STANDARDS PUBLICATION NO. EW 4

nema

Graphic Symbols for Arc Welding and Cutting Apparatus

NEMA

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ■ 2101 L STREET, N.W., WASHINGTON, D.C. 20037

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

NEMA EW*4 93 ■ 6470247 0508965 343 ■

NEMA Standards Publication No. EW 4-1993

GRAPHIC SYMBOLS FOR ARC WELDING AND CUTTING APPARATUS

Published by

National Electrical Manufacturers Association
2101 L Street, N.W.
Washington, DC 20037-1526

©1994 by National Electrical Manufacturers Association

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

TABLE OF CONTENTS

		Page
	Foreword	i
	Purpose	i
	Scope	i
	History of Graphic Symbols	ii
Section 1	REFERENCED STANDARDS AND DEFINITIONS	1
Section 2	IDENTIFICATION OF PARTS AND APPLICATION	5
Section 3	GRAPHIC SYMBOLS	7
Section 4	HOW TO COMBINE GRAPHIC SYMBOLS	39
Section 5	EXAMPLES OF THE GROUPING OF SYMBOLS	43

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Foreword

User needs were considered throughout the development and revision of these graphic symbols.

This NEMA publication is intended to provide a basis of common understanding throughout the electrical arc welding and cutting industrial community. Copies were sent during the draft stage to a number of typical individuals and organizations in the public and private sector. These parties would have an interest in or responsibility for the purchase, future application, use, or inspection of arc welding and cutting power sources and associated equipment. Their comments, prior to final NEMA approval, provided vital user and general interest input and resulted in a number of substantive changes being made to this publication. As future major revisions to this publication are proposed, NEMA intends to offer the same or similar individuals or organizations an opportunity to participate.

These recommendations of the Arc Welding Section of the National Electrical Manufacturers Association will be reviewed periodically by the Section for the purpose of updating graphic symbols to reflect advancing technology or the latest graphic symbol applications. Please address any comments or questions regarding this publication to the following person:

Vice-President, Engineering Department
National Electrical Manufacturers Association
2101 L Street, NW
Washington, DC 20037-1526

Purpose

The purpose of this publication is to provide manufacturers and users of arc welding and cutting equipment with a uniform system of symbols and their meanings which will be used and recognized throughout the arc welding and cutting industry. These graphic symbols are meant to transmit the required message independent of any language, and their use should minimize language difficulties that may arise when equipment is used in various countries.

Three major factors contributing heavily to the need for graphic symbols are: large numbers of functionally illiterate people in the labor force, large numbers of non-English speaking U.S. residents, and the diversity of the international or global marketplace. In an effort to communicate with as many people as possible, graphic symbols have evolved. The basic idea is old and simple: convey meaning with pictures. It is in this spirit that this publication is presented. NEMA has developed a comprehensive and unified approach for the use of such word pictures on arc welding and cutting equipment. The total purpose of this publication is to present the standardized graphic symbols and explain their direct meaning and proper use.

Scope

This publication establishes graphic symbols for arc welding and cutting equipment. The symbols provided include those used to identify controls, indicators, connection points, functions, and processes. Symbols and examples of their use are also provided to identify (describe a control or connection point), instruct (describe an operation or method of use), indicate (show direction or quantity), qualify (describe a variation or a secondary function), and command (to do or not to do something) regarding typical use on welding and cutting equipment. This publication does not cover graphic symbols used to alert personnel of immediate or potential personal hazards in the use of the equipment.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

History of Graphic Symbols

This information provides a practical means of communicating to operators of arc welding and cutting equipment the function and use of equipment controls that are unique to the arc welding and cutting industry.

Symbols have been in use in certain countries for a number of years. Such symbols were developed as needed by equipment manufacturers to ease the language communication problem.

In 1957, the International Organization for Standardization Technical Committee 44 (Welding) (ISO/TC44) began work on the rating of manual arc welding equipment. This led to the publication of ISO Recommendation R700.

In 1976, Subcommittee SC4 (Arc Welding Equipment) of ISO/TC44 proposed a revision of ISO R700 which incorporates graphic symbols for identification of the equipment and description of the welding processes for which the equipment may be used.

In 1977, representatives of arc welding equipment manufacturers reviewed ISO symbols and proposed other symbols for use and identification of equipment controls. This group became the NEMA Arc Welding Apparatus Graphic Symbol Committee.

In 1982, this first edition of NEMA Authorized Engineering Information for Graphic Symbols for Arc Welding Apparatus was published as NEMA Standards Publication EW 4. In its preparation, consideration was given to the work of other organizations, such as the International Organization for Standardization, the American Welding Society, Society of Automotive Engineers, the American Society of Mechanical Engineers, and the various welding and cutting equipment manufacturers, including European manufacturers. Many of the symbols were adopted directly from the work of these organizations, and credit is hereby given to them.

In 1984, Technical Committee ISO/TC145 published ISO 7000 which incorporated draft Addendum 1 from 1979. This document provided symbols for all kinds of equipment.

In 1988 NEMA Standards Publication EW 4 was rescinded. In 1994, a new version of NEMA Standards Publication EW 4 was published. In this publication, consideration was given to the work of other organizations as in the past. Where symbols were used directly from another source, credit is given to that document. In keeping with the global marketplace and the desire for international harmony, symbols were also advanced for new, high-technology needs. In as many cases as possible, historical perspective was used and actively applied. Where symbols were revised or created, it was done using the most careful judgment of the NEMA Committee, Arc Welding Section, in light of the current and possible future needs of the end users in the arc welding and cutting industry.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 1
REFERENCED STANDARDS AND DEFINITIONS

1.1 REFERENCED STANDARDS

The following publications are for information purposes and are available from the organizations and addresses shown below. It is suggested when ordering those documents that one request the latest edition.

American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036

ANSI Standard Z49.1-1992	*Safety in Welding and Cutting*
ANSI Z129.1-1988	*American National Standard for the Precautionary Labeling of Hazardous Industrial Chemicals*
ANSI Z535.1-1991	*Safety Color Code*
ANSI Z535.2-1991	*Environmental and Facility Safety Signs*
ANSI Z535.3-1991	*Criteria for Safety Symbols*
ANSI Z535.4-1991	*Product Safety Signs and Labels*
ANSI Z535.5-1991	*Accident Prevention Tags (for Temporary Hazards)*

American Welding Society
550 N.W. LeJeune Road
P.O. Box 351040
Miami, FL 33135

AWS A 3.0-1989	*Standard Welding Terms and Definitions*

The Institute of Electrical and Electronics Engineers, Inc.
345 East 47th Street
New York, NY 10017

ANSI/IEEE Standard 315A-1986	*Supplement to ANSI Y32.2-1975*
ANSI/IEEE 315-1975	*Supplement to Graphic Symbols for Electrical and Electronics Diagrams*
ANSI Y14.5M-1982	*Dimensioning and Tolerancing*
IEEE Standard 315-1975 (ANSI Y32.2-1975)	*Graphic Symbols for Electronics Diagrams*

International Organization for Standardization
Case postale 56
Sales Department, 1, Rue de Varembe,
CH-1211 Geneva 20
Switzerland

ISO 700-1982	*Power Sources for Manual Metal Arc Welding with Covered Electrodes and for the TIG Process*
ISO 3461-1976	*Graphic Symbols—General Principles for Presentation*
ISO 3461-1:1988	*General Principles for the Creation of Graphical Symbols—Part 1: Graphical Symbols for Use on Equipment*
ISO 7000: 1989-(E/F)	*Graphical Symbols for Use on Equipment-Index and Synopsis*
DIN 30 600	*Graphic Symbols (Bildzeichen Ubersicht)*

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

International Electrotechnical Commission
Sales Department, 1, Rue de Varembe,
1211 Geneva 20,
Switzerland

IEC 974-1-1989	*Safety Requirements for Arc Welding Equipment Power Sources*
IEC 416-1973	*General Principles for the Creation of Graphic Symbols for Use on Equipment*
IEC 417-1973	*Graphic Symbols for Use on Equipment. Index, Survey and Compilation of the Single Sheets*

The Superintendent of Documents
U.S.Government Printing Office
Washington, DC 20402

OSHA 29 CFR 1910-1989	*Safety and Health Standards*

Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 75096-0001

SAE Handbook-1989	

National Electrical Manufacturers Association
2101 L Street N.W., Suite 300
Washington, DC 20037-1526

NEMA EW 1-1988	*Electric Arc Welding Power Sources*

Underwriters Laboratories, Inc.
UL Publications Stock
333 Pfingsten Road
Northbrook, IL 60062

UL 551	*Standard for Transformer-Type Arc Welding Machines*

The National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

NFPA 70-1990	*National Electrical Code*

The Canadian Standards Association
Standards Sales
178 Rexdale Boulevard
Rexdale, (Toronto) Ontario
Canada M9W 19R3

CSA Standard C22.2 No. 60-M1990	*Arc Welding Equipment*

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

FMC Corporation
Corporate Technology Center
P.O. Box 580
Santa Clara, CA 95052

FMC Handbook-1985 — *Product Safety Sign and Label System*

Westinghouse Electric Corporation
Westinghouse Building
Gateway Center
Pittsburgh, PA 15222

Westinghouse MB 3699-1981 — *Product Safety Label Handbook*

McGraw-Hill Book Company
New York, London, and Toronto
Henry Dreyfuss

Symbol Sourcebook-1972

1.2 DEFINITIONS

1.2.1 Air Carbon Arc Cutting (CAC-A)

A carbon arc cutting process variation that removes molten metal with a jet of air.

1.2.2 Connection Point

Place such as output terminal or receptacle where electrical connections are made (can be mechanical, water or gas connections).

1.2.3 Control

Device whose movement causes changes in equipment operation or status such as rheostats, potentiometers, or switches.

1.2.4 Downslope

The time during which the process parameters change from one welding or cutting value to a second lower value.

1.2.5 Flux Cored Arc Welding (FCAW)

An arc welding process that uses an arc between a continuous filler metal electrode and the weld pool. The process is used with shielding gas from a flux contained within the tubular electrode, with or without additional shielding from an externally supplied gas, and without the application of pressure.

1.2.6 Function

The action that a control causes to happen or not to happen by adjusting the control.

1.2.7 Gas Metal Arc Welding (GMAW)

An arc welding process that uses an arc between a continuous filler metal electrode and the weld pool. The process is used with shielding from an externally supplied gas and without the application of pressure.

1.2.8 Gas Tungsten Arc Welding (GTAW)

An arc welding process that uses an arc between tungsten electrode (nonconsumable) and the weld pool. The process is used with shielding gas and without the application of pressure.

1.2.9 Graphic Symbol

A picture used to convey written words or a single word; sometimes called pictograms, graphical symbols or pictorials; also pictures used to transmit a message or represent an object, concept, or function.

1.2.10 Indicator

Device that shows or indicates something such as water level or temperature level.

1.2.11 Input

Normally the input power requirements of equipment including volts, amps, phase, and hertz (frequency).

1.2.12 Intermittent Weld

A weld in which the continuity is broken by recurring spaces.

1.2.13 Memory

The capability of the equipment, usually microprocessor based, to store one or a group of process parameters for recall at a later time.

1.2.14 Mode

Describes volt-ampere curve type of operation such as CC (constant current, drooper) or CV (constant voltage, flat).

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

1.2.15 Output

Normally the rated output of the equipment at a specific load; usually expressed in amperes and volts at a specific duty cycle; machine open-circuit voltage.

1.2.16 Plasma Arc Cutting (PAC)

An arc cutting process that uses a constricted arc and removes the molten metal with a high velocity jet of ionized gas issuing from the constricting orifice.

1.2.17 Plasma Arc Gouging (PAG)

A plasma arc cutting process variation that uses a constricted arc and removes the molten metal with a high velocity jet of ionized gas issuing from the constricting orifice to form a bevel or groove.

1.2.18 Plasma Arc Welding (PAW)

An arc welding process that uses a constricted arc between a nonconsumable electrode and the weld pool (transferred arc) or between the electrode and the constricting nozzle (nontransferred arc). Shielding is obtained from the ionized gas issuing from the torch, which may be supplemented by an auxiliary source of shielding gas. The process is used without the application of pressure.

1.2.19 Program

The single program selected in a multi-program device; usually found on microprocessor-controlled type of equipment.

1.2.20 Submerged Arc Welding (SAW)

An arc welding process that uses an arc or arcs between a bare metal electrode or electrodes and the weld pool. The arc and molten metal are shielded by a blanket of granular flux on the workpieces. The process is used without pressure and with filler metal from the electrode and sometimes from a supplemental source (welding rod, flux, or metal granules).

1.2.21 Pulsed Gas Metal Arc Welding (GMAW-P)

A gas metal arc welding process variation in which the current is pulsed.

1.2.22 Pulsed Gas Tungsten Arc Welding (GTAW-P)

A gas tungsten arc welding process variation in which the current is pulsed.

1.2.23 Shielded Metal Arc Welding (SMAW)

An arc welding process with an arc between a covered electrode and the weld pool. The process is used with shielding from the decomposition of the electrode covering, without the application of pressure, and with filler metal from the electrode.

1.2.24 Sequence

The various parts of a process cycle such as preflow, initial, weld, crater, final, and postflow.

1.2.25 Slope

Rising or falling areas of a process cycle.

1.2.26 Source

Place, document, or group from which the symbol element(s) were taken or originated.

1.2.27 Stitch Weld

A nonstandard term for intermittent weld.

1.2.28 Units of Measurement

The units used to describe a quantity such as amperes for current and volts for potential or emf.

1.2.29 Upslope

The time during which the process parameters change from one welding or cutting value to a second higher value.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 2
IDENTIFICATION OF PARTS AND APPLICATION

2.1 GENERAL

The symbols are normally placed on equipment to instruct as to its use and operation. In addition, there may be warnings or limits as to use of some controls. In some cases, symbols may be used to identify the complete package or subassemblies.

The user of equipment can determine the meaning of symbols by referencing Section 3 of this standard.

Symbols may be accompanied by words and phrases until such time that universal recognition is achieved. Words or phrases, to be used in addition to the symbols, are to be selected by the manufacturer. The process of selecting symbols for a particular application is simplified by the following procedure.

2.2 PROCEDURE FOR PARTS

2.2.1 List all existing parts that need identification or that could be expressed by symbols. Group similar parts together in tabular form, for example: switches, receptacles, and terminals.

2.2.2 List after each part its exact function, for example:

a. Switch—To control input power
b. Rheostat—To control welding current
c. Lamp—To indicate low oil pressure when lit
d. Terminal— To identify as work lead connection point

2.2.3 List the direction of movement and result of such movement associated with the part, for example:

a. Rotate clockwise to increase
b. Push up for ON, down for OFF
c. Pull out to STOP

2.2.4 List the command associated with the part, for example: do not switch while welding.

2.2.5 List the quantity and unit of measurement related to the part, for example:

a. 0–10 dial, in seconds
b. 0–10 dial, no meaning to graduations

2.2.6 List all items (words or phrases) that are not physical parts but for which symbols are to be selected, for example: water, high frequency, positive polarity.

2.2.7 Review the preceding steps to assure that all physical parts have some distinguishing description that clearly states, in an understandable manner, exactly what is to be represented by graphic symbols. It is important that the language description be clear before attempting to select symbols.

2.3 SELECTION OF SYMBOLS

2.3.1 A symbol may exist that exactly transmits the requirements worked out in the preceding sections. However, it is usually necessary to use a building block approach and use combinations of symbols as required.

2.3.2 Refer to Tables 3-2 and 3-3 which list the function keyword or phrase columns and corresponding graphic symbol number. Select symbols by looking at both the symbol and the function, keyword or phrase columns. List the symbol numbers opposite the parts and items listed from 2.2. Use this composite list as a guide for preparing the artwork for labels or screening process. Consistent positioning of each symbol around the device promotes overall readability.

2.3.3 Alternative methods of applying symbols are shown in the examples in Section 5. Select the method that best identifies the control or component, how it is to be used, and what is indicated, as needed for the application.

2.4 SIZE OF SYMBOLS

For the application of the symbols it may be necessary either to reduce or to enlarge the original to a suitable size. In the case of symbols composed of several graphic elements, or when reducing to minimum height, check that clear identification is still possible and legibility is adequate.

Recommended minimum symbol size is 1/4 inch (6.3 mm) square. It will be necessary to use sound judgment when size reduction is done. Show the proposed size to a typical target audience, and carefully check their responses. Consider available light, user distance, and possible operating conditions as factors during size selection also. Always retain adequate line thickness for reproduction process and user visibility.

2.5 USE OF COLOR

In general, the graphic form of a symbol reproduced in black on white or white on black should be sufficient for its identification. However, there may be cases in which the meaning of the symbol may depend on the application of one or more colors. In these cases the relevant colors are normally specified in the standard regulating or advising that specific area of concern. For

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

the purposes of this standard and these symbols, adequate contrast between symbol and background is most important. As long as the symbol is clearly delineated and fully legible, actual color selection is not mandatory. Be aware that certain colors, such as red, orange, and yellow, are designated safety alerting colors according to ANSI Z535.1. If necessary for legibility when reduced in size, the symbol may be filled.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 3
GRAPHIC SYMBOL

3.1 GENERAL

The following symbols are for use on arc welding and cutting apparatus. Table 3-1 presents the symbols along with its reference number; function, keyword or phrase; application and source.

Table 3-2 provides an alphabetical listing by function, keyword or phrase with corresponding symbol numbers. Table 3-3 provides a numerical listing by symbol number with corresponding function, keyword or phrase.

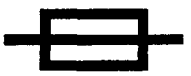
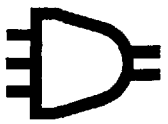
Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
1	A	AMPERAGE	Signifies amperage or amperage control	SI
2	V	VOLTAGE	Signifies voltage or voltage control	SI
3	Hz	HERTZ	Signifies cycles per second	SI
4	f	FREQUENCY	Signifies frequency	SI
5	s	SECONDS	Signifies time in seconds	SI
6	t	TIME	Signifies time	SI
7	—	NEGATIVE	Signifies negative switch position or connection	IEC 417 5006

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

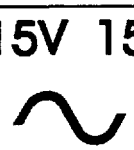
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
8		POSITIVE	Signifies positive switch position or connection	IEC 417 5005
9		DIRECT CURRENT (DC)	Signifies direct current	IEC 417 5031
10		ALTERNATING CURRENT (AC)	Signifies alternating current	IEC 417 5032
11		EARTH (GROUND)	Signifies the earth (ground) connection	IEC 417 5017
12		PROTECTIVE EARTH (GROUND)	Signifies the equipment connection point for the protective earth ground	IEC 417 5019
13		FRAME OR CHASSIS	Signifies the frame or chassis connection	IEC 417 5020
14		FUSE	Signifies a fuse	IEC 417 5016
15		LINE	Signifies an input power cord or plug that connects to line	ANSI / NEMA
16		LINE CONNECTION	Signifies a line connection	IEC 974

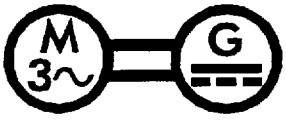
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
17		AUXILIARY POWER	Signifies an auxiliary power outlet	ANSI / NEMA
18		CIRCUIT BREAKER	Signifies a circuit breaker in an electrical circuit	ANSI / NEMA
19		RECEPTACLE RATING-AUXILIARY POWER	Signifies the receptacle rating	ANSI / NEMA
20		SINGLE PHASE	Signifies single phase	IEC 974
21		THREE PHASE	Signifies three phase	IEC 974
22		SINGLE PHASE TRANSFORMER	Signifies single phase transformer	IEC 974
23		SINGLE PHASE TRANSFORMER RECTIFIER	Signifies a single phase transformer and rectifier	IEC 974
24		THREE PHASE TRANSFORMER RECTIFIER	Signifies a three phase transformer and rectifier	IEC 974
25		DIRECT CURRENT GENERATOR WITH COMMUTATOR	Signifies a direct current generator with commutator	IEC 974

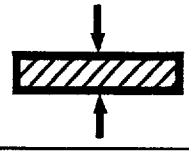
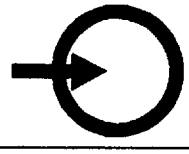
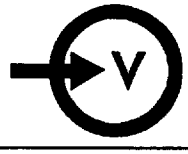
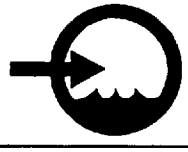
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
26		SINGLE PHASE ALTERNATOR	Signifies a single phase alternator	IEC 974
27		THREE PHASE ALTERNATOR WITH RECTIFIER	Signifies a three phase alternator with rectifier	IEC 974
28		THREE PHASE MOTOR THREE PHASE ALTERNATOR RECTIFIER	Signifies motor driven three phase alternator and rectifier	IEC 974
29		MOTOR GENERATOR	Signifies a motor generator	IEC 974
30		SINGLE PHASE TRANSFORMER AC & RECTIFIER DC POWER SOURCE	Signifies a single phase transformer with single phase AC output, and rectified DC output	IEC 974
31		SINGLE PHASE STATIC FREQUENCY CONVERTER-TRANSFORMER-RECTIFIER	Signifies a single phase static frequency converter, transformer and rectifier	IEC 974
32		THREE PHASE STATIC FREQUENCY CONVERTER-TRANSFORMER-RECTIFIER	Signifies a three phase static frequency converter, transformer and rectifier	IEC 974
33		DANGEROUS VOLTAGE	Signifies a dangerous voltage	IEC 417 5036A
34		GAS (SUPPLY)	Signifies a gas supply	ANSI / NEMA

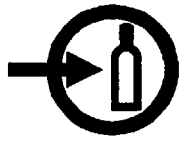
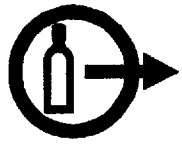
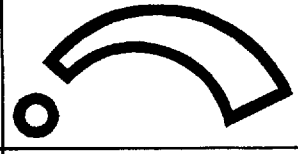
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
35		GAS TYPE	Signifies the type of gas such as Argon, CO_2	ANSI / NEMA
36		MATERIAL TYPE	Signifies the type of material to be welded or cut	ANSI / NEMA
37		MATERIAL THICKNESS	Signifies the thickness of material to be welded or cut	ANSI / NEMA
38		DIAMETER mm (in)	Signifies diameter such as the diameter of wire or electrode	ANSI Y14.5 M 1982
39		INPUT	Signifies input	IEC 417 5034
40		OUTPUT	Signifies output	IEC 417 5035
41		VOLTAGE INPUT	Signifies voltage input	IEC 417 5034 ANSI/ NEMA
42		WATER (COOLANT) INPUT	Signifies water (coolant) input	ANSI / NEMA
43		WATER (COOLANT) OUTPUT	Signifies water (coolant) output	ANSI / NEMA

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
44		GAS INPUT	Signifies gas input	ANSI / NEMA
45		GAS OUTPUT	Signifies gas output	ANSI / NEMA
46		OFF	Signifies an OFF position of a switch or control	IEC 417 5008
47		ON	Signifies an ON position of a switch or control	IEC 417 5007
48		INCREASE/DECREASE OF QUANTITY (ROTATING; NUMBER OF POSITIONS)	Signifies an increase/ decrease of quantity with a rotary control in steps	ISO N95 31
49		INCREASE/DECREASE OF QUANTITY (ROTATING; AND OFF POSITIONS)	Signifies an increase/ decrease of quantity with a rotary control and OFF position	ISO N95 32
50		INCREASE/DECREASE OF QUANTITY (ROTATING)	Signifies an increase/ decrease of quantity with a rotary control continuously variable	ISO N95 30
51		INCREASE/DECREASE OF QUANTITY (LINEAR; NUMBER OF POSITIONS)	Signifies an increase/ decrease of a quantity (linear) in steps usually by a switch	ISO N95 28
52		INCREASE/DECREASE OF QUANTITY (LINEAR)	Signifies an increase/ decrease of a quantity (linear) continuously variable usually by a potentiometer	ISO N95 27

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
53		DIRECTION OF CONTINUOUS ROTATION	Signifies continuous clockwise rotary motion. For counterclockwise motion symbol is reversed	ISO 7000-0004
54		DO NOT SWITCH WHILE WELDING	Signifies that switching while welding is prohibited	ANSI / NEMA
55		PANEL/LOCAL	Signifies panel/local function or switch such as a switch to change between a local and a remote control	ANSI / NEMA
56		DIRECTIONAL ARROW	Signifies a direction	ANSI / NEMA
57		REMOTE	Signifies a remote control connection or function	ISO 7000-0093
58		PUSH BUTTON SWITCH (IN)	Signifies the IN position of a push button control	IEC 417 5268
59		PUSH BUTTON SWITCH (OUT)	Signifies the OUT position of a push button control	IEC 417 5269
60		START OF ACTION	Signifies the start (of action) function or control	IEC 417 5104
61		STOP OF ACTION	Signifies the stop (of action) function or control	IEC 417 5110

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
62		FOOT CONTROL	Signifies a foot control device; function, connection or control	ANSI / NEMA
63		MANUAL CONTROL	Signifies the switch position for manual control as opposed to automatic control	ISO 7000-0096
64		READ OPERATOR'S MANUAL	Signifies that the operator's manual should be read	SAE
65		WELDING ARC (GENERAL)	Signifies welding	ISO 7000-0459
66		SHIELDED METAL ARC WELDING (SMAW)	Signifies SMAW welding	ISO 7000-0460
67		GAS METAL ARC WELDING (GMAW)	Signifies GMAW welding	ISO 7000-0461
68		FLUX CORED ARC WELDING (FCAW)	Signifies FCAW welding (without gas shielding)	ANSI / NEMA
69		SUBMERGED ARC WELDING (SAW)	Signifies SAW welding	ISO 7000-0467
70		GAS TUNGSTEN ARC WELDING (GTAW)	Signifies GTAW welding	ISO 7000-0462

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

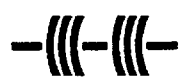
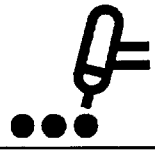
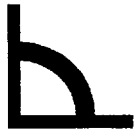
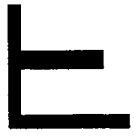
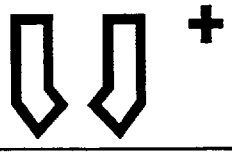
Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
71		AIR CARBON ARC CUTTING (CAC-A)	Signifies CAC-A cutting	ANSI / NEMA
72		PLASMA ARC CUTTING (PAC)	Signifies PAC cutting	ISO 7000-0479
73		PLASMA ARC WELDING (PAW)	Signifies PAW welding	ISO 7000-0478
74		PLASMA ARC GOUGING	Signifies plasma arc gouging function or control	ANSI / NEMA
75		SPRAY TRANSFER	Signifies spray transfer	ISO 7000-0472
76		SHORT CIRCUITING TRANSFER	Signifies short circuiting transfer	ISO 7000-0471
77		PULSE TRANSFER	Signifies pulse transfer	ISO 7000-0473
78		ARC SPOT WELDING	Signifies arc spot welding	ISO 7000-0468
79		CONTINUOUS WELDING	Signifies a continuous welding function or control	ISO 7000-0831

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

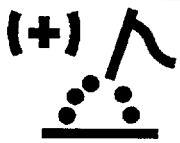
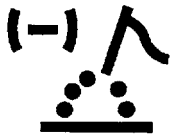
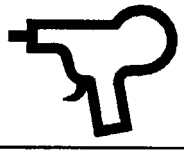
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
80		INTERMITTENT (STITCH) WELDING	Signifies an intermittent (stitch) welding function or control	ISO 7000-0832
81		GTAW SPOT WELDING	Signifies GTAW spot welding	ISO 7000-0470
82		GMAW SPOT WELDING	Signifies GMAW spot welding	ISO 7000-0469
83		CONSTANT CURRENT	Signifies a constant current (drooping) characteristic	ISO 7000-0454
84		CONSTANT VOLTAGE OR CONSTANT POTENTIAL	Signifies a constant voltage characteristic (substantially level load voltage characteristic)	ISO 7000-0455
85		ELECTRODE CONNECTION	Signifies an electrode connection	ANSI/ NEMA
86		WORK CONNECTION	Signifies workpiece connection	ISO 7000-0453
87		PLASMA TORCH CONNECTION + NOZZLE (POSITIVE SUPPLY)	Signifies a plasma torch connection + nozzle (positive supply)	ISO 7000-0483
88		PLASMA TORCH CONNEC-TION - ELECTRODE (NEGATIVE SUPPLY)	Signifies a plasma torch connection to - electrode (negative supply)	ISO 7000-0482

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

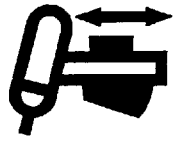
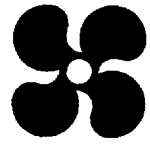
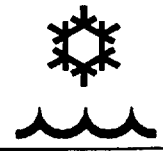
Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
89		ELECTRODE POSITIVE	Signifies electrode positive connection or switch position	ANSI/ NEMA
90		ELECTRODE NEGATIVE	Signifies electrode negative connection or switch position	ANSI/ NEMA
91		SHIELDED METAL ARC (SMAW) ELECTRODE HOLDER	Signifies a SMAW electrode holder	ISO 7000-0463
92		GAS METAL ARC WELDING (GMAW) GUN	Signifies a GMAW gun	ISO 7000-0464
93		FLUX CORED ARC WELDING (FCAW) GUN	Signifies a FCAW gun (torch) with or without gas shielding	ANSI/ NEMA
94		WIRE FEED SPOOL GUN	Signifies a spool gun, which consists of a welding gun and small spool of electrode	ANSI/ NEMA
95		GAS TUNGSTEN ARC WELDING (GTAW) TORCH	Signifies a GTAW torch	ISO 7000-0465
96		AIR CARBON ARC CUTTING (CAC-A) ELECTRODE HOLDER	Signifies an CAC-A electrode holder	ANSI/ NEMA
97		PLASMA TORCH	Signifies a plasma torch	ISO 7000-0477

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

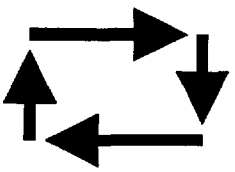
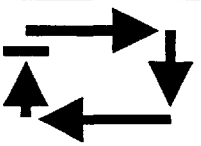
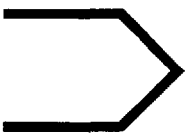
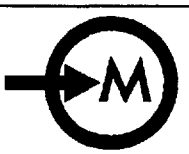
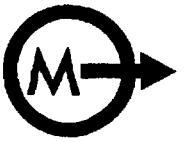
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
98		GMAW GUN SWITCH/CONTROL	Signifies a GMAW gun switch/control used to change welding parameters	ANSI/ NEMA
99		GTAW TORCH SWITCH/CONTROL	Signifies a GTAW torch switch/control used to change welding parameters	ANSI/ NEMA
100		FCAW GUN WITH SWITCH	Signifies a FCAW gun with switch	ANSI/ NEMA
101		GMAW GUN WITH SWITCH	Signifies a GMAW gun with switch	ANSI/ NEMA
102		GTAW TORCH WITH SWITCH	Signifies a GTAW torch with switch	ANSI/ NEMA
103		VENTILATING AND AIR CIRCULATING FAN	Signifies a ventilating fan or air circulating fan	ISO 7000-0089
104		COOLING	Signifies cooling of components or system	ISO 7000-0027
105		COOLING WITH LIQUID	Signifies cooling with liquid	ISO 7000-0544
106		COOLING PUMP	Signifies a cooling pump	ISO 7000-0355

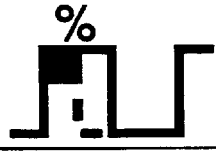
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
107		COOLANT CONDUCTIVITY	Signifies the conductivity of coolant	ANSI/ NEMA
108		HIGH TEMPERATURE	Signifies the high temperature function or control such as an overtemperature light	ANSI/ NEMA
109		DISTURBANCE	Signifies a disturbance in the proper run of a procedure, for example a light indication of a circuit overload	ISO 7000-0228
110		AUTOMATIC CYCLE	Signifies an automatic sequence of machine functions repeated continuously without manual intervention	ISO 7000-0026
111		ONE CYCLE	Signifies one cycle, for example on a control of a machine tool	ISO 7000-0426
112		PROGRAM	Signifies a program function or control such as found on a microprocessor control circuit	ISO 7000-0982
113		SAVE TO MEMORY	Signifies a saving to memory function or control	ANSI/ NEMA
114		RECALL FROM MEMORY	Signifies a recall from memory function or control	ANSI/ NEMA
115		DIGITAL DISPLAY	Signifies a digital display function or control	ANSI/ NEMA

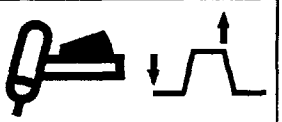
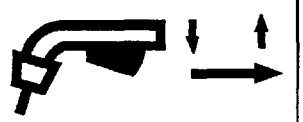
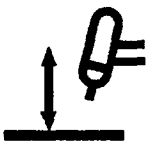
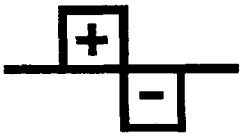
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
116		CLOCK, TIME SWITCH	Signifies a clock, time switch or time	IEC 417 5184
117		PERCENT	Signifies percent	ANSI/ NEMA
118		PROCESS CYCLE	Signifies one complete process cycle	ANSI/ NEMA
119		PERCENT ON TIME	Signifies percent on time (duty cycle) function or control	ANSI/ NEMA
120		PULSE	Signifies a pulse function or control	ANSI/ NEMA
121		SOFT START	Signifies a soft start of welding current	ANSI/ NEMA
122		HOT START	Signifies a hot start of welding voltage	ANSI/ NEMA
123		ARC FORCE	Signifies the arc force function or control	ANSI/ NEMA
124		HIGH FREQUENCY-GENERAL	Signifies a high frequency connection or function	ANSI/ NEMA

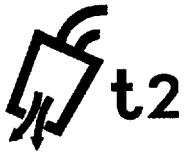
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
125		HIGH FREQUENCY-ON CONTINUOUS	Signifies the high frequency is on continuously during the weld cycle	ANSI/ NEMA
126		HIGH FREQUENCY ON-START ONLY	Signifies the high frequency is on at start only	ANSI/ NEMA
127		TWO-STEP TRIGGER OPERATION (GTAW)	Signifies a two-step trigger operation of a GTAW torch. Press to start, release to go into crater fill and stop	ANSI/ NEMA
128		FOUR-STEP TRIGGER OPERATION (GTAW)	Signifies a four-step trigger operation of a GTAW torch. Press to start, release after arc ignition, weld, press to go into crater fill, release to stop	ANSI/ NEMA
129		TWO-STEP TRIGGER OPERATION (GMAW)	Signifies a two-step trigger operation of a semi-automatic gun. Press to initiate wirefeed and welding, release to stop	ANSI/ NEMA
130		FOUR-STEP TRIGGER OPERATION (GMAW)	Signifies a four-step trigger operation of a semi-automatic gun. Press to start, release after arc ignition, weld, then press and release to stop	ANSI/ NEMA
131		IMPULSE STARTING (GTAW)	Signifies ignition of GTAW arc welding by an impulse other than HF	ANSI/ NEMA
132		TOUCH START (GTAW)	Signifies ignition of GTAW arc welding by touching the workpiece and lifting	ANSI/ NEMA
133		WAVE BALANCE	Signifies an AC wave balance function or control	ANSI/ NEMA

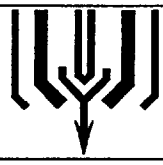
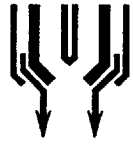
Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
134		MAXIMUM CLEANING	Signifies the maximum cleaning (min. penetration) of a GTAW process, function, or control	ANSI/ NEMA
135		MAXIMUM PENETRATION	Signifies the maximum penetration (min. cleaning) of a GTAW process, function, or control	ANSI/ NEMA
136		PURGE BY GAS	Signifies purging of air (by gas)	ISO 7000-0474
137		GAS POSTFLOW	Signifies gas postflow time	ISO 7000-0474 ANSI/ NEMA
138		GAS PREFLOW	Signifies gas preflow time	ISO 7000-0474 ANSI/ NEMA
139		LOW INDUCTANCE	Signifies low inductance: connection, function, or control	ANSI/ NEMA
140		MEDIUM INDUCTANCE	Signifies medium inductance: connection, function, or control	ANSI/ NEMA
141		HIGH INDUCTANCE OR INDUCTANCE	Signifies inductance, or when used with other inductance symbols, high inductance	ANSI/ NEMA
142		VARIABLE INDUCTANCE	Signifies a variable inductance function or control	ANSI/ NEMA

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

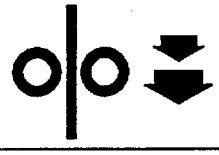
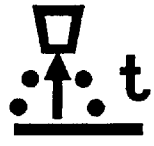
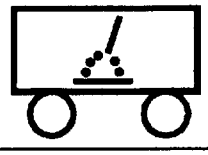
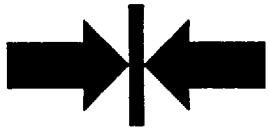
Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
143		PLASMA GAS	Signifies plasma gas	ISO 7000-0480
144		PLASMA SHIELDING GAS	Signifies plasma shielding gas	ISO 7000-0481
145		PILOT/PULSE STARTING	Signifies pilot or pulse starting of a plasma torch	ANSI/ NEMA
146		WIRE FEED	Signifies a wire feed unit or wire feed function	ANSI/ NEMA
147		WIRE FEED FORWARD	Signifies the feeding of wire forward towards the workpiece	ANSI/ NEMA
148		WIRE FEED REVERSE	Signifies the feeding of wire away from the workpiece	ANSI/ NEMA
149		WIRE FEED INTERMITTENT (STITCH)	Signifies intermittent wire feed, such as stitching	ANSI/ NEMA
150		COLD JOG (INCH) TOWARDS WORKPIECE	Signifies the feeding of wire towards the workpiece with output voltage off	ANSI/ NEMA
151		COLD JOG (INCH) AWAY FROM WORKPIECE	Signifies the feeding of wire away from the workpiece with output voltage off	ANSI/ NEMA

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

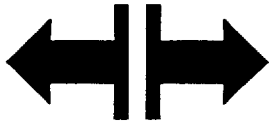
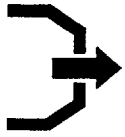
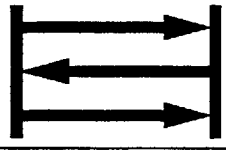
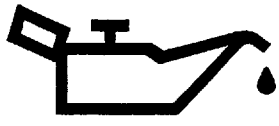
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
152		WIRE FEED SLOW RUN-IN	Signifies the slow run or feed of wire toward the workpiece before welding	ANSI/ NEMA
153		WIRE DIAMETER	Signifies the diameter of welding electrode: function or control	ANSI/ NEMA
154		WIRE TYPE	Signifies the type of welding electrode such as steel or aluminum	ANSI/ NEMA
155		MELTBACK (BURNBACK)	Signifies meltback (burnback) time at the end of a weld	ANSI/ NEMA
156		ARC IGNITION BY CONTACT	Signifies arc ignition by contact	ISO 7000-0475
157		AIR PRESSURE	Signifies air pressure function or control	ANSI/ NEMA
158		HOPPER	Signifies a flux (powder) hopper	ISO 7000-0466
159		ARC WELDING EQUIPMENT CARRIAGE	Signifies a welding carriage	ISO 7000-0451
160		LOCK OR TIGHTEN	Signifies the function of locking or clamping two machine elements together	ISO 7000-0018

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
161		UNLOCK OR UNCLAMP	Signifies the function of releasing two machine elements locked or clamped together	ISO 7000-0019
162		BLOWING	Signifies the production of a current of air directed at an object	ISO 7000-0032
163		SUCTION	Signifies the generation of an air current by use of suction	ISO 7000-0033
164		TORCH	Signifies a welding or cutting torch	ANSI/ NEMA
165		OSCILLATION	Signifies oscillation such as the oscillation of a welding torch	ISO 7000-0003
166		ENGINE OIL	Signifies the engine oil indicator on the instrument panel or oil filling area	ISO 7000-0248
167		PULL TO STOP ENGINE	Signifies the pull device used to stop the engine	ANSI/ NEMA
168		ENGINE CHOKE	Signifies the operating device of the choke (cold starting aid) on the instrument panel	ISO 7000-0243
169		FUEL	Signifies fuel	ISO 7000-0245 SAE

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
170		ENGINE COOLANT	Signifies the engine coolant radiator or reservoir	ANSI/ NEMA
171		ENGINE COOLANT TEMPERATURE	Signifies the engine coolant temperature indicator on the instrument panel	ISO 7000-0246
172		BATTERY (ENGINE)	Signifies the battery charging condition indicator on the instrument panel	ISO 7000-0247
173		AIR FILTER	Signifies an air filter	SAE
174		ENGINE	Signifies a gasoline or diesel engine	SAE
175		ENGINE RPM	Signifies engine RPM	SAE
176		ENGINE STOP	Signifies the stop engine function or control	SAE
177		GLOW PLUG	Signifies a glow plug function or indicator on a diesel engine	SAE
178		ENGINE START	Signifies the start function or control of an engine welder	SAE

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-1 Continued
GRAPHIC SYMBOLS

NO.	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION	SOURCE
179		HOUR METER	Signifies an hour meter function or indicator	SAE
180		ELAPSED ENGINE HOURS	Signifies the elapsed engine hours	SAE
181		FUEL SHUT OFF	Signifies the fuel shutoff to an engine	SAE
182		SLOW	Signifies slow action or operation	SAE
183		FAST	Signifies fast action or operation	SAE
184		UNLOCKED	Signifies an unlocked function or control	ANSI/ NEMA
185		LOCKED	Signifies a locked function or control	ANSI/ NEMA

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Table 3-2
ALPHABETICAL LIST FUNCTION KEYWORD OR PHRASE

	Graphic Symbol Number
ARC SPOT WELDING	78
AIR CARBON ARC CUTTING (AAc)	71
AIR CARBON ARC CUTTING (AAc) ELECTRODE HOLDER	96
AIR FILTER	173
AIR PRESSURE	157
ALTERNATING CURRENT (AC)	10
AMPERAGE	1
ARC FORCE	123
ARC IGNITION BY CONTACT	156
ARC WELDING EQUIPMENT CARRIAGE	159
AUTOMATIC CYCLE	110
AUXILIARY CYCLE	17
BATTER (ENGINE)	172
BLOWING	162
CIRCUIT BREAKER	18
CLOCK, TIME SWITCH	116
COLD JOG (INCH) AWAY FROM WORK PIECE	151
COLD JOG (INCH) TOWARDS WORK PIECE	150
CONSTANT CURRENT	83
CONSTANT VOLTAGE OR CONSTANT POTENTIAL	84
CONTINUOUS WELDING	79
COOLANT CONDUCTIVITY	107
COOLING	104
COOLING PUMP	106
COOLING WITH LIQUID	105
DANGEROUS VOLTAGE	33
DIAMETER MM/IN	38
DIGITAL DISPLAY	115
DIRECT CURRENT (DC)	9
DIRECT CURRENT GENERATOR WITH COMMUTATOR	25
DIRECTION OF CONTINUOUS ROTATION	53
DIRECTIONAL ARROW	56
DISTURBANCE	109
DO NOT SWITCH WHILE WELDING	54
EARTH (GROUND)	11
ELAPSED ENGINE HOURS	180
ELECTRODE CONNECTION	85
ELECTRODE NEGATIVE	90
ELECTRODE POSITIVE	89
ENGINE	174

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-2 (continued)
ALPHABETICAL LIST FUNCTION KEYWORD OR PHRASE

	Graphic symbol Number
ENGINE CHOKE	168
ENGINE COOLANT	170
ENGINE COOLANT TEMPERATURE	171
ENGINE OIL	166
ENGINE RPM	175
ENGINE START	178
ENGINE STOP	176
FAST	183
FCAW GUN WITH SWITCH	100
FLUX CORED ARC WELDING (FCAW)	68
FLUX CORED ARC WELDING (FCAW) GUN	93
FOOT CONTROL	62
FOUR-STEP TRIGGER OPERATION (GMAW)	130
FOUR-STEP TRIGGER OPERATION (GTAW)	128
FRAME OR CHASSIS	13
FREQUENCY	4
FUEL	169
FUEL SHUT OFF	181
FUSE	14
GAS (SUPPLY)	34
GAS INPUT	44
GAS METAL ARC WELDING (GMAW)	67
GAS METAL ARC WELDING (GMAW) GUN	92
GAS OUTPUT	45
GAS POSTFLOW	137
GAS PREFLOW	138
GAS TUNGSTEN ARC WELDING (GTAW)	70
GAS TUNGSTEN ARC WELDING (GTAW) TORCH	95
GAS TYPE	35
GLOW PLUG	177
GMAW GUN SWITCH/CONTROL	98
GMAW GUN WITH SWITCH	101
GMAW SPOT WELDING	82
GTAW SPOT WELDING	81
GTAW TORCH SWITCH/CONTROL	99
GTAW TORCH WITH SWITCH	102
HERTZ	3
HIGH FREQUENCY—GENERAL	124
HIGH FREQUENCY—ON CONTINUOUS	125
HIGH FREQUENCY—ON START ONLY	126

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-2 (continued)
ALPHABETICAL LIST FUNCTION KEYWORD OR PHRASE

	Graphic symbol Number
HIGH INDUCTANCE OR INDUCTANCE	141
HIGH TEMPERATURE	108
HOPPER	158
HOT START	122
HOUR METER	179
IMPULSE STARTING (GTAW)	131
INCREASE/DECREASE OF QUANTITY	
LINEAR	52
LINEAR; NUMBER OF POSITIONS	51
ROTATING	50
ROTATING; AND OFF POSITIONS	49
ROTATING; NUMBER OF POSITIONS	48
INPUT	39
INPUT VOLTAGE	41
INTERMITTENT (STITCH) WELDING	8
LINE	15
LINE CONNECTION	16
LOCK OR TIGHTEN	160
LOCKED	185
LOW INDUCTANCE	139
MANUAL CONTROL	63
MATERIAL THICKNESS	37
MATERIAL TYPE	36
MAXIMUM CLEANING	134
MAXIMUM PENETRATION	135
MEDIUM INDUCTANCE	140
MELTBACK (BURNBACK)	155
MOTOR GENERATOR	29
NEGATIVE	7
OFF	46
ON	47
ONE CYCLE	111
OSCILLATION	165
OUTPUT	40
PANEL/LOCAL	55
PERCENT	117
PERCENT ON TIME	119
PILOT/PULSE STARTIN	145
PLASMA ARC CUTTING (PAC)	72
PLASMA ARC GOUGING	74

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-2 (continued)
ALPHABETICAL LIST FUNCTION KEYWORD OR PHRASE

	Graphic symbol Number
PLASMA ARC WELDING (PAW)	73
PLASMA GAS	143
PLASMA SHIELDING GAS	144
PLASMA TORCH	97
PLASMA TORCH CONNECTION + NOZZLE (POSITIVE SUPPLY)	87
PLASMA TORCH CONNECTION - ELECTRODE (NEGATIVE SUPPLY)	88
POSITIVE	8
PROCESS CYCLE	118
PROGRAM	112
PROTECTIVE EARTH (GROUND)	12
PULL TO STOP ENGINE	167
PULSE	120
PULSE TRANSFER	77
PURGE BY GAS	136
PUSH BUTTON SWITCH (IN)	58
PUSH BUTTON SWITCH (OUT)	59
READ OPERATOR'S MANUAL	64
RECALL FROM MEMORY	114
RECEPTACLE RATING - AUXILIARY POWER	19
REMOTE	57
SAVE TO MEMORY	113
SECONDS	5
SHIELDED METAL ARC (SMAW) ELECTRODE HOLDER	91
SHIELDED METAL ARC WELDING (SMAW)	66
SHORT CIRCUITING TRANSFER	76
SINGLE PHASE	20
SINGLE PHASE ALTERNATOR	26
SINGLE PHASE STATIC FREQUENCY CONVERTER-TRANSFORMER-RECTIFIER	31
SINGLE PHASE TRANSFORMER	22
SINGLE PHASE TRANSFORMER AC & RECTIFIER DC POWER SOURCE	30
SINGLE PHASE TRANSFORMER RECTIFIER	23
SLOW	182
SOFT START	121
SPRAY TRANSFER	75
START OF ACTION	60
STOP OF ACTION	61
SUBMERGED ARC WELDING (SAW)	69
SUCTION	163
THREE PHASE	21
THREE PHASE ALTERNATOR WITH RECTIFIER	27

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-2 (continued)
ALPHABETICAL LIST FUNCTION KEYWORD OR PHRASE

	Graphic symbol Number
THREE PHASE MOTOR THREE PHASE ALTERNATOR RECTIFIER	28
THREE PASE STATIC FREQUENCY CONVERTER-TRANSFORMER-RECTIFIER	32
THREE PHASE TRANSFORMER RECTIFIER	24
TIME	6
TORCH	164
TOUCH START (GTAW)	132
TWO-STEP TRIGGER OPERATION (GMAW)	129
TWO-STEP TRIGGER OPERATION (GTAW)	127
UNCLOCK OR UNCLAMP	161
UNLOCKED	184
VARIABLE INDUCTANCE	142
VENTILATING AND AIR CIRCULATING FAN	103
VOLTAGE	2
WATER (COOLANT) INPUT	42
WATER (COOLANT) OUTPUT	43
WAVE BALANCE	133
WELDING ARC (GENERAL)	65
WIRE DIAMETER	153
WIRE FEED	146
WIRE FEED FORWARD	147
WIRE FEED INTERMITTENT (STITCH)	149
WIRE FEED REVERSE	148
WIRE FEED SLOW RUN-IN	152
WIRE FEED SPOOL GUN	94
WIRE TYPE	154
WORK CONNECTION	86

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-3
NUMERICAL LIST FUNCTION KEYWORD OR PHRASE

Symbol No.	
1.	AMPERAGE
2.	VOLTAGE
3.	HERTZ
4.	FREQUENCY
5.	SECONDS
6.	TIME
7.	NEGATIVE
8.	POSITIVE
9.	DIRECT CURRENT (DC)
10.	ALTERNATING CURRENT (AC)
11.	EARTH (GROUND)
12.	PROTECTIVE EARTH (GROUND)
13.	FRAME OR CHASSIS
14.	FUSE
15.	LINE
16.	LINE CONNECTION
17.	AUXILIARY POWER
18.	CIRCUIT BREAKER
19.	RECEPTACLE RATING—AUXILIARY POWER
20.	SINGLE PHASE
21.	THREE PHASE
22.	SINGLE PHASE TRANSFORMER
23.	SINGLE PHASE TRANSFORMER RECTIFIER
24.	THREE PHASE TRANSFORMER RECTIFIER
25.	DIRECT CURRENT GENERATOR WITH COMMUTATOR
26.	SINGLE PHASE ALTERNATOR
27.	THREE PHASE ALTERNATOR WITH RECTIFIER
28.	THREE PHASE MOTOR THREE PHASE ALTERNATOR RECTIFIER
29.	MOTOR GENERATOR
30.	SINGLE PHASE TRANSFORMER AC AND RECTIFIER DC POWER SOURCE
31.	SINGLE PHASE STATIC FREQUENCY CONVERTER—TRANSFORMER—RECTIFIER
32.	THREE PHASE STATIC FREQUENCY CONVERTER—TRANSFORMER—RECTIFIER
33.	DANGEROUS VOLTAGE
34.	GAS (SUPPLY)
35.	GAS TYPE
36.	MATERIAL TYPE
37.	MATERIAL THICKNESS
38.	DIAMETER MM/IN
39.	INPUT
40.	OUTPUT

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-3 (continued)
NUMERICAL LIST FUNCTION KEYWORD OR PHRASE

Symbol No.	
41.	VOLTAGE INPUT
42.	WATER (COOLANT) INPUT
43.	WATER (COOLANT) OUTPUT
44.	GAS INPUT
45.	GAS OUTPUT
46.	OFF
47.	ON
48.	INCREASE/DECREASE OF QUANTITY (ROTATING; NUMBER OF POSITIONS)
49.	INCREASE/DECREASE OF QUANTITY (ROTATING; AND OFF POSITIONS)
50.	INCREASE/DECREASE OF QUANTITY (ROTATING)
51.	INCREASE/DECREASE OF QUANTITY (LINEAR; NUMBER OF POSITIONS)
52.	INCREASE/DECREASE OF QUANTITY (LINEAR)
53.	DIRECTION OF CONTINUOUS ROTATION
54.	DO NOT SWITCH WHILE WELDING
55.	PANEL/LOCAL
56.	DIRECTIONAL ARROW
57.	REMOTE
58.	PUSH BUTTON SWITCH (IN)
59.	PUSH BUTTON SWITCH (OUT)
60.	START OF ACTION
61.	STOP OF ACTION
62.	FOOT CONTROL
63.	MANUAL CONTROL
64.	READ OPERATORS MANUAL
65.	WELDING ARC (GENERAL)
66.	SHIELDED METAL ARC WELDING (SMAW)
67.	GAS METAL ARC WELDING (GMAW)
68.	FLUX CORED ARC WELDING (FCAW)
69.	SUBMERGED ARC WELDING (SAW)
70.	GAS TUNGSTEN ARC WELDING (GTAW)
71.	AIR CARBON ARC CUTTING (CAC-A)
72.	PLASMA ARC CUTTING (PAC)
73.	PLASMA ARC WELDING (PAW)
74.	PLASMA ARC GOUGING
75.	SPRAY TRANSFER
76.	SHORT CIRCUITING TRANSFER
77.	PULSE TRANSFER
78.	ARC SPOT WELDING
79.	CONTINUOUS WELDING
80.	INTERMITTENT (STITCH) WELDING

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-3 (continued)
NUMERICAL LIST FUNCTION KEYWORD OR PHRASE

Symbol No.	
81.	GTAW SPOT WELDING
82.	GMAW SPOT WELDING
83.	CONSTANT CURRENT
84.	CONSTANT VOLTAGE OR CONSTANT POTENTIAL
85.	ELECTRODE CONNECTION
86.	WORK CONNECTION
87.	PLASMA TORCH CONNECTION + NOZZLE (POSITIVE SUPPLY)
88.	PLASMA TORCH CONNECTION – ELECTRODE (NEGATIVE SUPPLY)
89.	ELECTRODE POSITIVE
90.	ELECTRODE NEGATIVE
91.	SHIELDED METAL ARC (SMAW) ELECTRODE HOLDER
92.	GAS METAL ARC WELDING (GMAW) GUN
93.	FLUX CORED ARC WELDING (FCAW) GUN
94.	WIRE FEED SPOOL GUN
95.	GAS TUNGSTEN ARC WELDING (GTAW) TORCH
96.	AIR CARBON ARC CUTTING (CAC-A) ELECTRODE HOLDER
97.	PLASMA TORCH
98.	GMAW GUN SWITCH/CONTROL
99.	GTAW TORCH SWITCH/CONTROL
100.	FCAW GUN WITH SWITCH
101.	GMAW GUN WITH SWITCH
102.	GTAW TORCH WITH SWITCH
103.	VENTILATING AND AIR CIRCULATING FAN
104.	COOLING
105.	COOLING WITH LIQUID
106.	COOLING PUMP
107.	COOLANT CONDUCTIVITY
108.	HIGH TEMPERATURE
109.	DISTURBANCE
110.	AUTOMATIC CYCLE
111.	ONE CYCLE
112.	PROGRAM
113.	SAVE TO MEMORY
114.	RECALL FROM MEMORY
115.	DIGITAL DISPLAY
116.	CLOCK, TIME SWITCH
117.	PERCENT
118.	PROCESS CYCLE
119.	PERCENT ON TIME
120.	PULSE

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-3 (continued)
NUMERICAL LIST FUNCTION KEYWORD OR PHRASE

Symbol No.	
121.	SOFT START
122.	HOT START
123.	ARC FORCE
124.	HIGH FREQUENCY-GENERAL
125.	HIGH FREQUENCY ON - CONTINUOUS
126.	HIGH FREQUENCY ON - START ONLY
127.	TWO-STEP TRIGGER OPERATION (GTAW)
128.	FOUR-STEP TRIGGER OPERATION (GTAW)
129.	TWO-STEP TRIGGER OPERATION (GMAW)
130.	FOUR-STEP TRIGGER OPERATION (GMAW)
131.	IMPULSE STARTING (GTAW)
132.	TOUCH START (GTAW)
133.	WAVE BALANCE
134.	MAXIMUM CLEANING
135.	MAXIMUM PENETRATION
136.	PURGE BY GAS
137.	GAS POSTFLOW
138.	GAS PREFLOW
139.	LOW INDUCTANCE
140.	MEDIUM INDUCTANCE
141.	HIGH INDUCTANCE OR INDUCTION
142.	VARIABLE INDUCTANCE
143.	PLASMA GAS
144.	PLASMA SHIELDING GAS
145.	PILOT/PULSE STARTING
146.	WIRE FEED
147.	WIRE FEED FORWARD
148.	WIRE FEED REVERSE
149.	WIRE FEED INTERMITTENT (STITCH)
150.	COLD JOG (INCH) TOWARDS WORK PIECE
151.	COLD JOG (INCH) AWAY FROM WORK PIECE
152.	WIRE FEED SLOW RUN-IN
153.	WIRE DIAMETER
154.	WIRE TYPE
155.	MELTBACK (BURNBACK)
156.	ARC IGNITION BY CONTACT
157.	AIR PRESSURE
158.	HOPPER
159.	ARC WELDING EQUIPMENT CARRIAGE
160.	LOCK OR TIGHTEN

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Table 3-3 (continued)
NUMERICAL LIST FUNCTION KEYWORD OR PHRASE

Symbol No.	
161.	UNLOCK OR UNCLAMP
162.	BLOWING
163.	SUCTION
164.	TORCH
165.	OSCILLATION
166.	ENGINE OIL
167.	PULL TO STOP ENGINE
168.	ENGINE CHOKE
169.	FUEL
170.	ENGINE COOLANT
171.	ENGINE COOLANT TEMPERATURE
172.	BATTERY (ENGINE)
173.	AIR FILTER
174.	ENGINE
175.	ENGINE RPM
176.	ENGINE STOP
177.	GLOW PLUG
178.	ENGINE START
179.	HOUR METER
180.	ELAPSED ENGINE HOURS
181.	FUEL SHUT OFF
182.	SLOW
183.	FAST
184.	UNLOCKED
185.	LOCKED

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 4
HOW TO COMBINE GRAPHIC SYMBOLS

4.1 GENERAL

Follow the instructions in Section 3 to determine what part is being described and how to select an existing symbol for it if one exists. Always try to use the standard symbols in Section 3 exactly as they are presented. If they do not satisfy the need, then develop a combination or composite symbol using standard symbols according to Section 4.2.

A combination or composite symbol is one that is made up of one or more symbols. Composite symbols are useful when standard symbols do not provide enough information to communicate the desired information. There are some composite symbols that are listed in Section 3. These symbols are used often and should be used in new applications whenever possible. The following examples show how to develop composite symbols when a new symbol is required.

4.2 PROCEDURE TO COMBINE SYMBOLS

4.2.1 For sake of example, assume a symbol is needed to explain that a given receptacle is used for connecting a Remote Amperage Control to the unit. Proceed as follows:

List the connection to be explained in full and then break into parts as follows.

Remote Amperage Control

Key Words: Remote
Amperage Control

Use the standard symbol for each key word from the list in Section 3. This example uses symbols number 1 and 57.


= Remote


= Amperage (Control)

Combine the standard symbols to produce the composite.


= Remote Amperage Control
(Connection Point or Function)

4.2.2 Apply the same process to develop a composite symbol for a Remote Amperage and Voltage Control connection point or function.

Remote Amperage and Voltage Control

Key Words: Remote
Amperage Control
Voltage

Find and apply the standard symbol for each keyword from Section 3. This example uses symbols number 1, 57, and 2.


= Remote


= Amperage (Control)


= Voltage

Combine the standard symbols to produce the composite.

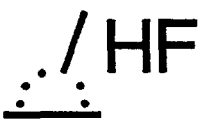

= Remote Amperage and Voltage Control
(Connection Point or Function)

4.2.3 More examples follow using the same basic procedure. This example uses symbols numbers 124 and 65.


= High Frequency

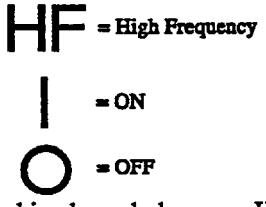

= General Arc Welding

The two combined symbols mean arc starting (ignition) by High-Frequency energy.



Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

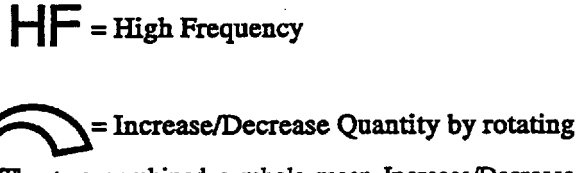
Another example, this time for a High-Frequency Switch, follows.



The three combined symbols mean High-Frequency (probably a switch) with two positions: ON and OFF. This example uses symbols number 124, 47, and 46.



Another example, this time for an adjustable High-Frequency Intensity control, follows.

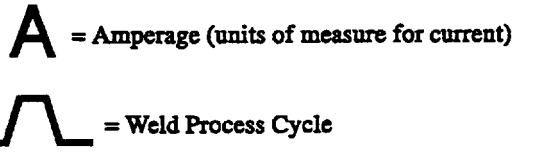


The two combined symbols mean Increase/Decrease amount of High-Frequency by rotating control. This example uses symbols number 124 and 50.



4.2.4 Examples follow using the same basic procedure but with different symbols for different purposes. This group shows Initial Current and Weld Current for use with controls for separate functions during parts of a weld cycle.

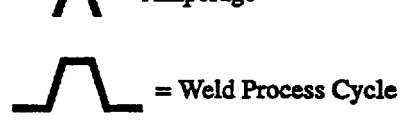
To create the symbol for Initial Current, proceed as follows.



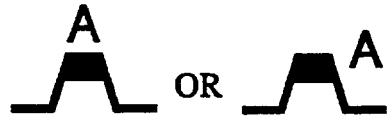
The two combined symbols, along with a thickened portion of the process cycle, mean Initial Current.



The Initial Current segment of the process cycle symbol is widened to approximately 3 to 4 times the thickness of the other segments to show clearly the portion being emphasized. This example uses symbols number 1 and 118. The symbol for Weld Current is created in the same way.



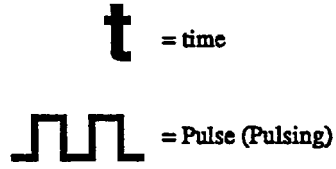
The two combined symbols, along with a thickened portion of the Process Cycle, mean Weld Current.



The exact location of "A" in relation to the thickened portion can be moved slightly to accommodate nameplate space as shown. This example uses symbols number 1 and 118. The emphasized portion again is consistently thickened to indicate clearly the selected segment of the process cycle.

4.2.5 Examples follow using the same basic procedure but with different symbols for different purposes. This group shows Peak (High) Pulse Time and Background (Low) Pulse Current for use with pulsing controls.

To create the symbol for Peak (High) Pulse Time, proceed as follows.

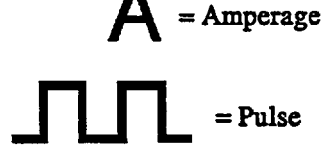


The two combined symbols, along with a thickened portion of the pulse, mean Peak (High) Pulse Time.



The top segment of the pulse symbol is widened to approximately 3 to 4 times the thickness of the other segments to show clearly the portion being emphasized. This example uses symbols number 6 and 120.

The symbol for Background (Low) Pulse Current is created the same way.



Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

The two symbols, along with a thickened portion of the pulse, mean Background (Low) Pulse Current.



This example uses symbols number 1 and 120. The emphasized portion again is consistently widened to indicate clearly the selected segment of the pulse.

4.2.6 Examples follow using the same method but for a different purpose. This example shows Fast Pulse Frequency for use on the positions of a pulse time range switch.

To create the proper symbol, proceed as follows.

 = Pulse (Pulsing)

 = Slow Pulse

The two symbols now mean fast and slow pulsing. Notice the consistent line weights, heights, and total length of both symbols. Use this procedure and apply these considerations when creating new symbols.

The two symbols work well when used as Fast Pulse and Slow Pulse positions of a Pulse Time Range Switch. This example uses symbol number 120 as the base symbol.



4.3 SUMMARY

Creating composite symbols is not difficult. It requires only simple care and precision. Always proceed according to the standard method in 4-2 using the following guidelines:

a. Write down the name for the connection or control.

b. Identify the keywords.

c. Find the standard symbol in Section 3 for each keyword.

d. Combine the standard symbols according to 4-2.

e. Locate symbols with controls and connection points according to examples in Section 5.

f. Pay attention to line weight, height, width and position of each symbol.

g. Be consistent in application and always use approved symbols from Section 3 for composites whenever possible.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 5
EXAMPLES OF THE GROUPING OF SYMBOLS

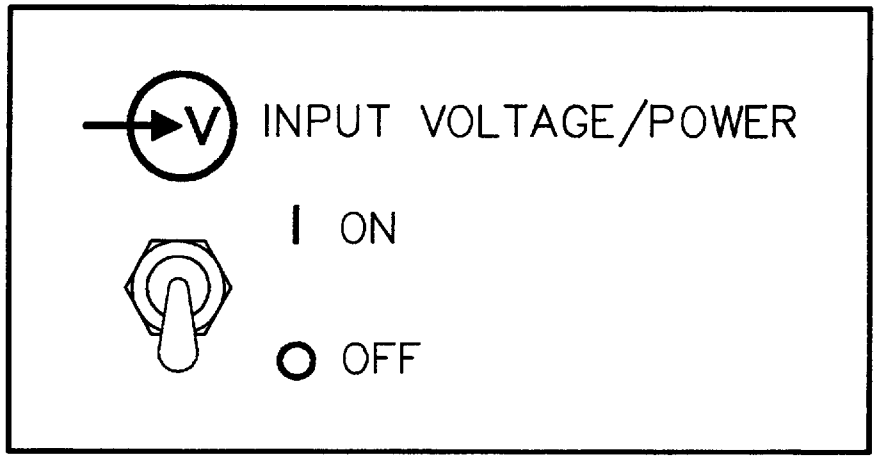


Figure 5-1
INPUT VOLTAGE/POWER SWITCH

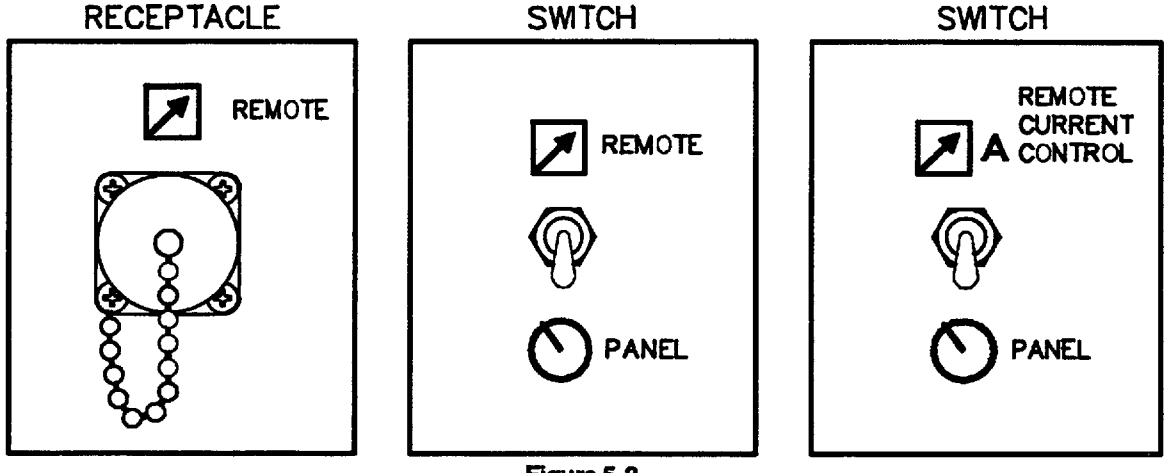


Figure 5-2
USE OF REMOTE RECEPTACLES AND SELECTOR SWITCHES

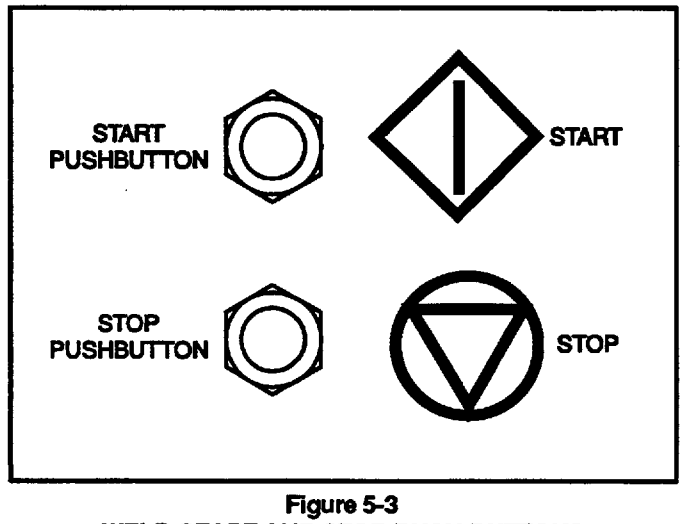


Figure 5-3
WELD START AND STOP PUSH BUTTONS

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

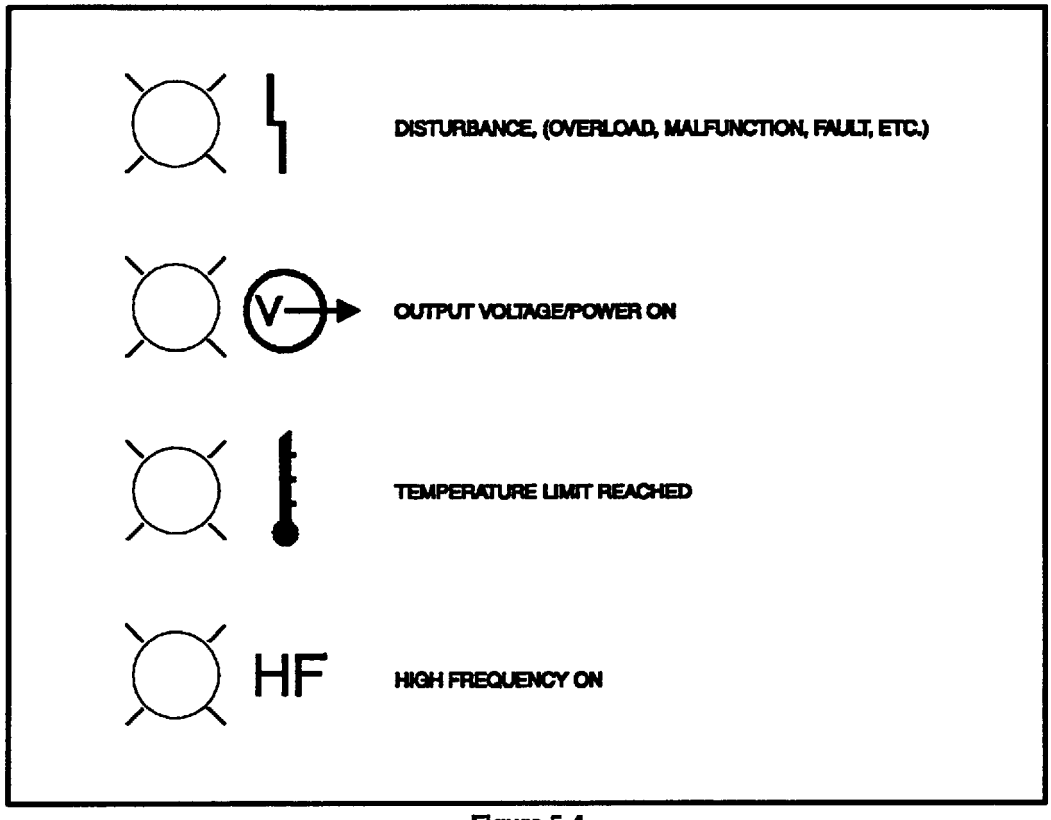


Figure 5-4
PANEL INDICATOR LIGHTS

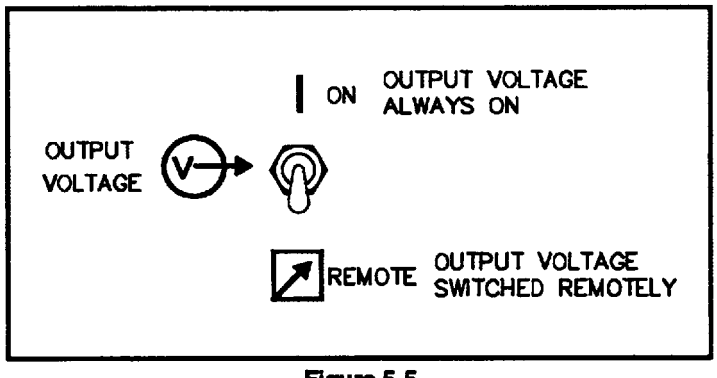


Figure 5-5
OUTPUT (CONTACTOR) SWITCH

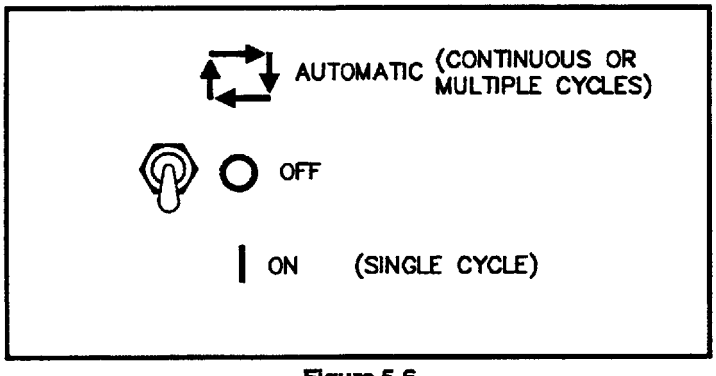


Figure 5-6
AUTOMATIC/MANUAL SWITCH

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

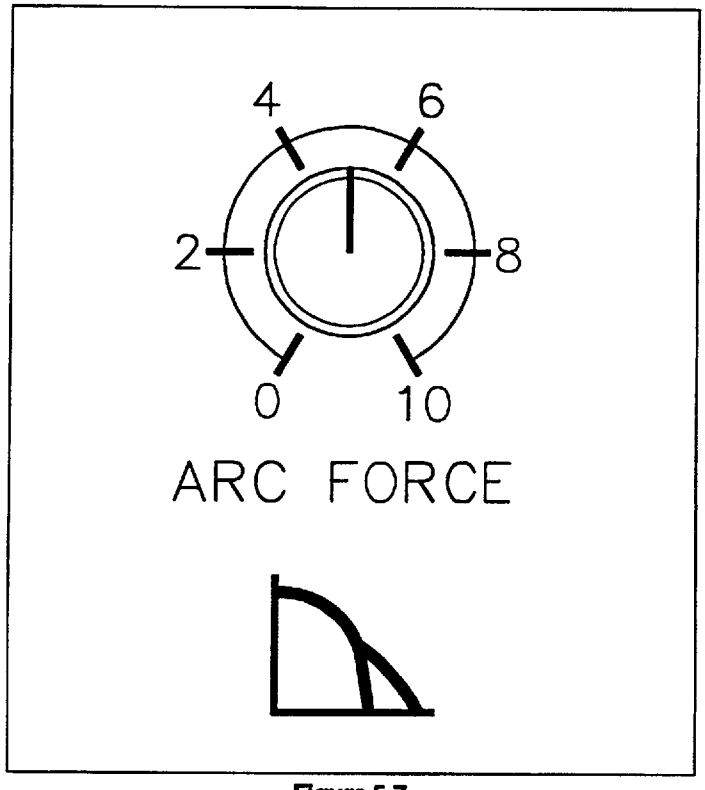


Figure 5-7
ARC FORCE CONTROL POTENTIOMETER

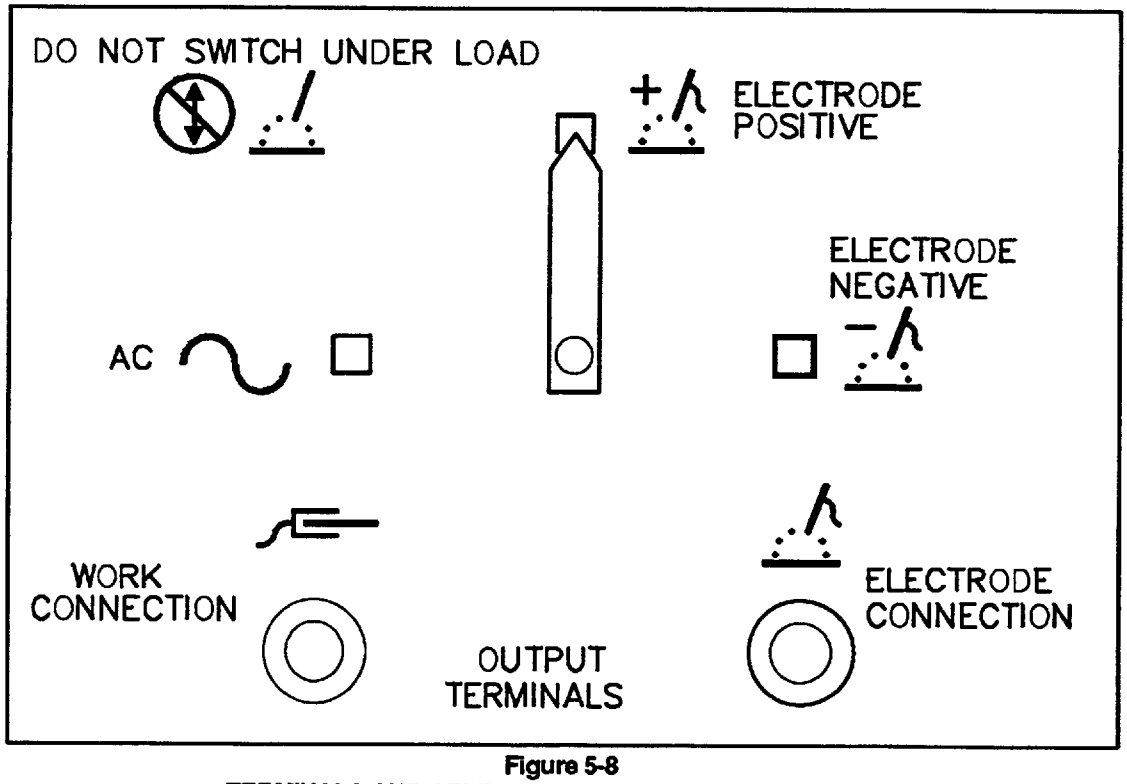
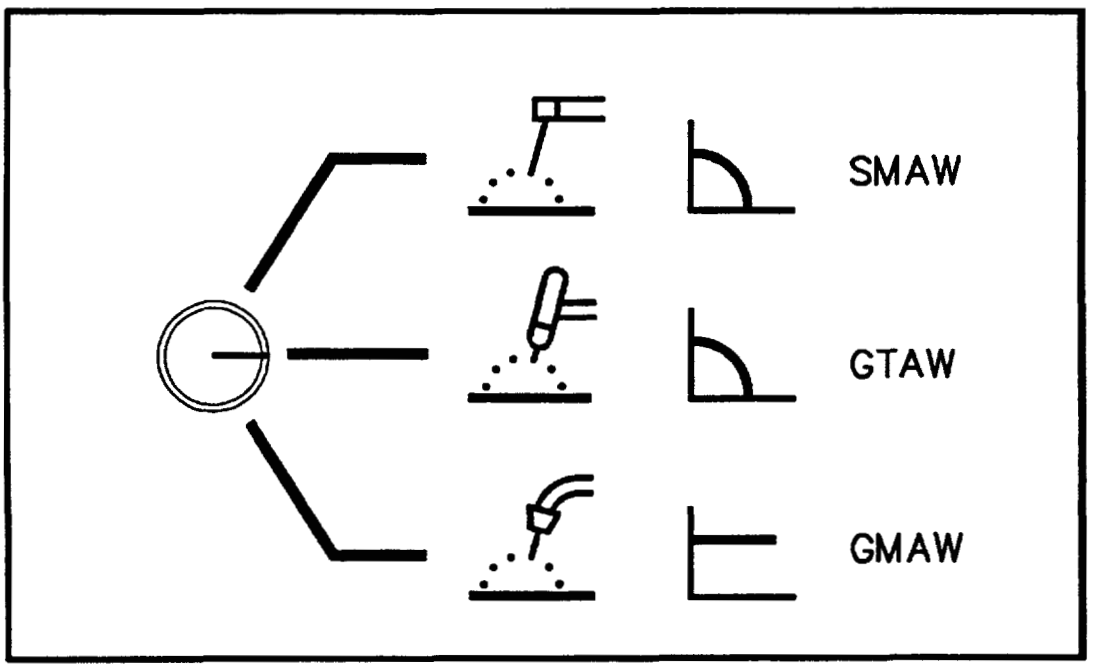


Figure 5-8
TERMINALS AND SELECTOR SWITCH ON AC/DC WELDER

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale



SWITCH
(CONSTANT CURRENT AND CONSTANT VOLTAGE SYMBOLS ARE OPTIONAL)

Figure 5-9
PROCESS SWITCH (SMAW-GTAW-GMAW)

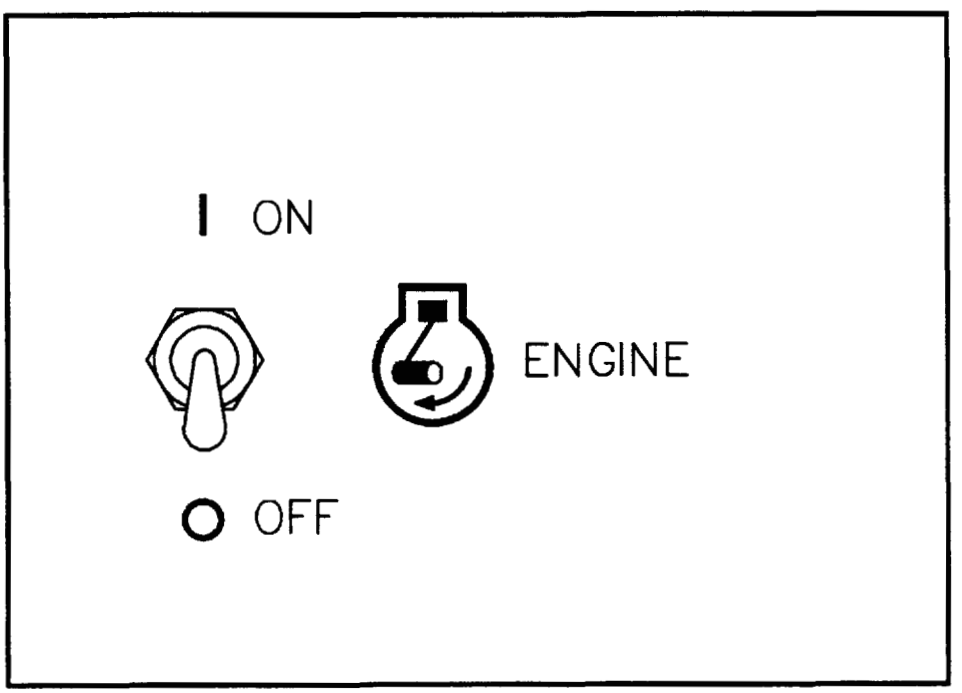


Figure 5-10
IGNITION SWITCH ON ENGINE DRIVEN WELDER

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

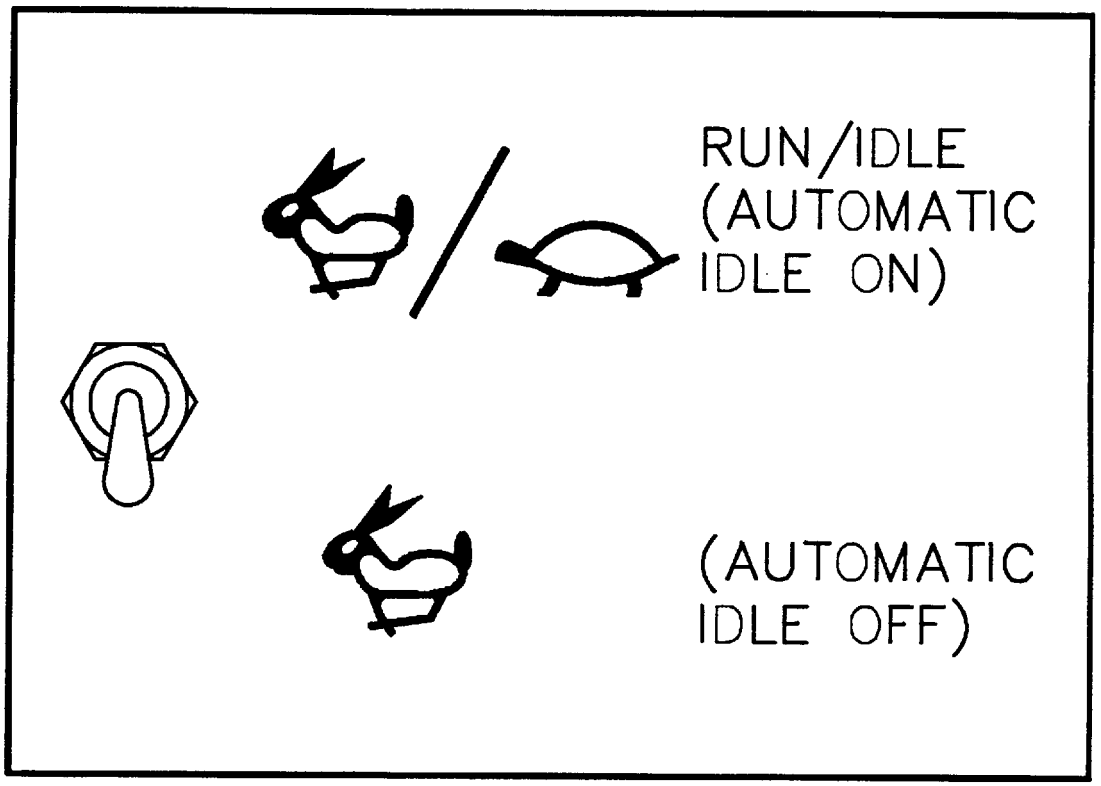


Figure 5-11
IDLE SWITCH

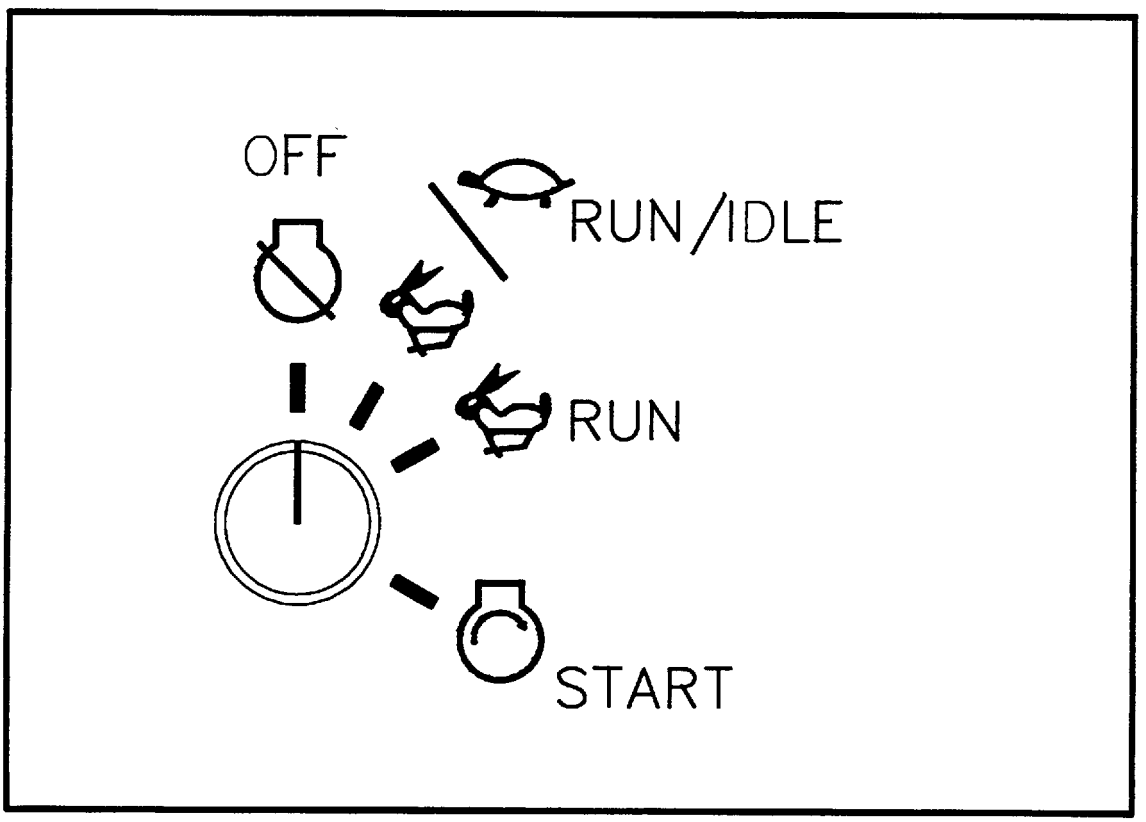


Figure 5-12
START/RUN SWITCH

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

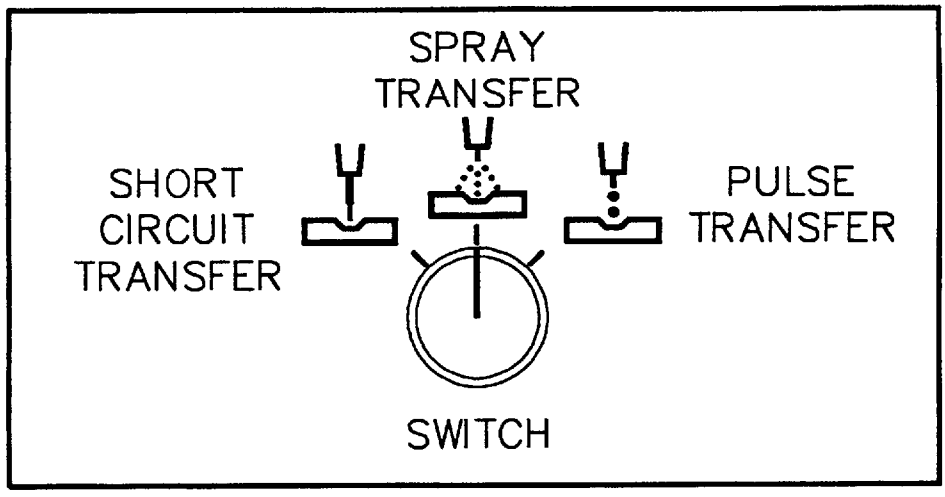


Figure 5-13
PROCESS SELECTION FOR GMAW WELDING

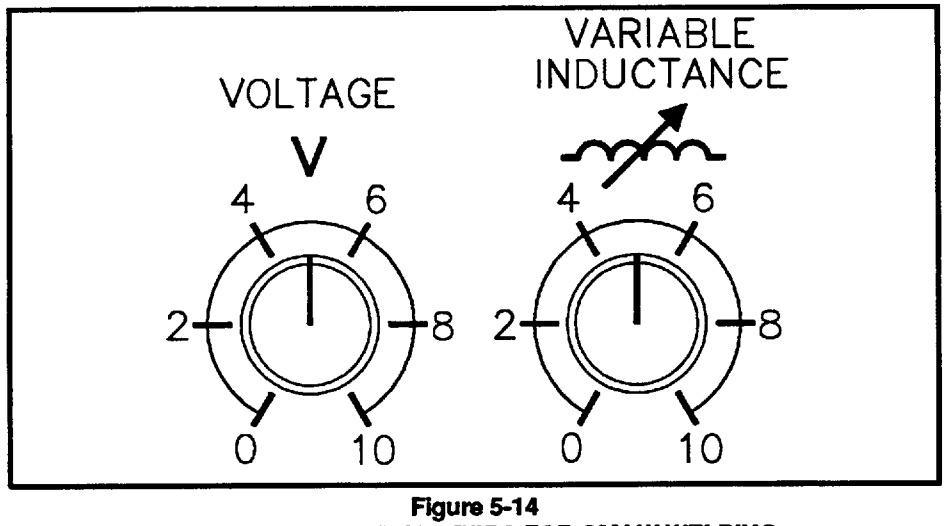


Figure 5-14
CONTROL POTENTIOMETERS FOR GMAW WELDING

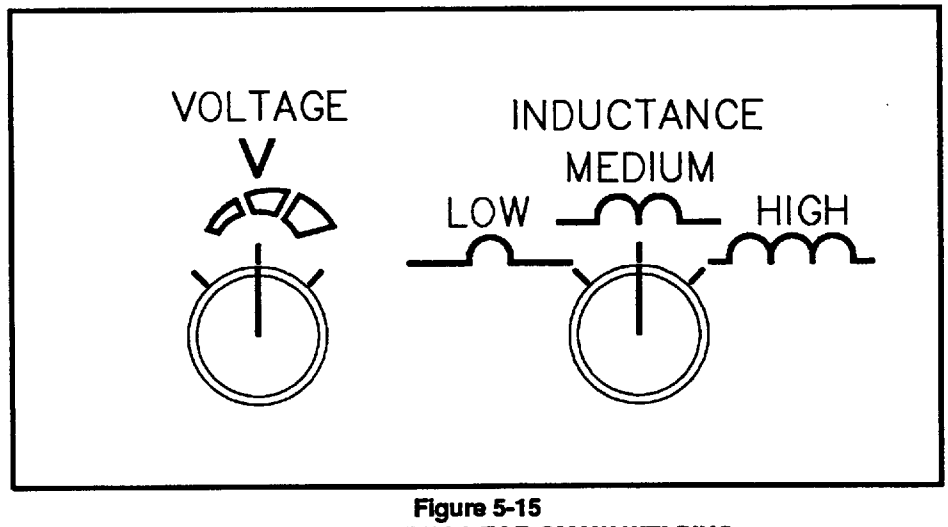


Figure 5-15
SWITCHED SETTINGS FOR GMAW WELDING

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

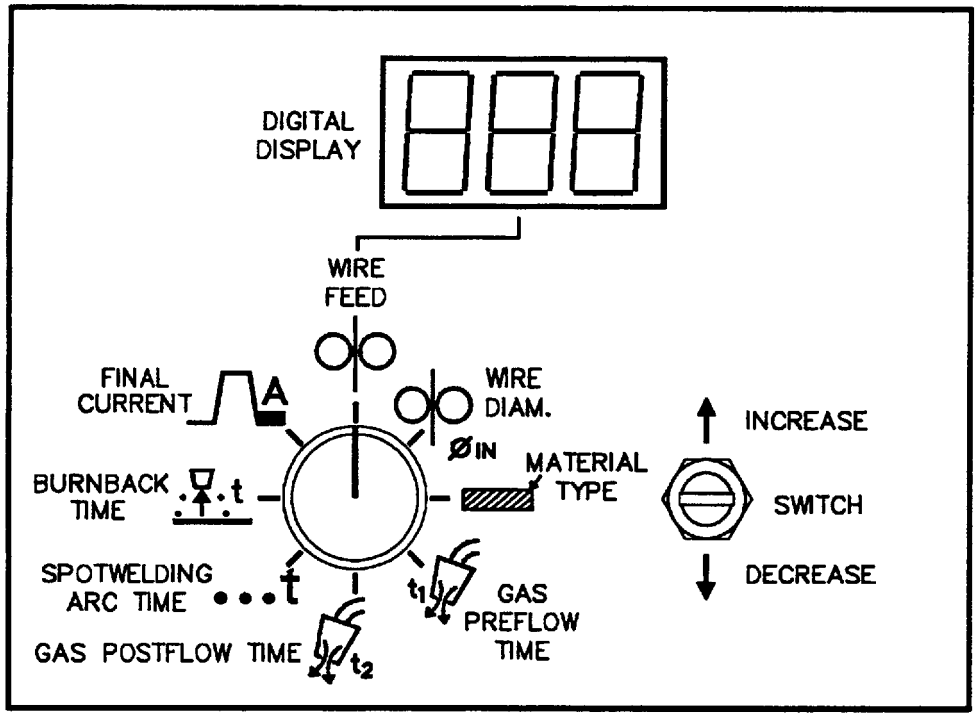


Figure 5-16
SETTING MULTIPLE PARAMETERS USING DIGITAL DISPLAY

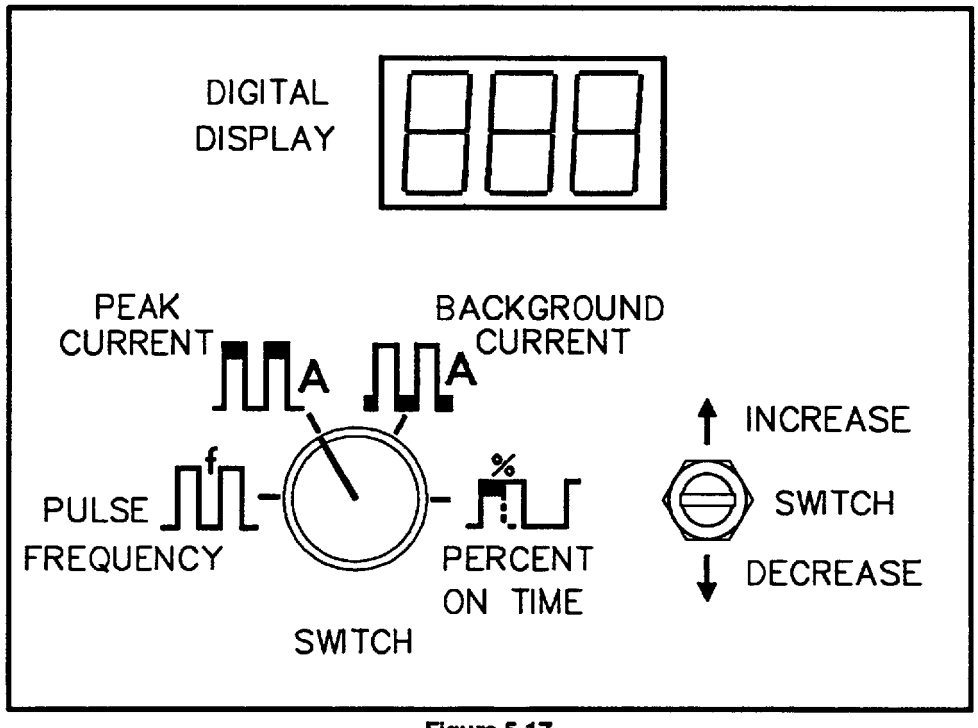


Figure 5-17
SETTING PULSING PARAMETERS USING DIGITAL DISPLAY

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

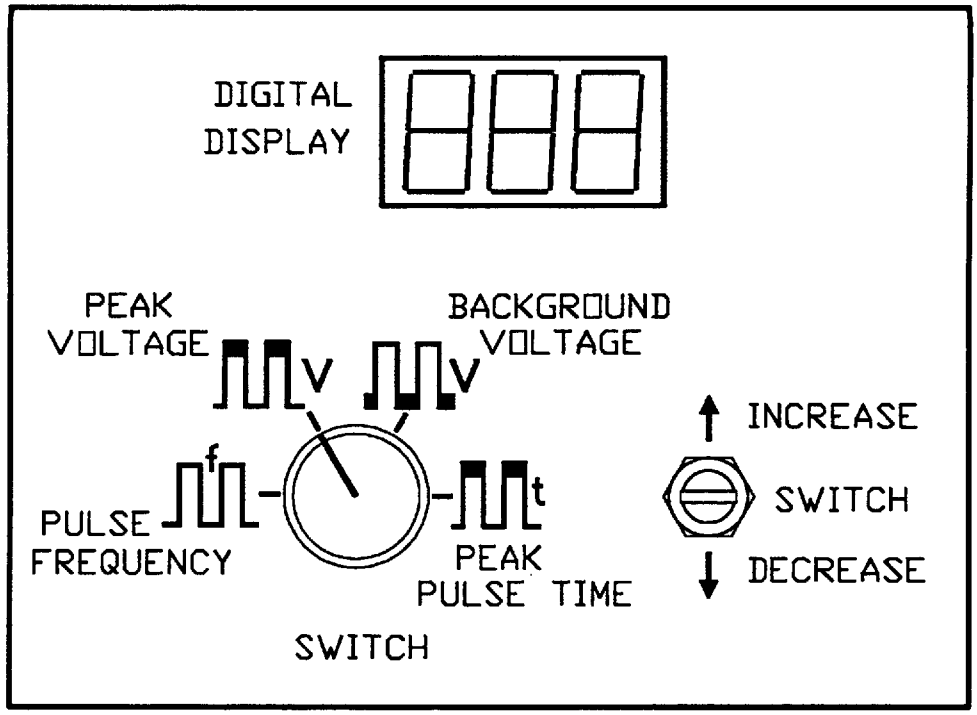


Figure 5-18
SETTING PULSED GMAW PARAMETERS WITH DIGITAL DISPLAY

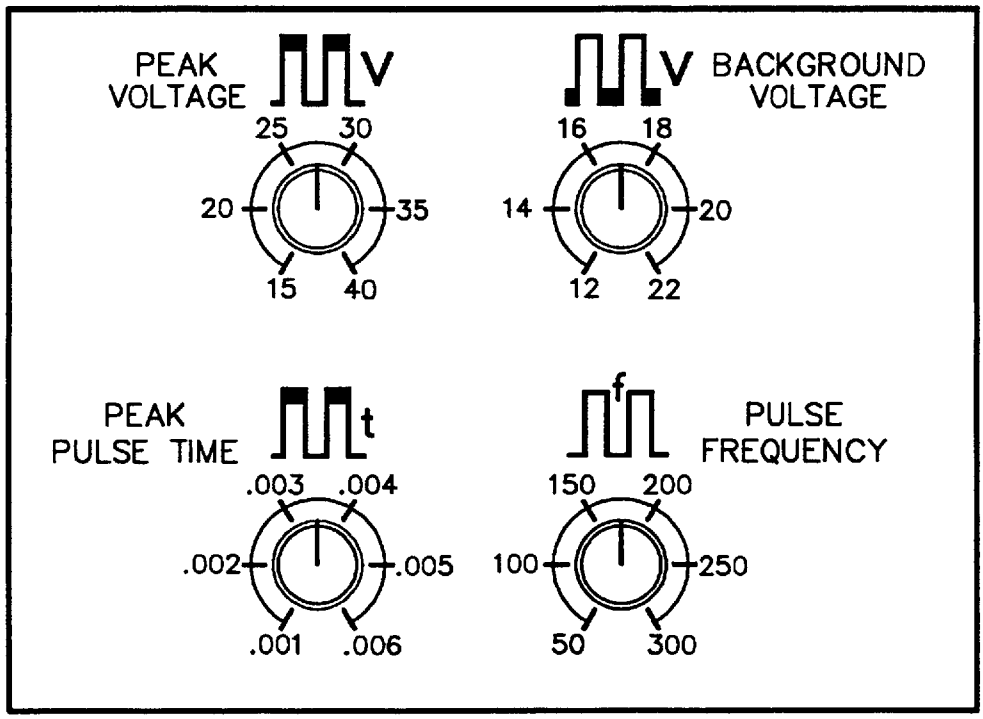


Figure 5-19
SETTING PULSED GMAW PARAMETERS WITH POTENTIOMETERS

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

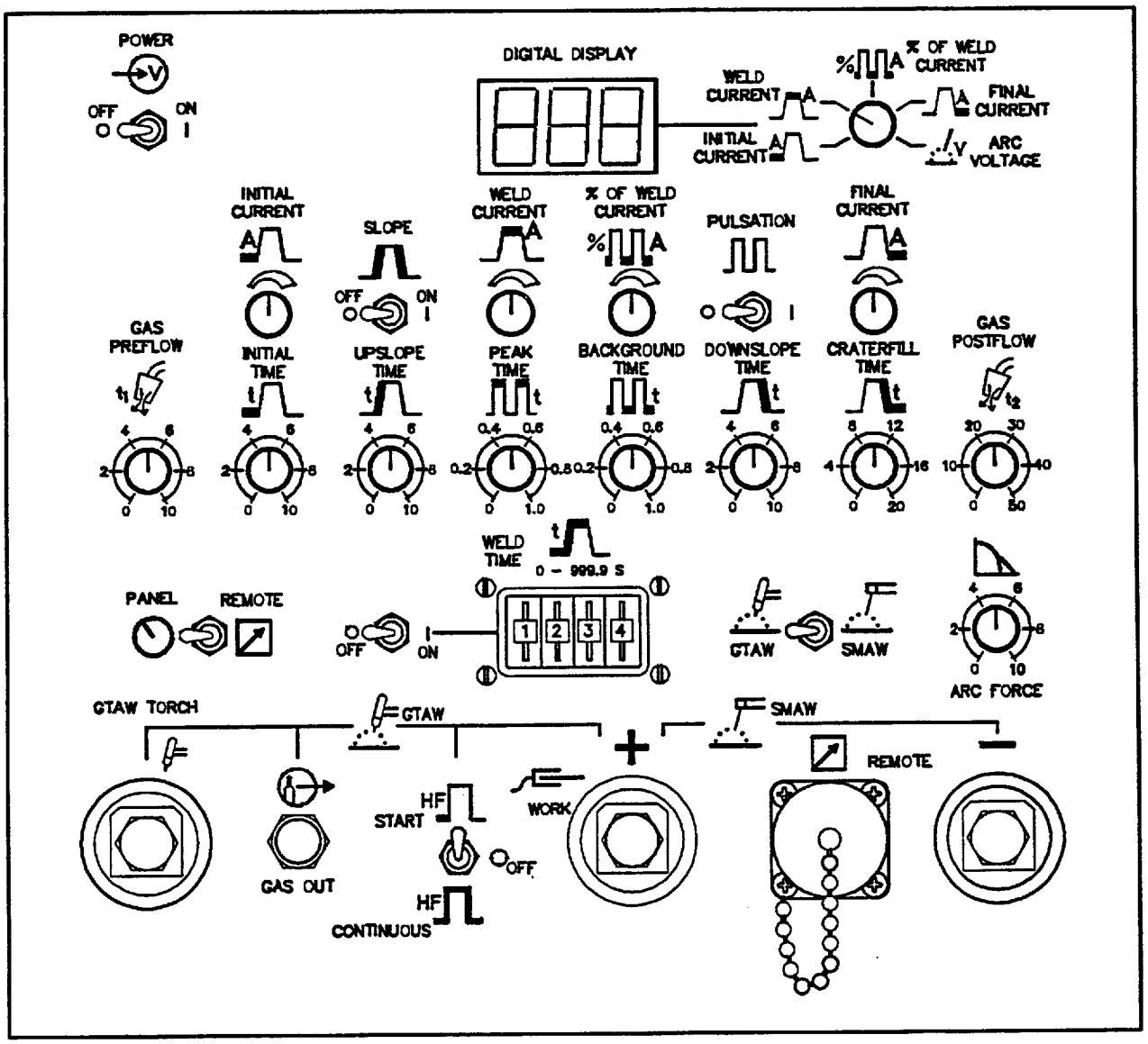


Figure 5-20
TYPICAL CONTROL PANEL FOR AUTOMATIC GTAW WELDING

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

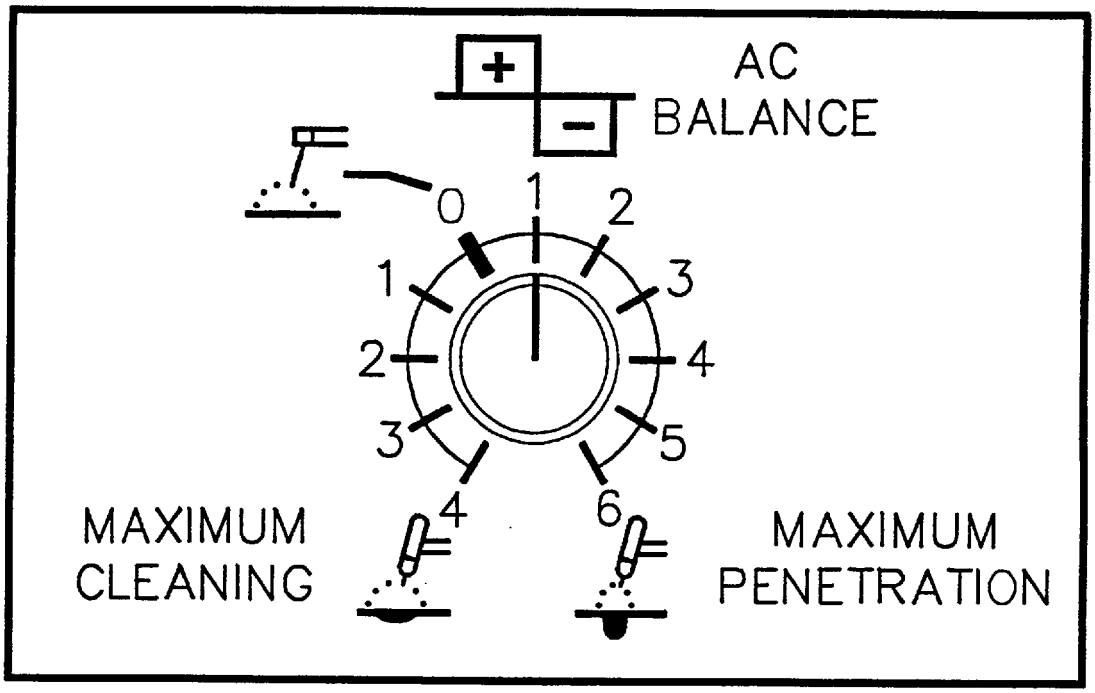


Figure 5-21
AC BALANCE CONTROL WITH BALANCED POSITION USED FOR THE SMAW PROCESS

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

NEMA STANDARDIZATION BACKGROUND

The purpose of NEMA standards, their classification, and status are set forth in certain clauses of the NEMA *Standardization Policies and Procedures* manual and are referenced below:

Purpose of Standards

National Electrical Manufacturers Association Standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for their particular needs. Existence of a National Electrical Manufacturers Association Standard does not in any respect preclude any member or nonmember from manufacturing or selling products not conforming to the standard.

Definition of a Standard

A standard of the National Electrical Manufacturers Association defines a product, process, or procedure with reference to one or more of the following: nomenclature, composition, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Standardization Policies and Procedures, p. 1)

Dimensions

Where dimensions are given for interchangeability purposes, alternate dimensions satisfying the other provisions of the Standards Publication may be capable of otherwise equivalent performance.

(Standardization Policies and Procedures, p. 6)

Categories of Standards

National Electrical Manufacturers Association Standards are of three classes, which have received the affirmative vote of at least two-thirds of the Subdivision votes cast in the affirmative or negative:

1. NEMA Standard, which relates to a product, process, or procedure commercially standardized and subject to repetitive manufacture.
2. Suggested Standard for Future Design, which may not have been regularly applied to a commercial product, but which suggests a sound engineering approach to future development.
3. Adoptive Standard, which is adopted in whole or in part from the standards of another organization, either domestic, regional, or international.

(Standardization Policies and Procedures, pp. 5)

Authorized Engineering Information

Authorized Engineering Information consists of explanatory data and other engineering information of an informative character not falling within the classification of NEMA Standard or Suggested Standard for Future Design, which standard has received the affirmative vote of at least two-thirds of the Subdivision votes cast in the affirmative or negative.

(Standardization Policies and Procedures, pp. 5)

Identification of Status

Standards in NEMA Standards Publications are identified as "NEMA Standard," "Suggested Standard for Future Design," or "Adoptive Standard." These indicate the status of the standard. A statement incorporating the auxiliary verb "shall" indicates that compliance with a requirement is mandatory for compliance with the standard. These classes of standards are identified in the foreword or throughout the text.

The material identified as "Authorized Engineering Information" is designated similarly. Statements incorporating other auxiliary verbs such as "should," "may," etc. refer to the authorized engineering information and not to procedures required for compliance with the standard.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

ARC WELDING SECTION
OF THE
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

MEMBER COMPANIES

Alloy Rods Corporation
Hanover, PA 17331

Arc Machines, Inc.
Pacoima, CA 91331

Century Manufacturing Company
Minneapolis, MN 55431

C-K Systematics, Inc.
Auburn, WA 98002

ESAB Welding Products, Inc.
Florence, SC 29501-0536

Hobart Brothers Company
Troy, OH 54373

Hypertherm, Incorporated
Hanover, NH 03755

The Lincoln Electric Company
Cleveland, OH 44117

Miller Electric Mfg. Company
Appleton, WI 54912

National Standard Company
Niles, MI 49120

PowCon Inc.
San Diego, CA 92126

Sandvik Steel Company
Welding Wire Division
Scranton, PA 18501-1220

Stoody
Div. of Deloro Sattelite, Inc.
St. Louis, MO 63105

McKay Welding Products
York, PA 17405-1509

Thermadyne Industries, Inc.
St. Louis, MO 63105UPT

Welding Materials, Inc.
Houston, TX 77272-1678

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale