# matrx® MAC

Multi-adjustable contour back with HUG cushion insert

## Development and Testing Study

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## Introduction

As the world population continues to age and manage chronic conditions, more and more people find themselves in need of a wheelchair. According to the World Health Organization, around 80 million people across the globe require a wheelchair for mobility1. It is estimated that 1% of Canadians over the age of fifteen (about 250, 000 people) rely on either a manual or a power wheelchair2. In the United States, approximately 4 million people require the use of a wheelchair for mobility[3].

## The Wheelchair – A very special mobility device

For a large number of people, the use of a wheelchair is essential for independent mobility. Wheelchairs offer users the freedom and mobility to get from point A to point B when walking isn't possible. When prescribed correctly, wheelchairs provide additional safety by reducing the risk of falling. When a seat cushion and back support are properly matched to the users' clinical needs, a wheelchair can also provide postural support and improve the performance of day-to-day activities. Many users describe their wheelchair as an extension of their bodies and want their device to be 'fitted like a glove'. For caregivers, a wheelchair becomes an important 'helper' to assist with the provision of personal care. Some wheelchairs offer tilt or a combination of tilt and recline, which allow body repositioning for pressure distribution, rest, as well as immediate postural assistance in an emergency. Some users also nap in their tilt wheelchairs[4].

## Comfort and Maintenance

When a person spends a long portion of the day in a wheelchair, comfort matters. Wheelchair seating components are frequently recommended to enhance pressure distribution and provide postural support. In addition to comfort, wheelchair seating should also be durable, and easy to care for and maintain. Historically, the design of back supports, seat cushions, and headrests have incorporated the use of foams, fluids, air and polymers. Various industry tests demonstrate how each of these design concepts compare in terms of immersion, pressure distribution, envelopment, and durability*. These are the product qualities most important to prescribing clinicians. However, a wheelchair user (usually not a healthcare practitioner) is typically more concerned with the practical side of owning a wheelchair, and cares more about overall comfort and daily maintenance. Their questions often include, how easy will it be to clean the seat cushion when it gets soiled, will their wheelchair be helpful in accomplishing daily tasks, and will their wheelchair make it easier to move around the home4. Wheelchair users also like to try different seating products and typically make their selection based on the 'feel'.

## Innovation

Innovation never stops. For decades, new innovative materials have emerged from other industries, and quickly become integrated into all aspects of the wheelchair industry, from the frame design to the seating components. New environmentally safe fibers and materials that offer comfort, longevity, and easy maintenance continue to find their way into the wheelchair industry.

*ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies which includes Wheelchairs workgroups 1 (Test methods) and 11 (Wheelchair seating) under the Sub-committee ISO/TC 173/SC1. In North America, RESNA (Rehabilitation Engineering and Assistive Technology Society) is the organization

**StaminaFibre®** is a new synthetic filler material that has the feel of a natural down, yet is machine-washable, flame-resistant, and hypoallergenic. We tested and trialed StaminaFibre®-filled inserts as a foam alternative for a rigid contoured back that may be used in tilt chairs. The result – an amazingly comfortable surface, described as 'hugging', and 'pillow soft' by those who tried it. Hence, we call it the Hug Pad.

## New Product

The Matrx® TR back was designed over a decade ago for tilt/recline applications and has been reliably used in manual and power chairs ever since. The Dual Layer high resilience foam of the TR backs has become very popular since entering the market. It is a dependable medium offering excellent pressure distribution without the risk of bottoming out, even if a person stays in a tilted or reclined position for extended periods of time.

The **Matrx® MAC Back** development began when clinicians asked for taller back options and adjustable lateral supports. It was designed to offer a choice of either Dual Layer foam or the new **HUG StaminaFibre®** insert. The HUG insert design provides enhanced softness and comfort for sensitive users, those with asymmetrical fixed postures, or presenting with higher pressure risks.

MAC Back – HUG StaminaFibre® Model

MAC Back – Dual Layer Foam Model

MAC Back – Asymmetrical Contour

MAC Back – Height and Width Adjustable Laterals

## Product Testing

RESNA's WC-3 and ISO 16840 series of standards are concerned with wheelchair seating. Currently, testing standards exist for physical and mechanical characteristics of cushions and backs, static, repeated and impact load strengths, simulated aging, ignition, lateral stability, and envelopment. It is up to manufacturers to determine which test is relevant to the product in question. The Matrx® MAC back was subjected to static, impact, and repeated load testing, ignition, and crash testing.

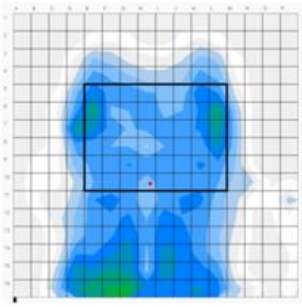
Since we found no test that would allow us to look specifically at the performance of the new StaminaFibre®, Motion Concepts' team turned to interviews with clinicians and wheelchair users to inform development of the testing protocols for the Hug Pad. We also made prototypes of the MAC Back with Hug insert and introduced it to clinicians in Canada and the United States. The questions and concerns we heard guided our focus for testing. Clinicians asked if Stamina fibers collapse or migrate over time, if the StaminaFibre® would bottom-out if a patient was left in tilt. They also asked if laundry and different methods of drying the pad would affect pressure distribution over time. Hence, it was decided that the MAC back with Hug insert would be pressure mapped with at least 10 people in a tilted position, repeatedly laundry-washed, and then tested again.

## STAGE 1

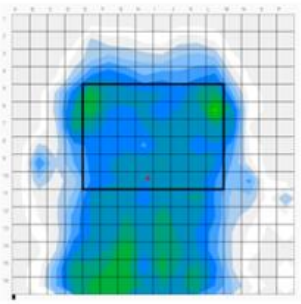
The baseline pressure mapping protocol was completed using the same wheelchair and MAC Back 1822 set up for all the subjects. The position of the headrest was adjusted for comfort. Ten tallest able-bodied people were chosen. Measurements of surface area (in2), peak pressures (mmHg), peak pressure index (mmHg), and subjective level of comfort (1-10 scale) were done with every subject on both the Dual Layer foam and the Hug insert at 3 min and also after 20 min in 45-degree tilt.

*Test participant #1 in a tilted wheelchair, Mac Back*

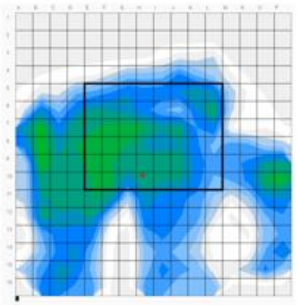
### PRESSURE MAPPING



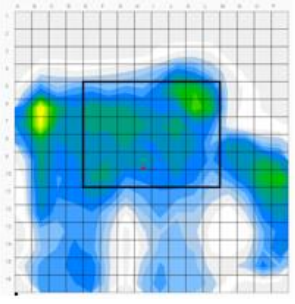
Hug (3min)



Hug (20min)



Dual Layer Foam (3min)



Dual Layer Foam (20min)

## STAGE 2

The MAC Back was tested following RESNA/ISO methods for repetitive, static, and impact loads. Additionally, the Hug insert was tested separately for repetitive load during which it was loaded 17,500 times with 160 lb to simulate 2-year use.


## STAGE 3

The same Hug test sample went through 5 laundry machine cycles and machine drying cycles, both on warm settings, with other clothing and bedding items.

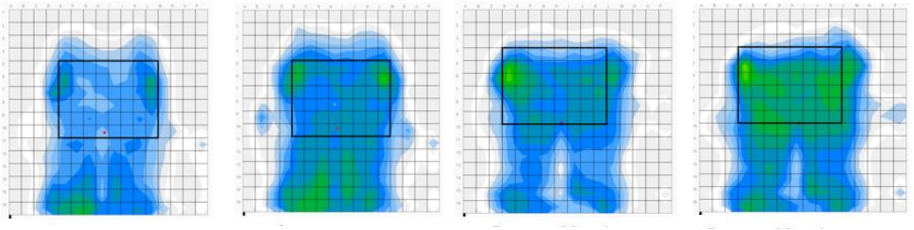
***Recommended:***
*Machine wash warm setting*


*Tumble dry low heat*

## STAGE 4

The Hug test sample was returned for final pressure mapping using the same protocol as the one followed during the baseline testing, with the same 10 people.

BASELINE PRESSURE MAPPING



Hug (3min) | Hug (20min) | Post-wash Hug (3min) | Post-wash Hug (20min)

Data gathered during pressure mapping of the post-washed Hug insert was compared to the baseline pressure mapping data for both the Hug insert and the Dual Layer foam. Quantitative as well as visual map comparisons revealed remarkable pressure distribution performance of the Mac Back with both Dual Layer and Hug inserts.

## Our findings – Product Performance

As a manufacturer of Seating and Positioning equipment, we approach the question of product performance diligently. Understanding that StaminaFibre® has not been introduced in wheelchair seating products before, we developed additional testing protocols that included human subjects and the scenario of laundering the product for hygienic purposes.

During the course of testing, we were impressed with the product performance. In terms of pressure mapping, the Hug insert demonstrated low pressure values and greater contact area compared to the Dual Layer foam. After Hug laundering, pressure mapping indicated even larger surface contact area and lower peak pressure values. The Hug StaminaFibre® also demonstrated superior pressure distribution performance in tilt compared to the Dual Layer foam.

We selected a heavier and taller client population for the testing with a tilt angle of 45° to test product performance with the highest loads. Pressures were measured after continuous 3 minutes and also after 20 minutes in the wheelchair. We re-mapped the same Hug insert sample with the same people after it was subjected to the ISO/RESNA repetitive load testing and repetitive washing and drying. Interestingly, the performance of the Mac Hug back has improved: we saw better contact area numbers, peak pressures, and peak pressure index values after the washes. The level of testing completed is above and beyond the industry's minimum expectations.

## Results

### PEAK PRESSURES

Peak pressure is the highest value of the pressures recorded by the sensor units in the mat. For the purposes of the experiment, maximum peak pressure values for left and right scapulas as well as left and right PSIS were recorded over a 30-sec interval and compared later.

Compared to the Dual Layer foam, the Hug insert demonstrated 7.2 mmHg lower peak value average for pressure points initially and 12.6 mmHg lower peaks after 20 min in tilt.

**PPI** (Peak Pressure Index)

PPI is the pressure average value calculated within a 10 cm2 area of the highest recorded pressure values. In our study, the pressure mat's sensel window was positioned around the scapula area. Lower peak values and lower gradients from peak to adjacent sensors indicate better envelopment of the bony prominences.

Compared to the Dual Layer foam, the Hug insert demonstrated lower PPIs (peak pressure index)

### CONTACT AREA

Contact area is the area of the cushion in contact with the person and under load. If a specified load is distributed over a larger area, pressure at a given unit of area would be lower. The larger the contact area, the lower is the pressure. Usually, clinicians strive to select seating that would maximize clients' surface contact.

Compared to the Dual Layer foam, the Hug insert demonstrated better initial contact area and comparable immersion after 20 min in tilt

### LEVEL OF COMFORT

Subjective level of comfort ranged between 7 and 10 for the Dual Layer foam, and between 8 and 10 for the Hug insert (1-10 scale). Half of the group found both the Dual Layer foam and the Hug insert equally comfortable. The other half gave the Hug insert a higher satisfaction score.

## Discussion – pressure mapping

Pressure mapping is a valuable comparative assessment tool that can help determine individual product suitability. To date, researchers agree that it is impossible to establish criteria of safety or a cut-off value to consider the product safe or unsafe using pressure mapping in isolation5. From a clinical point of view, wheelchair seating is one of multiple factors affecting skin condition. Proper nutrition, health status, activities of daily living, methods and frequencies of pressure relief, ways of transferring to and from the wheelchair, mobility level, seating cushion, and the wheelchair system set up all contribute to the condition of soft tissues6.

Nonetheless, pressure mapping can add value when a clinician decides between two or more products. When proper calibration, set up, and evaluation protocols are followed, pressure mapping can be an excellent tool for providing an immediate understanding of postural tendencies, pressure points, and the ways a seating surface reacts to a person's loading7. Pressure mapping may also be used when intervention involves making changes or customizations to the wheelchair seating. We used pressure mapping to compare the Hug insert to the Dual Layer foam which had already established itself as a safe interface based on years of data. Appendix A shows data on peak pressures, peak index, and contact area for both Dual Layer foam and Hug insert at 3 min and after 20 min in tilt. Seeing better surface area and lower peak pressure values with Hug insert is very promising. The Hug insert can be safely used as an alternative to the Dual Layer foam for use in tilt wheelchairs.

When selecting a back support model for an individual, it is beneficial to consider the peak pressure values in the areas of concern, aim for the overall wider contact area, and ensure that person is comfortable. Appendix B offers a comparison of contact area, PPI, and level of comfort for each subject of the study. Appendix C offers data for specific pressure points. However, while a review of absolute values may provide information on one or another parameter of interest, it is important to have a holistic approach and consider all the individual's lifestyle and health-related factors. Clinical judgement of a knowledgeable and experienced seating professional is critical in the selection of the product for the client.

## Conclusion

The Matrx® MAC Back is a product that offers the option of Dual Layer foam or Hug (StaminaFibre® insert). Both models demonstrated very effective pressure distribution. The Dual Layer foam is a tried-and-true interface material that has historically demonstrated superior immersion and greater surface contact area compared to a standard single-layer slab foam. Dual Layer foam is often preferred by people with symmetrical or mildly asymmetrical postures. In our experiment, participants found both Dual Layer foam and Hug insert very comfortable.

The new Hug insert featuring StaminaFibre® offers the softest interface and may be beneficial for the most sensitive users. The Hug insert demonstrated a consistently lower peak pressure values even after repetitive load testing and 5 laundry washes. The highly immersive MAC Back with Hug insert may be

chosen for people with asymmetrical postures and in need of soft padding for pressure points. It is a great option for people looking for a more conforming material with the softness of a pillow. Ease of cleaning and maintenance of the Hug insert offers an attractive and comfortable alternative to the foam interface.

## Summary

The Matrx® MAC back support is offered in standard back lengths from 16 to 22 inches, and custom length of 24 inches to ensure taller individuals have access to a suitable back size. The height-adjustable laterals with a possibility of mixing depths (3 choices) offers an opportunity to customize support for individual needs.

The Matrx® MAC back with Hug insert offers an alternative to the Dual Layer foam, providing the highest level of comfort for sensitive users. The pressure mapping experiments demonstrated superior immersion and pressure distribution of the Hug insert. In addition, the StaminaFibre® provides self-redistribution and envelopment properties historically seen only with fluids and air. Offered as an interface for rigid contoured backs, the Hug insert has the potential to enhance comfort for people with pressure points and exaggerated spinal curves.

# Appendix A

**Peak pressures**

Compared to the Dual Layer foam, Hug insert demonstrated on average:

- 7.2 mmHg lower peak values for pressure points initially
- 12.6 mmHg lower peak values after 20 min in tilt

| Peak pressures | Initial peaks Hug | Initial peaks Dual Density | 20-min peaks Hug | 20-min peaks Dual Density |
|---|---|---|---|---|
| Rt Scapula Hug 3 min | 79.9 | | | |
| Rt Scapula Hug 20 min | | | 91.3 | |
| Rt Scapula Dual Density 3 min | | 94.2 | | |
| Rt Scapula Dual Density 20 min | | | | 111.4 |
| Rt PSIS Hug 3 min | 83.3 | | | |
| Rt PSIS Hug 20 min | | | 95.8 | |
| Rt PSIS Dual Density 3 min | | 85 | | |
| Rt PSIS Dual Density 20 min | | | | 105.6 |
| Lt Scapula Hug 3 min | 77.6 | | | |
| Lt Scapula Hug 20 min | | | 82.3 | |
| Lt Scapula Dual Density 3 min | | 86.9 | | |
| Lt Scapula Dual Density 20 min | | | | 104.3 |
| Left PSIS Hug 3 min | 61.7 | | | |
| Left PSIS Hug 20 min | | | 78.7 | |
| Left PSIS Dual Density 3 min | | 65.3 | | |
| Left PSIS Dual Density 20 min | | | | 77 |
| | **75.6** | **82.9** | **87** | **99.6** |
| | | 7.2 | | 12.6 |

**Pressure Index**

Compared to the Dual Layer foam, Hug insert demonstrated on average:

- Lower PPI (peak pressure index) initially and after 20 min in tilt
- Better PPI values for the Hug sample subjected to 5 laundry and drying cycles for 9 out of 10 participants

| | Hug Insert - PPI sensel window (3 min) | Dual Layer - PPI sensel window (3min) | Hug Insert- PPI sensel window (20 min) | Dual Layer - PPI sensel window (20min) | Post-wash Hug PPI sensel window (20min) | PPI Difference b/w Post-wash Hug and Dual Layer (20 min) |
|---|---|---|---|---|---|---|
| Subject# 1 | 52 | 87 | 86 | 103 | 93.0 | -10.0 |
| Subject# 2 | 113 | 110 | 121 | 133 | 89.0 | -44.0 |
| Subject# 3 | 90 | 86 | 100 | 122 | 109.0 | -13.0 |
| Subject# 4 | 63 | 84 | 86 | 95 | 84.0 | -11.0 |
| Subject# 5 | 69 | 102 | 80 | 120 | 83.0 | -37.0 |
| Subject# 6 | 80 | 75 | 81 | 92 | 73.0 | -19.0 |
| Subject# 7 | 69 | 87 | 91 | 86 | 118.0 | 32.0 |
| Subject# 8 | 63 | 80 | 86 | 92 | 84.0 | -8.0 |
| Subject# 9 | 56 | 71 | 90 | 79 | 77.0 | -2.0 |
| Subject# 10 | 62 | 74 | 74 | 86 | 84.0 | -2.0 |
| **Average** | **71.7** | **85.6** | **89.5** | **100.8** | **89.4** | **-11.4** |
| | | 13.9 | | 11.3 | | |

**Contact Area**

Although both Dual Layer foam and Hug insert showed great contact area values, Hug insert demonstrated larger surface contact area at 3 min and 20 min time marks in 45-degree tilt

| | Baseline Hug surface contact area ($in^2$) 3 min | Baseline Hug surface contact area ($in^2$) 20 min | Dual Hug surface contact area ($in^2$) 3 min | Dual Hug surface contact area ($in^2$) 20 min |
|---|---|---|---|---|
| Subject# 1 | 269 | 282 | 258 | 258 |
| Subject# 2 | 267 | 282 | 280 | 300 |
| Subject# 3 | 292 | 308 | 271 | 293 |
| Subject# 4 | 186 | 203 | 174 | 191 |
| Subject# 5 | 199 | 215 | 190 | 211 |
| Subject# 6 | 234 | 250 | 238 | 243 |
| Subject# 7 | 187 | 197 | 177 | 183 |
| Subject# 8 | 206 | 218 | 190 | 202 |
| Subject# 9 | 214 | 230 | 189 | 209 |
| Subject# 10 | 179 | 186 | 186 | 202 |
| | **223.3** | **237.1** | **215.3** | **229.2** |

After the five washing and drying cycles, Hug Insert still demonstrated superior immersion.

| | Person's weight (lb) | Baseline Hug surface contact area ($in^2$) 3 min | Baseline Hug surface contact area ($in^2$) 20 min | Dual Hug surface contact area ($in^2$) 3 min | Dual Hug surface contact area ($in^2$) 20 min | Post-wash 20 min Hug surface area |
|---|---|---|---|---|---|---|
| Subject# 1 | 239 | 269 | 282 | 258 | 258 | 247 |
| Subject# 2 | 232 | 267 | 282 | 280 | 300 | 265 |
| Subject# 3 | 278 | 292 | 308 | 271 | 293 | 308 |
| Subject# 4 | 159 | 186 | 203 | 174 | 191 | 189 |
| Subject# 5 | 196 | 199 | 215 | 190 | 211 | 225 |
| Subject# 6 | 205 | 234 | 250 | 238 | 243 | 265 |
| Subject# 7 | 180 | 187 | 197 | 177 | 183 | 210 |
| Subject# 8 | 149 | 206 | 218 | 190 | 202 | 238 |
| Subject# 9 | 164 | 214 | 230 | 189 | 209 | 213 |
| Subject# 10 | 181 | 179 | 186 | 186 | 202 | 237 |
| | | **223.3** | **237.1** | **215.3** | **229.2** | **239.7** |

# Appendix B

## Comparison of surface contact area, peak pressure index, and level of comfort

### Compare immersion (surface contact area)

- For 7 people, Hug offered better surface contact, even after the washing and repetitive loading tests

| | Baseline Hug surface contact area ($in^2$) 3 min | Post-wash Hug surface contact area ($in^2$) min | Dual Layer surface contact area ($in^2$) 3 min | Hug surface contact area ($in^2$) 20 min | Post-wash Hug surface area ($in^2$) 20 min | Dual Layer surface contact area ($in^2$) 20 min |
|---|---|---|---|---|---|---|
| Subject# 1 | 269 | 239 | 258 | 282 | 247 | 258 |
| Subject# 2 | 267 | 234 | 280 | 282 | 265 | 300 |
| Subject# 3 | 292 | 285 | 271 | 308 | 308 | 293 |
| Subject# 4 | 186 | 177 | 174 | 203 | 189 | 191 |
| Subject# 5 | 199 | 195 | 190 | 215 | 225 | 211 |
| Subject# 6 | 234 | 238 | 238 | 250 | 265 | 243 |
| Subject# 7 | 187 | 183 | 177 | 197 | 210 | 183 |
| Subject# 8 | 206 | 201 | 190 | 218 | 238 | 202 |
| Subject# 9 | 214 | 209 | 189 | 230 | 213 | 209 |
| Subject# 10 | 179 | 206 | 186 | 186 | 237 | 202 |
| | **223.3** | **216.7** | **215.3** | **237.1** | **239.7** | **229.2** |

### Compare peak pressure index

- For 8 people, results of pressure mapping on new sample of Hug insert demonstrated lower PPI values at 3 min compared to the results with Dual Layer foam
- Even after the washing cycles, PPI values were better (lower) for 9 people on Hug insert compared to dual density foam after 20-min in tilt

| | Hug - PPI sensel window 3min | Dual Layer - PPI sensel window 3min | Post-wash Hug - PPI sensel window 3min | Diff b/w new and Post-wash Hug 3min | Dual Layer - PPI sensel window 20min | Post-wash Hug - PPI sensel window 20min | Diff b/w new and Post-wash Hug 20min |
|---|---|---|---|---|---|---|---|
| | 52 | 87 | 95 | 43 | 103 | 93 | 7 |
| | 113 | 110 | 54 | -59 | 133 | 89 | -32 |
| | 90 | 86 | 82 | -8 | 122 | 109 | 9 |
| | 63 | 84 | 80 | 17 | 95 | 84 | -2 |
| | 69 | 102 | 42 | -27 | 120 | 83 | 3 |
| | 80 | 75 | 61 | -19 | 92 | 73 | -8 |
| | 69 | 87 | 74 | 5 | 86 | 118 | 27 |
| | 63 | 80 | 68 | 5 | 92 | 84 | -2 |
| | 56 | 71 | 79 | 23 | 79 | 77 | -13 |
| | 62 | 74 | 63 | 1 | 86 | 84 | 10 |
| **PPI AVE** | **71.7** | **85.6** | **69.8** | **-1.9** | **100.8** | **89.4** | **-0.1** |
| **Diff after immersion** | | | | | **15.2** | **19.6** | |

**Level of comfort**

- Half of the group found both the Dual Layer foam and the Hug insert equally comfortable.
- Four out of 10 people gave the Hug insert a higher score, even on sample that was tested and washed.

| | Subjective level of comfort (1-10 scale) | | Subjective level of comfort (1-10 scale) | | Subjective level of comfort (1-10 scale) | |
|---|---|---|---|---|---|---|
| | **Baseline 3mm Hug** | **Baseline 20mm Hug** | **Post-wash 3mm Hug** | **Post-wash 20mm Hug** | **3min Dual Layer** | **20 min Dual Layer** |
| Subject# 1 | 9 | 10 | 10 | 10 | 9 | 9 |
| Subject# 2 | 10 | 10 | 8.5 | 9 | 10 | 10 |
| Subject# 3 | 8.5 | 8.5 | 9 | 8.5 | 8.5 | 8.5 |
| Subject# 4 | 9 | 10 | 10 | 10 | 10 | 8 |
| Subject# 5 | 10 | 10 | 9 | 10 | 7 | 7 |
| Subject# 6 | 10 | 10 | 9 | 9 | 10 | 10 |
| Subject# 7 | 10 | 8 | 10 | 9 | 7 | 7 |
| Subject# 8 | 10 | 10 | 9 | 9 | 10 | 10 |
| Subject# 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| Subject# 10 | 9.5 | 10 | 10 | 9 | 9 | 9 |
| | **9.5** | **9.55** | **9.4** | **9.3** | **9.0** | **8.8** |

# Appendix C

**Comparison of peak pressures for 10 people on Hug, Dual Layer, and Hug post-wash**
(3 min and 20 min)

| | Rt Scapula Hug 3min | Rt Scapula Dual Layer 3min | Rt Scapula Hug post-wash 3min | | Rt Scapula Hug 20min | Rt Scapula Dual Layer 20min | Rt Scapula Hug post-wash 20min | |
|---|---|---|---|---|---|---|---|---|
| Subject# 1 | 83 | 95 | 114 | | 92 | 152 | 122 | |
| Subject# 2 | 71 | 85 | 60 | | 79 | 99 | 99 | |
| Subject# 3 | 106 | 86 | 72 | | 108 | 112 | 89 | |
| Subject# 4 | | | | | | | | |
| Subject# 5 | 78 | 114 | 71 | | 88 | 123 | 76 | |
| Subject# 6 | 85 | 73 | 59 | | 95 | 116 | 98 | |
| Subject# 7 | 83 | 132 | 112 | | 104 | 123 | 167 | |
| Subject# 8 | 115 | 103 | 103 | | 123 | 99 | 106 | |
| Subject# 9 | 79 | 64 | 74 | | 63 | 92 | 64 | |
| Subject# 10 | 77 | 82 | 64 | | 72 | 91 | 102 | |
| | mmHg | mmHg | mmHg | Peak pressures | mmHg | mmHg | mmHg | Peak pressures |
| | **86.3** | **92.7** | **81.0** | **-11.7** | **91.6** | **111.9** | **102.6** | **-9.3** |
| | | | | Washed Hug Compared to Dual Layer | | | | Washed Hug Compared to Dual Layer |

| | Lt Scapula Hug 3min | Lt Scapula Dual Layer 3min | Lt Scapula Hug post-wash 3min | | Lt Scapula Hug 20min | Lt Scapula Dual Layer 20min | Lt Scapula Hug post-wash 20min | |
|---|---|---|---|---|---|---|---|---|
| Subject# 1 | | | | | | | | |
| Subject# 2 | 61 | 58 | 79 | | 79 | 101 | 112 | |
| Subject# 3 | 111 | 95 | 75 | | 109 | 121 | 92 | |
| Subject# 4 | | | | | | | | |
| Subject# 5 | 83 | 106 | 83 | | 92 | 144 | 106 | |
| Subject# 6 | 88 | 90 | 74 | | 11 | 102 | 89 | |
| Subject# 7 | 77 | 97 | 73 | | 115 | 136 | 122 | |
| Subject# 8 | 86 | 82 | 42 | | 105 | 83 | 70 | |
| Subject# 9 | 51 | 54 | 61 | | 64 | 78 | 62 | |
| Subject# 10 | 74 | 70 | 70 | | 81 | 83 | 86 | |
| | mmHg | mmHg | mmHg | Peak pressures | mmHg | mmHg | mmHg | Peak pressures |
| | **78.9** | **81.5** | **69.6** | **-11.9** | **82.0** | **106.0** | **92.4** | **-13.6** |
| | | | | Washed Hug Compared to Dual Layer | | | | Washed Hug Compared to Dual Layer |

## Appendix C

**(Continued)**

| | Rt PSIS Hug 3min | Rt PSIS Dual Layer 3min | Rt PSIS Hug post-wash 3min | | Rt PSIS Hug 20min | Rt PSIS Dual Layer 20min | Rt PSIS Hug post-wash 20min | |
|---|---|---|---|---|---|---|---|---|
| Subject# 1 | | | | | | | | |
| Subject# 2 | 132 | 122 | 67 | | 150 | 144 | 91 | |
| Subject# 3 | 99 | 101 | 107 | | 114 | 140 | 120 | |
| Subject# 4 | | | | | | | | |
| Subject# 5 | 58 | 68 | 83 | | 72 | 83 | 102 | |
| Subject# 6 | 91 | 87 | 75 | | 99 | 116 | 85 | |
| Subject# 7 | 44 | 78 | 64 | | 68 | 99 | 87 | |
| Subject# 8 | 97 | 80 | 62 | | 102 | 101 | 86 | |
| Subject# 9 | 74 | 82 | 79 | | 91 | 84 | 94 | |
| Subject# 10 | | | | | | | | |
| | mmHg | mmHg | mmHg | Peak pressures | mmHg | mmHg | mmHg | Peak pressures |
| | **85.0** | **88.3** | **76.7** | **-11.6** | **99.4** | **109.6** | **95.0** | **-14.6** |
| | | | | Washed Hug Compared to Dual Layer | | | | Washed Hug Compared to Dual Layer |

| | Lt PSIS Hug 3min | Lt PSIS Dual Layer 3min | Lt PSIS Hug post-wash 3min | | Lt PSIS Hug 20min | Lt PSIS Dual Layer 20min | Lt PSIS Hug post-wash 20min | |
|---|---|---|---|---|---|---|---|---|
| Subject# 1 | | | | | | | | |
| Subject# 2 | 98 | 96 | 76 | | 97 | 94 | 94 | |
| Subject# 3 | 75 | 84 | 93 | | 95 | 109 | 112 | |
| Subject# 4 | | | | | | | | |
| Subject# 5 | 48 | 70 | 68 | | 55 | 83 | 79 | |
| Subject# 6 | 69 | 70 | 51 | | 93 | 77 | 67 | |
| Subject# 7 | 72 | 53 | 59 | | 93 | 68 | 79 | |
| Subject# 8 | 82 | 68 | 54 | | 88 | 87 | 72 | |
| Subject# 9 | 65 | 73 | 63 | | 88 | 80 | 69 | |
| Subject# 10 | | | | | | | | |
| | mmHg | mmHg | mmHg | Peak pressures | mmHg | mmHg | mmHg | Peak pressures |
| | **72.7** | **73.4** | **66.3** | **-7.1** | **87.0** | **85.4** | **81.7** | **-3.7** |
| | | | | Washed Hug Compared to Dual Layer | | | | Washed Hug Compared to Dual Layer |

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