TULSA INSPECTION RESOURCES
INSPECTION & INTEGRITY

Positive Material Identification (PMI)

PHMSA's Final Rule effective May 16th, 2022 categorizes Type A, B, and C onshore gas gathering transmission lines while also defining criteria for insufficient material property records. In turn, certain measures must be taken by pipeline operators to obtain the following physical material properties:

- Pipeline segment's diameter
- Wall thickness
- Seam type
- Grade (minimum yield strength and ultimate tensile strength of the pipe)
- Charpy V-notch toughness values

The new rule aims to accurately identify asset materials and thus ensure the safe operation of onshore oil & gas pipelines.

Material Testing

Key Differentiators:

- TIR equipment & personnel are readily available.
- The TIR NDE technicians are cross trained and capable in the execution of our PMI method along with other "in-situ" NDE functions, namely UT, PAUT, MPI, Soil Resistivity/PH, Coating Inspection, External Corrosion Direct Assessment (ECDA), Internal Corrosion Direct Assessment (ICDA).

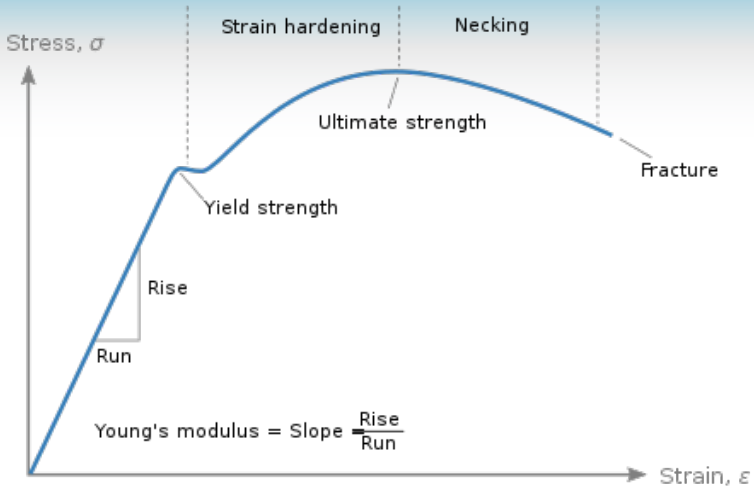
TIR has developed a PMI process which provides a Non-Destructive Method of identifying both the chemical and mechanical properties of the material:

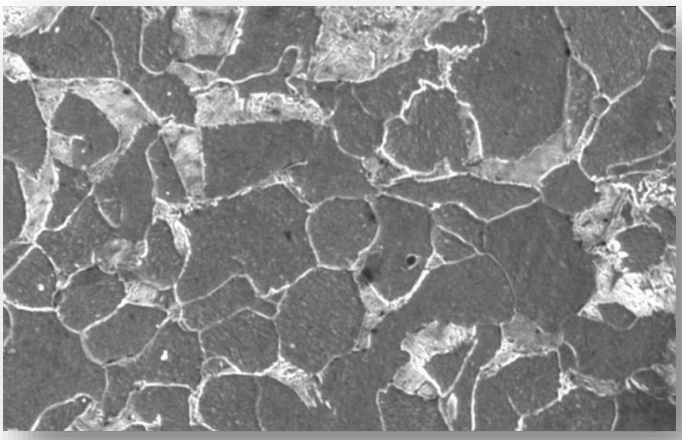
- Proven and repeatable PMI process
- Provides Traceable, Verifiable, and Complete material properties for inclusion in the operators "TVC records".
- Combines the relationship between chemistry, hardness, geometry, microstructure of Ferrite/Pearlite, and metallic inclusions to determine the Ultimate Tensile Strength & Minimum Yield Strength of tested material.
- Utilizes a proprietary material verification algorithm which has been verified by both internal and client trials.
- Avoids cutouts, line shutdowns and hydrotests.
- Provides a reliable non-destructive "in-situ" pipeline analysis.
- Highly accurate and effective alternative to existing PMI technologies.

Hardness Testing

Applications for TIR NDE- PMI Services:

- Vintage or other pipeline assets where historical material property records are not available.
- In-service pipeline where a test coupon cannot be cut.
- Short notice call-offs. Equipment and personnel are available for quick mobilization anywhere in the US.
- To minimizing number of contractors for in-ditch services during a pipeline excavation. TIR has the capability to execute all in-ditch services related to anomaly mapping and testing, NDE functions and coating inspection.





Microstructure Analysis

INPUT values of TIR NDE- PMI method:

- Chemical Analysis – We conducted extensive testing between OES/XRF/LIBS to determine which method is the most repeatable/precise/accurate in detecting the trace elements in Carbon Steel by comparing the Limits of Detection.
- Hardness – Leeb D method
- Microstructural Observations
  - Ferrite grains
  - Pearlite volume
  - Inclusion volume
- Ultrasonic Thickness testing (UT)
- Magnetic particle Inspection testing (MPI)

Magnetic Particle Inspection (MPI)

OUTPUT values from TIR NDE mechanical examination:

- V-Notch Charpy Values
- Strength Properties including:
  - Longitudinal Yield Strength
  - Transverse Yield Strength
  - Ultimate Tensile Strength

Anomaly Dig

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