MCAA 25

FIND YOUR RHYTHM

What Mechanical Contracting Managers Need to Know About Piping Codes & Customer Specifications

Walter Sperko

Wednesday, March 5th
11:00 a.m. – 12:30 p.m.

Please let us know what you thought of this session

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MCAA25

Walter Sperko

What Mechanical Contracting Managers Need to Know About Piping Codes and Customer Specifications

Objective

- To make management of mechanical contractors aware of requirements associated with doing work to ASME B31 Piping Codes and to instill awareness of the need to be aware of customer specification requirements.

The Process

- Existence of the B31 Codes as standard industry practice.
- Fabrication, installation practices under ASME B31 codes
- Inspection requirements of the various B31 Code Sections compared.
- Contract and specification issues, supplementary examinations and "death clauses”
- Advertising

Notice

All statements by the speakers represent their opinions alone and do not necessarily represent the position of the ASME Boiler and Pressure Vessel Code Committee. All requests for interpretations or other inquiries relative to ASME Code and Standards should be addressed to the Secretary, ASME Boiler and Pressure Vessel Code Committee, ASME International, Three Park Avenue, New York, NY 10016-5990.

Why do we have Codes. . .

- Industrial Revolution
- Steam became a prime mover for transportation, factories, space heating
- Boilers would blow up regularly and kill people

Historical Background

- Boiler Code Committee was formed in 1911 to prepare a uniform code that could be adopted by local jurisdictions for safe design, manufacture and testing of steam boilers.
- The first edition of this safety code was published in 1914 (Boiler Code). 5 X 8 format, 119 pages
- The Boiler Code was expanded to include pressure vessels in 1928 (P&PV Code).
- The first piping code “B31” was published in 1935

BOILER AND PRESSURE VESSEL CODE

I Rules for Construction of Power Boilers
II Materials
III Divisions 1 through 5 -- Nuclear Components
IV Heating Boilers
V Nondestructive Examination
VIII Rules for Construction of Pressure Vessels
IX Welding, Brazing and Fusing Qualifications
XI In-service Inspection of Nuclear Plants
XII Transport Tanks
XIII Pressure Relief Valves

ASME B31 Code for Pressure Piping

ASME B31.1	Power Piping
ASME B31.3,	Process Piping
ASME B31.4,	Pipeline Transportation Systems for Liquids and Slurries
ASME B31.5	Refrigeration Piping
ASME B31.8	Gas Transmission and Distribution Piping Systems
ASME B31.9	Building Services Piping
ASME B31.12	Hydrogen Piping

ASME CODES

When is Code required to be followed

1) By law:
   - ASME BPVC is adopted by law in most states.
   - Piping Codes are generally not adopted by law
   - Piping Codes are invoked in industrial facilities as a result of OSHA Process Safety Management laws.
   - Some cities invoke piping codes, others refer to the IMC or UMC which have some rules on piping
   - NFPA 99 is invoked for Medical Gas Piping
   - NFPA 13 is invoked for Fire Protection Piping
   - Laws are available on jurisdictional web sites.

ASME CODES

When is Code required to be followed?

2) By contract:
   - When the code is not imposed by law, Owners and their engineers will elect to follow a Code and impose it on fabricators and contractors.
   - Most commonly occurs with piping since piping codes are not typically adopted by law.
3) Just to follow industry-accepted practices. (Due diligence to follow standard industry practice)

Consensus Aspects

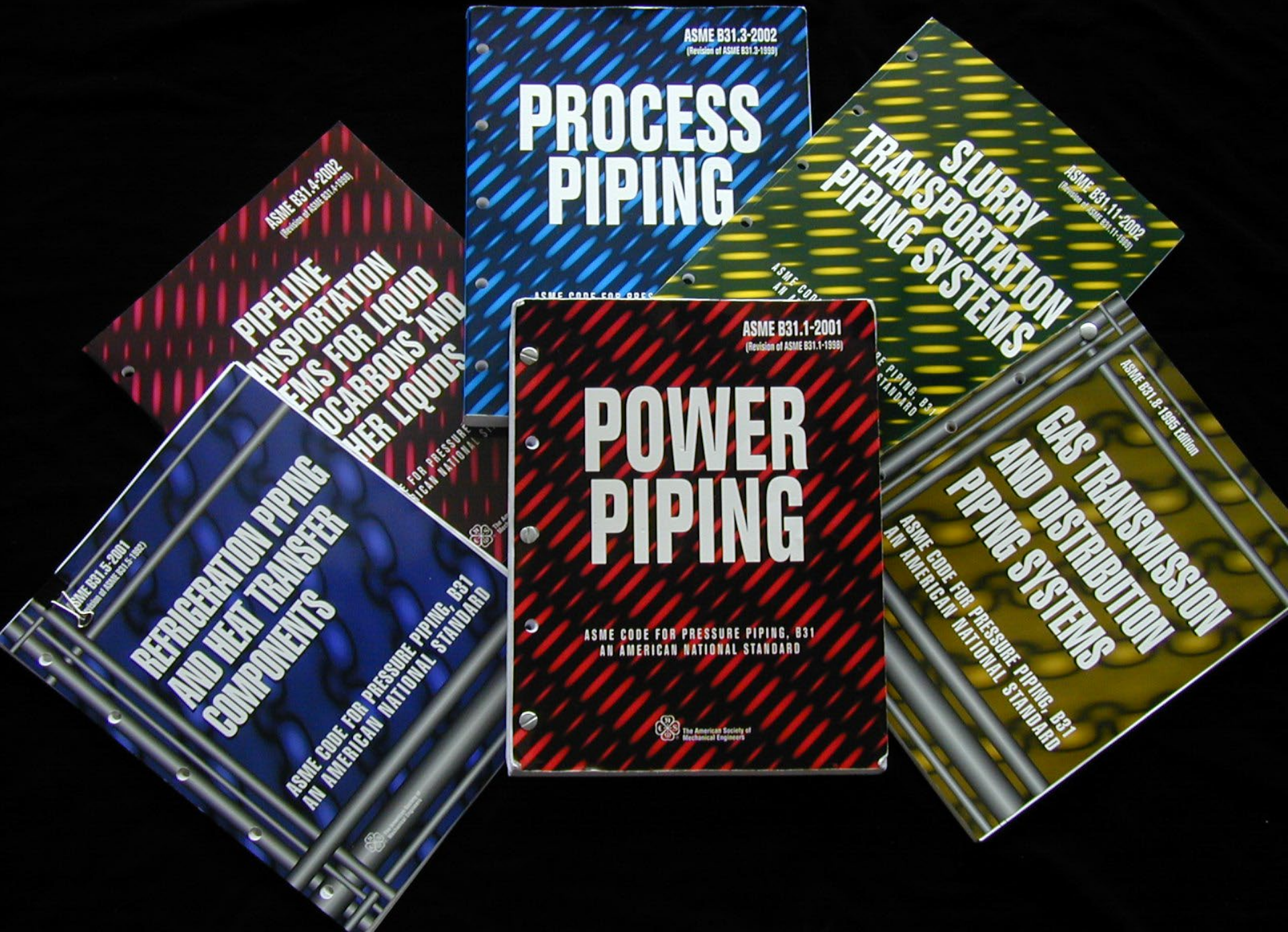
- ASME Codes are consensus standards.
- ASME Committees membership represents: designers, fabricators, constructors, inspectors, regulators, owners and general interest members.
- Representation of these interest groups is balanced on the committees. Domination by any group is not permitted.
- Code rules are issued only when consensus is reached and negative votes have been addressed.

Consensus Aspects

- Code represents Standard Industry Practice
- Under contract law, *SIP is recognized by the courts* as a basis for supporting the activities of one party or another in a contract dispute.
- Codes are in writing, clearly defining SIP

Selection of Piping Code Sections

- The most commonly referenced codes governing piping are those covered by the American Society of Mechanical Engineers ASME *B31 Code for Pressure Piping.*
- It is written in several Sections which address specific industries.


ASME B31.3-2002
(Revision of ASME B31.3-1999)
PROCESS PIPING
ASME B31.4-2002
PIPELINE TRANSPORTATION SYSTEMS FOR LIQUID HYDROCARBONS AND OTHER LIQUIDS
SLURRY TRANSPORTATION PIPING SYSTEMS
ASME B31.11-2002
ASME B31.1-2001
(Revision of ASME B31.1-1998)
POWER PIPING
ASME CODE FOR PRESSURE PIPING, B31
AN AMERICAN NATIONAL STANDARD
The American Society of Mechanical Engineers
REFRIGERATION PIPING AND HEAT TRANSFER COMPONENTS
ASME CODE FOR PRESSURE PIPING, B31
AN AMERICAN NATIONAL STANDARD
GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS
ASME B31.8-1995 Edition
ASME CODE FOR PRESSURE PIPING, B31
AN AMERICAN NATIONAL STANDARD

Selection of Code Sections

Each Section Covers:

- materials which are permitted,
- design formulae,
- sets limits on stresses,
- **specifies fabrication, installation methods and techniques,**
- **specifies the type, extent and acceptance criteria for examinations, inspections and tests**
- Maintenance and repair activities (recently added to some sections)

SELECTING APPLICABLE PIPING CODES

Introduction to every B31 Code Section says:

It is the owner's responsibility to select the Code Section(s) that most to a proposed piping installation. . . . Each Code Section should be applied as a whole to a given selection of piping. The owner is also responsible for imposing requirements supplementary to those of the Code to assure safe piping for the proposed installation

For the Owner's and your convenience, the scopes for all B31 Code Sections are posted on the B31 committee home page. Find it by searching on:

"Selecting ASME B31 Code Sections"

The URL should include "CSTools.ASME.org."

Contents of a Typical Engineering Package

Most important, the ***very first thing to look for in the Engineer's Specification or Drawings*** is:

1) Reference to a specific B31 Piping Code Section for the job or for each system.

Contents of a Typical Engineering Package

- If the specification lists all the codes and standards known to God related to piping, welding, bricklaying and steelwork. . . .

Contents of a Typical Engineering Package

Then the specification says:

“Install the piping in accordance with the applicable Code Section. . . “

Look out!!!

Why?

B31 Code for Pressure Piping

It is possible for more than one of the Sections of B31 to apply. For example, within a refinery, there may be a power plant, there may be refrigeration or cooling systems and there may be office buildings.
Your contract is to install the HVAC piping in the office building. . .

Which B31 Section applies?

B31 Code for Pressure Piping

- B31.1, Power Piping, covers piping used in power generation facilities and central district heating plants, including water, steam, gas, vacuum and compressed air.
- B31.3, Process Piping, covers all piping within chemical process plants and petroleum refineries.
- B31.5, Refrigeration Piping, covers ammonia, chlorofluorocarbon and other gas piping used in refrigeration piping.
- B31.9, Building Services Piping, covers water, air and steam piping which is inside or services buildings such as office buildings, motels, hospitals, etc.

If a B31 Code is not specified in contract documents, state which Section you will follow in your quote :

- Recognized Standards
- safety standards that are widely used
- They Provide basis for contractual defense of the quality of installed work
- They are Standard Industry Practice which is recognized by the courts under contract law in the resolution of disputes.

Common Welding And Brazing Processes for Piping and Pressure Vessels

Welding Processes

Welding Process Formal Name/Description	Common Name	Relative Cost[1]	Welder/Brazer Skill Level	Equipment Complexity	Shielding Gas [2]	Welding Positions
Shielded Metal Arc (SMAW) Using E6010, E7018, E308-16, etc.	Stick	20	Medium-High	Minimal	None	All
Shielded Metal Arc (SMAW) Using E7024, E7028, E308-26	Stick, Jet-rod	7	Low	Minimal [3]	None	Flat [4]
Gas Tungsten Arc (GTAW)	TIG, Heliarc	100 [5]	High	Simple	Yes	All
Gas Metal Arc (GMAW-S) Short Circuiting Transfer	MIG, Micro-wire	12	Medium-High	Medium	Yes	All
Gas Metal Arc (GMAW) Spray Transfer Mode	MIG	3	Low	Medium to High	Yes	Flat
Gas Metal Arc (GMAW-FC) Flux core Wire	Flux core Dual-shield	8	Medium-Low	Medium	Yes	All
Gas Metal Arc (GMAW-FC) Flux core Wire	Flux core Dual-shield	3	Low	Medium to High	Yes	Flat
Gas Metal Arc (GMAW-FC) Self-shielding Flux core Wire	Innershield	15	Medium-High	Medium-Low	No	All
Submerged Arc (SAW)	Sub-Arc, “Automatic”	1	Medium Low	High	No	Flat

[1] Higher Numbers indicate more costly processes to use.
[2] Protection from wind is needed when shield gas is required.

elding

Gas Metal Arc Welding (GMAW)

- Commonly known as ‘MIG (Metal inert Gas).”
- Deposition rates 3 to 4 times faster than SMAW (stick)
- Less welder skill required
- Minimal post weld cleaning is required
- All-position capability
- Welds can be made with fewer starts and stops especially when the weld is rotated

Modern Pulsed Power Supply waveform control technology

- All Settings are preprogrammed.
- Welder enters filler metal size, type, shielding gas, computer sets basic pulse parameters.
- Welder can adjust wire feed speed and arc intensity.
- Makes a so-so welder into a great welder using waveform control technology

Miller Pipe Pro

PipePro™ Welding System

The one-package pipe welding solution for both field and shop fabrication. Multiprocess capabilities include new patented RMD Pro and Pro-Pulse which are optimized for steel and stainless steel pipe.

PipePro 450 RFC shown with PipePro Bench Feeder and Bernard PipeWorx Gun

See the Advanced Software Technology featured on the PipePro System CD:

RMD™ Pro (Regulated Metal Deposition) - Precisely controlled short-circuit transfer technology provides welders with an easy to use welding process with excellent puddle control for the root pass. Calm, stable arc/puddle reduces weld training and improves quality.

Pro-Pulse™ - This method of pulse welding is easier to use than conventional pulse in out-of-position pipe welding applications. This is accomplished through precise control of the arc and puddle even in narrow joints, which provides optimum molten puddle control for out-of-position welding.

The **PipePro 450 RFC** power source

Lincoln Invertec STT

Invertec STT II 208/230/460/3/60

Featuring the Surface Tension Transfer (STT) Process

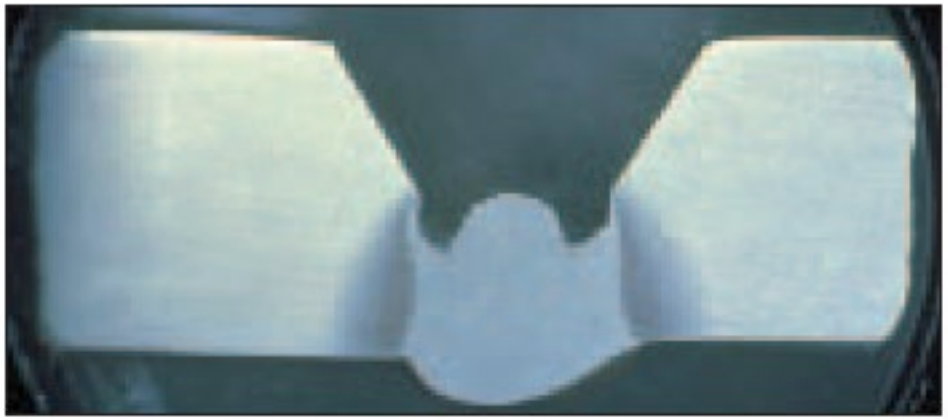
Product Number: K1525-1

Industrial Price: 8672.00 (USD) *See Details

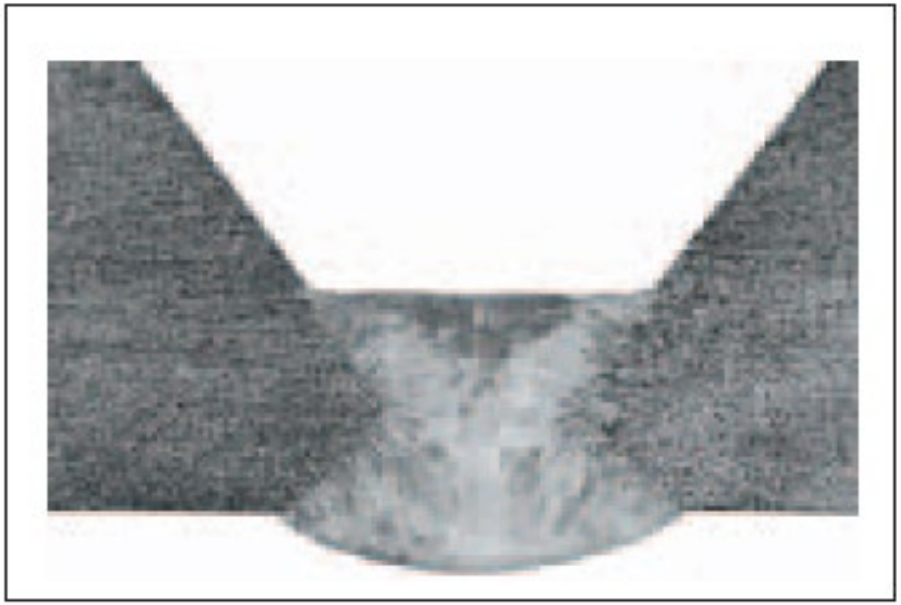
The revolutionary STT II power source combines high frequency inverter technology with advanced Waveform Control Technology™ to provide a better welding solution than traditional short arc MIG. Unlike CV MIG machines, the STT machine has no voltage control knob. STT uses current controls to adjust the heat independent of the wire feed speed, so

Root Pass Bead Shape

ROOT PASS?

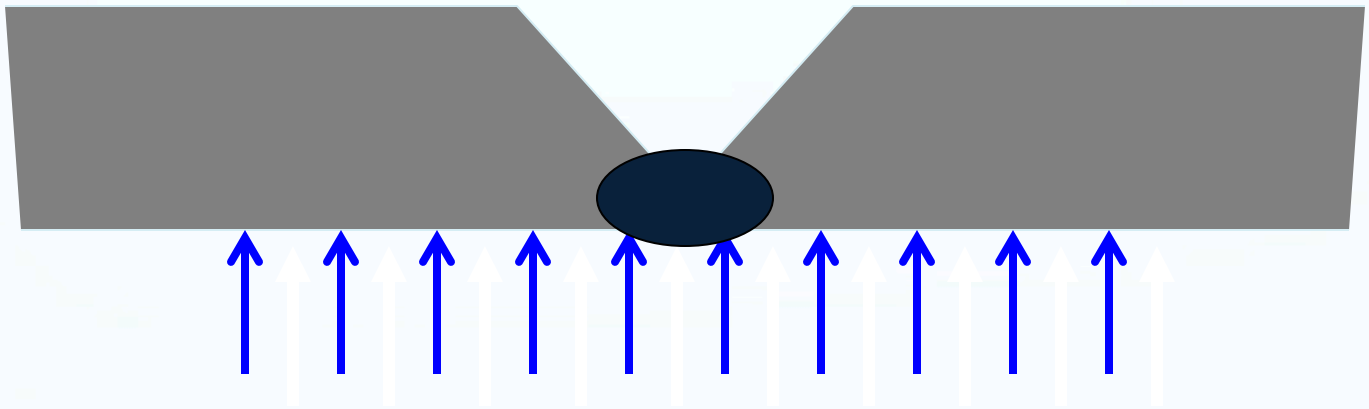


Open Root Pass with Stick Electrode



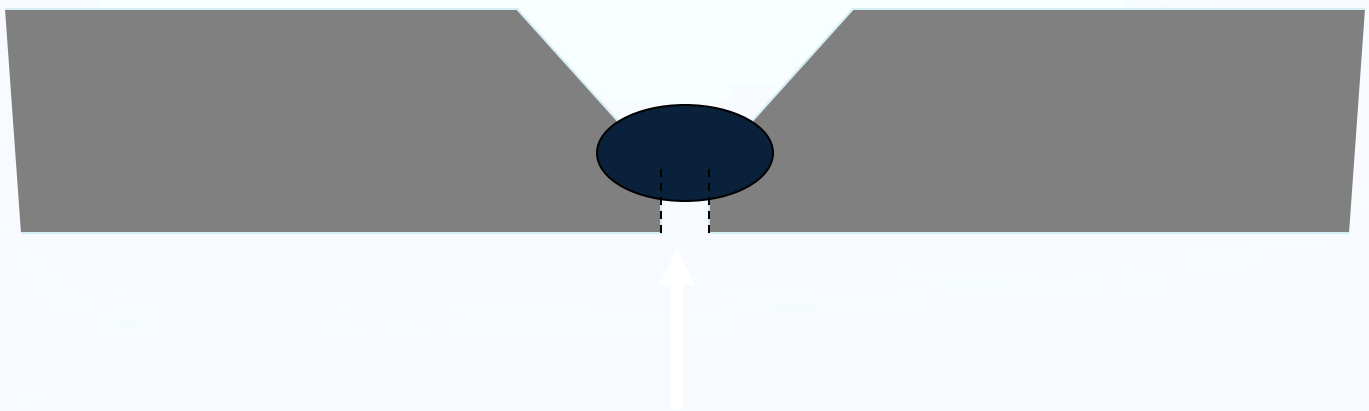
Open Root Pass with STT provides a weld ligament thickness of approximately 0.22˝.

Full Root Penetration



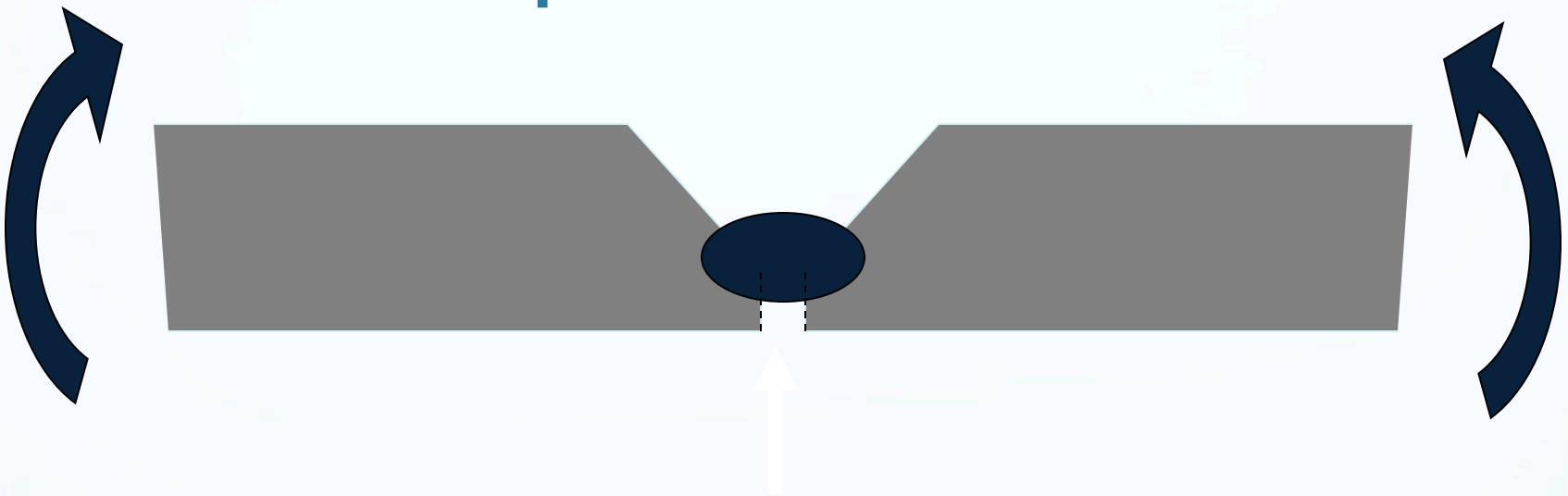
Continuous metal surface from one member across the weld to the other member without backing

Incomplete Penetration



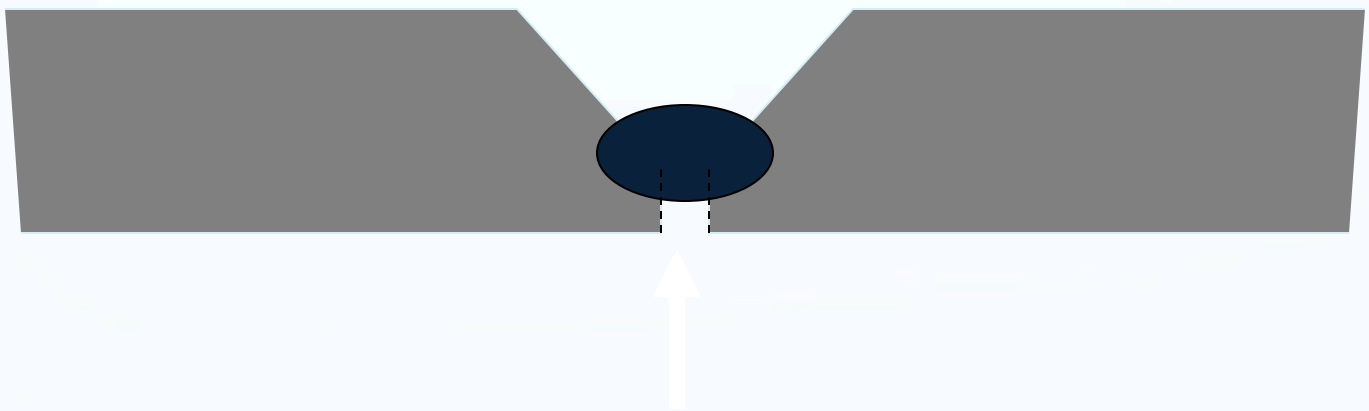
Disrupted metal surface from one member across the weld to the other member

Incomplete Penetration



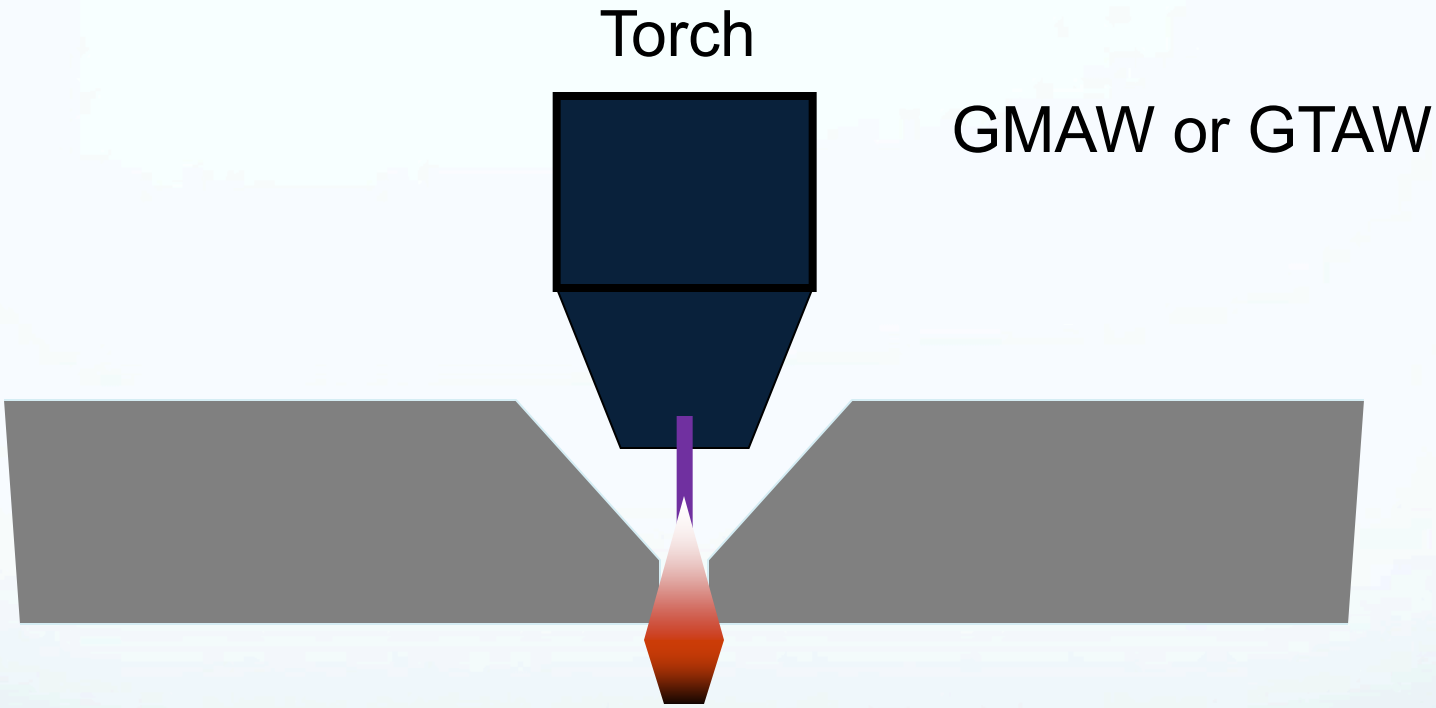
Disrupted metal surface forms a notch which can increase local stress up to 20 times the bulk section stress

Incomplete Penetration



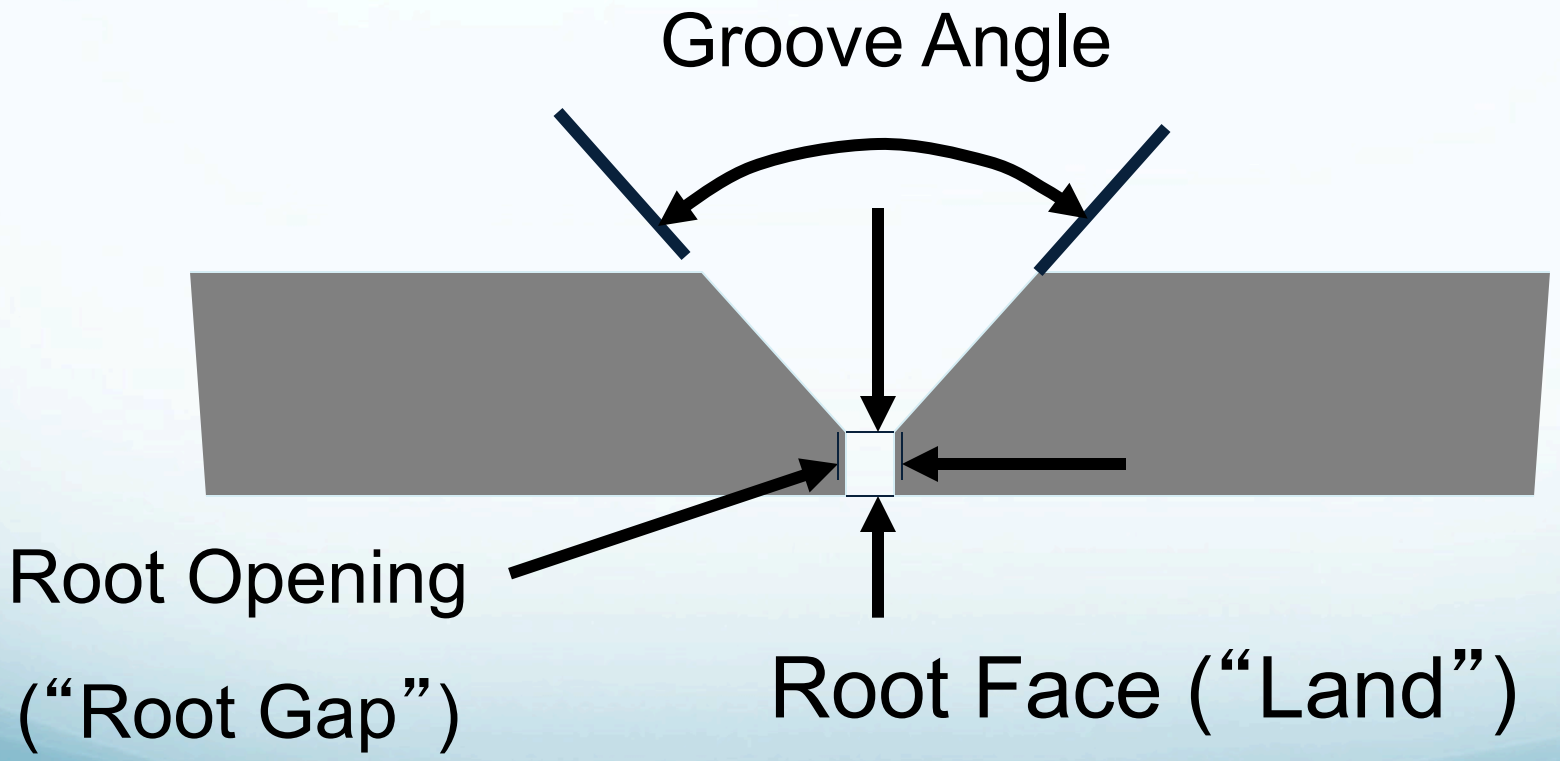
Crevice is a site for potential accelerated (local) corrosion, crud trap, bacteria trap, etc

Key to Achieving Full Penetration

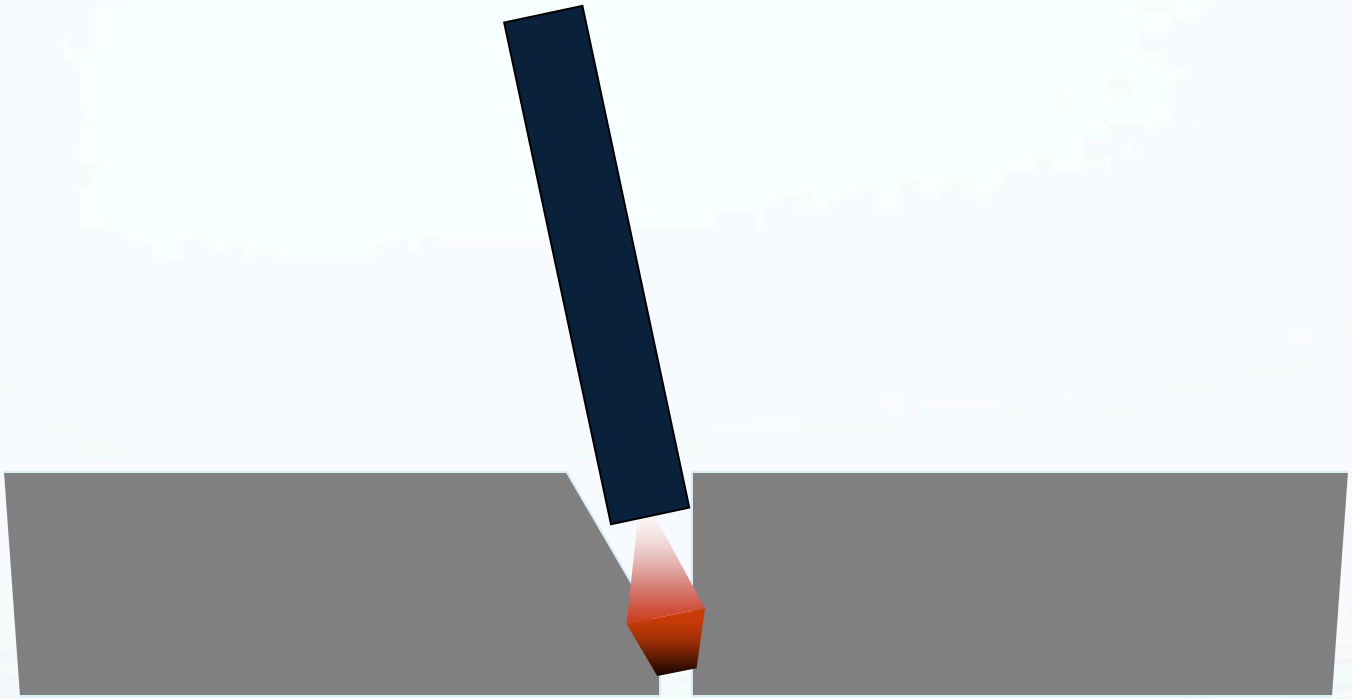


1. Blast the arc force through the root opening
2. Melt the edges of the metal, then
3. Fill the opening with filler metal

Weld Joint Groove Design

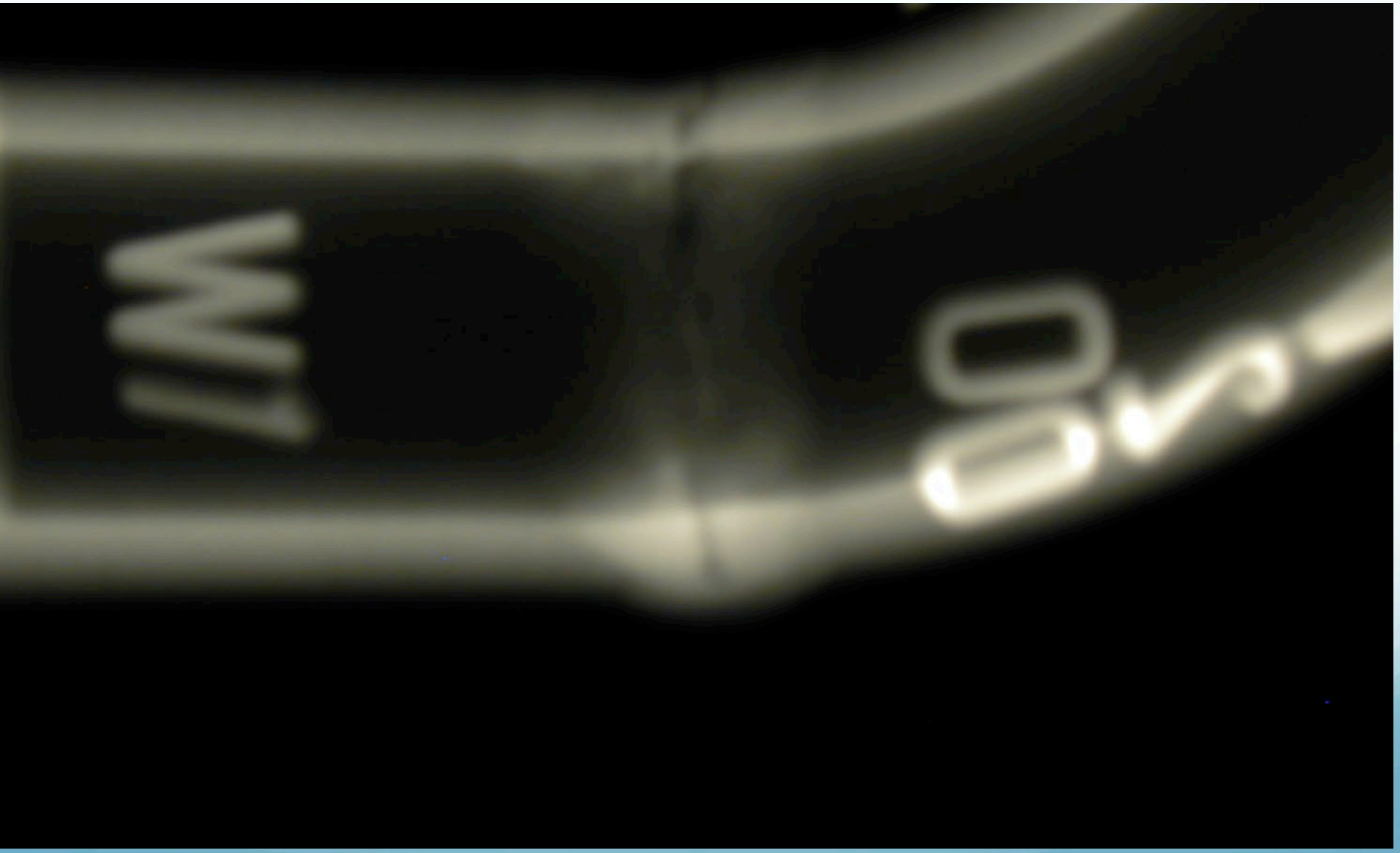


Effect of Included Angle

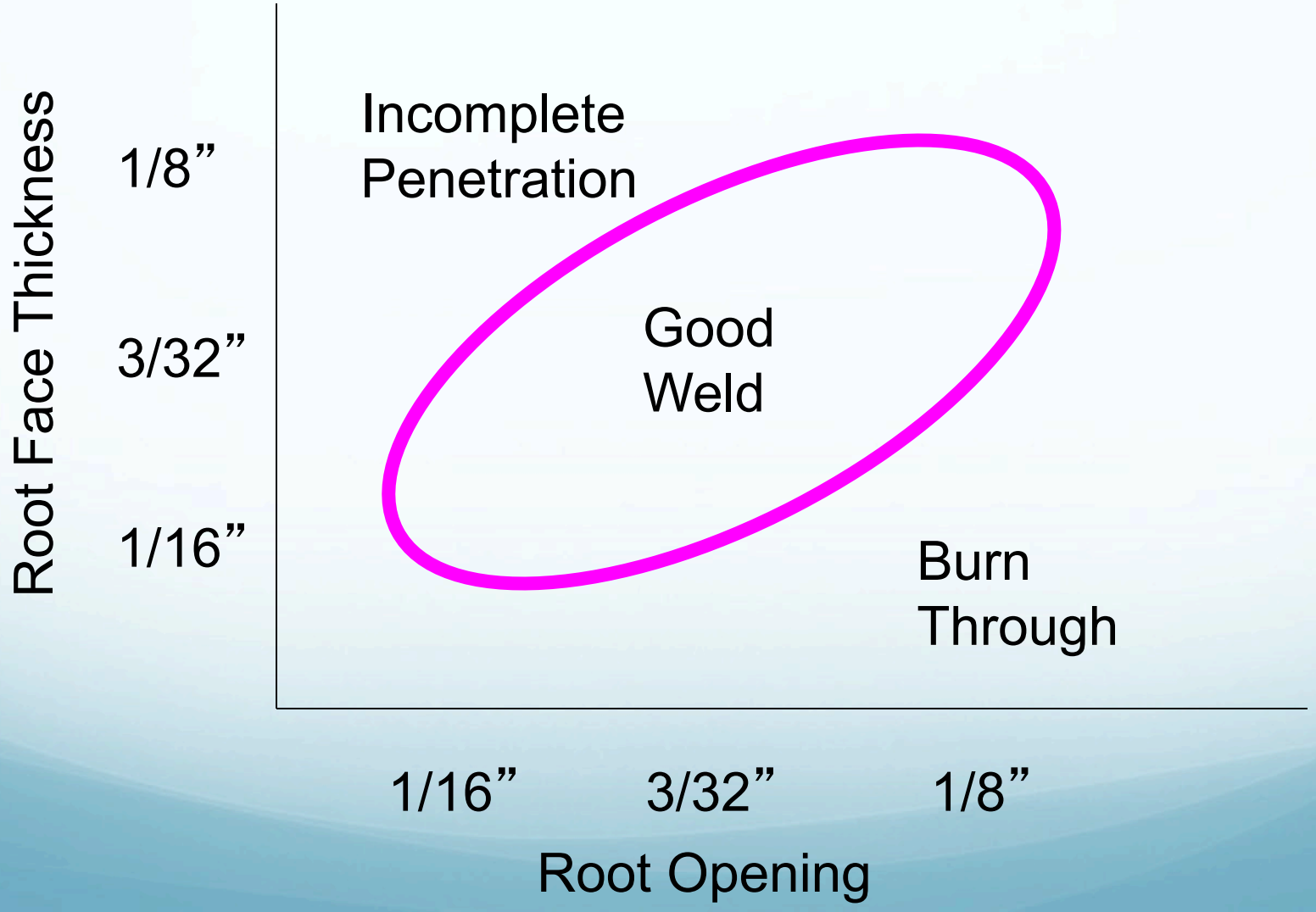


Square end to beveled fitting will lead to incomplete penetration

Incomplete Penetration



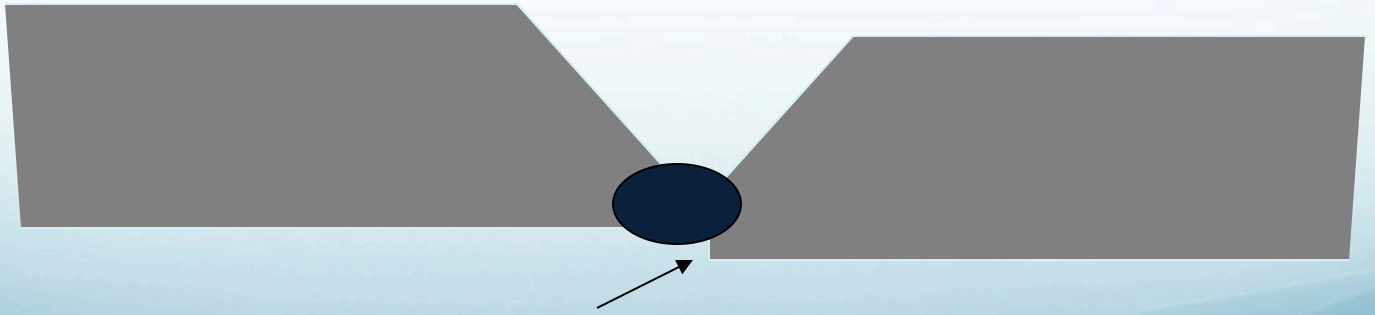
Root opening – Root Face relationship



Internal Mismatch

Excessive mismatch makes it difficult to get a good root. . . .

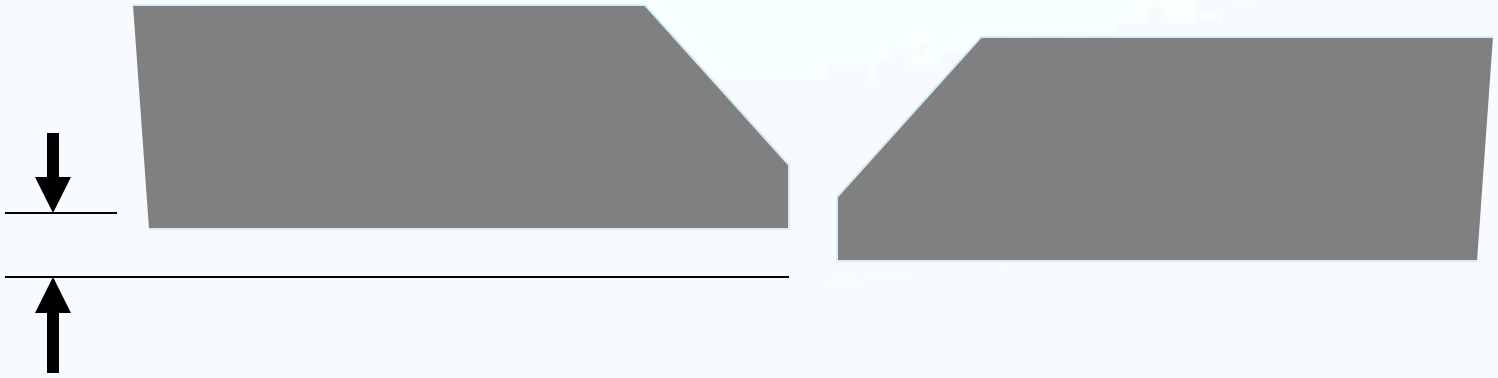
Internal (ID) Mismatch



Incomplete Penetration

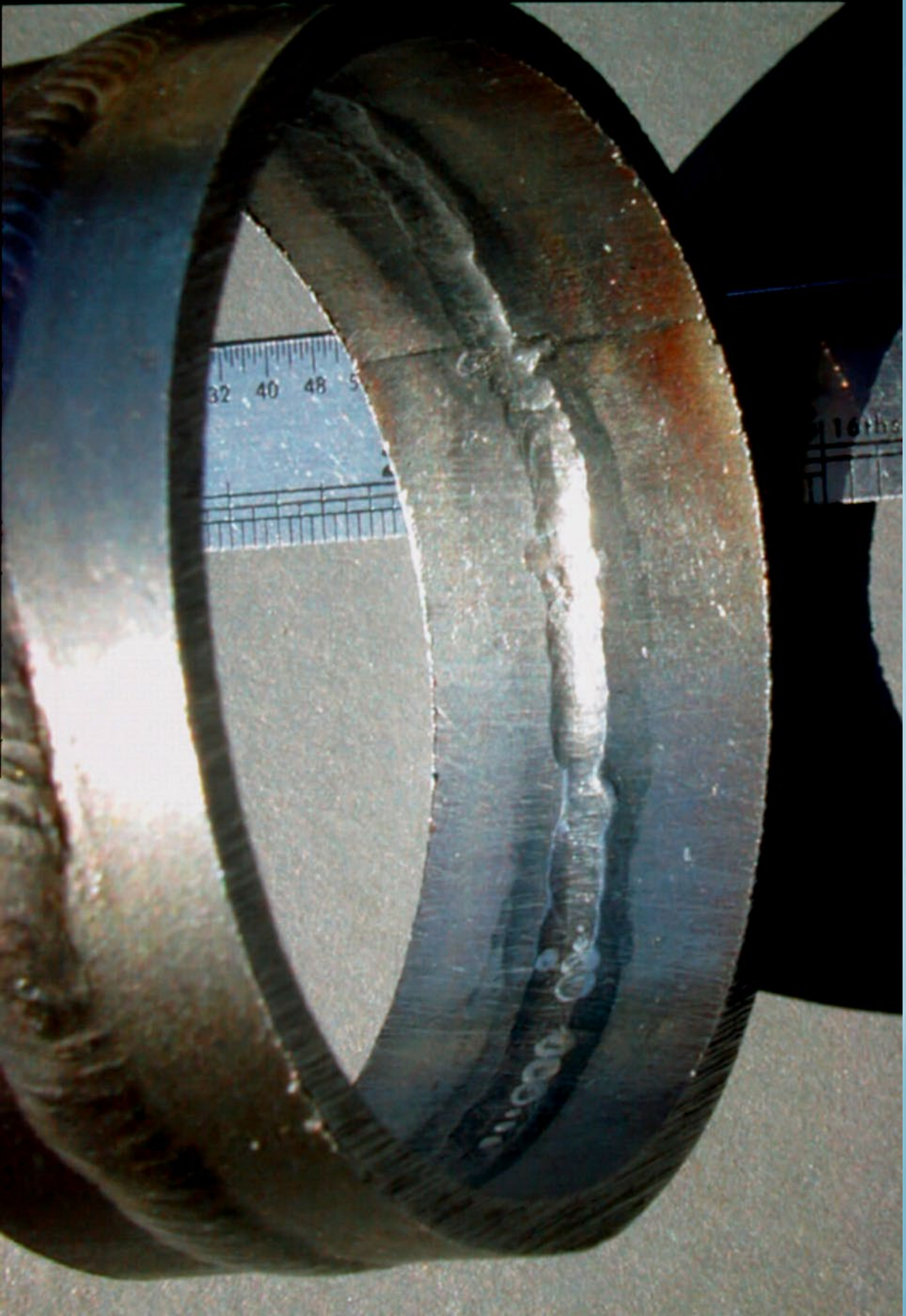
Internal Mismatch

Excessive mismatch makes it difficult to get a good root. . . .



1/16” max per B31.1, as specified by the WPS in other B31 Sections.


24
32
40
48
3
8
16
3
16ths


32 40 48

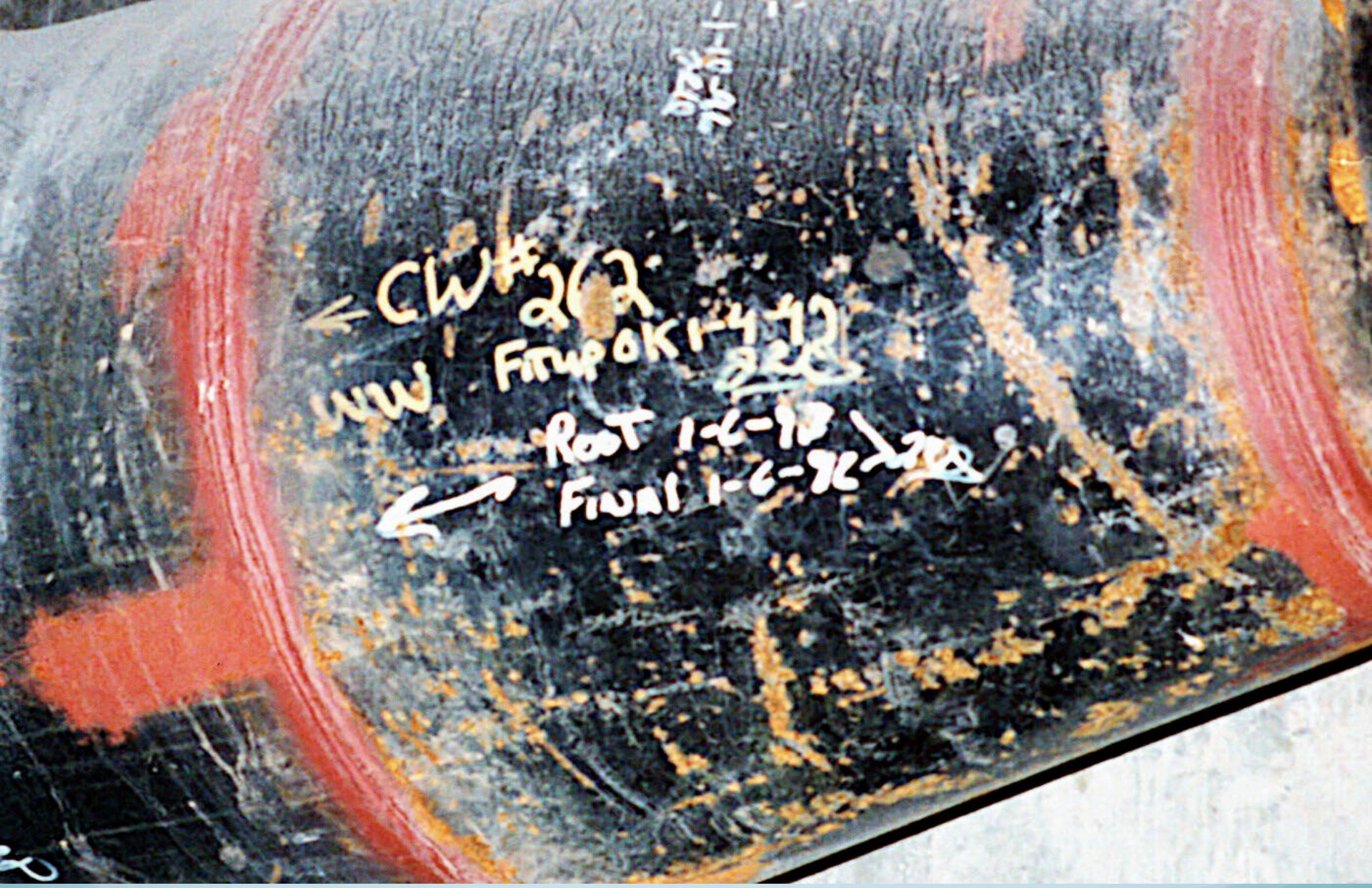
What is the most cost-effective inspection hold point?

How do I avoid this?

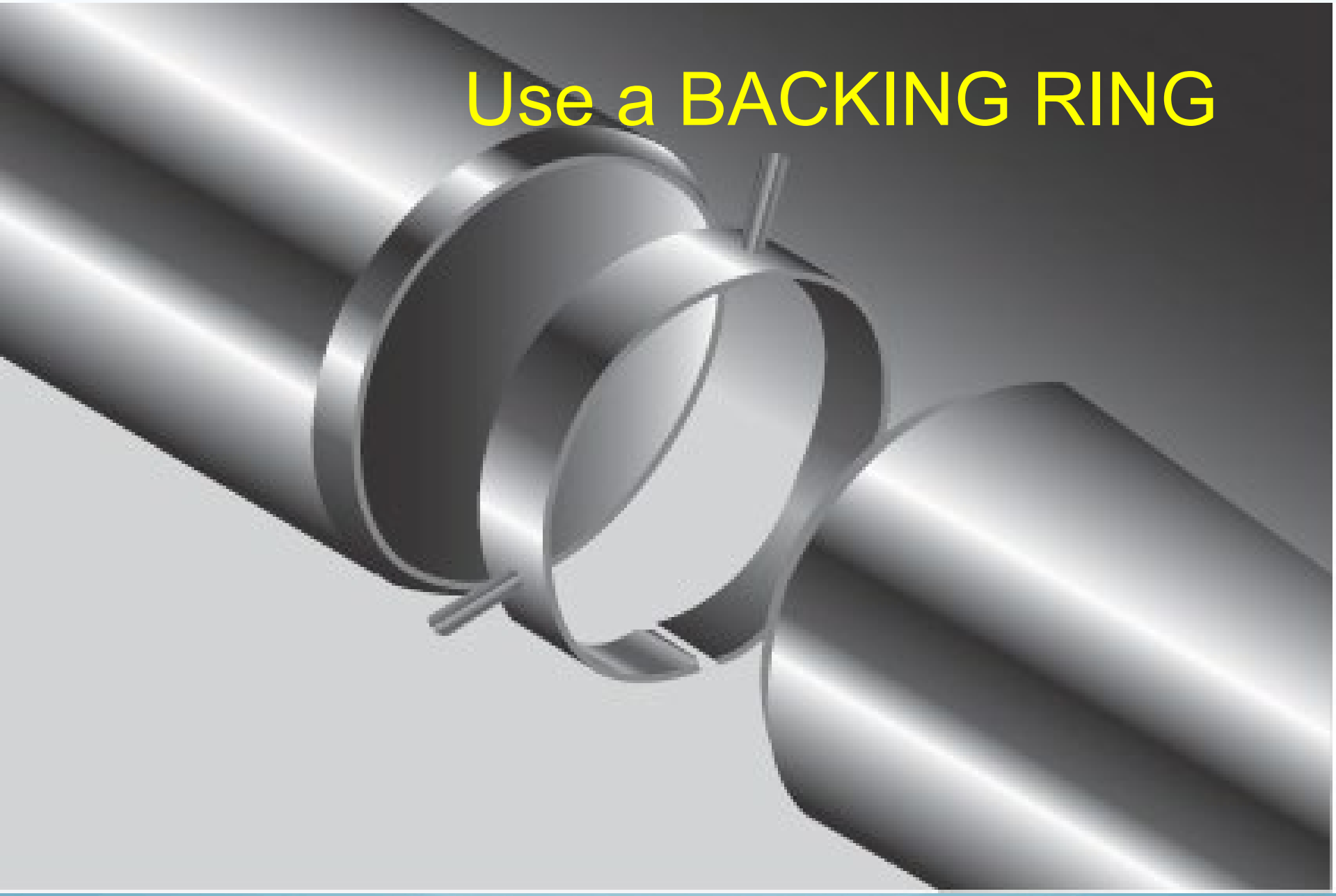
FIT-UP Inspection

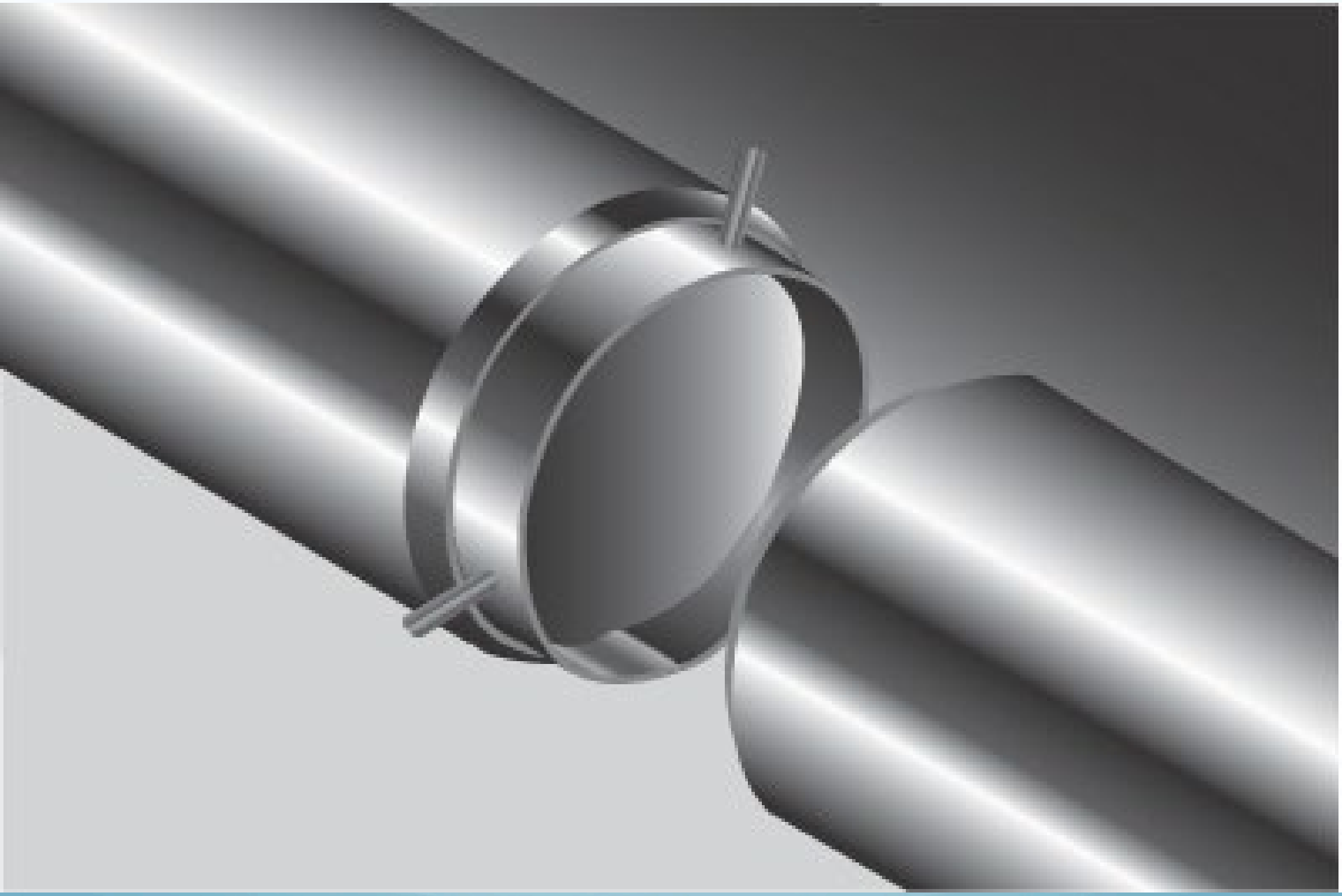
i.e., after the pipe has been cut, beveled, tack welded and ready to make the root pass

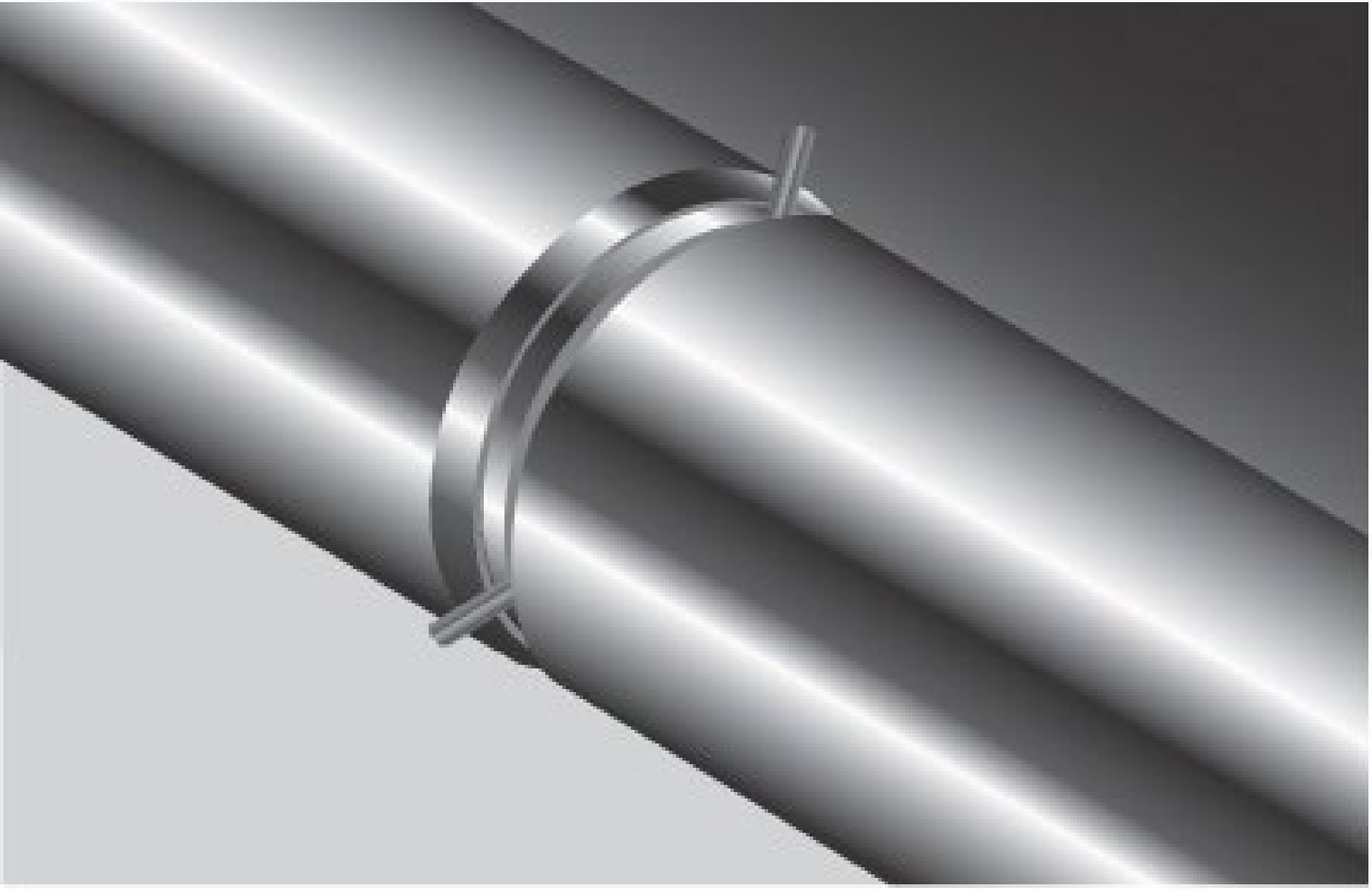
- Make sure your welders are doing a good job cutting, beveling and fitting.
- **Have someone other than the welder perform fit-up inspection**.
- Welders weld to meet the level of inspection imposed on them

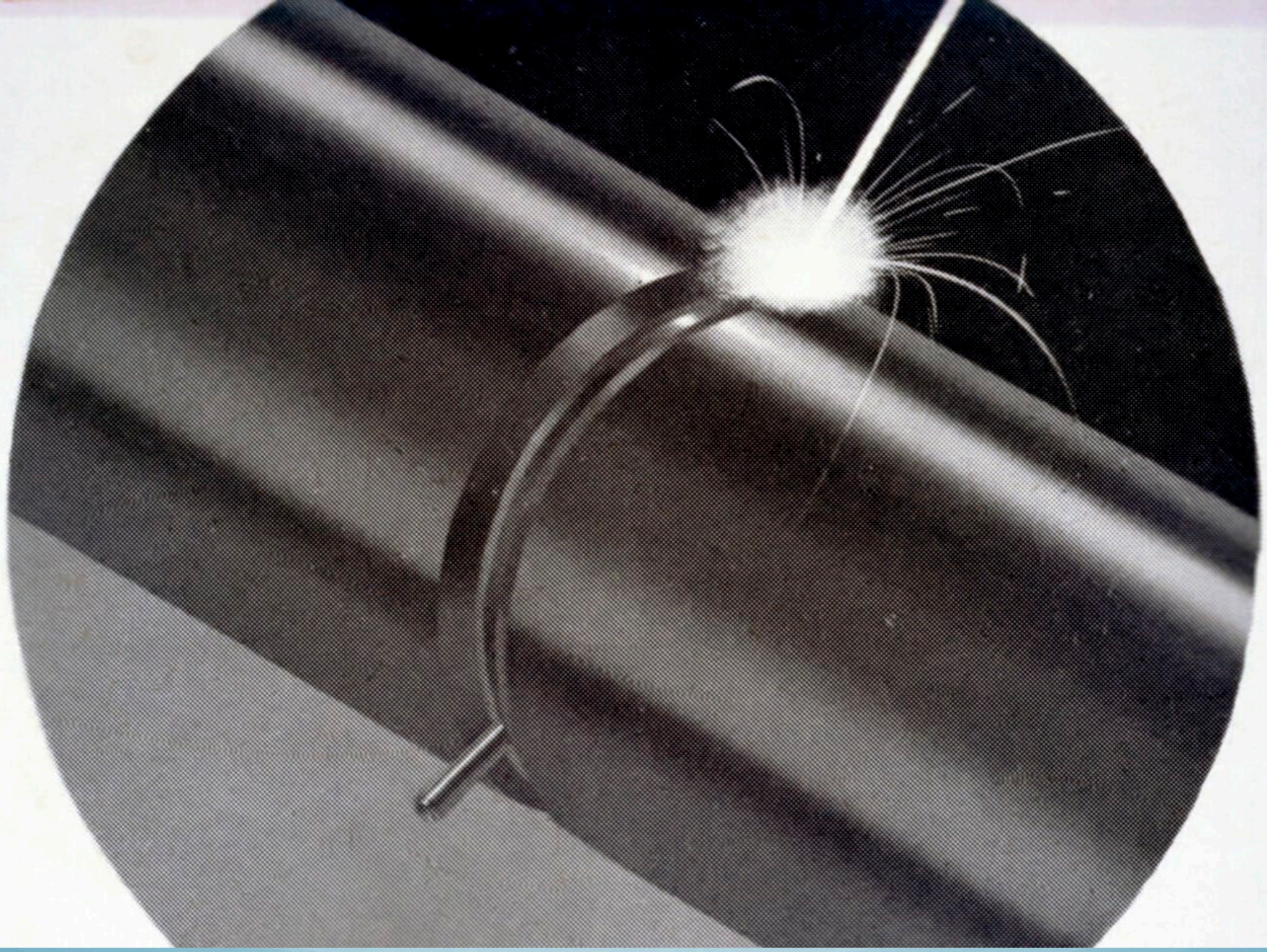

CW#2
NW
FITUP OK
ROOT
FINAL

Use a BACKING RING

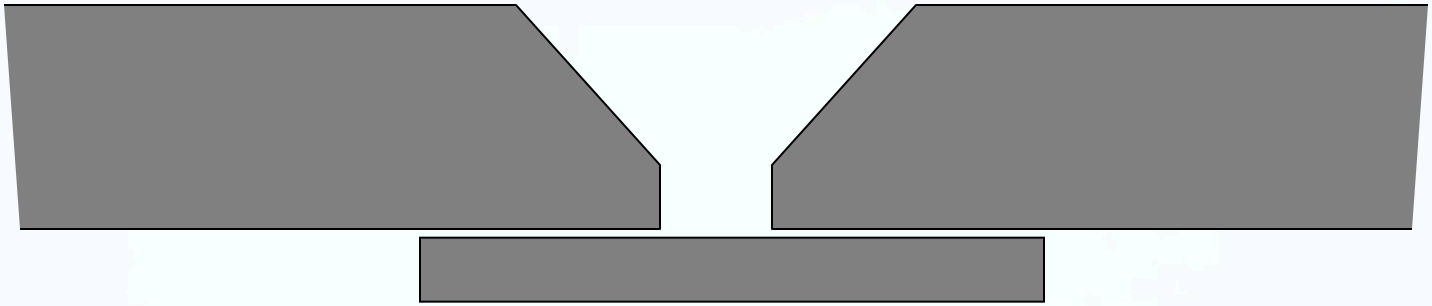









Good root gap (3/16") ensures penetration of the root pass even with a lower-skilled welder.

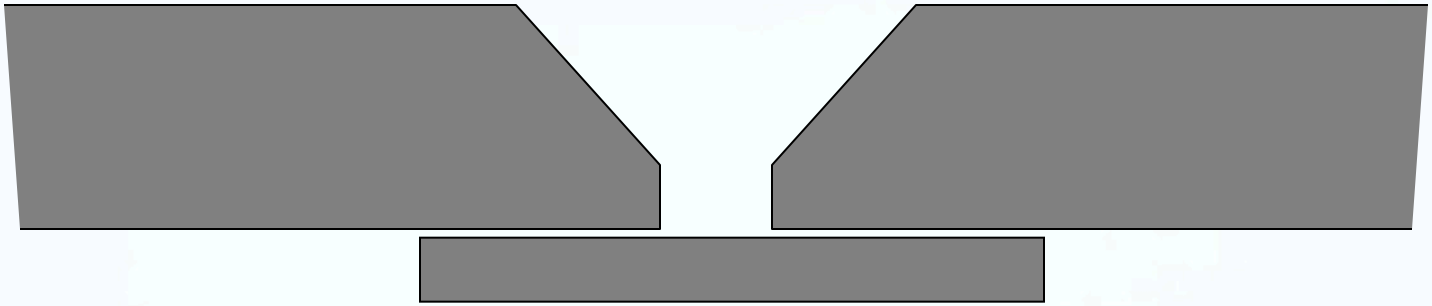


Use of Backing (“Chill”) rings

ensures that the joint will be fully penetrated.

Service Conditions may preclude the use of backing rings. Only the Engineer can determine if backing rings are acceptable.

Backing rings have been used in steam and water service on carbon and low alloy piping since the earliest use of welding for piping



Use of Backing (“Chill”) rings

Contractor bid 100% RT job using backing rings (NPS 10 and smaller Standard Weight) at 60% of LEM rates and still made a bunch of money. His welders whined at first, but once they figured it out, they did well (2 RT rejects on a job of several hundred welds.)

Examination and Inspection Examination Methods

- Radiography (volumetric)
- Ultrasonic (volumetric)
- Magnetic Particle (Surface)
- Liquid Penetrant (Surface)
- Visual (Surface)

NDE in B31.1

- B31.1 Table 136.4: (roughly)
  - 100% radiography of butt welds and branch connections that are in service over 750° F regardless of pressure.
  - 100% radiography of butt welds and branch connections that are in service over 1025 psig *and* over 1-1/8 inches thick *and* between 350 and 750° F.
  - All other welds require only visual examination.

Acceptance Criteria in B31.1

- No cracks, incomplete fusion, incomplete penetration are permitted. Slag, porosity and porosity are more restricted than other B31 Sections permit.
- No incomplete penetration is permitted *even when radiography is not specified*. This was written when backing rings were industry practice. A properly installed backing ring always results in full penetration.

NDE in B31.3 Extent

* B31.3 has Fluid Service Categories is:
  * **Normal** –**This is the default Fluid Service Category.** It requires 5% random radiography (RT) or ultrasonic examination (UT) of butt welds
  * **Category M** – 20% random RT or UT of butt welds
  * **High Pressure** – 100% RT or UT of butt and branch connections
  * **Severe Cyclic** – 100% RT or UT of all butt welds and branch connections.
  * **High Purity –** Pharmaceutical, Food and Beverage, Chip manufacture. Visual only. Borescopic examination may be imposed.
  * **Category D** – Visual examination only

NDE in B31.3 Extent

Special Note for B31.3 Normal Fluid Service:

- Requires 5% random RT or UT on a lot basis.
- Contractor gets to define lots.
- If a weld is rejected, 2 more welds made **by that welder in that lot** to be examined.
- If those welds pass, that lot is accepted, and no further RT or UT is required.
- If one of those welds is rejected, 2 more welds made **by that welder in that lot** to be examined.

NDE in B31.3 Extent

- If those welds pass, that lot is accepted, and no further RT or UT is required.
- If one of those welds is rejected, 2 more welds made **by that welder in that lot** to be examined.
- If those welds pass, that lot is accepted, and no further RT or UT is required.
- If one of those welds is rejected, all the welds made **by that welder in that lot** to be examined by RT or UT.

NDE in B31.3 Extent

- Lot testing must be contemporaneous with the work. When you are 25 welds into a job is no time to find out you have an unskilled welder.
- There can be more than one lot type. Define yours before the work is started.
- Welders cannot know which welds will be examined.
- **Once a lot is accepted, the owner is not entitled to RT or UT welds in a lot that were not examined by RT or UT.**

NDE in B31.3 Acceptance

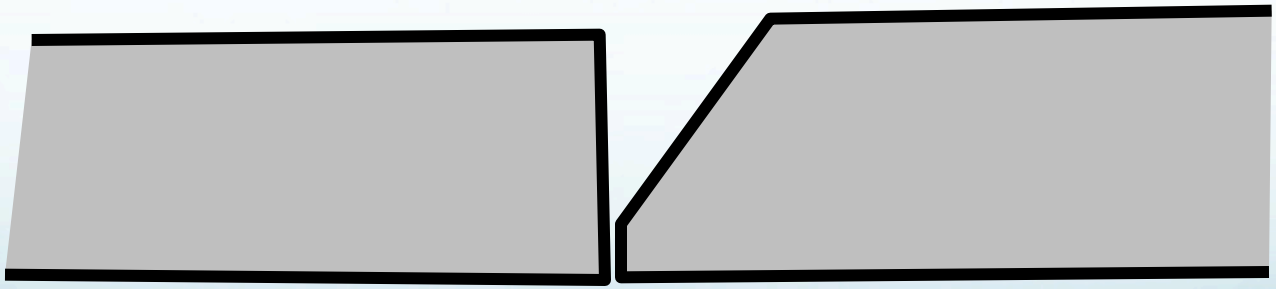
- Each fluid service category has its own radiographic acceptance criteria.
  - **Normal** – Allows some incomplete penetration!
  - **Category M** – Same as Normal Fluid Service.
  - **High Pressure** – Tight limits on reinforcement both OD and ID, no undercut permitted (either OD or ID), and there is a surface roughness limitation of 500 micro-inches. No incomplete penetration is permitted.
  - **Severe Cyclic** – similar to High Pressure
  - **Category D** – Reinforcement, undercut, etc.
  - **High Purity –** Boroscopic examination, no incomplete penetration

B31.5 and B31.9

* B31.5, *Refrigeration Piping*, and B31.9, *Building Services Piping*.
* Neither has any additional examination requirements beyond visual
* Except for B31.5 when the refrigerant is flammable; in that case, 5% radiography is required, but unlike B31.3, there is no escalation clause for rejected radiographs

Horror Story #1

- A contractor was working on his 5th new school in a city
- A customer's third-party inspector was wandering about when he found a welder making a weld with one end beveled and one square with a tight butt. . .



Horror Story #1

- Inspector had some welds radiographed. 80% were rejected -- incomplete penetration, incomplete fusion, slag, porosity. . . .
- Contractor did visual examination with a video camera; some incomplete penetration was found. Several welds were repaired due to 360° of incomplete penetration.


The root side –
one spot. . .

A little further along. . .


A little
further along. .
.


In cross-section.

Horror Story #1

- Owner has had the system 100% radiographed and demanded that any welds exhibiting any incomplete penetration or incomplete fusion be repaired.
- The contractor attempted to collect $400K for the cost of making the repairs.
- Owner threatened to radiograph the welds in the other 4 schools . . . Ending the lawsuit. . .

Horror Story #2

- Contractor on a large office complex was installing chilled water and hot water piping.
- The owner radiographed some welds. Rejected some.
- Project manager agreed to make repairs.
- Owner radiographed some more and rejected some
- Project manager balked – this was not part of the deal!
- Owner said: “You agreed to fix the previous bad welds – are these bad welds any different?”

Horror Story #2

- Project manager just being accommodating the first time!
- Way bad. Once you establish a precedent, changing the path is very difficult.
- Project managers should be aware -- customers who do not buy radiographic quality welds are not entitled to them. This is not the same a punch list items.
- Pass what you learn here on to your PMs!

Horror Story #3

- Owner's inspector caught the contractor's foremen accepting poor fit-up on a B31.9 job and had some welds radiographed. Many exhibited a lot of incomplete penetration.
- Owner's inspector insisted on examining and repairing the 30% of the welds already completed plus all the new ones.
- Contractor complied at a cost of $300K and sued.
- Contractor lost the lawsuit because his contract was with the GC, not the Owner, and the GC never directed the contractor to do what he did

Horror Story #4

- Contractor installed some NPS ¾ Schedule 160 stainless steel piping, all butt welded.
- Owner ran a borescope down the pipe and did not like the discoloration and observed ID weld reinforcement in excess of the 1/16” limit found in B31.3. Owner wanted it reinstalled.
- Visual examination using a borescope is defined in the code as remote examination, not direct examination that B31.3 specifies. The Owner was not entitled to use a borescope to examine the weld since the owner did not specify that examination in the contract.

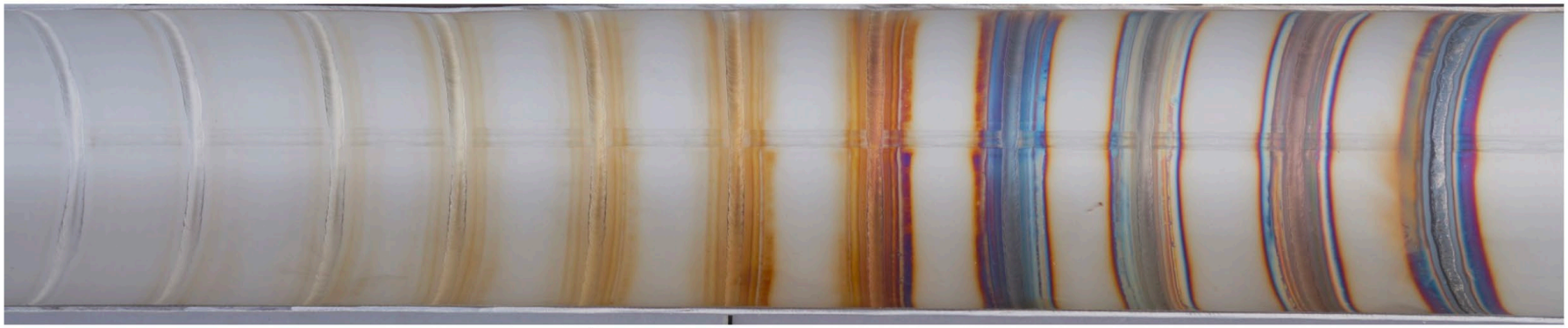
Horror Story #4

Resolution is pending, but the owner has directed the contractor to reinstall the piping, to inspect it using a borescope and the owner has specified an acceptable level of discoloration using PFI ES-50 color charts.

Figure 2

Weld Discoloration Levels on the Inside of 304L tube

NOTE: The user is cautioned that electronic versions or photocopies of these acceptance criteria should not be used for evaluation of sample or production welds since subtle differences in color can influence weld acceptability. Figures 1 and 2 are available from PFI as a stand-alone printed document suitable for use as reference standards



ID: 1 2 3 4 5 6 7 8 9 10 11

Recall the Horror Stories. . . .

* Unreasonable demands by owners and their engineers are frequently found in engineer's specifications,
* The worst situation occurs at the end of a job; the Owner insists on radiographing welds that were not required to be radiographed by Code or by contract.
* Or he radiographs them himself, then tells you how bad your welds are. And wants his money back!

Recall the Horror Stories. . . .

- This violates standard industry practice expressed in ASME B31.1, paragraph 136.1:
  - “The degree of examination and the acceptance standards beyond the requirements of this Code shall be a matter of prior agreement between the manufacturer, fabricator or erector and the Owner.

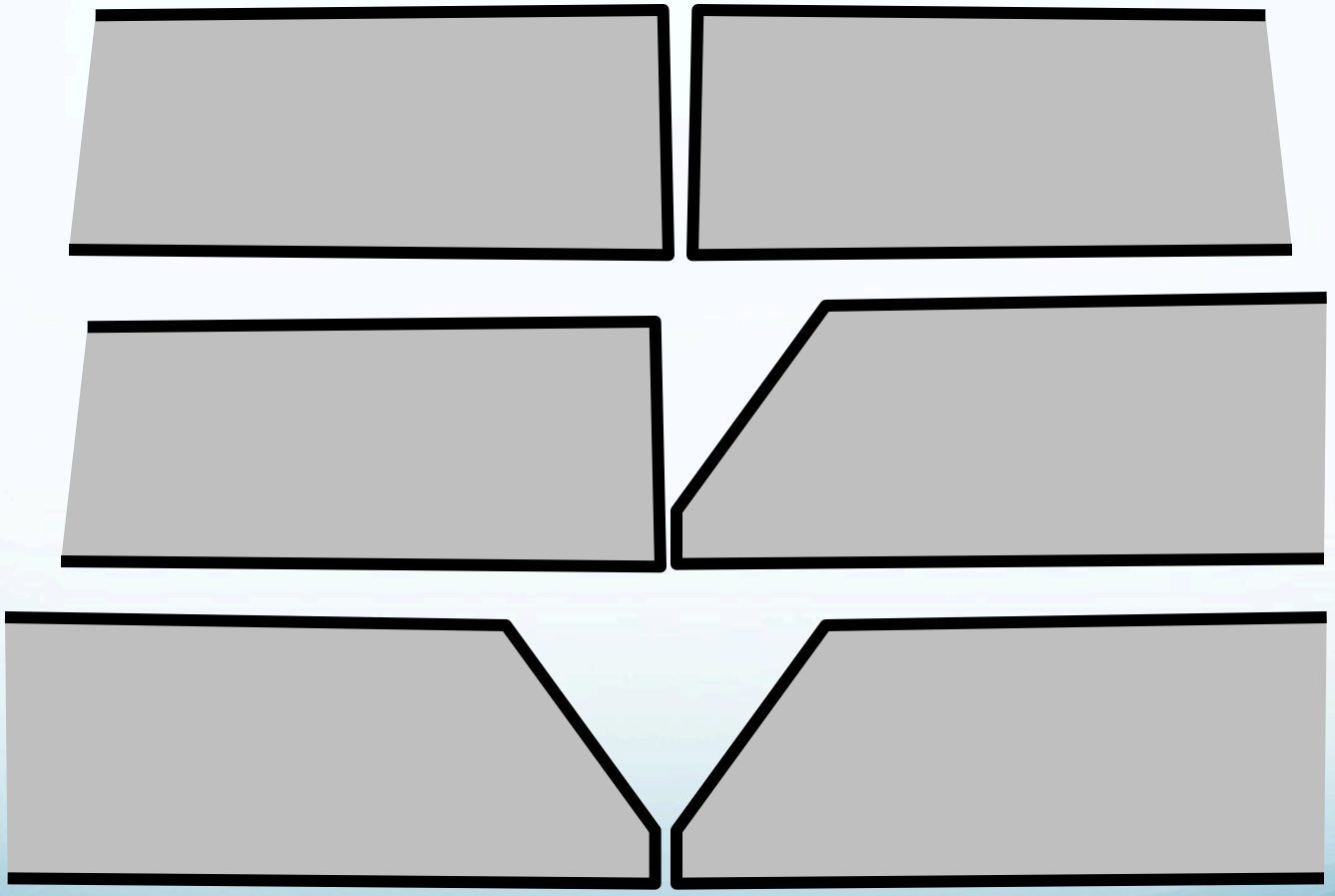
Recall the Horror Stories. . . .

- The reason for these words: it costs more to make welds that are radiographic quality than it does for welds that will not be radiographed, and the contractor should get paid for that work.

Recall the Horror Stories. . . .

* Standard industry practice expressed in this paragraph requires that purchaser-imposed examinations and the acceptance standards accepted by the fabricator or contractor before the job starts.
* Similar paragraphs are found in B31.3, B31.5, B31.9, ASME Sections I and VIII and AWS D1.1 through D1.8,
* AWS D1.1 handles it best: it makes the owner responsible for all repairs discovered by unspecified NDE except in the case of **gross negligence.**

Gross Negligence???




Gross Negligence???

Recall the Horror Stories. . . .

Don't sign up for the likes of:

> "Welding performed under these specifications shall be subject to special tests and inspections **by the Owner or his agent**, including rigid Ultra Sonic Testing (UT) and radiographic inspection **at random**. . . ."

Acceptance Criteria

- The Codes permit certain imperfections for all examination methods. Radiographs, for example, do not have to be free of any indications of discontinuities (flaws).
- Discontinuity ≈ Flaw ≠ Defect (rejectable by definition)

Acceptance Criteria

- Those who perform nondestructive examination have a vested interest in finding rejectable indications.
- Worthwhile to have an independent reviewer look at any radiographs to be sure that they are being interpreted to the correct requirements, not arbitrarily stringently -- or just as bad – too loosely!

Responsibility. . . .

- The extent of nondestructive examination and the acceptance criteria required are clearly understood by all parties and documented in writing.
- If radiographer works for the Owner, the Contractor is still responsible for being sure that radiographs are acceptable.
- A contractor who had a maintenance contract with a major oil company. . . .

Responsibility. . . .

- This extends to film quality (i.e., it the film exposed in such a manner that small indications can be seen)
- The film needs to be adequately exposed (if you hold it up to fluorescent lights in the office, you should not be able to see anything except identification marks)
- It needs to be adequately sensitive (the 4t hole should be visible on the penetrameter.)

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You are not alone. . .

* The UA and Local Unions will work with Contractors on projects utilizing specialized welding applications in developing site specific welder evaluation and training protocols.
* UA will meet with with project representatives to determine the need for any specialized welding requirements at the project jobsite.

You are not alone. . .

* Information gathered from the project planning meetings (construction codes, piping/weld materials, joint designs, specialized welding equipment, etc.) will be used to design specific training programs and evaluation protocols to address the unique welding needs of the project.
* Welders will also undergo an evaluation of their welding abilities by welding test coupons specifically designed to simulate the welding processes and types of welds they will encounter at the jobsite. Contractors will be involved in the evaluations.

Subcontracted Work

- Impose the same code and contract requirements on the fabricator who is doing subassembly work for you. Impose the same code that you are obligated to use.
- Impose one on the subcontractor -- even if you are not obligated to use one.
- Do it by contract.

Liability issues

- Codes and contract law make contractor responsible for the quality of welding and brazing his welders provide.
- At NY Cranes, a shop hand had part of a tower crane turret repaired at a local welding shop – no WPSs, no welder qualifications. The weld failed, the crane fell 20 stories killing the operator. The owner of NY Cranes faced manslaughter charges.
- He has no Standard Industry Practice to fall back on because he didn't follow it.

Liability issues

- While leaking hot or chilled water may just cause property damage and just jack up your insurance rates,
- Consider the consequences of a refrigerant or oxygen leak at a hospital or old folks home.
- The contractor responsible for the quality of welding and brazing his craft produce.

Advertising issues

- A large contractor posted his ”1.5% weld reject rate” on his web page.
- The contractor signed up for a $40 million refinery turnover. Everything ran late. Contractor had a hard time finding experienced welders and the acceptance criteria was ASME B31.3 severe cyclic service (radiographs near-water clear)
- He had a 22% reject rate for the project

Advertising issues

- The owner blamed the contractor for cost overruns and delay, accused the contractor of having poor weld quality.
- Owner quoted the contractor's promise of a "1.5% reject rate" as evidence.
- Ended up in court.
- Don't advertise a reject rate. There are too many variables that can affect it.

Hydrostatic Testing

- The B31 Code Sections require either hydrostatic or pneumatic testing of completed piping systems. Hydrostatic testing of piping subassemblies is neither required by Code nor is it customary. *Typical testing pressures is 1-1/2 times the design pressure*

- Although the Code permits pneumatic testing, the contractor should remember that compressed gas is a very good device for storing energy, and its release can be exceedingly destructive in the event of catastrophic pressure boundary failure. Do not do pneumatic testing except as a last resort, and even then with extreme care.

Horror Story

- Contractor was installing B31.9 piping in an office building. As portions of the system were installed, they did pneumatic testing at 125 PSI on each segment as they completed it.
- Due to the presence of some check valves in the system, a segment remained pressurized over a weekend.
- Young welder was killed by a flying end cap attached with a Victaulic coupling.


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Summary

- The Owner has to choose and specify the appropriate Code for his piping systems
- Engineer has to follow the Code in his design, utilize his engineering expertise and experience and ensure that the appropriate requirements are incorporated into the specifications and drawings.

Summary

- **The Contractor needs to:**
  - Understand what is in the Code and specifications
  - Pass that information on to craft supervision in terms they can understand.
  - Be sure that the work is done in accordance with the applicable Code and Specifications and Drawings
  - Get changes in writing from competent responsible representatives of the owner.

The Test

- What is the first thing you should look for when reviewing contract documents and specifications

The Test

- What is the first thing you should look for when reviewing contract documents and specifications
- Answer: Be sure that the B31 construction code section that applies to the work is clearly defined. If not, quote to the one that you will follow (B31.9, B31.3, etc.)

The Test

- What should you look for in the contract and specification regarding the **extent** and type of examinations that the Owner may perform?

The Test

- What should you look for in the contract and specification regarding the **extent** and type of examinations that the Owner may perform?
- Answer: Death clauses. Any provision that says that the owner or his representative may perform radiography or ultrasonic examinations exceeding those specified in the spec or contract.

The Test

- What should the contractor do to ensure that his welders make decent welds?

The Test

- What should the contractor do to ensure that his welders make decent welds?
- Have someone other than the welder perform fit-up inspection; remember:

Welders weld to meet the level of inspection imposed on them. . .

What Mechanical Contractors Need to Know about Piping Codes and Customer Specifications

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Ooooo... This not be cheap.