1997 - 2004 Corvette: FAQs Regarding the Re-sleeving of LS1/LS6 Engine Blocks with the Darton MID Sleeve Kit

Submitted by: Howard Wolf and Steve Demirjian, co-patent holder of the Darton MID Sleeve Kit

What's meant when you refer to a dry sleeve?

In a normal dry sleeve installation, the sleeve is pressed into the block using an interference fit. Engine coolant never comes in direct contact with the sleeve.

What does the stock LS1/LS6 block have?

The LS1/LS6 blocks have thin wall, gray iron dry sleeves that are cast in place during block casting at the foundry

What's meant when you refer to a wet sleeve?

Wet sleeves are replaceable liners that are installed into the block with a slight press fit. Coolant comes in direct contact with the liner. This provides much better cooling than a dry type liner.

What's meant when referring to a centrifugally cast sleeve?

Sleeves manufactured using the "Centrifugal Cast Process" are acknowledged to be the best method. They possess the bearing metal qualities that cause skin healing after abrasion and a structure that is readily wetted by oil and retains an oil film. In the centrifugal casting process, molten metal is poured into a die or mold which is revolving at a high speed. The metal is distributed evenly around the die or mold. The resulting castings are of a much finer grain, denser and free from porosity. Another important advantage is that the impurities, since they're lighter than the iron, are forced centrifugally to the bore surface. They're removed later on during machining of the bore surface.

Which is the better block to resleeve? The LS1 or the LS6?

The LS1 blocks are a little stronger but it's difficult to get new ones. That's the reason most engine builders are using the LS6.

The LS1 has a drilled crankcase breather hole instead of the large windows cast in the LS6 block. The block is a little stronger for this reason. The LS1 block also has a slightly wider deck surface

which provides more area for the head gasket to seal.

Best results are with seasoned LS1 blocks but new LS6 blocks are acceptable if they are stress relieved.

What is vibratory stress relief? Is it similar to cryogenics?

Vibratory stress relief is a separate process. It has nothing to do with cryogenics. The block is set to vibrate at it's resonant frequency for a certain length of time depending on the mass. After a set time elapses, the piece is considered stress relieved. Stress Relief Engineering has a machine called the Formula 62 which is very well suited to this task.

What are the advantages of using the Darton MID sleeves vs. the C5R factory block?

The Darton MID sleeves are considerably stronger than the sleeves in a C5R block. There is no chance of "dropping" a MID sleeve because they sit on a robust flange at the bottom of the coolant jacket. A major benefit is price. One can do two MID blocks for the price of one C5R and have money left over.

Are there any other advantages to using the Darton MID sleeve kit?

Darton pioneered modular sleeve designs and specialty ductile iron material beginning with the manufacture of top fuel sleeves for Keith Black Racing Engines and Milodon Engineering in 1978. This experience, our racing heritage, and our highly experienced staff of machinists and racing engine builders offered a unique set of blended talent to solve inherent block weakness design in the currently available engines where bore sizes were intended to be increased.

Many production cast iron and aluminum blocks suffer from a design weakness of cylinder stability by nature of poor support at the upper deck area. The manufacturing process of "cast in sleeves" provides for economy of scale in low horsepower engines, but does not accommodate high horsepower, high boost, or larger bore sizes.

Darton has engineered a superior solution by using a unique designed cylinder sleeve which, when siamesed and nested, creates a solid deck of sleeve flanges held in compression. This reinforces the upper deck area replacing it with what we call Modular Integrated Deck (MID). In addition, Darton's designs manage and enhance coolant flow from block to head to promote stability of cooling. All sleeves are of the "Wet" design.

The enhanced coolant flow in and around the flange area is possible because of ported coolant flow control engineering we call "swirl coolant technology". This process begins with specific engineering models of respective cylinder head and combustion chamber designs and then we promote increased flow of coolant in those areas of the upper sleeve area subjected to the most heat. While heat is generally considered to translate into energy, high resident heat in the

combustion chamber can lead to detonation. This is the single biggest cause of failure in the high horsepower engines. High RPM normally translates into efficient scavenging of airflow but during misfires or incomplete flame propagation, high cylinder pressures and temperatures are created. Our MID design compensates for this high resident heat soak condition.

In wet sleeve designs of the past, coolant never flowed efficiently between the block and head in order to provide maximum heat dissipation in the combustion chamber. Inherent in open or closed deck engine blocks of cast iron or aluminum is a certain amount of coolant stagnation. This is like pouring water through a funnel. There is really no flow or velocity until the water exits the spigot. In the case of blocks and heads, the casting ports are designed for ease of casting, not efficient flow. Now with Darton's "MID" swirl coolant technology, the cooling medium is ported and directed to significantly improve heat transfer where it's needed most in the upper cylinder wall/flange area.

I've heard of sleeves "dropping". Is there any chance the Darton MID sleeves would do this?

Aluminum is soft and will deform, especially if it gets too hot. The flange of a dry sleeve sits on the narrow shelf at the top of the block where combustion heat is greatest. The aluminum can soften enough for the sleeve to "drop". Blown gasket, end of story.

MID sleeves sit on a robust shelf toward the bottom of the cylinder and are surrounded by coolant far removed from the combustion heat. If the machining is done to specified tolerances and the sleeves are properly installed, the sleeves will not "drop".

I noticed in the Darton MID install instructions that a red loctite looking sealent is required. Can this sealent ever dry out and lead to block failure?

The red sealant is Loctite 518 Flange Sealer. It will not degrade over time. This and Loctite 515, also recommended (both flange sealants) are used on many production cars to seal both coolant and oil.

On the Darton website, they indicate that your local machine shop can do the necessary work. Isn't a CNC machine required for this operation?

The Darton MID sleeve kit must be installed using a CNC mill. There are a couple of reasons why. First is that the # 1 cylinder seat is not round - it incorporates a flat to prevent breaking through the block into the timing chain area. Thus, the seat must be milled to follow a tool path.

Second it's nearly impossible to hold a tolerance of +/- 1/2 thousandth on bore center location using a manual mill. If the holes are not machined in the correct locations and to the proper tolerances, the sleeves won't be round after installation.

Why is it necessary to use a flood coolant capable CNC vertical bed mill to machine the LS blocks?

A tolerance dimension of +/- one half of one thousandth of an inch must be held during machining on bore location due to the Darton sleeves being siamesed. There is no way to hold tolerance without coolant. A five inch section of block will grow .001" per twelve degrees temperature change. With the block being about 22" in length, you can multiply the length change by four (.004") per twelve degree change in block temperature. Don't forget that the bore size in the aluminum will change as well. The temperature change is both from machining friction as well as room temperature change during the day. Flood coolant, A/C and machining the entire block in one session are the answers to quality work when it comes to installing these kits. Also, one must not leave the block sit over night and start again the next day.

Is the Rottler F-65A CNC machine precise enough to use for the Darton MID sleeve installation?

The machine itself is accurate enough if it is set up correctly and backlash is recalibrated periodically. However, this will not make up for the lack of flood coolant capability. It's next to impossible to hold size and the required close tolerances without flood coolant as described above. Flood coolant is mandatory in order to stabilize temperatures when machining aluminum. Surface finish is also greatly improved with flood coolant.

Could one cut slowly to avoid the excessive heat build up without the cooling fluid?

Aluminum expands quite a bit with an increase in temperature as explained above. All machine work needs to be done in one session, preferably in the afternoon when shop temperatures have stabilized. Keeping the block as close to the same temperature from start to finish (doing the machining over a relatively short time period) is crucial for holding tolerance. Remember, we're not just boring these blocks .030". We're removing the entire original cylinder wall from every cylinder and leaving an open cavity for the new liners.

What bore size do the Darton MID sleeves come in?

The current large bore Darton MID sleeves are 4.100" in diameter. They'll need to be bored .020" and then finish honed to 4.125".
Note: these sleeves can be safely bored and honed to 4.160"

There will also be a semi finished stock bore Darton MID sleeve available shortly for those limited on bore size because of rules.

How thick would the cylinder wall be if it was bored to 4.160"

At 4.160" bore, the wall thickness would be .220". Keep in mind that 4.160" is the limit on bore

size due to the "O" ring groove depth at the bottom most portion of the sleeve.

Where are the "O" rings located on the MID setup? Do these need to be replaced due to wear?

The 3 "O" rings are located at the very bottom of the sleeve where it locates into the block - just below where the sleeve sits on the bottom of the coolant jacket. Since this is a static assembly, there is no wear on the "O" rings. Nothing lasts forever but the "O" rings will most likely outlast the engine.

Can a block that's already been resleeved with dry aftermarket sleeves be resleeved with the Darton MID sleeves?

This is not recommended. Usually, the dry wall sleeves are not installed precisely on crankshaft center line or center to center since they are installed with standard automotive style boring equipment. This makes it very difficult to remachine the block to precisely locate the Darton MID sleeves. Also, the decks are not always 90 degrees apart.

Which heads can I use with the Darton MID sleeved block?

If you're using stock heads, they should be late 99 and newer. There is a U shaped cut in the deck surface of earlier heads located on the exhaust side between two cylinders. This cut out will intersect the MID groove and cause a major coolant leak unless welded up and the head surfaced flat. Late 99 and newer heads do not have this recess cast into the head surface and need no modification.

Air Flow Research has a head for the LS engines that has a port volume of 205cc. These have a thicker deck surface and should keep the head firmly clamped to the block. They're working on a larger port version, 225cc, that's recommended for engines up to 427 cu. in. (normally aspirated). These should be available by summer 2004.

Which head gaskets are the best to use?

Cometic multi layer steel (MLS) gaskets are now available for the LS1 LS6 Darton MID sleeved blocks. The common size requested is for a 4.125 bore. Compressed thickness is .040". Part number is C 5789. The beauty of the Cometic gasket is the spring steel face. It will seal even if the head lifts off the block a bit.

Are there any special requirements for using these gaskets?

The deck and heads must be perfectly flat and very smooth. No sealer should be applied.

Can any other head gasket be used?

A copper gasket will work just fine for racing use with O-ringed sleeves. Some drivers use copper gaskets on the street but they're prone to leaking around the coolant holes.

Why do you recommend Evans coolant and their pump?

The stock GM pump volume is inadequate, especially on the right bank over 5000 rpm. Evans pumps flow more coolant. Just as important, an equal amount of coolant is supplied to each bank of cylinders. Pump part # is EP 3913.

When the block is machined for the MID sleeves, it's converted into a wet sleeve design (just like a diesel). The ductile iron sleeves need cavitation protection to prevent damage to the sleeve surfaces that are in contact with coolant. In a diesel engine, this is provided by mixing special additives into the coolant. Cavitation can, in time, eat a hole right through the sleeves.

The Evans coolant is not water based and will not cavitate. You don't need a high pressure radiator cap. Evans runs with a 0 7 lb. cap which reduces the chance of a blown hose and possible scalding . It will keep your engine intact should temperatures increase (approaching 300 degrees coolant temperature). Electrolytic damage is also greatly reduced or eliminated.

Evans also has high volume inlet style thermostats in stock. They are also working on a much higher volume outlet style thermostat housing for extreme power engines.

Evan's coolant is expensive but it's only needed once. The coolant does not need replacing and does not evaporate away like water. It is also enviro friendly compared with ethylene glycol.

Is the coolant flow path altered in any way?

The Darton MID sleeve does not alter the stock coolant flow path. Coolant enters the block through the rectangular holes and flows to the back of the block where it rises and enters the heads. From there it flows forward picking up heat from the heads, re enters a block passage on each bank and flows out the round holes to the radiator. There are bleed holes in the gasket around each cylinder to help prevent steam pockets from forming. The MID flange does a much better job of keeping the deck area cool than the stock block. This is a patent pending feature of this sleeve design.

Is it an absolute requirement to go with the Evans cooling system?

Yes, we prefer everyone use the Evans coolant and pump with the MID sleeve kits.

How much do the Evans water pumps cost?

The new casting runs $469.95 which includes a slightly smaller pulley to increase pump speed.