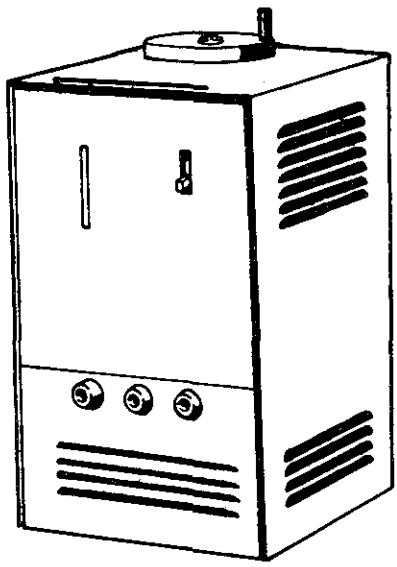
October 1975 FORM: OM-116A
Effective with Style No. HF-6B

MODEL	STOCK NO.
Thunderbolt 225V	902 031
Thunderbolt 225VP	902 032



MODEL/STOCK NO.	SERIAL/STYLE NO.	DATE PURCHASED

OWNER'S MANUAL

MILLER ELECTRIC MFG. CO.
APPLETON, WISCONSIN, USA 54911

NWSA CODE NO. 4579

PRINTED IN U.S.A.

OPTIONAL ACCESSORIES

1-TWA Welding Accessories (Stock No. 040 604)

This welding accessory consists of:

(1) Fifteen foot No. 4 electrode cable with an electrode holder.

(2) Ten foot No. 4 ground cable with clamp.

(3) Welding helmet.

AT-10 Carbon Arc Torch (Stock No. 040 229)

This Torch, when used in conjunction with the welding power source, provides the ability to weld or braze metals that ordinarily are considered weldable only by the oxy-acetylene method.

No. 11 Running Gear (Stock No. 040 874)

A five inch solid rubber tired wheel and handle for mobility of the welding power source.

ERRATA SHEET

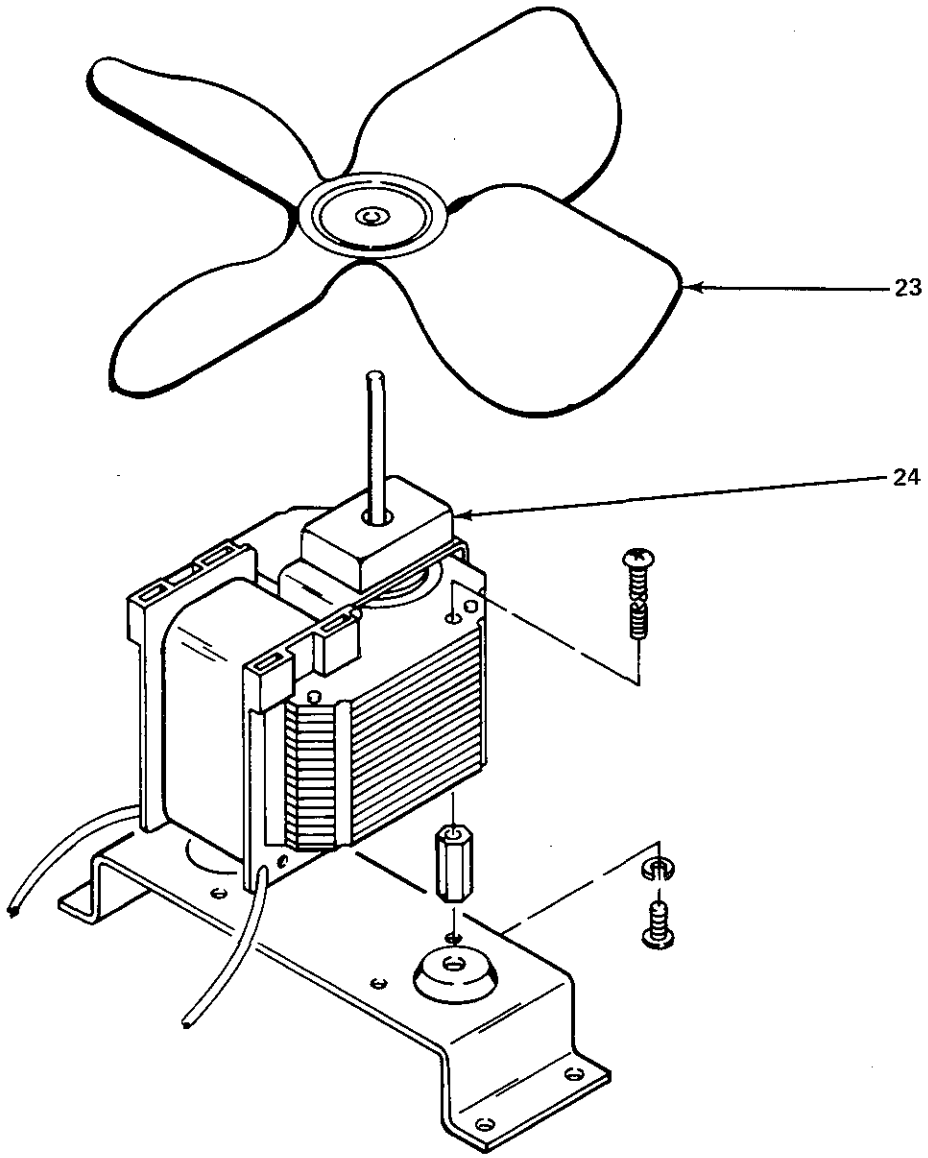
After this manual was printed, refinements in equipment design occurred. This sheet lists exceptions to data appearing later in this manual.

IMPORTANT

The motor and fan listed on this errata sheet are alternates for the one listed in the parts list. Fan blades are not interchangeable from the enclosed motor to the open motor.

Item No.	Dia. Mkgs.	Part No. Listed In Parts List	Replaced With Part No.	Description	Quantity
23		032 662	005 656	BLADE, fan 6 inch 4 wing 30 degree	1
24	FM	032 678	005 593	MOTOR, 230 volts 60 Hz 3000 rpm	1

BE SURE TO PROVIDE STOCK, MODEL, AND STYLE NUMBERS WHEN ORDERING REPLACEMENT PARTS.



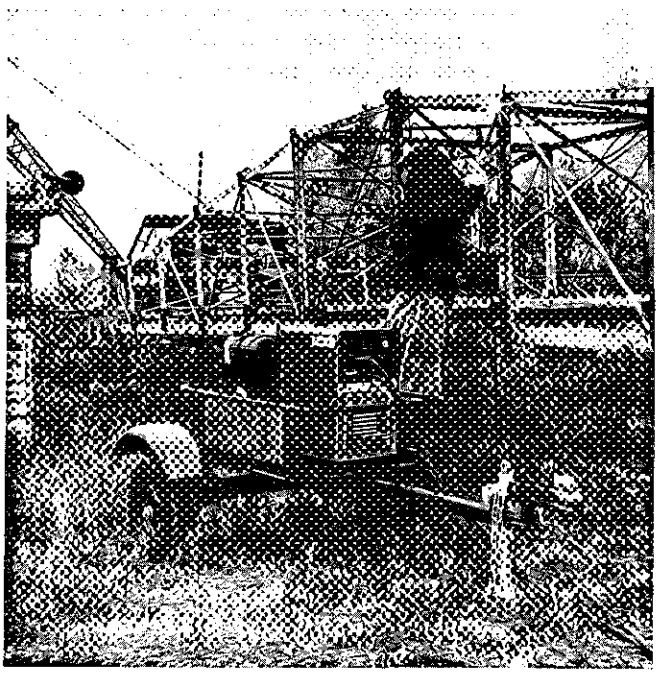
TD-901 863-A

MORE WAYS TO WELD BETTER

miller

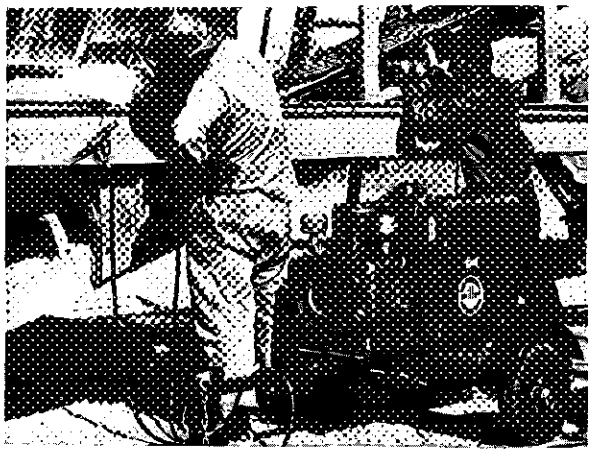
Roughneck 1

AIR-COOLED GASOLINE ENGINE DRIVEN PORTABLE WELDER/POWER PLANT



Roughneck 1 delivers 45 to 190 amperes of ac in five welding current ranges – with infinite current control in each range. It will, if needed, operate at 180 amperes, 100% duty cycle, around the clock without any "cooling off" period. Ideal for welding light gauge as well as heavy metal for construction work, factory maintenance, farm machinery repair, sign erection, job shop welding, shipyards, and many other uses.

As a power plant, Roughneck 1 produces 3500 watts 115 volt 60 Hz ac to operate compressors, power tools, electric motors, hoists, pumps, and other items.



miller AEA-200 and AEAD-200 AIR-COOLED GASOLINE ENGINE DRIVEN WELDER/POWER PLANTS

The Miller AEA-200 produces 30 to 250 amperes of ac in five welding current ranges with infinite current control in each range. 100% duty cycle rating is 225 amperes. Ample open circuit voltage assures superior performance of ac or ac/dc electrodes from 1/16" to 3/16" inclusive.

AEAD-200 ac welding output is the same as AEA-200, plus 30 to 200 amperes of dc, 200 amperes at 100% duty cycle. Handles all mild steel and stainless steel electrodes through 3/16". AEAD-200 is ideal for additional jobs such as repairing castings, laying the "wash coat" base when hardsurfacing, and welding non-ferrous metals.

Both AEA-200 and AEAD-200 produce 1000 watts of 115 volt auxiliary dc to operate drills, power tools or furnish lights while welding. Optional power plants provide 5000 watts of 115/230 volts 60 Hertz ac.

miller SPOT WELDERS SEW STEEL FAST!

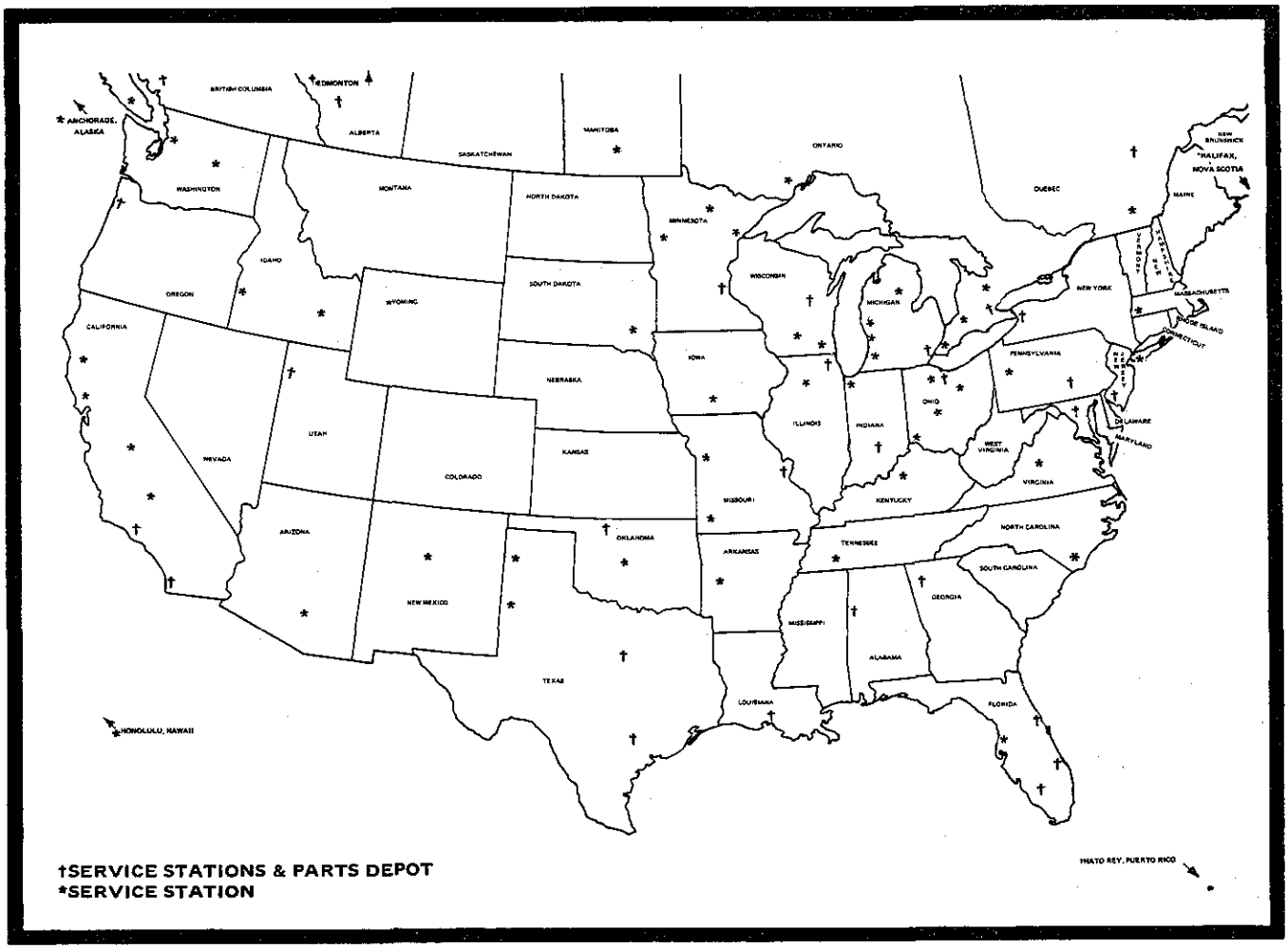
Miller makes 12 models of spot welders in sizes capable of joining a combined thickness of from 1/8" to 1/4" mild steel. Spot welding fastens metals faster, better, cheaper and more attractively than bolting, crimping, riveting or soldering.

MILLER series of Spot Welders, with pre-set tip pressure and available timer, make completely uniform and consistent welds.

Miller Portable Spot welders combine strength, speed and low cost of resistance welding in a welder light enough to easily carry and hold in position while welding. Also available, Gyro-Bail "hangs the weight" of the welder, operates with boom and counter-weight or from spring loaded cable to reduce operator fatigue.

Miller Water Cooled Spot welders are available as portable units or pedestal mounted, and manual or air operated.

SERVICE DIRECTORY
MILLER WELDERS



Service Available throughout United States & Canada

FORM: ME-796N
DATE: September, 1975
SUPERSEDES: ME-796M

We believe that efficient – knowledgeable – prompt service is an absolute must in a capital goods industry such as ours.

In addition to our factory service facility, we maintain in the neighborhood of one hundred other sources of authorized service throughout United States and Canada. These are Service Stations and Parts Depots and Service Stations.

A Service and Parts Depot or a Service Station is an independent organization under contract with MILLER. In order to qualify for such an arrangement, an organization must agree to send their representatives to the MILLER Service School in Appleton for periodic training sessions. As a Parts Depot they must agree to maintain a stock of MILLER parts.

During the course of a year, MILLER conducts many service schools for Service Stations and Parts Depots plus Service Station personnel. Large users of MILLER welders, too, frequently send people to the Appleton plant for Training sessions.

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APPLETON, WISCONSIN

Creators of the World's Finest Welders

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Mobile, Alabama 36609
Phone: 205-471-1591

*Higgins Electric Company, Inc.
206 North Appletree Street
Dothan, Alabama, 36301
Phone: 205-792-9231 or 794-6400

ALASKA

*A & P Sales and Service Company
712 West Potter Drive
Anchorage, Alaska 99502
Phone: 907-277-3315

ARIZONA

*Industrial Welder Repair & Service
1650 East 18th Street (Unit U)
Tucson, Arizona 85719
Phone: 602-623-6711

*Pioneer Industrial, Inc.
3550 South 16th
Phoenix, Arizona 85040
Phone: 602-243-1791

ARKANSAS

*Fagan Company, Inc.
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Little Rock, Arkansas 72209
Phone: 501-565-7561

CALIFORNIA

*BAWRCO (Bay Area Welder Repair Co.)
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San Jose, California 95112
Phone: 408-298-5118

†Cassimus Company
14492 Wicks Boulevard
San Leandro, California 94577
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*Electric Motor Shop, Inc.
253 Fulton St.
Fresno, California 93721
Phone: 209-233-1153

*Electric Motor Works, Inc.
803 Inyo Street
Bakersfield, California 93305
Phone: 805-327-4271

*Electric Service Company
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San Diego, California 92102
Phone: 714-232-2851

*Lahr Electric Motors, Inc.
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Santa Maria, California 93454
Phone: 805-922-8326

†Neely & Walker, Inc.
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Los Angeles, California 90040
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*Sacramento Industrial Electric
6313 Elvas Avenue
Sacramento, California 95819
Phone: 916-452-2828

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*Advance Electric Co.
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Fort Lauderdale, Florida 33315
Phone: 305-527-4521

*Collins Marine Electric
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Naples, Florida 33940
Phone: 813-649-2770

†Condo Electric Service
2251 Northwest First Place
Miami, Florida 33127
Phone: 305-573-5400

†Florida Electric Motors & Equipment
801 - 27th Street
West Palm Beach, Florida 33401
Phone: 305-833-0859

*Norman's Electric Motors
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Sarasota, Florida 33577
Phone: 813-365-0501

*Orlando Armature Works
600 West Central Avenue
Orlando, Florida 32801
Phone: 305-423-0555

*Southern Winding Service, Inc.
607 South Fremont Avenue
Tampa, Florida 33607
Phone: 813-253-0155

*Turner Electric Works
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Jacksonville, Florida 32206
Phone: 904-353-3661

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†McCullough Electric Motor Service
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*Ireland Electric Corp.
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Augusta, Georgia 30906
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*Dick's Electric Motor Repair
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*Gem State Electric
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Boise, Idaho 83704
Phone: 208-344-5461

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*Crowell's Electric Works
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Rockford, Illinois 61103
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*Motorcraft Electric Co.
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Chicago, Illinois 60608
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*Richards Electric Motor Co.
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Quincy, Illinois 62301
Phone: 217-222-7154

*Ther Electric & Machine Works
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Chicago, Illinois 60606
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*Cox Equipment Company
2010 W. Maryland Street
Indianapolis, Indiana 46222
Phone: 317-632-7137

*Koontz & Wagner Electric Co., Inc.
3801 Voorde Drive
South Bend, Indiana 46628
Phone: 219-232-2051

†McBroom Electric Company, Inc.
800 West 16th Street
Indianapolis, Indiana 46202
Phone: 317-926-3451

IOWA

*Industrial Engineering Equipment Co.
1958 West River Drive
Davenport, Iowa 52802
Phone: 319-323-9721

KENTUCKY

*Lexington Industrial Service Company Inc.
1151 Floyd Drive
Lexington, Kentucky 40505
Phone: 606-255-0818

*Quality Electric Service, Inc. of Paducah
532 Milliken Road
Paducah, Kentucky 42001
Phone: 502-422-4151 or 442-4144

LOUISIANA

†A & H Electric, Inc.
1330 Westbank Expressway
Westwego, Louisiana 70094
Phone: 504-347-3781

*Electrical Maintenance System, Inc.
300 Aycock St.
Morgan City, Louisiana 70380
Phone: 504-384-3866

*Harris A. Castille, Inc.
104 East Admiral Doyle Drive
New Iberia, Louisiana 70560
Phone: 318-364-8248

*Louisiana Electric Coil, Inc.
P.O. Box 15254
11997 Airline Highway
Baton Rouge, Louisiana 70815
Phone: 504-293-3333

MARYLAND

†Hanle Electric and Electronic Co., Inc.
8563 Baltimore Nat'l Pike
U.S. 40 West
Ellicott City, Maryland 21043
Phone: 301-465-5100

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*Joseph C. Helmund, Inc.
79 Clapp Street
Boston, Massachusetts 02125
Phone: 617-825-3230

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*Commercial Electric Company
333 Hamblin Avenue
Battle Creek, Michigan 49015
Phone: 616-962-8789

*D.M.S. Electric Apparatus Service
606 E. Gibson Street
Kalamazoo, Michigan 49006
Phone: 616-382-5307

*Electric Motor Service & Supply Company
2906 Longway Blvd.
Flint, Michigan 48506
Phone: 313-235-7120

†Hall Electric Company
2701 McIlwraith St.
Muskegon Heights, Michigan 49444
Phone: 616-733-1249

*Hamilton Electric Co.
708 South Hamilton Street
Saginaw, Michigan 48602
Phone: 517-799-6291

*Jay Electric Co.
5664 St. Jean Avenue
Detroit, Michigan 48213
Phone: 313-921-0400

*Spaulding Electric Company
1350 Michigan Avenue
Detroit, Michigan 48226
Phone: 313-962-6200

*Whittaker Electric Company
1336 Front Street, N.W.
Grand Rapids, Michigan 49504
Phone: 616-458-1253

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†Electric Motor Repair, Inc.
2405 Washington Avenue, North
Minneapolis, Minnesota 55411
Phone: 612-522-3318

*Horvick Electric Motor Company
303-307 Main Avenue
Moorhead, Minnesota 56560
Phone: 218-233-1566

*Malton Electric Company
1505 West Chestnut Street
Virginia, Minnesota 55792
Phone: 218-741-8252

*Mielke Electric Works, Inc.
2606 West Michigan Street
Duluth, Minnesota 55806
Phone: 218-727-7411

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*Power Electric Company, Inc.
1920 North Mill Street
Jackson, Mississippi 39206
Phone: 601-948-4622

MISSOURI

*Independent Electric Machinery Company
300 Southwest Boulevard
Kansas City, Missouri 64108
Phone: 816-471-2610

*Springfield Electric Company
1640 West Trafficway
Springfield, Missouri 65802
Phone: 417-862-0922

NEVADA

*Dratter Electrical Service
2963 Westwood Drive
Las Vegas, Nevada 89109
Phone: 702-734-2865

NEW JERSEY

†Industrial Electric Service Company
259-263 Goffle Road
Hawthorne, New Jersey 07506
Phone: 201-423-1212

NEW MEXICO

*Telco Electric, Inc.
2906 Fourth Street, N.W.
Albuquerque, New Mexico 87107
Phone: 505-345-2426

NEW YORK

*Chuck's Welder Repair Service
46 Letchworth Street
Buffalo, New York 14213
Phone: 716-883-3422

*Anthony Giordano
350 Piccadilly Downs
Lynbrook, New York 11563
Phone: 516-593-6436

*Volland Electric Equipment Company
1511 Niagara Street
Buffalo, New York 14213
Phone: 716-884-2713

NORTH CAROLINA

*Southeast Electric Motor Service
1020 Chestnut Street
Wilmington, North Carolina 28401
Phone: 919-763-7048

OHIO

†The B. & P. Electric Motor Repair Co.
15740 Industrial Parkway
Cleveland, Ohio 44135
Phone: 216-267-9070

*Berthold Electric Company
1025 Eagon Street
Barberton, Ohio 44203
Phone: 216-745-1136

*The Cahill Company
841 East Hudson Street
Columbus, Ohio 43211
Phone: 614-267-4595

*The Cincinnati Electric Equipment Co.
16 East 72nd Street
Cincinnati, Ohio 45216
Phone: 513-761-6105

*Economy Electric Company
645 Market Street
Youngstown, Ohio 44507
Phone: 216-744-4461

*J-B Welder Div.
Ohio Transformer Corporation
1 Willow Street
Louisville, Ohio 44641
Phone: 216-875-3333

OKLAHOMA

†National Electric Coil
39 North Peoria
Tulsa, Oklahoma 74120
Phone: 918-587-1125

*Southwest Electric Company
2617 - 21 South Agnew
Oklahoma City, Oklahoma 73108
Phone: 405-634-4445

OREGON

†Electrical Construction Company
2121 N. W. Thurman
Portland, Oregon 97210
Phone: 503-224-3511

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*Crowder Jr. Company
1107 Eaton Avenue
Bethlehem, Pennsylvania 18018
Phone: 215-866-8081

*Pennsylvania Electric Coil, Inc.
1301 Saw Mill Boulevard
Pittsburgh, Pennsylvania 15226
Phone: 412-881-4010

†Standard Electric Service Corporation
10th & Exeter Streets
Reading, Pennsylvania 19601
Phone: 215-921-0617

*Universal Electric & Mfg. Company
629 Elder Street
Johnstown, Pennsylvania 15902
Phone: 814-535-2566

SOUTH CAROLINA

*Ireland Electric Corporation
2200 Heriot Street at 1.26
Charleston, South Carolina 29403
Phone: 803-723-6449

SOUTH DAKOTA

*Shakstad Electric and Machine Works
1400 Industrial Avenue
Sioux Falls, South Dakota 57101
Phone: 605-336-3090

TENNESSEE

*Chattanooga Armature Works
1215 Duncan Avenue
Chattanooga, Tennessee 37404
Phone: 615-629-7361

*Tennessee Armature & Electric Company
P.O. Box 27
312 West Jackson Avenue
Knoxville, Tennessee 37901
Phone: 615-524-3681

TEXAS

*Beaumont Armature Works, Inc.
700 North Main
Beaumont, Texas 77704
Phone: 713-833-5113

*G.E. Jones Electric Company
212 North Polk Street
Amarillo, Texas 79107
Phone: 806-372-5505

*Gene White Electric Company
1833 N. University
Lubbock, Texas 79417
Phone: 806-765-8402

*Smith-Shields Electric Works
Highway 44 and Baldwin Blvd.
Corpus Christi, Texas 78405
Phone: 512-882-4221

†Staples Welding Machine Repair
6303 Brookhill Drive
Houston, Texas 77017
Phone: 713-645-2163

UTAH

*C.W. Silver Company
550 West 7th Street
Salt Lake City, Utah 84101
Phone: 801-355-5377

VIRGINIA

*Instrument Technical Representatives
1003 Starling Drive
Richmond, Virginia 23229
Phone: 703-288-7198

WASHINGTON

*Industrial Electric Company
2701 Hewitt Avenue
Everett, Washington 98201
Phone: 206-252-3129

*K & N Electric Motors, Inc.
217 West Cataldo
Spokane, Washington 99201
Phone: 509-328-3260

WEST VIRGINIA

*Kanawha Electric Machine Company
6304 McCorkle Avenue S.E.
Charleston, West Virginia 25304
Phone: 304-925-6691

WISCONSIN

*Electric Motors Unlimited, Inc.
1000 Jonathan Drive
Madison, Wisconsin 53713
Phone: 608-271-2311

†Miller Electric Mfg. Co.
P.O. Box 1087
718 South Bounds Street
Appleton, Wisconsin 54911
Phone: 414-734-9821

*Serv-All Welding Equipment Repair Corp.
16236 West Lincoln Avenue
New Berlin, Wisconsin 53151
Phone: 414-786-0180

†Service Stations and Parts Depots
***Service Stations**

LIMITED WARRANTY

MILLER Electric Mfg. Co., Appleton, Wisconsin, warrants all new equipment to be free from defects in material and factory workmanship for the periods indicated below, provided the equipment is installed and operated according to manufacturer's instructions.

MILLER Electric Mfg. Co's obligation, under this warranty, is expressly limited to replacing or repairing any defective part or correcting any manufacturing defect without charge during the warranty period if MILLER'S inspection confirms the existence of such defects. MILLER's option of repair or replacement will be f.o.b. factory at Appleton, Wisconsin or f.o.b. a MILLER authorized service facility, and therefore no compensation for transportation costs of any kind will be allowed.

The warranty period, beginning on the date of sale to the original purchaser-user of the equipment, will be as follows:

1. Arc welders, power sources, and components — 1 year
2. Original main power rectifiers — 3 years (unconditionally)
3. MHG-20E, 20K and all guns — 90 days
4. All other Millermatic Feeders — 1 year
5. Mag-Diesel engine on DEL-200 — 6 months
6. All other engines — 1 year

The labor expense on installing original main power rectifiers after being in service one year will be the owners responsibility.

Engine Warranties are covered by the engine manufacturers, subject to their procedures and to be handled through their authorized local Service Stations or agencies. No warranty will be made in respect to trade accessories, such being subject to the warranties for their respective manufacturers.

MILLER Electric Mfg. Co. will not be liable for any loss or consequential damage or expense accruing directly or indirectly from the use of equipment covered in this warranty.

This warranty supersedes all previous MILLER warranties and is exclusive with no other guarantees or warranties expressed or implied.

WHEN SERVICE IS REQUIRED

Should service be required under warranty, contact the MILLER Service Department (phone 414-734-9821) or the nearest authorized Service Station giving both model and serial number of the welder, the date the welder was placed in service and the nature of the complaint. Any repair work done on a welder under warranty without authorization of the MILLER Service Department or sent to a MILLER authorized Service Station will be done at the customer's expense.

RETURN OF NEW EQUIPMENT

A distributor who wishes to return new welders to the factory for credit will be subject to paying 10% of the distributor cost or $25 whichever is greater. Before effecting shipment, authority must first be obtained in writing directly from the Sales Department of MILLER Electric Mfg. Co., Appleton, Wisconsin. The Service Department will then issue a "return goods" label which must be affixed to returned equipment and it must bear the name of the person authorizing return and the date of the authorization. Standard cataloged items only may be returned.

RETURN OF EQUIPMENT TO BE REPAIRED

A distributor who wishes to return a welder to the factory for repair must contact the Service Department in order to obtain shipping instructions and a "return goods" label.

RETURN OF PARTS

On the return of parts, a 10% restocking charge or $25 minimum will apply, and the parts are to be returned prepaid. Before effecting shipment, authority must first be obtained in writing directly from the Service Department of MILLER Electric Mfg. Co., Appleton, Wisconsin. The Service Department will then issue a "return goods" label which must be affixed to returned parts.

MINIMUM BILLING

The minimum billing for orders shipped from the factory at Appleton, Wisconsin is $25.

CANADA

BRITISH COLUMBIA

*A.C. Electric Motor Service Limited
16 Nicol Street
Nanaimo, British Columbia, Canada
Phone: 604-754-5142

*Elworthy & Co. Ltd.
3709 East First Avenue
Burnaby, British Columbia, Canada
Phone: 604-299-4341

ALBERTA

+Bennet & Emmott Limited
P.O. Box 898
12345 - 149th Street
Edmonton, Alberta, Canada T5L 2J5
Phone: 403-453-1541

*Kristian Electric Ltd.
4708 First Street, S.W.
Calgary, Alberta, Canada T2G 0A1
Phone: 403-243-1492

MANITOBA

+King's Electric Motors Ltd.
835 Main Street
Winnipeg, Manitoba, Canada R2W 3N9
Phone: 204-947-1271

ONTARIO

+Hamilton Electric Equipment Co., Ltd.
137 Cannon Street, East
Hamilton, Ontario, Canada L8L 2A4
Phone: 416-528-5943

*Mahon Electric Co., Limited
Box 307, 611 Victoria Avenue
Thunder Bay "F", Ontario, Canada P7C 4V9
Phone: 807-623-8471

+Peel Engine Service Co., Ltd.
44 Chauncey Avenue
Toronto, Ontario, Canada M8Z 2Z4
Phone: 416-231-1042

*Toll-Morris Electric Limited
287 Adelaide St., South
London, Ontario, Canada N5Z 3K7
Phone: 519-432-2675

*Waffle's Electric Limited
400 Erie East
Windsor, Ontario, Canada N9A 3X4
Phone: 519-254-9215

QUEBEC

+Electro-Mecanik, Inc.
445, Marconi Ste-Foy
Quebec, P.Q., Canada G1N 4A7
Phone: 418-683-1724

+Rep-Arc Limited
6515 P.E. Lamarche
St. Leonard, Quebec, Canada
Phone: 514-321-5414 - 5

*Wood's Electrical & Equipment Service Inc.
360 - 366 Marquette Avenue
Sept Iles, Quebec, Canada
Phone: 418-962-6131

NEW BRUNSWICK

*Universal Sales Ltd.
P.O. Box 2150, Postal Station "C"
397 City Road
Saint John, New Brunswick, Canada E2L 3T9
Phone: 506-652-1858 - Electric Motor Rewinding

NOVA SCOTIA

+Nova Scotia Armature Works Limited
2451-53 James Street
Halifax, Nova Scotia, Canada
Phone: 902-429-1590

NEWFOUNDLAND

*Ozark Electrical Marine Ltd.
P.O. Box 1083
711-713 Water Street
St. John's, Newfoundland, Canada
Phone: 709-726-4554

†Service Stations and Parts Depots
***Service Stations**

TABLE OF CONTENTS

SECTION 1 - SAFETY RULES FOR OPERATION OF ARC WELDING POWER SOURCE

1-1. INTRODUCTION

We learn by experience. Learning safety through personal experience like a child touching a hot stove is harmful, wasteful, and unwise. Let the experience of others teach you.

Safe practices developed from experience in the use of welding and cutting are described in this manual. Research, development, and field experience have evolved reliable equipment and safe installation, operation, and servicing practices. Accidents occur when equipment is improperly used or maintained. The reason for the safe practices may not always be given. Some are based on common sense, others may require technical volumes to explain. It is wiser to follow the rules.

Read and understand these safe practices before attempting to install, operate, or service the equipment. Comply with these procedures as applicable to the particular equipment used and their instruction manuals, for personal safety and for the safety of others.

Failure to observe these safe practices may cause serious injury or death. When safety becomes a habit, the equipment can be used with confidence.

Responsibilities of installer, user, and serviceman. Installation, operation, checking, and repair of this equipment must be done only by a competent person, experienced with such equipment.

These safe practices are divided into two Sections: 1 - General Precautions, common to arc welding and cutting; and 2 - Arc Welding (and Cutting)(only).

Reference standards: Published Standards on safety are also available for additional and more complete procedures than those given in this manual. They are listed in the Standards Index in these safety rules. ANSI Z49.1 is the most complete.

The National Electrical Code, Occupation Safety and Health Administration, local industrial codes, and local inspection requirements also provide a basis for equipment installation, use, and service.

1-2. GENERAL PRECAUTIONS

A. Burn Prevention

Wear protective clothing - leather (or asbestos) gauntlet gloves, hat, and high safety-toe shoes. Button shirt collar and pocket flaps, and wear cuffless trousers to avoid entry of sparks and slag.

Wear helmet with safety goggles or glasses with side shields underneath, appropriate filter lenses or plates (protected by clear cover glass). This is a MUST for welding or cutting, (and chipping) to protect the eyes from radiant energy and flying metal. Replace cover glass when broken, pitted, or spattered. See 1-3A.

Avoid oily or greasy clothing. A spark may ignite them.

Hot metal such as electrode stubs and workpieces should never be handled without gloves.

Medical first aid and eye treatment. First aid facilities and a qualified first aid person should be available for each shift unless medical facilities are close by for immediate treatment of flash burns of the eyes and skin burns.

Ear plugs should be worn when working on overhead or in a confined space. A hard hat should be worn when others work overhead.

Flammable hair preparations should not be used by persons intending to weld or cut.

B. Toxic Fume Prevention

Adequate ventilation. Severe discomfort, illness or death can result from fumes, vapors, heat, or oxygen enrichment or depletion that welding (or cutting) may produce. Prevent them with adequate ventilation as described in ANSI Standard Z49.1 listed 1 in Standards index. NEVER ventilate with oxygen.

Lead, cadium, zinc, mercury, and beryllium bearing and similar materials, when welded (or cut) may produce harmful concentrations of toxic fumes. Adequate local exhaust ventilation must be used, or each person in the area as well as the operator must wear an air-supplied respirator. For beryllium, both must be used.

Metals coated with or containing materials that emit toxic fumes should not be heated unless coating is removed from the work surface, the area is well ventilated, or the operator wears an air-supplied respirator.

Work in a confined space only while it is being ventilated and, if necessary, while wearing an air-supplied respirator.

Gas leaks in a confined space should be avoided. Leaked gas in large quantities can change oxygen concentration dangerously. Do not bring gas cylinders into a confined space.

Leaving confined space, shut OFF gas supply at source. The space will then be safe to re-enter, if downstream valves have been accidently opened or left open.

Vapors from chlorinated solvents can be decomposed by the heat of the arc (or flame) to form PHOSGENE, a highly toxic gas, and other lung and eye irritating products. The ultraviolet (radiant) energy of the arc can also decompose trichloroethylene and perchloroethylene vapors to form phosgene. DO NOT WELD or cut where solvent vapors can be drawn into the welding or cutting atmosphere or where the radiant energy can penetrate to atmospheres containing even minute amounts of trichlorethylene or perchlorethylene.

C. Fire and Explosion Prevention

Causes of fire and explosion are: combustibles reached by the arc, flame, flying sparks, hot slag or heated material; misuse of compressed gases and cylinders; and short circuits.

Be aware that flying sparks or falling slag can pass through cracks, along pipes, through windows or doors, and through wall or floor openings, out of sight of the goggled operator. Sparks and slag can fly 35 feet.

To prevent fires and explosion:

Keep equipment clean and operable, free of oil, grease, and (in electrical parts) of metallic particles that can cause short circuits.

If combustibles are in area, do NOT weld or cut. Move the work if practicable, to an area free of combustibles. Avoid paint spray rooms, dip tanks, storage areas, ventilators. If the work can not be moved, move combustibles at least 35 feet away out of reach of sparks and heat; or protect against ignition with suitable and snug-fitting, fire-resistant covers or shields.

Walls touching combustibles on opposite sides should not be welded on (or cut). Walls, ceilings, and floor near work should be protected by heat-resistant covers or shields.

Fire watcher must be standing by with suitable fire extinguishing equipment during and for some time after welding or cutting if:

a. appreciable combustibles (including building construction) are within 35 feet
b. appreciable combustibles are further than 35 feet but can be ignited by sparks
c. openings (concealed or visible) in floors or walls within 35 feet may expose combustibles to sparks
d. combustibles adjacent to walls, ceilings, roofs, or metal partitions can be ignited by radiant or conducted heat.

Hot work permit should be obtained before operation to ensure supervisor's approval that adequate precautions have been taken.

After work is done, check that area is free of sparks, glowing embers, and flames.

An empty container that held combustibles, or that can produce flammable or toxic vapors when heated, must never be welded on or cut, unless container has first been cleaned as described in AWS Standard A6.0, listed 3 in Standards index.

This includes: a thorough steam or caustic cleaning (or a solvent or water washing, depending on the combustible's solubility) followed by purging and inerting with nitrogen or carbon dioxide, and using protective equipment as recommended in A6.0. Waterfilling just below working level may substitute for inerting.

A container with unknown contents should be cleaned (see paragraph above). Do NOT depend on sense of smell or sight *to determine if it is safe to weld* or cut.

Hollow castings or containers must be vented before welding or cutting. They can explode.

Explosive atmospheres. Never weld or cut where the air may contain flammable dust, gas, or liquid vapors (such as gasoline).

D. Compressed Gas Equipment

Standard precautions. Comply with precautions in this manual, and those detailed in CGA Standard P-1, PRECAUTIONS FOR SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, listed 6 in Standards index.

1. Pressure Regulators

Regulator relief valve is designed to protect only the regulator from overpressure; it is not intended to protect any downstream equipment. Provide such protection with one or more relief devices.

Never connect a regulator to a cylinder containing gas other than that for which the regulator was designed.

Remove faulty regulator from service immediately for repair (first close cylinder valve). The following symptoms indicate a faulty regulator:

Leaks - if gas leaks externally.
Excessive Creep - if delivery pressure continues to rise with downstream valve closed.
Faulty Gauge - if gauge pointer does not move off stop pin when pressurized, nor returns to stop pin after pressure release.

Repair. Do NOT attempt repair. Send faulty regulators for repair to manufacturer's designated repair center, where *special techniques and tools are used by trained personnel.*

2. Cylinders

Cylinders must be handled carefully to prevent leaks and damage to their walls, valves, or safety devices:

Avoid electrical circuit contact with cylinders including third rails, electrical wires, or welding circuits. They can produce short circuit arcs that may lead to a serious accident. (See 1-3C.)

ICC or DOT marking must be on each cylinder. It is an *assurance of safety when the cylinder is properly handled.*

Identifying gas content. Use only cylinders with name of gas marked on them; do not rely on color to identify gas content. Notify supplier if unmarked. NEVER DEFACE or alter name, number, or other markings on a cylinder. It is illegal and hazardous.

Empties: Keep valves closed, replace caps securely; mark MT; keep them separate from FULLS and return promptly.

Prohibited use. Never use a cylinder or its contents for other than its intended use, NEVER as a support or roller.

Secure from falling. Chain or secure cylinders upright when a regulator (and hose) are connected to it.

Passageways and work areas. Keep cylinders clear of areas where they may be struck.

Transporting cylinders. With a crane, use a secure support such as a platform or cradle. Do NOT lift cylinders off the ground by their valves or caps, or by chains, slings, or magnets.

Do NOT expose cylinders to excessive heat, sparks, slag, and flame, etc. that may cause rupture. Do not allow contents to exceed 130°F. Cool with water spray where such exposure exists.

Protect cylinders particularly valves from bumps, falls, falling objects, and weather. Replace caps securely when moving cylinders.

Stuck valve. Do NOT use a hammer or metal wrench to open a cylinder valve that can not be opened by hand. Notify your supplier.

Mixing gases. Never try to mix any gases in a cylinder.

Never refill any cylinder.

Cylinder fittings should never be modified or exchanged.

3. Hose

Prohibited use. Never use hose other than that designed for the specified gas. A general hose identification rule is: red for fuel gas, green for oxygen, and black for inert gases.

Use ferrules or clamps designed for the hose (not ordinary *wire or other substitute) as a binding to connect hoses to* fittings.

No copper tubing splices. Use only standard brass fittings to splice hose.

Avoid long runs to prevent kinks and abuse. Suspend hose off ground to keep it from being run over, stepped on, or otherwise damaged.

Coil excess hose to prevent kinks and tangles.

Protect hose from damage by sharp edges, and by sparks, *slag, and open flame.*

Examine hose regularly for leaks, wear, and loose connections. Immerse pressured hose in water; bubbles indicate leaks.

Repair leaky or worn hose by cutting area out and splicing (1-2D3). Do NOT use tape.

4. Proper Connections

Clean cylinder valve outlet of impurities that may clog orifices and damage seats before connecting regulator. Except *for hydrogen, crack valve momentarily, pointing outlet away* from people and sources of ignition. Wipe with a clean lintless cloth.

Match regulator to cylinder. Before connecting, check that the regulator label and cylinder marking agree, and that the regulator inlet and cylinder outlet match. NEVER CONNECT a regulator designed for a particular gas or gases to a cylinder containing any other gas.

Tighten connections. When assembling threaded connections, clean and smooth seats where necessary. Tighten. If connection leaks, disassemble, clean, and retighten. For metal-to-*metal seating, use correct wrenches, available from your* supplier. For O-ring connections, hand tighten.

Adapters. Use a CGA adapter (available from your supplier) between cylinder and regulator, if one is required. Use two wrenches to tighten adapter marked RIGHT and LEFT HAND threads.

Regulator outlet (or hose) connections may be identified by right hand threads for oxygen and left hand threads (with grooved hex on nut or shank) for fuel gas.

5. Pressurizing Steps:

Drain regulator of residual gas through suitable vent before opening cylinder (or manifold valve) by turning adjusting screw in (clockwise). Draining prevents excessive compression heat at high pressure seat by allowing seat to open on pressurization. Leave adjusting screw engaged slightly on single-stage regulators.
Before opening cylinder valve, check that hoses are connected and that downstream valves are closed.

Stand to side of regulator while opening cylinder valve.

Open cylinder valve slowly so that regulator pressure in*creases slowly. When gauge is pressurized (gauge reaches regu*lator maximum) leave cylinder valve in following position: For oxygen, and inert gases, open fully to seal stem against

possible leak. For fuel gas, open to less than one turn to permit quick emergency shutoff.

Use pressure charts (available from your supplier) for safe and efficient, recommended pressure settings on regulators. It will reduce backfiring and chance of flashbacks.

Check for leaks on first pressurization and regularly thereafter. Brush with soap solution (capful of Ivory Liquid* or equivalent per gallon of water). Bubbles indicate leak. Clean off soapy water after test; dried soap is combustible.

E. User Responsibilities

Remove leaky or defective equipment from service immediately and repair them only if recommended in equipment instruction manual. Send others for repair to manufacturer's designated repair center where special techniques and tools are used by trained personnel. Refer to User Responsibilities statement in equipment manual.

F. Leaving Equipment Unattended

Close gas supply at source and drain gas.

G. Rope Staging-Support

Rope staging-support should not be used for welding or cutting operation; rope may burn.

1-3. ARC WELDING

Comply with precautions in 1-2 and this section. Arc Welding, properly done, is a safe process, but a careless operator invites trouble. The equipment carries high currents at significant voltages. The arc is very bright and hot. Sparks fly, fumes rise, ultraviolet and infrared energy radiates, weldments are hot, and compressed gases may be used. The wise operator avoids unnecessary risks and protects himself and others from accidents. Precautions are described here and in standards referenced in index.

A. Burn Protection

Comply with precautions in 1-2.

The welding arc is intense and visibly bright. Its radiation can damage eyes, penetrate lightweight clothing, reflect from light-colored surfaces, and burn the skin and eyes. Skin burns resemble acute sunburn, those from gas-shielded arcs are more severe and painful. DON'T GET BURNED; COMPLY WITH PRECAUTIONS.

1. Protective Clothing

Wear long-sleeve clothing (particularly for gas-shielded arc) in addition to gloves, hat, and shoes (1-2A). As necessary, use additional protective clothing such as leather jacket or sleeves, flame-proof apron, and fire-resistant leggings. Avoid outergarments of untreated cotton.

Bare skin protection. Wear dark, substantial clothing. Button collar to protect chest and neck and button pockets to prevent entry of sparks.

2. Eye and Head Protection

Protect eyes from exposure to arc. NEVER look at an electric arc without protection.

Welding helmet or shield containing a filter plate shade no. 9 or denser must be used when welding. Place over face before striking arc.

Protect filter plate with a clear cover plate.

Cracked or broken helmet or shield should NOT be worn; radiation can pass through to cause burns.

Cracked, broken, or loose filter plates must be replaced IMMEDIATELY. Replace clear cover plate when broken, pitted, or spattered.

Flash goggles with side shields MUST be worn under the helmet to give some protection to the eyes should the helmet not be lowered over the face before an arc is struck. Looking at an arc momentarily with unprotected eyes (particularly a high intensity gas-shielded arc) can cause a retinal burn that may leave a permanent dark area in the field of vision.

*Trademark of Proctor & Gamble.

3. Protection of Nearby Personnel

Enclosed welding area. For production welding, a separate room or enclosed bay is best. In open areas, surround the operation with low-reflective, non-combustible screens or panels. Allow for free air circulation, particularly at floor level.

Viewing the weld. Provide face shields for all persons who will be looking directly at the weld.

Others working in area. See that all persons are wearing flash goggles.

Before starting to weld, make sure that screen flaps or bay doors are closed.

B. Toxic Fume Prevention

Comply with precautions in 1-2B.

Generator engine exhaust must be vented to the outside air. Carbon monoxide can kill.

C. Fire and Explosion Prevention

Comply with precautions in 1-2C.

Equipment's rated capacity. Do not overload arc welding equipment. It may overheat cables and cause a fire.

Loose cable connections may overheat or flash and cause a fire.

Never strike an arc on a cylinder or other pressure vessel. It creates a brittle area that can cause a violent rupture or lead to such a rupture later under rough handling.

D. Compressed Gas Equipment

Comply with precautions in 1-2D.

E. Shock Prevention

Exposed hot conductors or other bare metal in the welding circuit, or in ungrounded, electrically-HOT equipment can fatally shock a person whose body becomes a conductor. DO NOT STAND, SIT, LIE, LEAN ON, OR TOUCH a wet surface when welding, without suitable protection.

To protect against shock:

Keep body and clothing dry. Never work in damp area without adequate insulation against electrical shock. Stay on a dry duckboard, or rubber mat when dampness or sweat can not be avoided. Sweat, sea water, or moisture between body and an electrically HOT part - or grounded metal - reduces the body surface electrical resistance, enabling dangerous and possibly lethal currents to flow through the body.

1. Grounding the Equipment

When installing, connect the frames of each unit such as welding power source, control, work table, and water circulator to the building ground. Conductors must be adequate to carry ground currents safely. Equipment made electrically HOT by stray current may shock, possibly fatally. Do NOT GROUND to electrical conduit, or to a pipe carrying ANY gas or a flammable liquid such as oil or fuel.

Three-phase connection. Check phase requirement of equipment before installing. If only 3-phase power is available, connect single-phase equipment to only two wires of the 3-phase line. Do NOT connect the equipment ground lead to the third (live) wire, or the equipment will become electrically HOT - a dangerous condition that can shock, possibly fatally.

Before welding, check ground for continuity. Be sure conductors are touching bare metal of equipment frames at connections.

If a line cord with a ground lead is provided with the equipment for connection to a switchbox, connect the ground lead to the grounded switchbox. If a three-prong plug is added for connection to a grounded mating receptacle, the ground lead must be connected to the ground prong only. If the line cord comes with a three-prong plug, connect to a grounded mating receptacle. Never remove the ground prong from a plug, or use a plug with a broken off ground prong.

2. Electrode Holders

Fully insulated electrode holders should be used. Do NOT use holders with protruding screws.

3. Connectors

Fully insulated lock-type connectors should be used to join welding cable lengths.

4. Cables

Frequently inspect cables for wear, cracks and damage. IMMEDIATELY REPLACE those with excessively worn or damaged insulation to avoid possibly - lethal shock from bared cable. Cables with damaged areas may be taped to give resistance equivalent to original cable. Keep cable dry, free of oil and grease, and protected from hot metal and sparks.

5. Terminals

Terminals and other exposed parts of electrical units should have insulating covers secured before operation.

6. Electrode Wire

Electrode wire becomes electrically HOT when the power switch of gas metal-arc welding equipment is ON and welding gun trigger is pressed. Keep hands and body clear of wire and other HOT parts.

7. Safety Devices

Safety devices such as interlocks and circuit breakers should not be disconnected or shunted out.

Before installation, inspection, or service, of equipment, shut OFF all power and remove line fuses (or lock or red-tag switches) to prevent accidental turning ON of power. Disconnect all cables from welding power source, and pull all 115 volts line-cord plugs.

Do not open power circuit or change polarity while welding. If, in an emergency, it must be disconnected, guard against shock burns, or flash from switch arcing.

Leaving equipment unattended. Always shut OFF and disconnect all power to equipment.

Power disconnect switch must be available near the welding power source.

1-4. STANDARDS BOOKLET INDEX

For more information, refer to the following standards or their latest revisions and comply as applicable:

1. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING obtainable from the American Welding Society, 2501 NW 7th St., Miami, Fla. 33125.

2. ANSI Standard Z87.1, SAFE PRACTICE FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

3. American Welding Society Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES, obtainable same as item 1.

4. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING, obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

5. NFPA Standard 51B, CUTTING AND WELDING PROCESSES, obtainable same as item 4.

6. CGA Pamphlet P-1. SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, obtainable from the Compressed Gas Association, 500 Fifth Avenue, New York, N. Y. 10036.

7. OSHA Standard 29 CFR, Part 1910, Subpart Q, WELDING, CUTTING AND BRAZING.

SECTION 2 - INTRODUCTION

Model	Welding Current Ranges Amperes		Rated Current Output at 25 Volts 20% Duty Cycle	Maximum Open-Circuit Volts	Rated Input at Rated Load 60 Hertz Single-Phase Amperes	kw	Overall Dimensions (Inches)			Approx. Weight (Pounds)	
	High	Low			230V		Height	Width	Depth	Net	Ship
Without P.F. Correction	40-225	30-150	225	80	45.4	7.2	21-1/2	12-1/2	14	100	105
With P.F. Correction	40-225	30-150	225	80	39.5	7.2	21-1/2	12-1/2	14	104	109

Figure 2-1. Specifications

2-1. GENERAL

This manual has been prepared especially for use in familiarizing personnel with the design, installation, operation, maintenance, and troubleshooting of this equipment. All information presented herein should be given careful consideration to assure optimum performance of this equipment.

2-2. RECEIVING-HANDLING

Prior to installing this equipment, clean all packing material from around the unit and carefully inspect for any damage that may have occurred during shipment. Any claims for loss or damage that may have occurred in transit must be filed by the purchaser with the carrier. A copy of the bill of lading and freight bill will be furnished by the carrier on request if occasion to file claim arises.

When requesting information concerning this equipment, it is essential that Model Description and/or Stock Number and Serial (or Style) Numbers of the equipment be supplied.

2-3. DESCRIPTION

This unit is a single-phase welding power source which produces ac welding current. It is designed to be used as the welding power source for the Shielded Metal-Arc (Stick Electrode) Welding process.

2-4. SAFETY

Before the equipment is put into operation, the safety section at the front of this manual should be read completely. This will help avoid possible injury due to misuse or improper welding applications.

The following definitions apply to CAUTION, IMPORTANT, and NOTE blocks found throughout this manual:

CAUTION

Under this heading, installation, operating, and maintenance procedures or practices will be found that if not carefully followed may create a safety hazard to personnel.

IMPORTANT

Under this heading, installation, operating, and maintenance procedures or practices will be found that if not carefully followed may result in damage to equipment.

NOTE

Under this heading, explanatory statements will be found that need special emphasis to obtain the most efficient operation of the equipment.

SECTION 3 - INSTALLATION

3-1. LOCATION (Figure 3-1)

A proper installation site should be selected for the welding power source if the unit is to provide dependable service, and remain relatively maintenance free.

A proper installation site permits freedom of air movement into and out of the welding power source, and also least subjects the unit to dust, dirt, moisture, and corrosive vapors. A minimum of 18 inches of unrestricted space must be maintained between the welding power source front and rear panels and the nearest obstruction. Also, the underside of the welding power source must be kept completely free of obstructions. The installation site should also permit easy removal of the welding power source outer enclosure for maintenance functions.

IMPORTANT

Do not place any filtering device over the intake air passages of the welding power source as this would restrict the volume of intake air and thereby subject the welding power source internal components to an overheating condition and subsequent failure. Warranty is void if any type of filtering device is used.

Holes are provided in the welding power source base for mounting purposes. Figure 3-1 gives overall dimensions and the base mounting hole layout.

On most welding power sources a lifting device is provided for moving the unit. However, if a fork lift vehicle is used for lifting the unit, be sure that the lift forks are long enough to extend completely under the base.

IMPORTANT

The use of lift forks too short to extend out of the opposite side of the base will expose internal components to damage should the tips of the lift forks penetrate the bottom of the unit.

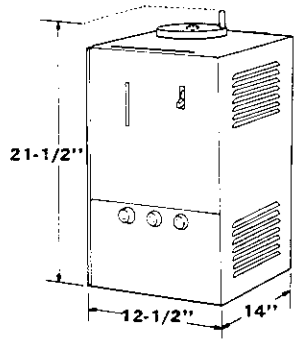

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Figure 3-1. Dimensional Drawing

3-2. INPUT ELECTRICAL CONNECTIONS

NOTE

It is recommended that a Line Disconnect Switch be installed in the input circuit to the welding power source. This would provide a safe and convenient means to completely remove all electrical power from the welding power source whenever it is necessary to perform any internal function on the unit.

CAUTION

Before making electrical input connections to the welding power source, "machinery lockout procedures" should be employed. If the connection is to be made from a line disconnect switch, the switch should be padlocked in the open position. If the connection is made from a fuse box, remove the fuses from the box and padlock the cover in the closed position. If locking facilities are not available, attach a red tag to the line disconnect switch (or fuse box) to warn others that the circuit is being worked on.

Table 3-1. Input Fuse Size

Model	Fuse Size In Amperes				
	115V	208V	230V	460V	575V
Without PFC*	175A	100A	90A	45A	35A
With PFC*	150A	90A	80A	40A	30A

*Power Factor Correction

A. Input Electrical Requirements

This welding power source is designed to be operated from a single-phase, 60 Hertz, ac power supply which has a line voltage rating that corresponds with one of the primary voltages shown on the welding power source nameplate. Consult the local electric utility if there is any question about the type of electrical system available at the installation site or how proper connections to the welding power source are to be made.

B. Input Conductor Connections

All models are ordinarily equipped with a three-conductor power cable. Models requiring 230 volts input are equipped with a three-prong polarized plug and wall receptacle. The wall receptacle should be installed in a convenient location by a competent electrician. The wall receptacle should be installed with the grounding terminal at the top. This would allow the power cable to hang downward without undue bending or twisting.

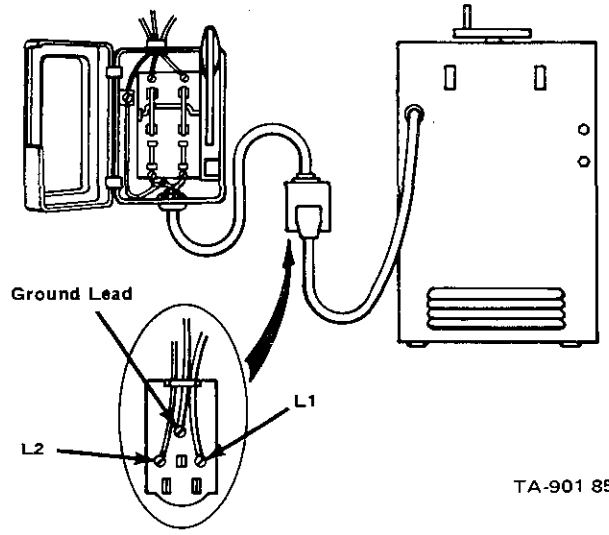

Figure 3-2. Input Electrical Power Connections

IMPORTANT

Models having an electrical input voltage above 250 volts have 3 conductors which protrude from the power cable. The black and white conductors must be connected to the line terminals and the green conductor to a proper ground. Use whatever grounding method which is acceptable to the local electrical inspection authority.

3-3. SECONDARY WELDING CONNECTIONS

A. Welding Cables

It is recommended that the welding cables be kept as short as possible, placed close together, and be of adequate current carrying capacity. The resistance of the welding cables and connections cause a voltage drop which is added to the voltage of the arc. Excessive cable resistance may result in overloading as well as reducing the maximum current output of which the welding power source is capable. The proper operation of any arc welding power source is to a great extent dependent on the use of welding cables and connections that are in good condition and of adequate size. An insulated electrode holder must be used to ensure the operator's safety.

Use Table 3-2 as a guide for selecting the correct welding cable size for the anticipated maximum weld current that will be used. Table 3-2 takes into account the total cable length for the weld circuit. This means the length of the Electrode cable that connects the Electrode Holder to the welding power source and the Work or ground cable between the welding power source and the workpiece. For example: If the Electrode cable is 75 feet long and the Work or ground cable is 25 feet long, select the size cable from Table 3-2 that is recommended for 100 feet. In a situation where a maximum weld current of 150 amperes is anticipated, No. 3 weld cable is recommended for both the Electrode and Work cables.

Table 3-2. Secondary Weld Cable Size

WELDING AMPERES	*TOTAL LENGTH OF CABLE (COPPER) IN WELD CIRCUIT							
	*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			
200	2	2	1	1/0				
250	1	1	1/0					

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NOTE: *A. 50 FEET OR LESS.

*B. CABLE SIZE IS BASED ON DIRECT CURRENT (DC), 60% DUTY CYCLE AND EITHER A 4 VOLTS OR LESS DROP OR A CURRENT DENSITY OF NOT OVER 300 CIRCULAR MILS PER AMP.

*C. WELD CABLE INSULATION WITH A VOLTAGE RATING TO WITHSTAND THE OPEN-CIRCUIT VOLTAGE (OCV) OF THE WELDING POWER SOURCE MUST BE USED. WHILE MOST WELDING POWER SOURCES HAVE AN OPEN-CIRCUIT VOLTAGE OF LESS THAN 100 VOLTS, SOME WELDING POWER SOURCES OF SPECIAL DESIGN MAY HAVE HIGHER OPEN-CIRCUIT VOLTAGE.

B. Jack Plug Installation

The supplied red jack plugs are to be connected to the secondary weld cables in order to facilitate connection to the secondary receptacles. Connect the jack plugs to the Electrode Holder cable and the Work clamp cable as follows:

1. Remove 3/4 inch of insulation from one end of each welding cable.
2. Clamp the welding cable in a vise with the uninsulated end protruding upward out of the vise approximately 1-3/4 inches.
3. Place the steel tie wire (See item A Figure 3-4) approximately 1/4 inch from the end of the insulation.
4. Make a half turn around the cable bringing the looped ends of the tie wire together.
5. Insert a rod of approximately 3/8 inch diameter through the two looped ends of the tie wire.

6. Twist the tie wire (B) until the entire tie wire is twisted and is tight around the insulation of the welding cable.

7. Clip off the looped ends of the tie wire.

8. Bend the twisted tie wire over and along the side (C) of the uninsulated portion of the welding cable.

9. Wrap the strip of copper foil tightly around the uninsulated end of the welding cable and the twisted tie wire (D).

10. Place the jack plug on the end of the welding cable and push it onto the welding cable over the copper foil (D).

11. Insert the 1/4-20 set screws into the center and bottom holes in the jack plug and tighten.

12. Remove the welding cable from the vise and insert the jack plug into the fiber sleeve. Slide the fiber sleeve over the jack plug and welding cable until the hole in the fiber sleeve lines up with the remaining hole in the jack plug.

13. Insert the 8-32 self-tapping screw (F) through the hole in the fiber sleeve and on into the jack plug. Tighten the screw with a screw driver.

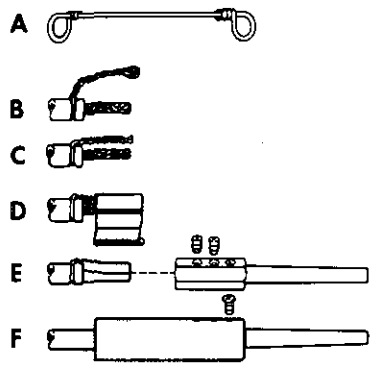

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Figure 3-4. Jack Plug Installation

C. Secondary Receptacles

Three red receptacles are provided on the lower portion of the front panel for making secondary connections. Insert the electrode holder cable jack plug into the desired (HIGH or LOW) ELECTRODE Receptacle and the work cable jack plug into the WORK Receptacle.

SECTION 4 - FUNCTION OF CONTROLS

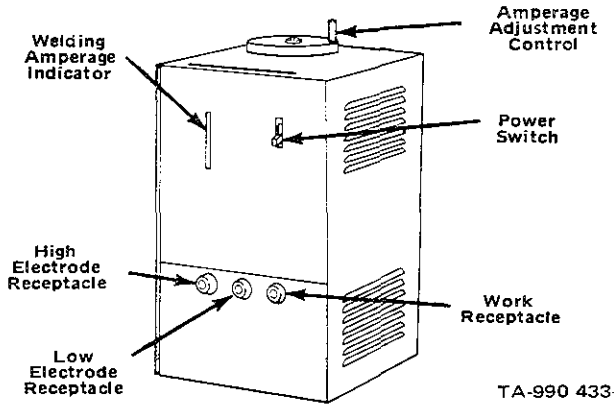

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Figure 4-1. Control Location

4-1. POWER SWITCH (Figure 4-1)

Placing the POWER Switch in the ON position will energize the welding power source fan motor and main transformer and place the welding power source in a ready-to-weld status. Placing the POWER Switch in the OFF position will shut the welding power source down.

CAUTION

Even though the POWER Switch is in the OFF position and the welding power source is apparently electrically shut down, electrical input power is still present on all circuitry up to the POWER Switch. To completely cut-off all electrical input power to the welding power source, it will be necessary to place the line disconnect switch in the OFF position or remove the line fuses.

4-2. AMPERAGE CONTROL

The welding amperage is controlled by the Secondary Receptacles on the front panel and the Amperage Adjustment Control on the top of the welding power source.

A. Course Amperage Range (Figure 4-1)

The three receptacles which are labeled HIGH, LOW, and WORK, provide a selection of either a high amperage range (40 to 225 amperes) or a low amperage range (30-150 amperes). To obtain the HIGH amperage range, insert the jack plug of the electrode cable into the receptacle labeled HIGH and the jack plug of the work cable into the receptacle labeled WORK. To obtain the LOW amperage range insert the jack plug of the electrode cable into the receptacle labeled LOW and the jack plug of the work cable into the receptacle labeled WORK.

B. Amperage Adjustment Control (Figure 4-1)

The Amperage Adjustment Control, located on the top center portion of the wrapper, provides a means of selecting the exact amperage desired within the range being used. Rotating the control in a clockwise direction will increase the amperage output.

C. Welding Amperage Indicator (Figure 4-1)

An indicator, labeled WELDING AMPERAGE, is provided on the front panel to display the amperage selected. The reading on the WELDING AMPERAGE Indicator will change when the Amperage Adjustment Control is rotated. The HIGH scale on the indicator must be used when the Electrode cable jack plug is in the HIGH Secondary Receptacle and the LOW scale used when the Electrode cable jack plug is in the LOW Secondary Receptacle.

4-3. DUTY CYCLE (Figure 4-2)

Welding power sources are rated on a percent duty cycle based on 10 minute intervals. For example: A 20 percent duty cycle simply means that the welding current is off for 8 minutes, on again for 2 minutes, and so on. It must be kept in mind that time intervals of other than 10 minutes will yield different test rating results. As the output is reduced or increased, the duty cycle will increase or decrease.

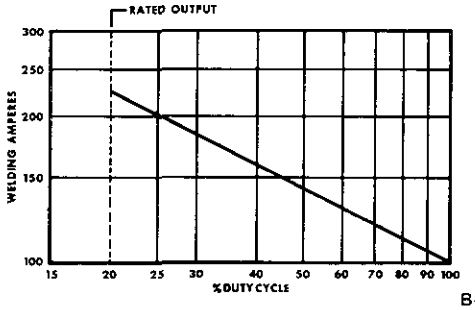

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Figure 4-2. Duty Cycle Chart

Figure 4-2 enables the operator to determine the safe output of the welding power source at various duty cycles.

IMPORTANT

Exceeding the indicated duty cycle will cause the welding power source to overheat and thereby cause damage to the internal components.

4-4. VOLT-AMPERE CURVE (Figure 4-3)

The volt-ampere curve shows the output voltage available at any given output current within the limits of the minimum and maximum Amperage Adjustment Control setting. Load voltage is predetermined to a large degree by arc characteristics. With the use of the volt-ampere curve, it is possible to determine the amperage required for a specific load voltage. With reference to the volt-ampere curve (Figure 4-3), the curve shows only the maximum and minimum settings of the Amperage Adjustment Control for each of the welding current ranges available. Curves of other settings will fall between the maximum and minimum curves shown.

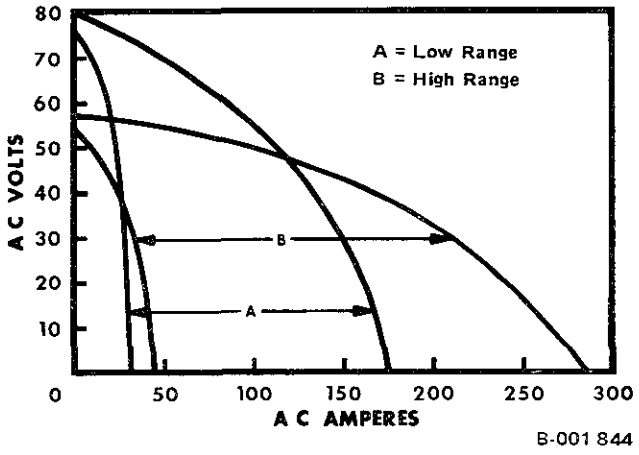

Figure 4-3. Volt-Ampere Curves

SECTION 5 - SEQUENCE OF OPERATION

CAUTION

Never, under any circumstances, operate the welding power source with any portion of the outer enclosure removed. In addition to a safety hazard, improper cooling may result in damage to the welding transformer and the welding power source components. Warranty is void if the welding power source is operated with any portion of the outer enclosure removed.

5-1. SHIELDED METAL-ARC (STICK ELECTRODE) WELDING (Figure 5-1)

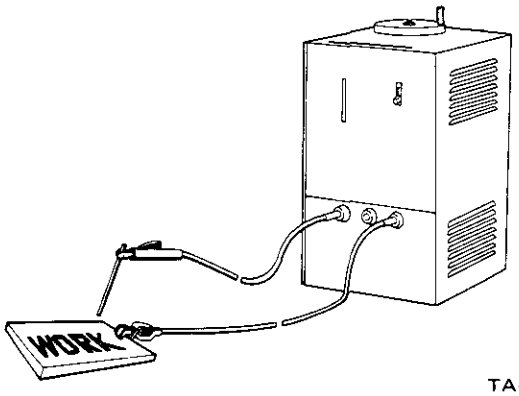

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Figure 5-1. Shielded Metal-Arc Welding Connections

1. Make electrical input and secondary connections as outlined in Section 3.
2. Insert the jack plugs of the secondary leads in the WORK receptacle and either the HIGH or LOW electrode receptacle.

NOTE

An electrode holder and work clamp will have to be supplied by the operator and connected to the welding power source secondary leads.

3. Rotate the Amperage Adjustment Control to the desired amperage.
4. Connect the work clamp to the item to be welded.
5. Place the desired electrode into the electrode holder.

CAUTION

Prior to welding, it is imperative that proper protective clothing (welding coat and gloves) and eye protection (glasses and/or welding helmet) be put on. Failure to comply may result in serious or permanent bodily damage.

6. Commence welding.
7. Readjust the Amperage Adjustment Control if necessary. The Amperage Adjustment Control may be adjusted while welding.

5-2. SHUTTING DOWN

1. Break the arc.
2. Allow the welding power source to idle for 3 minutes with no load being applied.
3. Place the POWER Switch in the OFF position.

SECTION 6 - MAINTENANCE

CAUTION

Be sure the branch circuit or main disconnect switch is open or electrical input circuit fuses are removed before attempting any inspection or work on the inside of the welding power source. Placing the POWER Switch on the welding power source in the OFF position does not remove voltage from the power terminals inside of the welding power source.

6-1. TRANSFORMER

Occasional blowing out of dust and dirt from around the transformer is recommended. This should be done periodically depending upon the location of the unit and the amount of dust and dirt in the atmosphere. A clean dry air stream should be used for this cleaning operation.

6-2. MOVABLE SHUNT

Approximately once a year, it may be necessary to lubricate the lead screw, guides and slider. Apply a light coat of

Socony BRB high temperature grease (or equivalent), taking care to avoid getting grease on any electric components of the welding power source.

6-3. FAN MOTOR

The fan motor bearings are of oil impregnated construction. Apply a few drops of light machine oil to the oil holes on the fan motor once a year. Be sure not to over oil. Excess oil may get on the power transformer windings and may damage the insulation of the transformer winding.

6-4. SHUNT GUIDE ADJUSTMENT (Figure 6-1)

CAUTION

Ensure that the welding power source is completely disconnected from the electrical input power line prior to beginning shunt guide adjustment.

This adjustment is provided in order to compensate for vibration noises should they arise. This adjustment eliminates vibration noises by applying pressure against the movable shunt which in turn holds the movable shunt firmly in the shunt guides.

If it should become necessary to perform a shunt guide adjustment, proceed as follows:

1. Remove the screws (item 3, Figure 6-1) from handwheel (2) and pull handwheel (2) off.
2. Remove cotter pin (5) from handwheel hub (1).
3. Remove screws (9) and lift outer wrapper (4) upward and off.
4. Remove handwheel hub (1) from wrapper (4) and place hub (1) on shaft (8).
5. Insert cotter pin 5 thru hub (1) and shaft (8).
6. Place handwheel (2) on top of hub (1) and secure in place with screws (3).
7. Locate the adjustment screws (7) and loosen locking nuts (6) on each screw (7).

NOTE

It is recommended that the shunt be cleaned and lubricated prior to performing the following adjustment.

8. Turn all screws (7) in a clockwise direction by hand as far as possible.

CAUTION

Ensure that the wrapper is installed on the welding power source prior to energizing the welding power source and re-checking for shunt noise.

9. Using a screw driver, rotate all screws (7) 1/4 turn clockwise. If this does not remedy the noise problem, rotate the screws in 1/4 turn increments until the noise desists.

NOTE

The amount of pressure that should be applied on the shunt should not be sufficient to produce a hard cranking situation when the handwheel is rotated. If a condition cannot be reached where the handwheel rotates with a fair degree of ease and also the vibration noise has been eliminated, it is recommended that a serviceman be called.

10. Tighten locking nuts (6) on screws (7).
11. Reverse steps 7 thru 1.

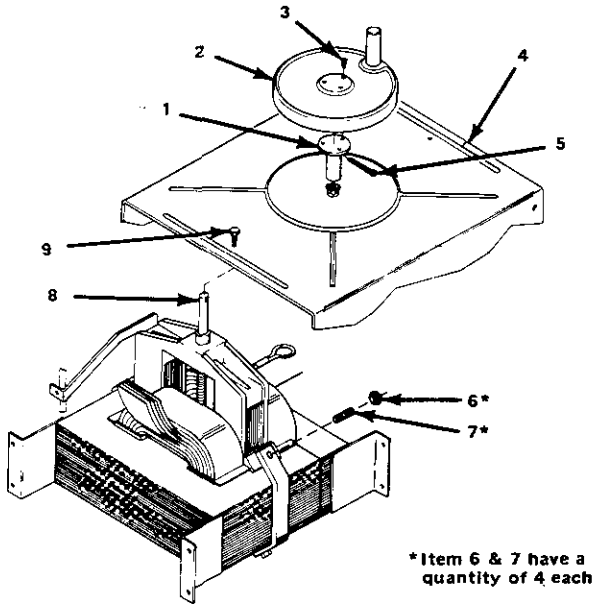


Figure 6-1. Location of Shunt Guide Adjustment Screws

SECTION 7 - TROUBLESHOOTING

The data collected here, discusses some of the common problems which may occur in this welding power source.

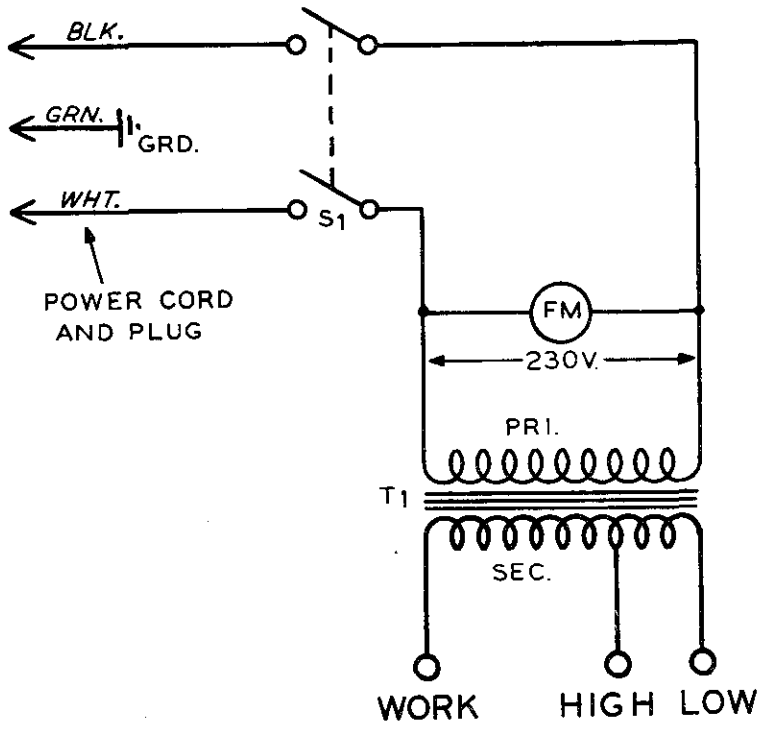
The assumption of this data is that a proper welding condition has been achieved and has been used until trouble developed. In all cases of equipment malfunction, the manufacturer's recommendations should be strictly adhered to and followed.

If after performing the following procedures the trouble is still not remedied, it is recommended that a serviceman be called.

It is recommended that the circuit diagram be used for reference during the troubleshooting.

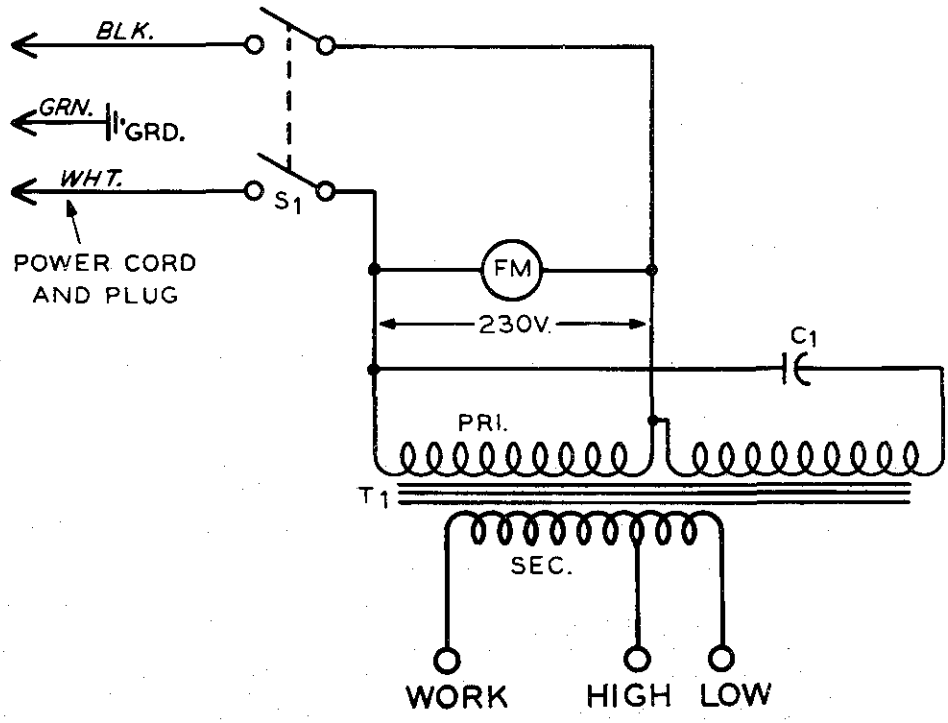
TROUBLE	PROBABLE CAUSE	REMEDY
No output or Welding Current.	Open line fuse.	Check line fuses and replace if open.
	POWER Switch defective.	Check for continuity; if defective, replace switch.

Erratic weld current.	Loose welding connections.	Check welding connections. Make sure plugs fit properly into the WORK and Electrode Receptacles.
	Bad or damp electrodes.	Try different electrodes.
Fan does not run.	POWER Switch defective.	Check for continuity; if defective, replace switch.
	Fan motor defective.	Check fan motor and leads. If O.K. and fan motor turns freely, the fan motor could be defective. Replace if necessary.



Circuit Diagram No.
CA-902 031-1A

Figure 7-1. Circuit Diagram For Model Without Power Factor Correction



Circuit Diagram No.
CA-902 032-1A

Figure 7-2. Circuit Diagram For Model With Power Factor Correction

SECTION 8 - PRINCIPLES OF SHIELDED METAL ARC WELDING

8-1. GENERAL

Shielded Metal-Arc welding with a transformer welding machine depends upon the fundamental fact that when one side of the secondary welding circuit is attached to a piece of steel and the other side of the circuit is connected to an electrode, an arc will be established when the electrode touches the steel. If the arc is properly controlled, the metal from the electrode will pass through the arc and be deposited on the steel. When the electrode is moved along the steel at the correct speed, the metal will deposit in a uniform layer called a bead. The electrodes used in welding are carefully manufactured to produce strong, sound welds. They consist of a core of steel wire, usually called mild since it contains a low (0.10-0.14) percentage of carbon. Around this core is applied a special coating which assists in creating the arc and at the same time protects the molten steel as it transfers across the arc.

In order to utilize these principles in shielded metal-arc welding, some means of controlling the power is essential. The power in a welding circuit is determined by the voltage and current. The arc voltage is governed by the arc length and the electrode diameter. Therefore, the practical measure of the power or heat, is in terms of the current, measured in amperes. A small electrode requires less current than a large one. To simplify operations, the scale on the front of the welding machine is marked off for the various current values.

The exact current required for a job depends upon the size of the pieces to be welded and the position of welding. Generally a lower current will be sufficient for welding on a small part than would be necessary to weld on a large piece of the same thickness. Similarly, with a given size of electrode, a lower current should be used on thin metals than on the thicker sections. Most manufacturers of electrodes have ampere recommendation charts available.

CURRENT REQUIREMENTS FOR MILD STEEL ELECTRODES		
Electrode Diameter	Amperage	
	Min.	Max.
5/64	20	50
3/32	40	80
1/8	65	125
5/32	90	160
3/16	120	180

Table 8-1. Current Requirements For Mild Steel Electrodes

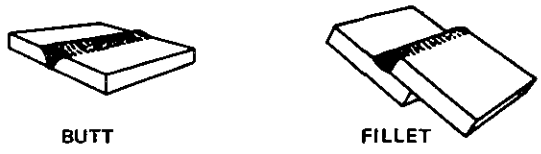


Figure 8-1. Flat Position Welds

While it is always easier to weld on work in the flat position, as shown in Figure 8-1, occasionally, it is necessary to weld in a horizontal, vertical or overhead position as shown in Figures 8-2, 8-3, and 8-4, respectively. Generally, under these conditions it is helpful to reduce the current from the value used on welding in the flat position.

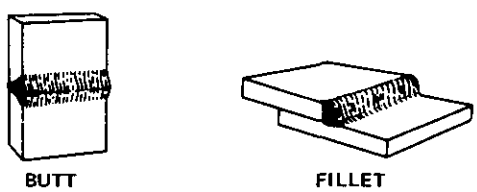


Figure 8-2. Horizontal Position Welds

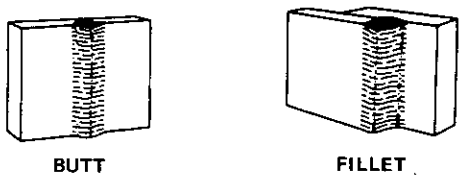


Figure 8-3. Vertical Position Welds

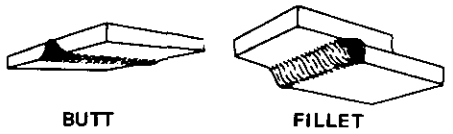


Figure 8-4. Overhead Position Welds

8-2. STRIKING THE ARC-RUNNING BEADS

In learning to weld there are certain fundamental steps which must be mastered before one can attempt to weld on actual work. Prior to striking an arc, insert the electrode in the holder, as shown in Figure 8-5. To strike an arc, Figure 8-6

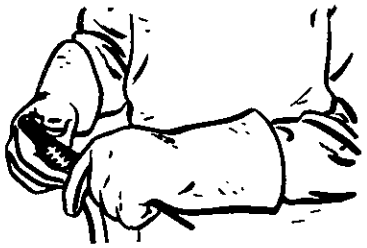


Figure 8-5. Electrode Insertion

illustrates what is commonly known as the "scratch start technique." In this method the striking end of the electrode is dragged across the work in a manner much the same as striking a match. When the electrode touches the work, the welding current starts. If held in this position, the electrode would "freeze" or weld itself to the work. To overcome this, the electrode should be slightly withdrawn from the work immediately after contact has been made. The distance that the electrode is withdrawn is small and depends upon the diameter of the electrode; this distance is known as the arc length. If in striking an arc, the electrode freezes, it may be freed by a quick twist of the wrist.

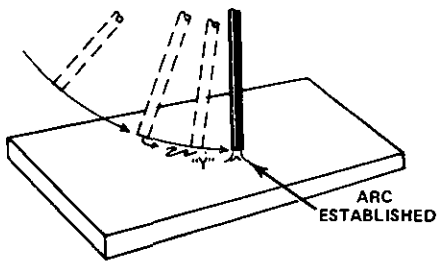


Figure 8-6. Arc Initiation - Scratch Start Technique

Another method of establishing the arc is known as the "tapping method" as shown in Figure 8-7. The electrode is brought straight down on the work and immediately after contact, is withdrawn to the proper arc length.

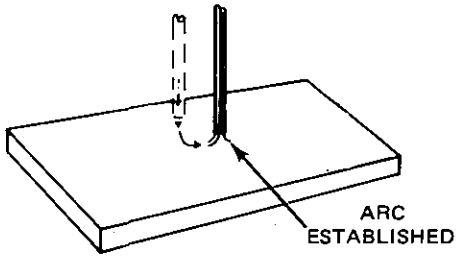


Figure 8-7. Arc Initiation - Tapping Technique

Practice striking the arc using both methods. Generally the scratch method is preferred for ac welding.

Determination of the correct arc length is difficult since there is no ready means of measuring it. As a preliminary guide, use about 1/16" arc length on 1/16" and 3/32" electrode; for 1/8" and 5/32" electrodes use about 1/8" arc length. As skill is acquired, the sound of the arc will be a good guide. A short arc with correct current will give a sharp, crackling sound.

A portion of the electrode coating forms a protective coating called slag over the deposited weld metal. To examine the weld, remove the slag from the weld with a chipping hammer.

Once the knack of establishing and holding an arc has been learned, the next step is learning to run a good weld bead. In the beginning it is best to run beads of weld metal on flat plates using a full electrode. Practice moving from left to right and from right to left. The electrode should be held less than perpendicular to the work, tilting it in the direction of travel. The correct position is shown in Figure 8-8.

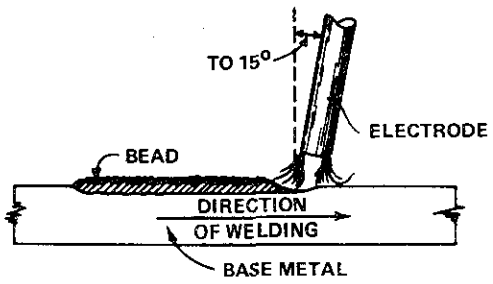


Figure 8-8. Electrode Position

A proper weld bead is illustrated in Figure 8-9. This shows a cross-section through the bead and identifies the various terms used in describing a weld. To produce these results it is necessary to hold a short arc, travel at a uniform speed, and feed the electrode downward at a constant rate as it melts.

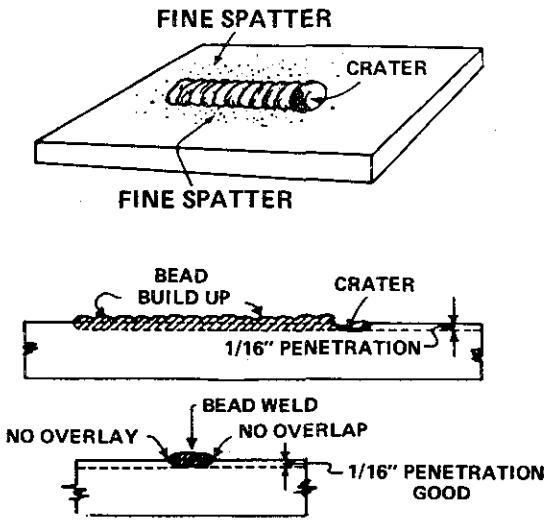


Figure 8-9. Proper Weld Bead

Probably the first attempts in the practice will fall short of the results shown. Too long an arc will be held or the travel speed will vary from slow to fast and the welds will look as illustrated in Figure 8-10 showing a cross section through a poor weld bead. In addition, the weld will probably be spongy (porous) and of low strength.

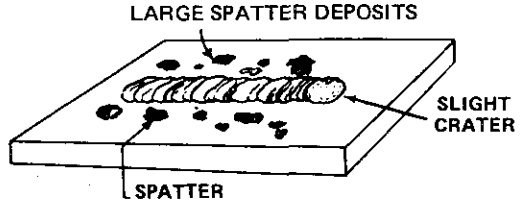


Figure 8-10. Poor Weld Bead

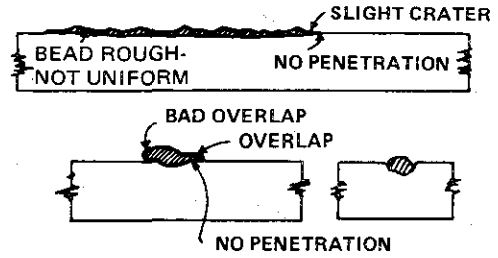


Figure 8-10. Poor Weld Bead (continued)

Continue practicing until uniform beads as shown in Figure 8-9 can be produced. A good method of practicing is to deposit a series of beads, one next to the other until the plate is covered. The slag must be thoroughly removed between each pass. Then deposit another series of beads at right angles to the first, thus building up the plate to a greater thickness.

8-3. WEAVING

When it is necessary to cover a wider area in one pass of the electrode, a method known as weaving is employed. In this the electrode is moved or oscillated from side to side in a set pattern. In order to be sure of uniform deposits, it is necessary to use a definite pattern such as those illustrated in Figure 8-11. While weaving is helpful, particularly when building up metal, it should be limited to weaves not exceeding 2-1/2 times the diameter of the electrode.

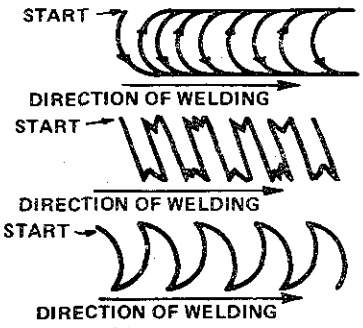


Figure 8-11. Weave Patterns

8-4. BUTT JOINTS

Up to this point the discussion has covered only the deposit of beads on flat plate. Such operations are helpful in building up worn parts or applying hardfacing materials. The next step is learning to weld two pieces of metal together. For this purpose, other types of welds are illustrated in Figure 8-12.

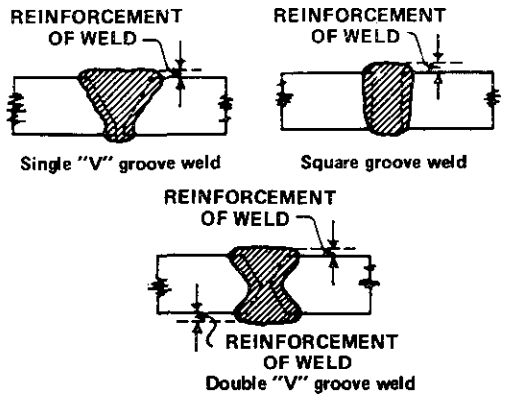


Figure 8-12. Butt Joint Welds

In making weld beads previously described, it was probably noted that depositing weld metal on one side of the plate, caused it to "curl" up towards the weld; this is called distortion and will almost always be found when heat is applied locally to a metal plate. Similarly in making a butt weld, distortion will cause the edges of the plate to draw together ahead of the electrode travel. This is caused by the contraction of the deposited weld metal on cooling. This may be overcome by spreading the edges of the joint apart on a taper of about 1/8" per foot.

Another procedure to avoid metal movement caused by weld heat is to make short welds, tying the two pieces together at spaced intervals. This is known as tack welding and holds the metal in position for welding.

In making welds in a butt joint, preparation of the edges may be necessary to insure good results. In shielded metal-arc welding it is a common practice to weld thin materials up to 3/16" thick without any special preparation using the square groove butt joint. For thickness of 3/16" and over, either the single or double "V" groove is employed. Generally the single "V" groove will be satisfactory on thicknesses up to 3/4", regardless of thickness, where one can work on the weld from one side only.

One method for beveling steel for "V" groove welding is by means of using an oxyacetylene cutting torch. The work may be done with a hand guided torch or special oxyacetylene cutting machine. However, in performing this cutting, a scale will develope on the plates. This must be removed by grinding or chipping before welding as it is likely to become entrapped in the weld bead and produce an unsound weld. Where oxyacetylene cutting equipment is not available, grinding will probably be the best means of preparing bevels. The angles of these bevels should be about 30 degrees and the bottom edge may be left square for a distance of about 1/16". See Figure 8-13.

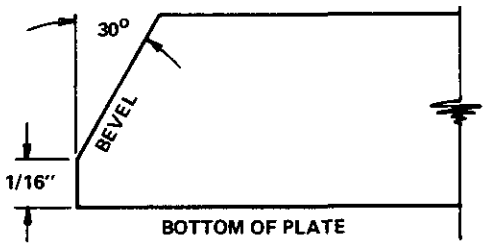


Figure 8-13. Single Bevel

Practice making butt welds starting on thin material about 1/8" thick (avoid very thin material, around 1/16" thick, in the beginning as this requires a fair degree of skill). Separate the squared edges of the 1/8" material about 1/16" and make a butt weld all the way through with a 1/8" electrode. Probably the first attempt will either fail to penetrate the sheet or burn through it. Keep trying, adjusting the current within the recommended range; also vary the electrode travel speed to give the desired weld. Having mastered 1/8" thich metal, proceed to a similar exercise on 1/4" thick metal. This time, however, deposit a bead on each side of the joint and try to fuse one to the other. Since the weld from one side is in effect an 1/8" thickness, no bevel is needed.

Next make a single "V" groove on 1/4" plate beveled 30 degrees. Start with a 1/8" electrode at the bottom of the groove and finish over that with a 5/32" electrode. Be sure to penetrate about 1/32" beyond the bottom of the "V" (called the root). When skill has been acquired on the 1/4" material, proceed to 3/8" and then to 1/2" thick metal. On these, particularly the 1/2", also make the double "V" groove butt joints. Generally speaking, it will be necessary to deposit a bead or layer for each 1/8" thickness. On the heavier plates, weaving the top layers may be necessary to fill the groove completely.

When making practice butt welds it is wise to check the results occasionally. Where elaborate testing equipment is not available, this may be done with a hammer and vise.

CAUTION

Caution should be observed in handling welded pieces of metal, since weld heat absorbed by the metal is intense and can cause serious burns.

Grip a short, welded piece with the weld just above the jaws of the vise. Hammer it in a direction that tends to open the bottom, root side of the weld, in the manner shown in Figure 8-14. A good weld will not break under this test, but will bend over. If the weld breaks, examine it to determine the cause. If there are a large number of holes (the weld looks spongy) it is porous. This is probably due to holding too long an arc. If there are bits of slag in the weld perhaps the arc was too short or the electrode was manipulated incorrectly thus permitting molten slag from the electrode coating to be trapped. This is quite likely to happen on a "V" joint made in several layers and calls for thorough cleaning between layers. Perhaps on breaking it will be found that the original surface of the bevel is still evident. That means that it was not melted and the cause is quite likely to be found in too fast a travel speed or insufficient heat.

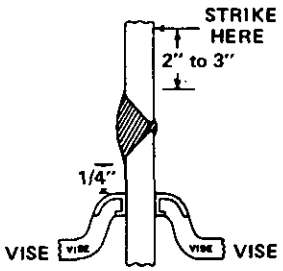


Figure 8-14. Weld Test

8-5. TEE AND LAP JOINTS

The other basic type of weld, the fillet weld, is used for making tee and lap joints. For this type of welding, no special preparation, other than squared edges, is necessary. Typical welded tee and lap joints are pictured in Figurees 8-15 and 8-16 respectively.

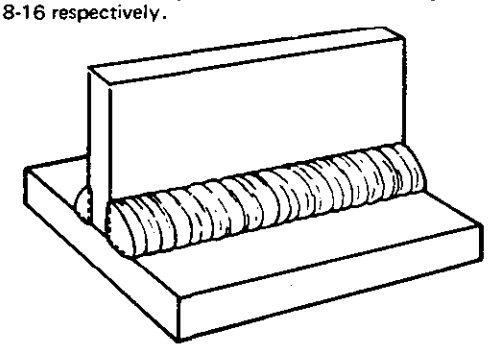


Figure 8-15. Tee Joint

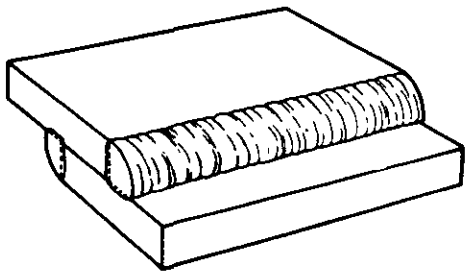


Figure 8-16. Lap Joint

Considering the tee joint first, it will be seen immediately that the position of the pieces requires a different method of electrode manipulation than for a butt weld. The method of holding the electrode for butt welds will not be satisfactory.

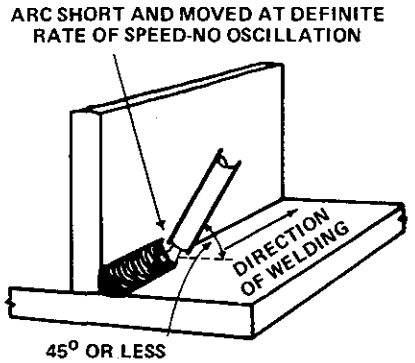


Figure 8-17. Tee Joint Fillet Weld

To deposit a single pass fillet weld, hold the electrode as shown in Figure 8-17. This will provide fusion into the corner and a fillet, the sides of which will be approximately equal. For maximum strength a fillet weld should be deposited on each side of the upright section. When a heavier fillet is needed, deposit a second layer as indicated in Figure 8-18, using any of the weaving patterns shown in Figure 8-19.

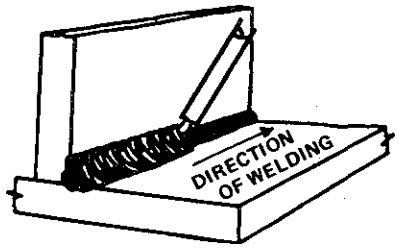


Figure 8-18. Multi-Layer Deposits - Tee Joint

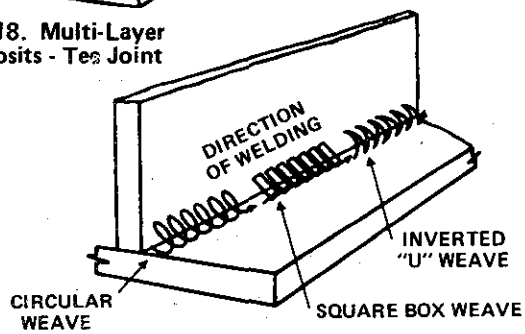


Figure 8-19. Tee Joint Fillet Weld Weave Patterns

The lap joint, while involving the same fundamental weld type, the fillet, has metal distributed differently and therefore requires still another technique. The details of the application are given in Figure 8-20, for a single pass weld. For a two pass weld, Figure 8-21 provides the details.

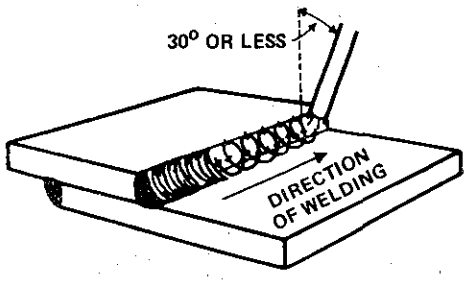


Figure 8-20. Lap Joint Fillet Weld

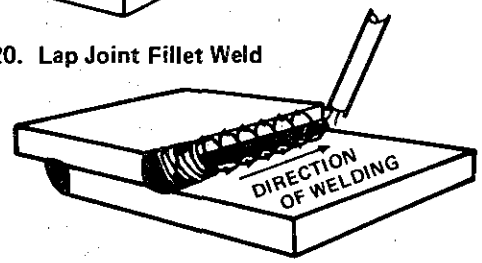


Figure 8-21. Multi-Layer Deposit Lap Joint

8-6. WELDING VERTICALLY, HORIZONTALLY AND OVERHEAD

The importance of welding in the flat position, whenever possible, cannot be stressed too strongly. The quality of the weld is better, the operation easier and faster. However, occasions will arise when it is necessary to work on parts in a position in which welds must be deposited horizontally, vertically and overhead. It must be realized at the very beginning that welding in these positions is difficult and will require constant practice to develop skill.

As in the case of welding in the flat position, it is best to start practicing by first running weld beads in the various positions. Then as proficiency is gained on these operations, practice may be continued on butt and fillet welds (tee and lap joints) in these positions.

One of the first facts to be noted when welding in these positions is that the force of gravity tends to cause the molten metal to drip (fall) down. The technique used, therefore, must be acquired to overcome this. Start by making horizontal weld beads on plates inclined at 45 degrees as shown in Figure 8-22. When this has been mastered so that

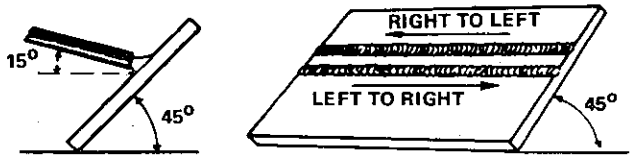


Figure 8-22. Horizontal Weld Beads - Inclined Plate

uniform beads can be made consistently, practice on welding vertically may be started. Again begin with an easy operation such as running beads vertically on plates set at 45 degrees. (See Figure 8-23).

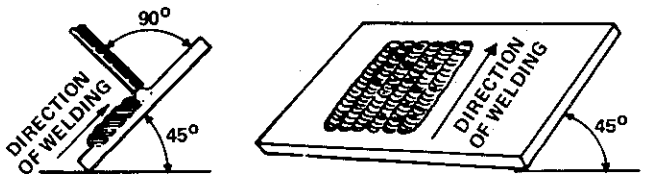


Figure 8-23. Vertical Weld Beads - Inclined Plate

To progress with this practice it is necessary now to move the plates into vertical position. The details of horizontal weld beads are given in Figure 8-24.

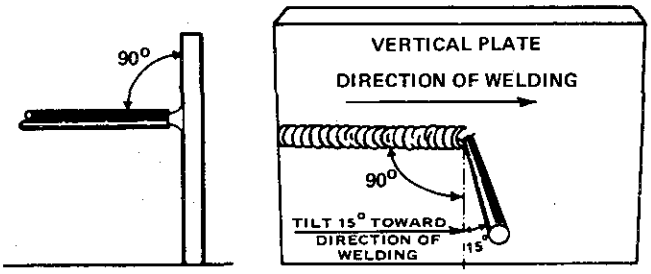


Figure 8-24. Horizontal Weld Beads - Vertical Plate

Welding vertically may be performed either by welding upward or starting from the top and welding down. It is generally conceded that working upward is easier and therefore, weld beads in this manner should be practiced. A method for making weave weld beads is illustrated in Figure 8-25.

Since single weld beads are of limited value, weaving weld beads must be practiced on butt welds in the vertical and horizontal positions.

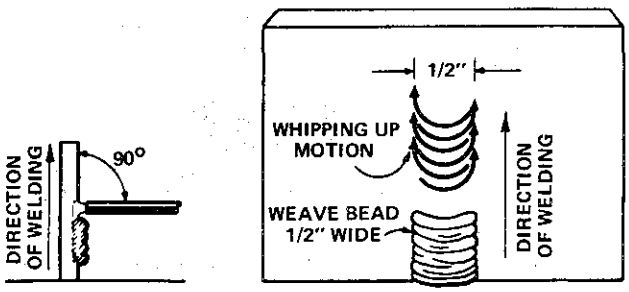


Figure 8-25. Weave Pattern - Vertical Plate

Figure 8-26 provides information suitable for a single pass vertical butt weld or the first pass of a multiple layer deposit. Two methods of depositing the subsequent layers are given in Figure 8-27.

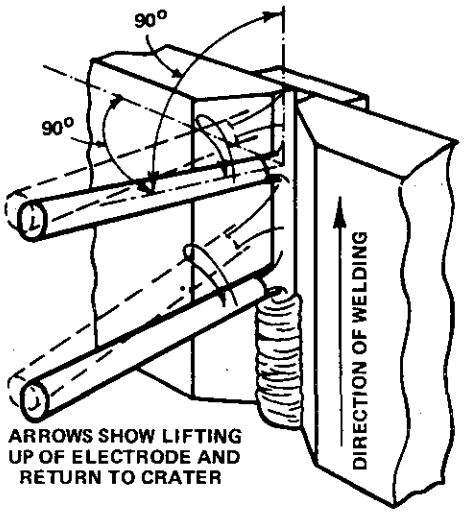
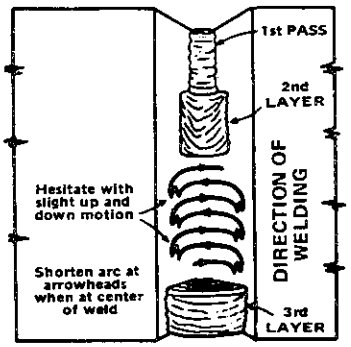


Figure 8-26. Single Pass Vertical Butt Weld



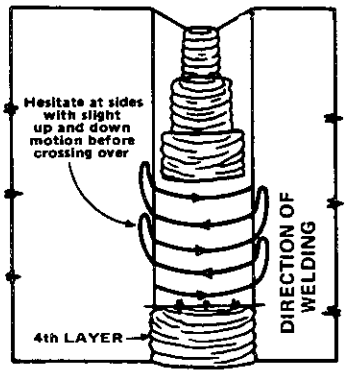


Figure 8-27. Multi-Layer Deposit Vertical Butt Weld

For horizontal welds the details are shown in Figures 8-28 and 8-29. Note that a strip of metal is shown at the foot of the weld. This is known as the backing strip. Its use permits securing a sound root pass without great difficulty. In use, the beveled plate edges should be centered on the backing strip and the strip tack welded to the plates on the reverse side.

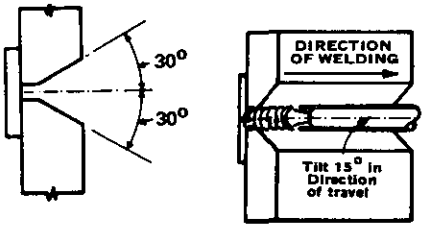


Figure 8-28. Root Pass

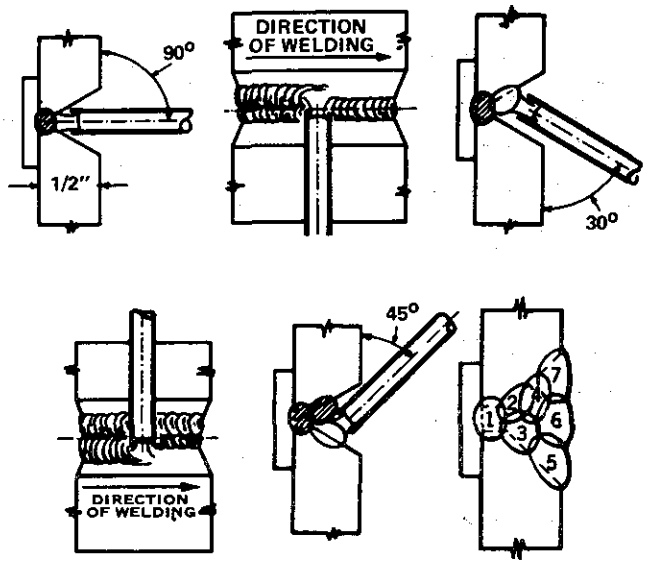


Figure 8-29. Multi-Layer Deposit - Horizontal Butt Weld

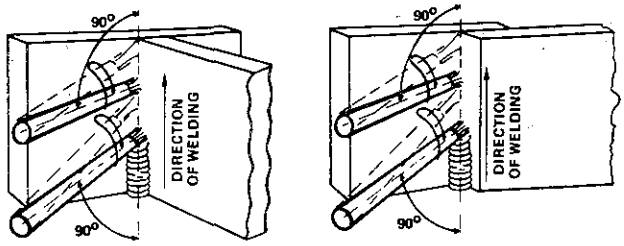


Figure 8-30. Fillet Weld - Vertical Tee Joint

For fillet welds on tee and lap joints the technique is shown in Figure 8-30. When depositing a multilayer fillet weld, the same method would be used to deposit the first layer on both lap and tee joints. For depositing subsequent layers on tee joints two means are used and are shown in Figure 8-31. For additional layers on lap joints a somewhat similar weave may be seen in Figure 8-32.

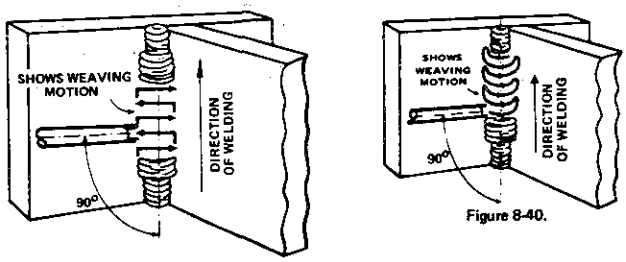


Figure 8-40.

Figure 8-31. Multi-Layer Deposit - Tee Joint

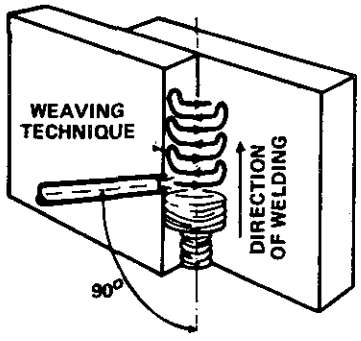


Figure 8-32. Multi-Layer Deposit - Lap Joint

Welding in the overhead position is the final problem to master. Again proceed through the steps of making weld beads, the making of butt welds and finally the making of fillet welds. For overhead welding, the electrode position, Figure 8-33, will prove helpful. When weaving is necessary, the pattern in Figure 8-34 may be used. The technique for overhead butt welds is illustrated in Figure 8-35; this covers single pass welds or the first pass of multilayer welds. Subsequent beads may be deposited as shown in Figure 8-36. For depositing single layer fillets or the first layer of multiple

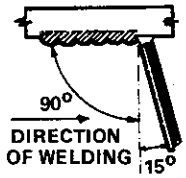


Figure 8-33. Electrode Position - Overhead Weld

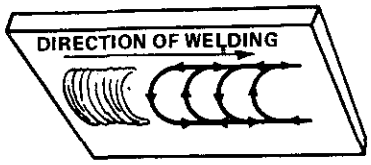


Figure 8-34. Weave Pattern - Overhead Weld

Figure 8-35. Overhead Butt Weld - Root Pass

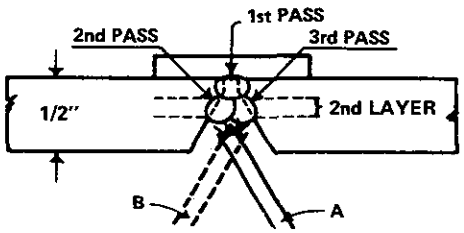


Figure 8-36. Multi-Layer Deposit - Overhead Butt Weld

fillets in the overhead position the technique in Figure 8-37 should be employed. The sequence for depositing beads on a multilayer fillet weld is provided in Figure 8-38. Note that single beads are recommended and for that reason use the same technique shown in Figure 8-37. Again the technique for fillet welds may be employed for welding lap joints.

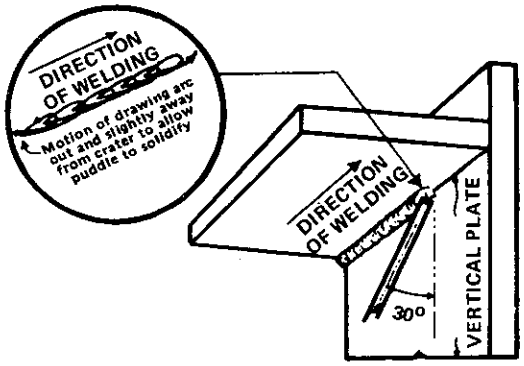


Figure 8-37. Overhead Weld Tee Joint - Single Pass

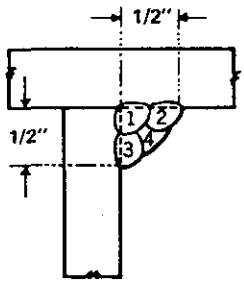


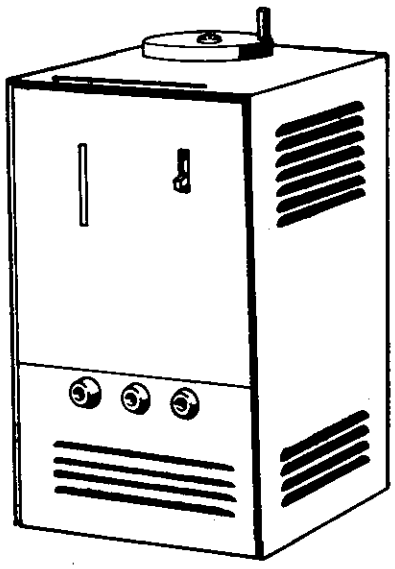
Figure 8-38. Multi-Layer Deposit - Overhead Tee Joint

8-7. CONCLUSION

It may be appreciated that no printed instruction can impart to the beginner all the skill necessary for successful welding. Personal instruction by an experienced welding operator is the best means for accomplishing this end. Therefore, an effort should be made to secure some facility for instruction and practice under competent supervision. In any event the beginner should at least secure the benefit of criticism of finished welds by a qualified welder.

October 1975 FORM: OM-116A

Effective with style No. HF-6B



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PARTS LIST

PRINTED IN U.S.A.

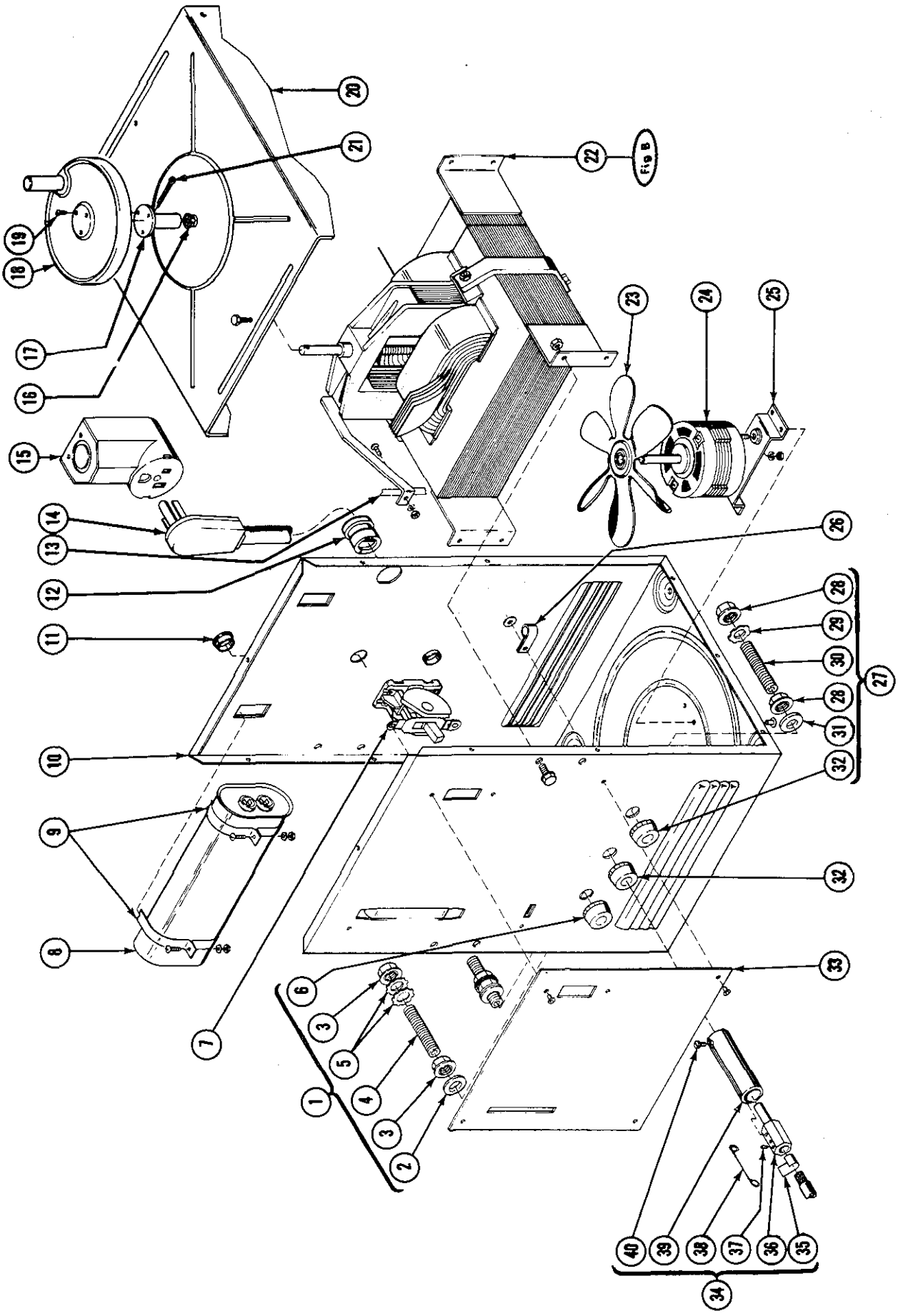

Figure A — Main Assembly

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Model Without PFC	Quantity Model With PFC
Figure A			**Main Assembly**		
1		039 879	RECEPTACLE ASSEMBLY, jack - high (consisting of)	1	1
2		010 291	. WASHER, flat - nylarfil 5/8"	1	1
3		604 668	. NUT, steel - self locking hex 1/2-20	2	2
4		039 777	. RECEPTACLE, jack	1	1
5		602 217	. WASHER, lock - external tooth 1/2"	2	2
6		039 768	. NUT, terminal - red	1	1
7	S1	*011 629	SWITCH, toggle DPST 30 ampere (for units over 250 volts) or		
7	S1	*025 864	SWITCH, toggle 2PST 40 amp 250 volts (for units 250 volts or under)	1	1
8	C1	025 315	CAPACITOR, 30 uf 460 volt ac		1
9		017 125	CLAMP, mtg - capacitor		2
10		024 101	CASE SECTION, base/front/rear	1	1
11		024 103	BLANK, snap in - nylon 3/4" hole	2	2
12		010 290	BUSHING, strain relief 1" hole	1	1
13		022 383	BAND, indicator	1	1
14		023 898	CORD SET, power (230 volt & under)	1	1
14		023 926	CORD, power-without cap (over 230 volt)	1	1
15		039 778	RECEPTACLE, straight 3P 50 ampere 250 volt	1	1
16		024 102	BUSHING, nylon 3/4" hole	1	1
17		024 078	HUB, handwheel	1	1
18		024 079	HANDWHEEL	1	1
19		602 144	SCREW, self tapping 8-32 x 3/8	3	3
20		024 076	WRAPPER	1	1
21		602 336	PIN, cotter 1/8 x 1-1/2"	1	1
22	T1	004 605	TRANSFORMER & SHUNT (See Fig. B Page 3)	1	
22	T1	004 606	TRANSFORMER & SHUNT (See Fig. B Page 3)		1
23		032 662	BLADE, fan 10 inch 6 wing	1	1
24	FM	032 678	MOTOR, 230 volt ac	1	1
25		022 385	BRACKET, mtg - fan	1	1
26		010 142	CLAMP, nylon 5/16 dia	2	2
27		039 839	RECEPTACLE ASSEMBLY, jack - low & work (consisting of)	2	2
28		604 668	. NUT, steel - self locking hex 1/2-20	2	2
29		602 217	. WASHER, lock - external tooth 1/2"	1	1
30		039 777	. RECEPTACLE, jack	1	1
31		010 291	. WASHER, flat - nylarfil	1	1
32		039 768	. NUT, terminal - red	1	1
33			NAMEPLATE (order by stock, model & serial number)	1	1
34		039 608	PLUG ASSEMBLY, jack (consisting of)	2	2
35		019 833	. STRIP, copper	1	1
36		101 219	. PLUG, jack	1	1
37		602 178	. SCREW, set 1/4-20 x 3/8"	2	2
38		010 521	. WIRE, tie	1	1
39		602 814	. INSULATOR, red	1	1
40		602 160	. SCREW, self tapping fil hd 8-32 x 1/4"	1	1

*Recommended Spare Parts
BE SURE TO PROVIDE STOCK, MODEL, AND STYLE NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Factory Part No.	Description	Quantity Models Without PFC	Quantity Models With PFC
Figure B			**Transformer & Shunt (See Fig. A Page 2 Item 22)**	024 251	024 252
51		010 256	BLOCK, anti - noise	4	4
52		601 869	NUT, steel - hex 5/16-18 jam	4	4
53		605 063	SCREW, set - headless 5/16-18 x 1-1/4"	4	4
54	SEC	**022 462	COIL, secondary	1	1
55		024 085	SHUNT (See Fig. B1 Page 4)	1	1
56	PRI	**004 601	COIL, primary	1	
56	PRI	**004 602	COIL, primary		1
57		**022 387	TRANSFORMER SUBASSEMBLY (consisting of)	1	1
58		010 188	. INSULATOR, coil - top	2	2
59		010 370	. GUIDE, shunt	2	2
60		010 369	. GUIDE, shunt	2	2
61		010 189	. INSULATOR, coil - bottom	2	2
62		020 284	. WEDGE, coil	1	1
63		605 129	. SCREW, cap - hex hd 1/4-20 x 7"	1	1
64		602 241	. WASHER, flat 1/4 S.A.E.	2	2
65		020 300	. WEDGE, rear - movable	2	2
66		020 301	. GUIDE, wedge - rear	1	1
67		605 144	. NUT, self locking - hex 1/4-20	1	1

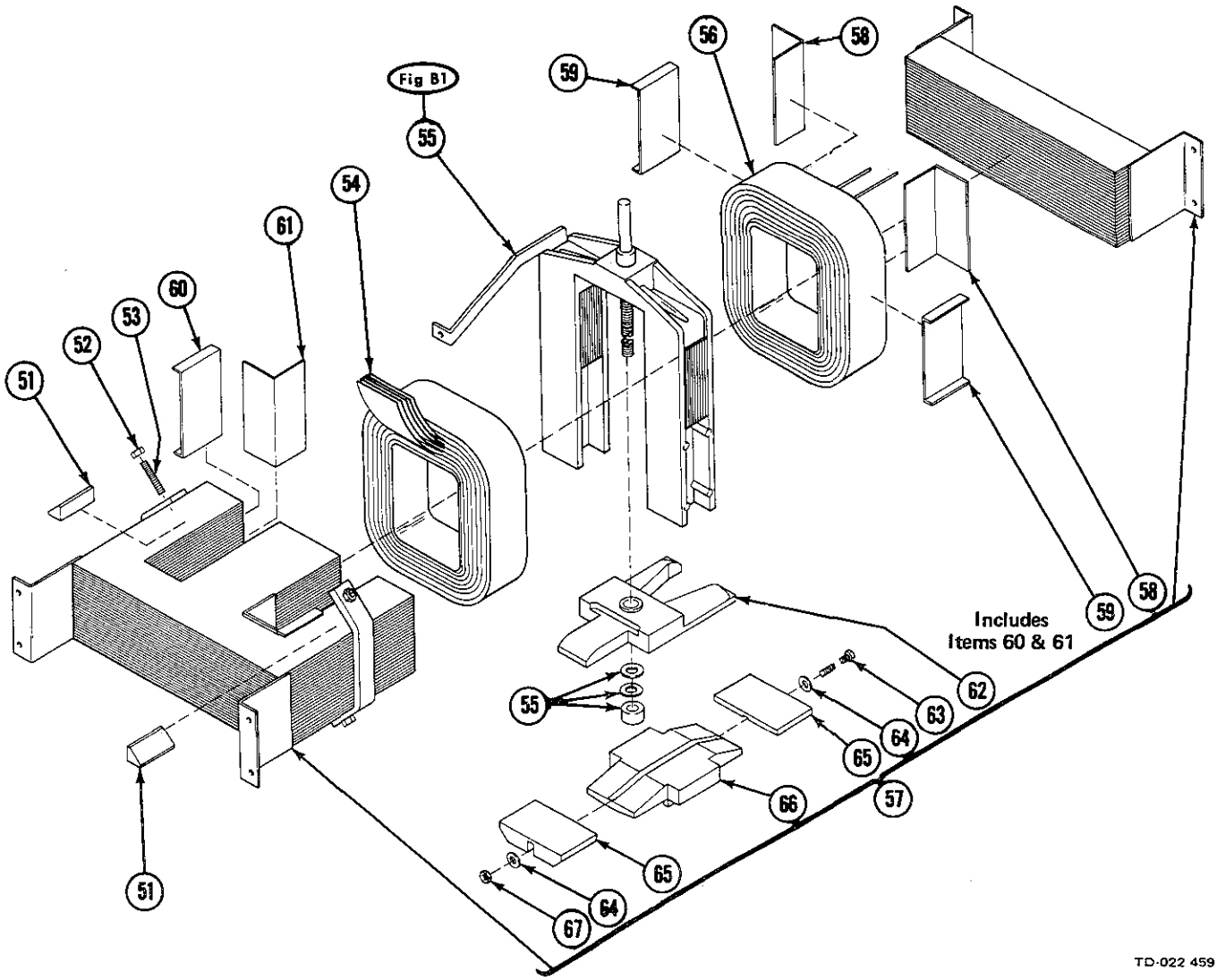

Figure B — Transformer & Shunt

**Replace At Factory or Authorized Service Station

BE SURE TO PROVIDE STOCK, MODEL, AND STYLE NUMBERS WHEN ORDERING REPLACEMENT PARTS.

Item No.	Factory Part No.	Description	Quantity
Figure B1	**024 085**	**Shunt (See Fig. B Page 3 Item 55)**	
77	022 382	BRACKET, mtg - indicator band	1
78	605 795	SCREW, self tapping - fillister head 8-32 x 1/2"	1
79	601 860	NUT, steel - hex 8-32	2
80	024 077	SCREW, lead	1
81	021 100	NUT, lead screw	1
82	604 633	SCREW, machine - round head 8-32 x 1-1/2"	2
83	036 356	BLOCK, shunt	2
84	010 653	BEARING, thrust 3/8 ID x 3/4 OD x 1/16"	1
85	010 929	WASHER, flat - spring 3/8"	1
86	024 869	COLLAR SET (consisting of)	1
87	024 612	. COLLAR	1
88	602 176	. SCREW, set 1/4-20 x 3/8"	2

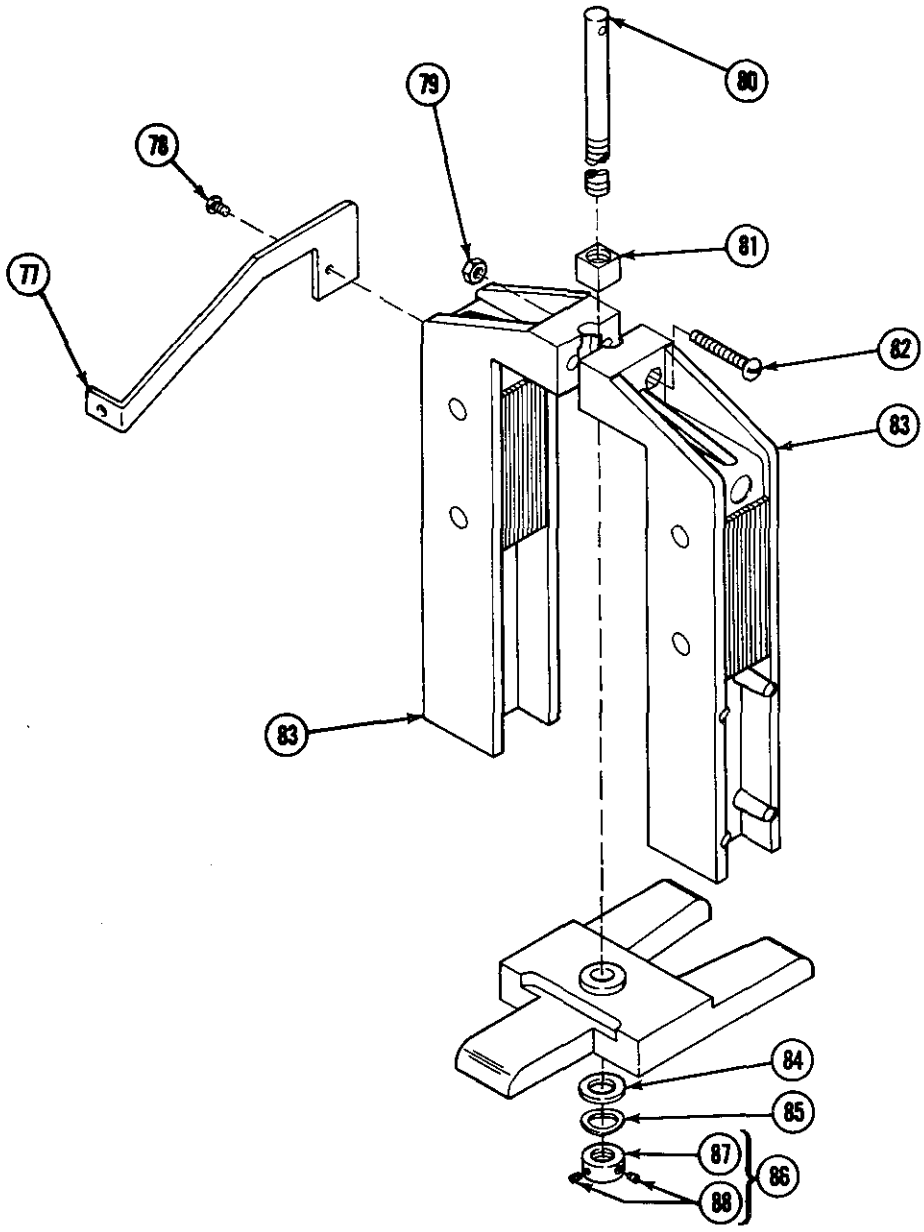

Figure B1 — Shunt

BE SURE TO PROVIDE STOCK, MODEL, AND STYLE NUMBERS WHEN ORDERING REPLACEMENT PARTS.