HAWORTH

The Importance Of Good Sitting

Ergonomic Seating Guide

Table of Contents

Improving Comfort and Support for Worker Well-Being

A large body of research shows that health and well-being are directly affected by many features of the overall physical environment.[1] When 54 percent of our waking hours are spent at work[2] and 75 percent of work in industrialized countries is performed while sitting[3], ergonomic support and seated comfort can make a crucial difference for employee well-being and engagement. Worker comfort is one of the top workplace issues challenging organizations. Providing good back support not only promotes healthy sitting, but can also support mental acuity for seated workers.

We have studied the relationship between the human body and chair to minimize discomfort and promote people's well-being—physically, emotionally, and cognitively. Through global design and development partnerships, our task chairs accommodate the range of body sizes around the world. Our commitment to the science of sitting is grounded in our history of strong design, engineering, and manufacturing—and our ergonomic expertise—to support people at work.

Haworth and the Human Performance Institute at Western Michigan University have partnered since 2004 with the goal of investigating the physical relationship between a person and a seating surface. This effort has resulted in over 5.5 billion high resolution pressure mapping data points used to understand seating challenges, enabling Haworth to deliver the very latest science through analytics in our products.

1 National Safety Council, 2007.

2 healthycomputing.com, 2007.

3 Amick, Robertson, DeRango, Bazzani, Moore, Rooney, and Harrist, 2003.

Why You Need This Guide

In 2017, there were approximately 2.8 million non-fatal workplace injuries reported by employers, 35 percent of which were musculoskeletal disorders. One-third of these injuries resulted in days away from work. For these workers who suffered musculoskeletal injuries, the average amount of time spent out of work was 12 days.[4]

With figures like these, the importance of providing a well-designed work environment with appropriate training that could help lessen costs—as well as days lost to injuries—is obvious. The right ergonomic chair with the proper ergonomic training can help reduce injuries—and more. When you deliver innovative, science-based, seated support to minimize worker discomfort, you can promote well-being and increase employee engagement.

Studies also show that work-related injuries can be reduced and productivity increased using an ergonomic chair and proper ergonomic training:

Proper office ergonomics training resulted in a higher quantity and quality of work produced.[5]

Use of an ergonomic chair during prolonged seated work decreases the risk of suffering musculoskeletal disorders in the neck, shoulders, arms, back, and legs.[6]

4 US Bureau of Labor Statistics, 2018.

5 Karakolis and Callaghan, 2014.

6 Zemp et al, 2016.

A Chair is a Personal Choice

Ergonomic Seating Standards

Few things in the workplace evoke a stronger physical and emotional attachment than a person's chair. It's the center of work—and perhaps the single most important component of a healthy working environment.[7] Good ergonomic seating enables concentration and minimizes the distractions that stem from being uncomfortable.

The purpose of this guide is to highlight seating features that help improve comfort, support, and well-being to enable worker performance and keep people engaged. But the human body comes in many different sizes and shapes. A design that's comfortable for one person may be inappropriate for another. Proper fit is imperative when people physically interact with their chairs for hours at a time.

To improve chair designers' abilities to meet the needs of users, several organizations have compiled standards with the help of Human Factors and Ergonomics experts. These standards represent the combined cumulative knowledge and expertise aimed at improving the accommodation of people and reducing the risks of injury in the office environment.

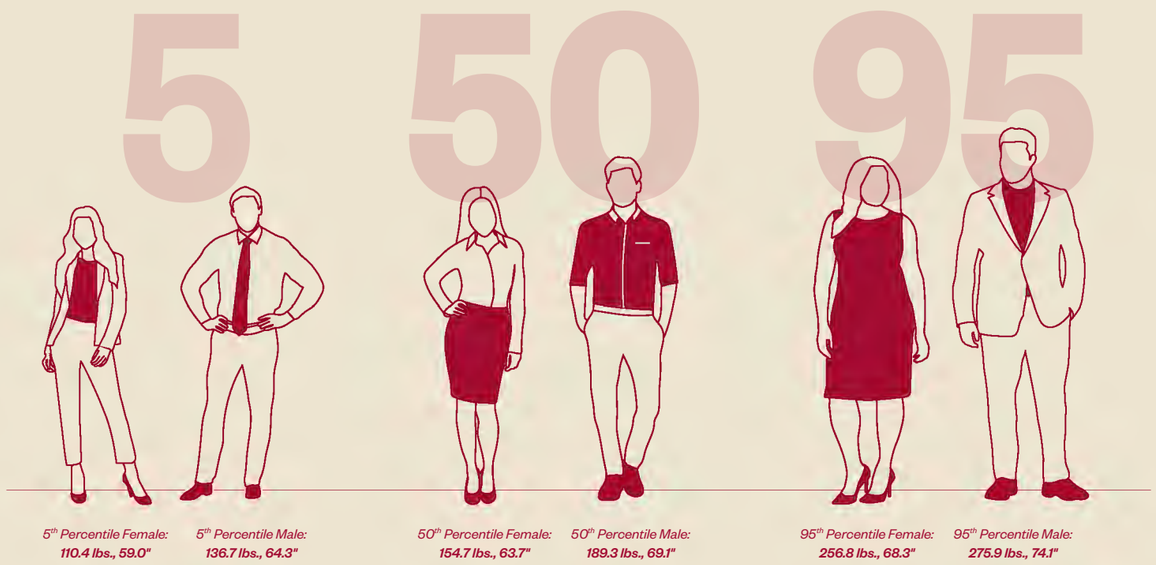
Haworth always considers global ergonomic requirements in our chair development process, in addition to the following North American standards:

- HFES 100-2017
- Business and Institutional Furniture Manufacturer's Association: BIFMA G1-2013
- Canadian General Standards Board: CGSB-44.232-2018
- Canadian Standards Association: CSA-Z412-2017

These chair standards are intended as a reference and starting point for design. They are updated periodically to reflect accepted research and best practices. The standards provide design guidance to meet minimum requirements in addition to adjustability ranges to increase the percentage of the population accommodated.

7 healthycomputing.com, 2007.

The standards propose dimensional specifications based on body dimensions of the 5th percentile (small) female to the 95th percentile (large) male. (Refer to graph below.) This range covers approximately 95 percent of the population and is intended to meet the minimum requirements of users. Haworth's ergonomic seating products are based on state-of-the art research and are designed to exceed standards, meeting the needs of a broad range of users.



5th Percentile Female: ***110.4 lbs., 59.0"***
5th Percentile Male: ***136.7 lbs., 64.3"***
50th Percentile Female: ***154.7 lbs., 63.7"***
50th Percentile Male: ***189.3 lbs., 69.1"***
95th Percentile Female: ***256.8 lbs., 68.3"***
95th Percentile Male: ***275.9 lbs., 74.1"***

Source: US Department of Health and Human Services. "Anthropometric Reference Data for Children and Adults: United States, 2011–2014." National Health and Nutrition Examination Survey, Aug. 2016, www.cdc.gov/nchs/data/series/sr_03/sr03_039.pdf.

Design of Chair Controls

By design, ergonomic seating incorporates a range of adjustability. People need to be able to get into comfortable postures easily and make adjustments over time. To achieve this, accessible, responsive design and consistency in control placement and function are essential. In our chair development process, our research focuses on the user, resulting in intuitive controls that require minimal force to operate—if they're not easy to use, people won't use them.

Desirable control features include:

- Low hand and finger forces to operate
- Majority of adjustments achievable while seated
- Control motion intuitive and indicated by feel
- Control location consistent

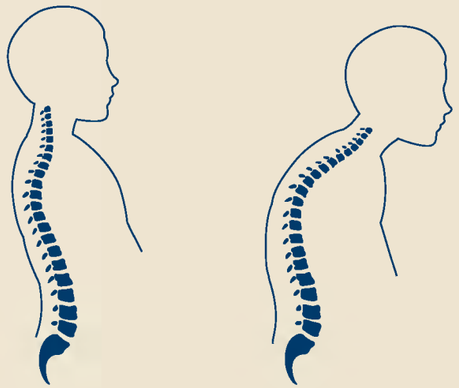
The importance of control design and consistency increases as chairs are shared between people. This is a common requirement in multi-shift situations, such as customer support operations or call centers.

Adjustability Features

Back Support

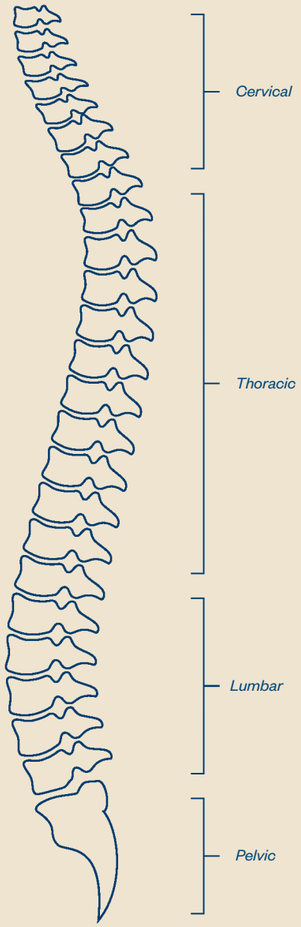
Made up of 24 vertebrae, the human spine forms an S-shape when viewed from the side. These four curves—cervical (neck), thoracic (upper back/rib cage), lumbar (lower back), and sacrum (pelvis)—are designed for shock absorption, balance, and movement. It's been said that the shape of our spinal columns are as unique as our fingerprints, including variations in curvature and length: True height can vary throughout the day by up to two percent.[8]

On top of that, the level of back support required when you're seated varies: The thoracic spine is different from the lumbar spine, so it's important to consider these needs in seating design—especially in the backrest to accommodate postural differences among people.



Good Posture

Poor Posture



8 Martin and Richards, 2017.

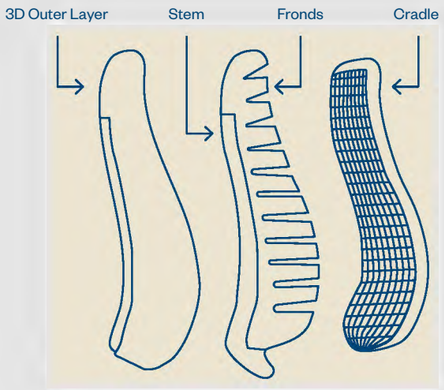
The Importance of Good Sitting | Ergonomic Seating Guide

Total Back Support

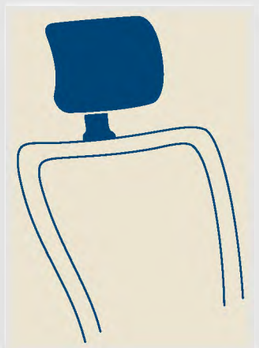
Total back support enhances the sitting experience for people by giving them the ability to move with natural freedom, comfort, and support—from the neck and thoracic spine all the way down to the pelvis.

Wave Suspension™

Wave Suspension is a new paradigm derived from research advising the need for total back support. Available only on Haworth's Fern® task seating, Wave Suspension allows the spine to serve as the pivot point of movement, providing highly customized support for each region of the back, independently undulating with the body's movements without the need for adjustment by the user. Much like the human body's spinal anatomy, Wave Suspension includes a centralized Stem™ that supports a series of Fronds™. Overlaying the Fronds and Stem, the Cradle™ works in concert with them for effortless support, cradling and suspending the user's body.



Wave Suspension



Headrest

Cervical/Thoracic

The cervical vertebrae in the neck allow the most motion in the spine.

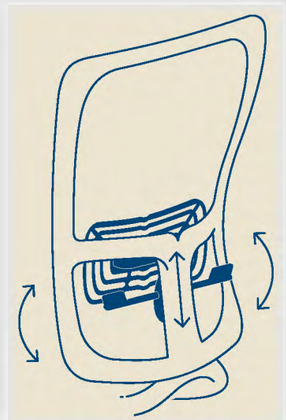
The thoracic vertebrae are designed for minimal movement and help stabilize the upper back and rib cage while protecting internal organs.

Headrests

Some people prefer the optional headrests on task seating to enhance total body support. The headrest fits the curvature of the neck while still supporting the head, flexing in response to the body's natural movements.

Lumbar

The lumbar vertebrae provide some motion but are designed to support the weight of the upper body. Since every back is different, it's important to provide lumbar support with different levels of performance.



Asymmetric Adjustable Support

Asymmetric Lumbar Support

Independent university research has indicated that over 74 percent of individuals tend to prefer more support on one side of their lower back than the other.[9]

Performance of Lumbar Support

Minimum **Fixed Support —** Based on seating standards, a curvature is designed into the lower seat back to support the lumbar spine. Unfortunately, one size does not fit all.

Good **Height-Adjustable Lumbar Support —** The lower back seat curvature is adjustable in at least one direction.

Better **Dual-Axis Adjustable Support —** The lower back seat curvature is adjustable in two directions. This would include 4" of height adjustment as well as support of the lumbar curve.

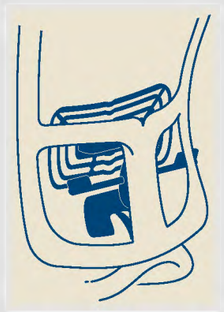
Best **Asymmetric Adjustable Support —** This offers the highest available performance. Comfort is greatly enhanced by allowing users to adjust the height by 4" as well as independently adjust support on either side of the spine.

Pelvic

The sacrum is attached to the pelvis, allowing for little to no motion, which helps strengthen and stabilize the pelvis. However, there is a tendency for the pelvis to rotate backwards into an unhealthy posture when a person is sitting. Pelvic support helps stop the progression of this backward rotation, keeping the spine in alignment.

Pelvic and Asymmetrical Lumbar (PAL) Back System

A Pelvic and Asymmetrical Lumbar (PAL) back system allows people to set their own comfort throughout the day. The pelvic support helps to maintain the spine's natural curvature while the lumbar pad is designed to fit the natural spine curvature.



Pelvic and Asymmetrical Lumbar (PAL) Back System

9 Fredericks and Butt, 2005.

Armrests

The arms represent approximately 10.2 percent of our total body weight, which can result in considerable exertion in the muscles of the upper back, shoulders, and neck.[10] Static exertions (exertion maintained for extended durations in a fixed posture) dramatically increase the risk of muscle fatigue and are often considered the first threshold to injury. Most people experience fatigue as soreness or discomfort in their muscles.

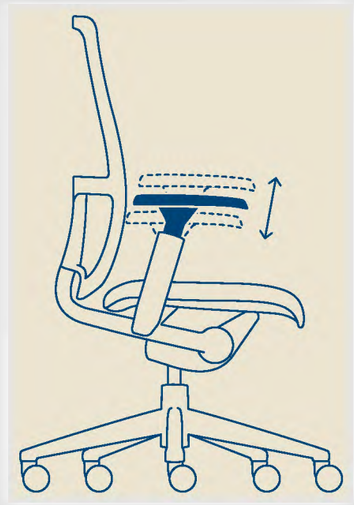
Incorrect

Correct

Supporting arm weight reduces the stress on the spine; however, in order to work armrests must fit. It is also preferable that they are adequately padded.

Armrests that do not adjust and produce contact stress in the vulnerable areas of the elbow and forearm can increase the risks of injuries to these areas. To meet the size range of users, armrests need a considerable range of adjustment so users can adjust arms differently.

10 Winter, 2009.



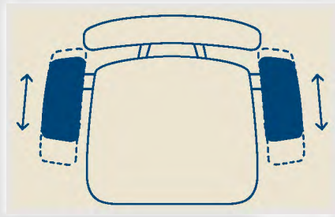
Height

Height

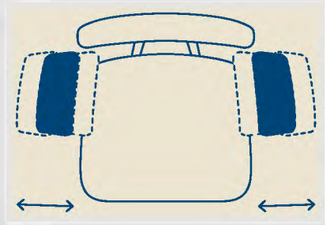
There is considerable variation in the resting seated elbow height. North American standards specify approximately 4" of vertical armrest adjustment.

Front-to-Back Adjustability

To fit the variations in body size, task requirements, and workstation layout, front-to-back armrest adjustability is essential. This can be accomplished through front-to-back movement or 360° rotation arm caps.



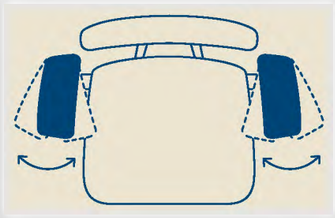
Front-to-Back



Width

Width and Pivot

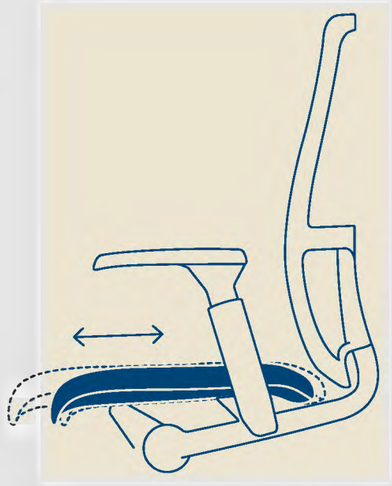
To accommodate the variation in girth, width and pivot adjustments ensure proper fit. In some cases, rotation of a full 360° is desirable.



Pivot

Seat Depth

A chair with a fixed seat pan length limits the population that can fit the chair comfortably. Typically, a taller person will require more seat pan length to reduce contact pressure under the thighs; a shorter person will require less seat pan length to avoid pressure behind the knees or prevent sitting on the edge (which results in loss of back support). Good ergonomic seating incorporates several inches of adjustable seat pan depth. A minimum of 2" of adjustability is recommended; 3" is preferred. A mismatch in the dimensions of a chair impairs the ability of the postural muscles to support the body and can lead to strain on the neuromuscular system. Chairs with adjustable seat pans will help to mitigate and prevent this.[11]

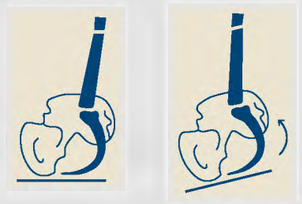


Seat Depth

Forward Tilt

Some people tend to sit on the front edge of the chair. Typically, this is associated with certain task requirements and/or an individual's adopted sitting habit. Often referred to as "perching," this posture may increase ergonomic risks due to reduced support from the seat back and seat pan. However, postural ergonomics can be enhanced through proper seat pan adjustment. A forward tilt of the seat pan can support this seating style while promoting a healthy spinal posture. By tilting the seat forward it provides an alternative sitting posture and relieves lower back pressure.

Forward Tilt



Forawrd tilt rotates the pelvis forward

Seat Recline

Movement is healthy. As we recline in our chairs we stimulate blood flow and relieve the pressure on our spine. By just reclining 20 degrees (from 90 to 110), we can reduce the stress on our spinal discs by approximately 40 percent.[11]

There are different types of seat recline mechanisms and some provide advantages over others. The preferred designs incorporate multiple pivot points, integrate the movement of the seat pan and the seat back movement, and provide adjustable recline effort as well as lockable/stoppable settings.

Tension control is important so that a chair can be adjusted to accommodate users of different body types and sizes and for different workstyles. A summary of recline mechanism performance for a task chair is outlined to the right.

Weight-Activated Mechanism

There are also weight-activated mechanisms that require a person to use their weight to recline, which means larger or heavier people are challenged to stay upright; lighter or smaller people require more effort to recline. Both of these scenarios could cause ergonomic issues. Ultimately, a chair should work with you, not against you, which is why weight-activated mechanisms are more appropriate for touchdown and conference spaces than task seating.

Back Adjustment Options

- **No lock**
- **Upright back lock** — Helps maintain upright position; mainly for people who prefer not to recline.
- **Back stop** — Multi-position; allows for adjusting the recline to the preferred angle.

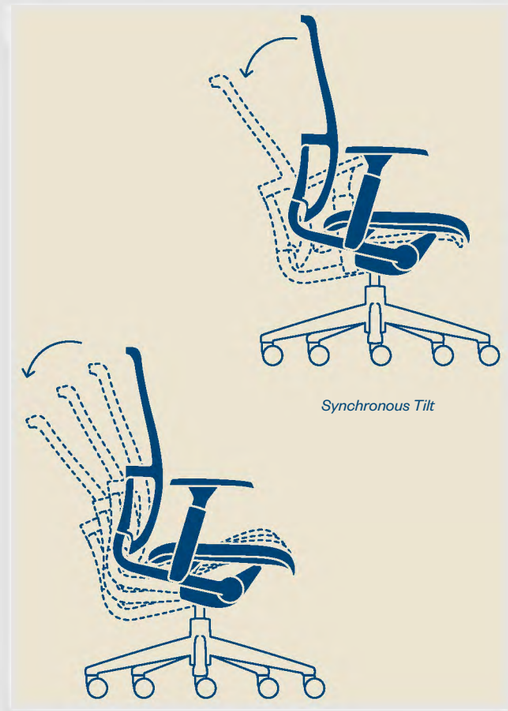
11 van Niekerk, Louw, and Hillier, 2012.

Performance of Seat Recline Mechanisms in Task Chairs

Minimum **Single-Point Pivot** — The seat back reclines approximately 20° in relation to the seat pan. With this type of mechanism, the front edge of the seat pan often rises, creating unwanted pressure under the thighs.

Better **Synchronous Tilt** — The motion of the seat back is linked with partial motion of the seat pan to maintain proper lower body and lumbar support throughout the recline motion. For every 2° of seat back recline the rear edge of the seat pan lowers 1°. This minimizes the front edge seat rise and also opens the chest cavity to allow for easier breathing.

Best **3-Point Pivot** — This synchronous style mechanism has all the benefits of a synchronous tilt, plus it allows the user complete control to further "fine-tune" a more comfortable posture. It also allows a deeper recline of the seat back to further reduce back stress while maintaining effective lumbar and thigh support.



Synchronous Tilt

3-Point Pivot

Critical Chair Features

Here is a summary of the recommended features considered critical to achieve acceptable levels of ergonomics performance across a broad range of users.

Minimum Recommendation

- Appropriate lumbar (lower back) support with at least one axis of adjustment
- Vertically adjustable armrests with adequate padding
- Synchronous recline with tension adjustment and back lock/stop settings
- 2" seat depth adjustment
- 5" seat height adjustment

Desirable Features

- Adjustable lumbar support (height and lateral support)
- Fully-adjustable armrests (pivot and width or 360° rotation)
- 3" seat depth adjustment
- Forward tilt

Special Accommodation

Most chairs will accommodate approximately 95 percent of the population; however, some populations, like smaller females and larger individuals, may need special accommodation for chairs to fit them. Additionally, there may be certain environments that don't need task chairs. Variations on existing chair models may include:

- Low-height bases
- Extra-large chairs to accommodate up to 500 lbs.
- Table stools for various applications
- De-featured chairs for conferencing

User Support and Education

The principles of ergonomic chair adjustments are very simple. However, even the best ergonomic or some basic educational support is recommended—this may be in the form of a hang tag on the chair, or, preferably, electronic documentation available online. Digital support tools enable easy distribution throughout the organization.

How They Compare

A chair is a personal choice, and our portfolio offers a variety of options. All Haworth high-performing ergonomic task chairs are supported by our 12-year, 24/7 warranty, and they share a focus on environmental responsibility.

Fern®

Zody®

Very®

Soji®

Improv® H.E.

	Fern®	Zody®	Very®	Soji®	Improv® H.E.
Family Options					
Task Chair	●	●	●	●	●
Task Stool	●	●	●		●
Headrest	●	●	●		
Family Chairs Available		●	●		●
XL Task Chair					●
Back Stlyes					
Mesh Back		●	●		● (Tag)
Knit Back	●		●	●	
Back Jacket or Upholstered	●	●	●		●
Back Support					
Thoracic	●				
Lumbar (Asymmetrical Adjustment)		● (+ Height-Adjustable)	● (+ Height-Adjustable)		
Lumbar (Height-Adjustable)	●			●	● (+ Depth Adjustment)
Pelvic	●	●			
Arms					
4-D	●	●	●	●	●
3-D					● (Flipper)
Height-adjustable	●	●	●	●	●
Fixed	●	●	●	●	●
No Arms	●	●	●	●	●
Seat					
Seat Depth	●	●	●	●	●
Low-Position Seat Height Adjustment	●	●	●	●	●
Extended/High-Seat Height Range	●	●	●	●	●
Gel Seat Insert		●			
Mechanism					
Back Stop/Lock	●	●	●	●	●
Forward Tilt	●	●	●	●	●
Materials and Finishes					
Plastic Base	●	●	●	●	●
Aluminum Base	●	●	●	●	
Upholstery, Leather (Seat)	●	●	●	●	●
Upholstery, Faux Leather (Seat and Back)	●	●	●		●
Sustainability					
BIFMA level® Certification	level 3	level 3	level 3	level 3	level 1

All task seating is manufactured in the USA. Chairs fit the 5th–95th percentile, up to 325 lbs., and ship completely assembled within a standard three-week lead time.

Ergonomic Seating Evaluation Form

Evaluator Name: _____ Title: _____ Date: _____

Manufacturer: _____ Model #: _____

Manufacturer: _____ Model #: _____

Manufacturer: _____ Model #: _____

Evaluation Criteria		Check Yes or No		Check Yes or No		Check Yes or No	
A.	**Chair Features**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
1.	Seat height adjusts at least 4.5".						
2.	Standard seat pan depth adjusts at least 2".						
3.	Seat pan has a waterfall or flexing front edge.						
4.	The backrest to seat pan angle allows the user to keep his/her torso-to-thigh angle at 90° or greater.						
5.	The tension for the chair's recline can be adjusted.						
6.	The chair has a back stop or back lock.						
7.	The chair has forward tilt or has the option for forward tilt where the seat and backrest move with each other to maintain back support while in the forward tilt position.						
8.	The chair has a lumbar support.						
9.	Lumbar support is adjustable up and down.						
10.	Lumbar support can be adjusted to provide different levels of support.						
11.	Lumbar support can be adjusted to provide asymmetrical support.						
12.	The chair has a self-adjusting pelvic support.						
13.	The armrest height adjusts at least 4".						
14.	The armrests/caps adjust side to side.						
15.	The armrests/caps pivot at least 15° towards the body and away from the body.						
16.	The armrests adjust forward and backward.						
17.	The armrests are soft/padded (i.e., gel, foam).						
A:	**Total Chair Features**						
B.	**Aesthetics**						
17.	The chair's aesthetics are appealing.						
18.	The chair looks comfortable.						
19.	The chair controls integrate well into the overall design of the chair.						
B:	**Total Aesthetics**						

		Strongly Disgree				Strongly Agree	Strongly Disgree				Strongly Agree	Strongly Disgree				Strongly Agree
C.	**Chair Comfort**															
20.	The chair's backrest does not interfere with the movement of the arms/shoulders when reaching for something.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
21.	The shape of the backrest fits the back.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
22.	The chair's lumbar support provides the appropriate amount of support.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
23.	The chair's pelvic support provides the appropriate amount of support.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
24.	The chair's backrest is comfortable.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
25.	The chair's seat pan is soft around the edges.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
26.	The shape/contour of the chair's seat pan fits and does not create any pressure points.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
27.	Sitting in the chair does NOT cause any pain/numbness in the buttocks or legs.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
28.	When reclining in the chair, the front edge of the seat does not rise and the feet remain flat on the floor.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
29.	This chair allows for comfortable sitting in a variety of postures.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
30.	The chair can be adjusted to an individual's ideal comfort position.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
C:	**Total Chair Comfort**															
D.	**Ease of Use**															
31.	The chair is easy to adjust from a seated position.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
32.	The chair adjustments/controls are easy to find.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
33.	The chair adjustments/controls are easy to use.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
34.	The symbols/pictures on the adjustment lever/controls are easy to understand.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
35.	The chair's adjustment levers/controls have enough clearance room around them for the user's hands.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
36.	The chair's tension can be easily adjusted.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
37.	The lumbar support can be adjusted from a seated position.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
D:	**Total Ease of Use**															
E.	**Body Support**															
38.	While working, a person's back is firmly pressed against the backrest.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
39.	The chair is stable when sitting in a reclined posture.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
40.	The chair has consistent lumbar support when reclining.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
41.	The armrests can be adjusted to support the forearms in a variety of postures and angles.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
42.	The armrest length allows an individual to sit close to the work surface while maintaining contact with the backrest.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
E:	**Total Body Support**															

Total Score (A (number of yes's) + B (number of yes's) + C + D + E) =

References

Amick, B., Robertson, M., DeRango, K., Bazzani, L., Moore, A., Rooney, T., and Harrist, R. Effect of office ergonomics intervention on reducing musculoskeletal symptoms. Spine, 28(24), (2003): 2706-2711.

Fredericks, T.K. and Butt, S.E. Objectively Determining Comfortable Lumbar Support in Task Seating, 2005. (Available from Haworth, Inc., One Haworth Center, Holland, MI 49423.)

Healthy Computing. Office Ergonomics – Chair Setup and Usage, March 8, 2007. healthycomputing.com/office/setup/chair/index.

Karakolis, Thomas, and Jack P. Callaghan. "The Impact of Sit–Stand Office Workstations on Worker Discomfort and Productivity: A Review." Applied Ergonomics, vol. 45, no. 3, 2014: pp. 799–806.

Martin, D. C., and Richards, G. N. Predicted body weight relationships for protective ventilation – unisex proposals from pre-term through to adult. BMC Pulmonary Medicine, 17(1), 85 (2017).

National Safety Council. Injury Facts. Itasca, IL: National Safety Council, 2007: 47-83.

US Bureau of Labor Statistics. "United States Department of Labor." Economic News Releases Press Office Employer Reported Workplace Injury and Illnesses, 2017, Bureau of Labor Statistics, 2018.

US Department of Health and Human Services. "Anthropometric Reference Data for Children and Adults: United States, 2011–2014." National Health and Nutrition Examination Survey, August 2016, www.cdc.gov/nchs/data/series/sr_03/sr03_039.pdf.

Winter, David A. Biomechanics and Motor Control of Human Movement. Hoboken: John Wiley & Sons, 2009.

van Niekerk, S. M., Louw, Q. A., and Hillier, S. The effectiveness of a chair intervention in the workplace to reduce musculoskeletal symptoms. A systematic review. BMC Musculoskeletal Disorders, 13, 145 (2012).

Zemp, Roland, et al. "Seat Pan and Backrest Pressure Distribution While Sitting in Office Chairs." Applied Ergonomics, vol. 53, (2016): pp. 1–9.

haworth.com | 800.344.2600