

General Motors Oxidation & Deposit Test

Engine Assembly Manual

Contact Person:

Tim Cushing

GM Global Propulsion Systems

800 North Glenwood Ave

Pontiac, MI. 48340-2920

MC 483-730-322

Phone 248-881-3518

Revision 09

15-Feb-16

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Section 0

Hardware usage guidelines

All materials used in this test must conform to acceptance guidelines as specified in the General Motors Oxidation & Deposit (GMOD) Test Procedure, the GMOD Test Stand Configuration Manual (TSCM), the GMOD Engine Assembly Manual, and any local regulatory mandates applying to the test facility conducting this testing.

Any changes in procedures or substitutions of qualified parts or materials must be approved by General Motors and/or The ASTM Test Monitoring Center or appropriate Surveillance Panel prior to their use in non-reference and reference oil tests.

Any parts or materials specified in this document that are found to be unacceptable for testing, both pre and post test, must be reported to the Test Sponsor, and the appropriate Critical Parts Distributor.

Unless otherwise directed, all parts and materials required for testing should be stored and used on a first in – first out basis.

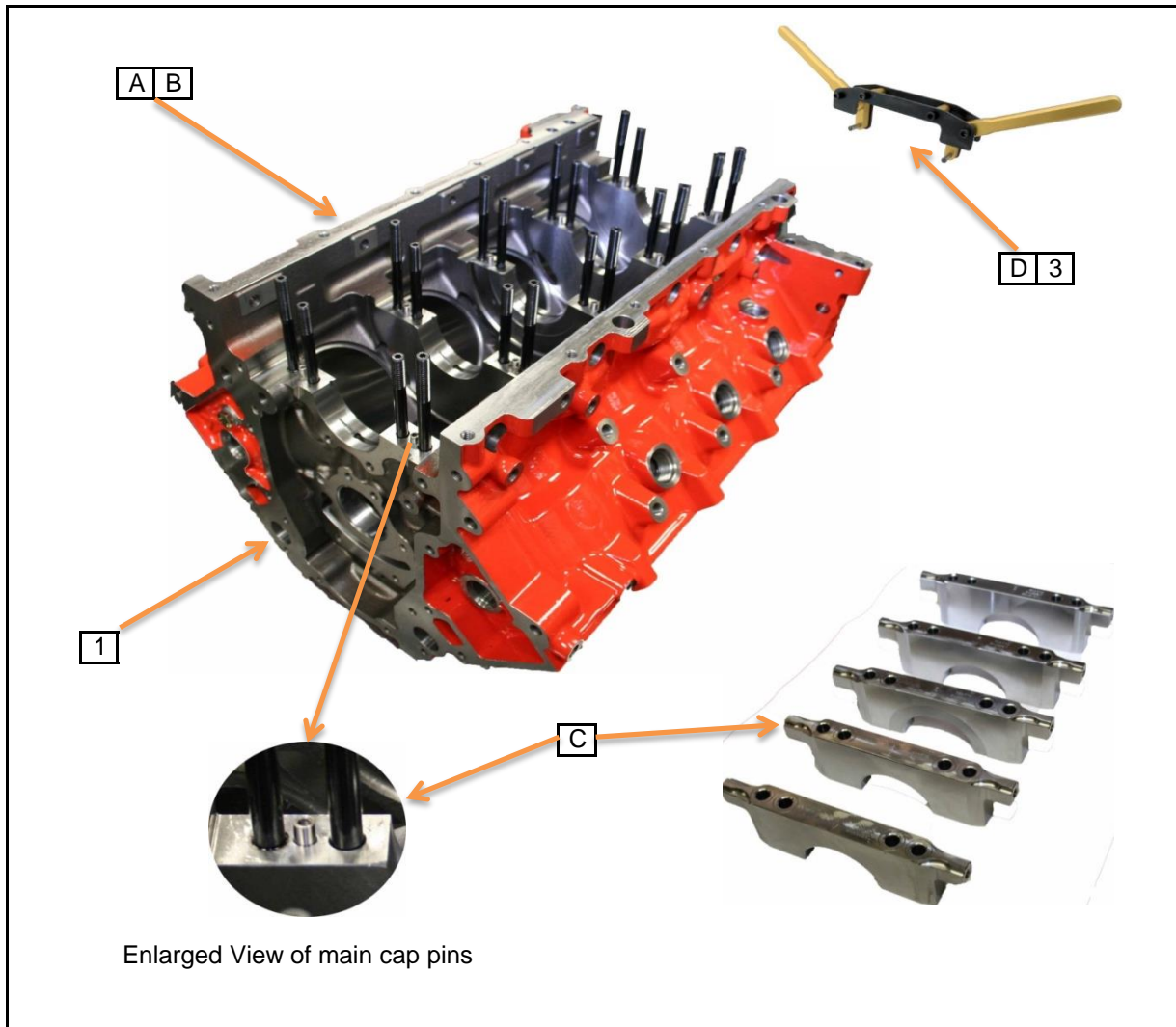
Section 01

Revision Update Timeline

- 8/25/2014 Post August 2014 Build Workshop revision
- 10/13/2014 Mostly additions to section 2
- 2/5/2015 Sections 1, 2, 3, 5, 6, 10, and 11.
- 6/9/2015 Sec. 3.5 changed torque to 44 from 55,
- 6/23/2015 Added Engine Build Clearance Specification table and ring part numbers Section 3
- 10/26/2015 3.1 Post Hone cleaning procedure option A, option B.
2.21 Surface finish limit update post prove out tests
8-3 Parts Cleaning Procedure: remove Block word and clarify where Block Post Hone Cleaning Procedure is in this manual.
- 2/15/2016 2-20 Added sentence concerning the Surface Finish control charts
3-6 note concerning the larger oring for large core plugs
3-10,11. Added picture with OHT rear cover bolted to block
3-14. Removed note about oil pump measurements for the PM. Changed oil pump maximum usage from 6 to 4.
5-8,12. Added alternative fuel rail part number
7-07 Added picture of Rear Cover
10. Removed GM part number for rear cover and added new o-ring for larger core plugs in CPW parts.

Section 1

New Block and Pre Hone Preparation



Enlarged View of main cap pins

Description of Operation

- A Upon introduction of a new block into the test lab, check for any damage to machined surfaces which might have occurred during shipping or handling.
- B Main cap fasteners are "ARP Stud Type" and are installed during machining of the block. Care should be taken to keep these studs and nuts with the engine block for the life of the block. If necessary to replace any of these materials, use only appropriate ARP replacement parts.
- C **Note: Main Bearing Caps are pinned on each side between the studs. Do Not Hammer or use excessive side to side or fore and aft rocking force during removal. Leaving the studs in place when the caps are removed will help prevent damage to the pins.**
- D After removal of main cap nuts, studs, and side bolts, carefully remove the main caps using the special main cap removal tool. **Labs must use one of the two special tools listed for proper removal.** Record engine serial number and assign a lab number as appropriate.

Specification

- 1 88958771 Block, GMOD Oil Test *
- 2 234-5608 Kit Stud, ARP
- 3 All Star Performance All 96525 Racing Head Service RHS 549106
- * Contact Chevy Performance for order information.

REV	Date	Revision History

View	
Pre Cleaning & New Block Prep	
New block, inspection, main cap removal, serial number and lab number recording.	

New Block and Pre-Hone Prep	GMOD
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Section	Sheet
1	1



A
B
C

Description of Operation

- A Deburr all leading edges of the camshaft tunnel including the oil feed hole (not shown). Use air or electric rotary tools with carbide cutter or stone materials. A 2.5" 60 grit sanding wheel has been found to be effective in removing any sharp edge left by the cutter or stone. End result is to prevent cutting or gouging of the camshaft bushings during installation.
- B After deburring, thoroughly clean the engine block to remove all debris from the deburring operation.
- C Carefully inspect the post-test bushings after removal for evidence of distress on the outer diameters. Correct any possible areas of concern for the next installation.

Specification

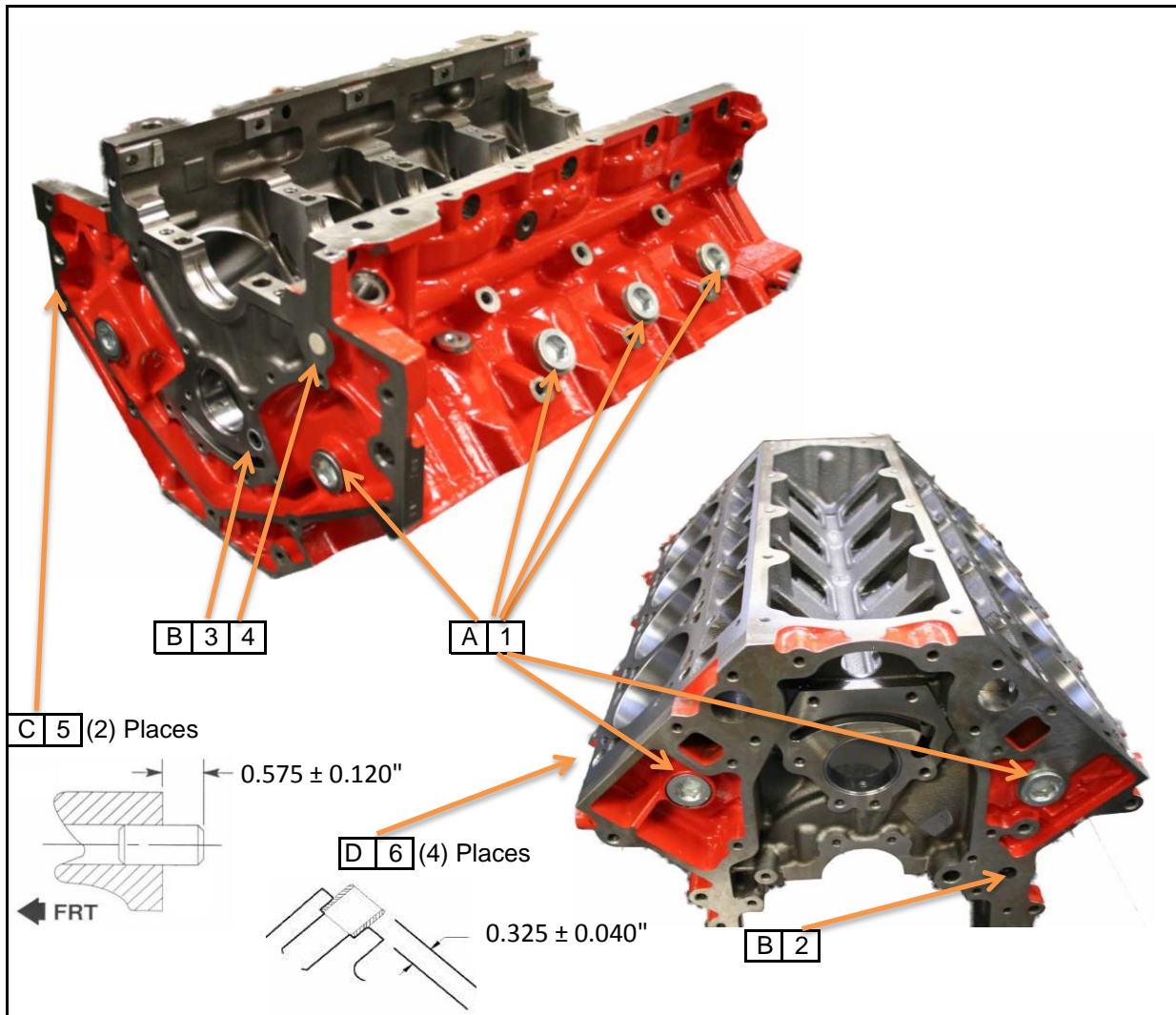
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REV	Date	Revision History

View
Camshaft Tunnel Deburring
Deburring of all leading edges including the oil gallery feed holes.

New Block and Pre-Hone Prep	GMOD
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Section	Sheet
1	2

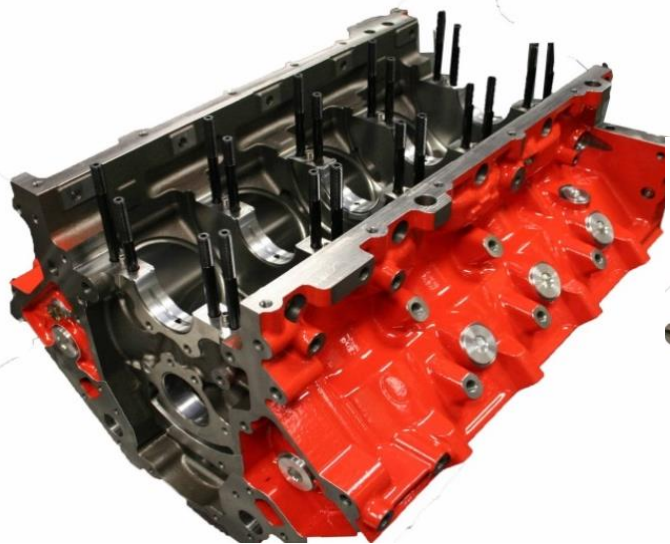


Description of Operation	
A	Remove all core sand plugs from front, rear, and sides of block.
B	Remove all oil gallery, threaded plugs, cup plugs, plastic insert plugs, and any special test cell oil gallery fittings.
C	If not already installed, install the rear transmission locating pins (2)
D	If not already installed, install the cylinder head locating bushings (4)

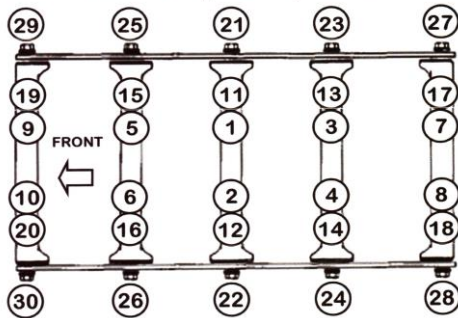
Specification	
1	AN Type Core Sand Plug (10)
2	9427693 Cup Plug Oil Gallery
3	14090911 Plug Threaded Oil Gallery
4	12573460 Plug Rear Oil Gallery Plastic Dog Bone Type with O-Ring
5	1453658 Pin, Transmission
6	12570326 Bushing Cyl. Head Location

REV	Date	Revision History
New Block and Pre-Hone Prep		GMOD

View	
Pre Cleaning Prep	
New and used block sand core and oil gallery plug removal.	
Section	Sheet
1	3



Bolt Torque Sequence



Outer Studs 4.55 long Nuts 50 lb.ft.
 Inner Studs 4.77 long Nuts 60 lb.ft.

M8 side bolts 20 lb.ft.



Description of Operation

A

Chase all threaded bores with proper thread chase if necessary.

Coat all studs with EF-411.

Install studs "hand tight" with speed handle. Follow torque specification chart for final application.

Note: To ensure caps are fully seated in block, apply 20 lb.ft. torque on inner stud nuts following crisscross pattern. Loosen nuts, back off three to four threads. Hold nut with finger while tightening stud to 100 inch pounds to ensure stud is fully bottomed in block.

Follow torque sequence in chart for final application.

Specification

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REV	Date	Revision History

View	
Pre Hone & New Block Prep	
Main cap installation and fastener torque.	

New Block and Pre-Hone Prep

GMOD

Section
1

Sheet
4

Description of Operation

Parts cleaning guidelines

GMOD Test Engine parts may be cleaned using differing levels of cleaning prior to honing based on the level of post test cleanliness.

- 1) New blocks can go straight into the Ultrasonic Cleaner.
- 2) Used blocks can be sprayed with engine degreasing solvent if desired to remove heavy deposits before going into the Ultrasonic Cleaner.
- 3) Follow the Ultrasonic Cleaner Guidelines in the parts cleaning section 8.

Specification

REV	Date	Revision History

View

Pre-Hone Cleaning

Section

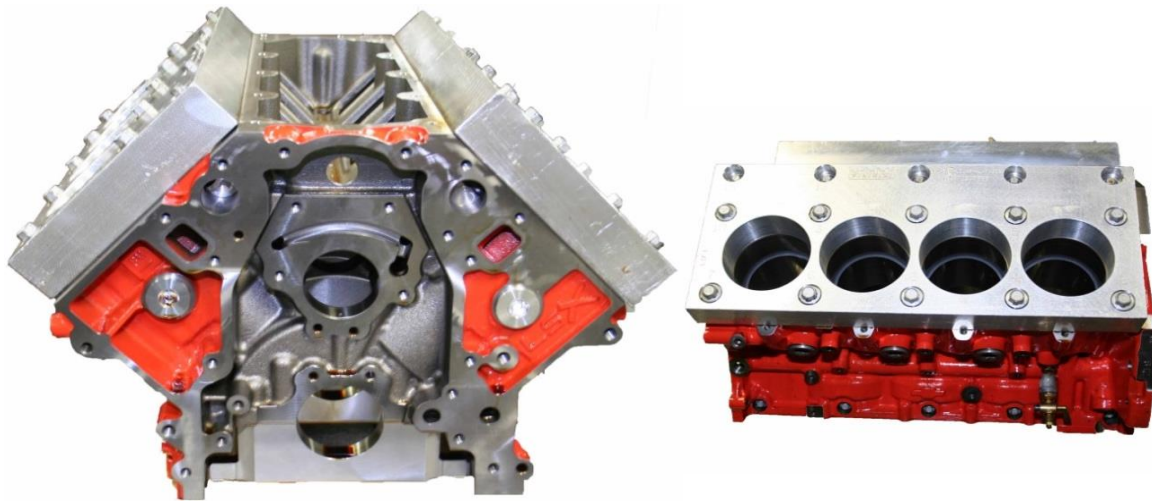
Sheet

1

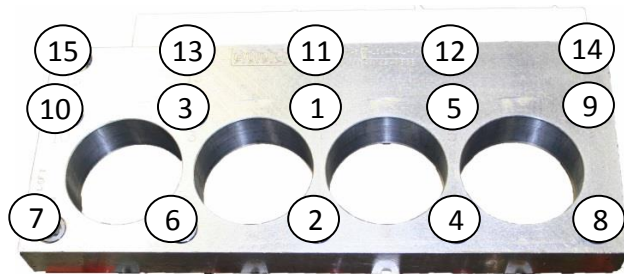
5

New Block and Pre-Hone Prep

GMOD



First Pass	M11 Bolts (1-10) in sequence 22 ± 2 lb.ft.
Second Pass	M11 Bolts (1-10) in sequence 90°
Final Pass	M11 Bolts (1-10) in sequence 70°
	M8 Bolts (11-15) in sequence 22 ± 2 lb.ft.



Description of Operation

- A Install BJJ Torque Plates with head gaskets. Lightly lubricate the NEW head bolt threads with EF411.
- B Torque fasteners following proper sequence according to the table
- Head Gaskets are to be used no more than twice with the torque plates. Labs need to identify each application and discard after the second use.
- The block is now ready for honing.

Specification

- 1 Plate Torque, BJJ GM5.7-LS1-R-AL-T-DID
- 2 Cylinder Head Bolt, long, 19258707
- 3 Cylinder Head Bolt, short, 12558840.

REV	Date	Revision History

View	
BJJ Torque Plate	
Torque Plate Installation.	

New Block and Pre-Hone Prep	GMOD
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Section	Sheet
1	6

Section 2
2-15-2016
Cylinder Block Honing

GMOD Engine SUNNEN® Vertical Honing Machine Model SV-10 Setup and Maintenance

OPERATOR CONTROLS AND DEFINITIONS

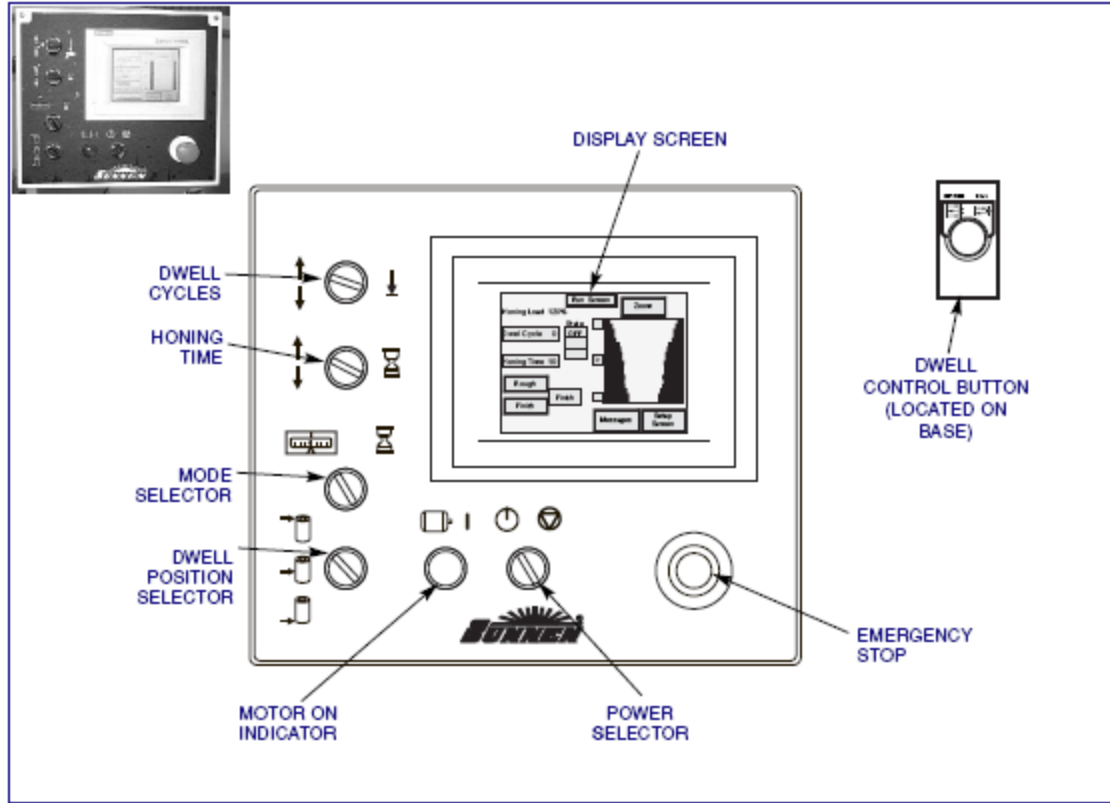


FIGURE 2-2, Operator Controls

TABLE 2-1, Operator Controls

















SYMBOL	DESCRIPTION	FUNCTION
DWELL CYCLES 	2 Position Selector Switch	Switch is used to set the number of strokes the machine will dwell at the location selected by the Dwell Position Selector Switch. (Count is found on the Run Screen.)
HONING TIME 	Selector Switch	Switch is used to set honing time in seconds, when a timed cycle is selected. (Time is found on the Run Screen.)
MODE SELECTOR 	2 Position Selector Switch	TIMED – Machine will hone until the number of seconds on the Honing Time display reaches zero. ZERO SHUTOFF – Machine will hone until zero is reached on the Graduated Feed Dial (5).
DWELL POSITION SELECTOR 	3 Position Selector Switch	Switch is used to select position in the bore that the machine will dwell at when the Dwell Cycle Switch or Dwell Button are used.
MOTOR ON INDICATOR 	Motor ON Light	When light is on, indicates that the machines pump is on and the machine is ready to start a cycle.
POWER SELECTOR (ON) 	Selector Switch	Turns ON electrical power to Machine's Operator Controls; places machine in standby mode.
POWER SELECTOR (OFF) 	Selector Switch	Turns OFF electrical power to Machine.
(EMERGENCY STOP) 	Red Locking Pushbutton Switch	Brings machine to an immediate controlled stop & removes all power to the machine functions. Button must be released to continue.

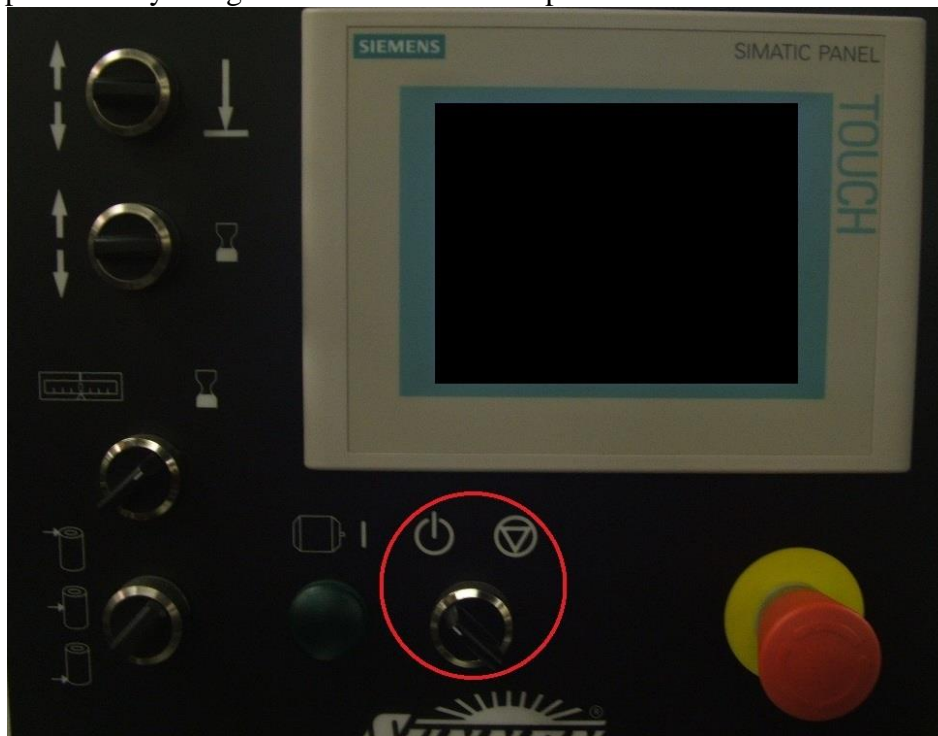
TABLE 2-2, Other Machine Controls & Warning Symbols

SYMBOL	DESCRIPTION	FUNCTION
	Warning Label	Warns that an electrical hazard exists.
	Dwell - Single	Depressing the Dwell Control Button momentarily will result in a single Dwell Cycle at location selected by Dwell Position Selector.
	Dwell - Continuous	Depressing Dwell Control Button for 2 seconds will result in a dwell cycle every cycle at location selected by Dwell Position Selector, until button is pressed again, removing machine from auto dwell mode.
	Cradle Height Adjustment	Indicates direction to turn elevating crank to raise cradle.
	Clutch Control	Indicates that when clutch lever is pushed back to (⌚) position motors are ON and the machine is in stand-by condition. When clutch lever is pulled to Φ position honing cycle begins. Warns that the clutch lever should not be pulled forward until honing tool is properly positioned within workpiece.
	Warning Label	Warns that no drilling is allowed. Drilling any new holes may void warranty.
	Warning Label	Warns that safety glasses should be worn at all times when operating this machine.
	Label	Designates this machine is "CE" compliance.

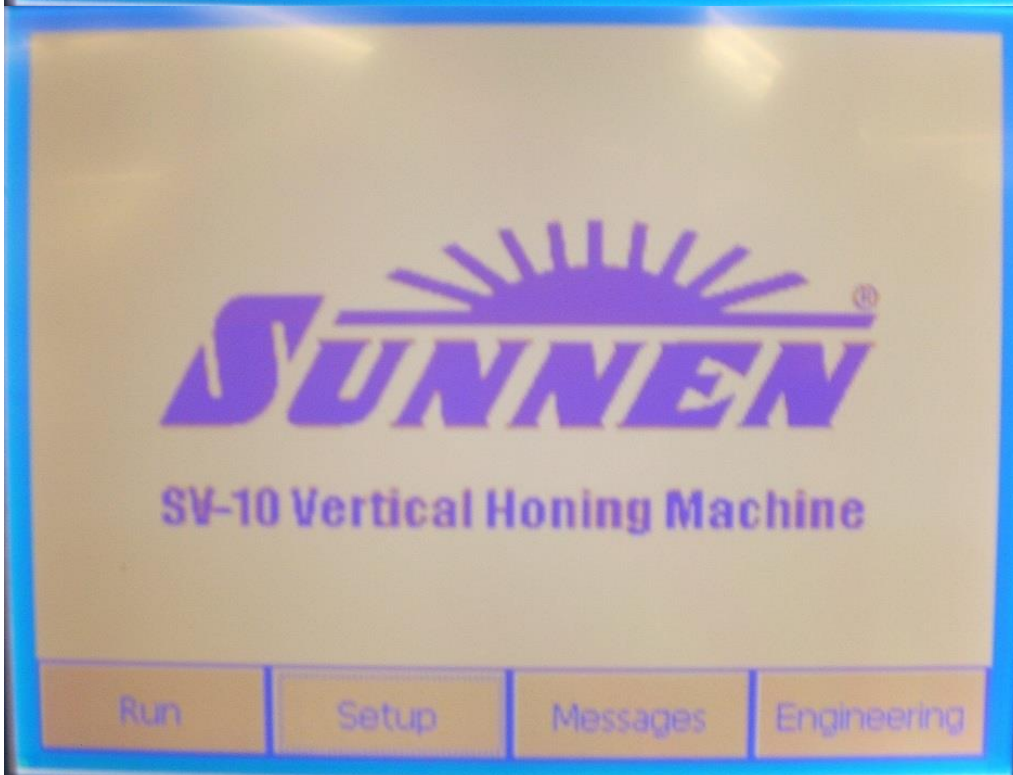
MACHINE SETUP

Getting Started / Setup

1. Turn power on by using switch located on the operator console.

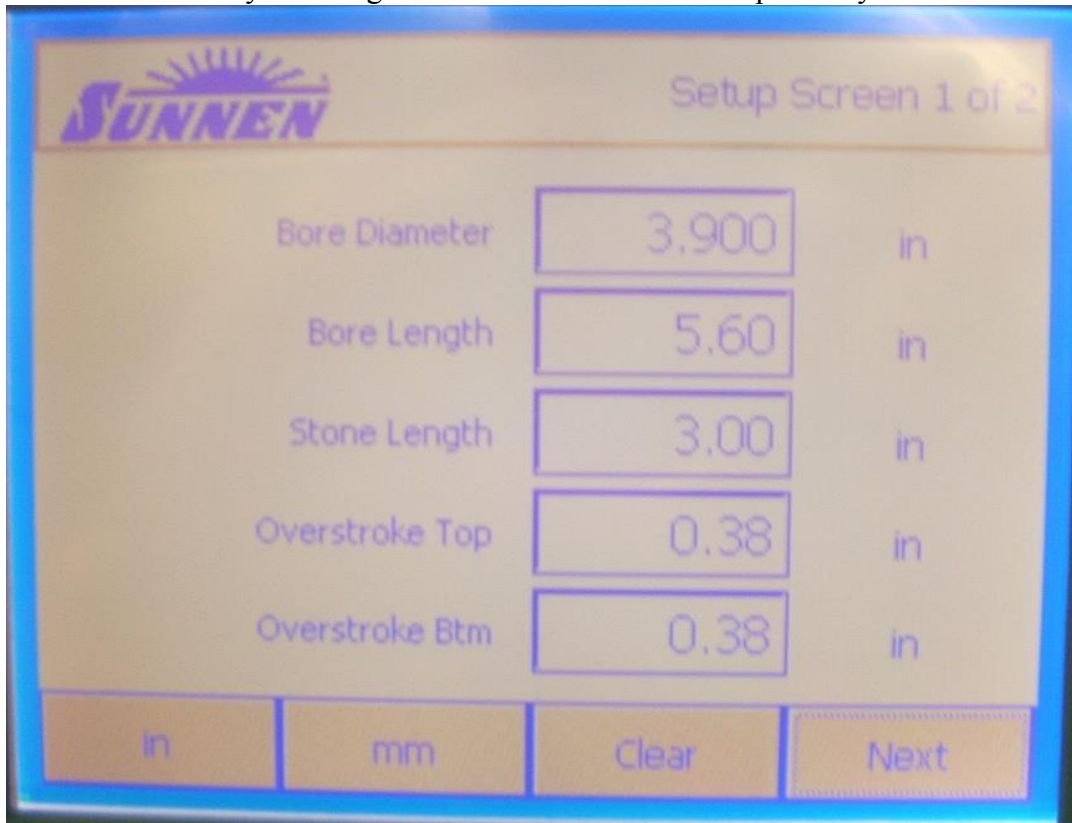


2. Wait for main screen to appear on the machine and select the setup key to take you to the 1st Setup Screen.



MAIN SCREEN

3. You may now enter the specifics of the job you are working on. (i.e. Bore diameter, Bore length, Stone Length, top & bottom over-strokes). If you would like to start over, press the clear button to rezero all of the parameters. You can also switch between inch and metric mode by selecting the “IN” or “mm” button respectively.



4. To enter data, simply touch the field with your finger and a keypad will appear that will allow the operator to input the necessary data.

KEYPAD

5. The data entered in this screen is completely optional. This data will allow the machine to calculate recommended stroke and spindle speeds, stroke length, and average cross-hatch angles. The machine will still operate if the 1st setup screen is bypassed.

CAUTION

Beware that if the 1st setup screen is ignored the data presented in the recommended speed, stroke length and x-hatch angle fields will be inaccurate and may cause a dangerous operating condition.

6. Use the next button to proceed to the second setup screen.

SETUP SCREEN 2

Set spindle and stroke speed

7. Using the data input on the Setup Screen 1, the machine presents a recommended Spindle and Stroke speed. Using this feedback, the operator can input both roughing and finishing speeds.

The screenshot shows the SUNNEN Setup Screen 2 of 2. It displays recommended and user-input speeds for roughing and finishing operations, along with average X-Hatch angles and a suggested stroke length.

SUNNEN		Setup Screen 2 of 2	
Spindle RPM	195	Recommended	
Stroke Speed	80	Recommended	
Roughing Spindle RPM	200	User Input	
Roughing Stroke Speed	70	User Input	
Finishing Spindle RPM	200	User Input	
Finishing Stroke Speed	70	User Input	
Avg. X-Hatch Angle Rough	34	Stroke Length	
Avg. X-Hatch Angle Finish	34	3.4	in

Buttons: Back, Run

8. To enter the speeds, touch the area of interest with your finger. This will open a keypad that will allow the operator to input the necessary data.

NOTE: Notice on fields that have minimum and maximum conditions that the limits are indicated on the top of the keypad

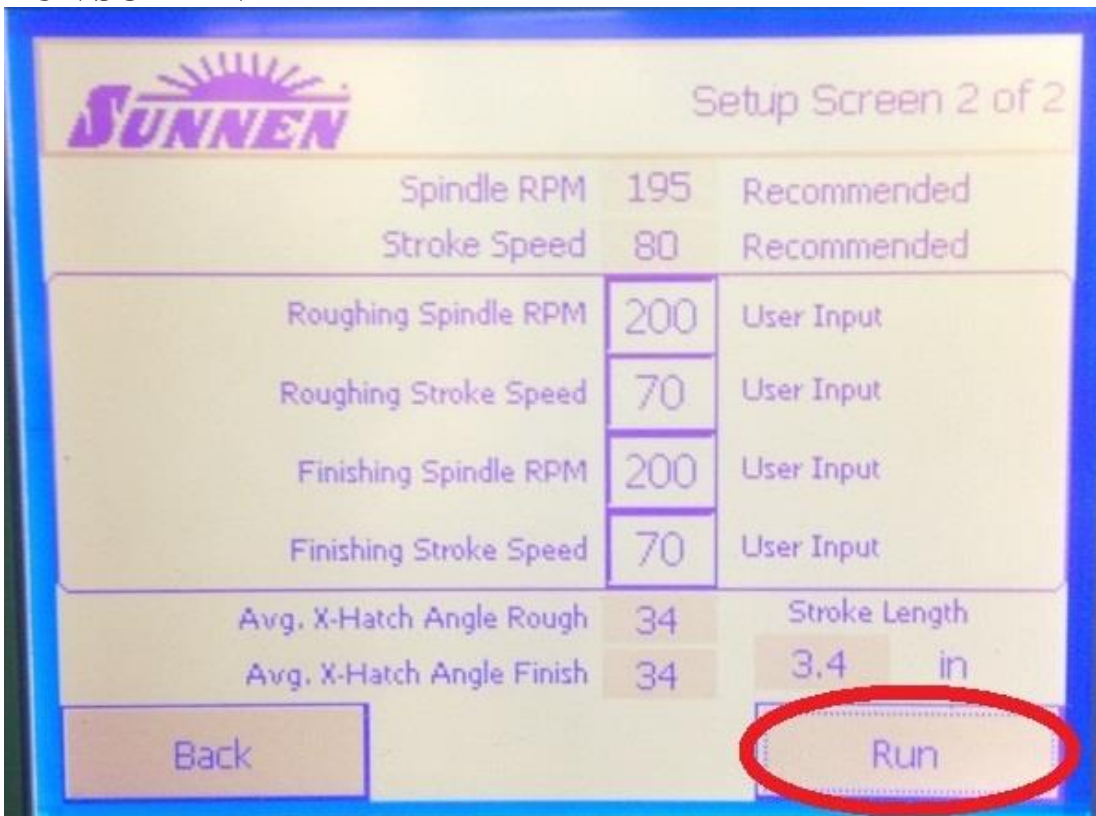
9. Notice that the avg. X-Hatch angle rough and finish update as the user inputs speeds.

10. Also located on Setup Screen 2 is the suggested stroke length for this setup.

NOTE: Notice that inaccurate data input on Setup Screen 1 can lead to an inaccurate recommended stroke length and may cause a dangerous operating condition.

11. At this point the operator can select BACK to go back to Setup Screen 1 or proceed to the Run Screen.

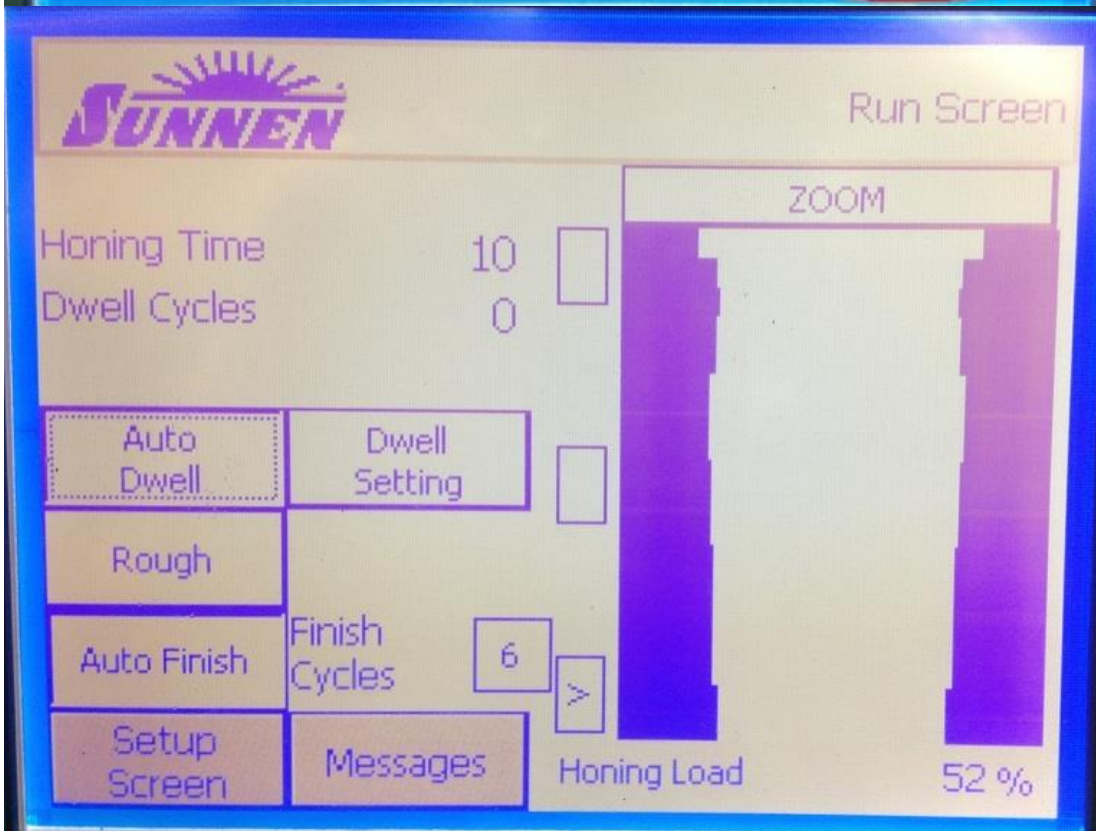
RUN SCREEN



SUNNEN Setup Screen 2 of 2

Spindle RPM	195	Recommended
Stroke Speed	80	Recommended
Roughing Spindle RPM	200	User Input
Roughing Stroke Speed	70	User Input
Finishing Spindle RPM	200	User Input
Finishing Stroke Speed	70	User Input
Avg. X-Hatch Angle Rough	34	Stroke Length
Avg. X-Hatch Angle Finish	34	3.4 in

Back Run



SUNNEN Run Screen

Honing Time 10

Dwell Cycles 0

Auto Dwell	Dwell Setting	<input type="text"/>
Rough		
Auto Finish	Finish Cycles	6 <input type="text"/>
Setup Screen	Messages	<input type="text"/>

ZOOM

Honing Load 52 %

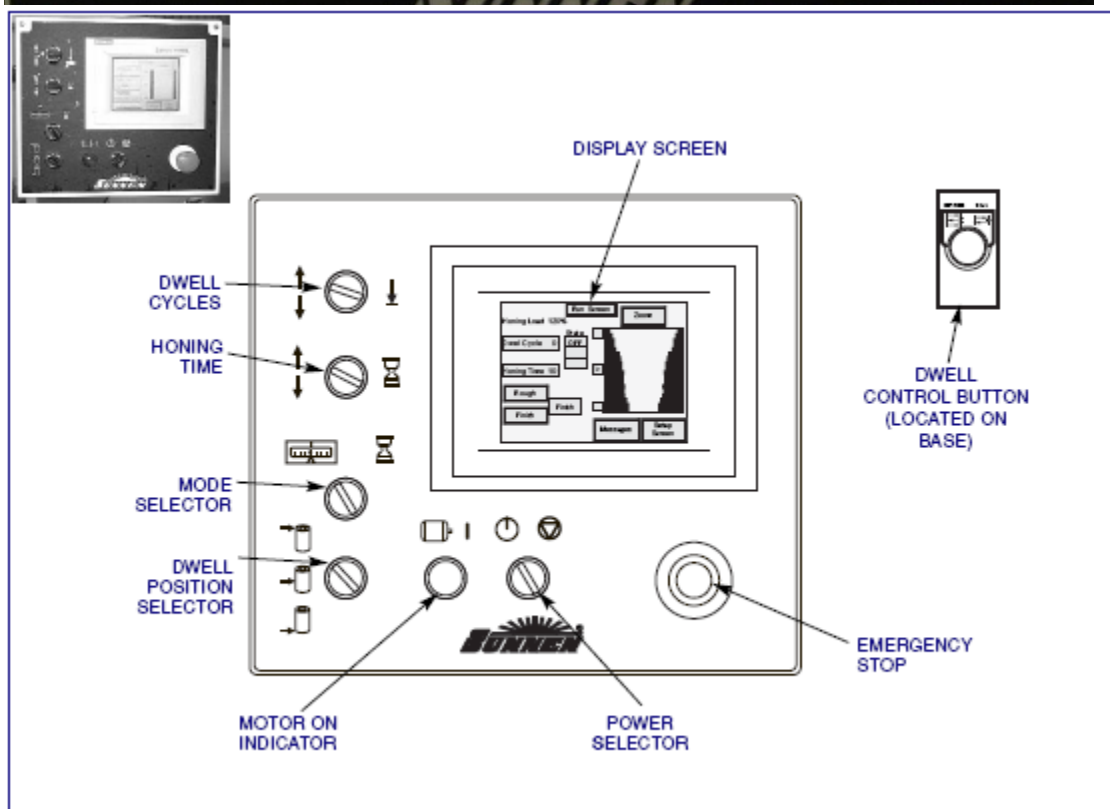


FIGURE 2-2, Operator Controls

Honing Load:

Will update as the spindle power requirements change during a cycle. (This is a percentage % of the spindle power used.) High Load Meter Reading: An initial load meter reading of more than 10% above reading for the previous cylinder indicates:

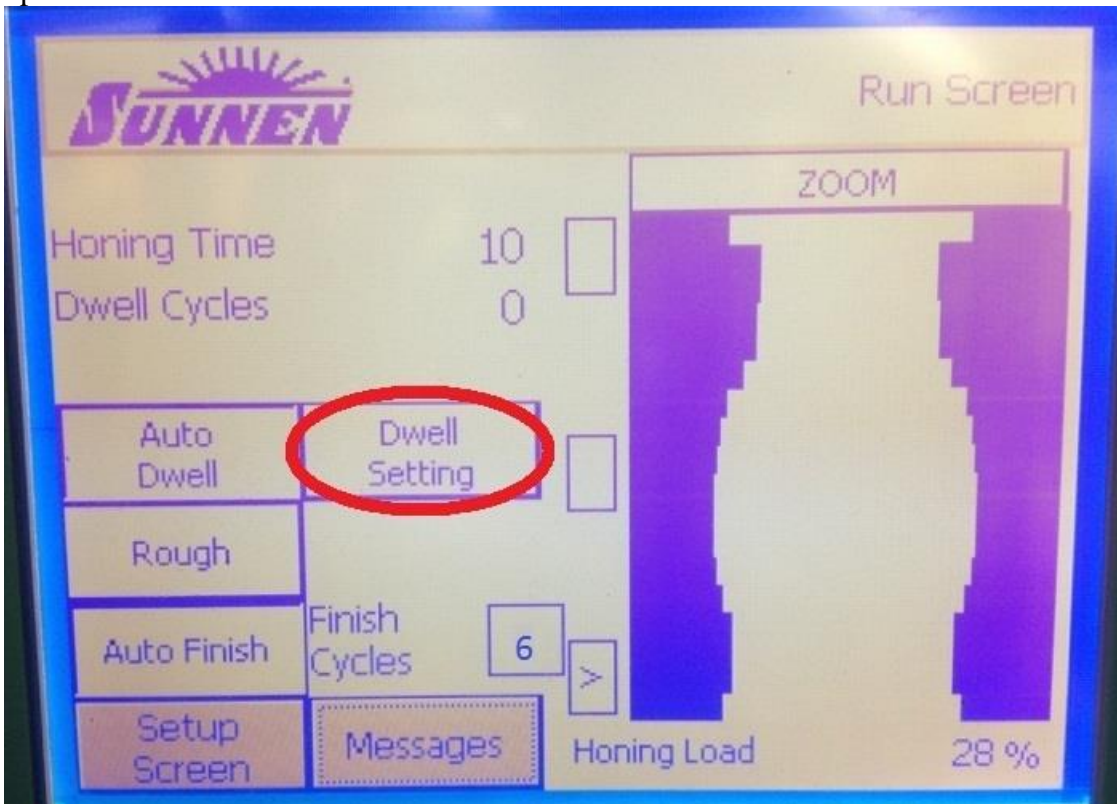
Feed Handwheel has been manually advanced too far.

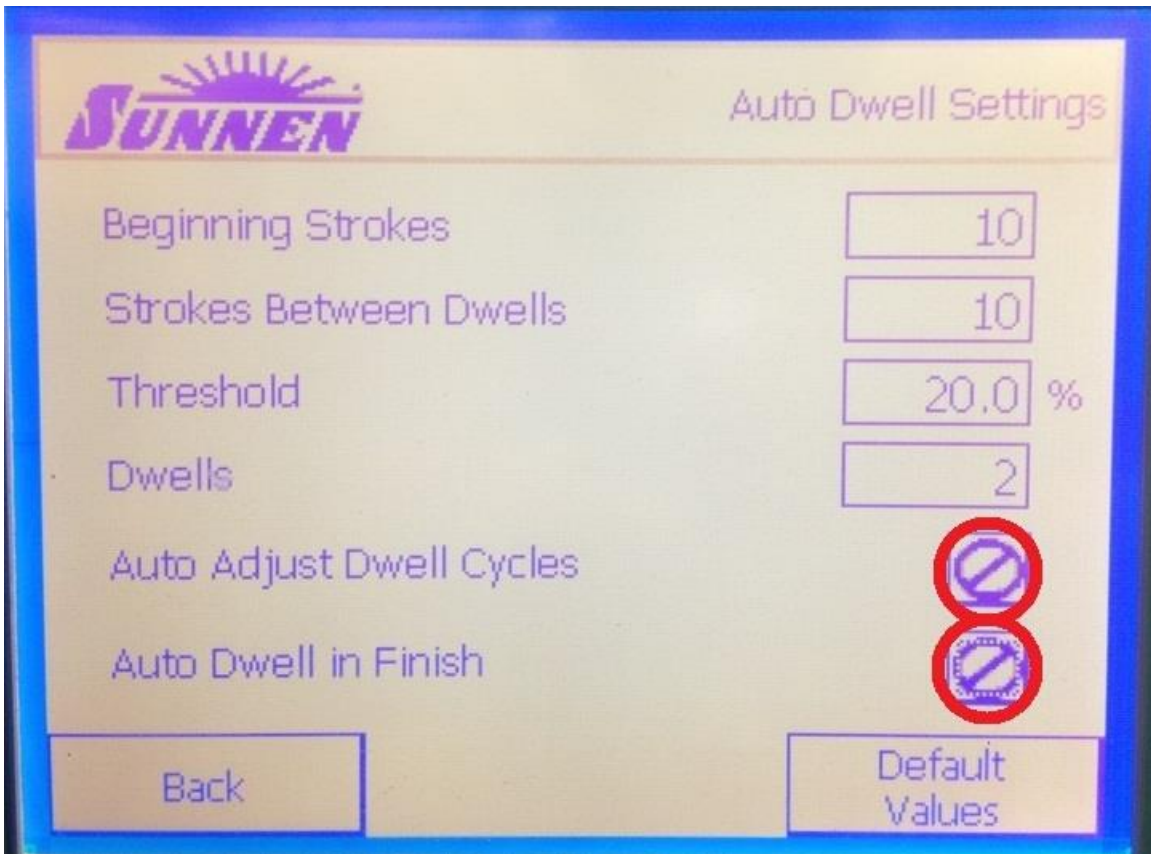
Feed Handwheel has been manually advanced too fast.

In either case, the result is a higher than normal stone breakdown and a rougher than normal surface finish for that particular abrasive. Low Load Meter Reading: An initial load meter reading of more than 10% below the reading for the previous cylinder indicates the Feed Handwheel has not been manually advanced far enough, or it has been manually advanced too slowly. The surface finish left by the prior operation is too rough for the stones being used; therefore, an intermediate stone must be used between the rough and the fine finish honing operation. Stone glazing and smoother than normal surface finishes will result from incorrect Handwheel pressure. Erratic surface finishes and excessive finishing stone wear will result from incorrect Stone selection.

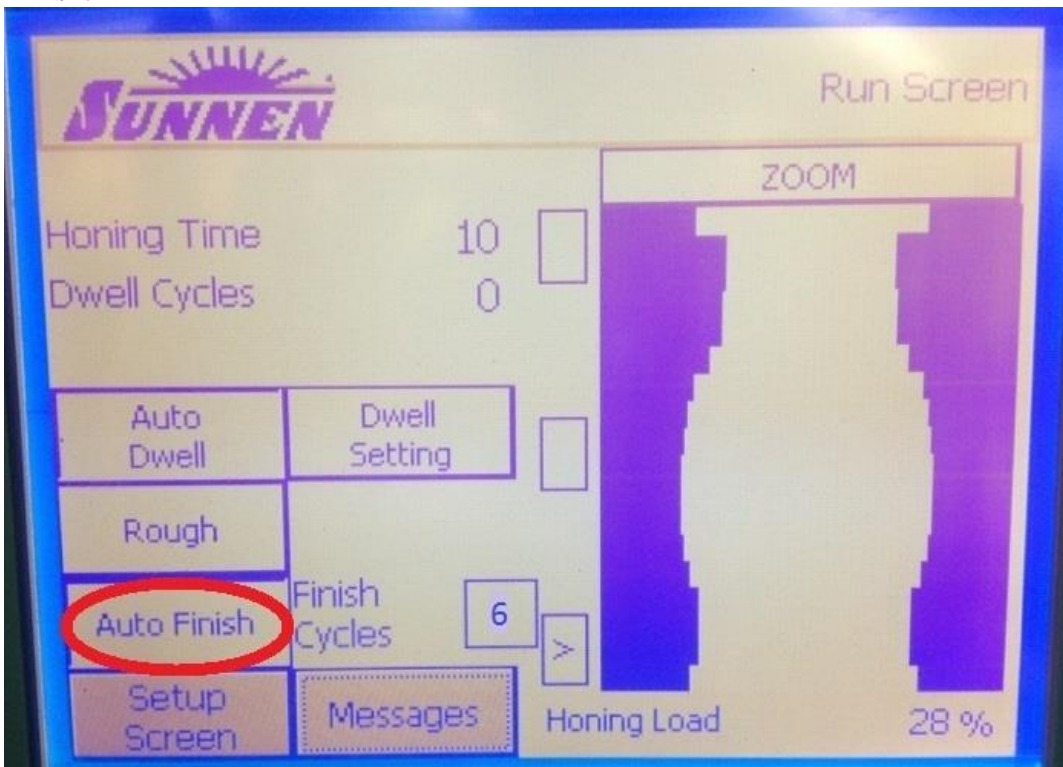
DWELL SETTING SCREEN

12. From the Run Screen, the operator must select Dwell Setting to DISABLE the Auto Adjust Dwell Cycles and Auto Dwell in Finish options from the Auto Dwell Settings options screen.





13. At this point the operator can select BACK to go to the Run Screen and select Auto Finish.



14. The Finish Cycles need to be set to 6 prior to proceeding with the hone.



Dwell Cycles:

Shows the number of strokes the machine will dwell at a location in the bore as selected by the Dwell Position Selector.

Honing Time:

Displays the number of seconds that the machine will run while in the Timed Honing mode as selected on the operator console.

State:

Indicates the state of the dwell function (i.e. off, on, or on continuous). By using Dwell Control Button operator located on the workbase, the operator can push the button one time to dwell the machine 1 cycle. This will switch the state indicator from Off to ON. The operator can press and hold the button for 2 seconds and dwell the machine every cycle until the button is depressed again. This will switch the state indicator from Off to On Cont. Note that the location of the dwell is determined by the Dwell Position Selector.

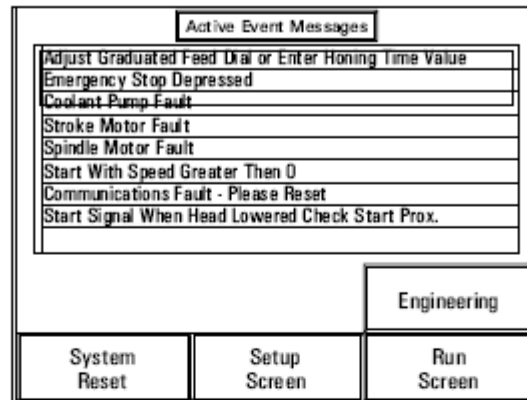
Rough / Finish buttons:

Switches the spindle speed and stroke rate between the rough and finish setup entered on Setup screen 2. For GMOD honing this is always set to Rough.

Event Message Exists:

This message reminds the operator to go to the message screen to review warnings or errors that may have occurred with the machine.

ERROR MESSAGES SCREEN



Adjust Graduated Feed Dial or Enter Honing Time Value:

If in zero shut off mode, the machine will not start if the feed dial reads zero from the previous cycle. Adjust dial, press "system reset" and restart. If in a timed cycle mode, the machine will not start unless there is a value other than zero in the display. Set time, press system reset, and restart.

Emergency Stop Depressed: Release Emergency Stop, press system reset and restart.

Coolant Pump Fault: Check that pump overload is not tripped. Press system reset and restart.

Spindle Motor Fault: Press system reset and restart. Contact Sunnen if problem persists.

Stroke Motor Fault: Press system reset and restart. Contact Sunnen if problem persists.

Start With Speed Greater Than 0: This indicates that the machine was attempting to start and also turn the spindle and stoker at a given speed when the clutch control handle was pushed rearward. This is purely a safety feature that prevents the machine from running unexpectedly. Verify that the Clutch proximity sensor is secure. Verify that the Clutch pivot screw is secure. Press system reset and restart.

Communication Fault: Occurs during Emergency stops and may occur if constant communication is not maintained between the PLC, Drives, And Operator Station. Press system reset to clear and restart. If problem persists, verify wiring is secure in cabinet. If problem continues, contact Sunnen.

Start Signal When Head Lowered Check Start Prox: This indicates that the machine was receiving a signal to start at the same time the head was being lowered. This is purely a safety feature that prevents the machine from running unexpectedly. Verify that the operator was not in contact with the clutch control lever when the head was lowered. If problem persists, verify that the Clutch proximity sensor is secure. Verify that the Clutch pivot screw is secure. Also verify that the Head proximity sensor and target are in adjustment. Press system reset to clear and restart.

ENGINEERING SCREEN

Engineering Screen		
Sensor Status		
Top of Stroke	<input type="checkbox"/> OFF	Total Cycle Time = 15
Zero Shutoff	<input type="checkbox"/> OFF	Graph Scale = 2.0
Hone Head Down	<input type="checkbox"/> OFF	TYPE < 100
Cycle Start	<input type="checkbox"/> OFF	STEP < 100
Clutch Prox	< 100	
Running Second		< 20
Panel Settings	Setup Screen	Run Screen

Sensor Status: Allows for troubleshooting of all machine sensors. Status of each sensor will toggle between ON & OFF when each function is performed. If a change in status is not seen, check switch for proper adjustment and make sure all cable connections are tight.

Total Cycle Time: Time in seconds the machine ran from when the Clutch Handle was pulled forward until the cycle ended. This number resets each time the Clutch Handle is pushed rearward.

Graph Scale: Graph Scale is a touch screen function that can be adjusted between two limits to adjust the magnification of the bore profile graph. (Tips: If spindle load is low, graph scale value should be set higher. If spindle load is high, graph scale value should be set lower.)

Running Second: Total spindle run time in seconds. This is a cumulative number that never resets.

Type: Should a persistent error occur, before any system reset, please record information presented in this field and have handy when calling for service.

Step: Should a persistent error occur, before any system reset, please record information presented in this field and have handy when calling for service.

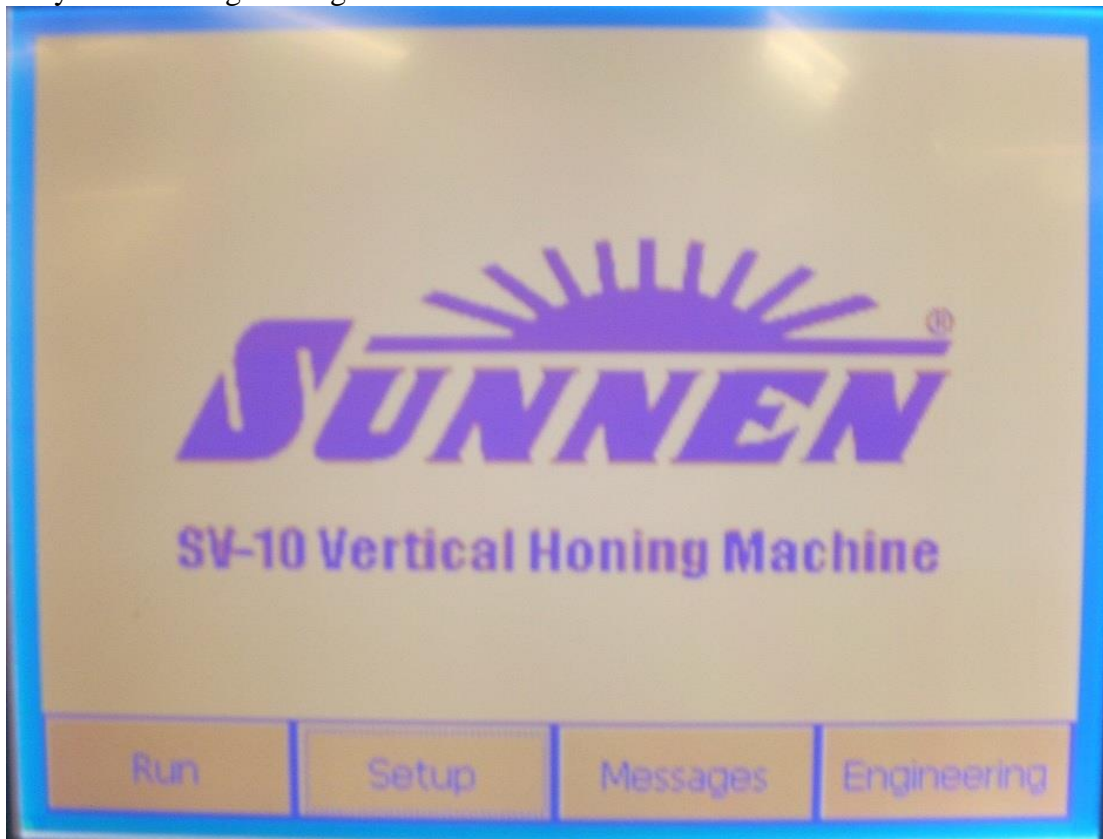
ENGINEERING SCREEN

Getting Started / Engineering

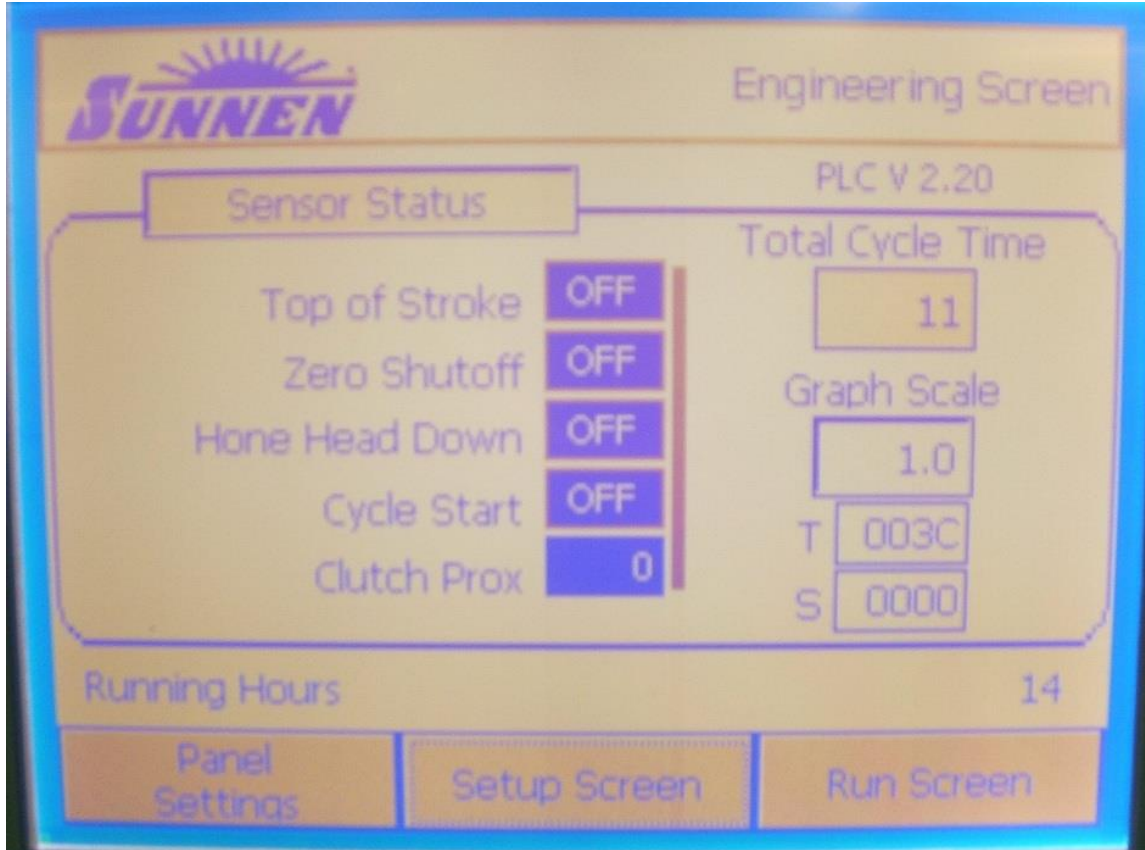
1. Turn power on by using switch located on the operator console.



2. Wait for main screen to appear on the machine and select the Engineering key to take you to the Engineering Screen.



3. **Running Hours:** Total spindle run time in hours. This is a cumulative number that never resets.



MAINTENANCE

Use the honing machine Engineering Screen Running Hours meter to determine hours of operation.

1. Replace the honing filters, CV1100 honing mats, and check the fluid level after every 15 hours of operation. Top off the fluid as necessary.
2. Replace the honing fluid in the honing machine after no more than 60 h of honing machine operation.
3. Follow the Sunnen recommended Routine Maintenance in the SV-10 Installation, Setup and Operations Instructions manual.

Citation

Installation, Setup and Operation INSTRUCTIONS for SUNNEN® VERTICAL HONING MACHINE (FOR AUTOMOTIVE & INDUSTRIAL APPLICATIONS) Model SV-10 (2005). *SUNNEN® VERTICAL HONING MACHINE Model SV-10*. SUNNEN®, St. Louis, MO. Intertek San Antonio, TX.

Materials

Honing Fluid SHO 965
Honing Fluid Filters PF 105 (5 micron)
Honing Matts CV-1100

Sunnen SV-10 Mechanical Setting and Trimming of the Lower Stone Holding Springs to prevent stone damage.

The Sunnen SV-10 has a mechanical setting in the head dependent on the bore length (see photo attached). The stroke length can be correctly programmed into the machine and will be performed despite the manual setting, however based on the manual setting the head can potentially contact the honing deck if not properly positioned.

The setting for GMOD block honing is as follows:

- i. 5.60" (bore length)
- 3.00" (to account for the length of the stones)
- + 3/8" (top overstroke)
- + 3/8" (bottom overstroke)
- i. 3.35" (manual setting for the SV-10)



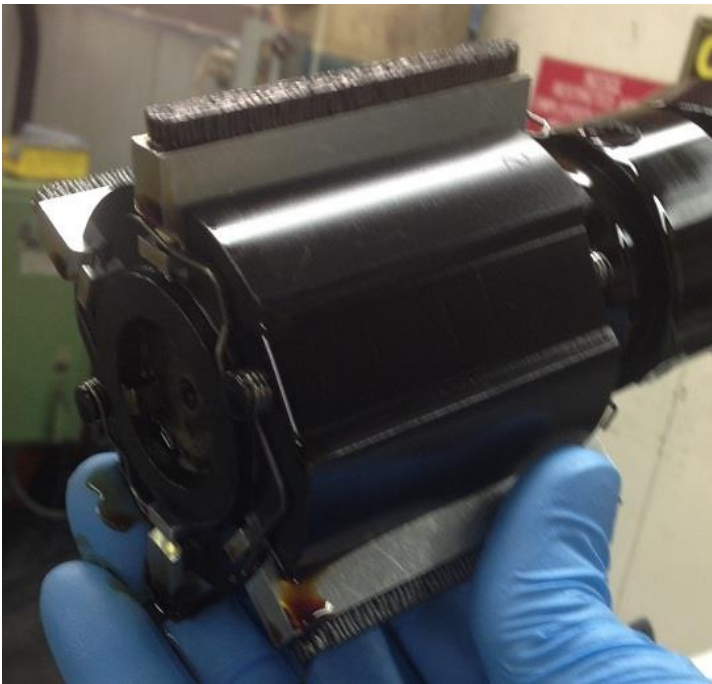
Picture of 3.35" (manual setting for the SV-10)

Trimming of the Lower Stone Holding Springs

These springs needed to be trimmed at the bottom of the honing head due to the GMOD cylinder bore and the position of the main caps (shown in "GMOD Cylinder Bore" photo). Without being trimmed, the springs would contact the main cap portion of the block at the bottom of the cylinder when honing a fresh block. The "SV-10 Honing Head Top" photo depicts what the holding springs looked like before modification on the bottom of the honing head. The modification made is shown in the "SV-10 Honing Head Bottom (Springs Trimmed)" photo.

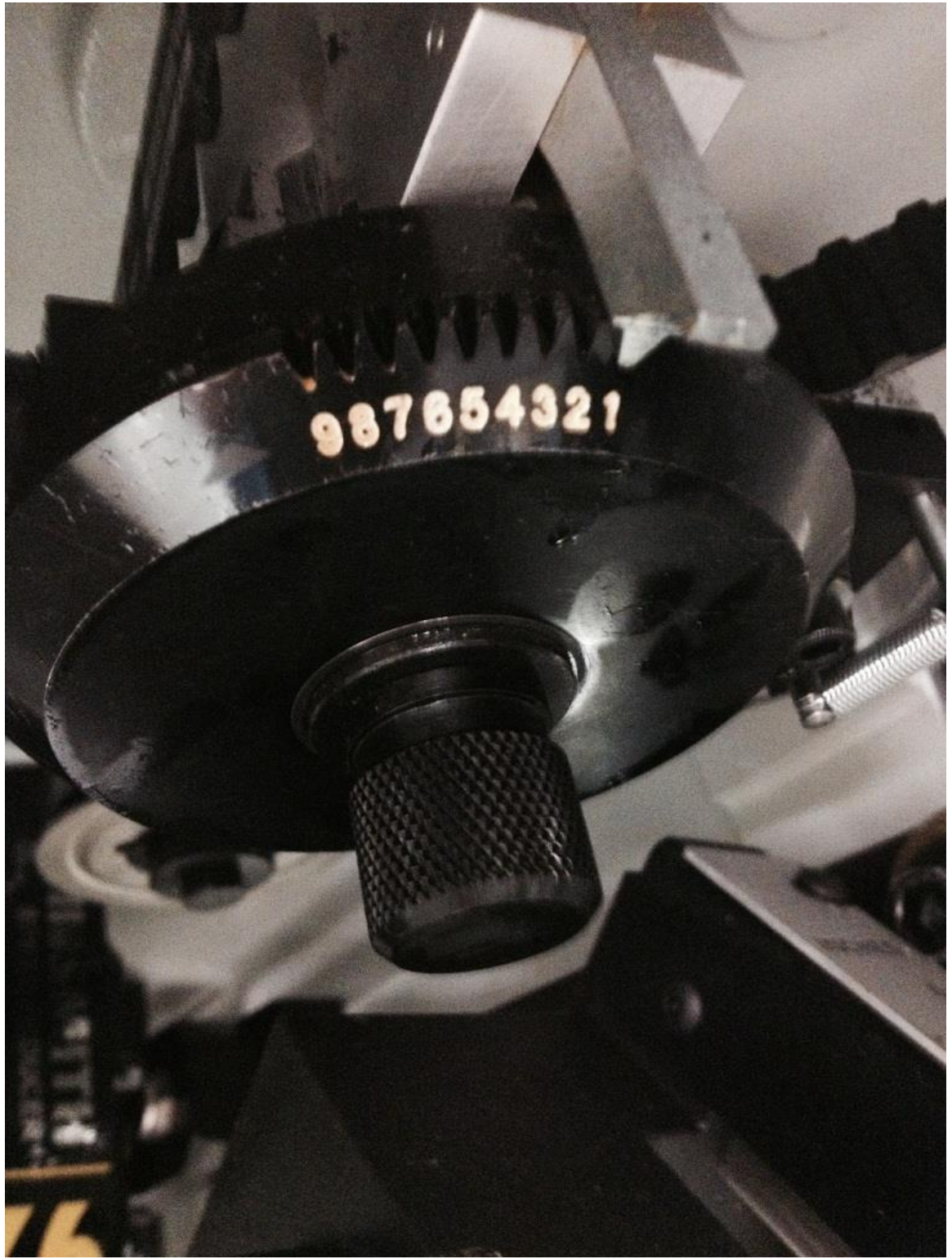


SV-10 Honing Head Top



SV-10 Honing Head Bottom with the lower Springs Trimmed

Feed rate setting



New stone break-in procedure

1. Using a honing practice block, start by using Dykem on the face of the stone and hone a cylinder bore.
2. Look for the contact pattern on the stone so if the Dykem has been removed then the stone is obviously higher in that position.
3. Use the white dressing stick supplied by Sunnen with the honing head, to rub the stone in the highest area.
4. The process is repeated until a good line contact is visible along the length of the stone. Typically we see that the stone radius will start in the middle of the stones and work its way to the outside of the stick.
5. Another process that can be used is lapping paste (fine grit abrasive and honing oil) that can be put in a cylinder and run to help break down the higher areas of the stone.

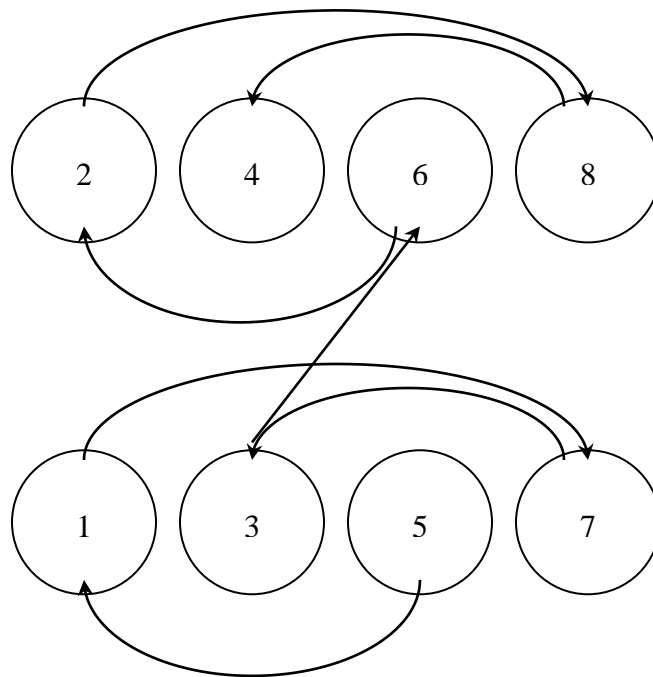
GMOD Engine Honing Requirements

- Block must be at room temperature before honing
- Torque plates and main bearing caps are to be installed
- New head bolts are to be used on the torque plates for every block hone.
- The flow rate of the honing fluid is to be set at 7 L/minute. This flow rate is to be measured and confirmed on a monthly basis. A log recording the dates of these checks is to be kept to confirm measurement frequency.
- Set feed rate to position 1. See picture on page 18.
- Hone Speed is set to 200 rpm for all steps
- When new diamond honing stones are first used it is important to ensure the stone exhibits full contact across the face. The Sunnen Dressing stone can be used to adjust the face.

Cylinder Honing Sequence

Follow the recommended honing sequence (5, 1, 7, 3 – 6, 2, 8, 4)

*Note: DO NOT hone adjacent cylinders



Honing Procedure

Step 1) Check the level of the honing fluid is within 1 inch (25mm) of the full mark. Add Honing Fluid SHO 965 if necessary.

Step 2) Hone the engine block to within 0.0005” of target bore size with **DHH7GMH55** and with initial load settings between 30-35%. As the machine hones the load may fluctuate but no further manual operator inputs to the Feed Handwheel are to occur after the initial load setting. Dwell switch set to Auto and select Auto Finish on the Run Screen. Set the number of Finish Cycles to 6 on the Run Screen. The machine will automatically enter the Auto Finish step after the Feed Handwheel reaches zero.

Step 3) Hone an additional 0.0005” to target bore size with DHH7GMH55 and with initial settings at 20-25% load. As the machine hones the load may fluctuate but no further manual operator inputs to the Feed Handwheel are to occur after the initial load setting. Dwell switch set to Auto and select Auto Finish on the Run Screen. Set the number of Finish Cycles to 6 on the Run Screen. The machine will automatically enter the Auto Finish step after the Feed Handwheel reaches zero.

Step 4) Set the hone timer to 15 seconds and hone with **DHH7RMH907** and with initial settings at 15-20% load. As the machine hones the load may fluctuate but no further manual operator inputs to the Feed Handwheel are to occur after the initial load setting. Dwell switch is set to Manual*.

Step 5) Set the hone timer to 10 seconds and hone with DHHB7534 with initial settings at 10-15% load. As the machine hones the load may fluctuate but no further manual operator inputs to the Feed Handwheel are to occur after the initial load setting.

Step 6) Measure and record the surface finish utilizing the Mitutoyo SJ-410 at 1.25”, 2.25”, and 3.25” from the top of each cylinder. Follow the **Mitutoyo Surftest SJ-410 Setup and Measurements Procedure** in this section to take these measurements. The average surface finish in each cylinder must meet the specifications in the table below. No re-measuring to find more favorable data is allowed.

Target Surface Finish (μ in)	
Rpk	1 - 12
Rk	1 - 41
Rvk	16 - 57

Record each cylinders average Rpk, Rk, and Rvk, in control charts so the honing process can be tracked and to prevent the occurrence of honing outside of the above target ranges. These control charts must be maintained and will be reviewed during the annual TMC inspections.

Step 7) Using a dial bore gage, whose setting has been verified with either a 99.000 mm or a 3.9000” certified master ring gage, measure the final bore size of each cylinder. Take transverse and longitudinal measurements at 3/4” down from the deck, 1-3/4” down from top measurement, and 1 3/4 down from center measurement.

A bore measurement ladder has been found to be beneficial for taking these measurements. Such a device can be found in the GMOD Test Stand Manual Appendix H.

The intent is to have the finished cylinders within +/- 0.0002in. of the target size.

Record the cylinder bore measurements in the Data Dictionary Form 18, A.1

Maximum allowable taper = 0.0127mm (0.0005in)

Maximum allowable out-of-round = 0.0127mm (0.0005in)

Step 8) Prior to cleaning in the ultrasonic bath the torque plates and main bearing caps are to be removed from the block.

***NOTE:** The reason the switch is turned to Manual is to avoid a Dwell occurring during the final strokes.

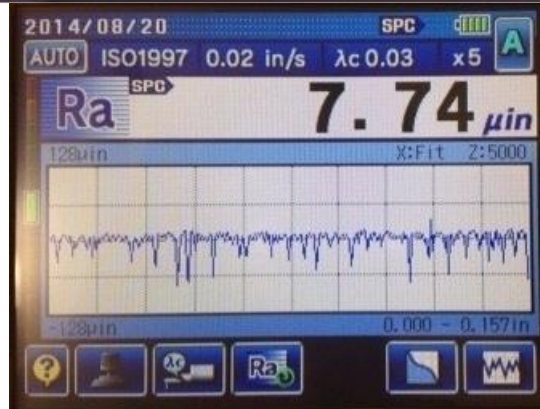
GMOD Engine Block Target Bore Sizes by Run Number						
Engine Block Run Number	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
<i>Target Bore Size (in)</i>	3.898	3.899	3.900	3.901	3.902	3.903
<i>Target Bore Size (mm)</i>	99.009	99.035	99.060	99.085	99.111	99.136

What to do if your surface finish is out of specification

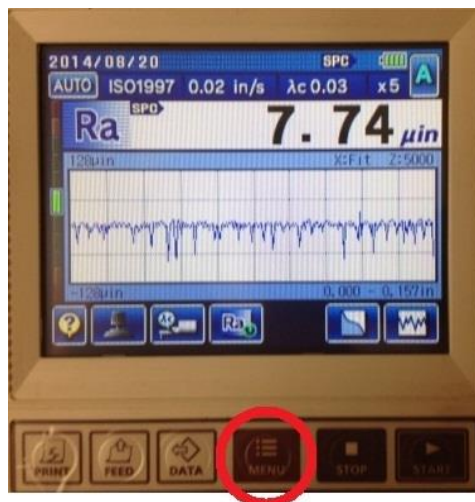
1. Using the SF control charts determine whether a gradual change been occurring or if this is a sudden change.
2. If the stones are new have the stones had adequate bedding in time?
3. Check calibration of SF measurer.
4. Check the honing fluid flow rate
5. Examine the stylus tip.
 - i. Is it secure?
 - ii. Is it damaged? Use a magnifying glass to examine.
6. Check the security of the table holding the SF analyzer to ensure it is secure to the block.
7. Is the SF Analyzer correctly positioned on the holding table?
8. Replace the honing fluid and mats.

Mitutoyo Surftest SJ-410 Setup and Measurements Procedure

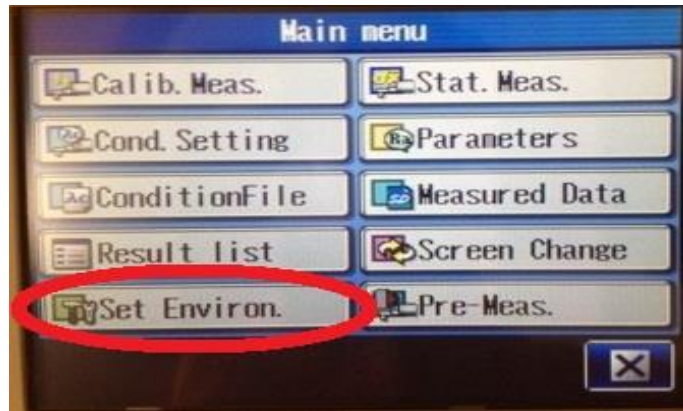
Power On



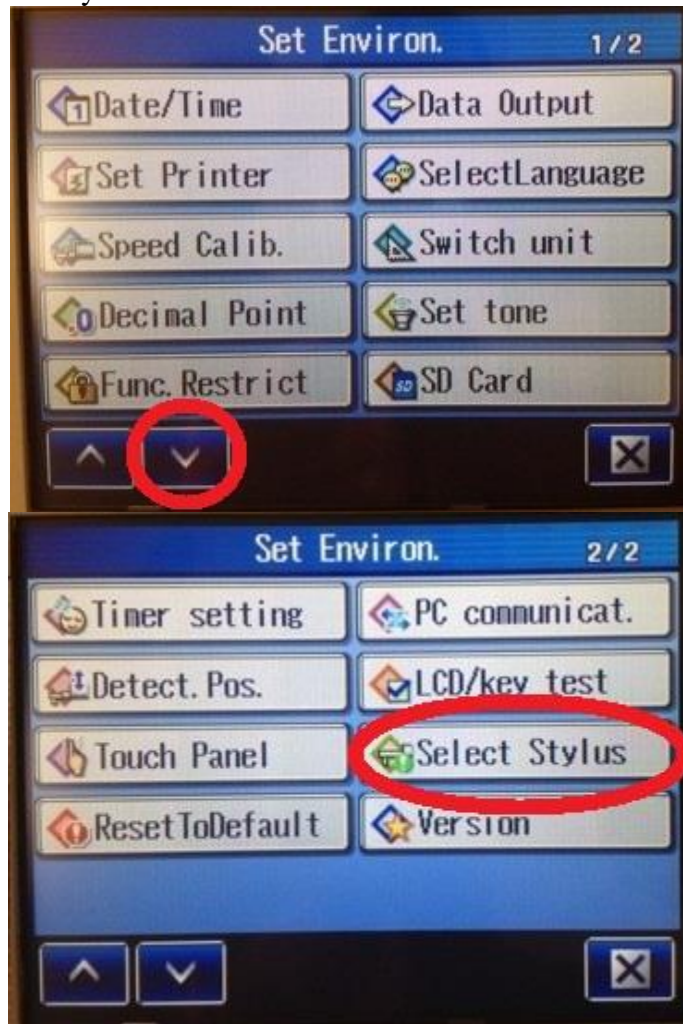
Select Stylus MENU



Set Environ.



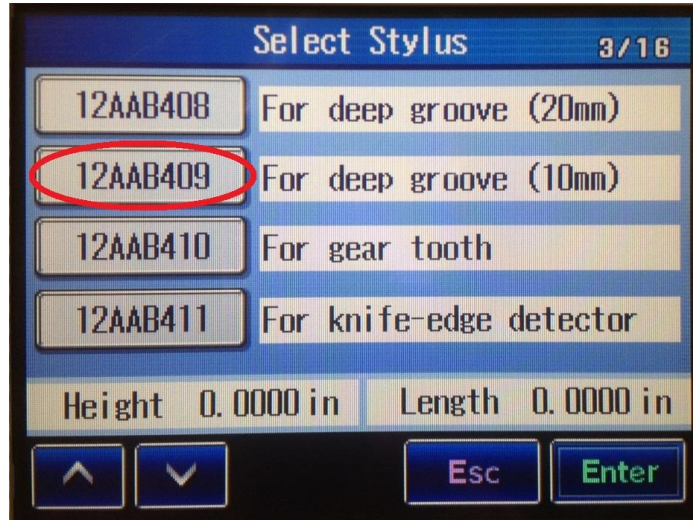
Select Stylus



Select ***



Select 12AAB409: For deep groove (10mm)
Press Enter

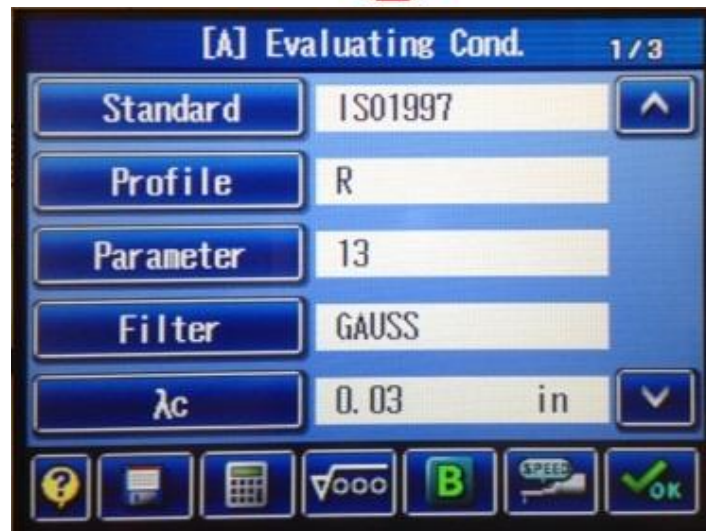
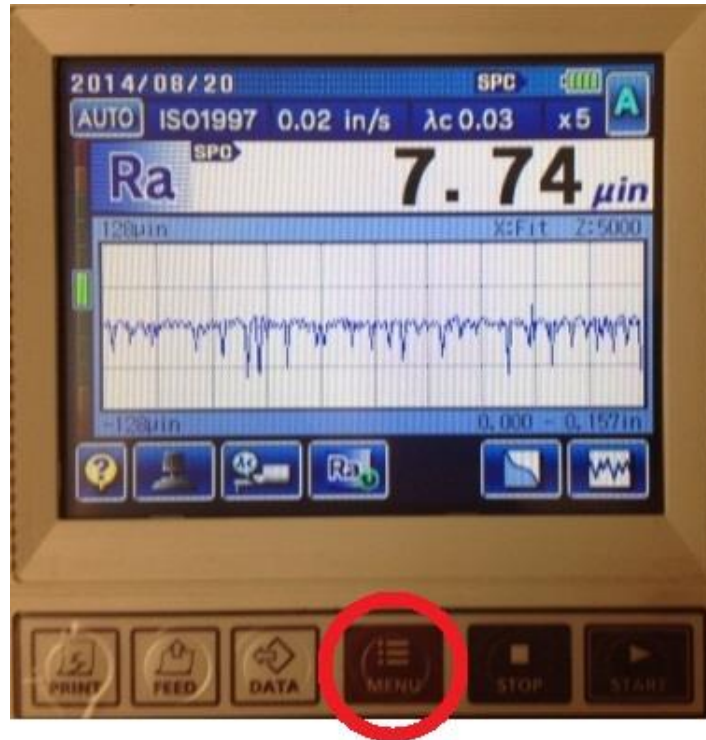


Highlight the correct Stylus
Press OK



Return to MENU

Condition Settings
MENU





Cond. Setting
Standard: ISO1997



Profile: R



Parameter: Rk, Rpk, Rvk,



Filter: GAUSS

λ_c : 0.03 in

λ_c		in
0.003	$R_a \leq$	0.8 μin
0.01	$R_a \leq$	4.0 μin
0.03	$R_a \leq$	80.0 μin
0.1	$R_a \leq$	400.0 μin
0.3	$R_a \leq$	3200.0 μin
1	$R_a \leq$	*

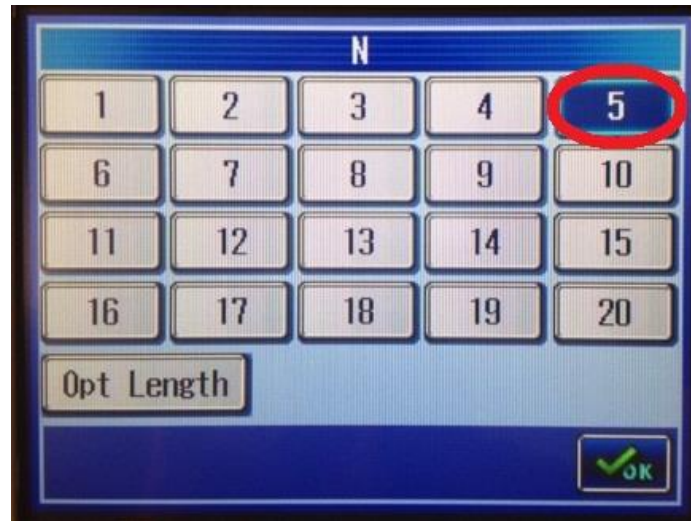
Buttons: Ra, Rz, RSm, OK

λ_s : 100 μin

λ_s	μin
100	320
1000	

Buttons: OK

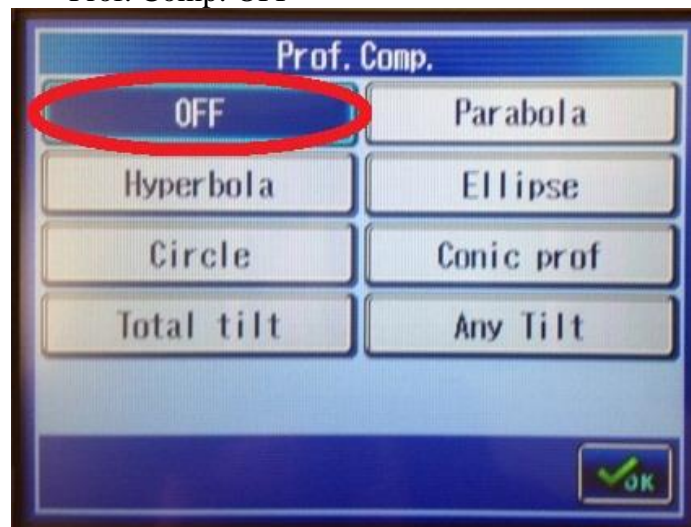
N: 5



Pre/Post: ON
Del. Wave: OFF

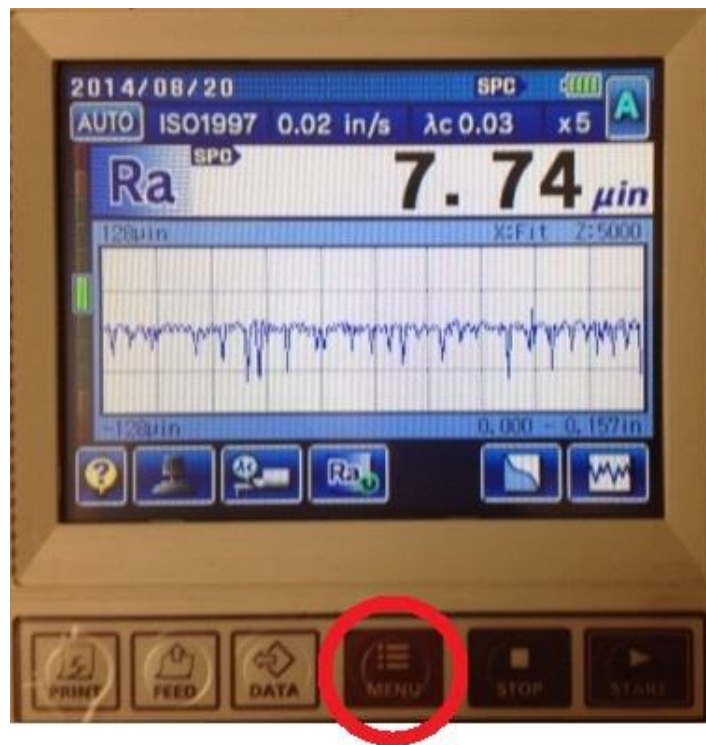


Prof. Comp: OFF

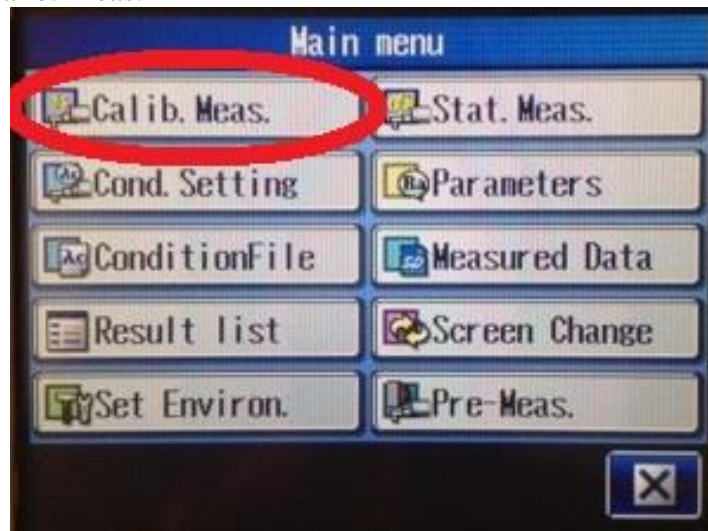


Mean Line: OFF
Return to MENU

Calibration Measurement
MENU



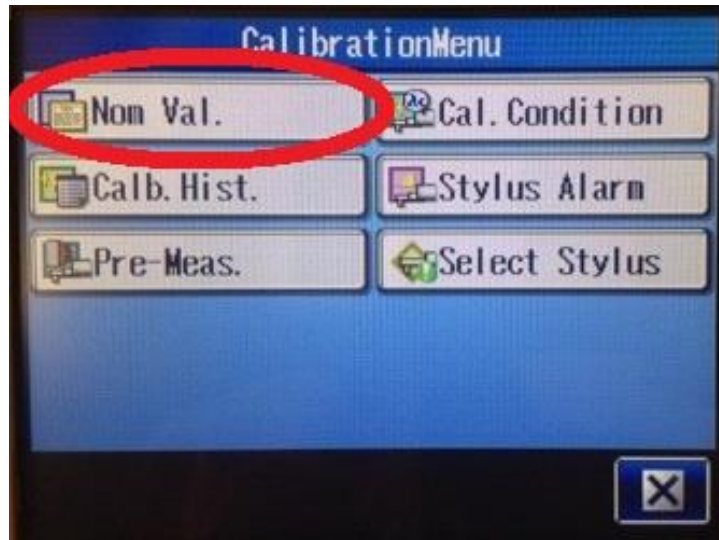
Calib. Meas.



Touch Screen MENU



Nom Val.



Specimen value: 117.00 μin
Press Enter



Perform leveling



Top knob (large adjustments)



Bottom knob (small adjustments)



START



Update Calibration Value



Recycle to discard Calibration Value



Return to MENU

Setup and Measurement

- 1) Leveling of the stylus in the liner is crucial.
- 2) Measuring fixture platforms are standardized for the test labs.
- 3) Conditional settings within the SJ-410 must be the same.
- 4) Skid nose piece needs to be in use when performing surface finish measurements.

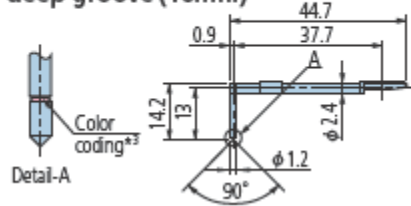
Note: To perform the skid-attached measurement, turn the skidless/skid attached switching screw clockwise gently with a flat head crew driver to loose until it stops. This screw is located underneath the drive unit.

Mitutoyo SJ-410 Parts List:

Deep Groove Stylus (5 μ m tip): 12AAB409

Styli

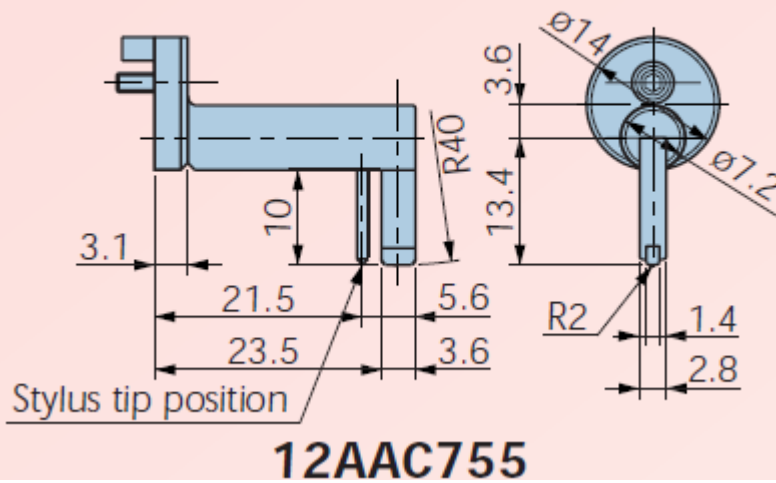
For deep groove (10mm)



12AAB409 (5 μ m)
(): Tip radius

Skid Nose Piece: 12AAC755

Applicable skid nosepiece



12AAC755

50 mm Extension: 12AAG202

Extension rods

- 12AAG202 Extension rod 50mm



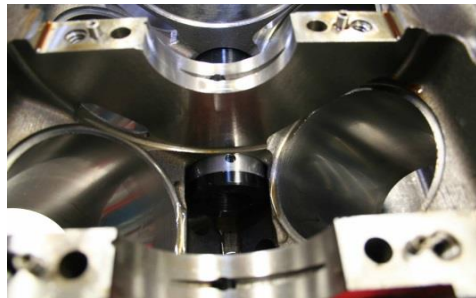
Section 3 Short Block Assembly

2/15/2016

Engine Build Specification Table

Engine Build Clearances	Specification Inch/mm	Location in Section 3	Data Dictionary Page
Camshaft bearing clearance	0.0008-.0055" / 0.0203-0.1397 mm	Sheet 4	Form 19, A.8
Camshaft End Play	0.001-0.012" / 0.025-0.305 mm	Sheet 13	Form 19, A.5
Connecting Rod bearing clearance	0.0009-0.0025"/ 0.023-0.064 mm	Sheet 26	Form 19, A.11
Crankshaft Main bearing clearance	0.0008-0.0025"/ 0.02-0.065 mm	Sheet 8 & 9	Form 19, A.7
Crankshaft end play clearance	0.0015-0.0078" / 0.04-0.2mm	Sheet 9	Form 19, A.6
Cylinder bore out of round maximum	0.0005" / 0.0127mm	Sec. 2 page 21-22	
Cylinder bore taper maximum	0.0005" / 0.0127mm	Sec. 2 page 21-22	
Piston to cylinder bore clearance	0.003 – 0.005" / 0.076 – 0.127 mm	Sheet 23 & Sec.2 page 21-22	Form 18, A.2

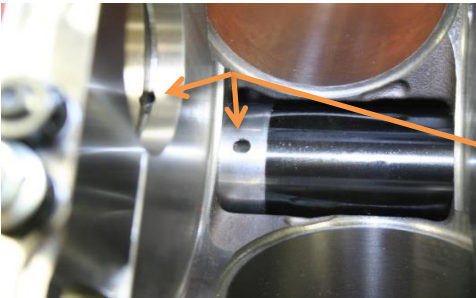
A		A		Description of Operation		
<p><u>Post Hone Block Cleaning Procedure</u> Torque plates and main caps removed Follow <u>Parts Cleaning Procedure Steps 1</u> through 5 only, Section 8, page 3.</p> <p>Option A. Step 1. Clean block in sonic cleaner for 1 hr. Step 2. Quickly remove block from the ultrasonic cleaner and immediately spray with hot water for one minute. Do not spray over the ultrasonic bath. Step 3. Spray with 50/50 stoddard and EF-411 to remove the water and prevent rust and oxidation flash over. Step 4. Once block is cooled to room temperature, spray with 100% Stoddard and use a bristle brush on all internal surfaces including the cylinder walls using a nylon bore brush. Step 5. Wipe cylinder walls with a lint free white cloth to verify no rust or residue is left on cylinder walls. Step 6. Spray with 50/50 stoddard and EF-411 mix. Step 7. Air dry. Step 8. Proceed to Operation B.</p>		<p><u>Post Hone Block Cleaning Procedure</u> Torque plates and main caps removed Follow <u>Parts Cleaning Procedure Steps 1</u> through 5 only, Section 8, page 3.</p> <p>Option B. Step 1. Clean block in sonic cleaner for 1 hr. Step 2. Quickly remove block from the ultrasonic cleaner and immediately spray with 50/50 Stoddard and EF-411 mix. Do not spray over the ultrasonic bath. Step 3. Once block is cooled to room temperature, spray with 100% Stoddard to remove oil. Step 4. Air dry. Step 5. Rinse entire block with untreated water (deionized water is acceptable to use) using a bristle brush on all internal surfaces. Make sure cylinder walls are thoroughly brushed using a nylon bore brush. Step 6. Wipe cylinder walls with a lint free white cloth to verify no rust or residue is left on cylinder walls. Step 7. Spray with 50/50 stoddard and EF-411 mix. Step 8. Air dry. Step 9. Proceed to Operation B.</p>		A	Follow either Option A or Option B of the Post Hone Cleaning Procedure	
				B	Clean out the holes in the crankshaft counter weights so all post test residue is removed.	
				C	Check engine block, camshaft tunnel, lifter bores, oil galleries, gasket surfaces, and cylinder bores for cleanliness.	
				D	No more than 8 oz. of EF411 is to be used in each engine build.	
		Specification				
		View				
				Engine block post-hone cleanliness inspection		
				Section	Sheet	
Short Block		GMOD		3	1	



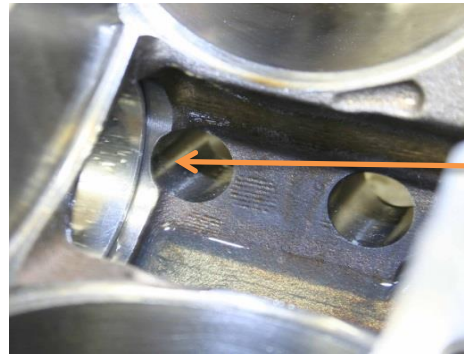
Camshaft Bushing Alignment Notes:

With Main Caps Removed;

- 1) Align bushing oil feed hole with drilled oil feed gallery from main bearing bore.
- 2) Position bushing 1 recessed from the machined face of the block.
- 3) A good practice is to use a pin light and view the oil feed hole in the bushing, ensuring it is lined up with the drilled passage through the main bore.
- 4) Make sure bushings clear lifter bores on front and rear of bushings.

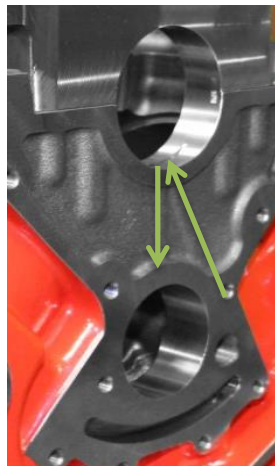


Align oil feed holes while installing bushings



Oil Flow (Green Arrows)

Lifter Bore (Breakout)



Description of Operation

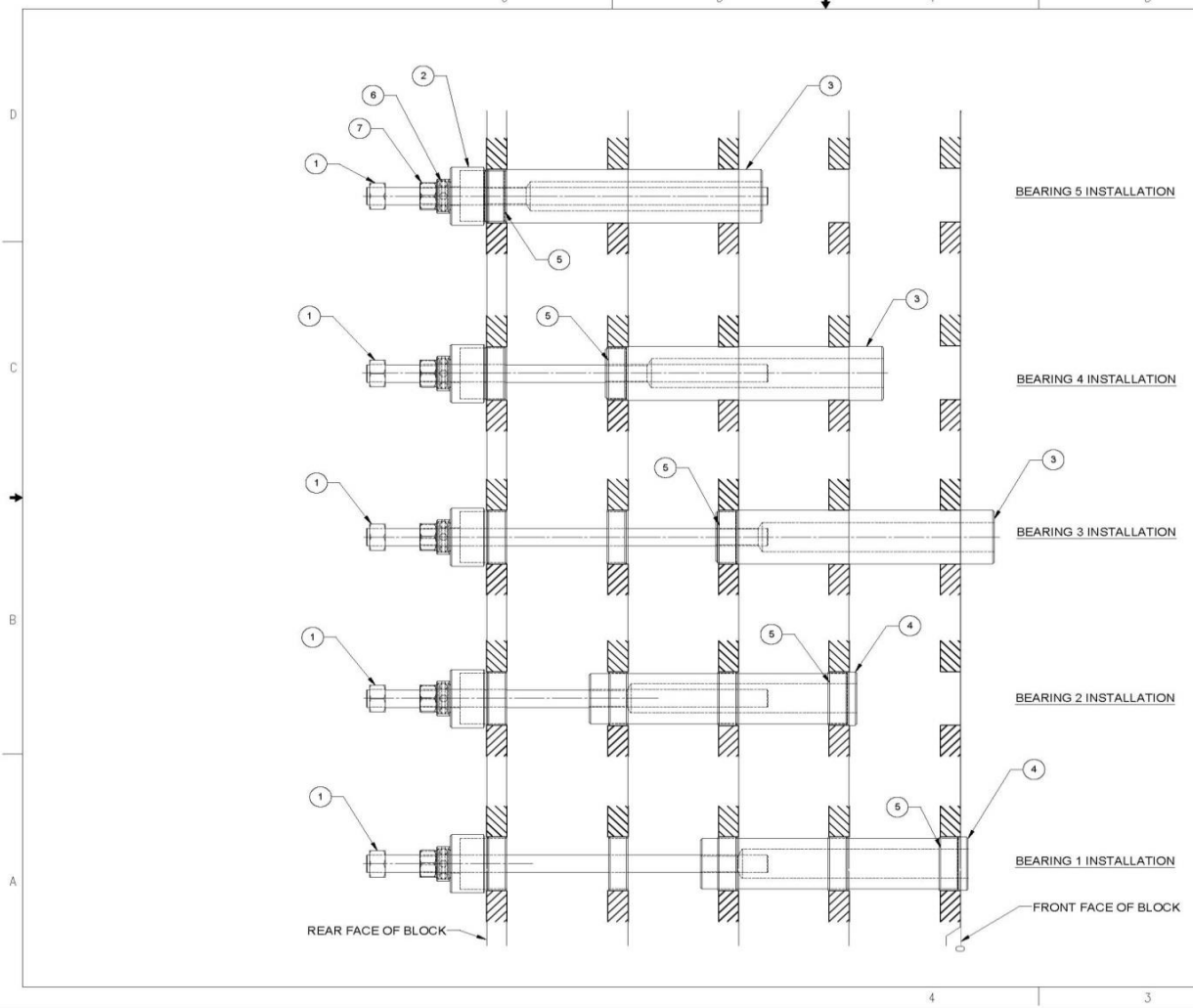
- A Install the OHT Camshaft Bushings using the special OHT Camshaft Bushing Installation Tooling. (See Section 3 Sheet 3)
- B The GMOD LSX Oil Test Block has a priority oiling design which feeds oil off the main oil gallery straight to the crankshaft main bearings and then up to the camshaft bushings. Care must be exercised to align the oil feed hole in the bushings with the drilled gallery passage from the upper main bore. Care must also be exercised to position the bushings in the number 2,3,& 4 positions so they are equally spaced between the lifter bore holes on each side of the camshaft bushings. The front bearing is to be installed flush with the block face. This improves alignment of the oil holes in bearing and block.
- C

Specification

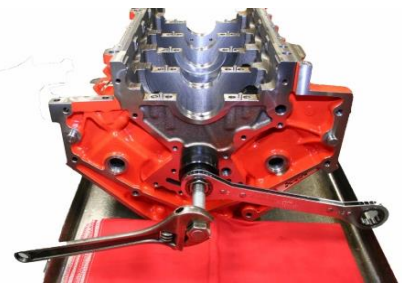
- 1 GMOD 001-06 Camshaft Bushings 1-5

REV	Date	Revision History
Short Block		GMOD

View	
Camshaft Bushing Installation	
Section	Sheet
3	2

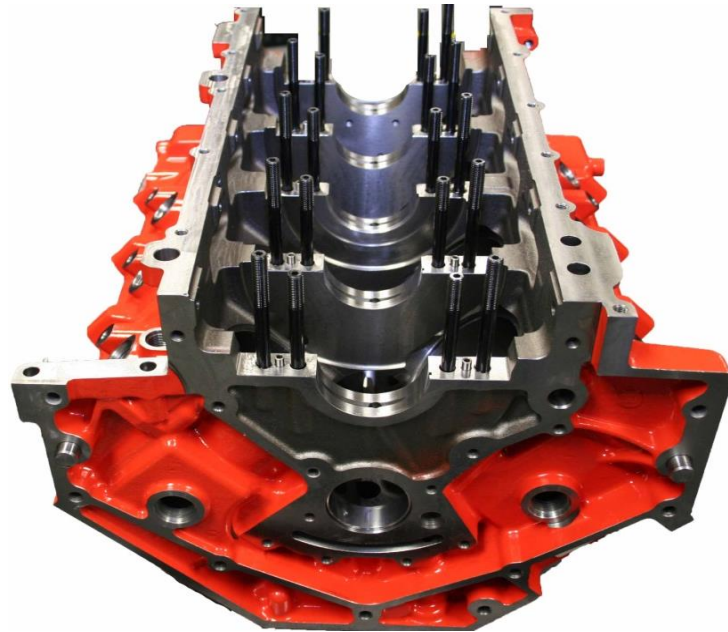


ITEM NO.	PART NUMBER	DESCRIPTION	QTY
1	OHTGMOD-004-5	PULLER SCREW, CAM BEARING INSTALLATION, SEQ. GMOD	1
2	OHTGMOD-004-2	END CAP, CAM BEARING INSTALLATION, SEQ. GMOD	1
3	OHTGMOD-004-3	SHAFT A, CAM BEARING INSTALLATION, SEQ. GMOD	1
4	OHTGMOD-004-4	SHAFT C, CAM BEARING INSTALLATION, SEQ. GMOD	1
5	CAMSHAFT BEARING		REF
6		.75 ID THRUST BEARING	1
7		3/4-16 HEX NUT, BLACK OXIDE FINISH	1



TOLERANCES:		UNLESS OTHERWISE SPECIFIED
FRAMES:	SEE PART LIST	
FINISH:		
ASSEMBLY:		
DATE:		
BY:		
REV:	1 OF 1	DATE: 1/18/2013
TOOL, CAM BEARING INSTALLATION		
ITEM NO.:	OHTGMOD-004-1	REV.:

REV	Date	Revision History	View		
			OHT Camshaft Bushing Installation Tool		
			The chart on this sheet outlines the proper sequencing of the camshaft bushing installation using OHTGMOD 004-1 Installation Tooling.		
Short Block		GMOD		Section	Sheet
				3	3



Note:

Use compressed shop air to blow through main cap oil drilled passages and main gallery oil passages to insure no materials are in oil passages after camshaft bushing installation.

Description of Operation

Check final positioning of camshaft bushings to ensure they are properly positioned between lifter bore holes.

Inspect all oil galleries for possible debris from bushing installation.
See "Note"

Measure the camshaft bearing clearances.
See Build Specification Table Section 3, Sheet 0.
Record clearances in the Data Dictionary Form 19, A.8.

Install main caps
(See Section 1 Sheet 4)
Prepare engine for final cleaning before test assembly.

Specification

REV	Date	Revision History

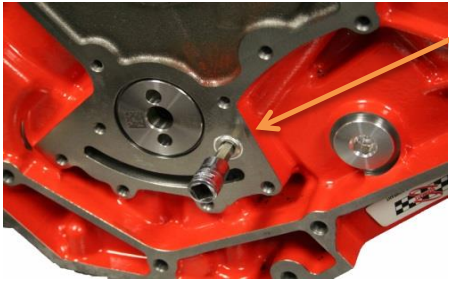
View	
Camshaft Bushing Inspection	
General inspection prior to cleaning after camshaft bushing installation.	

Short Block

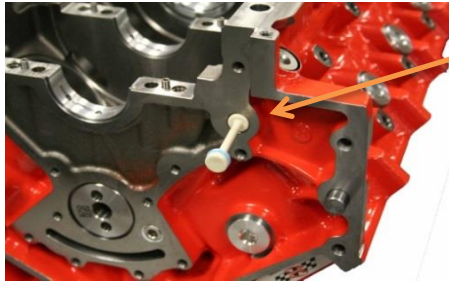
GMOD

Section
3

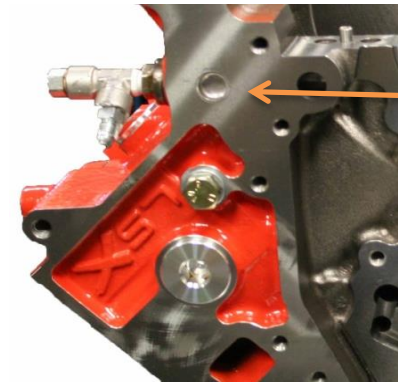
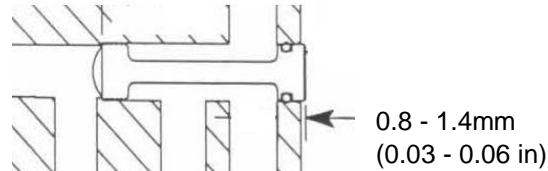
Sheet
4



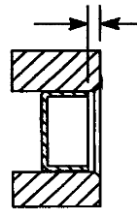
A1 Note: "A" Rear Oil Gallery Plug should be installed so that the plug is flush to no more than 0.040 inch protrusion from machined surface of block. The rear cover has a recess for this clearance. Make sure there is no interference when rear cover is bolted to block. Do not use alternate threaded plug as deeper reach plugs will protrude into cross drilled oil gallery passage.



B2 Note: "B" Oil Gallery Passage Divider, (Dog Bone Shape with O-Ring) should protrude as specified below from machined surface so rear cover applies slight pressure for proper internal sealing on recessed oil gallery diameter.



C3 Note: "C" Front Oil Gallery Cup Plug should be installed flush to slightly below machined surface of block.



Description of Operation

All plugs described on this page are replaced every test with new parts.

A Install rear oil gallery threaded plug. (See Note: "A"). The use of #2 Permatex to seal these threads is recommended. Torque to 44 lb-ft and check protrusion in note A1.

B Install rear oil gallery plastic dog bone style passage divider (See Note: "B").

C Install front oil gallery cup plug (See Note: "C").

Specification

- 1 14090911 Plug, Oil Gallery Threaded
- 2 12573460 Plug, Oil Gallery Passage Divider
- 3 9427693 Plug Oil Gallery Cup

REV	Date	Revision History

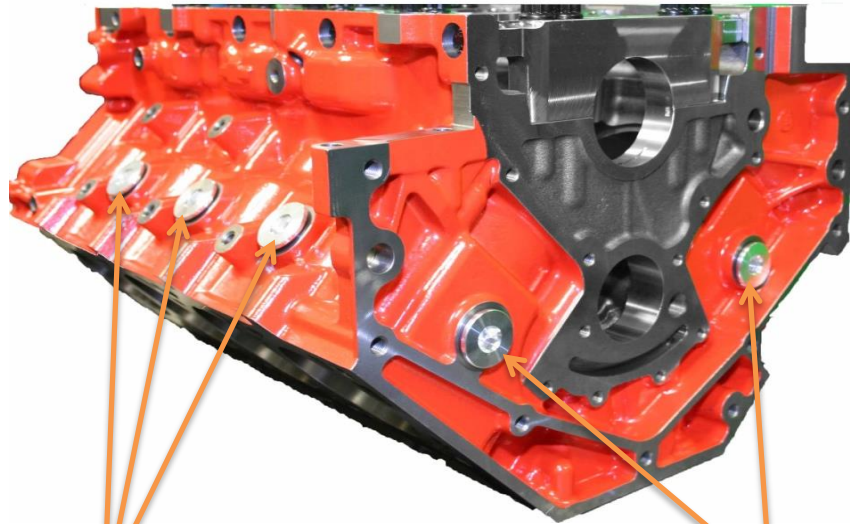
View
Oil Gallery Plug Installation
Installation views and notes for oil gallery plug installations.

Short Block

GMOD

Section
3

Sheet
5



A 1
AN Core Sand Plugs
3 Each Side

A 1
AN Core Sand Plugs
2 Each Front & Back

Description of Operation

A
Install all AN type core sand plugs using new O-rings.
Tighten the core sand plugs to 11Nm (100 in lb).

Specification

- 1 AN type Plug, Core Sand
- 2 GMW395 Kit, O-ring, GMOD Test Block
or use MS92794 if plug is large size

REV	Date	Revision History

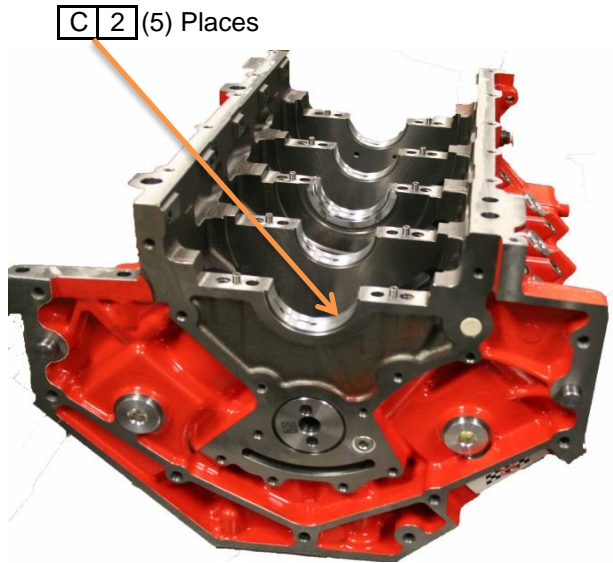
View	
Coolant Jacket Core Plugs	

Short Block

GMOD

Section
3

Sheet
6



- OHT GMOD Bearing Kit
- OHTGMOD001-1 Bearing, Connecting Rod (16 Ea.)
 - OHTGMOD001-2 Bearing, Crankshaft, Upper (4 Ea.)
 - OHTGMOD001-3 Bearing, Crankshaft, Lower (4 Ea.)
 - OHTGMOD001-4 Bearing, Crankshaft, Thrust, Upper (1 Ea.)
 - OHTGMOD001-5 Bearing, Crankshaft, Thrust, Lower (1 Ea.)
 - OHTGMOD001-6 Bushing, Camshaft, High Performance (5 Ea.)

Description of Operation

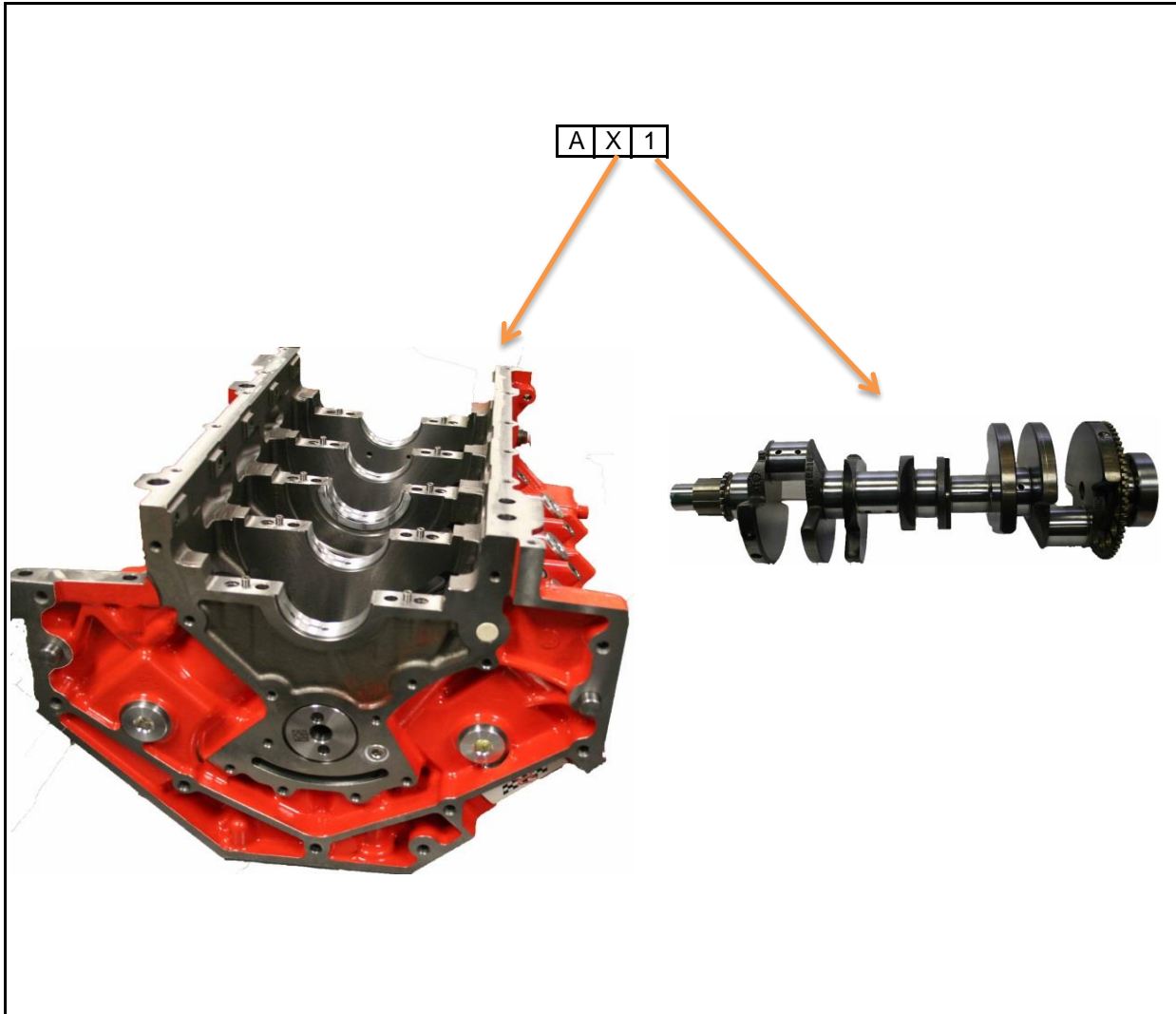
- A The camshaft is usable for up to six runs. The camshaft should be visually inspected for evidence of frosting or distress on the lobes between each test.
- B Lubricate the camshaft with EF-411 assembly lube and install the camshaft.
- C Install the upper main bearing shells
- X Lubricate with EF-411 assembly lube.

Specification

- 1 12625437 Camshaft
- 2 Bearing, upper part of OHTGMOD 001

REV	Date	Revision History
Short Block		GMOD

View	
Camshaft & Upper Main Bearings	
Section	Sheet
3	7



A X 1

Description of Operation

A Crankshafts are allowed to be used for up to 6 runs or less if they do not meet recommended service specifications.

Note: No special conditioning of crankshafts are allowed. No cleaning with abrasive materials is permitted.

Record main bearing clearances on GMOD Engine Build Data Form 19.

X Lubricate all bearings and journals with EF-411 during final assembly.

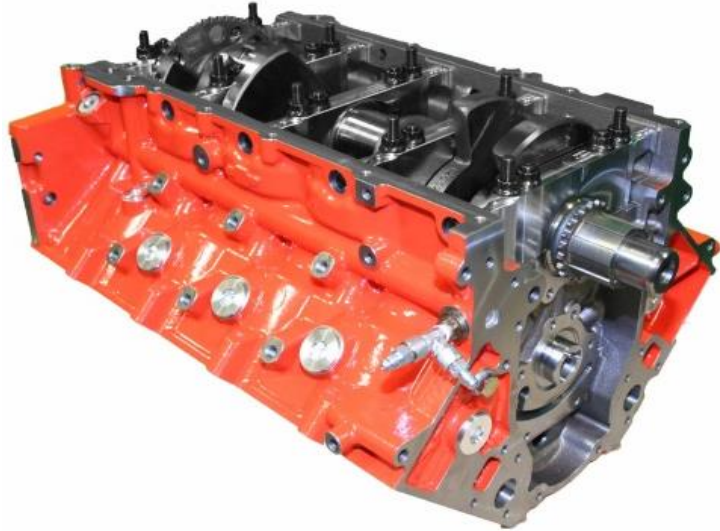
Specification

1 12588612 Crankshaft
Special order through Chevy Performance

REV	Date	Revision History
Short Block		GMOD

View	
Crankshaft Installation	
Section	Sheet
3	8

A B C D

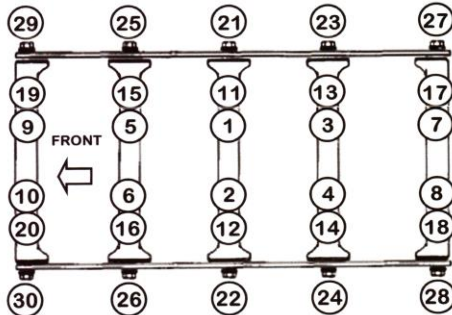


Note: If using a new crankshaft, install the crankshaft key and timing chain / oil pump drive gear to the crankshaft using Kent Moore installation tool J-41665-1A



Note: 1) After operation B has been completed, run all nuts down snug with a speed handle. Lightly tap the crankshaft Fore & Aft to position the thrust bearing for clearance measurement.

Bolt Torque Sequence



Outer Studs 4.55 long Nuts 50 ± 2 lb.ft.
Inner Studs 4.77 long Nuts 60 ± 2 lb.ft.

M8 side bolts 20 ± 2 lb.ft. (with #2 Permatex under head)

Description of Operation

- A Coat all studs with EF-411

Install studs "hand tight" with speed handle. Follow torque specification chart for final application.
- B Note: 1) To ensure caps are fully seated in block, apply 20 ± 2 lb.ft. torque on inner stud nuts following crisscross pattern. Loosen nuts, back off three to four threads. Hold nut with finger while tightening stud to 100 ± 10 inch pound to ensure stud is fully bottomed in block.

Follow torque sequence in chart for final application. Apply #2 Permatex sealer under head of side bolts.
- D Thrust Clearance ($0.0015 - 0.0078$ in.)

Record main bearing clearance on GMOD Engine Build Data Form 19.

Specification

- 1 234-5608 Kit Stud, ARP
- 2 12375821 RTV Sealant
- 3 OHTGMOD001-2 Bearing Upper (4)
- 4 OHTGMOD001-3 Bearing Lower (4)
- 5 OHTGMOD001-4 Bearing Thrust Upper
- 6 OHTGMOD001-5 Bearing Thrust Lower
- 7 12556582 Sprocket, Crankshaft
- 8 12561513 Key Crankshaft

Revision History

REV	Date	Revision History

View

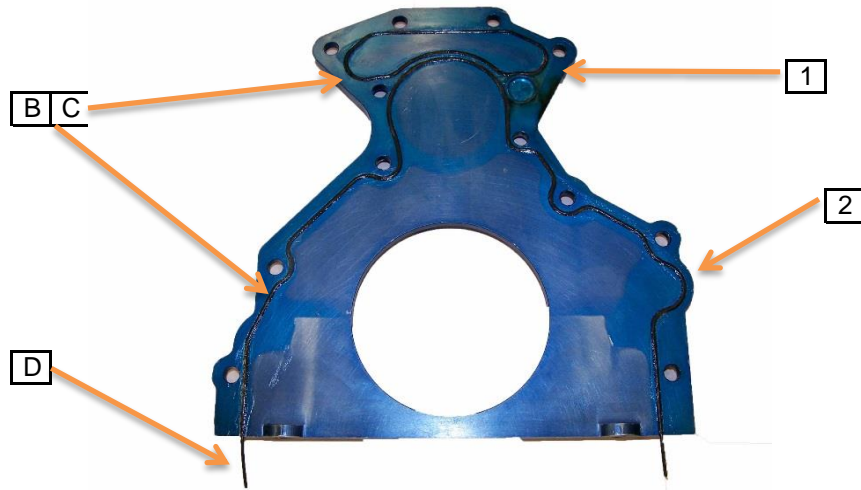
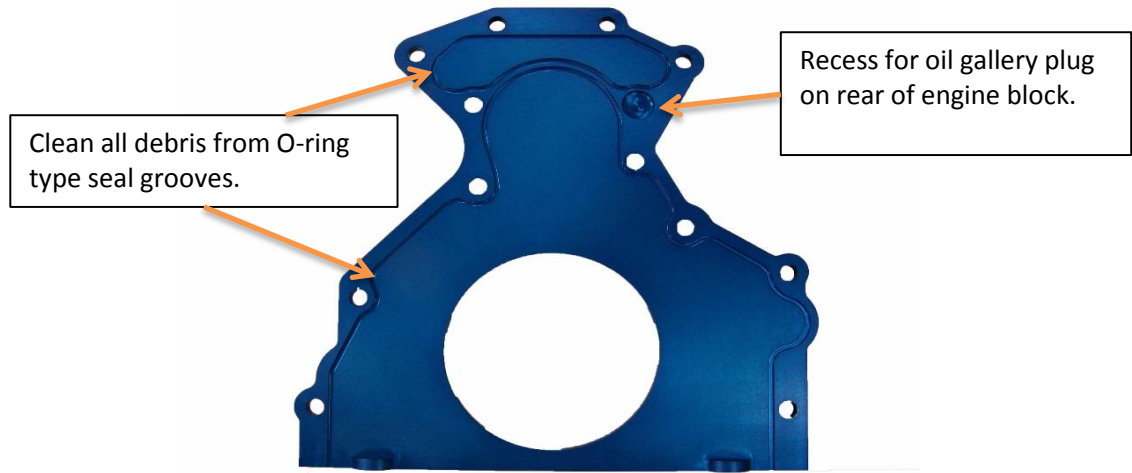
Main Cap & Bearing Installation
Main Bearings, Crankshaft, Main Caps with Studs, and Crankshaft end play clearance check.

Short Block

GMOD

Section
3

Sheet
9



Description of Operation

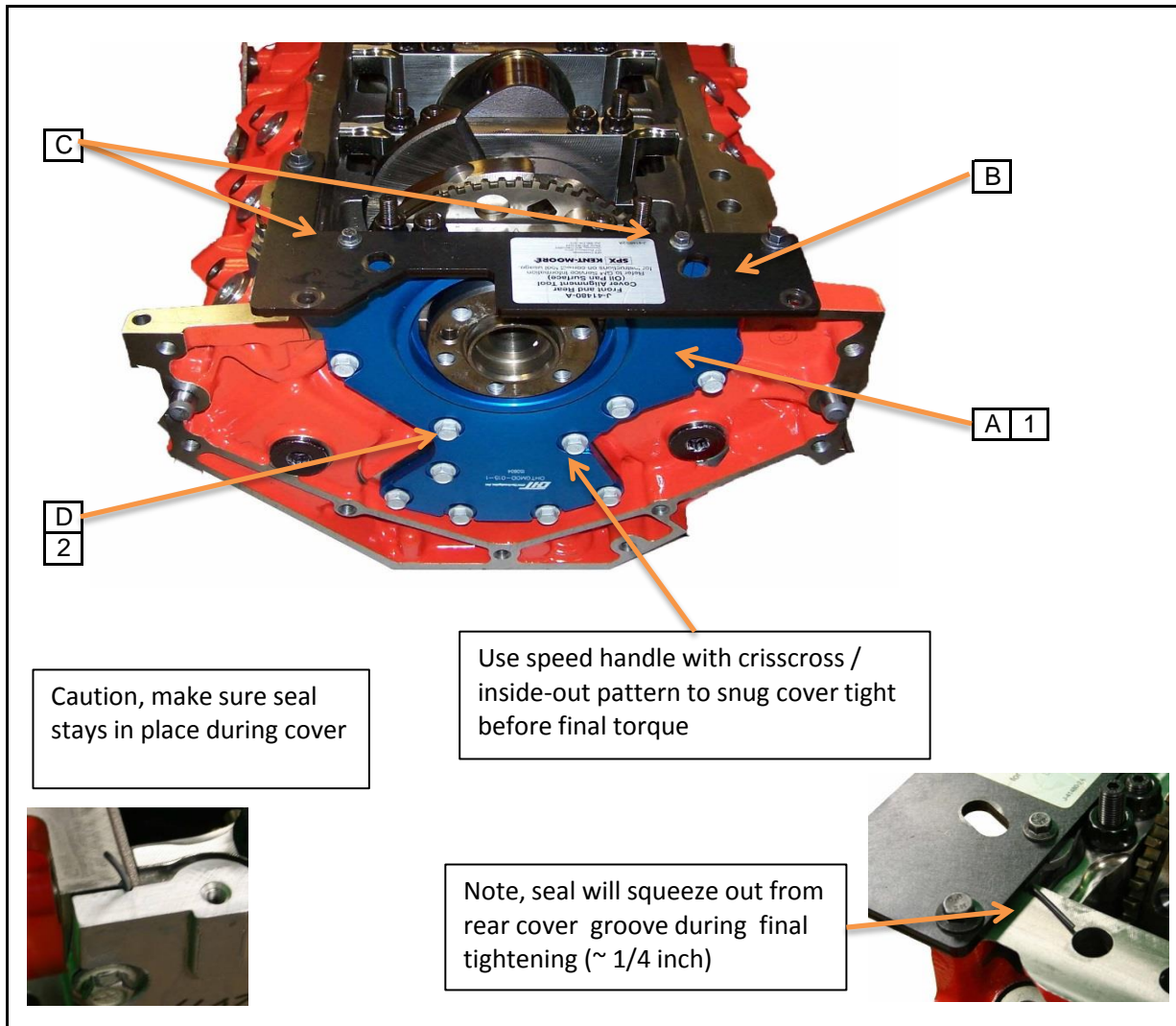
- A Clean rear cover to remove any residue from previous test. Pay specific attention to seal areas for O-ring type seals.
- B Apply a very small bead of Petroleum Jelly to the grooves for both O-ring type seals. Use a plastic scraper to remove excess.
- C Install the O-rings following the grooves with finger pressure. Remove any excess Petroleum Jelly with a plastic scraper and clean shop towel.
- D Leave excess seal protruding from bottom of cover. Excess seal will be trimmed after cover installation.

Specification

- 1 OHTGMOD 201-1 Seal Short, Rear Cover
- 2 OHTGMOD 202-2 Seal Long, Rear Cover

REV	Date	Revision History
Short Block		GMOD

View	
Rear Cover Seal	
Rear cover cleaning and O-ring seal installation.	
Section	Sheet
3	10



Caution, make sure seal stays in place during cover

Use speed handle with crisscross / inside-out pattern to snug cover tight before final torque

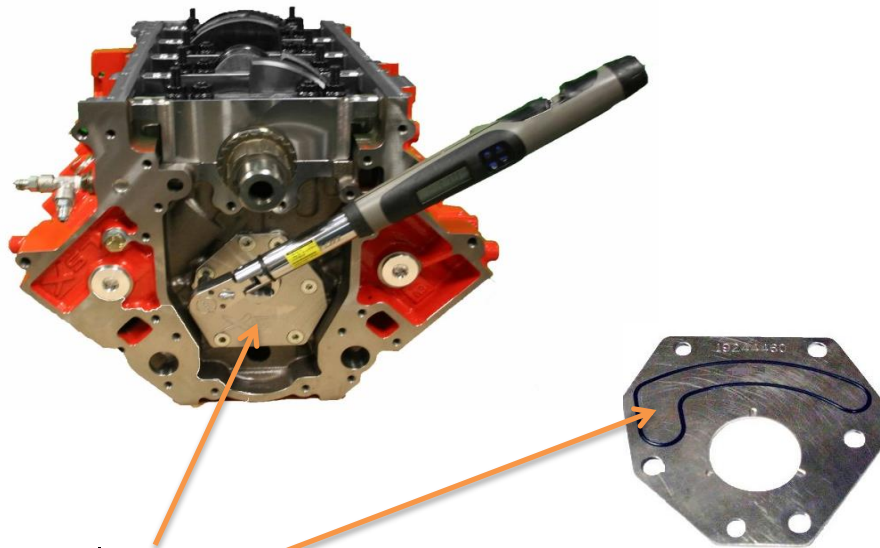
Note, seal will squeeze out from rear cover groove during final tightening (~ 1/4 inch)

Description of Operation	
A	Carefully position the rear cover onto the block without dislodging the seals and draw the fasteners snug by hand, (cover must be able to move slightly during final alignment).
B	Attach Kent Moore J-41480-A to the oil pan rail of the engine block using caution to avoid pinching the seals protruding from the bottom of the rear cover.
C	Install two fasteners through the Kent Moore tool into the bottom of the rear cover and draw snug to position the rear cover.
D	Tighten the rear cover fasteners to 18 ± 2 lb. ft. and cut off the excess seal length.

Specification	
1	OHTGMOD-015-1 Cover, Rear
2	11588723 Bolt, Rear Cover

REV	Date	Revision History
Short Block		GMOD

View	
Rear Cover Installation	
Section	Sheet
3	11



A	B	C
1	2	3

Description of Operation

- A Install oil transfer gallery O-ring seal on rear of camshaft thrust plate using a small amount of Petroleum Jelly.
- B Carefully position the camshaft thrust plate to the engine and secure with (6) Screw type fasteners.
- C Torque the screw type fasteners to 11 ± 1 lb.ft.

Specification

- 1 19244460 Plate, Camshaft, Thrust
- 2 OHTGMOD 200-1 Seal, Thrust Plate
- 3 11561455 Screw, Camshaft Thrust Plate

REV	Date	Revision History

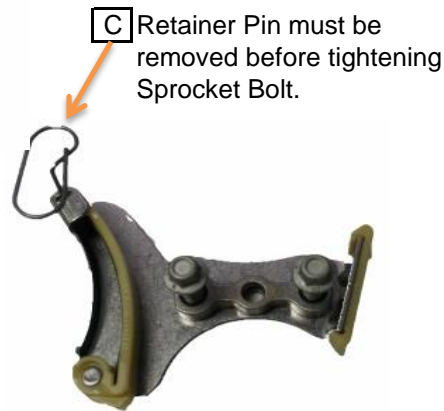
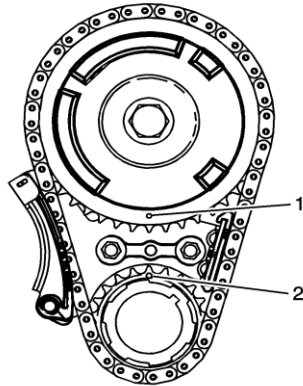
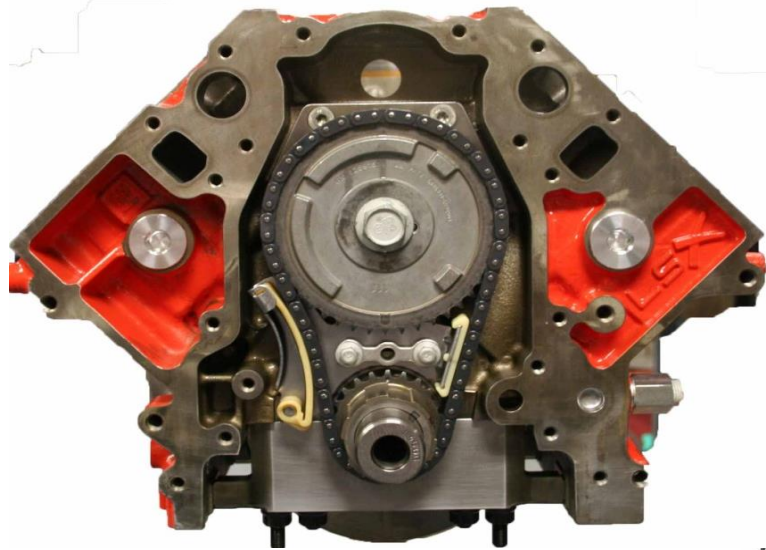
View	
Camshaft Thrust Plate	
Camshaft Thrust Plate attachment.	

Short Block

GMOD

Section
3

Sheet
12



Description of Operation

- A Install the timing chain tensioner assembly and torque the fasteners to 22 ± 2 lb.ft.
- B Align the markings on the crankshaft timing chain drive gear and the markings on the camshaft sprocket together and install the chain and sprocket assembly, positioning the camshaft so everything is in alignment. Ref. 1 & 2 in drawing
- C Install the camshaft sprocket bolt and tighten to hold the assembly snug. Remove the camshaft tensioner retainer pin.
- D Using a holding device, hold the crankshaft from turning while tightening the camshaft sprocket bolt to 55 ± 2 lb.ft. + 50° .
- E Measure the camshaft endplay. See specification Section 3 sheet 0. Record in Data Dictionary Form 19, A.5.

Specification

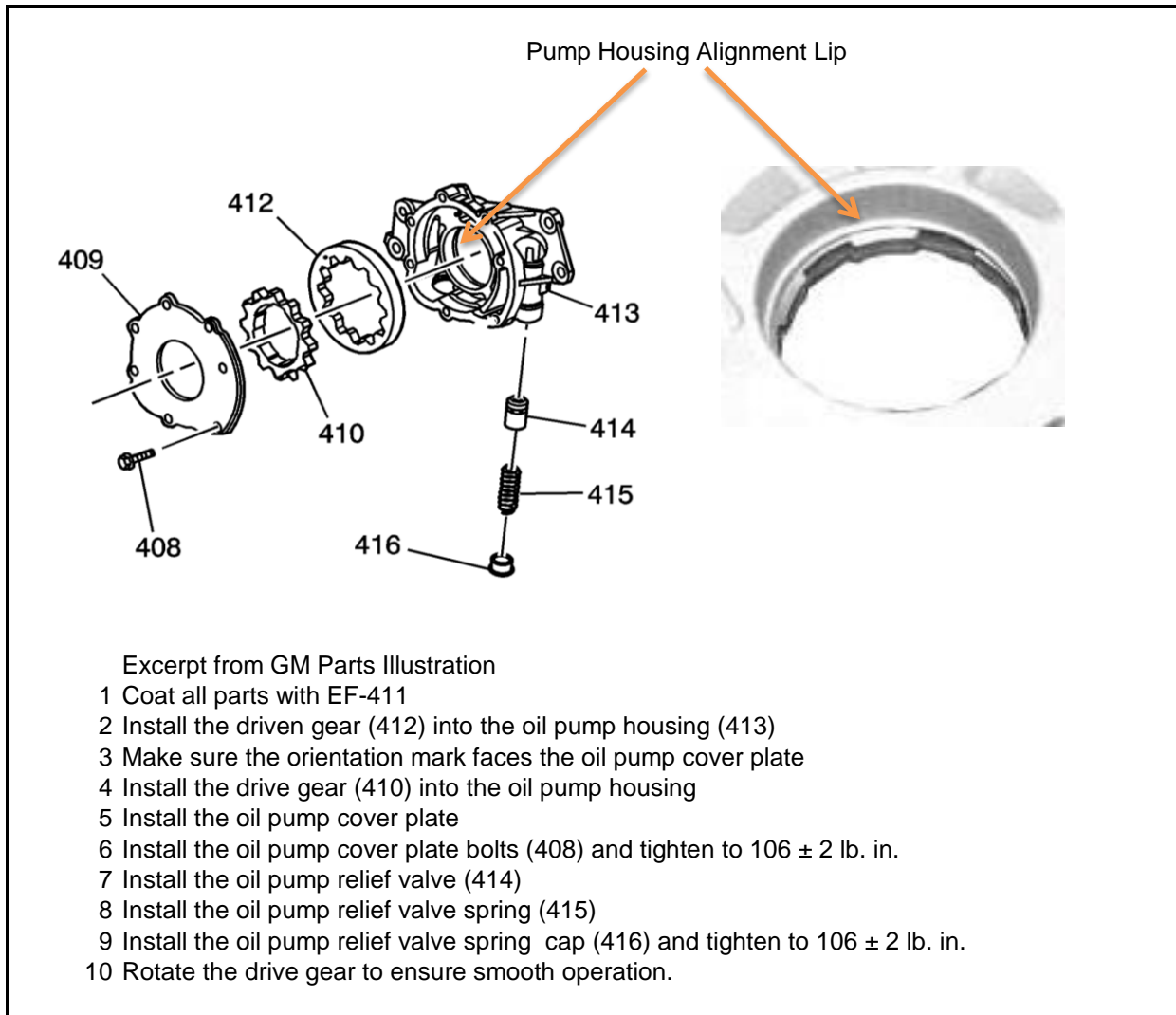
- 1 12626407 Tensioner, Timing Chain w/Bolts
- 2 12591689 Sprocket, Camshaft Timing
- 3 12646386 Chain Timing
- 4 11561283 Bolt, Camshaft, Sprocket

REV	Date	Revision History

View	
Timing Chain Assembly	
Installation of the timing chain assembly	

Short Block	GMOD
--------------------	-------------

Section	Sheet
3	13



Description of Operation

Engine oil pump assembly
 The oil pump assembly is allowed to be used for a maximum of 4 6 runs or less .

Oil pump assemblies must be disassembled, cleaned and inspected before each test.
 Coat all parts with EF-411

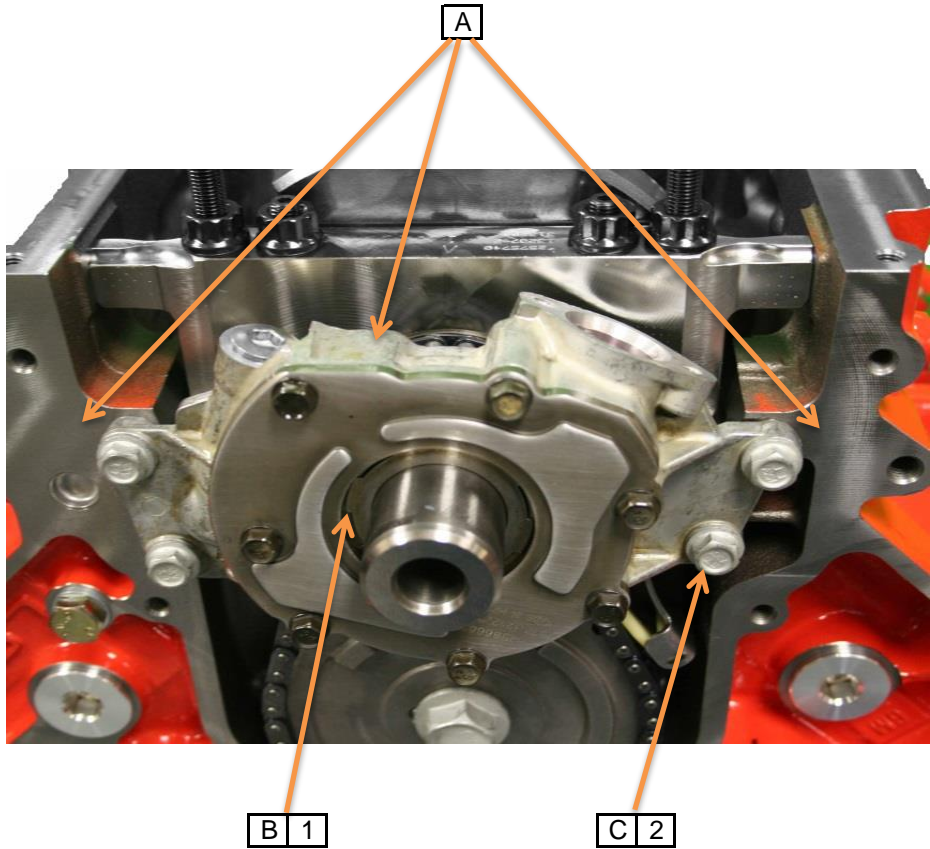
Note: Pump housing must be inspected for excessive wear on the alignment lip that pilots off the inner gearrotor gear (410) to properly align the pump housing during installation.

Specification

1 12586665 Pump, Oil, Assembly Kit
 Parts not serviced separately

REV	Date	Revision History
Short Block		GMOD

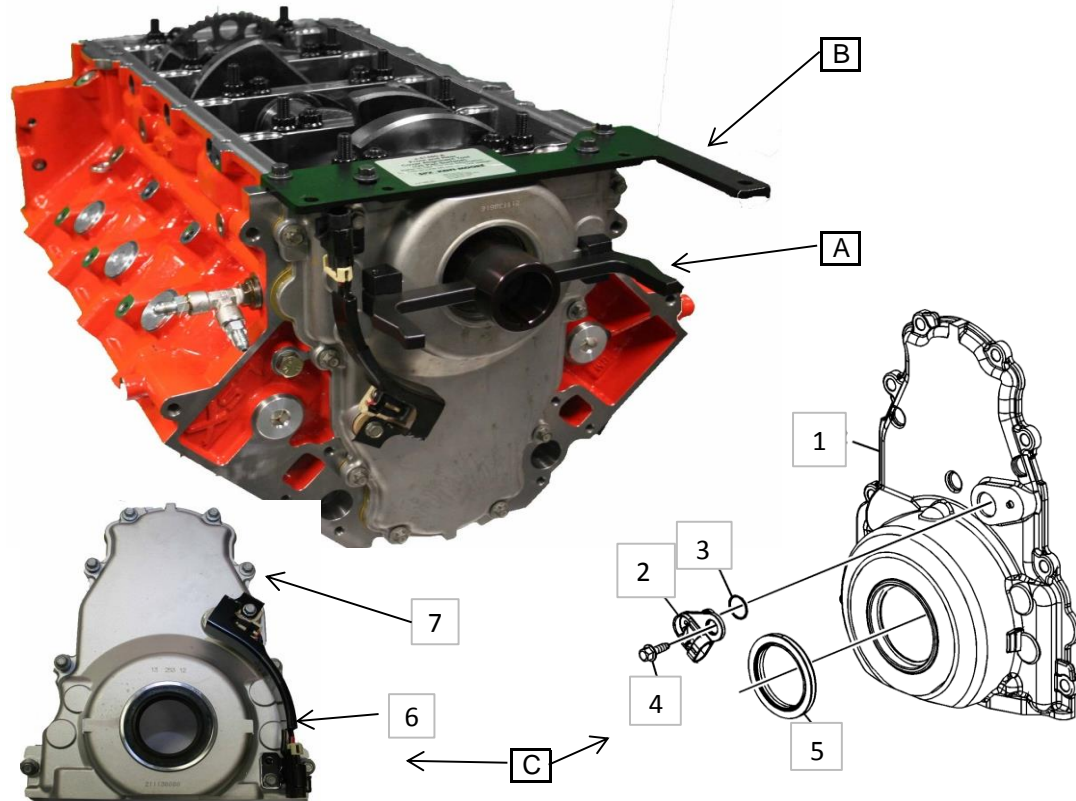
View	
Oil Pump Assembly	
Section	Sheet
3	14



Description of Operation	
A	Closely inspect the mating areas of the engine block and the oil pump to ensure they are clean.
B	Install the oil pump assembly by aligning the splined surfaces of the crankshaft sprocket and the oil pump drive gear. Install the oil pump until the pump housing firmly seats itself against the face of the engine block.
C	Install all four fasteners and while pushing upwards on the pump housing hand tighten with a speed handle. Torque the fasteners to 18 ± 2 lb. ft. Note: Make sure bolt holes are clean and allow fastener to torque against oil pump housing. Position assembly so the inner gear is centered without any side loading to position housing properly. See Section 3 Sheet 14
Specification	
1	12586665 Pump Assembly, Oil
2	11515758 Bolt, Oil, Pump, Housing (4)

REV	Date	Revision History
Short Block		GMOD

View	
Oil Pump Installation	
Oil Pump Installation	
Section	Sheet
3	15



Front Cover Assembly 12633906 includes bolts, gasket, seal, and camshaft sensor with connector

Note: Balancer seal must be removed for proper alignment with Kent Moore Tools when part is purchased as assembly

Description of Operation

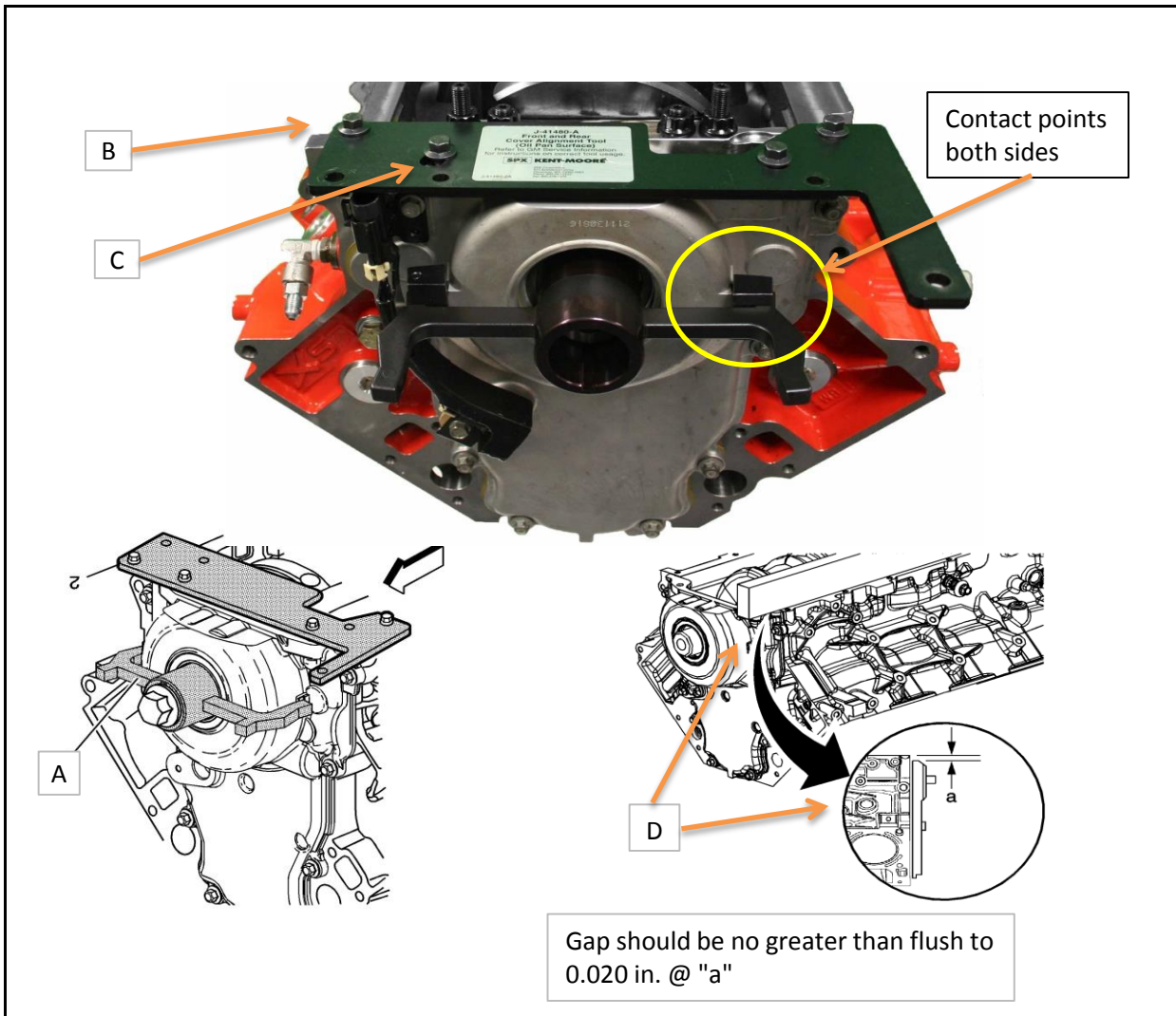
- A Kent Moore special front cover alignment installation tool J-48853
 - B Kent Moore special front cover to oil pan rail alignment tool J-41480-A
 - C Front cover sub assembly components.
 - 1 Install front cover with gasket and fasteners, finger tight.
 - 2 Install Kent Moore J-41480 (A) to oil pan rail and bottom of front cover with two fasteners in each and tighten finger tight .
- Note: All fasteners should only be finger tight and all components should be free to move until final alignment process.

Specification

- 1 12600326 Cover Front
- 2 12591720 Sensor Cam. Position w/seal
- 3 O-ring Seal, part of 12591720
- 4 11588712 Bolt Camshaft Sensor
- 5 12585673 Seal, Crankshaft Balancer
- 6 12627501 Sensor, Wire Assembly
- 7 11515758 Bolt, Front Cover
- 8 12633904 Gasket Ft. Cover (Not Shown)

REV	Date	Revision History
Short Block		GMOD

View
Front Cover
Front Cover Sub Assembly with Kent Moore specialty tools.
Section
3
Sheet
16

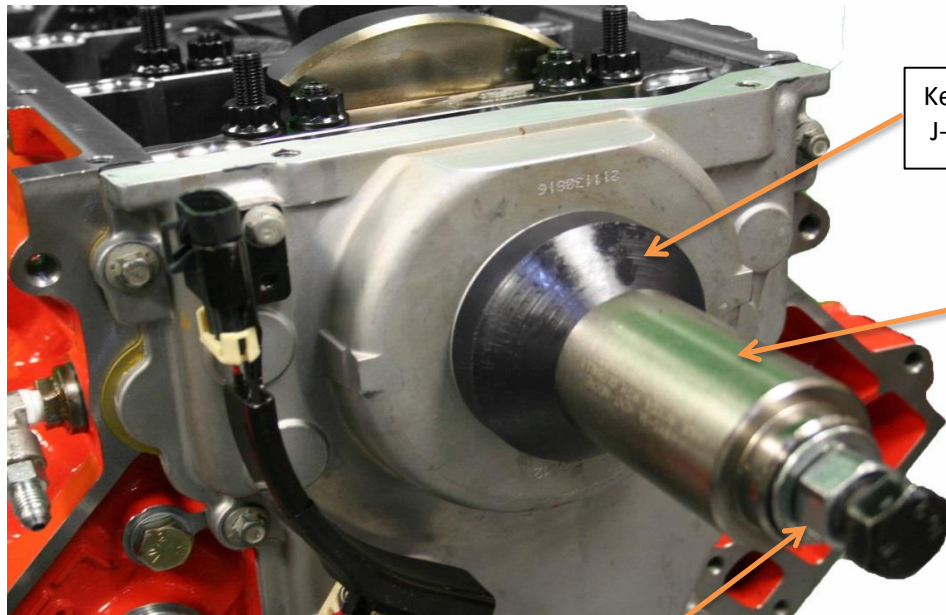


Description of Operation	
A	Install Kent Moore front cover alignment tool J-48853. Tighten the balancer bolt snug by hand until the tool contacts the centering contacts either side of front seal on front cover.
B	Tighten the two fasteners on the oil pan rail at the rear of Kent Moore J-41480-A alignment tool.
C	Snug the two fasteners threaded into the bottom of the front cover to draw the cover snug against the Kent Moore positioning tool.
	Tighten the front cover bolts to 22 ± 2 lb. ft.
D	Check height between pan rail and front cover using straight edge.

Specification	

REV	Date	Revision History
Short Block		GMOD

View	
Front Cover Installation	
Alignment and tightening procedure for front cover.	
Section	Sheet
3	17



Kent Moore
J-41478-1A

Kent Moore
J-41665-1A

Position installation tools with seal square to front cover drawing snug with bolt threaded into crankshaft. Push seal into front cover using nut on J-41665-1A

Description of Operation

Install front seal using Kent Moore tools J-41478-1A and J-41665-1A.

Note: Do not use oil on ID of front seal.

Install seal on Kent Moore J-41478-1A. Apply light coat of EF-411 on outside diameter of seal.

Align seal and Kent Moore J-41478-1A square to front cover. Using Kent Moore tool J-41655-1A, thread bolt into crankshaft until tools are snug. Install seal using Nut on J-41655-1A until firmly seated in front cover.

Specification

1 12585673 Seal, Crankshaft, Balancer
(Seal not viewable in photo)

REV	Date	Revision History

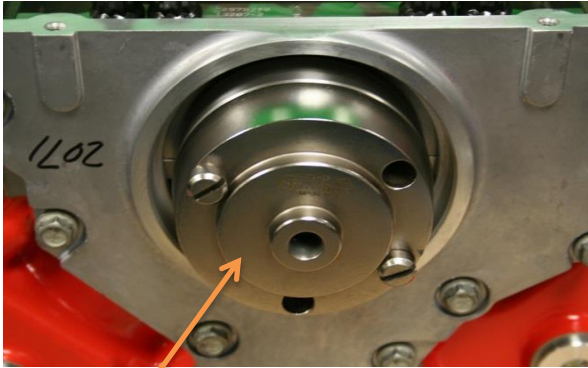
View	
Front Balancer Seal Installation	

Short Block

GMOD

Section
3

Sheet
18

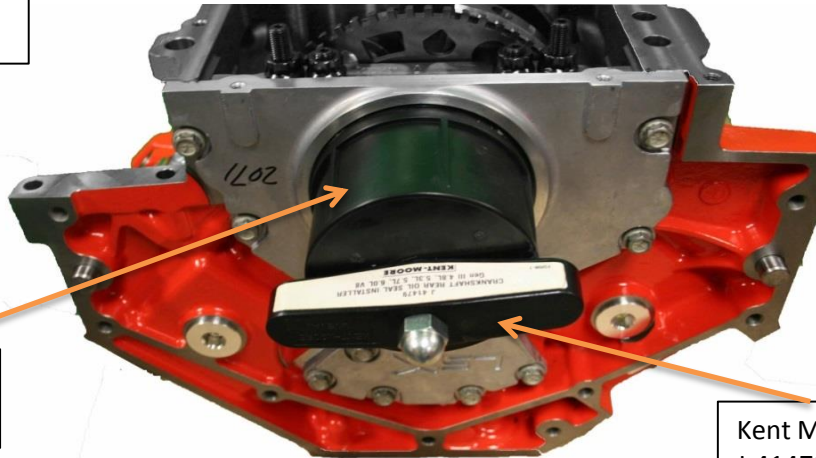


Kent Moore
J-41479-2B



1 Seal with Shipping Protector

Caution; Seal is reverse lip technology, blocking crankcase breathers during blowby measurement may cause oil leakage.



Kent Moore
J-41479-1

Kent Moore
J-41479

Description of Operation

Do not lubricate ID of crankshaft seal.

1. Lubricate the OD of the rear seal with a light coat of EF-411.
2. Lubricate the bore in the rear cover with a light coat of EF-411.
3. Install J-41479-2B cone onto the rear of the crankshaft and tighten snug with straight slot screws.
4. Install the rear oil seal onto the tapered cone and gently push the seal square to the rear cover.
5. Thread J-41479 with J-41479-1 into the tapered cone until the tool contacts the rear seal.
6. Align the tool and rear oil seal square with the seal and rear cover.
7. Rotate the handle on the tool clockwise to install the seal into the rear cover until the seal bottoms into the rear cover.

Specification

1 89060436 Seal, Crankshaft, Rear

REV	Date	Revision History
Short Block		GMOD

View	
Rear Crankshaft Seal	
Installation of rear crankshaft lip seal.	
Section	Sheet
3	19



View A



Tool orientation to start balancer on crankshaft

View B

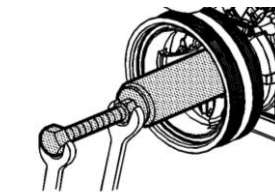


Tool orientation to install balancer on crankshaft

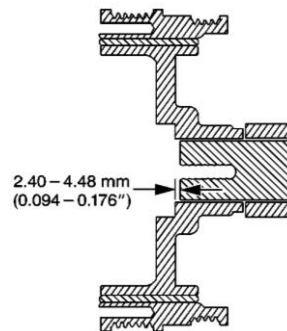
Balancer Installation

- 1) Install crankshaft holding fixture (in-house fabricated).
- 2) Use Kent Moore tool configured as shown in view A to start balancer and push balancer ~ 1/4" onto crankshaft.
- 3) Remove Kent Moore tool and reposition as shown in view B to install balancer until fully positioned against crankshaft sprocket.
- 4) Using a used balancer bolt, tighten the balancer bolt to 240 lb.ft. and then remove the bolt to check for proper clearance between the front of the balancer and the nose of the crankshaft. (View D)
- 5) If there is insufficient clearance, remove balancer and inspect all parts to determine cause. Select washers are available through service parts. Contact test sponsor for further information.
- 6) Install a new crankshaft balancer bolt and tighten to 110 lb.ft.
- 7) Loosen the crankshaft balancer bolt 360°
- 8) Tighten the crankshaft balancer bolt to 59 ± 2 lb.ft.
- 9) Tighten the crankshaft balancer bolt a final pass to 125°

Note: Labs may hone the ID of the balancer to make it a slip fit. Clearance between the crankshaft OD and the balancer ID should not



View C



View D

Description of Operation

- A Kent Moore J 41665 Crankshaft Balancer and Sprocket Installer configured for initial balancer alignment.
- B Kent Moore J 41665 Crankshaft Balancer and Sprocket Installer configured for final balancer installation.
- C Balancer installation using Kent Moore tooling.
- D Balancer to crankshaft clearance check, must be (0.094 - 0.176 inch).

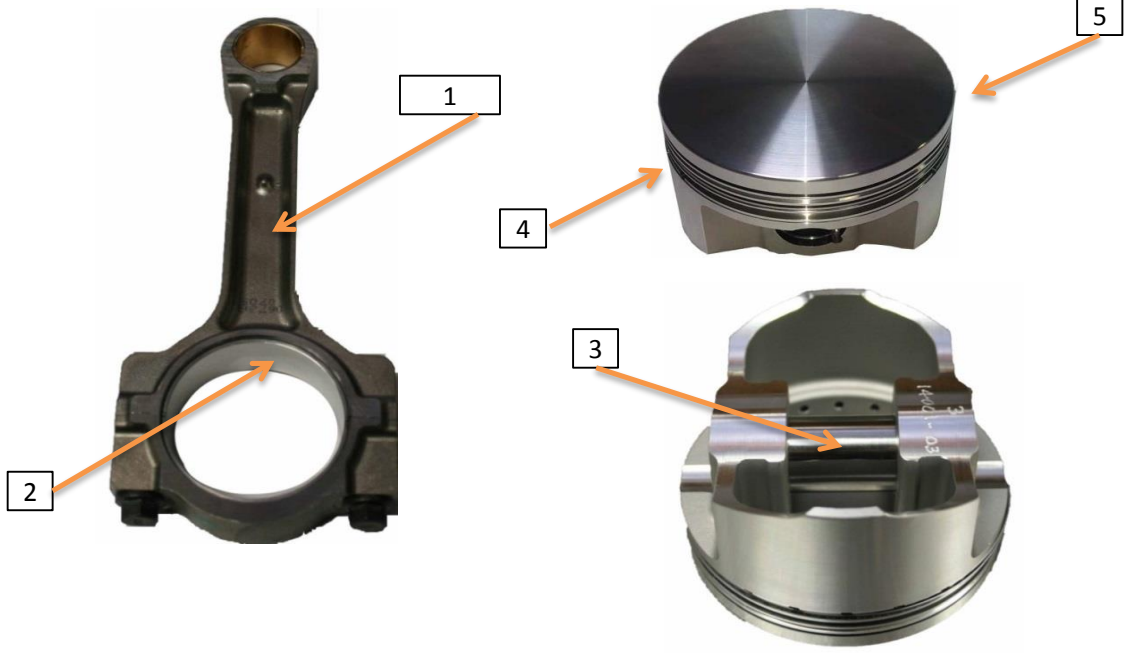
Labs may hone balancer for slip fit, however, clearance must be checked and proper torques applied.

Specification

- 1 12557840 Bolt, Balancer
- 2 12634105 or 19300488 Balancer, Harmonic

REV	Date	Revision History
Short Block		GMOD

View	
Balancer Installation	
Install balancer as outlined in "Balancer Installation" Text Box. Read all information contained on this page for proper installation.	
Section	Sheet
3	20



Description of Operation	
1	Connecting Rod, Special Order Chevy Performance
2	Connecting Rod Bearing, Special Order OHT GMOD Bearing Kit
3	Piston Pin, Special Order Chevy Performance
4	Piston , Special Order, OHT
5	Piston Ring, Special Order, OHT
6	Piston Pin Clip, Special Order OHT

Piston	Bore Size	Ring
OHTGMOD-898-1 RUN 1	3.898	OHTGMOD-03898-1
OHTGMOD-899-1 RUN 2	3.899	OHTGMOD-03899-1
OHTGMOD-900-1 RUN 3	3.900	OHTGMOD-03900-1
OHTGMOD-901-1 RUN 4	3.901	OHTGMOD-03901-1
OHTGMOD-902-1 RUN 5	3.902	OHTGMOD-03902-1
OHTGMOD-903-1 RUN 6	3.903	OHTGMOD-03903-1

Specification	
1	12649190 Rod Connecting
2	OHTGMOD-001-1, Bearing Rod Kit
3	12570512 Pin Piston
4	Piston Special Test (See Chart)
5	Ring Special Test (See Chart)
6	OHTGMOD-020-1 Wrist Pin Clip Wrist Pin Clip not shown in view.

View	
Piston & Connecting Rod Assembly	

Section	Sheet
3	21

REV	Date	Revision History
Short Block		GMOD

Top Rings		Second Rings	
Run #	Color Code	Run #	Color Code
1	One Pink Stripe	1	One Yellow Stripe
2	Two Pink Stripes	2	Two Yellow Stripes
3	Three Pink Stripes	3	Three Yellow Stripes
4	One Purple Stripe	4	One Green Stripe
5	Two Purple Stripes	5	Two Green Stripes
6	Three Purple Stripes	6	Three Green Stripes



Description of Operation

A Confirm correct ring grade and gaps for the engine run/piston grade.

Using a Piston Ring Locating Tool, position each ring $1 \pm \frac{1}{4}$ inch below the deck of the engine block. Using the Starrett Taper Gage, measure and record the top and second piston ring gaps. Keep all rings mated with the appropriate cylinder. Record all individual piston ring gap information in the engine build data packet.

Note: No adjustments to the pre-gapped piston rings are allowed.

Target Ring Gaps

Top Ring Gap 0.019"
 2nd Ring Gap 0.032"
 All piston ring gaps to be +/- 0.002"

Specification

1 Starrett No 270 tapered gage

REV	Date	Revision History

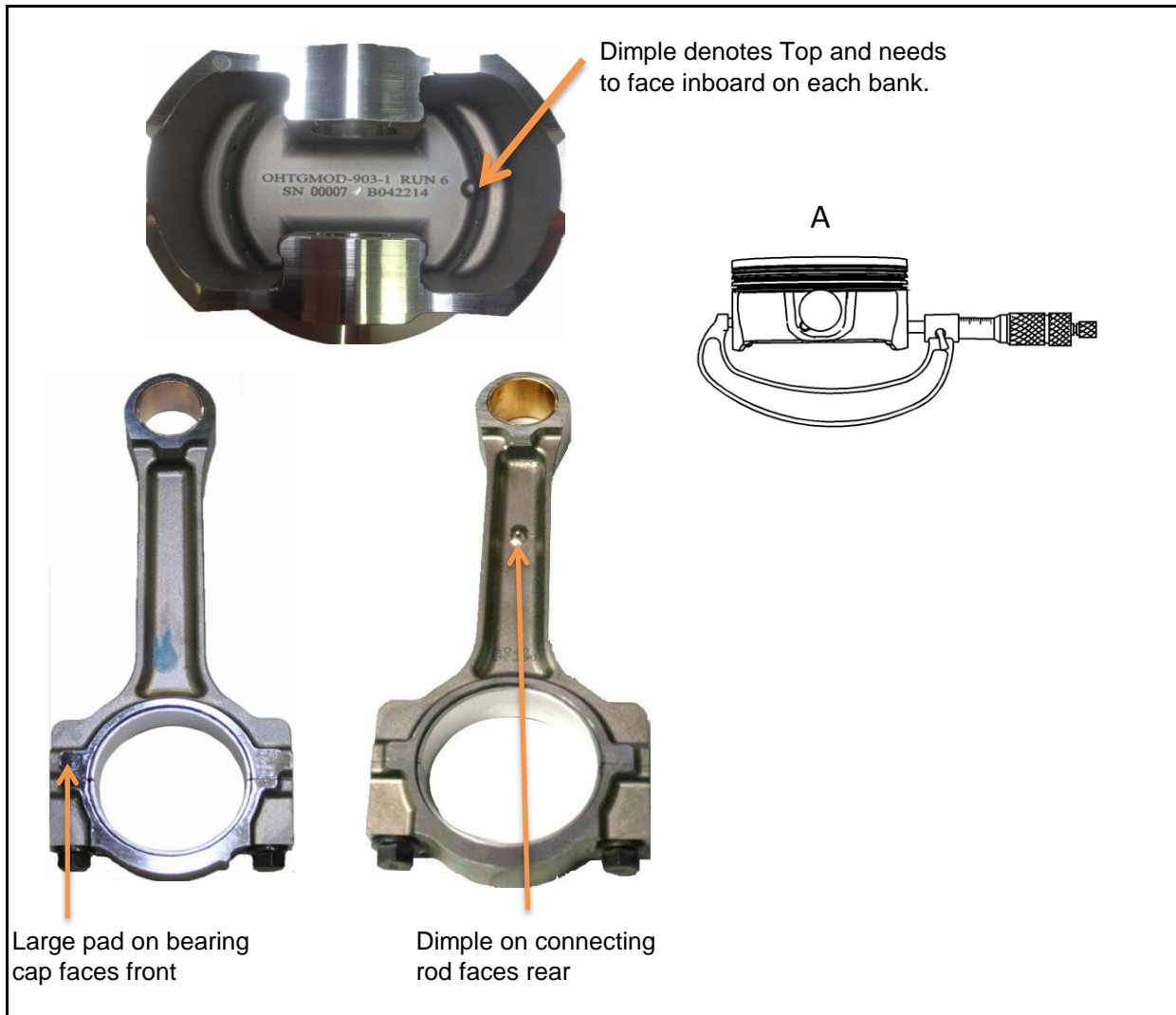
View	
Ring Gap Measurement	
Piston ring gap data measurement.	

Short Block

GMOD

Section
3

Sheet
22



Description of Operation

A With a micrometer at a right angle, measure the piston outside diameter (OD). Measure the diameter 43 mm (1.69 in) from the top of the piston. Record the piston skirt diameter in the Data Dictionary Form 18, A.2.

B Lightly lubricate the piston and connecting rod pin bores with EF-411

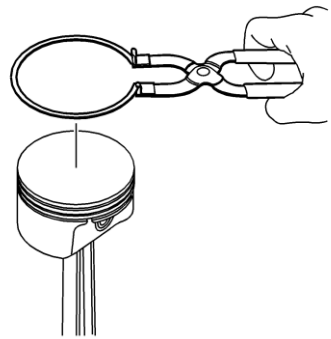
C Install the piston pin, connecting rod, and piston pin clips. The retainer clips should be seated in the grooves of the piston pin bore.

D Note: Make sure the large tab on the connecting rod faces front and the dimple on the underside of the piston is positioned inboard on each bank. **(Dimple on connecting rod will be facing rearward)**

E Separate the connecting rod cap and install the engine bearing set. Lightly lube under the head and on the threads of the cap bolts.
Note: Rods are cracked parting lines and will only fit one direction, do not mix rods & caps.

REV	Date	Revision History
Short Block		GMOD

Piston Measurement & Piston & Rod Orientation	
Section	Sheet
3	23



B

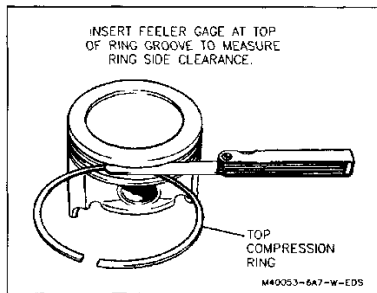


Figure 89 - Measuring Piston Ring Side Clearance

C

Note:

When installing piston rings, use a ring expander plier type tool. Do not roll the rings into the grooves of the piston. Use caution and care to expand the rings only slightly larger than the outside diameter (OD) of the piston.

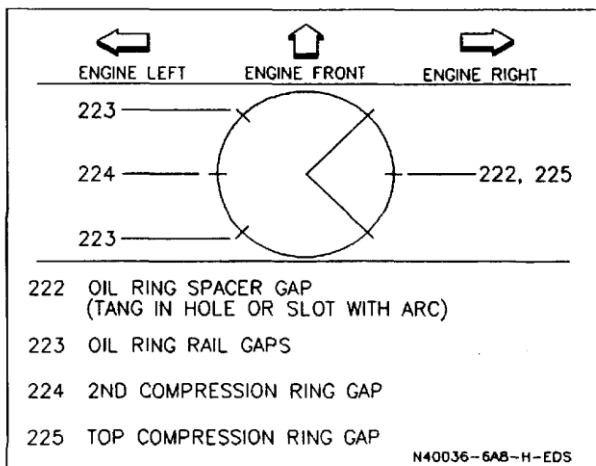


Figure 64 - Piston Ring Gap Location

D

Position the oil control ring end gaps a minimum of 1 inch from each other. Position the compression ring end gaps 180 degrees opposite each other.

Description of Operation

A

Remove the paint marks from the rings

B

Check the ring side clearance.
 Top and Second 0.001" to 0.003"
 (0.025 mm - 0.076 mm)
 Oil: 0.001" to 0.008"

C

Using piston ring pliers, install the piston rings onto the piston. The dimple or mark on the piston ring should face the top of the piston. If no dimple or mark can be found on the top compression ring, it may be installed in either direction. The second compression ring must be positioned with the dimple or mark to the top. This corresponds to the larger diameter of the taper face positioned toward the bottom of the piston.

D

Position the ring end gaps as shown

Specification

REV	Date	Revision History

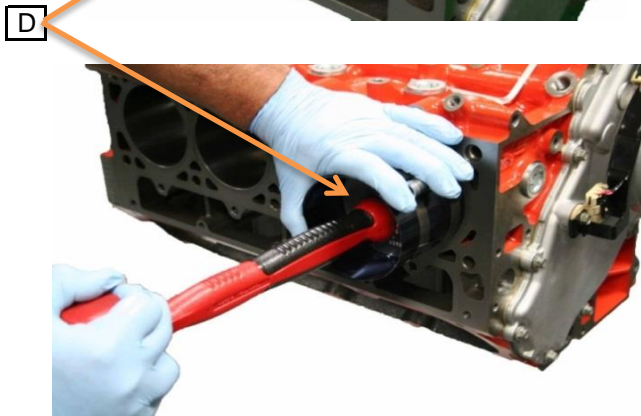
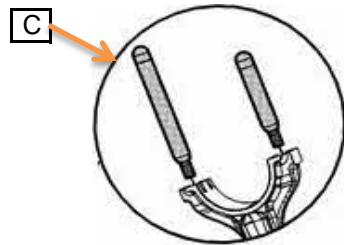
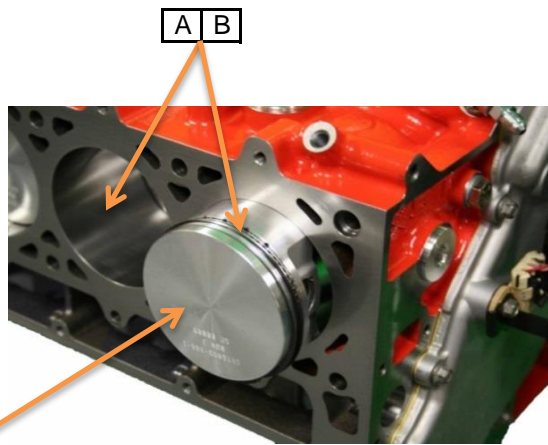
View	
Piston Ring Installation	

Short Block

GMOD

Section
3

Sheet
24



Text Box E
 Use caution to insure piston rings, rails, & expander are seating properly during compression using Kent Moore J-8037 Ring Compressor. Install the piston assembly into the cylinder bore aligning the connecting rod to the crankshaft. Lightly tap the piston ring compressor to insure it is properly seated against the cylinder deck. Using a plastic dead blow hammer handle, see view, lightly tap the piston assembly until all of the piston rings have entered the cylinder. After checking for proper alignment, gently tap the piston assembly until it seats the connecting rod & bearing into position. Remove Kent Moore J-41556 guides, oil the crankshaft with EF-411 and install the connecting rod cap with bearing. Use a speed handle and socket to seat the rod cap fasteners.

Description of Operation

- A Clean cylinder bores with lint free cloth and EF-411.
- B Lubricate piston, rings, cylinder bore, and connecting rod bearings with EF-411.
- C Install connecting rod guides, Kent Moore J-41556 has been found acceptable, to the connecting rod.
- D Insert piston into bore making sure connecting rod is properly lined up with the crankshaft journal and the piston assembly is properly facing front and top as outlined in Section 2 Sheet 22.
- E Use a piston ring compressor and follow instructions in text box "E"

Specification

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REV	Date	Revision History

View	
Piston Installation	

Short Block	GMOD	Section	Sheet
		3	25



Tighten connecting rods in sequence
Two steps:
1) Torque
2) Angle

Check clearance for each journal set; gage between rods and crank journal.



Description of Operation

- A Lubricate each connecting rod / crankshaft journal and align each connecting rod cap correctly. Use a speed handle to snug each fastener. Once all eight pistons have been installed, tighten the connecting rods in sequence in two steps.
- B 1) Torque all fasteners to 15 ± 1 lb.ft.
2) Tighten all fasteners an additional $85^\circ \pm 2^\circ$
- C Check and record the clearance for each rod bearing set. Check and record the side clearance between each journal set and crankshaft. Side clearance should be between 0.0043 to 0.020 inches.
Record all clearance data on GMOD Form 18.

Specification

REV	Date	Revision History
Short Block		GMOD

View	
Connecting Rod Torque	
Connecting rod torquing and clearance checking.	
Section	Sheet
3	26

Description of Operation

The windage tray has two fastener positions needing modification.

Two positions are slotted holes. Using an appropriate device, modify the slotted opening making it larger to receive the ARP Main Cap Fastener Stud for the areas identified in the view.

Oval Slot Modifications



Specification

1 12611129 Deflector, Crankshaft, Oil (Windage Tray)

REV	Date	Revision History

View

Windage Tray Modification

Section

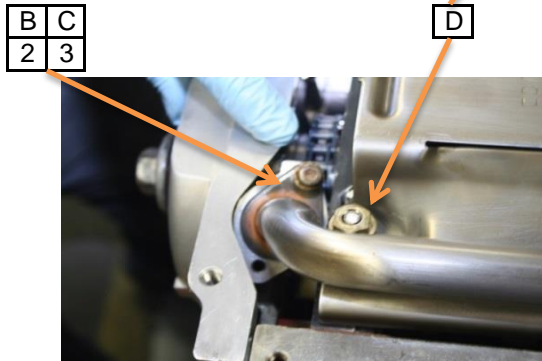
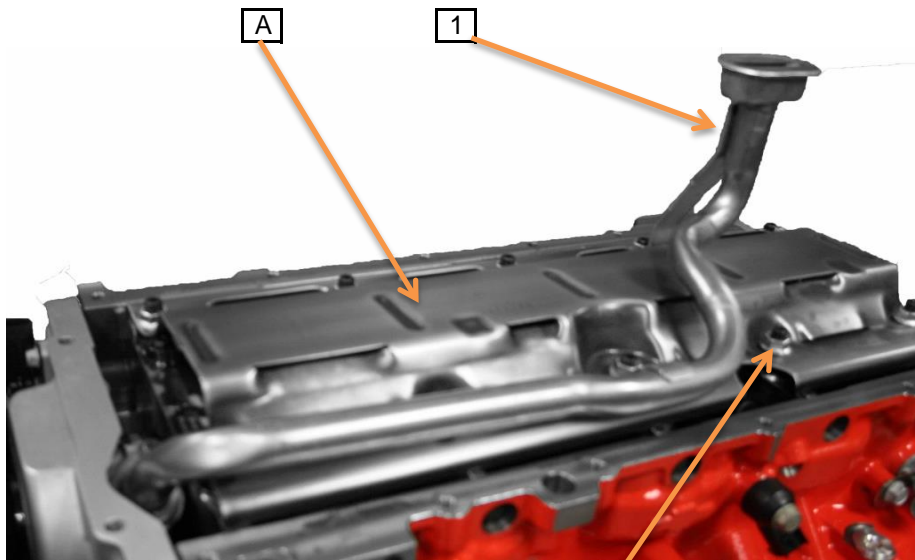
3

Sheet

27

Short Block

GMOD



Description of Operation

- A Install the windage tray and snug using a couple of fasteners on the outside edges.
- B Install the oil pickup tube assembly using a new O-ring
- C Torque the oil pickup tube to the oil pump housing to 106 ± 2 lb.in.
- D Torque the fasteners on the windage tray and oil pickup tube supports to 18 ± 2 lb.ft.

Specification

- 1 12608579 Tube, Oil, Pickup w/O-ring
- 2 12584922 Seal, O-ring (Not Shown)
- 3 11519133 Bolt, Pickup, Tube

REV	Date	Revision History

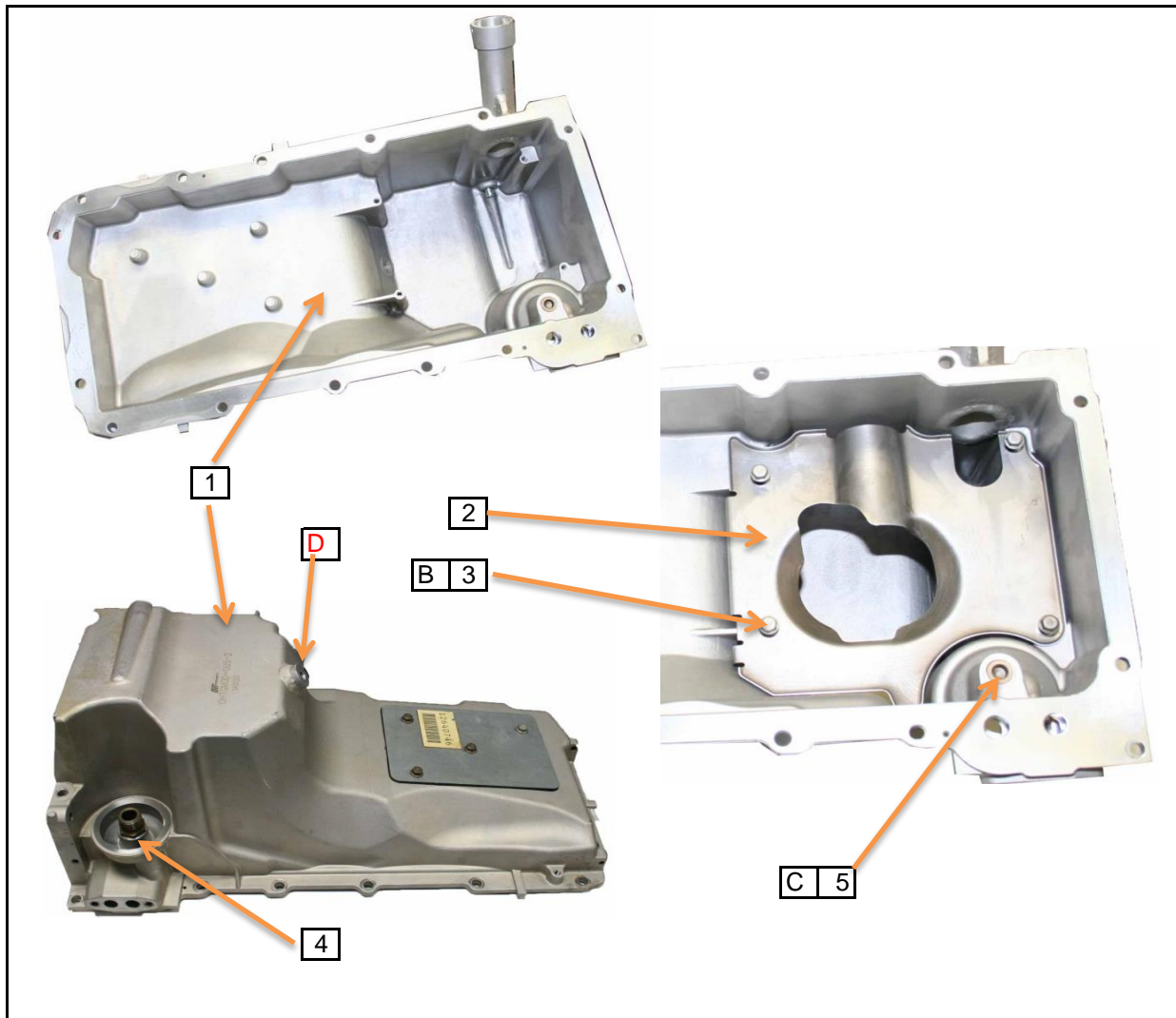
View	
Windage Tray & Pickup Tube	

Short Block

GMOD

Section
3

Sheet
28

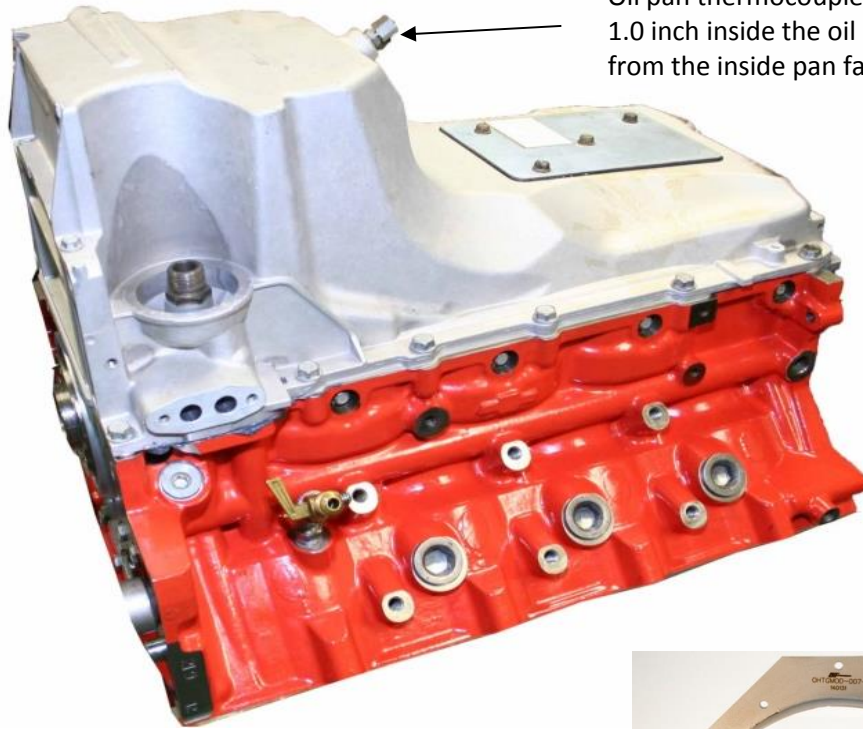


Description of Operation	
A	When cleaning the OHT Oil Pan before each test, the oil pan baffle and relief valve plug should be removed to ensure all deposits in this area are cleaned.
B	Baffle bolt torque 9Nm (80 lb in)
C	Relief Valve Plug 27 Nm (20 lb ft)
D	Install an E type 3" length Thermocouple into the oil pan so 1" protrudes from the inside surface to the tip.

Specification	
1	OHTGMOD-005-2, Oil Pan
2	12575788 Baffle, Oil Pan
3	11519133 Bolt, Oil Pan Baffle
4	12600225, Adapter Fitting, Oil Filter
5	Oil relief valve plug

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Oil pan thermocouple tip is to be set to 1.0 inch inside the oil pan. Measured from the inside pan face to the TC tip.



Description of Operation

- A Install the oil pan gasket, applying small amounts of RTV Sealant, GM RTV 12378521 at all four corners of the gasket where they contact the front and rear cover gaskets.
 - B Before installing the pan ensure the pin holding the dipstick plug is positioned so it can be removed towards the front of the engine.
 - C Align the oil pan until the rear of engine block and rear of oil pan are flush . Tighten the oil pan-to-block and oil pan-to-front cover bolts to 18 ± 1 lb.ft. Tighten the oil pan-to-rear cover bolts (long bolts) to 106 ± 2 lb. in.
- Note: Rear side of OHTGMOD-007-1 Rear Engine Mount is relief cut for clearance at the oil pan area.

Specification

- 1 OHTGMOD-005-3, Oil Pan
- 2 12612350 Gasket, Oil Pan
- 3 11515758 Bolt, Oil Pan Short (13)
- 4 12554990 Bolt, Oil Pan Long (2)
- 5 12600225, Adapter Fitting, Oil Filter
- 6 OHTGMOD-007-1, Rear Mount

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Description of Operation

- A Install the Canton Oil filter Adapter with new "O" rings and seals. The threaded fitting in the oil pan is torqued to 40 ft-lb. Torque the retaining bolt which threads onto the fitting to 20 lb ft.
- B Install the OHT Oil Block with a new gasket. Position the oil temperature thermocouple tip flush with the base of the oil block. Torque the retaining bolts to 80 lb in.

Specification

- 1 22-598 Oil Filter Adapter
Canton Racing Products
- 2 98-004 Seal, kit, Oil Filter Adapter
Canton Racing Products
- 3 12611384 Gasket OHT Oil Block
- 4 OHTGMOD-016-1, Oil Block

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