HOBART BROTHERS

Metal core Process

Basics of Welding Metal Cored Wires

AWS Metal Core Classification

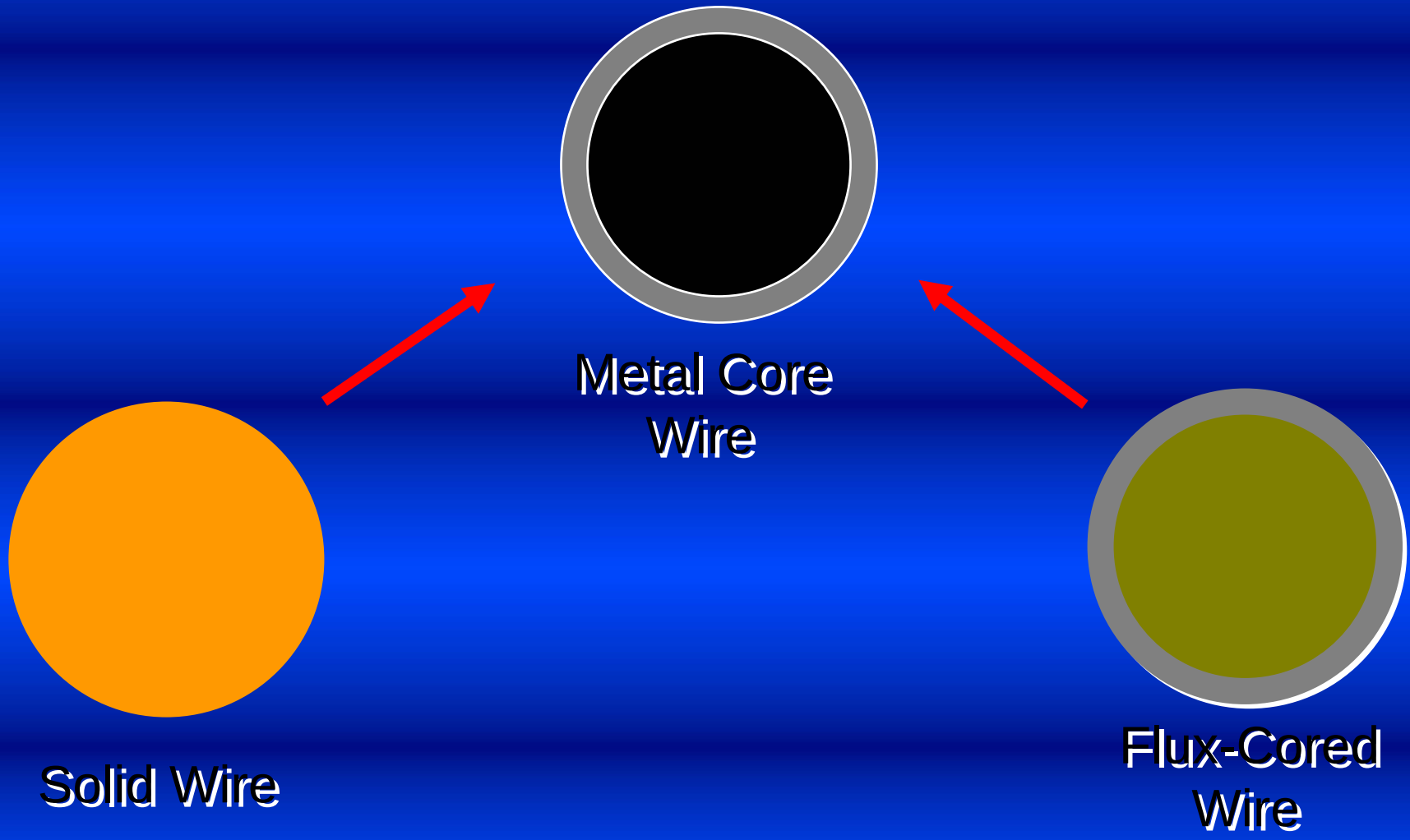
AWS A5.18

E 70 C-6 M

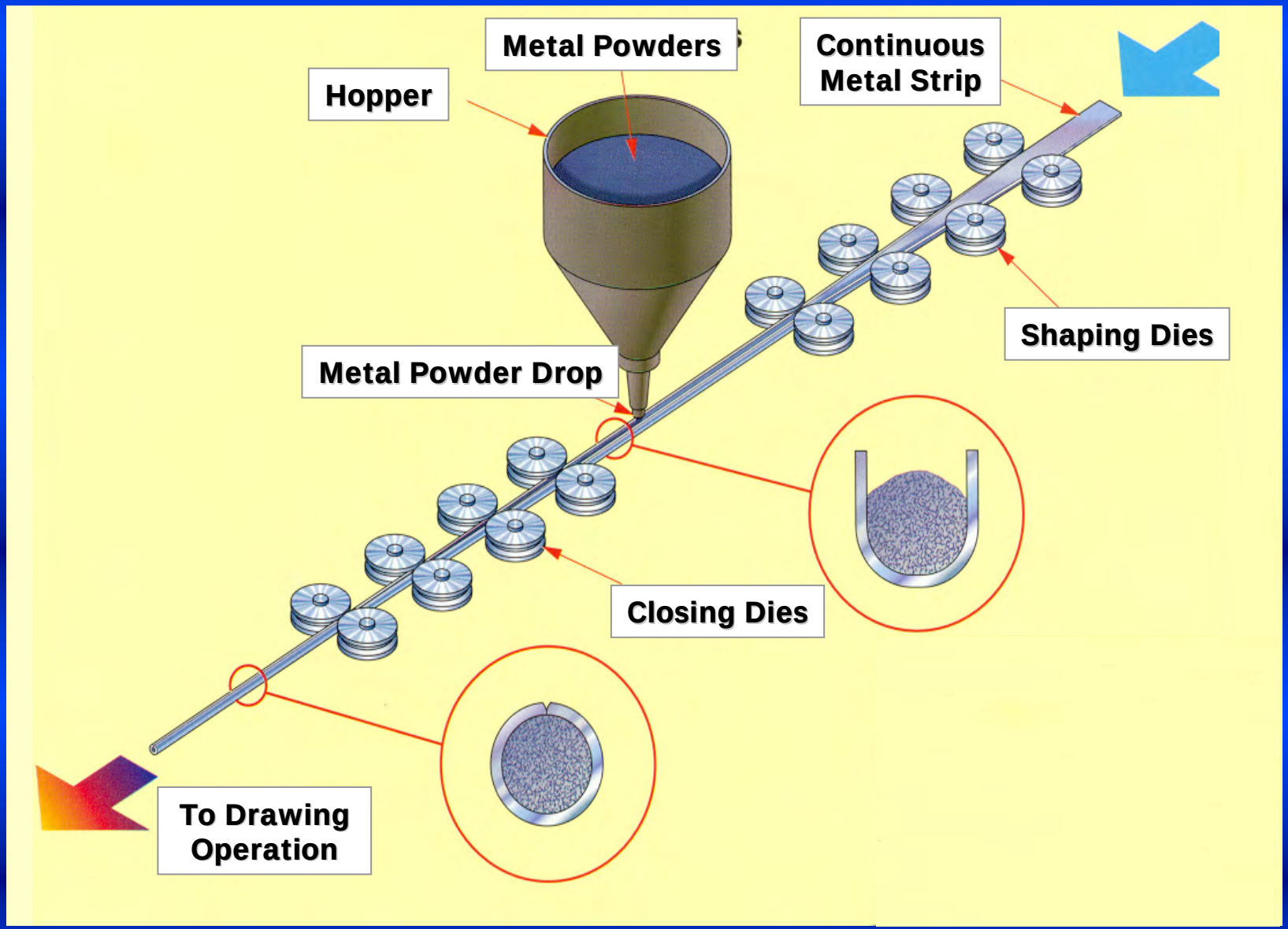
What is Metal Core?

A composite tubular electrode consisting of a metal sheath and a core of various powdered materials, producing no more than slag islands on the face of the weld bead

Hybrid: Characteristics & Benefits of Solid Wire & Flux-Cored Wire

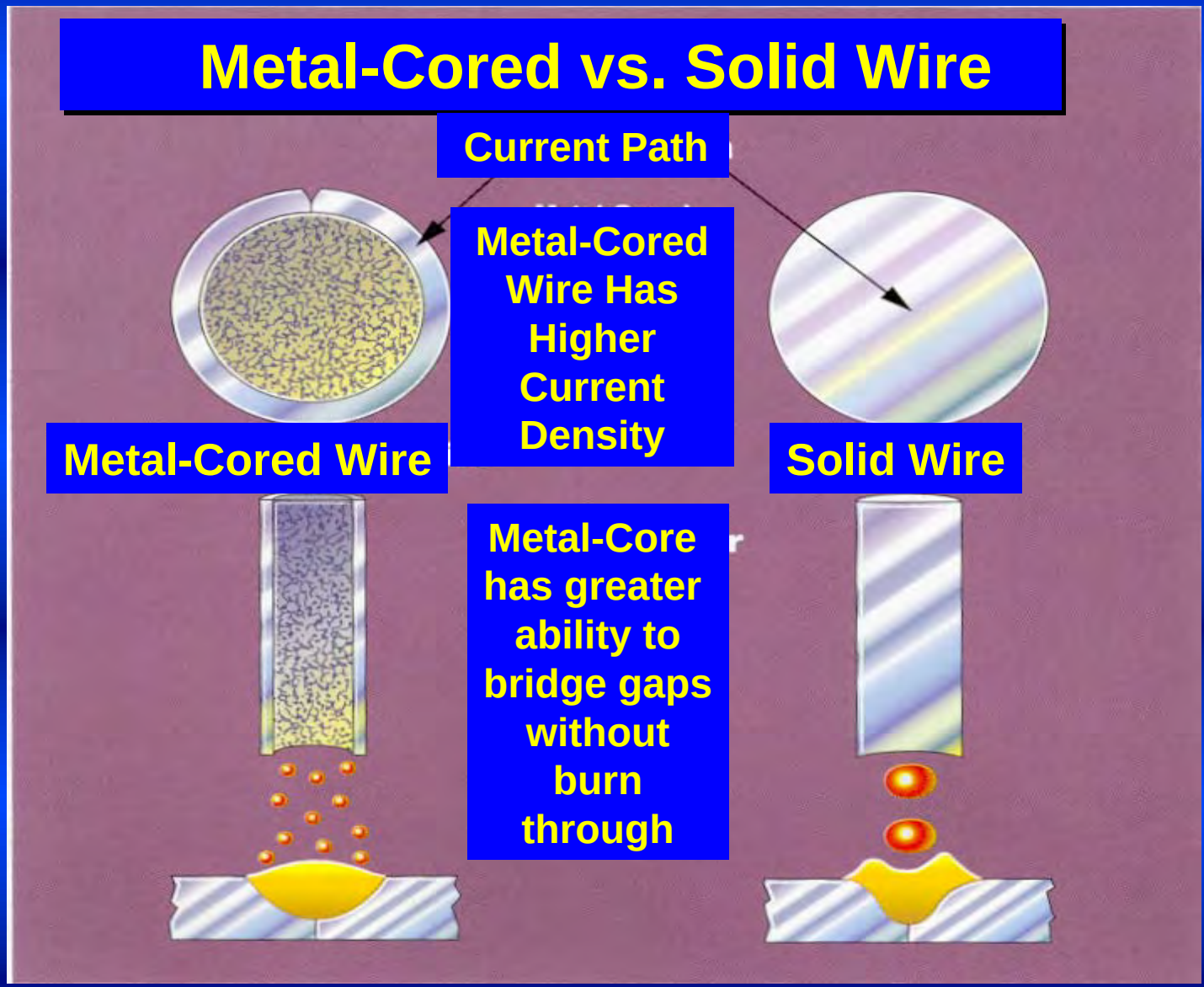


How Is Metal Core Manufactured?

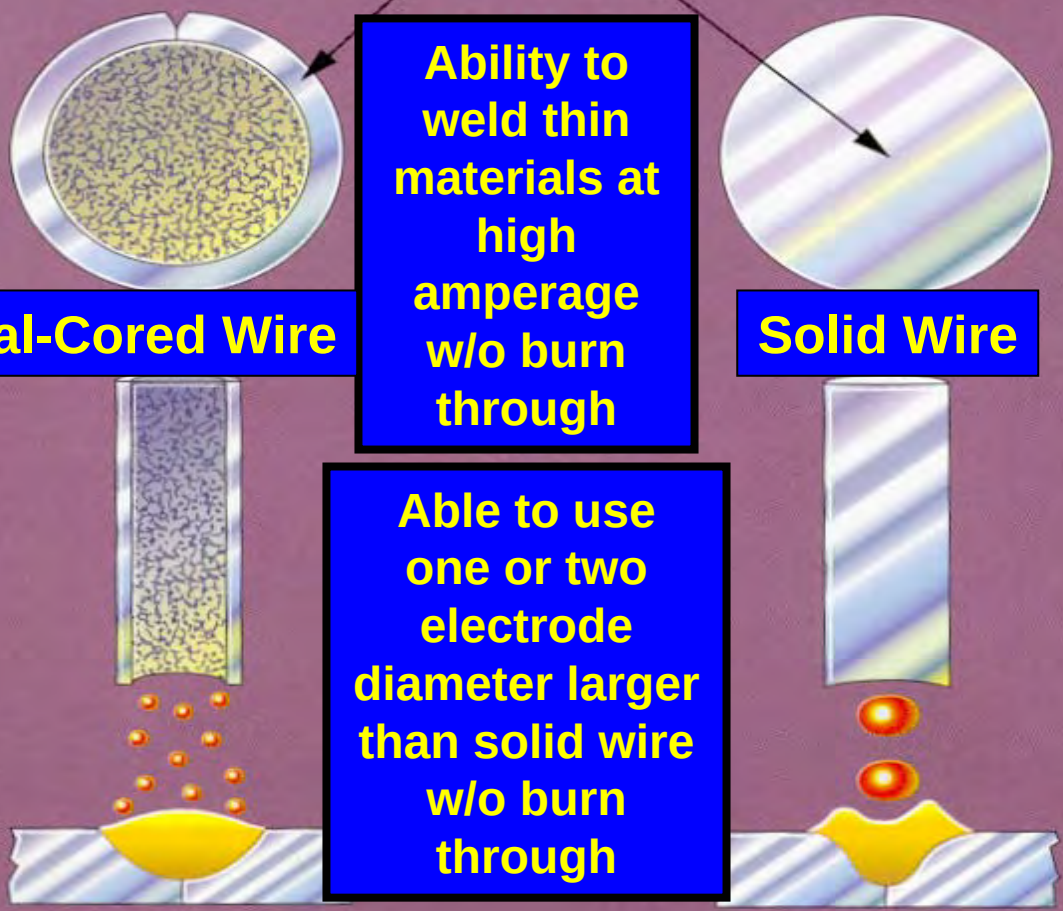


WHAT ARE SOME OF THE MAJOR CHARACTERISTICS OF METAL CORE?

Metal-Cored vs. Solid Wire



Metal-Cored vs. Solid Wire



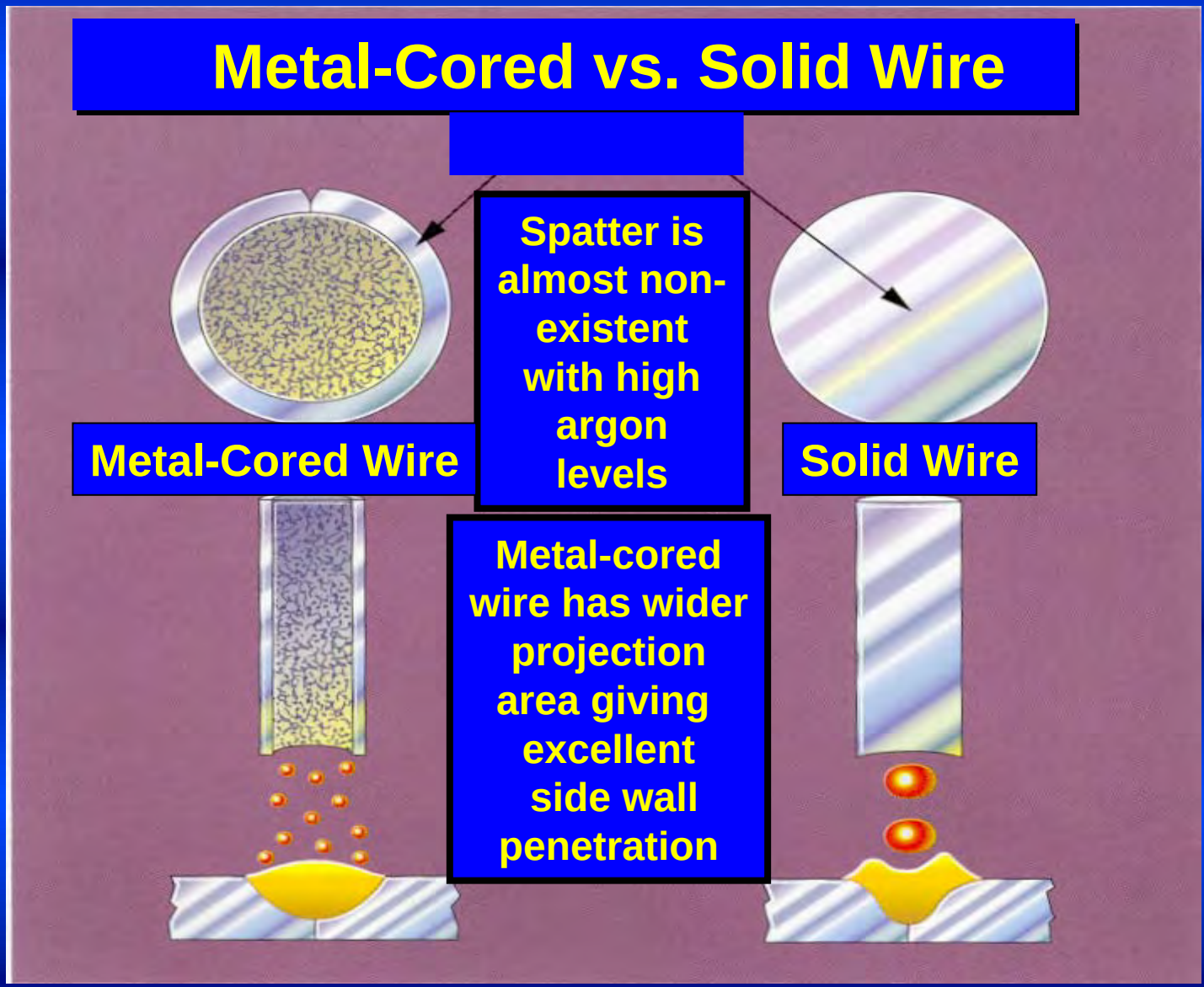
Metal-Cored Wire

Ability to weld thin materials at high amperage w/o burn through

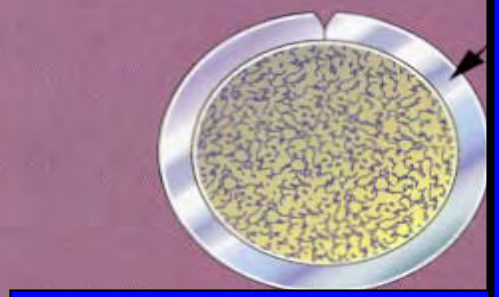
Solid Wire

Able to use one or two electrode diameter larger than solid wire w/o burn through

Metal-Cored vs. Solid Wire

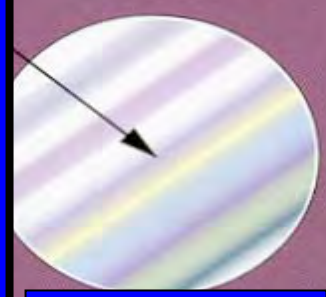


Metal-Cored vs. Solid Wire

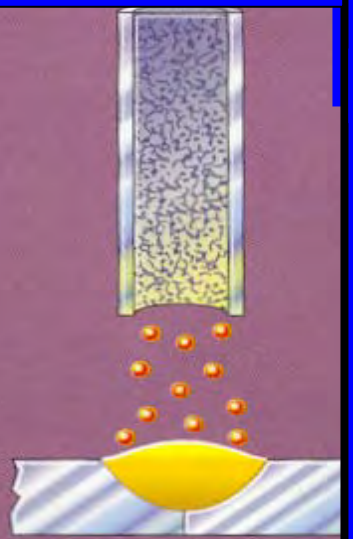


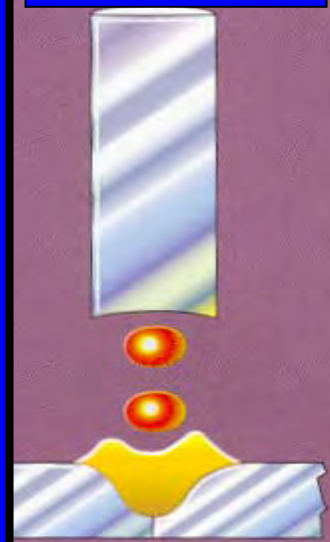
Metal-Cored Wire

Metal-cored wire has higher current density, so, with the same electrode diameters at the same operating parameters (amperage), metal core typically has a higher deposition rate, resulting in higher travel speeds for the same size weld

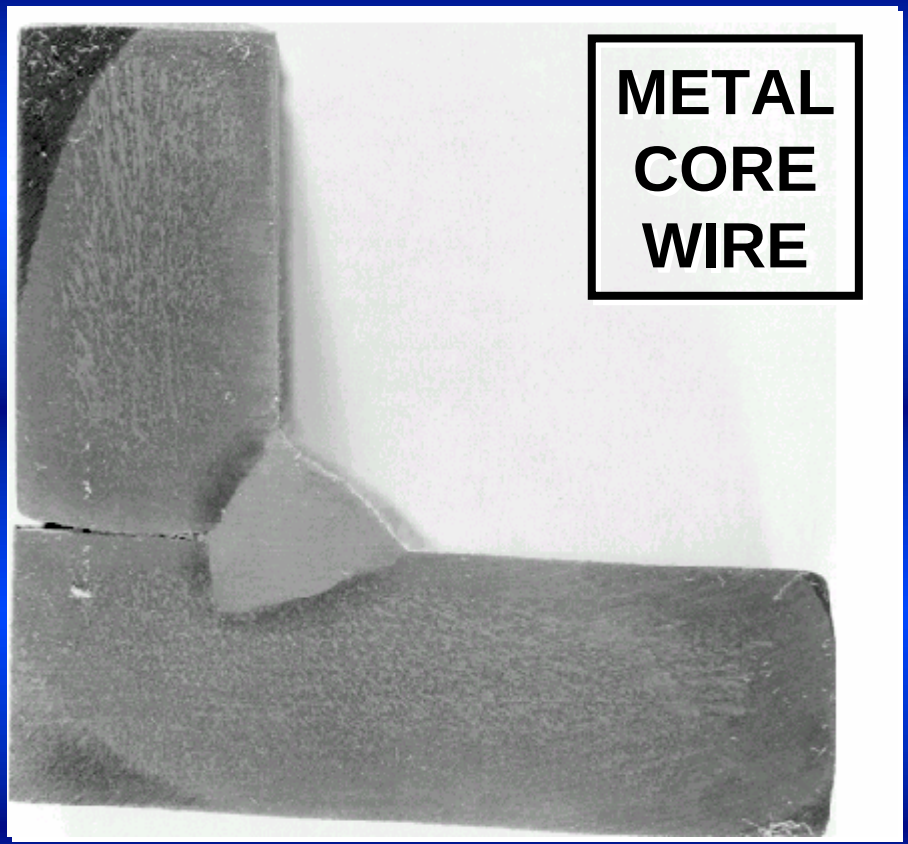


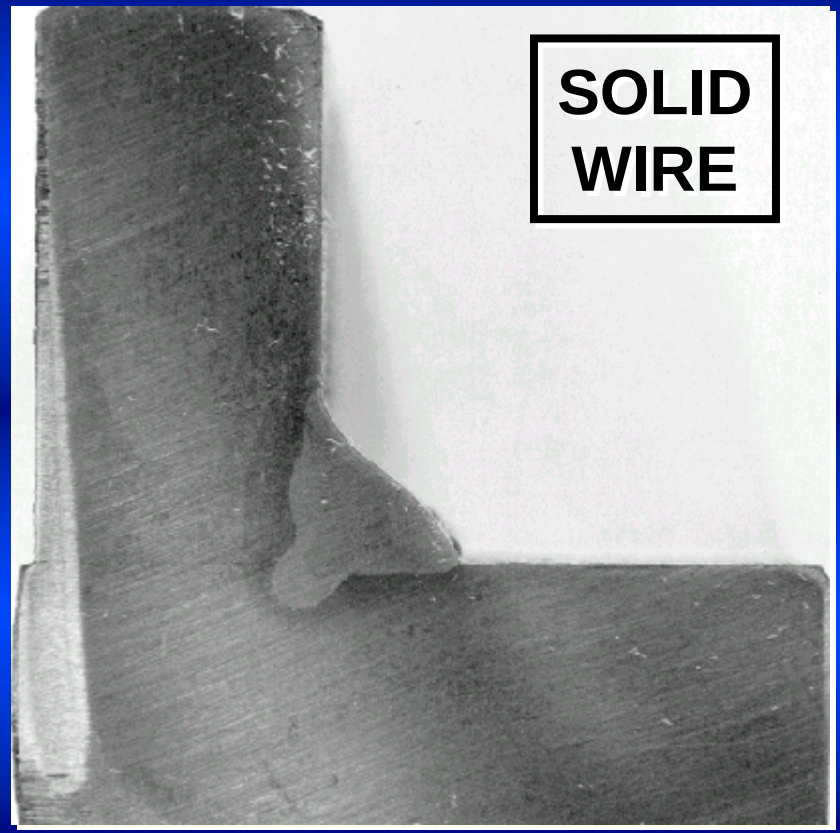
Solid Wire



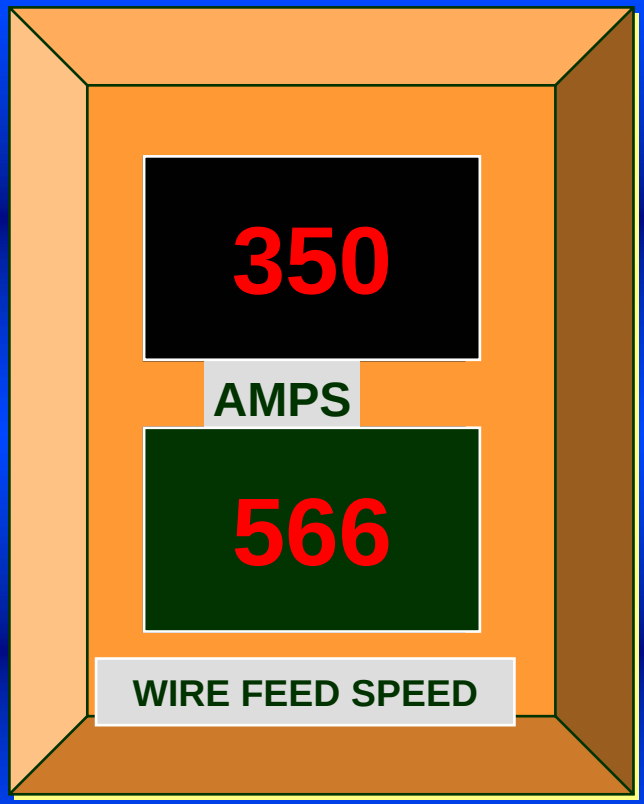


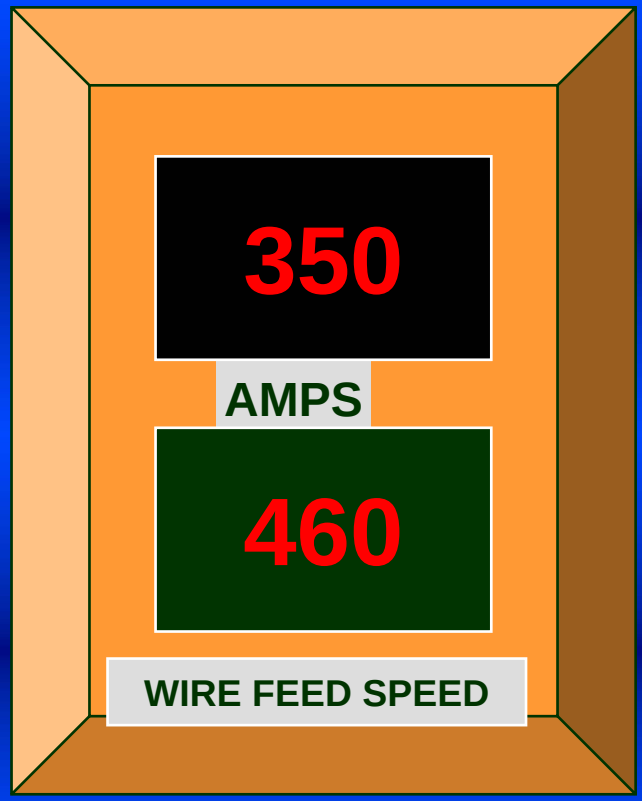
Nugget Profile Cross Sections





METAL CORE VS. SOLID WIRE



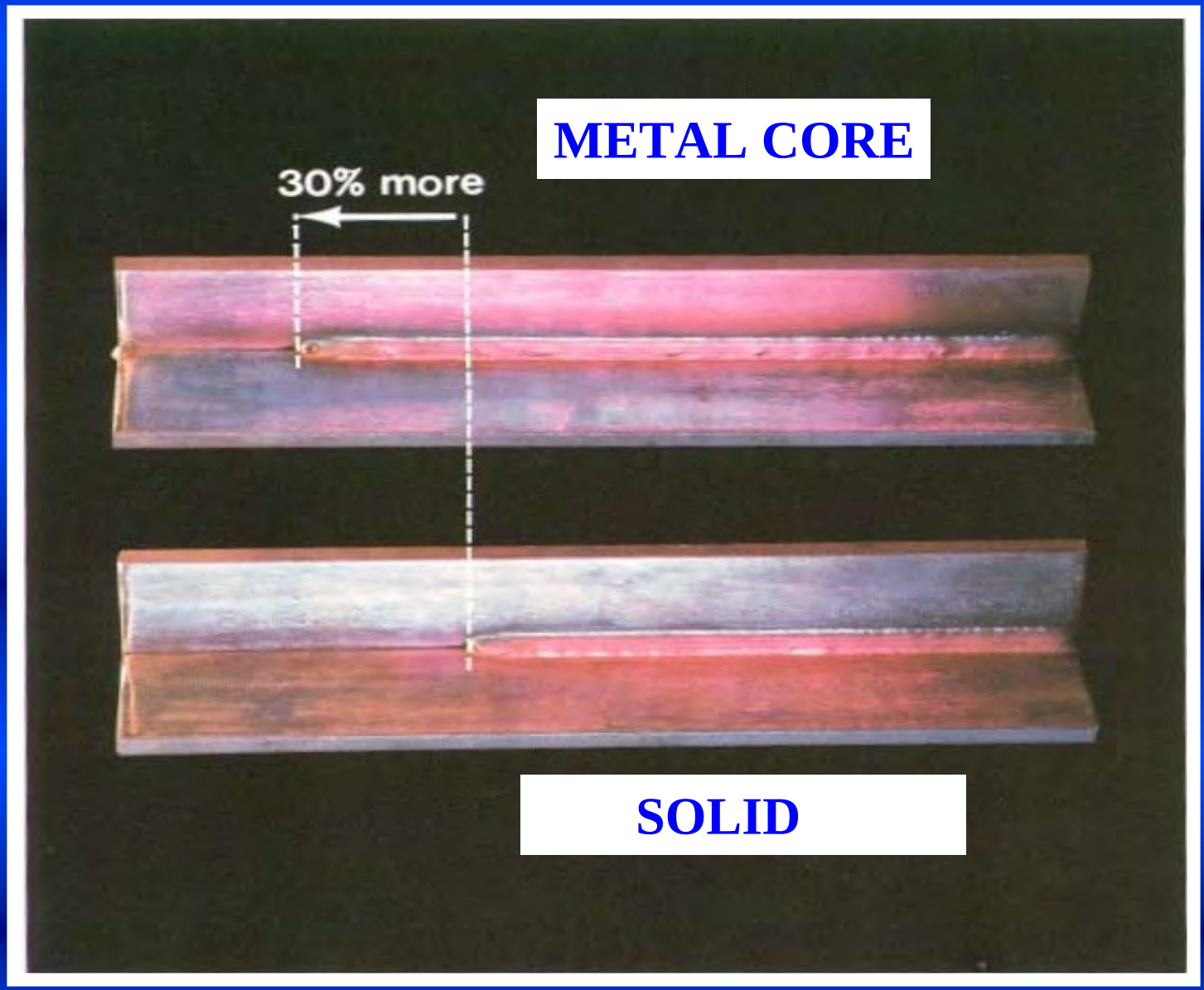


14.9 Lbs./Hr. Deposition

.045" Diameter

13.2 Lbs./Hr. Deposition

Higher wire feed speeds for a given arc current giving higher deposition rates


METAL CORE
30% more
SOLID

Wire Feeders / Drive Rolls

- Wire feeders have either two or four drive rolls to help push the wire through the liner
- Proper type of drive is dependent upon the type of wire used :
  - U-grooved
    - Soft solid wires, eg. Aluminum
  - V-grooved
    - Hard solid wires, eg. Mild steel, stainless steel
  - V-knurled
    - Flux cored wires, Metal cored wires

Wire Feeders / Drive Rolls

- Proper size drive rolls are important for good feeding
- Proper pressure on wire is also important for good feeding
  - Too much pressure deforms the wire
  - Too little pressure cause slippage resulting in erratic feeding and wear spots that can jam in the contact tip

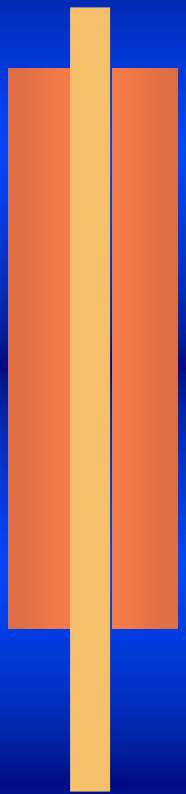
Contact Tips

- The main function of the contact tip is to transfer the electrical energy to the wire
- Contact tips are made of copper for the following reasons :
  - Good conductivity
  - Can dissipate heat quickly
- Unfortunately, copper is a soft metal and the contact tips will wear over time
- Use tight tolerance tips for Metal core

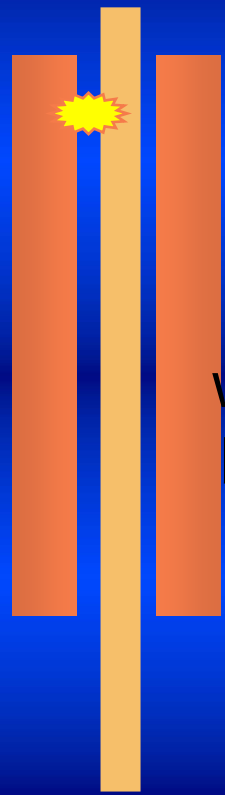
Welding Guns

Contact Tips

Why is correct contact tip size so important ?



Correct tip size maintains electrical contact at all times between the contact tip and the welding wire.



Oversize tips create potential condition where arc can initiate between the contact tip and the welding wire.

Metal Core Wire Set-up

Setting Welding Variables

- Gun angle
- Wire feed speed
- Voltage
- Contact Tip to Work Distance (stick-out)
- Travel speed
- Gas flow rate
- Whipping

Welding Variables

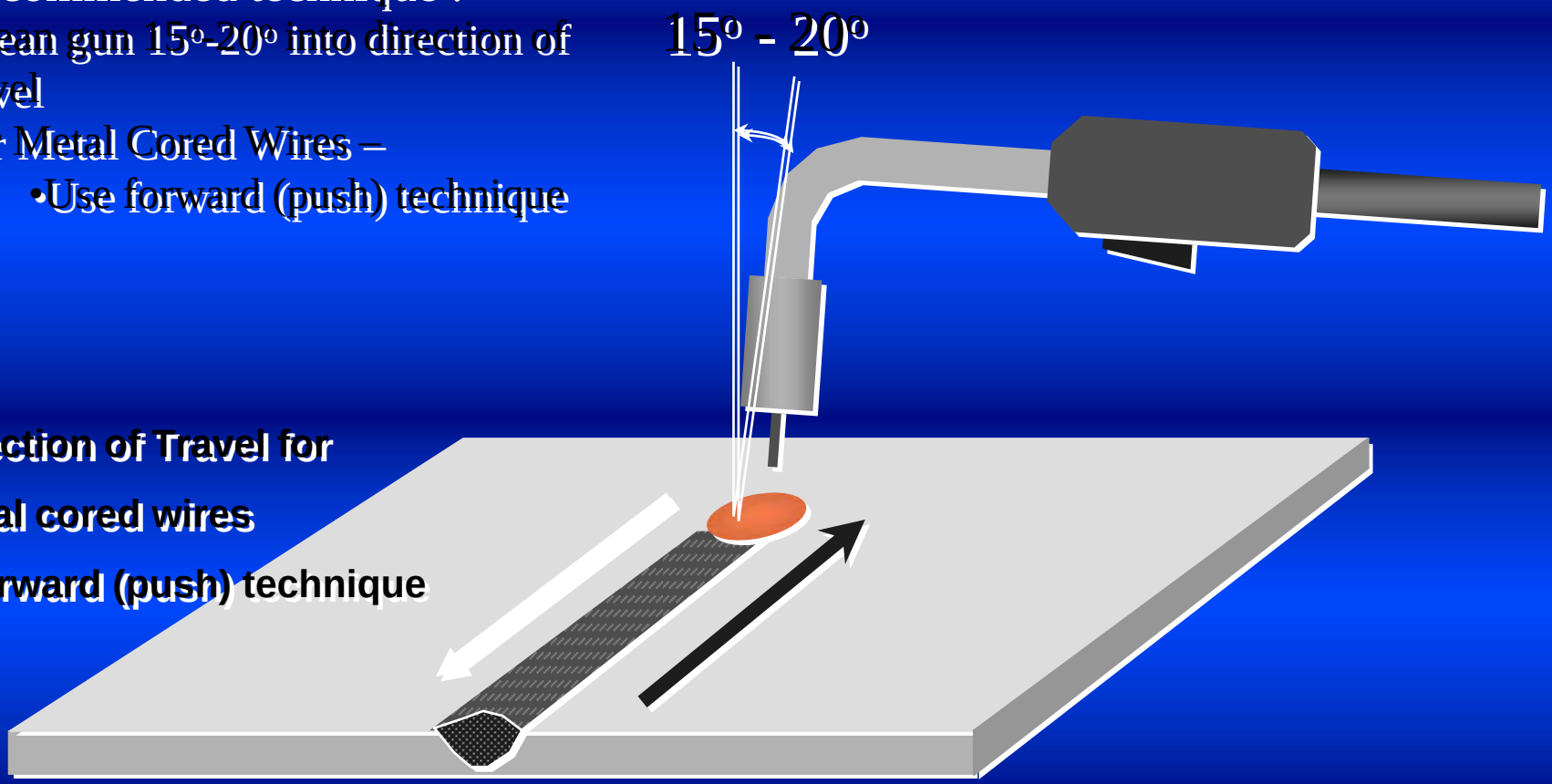
Gun Angle

Recommended technique :

- Lean gun 15º-20º into direction of travel

For Metal Cored Wires –

- Use forward (push) technique



Direction of Travel for Metal cored wires

- Forward (push) technique

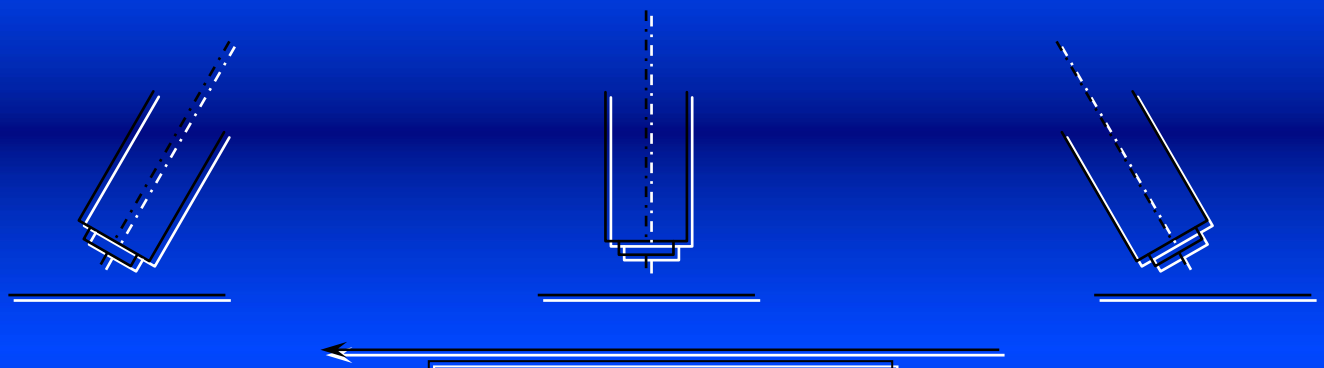
Welding Variables

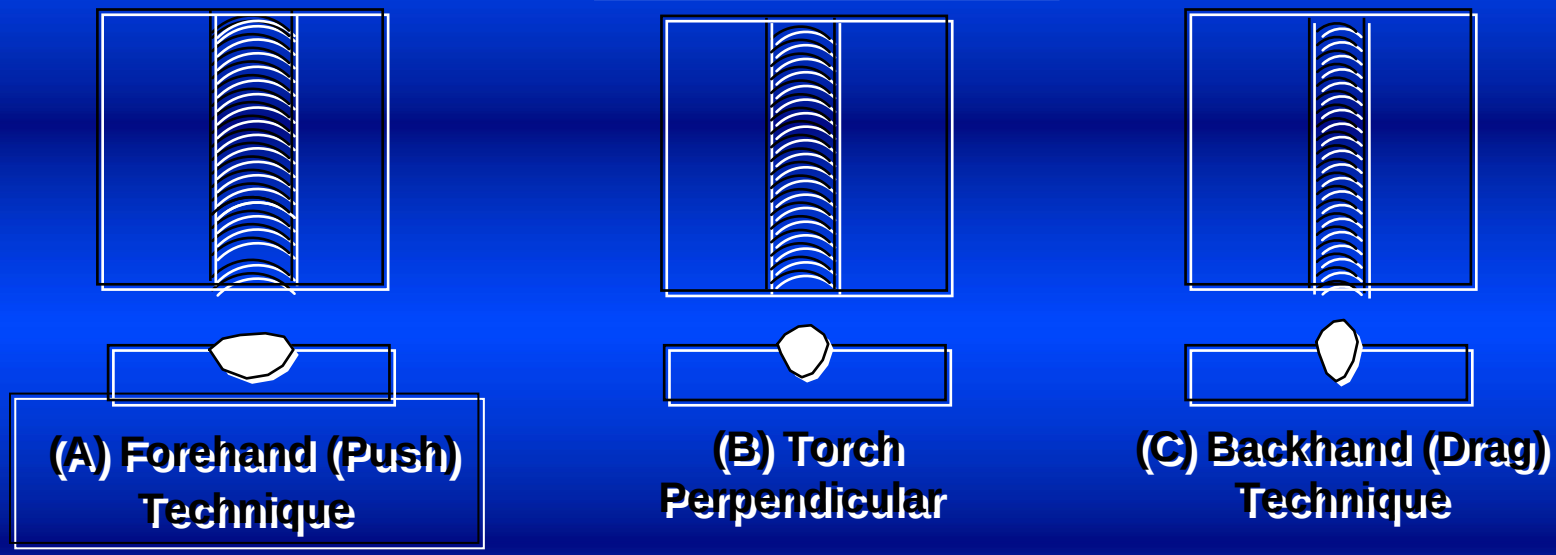
Gun Angle

- Gun angle is also used to control bead appearance and weld quality
- As seen on following slide, gun angle affects bead width, bead profile and penetration
- Incorrect gun angle can cause weld defects such as :
  - Undercut on fillet welds
  - Lack of penetration

Welding Variables

Gun Angle Effect on Penetration





Welding Variables

Wire Feed Speed

- Wire feed speed (WFS) is generally set at the wire feeder
  - WFS is proportional to the average amperage
    - Amperage translates to penetration
  - WFS is also a measure of the deposition rate
  - Units of WFS:
    - inches per minute (ipm) or meters per minute (m/min)
- The correct WFS is generally determined by
  - size of weld bead required
  - weld position and thickness of material

Welding Variables

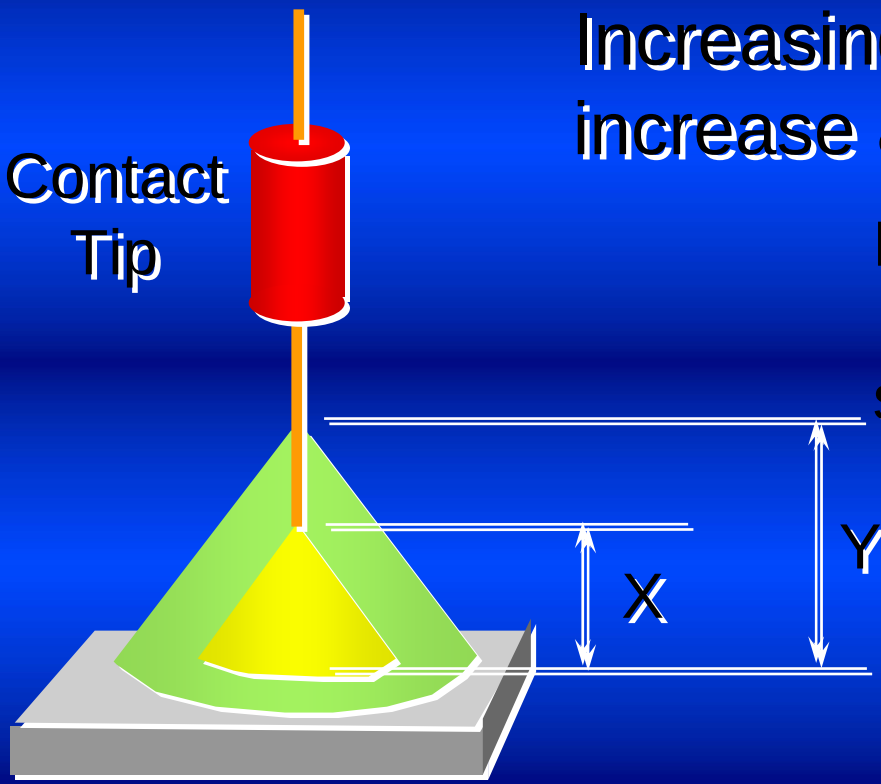
Voltage

- Voltage is generally set at the power source
  - Voltage is the force that causes current (amperage) to flow
  - Voltage is also a measure of the heat into the weld
  - Changes in voltage affect :
    - Arc length
      - Arc length determines how well the weld puddle will flatten (wet) out
    - Weld bead width
    - Weld bead profile

Welding Variables

Voltage

Relationship Between Arc Length and Voltage



Increasing voltage will tend to increase arc length

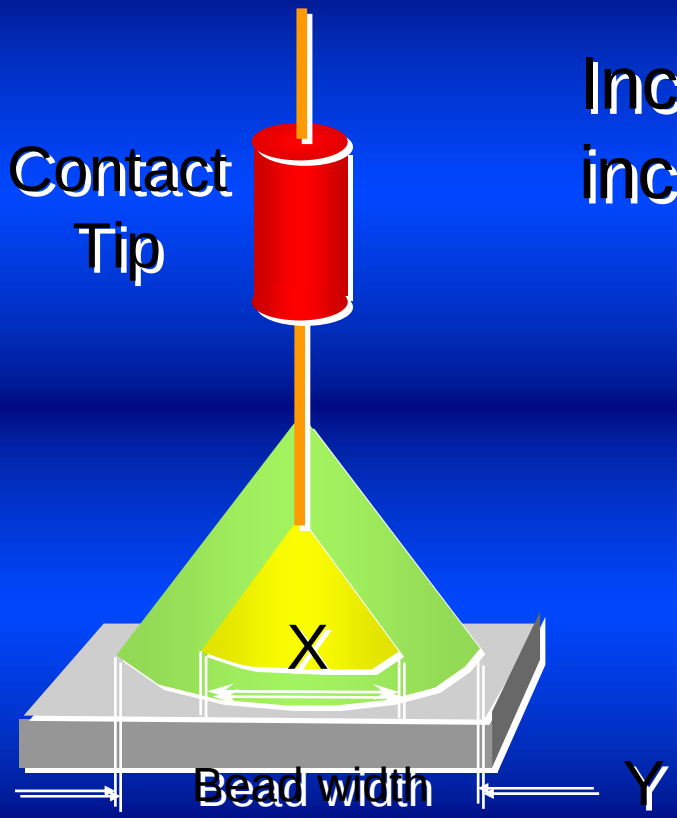
For example (at constant wire feed speed) :

X = 25 Volts
Y = 28 Volts

Welding Variables

Voltage

Relationship Between Bead Width and Voltage



Increasing voltage will tend to increase bead width

For example
(at constant wire feed speed) :

X = 25 Volts
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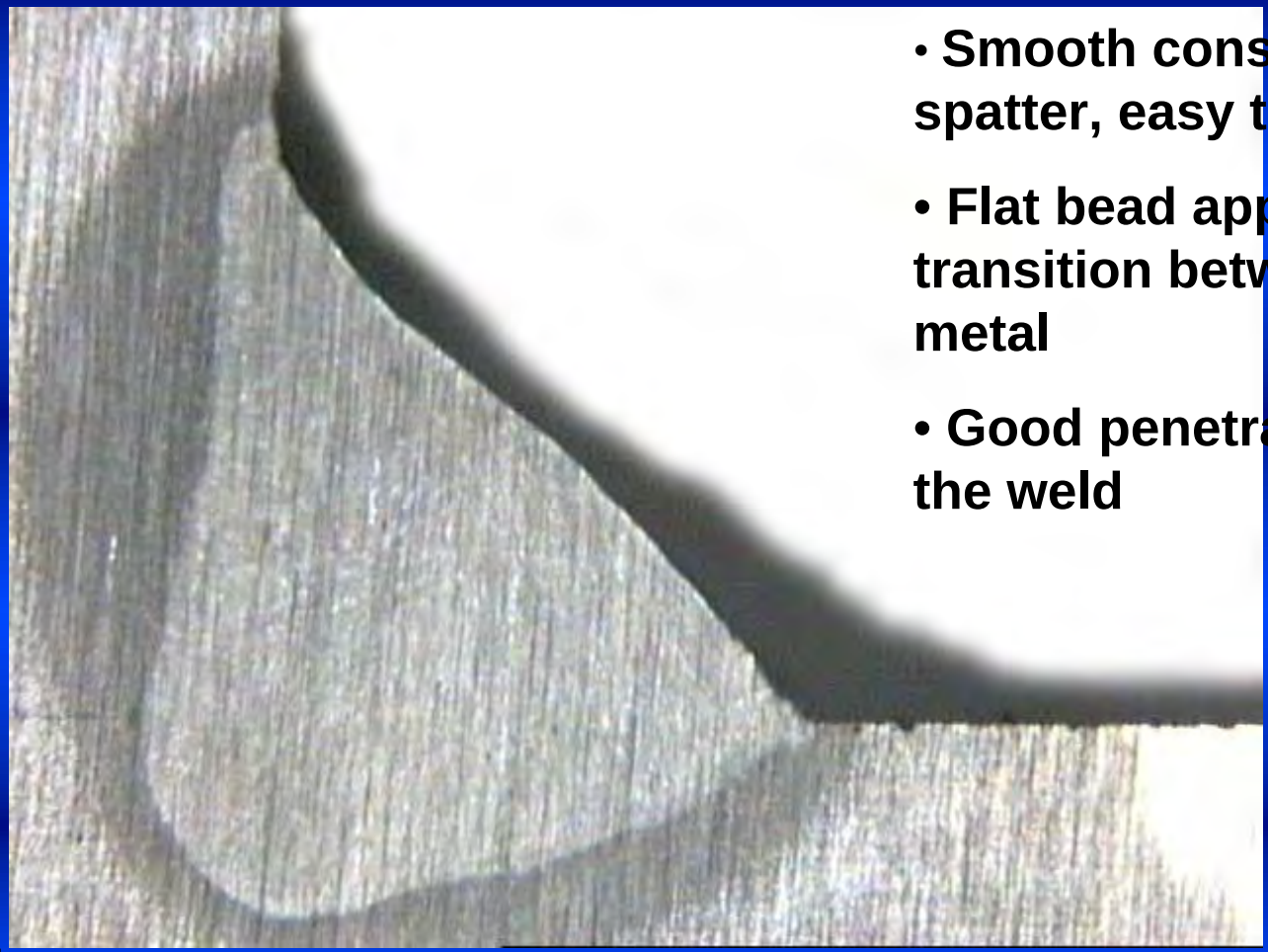
Welding Variables
- Correct Technique – Voltage



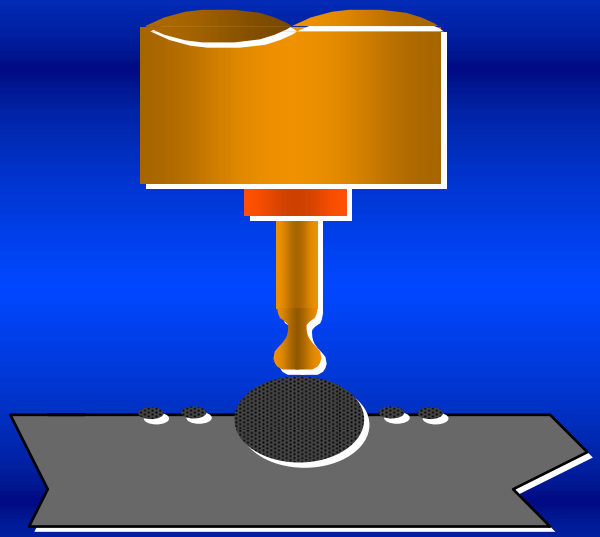
- Smooth consistent arc, minimal spatter, easy to manipulate arc
- Flat bead appearance, smooth transition between weld and base metal
- Good penetration at the root of the weld

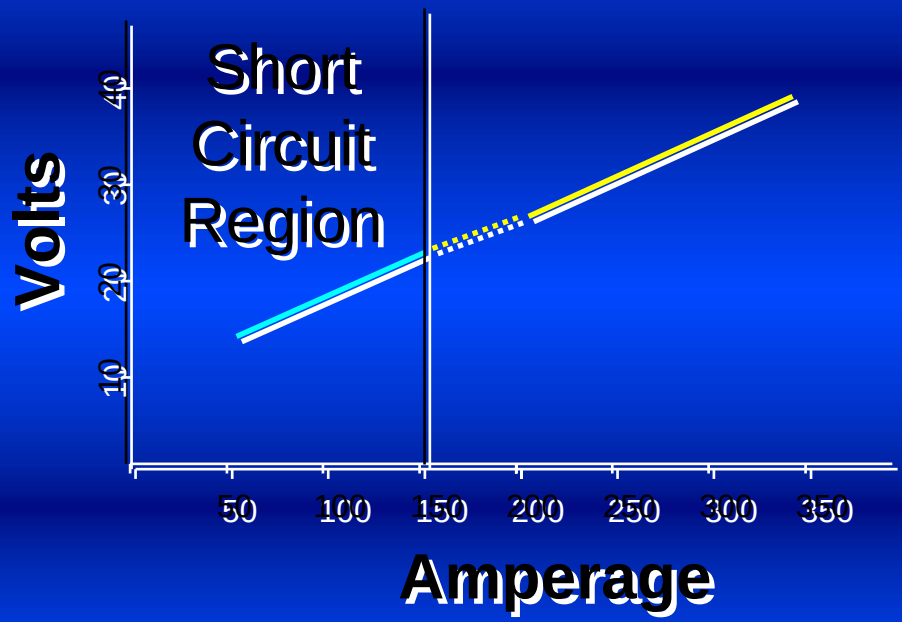
Droplet Transfer Modes

- Changes in the wire feed speed (WFS) and voltage settings can change the way that molten metal droplets are transfer from the end of the electrode to the weld pool
- There are three common modes of metal droplet transfer:
  - Short circuit transfer mode
    - Lower WFS and voltage
  - Globular transfer mode
    - Medium WFS and voltage
  - Spray transfer mode
    - Higher WFS and voltage

Droplet Transfer Modes

Short Circuit Transfer Mode





Features

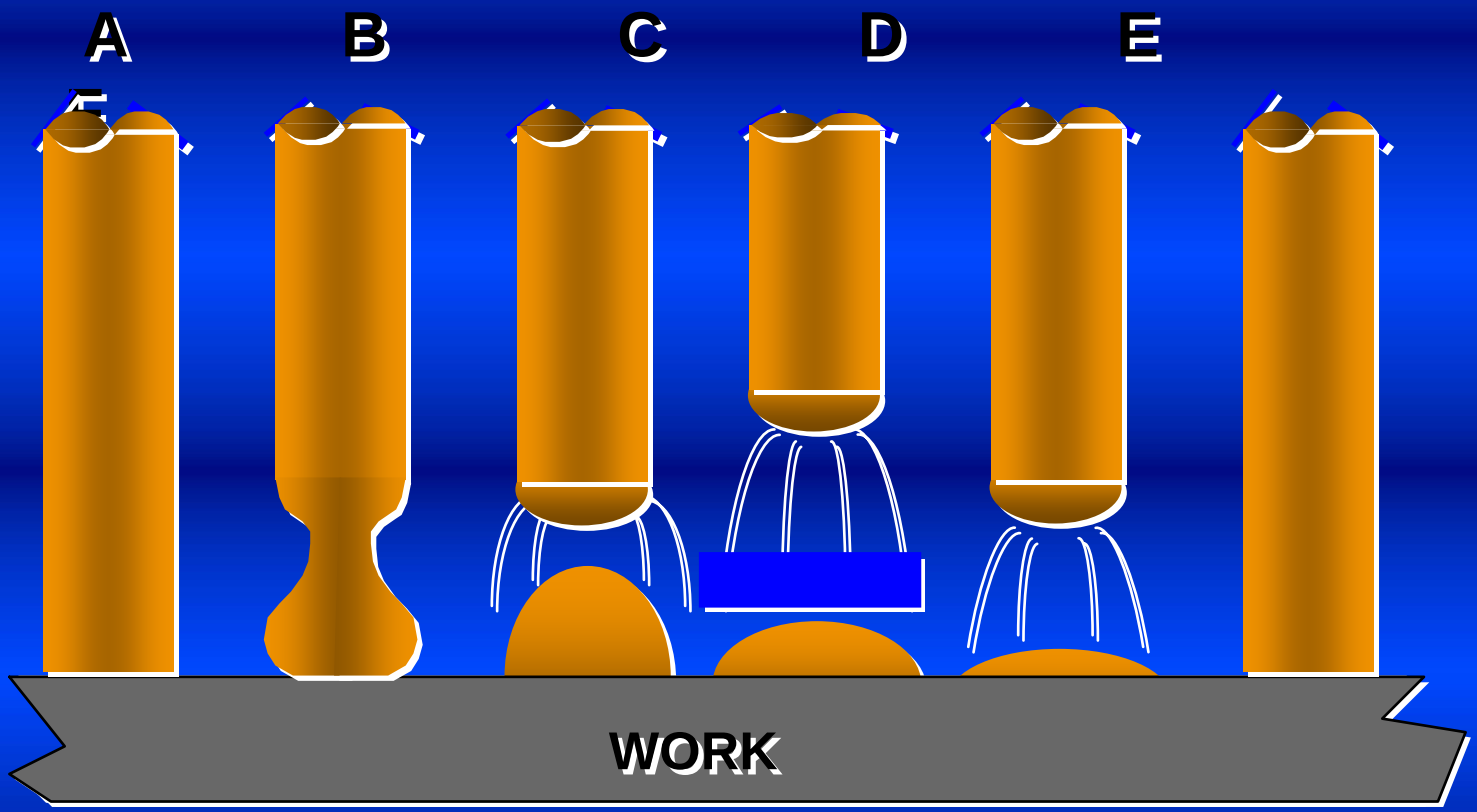
- Low Voltage (less than 22 volts)
- Low Amperage
- Low Heat Input
- Spatter is Commmon

Applications

- Thin Materials
- Out of Position Welding

Droplet Transfer Modes

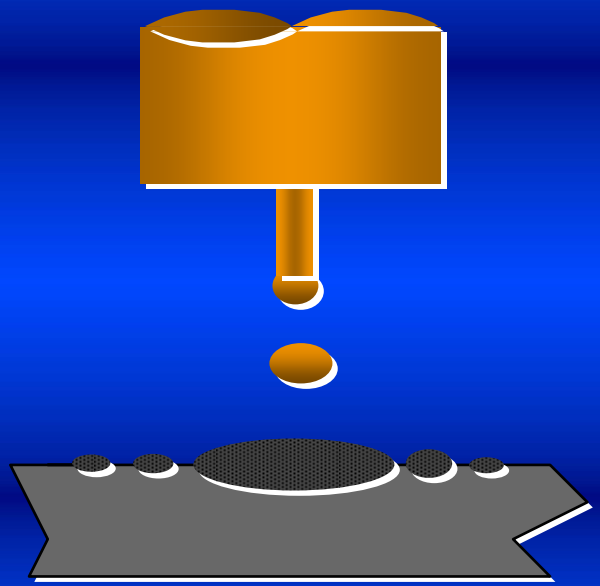
Short Circuit Transfer Mode

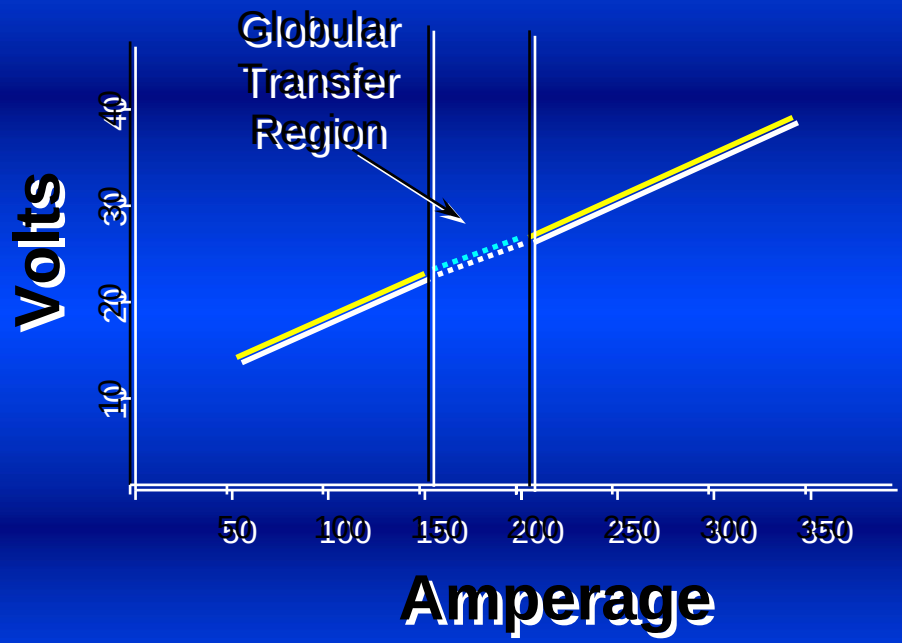


Mechanics of Short Circuit Transfer Mode

Droplet Transfer Modes

Globular Transfer Mode





Features

- Medium Voltage (22 - 26 volts)
- Medium Amperage
- Low Heat Input
- Gross Spatter is Common
- Little Penetration

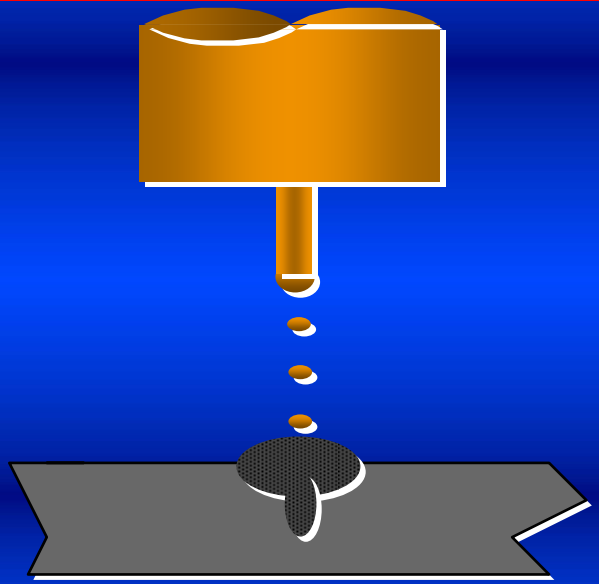
Applications

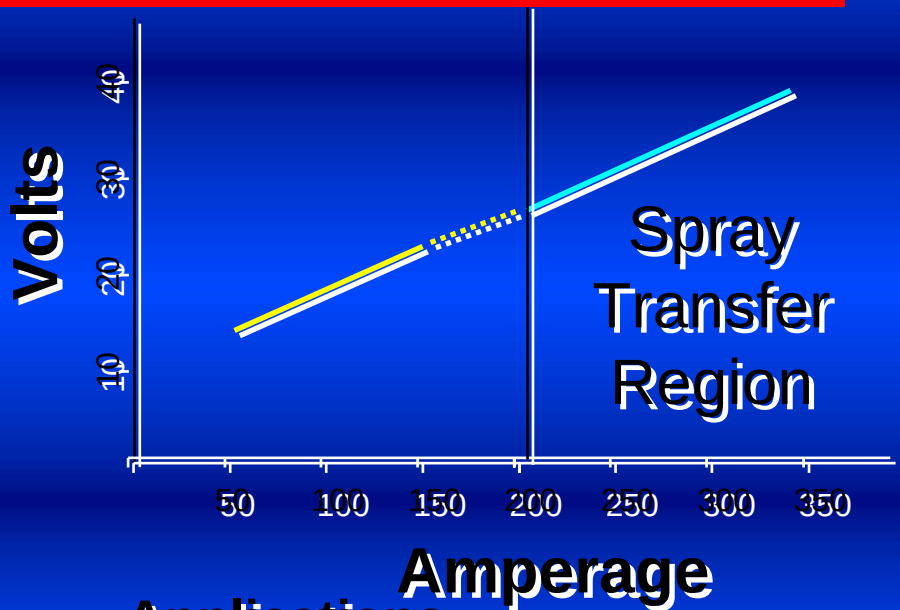
- Overlay
- Hardfacing

Droplet Transfer Modes

Spray Transfer Mode

Recommended Mode for Metal-Core Wire





Features

- High Voltage (over 26 volts)
- High Amperage
- High Heat Input
- No Spatter is Common
- Fingernail-like Penetration

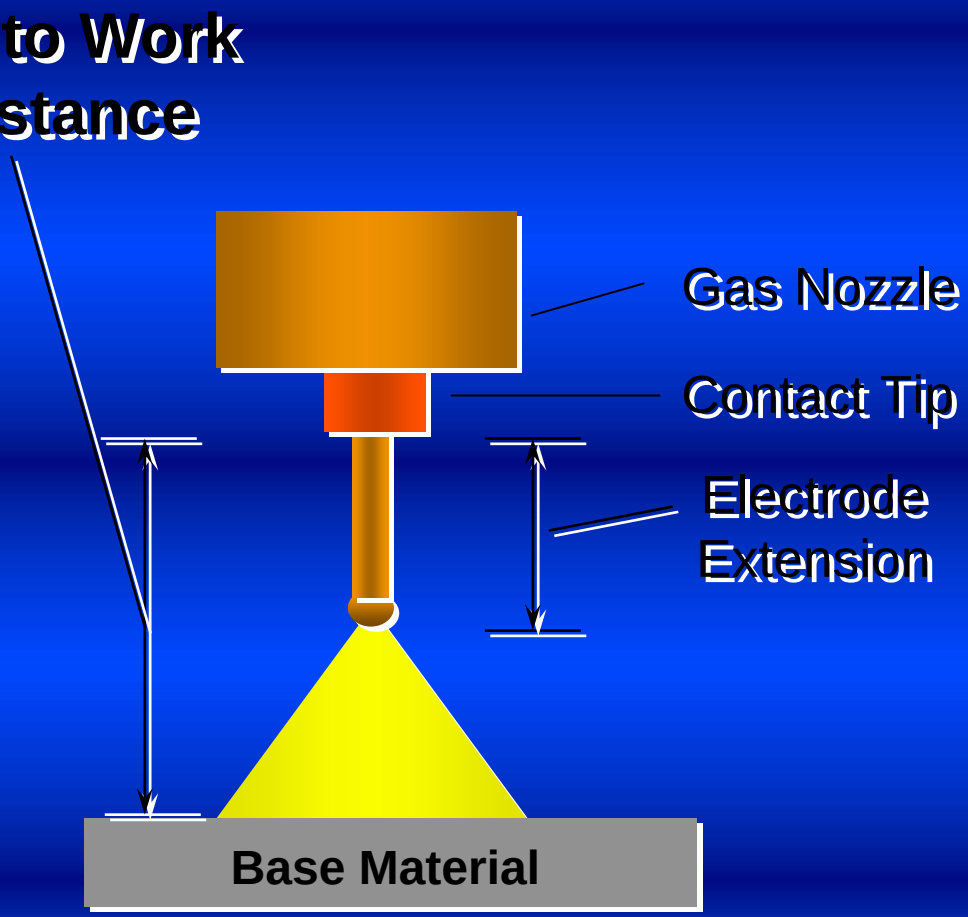
Applications

- High Deposition
- High Production Welding
- Welding Thick Materials
- Typically used for flat and horizontal fillet welding

Welding Variables

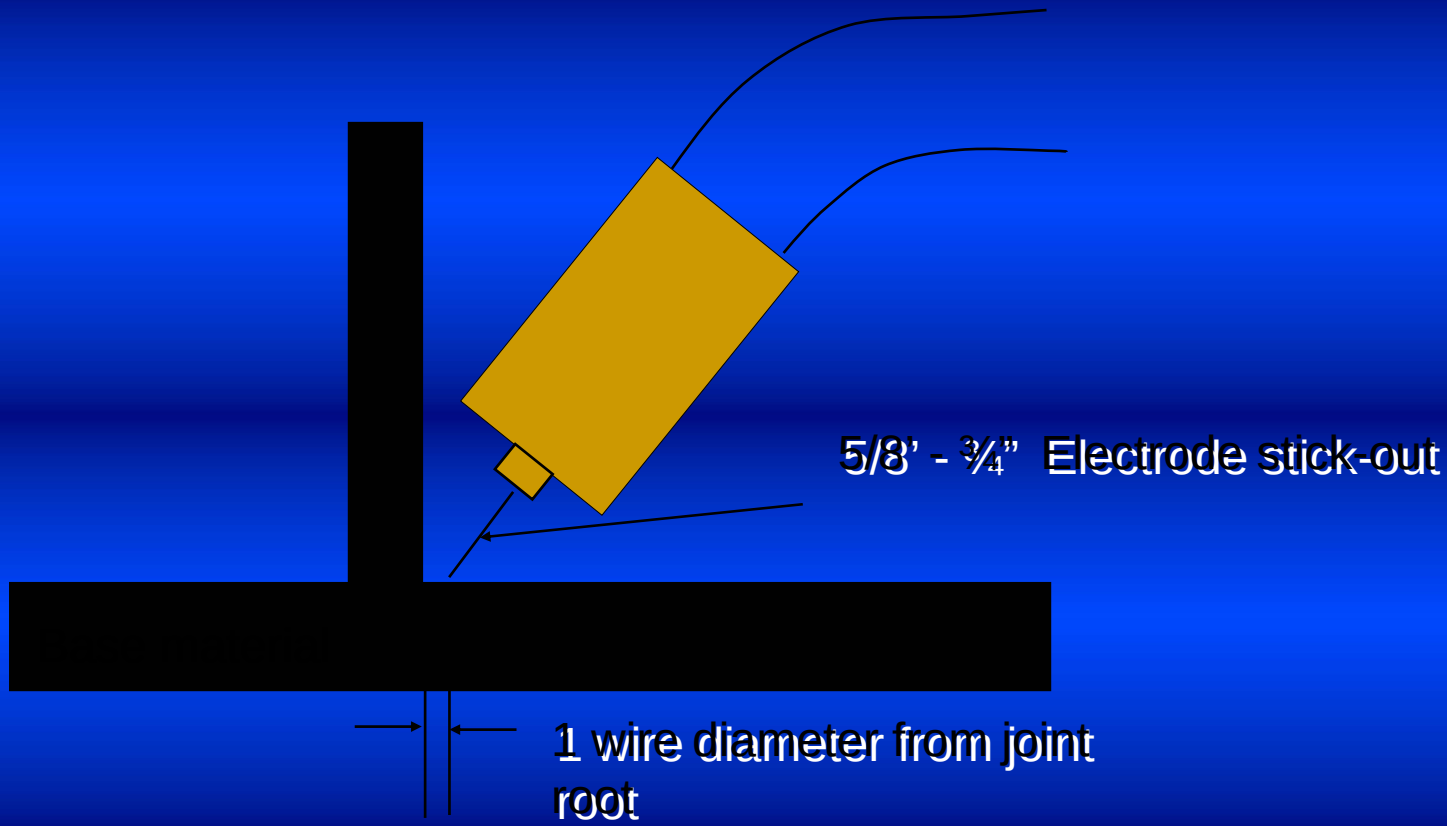
Contact Tip to Work Distance (stick-out)

- The tip to work distance is commonly called stick out
- The tip to work distance is the combination of the electrode extension and the arc length
- When welding, the tip to work distance should be kept relatively constant
- Changes in the tip to work distance affect the quality and appearance of the weld



Welding Variables

Contact Tip to Work Distance (stick-out)



Welding Variables

Travel Speed

- For a given WFS and voltage setting an optimum travel speed is obtained for different weld sizes
- Increases in travel speed will :
  - Decrease penetration
  - Reduces weld size
  - Reduces heat input

Welding Variables

Gas Flow Rate

- Proper shielding gas flow rate must be maintained to ensure that the molten weld puddle is protected from the atmosphere
- Too low or too high of a gas flow can have detrimental effects on the weld quality
  - Too low can cause lack of proper shielding
  - Too high can cause turbulence which pulls in outside air
- Care should be taken to protect the weld area from external drafts
- Correct gas and or gas mixtures should be used
- Correct nozzle diameter should be used

Advantages of Metal core

- More parts per hour
- Better control of weld deposit
- Less spatter
- Less clean up
- Faster weld travel speeds
- Potential for less burn through
- Improved quality of parts

Questions?

- Thank You for Your Time!