INSPECTION OF

FIELD WELDING

Objective

- *Types of Projects Involving Welding*
- *Common Welding Terms & Symbols*
- *Welder Qualifications*
- *Common Welding Requirements*
- *Welding Inspection*

Types of Projects Involving Field Welding

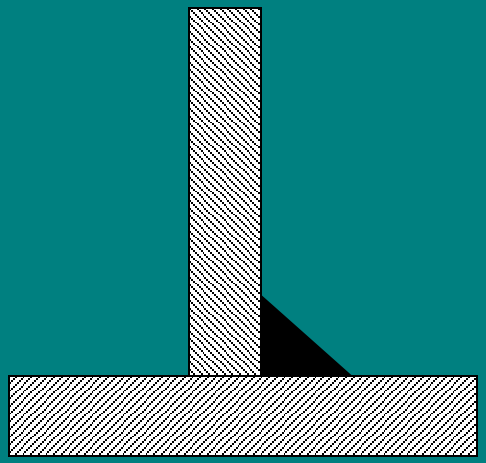
- *New Structures:*
  - *Bridge Rail*
  - *Strip Seal Extrusions / Armor Angles*
  - *Pile-to-Girder Connections*
  - *Pile splice*

Types of Projects Involving Field Welding

- *Rehabilitation Projects*
  - *Bridge Rail*
  - *Strip Seal Extrusions / Armor Angles*
  - *Fatigue Retrofits*
  - *Weld Repairs*

Common Field Weld Types

- *Fillet Welds*



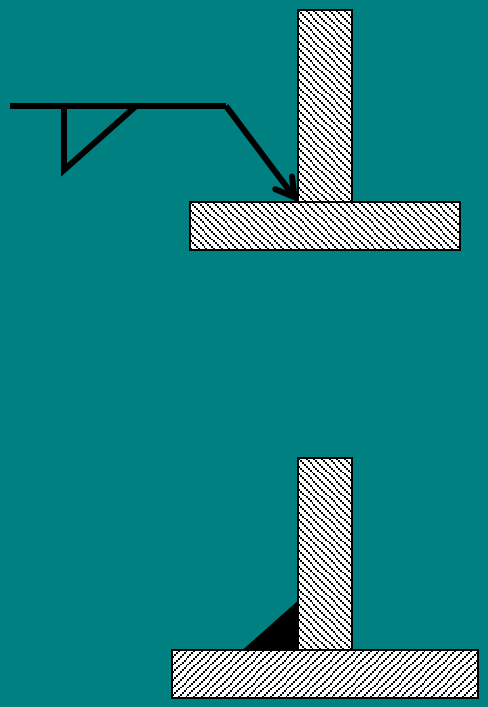
Fillet Weld

- *Groove Welds*

Square Groove Weld

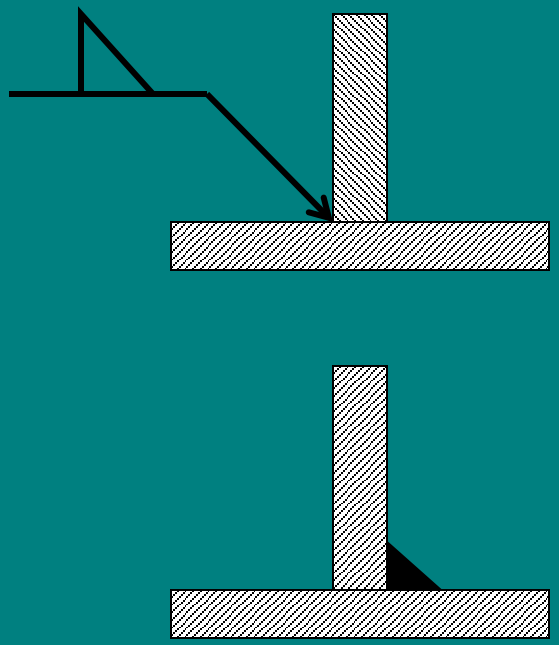
V - Groove Weld

Symbols for Fillet Welds



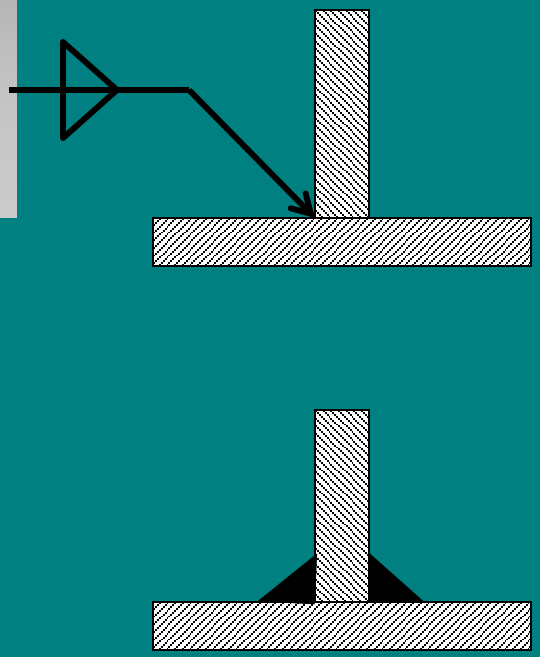
- *When symbol is below the line, the weld is to be placed on the side to which the arrow points*

Symbols for Fillet Welds



- *When the symbol is above the line, the weld is to be placed on the opposite side of the joint to which the arrow is pointing.*

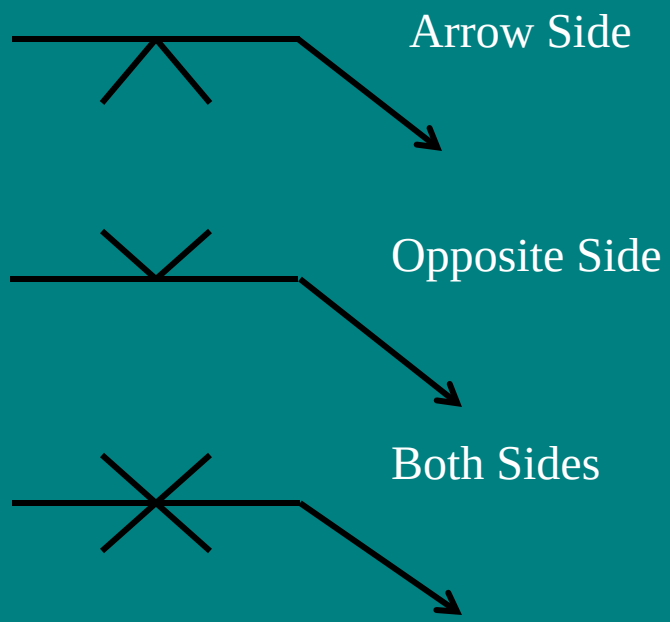
Symbols for Fillet Welds



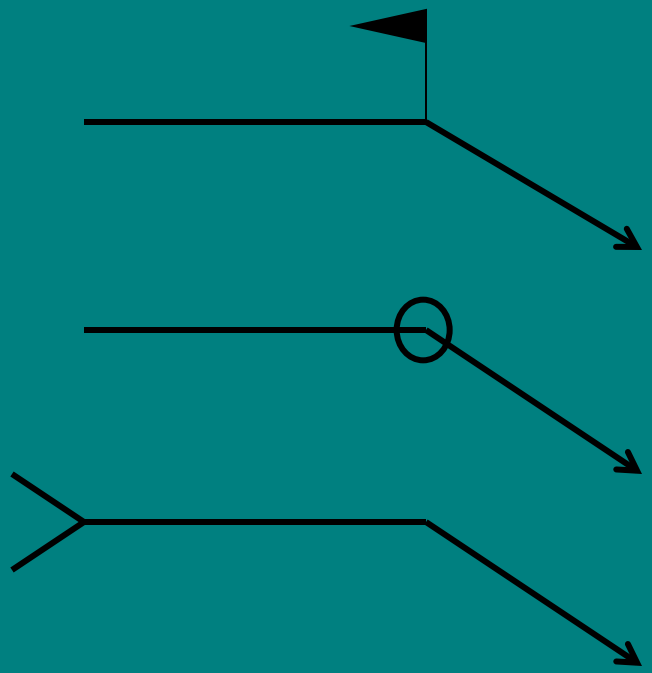
- *Weld symbols both sides of the line indicate that the weld is to be placed on both sides of the joint.*

Symbols for Groove Welds

- *Typical Groove Weld Symbols*



Additional Weld Markings



Field Weld

Weld All Around

Tail on end of weld is where any special instruction are placed

Surface Contours of Welds

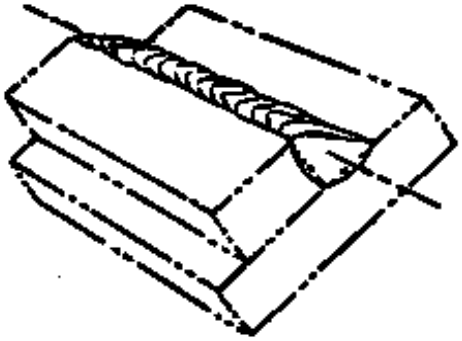
It may be specified that the weld surface of a groove weld have a certain contour:

Weld Flush Without Grinding

Grind to Convex

Grind to Flush

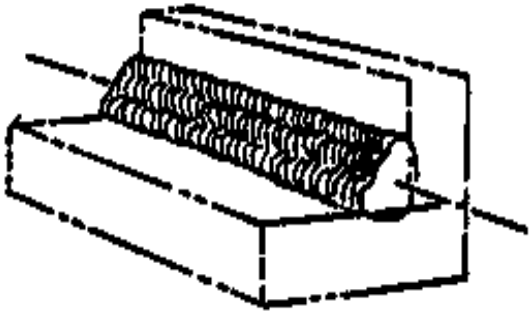
Welding Positions



FILLET WELD
(1 F)

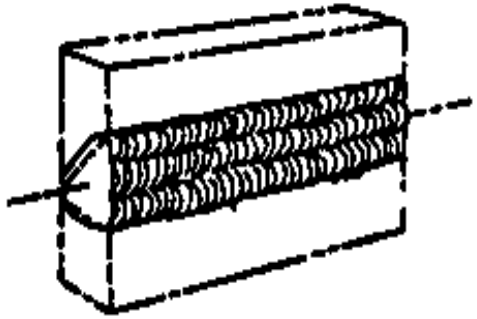
Flat Position

GROOVE WELD
(1 G)



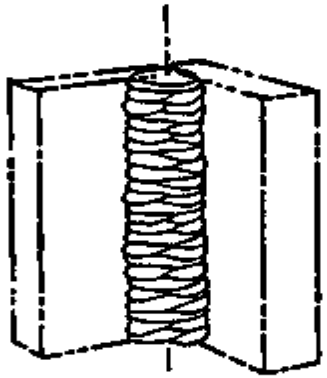
FILLET WELD
(2 F)

Horizontal Position



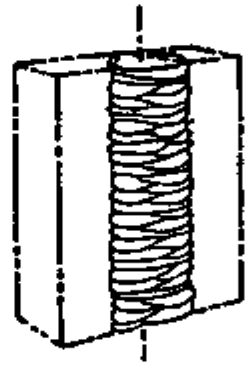
GROOVE WELD
(2 G)

Welding Positions

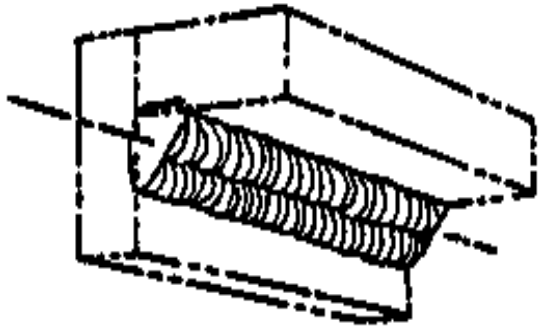


FILLET WELD
(3F)

Vertical Position



GROOVE WELD
(3G)

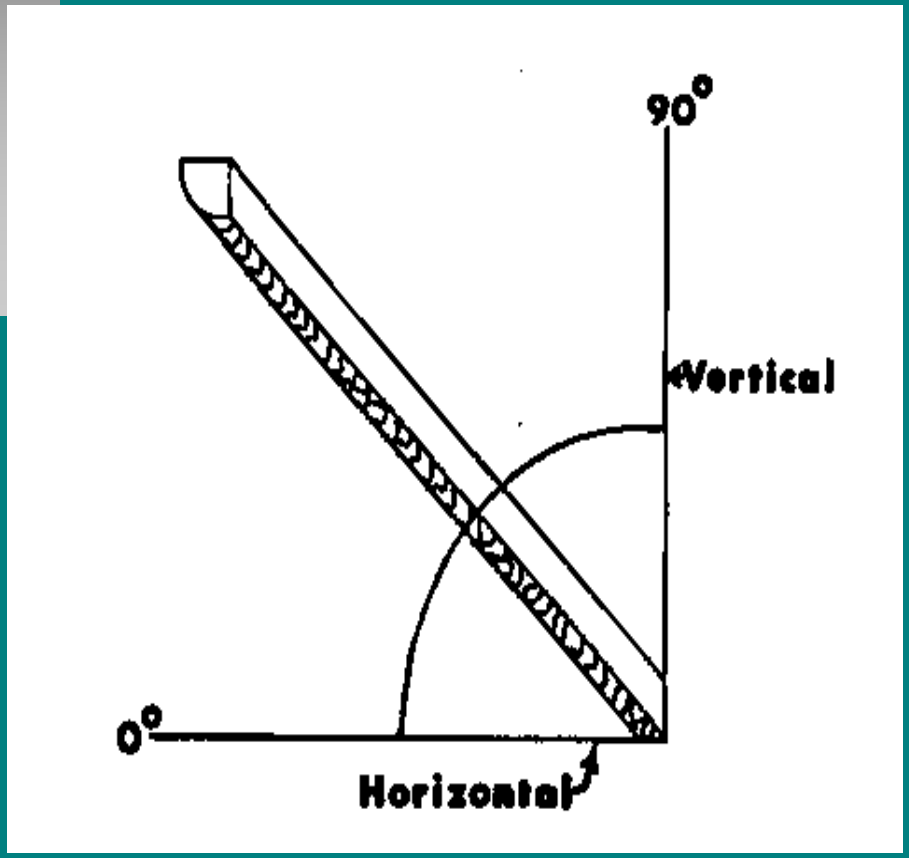


FILLET WELD
(4F)

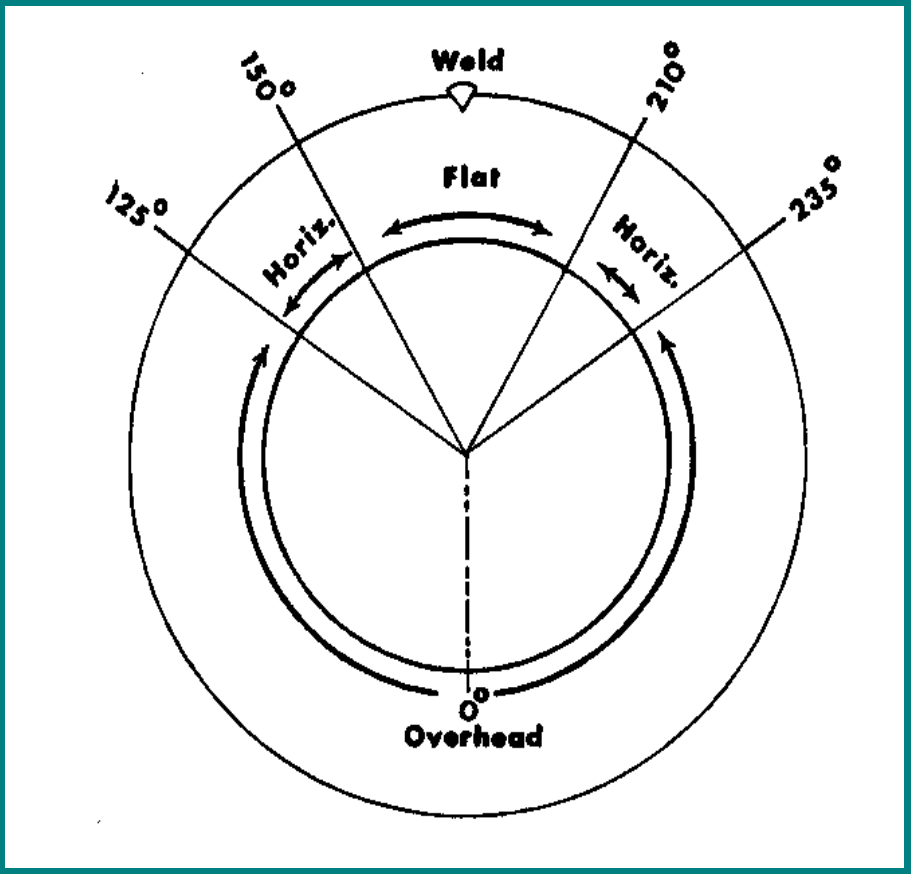
Overhead Position

GROOVE WELD
(4G)

Welding Positions

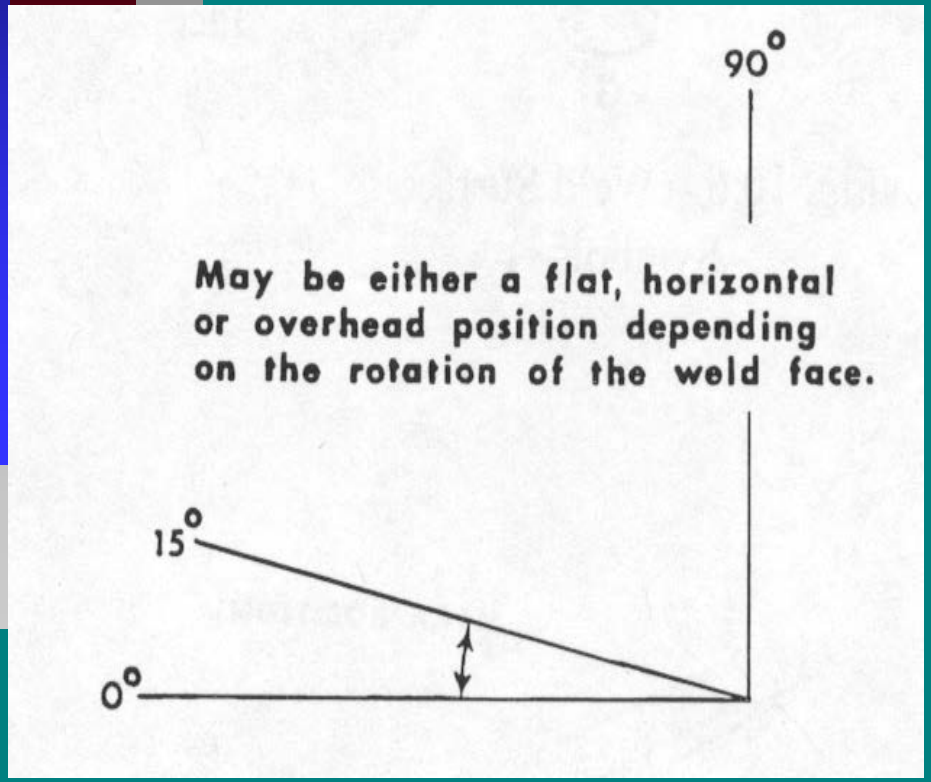


Side View

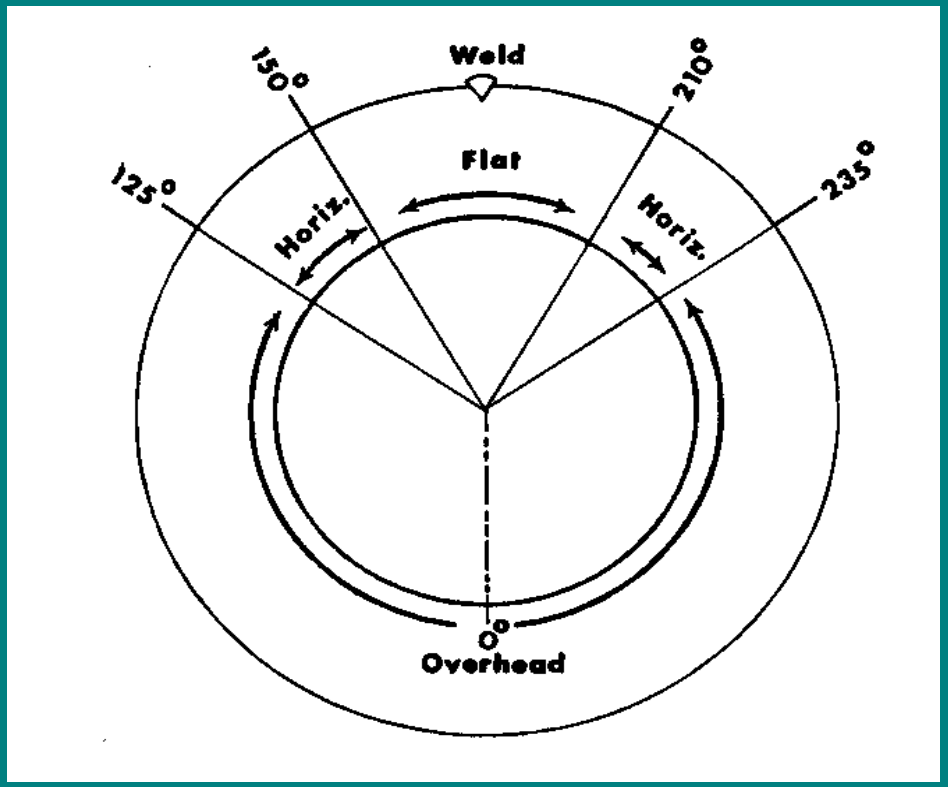


End View

Welding Positions

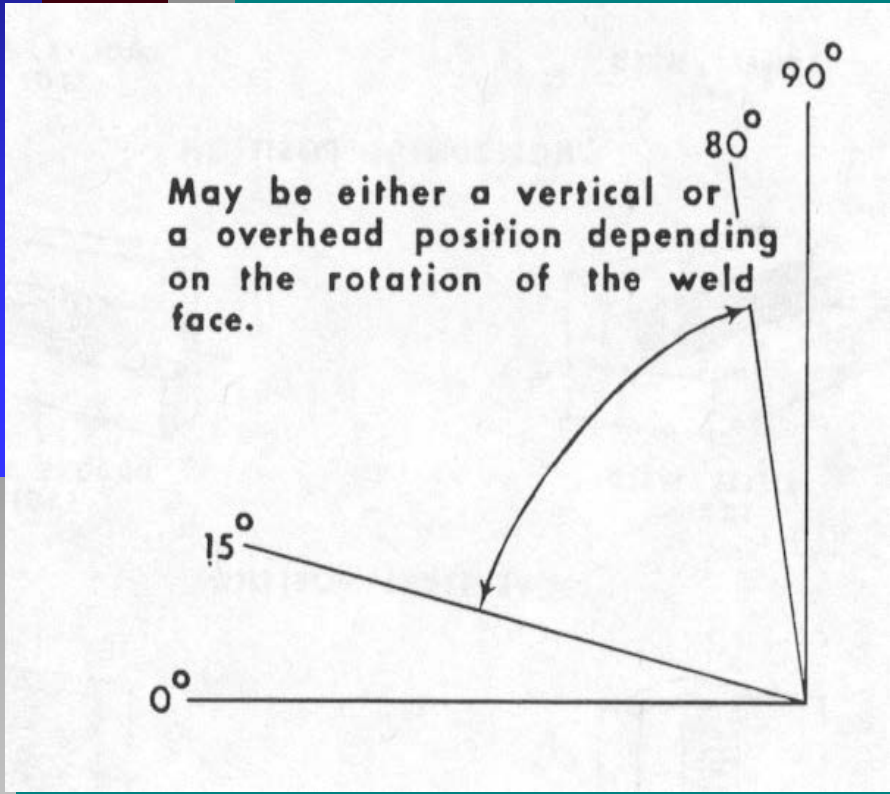


Side View

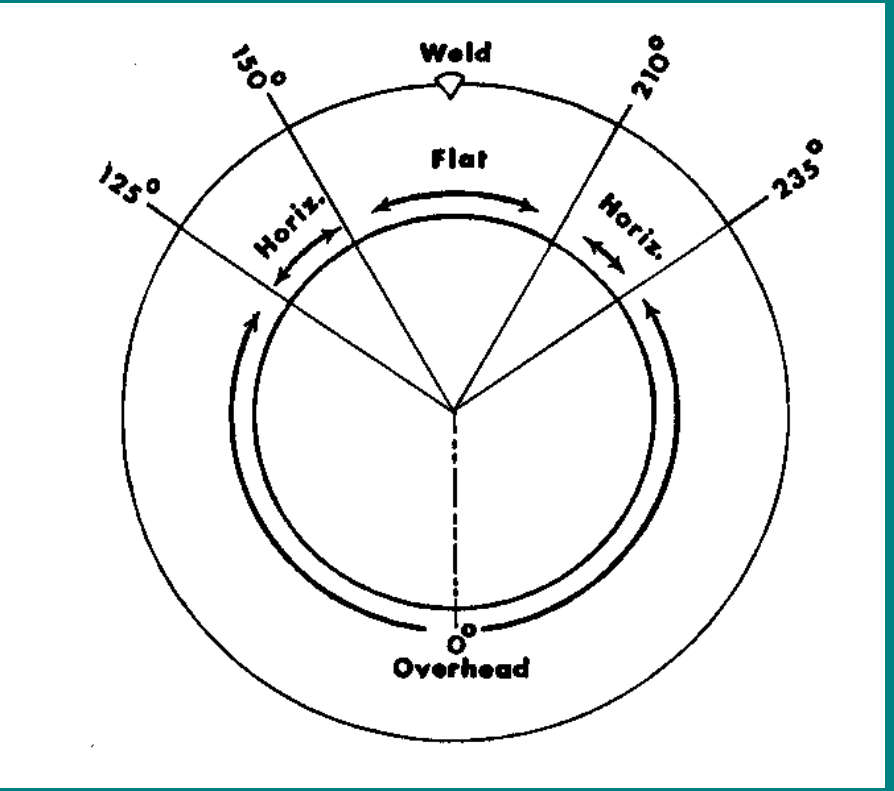


End View

Welding Positions

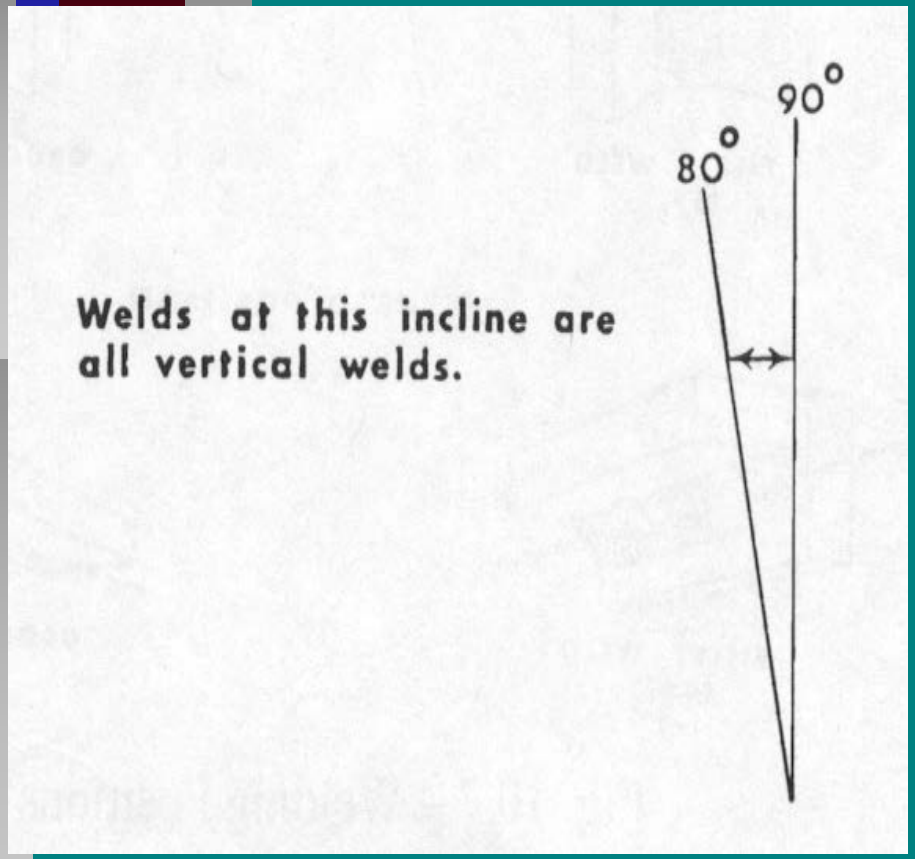


Side View

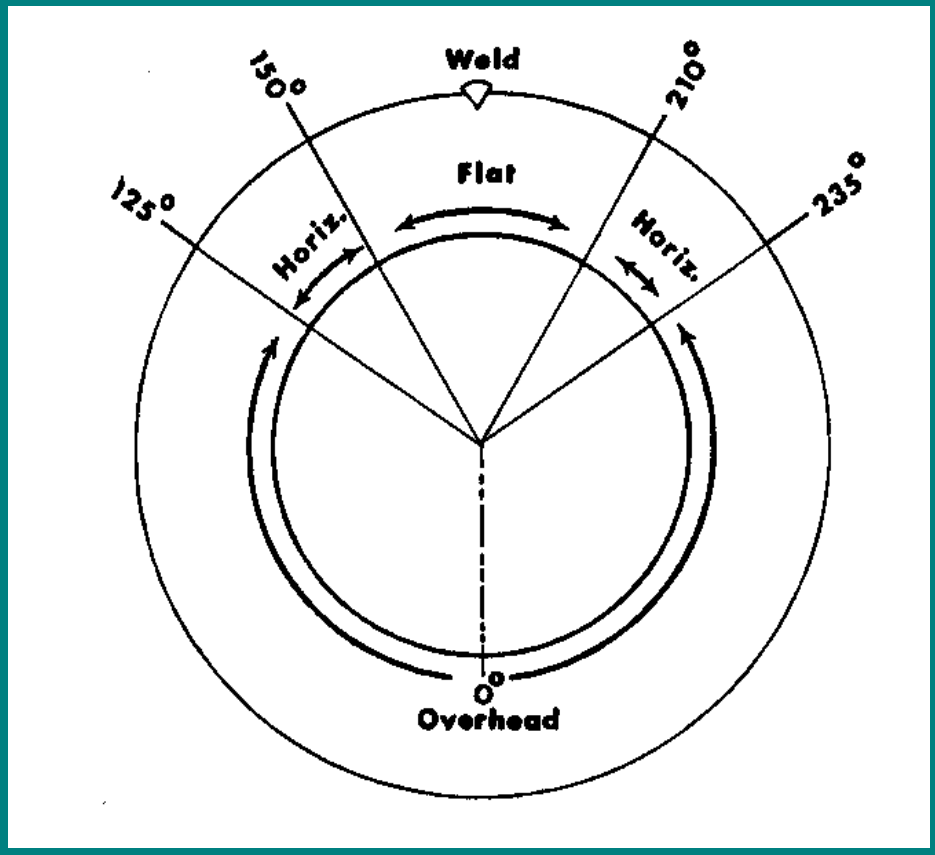


End View

Welding Positions

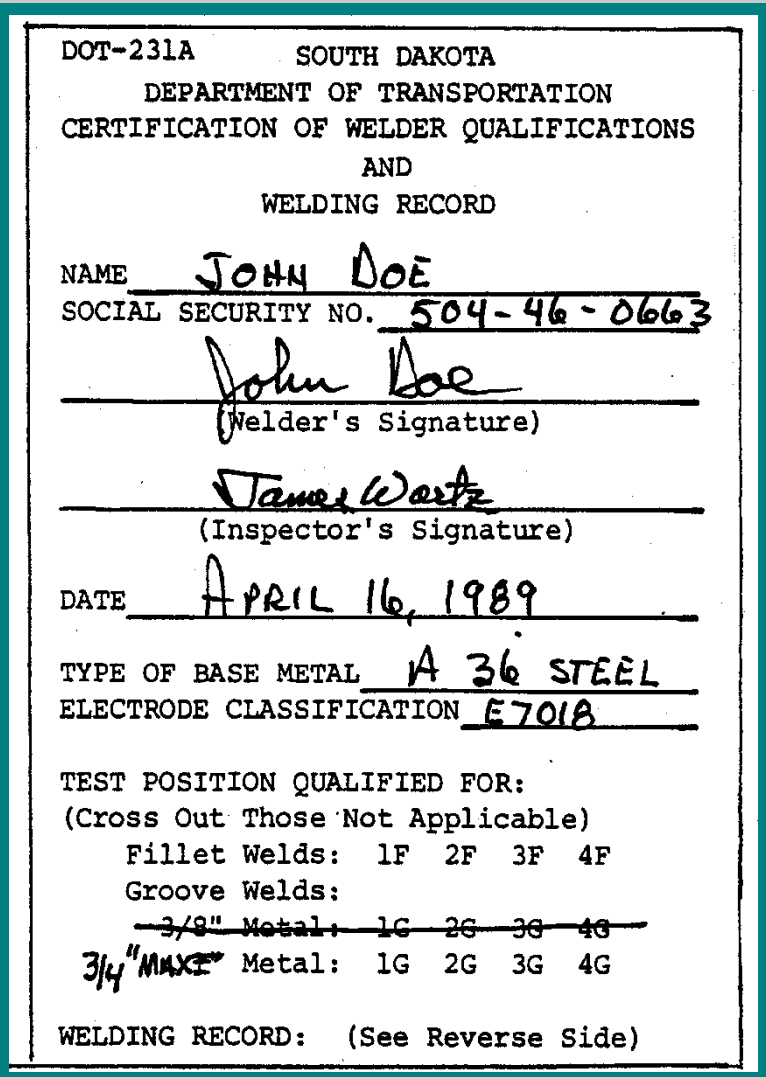


Side View



End View

Welder Certification



DOT-231A SOUTH DAKOTA
DEPARTMENT OF TRANSPORTATION
CERTIFICATION OF WELDER QUALIFICATIONS
AND
WELDING RECORD

NAME JOHN DOE
SOCIAL SECURITY NO. 504-46-0663

John Doe
(Welder's Signature)

James Wertz
(Inspector's Signature)

DATE APRIL 16, 1989

TYPE OF BASE METAL A 36 STEEL
ELECTRODE CLASSIFICATION E7018

TEST POSITION QUALIFIED FOR:
(Cross Out Those Not Applicable)
Fillet Welds: 1F 2F 3F 4F
Groove Welds:
~~3/8" Metal: 1G 2G 3G 4G~~
3/4" MAX Metal: 1G 2G 3G 4G

WELDING RECORD: (See Reverse Side)

- *2004 Standard Specifications Require that a Welder be Certified in Test Position 3G (Vertical) for Unlimited Thickness Groove Welds.*

Welders Wanting to be Certified Need to:

- *Tested in accordance with ANSI/AASHTO/AWS D1.5 Bridge Welding Code to at least 3G (vertical up)*
- *Qualification to ANSI/AWS D1.1 Structural Welding Code is NOT Acceptable.*

  (Refer to Section 410.3.H)

Welders Wanting to be Certified Need to:

- *Welder Qualification needs to be performed under the supervision of an AWS Certified Welding Inspector (CWI) and certified in accordance with AWS QC1.*
  - *Testing Firms*
  - *Vo-Tech Schools*

Welding Electrodes

- *Field welding is done with a covered electrode (Stick Electrode)*
- *SMAW (Shielded Metal Arc Welding)*
  - *Metal wire with a protective covering*
  - *Current is passed through the electrode.*
    - *This causes metals to melt and fuse together.*

Welding Electrodes

- *Only "Low Hydrogen Electrodes" shall be used.*
  - *E7016*
  - *E7018* ← *Most Common*
  - *E7028*
- *Approved List or Certificate of Compliance.*
- *Electrodes exposed to the atmosphere will absorb moisture, therefore:*
  - *Electrodes in unopened original containers may be used directly from container.*
  - *Electrodes not used within 4 hours or brought to the job in open containers must be dried.*

Drying Electrodes

- *Electrodes not used with 4 hours or from open containers shall be dried as follows:*
  - *E7018 2 hrs. @ 450°F to 500°F*
- *After drying, store in storage ovens @ 250°F*
- *Reject Electrodes that have been wet.*

Weather and Temperature

- Steel Must be preheated
- Welds shall not be placed when there is rain rain or snow
- Preheat will remove any water on cold days

Preheat

- For A36 and A709 Gr. 36 & Gr.50:

PLATE THICKNESS	MIN. INTERPASS AND PREHEAT TEMP °F
3/4” or Less	50
>3/4” thru 1 1/2”	70
>1 1/2” thru 2 1/2”	150
Over 2 1/2”	225

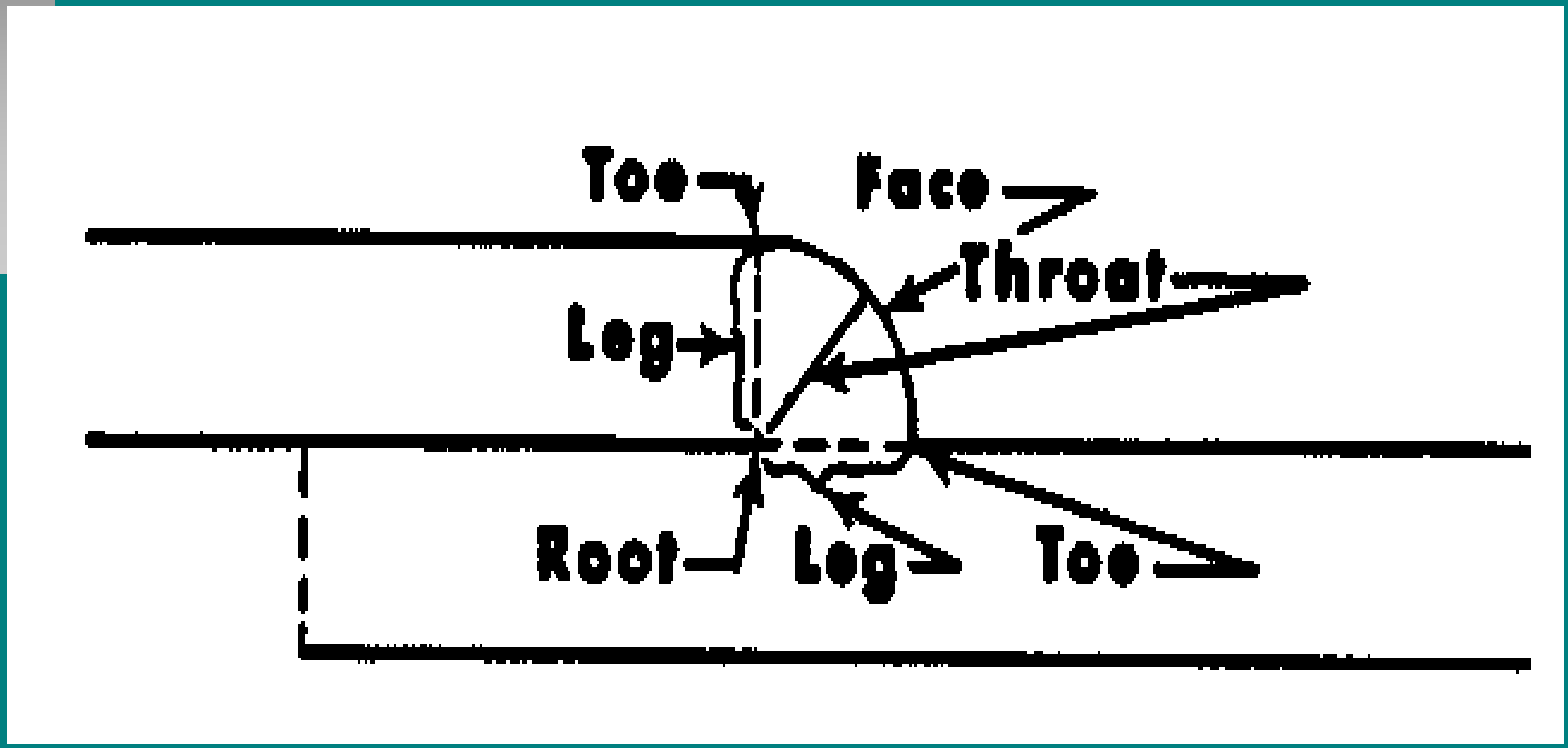
Preheat

- *Carefully Review Plans/Shop Plans for Other Preheat Conditions.*
  - *Other Types of Steels May Require Higher Preheat.*
  - *High Restraint Details May Require Higher Preheat.*

Preheat

- *Methods of Monitoring Preheat*
  - *Surface Thermometer*
  - *Thermomelt Stick*
    - *Thermomelt Sticks are made for several different temperatures.*
    - *Make sure proper stick is used.*

Fillet Welds

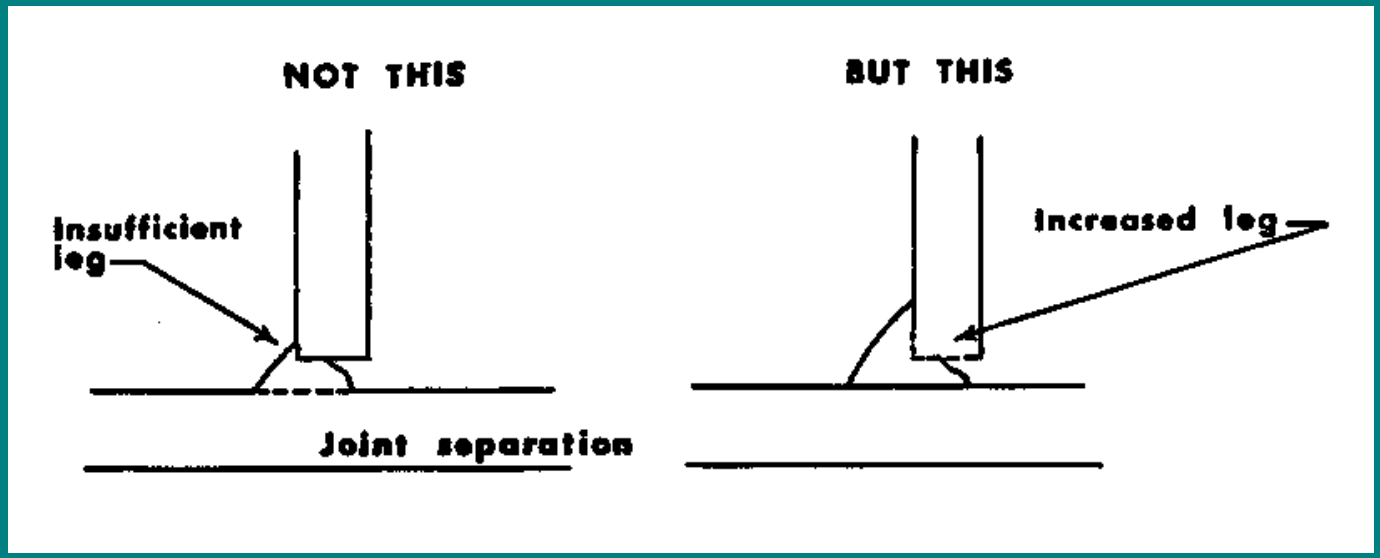


Preparation of Base Metal

- *Weld Connection Area Must be Free of Defects and be Cleaned 2” Each Side of Weld:*
  - *No loose mill scale, rust, oil, or grease*
  - *Galvanizing / Paint Removed*
  - *Moisture Free*

Fit-Up of Plates With Fillet Welds

- *Proper Fit-up and Weld Size*
  - *Plate separations of 1/16” to 3/16” require leg of weld to be increased by the amount of seperation.*



Fit-Up of Plates With Fillet Welds

- *Separations of More than 3/16” Should Not be Allowed.*
  - *Contractor must correct*

Alignment of Plates

- *Plates Welded With Fillet or Groove Welds Need to be Held in Proper Alignment.*
  - *Erection Bolts*
  - *Tack Welds*
  - *Clamps, Jacks, etc.*

General Field Welding Procedures

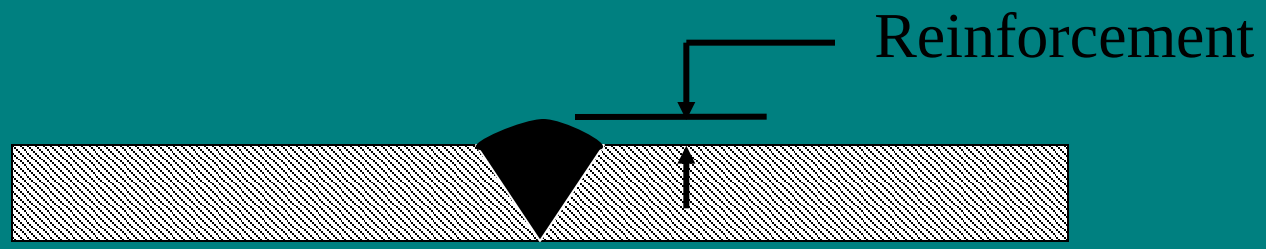
- Use Flat Welding Position if Possible
- Vertical Welds from Bottom Up
- Remove Slag Between Passes
  - Chipping Hammer
  - Wire Brush
- Arc Must be Struck in Immediate Weld Area

Inspection of Field Welds

- *Most Field Welding is in Low Stress Areas.*
  - *Visual Inspection*
- *Welds in High Stress Areas are Much More Critical:*
  - *Visual Inspection*
  - *Non-Destructive Testing*

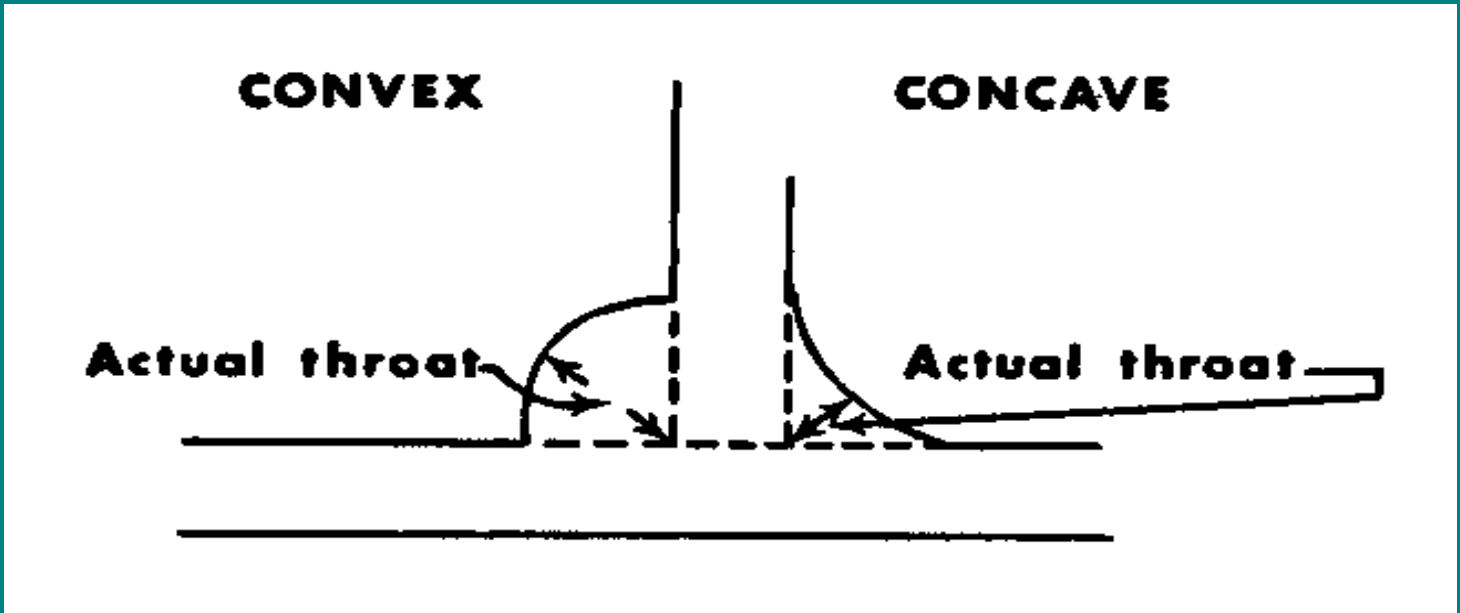
Visual Inspection

- *Groove Welds*
  - *Weld Reinforcement of 1/32” to 1/8”*
    - *– Except when a “Flush” weld is specified.*

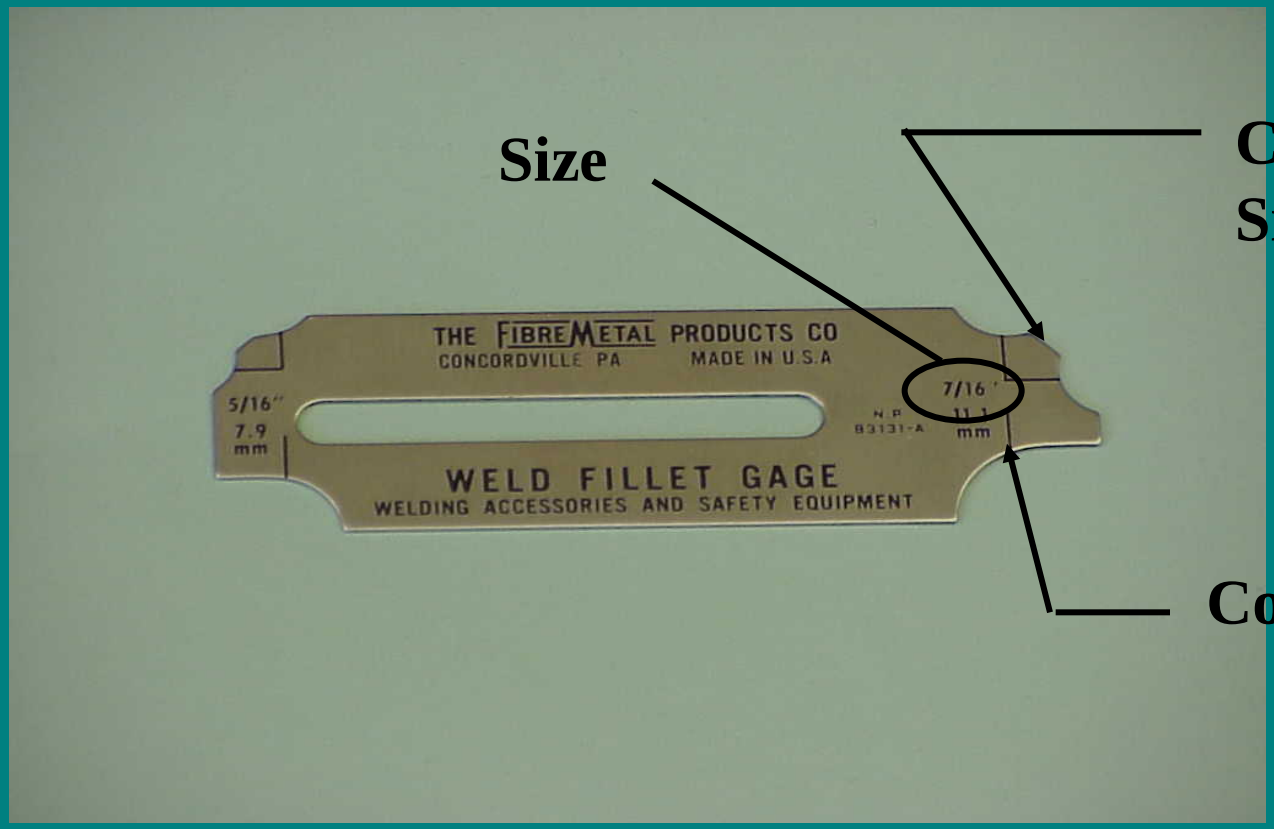


Visual Inspection

- *Fillet Welds - Proper Size*
  - *Concave*
  - *Convex*
  - *Near Flat Preferred*



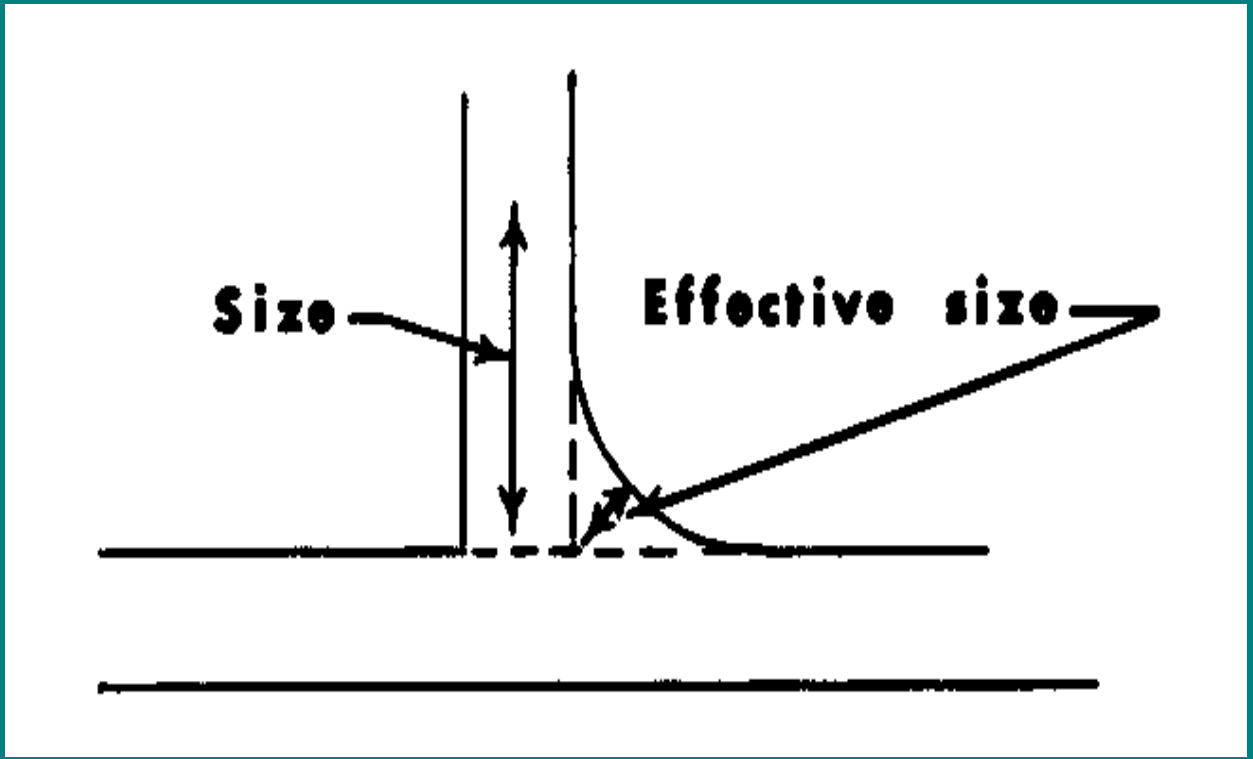
Fillet Weld Gauge



Type of Gauge Used By Department of Transportation

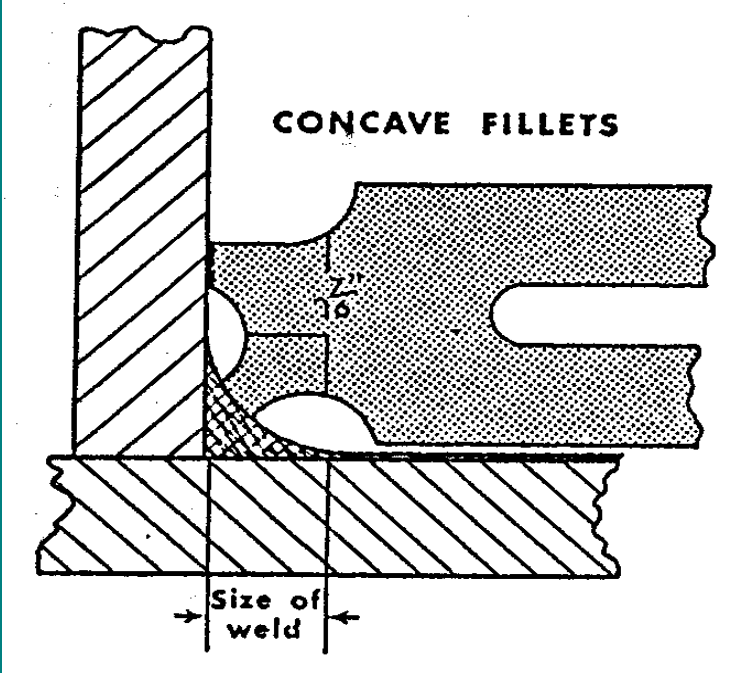
Concave Fillet Weld

- *Effective Size of Concave Fillet Weld Should be at Least the Weld Size Specified.*



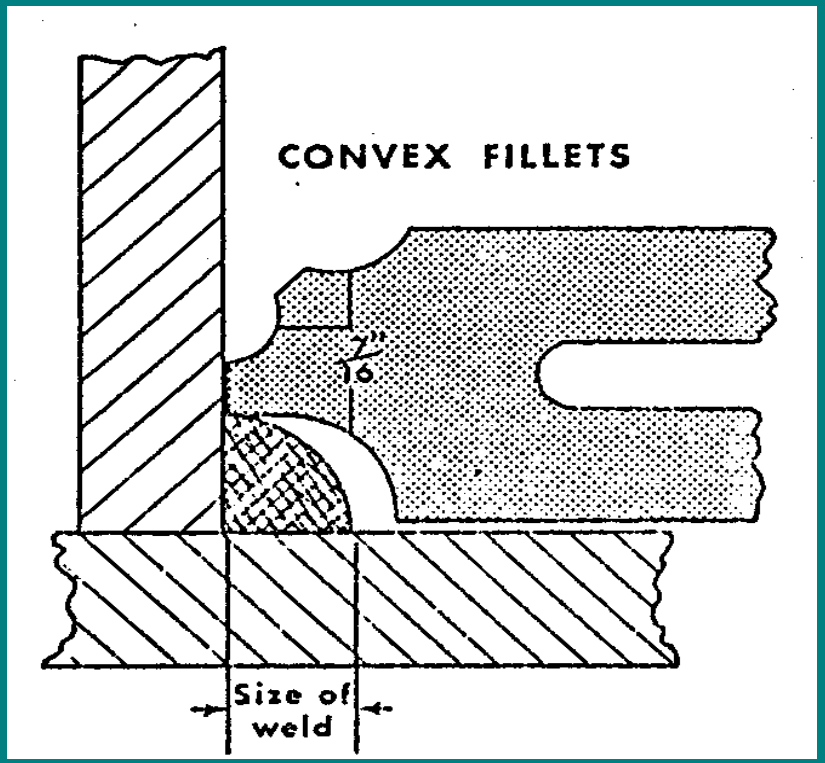
Concave Fillet Weld

- Weld Size Measured With Fillet Gauge



Convex Fillet Weld

- Weld Size Measured With Fillet Gauge



WELDING ACCESSORIE
5/16"
7.9
mm
CONCORDVILLE,
OCT 11

THE
WELDING A
5/16"
7.9
mm
OCT 11 2007

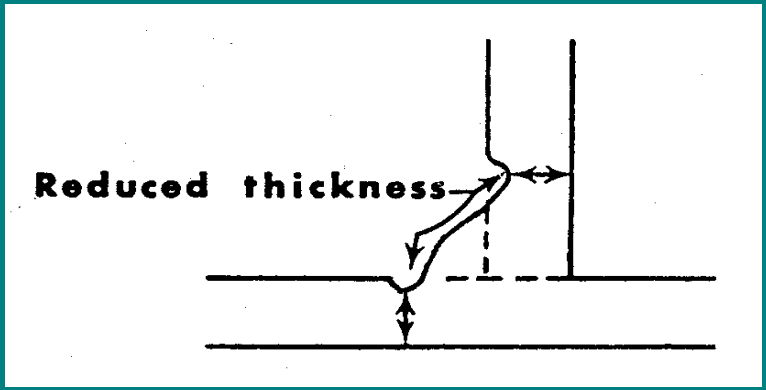
Weld Defects

- *Types of Weld Defects:*
  - *Undercut*
  - *Overlap*
  - *Porosity*
  - *Cracks*
  - *Spatter*

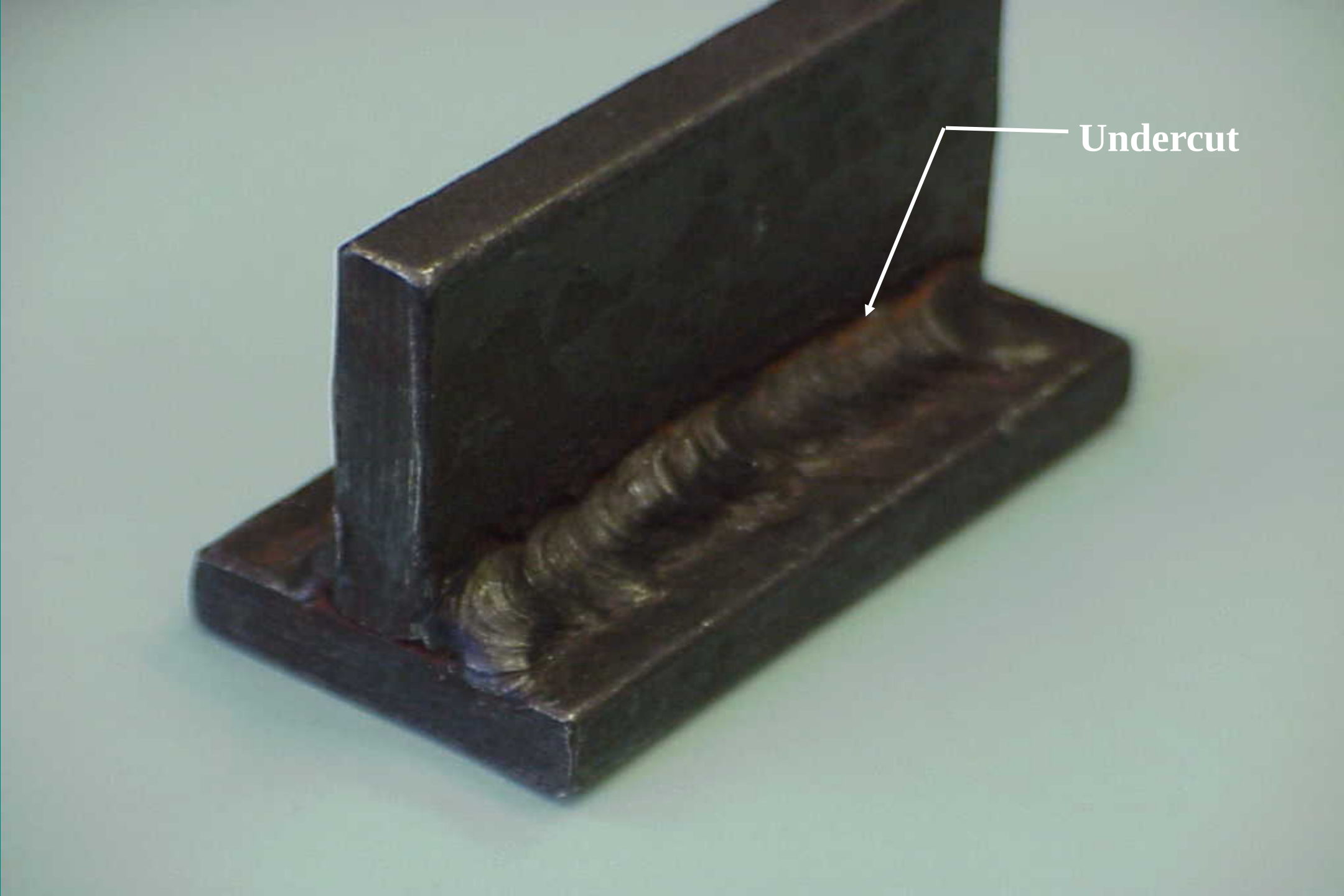
Undercut

Undercut:

Reduction in Base Metal Thickness Alongside Weld



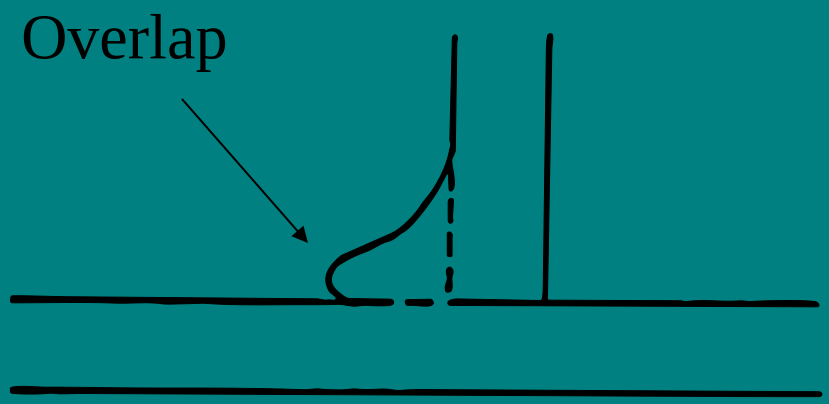
- *Causes:*
  - *Excessive Current*
  - *Too Rapid of Welding Speed*
  - *Excessive Manipulation of Electrode*
  - *Electrode at Wrong Angle*
- *Correction:*
  - *Add Weld Metal at undercut.*


Undercut

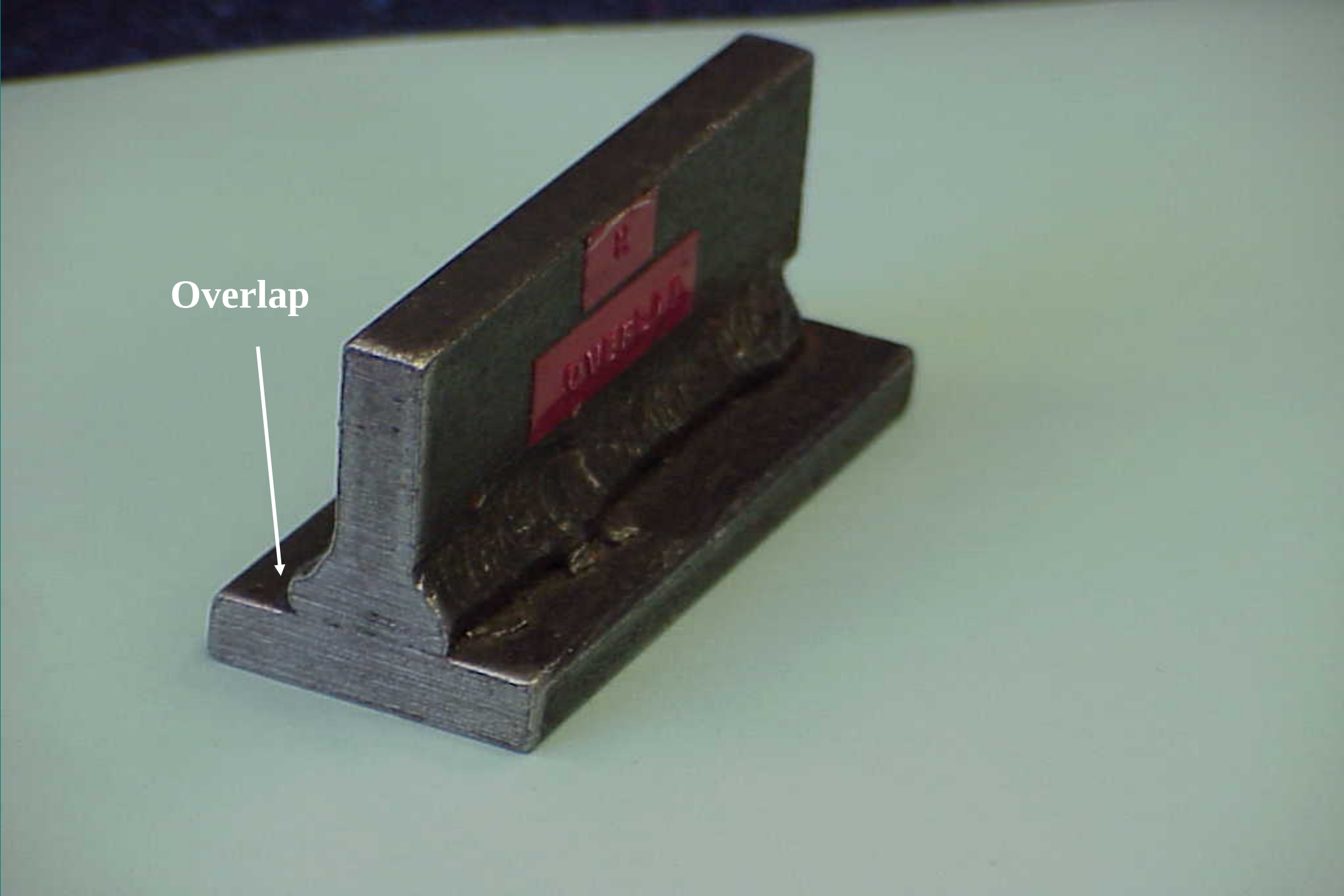
Overlap

Overlap:

Overflow Onto Base Metal Without Fusion.



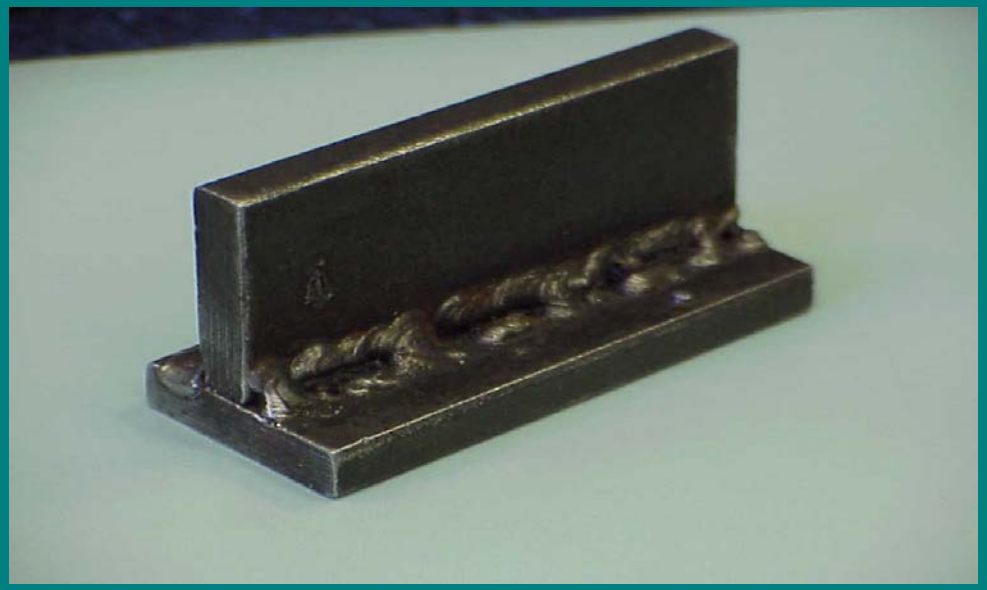
- *Causes:*
  - *Incorrect Current*
  - *Too Slow Welding Speed*
  - *Electrode at Wrong Angle*
- *Correction:*
  - *Remove Excess or Defective Weld Metal*
    - *Grinder*
    - *Air Carbon Arc*
  - *Re-Weld to Correct Size*


Overlap

Porosity

Porosity:

Cavities Caused by Trapped Gases.



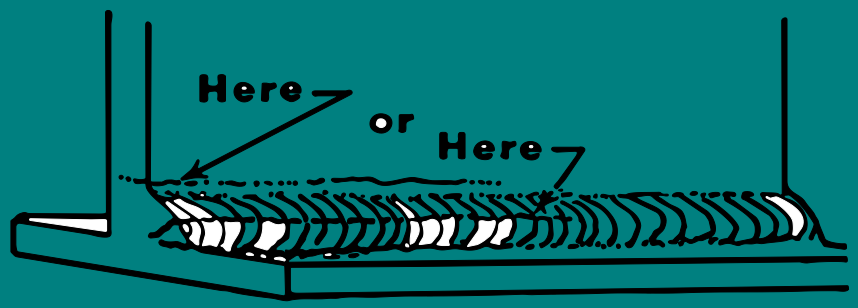
- *Causes:*
  - *Excessive Moisture*
  - *Low Welding Current*
  - *Improper Arc Length*
- *Correction:*
  - *Remove Defective Weld*
    - *– Grinding*
    - *– Air Carbon Arc*
  - *Re-Weld to Proper Size*

Cracks

Cracks:

Separation in Weld Metal or Adjacent Base Metal.

"All Cracks Must Be Repaired"

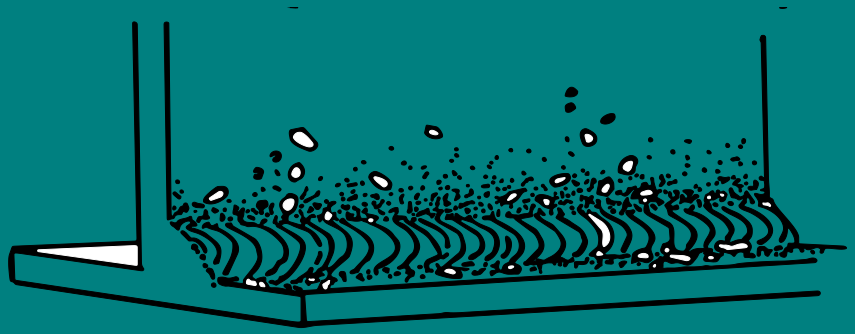


- *Causes:*
  - *Shrinkage of Weld Metal and Resistance to Movement of Joined Parts.*
  - *Excessive Current With Rapid Cooling.*
  - *Low Air Temperature.*
- *Correction:*
  - *Remove Defective Weld*
  - *Re-Weld*

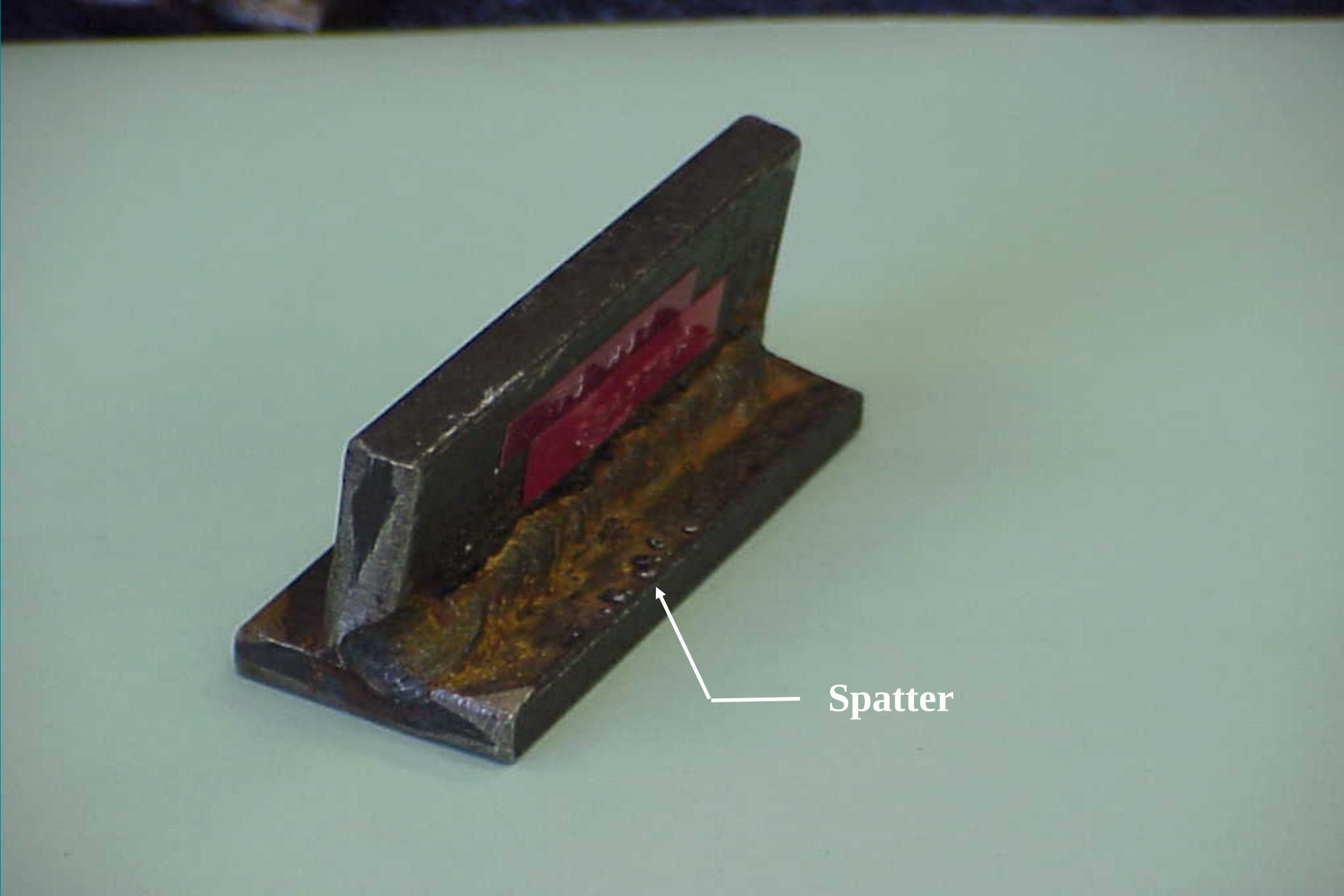
Spatter

Spatter:

Small Pieces of Metal Scattered Over Weld Surface and Base Metal



- *Causes:*
  - *Excessive Current*
  - *Improper Arc*
- *Correction:*
  - *Remove Spatter With Wire Brush and/or Chipping Hammer*


Spatter

Seal Weld

- Occasionally Used to Seal Out Moisture
- Not a Structural Weld
- Should be Visually Inspected

Safty

- *Do not watch the welding with out a welding helmet*
- *Do not touch the red hot stuff*