

# Chair Specifications and Testing for Big & Tall Seating

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# Outline

- Literature Research
- Notes from Lab Study
- Notes from Field Studies
  - Real-Time Caster Roll Test
  - Real-Time Seating Habits Performance Test
- Performance Test Implications
- Conclusions

# Obesity and BMI

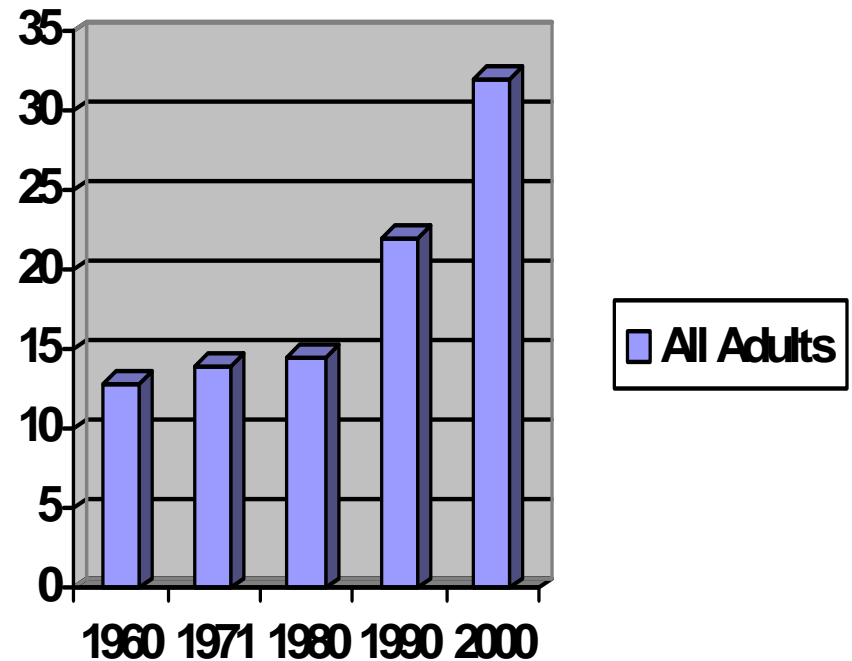
- The percentage of overweight or obese in the US adult population has soared to over 60% in the last few years. (NCHS 1999)
- The BMI is determined by dividing weight in kilograms by height in meters squared.
- Clinical guidelines from the National Institutes of Health define overweight as a body mass index (BMI) of 25-29.9 kg/m<sup>2</sup>, while obesity is defined as a BMI of 30kg/m<sup>2</sup> or more. (NIH 1998)
- More specifically, about 35 percent of US adults are overweight and 26 percent are obese.
  - BMI vs. ab/hip ratio

<u>Weight</u>	<u>BMI</u>
Acceptable Weight	18.5-24.9
Overweight	25-29.9
Obese	30-34.9
Severely Obese	35-39.9
Morbidly Obese	40-49.9
Super Morbidly Obese	50 or more

# Obesity and Technology

## Change the Office Worker and the Work

- Since 1960, computers have allowed increased task work without interruption to occur at the primary office workstation.
- At the same time, the worker has become increasingly obese.
- Both factors are significant to the design and layout of office furniture.



% obesity in US adults vs. time

# Literature Search

- ANSI/BIFMA 5.1-2002 Outline
- Lab and Field Study notes

# ANSI/BIFMA 5.1 - 2002

Section	Standard Tests for 225lb 95%tile male max.	Current Test Parameters
5	<b>Backrest Strength</b> – Static - Type I	Functional and Proof loads of 200lbF and 300lbF are applied with locked mech at standard rear tilt angle for 1 minute each
6	<b>Backrest Strength</b> – Static - Type II & III	Functional and Proof loads of 100lbF and 150lbF are applied with locked mech at locked upright position for 1 minute each
10	<b>Tilt Mechanism Test</b> – Cyclic	225lb weight in the seat is rocked just short of front and back stops for 300,000 cycles

# ANSI/BIFMA 5.1 - 2002

Section	Standard Tests for 225lb 95%tile male max.	Current Test Parameters
7	<b>Base Test</b>	2500lbF for 1 minute, 2 cycles
8	<b>Drop Test – Dynamic</b>	225lbF dropped from 6" at 2" forward of center depth of seat for one cycle
9	<b>Swivel Test – Cyclic</b>	225lb weight in CG of seat swiveled 360deg for 120,000 cycles
14	<b>Arm Strength Test – Horizontal - Static</b>	Functional and proof horizontal loads are applied over 5" long area on the arms for 1minute at 100lbF and 150lbF respectively
15	<b>Backrest Durability Test – Cyclic - Type I</b>	100lbF pulled against rearward tilt stop for 80,000 cycles and then 20,000 to each side at 4" from centerline

# ANSI/BIFMA 5.1 - 2002

Section	Standard Tests for 225lb 95%tile male max.	Current Test Parameters
10	<b>Tilt Mechanism Test –</b> Cyclic	225lb weight in the seat is rocked just short of front and back stops for 300,000 cycles
12	<b>Stability Tests</b>	Forces required to tip chair forward and rearward with 173lb in chair
11	<b>Seating Durability Tests –</b> Cyclic	125lb weight dropped from 1" for 100,000 cycles over seat center and then 20,000 cycles on each front corner at 165lbF



# ANSI/BIFMA 5.1 - 2002

Section	Standard Tests for 225lb 95%tile male max.	Current Test Parameters
13	<b>Arm Strength Test –</b> Vertical - Static	Functional and proof vertical loads are applied over 5" long area on the arms for 1 minute at 200lbF and 300lbF respectively
14	<b>Arm Strength Test –</b> Horizontal - Static	Functional and proof horizontal loads are applied over 5" long area on the arms for 1 minute at 100lbF and 150lbF respectively
15	<b>Backrest Durability Test –</b> Cyclic - Type I	100lbF pulled against rearward tilt stop for 80,000 cycles and then 20,000 to each side at 4" from centerline
16	<b>Backrest Durability Test –</b> Cyclic - Type II & III	75lbF pulled against upright tilt stop for 80,000 cycles and then 20,000 to each side at 4" from centerline
20	<b>Arm Durability Test –</b> Cyclic	60,000 cycles at 10 deg out and down using 90lbF(9/22.5 of 225lb max)

# ANSI/BIFMA 5.1 - 2002

<b>Section</b>	<b>Standard Tests for 225lb 95%tile male max.</b>	<b>Current Test Parameters</b>
17	<b>Caster/Chair Base Durability Test</b> - Cyclic	Base only is loaded with 225lb and rolled back and forth across 3 bumps on a 6' table for 2000 cycles and then bumps are removed and it is rolled for 98,000 cycles
19	<b>Footrest Durability Test –</b> Vertical - Cyclic	200lbsF for 50,000 cycles centered at weakest point of foot support.
21	<b>Out Stop Tests</b>	Seat slider test for durability of forward slide to ensure that seat won't separate from mechanism.

# Literature Search on Interesting Findings from Other Studies....

- The World Health Organization recently announced that overweight/obesity is now a pandemic affecting nearly 1.7 Billion people worldwide.
- In the USA, the percent of black women with BMI greater than or equal to 40 has doubled in less than a decade to 15%. Overall, 6.3% of US women (1 in 16) are morbidly obese. (James 2003)\*

\*Professor Philip James, Chair of the London Based International Obesity Task Force, Monte Carlo, March 17, 2003. [www.iotf.org/media](http://www.iotf.org/media).

# Literature Search on Interesting Findings from Other Studies....

- It appears that obesity is now poised to take over tobacco as the number one threat to life and the cost of healthcare. (James 2003)\*
- The number of obesity related deaths each year in the US has now exceeded 400,000 which is second to the 450,000 from tobacco. (WHO 2002)\*\*

\*\*World Health Report 2002. [www.who.int/peh/burden/globalestim.htm](http://www.who.int/peh/burden/globalestim.htm)

# Literature Search on Interesting Findings from Other Studies....

- In 1998, a study was conducted by Coleman to determine the preferred lumbar support settings on adjustable office chairs. (Coleman et al 1998)\*\* The most significant finding of this study was the report from the author that nearly 1 out of 9 workers or approximately 11% of this population fell outside of the current BIFMA criteria of a standard office chair which is listed in the ANSI/BIFMA 5.1-2002 Guideline as 225lbs.

\*\*Coleman N, Hull BP, Ellitt G. An empirical study of the preferred settings for lumbar support on adjustable office chairs. Ergonomics 1998 Apr;41(4):401-19.

# Literature Search on Interesting Findings from Other Studies....

- In automotive and wheelchair seat design, tests are conducted with actual human like test dummies.
- They have begun to call for augmentation of the 100kg ISO test dummy with higher mass. Specifically, Cooper et al suggested that testing actually needs to occur up to 250kg with the greatest need being an immediate switch to testing with a 150kg dummy. (Cooper et al 1999)\*
- His study also revealed that mass be distributed between the lower torso and legs at a ratio of six to one.

\*Cooper, R; O'Connor T; etal. "Augmentation of the 100kg ISO wheelchair test dummy to accommodate a higher mass. Journal of Rehabilitation Research and Development Vol. 36 No. 1 Jan. 1999 pgs 45-54.

# Literature Search on Interesting Findings from Other Studies....

- High BMI was not found to be a positive correlate, for normal weight individuals in Koskelo's study to investigate whether temperature and humidity of the scrotal skin were affected during sitting on commonly used office chairs. (Koskelo et al 2004)\* For obese participants, chair design did affect scrotal temperature and the seating with pommels in the center had the lower temperatures.
- Another study by Kernozek et al was conducted to determine whether BMI influenced seat interface pressure in the elderly. In this case, high BMI seems to protect from the development of decubitus ulcers just as it reduced automotive fatalities in several studies designed to test the efficacy of seat belts and air bags in collisions.

\*Koskelo R, Zaproudina N, Vuorikari K. High scrotal temperatures and chairs in the pathophysiology of poor semen quality. Pathophysiology 2005 May;11(4):221-224.

# Preliminary Findings from Obese Office Worker Study\* at Texas A&M University

- Lab Study
  - Anthropometry, Center of Gravity and Armrest Use (n=16)
- Field Study of Caster Roll Distance
  - Daily Rolling Habits of Seated Workers (n=50)
- Field Study of Seat and Back Usage Parameters (n=51)

## Two Major Goals from All 3 Studies

1. Does a significant and relevant difference exist between normal and obese workers?
2. If so, what new test parameters should be considered.

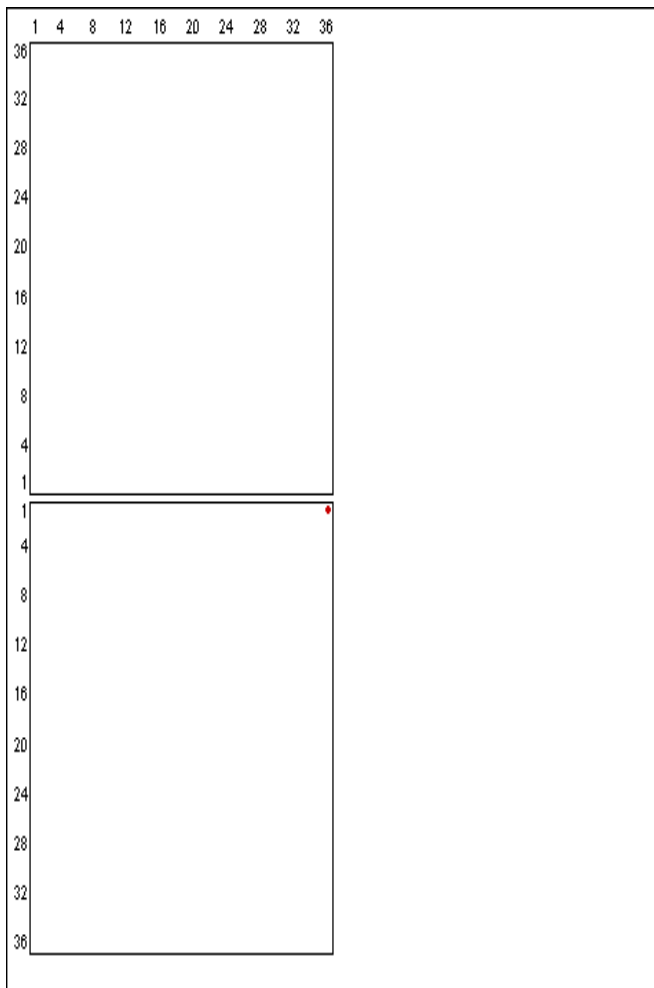
\*"THE OBESE OFFICE WORKER SEATING PROBLEM" A Dissertation by MARK E. BENDEN PhD, CPE; Texas A&M University December 2006



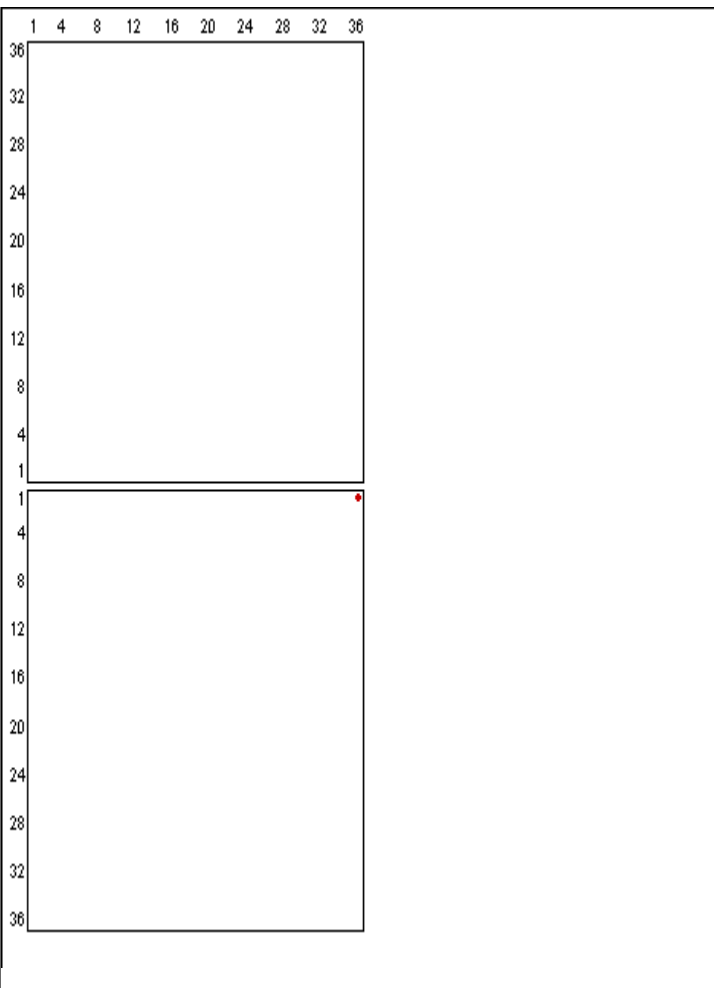
# Arm Use Video

## Normal

## Obese



PSI		PSI	
1.0	0	3.87	0
0.98	0	3.75	0
0.95	0	3.63	0
0.93	0	3.52	0
0.9	0	3.4	0
0.88	0	3.28	0
0.86	0	3.17	0
0.83	0	3.05	0
0.81	0	2.93	0
0.78	0	2.82	0
0.76	0	2.7	0
0.73	0	2.58	0
0.71	0	2.47	0
0.69	0	2.35	0
0.66	0	2.23	0
0.64	0	2.12	0
0.61	0	2.0	0
0.59	0	1.88	0
0.57	0	1.77	0
0.54	0	1.65	0
0.52	0	1.54	0
0.49	0	1.42	0
0.47	0	1.3	0
0.45	0	1.19	0
0.42	0	1.07	0
0.4	0	0.95	0
0.37	0	0.84	0
0.35	0	0.72	0
0.32	0	0.6	0
0.3	0	0.49	0
0.28	0	0.37	0
0.25	0	0.25	0
0.0	1296	0.0	1296
0.25 - 1.0		0.25 - 3.87	

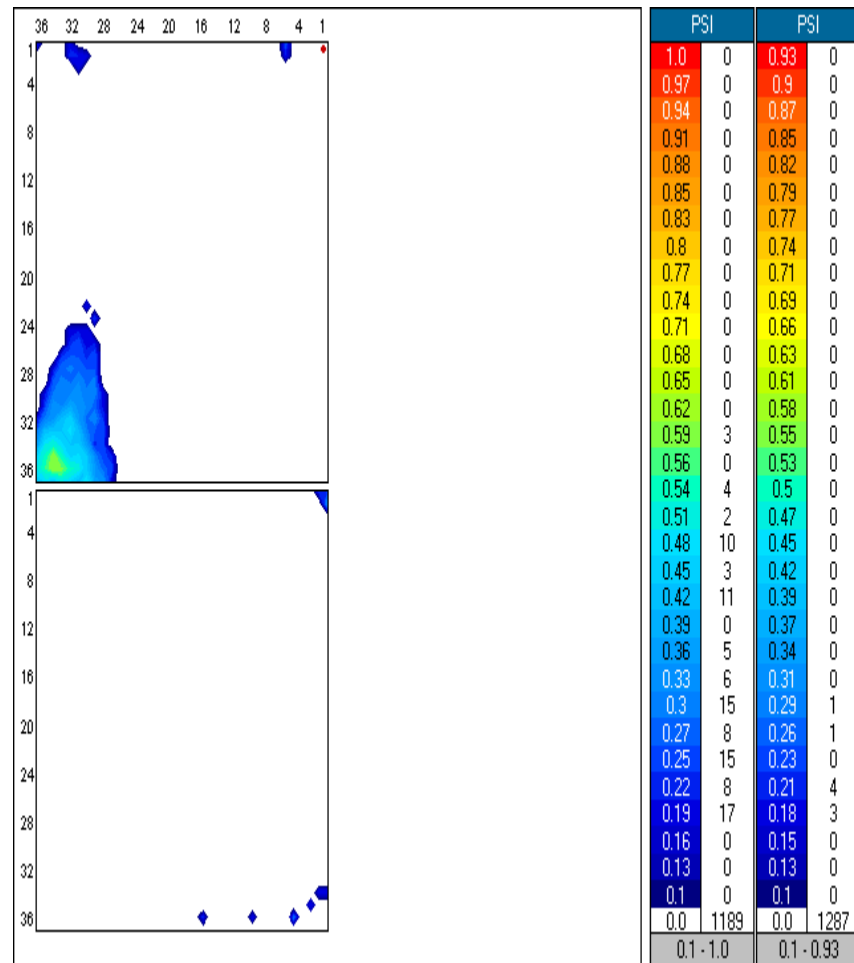
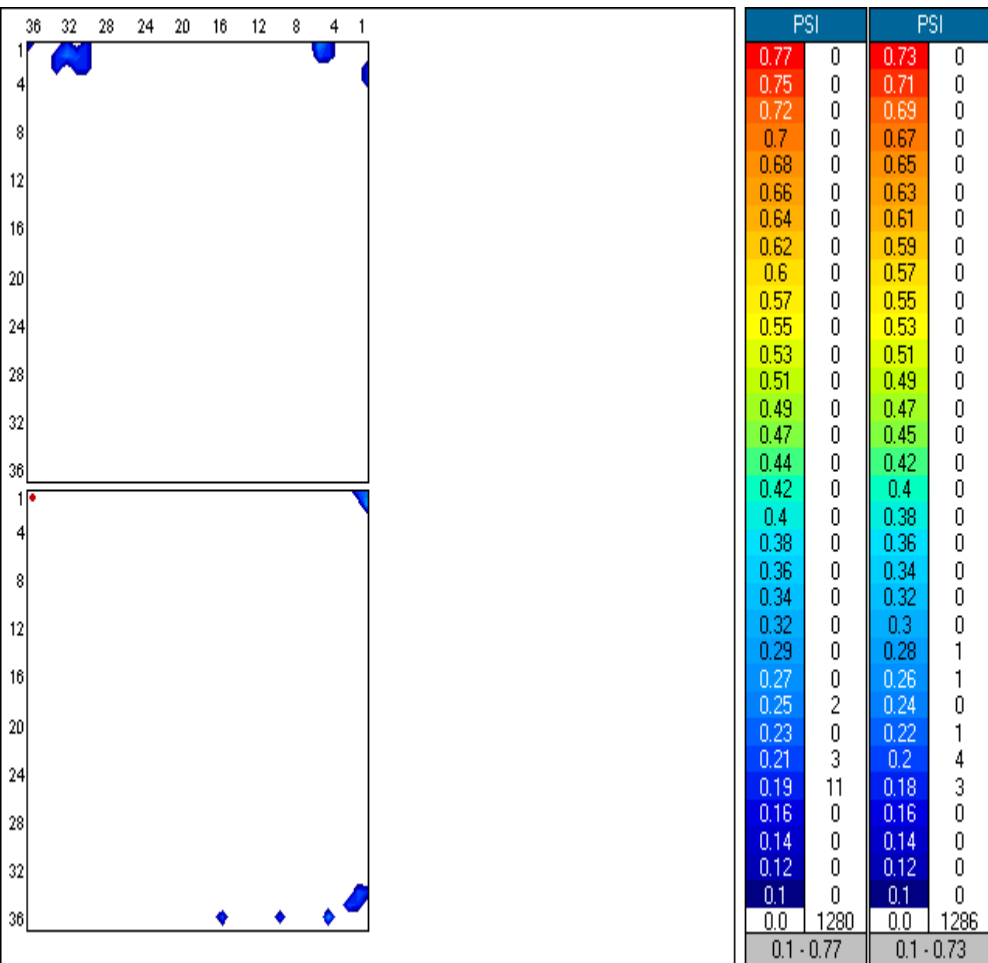


PSI		PSI	
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0.9	0	3.4	0
0.88	0	3.28	0
0.86	0	3.17	0
0.83	0	3.05	0
0.81	0	2.93	0
0.78	0	2.82	0
0.76	0	2.7	0
0.73	0	2.58	0
0.71	0	2.47	0
0.69	0	2.35	0
0.66	0	2.23	0
0.64	0	2.12	0
0.61	0	2.0	0
0.59	0	1.88	0
0.57	0	1.77	0
0.54	0	1.65	0
0.52	0	1.54	0
0.49	0	1.42	0
0.47	0	1.3	0
0.45	0	1.19	0
0.42	0	1.07	0
0.4	0	0.95	0
0.37	0	0.84	0
0.35	0	0.72	0
0.32	0	0.6	0
0.3	0	0.49	0
0.28	0	0.37	0
0.25	0	0.25	0
0.0	1296	0.0	1296
0.25 - 1.0		0.25 - 3.87	

# Seat and Back Use Video

## Normal

## Obese



# Note on Field Results

- At one of the offices studied, 35 participants were combined with the remainder of their staff for a total of 48 and then evaluated against the old ANSI/BIFMA maximum of 225 lbs. In the 1970's, when established, 1 out of 50 people exceeded that weight. In this particular office in 2006, 1 out of 7 exceeded that amount.

# Conclusions

- Many of the old industry standard assumptions of seating use in the office are invalid.
- Key performance measures for tests of office seating should be revised to better reflect these new usage patterns along with the impact of a physically larger, more sedentary population.
- A test standard for seating designed for severely obese (BMI > 35) office workers should be developed.