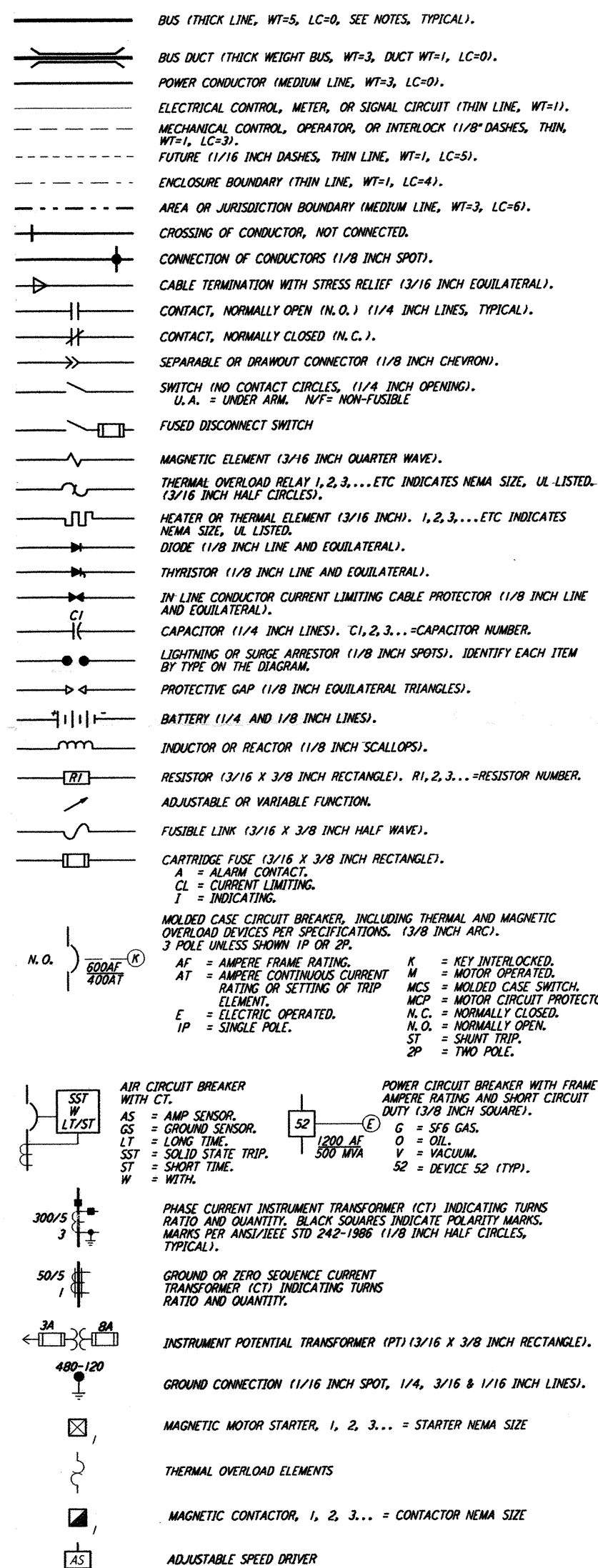


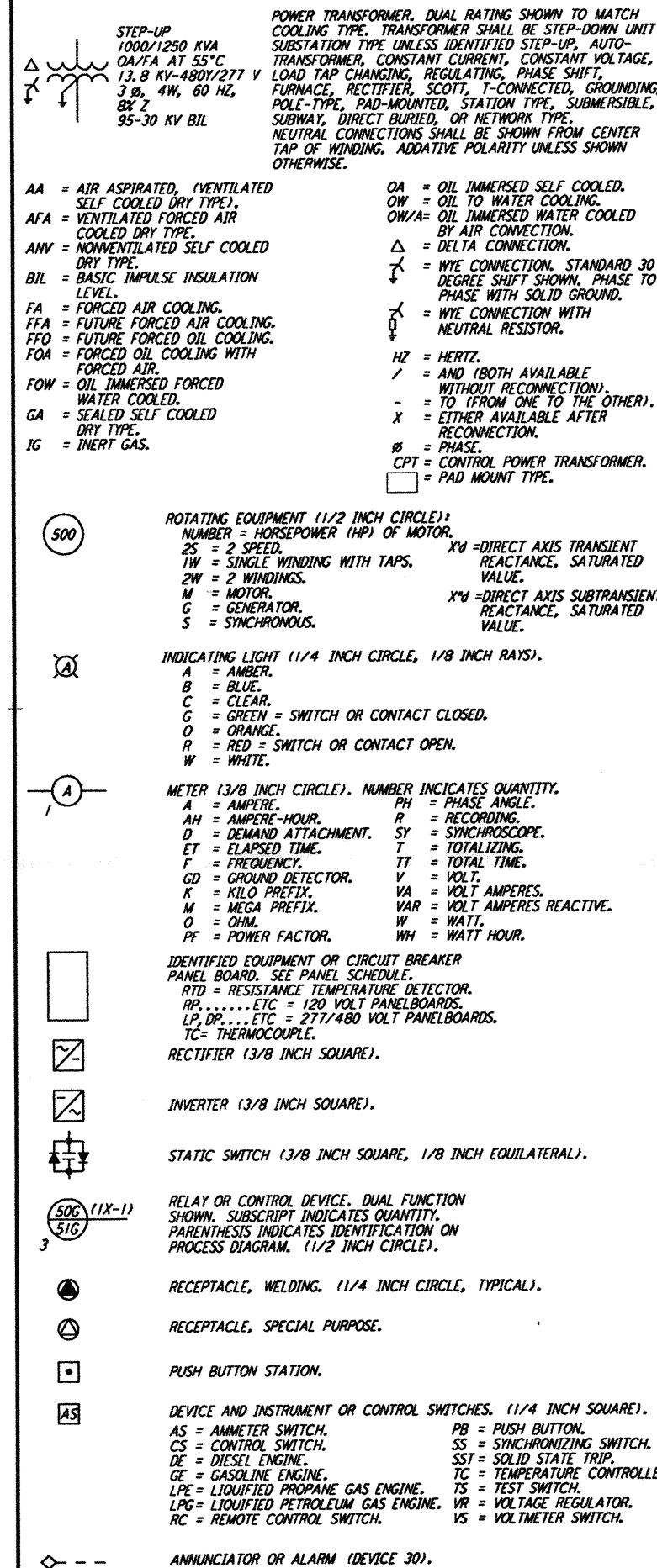
ONE AND THREE LINE DIAGRAM SYMBOLS



REFERENCE DRAWINGS

- WA-E-003 SCHEMATIC & WIRING SYMBOLS
- WA-E-002 STANDARD PLAN SYMBOLS
- WA-E-001 ABBREVIATIONS & ACRONYMS

ONE AND THREE LINE DIAGRAM SYMBOLS



DEVICE FUNCTION NUMBERS

- ADAPTED FROM ANSI C37, 2-1987, USAGE PER IEEE STD. 242-1986
- MASTER ELEMENT OR INITIATING DEVICE SUCH AS FLOAT SWITCH.
 - TIME DELAY STARTING OR CLOSING RELAY.
 - CHECKING OR INTERLOCKING RELAY. (AND GATE).
 - MASTER CONTACTOR.
 - STOPPING DEVICE.
 - STARTING CIRCUIT BREAKER.
 - ANODE CIRCUIT BREAKER.
 - CONTROL POWER DISCONNECTING DEVICE.
 - REVERSING DEVICE.
 - UNIT SEQUENCE SWITCH.
 - THREE OR MORE FUNCTIONS PER LEGEND.
 - OVER SPEED DEVICE.
 - SYNCHRONOUS SPEED DEVICE.
 - UNDER SPEED DEVICE.
 - SPEED OR FREQUENCY MATCHING DEVICE. RESERVED FOR FUTURE APPLICATION.
 - SHUNTING OR DISCHARGE SWITCH.
 - ACCELERATING OR DECELERATING DEVICE.
 - STARTING TO RUNNING TRANSITION DEVICE.
 - ELECTRICALLY OPERATED VALVE.
 - DISTANCE RELAY. (IMPEDANCE CHANGE DETECTOR).
 - EQUALIZER CIRCUIT BREAKER.
 - TEMPERATURE CONTROL DEVICE. (SPACE HEATER THERMOSTAT).
 - VOITS PER HERTZ RATIO RELAY.
 - SYNCHRONIZING OR SYNCHRONISM CHECK DEVICE.
 - APPARATUS THERMAL DEVICE. (FIELD OR COOLANT OVERTEMPERATURE).
 - UNDERVOLTAGE RELAY.
 - FLAME DETECTOR.
 - ISOLATING CONTACTOR.
 - ANNUNCIATOR RELAY.
 - CONTROL EXCITATION DEVICE.
 - DIRECTIONAL POWER RELAY. (ANTI MOTORING).
 - POSITION INDICATOR SWITCH. (CELL SWITCH).
 - MASTER SEQUENCE DEVICE.
 - BRUSH OPERATING OR SLIP RING SHORT CIRCUITING DEVICE.
 - POLYCURRENT OR UNDERPOWER DEVICE (GROUND CONTINUITY MONITOR).
 - BEARING PROTECTIVE DEVICE.
 - MECHANICAL CONDITION (VIBRATION ETC.) MONITOR.
 - FIELD RELAY. (EXCITATION LOSS).
 - FIELD CIRCUIT BREAKER.
 - THYRISTOR RELAY.
 - CONTROL CIRCUIT MANUAL TRANSFER OR SELECTOR DEVICE.
 - UNIT SEQUENCE STARTING RELAY.
 - ATMOSPHERIC CONDITION MONITOR.
 - REVERSE PHASE OR PHASE BALANCE CURRENT RELAY.
 - PHASE SEQUENCE VOLTAGE RELAY.
 - INCOMPLETE SEQUENCE RELAY.
 - MACHINE OR TRANSFORMER (ARMATURE OR LOAD WINDING) THERMAL RELAY.
 - INSTANTANEOUS OVERCURRENT RELAY.
 - AC TIME OVERCURRENT RELAY.
 - AC CIRCUIT BREAKER.
 - EXCITER OR GENERATOR RELAY.
 - TURNING GEAR ENGAGING DEVICE.
 - POWER FACTOR RELAY.
 - GROUND DETECTOR RELAY.
 - SHORT CIRCUITING OR GROUNDING DEVICE.
 - RECTIFIER FAILURE RELAY.
 - OVERVOLTAGE RELAY.
 - VOLTAGE BALANCE RELAY.
 - GAS DENSITY SWITCH.
 - TIME DELAY STOPPING OR OPENING RELAY.
 - LIQUID OR GAS SUDDEN PRESSURE RELAY. (MANUAL RESET).
 - GROUND PROTECTION RELAY (UNDERVOLTAGE = INSULATION FAILURE).
 - GOVERNOR.
 - NOTCHING OR JOGGING DEVICE.
 - AC DIRECTIONAL OVERCURRENT RELAY.
 - BLOCKING RELAY.
 - PERMISSIVE CONTROL DEVICE.
 - ELECTRICALLY OPERATED RHEOSTAT.
 - LEVEL SWITCH.
 - DC CIRCUIT BREAKER.
 - LOAD RESISTOR CONTACTOR.
 - ALARM RELAY. (ALARMS OTHER THAN ANNUNCIATOR, DEVICE 30).
 - POSITION CHANGING MECHANISM.
 - DC OVERCURRENT RELAY.
 - TELEMETERING DEVICE.
 - PHASE ANGLE MEASURING OR OUT-OF-STEP RELAY.
 - AC RE-CLOSING RELAY.
 - FLOW SWITCH.
 - FREQUENCY RELAY.
 - DC RE-CLOSING RELAY.
 - AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY.
 - OPERATING MECHANISM.
 - CARRIER OR PILOT WIRE RECEIVER RELAY.
 - LOCKOUT AUXILIARY RELAY. (MANUAL RESET).
 - DIFFERENTIAL PROTECTIVE RELAY.
 - AUXILIARY MOTOR OR MOTOR GENERATOR.
 - LINE SWITCH.
 - REGULATING DEVICE.
 - VOLTAGE DIRECTIONAL RELAY.
 - VOLTAGE AND POWER DIRECTIONAL RELAY.
 - FIELD CHANGING CONTACTOR.
 - TRIPPING OR TRIP FREE RELAY.
 - OPEN FOR SPECIFIC APPLICATIONS.
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NOTES:

- THIS IS A STANDARD DRAWING. ITEMS NOT SHOWN ON DIAGRAMS ARE FOR FUTURE USE. DO NOT EDIT THIS SHEET FOR SPECIFIC APPLICATION. CADD AND MANUAL DRAFTING INSTRUCTIONS SHALL REMAIN FOR FIELD CHANGES AND AS BUILTS. SPECIFICATION DATA SHALL REMAIN FOR QUALITY CONTROL.
- SYMBOLS ON THIS DRAWING HAVE BEEN ADAPTED FROM ANSI/ASME Y14.15-1966 (1958) AND ANSI/ASME Y32.2-1975 (IEEE STD. 315-1975 (1989)) WITH IEEE STD. 315A-1986 AND RESOLUTION OF CONFLICTS AND SHALL BE USED AS BASIC BUILDING BLOCKS TO ASSEMBLE ALL REQUIRED FORMS OF GRAPHIC REPRESENTATION IN BOTH ONE LINE DIAGRAMS AND THREE LINE DIAGRAMS.
- DRAFTING SHALL INCLUDE LINE THICKNESS PER ANSI/ASME Y 14.2M-1979 (R 1987) AND ANSI/ASME Y14.15-1966 (R 1988) AS FOLLOWS:
THIN --- CENTER, DIMENSION, BREAK, EXISTING, AND BACKGROUND LINES.
(0.016, 1/64, INCH, WT=1).
MEDIUM --- NEW WORK.
(0.032, 1/32, INCH, WT=3).
THICK --- MATCH LINE, POWER BUS, OR BATTERY LIMIT.
(0.048, 3/64, INCH, WT=5).
DO NOT USE WT=0, 2 OR 4 FOR LINES.
CADD WEIGHT SHALL BE AS INDICATED WITH WT=3.
TEXT, EQUIPMENT CALLOUTS, AND LEADER LINES, CADD LV=32.
SYMBOLS, BUSWAY AND FEATURES, CADD LV=31.
- LETTERING SHALL BE SLANTED WITHIN DRAWING, 1/8 INCH FOR TEXT, 1/4 INCH FOR HEADINGS AND TITLES. CADD FONT 61. WIDTH RATIO SHALL BE 80 PERCENT. LINE SPACING SHALL BE 1/2 TEXT HEIGHT. 1/8 INCH LETTERS SHALL BE WT=2. 1/4 INCH LETTERS SHALL BE WT=4. LOWER CASE LETTERS SHALL NOT BE USED. FOUR LINE TITTLE BLOCKS SHALL BE 3/16 INCH WT=2.
- ALL WORK SHALL BE SUITABLE FOR LEGIBLE REPRODUCTION FROM HALF SIZE SECOND GENERATION REPRODUCIBLES.
- RATINGS SHALL BE SHOWN WHERE ESSENTIAL FOR OVERALL UNDERSTANDING OF THE SYSTEM.
- DIAGRAMS SHALL BE LAID OUT WITH SOURCES TOWARD THE TOP OF THE SHEET WITH POWER FLOW FROM TOP TO BOTTOM AND FROM LEFT TO RIGHT, PER ANSI Y14.5-1966 (R1988).
- PROVIDE SEPARATE WIRING DIAGRAMS WHERE PHYSICAL ARRANGEMENT OF THE WIRING MUST BE SHOWN FOR CLARITY.
- DRAWING TITLES AND REFERENCES SHALL BE STANDARDIZED AS ONE OR THREE LINE DIAGRAMS. THE WORDS "SINGLE LINE" SHALL NOT BE USED.
- STACKED FRACTIONS SHALL NOT BE USED.

DEVICE SUFFIX DESIGNATIONS:

- SPECIFIC USAGE SHALL BE IDENTIFIED IN A LEGEND ON THE DIAGRAM.
- A = AIR.
 - B = BUS.
 - C = CURRENT.
 - CS = CONTROL SWITCH.
 - E = ELECTRIC.
 - F = FREQUENCY.
 - G = GROUND. CONNECTION ON NEUTRAL OF WYE POWER TRANSFORMER.
 - GS = GROUND SENSOR. ZERO SEQUENCE WINDOW TYPE CT ENCLOSING ALL PHASE CONDUCTORS AND NO GROUND PATH.
 - HR = HAND RESET.
 - J = DIFFERENTIAL.
 - L = LIQUID, LEVEL, OR LINE.
 - M = MANUAL.
 - N = RESIDUAL CURRENT CONNECTION ON WYE OF THREE 1Ø CTS.
 - P = POWER.
 - PR = PRESSURE RELIEF.
 - O = OIL.
 - S = SYNCHRONIZING.
 - T = TEMPERATURE OR TRANSFORMER.
 - 2 = SEQUENTIAL NUMBER OF IDENTICAL UNITS.
 - V = VOLTAGE.
 - X = AUXILIARY (ENERGIZING) RELAY.
 - Y = AUXILIARY (ANTI-PUMPING) RELAY.
 - Z = AUXILIARY RELAY.

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100 WEST WALNUT STREET PASADENA, CALIFORNIA		CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		TITLE: ELECTRICAL STANDARD ONE & THREE LINE DIAGRAM SYMBOLS SHEET NUMBER: WA-E-004	
DATE: 10-31-95 DRAWN: J.G. CHECKED: ENGINEER: PROJ MGR:		NO. DATE APRO BY DESCRIPTION OF REVISION 1 10-31-95 TDM PRELIMINARY DESIGN REVIEW 2 3 4 5		NO. DATE APRO BY DESCRIPTION OF REVISION 1 10-31-95 TDM PRELIMINARY DESIGN REVIEW 2 3 4 5	

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