# INSTALLATION PROCEDURE

## K-LINE® BRONZE BULLET® VALVE GUIDE-LINER®

### BORING THE VALVE GUIDE

The valve guide is to bored oversized, taking care to consistently produce an accurate size valve guide bore concentric to the valve seat. In order to ensure proper alignment, a valve guide boring fixture should be used. In order to control valve guide bore diameters and roundness, K-Line® Black Beauty® carbide boring tools should be used in conjunction with the boring fixture. Two-point alignment, using valve seat bushing and precision reamer bushings, insure efficiency and accuracy.

**STEP 1**

Position the cylinder head on the adjustable head cradles of the boring fixture with the combustion side facing upward and the valve seat face having a slight angle toward the operator.

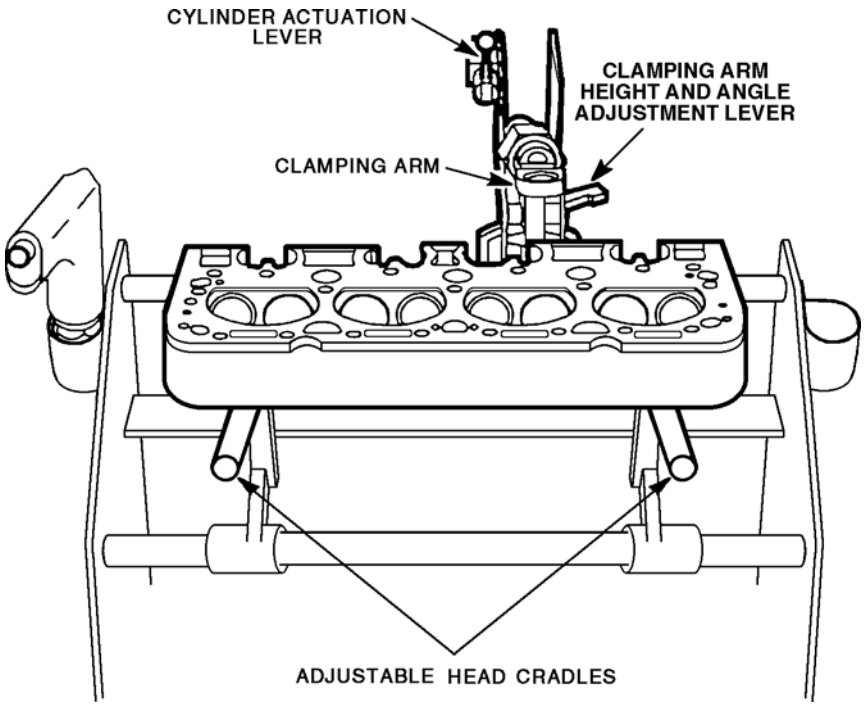


*Figure 1: Valve Guide Boring Fixture*

*NOTE: Always disconnect the air supply before making any adjustments to the boring fixture in order to avoid injury. Accidentally moving the cylinder actuation lever will cause the clamping arm of the bore fixture to engage, causing potential injury at the point of pressure.*

**STEP 2**

Select the valve seat bushing which best fits the valve seat of the valve guide you are about to bore. Typically, one size valve seat bushing will be required for the exhaust valve, and another size for the intake valve.

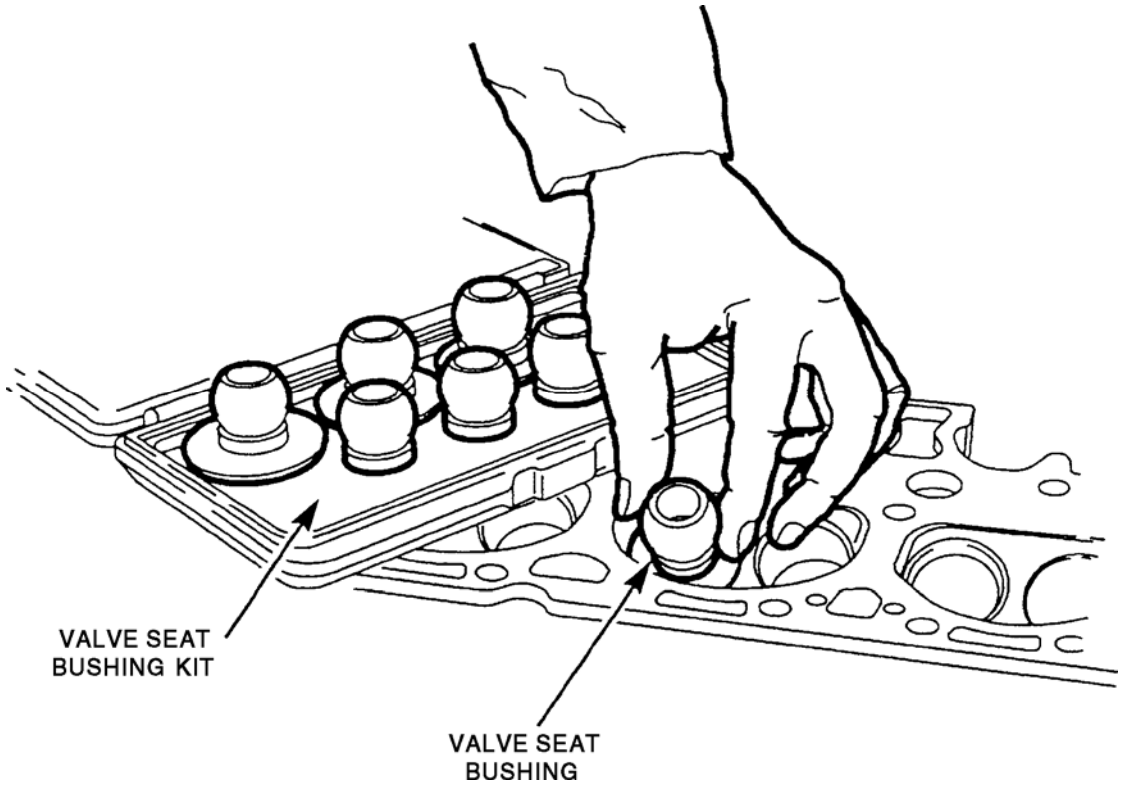


*Figure 2: Valve Seat Bushing Section*

*NOTE: There should be no interference between the combustion chamber and the outside diameter of the valve seat bushing.*

**STEP 3**

Insert the valve seat bushing into the clamping arm of the boring fixture, and then move the bushing retainer forward into the locking position.

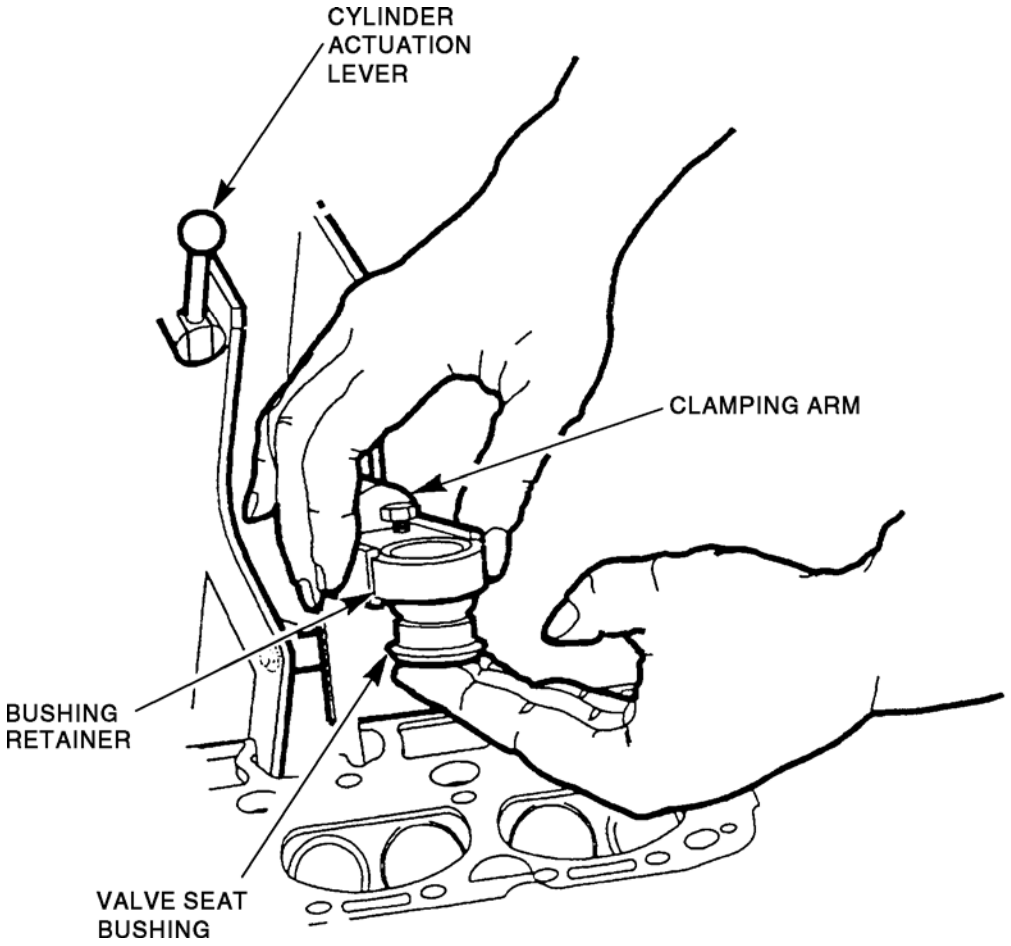


*Figure 3: Valve Seat Bushing Section*

**STEP 4**

Release the boring arm adjustment lever. Position the clamping arm of the boring fixture over the valve seat of the valve guide you are about to bore. Note that the boring fixture column is completely adjustable for height, and will also rotate for canted valve applications. In order to maximize the efficiency and accuracy, position the boring fixture column so the clamping arm is tilted slightly towards the operator with clearance between the clamping arm and cylinder head. Lock the boring fixture column in position by moving the boring arm adjustment lever to the center position.

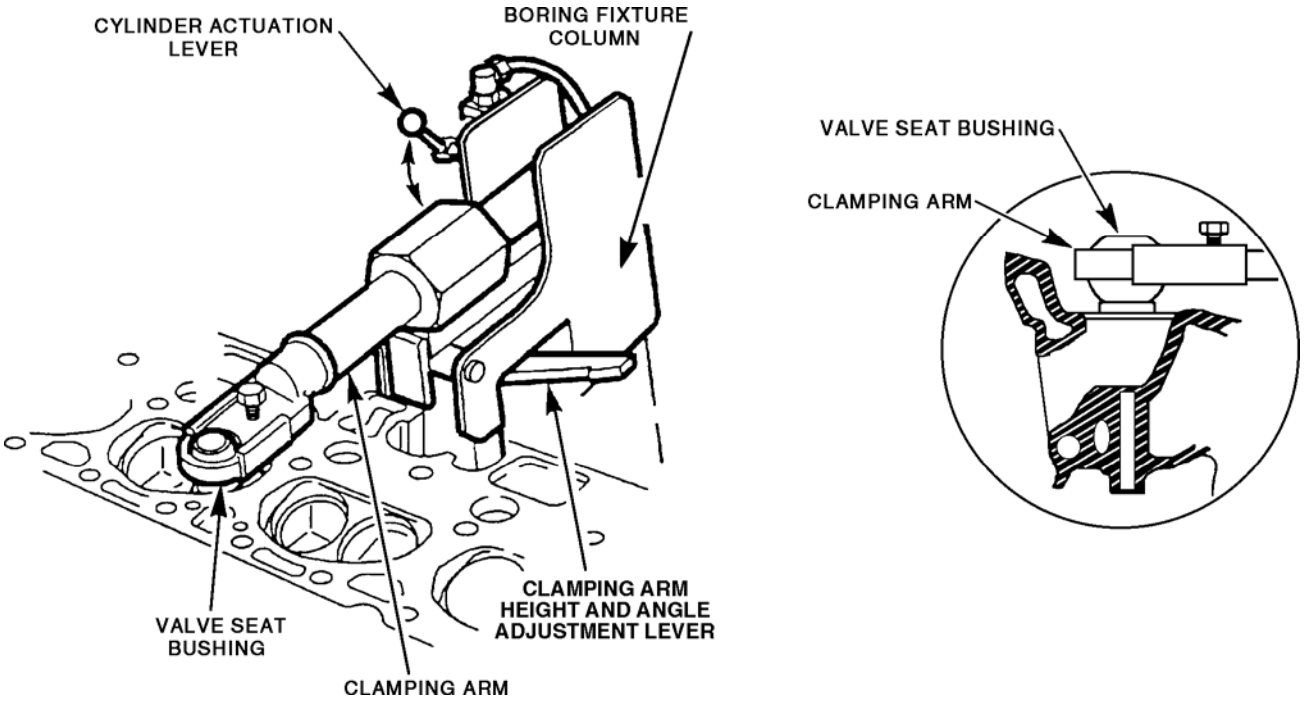


*Figure 4: Position Clamping Arm*

*NOTE: Reconnect the air supply to the boring fixture.*

**STEP 5**

With the appropriately selected carbide boring tool for Guide-Liners® chucked in an air drill, position the carbide boring tool and reamer bushing so they are centered through the valve seat bushing and the pilot is in the valve guide. Be sure that the boring tool and clamping arm are at approximately a 90° angle to each other. The pilot of the carbide boring tool and the reamer bushing now provide a positive 2-point alignment, locating off the valve seat bushing on the valve seat and the center of the valve guide. Lock the clamping arm into place by moving the air cylinder actuation lever to the forward position. The air pressure in the air cylinder ensures that alignment will be maintained throughout the boring process.

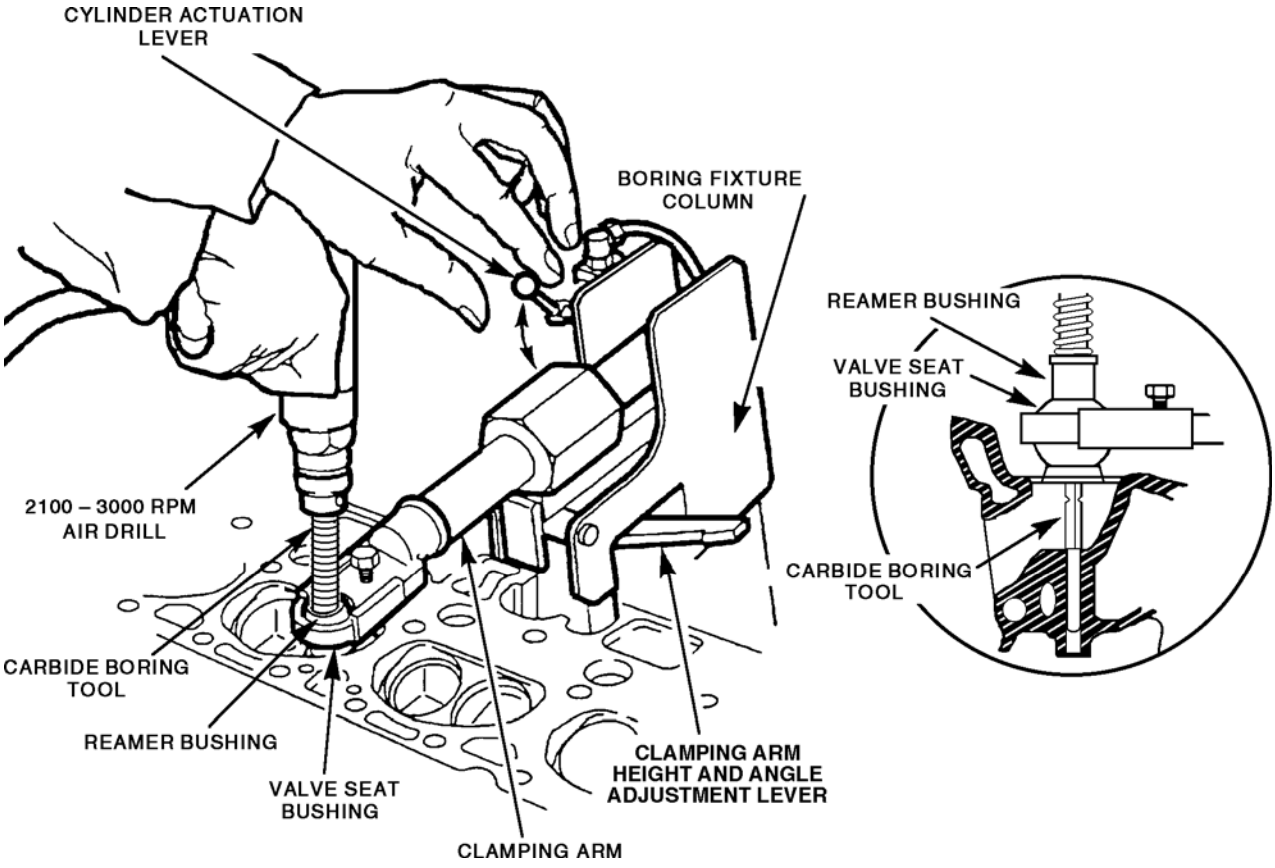


*Figure 5: Lock Clamping Arm*

*NOTE: The carbide boring tool pilot is of sufficient length to reach a point close to the center of the valve guide hole to be bored. This will minimize any effect from previous wear which more commonly will be situated at either end of the valve guide.*

**STEP 6**

Carefully move the air drill with the carbide boring tool up and down to check freedom of movement. If any binding occurs, repeat Steps 4 & 5.

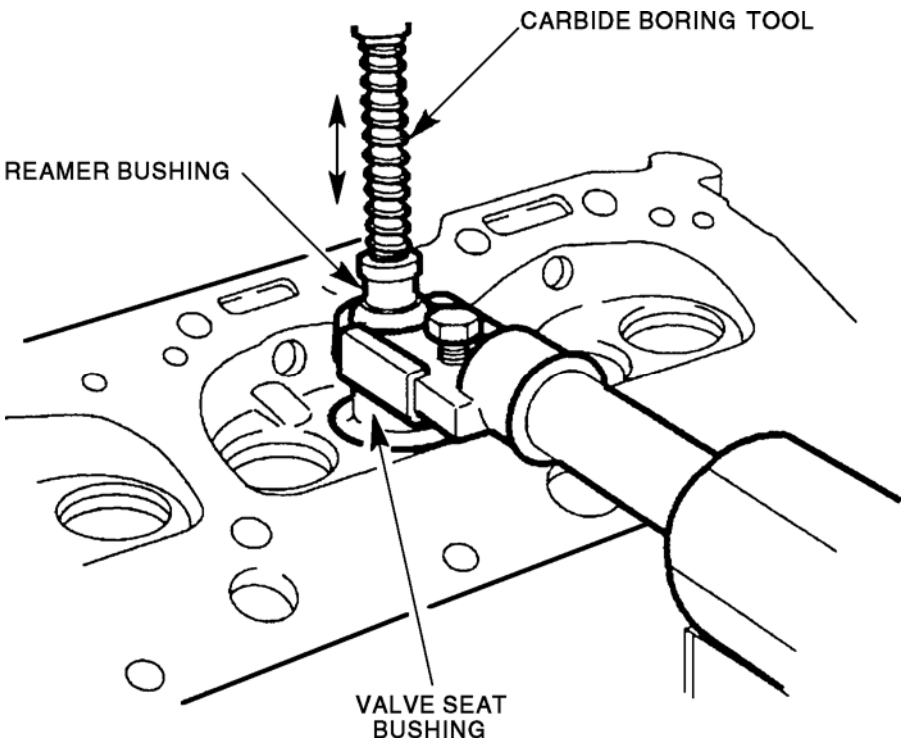


*Figure 6: Check Freedom of Carbide Boring Tool Movement*

**CAUTION: While checking movement, DO NOT contact the carbide boring tool with the cylinder head, as the carbide cutting edge can be chipped causing an oversized valve guide hole.**

**STEP 7**

Run the carbide boring tool through the valve guide, taking care to adhere to the following precautions:

1. The carbide boring tool and bushing should be free to move through the valve seat bushing and valve guide without the pilot of the carbide boring tool binding at any point.

2. Initiate power to the carbide boring tool with the pilot already in the valve guide, but prior to the carbide cutting edge contacting the valve guide to be bored (i.e., allow the carbide boring tool to be operating at maximum RPM as it begins to cut).

3. Boring of cast iron with a carbide boring tool should be done at high speeds. 2100-3000 RPM in a no load state is recommended.

4. Use of an air drill is preferred over electric, as the air drill will stop spinning immediately after being disengaged. It is important that the boring tool is not turning while being removed from the bored valve guide in order to avoid distortion to the bored valve guide.

5. It is important that a consistent feed rate be maintained as you push the carbide boring tool through the valve guide. Consistent, steady pressure must be applied to ensure that the carbide boring tool is removing cast iron at an even rate. The average length guide (2.25”-2.50”) should take 3-4 seconds to bore, cutting the cast iron at a rate of 40” per minute for hardened guides, or a rate of 55” per minute for soft cast iron guides.

6. All boring of cast iron must be done dry, free of lubricants.

7. Carbide is a very hard material. As mishandling can cause chipping or breakage to the cutting edge, tools should be inspected on a regular basis.

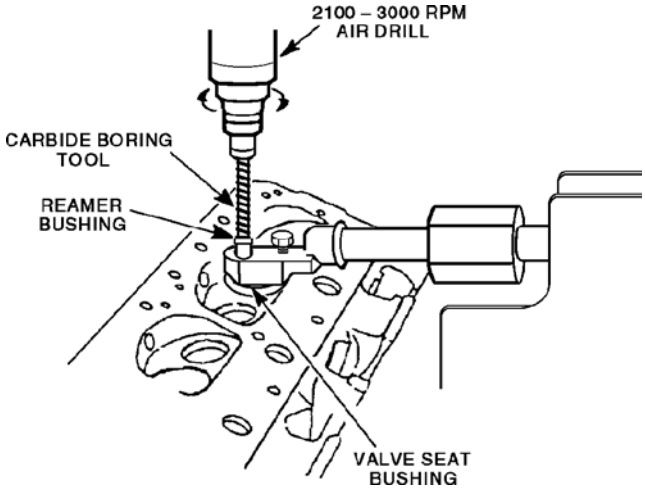


*Figure 7: Valve Guide Boring*

NOTE: With a Rockwell C hardness of 93-95, the Black Beauty® carbide boring tool allows faster operating speeds with extended tool life, even in hardened guides. Each reamer is crafted to a .0002 tolerance or less, providing a true and consistent hole size. Additionally, unlike many "off the shelf" coatings, the Black Beauty® coating process is applied at a low temperature, eliminating the possibility of tool warpage or annealing, and a unique molecular structure resists galling or chip buildup which can cause oversize boring. All of this adds up to a lubricious surface which cuts at a lower temperature and aids in very efficient chip removal.

NOTE: Common causes of excessive boring tool wear and/or breakage are:

- Incorrect cutting speeds
- Incorrect feed rate
- Reversing boring tool rotation and backing out of hole
- Stopping boring tool before cutting entire length of the hole
- Poor alignment
- Careless handling
- Excessive chip buildup
- Boring tool chatter
- Failure to maintain a steady feed rate
- Failure to apply even pressure on the air tool

NOTE: With the use of the Bronze Bullet® Valve Guide-Liner® system, there is no need to apply a chamfer to the head prior to installing the Valve Guide-Liner®. Uncontrolled depth chamfers can cause inconsistencies between the bronze to cast iron interface as well as form a pocket for carbon deposits on the combustion side of the valve guide.

**STEP 8**

Using compressed air, clean all debris from the valve guides.

**STEP 9**

Due to the critical importance of a properly bored vale guide hole, inspection with a K-Line® Go-No-Go bore gage is necessary. K-Line® offers a complete selection of Go-No-Go gages which will assist in identifying any holes which may be bored undersized or oversized.

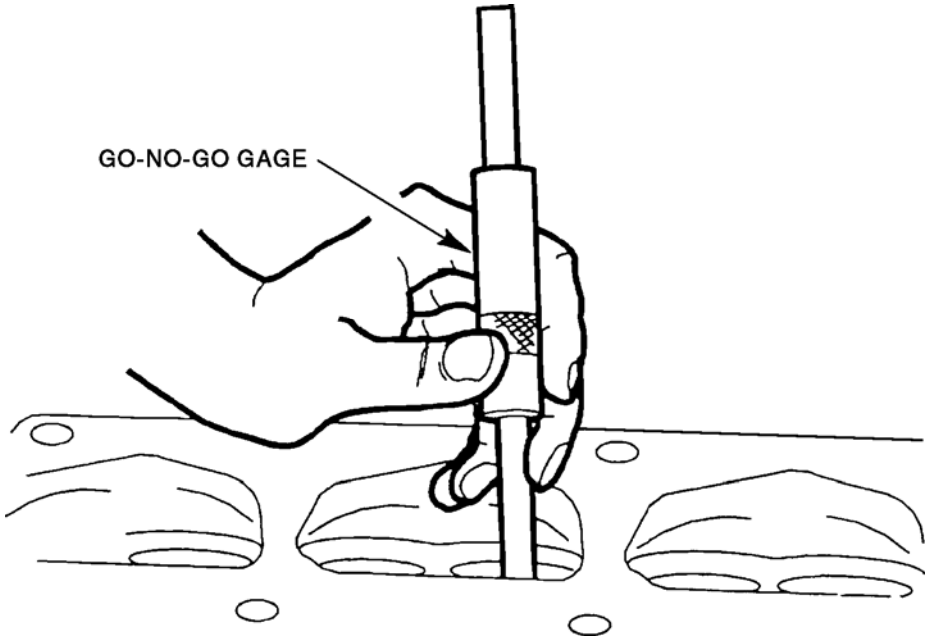


*Figure 8: Inspection with Go-No-Go Bore Gage*

*NOTE: This gage is used to prevent under or oversized boring of the valve guide by helping the operator to know when the carbide boring tool is worn and needs to be replaced.*

*NOTE: Use a .015 over piloted .030 boring tool when a cylinder head has already been bored for .015 valve guides and the next repair would be in repair would be installing K-Line® Bronze Bullet® Guide-Liners®.*

**STEP 10**

Install K-Line® Bronze Bullet® Guide-Liners®. See Bronze Bullet® Guide-Liners® installation procedure (next).

# INSTALLATION PROCEDURE OF THE K-LINE® BRONZE BULLET® VALVE GUIDE-LINER®

Once the valve guide is bored oversize, the Bronze Bullet® Valve Guide Liner® installation process uses a K-Line® Valve Guide Brush (KL1036) to clean debris from the bored hole. The liner is installed with the K-Line® Auto-Installer and sized using a K-Line® Roller Burnishing Tool, K-Line® Hard Chrome Ball Broaches or K-Line® Carbide Sizing Balls. Finish with a K-Line® Deluxe Guide-Top Cutter (KL4235) and K-Line® Flex-Hone.

**STEP 1**

Turn the cylinder head over. Clean the valve guide using a valve guide brush. Wet brushing the bored valve guide hole with a water-displacing lubricant will assist in lubricating the valve guide for the Valve Guide-Liner® installation.

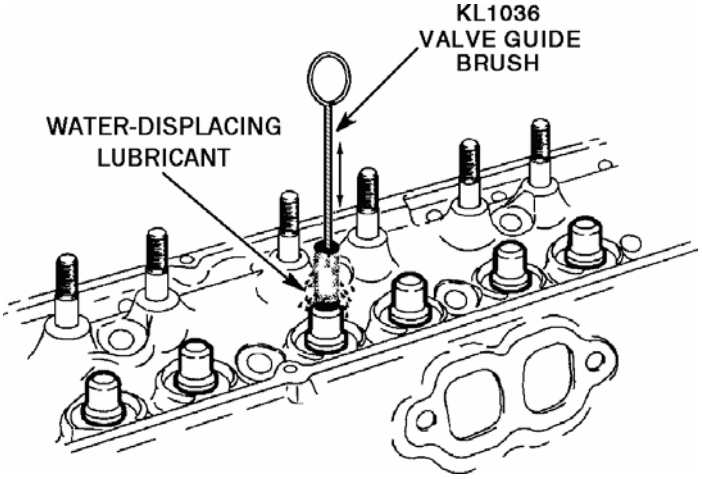


*Figure 9: Lubrication of Valve Guide*

**STEP 2**

Insert the appropriate Bronze Bullet® Guide-Liner® onto the Auto-Installer. The Valve Guide-Liner® is inserted from the non-chamfered end onto the Auto-Installer. The chamfered end will then be inserted into the valve guide first. Installation of the Bronze Bullet® Guide-Liner® is recommended from the valve guide boss or valve spring side.

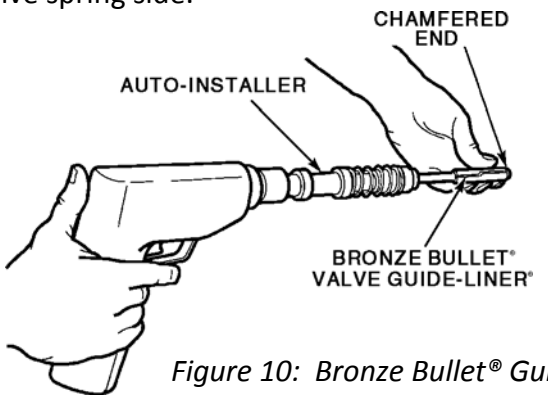


*Figure 10: Bronze Bullet® Guide-Liner®*

**STEP 3**

Using a short stroke air hammer, drive the Bronze Bullet® Guide-Liner® into the valve guide hole until the liner is flush with the valve guide boss.

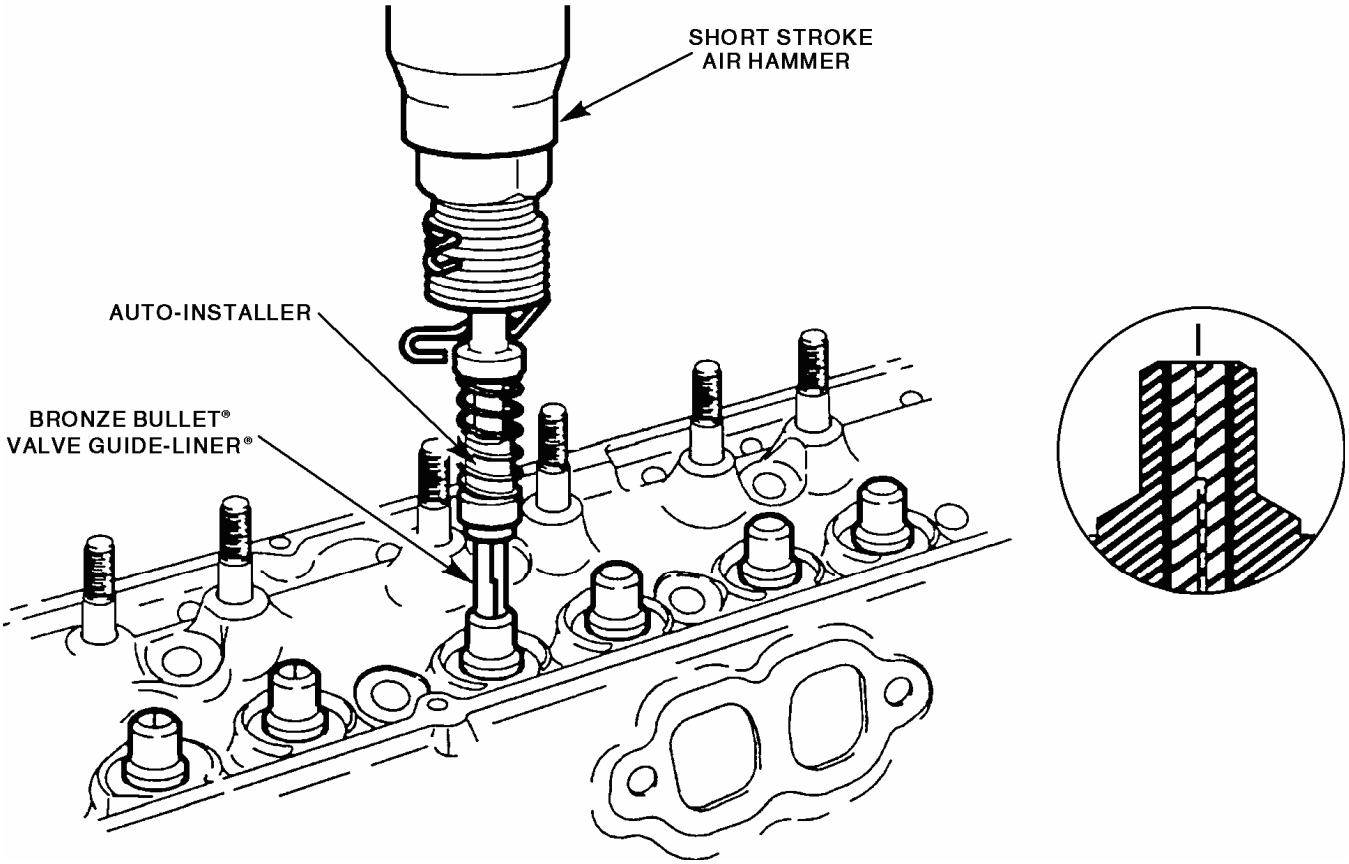


*Figure 11: Bronze Bullet® Guide-Liner® Installation*

*NOTE: Properly installed, the Valve Guide-Liner® offers an improved wear surface for remanufactured valve guides. In addition to enhanced oil retention and decreased oil pass through, these liners exhibit decreased wear relative to either thin wall cast or smooth wall liners. In a series of dyno test, the interrupted spiral feature of the Bronze Bullet® Valve Guide-Liner® has exhibited 41% less wear than smooth wall liners. In addition, historically documented data has shown that bronze dissipates heat better than cast iron by up to 20%, has 80% less thermal expansion, and has exhibited improved wear characteristics vs. cast iron.*

**HARD CHROME BALL BROACHES (Optional)**

**STEP 1**

Select the proper hard chrome ball broach for sizing. Insert the pilot of the hard chrome ball broach into the Bronze Bullet® Guide-Liner® until the raised sizing area is in contact with the valve guide boss. Drive the hard chrome ball broach through the Bronze Bullet® Guide-Liner® until it passes through the entire length. This can be completed by using a K-Line® air hammer broach holder (KL5758 or KL5759) and a short stroke air hammer.

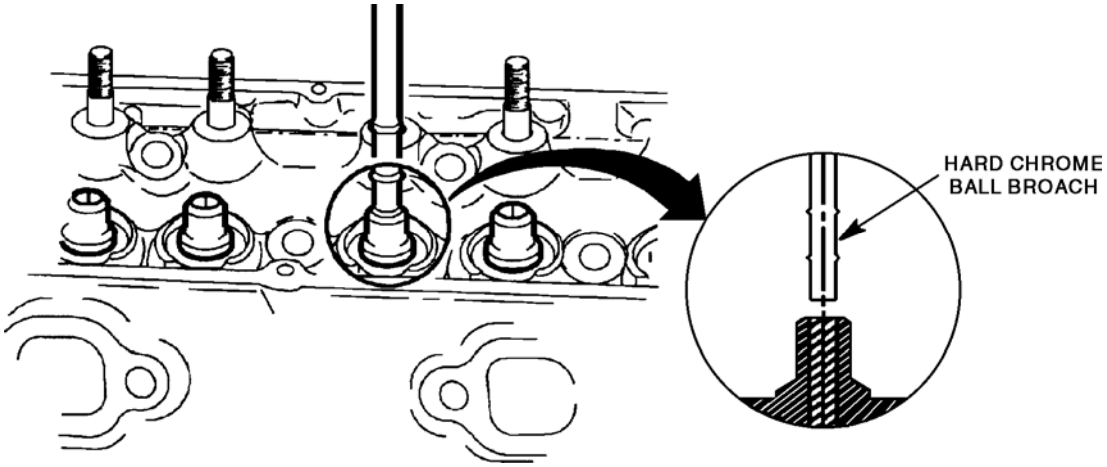


*Figure 12: Sizing with Hard Chrome Ball Broaches*

*NOTE: All Bronze Bullet® Valve Guide-Liners® must be enlarged a minimum of .001" after installation, but the amount of material to be displaced should not exceed .003".*

*NOTE: Care must be taken to keep the hard chrome ball broach clean and free of lubricant or debris at all times. Any debris on the surface of this tool will obviously have a negative effect on surface finish and accuracy of sizing.*

*NOTE: Due to material flow-back that occurs when pressure forming bronze or other materials, hard chrome ball broaches will not finish the inside diameter to the exact size as labeled. You should generally use a hard chrome ball broach up to .0015" larger than the desired finish inside diameter.*

**STEP 2**

For each cylinder head it is recommended to inspect one Valve Guide-Liner® inside diameter for size to specification for specific engine.

The recommended checking method is the use of an air bore gage system. An optional checking method would be the use of a three-point bore gage. With either checking method, the gage must be able to check to ten thousands of an inch (.0001").

**FINAL PREPARATION OF THE BRONZE BULLET® GUIDE-LINER®**

**STEP 1**

After sizing is complete, check to see if the Bronze Bullet® Guide-Liner® is protruding out of the cast iron. If there is any protrusion, the excess material must be trimmed off using the KL4235 Deluxe Guide-Top Cutter.

**STEP 2**

Chuck the Deluxe Guide-Top Cutter into a 900-1500 RPM air drill, and insert the appropriate interchangeable pilot.

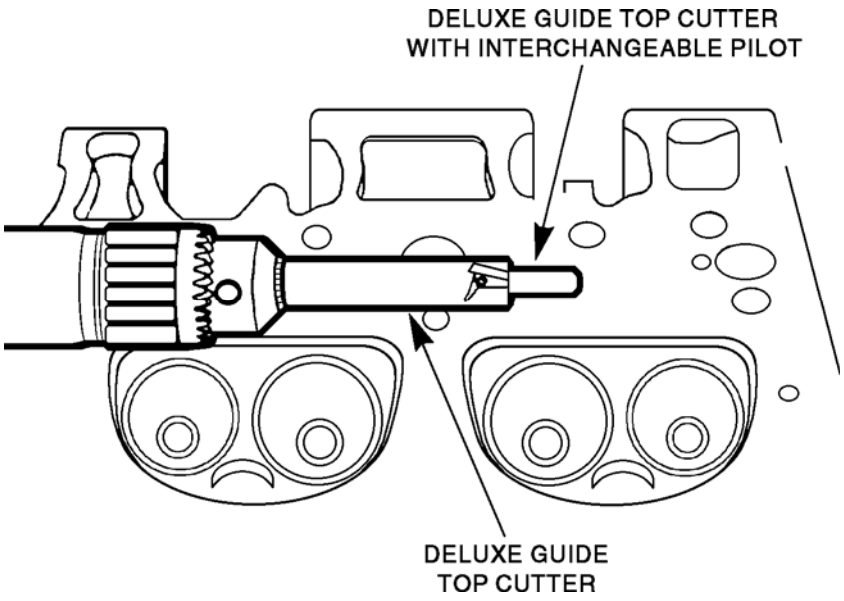


*Figure 13: KL4235 Deluxe Guide-Top Cutter*

**STEP 3**

Using the Deluxe Guide-Top Cutter, remove any excess material from both the top and bottom of the valve guide, making sure to finish the Bronze Bullet® Guide-Liner® flush with the cast iron, while removing minimal amounts of cast iron.

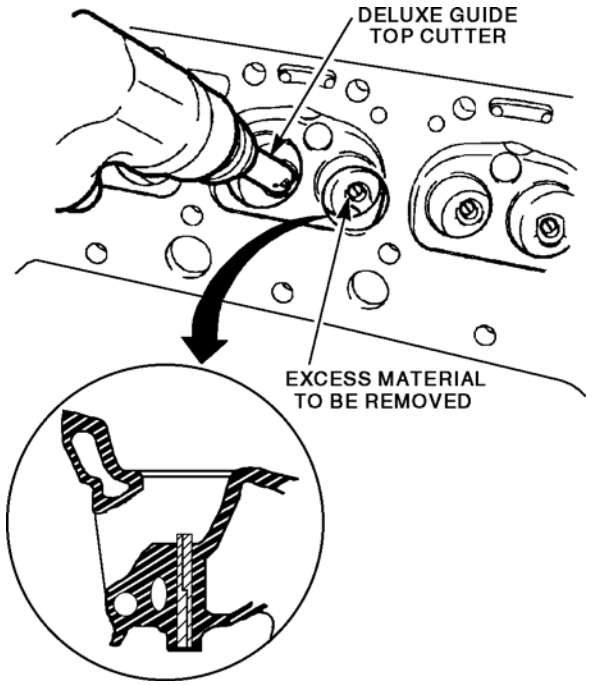


*Figure 14: Remove Excess Guide-Liner® Top*

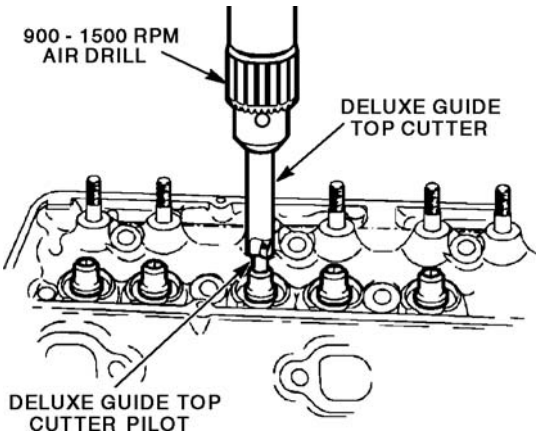


*Figure 15: Remove Excess Guide-Liner® Bottom*

**STEP 4**

Using compressed air, clean all debris from the valve guides.

**CAUTION:** ***Failure to thoroughly clean the inside diameter of the Valve Guide-Liner® properly can cause premature wear to both the valve stem and the Valve Guide-Liner®.***

*NOTE: Valve seat work should be performed prior to the Flex-Hone® operation.*

**STEP 5**

Chuck the appropriate Flex-Hone® in an air drill generating approximately 2000-2100 RPM in a no load state. Then run the Flex-Hone® through the Bronze Bullet® Guide-Liner®. One pass down and one pass up will be sufficient to gain the desired effect.

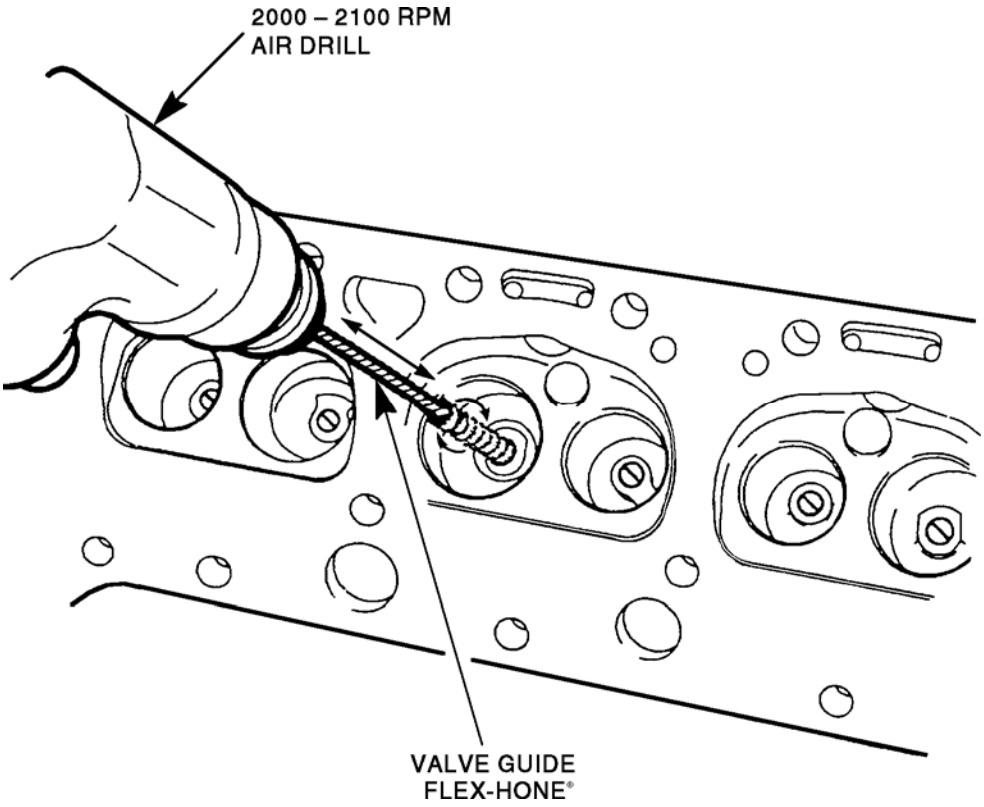


*Figure 16: Flex-Hone®*

*NOTE: The benefits of flex-honing are to obtain an optimal surface finish range. By creating a cross-hatch pattern, lubricating capabilities of the interrupted Spiral® are enhanced.*

**STEP 6**

Dry brush to clean any debris from the Bronze Bullet® Guide-Liner®. Slowly twist the K-Line® Nylon Brush (KL1036) through each Bronze Bullet® Guide-Liner®.

## THIS COMPLETES THE INSTALLATION PROCEDURE