MULTIPHASE FLOW SECTION

SOUTHWEST RESEARCH INSTITUTE®

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Mechanical and Materials Engineering Division
August 12, 2003

Mr. Tracy Hammac
Valvtechnologies, Inc.
5904 Bingle Road
Houston, Texas 77092

Reference: Fire Test Conducted On
8.00" - Class 1500, Downstream Sealing Ball Valve
per API Standard 607, 4th Edition
SwRI Project No. 18.18015.03.516
SwRI Test No. 6-945

Dear Mr. Hammac:

Enclosed please find two copies of our test report for subject fire test, as requested by your Purchase Order Number 013714-00.

This valve meets the performance requirements of API Standard 607, Fourth Edition.

Should you have any questions relative to this test or test report, please do not hesitate to contact us. I may be contacted by telephone at 210-522-2350, by telefax at 210-681-9661, or by e-mail at RHart@swri.org.

Sincerely,

Robert Hart
Project Manager

RH/*meb*

Enclosure

c: Contracts (w/out Encl.)
Test File (Encl.)

REVIEW AND APPROVAL

The contents of this Test Report for SwRI® Test Number 6-945 are correct and accurate, and all performance test results and procedures conducted by this laboratory are in compliance with API Standard 607, Fourth Edition.

Prepared By:

Southwest Research Institute®
Mechanical & Fluids Engineering Department
P. O. Drawer 28510
San Antonio, Texas, USA 78228-0510

Test Report Reviewed By:

Robert Hart — 8-12-03

Robert Hart
Project Manager

Date

Management Review:

Chris B — 8/12/03

J. Christopher Buckingham
Manager, Multiphase Flow

Date

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SwRI policies specifically prohibit the use in advertising of its name, logo and results provided by our studies. The following paragraph, extracted verbatim from SwRI contractual documents clarifies this point:

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SwRI will retain a record copy of the test report for a period of five (5) years. This permits us to answer questions, which may be raised after a report has been mailed and provides a basis for additional work, if required. The contents of the report and any information, which comes into our possession during the course of a study, are held confidential to the company conducting the study and are not disclosed to anyone without client's prior permission.

VALVE FIRE TEST
PER API STANDARD 607, FOURTH EDITION

SwRI Test Number:	6-945	Test Date:	07/30/2003
Valve Type:	Downstream Sealing (Floating) Ball	Model Number:	B8C1-BW-RP-BS-8
Rating:	Class 1500 Size: 8.00 inch	Valve Serial Number:	03011743
Valve Manufacturer:	Valvtechnologies, Inc.		
Manufacturer's Representative(s):	Tracy Hammac		

The purpose of this test was to evaluate the performance of a downstream sealing (floating) ball valve by the valve fire test procedure of American Petroleum Institute (API) Standard 607, Fourth Edition, 1993.

1. Through Leakage During Burn

Average through leakage rate of 0.0 ml/min/NPS occurred during the 30.78-minute burn period. Allowable rate is 1000.0 ml/min.

2. Through Leakage During Cooldown

Average leakage rate of 0.0 ml/min/NPS occurred during the 10.00-minute cooldown period. The standard does not have a requirement for the through leakage during cooldown.

3. External Leakage During Burn and Cooldown

Average external leakage rate of 0.0 ml/min/NPS occurred during the 40.78-minute burn and cooldown period. Allowable rate is 25.0 ml/min/NPS.

4. Valve Operation After Fire Test

The valve was capable of being unseated against the high-test pressure differential and moving to the full open position and back to the full closed position. The valve was operated using the manufacturer supplied gear operator and hand wheel.

5. Operational Test Following Cooldown

a. Average through leakage rate of 0.3 ml/min/NPS occurred during the 5.00-minute test period. Allowable rate is 100.0 ml/min/NPS.

b. Average external leakage rate of 0.1 ml/min/NPS occurred during the 5.00-minute test period. Allowable rate is 25.0 ml/min/NPS.

6. Qualifications

Test valve meets the performance requirements of API Standard 607, Fourth Edition.

VALVE FIRE TEST
PER API STANDARD 607, FOURTH EDITION

SwRI Test Number:	6-945	Test Date:	07/30/2003
Test Valve Size (NPS):	8.00 inches		

1. During Burn

A. Volume collected downstream during burn: 0 ml.

B. Burn duration: 30.78 minutes

C. Body cavity volume: N/A

$$\text{Average through leakage} = \frac{A - C}{B \times NPS} = 0.0 \text{ ml/min/NPS}$$

2. During Burn and Cooldown

D. Beginning reservoir level: 60357 ml.

E. Ending reservoir level: 61630 ml.

F. Volume collected downstream during cooldown: 0 ml.

G. Cooldown duration: 10.00 minutes

$$\text{Average external leakage} = \frac{D - E - A - F}{(B + G) x NPS} = -3.9 \text{ ml/min/NPS}$$ **(1)**

3. Operational Test After Cooldown

H. Volume collected downstream during operational test: 12 ml.

J. Test duration: 5.00 minutes

$$\text{Average through leakage} = \frac{H}{JxNPS} = 0.3 \text{ ml/min/NPS}$$

K. Total external leakage during operational test: 5 ml.

$$\text{Average external leakage} = \frac{K}{JxNPS} = 0.1 \text{ ml/min/NPS}$$

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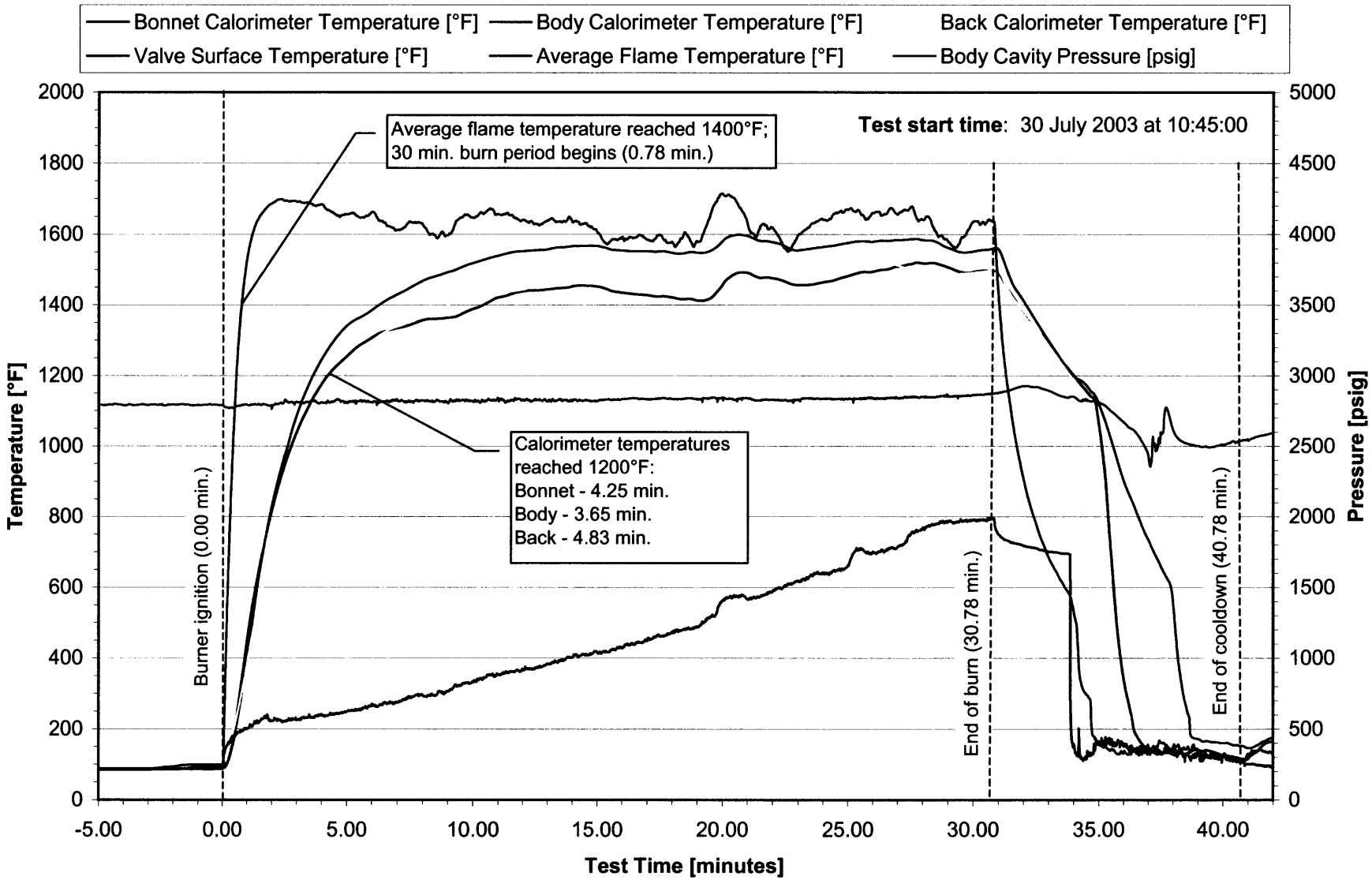
(1) **Leakage during the burn and cooldown is calculated by subtracting the ending reservoir level from the beginning reservoir level. When there is little or no leakage during the burn and cooldown, the upstream supply piping may not cool to its initial temperature by the end of the cooldown period. The resulting thermal expansion of the water in this piping can result in a higher reservoir level at the end of the test than was present at the beginning of the test. This condition will cause a negative result in this calculation for leakage. In these cases, the leakage is assumed to be zero.**

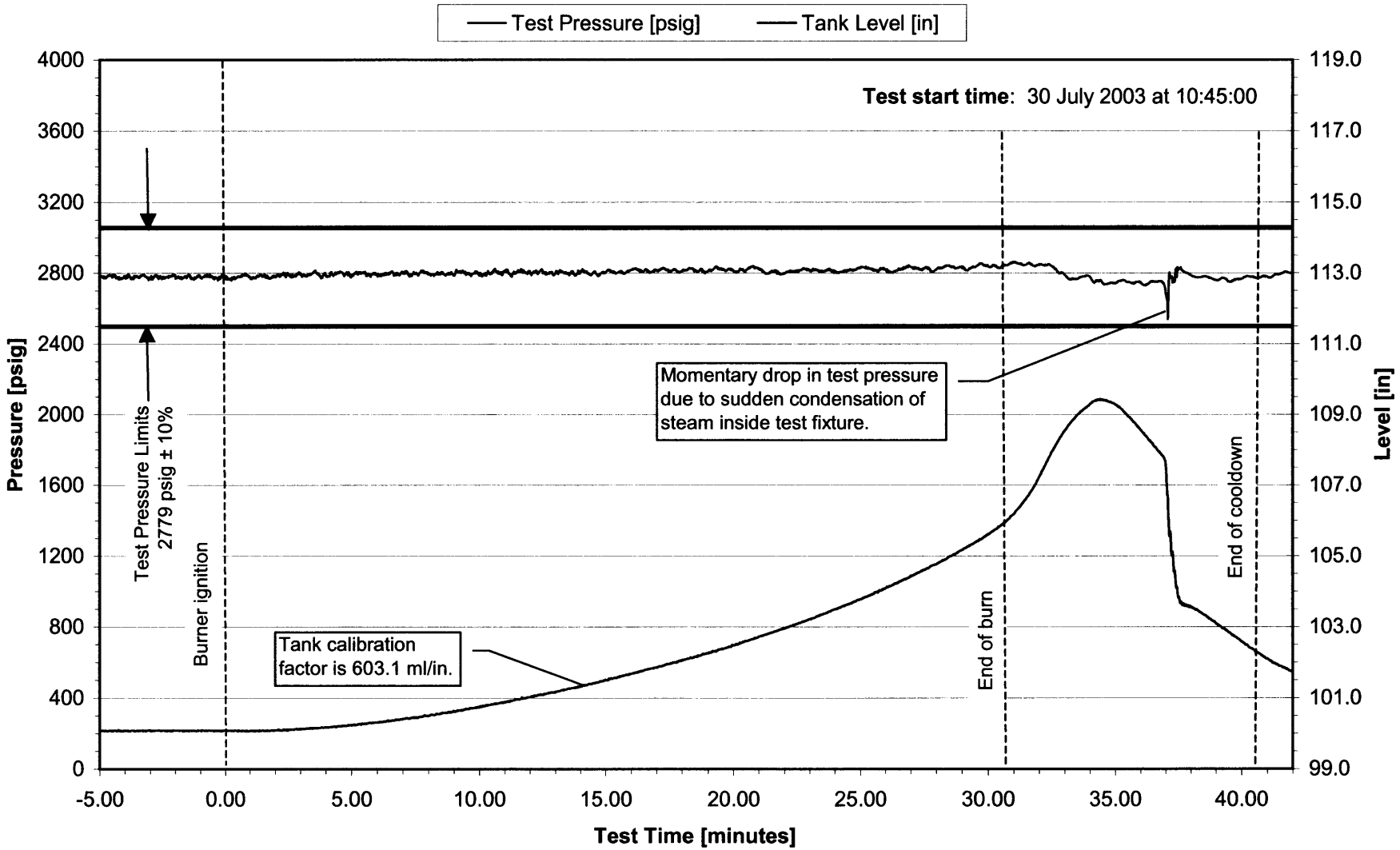
APPENDIX A

PRESSURE & TEMPERATURE DATA

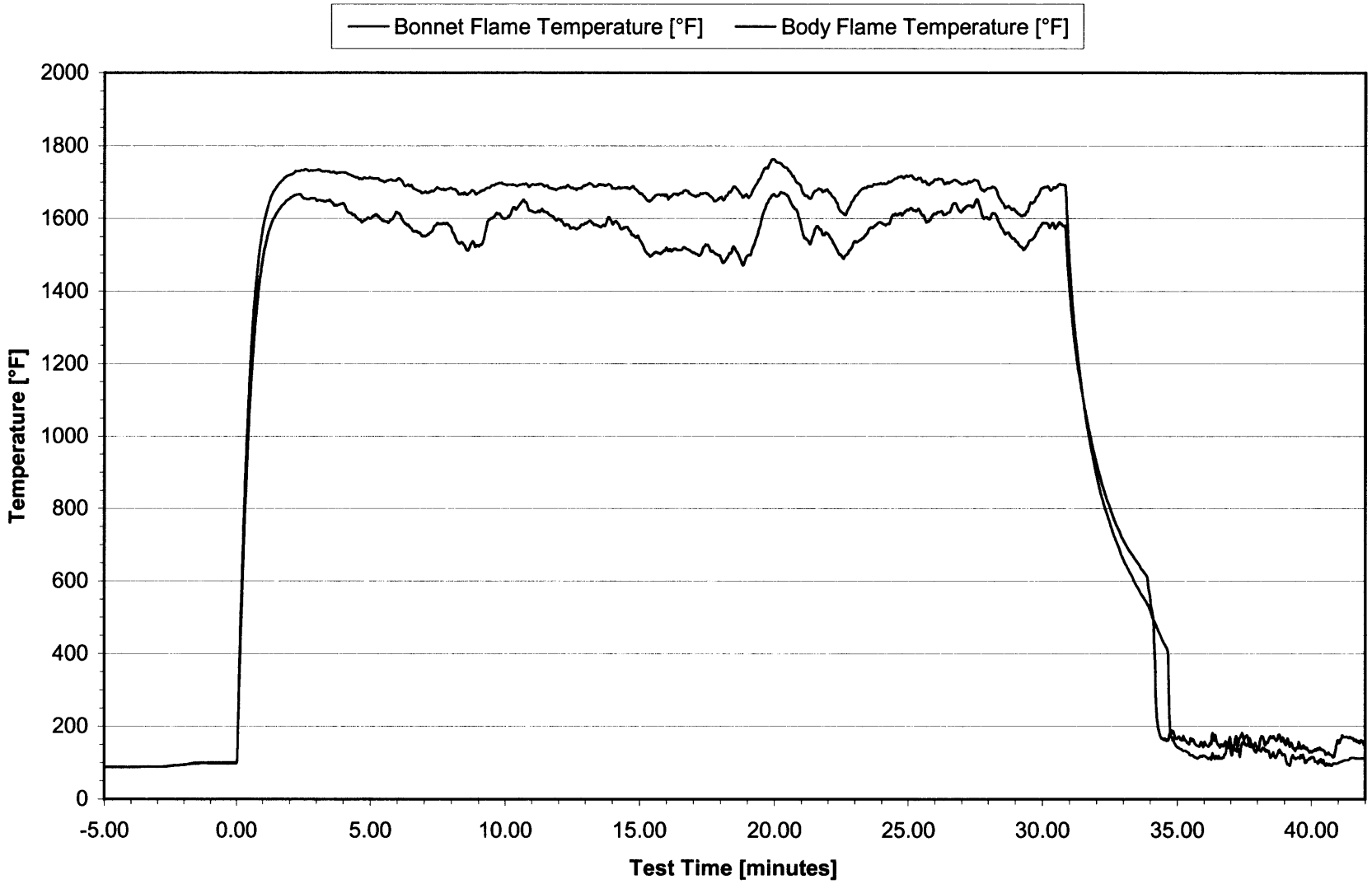
SwRI Fire Test Number 6-945
Test Temperatures and Body Cavity Pressure



SwRI Fire Test Number 6-945
Test Pressure and Supply Reservoir Level



SwRI Fire Test Number 6-945
Individual Thermocouple Records



APPENDIX B

SwRI FACILITY DESCRIPTION

SWRI FIRE TEST FACILITY

1. General

1.1 Facility Configuration. The test facility is located outdoors under a 34-foot high roof. For personnel protection, the fire test stand is surrounded on three sides by 8-foot high concrete walls. Portable insulated screens are placed around the test item to form a four-sided enclosure, as shown in Figure 1. These screens are designed to reduce heat loss and minimize the effect of wind gusts. The area above the test item is partially closed by baffles that direct the burner flames to uniformly envelop the test item.

1.2 Test Item Installation. Test items are installed as shown in Figure 1. A short length of pipe is attached to both the upstream and downstream ends to support the item in the test stand and to allow for connection of supply, drain, and vent lines. The test fixture is pressurized with water from the upstream side during the test. The downstream pipe is connected to a drain and condenser system for collection of any through leakage. The test fixture is supported on two pedestals, as shown in the elevation view of Figure 1. The upstream pipe is clamped in a pipe vise located on top of the pedestal. The downstream pipe rests in a pipe vise on top of a second pedestal. The downstream pipe is left unclamped to allow for thermal movement of the test fixture during the test. The entire test fixture is slightly sloped toward the downstream end to ensure complete drainage. For valve fire tests, the valve is placed in the test stand so that the valve stem is horizontal (i.e., parallel to the floor).

1.3 Burners. Fire conditions are simulated using four natural gas burners located below the test item. The 3-inch self-aspirating burners are individually mounted on portable stands with adjustable tilt angles. The burner stands are positioned to provide full envelopment of the test item by the flames.

1.4 Preparation. Upon request, all materials needed for preparation of an item for testing will be supplied by SwRI. Assembly will be performed by SwRI personnel in accordance with the manufacturer's instructions.

2. System Plumbing

2.1 Pressurization System. Water for the testing is supplied from a series of five pressurized reservoirs of different diameters. Depending on test item size, different combinations of the reservoirs are used in order to minimize uncertainty of the level measurements. For low-test pressures (<50 psig), the reservoirs are connected directly to the test item. For higher test pressures, the reservoirs are connected to a system in which a triplex pump and a back-pressure regulator are used to establish the test pressure.

2.2 Downstream System. Piping from the downstream end of the test fixture is routed through a condenser consisting of a copper coil in a running water bath. The discharge from the condenser is mounted on a swinging arm whose position is set from the control room via the data acquisition/control system. The first position is over the container in which any discharge during the burning period is collected. The second position is over another container for collection of any discharge during the cooldown. The third position is away from both containers.

2.3 Body Cavity Vent and Relief System. This system is required for all dual-seated valves, which may trap liquid in the body cavity when the valve is in the closed position. The manufacturer will have provided a tapped port in the topmost part of the test valve body for connection of the body cavity relief system. The relief system consists of a pressure transducer used for recording the cavity pressure and a remotely controlled valve, which is actuated at the manufacturer's recommended maximum allowable body cavity pressure.

2.4 Water Quenching System. For water quenching, a moveable arm, containing spray nozzles on a manifold, is positioned over the test item. The spray arm and water flow are operated remotely from the control room.

3. Instrumentation

3.1 Test Pressure. The upstream test pressure is measured with a transducer of appropriate range tapped into the pressurization line about 20 feet upstream of the test item connection.

3.2 Temperature. All temperatures are measured with Type K (Chromel/Alumel) thermocouples (T/Cs). The flame temperature T/Cs are 1/4" diameter rigid probes with stainless or inconel sheaths. The thermocouples for sensing valve body and bonnet temperatures are 1/8" diameter probes similar to the flame thermocouples. Calorimeters (if required) consist of 1/16" diameter probe embedded in 1-1/2" carbon steel cubes. If calorimeters are used, a bare wire thermocouple with braided ceramic insulation is spot-welded to the test item in order to obtain a direct measure of surface temperature.

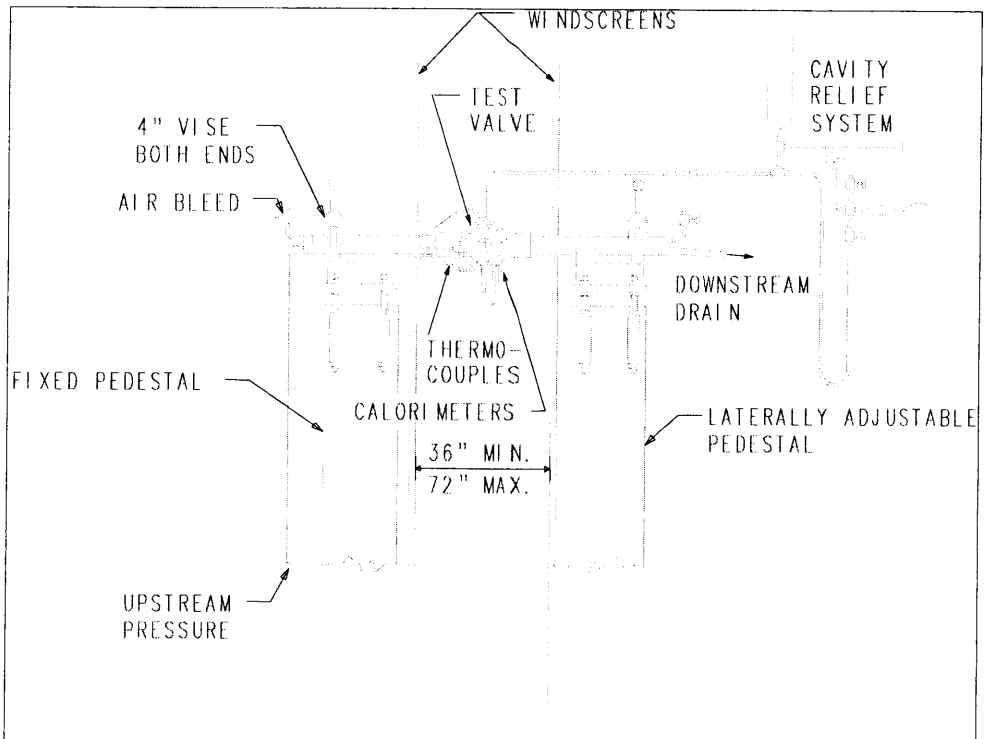
3.3 Upstream Reservoir Level. The water level in the upstream reservoirs is measured with a differential pressure transducer that is calibrated to read in inches of water. Using the known calibration factor for each reservoir (volume per unit height), the level measurement allows for determination of the change in the volume of water that occurs over the period of the burn and cooldown. This volume change is used to determine external leakage. While continuous recordings of the reservoir level are given in the test report, values between the beginning of the burn and the end of the cooldown may not be accurate due to the presence of steam in the piping. The applicable calibration factor for the reservoirs is shown on the plot.

3.4 Data Acquisition. A HP 34970A Data Acquisition Unit is used to log data during the test and to remotely operate the test equipment. Data is acquired from all sensors every second. The data acquisition unit is connected to a personal computer in the control room, which runs software that allows the operator to record and visualize all data and control the test.

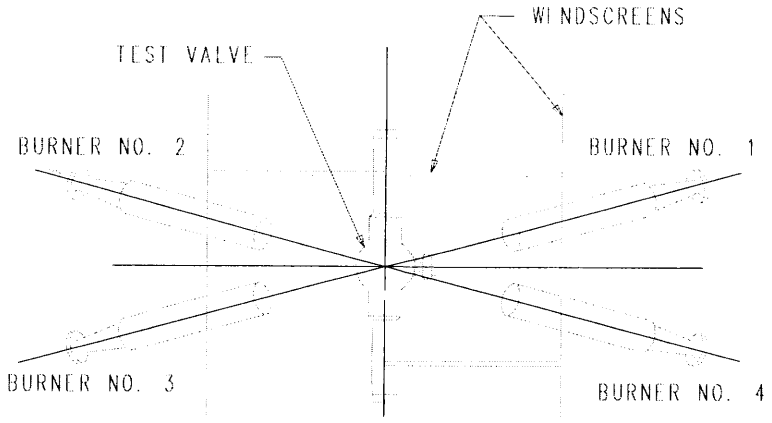
3.5 Calibration. Pressure transducers are calibrated periodically at the SwRI calibration lab. The data logger input calibrations are also checked periodically against traceable voltage references. Thermocouple calibrations are assumed to be within standard commercial tolerances.

3.6 Video. Two video cameras are used to monitor the tests. One, mounted under the facility roof, provides an overhead view of the test chamber. The other camera is mounted at floor level for close-up viewing of the downstream collection containers. This camera can also be used to provide a front view of the test item during the post-cooldown operational and hydrostatic tests. A split-screen video system in the control room allows simultaneous recording and viewing of both camera angles. The output from both cameras is recorded on a VCR to provide a visual record of the test.

ELEVATION VIEW OF TEST CHAMBER



PLAN VIEW OF TEST CHAMBER



SECTION THROUGH TEST CHAMBER

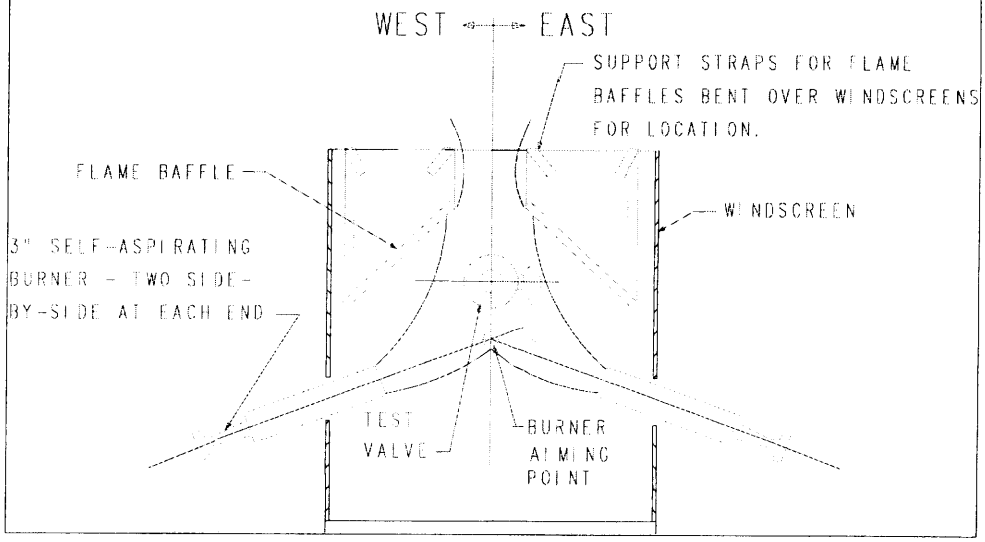


Figure 1

DNV

DET NORSKE VERITAS

SURVEY REPORT

P.O. Number: 014660-00	**Date:** 30 July, 2003	
Main Vendor: Valve Technologies	**Location:** San Antonio, TX	
Sub Vendor: SW Research Institute	**Vendor Contact:** Robert Hart	
Sub Vendor Ref: 9-945	**Vendor Phone:** 210-522-2350	
Req. No: N/A	**Quantity:** 1	**Week No:** 32
Part No: N/A	**Serial No:** N/A	

EQUIPMENT DESCRIPTION:

8" 1500# Class, Floating Ball Valve

Survey Comments:

Purpose of survey: Witness Fire Test

Reference & Acceptance Document: API Standard 607

DET NORSKE VERITAS HOUSTON

FAX #: Yes **Date:** 10 August, 2003 **Signature:** G. Rektorik

Distribution:
Original to Client: Valve Technologies
Copy to File: 410-1-5889

Attn:
Tracey Hammick

FAX #:
713-860-0454

Scope of Activity:

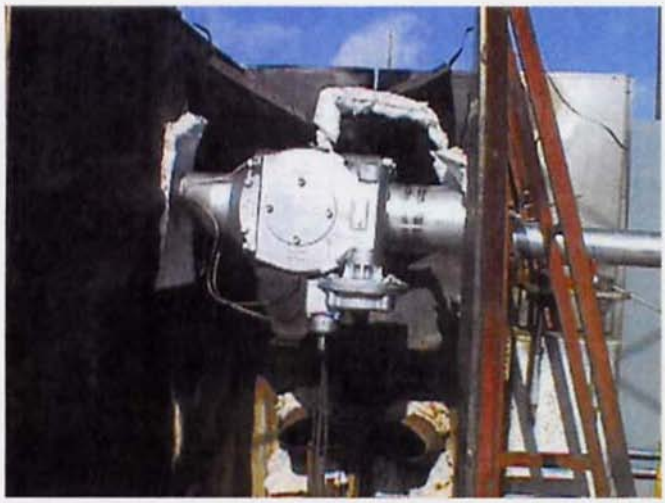
A. Attending surveyor witnessed a fire test of the referenced Ball Valve with the following results:

Fire Test

- Test setup was per figure 2 of API 607.
- Test valve was filled with water and tested in the closed position, valve stem and bore were in the horizontal position.
- Valve was pressurized to 2779 minimum (75% of the cold working pressure) prior to the start of the test. No visible leaks were noted.
- Valve was enveloped in flame throughout the test. The flame temperature reached 1400°F prior to lapse of 2 minutes. Temperature readings of thermocouples were maintained between 1400-1800°F for 30 minutes.
- **No measurable through leakage was noted during burn.**
- After 30 minute burn test, valve was sprayed with water to achieve a rapid cool down to below 212°F within 10 minutes. (Note during this cool down the gear box housing cracked. This did not affect the operation of the valve)

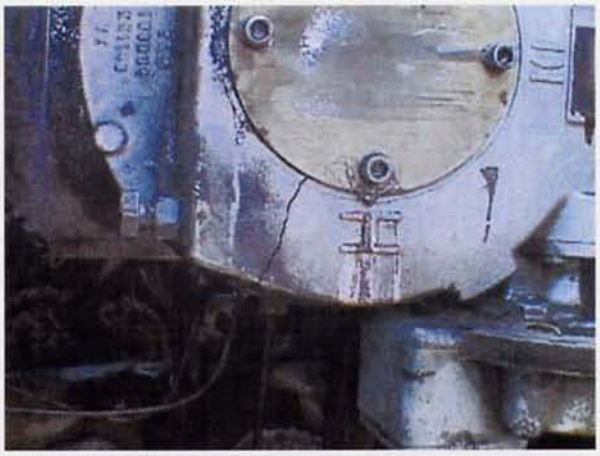
Operation Test

- After cool down the valve was operated open and then closed under test pressure.
- The downstream drain valve was opened and the system was allowed to stabilize for 5 minutes.
- Through leakage and packing leakage was collected for the next 5 minutes.
- **Leakage collected: 5 ml. – at packing; 12 ml. – through leakage**



Test Setup

Valve After Burn and Cool Down



Crack in Gear Box Housing

Note: Official results of these tests will be generated by SW Research Institute.

Signature: Gary Rektorik
Senior Surveyor

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HOUSTON