

## CYLINDER SLEEVE REMOVAL

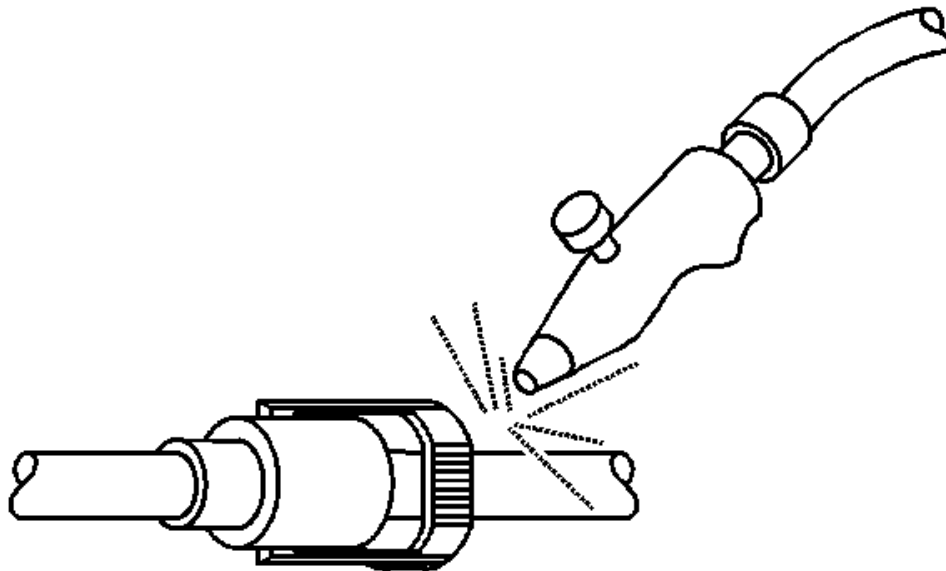
### Special Tools

**EN 45680-850** Cylinder Liner Removal and Installation Kit. See **Special Tools**.

### Removal Procedure

**CAUTION: Do not chill or heat the cylinder bore sleeve or the cylinder block when removing or installing a new cylinder bore sleeve. Chilling or heating the cylinder bore sleeve or the cylinder block will cause engine damage and will not aid the removal or installation of the new cylinder bore sleeve.**

**CAUTION: Do not damage the crankshaft connecting rod journals or reluctor ring or engine damage will occur.**

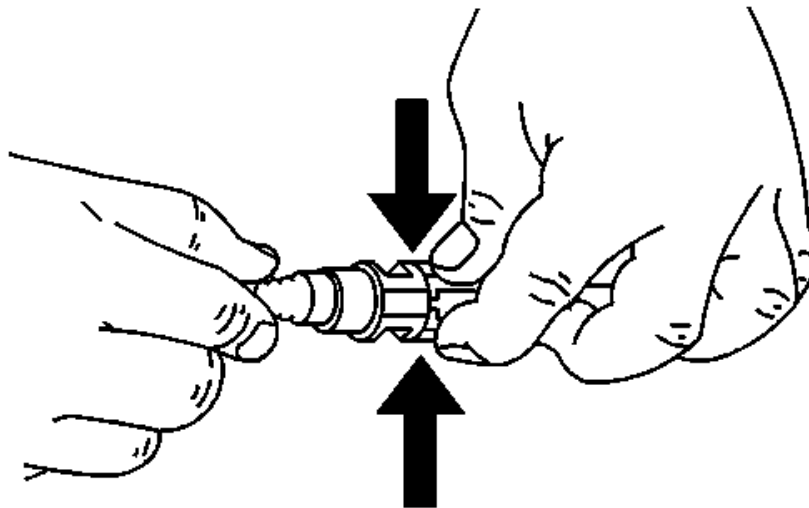


**Fig. 460: View Of Cylinder Bore Liner Puller**  
Courtesy of GENERAL MOTORS CORP.

1. If the crankshaft is still installed, rotate the crankshaft so that the counterweight is to the right side and the connecting rod journal is to the left side and not in alignment with the cylinder bore.
2. Install the cylinder bore sleeve puller (1) through the cylinder bore.

**CAUTION: Ensure that the shoe is flat against the bottom of the cylinder bore sleeve or damage to the cylinder bore sleeve puller will occur.**

3. Align the shoe (1) of the cylinder bore sleeve puller to the bottom of the cylinder bore sleeve (117).



**Fig. 461: Aligning Cylinder Bore Sleeve Puller**  
Courtesy of GENERAL MOTORS CORP.

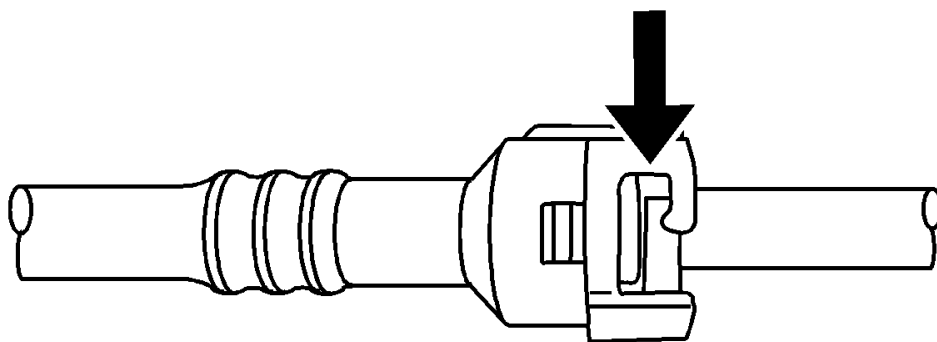
4. Hold the threaded shaft of the cylinder bore sleeve puller upward in order to retain the shoe alignment to the bottom of the cylinder bore sleeve.
5. Install the fixture (4) onto the threaded shaft of the cylinder bore sleeve puller and the engine block.
6. Install the bearing (3) and the nut (1).
7. Tighten the nut (1) to the bearing (3).

**CAUTION: Refer to Fastener Caution .**

**NOTE:** Use 4 old cylinder head bolts for the attaching bolts.

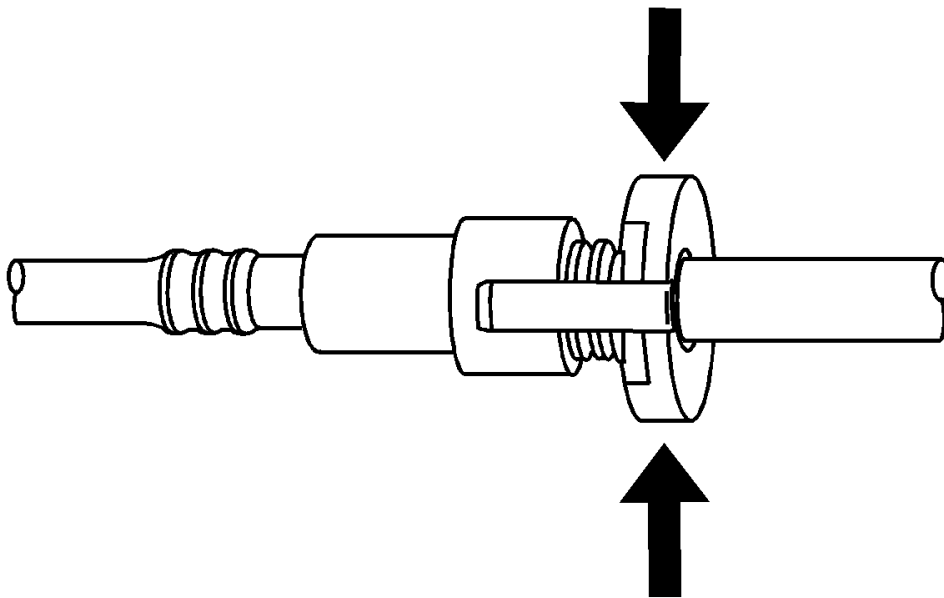
8. Install and tighten the 4 attaching bolts (2) into the cylinder head bolt holes of the block.

**Tighten:** Tighten the bolts to 15 N.m (11 lb ft).



**Fig. 462: View Of Cylinder Bore Sleeve Removal**  
Courtesy of GENERAL MOTORS CORP.

9. Rotate the nut clockwise in order to remove the cylinder bore sleeve.



**Fig. 463: View Of Cylinder Bore Sleeve & Removal Tool**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION: Do not damage the cylinder block surface.**  
**Damage to the cylinder block surface can cause engine failure.**

10. Remove the fixture, cylinder bore sleeve puller, and the cylinder bore sleeve (117) from the engine block.
11. Loosen the nut (1) to remove the cylinder bore sleeve (117).
12. Inspect the cylinder bore in the cylinder block for cracks or damage. If cracked or damaged, replace the cylinder block.
13. Inspect the piston, piston rings, and connecting rod for damage. Refer to **Piston, Connecting Rod, and Bearing Cleaning and Inspection.**

## CYLINDER SLEEVE INSTALLATION

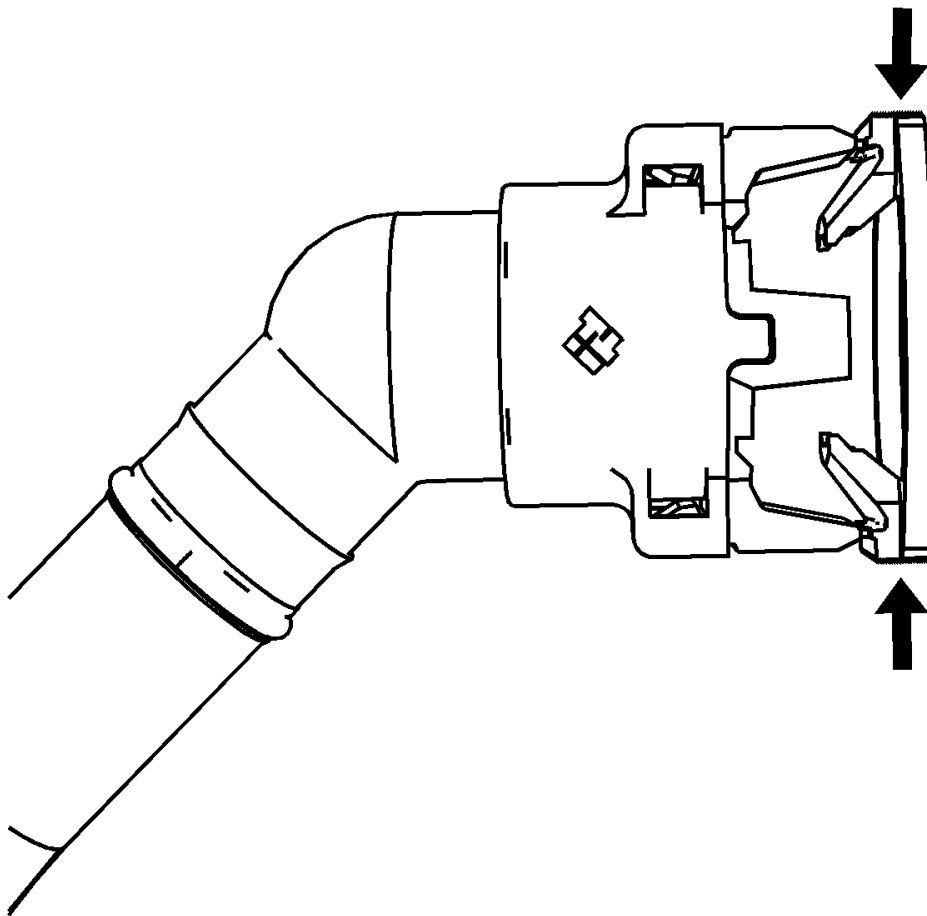
### Special Tools

**EN 45680-850** Cylinder Sleeve Removal and Installation Kit. See **Special Tools**.

### Installation Procedure

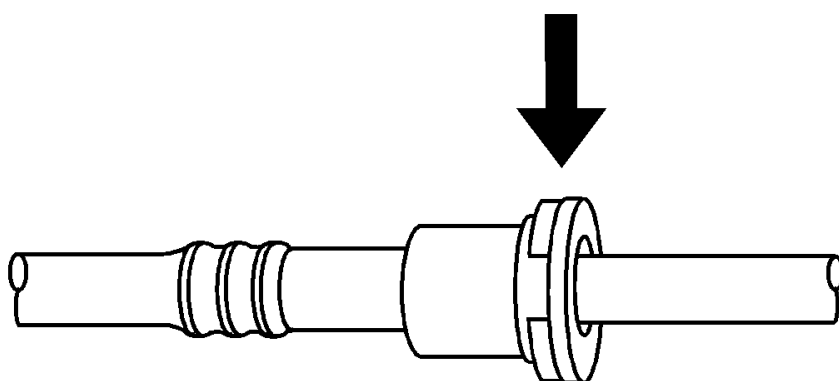
**CAUTION:** Do not use assembly aids or lubricants on the cylinder bore sleeve or the cylinder bore block when installing a new cylinder bore sleeve, or engine damage will occur. These items will not aid in the installation of the new cylinder bore sleeve.

**CAUTION:** Do not chill or heat the cylinder bore sleeve or the cylinder block when removing or installing a new cylinder bore sleeve. Chilling or heating the cylinder bore sleeve or the cylinder block will cause engine damage and will not aid the removal or installation of the new cylinder bore sleeve.



**Fig. 464: View Of Cylinder Bore Sleeve Fixture**  
Courtesy of GENERAL MOTORS CORP.

1. Place the NEW cylinder bore sleeve (117) onto the cylinder block.
2. Install the fixture EN 45680-851 and the cylinder bore sleeve installer EN 45680-853 (1) from **EN 45680-850** over the cylinder bore sleeve (117) and onto the cylinder block. See **Special Tools**. Do not apply downward pressure to the cylinder bore sleeve (117).



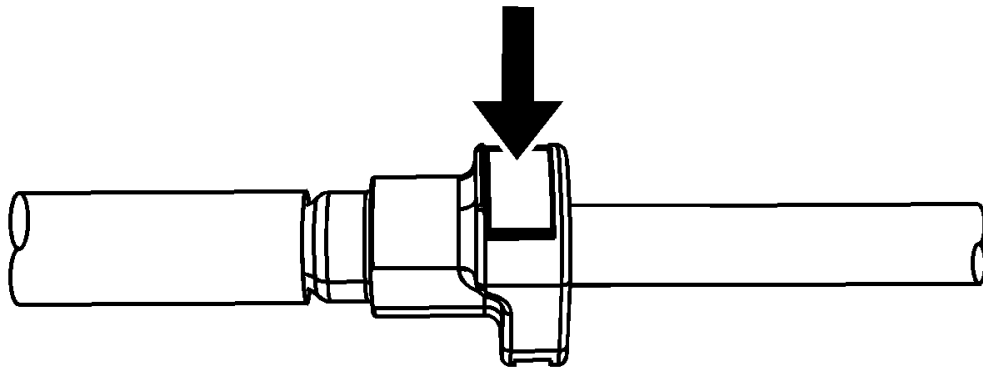
**Fig. 465: View Of Cylinder Bore Sleeve Puller & Attachment Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE: Use 4 old cylinder head bolts for the attaching bolts.**

3. Insert the 4 attachment bolts into the legs of the fixture EN 45680-851 (1).

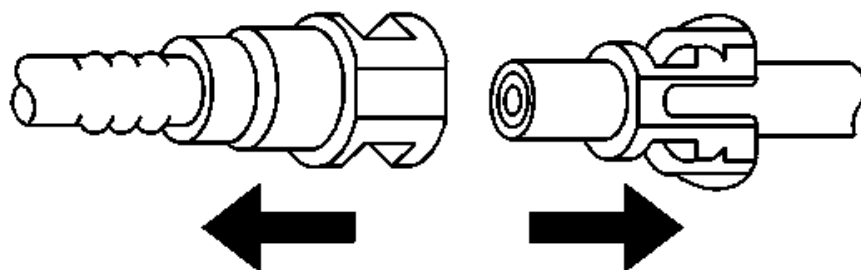
**CAUTION: Refer to Fastener Caution .**

4. Tighten the 4 attachment bolts. Do not apply downward pressure to the cylinder bore sleeve (117). Tighten the 4 attachment bolts to 15 N.m (11 lb ft).



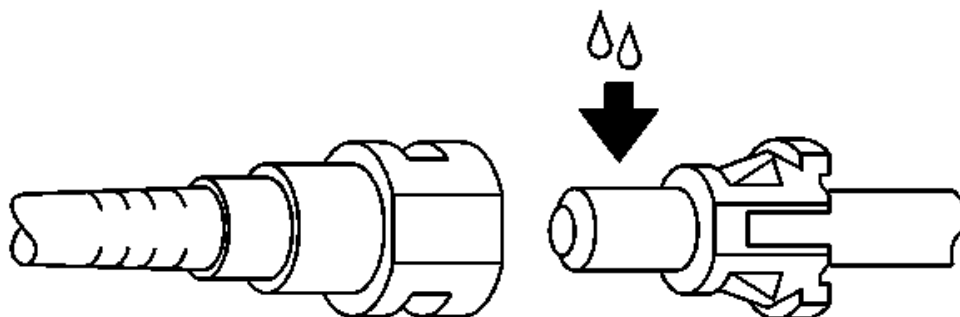
**Fig. 466: View Of Proper Liner Alignment**  
Courtesy of GENERAL MOTORS CORP.

5. Align the bottom of the cylinder bore sleeve (117) with the cylinder bore of the block (100).



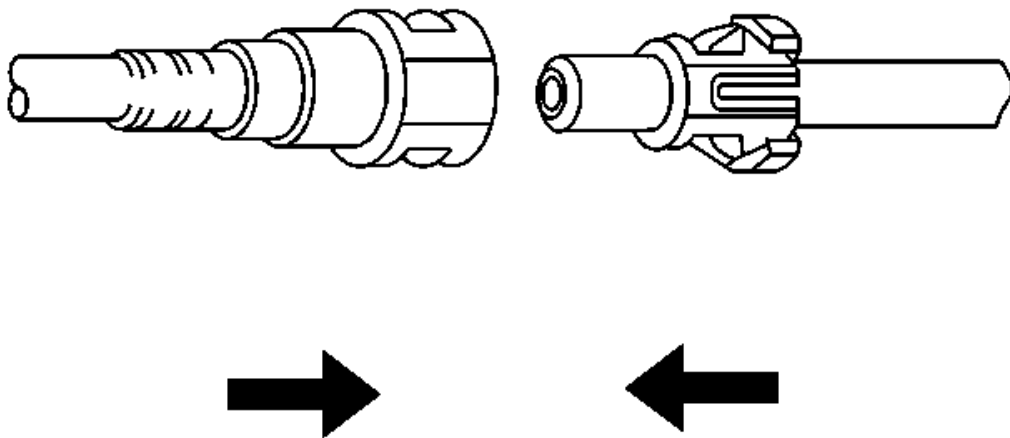
**Fig. 467: View Of Installation Arbor**  
**Courtesy of GENERAL MOTORS CORP.**

6. Align the installation arbor (1) of the cylinder bore sleeve installer EN 45680-853 onto the top of the cylinder bore sleeve (117).



**Fig. 468: View Of Pusher Block**  
**Courtesy of GENERAL MOTORS CORP.**

7. Align the pusher block (2) of the cylinder bore sleeve installer EN 45680-853 into the groove of fixture EN 45680-851 (1).

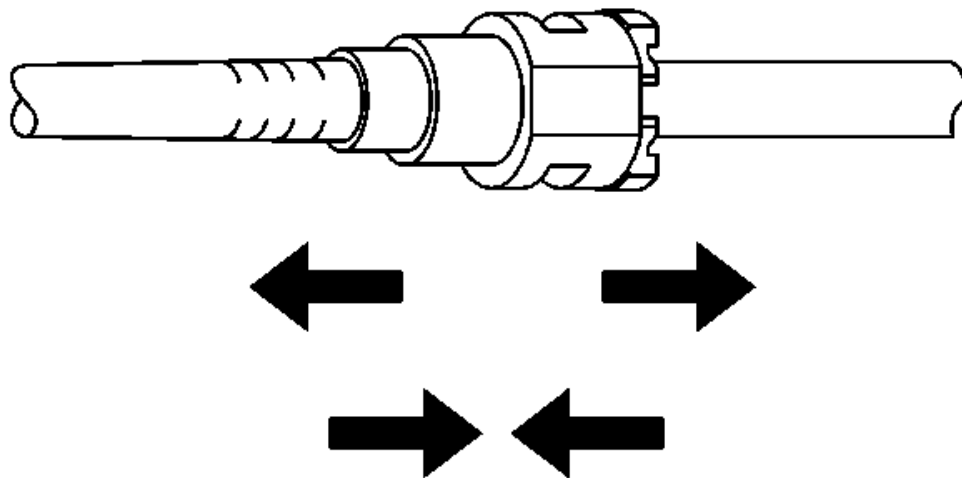


**Fig. 469: View Of Cylinder Bore Sleeve, Engine & Installation Using Tool**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION: Do not use any air powered or electric tools to rotate the threaded shaft of the cylinder bore sleeve installer in the fixture assembly or damage to the cylinder bore sleeve will occur.**

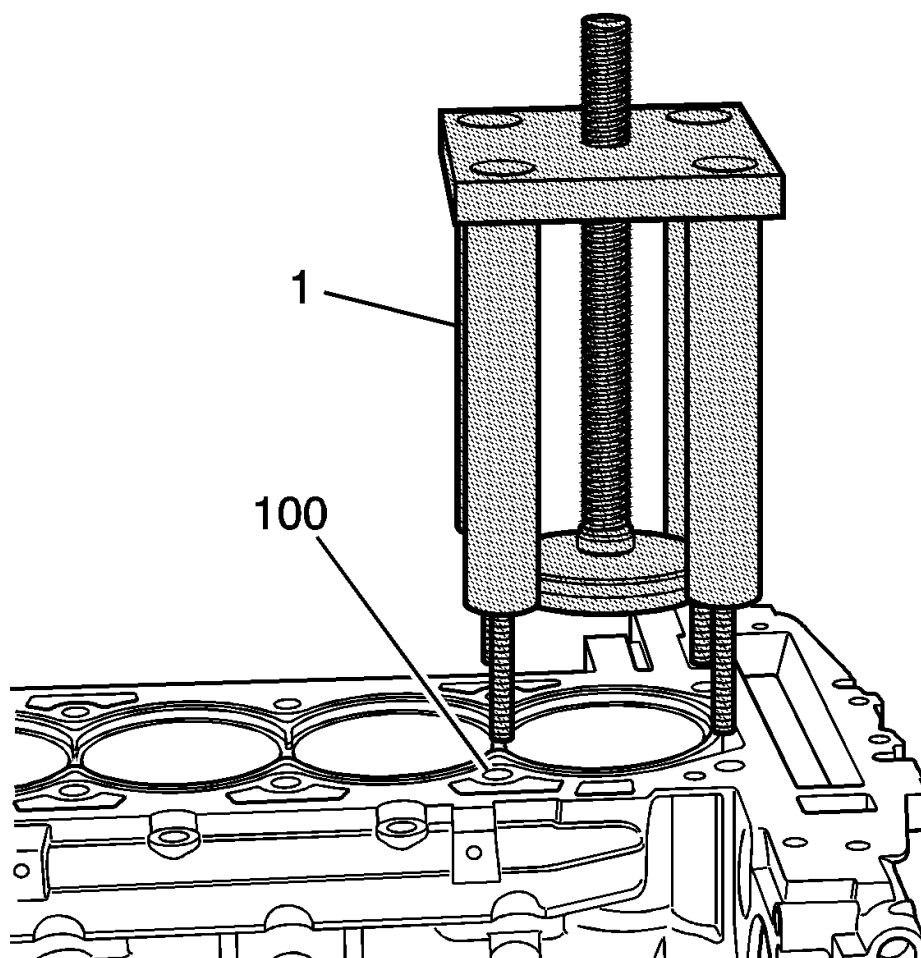
8. Using a ratchet, rotate the threaded shaft of the cylinder bore sleeve installer EN 45680-853 (1) in order to install the cylinder bore sleeve (117) into the engine block (100).
9. Do not completely seat the cylinder bore sleeve in the block. Leave approximately 1/16 inch of the cylinder bore sleeve above the surface of the

cylinder block.



**Fig. 470: Illustrating Cylinder Bore Sleeve Seating**  
Courtesy of GENERAL MOTORS CORP.

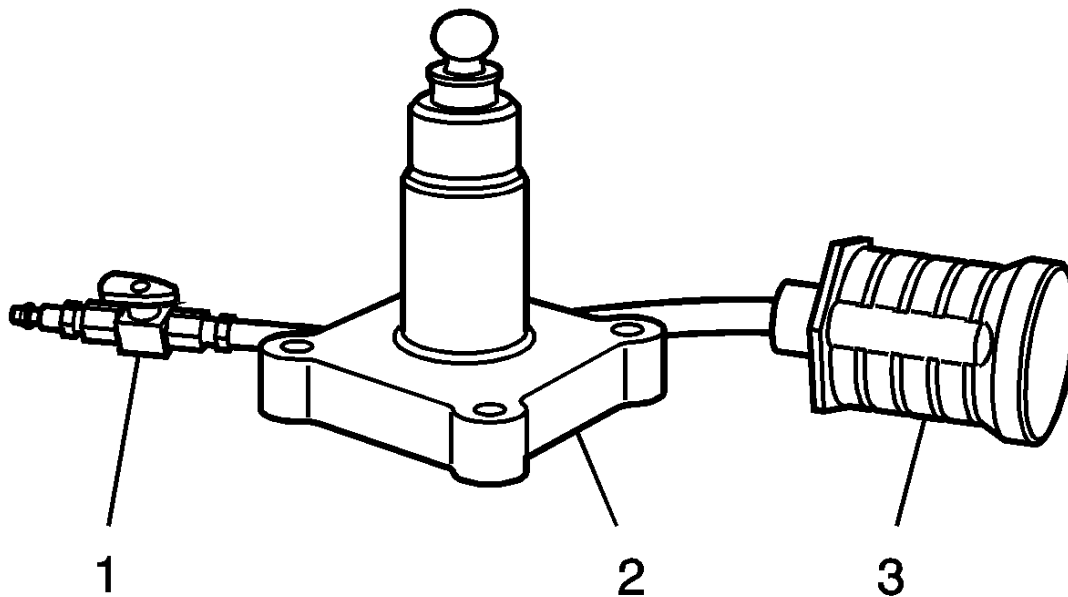
- Using a torque wrench, torque the threaded shaft to 102 N.m (75 lb ft) to completely seat the cylinder bore sleeve in the cylinder block. With the cylinder bore sleeve properly installed, a minimal portion of the cylinder bore sleeve flange will protrude above the block deck surface.



**Fig. 471: View Of Service Tool Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

11. Remove the fixture assembly EN 45680-851 with the cylinder bore sleeve installer EN 45680-853 (1) from the cylinder block (100).

**Cylinder Sleeve Trimming**



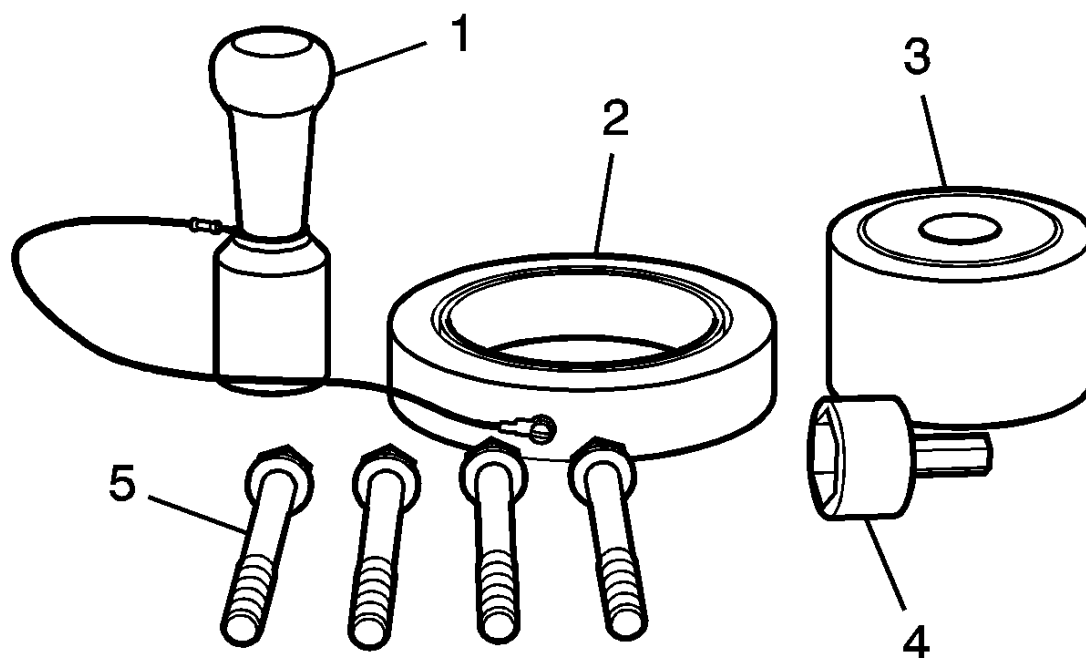
**Fig. 472: View Of Cylinder Liner Trimming Tools (1 Of 2)**  
Courtesy of GENERAL MOTORS CORP.

The EN 45680-861 trim tool assembly (2) from **EN 45680-850** contains or requires the following components to complete 86 mm cylinder sleeve trimming. See **Special Tools**.

- Debris collector (3) with filter EN 45680-865 from **EN 45680-850** . See **Special Tools**.
- Air control valve (1)
- Drill motor with 1/2 inch chuck, 1 1/8 hp, 7 amps, triple gear reduction, and a 450-600 RPM rotational speed in a clockwise direction
- EN 45680-869 bore cutter bit and screw from **EN 45680-850** . See **Special**

**Tools.**

- EN 45680-899 Bore trimmer pilot from **EN 45680-850** , white in color. See **Special Tools**.



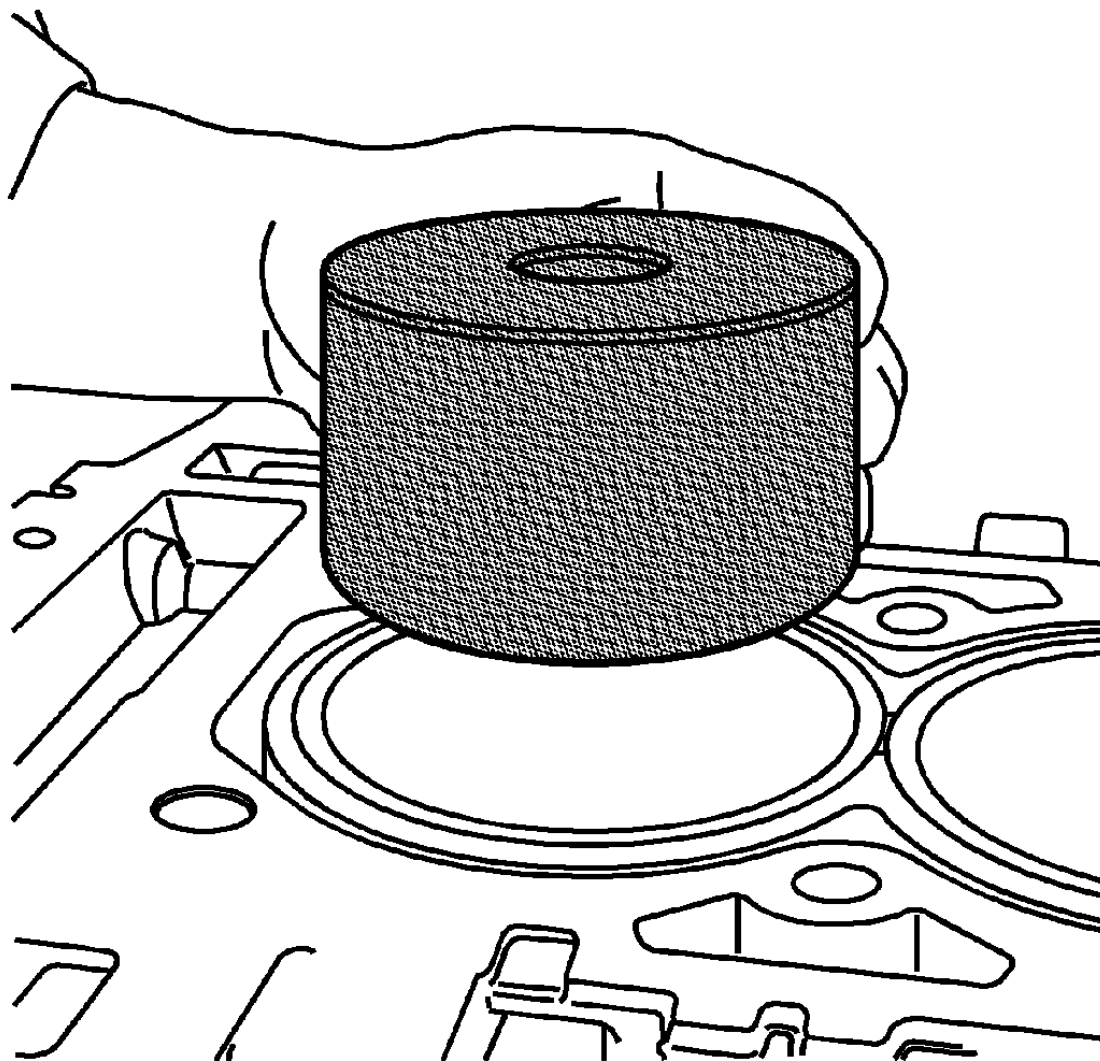
**Fig. 473: View Of Cylinder Liner Trimming Tools (2 Of 2)**  
**Courtesy of GENERAL MOTORS CORP.**

- Gage ring assembly EN 45680-862 from **EN 45680-850** . See **Special Tools**.
  - Trim tool preloader (1)
  - Set gage ring (2)
- EN 45680-412 Set Gage Ring (2)
- EN 45680-863 metal shavings catch plug (3) from **EN 45680-850** . See **Special**

**Tools.**

- EN 45680-866 drive adapter (4) from **EN 45680-850** . See **Special Tools**.
- EN 45680-864 bolts (5) from **EN 45680-850** . See **Special Tools**.

**CAUTION:** Do not bore or hone the cylinder bore sleeve. The cylinder bore sleeve inside diameter (I.D) is fully machined and honed to size and is optimally finished as shipped. Any attempt to modify this factory-produced sizing and finish with additional boring and honing will lead to engine damage, excessive noise or abnormal oil consumption.

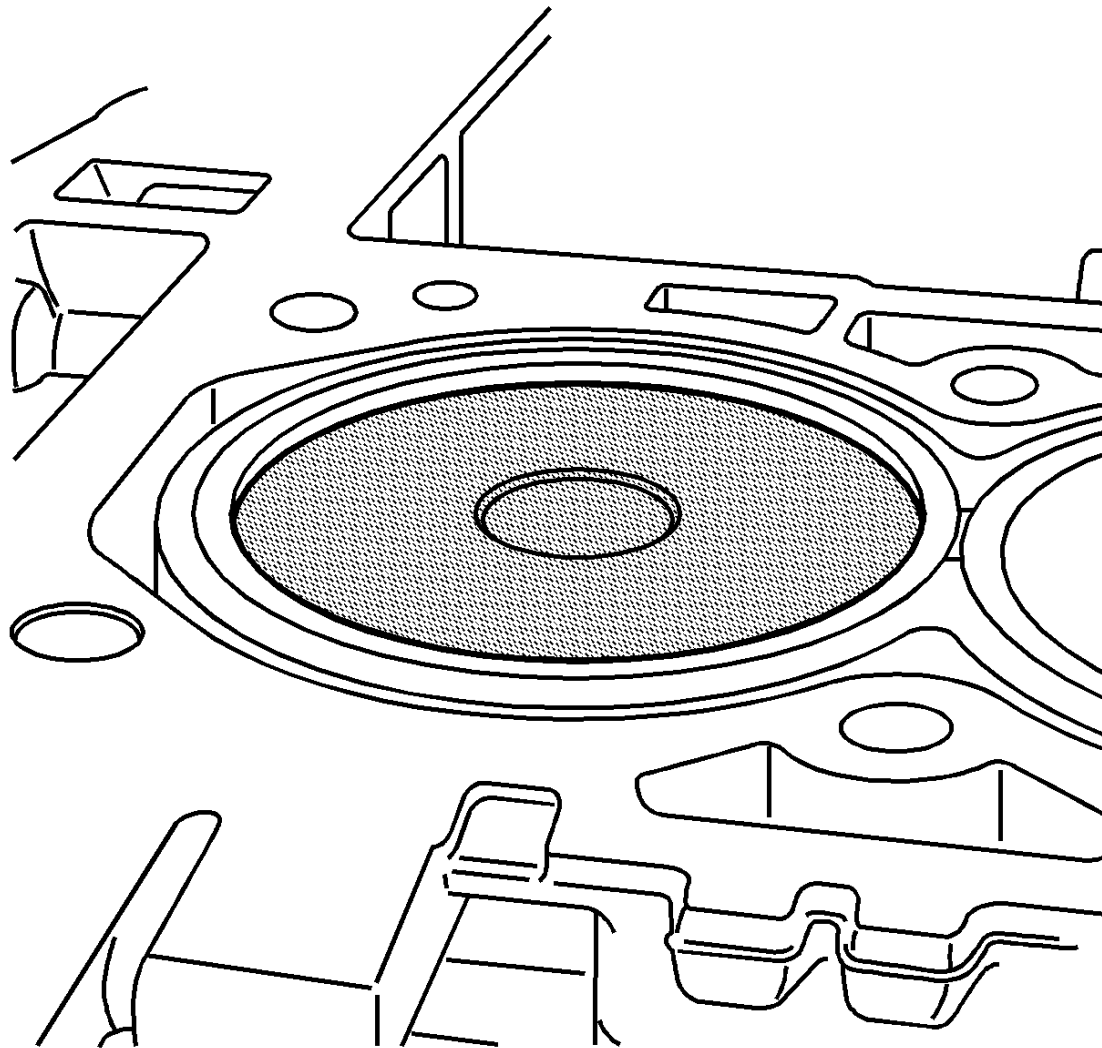


**Fig. 474: View Of Metal Shaving Catch Plug**  
**Courtesy of GENERAL MOTORS CORP.**

1. After installing the NEW cylinder bore sleeve(s) into the engine block, trim the excess material from the cylinder bore sleeve flange.

**CAUTION: Ensure that all the metal particles are collected in order to prevent internal damage to the engine or bearings.**

2. Place the metal shaving catch plug EN 45680-863 into the cylinder bore sleeve to be trimmed. Position the top approximately 3.0 mm (0.12 in) below the top surface of the cylinder bore sleeve.
3. Place an additional metal shaving catch plug EN 45680-863 into all remaining cylinder bore sleeves.

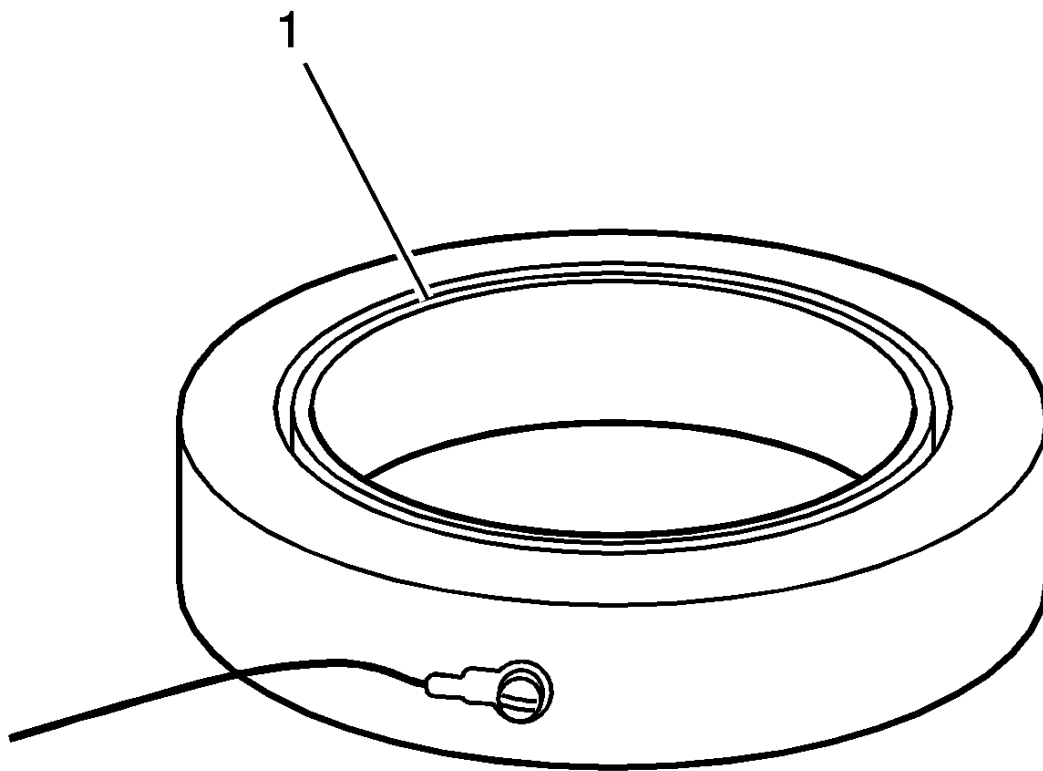


**Fig. 475: Identifying Catch Plug Positioning**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION:** Installing the metal shaving catch plug deeper than the recommended depth will create a decrease in vacuum system performance. A decrease in vacuum system performance will cause metal shavings to enter the engine and cause engine failure.

**CAUTION:** Installing the metal shaving catch plug above the recommended depth will cause damage to the metal shaving catch plug.

4. Ensure that the metal shaving catch plug EN 45680-863 is 3.0 mm (0.12 in) below the top surface of the cylinder bore sleeve.
5. Ensure that the correct bore trimmer pilot and cutter bit are installed on the trimmer base assembly EN 45680-861:
  - EN 45680-869 cutter bit and screw
  - EN 45680-899 trimmer pilot, 86 mm sleeve

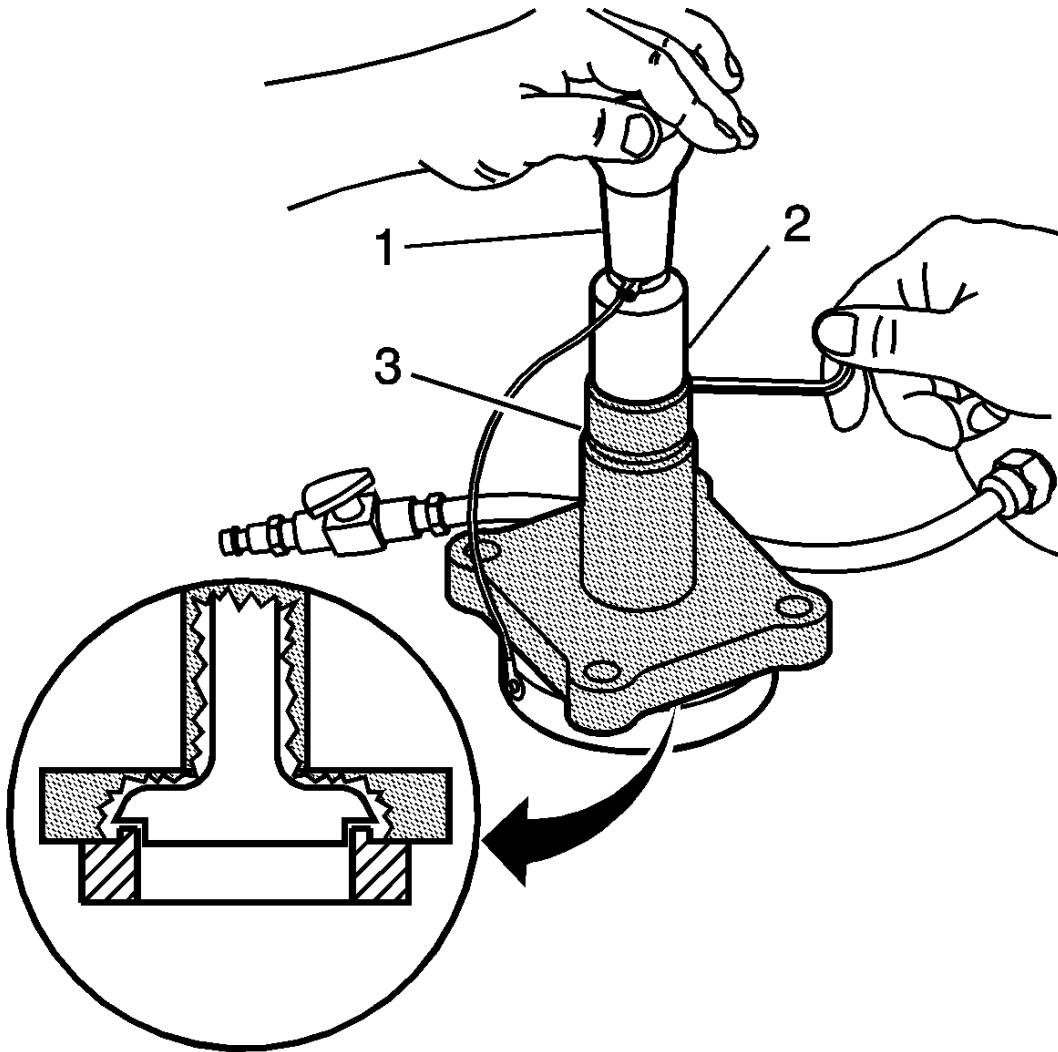


**Fig. 476: Identifying Set Gauge Ring Groove**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Before using the trim tool assembly, the height of the cutting blades must be set to the proper specification.

The proper specification is that the cylinder bore sleeve flange must be flush to  $+0.02$  mm (0.0008 in) above the block deck surface.

6. The groove side of the set gage ring (1) on the gage ring assembly EN 45680-862 should be positioned upward on a flat surface.



**Fig. 477: View Of Trim Tool Assembly Components & Positioning**  
Courtesy of GENERAL MOTORS CORP.

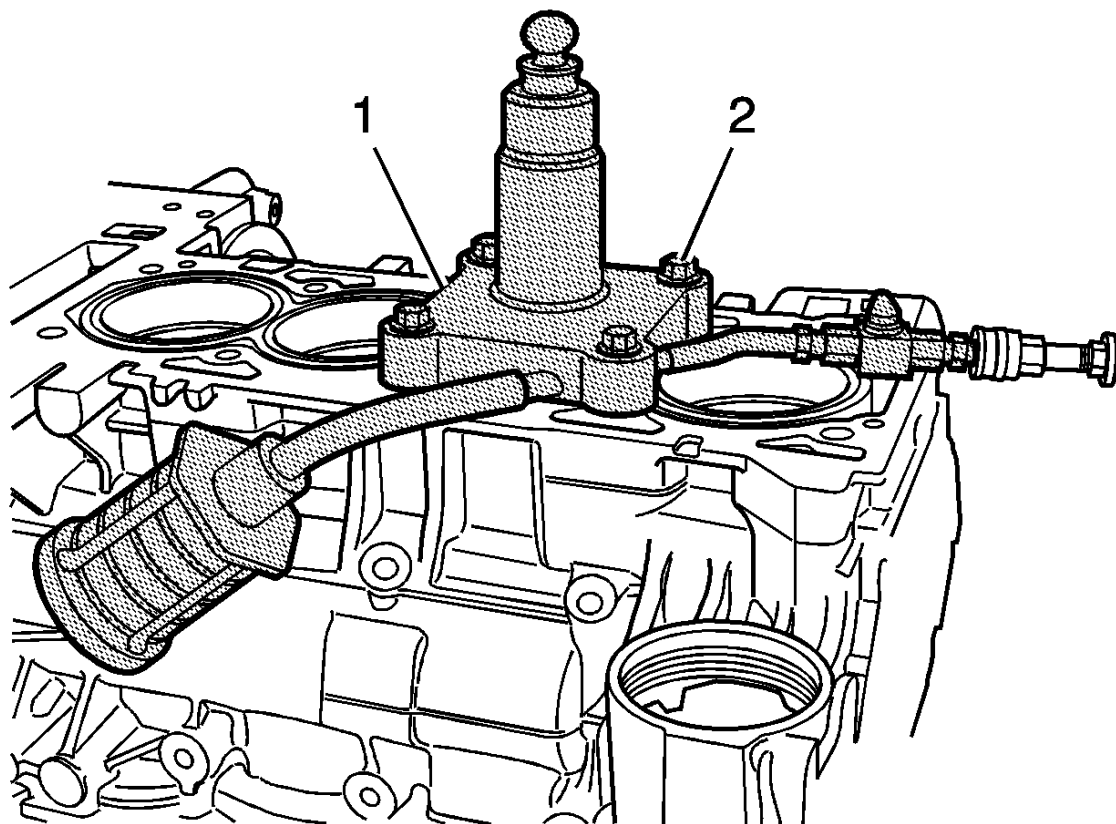
**NOTE:** Ensure that the set gage ring surfaces are clean.

7. Carefully position the trim tool assembly EN 45680-861 onto the set gage ring.

8. Loosen the shaft collar screw (2).
9. Push the shaft collar (2) downward using the trim tool preloader (1) on the gage ring assembly EN 45680-862 until the shaft collar is positioned against the top of the flange bearing (3).

**NOTE:** Once this procedure is done, it is not necessary to reset the trim tool assembly height until the blades are worn, damaged, or replaced.

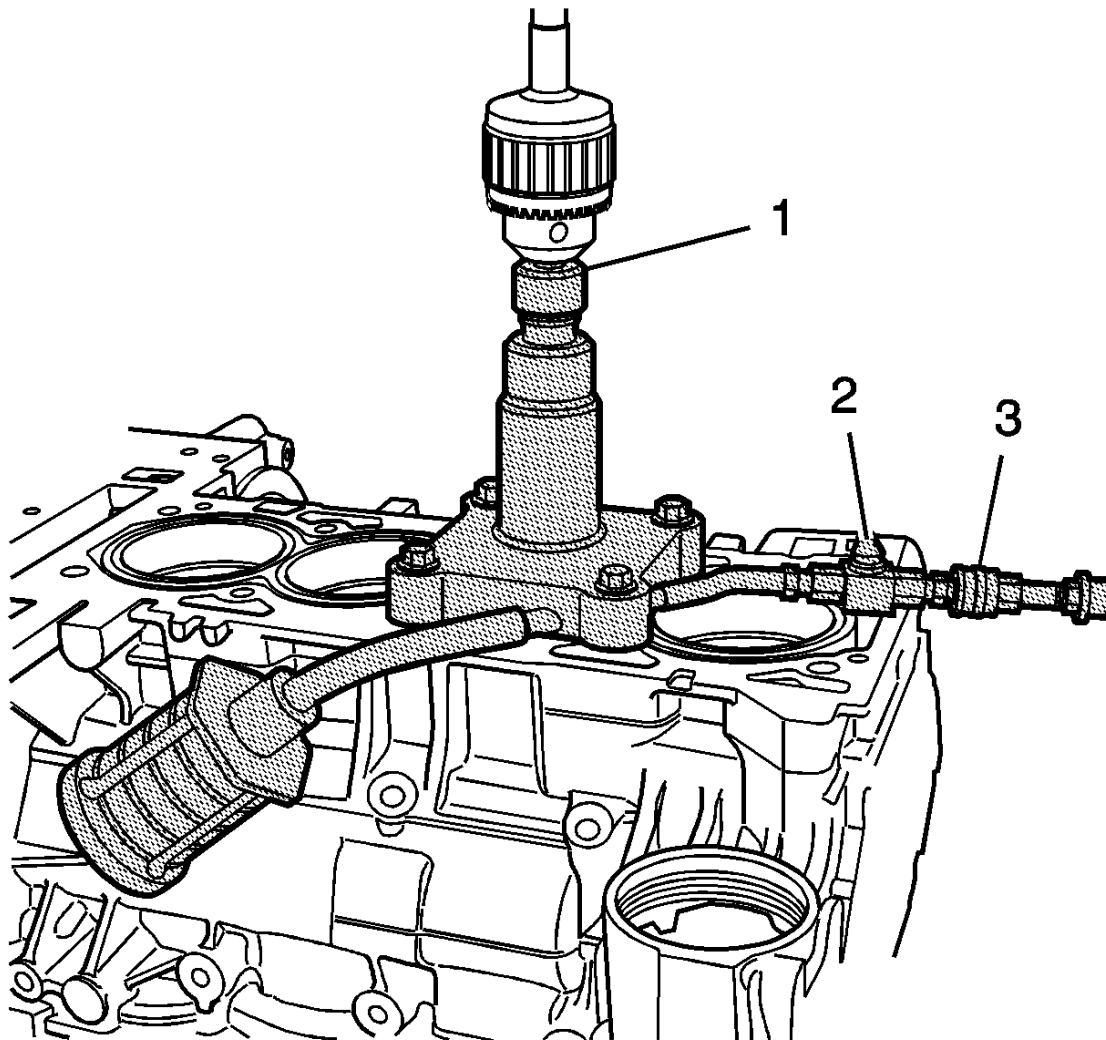
10. Apply downward pressure on the collar and inner drive shaft using the trim tool preloader (1), then tighten the shaft collar screw to 19 N.m (14 lb ft).



**Fig. 478: Aligning Trim Tool Assembly**

**Courtesy of GENERAL MOTORS CORP.**

11. Place the trim tool assembly EN 45680-861 onto the cylinder to be trimmed with the directional arrow (1) pointing in line with the crankshaft centerline and the front of the block.
12. Install the 4 bolts EN 45680-864 (2) into the cylinder head bolt holes in the block. Tighten the bolts to 20 N.m (15 lb ft).



**Fig. 479: View Of Drive Adapter**  
**Courtesy of GENERAL MOTORS CORP.**

**CAUTION:** For proper tool operation, a drill motor with a 1/2 inch chuck, 1 1/8 hp, 7 amps, triple gear

**reduction, and a 450-600 RPM rotational speed in a clockwise direction must be used. If the proper drill motor is not used, damage to the cylinder bore sleeve will occur.**

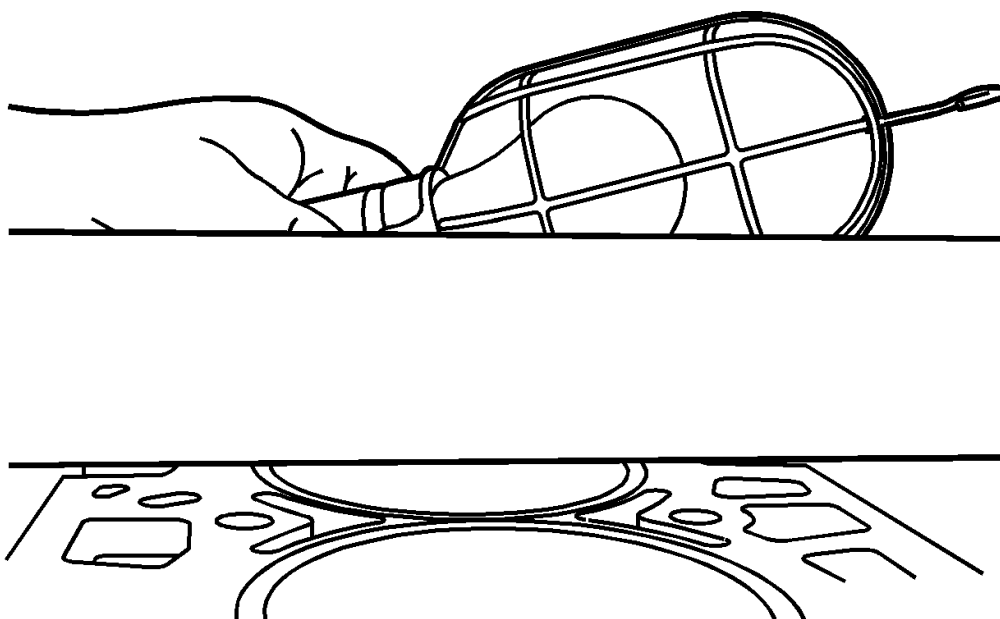
13. Fasten the drive adapter EN 45680-866 (1) into the drill chuck.

**CAUTION: Ensure that there are no crimps in the air feed hose or the vacuum hose. Crimps in the hose may cause metal shavings to exit the cutting tool in any direction, causing engine damage.**

14. Connect a compressed air supply 517.10-861.84 kPa (75-125 psi) to the male quick connect (3) located on trim tool assembly EN 45680-861. Turn the compressed air valve (2) to the open position. This starts the venturi vacuum system that will catch the metal shavings.

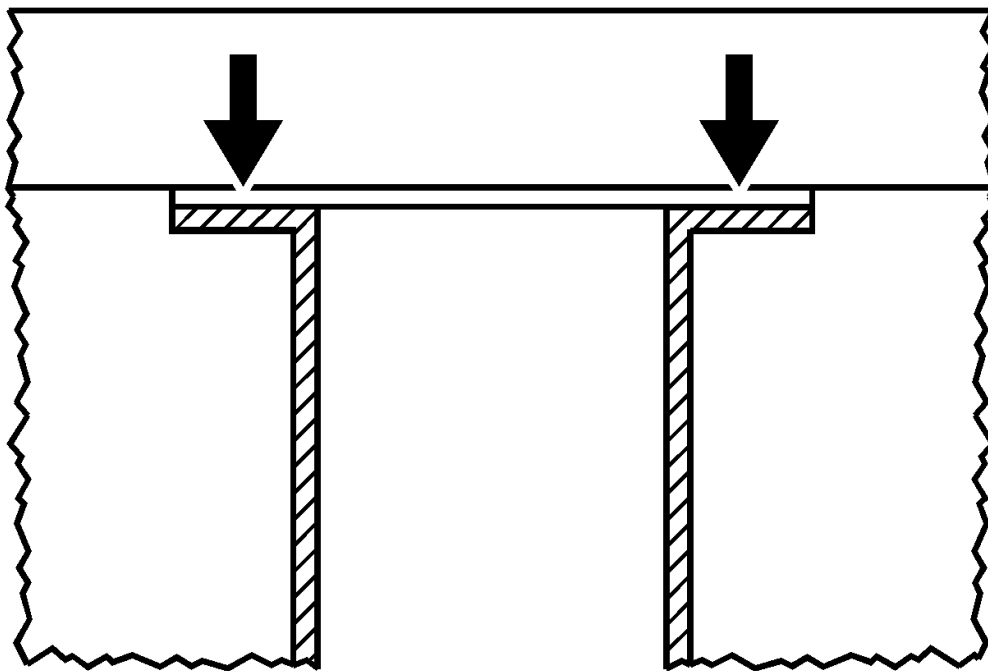
**NOTE: It should not take longer than 15 seconds to complete the trimming procedure. If it does, the trimming bits must be repositioned to a new cutting surface.**

15. Place the drive adapter EN 45680-866 and drill assembly (1) vertically onto the drive adapter end of trim tool assembly EN 45680-861. Do not apply downward force on the drill until full rotational speed has been reached. After reaching full rotational speed, apply firm downward force until the cutting action is complete.
16. Remove the drive adapter EN 45680-866 (1) and drill assembly from the trim tool assembly EN 45680-861.
17. Turn off the compressed air valve (2).
18. Remove the trim tool assembly EN 45680-861 from the engine block.
19. Remove any material shavings that may be found on the metal shaving catch plug EN 45680-863.
20. Wipe the cylinder bore sleeve and surrounding areas free of any powder residue and then remove the metal shaving catch plug EN 45680-863.



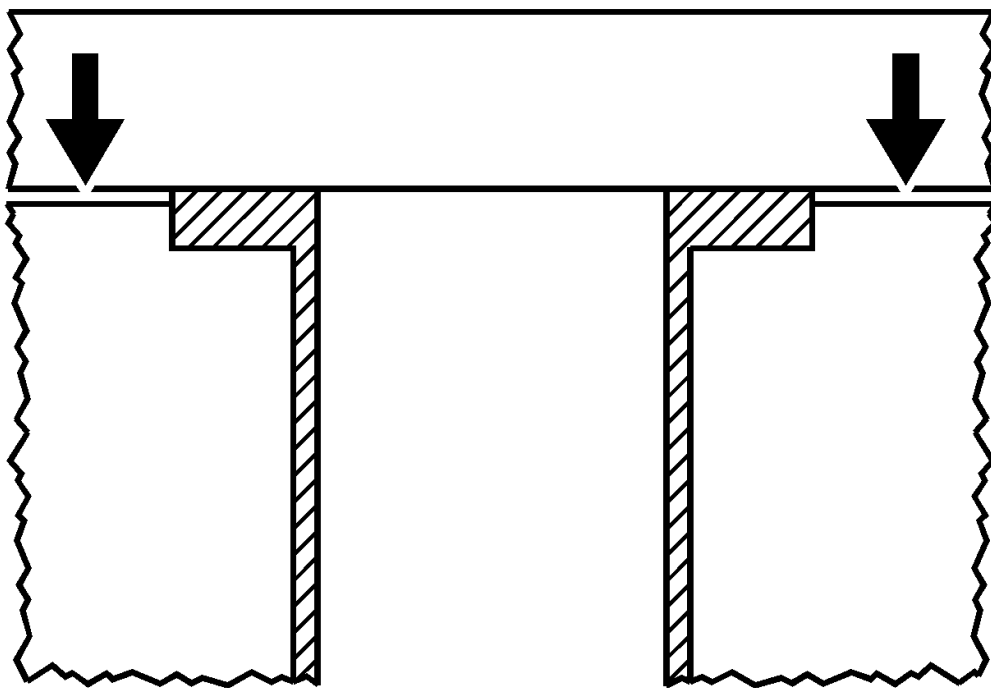
**Fig. 480: Checking Cylinder Block Deck Surface With Straight Edge**  
Courtesy of GENERAL MOTORS CORP.

21. Install a straight edge on the cylinder block perpendicular to the crankshaft center line.
22. Using a light, illuminate the backside of the straight edge.



**Fig. 481: View Of Improperly Cut Cylinder Bore Sleeve**  
Courtesy of GENERAL MOTORS CORP.

23. Looking at the front of the straight edge, check to see if light is protruding through the bottom of the straight edge and the top of the cylinder bore sleeve flange. If light is present on either side or both sides of the cylinder bore sleeve, the cylinder bore sleeve is cut incorrectly and a new cylinder bore sleeve needs to be installed.



**Fig. 482: View Of Properly Cut Cylinder Bore Sleeve**  
Courtesy of GENERAL MOTORS CORP.

24. Looking at the front of the straight edge, check to see if light is protruding through the bottom of the straight edge and the top of the cylinder block deck surface. If light is present on both sides of the cylinder block, the cylinder bore sleeve is cut correctly.
25. Proceed to the next bore sleeve to be trimmed repeating steps 10-23 if necessary.