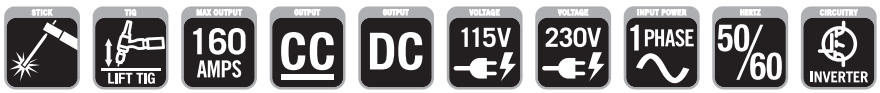
ESAB ET 186i AC/DC
Inverter Arc Welder

Operating Manual

Art# A-13113



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WE APPRECIATE YOUR BUSINESS!

Congratulations on your new ESAB product. We are proud to have you as our customer and will strive to provide you with the best service and reliability in the industry. This product is backed by our extensive warranty and world-wide service network. To locate your nearest distributor or service agency, visit us on the web at **www.esab.com**.

This Operating Manual has been designed to instruct you on the correct use and operation of your ESAB product. Your satisfaction with this product and its safe operation is our ultimate concern. Therefore please take the time to read the entire manual, especially the Safety Precautions. They will help you to avoid potential hazards that may exist when working with this product.

YOU ARE IN GOOD COMPANY!

The Brand of Choice for Contractors and Fabricators Worldwide.

ESAB is a Global Brand of manual and automation Plasma Cutting Products.

We distinguish ourselves from our competition through market-leading, dependable products that have stood the test of time. We pride ourselves on technical innovation, competitive prices, excellent delivery, superior customer service and technical support, together with excellence in sales and marketing expertise.

Above all, we are committed to developing technologically advanced products to achieve a safer working environment within the welding industry.

WARNING
Read and understand this entire Manual and your employer's safety practices before installing, operating, or servicing the equipment.
While the information contained in this Manual represents the Manufacturer's best judgement, the Manufacturer assumes no liability for its use.

Welding Power Supply
ESAB ET 186i AC/DC Inverter Arc Welder
Operating Manual Number 0-5425

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Revision Date:

Record the following information for Warranty purposes:

Where Purchased:_____ _____

Purchase Date:_____ _____

Power Supply Serial #:_____ _____

Torch Serial #:_____ _____

Be sure this information reaches the operator.
You can get extra copies through your supplier.

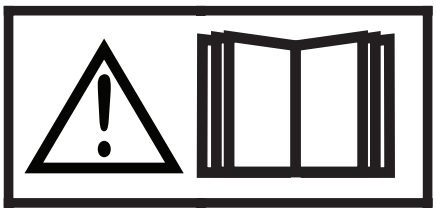
CAUTION

These INSTRUCTIONS are for experienced operators. If you are not fully familiar with the principles of operation and safe practices for arc welding and cutting equipment, we urge you to read our booklet, "Precautions and Safe Practices for Arc Welding, Cutting, and Gouging," Form 52-529. Do NOT permit untrained persons to install, operate, or maintain this equipment. Do NOT attempt to install or operate this equipment until you have read and fully understand these instructions. If you do not fully understand these instructions, contact your supplier for further information. Be sure to read the Safety Precautions before installing or operating this equipment.

USER RESPONSIBILITY

This equipment will perform in conformity with the description thereof contained in this manual and accompanying labels and/or inserts when installed, operated, maintained and repaired in accordance with the instructions provided. This equipment must be checked periodically. Malfunctioning or poorly maintained equipment should not be used. Parts that are broken, missing, worn, distorted or contaminated should be replaced immediately. Should such repair or replacement become necessary, the manufacturer recommends that a telephone or written request for service advice be made to the Authorized Distributor from whom it was purchased.

This equipment or any of its parts should not be altered without the prior written approval of the manufacturer. The user of this equipment shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, damage, improper repair or alteration by anyone other than the manufacturer or a service facility designated by the manufacturer.



READ AND UNDERSTAND THE INSTRUCTION MANUAL BEFORE INSTALLING OR OPERATING.
PROTECT YOURSELF AND OTHERS!

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SECTION 1: SAFETY

1.0 Safety Precautions

Users of ESAB welding and plasma cutting equipment have the ultimate responsibility for ensuring that anyone who works on or near the equipment observes all the relevant safety precautions. Safety precautions must meet the requirements that apply to this type of welding or plasma cutting equipment. The following recommendations should be observed in addition to the standard regulations that apply to the workplace.

All work must be carried out by trained personnel well acquainted with the operation of the welding or plasma cutting equipment. Incorrect operation of the equipment may lead to hazardous situations which can result in injury to the operator and damage to the equipment.

1. Anyone who uses welding or plasma cutting equipment must be familiar with:
   - its operation
   - location of emergency stops
   - its function
   - relevant safety precautions
   - welding and / or plasma cutting
2. The operator must ensure that:
   - no unauthorized person stationed within the working area of the equipment when it is started up.
   - no one is unprotected when the arc is struck.
3. The workplace must:
   - be suitable for the purpose
   - be free from drafts
4. Personal safety equipment:
   - Always wear recommended personal safety equipment, such as safety glasses, flame proof clothing, safety gloves.
   - Do not wear loose fitting items, such as scarves, bracelets, rings, etc., which could become trapped or cause burns.
5. General precautions:
   - Make sure the return cable is connected securely.
   - Work on high voltage equipment **may only be carried out by a qualified electrician**.
   - Appropriate fire extinguishing equipment must be clearly marked and close at hand.
   - Lubrication and maintenance **must not** be carried out on the equipment during operation.

Dispose of electronic equipment at the recycling facility!
In observance of European Directive 2002/96/EC on Waste Electrical and Electronic Equipment and its implementation in accordance with national law, electrical and/or electronic equipment that has reached the end of its life must be disposed of at a recycling facility.
As the person responsible for the equipment, it is your responsibility to obtain information on approved collection stations.
For further information contact the nearest ESAB dealer.

ESAB can provide you with all necessary cutting protection and accessories.

WARNING	**Arc welding and cutting can be injurious to yourself and others. Take precautions when welding and cutting. Ask for your employer's safety practices which should be based on manufacturers' hazard data.**

ELECTRIC SHOCK - Can kill.

- Install and earth (ground) the welding or plasma cutting unit in accordance with applicable standards.
- Do not touch live electrical parts or electrodes with bare skin, wet gloves or wet clothing.
- Insulate yourself from earth and the workpiece.
- Ensure your working stance is safe.

FUMES AND GASES - Can be dangerous to health.

- Keep your head out of the fumes.
- Use ventilation, extraction at the arc, or both, to take fumes and gases away from your breathing zone and the general area.

ARC RAYS - Can injure eyes and burn skin.

- Protect your eyes and body. Use the correct welding / plasma cutting screen and filter lens and wear protective clothing.
- Protect bystanders with suitable screens or curtains.

FIRE HAZARD

- Sparks (spatter) can cause fire. Make sure therefore that there are no inflammable materials nearby.

NOISE - Excessive noise can damage hearing.

- Protect your ears. Use earmuffs or other hearing protection.
- Warn bystanders of the risk.

MALFUNCTION - Call for expert assistance in the event of malfunction.

READ AND UNDERSTAND THE INSTRUCTION MANUAL BEFORE INSTALLING OR OPERATING.

PROTECT YOURSELF AND OTHERS!

WARNING	**Do not use the power source for thawing frozen pipes.**

CAUTION	**Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. There may be potential difficulties in ensuring electromagnetic compatibility of class A equipment in those locations, due to conducted as well as radiated disturbances.**	

CAUTION	**This product is solely intended for metal removal. Any other use may result in personal injury and / or equipment damage.**

CAUTION	**Read and understand the instruction manual before installing or operating.**	

SECTION 2 SYSTEM: INTRODUCTION

2.01 How To Use This Manual

This Owner's Manual applies to just specification or part numbers listed on page i.
To ensure safe operation, read the entire manual, including the chapter on safety instructions and warnings.
Throughout this manual, the words WARNING, CAUTION, DANGER, and NOTE may appear. Pay particular attention to the information provided under these headings. These special annotations are easily recognized as follows:

NOTE!
An operation, procedure, or background information which requires additional emphasis or is helpful in efficient operation of the system.

CAUTION
A procedure which, if not properly followed, may cause damage to the equipment.

WARNING
A procedure which, if not properly followed, may cause injury to the operator or others in the operating area.

WARNING
Gives information regarding possible electrical shock injury. Warnings will be enclosed in a box such as this.

DANGER
Means immediate hazards which, if not avoided, will result in immediate, serious personal injury or loss of life.

Additional copies of this manual may be purchased by contacting ESAB at the address and phone number in your area listed on back cover of this manual. Include the Owner's Manual number and equipment identification numbers.
Electronic copies of this manual can also be downloaded at no charge in Acrobat PDF format by going to the ESAB web site listed below

http://www.esab.com

2.02 Equipment Identification

The unit's identification number (specification or part number), model, and serial number usually appear on a data tag attached to the rear panel. Equipment which does not have a data tag such as torch and cable assemblies are identified only by the specification or part number printed on loosely attached card or the shipping container. Record these numbers on the bottom of page i for future reference.

2.03 Receipt Of Equipment

When you receive the equipment, check it against the invoice to make sure it is complete and inspect the equipment for possible damage due to shipping. If there is any damage, notify the carrier immediately to file a claim. Furnish complete information concerning damage claims or shipping errors to the location in your area listed in the inside back cover of this manual.
Include all equipment identification numbers as described above along with a full description of the parts in error.
Move the equipment to the installation site before un-crating the unit. Use care to avoid damaging the equipment when using bars, hammers, etc., to un-crate the unit.

2.04 Description

The ESAB ET 186i AC/DC is a single phase constant current welding inverter capable of performing SMAW (STICK), GTAW (HF TIG) and GTAW (LIFT TIG) welding processes. The unit is equipped with digital amperage and voltage meters, and a host of other features in order to fully satisfy the broad operating needs of the modern user. The unit is also fully compliant to Standard CSA E 60974-1-00 and UL 60974.1.

The ET 186i AC/DC provides excellent welding performance across a broad range of applications when used with the correct welding consumables and procedures. The following instructions detail how to correctly and safely set up the machine and give guidelines on gaining the best efficiency and quality from the Power Source. Please read these instructions thoroughly before using the unit.

2.05 User Responsibility

This equipment will perform as per the information contained herein when installed, operated, maintained and repaired in accordance with the instructions provided. This equipment must be checked periodically. Defective equipment (including welding leads) should not be used. Parts that are broken, missing, plainly worn, distorted or contaminated, should be replaced immediately. Should such repairs or replacements become necessary, it is recommended that such repairs be carried out by appropriately qualified persons approved by ESAB. Advice in this regard can be obtained by contacting an Accredited ESAB Distributor.

This equipment or any of its parts should not be altered from standard specification without prior written approval of ESAB. The user of this equipment shall have the sole responsibility for any malfunction which results from improper use or unauthorized modification from standard specification, faulty maintenance, damage or improper repair by anyone other than appropriately qualified persons approved by ESAB.

2.06 Transporting Methods

This unit is equipped with a handle for carrying purposes.

WARNING
ELECTRIC SHOCK can kill. DO NOT TOUCH live electrical parts. Disconnect input power conductors from de-energized supply line before moving the welding power source.

WARNING
FALLING EQUIPMENT can cause serious personal injury and equipment damage.

Lift unit with handle on top of case.
Use handcart or similar device of adequate capacity.
If using a fork lift vehicle, place and secure unit on a proper skid before transporting.

2.07 Packaged Items

- ET 186i AC/DC Inverter Power Source
- ESAB 200 Amp Electrode Holder with 13ft (4m) Lead
- ESAB 200 Amp Work Clamp with 10ft (3m) Lead
- 26 TIG Torch 13ft (4m) Lead with Integrated Controls & Accessory
- 9ft (2.75m) Power Cord and NEMA6-50P 230V AC Plug
- Victor Argon Flow Gauge & 12.5 ft (3.8m) Hose
- 4 General Purpose Stick Electrodes (E6013)
- Shoulder Strap
- Operating Manual & CD
- ESAB Cap

Figure 2-1: ET 186i AC/DC Packaged System

2.08 Duty Cycle

The rated duty cycle of a Welding Power Source, is a statement of the time it may be operated at its rated welding current output without exceeding the temperature limits of the insulation of the component parts. To explain the 10 minute duty cycle period the following example is used. Suppose a Welding Power Source is designed to operate at a 20% duty cycle, 200 amperes at 18.0 volts. This means that it has been designed and built to provide the rated amperage (200A) for 2 minutes, i.e. arc welding time, out of every 10 minute period (20% of 10 minutes is 2 minutes). During the other 8 minutes of the 10 minute period the Welding Power Source must idle and be allowed to cool. The thermal cut out will operate if the duty cycle is exceeded.

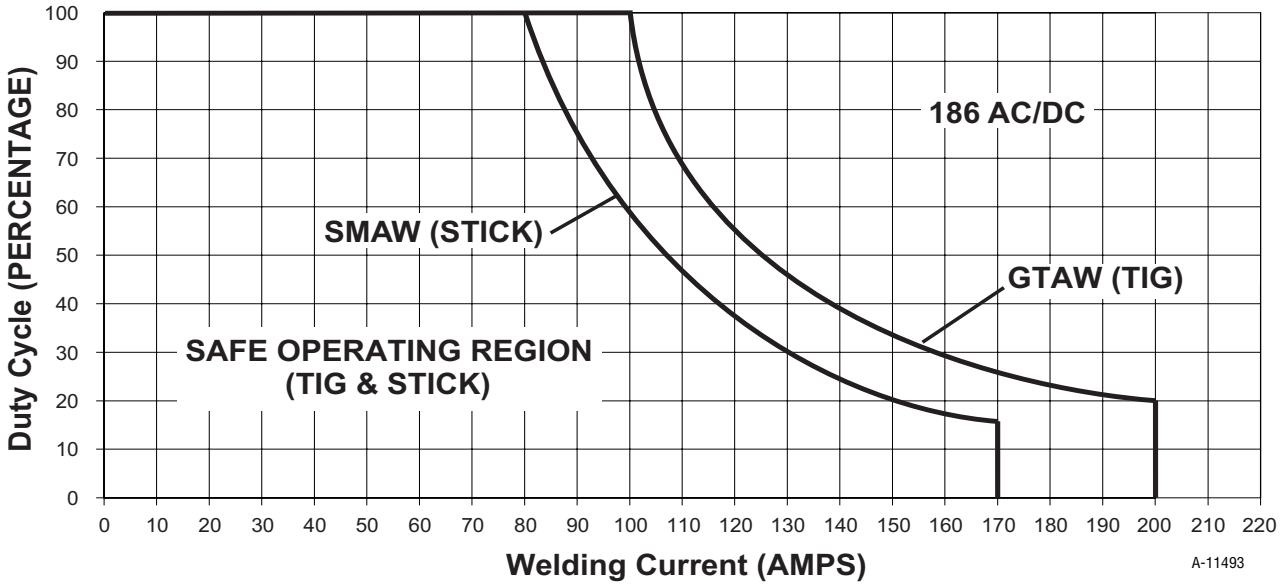


Figure 2-2: ET 186i AC/DC Duty Cycle

2.09 Specifications

Description	ESAB ET 186i AC/DC INVERTER	
Part Number	W1006300	
Power Source Weight	48.4lbs (22 kg)	
Power Source Dimensions	H15.75"xW9.45"xD18.7" (H 400mm x W 240mm x D 475mm)	
Cooling	Fan Cooled (Runs Continually)	
Welder Type	Inverter Power Source	
Applicable Standards / Approvals	CSA E60974-1-00 / UL60974-1 / IEC 60974-1	
Number of Phases	1	
Nominal Supply Frequency	50/60Hz	
Welding Current Range (STICK Mode)	5 - 170A (DC Stick)	10-170A (AC Stick)
Welding Current Range (TIG Mode)	5 - 200A (DC TIG)	30-200A (AC LIFT TIG) 10-200A (AC HF TIG)
Nominal Supply Voltage	208V	230V
Effective Input Current (I1eff) (See Note 1)		
STICK	16.4A	15.5A
TIG	16.5A	14.1A
Maximum Input Current (I1max)		
STICK	35.6A	34.9A
TIG	35.4A	32.4A
Single Phase Generator Requirement (See Note 2)	9.5KVA (7KW)	
STICK (SMAW) Welding Output, 40ºC, 10 min.	170A @ 15%, 26.8V 100A @ 60%, 24.0V 80A @ 100%, 23.2V	
TIG (GTAW) Welding Output, 40ºC, 10 min.	200A @ 20%, 18V 116A @ 60%, 14.6V 90A @ 100%, 13.6V	
Open circuit voltage	70.3 VDC / 50VAC	
Protection Class	IP23S	

Table 2-1: ET 186i AC/DC Specification

NOTE!
The Effective Input Current should be used for the determination of cable size & supply requirements. Generator Requirements at the Maximum Output Duty Cycle.

2.10 Optional Accessories

26 Style TIG Torch with Remote Current Control.....Part No. W4013600

Basic Utility Cart..... Part No. W4014700

Foot Control ..... Part No. W4013200

ESAB Helmet (USA Only) ..... Part No. 4100-1004

2.11 Volt-Ampere Curves

Voltage-Amperage Curves shows maximum voltage and amperage output capabilities of welding power source. Curves of other settings fall between curves shown.

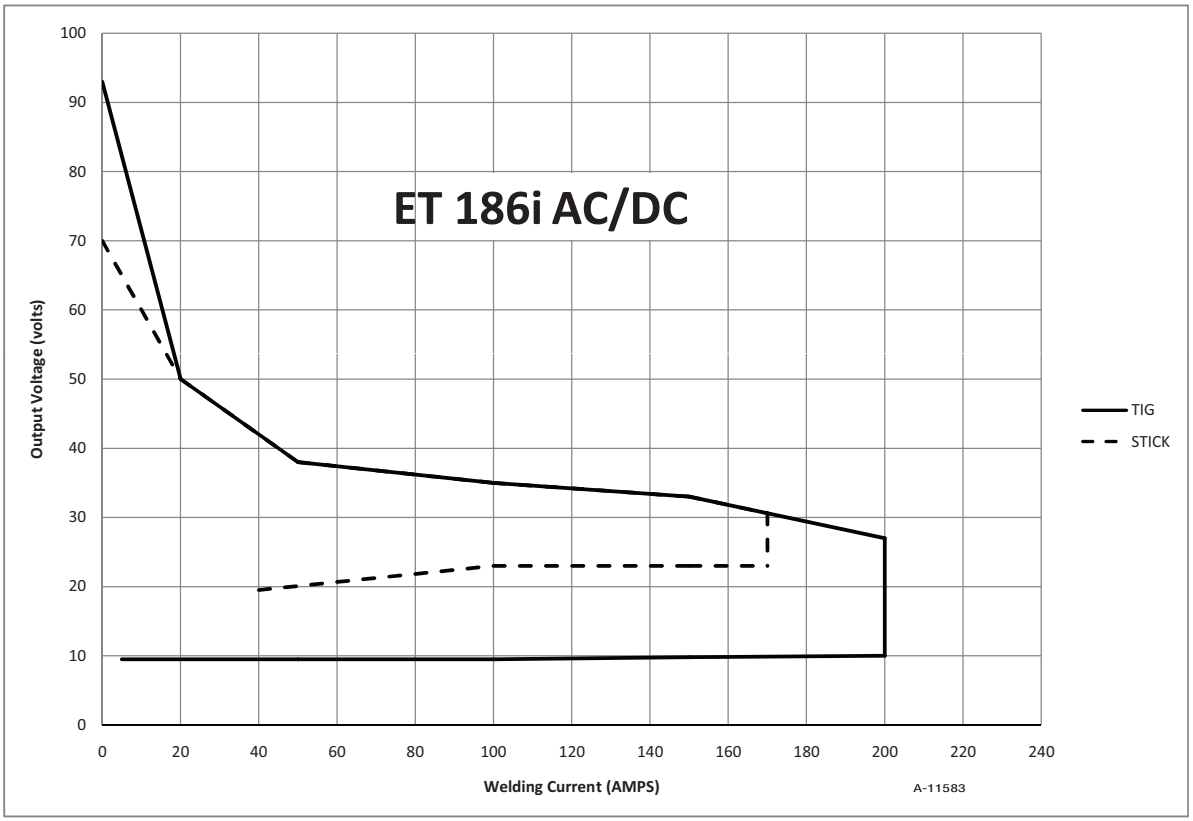


Figure 2-3: ET 186i AC/DC Volt-Amp Curves

SECTION 3:
INSTALLATION, OPERATION AND SETUP

3.01 Environment

These units are designed for use in environments with increased hazard of electric shock as outlined in EN 60974.1. Additional safety precautions may be required when using unit in an environment with increased hazard of electric shock. Please refer to relevant local standards for further information prior to using in such areas.

A. Examples of environments with increased hazard of electric shock are:
   1. In locations in which freedom of movement is restricted, so that the operator is forced to perform the work in a cramped (kneeling, sitting or lying) position with physical contact with conductive parts.
   2. In locations which are fully or partially limited by conductive elements, and in which there is a high risk of unavoidable or accidental contact by the operator.
   3. In wet or damp hot locations where humidity or perspiration considerable reduces the skin resistance of the human body and the insulation properties of accessories.

B. Environments with increased hazard of electric shock do not include places where electrically conductive parts in the near vicinity of the operator, which can cause increased hazard, have been insulated.

3.02 Location

Be sure to locate the welder according to the following guidelines:

A. In areas, free from moisture and dust.

B. Ambient temperature between 0° C to 40° C.

C. In areas, free from oil, steam and corrosive gases.

D. In areas, not subjected to abnormal vibration or shock.

E. In areas, not exposed to direct sunlight or rain.

F. Place at a distance of 12" (300 mm) or more from walls or similar that could restrict natural air flow for cooling.

G. The enclosure design of this power source meets the requirements of IP23S as outlined in EN 60529. This provides adequate protection against solid objects (greater than 0.5" (12mm)), and direct protection from vertical drops. Under no circumstances should the unit be operated or connected in a micro environment that will exceed the stated conditions. For further information please refer to EN 60529.

H. Precautions must be taken against the power source toppling over. The power source must be located on a suitable horizontal surface in the upright position when in use.

WARNING
This equipment should be electrically connected by a qualified electrician.

3.03 Ventilation

WARNING
Since the inhalation of welding fumes can be harmful, ensure that the welding area is effectively ventilated.

3.04 Mains Supply Voltage Requirements

WARNING
The Mains supply voltage should be within ± 15% of the rated mains supply voltage. Too low a voltage may cause poor welding performance. Too high a supply voltage will cause components to overheat and possibly fail.

The Welding Power Source must be:

- Correctly installed, if necessary, by a qualified electrician.
- Correctly earthed (electrically) in accordance with local regulations.
- Connected to the correct size power point and fuse as per the Specifications on page 3-2.

WARNING
ELECTRIC SHOCK can kill; SIGNIFICANT DC VOLTAGE is present after removal of input power. DO NOT TOUCH live electrical parts.

SHUT DOWN welding power source, disconnect input power employing lockout/tagging procedures. Lock-out/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting OFF and red-tagging circuit breaker or other disconnecting device.
Power Cords Included With Power Supply

Attached to the power supply is an input power cord with a 208/230Volt 50 Amp NEMA 6-50 P for plug.

WARNING
An electrical shock or fire hazard is probable if the following electrical service guide recommendations are not followed. These recommendations are for a dedicated branch circuit sized for the rated output and duty cycle of the welding Power Source.

	50 / 60 Hz Single Phase Supply
Supply Voltage	**208/230V AC**
Input Current at Maximum Output	32 Amps
Maximum Recommended Fuse* or Circuit Breaker Rating * Time Delay Fuse, UL class RK5. Refer to UL248	50 Amps
Maximum Recommended Fuse^ or Circuit Breaker Rating ^Normal Operating , UL class K5. Refer to UL248	50 Amps
Minimum Recommended Cord Size	12 AWG
Maximum Recommended Extension Cord Length	50 ft
Minimum Recommended Grounding Conductor Size	12 AWG

Table 3-1: Electrical Service Guide

3.05 High Frequency Introduction

The importance of correct installation of high frequency welding equipment cannot be overemphasized. Interference due to high frequency initiated or stabilized arc is almost invariably traced to improper installation. The following information is intended as a guide for personnel installing high frequency welding machines.

WARNING
The high frequency section of this machine has an output similar to a radio transmitter. The machine should NOT be used in the vicinity of blasting operations due to the danger of premature firing

WARNING
It is also possible that operation close to computer installations may cause computer malfunction.

3.06 High Frequency Interference

Interference may be transmitted by a high frequency initiated or stabilized arc welding machine in the following ways.

1. **Direct Radiation**: Radiation from the machine can occur if the case is metal and is not properly grounded. It can occur through apertures such as open access panels. The shielding of the high frequency unit in the Power Source will prevent direct radiation if the equipment is properly grounded.

2. **Transmission via the Supply Lead**: Without adequate shielding and filtering, high frequency energy may be fed to the wiring within the installation (mains) by direct coupling. The energy is then transmitted by both radiation and conduction. Adequate shielding and filtering is provided in the Power Source.

3. **Radiation from Welding Leads:** Radiated interference from welding leads, although pronounced in the vicinity of the leads, diminishes rapidly with distance. Keeping leads as short as possible will minimise this type of interference. Looping and suspending of leads should be avoided wherever possible.

4. **Re-Radiation from Unearthed Metallic Objects**: A major factor contributing to interference is re-radiation from unearthed metallic objects close to the welding leads. Effective grounding of such objects will prevent re-radiation in most cases.

3.07 Electromagnetic Compatibility

WARNING
Extra precautions for Electromagnetic Compatibility may be required when this Welding Power Source is used in a domestic situation.

A. Installation and Use - Users Responsibility

The user is responsible for installing and using the welding equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user of the welding equipment to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing the welding circuit, see NOTE below. In other cases it could involve constructing an electromagnetic screen enclosing the Welding Power Source and the work, complete with associated input filters. In all cases, electromagnetic disturbances shall be reduced to the point where they are no longer Troublesome.

NOTE!
The welding circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, e.g. by allowing parallel welding current return paths which may damage the earth circuits of other equipment.

B. Assessment of Area

Before installing welding equipment, the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account.

1. Other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the welding equipment.
2. Radio and television transmitters and receivers.
3. Computer and other control equipment.
4. Safety critical equipment, e.g. guarding of industrial equipment.
5. The health of people around, e.g. the use of pace-makers and hearing aids.
6. Equipment used for calibration and measurement.
7. The time of day that welding or other activities are to be carried out.
8. The immunity of other equipment in the environment: the user shall ensure that other equipment being used in the environment is compatible: this may require additional protection measures.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

C. Methods of Reducing Electromagnetic Emissions

1. Electricity Supply

   Welding equipment should be connected to the Electricity Supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the Electricity Supply. Consideration should be given to shielding the supply cable of permanently installed welding equipment in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the Welding Power Source so that good electrical contact is maintained between the conduit and the Welding Power Source enclosure.

2. Maintenance of Welding Equipment

   The welding equipment should be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the welding equipment is in operation. The welding equipment should not be modified in any way except for those changes and adjustments covered in the manufacturer's instructions.

3. Welding Cables

The welding cables should be kept as short as possible and should be positioned close together but never coiled and running at or close to the floor level.

4. Equipotential Bonding

   Bonding of all metallic components in the welding installation and adjacent to it should be considered. However, metallic components bonded to the work piece will increase the risk that the operator could receive a shock by touching the metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

5. Earthing/grounding of the Work Piece

   Where the work piece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, e.g. ship's hull or building steelwork, a connection bonding the work piece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the work piece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the work piece to earth should be made by direct connection to the work piece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitance, selected according to national regulations.

6. Screening and Shielding

   Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening the entire welding installation may be considered for special applications.

3.08 ET 186i AC/DC Power Source Controls, Indicators and Features

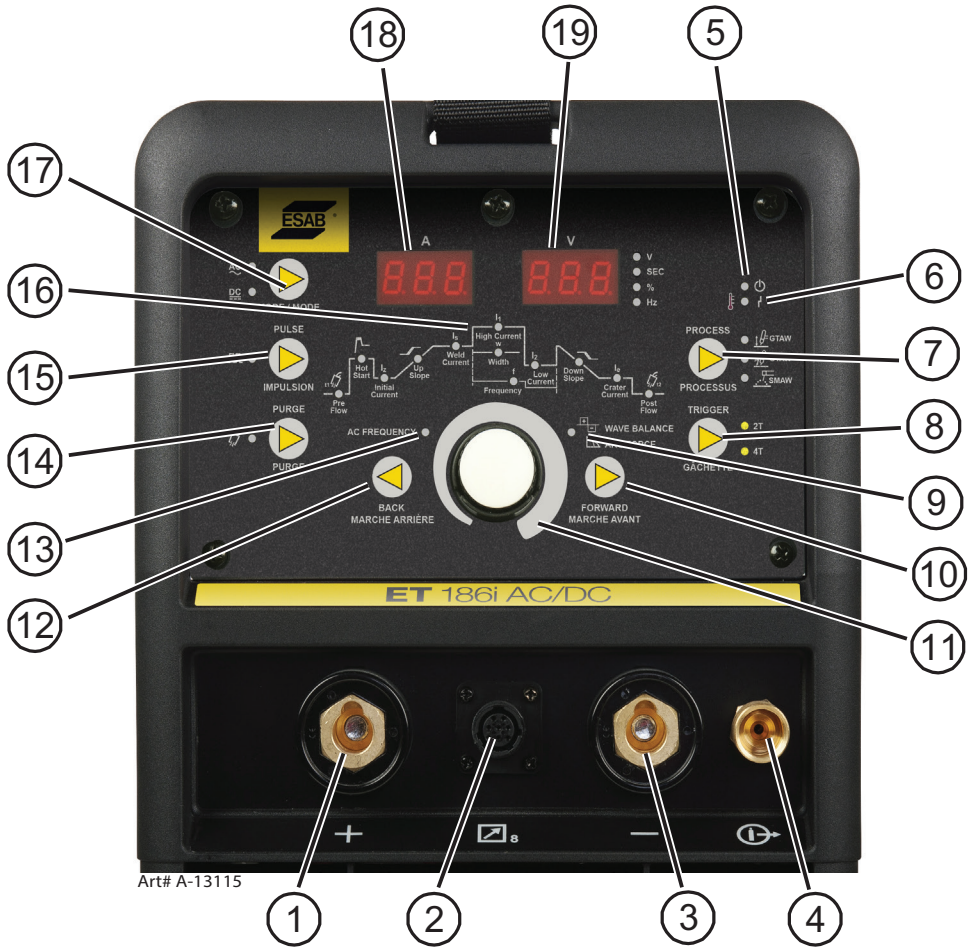


Figure 3-1: Controls on Front Panel

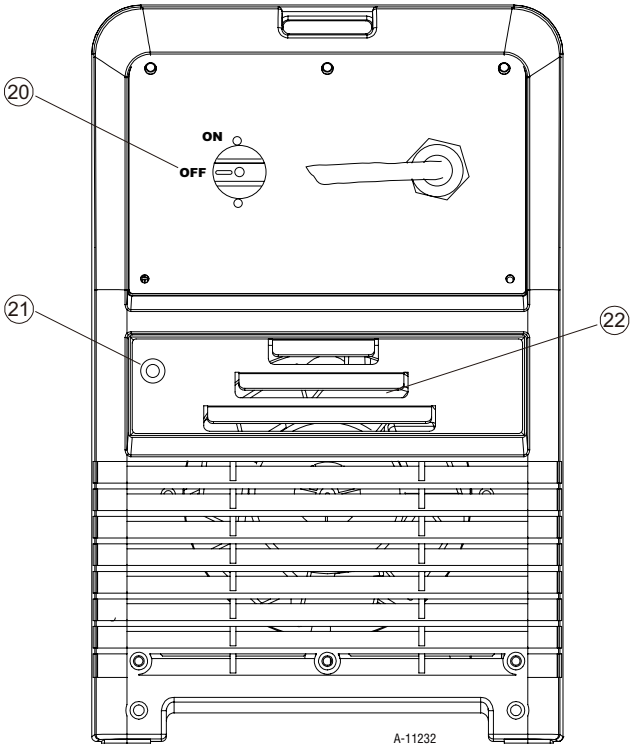


Figure 3-2: Rear Panel

1. Positive Welding Terminal

Positive Welding Terminal 2" (50mm) dinse. Welding current flows from the Power Source via heavy duty bayonet type terminals. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

2. 8 Pin Control Socket

The 8 pin receptacle is used to connect a trigger switch or remote control to the welding Power Source circuitry:

To make connections, align keyway, insert plug, and rotate threaded collar fully clockwise. The socket information is included in the event the supplied cable is not suitable and it is necessary to wire a plug or cable to interface with the 8 pin receptacle.

NOTE!
When not using a Remote, disconnect any remote control device or it may limit the preview and actual output current range.

Socket Pin	Part Number / Description
1	Not used
2	Trigger Switch Input
3	Trigger Switch Input
4	Not used
5	Remote Control 5k ohm Potentiometers Maximum
6	Remote Control 5k ohm Potentiometers Minimum
7	Remote Control 5k ohm Potentiometer Wiper
8	Not used

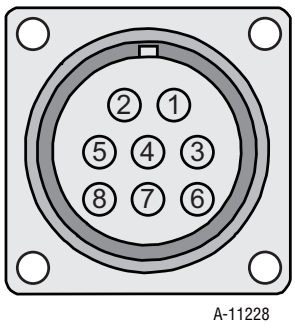


Table 3-2: 8 Pin Control Plug Configuration

3. Negative Welding Terminal

Negative Welding Terminal 50 mm dinse. Welding current flows from the Power Source via heavy duty bayonet type terminals. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection

CAUTION
Loose welding terminal connections can cause overheating and result in the male plug being fused in the terminal.

4. Shielding Gas Outlet

The Shielding Gas Outlet located on the front panel is a 5/8-18 UNF female gas fitting and is utilized for the connection of a suitable TIG Torch.

5. Power ON Indicator

The POWER ON indicator illuminates when the ON/OFF switch (20) is in the ON position and the correct mains voltage is present.

6. Fault Indicator (Thermal Overload or Primary Circuit Overcurrent)

The Fault Indicator will illuminate in conjunction with an “Err 001” displayed on the ammeter and voltmeter digital displays if either of the following two conditions exists

a. Thermal Overload

This is due to the duty cycle of the power source being exceeded. Once the power source cools sufficiently it will automatically reset and the Fault Indicator and Err 001 will go off and the power source is then able to continue welding. During the time of cooling the power source should remain ON such that the fan continues to operate allowing the unit to cool sufficiently. If after 30 minutes with the fan running the Fault Indicator has not gone OFF then have an Accredited ESAB Service Provider check the power source.

b. Primary Circuit Overcurrent

This is due to primary circuit component(s) malfunctioning which results in excessive primary circuit current. Switch OFF the power source immediately to allow all components to cool down for at least 30 minutes. If after 30 minutes “Err 001” is displayed and Fault Indicator illuminates when the power source is switched back ON turn the power source OFF and have an Accredited ESAB Service Provider check the power source.

7. Process Selection Button

The process selection control is used to select the desired welding mode. Three modes are available, GTAW (LIFT TIG), GTAW (HF TIG) and SMAW (Stick) modes.

Note that when the unit is powered off the mode selection control will automatically default to LIFT TIG mode.

This is necessary so as to prevent inadvertent arcing should an electrode holder be connected to the unit and mistakenly be in contact with the work piece during power up.

8. Trigger Mode Control Button (HF TIG and LIFT TIG Mode only)

The trigger mode control is used to switch the functionality of the torch trigger between 2T (normal), and 4T (latch mode).

2T Normal Mode

In this mode, the torch trigger must remain depressed for the welding output to be active. Press and hold the torch trigger to activate the power source (weld). Release the torch trigger switch to cease welding.

NOTE!
When operating in GTAW (HF and LIFT TIG modes), the power source will remain active until the selected down slope time has elapsed.

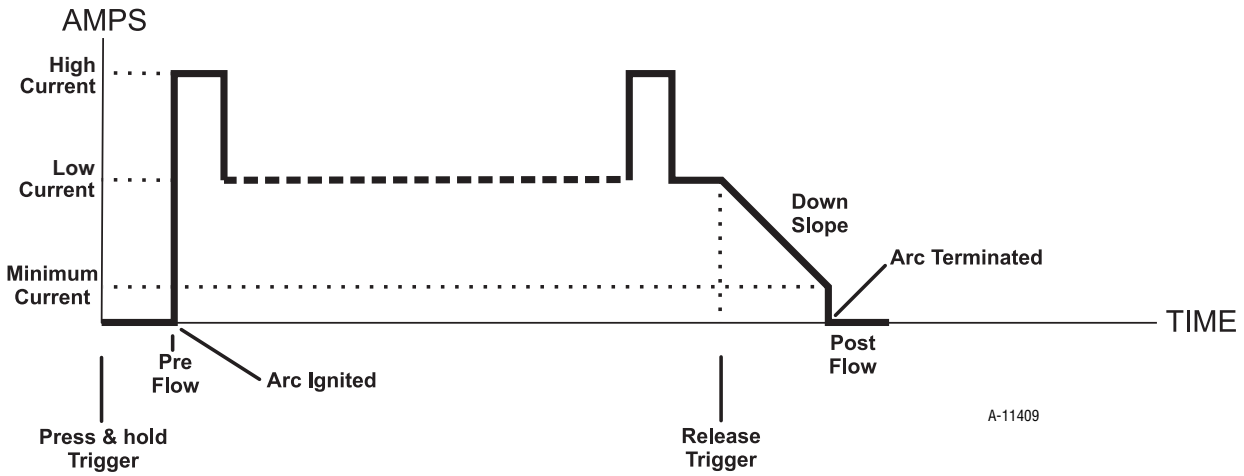


Figure 3-3

4T Latch Mode

This mode of welding is mainly used for long welding runs to reduce operator fatigue. In this mode the operator can press and release the torch trigger and the output will remain active. To deactivate the power source, the trigger switch must again be depressed and realized, thus eliminating the need for the operator to hold the torch trigger.

Note that when operating in GTAW (HF and LIFT TIG modes), the power source will remain activated until the selected down slope time has elapsed

NOTE!
This Up Slope operates in (4T) TIG modes only and is used to set the time for the weld current to ramp up, after the torch trigger switch has been pressed then released, from Initial Current to High or Weld Current.

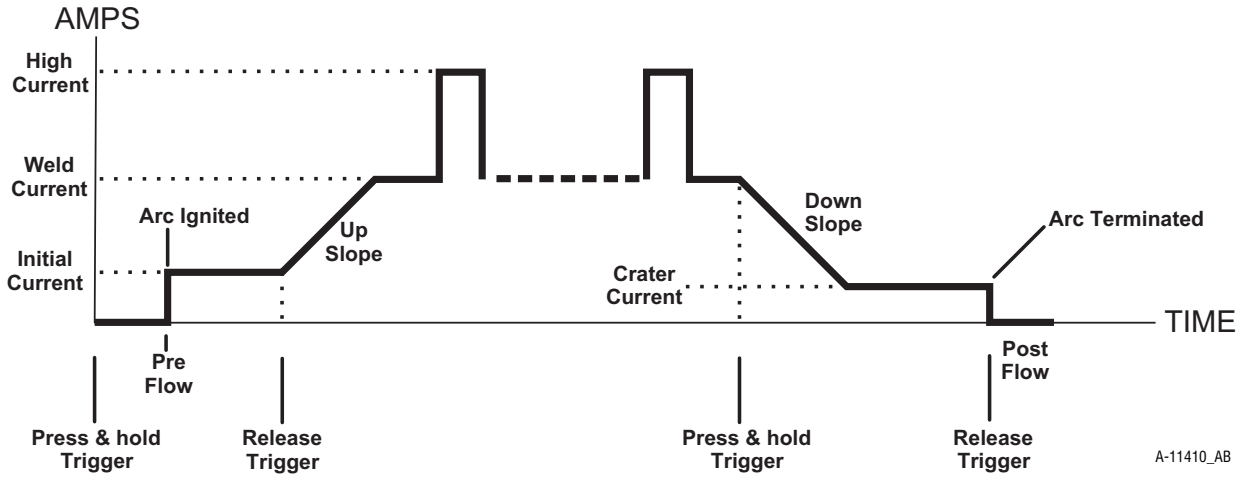


Figure 3-4

9. Wave Balance / Arc Force Indicator

This indicator light will illuminate when programming Wave Balance (AC HF TIG mode only) or Arc Force (STICK mode only).

10. Forward Programming Button

Pressing this button will advance to the next step in the programming sequence.

11. Multifunction Control

The multifunction control knob is used to adjust welding current.

It is also used to adjust parameters when in programming mode.

12. Back Programming Button

Pressing this button will go back to the previous step in the programming sequence.

13. AC frequency Indicator

This indicator light will illuminate when programming AC Frequency (AC HF TIG mode only).

14. Purge Button

Press the PURGE button to purge the gas line in LIFT TIG and HF TIG modes. To PURGE the shielding gas line in LIFT TIG and HF TIG modes press the PURGE button and release. The indicator will illuminate and shielding gas will purge for a preset period of 15 seconds. (This cannot be adjusted). To stop shielding gas from purging within this time press the PURGE button and release and the purge indicator will extinguish and shielding gas will cease.

15. Pulse Button

Press the PULSE button to toggle Pulse On and OFF in LIFT TIG and HF TIG modes

16. Programming Parameter Indicators (Front Panel Display Indicators)

The Front Panel LED indicators serve two purposes. First, they show what process and what parameter is selected and the value of that parameter. The AMP DISPLAY shows only amperage values measured in AMPS, the VOLT DISPLAY can indicate Voltage, Time, Percentage, or Frequency. The UNITES lights indicate the unit of measurement for the reading on the VOLT DISPLAY: Volts (V), Seconds (SEC), Percent (%),Hertz (HZ). Only the parameters that are applicable to a specific PROCESS, MODE, or TRIGGER SELECTION will light when using the FORWARD or BACK programming switches. Secondly, during the welding process, the following sequence indicators will light to indicate the specific phase of the weld process which is active:

TIG	STICK
PREFLOW	WELD CURRENT
HOT START	
INITIAL CURRENT (4T)	
UPSLOPE (4T)	
WELD CURRENT (PULSING OFF)	
HIGH CURRENT (PULSING ON)	
LOW CURRENT (PULSING ON)	
DOWNSLOPE	
CRATER CURRENT (4T)	
POST FLOW	

17. Mode Button

Press the MODE button to toggle AC and DC output in all Process modes

18. Digital Ammeter

The digital amperage meter is used to display both the pre-set current and actual output current of the power source.

At times of non-welding, the amperage meter will display a pre-set (preview) amperage value. This value can be adjusted by varying the multifunction control when the Programming Parameter Indicator light shows WELD CURRENT .

When welding, the amperage meter will display actual welding current.

Should a remote device be connected the maximum setting of the power source will be determined by the respective front panel control, irrespective of the remote control device setting. As an example, if the output current on the power source front panel is set to 50% and the remote control device is set to 100%, the maximum achievable output from the unit will be 50%. Should 100% output be required, the respective power source front panel control must be set to 100%, in which case the remote device will then be able to control between 0-100% output.

19. Digital Voltmeter / Parameter meter

The digital volt meter is used to display the actual output voltage of the power source. It is also used to display Parameters in Programming Mode.

Depending on the Programming Parameter selected, the status indictor adjacent to the volt meter will illuminate to show the units of the programming parameter.

When welding, the volt meter will display actual welding voltage.

20. ON / OFF Switch

This Switch is located on the rear of the Power Source and turns mains power off and on.

WARNING
When the front digital displays are lit, the machine is connected to the Mains supply voltage and the internal electrical components are at Mains voltage potential.

21. Shielding Gas Inlet

Unit has a 5/8" Inert gas fitting suitable for connection of a gas hose to a regulated Shielding Gas Supply. The Shielding Gas inlet is located on the rear of the Power Source.

22. Cooling Fan

The ET 186i AC/DC is fitted with a cooling fan that will operate continuously when the ON/OFF switch on the rear panel is switched to the ON position.

3.09 ET 186i AC/DC - STICK Programming Mode

Press the PROCESS SELECTION button to select STICK mode.
Press the MODE switch to toggle between AC and DC welding output.
Press FORWARD or BACK to cycle through available programming functions.
Use the Multi Function Control to adjust the Parameter selected.
While welding the Multi Function Control directly controls the WELD CURRENT.

Figure 3-5: Stick Programming Mode

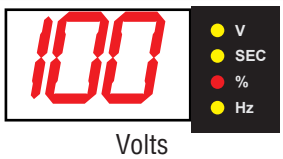
Programming Parameter	Adjustment Device	Display
Hot Start This parameter operates in all weld modes except LIFT TIG mode and is used to heat up the weld zone in TIG modes or improve the start characteristics for stick electrodes the peak start current on top of the WELD current. e.g. HOT START current = 130 amps when WELD = 100 amps & HOT START = 30 amps		 Amps 0 to 70A (max 170A weld current)
Weld Current This parameter sets the TIG WELD current when PULSE is OFF. This parameter also sets the STICK weld current.		 Amps 5 to 170A (DC STICK mode) 10 to 170A (AC STICK mode)
Arc Force (STICK Mode only) Arc Force is effective when in STICK Mode only. Arc Force control provides and adjustable amount of Arc Force (or "dig") control. This feature can be particularly beneficial in providing the operator the ability to compensate for variability in joint fit-up in certain situations with particular electrodes. In general increasing the Arc Force control toward 100% (maximum Arc Force) allows greater penetration control to be achieved.		 Volts 0 to 100%

Table 3-3

3.10 ET ET 186i AC/DC – LIFT TIG and HF TIG Programming Mode

Press the PROCESS SELECTION button to select LIFT TIG or HF TIG mode.
Press the MODE switch to toggle between AC and DC welding output.
Press FORWARD or BACK to cycle through available programming functions.
Use the Multi Function Control to adjust the parameter selected.

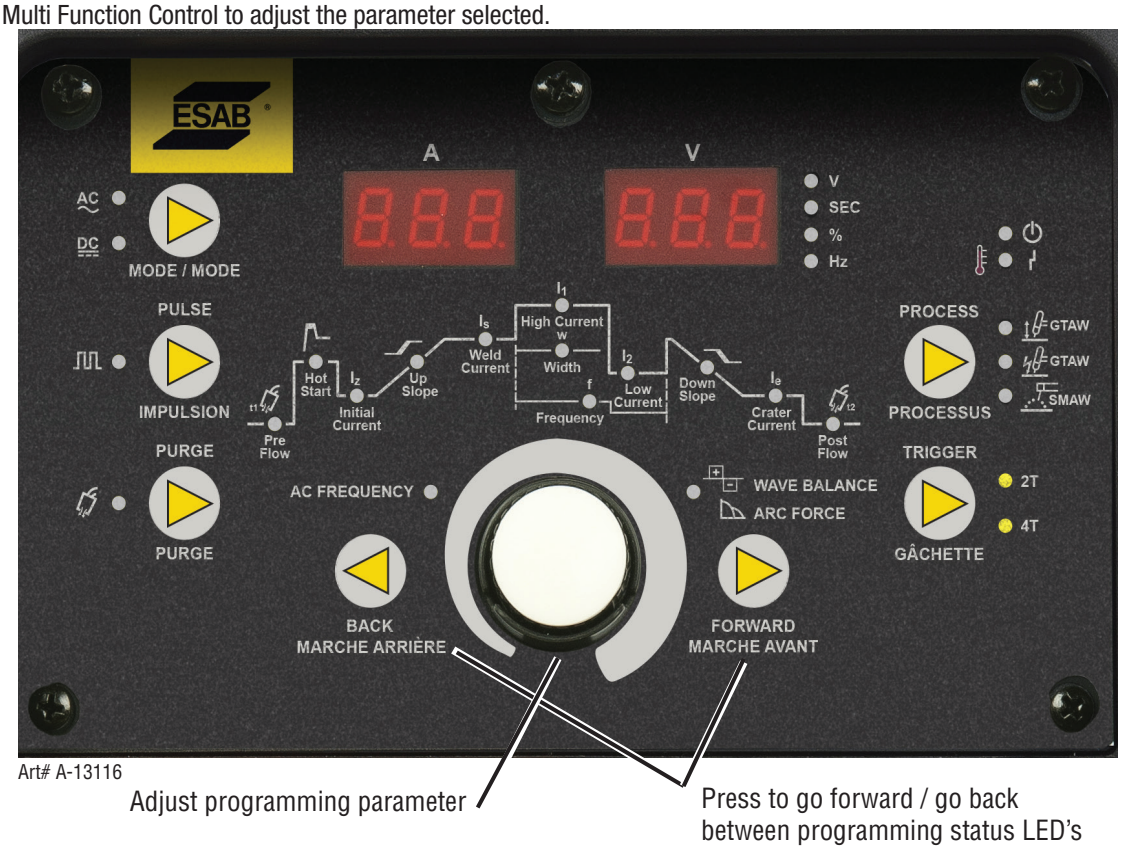


Figure 3-6: LIFT TIG and HF TIG Programming Mode

Programming Parameter	Adjustment Device	Display
Pre-Flow This parameter operates in TIG modes only and is used to provide gas to the weld zone prior to striking the arc, once the torch trigger switch has been pressed. This control is used to dramatically reduce weld porosity at the start of a weld.		 Volts 0.0 to 1.0 second
Initial Current This parameter operates in (4T) TIG modes only and is used to set the start current for TIG. The Start Current remains on until the torch trigger switch is released after it has been depressed. Note: The maximum initial current available will be limited to the set value of the weld current.		 Amps 5 to 200 Amps (DC TIG mode) 30 to 200 Amps (AC LIFT TIG mode) 10 to 200A (AC HF TIG mode)
Up Slope This parameter operates in (4T) TIG modes only and is used to set the time for the weld current to ramp up, after the torch trigger switch has been pressed then released, from Initial Current to High or Weld current.		 Volts 0.0 to 15.0 seconds
Weld Current This parameter sets the TIG WELD current when PULSE is OFF. This parameter also sets the STICK weld current.		 Amps 5 to 200A (DC TIG mode) 30 to 200A (AC LIFT TIG mode) 10 to 200A (AC HF TIG mode)
High Current This parameter sets the High weld current when in PULSE mode.		 Amps 10 to 200A (DC TIG mode) 30 to 200A (AC TIG mode)

Programming Parameter	Adjustment Device	Display
Low Current The lowest point in the pulse is called the Low Current.		 Amps 5 to 200A (DC HF TIG mode) 30 to 200A (AC LIFT TIG mode) 10 to 200A (AC HF TIG mode)
Pulse Width This parameter sets the percentage on time of the PULSE FREQUENCY for High weld current when the PULSE is ON.		 Volts 15 to 80%
Pulse Frequency This parameter sets the PULSE FREQUENCY when the PULSE is ON.		 Volts 0.5 to 200 Hz
Down Slope This parameter operates in TIG modes only and is used to set the time for the weld current to ramp down, after the torch trigger switch has been pressed, to crater current. This control is used to eliminate the crater that can form at the completion of a weld.		 Volts 0.0 to 25.0 seconds
Crater Current This parameter operates in (4T) TIG modes only and is used to set the finish current for TIG. The CRATER Current remains ON until the torch trigger switch is released after it has been depressed. Note: The maximum crater current available will be limited to the set value of the weld current.		 Amps 5 to 200A (DC TIG mode) 30 to 200A (AC TIG mode) 10 to 200A (AC HF TIG mode)
Post Flow This parameter operates in TIG modes only and is used to adjust the post gas flow time once the arc has extinguished. This control is used to dramatically reduce oxidation of the tungsten electrode.		 Volts 0.0 to 60.0 seconds

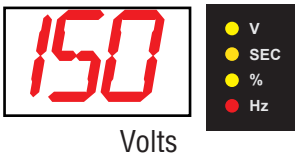
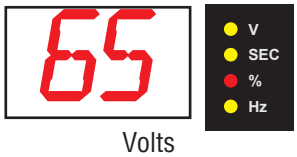
Programming Parameter	Adjustment Device	Display
AC Frequency This parameter operates in AC TIG mode only and is used to set the frequency for the AC weld current.		 Volts 15 to 150 Hz
Wave Balance This parameter operates in AC TIG mode and is used to set the penetration to cleaning action ratio for the AC weld current. Generally WAVE BALANCE is set to 50% from the factory for AC TIG Welding. The WAVE BALANCE control changes the ratio of penetration to cleaning action of the AC TIG welding arc. Maximum weld penetration is achieved when the WAVE BALANCE control is set to 10%. Maximum cleaning of heavily oxidized aluminium or magnesium alloys is achieved when the WAVE BALANCE control is set to 65%.		 Volts 10 to 65%

Table 3-4

WAVE BALANCE is used for aluminium welding in AC HF TIG or AC LIFT TIG mode
It is used to set the ratio of penetration to cleaning action for the AC TIG welding arc.
Maximum weld penetration is achieved when the WAVE BALANCE is set to 10%. Maximum cleaning of heavily oxidized aluminium or magnesium alloys is achieved when the WAVE BALANCE is set to 65%.

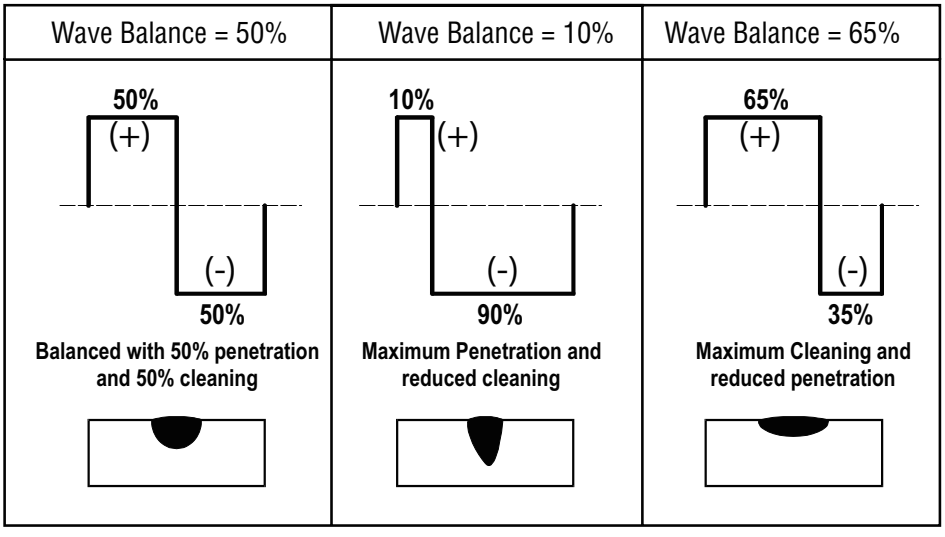


Table 3-5: AC TIG Wave Balance

3.11 Short Circuit Protection While Welding

To prolong the useful life of a TIG tungsten electrode and eliminate tungsten contamination to welding point, the ET 186i AC/DC incorporates special circuitry.
In all TIG processes, after the welding arc has established, if the tungsten electrode touches the work the current defaults to 33 amps. If the short exists for more than 1-2 seconds, the output is turned off.
In STICK mode, if the electrode touches the work for more than two seconds the welding current is reduced to 0 Amps.

3.12 Victor Regulator

Pressure regulator (Figure 3-7) attached to the cylinder valve reduce high cylinder pressures to suitable low working pressures for welding, cutting, and other applications.

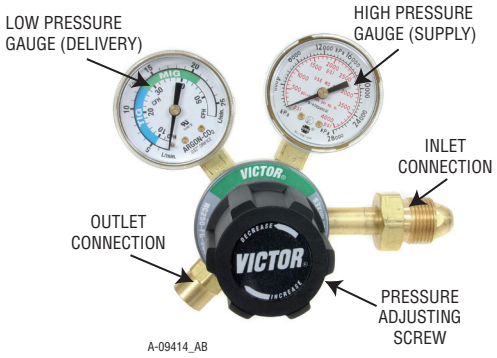


Figure 3-7: Victor CS Regulator

WARNING
Use the regulator for the gas and pressure for which it is designed. NEVER alter a regulator for use with any other gas.

NOTE!
Regulators purchased with open 1/8", 1/4", 3/8", or 1/2" NPT ports must be assembled to their intended system.

1. Note the maximum inlet pressure stamped on the regulator. DO NOT attach the regulator to a system that has a higher pressure than the maximum rated pressure stamped on the regulator.
2. The regulator body will be stamped “IN" or “HP" at the inlet port. Attach the inlet port to the system supply pressure connection.
3. If gauges are to be attached to the regulator and the regulator is stamped and listed by a third party (i.e. “UL" or “ETL"). The following requirements must be met:
   a) Inlet gauges over 1000 PSIG (6.87 mPa) shall conform with the requirements of UL 404, “Indicating Pressure Gauges for Compressed Gas Service."
   b) Low pressure gauges must be UL recognized for the class of regulator they are being used on according to UL252A.

WARNING
DO NOT use a regulator that delivers pressure exceeding the pressure rating of the downstream equipment unless provisions are made to prevent over-pressurization (i.e. system relief valve). Make sure the pressure rating of the downstream equipment is compatible with the maximum delivery pressure of the regulator.

4. Be sure that the regulator has the correct pressure rating and gas service for the cylinder used.
5. Carefully inspect the regulator for damaged threads, dirt, dust, grease, oil, or other flammable substances. Remove dust and dirt with a clean cloth. Be sure the inlet swivel filter is clean and in place. Attach the regulator (Figure 3-9) to the cylinder valve. Tighten securely with a wrench.

WARNING
DO NOT attach or use the regulator if oil, grease, flammable substances or damage is present! Have a qualified repair technician clean the regulator or repair any damage.

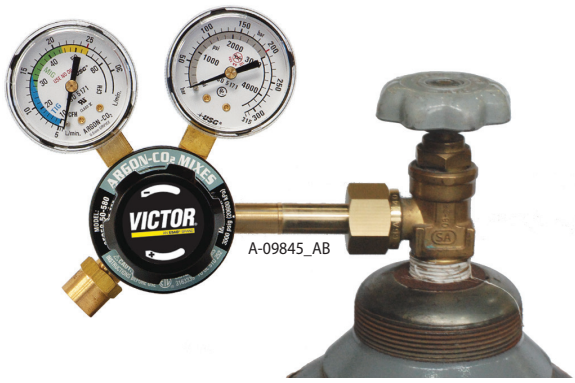


Figure 3-8: Regulator to Cylinder Valve

6. Before opening the cylinder valve, turn the regulator adjusting screw counterclockwise until there is no pressure on the adjusting spring and the screw turns freely.
7. Relief Valve (where provided): The relief valve is designed to protect the low pressure side of the regulator from high pressures. Relief valves are not intended to protect downstream equipment from high pressures.

WARNING
DO NOT tamper with the relief valve or remove it from the regulator.

WARNING
Stand to the side of the cylinder opposite the regulator when opening the cylinder valve. Keep the cylinder valve between you and the regulator. For your safety, NEVER STAND IN FRONT OF OR BEHIND A REGULATOR WHEN OPENING THE CYLINDER VALVE!

8. Slowly and carefully open the cylinder valve (Figure 3-9) until the maximum pressure shows on the high pressure gauge.

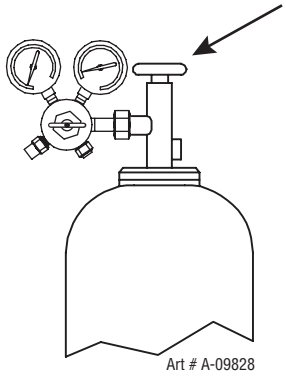


Figure 3-9: Open Cylinder Valve

9. Open the cylinder valve completely to seal the valve packing. On gaugeless regulators, the indicator will register the cylinder contents open.

CAUTION
Keep the cylinder valve wrench, if one is required, on the cylinder valve to turn off the cylinder quickly, if necessary.

10. Attach the desired downstream equipment.

3.13 Specification for TIG Torch

1. SPECIFICATION FOR TIG TORCH PART NO: W4013600 TO SUIT ESAB ET 186iAC/DC

TIG Torch Contents include:
1 x 26 TIG Torch with Long Back Cap, 12.5 ft lead length, 10.5" gas hose length, 9.5" control lead with 8 pin plug and Rigid Head.
Remote Control Cartridge, Potentiometer with integrated on/off switch (installed).

A-11556_AB

NOTE!
The additional switches/controls below are interchangeable with the installed control in the TIG torch.

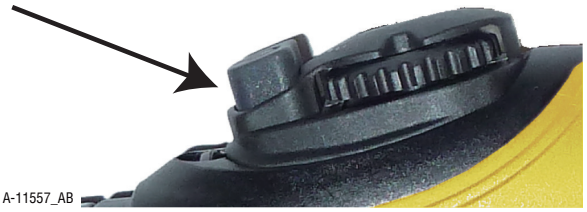
ART# A-11587


Control module with push button on/off switch only.


Control module with push button on/off switch with roller potentiometer.

Control module with roller potentiometer and integrated on/off switch.

Additional On/Off Switch Cartridge in a Sealed Plastic Bag.
Additional On/Off Switch-Remote Amperage Control Cartridge in a Sealed Plastic Bag (NOTE: You will not be able to view the pre-set amperage on the power source with this control, amperage will not be viewable until the arc is initiated).


A-11557_AB

1 x Accessory Kit containing 1 x Short Back Cap, 1 x Collet Body 1/8" (3.2mm),

1 x Collet Body 3/32" (2.4mm), 1 x Collet Body 1/16" (1.6mm), 1 x Collet 1/8" (3.2mm), 1 x Collet 3/32" (2.4mm), 1 x Collet 1/16" (1.6mm), 1 x Nozzle Alumina No5, 1 x Nozzle Alumina No6, 1 x Nozzle Alumina No7, 1 x Tungsten Electrode 1/8" (3.2mm) Thoriated Type (red band), 1 x Tungsten Electrode 3/32" (2.4 mm) Thoriated Type (red band) and 1 x Tungsten Electrode 1/16" (1.6mm) Thoriated Type (red band).

3.14 Setup for TIG (GTAW) Welding

A. Select Lift TIG or HF TIG mode with the process selection control (refer to Section 3.08.7 for further information).

B. Connect the TIG Torch to the negative welding terminal (-). Welding current flows from the power source via heavy duty bayonet type terminals. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

C. Connect the work lead to the positive welding terminal (+). Welding current flows from the Power Source via heavy duty bayonet type terminals. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

CAUTION
Loose welding terminal connections can cause overheating and result in the male plug being fused in the bayonet terminal.

D. Connect the TIG torch trigger switch via the 8 pin socket located on the front of the power source as shown below. The TIG torch will require a trigger switch to operate in Lift TIG or HF TIG Mode.

NOTE!
See Appendix A3 for TIG torch contents and trigger switch options.

NOTE!
If the TIG torch has a remote TIG torch current control fitted then it will require to be connected to the 8 pin socket. (Refer to section 3.08.2 Remote Control Socket for further information).

E. Fit the welding grade shielding gas regulator/flowmeter to the shielding gas cylinder (refer to Section 3.12) then connect the shielding gas hose from the regulator/flowmeter outlet to the gas INLET on the rear of the ET 186i AC/DC Power Source. Connect the gas hose from the TIG torch to the gas OUTLET on the front of the ET 186i AC/DC Power Source.

WARNING
Before connecting the work clamp to the work make sure the mains power supply is switched off.
Secure the welding grade shielding gas cylinder in an upright position by chaining it to a suitable stationary support to prevent falling or tipping.

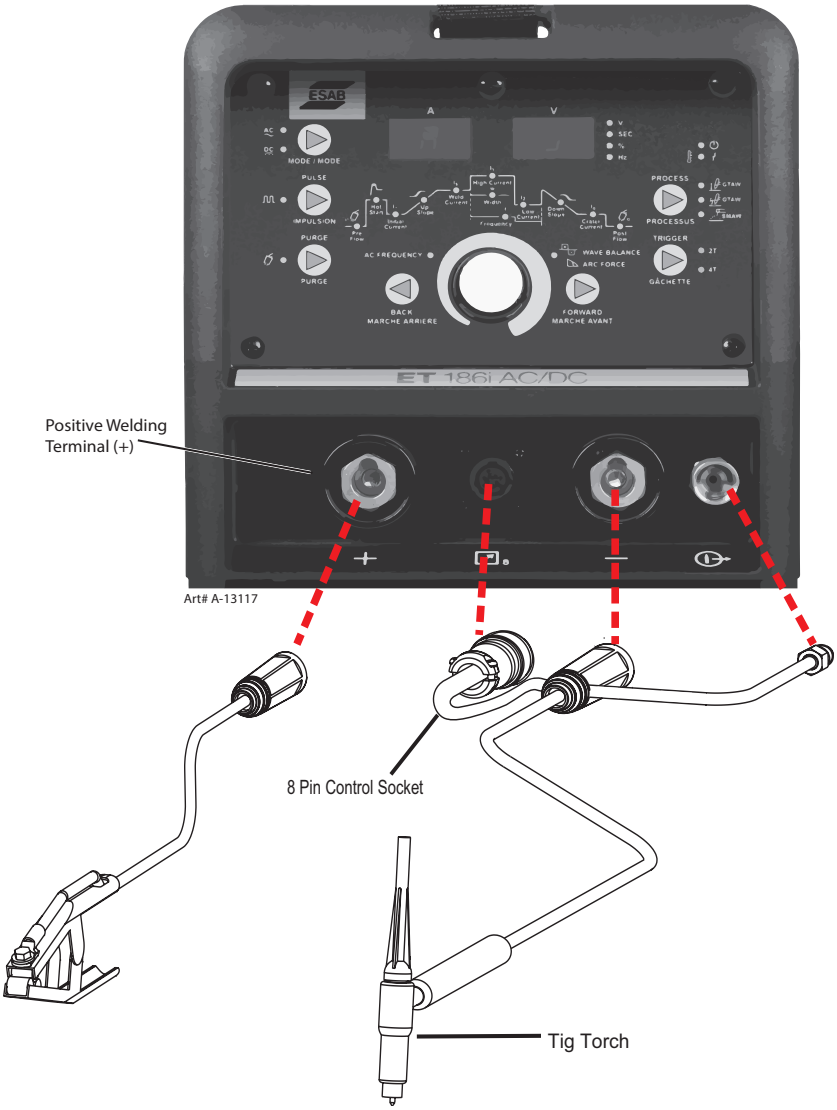


Figure 3-10: Setup for TIG Welding

NOTE!
When the ET 186i AC/DC is used with a Remote Foot Control in, depress foot control to maximum to allow max current to be previewed/adjusted on the front panel. To avoid premature arcing, please ensure the TIG Torch is located away from your work piece.

LIFT TIG (GTAW) Sequence of Operation

CAUTION
Before any welding is to begin, be sure to wear all appropriate and recommended safety equipment.

1. Switch the ON/OFF Switch (located on the rear panel) to OFF.
2. Connect the ground (work) clamp cable to positive output terminal. It is essential that the male plug is inserted and turned fully clockwise until connector locks in place to achieve reliable electrical connection.
3. Connect the TIG torch as follows:
   a) Place the power cable into the negative output terminal. It is essential that the male plug is inserted and turned fully clockwise until connector locks in place to achieve reliable electrical connection;
   b) Place the 8 pin plug into the 8 pin socket. To make connections, align keyway, insert plug, and rotate threaded collar fully clockwise.

c) Place the TIG torch gas hose to the gas outlet and tighten with a wrench. Caution: DO NOT over tighten.

4. Using a secured Argon cylinder, slowly crack open then close the cylinder valve while standing off to the side of the valve. This will remove any debris that may be around the valve & regulator seat area.
5. Install the regulator (for details of VICTOR regulator, please refer to 3.18) and tighten with a wrench.
6. Connect one end of the supplied gas hose to the outlet of the Argon regulator and tighten with a wrench. Caution: DO NOT over tighten.
7. Connect the other end of the supplied gas hose to the gas inlet fitting on the rear panel of the welder and tighten with a wrench. Caution: DO NOT over tighten.
8. Open the Argon Cylinder Valve to the fully open position.
9. Connect the ground (work) clamp to your work piece.
10. Set the DOWN SLOPE control knob to the desire weld current ramp down time.
11. Set the weld current control knob to the desired amperage.
12. The tungsten must be ground to a blunt point in order to achieve optimum welding results. It is critical to grind the tungsten electrode in the direction the grinding wheel is turning.
13. Install the tungsten with approximately 1/8" (3.2mm) to ¼" (6.0mm) sticking out from the gas cup, ensuring you have correct sized collet.
14. Tighten the back cap then open the valve on the torch.
15. Plug the power cable into the appropriate outlet, and turn the switch to the “ON" position. The power L.E.D. light should illuminate. Set the “Process Selection Switch" to LIFT TIG.
16. You are now ready to begin TIG Welding.

NOTE!
When the ET 186i AC/DC is used with a Remote Foot Control in, depress foot control to maximum to allow max current to be previewed/adjusted on the front panel. To avoid premature arcing, please ensure the TIG Torch is located away from your work piece.

3.15 Setup for STICK (SMAW) Welding

A. Connect the Electrode Holder lead to the positive welding terminal (+). If in doubt, consult the electrode manufacturer. Welding current flows from the Power Source via heavy duty bayonet type terminals. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

B. Connect the work lead to the negative welding terminal (-). If in doubt, consult the electrode manufacturer. Welding current flows from the power source via heavy duty bayonet type terminals. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

C. Select STICK mode with the process selection control (refer to Section 3.08.7 for further information)

WARNING
Before connecting the work clamp to the work and inserting the electrode in the electrode holder make sure the mains power supply is switched off.

CAUTION
Remove any packaging material prior to use. Do not block the air vents at the front or rear of the Welding Power Source.

CAUTION
Loose welding terminal connections can cause overheating and result in the male plug being fused in the bayonet terminal.

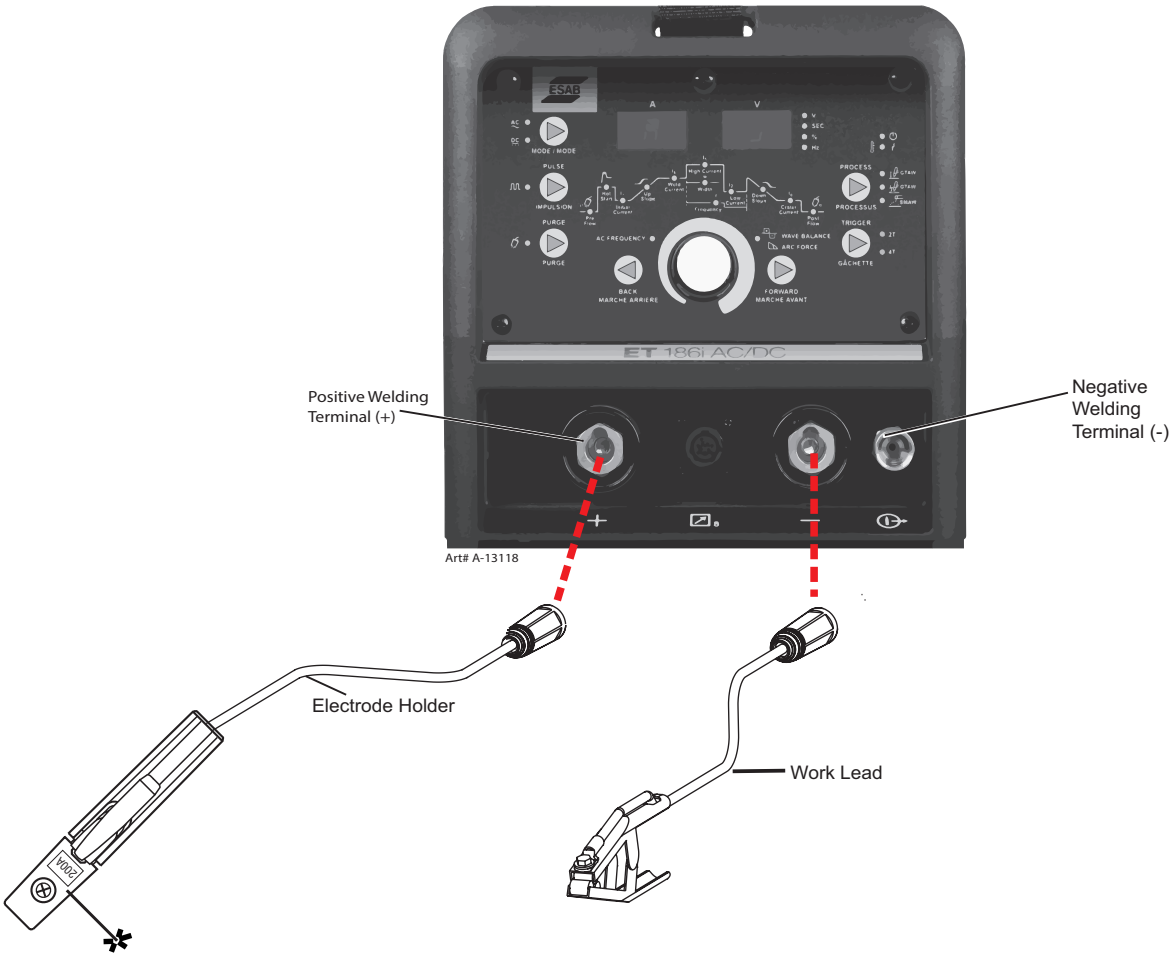


Figure 3-11: Setup for Manual Arc Welding.

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SECTION 4:
BASIC WELDING GUIDE

4.01 STICK (SMAW) Basic Welding Technique

Size of Electrode

The electrode size is determined by the thickness of metals being joined and can also be governed by the type of welding machine available. Small welding machines will only provide sufficient current (amperage) to run the smaller size electrodes.
For thin sections, it is necessary to use smaller electrodes otherwise the arc may burn holes through the job. A little practice will soon establish the most suitable electrode for a given application.

Storage of Electrodes

Always store electrodes in a dry place and in their original containers.

Electrode Polarity

Electrodes are generally connected to the ELECTRODE HOLDER with the Electrode Holder connected positive polarity. The WORK LEAD is connected negative polarity and is connected to the work piece. If in doubt consult the electrode data sheet or your nearest Accredited Tweco Distributor.

Effects of Stick Welding Various Materials

A. High Tensile and Alloy Steels

The two most prominent effects of welding these steels are the formation of a hardened zone in the weld area, and, if suitable precautions are not taken, the occurrence in this zone of under-bead cracks. Hardened zone and under-bead cracks in the weld area may be reduced by using the correct electrodes, preheating, using higher current settings, using larger electrodes sizes, short runs for larger electrode deposits or tempering in a furnace.

B. Manganese Steels

The effect on manganese steel of slow cooling from high temperatures is to embrittle it. For this reason it is absolutely essential to keep manganese steel cool during welding by quenching after each weld or skip welding to distribute the heat.

C. Cast Iron

Most types of cast iron, except white iron, are weldable. White iron, because of its extreme brittleness, generally cracks when attempts are made to weld it. Trouble may also be experienced when welding white-heart malleable, due to the porosity caused by gas held in this type of iron.

D. Copper and Alloys

The most important factor is the high rate of heat conductivity of copper, making pre-heating of heavy sections necessary to give proper fusion of weld and base metal.

E. Types of Electrodes

Arc Welding electrodes are classified into a number of groups depending on their applications. There are a great number of electrodes used for specialized industrial purposes which are not of particular interest for everyday general work. These include some low hydrogen types for high tensile steel, cellulose types for welding large diameter pipes, etc The range of electrodes dealt with in this publication will cover the vast majority of applications likely to be encountered; are all easy to use.

Metal Being Joined	Electrode	Comments
Mild Steel	E6011	This electrode is used for all-position welding or for welding on rusty, dirty, less-than-new metal. It has a deep, penetrating arc and is often the first choice for repair or maintenance work.
Mild Steel	E6013	This all-position, electrode is used for welding clean, new sheet metal. Its soft arc has minimal spatter, moderate penetration and an easy-to-clean slag.
Mild Steel	E7014	All positional, ease to use electrode for use on thicker steel than E6013. Especially suitable sheet metal lap joints and fillet welds, general purpose plate welding.
Mild Steel	E7018	A low-hydrogen, all-position electrode used when quality is an issue or for hard-to-weld metals. It has the capability of producing more uniform weld metal, which has better impact properties at low temperatures.
Cast Iron	Eni-CI	Suitable for joining all cast irons except white cast iron.
Stainless Steel	E318L-16	High corrosion resistances. Ideal for dairy work etc.

Welding Position

The electrodes dealt with in this publication can be used in most positions, i.e. they are suitable for welding in flat, horizontal, vertical and overhead positions. Numerous applications call for welds to be made in positions intermediate between these. Some of the common types of welds are shown in Figures 4-5 through 4-12.

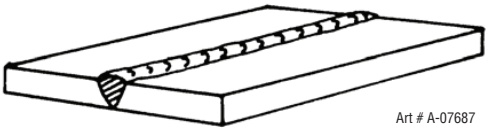


Figure 4-1: Flat Position, Down Hand Butt Weld

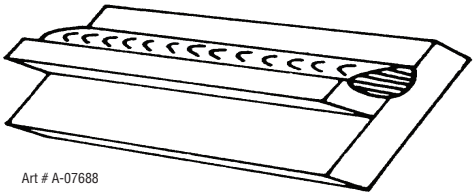


Figure 4-2: Flat Position, Gravity Fillet Weld

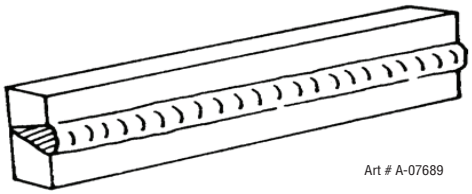


Figure 4-3: Horizontal Position, Butt Weld

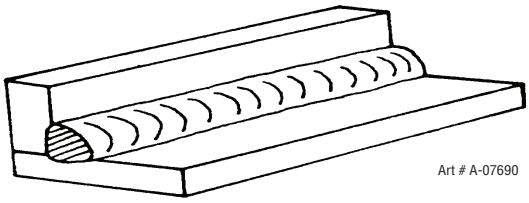


Figure 4-4: Horizontal-Vertical (HV) Position

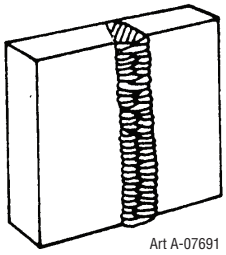


Figure 4-5: Vertical Position, Butt Weld

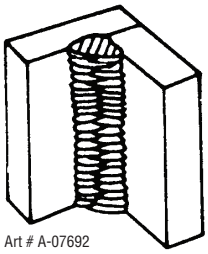


Figure 4-6: Vertical Position, Fillet Weld

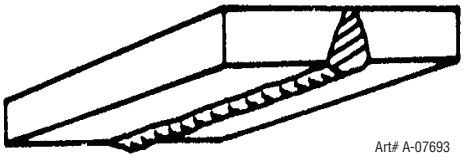


Figure 4-7: Overhead Position, Butt Weld

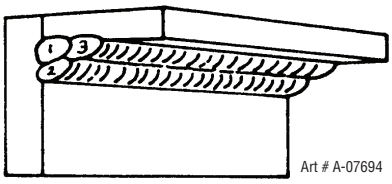


Figure 4-8: Overhead Position, Fillet Weld

Joint Preparations

In many cases, it will be possible to weld steel sections without any special preparation. For heavier sections and for repair work on castings, etc., it will be necessary to cut or grind an angle between the pieces being joined to ensure proper penetration of the weld metal and to produce sound joints.
In general, surfaces being welded should be clean and free of rust, scale, dirt, grease, etc. Slag should be removed from oxy-cut surfaces. Typical joint designs are shown in Figure 4-9.

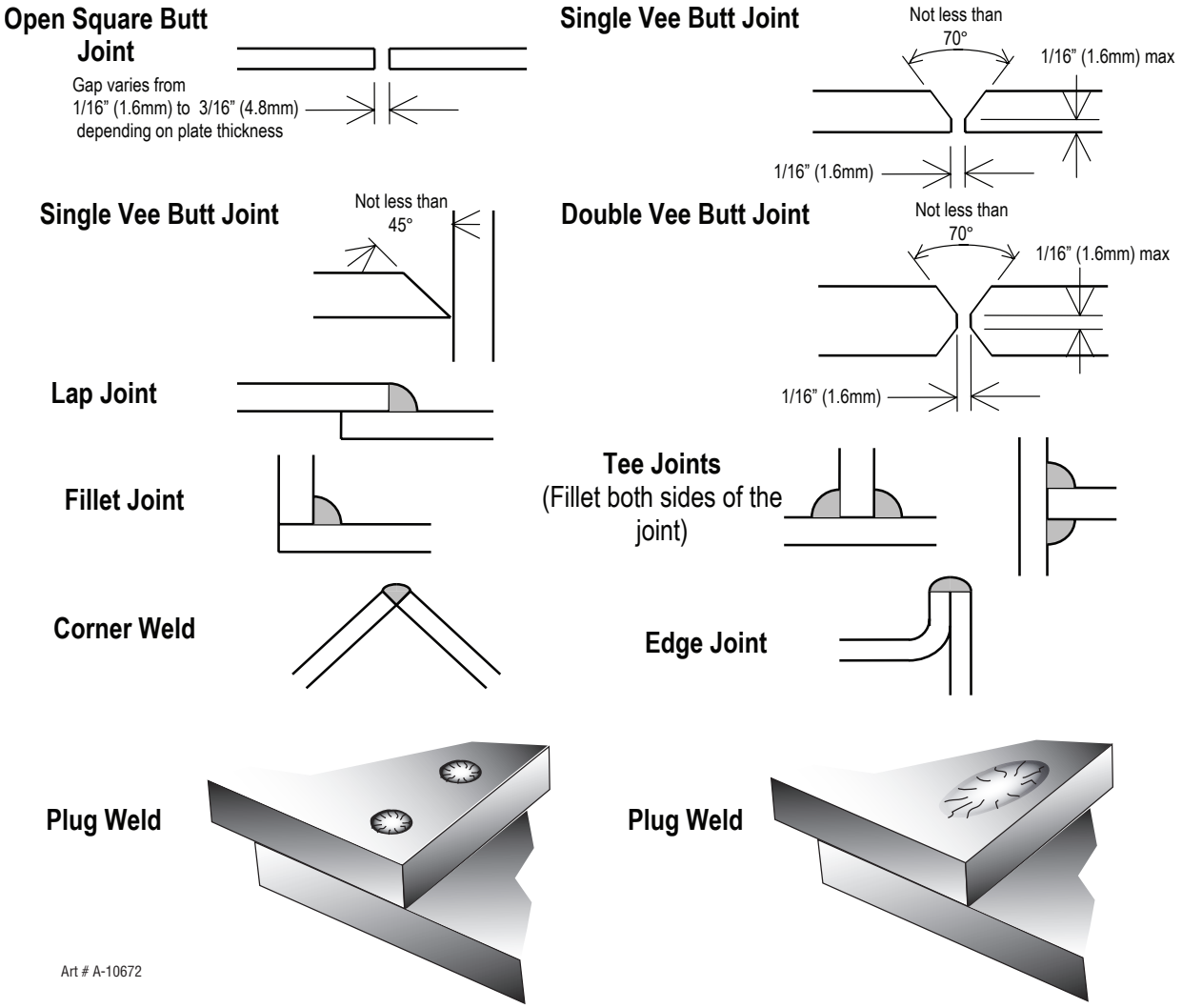


Figure 4-9: Typical Joint Designs for Arc Welding

Arc Welding Technique - A Word to Beginners

For those who have not yet done any welding, the simplest way to commence is to run beads on a piece of scrap plate. Use mild steel plate about 1/4" (6.0mm) thick and a 1/8" (3.2mm) electrode. Clean any paint, loose scale or grease off the plate and set it firmly on the work bench so that welding can be carried out in the downhand position. Make sure that the work clamp is making good electrical contact with the work, either directly or through the work table. For light gauge material, always clamp the work lead directly to the job, otherwise a poor circuit will probably result.

The Welder

Place yourself in a comfortable position before beginning to weld. Get a seat of suitable height and do as much work as possible sitting down.
Place the work so that the direction of welding is across, rather than to or from, your body. The electrode holder lead should be clear of any obstruction so that you can move your arm freely along as the electrode burns down. Be sure the insulation on your cable and electrode holder is not faulty, otherwise you are risking an electric shock.

Striking the Arc

Practice this on a piece of scrap plate before going on to more exacting work. You may at first experience difficulty due to the tip of the electrode "sticking" to the work piece. This is caused by making too heavy a contact with the work and failing to withdraw the electrode quickly enough. A low amperage will accentuate it. This freezing-on of the tip may be overcome by scratching the electrode along the plate surface in the same way as a match is struck. As soon as the arc is established, maintain a 1/16" (1.6mm) to 1/8" (3.2mm) gap between the burning electrode end and the parent metal. Draw the electrode slowly along as it melts down. Another difficulty you may meet is the tendency, after the arc is struck, to withdraw the electrode so far that the arc is broken again. A little practice will soon remedy both of these faults.

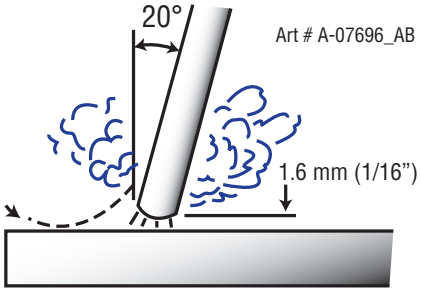


Figure 4-10: Striking an Arc

Arc Length

The securing of an arc length necessary to produce a neat weld soon becomes almost automatic. You will find that a long arc produces more heat. A very long arc produces a crackling or spluttering noise and the weld metal comes across in large, irregular blobs. The weld bead is flattened and spatter increases. A short arc is essential if a high quality weld is to be obtained although if it is too short there is the danger of it being blanketed by slag and the electrode tip being solidified in. If this should happen, give the electrode a quick twist back over the weld to detach it.

Rate of Travel

After the arc is struck, your next concern is to maintain it, and this requires moving the electrode tip towards the molten pool at the same rate as it is melting away. At the same time, the electrode has to move along the plate to form a bead. The electrode is directed at the weld pool at about 20º from the vertical. The rate of travel has to be adjusted so that a well-formed bead is produced. If the travel is too fast, the bead will be narrow and strung out and may even be broken up into individual globules. If the travel is too slow, the weld metal piles up and the bead will be too large.

Making Welded Joints

Having attained some skill in the handling of an electrode, you will be ready to go on to make up welded joints.

A. Butt Welds

Set up two plates with their edges parallel, as shown in Figure 4-11, allowing 1/16" (1.6mm) to 3/32" (2.4mm)gap between them and tack weld at both ends. This is to prevent contraction stresses from the cooling weld metal pulling the plates out of alignment. Plates thicker than 1/4" (6.0mm) should have their mating edges bevelled to form a 70º to 90º included angle. This allows full penetration of the weld metal to the root.

Do not weave the electrode, but maintain a steady rate of travel along the joint sufficient to produce a well-formed bead. At first you may notice a tendency for undercut to form, but keeping the arc length short, the angle of the electrode at about 20º from vertical, and the rate of travel not too fast, will help eliminate this. The electrode needs to be moved along fast enough to prevent the slag pool from getting ahead of the arc. To complete the joint in thin plate, turn the job over, clean the slag out of the back and deposit a similar weld.

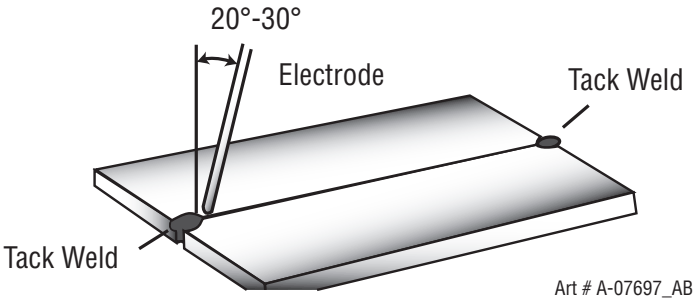


Figure 4-11: Butt Weld

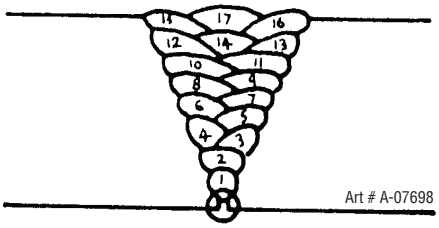


Figure 4-12: Weld Build up Sequence

Heavy plate will require several runs to complete the joint. After completing the first run, chip the slag out and clean the weld with a wire brush. It is important to do this to prevent slag being trapped by the second run. Subsequent runs are then deposited using either a weave technique or single beads laid down in the sequence shown in Figure 4-12. The width of weave should not be more than three times the core wire diameter of the electrode. When the joint is completely filled, the back is either machined, ground or gouged out to remove slag which may be trapped in the root, and to prepare a suitable joint for depositing the backing run. If a backing bar is used, it is not usually necessary to remove this, since it serves a similar purpose to the backing run in securing proper fusion at the root of the weld.

B. Fillet Welds

These are welds of approximately triangular cross-section made by depositing metal in the corner of two faces meeting at right angles. Refer to Figure 4-4.

A piece of angle iron is a suitable specimen with which to begin, or two lengths of strip steel may be tacked together at right angles. This is known as a horizontal-vertical (HV) fillet. Strike the arc and immediately bring the electrode to a position perpendicular to the line of the fillet and about 45º from the vertical. Some electrodes require to be sloped about 20º away from the perpendicular position to prevent slag from running ahead of the weld. Refer to Figure 4-13. Do not attempt to build up much larger than 1/4" (6.4mm) width with a 1/8" (3.2mm) electrode, otherwise the weld metal tends to sag towards the base, and undercut forms on the vertical leg. Multi-runs can be made as shown in Figure 4-14. Weaving in HV fillet welds is undesirable.

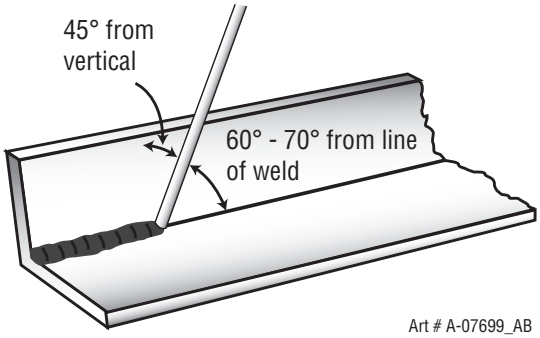


Figure 4-13: Electrode Position for HV Fillet Weld

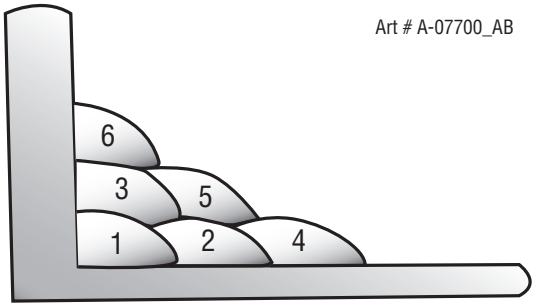


Figure 4-`14: Multi-runs in HV Fillet Weld

C. Vertical Welds

1. Vertical Up

Tack weld a three feet length of angle iron to your work bench in an upright position. Make yourself comfortable on a seat in front of the job and strike the arc in the corner of the fillet. The electrode needs to be about 10º from the horizontal to enable a good bead to be deposited. Refer Figure 4-15. Use a short arc, and do not attempt to weave on the first run. When the first run has been completed de-slag the weld deposit and begin the second run at the bottom. This time a slight weaving motion is necessary to cover the first run and obtain good fusion at the edges. At the completion of each side motion, pause for a moment to allow weld metal to build up at the edges, otherwise undercut will form and too much metal will accumulate in the centre of the weld. Figure 4-16 illustrates multi-run technique and Figure 4-17 shows the effects of pausing at the edge of weave and of weaving too rapidly.

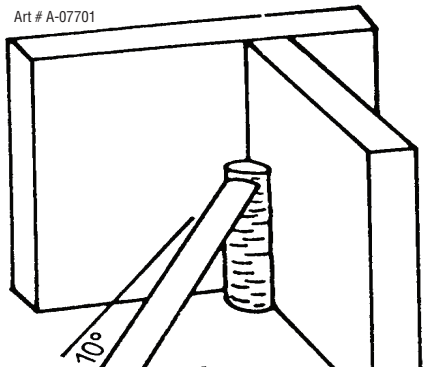


Figure 4-15: Single Run Vertical Fillet Weld

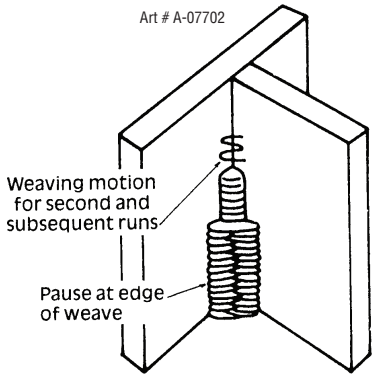


Figure 4-16: Multi Run Vertical Fillet Weld

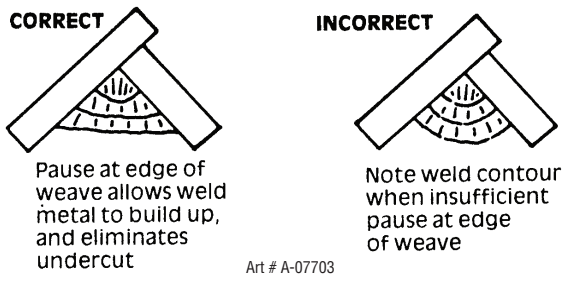


Figure 4-17: Examples of Vertical Fillet Welds

2. Vertical Down

Use a 1/8" (3.2mm) electrode at 100 amps. The tip of the electrode is held in light contact with the work and the speed of downward travel is regulated so that the tip of the electrode just keeps ahead of the slag. The electrode should point upwards at an angle of about 45º.

3. Overhead Welds

Apart from the rather awkward position necessary, overhead welding is not much more difficult that downhand welding. Set up a specimen for overhead welding by first tacking a length of angle iron at right angles to another piece of angle iron or a length of waste pipe. Then tack this to the work bench or hold in a vice so that the specimen is positioned in the overhead position as shown in the sketch. The electrode is held at 45º to the horizontal and tilted 10º in the line of travel (Figure 4-18). The tip of the electrode may be touched lightly on the metal, which helps to give a steady run. A weave technique is not advisable for overhead fillet welds.

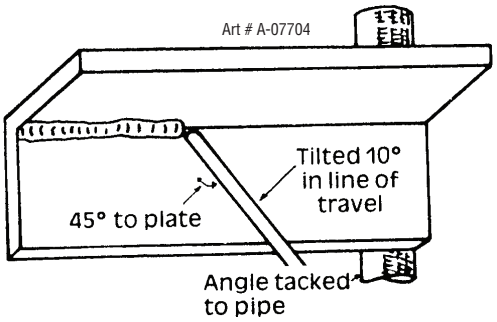


Figure 4-18: Overhead Fillet Weld

Distortion

Distortion in some degree is present in all forms of welding. In many cases it is so small that it is barely perceptible, but in other cases allowance has to be made before welding commences for the distortion that will subsequently occur. The study of distortion is so complex that only a brief outline can be attempted hear.

The Cause of Distortion

Distortion is caused by:

A. Contraction of Weld Metal:

Molten steel shrinks approximately 11 per cent in volume on cooling to room temperature. This means that a cube of molten metal would contract approximately 2.2 per cent in each of its three dimensions. In a welded joint, the metal becomes attached to the side of the joint and cannot contract freely. Therefore, cooling causes the weld metal to flow plastically, that is, the weld itself has to stretch if it is to overcome the effect of shrinking volume and still be attached to the edge of the joint. If the restraint is very great, as, for example, in a heavy section of plate, the weld metal may crack. Even in cases where the weld metal does not crack, there will still remain stresses "Locked-up" in the structure. If the joint

material is relatively weak, for example, a butt joint in 5/64" (2.0mm) sheet, the contracting weld metal may cause the sheet to become distorted.

B. Expansion and Contraction of Parent Metal in the Fusion Zone:

While welding is proceeding, a relatively small volume of the adjacent plate material is heated to a very high temperature and attempts to expand in all directions. It is able to do this freely at right angles to the surface of the plate (i.e., "through the weld", but when it attempts to expand "across the weld" or "along the weld", it meets considerable resistance, and to fulfil the desire for continued expansion, it has to deform plastically, that is, the metal adjacent to the weld is at a high temperature and hence rather soft, and, by expanding, pushes against the cooler, harder metal further away, and tends to bulge (or is "upset". When the weld area begins to cool, the "upset" metal attempts to contract as much as it expanded, but, because it has been "upset" it does not resume its former shape, and the contraction of the new shape exerts a strong pull on adjacent metal. Several things can then happen.

The metal in the weld area is stretched (plastic deformation), the job may be pulled out of shape by the powerful contraction stresses (distortion), or the weld may crack, in any case, there will remain "locked-up" stresses in the job. Figures 4-19 and 4- 20 illustrate how distortion is created.

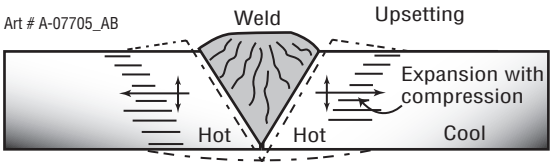


Figure 4-19: Parent Metal Expansion

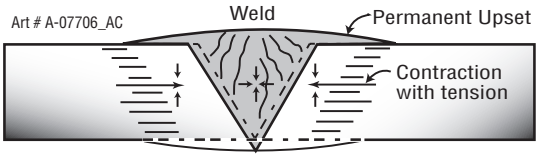


Figure 4-20: Parent Metal Contraction

Overcoming Distortion Effects

There are several methods of minimizing distortion effects.

A. Peening

This is done by hammering the weld while it is still hot. The weld metal is flattened slightly and because of this the tensile stresses are reduced a little. The effect of peening is relatively shallow, and is not advisable on the last layer.

B. Distribution of Stresses

Distortion may be reduced by selecting a welding sequence which will distribute the stresses suitably so that they tend to cancel each other out. See Figures 4-20 through 4-23 for various weld sequences. Choice of a suitable weld sequence is probably the most effective method of overcoming distortion, although an unsuitable sequence may exaggerate it. Simultaneous welding of both sides of a joint by two welders is often successful in eliminating distortion.

C. Restraint of Parts

Forcible restraint of the components being welded is often used to prevent distortion. Jigs, positions, and tack welds are methods employed with this in view.

D. Presetting

It is possible in some cases to tell from past experience or to find by trial and error (or less frequently, to calculate) how much distortion will take place in a given welded structure. By correct pre-setting of the components to be welded, constructional stresses can be made to pull the parts into correct alignment. A simple example is shown in Figure 4-21.

E. Preheating

Suitable preheating of parts of the structure other than the area to be welded can be sometimes used to reduce distortion. Figure 4-22 shows a simple application. By removing the heating source from b and c as soon as welding is completed, the sections b and c will contract at a similar rate, thus reducing distortion.

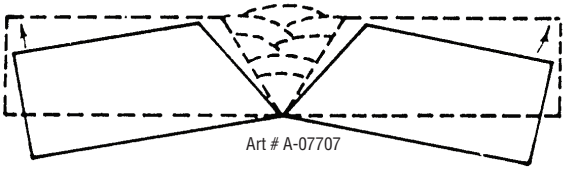
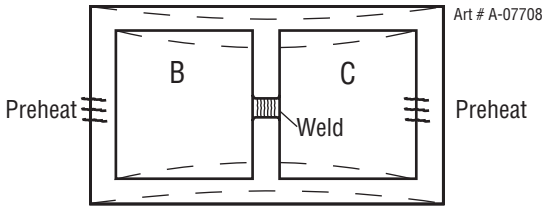


Figure 4-21: Principle of Presetting



Dotted lines show effect if no preheat is used

Figure 4-22: Reduction of Distortion by Preheating

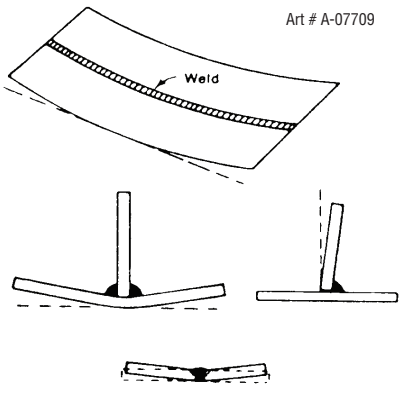
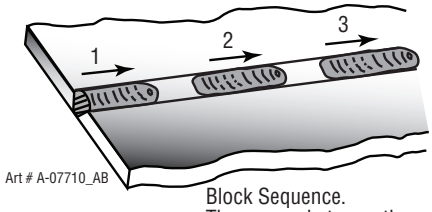


Figure 4-23: Examples of Distortion



Block Sequence.
The spaces between the welds are filled in when the welds are cool.

Figure 4-24: Welding Sequence

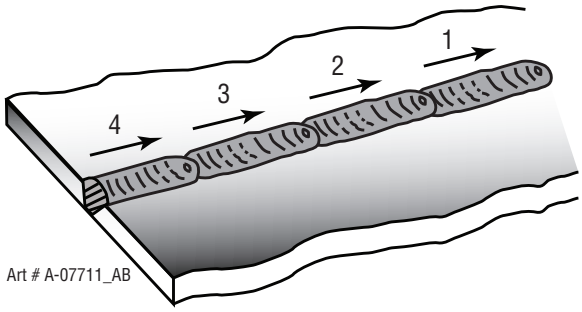


Figure 4-25: Step Back Sequence

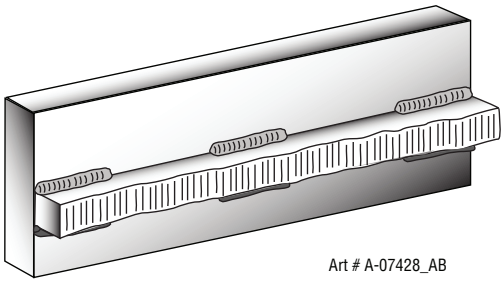


Figure 4-26: Chain Intermittent Welding

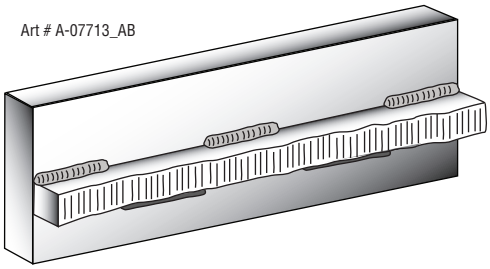
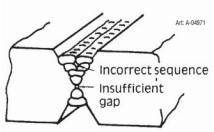


Figure 4-27: Staggered Intermittent Welding

4.02 STICK (SMAW) Welding Troubleshooting

FAULT	CAUSE	REMEDY
1 Welding current varying	ARC FORCE control knob is set at a value that causes the welding current to vary excessively with the arc length.	Reduce the ARC FORCE control knob until welding current is reasonably constant while prohibiting the electrode from sticking to the work piece when you “dig" the electrode into the workpiece.
2 A gap is left by failure of the weld metal to fill the root of the weld.	A Welding current too low	A Increase welding current.
	B Electrode too large for joint.	B Use smaller diameter electrode.
	C Insufficient gap.	C Allow wider gap.
3 Non-metallic particles are trapped in the weld metal.	A Non-metallic particles may be trapped in undercut from previous run.	A If a bad undercut is present clean slag bout and cover with a run from a smaller gauge electrode.
	B Joint preparation too restricted.	B Allow for adequate penetration and room for cleaning out the slag.
	C Irregular deposits allow slag to be trapped.	C If very bad, chip or grind out irregularities.
	D Lack of penetration with slag trapped beneath weld bead.	D Use smaller electrode with sufficient current to give adequate penetration. Use suitable tools to remove all slag from comers.
	E Rust or mill scale is preventing full fusion.	E Clean joint before welding.
	F Wrong electrode for position in which welding is done.	F Use electrodes designed for position in which welding is done, otherwise proper control of slag is difficult.
		
	Figure 1 - Example of insufficient gap or incorrect sequence	
4 A groove has been formed in the base metal adjacent to the toe of a weld and has not been filled by the weld metal (undercut).	A Welding current is too high.	A Reduce welding current.
	B Welding arc is too long.	B Reduce the length of the welding arc.
	C Angle of the electrode is incorrect.	C Electrode should not be inclined less than 45° to the vertical face.
	D Joint preparation does not allow correct electrode angle.	D Allow more room in joint for manipulation of the electrode.
	E Electrode too large for joint.	E Use smaller gauge electrode.
	F Insufficient deposit time at edge of weave.	F Pause for a moment at edge of weave to allow weld metal buildup.

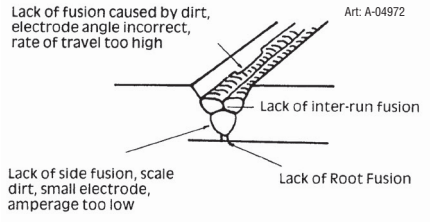
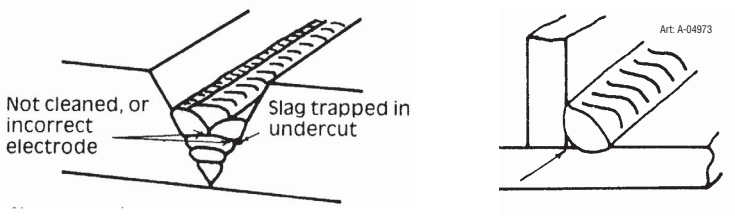
FAULT	CAUSE	REMEDY
5 Portions of the weld run do not fuse to the surface of the metal or edge of the joint.	A Small electrodes used on heavy cold plate.	A Use larger electrodes and preheat the plate.
	B Welding current is too low.	B Increase welding current.
	C Wrong electrode angle.	C Adjust angle so the welding arc is directed more into the base metal.
	D Travel speed of electrode is too high.	D Reduce travel speed of electrode.
	E Scale or dirt on joint surface.	E Clean surface before welding.
		
	Figure 2: Example of Lack of Fusion	
6 Gas pockets or voids in weld metal (porosity)	A High levels of sulphur in steel.	A Use an electrode that is designed for high sulphur steels.
	B Electrodes are damp.	B Dry electrodes before use.
	C Welding current is too high.	C Reduce welding current.
	D Surface impurities such as oil, grease, paint, etc.	D Clean joint before welding.
	E Welding in a windy environment.	E Shield the weld area from the wind.
	F Electrode damaged i.e. flux coating incomplete.	F Discard damaged electrodes and only use electrodes with a complete flux coating.
7 Crack occurring in weld metal soon after solidification commences	A Rigidity of joint.	A Redesign to relieve weld joint of severe stresses or use crack resistance electrodes.
	B Insufficient throat thickness.	B Travel slightly slower to allow greater build up in throat.
	C Weld current is too high.	C Decrease welding current.
		
	Figure 3: Example of Slag Inclusion	

Table 4-2: Welding Problems SMAW (STICK)

4.03 TIG (GTAW) Basic Welding Technique

Gas Tungsten Arc Welding (GTAW) or TIG (Tungsten Inert Gas) as it is commonly referred to, is a welding process in which fusion is produced by an electric arc that is established between a single tungsten (non-consumable) electrode and the work piece. Shielding is obtained from a welding grade shielding gas or welding grade shielding gas mixture which is generally Argon based. A filler metal may also be added manually in some circumstances depending on the welding application.

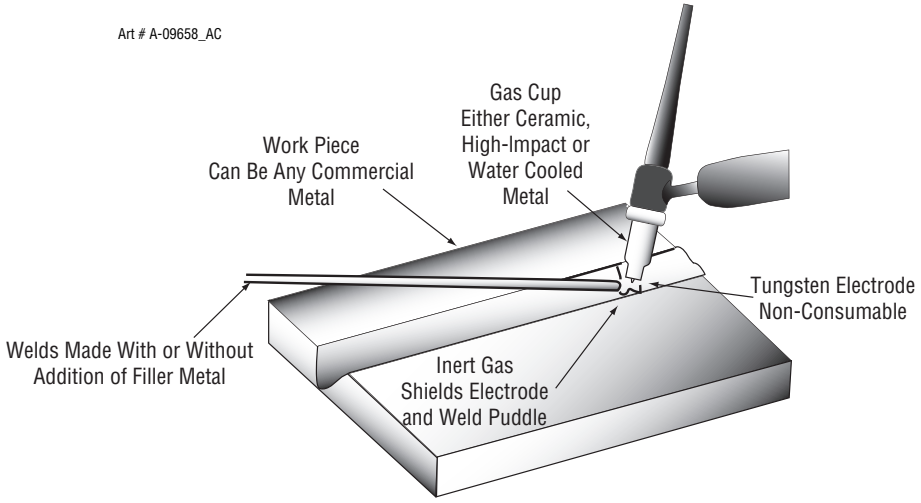


Figure 4-28: TIG Welding Application Shot

Tungsten Electrode Current Ranges

Electrode Diameter	DC Current (Amps)
0.040" (1.0mm)	30-60
1/16" (1.6mm)	60-115
3/32" (2.4mm)	100-165
1/8" (3.2mm)	135-200
5/32" (4.0mm)	190-280
3/16" (4.8mm)	250-340

Table 4-3: Current Ranges for Various Tungsten Electrode Sizes

Guide for Selecting Filler Wire Diameter

Filler Wire Diameter	DC Current Range (Amps)
1/16" (1.6mm)	20-90
3/32" (2.4mm)	65-115
1/8" (3.2mm)	100-165
3/16" (4.8mm)	200-350

Table 4-4: Filler Wire Selection Guide

Tungsten Electrode Types

Electrode Type (Ground Finish)	Welding Application	Features	Color Code
Thoriated 2%	DC welding of mild steel, stainless steel and copper	Excellent arc starting, Long life, High current carrying capacity	Red
Zirconated 1%	High quality AC welding of aluminium, magnesium and their alloys.	Self cleaning, Long life, Maintains balled end, High current carrying capacity.	White
Ceriated 2%	AC & DC welding of mild steel, stainless steel, copper, aluminium, magnesium and their alloys	Longer life, More stable arc, Easier starting, Wider current range, Narrower more concentrated arc.	Grey

Table 4-5 Tungsten Electrode Types

Base Metal Thickness	AC Current for Aluminium	Tungsten Electrode Diameter	Filler Rod Diameter (if required)	Argon Gas Flow Rate	JOINT TYPE
1/16" 1.6mm	60-80 70-90	1/16" 1.6mm	1/16" 1.6mm	15 CFM 7 LPM	Butt/Corner Lap/Fillet
1/8" 3.2mm	125-145 140-160	3/32" 2.4mm	1/16"-3/32" 1.6mm - 2.4mm	17 CFM 8 LPM	Butt/Corner Lap/Fillet

Table 4-6 Aluminium Welding Material

Base Metal Thickness	DC Current for Mild Steel	DC Current for Stainless Steel	Tungsten Electrode Diameter	Filler Rod Diameter (if required)	Argon Gas Flow Rate	Joint Type
0.040" 1.0mm	35-45 40-50	20-30 25-35	0.040" 1.0mm	1/16" 1.6mm	10 CFH(5 LPM)	Butt/Corner Lap/Fillet
0.045" 1.2mm	45-55 50-60	30-45 35-50	0.040" 1.0mm	1/16" 1.6mm	13 CFH(6 LPM)	Butt/Corner Lap/Fillet
1/16" 1.6mm	60-70 70-90	40-60 50-70	1/16" 1.6mm	1/16" 1.6mm	15 CFH(7 LPM)	Butt/Corner Lap/Fillet
1/8" 3.2mm	80-100 90-115	65-85 90-110	1/16" 1.6mm	3/32" 2.4mm	15 CFH(7 LPM)	Butt/Corner Lap/Fillet
3/16" 4.8mm	115-135 140-165	100-125 125-150	3/32" 2.4mm	1/8" 3.2mm	21 CFH(10 LPM)	Butt/Corner Lap/Fillet
1/4" 6.4mm	160-175 170-200	135-160 160-180	1/8" 3.2mm	5/32" 4.0mm	21 CFH(10 LPM)	Butt/Corner Lap/Fillet

Table 4-7: Welding Rate

TIG Welding is generally regarded as a specialised process that requires operator competency. While many of the principles outlined in the previous Arc Welding section are applicable a comprehensive outline of the TIG Welding process is outside the scope of this Operating Manual. For further information please refer to www.victortechnologies.com or contact Tweco.

4.04 TIG (GTAW) Welding Problems

FAULT	CAUSE	REMEDY
1 Excessive bead build up or poor penetration or poor fusion at edges of weld.	Welding current is too low	Increase weld current and/or faulty joint preparation.
2 Weld bead too wide and flat or undercut at edges of weld or excessive burn through.	Welding current is too high	Decrease weld current.
3 Weld bead too small or insufficient penetration or ripples in bead are widely spaced apart.	Travel speed too fast	Reduce travel speed.
4 Weld bead too wide or excessive bead build up or excessive penetration in butt joint.	Travel speed too slow	Increase travel speed.
5 Uneven leg length in fillet joint	Wrong placement of filler rod	Re-position filler rod.
6 Electrode melts or oxidises when an arc is struck.	A Torch lead connected to positive welding terminal.	A Connect torch lead to negative welding terminal.
	B No gas flowing to welding region.	B Check the gas lines for kinks or breaks and gas cylinder contents.
	C Torch is clogged with dust or dirt.	C Clean torch.
	D Gas hose is cut.	D Replace gas hose.
	E Gas passage contains impurities.	E Disconnect gas hose from the rear of Power Source then raise gas pressure and blow out impurities.
	F Gas regulator turned off.	F Turn on.
	G The electrode is too small for the welding current.	G Increase electrode diameter or reduce the welding current.
	H Power source is set for STICK welding.	H Set Power Source to LIFT TIG or HF TIG mode.
7 Dirty weld pool	A Electrode contaminated by contact with work piece or filler rod material.	A Clean the electrode by grinding off the contaminates.
	B Work piece surface has foreign material on it.	B Clean surface.
	C Gas contaminated with air.	C Check gas lines for cuts and loose fitting or change gas cylinder.

FAULT	CAUSE	REMEDY
8 Poor weld finish	Inadequate shielding gas.	Increase gas flow or check gas line for gas flow problems.
9 Arc start is not smooth.	A Tungsten electrode is too large for the welding current.	A Select the right size tungsten electrode. Refer to Table 4-3 Tungsten Electrode Selection Chart.
	B The wrong electrode is being used for the welding job.	B Select the right tungsten electrode type. Refer to Table 4-5 Tungsten Electrode Selection Chart.
	C Gas flow rate is too high.	C Select the right rate for the welding job. Refer to Table 4-7.
	D Incorrect shielding gas is being used.	D Select the right shielding gas.
	E Poor work clamp connection to work piece.	E Improve connection to work piece.
10 Arc flutters during TIG welding.	Tungsten electrode is too large for the welding current.	Select the right size tungsten electrode. Refer to Table 4-3 Tungsten Electrode Selection Chart.

SECTION 5: POWER SOURCE PROBLEMS AND ROUTINE SERVICE REQUIREMENTS

5.01 Basic Troubleshooting

WARNING
There are extremely dangerous voltage and power levels present inside this product. Do not attempt to open or repair unless you are a qualified electrical tradesperson and you have had training in power measurements and troubleshooting techniques.

If major complex subassemblies are faulty, then the Welding Power Source must be returned to an accredited ESAB Service Provider for repair. The basic level of troubleshooting is that which can be performed without special equipment or knowledge. Refer also to section 4 for solving welding problems.

5.02 Power Source Problems

FAULT	CAUSE	REMEDY
1 Mains supply voltage is ON, power indicator is illuminated however unit will not commence welding when the torch trigger switch is depressed.	A Power source is not in the correct mode of operation. B Faulty torch trigger.	A Set the power source to the correct mode of operation with the process selection switch. B Repair or replace torch trigger switch/lead.
2 Mains supply voltage is ON. Indicator light is not lit and welding arc cannot be established.	A Primary control fuse is blown. B Broken connection in primary circuit.	A Replace primary control fuse. B Have an Accredited ESAB Service Provider check primary circuit.
3 Fault Indicator is illuminated and unit will not commence welding when the torch trigger switch is depressed.	Duty cycle of power source has been exceeded.	Leave the power source switched ON and allow it to cool. Note that fault indicator must be extinguished prior to commencement of welding.
4 Welding output continues when torch trigger released	A Trigger mode selection is in 4T (LATCH) mode B Torch trigger leads shorted	A Change to 2T (NORMAL) mode B Repair or replace Torch / trigger lead
5 Welding output voltage is present when the torch trigger switch is depressed but arc cannot be established.	Poor or no work lead contact.	Clean work clamp area and ensure good electrical contact.
6 Welding output voltage is not present when torch trigger depressed	Faulty trigger switch / lead	Repair or replace Torch / trigger lead
7 TIG electrode melts when arc is struck.	TIG torch is connected to the (+) VE terminal.	Connect the TIG torch to the (-) VE terminal.
8 Arc flutters during TIG welding.	Tungsten electrode is too large for the welding current.	Select the correct size of tungsten electrode.
9 No HF output in HF mode	HF Circuit faulty	Have an Accredited ESAB Service Provider check HF circuit.

FAULT	CAUSE	REMEDY
Error Code “Err 001” is displayed on the digital displays in conjunction with the Fault Indicator Illuminating. 	A Thermal Overload	This is due to the duty cycle of the power source being exceeded. Once the power source cools sufficiently it will automatically reset and the Fault Indicator and Err 001 will go off and the power source is then able to continue welding. During the time of cooling the power source should remain ON such that the fan continues to operate allowing the unit to cool sufficiently. If after 30 minutes with the fan running the Fault Indicator has not gone OFF then have an Accredited ESAB Service Provider check the power source.
	B Primary Circuit Overload	This is due to primary circuit component(s) malfunctioning which results in excessive primary circuit current. Switch the power source to OFF immediately to allow all components to cool down for at least 30 minutes. If after 30 minutes “Err 001” is displayed and Fault Indicator illuminates when the power source is switched back ON turn the power source OFF and have an Accredited ESAB Service Provider check the power source.

Table 5-1: Power Source Problem

5.03 Routine Service and Calibration Requirements

WARNING
There are extremely dangerous voltage and power levels present inside this Inverter Power Source. Do not attempt to open or repair unless you are an accredited ESAB Service Provider. Disconnect the Welding Power Source from the Mains Supply Voltage before disassembling.

Routine Inspection, Testing & Maintenance

The inspection and testing of the power source and associated accessories shall be carried out in accordance with Section 5 of EN 60974.1: Safety in Welding and Allied Processes-Part 2 Electrical. This includes an insulation resistance test and an earthing test to ensure the integrity of the unit is compliant with ESAB original specifications.
If equipment is to be used in a hazardous location or environments with a high risk of electrocution as outlined in EN 60974.1, then the above tests should be carried out prior to entering this location.

A. Testing Schedule

1. For transportable equipment, at least once every 3 months; and
2. For fixed equipment, at least once every 12 months.

The owners of the equipment shall keep a suitable record of the periodic tests and a system of tagging, including the date of the most recent inspection.

A transportable power source is deemed to be any equipment that is not permanently connected and fixed in the position in which it is operated.

B. Insulation Resistance

Minimum insulation resistance for in-service ESAB Inverter Power Sources shall be measured at a voltage of 500V between the parts referred to in Table 5-2 below. Power sources that do not meet the insulation resistance requirements set out below shall be withdrawn from service and not returned until repairs have been performed such that the requirements outlined below are met.

Components to be Tested	Minimum Insulation Resistance (M Ω)
Input circuit (including any connected control circuits) to welding circuit (including any connected control circuits)	5
All circuits to exposed conductive parts	2.5
Welding circuit (including any connected control circuits) to any auxiliary circuit which operates at a voltage exceeding extra low voltage	10
Welding circuit (including any connected control circuits) to any auxiliary circuit which operates at a voltage not exceeding extra low voltage	1
Separate welding circuit to separate welding circuit	1

Table 5-2: Minimum Insulation Resistance Requirements: ESAB Inverter Power Sources

C. Earthing

The resistance shall not exceed 1Ω between any metal of a power source where such metal is required to be earthed, and -

1. The earth terminal of a fixed power source; or
2. The earth terminal of the associated plug of a transportable power source

Note that due to the dangers of stray output currents damaging fixed wiring, the integrity of fixed wiring supplying ESAB welding power sources should be inspected by a licensed electrical worker in accordance with the requirements below -

1. For outlets/wiring and associated accessories supplying transportable equipment - at least once every 3 months; and
2. For outlets/wiring and associated accessories supplying fixed equipment - at least once every 12 months.

D. General Maintenance Checks

Welding equipment should be regularly checked by an accredited ESAB Service Provider to ensure that:

1. Flexible cord is of the multi-core tough rubber or plastic sheathed type of adequate rating, correctly connected and in good condition.
2. Welding terminals are in suitable condition and are shrouded to prevent inadvertent contact or short circuit.
3. The Welding System is clean internally, especially from metal filing, slag, and loose material.

E. Accessories

Accessory equipment, including output leads, electrode holders, torches, wire feeders and the like shall be inspected at least monthly by a competent person to ensure that the equipment is in a safe and serviceable condition. All unsafe accessories shall not be used.

F. Repairs

If any parts are damaged for any reason, it is recommended that replacement be performed by an accredited ESAB Service Provider.

Power Source Calibration

A. Schedule

Output testing of all ESAB Inverter Power Sources and applicable accessories shall be conducted at regular intervals to ensure they fall within specified levels. Calibration intervals shall be as outlined below -

1. For transportable equipment, at least once every 3 months; and
2. For fixed equipment, at least once every 12 months.

If equipment is to be used in a hazardous location or environments with a high risk of electrocution as outlined in EN 60974.1, then the above tests should be carried out prior to entering this location.

B. Calibration Requirements

Where applicable, the tests outlined in Table 5-3 below shall be conducted by an accredited ESAB service provider.

Testing Requirements
Output current (A) to be checked to ensure it falls within applicable ESAB power source specifications
Output Voltage (V) to be checked to ensure it falls within applicable ESAB power source specifications
Accuracy of digital meters to be checked to ensure it falls within applicable ESAB power source specifications

Table 5-3: Calibration Parameters

Periodic calibration of other parameters such as timing functions are not required unless a specific fault has been identified.

C. Calibration Equipment

All equipment used for Power Source calibration shall be in proper working condition and be suitable for conducting the measurement in question. Only test equipment with valid calibration certificates (NATA certified laboratories) shall be utilized.

5.04 Cleaning the Welding Power Source

WARNING
There are dangerous voltage and power levels present inside this product. Do not attempt to open or repair unless you are a qualified electrical tradesperson. Disconnect the Welding Power Source from the Mains Supply Voltage before disassembling.

To clean the Welding Power Source, open the enclosure and use a vacuum cleaner to remove any accumulated dirt, metal filings, slag and loose material. Keep the shunt and lead screw surfaces clean as accumulated foreign material may reduce the welders output welding current.

SECTION 6:
KEY SPARE PARTS

6.01 Power Source

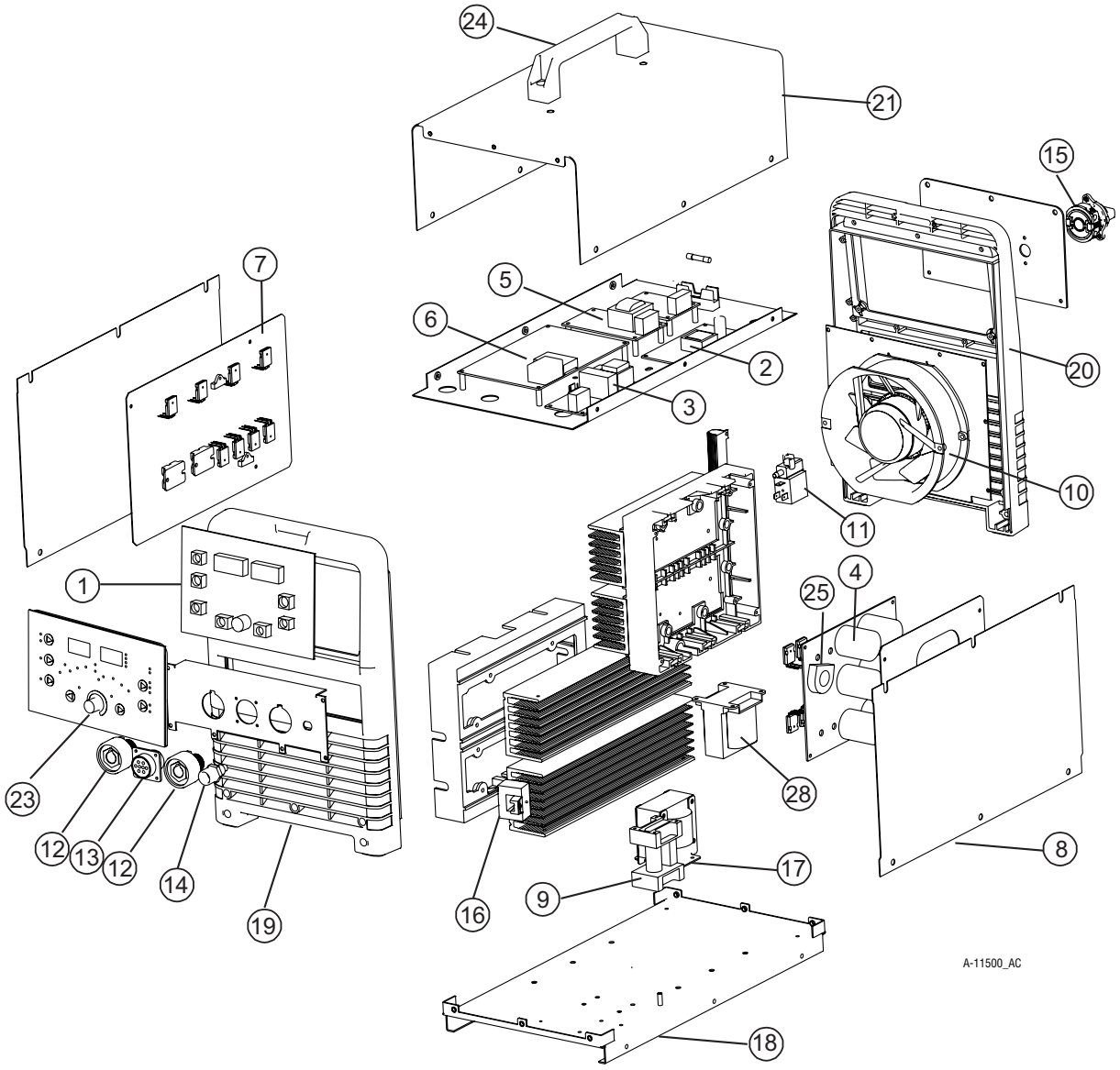
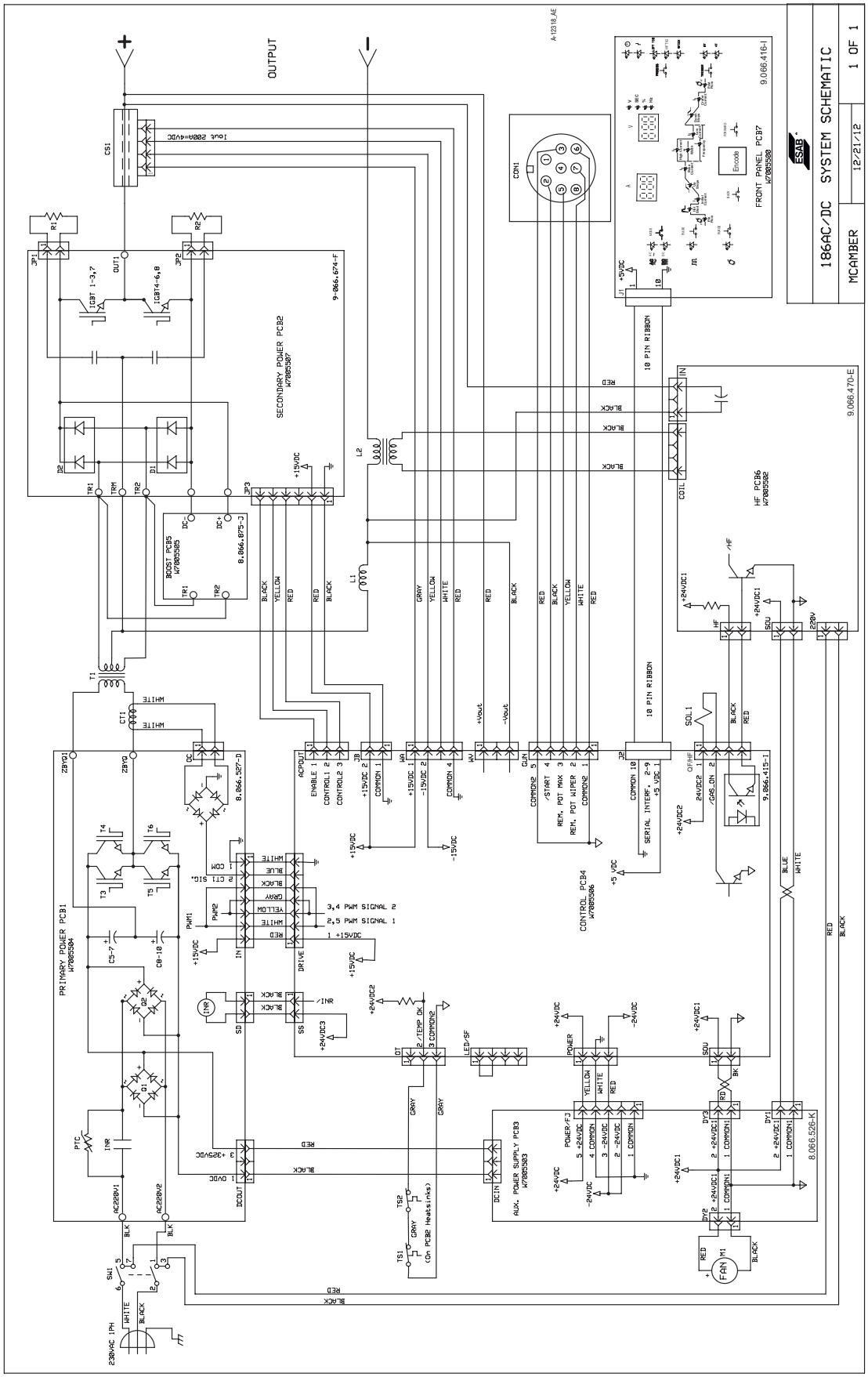


Figure 6-1

ET 186i AC/DC Spare Parts		
Item	**Part Number**	**Description**
1	W7005500	PCB display
2	W7005503	PCB aux power supply
3	W7005502	PCB HF
4	W7005504	PCB 186ACDC
5	W7005505	PCB AC output drive
6	W7005506	PCB control
7	W7005507	PCB secondary rectifier
8	W7005538	Side Panel
9	W7005509	Coil coupling HF
10	W7005520	Fan assembly
11	W7003033	Gas solenoid assembly
12	W7005513	Dinse Socket 50mm²
13	W7005568	Control socket 8 pin (including wire harness)
14	W7005514	Gas outlet, front panel
15	W7005515	Switch, On/Off
16	W7003076	CT, output
17	W7005539	Inductor 186AC/DC
18	W7005517	Base Panel
19	W7005531	Front panel
20	W7005516	Rear panel
21	W7005518	Panel, Top Cover
22	W7003215	Gas inlet fitting(not shown)
23	W7005537	Control knob, (25mm² OD)
24	W7005536	Handle
25	W7004952	CT, primary
26	W7005501	Shroud, Knob, Front Panel (not shown)
27	W7004930	Shielding Gas Hose Assy (not shown)
28	W7005511	Transformer
29	831761	Set-Up Guide, English (not shown)
30	831762	Set-Up Guide, French (not shown)

Table 6-1

APPENDIX 1 : CIRCUIT DIAGRAM



APPENDIX 2 : ET 186i AC/DC SETUP GUIDE

LIFT TIG / HF TIG SET-UP GUIDE

1 SELECT PROCESS	2 MODE SELECTION	a MATERIAL SELECTION	b BASE METAL SIZE	c JOINT TYPE	d TUNGSTEN / FILLER ROD SIZE*	3 WELD CURRENT	3 AC FREQUENCY	3 POST FLOW	SELECT TIG CUP SIZE	SELECT GAS FLOW
HF TIG	AC ~	Aluminum	16 ga. (1.6 mm)	Butt	1/16" (1.6 mm)	65A	150 Hz	5 sec.	4, 5, 6	15 cfh (7 l/
			16 ga. (1.6 mm)	Fillet	1/16" (1.6 mm)	85A	150 Hz	6 sec.	4, 5, 6	15 cfh (7 l/
			1/8" (3.2 mm)	Butt	3/32" (2.4 mm)	135A	150 Hz	11 sec.	6, 7	17 cfh (8 l/
			1/8" (3.2 mm)	Fillet	3/32" (2.4 mm)	150A	150 Hz	13 sec.	6, 7	17 cfh (8 l/
			3/16" (4.7 mm)	Butt	1/8" (3.2 mm)	160A	100 Hz	13 sec.	7, 8	17 cfh (8 l/
			3/16" (4.7 mm)	Fillet	1/8" (3.2 mm)	170A	80 Hz	13 sec.	7, 8	17 cfh (8 l/
			1/4" (6.4 mm)	Butt	1/8" (3.2 mm)	200A	80 Hz	13 sec.	7, 8	17 cfh (8 l/
			1/4" (6.4 mm)	Fillet	1/8" (3.2 mm)	200A	80 Hz	13 sec.	7, 8	17 cfh (8 l/
LIFT TIG /HF TIG	DC (-) ⎓	Stainless Steel	16 ga. (1.6 mm)	Butt	1/16" (1.6 mm)	50A	-	5 sec.	4, 5, 6	15 cfh (7 l/
			16 ga. (1.6 mm)	Fillet	1/16" (1.6 mm)	60A	-	6 sec.	4, 5, 6	15 cfh (7 l/
			1/8" (3.2 mm)	Butt	3/32" (2.4 mm)	110A	-	11 sec.	6, 7	17 cfh (8 l/
			1/8" (3.2 mm)	Fillet	3/32" (2.4 mm)	150A	-	13 sec.	6, 7	17 cfh (8 l/
			3/16" (4.7 mm)	Butt	1/8" (3.2 mm)	170A	-	13 sec.	7, 8	17 cfh (8 l/
			3/16" (4.7 mm)	Fillet	1/8" (3.2 mm)	170A	-	13 sec.	7, 8	17 cfh (8 l/
			1/4" (6.4 mm)	Butt	1/8" (3.2 mm)	175A	-	13 sec.	7, 8	17 cfh (8 l/
			1/4" (6.4 mm)	Fillet	1/8" (3.2 mm)	180A	-	13 sec.	7, 8	17 cfh (8 l/
LIFT TIG /HF TIG	DC(-) ⎓	Mild Steel	16 ga. (1.6 mm)	Butt	1/16" (1.6 mm)	50A	-	5 sec.	4, 5, 6	15 cfh (7 l/
			16 ga. (1.6 mm)	Fillet	1/16" (1.6 mm)	60A	-	6 sec.	4, 5, 6	15 cfh (7 l/
			1/8" (3.2 mm)	Butt	3/32" (2.4 mm)	125A	-	11 sec.	6, 7	17 cfh (8 l/
			1/8" (3.2 mm)	Fillet	3/32" (2.4 mm)	125A	-	13 sec.	6, 7	17 cfh (8 l/
			3/16" (4.7 mm)	Butt	1/8" (3.2 mm)	170A	-	13 sec.	7, 8	17 cfh (8 l/
			3/16" (4.7 mm)	Fillet	1/8" (3.2 mm)	200A	-	13 sec.	7, 8	17 cfh (8 l/

Note: LIFT TIG / HF TIG set-up guide parameters may vary depending upon welding position and joint design. * - If Required

PULSE SET-UP GUIDE

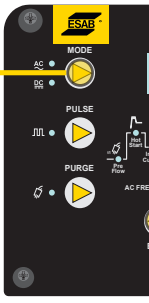
1 SELECT PROCESS	2 MODE SELECTION	a MATERIAL SELECTION	b BASE METAL SIZE	3 HIGH CURRENT	3 WIDTH	3 FREQUENCY	3 LOW CURRENT
	AC ~ Pulse ⎍	Aluminum	16 ga. (1.6 mm)	120A	60%	100 Hz Pulse	55A
			1/8" (3.2 mm)	170A	60%	1 Hz Pulse	60A
LIFT TIG /HF TIG	DC(-) ⎓ Pulse ⎍	Stainless Steel	16 ga. (1.6 mm)	65A	50%	1 Hz Pulse	30A
			1/8" (3.2 mm)	125A	65%	1 Hz Pulse	50A
			3/16" (4.7 mm)	195A	60%	1 Hz Pulse	75A
		Mild Steel	16 ga. (1.6 mm)	85A	60%	1 Hz Pulse	40A
			1/8" (3.2 mm)	150A	60%	1 Hz Pulse	50A

Pulse Notes
Wave Balance is 30% (AC Mode Only)

Note: Butt or Fillet Joint types can be used in Pulse mode. Set-up guide parameters may vary depending upon welding position.

PANEL SET-UP

2 Select Mode: AC ~ or DC ⎓



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LIFT TIG / HF TIG Notes

Gas is 100% Pure Argon.

Wave balance is 30% (AC Mode Only)

STICK SET-UP GUIDE

1 SELECT PROCESS	2 MODE SELECTION	a ELECTRODE SELECTION	b ELECTRODE DIAMETER	3/32" (2.4 mm)	1/8" (3.2 mm)	5/32" (4.0 mm)
STICK	DC(+) ⎓	E6011	3 Weld Current (Range)	50-75A	70-110A	80-145A
			Arc Force	-	-	-
			Polarity Selection	DC Reverse Polarity (Positive)		
		E6013	3 Weld Current (Range)	70-95A	100-135A	145-170A
			Arc Force	-	-	-
			Polarity Selection	DC Reverse Polarity (Positive)		
		E7014	3 Weld Current (Range)	70-95A	100-145A	135-170A
			Arc Force	-	-	-
			Polarity Selection	DC Reverse Polarity (Positive)		
		E7018	3 Weld Current (Range)	70-110A	90-160A	130-170A
			Arc Force	-	-	-
			Polarity Selection	DC Reverse Polarity (Positive)		

ET 186i AC/DC
SET-UP GUIDE

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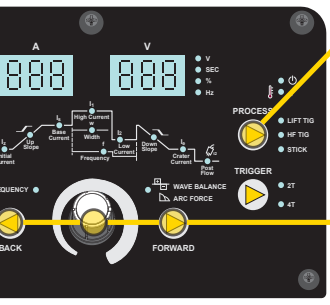
This set-up information is intended to act as a guide only. Please refer to operating manual for further information.

STICK	DC(+) ⎓	E7024	3 Weld Current (Range)	-	100-160A	-
			Arc Force	-	-	-
			Polarity Selection	DC Reverse Polarity (Positive)		
		E308L-16 E316L-16	3 Weld Current (Range)	30-60A	55-95A	80-140A
			Arc Force	-	-	-
			Polarity Selection	DC Reverse Polarity (Positive)		

Note: STICK set-up guide parameters may vary depending upon welding position, joint design.

GUIDE



1 **Select Process: LIFT TIG, HF TIG, or STICK**

3 **Adjust Parameters**

LIFT TIG & HF TIG		STICK
2T Mode (AC or DC)	4T Mode (AC or DC)	(AC or DC)
Pre Flow	Pre Flow	Hot Start
Hot Start (HF TIG Only)	Hot Start (HF TIG Only)	Weld Current
Weld Current	Initial Current	Arc Force
Down Slope	Up Slope	
Post Flow	Weld Current	
Wave Balance (AC TIG Only)	Down Slope	
AC Frequency (AC TIG Only)	Crater Current	
	Post Flow	
	Wave Balance (AC TIG Only)	
	AC Frequency (AC TIG Only)	

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