



Ergonomics eTool: Solutions for Electrical Contractors

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Materials Handling

Electrical workers face ergonomic issues when transporting supplies and equipment around shops, storage areas, and worksites. This section discusses potential hazards and identifies possible solutions involved in the following tasks:



- [Heavy Lifting](#)
- [Pushing, Pulling, & Carrying](#)
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Materials Handling: Heavy Lifting

Lifting heavy items is one of the leading causes of injury in the workplace. In 2001, the Bureau of Labor Statistics reported that over 36 percent of injuries involving missed workdays were the result of shoulder and back injuries. Overexertion and cumulative trauma were the biggest factors in these injuries.

When workers use smart lifting practices and work in their "[power zone](#)," they are less likely to suffer from back sprains, muscle pulls, wrist injuries, elbow injuries, spinal injuries, and other injuries caused by lifting heavy objects.



- [Weight of Objects](#)
- [Awkward Postures](#)
- [High-Frequency and Long-Duration Lifting](#)
- [Inadequate Handholds](#)
- [Environmental Factors](#)

Weight of Objects

Potential Hazards:

- Some loads, such as large spools of wire (Figure 1), bundles of conduit, or heavy tools and machinery place great stress on muscles, discs, and vertebrae.
- Lifting heavy loads has been associated with increased risk of injury.



Figure 1
A spool holding 117 pounds of wire

Possible Solutions

- Use mechanical means such as [forklifts](#) (Figure 2) or [duct lifts](#) to lift heavy spools, transformers, switch gear, service sections, conduit, and machinery.
- Use pallet jacks and hand trucks to transport heavy items.
- Avoid rolling spools. Once they are in motion, it is difficult to stop them.
- Use suction devices (Figure 3) to lift junction boxes and other materials with



Figure 2
Forklift

smooth, flat surfaces. These tools place a temporary handle that makes lifting easier.

- Use [ramps](#) or lift gates to load machinery into trucks rather than lifting it.
- Place materials that are to be manually lifted at "[power zone](#)" height, about mid-thigh to mid-chest. Maintain neutral and straight spine alignment whenever possible. Usually, bending at the knees, not the waist, helps maintain proper spine alignment.
- Order supplies in smaller quantities and break down loads off-site. When possible, request that vendors and suppliers break down loads prior to delivery.
- Prefabricate items in a central area where [mechanical lifts](#) can be used. Only transport smaller, finished products to the site.
- Establish a weight limit for single person lifts. Consider mechanical assists or multiple persons (Figure 4) for lifting loads heavier than your established limit.
- Work with suppliers to make smaller, lighter containers.



Figure 3
Suction tool



Figure 4
Two-man lift

Awkward Postures

Potential Hazards:

- Bending while lifting (Figure 5) forces the back to support the weight of the upper body in addition to the weight you are lifting. Bending while lifting places strain on the back even when lifting something as light as a screwdriver.
- Bending moves the load away from the body and allows leverage to significantly increase the effective load on the back. This increases the stress on the lower spine and fatigues the muscles.
- Reaching moves the load away from the back, increases the effective load, and places considerable strain on the shoulders.
- Carrying loads on one shoulder, under an arm, or in one hand, creates uneven



Figure 5
Worker twisting in an awkward position

pressure on the spine.

- Poor housekeeping limits proper access to objects being lifted, and forces awkward postures.

Possible Solutions

- Store and place materials that need to be manually lifted and transported at [power zone](#) height, about mid-thigh to mid-chest.
- Minimize bending and reaching by placing heavy objects on shelves, tables, or racks. For example, stack spools on pallets to raise them into the power zone.



Figure 6
Different approaches to lifting

- Avoid twisting, especially when bending forward while lifting. Turn by moving the feet rather than twisting the torso.
- Keep the vertical distance of lifts between mid-thigh and shoulder height. Lifting from below waist height puts stress on legs, knees, and back. Lifting above shoulder height puts stress on the upper back, shoulders, and arms.
- Keep the load close to the body. When lifting large, bulky loads, it may be better to bend at the waist instead of at the knees in order to keep the load closer to your body (Figure 6).



Figure 7
Aerial lift

- Use [ladders](#) or [aerial lifts](#) (Figure 7) to elevate workers and move them closer to the work area so overhead reaching is minimized.
- Break down loads into smaller units and carry one in each hand to equalize loads. Use buckets with handles, or similar devices, to carry loose items.
- Optimize employee access to heavy items through good housekeeping and preplanning.
- Use [roll-out decks](#) installed in truck beds to bring materials closer to the worker and eliminate the need to crawl into the back of a truck. See the [Vehicular Activities](#) section for more information.

High-Frequency and Long-Duration Lifting

Potential Hazards:

- Holding items for a long period of time, such as when installing fixtures or j-boxes (Figure 8), even if loads are light, increases risk of back and shoulder injury, since muscles can be starved of nutrients and waste products can build up.
- Repeatedly exerting, such as when pulling wire, can fatigue muscles by

limiting recuperation times. Inadequate rest periods do not allow the body to rest.

Possible Solutions

- Use a template made of a lightweight material (Figure 9) such as cardboard to mark holes for drilling when mounting heavy items such as junction boxes and service panels. This ensures that the heavier item does not need to be held in place to level and measure for anchor mounts.
- Provide stands, jigs, or mechanical lifting devices such as duct lifts to hold large, awkward materials such as junction boxes and service panels in place for fastening.
- Rotate tasks so workers are not exposed to the same activity for too long.
- Work in teams; one worker lifts and holds items while the other assembles.
- Take regular breaks and break tasks into shorter segments. This will give muscles adequate time to rest. Working through breaks increases the risk of musculoskeletal disorders (MSDs), accidents, and reduces the quality of work because workers are overfatigued.
- Plan work activities so workers can limit the time they spend holding loads.
- Pre-assemble work items such as fixtures or boxes (Figure 10) to minimize the time workers spend handling them.



Figure 8
Worker reaching overhead



Figure 9
Cardboard template for lighting fixtures



Figure 10
A prefabricated electrical box

Inadequate Handholds

Potential Hazards:

- Inadequate handholds (Figure 11) make lifting more difficult, move the load away from the body, lower lift heights, and increase the risk of contact stress and of dropping the load.

Possible Solutions

- Utilize [proper handholds](#), including handles, slots, or holes (Figure 12), with enough room to accommodate gloved hands.
- Ask suppliers to place their materials in containers with proper handholds.
- Move materials from containers with poor handholds or without handholds into containers with good handholds.
- Wear proper personal protective equipment (PPE) to avoid finger injuries and contact stress. Ensure that [gloves](#) fit properly and provide adequate grip to reduce the chance of dropping the load.
- Use suction devices (Figure 13) to lift junction boxes and other materials with smooth, flat surfaces. These tools place a temporary handle that makes lifting easier.



Figure 11
Boxes without handles



Figure 12
Slots in boxes help in lifting



Figure 13
Suction device

Environmental Factors

Potential Hazards:

- Cold temperatures can cause decreased muscle flexibility, which can result in muscle pulls.
- Excessively hot temperatures can lead to dehydration, fatigue, and increased metabolic load.
- Low visibility or poor lighting (Figure 14) increases the chance of trips and falls.

Possible Solutions

- Adjust work schedules to minimize



Figure 14
Work space with window as only light source

exposure to extreme temperatures.

- Wear warm clothing when exposed to cold temperatures.
- Drink lots of water to avoid dehydration in excessive heat.
- Provide proper lighting (Figure 15) for areas with low light and perform work during daylight hours.



Figure 15
Light stand illuminating the work area.

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Materials Handling: Pushing, Pulling & Carrying

Electrical work involves moving materials around the worksite. Commonly, there is a central staging area from where supplies are distributed to separate work areas. This can involve pushing, pulling, and lifting materials, sometimes with the help of a hand truck or utility cart.



The following hazards may exist when workers transport materials around the worksite:

- [Awkward Postures](#)
- [Forceful Exertion](#)

Awkward Postures

Potential Hazards:

- Assuming awkward postures such as reaching behind the body, bending forward and to the side, and twisting when pushing and pulling materials (Figure 1), may lead to muscle strain and spinal injuries.
- Handles that arc too high or too low require extra force exertion.

Possible Solutions:

- Use [transport devices](#), such as hand trucks and pallet jacks, and know the [correct postures](#) to maintain when using these tools.
- Provide transport devices with appropriate handles. These handles should be in the [power zone](#) (Figure 2) when pushing and large enough to accommodate the entire hand. There should be no sharp edges or rough spots that could cut or pinch the worker's hands.
- Avoid pulling when possible. Pushing generally takes less effort than pulling because your body weight is used to assist the exertion. Also, pulling a load often causes carts to run into the shins or ankles.
- Use vertical handles instead of horizontal handles



Figure 1
Worker twisting in an awkward posture

to allow workers of different heights to maintain neutral postures.

- Do not stack materials on a cart higher than eye level so that you do not have to bend to the side to see around the load. Workers should be able to easily see over the top of the load.
- Use [stair-climbing hand trucks](#) to transport materials up and down stairs.
- Limit the weight of loads to limit the necessary pushing force. For example, the [IEC](#) recommends limiting the weight of loads so that the required pushing force remains less than 50 pounds. The greater the force that is necessary to push the load, the greater the risk of injury.



Figure 2
Pushing in the power zone

Forceful Exertion

Potential Hazards:

- Operating transport devices with improperly functioning wheels (Figure 3) makes moving materials more difficult than necessary.
- Exerting more force to guide a hand cart with under-inflated or unevenly pressurized tires may put stress on a worker's arms, back, and legs.
- Moving carts or hand trucks over bumpy, rough terrain or up and down stairs may expose workers to abrupt, jarring impacts which can cause shoulder and back strain.



Figure 3
Uneven, thinning wheels
on a hand truck

Possible Solutions:

- Replace wheels when they become wobbly or uneven.
- Select [hand trucks or carts](#) with pneumatic wheels (Figure 4) for moving things over bumpy, uneven terrain or up and down stairs.
- Check the air pressure of pneumatic tires and fill them to the recommended pressure.
- Use [transport devices](#), such as hand trucks and pallet jacks, and know the [correct postures](#) to maintain when using these tools.
- Provide workers with access to elevators or ramps so they can avoid stairs and bumpy ground.
- Use [powered hand trucks](#) with stair-climbing and self-leveling abilities when stairs can not be avoided.
- Develop good housekeeping practices to ensure that floors are clean so there



Figure 4
Pneumatic tires

is minimal resistance.

- Wear shoes with good soles to maintain firm footing.
- Reduce the size of the load you carry when going up and down stairs to reduce the force required to transport loads.
- Use curb ramps that allow the worker to easily push the transport device over curbs.



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Materials Handling: Staging & Housekeeping

Everybody benefits when employers encourage proper staging and housekeeping practices; productivity rises, quality improves, profits increase, and the risk of injury is reduced. Workers can spend less time moving materials and more time performing skilled tasks.

- [Staging](#)
- [Housekeeping](#)



Staging

Potential Hazards:

- Poorly-planned staging may result in workers lifting materials from awkward locations or carrying materials longer than necessary.

Possible Solutions

- Place materials on stands, racks, or other devices (Figure 1) that allow them to be in the [power zone](#), minimizing the need to bend or reach to access materials.
- Try to stage materials at close proximity to the point of use. This reduces walking distances, an element that affects risk factors, efficiency, and productivity.
- Plan staging so that materials and equipment can be placed in a central location so workers have good access to materials.
- Preplan, in the bidding stage, the space and type of racking needed (Figure 2) to store conduit and spools of wire at a central location, allowing easy access and locating materials in the [power zone](#).



Figure 1
Materials placed on a raised stand for easy access



Figure 2
Materials placed on a mobile rack

Housekeeping

Poor housekeeping (Figure 3) creates a disorderly workspace, which increases the risk of ergonomic and other injuries and decreases productivity.

Possible Solutions

- Make housekeeping a priority by performing housekeeping tasks daily or more often if necessary.
- Plan to create a work space that is easy to maintain (Figure 4).



Figure 3
Poor housekeeping



Figure 4
A clean, organized site with aisles

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Materials Handling: Vehicular Activities

Electrical contractors often use vans or trucks to transport tools and supplies. Workers may have to reach over or climb into the small, awkward areas of these automobiles.

Contractors can implement the following solutions to ease the tasks of transporting and retrieving supplies and tools from automobiles.

- [Reaching into a Vehicle](#)
- [Loading and Unloading](#)



Reaching into a Vehicle

Potential Hazards:

- Crouching or kneeling to reach into the back of a van (Figure 1) or a truck with a shell might put contact stress on the knees and stress on the lower back.
- Employers often use vans with a narrow, short access space to store materials. Stooping and reaching may be required to access these materials.



Figure 1
Worker crouching in a cluttered van

Possible Solutions:

- When working in cramped areas cannot be avoided, perform lifting tasks from a kneeling position and pushing and pulling tasks from a crouched position. Use knee pads when kneeling.
- Place the most commonly-used materials closest to doors or in outside [truck bins](#), minimizing the stooping and reaching.
- Install a [roll-out truck bed deck](#) (Figure 2). Materials will be free from the confines of the truck shell and sides, allowing workers to gain easy access to the contents of the truck. These deck platforms also provide a convenient waist-high work space.



Figure 2
Roll-out truck bed deck

Loading and Unloading

Potential Hazards:

- Lifting and lowering materials and equipment from the back of vehicles may place strain on the back.
- Lifting toolboxes, supplies, or other materials over the sides of the truck may stress the shoulders and back.

Possible Solutions:

- Use a vehicle with [hydraulic lift](#) equipment (Figure 4).
- Use [reach forklifts](#) that extend the forks over the truck sides and lift materials out of the back.
- Use [truck ramps](#) that allow workers to wheel loads in and out of the back of vehicles.
- Reposition materials to minimize the need to lift over the sides of a truck or latched tailgate. When this is not possible, try to position materials closer to the tailgate so you can lift in the [power zone](#).
- Use a multiple-man lift when necessary. A rule of thumb is to use one person for every 50 pounds.



Figure 3
Worker lifting heavy equipment



Figure 4
Hydraulic lift raising a mobile tool box

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