



Pipeline and Hazardous
Materials Safety Administration

Hazardous Liquid Pipeline Integrity Verification Process (HL IVP)

Overview

Industry (API/AOPL) Briefing

November 18, 2014



Know what's below.
Call before you dig.



PHMSA
Your Safety
Our Mission



Pipeline and Hazardous Materials Safety Administration

HL IVP

- **What is HL IVP**
- **Where would HL IVP be applicable**
- **Drivers -** GT Statutory Mandates and NTSB Rec.
- **Goals - Principles**
- **IVP Process**
 - IVP Chart
 - Definitions
 - MOP Determination
 - Material Documentation
- **Other Part 195 Updates**



Pipeline and Hazardous Materials Safety Administration

HL IVP

What is it HL IVP:

- Verification of MOP and material records
- Pressure testing and material verification where records do not exist
- Re-evaluation, where Risk-Based Alternative used instead of Pressure Testing
- Fatigue analysis process used for determining reassessment intervals for cracking issues
- Other Part 195 Updates



Pipeline and Hazardous Materials Safety Administration

HL IVP

Where would HL IVP be applicable:

- High consequence areas (HCA);
- Rural gathering lines (195.11) that could affect an HCA;
- Could affect right-of-ways of a designated interstate, freeway, expressway, and other principal 4-lane arterial roadways;
- Highly volatile liquid (HVL) pipelines; and
- Any other non-HCA hazardous liquid pipeline with an MOP of > 20% SMYS.



Pipeline and Hazardous Materials Safety Administration

GT Drivers considered for HL Pipelines: Pipe, MOP and Material Documentation Issues

- **PSA §23(a) 60139(d) mandate for “Testing Regulations”**
 - requires either pressure testing or an alternative equivalent means such as an ILI program for pipe not previously tested;
- **PSA §23(a) 60139(a) & (b)**
 - requires operators to self-report that they do not have records to substantiate MOP and requires a strategy for addressing and correcting non-compliances that emerge from this reporting;
- **NTSB P-11-14 “Delete Grandfather Clause”**
 - recommended grandfathered pipelines be pressure tested, including a “spike” test. (This can be applied to HL’s Risk-Based Alternative” pipe.); and
- **NTSB P-11-15 “Seam Stability”**
 - recommended pressure testing to 1.25 x MOP before treating latent manufacturing and construction defects as “stable.”



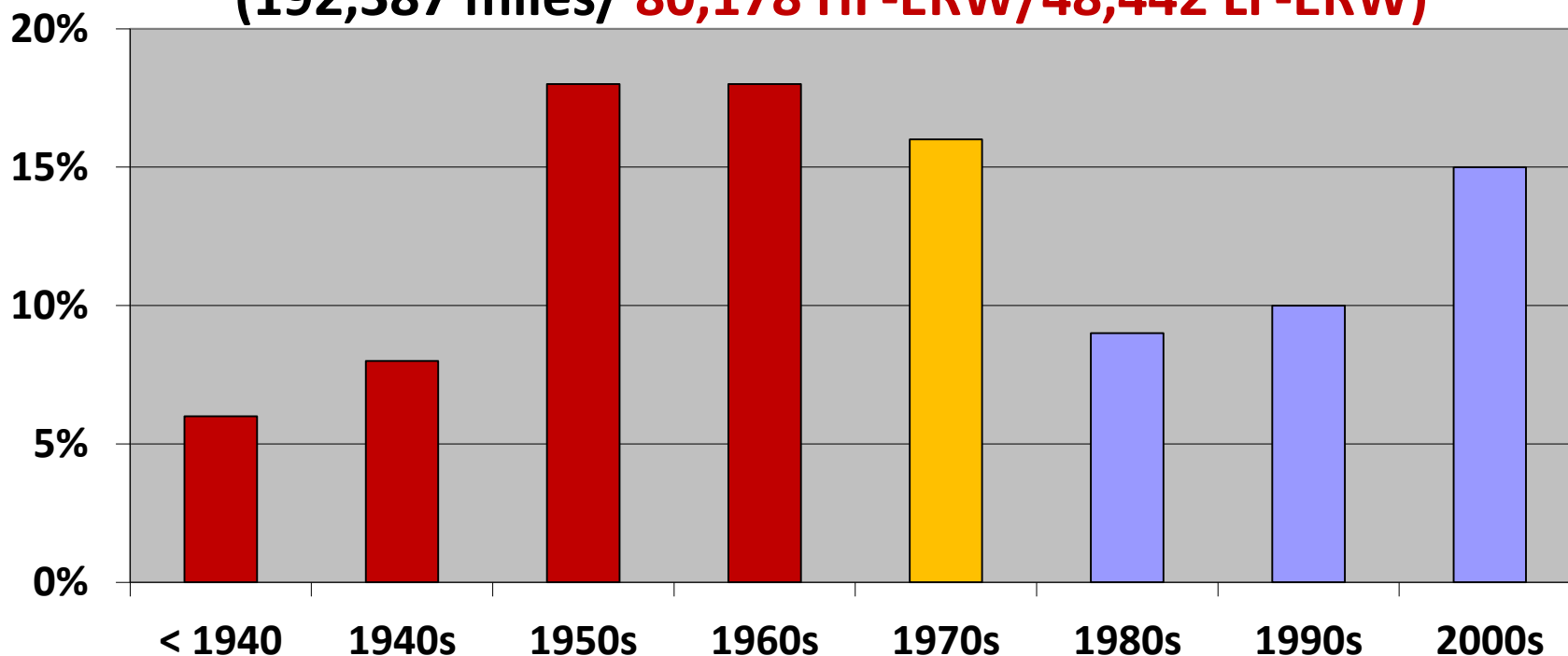
Pipeline and Hazardous
Materials Safety Administration

U.S. Pipeline Infrastructure

Hazardous Liquid Pipeline Vintage

50% installed prior to 1970

(192,387 miles/ 80,178 HF-ERW/48,442 LF-ERW)





Basic Principles of HL IVP Approach

- **HL IVP is based on 4 principles**
 1. Apply to higher risk locations
 2. Screen segments for categories of concern
 3. Assure adequate material and documentation
 4. Perform assessments to establish MOP



Principle # 1

Apply to Higher Risk Locations

- High Consequence Areas (HCAs)
- Interstate ROW
- Rural Gathering (195.11) could affect an HCA
- HVL pipelines
- Non-HCA pipelines w/ MOP > 20% SMYS
- PHMSA Estimates ~ **182,000 miles; 95% HL mileage**



Principle # 2

Screen for Categories of Concern

- **Apply process to pipeline segments with:**
 - Segments w/o valid pressure test
(i.e., MOP established per risk-based approach § 195.303)
 - Legacy pipe w/o valid **spike** pressure test
 - History of Failures Attributable to M&C Defects
 - Lack of Records to Substantiate MOP



Principle # 3

Know & Document Pipe Material

- **If Missing or Inadequate Validated Traceable Material Documentation, then Establish Material Properties by an approved process:**
 - Test Pipe Samples (Code approved process)
 - *In Situ* Non-Destructive Testing (if validated)
 - Field verification of code stamp for components such as valves, flanges, and fabrications
 - Other verifications



Principle # 4

Assessments to Establish MOP

- **Allow Operator to Select Best Option to Establish MOP**
- **Candidate IVP Options for Establishing MOP**
 - Pressure Test (with Spike Test for Legacy Pipe or pipe with M&C failure history)
 - Derate pressure
 - Engineering Critical Assessment
 - Replace
 - Alternative technology (notification to PHMSA required)
 - **Any other options to consider?**



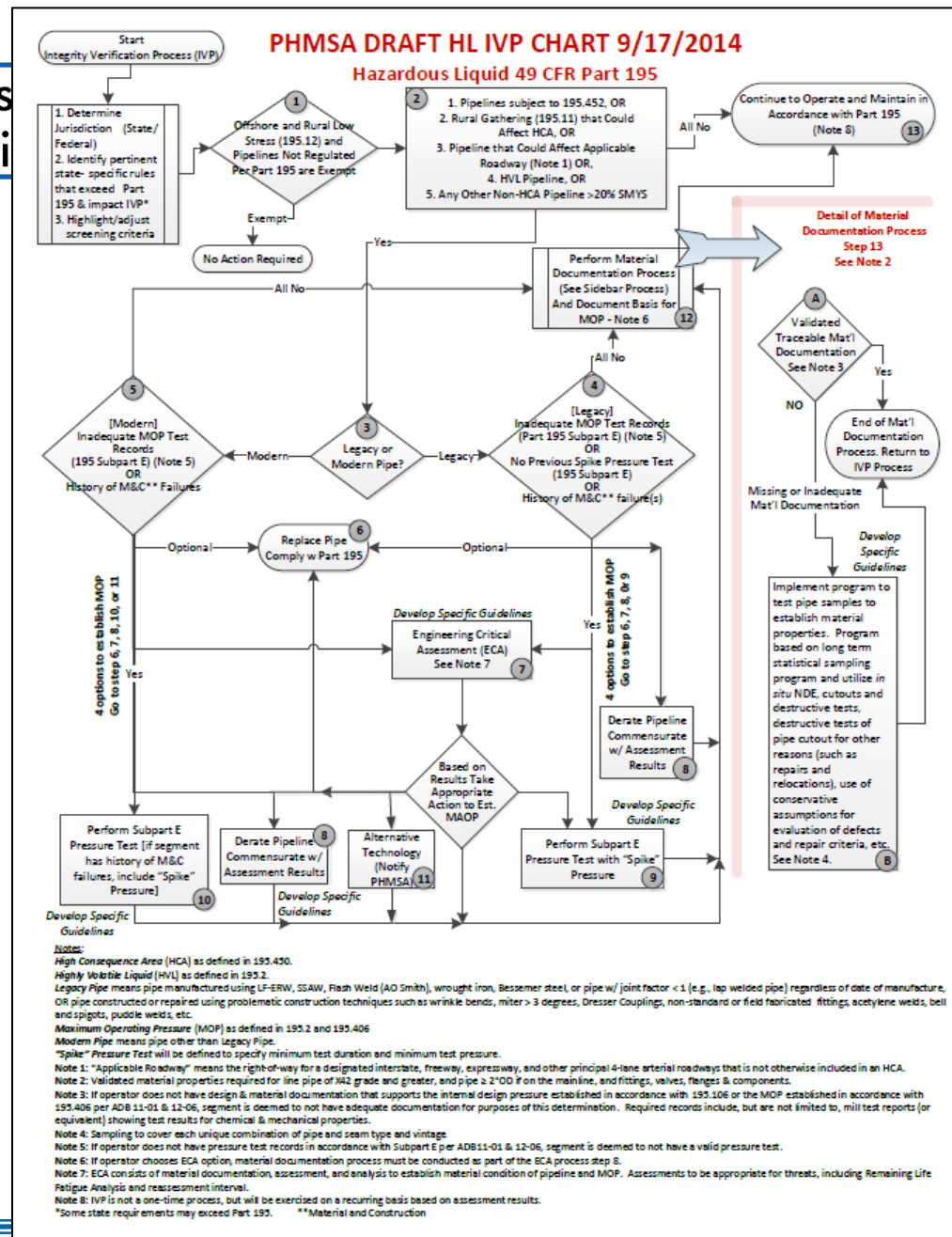
Draft – IVP Process Steps

- **13 Step Process Embodies These 4 Principles**
 - **Screen for High Risk Pipe** – Process Steps 1 – 2
 - **Integrity Review** – Process Steps 3 – 5
 - **Assessment/MOP Determination** – Steps 6 – 11
 - **Material Documentation Review** – Process Step 12
 - **Continue Operations** – Process Step 13



Pipeline and Hazardous Materials Safety Admini

- **HL IVP Chart - Draft**
- **Applicable Segments**
(Steps 1 and 2)
- **Integrity Review** (Steps 3 – 5)
- **Assessment/MOP Determination** (Steps 6 – 11)
 - Pressure Test
 - Pressure Reduction
 - Engineering Critical Assessment
 - Pipe Replacement
 - Alternative Technology
- **Materials Documentation**(12)
 - Destructive
 - Non-destructive
- **Continue Operations** (13)





Pipeline and Hazardous Materials Safety Administration

Part 195 Code Requirements - MOP

- **Code - Liquid Pipeline**
 - **MOP Determination**
 - 195.106 – Design Pressure
 - 195.406 - MOP
 - Subpart E – Pressure Test
 - 195.300 thru 195.310
 - **Material Determination**
 - 195 Subpart C – Design
 - 195.106 – Yield Strength, Wall thickness, & Joint factor
 - 195.112 & 114 – Pipe Qual.



Pipeline and Hazardous Materials Safety Administration

MOP Verification



Definitions

- **Legacy Pipe**
 - LF-ERW, DC-ERW, SSAW, Flash Weld (AO Smith), wrought iron, Bessemer Steel, or pipe w/ joint factor <1 (e.g., lap welded pipe)
- **Modern Pipe**
 - Pipe not manufactured with any techniques listed under Legacy Pipe
- **Spike Hydrostatic Pressure Test**
 - Minimum pressure and duration
- **Legacy construction techniques**
 - Usage of any historic, now-abandoned, construction practice to construct or repair pipe segments, including wrinkle bends, miter > 3 degrees, Dresser Couplings, non-standard fittings, arc welds, oxyacetylene welds, bell spigots, puddle weld repairs, etc.



Consideration of State-Specific Requirements

- 1. Determine Jurisdiction (State/Federal)**
- 2. Identify State-Specific Rules**
- 3. Adjust Screening Criteria Accordingly**

- ****Some states have requirements that exceed federal regulations, e.g.,**
- Process must account for those differences



Draft Process Steps 1 and 2

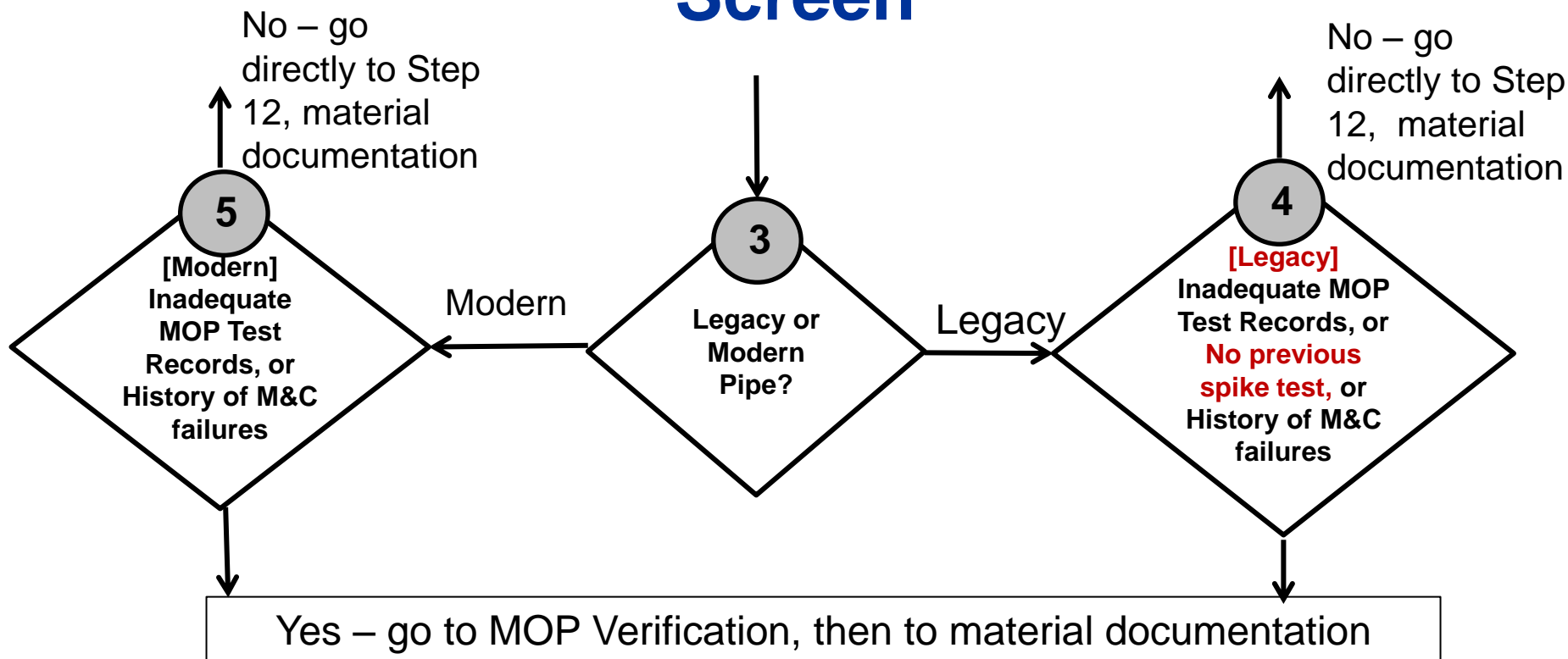
Risk-based Screening

- **Screening criteria based on location**
 - Offshore and rural low stress lines are exempt
- **Screening criteria based on operational risk**
 - High Consequence Areas – ~ 83,000 miles
 - HL pipeline (**Onshore HL = ~ 182,000 miles**)
 - Segment \leq 20% SMYS - **~ 2,000 miles**)
- **PHMSA High End Estimate ~ 182,000 miles; ~ 95% HL**



Pipeline and Hazardous Materials Safety Administration

Draft - Process Steps 3 - 5 Inadequate Records and Failure History Screen





Draft - Process Steps 3-5

Mileage that would Require MOP Verification

- HL operators did not have to report grandfathered pipe or inadequate records
- **97,050 miles** pre-1970 or unknown decade of installation
- **1,054 miles** of Low Frequency pipe installed after 1970
- **~ 98,104 Miles high end Est. for MOP Verification (roughly half the miles that passed initial screen)**



Draft - Process Steps 6 through 11 MOP Determination Methods

- **Approaches based on case-specific considerations:**
 - Method 1: **Pressure Test (PT)**
 - Method 2: **Pressure Reduction**
 - Method 3: **Engineering Critical Assessment (ECA)**
 - Method 4: **Pipe Replacement**
 - Method 5: **Alternative Technology**
 - Method 6: **Other Methods to Consider?**



MOP Determination Methods

- **Method 1: Pressure Test**
 - 1.25 test factor times MOP
 - Spike test segments w/ reportable in-service incident due to legacy pipe/construction, SSC, SSC, etc.
 - Estimate remaining life, segments w/crack defects
- **Method 2: Pressure Reduction**
 - Reduce pressure by MOP divided by 1.25
 - Estimate remaining life, segments w/crack defects



MOP Determination Methods

- **Method 3: Engineering Critical Assessment (ECA)**
 - **ECA analysis** - MOP based upon lowest predicted failure pressure (PFP)
 - Segment specific technical and material documentation issues
 - Analyze crack, metal loss, and interacting defects remaining in the pipe, or could remain in the pipe, to determine PFP
 - MOP established at the lowest PFP divided by a safety factor
 - **In-Line Tool Inspections** - for threats would be main inspection tools for ECA



MOP Determination Methods

- **Method 4: Pipe Replacement**
- **Method 5: Alternative Technology**
 - May use an alternative technical evaluation process that provides a sound engineering basis for establishing MOP.
 - Notify PHMSA at least 90 or 180 days in advance of use
 - Notification must include details
 - No objection from PHMSA
- **Method 6: Other Methods to Consider?**



MOP Determination Methods

- **Fracture mechanics modeling for failure stress and cyclic fatigue crack growth analysis**
 - Contains/susceptible to cracks or crack-like defects
 - Fatigue analysis techniques
 - Analyze microstructure(ductile/brittle or both), location and type of defect, and operating conditions/pressure cycling
 - 2nd re-evaluation before **XX%** of the remaining life has expired, but within **XX** years
 - Results confirmed by an independent expert ?



MOP Determination – Timing?

- **MOP Documentation Timing:**
 - require that existing pipeline segments in high consequence areas be assessed within **XX** years and reassessments every **XX** years thereafter
 - **Any suggestions?**



**Pipeline and Hazardous
Materials Safety Administration**

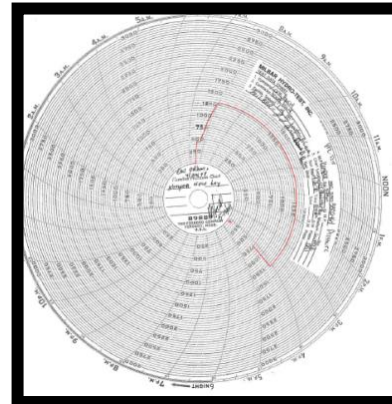
Material Documentation



Pipeline and Hazardous Materials Safety Administration

Why are material records needed?

- To establish design and maximum operating pressures (MOP)
- For integrity management (IM)
- Anomaly evaluations for safe operating pressure



Metallurgical and Pipe Test Report

SAW PIPES USA, Inc.
P.O. Box 2348
Houston, TX 77232-2348
Phone: (281) 983-3300
Fax: (281) 983-0473

PO Number: 45000020362 PO Date: 11/04/05 Date: 09/15/06
Diameter (in): 42 Wall (in): 0.438 Grade: X70 PSL2 Heat No: B04625
Comments: 100% Wall seen inspection by ultrasonic testing method
Calibration standard: 1/4" notches and 1/8" through drilled hole

Customer: SPEC 101, REV 4, DATED 01-17-05
API 5L October 2004 43rd Ed

Physical Analysis:

Width (inch)	Yield (PSI)	Tensile (PSI)	Elong (%)	YR Ratio
TBT 1.50	75006	87007	38	0.85
TWT 1.47		89203		

Weld Tensile Fracture Location

Root	Face
OK	OK

Hydrostatic Test

1402
MINIMUM HYDROTEST PRESSURE FOR THIS HEAT @ 1402 PSI @ 90%
MACRO OK

Chemical Analysis

Type	C	Mn	P	Si	S	Cu	Ni	Cr	Mo	Ti	Al	N	V	B	Nb	Ca	Zr	CE	Pcm	V
Ladle	0.09	1.90	0.006	0.005	0.27	0.02	0.22	0.18	0.01	0.013	0.027	0.007	0.005	0.0005	0.054	0.002	0.000	0.39	0.19	0.13
Prod1	0.08	1.83	0.007	0.007	0.26	0.01	0.21	0.15	0.00	0.017	0.026	0.004	0.009	0.0002	0.057	0.002	0.000	0.38	0.18	0.13
Prod2	0.08	1.83	0.008	0.006	0.26	0.01	0.21	0.15	0.00	0.017	0.026	0.004	0.009	0.0001	0.057	0.002	0.000	0.38	0.18	0.13

CE MAX = 0.41% PCM MAX = 0.21%

Hardness Analysis

Temp	Shear 1	Shear 2	Shear 3	Shear Avg
1: 108	81	182	111	188
2: 188	71	180	112	192
3: 192	81	188	112	192
4: 192	91	184	112	191
5: 206	101	192	112	206

Charpy Impact Analysis

DirNotch	Spec Size	Temp	Ft 1b1	Ft 1b2	Ft 1b3	Ft 1b 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	88	81	86	85	100	100	100	100

Fracture Toughness Criteria: As per API 5L, PSL2, SPSA @ 57, 57R @ 30 F, 57R @ 30 F
The material has been manufactured, sampled, tested, and inspected in accordance with the spec/API and has been found to meet the requirements. If you find the above to be incorrect as contained in the records of the company.



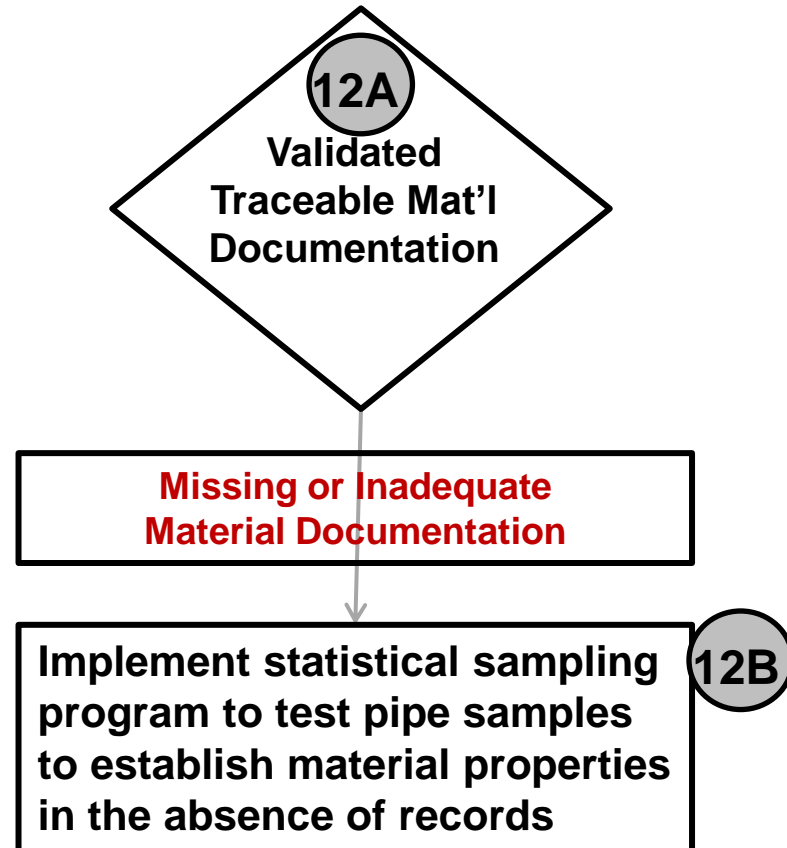
Material Records

- **Materials manufactured in accordance:**
 - DOT referenced standards or other applicable standards
 - **Able to maintain structural integrity of the pipeline:**
 - Operating pressure, temperature, and environmental conditions including outside force loads
 - **Pipe Design**
 - Withstand external pressures and anticipated loads
 - Designed for service and class location
 - Must verify: diameter, wall thickness, grade and seam type
 - **Integrity Management (IM)**
 - Predicted failure pressure of defects
-
-



Draft - Process Step 12 Material Documentation

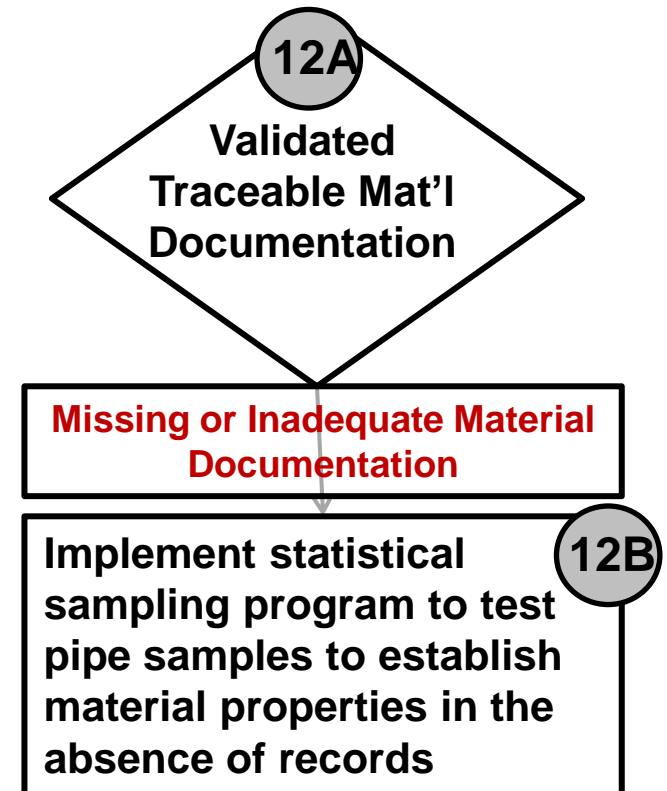
1. **Material Documentation also Required for Pipe, Valves, Flanges, Fittings, & Components**
2. **Validated material properties required for X-42 and greater & pipe \geq 2-inch OD, if on mainline**





Draft - Process Step 12 Material Documentation (cont.)

3. Valves and Components (ANSI Rating)
4. Cutouts each **XX joints or XX miles**
5. May use *in situ* NDE, if validated
6. May not be required for some short segments
7. Each Unique Combination of Pipe Type, Seam, Vintage





Specific Guidelines & Criteria

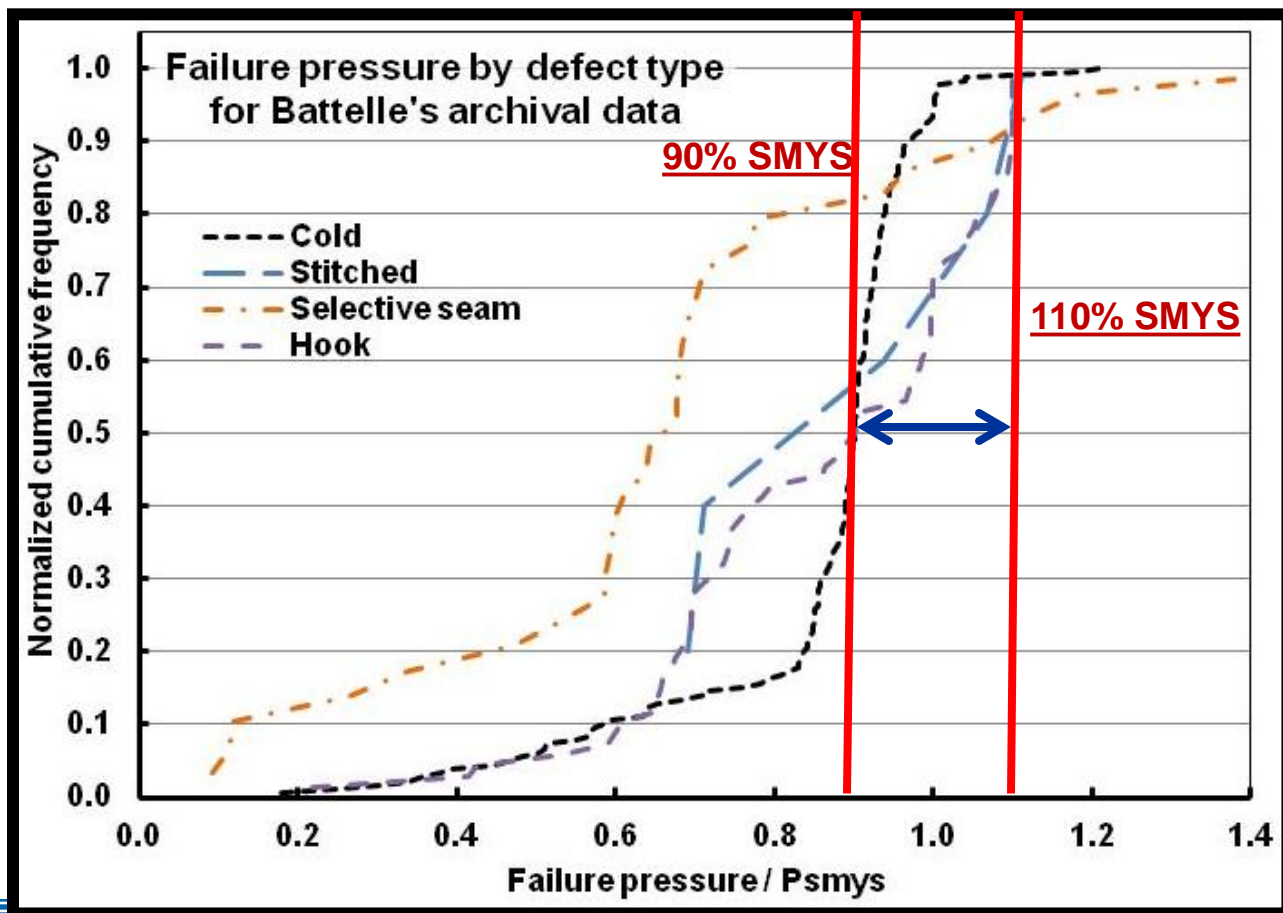
- **IVP chart is high level concept**
- **Details and specifications to be developed**
- **For example:**
 - Spike pressure test specs (pressure, hold time, etc.)
 - De-rate criteria (amount of MOP reduction)
 - ILI program requirements and specifications
 - Material verification specs (# of cutouts, etc.)



Pipeline and Hazardous
Materials Safety Administration

Pipe and Seam Cracking

Long Seam ERW Failures Chart



What should be considered for spike pressure test for cracking issues?

- 90% SMYS
- 100% SMYS
- 105% SMYS
- 110% SMYS
- or
- X times MOP



Other Part 195 Updates

- **External Corrosion Assessment and Remediation**
 - Usage of close interval surveys to find loss of cathodic protection and ineffective coatings
 - AC/DC interference surveys in high voltage power line routings
- **New Construction**
 - Coating assessments (DCVG) after backfill for new construction;
 - Girth weld NDE requirements for new construction (+95%)
 - CO₂ pipelines fracture mitigation plan requirements
 - address operating temperatures, pressures, product compositions, pipe grade and operating stress levels
 - Mitigation or arrest measures
- **GWUT Assessment Guidance in Part 195 Code**
 - for segments where ILI cannot be run



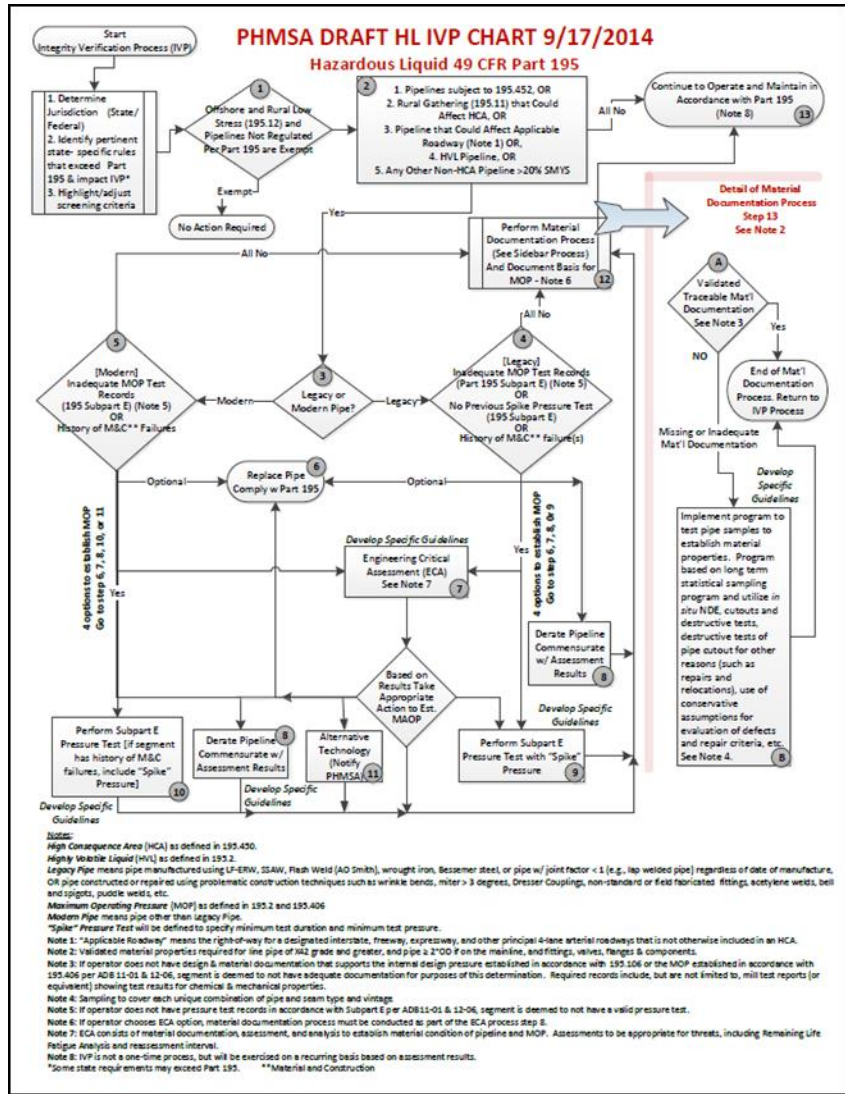
Other Part 195 Updates

- **Records Retention**
 - **Appendix – Records for Life of Facility or X-years**
 - **Materials** – pipe, valves, fittings, flanges & components
 - **Design** – external loads and design pressures
 - **Construction** – inspection, welding procedures, and NDT
 - **Pressure Testing**
 - **Corrosion Control**
 - **O & M** – measurement, patrols, surveys, repairs, manuals
 - Integrity Management
 - OQ Plans
 - Control Room Management
-
-



Pipeline and Hazardous Materials Safety Administration

Questions?





Pipeline and Hazardous
Materials Safety Administration

Thank you

**US DOT / PHMSA
mike.israni@dot.gov
steve.nanney@dot.gov**



**Know what's below.
Call before you dig.**



PHMSA
Your Safety
Our Mission