ARC WELDING

ME 353 Presentation

11-3-2000

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OUTLINE

- What is Arc Welding
- The four most common types
- Non destructive testing
- Design considerations
- Strength
- Safety

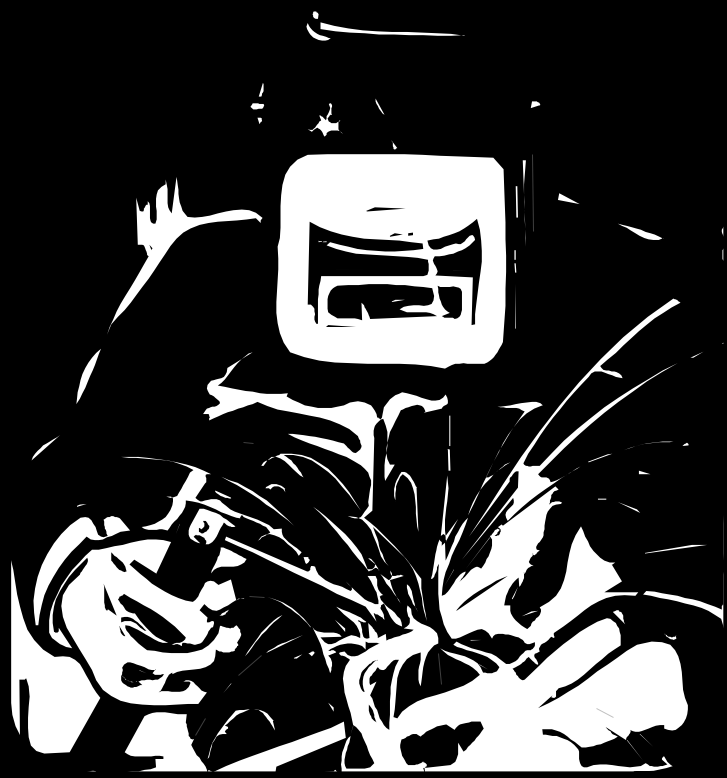
Feel free to ask questions at any questions at any time.

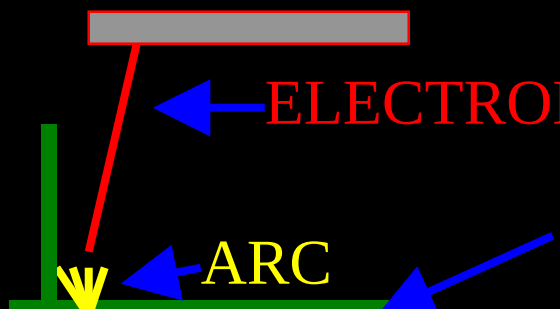
Arc Welding

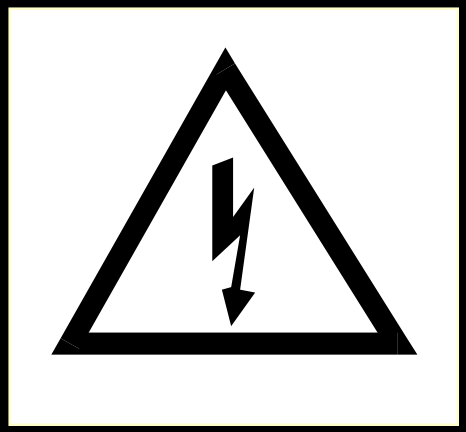
- Welcome to the world of WELDING

What is Arc Welding?

An electric arc between the and electrode and the work piece generates heat. Sufficient heat is generated to melt the work pieces together.







Electricity

The range of welding current used can be from 5 to 500 amps. The voltage ranges from 20 to 30 volts,

AC or DC. Both are determined by the material thickness.

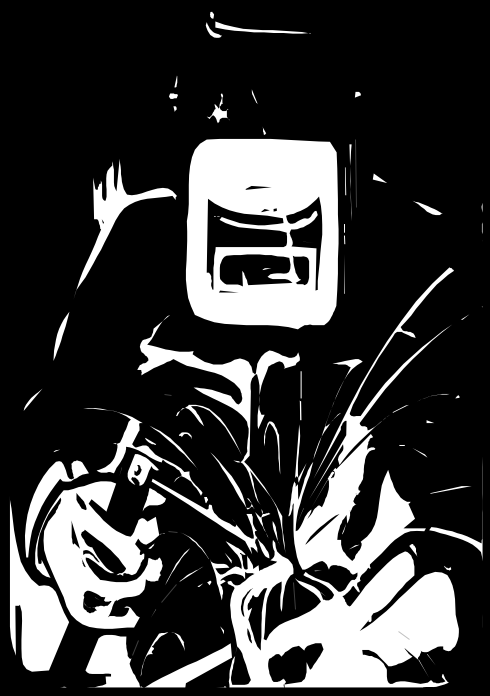
A 60 watt light bulb draws .5 amps.

Four Common Types of Welding

- Stick SMAW (shielded metal arc welding)
- Mig GMAW (Gas Metal Arc Welding)
- Flux-Core FCAW (Flux-core Arc Welding)
- Tig GTAW (Gas Tungsten Arc Welding)

Characteristics

Each welding process has unique traits that make it more suited for particular processes



Some Terms

Electrode

This is where the current passes from the welder to the work piece.

There are two types:

1) Contact/consumable

2) Non Contact

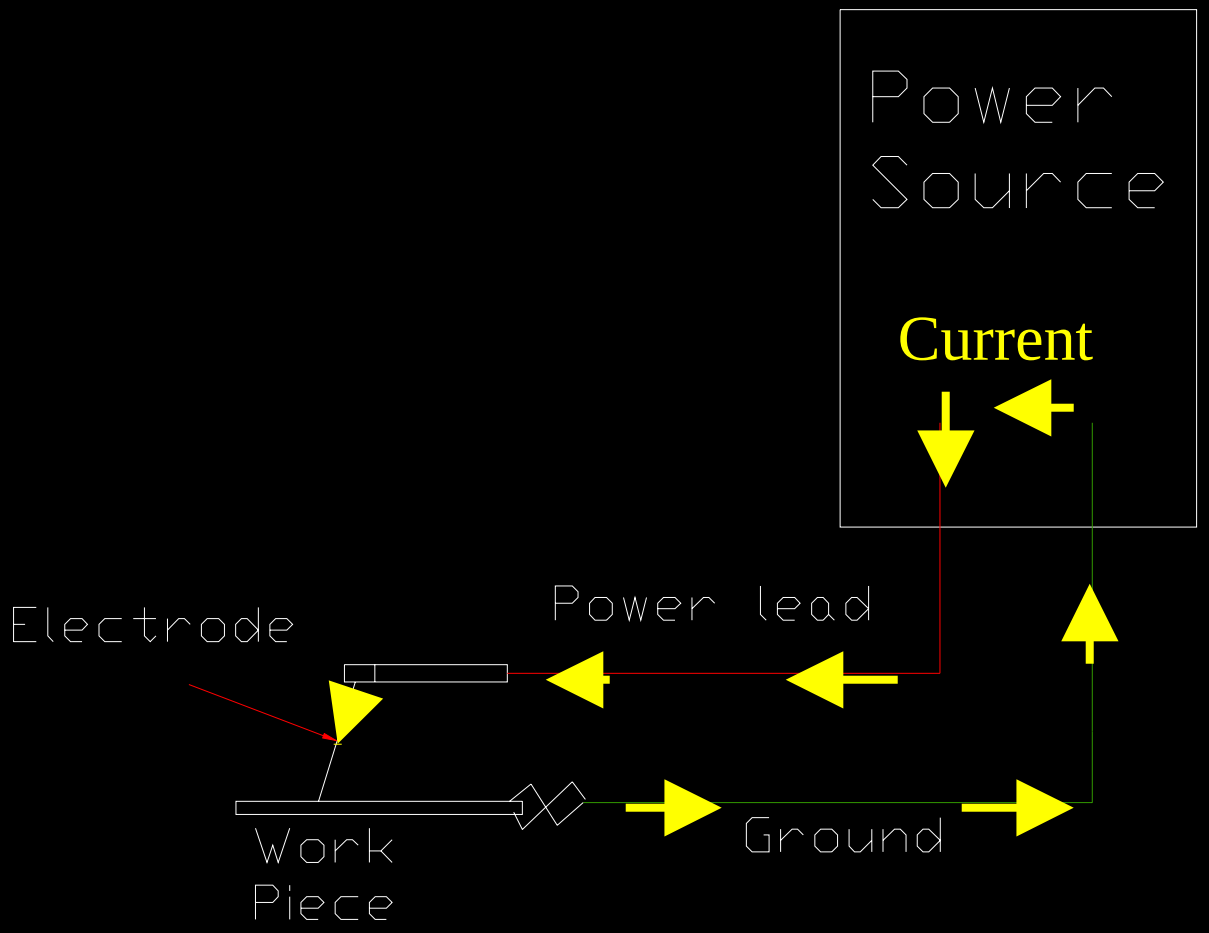
More Terms

Atmospheric protection

There are 2 types:

1) Shielding Gas
2) Flux

Stick Weld Schematic



Stick Welding

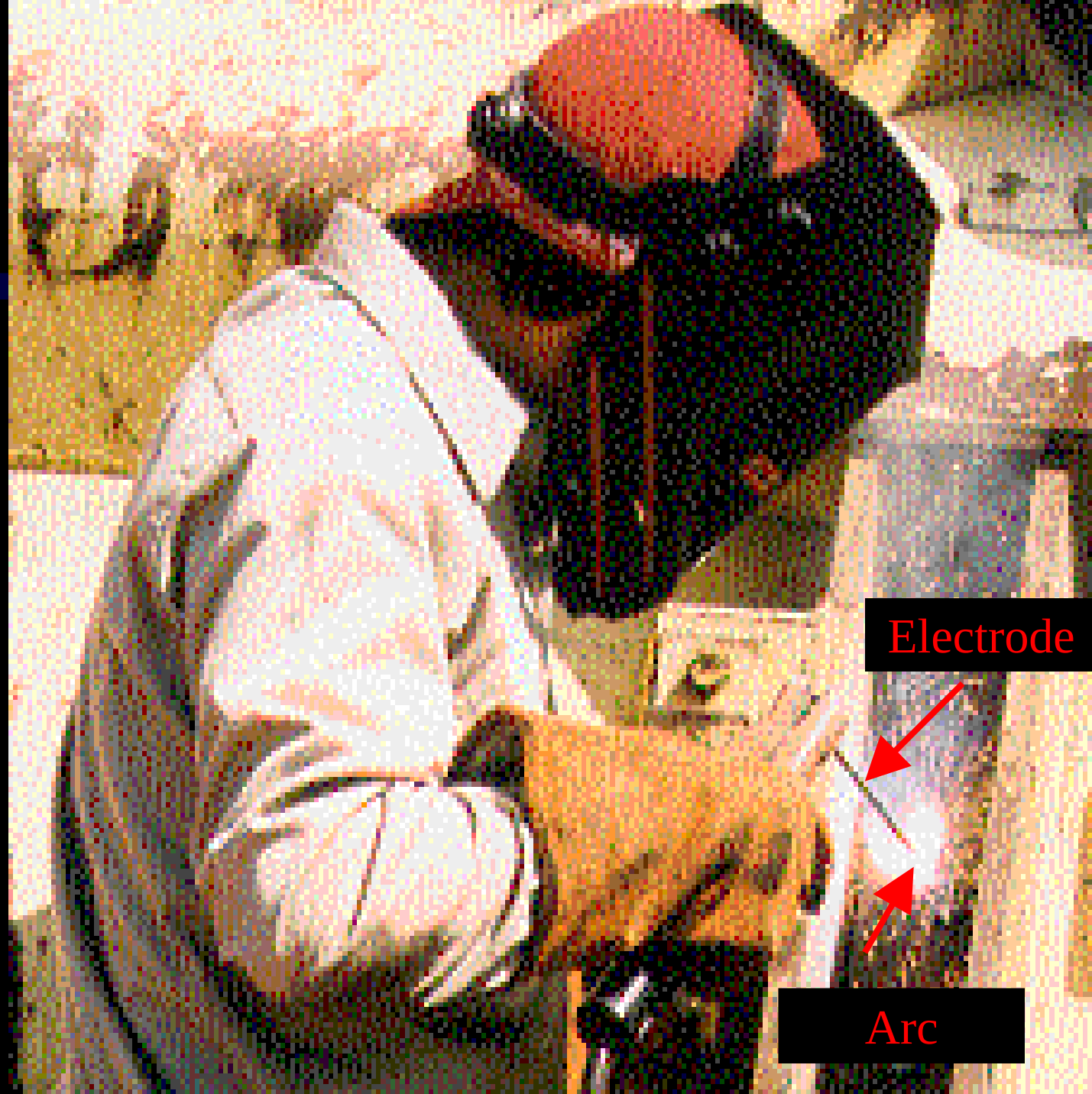
- Uses a consumable electrode (rod), with a flux coating.
- Stick welding requires a moderate to high skill level.
- Advantages:

  Portable

  Can be used in all environments

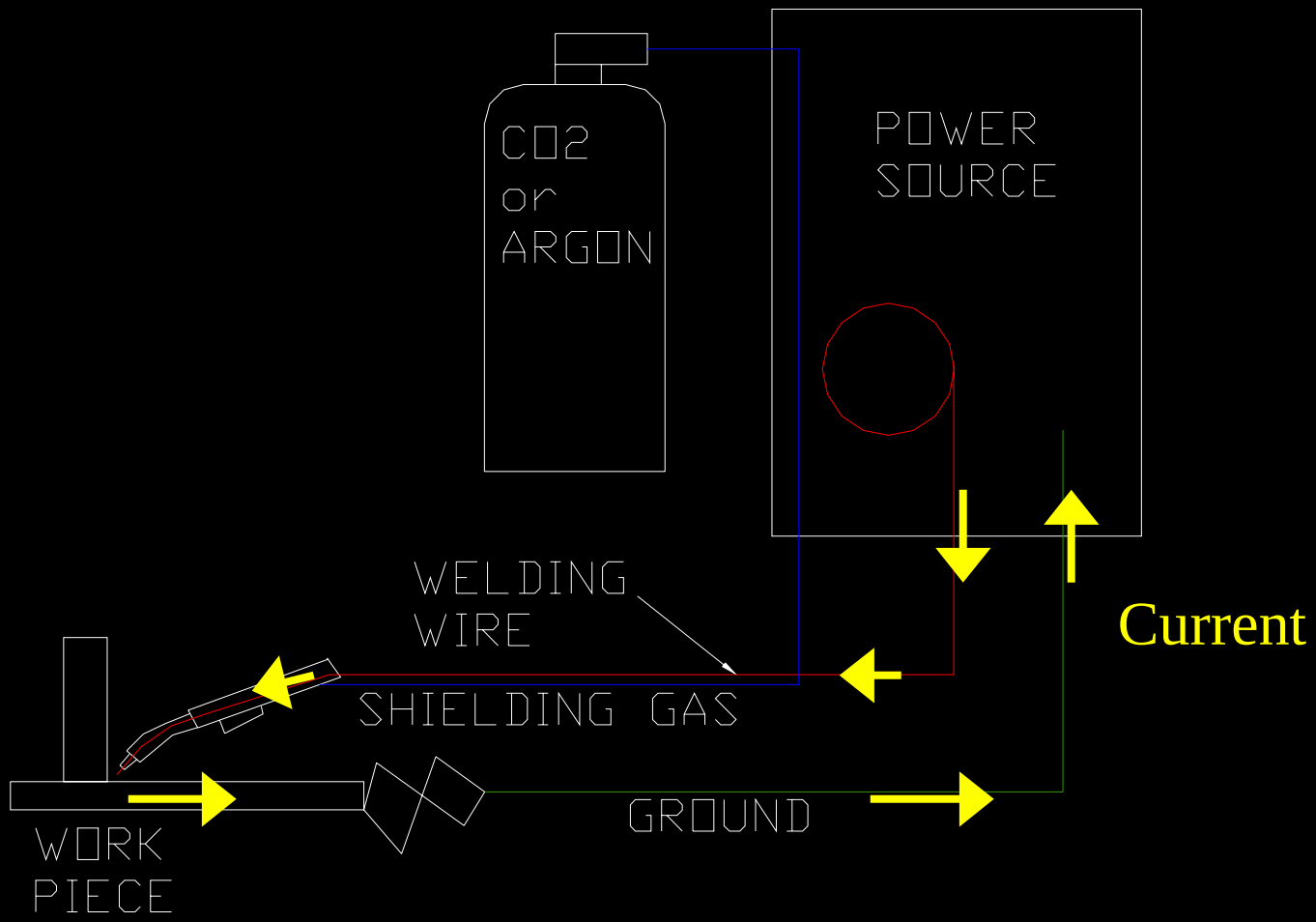
  Not as dependent on surface preparation

Stick Welding



Stick welder joins sections of oil pipe in Alaska.

MIG WELDING SCHEMATIC



Mig Welding

- The electrode is a wire, fed from a spool to the end of the “gun”.
- A shielding gas is used to give atmospheric protection.
- This process requires a low to moderate skill level.

Advantages:

1) Very fast process
2) Easy to learn

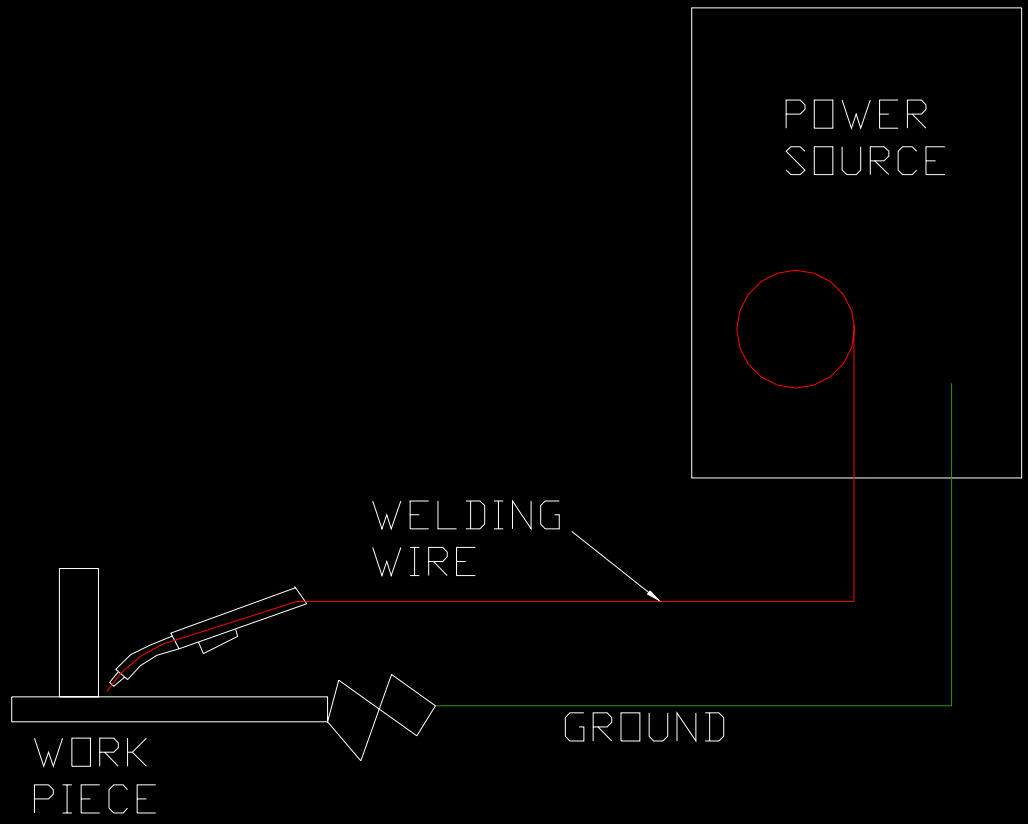
Disadvantages:

1) Weld area must be protected from air movements

Mig Welding

MIG welding stainless steel

Flux Core Schematic



Flux Core

- This process is a hybrid between Mig and Stick welding.
- It is the same process as Mig welding, except instead of a shielding gas, there is flux in welding wire.

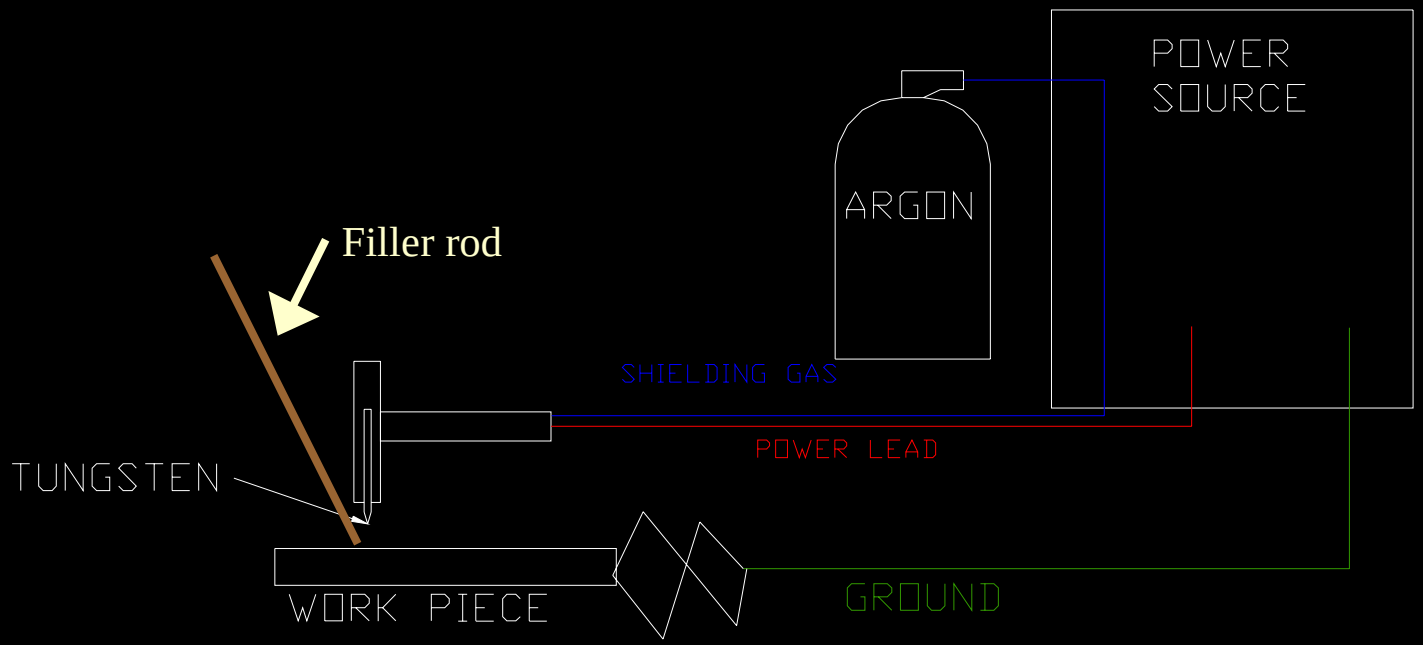
Advantages:

1) Can be done in all environments

Disadvantages:

1) Requires additional clean up to remove flux

TIG WELDING SCHEMATIC



Tig Welding

- There is a Tungsten electrode through which the current is passed. (Melting pt. = 3700 degrees K)
- Argon is used as a shielding gas.
- Requires the highest skill level.

Advantages:

1) Nearly all metals can be welded using this process.

2) Very precise

Disadvantages:

1) Slow process

Tig Welding

TIG welding a Nascar chassis together.

PROBLEM 1

A semi-truck is parked along side I-80 with a broken air brake mount on it's trailer. The mount is made out of standard steel. The truck can not be moved until the repair is made. Which welding process, (MIG, TIG, Stick, Flux Core) could be used to make the repair? Discuss what factors were involved in your selection process.

Answer on page 4 of handout

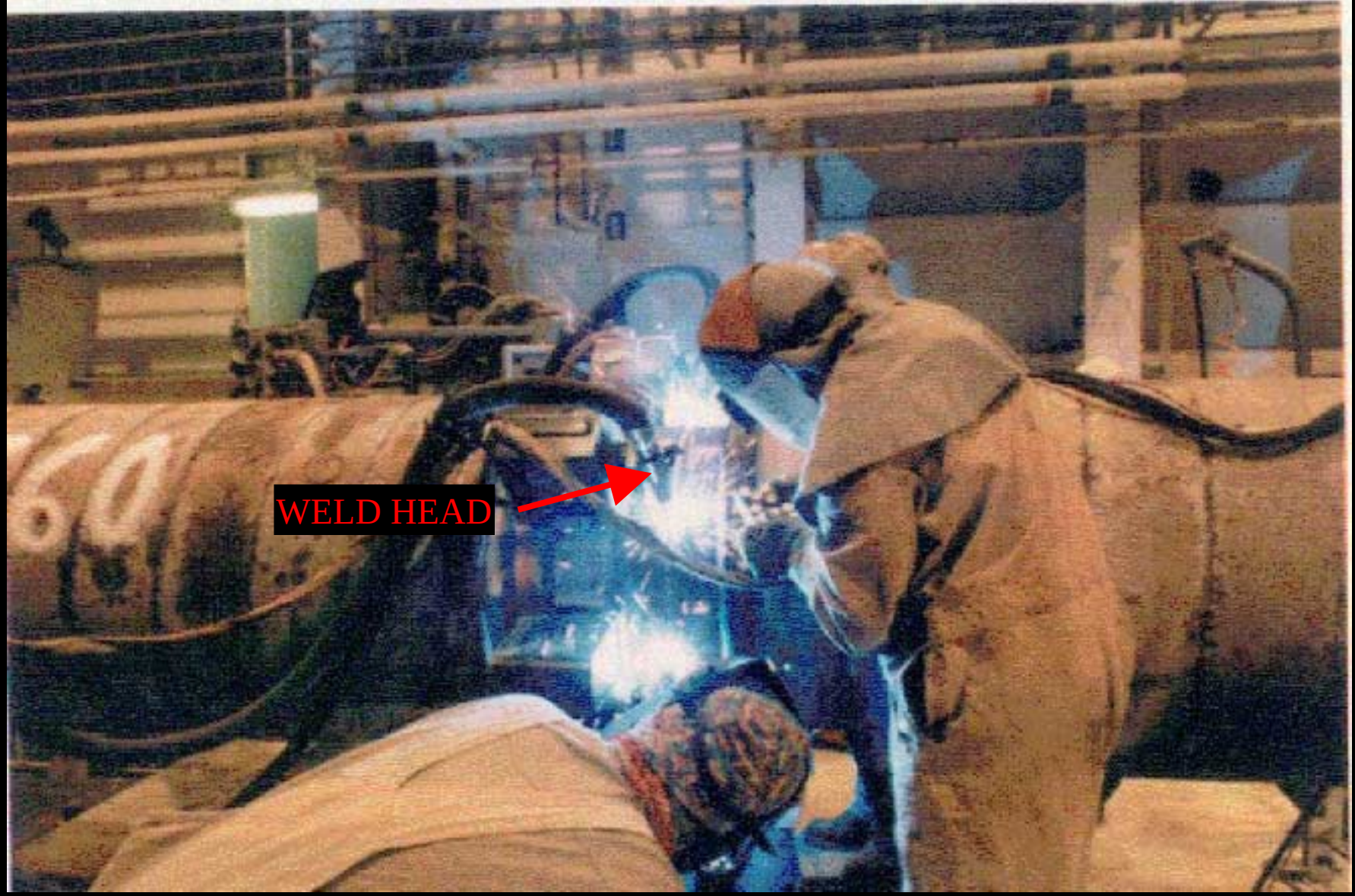
ANSWER TO PROBLEM 1

There are two process that could be used to make the needed repair. Those two processes are flux core, and stick welding. Because the repair had to take place in the field, a process must be used that did not require an external shielding gas. Both of the processes are equally suited to make the repair. Stick welding requires a higher skill level than flux core, so the operator skill level is a factor.

Automatic/ Robotic Welding

- Can be done using the MIG or TIG processes
- Used when there are long, reproducible weld joints
- It can be used where the environment is hazardous to humans
- Saves time and money

This robotic TIG welder is sealing nuclear waste storage containers.



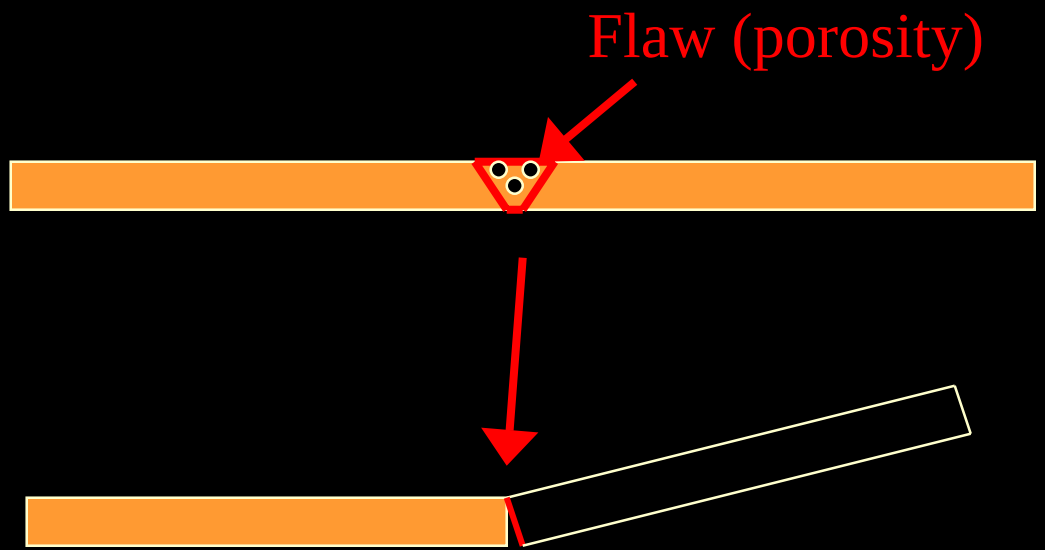
An automatic Multi-Head Mig welder joins sections of pipe together.

Radiography

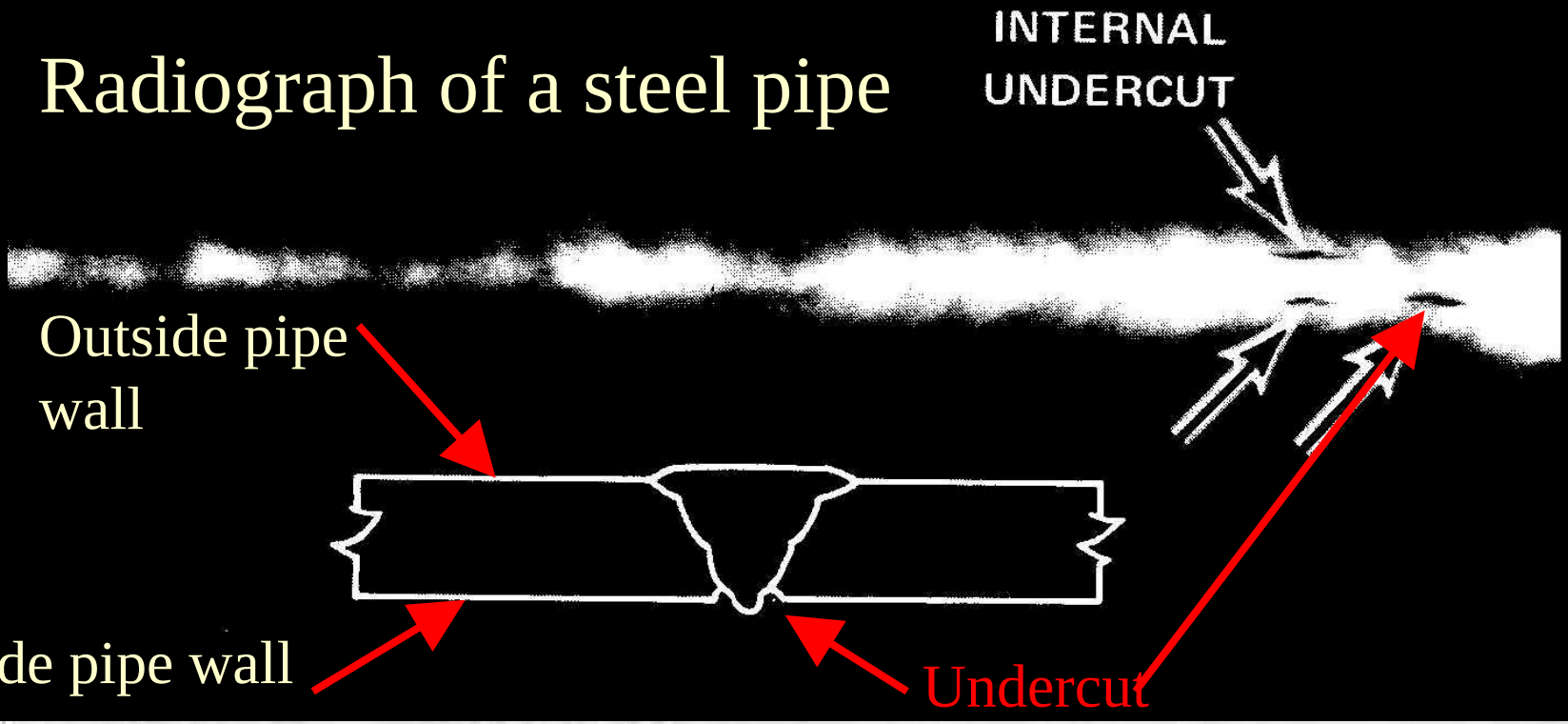
- A non-destructive process to test welds using X-Rays

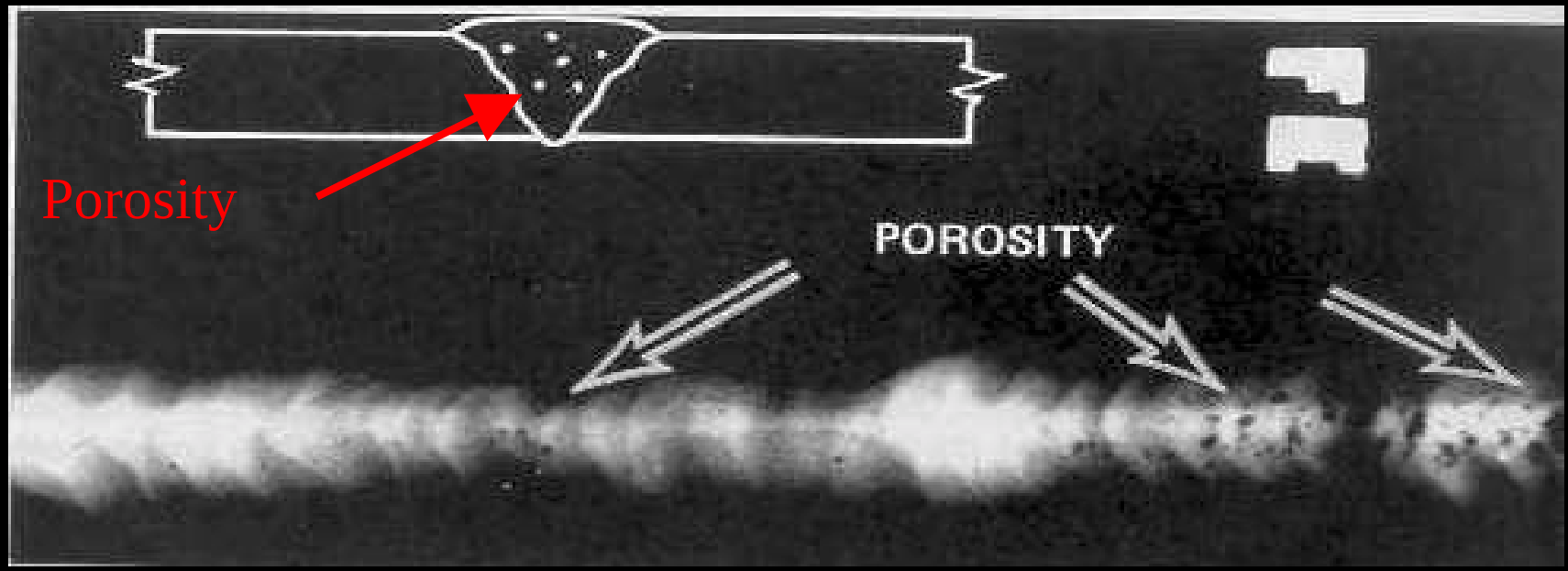
Welds with internal flaws can lead to failures

DANGER

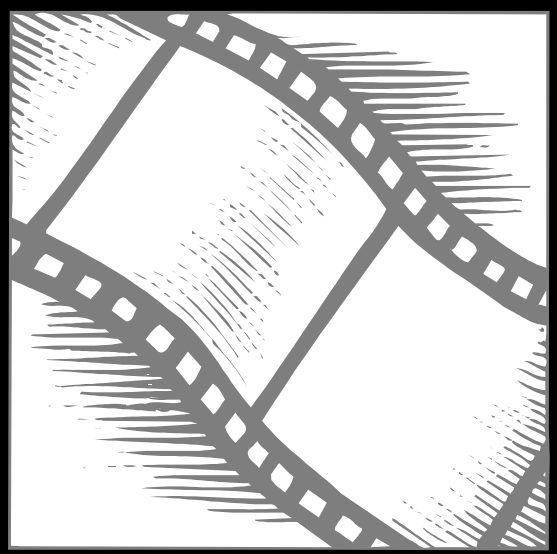


Radiograph of a steel pipe





And now for a short movie



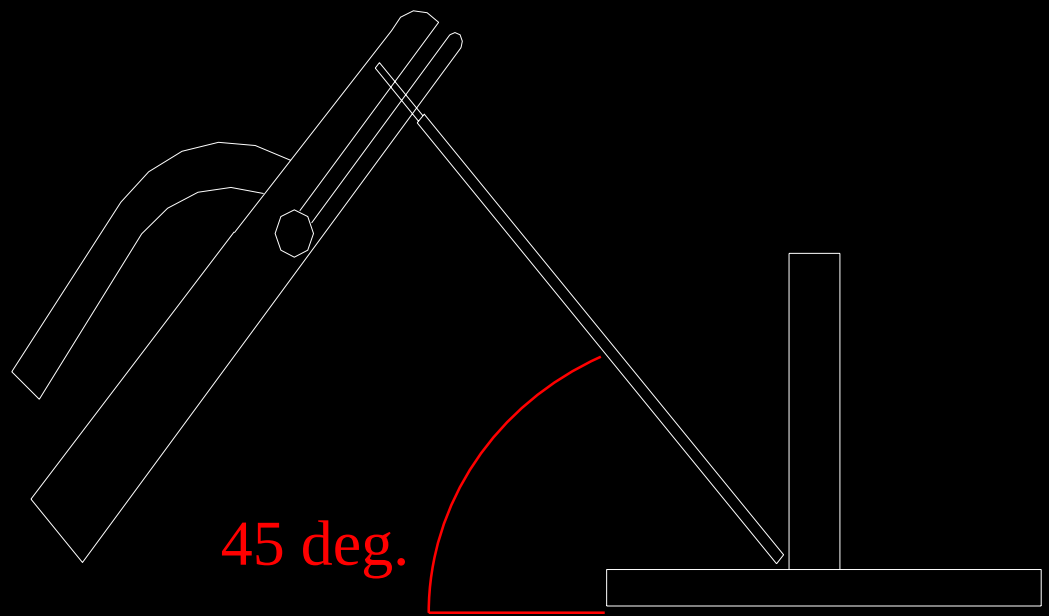
This will show Mig welding and will show some common joint types

Things to consider in weld design

- Material selection is critical for success
- Some factors that influence selections are:
  - Strength
  - Weight
  - Cost
  - Service environment
  - Location where the welding is going to occur

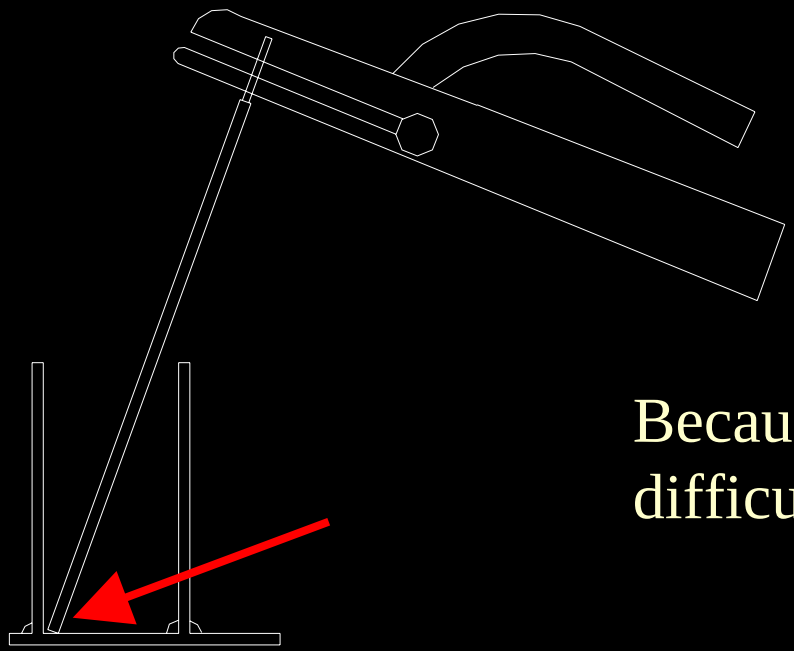
Other things to ponder

- Welding apparatuses have physical size and that can limit weld design



Design Considerations

Planning must be done to allow joints to be welded



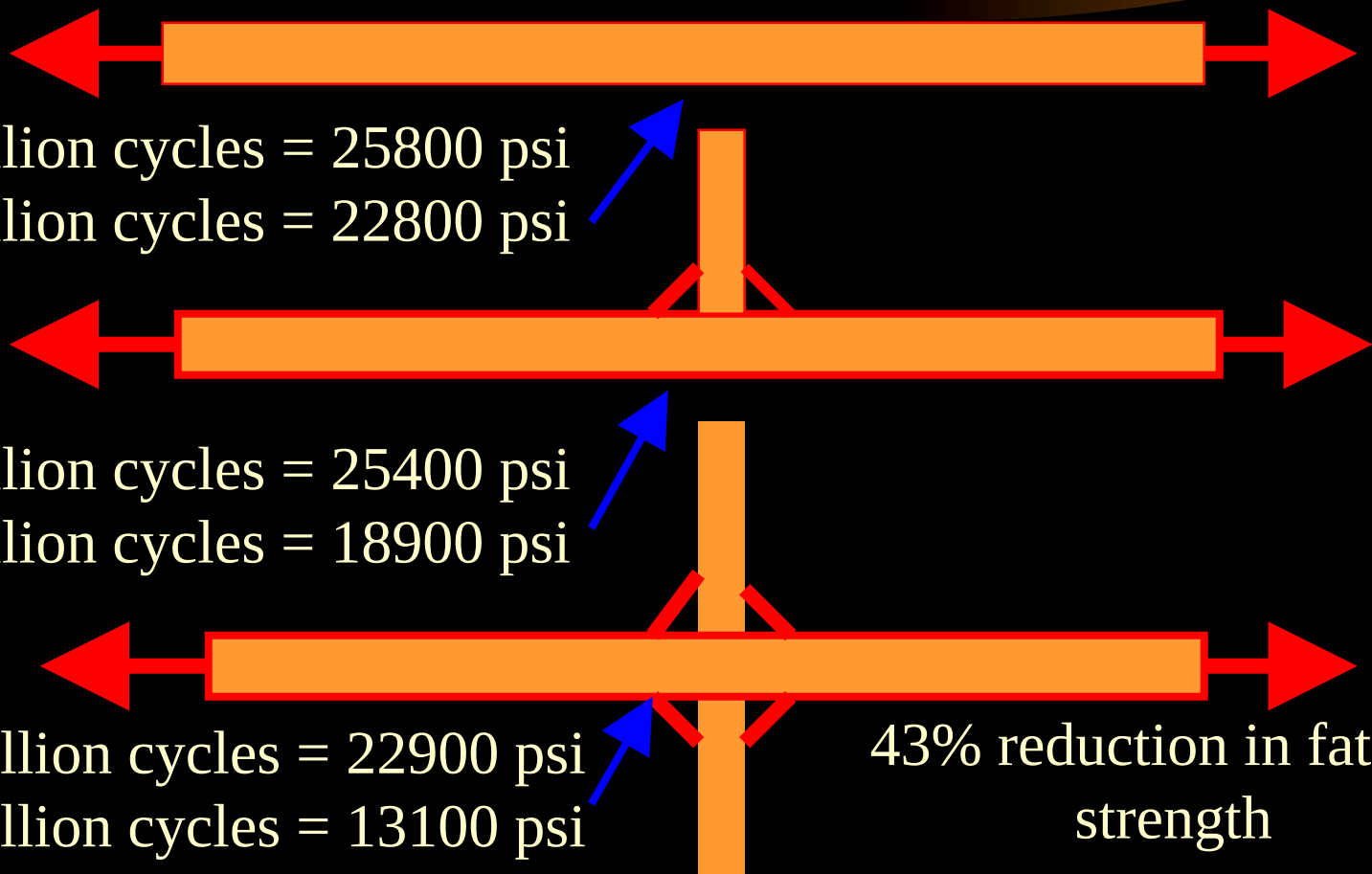
Because of poor design this weld is difficult to complete successfully.

Weld Strength

- A “good” weld is stronger than the parent material
- Welding creates stresses at the weld boundaries
- The stresses will always lead to a failure at the weld edges, not in the weld itself

Effects of weldments on fatigue strength

Avoid abrupt changes in stiffness



1 million cycles = 25800 psi
2 million cycles = 22800 psi

1 million cycles = 25400 psi
2 million cycles = 18900 psi

1 million cycles = 22900 psi
2 million cycles = 13100 psi

43% reduction in fatigue strength

Welding Safety

- Arc rays can injure eyes causing scar tissue and even blindness with prolonged exposure
- Arc rays emit UV light and have been found to cause skin cancer

  SPF 1000 sun block is recommended
- High levels of current can cause electrocution
- Extreme heat can cause severe burns

Welding Safety

Welding fumes are hazardous to your health!

- Short term effects include:

  Nausea, dizziness, irritation of the nose, throat and eyes.

- Long term effects include:

  Iron deposits in the lungs, central nervous system effects, Bronchitis and **Cancer**

PROBLEM 2

Assume that you are an Engineer who has designed a device, and you must now specify a particular weld process. Discuss some of factors that could affect the decision.

ANSWER TO PROBLEM 2

Answers included on page 5 of the handouts

Material to be welded:
-Some materials require special processes that take more time and skill than others.

Number of welds, or length of weld:
-Some welding processes are faster than others.
-MIG/Flux core are fastest, then Stick, then TIG

Weld bead size:
-Tig welding produces a smaller weld than mig or stick. If space is critical, then a small weld bead is desirable.

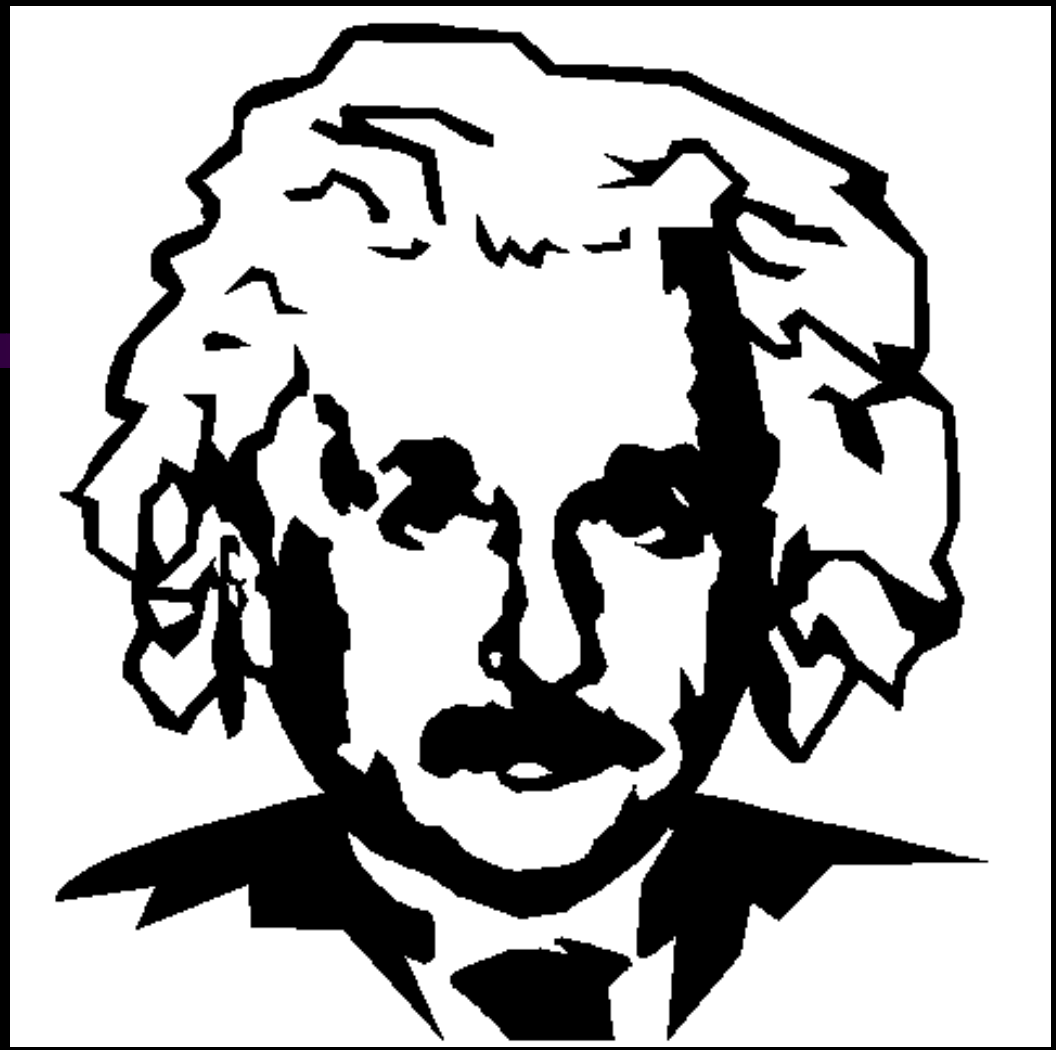
PROBLEM 2 CONTINUED

Weld bead size:
-Tig welding produces a smaller weld than mig or stick. If space is critical, then a small weld bead is desirable.

Location where welding is to occur:
-See question one.

Operator skill level:
-The four welding processes require different skill levels. TIG highest, MIG/Flux core lowest.

Any Questions ?



Albert Einstein once said:
“Education is what remains when one has forgotten everything he learned in school”

This concludes the presentation