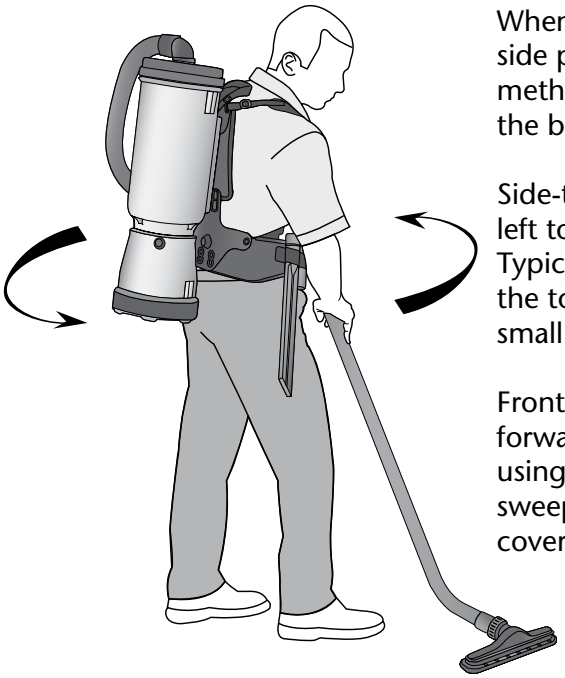
Backpack Vacuum Ergonomics and Productivity

By Jim Fullmer, CHFP



When using a backpack vacuum, it is best to vacuum using a side-to-side pattern rather than front to back. Not only does the side-to-side method allow people to vacuum an area twice as fast, it is also one of the best ways to vacuum from an ergonomic perspective.

Side-to-side vacuuming refers to guiding the head of the vacuum from left to right across the floor, then right to left, to vacuum an area. Typical observations, when using a backpack vacuum, include twisting the torso to move the vacuum head from side to side as well as taking small steps forward to reach new areas to vacuum.

Front-to-Back vacuuming refers to guiding the head of the vacuum forward and backward to vacuum an area. Typical observations, when using an upright vacuum, include trying to maximize the front-to-back sweep by extending forward as far as possible to maximize the area covered with each stroke then returning to a standing position.

In general, the term ergonomics refers to the science of adapting jobs or equipment to people for optimal safety and productivity.

The content of this paper explains the science that has gone into the ProTeam backpack vacuum systems as part of ergonomic design and testing.

ProTeam backpacks require less than half the energy and effort to clean the same area as an upright.

The main reason for the gain in productivity is due to the side-to-side vacuuming pattern possible when using a backpack vacuum. Given the same square footage to vacuum, participants in a study at the Battelle Memorial Institute vacuumed front-to-back with an upright and with a backpack vacuum. These same participants also vacuumed with the backpack vacuum using the side-to-side vacuuming pattern. The study found that people could vacuum the same area in about half the time when vacuuming side-to-side as compared to using the front-to-back pattern.

How was the energy needed to perform the vacuuming tasks measured?
During each of the vacuuming trials, participants were connected to equipment that measured their oxygen consumption while vacuuming. The amount of oxygen used corresponds to the number of calories, or energy, used to accomplish the task.

Little difference was found in energy usage rates between upright vacuums vs. backpack vacuums nor front-to-back vacuuming vs. side-to-side vacuuming. Given that a person can vacuum twice the area in the same amount of time using the side-to-side pattern possible with a backpack vacuum, however, it only takes about half the energy to vacuum the same area compared to using an upright.

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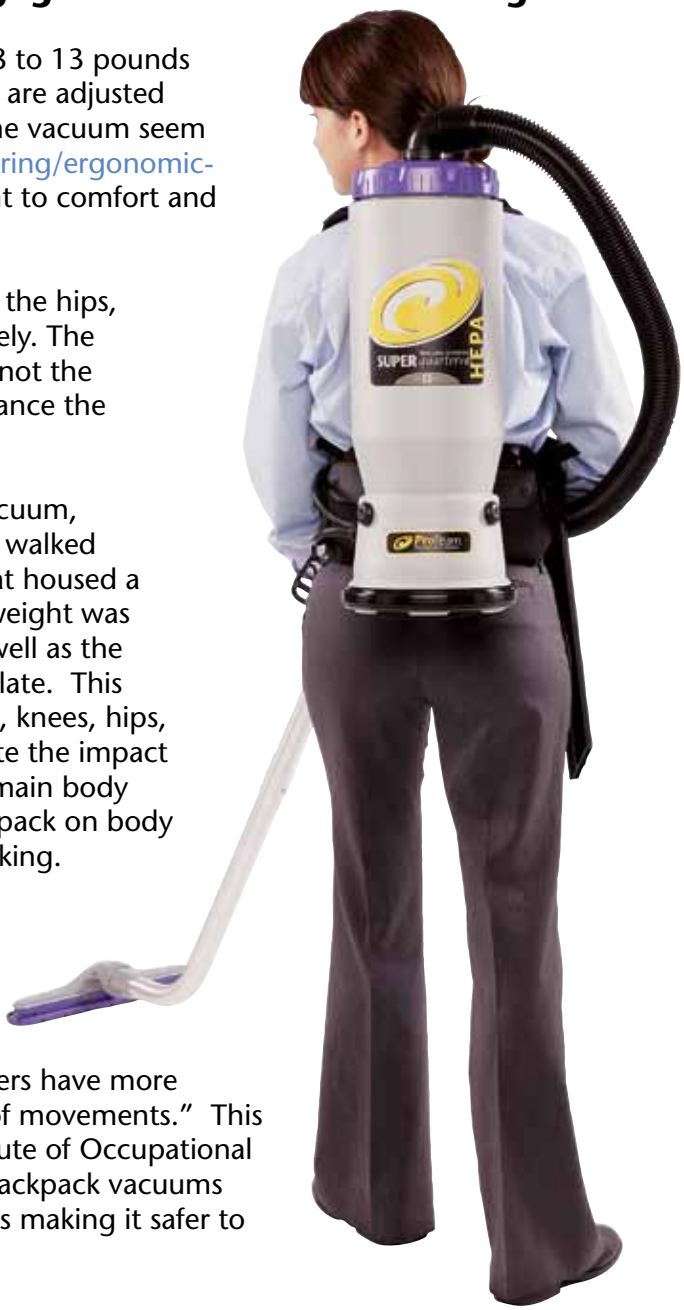
Many people first learn to vacuum using the front-to-back pattern. A small amount of training may be necessary to achieve the approximate two times productivity possible with a backpack vacuum and side-to-side vacuuming.

Backpack vacuums are lightweight. When worn properly, the affect of the backpack on body joints and posture is negligible and similar to walking.



ProTeam backpack vacuums range in weight from 8 to 13 pounds (3.6 to 5.9 kilograms). When harnesses and straps are adjusted properly, the weight is evenly distributed making the vacuum seem like it weighs much less. (http://asumag.com/Flooring/ergonomic-backpack-vacuums-200907/) Proper fit is important to comfort and load balancing.

The padded waist belt should fasten snugly around the hips, allowing shoulder straps to fit comfortably but loosely. The primary weight of the unit should rest on the hips, not the shoulders, since shoulder straps serve mainly to balance the pack and prevent load shifting.

After being properly fitted to wear the backpack vacuum, participants in the Battelle Memorial Institute study walked over a portion of the area they were vacuuming that housed a force plate. This plate would measure how much weight was transferred from the person's shoes to the floor as well as the direction of the force as people moved across the plate. This data, along with 3-D position of body joints (ankles, knees, hips, shoulders, elbows, etc.), made it possible to estimate the impact of vacuuming with the backpack vacuum on each main body joint. Researchers found that the affect of the backpack on body joints and posture was negligible and similar to walking.

When working near stairs, using a backpack vacuum improves mobility and is recommended to reduce the risk of falling.

"Because the vacuums are worn on the body, workers have more maneuverability and greater variety in their range of movements." This quote from a report available on the National Institute of Occupational Safety and Health (NIOSH) website indicates that backpack vacuums provide better mobility than other types of vacuums making it safer to work near obstacles such as stairs.

Backpack vacuum users tend to use a more neutral posture compared to extreme arm and leg extensions seen when using an upright.

When wearing a backpack vacuum, users tend to have a more neutral posture similar to what might be seen when people walk. When using an upright vacuum, people tend to extend their body as far forward as possible to maximize the length of each vacuum stroke. Continuously repeating these extreme body extensions, when using an upright, could increase fatigue in the arms and legs.

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With a backpack vacuum, people tend to walk to cover more area rather than try to reach as far as possible with their arms. Staying upright while vacuuming with a backpack vacuum also keeps your spine in a neutral posture and helps avoid lower back pain.

Side-to-side vacuuming uses leg and back muscles that do not fatigue as easily as the arms.

Certain muscle groups are better equipped for extended use. The leg muscles, for example, allow the average person to walk for a very long time. The arms, on the other hand, get fatigued more easily and need more rest more often when used heavily. With front-to-back vacuuming, people tend to use their arms a lot which leads to quick fatigue. As previously stated, people tend to walk more to cover more area when using a backpack vacuum. This causes more use of the leg muscle groups and less need for frequent rest. With the side-to-side vacuuming pattern, large muscle groups in the back (Latisimus Dorsi) are used to achieve the side-to-side motion. These large muscles are also well equipped for longer periods of light work like vacuuming.

Don't larger muscle groups require more energy?
Generally, yes. When more muscle fibers are recruited to achieve movement, more energy is needed to achieve that movement. Fortunately, just because a person walks and uses his or her leg muscles, it does not mean that every muscle fiber within the leg muscles is being used. In other words, a typical person will only use a fraction of the muscle fibers in their legs when walking as compared to using most of the muscle fibers in the leg to lift something very heavy. Side-to-side vacuuming with a backpack vacuum may use larger muscle groups but uses them at casual levels. In fact, the Battelle Memorial Institute study found that energy expenditure was approximately the same whether a person used an upright vacuum, a backpack vacuum, vacuumed front-to-back, or side-to-side. What was found in the study, however, is that a person could vacuum twice the area in the same amount of time with the side-to-side vacuuming technique possible with a backpack vacuum. That equals half the energy required to clean the same area with an upright.

Summary

Side-to-side vacuuming, along with a typical work/rest schedule, is one of the best ways to vacuum a large area on a regular basis from an ergonomic and productivity standpoint.

Note: A typical work/rest schedule in the United States is to provide 15 minutes of rest for every two hours of work.

Jim Fullmer is a Certified Human Factors Professional with experience in ergonomic design of manufacturing equipment and workstations. Jim earned his Master's degree in Industrial Engineering at Texas Tech University and a Baccalaureate degree in Psychology from University of Idaho.

Source—
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