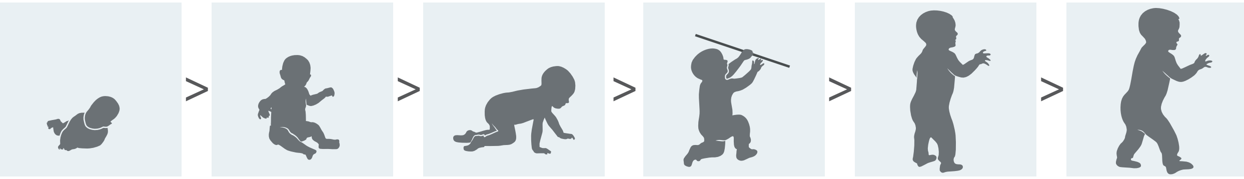
STANDING/CARIBOU

Clinical & Therapeutic folder

Normal gross motor development

Normal human motor development follows a general path from crawling, floor sitting, creeping, pull to stand, independent standing and later walking (Woollacott and Shumway-Cook 2011). The development of these motor skills is dependent upon the development of the child's postural control. Postural control involves 'controlling the body's position in space for the dual purposes of stability and orientation'. Quiet standing requires very precise postural control and a high degree of coordination between sensory feedback from sight, balance centers in the inner ear, joint position sensors in joint ligaments, stretch sensors in muscles and pressure sensors under the feet and the motor system comprising the motor nervous system, muscles and joints. To stand up without falling, the child needs to hold their center of gravity over their feet. This is a great feat of balance and requires very precise motor coordination and very sensitive feedback to adjust the child's posture. It is no wonder that a typically developing child takes 12-13 months to learn this skill.



Rolling Sitting Crawling Pull to stand Standing Walking

Gross motor function classification system (GMFCS)

The Gross Motor Function Classification System (GMFCS) for cerebral palsy is based on self-initiated movement, with emphasis on sitting, transfers, and mobility. When defining a five level classification system, the primary criterion has been that the distinctions between levels must be meaningful in daily life.
Distinctions are based on functional limitations, the need for hand-held mobility devices (such as walkers, crutches, or canes) or wheeled mobility and, to a much lesser extent, quality of movement.

The focus is on determining which level best represents the child's present abilities and limitations in motor function. Emphasis is on the child's usual performance in home, school, and community settings. It is therefore important to classify on ordinary performance (not best capacity), and not to include judgments about prognosis. Remember the purpose is to classify a child's present gross motor function, not to judge quality of movement or potential for improvement.

The descriptions of the 5 levels which appear below are broad and are not intended to describe all aspects of the function of individual children. The title for each level represents the highest level of mobility that a child is expected to achieve between 6-12 years of age.

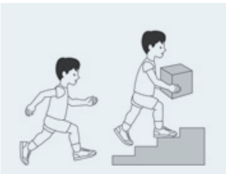
An effort has been made to emphasize children's function rather than their limitations. Thus as a general principle, the gross motor function of children who are able to perform the functions described in any particular level will probably be classified at or above that level; in contrast the gross motor functions of children who cannot perform the functions of a particular level will likely be classified below that level.

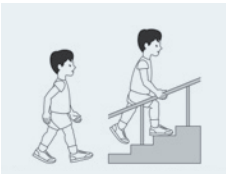
GMFCS levels

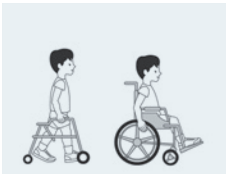
Distinctions Between Levels I and II - Compared with children in Level I, children in Level II have limitations in the ease of performing movement transitions; walking outdoors and in the community; the need for assistive mobility devices when beginning to walk; quality of movement; and the ability to perform gross motor skills such as running and jumping.
Distinctions Between Levels II and III - Differences are seen in the degree of achievement of functional mobility. Children in Level III need assistive mobility devices and frequently orthoses to walk, while children in Level II do not require assistive mobility devices after age 4.

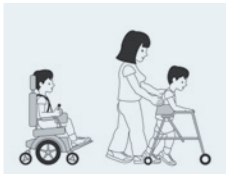
Distinctions Between Level III and IV - Differences in sitting ability and mobility exist, even allowing for extensive use of assistive technology. Children in Level III sit independently, have independent floor mobility, and walk with assistive mobility devices. Children in Level IV function in sitting (usually supported) but independent mobility is very limited. Children in Level IV are more likely to be transported or use power mobility.
Distinctions Between Levels IV and V - Children in Level V lack independence even in basic antigravity postural control. Self-mobility is achieved only if the child can learn how to operate an electrically powered wheelchair.

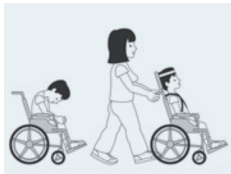
GMFCS Expanded & Revised 6 to 12 years


Level I

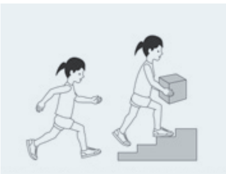

Level II

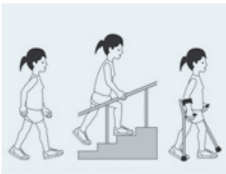

Level III

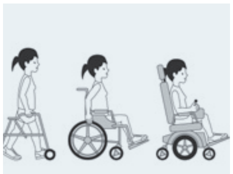

Level IV

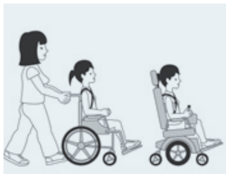

Level V

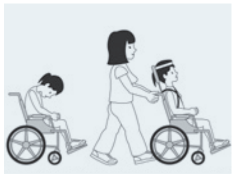
GMFCS Expanded & Revised 12 to 18 years


Level I


Level II


Level III


Level IV


Level V

Challenges in standing

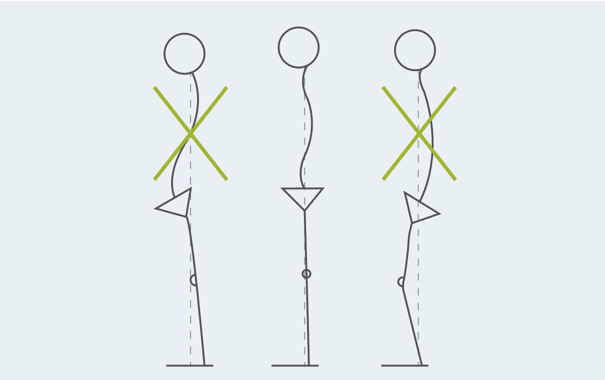
Children with a motor handicap can have challenges in standing. This can be due to many factors:

- **Poor coordination** or an imbalance of muscles around the ankle and hip joints making fine adjustments to the position of the child's centre of gravity difficult
- **Poor postural control** of the trunk and head
- **Weakness** in the anti-gravity muscles, more specifically ankle plantarflexors, knee and hip extensors and trunk extensors
- **Contracture** in muscles so that the child cannot attain a correct alignment for standing, specifically muscles tending to plantarflex the ankle and flex the knee and hip
- Difficulties in organising **sensory information**
- **Reduced ability** to meet the attentional demands of standing.

Standing devices compensate for the above challenges by controlling the joint position and posture of the child where required and providing a greater base of support so that the child's center of gravity is maintained over the base of the standing device, providing stability. As with other equipment, the challenge in adjusting the equipment correctly is to provide precisely the degree of support necessary – too little and the child becomes unstable, too much and we reduce the child's freedom to move in the stander and develop their postural control.

How to obtain a good standing position

- The child must stand symmetrically (equal weight bearing)
- The pelvis must be in frontal symmetry (spina iliaca anterior superior at the same level)
- The pelvis must be in a neutral tilt position
- The line from head to foot must be the same as the line of gravity in the standing position
- Body and head in midline



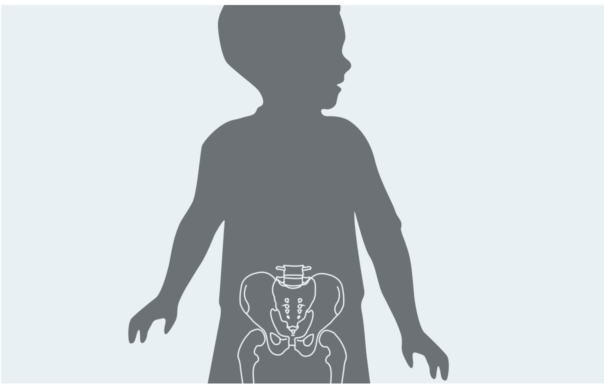
Why do we want children to stand?

Therapists, parents and carers quite often have clear objectives when including a standing program as a part of a child's therapy. Common grounds cited by therapists are:

Improve hip integrity

Development of the hip depends on weight bearing. The angle of the femur bone and the caput of the femur develop from a more upright position to about 120°. Having a femur/caput angle of 120° will protect the hip from sub/disluxation, especially if the muscle pull is strong in an adducted direction (CP).

Weight bearing is believed to facilitate the development of stable hips (Scrutton et al. 2001, Connelly et al. 2009). A case series (Martinsson and Himmelmann 2011) studied the effect of weight-bearing with abducted hips on hip migration percent. The study concluded that one year of weight-bearing with the maximum achievable abduction (25°-30°) and 0° hip extension for at least one hour per day improved hip status both in children following adductor-iliopsoas tenotomy and children without surgery. The Gazelle by R82 was used for this research.



Prevent contractors

In a standing position the joints are extended, whilst in the sitting position they are more flexed. If the child is standing, the joints, ligaments and muscles are stretched .
Children with motor delays will not come to standing themselves and therefore need help to achieve the standing position in supportive frames.
The seated position flexes the hips and knees. When these joints are flexed for a longer period of time, the muscles that remain unstretched (iliopsoas, hamstrings and gastrocnemius) can develop contractures.

There are no studies in children, but an RCT (randomised controlled trial) of six adults with MS (multiple sclerosis) (Baker et al. 2007) who stood for 30 minutes, three sessions a week for three weeks showed a significant increase in knee and ankle range of motion. A survey of 126 adults with SCI (spinal cord injury) who stood approximately 40 minutes, three to four times per week reported an improved ability to straighten their legs. Studies based on surveys (Dunn et al. 1998, Walter et al. 1999) reported improved range of motion. Studies based on case series report varying effect of standing on range of motion, but the results are generally positive.

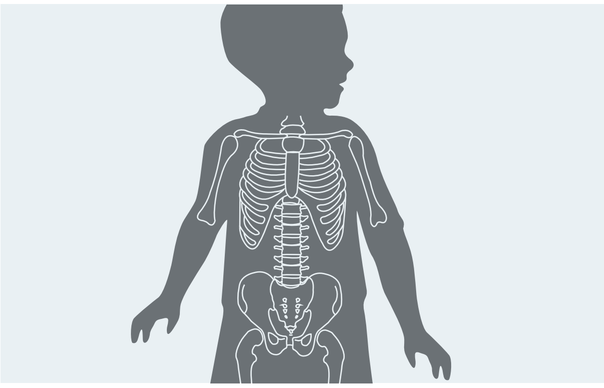
Why do we want children to stand?

Increase in bone mineral density

Active weight bearing is important for strength and growth of the bones. The reduced loading of the lower extremities from prolonged sitting is thought to be a contributing factor in the reduction of BMD (bone mineral density) leading to increased risk of fracture and osteoporosis. It has been proposed that a standing program halts or reverses the decalcification in response to loading of the bones.

There are few paediatric studies documenting this area. One high quality randomised study (Caulton et al. 2004) measured a 6% mean increase in vertebral BMD but no change in proximal tibial BMD for 26 children with CP (cerebral palsy) in response to a 50% increase in regular standing duration over a nine month period. Another study (Ward et al. 2004) of 20 children with disabling conditions randomised children to treatment either with passive standing or standing with WBV (whole body vibration). The group who stood with WBV increased proximal tibia BMD whereas the passive stander group had a decrease in their proximal tibia BMD. Vertebral BMD changed to a greater extent in the WBV group.

One of the issues in considering BMD is the degree of loading the subject experiences. A study of 20 children with CP (Kecskemethy et al. 2008) measured standing loads between 37-101% BW (bodyweight) dependent upon the type of stander and inclination. Another study of 19 children with CP (Herman et al. 2007) measured loads during standing of 23-102%, averaging 68%. Different loading will possibly impact on BMD and can be a factor in explaining the variation in BMD response.



Tone reduction

Prolonged standing is thought to affect muscle tone through prolonged stretch of the muscle spindle and Golgi tendon organs together with compression of cutaneous proprioceptive and joint receptors.

A number of studies have measured the effects of a standing program on spasticity. An RCT of 22 children with CP (Tremblay et al. 1990) showed a significant short-term decrease in spasticity after standing with dorsiflexed feet on a tilt table for 30 minutes in comparison to a control group at rest. An RCT of six wheelchair dependent adults with MS (Multiple Sclerosis) (Baker et al. 2007) demonstrated a reduction in spasticity measured with Ashworth Scale following a three week standing program of three 30 minute standing sessions per week. A study using objective neurophysiological test methods (Kunkel et al. 1993) on six adults (four SCI, two MS) found no effect from standing an average of 144 hours over an average of 135 days. Another study (Tsai et al. 2001) using an objective neurophysiological test method reported reduced plantarflexor spasticity in 17 adults after CVA (Cerebrovascular Accident) following a 30 minute plantarflexor stretch on a tilt table.

Presure relief

Changing position from sitting to standing gives a pressure relief for the bottom. The importance of presure relief increases as the child gets older.

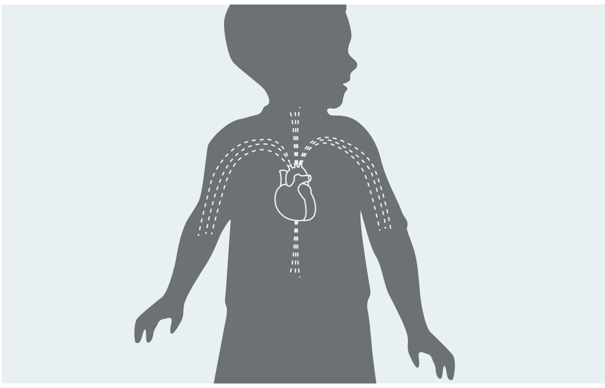
There are few studies documenting reduction in pressure sores as a result of a standing program, but a single study (Walter et al. 1999) of 99 adults with SCI (Spinal Cord Injury) who stood more than 30 minutes a day showed a significant reduction in bedsores. Skin integrity was one of the benefits documented in a survey of 126 adults with SCI (Eng et al. 2001).

Why do we want children to stand?

Cardiopulmonary function

Comming from sitting to a standing position will stimulate the cardiopulmonary fuction.

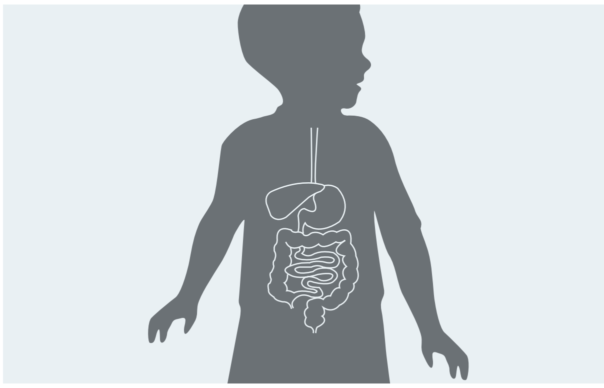
The evidence of two RCT's (Randomized Controlled Trial), (Faghri et al. 2001, Faghri and Yount 2002) on people with SCI would seem to indicate that it is important in this patient group to use FES (Functional Electrical Stimulation) in conjunction with passive standing to avoid reduced cardiac stroke volumes and output together with increased peripheral resistance. During 30 minutes of active standing using FES, the subjects' haemodynamics were maintained at the pre-standing level.



Bowel/bladder function

The standing position lifts the trunk and creates more space in the abdominal region, which results in better peristaltic movements.

The studies in this area are solely on adult patients primarily with SCI and are low evidence comprising surveys and case studies. These publications would seem to indicate reduced constipation, more regular bowel movements and a decrease in urinary tract infections in subjects who participate in standing programs.



Psychological well-being

The standing position will stimulate the sensor-motor development. The psycological well-being is an important consideration in implementing standing programs.

There is one study (Eng et al. 2001) with a survey of 126 adults with SCI where the participants responded that psychological well-being was one of the benefits of standing programs.

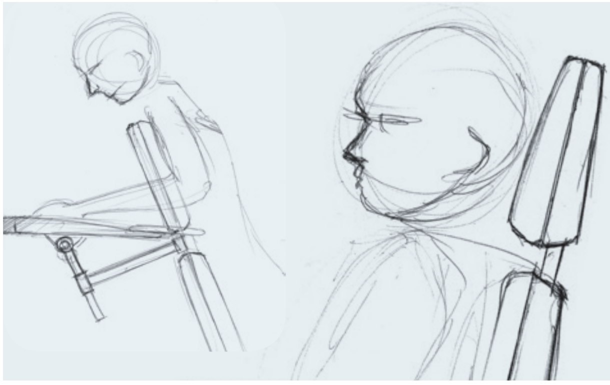
Improvements of functional goals

The standing position is the best possible postion for head- and trunk control training. Achieving better postural control potentially gives the child the ability to stand independently and start walking (using a walking aid).

A single study has investigated the effect of prolonged standing for 45 minutes three times a week for three weeks on six subjects with CP (Salem et al. 2010). The study demonstrated a significant improvement in gait speed, stride length, stance phase time and double support time as a result of the program.

Development through cooperation

R82 works together with both users and experts when developing new products, thus combining know-how and experience from previous standing aids. The Caribou by R82 now appears with important features; comfortable material, strong and stable frame, anatomic shape, easy handling posibilities for the caregiver and adjustable support for various levels of disability. All features have been developed to create user-friendly products, that provide pleasure and greater physical well-being for the users.



Caribou by R82

The Caribou is our new standing frame, with an ability to adjust from a horizontal to a vertical position.

The Caribou is built with a base board and a series of optional upper body supports is available to provide the optimum freedom of movement. A wide range of accessories is also available to meet the specific needs of the user.

The Caribou is available in four sizes and suitable for children between the ages of 1-18.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Target groups

The Caribou standing frame can be used in prone or in supine position. The frame is designed to assist standing for a child with a wide range of disabilities ranging from children with a spastic pattern to paralyzed children:

- Cerebral Palsy (GMFCS III-V)
- Spina Bifida
- Muscular Dystrophy
- Neuro-muscular diseases
- Late brain damage
- Spinal cord injury

Two position options

Supine position

Supine standing can be chosen for children with poor head- and trunk control. These children may not be able to prone stand because they will collapse in their upper trunk and their head will drop. By giving these children support from behind, it may be possible to create a supported standing position. The Caribou can be tilted to bring the child as close to upright as they can manage without the head falling forward. In this position the child will not have full weight bearing, but contractures will be avoided and the other benefits of standing previously discussed may be achieved.

Prone position

Prone standing is a more active way of standing. It facilitates extension of the spine. Standing close to upright or slightly tilted forward the child will stand with good weight bearing, which is very important for increasing bone density and growth. The extended position is important for the stretching the muscles and preventing contractures from arising.

Steps to find the correct size and configuration

Follow the four steps described below to....

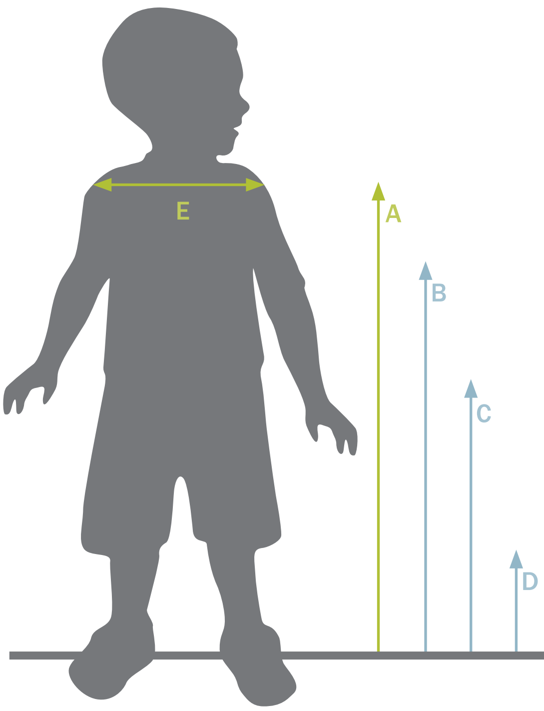
1. Measure the child correctly based on supine or prone standing

2. Choose the correct size of Caribou standing aid based on the measurements of the child

3. Choose correct size of top plate based on the measurements of the child

4. Configure the Caribou based on the measurements of the child and choose the correct accessories

1. Useful measures for **Supine** Standing



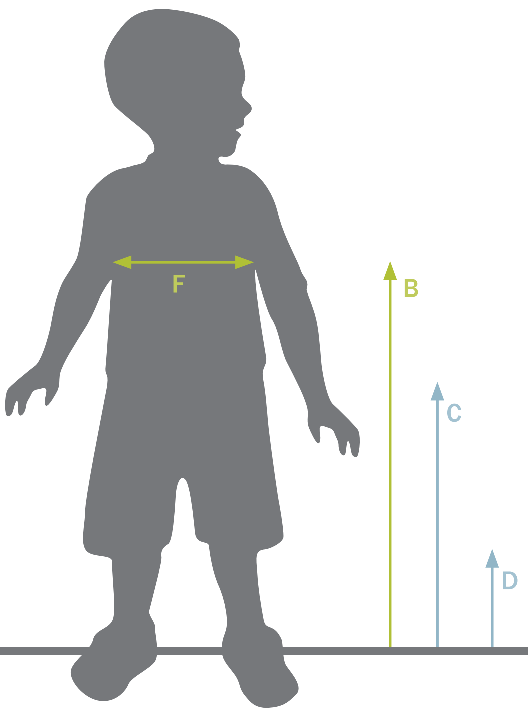
Supine

Measurements to choose the correct product size:
A: Shoulder height
E: Shoulder width

Measurements to adjust the product correctly:
B: Armpit height
C: Top of pelvis (crista)
D: Lower leg length

1.

Useful measures for **Prone** Standing



Prone

Measurements to choose the correct product size:
B: Armpit height
F: Chest width

Measurements to adjust the product correctly:
C: Top of pelvis (crista)
D: Lower leg length

2.

Choose the correct size of Caribou as a **Supine** Stander

Shoulder height (A)	Caribou size 1	Caribou size 2	Caribou size 3	Caribou size 4
Approximate total height (child)	85-112 cm (33½-44”)	98-129 cm (38½-50¾”)	125-156 cm (49¼-61½”)	153-184 cm (60¼-72¾”)
Height of Caribou from foot plate to top base plate (H)	46-57 cm (18-22½”)	53-64 cm (21-25¼”)	68-79 cm (26¾-31”)	88-99 cm (34½-39”)
Height of Caribou from foot plate to top of top plate = shoulder height (A)	66-77 cm (26-30¼”)	78-89 cm (30¾-35”)	100-111 cm (39¼-43¾”)	128-139 cm (50½-54¾”)
Top plate height (1) (H)	20 cm (8”)	25 cm (10”)	32 cm (12½”)	40 cm (15¾”)
Extra cushion height (2) (H)	8 cm (3¼”)	10 cm (4”)	10 cm (4”)	10 cm (4”)
Two extra cushions height (3) (H)	16 cm (6¼”)	20 cm (8”)	20 cm (8”)	20 cm (8”)
Max. load	40 kg (88 lb)	60 kg (132 lb)	80 kg (176 lb)	100 kg (220 lb)
Min. height (A)	66 cm (26”)	78 cm (30¾”)	100 cm (39½”)	128 cm (50½”)
Max. height (A+3)	93 cm (36¾”)	109 cm (43”)	131 cm (51½”)	159 cm (62½”)

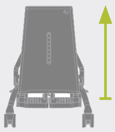
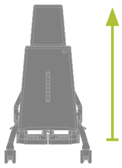
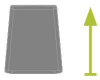
Combination examples for **Supine** Standing

Ex. 1: Shoulder height of child (A) = 80 cm (31½”)	Height
Caribou size 2	53-64 cm (21-25¼”)
Top plate size 2	25 cm (10”)
Extra cushion	-
Lowering footplate	2 cm (¾”)
Total height	80 cm (31½”)
Growth potential:	
Growth potential by adjusting the foot plates	9 cm (3½”)
Growth by mounting two extra cushion	20 cm (8”)
Total growth potential	29 cm (11½”)

Ex. 2: Shoulder height of child (A) = 113 cm (44½”)	Height
Caribou size 3	68-79 cm (26¾-31”)
Top plate size 3	32 cm (12½”)
Extra cushion size 3	10 cm (4”)
Lowering footplate	3 cm (1¼”)
Total height	113 cm (44½”)
Growth potential:	
Growth potential by adjusting the foot plates	8 cm (3¼”)
Growth by mounting two extra cushion	10 cm (4”)
Total growth potential	18 cm (7”)

2.

Choose the correct size of Caribou as a **Prone** Stander

Armpit height (B) Chest width (F)		Caribou size 1	Caribou size 2	Caribou size 3	Caribou size 4
Height of Caribou from foot plate to top base plate		46-57 cm (18-22½")	53-64 cm (21-25¼")	68-79 cm (26¾-31")	88-99 cm (34½-39")
Height of Caribou from foot plate to top of top plate = armpit height (B)		66-77 cm (26-30¼")	78-89 cm (30¾-35")	100-111 cm (39¼-43¾")	128-139 cm (50½-54¾")
The top plate must be high enough and fit the child's chest width to give freedom for arm movements. Often a smaller size of top plate will be used.					
Top plate height (1)		20 cm (8")	25 cm (10")	32 cm (12½")	40 cm (15¾")
Top plate width =/< chest width (F)		15 cm (6")	19 cm (7½")	22 cm (8¾")	25 cm (9¾")
Extra cushion height (2)		8 cm (3¼")	10 cm (4")	10 cm (4")	10 cm (4")
Two extra cushions height (3)		16 cm (6¼")	20 cm (8")	20 cm (8")	20 cm (8")
Max. load		40 kg (88 lb)	60 kg (132 lb)	80 kg (176 lb)	100 kg 220 lb)
Min. height (baseplate)		46 cm (18")	53 cm (21")	68 cm (27")	88 cm (34½")
Max. height (B+3)		93 cm (36½")	109 cm (43")	131 cm (51½")	159 cm (62½")

Combination examples for **Prone** Standing

Ex. 1: Armpit height (B) 88 cm (34¾"), Chest width (F) 22 cm (8¾")

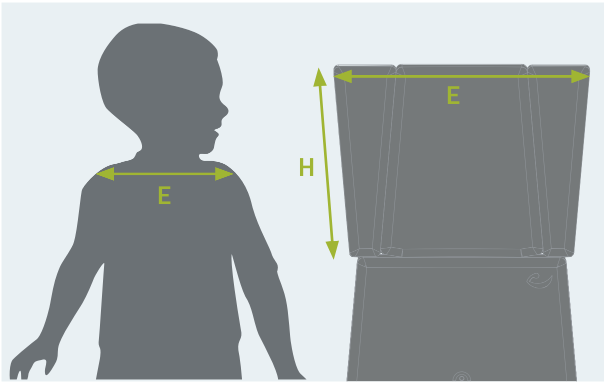
	Height	Width
Caribou size 2	53-64 cm (21-25¼")	
Top plate size 2	25 cm (9¾")	19 cm (7½")
Extra cushion size 2	10 cm (4")	
Lowering footplate	-	
Total height	88 cm (34¾")	
Growth potential:		
Growth potential by adj. the foot plates	11 cm (4½")	
Growth by mounting one extra cushion	10 cm (8")	
Total growth potential	21 cm (8¼")	

Ex. 2: Armpit height (B) 123 cm (48½"), Chest width (F) 27 cm (10¼")

	Height	Width
Caribou size 4	88-99 cm (34¾-39")	
Top plate size 3	32 cm (12½")	22 cm (8¾")
Extra cushion	-	
Lowering footplate	3 cm (1¼")	
Total height	123 cm (48½")	
Growth potential:		
Growth potential by adj. the foot plates	8 cm (3¼")	
Growth by mounting two extra cushion	20 cm (16")	
Total growth potential	28 cm (11")	

3.

Choose the correct support of the upper body as **Supine** use



Supine

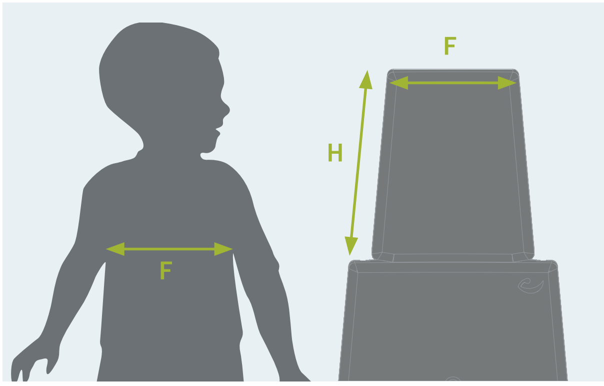
If the user is placed in Supine position, they need support around the upper part of the body. By choosing the correct top plate together with shoulder supports, you are able to provide the user with the optimal support for Supine postion.

Width of top plate and shoulder supports should be the minimum shoulder width of the user.

	E	H
Size 1	30 cm (11¾”)	20 cm (8”)
Size 2	36 cm (14¼”)	25 cm (9¾”)
Size 3	42 cm (16½”)	32 cm (12½”)
Size 4	48 cm (19”)	40 cm (16”)

3.

Choose the correct support of the upper body as **Prone** use



Prone

If the user is placed in Prone position, it can be advantageous to choose a top plate that gives the user space for movement of the arms.

The chest width of the user is the important measurement when you need to choose the correct size of top plate. The top of the top plate must not be wider than the chest width in order to obtain the most space for movement of the arms.

	F	H
Size 1	15 cm (6”)	20 cm (8”)
Size 2	19 cm (7½”)	25 cm (9¾”)
Size 3	22 cm (8¾”)	32 cm (12½”)
Size 4	25 cm (10”)	40 cm (16”)

4.

Configuring the Caribou with accessories - **Supine** stander

Head support

Gives support for the head when the frame is in a horizontal position and during transfer. Ensures head is in the midline and good symmetry. You can choose between the full range of R82 head supports

Chest strap

Can be mounted between the top plate and the shoulder support, meaning very close to the body, providing firm support. Use measurement B - arm pit height for mounting the chest strap

Pommel

The pommel, in combination with the straps above the knees, can be an alternative or an addition to the knee supports

Foot supports

The individual foot supports make it possible to mount the foot plates at different heights. They can be adjusted in dorsal/plantar flexion. Duck feet, heel stops and/or straps can be mounted

Shoulder supports

Mounted on the top plate. Gives support for the trunk and shoulders when the frame is in a horizontal position and during transfer. Ensures that the child feels safe.

Extra cushion

To extend the base you can add a maximum of 2 extra cushions

Hip Strap

The hip strap will be mounted around the pelvis. Use measurement C - top of pelvis, for correct position

Knee supports

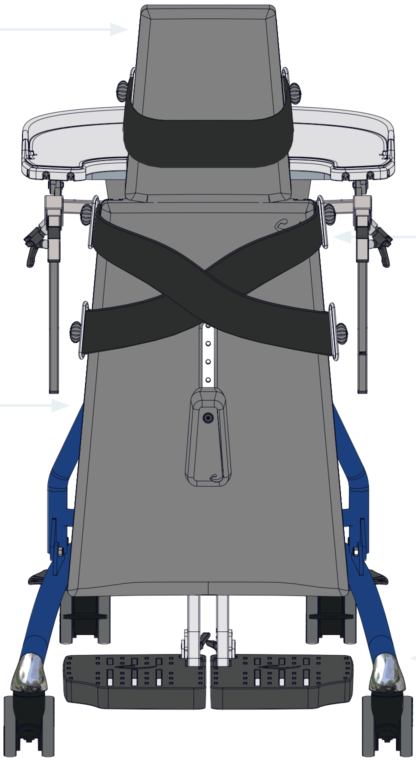
The individually fixed or swing away knee supports can be mounted below or above the knee. Use measurement D - lower leg lenght, for correct position

4.

Configuring the Caribou with accessories - **Prone** stander

Top plate
The top of the top plate should be at armpit height. Use measurement B - armpit height, for correct position. If the child has good trunk control you can lower the plate. A strap for extra safety can be mounted around the chest

Pommel
A pommel can be placed between the legs and help to keep the user's thighs apart. Standing prone, the base plate gives support for the knees



Cross straps
The cross straps must be mounted close to each other to provide lateral support. The cross should be on the sacrum. Use measurement C - top of pelvis, for correct position. The long straps makes it possible to mount the straps tightly to ensure an extended hip joint

Foot supports
The individual foot supports make it possible to mount the foot plates at different heights. They can be adjusted in dorsal/plantar flexion. Duck feet, heel stops and straps can be mounted

Good ergonomics

It is extremely important that it is easy to transfer the user from a wheelchair to the stander. To take care of the helper and protect them from back injury, the frame should be in a horizontal position. Using a hoist/lift makes it so much easier to do the transfer.

If the child/young person is standing prone, consider the users ability to take weight on their legs and their trunk stability.

A user not able to take weight on their legs and with poor head/trunk control (Supine standing):
If the user is sitting in the wheelchair, a sling is mounted around the user who is lifted over to the stander, which is in a horizontal position. If the user is lying flat on their back, chest belts are mounted around the trunk, over the pelvis and knee supports or a belt positioned on the legs, either above or below the knees. The stander is tilted to a more upright position.

A user with ability to take weight and having some head/trunk stability (Prone standing):
If the user can walk into the frame or can sit in a wheelchair their feet should be placed on the foot plates and assisted to pull up to standing. Next step could be to tilt the frame to a horizontal position, mount the cross belt around pelvis and the chest belt and tilt up close to a vertical position.

A user not able to take weight but with some trunk stability (Prone standing):
If the user sits in the wheelchair, a standing sling is mounted on the user and a hoist/lift is used to pull the user out of the chair. The stander is in a vertical position and the user is lifted up and over in the stander. The stander is tilted to a horizontal position and the cross belt around the pelvis and the chest belt around the trunk is mounted. The stander is tilted to a more upright position.

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