Guidance for Measurement of Shear

Laboratory Based Measurements

1. Calibration of sensors must be performed prior to any use.

2. If bench calibration is not possible for the device in use, accuracy of device should be confirmed prior to use.

3. Calibration load should be approximately 2 times the expected shear force. Prior to calibration the expected shear force should be estimated by placing the same loading as measured in the test case on the two mating surfaces to be used in the test case. Apply a horizontal load with a force gauge or spring scale to one of the surfaces while loaded. The peak value observed prior to the weighted fabric’s moving across the surface is the expected shear range.

4. Calibration should be performed using either a tilting table or sliding sled, with deference to the method prescribed by the manufacturer. However cross-checking performance on alternative methods is desirable.

5. The period of calibration will vary based on the shear measurement device’s construction. Experience will drive frequency, but it should not be considered abnormal to perform calibrations multiple times each day, or testing period. In addition, a post-test calibration provides a validity check on the data. If the device does not measure the calibration conditions as identical, both before and after, the data that has been gathered should be considered “in question.”

6. Place the support surface on which shear is to be measured on a horizontal test surface.

7. Attach the shear sensor to an indenter.

8. Apply an appropriate normal load to the indenter.

9. The test surface should be reset to a minimal or zero shear value before each trial.

10. Initiate data recording.

11. Apply shearing load.

12. Document observed shear.

13. Limitations in shear measurement.

   a. Shear sensors measure horizontal forces, not displacement.
b. Forced displacement on a shear sensor may damage it.

c. Data interpretation should consider the elastic deformation and the stress and strain characteristics of all components in the test.

Clinically Based Measurements

Elasticity and extreme deformation of the skin dramatically exceed the deformation of shear sensors. This requires that shear measurements be made, using currently available single site sensors, from the perspective of forces applied to the skin, rather than forces applied to the support surface by the body. With this in mind, consider the following process to measure shear forces applied to the skin of a patient.

Caregivers should periodically assess the patient for susceptibility to risk factors (Braden or other scale). Other factors to consider related to shear forces on the skin, include, but not limited to:

1. General state of health
2. Support surface characteristics
   a. Immersion
   b. Envelopment
   c. Microclimate
3. Positioning with assistance from caregiver or support surface
   a. Rate
   b. Frequency
   c. Angle
4. Turgor of the skin.
5. Elastic nature of the skin
6. Devices and dressings attached to the body

The risk of shear injury may increase when:
   a. Head of bed is elevated above 30°
   b. Bed frame shortens when articulating the bed
   c. Patient is rolled laterally

These may be partially mitigated by:
   a. When head of bed is elevated, elevate the knee
   b. Repositioning of bed or patient in bed should be followed by shear relieving rocking of the patient, being cautious not to induce additional shear.

Shear forces are present in all loading conditions, even in patients lying in a static supine position. These forces may be difficult to measure because shear forces are directional
in nature and thus may require multiple attempts. No known “safe” threshold or allowance for shear has been identified.

Static Shear Measurement:

1. Confirm that the measurement device is properly sized for the expected shear forces expected. See Laboratory Based Measurements step 3 (above) for the measurement range selection method.
2. Using an appropriate two-sided medical adhesive, attach the shear measurement device so that the sensor covers the site of interest.
3. Place the patient in the position to be used during measurement, supine for example.
4. Gently roll patient once to each side releasing shear, thus creating a zero point for shear measurement.
5. Connect the sensor to the measurement system.
6. Record shear values.
7. It may be appropriate to repeat the measurement process, after orientation of the sensor has been changed, or after shear reducing intervention has been introduced.

Dynamic Shear Measurement:

1. Confirm that the measurement device is properly sized for the expected shear forces expected. See Laboratory Based Measurements step 3 (above) for the measurement range selection method.
2. Using an appropriate two-sided medical adhesive, attach the shear measurement device to the sacrum, so that the sensor covers the site of interest.
3. Place the patient in the position to be used during measurement, supine for example.
4. Gently roll patient once to each side releasing shear, thus creating a zero point for shear measurement.
5. Connect the sensor to the measurement system.
6. Confirm that device is functional.
7. Initiate the measurement process or data recording.
8. Perform the repositioning to be tested in dynamic process.

Data analysis will be dependent upon the focus of the test. For example in consideration of shear forces (reduction of shearing):

a. No known limitations can be used as action limits to drive intervention. However the goal of the measurement process should be to provide as low as possible shear environment.
b. Repeating testing with a proposed intervention allows a caregiver to check the assumption that the intervention has reduced the undesirable loading on the skin.