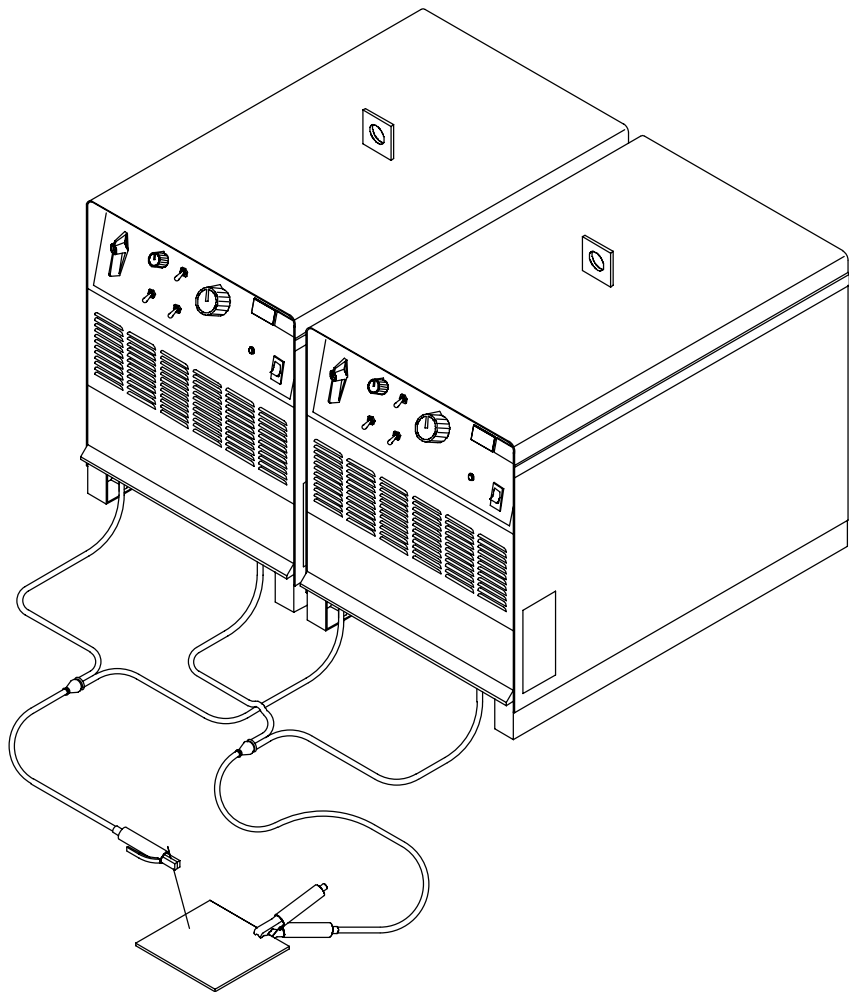




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2005-10

Paralleling Arc Welding Power Sources



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www.MillerWelds.com

SECTION 1 – SAFETY PRECAUTIONS - READ BEFORE USING

som _3/05

▲ **Warning: Protect yourself and others from injury — read and follow these precautions.**

1-1. Symbol Usage



Means Warning! Watch Out! There are possible hazards with this procedure! The possible hazards are shown in the adjoining symbols.

▲ **Marks a special safety message.**

☞ Means "Note"; not safety related.



This group of symbols means Warning! Watch Out! possible ELECTRIC SHOCK, MOVING PARTS, and HOT PARTS hazards. Consult symbols and related instructions below for necessary actions to avoid the hazards.

1-2. Arc Welding Hazards

▲ **The symbols shown below are used throughout this manual to call attention to and identify possible hazards. When you see the symbol, watch out, and follow the related instructions to avoid the hazard. The safety information given below is only a summary of the more complete safety information found in the Safety Standards listed in Section 1-5. Read and follow all Safety Standards.**

▲ **Only qualified persons should install, operate, maintain, and repair this unit.**

▲ **During operation, keep everybody, especially children, away.**



ELECTRIC SHOCK can kill.

Touching live electrical parts can cause fatal shocks or severe burns. The electrode and work circuit is electrically live whenever the output is on. The input power circuit and machine internal circuits are also

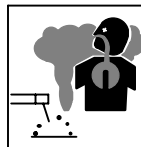
live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.

- Do not touch live electrical parts.
- Wear dry, hole-free insulating gloves and body protection.
- Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground.
- Do not use AC output in damp areas, if movement is confined, or if there is a danger of falling.
- Use AC output ONLY if required for the welding process.
- If AC output is required, use remote output control if present on unit.
- Additional safety precautions are required when any of the following electrically hazardous conditions are present: in damp locations or while wearing wet clothing; on metal structures such as floors, gratings, or scaffolds; when in cramped positions such as sitting, kneeling, or lying; or when there is a high risk of unavoidable or accidental contact with the workpiece or ground. For these conditions, use the following equipment in order presented: 1) a semiautomatic DC constant voltage (wire) welder, 2) a DC manual (stick) welder, or 3) an AC welder with reduced open-circuit voltage. In most situations, use of a DC, constant voltage wire welder is recommended. And, do not work alone!
- Disconnect input power or stop engine before installing or servicing this equipment. Lockout/tagout input power according to OSHA 29 CFR 1910.147 (see Safety Standards).
- Properly install and ground this equipment according to its Owner's Manual and national, state, and local codes.
- Always verify the supply ground – check and be sure that input power cord ground wire is properly connected to ground terminal in disconnect box or that cord plug is connected to a properly grounded receptacle outlet.
- When making input connections, attach proper grounding conductor first – double-check connections.
- Frequently inspect input power cord for damage or bare wiring – replace cord immediately if damaged – bare wiring can kill.

- Turn off all equipment when not in use.
- Do not use worn, damaged, undersized, or poorly spliced cables.
- Do not drape cables over your body.
- If earth grounding of the workpiece is required, ground it directly with a separate cable.
- Do not touch electrode if you are in contact with the work, ground, or another electrode from a different machine.
- Do not touch electrode holders connected to two welding machines at the same time since double open-circuit voltage will be present.
- Use only well-maintained equipment. Repair or replace damaged parts at once. Maintain unit according to manual.
- Wear a safety harness if working above floor level.
- Keep all panels and covers securely in place.
- Clamp work cable with good metal-to-metal contact to workpiece or worktable as near the weld as practical.
- Insulate work clamp when not connected to workpiece to prevent contact with any metal object.
- Do not connect more than one electrode or work cable to any single weld output terminal.

SIGNIFICANT DC VOLTAGE exists in inverter-type welding power sources after removal of input power.

- Turn Off inverter, disconnect input power, and discharge input capacitors according to instructions in Maintenance Section before touching any parts.



FUMES AND GASES can be hazardous.

Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.

- Keep your head out of the fumes. Do not breathe the fumes.
- If inside, ventilate the area and/or use local forced ventilation at the arc to remove welding fumes and gases.
- If ventilation is poor, wear an approved air-supplied respirator.
- Read and understand the Material Safety Data Sheets (MSDSs) and the manufacturer's instructions for metals, consumables, coatings, cleaners, and degreasers.
- Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Always have a trained watch-person nearby. Welding fumes and gases can displace air and lower the oxygen level causing injury or death. Be sure the breathing air is safe.
- Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
- Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.



ARC RAYS can burn eyes and skin.

Arc rays from the welding process produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin. Sparks fly off from the weld.

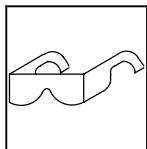
- Wear an approved welding helmet fitted with a proper shade of filter lenses to protect your face and eyes when welding or watching (see ANSI Z49.1 and Z87.1 listed in Safety Standards).
- Wear approved safety glasses with side shields under your helmet.
- Use protective screens or barriers to protect others from flash, glare and sparks; warn others not to watch the arc.
- Wear protective clothing made from durable, flame-resistant material (leather, heavy cotton, or wool) and foot protection.



WELDING can cause fire or explosion.

Welding on closed containers, such as tanks, drums, or pipes, can cause them to blow up. Sparks can fly off from the welding arc. The flying sparks, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode to metal objects can cause sparks, explosion, overheating, or fire. Check and be sure the area is safe before doing any welding.

- Remove all flammables within 35 ft (10.7 m) of the welding arc. If this is not possible, tightly cover them with approved covers.
- Do not weld where flying sparks can strike flammable material.
- Protect yourself and others from flying sparks and hot metal.
- Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
- Watch for fire, and keep a fire extinguisher nearby.
- Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
- Do not weld on closed containers such as tanks, drums, or pipes, unless they are properly prepared according to AWS F4.1 (see Safety Standards).
- Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock, sparks, and fire hazards.
- Do not use welder to thaw frozen pipes.
- Remove stick electrode from holder or cut off welding wire at contact tip when not in use.
- Wear oil-free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes, and a cap.
- Remove any combustibles, such as a butane lighter or matches, from your person before doing any welding.
- Follow requirements in OSHA 1910.252 (a) (2) (iv) and NFPA 51B for hot work and have a fire watcher and extinguisher nearby.



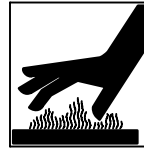
FLYING METAL can injure eyes.

- Welding, chipping, wire brushing, and grinding cause sparks and flying metal. As welds cool, they can throw off slag.
- Wear approved safety glasses with side shields even under your welding helmet.



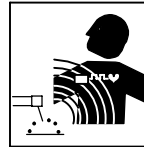
BUILDUP OF GAS can injure or kill.

- Shut off shielding gas supply when not in use.
- Always ventilate confined spaces or use approved air-supplied respirator.



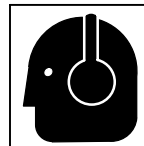
HOT PARTS can cause severe burns.

- Do not touch hot parts bare handed.
- Allow cooling period before working on gun or torch.
- To handle hot parts, use proper tools and/or wear heavy, insulated welding gloves and clothing to prevent burns.



MAGNETIC FIELDS can affect pacemakers.

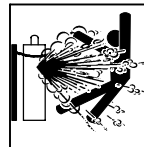
- Pacemaker wearers keep away.
- Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.



NOISE can damage hearing.

Noise from some processes or equipment can damage hearing.

- Wear approved ear protection if noise level is high.



CYLINDERS can explode if damaged.

Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.

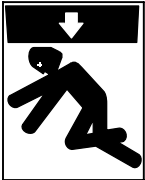
- Protect compressed gas cylinders from excessive heat, mechanical shocks, physical damage, slag, open flames, sparks, and arcs.
- Install cylinders in an upright position by securing to a stationary support or cylinder rack to prevent falling or tipping.
- Keep cylinders away from any welding or other electrical circuits.
- Never drape a welding torch over a gas cylinder.
- Never allow a welding electrode to touch any cylinder.
- Never weld on a pressurized cylinder – explosion will result.
- Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
- Turn face away from valve outlet when opening cylinder valve.
- Keep protective cap in place over valve except when cylinder is in use or connected for use.
- Use the right equipment, correct procedures, and sufficient number of persons to lift and move cylinders.
- Read and follow instructions on compressed gas cylinders, associated equipment, and Compressed Gas Association (CGA) publication P-1 listed in Safety Standards.

1-3. Additional Symbols For Installation, Operation, And Maintenance



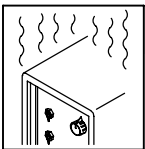
FIRE OR EXPLOSION hazard.

- Do not install or place unit on, over, or near combustible surfaces.
- Do not install unit near flammables.
- Do not overload building wiring – be sure power supply system is properly sized, rated, and protected to handle this unit.



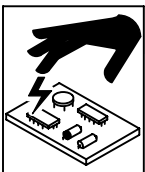
FALLING UNIT can cause injury.

- Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
- Use equipment of adequate capacity to lift and support unit.
- If using lift forks to move unit, be sure forks are long enough to extend beyond opposite side of unit.



OVERUSE can cause OVERHEATING

- Allow cooling period; follow rated duty cycle.
- Reduce current or reduce duty cycle before starting to weld again.
- Do not block or filter airflow to unit.



STATIC (ESD) can damage PC boards.

- Put on grounded wrist strap BEFORE handling boards or parts.
- Use proper static-proof bags and boxes to store, move, or ship PC boards.



MOVING PARTS can cause injury.

- Keep away from moving parts.
- Keep away from pinch points such as drive rolls.



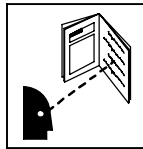
WELDING WIRE can cause injury.

- Do not press gun trigger until instructed to do so.
- Do not point gun toward any part of the body, other people, or any metal when threading welding wire.



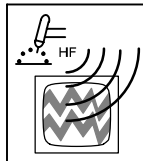
MOVING PARTS can cause injury.

- Keep away from moving parts such as fans.
- Keep all doors, panels, covers, and guards closed and securely in place.
- Have only qualified persons remove doors, panels, covers, or guards for maintenance as necessary.
- Reinstall doors, panels, covers, or guards when maintenance is finished and before re-connecting input power.



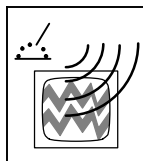
READ INSTRUCTIONS.

- Read Owner's Manual before using or servicing unit.
- Use only genuine Miller/Hobart replacement parts.



H.F. RADIATION can cause interference.

- High-frequency (H.F.) can interfere with radio navigation, safety services, computers, and communications equipment.
- Have only qualified persons familiar with electronic equipment perform this installation.
- The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
- If notified by the FCC about interference, stop using the equipment at once.
- Have the installation regularly checked and maintained.
- Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding to minimize the possibility of interference.



ARC WELDING can cause interference.

- Electromagnetic energy can interfere with sensitive electronic equipment such as computers and computer-driven equipment such as robots.
- Be sure all equipment in the welding area is electromagnetically compatible.
- To reduce possible interference, keep weld cables as short as possible, close together, and down low, such as on the floor.
- Locate welding operation 100 meters from any sensitive electronic equipment.
- Be sure this welding machine is installed and grounded according to this manual.
- If interference still occurs, the user must take extra measures such as moving the welding machine, using shielded cables, using line filters, or shielding the work area.

1-4. California Proposition 65 Warnings

- ▲ **Welding or cutting equipment produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety Code Section 25249.5 et seq.)**
- ▲ **Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling.**

For Gasoline Engines:

- ▲ **Engine exhaust contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.**

For Diesel Engines:

- ▲ **Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.**

1-5. Principal Safety Standards

Safety in Welding, Cutting, and Allied Processes, ANSI Standard Z49.1, from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihs.com).

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping, American Welding Society Standard AWS F4.1 from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihs.com).

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, P.O. Box 9101, 1 Battery March Park, Quincy, MA 02269-9101 (phone: 617-770-3000, website: www.nfpa.org).

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 1735 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102 (phone: 703-412-0900, website: www.cganet.com).

Code for Safety in Welding and Cutting, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 178 Rexdale

Boulevard, Rexdale, Ontario, Canada M9W 1R3 (phone: 800-463-6727 or in Toronto 416-747-4044, website: www.csa-international.org).

Practice For Occupational And Educational Eye And Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 11 West 42nd Street, New York, NY 10036-8002 (phone: 212-642-4900, website: www.ansi.org).

Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, NFPA Standard 51B, from National Fire Protection Association, P.O. Box 9101, 1 Battery March Park, Quincy, MA 02269-9101 (phone: 617-770-3000, website: www.nfpa.org).

OSHA, Occupational Safety and Health Standards for General Industry, Title 29, Code of Federal Regulations (CFR), Part 1910, Subpart Q, and Part 1926, Subpart J, from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250 (there are 10 Regional Offices--phone for Region 5, Chicago, is 312-353-2220, website: www.osha.gov).

1-6. EMF Information

Considerations About Welding And The Effects Of Low Frequency Electric And Magnetic Fields

Welding current, as it flows through welding cables, will cause electromagnetic fields. There has been and still is some concern about such fields. However, after examining more than 500 studies spanning 17 years of research, a special blue ribbon committee of the National Research Council concluded that: "The body of evidence, in the committee's judgment, has not demonstrated that exposure to power-frequency electric and magnetic fields is a human-health hazard." However, studies are still going forth and evidence continues to be examined. Until the final conclusions of the research are reached, you may wish to minimize your exposure to electromagnetic fields when welding or cutting.

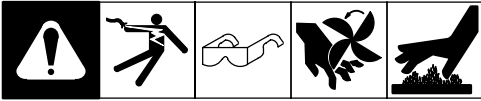
To reduce magnetic fields in the workplace, use the following procedures:

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cables around your body.
4. Keep welding power source and cables as far away from operator as practical.
5. Connect work clamp to workpiece as close to the weld as possible.

About Pacemakers:

Pacemaker wearers consult your doctor before welding or going near welding operations. If cleared by your doctor, then following the above procedures is recommended.

SECTION 2 – PARALLELING



2-1. Typical Uses For Paralleled Welding Power Sources

When amperage demands for a particular application exceed the capabilities of one welding power source, two or more electrically similar welding power sources may be connected in parallel to provide the amperage required.

When paralleled correctly, the amperage of the paralleled welding power sources is the sum of the amperage supplied by each power source. Voltage remains the same as for one welding power source.

Compatible engine-driven or inverter DC welding power sources, or transformer-type welding power sources can be paralleled. Each type requires special attention to certain areas unique to the equipment involved. The safety and efficiency of a paralleled system depends upon careful attention to correct paralleling procedures.

2-2. Equipment

The following equipment can be successfully paralleled:

- DC Constant Current (CC) Rectifier-Type Power Sources
- DC Constant Current (CC) Inverter-Type Power Sources
- DC Constant Current (CC) Rectifier Engine-Driven Power Sources
- AC Constant Current (CC) Transformer-Type Power Sources

The following equipment is not recommended for paralleling:

- Most DC Constant Voltage (CV) Power Sources
- Brush Commutator Design Engine Driven Power Sources
- Motor Generator DC Power Sources
- AC Engine Driven Power Sources
- AC Inverter-Type Power Sources

SECTION 3 – RECOMMENDED EQUIPMENT

3-1. Paralleling DC Constant Current Power Sources

Two or more DC transformer/rectifier or inverter power sources can be paralleled as follows:

1. Each power source to be paralleled must be individually protected (fused). For transformer/rectifier units, all must be connected to the same primary input power feed and be connected the same phase to phase.
2. Power sources must all be connected for the same polarity. If the power sources are equipped with polarity switches, they must all be set for the same polarity.
3. If the power source has various output terminals such as High and Low (range), use the same range terminal on all power sources connected in parallel.

If the power sources are equipped with a range switch, the range switch on all paralleled power sources should be in the same range.

4. Amperage adjustment controls on all power sources should be adjusted to provide the same output. Do not split the load unevenly. For example, if 800 amps are required from a paralleled connection of two power sources, adjust amperage control of each power source to provide 400 amps.
5. The amperage being used and total length of cable must be considered when selecting cable sizes. Use Table 3-1 to select weld cable size. Use Figure 1-1 to compute weld cable size.

3-2. Paralleling DC Constant Current Engine Driven Power Sources

DC constant current engine-driven power sources can be paralleled like the transformer/rectifier and inverter-type power sources. If the unit is an AC/DC unit, using the DC output for paralleling is required. The rectifier permits current flow in only one direction so a feedback situation does not occur even if the outputs are not exactly balanced.

Table 3-1. Selecting Cable Sizes*



▲ ARC WELDING can cause Electromagnetic Interference.

To reduce possible interference, keep weld cables as short as possible, close together, and down low, such as on the floor. Locate welding operation 100 meters from any sensitive electronic equipment. Be sure this welding machine is installed and grounded according to this manual. If interference still occurs, the user must take extra measures such as moving the welding machine, using shielded cables, using line filters, or shielding the work area.

| Weld Output Terminals ▲ Turn off power before connecting to weld output terminals. ▲ Do not use worn, damaged, undersized, or poorly spliced cables. | Welding Amperes | Weld Cable Size** and Total Cable (Copper) Length in Weld Circuit Not Exceeding*** | | | | | | | |
|---|-----------------|--|----------------------|----------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | 100 ft (30 m) or Less | | 150 ft (45 m) | 200 ft (60 m) | 250 ft (70 m) | 300 ft (90 m) | 350 ft (105 m) | 400 ft (120 m) |
| | | 10 – 60% Duty Cycle | 60 – 100% Duty Cycle | 10 – 100% Duty Cycle | | | | | |
| | 400 | 1/0 (60) | 2/0 (70) | 3/0 (95) | 4/0 (120) | 2 ea. 2/0 (2x70) | 2 ea. 3/0 (2x95) | 2 ea. 4/0 (2x120) | 2 ea. 4/0 (2x120) |
| | 500 | 2/0 (70) | 3/0 (95) | 4/0 (120) | 2 ea. 2/0 (2x70) | 2 ea. 3/0 (2x95) | 2 ea. 4/0 (2x120) | 3 ea. 3/0 (3x95) | 3 ea. 3/0 (3x95) |
| | 600 | 3/0 (95) | 4/0 (120) | 2 ea. 2/0 (2x70) | 2 ea. 3/0 (2x95) | 2 ea. 4/0 (2x120) | 3 ea. 3/0 (3x95) | 3 ea. 4/0 (3x120) | 3 ea. 4/0 (3x120) |
| | 700 | 4/0 (120) | 2 ea. 2/0 (2x70) | 2 ea. 3/0 (2x95) | 2 ea. 4/0 (2x120) | 3 ea. 3/0 (3x95) | 3 ea. 4/0 (3x120) | 3 ea. 4/0 (3x120) | 4 ea. 4/0 (4x120) |
| | 800 | 4/0 (120) | 2 ea. 2/0 (2x70) | 2 ea. 3/0 (2x95) | 2 ea. 4/0 (2x120) | 3 ea. 4/0 (3x120) | 3 ea. 4/0 (3x120) | 4 ea. 4/0 (4x120) | 4 ea. 4/0 (4x120) |
| | 900 | 2 ea. 2/0 (2x70) | 2 ea. 3/0 (2x95) | 2 ea. 4/0 (2x120) | 3 ea. 3/0 (3x95) | | | | |
| | 1000 | 2 ea. 2/0 (2x70) | 2 ea. 3/0 (2x95) | 2 ea. 4/0 (2x120) | 3 ea. 3/0 (3x95) | | | | |
| | 1250 | 2 ea. 3/0 (2x95) | 2 ea. 4/0 (2x120) | 3 ea. 3/0 (3x95) | 4 ea. 3/0 (4x95) | | | | |

* This chart is a general guideline and may not suit all applications. If cable overheats, use next size larger cable.

**Weld cable size (AWG) is based on either a 4 volts or less drop or a current density of at least 300 circular mils per ampere.
 () = mm² for metric use

S-0007-F

***For distances longer than those shown in this guide, call a factory applications representative at 920-735-4505.

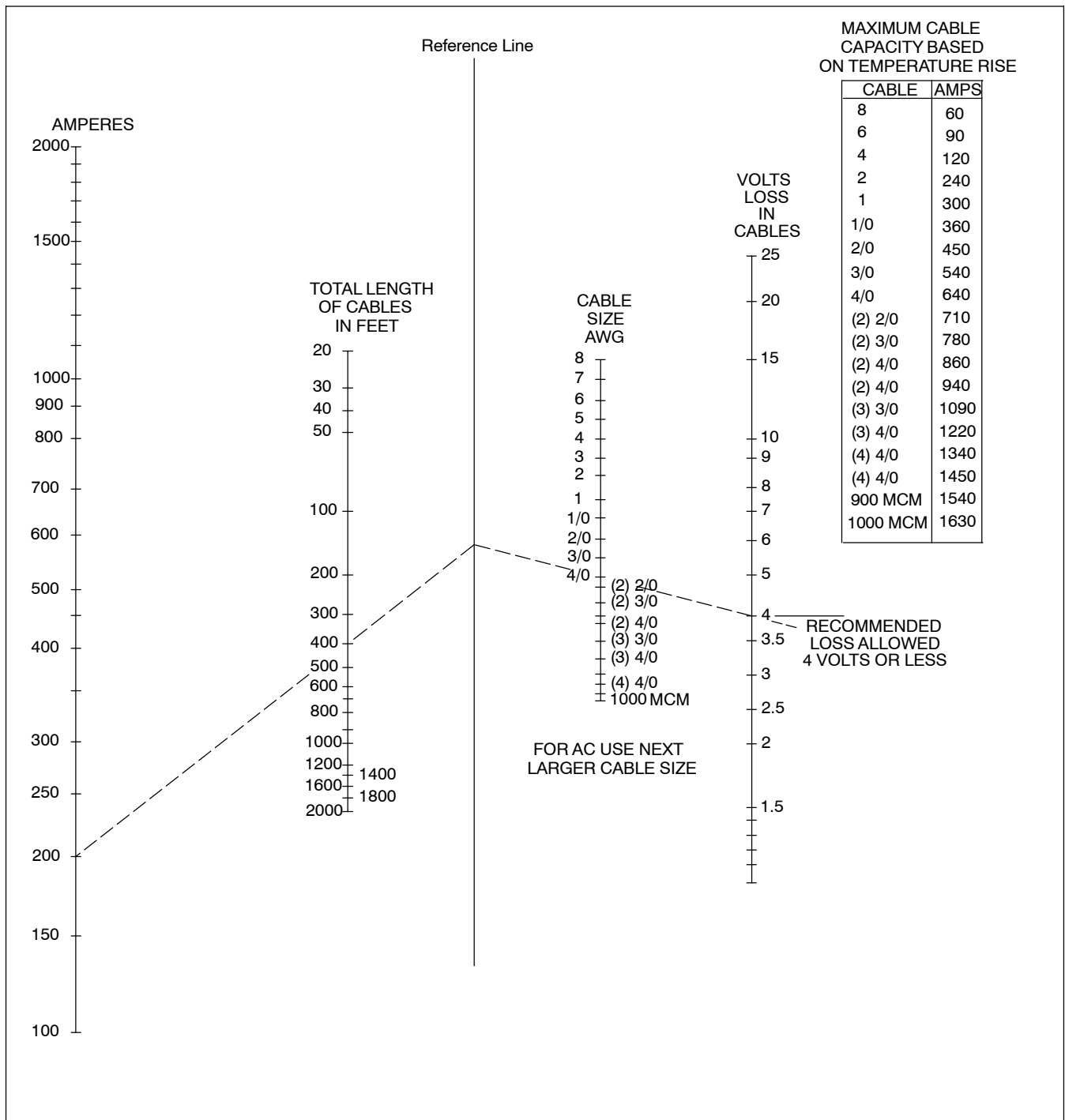


Figure 3-1. Nomogram For Computing Weld Cable Size

3-3. Using the Nomogram

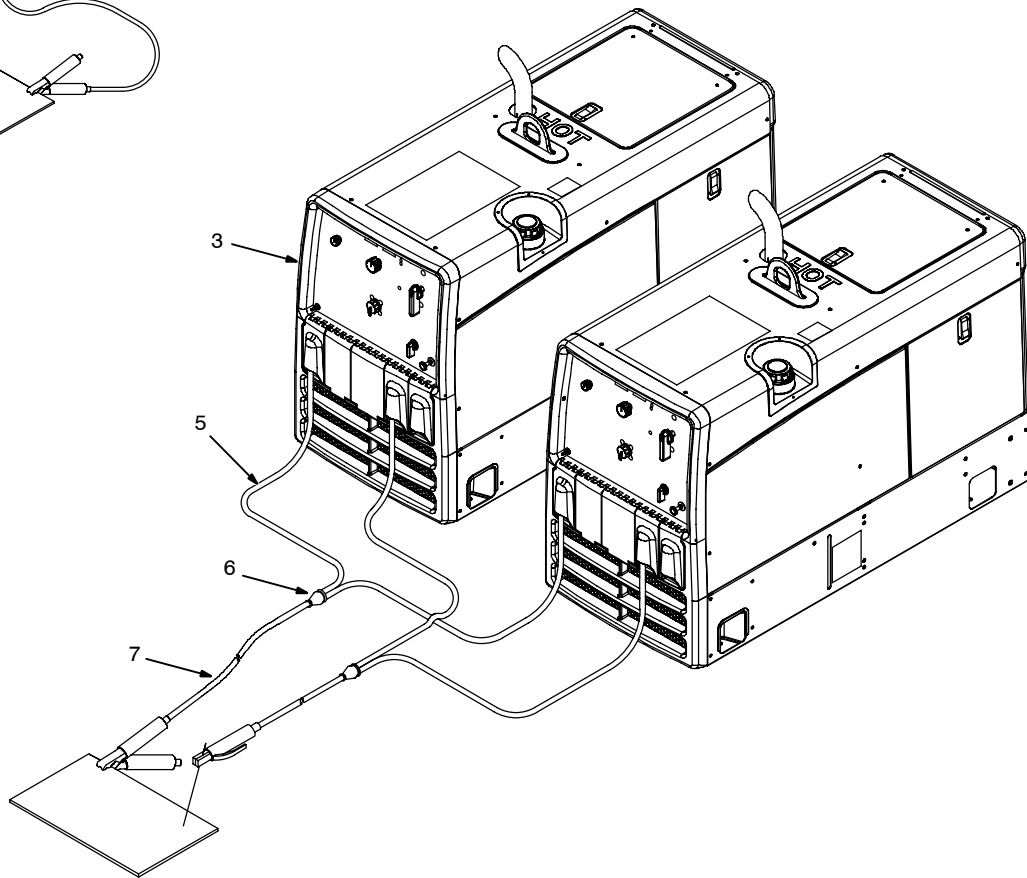
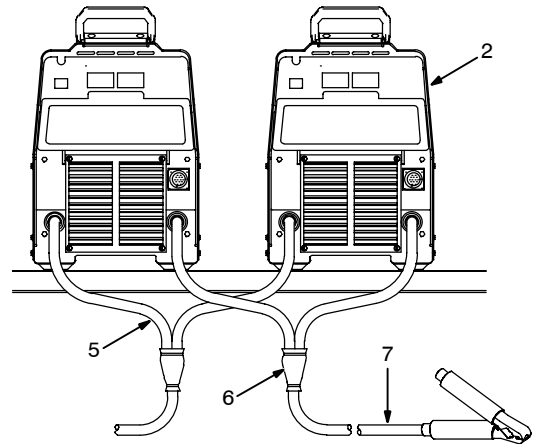
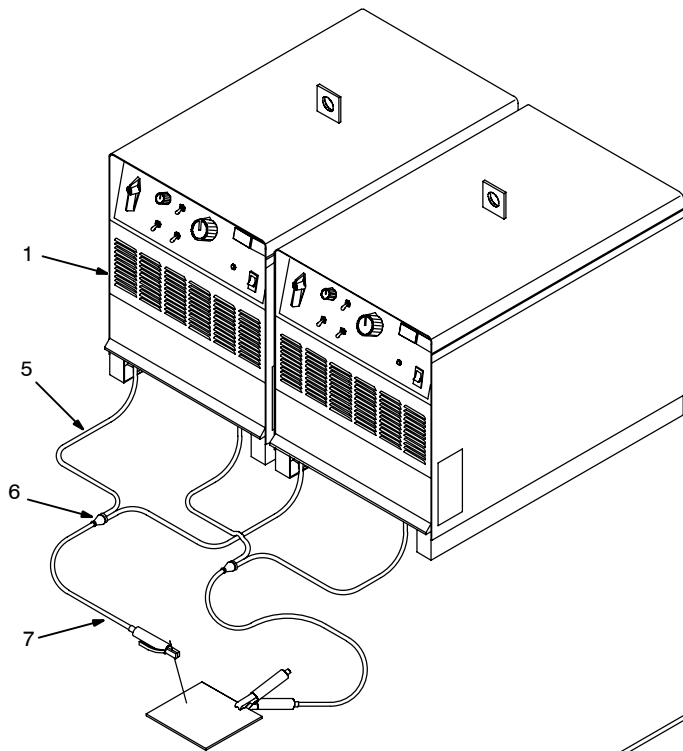
A. Example 1

The welding current will be 200 amperes DC. The work lead is 190 feet long while the electrode lead is 210 feet long. The total lead length is 400 feet.

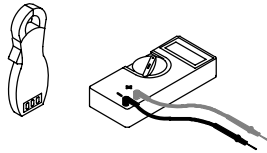
Draw a straight line from 200 amperes through 400 feet and intersect the reference line. Draw a straight line from the reference intersection through and cable size that will give less than a 4 volt loss. In this example, a 4/0 cable will give a 3.9 volt loss. Check this cable size in the maximum current capacity table. It shows a 4/0 cable has a maximum capacity of 640 amperes, well above the 200 amperes used in this example.

The solution: Use 4/0 weld cable for the connections.

3-4. Connecting Cables



Tools Needed:



- 1 Transformer/Rectifier Welding Power Source
- 2 Inverter Welding Power Source
- 3 Engine-Driven Welding Power Source
- 4 AC/DC Transformer/Rectifier Welding Power Source
- 5 Weld Cable

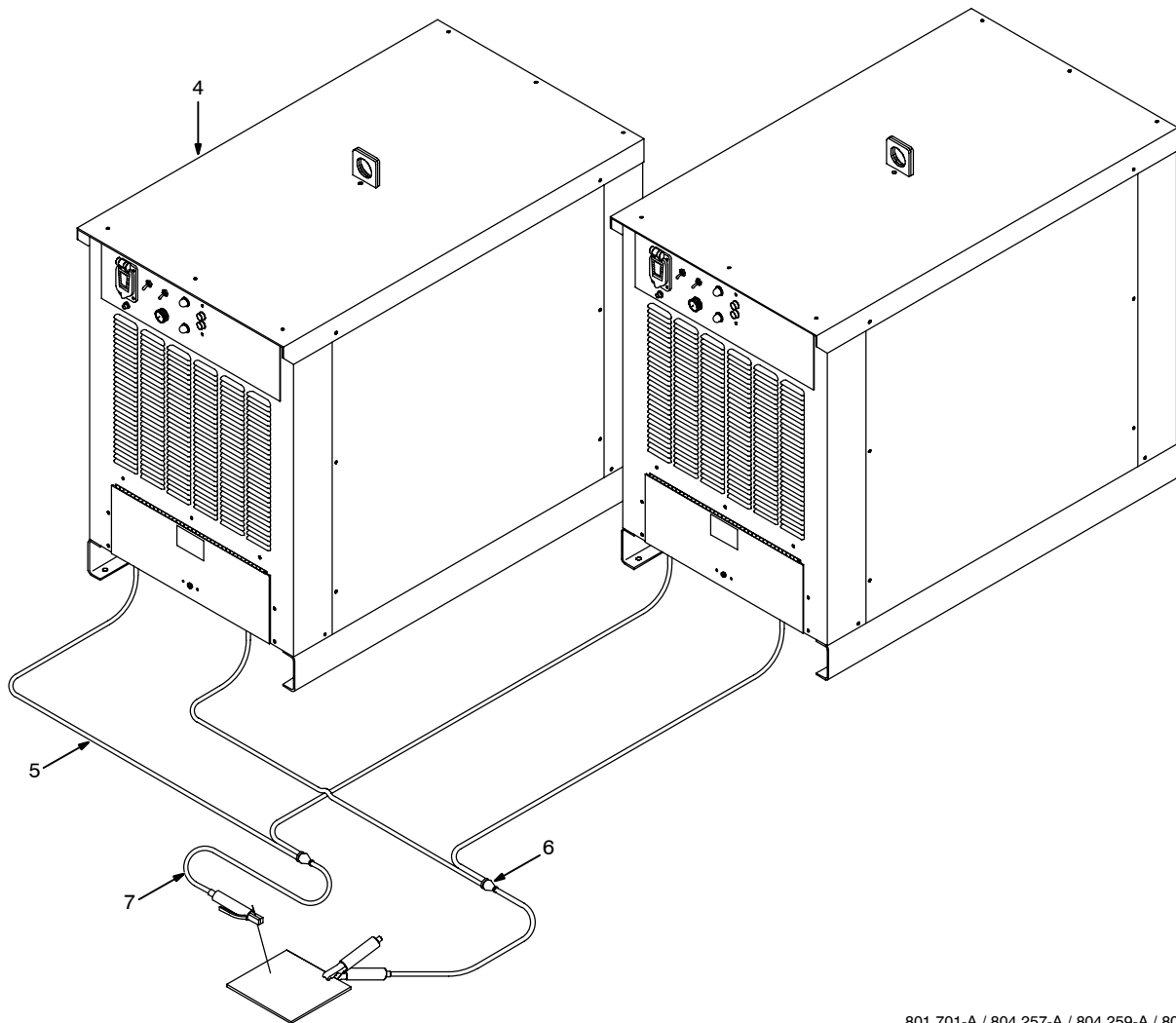
Connect separate cables of adequate size and equal length to the weld output terminals.

6 Junction

Where the weld cables are joined, be sure connecting hardware is adequate for expected amperage and that the junction is properly insulated.

7 Single Weld Cable

The single cable must be adequate to carry the full expected amperage.



801 701-A / 804 257-A / 804 259-A / 804 328-A

3-5. Paralleling AC Constant Current Transformer-Type Power Sources

AC transformer-type power sources can be paralleled for increased amperage demands; however, additional precautions must be taken.

The following procedure is recommended:

1. Connect primary wiring of suitable size from each power source to the same phase in the main disconnect switch box. This arrangement enables all power sources to be connected to the power lines simultaneously when the line disconnect switch is placed in the "On" position.
All primary connections should be made by a qualified electrician. Wire and fuse sizes must be in accordance with National Electrical Code specifications and local code requirements.
When connecting two or more power sources in parallel, the primary side of each power source must be individually protected (fused).
Primary wiring from the primary terminals to the common switch should be the same length and size. It is desirable that the junction of the primary wiring be made at the line disconnect rather than at the power source terminal board.
2. Make sure all power sources connected in parallel have the proper phase relationship. Check this as follows:
 - a. Temporarily connect all electrode terminals together with a No. 14 AWG or larger wire.
 - b. Energize all power sources.
 - c. With a voltmeter, check the voltage across the work terminal of one power source and the work terminal of the other power source(s). If the voltage is approximately zero, the phase relationship is correct. If, however, the voltage is substantially greater than zero and slightly less than two times the individual machine open-circuit voltage, the phase relationship is incorrect. Reverse the primary connections on one power source at a time until zero volts between all work terminals is achieved. Remove the temporary jumper wires connecting the electrode terminals.
3. When making secondary cable connections, the same procedure and recommendations outlined for DC constant current transformer/rectifier power sources should be used. Be sure connections are made work to work and electrode to electrode.
4. When using AC, power source control systems must be synchronized according to their instructions.

3-6. Paralleling AC/DC Constant Voltage/Constant Current Transformer/Rectifier Type Power Sources

When connecting two or more units in parallel, do not use more than one unit in CV mode. If constant voltage output is required, operate only one unit in the CV mode and put the remaining units in the CC mode with their output set to a percentage of total welding output divided by the total number of units used. When using AC, be sure the input power phase relationship is correct according to Section 3-5 and that power sources control systems are synchronized according to their instructions.

SECTION 4 – OTHER EQUIPMENT

4-1. Paralleling DC Constant Voltage Power Sources (Not Recommended)

It is very difficult to balance these machines as they will only balance in a very narrow band of operation; therefore, paralleling is not typically recommended. When paralleling dc constant voltage power sources for increased amperage, it is necessary to balance the machines by amperage output. An ammeter is necessary to make a proper adjustment.

Adjust the voltage control of each machine until the amperage output of each power source is about equal. The voltage level will equal itself. The actual voltage control settings may read differently on each machine due to tolerances. On electronically controlled machines it is recommended the machines be adjusted individually rather than with a common ganged rheostat.

4-2. Paralleling Brush Commutator Design Engine Driven Power Sources Or Motor Generators (Not Recommended)

The amperage output of these machines must be exactly balanced, otherwise, one power source tries to drive the other. Paralleling brush commutator design machines is not recommended for this reason. If the outputs are not exactly balanced, the power source supplying the higher output feeds current back to the other power source. The current goes through the paralleled connection, through the brushes to the commutator and is dissipated as heat in the windings. The heat build-up can cause failure of the generator components.

4-3. Paralleling AC Engine Driven Power Sources (Not Recommended)

Any fluctuation of engine speed will affect output amperage and frequency resulting in a feedback situation. Paralleling AC engine driven power sources is not recommended for this reason. If the engine speed fluctuates, the control systems of the power sources do not have synchronization capabilities to compensate for this fluctuation. The AC output is no longer in phase which can be a hazard for hand-held welding operations. The current feedback from one power source to the other would cause heat build up in the windings. The heat build-up can cause failure of generator components.

4-4. Paralleling AC Inverter Type Power Sources (Not Recommended)

The control systems of AC inverter power sources do not allow for synchronization of the output when the outputs are not exactly balanced. If the AC output is not in phase it can be a hazard for hand-held welding operations. The current feedback from one power source to the other would cause heat build up in the equipment. The heat build-up can cause failure of power source components.

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