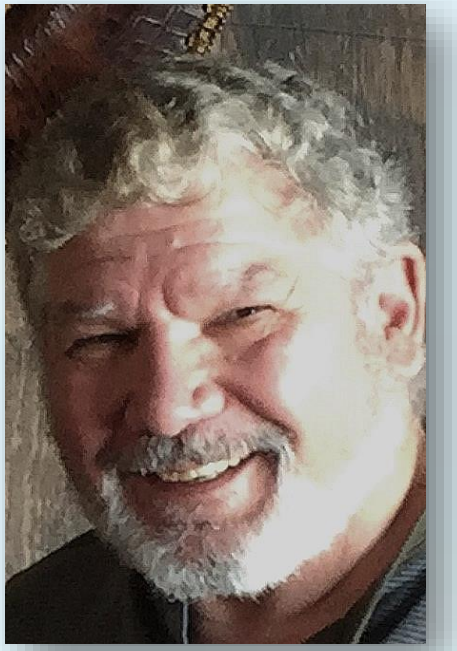
Material Verification

192.607

Montgomery, Alabama

Introductions



Wayne St. Germain
PHMSA Training & Qualifications

405-823-4268

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Agenda

- **Overview of regulatory requirements (§ 192.607):**
  - **Applicability of the Rule,**
  - **Traceable, Verifiable, and Complete records,**
  - **Opportunistic Dig Definition,**
  - **Methods for Determining Material Properties,**
  - **Pipeline Populations and Sampling**

  - **This presentation will not include**
    - **Pipeline components**
    - **Compliance considerations derived from FAQs**
    - **Possible inspection questions**
    - **Examples of lessons learned found during pilots**

Applicability (July 1, 2020 Revision)

- **§ 192.607 - Verification of Pipeline Material Properties and Attributes: Onshore steel transmission pipelines.**

  (a) Wherever required by *this part*, operators of onshore steel transmission pipelines must document and verify material properties and attributes in accordance with this section.

Applies to both line pipe and certain components.

Compliance Dates

- **By July 1, 2020:**
  - **Operators must prepare and follow procedures (per §§ 192.13(c) and 192.605) addressing applicable regulations without timeframes explicitly defined in the Final Rule ---192.607 (if material verification is being used per § 192.712).**
- **By July 1, 2021:**
  - **Operators must develop and document processes for performing a spike test or material verification per §§ 192.506 and 192.607, if applicable.**

See FAQ-1.

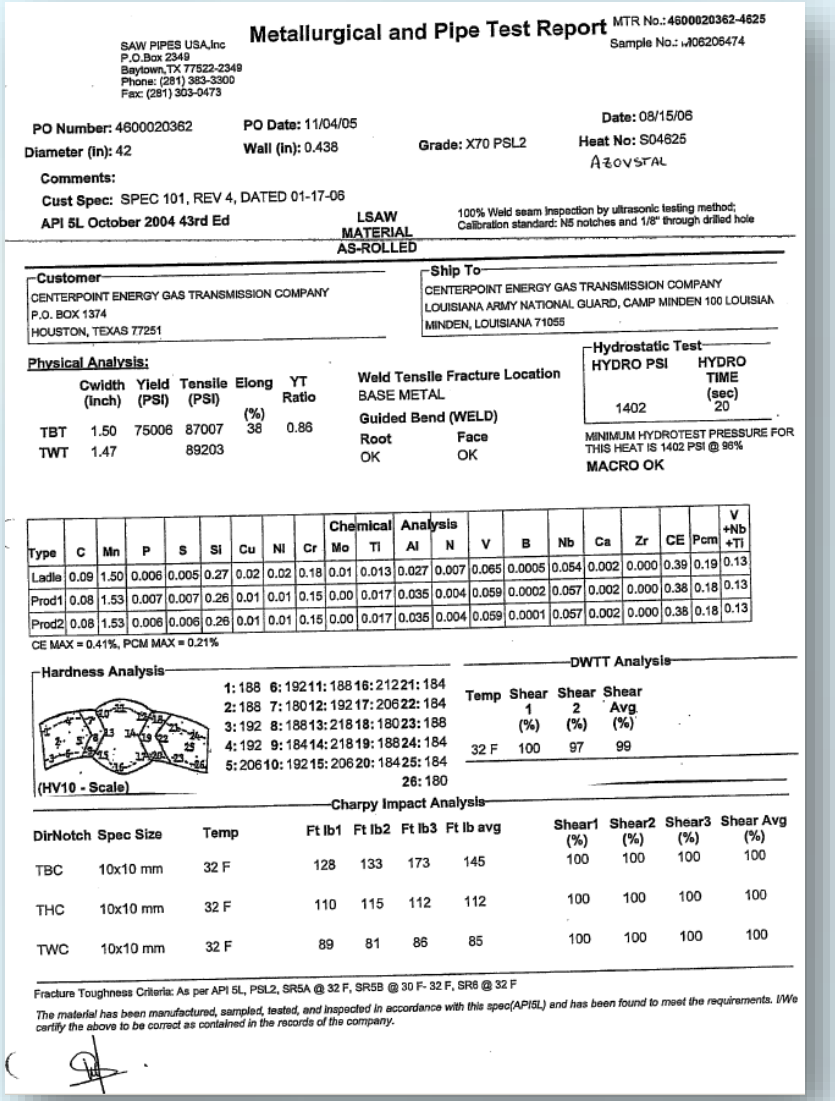
Pipeline Attributes - § 192.607(b)

- **Operators must capture the following physical pipeline characteristics and attributes:**
  - **diameter,**
  - **wall thickness,**
  - **seam type, and**
  - **grade (e.g., yield strength, ultimate tensile strength, or pressure rating for valves and flanges…).**

These must be maintained for <u>the life of the pipeline</u> and be *traceable, verifiable, and complete*.

Pipeline Attributes - § 192.607(b)

- **Charpy v-notch toughness values**
  - **Needed for ECA or fracture mechanics requirements of § 192.712.**
  - **Must be maintained for <u>the life of the pipeline</u>.**



SAW PIPES USA,Inc
P.O.Box 2349
Baytown,TX 77522-2349
Phone: (281) 383-3300
Fax: (281) 303-0473

Metallurgical and Pipe Test Report MTR No.: 4600020362-4625
Sample No.: W06206474

PO Number: 4600020362 PO Date: 11/04/05 Date: 08/15/06
Diameter (in): 42 Wall (in): 0.438 Grade: X70 PSL2 Heat No: S04625
Azovstal
Comments:
Cust Spec: SPEC 101, REV 4, DATED 01-17-06
API 5L October 2004 43rd Ed LSAW
MATERIAL
AS-ROLLED
100% Weld seam inspection by ultrasonic testing method; Calibration standard: N5 notches and 1/8" through drilled hole

Customer
CENTERPOINT ENERGY GAS TRANSMISSION COMPANY
P.O. BOX 1374
HOUSTON, TEXAS 77251

Ship To
CENTERPOINT ENERGY GAS TRANSMISSION COMPANY
LOUISIANA ARMY NATIONAL GUARD, CAMP MINDEN 100 LOUISIAN
MINDEN, LOUISIANA 71055

Physical Analysis:

	Cwidth (inch)	Yield (PSI)	Tensile (PSI)	Elong (%)	YT Ratio
TBT	1.50	75006	87007	38	0.86
TWT	1.47		89203		

Weld Tensile Fracture Location
BASE METAL
Guided Bend (WELD)
Root: OK Face: OK

Hydrostatic Test
HYDRO PSI: 1402 HYDRO TIME (sec): 20
MINIMUM HYDROTEST PRESSURE FOR THIS HEAT IS 1402 PSI @ 96%
MACRO OK

Chemical Analysis

Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Ti	Al	N	V	B	Nb	Ca	Zr	CE	Pcm	V +Nb +Ti
Ladle	0.09	1.50	0.006	0.005	0.27	0.02	0.02	0.18	0.01	0.013	0.027	0.007	0.065	0.0005	0.054	0.002	0.000	0.39	0.19	0.13
Prod1	0.08	1.53	0.007	0.007	0.26	0.01	0.01	0.15	0.00	0.017	0.035	0.004	0.059	0.0002	0.057	0.002	0.000	0.38	0.18	0.13
Prod2	0.08	1.53	0.006	0.006	0.26	0.01	0.01	0.15	0.00	0.017	0.035	0.004	0.059	0.0001	0.057	0.002	0.000	0.38	0.18	0.13

CE MAX = 0.41%, PCM MAX = 0.21%

Hardness Analysis
(HV10 - Scale)

1: 188	6: 192	11: 188	16: 212	21: 184
2: 188	7: 180	12: 192	17: 206	22: 184
3: 192	8: 188	13: 218	18: 180	23: 188
4: 192	9: 184	14: 218	19: 188	24: 184
5: 206	10: 192	15: 206	20: 184	25: 184
				26: 180

DWTT Analysis

Temp	Shear 1 (%)	Shear 2 (%)	Shear Avg (%)
32 F	100	97	99

Charpy Impact Analysis

DirNotch	Spec Size	Temp	Ft lb1	Ft lb2	Ft lb3	Ft lb avg	Shear1 (%)	Shear2 (%)	Shear3 (%)	Shear Avg (%)
TBC	10x10 mm	32 F	128	133	173	145	100	100	100	100
THC	10x10 mm	32 F	110	115	112	112	100	100	100	100
TWC	10x10 mm	32 F	89	81	86	85	100	100	100	100

Fracture Toughness Criteria: As per API 5L, PSL2, SR5A @ 32 F, SR5B @ 30 F- 32 F, SR6 @ 32 F

The material has been manufactured, sampled, tested, and inspected in accordance with this spec(API5L) and has been found to meet the requirements. I/We certify the above to be correct as contained in the records of the company.

Material Verification: TVC Records

- **If an Operator determines they do not have TVC records, they must implement procedures for gathering these material properties [§ 192.607(b)].**

- **This is nothing new for operators – See *Pipeline Safety: Verification of Records* (77 FR 26822).**

  - **Advisory Bulletin issued by PHMSA in 2012**

https://www.federalregister.gov/documents/2012/05/07/2012-10866/pipeline-safety-verification-of-records

TVC Records: Review

Traceable, Verifiable, & Complete (TVC) Records

- **Traceable: Records that can be clearly linked to original information about pipeline segment or facility.**
  - **Examples: pipe mill records, which include mechanical and chemical properties; purchase requisition; as-built documents indicating minimum pipe yield strength, seam type, wall thickness, and diameter.**

TVC Records: Review

Traceable, Verifiable, & Complete (TVC) Records

- **Verifiable: Records are those in which information is confirmed by other complementary, but separate documentation.**
  - **Examples: pressure test of a segment complemented by pressure charts or field logs; purchase order to a pipe mill with pipe specifications verified by a metallurgical test of a coupon pulled from the same pipeline segment.**

TVC Records: Review

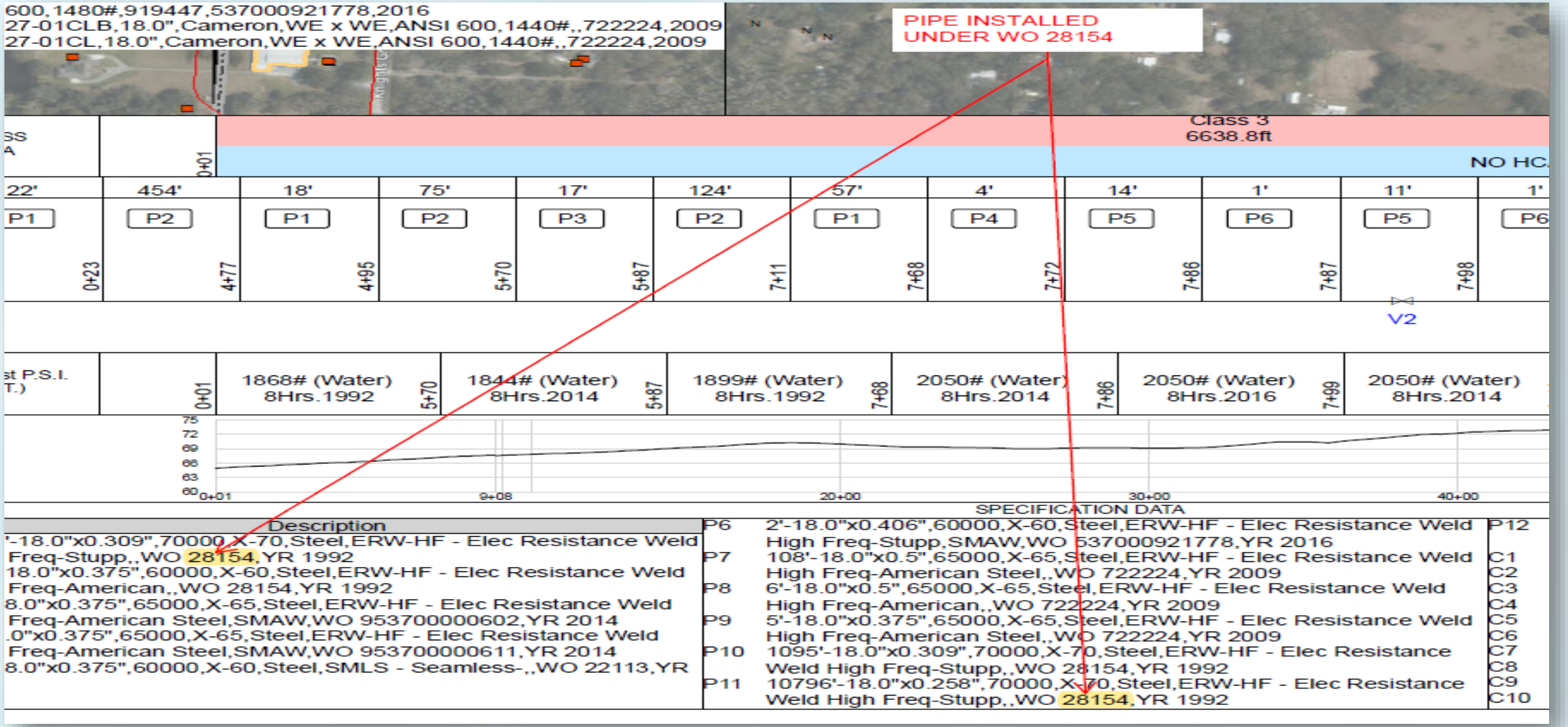
Traceable, Verifiable, & Complete (TVC) Records

- **Complete: Records finalized as evidenced by a signature, date, or other appropriate marking such as a corporate stamp or seal.**
  - **Example: Complete pressure testing record that identifies a specific segment of pipe, who conducted test, duration, medium, temperatures, accurate pressure readings, and elevation information, as applicable.**

TVC Records: An Example

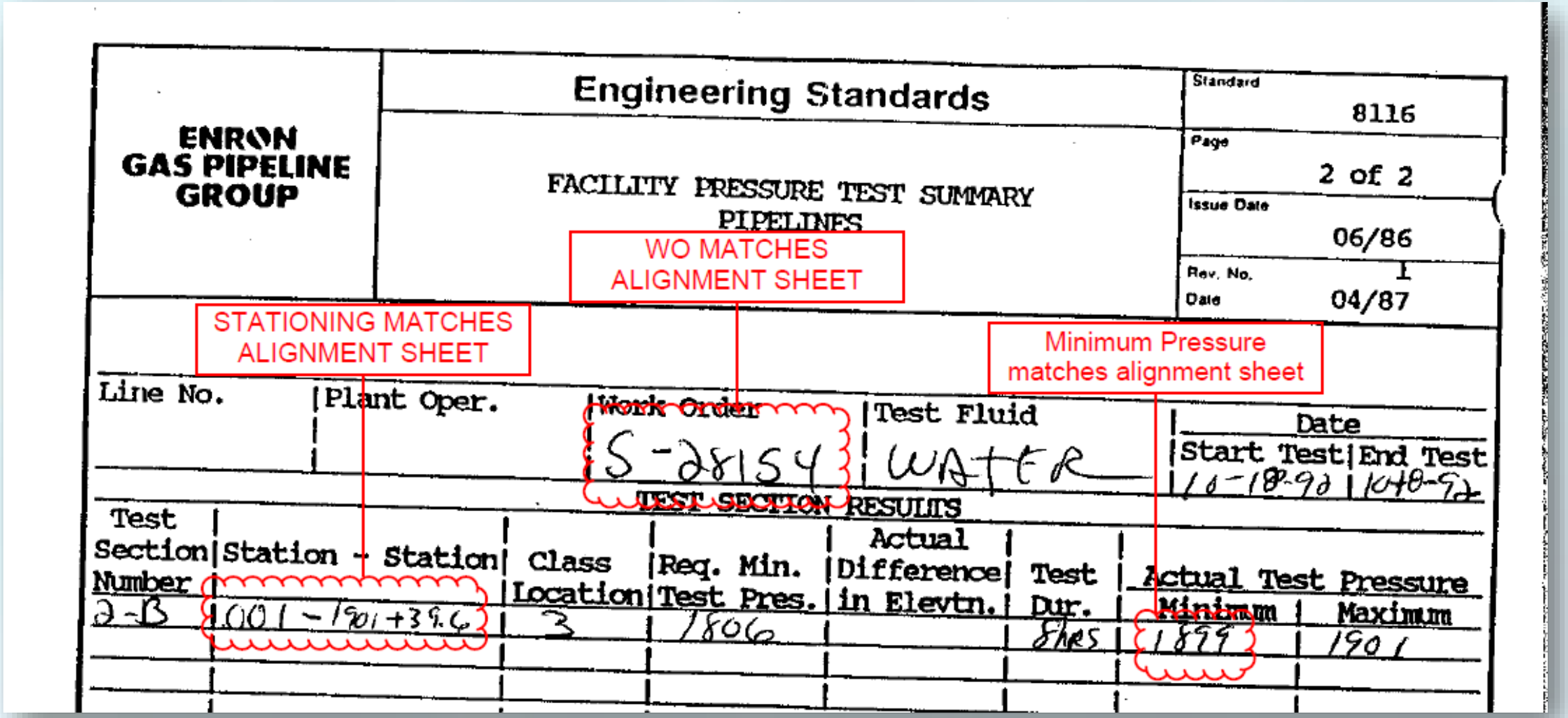
- **Florida Gas Transmission provided GRIT (PHMSA's Gas Rule Implementation Team an example of TVC records for an MAOP determination for a single pipeline segment.**
- **Records provided:**
  - **Alignment sheet,**
  - **Hydrostatic test log and pressure chart, and**
  - **Mill test report.**
- **Records are *complete* (met requirements of Part 192).**
- **FGT was able to link each record together to show that the information was *verifiable* and *traceable*.**

TVC Records: An Example



Alignment sheet mentions WO 28154.

TVC Records: An Example



ENRON GAS PIPELINE GROUP

Engineering Standards

FACILITY PRESSURE TEST SUMMARY PIPELINES

Standard 8116

Page 2 of 2

Issue Date 06/86

Rev. No. 1

Date 04/87

WO MATCHES ALIGNMENT SHEET

STATIONING MATCHES ALIGNMENT SHEET

Minimum Pressure matches alignment sheet

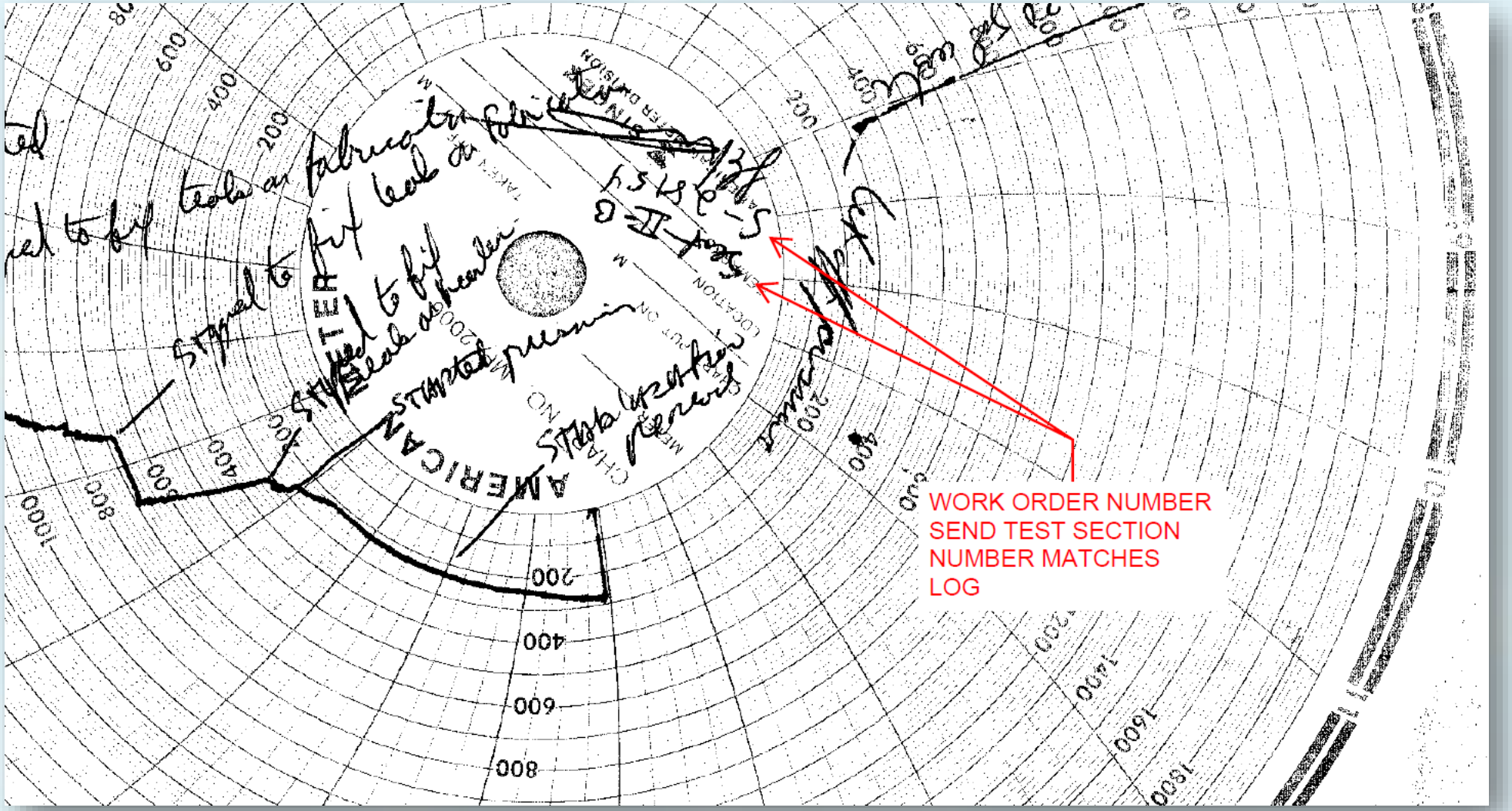
Line No.	Plant Oper.	Work Order	Test Fluid	Date Start Test	Date End Test
		S-28154	WATER	10-18-92	10-20-92

TEST SECTION RESULTS

Test Section Number	Station - Station	Class Location	Req. Min. Test Pres.	Actual Difference in Elevtn.	Test Dur.	Actual Test Pressure Minimum	Actual Test Pressure Maximum
2-B	1001 - 1901+39.6	3	1806		8HRS	1899	1901

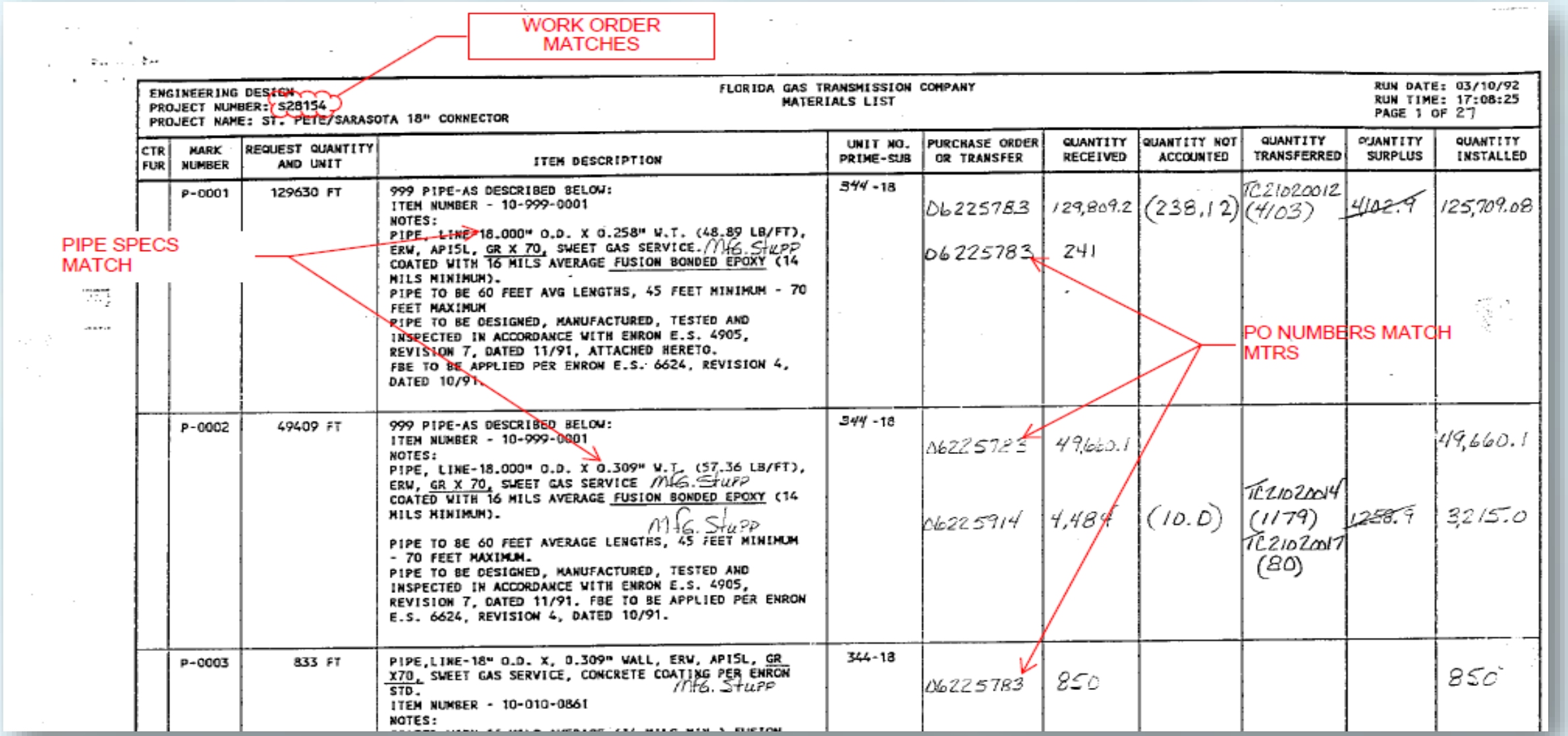
Hydro Test Log links WO 28154 and proper stationing to Alignment sheet.

TVC Records: An Example



Pressure Chart links to WO 28154.

TVC Records: An Example



WORK ORDER MATCHES

PIPE SPECS MATCH

PO NUMBERS MATCH MTRS

ENGINEERING DESIGN
PROJECT NUMBER: S28154
PROJECT NAME: ST. PETE/SARASOTA 18" CONNECTOR

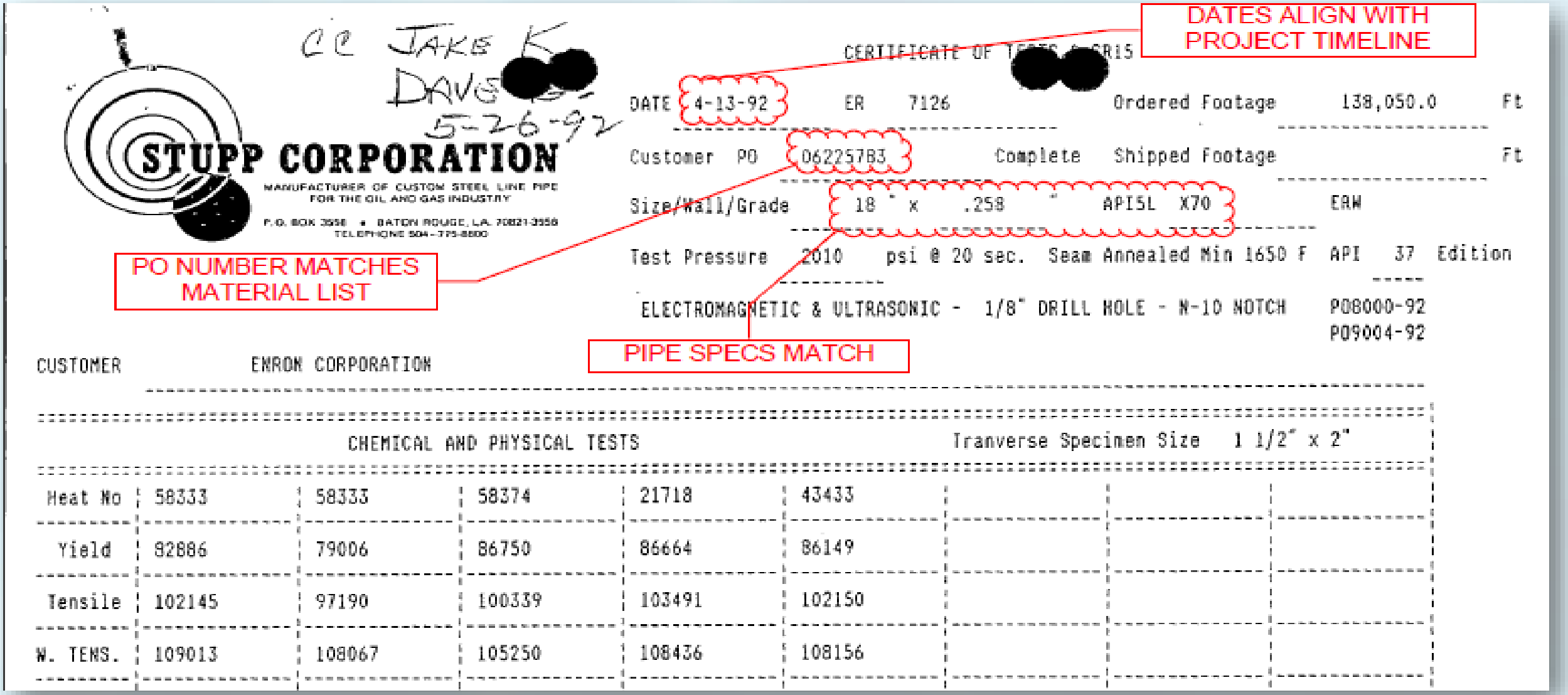
FLORIDA GAS TRANSMISSION COMPANY
MATERIALS LIST

RUN DATE: 03/10/92
RUN TIME: 17:08:25
PAGE 1 OF 27

CTR FUR	MARK NUMBER	REQUEST QUANTITY AND UNIT	ITEM DESCRIPTION	UNIT NO. PRIME-SUB	PURCHASE ORDER OR TRANSFER	QUANTITY RECEIVED	QUANTITY NOT ACCOUNTED	QUANTITY TRANSFERRED	QUANTITY SURPLUS	QUANTITY INSTALLED
	P-0001	129630 FT	999 PIPE-AS DESCRIBED BELOW: ITEM NUMBER - 10-999-0001 NOTES: PIPE, LINE-18.000" O.D. X 0.258" W.T. (48.89 LB/FT), ERW, APISL, GR X 70, SWEET GAS SERVICE. Mfg. Stupp COATED WITH 16 MILS AVERAGE FUSION BONDED EPOXY (14 MILS MINIMUM). PIPE TO BE 60 FEET AVG LENGTHS, 45 FEET MINIMUM - 70 FEET MAXIMUM PIPE TO BE DESIGNED, MANUFACTURED, TESTED AND INSPECTED IN ACCORDANCE WITH ENRON E.S. 4905, REVISION 7, DATED 11/91, ATTACHED HERETO. FBE TO BE APPLIED PER ENRON E.S. 6624, REVISION 4, DATED 10/91.	344-18	06225783 06225783	129,809.2 241	(238.12)	TC21020012 (4/03)	4102.9	125,709.08
	P-0002	49409 FT	999 PIPE-AS DESCRIBED BELOW: ITEM NUMBER - 10-999-0001 NOTES: PIPE, LINE-18.000" O.D. X 0.309" W.T. (57.36 LB/FT), ERW, GR X 70, SWEET GAS SERVICE Mfg. Stupp COATED WITH 16 MILS AVERAGE FUSION BONDED EPOXY (14 MILS MINIMUM). Mfg. Stupp PIPE TO BE 60 FEET AVERAGE LENGTHS, 45 FEET MINIMUM - 70 FEET MAXIMUM. PIPE TO BE DESIGNED, MANUFACTURED, TESTED AND INSPECTED IN ACCORDANCE WITH ENRON E.S. 4905, REVISION 7, DATED 11/91. FBE TO BE APPLIED PER ENRON E.S. 6624, REVISION 4, DATED 10/91.	344-18	06225725 06225914	49,660.1 4,484	(10.0)	TC21020014 (1179) TC21020017 (80)	1258.9	49,660.1 3,215.0
	P-0003	833 FT	PIPE, LINE-18" O.D. X. 0.309" WALL, ERW, APISL, GR X70, SWEET GAS SERVICE, CONCRETE COATING PER ENRON STD. Mfg. Stupp ITEM NUMBER - 10-010-0861 NOTES:	344-18	06225783	850				850

Pipeline material list links to WO 28154 and mentions PO numbers...

TVC Records: An Example



CC JAKE K DAVIS 5-26-92

STUPP CORPORATION

MANUFACTURER OF CUSTOM STEEL LINE PIPE FOR THE OIL AND GAS INDUSTRY

P.O. BOX 3556 • BATON ROUGE, LA. 70821-3556
TELEPHONE 504-775-5500

CERTIFICATE OF TEST & ANALYSIS

DATE 4-13-92 ER 7126 Ordered Footage 138,050.0 Ft

Customer PO 06225783 Complete Shipped Footage Ft

Size/Wall/Grade 18 " x .258 " API5L X70 ERW

Test Pressure 2010 psi @ 20 sec. Seam Annealed Min 1650 F API 37 Edition

ELECTROMAGNETIC & ULTRASONIC - 1/8" DRILL HOLE - N-10 NOTCH P08000-92
P09004-92

CUSTOMER ENRON CORPORATION

CHEMICAL AND PHYSICAL TESTS Tranverse Specimen Size 1 1/2" x 2"

Heat No	58333	58333	58374	21718	43433			
Yield	82886	79006	86750	86664	86149			
Tensile	102145	97190	100339	103491	102150			
W. TENS.	109013	108067	105250	108436	108156			

DATES ALIGN WITH PROJECT TIMELINE

PO NUMBER MATCHES MATERIAL LIST

PIPE SPECS MATCH

Mill Test Report links to WO 28154, proper pipe specs, PO, etc.

Material Verification: Procedure Overview

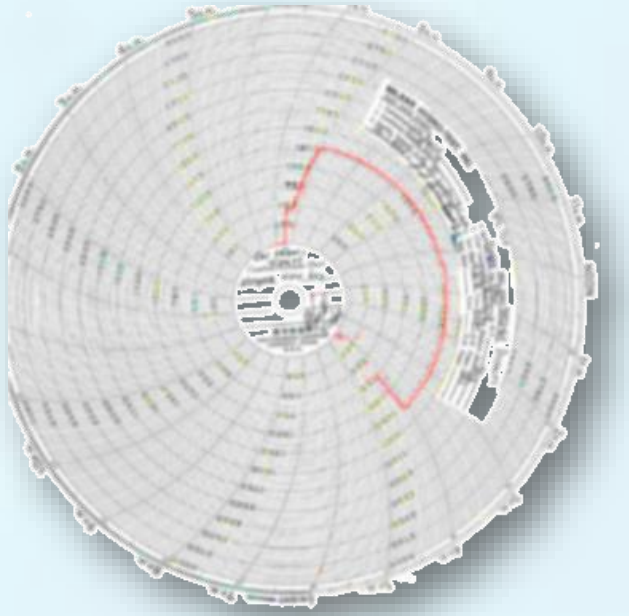
- Definition of Opportunistic Digs
- Nondestructive and Destructive Testing methods
- Population Groups and Sampling
- Components
- Required Notifications to PHMSA

Opportunistic Digs - § 192.607(c)

- **The Rule allows Operators to gather these material properties "opportunistically."**
  - **Operators must define what an "Opportunistic Dig" means to them in its procedures – pretty much any time the operator is going safely expose the pipe.**

- **The Rule and preamble gives some guidance…**

Opportunistic Digs - § 192.607(c)



- **Opportunistic Digs – From the rule:**
  - **Anomaly direct examinations,**
  - **In situ evaluations,**
  - **Repairs,**
  - **Remediations,**
  - **Maintenance,**
  - **Excavations that are associated with replacements or relocations of pipeline segments that are removed from service, and**
  - ***Other opportunities defined by the Operator….***

Opportunistic Digs - § 192.607(c)

- **Operators must define criteria that would render an exposure inappropriate for material verification.**
  - **Unsafe conditions, e.g. confined spaces or unstable excavations.**
- **In most cases, an operator should be able to conduct material properties tests after completing an immediate repair – or make plans to go back after emergency abates.**

See FAQs-24 and 25.

Methods for Gathering Pipeline Properties

- **Tests, examinations, and assessments used by Operators "must be appropriate for verifying the necessary material properties and attributes."**
- **Operator must have procedures for gathering material properties using both NDT and DT methods.**

See § 192.607(c)(3).

Methods for Gathering Pipeline Properties

- **Nondestructive Testing Methods**
  - **"…at each test location, material properties for minimum yield strength and ultimate tensile strength must be determined at a minimum of 5 places in at least 2 circumferential quadrants of the pipe for a minimum total of 10 test readings at each pipe cylinder location."**

See § 192.607(c)(1).

Methods for Gathering Pipeline Properties

- **Destructive Testing Methods**
  - **"…a set of material properties tests for minimum yield strength and ultimate tensile strength must be conducted on each test pipe cylinder removed from each location, in accordance with API Specification 5L."**

See § 192.607(c)(2).

Gathering Toughness Properties

- **Toughness properties**
  - **If an Operator needs to verify toughness properties, the procedures must include accepted industry methods.**

See § 192.607(c)(4).

Special Considerations for Nondestructive Testing - § 192.607(d)

- **The Rule requires that if Operators use nondestructive testing, special considerations must be taken.**
- **These must be captured in the Operator's procedures:**
  - **(1) Use methods, tools, procedures, and techniques that have been validated by a subject matter experts…,**
  - **(2) Account for measurement inaccuracy and uncertainty using reliable engineering tests and analyses; and**
  - **(3) Use test equipment that has been properly calibrated for comparable test materials prior to usage.**

Nondestructive Testing Methods

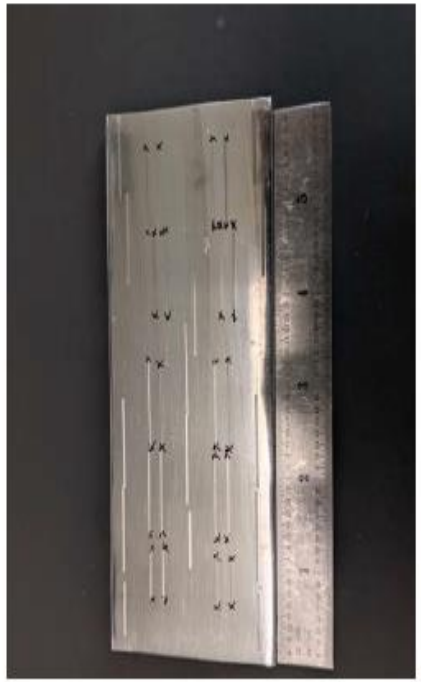
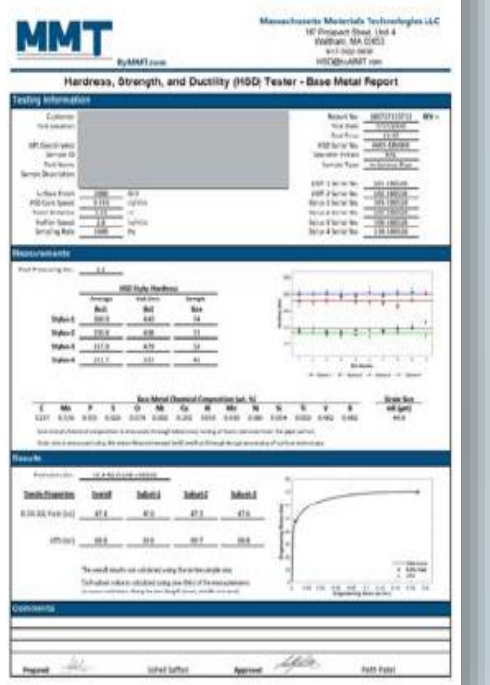
- **Overview of some nondestructive testing methods for material testing.**
- **Examples the GRIT team saw during pilot inspections.**
- **PHMSA does not endorse these companies, this is just to help inspectors familiarize themselves with the methods out there.**
  - **MMT – HDS overview (hardness, ductility, strength)**
  - **TDW – Positive Material Identification (PMI)**

MMT Material Testing Methods

- § 192.607(c)(1) NDE Test Locations.
- Performs at least 1 HSD test in 2 circumferential quadrants.
- For each HSD test, more than 50 samples collected.

MMT Material Testing Methods

- **Field testing process:**

HSD Daily Calibration	Field Surface Preparation	HSD Testing and Seam Characterization	Full Chemistry and Metallography	Instant Data QA/QC (Final Report in 5-10 business days)
				

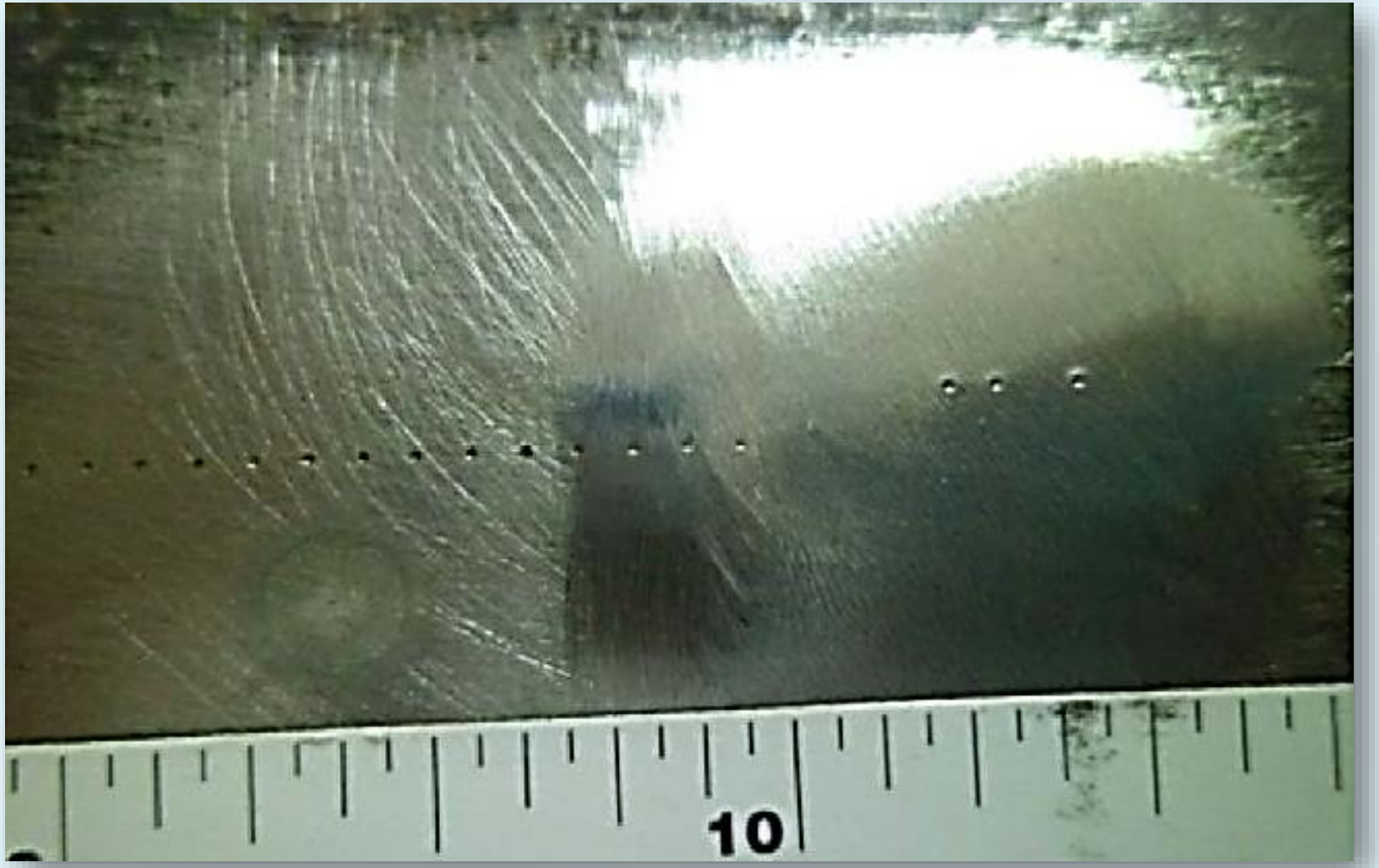
TDW – Positive Material Identification

- **The TDW Non-Destructive Evaluation process consists of five methods:**
  - **Ultrasonic thickness testing (UTT)**
  - **AUT B-scanner (C-scan display)**
  - **Automated Ball Indenter (ABI)**
  - **Optical Emissions Spectrometry (OES)**
  - **Magnetic Particle Testing (MT)**

TDW – Positive Material Identification

- **Automated Ball Indenter (ABI) uses sophisticated algorithm to determine material yield strength based on stress strain curve generated by equipment software.**

TDW – Positive Material Identification



- **A ball indenter sequentially applies a load fifteen times at a single location.**

TDW – Positive Material Identification

- **ABI – Automated Ball Indenter**

Validation of "New" Material Testing

- **In 2013, Kiefner & Associates performed some testing on TD Williamson's material properties field testing processes and results.**
  - ***Positive Material Verification Process***
- **Used actual pipe from a cooperating Operator's system.**
- **Compared PMI results to laboratory results – concluded that the PMI results should only be used for *quantitative purposes such as grade comparisons.***

Table 1. Mechanical Property Results

Pipe Sample	Lab Yield Strength	Lab Tensile Strength	TDW Yield Average	TDW Tensile Average	Yield Diff	Tensile Diff

Material Testing

- **Items to look for in the procedures:**
  - **Qualifications**
    - ***Operator Qualifications* – Operator OQs versus Operator-accepted certifications**
    - ***Special Certifications* – Contractor employees should have the required certifications (e.g. specific training/experience on equipment)**
  - **Equipment – Calibration requirements**
    - **Is equipment calibrated ahead of time?**
    - **Does equipment need to be calibrated once it's mounted on the pipe?**

Material Testing: Field Inspections

- **Test set up - *surface preparation of pipe required?***
- **Equipment set up – *has equipment been properly calibrated?***
- **Results acceptance criteria**
  - ***Operators comparing NDT results to more traditional lab results of the same pipeline segment?***
- **Report outputs – *what documentation will Operator receive?***

Remember: All of this is memorialized in the contractor's procedures.

Material Testing: Opportunistic Digs

- **This dig is opportunistic dig – why else is the Operator here?**

  Is the Operator's following those procedures?

  - **Anomaly dig,**
  - **Verification dig,**
  - **Repairs/remediations,**
  - **Valve replacements/installations, or**
  - **Test lead installations…**

Sampling Multiple Segments of Pipe - § 192.607(e)

- Operators can use a sampling program to gather unknown pipeline material properties.
- Rule requires Operators to determine “populations” of similar pipeline segments.
- The total mileage of each “population” is the cumulative mileage of pipeline segments with these similar properties.
- The pipeline segments need not be continuous.

Creating Pipeline Populations for Material Verification - § 192.607(e)

- **When Operators create pipeline populations, they must contain combinations of the following properties:**
  - **Nominal wall thicknesses,**
  - **Grade,**
  - **Manufacturing process,**
  - **Pipe manufacturing dates, and**
  - **Construction dates.**
- **If the dates between the manufacture or construction of the pipeline segments exceeds 2 years, these segments cannot be in the same population.**

See FAQ-18.

Creating Pipeline Populations for Material Verification - § 192.607(e)

- **Operators can only split populations based on *known* attributes.**
- **Separate populations of pipe segments should be created where attributes are unknown.**
- **Operators can initially group pipe segments with no known material properties into a single population.**
  - **Once material properties are discovered, these segments should be incorporated into populations with similar attributes.**

See FAQs-19 and 20.

Creating Pipeline Populations for Material Verification - § 192.607(e)

- **Operators can use inline inspection data to create pipeline populations for material verification.**
  - **Diameter**
  - **Wall thickness, etc.**
- **Like any inline inspection – Operators must establish "acceptance criteria."**
- **Considered an "alternative method" so must notify PHMSA per § 192.18.**

See FAQ-21.

How Many Samples?

- **Once the Operator defines population groups, it must complete:**
  - **(i) One excavation per mile rounded up to the nearest whole number; or**
  - **(ii) 150 excavations if the population is more than 150 miles.**
- **Operators can use prior material property testing performed during *a single excavation* if the Operator can show it meets the requirements of § 192.607.**
  - ***It will be counted as a single sample for that specific population.***

Material Verification: Inconsistent Findings

- **If the Operator performs material property testing and finds properties inconsistent with what is expected in the population…**
- **<u>They MUST expand the sampling program</u>!!**

See FAQ-28.

Material Verification: Inconsistent Findings - § 192.607(e)(4)

- **Operators must define what "not consistent" means in its procedures.**
- **Rule requires some statistical analysis for the expanded sampling program.**
  - **"…must use valid statistical bases designed to achieve at least a 95% confidence level that material properties used in the operation and maintenance of the pipeline are valid."**
  - **Operators must show how this expanded sampling program will address inconsistencies.**

See FAQ-28.

Alternative Sampling Methods - § 192.607(e)(5)

- **Alternative sampling methods can be used – similar to the requirements of an "expanded sampling program"**
  - **"…must use valid statistical bases designed to achieve at least a 95% confidence level that material properties used in the operation and maintenance of the pipeline are valid."**
  - **Operators must show how this alternative sampling program will address inconsistencies.**

Expanded and Alternative Sampling Program - § 192.607(e)

- **Both Expanded Sampling Programs and Alternative Sampling Programs require the Operator to notify PHMSA per the requirements of § 192.18.**

§ 192.18 How to notify PHMSA.

(a) …

(c) Unless otherwise specified, if the notification is made pursuant to § 192.607(e)(4), § 192.607(e)(5), … to use a different sampling approach….the operator must notify PHMSA at least 90 days in advance of using the other technology.

"Alternative Method" for Populations - § 192.607(e)

Washington, DC 20590

To whom it may concern,

In accordance with §192.18, Gulf South Pipeline Company, LP (Gulf South) is hereby notifying PHMSA of its intent to use an alternative statistical sampling approach as outlined in §192.607(e)(5). Gulf South intends to use Rosen's RoMAT PGS in-line inspection pipeline grading tool on Gulf South's Index 915-6 in Escambia County, Florida on or around August 26, 2021.

As clarified in FAQ-21 [1], the data collected from Rosen's RoMAT tool will be used to determine pipeline population groups under §192.607(e). Also as stated in FAQ 22 [1], ILI can be used to determine pipeline material properties and attributes. The RoMAT tool is capable of collecting material properties and attributes on every pipe joint and every bend. This approach far exceeds the sampling frequency required by §192.607(e)(2) (one per mile in each population) and meets the requirements of §192.607(e)(5) ensuring that the material properties and attributes are valid.

Rosen's analysis of the ILI data will be based on a statistical analysis to achieve at least a 95% confidence level that the material properties are valid. Furthermore, Rosen's analysis will be supplemented with in-ditch non-destructive and/or destructive testing once population groups are established. The frequency of the in-ditch testing will be defined after the ILI data analysis is completed.

"Alternative Method" for Populations - § 192.607(e)

- **On August 4, 2021, Gulf South notified PHMSA requesting an alternative population determination and sampling program for material verification.**
- **Notification for an ILI run in Escambia County, Florida on or around August 26, 2021.**
  - **"As clarified in FAQ-21, the data collected from Rosen's RoMAT tool will be used to determine pipeline population groups under §192.607(e). Also as stated in FAQ 22, ILI can be used to determine pipeline material properties and attributes."**

"Alternative Method" for Populations - § 192.607(e)

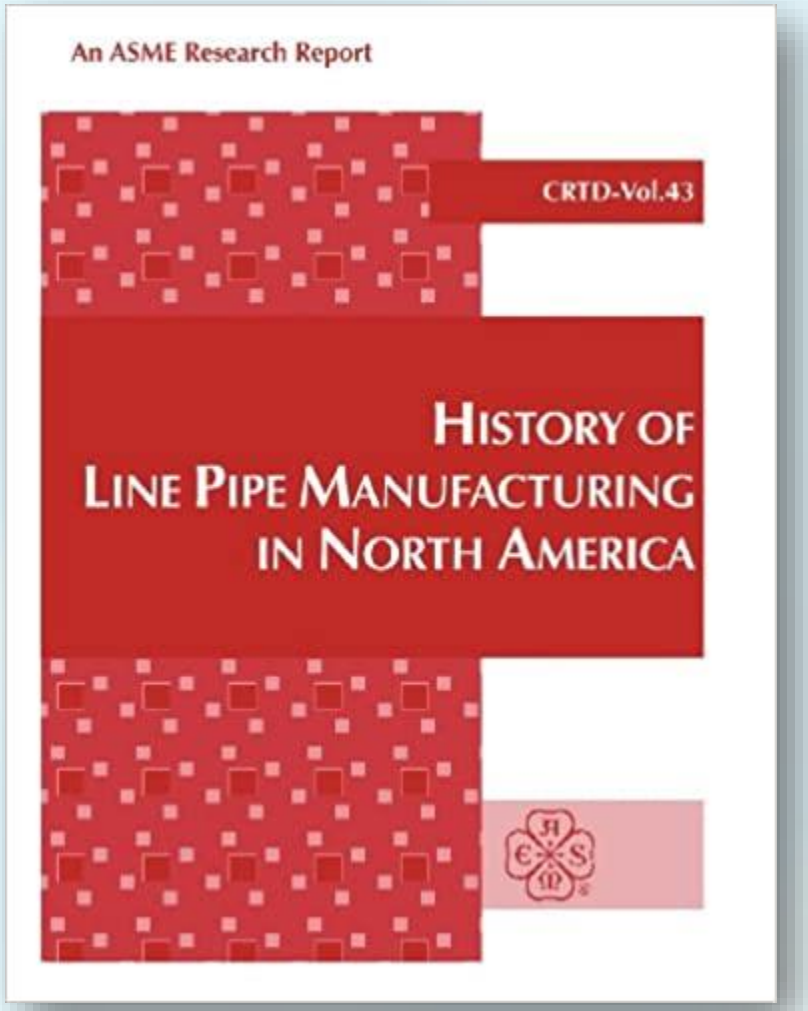
- **PHMSA responded to Gulf South's notification:**
  - **Essentially, PHMSA granted permission for Gulf South to use ILI to determine population groups…**
  - ***BUT*** **Gulf South must come back to PHMSA once population groups are determined and provide more information before the Operator is allowed to use the proposed sampling approach.**
    - **"PHMSA supports Gulf South's usage of "other technology" (ILI verification process) to determine pipeline "population groups" (diameter, wall thickness, grade, and seam type) to meet 49 CFR 192.607."**

Material Verification: Uprating § 192.607(g)

- **Operators cannot use the material properties determined from the destructive or nondestructive tests required by this section to raise the grade or specification of the material**
  - **unless the original grade or specification is unknown, *AND***
  - **the MAOP is based on an assumed yield strength of 24,000 psi in accordance with § 192.107(b)(2).**

Expanded and Alternative Sampling Program – CRTD-91

- ***Applications Guide for Determining the Yield Strength of In-Service Pipe by Hardness Evaluation*** **(2009)**
- **Report originally written as an alternative process for gathering pipeline hardness values outside of Part 192.**
  - **"This Guide describes a complete process for conducting field hardness testing to estimate the yield strength of pipeline steel."**
- **Operators are now considering using it as an alternative sampling method – to reduce the number of digs, but to still maintain 95% confidence (but below the one dig per mile).**



This document's purpose is to provide pipeline operators with historical data on line pipe. The document is comprised of four major sections.

- Manufacturing processes that have been and are being used to make line pipe.
- Tables by type of pipe listing the manufacturers of line pipe, past and present, in North America.
  - some techniques for identifying unknown pipe samples
- API line pipe specifications as they have evolved since 1928 are reviewed.
- A glossary of terms frequently associated with line pipe manufacturing.