

EMERGENCY SAFETY VALVES



GET THE **POWER** OF THE PIN



Advanced Pressure Relief & Isolation Valves



WWW.RUPTUREPIN.COM





Table of Contents

1 Get the Power of the Pin

**2 History
Valve Operation**

**3 Advantages Over The
Competition**

4-7 About The Pin

8-10 How We Test Our Valves

**11 Client List
Applications
Industries Served
Contact Information**

Our valves have solved the toughest problems around the world for 27 years with a 99.99% satisfaction rate!

Our unique, patented pin technology has been used for over 20 years in more than 30,000 valves around the world with an impressive satisfaction rate of 99.99%! It's also safe for the environment!

Get the POWER of the PIN!

For over 27 years, many of the world's top companies have experienced the performance advantages of our advanced relief valve technology.

These companies have come to trust our technology because they understand what uniquely sets us apart and gives us the edge over other relief valves and rupture discs on the market.

So, what sets us apart from the rest? It's something we call **"The Power of the Pin"**.

The pin is the heart of each advanced pressure relief valve and is vital to the function, accuracy and consistency of the valve.

By modifying the pin, we are able to control the valve's performance – from small changes to more dramatic changes. It is for this reason that each pin is carefully crafted using a precise manufacturing process.

This process ensures that each valve will perform its function accurately, consistently and within an extremely tight tolerance – something other products on the market simply can't achieve.

We invite you to find out more about our exciting technology by reading this information, visiting our website at www.rupturepin.com and calling our reps.

GET THE POWER OF THE PIN for the best overall value on the market and keep people, systems, products and the environment safe!





History of Rupture Pin

In 1986, Shell and Exxon came to Mr. Julian Taylor of Taylor Tools and asked him to solve a serious problem with pilot operated valves that were failing to operate 5% of the time. The set pressure was 83 bar (1220 psi) and the tolerance was $\pm 1.5\%$. This tolerance was not possible with conventional methods.

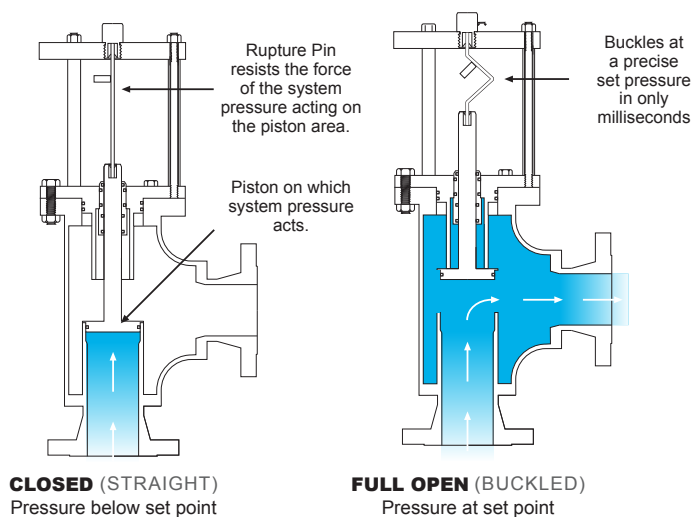
Mr. Taylor developed the Rupture Pin™ pressure relief valve. This Rupture Pin valve was used as back-up dome relief for the existing pilot operated valves. He used Euler's Law of Compressed Columns to meet the stringent requirements handed to him.

After meeting the challenge presented and obtaining approval of ASME Section VIII, paragraph UG 127(c), Code Case #2091-3, for Buckling Pins, volume sales of the Rupture Pin Valve started in 1990. With the need for high pressure relief of slurries and more viscous fluids requiring full flow orifices, high pressure valves were developed using ball valves and pistons for pressures to 20,000 PSI.

Today Rupture Pin Technology is located in Oklahoma City, Oklahoma. They are still owned and operated by Mr. Taylor and enjoy an honored and excellent reputation in the pressure relief business. Our customers come to us for solutions to problems with any pressurized system, whether it is relief or shutoff. Over 30,000 valves have been sold through trained independent representatives around the world and have a remarkable 99.99% customer satisfaction rate.

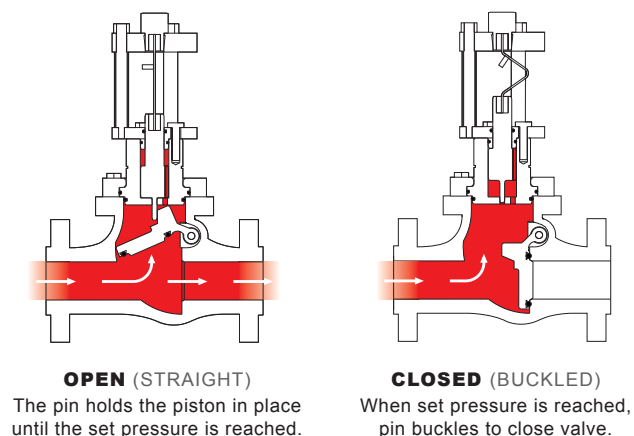
Valve Operation

It opens in milliseconds to relieve pressure.



Valve Operation

It closes in milliseconds for pressure isolation.





Advantages Over the Competition

- 1 We have over 30,000 valves operating worldwide with a satisfaction rate of 99.9% in over 27 years!
- 2 Pins buckle at set pressure
- 3 No worker safety concerns
- 4 No product loss
- 5 No environmental pollution
- 6 No fragmentation
- 7 Extremely accurate
- 8 Low maintenance costs
- 9 Low pin replacement costs
- 10 Full bore relief in milliseconds
- 11 Pin can be replaced by one person in only one minute
- 12 Minimal downtime
- 13 Works close to set point
- 14 Does not require vacuum support
- 15 Can sense upstream pressure only or differential pressure only
- 16 Pins are rugged and can be stored at the valve
- 17 No costly handling
- 18 It is easy to tell when a pin is buckled visually or remotely when using a proximity sensor
- 19 You don't break the line to change the pin
- 20 Buckling stress is lower than yield stress
- 21 Few inspections
- 22 Replacement pins can be produced quickly
- 23 Replacement pins can be shipped immediately
- 24 We make custom valves to your specifications
- 25 We take on "mission impossible" projects
- 26 Settings can be changed in minutes without breaking the line by changing the pin (with POCO option)
- 27 Reliability can be checked in the field under pressure
- 28 It is safe for your system providing emergency relief
- 29 There is no size limit large or small (within reason)





Pin Lots

The Rupture Pin raw material is ordered in large lots with certification that the entire lot came from the same batch of material with the same heat number. The Rupture Pins then are centerless ground to four or five decimal places, depending on pin diameter, to meet our stringent specifications and tolerances.

Rupture Pin diameters vary from 0.010" to 1.250" in small increments. There are three proprietary alloys – each is highly corrosion resistant and selected for the ambient conditions at the application. With alloy #3, the Rupture Pin's ambient temperature can vary from -100°F to +400°F and the modulus of elasticity will vary no more than 0.3%.

Pin Calculations

When our team knows the effective piston diameter and set pressure to protect the user's system, we can calculate the axial force on the Rupture Pin for a specific application.

The Rupture Pin alloy, diameter, and length are then selected by utilizing Euler's Law with the optimum slenderness ratio.

These initial calculations are used for a starting point in the testing and setting of the valve. This method of determining the Rupture Pin's dimension nails down the pin length and diameter in about three trial openings.

The Pin Buckling Process

The Rupture Pin ends are supported in the valve by close tolerance bushings. This causes the pin to buckle accurately at three places, assuring that the force to buckle the pin is much greater in comparison to the seal friction within the valve.

Another key feature is the slight bowing of the Pin before buckling. Pressure increases allow the piston to move up slightly prior to buckling.

In a test of 2" valves, it was found that the bowing of the Rupture Pin allowed the piston to move up

0.012" prior to buckling. Because the elastic limit of the Rupture Pin material is not reached until full buckling, the set point is held.

This Rupture Pin bowing is critically important for the valve's proper functioning. Over long periods of use, there may be some seal cold vulcanization to the adjacent cylindrical surface. Due to the bowing which allows a slight movement of the piston, the seal stiction is removed prior to the buckling of the Rupture Pin at set pressure. This prevents the seal friction from building up over time. The set pressure is held.

Pin Preparation

In order to meet customer specifications, Rupture Pins are cut and tuned in the valve. This cutting process is performed using proprietary machines which give the Rupture Pin a burr free, perfectly flat end, with an overall length accurate to 0.0005".

The seal friction and piston weight modify the calculated Rupture Pin's length to a slight degree. This difference is overcome by performing a series of tests on each valve and slightly varying the Rupture Pin's length until the proper set pressure is reached. During these tests, the valve is oriented as it will be in the actual application.

This process may take as many as 3 to 5 test Rupture Pins to get the exact pin length. Once these tests are complete, the Rupture Pin's parameters are then fixed and recorded.

The Rupture Pins are then cut and buckled in the valve three times. The test results and all pertinent information is sent with the valve order. The peak force at buckling is measured with an accuracy of 0.01% using calibrated vaetrix electronic gauges. This locks in the valve accuracy, on average at set point between +/-1% to +/-3%. Additional Rupture Pins are now cut for customer requirements and three tests in the Tinius Olsen compression test instrument. The results are then archived for correct settings of replacement pins.



Pin Labeling

Once the Rupture Pin specifications are determined, each pin is then labeled. The label contains the Rupture Pin code, the valve serial number, and the set pressure of the valve.

Each valve is assigned a unique serial number to which all design calculations, sizing information, and production drawings are associated. This information, along with the valve's set pressure, simplifies the re-ordering process by giving the customer all the information we need to reproduce replacement Rupture Pins.

In addition to the label, a name plate with serial number and all relevant information is attached to the valve bonnet. We also stamp the serial number on the valve bonnet should the name plate be accidentally removed. These steps make future orders of pins or valve parts very easy. Pins ordered before noon on business days are shipped the same day.

Pin Archiving

Our Tinius Olsen instrument is capable of slowly adding a force load to a Rupture Pin while recording and providing real time feedback of the applied force, the distance compressed, and the buckling point of the Rupture Pin once it is reached.

Three Rupture Pins are tested in this manner for archive results.

This test is used because it is free of valve friction. These results assure that Rupture Pins from a new material batch can be tested in an identical manner to conform to the original archived results. Proprietary methods are used to bring the latest material batch to conformity.

Pin Diameter Variations

To show you how the pin diameter affects performance, we conducted the Diameter Variations test. (see below) We took 4 different diameters (0.12063", 0.12571", 0.15618", 0.18741") all cut to the same length of 6.9951". We then took 5 samples of each diameter and determined the ultimate load at the buckling point with our Tinius Olsen Machine.

In the Diameter Variations table, we have listed the average ultimate buckling force for each diameter. As the diameter slowly increases, the capacity of the pin increases dramatically. This illustrates that even a diameter change of 0.00508" can effect the load capacity of the pin and why we are so meticulous in getting the Rupture Pin measurements right.

Diameter Variations			
Diameter (in)	% Difference	Ultimate Load (lbf)	% Increase
0.12063"	-	249.008312	-
0.12571"	4.17%	294.253781	18.17%
0.15618"	30.0%	564.913319	126.87%
0.18741"	55.8%	1225.693782	392.23%



Pin Length Variations

In this test, we took the same diameter material (0.09005") and cut it to varying lengths (3.9945", 4.0932", 4.1936", and 4.2910").

We tested 5 samples of each length to

determine the ultimate force required to make the Rupture Pin buckle.

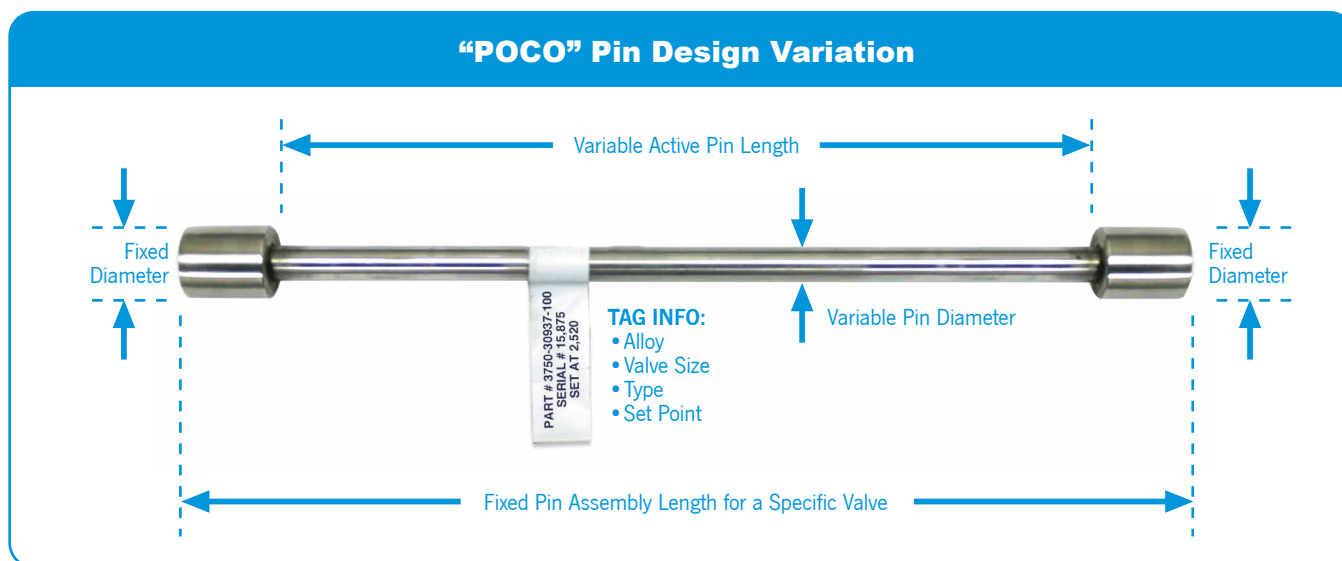
In the table below, we have listed the average values for each length.

Length Variations			
Length (in)	% Length Difference	Ultimate Load (lbf)	% Decrease
3.9945"	-	243.511804	-
4.0932"	2.49%	239.834812	1.53%
4.1936"	4.98%	232.151709	4.89%
4.2910"	7.43%	212.647204	14.51%

"POCO" Pin Design Variation

This intelligent design allows the user to change the set pressure of the valve by simply changing pins. This is done by affixing pin spacers on each end of the Rupture Pin while keeping the overall length of the pin assembly constant.

The changes in set pressure are accomplished by varying the diameter and length between the spacers of the actual Rupture Pin. We're able to meet customer requirements for multiple settings.





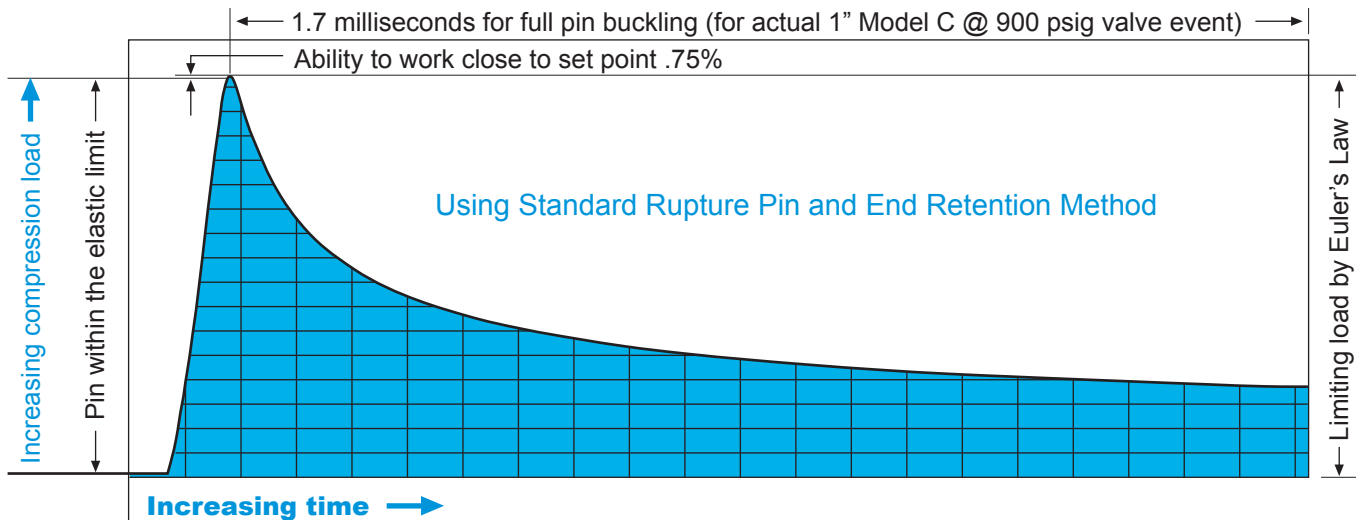
Euler's Law

Axial Force on the Pin Causing the Pin to Buckle
(Piston/Plunger Area x System Pressure)

~

$\frac{\text{Pin Diameter}^4 \times \text{Pin Material Modulus of Elasticity}}{\text{Pin Length}^2}$

Tinius-Olson Test



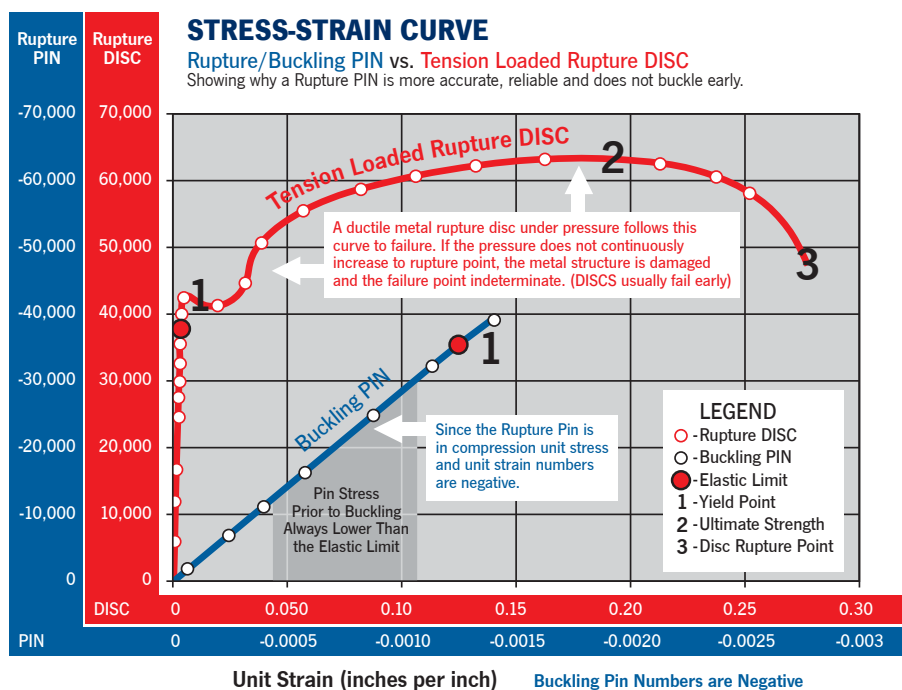
Rupture Pin vs. Rupture Disc

Why Rupture Discs Fail

The main weaknesses of the disc is the fact that the disc's stress at the burst point is much greater than the yield stress. The stress-strain curve of the forward acting/tension loaded rupture disc is shown. Once the disc is pressured beyond its yield point, the disc is irreversibly damaged. Unless the pressure continues to increase to the burst pressure, the disc will fail far below set point, usually at the next pressure increase over yield point. Yes, when the disc breaks early, it "fails safe", but consider the needless pollution, loss of product, downtime, disc replacement cost and labor to replace the disc.

With the Rupture Pin, the stress is always below the elastic limit. Because its mechanism of buckling is Euler's Law, the pin can't fatigue.

Unit Stress (pounds per square inch) Buckling Pin Numbers are Negative

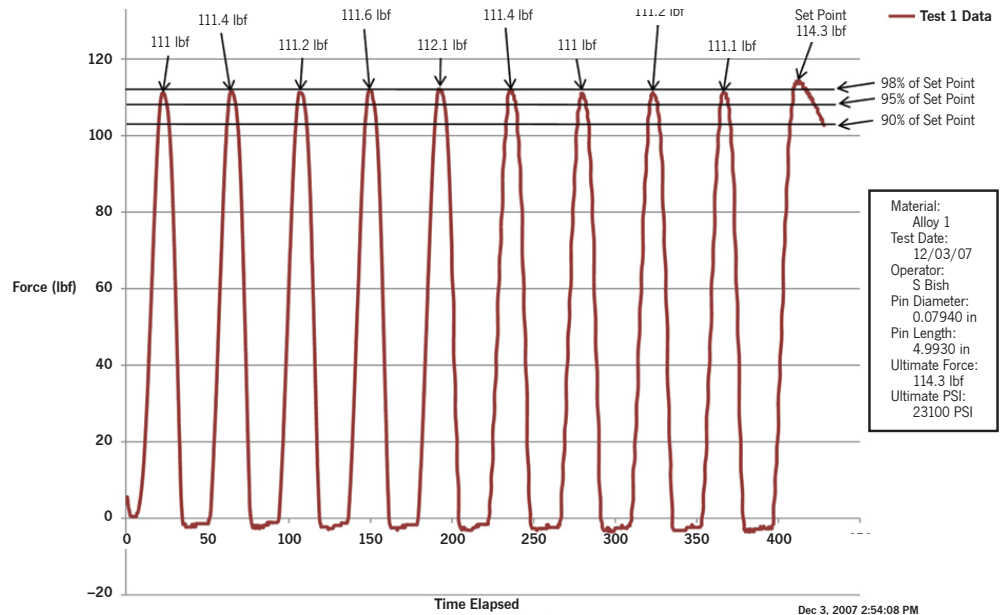




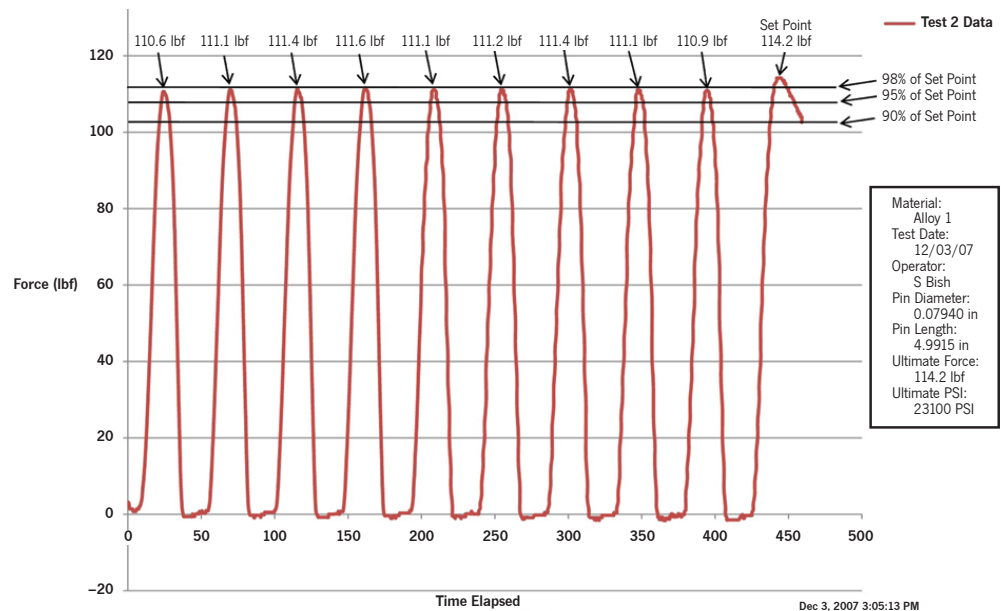
Stress Tests

In these pin tests, we load the pin to 98% of set point 9 consecutive times and then buckle the pin on the 10th compression. Each test showcases the ability of our design to operate just below set point without fatigue of the pin or risk of an early rupture. The tests also show the accuracy of the set point.

STRESS TEST 1 (98% of Set Point)



STRESS TEST 2 (98% of Set Point)





How We Test Our Valves

Every valve manufactured by Rupture Pin Technology is shipped with a Valve Certification Document unique to each individual valve. These “Valve Testing Certifications” are prepared to the Customer’s exact specifications set forth by the Sales Order. Each valve undergoes Quality Control checks at various stages of production. The production process is controlled from the inspections of raw materials received, to in-progress tolerance checks, and welding quality inspections. The final and most critical inspection is done by personnel that do final assembly and testing of each valve. If any deficiencies show up here, Quality Control will be notified and any parts not meeting the requirements will be reworked and scrapped. When Assembly and Quality Control have approved all components, the valve may be assembled and tested.

All valves are given a “Bubble Test” to verify the integrity of the valve body, a “Seat Test” to verify the pistons Class VI seal, and a “Shell Test” to verify the sustained pressure integrity over time. When these three tests have been documented, the assembly personnel will begin testing to determine the exact pin material, length and diameter to achieve the Customer’s required pressure setting. Once the setting is determined, we will run a series of at least three additional tests to verify consistent operation under air pressure. Valves with set requirements over 3,000 PSIG will be tested with water “Hydro” or other materials specified by the Customer. Each valve tested is given a “Test Certificate” with this information documented and signed by our Quality Control Inspector.

Special Testing such as X-Ray, Dye Penetration, and Extended Shell Testing can be provided at the Customer’s request.

In testing for a valve’s set point with an electronic pressure or vacuum gauge, it is important to know the incremental event sample time. Usually the time is one second. During this second, four readings are taken and the average of the four is displayed. It is obvious that the average display

is 500 milliseconds behind if the pressure increase is uniform. To reduce the delay error, we use the following maximum test times:

- 0% to 50% of set point **1/2 minute**
- 51% to 90% of set point **2 minutes**
- 91% to the buckling point **2 minutes**

Pin Testing: Before each valve is shipped to the Customer, Engineering performs a final test on our Tinius Olsen instrument. This machine measures and documents the force to buckle the pin material used in each valve. A test set of at least three pins from each job are tested to record the buckling pounds of force. These test results give us an archive benchmark, free of seal friction. If the Customer needs a replacement pin or an o-ring, the original test information will be available. In addition to that, all the Customer’s job prints and information are kept.

Each valve has a “Serial Information Tag” that includes: Valve Type – Size – Set Pressure PSI – Capacity in SCFM or GPM – Serial Number – Pin Data – and Date. This Tag is attached to the valve bonnet. The valve bonnet is also stamped with the serial number. All Pins are tagged with the Pin Code, Valve Serial Number and the specified Set Pressure.

TEST CERTIFICATE

Rupture Pin Technology Test Certificate - Serial Copy			
Sales Order # 7741 Serial # 9545 thru 9892 Customer: Redman Pipe & Supply		Certification Date: 27-Feb-05 Customer P.O. #: 87-51021-324	
Product #: 2-A-ESV-2MNPT-2FNP1-0798-03502-01985-3-0-250 Pin Code: 0798-03502-1004-5			
General Information			
Valve Size & Model	2" Model A-ESV		
Mark #	1 Series 1		
Inlet Configuration	2" MNPT		
Outlet Configuration	2" FNPT		
Set Pressure	250 PSI		
Set Tolerance	5%		
Vacuum Pressure	n/a		
Back Pressure	n/a		
Body Material	Carbon Steel		
Piston Material	Type 316 SS		
Seal Material	Type 316 SS		
Bushing Material	Type 316 SS		
Piston Seal Qty & Size	(1) 2-217 O-Ring		
Piston Seal Mat. & Duro	Viton, 90 Duro		
Bonnet Seal Qty & Size	(1) 2-234 O-Ring		
Bonnet Seal Mat. & Duro	Viton, 90 Duro		
Stem Seal Qty & Size	(2) 2-214 O-Ring		
Stem Seal Mat. & Duro	Viton, 90 Duro		
Bushing Seal Qty & Size	(1) 2-148 O-Ring		
Bushing Seal Mat. & Duro	Viton, 90 Duro		
Inlet Orientation	Vertical - Up		
Pin Cage Pos./Dir.	Vertical - Down		
Pin Cage Elev./Rot.	n/a		
Outlet to CL Inlet	3.750 Inches		
Inlet to CL Outlet	8.000 Inches		
Overall Length (Inlet)	Not Appl.		
Shell Testing			
Hydro Shell Test Results	Not Appl. - Tested on Air		
Air Shell Test Results	Acceptable		
Bubble Test Results	Acceptable		
Specific Valve Information			
Piston Diameter	1.985 Inches		
Seat Diameter	1.750 Inches		
Stem Diameter	1.000 Inches		
Post Type	1/2" x 13NC Solid		
Post Length	4.500 Inches		
Spacer Length	2.615 Inches		
Pin Storage	n/a		
Weight	27 Lbs		
Customer Information			
Billing Address	Redman Pipe & Supply PO Box 36832 Tulsa, OK 74153		
Shipping Address	Redman Pipe & Supply 1501 43rd Street Evans, CO 80620		
Ship VIA	Best Way FPLA		
Shipping Date	01-Mar-05		
Test Information			
Pin Diameter	0.0788 Inches (by Laser)		
Pin Length	3.502 Inches		
Pin Material	Type 304 SS		
Pin Constant	100		
Lot Number	0392		
Performance Tests			
Pressure, PSI		Deviation, %	
Test Number 1	248	-0.81%	
Test Number 2	247	-1.21%	
Test Number 3	251	0.40%	
Test Number 4	247	-1.21%	
Test Number 5	253	1.19%	
Test Number 6	248	-0.84%	
Average Results	248.50	-0.60%	
with	n/a	psi Back Pressure Applied	
Capacity Air	6,757	SCFM	
Capacity Water	1,002	GPM	J

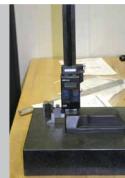


Quality Assurance, Product Testing and Research



TYPICAL TEST SETUP

Gives the hydro test and required pin length and diameter for the exact set pressure and a Class VI seal.



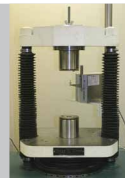
PIN LENGTH MEASUREMENT

We measure pin length to four decimal places.



AIR TESTING

We test a Model I-A slurry relief valve at 6,000 PSI to assure proper function and repeatability at maximum stress.



TINIUS-OLSEN PIN TEST

Gives precise pin buckling force for archive information on each valve to assure exact replacement pins.



AIR TEST STAND

We test valve set pressures to 21,000 PSI.



DATA ACQUISITION

Tinius Olsen test results are kept on record.



WATER TEST STAND

We test valve set pressures to 50,000 PSI and are now working on a stand to 100,000 PSI.



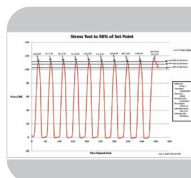
HEAT TREATING

We heat treat valve parts and tweak the pin modulus as required.



AIR TEST VESSEL

Used to test large valves to 21,000 PSI.



RESEARCH TEST

Determines how close our valve can operate to set point. This valve shows 2% max.



PIN MATERIALS

We carry a large stock of pin materials to meet immediate pin orders. One bin is shown.



HIGH SPEED VIDEO

Piston speed when the pin buckles is determined by the distance between frames at up to 5,000 frames/sec.



DIAMOND SAW

Cuts our pins to the exact length with polished square ends.



TINIUS OLSEN SEAL TEST

We research our seal tensile strength.



LASER MIKE

Determines pin diameter to five decimal places



SEAL TESTING

We do careful research and test our seals up to 6,000 PSI with air.



Client List

3M
Air Products
Alabama Gas Corp
Alabama Pine Pulp
Allied Signal
Amalgamated Sugar
American Azide
American Cyanimid
Amoco
Aramco
Arco
Arizona Chemical
BASF
Bauer, Inc.
Belize Natural Energy
Bohai Oil
Boom Drilling
British Petroleum American
British Petroleum United Kingdom
Brunswick Cellulose
Cactus Drilling
Calidra de Occidente
Carbon Fuels
Chalmette Refining LLC
CIBUS Inc.
Conoco
Columbia Natural Gas
Cytec Engineered Materials
Day & Zimmerman
Dow Chemical

DuPont
Durez Corporation
Eastman Chemical
El Paso Natural Gas
Encore
Energy Transfer
Englobal Engineering
Exxon
Fermilab
Fluor Daniel
Foster Wheeler
General Dynamics
Georgia Pacific
Goodyear
Hanover LTD
Hazen Research
Kerr-McGee Oil & Gas
Koch Engineering
Koch Pipeline
Lockwood Greene
LTV Energy
M-Wave Marketing
Mahr Corp
Marathon Oil
Midway Tool
Miller Brewery
Mobil
Monsanto
Mustang Hydraulics
MW Kellogg

NASA
National Oilwell Varco
Nomac Drilling
Northern Natural Gas
O'Brien & Gere
Parsons
Petrobras
Pfizer
PPG
Procter & Gamble
Ram Instruments
Rmax
Raytheon United Engineers
Santos
Sappi Fine Paper
Seaway Crude
Shell
Sinergia Soluciones
Solvay Solexis
Southern Natural Gas
Stepan
Stone Container
Sunoco Pipeline
Terasen Pipeline
Tinker AFB
Twin Rivers Technologies
Unit Drilling
Vetco Gray
Weyerhaeuser
Wissington Sugar Factory

Industries Served

Chemical Processing
Food Processing
Oil & Gas Production
Pharmaceutical
Pipeline
Pulp & Paper
Well Drilling (Mud Pump Relief)

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Contact a Sales Representative Today



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