



LAPPING VALVE SEATING SURFACES

By Leland C. Brown, Jr.

Once a safety valve begins to leak, it will never get better until it is repaired,” asserts John Strabavy, quality control engineer of Allied Valve Industries (Chicago, IL). Strabavy knows from experience that no matter what the industry, pressure and safety relief valve repair is a critical aspect of plant maintenance. Leaking valves can be costly to a company in lost steam or product, in fines for polluting the environment, in damaged property or, worse, in the injury and death of workers.

According to the National Board of Boiler and Pressure Vessel Inspectors (NBBI), there was a 600 percent increase in the percentage of accidents tied to power boiler safety valves in 1993. This is one of the reasons why establishing a preventive maintenance program for these critical valves is essential.

Recognizing the need for proper repair of pressure and safety relief valves, in 1978 the NBBI began issuing a “VR” stamp which certifies authorization to perform valve repair. Qualified companies are required to demonstrate and uphold quality standards in their valve repair programs, including ongoing training of their technicians.

RECONDITIONING RECOMMENDATIONS

Vital to pressure and safety relief valve repair is the condition of the seating surfaces, the disc, and nozzle seats. According to J. Alton Cox of Lee Valve Co. (Charlotte, NC), a veteran in the field of valve repair, “A critical point of valve inspection involves decisions which affect the economics of PRV repair: the time element involved in machining or lapping versus the cost of the part.”

This means that if the part is too damaged it must be replaced; or, if damaged but still repairable, it can be machined back to original flatness. The least expensive option is to lap it—provided the seat is not seriously damaged.

The American Society of Mechanical Engineers (ASME) maintains seat tightness requirements in Sections I and VIII of its code. Also, the valve manufacturers provide end users with manuals including detailed instructions on disc and nozzle seat maintenance.

Because the manufacturers have design variations on these integral parts, a maintenance technician must be familiar with and comply with the instructions as detailed in the operating/maintenance manuals. However, general rules of thumb related to the “art” of lapping and polishing can be helpful for personnel qualified and properly trained to repair pressure relief valves.

LAPPING VALVE DISCS

1. Ensure that the work area is clean. Have several lint-free wipes open-end and ready for use.
2. Ensure that you have the appropriate sized laps for the disc diameter.
3. Select the type of compound to use for the first lapping sequence.
4. Set the lap on a lint-free wipe to avoid dirt contamination.
5. Apply a small amount of compound onto only the lap surface that will come in contact with the disc surface. Wipe any excess compound off the lap.
6. Begin lapping by placing the disc flat onto the lap (avoid dropping it or placing it on the lap at an angle), then—without any downward pressure—apply a circular oscillating motion for three seconds followed by a one-eighth turn. Alternate between these two actions for approximately two minutes.
7. Remove the disc from the lap by pulling it straight up. If done properly, you should feel a suction or “popping” effect. Avoid removing it horizontally or “turning” it off at an angle.
8. Clean the disc surface and the entire lap (top, bottom and sides), using an approved cleaner/degreaser. Let each part evaporate dry. **Do not wipe dry.**
9. Using a 7x measuring magnifier and a flashlight, inspect the disc surface and determine whether the next lapping phase is to be done with the same compound. A dull, dark, gray satin finish or “matte” and no obvious surface imperfections on the disc indicate that a finer compound can be used.
 - If the same compound is to be used in the next lapping sequence, repeat steps 5 through 9 one or two more times.
 - If a finer compound is to be used in the next lapping sequence, clean the lap with a cleaner/degreaser and store it in a moisture-proof container to keep it from rusting. Dedicate the lap to “C” (coarse), “M” (medium), or “P” (polish) service by marking its storage container. This will prevent cross-contamination of coarser grit compounds onto the laps dedicated for polishing (finer grit compounds).



10. Select the finer compound (500 grit or 900 grit) to be used in the next lapping sequence.
11. Lap with the finer compound by repeating steps 4 through 9 using the lap dedicated to the compound type. Use the same circular oscillating and turning motion technique as described in step 6 for approximately two minutes. During these short intervals, clean only the disc surface using a cleaner/degreaser. If inspection dictates that lapping is required again using the same compound, repeat the procedure outlined in step 6 without reapplying any new compound.

In general, using finer compounds requires shorter lapping periods but more frequent checking for surface imperfections.

12. When all surface imperfections have been removed, clean the disc surface and entire lap using a cleaner/degreaser as in step 8 and allow each part to evaporate dry. Do not wipe dry. Return the lap to a moisture-proof container and *dedicate* it with an “M,” to be kept strictly for use with medium lapping compound.
13. Lap with a polishing compound (1200 grit) by repeating steps 4 through 8 using the lap dedicated to this compound. Use the same circular oscillating and turning motion performed in step 6.
14. Inspect the disc surface using the 7x measuring magnifier and a flashlight. Its finish should now be smooth and mirror-like, and may reveal surface imperfections not seen before.
 - If surface imperfections are discovered, repeat the lapping procedures using one of the compounds (and dedicated laps) used previously, up through the polishing phase of step 13.
 - If there are no surface imperfections, repeat step 13.
15. Inspect the disc surface again using the 7x measuring magnifier and flashlight. This final inspection is to ensure that no scratches are detected on the disc surface.
16. After you have completed the lapping procedure for this valve disc, return the disc to the valve and wrap the latter in a protective cloth. Then, return the lap to its moisture-proof bag or container; *dedicate* it with a “P.”

Before lapping again with the laps, make plans to recondition each of them. The lap must be flat in order to impart flatness to the parts.

LAPPING VALVE NOZZLE SEATS

Follow the procedure for lapping valve discs with the following exceptions:

Step 5: Squeeze a small amount of the compound on various spots of the lap.

Step 6: With the side of the lap containing the compound facing you, held the lap such that all five of your fingers point toward you and extend approximately 1 inch beyond the surface edge of the lap.

Then, invert the lap and place it flat onto the nozzle seat, avoiding any downward pressure, and proceed with a similar circular oscillating and turning action as described in step 6. Move the lap with one hand to execute the circular oscillating motion and move the valve containing the nozzle seat with the other hand to execute the turning motion. If the nozzle is secured in a vice, execute the turning action by moving your body around the nozzle.

Step 9: The intermediate lapping sequence(s) using the finer compounds can be eliminated. Therefore, if inspection at step 9 indicates that no further lapping is required with the “C” compound, skip steps 10 through 12 and continue with the lapping procedure using the “P” compound in step 13.

Step 15: As part of the final inspection, measure the nozzle seat width with the 7x measuring magnifier according to the valve manufacturer’s instructions, if any.

SUCCESS STRATEGIES

Keep the following in mind when lapping valve discs or nozzle seats:

- Discs typically require lapping with 320 grit, 500 or 900 grit, and 1200 grit. Nozzle seats, because of their smaller surface area, generally require lapping with only 320 grit and 1200 grit. The exception is if either part has been severely damaged, having metal surfaces eaten away by chemical residues. In such cases the 220 grit is recommended over the 320 grit compound.
- Using the 7x measuring magnifier and flashlight for inspections (rather than only the naked eye) may save steps in the overall lapping procedure. If the magnifier reveals that most if not all surface imperfections are gone, you may proceed directly to polishing the part (1200 grit compound), thereby eliminating unnecessary intermediate lapping steps with coarser compounds.



- Generally, all laps should be reconditioned after they have been used to lap a disc or nozzle seat. Time between reconditionings may increase, however, by applying the opposite side of the lap (provided it is clean and flat) when using the same compound a second time.
- The lap used for a nozzle seat typically should be smaller than that for lapping a disc—not only because of the seat’s smaller surface area, but also to decrease the chances of producing a rocking or “wobbling” motion while lapping.
- When lapping a nozzle seat, hold the lap with all five fingers extended approximately 1 inch from the edge of the lap. This procedure will guide you both in keeping the lap centered over the seat and in preventing a rocking or “wobbling” motion while lapping.

PRECAUTIONS TO HEED

Observe precautions when lapping either a valve disc or nozzle seat:

- Never lap using downward pressure, figure-eight motions, linear motions or rocking motions.
- Never lap using a circular oscillating motion without an accompanying turning motion. Doing so could produce “phonograph” type scratches (i.e., spiraling from the inside to the outside of the parts’ surface or vice versa).
- Never remove a lap from a part either horizontally or by “turning” at an angle.
- Never apply more compound to a lap beyond that required to cover the area to be lapped. Doing so could cause rounded corners on the part after lapping.
- Never allow compound to remain on its container after application. Doing so could contaminate the remaining compound in the container.
- Never wipe a surface dry after lapping. Doing so could cause cross-scratching of the part surface, especially when coarse compounds are used. Cleaner/degreaser can be sprayed onto a lint-free wipe and the part may be lightly touched around its circumference.

RECONDITIONING THE LAPS

It’s essential that the laps be reconditioned after use to restore a minimum flatness of two light bands in order to maintain flatness of the disc and nozzle seats when lapping. This can be achieved with either a hand lapping plate or a lapping machine designed for the purpose.

The most important criterion for success in lapping and polishing disc and nozzle seats is that the technician be properly trained, following the precise procedures as detailed by the valve manufacturer and/or authorized training organization.

Secondly, attention to the tools one uses to lap is imperative—especially ensuring that the lap is softer than the part. About 99.9 percent of the lapping and polishing of a workpiece is completed by the abrasive grains (compounds) impregnated in the close-grained cast iron lap and then revolved over the plane of the workpiece.

If the lap is too hard, the abrasive grains will not embed properly in the lap, causing them to roll and potentially lead to ploughing, scratching, and rounding of the edges of the seat or disc. Also, the use of laboratory-grade abrasive compounds ensures the best-quality mirror finish on the stainless steel parts.

It is also advisable to use lint-free wipes that are absorbent and will not scratch the finish on the seating surfaces. Finally, any cleaner/degreaser should contain no CFCs, be fast-drying, and leave no residue.

ABOUT THE AUTHOR

Leland C. Brown, Jr., company president for the past 20 years, has more than 40 years of experience in the abrasives field of grinding, lapping, and polishing at the United States Products Co., Pittsburgh, PA.

UNITED STATES PRODUCTS CO.

518 Melwood Ave. • Pittsburgh, PA 15213-1136 • Phone: 412-621-2130 • Fax: 412-621-8740

Web Site: www.us-products.com

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