

Russell W. Brown

Tank Maintenance & Construction, Inc.

Tank Maintenance Services LLC

Farmington, New Mexico 87499-2014

www.tankmaintenancenow.com

Session Objective

- Our objective today is to address some water tank design issues and the impact of general inspection basics on final contract quality outcomes.
- An owner can have more control over what is and isn't done with building new or maintaining existing potable-grade water storage tanks.

Some topics to cover

- Basics of corrosion
- NACE guidelines for designing and using steel components in corrosive environments
- Surface preparation methods and results
- Protective coatings basics
- Coating selection
- Types of systems
 - Barrier systems
 - Galvanic acting systems
- Film formation mechanisms
- Surface preparation and coating application conditions

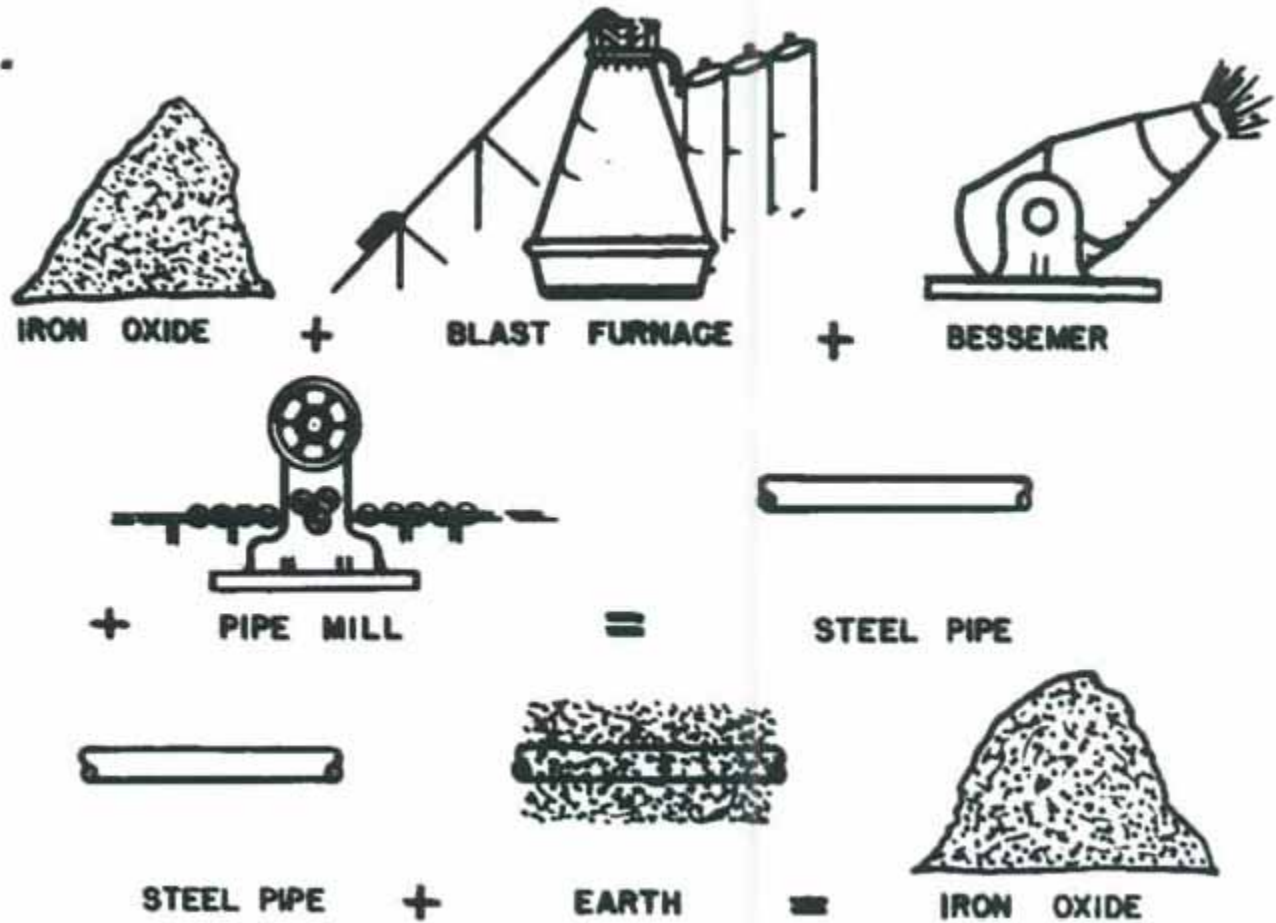
Topics continued...

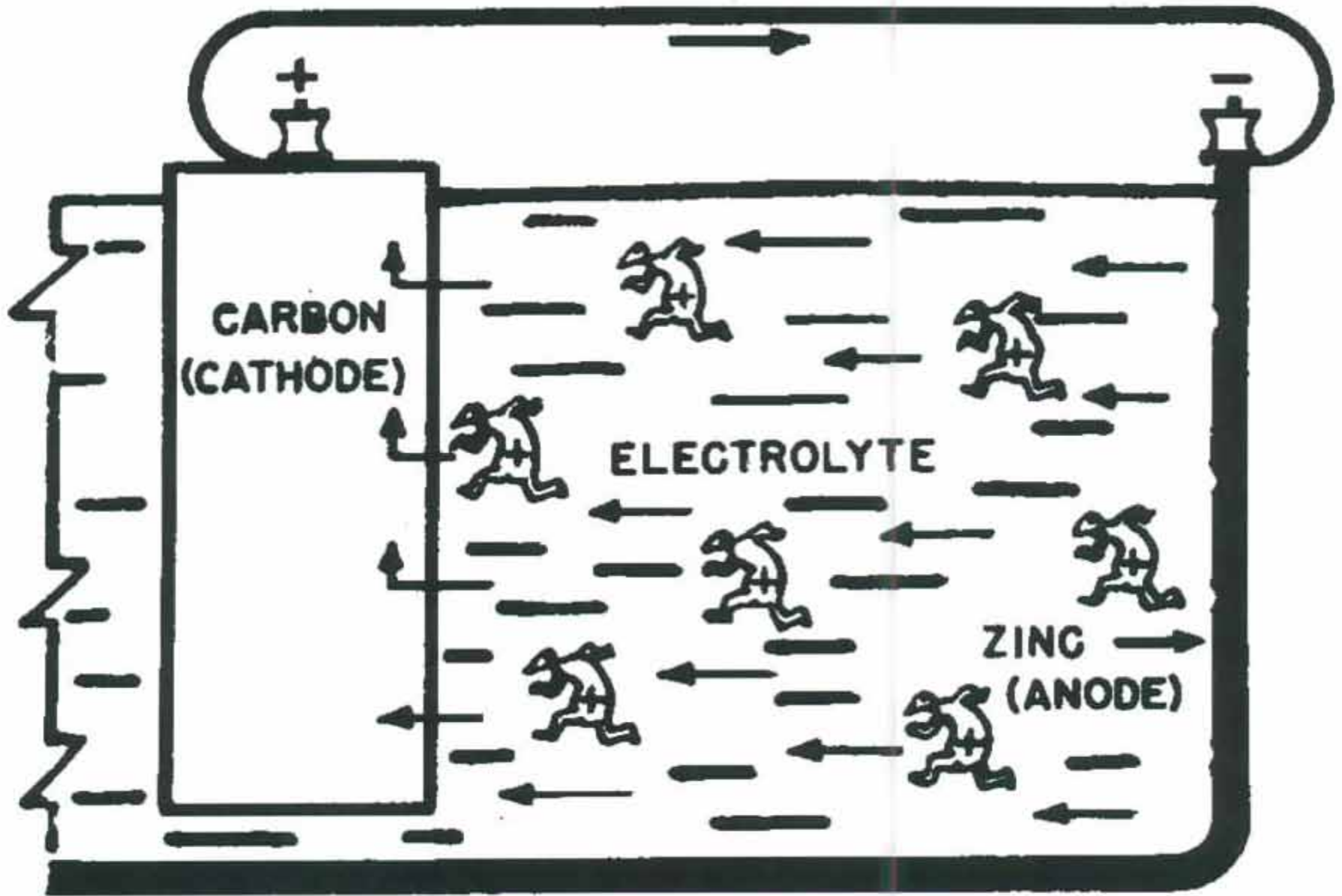
- Blast air & its effects on coating systems
- Mixing paint thoroughly
- Some types of application equipment
- Basic inspection equipment
- Adequate inspection records
- Viewing each step in the contract
- Safety and you the inspector

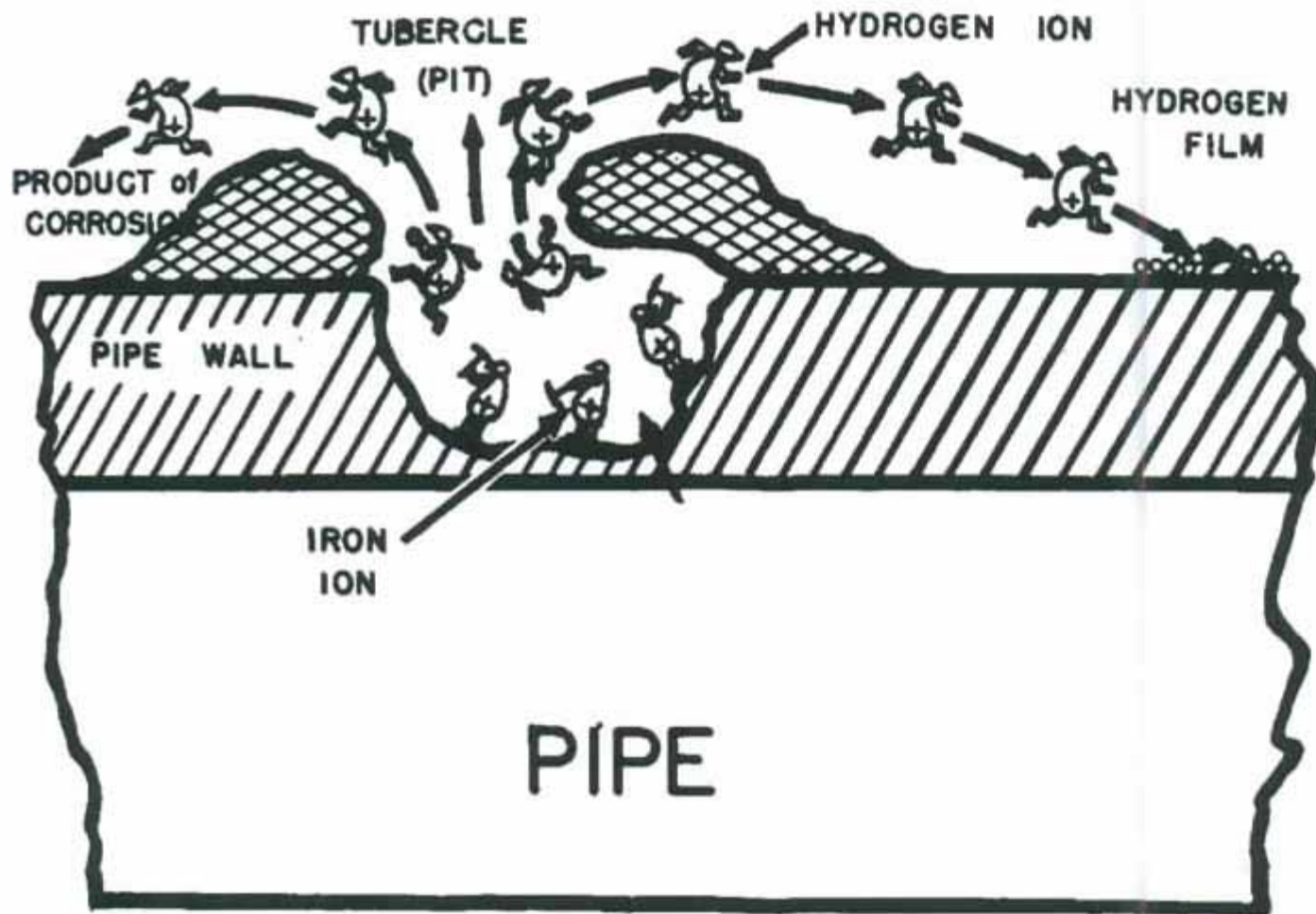
Basics of corrosion

- Four basic requirements for a corrosion cell
 - Anode
 - Cathode
 - Metallic substrate
 - **Electrolyte**

Dust to dust



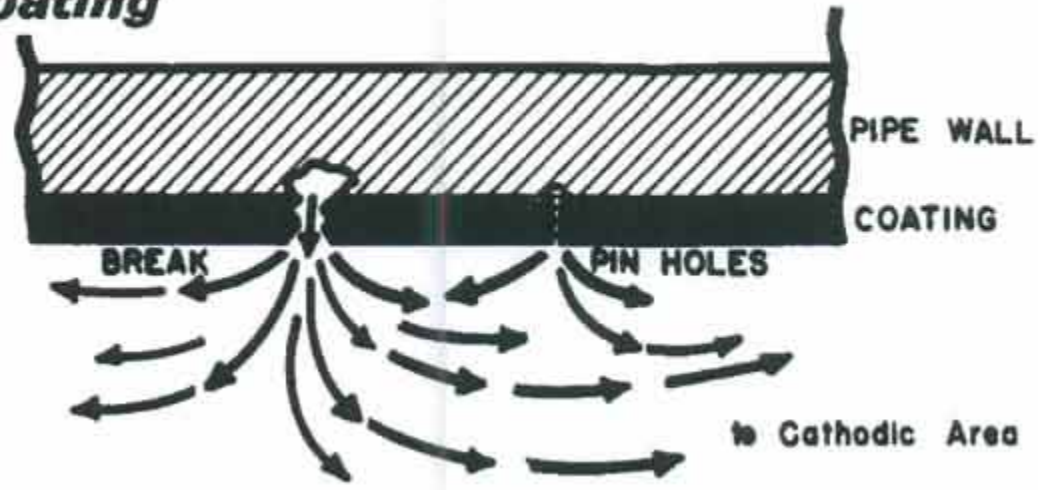




Pit Action

Concentration of Corrosion at Breaks and Pin Holes in Coating

Rate of Corrosion
Depends on Conductivity
of Earth



NACE Design Guidelines - RP178-2003

- Corrosion is a natural process. It will happen! The challenge at hand is to slow it down and make it an acceptable and economical fact of life
- Poor design, sloppy construction and lack of attention to detail causes most severe corrosion problems
- Not watching what you buy is just asking for huge financial outlays later; after time and its service environment attack your structure

Some Do's and Don'ts Building with Steel Components in Immersion

Appendix A: Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Metal Tanks and Vessels to Be Lined for Immersion

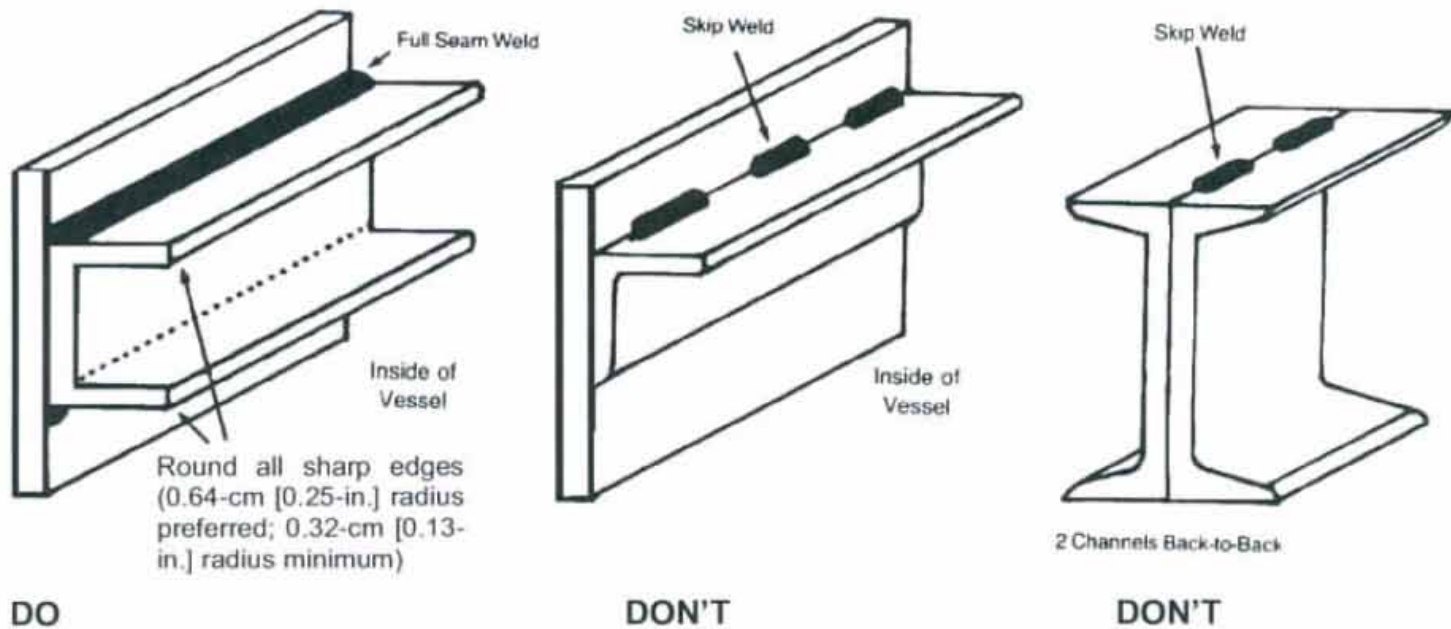
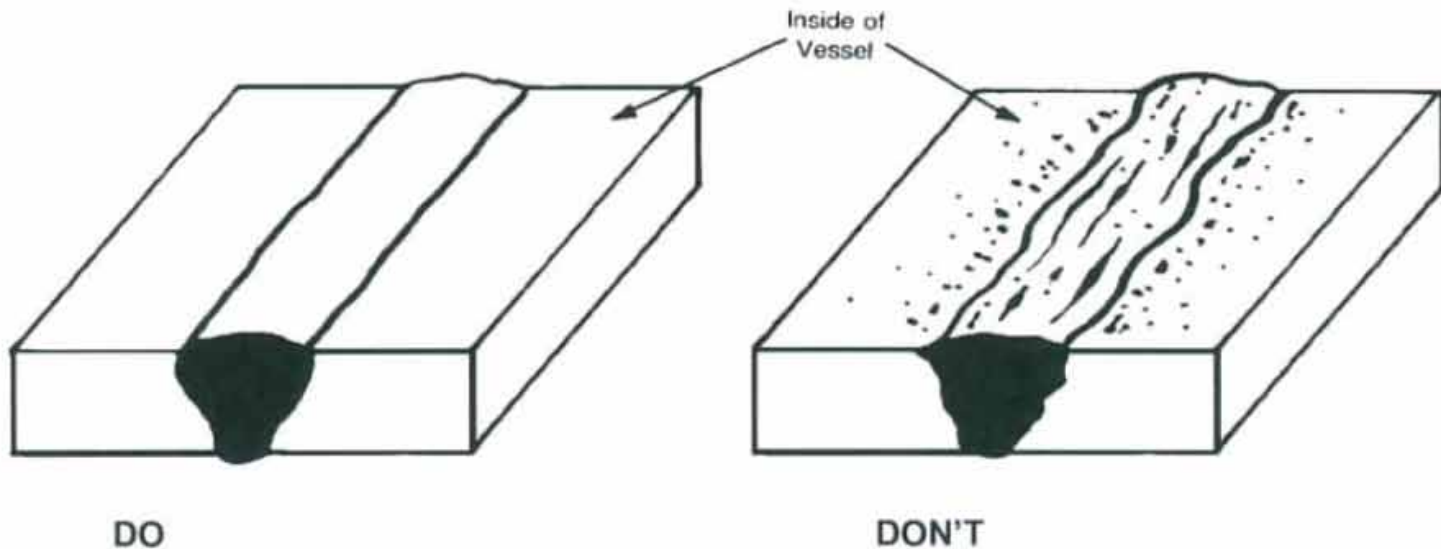


FIGURE A.1

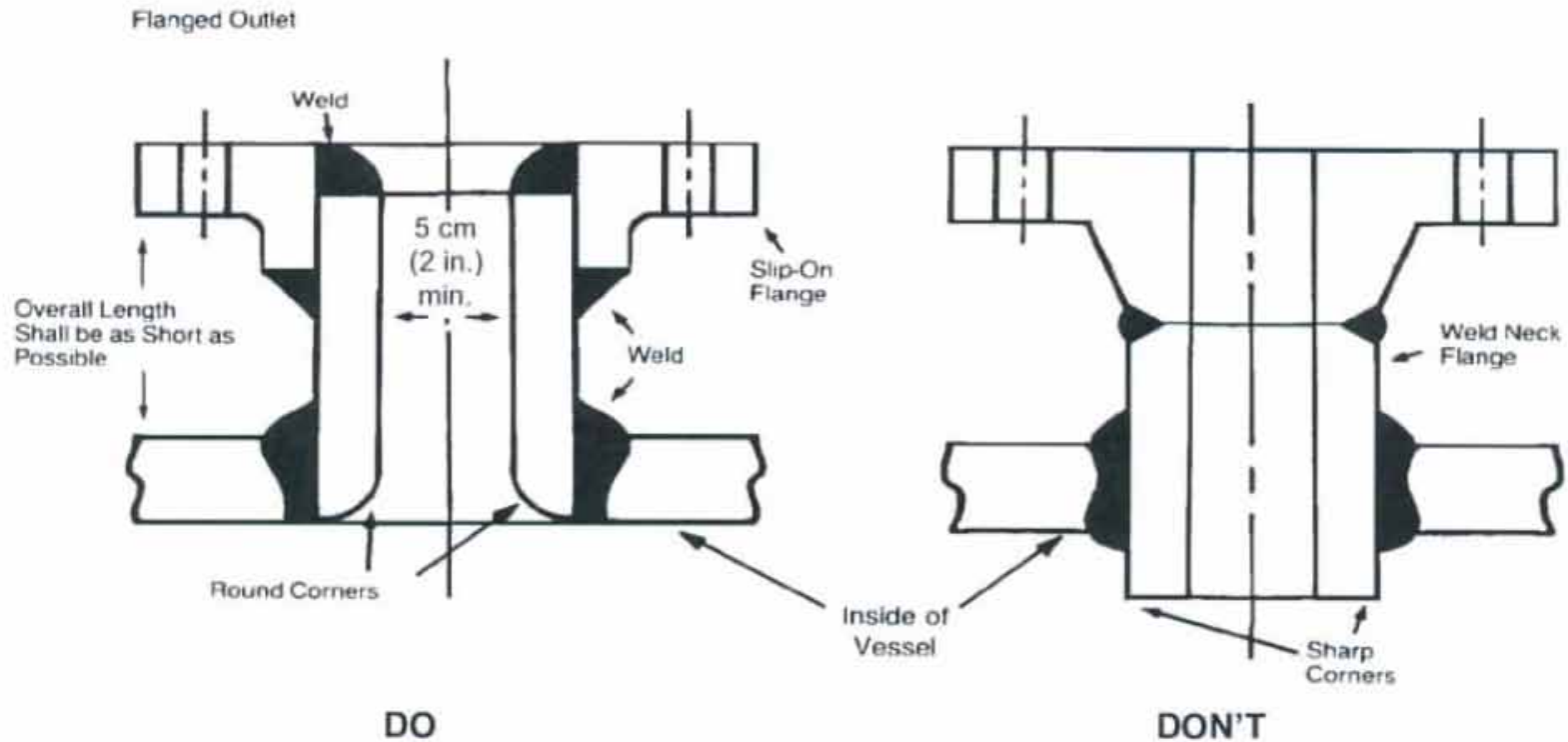
General weld preparation



Weld-spatter usually means immediate immersion coating failure



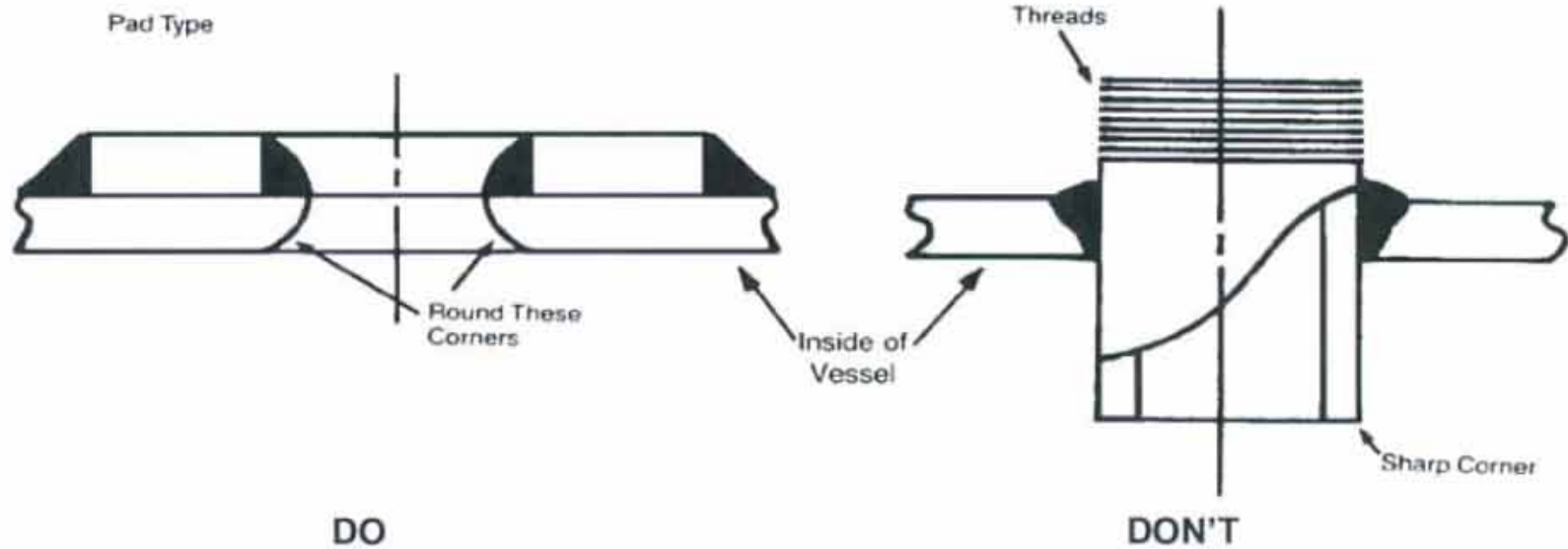
Small opening treatment



Typical small opening failure



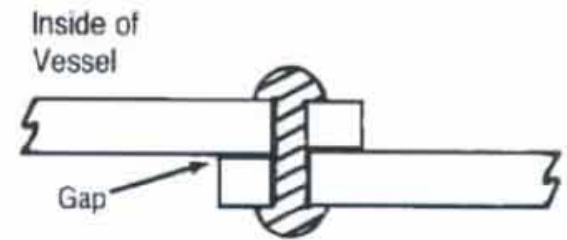
No threads in immersion service



On Internet - NACE RP178-2003



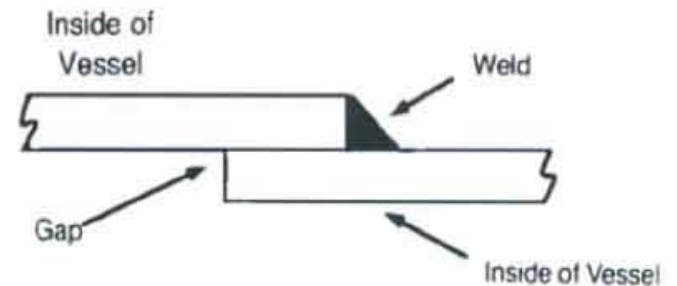
DO



DON'T



DO



DON'T

Planning before bidding

- Specification writing
- Site selection
- Time of the year for construction
- Field storage of tank components before erection
- Field erection methods
- Field painting and subcontractors

Specification writing

- Based on best intelligence gained by an inspection before writing bid document or request for proposals
- Best type of inspection is a structural inspection done in a cleaned out, empty tank
- Dive inspections are generally easy on everyone but the tank's future
- Dives, and to a lesser extent float-downs are easy/convenient/cheap... they don't cut it economically in the long run though

Benefits of a washout inspection

- Easier to see substrates and judge the severity of corrosion problems & coating failures
- Silt can be removed and bio-films washed off the surface quickly and economically
- Pitting is better revealed on floor and shell-wall
- Take time to remove roof vent cover to look into rafter assembly on top of the dollar-plate
- Use AWWA spray method # 2 to disinfect tank - to gain quick use of tank

Can you say bio-film?



Here is why the vent cover should come off



What can be left when test-blasted



Site selections

- Consider very seriously doing a Water Study plan first before building any new tank?
- Think about fifteen to twenty years out?
- Fence space! Razor-wire on the barbed-wire for adequate security from illegal intruders
- Overflow drainage considerations (normal rules vs. practical site demands)
- Steel ring wall & space around tank placed on a hillside excavation

Who chose this site?



What's wrong with this picture?



No room for errors here!



Time of the year

- New Tank should complete erection at a time of the year when temperatures favor quality field painting outcomes
- Best to paint when temperatures are rising not falling
- Choose your paint system in part for time of the year
- Consult with a trusted coatings vendor on this point
- Weigh the pros and cons of shop priming all components before erection. There are pros and cons!
- Zinc-rich primers vs. epoxy primers in shop

Protective coating basics

- **ANSI/NSF Standard 61 Testing is Required for potable water storage interior use**
- **Barrier coating systems**
 - Many varied epoxy formulas - polyamides, amines, polyamines, polyamidoamines, cycloaliphatic amines
- **Galvanic acting systems**
 - Organic zinc-rich formulas - usually urethane binders
 - Inorganic zinc-rich formulas - No

Component field storage before erection

- This topic should be covered in the bid specification and also in the tank builder's contract
- Field storage of primed steel is very important – especially zinc-primed steel
- Erection lugs should be ground flush and sharp edges broken before any blasting takes place. This should be spelled out in the surface preparation specification and enforced by the QA inspector

Surface preparation specifications

- Interior blast SSPC-SP10, near-white level of cleanliness – 2.0 to 3.0 mil profile
- Exterior blast to SSPC-SP6, commercial-grade level of cleanliness – 1.5 to 2.5 mil profile
- Exterior – if overcoating (based on cross-hatch test or X-scribe results, etc. Power wash using < 3,000 psi water, SSPC-SP3 Power-tool cleaning to tight edges, feather boundaries
- Spot prime with epoxy mastic/finish with acrylic

Choosing an interior lining system

- First choose the material supplier
- Look for any available extended warranty from that supplier
- Demand a minimum of a two-year warranty from the low bid tank fabricator
- Include a two-year inspection - empty/washout/detailed inspection/required touchup
- Check the credentials of the sub-contractor doing the painting for the fabricator
- Talk to the last two to three owner's that they teamed up with to check their quality outcomes

Continued...

- What exterior color will you choose and how will that effect the life of the chosen interior lining system
- Pick a VOC compliant system for the exterior coating and interior lining systems
- All epoxy system? One coat, two coats or three coats?
*Always include a stripe coat after the primer coat
- Assure that the interior system has ANSI/NSF Standard 61 credentials when reviewing submittals

Choosing an exterior finish system

- How important is graffiti resistance to your group
- Will your final site be securely/adequately fenced
- Will the fence be right on top of the tank or will space be allowed for later maintenance equipment and crews to work effectively
- Is the surrounding area now built up with homes or commercial buildings
- If not now, will there be a built up surrounding by the time the first maintenance work is done on the tank

Continued...

- Is the intent to hide the tank/keep it discreetly visible only or to flatter the neighborhood with an extra aesthetic effort and bold colors
- Do you want high gloss or low gloss finish
- What about color and gloss retention
- Will exterior coats need to be sprayed or rolled
- When sprayed, some coatings can drift wet for a mile or more

General tank considerations

- Will there be adequate clearance between excavated hillside and the tank shell
- Will there be an 18” deep steel ring-wall built 24” out from around the base of the new tank shell
- Will there be two shell Manways & what sizes
- Will the shell Manways have Davit Arm or hinges
- Will the overflow outlet enter the ground or splash onto the ground with a concrete splash-pad
- Will the latter be equipped with a flapper-valve

No steel ring-wall around shell wall



Ideal 30" shell Manway complete with hinge



Continued...

- Will the access ladder have a cage and a practical security ladder-gate
- Will the ladder meet the roof to one side of the roof Manway or force a dangerous entry by stepping onto or over the roof hatch
- Will there be fall-protection on the access ladder
- Will there be a second roof hatch for ventilation/light
- Will the roof vent be corrosion-resistant

Continued...

- Will there be Cathodic Protection installed inside tank
- If there will be, will it float or hang from the ceiling
- Will there be a water-mixer in the tank
- why place one there
- If no mixer is installed, how many feet will the drain line be from the fill-pipe entrance
- What level will the overflow weir-box be set at with respect to the rafter end-clips

This unit was set too high



Continued...

- Will there be an internal ladder to the floor from a roof Manway (consider OSHA confined space entry here)
- Will each shell Manway be equipped with warning notices for vessel entry training requirements
- Will there be handrails each side of the arrival point at top of access ladder
- Will SCADA be installed. Keep antenna off the ladder
- Will cellular phone antennas be built onto this new tank roof

Continued...

- Anyone here ever read a cellular company/City contract?
- Does the contract even acknowledge that the structure is a potable water storage structure?
- Will there be logos or graphics painted on the tank
- If logos are involved in the tank painting system design are there any reds, yellows or greens involved

Contractor QC working with Owner QA

- *Don't blur the two roles*
- *Let the contractor initially test & report and then you verify*
- *Meet earlier than pre-con meeting to develop a working/predictable quality outcome system*
- *Make sure bid specification reads to include QA if owner expects QA to be effective and not an outright conflict with builder/subs and their QC people*
- *Make sure your superior will back you as the job progresses*

Basic inspection equipment

- Testex Kit for measuring blasted surface profile (Interior)
- Visual SSPC Blast result pictorial standards (Exterior)
- Wet film indicator for use during coating application
- Dry film indicator, c/w calibration set for checking dry paint films
- Digital camera for documenting situations
- Chloride testing kit (Chlor-rid®) - redos
- Chemical contamination testing kit - redos
- Clean, soft, absorbent rags for trace oil, grease testing

Continued...

- Low-Voltage (12V) holiday detection device (for less than 20.0 mils DFT films) (K-D Bird-Dog instrument)
- Blast-nozzle hypodermic blast pressure measuring needle gauge
- Sharp pocket knife
- Sling Psychrometer c/w US Weather Bureau Psychometric Tables
- Magnetic substrate temperature measuring gauge
- Blotter paper for testing compressed blast-air for oils

Storage/mixing/using paints & coatings

- Sit in on contractor's safety meetings to be on the same page as they are
- Store paint in a safe (thievery) fire-secure, dry, temperature controlled environment if at all possible
- Mix whole container when mixing parts A & B, etc.
- Measure temperature of material before mixing and compare to directions on Manufacturer's PDS
- Read and understand the Manufacturer's MSDS*
- Ground in-use containers, pumps, etc. as well as tank
- Wear appropriate breathing-air protection* when around application activity (per applicable MSDS)

Continued...

- Assure that interior LEL's are controlled by ample air-movement when application, film formation and cure activity is going on (consider using exhaust outlet filtering to stop extended overspray damage)
- Watch for overspray activity when forced-ventilation is adopted. Understand prevailing wind directions and watch for shifting weather/wind patterns
- Contractor foreman/crew often too close to the potential problem to see it happening until too late

Coating project safety & you

- Safety is everybody's business. Safety is your business!
- Its up to you to protect yourself by being aware and careful
- Easier to be careful when you are aware!
- The more you understand about your working environment each day the safer your day will be and the less damage will occur to your short term and long term health

Inspector responsibility for safety

- Inspectors share in safety of others
- Everyone on site should watch for safety violations and report them
- Obtain specific guidance from your employer with regards to your safety role
- Take immediate action if safety violations can cause death/serious injury

Continued...

- Obtain guidance on role regarding safety from employer/counsel prior to project startup
- Should not routinely address safety & health issues unless:
 - Part of defined scope of services
 - You are qualified

Safety risks

- **General Risks (Affect inspectors, workers, public):**
 - Hazardous environment (explosion, solvent release, dust/toxic metals)
 - Improper erection of access structure (collapsing scaffolding)
 - Lack of site hazard warnings and/or barriers

Continued...

- **Personal Risks that affect individual inspectors, and workers**
 - Entering a hazardous work environment
 - Tripping/Falling
 - Breathing toxic materials (Solvent vapors, dusts, etc.)

Other hazardous environments

- Slippery/obstructed walkways (falls)
- Excessive heat (stress/exhaustion/dehydration)
- Inadequate lighting (falls)
- Noise (hearing loss)
- Abrasive blast cleaning -inspector shouldn't be nearby
- Airless spray activity – inspector shouldn't be nearby

Confined spaces

- Hazardous Conditions:
 - Flammable gas, vapor, mist, CO₂
 - Airborne combustible dust
 - Oxygen depletion (<19.5%)
 - Oxygen enriched (>23.5%)
 - Atmospheric substances in excess of PEL

Confined space entry for the coatings inspector

- Verify space has been tested and cleared for safe entry
- Employ proper PPE (may include supplied air respirator on rare occasions)
- Participate in confined space entry training and keep up-to-date

Organic solvents

- Toxicity based on exposure magnitude and duration
- They are heavier than air – Consider Ventilation
- Their routes of entry to the body
 - Skin Contact
 - Inhalation
 - Ingestion
 - Ignoring solvent exposure can be a very serious problem

Solvents & co-solvents

- MSDS can save your health
- Cleaning solvent use
- Ignition point dangers
- Skin irritation & dermatitis

Reading for your safety

- Project's specification document
- Manufacturer's product data sheet
- Manufacturer's MSDS
- Industry publications

Testing a lining for final cure

- Substrate temperature matters most
- Time/temperature film formation - see the manufacturer's product data/application sheet
- Humidity control is often very helpful
- Air movement matters immensely
- Project record keeping for surface temperatures
- Final MEK double-rub testing

Disinfection before use

- **AWWA C652 – Spray method # 2**
- **Know your state rules on dumping water with chlorine residuals in it**
- **Don't be bashful about demanding proper disposal methods for over-chlorinated water**
- **Let the contractor submit a disinfection plan and do the testing with his crew**
- **Conduct and pay for your own Bac-T tests**

Questions?

Remember These Wise Statements

- There's more trouble in a gallon of paint than there is in a fifth of whiskey!
- Water always runs uphill towards the money!
- Whiskey is for drinking and water is for fighting!