



What makes a good trunk support?

4. Back support measures

Within a seating system, the primary support surfaces are the seat cushion and back support. What are the measures of a back support that offer up a good fit for the occupant?

Many accessories to a seating system are two-dimensional and therefore are easy to describe and to measure. Back supports tend to be more complicated because most offer a mix of posterior and lateral support, with differing functional needs at different points along the length of the upper body.

Back supports are usually prescribed to support different, but at the same time, 'articulated' parts of the body. The back bone of the trunk is a collection of separate components, the vertebrae, most of which can articulate to a degree in three dimensions, and therefore each of which has an individual degree of need of support. These separate, but connected, components all provide for flexibility of body position, but at the same time provides multiple areas where intervention and support may be required to prevent deterioration or damage – hence the need for a back support that can manage these components while permitting the greatest degree of freedom.

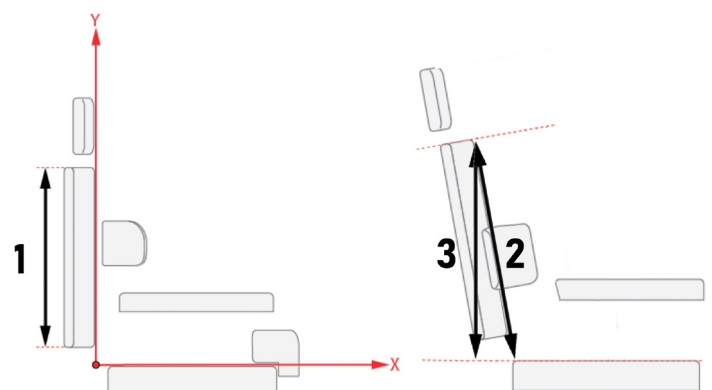
Back support measures

Managing these needs is the remit of the prescribing individual, but how can the manufacturer describe the measures of the different elements of the back support so that the prescriber knows which one to order? The ISO wheelchair seating standards task group has come up with a series of terms and their definitions for complex seat cushions, and these will be part of the revision of ISO 16840-1¹ when it gets published (if the reader wants more detail of these in the meantime, please drop me an email at barend@beshealthcare.net). However, to date there has not been a recommendation for the terminology for even basic back supports, and the intent of this article is to put some suggestions forward.

The complexity, for even the more simple back supports,

is the range of components involved. This includes i) the mounting hardware (which pertains to the wheelchair's dimensions), ii) the back support supporting structure (e.g. shell), and iii) the attached back support cushion (which pertain to the occupant's dimensions). The existing standardised terminology covers the basic starting points. Width is the size dimension from left to right. Depth is a front to back size dimension. Length is a top to bottom size dimension. Thickness is the size dimension under and at right angles to the support surface itself. Height, on the other hand, is a placement measure and is defined as the distance from the top of a reference point on the back support component to a fixed point elsewhere.

For example, the back support out of the box has a length (Figure 1, 1), but does not have a height until it is attached to the chair: at this point, the height is the distance from the top of the back support to the top of the seat cushion (Figure 1, 2) at whatever angle the back support is reclined. This is not to be confused with the vertical height which is important to see if the chair will fit into a vehicle, for example, and which is the vertical distance from the top of the support to a horizontal projection from the top of the seat cushion (Figure 1, 3).



1 Back support length

2 Back support height

3 Back support vertical height

Figure 1. Back support length and height dimensions

Mounting hardware dimensions

Some wheelchairs have their back supports mounted on a central pillar, often known as a Captain's seat, and which is more common on scooters. However, most wheelchairs have a pair of vertical poles which are usually placed as far apart as the tubing of the seat support structure. It is this width that is normally ascribed to the 'width' of the back support.

The existing standard for wheelchair dimensions, ISO 7167-7², defines as Dimension 8 the back support structure width as the maximum width at a height between 200 and 500 mm from the seat surface on a loaded chair. However, the illustrative figure (Fig. 17) suggests the points for measurement on each side of the chair are from different parts of the tube, depending on where an existing canvas is attached. This standard is being revised, and the proposal is that the chair back support structure width be stated as being the maximum distance across the outside of the uprights (Figure 2). This measure in the standard is currently made after the chair seat has been loaded with a weighted dummy since the distance between the uprights can decrease in folding chairs, though is less likely in chairs with a rigid frame.

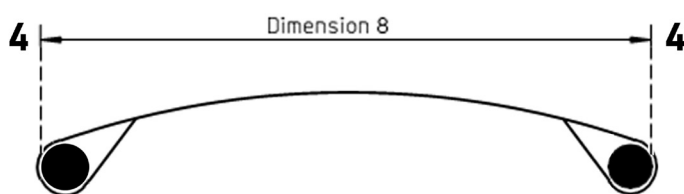


Figure 2. Seat frame width (4 to 4: "Dimension 8") measure (view from above)

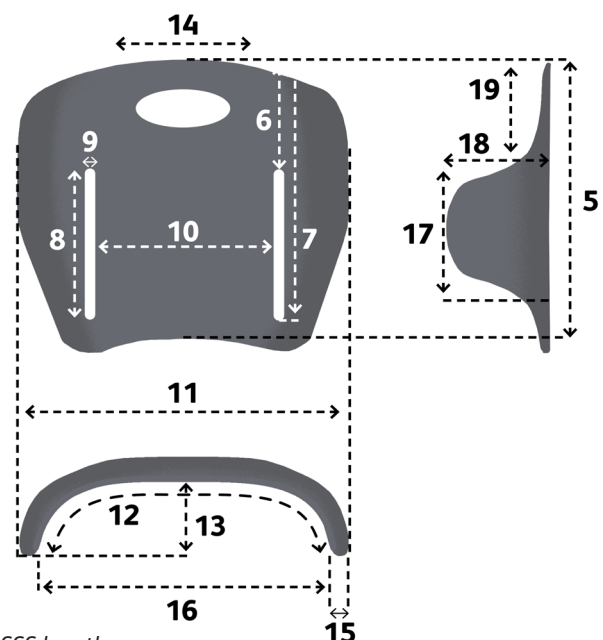
If the back support is mounted in front of the uprights, then the support itself could in practice be wider than the distance between the uprights: otherwise it will need to be narrow enough to fit between the poles, which will be the 'Dimension 8' less the diameter of the poles.

These days most back supports are supplied with 2-point mounting options to accommodate the paucity of space on the uprights for 4-point mounting systems, especially for back supports with a short length. Many hardware mounting systems have built into them adjustability for variations in width, height, and angle. These should be described by the manufacturer in mm and degree ranges respectively. In some cases, width and height adjustments are provided in addition or alternatively by slots in the back support support structures. The width adjustability not only accommodates for variability in the upright poles' width variability, but also allows the back support to be mounted in an offset position, if needed to accommodate a scoliotic spine, for example.

Back support support structure

The back support support structure (BSSS), is usually a board of some type in a planar (flat) seating system, but in most cases it is a 'shell'. The BSSS provides the means to have the back support attached to the mounting hardware on the one side, and the back support cushion on the other. The shell structure measures are likely to be slightly smaller than the attached cushioning so that the occupant is protected from injury from the edges of the shell. The BSSS is also the structure to which ancillary support items such as anterior, lateral, or head supports are attached.

The key measures for the BSSS are going to be a mix of its linear 2-dimensional measures, its surface measures, and the measures of any additional elements for both mounting hardware and also for other accessories. Figure 3 provides illustrations of key measures and suggestions for relevant naming for a standard shell. Where the shell has integrated elements for additional lateral support, these should be ascribed additional measures to cover their attributes (Figure 3, 17, 18 and 19).



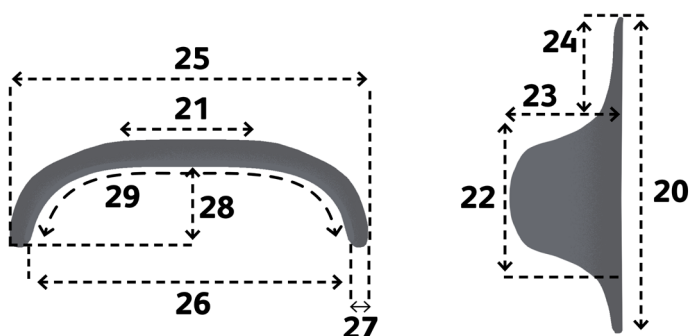
- 5 BSSS length
- 6 Height from bottom of BSSS vertical slot
- 7 Height from top of BSSS vertical slot
- 8 Length of BSSS vertical slot
- 9 Slot width
- 10 Internal slot width
- 11 BSSS maximum external width
- 12 BSSS internal semi-circumferential width
- 13 BSSS depth
- 14 BSS posterior planar width
- 15 BSSS thickness
- 16 BSSS internal width
- 17 BSSS integrated lateral support length
- 18 BSSS integrated lateral support depth
- 19 BSSS integrated lateral support height

Figure 3. Measures of aspects of a back support support structure (BSSS) from in front, side (17-19), and above (12, 13, 15, 16)

Back Support Cushion

The back support cushion is the interface between the occupant and the back support, and so these measures are the ones that are needed to meet the relevant measures of the occupant.

From the posterior aspect, the amount of support needed is a limited width (Figure 4, 21). If a pressure mapping system is used to assess the surface contact on a planar back support, the contact surface is unlikely to be more than 200 mm wide. However, most back supports are wider than this to accommodate the back support mounting system, to enable the addition of further positioning accessories, and usually to provide some lateral support to a lesser or greater degree.



- 20 BSC length
- 21 BSC posterior planar width
- 22 BSC integrated lateral support length
- 23 BSC integrated lateral support depth
- 24 BSC integrated lateral support height
- 25 BSC maximum posterior width
- 26 BSC internal width
- 27 BSC thickness
- 28 BSC depth
- 29 BSC internal semi-circumferential width

Figure 4. Measures of elements of a back support cushion (BSC) from above (21, 25-29) and from the side (20, 22-24)

Practicalities

These measures are suggestions to cater for off-the-shelf after-market back supports, and are therefore not applicable to more custom-seating solutions such as foam-carve or FreeForm (Figures 5) types of supports. They cover linear measures on the whole and relate mainly to items as supplied by a manufacturer.



Figure 5. The Symmetric Designs FreeForm customisable modular back and seating system.

In Part 5 we cover measuring the individual to enable us to prescribe the most suitable product match for the individual's dimensions, as well as selecting the appropriate back support and set-up for that individual's needs. Part of the set-up includes selecting the appropriate angle for placing the supports on the wheelchair frame. The foundations for these measures were covered in previous articles, in the Measurements in Seating series. Further guidance can be found in Waugh and Crane's Clinical Application Guide to the ISO 16840-1 measures³.

1. *ISO 16840-1:2006 Wheelchair Seating — Part 1: Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces*
2. *ISO 7176-7:1998 Wheelchairs — Part 7: Measurement of seating and wheel dimensions*
3. *Waugh, K and Crane, B (2013) A clinical application guide to standardized wheelchair seating measures of the body and seating support surfaces. Accessible as BPG3 from <https://www.pmguk.co.uk/resources/best-practice-guidelines/bpg-archive>*



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