

# Plastic Piping Information



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**Project Manager, Central Region**  
**PHMSA Office of Pipeline Safety**

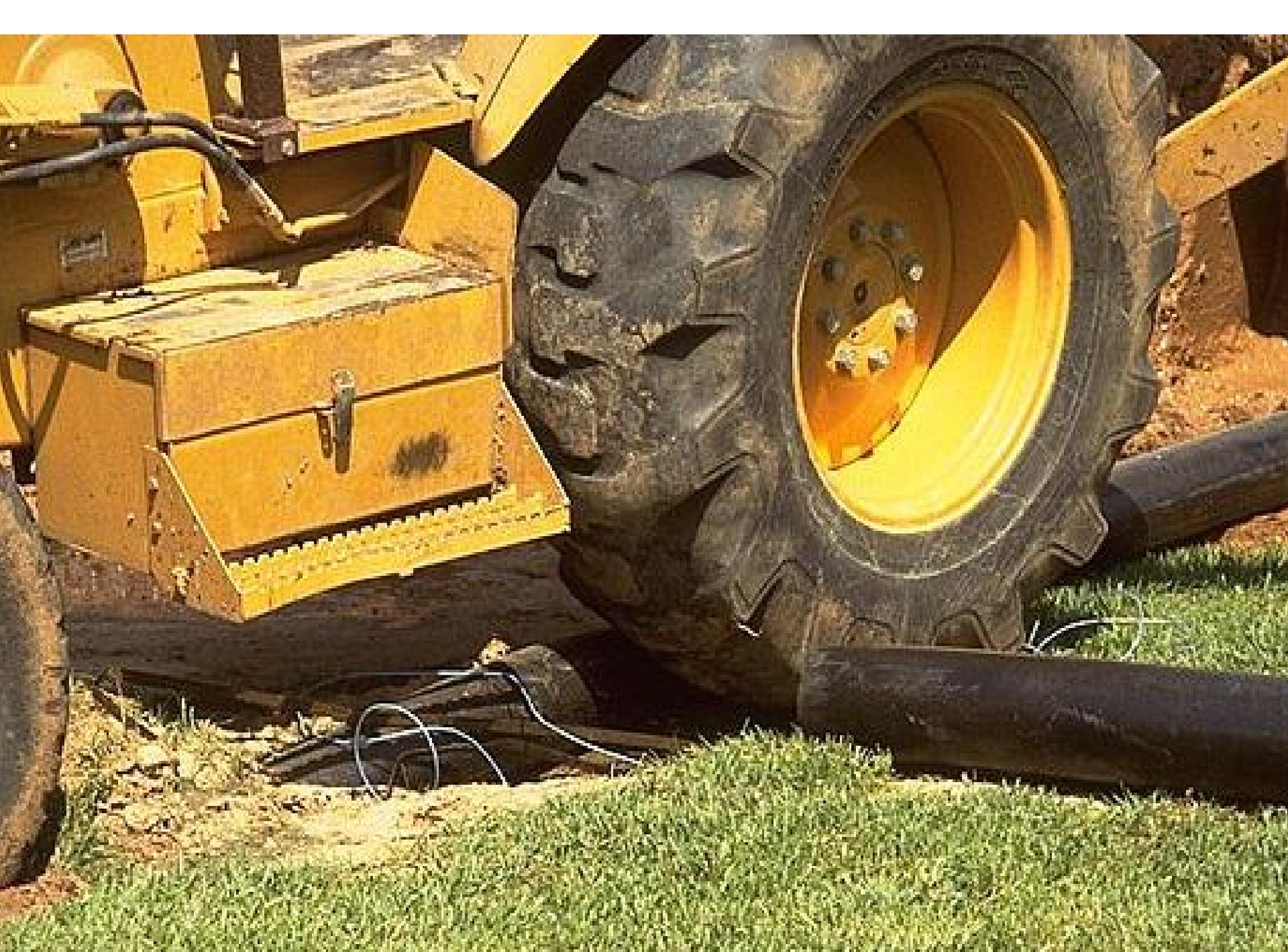


# Plastic Pipe Construction Issues



# Installation – Handling Issues









OCT 8 2002



OCT 8 2002

8" — .500

2

3



W.R. THORPE CO

USEFUL FORMULAS

$AREA = 0.7854 \times D^2$   
 $CIRCUM = 3.1416 \times D$   
 $SURFACE = 3.1416 \times D \times L$   
 $PRESSURE = \frac{2.5 T}{D}$   
 S = FIBER STRESS  
 T = WALL THICKNESS  
 D = PIPE DIAMETER  
 P = PRESSURE  
 L = LENGTH

7.48 U.S. GAL. = 1 CUBIC FOOT

42 U.S. GAL. = 1 BARREL

1 CU. FT AIR = 0.0809 LBS

EXTRA HEAVY

2"	.218
3"	.300
4"	.337
6"	.432
8"	.500

STANDARD

2"	.154
3"	.218
4"	.237
6"	.280
8"	.322
10"	.365
12"	.375



W. R. THORPE

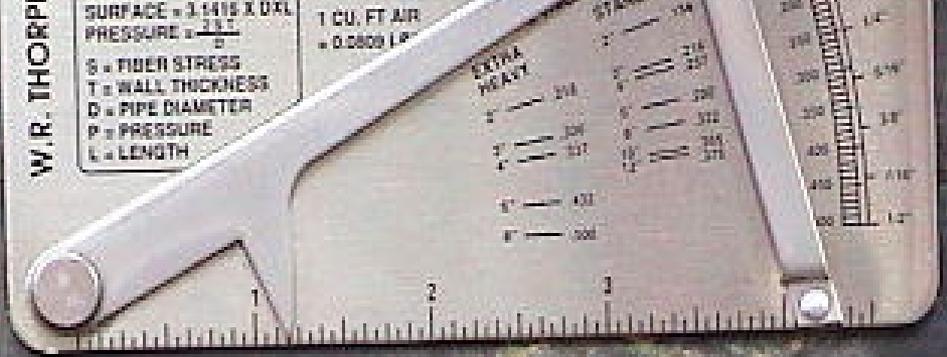
SURFACE = 3.1416 x D x L  
PRESSURE =  $\frac{2.31 T}{D}$   
S = FIBER STRESS  
T = WALL THICKNESS  
D = PIPE DIAMETER  
P = PRESSURE  
L = LENGTH

1 CU. FT AIR  
= 0.0809 LB

EXTRA  
HEAVY

- 1" - 214
- 2" - 204
- 3" - 217
- 4" - 431
- 6" - 646

- STAINLESS
- 304
- 316
- 321
- 307
- 310
- 312
- 315
- 317









U.S. Department of Transportation  
Pipeline and Hazardous Materials  
Safety Administration

To Protect People and the Environment From the Risks of  
Hazardous Materials Transportation











U.S. Department of  
Transportation  
Pipeline Safety





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# Recent Fusion Issues

**Proposed Third Person  
Inspection Rule  
has been Temporarily Suspended**





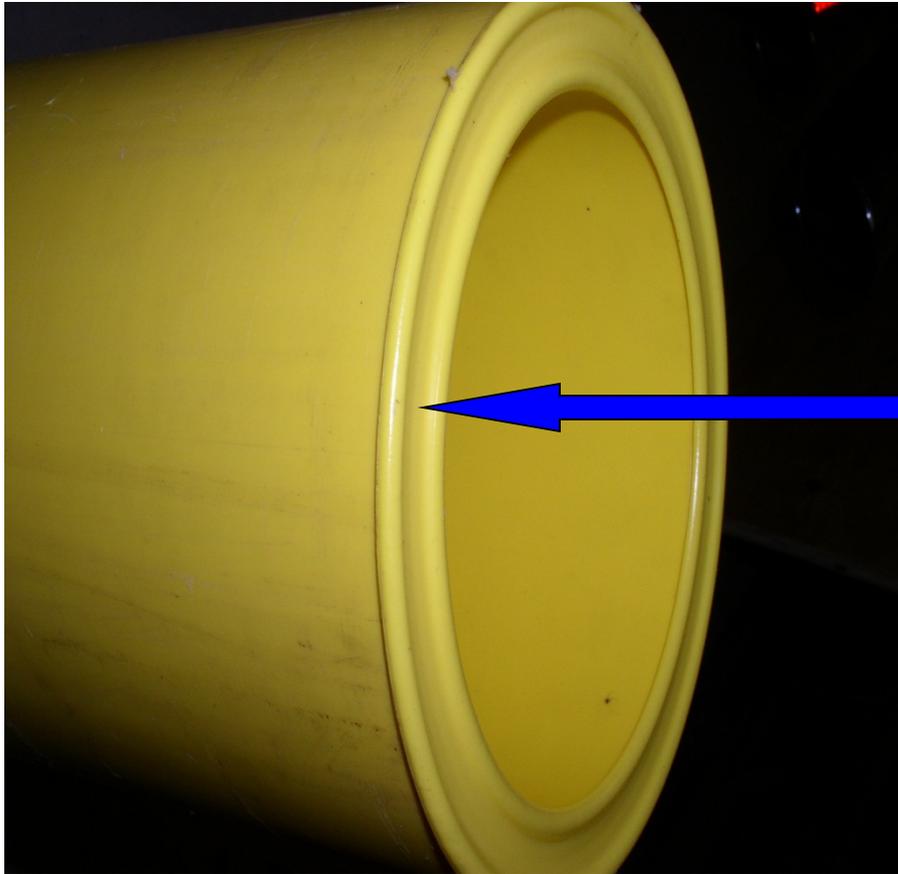
GDY20 GAS - - -



# Butt Fusion Procedures

## “COLD FUSION”

**Note the concave effect in the wall of the pipe. The melt has been pushed out of the fusion area. This will produce a bad joint.**



**UNACCEPTABLE**



# Current Investigation

- **Installed 1500 feet of 4 inch plastic pipe in 1980 – 40 foot lengths = 38 joints**
- **Recent Failure Caused Explosion and 3 injuries**
- **8 Previous Leaks from 1983 to 2012**
- **Failed to investigate cause of the leak failures**
- **Never integrated previous failures investigations. (Root Cause Analysis?)**
- **In 1980's what was there fusion procedures?**





A

B

DO NOT USE  
A V E

PerformancePipe.com



**PERFORMANCE PIPE**  
Performance Pipe Company, LP

114 IPS RTB STT 80 PS2-12  
12 06 0783 W

D-2513 / D-2683 CEE PE3408/4710 PE100

MADE IN USA

280/0/140

03/08/2013

Performance  
**PERFORMANCE PIPE**  
A Division of GEORGE FILLARD CHEMICAL COMPANY LP  
8" M 2X3/4 IPS RTB STT 80 PS2-12  
1104123 12 06 0783 JW  
ASTM D-2513 / D-2683 CEE PE3400  
280101140  
MADE IN USA

03/08/2013



03/08/2013



03/18/2013



03/08/2013









# Rapid Crack Propagation Failure



# Rapid Crack Propagation Failure



# Arrest of Rapid Crack Propagation



Crack arrest in ERGO pipe



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# ADB-07-01 (02)

**Adding:**

- **Delrin insert tap tees**
- **Plexco service tee Celcon (polyacetal) caps.**



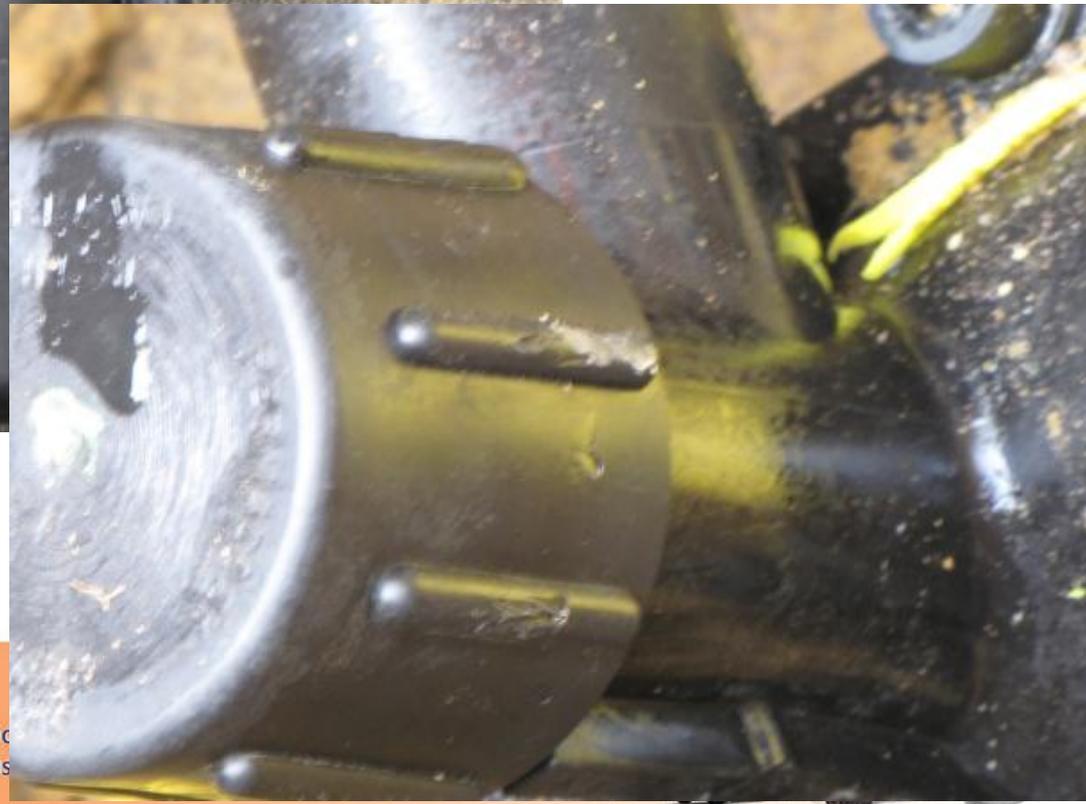


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ansportation









# Polyamides



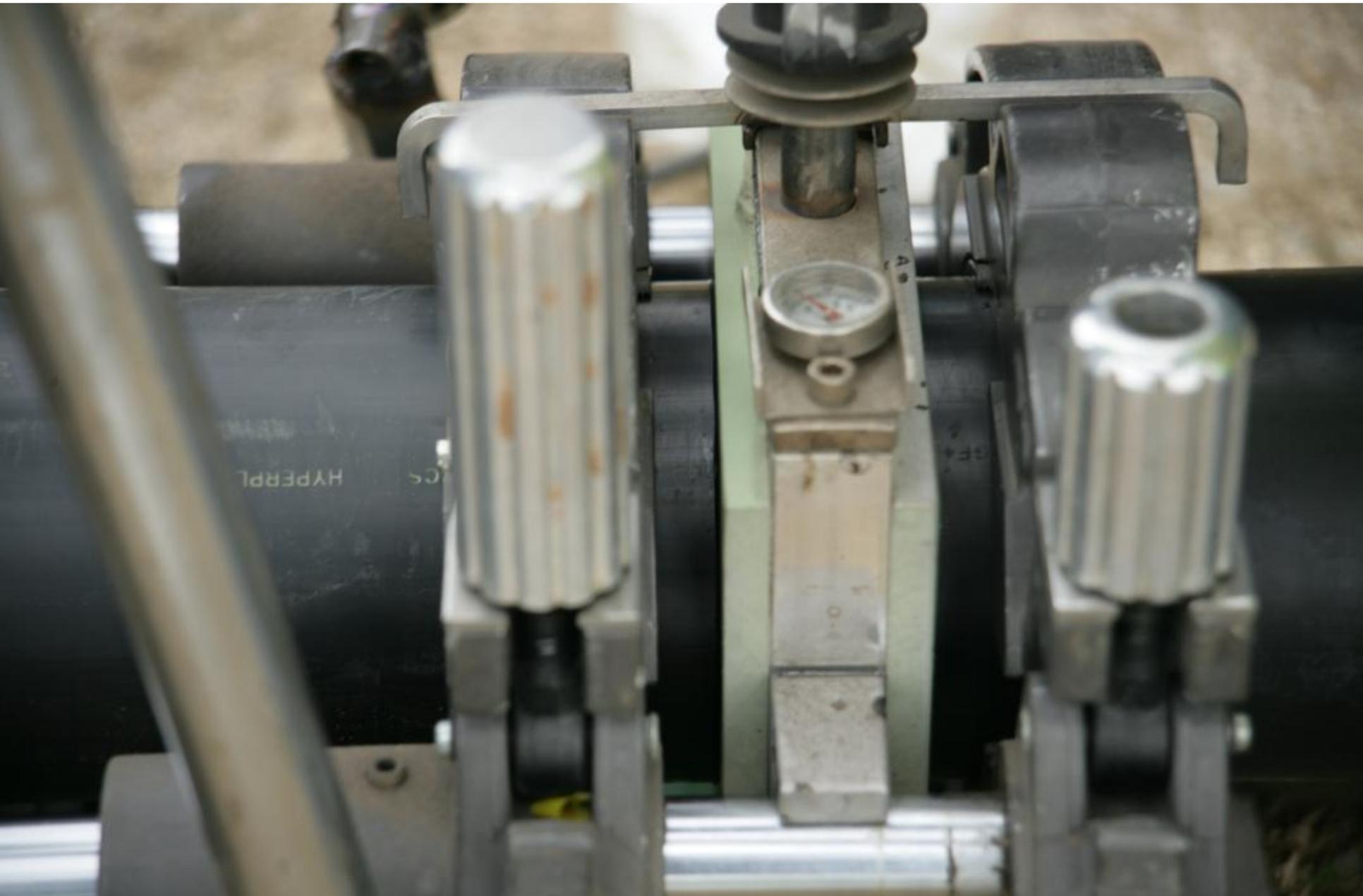




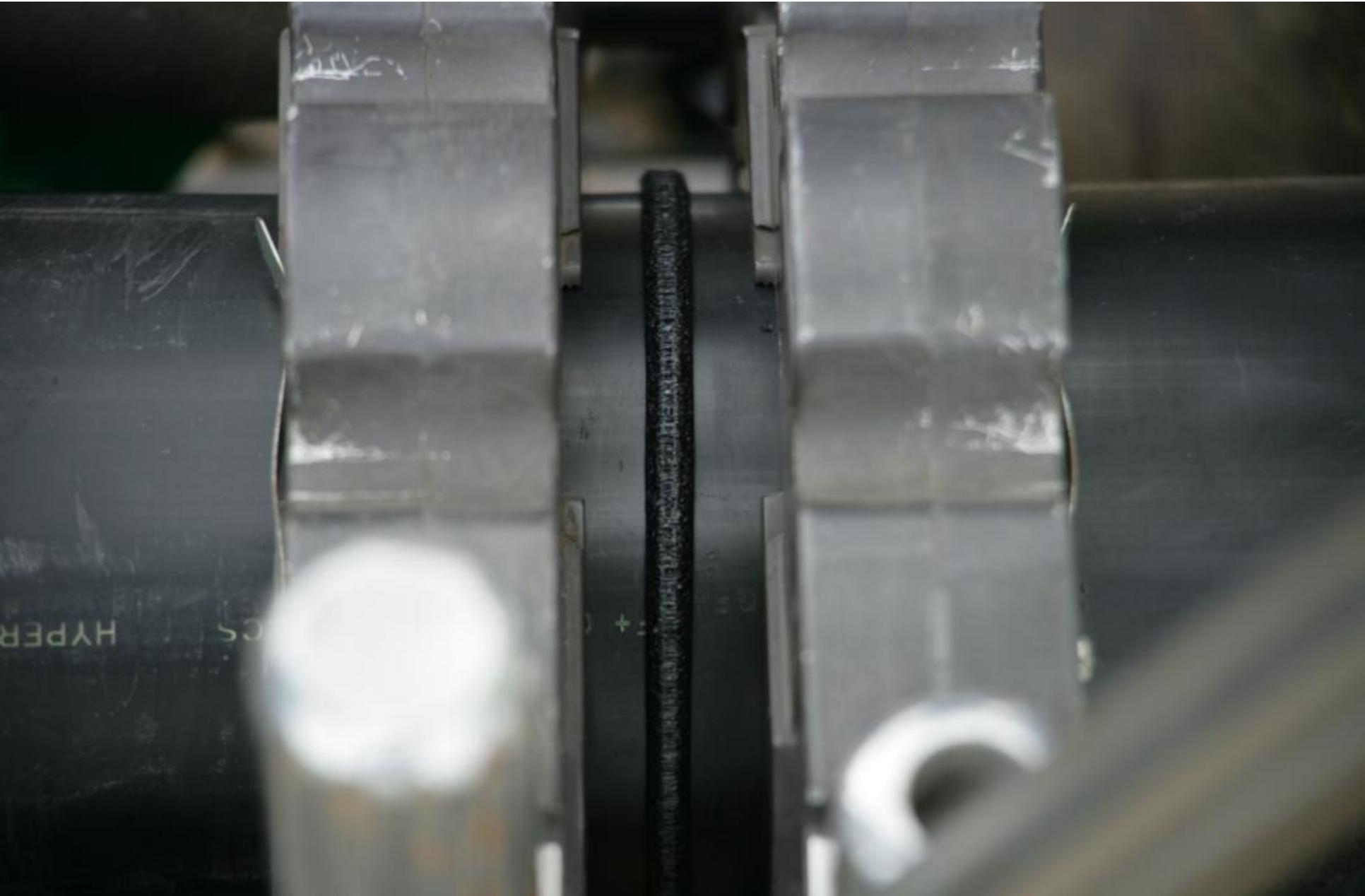






















































# Other Issues







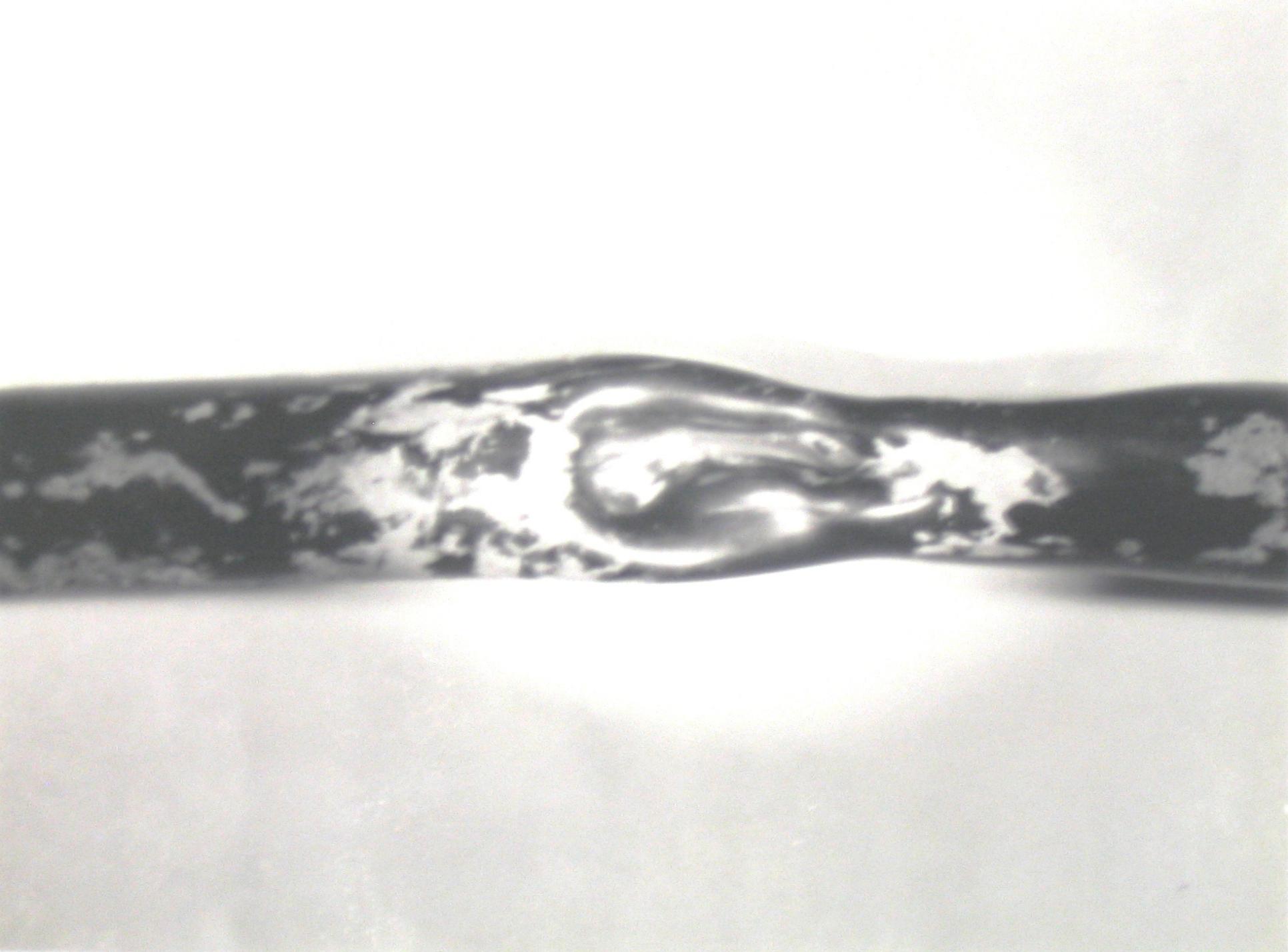


07/11/2011

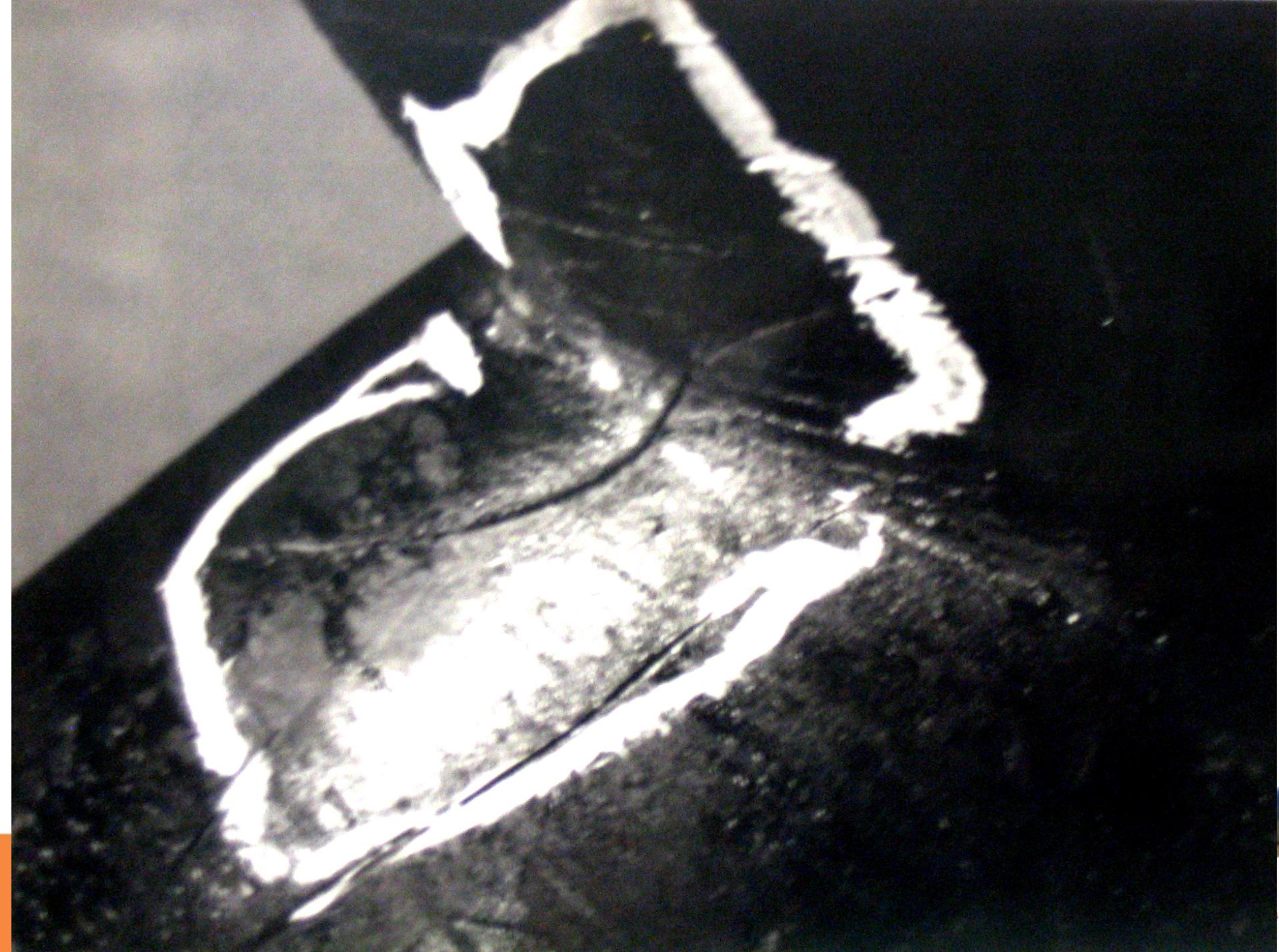






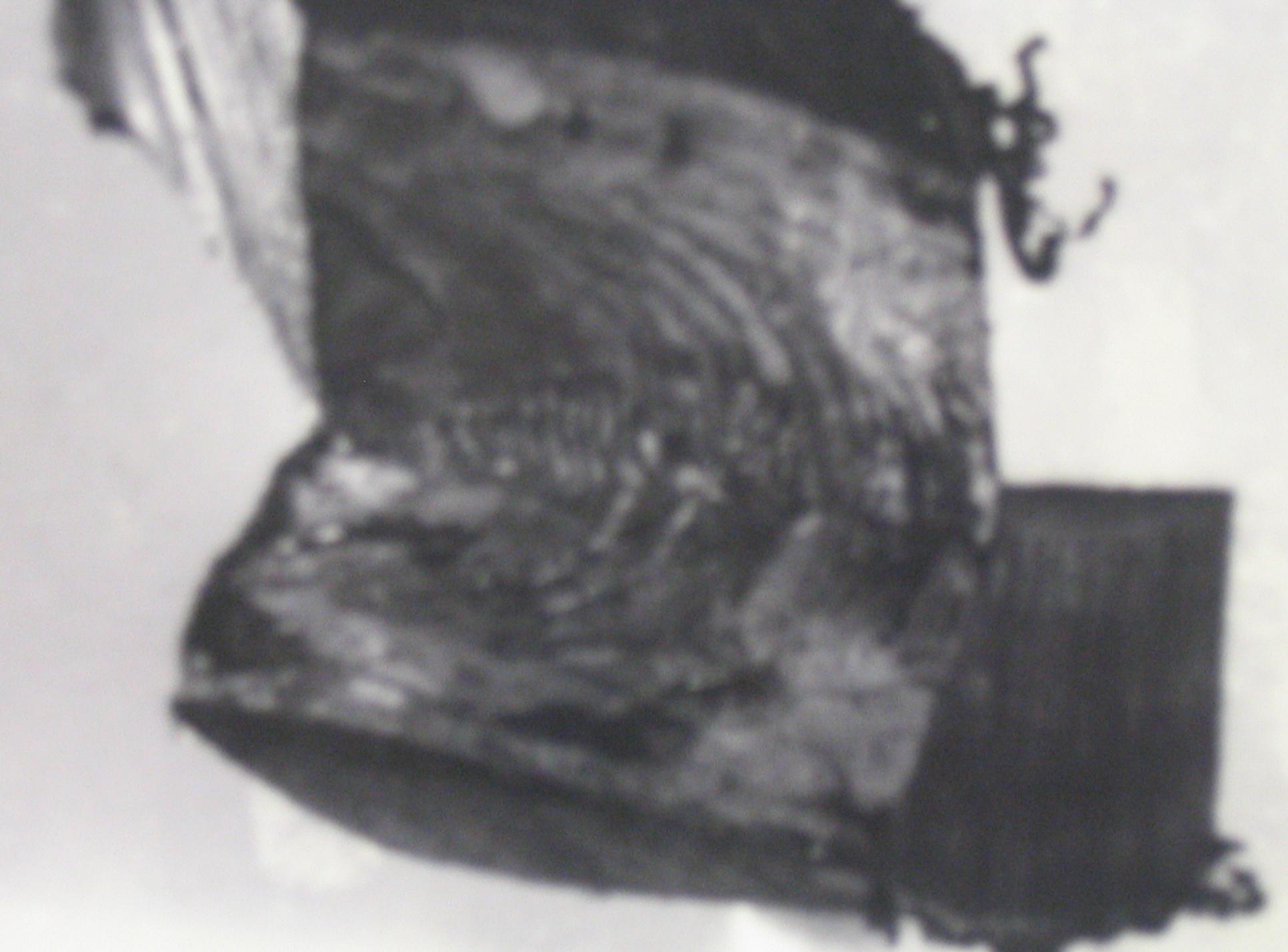


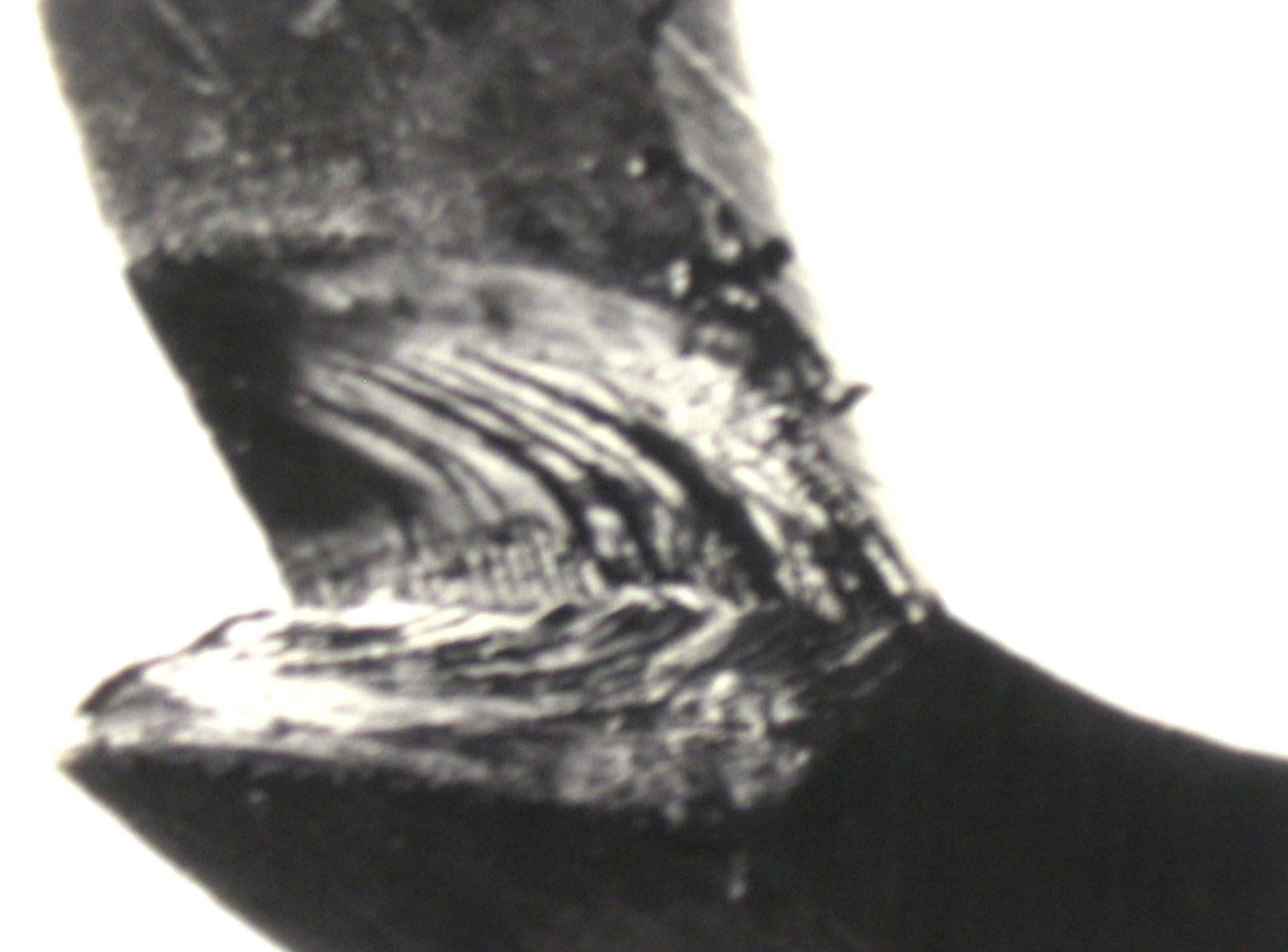












# Ultra Violet Issues



# Outdoor Storage/UV Exposure

- ASTM D2513-99 Outdoor Storage Stability
  - stored outdoors unprotected – 2 yrs. date of manufacture.
  - Over 2 yrs. must meet the requirements of this part
- Changed as of March 6, 2015



# ASTM D2513-09a

- March 6,2015 - No Rework - Section 4.2 Excepted
- 4.10 *Outdoor Storage Stability*—PE materials shall be Code C or E as defined in Specification D3350.
- Code C material
  - contain 2 to 3 percent well dispersed carbon black, and due to the absorptive properties of the carbon black,
  - considered to be stabilized against deterioration from unprotected exposure to UV for not less than **10 years**.
- Code E material
  - shall be stabilized and protected against deterioration from unprotected UV exposure for not less than **3 years**.



# §192.321 Installation of plastic pipe.

- (g) Uncased Plastic pipe may be temporarily installed above ground level under the following conditions:
- (1) The operator [a person who engages in the transportation of gas] must be able to demonstrate that the cumulative aboveground exposure of the pipe does not exceed the manufacturer's recommended maximum period of exposure or 2 years, whichever is less.
- (2) The pipe either is located where damage by external forces is unlikely or is otherwise protected against such damage.
- (3) The pipe adequately resists exposure to ultraviolet light and high and low temperatures.



# Federal Code

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# PE only

- *ASTM D2513-09a*— PHMSA will incorporate ASTM D2513-09a, “Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings,” except section 4.2, “Rework Material.”



# The revisions are summarized below:

- ○ In § 192.7, PHMSA is adding ASTM D2513-09a to the listing of documents incorporated by reference.
- ○ In § 192.59, PHMSA is adding a new paragraph (d) to specify that PHMSA will prohibit rework for all plastic pipe manufactured after the effective date of this final rule and used in pipeline systems subject to Part 192.
- ○ In § 192.63(a)(1), PHMSA is clarifying that ASTM D2513-87 applies to plastic pipe and fittings made of materials other than polyethylene.
- ○ In § 192.123(e)(2), PHMSA is including verbiage to indicate that ASTM D2513-09a pertains to PE pipe only.
- ○ In § 192.191, PHMSA is clarifying that ASTM D2513-99 is applicable to plastic materials other than polyethylene and is adding a reference to ASTM D2513-09a applicable to PE materials only.
- ○ In § 192.283(a)(1)(i), PHMSA is clarifying that ASTM D2513-99 is applicable to plastic materials other than polyethylene and is adding a reference to ASTM D2513-09a applicable to polyethylene plastic (PE) materials only.
- ○ In Part 192, Appendix B, Section 1, PHMSA is adding ASTM D2513-09a to the list of pipe specifications.



# What Does that Mean?

- PE Pipe exposed to UV
  - Storage Code E – 3 years
  - Storage Code C – 10 years
  - Temporary Above Ground Code E or C – 2 years max exposure –date of manufacture
- Other Pipe exposed to UV
  - Storage and temporary above ground -2 years
- What about Yellow Stripe and 8100 Yellow coated?



# Hydro Carbon Permeation Issues



# Appendix X1.7.2.2

- During the heat fusion joining of PE piping that has been in service
  - conveying fuel gases that consist of, or
  - that include heavier hydrocarbons, the
- PE surfaces being heated in preparation for fusion sometimes exhibit a *bubbly* appearance.
  - This bubbling is the result of the rapid expansion (by heat)
  - Causing passage of absorbed heavier hydrocarbon gases through the molten material.
- Heat fusion (butt, socket, saddle, or electrofusion)
  - Joint strength may be reduced by the presence of the heavier hydrocarbons.



# When is it a concern?

- Pimputkar et al **(8)** conclude that for a system
  - operating at 50psi and
  - conveying a mixture of as high as 16 volume percent in methane
- the propane concentration in PE will be under 0.2 percent,
  - sufficient to sometimes show some bubbling, but
  - not high enough to effect any significant degradation in fusion strength.
- However, if the concentration of propane in PE exceeds 0.2 percent,
  - risk of a rapid and large drop in fusion strength.
- Field tests to verify the level of contamination and subsequent degradation of joint strength are not currently available.
- Therefore, in the case of PE pipe that has previously been installed in these types of services, one should use mechanical fittings to join or repair the pipe.





# NFPA 58 Restrictions

- Piping for vapor LP-Gas distribution.
- NFPA limits the size of PE piping to 2”
- NPS piping with a nominal OD of 2.375”.
- Maximum operating pressure of PE vapor LP-Gas piping systems to 30 psig.
- Refer to NFPA 58 for the details of these and other installation



# USE RECOMMENDATIONS

- Plastic material to qualify for use as a vapor LP-Gas piping system
  - Recommended by the manufacturer for such use,
  - Qualified using vapor LP-Gas as the medium,
  - Hydrostatic design basis (HDB) category of at least 1250 psi (8.6 MPa) at 73°F (23°C)
  - Design factor of 0.25 is recommended (see also PPI TR-9 on recommended design factors)
- NFPA maximum recommended operating pressure of 30 psig for LPG systems (see X1.3.4)
  - Minimizes the possible occurrence of condensates
  - Adequate consideration of the effect of LPG fuels on the long-term strength of PE piping.”
- Studies that propane, propylene and butane, when in the liquid phase, can cause a greater reduction in long-term strength, up to 40 %.



# Effects of Hydrocarbon Permeation on Plastic Pipe Strength and Fusion Performance

- PHMSA R&D - objective of this project is to develop a validated method to be used by any plastic testing laboratory to quantify the effects of hydrocarbon permeation on:
  - 1) the fusibility of plastic pipe,
  - 2) the life expectancy of existing fused joints that have been subjected to hydrocarbon permeation,
  - 3) the Hydrostatic Design Basis (strength) of plastic pipe, and
  - 4) the impact on slow crack growth
- <https://primis.phmsa.dot.gov/matrix/FilGet.rdm?fil=10327&c=1&s=31CB4A4F663746DD90401E9ABF4314FC>



# GTI Report 12-31-2015

- True stress strain curves at all temperatures clearly show the softening effect of the hydrocarbon permeation at low strains.
- Permeated materials are up to 55% weaker at low strains relative to non-permeated material.
- Strains below 30% the softening effect of the HHC permeation is equivalent to an approximately 20°C (36°F) temperature increase in non-saturated material i.e. at 73°F the saturated material behaves like non-saturated material at 109°F.
- True stress and true strain at break are fairly constant for each material group with up to 20% reduction in strength at break.
- The implications of these two findings are as follows:
  - i. Caution should be exercised in applications where the creep resistance of the polyethylene material is essential to the operation of the system.
  - ii. The long term hydrostatic strength of the pipes may need to be reduced by 20% to account for the break strength reduction.



# Concern

- An example of an application where care should be exercised is mechanical fittings where the resistance to mechanical pullout could be impaired due to the softer material. This may warrant further investigation given that some utilities specifically use mechanical fittings where hydrocarbon permeation is detected.
- NFPA 58 Guidelines?



**How does the gas distribution industry use the information in this GTI Report that was funded by PHMSA and is currently on the PHMSA website?**



# Need Testing?

- For additional information on how **GTI** can test your pipeline to **determine the chemical design factor in the presence of liquid hydrocarbons** (from inside or outside the pipe) contact:

Dr. Gene Palermo  
[gpalermo@plasticpipe.com](mailto:gpalermo@plasticpipe.com)  
(865) 995-1156

Dennis Jarnecke- GTI  
[Dennis.Jarnecke@gastechnology.org](mailto:Dennis.Jarnecke@gastechnology.org)  
(847) 544-3415



# Be Careful and Be Safe

If it doesn't  
look right –  
It probably  
isn't....

