

INGENIUM ACCESSIBILITY STANDARDS FOR EXHIBITIONS

Last Revision: Feb. 19, 2018

Contents

List of Figures.....	4
List of Tables.....	5
Introduction	6
Core Principles	6
1. Circulation Routes.....	7
1.1 Paths.....	7
1.2 Single Direction of Travel (Corridors).....	8
1.3 Colour	8
1.4 Turning space	8
1.4.1 U-turns and 360° turns	8
1.4.2 Corners.....	8
1.5 Obstacles, protrusions, obstructions	9
1.5.1 Wall mounted obstructions.....	9
1.5.2 Overhead obstructions	10
1.6 Floors.....	10
1.7 Doors, doorways, and thresholds	10
2. Cases and Displays	11
2.1 Displaying Objects	11
2.1.1 Vision support.....	11
2.1.2 Object viewing height.....	11
2.1.3 Up-Close Viewing.....	12
2.2 Cases and Vitrines	12
2.3 Table Cases.....	13
3. Seating.....	14
3.1 Heights.....	14
3.2 Location of seating.....	14
3.3 Seating design.....	14
4. Mechanical Interactives and Tactile Experiences	15
4.1 Reach Range and Clearance	15
4.1.1 Approach	15

4.1.2 Table-top Interactives/Hands-on Experiences	15
4.1.3 Knee Clearance	15
4.1.4 Forward reach.....	16
4.1.5 Side reach	17
4.2 Controls and Feedback	18
4.2.1 Dexterity Support	18
4.2.2 Vision Support	18
4.2.3 Audio Support.....	18
4.2.4 Timing	18
5. Audio-Visual Media and Digital Interactives.....	19
5.1 Reach Ranges and Clearance for Controls	19
5.1.1 Approach	19
5.1.2 Knee Clearance	19
5.1.3 Height of controls	19
5.2 Videos.....	21
5.2.1 Height of video screens	21
5.2.2 Accessible alternatives	21
5.3 Audio	21
5.3.1 Accessible alternatives	21
5.3.2 Managing sound	21
5.4 Touchscreens.....	21
5.4.1 Approach	21
5.4.2 Screens.....	22
5.4.3 Heights.....	22
5.4.4 Controls.....	22
5.5 Accessible Alternatives for Digital Interactives.....	23
5.5.1 Touchscreens and touch-operated controls	23
5.5.2 Vision Support	23
5.5.3 Audio Support.....	23
5.4.7 Timing	24
6. Texts, text panels, and graphics.....	25

6.1 Text Presentation	25
6.1.1 Accessible formats.....	25
6.1.2 Colour and contrast	25
6.1.3 Spacing and margins.....	25
6.1.4 Legibility.....	25
6.1.5 Lighting text	25
6.2 Text and Graphics: Height and Viewing Distance	26
6.2.1 Label Placement	26
6.2.2 Reader Rails	26
6.2.3 Text panels and graphics (printed and digital)	26
6.3 Viewing Distance and Type Size	26
6.4 Text Comprehension	28
7. Lighting.....	29
7.1 General exhibition lighting	29
7.2 Light Sensitive Artifacts	29
Appendix 1: Colour Contrast.....	30
Appendix 2: List of Measurements (Metric and Imperial).....	30
Appendix 2: Reference Sources	33

List of Figures

Figure 1.1a Recommended width of a circulation path.....	7
Figure 1.1b Minimum width of a circulation path.....	7
Figure 1.4.1 Turn space for mobility devices; ideal and minimum requirements.....	8
Figure 1.5.1 Adult using a cane to detect a wall mounted obstruction.....	9
Figure 2.1.2 Object viewing heights at a presumed distance of 1830 mm.....	11
Figure 2.2 Knee clearance for reader rails.....	12
Figure 2.3 Maximum height of a table case.....	13
Figure 4.1.2 Interactive controls heights (minimum and maximum).....	15
Figure 4.1.3 Interactive knee clearance.....	15
Figure 4.1.4a Forward reach for a mechanical interactive.....	16
Figure 4.1.4b Forward reach over an obstacle for a mechanical interactive.....	16
Figure 4.1.5a Side reach for a mechanical interactive.....	17
Figure 4.1.5b Side reach over an obstacle for a mechanical interactive.....	17
Figure 5.1.3a Interactive Control Heights.....	19
Figure 5.1.3b Wall mounted audio listening device and volume control.....	20
Figure 5.1.3c Microscope and microphone maximum heights.....	20
Figure 5.4.3 Interactive touchscreens, minimum and maximum heights.....	22
Summary of Heights for Exhibition Components (Sections 1 to 6).....	27

List of Tables

Table 1: Viewing Distances and Type Size.....	26
Table 2: Summary of Heights for Text, Graphics, Controls, and Objects at Close View.....	27
Table 3 Accessible Lighting Levels for Different Environments.....	29
Table 4: Measurements for Circulation Routes.....	30
Table 5: Measurements for Cases and Displays.....	30
Table 6: Measurements for Seating.....	30
Table 7: Measurements for Physical Interactives and Tactile Experiences.....	31
Table 8: Measurements for Audio Visual Media and Digital Interactives.....	31
Table 9: Measurements for Text and Graphics.....	32
Table 10: Child Specific Measurements.....	32

Introduction

Disability is the result of a mismatch between a person’s ability and the form and function of the environment created by people. Environments are changing, and technology for people with disabilities has made exciting leaps in recent decades. Many innovations average consumers enjoy today can be traced back to technology designed to make information and communication accessible for people with disabilities.

The best way to achieve accessibility is preventing new barriers from being created. When procuring a product, Ingenium is recommended to procure products which comply with Exhibition Accessibility Standards when such products are available in the commercial marketplace or when such products are developed in response to an RFP solicitation.

The following technical requirements will enable museum exhibition designers to follow general guidelines to be used on all projects. The requirements are selected from a variety of accessibility standards to provide a reference document with the most commonly needed specifications. The aim is to support exhibition designers and contractors to prevent accessibility barriers. The original standards quoted in the final section “Reference Sources” are strongly recommended for additional context, more accessible design recommendations, and illustrations.

Questions about the interpretation or implementation of accessibility requirements should be directed at the project’s Exhibition Interpretation Officer so that they may seek advice, identify alternatives, or create variance requests. Integrating requirements at the beginning of a project prevents delays in approval stages and time lost and possible materials costs for redesigning, or remediating inaccessible conditions.

Please note that this is a living document and will be updated as new solutions and clarifications are required.

Core Principles

Standards provide minimum requirements for accessibility. **Strive to exceed minimums.**

Content that is essential to an exhibition theme¹ will be made accessible in alternate formats which may include: tactile models, reproduction models, audio description, closed captions, simple language, and large font, as appropriate.

¹ Essential content and key experiences will be determined by the Museum’s exhibition team.

1. Circulation Routes

Make every effort to exceed the minimum width, especially near key experiences.

1.1 Paths

- Strive for a width of 1830 mm for circulation paths; the width for two mobility devices
- For children specific areas, widen the width to 2235 mm
- The minimum width shall be 1370 mm; the width of a wheelchair and a person standing

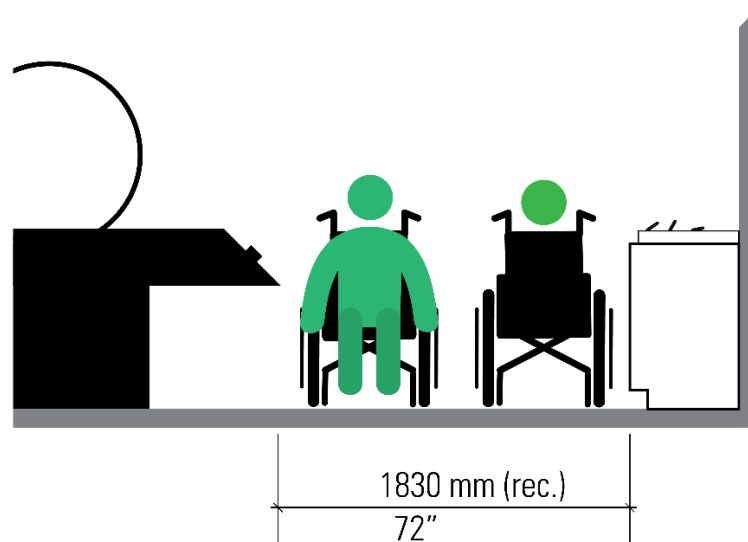


Figure 1.1a Recommended width of a circulation path

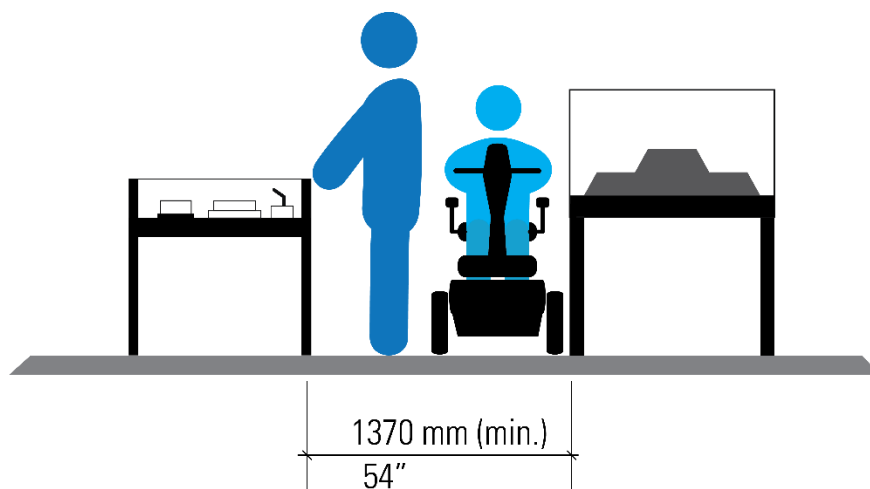


Figure 1.1b Minimum width of a circulation path

1.2 Single Direction of Travel (Corridors)

- The minimum corridor width for travel in a single direction shall be 920 mm; make every effort to exceed the minimum width

1.3 Colour

- The floor and wall colour will respect a contrast of 70%; see Appendix 1

1.4 Turning space

1.4.1 U-turns and 360° turns

- Key experiences should allow a 2440 mm width / diameter best for U-turns and 360° turns. This accommodates longer mobility devices such as scooters and reclining wheelchairs
- The minimum width to enable 360° turns for wheelchairs is 1525 mm by 1525 mm

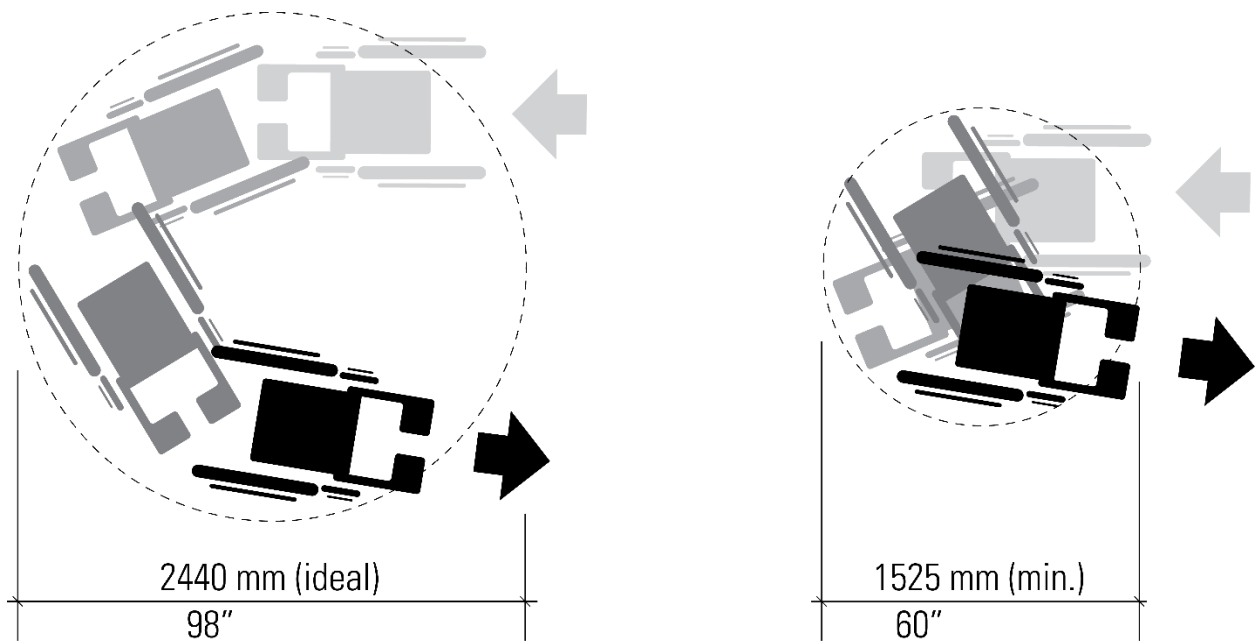


Figure 1.4.1 Turn space for mobility devices; ideal and minimum requirements

1.4.2 Corners

- Allow 1220 mm by 1220 mm minimum space for turning radius, such as turning a 90° corner using a mobility device

1.5 Obstacles, protrusions, obstructions

Items placed lower than 305 mm are considered obstacles; avoid placing these in the middle of routes or manoeuvring spaces.

- If obstacles are unavoidable, use lighting, high contrast colour, a barrier or raised platform to reduce hazards

1.5.1 Wall mounted obstructions

- Wall mounted obstructions may be any size if they start below 680 mm, making their bottom edge cane detectable
- Display cases that reach the floor are recommended to ensure detection with a white cane. If impossible, use floor to wall colour contrast of 70% and lighting to reduce hazards

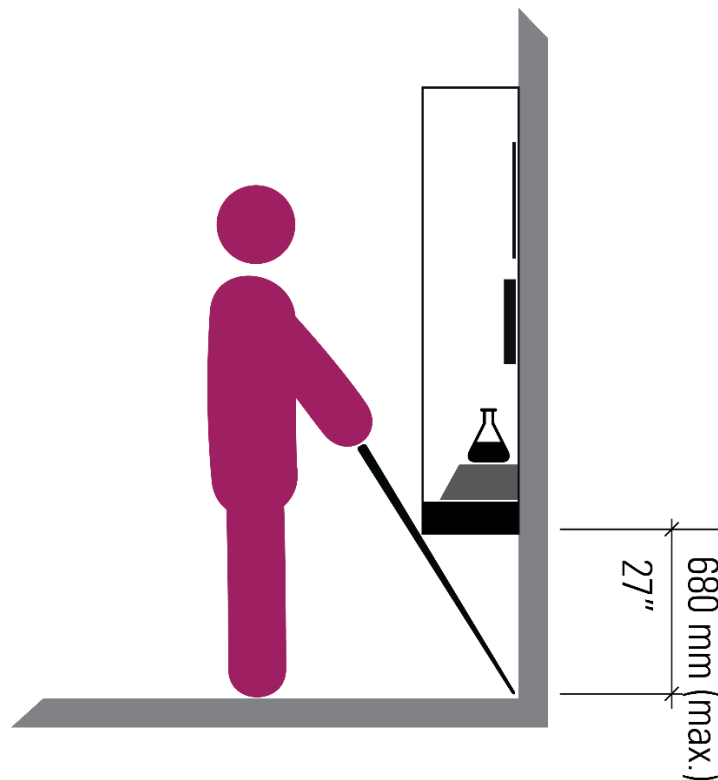


Figure 1.5.1 Adult using a cane to detect a wall mounted obstruction

1.5.2 Overhead obstructions

- The minimum clearance from the floor to any overhead obstructions (such as signage) shall be 2100 mm

1.6 Floors

- Use firm, level, non-slip, non-glare materials; low pile if carpeted
- The floor and walls shall respect 70% colour contrast; see Appendix 1
- Avoid strong patterns

1.7 Doors, doorways, and thresholds

Independent use of doors is desirable. For non-power operated doors, additional requirements are applicable². For open doorways use Paths requirements (see section 1.1).

- The minimum clear opening shall be 950 mm for one individual at a time
- The doorway and its surroundings shall respect a colour contrast of 70%; see Appendix 1
- Hardware will be 900 mm to 1000 mm from the floor and operable with a closed fist
- No revolving doors, turnstiles or frameless glass doors
- Avoid thresholds over 13 mm high; thresholds over 6mm must have a 1:2 bevel on both sides

² Additional requirements for Accessible Doors and Doorways is available in Section 3.8.3.3, of the Ontario Building Code http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_120332_e.htm, or Section 4.1.6 of London Facility Accessibility Design Standards https://www.london.ca/city-hall/accessibility/Documents/FADS_2007_final.pdf

2. Cases and Displays

2.1 Displaying Objects

Strive to provide visitors with the closest possible approach to key objects on display.

2.1.1 Vision support

- Provide 70% colour contrast between objects and background; see Appendix 1
- Do not mount objects against complex backgrounds
- Ensure objects do not compete; no overlapping objects, or excessive density of exhibit elements (distance apart and total number of elements)
- Place small items up front, larger items farther back
- Do not place items in shadows
- Place artifact labels in close proximity to objects

2.1.2 Object viewing height

- The accessible viewing height shall be between 1090 mm and 1700 mm when at a distance of 1830 mm from the object
- For children specific spaces, the average viewing height shall be 1036 mm
- If objects require high mounting strive to supplement with comprehensive audio descriptions, photos, large printed formats, reproductions, and touchable models or materials

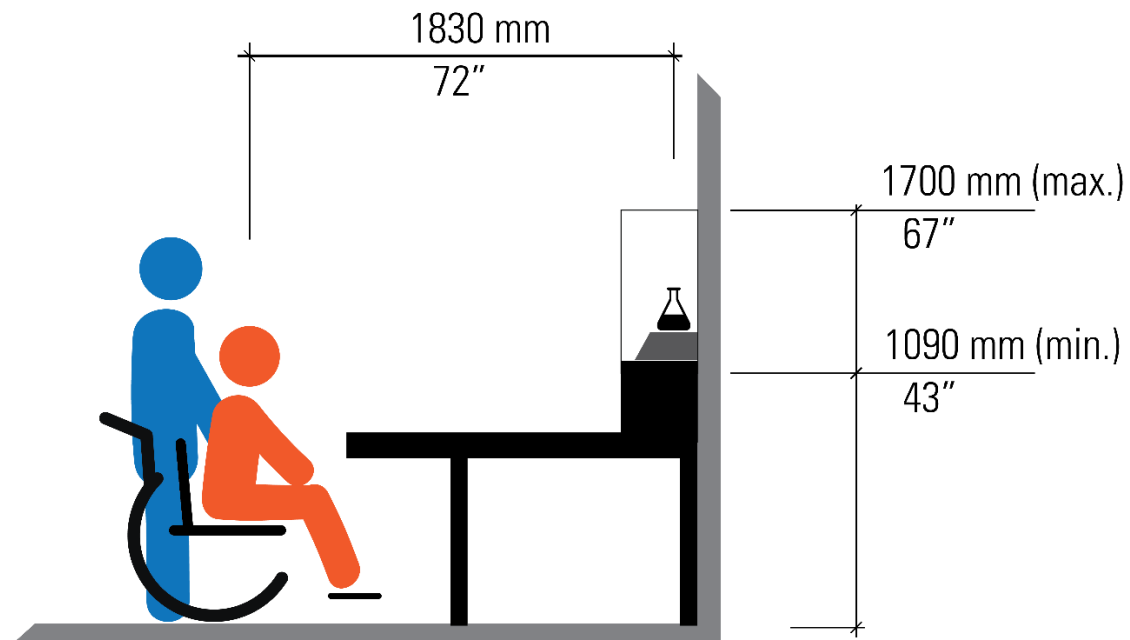


Figure 2.1.2 Object viewing heights at a presumed distance of 1830 mm

2.1.3 Up-Close Viewing

- When located closer to an object, height must be reduced to maintain line of sight for people seated in a mobility device or of short stature
- For up close viewing, vitrines shall be placed between 1090 mm and 1295 mm (see Summary of Heights for Exhibition Components, p.27)

2.2 Cases and Vitrines

- Use anti-glare, anti-reflective glass or acrylic
- Horizontal visual barriers (e.g. railings, frames) have a maximum height of 915 mm
- Where display cases have a counter or reading rail, it will provide clear knee space 610 mm high, 610 mm deep, and 760 mm wide
- Wall mounted cases must start below 680 mm, making their bottom edge cane detectable (see Figure 1.5.1, p.9)

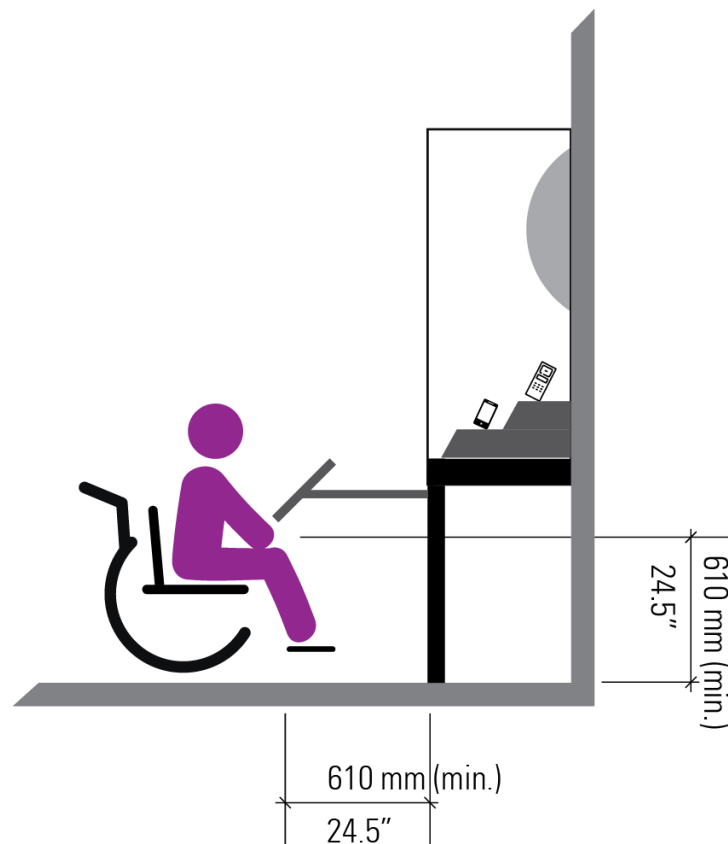


Figure 2.2 Knee clearance for reader rails

2.3 Table Cases

- Use anti-glare, anti-reflective glass or acrylic
- Table cases will be shallow and respect a maximum height of 915 mm; a low bottom is hard to see in

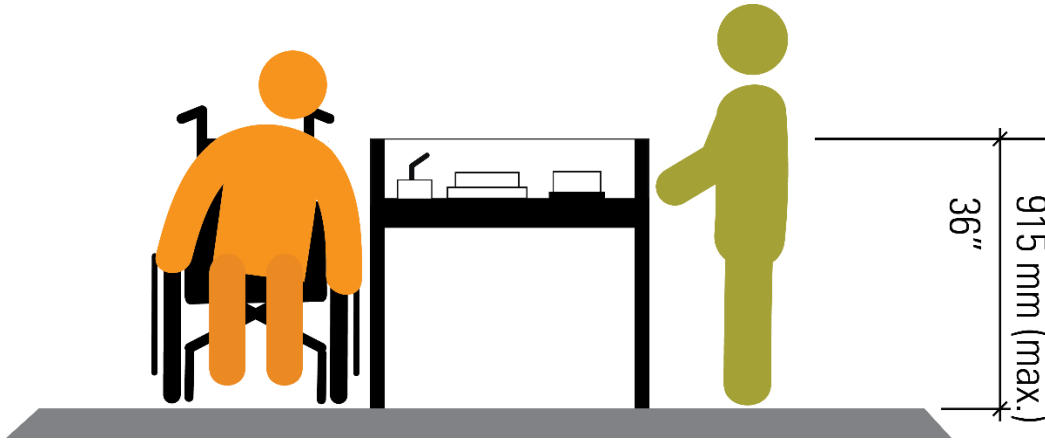


Figure 2.3 Maximum height of a table case

3. Seating

Seating must be provided in each exhibition.

3.1 Heights

- Seats should be between 430 mm and 510 mm above the floor
- Children's seat heights should respect a height of 203 mm to 305 mm (5 years and less), and 305 mm to 432 mm (5 years +)

3.2 Location of seating

- Seating and rest areas will include accessible locations that do not encroach on circulation routes
- Locations will have clear approach not less than 920 mm wide by 1525 mm long

3.3 Seating design

- Seats should be firm
- Strive to incorporate chairs or benches that have both arm and back support
- Near key areas where visitors are invited to spend more time (near play areas, display walls of artifacts, AV presentations) seating shall have back and arm support
- Chairs should have a colour contrast with their environment of 70%; see Appendix 1

4. Mechanical Interactives and Tactile Experiences

4.1 Reach Range and Clearance

Approach to interactives must provide access to controls (e.g. levers and buttons) and strive for forward reach³. Some people who are of short stature may not be able to reach controls above 915 mm from the floor.

4.1.1 Approach

- Interactives shall not have permanent seating that blocks the approach and participation of a person seated in a mobility device
- Clear floor space shall not be less than 760 mm by 1370 mm

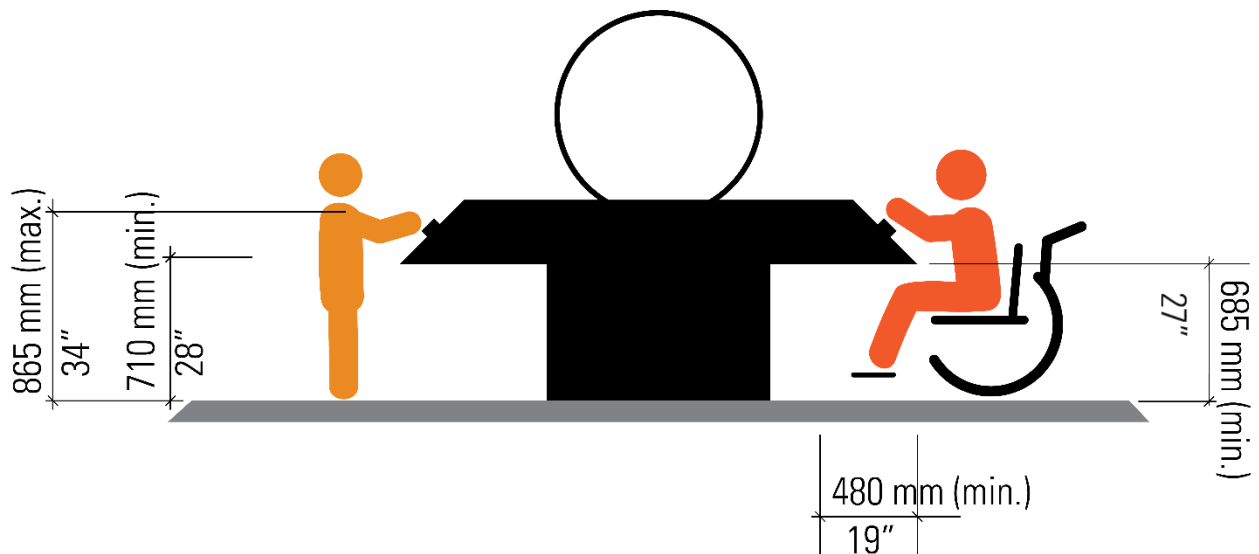
4.1.2 Table-top Interactives/Hands-on Experiences

- Table or rail mounted controls shall be located between 710 mm to 865 mm from floor
- Viewing devices (e.g. microscopes) shall be placed at a maximum 915 mm from floor, or adjustable in height (see Figure 5.1.3c, p.20)

Wherever possible, provide adjustable-height surfaces

4.1.3 Knee Clearance

- Clear knee space shall be 685 mm high, 480 mm deep, 760 mm wide
- For children 610 mm high, 610 mm deep, 760 mm wide



Figures 4.1.2 and 4.1.3 Interactive controls heights (minimum and maximum) and knee clearance

³ Dimensions for reach range are based on research for average-size people sitting in wheelchairs. Forward reach range for a person using a scooter depends on the design of the front of the scooter.

4.1.4 Forward reach

- The forward reach range shall be between 380 mm to 1220 mm from the floor
- For children specific areas, the range shall be between 508 mm to 915 mm above the floor
- Over an obstacle such as a table top, maximum forward reach height shall be 1120 mm

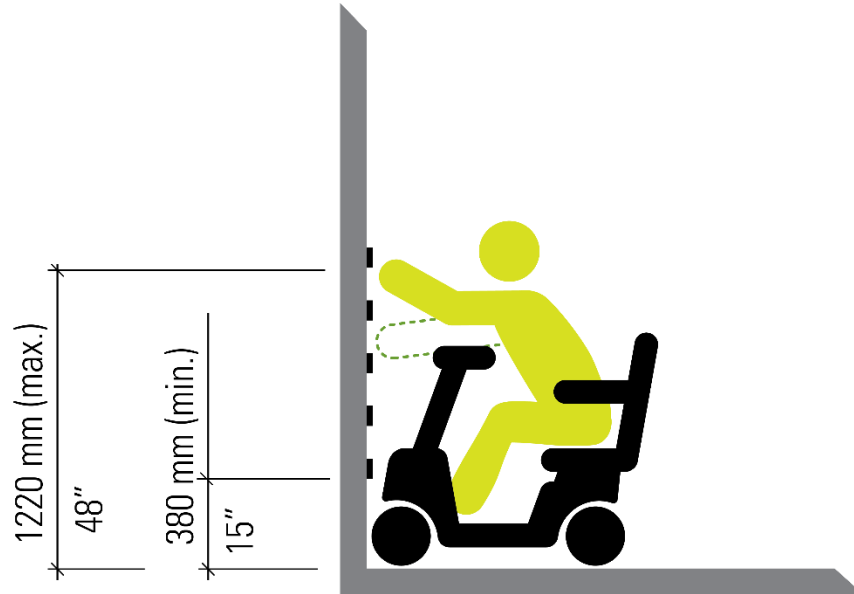


Figure 4.1.4a Forward reach for a mechanical interactive

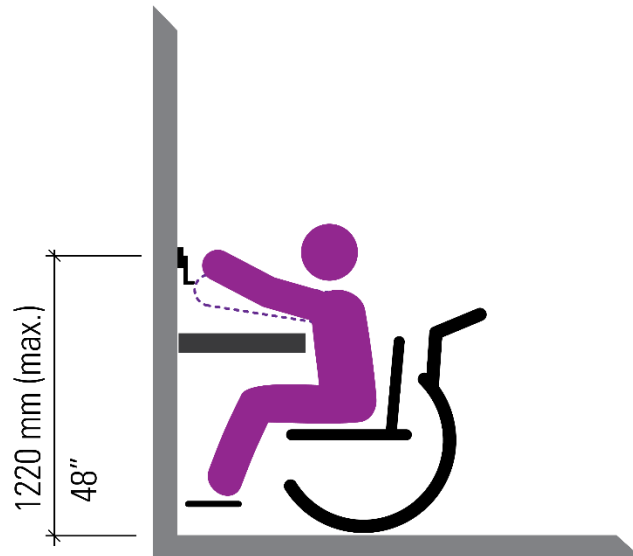


Figure 4.1.4b Forward reach over an obstacle for a mechanical interactive

4.1.5 Side reach

- The range shall be between 230 mm to 1370 mm from the floor
- For children specific areas, the range shall be between 508 mm to 915 mm above the floor
- Over obstacles such as a table top, maximum forward reach height shall be 1170 mm

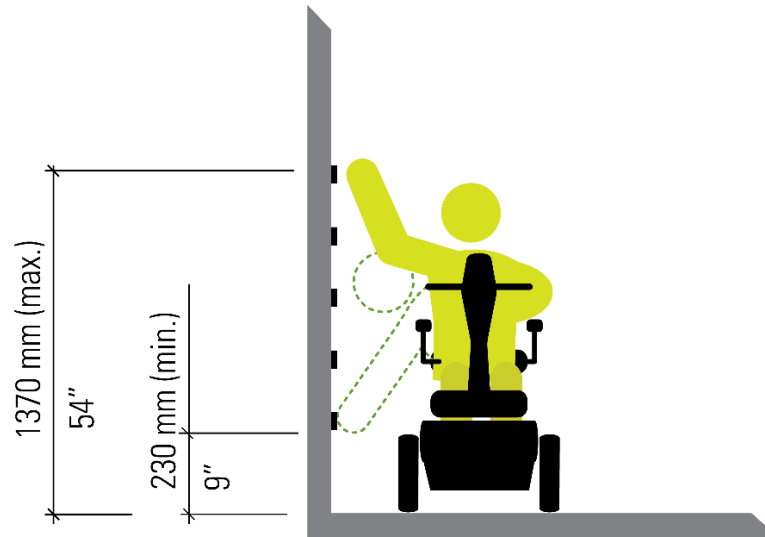


Figure 4.1.5a Side reach for a mechanical interactive

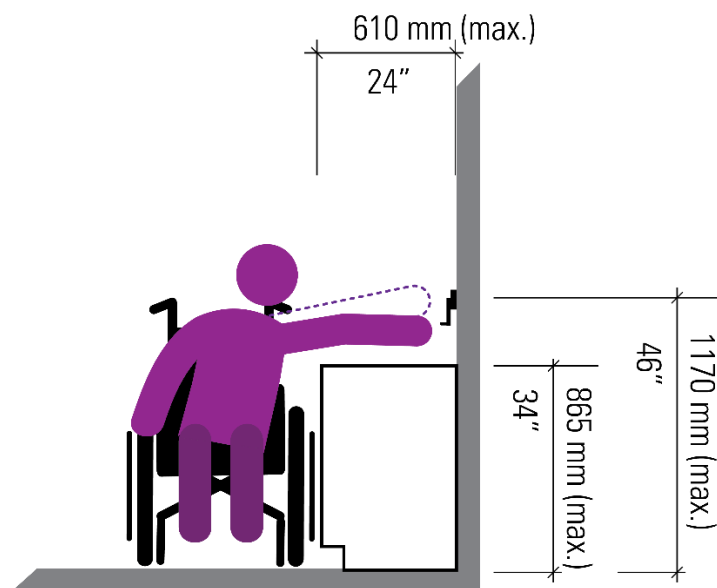


Figure 4.1.5b Side reach over an obstacle for a mechanical interactive

4.2 Controls and Feedback

4.2.1 Dexterity Support

- Controls shall be operable with one hand and minimal strength and dexterity (can be operated without tight grasping, pinching, or twisting of the wrist)
- Strive to use the largest buttons obtainable. Buttons that are 75 mm square, or 75 mm in diameter are the most accessible

4.2.2 Vision Support

- Controls require 70% colour contrast to background; see Appendix 1
- Strive to provide tactile characters or Braille below knobs to indicate function controls
- Labels buttons appropriately; color coding shall not be used as the only means of conveying information, indicating an action, prompting a response, or distinguishing a visual element (e.g. no Start-green and Stop-red buttons)

4.2.3 Audio Support

- Visual cues shall be provided for all audio alerts
- When products provide auditory output, the audio signal shall be provided at a standard signal level through an industry standard connector that will allow for private listening. The product must provide the ability to interrupt, pause, and restart the audio at anytime
- When possible, provide a physical volume control or provide an interface so that volume can be controlled with software
- When products deliver voice output in a public area, incremental volume control shall be provided with output amplification up to a level of at least 65 dB. Where the ambient noise level of the environment is above 45 dB, a volume gain of at least 20 dB above the ambient level shall be user selectable. A function could be provided to automatically reset the volume to the default level after every use

4.2.4 Timing

- When a timed response is required, efforts will be made to provide an option to indicate more time is required

5. Audio-Visual Media and Digital Interactives

5.1 Reach Ranges and Clearance for Controls

Approach to interactives and media must provide access to controls such as buttons, volume knobs, track balls, and microphones; always strive for forward reach⁴. Some people who are of short stature may not be able to reach controls above 915 mm from the floor.

5.1.1 Approach

- Interactives and controls for audio visual elements shall not have permanent seating that blocks the approach and participation of a person seated in a mobility device
- Clear floor space shall not be less than 760 mm by 1370 mm

5.1.2 Knee Clearance

- Clear knee space shall be 685 mm high, 480 mm deep, 760 mm wide
- For children 610 mm high, 610 mm deep, 760 mm wide
- Wherever possible, provide adjustable-height surfaces

5.1.3 Height of controls

- Table or rail mounted controls shall be located between 710 mm to 865 mm from floor
- Over obstacles such as a table top, the maximum forward reach height shall be 1170 mm

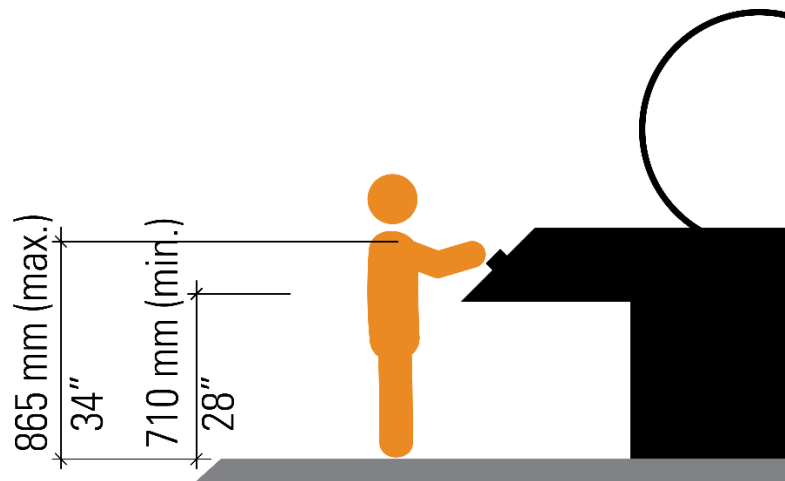


Figure 5.1.3a Interactive Control Heights

⁴ Dimensions for reach range are based on research for average-size people sitting in wheelchairs. Forward reach range for a person using a scooter depends on the design of the front of the scooter.

- Listening devices shall be placed at a maximum height of 1015 mm from floor, or adjustable height

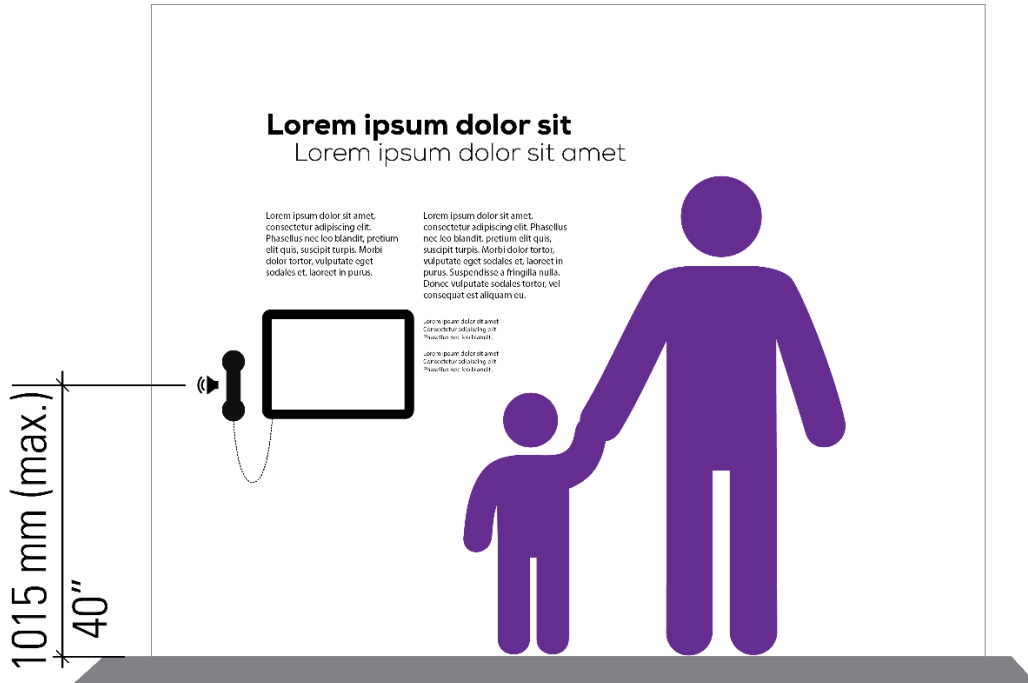


Figure 5.1.3b Wall mounted audio listening device and volume control

- Viewing devices (such as microscopes) shall be placed at a maximum 915 mm from floor, or adjustable in height
- Microphones shall be placed at a maximum height of 1015 mm from the floor, or adjustable in height



Figure 5.1.3c Tabletops with microscope and microphone showing maximum heights

5.2 Videos

5.2.1 Height of video screens

- Television screens shall be placed at a viewing level of 1090 mm and 1295 mm from the floor

Note: the viewing distance and size of screen may affect the final placement of the screen. Testing is strongly recommended.

5.2.2 Accessible alternatives

- Key experiences that contain visual information necessary for the comprehension of the content, shall be audio described.
- Display or presentation of alternate text presentation or audio descriptions could be user-selectable unless permanent
- Closed captions must be time stamped

5.3 Audio

5.3.1 Accessible alternatives

- All content that contains speech or other audio information necessary for the comprehension of the content, shall be open or closed captioned (and bilingual)

Embedded Sign Language (ASL/LSQ) video is appreciated by culturally Deaf people⁵.

- The least preferred audio accommodation is a transcript

5.3.2 Managing sound

- Provide volume control that automatically resets to default level after every use
- Manage acoustics to minimize sound pollution

5.4 Touchscreens

5.4.1 Approach

- Interactives shall not have permanent seating that blocks the approach and participation of a person seated in a mobility device
- Approach to interactives must provide access to controls

⁵ For tips on embedding ASL videos in a video stream <http://www.w3.org/TR/WCAG20-TECHS/G54.html>

5.4.2 Screens

- Eliminate glare on screens. Evaluate multiple angles for those who would be seated or standing, centred or off to the side⁶

5.4.3 Heights

- Rail mounted and/or table-top digital interactives shall be located between 710 mm to 865 mm from the floor

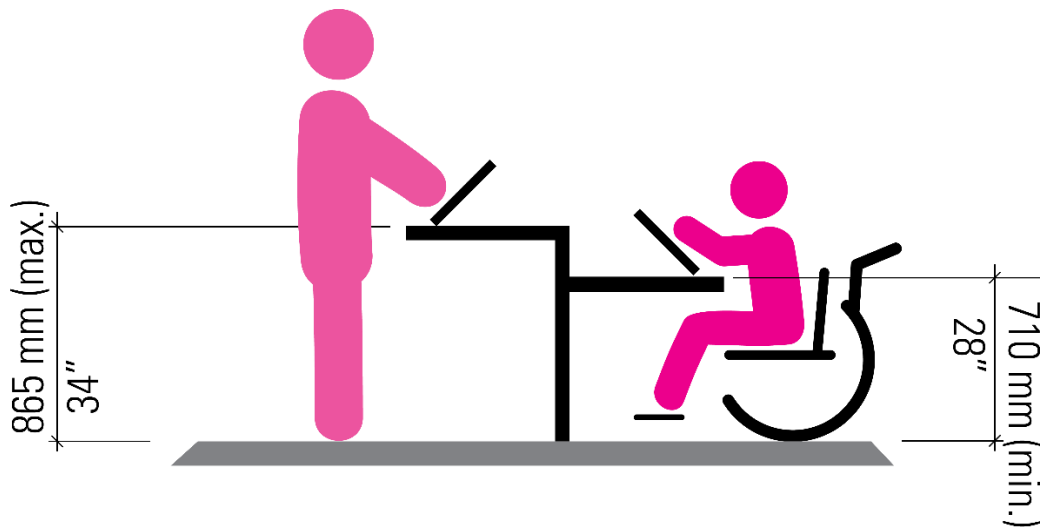


Figure 5.4.3 Interactive touchscreens, minimum and maximum heights

5.4.4 Controls

- Controls shall be operable with one hand and minimal strength and dexterity
- Strive to use the largest buttons obtainable. Buttons that are 75 mm square, or 75 mm in diameter are the most accessible
- Provide industry standard ports for alternative input and output devices (such as personal headsets for private listening)

⁶ **NOTE:** Anti-glare coatings on screens are designed for viewing at either 0° angle or 45° angle. Specify the correct screen for the viewing angle or image colours will appear distorted. Ideal viewing angles are provided where screen height can be adjusted up or down to suit viewers seated or standing, short or tall.

5.5 Accessible Alternatives for Digital Interactives

Make every effort to provide alternate methods of operation and information retrieval for digital interactives.

5.5.1 Touchscreens and touch-operated controls

- Strive to develop accessible touchscreens or touch-operated controls that convey sufficient information about a user interface element (including the identity, operation and state of the element) and gesture-based controls, or provide alternative methods such as additional physical controls for operation and information retrieval
- Where a product utilizes touchscreens or contact-sensitive controls that are not accessible, strive to provide an input method that:
 - Provides keys which are tactilely discernible without activating them.
 - Provide the status of all locking or toggle keys visually and either through touch or sound
 - If key repeat is supported, the delay before repeat shall be adjustable to at least 2 seconds

5.5.2 Vision Support

- Controls require 70% colour contrast to background; see Appendix 1
- Labels buttons appropriately, color coding shall not be used as the only means of conveying information, indicating an action, prompting a response, or distinguishing a visual element. (e.g. no Start-green and Stop-red buttons)
- Strive to provide tactile characters or Braille below knobs to indicate function controls
- Provide system settings for high contrast for all user interface controls and content
- If color customization is supported, provide a variety of color selections capable of producing a range of contrast levels
- When a product permits a user to adjust color and contrast settings, a range of color selections capable of producing a variety of contrast levels could be provided

5.5.3 Audio Support

- Visual cues shall be provided for all audio alerts
- When interactives provide auditory output, the audio signal shall be provided at a standard signal level through an industry standard connector that will allow for private listening
- The product must provide the ability to interrupt, pause, and restart the audio at anytime

(5.3.3 Audio Support Continued)

- When products deliver voice output in a public area, incremental volume control shall be provided with output amplification up to a level of at least 65 dB
- Where the ambient noise level of the environment is above 45 dB, a volume gain of at least 20 dB above the ambient level shall be user selectable
- A function could be provided to automatically reset the volume to the default level after every use
- When possible, provide a physical volume control or provide an interface so that volume can be controlled with software

5.4.7 Timing

- When a timed response is required, strive to provide an option to indicate more time is required, or allow the instructions to persist
- Software shall not use flashing or blinking text, objects, or other elements having a flash or blink frequency greater than 2 Hz and lower than 55 Hz

6. Texts, text panels, and graphics

The following apply to all interpretive text whether in printed or digital formats.

6.1 Text Presentation

6.1.1 Accessible formats

- Strive to ensure that print is developed in accessible formats that are conversion ready⁷
- Alternate formats may include Braille, audio, or large print

6.1.2 Colour and contrast

- Ensure text provides a 70% colour contrast to background; see Appendix 1
- Dark on light is marginally better than light on dark. When font is light on dark, use lighter type weight and greater space between letters to enhance legibility

6.1.3 Spacing and margins

- Provide leading (space between lines) 20% of font size
- Use consistent letter spacing and word spacing. Prevent letters from touching (i.e. no ligatures)⁸
- Align to left margin
- Avoid justified lines and limit centred text to 3 lines

6.1.4 Legibility

- Print on non-glare, non-glossy surface
- No printing on clear glass or acrylic
- No back printing, text on printed backgrounds, and no printing on textured surfaces
- Use sans serif fonts with clear extension for lowercase b, d, g, h, j, k, l, p, q, t, and y, and easily legible numbers; exceptions are permitted for headings and titles
- Do not use all upper case letters; exceptions are permitted for headings and titles
- No script or italic type. Oblique type is generally legible
- Use bold face, quotation marks, and alternate colours to emphasize text

6.1.5 Lighting text

- Light text panels and labels between 100 lux and 300 lux
- Avoid shadows on text panels and labels
- Avoid backlit panels as much as possible

⁷ conversion ready” means an electronic or digital format that facilitates conversion into an accessible format;

⁸ Excepting the French æ and œ ligatures

6.2 Text and Graphics: Height and Viewing Distance

Visibility and legibility of text is also affected by the size of the text at different viewing distances. Text must be larger when viewed at greater distances. When calculating distance, consider how crowds will impact viewing distances.

6.2.1 Label Placement

- Place artifact labels in close proximity to objects

6.2.2 Reader Rails

- Where display cases have a counter or reading rail it will provide clear knee space of 610 mm high, 610 mm deep, and 760 mm wide (see Figure 2.2 p.12)
- Rails will respect a maximum height of 915 mm

6.2.3 Text panels and graphics (printed and digital)

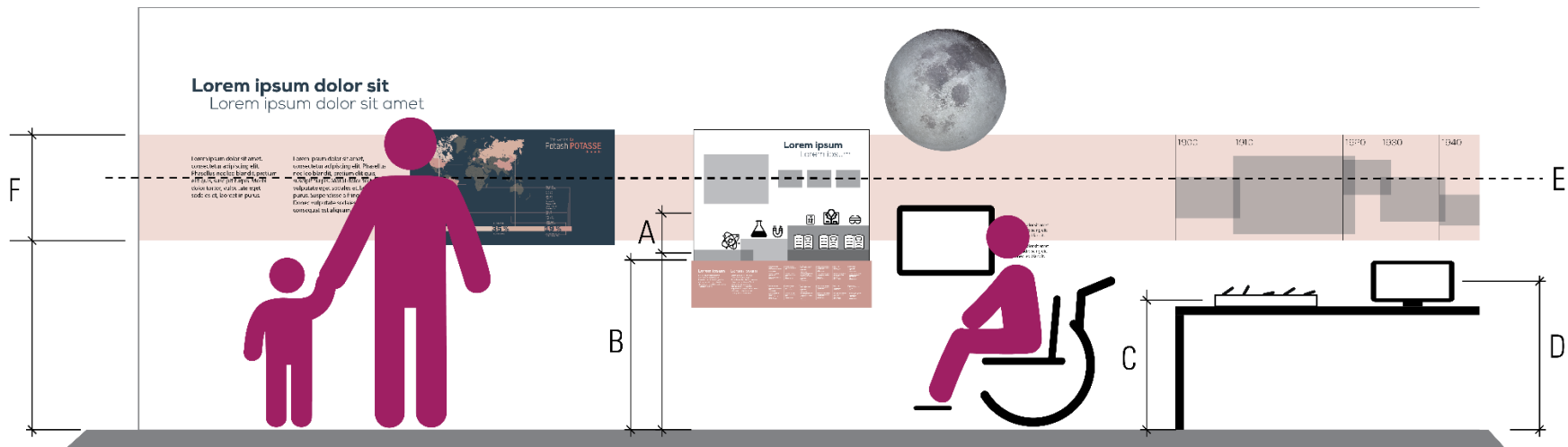
- See Summary Figure of Heights (p.26)
- Accessible viewing height of body text and graphics shall be between 1090mm and 1700 mm when at a distance of 1830 mm
- When located closer to text, height must be reduced to maintain line of sight for people seated in a mobility device or of short stature
- Mount labels with a centreline at 1370 mm; ideal for most standing and seated (adult) viewers
- Mount small items (to center line) at no higher than 1015 mm above floor

6.3 Viewing Distance and Type Size

At a distance of 1830 mm from the object, minimum text height should be 19mm, for the smallest font such as photo captions. Strive to achieve the following guidelines as much as possible.

Table 1: Viewing Distances and Type Size

Viewing Distance	Minimum “x-height” Type Size
75 mm	5 mm (credit info)
1 m	10 mm
2 m	19 mm
3 m	28 mm



Summary of Heights for Exhibition Components (Sections 1 to 6)

Table 2: Summary of Heights for Text, Graphics, Controls, and Objects at Close View

A	2.1.3 Objects in case (up close viewing)	1090 mm – 1295 mm	43” – 51”
B	2.2 Reader rail in front of case, maximum height	915 mm	36”
C	4.1.2 Mechanical interactive, recommended height	710 mm – 865 mm	28” – 34”
D	5.4.1 Touchscreen interactive, recommended height	710 mm – 865 mm	28” – 34”
E	6.2.1 Centreline of labels and text panels	1370 mm	54”
F	6.2.1 Text panels and graphic elements, recommend height	1090 mm to 1700 mm	43” – 67”

6.4 Text Comprehension

People with reading difficulties as well as those with low vision tire easily from the effort of seeing and reading a great number of printed words. When possible, offer an overview sentence or two --set in clear, large print—to allow these visitors to gather key information without having to read all of the text.

- Text shall be written for language skill of about Grade 6 level reading comprehension⁹
- Content will be provided at multiple intellectual levels and through more than one sensory channel
- Obvious story line, theme, or repeated element offers landmarks, repetition, and a connecting thread
- Use short sentences (subject, verb, object) average 15 words, label using a maximum 60 to 80 words (English language) for body text and 35 words for artifact and photo labels
- Use short lines with columns averaging 50 characters
- Avoid words that represent complex concepts
- When technical terms are used offer a definition or explanation
- Use the active voice
- Provide line drawings, silhouettes, and photographs that complement label text to aid comprehension for those with reading difficulties
- Place label text in close proximity to artefacts to provide greater ease at processing information
- Create a semantic structure hierarchy of text size and weight for Title, Headings, Body Text, and Secondary Text where the smallest font (e.g. photo caption) is not smaller than the minimum x-height for that viewing distance

⁹ Readability analysis tools are available in Microsoft Word, or using free online tools such as <https://readability-score.com/>

7. Lighting

For artifacts and text to be visible to people with low vision, lighting levels should be between 100 lux and 300 lux.

7.1 General exhibition lighting

- Ensure lighting does not cause bright pools of light or shadows
- Ensure lighting does not create shadows of the visitor over content being viewed
- Ensure lighting does not create glare on glass, or acrylic including video screens or interactives
- Balance lighting inside displays with ambient lighting to reduce reflections; brighter interior conditions cuts reflection
- Use soft upward ambient lighting to cut shadows
- Design lighting to prevent glare and reflections from multiple viewing angles including the perspective of people of short stature and people seated in a mobility device
- Ensure that there is sufficient light on labels to make them readable by all visitors
- Provide sufficient light to accommodate speechreading and sign language conversation in locations throughout the exhibition

Table 3: Accessible Lighting Levels for Different Environments

Purpose	Lux	Foot Candles
Ambient Lighting	50 – 300 lx	5 – 30 fc
Text Panels	100 – 300 lx	10 – 30 fc
Controls	100 lx	10 fc
Directional Signage	200 – 300 lx	20 – 30 fc
Artefacts, Objects	50 – 300 lx	5 – 30 fc
Ramps, Stairs	100 – 300 lx	10 – 30 fc
Visitor Pathways	100 – 300 lx	10 – 30 fc

7.2 Light Sensitive Artifacts

The maximum intensity of lighting for light sensitive artifacts is often 50 lux. Some strategies can help some people with low vision to see in lowered light levels:

- Supplement with comprehensive audio descriptions, and in brighter locations include photos, large printed formats, reproductions, or touchable models or materials
- Use consistent even lighting on the object
- Ensure the highest possible contrast background
- Ensure the closest possible visitor approach
- Avoid spotlighting the object
- Maintain ambient lighting in the gallery
- Use anti-glare glass or acrylic to prevent reflections

Appendix 1: Colour Contrast

People with vision loss can benefit from strong colour contrasts between light and dark. Use high contrast colours to make objects and text more visible against background colours.

Colour contrast is expressed as differences in light reflectance values (LRV). The formula is expressed as:

$$\text{Contrast} = [(B1-B2)/B1] \times 100$$

B1 = light reflectance value (LRV) of the lighter area whereas, B2 = light reflectance value (LRV) of the darker area.

Online colour contrast tools are available such as Web Aim Contrast Checker⁹. Be sure to check prototypes or samples under actual lighting conditions. Colours that may appear high contrast on a back-lit computer screen, may deliver poor results in low lighting.

Appendix 2: List of Measurements (Metric and Imperial)

Table 4: Measurements for Circulation Routes

1.1	Circulation paths width -ideal	1830 mm	72"
1.1	Circulation paths width -minimum	1370 mm	54"
1.2	Corridors -single direction of travel	920 mm	36.2"
1.4.1	Turning space U-turn and 360° turn	2440 mm diameter	96"
1.4.1	360° turn minimum	1525 mm by 1525 mm	60"
1.4.2	Corners 90° turn	1220 mm by 1220 mm	48"
1.5.1	Wall mounted obstruction –bottom edge	Start below 680 mm	Below 26.7"
1.5.2	Overhead Obstruction -clearance	2100 mm	82.7"
1.7	Doorway opening -minimum	950 mm	37.4"
1.7	Doorway hardware height	900 mm to 1000 mm	35.4" to 39.4"
1.7	Threshold maximum	13 mm	0.51"

Table 5: Measurements for Cases and Displays

2.1.2	Object viewing height at 1830 mm	1090 mm to 1700 mm	43" to 67"
2.1.3	Up Close Viewing	1090 mm to 1295 mm	43" to 51"
2.2	Horizontal Visual Barrier max height	915 mm	36"
2.2	Reader rail knee clearance	610 mm high	24"
		610 mm deep	24"
		760 mm wide	30"
2.2	Cane detection -wall cases	Start below 680 mm	Below 26.7"
2.3	Table Case Height maximum	915 mm	36"

Table 6: Measurements for Seating

3.1	Seat Heights	430 mm to 510 mm	17" to 20"
3.2	Clear approach to seating	920 mm wide	36.2"
		1525 mm long	60"

Table 7: Measurements for Physical Interactives and Tactile Experiences

4.1.1	Clear floor space	760 mm by 1370 mm	30" by 54"
4.1.2	Table top height	710 mm to 865 mm	28" to 34"
4.1.2	Viewing device height maximum	915 mm	36"
4.1.3	Knee Clearance	685 mm high	27"
		480 mm deep	18.9"
		760 mm wide	30"
4.1.4	Forward reach	380 mm to 1220 mm	15" to 48"
4.1.4	Forward reach over obstruction	1120 mm	44"
4.1.5	Side reach	230 mm to 1370 mm	9" to 54"
4.1.5	Side reach over obstacle	1120 mm	44"
4.2.1	Button size (recommended)	75 mm ²	3" square

Table 8: Measurements for Audio Visual Media and Digital Interactives

5.1.1	Clear floor space	760 mm by 1370 mm	30" by 54"
5.1.3	Knee clearance	685 mm high	27"
		480 mm deep	18.9"
		760 mm wide	30"
5.1.3	Table top/rail top controls	710 mm to 865 mm	28" to 34"
5.1.3	Forward reach over obstruction	1170 mm	46"
5.1.3	Microphones max height	1015 mm	40"
5.1.3	Listening device max height	1015 mm	40"
5.1.3	Viewing device height maximum	915 mm	36"
5.2.1	Screen heights	1090 mm to 1295 mm	43" to 51"
5.4.3	Touchscreen heights	710 mm to 865 mm	28" to 34"
5.4.4	Button size (recommended)	75 mm ²	3" square

Table 9: Measurements for Text and Graphics

6.1.3	Leading space	20% of font size	
6.1.5	Lighting	100 lux to 300 lux	
6.2.1	Heights body text and graphics	1090 mm and 1700 mm	43" to 67"
6.2.1	Centreline labels and panels	1370 mm	54"
6.2.2	Reader rail knee clearance	610 mm high	24"
		610 mm deep	24"
		760 mm wide	30"
6.2.3	Small items	1015 mm maximum	40"

Table 10: Child Specific Measurements

1.1	Circulation path	2235 mm	88"
2.1.2	Average viewing height	1036 mm	40.8"
3.1	Seat height -5 years and less	203 mm to 305 mm	8" to 12"
3.1	Seat height -6 years +	305 mm to 432 mm	12" to 17"
4.1.3	Forward reach	508 mm to 915 mm	20" to 36"
4.1.4	Side reach	508 mm to 915 mm	20" to 36"
4.1.5 5.1.3	Knee Clearance	610 mm high	
		610 mm deep	
		760 mm wide	

Appendix 2: Reference Sources

Smithsonian Guidelines for Accessible Design

<http://accessible.si.edu/pdf/Smithsonian%20Guidelines%20for%20accessible%20design.pdf>

City of London, Facility Accessibility Design Standards (FADS)

Note: City of Ottawa also has municipal accessibility design standards. However, London FADS are regarded as providing more accessible requirements, is easy to navigate and is supported by well depicted line drawings.

https://www.london.ca/city-hall/accessibility/Documents/FADS_2007_final.pdf

Ontario Building Code (Section 3.8 Barrier Free Requirements)

http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_120332_e.htm

Section 508 of the Rehabilitation Act (Americans with Disabilities Act)

<http://www.uspto.gov/about/offices/cio/section508/>

Section 508 Reference Guide

http://www.uspto.gov/about/offices/cio/section508/guide_index.jsp

IBM Accessibility, Developer Guides

<http://www-03.ibm.com/able/guidelines/>

Graphic Design

The following resources are produced for the US using requirements from the Americans with Disabilities Act (ADA). Despite minor discrepancies with Smithsonian Guidelines, these tools offer strong support for graphic designers

Signage and the 2010 ADA Standards for Accessible Design, produced by Luminant Design

http://www.etikk.hu/wp-content/uploads/2013/05/ADA_informacios_tablak.pdf

Signage Requirements in the 2010 Standards for Accessible Design. A white paper produced by the Society for Environmental Graphic Design

https://segd.org/sites/default/files/SEGD_2012_ADA_White_Paper_Update.pdf