

**INTERNAL FIRE ENDURANCE TEST L3 IN  
ACCORDANCE WITH IMO RESOLUTION A.753  
(18) FOR DISCONTINUOUS FILAMENT WOUND  
FIBERGLASS PIPE ND350**

**Manufacturer: TECNOPLAST SRL**

July 2016



**Summary**

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**ANNEX A**

Fire Poly FPCC Coating Technical Data Sheet

**ANNEX B**

IMO L3 Test Report issued by Southwest Research Institute San Antonio Texas

## 1.0 Generality

### 1.1 Standards

Test was carried out according to IMO Resolution A.753(18), 22 November 1993, "Guidelines for the Application of plastic Pipes on Ships" Appendix 2, "Test Method for Fire Endurance Testing of Water-filled plastic piping.

The test is intended to ensure that piping systems meet the fire endurance requirements of the level 3. This lowest level is considered to provide the fire endurance necessary for a water filled piping system to survive a local fire of short duration. The piping systems essential to the safe operation of the ship have to meet level 3 fire endurance standard (Fire endurance requirements matrix is presented in Appendix 4 of IMO A.753(18)).

For plastic piping systems three levels (1, 2 and 3) of fire endurance are given, level 1 being the highest and level 3 the lowest one.

Test was supervised by the representative of Consorzio Polo Tecnologico Magona Cecina (LI) Dott. Ing. Alberto Niccolini. Consorzio Polo Tecnologico Magona (CPTM <http://www.polomagona.it>) was founded in 1997, creating a research centre of excellence in the ex-industrial Magona area in the city of Cecina (LI) with the cooperation/support of Pisa University.

### 1.2 Description of Specimen

Pipe ND350 closed at both the ends (cap on one side and a flange connection on the other side) with a length of 1500 mm  $\pm$  100 mm, is mounted freely in a horizontal position on two V-shaped supports.

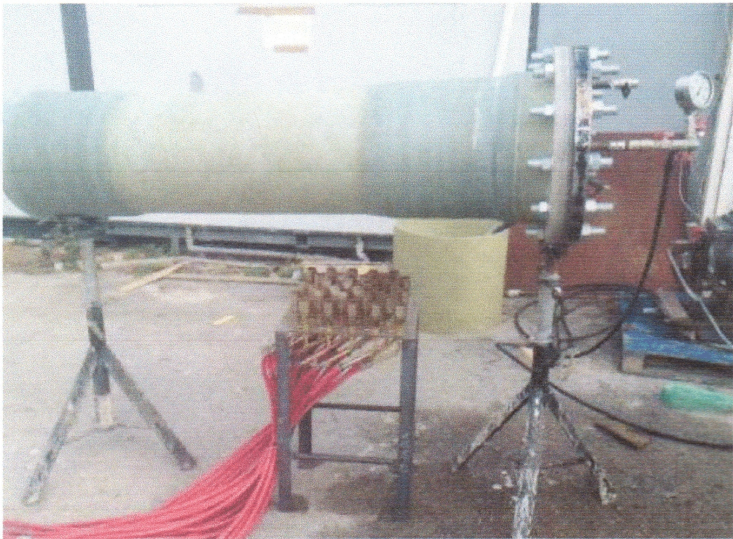
The free length of the pipe between the supports is 800 mm  $\pm$  50 mm.

The actual pipe dimensions, as measured before to start the testing, are shown in Table 1 below:

Nominal diameter	mm	350
Resistant internal diameter	mm	350
Average measured outside diameter	mm	363.8
Nominal wall thickness	mm	6.9
Measured average thickness	mm	6.95
Liner thickness	mm	1.5
Mechanical resistant thickness	mm	4.6
Outer layer thickness (Gel Coat + Fire Poly FPCC coating)	mm	0.8

Table no. 1: Table with pipe data

The ends of the pipe are closed and at one of the ends pressurized water is connected. The water inside the pipe is stagnant and the pressure is maintained at  $3 \pm 0,5$  bar during the test. A relief valve is connected to one of the end closures of the specimen and the water inside the pipe is deaerated. The water temperature measured at the beginning of the test was about 20°C.



Picture no. 1: Specimen and test device

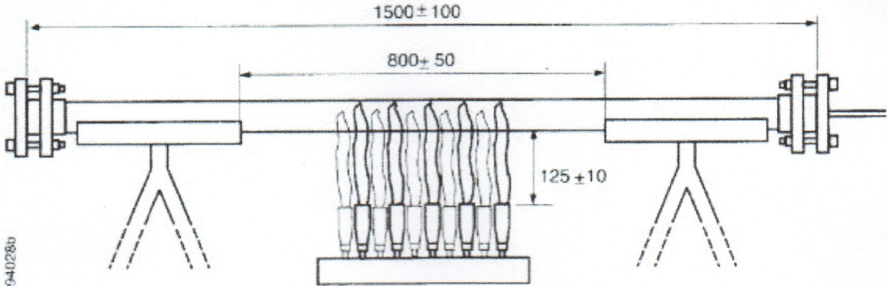
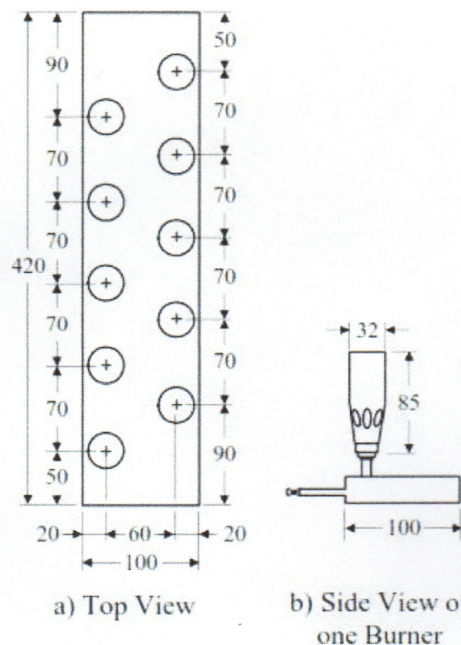


Fig no. 1: Fire Endurance Test: Stand with mounted sample (from Resolution A753 (18))

The fire source consists of 6 rows of burners (for ND350 pipe) mounted centrally below the test pipe parallel to the pipe's axis. The distance between the burner heads and the pipe is  $125 \pm 10$  mm. A constant heat flux averaging  $113,6 \text{ kW/m}^2$  ( $\pm 10\%$ ) is maintained at the level of the bottom surface of the pipe. The gas consumption is measured at the end of the test.



Picture No. 2: Burner assembly

**The duration of fire endurance test in the wet condition is 30 minutes.**

After termination of the burner regulation test, the specimen is allowed to cool down to ambient temperature. Then it is tested with internal pressure of 18 barg.

The test time in the pressure tests is 15 min.

## 2.0 Pipe characteristics

The pipe is produced by discontinuous/reciprocal filament winding according to ASTM D3517-96 and accordingly the designation is:

Type	2	Glass fiber reinforced thermosetting polyester resin (RTRP)
Liner	1	Reinforced thermosetting internal liner
Grade	2	Vinylester resin surface liner – non reinforced
Class	C250	Pressure class (250 psi – 16 bar)
Stiffness	D	72 psi – 5000 Pa

The nominal characteristics of the pipe are the following:

- The innermost part of the liner is reinforced with 1 “C” glass surfacing veil (33 g/m<sup>2</sup>) with a glass to resin ratio 10/90 by weight and a thickness of 0.2 mm
- The second layer of the liner is reinforced with no. 2 chopped “E” glass roving mat (375 g/m<sup>2</sup>) with a glass to resin ratio of 30/70 and a thickness of 1.3 mm for a total thickness of the internal liner of 1.5 mm.
- The mechanical resistant wall is made of approximately (percentages are by weight):
  - 27% vinylester resin
  - 73% continuous glass fiber roving
- The outer coat is made by not reinforced resin + Fire Poly FPCC coating with a thickness of 0.8 mm.

## 3.0 Performance criteria

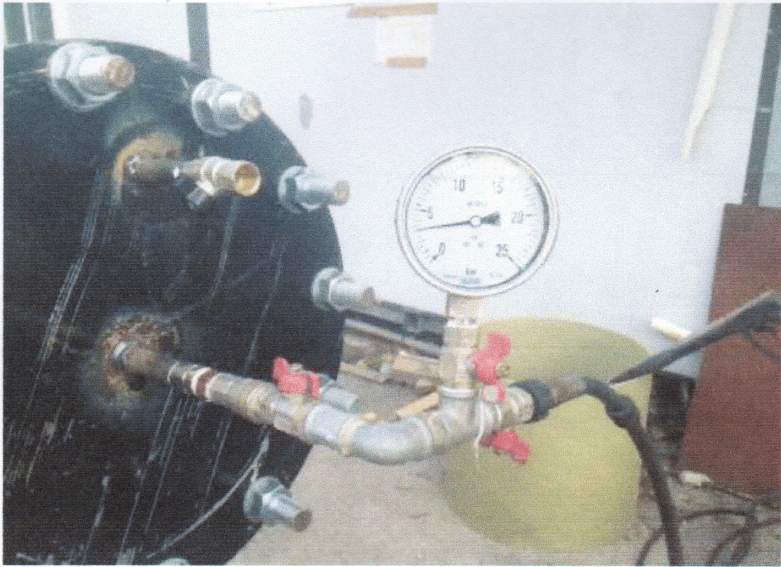
During the test, no leakage from the specimen should occur except that slight weeping through the pipe wall may be accepted.

In the hydrostatic test (after the fire test) the pressure should be held for a minimum of 15 minutes without significant leakages, i.e. not exceeding 0,2 l/minute

**4.0 Observations during the fire endurance test**

Time/min:s	Observation
00:00	Fire endurance test was started.
00:05	The exposed surface began to darken
00:10	Water pressure measurement: 3.2 bar
30:00	The test was terminated.

No leakage was observed during the test



*Picture No. 3: Pressure at start of the test*

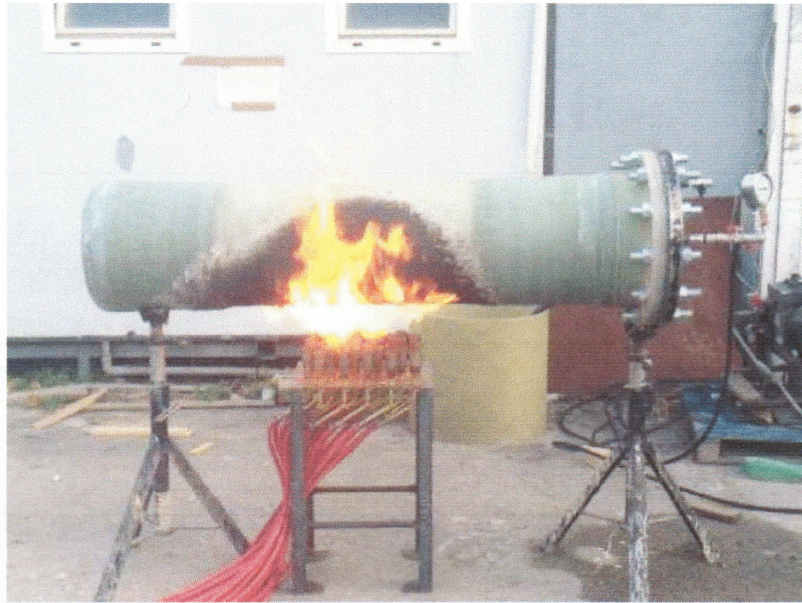


*Picture No. 4: Fire endurance test. Test time 5 min.*



*Picture No. 5: Fire endurance test. Test time 10 min.*





*Picture no. 6: Fire endurance test. Test time 18 min.*



*Picture no. 7: Fire endurance test. Detail (Test time 18 min.)*



*Picture no. 8: Fire endurance test. Test time 25 min.*



*Picture no. 9: The test specimen after the fire endurance test. The exposed face of the pipe*



Picture no. 10: The test specimen after the fire endurance test. The exposed face of the pipe

5.0 Observations during the internal pressure test

Time/min:s	Observation
00:00	Internal pressure test was started.
15:00	The test was terminated.
	No leakage was observed during the test

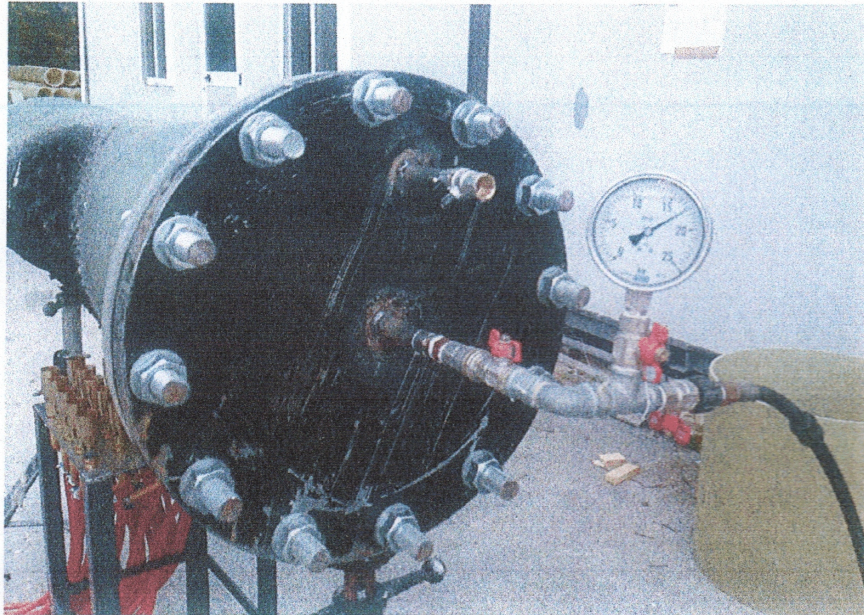
It was also observed that there was not damages or erosion of the mechanical wall of the pipe but only the external coating was damaged as appear from picture no. 10 above.



*Picture no. 11: start of pressure test at 18 barg*



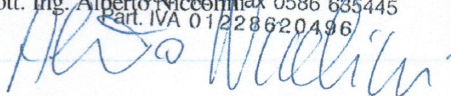
*Picture no. 12: Test Specimen during pressure test (no leakage observed)*



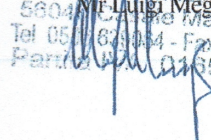
Picture no. 13: Test Completed after 15 min (no leakage observed)

Casale Marittimo 21.07.2016

**Consorzio Polo Tecnologico Magona**  
Via Magona - 57023 CECINA (LI)  
Tel 0586 639143 - Fax 0586 635445  
Dott. Ing. Alberto Niccoli  
Part. IVA 01228620496



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**TECNOPLAST s.r.l.**  
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Part. IVA 01651700500





**COSTRUZIONE E INSTALLAZIONE  
DI MANUFATTI PLASTICI E COMPOSITI**

## **ANNEX A**

Fire Poly FPCC Coating Technical Data Sheet

## **ANNEX B**

IMO L3 Test Report issued by Southwest Research Institute San Antonio Texas



# FLAME SAFE FIRE POLY FPCC

CLASSIFICATION FOR PLASTIC PIPE  
INTERNATIONAL MARITIME ORGANIZATION  
(MQ) RESOLUTION A 753 (18) ASTM F1173-95  
FIRE RETARDANT COATING

SOUTHWEST RESEARCH INSTITUTE

TEST	MATERIAL TESTED	RESULTS
Fire Endurance and Hydrostatic Evaluation Based on International Maritime Organization Resolution (IMO) Resolution A.753(18); Appendix 2 and ASTM F1173-95 Section A5 Wet Condition Classification of Water Filled Plastic Pipe	Conley epoxy 20, 6-in. FLGXFLG Spool pipe coated with Flame Safe Chemical Corporation's Fire Poly FPCC	PASSED

**FIRE ENDURANCE**

**PASSED**

Number of fire retardant coats  
Rate per coat (ft<sup>2</sup>/gal)

3  
1050

**Styrofoam - NFPA 701 - PASSED**



**FIRE POLY FPCC TECHNICAL DATA**  
**(Coating for Plastic Pipe)**  
**EXTERIOR/INTERIOR**

**Fire Poly**  
**FPCC**

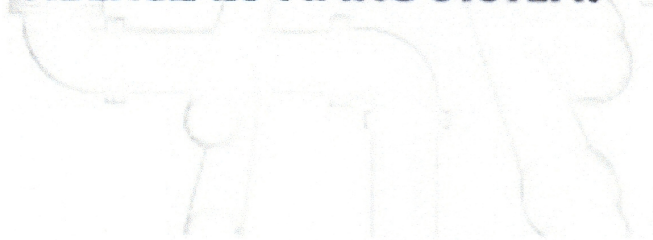
**PRODUCT DESCRIPTION:** Aqueous Based Resin

<b>PRODUCT ANALYSIS</b>			
Total Solids	46%	PH	2.5 - 2.8
Weight per gallon	11.7 lbs	Flash point	Non-flammable
Specific gravity	1.33	Color	Water clear at 78°F. - slight haze at 50°F. And lower
Volatility	Non-volatile	Solvents	Water (contains no petroleum or derivatives of petroleum.)
Impact Resistance	Good	Bacterial	Good resistance
Corrosive	Slight with some common metals	Moisture absorption	Slight
Toxic	None, (when dry)	Incompatibility	Strong oxidizers, alkalis or acids (materials to avoid)
Scrubability	1000 cycles		

**RECOMMENDED USE:** Pressurized plastic and composite piping system, styrofoam, polyurethane foam, polystyrene

**FLAME SAFE FIRE POLY FPCC:** Specially formulated for use on plastic pipe

**FIBERGLASS PIPING SYSTEM.**



**ENVIRONMENTAL REGULATION:**

This product complies will U. S. Federal Regulations concerning the use of lead in paint, and hydrocarbon emissions.

The information contained herein is the property of Fire Prevention Technologies d/b/a Flame Safe Chemical Corporation and Flame Safe Wood Products, Inc. ©1990 revised 8/20/2009





**FIRE POLY  
FPCC**

**QUICK REFERENCE FOR APPLYING  
FIRE POLY FPCC**

MATERIAL	APPLICATION	COVERAGE
Plastic Pipe	<p>Be sure surface is clean and dry before treating.</p> <p>Apply with sprayer head held at 8 to 12 inches from surface.</p>	<p>Apply three (3) coats at 1050 sq. ft. Per coat with the final coverage rate of 350 sq. ft. per gallon</p>
Styrofoam, polyurethane foam, polystyrene	<p>Be sure to allow drying between each coat.</p>	<p>Apply at a coverage rate of 200 sq.ft. Per gallon</p>

**EXTERIOR/INTERIOR:**

All surfaces to be treated must be clean and dry. Fire Poly FPCC is water based, clear liquid that becomes insoluble when dry. If over-coating is intended, Fire Poly FPCC is an excellent primer for use under or over latex paints. **DO NOT DILUTE OR MIX FIRE POLY FPCC WITH ANY OTHER PRODUCTS.** Avoid wasteful runs and dripping. It should be noted that unlike some products, materials treated with Fire Poly FPCC require no special cutting tools or special fasteners. Contact parts of any equipment should be stainless steel or plastic to prevent chemical reaction and breakdown. Storage may be done in polyethylene containers.



**CAUTION:**

Product must not freeze. It **MUST NOT** be thinned or diluted.

**OVERSPRAY:**

The overspray will not harm plants or animals. Spills can be flushed with water. A rag wetted with bleach and water mix will clean up spotting.

**CLEAN UP PROCEDURE:**

Airless Equipment:

1. Run clear water through the system until saturant is flushed out. When minor sudsing on surface stops, the system is flushed.
2. Run bleach and water mix (1 part to 4 parts) through the spray system as solvent for cleaning and to remove any residue.
3. Repeat Step 1 if any foaming occurs in Step 2.
4. Lubricate system as specified by equipment manufacturer to combat rusting or corrosion.

If two or more jobs are planned in the same day, the sprayer can be kept clean by running water through the system between jobs.

**SAFETY FIRST:**

It is a good practice to wear a respirator or mask and protect hands with rubber gloves when spraying any coating or chemical. When engineered air control is not feasible, use properly maintained and properly fitted NIOSH approved respirator for solvent vapors. A dusk mask does not provide protection against vapors.

If eye contact occurs, flood with water for fifteen (15) minutes and call a physician. **KEEP OUT OF REACH OF CHILDREN. DO NOT TAKE INTERNALLY.**

FLAME SAFE CHEMICAL CORPORATION  
2653 WARFIELD AVENUE  
FORT WORTH, TEXAS 76106  
Phone: (817) 740-9197 Fax: (817) 740-9199  
website: [www.flame-safe.com](http://www.flame-safe.com)

# THE DEPARTMENT OF FIRE TECHNOLOGY

FIRE ENDURANCE AND HYDROSTATIC EVALUATIONS  
BASED ON IMO RESOLUTION A.753(18); APPENDIX 2; AND  
ASTM F1173-95 SECTION A5 WET CONDITION  
CLASSIFICATION OF WATER-FILLED PLASTIC PIPE

FINAL REPORT  
SwRI Project No. 01-1205-406  
August 1998

Prepared for:

Conley Corporation  
2195 East 91st Street  
Tulsa, Oklahoma 14137



## SOUTHWEST RESEARCH INSTITUTE

Chemistry & Chemical Engineering Division

SAN ANTONIO, TEXAS  
Houston, Texas · Detroit, Michigan · Washington, D.C.

# SOUTHWEST RESEARCH INSTITUTE

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION  
DEPARTMENT OF FIRE TECHNOLOGY FAX (210) 522-  
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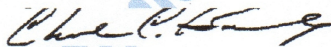
FIRE ENDURANCE AND HYDROSTATIC EVALUATIONS  
BASED ON IMO RESOLUTION A.753(18); APPENDIX 2 AND  
ASTM F1173-95 SECTION AS WET CONDITION  
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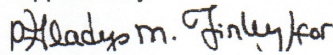
Conley Corporation  
2795 East 9181 Street  
Tulsa-Oklahoma 74137

Submitted by:



Charles C. Bailey  
Sr. Engineering  
Technologist Fire Testing  
Services

Approved by:



Alex B. Wenzel  
Director  
Department of Fire  
Technology



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## 1.0 OBJECTIVE

The wet condition fire endurance and hydrostatic evaluation described herein, were conducted by Southwest Research Institute's (SwRI1s) Department of Fire Technology located in San Antonio, Texas, for Conley Corporation located in Tulsa, Oklahoma. The test was performed on a 6-in. diameter plastic pipe assembly with a connector sleeve joint coated with Flame Safe Chemical Corporation's "Fire Poly FPCC." The specimen, identified as Conley epoxy schedule 20, 6-in. FLGX FLG Spool pipe, was received by SwRI on June 9, 1998. The evaluation was conducted using the specifications and protocol described in International Maritime Organization Resolution (IMO) Resolution A. 753(18) and American Society for Testing and Materials (ASTM) F1173-95 for Level 3 Wet Condition Classification for Plastic Pipe. The test procedure involves subjecting a water-filled plastic pipe to two separate endurance tests while under pressure. Note that the results apply only to the specimens tested, in the manner tested, and not to the entire production of this or similar materials, nor to the performance of this material when used in combination with other materials.

The first test is a fire exposure from a specific air mixed propane gas fired burner array producing an open flame which is adjusted to envelope the base of each water-filled pipe specimen for a period of 30 min while pressurized to approximately 43 psi (3 bars). The second test is a static hydrostatic pressurization test that subjects the water-filled fire tested assembly to the pipe's rated working pressure, (150 psig 10.34 bars for these specimens). The pressure is to be maintained for 15 min without exceeding a water leakage rate of 0.05 gal/min (0.21/min).

## 2.0 CLASSIFICATION CRITERIA

Piping systems must meet the following criteria to qualify for Level 3, wet condition piping:

- During the 30-min fire endurance exposure and while maintaining a static pressure of 43.5 psig ( $3 \pm 0.5$  bars), no leakage from the specimen should occur. Slight weeping through the pipe wall may be accepted.
- After the fire test, the water-filled specimen is allowed to cool to ambient temperature and pressurized to the rated pressure of the pipe and held at that pressure for 15 min. Leakage rate should not be in excess of 0.05 gal/min (0.2 l/min).

### 3.0 TEST CONFIGURATION

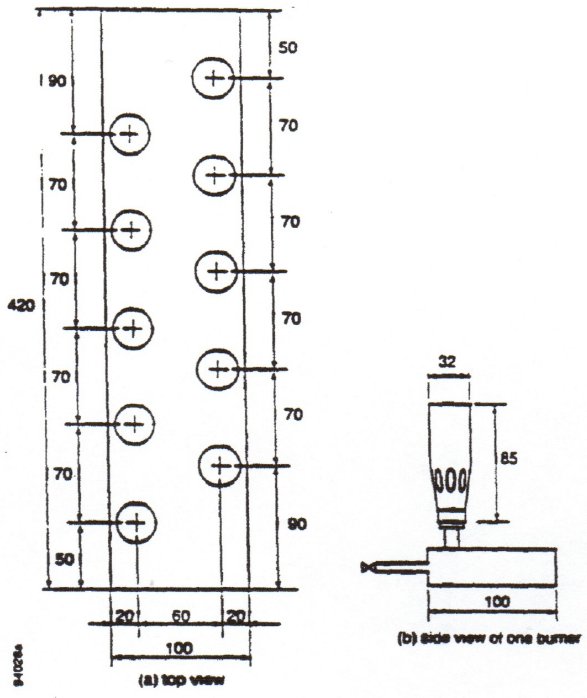
The test was performed at the Department of Fire Technology's air conditioned high bay testing facility. The fire endurance burner consisted of a multiple burner array with two rows of five Sieven No. 2942 burners as shown in Figure 1. The burner system was calibrated, and all testing conducted, using technical grade propane (98 percent purity) to obtain an average heat flux of 36,011 BTU/hr sq ft (113.6 kW/m sq) measured  $5 \pm 3/8$  in. ( $12.5 \pm 1$  cm) above the centerline of the burner array. The heat flux corresponds to a total heat release rate of 221,780 BTU/hr (65 kW). The pressurization of the specimen was maintained manually and was monitored with both a calibrated pressure gauge and a voltage transducer connected to the computer data acquisition system. A pressure relief valve set at 48 psi (3.3 bars) was mounted in the opposite end cap.

### 4.0 FIRE ENDURANCE TEST MATRIX

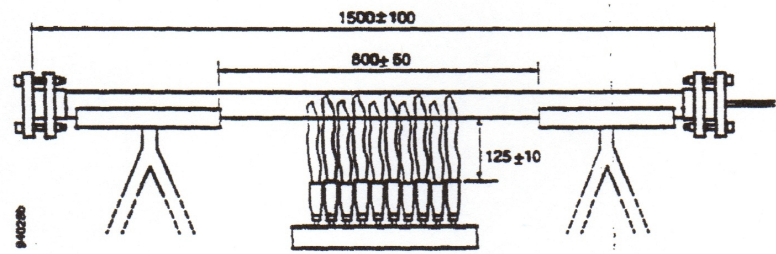
The fire endurance tests were run on June 11, 1998. The ignition source used in this program was an air mixed propane gas fired burner array as specified above. The burner and specimen holder were mounted on cement blocks laid flat on the floor of the test room to achieve a height to the top of the burners of 14 in. (35.5 cm). This placed the bottom of the specimen at a height of approximately 1.58 ft (48 cm) above the floor (see photograph No. A-1). The specimen was placed into the steel support holders centered parallel over the burner array axis such that the flame impinged on the base of the specimen. After filling with water, all possible air was expelled from the specimen. The test was initiated by pressurizing the specimen and then igniting each burner. Complete ignition of the burner array marked time zero.

### 5.0 HYDROSTATIC TEST MATRIX

The hydrostatic test was run on June 12, 1998. The test was conducted using an air activated low volume high pressure pump system to provide the required rated water pressure. The specified pressure of 150 psi was continuously monitored and adjusted by visual readings of a calibrated pressure gage (Wika brand 0-200 psi; 2-in. diameter dial) and an electronic pressure transducer with digital readout.



Fire endurance test: burner assembly (all dimensions in mm)



Fire endurance test: stand with mounted sample (all dimensions in mm)

Resolution A753(18)- 355

Figure 1. Multiple Burner Array with Two Rows of Five Sievert No. 2942 Burners.

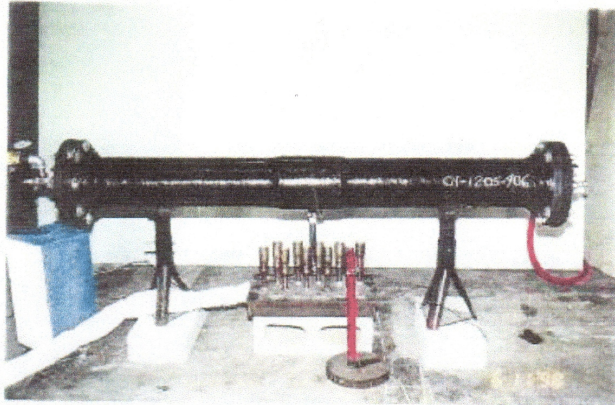
## 6.0 TEST RESULTS

The specimen, identified as Conley epoxy schedule 20, 6-in. FLGX FLG Spool pipe passed both the fire endurance classification criteria and the hydrostatic test pressure classification in accordance with the specifications and protocol described in IMO Resolution A. 753(18) and ASTM F1173-95 for Level 3 Wet Condition Classification for Plastic Pipe.

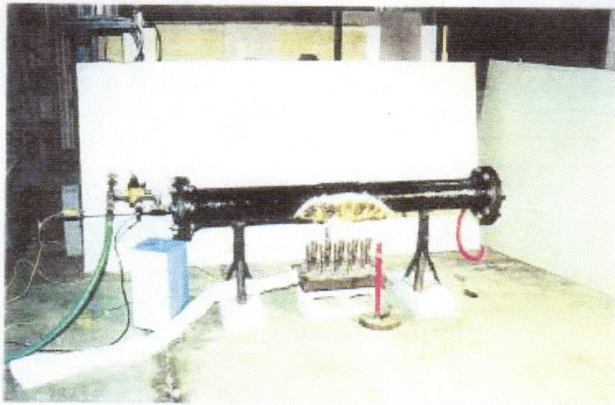
Photographic documentation is presented in Appendix A. Appendix B consists of Flame Safe letter dated June 16, 1998, stating coating specifications.

A videotape of the fire endurance test is included as part of this report.





A-1. Pretest Setup.



A-2. Start of Test.

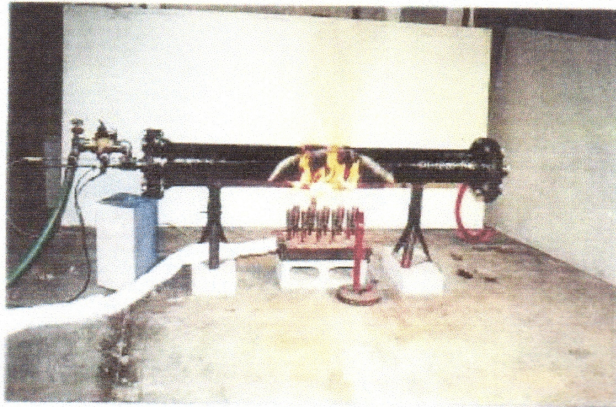
Conley Corporation

A-1

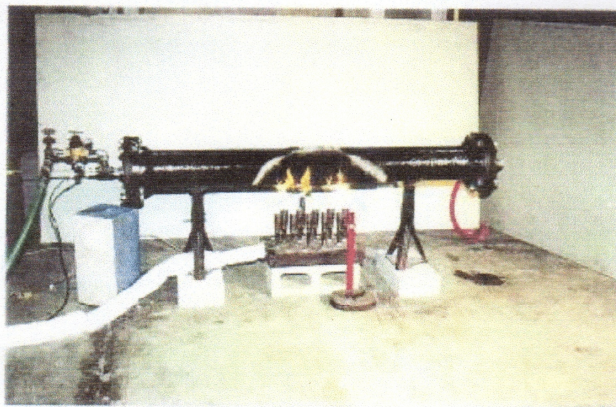
SwRI Project No. 01-1205-006

Prepared by

afe Chemical Corp.



A-3. 5 Min Into Test.



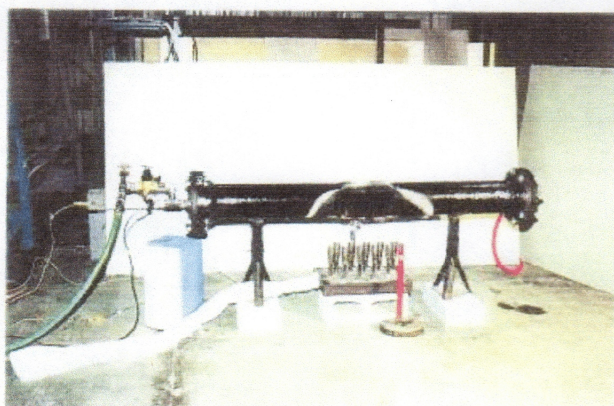
A-4. 10 Min Into Test.

Safe Chemical Corp.

Prepared by



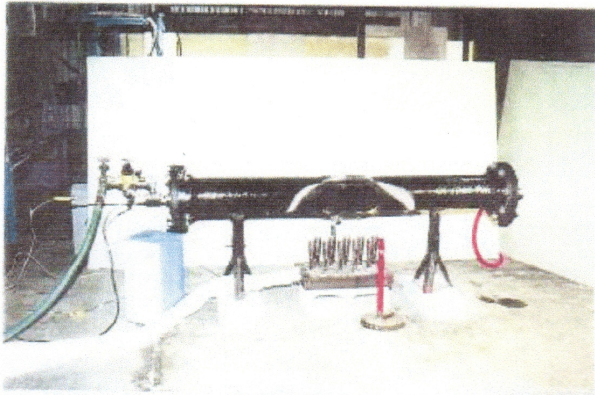
A-5. 15 Min into Test.



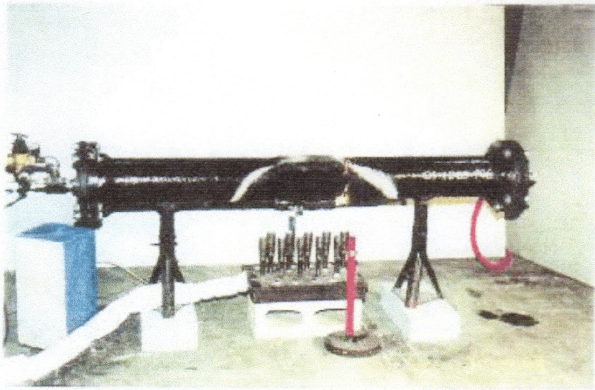
A-6. 20 Min into Test.

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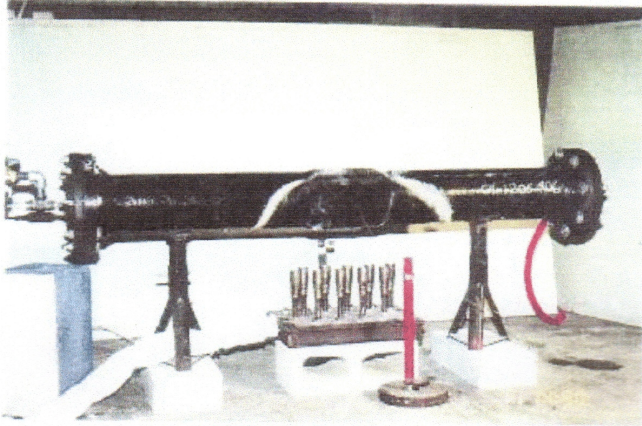
A-7. 25 Min Into Test.



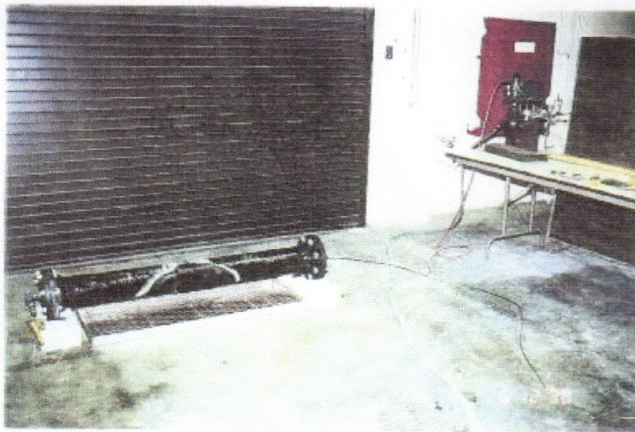
A-8. End of Test, 30 Min.

Prepared for

Safe Chemical Corp.



A-9. Post Test Fire Endurance.



A-10. Hydrostatic Test Setup.

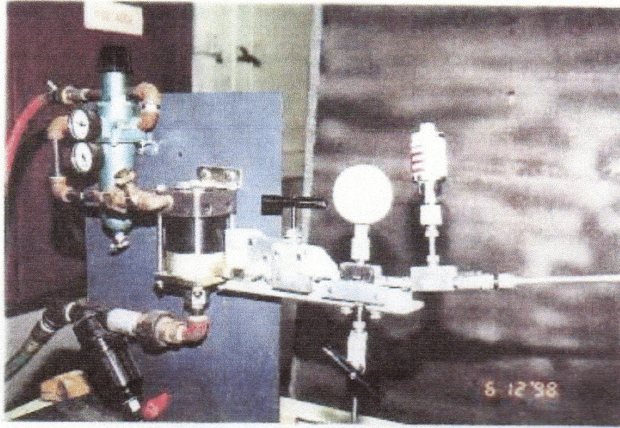
Conley Corporation

A-5

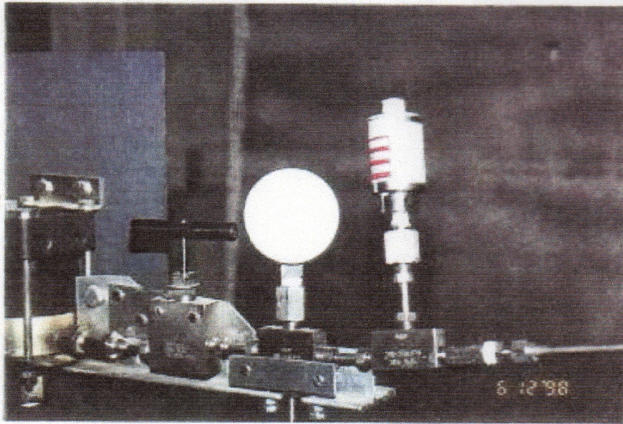
SwRI Project No. 01-1205-406

Prepare

afe Chemical Corp.



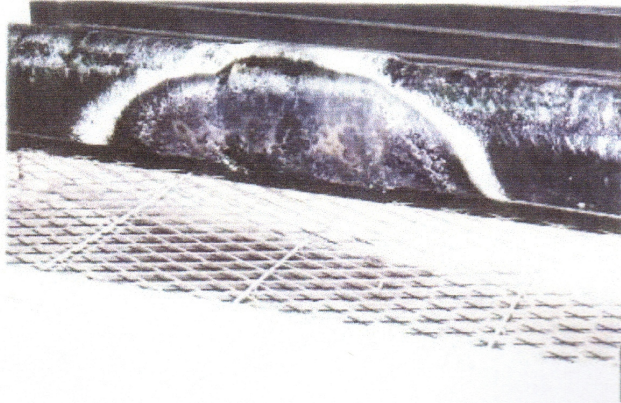
A-11. Closeup of Low Volume - High Pressure Pump System.



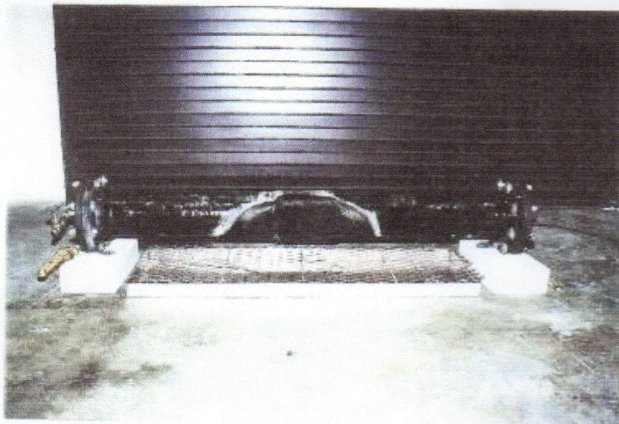
A-12. Closeup of Gage at 150 Psi.

afe Chemical Corp.

Prepared



A-13. Test in Progress - Closeup of Specimen.



A-14. Hydrostatic Test - Post Test.

Prepared

Safe Chemical Corp.

**APPENDIX B**  
**COATING SPECIFICATIONS**  
**(Consisting of 1 Page)**

Prepared for Conley Corp. & Flame Safe Chemical Corp.





June 16, 1998

Chip Bailey  
Southwest Research Institute  
6220 Culebra Road  
San Antonio, Texas 78284

RE: Tests conducted for Conley Corporation on June 11 th and June 12th, 1998

Dear Chip:

The following is the specifications for applying fire retardant coating to the composite pipe and coupling furnished by Conley Corporation to Southwest Research Institute for testing.

**SAMPLE PREPARATION**  
prepared by Conley Corporation

**Pipe**

Flame Safe Chemical Corporation's Fire Poly FPCC was applied to test specimen in three coats at a final coverage rate of 350 square feet per gallon. Each coat was allowed to dry to the touch before application of the next. The final coat was allowed to dry. The amount of coating applied was determined by weight difference. The pipe was then cut in half.

**Coupling**

Flame Safe Chemical Corporation's Fire Poly FPCC was applied to test specimen in three coats at a final coverage rate of 350 square feet per gallon. Each coat was allowed to dry to the touch before application of the next. The final coat was allowed to dry. The amount of coating applied was determined by weight difference.

**Connection**

Two sections of pipe were connected by the coupling using Conley Corporation's standard adhesive. Flame Safe Chemical Corporation's Fire Poly FPCC binary coating (field kit) was prepared according to the manufacturer's specifications. A single coat of the Flame Safe binary coating was applied by brush at the rate of 200- 250 square feet per gallon extending a minimum of four (4) inches beyond each end of the coupling/pipe joint with beading allowed to occur at the raised edge of the coupling to the surface of the pipe. The amount of coating applied was determined by weight difference. The completed test specimen was allowed to dry to the touch before delivery to Southwest Research Institute, San Antonio, Texas for testing. .

'i\_uE\\-

Sincerely,

A handwritten signature in black ink, appearing to read "L.A. Jacobini".

L.A. Jacobini

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