



Knoll Workplace Research

ReGeneration by Knoll: An Ergonomic Evaluation

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Knoll

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It's a new generation for office work. Today we work in and out of traditional offices, in personal and shared workspaces, at individual and collaborative activities, using an ever-growing array of technologies. The cliché that the one constant thing about office work is change contains a great truth. Office work is a sequence of changes: changes in tasks, the people we work with and, importantly, the postures in which we work.

With the ReGeneration by Knoll® chair, Knoll has produced an innovative ergonomic design that keeps pace with these changes while minimizing the amount of user input required. It is the latest in a family of chairs with built-in flexibility designed to address the way we work today. In this paper, we asked Tom Albin, a leading ergonomist, to define the changing parameters of office work and then review the ReGeneration chair as an ergonomic solution.

There's No One Right Way to Sit

Common myth has it that there is one perfect ergonomic posture for all office work. In fact, there is no one "right way" to sit. A basic concept of ergonomics is bending the tool to fit the work, not bending the worker to fit what's available. Since office work is all about change, we need to think about office tools that bend with users rather than constraining their postures.

A prime example of such a tool is the office chair. If we ever had the misapprehension that there was one correct way to sit, that opinion has happily been put to rest. Ergonomic office chairs must accommodate a wide range of users, tasks and working postures.

Chair Users Vary in Size and Shape

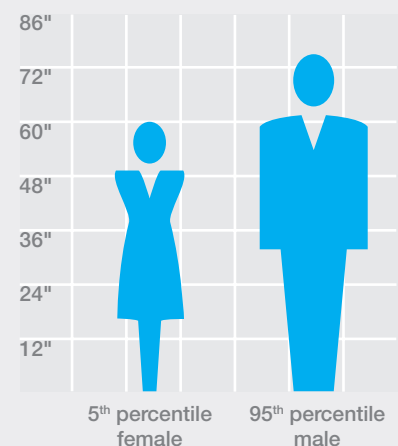
People who work in offices vary in size and shape, and a good office chair must accommodate the range of expected users, which is typically done by making chairs that adjust. Ergonomic technical standards¹ for chairs typically specify chair dimensions

that, when appropriately adjusted, will accommodate individuals ranging in size between a 5th percentile female and a 95th percentile male. Ergonomic office chairs need to be able to readily adjust to fit these widely varying sizes of users.

Tasks and Seated Postures Change Constantly

Studies carried out in 2004 and 2005 showed that people working in offices spend an average of 3 to 11 minutes on any given task before changing to another; and they change work tools every 2 minutes on average.^{2,3} This means that people performing office work while seated constantly change their posture. As an example, a Swiss study found that office workers changed trunk postures every 3-4 minutes.⁴ A good ergonomic chair needs to be able to quickly follow the changes in order to keep pace with these movements and accommodate these postural changes.

Ergonomic office chairs must be able to readily adjust to fit widely varying sizes of users



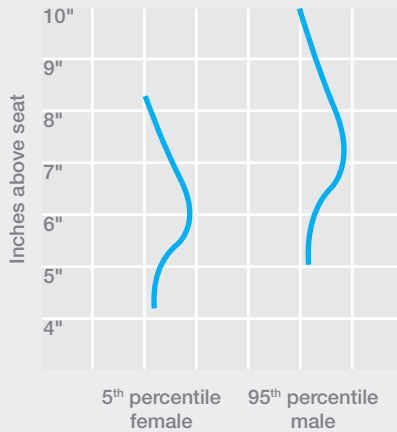
Ergonomic office chairs should accommodate individuals between a 5th percentile female and a 95th percentile male

Tasks Change Constantly



Chairs need to be able to quickly adjust to changing tasks and postures

The shape and location of the lumbar curve varies between individuals



Ergonomic office chairs should be able to support the lumbar curve variations among a wide range of individuals

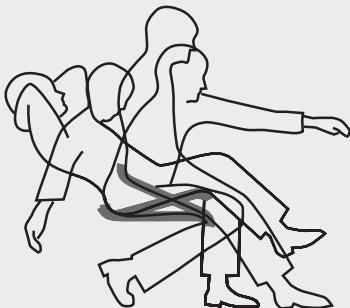
The Shape We're In Now

While we now understand that there is no one correct way to sit and that ergonomic standards, such as ANSI/HFES 100, describe a range of valid seated postures, we also know that certain chair contours are very important. For example, lumbar support helps maintain *lumbar lordosis*, the natural curve of the spine in the lumbar region. The shape of the lumbar curve varies between individuals. Sitting without an appropriately shaped and located lumbar support causes the lumbar curve to flatten, creating unequal pressure concentrations on the spinal disks.

Movement Is Critical

Ergonomists agree that it is better for people to move than to sit constantly in one position, which is fortunate indeed, because movement is necessary to assume the different postures and to perform the different tasks that office workers perform.

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Movement has other important benefits for back health and comfort: it allows the muscles in the back to relax and contract and it promotes disk nutrition. As people change posture while seated, pressure on the disks between the vertebrae increases and decreases. This movement is necessary for good disk nutrition. When the pressure is relieved, nutrients enter the disk, nourishing it. When the pressure increases, waste products are squeezed out. Movement while seated is both natural and healthy.

An Unadjusted Chair Is Not Ergonomic

Office chairs must be able to support people in a wide range of sizes and shapes as they work in a broad array of frequently changing task postures. However, this capability requires ongoing adjustments. If the chair isn't adjusted to fit the person sitting in it, or the posture that he is working in, it isn't an ergonomic chair. And here's the big problem: people often don't change the adjustments of their chairs.

A Dutch study⁵ confirmed that controls are rarely used. In the best case, seat height control, the most consistently used adjustment, was used less than half the time! When people change postures every few minutes, manually adjusting controls that change chair contours becomes onerous and is quickly forgotten.

Summing Up the Problem

- ▶ People come in many sizes and shapes but do not consistently use controls to change chair contours to fit their body type
- ▶ People change their torso postures every few minutes, but they commonly sit in chairs adjusted for only one work posture
- ▶ An unadjusted adjustable chair is really a fixed contour chair
- ▶ A fixed contour chair generally provides comfort for only one body position and does not address individual differences in size or shape

A New Approach

If people don't make appropriate chair adjustments or don't know how to make them, then why not take a new approach and create chairs that adjust as tasks and individuals change – and that do it with minimal use of manual controls?

In response to this challenge, Knoll explored emerging material technology and designed and developed a chair with a seat and back that respond differentially to a user's weight and size. The key to the back support is a high-performance flexible elastomeric net that provides "omni-contouring" support for users' backs.

The term comes from research at the Aero Medical Laboratory at Wright Patterson Air Force Base that looked at the comfort of designs for extremely light,

high-performance aircraft seats⁶. The study concluded, "Contouring of seats is predicated on the assumption that maximum contact and support over the greatest body area leads to

improvements in seating comfort." It noted that, "With a fixed, or rigid contour this is successful for only one body position. If the seated individual shifts his positioning, the contouring no longer fits." The study observed that, "... flexibility of material suggests the property of omni-contouring." And the research identified a need for "lumbar support and adequate support for the shoulders and upper back."

Omni-contouring is the ability of a sitting surface to conform to individual differences in body size and type — and to shifts in body position.

ReGeneration maintains a good lumbar arch

In an informal assessment of the adaptability of the ReGeneration chair's lumbar support in response to weight and size of two users, the shape of the lumbar profile was measured for one small female and one large male. The shape of the lumbar arch changed consistently to match each user, with the position of the maximum depth of lumbar support lower for the female than for the male, as would be expected from differences in height and weight.

Ergonomic Features of the ReGeneration Chair

The ReGeneration chair brings form and function to the learnings from the Air Force study and half a century of innovation in materials and technology. ReGeneration uses a sophisticated high performance elastomeric material in a net design that “reads” the body of the user, conforming to the position of the body as surface contact changes.

Automatic Adjustment/Limited Manual Controls

- ▶ Has automatic backrest tension which is calibrated to body weight, movement and dimension
- ▶ Has two levers which control seat height/recline resistance and seat depth

Dynamic Suspension Control

- ▶ Is a solid-state construction using high performance elastomer flexors and a nest-like structure supporting the seat
- ▶ “Reads” and automatically adjusts backrest recline resistance to the user’s weight. Perceived sense of “springiness” changes in response to the weight of the user. The heavier the user, the greater the support and hence the greater perceived “stiffness” of the backrest. The lighter the user, the less the stiffness required for support and hence the greater perceived “softness.”
- ▶ Maintains upright position with a manual recline resistance feature

Flex Back Net

- ▶ Changes contour in response to user size and changes in posture (omni-contouring)
- ▶ Provides support in the lumbar and upper back regions. Wider net spacing in the lumbar region provides greater flexibility and conformance to the shape of the user’s back. Tighter net spacing in the shoulder region provides firmer support for the upper back.

Contoured Polymer Frame

- ▶ Is shaped to support the user’s back and shoulders
- ▶ Provides flexibility on front and both sides of seat to avoid constricting circulation behind the knees

Adjustable Seat Height

- ▶ Has four cylinder ranges — low, standard, high and high task — to suit a range of users and work settings



Adjustable Arms

- ▶ Provide support without rigidity
- ▶ Adjust in height within a 4” range; optional width, depth and pivot arm pads available
- ▶ Are mounted toward the back of the chair — to allow greater side-to-side movement

Lumbar Arch

- ▶ Maintains good arch support in lumbar region for both male and female users (Lumbar region approximately 5.9 – 9.9 inches above compressed seat height)

Conclusions

The ReGeneration chair conforms to the ergonomic requirements of ANSI/HFES 100-2007 and to the durability testing of ANSI/BIFMA X5.1:2011, the two key documents that provide guidance in the development of ergonomic furniture products.⁷

The omni-contouring capability of the ReGeneration chair backrest dynamically conforms to the size and shape of an individual user’s back to provide good back support without the use of manual adjustment controls. The design of the backrest responds differentially to individualize support for the lower and upper back.

This innovative strategy of the ReGeneration chair is an interesting ergonomic advancement that facilitates ergonomic backrest adjustments that are dynamic and follow users’ constant postural changes without requiring manual control changes for each posture. The ability of the ReGeneration chair to provide omni-contouring with fitted back support for people of different sizes and shapes as they change position without extensive input from the user is an ergonomics “plus.”

About the Author

Tom Albin, MA, MS, PE, CPE, leads an ergonomics consulting practice, High Plains Engineering Services. He has more than 20 years of experience in industrial and office ergonomics, including program design and implementation, applied research, product development, and usability testing. He chaired the committee that published ANSI/HFES 100-2007, the American National Standard for computer workstations. Additionally, he serves as a US representative to various international standards committees and is the vice-convenor of the committee responsible for ISO 9241-5, the international standard for workstation ergonomics.

End Notes

- 1 ANSI/HFES 100-2007 Human Factors Engineering of Computer Workstations, Human Factors and Ergonomics Society, Santa Monica, California <http://www.hfes.org/Publications/ProductDetail.aspx?ProductID=69>
- 2 Gonzalez, V.M., and Mark, G. (2004) "Constant, Constant, Multi-Tasking Crazy: Managing Multiple Working Spheres." Proceedings, CHI 2004, 6 (1), Vienna, Austria
- 3 Mark, G., Gonzalez, V.M., Harris, J. (2005) "No Task Left Behind? Examining the Nature of Fragmented Work." Proceedings, CHI 2005, Portland, OR
- 4 Graf, M., Guggenbühl, U., Krueger, H. (1995) An Assessment of Seated Activity and Posture at Five Workplaces. *International Journal of Industrial Ergonomics* 15, p. 88.
- 5 Vink, P., Porcar-Seder, R., Page de Pozo, A., Krause, F., (2007) Office Chairs are Often Not Adjusted by End-Users. Proceedings of the Human Factors and Ergonomics Society 51st Annual Meeting - 2007, Santa Monica, CA
- 6 Forrest, J., Wade, E.A. (1958) Light Weight Seating: Design Research on a Nylon Net Seat – One of a Series of Studies Pertaining to Crew Compartment Habitability for Extended Missions. Aero Medical Laboratory, Wright-Patterson Air Force Base
- 7 O'Neill, M. (2011) Office Ergonomic Standards: A Layperson's Guide. White Paper, Knoll, Inc., New York, NY

Through research, Knoll explores the connection between workspace design and human behavior, health and performance, and the quality of the user experience. We share and apply what we learn to inform product development and help our customers shape their work environments. To learn more about this topic or other research resources Knoll can provide, visit www.knoll.com/research/index.jsp



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