



Overview

Assistive Products for
Children with Disabilities

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1.0 Introduction

There are more than one billion people with disabilities globally, of which more than 150 million are children. The rights of children with disabilities have always been a critical part of UNICEF's work. The right to assistive technology and to the full and equal enjoyment of all human rights are enshrined within the Convention on the Rights of Persons with Disabilities (CRPD). Currently, more than 100 UNICEF country offices are implementing programmes for children with disabilities in education; child protection; water, sanitation and hygiene (WASH); health and nutrition. Assistive products can be instrumental for children's development and health, as well as for participation in various facets of life.

Supplies are critical inputs into UNICEF support to Governments and partners through country programmes. The positive socio-economic impact achieved through the provision of assistive technology (AT) to communities cannot be overstated. UNICEF and its implementing partners understand that for children with disabilities, assistive products can represent the difference between enjoying basic rights, or being deprived of them.¹ Assistive products can help children to become more mobile, communicate, see and hear better, and participate more fully in family and community life. However, these products are effective only if they are appropriate to the individual child who uses them, and if they work well in the context in which the child lives.

This overview is a resource for procurement practitioners in development and humanitarian organizations and for government policymakers who support the planning, procurement and provisioning of assistive products. The overview provides details of some assistive products currently available on the market and information on when and how they are to be used. It covers a range of devices, from low-tech (e.g., walking sticks, pencil grips) to more complex (e.g., specialized computer software/hardware or motorised wheelchairs).

The selection of assistive products in this overview is based on the World Health Organization's (WHO's) 2016 Assistive Products Priority List (APL), which categorizes products into six broad domains: mobility, vision, hearing, communication, cognition and environment. The overview of products is by no means exhaustive. References to particular brands and models are only illustrative examples available at the time of publication and do not constitute an endorsement of the manufacturer by UNICEF. Indicative prices listed are in US dollars.

The overview is available online and will be updated regularly by UNICEF. Feedback from users to improve its content is always welcome and can be submitted to supply@unicef.org.

¹ 'Assistive technology' is used as an umbrella term for both assistive products and related services. Assistive products are also known as assistive devices. There are various definitions of 'assistive technology'. For example, the International Classification of Functioning, Disability and Health (ICF) defines assistive products and technology as any product, instrument, equipment or technology adapted or specially designed for improving the functioning of a person with a disability. Drawing from the ICF, the International Organization for Standardization (ISO) defines assistive products more broadly as "any product (including devices, equipment, instruments and software), especially produced or generally available, used by or for persons with disability for: participation; to protect, support, train, measure or substitute for body functions/structures and activities; to prevent impairments, activity limitations or participation restrictions" (ISO 9999).

Selecting appropriate assistive products

This overview provides practical information to guide UNICEF, partner agencies and Governments in procurement planning and provisioning of assistive products. The information is designed to help with decision-making on the most appropriate assistive products to meet programme objectives and realize the rights of children with disabilities.

This table identifies some basic questions that should be considered when determining whether an assistive product is appropriate. It also gives a general indication of the relevant information that may be found in product descriptions located in Sections 1 to 6.

| Factors that determine appropriateness | Considerations for procurement and programme planning |
|---|--|
| Planning and coordination | <ul style="list-style-type: none"> • Have the needs been addressed and prioritized with the concerned ministry of the Government? • Are the needs documented and expected results registered as part of the country programme? |
| Availability | <ul style="list-style-type: none"> • Are services and products available in sufficient quantity as close as possible to children's communities? |
| Accessibility | <ul style="list-style-type: none"> • Are services and products accessible to every child who needs them? • Are there country-specific regulatory and import requirements for the products? • Is delivery equitable (i.e., avoids discrepancies between genders, impairment groups, socioeconomic groups and geographic regions)? • Are distribution points accessible for people with physical disabilities (e.g., appropriate lighting, Braille signage, low noise level, ramps and appropriate passages)? • Are verbal and written information and instructions clear and simple? • Are language and symbols concrete rather than abstract? • Are products intuitive and easy to use? |
| Affordability | <ul style="list-style-type: none"> • Are services and products affordable to the family of every child who needs them? • Are financial help schemes available for assistive products (e.g., free-of-charge provision, subsidized cost)? |
| Assessment, fitting and adaptability | <ul style="list-style-type: none"> • Can the product accommodate differences in terms of individual factors (e.g., the child's health condition, body structure, body function, capacity, gender, age)? • Can the product be adjusted/modified to accommodate the growing child's changing needs? • Can the product be easily managed (e.g., folded, stored, loaded in a vehicle, pushed – in the case of a mobility device) by the child's parents or caregivers? |

| Factors that determine appropriateness | Considerations for procurement and programme planning |
|---|---|
| Suitability for the environment | <ul style="list-style-type: none"> • Can the product withstand unique environmental conditions where the child lives (e.g., rough terrain, steep grades, extreme climate)? • Does available electricity allow for effective use of the product? |
| Quality | <ul style="list-style-type: none"> • Does the product meet quality requirements as measured through technical standards or guidelines for strength, durability, capacity, safety and comfort? • If national standards have not been adopted, does the product comply with other relevant international standards (e.g., European Committee for Standardization (CEN) or International Standardization Organization (ISO) standards)?² |
| Repair and maintenance | <ul style="list-style-type: none"> • Does the product require active maintenance to reduce the risk of equipment-related injuries and accidents? • To what extent is maintenance easy (i.e., can the user or their family carry out maintenance independently, or is maintenance dependent on specialized services)? • Is there sufficient informational material and availability of repair and maintenance to prevent user dissatisfaction and possible abandonment of the product? • Who will carry out repair and maintenance (i.e., users and their families, manufacturers, issuing agencies, another agency)? • Does the product require a steady supply of accessories to function properly (e.g., batteries)? • Is there a back-up system for users whose equipment has to undergo lengthy repairs? • Is there a known product lifecycle with information on its end of support and/or end of life? |
| Training | <ul style="list-style-type: none"> • Does effective use of the product require lengthy or advanced training? • Can users or their families be trained to troubleshoot issues/carry out preventive maintenance and repair without external support? • Is it possible to create community-based support through training (e.g., a mobile service or regular meeting point in the community for people needing repairs for their devices)? |

² Most ISO international standards related to assistive products have been produced and are maintained by the ISO Technical Committees 168 (prosthetics and orthotics), 172 (optics and photonics) and 173 (assistive products for persons with disability). Some standards are concerned with products safety or appropriateness, others with properties measurement, and yet others with terminology and classification.

2.0 Mobility

Mobility assistive products enable people to walk or move. They have specialized features to accommodate the needs of the user. For example, a person with cerebral palsy may require a wheelchair with trunk or head supports to be able to maintain a good sitting position. The WHO 'Guidelines on the Provision of Manual Wheelchairs in Less Resourced Settings' is a useful reference for people involved in the design, production and distribution of wheelchairs. Examples of mobility products include:

- Wheelchairs
- Tricycles
- Crutches
- Walking sticks/canes
- Walking frames/walkers/Standing frames

Positioning devices assist people with physical impairments who often have difficulty maintaining good lying, standing or sitting positions for functional activities, and are at risk of developing injuries due to improper positioning. The following devices can help overcome some of these difficulties:

- Wedges
- Chairs (e.g., corner chairs, special seats)
- Standing frames

Daily living devices enable people with disabilities to complete the activities of daily living (e.g., eating, bathing, dressing, toileting, home maintenance). There are many examples of these devices, including:

- Adapted cutlery and cups
- Shower seats and stools
- Toilet seats and frames
- Commodes
- Dressing sticks

Walking canes/sticks

Description – Walking canes/sticks are used to facilitate walking for people with poor balance and/or difficulties walking due to weakness or pain in a lower limb. They help in redistributing weight from the affected lower limb and improving stability.

Product classification – ISO 9999: 2016 12 03 03 Walking sticks

Product standards

- ISO 24415-1:2009 Tips for assistive products for walking – Requirements and test methods – Part 1: Friction of tips
- ISO 10993: Biological evaluation of medical devices
- EN 12182

General features – A walking cane for children comprises a handle, a shaft and a tip that provides friction and prevents the cane from slipping on the ground. A common accessory is a wrist strap to prevent loss of the cane.

Indicative price – \$6 to \$50, depending on size, materials, whether the cane is height-adjustable and whether the design is ergonomic.

Repair and maintenance as applicable – The tip can be replaced as desired according to the environment (e.g., a special metal tip for safety in icy conditions), user preferences, or simply due to wear and tear. The grip handle can also be replaced.

Assessments and fitting – The handle should match the size of the user's hand. Considering the changing needs of a growing child, the shaft should be height-adjustable (telescopic). When standing upright with the arm hanging down and elbow straight, the wrist should be level with the top of the cane.

Use – Canes are generally held in the hand on the opposite side of the injured or weak lower limb. It is brought forward simultaneously with the affected limb, similar to arm swing in a person of normal gait. However, this can be overruled by personal preference or the need to hold the cane in the dominant hand.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Canes Galore, <<http://www.canesgalore.com/cheery-pediatric-offset-cane-p-1235.html>>

Quest 88,

<http://www.quest88.com/media/122128/quest_88_assisted_walking_brochure_2015_reduced.pdf>

Medical Eshop, <<http://www.medicaleshop.com/tfi-pediatric-offset-handle-adjustable-cane.html>>

Example illustration



Tripod/quadripod sticks

Description – Tripod and quadripod sticks are similar to walking canes, but have three or four ferrules at the base, thereby offering more stability.

Product classification – ISO 9999: 2016 12 03 16 Walking sticks with three or more legs

Product standards

- ISO 24415-1:2009: Tips for assistive products for walking – Requirements and test methods – Part 1: Friction of tips

- ISO 11334-4:1999: Walking aids manipulated by one arm – Requirements and test methods – Part 4: Walking sticks with three or more legs
- ISO 10993: Biological evaluation of medical devices

General features – A tripod or quadripod cane comprises a handle, a shaft and a base with three or four tips, such that the cane can stand upright by itself. The tips provide friction and prevent the cane from slipping on the ground. A common accessory is a wrist strap to prevent loss of the cane. Some quadripods are symmetrical and therefore are suitable for both left and right hand usage. All tripods and some quadripods are asymmetrical, in which case the handle can sometimes be rotated for right or left hand use, or the handle can be a fork type which does not need to be rotated.

Indicative price – \$14 to \$115 depending on size and whether it is a tripod or quadripod stick. Tripods are usually cheaper.

Repair and maintenance – The tip can be replaced as desired according to the environment or user preferences, or simply due to wear and tear. The grip handle can also be replaced.

Assessment and fitting – The handle should match the size of the user's hand. Considering a growing child, the shaft should be height adjustable (telescopic). When standing upright with the arm hanging down and elbow straight, the wrist should be level with the top of the cane.³

Use – The cane is generally held in the hand on the opposite side of the injured or weak lower limb. The cane is brought forward and placed firmly on the ground before the legs follow, first the weak leg, then the strong leg.⁴

References

European Assistive Technology Information Network, <www.eastin.eu>

Canes Galore, <<http://www.canesgalore.com/cheery-pediatric-adjustable-quad-cane-p-3507.html>>

Medical Eshop, <<http://www.medicaleshop.com/walk-easy-tripod-straight-neck-cane.html>>

Quest 88,

<http://www.quest88.com/media/122128/quest_88_assisted_walking_brochure_2015_reduced.pdf>

Hjælpe-middelbasen, <<http://www.hmi-basen.dk/r11x.asp?linkinfo=34929>>

<http://www.assistireland.ie/eng/Products_Directory/Walking_Standing_Devices/Tripods_and_Quadropeds/>

³ Sears, Brett, 'Quad Canes to Help with Walking', <<https://www.verywell.com/quad-canes-to-help-with-walking-2696069>>.

⁴ Sears, Brett, 'Quad Canes to Help with Walking', <<https://www.verywell.com/quad-canes-to-help-with-walking-2696069>>.

Example illustration



Elbow crutches

Description – A mobility aid with a perpendicular grip and vertical forearm support with a cuff that keeps the forearm in place. It allows the user to transfer some or all of their weight from one lower limb to the upper body.

Product classification – ISO 9999: 2016 12 03 06 Elbow crutches.

Product standards

- ISO 24415: Tips for assistive products for walking – Requirements and test methods
- ISO 10993: Biological evaluation of medical devices
- ISO 11334-1:2007: Assistive products for walking manipulated by one arm – Requirements and test methods – Part 1: Elbow crutches

General features – Forearm crutches consist of a grip, cuff, shaft and tip. The bearing parts (shaft and grip) are made from a lightweight durable material/metal, usually aluminium. The grip is usually covered by a plastic material, which may be contoured with an ergonomic design. The cuff is usually made of a plastic material and can either be open (wrapping around and supporting the back of the forearm) or closed (encircling the forearm). The tip is usually made of rubber and comes in different sizes and shapes. Most crutches are tip-to-grip height-adjustable, and many also have adjustable grip-to-cuff height.

Indicative price – \$15 to \$124. Pricing depends on the size, material, whether the elbow crutch can be adjusted and whether the grip and cuff are ergonomic.

Repair and maintenance – The tip can be replaced when worn or as desired according to the environment (e.g., a special metal tip for increased safety in icy conditions) and user preferences.

Assessments and fitting – Crutches should not be used by persons who have upper limb injuries which may be aggravated through their use. The height of the crutches should be adjusted so the elbow is slightly bent (15–30°) when standing with a straight back. When holding the grip, the cuff should be situated 2.5 to 5 cm below the elbow. It should be refitted as a child grows.⁵

⁵ WikiHow, 'How to Adjust Forearm Crutches', <<http://www.wikihow.com/Adjust-Forearm-Crutches>>.

Use – Usually two crutches are used together, one for each arm. When the injured, weak or disabled lower limb is non-weight-bearing, the user starts by standing on the good leg. Both crutches are then moved forward and placed on the ground, followed by the good leg hopping to, or slightly past, the tips of the crutches.

If the injured, weak or disabled lower limb is partially weight bearing, it is brought forward in line with the crutches. When walking upstairs, each step is climbed by advancing the good leg first, followed by the weak leg and crutches. When walking downstairs, the impaired leg is advanced first.⁶

If the crutches are used for balance, the right foot and left crutch is first moved forward, followed by the left foot and right crutch.⁷

References

European Assistive Technology Information Network, <www.eastin.eu>

Essential Aids, <<https://www.essentialaids.com/children-with-disabilities/paediatric-mobility/children-s-elbow-crutches.html>>

Senior Shop (Denmark), <<http://www.seniorshop.dk/product/Krykkestokke/Albuestok-Barn-1>>

Canes Galore, <<http://www.canesgalore.com/front-open-vinyl-crutch-pediatric-kiddie-standard-p-825.html>> Medical Eshop, <<http://www.medicaleshop.com/drive-medical-aluminum-forearm-crutch.html>>

Example illustration



Axillary crutches

Description – A mobility aid with a perpendicular grip and pad at the upper end, which is placed against the ribs beneath the armpit. It allows the user to transfer some or all of their weight from one lower limb to the upper body.

Product classification – ISO 9999: 2016 12 03 12 Axillary crutches

⁶ Physio Advisor, 'How to Use Crutches', <<http://www.physioadvisor.com.au/health/injury-rehabilitation/how-to-use-crutches/>>; Oxford University Hospital and NHS, 'Using Elbow Crutches', <<http://www.ouh.nhs.uk/patient-guide/leaflets/files%5C11679Pcrutches.pdf>>.

⁷ Drugs.com, 'Crutch Instructions', <<https://www.drugs.com/cg/crutch-instructions.html>> .

Product standards

- ISO 24415: Tips for assistive products for walking – Requirements and test methods
- ISO 10993: Biological evaluation of medical devices

General features – Axillary crutches consist of an axillary bar, a hand piece and double uprights joined distally by a single leg. The parts are made of wood or a lightweight metal such as aluminium tubing. The axillary bar and often the hand piece are coated/padded with soft plastic, rubber or foam. Both the total height and the height of the hand piece can be adjusted.

Indicative price – \$21 to \$76.

Repair and maintenance as applicable – The tip can be replaced when worn or as desired according to the environment (e.g., a special metal tip for icy conditions) and user preferences. The axilla and hand piece pads can usually be replaced as well. Underarm and hand grip cushion covers can be acquired; these protect the cushions from odours and are easy to detach and wash. Additional cushioning can sometimes be provided.

Assessment and fitting – The height of the crutches should be adjusted so there is space for two to three fingers between the top of the crutch and the armpit of the user (i.e., approximately 5 cm) when he/she stands straight. The hand piece should be adjusted so the elbow is slightly bent (15–30°) when standing with a straight back. Crutches should be refitted as a child grows.⁸

Use – The user should avoid resting their armpits on the axillary bar, as this can damage a nerve passing under the arm, eventually leading to ‘crutch palsy’ (temporary or permanent loss of sensation or muscle control in some parts of the affected arm). It is for short-term use only. Usually two crutches are used together, one for each hand. When the injured, weak or disabled lower limb is non-weight-bearing, the user starts by standing on the strong leg. Both crutches are then moved forward and placed on the ground, followed by the strong leg hopping to, or slightly past, the tips of the crutches.

If the injured, weak or disabled lower limb is partially weight-bearing, it is brought forward in line with the crutches. When walking upstairs, each step is climbed by advancing the stronger leg first, followed by the impaired leg and crutches. When walking downstairs, the impaired leg is advanced first.⁹ If the crutches are used for balance, the right foot and left crutch is first moved forward followed by the left foot and right crutch.¹⁰

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Essential Aids, <<https://www.essentialaids.com/mobility/crutches-crutch-accessories/aluminium-axilla-crutches.html>>

Medical Eshop, <<http://www.medicaleshop.com/drive-medical-pediatric-aluminum-crutches-pair.html>>

⁸ Drugs.com, ‘Crutch Instructions’, <<https://www.drugs.com/cg/crutch-instructions.html>>

⁹ Physio Advisor, ‘How to Use Crutches’, <<http://www.physioadvisor.com.au/health/injury-rehabilitation/how-to-use-crutches/>>; Oxford University Hospital and NHS, ‘Using Elbow Crutches’, <<http://www.ouh.nhs.uk/patient-guide/leaflets/files%5C11679Pcrutches.pdf>>.

¹⁰ Drugs.com, ‘Crutch Instructions’, <<https://www.drugs.com/cg/crutch-instructions.html>>.

E Special Needs, <<https://www.especialneeds.com/shop/mobility/canes-crutches/crutches/walk-easy-youth-under-arm-crutches.html>>

One Med (Denmark),

<https://www.onemed.dk/Produkter/Rehab/Stokke_og_tilbehr/Armhule_og_underarm/289580.1>

Example illustration



Walking frames

Description – Definition from ISO 11199-2:2005: A walking aid with built-in handgrips and three or more legs of which two or more have wheels, which provide support whilst walking, for balance or stability. It consists of a height-adjustable frame slightly wider than the user, without wheels and with no support devices other than handles. The user stands and walks behind and inside the frame, with the handles positioned laterally and anterior to the hips.

Product classification – ISO 9999: 2016 12 06 03 Walking frames

Product standards

- ISO 24415: Tips for assistive products for walking – Requirements and test methods
- ISO 10993: Biological evaluation of medical devices
- ISO 11199-1:1999: Walking aids manipulated by both arms – Requirements and test methods – Part 1: Walking frames

General features – A walking frame consists of a frame with horizontal handgrips at the top, which are attached to corresponding handles. The frame is usually made of lightweight metal tubing, such as aluminium tubing. All four legs have rubber tips/ferrules. The legs are height-adjustable. They are often foldable and rarely include a seat. It is often possible to exchange the tips with wheels (swivel or fixed, with or without push down breaks, cable breaks or castor breaks) or ski glides, transforming the standard walking frame into a rollator.

Indicative price – \$28 to \$91, but can be as high as \$300.

Repair and maintenance – Tips and handgrips can be replaced.

Assessment and fitting – If the user needs to lean against the walker for balance, or if stability is a significant concern, a standard walking frame may be preferred to a rollator. However, the user must be

strong enough to pick it up and place it down. The height of the frame must be adjusted so that the handgrips line up with the crease on the inside of the user's wrist when he/she is standing straight with relaxed arms and shoulders. When holding the handgrips, the elbows should be slightly bent, at an angle of about 15°. For a child, it should be readjusted as the child grows.¹¹

Use – The walking cycle for the walking frame is as follows: move the walker forward and place it on the ground. Place first one leg (the injured or weak limb), then the other, inside the walker and repeat. The user should keep his/her back upright at all times. The walking frame is not operable on stairs.¹²

References

European Assistive Technology Information Network, <www.eastin.eu>

Walgreens,

<<https://www.walgreens.com/store/store/category/productlist.jsp?N=361793&Eon=361793&No=24>>

Better Life Healthcare, <<http://www.betterlifehealthcare.com/browse/walking-frames-and-wheeled-walkers/>>

Independent Living Centres (Australia), <<http://ilcaustralia.org.au/products/726>>

Example illustration



Rollators

Description – Definition from ISO 11199-2:2005: A walking aid with built-in handgrips and three or more legs of which two or more have wheels, which provides support whilst walking.

Product classification – ISO 9999: 2016 12 06 06 Rollators

Product standards

- ISO 24415: Tips for assistive products for walking – Requirements and test methods
- ISO 10993: Biological evaluation of medical devices

¹¹ Mayo Clinic, 'Slideshow: Tips for choosing and using walkers', <<http://www.mayoclinic.org/healthy-lifestyle/healthy-aging/multimedia/walker/sls-20076469?s=3>>.

¹² Mayo Clinic, 'Slideshow: Tips for choosing and using walkers', <<http://www.mayoclinic.org/healthy-lifestyle/healthy-aging/multimedia/walker/sls-20076469?s=4>>.

- ISO 11199-2:2005: Walking aids manipulated by both arms – Requirements and test methods – Part 2: Rollators

General features – A rollator consists of a frame with horizontal handgrips at the top, which are attached to corresponding handles. The frame is usually made of lightweight metal tubing, such as aluminium tubing. The legs are height-adjustable. Rollators can be divided into two main types:

- 1) Frames with wheels/castors at the two front legs and tips at the two rear legs (two-wheeled walker).
- 2) Frames with three or four wheels/castors and no tips.

Type 1 is often foldable and rarely incorporates a seat. It is often possible to exchange the rear tips with ski glides, making them easier to manoeuvre in a home with carpets.

Type 2 is sometimes foldable and often incorporates a seat (which could feature padding, flip-up design and/or a back rest). In many cases, a basket or pockets are attached. The front wheels are usually swivel wheels, while the rear wheels are fixed.

Multiple braking systems exist, including parking brakes that stay engaged after activation, cable brakes operated by the user during walking, and pressure brakes that engage when a vertical load is applied.

Some wheeled walkers are placed behind the user (posterior walkers, which facilitate postural alignment and balance; these are supposedly better for children with cerebral palsy or other musculoskeletal impairments). Others are pushed in front of the user (anterior walkers). Some types can be transformed into a simple manual push type wheelchair.

Indicative price – The basic two-wheeled rollators are approximately in the same price range as basic walking frames with no wheels, i.e., \$54–\$160. Four-wheeled walkers range from \$117 to \$300 (and can reach \$1,000) depending on complexity, padding, braking system and accessories. A basic four-wheeled rollator can have multiple optional accessories, such as a folding seat, pelvic stabilizer, forearm supports and seat harness.

Repair and maintenance as applicable – Tips, wheels, handgrips and braking systems are essential features that should be replaced when worn out or broken.

Assessment and fitting – A two-wheeled walker allows the user to easily push the walker forward between steps, while still allowing leaning against the walker when taking a step. The legs with tips prevent the walker from rolling during the stepping phase. If the user does not need to lean into the walker for balance, a four-wheeled walker may be preferable.

The height of the walker must be adjusted such that the handgrips of the walker line up with the crease on the inside of the user's wrist, when he/she is standing straight with relaxed arms and shoulders. When holding the handgrips, the elbows should be slightly bent, at an angle of about 15°. ¹³

¹³ Mayo Clinic, 'Slideshow: Tips for choosing and using walkers', <<http://www.mayoclinic.org/healthy-lifestyle/healthy-aging/multimedia/walker/sls-20076469?s=3>>.

Use – The walking cycle for the two-wheeled anterior walker is as follows: move the walker forward and place it on the ground. Place first one leg (the weak limb), then the other, inside the walker, and repeat. The user should keep their back upright at all times. If the walker is used only for balance, the user can stand inside it and walk as they would normally do, simply pushing along the walker. For this purpose, the three- or four-wheeled walker/rollator may be preferable.

References

European Assistive Technology Information Network, <www.eastin.eu>

Exyo Project (United Kingdom), <<http://exyo.co.uk/>>

1800Wheelchair.com, <<http://www.1800wheelchair.com/product/guardian-tyke-pediatric-walker/>>, <<http://www.1800wheelchair.com/product/pediatric-anterior-safety-roller/>>

Rehab Mart, <<http://www.rehabmart.com/product/wenzelite-nimbo-lightweight-posterior-safety-walker-10550.html>>

Especial Needs, <<https://www.especialneeds.com/shop/mobility/gait-trainers-walkers.html?p=1>>, <<https://www.especialneeds.com/duet-transport-chair-rollator.html>>

Just Walkers, <<http://justwalkers.com/nimbo-rehab-lightweight-posterior-posture-walker.html>>

Essential Aids, <<https://www.essentialaids.com/children-with-disabilities/paediatric-mobility.html>>

Example illustration

Paediatric rollator (four-wheel), foldable rollator (two-wheel), and posterior walker.



Standing frames (adjustable)

Description – Used by persons relying on a wheelchair for mobility. Provides an alternative position other than sitting, by supporting the user in a standing position. Standing frames benefit the bones in the legs by preventing osteoporosis. They improve the circulation and digestion and help to improve/maintain range of motion, decrease contractures, manage pressure ulcers, and increase strength and endurance. A standing frame can be static or mobile and is often equipped with a table.

Product classification – ISO 9999:200704 48 08 Standing frames

Product standards

- ISO 10993: Biological evaluation of medical devices

General features – There are five different types of standing frames that all include features for foot/heel fixation, knee fixation and seat/back support:¹⁴

- 1) Upright/vertical standing frames are the simplest type of standing frames. They consist of a bottom plate with foot restraints, and two vertical bars, between which the user can stand with the aid of suspended chest supports, pelvic supports and knee supports. Another configuration is a foot plate/base and one vertical bar, to which knee, pelvic, and optionally chest supports are attached.
- 2) Sit-to-stand frames, which require a transfer, consist of a planar seat, knee pads, foot plates, back support, a chest pad or chest strap, and a lifting system. The lifting system usually allows for stopping at any angle between sitting and standing and is most often managed by a gas spring lift, operated by a caregiver, or a hydraulic pump or battery-driven lift, which can also be managed by the user. The standing frame can either have tips or wheels/casters. Optional accessories include a tray, chest vest, alternative options for seating and back rest, head support, hip supports, lateral supports, foot straps, pelvic belt, hand grips, push handles and seat angle locators.

Another type of sit-to-stand device is the strap stander that uses one or two straps to lift the user out of the wheelchair. This system works well for larger, heavier adolescents and adults, since transfer is unnecessary, although it requires that the user have head control and fair trunk control. It includes foot plates, knee pads, a chest pad and a lifting strap/harness.

- 3) Prone, supine or multi-position standers can be tilted to different degrees. Usually, the person in the stander cannot control the stander's position. In multi-position standers, the person can be reversed, i.e., be placed in either prone or supine positions, depending on their abilities.
- 4) Mobile standers can either be sit-to-stand, prone or upright standers, with an incorporated system that allows the user to propel themselves while in a standing position. These are for users who have good head control and upper body strength.
- 5) Active/dynamic standers are less rigid standing frames that allows simultaneous movement of arms and legs in a reciprocal motion.

Indicative price – Upright/vertical standers cost between \$693 and \$2,600. Sit-to-stand standers range from \$1,822 to \$2,800. Prices for prone, supine and multi-position standers range between \$1,150 and \$4,200. Active/dynamic standers with a gliding system can cost \$5,300 to \$7,500. Some standers have optional accessory features that make them mobile; these can cost over \$1,000.

Repair and maintenance as applicable – The lifting system in a sit-to-stand stander can become dysfunctional and may have to be replaced. Pads, belts and cushioning can be worn out and castors can break.

¹⁴ Warner, Mark, 'Standing Tall: The benefits of standing devices',
<<http://www.rifton.com/resources/articles/2007/march/standing-tall>>.

Assessments and fitting – People who have multiple sclerosis, muscular dystrophy, cerebral palsy, spina bifida, strokes or spinal cord injury (paraplegics/quadruplegics) often use standing frames. Contraindications for using a standing frame include osteogenesis imperfecta, severe contractures, osteoporosis and cardiac/circulatory issues. A qualified physician should be consulted before a standing programme is commenced. All standing frames can be adjusted easily to fit the individual, i.e., kneepads, hip straps, chest pad and in some cases foot plates/straps, headrest, etc., are height-/width-/depth-adjustable.

Use – Instruction by a physiotherapist is essential. The recommended standing duration varies from 12–60 minutes per day, and multiple shorter periods of standing may be more beneficial than one prolonged period.

References

European Assistive Technology Information Network, <www.eastin.eu>

Rehab Mart,

<http://www.rehabmart.com/category/pediatric_standers,_standing_frames_and_systems.htm>

Easy Stand, <<http://easystand.com/>>

Leckey, <<http://www.leckey.com/products/>>

Oswestry Frames, <<http://www.oswestry-frames.co.uk/home>>

Special Needs Equipment, <<http://specialneedsequipment.eu/category/19/standing-frames.html?gclid=Cj0KEQjw3ZS-BRD1xu3qw8uS2s4BEiQA2bcfM8gpieM5-MpVRxbAg8j1jTSjZ5jdtP6ggczeTgT7hcMaAudQ8P8HAQ>>

Special Needs Solutions (Australia), <<https://www.specialneedssolutions.com.au/browse/standing-frames/>>

Adaptive Mall, <<http://www.adaptivemall.com/sist.html>>

Tadpole Adaptive, <<https://tadpoleadaptive.com/special-needs-standers.html>>

Alreh Medical, <<http://alreh.com/>>

Example illustration



Wheelchairs: Overview

The International Society of Wheelchair Professionals and The United States Agency for International Development (USAID) provide lists of disability products intended for users in low-resource settings and their respective manufacturers.¹⁵

Paediatric wheelchairs are available and are adjustable to accommodate the growth of a child, up to a point. Prices vary depending on quality and features (i.e., some complex paediatric wheelchairs may be more expensive than basic adult ones.)

Wheelchairs, manual basic type for active users

Description – A chair with wheels used by people who are incapable of walking, but whose upper body function and strength is intact.

Product classification – ISO 9999:2007 12 21 06 Bimanual rear-wheel driven wheelchairs

Product standards

- ISO 7176: Wheelchairs
- ISO/TR 13570: Wheelchairs (technical report related to ISO 7176)
- ISO 16840: Wheelchair seating
- ISO 10993: Biological evaluation of medical devices
- EN 12183

General features – A manual basic wheelchair consists of a seat and back rest (seating support system), a foot rest, one or two swivel castor wheels at the front, and two larger wheels at the rear with push rims or, in some cases, levers for manual propulsion and steering by the user. Wheels incorporating a lever propulsion system are often bought separately and are used in place of the normal wheels. The chair frame is usually made of aluminium or titanium, and can be rigid or foldable.

Different types of push-rims are available, some of which may be easier and/or safer to operate. Different types of tires (inflatable or solid) can also be chosen.

Optional features include push handles at the top rear of the back support, for manual propulsion by a second person; spoke guards/protectors; wheel brakes/locks; flip-up arm rests; calf supports/pads on the leg rests; different medial/lateral/anterior/posterior/superior/inferior supports; (fendered) side guards; anti-tip wheels/bars that prevent the wheelchair from tipping backwards; and shock absorbing front castors. Some wheelchairs have a camber angle to their wheels for better stability. The leg rests are usually of the flip-up or swing-away type.

The options for adjustment on multi-adjustable wheelchairs include: multiple vertical and horizontal rear wheel positions, seat angle, front castor position and angle, footrest length and position, backrest height, back angle, wheel-lock position and type, seat width, seat depth, seat-surface height, rear wheel camber, armrest height, type and size of wheels and castors. Alternatively, the seating dimensions can

¹⁵ International Society of Wheelchair Professionals, <<http://wheelprogress.org/>>; USAID, 'Resource List: Wheelchairs for less resourced settings', <https://www.wheelchairnet.org/ISWP/Documents/ISWP_WCProductTable04282015.pdf>.

be altered through cushioning thickness, by adding padding or a solid insert under or behind the cover.¹⁶

Indicative price – \$30 to \$5,900, depending on material (titanium is the most expensive), type of wheels (the quick-release type is more expensive), foldability of the chair, the material used for the seating support system and cushions, how customizable it is, and how sophisticated the wheelchair mechanics are.

Repair and maintenance – Mag wheels are essentially maintenance-free but heavier than spoke wheels. Spoke wheels are maintained in the same way as bicycle wheels, and spare parts (e.g., tubes, tires, spokes, patches, nuts and bolts) can be acquired from standard bicycle shops. Tools needed for basic repair include: hex wrench (Allen keys), socket wrench, adjustable wrench, head screwdriver, tire lever and tire pump for pneumatic tires. The chair frame should be cleaned and waxed regularly, the wheel axles should be cleaned and oiled, and the remaining chair should be cleaned and inspected for tire pressure, loose/bent spokes, bottomed-out cushioning, loose wheel locks, loose nuts and bolts, proper positioning/adjustment, wheel alignment and cracks in the frame.

Assessment and fitting – A wheelchair must be fitted to the individual for the user to experience maximum comfort and mobility, and in order to prevent injuries. For children, it is essential to ensure that the wheelchair is adjusted as the child grows. Inattention to proper fit for growing children could result in discomfort and pain.

The optimal sitting position for most wheelchair users is a seat-to-back angle of 90°–100° and a knee angle of 90°–120°. Both the feet and thighs should be well supported by the footrest and cushion/seat, respectively. The seat should be as narrow as possible without touching the hip bones. There should be about half an inch of space on either side of the thighs. On the other hand, the correct seat depth typically permits one inch of space between the front edge of the cushion to the back of the knees. Usually, the front castors and rear wheels have two to three possible positions of the wheel axle that can be used to adjust the front and rear height of the chair, respectively.¹⁷

Use – When using the wheelchair, the user should keep as upright as possible, i.e., he/she should not lean forward or slide down in the seat. The user, family or caregiver should know how to repair and maintain the wheelchair and have access to the necessary training and tools for doing so.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>
1800Wheelchair.com, <<http://www.1800wheelchair.com/category/manual-wheelchairs/>>
Walgreens, <https://www.walgreens.com/store/store/category/productlist.jsp?N=361785&Eon=361785&Ns=Final_Price&Nso=1&>

¹⁶ USAID, 'Resource List: Wheelchairs for less resourced settings', <http://www.wheelchairnet.org/WCN_ProdServ/Docs/MWTG/Sec2/sec2.html>.

¹⁷ World Health Organization, 'Guidelines on the Provision of Manual Wheelchairs in Less Resourced Settings', 2008, <[http://www.who.int/disabilities/publications/technology/English%20Wheelchair%20Guidelines%20\(EN%20for%20the%20web\).pdf](http://www.who.int/disabilities/publications/technology/English%20Wheelchair%20Guidelines%20(EN%20for%20the%20web).pdf)>; World Health Organization, 'Fact Sheet on Wheelchairs', <http://www.searo.who.int/entity/disabilities_injury_rehabilitation/wheelchair_factsheet.pdf>.

Mountain Trike, <<http://www.mountaintrike.com/product/mountain-trike/>>

Grit Freedom Chair, <<http://www.gogrit.us/lfc/>>

Wicked Wheelchairs, <<http://www.wickedwheelchairs.com.au/wheelchairs.html>>

Nu-drive Air, <<http://www.nu-drive.com/>>

SafariSeat (Kickstarter project, China), <<https://www.kickstarter.com/projects/safariseat/safariseat-open-source-wheelchair-for-developing-c/description>>

Example illustration



Wheelchairs, manual push type

Description – This wheelchair is similar to the manual basic wheelchair with push handles, designed to be propelled by a caregiver or friend who will push the wheelchair using the handles. The back wheels are rimless and often smaller than those on the manual basic wheelchair. Manual push type wheelchairs are lightweight, easy to manoeuvre (and often foldable). They are typically used for transport over short distances, e.g., in hospitals and airports.

Product classification – ISO 9999:2007 12 21 03 Manual attendant controlled wheelchairs

Product standards

- ISO 7176: Wheelchairs
- ISO/TR 13570: Wheelchairs (technical report related to ISO 7176)
- ISO 16840: Wheelchair seating
- ISO 10993: Biological evaluation of medical devices

General features – A manual push type or transport wheelchair consists of a frame, usually foldable, seat and back rest, arm rests (fixed or flip-up), foot rests, four wheels and push handles. The front wheels are swivel castors, while the rear wheels are fixed with wheel locks. Most chairs feature a flexible sling design, where the fabric of the seat and backrest is stretched between the sides of the chair. Some transport chairs feature solid, one-piece bar footrests, but most offer separate, adjustable footrests. Transport chairs are designed to be easy to transport and stow away; this is prioritized over comfort. Some chairs are hybrids that can function both as a rollator and transport chair. Some transport chairs recline or tilt, and some offer the option of adding accessories for additional support, such as head rests or calf supports.

Indicative price – \$60 to \$580. Bariatric chairs and chairs with improved comfort are usually the most expensive. Chairs with features such as recline, tilt or optional accessories for individual adjustment (in case of severe disability) can cost up to \$1,700.

Repair and maintenance – Usually transport chairs have airless/solid tires, which require essentially no maintenance. The wheelchair should be cleaned and checked regularly. Upholstery, wheels/bearings and padding on arm rests and push handles can wear out and may need replacement.

Assessments and fitting – Transport wheelchairs are intended to be used for short amounts of time, due to their poor seating support. They are for persons with transient mobility issues, or persons who can still walk by themselves, but tire easily. If the wheelchair is to be used for longer periods of time (more than two hours), it is recommended to use seat and back cushions for comfort.¹⁸

Use – Users and caregivers should be aware that transport wheelchairs are not appropriate for long-term usage.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>
Parent Giving, <<http://www.parentgiving.com/shop/transport-chairs-429/c/>>
1800Wheelchair, <<http://www.1800wheelchair.com/category/369/transport-wheelchairs/?dir=asc&order=price>>
Medical Eshop, <<http://www.medicaleshop.com/manual-wheelchairs/transport-wheelchairs.html>>
Alibaba, <<https://www.alibaba.com/showroom/wheelchairs-for-cerebral-palsy-children-sale.html>>
Drive DeVilbiss Medical, <<http://www.drivemedical.com/index.php/wheelchairs/transport-chairs.html>>
Walgreens, <https://www.walgreens.com/store/store/category/productlist.jsp?N=361783&Eon=361783&Ns=Final_Price&Nso=1&No=48&>

¹⁸1800Wheelchair.com, 'Transport Wheelchairs', <<http://www.1800wheelchair.com/category/369/transport-wheelchairs/>>, Just Walkers, 'What to Look for in a Transport Wheelchair', <<http://justwalkers.com/wheelchairs-tips/>>.

Example illustration



Wheelchairs, power-assisted

Description – A power-assisted wheelchair is basically a manual basic wheelchair with a power assist add-on for users who have reduced upper body strength. It increases the possible travel distance and propulsion efficiency while retaining the functionality of a manual wheelchair.

Product classification – ISO 9999:2007 12 21 12 Manual wheel-driven power assisted wheelchairs

Product standards

- ISO 7176: Wheelchairs
- ISO/TR 13570: Wheelchairs (technical report related to ISO 7176)
- ISO 16840: Wheelchair seating
- ISO 10993: Biological evaluation of medical devices
- IEC 60601: Medical electrical equipment

General features – A manually driven wheelchair can generally be converted to a power-assisted wheelchair by adding one of three types of accessories:

- The wheels are replaced with power-assisted wheels equipped with battery-powered motors in the hubs. The power sensor in the wheel senses the pressure applied on the push rims by the user and activates the motors proportionately. In some cases, the wheels come with a joystick, making it possible to switch between manual and electrically powered configuration as desired. In both cases, anti-tip wheels/bars are usually attached to prevent the wheelchair from tipping over backwards.
- An external motor with one or more wheels is attached to the back of the wheelchair between the rear wheels. Again, the power sensor in the wheel either senses the movement of the wheelchair, providing assisting power accordingly, or is controlled by a joystick and can be turned on and off as desired.
- A device with two small motor-powered wheels can be attached to the back of the chair, such that the wheels are in close contact with the rims of the existing wheels. When the cylinders

spin, so do the wheels. The device either senses the movement of the wheelchair, providing assisting power accordingly, or is controlled by a joystick and can be turned on and off as desired.

Another type of assisted power comes from hand bike add-ons, i.e., a wheel with a tiller for steering or hand pedals for both propulsion and steering, attached at the front of a manual basic wheelchair, thereby lifting up its front castors. It can either be fully electrically powered or power-assisted (hybrid). In some cases, the power assist system and wheelchair are purchased as a single unit and cannot be separated. These most often allow for switching between manual and electric joystick-control drive. In power assist systems, the motor is driven by a rechargeable battery.

Price range – Prices for power assist add-on systems with battery-powered motors in the hubs range from \$920 to \$7,100. Add-on systems that attach to the back of the chair can cost from \$1,700 up to \$10,000. Add-on systems that attach to the front of the chair, turning it into a three-wheeled scooter or hand cycle, cost between \$500 and \$8,200. Wheelchairs purchased with an integrated power assist system cost between \$350 and \$4,000.

Repair and maintenance – Access to batteries and a power outlet for recharging them is essential.

Assessment and fitting – Power assist add-on systems must be fitted to the wheelchair. Wheelchairs with built-in power assist systems should be fitted in the same way as manual basic wheelchairs.

Use – N/A

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>
<<http://www.medicaleshop.com/manual-wheelchairs/power-add-on-systems.html>>
AAT The Stair Climber People, <<http://www.aatgb.com/servo.html>>
The Living Centre, <<http://www.thelivingcentre.co.uk/wheelchairs/wheelchair-powerpacks.html>>
Gerald Simonds, <http://www.gerald-simonds.co.uk/catalog/index.php?CG_ID=5>
Benoit Systemes, <<http://www.benoitsystemes.com/motorisation2.html>>
Ability in Motion (Australia), <<http://abilityinmotion.com.au/products/power-assist-add-ons/>>
Wicked Wheelchairs, <<http://www.wickedwheelchairs.com.au/power-assist1.html>>
Bike-on, <<https://bike-on.com/handcycles/attachable-handcycles?dir=asc&order=shoxwheelchairtires>>

Example illustration



Power-assisted wheels



Detachable e-powered wheel



Detachable e-powered wheel



Detachable propelling device



Detachable power-assisted hand cycle



Detachable powered wheel cycle



Built-in e-powered wheels – joystick-controlled

Wheelchairs, powered/electrical

Description – A wheelchair powered by an electric motor, used by severely impaired individuals or those who do not have the upper body strength to propel a manual wheelchair.

Product classification – ISO 9999:2007 12 21 24 Electric motor-driven wheelchairs with manual steering

Product standards

- ISO 10993: Biological evaluation of medical devices
- ISO 7176: Wheelchairs
- ISO/TR 13570: Wheelchairs (technical report related to ISO 7176)
- ISO 16840: Wheelchair seating

- IEC 60601: Medical electrical equipment
- EN 12184

General features – An electrically powered wheelchair consists of a seat and back rest (seating support system), footrests and armrests. Usually, it is propelled by two larger wheels, for which the motor power is derived from an integral source of electric power. It can either be front- or rear-wheel drive with two smaller additional wheels/castors, or mid-wheel drive with four smaller additional wheels/castors. Scooters are a type of electrically powered wheelchairs with three or four wheels and a tiller for direct steering. The user directs the wheelchair to move at the desired speed and/or in the desired direction of travel by means of a control device; the standard is a small joystick mounted on an armrest, but other control devices are optional depending on the type and severity of the user's disability (e.g., allowing for steering by the chin).

Powered chairs usually have four standard powered seating options: tilt in space, seat elevation, recline and leg elevation. Possible manual adjustments include seat angle, footrest length and position, backrest height, back angle, seat depth, seat-surface height, armrest height, head support height and forward/backward position.

In addition, different types of medial/lateral/anterior/posterior/superior/inferior supports (e.g., a headrest) and cushioning can be added. The leg rests can be static, flip-up or swing-away.

Some powered chairs have an integral seat, meaning that the seating system and drive system cannot be separated. Others come in three parts: the powerbase containing the drive system, batteries and wheels; the seating; and the control device. Some are foldable.¹⁹

Indicative price – Prices generally range from \$265 to \$4,000. Some powered chairs adapted for very rough and steep terrain can cost up to \$16,000.

Repair and maintenance – As electric wheelchairs are battery-powered, services for recharging the battery are essential. The condition of the wheelchair should be regularly inspected: condition of cushions, upholstery and tires; pressure in pneumatic tires; wheelchair alignment; wheel bearings; tightness and alignment of back/arm/leg/foot supports. Frame, cushions and castor axles should be cleaned regularly. Upholstery, cushions, tires, tubes, bearings, suspensions and castors will have to be replaced when broken or worn out. Educated personnel are needed to inspect the motor, battery charger, control device and wiring/connections.²⁰

Assessment and fitting – In cooperation with a physiotherapist (or other trained staff), the intended user should assess whether an electrically powered chair is necessary compared to other alternatives. The chair should be fitted to the needs of the individual, according to the person's size and severity of the impairment.

¹⁹ Spinal Cord Injuries Australia, 'Wheelchair Selection: Power chairs', <<https://www.youtube.com/watch?v=NNTfbj-L02c>>.

²⁰ Toro, Maria, et al., 'Basic Wheelchair Maintenance Training for Manual and Power Wheelchair Users', <http://www.iss.pitt.edu/iss2015/ISS2015Handouts/IC40_Handouts.pdf>.

Use – In order to prevent damage to the chair and its user, the latter should know the capability and limits of the wheelchair. The user, family or caregiver should have basic knowledge of how to repair and maintain the wheelchair and have access to the necessary tools for doing so.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>
1800Wheelchair, <<http://www.1800wheelchair.com/category/335/motorized-wheelchairs/>>
Walgreens, <https://www.walgreens.com/store/store/category/productlist.jsp?N=365482&Eon=365482&Ns=Final_Price&Nso=1&>
Sunrise Medical, <<http://www.sunrisemedical.com/power-wheelchairs/zipie/mid-wheel-drive>>
Medical Eshop, <<http://www.medicaleshop.com/special-needs-kids/pediatric-wheelchairs/pediatric-power-wheelchairs.html>>
Ali Express, <https://www.aliexpress.com/premium/electric-wheelchair.html?type=wholesale&d=y&origin=y&isViewCP=y&catId=0&initiative_id=SB_20160914033325&SearchText=electric+wheelchair&blanktest=7>

Example illustration



Tricycles

Description – A tricycle works like a bicycle, with two rear wheels and one front wheel used for steering. A tricycle wheelchair is pedalled and steered by the hands of the user. Compared with basic wheelchairs, tricycles are more robust on uneven terrain.

Product classification – ISO 9999:2007 12 18 09 Hand-propelled tricycles

Product standards

- ISO 7176: Wheelchairs
- ISO/TR 13570: Wheelchairs (technical report related to ISO 7176)
- ISO 16840: Wheelchair seating
- ISO 10993: Biological evaluation of medical devices

General features – Tricycle wheelchairs consist of a frame with a seating system, hand pedal(s) and three wheels. The wheels can either be positioned in a delta configuration, i.e., one front wheel and two

rear wheels, or a tadpole configuration, i.e., two front wheels and one rear wheel. Delta configurations are most common.

Different propulsion and steering configurations exist:

1. Propulsion and steering function are separated – A turning handle/hand pedal is manually turned with one hand, while the vehicle is steered with the other hand by turning the front wheel with a tiller. These can be one-hand drive, where the hand pedal is positioned at one side only, or two-hand drive, with hand pedals at both sides.
2. Propulsion and steering function are integrated – Two pedals are positioned centrally in front of the user. Both are used for propelling and steering. The relative position of the pedals can coincide or be shifted by 180° (similar to normal bicycles).
3. Propulsion and steering function are integrated – The front wheel is connected to a tiller or steering wheel by which the user propels and steers the chair. By pushing and pulling the tiller or steering wheel back and forth in a rowing fashion, propulsion is achieved.
4. Clip-ons – A front wheel with integrated propulsion and steering function (configuration 2 or 3) is clipped onto a normal wheelchair, transforming it into a tricycle. It can be detached in situations where a basic push-rim wheelchair is more practical, e.g., when the user is indoors or accessing a toilet. Clip-ons are always front-wheel drive, which makes it more difficult to climb steep hills.

Indicative price – Tricycles cost between \$112 and \$1,000. The clip-ons cost between \$1,190 and \$4,500. One organization provides a clip-on tricycle attachment that fits with their three-wheeled wheelchair for \$117. Tricycles with propulsion and steering configuration 3 are less widespread. A wheelchair manufacturer in Viet Nam produces tricycles of this type for \$184 to \$284.

Repair and maintenance – It should be possible to repair a tricycle using standard bicycle parts, which are locally available in most areas of the world. Basic tools and a pump should be provided with the chair.

Assessment and fitting – A wheelchair must be fitted to the individual for the user to experience maximum comfort and mobility, and in order to prevent injuries from developing. Optimal sitting position for most wheelchair users is a seat-to-back angle of 90°–100° and a knee angle of 90°–120°. Both the feet and thighs should be well supported by the footrest and cushion/seat, respectively. The seat should be as narrow as possible without touching the hip bones. There should be about half an inch of space on either side of the thighs. On the other hand, the correct seat depth typically permits one inch of space between the front edge of the cushion to the back of the knees.

Use – Training on how to transfer in and out of the tricycle and how to operate (propel and steer) it is necessary.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>
Artificial Limbs Manufacturing Corporation of India,
<http://www.alimco.in/content/843_1_Tricycles.aspx>

WheelchairIndia, <<https://www.wheelchairindia.com/Wheelchair/0/TRICYCLE>>
Wheelchairs of Nigeria, <<http://www.wheelchairsfornigeria.org/>>
Tempo Tricycle (Australia), <<http://www.tempotricycle.com/>>

Clip-ons:

Motivation, <<https://www.motivation.org.uk/tricycle>>
Da Vinci Mobility, <<http://www.davincimobility.com/handcycles-handbikes>>
Armbike, <<http://www.armbike.se/>>

Example illustration



3.0 Environment

Pressure relief cushions

Description – Cushions and pads designed for management of tissue loads and microclimate. They range from simple pillow-like inserts to individualized conforming cushions. They are used in seats of wheelchairs and special needs chairs, where they provide pressure redistribution and reduce shear and friction of the skin, thereby preventing development of pressure ulcers (bedsores). They also help to absorb shocks and provide stability, comfort and posture control.

Product classification – ISO 9999:2007 04 33 03 Seat cushions and underlays for pressure-sore prevention

Product standards

- ISO 16840: Wheelchair seating
- ISO 10993: Biological evaluation of medical devices

General features – Pressure redistribution cushions used for wheelchair seats consist of a cushion and a cover that can be detached and washed separately. Seat cushions can be flat or contoured. The contoured types are designed to reduce sacral sitting, reduce leg elevation and prevent forward sliding and thrusting. They usually feature contoured leg abductors and adductors (to increase seating surface area and promote postural alignment), a pommel (to prevent forward migration, thereby maintaining posture and minimizing shear), a low-profile/waterfall front (to reduce pressure behind knees and thighs) and a posterior cut-out (to reduce pressure on the coccyx, ischial bones and perineum). Foam cushions that have crosscut surface are able to move with the body, which reduces friction and shear of the skin. It also improves ventilation compared with foam cushions with a flat surface, which can act as an insulator. Gel cushions conform well to the body and are able to conduct heat away from the skin, but they can be very heavy.

Common cushion materials include polyurethane foam, viscoelastic (memory) foam, elastic foam, gel, air/water-filled pockets, or a combination of materials, e.g., gel pad and foam.²¹

Indicative price – \$14 up to \$500. The cheapest cushions are usually non-contoured, relatively thin and made of only one type of non-memory foam. Thicker cushions made with memory foam are more expensive, while the contoured types made of several materials, including gel layer inserts, are the most expensive.

Repair and maintenance – The cushion cover should be regularly cleaned, and the cushion needs to be washed (if washable) and inspected for bottoming out. Foam deteriorates if exposed to heat and/or ultraviolet light and should be replaced every six to nine months. Some cushions are designed to last longer, providing they are maintained appropriately. Flat/non-contoured foam cushions should be regularly turned, on a weekly basis, in order to prolong their life expectancy and pressure redistribution properties.²²

Assessment and fitting – Cushions should be available in different widths and lengths and should be selected based on the user's size. Often it is possible to cut the cushion to the size of the wheelchair. If it is contoured, it should only be cut in length by skilled wheelchair service practitioners.

Use – It is essential that users and caregivers are instructed in maintaining the cushions, and assessing whether replacement is required. They should be instructed to regularly assess the state of the skin in areas that are at risk of developing pressure ulcers. They should be informed of factors that increase or decrease the risk (e.g., regular and timely repositioning) and about what to do if pressure ulcers develop.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

²¹ Assist Ireland, 'Choosing Pressure Relief Equipment', <http://www.assistireland.ie/eng/Information/Information_Sheets/Choosing_Pressure_Relief_Equipment.html#_Toc98911853>.

²² Assist Ireland, 'Choosing Pressure Relief Equipment', <http://www.assistireland.ie/eng/Information/Information_Sheets/Choosing_Pressure_Relief_Equipment.html#_Toc98911853>.

Assist Ireland,

<http://www.assistireland.ie/eng/Information/Information_Sheets/Choosing_Pressure_Relief_Equipment.html>

Motivation, <<https://www.motivation.org.uk/universal-cushion>>

Jarik Medical, <<http://www.jarikmedical.com/>>

HKTCD, <<http://www.hktdc.com/suppliers-products/Air-Cushion/en/1X00GNV8/2703692/>>

Example illustration



Pressure relief mattresses

Description – Pressure redistribution mattresses are required for patients with decreased mobility and sensations, who are at risk of acquiring pressure ulcers when lying down over longer periods of time. They are designed for management of tissue loads and microclimate. The objective is to provide pressure redistribution and reduce shear and friction of the skin, thereby preventing development of pressure ulcers/bedsores.

Product classification ISO 9999:2007 04 33 06 Mattresses and mattress coverings for pressure-sore prevention

Product standards

- ISO 10993: Biological evaluation of medical devices
- ISO 12949:2011: Standard test method for measuring the heat release rate of low flammability mattresses and mattress sets
- ISO 12952: Textiles – Assessment of the ignitability of bedding items
- IEC 60601: Medical electrical equipment

General features – Pressure redistribution mattresses can either be foam, air-filled, water-/gel-filled or a combination of foam and air-filled. They can be full mattress replacements or overlays designed to be

placed on top of an existing mattress. The simplest type is made of foam, which can be high-density foam, visco-elastic (memory) foam or lower-density foam that in some cases features a cross-cut modulated structure that conforms to the body contours, thus distributing pressure evenly over the entire contact surface. These are for patients at low to intermediate risk of acquiring pressure ulcers.

Air-filled mattresses can be either static (non-powered) or dynamic (powered). They consist of a number of air cells that are inflated. The dynamic air-filled mattresses are connected to a pump that alternately inflates and deflates the individual air cells, usually over a time frame of 7–12 minutes, continually redistributing pressure to different areas on the contact surface. These types are for patients at high risk of acquiring and/or who already have pressure ulcers.²³

Indicative price – Foam mattresses: \$80–\$350

Foam overlays: \$10–\$50

Static air-cell mattress replacement systems: N/A

Static air-cell overlays: N/A

Dynamic air-cell mattress replacement systems: \$35–\$180

Dynamic air-cell overlays: \$350

Waterbeds: N/A

Regarding foam mattresses and overlays, the unit cost of polyurethane foam increases in a linear fashion with density, but higher densities generally also equate to increased durability.

Repair and maintenance – Foam mattresses should be turned on a regular basis to prevent them from bottoming out. Air mattresses will need patches for mending in case of puncture.

Assessment and fitting – The patient's risk of developing pressure sores should be assessed using a risk assessment tool such as the Braden Scale for Predicting Pressure Sore Risk.²⁴ Based on the risk, an appropriate mattress solution should be chosen.

Use – Air-filled mattresses are mostly used in hospital and care facilities. Regarding static air-filled mattresses, it is essential that users and/or health care professionals know how much to inflate/deflate the mattress in order to provide effective pressure redistribution. Users and caregivers should be instructed to regularly assess the state of the skin in areas that are at risk of developing pressure ulcers. They should be informed of factors that increase/decrease the risk (e.g., regular and timely repositioning) and about what to do if pressure ulcers develop.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Assist Ireland,

<http://www.assistireland.ie/eng/Information/Information_Sheets/Choosing_Pressure_Relief_Equipment.html>

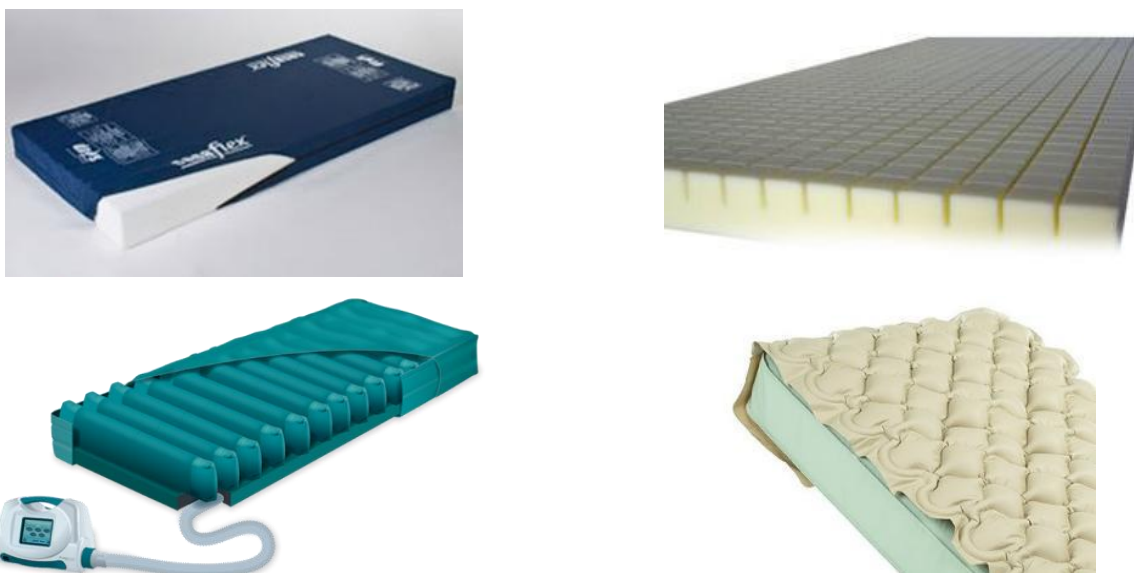
²³Assist Ireland, 'Choosing Pressure Relief Equipment',

<http://www.assistireland.ie/eng/Information/Information_Sheets/Choosing_Pressure_Relief_Equipment.html#_Toc98911853>.

²⁴ Braden Scale for Predicting Pressure Sore Risk, <https://www.in.gov/isdh/files/Braden_Scale.pdf>.

Rober Limited, <<http://www.roberlimited.info/products/>>, have a range of so called 'cost effective' mattresses (the AirFlex product range) and have distributors around the world, including India Romsons (India), <<http://www.romsons.com/domestic/products/SORENIL.html>> VitaFoam (Nigeria), <<http://www.vitafoamng.com/store/shop/bedroom/Vita-Standard-Hospital-Mattress>> Drive Devilbiss Medical, <<http://www.drivemedical.com/index.php/pressure-prevention>> PlusMed (Turkey), <<http://www.plusmed-health.com/en/contact.html>> Stryker Patient Care, <<http://patientcare.stryker.com/en/products/surfaces>>, active in over 100 countries PrimaCare (South Africa), <<http://www.primacare.co.za/product-category/mattresses/>> ArjoHuntleigh, <<http://www.arjohuntleigh.com/products/therapeutic-support-systems/home-care/foam-range/simuflex-range/>>, serves more than 100 countries U-Med (Hong Kong, China), <<http://www.umed.com.hk/en/product/6/32>>

Example illustration



Ramps, portable

Description – A lightweight, portable ramp that provides wheelchair access into homes, buildings, vehicles and more.

Product classification – ISO 9999:2007 18 30 15 Portable ramps

Product standards

- ISO 21542: Building construction – Accessibility and usability of the built environment
- UK: Statutory Guidance – Access to and use of Buildings: Approved Document M²⁵

²⁵ Department for Communities and Local Government (United Kingdom), 'Access to and Use of Buildings: Approved Document M', 2015, <<https://www.gov.uk/government/publications/access-to-and-use-of-buildings-approved-document-m>>.

- BS 8300:2009+A1:2010 – Design of buildings and their approaches to meet the needs of disabled people: Code of practice

General features – Portable ramps can be horizontally and longitudinally folding, telescopic or with fixed dimensions. In addition, they can be either wide platforms or channel-ramps. They are usually made of aluminium and sometimes fiberglass/graphite fibre. Smaller ramps used to overcome small thresholds, such as doorsteps and curbs, are available. These ramps can be made of aluminium, rubber and fiberglass.

In addition, a range of semi-permanent ramps exist. They normally feature handrails and can be modular systems consisting of ramps and platforms/landings, which can be combined in a variety of ways to accommodate different entrances. In the United Kingdom, it is recommended that wheelchair ramps for communal use have a non-slip surface, be at least 1200 mm wide and have a maximum cross fall of 1 in 40. Every landing should be at least 1200 mm long.²⁶

Types of non-slip surfaces include patterned, pressed, gritty paint and glass paper.

Indicative price – Portable (folding) ramps: \$80–\$1,100, depending on size, material and folding capabilities.

Curb/threshold ramps: \$25–\$450, depending on size and material.

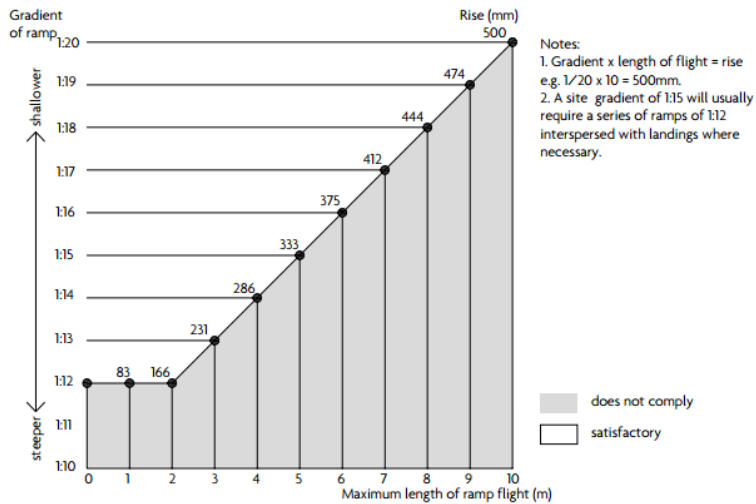
Semi-permanent ramps: \$150–\$3,800, depending on size and complexity.

Repair and maintenance – Some may be required. Hinge joints in folding ramps may break and need replacement.

Assessments and fitting – N/A

Use – In the United Kingdom, it is recommended that the gradient of wheelchair ramps should be between 1:20 and 1:12. The maximum flight length at a given gradient should comply with the diagram below.

²⁶HM Government (United Kingdom), 'The Building Regulations 2010', 2010, <http://webarchive.nationalarchives.gov.uk/20151113141044/http://www.planningportal.gov.uk/uploads/br/br_pdf_ad_m1_2015.pdf>.



References

- European Assistive Technology Information Network, <<http://www.eastin.eu>>
- MobilityOne (South Africa), <<http://www.mobilityone.co.za/wheelchair-ramps>>
- The Ramp People (United Kingdom), <<http://www.theramppeople.co.uk/multifold-wheelchair-ramp>>
- Instructables, 'Portable Wheelchair Ramps', <<http://www.instructables.com/id/Portable-Wheelchair-ramps/>>, on how to build wooden ramps for use with electrical wheelchair with an occupant
- DiscountRamps (United States), <<http://www.discountramps.com/wheelchair-ramps/c/3100/>>
- Wheelchair Ramps (United Kingdom), <<http://www.wheelchair-ramps.co.uk/>>
- Wheelchair Ramp Kit, <https://www.youtube.com/watch?v=t_yB8KmloqU>

Example illustration



Foldable



Threshold ramp and semi-permanent ramps



Shower commode chair

Description – A special seat used by people who are unable to stand or have difficulty doing so. It is made for use in bathtubs and/or showers with good drainage and an opening in the seat. It also works as a commode chair when placed over a normal toilet or when a commode pan can be attached underneath.

Product classification – ISO 9999:2007 09 12 03 Commode chairs (with or without castors)

Product standards

- ISO 10993: Biological evaluation of medical devices
- ISO 17966:2016: Assistive products for personal hygiene that support users – Requirements and test methods

General features – The support system (seat and back) of a shower commode chair is usually mesh fabric stretched over the frame or plastic (PVC), where the seat can have water-resistant padding. The seat features an opening with a pan holder underneath, such that it can be used as a commode chair. Back rests and seats can have different degrees of adjustability. The frame is normally made of stainless steel. Most types are height-adjustable and some offer tilt in space and recline features.

Additional possible features for those with more severe mobility issues include arm and foot rests (removable or stationary), head rest, safety belts and ankle straps. Shower commode chairs usually have locking castor wheels, allowing the user to transfer to the chair before they enter the bathroom, where transfer may be difficult and dangerous due to slippery floors, tight space and hard surfaces. In case of active users, a chair with large rear wheels with push rims for self-propulsion is a possibility. Most shower commode chairs have a weight capacity of up to 181.44 kg (400 lbs).

Some chairs are made only to facilitate showering, i.e., there is no opening in the seat. These chairs can be simple stools, wall-mounted seats (fixed or hinged), or freestanding or wheeled shower chairs. Another type, freestanding or wheeled shower cradles, usually consist of a mesh fabric stretched over a metal/plastic frame mounted on a base.

Indicative price – The simplest basic types of commode shower chairs with minimal adjustment possibilities can cost between \$14 and \$400. Basic single-purpose shower chairs are generally cheaper, while the more advanced multipurpose chairs with multiple adjustment options are more expensive.

Repair and maintenance – Castor wheels should be replaced when broken/damaged. Detachable upholstery should be washed at regular intervals.

Assessments and fitting – Guidelines on equipment for showering have been developed by the Disabled Living Foundation, available at <<http://www.dlf.org.uk/factsheets/showering>>.

Use – Users and caregivers should know techniques to transfer in and out of the chair from a bed and/or wheelchair. If the chair features locking castor wheels, the user and caregiver should be instructed to lock the wheels before transfer.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

1800 Wheelchair, <<http://www.1800wheelchair.com/category/500/bathroom-wheelchairs/>>

Alibaba, <https://www.alibaba.com/product-detail/Adjustable-porttable-commode-chair-lightweight-folding_60425459217/showimage.html>

Invacare (Australia), <<http://www.invacare.com.au/ass/content/857/891/6-ocean-commode-series-lr.pdf>>

Essential Aids (United Kingdom), <<https://www.essentialaids.com/bathroom/wheeled-shower-chairs.html>>

Rifton, <<http://www.adaptivemall.com/riftonhtsmall.html>>

Example illustration



Grab rails/bars

Description – Grab bars and rails positioned at selected areas provide support for persons with impaired mobility, gait and/or balance. They are used to assist with balance and support, to assist with transfers, or in areas where the risk of a slip or fall is considered high. They are primarily used in the bathroom and toilet, but can be positioned anywhere: to push or pull against when standing up/sitting down, to provide support when sitting and balance when standing, walking or dressing, and to provide a firm grip when transferring from one position to another (e.g., on/off the toilet, in/out of the bath/shower).

Different types exist in different lengths and thicknesses: wall-mounted straight or angled rails, floor-to-ceiling rails, system rails, drop-down hinged rails (next to the toilet, with or without support leg), floor-mounted rails, right-angled wall-to-floor rails, long handrails (for stairs and corridors), freestanding portable support rails, and newel rails.

Product classification – ISO 9999:2007 18 18 03 Hand rails and support rails; ISO 9999:2007 18 18 06 Grab rails and hand-grips

Product standards

- ISO 17966:2016: Assistive products for personal hygiene that support users – Requirements and test methods
- ISO 21542:2011: Building construction – Accessibility and usability of the built environment
- AS 1428.1-2009: Design for access and mobility – General requirements for access – New building work (Australian Standard)
- 2010 Americans with Disabilities Act (ADA) Standards for Accessible Design²⁷
- BS 8300:2009+A1:2010: Design of buildings and their approaches to meet the needs of disabled people: Code of practice (British Standard)
- ICC A117.1-2009: Accessible and Usable Buildings and Facilities

General features – Grab rails must be designed to withstand the forces applied to them. They can be made of a range of materials including stainless steel, aluminium, brass, plastic and galvanized tubing. The finish can be slip-resistant, satin, powder-coated, epoxy-coated, enamel-coated or polished, based on considerations of safety and aesthetics. For example, a slip-resistant finish may be needed in a wet area, such as a shower, which creates more friction between the hand and the rail, making it easier for the user to maintain a firm grip.

The rail diameter is critical, and should allow the user's hand to encircle and be in complete contact with the rail when gripping. Recommended outside diameter is between 32mm and 51mm (ICC A117.1-2009). Grab rails are available in common standard lengths of 300 mm, 450 mm, 600 mm and 900 mm. However, they can be customized. Most grab rails are designed to be permanently fixed at both ends to the wall. When there is no practical wall nearby, some grab rails can be attached to the floor and/or ceiling.

Price range – Simple wall-mounted grab rails cost between \$2 and \$16. More specialized/advanced grab bars/rails (such as wall-to-floor rails, drop-down hinged rails and bathtub rails) are priced between \$26 and \$100.

Repair and maintenance – Rails and fittings should be regularly checked for signs of rusting, insecure attachment, rotation in the fitting, or change of shape. Fixings (e.g., on bath-fixed rails that clamp onto the side of a bath) should be checked on a regular basis and tightened when necessary.

Assessment and fitting – According to ICC A117.1-2009, when mounting grab bars to a wall, there should be a clearance of 38 mm between wall and grab bar. At the ends, and below the grab bar, there should be a minimum clearance of 38 mm to projecting objects. The recommended minimum clearance to projecting objects above the grab bar is 305 mm.²⁸

²⁷ United States Department of Justice, '2010 ADA Standards for Accessible Design', 2010, <<https://www.ada.gov/regs2010/2010ADASTandards/2010ADASTandards.htm#c6>>.

²⁸ Disabled Living Foundation, 'Choosing and Fitting Grab Rails', <<http://www.dlf.org.uk/factsheets/grab-rails>>; Government of South Australia, 'Grab Rails', <https://www.sa.gov.au/_data/assets/pdf_file/0013/13711/grab-rails.pdf>; and Americans with Disabilities Act, 'ADA Grab Bar Requirements for Shower Stalls, Bath Tubs and Toilet Stalls: Mounting guidelines', <http://www.adabathroom.com/grab_bar.html>. ICC A117.1-2009 is also useful as an installation guide.

Use – Use of grab bars and rails should be encouraged in order to increase independence in persons with impairments and decrease the workload on caregivers.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Betterlife from Lloyds Pharmacy (United Kingdom), <<http://www.betterlifehealthcare.com/browse/grab-rails/>>

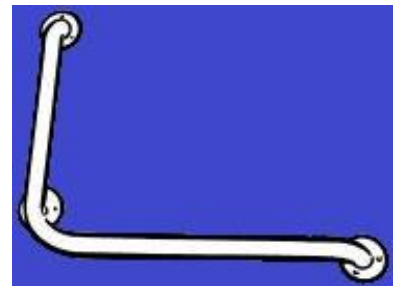
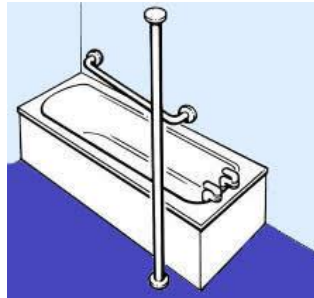
MobilitySmart (United Kingdom), <<http://www.mobilitysmart.cc/daily-living-aids-c-30/grab-rails.html>>

Welcome Mobility (United Kingdom), <<http://www.welcomemobility.co.uk/Departments/Mobility/Grab-Rails.aspx>>

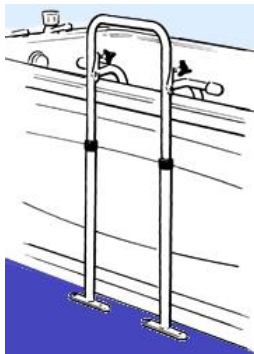
Essentialaids, <<https://www.essentialaids.com/mobility/grab-rails-grabrails.html>>

Example illustration

Wall-mounted straight rails, drop-down hinged rail without support leg, floor-to-ceiling rail and wall-mounted angled rail



Special bath rails: floor-mounted and tab-fixed



Incontinence products

Description – Absorbent products designed to be worn inside underwear, used by people larger than infants who have bladder or bowel incontinence, mobility impairment or severe diarrhoea.

Product classification – ISO 9999:2007 09 30 09 Urine/faeces absorption products

Product standards

- ISO 10993: Biological evaluation of medical devices
- ISO 15621:2011: Urine-absorbing aids – General guidelines on evaluation
- ISO 16021:2000: Urine-absorbing aids – Basic principles for evaluation of single-use adult-incontinence-absorbing aids from the perspective of users and caregivers
- ISO 9949:1993: Urine-absorbing aids – Vocabulary
- ISO 17190:2001: Urine-absorbing aids for incontinence – Test methods for characterizing polymer-based absorbent materials
- ISO/DIS 15621: Absorbent incontinence aids for urine and/or faeces – General guidelines on evaluation

General features – Incontinence products are usually made up of three separate layers; an inner/top sheet (closest to the skin), an absorbent core and a waterproof backing/outer layer. These layers are usually made of the following materials in disposable and washable products, respectively:

1. Disposable incontinence products

- Inner/top sheet: nonwoven material with a distribution layer directly beneath, which transfers moisture to the absorbent core.
- Absorbent core: fluffed wood pulp fibres, usually combined with superabsorbent polymer (SAP) powder, which can be antibacterial, that neutralizes odour. The SAP is usually concentrated in the central area of the pad, closest to the urethral opening.
- Waterproof backing: different types of plastic.

2. Washable incontinence products

- Inner/top sheet: polyester (transfers moisture away from the skin and feels dry even when wet because it is hydrophobic) or cotton (which is hydrophilic).
- Absorbent core: needle felt or knitted fabric comprising rayon and/or polyester fibres, cotton gauze or flannel, in addition with anti-microbial/anti-bacterial fibres that resist odour-causing bacteria.
- Waterproof backing: different types of plastic or nylon.
- Soft outer layer (briefs): cotton or nylon.

Other features of incontinence products:

- Adhesive strip (disposable pads): used to secure the pad to the underwear.
- Indicator strip (disposables): changes colour when the pad/brief is wet and needs changing.
- Elastics (pad): slight elastics along pad length is intended to improve fit.
- Standing gathers: longitudinal, elasticated standing gathers of hydrophobic material intended to prevent leakage to the sides.
- Shaping (pads): pads are sometimes rectangular, but mostly they have an hourglass shape to better fit the body shape.

Incontinence briefs, disposable or washable, are generally for moderate to heavy incontinence. They are applied front to back, with elasticized waist and legs and side fasteners (in case of disposable briefs, side fasteners are usually re-sealable). Pull-ups (also known as incontinence pants or protective underwear) look, and are worn, like generic underwear. They are generally for persons with light to moderate incontinence. Washable pull-ups usually feature a washable absorbent pad that is sewn into the fabric. Absorbent pads are placed inside generic underwear used by persons with light to moderate

incontinence problems. Some absorbent pads (booster pads) do not have a waterproof backing, and are meant to be worn inside briefs or pull-ups for added absorbency.²⁹

Price range (unit price) –

Disposable briefs: \$0.50–\$2; pull-ups have a smaller price range of \$0.70 – \$1.70

Washable briefs: \$7.90–\$30, the fancier or more feminine or discreet, the more expensive

Disposable pads: \$0.20–\$1.30

Washable pads: \$6–\$15

Repair and maintenance – Washable products are washed as usual; however, only non-biological detergent should be used, and fabric conditioner (cationic surfactants) and bleach or sterilizers should be avoided. Staining can be reduced by pre-washing or soaking the product in cold water before washing.

Assessments and fitting – Washable products are generally not suitable for managing bowel leakage. They are harder to launder when in contact with stool, and pads are unlikely to provide cover over the bottom.

Relevant organizations:

International Continence Society (ICS) – <<http://www.ics.org/>> ; for interactive map of continence organizations worldwide, see <<http://www.ics.org/SiteLinks.aspx>>; for guidelines and more on 'Management Using Continence Products', see <http://www.ics.org/publications/ici_4/files-book/comite-20.pdf>

International Children's Continence Society (ICCS), <<http://i-c-c-s.org/>>

Continence Product Advisor, <<http://www.continenceproductadvisor.org/products/pads>>

National Incontinence, <<https://www.nationalincontinence.com/s/using-incontinence-products#changing>>, tips and advice on using incontinence products

Use – Incontinence products should preferably be replaced as soon as soiling occurs, especially in case of faecal incontinence. It is important to thoroughly clean the diaper area with each change in order to reduce skin irritation and infections.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

StayDry Incontinence products (disposable), <<http://staydryincontinenceproducts.com/about/>>

Tena (disposables), <<http://www.tena.com/>>

Medtronic (disposables), <<http://www.medtronic.com/covidien/products/incontinence>>

Abena, <<http://www.abenaonline.co.uk/shop/abena-ladies-175s1.html>>

iDiaper, <<http://www.idiaper.com/>>

Northshore Care, Youth and Teen, <<http://www.northshorecare.com/youthdiapers1.html>>

Youth Diapers, <<http://www.youthdiapers.com/>>

Children's Incontinence Products – Upsey Daisy (United Kingdom),

<http://www.pshealthcare.co.uk/incontinence/index.asp?section=upsey_daisy_childrens_incontinence_13>

²⁹ On types of absorbent incontinence products, see Incontinence Resource Center, 'Types of Absorbent Incontinence Products', <http://www.incontinencesupport.info/Absorbent_Product_Definitions.html#V_y0k4-LTIU>.

Example illustration

Below (left to right): disposable, disposable, washable



Pencil/pen grip

Description – The pencil/pen grips are made for left- and right-handed users to make gripping a pencil/pen easier. It is made in many different shapes and allows the user to write for long periods of time without cramping.

Product classification – ISO 9999 (2007) 24 18 06: Grip adaptors and attachments

Product standards – N/A

General features – N/A

Price range – The cost of the pencil/pen grips ranges between \$5 and \$10.

Repair and maintenance – N/A

Assessments and fitting –N/A

Use – The pencil/pen grips are used to make gripping a writing instrument easier and avoids cramping.

Example illustration



4.0 Hearing

Hearing assistive products. Hearing loss affects a person's ability to communicate and interact with others; it can have an impact on many areas of development, such as speech and language, and restricts educational and employment opportunities, resulting in social discrimination and isolation. Devices include:

- Hearing aids
- Headphones for listening to the television
- Amplified telephones
- TTY/TTD (telecommunication devices)

- Visual systems to provide cues (e.g., a light that turns on when the doorbell rings)

Behind-the-ear (BTE) digital hearing aids and accessories

Description – BTE digital hearing aid is a small battery powered devices that hooks over the top of the ear and rests behind the ear. Normally, a tube connects the speakers in the digital hearing aid to a custom ear mould, which fits in the ear canal of the individual. Microphones pick up sounds from the environment and an integrated, programmable chip analyses and adjusts the sound according to the needs of the individual, and plays it through the speakers.

Product classification – ISO 9999: 2016 22 06 15 Hearing aids behind the ear.

Product standards

- IEC 60118: Hearing aids
- IEC 60601-2-66. Medical electrical equipment – Part 2-66: Particular requirements for the basic safety and essential performance of hearing instruments and hearing instrument systems
- IEC 61669 (2001) – Electroacoustics – Equipment for the measurement of real-ear acoustical characteristics of hearing aids
- ISO 12124 (2001) – Acoustics – Procedures for the measurement of real-ear acoustical characteristics of hearing aids

General features – In a BTE digital hearing aid, all major parts and components of the aid are contained within a protective case that rests behind the ear. The case is often made of plastic. The first major component is the microphone that picks up sounds from the environment and converts it into electrical signals. An amplifier (electrical circuit) processes and strengthens the sound signal, and converts it from an analogue to a digital signal. A microchip, or mini-computer, further analyses and modulates the signal. It allows the hearing aid to be programmable such that it can be customized to the needs of the individual. The digital signal is then converted into an analogue electrical signal, which a receiver, or speaker, converts into sound. The sound is channelled into the ear canal through a small tube and an ear mould or soft dome/tip. A battery powers the system. Batteries should be zinc-air or rechargeable, in some cases powered by solar energy.

Features provided by the microchip include background noise reduction and active feedback cancellation. Multi-memory settings make it possible to switch between programmes, each remembering settings that the user prefers for different situations/environments. Other popular features include directional microphones. When inactive, i.e., set to the normal, non-directional (omnidirectional) setting, the aid focuses equally on sounds coming from all directions. When activated, the aid focuses on sound coming from in front of the user. Many BTE hearing aids come with a telecoil, which enables the hearing aid to bypass the microphone and instead pick up signals from an electromagnetic field generated by a Hearing Aid Compatible (HAC) telephone/cell phone or an induction loop installation.³⁰

³⁰ Hearing Loss Association of North Carolina, 'Telecoil', <<http://www.nchearingloss.org/telecoil.htm?fromncshhh>>.

Standard BTE hearing aids can have an occluded-ear fit (with an ear mould) or an open-ear fit (without an ear mould). Ear moulds maximize a hearing aid's potential to deliver sound to the ear, since none of the finely processed sound escapes the ear. However, they take time, materials and expertise to make and cause the 'occlusion effect' – the user's own voice sounds muffled, there is a sense of pressure in the ear, and chewing sounds are loud. Some companies offer standardized tips for an occluded-ear fit, eliminating the need for a customized mould. Some moulds are vented to reduce the occlusion effect. The larger the vent, the more it resembles the complete open-ear fit.

Open-ear fit has the advantage of eliminating the occlusion effect and not necessarily requiring a custom mould. They usually feature a dome that fits in the ear canal and optionally a retention guard/strand that curls up in the outer ear, helping to keep the aid in place. However, the open fit allows sounds, especially in the low frequency range, to escape the ear, thus decreasing the maximum possible amplification at lower frequencies. Therefore, they are only appropriate for persons with mild to moderate hearing loss at high frequencies (>1000 Hz), and an efficient feedback suppression algorithm is necessary. Open-fit BTE hearing aids are used for children, but no investigation has been done on whether this is appropriate.³¹

Some BTEs come with a thin tube, which is more discreet than the standard #13 tube, and chosen purely for cosmetic reasons. With this design, the available high-frequency output from the hearing aid is compromised, which limits the fitting range.

In receiver-in-canal (RIC) BTE hearing aids, the receiver is placed in the ear canal and connected to the BTE case via a thin wire in a tube cover. They exist with both open-ear and occluded-ear fits, although most feature the open fit. This design is supposed to offer superior sound quality compared to traditional BTE hearing aids, where acoustic modifications can occur as the sound travels through the plastic tube between the receiver and the ear canal. However, it is a general rule that maximum power output (MPO) is correlated with the physical size of the receiver. Thus, the receiver may be too large to fit in the ear of a small person or a child with severe hearing loss, who needs a high MPO and consequently a large receiver. In addition, RIC devices are more difficult to clean, less robust and less resistant to wax and moisture build-up.

In general, standard BTE hearing aids with occluded-ear fit have the largest fitting range compared to others.³²

Special accessories for children: To prevent hearing aids from detaching from the ears of small children, with the result of the aids getting damaged or lost, it may be beneficial to secure them to the

³¹ The Hearing Review, 'Hearing Aid Selection and BTEs: Choosing among various "open-ear" and "receiver-in-canal" options', <<http://www.hearingreview.com/2008/03/hearing-aid-selection-and-btes-choosing-among-various-open-ear-and-receiver-in-canal-options/>>; McCreary, Ryan, 'Pediatric Hearing Aid Verification: Innovative trends', Audiology Online, <<http://www.audiologyonline.com/articles/pediatric-hearing-aid-verification-innovative-913>>.

³² For a thorough review of types of BTE hearing aids in terms of sound quality, comfort, aesthetics and user characteristics, see The Hearing Review, 'Hearing Aid Selection and BTEs: Choosing among various "open-ear" and "receiver-in-canal" options', <<http://www.hearingreview.com/2008/03/hearing-aid-selection-and-btes-choosing-among-various-open-ear-and-receiver-in-canal-options/>>; Consumer Reports, 'Hearing Aid Buying Guide', <<http://www.consumerreports.org/cro/hearing-aids/buying-guide.htm>>; Association of Independent Hearing Aid Professionals, 'Hearing Aids', <<http://www.aihhp.org/your-hearing/hearing-aids/>>.

child's ears by using lightweight caps and headbands, fishing line and a safety pin, or hearing aid clips. Accessories that protect hearing aids from sweat, moisture and dirt are also available, and may prolong the lifespan of the aids and reduce frequency and cost of repairs. Older children may be more willing to wear their hearing aids if they have been engaged in choosing the colour of their ear mould or hearing aid.

Indicative price – From under \$100 up to \$3,000³³

Repair and maintenance – Ear moulds should be replaced every 3 to 6 months in young children, every 6 to 12 months in older children, and every 2 to 3 years in adults. Because this can be expensive over time, it is advisable to consult an unbiased expert, preferably with no vested interest in the sale of the product. Batteries should be replaced when drained (approximately once a week). Rechargeable batteries should be recharged when necessary, and replaced when worn out (approximately once every two to three years). The availability of a reliable supply of batteries is essential. In case of malfunction, initial contact should be made with a worker in the area who is trained in primary ear and hearing care and can identify and solve minor problems, e.g., replace ear mould tubing.

It may be beneficial to supply hearing aid cleaning kits together with hearing aids in order to make them last longer and reduce repair expenses.³⁴

In RIC BTE hearing aids, ear moulds are more difficult to clean, as they cannot be detached. With open-ear fits in RIC BTE hearing aids, the domes (silicone tips) that cover the speaker units should not be cleaned, but instead replaced at least once a month.³⁵

Assessments and fitting – An audiologist performs an audiometric test, and based on the resulting audiogram, determines if the child will benefit from a hearing aid and, if so, what type is appropriate. The hearing aid is adjusted or programmed according to the needs of the individual (based on the audiogram), and a tube and ear mould (or other type of fitting) are fitted. For small children, the basic BTE with a custom ear mould is most commonly recommended. For older children and adults, an open fit can be used.

Ear moulds: Individual ear impressions are made using a syringe technique. In two-stage techniques, ear impressions are brought to a central ear mould laboratory where (1) a cast of the impression is made using Plaster of Paris (partly dehydrated gypsum), and (2) the cast is filled with acrylic-, vinyl- or silicone-based ear mould material (acrylic ear moulds are not recommended for infants and children as they are too hard³⁶). Ear impressions need to be brought to the laboratory quickly since shrinkage occurs after a few days. Other production methods are possible, e.g., a direct (one-stage) procedure where the ear impression becomes the final ear mould. This technique can be suitable where a central ear mould laboratory has not yet been established.

³³ UnreasonableAtSea, 'Solar Ear: Solar-powered hearing aids', <<http://unreasonableatsea.com/solar-ear/>>.

³⁴ HearingLink, Easy Hearing Aid Care Kit, <http://shop.hearinglink.org/easy-hearing-aid-care-kit-with-battery-tester--holder-134-p.asp?_ga=1.188096811.228643270.1476719493>, .

³⁵ Oticon, 'How to Clean Behind-the-Ear Hearing Aids', <<http://www.oticon.global/support/how-to/clean-hearing-aid/clean-bte/>>.

³⁶ West, Michael, 'Earmolds and More: Maximizing patient satisfaction', Audiology Online, <<http://www.audiologyonline.com/articles/earmolds-and-more-maximizing-patient-850>>.

Guidelines:

WHO, 'Guidelines for Hearing Aids and Services for Developing Countries',

<http://www.who.int/pbd/deafness/en/hearing_aid_guide_en.pdf>

Better Hearing Institute, 'A Guide to Your Child's Hearing',

<[http://www.betterhearing.org/sites/default/files/hearingpedia-resources/Guide to Your Childs Hearing.pdf](http://www.betterhearing.org/sites/default/files/hearingpedia-resources/Guide%20to%20Your%20Childs%20Hearing.pdf)>

Academy of Doctors of Audiologists, 'Thin Tubes, Thin Wires and Earpiece Options: How much gain?',

<http://www.audiologist.org/resources/2012_convention_presentations/McBride-ThinTubes.pdf>

Use – Users and caregivers should be instructed on how to insert and remove the hearing aid from the ear and how to replace and/or recharge batteries. In addition, they should be informed about all features, e.g., volume control, telecoil and directional microphone, and how to use these optimally. A learning period with repeated instructions and support is needed.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Solar Ear (Brazil, Botswana and China), <<http://solarear.com.br/products/>>

Audicus, <<https://www.audicus.com/pages/hearing-aids>>

Widex, <<http://www.widex.com/en/hearing-aids/unique-hearing-aids/product-details#filterCategory=0&filterType=1¤tSlide=undefined&filterModel=0&colourPicker=0&colourGridPicker=0>>

Health Innovations, <<https://www.hihealthinnovations.com/page/productlanding>>

MDHearingAid, <<https://www.mdhearingaid.com/shop/hearing-aid-comparisons/>>

Ovation Hearing, <<http://www.ovationhearing.com/ovation-boost-hearing-aid.shtml>>

Oticon, <<http://www.oticon.global/solutions/alta2/>>

Ear Gear, <<https://www.gearforears.com/>>

Example illustration

Occluded-ear fit with customized ear mould (1) and standardised tip (2), and open-ear fit, or just open fit (3) with silicone dome and retention guard/strand.





Direct auditory input (DAI) systems: FM-systems

Description – Direct auditory input is a feature that allows an external source to be directly connected to a behind-the-ear (BTE) hearing aid, as an input that bypasses the microphone. This can either be directly via a wire connection to the audio source, or the BTE can have a tiny FM radio receiver attached at the bottom.

Product classification – ISO 9999:2007 22 06 27 Hearing accessories

Product standards

- ISO 21542:2011(EN), Building construction – Accessibility and usability of the built environment
- IEC 60118, Hearing aids
- ISO/IEC TR 29138, Information technology – Accessibility considerations for people with disabilities
- ISO/IEC TR 19765:2007(EN), Information technology – Survey of icons and symbols that provide access to functions and facilities to improve the use of information technology products by the elderly and persons with disabilities

General features – The IEC standard 60118-6 calls for the BTE plug of a DAI device to be a three-pin polarized plug of specific dimensions and signal polarity. For a hearing aid to be compatible with such a DAI device, it must obviously have a socket compatible with the plug. However, as the plug is rather large, most hearing aids do not come with a built-in socket. Instead, an adaptor can be offered, which is slipped onto the bottom of the hearing aid where it connects with the hearing aid's dedicated (small) DAI input contacts (or it may be in the form of a cover/case replacement). The plug of the DAI device (wire connection or FM receiver) is then inserted into the adaptor.

A wire-connection DAI has the three-pin polarized plug at one end and a mini (3.5 mm) plug at the other end, which is inserted into the headphone jack of the audio source (e.g., laptop, MP3 player, external microphone or a receiver for a FM-, infrared or Bluetooth connection). Wire-connections can also have other types of audio input plugs for certain types of audio sources.

FM-connections are usually intended for one-on-one or group communication over distance and in noisy environments between a teacher/parent/caregiver and one or more children/student(s). The teacher/parent/caregiver wears a portable microphone and transmitter that converts the electrical signal to an FM signal, which is picked up by the FM receiver inserted in the hearing aid via the 3-pin plug

(some hearing aids have integrated FM receivers). FM systems may also be connected with computers, television or other audio sources.³⁷

Indicative price – Up to \$2,500.

Repair and maintenance – Performed by professionals.

Assessments and fitting – The DAI system must be compatible with the hearing aid.

Use – An FM system can be beneficial in a classroom; the teacher wears a small microphone and transmitter that sends sound directly to the child's hearing aid via an FM receiver. The receiver must be set to the right channel. It is important that the teacher remembers to wear the FM microphone and turn it on. The teacher should check with the hearing impaired student that the FM system is turned on and working properly. In addition, it is very difficult for a hearing impaired student to hear questions and remarks from other students, even when wearing hearing aids. For the student to be able to follow the conversations in the class, the teacher should repeat questions and remarks from other students before answering and commenting.³⁸

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Center for Hearing Loss Help, <<http://hearinglosshelp.com/shop/comfort-contego-personal-fm-system/>>, <<http://hearinglosshelp.com/shop/transportable-fm-personal-listening-system/>>

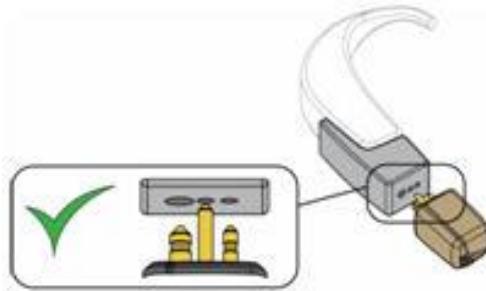
Widex SCOLA system, <<http://www.widex.com/en/hearing-aids/hearing-aid-accessories/scola-fm-system>>

Oticon Amigo FM, <<http://www.oticon.global/solutions/accessories/amigo-fm/>>

Example illustration

³⁷For additional information, see HearingLink, 'FM Systems', <<https://www.hearinglink.org/living/loops-equipment/fm-systems/>>; BabyHearing.org, 'Frequency Modulation (FM) Systems', <<http://www.babyhearing.org/hearingamplification/aidchoices/fmsystem.asp>>; MED-EL, 'What Are Examples of ALDs?', <<http://www.medel.com/us/using-ald-examples-of-alds/>>; Centrum Sound, 'Sound Couplings and Fitting Options', <<http://www.centrumsound.com/Audiology/soundcouplings.html#stop9>>; Hearing Loss Association of North Carolina, 'ALDs and Movies', <http://www.nchearingloss.org/article_aldandmovies.htm>; Self-Help for Hard of Hearing People, 'Assistive Listening Systems in Public Places', <<https://www.shhhaust.org/assistive-listening-systems-in-public-places/>>.

³⁸ On the benefits and limitations of an FM transmitter system, see 'Hearing Aid: FM simulation', <<https://www.youtube.com/watch?v=1I37IzLlgQU>>, 'Hearing Loss in the Classroom', <<https://www.youtube.com/watch?v=ln8NHZVfJkQ>>.



Direct Auditory Input (DAI) Systems: Audio induction/hearing Loops

Description – Also known as hearing loops or audio induction loops. Most current hearing aids contain a telecoil. It works as a small receiver that converts an electromagnetic (EM) field into a sound signal. The EM field is generated by a loop wire installed around a room or building, e.g., in churches, concert halls, universities, airports and museums. The wireless signal can be accessed anywhere within the boundaries of the loop wire. The induction loop can also be in the form of a neck loop or silhouette, in the case of personal assistive listening devices (ALDs).

Product classification ISO 9999:2007 22 06 27 Hearing Accessories

Product standards

- IEC 60118-4, Electroacoustics – Hearing aids – Part 4: Induction loop systems for hearing aid purposes – Magnetic field strength
- IEC 62489-1:2010, Electroacoustics – Audio-frequency induction-loop systems for assisted hearing – Part 1: Methods of measuring and specifying the performance of system components
- ISO 21542:2011(EN), Building construction – Accessibility and usability of the built environment
- BS 7594:2011, Code of practice for audio-frequency induction-loop systems (AFILS)
- ISO/IEC TR 29138, Information technology – Accessibility considerations for people with disabilities

General features – A hearing/induction loop system consists of:

- 1) An audio source, such as a suitable microphone. Other audio sources such as a TV might need to be coupled with an adapter that converts the input to match the input of the chosen amplifier.
- 2) One or more audio induction loop amplifier(s), usually referred to as ‘drivers’. This is the heart of any Induction Loop System. A range of specialized induction loop driver solutions are available, each designed to suit a specific application. In order to drive complex systems, it may be necessary to use phase shifters and/or current transformers.
- 3) One or more induction loop(s), usually made of copper tape or wire. The wires can be embedded in concrete screed, hidden under a carpet or wooden flooring, or installed in the ceiling.³⁹
- 4) The copper tape or wire induction loop usually surrounds the area where the listening audience is located and produces a magnetic field, which is picked up by the Telecoil inside the hearing aid of

³⁹ Ampetronic, ‘Induction Loop Products: Overview’, <<http://www.ampetronic.co/Product-Overview>>.

hearing-impaired members of the audience. The hearing aid tailors the sound to the specific needs of the individual.

Some types of audio induction loops are personal devices where the induction loop is slung around the neck (neck loop) or hooked over the ear next to the BTE hearing aid (silhouette). The neck loop or silhouette can be connected directly to an audio source via a wire connection or to a receiver for an FM, infrared or Bluetooth connection to an external audio source.

Indicative price – The price of an induction loop system is proportional to its size, complexity, associated amplifiers and accessories. A retail/reception desk loop (at shops, banks, post offices, reception desks, ticket counters) or a home TV-room loop should cost a few hundred dollars, while a system for a large venue may cost several thousands.⁴⁰ Neck loops and silhouettes cost between \$25 and \$300, depending on their flexibility (i.e., how many different types of devices they are capable of coupling up with).

Repair and maintenance as applicable – When installed, induction loops require little maintenance and operation. Nevertheless, staff at the venue should perform regular, simple checks to ensure that the system is turned on and operating properly. An induction loop receiver and field strength meter (the two functions can be integrated in a single unit) are needed to perform such a check, in addition to a simple user/procedure manual to help guide anyone through the checking process. If the system fails the test, it should be reported to the person responsible for maintenance and repair of the induction loop system.⁴¹

Assessments and fitting – Induction loops can be fitted in a wide range of environments, from one-to-one communications at ticket counters, to large venues such as cinemas, theatres and conference facilities. Induction loops are the only viable assistive listening solution for environments where the users are passing by in large numbers as they already have the receiver (telecoil) in the hearing aid, removing the need to distribute and clean them. Induction loops should only be installed where the system can be put to appropriate use. The most suitable type of loop and amplifier will depend on the application, the size, structure and materials of the room/area (e.g., metal construction weakens and distorts the magnetic field), whether hearing loop systems are installed in adjacent rooms (or at adjacent counters), and whether there are confidentiality issues (i.e., if confidential information is transmitted within a room, it should not be possible for a person standing outside the room to pick up the signal).

Generally, any induction loop system should meet the requirements of the internationally recognized Standard for Hearing Loop performance (IEC 60118-4) relating to field strength, frequency response, background noise and subjective testing.

⁴⁰ Ampetronic, 'All about Induction Loops', <http://www.ampetronic.co/write/Documents/Technical%20Library/Information%20Sheets/UP30072-2_All_about_induction_loops.pdf>.

Ampetronic, 'All about Counter Induction Loops', <http://www.ampetronic.co/write/Documents/Technical%20Library/Information%20Sheets/UP30073-2_All_about_counter_induction_loops.pdf>.

⁴¹ Ampetronic, 'Regular Simple Staff Checks', <<http://www.ampetronic.co/Regular-Checks>>.

A loop receiver with basic field strength indication must be provided with each loop system. In addition, signage is crucial, as the installation is hidden from view. The internationally recognized sign for assistive listening devices in the form of hearing loops should be displayed at each entry point to the looped space, and at least one clearly visible sign should be within it. In case of fixed service point loops, a sign should be placed at the counter and be visible for persons queuing in front of it.

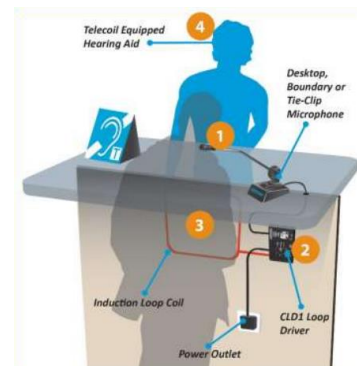
Use – Staff at the venue of a hearing loop installation should be trained to use the system and help customers. They must know how to read the loop receiver with basic field strength indication, how often to check it and how to make basic fixes.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>
 Ampetronic, <<http://www.ampetronic.co/Products>>, ‘

Example illustration

Installation kit with power plug, loop driver/amplifier, pre-formed loop, desktop microphone (a boundary or tie-clip microphone can also be used), a user manual and signage sticker. An illustration of the system in action is included to the right.



Example of application covering a designated seating area in a room



Neck loop and silhouette



5.0 Vision

Vision assistive products. Low vision or blindness has a great impact on a person's ability to carry out important life activities. A range of devices (from simple to complex) can be used to maximize participation and independence, including:

- Magnifiers
- White canes
- Braille systems for reading and writing
- Audio devices, e.g., radios, talking books, mobile phones
- Screen readers for computers (e.g., JAWS, or Job Access with Speech)

Magnifiers

Description – Magnifiers are used by visually impaired persons in order to enlarge text in books, magazines and newspapers, as well as everyday objects. Magnifiers have no requirement for maintenance and are only replaced when the magnifying power becomes too low or the device breaks.

Product classification – ISO 9999:2007 22 03 09 Glasses lens and lens system for magnification

Product standards – When looking at the different types of magnifiers, it is important to make sure that the magnifying power is of the right level, as each person may have different needs. Hand-held magnifiers range in levels from 2.5X up to 15X.

General features – Magnifiers that use LED light will require a battery in order to operate. Battery disposal must be done properly, and there is a risk of not finding replacement batteries.

Optional features and accessories – Magnifiers come in different models and have different applications. The most commonly used types of magnifiers are handheld and/or stand-mounted. Handheld magnifiers are lightweight and can be moved around the text. They come with shatterproof glass, while stand-mounted magnifiers have the advantage that objects or reading materials underneath them can be moved during their use; these magnifiers can also include a light to provide higher visibility.

Price range – Prices range from \$10 up to \$60, depending on magnifying strength and type – whether with an LED light or not, or if they are purchased as a combination of handheld and stand-mounted.

Repair and maintenance – There is no maintenance required for magnifiers; when a magnifier breaks, it normally will get replaced with a new one.

Assessments and fitting – N/A

Use – The product is intuitive and does not require formal training. It is available in office and school supply stores.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Braille slate and stylus

Description – A slate and stylus are small, mechanical devices used for writing Braille by hand. Typically, a Braille slate is a pocket-sized or desktop two-part hinged device. The top part contains rows of rectangular openings corresponding to individual Braille cells that guide the stylus, while the bottom part has rows of indentations arranged in cells, allowing the stylus to emboss dots on paper. A stylus consists of a small handle made of wood or plastic with a sharp metal point. Writing on a Braille slate is done by inserting paper between the top and bottom parts of the slate, inserting the point of the stylus through the openings in the top part, and pressing the paper into the depressions below.

Product classification – ISO 9999 (2007) 22 12 12: Manual Braille writing equipment

Product standards – There are a wide variety of configurations for Braille slates. They can be made of metal or plastic, with or without a board made of wood or plastic. Common styles include four- and six-line pocket-size slates, and larger slates that are moved down a wooden or plastic clipboard. Styluses come in many shapes and sizes to accommodate many sizes of hands.

General features – Slates and styluses are great portable devices for children who are blind as well as those with low vision. The device does not contain any electronic devices, which makes it low-cost and operable anywhere.

Optional features and accessories – Slates and styluses are widely used for writing Braille by persons in developing countries who are blind or have low vision. The ease of use of the slate and its

portability make it ideal for making labels, writing quick notes, making shopping lists, Braille playing cards, and other personal uses. It is a manual device, which also eliminates the risk of using electric power or batteries.

Price range – The cost ranges from \$10 to \$30 depending on the number of lines and cells.

Repair and maintenance – Slates require no accessories, and the parts do not break very easily. However, the hinges represent a weak point in the device, and the user must be careful, especially when inserting paper.

Assessments and fitting – N/A

Use – The slate and stylus allow for a quick, easy, convenient and constant method of making embossed printing for Braille character encoding, and require very little training.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Talking calculator

Description – A talking calculator features a built-in speech synthesizer that reads aloud each number, symbol or mathematical operation. The idea behind it is to make simple calculating tasks more convenient and efficient for someone who cannot easily read a standard display.

Product classification – ISO 9999:2007 22 15 06 Calculating machines

Product standards – There are a wide variety of talking calculators, from a basic desktop model to a more sophisticated scientific model.

General features – Most come with all the basic arithmetic functions, memory plus and memory minus, square root and per cent keys, 12-digit 3/4 inch LCD display, volume control, and an on/off button. Talking calculators are electronic devices powered by batteries, and once they are no longer functional, must be disposed of properly according to waste disposal and recycling guidelines.

Optional features and accessories – Talking calculators are used by children who are blind as well as those who have low vision. Most will require batteries to operate.

Price range – The cost ranges from \$10 for a simple desktop calculator to over \$200 for scientific calculators with multiple functions.

Repair and maintenance – Talking calculators require very little maintenance other than general care.

Assessments and fitting – N/A

Use – Using the talking calculator does not require extensive training.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Math abacus for the blind

Description – An abacus is a tool used by students to perform simple math equations using rods and sliding beads. An abacus made for children who are blind has a felt surface behind the beads and rods to stop the beads from sliding.

Product classification – ISO 9999:2007 22 15 03 Manual devices for calculation

Product standards – N/A

General features – The feature of this product that distinguishes it from a standard abacus is the felt surface in the back, to prevent accidental movement of the beads.

Optional features and accessories – N/A

Price range – Cost ranges between \$15 and \$20.

Repair and maintenance – The product requires no repair or maintenance.

Assessments and fitting – N/A

Use –The abacus is used to perform math equations and does not require extensive training.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Braille Taylor math frame

Description – The Braille Taylor math frame (or mathematical slate) is a device used to teach mathematics to students who are blind, and can be used in low-resource settings. It consists of an aluminium frame and a set of metal pegs or type with the patterns. The frame has rows of openings, each set out as an eight-pointed star. The pegs may be placed in the frame in one of eight orientations that could be used to represent numbers, letters or signs.

Product classification – ISO 9999:2007 22 15 03 Manual devices for calculation

Product standards – N/A

General features – N/A

Optional features and accessories – N/A

Price range – Cost ranges between \$15 and \$20.

Repair and maintenance – The product requires no repair or maintenance.

Assessments and fitting – N/A

Use – The Taylor frame is used to perform math equations and does not require extensive training.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Braille duplicator

Description – The heavy-duty Braille duplicator is a quick and efficient machine to duplicate original Braille copies with text and tactile graphics. It is an intuitive machine to use. The machine works much like a standard copier, with some minor additional manual steps. A plastic sheet goes over the origin,

and an impression is made using thermal heat. The duplicate is an exact copy of the original and takes only a few seconds to process.

Product classification – ISO 9999:2007 22 39 06 Printers

Product standards – The duplicator comes in different sizes to fit different size sheets, with sheet sizes varying from 11 x 11.5 inches to 14 x 19 inches.

General features – N/A

Optional features and accessories – N/A

Price range – Cost ranges between \$3,300 and \$3,800, depending on the size of duplicates required.

Repair and maintenance – The product may require maintenance. However, most duplicators will come with a user manual that goes through frequently encountered problems. For more complicated issues, it may be sent back to the manufacturer for repair, or a local electronics or electric expert may correct it.

Assessments and fitting – N/A

Use – The duplicator is used for high-volume embossing of Braille.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Braille desktop embosser

Description – The Braille desktop embosser functions as a printer for Braille. The machine works similarly to a desktop printer. Users are easily guided by the multilingual speech feedback function and Braille labels. In order to use the embosser, Braille translation software (e.g., WinBraille, iBraille) is required, but usually not included. The Braille desktop embosser is available in different sizes, from small desktop models to larger models.

Product classification – ISO 9999:2007 22 12 12 Manual Braille writing equipment.

Product standards – The embosser can be used with different sizes of paper to fit different size sheets, with sheet sizes varying from 27.94 cm x 29.21 cm (11 x 11.5 inches) to 35.56 cm x 48.26 cm (14 x 19 inches).

General features – The embosser prints at 100 characters/second, horizontally and vertically, with tractor-fed paper. It uses interpoint Braille, and has a Braille-labeled and speech-guided, multilingual user interface, making it a very intuitive machine to use.

Optional features and accessories – N/A

Price range – Cost ranges between \$3,330 and \$3,800.

Repair and maintenance – The product may require maintenance; however, most embossers will come with a user manual that covers frequently encountered problems. For more complicated issues, the embosser may be sent back to the manufacturer for repair, or a local electronics or electric expert may fix it.

Assessments and fitting – N/A

Use – The duplicator is used for high-volume embossing of Braille.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Braille, standard, electric (25 lines with 42 cells)

Description – The standard electric Braille is a machine used to write all standard Braille. It works much like a typewriter, transcribing text to paper, and is portable but heavy. It is easy to use, and suitable for most users.

Product classification – ISO 9999:2007 22 12 15 Typewriters

Product standards – The Braille can be used with sheet size 27.94 cm x 29.21 cm (11 x 11.5 inches).

General features – The Braille can be used with both hands, although there are Brailles that can be used by persons with physical disabilities, and by left-handed or right-handed persons. Standard Brailles may require the use of special Braille paper.

Optional features and accessories – N/A

Price range – Cost ranges between \$1,000 and \$1,500.

Repair and maintenance – The product may require maintenance. Most Braille machines will come with a user manual that covers troubleshooting solutions for common problems. For more complicated issues, it may be sent back to the manufacturer for repair, or a local electronics expert may fix it.

Assessments and fitting – N/A

Use – The Braille machine is used for high-volume embossing of Braille, as it is easier to depress the keys compared to a manual Braille machine.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Braille tactile world map book

Description – The Braille tactile world map book is produced using tactile Braille to represent landscapes on maps, with raised ink to mark borders and regular Braille to label countries.

Product classification – ISO 9999:2007 12 39 18 Tactile orientation materials

Product standards – N/A

General features – N/A

Optional features and accessories – N/A

Price range – Cost ranges between \$35 and \$40.

Repair and maintenance – N/A

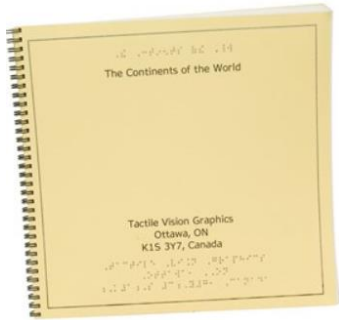
Assessments and fitting –N/A

Use – The Braille tactile world map book helps users identify country shapes as well as landscapes across the globe.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Braille alphabet and numbers magnets

Description – Tactile Braille numbers and alphabet made from hard plastic material, with a magnet secured onto the back for easy removal and placement.

Product classification – ISO 9999:2007 24 27 18 Magnets, magnetic strips and clamps

Product standards – N/A

General features – N/A

Optional features and accessories – N/A

Price range – Cost ranges between \$15 and \$20.

Repair and maintenance – N/A

Assessments and fitting – N/A

Use – The tactile Braille numbers and alphabet help users identify numbers and the alphabet.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Braille book holder

Description – The book holder is meant to give Braille readers a rest from the fatigue and stress of holding a book. It also comes with a magnifier.

Product classification – ISO 9999:2007 22 30 15 Book support and book holders

Product standards – N/A

General features – N/A

Optional features and accessories – N/A

Price range – Cost ranges between \$35 and \$180.

Repair and maintenance – N/A

Assessments and fitting – N/A

Use – The book holder is used to relieve the stress and fatigue of holding a book while reading Braille.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Spectacles

Description – These are devices consisting of lenses mounted on a frame, worn in front of the user’s eyes for correction of vision in those with refractive errors, and for magnification of objects in those with low vision.

Product classification – ISO 9999:2007 21 03 03 Spectacle lenses; ISO 9999:2007 21 03 06 Spectacle frames

Product standards

- ISO 12870:2016(EN), Ophthalmic optics – Spectacle frames – Requirements and test methods
- ISO 11380:1994(EN), Optics and optical instruments – Ophthalmic optics – Formers
- ISO 8624:2011(EN), Ophthalmic optics – Spectacle frames – Measuring system and terminology
- ISO 8980:2005(EN) series, Ophthalmic optics – Uncut finished spectacle lenses
- ISO 13666:2012(EN), Ophthalmic optics – Spectacle lenses – Vocabulary

General features – Spectacle frames are normally made of plastic or metal, or a combination of these. Metal frames feature nose pads made from silicone or vinyl. They come in different shapes and sizes and have different mounting mechanisms.⁴² Some frames have temples (the ‘arm’ of a pair of glasses, running from the lens area to the back of the ear) that wrap around the back of the ear. Another option is a strap that goes around the head. These options (mostly for children) are used to prevent glasses from sliding down the nose or falling off completely, and are only appropriate for full-time spectacle users.

Temples can have spring hinges, which give them a greater range of movement, making them more durable. This also allows for a tighter and snugger fit, which is a good feature in children’s spectacles.⁴³ Some frames are made only from a flexible, durable plastic material with no hinges or nose pads – no loose parts or metal parts – making them very safe for small children.

Spectacle lenses are usually made from polycarbonate or trivex, which are high-tech impact-resistant plastics, recommended for children. Other possible materials are high-index plastic with aspheric design, which are lighter, thinner and flatter than those made from other materials. Photochromic materials become tinted when exposed to sunlight. The shape of the lenses (concave, convex, cylindrical) is determined by the degree of refractive error and/or astigmatism in the user’s eye, and/or the need for magnification in case of low vision.

⁴² On nose pad mounting mechanisms and replacement, see nosepads.co.uk, <<http://nosepads.co.uk/information.php>>.

⁴³ See FramesDirect.com, ‘Hinges for Eyeglasses: What are the different types?’, <<http://www.framesdirect.com/landing/a/glasses-hinges-types.html>>; All About Vision, ‘10 Tips for Buying Kids’ Eyewear’, <<http://www.allaboutvision.com/buysmart/kidseyewear.htm>>.

Lenses can have a number of final coatings: anti-reflective, scratch-resistant and ultraviolet protection (most lenses today have these built in), tint (may help the user to see better), or mirror coatings (purely for aesthetics).⁴⁴

Indicative price – From \$6 and upwards. The price increases as the visual impairment becomes more complicated. Low-refractive-error spectacles equal on both eyes will be cheapest, while mixed-refractive-error and astigmatism with differences between eyes will be more expensive.

Repair and maintenance – Plastic frames are essentially maintenance-free, although the hinges may break and need to be replaced. Nose pads on metal frames can break or wear out and can be replaced. Glasses should be cleaned regularly with a microfiber cloth for optimal user experience and durability. The microfiber cloth should be cleaned with water and a bit of dishwashing soap (no fabric softeners). When not in use, spectacles should be stored in a hard case. If stored in a pocket, purse, soft case, etc., the frame can break or be bent out of shape.

Assessments and fitting – Plastic frames must be chosen carefully, so they fit the nasal bridge of the user (this can be difficult to achieve in children) and thus do not slide down the nose. Metal frames with adjustable nose pads, on the other hand, can be adjusted to fit many nasal bridges. Special consideration should be made for children, to prevent spectacles from getting damaged or lost, and to make sure that the child will use them correctly; a strap around the back of the head, temples that wrap around the ear, spring hinges and metal parts can help. An eye doctor will assess the need for spectacles and determine the appropriate lenses.⁴⁵

Relevant organizations:

Christian Blind Mission (CBM), <<http://www.cbm.org/index.php>>

Restoring Vision, <<http://restoringvision.org/>>

Use – As prescribed by the ophthalmologist.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Zenni Optical (United States), <<http://www.zennioptical.com/kids/boys-glasses>>

Jonas Paul Eyewear, <<https://jonaspaleyewear.com/collections/buy-kids-glasses-online/products/kids-glasses-frames-ruth?variant=3140241539>>

Miraflex, <<http://miraflexglasses.net/products/>>, metal-free (hingeless) spectacles for children,

Safilo (Italy), <<http://safilo.com/kids/#subSafe>>

Example illustration

⁴⁴ For more information on spectacles, see Provision, 'Lenses: More than meets the eye',

<<http://www.provision.com.au/page/lenses>>; for more information on low vision, see Vision Aware, 'What Is Low Vision?', <<http://www.visionaware.org/info/your-eye-condition/eye-health/low-vision/123>>.

⁴⁵ World Society of Paediatric Ophthalmology and Strabismus, 'Consensus Statement on Spectacle Frames for Children', <http://www.hadassah-med.com/media/3682441/pediatric_ophthalmology_spectacles_frames_for_children.pdf>



White cane

Description – A white cane is used by blind or visually impaired users to detect objects in their path or changes in elevation.

Product classification – ISO 9999:2007 12 39 03 Sticks (white) tactile

General features – A cane that folds up easily when traveling and stays rigid when in use.

Indicative price – Cost ranges between \$14 and \$50.

Repair and maintenance – N/A

Assessments and fitting – It is essential to obtain the correct length of cane for the user's height.

Use – The cane is held with the wrist between the waist and the belly button, and is swung from left to right as the user walks.

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Braille Bookstore, <www.Braillebookstore.com/White-Canes>

VisionAware, <www.visionaware.org>

World Blind Union, <www.worldblindunion.org>

Example illustration



Braille display

Description – Braille displays allow the user to read content on a computer screen by translating it to Braille. It provides direct, accurate access to the information on the screen.

Product classification – ISO 9999:2007 22 39 03 Braille displays

Product standards – N/A

General features – A Braille display operates on either electromagnetic or piezoelectric principles. Braille displays provide access to information on a computer screen by electronically raising and lowering different combinations of pins in Braille cells. This simulates the effect of the raised dots of Braille impressed on paper. There are usually 40, 65 or 80 arrays (characters) per line of text, depending on the device. A Braille display is refreshable, and changes continuously as the user moves the cursor around on the screen, using either the command keys, cursor routing keys, or Windows and screen reader commands. The Braille display usually is placed underneath the computer keyboard connected via USB. Braille displays can be used in conjunction with Braille keyboards, personal digital assistants (PDAs) and/or speech recognition software.

Specifications – Vary by model. At a minimum, includes battery, USB cable and navigation keys.

Optional features and accessories – There are no optional features or accessories for this product.

Indicative Price – Cost ranges between \$2,500 and \$15,000.

Repair and maintenance – The product requires no special repair or maintenance.

Assessments and fitting – The Braille display can be easily connected via USB. There are no drivers to install, no additional configuration is necessary during installation, and no administrator rights are needed.

Use – The user moves the cursor using the navigation keys and pins on the Braille display to read and understand the content on the screen.

References

Esys 40, Brailliant BI 40, BRAILLEX EL 40c, Braille EDGE 40, SuperVario 2
European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Screen reader

Description – Screen readers are software programmes that allow the user to read text displayed on a computer screen with a speech synthesizer or Braille display.

Product classification – ISO 9999:2007 22 39 12 Text to speech

Product standards – N/A

General features – A screen reader is primarily software that is installed on a computer and works in conjunction with certain commands through a combination of keys on a computer keyboard. A synthetic speech system is composed of two parts: the synthesizer that does the speaking, and the screen reader that tells the synthesizer what to say. This includes reading a line, highlighting text, and reading certain parts of the screen. The software works with the computer's sound card.

Specifications – Software is specific to computer operating systems such as Windows, iOS or Android.

Optional features and accessories – There are no optional features or accessories for this product.

Indicative price – Available free of cost with the operating system. Special screen readers may cost up to \$1,500.

Repair and maintenance – The product requires no special repair or maintenance.

Assessments and fitting – The product requires no assessments or fittings.

Use – Products are intuitive to use. Training manuals are available.

References

VoiceOver for iOS, Talkback for Android, SuperNova Access Suite, NVDA (Non-Visual Data Access) European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Speech recognition software

Description – Speech recognition software translates voice to text and enables the user to use their voice to dictate and edit documents, send email and transcribe voice memos from computers and handheld devices such as smartphones or portable voice recorders.

Product classification – ISO 9999:2007 22 12 24 Speech recognition

Product standards – N/A

General features – Speech is used to instruct the software installed on computers and handheld devices to transcribe to text. The speech recognition software listens and responds to spoken commands. It allows the user to run programmes and interact with the system. The software is built in with intelligence to recognise, understand and adjust to different accents.

Specifications – Software is specific to computer operating systems such as Windows, Mac OS, iOS and Android. Some software has minimum memory requirements.

Optional features and accessories – There are no optional features or accessories for this product.

Indicative Price: Free to \$2,000.

Repair and maintenance – Regular software updates made available.

Assessments and fitting – The product requires no assessments and fittings.

Use – Easy to use. User guides provided with the software.

References

Dragon Dictate, Dragon Dictation, Windows speech recognition
European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Screen magnifier

Description – Screen magnifiers are used to assist children and adults with partially impaired vision, and/or with vision conditions limiting their activities due to other health challenges, to perform regular

functions on computers and handheld devices. A screen magnification system enlarges text and graphics on a computer screen.

Product classification – ISO 9999:2007 22 39 12 Screen magnifier

Product standards – N/A

General features – Magnifying hardware attached to the computer display and/or a software magnifier installed on the computer. Screen magnifiers usually enlarge text, icons and other graphics up to 10 to 20 times or more. Magnifiers can also adjust contrast colours and provide features for custom settings.

Specifications: Hardware magnifiers are usually LCDs with ergonomic adjustments and with five to seven modes for colour and background settings. They operate in 100V–240V, 50/60HZ and come with cables to link with a computer. There are no special specifications for software magnifiers. They are available for various operating systems, and requirements vary.

Optional features and accessories – There are no optional features or accessories for this product.

Indicative Price – Hardware screen magnifiers may cost up to \$3,000. Software magnifiers range usually between \$300 and \$800.

Repair and maintenance – The product requires no special repair or maintenance.

Assessments and fitting – The product requires no assessments and fittings.

Use – Intuitive and easy to use. User manual provided for support.

References

LifeStyle, CCTV, Ruby, MAGic, ZoomText, SuperNova

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



Recording and playback devices

Description – Devices with the ability to record, store and play back text and audio can be used by those with visual impairments or learning disabilities to access print information. DAISY (Digital Accessible Information System) software players, for example, render text, audio (human narration or

synthetic speech) and embedded images (if present). They are available as handheld players and support various formats.

Product classification – ISO 9999:2007 22 18 03 Recording and playback

Product standards – Not available

General features – Available as handheld devices, support formats such as PCM, Wav, MP3, MP4, etc. Records voice and media with built-in microphone or line-in. Built-in text-to-speech engine with speakers and microphones that makes a wide range of electronic documents easily accessible. Some have wireless networking capability. Supports SD slot for additional storage. Operating time up to 15 hours with rechargeable lithium ion batteries. Real-time clock with date/time announcements. Firmware upgrades via SD card or online.

Optional features and accessories – There are no optional features or accessories for this product.

Indicative Price – \$200 to \$1,000.

Repair and maintenance – The product requires no special repair or maintenance.

Assessments and fitting – The product requires no assessments and fittings.

Use – Intuitive and easy to use. User manual provided for support.

References

BookSense T50, Victor Reader Stream

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Example illustration



6.0 Communication

Communication assistive products. Augmentative and alternative communication devices can assist individuals who have difficulty understanding and producing speech. They are provided to support speech (augmentative), or to compensate for speech (alternative). There are two forms of communications.

Unaided communication– These are gestures and sign languages used to convey messages.

Aided communication – Tools or equipment are used to communicate. This ranges from using communication books/boards to using devices/software that can produce voice output in different languages. This product guide will focus on aided communication products such as

- Communication books/boards with pictures, symbols or letters of the alphabet
- Request cards
- Electronic speech output devices
- Computers with specialized equipment and programs.

Communication books/boards/charts/cards

Description – A communication book provides symbols organised by topic that can be used to learn about alternate means of communication. Boards/charts and cards are used as alternatives to books. A chart is similar to a communication book, with items illustrated on a single board. Cards with symbols or phrases, similar in size to a business card, are portable and easy to and carry.

Product classification – ISO 9999: 2016 22 01 03 Letter and/or symbol sets and boards

General features – Each page in the book can contain one or many symbols/pictures. The topics in the book are designed to address different ages, needs, abilities and interests. The books are usually further divided for ease of use and to manage the content on each page. Some include sections for most commonly used words and phrases. Every book should contain a section at the front on how to use the book. Electronic and software-based systems are available to create and print books as needed. Templates are available to assist in developing the books. Pragmatic Organization Dynamic Display (PODD) and Picture Exchange Communication System (PECS) can be used to help children learn to use aided symbols. Careful consideration has to be given to the iconicity of the symbols, to make sure they respect the culture and practices in different countries.

Indicative price – Free to \$1000.

Repair and maintenance – No specific instructions for paper-based books, charts or cards. Regular upgrades are available for electronic and software systems.

Assessments and fitting – Not Applicable

References

European Assistive Technology Information Network, <<http://www.eastin.eu>>

Pictogram, <<https://www.pictogram.se/>>

Independent Living Centre WA, ' Example Communication Books and Boards', <<http://ilc.com.au/example-communication-books-and-boards/>>

Spectronics, 'Pragmatic Organisation Dynamic Display (PODD) Communication Books: Direct access templates', <<http://www.spectronics.com.au/product/pragmatic-organisation-dynamic-display-podd-communication-books-direct-access-templates>>

Autism Speaks, 'Visual Tools', <<https://www.autismspeaks.org/family-services/resource-library/visual-tools>>

All About AAC, 'Symbol Systems', <<https://allaboutaac.wordpress.com/symbol-system/>>

Example illustration

