University of Pittsburgh
Department of Rehabilitation Science and Technology
School of Health and Rehabilitation Sciences

OFFICE CHAIR PERFORMANCE CHARACTERIZATION

Combined Report

June 2025

OVERVIEW

Background

Published technical standards for wheelchair seat cushions provide standardized terminology and methods for characterizing product performance. ISO 16840 seating standards have been published (https://www.iso.org/committee/53792/x/catalogue/). These voluntary standards provide information that can be used by manufacturers to assess and benchmark their products, by consumers and clinicians to compare and select products, and by regulators, purchasers and third-party payers in regulatory and purchasing policies. These standards were modified and applied to a cohort of office chairs.

Methodology

ISO Standards

The following ISO standards should be referenced for more information on the procedures described in this test report:

- **ISO 16840-6:** *Simulated use and determination of the changes in properties of seat cushions*
- ***ISO 16840-13****: Determination of the lateral stability property of a seat cushion*

Procedural overview

The cushions underwent the following characterization tests:

- ***Pressure Mapping (ISO 16840-6:2015 Clause 14),*** *a test that utilizes interface pressure measurements to assess the magnitude and distribution of pressure on a loaded cushion before and after aging (relative changes)*

At the request of the client and consistent with 2022 testing, the above methods were modified to use a larger (390 mm width) Rigid Cushion Loading Indenter (RCLI) with the normative 500N load. The 390 mm indenter width as specified in Annex D of ISO 16840-2 for testing alternatively sized cushions was used for this testing with a denim material covering as specified in ISO 16840-13.

Samples Tested

The office chairs listed in Table 1 were provided for testing.

Table 1. Samples provided for all tests. Samples 1-7 were tested in 2025; samples 8-19 were tested in 2022.

	Model
1	Anthros Chair
2	Secret Lab Titan
3	Secret Lab Nanogen

4	Maxnomic Dominator
5	Herman Miller Embody
6	Logitech Embody
7	Herman Miller Aeron
8	X Chair
9	Humanscale Freedom
10	Steelcase Gesture
11	Steelcase Leap

Pressure Mapping

Test Overview and Methodology

Pressure Mapping is a test that utilizes interface pressure measurements to assess the magnitude and distribution of pressure on a loaded cushion. Figure 1a shows a visualization of the Pressure Mapping test procedures from ISO 16840-6:2015 Clause 14 that were followed. This method is not a validated stand-a-lone test method and is intended to be used to compare pressure mapping metrics before and after simulated aging. A BT2-3232-200 BodiTrak2 pressure mat that has a 32x32 array and 47cm x 47cm sensing area was used for pressure mapping pressure measurements. Each sensor is 11mm x 11mm with 2mm spacing and saturates at 200 mmHg.

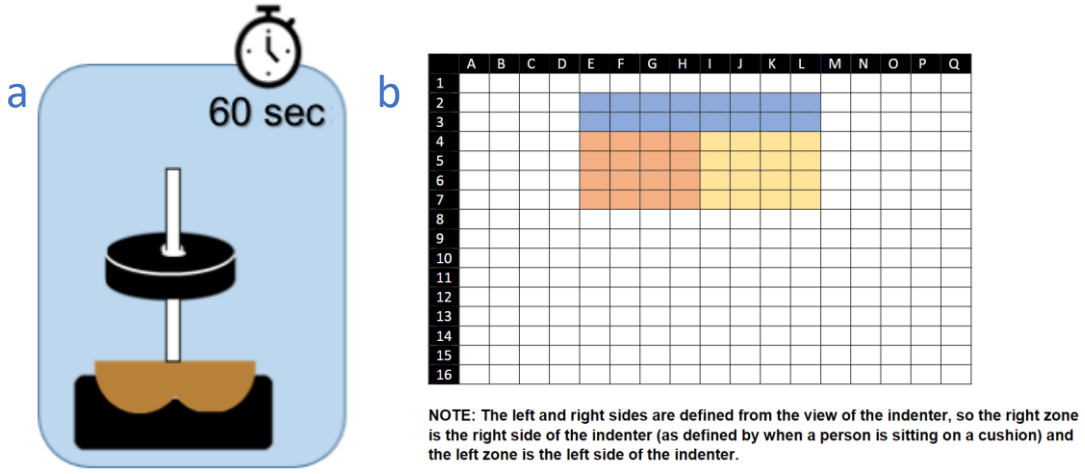


Figure 1. a: The cushion is loaded with a rigid cushion loading indenter and load totaling 500N and pressure map placed at the interface between the cushion and indenter records for 60 seconds. b: Guidance on interpretation of the pressure map and base zones. Representation of a pressure map that shows Right (orange) and Left (yellow) Base Zones as well as Rear Center (blue) zone (a 16x16 map is shown, but a 32x32 array was used for testing).

The standard defines several key outcomes for the interface pressure measurement test related the base zones highlighted in Figure 1b including Peak Pressure Index (PPI) for the right and left

base zones; Dispersion index; and Contact area. For more information on these metrics please reference ISO 16840-6:2015 Clause 14. Low Peak Pressure Indices (PPI) and Dispersion Index are desirable, and high Contact Area is desirable.

Results

Pressure Mapping test results can be seen in Table 2 and Figures 2-15. Additional figures can be found in Appendix A.

Table 2. Pressure Mapping Results averaged over five trials

	Dispersion Index (%)	PPI – Left Base Zone (mmHg)	PPI – Right Base Zone (mmHg)	Contact Area (mm^2)
Anthros Chair	34%	87	90	63558
Secret Lab Titan	62%	158	175	51649
Secretlab Nanogen	69%	171	176	60095
Maxnomic Dominator	68%	110	107	58997
Herman Miller Embody	52%	163	173	55070
Logitech Embody	50%	146	130	71878
Herman Miller Aeron	51%	196	172	41767
X Chair	55%	125	130	66515
Humanscale Freedom	48%	95	94	77241
Steelcase Gesture	56%	115	115	80282
Steelcase Leap	43%	100	104	82267

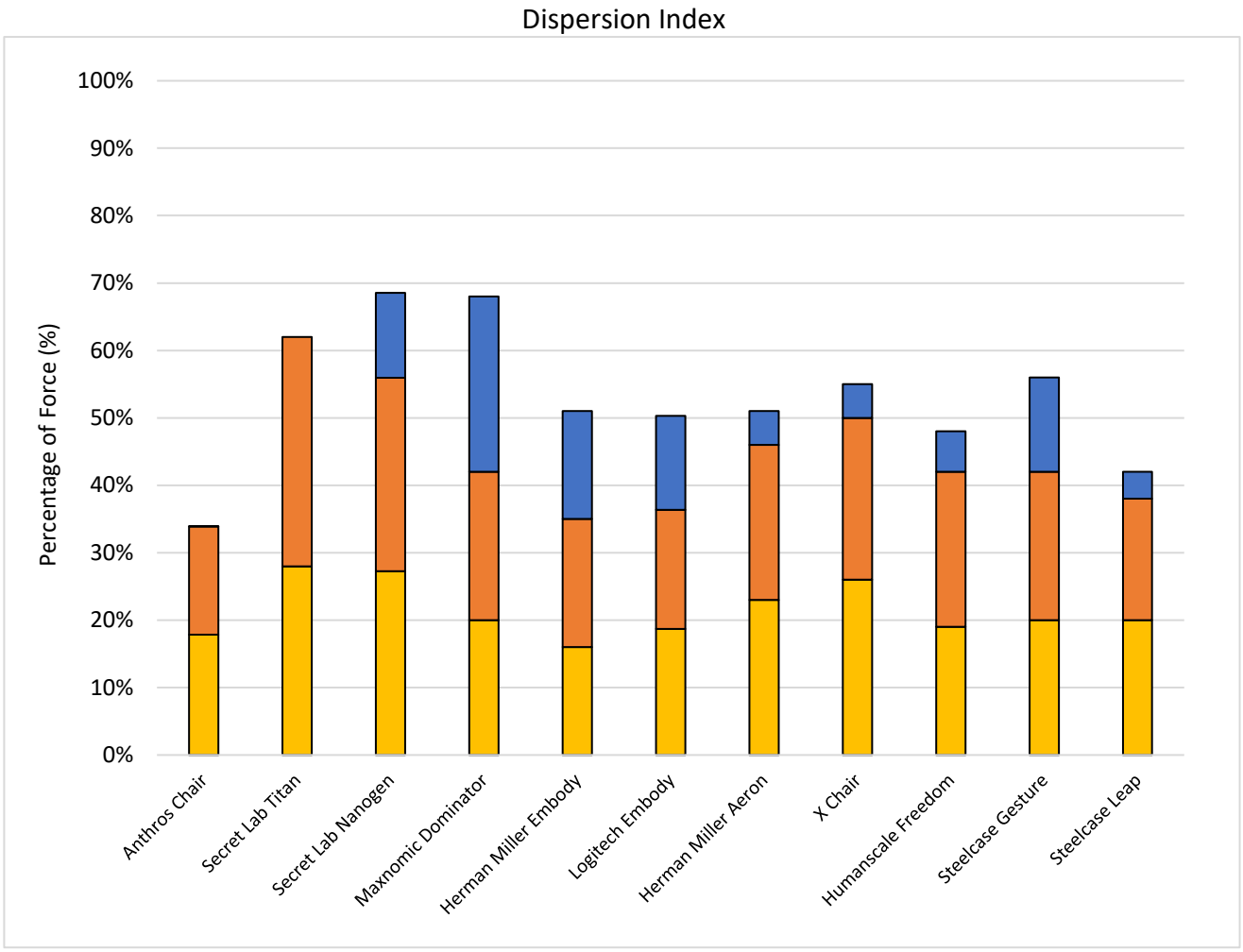


Figure 2. Percentage of force seen on the Left Base Zone (LBZ) (yellow), Right Base Zone (RBZ) (orange) and Rear center zone (CZ) (blue).

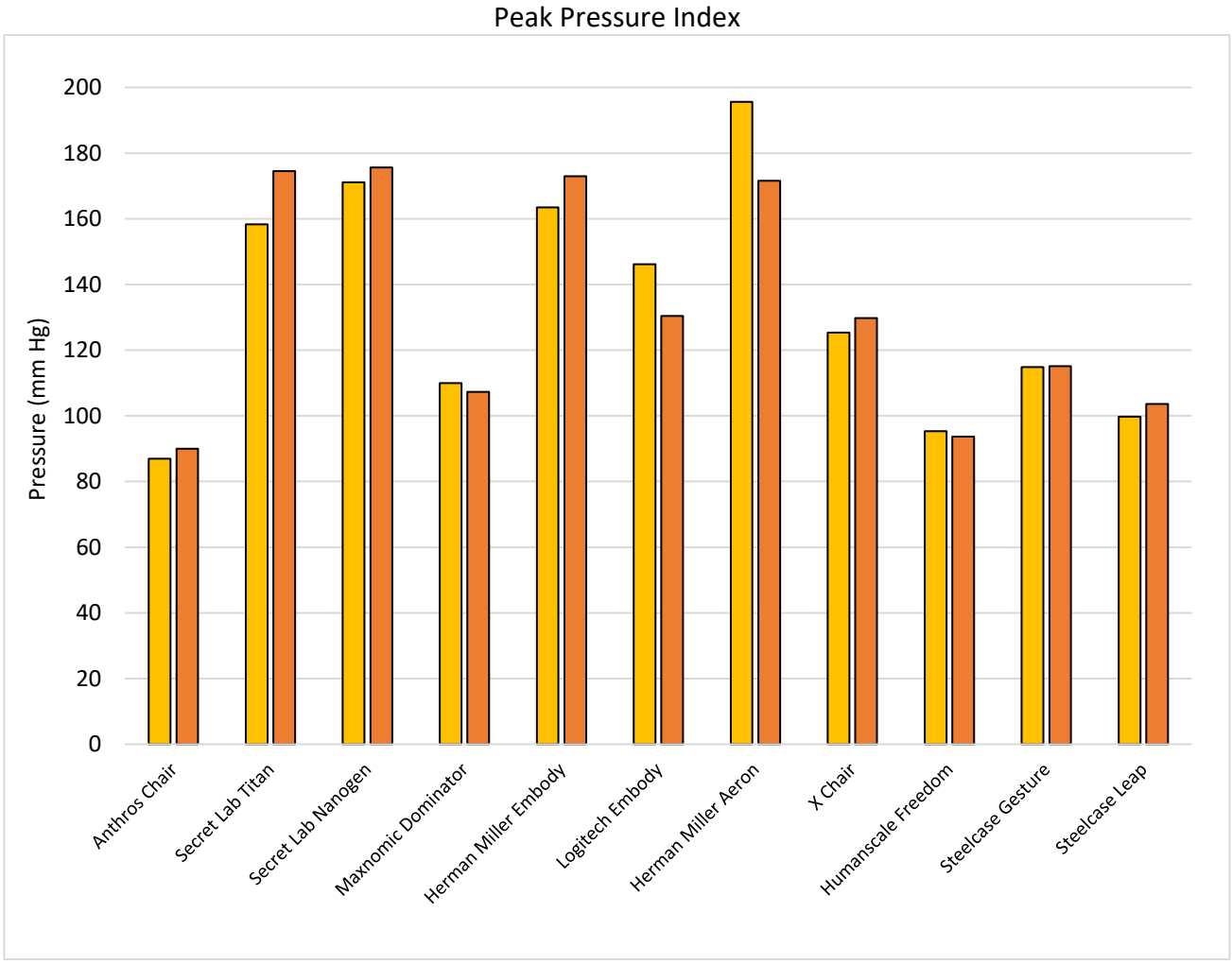


Figure 3. Peak pressure index of the Left Base Zone (LBZ) (yellow) and Right Base Zone (RBZ) (orange).

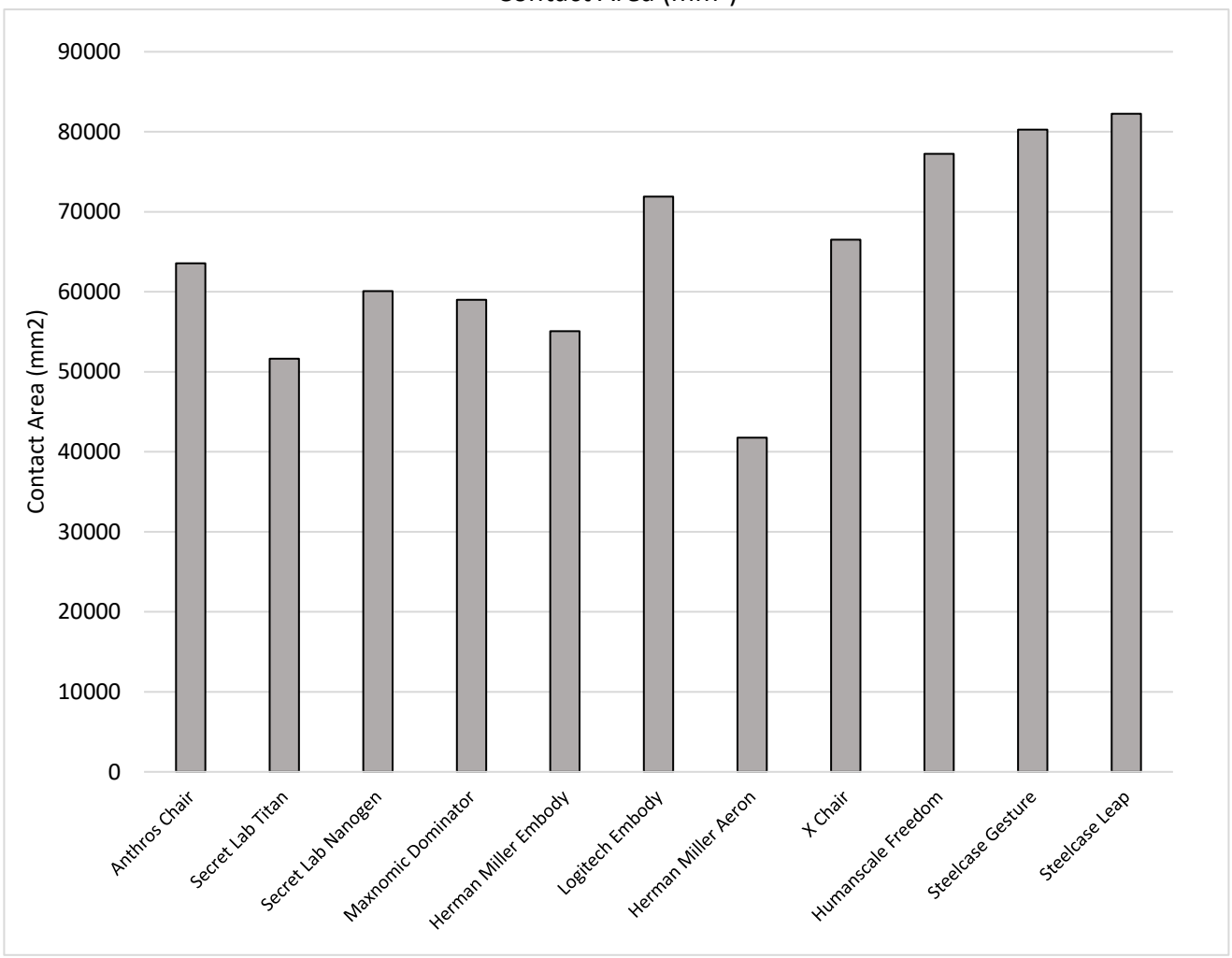


Figure 4. Contact Area

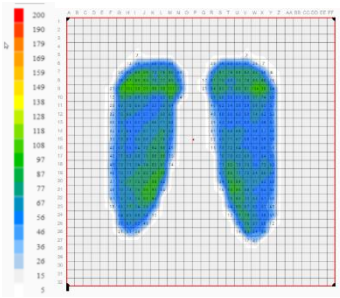


Figure 5. Sample Pressure Mapping output for the Anthros Chair 60 seconds after load application

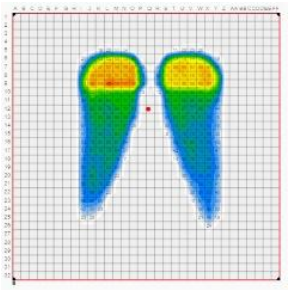


Figure 6. Sample Pressure Mapping output for the Secret Lab Titan 60 seconds after load application

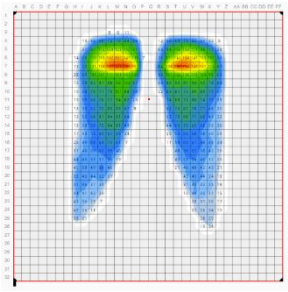


Figure 7. Sample Pressure Mapping output for the Secret Lab Nanogen 60 seconds after load application

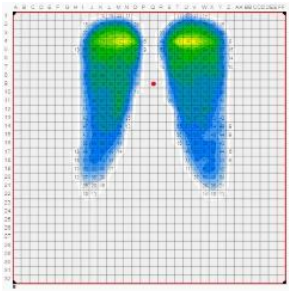


Figure 8. Sample Pressure Mapping output for Maxnomic Dominator 60 seconds after load application

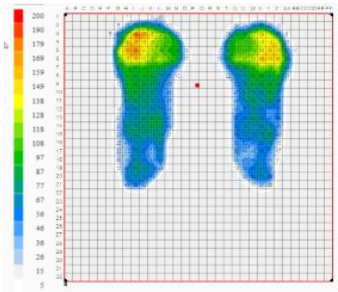


Figure 9. Sample Pressure Mapping output for Herman Miller Embody 60 seconds after load application

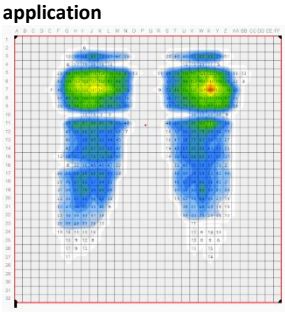


Figure 10. Sample Pressure Mapping output for the Logitech Embody 60 seconds after load application

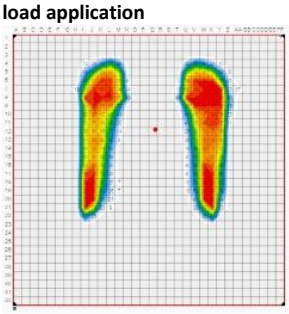


Figure 11. Sample Pressure Mapping output for Herman Miller Aeron 60 seconds after load application

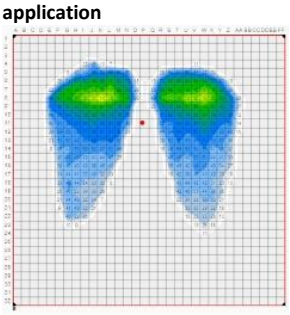


Figure 12. Sample Pressure Mapping output for X Chair 60 seconds after load application

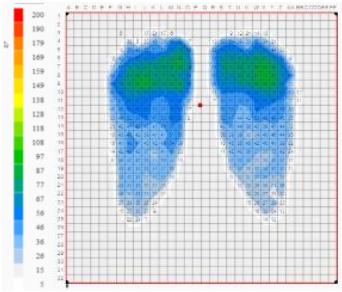


Figure 13. Sample Pressure Mapping output for Humanscale Freedom 60 seconds after load application

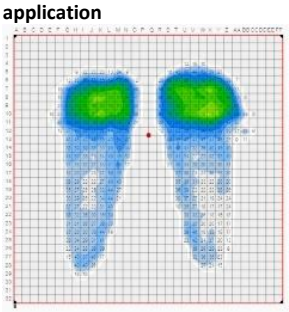


Figure 14. Sample Pressure Mapping output for Steelcase Gesture 60 seconds after load application

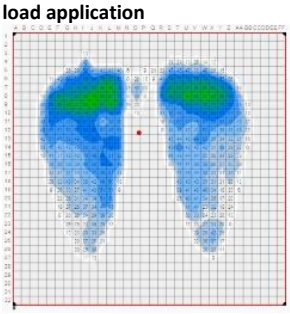
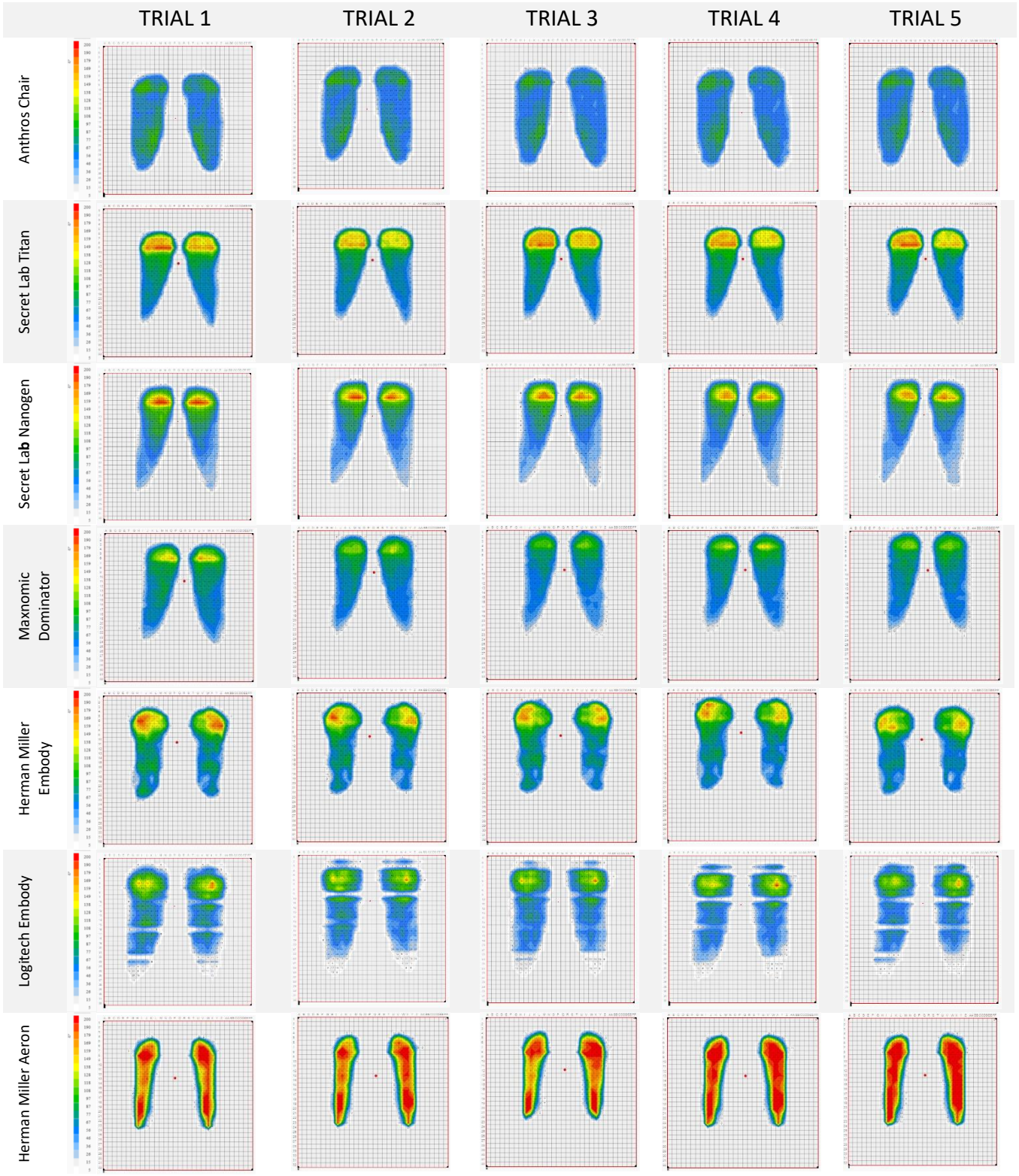
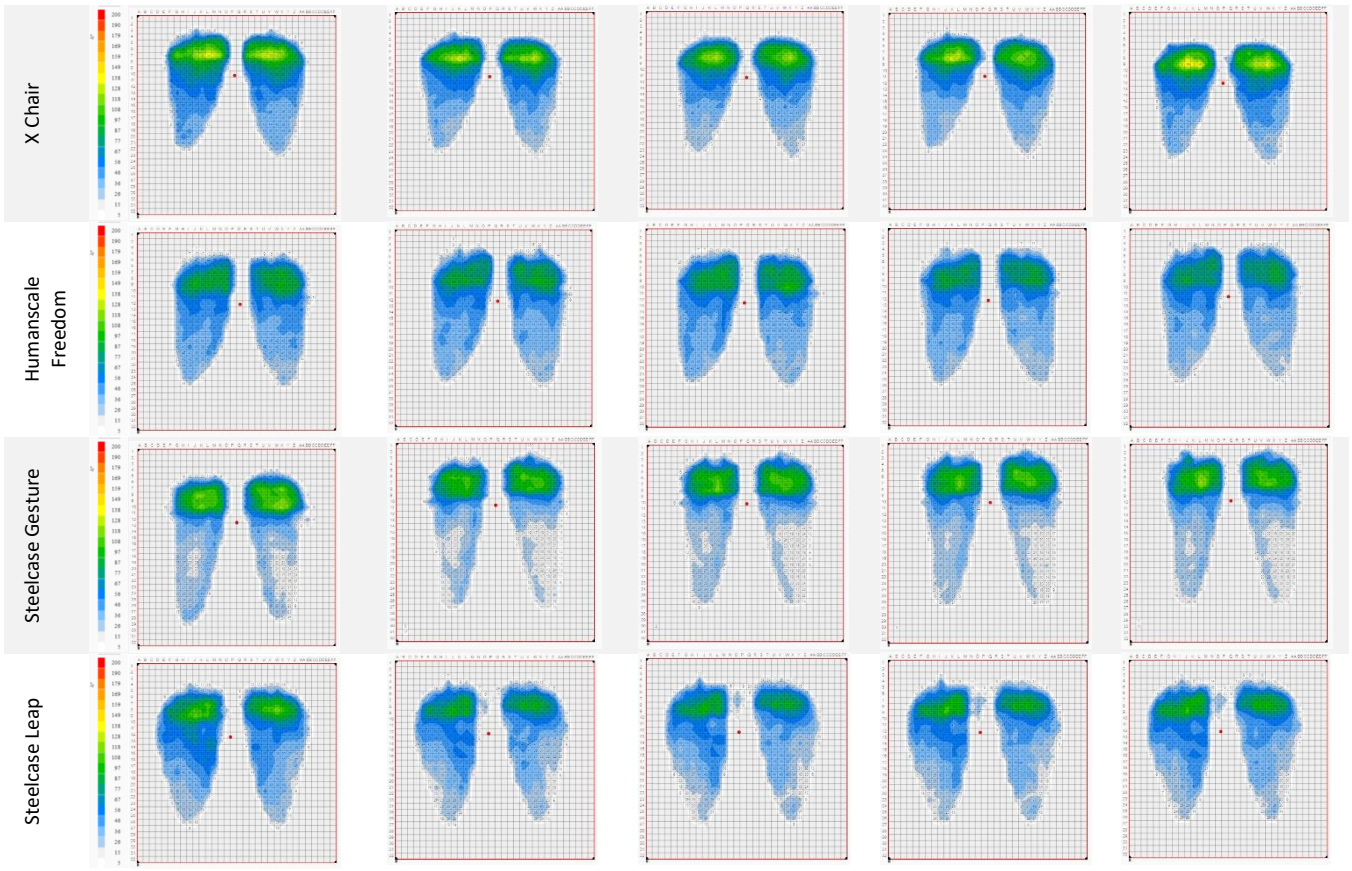


Figure 15. Sample Pressure Mapping output for Steelcase Leap 60 seconds after load application

APPENDIX A: Pressure Mapping Individual Trials




X Chair
Humanscale Freedom
Steelcase Gesture
Steelcase Leap