



**immedia**

# Pressure mapping

Measured with Immedia in-bed systems

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# About pressure mapping

Sometimes it is said that nothing should be in bed between the user and the pressure relieving mattress, but a pressure relieving mattress is often not enough. Patients must be turned several times daily for personal hygiene, applying a sling, caring for sores, etc. However, turning or repositioning can cause shear on the user and risk injury for the carer.

## What is pressure mapping?

Interface pressure mapping involves using sensors to quantify the pressure between two contacting objects, such as a person and their support surface. Pressure mapping has many widespread applications, but in assistive technology, it is commonly used by clinicians to determine the suitability of a wheelchair cushion and by researchers investigating support surfaces, risk factors for ulceration, and ulcer prevention protocols.

Pressure mapping is a “snapshot” of pressure on a person’s body lying on a defined mattress for a given period. Change one parameter – person, positioning, mattress, temperature, clothes - a new and different snapshot will appear. Always conduct a risk assessment, and ensure that the in-bed system and the pressure relieving mattress are safe for the user and carer.

Combining an in-bed system and a pressure relieving mattress will often make good sense to protect the user from pressure injuries and the carer from work-related injuries. In this study, we have placed the Immedia in-bed systems on top of a standard foam mattress and an alternating air mattress to see if the combination will have a negative effect on the pressure relieving mattress or if it will be within an acceptable level, but at the same time improve the working environment for the carer.

All measurements have been taken with FSA “Body Track” independently by Raskov & Co, Ole L. Thy, physiotherapist, Etac and Anette R. Raun, International Product Manager, Etac.



## Conclusion

When in-bed systems were used on an air mattress it generally had a lower average pressure on all measurements. But during circulation, the maximum pressure can be higher and even become "yellow" on certain pressure points. Supine positioning gives the highest average and maximum pressure measurements but on a lower sensing area. The pressure is higher on well-known defined risk points such as shoulders, elbows, hip area and heels.

### Immedia SatinSheet System

Placing the SatinSheet regardless of variant and combination on both the foam and air mattress shows nearly the same picture as on the mattress without any in-bed systems, a slight improvement on the average and maximum measurements using the SatinSheet, especially on the foam mattress.

### Immedia 4WayGlide System

Placing the 4WayGlide system regardless of the mattress material and variant of NylonSheet on both the foam and air mattress shows nearly the same picture as on the mattress without any in-bed systems. A slight improvement in the average and maximum measurements can be seen, with the 4WayGlide system, especially in the supine position.

### Immedia TwinSheet4Glide System

Placing the TwinSheet4Glide regardless of variant of nylon sheet (with or without locks) on both the foam and air mattress shows a slightly higher average and maximum measurements than on the mattress without any in-bed systems. It is important to notice that the join on the two parted TwinSheet4Glide Mattress is not visible on the measurements.

A combination of mattress and in-bed systems is possible without any significant change in the features of the mattress. Further, in-bed systems improve the working environment for the carer and minimize shear on the user.

The best way to prevent pressure injuries is pressure distribution and minimizing shear and friction. When making combinations of mattress and in-bed system, a risk assessment must always be done to ensure that every single user gets the best combination.

The conclusion was clear: "Using Immedia's in-bed systems on foam or air mattresses shows the same pressure tendency as when not using products. The pressure distribution ability is maintained - and even improved in some cases."

## Cost of pressure injuries

Pressure injury is a painful, costly, and often preventable complication for which many individuals are at risk. A recent systematic review reported global point prevalence of pressure injuries in acute hospitals at 14.8%.<sup>1</sup>

In the UK the total cost of pressure ulcer care is around 4% of the annual healthcare budget. Including community healthcare costs treatment consumes up to £2.1 billion of the National Health Service budget.

Hospital costs in the Netherlands have increased up to 1.4% of the healthcare budget (\$362 million to \$2.8 billion (USD) annually). In the US, the care is estimated to be \$11.6 billion (USD) annually; the Cost of individual patient care ranges between \$500 (USD) and \$152,000 (USD). The mean hospital stay in Australia is 4.3 days at a financial cost of \$699 to \$840 (AUD) per day, suggesting mean costs of \$3,600 (AUD) for inpatient care for a pressure injury.<sup>2</sup>

Without concerted effort this cost is likely to increase in the future as the population ages and the incidence of pressure injury increases. Preventive skin care, which focuses on promotion of skin integrity and protecting the skin from damage, is a key component of pressure injury prevention.

# Pressure injury

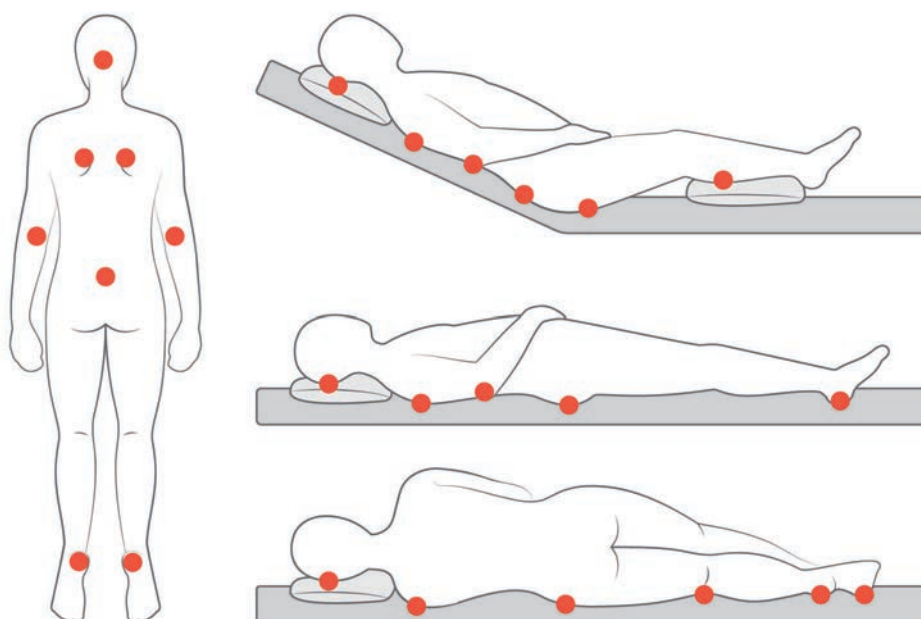
## International NPUAP-EPUAP Pressure Ulcer Definition

A pressure injury is defined as localized damage to the skin and/or underlying tissue, as a result of pressure or pressure in combination with shear. Pressure injuries usually occur over a bony prominence but may also be related to a medical device or other object<sup>2</sup>

## What causes a pressure injury?

A pressure ulcer/injury can occur due to a patient's body weight, or as a result of externally exerted forces such as those applied by an object, or by a combination of these. Several contributing or confounding factors are also associated with pressure injuries, primarily impaired mobility.

- Activity and mobility limitations
- Skin status
- Perfusion, circulation and oxygenation factors
- Nutrition indicators
- Moisture
- Body temperature
- Older age
- Sensory perception limitations
- Blood markers
- General and mental health status



# Immedia in-bed systems

## For users with limited mobility

Immedia in-bed systems are characterised by a two part system consisting of a BaseSheet or NylonSheet placed directly on the bed's mattress and a top layer, either as a DrawSheet or a GlideMattress. The main advantage of a permanently placed system is that it always remains in bed. No application or removal of slide sheets is necessary. User-friendly moving and handling solutions are crucial to ensure safe working environments.

An in-bed system reduces friction and addresses two major challenges:

- The workload on the carers is reduced, which means fewer work-related injuries
- Shear forces on the patient are reduced, which reduces the risk of pressure injuries

Immedia in-bed systems are also suitable for users with dementia or those who feel unsafe, suffers from a brain injury, pain, pressure injuries or are living with obesity.



### Immedia SatinSheet

#### An in-bed system for independent to assisted users

SatinSheet System consists of a BaseSheet and a 4Direction DrawSheet which reduces the friction between the user and the bed and reduces the workload on the caregiver assisting with repositioning in bed. A BaseSheet can be used on its own for more independent users.



### Immedia 4WayGlide

#### An in-bed system for severely immobile users

The Immedia 4WayGlide System consists of a NylonSheet and a GlideMattress that provides an extremely low friction surface for movement in all directions. This facilitates positioning and turning, both manually and by attaching the GlideMattress to a hoist.



### Immedia TwinSheet4Glide

#### An in-bed system for incontinent immobile users

Immedia TwinSheet4Glide is a two-part absorbent GlideMattress to be used together with a NylonSheet. It is suitable for turning and positioning incontinent users with severely reduced mobility.

## Type of mattress

### Foam mattress

100 mm HR40.  
With stretchable Polyurethane cover.  
The mattress is used for prevention and treatment of EPUAP Pressure Ulcer categories 1 and 2.

### Air mattress

Dynamic pressure relieving mattress, consists of 17 individual air cells, each 120 mm high. The pressure in the mattress adjusts to the user's weight and the pump is running in a cycle with a time interval of 10 minutes, which alternately increases and maintains the pressure. The cover is stretchable. The mattress is used for prevention and treatment of EPUAP Pressure Ulcer categories 1, 2 and 3.

# Test

## Measurements

The results are described in three main areas:

- Maximum mmHg = Maximum pressure in relation to the range of the study. A low figure is indicative of Minimal pressure.
- Average mmHg = The average of the number of cells that are used. Lower numbers are indicative of low pressure value. Coefficient of Variation: standard deviation/mean - Lower the % the better. How evenly is the pressure distributed over the surface.
- Sensing area = cm<sup>2</sup> area of the cells that are in use, the higher the number the smaller the average pressure.

The results are highlighted in the measurements which cover the legs, pelvis, spine and shoulder but not the head.

All measurements have been done by Raskov & Co<sup>3</sup>

## Method

- Supine and lateral positions
- 6 minutes per position on the foam mattress
- 10 minutes per position on the air mattress to cover a whole cyclus
- For this presentation the FSA pressure distribution scale is set on 50 mmHg - this is a generally accepted base line. It is believed that pressure above this level is not acceptable for users
- Surface area 850 x 1980 mm
- Average pressure
- Peak pressure

## Testperson

Age: 54

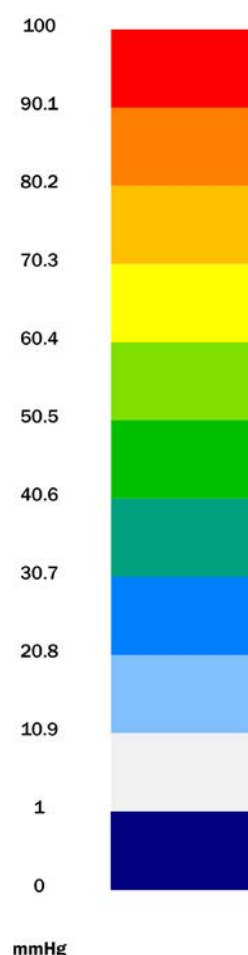
Weight: 85 kg

Height: 179 cm

BMI: 26,5

Sex: male

Clothes: Jeans, shirt and sweater



### References:

- 1 Tubaishat A, Papanikolaou P, Anthony D, Habiballah L. Pressure ulcers prevalence in the acute care setting: A systematic review, 2000-2015. Clin Nurs Res, 2018; 27(6): 643-659
- 2 European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline. Emily Haesler (Ed.) PUAP/NPIAP/PPPIA: 2019
- 3 <http://www.raskov.dk>

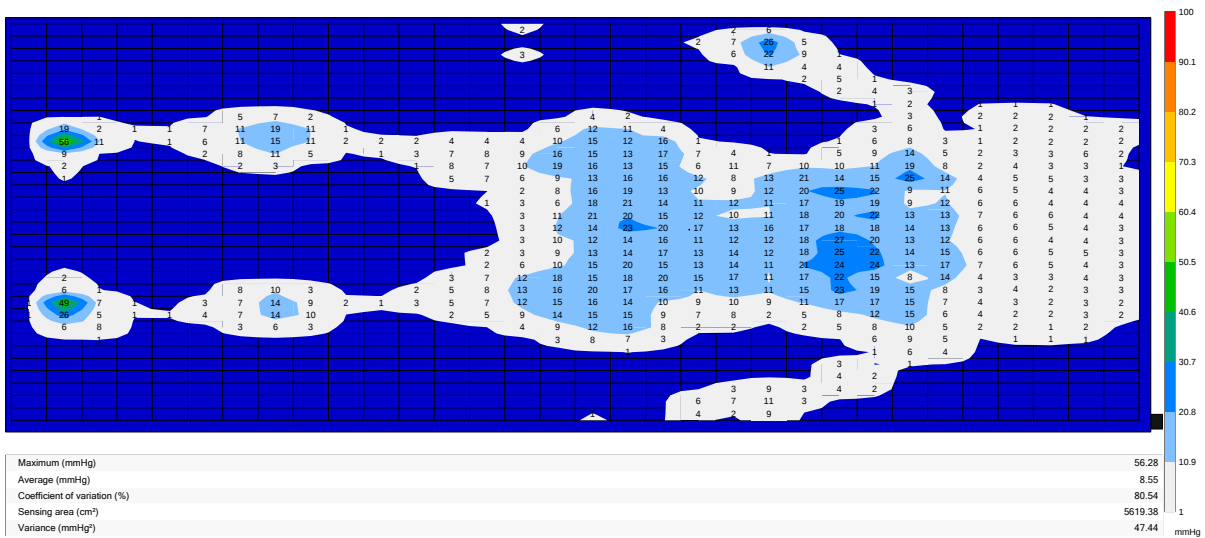
# Product combinations

| Description                                                                           | Item no                                      | Lateral  | Supine   |
|---------------------------------------------------------------------------------------|----------------------------------------------|----------|----------|
| <b>Immedia SatinSheet</b>                                                             |                                              |          |          |
|                                                                                       | (page 10-13)                                 |          |          |
| SatinSheet 2Direction Corner<br>SatinSheet DrawSheet Midi                             | IM4107S<br>IM4118S                           | foam/air | foam/air |
| SatinSheet 2Direction Fit<br>SatinSheet DrawSheet Midi                                | IM4112S<br>IM4118S                           | foam     | foam     |
| SatinSheet 2Direction Corner<br>SatinSheet 4Direction Maxi                            | IM4107S<br>IM4121S                           | foam/air | foam/air |
| SatinSheet 2Direction Fit<br>SatinSheet 4Direction Midi                               | IM4112S<br>IM4115S                           | foam     | foam     |
| <b>Immedia 4WayGlide</b>                                                              |                                              |          |          |
|                                                                                       | (page 14-18)                                 |          |          |
| 4WayGlide Mattress LPL<br>NylonSheet with 1 lock                                      | IM140/200LPL<br>IM85/200LPLNS                | foam/air | foam/air |
| 4WayGlide Mattress LPL<br>NylonSheet with 3 locks                                     | IM140/200LPL<br>IM85/2003LPL                 | foam     | foam     |
| 4WayGlide Mattress LPL<br>NylonSheet with 1 lock<br>4WayGlide Cover                   | IM140/200LPL<br>IM85/200LPLNS<br>IM140/200PU | foam     | foam     |
| 4WayGlide Mattress LPL<br>NylonSheet with 1 lock, Grey                                | IM140/200LPLG<br>IM85/200LPLNS               | foam     | foam     |
| 4WayGlide Mattress LPL<br>NylonSheet with 3 lock, Grey                                | IM140/200LPLG<br>IM85/2003LPL                | foam     | foam     |
| <b>Immedia TwinSheet4Glide</b>                                                        |                                              |          |          |
|                                                                                       | (page 19-21)                                 |          |          |
| Twinsheet4Glide - top<br>Twinsheet4Glide - down<br>4WayGlide NylonSheet LPL w/lock+NS | IM150/75N<br>IM150/140N<br>IM85/200LPLNS     | foam/air | foam/air |
| Twinsheet4Glide - top<br>Twinsheet4Glide - down<br>4WayGlide NylonSheet LPL w/3x lock | IM150/75N<br>IM150/140N<br>IM85/2003LPL      | foam     | foam     |
| TwinSheet4Glide Mattress Long<br>4WayGlide NylonSheet LPL w/3x lock                   | IM150/200N + IM85/2003LPL                    | foam     | foam     |

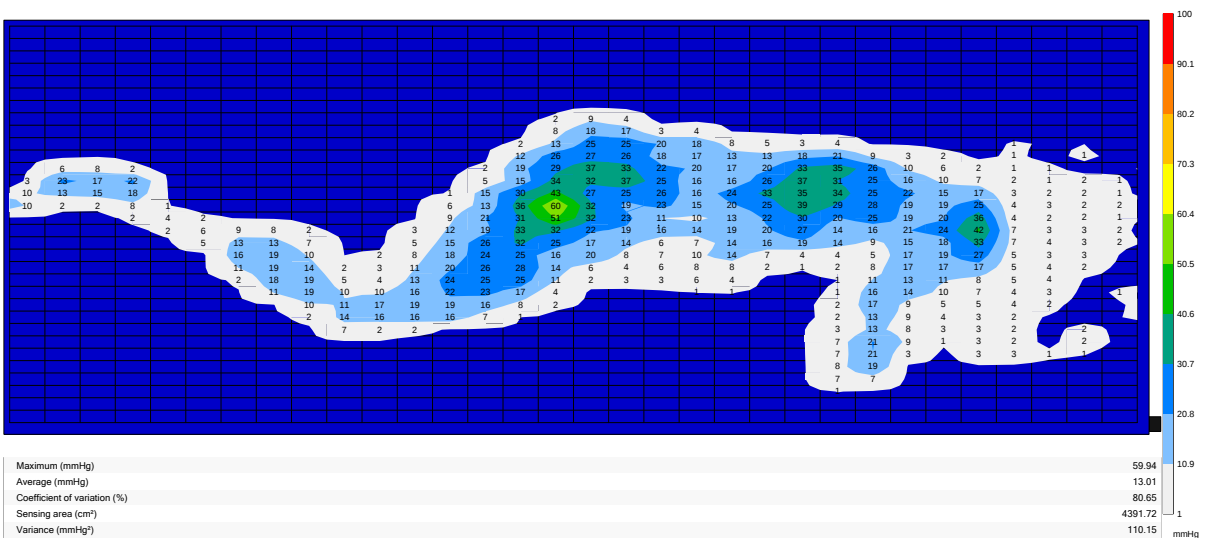
# Foam mattress

## Foam mattress without in-bed system

Standard foam mattress - supine position



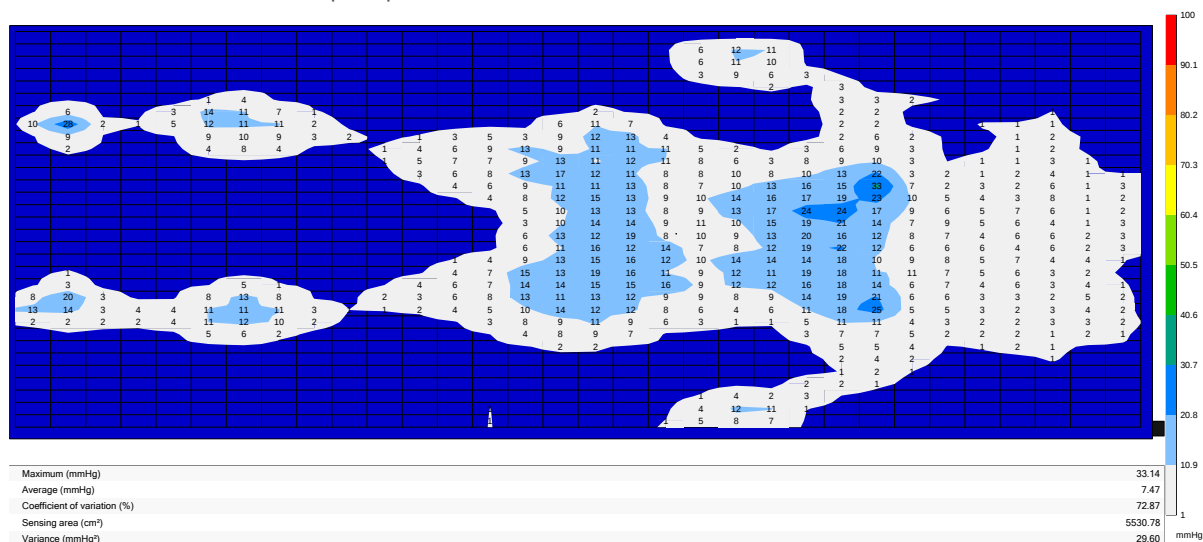
Standard foam mattress - side position



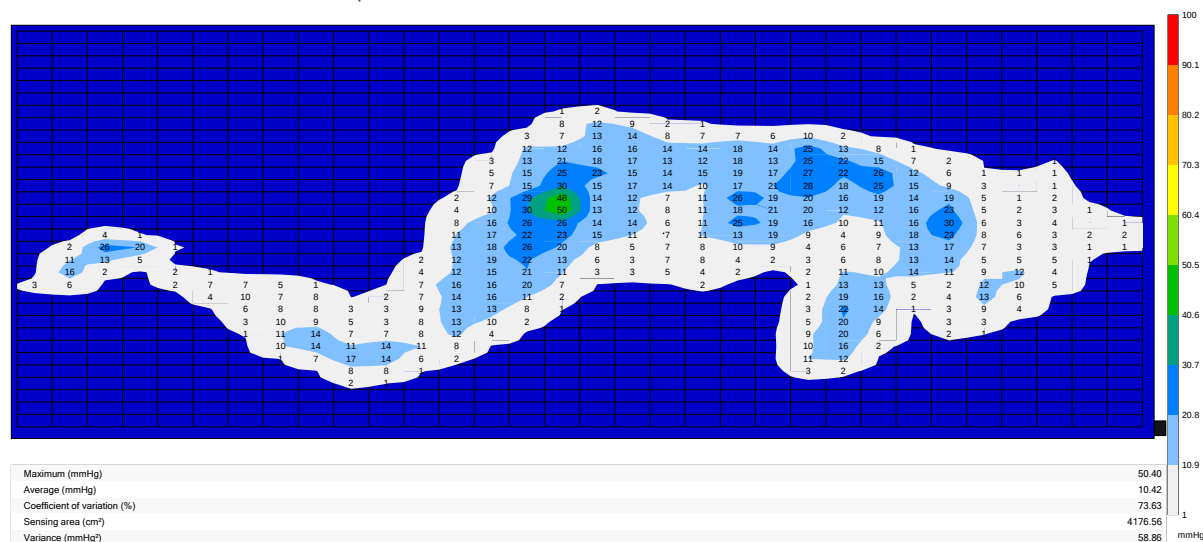
# Immedia SatinSheet System

- SatinSheet 2Direction Corner (polyester/cotton), item no: IM4107S
- SatinSheet DrawSheet Midi (polyester/cotton), item no: IM4118S

Standard foam mattress - supine position

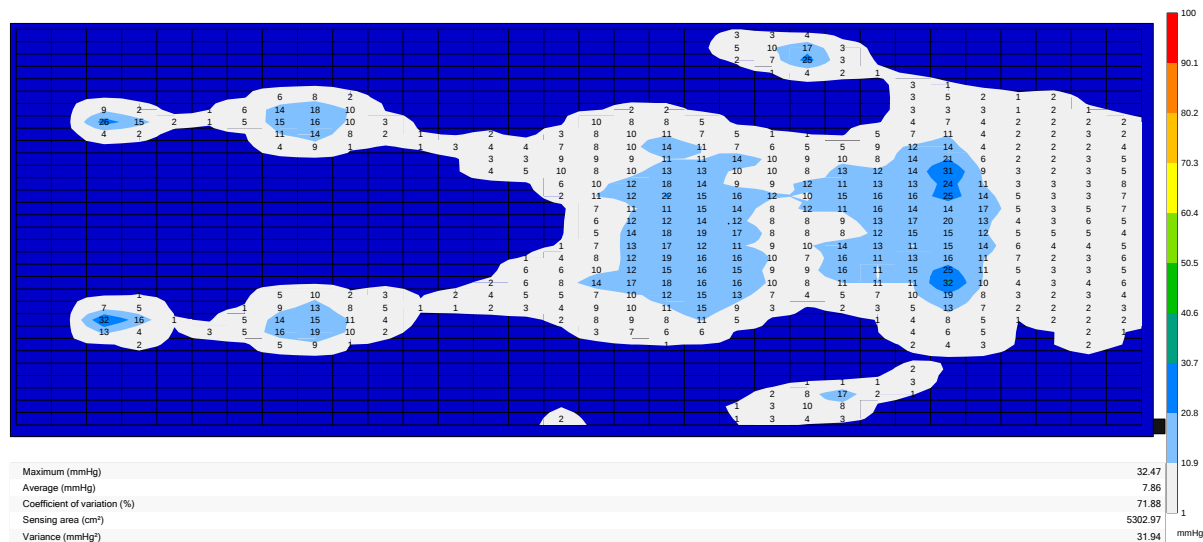


Standard foam mattress - side position

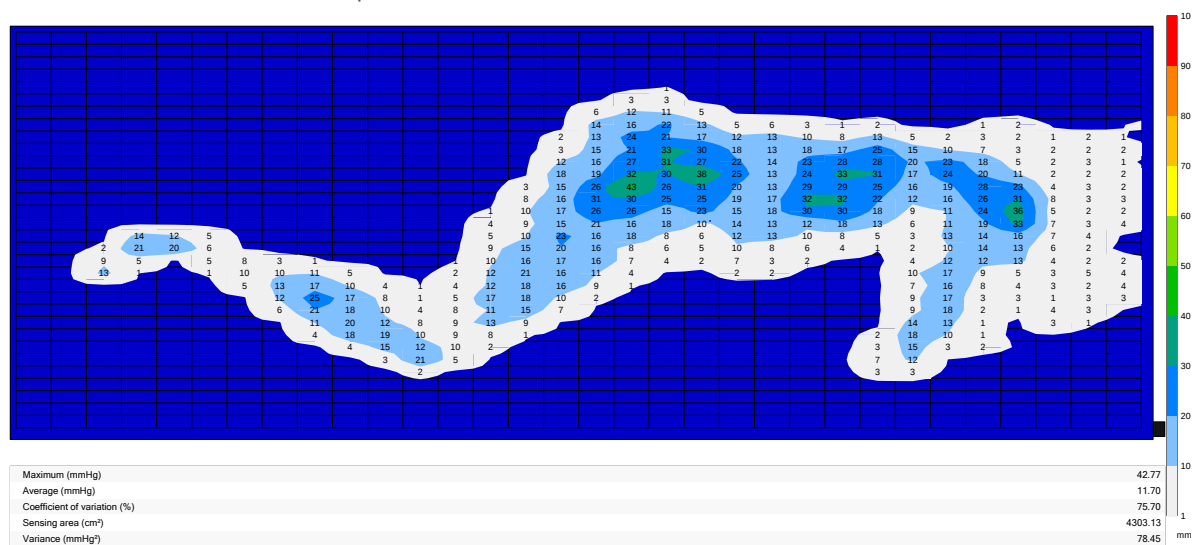


- SatinSheet 2Direction Fit (polyester/cotton), item no: IM4112S
- SatinSheet DrawSheet Midi (polyester/cotton), item no: IM4118S

### Standard foam mattress - supine position

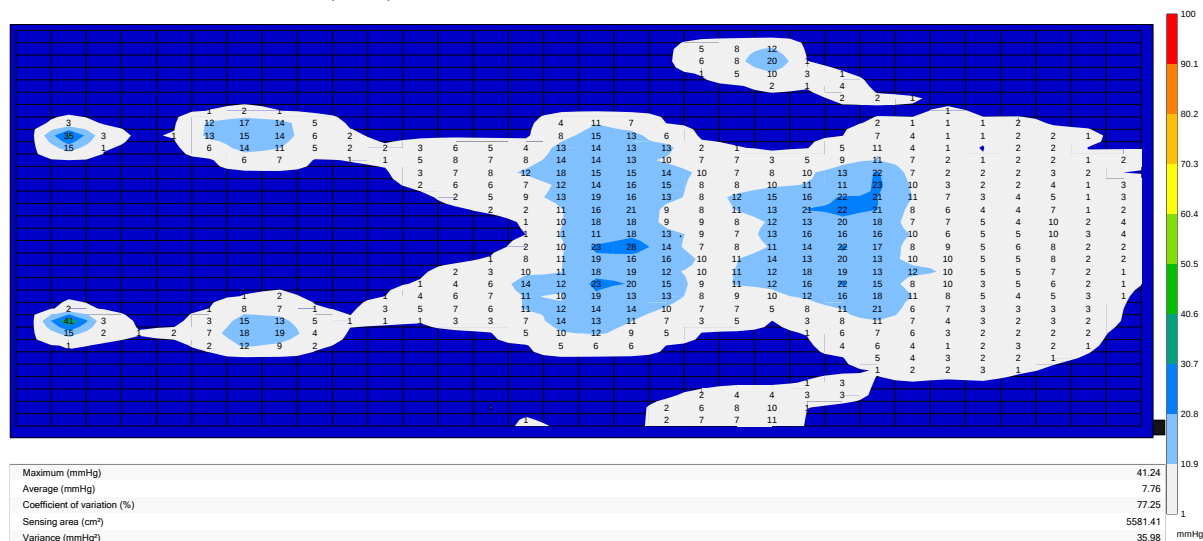


### Standard foam mattress - side position

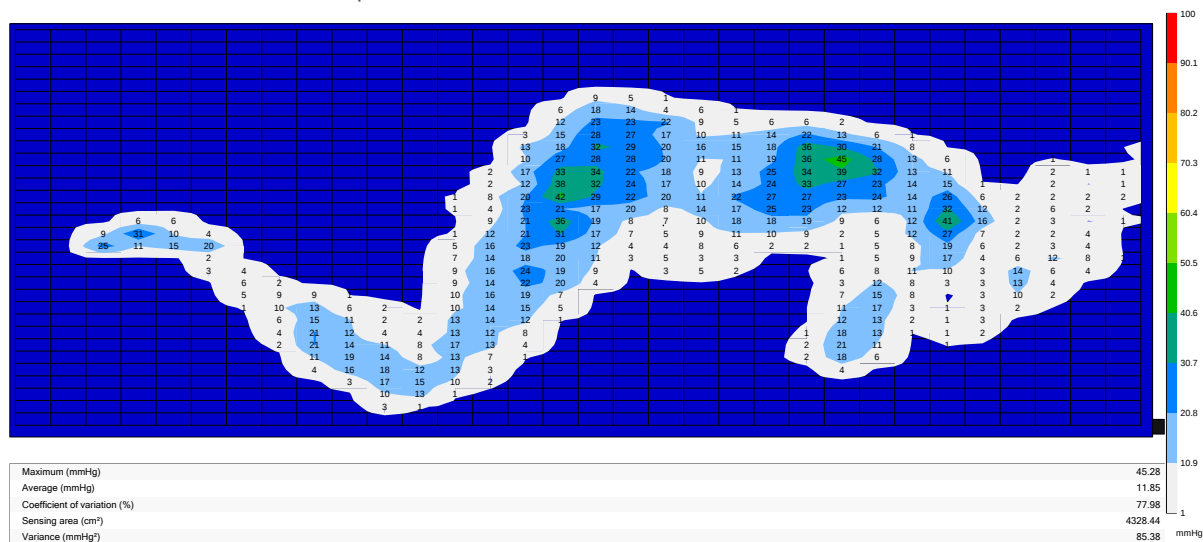


- SatinSheet 2Direction Fit (polyester/cotton), item no: IM4112S)
- SatinSheet 4Direction DrawSheet Maxi (polyester/cotton), item no: IM4121S

Standard foam mattress - supine position

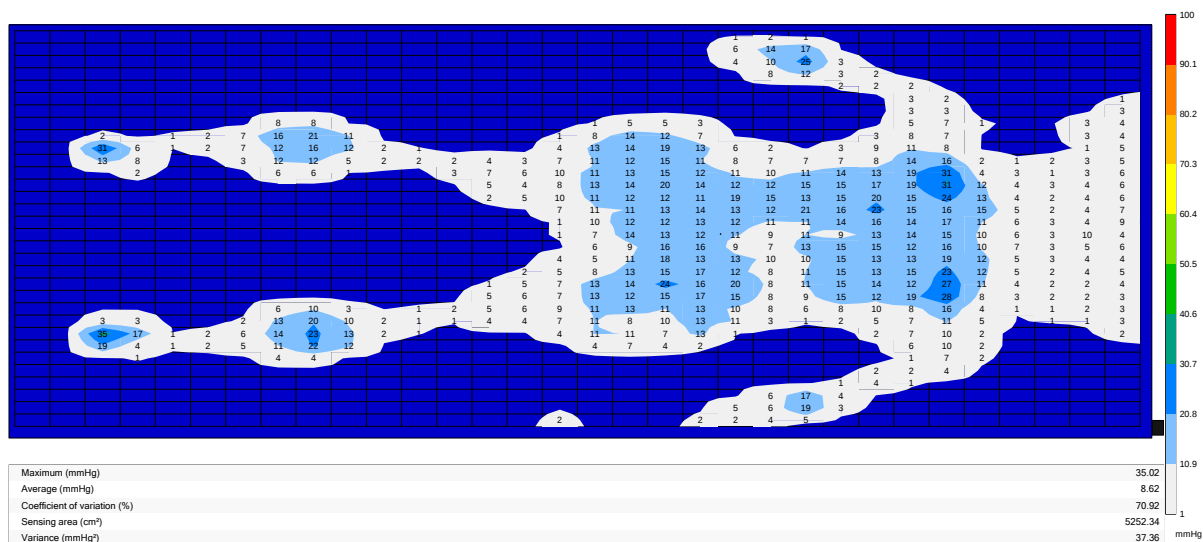


Standard foam mattress - side position

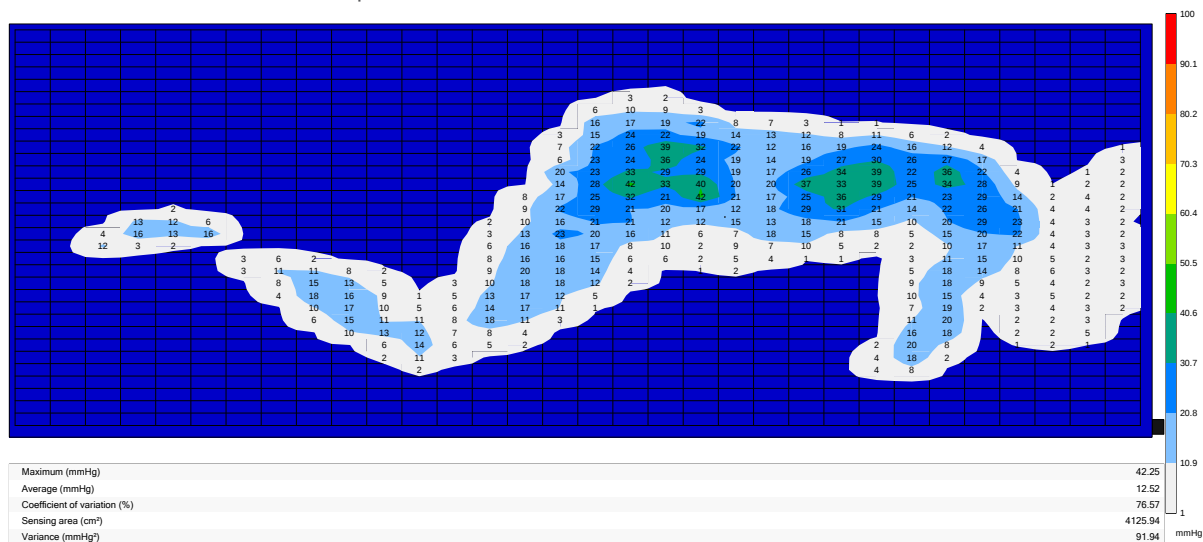


- SatinSheet 2Direction Corner (polyester/cotton), item no: IM4107S
- SatinSheet 4Direction DrawSheet Maxi (polyester/cotton), item no: IM4121S

### Standard foam mattress - supine position



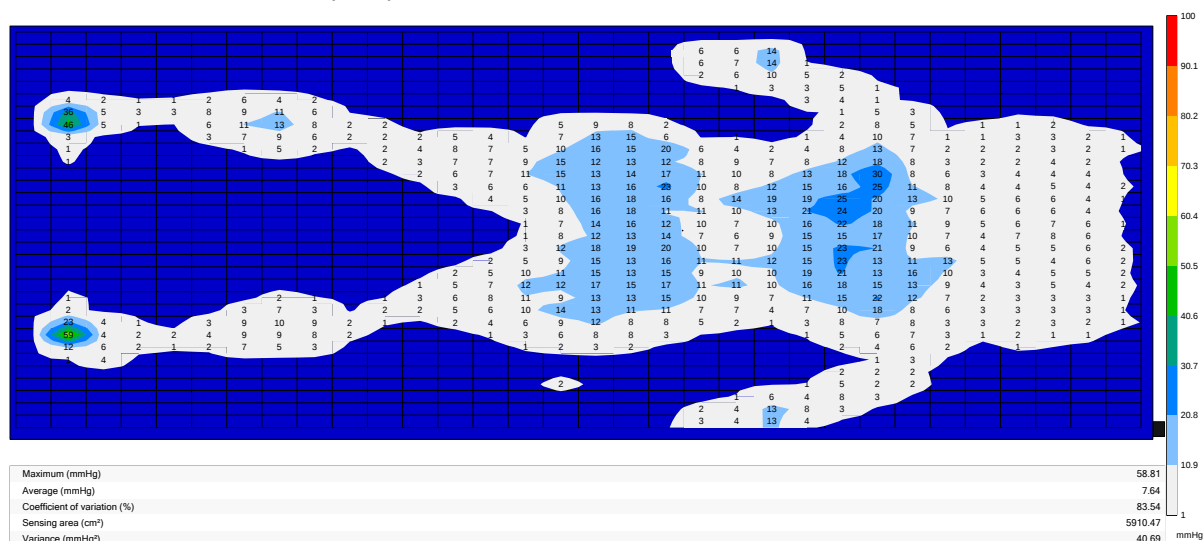
### Standard foam mattress - side position



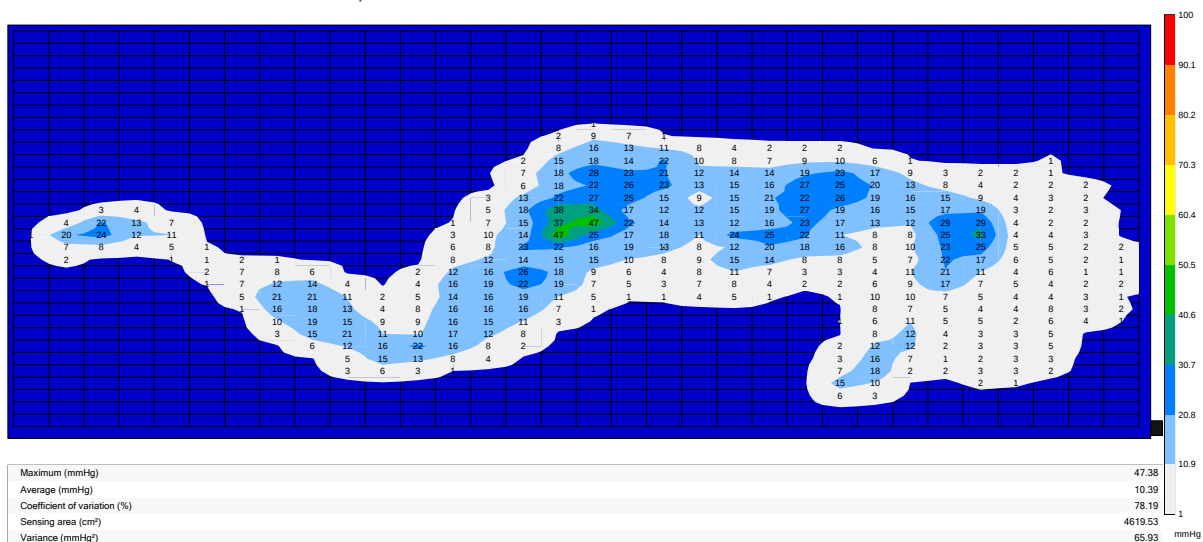
## Immedia 4WayGlide System

- 4WayGlide Mattress, (polyester/cotton), item no: IM140/200LPL
- 4WayGlide NylonSheet with one lock (nylon), item no: IM85/200LPLNS

Standard foam mattress - supine position

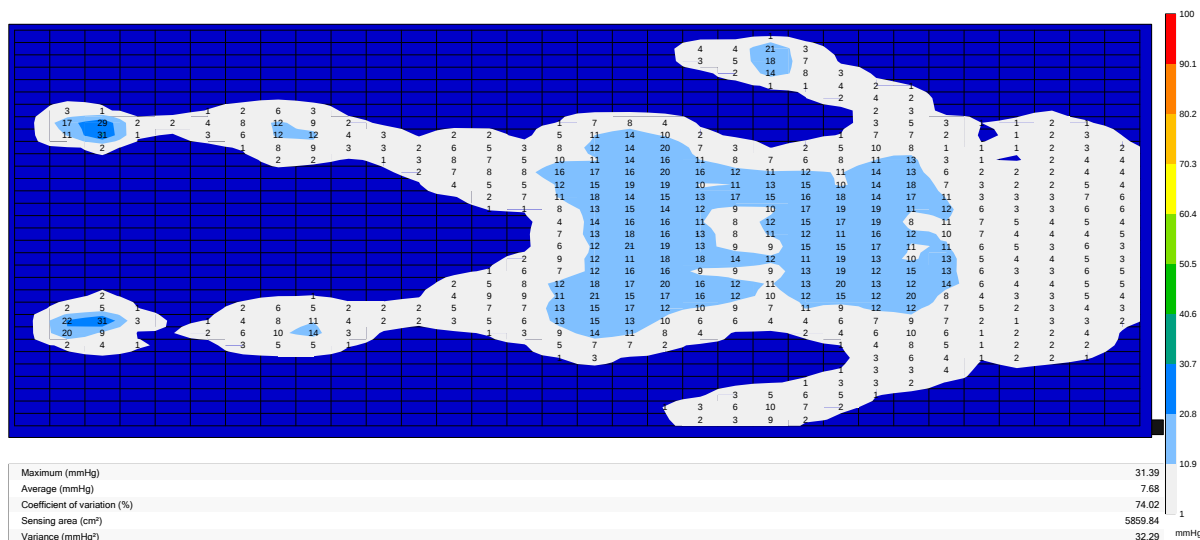


Standard foam mattress - side position

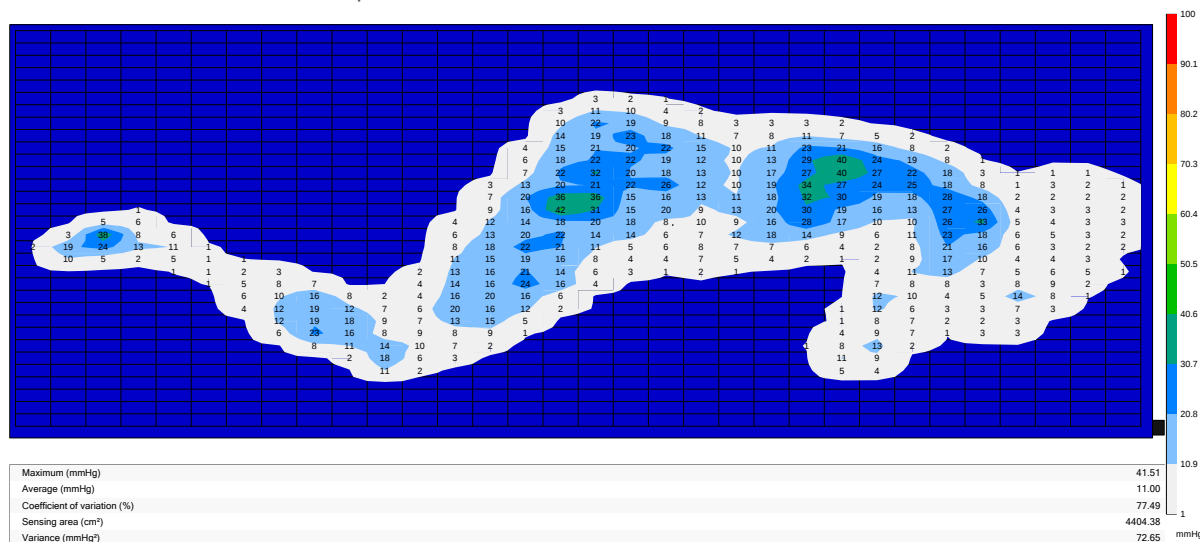


- 4WayGlide Mattress (polyester/cotton), item no: IM140/200LPL
- 4WayGlide NylonSheet with three locks (nylon), item no: IM85/2003LPL

Standard foam mattress - supine position

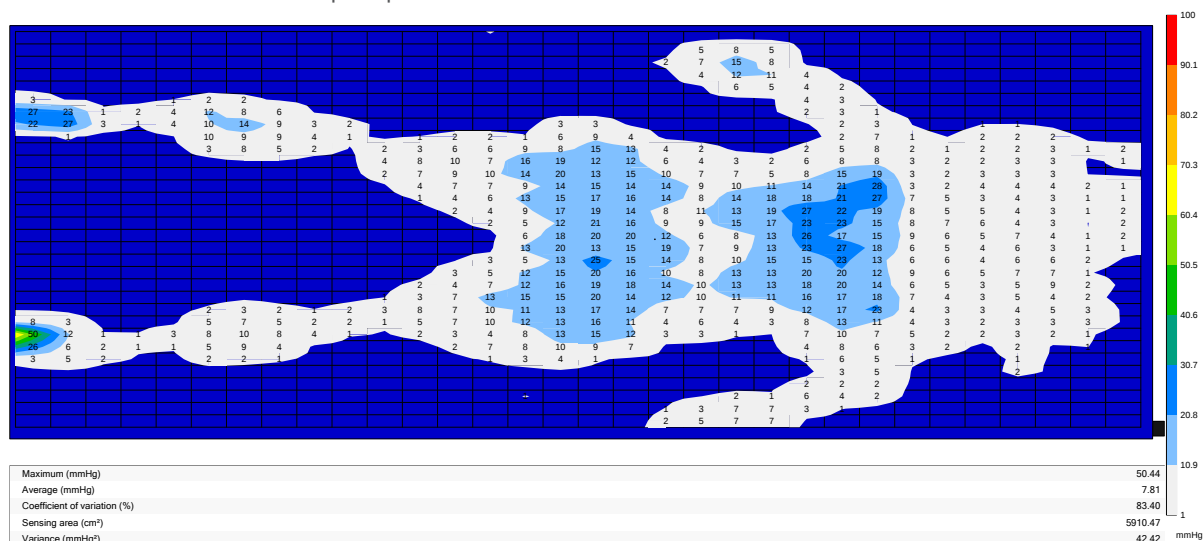


Standard foam mattress - side position

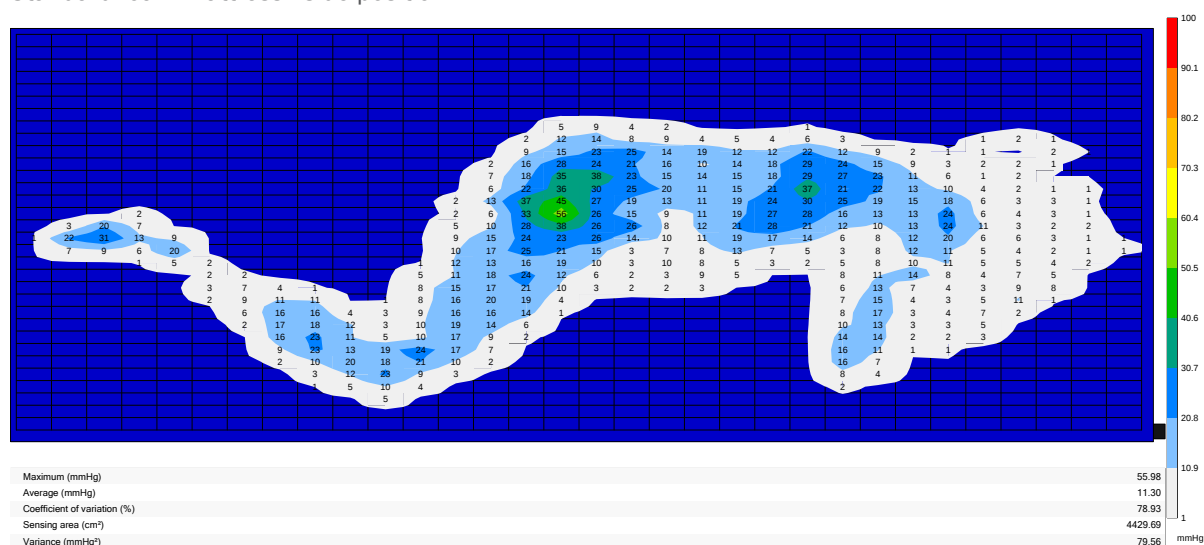


- 4WayGlide Mattress (polyester/cotton), item no: IM140/200LPL
- 4WayGlide NylonSheet with three locks (nylon), item no: IM85/200LPLNS
- 4WayGlide Cover (cotton/polyurethane), item no: IM140/200PU

Standard foam mattress - supine position

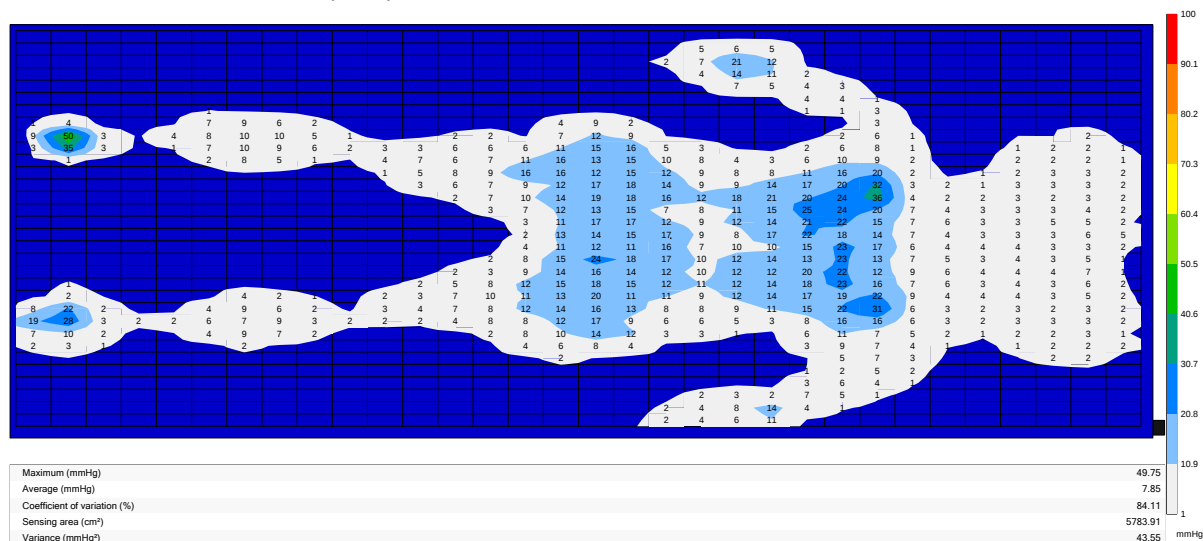


Standard foam mattress - side position

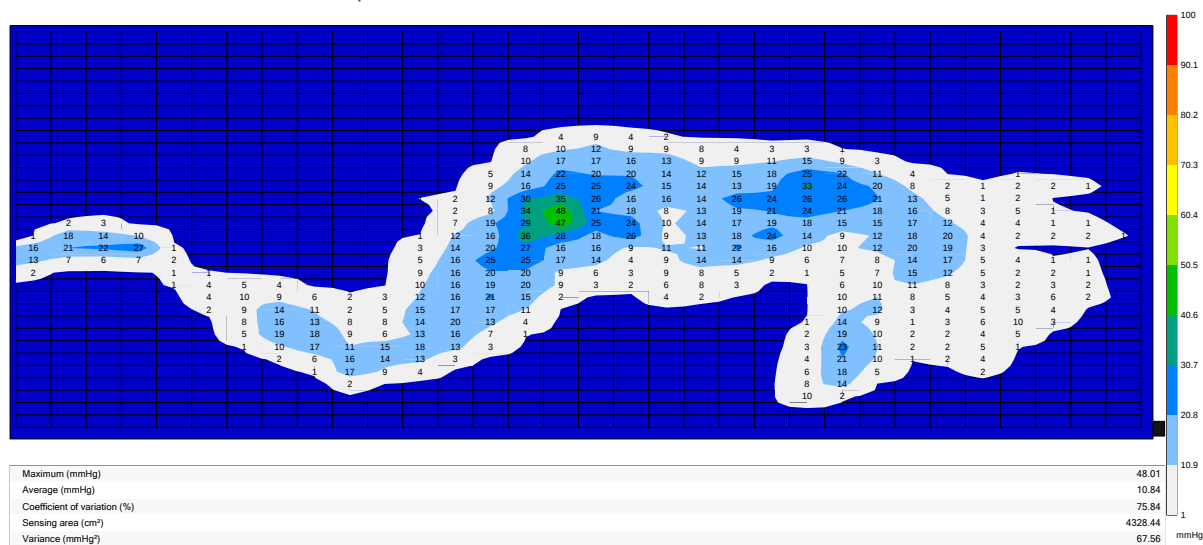


- 4WayGlide Mattress (polyurethane), item no: IM140/200LPLG
- 4WayGlide NylonSheet with one lock (nylon), item no: IM85/200LPLNS

Standard foam mattress - supine position

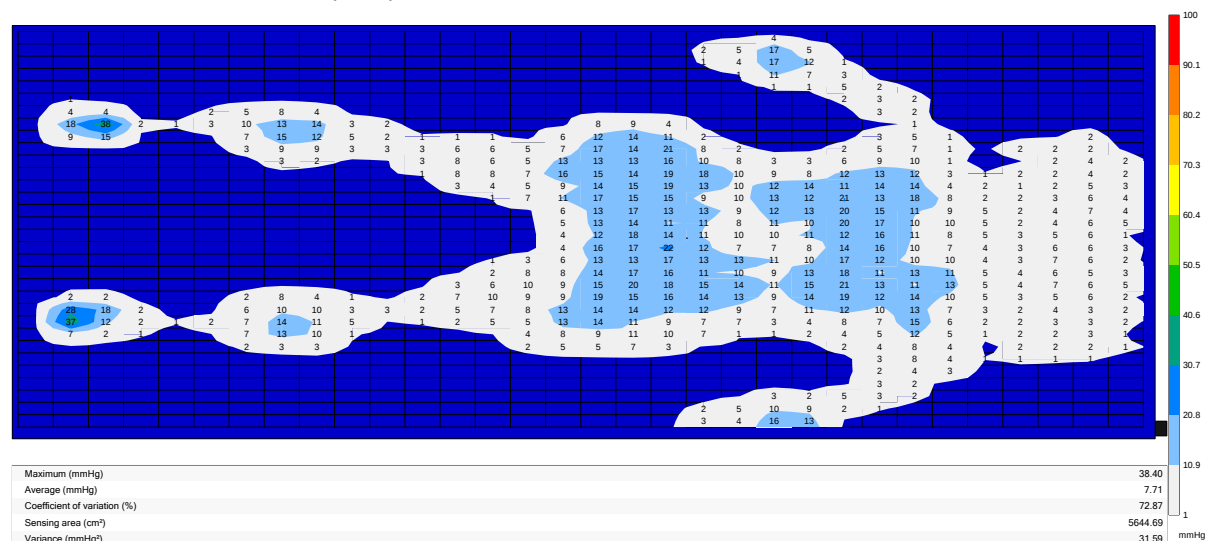


Standard foam mattress - side position

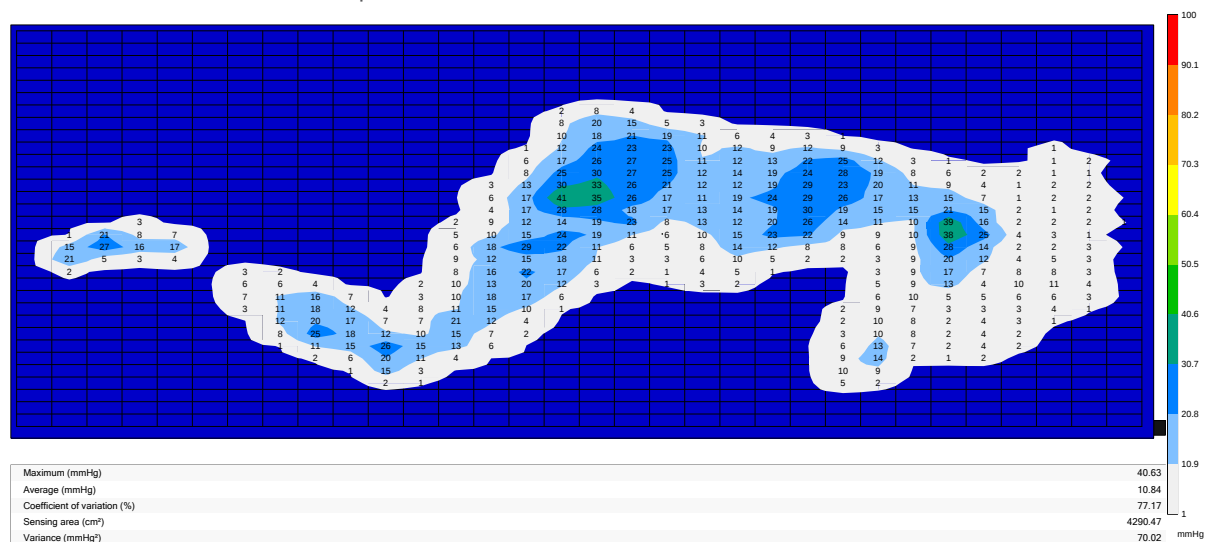


- 4WayGlide Mattress (polyester/cotton), item no: IM140/200LPLG
- 4WayGlide NylonSheet with three locks (nylon), item no: IM85/2003LPL
- 4WayGlide Cover, (cotton/polyurethane), item no: IM140/200PU

Standard foam mattress - supine position



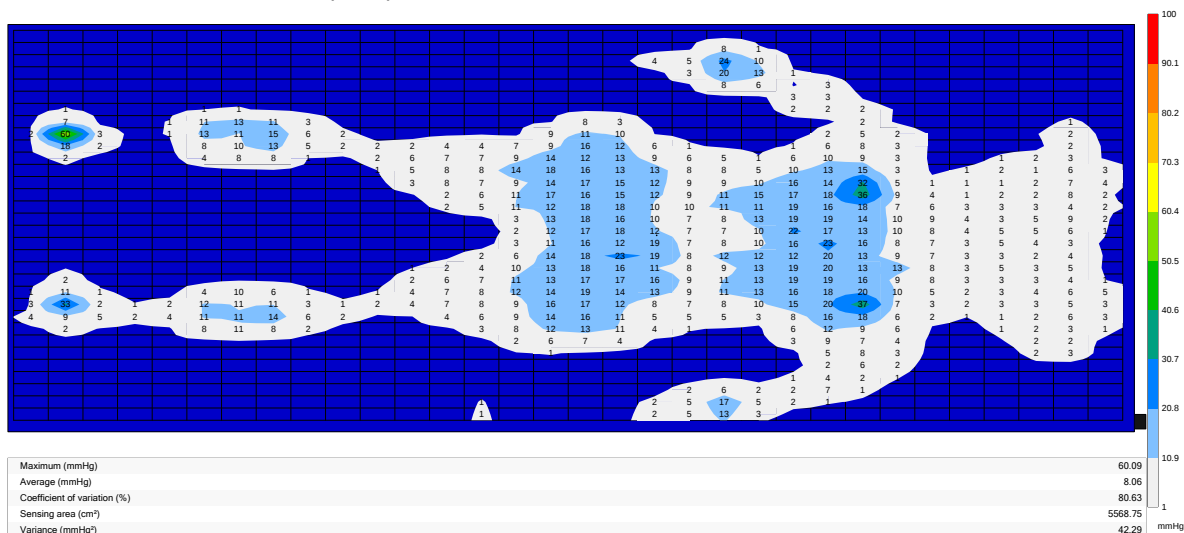
Standard foam mattress - side position



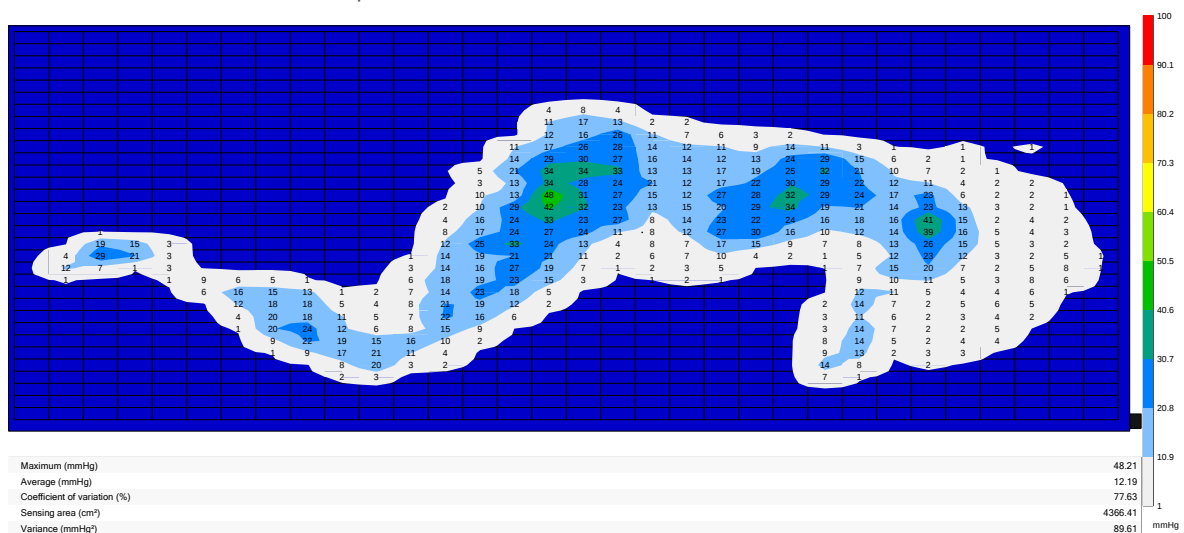
## Immedia TwinSheet4Glide

- TwinSheet4Glide two parted Mattress (polyester/viscose/polyurethane), item no: IM150/75N + IM150/140N
- 4WayGlide NylonSheet with one lock (nylon), item no: IM85/200LPLNS

Standard foam mattress - supine position

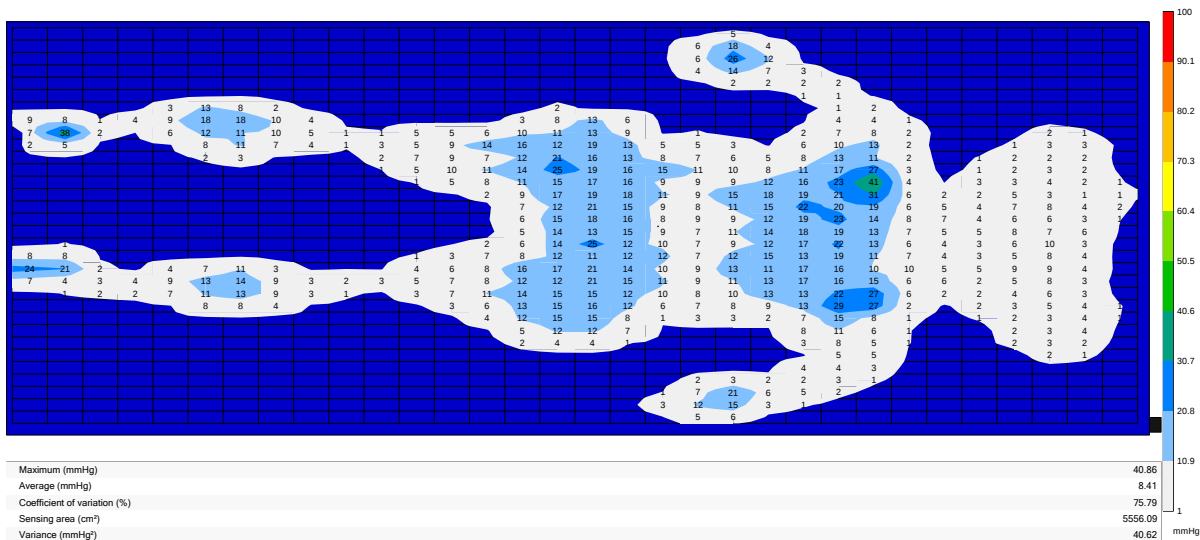


Standard foam mattress - side position

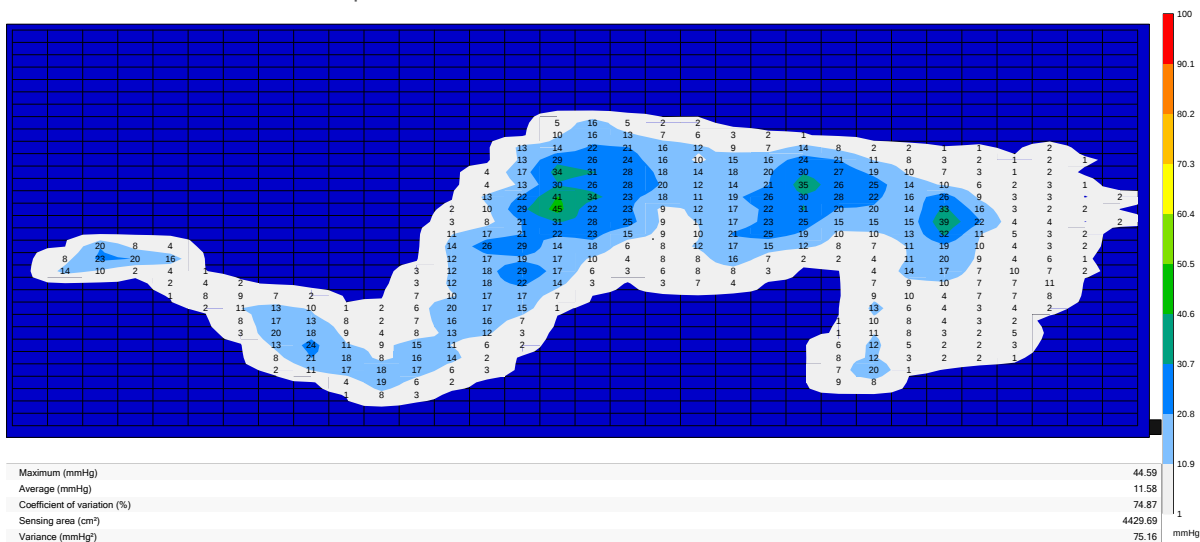


- TwinSheet4Glide two parted Mattress (polyester, viscose, polyurethane), item no: IM150/75N + IM150/140N
- 4WayGlide NylonSheet with three locks (nylon), item no: IM85/2003LPL

Standard foam mattress - supine position

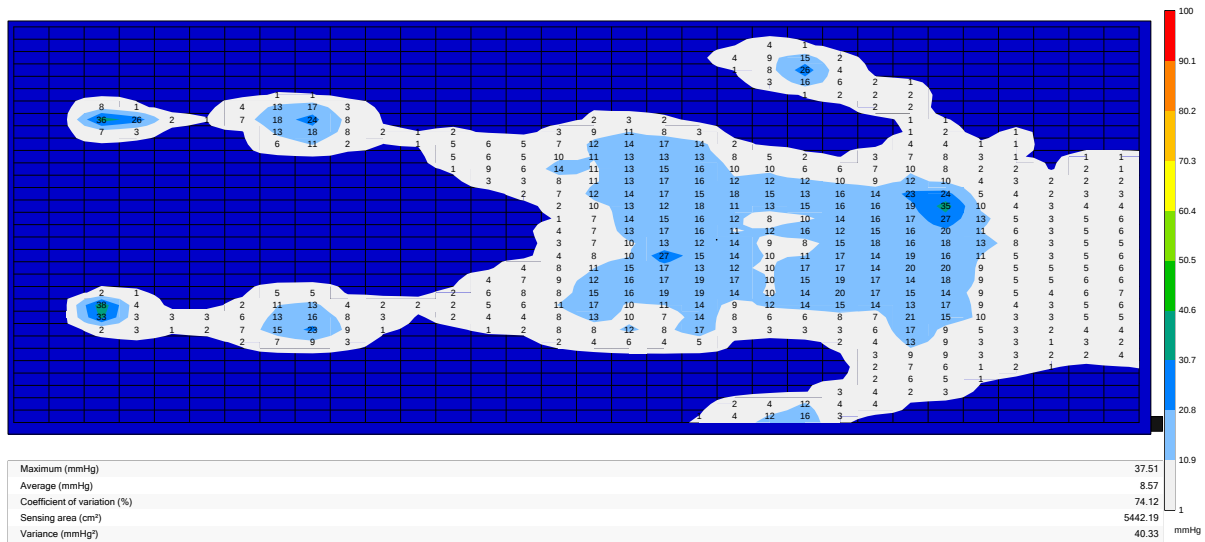


Standard foam mattress - side position

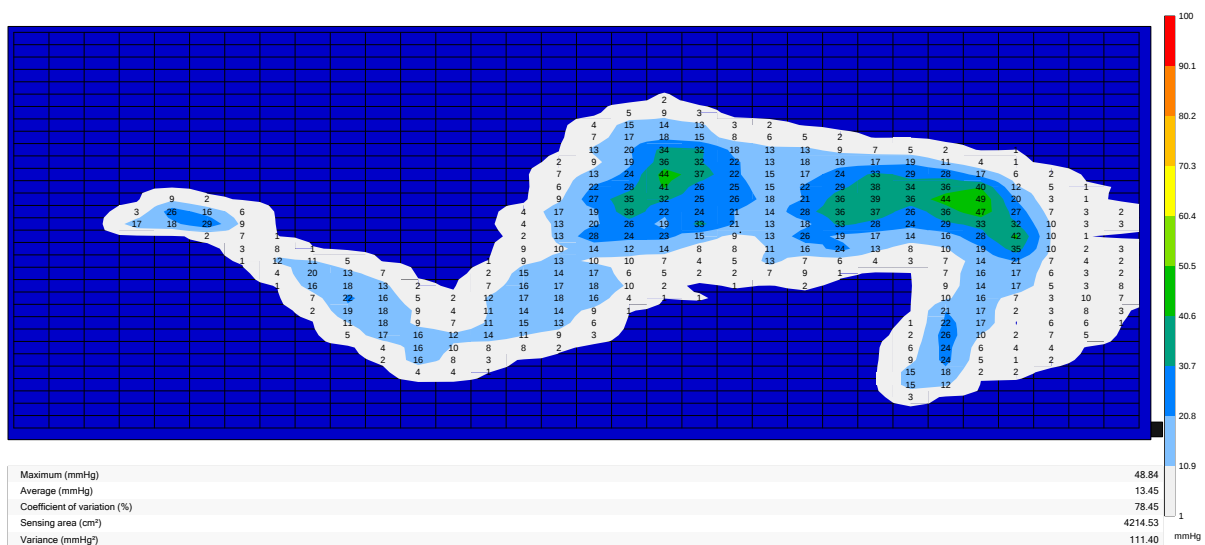


- TwinSheet4Glide full/long Mattress (polyester, viscose, polyurethane), item no: IM150/200N
- 4WayGlide NylonSheet with one lock (nylon), item no: IM85/2003LPL

Standard foam mattress - supine position



Standard foam mattress - side position

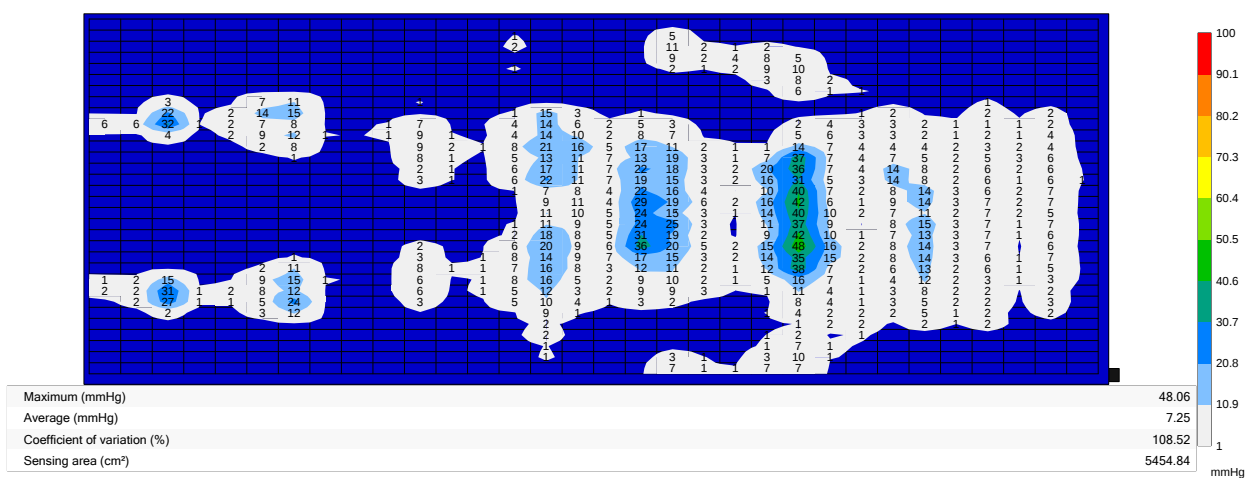


# Air mattress

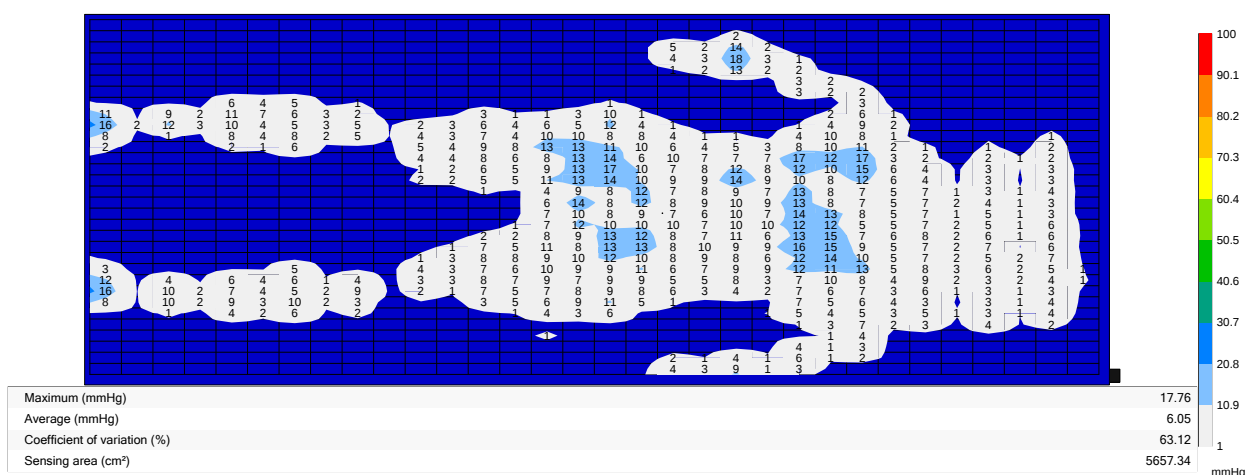
## Air mattress only, no in-bed system

The results from the air mattress are presented with two images in the same position, phase 1 and phase 2. This is because the images were taken during the same cycle, but when the cells of the mattress have different activities.

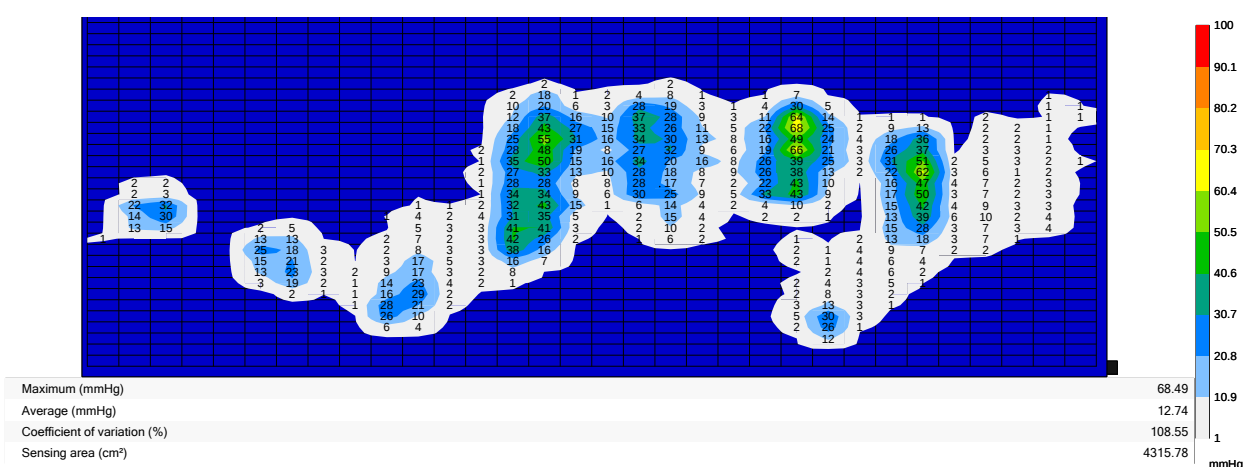
Alternating air mattress - supine position, phase 1



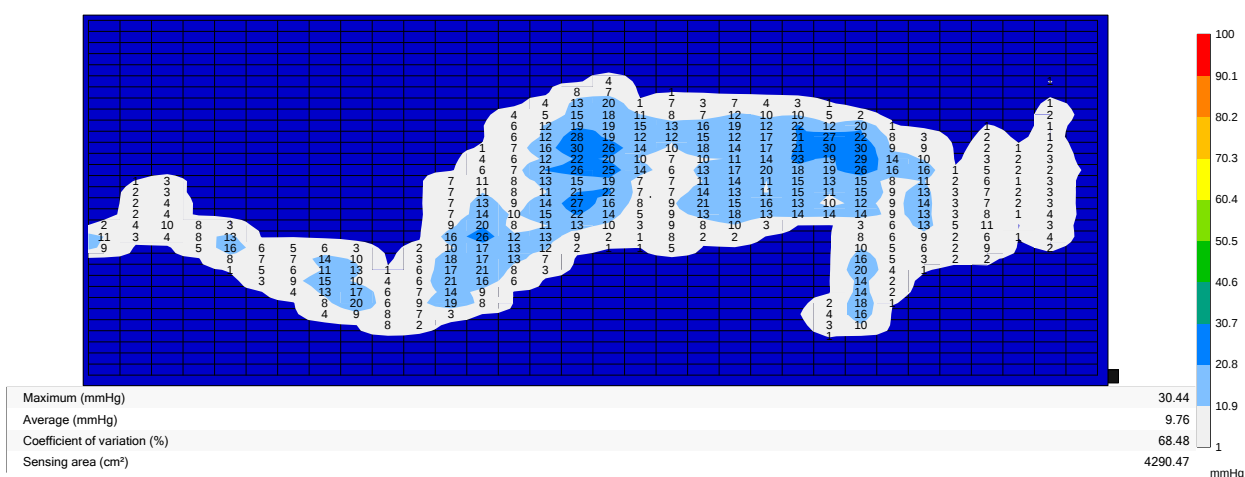
Alternating air mattress - supine position phase 2



Alternating air mattress - side position, phase 1



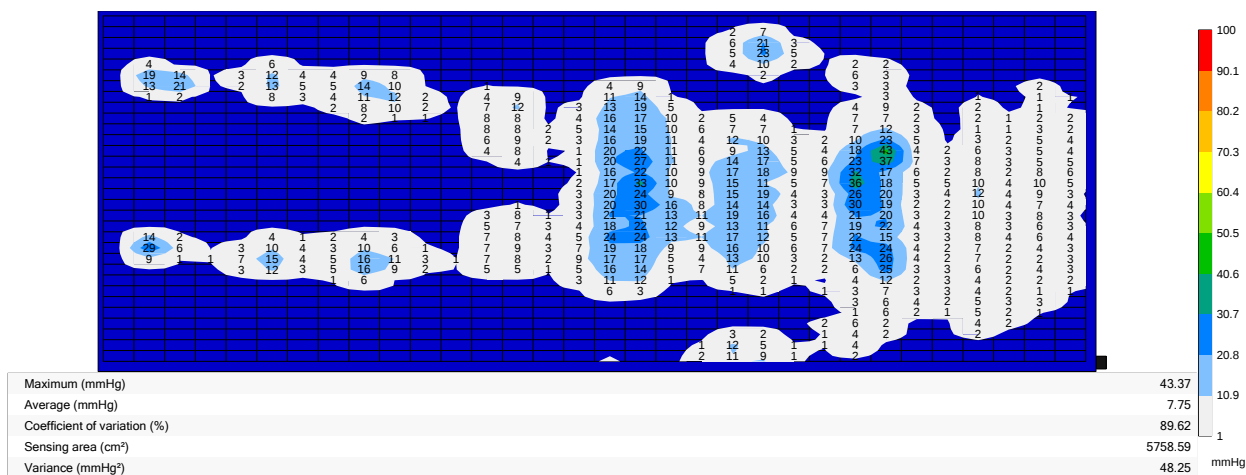
Alternating air mattress - side position, phase 2



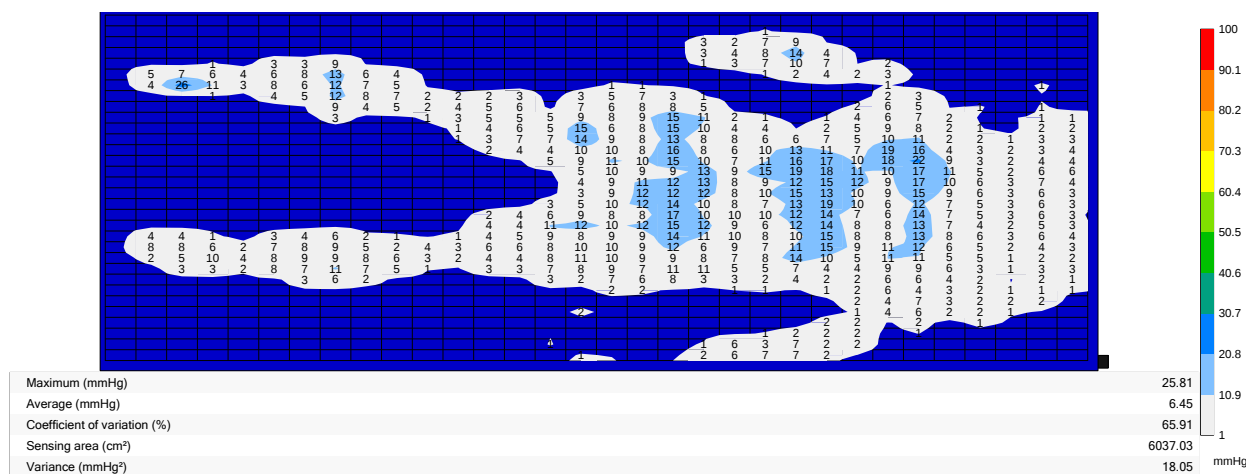
## Immedia 4WayGlide System

- 4WayGlide Mattress (polyester/cotton), item no: IM140/200LPL
- 4WayGlide NylonSheet with one lock (nylon), item no: IM85/200LPLNS

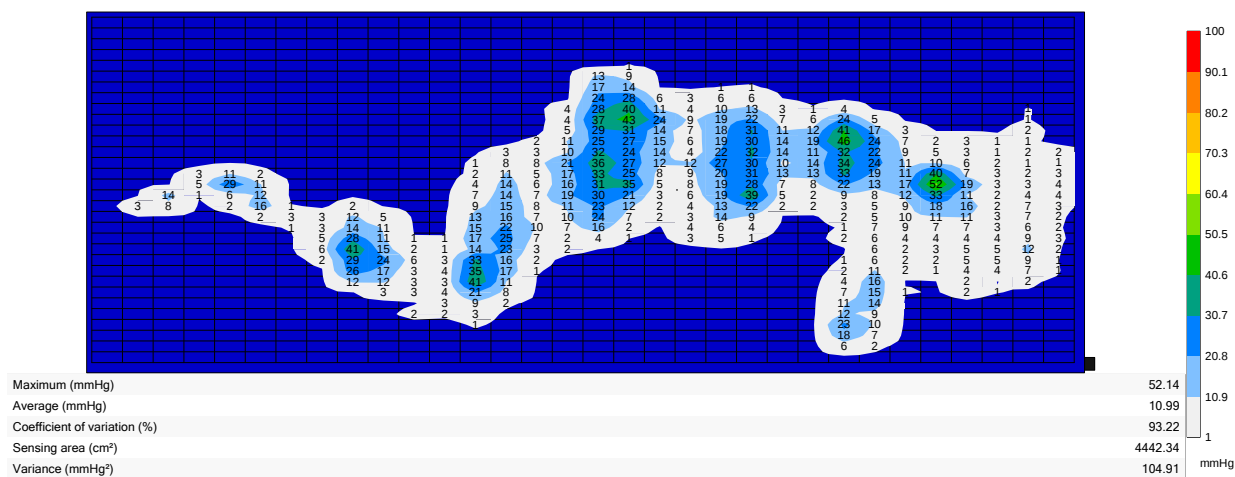
Alternating air mattress - supine position, phase 1



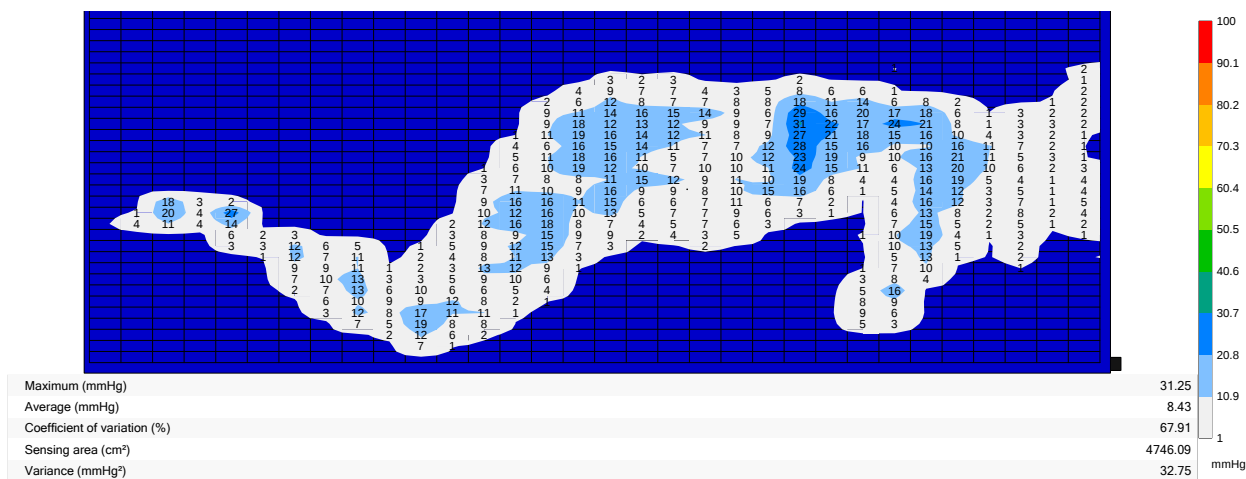
Alternating air mattress - supine position, phase 2



Alternating air mattress - side position, phase 1



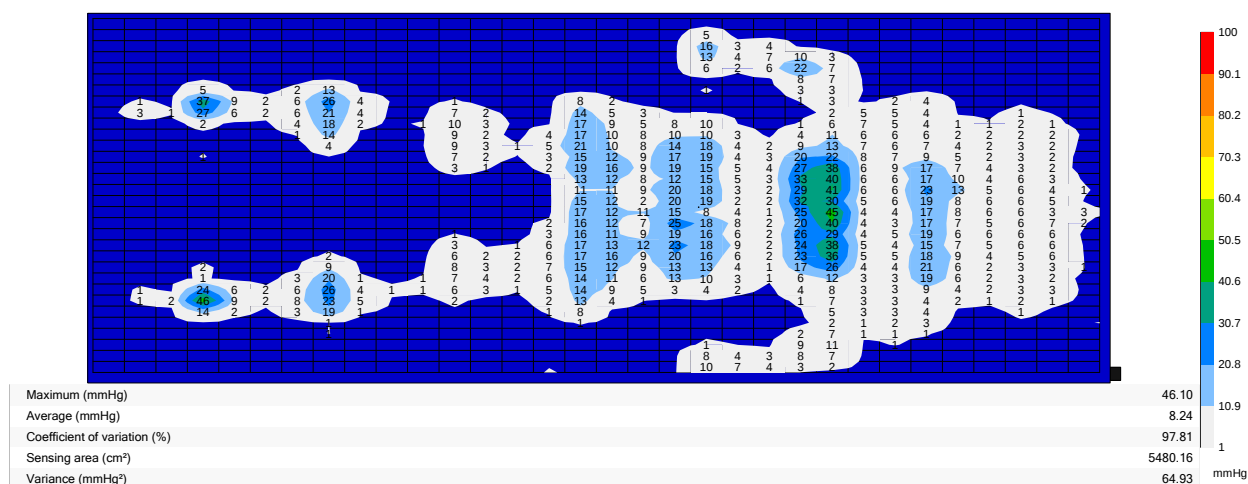
Alternating air mattress - side position, phase 2



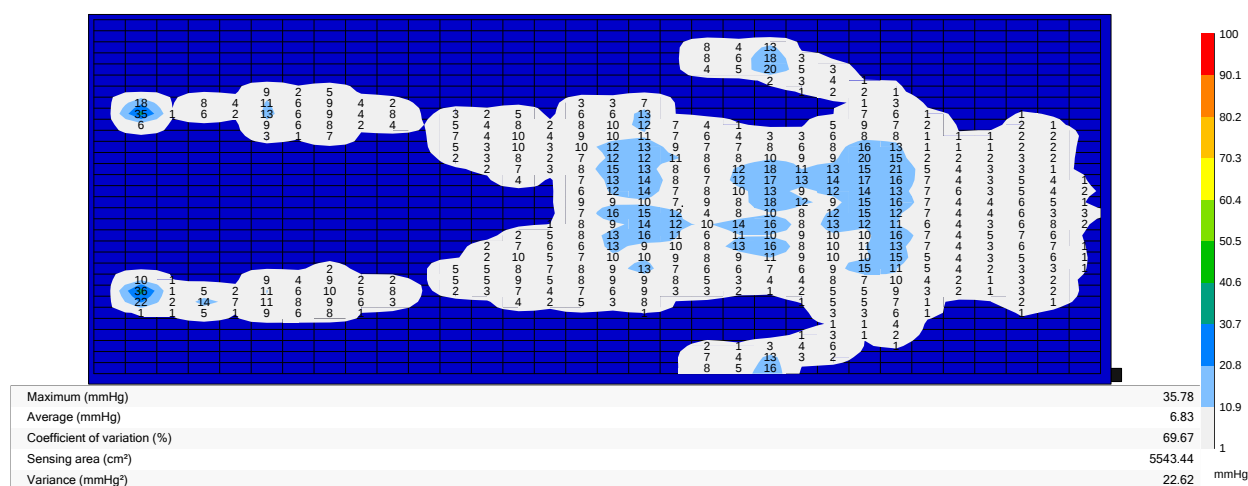
# Immedia TwinSheet4Glide System

- TwinSheet4Glide two parted Mattress (polyester, viscose, polyurethane), item no: IM150/75N + IM150/140N
- 4WayGlide NylonSheet with one lock (nylon), item no; IM85/200LPLNS

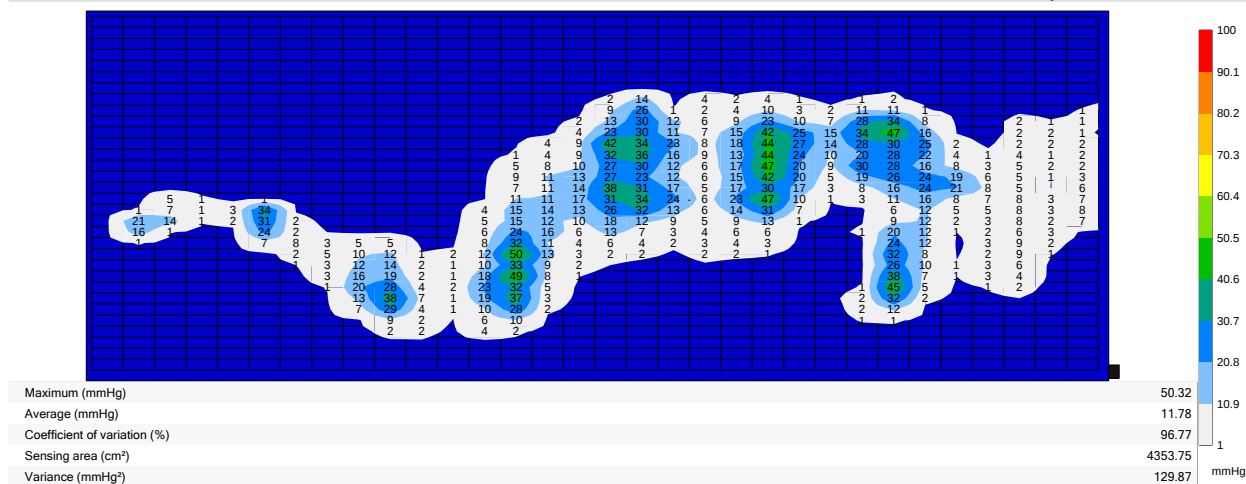
Alternating air mattress - supine position, phase 1



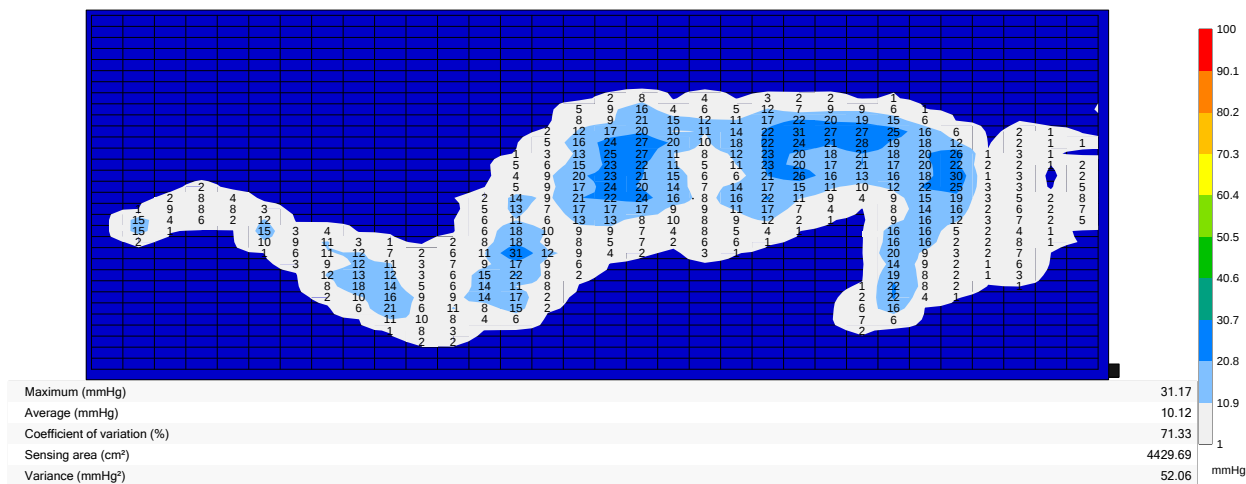
Alternating air mattress - supine position, phase 2



## Alternating air mattress - side position, phase 1



## Alternating air mattress - side position, phase 2

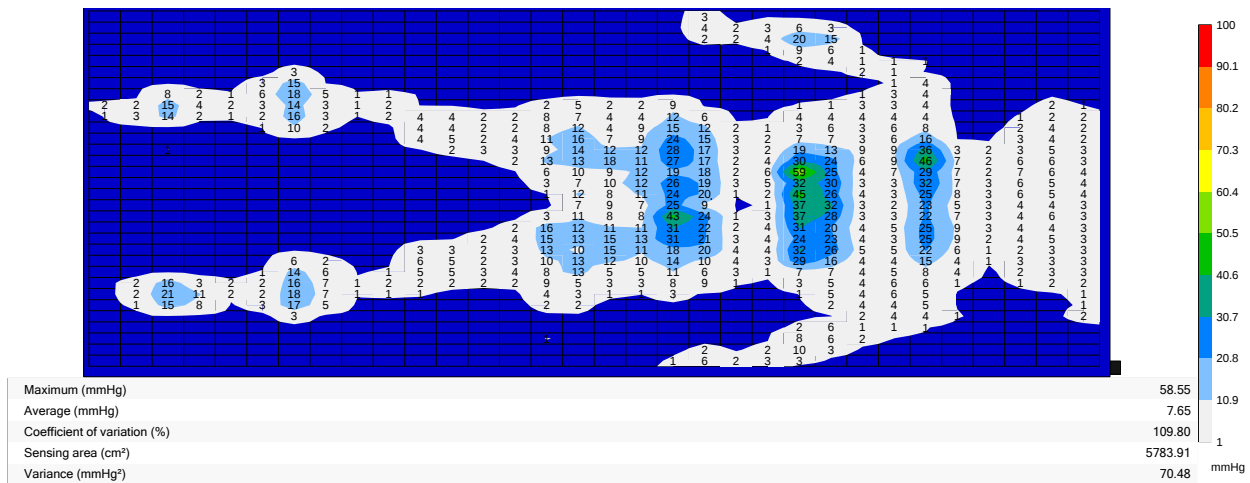


# Immedia SatinSheet System

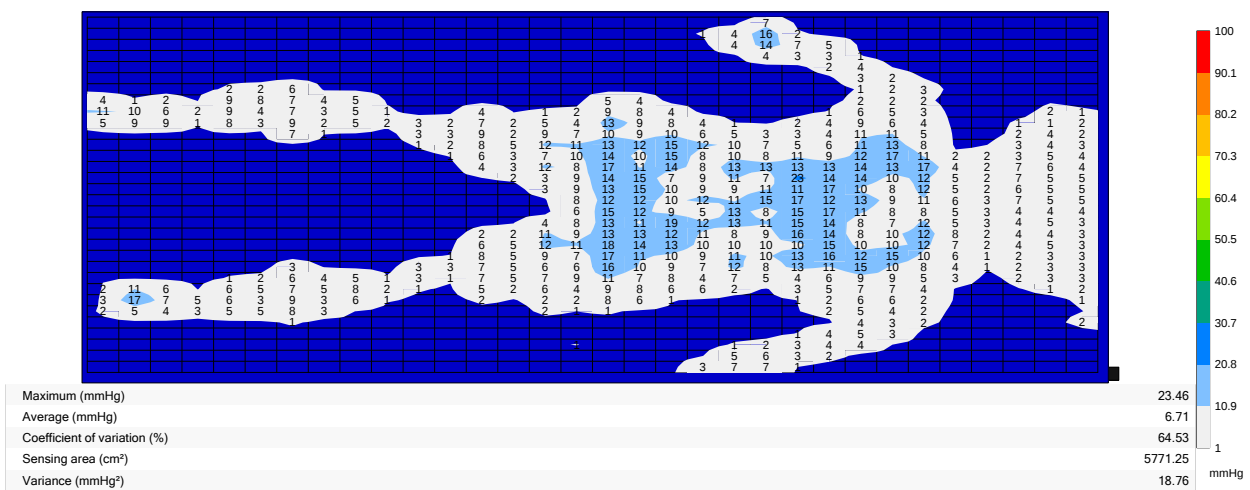
SatinSheet 2Direction Corner (cotton/polyester), item no: IM4107S

SatinSheet DrawSheet Midi, (cotton/polyester), item no: IM4118S

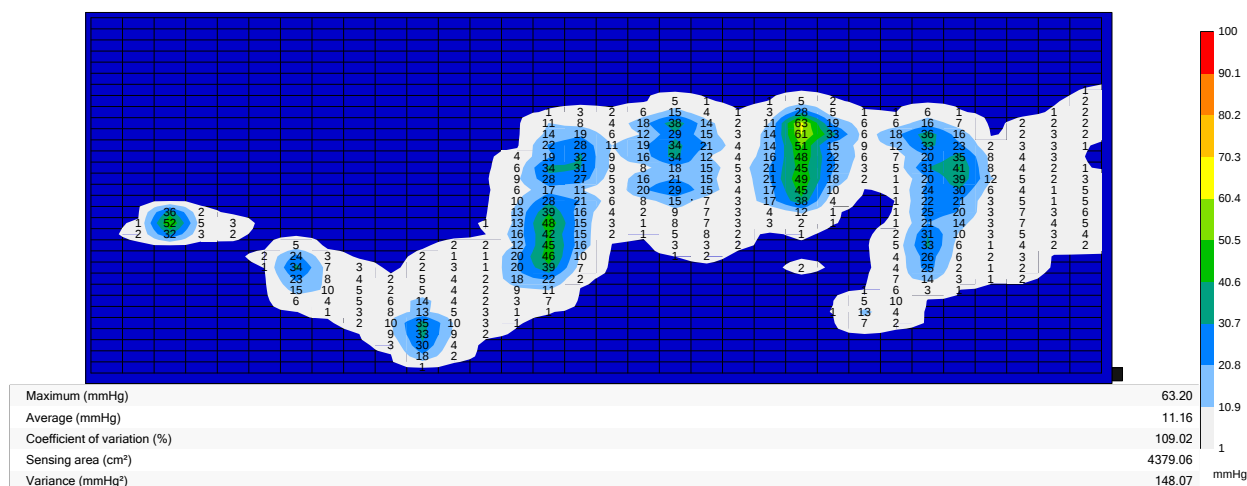
Alternating air mattress - supine position, phase 1



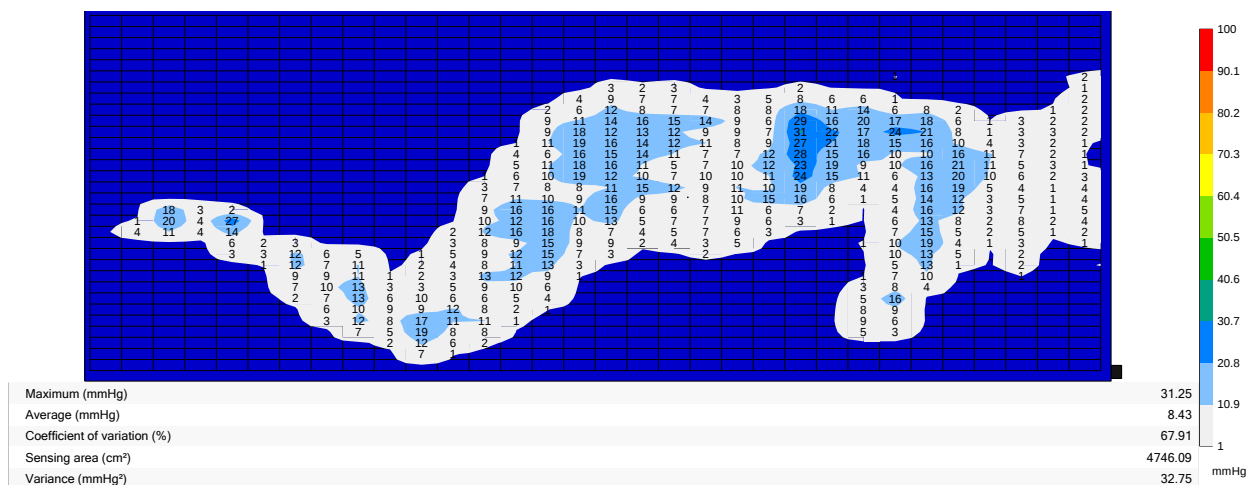
Alternating air mattress - supine position, phase 2



## Alternating air mattress - side position, phase 1

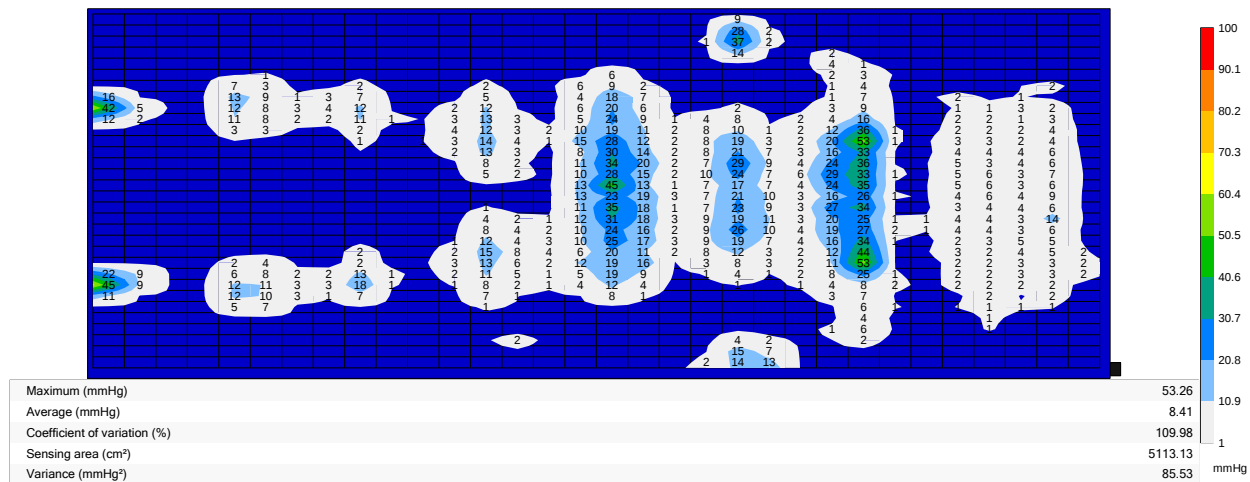


## Alternating air mattress - side position, phase 2

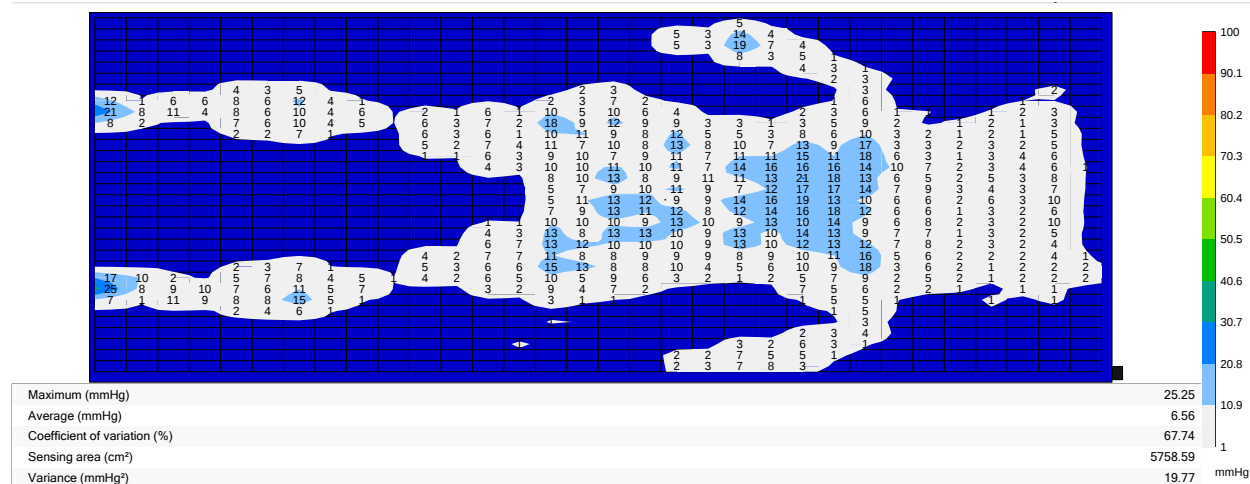


- SatinSheet 2Direction Corner (cotton/polyester), item no: IM4107S
- SatinSheet 4Direction DrawSheet Maxi (cotton/polyester), item no: IM4121S

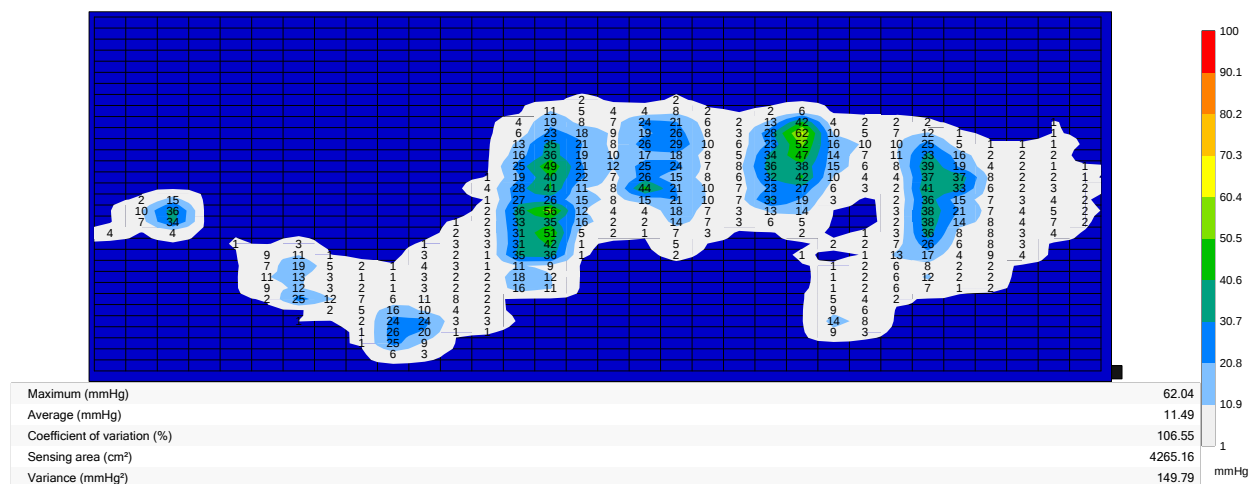
Alternating air mattress - supine position, phase 1



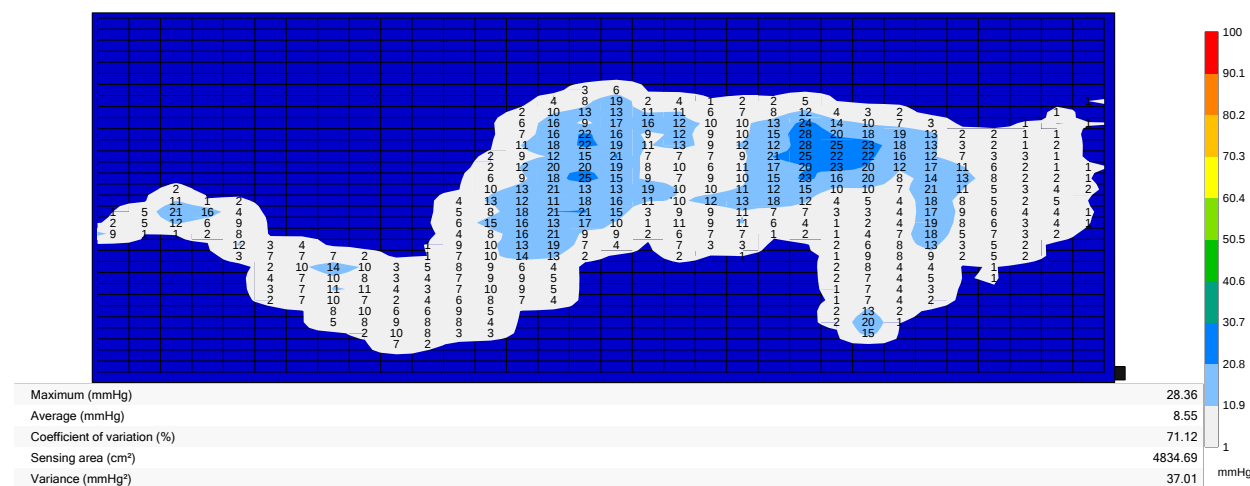
Alternating air mattress - supine position, phase 2



Alternating air mattress - side position, phase 1



Alternating air mattress - side position, phase 2



# General guidelines

## How it works - technical description

The FSA pressure mapping system is based on Piezo Resistive Technology.<sup>4</sup> This means that the resistance changes with applied pressure.

FSA has a proprietary piezo resistive semi conductive polymer sandwiched between two layers of highly conductive rip stop nylon fabric. The floating sandwich allows conformability to the compound curved surfaces of the seating environment as the slippery layers move freely and Minimizes hammocking.

The changes in resistance which result from the different pressures on the semiconductor are interpreted by the Interface module and relayed to the computer where they are displayed as an array of colors and digital pressure values. Corrections are made along the way for hysteresis (direction of loading) and creep (changes with time) and individual sensor variations.

FSA measurement elements:

FSA-pressure measuring carpet consists of a set of product protected pressure sensitive sensors that is Minimally affected by temperature and humidity. Researchers have verified that measure the carpet possesses the following characteristics: reliable, repeatable, durable and accurate. The technical components found in the ultra-thin measuring blankets, incorporated in substance which is 0.36 mm thick. Each sensor unit is 1 "x 1", very thin and consists mainly of three layers of fabric.

Two measurement options:

1. Continuous scanning that provides a real time picture
2. Scanning and recording that provides a real time image and all images are recorded

There are eight display options including combinations of isobars, iso numbers, press center, fencing (3D), statistics and opposite isobars or iso numbers.

The screen displays a range of statistics, including max. pressure, number of active sensors, average pressure, pressure center, variation coefficient and standard deviation.

FSA-pressure measurement system currently used in:

- in rehabilitation clinics and other health care facilities
- research
- manufacturers and suppliers of medical equipment
- sport equestrian

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<sup>4</sup> <http://www.raskov.dk>