GTAW (TIG) - GAS TUNGSTEN ARC WELDING

- ARC GENERATED BETWEEN A NON-CONSUMABLE TUNGSTEN ELECTRODE AND WORK PIECE.
- SHIELDING GAS PROTECTS ELECTRODE AND WELD PUDDLE
- FILLER METAL (ROD) WHICH IS NOT CONSIDERED AN ELECTRODE MAY OR MAY NOT BE USED. DIPPED INTO WELD PUDDLE EDGE AND SIMPLY MELTS.
- DIFFERS FROM GMAW (MIG) AND SMAW (STICK) BECAUSE ELECTRODE IS NON-CONSUMABLE AND NOT USED AS FILLER METAL. TUNGSTEN MELTS AT HOTTEST TEMPERATURE OF ANY METAL- 6,170°F VERY HARD AND BRITTLE.

REQUIRES COORDINATED SKILL TO MANIPULATE TORCH IN ONE HAND, FILLER ROD IN OTHER, AND FOOT-PEDAL TO CONTROL AMPERAGE.

- LIKE MIG, TIG IS A VERY CLEAN PROCESS BECAUSE SHIELDING GAS ELIMINATES NEED FOR FLUX AND RESULTANT SLAG
- NO SMOKE OR FUMES
- RECOMMENDED LENS SHADE IS 10 -14 (HIGHER ULTRAVIOLET LIGHT FROM ARC)

EQUIPMENT

- CONSTANT CURRENT (CC) MACHINE, CABLE WITH TORCH, WORK CABLE AND CLAMP, ELECTRODE, INERT GAS, GAS CYLINDER WITH REGULATOR OR FLOWMETER.
- REMOTE AMP CONTROL AND WATER-COOLED TORCH.
- OPTIONAL HIGH-FREQUENCY OUTPUT FOR NO-TOUCH ARC STARTING
  - COMBINATION OF HIGH FREQUENCY AND A/C USED FOR WELDING ALUMINUM

TORCH HOLDS ELECTRODE AND DELIVERS SHIELDING GAS. CAN BE AIR OR WATER COOLED. WATER COOLED RECOMMENDED ABOVE 150 AMPS AND ALWAYS FROM 200 - 600 AMPS.

TORCH PARTS: CUP (NOZZLE), COLLET, COLLET BODY, END CAP AND TORCH BODY.

- COLLET AND COLLET BODY HOLD ELECTRODE SECURELY. MUST MATCH ELECTRODE SIZE
- COMMON ELECTRODE DIAMETERS INCLUDE 1/16", 3/32", 1/8".
- CUP DIRECTS SHIELDING GAS AND ARE SIZED 1/4" TO 3/4" DIAMETER.

SHIELDING GASES: 2 MOST COMMON ARE 100% ARGON AND 100% HELIUM.

- ARGON - AN INERT GAS (MEANS IT DOES NOT REACT WITH OTHER ELEMENTS OR COMPOUNDS). 1.4 TIMES HEAVIER THAN AIR.
- HELIUM - GOOD FOR ALUMINUM AND MAGNESIUM TO PROTECT AGAINST OXIDIZING ELEMENTS.

- GAS FLOW RATE MEASURED IN C.F.H. (CUBIC FEET PER HOUR) AND IS ADJUSTED BASED ON: (1) CURRENT, (2) TORCH SIZE, (3) GAS USED, (4) WELD POSITION.
  - HIGHER OPERATING CURRENT REQUIRES LARGER CUP AND HIGHER GAS FLOW.
  - WHEN WORKING IN VERTICAL AND OVERHEAD POSITIONS, FLOW RATES MUST BE INCREASED TO MAINTAIN QUALITY BECAUSE ARGON IS 1.4X AS HEAVY AS AIR AND 10X HEAVIER THAN HELIUM (HELIUM CAN BE A BETTER CHOICE ON OVERHEAD BECAUSE IT FLOATS).

ELECTRODES - 6 COMMON TYPES; COLOR CODED AT END, WILL BE CUT INTO 7" LENGTHS.

1. PURE TUNGSTEN
2. 2% THORIATED
3. 2% CERIATED
4. 1.5% LANTHANATED
5. ZIRCONATED
6. RARE EARTH

- SIZE DEPENDS ON BASE METAL, THICKNESS, AND WHETHER A/C OR D/C CURRENT.
- TIP PREPARED BY EITHER SHARPENING TO A POINT OR MELTING END TO A BALL.
- WE WILL SHARPEN TIP ON GRINDER WITH WHEEL DEDICATED EXCLUSIVELY TO TUNGSTEN SO OTHER METAL PARTICLES DON'T CONTAMINATE ELECTRODE.

ELECTRODE SHOULD STICK OUT BEYOND END OF CUP BY 3 TIMES THE ELECTRODE'S DIAMETER.

most common
ELECTRODES ① PURE TUNGSTEN – USES A/C – USED FOR ALUMINUM – GREEN END

② 2% THORIATED – USES D/C – LONG LIFE, EASY ARC STARTS – RED END

③ 2% CERIATED – USES D/C – NOT AS GOOD AS THORIATED, BUT IS NOT RADIOACTIVE – ORANGE END

④ LANTHANATED – USES D/C – SIMILAR TO CERIATED – BLACK END

⑤ ZIRCONIATED – USES A/C – SIMILAR TO PURE TUNGSTEN, BUT USES HIGHER CURRENT (AMPS) – BROWN END

⑥ RARE EARTH (1% THORIATED) – MOSTLY D/C, SAME A/C – EASY ARC START, CARRIES MORE CURRENT, LOW-LEVEL RADIOACTIVITY. – YELLOW END

SET-UP IN SHOP -

- WORK CLAMP IS CONNECTED TO CONNECTOR ON TORCH LEAD
- ELECTRODE CLAMP IS CONNECTED TO WELDING TABLE OR WORK PIECE.
- AMPERAGE IS SET ACCORDING TO BASE METAL AND IT'S THICKNESS.

WE WILL BE USING $\frac{1}{8}$" MILD STEEL TO PRACTICE.

AMPS WILL BE SET AT ABOUT 2x PLATE THICKNESS WHEN WELDING MILD STEEL.

$\frac{1}{8}$" PLATE - CONVERT FRACTION TO DECIMAL

$$8\overline{)1.000} = .125"$$

$$-8 \downarrow$$
$$20$$
$$-16 \downarrow$$
$$40$$

.125" x 2 (2 TIMES PLATE THICKNESS) = .250 = **250 AMPS**

ON AIR-COOLED ONLY TORCH MACHINES WE WILL ONLY USE A MULTIPLE OF ABOUT 1 x PLATE THICKNESS BECAUSE TORCH WILL BECOME TOO HOT TO HANDLE.

3 TYPES OF ARC START:

① HIGH FREQUENCY - USES A/C AND ARC JUMPS WHEN ELECTRODE GETS CLOSE TO WORK PIECE.

② TAP START

③ LIFT-START (WHAT WE WILL BE USING)

WE WILL USE 100% ARGON SHIELDING GAS

REMEMBER, TIG REQUIRES SUPER CLEAN METAL, SO MAKE IT AS SHINY AS POSSIBLE. MIG WILL BURN THROUGH MILL SCALE PRETTY WELL, TIG WILL NOT.

TROUBLESHOOTING TIPS:

PROBLEM	SOLUTIONS
POROUS OR SOOTY WELD-	- MAKE SURE GAS IS ON, IS PROPER TYPE, AND FLOW RATE IS SUFFICIENT. - ELIMINATE DRAFTS - CLEAN AND DRY BASE METAL.
BASEMETAL DISTORTION-	- TACK WELD PARTS BEFORE WELDING - CLAMP PARTS DOWN - LESSON BUILD UP OF HEAT BY SCATTERING YOUR WELDS
ARC IS UNSTABLE -	- ADJUST WORK ANGLE OF TORCH - CLEAN METAL AND ELECTRODE (MAY RESHARPEN) - MAKE SURE YOU ARE CONNECTED PROPERLY - USE SHORTER ARC LENGTH