NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

February 25, 2021

MATERIALS LABORATORY FACTUAL REPORT Report No. 21-005

A. ACCIDENT INFORMATION

Place	:	Danville, Kentucky
Date	:	August 1, 2019
Vehicle	:	30-inch natural gas transmission pipe operated by Enbridge
NTSB No.	:	PLD19FR002
Investigator	:	Alexandria Colletti (RPH)

B. COMPONENTS EXAMINED

A 4-foot-long ring piece that was cut from the 30-inch natural gas transmission pipe for chemical analysis and tensile testing (referred in Materials Laboratory Factual Report 19-064 as the north ring piece).

C. DETAILS OF THE EXAMINATION

Pipeline Specification

Purchase records provided by Enbridge indicated that the pipe was manufactured to American Petroleum Institute (API) Specification for High-Test Line Pipe, Standard 5LX, 6th edition, dated February 1956, as Grade X52, 30-inch nominal outside diameter (OD), 0.375-inch nominal wall thickness, electric flash weld (EFW) longitudinal seam, ordered as cold-expanded welded steel plain end line pipe, and manufactured by A.O. Smith. The OD surface was coated with coal-tar enamel.

Chemical Composition of the Pipe

The 1956 edition of API Standard 5LX was consulted because it was the edition that was specified for the construction of the steel pipe. Chemical analysis of the wall portion of the pipe was performed by Engineering Services, Incorporated (ESI), Norcross, Georgia. The result of the chemical analysis was reported for elemental content that was greater than 0.01% by weight. Table 1 shows the carbon, manganese, phosphorus, and sulfur content, by weight percent, specified for welded cold-expanded pipe. The result of the chemical analysis indicates that the chemical composition of the pipe was consistent with those specified for API 5LX, Grade X52.

Tensile Test

A total of three transverse tensile specimens were machined from the pipe segment and tested by ESI. Table 2 shows the specified tensile values for welded cold-expanded pipe and the results of the measured tensile values. The yield strength and ultimate tensile strength values were within specified range, and elongation values were greater than the minimum specified values for API 5LX pipe grade X52 material.

The ESI certified test report for the chemical composition and tensile testing is shown in Appendix A.

Prepared by:

Frank Zakar
Senior Metallurgist

Table 1. Chemical Composition for API 5LX Pipe, Grade X52, Welded and Cold Expanded (Weight %)			
Element	Specified Maximum Limits		Measured
	Electric-furnace, open hearth, or killed, deoxidized, basic bessemer	Killed, deoxidized, acid-bessemer, or killed, deoxidized, basic-bessemer	
Carbon	0.28	0.24	0.22
Manganese	1.25	1.25	1.18
Phosphorus	0.04	0.10	0.019
Sulfur	0.05	0.05	0.026
Chromium	Not specified	Not specified	0.02
Molybdenum	Not specified	Not specified	0.02
Nickel	Not specified	Not specified	0.03
Silicon	Not specified	Not specified	0.08
Vanadium	Not specified	Not specified	<0.01
Niobium[1]	Not specified	Not specified	<0.01
Aluminum	Not specified	Not specified	<0.01
Titanium	Not specified	Not specified	<0.01
Iron	Remainder	Remainder	Remainder

[1] Formerly known as the element columbium.

Table 2. Tensile Properties for API 5LX Pipe, Grade X52				
Parameter	Specified, Minimum	Spec #1	Spec #2	Spec #3
		Measured	Measured	Measured
Yield Strength, 0.5% EUL, (psi)[2]	52,000	62,500	59,000	59,500
Ultimate Tensile Strength (psi)	66,000	87,500	83,500	83,500
Elongation (% in 2 inches)	22	30	32	32

[2] Extension under load (EUL) method - stress required to produce a total elongation of 0.5% of the gage length.

APPENDIX A
ESI TESTING RESULTS

Certified Test Report

CLIENT:	Engineering Systems Inc.	**CLIENT #:**	1140
ADDRESS:	2355 Polaris Ln N, Suite 120	**PROJECT #:**	12190 – R1
CITY, STATE	Plymouth, MN 55447	**PURCHASE ORDER #:**	79363H
REPORT DATE:	February 16, 2021	**CONTACT:**	Ron Parrington

Material Description: Customer Supplied 4ft Section of 30" x 0.375" Wall Pipe
Specification: Not Provided

TENSILE TEST – ASTM A370

Specimen ID	Dimensions (inches)	Area ($in.^2$)	Yield Load (lbf) 0.2% Offset	Yield Strength (psi) 0.2% Offset	Yield Load, 0.5% EUL	Yield Strength, 0.5% EUL	Ultimate Tensile Load (lbf)	Ultimate Tensile Strength (psi)	Elongation after Fracture, % (2 in. Gage)
1	1.500 x 0.378	0.5670	34,393	60,500	35,416	62,500	49,554	87,500	30
2	1.500 x 0.378	0.5670	32,592	57,500	33,324	59,000	47,361	83,500	32
3	1.500 x 0.378	0.5670	32,988	58,000	33,811	59,500	47,216	83,500	32

CHEMICAL ANALYSIS (%), ASTM E415

	C	Mn	S	P	Si	Cr	Mo	V	Ni	Nb	Al	Ti
MAX	-	-	-	-	-	-	-	-	-	-	-	-
MIN	-	-	-	-	-	-	-	-	-	-	-	-
1	0.22	1.18	0.026	0.019	0.08	0.02	0.02	< 0.01	0.03	< 0.01	< 0.01	< 0.01

Summary of Testing: Reported results pertain only to samples submitted for testing.

Reviewed By: Reed Pruitt, CWI
ESI, Laboratory and Industrial Services