

# CASTINGS

BY DICK WARDA, PHD.

The “casting or forging” question, which regularly confronts valve industry purchasing staff, does not have a simple answer. Over the years, industry experts have published detailed comparisons of the two processes (see Resources, page 46). A review of the available literature reveals that both the casting and forging industries are more than capable of making excellent valve bodies, resulting in a win-win situation for buyers. Ultimately, there will be situations in which castings are the optimum cost and performance solution, and other cases where forgings are the best choice. To help industry newcomers understand the differences, here’s a quick overview of the casting and forging processes and industries.

## CASTING BASICS

A cast valve is produced by pouring liquid metal into a mold, which defines the casting’s outer surface. One or more cores define the internal passages and may also define external pockets of a complex casting. A valve family production package may consist of multiple, interchangeable core and mold pieces, producing multiple variations of the same basic valve body. CAD, solid modeling and solidification modeling permit rapid iterations of the initial design, resulting in: reduced lead times; lighter, more efficient valves; and superior, “fit for purpose” casting quality. Final, digitized designs are rapidly converted into patterns and coreboxes ready for production.

Optimized valve design, converted into good molds and cores, is the starting point for high-quality cast valves. Metal selection and quality are equally, if not more, important. The casting process offers almost unlimited metal choice, enabling valve manufacturers to tailor metal performance to the valve application requirements. Additionally, small batch sizes, spectrographic analysis and cost- and property-focused charge calcu-



**A two-stage API 610 pump case: The internal cavity coring of a mold shows the complexity offered by the casting process. This photo was taken at Highland Foundry’s plant in Surrey, BC.**

lation programs result in flexibility, economy and metal chemistries that go beyond specifications to meet unique valve performance needs.

At the machine shop, castings offer further advantages. Cast-to-shape internal cavities, reduced draft and the ability to cast rather than machine valve changes, all add up to significant reductions in machining costs. The modern foundry’s casting advantage? Short lead times, flexibility, reduced economic lot sizes, reduced machining costs, and quality and chemistry to optimize lifecycle costs.

## Metal Performance

Increasingly challenging operating environments and the demand for more efficient and reliable valves place a greater emphasis on material selection. Experienced end users often go beyond specifications in defining their project requirements. The casting process offers the quality and flexibility to meet these new requirements. Cast valves currently meet or exceed ASTM, ASME, API, AWS, NORSOK and additional customer specifications for both mechanical properties and corrosion resistance. The casting process eliminates directionality of properties, thus avoiding issues of transverse vs. longitudinal properties. Reduced, near-net section sizes provide greater assurance that heat treatments of heavy-section cast valves will provide consistent through-wall properties.

Because foundries control their own metal composition, they are well placed to meet special customer requirements not covered in the broad standard specifications. Want a CF8M valve with guaranteed cryogenic performance? Can do! Need a super duplex valve with 248 max BHN, PREN over 41 and 40-45% ferrite that is super tough? No problem! And you get the certified test results to prove it.

## Cast Valve Quality

Forgings and castings are each vulnerable to specific types of defects, but the good news is that, for both processes, the described defects are possible but preventable. Defect types and their severity are defined in many NDE quality specifications, such as the MSS-SP series. The valve manufacturer should select acceptance levels that satisfy the valve performance and cost criteria.

Good basic foundry practices, widespread use of solidification modeling, and continuous improvements in mold

## THE ABC...D'S OF BUYING THE BEST VALVE BODY

- **Define the total operational environment, including risk analysis.** Investing in the front end of valve body procurement can pay off hugely during the production and life cycles of the end product.
- **Determine the required corrosion resistance and mechanical properties.** Corrosion testing can rank and confirm the corrosion resistance of candidate materials. Mechanical property requirements are intimately related to valve design. Good foundries have the capability and flexibility to react to these needs through custom alloys. Design changes suggested to improve castability and casting quality often have the added benefit of reduced operating stresses.
- **Due Diligence should be performed in evaluating the capabilities and track records of the candidate foundries and forge shops.** Good suppliers welcome and benefit from technical audits.
- **Dispel the myths about the two processes.** Castings and forgings fail for the same reasons—deficient designs or deficient processes. Good valve bodies are the result of high standards and the constant attention to critical details, from design to delivery.
- **Dialogue with the chosen supplier is essential to optimize the performance and cost of the valve body.** Information exchange at the quote stage gives both parties the opportunity to clarify requirements and improve both the process and the product.
- **Digitized solid model information should be an integral part of the information dialogue.** The modern foundry can add significant value to the cast valve body through detailed modifications that can reduce weight, improve efficiency, and enhance castability and final quality.
- **Develop partnerships with your best suppliers.** Like the natural world, mutually beneficial relationships improve the survivability of both parties.

and coremaking processes have combined to eliminate most casting defects. When required, castings may be upgraded using weld repair procedures that comply with ASME and ASTM codes, thus ensuring that the upgraded valve meets the most stringent performance standards. **VM**

## RESOURCES

- "Steel Castings vs. Forgings—A Realistic Evaluation," *CASTEEL*, V17, No.1, Summer 1984. Steel Founders' Society of America.
- "The Niche for Steel Castings," *Advanced*

*Materials & Processes*, 8/94. American Society for Metals.

"Castings vs. Forgings: A Realistic Evaluation," Malcolm Blair and Raymond W. Monroe, *Modern Casting*, November 1995. American Foundrymen's Society.

"Forgings vs. Castings," Felicia Miller Day, *Valve Magazine*, Winter 1994. Valve Manufacturers Association of America.

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