Body, Seating and Frame Measurements: Assessment to Delivery

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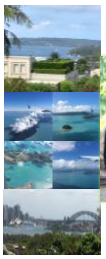


- Living and working in Melbourne Australia
- Hire and Scripted Rehab Equipment Service Delivery

No Conflicts of Interest to Declare

Center for Inclusive Design and Engineering (CIDE)
COLLEGE OF ENGINEERING, DESIGN AND COMPUTING
UNIVERSITY OF COLORADO DENVER | ANSCHUTZ MEDICAL CAMPUS
Breaking Barriers | Changing Lives

Kelly Waugh, PT, MAPT, ATP

- Colorado, USA
- Rocky Mountains
- University of Colorado-4 campus system
- Manager of CIDE **Assistive Technology Clinic**
- I have no conflicts of interests to declare

The Center for Inclusive Design and Engineering is a unique program within the Department of Bioengineering |College of Engineering, Design and Computing at the University of Colorado Denver campus.

Tech Act Data Collection

Where do you live?

Metro vs Non-Metro

Who do you represent?

(choose only one)

Learning Objectives

1. Translate range of motion measurements from a mat exam into corresponding relative angles of the seated person as part of a Postural Alignment Plan
2. Be able to identify 2 absolute body segment angles that can be used as outcome measures to objectively measure a change in sitting posture.
3. Translate angular and linear dimensions of a seated person into the corresponding angular and linear dimensions of the seating support system.

Learning Objectives

4. Be able to identify and prescribe key wheelchair frame features, components and dimensions that are required to support the desired body posture and configuration of seating support system components.
5. Understand which angular and linear measurements are critical to determine at each stage of the wheelchair service delivery process.

References: Terms, definitions and figures used in this presentation are from the following publications

1. ISO 7176 (2007): Wheelchairs-Part 26: Vocabulary. International Organization for Standardization
2. Waugh, K. et al (2013). Glossary of Wheelchair Terms and Definitions, Version 1.0, December 2013. Denver, CO: University of Colorado Denver (120 pgs). Available from: https://www1.ucdenver.edu/centers/center-for-inclusive-design-and-engineering
3. Waugh, K., Crane, B. et al (2013). A Clinical Application Guide to Standardized Wheelchair Seating Measures of the Body and Seating Support Surfaces *(Rev. Ed)*. Denver, CO: University of Colorado Denver (363 pgs). Available from: https://www1.ucdenver.edu/centers/center-for-inclusive-design-and-engineering/
4. Waugh, K. and Crane, B. (2017) Standardized Measures of the Person, Seating System and Wheelchair. In M. Lange and J. Minkel (Ed), *Seating and Wheeled Mobility: A Clinical Resource Guide* (pp.85-119). Thorofare, New Jersey: SLACK Incorporated

Body, Seating & Frame Measurements from Assessment to Delivery

- ❑ **Introduction to Terms and Measures**
- ❑ **Application of Measures: Therapy Evaluation**
- ❑ **Application of Measures: Technology Assessment**
- ❑ **Application of Measures: Implementation & Follow-Up**

❑ Introduction

- The Need for Terminology Standardization
- Terms for Body, Seating and Frame Components
- Terms for Measures (linear & angular dimensions)

❖ Need Identified for Term Standardization

- There is much variation in use of terms to describe and quantify the linear and angular dimensions of a person's wheelchair & seating support surfaces
- This creates barriers to communication between all people involved in wheelchair service delivery process

  ⬇

  » Inefficiency in service delivery
  » Errors, poor outcomes
- Research on wheelchair seated posture requires standardized objective measures of posture

Problem: Improper set up of critical seating angles and dimensions

Desired postural alignment achieved during shape capture

Poor postural alignment in new wheelchair and custom seating

What happened??

Communication of key seating angles and dimensions is critical to successful outcomes, increased efficiency and reduced costs

Effective seat depth = 18"
Seat to Back Support angle = 105
Seat to Lower Leg Support angle = 75

Effective seat depth = 21"
Seat to Back Support angle = 105
Seat to Lower Leg Support angle = 90

Improper set up of critical seating angles and dimensions COST OF ERROR

Costs:
- Stage I pressure injury coccyx
- Client discomfort/complaint
- Day program disruption
- 3 hrs client/caregiver time and travel costs
- 3 hrs clinician time
- 2 hrs RTS time
- 1 hr tech time
- Cost to replace posterior calf pad hardware
- Admin time/costs

Let's get it right the first time!

❖ Types of Terms

- Two types of terms that need standardization in our field
- **Labels:** *The words we use to label things*
  - Body parts
  - Seating system components, or "postural support devices"
  - Wheelchair frame components
- **Measures:** *The words we use to indicate a measurement*; includes linear (size and location) and angular dimensions
  - Body linear and angular measures
  - Seating system linear and angular measures
  - Wheelchair Frame linear and angular measures

It is critically important to differentiate terms for the body vs. seating system vs. wheelchair

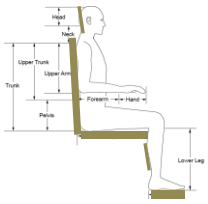
- Corresponding components and measures of the seated person's **body**, the **seating support system**, and the **wheelchair frame** must have different terms so that they can be differentiated…..because they are not necessarily the same
- **"Client's seat depth is 18 inches"-*what does that mean to you?***
  - distance from back of client's buttocks to back of knee, in sitting
  - actual depth of the seat cushion
  - *effective* seat depth from back support to front of cushion
  - wheelchair seat frame depth from back post to front of seat pan

❑ Introduction

- The Need for Terminology Standardization
- Terms for Body, Seating and Frame Components (Labels)
- Terms for Measures (linear & angular dimensions)

Body segment terminology

- The use of body segment terminology, instead of joint terminology, is useful for our field.
- The body can be divided into segments, and each segment given a name

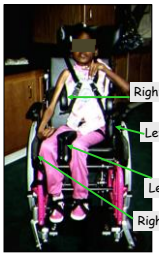


Dividing the body into segments

- Can describe seated posture by measuring orientation of segments
- Can relate orientation of body segments to the orientation of their supporting surface
- Helps define and label seating supports

(1) ISO 7176-26 (2007) Wheelchairs-Part 26: Vocabulary

Correct terminology for labeling secondary supports



Supports should be labeled by **where** they are intended to contact the body, **not by their desired purpose**

Right lateral trunk support (vs. "scoliosis pad")

Left lateral pelvic support (vs. "hip guide")

Left medial knee support (vs. "abductor")

Right lateral knee support (vs. "adductor")

(1) ISO 7176-26 (2007) Wheelchairs-Part 26: Vocabulary

Generic Terms for Wheelchair Frame Components

Wheelchair Frame = wheeled mobility base with a tubular frame construction

Lower leg support assembly
- Lower leg frame or Front Frame
- Lower leg support
- Foot support

Arm support assembly
- Arm support pad + mounting hardware as a unit

Caster assembly = Caster wheel, Caster wheel axle, Caster fork, Caster stem. Caster stem housing, bearings and tires

What would the generic term be for a calf pad?

(2) Waugh, K. et al (2013) Glossary of Terms and Definitions

❑ Introduction

- The Need for Terminology Standardization
- Terms for Body, Seating and Frame Components
- Terms for Measures (linear & angular dimensions)

Body	Seating	Frame
Linear	Linear	Linear
Angular	Angular	Angular

There are two types of linear measures

- Size dimensions:
  - Width
  - Length
  - Depth
  - Thickness
- Location, or "placement" dimensions:
  - Height
  - X, Y, Z coordinate locations of PSD

Examples of Linear Measures

Terms for linear measures of the wheelchair frame have not been standardized

Body	Seating	Frame
Buttock/thigh depth	Seat depth	*Seat frame depth*
Hip width	Seat width	*Seat frame width*
Lower leg length	Seat to foot support	*Seat pan to foot support*
Axilla height	Lateral trunk support height	

(3)Waugh, K; Crane, B. (2013) Clinical Application Guide

(2)Waugh, K. et al (2013) Glossary of Terms and Definitions

There are two types of angular measures: Relative & Absolute

- **Relative angles** define the angular relationship between two adjacent body segments, or between two adjacent seating support surfaces
- **Absolute angles** define the spatial orientation of a single body segment or support surface with respect to an external, absolute reference such as the vertical or horizontal
- *Give me an example of a relative angle measure*
- *Can you think of a measurement term we use in seating that would be an absolute angle measurement?*

Example of Relative Angles

Terms for angular measures of the wheelchair frame have not been standardized

Body	Seating	Frame
Thigh to trunk angle	Seat to back support angle	*Seat frame to back post angle*
Thigh to lower leg angle	Seat to lower leg support angle	*Seat frame to front frame angle*
Lower leg to foot angle	Lower leg support to foot support angle	*Front frame to foot support angle*

Body, Seating & Frame Measurements from Assessment to Delivery

- ❑ Introduction to Terms and Measures
- ❑ Application of Measures: Therapy Evaluation
- ❑ Application of Measures: Technology Assessment
- ❑ Application of Measures: Implementation & Follow-Up

Why do we take measurements?

- **To prescribe the right size and configuration of seating and mobility products**
- **To objectively describe and document current level of impairment or functional ability**
  - determine appropriate intervention
  - justify recommended product or services
  - document a baseline for measuring outcomes

When do we take measurements?

Overview of Service Delivery Steps

WHO Guidelines:

1. Referral and appointment
2. Assessment
3. Prescription (Selection)
4. Funding and Ordering
5. Product (wheelchair) Preparation
6. Fitting/delivery
7. User Training
8. Maintenance, repairs and follow up

Wheelchair Seating Assessment

Guidelines on the provision of manual wheelchairs in less resourced settings. World Health Organization (2008)

Wheelchair Seating Assessment Components

- Interview
- Personal Function
- Mobility Function
- **Physical Assessment**

→ Therapy Evaluation

- **Seating Simulation/Product Trials**
- **Product Specification**
- Implementation Plan

→ Technology Assessment

❑ Application of Measures: Therapy Evaluation

- Interview
- Personal Function
- Mobility Function
- **Physical Assessment**
  - Movement/Strength/Muscle tone
  - Current Wheelchair Seated posture
  - Current Wheelchair Parameters
  - Sleep-bed mobility, lying posture
  - Mat Exam – Supine
  - Sitting Assessment

❑ Application of Measures: Therapy Evaluation/Physical Assessment

- ❖ Current Wheelchair Seated Posture (Body)
- ❖ Current Wheelchair Seating Parameters (Seating)
- ❖ Mat Exam – Supine PROM assessment
- ❖ Sitting Assessment

Why measure seated posture?

- To identify postural problems and set postural alignment objectives
- To help determine product feature requirements
- To document postural outcomes before and after seating intervention
- To measure postural change over time

❖ Assess Current Wheelchair Seated Posture

1. Assess seated postural control in wheelchair
2. Assess and describe current seated posture
3. Measure the three relative body segment angles
4. Measure 2-4 absolute body segment angles that represent client's primary postural deviation

❖ Current Wheelchair Seated Posture

1. Assess seated postural control in wheelchair
2. Assess and describe current seated posture
3. Measure the three relative body segment angles
4. Measure 2-4 absolute body segment angles that represent client's primary postural deviation

Assess and describe current seated posture

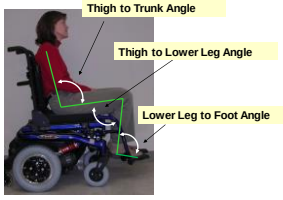
1. Pelvis: left oblique, left rotated, mild posterior tilt
2. Trunk: lat flexed right with ribs on top of pelvis on right; midline sternum (no lean); rotated left
3. Thighs: forward facing, slight windsweep right
4. Ankles/feet: plantar flexed
5. Head/neck: hyper-extended, laterally flexed right, rotated left

❖ Current Wheelchair Seated Posture

1. Assess seated postural control in wheelchair
2. Assess and describe current seated posture
3. Measure the three relative body segment angles
4. Measure 2-4 absolute body segment angles that represent client's primary postural deviation

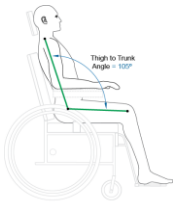
Measure the three relative body segment angles

This gives you a baseline objective measure of one aspect of sitting posture



Thigh to Trunk Angle	R 95 degrees L _____
Thigh to Lower Leg Angle	R 80 degrees L _____
Lower Leg to Foot Angle	R 90 degrees L _____

Demo & Practice: Thigh to Trunk Angle (THI-TK)



THIGH TO TRUNK ANGLE

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

THIGH TO TRUNK ANGLE

Type of Measurement: Relative body segment angle, right and left

Description: The angle between the thigh and the trunk, viewed from the side.

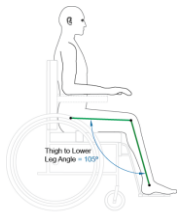
Landmarks used:
- Lateral hip center point (center of rotation)
- Lateral femoral condyle
- Lateral lower neck point

Body segment lines used to form angle:
- Sagittal trunk line
- Sagittal thigh line

Angle measured: The anterior side of the angle formed between the sagittal trunk line and the sagittal thigh line.

SRP Value: 90 degrees
Typical Values: 90 – 120

Demo & Practice: Thigh to Lower Leg Angle (THI-LLG)



THIGH TO LOWER LEG ANGLE

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

THIGH TO LOWER LEG ANGLE

Type of Measurement: Relative body segment angle, right and left

Description: The angle between the thigh and the lower leg, viewed from the side.

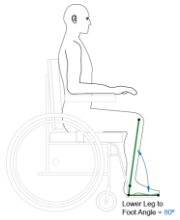
Landmarks used:
- Lateral femoral condyle (center of rotation)
- Lateral hip center point
- Lateral malleolus

Body segment lines used to form angle:
- Sagittal thigh line
- Sagittal lower leg line

Angle measured: The posterior side of the angle formed between the sagittal thigh line and the sagittal lower leg line.

SRP Value: 90 degrees
Typical Values: 80 – 120

Demo & Practice: Lower Leg to Foot Angle (LLG-FT)



LOWER LEG TO FOOT ANGLE

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

LOWER LEG TO FOOT ANGLE

Type of Measurement: Relative body segment angle, right and left

Description: The angle between the lower leg and the foot, viewed from the side. Right and left measures may differ.

Landmarks used:
- Lateral femoral condyle, Lateral malleolus
- Lateral heel point (center of rotation)
- Lateral toe point

Body segment lines used to form angle:
- Sagittal lower leg line
- Sagittal foot line

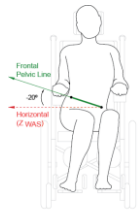
Angle measured: The anterior side of the angle formed between the sagittal lower leg line and the sagittal foot line.

SRP Value: 90 degrees
Typical Values: 80 – 110

❖ Current Wheelchair Seated Posture

1. Assess seated postural control in wheelchair
2. Assess and describe current seated posture
3. Measure the three relative body segment angles
4. Measure 2-4 absolute body segment angles that represent client's primary postural deviation

Demo: Frontal Pelvic Angle



FRONTAL PELVIC ANGLE

FRONTAL PELVIC ANGLE

Type of Angle: Absolute body segment angle
Description: The angle of orientation of the pelvis with respect to the horizontal, viewed from the front.

Landmarks used:
- Right ASIS
- Left ASIS

Lines used to form angle:
- Horizontal (Z_{WAS})
- Frontal pelvic line

Angle definition: Degree of rotation from the horizontal (Z_{WAS}) to the frontal pelvic line, viewed from the front and projected to the frontal plane.

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Demo: Frontal Sternal Angle

FRONTAL STERNAL ANGLE

FRONTAL STERNAL ANGLE

Type of Angle: Absolute body segment angle

Description: The angle of orientation of the upper trunk with respect to the vertical, viewed from the front.

Landmarks used:
- Upper sternal notch
- Lower sternal notch

Lines used to form angle:
- Vertical (Y_{WAS})
- Frontal sternal line

Angle definition: Degree of rotation from the vertical (Y_{WAS}) to the frontal sternum line, viewed from the front and projected to the frontal plane.

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Demo: Frontal Trunk Angle

FRONTAL TRUNK ANGLE

FRONTAL TRUNK ANGLE

Type of Angle: Absolute body segment angle

Description: The angle of orientation of the whole trunk with respect to the vertical, viewed from the front.

Landmarks used:
- Upper sternal notch
- ASIS midpoint

Lines used to form angle:
- Vertical (Y WAS)
- Frontal trunk line

Angle definition: Degree of rotation from the vertical (Y WAS) to the frontal trunk line, viewed from the front and projected to the frontal plane.

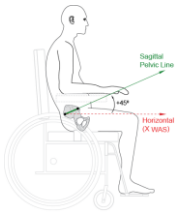
(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Let's Practice!

Absolute Body Segment Angles, Frontal plane

- Frontal Pelvic Angle (PS_{fang})
- Frontal Sternal Angle (ST_{fang})
- Frontal Trunk Angle (TK_{fang})

Demo: Sagittal Pelvic Angle



SAGITTAL PELVIC ANGLE

SAGITTAL PELVIC ANGLE

Type of Measurement: Absolute body segment angle

Description: The angle of orientation of the pelvis with respect to the horizontal, viewed from the side.

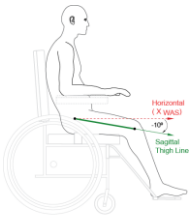
Landmarks used:
- ASIS
- PSIS

Lines used to form angle:
- Horizontal (X_{WAS})
- Sagittal pelvic line

Angle definition: Degree of rotation from the horizontal (X_{WAS}) to the sagittal pelvic line, viewed from the side and projected to the sagittal plane.

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Demo: Sagittal Thigh Angle



SAGITTAL THIGH ANGLE

SAGITTAL THIGH ANGLE

Type of Measurement: Absolute body segment angle, right and left

Description: The angle of orientation of the thigh in the sagittal plane, with respect to the horizontal.

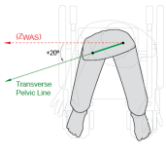
Landmarks used:
- Lateral hip center point
- Lateral femoral condyle

Lines used to form angle:
- Horizontal (X_{WAS})
- Sagittal thigh line

Angle defined: Degree of rotation from the horizontal (X_{WAS}) to the sagittal thigh line, viewed from the side and projected to the sagittal plane.

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Demo: Transverse Pelvic Angle



TRANSVERSE PELVIC ANGLE

TRANSVERSE PELVIC ANGLE

Type of Angle: Absolute body segment angle

Description: The angle of orientation of the pelvis in the transverse plane with respect to the wheelchair frame, viewed from the top.

Landmarks used:
- Right ASIS
- Left ASIS

Lines used to form angle:
- Wheelchair Z-axis (Z_{WAS})
- Transverse pelvic line

Angle defined: Degree of rotation from the Wheelchair Z-axis (Z_{WAS}) to the transverse pelvic line, viewed from the top and projected to the transverse plane.

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Let's Practice!

Absolute Body Segment Angles, Sagittal and Transverse planes

- Sagittal Pelvic Angle (PS_{sang})
- Sagittal Thigh Angle (TH_{sang})
- Transverse Pelvic Angle (PS_{tang})
- *Transverse Trunk Angle, Transverse Thigh Angle (if time)*

Summary of measurements to take during assessment of person's current **wheelchair seated posture**

1. **Measure the three relative body segment angles (right & left)**
   - ✓ Thigh to Trunk Angle
   - ✓ Thigh to Lower Leg Angle
   - ✓ Lower leg to foot angle

2. **Measure 2-4 absolute body segment angles that represent client's primary postural deviation and problem.** Most common angles include:
   - ✓ Sagittal thigh angle (right and/or left)
   - ✓ Frontal pelvic angle, frontal sternal angle, frontal trunk angle
   - ✓ Transverse trunk angle, transverse pelvic angle

❑ Application of Measures: Therapy Evaluation/Physical Assessment

- ❖ Current Wheelchair Seated Posture (Body)
- ❖ Current Wheelchair Seating Parameters (Seating)
- ❖ Mat Exam - Supine
- ❖ Sitting Assessment

❖ Current Wheelchair Seating Parameters

1. **Document current wheelchair and seating –** type, manufacturer, product model, age, condition

2. **Measure the three relative seating angles**
   - ✓ Seat to back support angle
   - ✓ Seat to lower leg support angle
   - ✓ Lower leg support to foot support angle

Why?

3. **Measure key linear dimensions**
   - ✓ Seat frame width
   - ✓ Seat depth and effective seat depth if different
   - ✓ Seat surface height at front edge
   - ✓ Rear and front seat frame height

Measure person: ***Body Segment Angles***

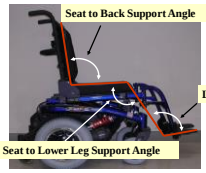
Measure equipment: ***Seating Support Surface Angles***

Figure 1

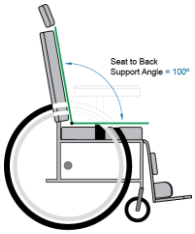
Figure 2

Measure the three relative seating angles

- Seat to back support angle __95 degrees_____
- Seat to lower leg support angle ___120 degrees_____
- Lower leg support to foot support angle _100 degrees_____



Demo: Seat to Back Support Angle



SEAT TO BACK SUPPORT ANGLE

SEAT TO BACK SUPPORT ANGLE

Type of Measurement: Relative support surface angle

Description: The angle between the seat and the back support viewed from the side.

Reference Planes Used:
- Back support reference plane
- Seat reference plane

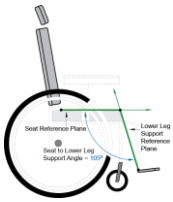
Angle measured: The anterior side of the angle formed between the back support reference plane and the seat reference plane, as viewed from the side.

SSRP Value: 90 degrees

Typical Values: 80 -120 degrees

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Demo: Seat to Lower Leg Support Angle



SEAT TO LOWER LEG SUPPORT ANGLE

Type of Measurement: Relative support surface angle, right and left

Description: The angle between the seat and the lower leg support, viewed from the side.

Reference Planes Used:
- Seat reference plane
- Lower leg support reference plane

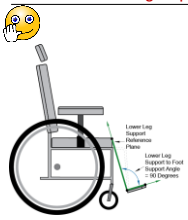
Angle measured: The posterior side of the angle formed between the seat reference plane and the lower leg support reference plane, as viewed from the side.

SSRP Value: 90 degrees

Typical Values: 80 – 120 degrees

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Demo: Lower Leg Support To Foot Support Angle



LOWER LEG SUPPORT TO FOOT SUPPORT ANGLE

Type of Measurement: Relative support surface angle, right and left

Description: The angle between the lower leg support reference plane and the foot support reference plane, viewed from the side

Reference planes used to form angle:
- Lower leg support reference plane
- Foot support reference plane

Angle measured: The anterior side of the angle formed between the lower leg support reference plane and the foot support reference plane, as viewed from the side.

SSRP Value: 90 degrees

Typical Values: 80-100 degrees

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Let's Practice!

Relative Seating Angles

- Seat to Back Support Angle (S-BS)
- Seat to Lower Leg Support Angle (S-LLS)
- Lower Leg Support to Foot Support Angle (LLS-FS)

❖ Current Wheelchair Seating Parameters

1. **Document current wheelchair and seating –** type, manufacturer, product model, age, condition

2. **Measure the three relative seating angles**
   - ✓ Seat to back support angle
   - ✓ Seat to lower leg support angle
   - ✓ Lower leg support to foot support angle

3. **Measure key linear dimensions**
   - ✓ Seat frame width
   - ✓ Seat depth and effective seat depth if different
   - ✓ Seat surface height at front edge
   - ✓ Rear and front seat frame height

Why?

Questions:

- What is "seat to floor height (STFH) and how would you measure it?
- Client transfers independently using a stand pivot, and you want to preserve this ability. What measure is critical to take?

We need two different measures!

- Seat frame height (front and rear if different)
- Seat surface height at front edge

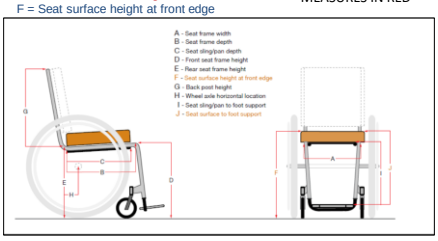
Measure these basic linear dimensions of current wheelchair frame and seating

Frame:
- Seat Frame Width
- Front & Rear Seat Frame Heights (in non-tilting wheelchair)

Seating:
- Seat Surface Height at front edge
- Seat width
- Seat depth
- **Effective Seat Depth**

A = Seat frame width
D = Front seat frame height
E = Rear seat frame height
F = Seat surface height at front edge

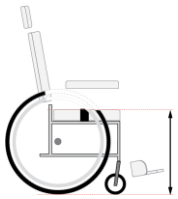
DEMO FRAME MEASURES IN RED



(4) Lange, M. and Minkel, J. *Seating and Wheeled Mobility-A Clinical Resource Guide* (Ch. 6, Fig 6-14)

Demo: Seat surface height at front edge

SEAT SURFACE HEIGHT AT FRONT EDGE



SEAT SURFACE HEIGHT AT FRONT EDGE

Type of Measurement: Support Surface Linear

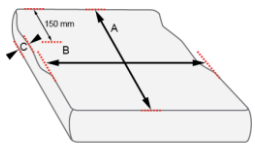
Description: The distance from the floor to the top of the seat at front edge, in area intended for thigh loading.

End points used:
- Floor.
- Top surface of front edge of the seat, midway between lateral edge and the seat centerline.

Definition: Vertical distance from the floor to the top of the seat at its front edge, in the area intended for distal thigh loading.

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Demo: Seat Width, Seat Depth

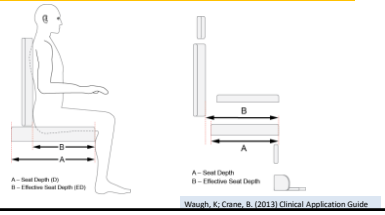


A – Seat Depth
B – Seat Width
C – Seat Thickness

Waugh, K; Crane, B. (2013) Clinical Application Guide

Demo: Effective Seat Depth

- **Seat depth** = actual depth of seat support, from back edge to front edge
- **Effective seat depth** = Distance from *back support reference plane* to the front edge of the seat.



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❑ Application of Measures: Therapy Evaluation

- ❖ Current Wheelchair Seated Posture (Body)
- ❖ Current Wheelchair Seating Parameters (Seating)
- ❖ Mat Exam - Supine
- ❖ Sitting Assessment

❖ Supine Mat Exam – what is it?

- **A hands on assessment, performed in supine, on a mat or mat table, which includes:**
  - ✓ Passive range of motion/joint flexibility
  - ✓ Assessment of deformity/body shape
  - ✓ Skin inspection, if indicated

YOUR GOAL AT END OF MAT EXAM IS TO BE ABLE TO ANSWER THESE TWO QUESTIONS:

1. **WHY is person sitting the way they are sitting? What is the CAUSE of their postural deviations?**
   - Postural deviations are usually caused by a combination of:
     - ✓ *Something about the person's body*
     - ✓ *Something about the parameters of the current seating*
   - So, during the Mat Exam, you will learn about the person's body
2. **What is this person potential for best alignment, in each area of the body, without the influence of gravity and function?**

❖ The Supine Mat Exam – *Outcome*

1. Determine fixed vs. flexible components of all postural deviations
2. Obtain some body measurements, angular and linear
3. Develop a hypothesis regarding the source of postural problems presented in wheelchair
4. Develop a preliminary **postural alignment plan**

❖ Supine Mat Exam

1. Assess pelvic/spine mobility
2. Hip flexion
3. Knee extension (w/hips flexed)
4. Ankle dorsiflexion/plantarflexion
5. Hip abduction/adduction
6. Hip internal/external rotation
7. Neck range of motion
8. Upper extremity range of motion

Assessing pelvic/spinal mobility-frontal plane

Fig 1: Postural tendency in sitting is significant **left pelvic obliquity**

Fig 2: Postural tendency on mat is also **left pelvic obliquity**

Fig 3: Assessing flexibility of pelvis and spine in frontal plane – **can pelvis be leveled?**

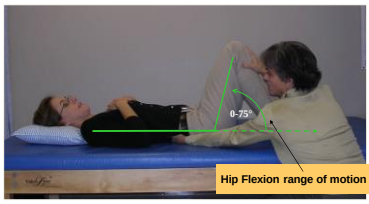
❖ Supine Mat Exam

1. Assess pelvic/spine mobility
2. Hip flexion
3. Knee extension (w/hips flexed)
4. Ankle dorsiflexion/plantarflexion
5. Hip abduction/adduction
6. Hip internal/external rotation
7. Neck range of motion
8. Upper extremity range of motion

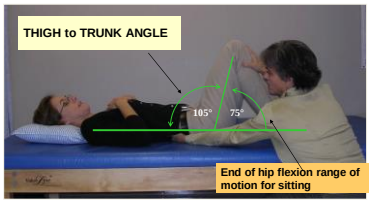
➢ Joint Motion, Body Segment Angles and Seating Angles

Joint Motion Assessed	Body Segment Angle	Seating Angle
Hip flexion (extension)	Thigh to trunk angle	Seat to back support angle
Knee Extension (Flexion)	Thigh to lower leg angle	Seat to lower leg support angle
Ankle DF (PF)	Lower leg to foot angle	Lower leg support / foot support angle

Measuring Hip Flexion range of motion during mat exam



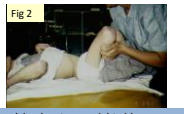
Measuring end of Hip Flexion ROM to help determine optimal Thigh to Trunk Angle for sitting



Example: Assessing passive hip flexion range of motion, **when there is a scoliosis**

Fig 1

Fig 2



At end of hip flexion range for this client, pelvis elevates on right side causing shortening on concave side of trunk, and increase in scoliosis/pelvic obliquity

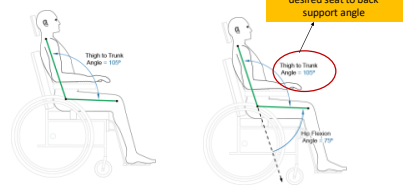
Fig 3

Back off until achieve client's optimal pelvis/spinal alignment, then take measurement of end range hip flexion = minimum thigh to trunk angle

Thigh to trunk angle

Relationship to hip flexion angle

More useful for prescribing desired seat to back support angle



THIGH TO TRUNK ANGLE

The angle between the thigh and the trunk, viewed from the side

...relationship to hip flexion angle

Waugh, K; Crane, B. (2013) Clinical Application Guide

Measure Hip Flexion → Thigh/Trunk angle

- **End of Hip Flexion range** = Minimum Thigh to Trunk angle
- **End of Hip Extension range** = Maximum Trunk to Thigh angle

	Passive joint ROM	Corresponding Body Segment Angle
HIP FLEXION	Max Hip Flexion R ____85_____ L ____60_____	Min Thigh to Trunk Angle R 95____ L 120____

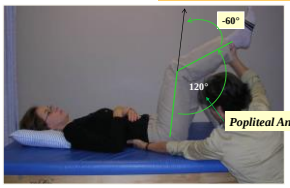
How would you set up the seat/back angle in this situation?

➢ Joint Motion, Body Segment Angles and Seating Angles

Joint Motion Assessed	Body Segment Angle	Seating Angle
Hip flexion (extension)	Thigh to trunk angle	Seat to back support angle
Knee Extension (Flexion)	Thigh to lower leg angle	Seat to lower leg support angle
Ankle DF (PF)	Lower leg to foot angle	Lower leg support / foot support angle

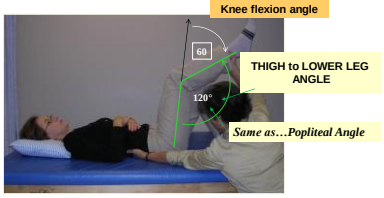
Measuring Knee Extension range of motion with hip flexed (to simulate sitting), during mat exam

Knee extension range of motion with hips flexed



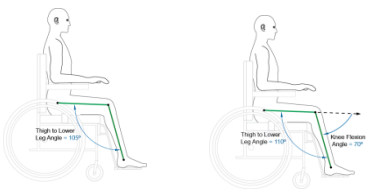
Measuring Popliteal Angle to help determine optimal Thigh to Lower Leg Angle for sitting

Knee flexion angle



Thigh to lower leg angle

Relationship to knee flexion angle



THIGH TO LOWER LEG ANGLE

The angle between the thigh and the lower leg, viewed from the side

…relationship to knee flexion angle

(3) Waugh, K; Crane, B. (2013) Clinical Application Guide

Measure Popliteal Angle = Thigh/Lower Leg Angle

- **End of Knee Extension range** with hips flexed
  = Popliteal Angle
  = Maximum Thigh to Lower Leg angle
- **End of Knee Flexion range** = Minimum Thigh to Lower Leg angle

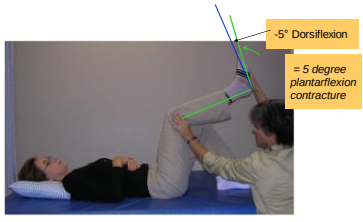
	Passive joint ROM	Corresponding Body Segment Angle
KNEE EXTENSION with hips flexed	Popliteal Angle R ___80_____ L ___110_____	Max Thigh/Lower Leg Angle R __80_____ L __110_____

How would you achieve these body segment angles in a wheelchair? Where would the footplates need to be positioned?

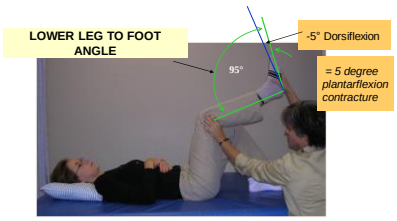
Joint Motion, Body Segment Angles and Seating Angles

Joint Motion Assessed	Body Segment Angle	Seating Angle
Hip flexion (extension)	Thigh to trunk angle	Seat to back support angle
Knee Extension (Flexion)	Thigh to lower leg angle	Seat to lower leg support angle
Ankle DF (PF)	Lower leg to foot angle	Lower leg support / foot support angle

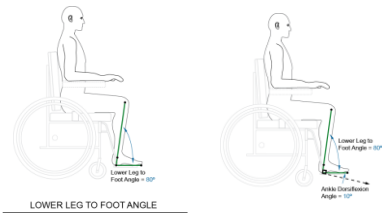
Measuring Dorsiflexion/Plantarflexion range of motion during mat exam



Measuring end of ankle dorsiflexion ROM to help determine optimal Lower Leg to Foot Angle for sitting



Lower leg to foot angle
Relationship to ankle dorsiflexion angle



LOWER LEG TO FOOT ANGLE

The angle between the lower leg and the foot, viewed from the side

...relationship to dorsiflexion angle

Waugh, K; Crane, B. (2013) Clinical Application Guide

Measure Ankle Dorsiflexion → Lower Leg/Foot angle

- **End of Dorsiflexion range** = Minimum Lower Leg to Foot angle
- **End of Plantarflexion range** = Maximum Lower Leg to Foot angle

	Passive joint ROM	Corresponding Body Segment Angle
Ankle Dorsiflexion	Max Dorsiflexion R ___0_____ L ___- 10_____	Min Lower Leg/Foot Angle R __90_____ L __100_____

How would you achieve these body segment angles in a wheelchair?
How would the footplates need to be positioned or angled?

❖ Supine Mat Exam

1. Assess pelvic/spine mobility
2. Hip flexion
3. Knee extension (w/hips flexed)
4. Ankle dorsiflexion/plantarflexion
5. Hip abduction/adduction
6. Hip internal/external rotation
7. Neck range of motion
8. Upper extremity range of motion

❑ HIPS: Observe Postural Tendency

Postural tendency = windswept to right

Right hip is abducted / externally rotated

Left hip is adducted / internally rotated

Assistive Technology Partners

❑ HIPS: Assess Abduction/Adduction

- Hips and knees flexed, pelvis/spine in client's optimal alignment
- Make sure pelvis is not rotated.
- Place one hand on the pelvis with your thumb on the ASIS to monitor pelvic movement as you move the opposite hip in/out of abduction and adduction.

Fig 1

Assessing left hip abduction

Fig 2

Assessing right hip adduction

❑ HIPS: Assess Internal/External Rotation

- Hips and knees flexed, pelvis/spine in client's optimal alignment
- Make sure pelvis is LEVEL, or in client's best alignment
- Holding the leg at the knee and ankle, rotate the lower leg in an arc about the knee as you watch for pelvic elevation (obliquity movement)

This is neutral rotation

This is a position of internal rotation

Mat Exam Summary

Preliminary Seating Equipment Angles - based on end comfortable passive range of motion at hips, knees, ankles

Passive joint ROM	Corresponding Body Segment Angle	Seating Angle
HIP FLEXION 80 L/R	Thigh to Trunk Angle 100 L/R	Seat/Back support Angle 100
POPLITEAL ANGLE 110 L/R	Thigh to Lower Leg Angle 110 L/R	Seat/Lower leg support Angle 110 L/R
ANKLE DORSIFLEXION 10 L/R	Lower Leg to Foot Angle 90 L/R	Lower Leg/Foot Support Angle 90 L/R

❑ Application of Measures: Therapy Evaluation

- ❖ Current Wheelchair Seated Posture (Body)
- ❖ Current Wheelchair Seating Parameters (Seating)
- ❖ Mat Exam - Supine
- ❖ Sitting Assessment

❖ Sitting Assessment – Unsupported

- Assess sitting posture and balance in unsupported or minimally supported sitting, on edge of mat table
  - Different or same as posture in wheelchair?
  - If different, why?
- Note spinal asymmetries and deformities by viewing person's back from behind
- **Note direction of postural collapse** – this tells you a lot about the person's postural tendencies, and how their body reacts to the force of gravity
- How much correction of postural asymmetry can you achieve with your hands? Where are key points of control?

❖ Sitting Assessment – "Unsupported"

Fig 1

Fig 2

Fig 3

As you put your hands on and begin to assess correction in the sitting position, you are beginning to think about intervention….

❖ Sitting Assessment – Supported/Corrected

- What is the best resting posture this person can achieve?
- We will call this their "optimal sitting posture"
- Neutral reference posture vs. optimal posture
- Take basic body linear measures if possible with client in desired optimal alignment (or close to)
- **Seating Simulation/Product Trials**
  - Use hands or trial seating surfaces to simulate the desired optimal sitting posture
  - May be necessary with more complex clients

Seating Simulation* – *using planar seating simulator

Current posture

What is causing him to sit like this?

Simulation of 'preliminary postural alignment plan'

What do you think our hypothesis was based on mat exam findings?

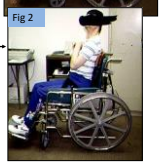
Seating Simulation* – *using existing or trial wheelchair

Foam wedges were used in existing wheelchair to:

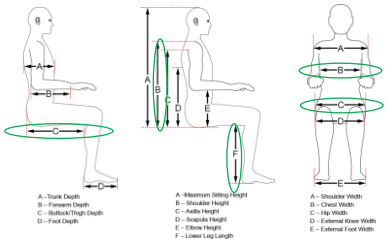
- Increase seat/back angle
- Decrease seat depth
- ….which helped to achieve desired thigh/trunk angle and thigh/lower leg angle

Fig 1

Fig 2



Preliminary linear body measures that can be taken during sitting assessment – *for set up of simulation equipment or product trials*



Summary of measures taken in Therapy Evaluation part of the Wheelchair Assessment

- **Current Wheelchair Seated posture-** as baseline
  - ✓ 3 relative body segment angles
  - ✓ 1-3 absolute body segment angles (optional)
- **Current Wheelchair Parameters**
  - ✓ 3 relative seating angles
  - ✓ 6 linear measures of seating and frame
- **Mat Exam – Supine**
  - ✓ Passive joint range of motion
- **Sitting Assessment**
  - ✓ Basic preliminary linear body measures (for simulation or trials)

Wheelchair Seating Assessment Components

Therapy Evaluation:

- Interview
- Personal Function
- Mobility Function
- **Physical Assessment** →
  - ✓ Current Wheelchair Seated posture
  - ✓ Current Wheelchair Parameters
  - ✓ Mat Exam – Supine
  - ✓ Sitting Assessment

OUTPUT FROM THERAPY EVALUATION:
- ✓ Client's primary problems and goals
- ✓ Preliminary Body Linear measures
- ✓ **POSTURAL ALIGNMENT PLAN**

❖ Postural Alignment Plan

1. **Describe client's *Optimal Sitting Posture*, i.e. goal for alignment in each area of the body**
   - – Is reference neutral the goal?
   - – Pelvis, trunk, head, lower extremities
2. **Relative Body Segment Angles (desired)**
   1. Thigh/Trunk Angles, R + L
   2. Thigh/Lower Leg Angles, R + L
   3. Lower Leg/Foot Angles, R + L

   } Based on mat exam and sitting assessment
3. **Preliminary Relative Seating Angles** to support desired posture
4. **Preliminary Absolute Body Segment Angles (optional)** to use as outcome measure, reflecting alignment goal in key areas

To develop a preliminary postural alignment plan answer these questions after your mat exam

WHY is person sitting the way they are sitting? What is the CAUSE of their postural deviations?

What is this person's best potential for alignment, gravity eliminated, in all areas of the body?

How does this person's lower extremities need to be aligned in order to achieve their best alignment in the pelvis/spine, trunk and head?

Preliminary relative body segment and seating angles based on mat exam range of motion

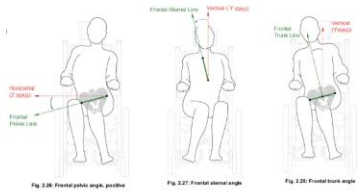
Passive joint ROM	Corresponding Body Segment Angle	Seating Support Surface Angle
Hip Flexion 60 R, 80 L	Thigh to Trunk Angle 120 R, 100 L	Seat to Back support Angle 120*
Popliteal Angle 100 R, 80 L	Thigh to Lower Leg Angle 100 R, 80 L	Seat to L.Leg Support Angle 100 R, 80 L
Ankle Dorsiflexion 0 R, -10 L	Lower Leg to Foot Angle 90 R, 100 L	L.Leg/Foot Support Angle 90 R, 100 L

❖ Postural Alignment Plan

1. **Describe client's *Optimal Sitting Posture*, i.e. goal for alignment in each area of the body**
   - Is reference neutral the goal?
   - Pelvis, trunk, head, lower extremities
2. **Relative Body Segment Angles (desired)**
   1. Thigh/Trunk Angles, R + L
   2. Thigh/Lower Leg Angles, R + L
   3. Lower Leg/Foot Angles, R + L

   Based on mat exam and sitting assessment
3. **Preliminary Relative Seating Angles** to support desired posture
4. **Preliminary Absolute Body Segment Angles (optional)** to use as outcome measure, reflecting alignment goal in key areas

Frontal Body Segment Angles:



	Frontal Pelvic Angle	Frontal Sternal Angle	Frontal Trunk Angle
Current:			
Desired:			

Image used by permission from Michelle Wetzel, PT of Canton, Ohio; form being developed

Body, Seating & Frame Measurements from Assessment to Delivery

- ❑ **Introduction to Terms and Measures**
- ❑ **Application of Measures: Therapy Evaluation**
- ❑ **Application of Measures: Technology Assessment**
- ❑ **Application of Measures: Implementation & Follow-Up**

Wheelchair Seating Assessment Components

Interview
Personal Function
Mobility Function
Physical Assessment

Therapy Evaluation

STOP, SUMMARIZE & LISTEN!!

Seating Simulation/Product Trials
Product Specification
Implementation Plan

Technology Assessment

❑ Application of Measures: Technology Assessment

- Translating Body Measures into Seating and Frame Measures
  - Linear
  - Angular
- Linear body to seating to frame
- Angular body to seating to frame
- Putting it all together – proper configuration

Preliminary seating equipment linear dimensions, based on preliminary body linear during mat exam sitting assessment

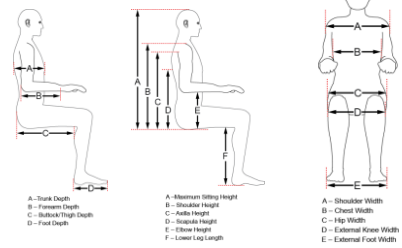
Why preliminary?

Linear Body Measure from sitting assessment mat table		Prelim equipment Dimension	
Buttock Thigh Depth (or Effective BThD if windswept)		Effective Seat Depth	
Lower Leg length		Seat to Footplate	
Shoulder Height		Back support height	
Hip Width (or widest dimension)		Seat Width	

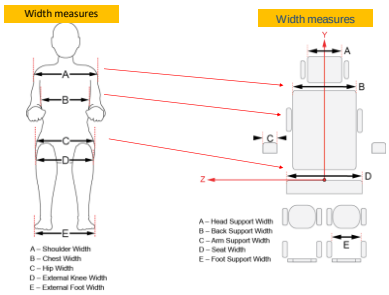
❖Final Linear Seating Measures

- ✓ Not all measures needed for accurate product specification can be obtained from body linear measures.
- ✓ Example – Lateral trunk support height
- ✓ If any primary or secondary supports need to be offset from a typical neutral position, measure and document
- ✓ Typically we measure from centerline for offset components

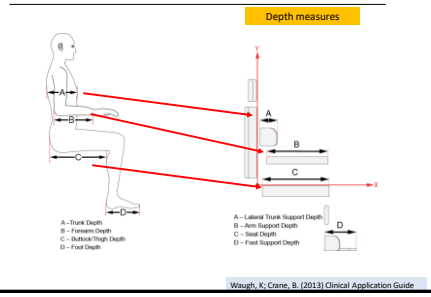
Final Linear Body Measures – taken with person seated in desired, planned alignment



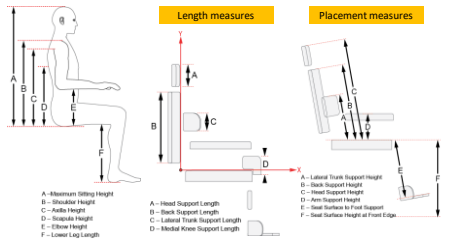
❖ **Final Linear Seating Measures**



❖ **Final Linear Seating Measures**



❖ Final Linear Seating Measures



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❖ Final Body and Seating Linear Seating Measures

Body Measures	R	L			Equipment Measures	R	L
(A) Buttock/thigh depth			(K) Shoulder width		Seat to Back Support Angle (BAB: lower / upper)		
(B) Lower leg length			(L) Chest width		Seat to Leg Support Angle		
(C) Foot depth			(M) Hip width		Leg to Foot Support Angle		
(D) Ischial depth			(N) External knee width		(a) Seat Depth, effective		
Seat surface to: (E) Elbow			Max overall width: From ____ to ____		(b) Seat to foot support length		
(F) PSIS			(O) Internal knee width		(c) Foot support depth		
(G) Iliac crest			(P) External ankle width		(d) Back support height (from seat)		
(H) Axilla			MORE EQ/ZP MEASURES		(e) BAB lower section height (from seat)		
(I) Top shoulder			Desired STFH		(f) Width between Lateral Trunk supports		
(J)Top of head			Medial Knee Support dimensions:		(g) Width between Lateral Pelvic supports		
					(h) Seat to top of lateral trunk supports		
					Size Lateral trunk supports (l x d)		
					Size lat pelvic/thigh supports (l x d)		
					Size lateral knee supports (l x d)		

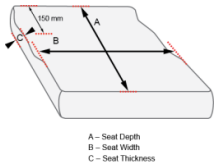
❑ Product Specification

- Seat cushion
- Back support
- Frame Measures – Linear
- Frame Measures – Angular

- Lateral trunk supports
- Foot support
- Head support
- Arm support

Basic seat cushion dimensions

- Seat width
- Seat depth
- Seat thickness



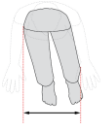
A – Seat Depth
B – Seat Width
C – Seat Thickness

NOTE: Manufacturer terminology and measurements are not consistent.

Seat Width

Body measures to consider

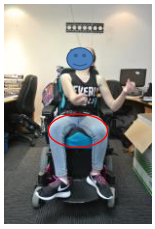
- Hip width (GT-GT) or the widest point
- External knee width
- Maximum lower body width (if windswept)
- Maximum sitting width



Maximum Lower Body Width

Seat Width

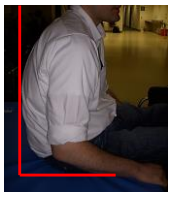
Body measures to consider

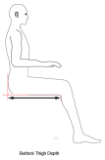


Seat Depth

Body measures to consider

- Buttock/thigh depth
- Thigh/lower leg angle
- Sagittal Pelvic angle



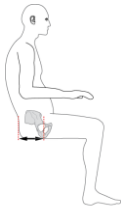


Buttock Thigh Depth

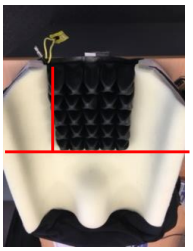
THIGH TO LOWER LEG ANGLE

Ischial Depth is affected by sagittal pelvic angle

(degree of posterior/anterior pelvic tilt)



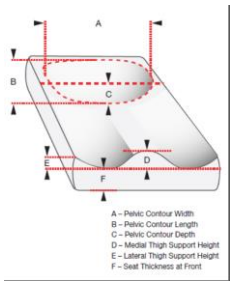
Ischial Depth



Contoured seat cushion dimensions

Body measures to consider

- Ischial depth
- Sagittal pelvic angle
- Thigh height
- Internal knee width
- External knee width
- **Postural Alignment Plan** – are thighs going to be forward facing, symmetrical?

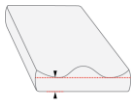


Seat thickness

- Two measures of seat thickness
- We'll talk later about seat cushion thickness, and it's impact on frame specification/configuration

Consider:
- Skin protection needs
- Transfers

A – Seat Thickness



Seat thickness at front

❑ Product Specification

- Seat cushion
- Back support
- Frame Measures – Linear
- Frame Measures – Angular

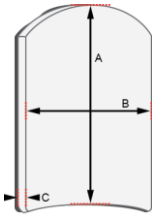
- Lateral trunk supports
- Foot support
- Head support
- Arm support

Basic Back Support Dimensions

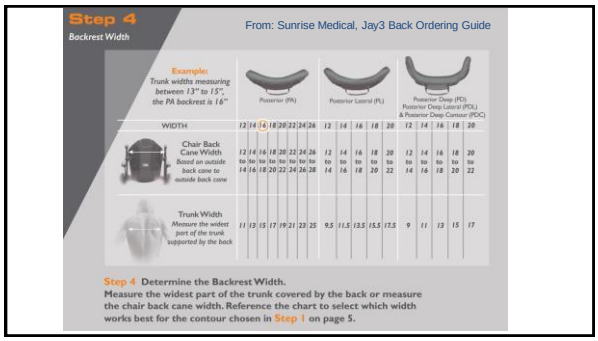
Body measures to consider

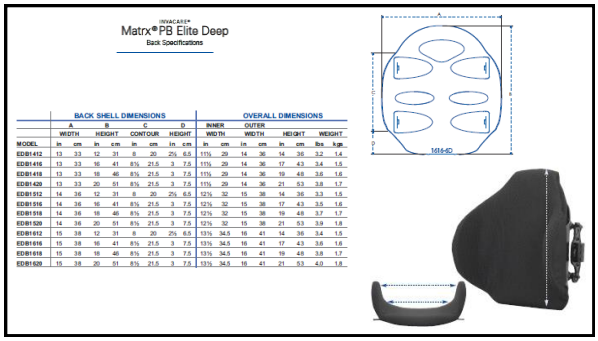
Back support width
- Hip Width
- Shoulder Width
- Chest Width
- Chest Depth

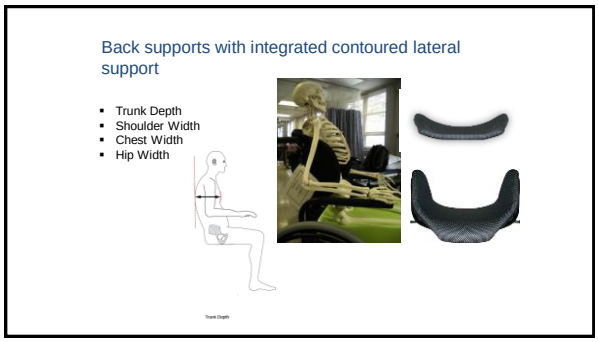
You must match the inside back support width to the client's body dimensions. How does the manufacturer measure back support width?



A – Back Support Length
B – Back Support Width
C – Back Support Thickness



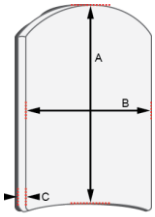




Basic Back Support Dimensions

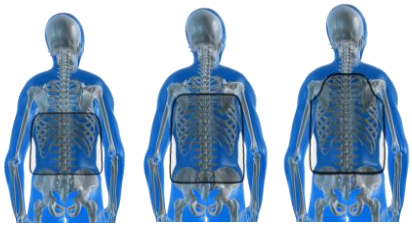
Body measures to consider

- **Back support width**
  - Hip Width
  - Shoulder Width
  - Chest Width
  - Chest Depth
- **Back support length**
  - Shoulder Height
  - Axilla Height
  - Scapula Height
- **Back support height**
- **Back support thickness**

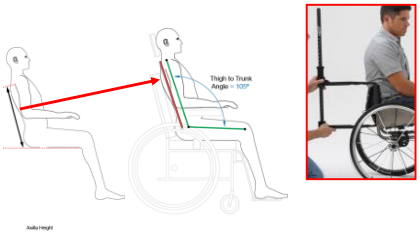


A – Back Support Length
B – Back Support Width
C – Back Support Thickness

Back support Length



Back Support Length and Height

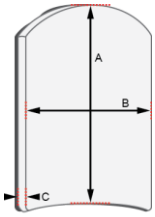


THIGH TO TRUNK ANGLE

Basic Back Support Dimensions

Body measures to consider

- **Back support width**
  - Hip Width
  - Shoulder Width
  - Chest Width
  - Chest Depth
- **Back support length**
  - Shoulder Height
  - Axilla Height
  - Scapula Height
- **Back support height**
- **Back support thickness**



A – Back Support Length
B – Back Support Width
C – Back Support Thickness

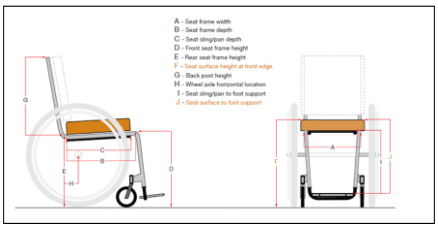
Consider: fixed kyphosis, rib hump – do you need to accommodate in the thickness of the back support?

❑ Product Specification

- Seat cushion
- Back support
- Frame Measures – Linear
- Frame Measures – Angular

- Lateral trunk supports
- Foot support
- Head support
- Arm support

Linear Frame Measures

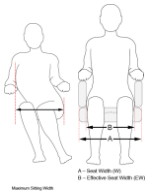


Seat frame width – measured from outside of seat rails

Body measures to consider:
- Hip width
- Lower body width, maximum sitting width
- External knee width, External foot width

Seating measures to consider
- Actual seat width
- Effective seat width

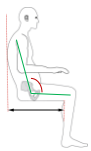
Other considerations:
- Width inside the front frame is ~2" less than seat frame

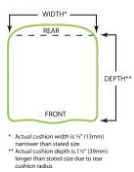


Seat frame depth-Measured from front of back cane to front of seat rail, or front of seat sling?

Body measures to consider:
- Buttock/thigh depth
- Maximum sitting depth
- Thigh/trunk angle

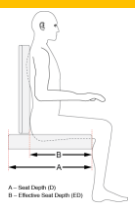
Seating measures to consider
- Actual Seat Depth; Effective Seat Depth
- Back support thickness
- Seat to back support angle

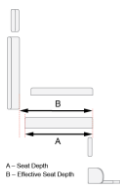




Effective Seat Depth

- **Seat depth** = actual depth of seat support, from back edge to front edge
- **Effective seat depth** = Distance from *back support reference plane* to the front edge of the seat.



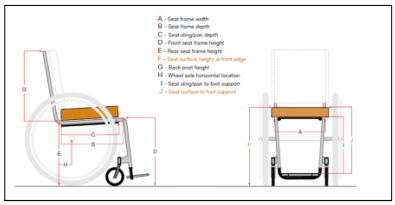


Seat Frame Depth – Ridid MWC

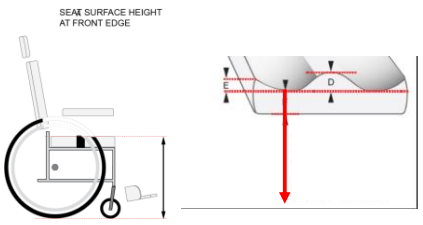
Photo courtesy
Steven J. Mitchell,
OTR/L, ATP

Seat frame height - Functional measures to determine

- Seat surface to foot support
- Seat sling/pan to foot support
- Seat surface height at front edge
- Front seat frame height
- Rear seat frame height
- Cushion thickness



Seat Surface Height at Front Edge



❑ Product Specification

- Seat cushion
- Back support
- Frame Measures – Linear
- Frame Measures – Angular

- Lateral trunk supports
- Foot support
- Head support
- Arm support

Summary

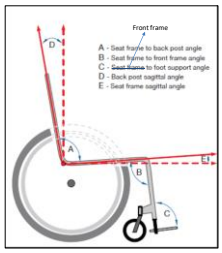
Joint PROM ⇨ Body Segment Angle ⇨ Seating Angle

Frame angles ⇦

Passive Joint ROM	Corresponding Body Segment Angle	Seating Support Surface Angle
HIP FLEXION 60 R, 80 L	Thigh to Trunk Angle 120 R, 100 L	Seat to Back support Angle 120°
POPLITEAL ANGLE 100 R, 80 L	Thigh to Lower Leg Angle 100 R, 80 L	Seat to L.Leg Support Angle 100 R, 80 L
ANKLE DORSIFLEXION 0 R, -10 L	Lower Leg to Foot Angle 90 R, 100 L	L.Leg/Foot Support Angle 90 R, 100 L

Angular Frame Measures

Proposed terms



- Seat frame to back post angle
- Seat frame to front frame angle
- Front frame to foot support angle

- Back post sagittal angle
- Seat frame sagittal angle
- *Front frame sagittal angle*

Waugh, K. (2018) **Standardized Measures of the Person, Seating System and Wheelchair.** In Lange, M. *Seating and Wheeled Mobility-A Clinical Resource Guide* (pp.85-119)

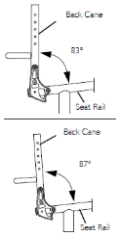
Angular (and linear) frame measures must support desired seating and body segment angles

Wheelchair Frame Angle	Related Seating Angle	Related Body Angle
Seat frame to back post	Seat to back support	Thigh to trunk
Seat frame to front frame	Seat to lower leg support	Thigh to lower leg
Front frame to foot support	Lower leg support to foot support	Lower leg to foot
Back post sagittal angle	Back support sagittal angle	Sagittal trunk angle
Seat frame sagittal angle	Seat sagittal angle	Sagittal thigh angle
Front frame sagittal angle	Lower leg support sagittal angle	Sagittal lower leg angle

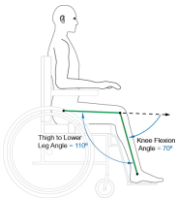
- How will you achieve the desired relative seating angles?
- What seating and frame components and measures need to be considered and specified?

Achieving desired seat to back support angle and back support sagittal angle

Body and Seating Angles to consider:
Thigh/trunk Angle
Sagittal trunk angle



Achieving desired seat to lower leg support angle



...relationship to knee flexion angle

Achieving desired seat to lower leg support angle
(to support desired thigh/lower leg angle)

- Foot support placement forward/backward
- Lower leg support assembly style (60-70-90 degree "legrest hanger")
- Angle adjustable footplate
- Effective seat depth, seat frame depth and back support thickness are critical as they dictate where the person's body sits in the frame and relative to the foot supports
- Caster clearance – seat to footrest distance

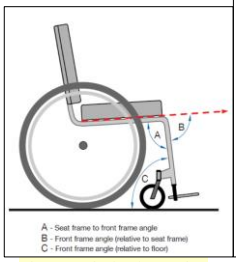


Fig 1: Comparing front frame angles in a rigid frame MWC

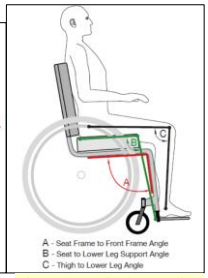


Fig 2: Corresponding frame, seating and body angles

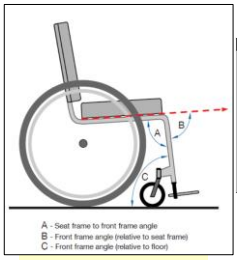
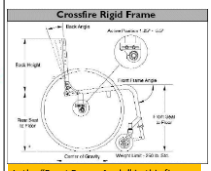
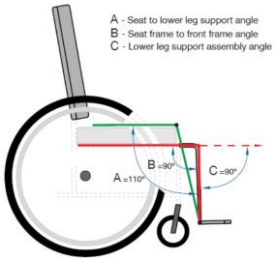


Fig 1: Comparing front frame angles



Is the "Front Frame Angle" in this figure the same as angle A, B or C in Fig 1?

Comparing angles in a frame with swing away lower leg support assembly



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❑ Product Specification

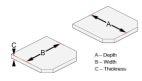
- Seat cushion
- Back support
- Frame Measures – Linear
- Frame Measures – Angular

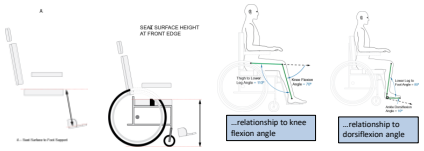
- Lateral trunk supports
- Foot support
- Head support
- Arm support

Lower Leg Support and Foot Supports

Body and seating measures to consider

- Seat surface to Foot Support
- Seat Surface Height at the Front Edge
- Seat Cushion Thickness
- Desired Thigh/lower leg angle
- Desired Lower Leg to Foot Angle

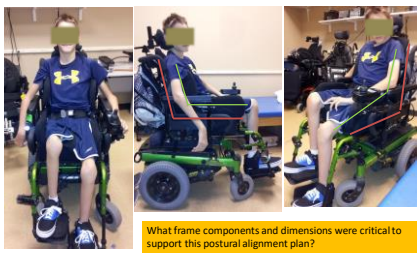




...relationship to knee flexion angle

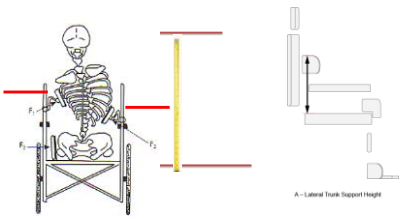
...relationship to dorsiflexion angle

Example of supporting two different thigh/trunk angles in a custom contoured seating system



What frame components and dimensions were critical to support this postural alignment plan?

Lateral Trunk Support Placement



Body, Seating & Frame Measurements from Assessment to Delivery

- ❑ Introduction to Terms and Measures
- ❑ Application of Measures: Therapy Evaluation
- ❑ Application of Measures: Technology Assessment
- ❑ Application of Measures: Implementation & Follow-Up

Overview of Service Delivery Steps

WHO Guidelines:

1. Referral and appointment
2. Assessment
3. Prescription (Selection)

Wheelchair Seating Assessment

4. Funding and Ordering
5. Product (wheelchair) Preparation
6. Fitting/delivery
7. User Training
8. Maintenance, repairs and follow up

❑ Application of Measures: Implementation & Follow-Up

- ❖ Product (wheelchair) Preparation
- ❖ Fitting/delivery
- ❖ Maintenance, repairs and follow up

The wheelchair should be set up prior to fit/delivery according to the documented seating angles and dimensions

- Seat/back support angle
- Seat to lower leg support angle
- Lower leg support/foot support angle
- Effective seat depth
- Seat to footplate distance
- Back support height
- Lateral trunk support height (if separate LTS)
- Other critical dimensions unique to client?

Discussion:
- Is this necessary? Why?
- How are these angles/dimensions being communicated to the product prep team in your setting?

Problem: Improper set up of critical seating angles and dimensions

Desired postural alignment achieved during shape capture

Poor postural alignment in new wheelchair and custom seating

What happened??

Communication of key seating angles and dimensions is critical to successful outcomes, increased efficiency and reduced costs

Effective seat depth = 18"
Seat to Back Support angle = 105
Seat to Lower Leg Support angle = 75

Effective seat depth = 21"
Seat to Back Support angle = 105
Seat to Lower Leg Support angle = 90

❑ Application of Measures: Implementation & Follow-Up

- ❖ Product (wheelchair) Preparation
- ❖ Fitting/delivery
- ❖ Maintenance, repairs and follow up

At beginning of fitting, check and adjust angles and placement of primary & secondary PSDs

- ➢ 3 Relative Seating Angles (S/BS; S/LLS; LLS/FS)
- ➢ Effective seat depth
- ➢ Seat to footplate distance
- ➢ Back support height
- ➢ Lateral trunk support height (if separate LTS)
- ➢ Arm support height
- ➢ Head support height, placement and angle (if necessary)

Assess client's posture - were postural objectives achieved?

- Review Postural Alignment Plan
- Assess & Measure client's posture in new seating – objectives met?
  - Three relative body segment angles
  - Any absolute body segment angles you are using as outcome measures
- This can help guide further adjustments as needed
- Document final posture achieved in new seating (even if didn't achieve objectives)

❑ **Application of Measures: Implementation & Follow-Up**

❖ Product (wheelchair) Preparation

❖ Fitting/delivery

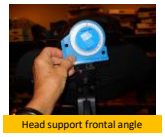
❖ Maintenance, repairs and follow up

Maintenance, repairs and follow up

- Do you do a good job with this?
- If there are specific angles and placements that are critical to person's posture and function, how do we ensure that these are maintained?
- Should there be a basic unique set of angles/dimensions in client record that is completed at delivery, and adjusted if client's needs change over time?

Documenting desired asymmetrical adjustment of head support

Head support sagittal angle



Head support frontal angle

Head support transverse angle

- Next time client came in for a follow up we were able to re-set the head support to the desired angles quickly and efficiently

Clinical application of these measures

When	Purpose	Measures
Initial clinical assessment	To document current set up of equipment	Seating relative angles (3) Seating linear dimensions (2-3)
	To document current posture as a baseline	Body segment relative angles (3) Body segment absolute angles (0-3)
	To set postural goals	Body segment relative angles (3) Body segment absolute angles (0-3)
	For prescription	Body linear dimensions (all) Seating linear dimensions (all) Seating relative angles (3)
At delivery		
At follow - up		

Clinical application of these measures

When	Purpose	Measures
Initial clinical assessment	To document current set up of equipment	Seating relative angles (3) Seating linear dimensions (2-3)
	To document current posture as a baseline	Body segment relative angles (3) Body segment absolute angles (0-3)
	To set postural goals	Body segment relative angles (3) Body segment absolute angles (0-3)
	For prescription	Body linear dimensions (all) Seating linear dimensions (all) Seating relative angles (3)
At delivery	To ensure accurate set up of seating supports	Seating relative angles (3) Seating linear dimensions (all)
	To document outcomes relative to postural goals	Body segment relative angles (3) Body segment absolute angles (0-3)
At follow - up		

Clinical application of these measures

When	Purpose	Measures
Initial clinical assessment	To document current set up of equipment	Seating relative angles (3) Seating linear dimensions (2-3)
	To document current posture as a baseline	Body segment relative angles (3) Body segment absolute angles (0-3)
	To set postural goals	Body segment relative angles (3) Body segment absolute angles (0-3)
	For prescription	Body linear dimensions (all) Seating linear dimensions (all) Seating relative angles (3)
At delivery	To ensure accurate set up of seating supports	Seating relative angles (3) Seating linear dimensions (all)
	To document outcomes relative to postural goals	Body segment relative angles (3) Body segment absolute angles (0-3)
At follow - up	To document intentional or unintentional change in seating set up	Seating relative angles (3) Seating linear dimensions (key)
	To document positive or negative postural change	Body segment relative angles (3) Body segment absolute angles (0-3)
	To document change in body size	Body linear dimensions (as needed)

QUESTIONS/COMMENTS?

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