

QUESTIONS AND ANSWERS FOR ELECTRICIAN'S EXAMINATIONS

15TH
EDITION

PAUL ROSENBERG



AUDEL QUESTIONS AND ANSWERS FOR ELECTRICIAN'S EXAMINATIONS

All New Fifteenth Edition

Paul Rosenberg



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INTRODUCTION

TIPS ON TAKING TESTS

It is the author's experience that, for most electricians, knowing how to take a test is almost as important as knowing the technical information, as far as obtaining a passing grade is concerned. A great number of electricians fear tests more than they fear 480 volts.

Really, there is no good reason why this should be so. After all, if hundreds of thousands of men and women can pass these tests, anyone interested who gives a real effort and pays particular attention to some basic rules can succeed. Some basic rules for taking tests are these:

1. Know the material being covered.
2. Know the format of the test.
3. Be physically and mentally prepared on the exam day.
4. RELAX!
5. Work the test in the smartest way you can.

The first point, *knowing the material being covered*, is a mandatory prerequisite. Most test failures come from violating this rule. No, it isn't always easy to learn all the material to be tested. It requires hours—sometimes many hours—of studying, when you'd rather be doing other things. It means that you have to make your brain work harder than it wants to, going over the material again and again. Sorry, but unless you have an exceptional aptitude for learning there are no shortcuts for hard, intense study. A good study guide (like this book) is about as much help as you can get.

The second rule for taking tests is that you need to *know the format of the test*. Some of the things you need to know are the following:

How many questions are on the test?

How many questions are open-book?

How many are closed-book?

Do all questions count for the same number of points?

Is there a penalty for wrong answers?

How much time is allowed for each section of the test?

Who wrote the test?

How will the test be graded?

By knowing the answers to these questions, you can plan your efforts intelligently. For example, if certain questions will count for more points than others, you should be ready to spend more time and effort on those questions. By knowing the time limits, you can calculate how much time you have for each question, and so on. Get answers to all of these questions and consider all of these facts as you prepare for the exam.

Now, as for *being physically and mentally prepared*: I think most readers are familiar with the way athletes prepare for an event. They make sure they eat the right kinds of food, so that they have enough energy. They get plenty of sleep, and they come to the event planning to win. The same thing should be done in preparation for a test.

The most important factor is what we already mentioned: planning to win. Psychologists have found that the results one achieves are directly related to what one expects to receive. If you believe that you will do well, you are quite likely to do well. (Of course, you can kill the whole deal by not studying, then faking your belief in yourself.) If you expect to do poorly, you probably will, regardless of how much studying you've done.

Remember, it does not matter what you wish for; what matters is what you expect. I'll pass on to you one of my favorite quotes along these lines, from Robert J. Ringer: "The results you produce in life are inversely proportional to the degree to which you are intimidated."

If you want to improve your confidence (expectations) in your test-taking abilities, picture yourself as having aced the test; refuse to imagine yourself failing. You'll also have to spend as much time studying as is necessary to believe in yourself.

On the day of a test, you want to walk in well rested (but not still groggy), having been well fed (but not full), and with a subdued confidence. Generally, heavy studying the night before the test is not a good idea. Do a light review and leisurely go over difficult parts of the information if you like, but the night before is not the time to get intense. You should have been intense two weeks ago. The night before the test is a time to eat well and go to bed early. Try not to eat within two or three hours of the test, as it tends to bog you down. It has been said that the level of mental efficiency is greatest on an empty stomach.

Confidence is built on a good knowledge of the material to be covered and the ability to pass with style.

Once you enter the test location, *relaxing* is very important. If you choke up during the test, you are automatically taking 5 points off of your score, and possibly more. You should have the same attitude as runners who show up for races they know they will win. They are ready to run their fastest, but they are not nervous, because they know that their fastest is good enough.

Before taking the test, clear your mind; don't get involved in trivial conversations. Then, when it is time to answer the questions, dig into the test with your full strength.

During the test, answer all of the easy questions first. Do all of the questions that you know the answers to; pass up the hard questions for now, and do the ones you know for sure. Then, once you have answered these questions, don't go over them again; just move on to the next group of questions. Next, do the questions that require some work, but do not do the most difficult questions; save them for last. It is silly to waste half your time on one difficult question. Do the 47 easier questions, and then come back to the 3 especially difficult ones.

Work the test in the smartest possible way. Pay attention to time requirements, books allowed during open-book tests, and so on. For your electrical exam, you should definitely put tabs on your codebook. Bring an electronic calculator with you and some scratch paper (as long as you are allowed to). Rather than buying a set of codebook tabs, I recommend that you create your own. Tab the index and the sections of the code that you use most frequently. I generally put tabs on the following:

Tables 250.66 and 250.122 (sizes of ground wires)

Table 310.15(B) (wire ampacities)

Appendix C (conduit fill tables)

Article 230 (services)

Table 300.5 (burial depths)

Tables 370.6 (number of wires in boxes)

Article 430 (motors)

Article 450 (transformers)

Article 490 (over 600 volts)

Article 500 (hazardous location wiring)

Article 590 (temporary installations)










Article 700 (emergency systems)

Remember: If hundreds of thousands of other people have passed these tests, you can, too — if you prepare.

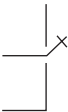

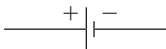
/// **ELECTRICAL SYMBOLS**

To avoid confusion, American Standards Association (ASA) policy requires that the same symbol not be included in more than one standard. If the same symbol were to be used in two or more standards and one of these standards was revised, changing the meaning of the symbol, considerable confusion could arise over which symbol was correct, the revised or the unrevised.

The symbols in this category include, but are not limited to, those in the following list. The reference numbers are the American Standard Y32.2 item numbers.

	46.3	<i>Electric motor</i>
	46.2	<i>Electric generator</i>
	86.1	<i>Power transformer</i>
	82.1	<i>Pothead (cable termination)</i>
	48	<i>Electric watthour meter</i>
	12.2	<i>Circuit element, e.g., circuit breaker</i>
	11.1	<i>Circuit breaker</i>
	36	<i>Fusible element</i>
	76.3	<i>Single-throw knife switch</i>





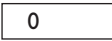



(continued)

	76.2	Double-throw knife switch
	13.1	Ground
	7	Battery'

Electrical Symbols.












List of Symbols

1.0 Lighting Outlets

Ceiling	Wall		
		1.1	Surface or pendant incandescent, mercury vapor, or similar lamp fixture
		1.2	Recessed incandescent, mercury vapor, or similar lamp fixture
		1.3	Surface or pendant individual fluorescent fixture
		1.4	Recessed individual fluorescent fixture
		1.5	Surface or pendant continuous-row fluorescent fixture
		1.6	Recessed continuous-row fluorescent fixture*

(continued)

*In the case of combination continuous-row fluorescent and incandescent spotlights, use combinations of the above Standard symbols.




		1.7	<i>Bare-lamp fluorescent strip**</i>
		1.8	<i>Surface or pendant exit light</i>
		1.9	<i>Recessed exit light</i>
		1.10	<i>Blanked outlet</i>
		1.11	<i>Junction box</i>
		1.12	<i>Outlet controlled by low-voltage switching when relay is installed in outlet box</i>

Lighting Outlets.

2.0 Receptacle Outlets

Unless noted to the contrary, it should be assumed that every receptacle will be grounded and will have a separate grounding contact.

Use the uppercase subscript letters described under Section 2 item a-2 of this Standard when weatherproof, explosion-proof, or some other specific type of device will be required.

	2.1	<i>Single receptacle outlet</i>
	2.2	<i>Duplex receptacle outlet</i>
	2.3	<i>Triplex receptacle outlet</i>

(continued)

**In the case of a continuous-row bare-lamp fluorescent strip above an area-wide diffusion means, show each fixture run, using the Standard symbol; indicate area of diffusing means and type of light shading and/or drawing notation.



2.4 *Quadruplex receptacle outlet*



2.5 *Duplex receptacle outlet—split wired*



2.6 *Triplex receptacle outlet—split wired*



2.7 *Single special-purpose receptacle outlet**



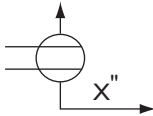
2.8 *Duplex special-purpose receptacle outlet**



2.9 *Range outlet*



2.10 *Special-purpose connection or provision for connection. Use subscript letters to indicate function (DW—dishwasher; CD—clothes dryer, etc.)*



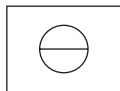
2.11 *Multioutlet assembly. Extend arrows to limit of installation. Use appropriate symbol to indicate type of outlet. Also indicate spacing of outlets as x inches.*



2.12 *Clock Hanger Receptacle*



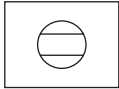
2.13 *Fan Hanger Receptacle*



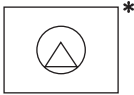
2.14 *Floor Single Receptacle Outlet*

(continued)

*Use numeral or letter, either within the symbol or as a subscript alongside the symbol keyed to explanation in the drawing list of symbols, to indicate type of receptacle or usage.



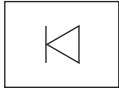
2.15 *Floor Duplex Receptacle Outlet*



2.16 *Floor Special-Purpose Outlet**



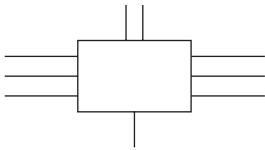
2.17 *Floor Telephone Outlet—Public*



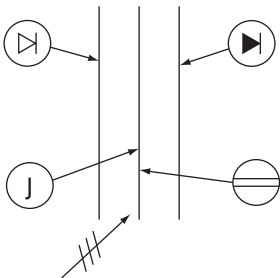
2.18 *Floor Telephone Outlet—Private*



Not a part of the Standard: example of the use of several floor outlet symbols to identify a 2-, 3-, or more-gang floor outlet



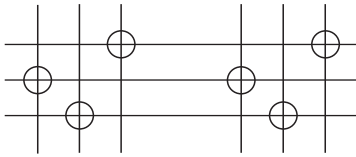
2.19 *Underfloor Duct and Junction Box for Triple, Double or Single Duct System as indicated by the number of parallel lines*



Not a part of the Standard: example of use of various symbols to identify location of different types of outlets or connections for underfloor duct or cellular floor systems

(continued)

*Use numeral or letter, either within the symbol or as a subscript alongside the symbol keyed to explanation in the drawing list of symbols, to indicate type of receptacle or usage.




2.20 Cellular Floor Header Duct

Receptacle Outlets.

3.0 Switch Outlets

S 3.1 Single-pole switch

 S_2 3.2 Double-pole switch S_3 3.3 Three-way switch S_4 3.4 Four-way switch S_K 3.5 Key-operated switch S_P 3.6 Switch and pilot lamp S_L 3.7 Switch for low-voltage switching system S_{LM} 3.8 Master switch for low-voltage switching system

 3.9 Switch and single receptacle


 3.10 Switch and double receptacle
 S_D 3.11 Door switch S_T 3.12 Time switch

(continued)


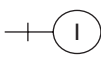
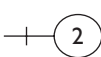
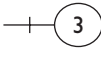
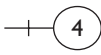
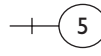
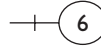
S_{CB}	3.13	<i>Circuit-breaker switch</i>
S_{MC}	3.14	<i>Momentary contact switch or pushbutton for other than signaling system</i>

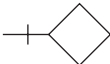
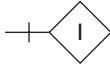
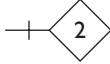
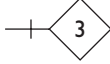
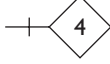
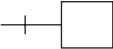






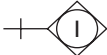
Switch Outlets.

Signaling System Outlets

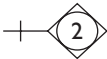
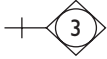


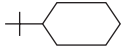
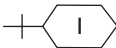
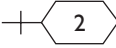
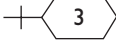
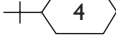
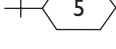
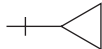
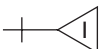
4.0 Institutional, Commercial, and Industrial Occupancies

These symbols are recommended by the American Standards Association but are not used universally. The reader should remember not to assume that these symbols will be used on any certain plan and should always check the symbol list on the plans to verify whether these symbols are actually used.

Basic Symbol	Examples of Individual Item Identification (Not a part of the Standard)	
		4.1 I. Nurse Call System Devices (and type)
		<i>Nurses' Annunciator (can add a number after it as +⊖ 24 to indicate number of lamps)</i>
		<i>Call station, single, cord, pilot light</i>
		<i>Call station, double cord, microphone speaker</i>
		<i>Corridor dome light, 1 lamp</i>
		<i>Transformer</i>
		<i>Any other item on same system—use numbers as required.</i>
		(continued)









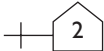
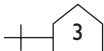



Basic Symbol	Examples of Individual Item Identification (Not a part of the Standard)	
		4.2 II. Paging System Devices (any type)
		<i>Keyboard</i>
		<i>Flush annunciator</i>
		<i>2-face annunciator</i>
		<i>Any other item on same system— use numbers as required.</i>
		4.3 III. Fire Alarm System Devices (any type) including Smoke and Sprinkler Alarm Devices
		<i>Control panel</i>
		<i>Station</i>
		<i>10" Gong</i>
		<i>Pre-signal chime</i>
		<i>Any other item on same system— use numbers as required.</i>
		4.4 IV. Staff Register System Devices (any type)
		<i>Phone operators' register</i>

(continued)

Basic Symbol	Examples of Individual Item Identification (Not a part of the Standard)	
	<i>Entrance register—flush</i>	
	<i>Staff room register</i>	
	<i>Transformer</i>	
	<i>Any other item on same system— use numbers as required.</i>	
	4.5 V. Electric Clock System Devices (any type)	
	<i>Master clock</i>	
	<i>12" Secondary—flush</i>	
	<i>12" Double dial—wall-mounted</i>	
	<i>18" Skeleton dial</i>	
	<i>Any other item on same system— use numbers as required.</i>	
	4.6 VI. Public Telephone System Devices	
	<i>Switchboard</i>	

(continued)

Basic
Symbol Examples of
Individual Item
Identification
(Not a part of
the Standard)

		<i>Desk phone</i>
		<i>Any other item on same system— use numbers as required.</i>
		4.7 VII. Private Telephone System Devices (any type)
		<i>Switchboard</i>
		<i>Wall phone</i>
		<i>Any other item on same system— use numbers as required.</i>
		4.8 VIII. Watchman System Devices (any type)
		<i>Central station</i>
		<i>Key station</i>
		<i>Any other item on same system— use numbers as required.</i>
		4.9 IX. Sound System
		<i>Amplifier</i>
		<i>Microphone</i>

(continued)

Basic
Symbol Examples of
 Individual Item
 Identification
 (Not a part of
 the Standard)



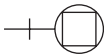
Interior speaker



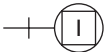
Exterior speaker



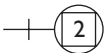
*Any other item on same system—
use numbers as required.*



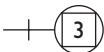
4.10 X. Other Signal System
Devices



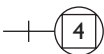
Buzzer



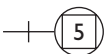
Bell



Pushbutton



Annunciator

















*Any other item on same system—
use numbers as required.*

Institutional, Commercial, and Industrial Occupancies.



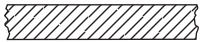
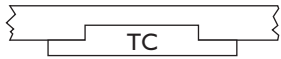
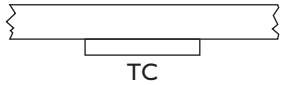


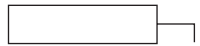
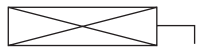
Signaling System Outlets

5.0 Residential Occupancies

When a descriptive symbol list is not employed, use the following signaling system symbols to identify standardized, residential-type, signal-system items on residential drawings. Use the basic symbols with a descriptive symbol list when other signal-system items are to be identified.


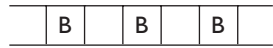
	5.1	<i>Pushbutton</i>
	5.2	<i>Buzzer</i>
	5.3	<i>Bell</i>
	5.4	<i>Combination bell-buzzer</i>
	5.5	<i>Chime</i>
	5.6	<i>Annunciator</i>
	5.7	<i>Electric door opener</i>
	5.8	<i>Maid's signal plug</i>
	5.9	<i>Interconnection box</i>
	5.10	<i>Bell-ringing transformer</i>
	5.11	<i>Outside telephone</i>
	5.12	<i>Interconnecting telephone</i>
	5.13	<i>Radio outlet</i>
	5.14	<i>Television outlet</i>

6.0 Panelboards, Switchboards, and Related Equipment

- 
- 6.1 Flush-mounted panelboard and cabinet*
- 
- 6.2 Surface-mounted panelboard and cabinet*
- 
- 6.3 Switchboard, power control center, unit substations*— should be drawn to scale
- 
- 6.4 Flush-mounted terminal cabinet.* In small-scale drawings the TC may be indicated alongside the symbol.
- 
- 6.5 Surface-mounted terminal cabinet.* In small-scale drawings the TC may be indicated alongside the symbol.
- 
- 6.6 Pull box (identify in relation to wiring section and sizes)
- 
- 6.7 Motor or other power controller*
- 
- 6.8 Externally-operated disconnection switch*
- 
- 6.9 Combination controller and disconnection means*

Panelboards, Switchboards, and Related Equipment.

7.0 Bus Ducts and Wireways

- 
- 7.1 Trolley duct*
- 
- 7.2 Busway (service, feeder, or plug-in)*

(continued)

*Identify by notation or schedule.

7.3 *Cable trough ladder or channel**7.4 *Wireway**

Bus Ducts and Wireways.

8.0 Remote Control Stations for Motors or Other Equipment*8.1 *Pushbutton station*8.2 *Float switch—mechanical*8.3 *Limit switch—mechanical*8.4 *Pneumatic switch—mechanical*8.5 *Electric eye—beam source*8.6 *Electric eye—relay*8.7 *Thermostat*

Remote Control Stations for Motor or Other Equipment.

9.0 Circuiting

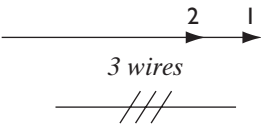
Wiring method identification by notation on drawing or in specification.

9.1 *Wiring concealed in ceiling or wall*9.2 *Wiring concealed in floor*9.3 *Wiring exposed*

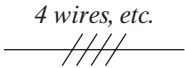
(continued)

*Identify by notation or schedule.

Note: Use heavyweight line to identify service and feeders. Indicate empty conduit by notation CO (conduit only).

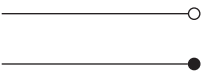


9.4 Branch-circuit home run to panel-board. Number of arrows indicates number of circuits. (A numeral at each arrow may be used to identify circuit number.) Note: Any circuit without further identification indicates two-wire circuit. For a greater number of wires, indicate with cross lines, e.g.:



Unless indicated otherwise the wire size of the circuit is the minimum size required by the specification.

Identify different functions of wiring system, e.g., signaling system by notation or other means.



9.5 Wiring turned up
9.6 Wiring turned down

Circuiting.

10.0 Electric Distribution or Lighting System, Underground



10.1 Manhole*



10.2 Handhole*



10.3 Transformer manhole or vault*



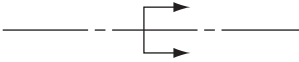
10.4 Transformer pad*



10.5 Underground direct burial cable. Indicate type, size, and number of conductors by notation or schedule.

(continued)

*Identify by notation or schedule.



10.6 *Underground duct line. Indicate type, size, and number of ducts by cross-section identification of each run by notation or schedule. Indicate type, size, and number of conductors by notation or schedule.*



10.7 *Streetlight standard feed from underground circuit**

Electric Distribution or Lighting System, Underground.

11.0 Electric Distribution or Lighting System, Aerial



11.1 *Pole**



11.2 *Streetlight and bracket**



11.3 *Transformer**



11.4 *Primary circuit**



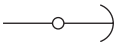
11.5 *Secondary circuit**



11.6 *Down guy*



11.7 *Head guy*



11.8 *Sidewalk guy*



11.9 *Service weather head**

Electrical Distribution or Lighting System Aerial.

4 Arrester, Lighting Arrester (Electric surge, etc.) Gap



4.1 *General*



4.2 *Carbon block*

(continued)

*Identify by notation or schedule.

Block, telephone protector

The sides of the rectangle are to be approximately in the ratio of 1 to 2, and the space between rectangles shall be approximately equal to the width of a rectangle.



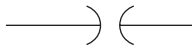
4.3 *Electrolytic or aluminum cell*
This symbol is not composed of arrowheads.



4.4 *Horn gap*



4.5 *Protective gap*
These triangles shall not be filled.



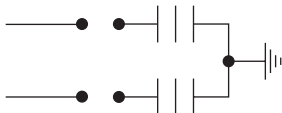
4.6 *Sphere gap*



4.7 *Valve or film element*



4.8 *Multigap, general*



4.9 *Application: gap plus valve plus ground, 2-pole*
Application: gap plus valve plus ground, 2-pole

Arrester, Lighting Arrester (Electric surge etc.) Gap.

7 **Battery**

The long line is always positive, but polarity may be indicated in addition.
Example:






7.1 *Generalized direct-current source*



7.2 *One cell*

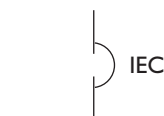
(continued)

	7.3	<i>Multicell</i>
	7.3.1	<i>Multicell battery with 3 taps</i>
	7.3.2	<i>Multicell battery with adjustable tap</i>

Battery.

11 Circuit Breakers

If it is desired to show the condition causing the breaker to trip, the relay-protective-function symbols in item 66.6 may be used alongside the break symbol.



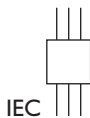
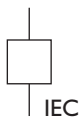
11.1 *General*



11.2 *Air circuit breaker, if distinction is needed; for alternating-current breakers rated at 1,500 volts or less and for all direct-current circuit breakers.*



11.2.1 *Network protector*



11.3 *Circuit breaker, other than covered by item 11.2. The symbol in the right column is for a 3-pole breaker.*

See Note 11.3A

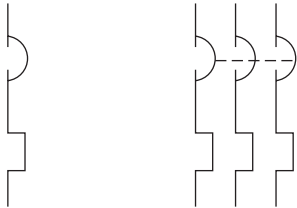
(continued)

Note 11.3A—On a power diagram, the symbol may be used without other identification. On a composite drawing where confusion with the general circuit element symbol (item 12) may result, add the identifying letters CB inside or adjacent to the square.

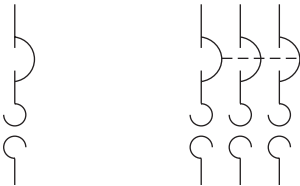


See Note 11.3A

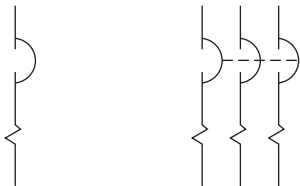
11.3.1 On a connection or wiring diagram, a 3-pole single-throw circuit breaker (with terminals shown) may be drawn as shown.



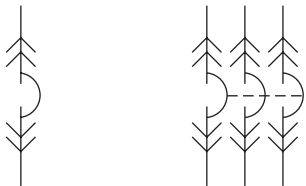
11.4 Applications



11.4.1 3-pole circuit breaker with thermal overload device in all 3 poles



11.4.2 3-pole circuit breaker with magnetic overload device in all 3 poles



11.4.3 3-pole circuit breaker, drawout type

Circuit Breakers.

Note 11.3A—On a power diagram, the symbol may be used without other identification. On a composite drawing where confusion with the general circuit element symbol (item 12) may result, add the identifying letters CB inside or adjacent to the square.

13 Circuit Return



13.1 Ground

- (A) *A direct conducting connection to the earth or body of water that is a part thereof*
- (B) *A conducting connection to a structure that serves a function similar to that of an earth ground (that is, a structure such as a frame of an air, space, or land vehicle that is not conductively connected to earth)*



13.2 Chassis or frame connection

A conducting connection to a chassis or frame of a unit. The chassis or frame may be at a substantial potential with respect to the earth or structure in which this chassis or frame is mounted.



Circuit Return



13.3 Common connections

*Conducting connections made to one another. All like-designated points are connected. *The asterisk is not a part of the symbol. Identifying valves, letters, numbers, or marks shall replace the asterisk.*

15 Coil, Magnetic Blowout*









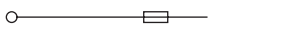
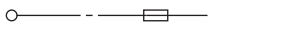



Coil, Magnetic Blowout.

*The broken line (— - —) indicates where line connection to a symbol is made and is not a part of the symbol.

23 Contact, Electrical

For buildups or forms using electrical contacts, see applications under CONNECTOR (item 19), RELAY (item 66), and SWITCH (item 76). See DRAFTING PRACTICES (item 0.4.6).

	23.1.1	<i>Fixed contact for jack, key, relay, etc.</i>
	23.1.2	<i>Fixed contact for switch</i>
	23.1.3	<i>Fixed contact for momentary switch</i> <i>See SWITCH (item 76.8 and 76.10).</i>
	23.1.4	<i>Sleeve</i>
	23.2.1.	<i>Adjustable or sliding contact for resistor, inductor, etc.</i>
	23.2.2	<i>Locking</i>
	23.2.3	<i>Segment; bridging contact</i>
	23.2.4	<i>Nonlocking</i> <i>See SWITCH (items 76.12.3 and 76.12.4).</i>
	23.2.5	<i>Vibrator reed</i>
	23.2.6	<i>Vibrator split reed</i>
	23.2.7	<i>Rotating contact (slip ring) and brush</i>

A. Contact, Electrical.

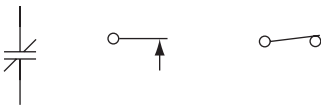
It is standard procedure to show a contact by a symbol that indicates the circuit condition produced when the actuating device is in the nonoperated, or deenergized, position. It may be necessary to add a clarifying note explaining the proper point at which the contact functions—the point where the actuating device (mechanical, electrical, etc.) opens or closes due to changes in pressure, level,

flow, voltage, current, etc. When it is necessary to show contacts in the operated, or energized, condition—and where confusion would otherwise result—a clarifying note shall be added to the drawing. Contacts for circuit breakers, auxiliary switches, etc., may be designated as shown below:

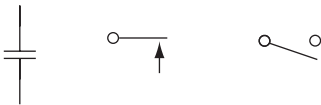
- (a)** Closed when device is in energized or operated position.
- (b)** Closed when device is in deenergized or nonoperated position.
- (aa)** Closed when operating mechanism of main device is in energized or operated position.
- (bb)** Closed when operating mechanism of main device is in deenergized or nonoperated position.

[See American Standard C37.2-1962 for details.]

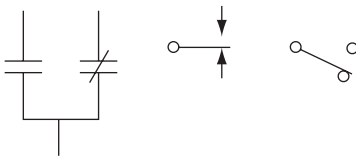
In the parallel-line contact, symbols showing the length of the parallel lines shall be approximately $1\frac{1}{4}$ times the width of the gap (except for item 23.6).



23.3.1 *Closed contact (break)*
See also *SWITCHING FUNCTION* (item 77).



23.3.2 *Open contact (make)*
See also *SWITCHING FUNCTION* (item 77).



23.3.3 *Transfer*
See also *SWITCHING FUNCTION* (item 77).



23.3.4 *Make-before-break*

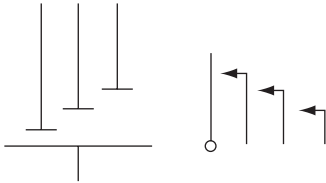


23.4 *Application: open contact with time closing (TC) or time delay closing (TDC) feature*

(continued)



23.5 *Application: closed contact with time opening (TO) or time delay opening (TDO) feature*



23.6 *Time sequential closing*

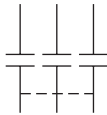
B. Contact, Electrical.

24 Contactor

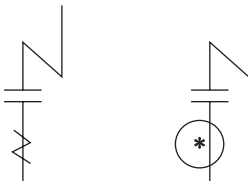
See also RELAY (item 66).

Contactors symbols are derived from fundamental contact, coil, and mechanical connection symbols and should be employed to show contactors on complete diagrams. A complete diagram of the actual contactor device is constructed by combining the abovementioned fundamental symbols for mechanical connections, control circuits, etc.

Mechanical interlocking should be indicated by notes.



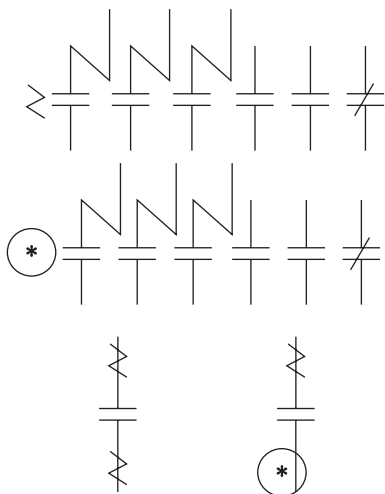
24.1 *Manually operated 3-pole contactor*



24.2 *Electrically operated 1-pole contact or with series blowout coil See Note 24.2A.*

(continued)

Note 24.2A—The asterisk is not a part of the symbol. Always replace the asterisk by a device designation.



24.3 *Electrically operated 3-pole contactor with series blowout coils; 2 open and 1 closed auxiliary contacts (shown smaller than the main contacts)*

24.4 *Electrically operated 1-pole contactor with shunt blowout coil*

Contactor.

46 Machine, Rotating



46.1 *Basic*



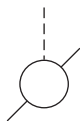
46.2 *Generator (general)*



46.3 *Motor (general)*

46.4 *Motor, multispeed*

**USE BASIC MOTOR SYMBOL AND
NOTE SPEEDS**



46.5 *Rotating armature with commutator and brushes**

(continued)

*The broken line (---) indicates where line connection to a symbol is made and is not a part of the symbol.