Vintage Pipelines

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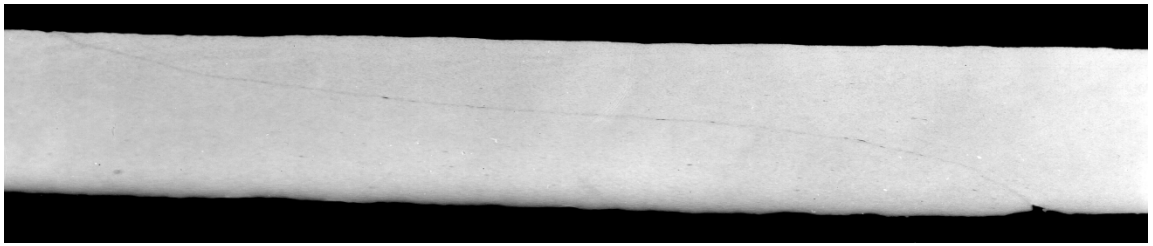
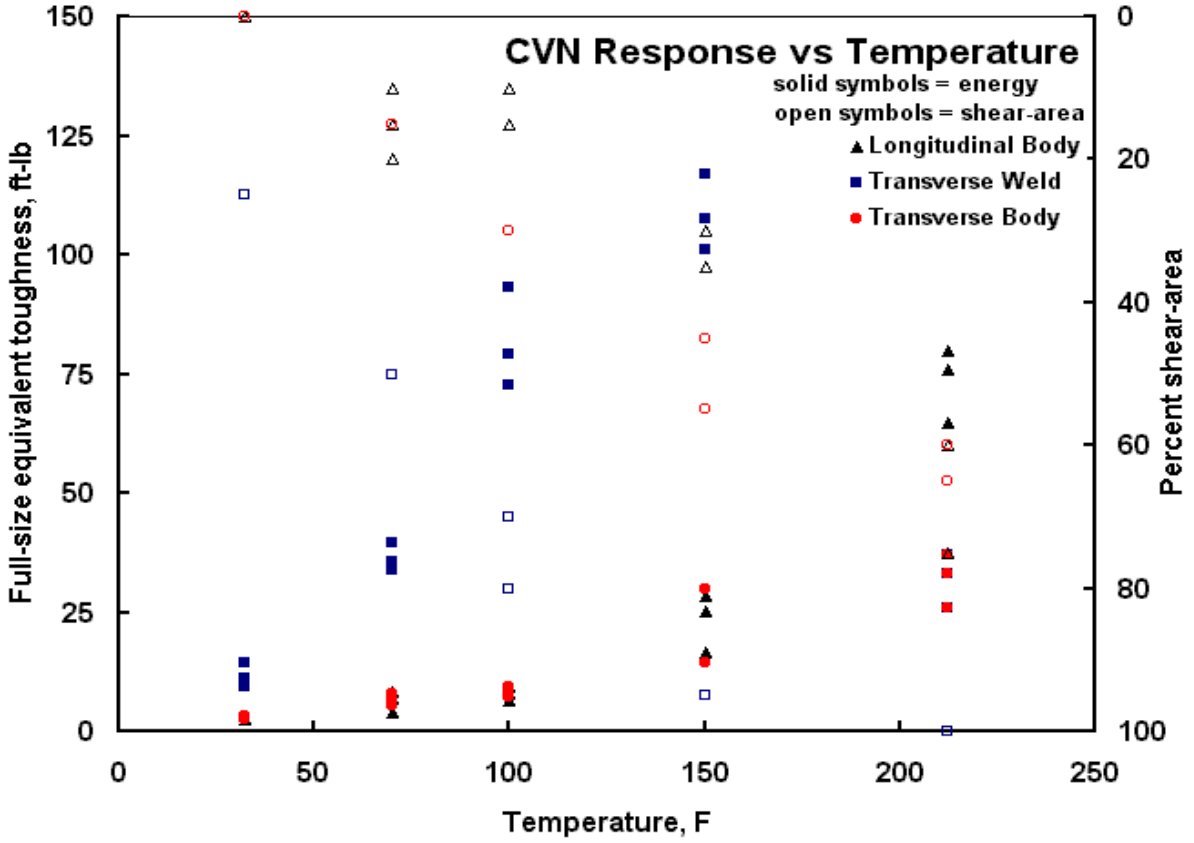
Talk focuses on some unique aspects of vintage pipelines –

What is a “vintage” pipeline?

- characterized by presence of “early” material, pipe-making, & construction practices / features used historically but since updated / replaced
- some construction aspects:
  - couplings, wrinklebends, miterbends, select joining practices like bell/spigot & welding practices (oxyacetylene)
- some material/pipe-material aspects:
  - chemistry & cleanliness (high DBTT, and occasionally lower toughness at service temperature), long seams (LFERW, Flash, Furnace (Butt & Hammer/Lap))
- Some illustrations / examples follow for unique features that have led to integrity concerns

Transition temperature and toughness





CVN response for body & lap-weld (Chalfont pipe – circa 1929)

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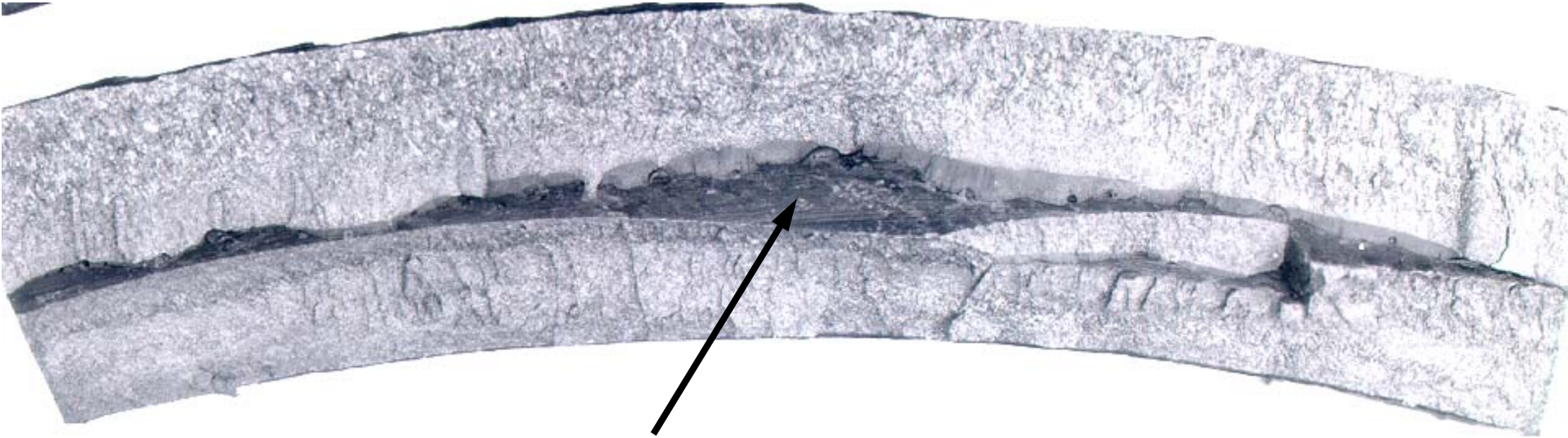
typical wrinklebend

Girth welds – process / quality issues & loading



LOF defect near mid-wall enveloped by area of fatigue crack growth

In general GWDs are stable unless secondary loadings activate them

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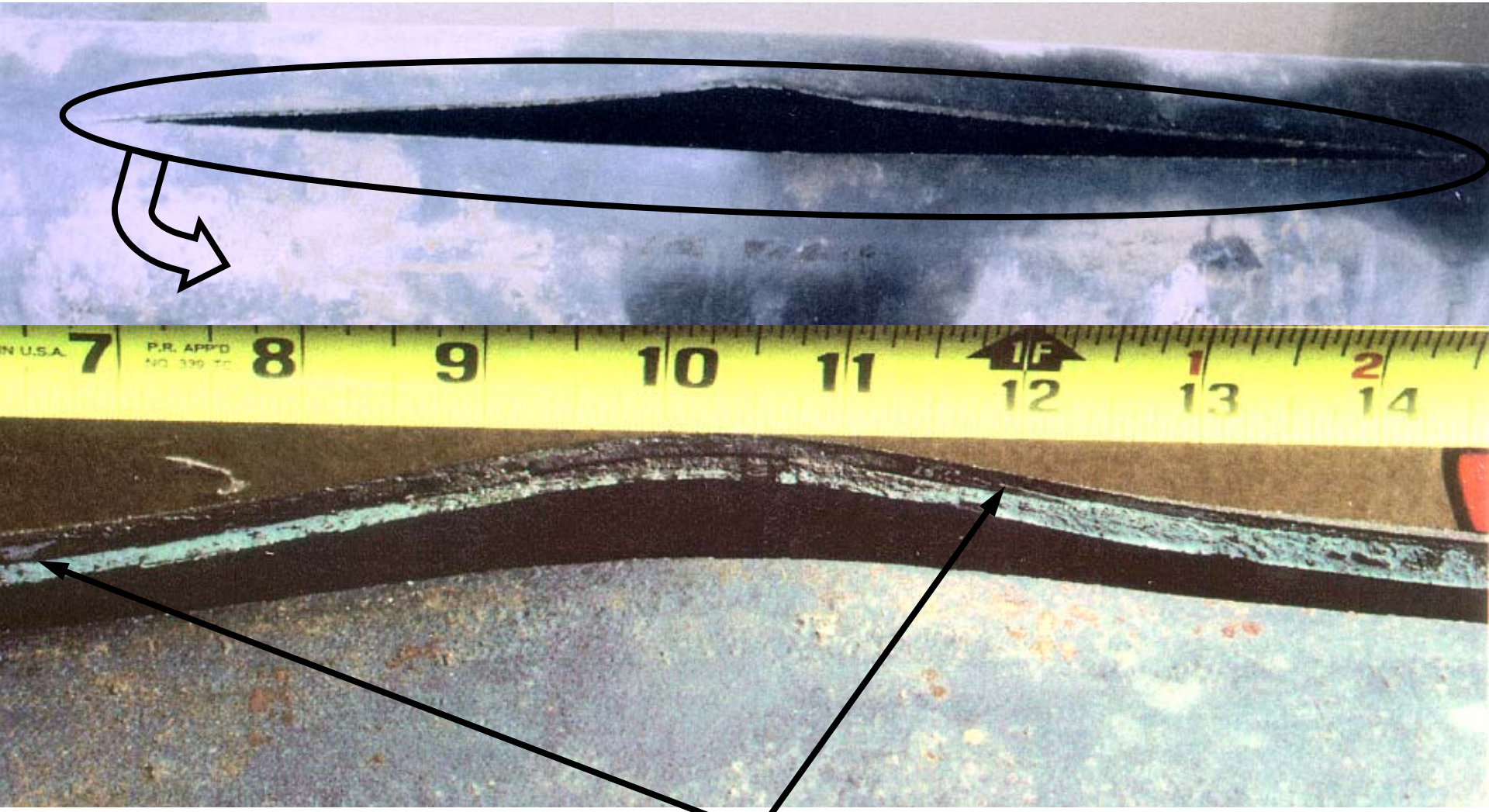

Limited fusion along the ERW seam

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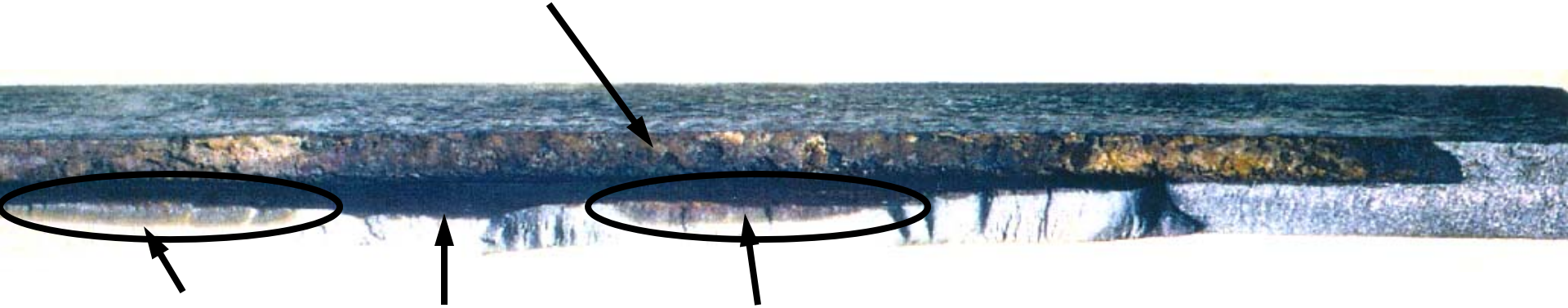
Precursor fabrication (ERW seam) defect



Fatigue cracks growing from the weld defect

Fast fracture area

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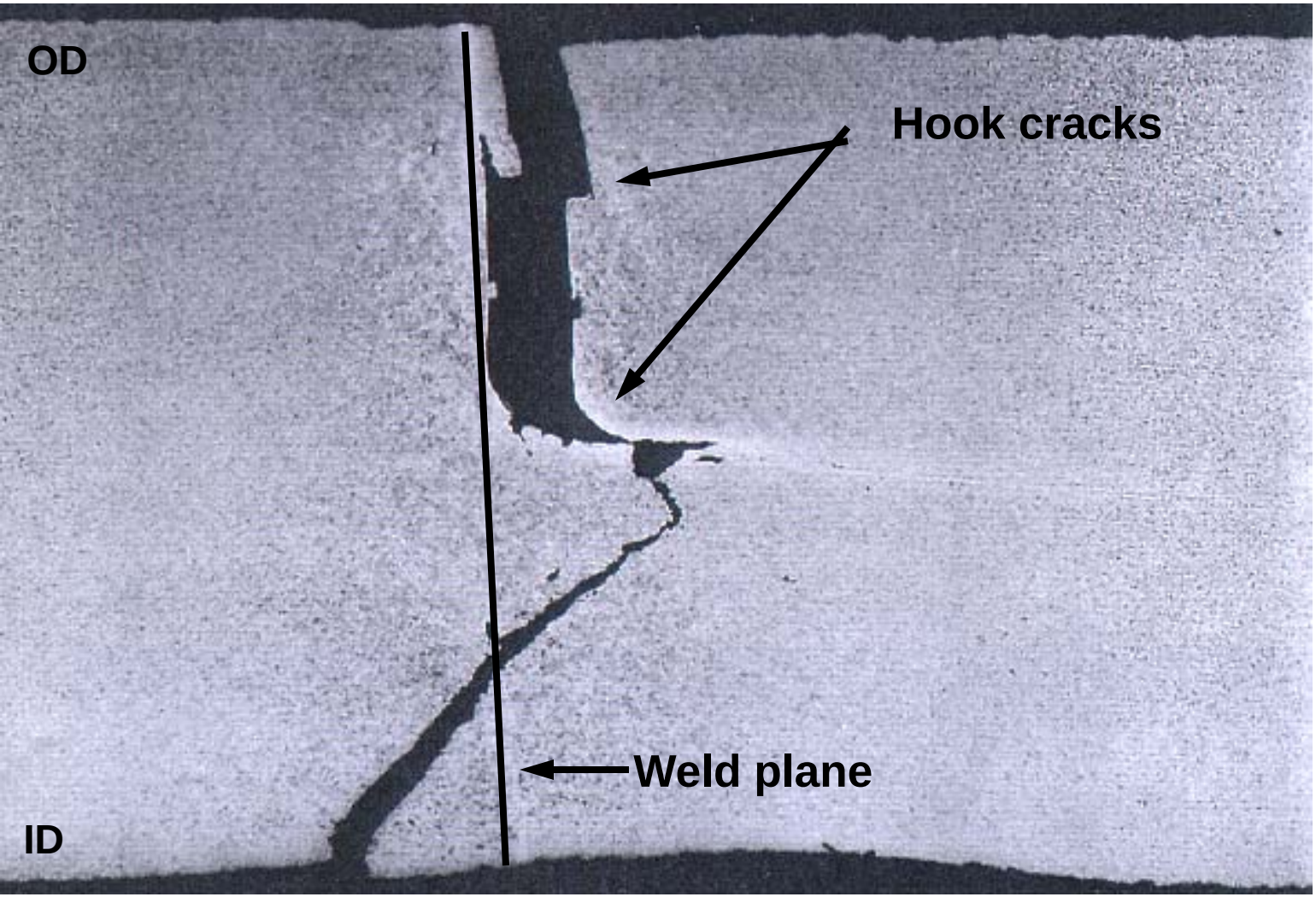

X-section of hook crack along an out-bent fiber

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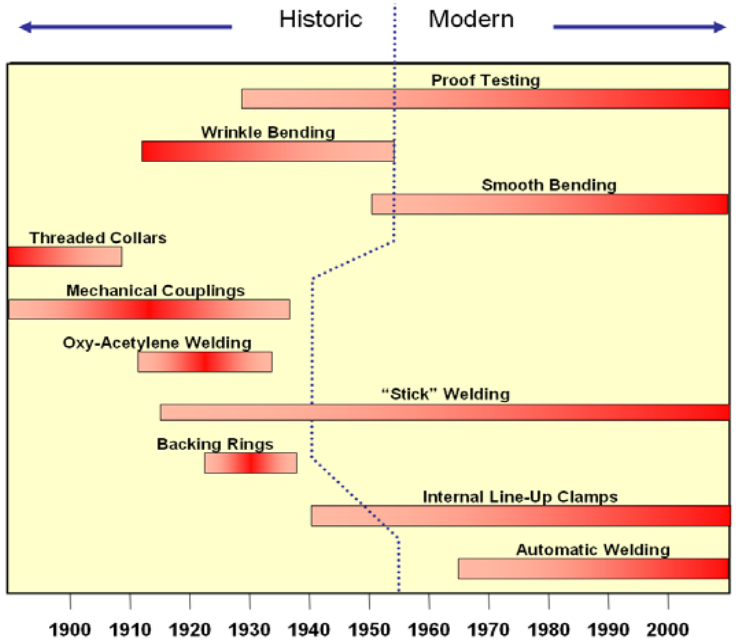
Timeline & Trends / Perspective & Outcomes

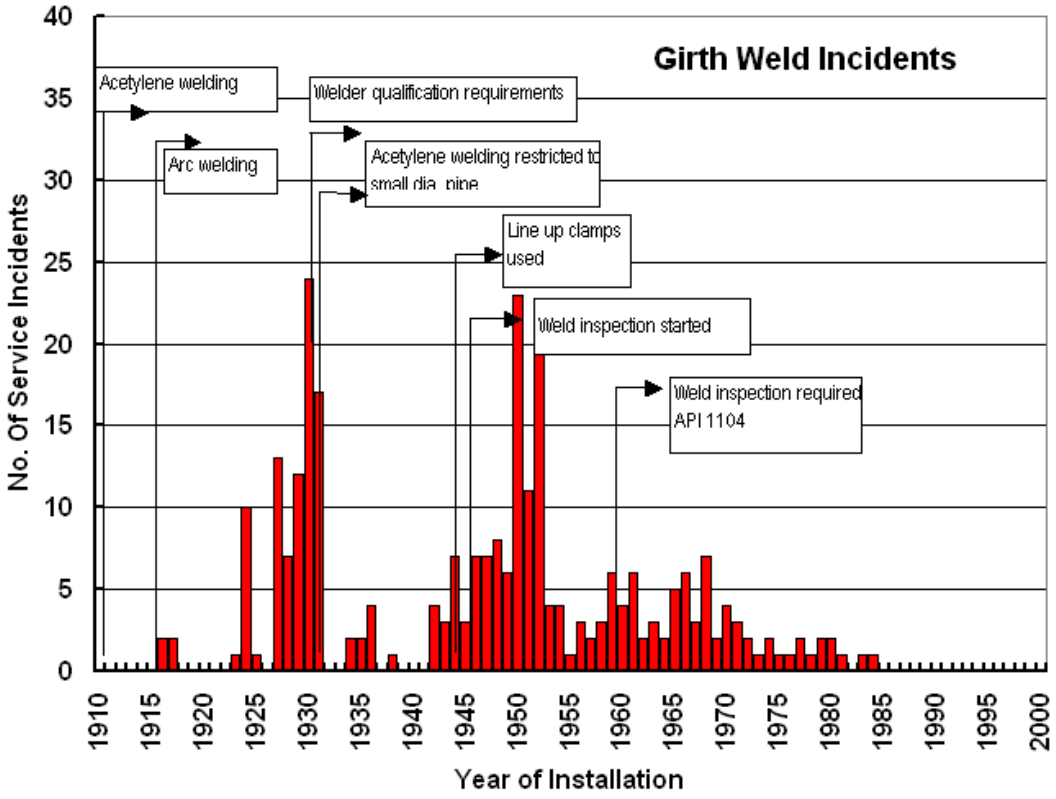


Pipeline construction practices

eg, Girth welds

major changes in processes

evolution of inspection AQ/QC



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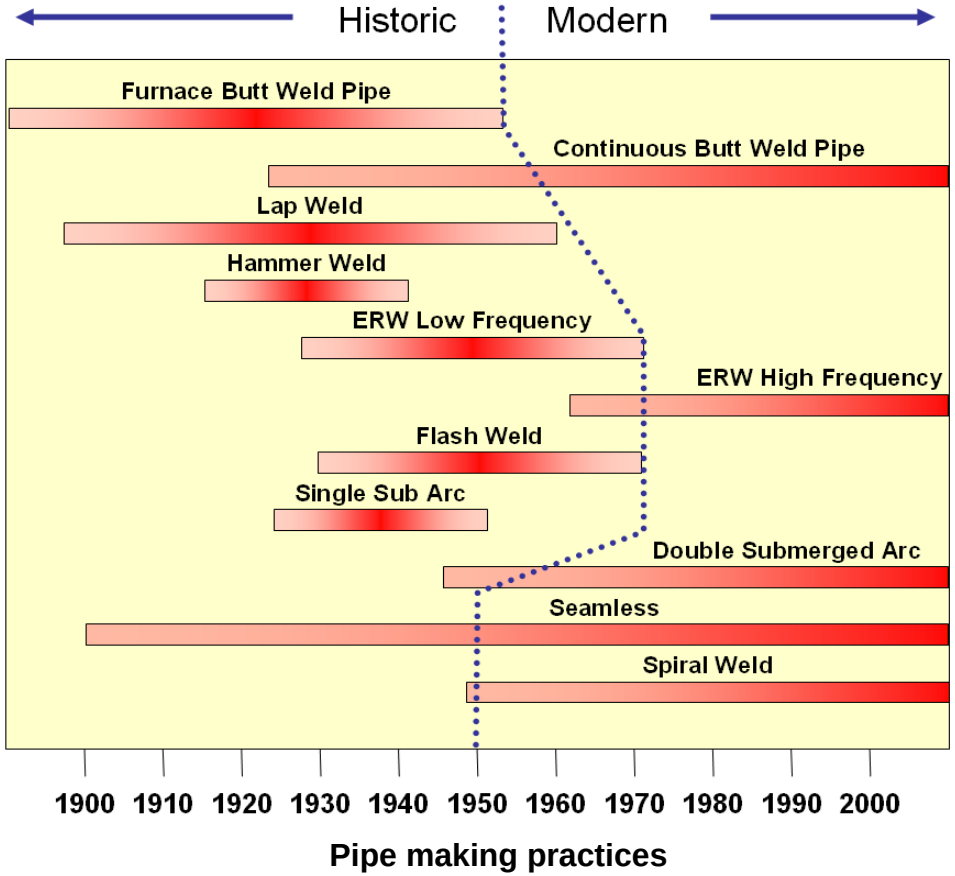
Timeline & Trends / Perspective & Outcomes



eg, ERW long-seam welds
major changes in processes (LF vs HF) & evolution of inspection AQ/QC have significantly affected control

What are termed vintage systems were built prior to ’70s with some features dropping out as early as the 50s

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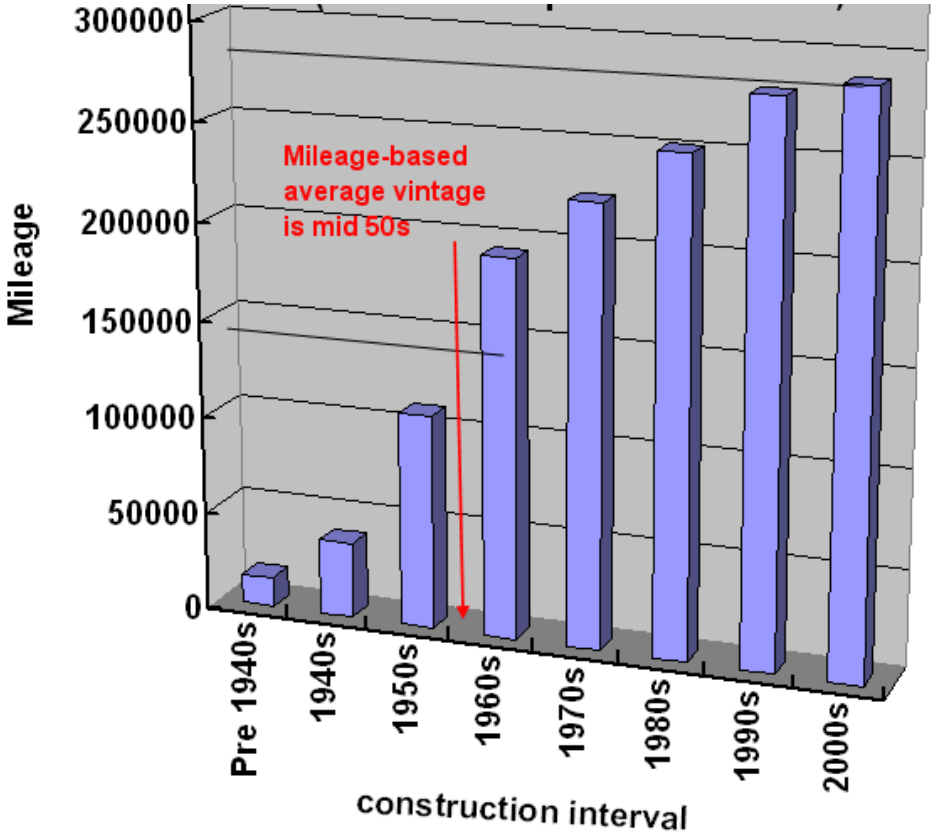
50s to 70s Timeline in Perspective



- Gas transmission data
  - > 50% built prior to 1950 with >75% prior to 1970
- Worst-case vintage features failed early – others remain benign if loadings don't activate them – so it is likely that vintage features remain in service – need to either locate & remediate if a threat, or manage – "tools" needed for both

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Oversight of “vintage” pipelines

- Codes/regulations/standards deal with such aspects case by case – sometimes exclusionary
  - language tends to have historical roots – in some cases largely unchanged since its introduction – constraints on use coupled with reduction factors
  - liquid/products requirements often differ from gas – service related with changes in gas service being food for thought
  - presence of vintage features / practices is not necessarily negative – some lines contain such features that have laid benign since the line went into service – even with sometimes significant features – thus loading and “activation” are the key drivers for problematic service
- Work on acceptance criteria indicate inconsistencies with outcomes for vintage vs “modern” high strength tough steels
  - criteria for both classes of steel have established validation – which opens to question what underlies this situation – reassessment of some of our vintage data suggests that “flow stress” reflects what appear to be “toughness-controlled” failures – perhaps need to review/reassess some of this historic “vintage” information

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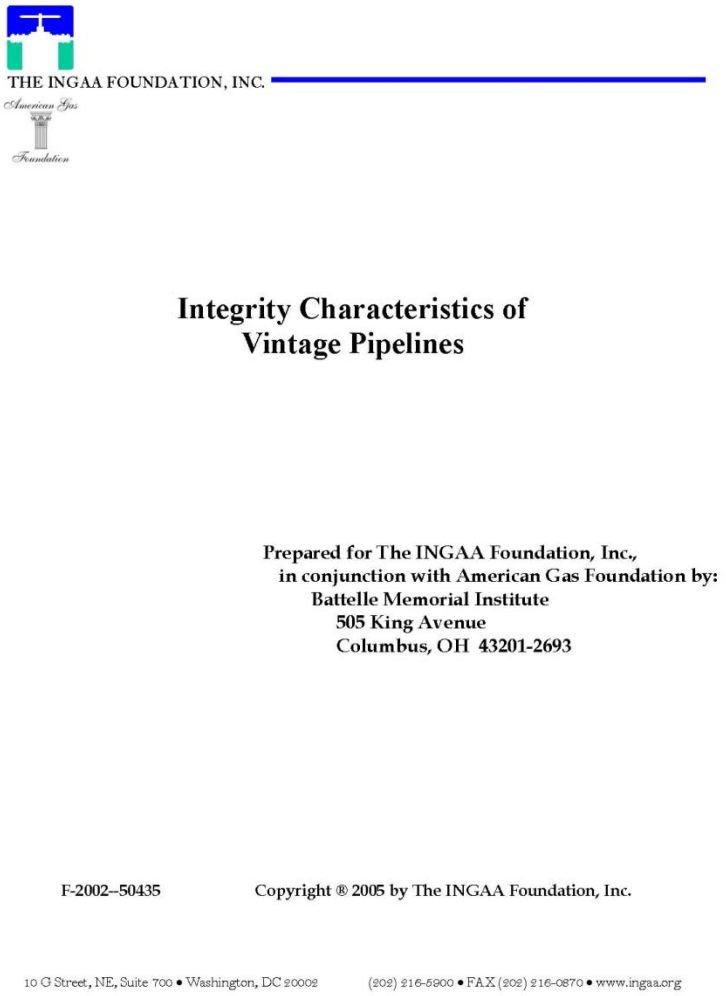
Managing Vintage Pipelines / Resources & Processes

- Much is available to guide decisions – both in concept and as detailed processes
  - GTI / INGAA / PRCI / …
  - PHMSA joint support also
  - API / ASME / NACE / …
- One example is illustrated:
  - reflects INGAA and GF funding
  - many other such documents



THE INGAA FOUNDATION, INC.

American Gas Foundation

Integrity Characteristics of Vintage Pipelines

Prepared for The INGAA Foundation, Inc.,
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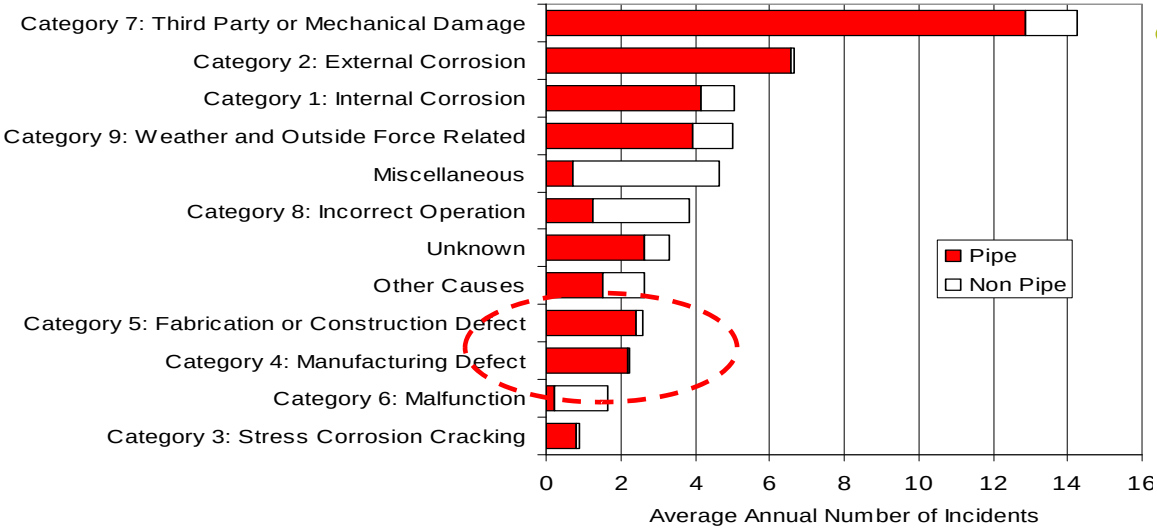
Managing Vintage Pipelines

Table 1. Categories of threats to integrity of natural-gas transmission pipelines

	Threat Category	Time Based Behavior
1	External corrosion	Time Dependent
2	Internal corrosion	
3	Stress corrosion cracking	
4	Manufacturing defects	Stable unless activated by a change in service conditions
5	Fabrication and construction defects	
6	Equipment related defects	
7	Third party or mechanical damage	Time Independent or Random
8	Incorrect operations	
9	Weather and outside force related	



Reportable natural gas transmission incidents 1984-2000

- View here is B31.8S, process of API 1160 conceptually similar
- Range of vintage features differs between gas & HL pipelines
- Its evident that threats other than vintage features occur with higher frequencies – other results note that other threats also pose greater risk – even so operators need to either excise or manage them

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Observations & Potential R&D Issues

- So called vintage behavior in materials and joining is not necessarily limited to old construction or line pipe –
  - eg, HFERW seams have failed the post-construction hydrotest – traced to apparently coincidental upsets in process and QA/QC – as for historical features such traits tend to be supplier and timeframe specific
- Tools are needed locate & remediate if remnant vintage threats, or to manage their continued service – for both blunt and crack-like defects – axial/circumferential orientation
- Need to bridge gaps between criteria used to make decisions for vintage versus modern line pipe