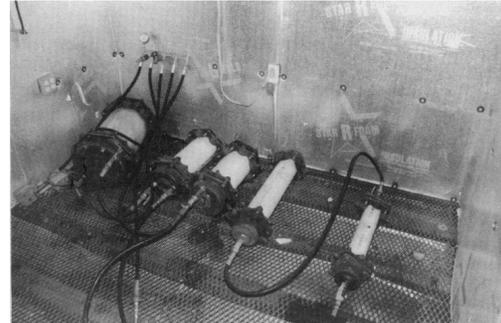


LONG TERM BURST STRENGTH OF PVC PIPE AND THE 2000PV

Over a period of almost three years EBAA performed high pressure proof tests of the 2000PV in various sizes. It was found that the 2000PV test sections held at hoop stress levels of 4000 psi and above for over 20,000 hours indicated no detrimental effect of the restraint on the PVC pipe. After being removed from the long term test, specimens were subjected to quick burst test. These pipe burst at pressures well in excess of the minimum quick burst requirements for the pipe.

restraint should be capable of being tested in the same manner.



TESTING AND BACKGROUND

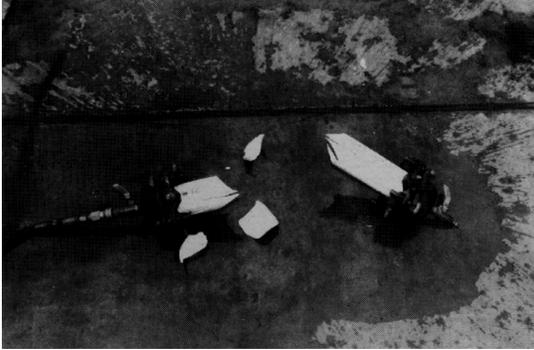
In the summer of 1990 EBAA began a long term, proof testing program on the 2000PV mechanical joint restraint for PVC pipe. The testing was to satisfy the requirements of Uni-Bell's UNI-B-13-87 "Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride (PVC) Pipe". The long term test requirement for this specification called for the internal pressure in the test section be held at twice the rated pressure of the restraint device for 1000 hours without failure. The bulk of our testing was for qualification on DR18, C900 PVC pipe with a pressure rating of 150 psi. The 2000PV is rated the same as the pipe, therefore, the UNI-B-13 required long term test pressure would be 300 psi. EBAA, however, elected to test for 1000 hours at the sustained pressure of 500 psi which is the requirement listed in AWWA C-900 for the pipe alone. The 1000 hour, sustained pressure test is a pipe production process quality control test. Since the pipe is tested to this, we felt that the pipe with

Samples of various sizes were placed at 500 psi at different times during the test. All samples were prepared and tested in accordance with the requirements of the UNI-B-13 specification. After the 1000 hour mark was satisfied., the samples were left at this pressure to meet the request of a potential customer. This customer had requested testing at the sustained pressure requirement for 10,000 hours as an added measure of proof of restraint performance.

With the successful completion of 10,000 hours at 500 psi, samples were removed and taken apart. Inspection of these parts revealed that there was no damage of any kind to the pipe. The remaining samples were kept at 500 psi until March 25, 1993.

The pressure in each sample was then taken from the 500 psi sustained pressure and increased until failure. The results of these burst tests are shown in the following table.

Pipe Size	Pipe Class	Sustained Hoop Stress	Time at Sustained	Ultimate Hoop Stress at Failure
3"	SCH140	3250 psi	6,381 hr	8430 psi
4"	DR18	4250 psi	24,682 hr	8449 psi
6"	DR18	4250 psi	21,237 hr	9223 psi
6"	SDR17	4000 psi	21,260 hr	8512 psi
10"	DR18	4250 psi	21,260 hr	8585 psi



The minimum burst stress for all the tested pipe was 6400 psi. The typical ultimate hoop stress at failure for a quick burst test specimen is around 7650 psi. The original intent of this testing was qualification of a product to a standard. For this reason, no control specimens were prepared. There is, however, a video recording of a ten inch quick burst test that was performed about the same time that the ten inch long term test specimen was placed on line. It is believed that the same pipe was used in the quick burst test and the sustained pressure test. That pipe burst at a pressure of 860 psi or 7310 psi hoop stress. After over 21,000 hours at a pressure of 500 psi the ultimate hoop strength increased by seventeen percent.

STRENGTH CHANGES OF PVC PIPE WITH TIME

The increase in ultimate capacity was the subject of a study described in the July, 1981 issue of Journal AWWA in an article titled "Changes in Strength of Pressurized PVC pipe with Time" by Robert T. Hucks Jr.

Mr. Hucks documented the testing of two inch diameter pipe samples. One sample was burst as

a control. Seven samples were pressurized to a hoop stress level of 2000 psi and seven samples were pressurized to a hoop stress level of 4000 psi. Samples from each stress level were removed, pressure released, and burst tested at time intervals of six weeks, three months, six months, one year, two years, five years, and ten years. The hoop stress at burst in each case exceeded that of the control. The increase in hoop capacity of the pipe after being pressurized for an amount of time compared to the control specimen varied from four percent to twenty-two percent with an average of fourteen percent.

SUMMARY

Hucks has shown that PVC pipe is capable of becoming stronger as time goes by. The ability of the 2000PV to restrain 500 psi for over two years demonstrates the capability and reliability of the individually actuated gripping surfaces of the 2000PV restraint. The fact that the pipes that were burst tested at EBAA fell within the same general rang as the data presented by Hucks indicates that the 2000PV does not affect the PVC pipe in an adverse manner. The positive results of this testing proves that, regardless of the pipe diameter, the use of the EBAA 2000PV is safe and reliable in the long term.

The 2000PV was the first joint restraint for PVC

pipe to be

Approved by Factory Mutual

Listed by Underwriters Laboratories

And Complaint with UNI-B-13-92 and

ASTM F 1674-96

No other PVC joint restraint product has been tested like the 2000PV. No other manufacturer of PVC joint restraint products has more experience or expertise in the field than EBAA Iron.

EBAA IRON – Your Connection to the Future.™

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P.O. Box 857, Eastland, Texas 76448 USA PHONE: (254) 629-1731

CALL TOLL FREE: 800-433-1716 TELEFAX: (254) 629-8931

contact@ebaa.com

<http://www.ebaa.com>