

## Defect Detection in Cast Valve Bodies Using Acoustic Emission

### INTRODUCTION

When valve bodies are first cast, they are subjected to hydro testing as required by various regulators and by the customer who purchases the valve bodies per API 6D. A fully assembled valve is then retested to determine if the seals are leaking and if any other problems can be identified. Despite all efforts to produce flawless valves, some are sold to customers that are returned under warranty with defects.



### AE DURING HYDRO TESTING

History has shown that Acoustic Emission Testing (AE) is a very useful addition to hydro testing. ASME, Section V, Article 12 (2010 Version) is a guide in the testing of both new and in-service metal pressure vessels.

The AE test uses the load from the hydro test to stimulate defects to release energy. This energy, or AE signal, propagates away from the source until it reaches the surface of the material and is detected by an AE sensor. The signal produced at the output of the sensor can be used to identify if a defect is present, as well as the severity of the defect.

This method can be used two ways. First is to test just the valve body before any assembly is performed. The cast valve body is blanked off at all openings, filled with water and loaded to a pressure as prescribed by API 6D. Using a slow pressurization rate, the pressure is increased from 50% of the maximum test pressure to 100% and then monitored with AE. The resulting data is then evaluated using a proprietary severity analysis. The results of the severity analysis lead to very specific recommendations which can be used as part of a QA/QC plan for accepting and rejecting parts.

The second method involves testing the valve after it is fully assembled. In these situations, the hydro test is usually performed very fast

and AE data acquisition does not start until the maximum test pressure is reached and a load hold begins. It has been shown that emissions during load holds are indicative of major structural defects.

### VALVES THAT HAVE BEEN TESTED

Although the majority of the valves tested to date are ball valves, this method can be applied to globe, gate and butterfly valves as well. The larger ball valves (6 inches and up) require 8 channels of Acoustic Emission instrumentation. The small ball valves (4 inches and less) require 4 channels.

### AE EQUIPMENT SET-UP

In most cases, the valve body is ferromagnetic and the AE sensors can be mounted using magnetic hold downs. This applies to both methods described above. The sensor can include an integral preamp otherwise one is required for connection between the sensor and the AE system.

A typical AE system can vary from 4 channels to 8 channels depending on the type of testing that is chosen. The Micro II system (shown on next page, top left) with four PCI-2 cards or two DSP-4 cards or the SAMOS™ is recommended for this type of testing. It is also possible to record the load (pressure) through the parametric inputs on the system.

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MICRO II Acoustic Emission System

## RESULTS

The use of Acoustic Emission (AE) testing during proof testing has resulted in defective cast valve bodies being detected when hydro testing alone did not. The system described above uses two alarms, one for leaks and the other for defects. During automated testing, these alarms can be used to turn on alarm lights warning the test operator that a defect has been detected.

Results for a fully assembled valve are shown to the right. The data collected during pressurization is shown in the background (Amplitude and Pressure versus Time) while the Alarm drop down menu tells you which alarm went off and when. When an Alarm is generated, the system outputs a TTL signal that triggers a red light at the test cell so that the operator knows that the test piece has failed the AE test.

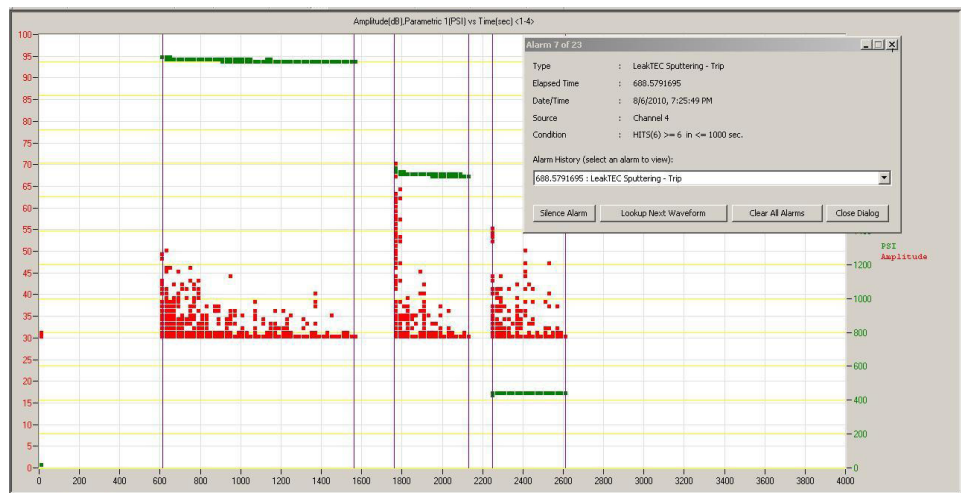
## CONCLUSION

AE testing is being used along with hydro testing to monitor cast valve bodies during acceptance testing. When testing just the cast valve body, defective parts can be detected early and not put through the fabrication process. This can eliminate the future investment made during fabrication and reduce the cost of production.

When applied to automated testing of fully assemble valves, AE testing can identify defects that are not detected via the hydro test or other methods of inspection. This can prevent

## Technology Benefits

- This technology can easily be integrated into an automated valve testing system
- Can improve the quality of the cast valve bodies supplied to the manufacturer
- Can reduce the number of parts returned under warranty
- Acoustic Emission system runs with very little operator intervention
  - Requires sensor installation
  - Acceptance of Auto Sensor Test (AST)
  - Requires serial number input if valve passes test
- Can be applied to valves ranging from 3 inch to 12 inch diameter and all Classes
- Adds only a few minutes to the total test time
- Can save test time when part failure is identified early



Software results for a fully assembled valve.

valves from being shipped to customers that are subsequently returned under warranty due to defects that grew and could be identified visually as leaking valves.

**For more information on our Defect Detection in Cast Valve Bodies Using Acoustic Emission:**

**Please call 1-609-716-4000 or visit us on the web at [www.mistrasgroup.com](http://www.mistrasgroup.com).**

**WORLDWIDE HEADQUARTERS:**  
195 Clarksville Rd •  
Princeton Jct, NJ 08550 • USA  
T: +1.609.716.4000 • F: +1.609.716.0706  
E-MAIL: [sales.systems@mistrasgroup.com](mailto:sales.systems@mistrasgroup.com)

**CANADA**  
**CHINA**  
**FRANCE**  
**GERMANY**  
**GREECE**

T: +1.403.556.1350  
T: +86.10.5877.3631  
T: +331.498.26040  
T: +49.040.2000.4025  
T: +30.210.2846.801-4

**HOLLAND**  
**INDIA**  
**JAPAN**  
**MALAYSIA**  
**MIDDLE EAST**

T: +31.010.245.0325  
T: +91.22.2586.2444  
T: +81.33.498.3570  
T: +60.9.517.3788  
T: +973.17.729.356

**RUSSIA**  
**SCANDINAVIA**  
**S. AMERICA**  
**UK**

T: +7495.789.4549  
T: +46(0)31.252040  
T: +55.11.3082.5111  
T: +44(0)1954.231.612