

DARTON™ SLEEVES



LS-1™
Installation Manual

MID™
MODULAR
INTEGRATED
DECK



Thank you for purchasing the Darton state of the art new **MID Sleeve Kit, US Patent No. 6,799,541**. The kit makes possible maximum bore sizes, increased cylinder strength and superior wear resistance.

Darton wants to provide you with the best technical information we have available to ensure that your sleeved engine will perform to your expectations. Because the **MID** ductile iron sleeve kit “reinvents” the block structure with substantially increased bore wall thickness, certain operational characteristics become more like diesel engine technology than gasoline engine. Therefore, we have formulated a program of required procedures and components, which we believe will ensure operating success of your sleeved engine in whatever application it will see service in.

Note: Certain LS-1 head castings ('97 – mid '99 with a factory casting cut out on face near cylinder 3 or 6) need to be modified/welded to be suitable for use with the **DARTON MID kit**. Most late model heads work as is.

INSTALLATION PROCEDURES

NOTES:

Revised: 11/01/04

LS1 - LS6 Sleeve Kits

Read and make sure you understand these instructions before proceeding with block machining. If you have questions concerning machining, assembly, proper tooling, machines, etc. call sales at Darton.

PREPARATION, FIXTURING

1. The block needs to be fully stripped, cleaned and inspected before machining. Main web cracks, or structural damage may prevent satisfactory sleeve installation. Blocks with cracked factory liners are good candidates for sleeving as long as the crack doesn't extend to the bottom most 1.5" of cylinder wall.

SETUP AND BLOCK MACHINING

Note: Prior to beginning machine work, review block machine prints to familiarize yourself with all critical dimensions, which must be adhered to.

1. With your block mounting fixture securely bolted to the CNC machine table, indicate the centerline of your block-mounting bar in the "Y" axis direction. That will be your "Y" fixture or part offset depending on terminology used with your machine. You will only have to do this one time since this position will remain the same. The object is to correct for factory machining errors, block warpage. You want the **MID** sleeves installed directly over the crankshaft axis and not offset as would probably happen if you merely went off the existing cylinder centerline. Bores must be 90° perpendicular and on crank cylinder centerline.

Now set the block up on the mounting fixture. The preferred method is with precision made mounting rings located in the front and rear main bearing bores and with the bell housing face securely bolted to a fixture plate. Rotate your fixture so the left (driver's side bank) is facing up. Indicate the rear deck surface of the block (by the bell housing) - **photos 1 and 2**. Rotate the block around the crank axis until you get close to zero run out across the deck from side to side. Lock your fixture when you are satisfied the block is true. Zero the degree wheel if so equipped. Note that most blocks will be warped front to back. This is why we recommend dialing in the deck surface at the rear of the block. Now indicate the "X" centerline of cylinder number one, (left

bank first cylinder) - **photos 3 and 4**. The centerline position is your "X" fixture offset position. Enter the "X" and "Y" offsets in your machine's fixture or part offset table.

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2. Clean the rust preventative from the MID sleeves using laquer thinner. Measure the bottom diameter, the upper flange diameter, and the seating depth of each sleeve. Generally, the diameters will be very close - within .001" in any one set. Measure the diameters at 90 degrees and average the result - **photos 5, 6 and 7**. The average diameter at the lower seal surface of the new **MID** sleeves is 4.284". This will vary about a thousandth plus or minus. If the largest sleeve averages out at 4.285" and the smallest at 4.284" use 4.2845" as your boring size for that part of the installation. The sleeves should be installed plus or minus .0003" of the measured size. **Do not attempt to install MID sleeves if you cannot hold this tolerance.** Call **Darton** for info on proper tooling and or machines to ensure a satisfactory job. Note that the seating depth of the sleeves may vary a bit. This is not critical since the block will be decked after the sleeves are installed. Average sleeve seating height is right around 4.334" - **photo 8**. We machine the block shy of this figure so the sleeves protrude .005 to .008 after installation.
3. Touch off your tools on the deck surface at the front of the left bank either before you begin machining or as you are about to use them, whichever you prefer - **photos 9 and 10**. Set your tool length offsets into your machine's tool table. Machining depths are from the deck surface down.
4. Note that the bore center to center is 4.400", same as a small block Chevy. You need to keep this centerline dimension to +/- .0005". Note that in order to maintain the required tolerances it is highly advisable you use a machine with **flood coolant**. It will be impossible to hold tolerance otherwise and a poor job will be the result due to the heating of the block causing distortion.
5. First operation is to bore the four cylinders on the left bank to 4.170" diameter to the main bearing webs. Use a double cutter boring head with .030" radius inserts for this operation, which will allow sizing in one pass - **photos 11 and 12**. Depth of cut is 6.250" from the deck surface.
6. Next operation removes the remaining cylinder walls to a diameter of 4.830" and to a depth of 3.125" on cylinder number one and 4.315" on cylinders two, three, and four. Again, a double cutter head should be used for this operation along with plenty of coolant. **CAUTION:** When you machine the right bank, all cylinders are machined to the 4.315" depth, except the number one cylinder which will break through into

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the timing chain area if you go down the full depth. You will later machine number one cylinder with a flat to prevent this break through from occurring – **photos 13 and 14**.

If the block you are machining is a used block, go on to instruction (7). Otherwise follow the instructions below if the block is a brand new, never run casting.

If this is a brand new block you are working on it **MUST** be stress relieved after the roughing operations. It will warp in service distorting the sleeves if this is not done. Rotate the block 90° to get the right bank vertical. Perform the above steps (5 and 6) on the right bank. Remember that the cylinder walls of all cylinders on the right bank are removed to a depth of 4.315". You must change the "X" axis fixture or part offset (depending on your machine) for the right bank. The offset is +.950". In other words the bore centerline of cylinder 2 is +.950" offset towards the rear of the block from cylinder one. Do not alter the "Y" offset position. This will always stay the same unless you remove the fixture from the machine.

Remove the block from the machine, clean and have the block vibratory stress relieved - **photo 15**. If you have questions, call **Darton Sales Dept.** for info on machines or facilities to perform this operation.

After stress relief, remount the block on the machine with the left bank facing up. Indicate the left bank as in instruction (1) above - **photo 16**. Indicate the "X" axis centerline of cylinder one - **photo 17**. Enter that position in your machine's fixture or part offset table as you did in instruction one. Continue on to step (7).

7. Next, install your precision boring head - **photo 18**. Machine the lower bore area of each cylinder on the left bank to a depth of 5.710" in several steps to the sleeve lower diameter dimension you previously measured and averaged in step (2) above - **photo 19**. Always double check your work so the finished bore is within plus or minus .0003" of your target diameter. The finish needs to be RA 32 or better (bottom o'ring and press area).
8. Next, machine the upper flange diameter to your measured diameter in step (2) +.001". The nominal diameter on the sleeve flange is 5.140". Your flange bore should be 5.141" machined to a depth of .500". You can bore or use circular interpolation for this cut dependent on your tooling and expertise. If you use circular interpolation with a carbide end mill, use two passes leaving ~ .010" for the finish pass - **photo 20**. This will ensure in a better surface finish and rounder hole.
9. Next, install a long insert style end mill that has .030" max radius inserts. You will use interpolation milling for the sleeve seating surfaces. Number one cylinder has a flat machined at an offset angle to

prevent break through into the timing chain area as stated above. You must have a program to machine this flat and seat to a depth of 4.328" according to the drawings. Machine cylinder one to the 4.328" depth in several passes usually .250" to .300" per pass depending on the rigidity of your set up. All other cylinders use a circular interpolation cut 4.800" diameter to a depth of 4.328". This depth will ensure the sleeves protrude .005" to .008" after installation. Again, use plenty of coolant to prevent buildup on the tool - **photo 21** and block distortion due to machining induced heat.

10. Finish the left bank by cutting a chamfer at each seating surface ID to facilitate the o'ring passing during installation. Adjust the tool so it clears the flat on number one cylinder. We prefer a 45° chamfer cut to a depth of .025". If you use a tool like that shown in the photo adjust the spindle speed to ~ 60 rpm to prevent chatter - **photos 22 and 23**.
11. Repeat operations (7 through 10) on the opposite bank after indexing the block 90°. Note again that the offset for cylinder two (front cylinder on the right bank) is +.950" towards the rear of the block from cylinder one on the left bank. Make certain to adjust your part offset position in the machine fixture or part offset table else you will ruin your block.
12. Remove the block from the machine, clean it, deburr it, lightly sand the chamfer you cut for the o'rings. Make certain the head threads are clean. A thread forming tool should be run through the head bolt holes on used blocks. The surface finish should be as shown in **photos 24, 25, and 26**.

SLEEVE INSTALLATION

1. A maximum temperature differential of 50° f between sleeves and block is recommended. It is not necessary or recommended to heat the block for sleeve installation. Leaving the block sit in the sun for a few minutes is sufficient. If the machining was done properly the sleeves will easily install with a shot filled plastic mallet and drive home with an aluminum plate and hammer.
2. Install the rubber o'rings into the lower sleeve grooves using minimal stretch. Do not roll the o'rings into the grooves. Lubricate the o'rings and lower area of the sleeves with the supplied lubricant - **photo 27**.
3. Apply a small amount of supplied Loctite flange sealant on perimeter of each sleeve upper flange as well as the siamesed flat. Only the top .500" of the flat area needs sealant - **photo 28**.
4. Start cylinder number one sleeve using a plastic mallet. Note that because of the flat on this sleeve it should self-orient closely as far as

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clocking is concerned. Drive it in just far enough to engage the upper flange. Start the adjacent sleeve and drive that in to the same depth as the first sleeve. Note that the side of the sleeve with the most holes in the flange goes towards the outside (exhaust side) of the block. Check to make sure the alignment half holes along the flats line up to form round holes. Adjust the clocking as necessary using a pointed tool carefully hammered in the alignment holes. Install the remaining two sleeves to the same depth again checking the clocking. Now drive them in the rest of the way using an aluminum plate and hammer. Lightly tap the pointed alignment tool in all the alignment holes to ensure the holes are round. The sleeves should protrude slightly from the deck surface. Install the sleeves on the right bank using the same procedure. This bank is more difficult because there is no flat on the front sleeve to help with alignment. Eye the first sleeves as close as you can then make the necessary adjustments when the adjacent sleeve is installed – **photos 28 - 33**. Or mark the block and sleeve with permanent marker pens for orientation. Sleeves depicted in **photo 30** are not aligned correctly and will cause an installation problem.

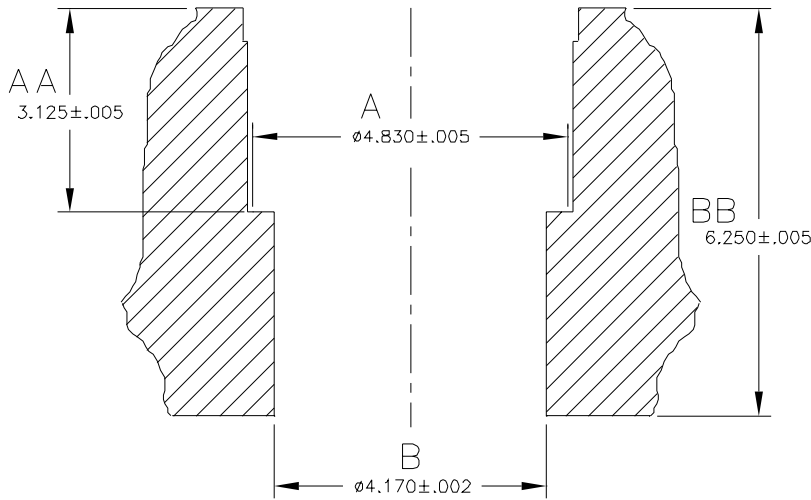
5. Clean off excess sealant from sleeve flange area. Install a pair of torque plates with a copper gasket or a Fel Pro 1041 head gasket. Torque to 50 to 60 ft./lbs. using ARP head bolts. This step ensures the sleeves are fully seated. Let stand at least two hours, preferably over night. **Remove plates, and deck block head surfaces flat and as smooth as possible. Do not deck any more than is required or you will have problems with the pistons protruding too far out of the block. The only recommended head gasket is the MID specific Cometic gasket.** Use the Fel Pro gasket only to seat the sleeves – **photos 34, 35, and 36**.

Note: Main cap studs and align honing are highly recommended.

BLOCK SPEC LS-1 CYL #1-S1

1st STEP: ROUGHING OUT CYLINDER #1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVAL
A	SEE SHEETS 2 & 3 FOR REVISIONS	11/01/04	
B	SEE SHEETS 2 FOR REVISION	11/12/04	



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DR. BY:	CAD DEPT		Darton International, Inc.	
DATE:	10/27/04			
CHK'D BY:		TITLE	BLOCK SPECIFICATION- LS-1 M.I.D. CYL #1	
MATERIAL:		SIZE	A	REV
HARDNESS:		DWG NO.	CYLINDER #1	B
		SCALE	1/2	SHEET 1 OF 3

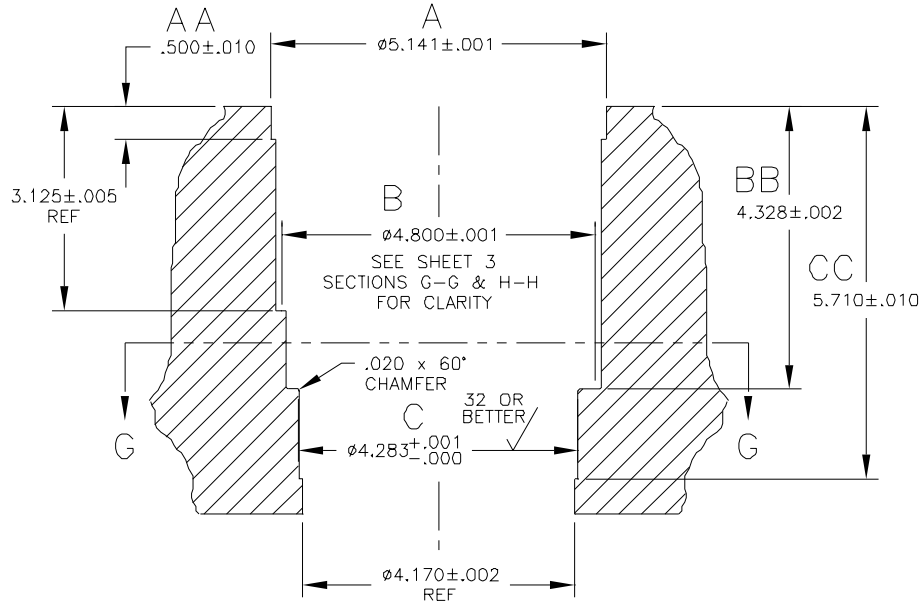
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NOTES:


BLOCK SPEC LS-1 CYL #1-S2

2nd STEP: FINISHING CYLINDER #1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVAL
A	A $\phi 5.141$ WAS A $\phi 5.139$; AA $.500$ WAS A $.425$ BB 4.328 WAS B 4.332 ; C $\phi 4.283 \pm .001 / - .000$ WAS $\pm .001$ CC 5.710 WAS D 5.700 ; SECTIONS GG & HH WAS A-A & B-B; ADDED 32 OR BETTER FINISH TO C DIA	11/01/04	
B	B $\phi 4.800 \pm .001$ WAS $\phi 4.800 \pm .005$	11/12/04	



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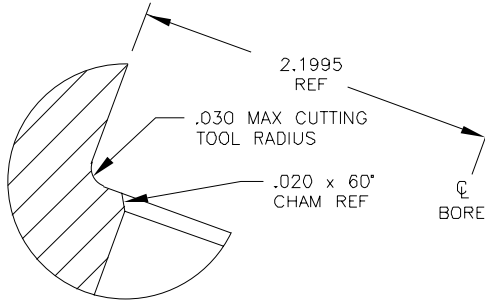
DR. BY:	CAD DEPT	 Darton International, Inc.		
DATE:	10/27/04			
CHKD BY:		TITLE		
MATERIAL:		BLOCK SPECIFICATION- LS-1 M.I.D. CYL #1		
HARDNESS:		SIZ	DWG NO.	REV
		A	CYLINDER #1	B
		SCALE 1/2		SHEET 2 OF 3

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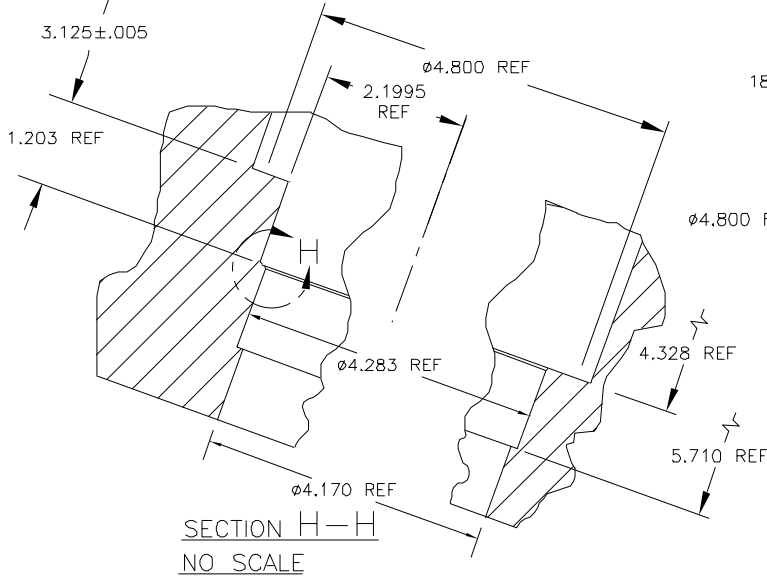
NOTES:

BLOCK SPEC LS-1 CYL #1-S3

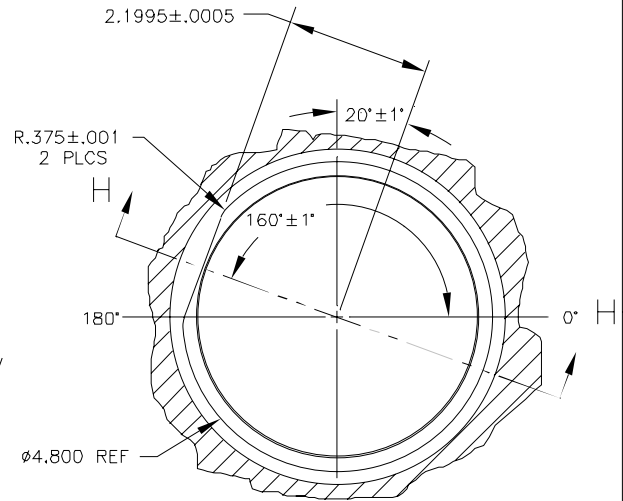
REVISIONS			
REV	DESCRIPTION	DATE	APPROVAL
A	SHEET 3 OF 3 WAS SHEET 2 OF 2; ADDED .030 MAX TOOL RADIUS; 2.1995±.0005 WAS 2.200±.001	11/01/04	
B	SEE SHEET 2 FOR REVISION	11/12/04	



DETAIL H
NO SCALE



SECTION H-H
NO SCALE



SECTION G-G

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Darton International, Inc.

TITLE			BLOCK SPECIFICATION LS-1 M.I.D. CYL #1		
REV	DWG. NO.		REV		
A	CYLINDER #1		B		
SCALE 1/2			SHEET 3 OF 3		

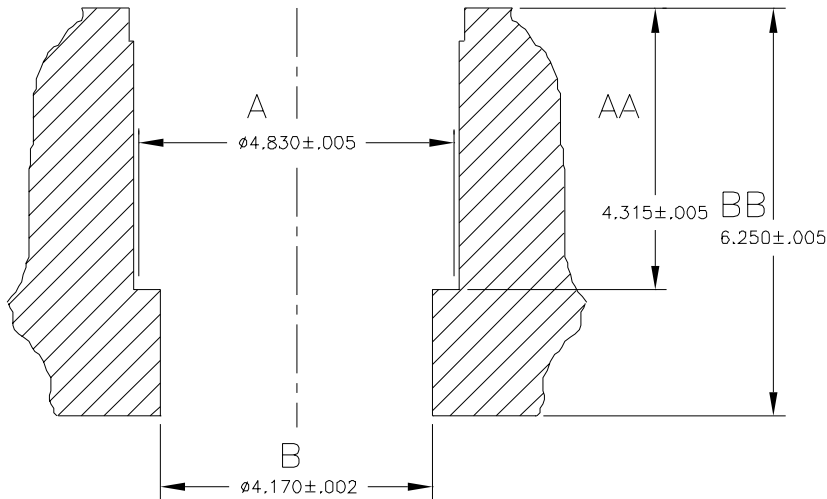
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NOTES:

BLOCK SPEC LS-1 CYL #2-8-S1

1st STEP: ROUGHING OUT CYLINDERS 2-8

REVISIONS			
REV	DESCRIPTION	DATE	APPROVAL
A	SEE SHEET2 FOR REVISIONS	11/01/04	



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DR. BY:	CAD DEPT		Darton International, Inc.	
DATE:	10/27/04			
CHK'D BY:		TITLE	BLOCK SPECIFICATION- LS-1 M.I.D. CYL #2 & 8	
MATERIAL:		SIZE	A	REV
HARDNESS:		DRG NO.	CYLINDER #2 & 8	A
		SCALE	1/2	SHEET 1 OF 2

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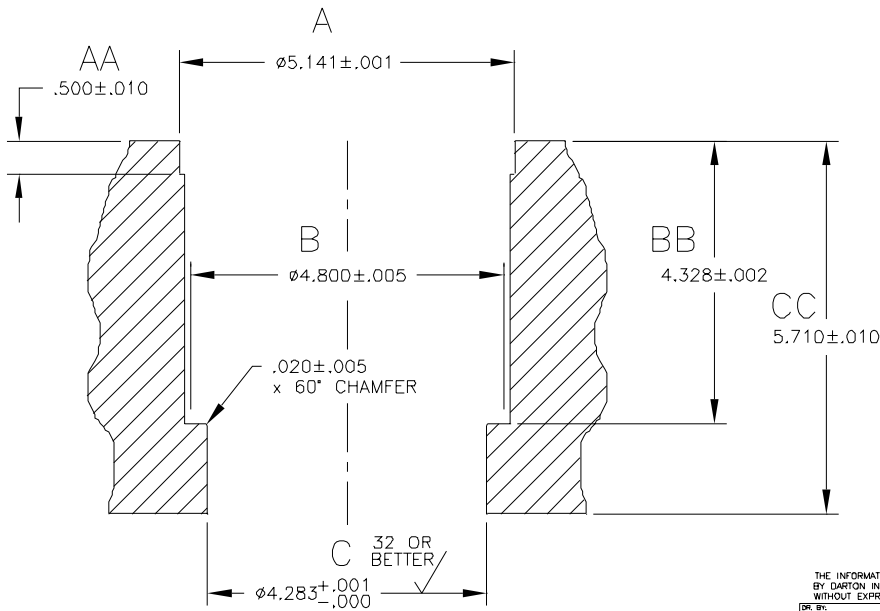
File N

NOTES:

BLOCK SPEC LS-1 CYL #2-8-S2

2nd STEP: FINISHING CYLINDERS 2-8

REVISIONS			
REV	DESCRIPTION	DATE	APPROVAL
A	A $\phi 5.141$ WAS A $\phi 5.139$; AA $.500$ WAS A $.425$ BB 4.328 WAS B 4.332 ; C $\phi 4.283 \pm .001 / - .000$ WAS $\pm .001$ CC 5.710 WAS D 5.700 ; ADDED 32 DR BETTER FINISH TO C	11/01/04	



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DR. BY:	CAD DEPT		Darton International, Inc.	
DATE:	10/21/04			
CHK'D BY:		TITLE:	BLOCK SPECIFICATION- LS-1 M.I.D. CYL #2-8	
MATERIAL:		DWG. NO.:	CYLINDER #2&8	REV.:
HARDNESS:		SCALE:	1/2	SHEET:
				2 OF 2

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POST MACHINING INSTRUCTIONS

Revised: 11/01/04

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LS-1 – LS-6 Engines with Darton MID Sleeves

PREPARATION PROCEDURES

1. Sleeves are delivered with a generous chamfer on the lower edge to help prevent piston damage. If sleeves are over bored and honed, it is mandatory that the bottom edge of the sleeve be chamfered or radiused (30 – 45 deg., Chamfer min. .050”) and completely deburred. Failure to do this will result in severe piston skirt damage and engine failure.
2. We recommend piston skirts be coated with a polymer coating, and piston tops with ceramic. Due to the acute rod angles at the bottom of the stroke with stroker cranks, pistons’ wall thrust is increased substantially, which requires generous chamfers at bore bottom and piston skirt coating to assure no scuffing and galling. Both coatings may allow the pistons to be fitted with less piston to wall clearance, which is desirable in terms of noise reduction and oil consumption on street driven vehicles. “Polydyne” and “Swain” are two well-known firms who can apply these coatings reliably.

ASSEMBLY

1. The block should have the cam and main journals checked and honed true if necessary.
2. The short block should be trial assembled without rings to inspect crankshaft, connecting rod, and connecting rod bolt clearance (.080” min.). Re-chamfer the sleeve bottom wherever it is ground for clearance. (Absolutely no burrs or sharp edges can remain on the bottom of the bore.) Minimum recommended ring gaps using ductile iron top and cast iron second rings are as follows: *(more gap may be used and is beneficial)*
 - Street performance use – top ring end gap min. .004” x bore diameter normally aspirated, second ring .005” x bore diameter.
 - Racing use – .0045” x bore diameter top, .0055” x bore diameter second normally aspirated.

- Street with nitrous oxide – .005" x bore diameter top, .006" x bore diameter second.
 - Drag racing with nitrous oxide – .007" x bore diameter top and second.
 - Supercharged or turbocharged – .006" x bore diameter top and second.
3. We highly recommend the use of 4032 alloy pistons for normally aspirated street use and 2618 alloy for racing, boosted or nitrous street use. 4032 is a low expansion alloy best suited for street use where one would want minimum piston to wall clearance to minimize piston rock, noise and oil consumption. 2618 alloy has superior strength and is the preferred alloy for racing use or street use with nitrous. But this alloy requires significant increases in piston/wall clearance.
 4. Both cylinder and align honing must have deck plates installed with the same type gaskets, fasteners as will be used in operation. Honing finish should be done according to the ring face material. For moly rings, generally no finer than 400 grit else the rings may not seat properly for street use; 280 grit for chrome faced rings. A plateau hone should be stroked through the cylinders as a finishing operation. **It is of utmost importance that the cylinder walls be thoroughly cleaned after honing to remove abrasives and metal particles.** Spray washing, or hot tanking is insufficient. Use paper towels coated with ATF or WD40 to wipe down cylinder walls after the wash operation. Continue wiping with towels and ATF until the towels show no more signs of dirt pick up.

Note: Honing head must be modified to accommodate stones and allow for over-stroke of .200. Piston to wall clearance must be reduced beyond piston manufacture recommendations.

5. *Tip:* When installing pistons into cylinders, coat pistons and rings with ATF instead of motor oil for faster and more reliable ring seating.

COOLING

The **Darton** ductile iron **MID** sleeves were designed specifically for racing and high performance street use. The sleeves are heavy wall construction, designed to remain round for effective ring sealing under conditions of high power output and stress. More power means more heat. This heat must be effectively transferred to the cooling system to prevent damage to the piston and sleeve. Roughly one third of the heat energy of the fuel is lost to the cooling system. The stock Corvette cooling system was designed

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for 400 horsepower and a stock cylinder block with cast-in dry liners. The **Darton** kit effectively converts the block to a wet sleeve configuration as used on diesel engines. One cannot expect the original cooling system to effectively cool and engine producing two or more times the power of the original engine, along with a modified cylinder arrangement. We recommend "Evans NPG+™" coolant be used as well as Evans LS-1 reworked water pump utilizing a relocated thermostat. High output applications may also require a larger radiator and coolant fan. Evans coolant is recommended because of the potential for hot spots and cavitation around wet style sleeves. We realize that most engines built will produce well in excess of the stock rated horsepower making cooling system enhancements a must. However, we have customers reporting success with large bores, stock cooling systems, therefore your cooling system requirements/modifications should be dictated by individual usages.

BREAK-IN, TUNING

Fill the engine with a good grade of mineral oil (not *synthetic*) with viscosity for your bearing clearance and intended use. **Prime the oil system** before engine start with ignition off using the engine or dyno starter. We require break-in and tuning using an engine dyno or chassis dyno as follows:

- ∑ After initial start up, warm up engine at 2000–2500, at no more than 100–150 ft. pounds of torque for 15–30 minutes. Precaution should be exercised to prevent excessively rich or lean conditions, which will gall the cylinders. Monitor oil pressure and temperatures.
- ∑ After initial run, adjust valves if using adjustable valve train and re-torque heads. Check for leaks.
- ∑ Street engines will require multiple run-ins with increasing rpm and load up to maximum output.

Use of a dyno allows one to apply a pre-set load to allow the piston rings, and other components to seat properly. It is also much easier to monitor temperatures and pressures than while driving. Most dynos are equipped with O₂ and EGT probes to aid in tuning. The timing and fuel curve needs to be tailored to your particular engine to ensure the engine stays out of detonation, which will lead to engine failure. A racing engine is generally built with sufficient clearance to require no further break-in after dyno tuning and power runs. **However, we recommend head bolt torques be re-checked cold after dyno testing as the head gaskets will take a set.** Remember to replace oil and filter after the dyno session as bearing coatings and metal particles will be trapped in the oil filter. Inspect the oil for

foreign material and excessive bearing flakes.

A street engine should be driven moderately for the first thousand miles, as follows:

- full throttle high torque power usage should be limited and never be used until the engine has been running for at least 15 minutes.
- from 0–500 miles, do not exceed 4000 rpm.
- from 500–1000, do not exceed 6000 rpm.
- over 1000 miles, no restrictions.

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Also, do not run at the same speed for extended periods during break-in. Make certain the engine is operating at proper coolant temperature and oil pressure. Do not allow the engine to overheat. Make necessary changes if required (radiator, fan, turning) to get the engine to run in the proper temperature range. We also recommend you do not run synthetic oil until at least 5000 miles. Synthetics work so well that the engine will never break in properly if it is used too soon.

NOTES / CAUTIONS / WARNINGS

1. Proper eyewear protection should be worn at all times during block machining.
2. Use of appropriate breathing filtration is highly recommended.
3. Observe all cautions and warnings on manufacturers MSDS's.
4. Failure to follow installation instructions will result in unsatisfactory performance and may involve sleeve distortion, water leaks, oil leaks, compression leaks or combinations thereof.
5. All sleeves are warranted against manufacturing defects for 1 year from date of sale. Damage as the result of engine failure is not covered, nor is any consequence of such damage weather or not caused by sleeves.
6. Caution must be exercised as old sleeves are bored out to prevent tearing of aluminum in block and possible tool breakage; original sleeves are ribbed and cast in place.
7. All machining must produce a good surface finish and the tolerances must be maintained to assure a quality fit and sleeve seal.
8. Field service and singular sleeve replacement is possible and practical using a slide hammer sleeve puller with the drive mandrel "Flatted" and oriented to provide main web clearance. Sleeves can then be ordered from **Darton**, by cylinder number.

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PHOTO 1



PHOTO 2

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PHOTO 3

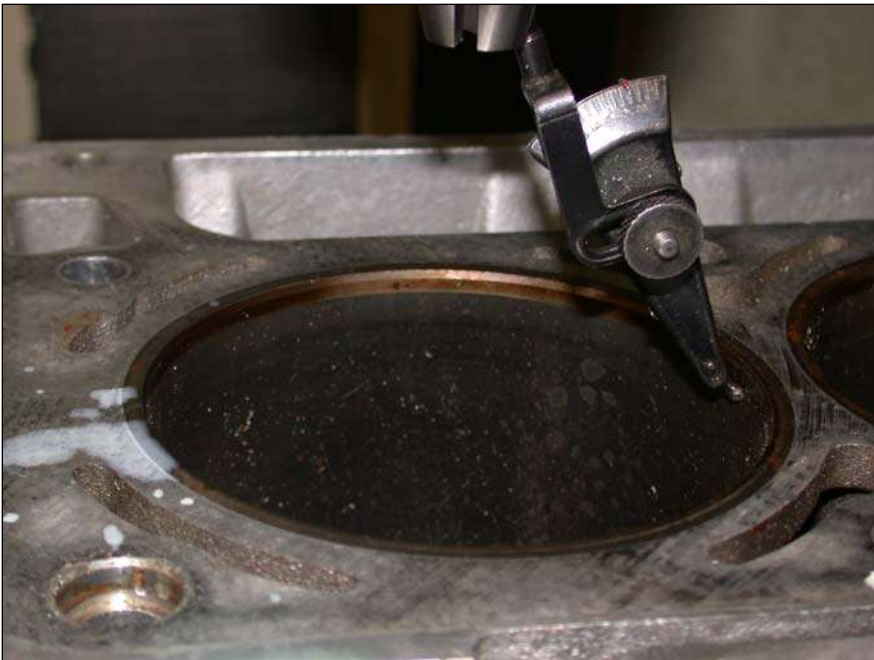


PHOTO 4

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PHOTO 5



PHOTO 6

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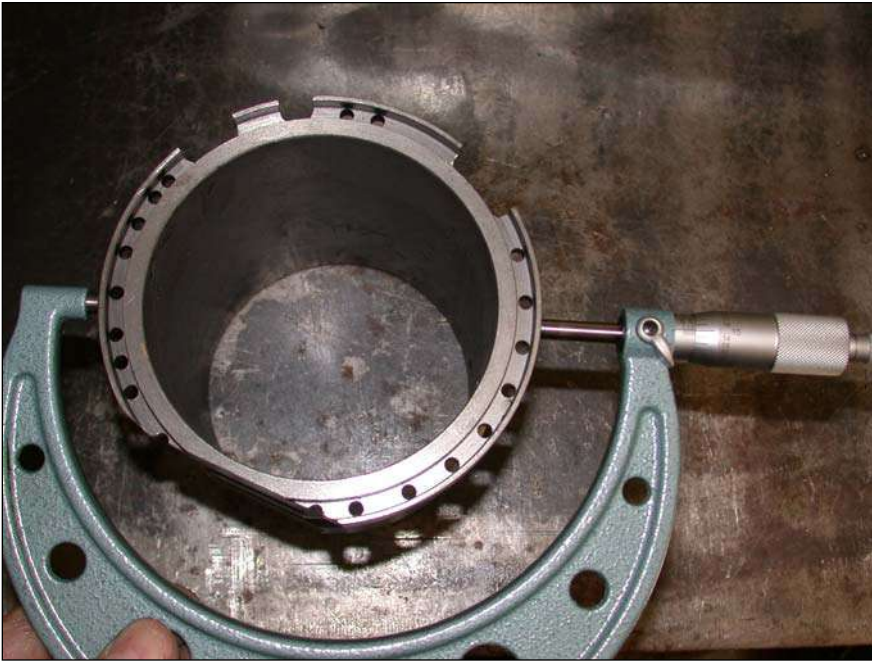


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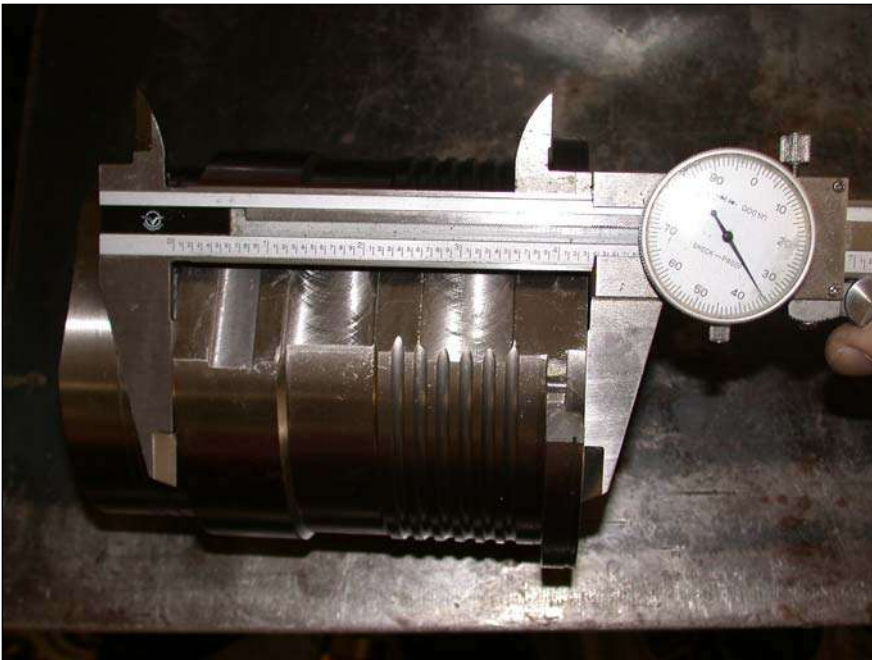


PHOTO 8

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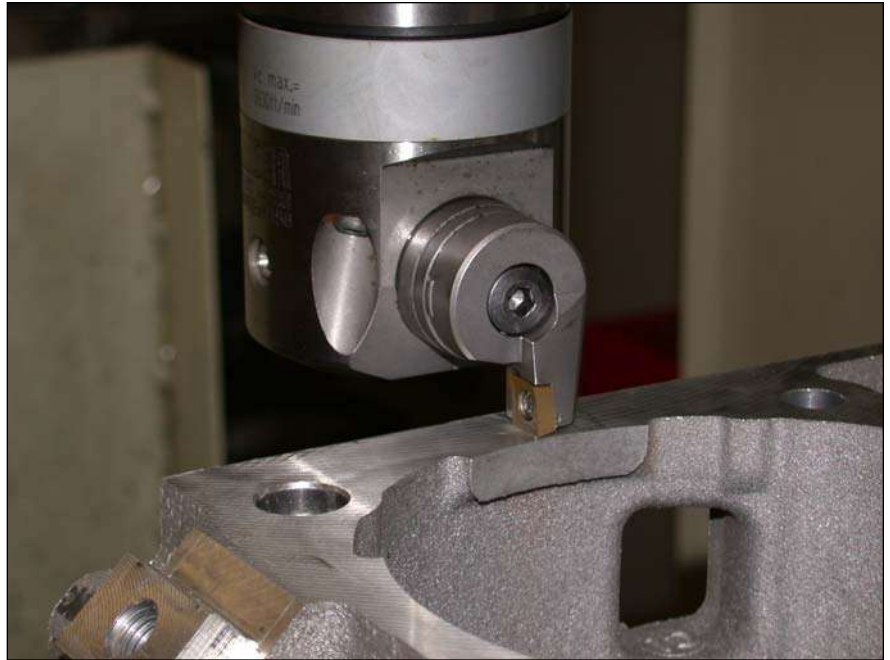


PHOTO 9



PHOTO 10

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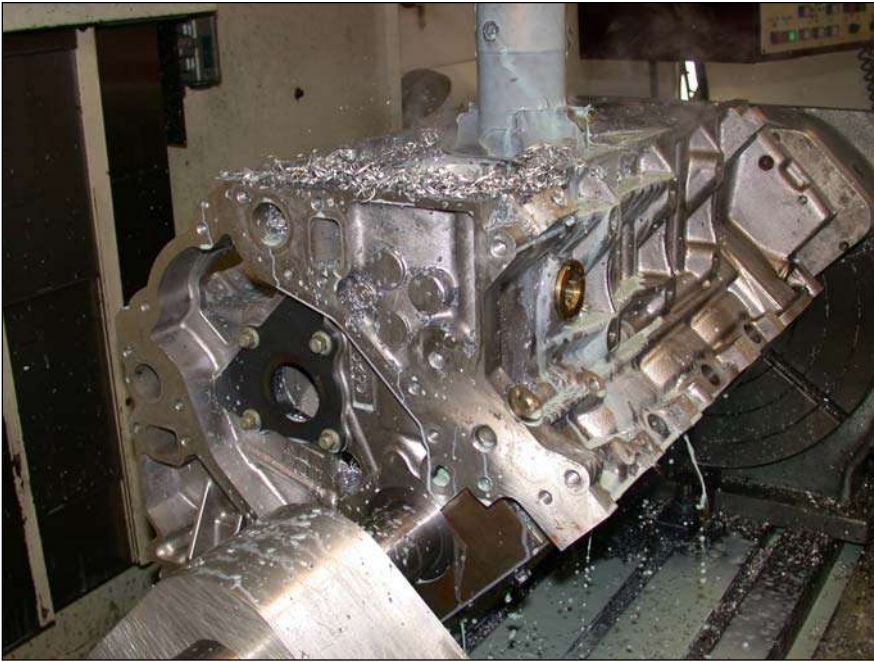


PHOTO 11



PHOTO 12

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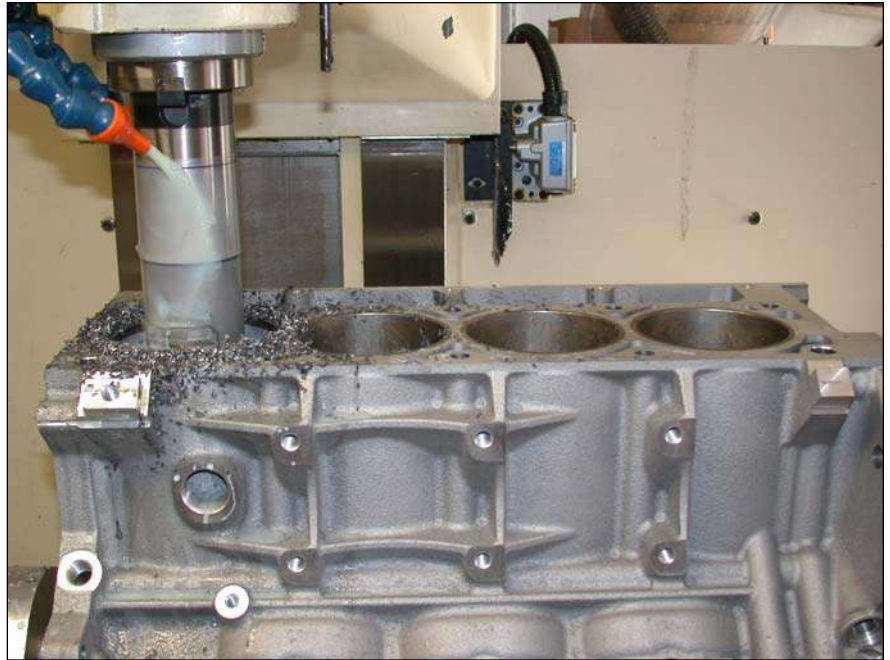


PHOTO 12



PHOTO 13

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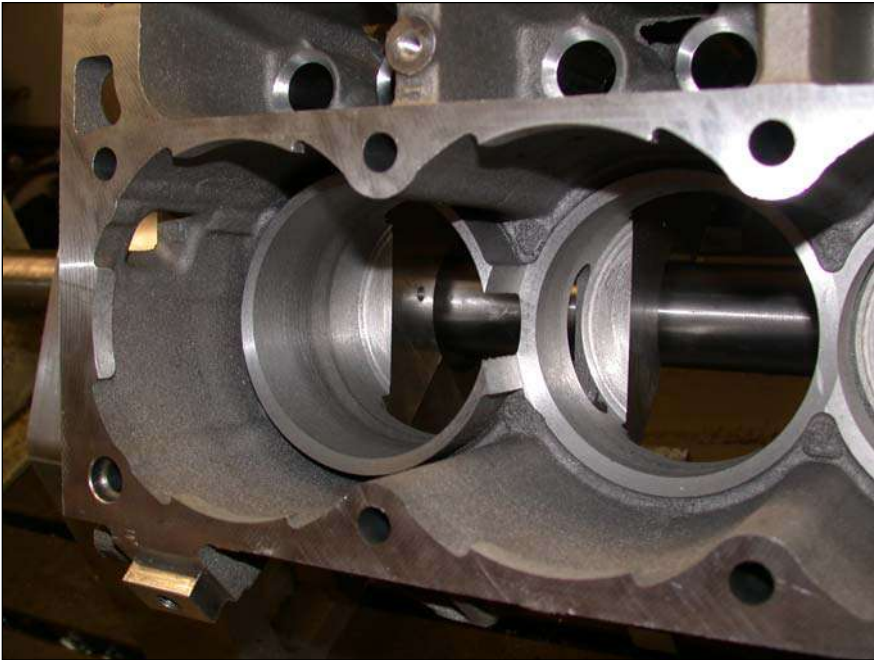


PHOTO 14



PHOTO 15

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PHOTO 16



PHOTO 17

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PHOTO 18



PHOTO 19

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PHOTO 20



PHOTO 21



PHOTO 22

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PHOTO 23

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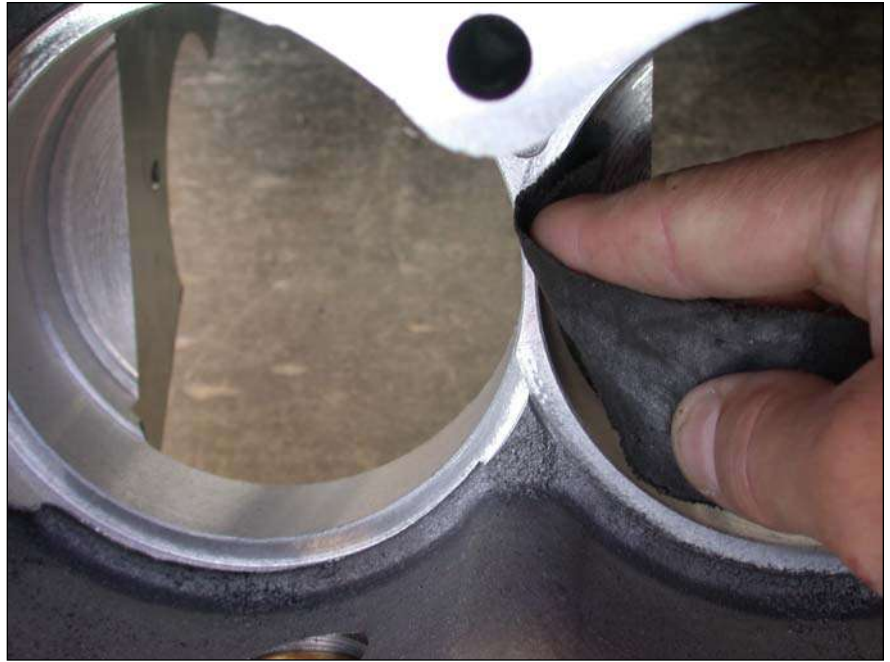


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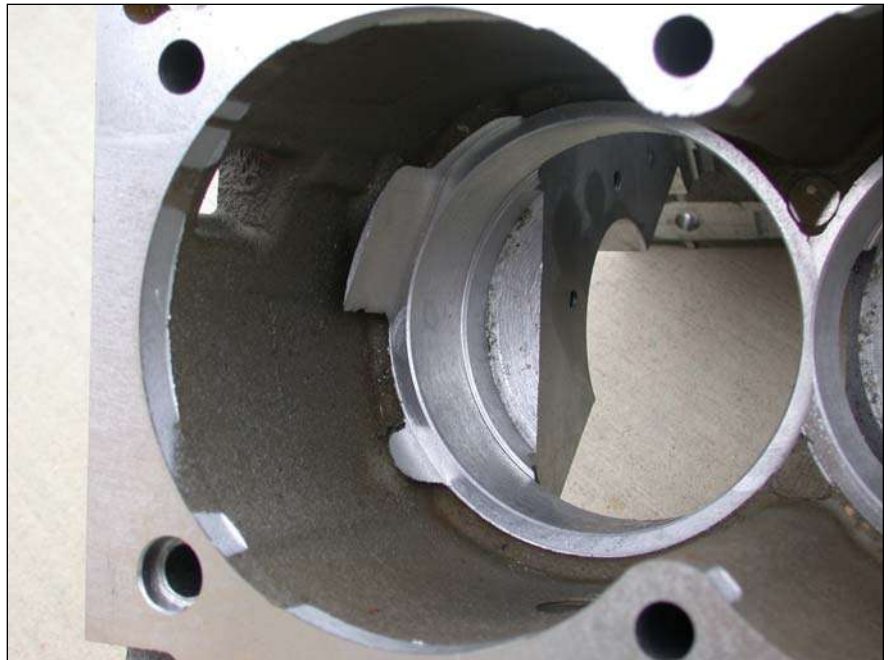


PHOTO 25

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PHOTO 26



PHOTO 27

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PHOTO 28



PHOTO 29

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PHOTO 30



PHOTO 31

NOTES:

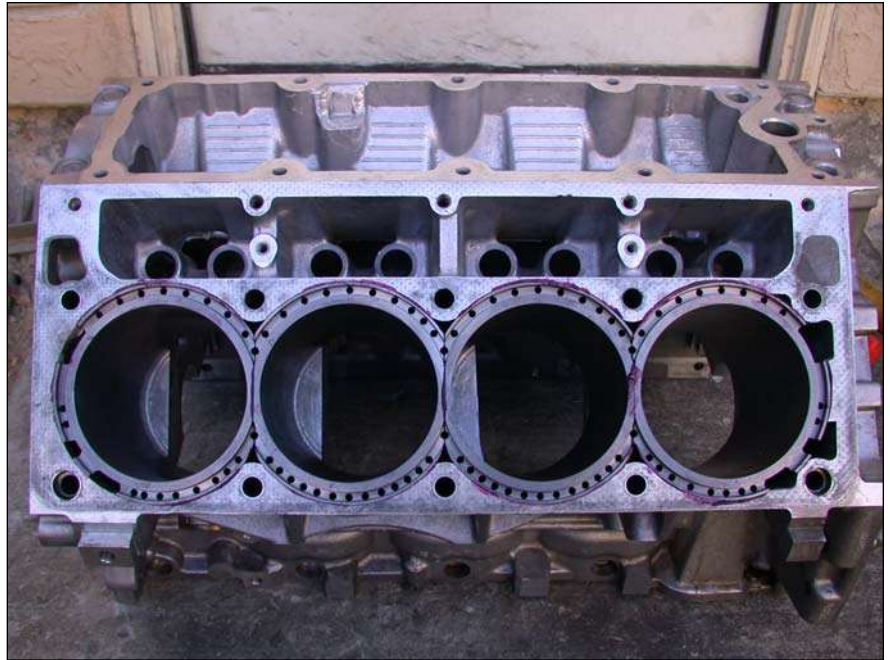


PHOTO 32

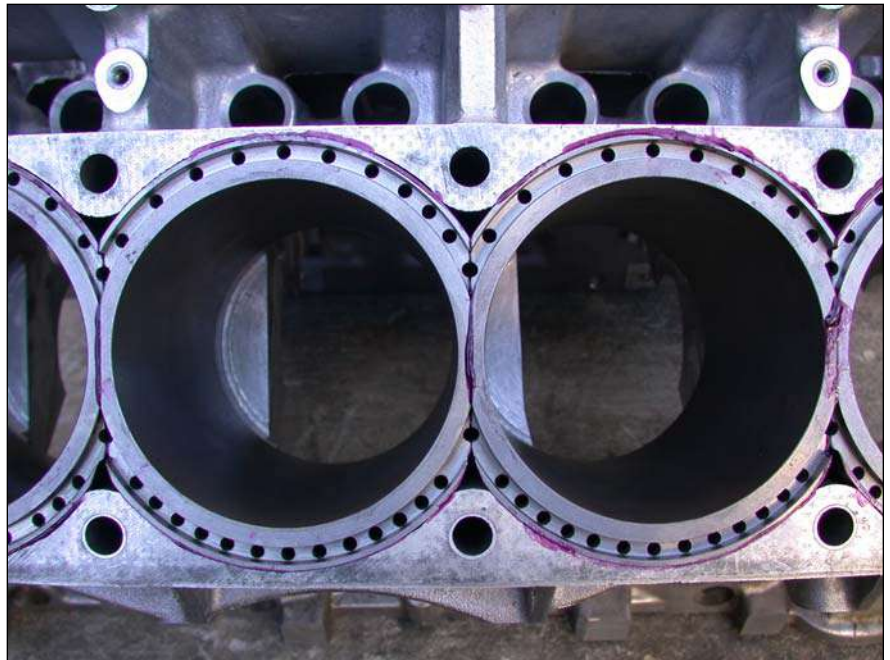


PHOTO 33

NOTES:



PHOTO 34



PHOTO 35

NOTES:



PHOTO 36



*Not actual gasket shown.

FOR BEST RESULTS:

Darton recommends the use of a Cometic M.I.D. MLS head gasket. These head gaskets are specifically made for use with our M.I.D. kits.

NOTES/CAUTIONS:

1. Make sure that block and head surfaces are machined within proper RMS specification.
2. Depending on the type of head bolts used, a re-torque of head bolts to proper specifications may be required.



PRODUCTS

FINALLY, A HIGH PERFORMANCE COOLANT PUMP FOR LS1/LS6 ENGINES.



EVANS COOLING SYSTEMS, INC. continues to expand their product line with the release of a high flow coolant pump and pulley combination for the hot-running GM LS1/LS6 engines. The new LS1 Coolant pump and pulley combination, part number **EP3913**, is designed to fill the current void in the LS1 Aftermarket. Flowing over 20 percent more than the OEM style replacement pumps available, the EP3913 increases the cooling efficiency in "built-up" LS1 Corvettes, Camaros and Firebirds.

Evans has changed the design of the OEM casting to include a Billet pulley hub and heavy duty 3/4" shaft bearing assembly. The EP3913 also includes the Evans 3.8" OD 8 vane scrolled impeller to reduce parasitic horsepower loss at high RPM. A new serpentine belt must be purchased separately for the specific application. Belts are available through Evans Cooling Systems **with core exchange credit** to finish the look of the EB3913-C or Camaro/Firebird—EB3913-CF.

The EP3913 is available for ceramic-coating is done on both the inside and outside of the pump in a show car. Ceramic-coating is done on both the inside and outside of the housing.

EP3913	Exchange LS1/LS6 High Flow Coolant Pump with Pulley	EB3913-C	Corvette Serpentine Belt	EB3913-CF	Camaro/Firebird Serpentine Belt
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EVANS
NPG COOLING SYSTEMS™

Order On-line 24 Hours


Coolant • Radiators • Pumps • Accessories

Darton recommends the use of **Evans** coolant with all **MID** kits!



MPG+ for all street applications.
MPGR for full race applications.

Finally, a High Performance Coolant specifically formulated to handle the extreme conditions of racing and high performance automotive, marine and motorcycle applications.



Evans Cooling Systems, Inc. introduces NPG-R, its newest addition to their innovative line of waterless Engine Coolants. NPG-R is specifically formulated to handle the extreme conditions of racing and high performance automotive, marine and motorcycle applications. Engines previously unable to be effectively cooled with water or conventional water-based antifreezes now have the option of the improved heat transfer formula of NPG-R.

NPG-R exhibits superior coolant flow, as it is less viscous than the popular NPG+. Its improvement in thermal-conductivity increases the ability of NPG-R to transfer extreme heat away from the engine coolant jacket. The temperature superior engine metal temperature control. High coolant with NPG-R as it stays in a more liquid state instead of converting to vapor and creating hot spots within the engine coolant jacket. Remaining in a more liquid state allows NPG-R to remove additional heat from the cylinder heads when compared to other coolants. The heat is then transferred away from the engine providing continuous control of cylinder head metal temperatures.

The reduced viscosity of NPG-R makes it more compatible with small tube copper-brass radiators while providing the superior cooling of Evans Waterless Coolants. (NPG+ and NPG are only recommended for large tube aluminum radiators.) All metals, including Magnesium, are safe to use with NPG-R. Although NPG-R is safe for all metals and contains no water, an annual coolant change is suggested for racing vehicles. For maximum performance street driven vehicles running NPG-R should change coolant every other year.

NPG-R does not freeze or boil-over in cold temperatures (down to -10°F) NPG-R will not freeze and expand like conventional water-based antifreezes potentially cracking the engine block. In contrast NPG-R contracts into thick slurry - never becoming a solid. With a boiling point of 400°F at 7psi, NPG-R will never boil-over because it immediately condenses back to a liquid within the cylinder head coolant jacket, maintaining a liquid contact on all metal surfaces at all times.

As with NPG+ and NPG, NPG-R is a stand-alone antifreeze and water to be removed from the radiator, engine block and heater core. (Evans Prep Fluid is available for smaller capacity systems where the engine block cannot be fully drained.) Once system is empty fill 100% with NPG-R. Test Strip is included with all purchases as a guide to a successful conversion. Technical assistance is available to assist in determining which Evans Waterless Coolant is right for your application.

EVANS
NPG COOLING SYSTEMS™

Coolant • Radiators • Pumps • Accessories

Sunnen CV-616 Setup

The cost-effective Sunnen CV-616 Automatic Cylinder Hone is one of the most versatile machines you can have in your shop. You can count on consistent results as the CV-616 produces the most precise cylinder bores possible, cylinder after cylinder, block after block.



Job: LS-6 Chevy block with Darton sleeves

	Semi Finish	Plateau Finish
<i>Cylinder Part #:</i>	600-100 (4")/600/120	600-120 (4.125")/600/120
<i>Stone Part #:</i>	EHU 412	C30 PHT 731
<i>Stroke Length:</i>	6"	6"
<i>Feed Rate:</i>	4	4
<i>Top Over Stroke:</i>	5/8"	5/8"
<i>Bottom Over Stroke:</i>	3/8"	3/8"
<i>Spindle Speed:</i>	170 rpm	170 rpm
<i>Stroke Speed:</i>	41 spm	41 spm
<i>Honing Oil:</i>	MAN 845	MAN 845
<i>Stroke Scale:</i>	2 3/4" PNP 1275	2 3/4" PNP 1275
<i>Guide Shoes:</i>	CK-3070	CK-2070
<i>Cross Hatch Angle:</i>	25-30	25-30
<i>Material:</i>	Ductile	Ductile
<i>Cylinder Length:</i>	5 5/8"	5 5/8"
<i>Load Meter:</i>	30%	20-30%
<i>Time Cycle:</i>		45 seconds



Sunnen CV-616 Setup

The cost-effective Sunnen CV-616 Automatic Cylinder Hone is one of the most versatile machines you can have in your shop. You can count on consistent results as the CV-616 produces the most precise cylinder bores possible, cylinder after cylinder, block after block.



Results with Sunnen Honing Stones on Darton Cylinder Sleeve Material

	<i>EHU 412</i>
RA	23.14 μ "
RY	231.14 μ "
RZ	184.4 μ "
RPK	26.34 μ "
RVK	68.14 μ "
RK	80.14 μ "
MR1	7%
MR2	86%

	<i>EHU 518</i>
RA	25.1 μ "
RY	266.2 μ "
RZ	198.3 μ "
RPK	29.9 μ "
RVK	44.5 μ "
RK	89.7 μ "
MR1	6%
MR2	88%

	<i>EHU-412</i>
	<i>C30 PHT 731 - 45 Seconds</i>
RA	15.4 μ "
RY	162.4 μ "
RZ	127.4 μ "
RPK	10.5 μ "
RVK	40.9 μ "
RK	35.4 μ "
MR1	5%
MR2	88%

	<i>EHU 518</i>
	<i>C30 PHT 731 - 30 Seconds</i>
RA	9.0 μ "
RY	132.0 μ "
RZ	93.5 μ "
RPK	7.8 μ "
RVK	38.4 μ "
RK	23.8 μ "
MR1	5%
MR2	81%



Sunnen CV-616 Set-up

JHU 623

RA	10 μ "
RY	99.6 μ "
RZ	85.5 μ "
RPK	17.8 μ "
RVK	18.8 μ "
RK	34.7 μ "
MR1	10%
MR2	89%

JHU 623

C30 PHT 731 - 15 Seconds

RA	6.4 μ "
RY	79.7 μ "
RZ	62.3 μ "
RPK	4.8 μ "
RVK	13.3 μ "
RK	20.9 μ "
MR1	4%
MR2	89%

Results obtained with Sunnen MAN 845 honing oils. Results may vary with other oils.

