

PARALLELING

Arc Welding Power Sources

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When amperage demands for a particular application are in excess of 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.

Compatible engine driven DC power sources or transformer-type welding power sources can be paralleled. Each type, whether engine driven or transformer, AC or DC, requires special attention to certain areas which are peculiar to the equipment involved. The safety and efficiency of a parallel system will depend on careful attention to correct paralleling procedure.

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

WARNING:

This document contains general information about the topics discussed herein. This document is not an application manual and does not contain a complete statement of all factors pertaining to those topics.

The installation, operation, and maintenance of arc welding equipment and the employment of procedures described in this document should be conducted only by qualified persons in accordance with applicable codes, safe practices, and manufacturer's instructions.

Always be certain that work areas are clean and safe and that proper ventilation is used. Misuse of equipment, and failure to observe applicable codes and safe practices, can result in serious personal injury and property damage.

PARALLELING DC CONSTANT POTENTIAL POWER SOURCES

When paralleling dc constant potential power sources, it is necessary to balance the machines by amperage output. An ammeter is necessary to make a proper adjustment. Watch the ammeters and adjust the voltage control until the amperage output of each power source is about equal. The voltage level will equal itself. The actual voltage dial settings may read differently on each machine due to tolerances in resistors, and core iron . . . and of course, meters. On electrical control machines, it is recommended the machines be adjusted individually rather than with a common "ganged" rheostat; again because of minor component tolerances.

PARALLELING DC TRANSFORMER-RECTIFIER WELDING POWER SOURCES

Two or more DC transformer-rectifier welding power sources may be paralleled using the procedure as follows:

1. Power sources must all be connected for the same polarity. If the power source is equipped with a polarity switch, all polarity switches must be set for the same polarity.
2. If the welding power source has various output terminals (high and low) the connection should be made to the same terminal on all welding power sources connected in parallel.

If the welding power sources are equipped with a range switch, the range switches on all welding power sources to be paralleled should be set at the same amperage range.
3. Amperage adjustment controls on all welding power sources should be adjusted to provide the same output. For example, if 800 amps are required from a parallel connection of two power sources, adjust each amperage control to provide 400 amps. Do not split the load 600 amps and 200 amps. (This is assuming each power source is rated for the same output.)
4. The amperage being used and total length of cable must be considered when selecting cable size. Table No. 1 will serve as a guide.

Figure No. 1 is a nomogram which can be used to compute cable size.

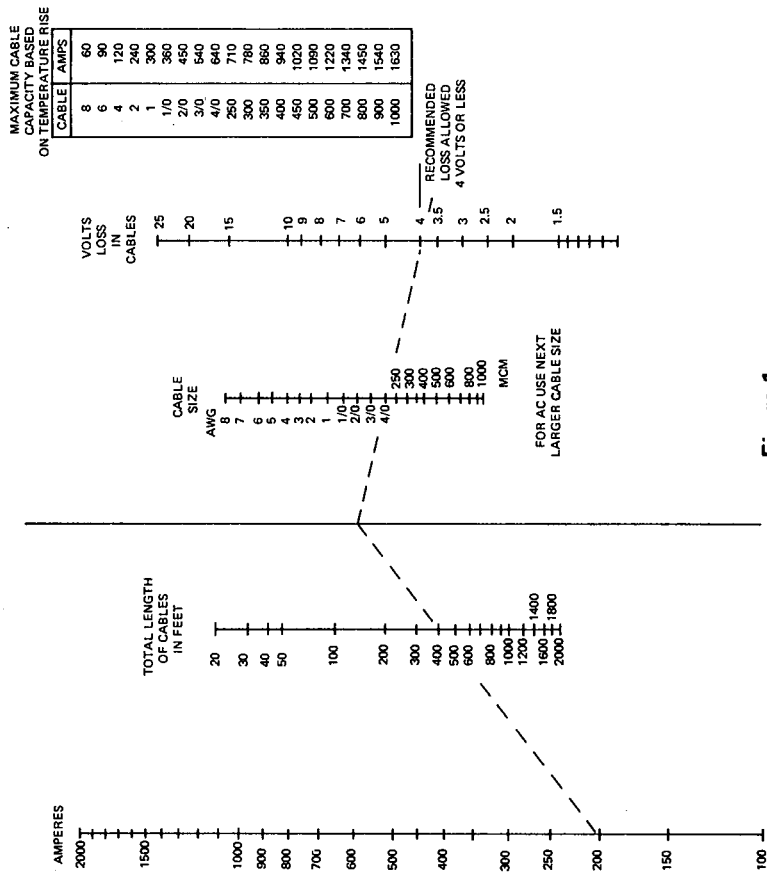


Figure 1.

EXAMPLES DEMONSTRATING THE USE OF THIS NOM- OGRAM

Example 1. The welding current will be 200 amperes dc. The work lead will be 190 feet long while the electrode cable will be 210 feet long. The total lead length will be 400 feet. Find the recommended cable size.

Solution: Draw a straight line from 200 amperes through 400 feet and intersect the reference line. Draw a straight line from the reference intersection through any cable size that will give less than 4 volts loss. Here a 4/0 cable will give 3.9 volts loss. Check this cable size in the maximum current capacity table. It shows a 4/0 cable has a maximum capacity of 640 amperes or well above the 200 amperes used in this example. 4/0 cable is then recommended.

Example 2. The problem here is basically the same as the preceding example except the welding current is 400 amperes and 4/0 cable is the largest available. Working the problem as indicated above, it is found that 4/0 cable will give a 7.8 volt loss which is above the 4 volt recommendation. The 7.8 volt loss can be cut in half by doubling up cables. That is, using two 4/0 cables in parallel for the work lead and two 4/0 cables in parallel as the electrode lead. This now gives a 3.9 volt loss exactly as Example No. 1 because each cable is only carrying 200 amperes.

Example 3. A construction company uses electrode holders with a 30 foot whip of 2/0 AWG cable as standard equipment. The largest electrode used by this company requires 400 dc amperes maximum. For standardization purposes, all leads are cut to 50 foot lengths. What size cable should be used for these 50 foot lengths in order that a standard job will be below the 4 volt recommended loss?

Solution: Draw a line from 400 amperes dc through 30 feet and intersect the reference. Draw a line from this intersection through 2/0 AWG cable and note that the voltage loss is about 1 volt. Now the loss value for the 50 foot work and the 50 foot electrode cable is 3 volts loss at 400 amperes with 100 feet of combined electrode and work cable. Check this size in the maximum current capacity table. 3/0 cable is recommended.

**TABLE 1
SECONDARY WELD CABLE SIZE***

Welding Amperes	*50	100	150	200	250	300	350	400
100	4	4	4	3	2	1	1/0	1/0
150	3	3	2	1	1/0	2/0	3/0	3/0
200	2	2	1	1/0	2/0	3/0	4/0	4/0
250	1	1	1/0	2/0	3/0	4/0	4/0	2-2/0 or 250 MCM
300	1/0	1/0	2/0	3/0	4/0	4/0	2-2/0 or 250 MCM	2-3/0 or 350 MCM
350	1/0	1/0	3/0	4/0	4/0	2-2/0 or 250 MCM	2-3/0 or 350 MCM	2-3/0 or 350 MCM
400	2/0	2/0	3/0	4/0	2-2/0 or 250 MCM	2-3/0 or 350 MCM	3-2/0 or 400 MCM	2-4/0 or 500 MCM
500	3/0	3/0	4/0	2-2/0 or 250 MCM	2-3/0 or 350 MCM	2-3/0 or 350 MCM	2-4/0 or 500 MCM	3-3/0 or 700 MCM
600	4/0	4/0	2-2/0 or 250 MCM	2-3/0 or 350 MCM	2-3/0 or 350 MCM	2-4/0 or 500 MCM	3-3/0 or 600 MCM	3-4/0 or 700 MCM
700	4/0	4/0	2-3/0	2-4/0 or 500 MCM	3-3/0 or 600 MCM	3-4/0 or 700 MCM	4-3/0 or 800 MCM	4-4/0 or 800 MCM
800	4/0	4/0	2-3/0 or 300 MCM	3-3/0 or 450 MCM	3-4/0 or 600 MCM	4-3/0 or 700 MCM	4-4/0 or 800 MCM	900 MCM
900	4/0	4/0	2-4/0 or 350 MCM	3-3/0 or 500 MCM	3-4/0 or 600 MCM	4-4/0 or 750 MCM	4-4/0 or 800 MCM	1000 MCM
1000	4/0	2-3/0 or 250 MCM	2-4/0 or 400 MCM	3-4/0 or 600 MCM	4-3/0 or 700 MCM	4-4/0 or 800 MCM	1000 MCM	1000 MCM

- *A. 50 feet or less
- *B. Cable size is based on direct current (DC) 60% duty cycle and a voltage drop of 4 volts or less. For alternating current (AC) or duty cycle above 60% use next size larger cable.
- *C. Weld cable insulation with a voltage rating to withstand the open circuit voltage (OCV) of the welding machine must be used. While most welding machines have an open circuit voltage of less than 100 volts, some welding machines of special design may have higher open circuit voltage.

Instructions For Direct Current Reverse Polarity (DCRP)

- A. Connect separate cables of adequate size (see Table No. 1) and equal length from the negative terminal of each welding power source to the work or to a suitable junction point connecting with a single cable. The single cable must be of adequate size to carry the total amperage of the combined output of the welding power sources in parallel.
- B. Connect separate cables of adequate size (see Table No. 1) and equal length from the positive terminal of each welding power source to a suitable junction connecting with a single cable. From the junction connect a single large cable to the electrode holder, air carbon-arc cutting torch, or welding head, depending upon the process being used.

Instructions For Direct Current Straight Polarity (DCSP)

- A. Connect separate cables of adequate size (see Table No. 1) and equal length from the positive terminal of each welding power source to the work or to a suitable junction point connecting with a single cable. The single cable must be of adequate size to carry the total amperage of the combined output of the welding power sources in parallel.
- B. Connect separate cables of adequate size (see Table No. 1) and equal length from the negative terminal of each welding power source to a suitable junction connecting with a single cable. From the junction, connect a single large cable to the electrode holder, air carbon-arc cutting torch, or welding head, depending upon the process being used.

Figures 2, 3, and 4 illustrate paralleling connections and control settings.

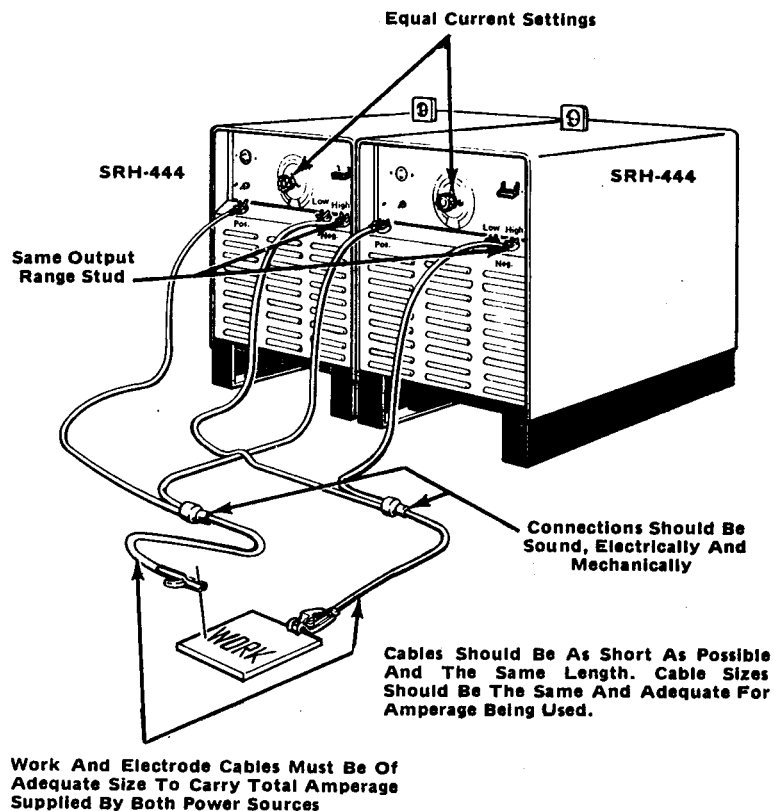


Figure 2. Correct Procedure — Two Welding Power Sources Paralleled

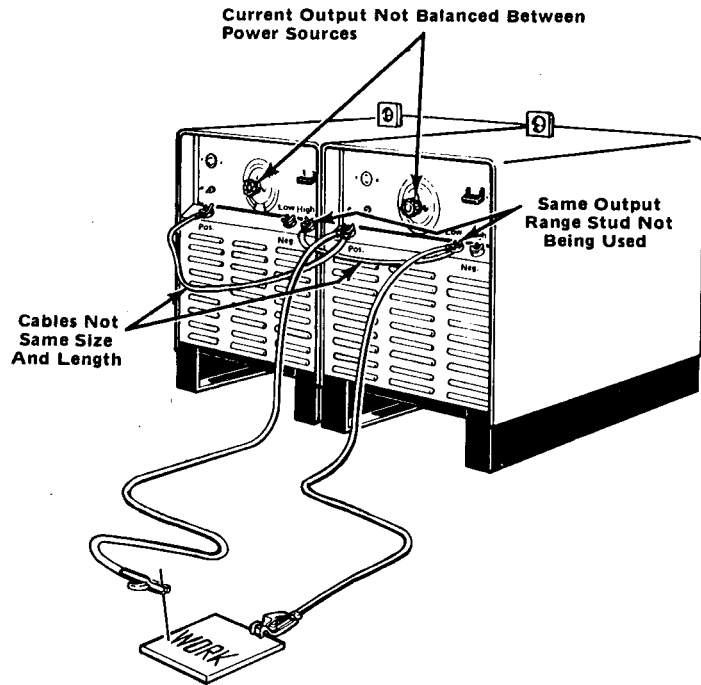


Figure 3. Incorrect Paralleling Procedure

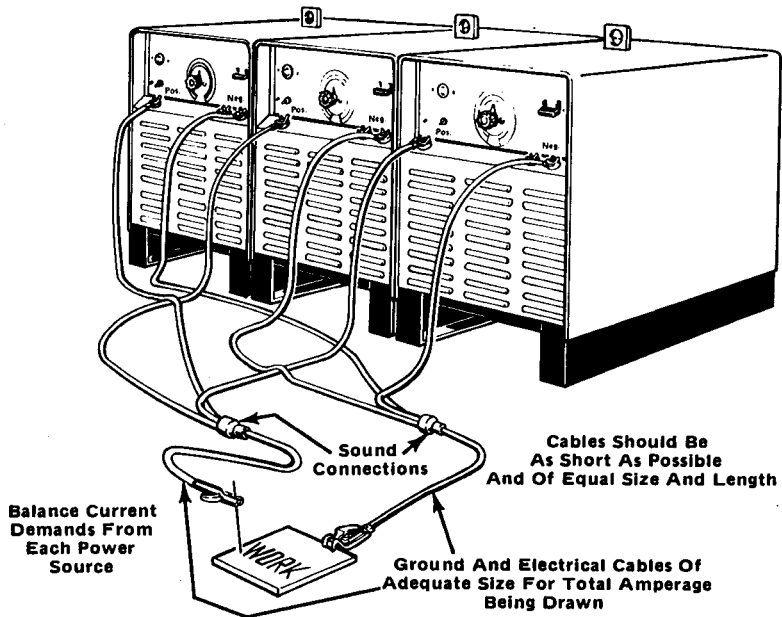


Figure 4. Correct Procedure — Paralleling 3 Or More Power Sources

PARALLELING ENGINE DRIVEN DC WELDING POWER SOURCES

MILLER engine driven DC welding power sources can be easily paralleled for increased amperage demands. This is not true of many other engine driven or motor generator welding power sources. The MILLER design permits paralleling without the use of "paralleling kits".

When DC brush-commutator type welding generators (either engine or motor driven) are paralleled, the amperage output of the individual welding generators must be exactly balanced. If they are not, the welding generator supplying the higher output will feed current back to the other welding generator. The current goes through the parallel connection, through the brushes, commutator and is dissipated as heat in the armature windings. One welding generator tries to drive the other.

This problem is not encountered on MILLER designed engine driven power sources where generated AC is rectified for DC output. The rectifier will permit current flow in only one direction; therefore current from one welding power source cannot feed the other welding power source even though the output is not exactly balanced.

It is not advisable to parallel a MILLER engine driven welding power source with a welding generator of another manufacture, since a feed back situation will invariably occur in which the MILLER power source will "drive" the other power source.

ENGINE DRIVEN AC WELDING POWER SOURCES

Engine driven AC welding power sources cannot be paralleled due to the fact that any fluctuation of engine speed will effect output amperage and frequency, and a feed back situation would occur. Current feedback from one welding power source to another would cause heat build up in the windings.

It would be virtually impossible to "phase" the output of multiple AC engine driven power sources. "Out of phase" alternating current is an electrical hazard to a welding operator's safety.

The DC output side of an AC/DC engine driven welding power source, such as the MILLER AEAD and Trailblazer series can be paralleled following the procedure outlined for DC welding power sources.

PARALLELING AC TRANSFORMER WELDING POWER SOURCES

AC transformer welding 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 welding power source to the same phase in the main disconnect switch box. This arrangement will enable all power sources to be connected to the power lines simultaneously when the line disconnect switch is placed in the "on" position.

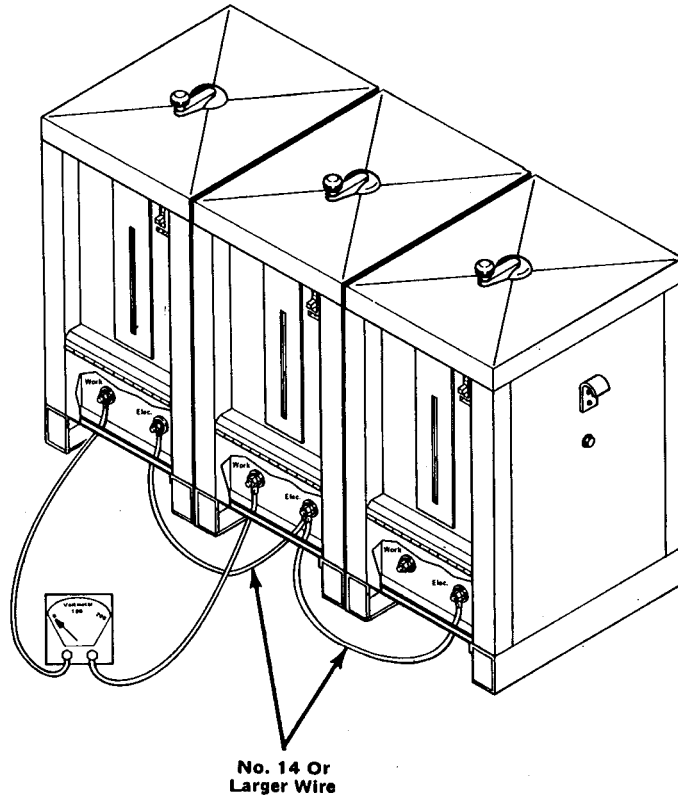
All primary connections should be made by a qualified electrician. Wire and fuse sizes must be in accordance with National Electrical Code specifications and local code requirements.

When connecting two welding power sources in parallel, do not exceed double the recommended fuse size for one power source. For three power sources, do not exceed three times the recommended fuse size, etc.

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 that all welding power sources connected in parallel have the same phase relationship. See Figure 5. This can be checked as follows:
 - A. Temporarily connect all "electrode" terminals together with a No. 14 or larger wire.
 - B. Energize all power sources connected in parallel.
 - C. With a voltmeter, check the voltage across the "work" terminal of one power source and the "work" terminals of the other power source or power sources. If the voltage is approximately zero, the phase relationship is correct. If, however, the voltage is approximately 160 volts (double open circuit voltage) the phase relationship is incorrect. Reverse the primary connections on one power source at a time until zero voltage between all work terminals is acquired. Remove the temporary jumper wires connected to the "electrode" terminals.

3. When making secondary cable connections, the same procedure and recommendations outlined for DC welding power sources should be followed. Be sure connections are made work to work and electrode to electrode.



- Temporarily Connect All "Electrode" Terminals Together With A No. 14 Or Larger Wire.
- Energize All Power Sources.
- Voltage Across "Work" Terminal Of One Power Source And Work Terminals Of Other Power Sources Should Read Approximately "Zero" When In Phase.
- If Voltage Reads Approximately 160 V. (Double O.C.V.) The Phase Relationship Is Incorrect.

Figure 5. Correct Procedure For Phasing AC Power Sources



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