkplugs.com	(877) 473-6767	Spark Plugs
Nitrous Express	www.nitrousexpress.com	(940) 767-7694	Nitrous
Precision Products Performance Center	www.pppcenter.com	(800) 421-9150	Wrist Pins
Precision Turbos	www.precisionturbo.net	(219) 996-7832	Turbos
RC Engineering	www.rceng.com	(310) 320-2277	Fuel Injectors and Replacement Parts
Recaro	www.recaro.com	(248) 364-3818	Racing Seats
Raybestos	www.raybestosproducts.com	(765) 362-3500	Transmission Clutches
RK Sport	www.rksport.com	(800) 214-8030	Body Kits and Suspension Components
Roush Industries	www.roushperformance.com	(734) 779-7331	Engines and Electronics
SCE Gaskets	www.scegaskets.com	(888) 427-5381	Head Gaskets
Schroth	www.schroth.com	(888) 536-8550	Safety Equipment
Shaver Specialties	www.shaverengines.com	(310) 370-6941	Engine Building
Sonny Bryant	www.bryantracing.com	(714) 535-2695	Crankshaft
Stef's Performance	www.stefs.com	(732) 367-8700	Oil Pans and T-Washers
Taylor Motorsports	www.taylormotorsports.com	(714) 630-7875	Trans Blanket
TCI	www.tciauto.com	(662) 224-8972	Transmission Cooler
Total Seal	www.totalseal.com	(632) 587-7400	Piston Rings
Trick Titanium	www.tricktitanium.com	(248) 588-9433	Spring Retainers
Turbo's By Garrett	www.turbobygarrett.com	—	Turbos

<b>SUPPLIERS LIST</b>			
<b>SUPPLIER</b>	<b>WEB ADDRESS</b>	<b>PHONE NUMBER</b>	<b>Component</b>
Turbonetics	<a href="http://www.turboneticsinc.com">www.turboneticsinc.com</a>	(805) 584-1913	Turbos, Waste Gates and Intercoolers
UMI Racing	<a href="http://www.umiracing.com">www.umiracing.com</a>	(800) 275-1615	Engine Management
Walker Evans Racing	<a href="http://www.weracing.com">www.weracing.com</a>	(888) 933-7223	Shocks
Weldon	<a href="http://www.weldonracing.com">www.weldonracing.com</a>	(440) 232-2282	Fuel Systems
Wiseco	<a href="http://www.wiseco.com">www.wiseco.com</a>	(440) 951-6660	Pistons
Xtrac	<a href="http://www.xtrac.com">www.xtrac.com</a>	(317) 472-2454	Race Transmissions

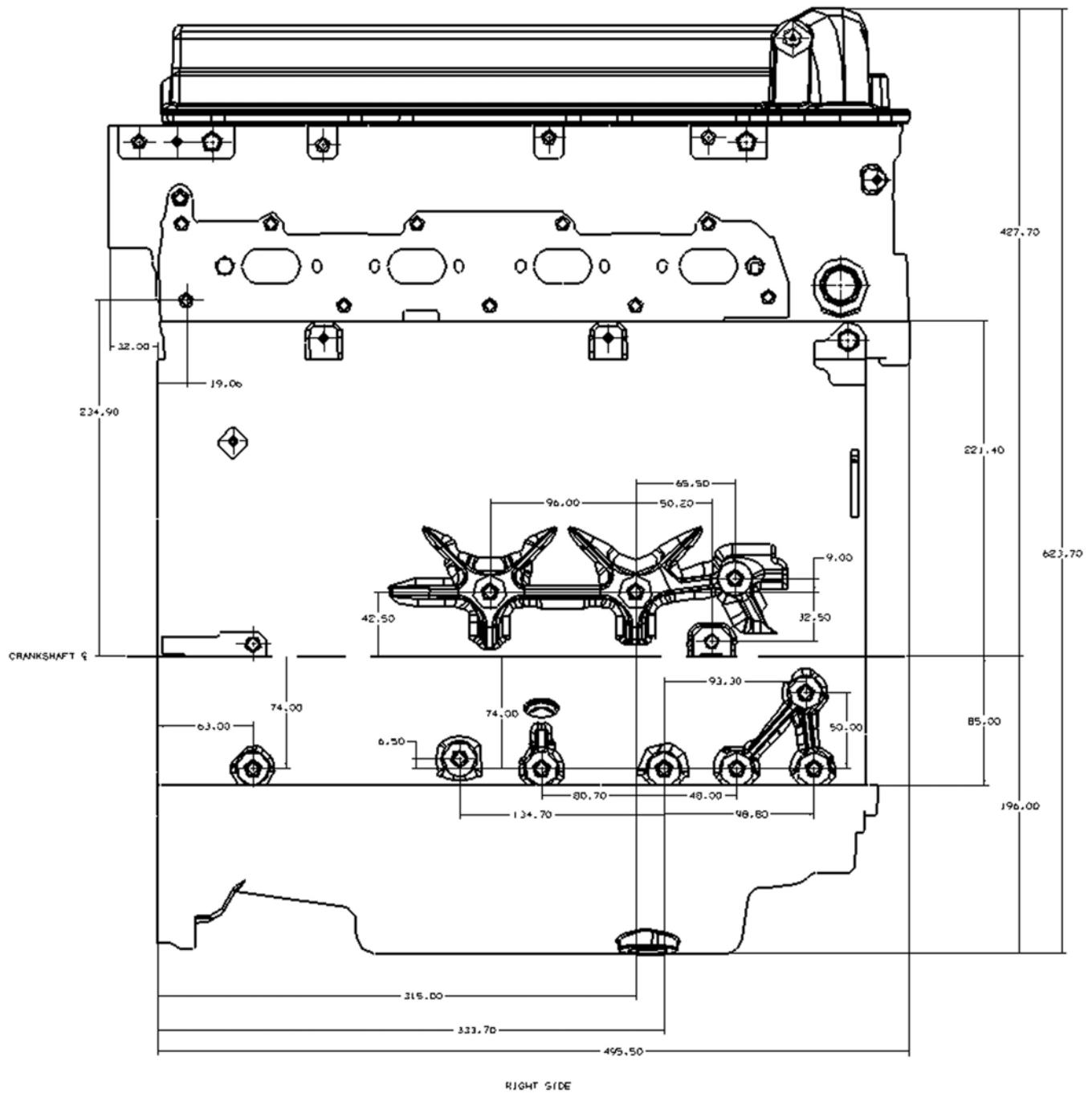
**LSJ ECOTEC PACKAGING DRAWINGS**



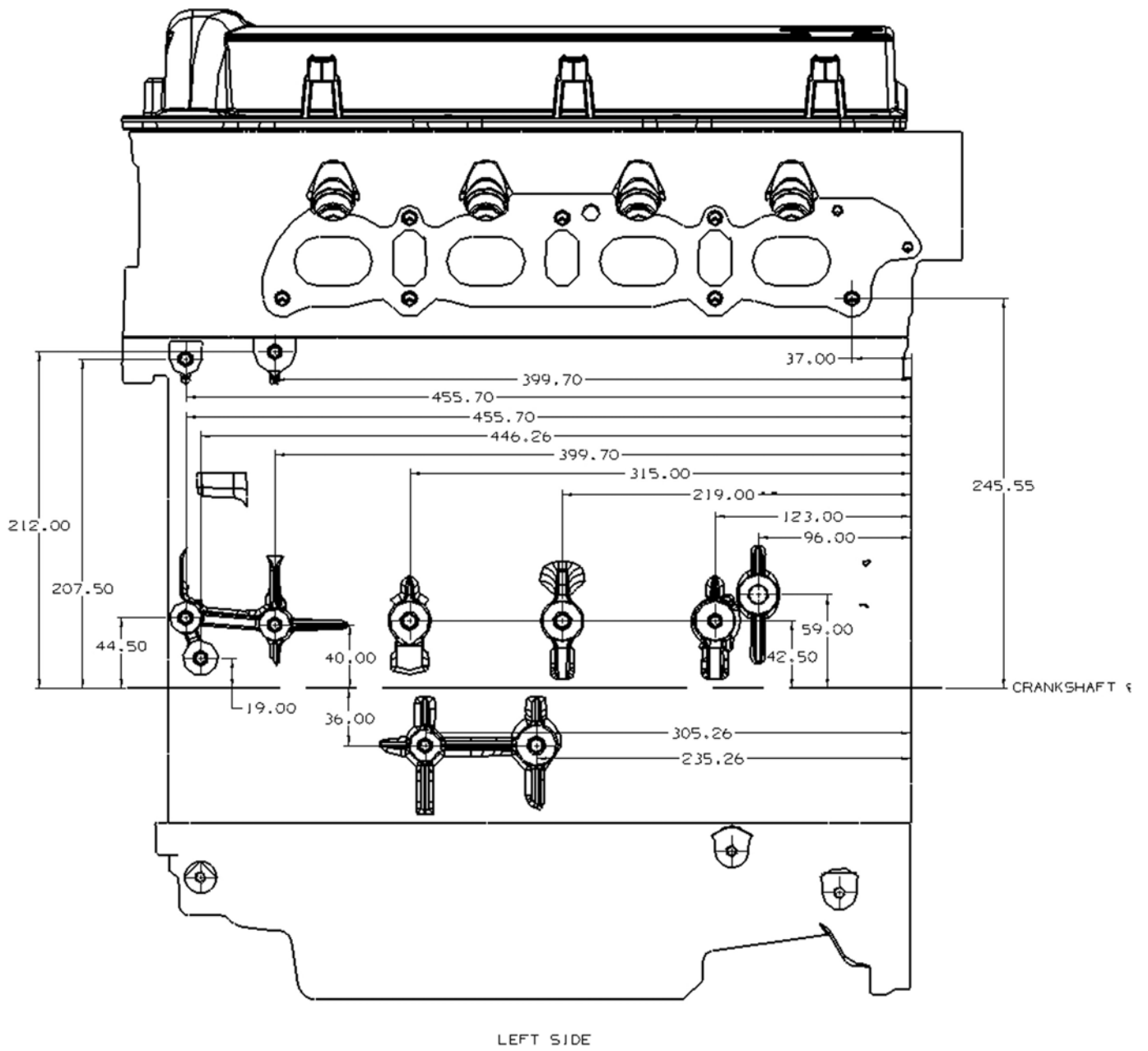
Note: Measurements in millimeters



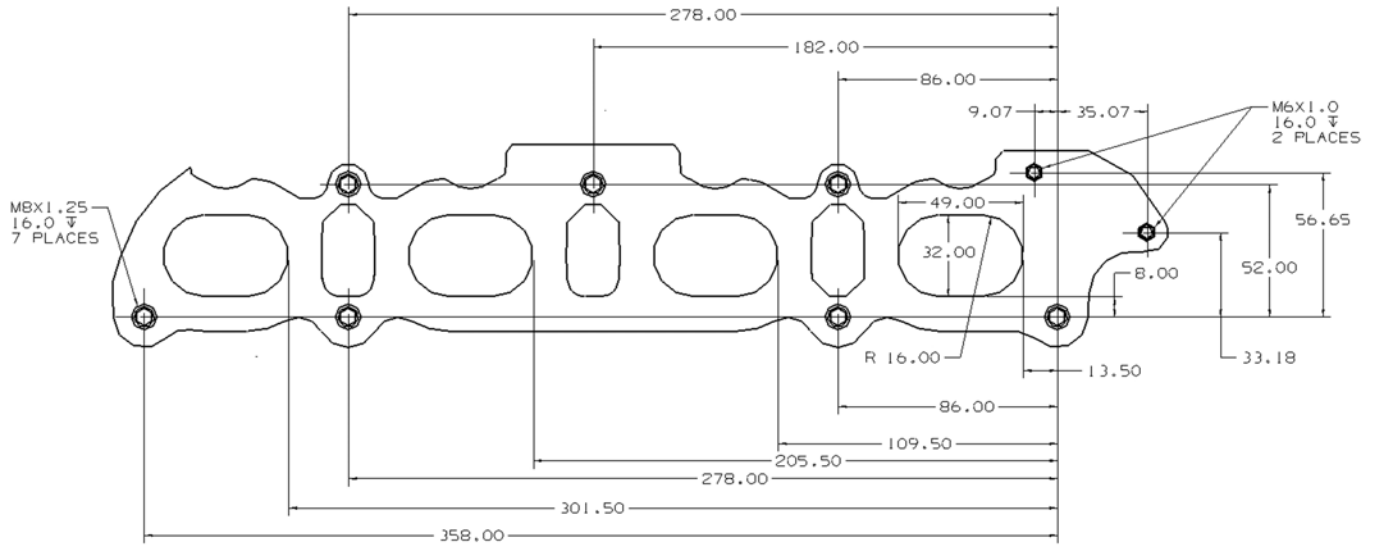
Note: Measurements in millimeters



Note: Measurements in millimeters

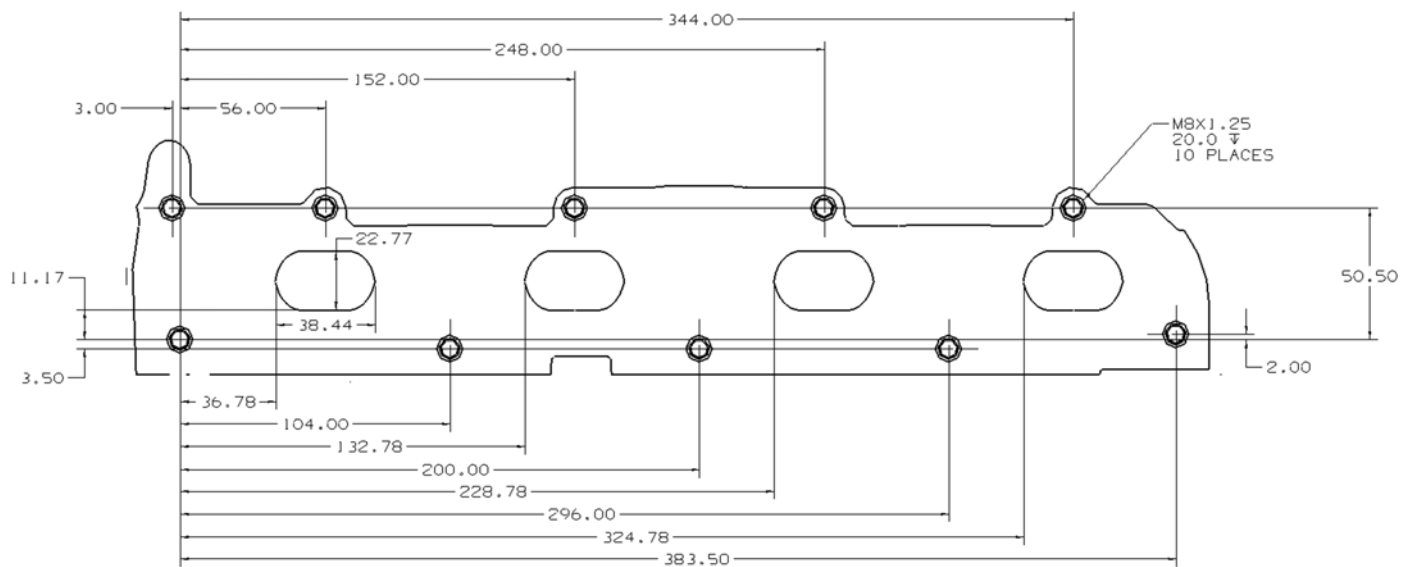


Note: Measurements in millimeters



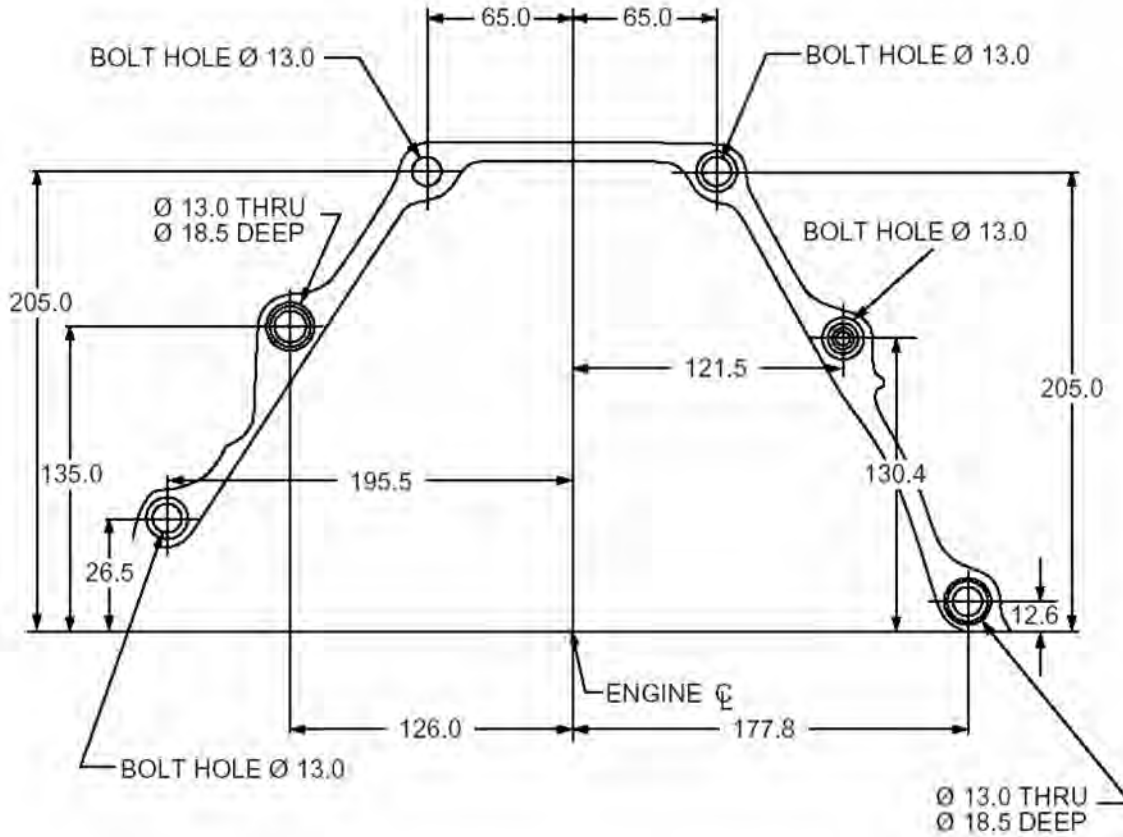
INTAKE MOUNTING FACE AT 12.5°

Note: Measurements in millimeters

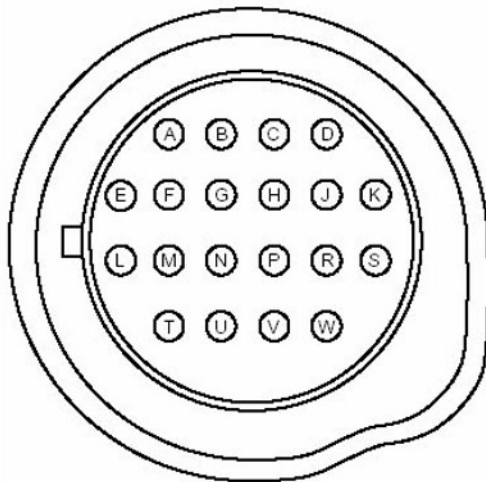


EXHAUST FACE

Note: Measurements in millimeters



**4T65 Hyrda-matic bolt pattern**  
**All dimensions in millimeters**



TRANSMISSION CONNECTOR

CAV	FUNCTION	WIRE*
A	PCM TO TRANS SHIFT SOL "A"	1222
B	PCM TO TRANS SHIFT SOL "B"	1223
C	PCM TO FM HIGH (VBS)	1228
D	PCM TO FM LOW (VBS)	1229
E	12 VOLT +, IGN "CRANK ON"	839
F		
G		
H		
J		
K		
L	TRAN TEMP SENSOR SIGNAL	1227
M	SENSOR RETURN	452
N	PSM MODE A	1224
P	PSM MODE C	1226
R	PSM MODE B	1225
S	TRANS INPUT SPD SENSOR HIGH	1230
T	TCC PWM TO PCM	418
U	TCC RELEASE SIGNAL	1804
V	TRANS INPUT SPD SENSOR LOW	1231
W		

# NOTES

# Mobil 1

## The Oil of Choice for Top GM Sport Compact Drag, Drift Teams, & Tuners

Every day, the GM drag and Drifting teams push the envelope of compact racing, so they require a motor oil that can withstand the extreme engine conditions their sport generates. And that's why they run only Mobil 1 5W-30 synthetic engine oil.



GM Racing team members have won their divisions in the NDRA Drag Race circuit running Mobil 1 synthetic in their GM Ecotec motors.

In the Pro Outlaw Front Wheel Drive, Charlie Schafer, crew chief and team owner of CSI Racing, watched one of his star drivers, Jason Hunt, finish top of the class for the third year in a row.

"CSI Racing relies exclusively on Mobil 1 for the protection and lubrication we require for record setting performances. We would not have been able to earn 3-peat championships without Mobil 1," Schafer said.

Hunt's CSI Racing team-mate, Brian Ballard, provided team owner Schafer with another victory, by topping The Turbo Street class.

And, Don Nase Jr., in his Pro Extreme Dragster, scored top honors and his times will only be getting faster with Mobil 1 synthetic oil in his GM Ecotec motor.

Each of those remarkable performances happened with Mobil 1 synthetic oil in the Ecotec engines.

Hunt, Ballard and Nase Jr. are among the many professional drivers who know to put their faith in Mobil 1.

Jason Whitfield of Whitfield Racing is also part of the GM Sport Compact Drag Race Team, as well as owner and operator of Whitfield Racing, a shop that builds top tuner cars in southern California. He also uses Mobil 1 exclusively, and for good reason. "Reaching over 900 HP in our cars is no longer a dream for us at Whitfield Racing," he says. "Mobil 1 has made it a reality."

GM Sport Compact Drag cars are not the only cars relying on Mobil 1.

The Pontiac Drift Solstice GXP running in the Formula D Drift Circuit is also using it, as well as Rhys Millen of Millen Motorsports. Millen, in fact, won a Formula D drifting title in his Pontiac GTO with Mobil 1 in the engine. And although he has recently switched to running the new Pontiac Solstice GXP, he continues to rely on Mobil 1 to help him get to the front of the finish line.

### Maximizing performance parameters

The reasons why these teams choose to work with Mobil 1 products is better understood by reviewing testing and race conditions. Mobil 1 products have long held a reputation for performing in extreme conditions, a reputation built through participation in many of the world's most arduous racing series, including Formula 1, NASCAR, ALMS, SCCA Speed World Challenge, Grand AM Rolex GT, and now Formula D Drifting and Sport Compact Drag Racing.



What distinguishes Mobil 1 from other products is its unique combination of base stocks and additives. Mobil 1 contains high-performance synthetic fluids, with superior low and high temperature performance properties (as a result of their higher viscosity index). A proprietary formulation of high performance additives is then added. This component blended system contains additives designed to maximize all around engine performance.

As these high-performance engine upgrades have proven, Mobil 1 has the ability to withstand extremely high temperatures, including demanding Supercharged and Turbocharged engines. Mobil 1 provides the same level of engine protection and performance from a street version Ecotec Engine to a modified 1000 HP high performance Ecotec race engine.



The bottom line is this: if Mobil 1 is good enough for championship racing teams, it's good enough for any engine – including yours.

# NOTES