

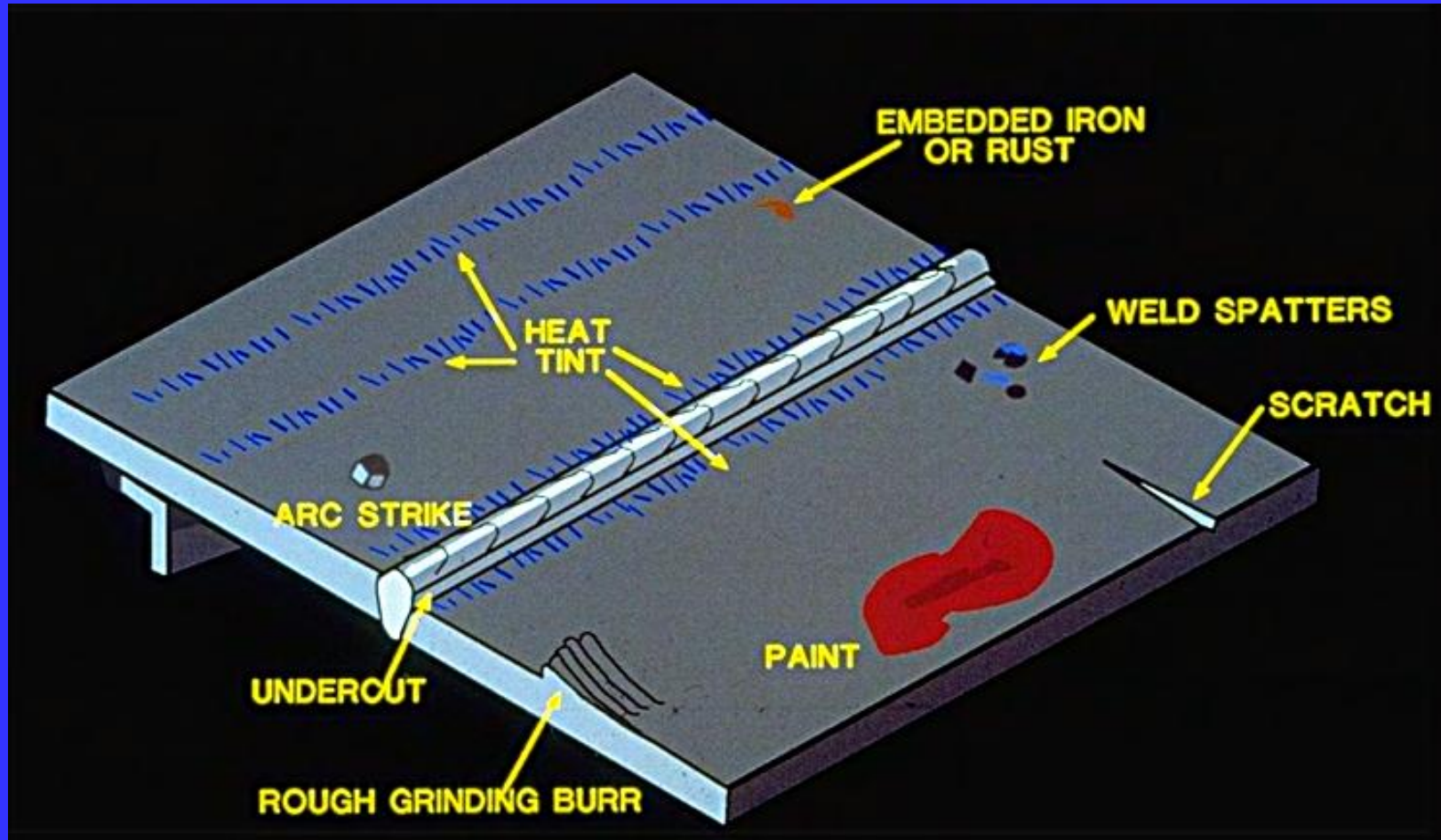
To Pickle or Not To Pickle

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Corrosion Solutions
Sept 2009

Two Reasons To Pickle

- Post Weld Cleaning
- Weld zone heat tint
- Not Spatter
- Not Slag
- Remove Surface Contamination
- Rust Bloom or Embedded Rust
- Not Markings
- Not Scratches

Weld Defects



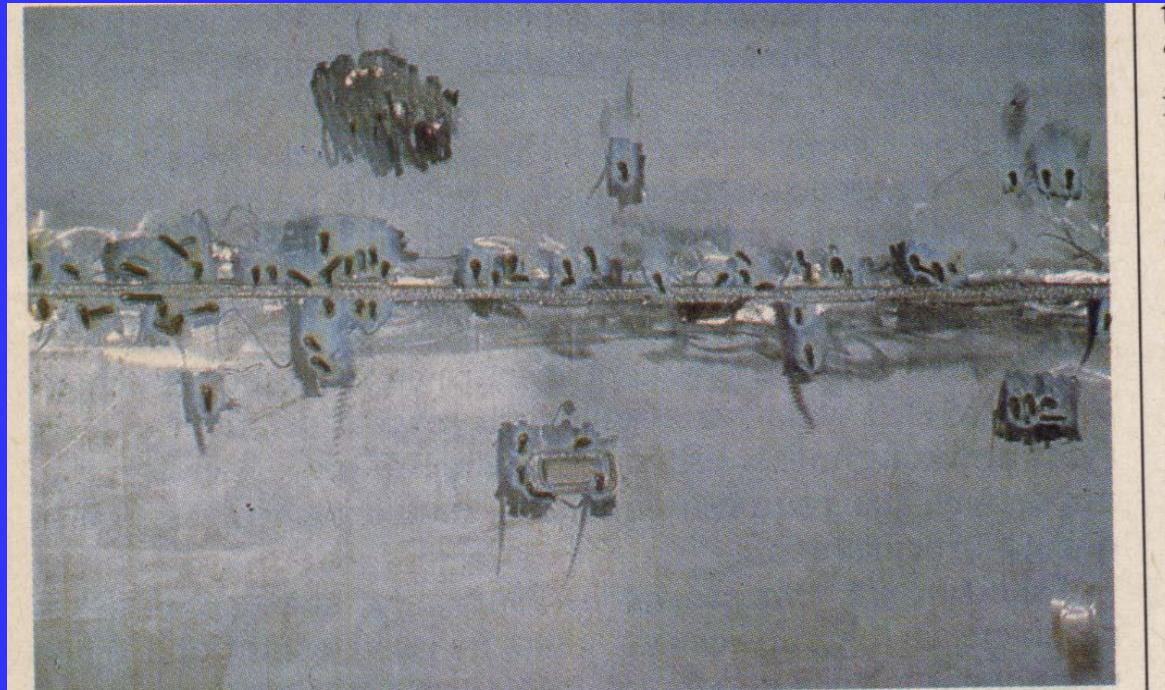
Heavy Heat Tint



Corrosion in Heat Tint Area



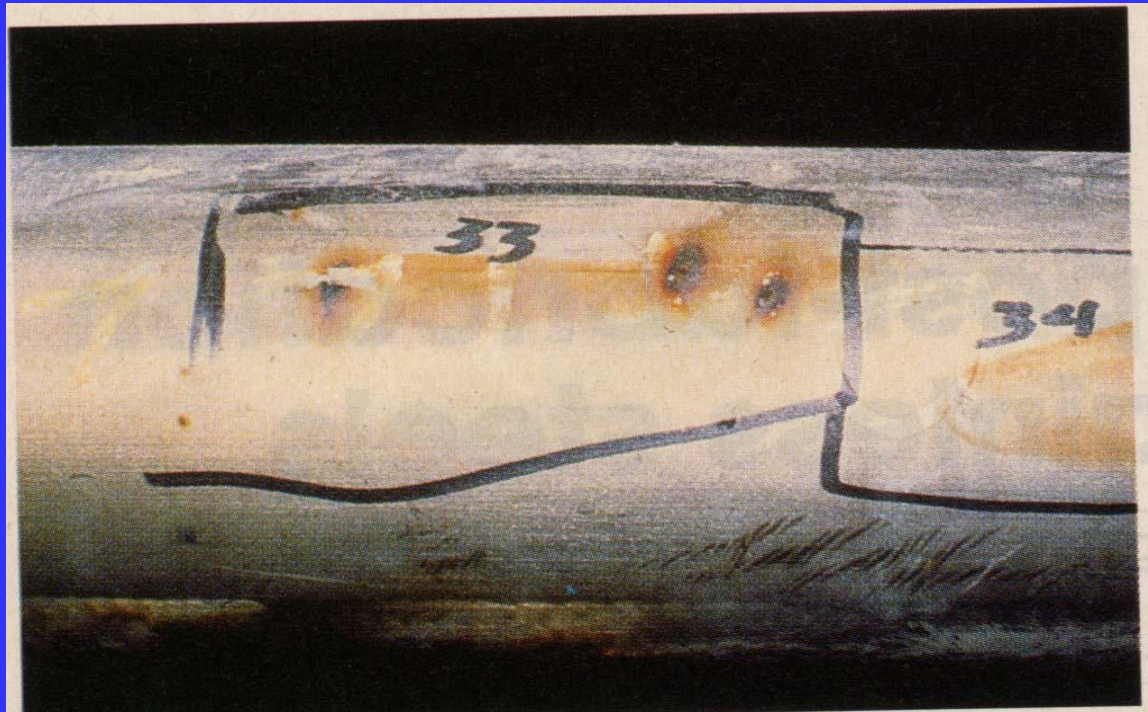
Repaired Weld Spatter



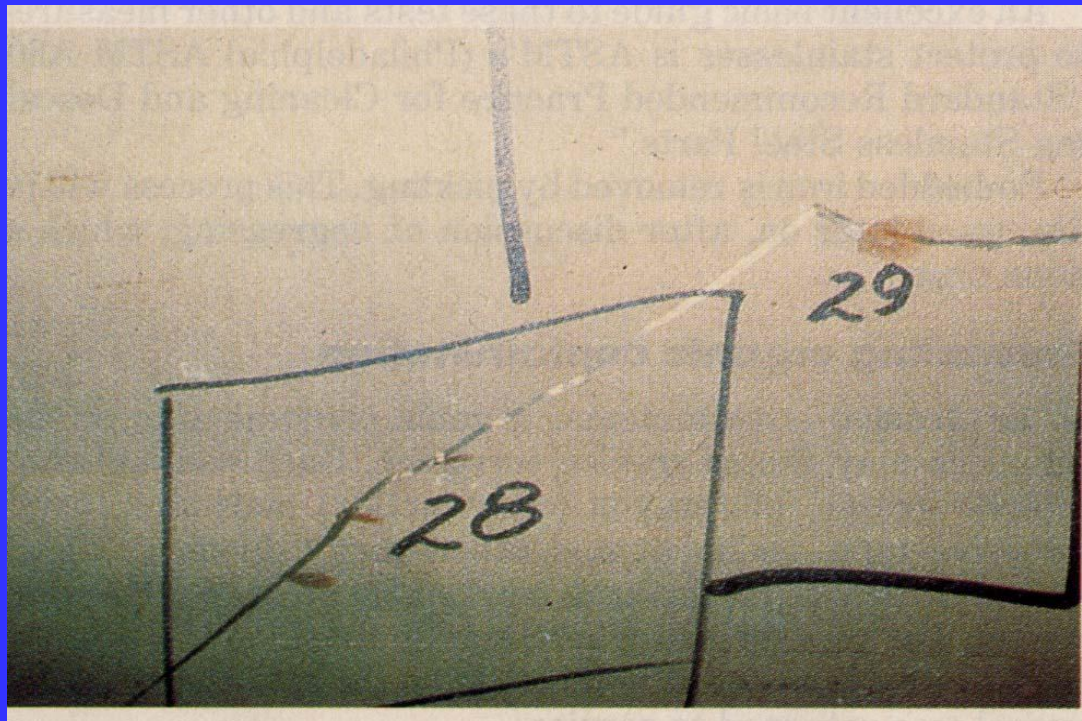
Un removed Slag



Identification Marking



Surface Scratch (with imbedded iron)



Things to Consider Before Pickling

- Alloy Selected
- Austenitic SS
- Duplex SS
- Safety Margin Required
- Corrosion Environment
- Localized corrosion
- General Corrosion

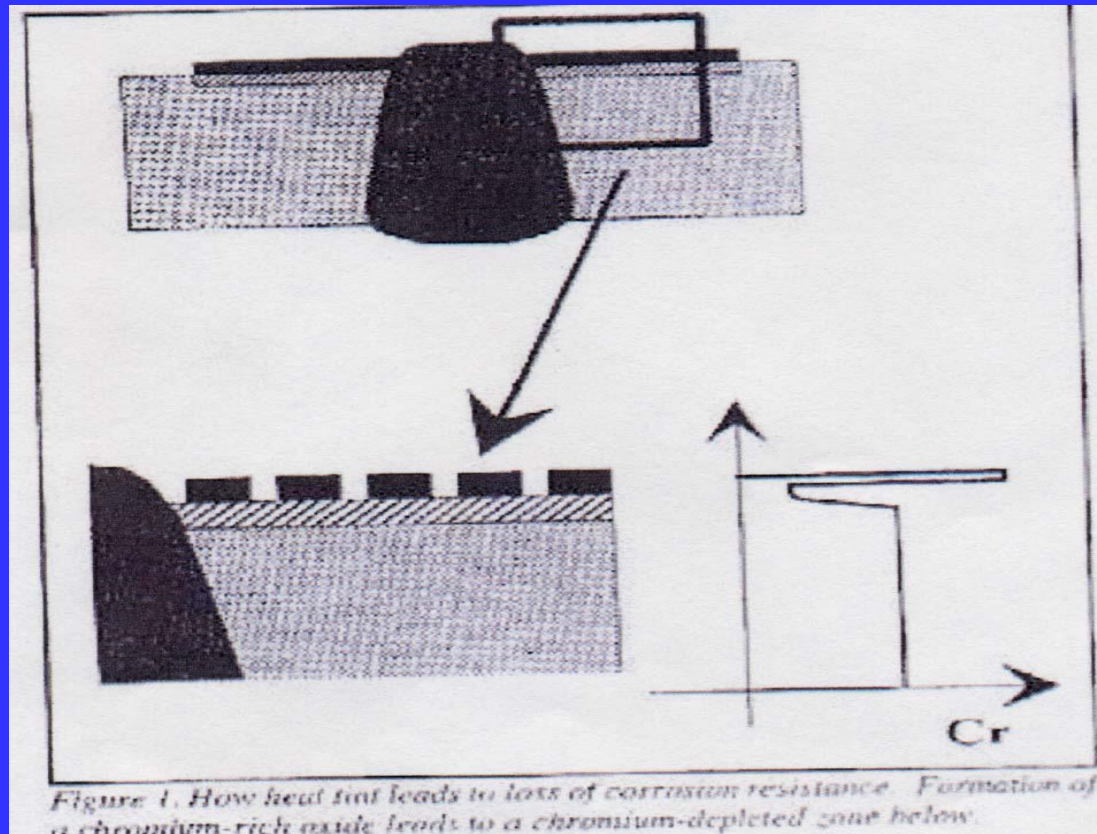
What is Heat Tint

- SS have a thin passive layer on their surface
- With exposure to O₂
at high temperature (400 – 1300F)
a thin “straw tinted” Cr₂O₃ layer forms
- As a result a Cr depleted layer forms
beneath the heat tint

What is Heat Tint

- With additional exposure and additional O₂ pickup the Cr₂O₃ layer becomes unstable
- A more volatile CrO₃ “dark blue/black” layer is formed
- There is an increase in Fe content at the surface

What is Heat Tint



Corrosive Environment Effect

- Localized Corrosion

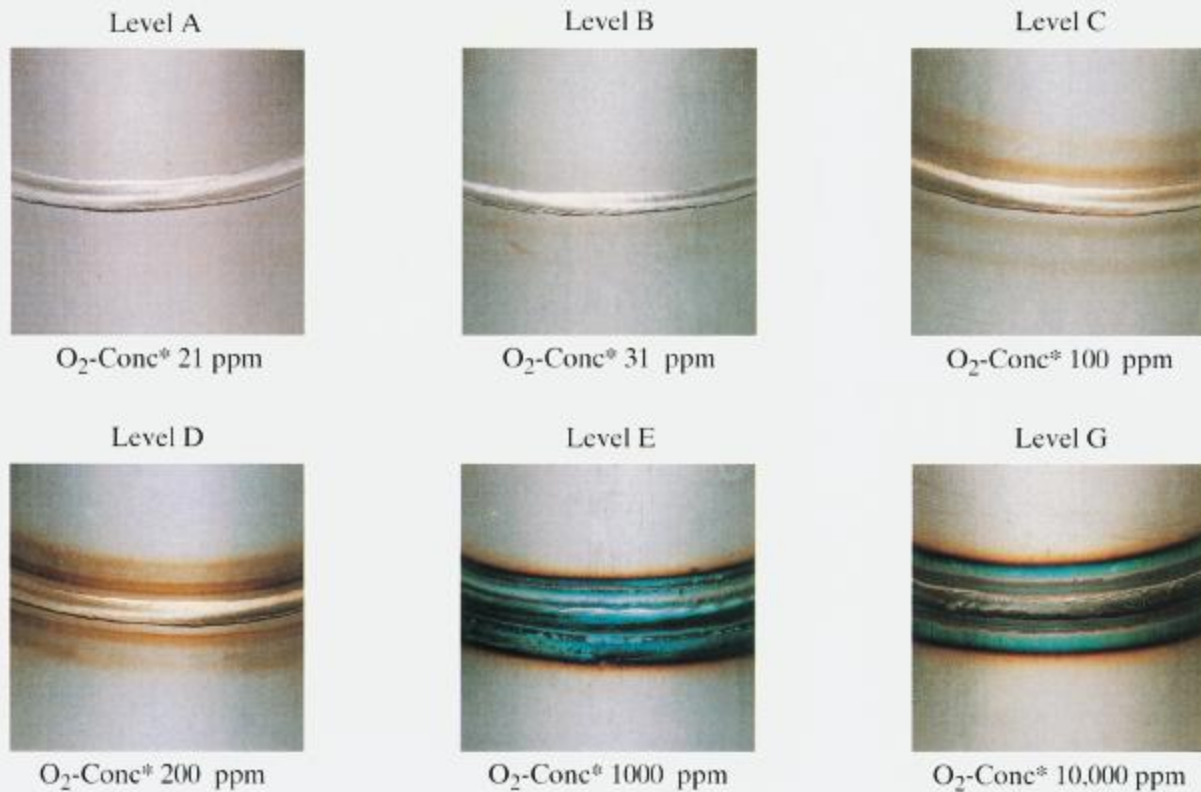
- Can break through heat tint and attack Cr depleted zone

- General Corrosion

- May break through heat tint and dissolve Cr depleted zone restoring base corrosion resistance

Heat Tint Color Level Reference

- The FORCE Institute, Denmark
Reference Color Charts – report 94.54
- “*Corrosion failures in stainless steel pipe systems*”, J.Vagn Hansen, The FORCE Institute, Denmark and Rene Gronmark, Weld Tech, Denmark, Tube International, May 1977



* t=1.6 Q=0.2-0.3 kJ/mm

Fig. 3 Using a Reference Colour Chart, it is possible to specify an acceptable heat tint on and adjacent to TIG welds on stainless steel piping. This permits visual inspection as well as video endoscopy. Courtesy of FORCE Institute.

Alloy Selected

- Austenitic SS

- May be resistant to localized attack under thin “straw colored” heat tint
- General corrosion environment should remove heat tint with no further attack

- Duplex SS

- Less resistant to localized attack even under thin “straw colored” heat tint
- General corrosion environment should remove heat tint with no further attack

What is Surface Rust

- Contamination of the surface by particles of carbon steel
- Rust bloom is usually fine particles lightly adhering to the surface (usually can be removed with a pencil eraser)
- Embedded rust is larger particles of carbon steel which have been driven into the stainless steels surface

Corrosive Environment Effect

- Localized Corrosion
 - Will attack the pit created by an embedded particle
- General Corrosion
 - Could attack the area around an embedded particle more aggressively than the base material

Alloy Selected

- Austenitic SS

- Will be susceptible to localized attack under embedded particles
- General corrosion environment should remove rust bloom with no further attack

- Duplex SS

- Will be susceptible to localized attack under embedded particles
- General corrosion environment should remove rust bloom with no further attack

Cost Implications

Pickling cost as a % of fabricated Tank
Cost

Diam/ Height	20'	(gals)	50'	(gals)
10'	6.5 / 7.5	23500	7.5 / 8.2	150000
20'	7.7 / 8.3	47000	6.9 / 8.2	300000
30'	8.4 / 8.8	71000	6.9 / 7.9	450000
40'	8.1 / 8.1	95000	6.4 / 7.4	600000
50'	8.3 / 9.8	118000	5.9 / 7.1	735000

Cost Implications

Pickling cost \$ vs.Fabricated Tank cost \$

Diam/ Height	20'	20'	50'	50'
	Pickle K\$ Total K\$ 304/316	Pickle K\$ Total K\$ 2304/2205	Pickle K\$ Total K\$ 304/316	Pickle K\$ Total K\$ 2304/2205
10'	4 60 / 63	5 66 / 68	16 206 / 222	19 223 / 238
20'	6 76 / 80	7 83 / 86	18 250 / 269	23 270 / 288
30'	8 92 / 97	9 100 / 105	21 293 / 317	26 317 / 338
40'	9 108 / 114	12 117 / 123	23 340 / 368	28 363 / 388
50'	11 128 / 136	14 139 / 146	25 404 / 437	31 422 / 450

So “What to Do”

Evaluate Condition •Heat Tint •Surface Contamination	Evaluate Corrosion •Localized •General	Understand Alloy Selection •Duplex SS •Austenitic SS
Evaluate Safety Margin •Pushed to the limit •Over alloyed	Determine Pickling Needed •Weld Areas •Larger surface Areas	Weigh Cost Implications •Cost of pickle and disposal •Cost of premature failure

Recommendations for Heat Tint

- Localized Corrosion Environment
Pickle for all alloy/tint combinations
- General Corrosion Environment
Pickle dark blue/black heat tints
Consider leaving light “straw” colored
heat tints

Recommendations for Surface Rust

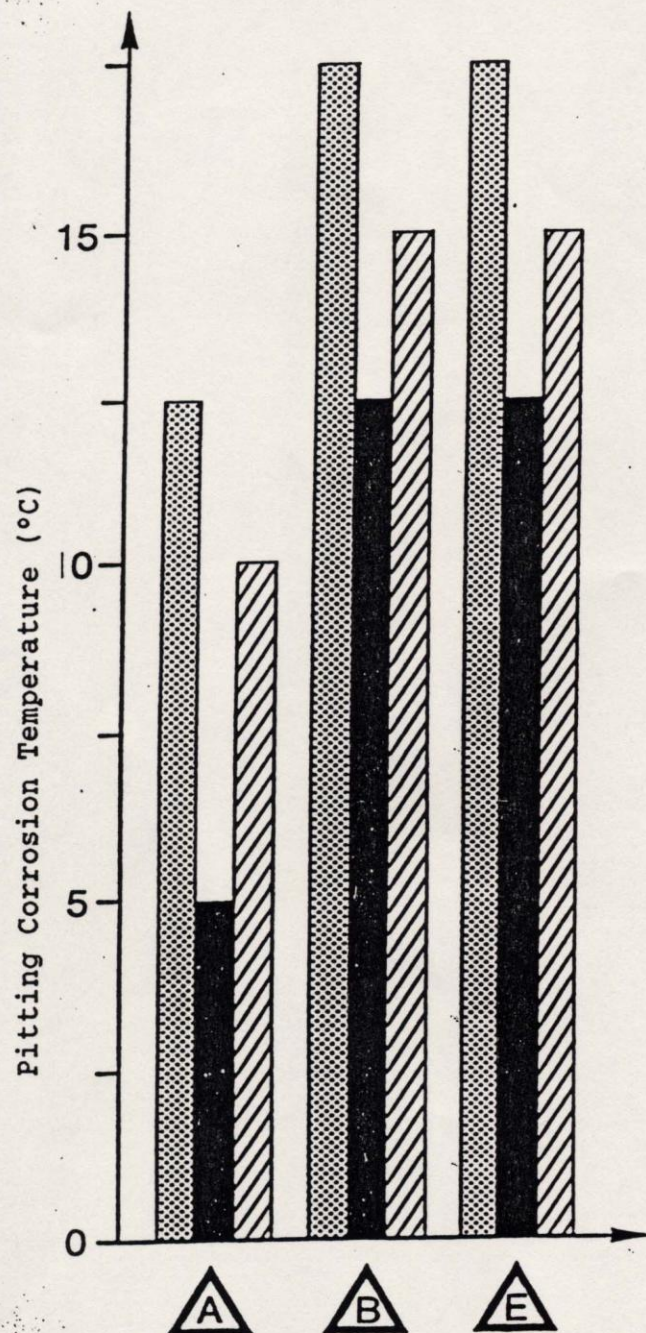
- Embedded Rust Particles

Pickle for all alloy/environment combinations

- Surface Rust Bloom

Make sure it is lightly adherent (eraser method)

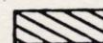
If it is leave it for all alloy/environment combinations



Test Medium: 10 % $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$



Basic Material



Weld



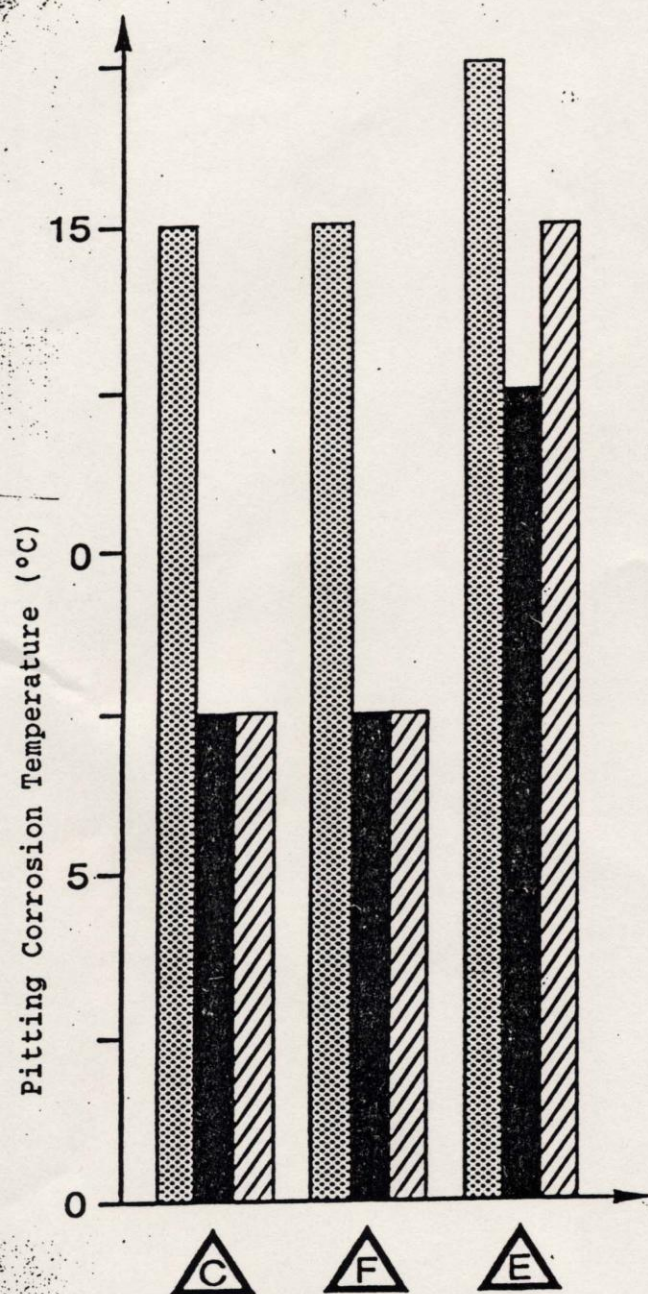
Heat-affected Zone

Surface Conditions

A original conditions
(oxide coating, welding
scale)

B pickled with liquid
pickle (HNO_3 + HF)

E pickled with Antox 71 E
(Metasco)



Test Medium: 10 % $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$



Basic Material



Weld



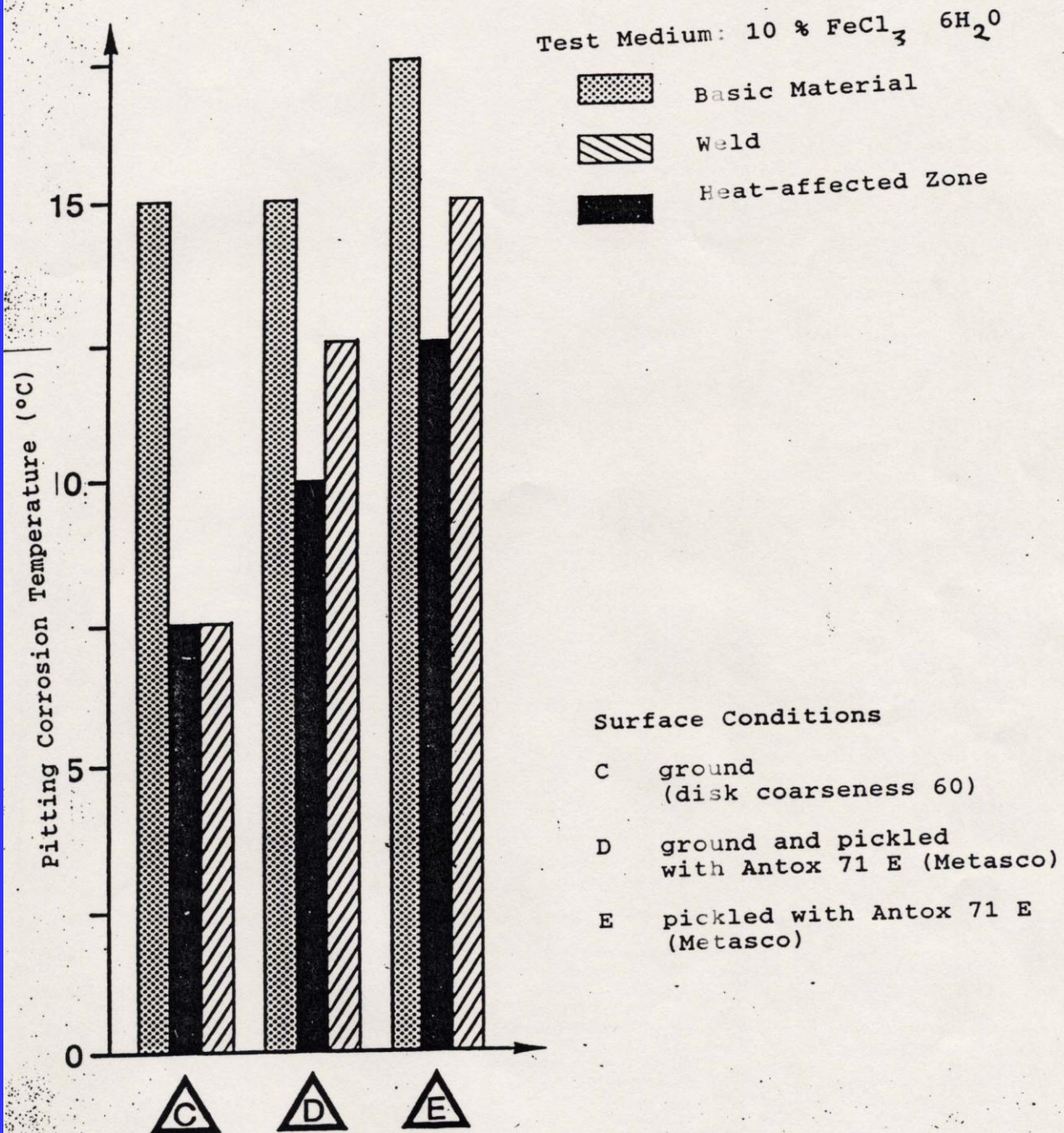
Heat-affected Zone

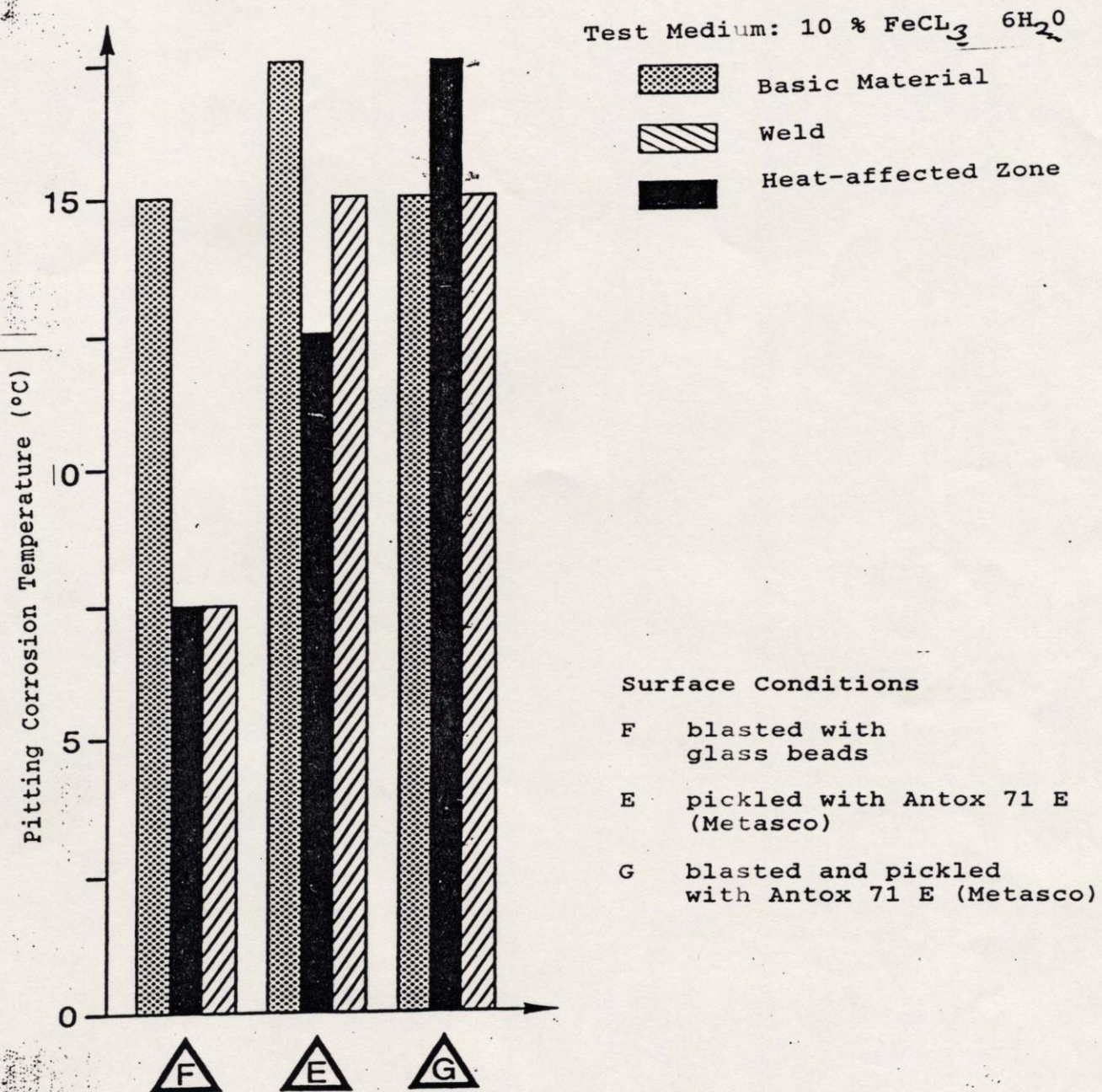
Surface Conditions

C ground
(disk coarseness 60)

F blasted with
glass beads

E pickled with Antox 71 E
(Metasco)





IN SUMMARY

WHEN

IN

DOUBT????

PICKLE!!!!