



Designation: F3021 – 17

# Standard Specification for Universal Design of Fitness Equipment for Inclusive Use by Persons with Functional Limitations and Impairments<sup>1</sup>

This standard is issued under the fixed designation F3021; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

The goal of this specification is to promote proper design and manufacturing practices for fitness equipment intended for use by persons with functional limitations and impairments. Through these specifications, this standard aims to assist designers and manufacturers in reducing the possibility of injury when these products are used in accordance with the operational instructions.

The equipment user must recognize, however, that the standard alone will not necessarily prevent injuries. Like other physical activities, exercise involving fitness equipment involves the risk of injury, particularly if the equipment is used improperly or not properly maintained. In addition, users with physical limitations should seek medical advice and instruction from the fitness facility prior to using this equipment. Certain physical conditions or limitations may preclude some persons from using this equipment as intended by the manufacturer, and using this equipment may increase the risk of injury.

## 1. Scope

1.1 This specification<sup>2</sup> established additional requirements not set forth in the referenced ASTM standards for the design of commercial fitness equipment to increase access and user independence by people with functional limitations or impairments.

1.2 The intent of this specification is to ensure that the fitness product being designed for inclusive use by individuals with and without functional limitations or impairments remains functional and safe when the equipment is operated according to the manufacturer's operational instructions.

1.3 It is the intent of this specification to specify products for indoor use in a commercial environment by individuals age 13 and above.

1.4 Products designed to meet this specification must not be automatically classified as fit for medical or rehabilitation fitness purposes. Products intended for medical use should comply with any applicable international or national standards.

1.5 Where users are exercising from a wheelchair, it is the intent of this specification to specify products for use by individuals using manual or powered wheelchairs (including scooters) (A1.4.5).

1.6 This standard does not purport to address the needs of every possible user and recognizes that access will not be possible for all individuals or all types<sup>1</sup> of assistive technologies.

1.7 Designers shall use this specification in conjunction with other ASTM fitness equipment standards and its accompanying test method.

1.8 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—Additional specifications applicable to specific pieces of equipment, such as treadmills, bicycles, ellipticals, and strength equipment are currently under development.

1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee F08.30 on Fitness Products.

Current edition approved April 1, 2017. Published July 2017. Originally approved in 2013. Last previous edition approved in 2016 as F3021 – 16. DOI: 10.1520/F3021-17.

<sup>2</sup> This work was funded, in part, by the Rehabilitation Engineering Research Center on RecTech through the National Institute on Disability, Independent Living, and Rehabilitation Research grant #90RE5009-01-00.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

**F1749** Specification for Fitness Equipment and Fitness Facility Safety Signage and Labels

**F2115** Specification for Motorized Treadmills

**F2276** Specification for Fitness Equipment

**F3022** Test Method for Evaluating the Universal Design of Fitness Equipment for Inclusive Use by Persons with Functional Limitations and Impairments

### 2.2 ADAAG:<sup>4</sup>

Americans with Disabilities Act Accessibility Guidelines (ADAAG)

### 2.3 Federal Standard:

**FED-STD-595B** Colors Used in Government Procurement

### 2.4 ISO Standards:<sup>5</sup>

**ISO 845** Cellular plastics and rubbers -- Determination of apparent density

**ISO 2439** Flexible cellular polymeric materials -- Determination of hardness (indentation technique)

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *access, v*—getting at or on fitness equipment or at fitness equipment controls or adjustments.

3.1.2 *assistive technologies, n*—adaptive or rehabilitative devices, or both, for people with disabilities that promote greater independence by enabling people to perform tasks that they were formerly unable to accomplish, or had great difficulty accomplishing.

3.1.2.1 *Discussion*—Assistive technologies include, but are not limited to, wheelchairs, walkers, canes, crutches, prosthetics, alternative communication devices, cell phones, etc.

3.1.3 *audible feedback or instruction, n*—audio voice/speech output.

3.1.4 *color value contrast, n*—the difference in luminance between two or more surfaces seen simultaneously or successively.

3.1.4.1 *Discussion*—In this standard, significant color value contrast is defined as 70 % or more, which is the current best practice.

3.1.4.2 *Discussion*—In this standard, contrast is measured by measuring the luminance (L) of color, as opposed to color hue or saturation.

3.1.5 *control panel/console, n*—equipment/user interface device for controlling the operation of, or displaying information about the operational state of the equipment.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup> Available from the US Access Board, [www.access-board.gov](http://www.access-board.gov), or contact the US Access Board Customer Service at [ta@access-board.gov](mailto:ta@access-board.gov).

<sup>5</sup> Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, <http://www.iso.org>.

3.1.6 *core branding and logo artwork/graphics, n*—equipment supplier logo, artwork, or graphics, or combinations thereof, that promote and market their brand.

3.1.6.1 *Discussion*—Core branding is not to be used within the body of instructional text.

3.1.7 *free weight style exercise bench, n*—an adjustable or fixed seat device that is intended to provide stability during exercise with free weights, generally consisting of a supported, padded area to sit, lean, or recline.

3.1.8 *gripping surface, n*—the area of the hand grips or hand grip bars/rails intended to be grasped by the hands for balance or stability during access, egress, or exercise, or combinations thereof.

3.1.9 *hand grips, fixed, n*—non-movable piece designed to be grasped by the hand(s) for support during access, egress, or exercise, or combinations thereof.

3.1.9.1 *Discussion*—This includes both applied and integral hand grips as defined in Specification **F2276**.

3.1.10 *hand grips, movable*—movable piece designed to be grasped by the hand(s) for support and use during exercise.

3.1.10.1 *Discussion*—This includes both applied and integral hand grips as defined in Specification **F2276**.

3.1.11 *iconography, n*—graphic or pictorial symbols used on consoles or other parts of the equipment to display information.

3.1.12 *impairment, n*—any deficit in psychological, physiological, or anatomical structure or function that has an adverse effect on a person's ability to carry out day to day activities, including health and leisure activities.

3.1.12.1 *Discussion*—An impairment is not a disability if it does not interfere with task performance.

3.1.13 *inclusive, adj*—including people with and without disabilities or impairments, or both.

3.1.14 *incremental weights, n*—additional fractional weights that can be applied in between the main weight plate selections.

3.1.15 *instructions for use, n*—user facing instructions that are affixed to the equipment relating to the use of a piece of equipment, not including core branding or logo artwork, manufacturer's labels, model number labels, or standards or certification marks, or owner's/training manual(s).

3.1.15.1 *Discussion*—For example: Placard, decal panel, or other means.

3.1.16 *labels, n*—information directed at the user to support the use of a specific element of a piece of equipment, not including core branding or logo artwork, manufacturer's labels, model number labels or standards, or certification marks.

3.1.17 *luminance (L), n*—value or lightness on a scale ranging from black to white of light reflected off a surface measured in candela per meter squared (cd/m<sup>2</sup>).

3.1.18 *main controls, n*—quick start, start, stop, enter, clear, numeric digits 0 to 9, increase resistance/level, decrease resistance/level, increase speed, decrease speed, increase gradient/incline, decrease gradient/incline, audio on/off, and any other functions, for example, emergency or safety stops, considered essential for the use of the equipment.

3.1.18.1 *Discussion*—See [Appendix X1](#) for suggested universal design symbols for main control functions.

3.1.19 *mobility aids, n*—any device used to assist in balance, transfer, or locomotion.

3.1.20 *movable seat, n*—a seat which can be moved away from the primary exercise position where the entire seat structure remains attached to the main structure of the equipment.

3.1.21 *postural supports, n*—integral element to the equipment which assists in holding the user in position during exercise.

3.1.22 *quick start, n*—one push mechanism that starts the equipment in manual mode at the minimal speed or resistance that is specified in the standard for the specific piece of equipment.

3.1.23 *removable seat, n*—a seat that can be moved away from the primary exercise position where the entire seat structure can be removed or separated from the remaining structure of the equipment.

3.1.24 *sans serif, n*—without any short lines stemming from or at an angle to the upper and lower ends of the strokes of a letter.

3.1.24.1 *Discussion*—For example: Times New Roman is a serif font where as Arial, Helvetica, and Calibri are sans serif fonts.

3.1.25 *seated cardio equipment, n*—recumbent cardio fitness equipment performed from the seated position, such as recumbent ellipticals, recumbent steppers, recumbent cycles, and total (upper and lower extremities) body and upper body ergometers.

3.1.25.1 *Discussion*—An upright cycle is not seated recumbent cardio equipment.

3.1.26 *skids, n*—a mechanism for moving equipment by sliding across the floor without wheels.

3.1.27 *swivel seat, n*—a seat that rotates horizontally about a vertical axis as if on a pivot.

3.1.28 *tactile, adj*—of, or relating to, or proceeding from, the sense of touch.

3.1.29 *transfer, v*—the action of getting onto (access) or off of (egress) a piece of fitness equipment, particularly from a wheelchair or other mobility aid.

3.1.30 *transfer surface, n*—area of the static or moving surface, or both, that is clear of any obstruction that would impede normal foot placements or motion, or both, and therefore is accessible for normal use.

3.1.31 *wheelchair, n*—device to provide wheeled mobility with seating support system for a person with mobility impairment, including manual wheelchairs which are powered by the user and electrically powered wheelchairs which are powered by a motor.

3.1.31.1 *Discussion*—A walking aid with wheels is not a wheelchair.

3.1.31.2 *Discussion*—A scooter is an electrically powered wheelchair.

## 4. Color Value Contrast

### 4.1 *Color Value Contrast Criteria Background:*

4.1.1 For the purpose of this standard, significant color value contrast is defined to be a value greater than or equal to 70 %.

4.1.2 The following applies to these sections within the document:

4.1.2.1 Integral surfaces and separate steps/frame (see [5.1.1.7](#)).

4.1.2.2 Element of the equipment where the user is required to step over/adjacent surface (see [5.1.1.21](#)).

4.1.2.3 Seats/primary adjacent surface (see [5.1.2.12](#)).

4.1.2.4 Adjustment mechanisms/adjacent surface (see [5.1.3.8](#)).

4.1.2.5 Markings/adjacent surface (see [5.1.3.12](#)).

4.1.2.6 Intended gripping surfaces of all hand grips/adjacent surface (see [5.1.4.4](#)).

4.1.2.7 Test, iconography, and a minimum of the border of the main instruction panel/adjacent surface (see [5.1.6.7](#)).

4.1.2.8 Inclusive fitness symbol/adjacent surface (see [5.1.6.8](#)).

4.1.2.9 Text, iconography, and a minimum of the border of the main control buttons/adjacent surface (see [5.2.4.3](#)).

4.1.2.10 Numeric readouts relating to the main controls/adjacent surface (see [5.2.6.2](#)).

4.1.2.11 Audio headphone jack (socket) symbol/adjacent surface (see [5.2.7.8](#)).

4.1.2.12 Information button symbol/adjacent surface (see [5.2.7.14](#)).

4.1.3 The US Access Board’s Americans with Disabilities Act Accessibility Guidelines (ADAAG) for signage specifies that signage is “more legible for persons with low vision when characters contrast with their background by at least 70 percent” ([A1.4.1](#)). The calculation of contrast is determined by:

$$\text{Color Value Contrast} = [(L1 - L2)/L1] \times 100 \quad (1)$$

where

*L1* = luminance (L) of the lighter area

*L2* = luminance (L) of the darker area

NOTE 2—It is a best practice to choose color pairs that have a color value contrast of greater than 80 % due to the approximately 10-point reproducibility limit for color pairings close to 70 % color value contrast found in the ASTM interlaboratory study. See Test Method [F3022](#) for more information on the test method and interlaboratory study results.

### 4.2 *Color Definitions:*

4.2.1 There are three basic properties of color: Hue (the color), Saturation (or intensity), and Lightness (or value). See [Fig. 1](#).

4.2.1.1 *Hue* refers to what is commonly called color, for example, red, green, blue-green, orange, etc.

4.2.1.2 *Saturation* refers to the richness of a hue as compared to a gray of the same lightness or value; in some color notation systems, saturation is also known as chroma.

4.2.1.3 *Lightness (or Value)*, of a light source or the lightness of an opaque object is measured on a scale ranging from dim to bright for a light source or from black to white for an opaque object (or from black to colorless for a transparent object). In some systems, lightness is called value.

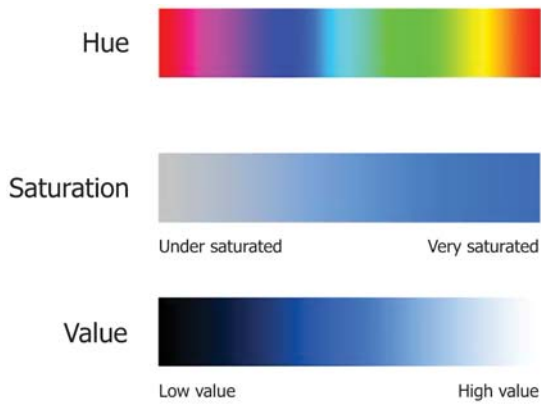


FIG. 1 Hue, Saturation, Value

4.2.2 Color value contrast in this standard is defined as the light to dark (or value) contrast since this is the characteristic that can be seen by most of the population, including people that are completely color blind.

4.2.2.1 *Luminance*—The measurement of reflected light is called luminance. Luminance is “the amount of visible light leaving a point on a surface in a given direction...due to reflection,” or the perceived or apparent brightness of a surface (A1.4.2). The standard unit of luminance is candela per square meter ( $\text{cd}/\text{m}^2$ ), also called nits. Luminance is measured using a reflective light meter, a technology that measures light within the visible spectrum.

4.2.2.2 *Illuminance*—The measurement of incident light is called illuminance. Illuminance is the total luminous flux incident on a surface, or the “quantity of light...falling on a unit area of a surface” (A1.4.3). The standard unit of luminance is lux (lx). Illuminance is measured using an incident light meter—a technology that measures light within the visible spectrum.

4.3 *Spot Luminance Meter Technology*—The ADAAG does not specify the technology or methodology to measure the luminance values in Eq 1. At the time this standard was written, at least one simple, low-cost technology solution had been identified: a spot meter designed for the photography and cinematography industries. An alternate technology, a spectrophotometer was investigated; however, its cost and complexity made it an unrealistic option. Spot meter technology measures color value, not hue, by measuring luminance, measures small areas, is economically priced, is portable, and uses light within the existing environment. The Sekonic L-758CINE meter was used at the time this document was written because it functions not only as a spot luminance meter, but also as an incident light meter that measures illuminance (in lux or footcandles) using a retractable lumisphere.<sup>6</sup> Any spot luminance meter or incident light meter, or both, combinations that meet the following specifications may be used:

<sup>6</sup> The sole source of supply of the apparatus known to the committee at this time is B&H Photo Video, 420 9th Ave, New York, NY 10001, www.bhphotovideo.com. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,<sup>1</sup> which you may attend.

4.3.1 Digital exposure meter with 1° spot viewfinder for ambient light readings of reflected light; the same meter or a separate meter can be used to measure incident light. Repeatability accuracy shall be  $\pm 0.1$  EV or less. Informative range and units for measurements are:

4.3.1.1 *Measured with Spot Meter*—Brightness: 0.25 to 190 000  $\text{cd}/\text{m}^2$  (to two significant digits).

NOTE 3—A small range will limit the lighting conditions that can be measured in the field.

NOTE 4—Limited research has been done using meters other than the Sekonic L-758CINE. Future research should include other meters.

4.3.1.2 *Measured with Incident Light Meter*—Illumination: 0.63 to 190 000 lux (to two significant digits).

NOTE 5—Further information on the specifications for spot luminance meters can be found in the test method that accompanies this standard, Test Method F3022.

## 5. Design and Construction Requirements

### 5.1 General Requirements:

#### 5.1.1 Access and Setup:

5.1.1.1 Easy access, egress, and transfer to get into and out of the correct start position shall not be impeded by the frame or other structural parts of the equipment, or both. This includes equipment with removable/movable seats, where the seat has been removed/moved.

NOTE 6—This specification refers to the equipment design only. It does not refer to equipment placement within the facility, which is beyond manufacturer’s control (see the US Access Board Accessible Sports Facilities Guidelines for best practice of fitness facility equipment layout) (see A1.4.4).

5.1.1.2 Access and egress should be possible from the maximum number of approach positions (for example, front, rear, or side), avoiding left/right bias where practicable.

NOTE 7—Some pieces of fitness equipment, such as the leg press, will have points of entry that are not possible due to the weight stack placement. Control panels/conssoles where necessary for exercise or for use, such as on a treadmill, will also prohibit access from all paths of entry.

5.1.1.3 The maximum step-on height onto a transfer surface should be no higher than 170 mm (6.7 in.) from the ground, measured with the equipment in the neutral position with 0 % grade/zero incline.

5.1.1.4 Where the user is required to step over supporting framework to access equipment, the maximum step-over height should be no higher than 400 mm (15.7 in.) measured from the ground to the highest point of the framework for a minimum width of 300 mm (11.8 in.) in the primary step-over position.

5.1.1.5 Where maximum step-on or step-over heights are exceeded, an integral surface or separate step shall be provided to reduce these heights to a maximum of 170 mm (6.7 in.) or 400 mm (15.7 in.), respectively.

NOTE 8—Only one transfer step is allowed per piece of equipment.

5.1.1.6 Integral surfaces and separate steps shall have a minimum length of 500 mm (19.7 in.), a minimum width of 300 mm (11.8 in.), and a maximum height of 170 mm (6.7 in.).



5.1.1.7 Integral surfaces and separate steps shall have a significant color value contrast from the adjacent surface of the equipment that they are primarily seen against. (as defined in 4.1).

NOTE 9—Consideration should be given to both light and dark colors for contrast with different floor surface.

5.1.1.8 Separate steps shall have a means of preventing unintentional movement during use and appropriate mechanisms, for example, wheels/skids and hand grips/gripping surface, to enable the step to move easily over different floor surfaces. Movement or removal shall not require the user to lift the step fully unless it weighs less than 7.5 kg (16.5 lb).

5.1.1.9 Seated cardio equipment shall have integral back support.

NOTE 10—Table top ergometers are exempt from this criteria.

5.1.1.10 Seated cardio equipment with back support must be walk through in design with the walk through structure no higher than 125 mm (4.9 in.).

NOTE 11—Walk through is an integral part of the design that allows the user to step through the structure of the equipment to access the exercise position as opposed to having to step over a centerpiece.

NOTE 12—Refer to ASTM Standards for specific walk through dimensions that may deviate from this criteria, such as Ellipticals.

NOTE 13—Rowing machines are exempt from this walk through criteria.

5.1.1.11 Walk through equipment shall have a minimum transition area box from the seat when adjusted in mid-position to the framework directly in front of the seat of 300 mm (11.8 in.) wide by 635 mm (25.0 in.) high across the entire step through structure.

5.1.1.12 Seated cardio equipment seat position shall be adjustable forwards and backwards through a range of at least 300 mm (11.8 in.).

NOTE 14—Table top ergometers are exempt from this criteria.

5.1.1.13 Seated total body cardio equipment which enables upper limb function/movement to aid lower limb function/movement shall have a swivel seat.

NOTE 15—Recumbent cycles and rowing machines are exempt from this requirement.

(1) Swivel seats shall automatically lock in the center position (primary exercise position). Swivel seats shall rotate and lock into position at a minimum of 45° and 90° to the right of center (primary exercise position) and 45° and 90° to the left of center.

NOTE 16—It is recommended to have as many rotating and locking positions as possible to increase access.

5.1.1.14 When adjusted in its most forward (lowest/shortest) position, seated cardio equipment seat height shall be a maximum height of 640 mm (25.2 in.) when measured from the ground to the top of the seat surface.

NOTE 17—Table top ergometers are exempt from this criteria.

5.1.1.15 Cardio equipment that can be operated by both the upper and lower body shall have an adjustment mechanism that

locks the foot and hand supports in place in order to facilitate placement of the feet/hands in position during mounting/dismounting.

5.1.1.16 For seated cardio equipment, fixed hand grips shall be provided (see 3.1.9).

NOTE 18—Table top ergometers are exempt from this criteria.

5.1.1.17 Foot platforms/pedals shall have adjustable toe retention, for example, straps, through a range of shoe sizes. Toe straps may be permanently fixed or detachable.

NOTE 19—Consideration should be given to user foot sizes from 5 % female to 95 % male.

NOTE 20—Detachable straps shall comply with 5.1.3.7.

5.1.1.18 Foot supports shall have a minimum length 300 mm (11.8 in.) and width 150 mm (5.9 in.).

5.1.1.19 For seated cardio equipment, foot supports shall have foot retention, for example, raised guard, with a minimum height of 30 mm (1.2 in.) for a minimum of 80 % along the inside edge and 12 mm (0.5 in.) along a minimum of 80 % of outside edge.

NOTE 21—This clause does not apply to pedals. Pedals are not considered foot supports.

5.1.1.20 For seated cardio equipment, foot supports shall have a mechanism for heel retention, for example, rear raised guard or strap, with a minimum height of 30 mm (1.2 in.).

5.1.1.21 To highlight potential trip hazards, an element of each part of the equipment where the user is required to step over or around shall have significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in 4.1).

NOTE 22—Trip hazards include step over structures on walk through equipment and structure that protrudes outside the footprint of the main body of the equipment.

5.1.1.22 Foot support/pedal heel and toe retentions shall have significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in 4.1).

5.1.2 *Seats, Sitting Surfaces, and Back Supports:*

5.1.2.1 Seats/sitting surfaces shall have minimum dimensions of 380 mm (15.0 in.) width at the widest point and 255 mm (10.0 in.) depth at the centerline of the seat. For seats used in conjunction with a back support, the seat angle shall be a minimum of 5°, with the front edge of the seat higher than the rear.

5.1.2.2 Fixed seats shall have a maximum height of 450 mm (17.7 in.) from the ground to the highest point of the seat. Where the maximum fixed seat height is exceeded, an integral surface or separate step that complies with the requirements described in 5.1.1.6 – 5.1.1.8 shall be provided to reduce the height to a maximum of 450 mm (17.7 in.).

5.1.2.3 For lower or upper body equipment that has adjustable seat heights, the adjustable height shall include a fixed seat height option in the range from 430 to 485 mm (16.9 to 19.1 in.).

5.1.2.4 Seated upper body equipment shall have an adjustable height seat.

NOTE 23—Upper body torso and back extension types of equipment are

exempt from these criteria.

5.1.2.5 Seated upper body equipment shall have a removable/movable seat which, when removed/moved, creates an accessible clear space of a minimum of 1300 mm (51.2 in.) length by 750 mm (29.5 in.) width by 975 mm (38.4 in.) height which is also free of physical obstructions above the height of 15 mm (0.6 in.) in the remaining floor area to prevent trip hazards.

NOTE 24—Removable seats should have a storage position to safely keep it out of the clear space.

NOTE 25—Upper body torso and back extension types of equipment are exempt from these criteria.

5.1.2.6 When the seat is in the removed/moved position on upper body pressing equipment with an integral back support, for example, chest and shoulder press, there shall be a minimum distance of 300 mm (11.8 in.) between at least one of the start positions of the hand grips designed for wheelchair use and the back support of the specific fitness equipment.

NOTE 26—This is to allow for the design of wheelchairs which have a brace behind their back support of the wheelchair to adopt a non-stressed start position.

NOTE 27—A broader range of start positions is desirable to accommodate a larger range of wheelchair users and users with limited shoulder mobility.

NOTE 28—This space shall also be clear of any horizontal protrusions above floor height that may pose a danger for persons with impairment due to sharp edges that may impede access for wheelchair users trying to achieve a correct exercise start position.

5.1.2.7 Removable/movable seats shall have appropriate mechanisms, for example, wheels or skids and hand grips or gripping surfaces, to enable the seat to move easily over different floor surfaces and a means of preventing unintentional movement during use (see Fig. 2). Seats which retain no permanent fixing to the equipment once removed shall have a hand grip(s) in an appropriate position to assist with moving them to/from the main structure of the equipment. Any



FIG. 2 Example of a Movable Seat

movement or removal shall not require the user to lift the seat fully unless the force required to move it weighs less than 7.5 kg (16.5 lb).

5.1.2.8 For removable/movable seats on products intended to have a specific exercise position, a physical locating or locking mechanism or a visual reference shall be provided to indicate the correct seat alignment (see Fig. 3).

NOTE 29—Where in Left the grey upholstery stripes provide a visual reference for the correct seat and back support alignment and in Right the head support provides a physical locating mechanism for the correct back and head support alignment (since the back support cannot be physically moved back any further).

5.1.2.9 Where a free weight style exercise bench is provided with equipment and where the movement path is primarily defined by the user, for example, adjustable or high/low pulley equipment, it shall be a minimum width of 380 mm (15.0 in.) at the hip/pelvic support area and a minimum length of 450 mm (17.7 in.) for seated benches and 1200 mm (47.2 in.) for prone/supine benches.

NOTE 30—Prone is the exercise position of lying face down while supine is face up.

NOTE 31—These benches are exempt from Specification F3021 adjustable height requirement.

5.1.2.10 Integral back supports shall have a minimum width of 180 mm (7.0 in.) for a continuous minimum height of 500 mm (19.7 in.).

5.1.2.11 All postural supports/surfaces shall be cleanable and padded to a minimum depth of 12.7 mm (0.5 in.) of foam. The manufacturer shall disclose the thickness of the padding, the density of the padding per ISO 845 with a minimum of 75 kg/m<sup>3</sup>, and the hardness per ISO 2439 with a minimum of 315 N (70.81 lbf).

5.1.2.12 Seats shall have significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in 4.1).

NOTE 32—Consideration should be given to both light and dark colors for contrast with different floor surfaces.

### 5.1.3 Adjustment Mechanisms:

5.1.3.1 Adjustment mechanisms required for set up shall be visible in a clear line of sight to the user when approaching the equipment or from the primary exercise position, or both, as seen from a 5 % female to 95 % male sitting height (refer to Table 1 “Dimensions of US Civilian Male and Females” in Test Method F3022).

5.1.3.2 Left/right hand bias of adjustment mechanisms required for set up shall be avoided.

NOTE 33—Weight stack(s)/resistance selection is excluded from the requirement for left/right hand bias, provided the resistance can be selected with either hand before mount or from the primary exercise position, or both.

5.1.3.3 Adjustment mechanisms required for set up shall not require the simultaneous use of two hands.

NOTE 34—Users with use of one hand may use body weight or other body parts (for example, shoulder) to facilitate adjustment.

NOTE 35—Interchanging detachable hand grips using carabiners (see Fig. 4) are exempt.

NOTE 36—Adjustment mechanisms for crank upper/lower body locking mechanisms are exempt.



FIG. 3 Example of a Physical Locating Mechanism



FIG. 4 Example of D-Shaped Carabiner

5.1.3.4 Adjustment mechanisms required for set up shall be easy to reach, use, insert, or remove, or combinations thereof, not requiring fine finger control, excessive wrist rotation, tight grasp, or a pinch grip.

5.1.3.5 The force required to activate adjustment mechanisms shall not exceed 30.0 N (6.7 lbf).

5.1.3.6 Assemblies that are intended to be adjusted by a mechanism shall function in a controlled manner and not free fall when being adjusted or when released, for example, there must be a mechanism that engages in the next available position when the adjustment is released.

NOTE 37—Example: The carriage that adjusts for handle height on cable products is an assembly and the pin which the user manipulates is the adjustment mechanism.

5.1.3.7 Detachable controls and adjustments shall be tethered where structure permits without interfering with access, egress, or performance of the exercise or have a storage position on the framework of the equipment.

5.1.3.8 Adjustment mechanisms shall have significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in 4.1).

5.1.3.9 Fixed position settings on adjustments shall be clearly identified with distinctive markings, for example, numbers, letters, or symbols, where more than three positions are available. The raised iconography shall not be solely in Braille.

NOTE 38—Adjustments which lock the user into position and cannot be preset before adopting the exercise position, for example, knee clamps on a lat pull down or seated leg curl, are excluded.

NOTE 39—Braille may be added in addition to other raised iconography.

5.1.3.10 Adjustment markings shall be in a sans serif, non-italic font, and shall be a minimum height of 15 mm (0.6 in.).

NOTE 40—Incremental weight markings may be a minimum height of 10 mm (0.4 in.) if the size of materials and proximity of adjustment settings precludes 15 mm (0.6 in.).



5.1.3.11 Adjustment markings shall be tactile and have a minimum raised height of 0.4 mm (0.016 in.) from the background surface, except where there is an interference fit where laser cut, deep engraved, or molded in relief markings are acceptable.

NOTE 41—The preference for relief markings would be laser cut if possible, followed by deep engraved or molded.

5.1.3.12 Adjustment markings shall have significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in 4.1).

#### 5.1.4 *Hand Grips:*

5.1.4.1 Fixed hand grips or other appropriate structural components, for example, sufficiently wide seat with a built-in grip underneath the edges, shall be provided in proximity according to 5.1.4.2 to sitting surfaces to assist with transfer for a minimum length of 150 mm (5.9 in.). Hand grips shall be designed in accordance with Specification F2276.

NOTE 42—Fixed means fixed relative to the seat, for example, the grips on the side of a leg press may move with the seat.

5.1.4.2 Fixed hand grips provided adjacent to sitting surfaces shall be flush or below the horizontal seat height so as not to interfere with transfer during access/egress, with the inside edge of the hand grip position 45 to 60 mm (1.8 to 2.4 in.) from the outside edge of the seat for a minimum length of 150 mm (5.9 in.).

NOTE 43—This clause is to ensure that there is sufficient gap to get a hand in and fingers around the grip but not too far apart where it is not a functional reach during a transfer.

5.1.4.3 The intended gripping surface of all hand grips shall have a circumference of 100 to 150 mm (3.9 to 5.9 in.), minimum length of 150 mm (5.9 in.), should be optimized in shape to facilitate grip, and of suitable material to reduce slippage. Where movable hand grips are used dynamically during exercise, they should be round or oval in design.

5.1.4.4 The intended gripping surfaces of all hand grips shall have a significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in 4.1).

5.1.4.5 Movable gripping surfaces, that is, active or dynamic hand grips, shall have a different color (hue) or contrast pattern from fixed gripping surfaces so that movable gripping surfaces are always distinguishable from fixed gripping surfaces.

#### 5.1.5 *Instructions for Use:*

5.1.5.1 Instructions for Use shall be available for users in an accessible electronic format, for example, a CD-ROM or website download with documents in PDF format.

NOTE 44—The document needs to be in a format that can be made more accessible to the visually impaired, that is, readable with screen readers, text enlargement, audio, etc.

NOTE 45—Manufacturers need to provide alternative format upon request.

5.1.5.2 Owner's/training manual(s) shall be available in an accessible electronic format, for example, a CD-ROM or website download with documents in PDF format.

#### 5.1.6 *Labeling Requirements:*

5.1.6.1 The material(s) used for the instruction panel(s) shall be printed on a matte or non-glare finish and it shall not be translucent.

NOTE 46—The material shall be heavy enough to prevent “show through” of housing details such as seams or fixings.

5.1.6.2 Printed text on all instruction panels and labels shall be a minimum height of 2 mm (0.08 in.) for the smallest lower case letter.

5.1.6.3 Sentence case (not block capitals), sans serif, and non-italic fonts shall be used for main headings and body text elements of the instruction panel(s), with the exception of core branding and logo artwork/graphics.

NOTE 47—This sentence is defined as sentence case; generally only the first word is capitalized in sentence case.

5.1.6.4 All text shall be aligned left and unjustified and shall remain horizontal without flowing around graphic elements or images, with the exception of core branding and logo artwork/graphics.

5.1.6.5 The spacing between words and characters shall be increased by a minimum of 20 % from standard font spacing and the spacing between lines shall be a minimum of 1.5 times the standard font space between the words on a line, with the exception of core branding and logo artwork/graphics.

5.1.6.6 If an arrow is used to provide direction to a specific component, then the arrow shall be positioned in between the instructions and the component, with the arrow pointing to the component.

5.1.6.7 Text, graphics, and at a minimum, the edge or border of each main instruction panel/label shall have significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in 4.1).

NOTE 48—Core branding and logo artwork/graphics are exempt.

5.1.6.8 Equipment intended for inclusive access may have an inclusive fitness symbol (see Fig. 5).

NOTE 49—The symbol may be placed within 100 mm (3.9 in.) of the instruction panel on the equipment.

(1) The inclusive fitness symbol shall be a minimum width through the centerline of 20 mm (0.79 in.).

(2) The inclusive fitness symbol shall be white in color with a FED-STD-595B blue #15180 background, and the blue and white shall have significant color value contrast.

(3) The inclusive fitness symbol white shall have significant color value contrast from the adjacent surface surrounding a minimum of 15 mm (0.6 in.) from the entire outside edge of the symbol to the equipment part that they are primarily seen against (as defined in 4.1 and shown in Fig. 6).

(4) The inclusive fitness symbol shall comply with 5.2.5.1 tactile requirements for main controls.

(5) The inclusive fitness symbol shall comply with 5.2.5.4 raised iconography requirements.

5.2 *Control Panels/Consoles*—Control panels shall meet the following specifications in addition to Specification F2276.

#### 5.2.1 *General Positioning:*

5.2.1.1 To allow easy access to the main controls from the primary exercise position, control panels/conssoles shall be





FIG. 5 Inclusive Fitness Symbol

located in a clear line of sight in front of the user with no physical obstruction to interfere with access.

NOTE 50—Designs should take into account height and reach use by persons with reduced core stability, trunk, and shoulder mobility, etc. They should consider all exercise positions listed in the Owner’s Training/Manual or Instructions for Use, including both standing and seated positions, if appropriate.

NOTE 51—For list of defined main controls, see Section 3.

5.2.1.2 Left/right hand bias of main controls should be avoided when setting up the equipment. The center of the main control buttons shall be located within 180 mm (7.1 in.) of the centerline of the control panel/console in both the horizontal and vertical planes to eliminate left/right hand bias or the main control buttons must be repeated on both sides.

NOTE 52—If the main control buttons are located within the centerline or repeated on both sides of the control panel/console in accordance with 5.2.1.2, then there is no restriction on placement of any additional duplication of controls.

5.2.1.3 Control panels/conssoles main controls shall have grouping/pairing of similar main operational controls.

NOTE 53—Example: Increase and decrease speed controls on a treadmill are an example of similar operational controls.

NOTE 54—This does not apply to start and stop controls where placement in close proximity could cause a safety issue.

### 5.2.2 Button Requirements:

5.2.2.1 Individual buttons shall be used for all available main controls, including those which are repeated or built into hand grips or other parts of the equipment other than the main control panel/console.

NOTE 55—Rocker type switches in which both individual buttons meet all other button specifications are allowed. For example, a rocker switch could increase grade when activated on the right hand side and decrease grade when activated on the left hand side.

NOTE 56—Rocker type switches are not allowed for either start or stop buttons.

5.2.2.2 A quick start button shall be provided and be labeled as “Quick Start,” or something similar (“Start,” “Go,” etc.) using words or iconography, or both.

5.2.2.3 Power driven equipment shall be activated by means of a single push/press of a start button that shall start the equipment in manual mode at the lowest default speed or equivalent.

NOTE 57—See specific requirements in the relevant standard, for example, Specification F2115.

5.2.2.4 Incremental increase or decrease in the main control functions, for example, speed, gradient/incline, level or equivalent settings, shall have an option that is achievable through a single actuation of a device in compliance with 5.2.5.5.

NOTE 58—Speed scrolling by holding down the button is acceptable in addition to individual button presses.

5.2.2.5 Quick start and stop controls shall have a minimum button diameter or equivalent width and height of 25 mm (1.0 in.). Other main control buttons shall have a minimum button diameter or equivalent width and height of 20 mm (0.08 in.).

### 5.2.3 Labeling Requirements:

5.2.3.1 All text shall be sans serif, non-italic fonts, and sentence case.

NOTE 59—Seven-segment displays are exempt from sentence case where this is not possible.

NOTE 60—Signal words complying with Specification F1749 are excluded.

NOTE 61—Example: This sentence is defined as sentence case; generally, only the first word is capitalized in sentence case.

5.2.3.2 All text on labels/signage on the front of the console shall be a minimum height of 2 mm (0.08 in.) for the lowercase letter height and 3 mm (0.12 in.) for the capitalized letter height. All main controls shall have a label indicating the button function on or in close proximity to the button in a minimum font size of 4 mm (0.16 in.) for the lowercase letter height and 5 mm (0.20 in.) for the capitalized letter height.

NOTE 62—This standard requires a larger font size for text on the main controls to address the needs of users with visual impairment. The font size for all other text is also slightly larger than Specification F1749 as this standard was based on the recommendations of the Royal National Institute of Blind People (RNIB) Guidelines in the UK and where 12/14

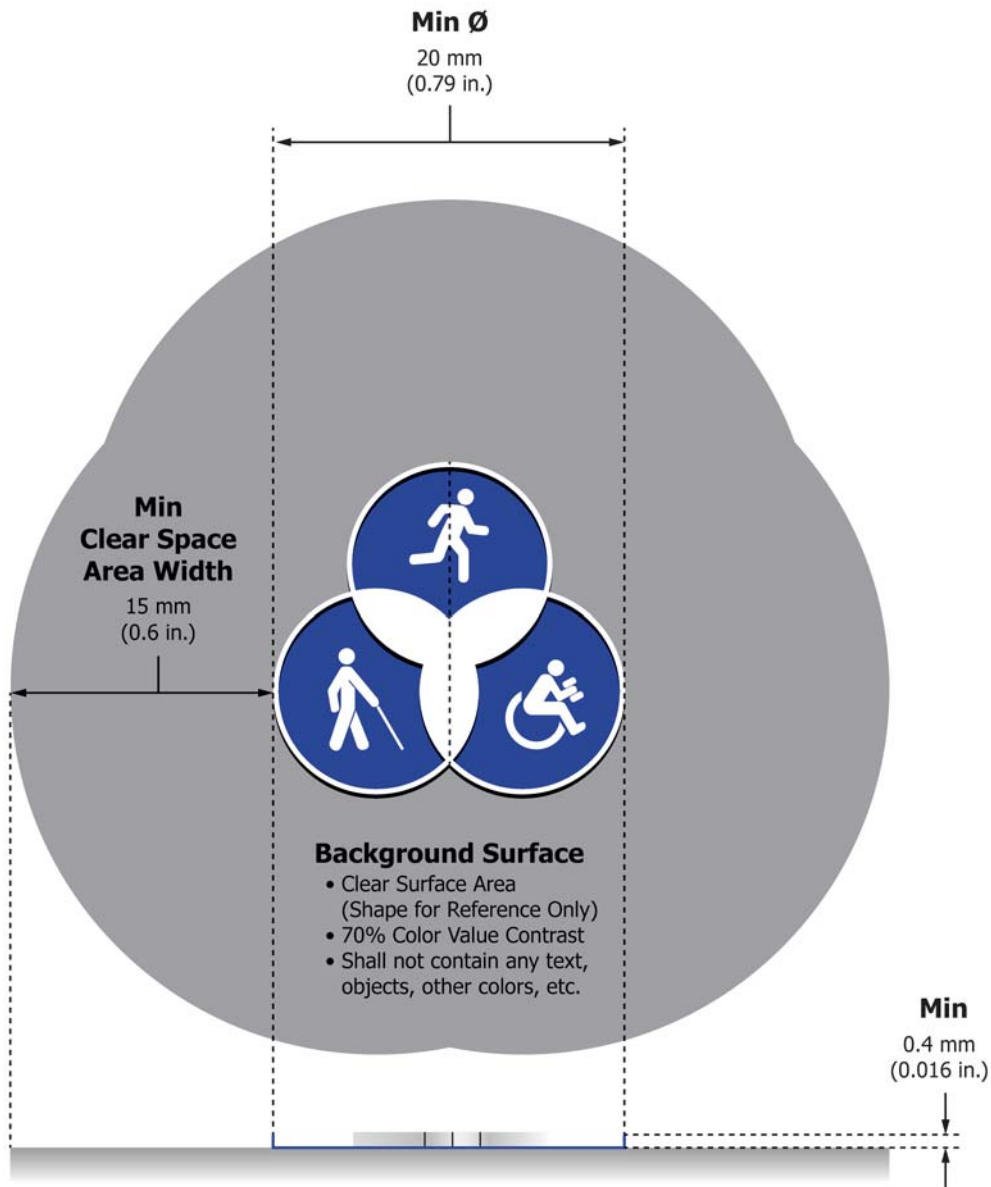


FIG. 6 Inclusive Fitness Symbol – Color Value Contrast

point font size equates to 2 mm lower case and 3 mm upper case.

**5.2.4 Color Requirements:**

5.2.4.1 All start controls shall incorporate the color green into either the background or text and all stop controls shall incorporate the color red.

5.2.4.2 Unified color coding shall be applied to the following main control pairs: increase/decrease resistance or level, increase/decrease speed, and increase/decrease gradient or equivalent. Different colors should be adopted for each control pair. Color codes shall not use green or red where they are already being used for start and stop controls.

5.2.4.3 Text, iconography, and a minimum of the border of the main control buttons shall have significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in 4.1).

NOTE 63—This also applies to main controls located away from the

main console, for example, main controls located on hand grips or other parts of the equipment.

**5.2.5 Tactile Requirements:**

5.2.5.1 To allow identification of the button location, all main controls shall have a tactile border with a minimum raised height of 0.4 mm (0.016 in.) or the whole button shall be raised with a minimum height of 2 mm (0.08 in.) from the background surface.

5.2.5.2 To allow identification of the button function, all main controls shall have simple and easily differentiated raised iconography, for example, raised distinctive texture, characters, or text (maximum 2 characters used as a symbol), contained within the button, which shall be a minimum size of 10 mm (0.4 in.). Iconography shall be a minimum raised height of 0.4 mm (0.016 in.) from the background surface.

NOTE 64—Numeric keypads are exempt from this requirement if a

standard calculator or telephone layout is provided in which case only the number 5 requires raised iconography from which subsequent navigation can occur.

NOTE 65—See [Appendix X1](#) for suggested universal design symbols for main control functions.

5.2.5.3 Raised text of more than two characters in length shall have a minimum font size of 11 mm (0.4 in.) for lower case letter height and a minimum font size of 15 mm (0.16 in.) for the capitalized letter height. The raised iconography shall not be solely in Braille.

NOTE 66—Braille may be added in addition to other raised iconography.

5.2.5.4 Raised iconography shall be durable and shall remain at the minimum height after cycle testing to the applicable product standard.

NOTE 67—Specification [F2115](#) states that switches that activate the treadmill for a commercial application must pass a minimum of 48 600 cycles. A product intended for use as defined in this standard would be required that the raised iconography meet the minimum requirements after 48 600 cycles.

5.2.5.5 Tactile or kinesthetic feedback, for example, a click or responsive feel to the actuation, or audio feedback, or both, shall be provided on main controls to indicate successful activation.

5.2.5.6 Main control buttons shall not be touch or close proximity sensing controls, for example, capacitive touch sensors, etc., in order to prevent accidentally activating buttons from touch.

NOTE 68—Touch or close proximity sensing controls are those that can be activated by light touch, such that would occur when a person with visual impairment scans the control panel with their finger tips for user orientation of button options and layout.

### 5.2.6 *Visual Feedback Requirements:*

5.2.6.1 Numeric readouts, for example, LED/LCD, on the display related to the main controls shall have a minimum font size of 10 mm (0.4 in.) and be labeled to indicate function, for example, speed, time, or distance, and the correct unit of measurement should be displayed.

5.2.6.2 Numeric readouts relating to the main controls shall have significant color value contrast from the adjacent surface of the equipment that they are primarily seen against (as defined in [4.1](#)).

5.2.6.3 Where scrolling or scanning type feedback is used, each segment shall remain static for a minimum of 3 s.

5.2.6.4 Visual feedback concerning performance shall be provided numerically at the end of exercise. The display shall continue to function to provide feedback for a minimum of 5 s after exercise has stopped.

5.2.6.5 For power driven equipment, visual feedback, for example, a light or 3–2–1 countdown, and non-visual feedback, for example, auditory through headphones, shall be provided immediately prior to the moving surface starting and stopping for all programs.

NOTE 69—If the stop is manually activated by the user, then it is exempt from the visual and non-visual feedback requirement.

### 5.2.7 *Audible Feedback Requirements:*

NOTE 70—See [Appendix X2](#) flowchart for reference to [5.2.7](#).

5.2.7.1 Equipment with a console shall be equipped with a standard US 3.5 mm (0.14 in.) audio headphone jack (socket).

5.2.7.2 Audio headphone jacks (sockets) shall be located within 180 mm (7.09 in.) of the vertical centerline of the console and within 25 mm (0.98 in.) of the lower edge of the console line of tangency closest to the user.

5.2.7.3 Audio headphone jacks (sockets) shall be located a distance greater than 50 mm (1.97 in.) from the following main control buttons where present on the equipment: start, quick start, speed, incline or resistance, stop, and emergency or safety stop.

5.2.7.4 Audio headphone jacks (sockets) shall have a tactile border with a minimum raised height of 0.4 mm (0.016 in.).

5.2.7.5 Audio headphone jacks (sockets) shall have a headphone symbol adjacent to the jack.

(1) If the symbol is placed on a different plane/surface, then the maximum distance from the headphone jack to the symbol shall not be more than 75 mm (3.0 in.) and the direction to the headphone jack shall be provided with an arrow adjacent to the symbol.

5.2.7.6 The audio headphone jack (socket) symbol shall be a minimum width through the centerline of 10 mm (0.39 in.).

5.2.7.7 The headphone symbol shall be a minimum raised height of 0.4 mm (0.016 in.) from the background surface (see [Fig. 7](#)).

NOTE 71—The headphone jack (socket) symbol is raised 0.4 mm (0.016 in.) in [Fig. 7](#).

5.2.7.8 The audio headphone jack (socket) symbol shall have 100 % (white on black or black on white) color value contrast from the adjacent surface of the equipment that they are primarily seen against surrounding a minimum of a 2 mm (0.08 in.) diameter border from the outer edge of the symbol (as defined in [4.1](#)).

5.2.7.9 An information button used to activate, deactivate, or replay audio feedback shall be located within 25 mm (0.98 in.) to the right of the audio headphone jack (socket) center point measured from the button center point. Such buttons shall comply with the requirements detailed in [5.2.5](#).

NOTE 72—Buttons used to activate audio features should be able to be activated without changing the user's position on the machine.

5.2.7.10 Upon audio headphone jacks (sockets) initial activation by pressing the information button, the voltage level shall default to  $0.21 \pm 0.063$  V.

5.2.7.11 The information button shall have a universal information symbol using a circle and 'i'.

5.2.7.12 The information symbol shall be a minimum width through the centerline of 20 mm (0.79 in.).

5.2.7.13 The information symbol (circle and 'i') shall be a minimum raised height of 0.4 mm (0.016 in.) from the background surface (see [Fig. 8](#)).

5.2.7.14 The information button symbol shall have 100 % (white on black or black on white) color value contrast from the adjacent surface of the equipment that they are primarily seen against surrounding a minimum of a 2 mm (0.08 in.) diameter border from the outer edge of the symbol (as defined in [4.1](#)).

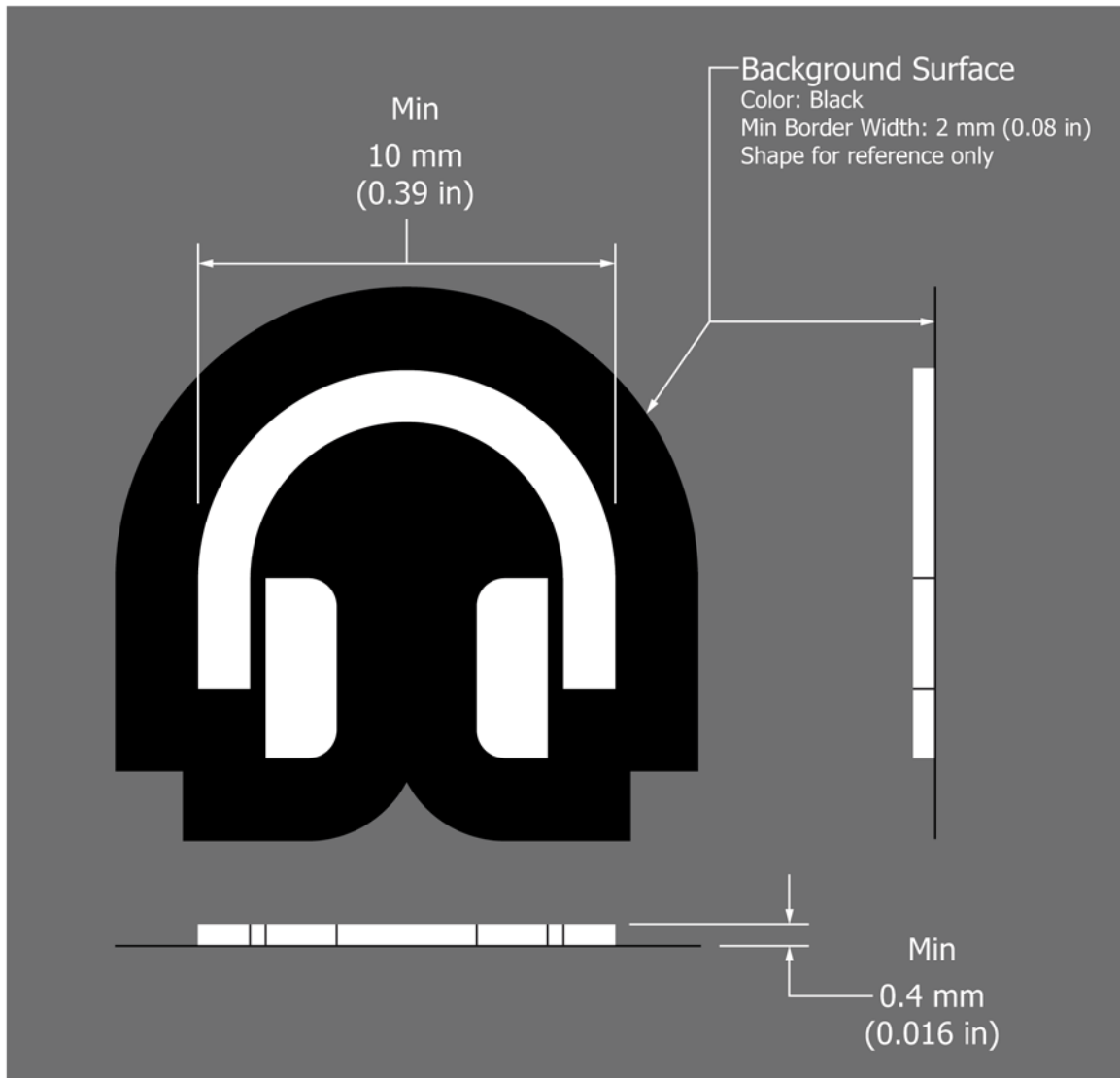


FIG. 7 Headphone Jack (Socket) Symbol and Dimensions

5.2.7.15 Audible feedback instructions shall be activated upon one press of the information button after the machine is out of standby mode, that is, fully operational.

5.2.7.16 Audible feedback instructions shall include how to adjust the volume and alert if the equipment is in pause mode.

5.2.7.17 Audible instructions shall include: warnings which are included on the equipment console label(s) (see product specific standards), the location and function of the main control buttons, and an explanation of any optional programs that the user can choose, for example, various terrains on a treadmill or cycle.

NOTE 73—Audible instructions may include entertainment system instructions.

NOTE 74—More detailed information may be provided via an alternate method, for example, QR-Code or company website.

NOTE 75—Warnings cannot be put solely on an alternate method, for example, QR-Code or company website.

5.2.7.18 Users who are familiar with the machine and wish to bypass/stop the audible feedback instructions will be in-

formed as to how to do so at the beginning of the audible feedback instructions.

5.2.7.19 Bypassing/stopping the instructions shall be achievable by activation of any other function button on the console.

5.2.7.20 The audible instructions shall be deactivated for the duration of the workout at any time during the workout by depressing the information button and holding for 2 s. Two beeps shall signify to the user that the information button has been deactivated.

(1) The audible instructions shall be reactivated at any time by pressing the information button.

5.2.7.21 Prior to starting a workout program, when any button is pushed that increases or decreases a main control function, for example, speed or level, audible feedback of the function shall be given immediately upon activation for each button press, for example, 5 % incline, in order that the user can verify that the function was actuated.



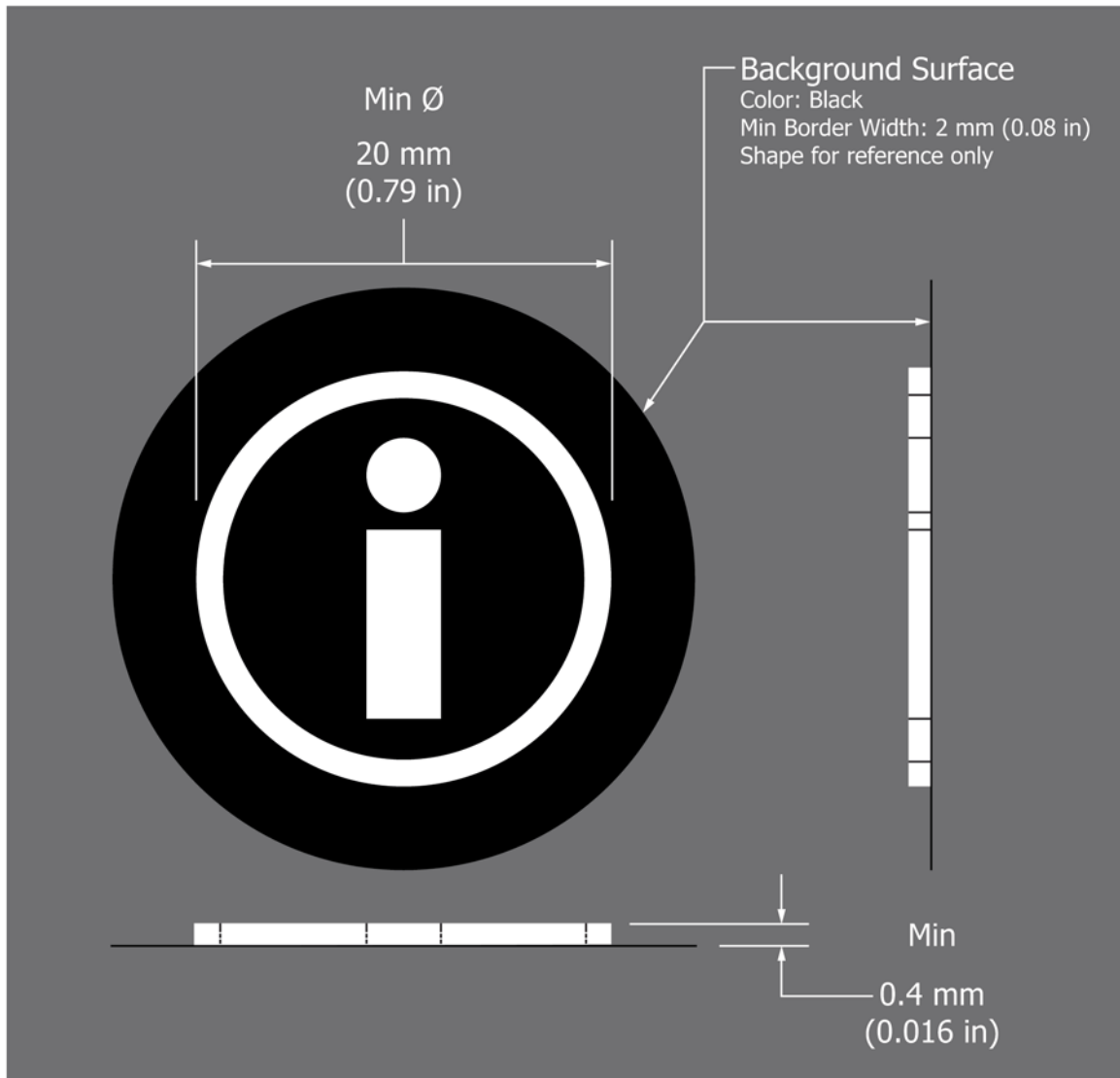


FIG. 8 Information Symbol and Dimensions

5.2.7.22 When a button is pushed to use a pre-programmed program, for example, various terrains on a treadmill or cycle, audible feedback of the program chosen shall be given to verify the selection.

5.2.7.23 For motor driven devices, when a change occurs in a pre-programmed program for speed, incline, or resistance, or a combination thereof, a warning of the change shall be available in audible feedback at least 5 s prior to the change.

5.2.7.24 Performance feedback shown on the console, for example, speed or RPM or SPM, time elapsed, distance traveled, incline, heart rate, and calories burned, shall be available in audible feedback throughout the exercise every 5 min and upon demand by pressing the information button.

5.2.7.25 When in a workout program, audible feedback shall be provided for automated changes in parameters 5 s prior to the change and shall be provided for manual changes in parameters immediately upon change.

NOTE 76—If the machine is in the off state, then the user needs to reactivate the machine according to 5.2.7.20(1).

5.2.7.26 When in a heart rate program, if visual feedback is provided regarding the heart rate being out of range or not detectable, equivalent audible feedback shall be provided every 30 s.

5.2.7.27 Performance summary feedback shown on the console shall be available automatically in an audible feedback post exercise and shall repeat until the summary screen times out.

5.2.7.28 The default language before the language is changed shall be the language used on the written text of the equipment labels/displays.

## 6. Keywords

6.1 accessibility; Americans with Disabilities Act (ADA); disability; disabled; inclusive; universal

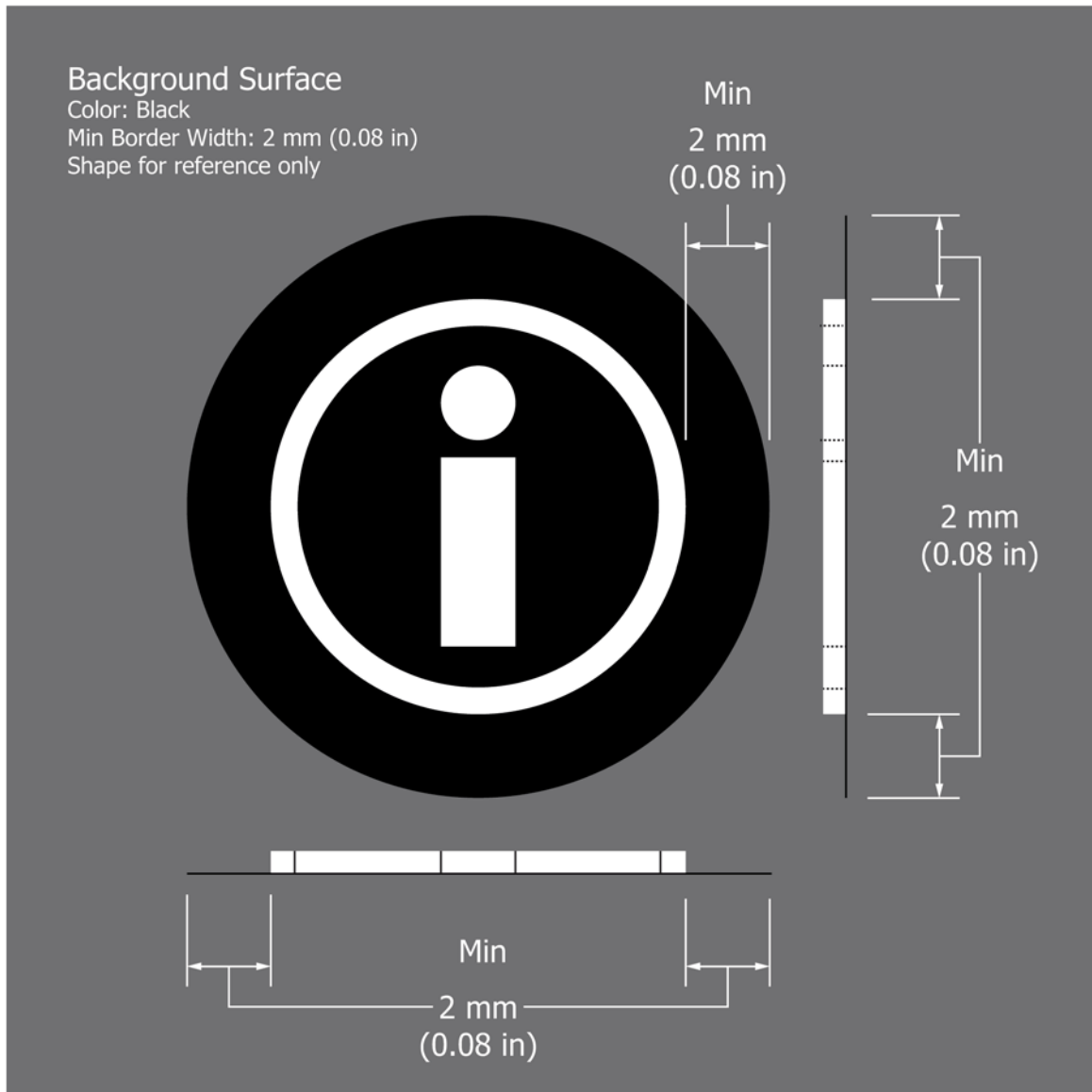


FIG. 8 Information Symbol and Dimensions (continued)

ANNEX

(Mandatory Information)

A1. Additional Reading

A1.1 ASTM Standards<sup>3</sup>

A1.1.1 F1250 Safety Specification for Stationary Exercise Bicycles

A1.1.2 F2216 Specification for Selectorized Strength Equipment

A1.1.3 F2810 Specification for Elliptical Trainers

A1.2 British Standard<sup>7</sup>

A1.2.1 BS 8300 Design of Buildings and their approaches to meet the needs of disability people—Code of Practice—British Standards Institute

<sup>7</sup> Available from British Standards Institution (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., <http://www.bsigroup.com>.

### A1.3 European Standards<sup>8</sup>

A1.3.1 EN 957–1 Stationary training equipment. General safety requirements and test methods.

A1.3.2 EN 957–2 Strength training equipment. Strength training equipment, additional specific safety requirements and test methods.

A1.3.3 EN 957–5 Stationary training equipment. Stationary exercise bicycles and upper body crank training equipment, additional specific safety requirements and test methods.

A1.3.4 EN 957–6 Stationary training equipment. Treadmills, additional specific safety requirements and test methods.

### A1.4 Others

A1.4.1 “The Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities,” (Sept 2002), Re-

<sup>8</sup> Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.

trieved January 11, 2010, from <http://www.access-board.gov/adaag/html/adaag.htm>.

A1.4.2 Mischler, G., “Lighting Design Glossary: Luminance,” (2003), Retrieved January 7, 2010, from <http://www.schorsch.com/kbase/glossary/luminance.html>.

A1.4.3 Koninklijke Philips Electronics, “Lighting Units: Definition of Illuminance” (2010), Retrieved November 10, 2010, from <http://www.lighting.philips.com/ph/v2/knowledge/basics.jsp>.

A1.4.4 The US Access Board Accessible Sports Facilities: Exercise Equipment and Machines,” (June, 2003), Retrieved October 23, 2014, from <http://www.access-board.gov/guidelines-and-standards/recreation-facilities/guides/sports-facilities/exercise-equipment-and-machines>.

A1.4.5 Beneficial Designs, Inc. (2013). Exercise guide for using fitness equipment for individuals who use a wheelchair. NCPAD. Birmingham, Alabama: NCPAD ([www.nchpad.org/wcguide](http://www.nchpad.org/wcguide)).

## APPENDIXES

### (Nonmandatory Information)

#### X1. SUGGESTED UNIVERSAL DESIGN SYMBOLS FOR CONSOLE MAIN CONTROL BUTTONS (5.2.5)

X1.1 See Fig. X1.1.

NOTE X1.1—The edges of the symbol areas (circles or hexagon-stop) as

well as the actual symbols (including the pointing arrow) should be raised the same way as is required for the information symbol (see Fig. 8).

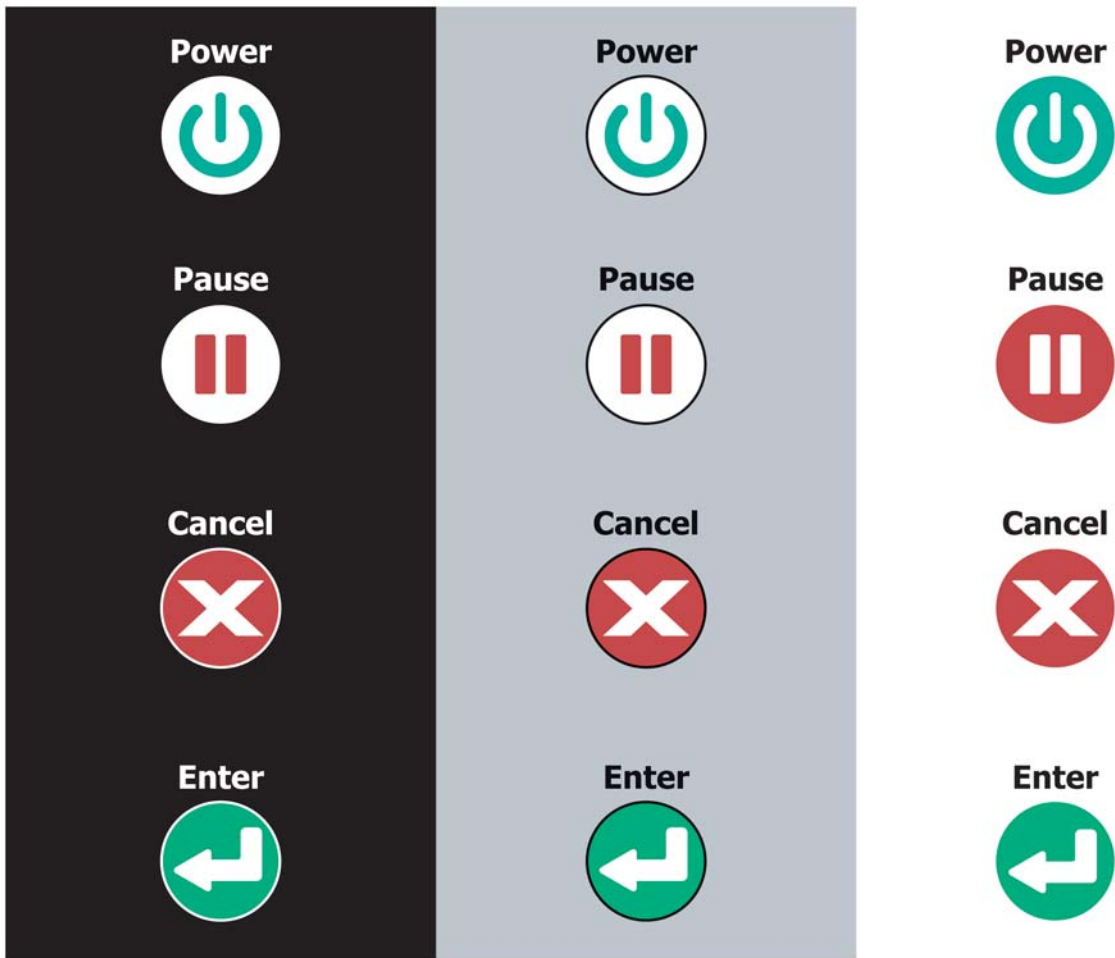


FIG. X1.1 Universal Design Symbols



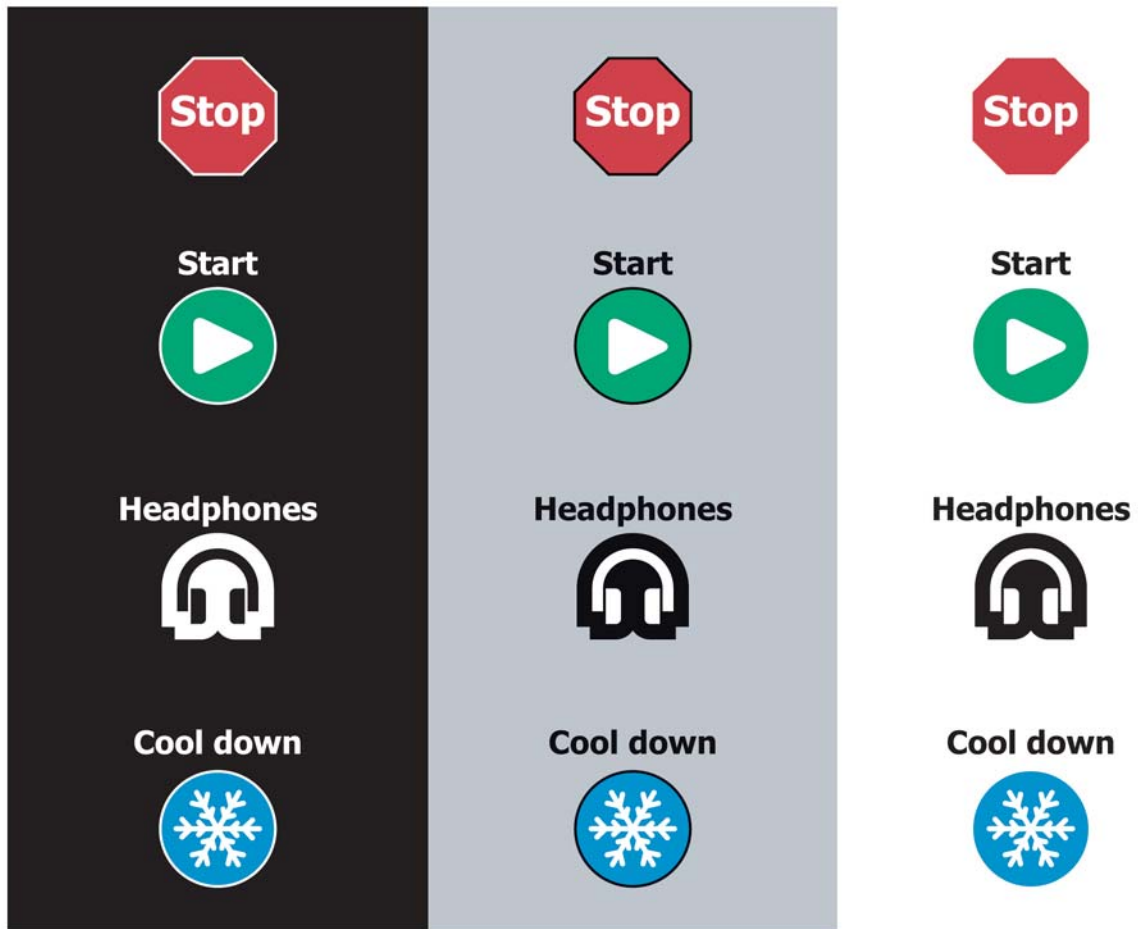


FIG. X1.1 Universal Design Symbols (continued)

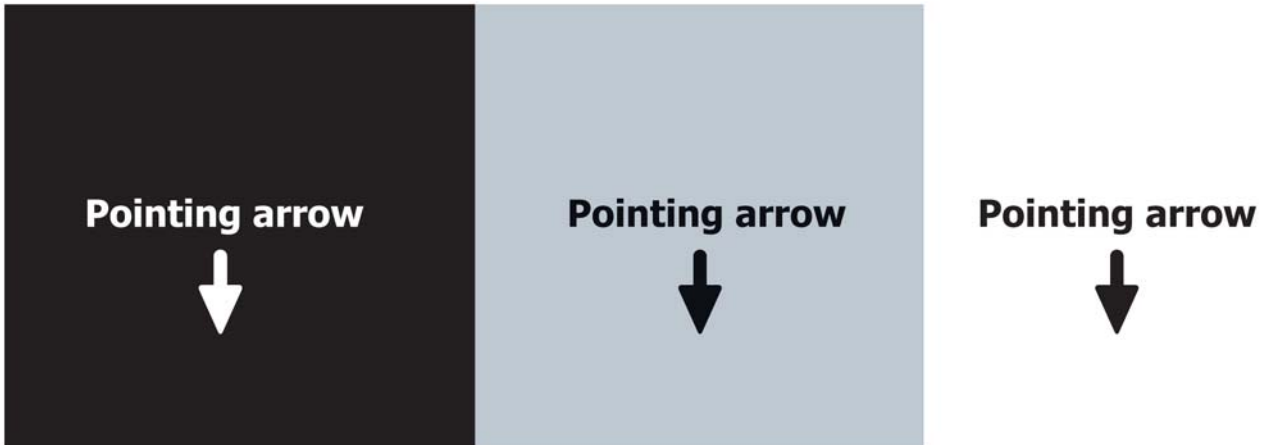
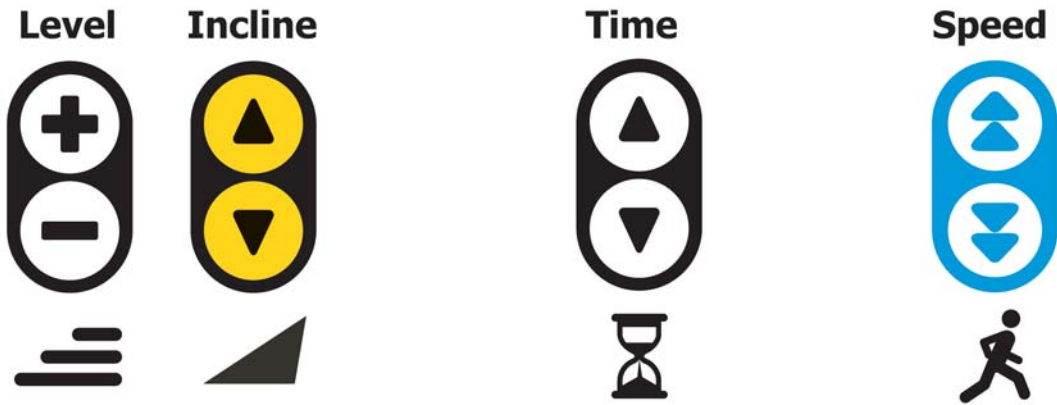
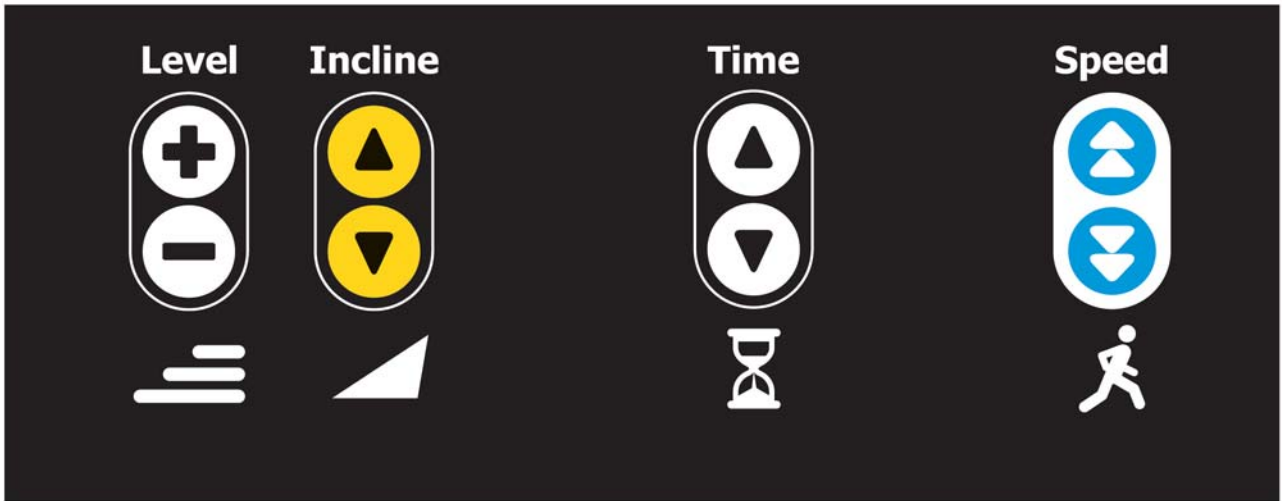


FIG. X1.1 Universal Design Symbols (continued)

X2. AUDIO FEEDBACK REQUIREMENTS FLOWCHART (5.2.7)

X2.1 See Fig. X2.1.

NOTE X2.1—The audible feedback requirements flowchart is to be used as a reference only. If there is any discrepancy between the flowchart and 5.2.7, 5.2.7 takes precedence.

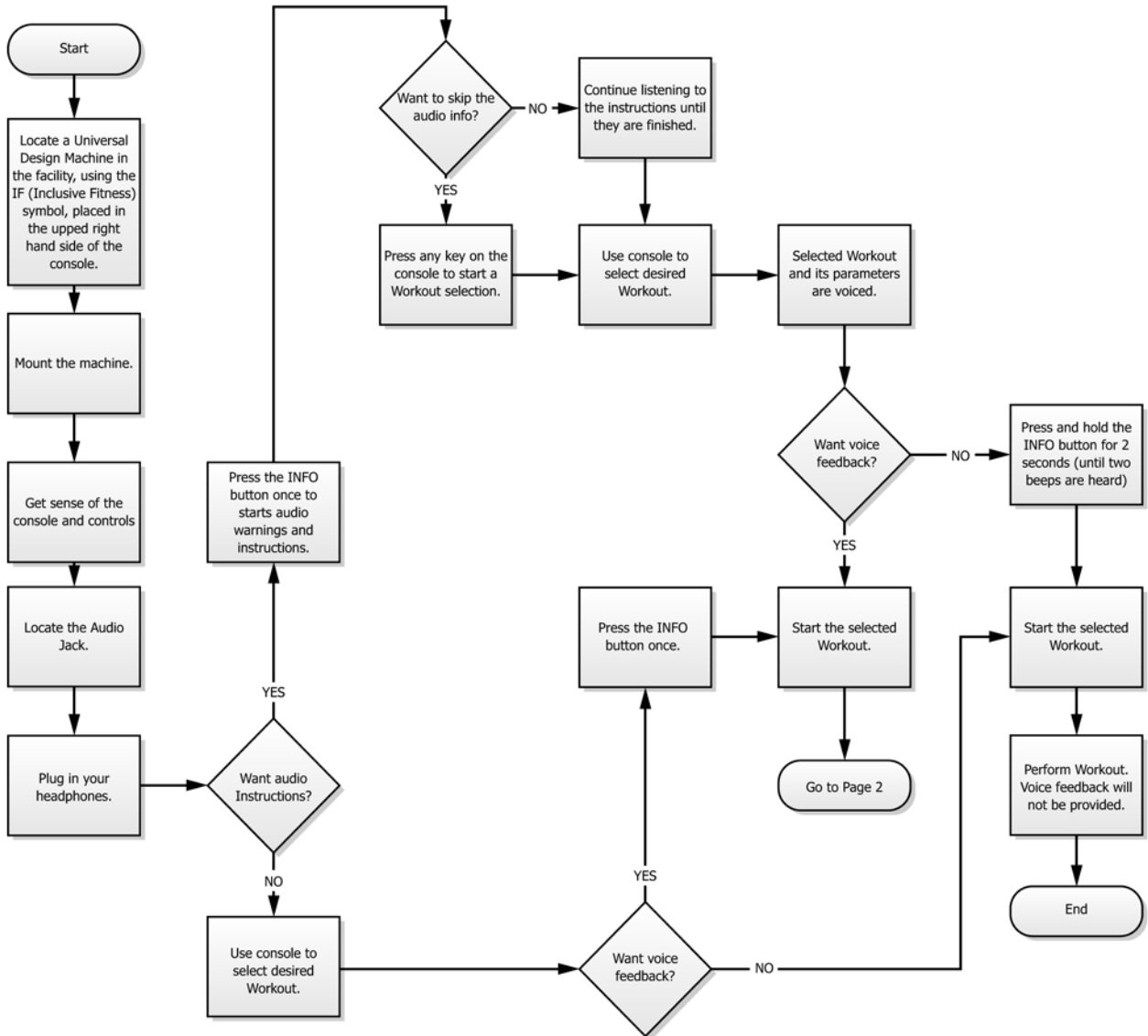


FIG. X2.1 Audio Feedback Requirements Flowchart

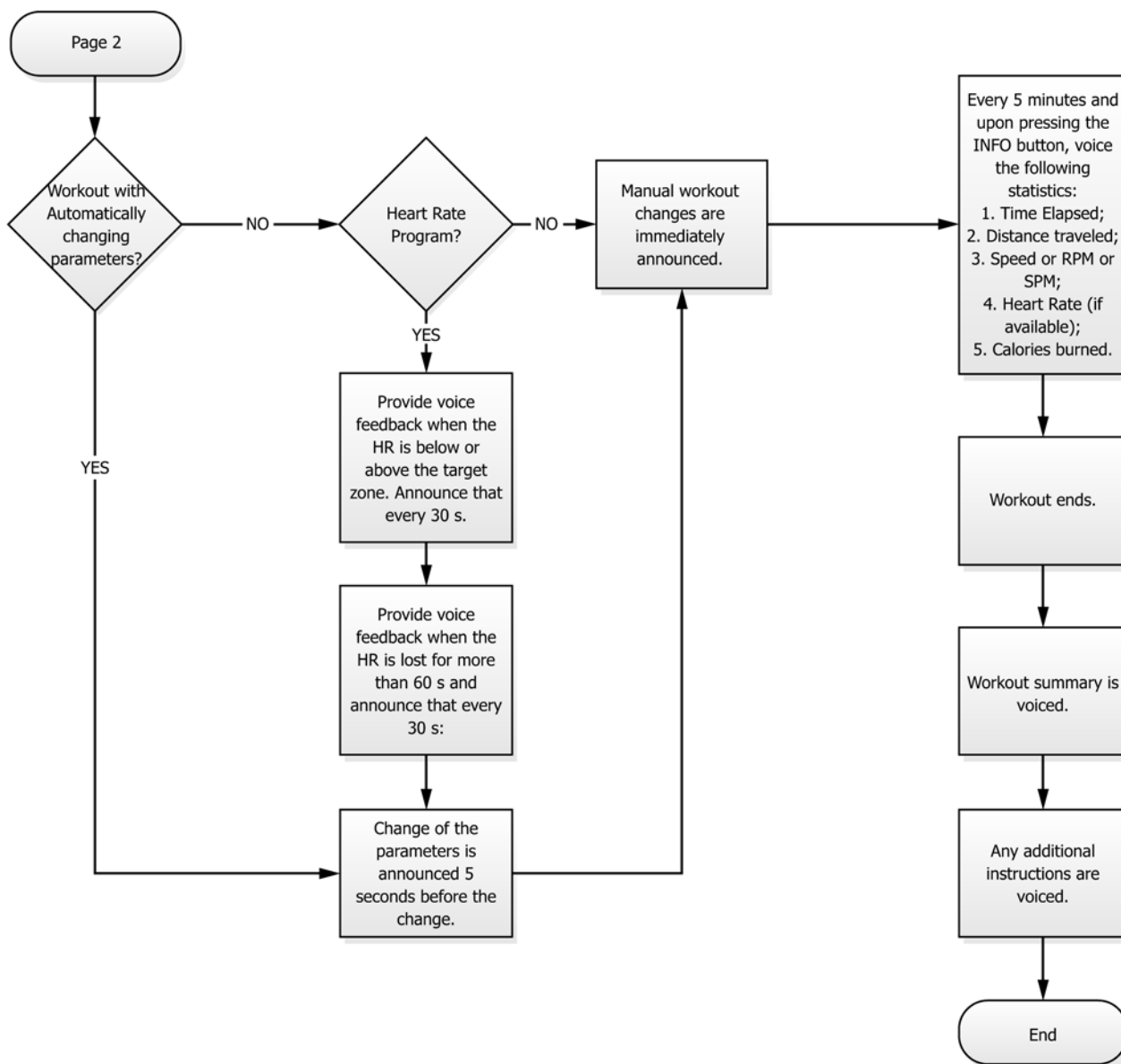


FIG. X2.1 Audio Feedback Requirements Flowchart (continued)

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