IEEE Std C95.2-1999
(Revision of
IEEE Std C95.2-1982)

IEEE Standard for Radio-Frequency Energy and Current-Flow Symbols

Sponsor

IEEE Standards Coordinating Committee 28 on Non-Ionizing Radiation

Approved 16 September 1999

IEEE-SA Standards Board

Abstract: Symbols to inform people about the presence of potentially hazardous levels of radio-frequency energy or the presence of contact current hazards in the frequency range of 3 kHz to 300 GHz are specified. Guidance is given about how these symbols should be used on warning signs and labels.
Keywords: caution, contact current, danger, hazard, labels, microwave, radio frequency, shock, signs, symbol, warning

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Introduction

(This introduction is not part of IEEE Std C95.2-1999, IEEE Standards for Radio-Frequency Energy and Current-Flow Symbols.)

In 1960, the American Standards Association approved the initiation of the Radiation Hazards Standards project under the co-sponsorship of the Department of the Navy and the Institute of Electrical and Electronics Engineers.

Prior to 1988, C95 standards were developed by an Accredited Standards Committee and submitted to ANSI for approval and issuance as ANSI C95 standards. Between 1988 and 1990, the committee was converted to Standards Coordinating Committee 28 (SCC28) under the sponsorship of the IEEE Standards Board. In accordance with policies of the IEEE, C95 standards will be issued and developed as IEEE standards, as well as being submitted to ANSI for recognition.

The present scope of IEEE SCC28 is:

"Development of standards for the safe use of electromagnetic energy in the range of 0 Hz to 300 GHz relative to the potential hazards of exposure of man, volatile materials, and explosive devices to such energy. It is not intended to include infrared, visible, ultraviolet, or ionizing radiation. The committee will coordinate with other committees whose scopes are contiguous with SCC28."

The IEEE SCC28 is responsible for this standard. There are five subcommittees concerned with

I Techniques, Procedures, and Instrumentation

II Terminology, Units of Measurements, and Hazard Communication

III Safety Levels with Respect to Human Exposure, 0–3 kHz

IV Safety Levels with Respect to Human Exposure, 3 kHz–300 GHz

V Safety Levels with Respect to Electro-Explosive Devices

Two standards, two guides, and one recommended practice have been issued. Current versions are

IEEE Std C95.1, 1999 Edition, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz (incorporating IEEE Std C95.1-1991 and IEEE Std C95.1a-1998).

ANSI C95.2-1982 (Reaff 1988), American National Standard Radio Frequency Radiation Hazard Warning Symbol.

IEEE Std C95.3-1991 (Reaff 1997), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields—RF and Microwave. (Replaces ANSI C95.3-1973 and ANSI C95.5-1981.)

ANSI C95.3-1973 (Reaff 1979), American National Standard Techniques and Instrumentation for the Measurement of Potentially Hazardous Electromagnetic Fields—RF and Microwave.

ANSI C95.5-1981, American National Standard Recommended Practice for the Measurement of Hazardous Electromagnetic Fields—RF and Microwave.

IEEE Std 1460-1996, IEEE Guide for the Measurement of Quasi-Static Magnetic and Electric Fields.

ANSI C95.4-1971, American National Standard Safety Guide for the Prevention of Radio-Frequency Radiation Hazards in the Use of Electric Blasting Caps.

Participants

IEEE Std C95.2-1999 was prepared by Subcommittee II on Terminology, Units of Measurements, and Hazard Communication of IEEE SCC28. The following persons participated in the Subcommittee II Working Group that approved this standard:

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Contents

IEEE Standard for Radio-Frequency Energy and Current-Flow Symbols

1. Overview

1.1 Scope

This standard defines the design of symbols denoting the incidence of radio-frequency (RF) electromagnetic energy in the frequency range from 3 kHz to 300 GHz. The standard also defines the use of these symbols in signs and labels intended to warn workers or the public of the presence of potentially hazardous levels of RF energy and other hazards that may arise from RF energy, such as RF induced currents, shocks, or burns. Guidance on the application and placement of these signs in operational settings is not within the scope of this document.

1.2 General

The purpose of this revision is to be consistent with the ANSI Z535 series[1] of standards addressing the design and use of environmental warning signs and labels, and IEEE Std C95.1, 1999 Edition. This standard addresses environmental and facility safety signs, and product safety signs and labels where the symbols specified in this standard may be used. Accident prevention tags are not addressed here because accident prevention tags used for protection against RF energy have no unique features. (See ANSI Z535.5-1998 for guidance concerning accident prevention tags.) This standard provides a single reference source for the design of signs and labels for RF hazards.

2. References

This standard shall be used in conjunction with the following publications. When the following publications are superseded by an approved revision, the revision shall apply. The safety level of RF energy with respect to personnel is contained in IEEE Std C95.1, 1999 Edition.

ANSI Z535.1-1998, American National Standard for Safety Color Code.[2]

ANSI Z535.2-1998, American National Standard for Environmental and Facility Safety Signs.

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[1]Information on references can be found in Clause 2.

[2]ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org/).

ANSI Z535.3-1998, American National Standard for Criteria for Safety Symbols.

ANSI Z535.4-1998, American National Standard for Product Safety Signs and Labels.

ANSI Z535.5-1998, American National Standard for Accident Prevention Tags (for Temporary Hazards).

IEEE Std 100-1996, IEEE Standard Dictionary of Electrical and Electronics Terms.[3]

IEEE Std C95.1, 1999 Edition, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

3. Definitions

For the purposes of this standard, the following terms and definitions apply. IEEE Std 100-1996 should be referenced for terms not defined in this clause.

3.1 hazardous levels of radio-frequency (RF) energy: Term used to describe incident RF energy that may be biologically detrimental or may directly or indirectly cause ignition of explosive materials or vapors.

3.2 radio-frequency (RF) energy: Includes RF fields and radiation with frequencies between 3 kHz and 300 GHz, and includes microwave frequencies.

3.3 safety sign: A visual alerting device in the form of a sign, label, decal, placard, or other marking that advises the observer of the nature and degree of the potential hazard(s), which can cause injury or death. It can also provide safety precautions or evasive actions to take, or provide other directions to eliminate or reduce the hazard.

3.4 signal word: The word or words that designate a degree of safety alerting. The words shall always be located in a distinctive panel located in the uppermost portion of a safety sign or label.

3.5 symbol(s): The radio-frequency (RF) energy and/or the RF current advisory symbols.

3.5.1 radio-frequency (RF) electric current hazard advisory symbol: Refers to the overall design and shape shown in Figure 1.

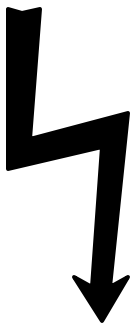


Figure 1—RF electric current hazard advisory symbol

[3]IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (http://www.standards.ieee.org/).

3.5.2 radio-frequency (RF) energy advisory symbol: Refers to the overall design, and shape shown in Figure 2. This symbol is consistent with the symbol found in Section C4 of ANSI Z535.3-1998.

Figure 2—RF energy advisory symbol

3.5.3 touch symbol: Refers to the overall design and shape shown in Figure 3. This symbol is normally shown under a red circle with bar to show the action (touching) is prohibited (see Figure 5).

Figure 3—Touch symbol

4. Description of symbols

4.1 Description of touch symbol

The touch symbol, shown in Figure 3, shows a finger approaching a surface as if ready to touch. When touching is prohibited, the symbol is shown under a circle with a diagonal bar (see Figure 5), consistent with ANSI Z535.3-1998.

4.2 Description of the RF electric current hazard advisory symbol

The RF electric current hazard advisory symbol, shown in Figure 1, is the downward pointed lightning bolt now used to warn people about lower frequency shock hazards. This symbol is consistent with ANSIZ535.3-1998.

4.3 Description of the RF energy advisory symbol

The advisory symbol for identifying incident of RF energy consists of black wavefronts radiating from a stylized point source antenna, as shown in Figure 2, and is consistent with ANSI Z535.3-1998.

5. Design and use of advisory signs

5.1 Colors

Advisory signs shall comply with the color specifications of ANSI Z535.1-1998 and colors shall be used as specified in ANSI Z535.2-1998, summarized in 5.2 through 5.8, with examples of when different signs should be used. Text and symbols shall be in colors that contrast strongly against the background color(s).

5.2 Use of symbols

These symbols should be used as a part of safety signs and labels that comply with the ANSI Z535 series of standards; safety signs that contain only words can be used although the use of symbols is encouraged. The RF electric current hazard advisory and the RF energy advisory symbols, shown in Figure 1 and Figure 2, shall be enclosed in a triangle when used for warning purposes, as shown in Figure 4. The touch symbol in Figure 3 shall be under a circle with bar when used to prohibit actions, as shown in Figure 5. The symbol and triangle shall be black in accordance with ANSI Z535.2-1998. The apices of the triangles may be rounded.

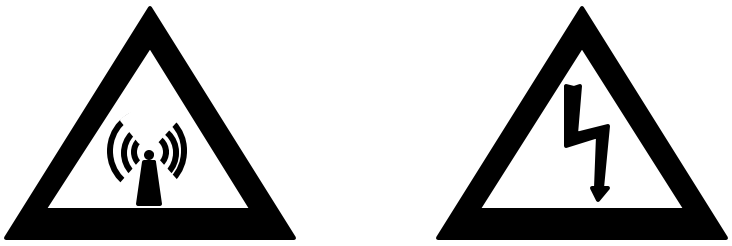


Figure 4—Use of triangles to denote a potential hazard

Figure 5—Use of circle and bar to show that an action is prohibited

5.3 Layout of signs

The symbols shall be located in a discrete section of the sign as specified by ANSI Z535.2-1998 and as summarized in Figure 6. In 5.4, 5.5, 5.6, 5.7, and 5.8, the design of the signal word portion of signs is defined.

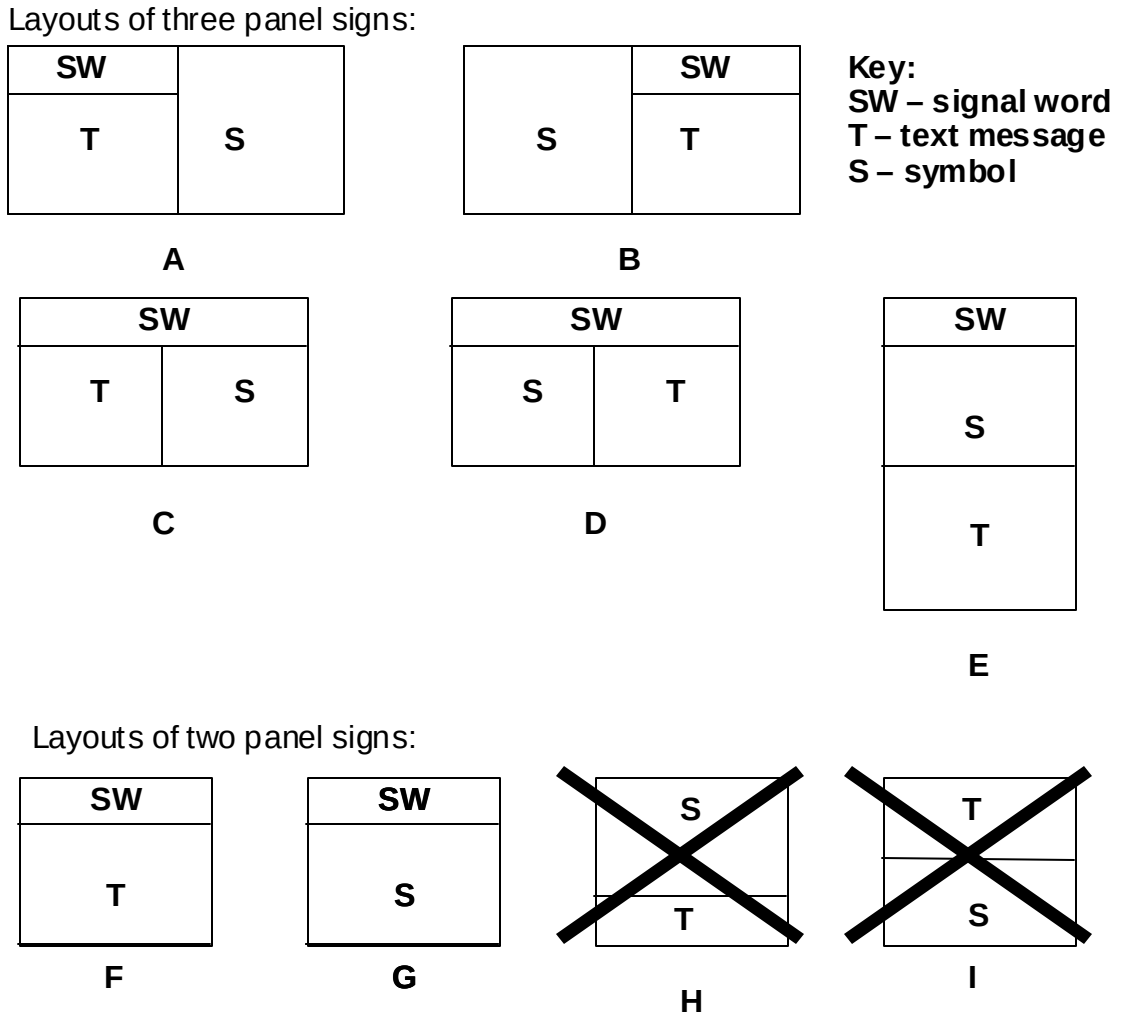


Figure 6—Formats of warning signs

Formats A through G in Figure 6 are permissible for "DANGER", "WARNING", "CAUTION", and "NOTICE" signs. Formats H and I are prohibited. ALL formats, including H and I, can be used for general safety signs.

5.4 "DANGER" signs

"DANGER" signs shall be used to indicate an imminently hazardous situation that, if not avoided, will result in death or serious injury. The signal word should be limited to the most extreme situations. The background

color of a “DANGER” sign is white. The signal word panel of a two- or three-panel sign is white against a red background immediately to the right of a white triangle surrounding a red exclamation point. The signal word can be all upper case. Alternatively, the signal word is white print in a red oval, which is surrounded by a white stripe, and which is centered in a black rectangle. (See Figure 7.)

Exclamation point and warning word together are centered against rectangle.

The apices of the triangle can be rounded.

Word, oval, and rectangle are mutually centered.

Figure 7—“DANGER” signs

Either symbol (Figure 1 or Figure 2) shall be enclosed in a triangle when used on a “DANGER” sign.

5.5 “WARNING” signs

“WARNING” signs shall be used to indicate a potentially hazardous situation that, if not avoided, could result in death or serious injury. The background color of a “WARNING” sign is white if the signal word is displayed against an orange rectangle; otherwise it is orange. The signal word panel of a two- or three-panel sign is black against an orange background immediately to the right of a black triangle surrounding an orange exclamation point. The signal word can be all upper case. Alternatively, the signal word is black print in an orange truncated diamond (hexagon) that is surrounded by a black rectangle. (See Figure 8.)

Exclamation point and warning word together are centered against rectangle.

The apices of the triangle can be rounded

Word, truncated diamond, and rectangle are mutually centered.

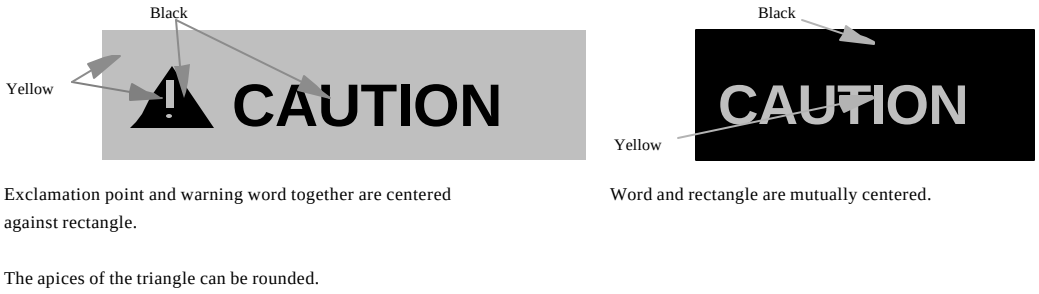
Figure 8—“WARNING” signs

Either symbol (Figure 1 or Figure 2) shall be enclosed in a triangle when used on a “WARNING” sign.

5.6 “CAUTION” signs

“CAUTION” signs shall be used to indicate a potentially hazardous situation that, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices. The background color of a

"CAUTION" sign is white if the signal word is displayed against a yellow rectangle; otherwise it is yellow. The signal word panel of a two- or three-panel sign is black against a yellow background immediately to the right of a black triangle surrounding a yellow exclamation point. The signal word can be all upper case. Alternatively, the signal word is yellow print surrounded by a black rectangle. (See Figure 9.)



Exclamation point and warning word together are centered against rectangle.

The apices of the triangle can be rounded.

Word and rectangle are mutually centered.

Figure 9—"CAUTION" signs

The triangle containing the exclamation point shall be omitted if the only outcome of violating the caution sign is property damage or equipment interference without any safety impact.

Either symbol (Figure 1 or Figure 2) shall be enclosed in a triangle when used on a "CAUTION" sign unless the only outcome of violating the caution sign is property damage or equipment interference without any safety impact. (See Figure 10.)

Word and rectangle are mutually centered.

Word and rectangle are mutually centered.

Figure 10—"CAUTION" sign for damage or interference without any safety impact

5.7 "NOTICE" signs

"NOTICE" signs are used to indicate a statement of organization policy as the message relates directly or indirectly to the safety of personnel or protection of property. This signal word shall never be associated with a hazard or hazardous situation in the place of "DANGER", "WARNING", or "CAUTION". The background color of a "NOTICE" sign is white. The advisory word panel of a two- or three-panel sign is shown as white print centered in a blue rectangle.

The RF electric current hazard advisory symbol shall not be used on a "NOTICE" sign. The RF energy advisory symbol shall not be enclosed in a triangle when used on a "NOTICE" sign. (See Figure 11.)

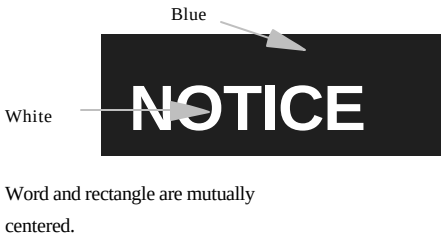


Figure 11—“NOTICE” sign

5.8 General safety signs

General safety signs are used to indicate general instructions relative to safety practices at work, reminders of proper safety procedures, and the locations of safety equipment. These signs may have signal words, such as “SAFETY FIRST”, “SAFETY INSTRUCTIONS”, “BE CAREFUL”, and “THINK”, in white letters against a green background. Other signal words that convey a general safety message are allowed. This type of sign shall never be associated with a hazard or hazardous situation that warrants a “DANGER”, “WARNING”, or “CAUTION” sign. The background color of a general safety sign is white. The advisory word panel of a two- or three-panel sign is white print centered in a green rectangle. (See Figure 12.)

Figure 12—General safety sign

The RF electric current hazard advisory symbol shall not be used on a general safety sign. The RF energy advisory symbol shall not be enclosed in a triangle when used on a general safety sign.

5.9 Guidance on text

Lead the text by stating how to avoid the hazard (e.g., “Keep out!”) and follow with supporting information. Use the active voice (“Keep out!”) rather than the passive voice (“Entry Prohibited”). The supporting information shall include identification of the hazard (e.g., “RF Electric Current”), and the probable consequences of not avoiding the hazard (e.g., “Will shock, burn, or cause death!”). Use headline style with nonessential text omitted. Include telephone numbers of people to contact in the text when appropriate. Text shall be left justified and shall not be centered or both-sides justified. An outline format shall be used rather than a paragraph format. (See Figure 13.)

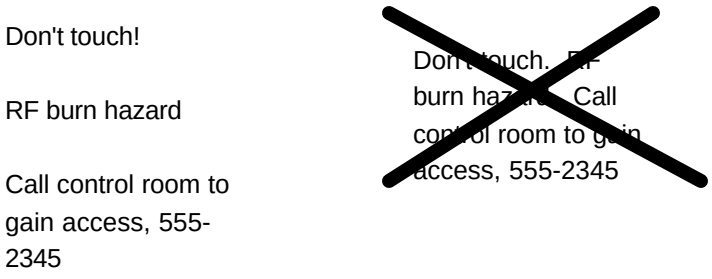


Figure 13—Formats of warning signs

Text bullets may be used in the outline format.

5.10 Print font and case

Signal words shall be sans serif letters in upper case only. Message panel lettering shall be in sans serif letters in mixed case combinations of uppercase and lowercase letters. Uppercase letters may be used sparingly in the text for emphasis. Examples of acceptable lettering styles are medium, folio medium, new gothic bold, poster gothic, and helvetica. Contrasting fonts, such as italics or boldface, may also be sparingly used for emphasis.

5.11 Print size

Minimum letter size shall be one unit in height for every 150 units of viewing distance from the safety sign for the signal word, and one unit in height for every 300 units of viewing distance from the safety sign for other words. Viewing distances for the signal word may be longer than required for the other words. When determining any viewing distance from the safety sign, the proximity of the reader to the hazard should be considered.

5.12 Line spacing

The amount of space between lines of text is called *line leading.* Lines of text should be separated by leading that is approximately 120% of the text point size (e.g., 10-point text should have 12-point leading).

5.13 Placement of signs

Safety signs

a) Shall be so placed to alert and inform the viewer in sufficient time to take appropriate evasive actions to avoid the potential harm from the hazard.

b) Shall be so placed that they are legible, nondistracting, and not hazardous in themselves.

c) Shall not be located in areas where they may be removed by the motion of the hazardous device, or rendered ineffective by situational conditions of the hazard. Moveable panels, such as doors, windows, racks, and gates, shall not block these alerting devices.

6. Design and use of labels

6.1 Layout

Product labels shall be designed in accordance with ANSI Z535.4-1998. Labels contain a signal word panel, as shown in Figure 14, and one or two other panels with a symbol and word message, as shown in Figure 15. The signal word panels always include a triangle surrounding an exclamation point immediately to the left of the word “DANGER”, “WARNING”, or “CAUTION”. The words “DANGER”, “WARNING”, and “CAUTION” shall be used as specified in 5.4, 5.5, and 5.6.

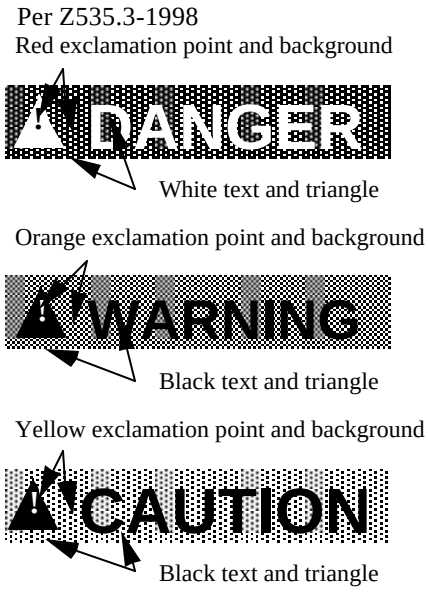


Figure 14—Layouts of signal word panels of labels

6.2 Print font and case

Signal words shall be sans serif letters in upper case only. Message panel lettering shall be in sans serif letters in uppercase only or in combinations of uppercase and lowercase letters, as deemed appropriate. Examples of acceptable lettering styles are medium, folio medium, new gothic bold, poster gothic, and helvetica.

6.3 Reference to instruction manual

When detailed instructions, precautions, or consequences require lengthy verbiage, it is permissible to refer the user to the proper instruction manual.

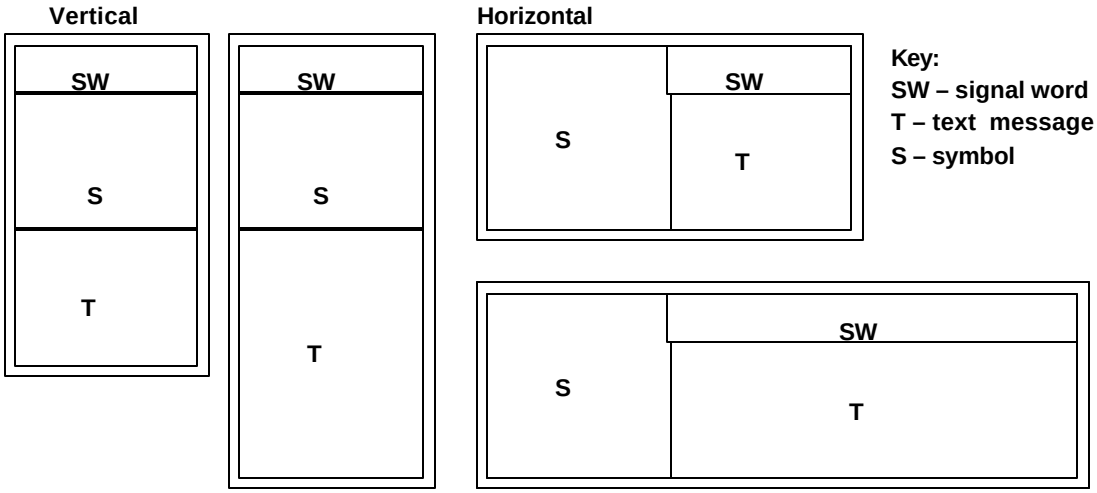


Figure 15—Layouts of two- and three-panel labels

6.4 Label placement

Product labels and signs shall be placed in a manner such that they will

a) Be readily visible to the intended viewer;

b) Alert the viewer to the potential hazard in time to take appropriate action; and

c) Not create an additional hazard.

7. Use of signs and labels to notify intended viewers of exposures and hazards

Signs and labels found in this document shall not be used as the sole means of notifying intended viewers that work is being done in controlled areas. Signs are part of an overall Hazards Communications program.

8. Signs and labels created using graphics applications

Signs created with graphics applications can be used, provided that the symbols are recognizable and the design and use comply with this standard and the referenced standards. Annex A includes large-sized symbols, which can be scanned and then reduced in size, using a graphics application, for use in locally printed signs.

9. Unusual color requirements

Different colors may be used if unusual lighting or other circumstances make the standard signs unusable. Personnel and visitors shall be instructed about the meaning and use of signs with special colors to avoid misunderstandings.

10. Use of other sign formats

Other sign formats that comply with the referenced standards may also be used. Examples of formats are shown in Section 8 of ANSI Z535.3-1998.

11. Conflicts with more recent standards

Advisory signs and labels complying with more recent versions of the referenced standards or successors shall be acceptable.

Annex A

(informative)

Symbols suitable for scanning and original 1:1 scale drawings

Figure A.1 through Figure A.6 show symbols suitable for scanning that are described in this standard.

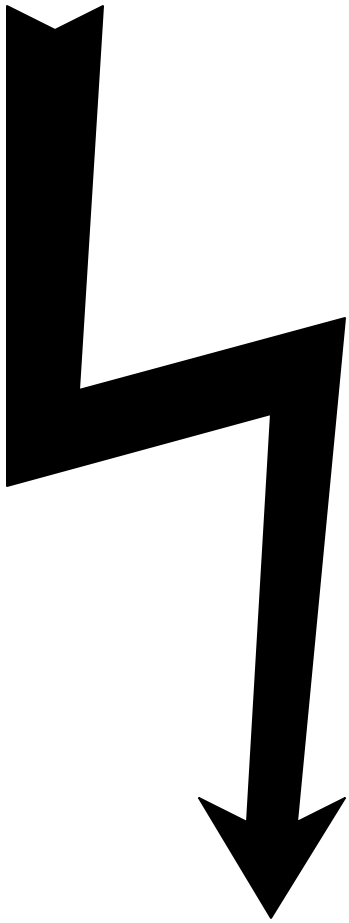


Figure A.1—Electric current hazard advisory symbol

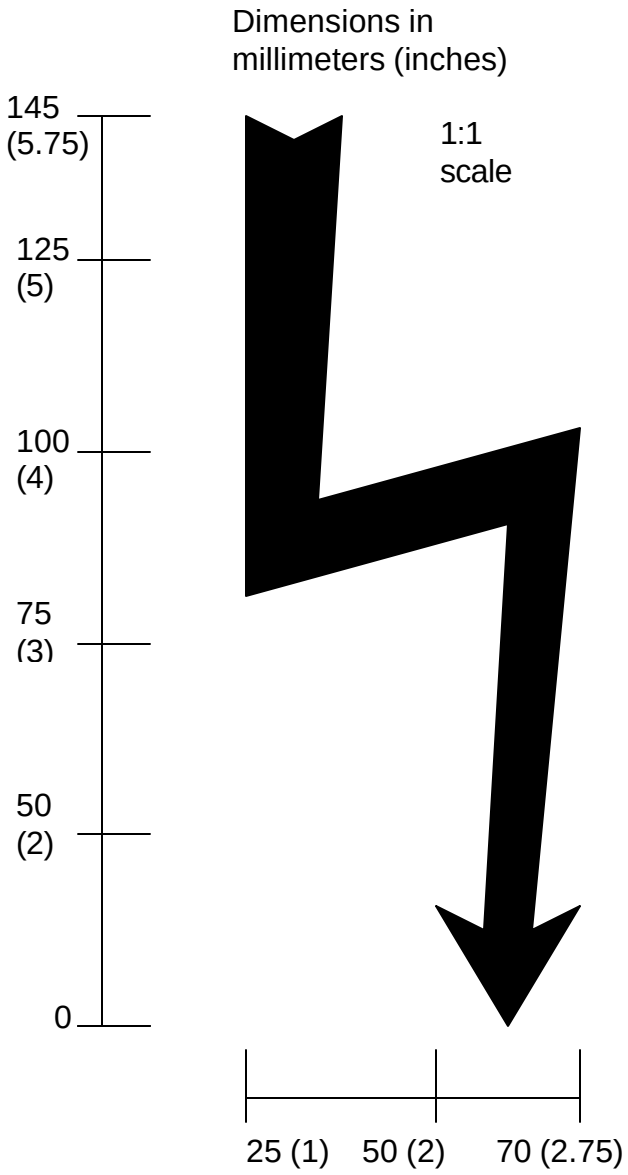


Figure A.2—Dimensions of electric current hazard advisory symbol

Figure A.3—RF energy advisory symbol

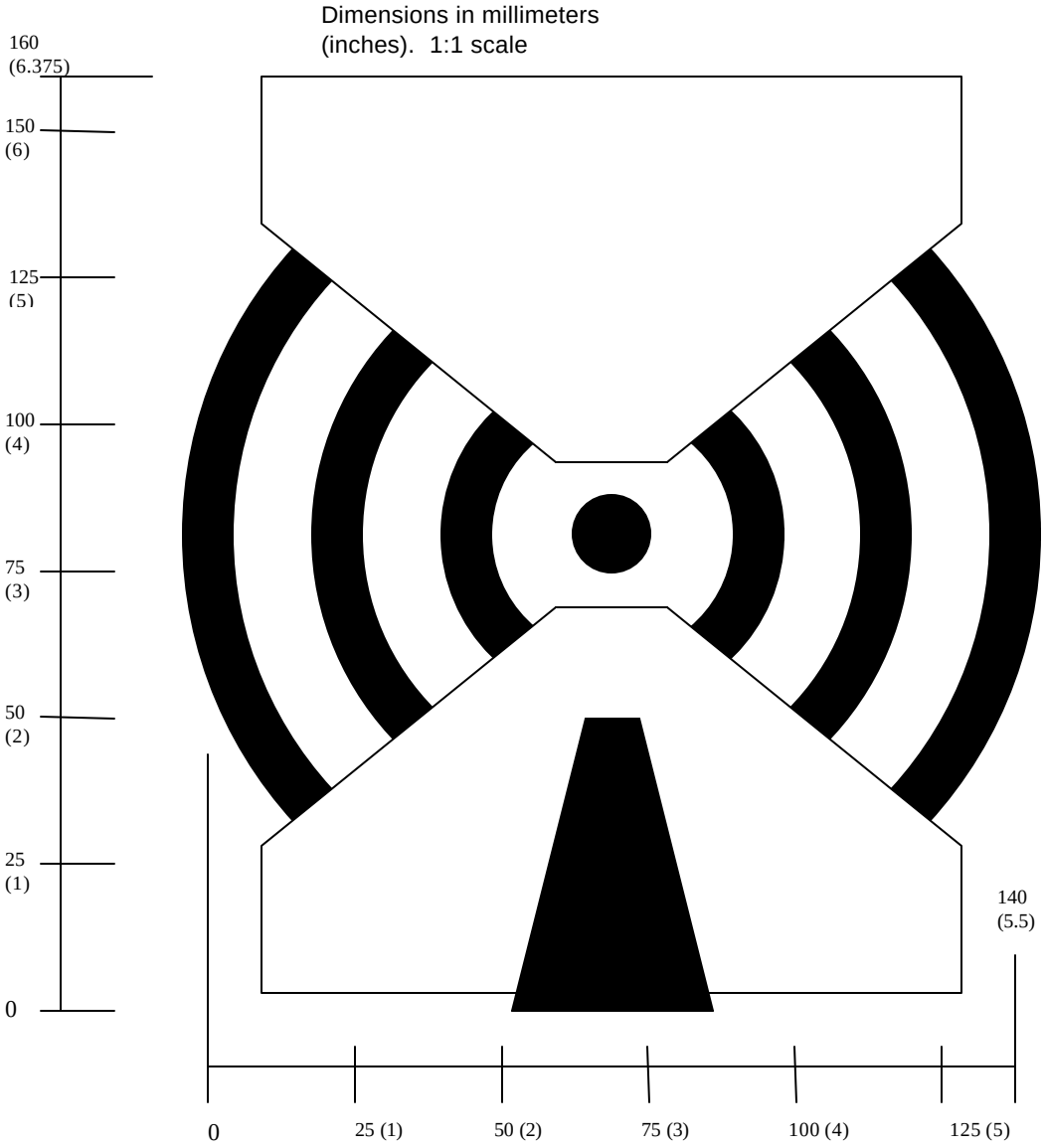


Figure A.4—Dimensions of RF energy advisory symbol

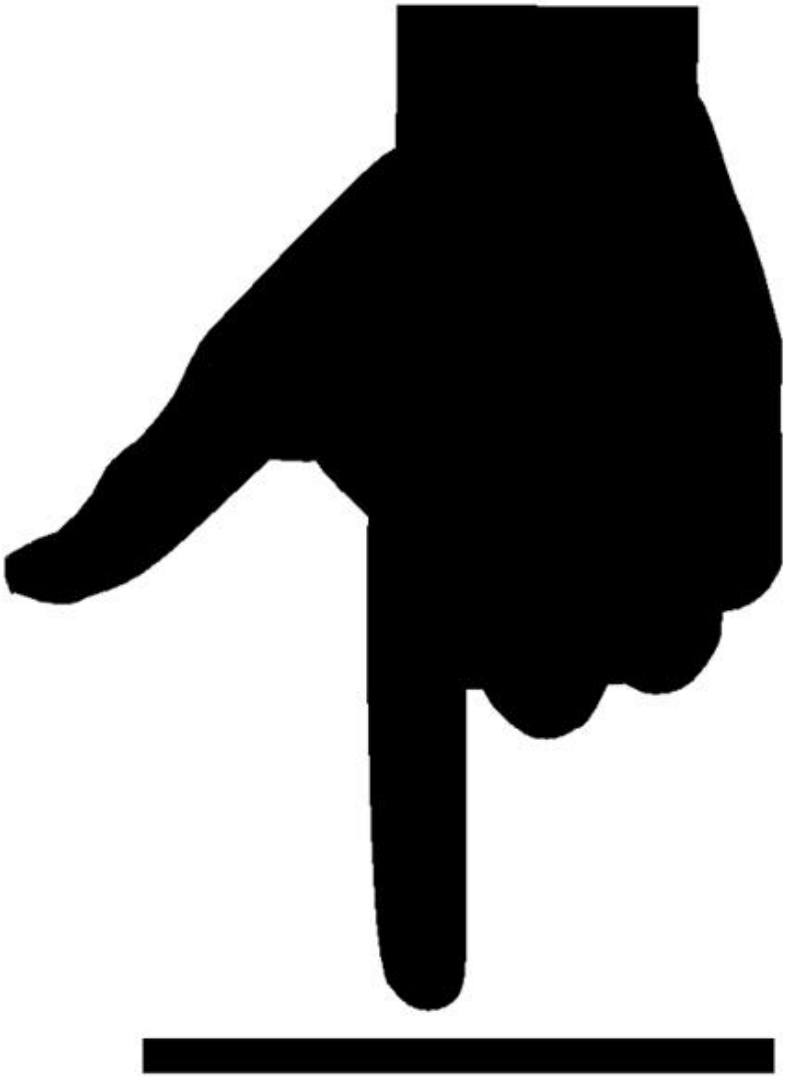


Figure A.5—Touch symbol

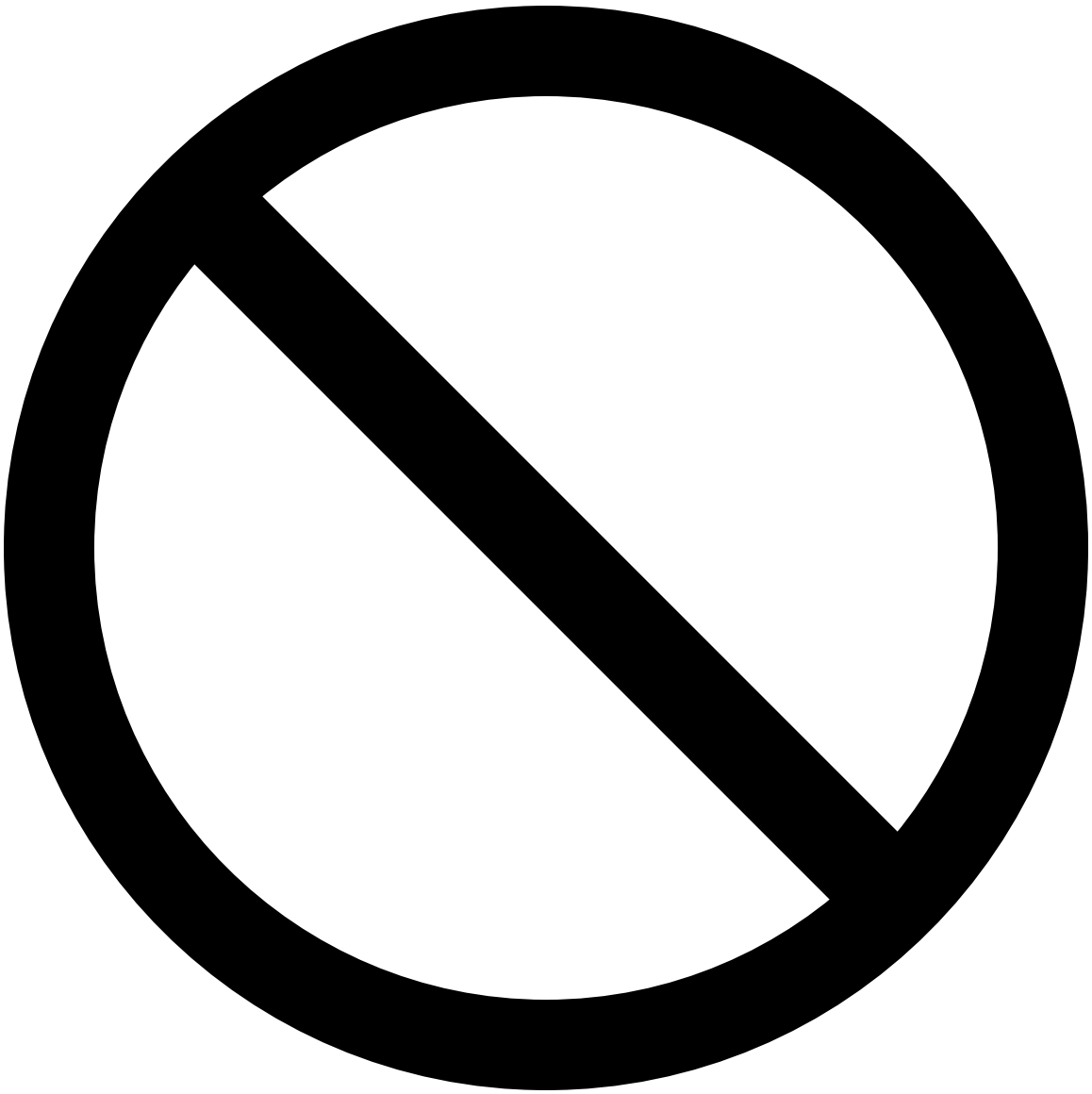


Figure A.6—Circle and bar symbol