Ergonomics of Back Pain in Farmers Descriptive Reference Manual

A Clinicians Guide for the Prevention and Treatment of Back Problems and Injury Associated With Midwest Dairy Farming

Center for Agricultural Research, Education, and Disease and Injury Prevention: A NIOSH Cooperative Agreement Program
#U07/CCU507126-03

Developed by National Farm Medicine Center
Marshfield Medical Research Foundation
Marshfield Clinic
Marshfield, Wisconsin

National FarmMedicine Center

Project staff

Ade Dillon, MD
Physical Medicine Department
Marshfield Clinic
Marshfield, Wisconsin

Mary Jo Knobloch, BS
Project Manager/Health Educator
National Farm Medicine Center
Marshfield, Wisconsin

Nancy Bellendorf, OTR
Occupational Therapist
Saint Joseph Hospital
Marshfield, Wisconsin

Joan Olson, BSN
Certified Insurance Rehabilitation Specialist
Industrial Rehabilitation Services
Marshfield Clinic
Marshfield, Wisconsin

Paul Gunderson, PhD
Co-Principal Investigator
Director
National Farm Medicine Center
Marshfield, Wisconsin

Dean Stueland, MD
Co-Principal Investigator
Medical Director
National Farm Medicine Center
Marshfield, Wisconsin

How to use this manual

This manual has been designed to serve as a descriptive reference for clinicians, chiropractors, and therapists who encounter agricultural workers suffering from low back pain. Various tasks performed by those working in dairy farming are outlined, along with weights, forces, and positioning necessary to perform these tasks. Also listed are the potential risks and concerns associated with each task. A photo accompanies each description.

This manual can be used by physicians, physical and occupational therapists, chiropractors and any other health care professional that may treat or counsel patients involved in dairy farming. It is intended to supplement the clinician's knowledge of farming operations and assist the clinician in recommending return-to-work strategies. The manual is divided into broad task categories. Please refer to the Table of Contents.

Questions regarding this manual can be directed to:

Ade Dillon, MD
Physical Medicine Department
Marshfield Clinic
1000 North Oak Avenue
Marshfield, WI 54449
715-387-5327

or

Nancy Bellendorf, OTR
Rehabilitation Services
Saint Joseph Hospital
611 St. Joseph Avenue
Marshfield, WI 54449
715-387-7885

or

Mary Jo Knobloch, BS
Project Manager/Health Educator
National Farm Medicine Center
1000 North Oak Avenue
Marshfield, WI 54449
715-389-3545

Work capacities evaluation

Definitions

The tasks described in this manual are farm tasks done by most Midwest dairy farmers. Since each farmer performs tasks differently, and the level of mechanization is different for each farm, work capacities vary greatly. For purposes of this manual, a work capacity range is given instead of one particular work capacity level.

The following are capacity level standards from the U.S. Department of Labor.

S-Sedentary work: Lifting 10 lbs. maximum with occasionally lifting and/or carrying such articles as dockets, ledgers and small tools. Although a sedentary job is defined as one which involves sitting, a certain amount of walking and standing is often necessary to carry out job duties. Jobs are sedentary if walking and standing are required only occasionally and other sedentary criteria are met.

L-Light work: Frequent carrying of objects weighing up to 10 lbs. with occasional lifting and/or carrying objects weighing 20 lbs. Even though the weight lifted may only be a negligible amount, a job is in this category when it involves sitting most of the time with a degree of pushing and pulling or arm and/or leg controls.

M-Medium work: Frequent carrying of objects weighing up to 25 lbs. with occasional lifting and/or carrying objects weighing 50 lbs.

H-Heavy work: Frequent carrying of objects weighing up to 50 lbs. with occasional lifting and/or carrying objects weighing 100 lbs.

V-Very Heavy Work: Frequent carrying of objects weighing 50 lbs. or more with occasional lifting and/or carrying objects weighing in excess of 100 lbs.

Occasional: 1%-33% of an 8 hour day
Frequent: 34%-66% of an 8 hour day
Constant: 67%-100% of an 8 hour day

Table of contents

Dairy Herd Management

Animal Environment Maintenance

Building and Repair Work

Fieldwork

Ergonomics of back pain in farmers

Ergonomics is the study of work, specifically the interaction of the worker to the work site. Ergonomic task analysis helps determine whether task demands match human capability. On a daily basis, farm workers are exposed to tasks that require 1) strength 2) reaching, bending, or stooping 3) awkward positions 4) repetition 5) frequency and 6) exposure to work environment stress such as temperature extremes, high noise, poor lighting and vibration.

Progress in reducing farm work-related back pain will depend on efforts in four areas: accurately identifying the bio-mechanical hazard; developing effective health promotion and hazard-control interventions; facilitating change in clinician and farm workers' practices with respect to levels of work performance; and developing mechanisms for the transfer of injury prevention technologies to both clinicians and farmers.

This manual is designed to facilitate change in the clinician and farm workers' practices with respect to levels of back-to-work performance. The manual and "quick reference" sheet lists tasks associated with small-to-medium size Midwest dairy operations. The tasks are described in detail to provide the "non-farmer" with enough information to help in determining back-to-work recommendations.

The funding for this project and manual is provided through a grant from the National Institute for Occupational Safety and Health (NIOSH) included in the *Center for Agricultural Research, Education, and Disease and Injury Prevention: A NIOSH Cooperative Agreement Program.* This project is titled *Ergonomics of Back Pain in Farmers.*

The project objectives include:

- Making ergonomic assessments of the agricultural work environment
- Developing clinical guidelines (based on assessments) that will be useful in return-to-work recommendations for farm workers with acute or chronic low back pain
- Developing educational reference materials for clinicians who encounter agricultural workers

Artificial insemination *(light to heavy work)*

**This task can be heavy work if the cow makes sudden movements.*

Usually an artificial inseminator is hired. When artificially inseminating, the worker stands and needs to reach forward in order to place the semen into the vagina of the cow. It usually takes about 1-2 minutes to do this activity. Continual working at shoulder level with one arm is needed during the process. A far forward reach is also required of this arm.

Potential risks/concerns

- Sudden movements of the cow

Ergonomic suggestions

Lean forward with your whole body when reaching. Use a breeding chute when possible. Have someone available to control the cow.

Frequent positions

- Walk, stand
- Use of hands/repetitive
- Work shoulder level

Occasional positions

- Bend, twist

Bedding *(medium to heavy work)*

**A high frequency of lifting bales will place this task in the heavy work category.*

Bedding is placed in stanchions (the area in a barn where a cow stands) to provide a clean and dry surface for the cow. The bedding is usually in bales but is sometimes loose. If the bedding is baled, the worker needs to retrieve the bales from storage and carry them to the stanchions or load them in a cart and push them to the stanchions. The bales are broken open and spread either manually or with a fork. The process time varies depending upon the size of the barn. Basically, the farmer starts at one end of the barn and beds each stanchion area. This requires frequent start and stop motions. A bale weighs about 35-40 pounds.

Potential risks/concerns

- Repetitive lifting and bending
- Balance is needed (climbing ladder)
- Risk of falling from the area above the barn
- Uneven or slippery surfaces

Ergonomic suggestion

Use carts to transport the bedding. Work with the fork as close to your body as possible. Avoid twisting by using a pivot motion with your feet.

Frequent positions

- Walk, stand, twist
- Level
- Use of hands/repetitive

Occasional positions

- Squat, climb, work overhead, work shoulder

Feed calves *(medium work)*

Calves are fed two or more times daily and will drink from a nipple or directly from a bucket. Usually, a large bucket of milk is prepared and is poured/divided into the individual buckets for the calves. The weight of the large bucket averages 35 lbs. The individual nipple bottle averages 4 lbs. At times, one hand is used to direct the calf's mouth into the bucket. When the calf drinks from a bucket, the bucket can be set on a surface or into a holder off ground level. This occasionally requires reaching over the top of a pen or hutch (shoulder to head level) to place the bucket in the holder. If needing to hold onto the bucket, a strong grip may be required to hold against the force of the calf. The average time feeding a calf is two minutes. At times, a long walk or carry is required depending upon where the calves are housed. A grain mix can also be fed to calves. This mix is usually packaged in 50 or 100 lb. bags.

Potential risks/concerns

- Sustained forward bending and reaching
- Sudden movements of animal
- Sustained gripping of bucket
- Some heavy lifting
- Long carry distances

Ergonomic suggestions

Place bucket within easy reach, and above floor level to decrease bending. Keep feet shoulder width apart to assist with balance. It may be easier to feed calves in individual housing. If this is not an option, attempt to halter and keep the calves in individual areas while feeding. Use a cart if milk needs to be transported any distance. Instead of carrying a full bucket of milk, divide it into two lighter loads.

Frequent positions

- Walk, stand, bend
- Use of hands/repetitive

Occasional positions

- Squat, twist, work overhead, work shoulder level

Feed cows *(light to very heavy work)*

**This task is light work-only if using an automated feeding system.*

Various methods are used to feed animals ranging from very heavy, manual labor to automated techniques. Animals are usually fed twice per day. Tools used include shovels, forks, wheelbarrows, large tubs, carts and motorized feeders. All tasks involve standing. If driving a motorized cart, the worker can sit. The worker bends to the side to monitor feed going to the animal. Frequent starts and stops occur during the process. Bending occurs to reach into carts, to lift, and to shovel. Climbing up ladders, on silos or climbing into the mow (the area above the barn) may be necessary. Carts of feed are pushed the length of the barn and usually there are 2 rows of animals/ stalls. The force to push a cart varies and can be 60 lbs. A bag of feed typically weighs 50 lbs. but can weight as much as 100 lbs. The upward force required to lift a wheelbarrow can be 30-60 lbs. The force to lift a shovelful of feed can average 30 lbs or heavier if it is wet feed. Some workers lift and carry a tub full of feed which can weigh 65 lbs. Carts or wheelbarrows can be used to transport feed. Some workers hand carry feed to the entire herd.

Potential risks/concerns

- Frequent twisting and bending
- Occasional heavy lifting

Ergonomic suggestions

Use carts or wheelbarrows to transport feed. If possible, use automated carts or other devices.

A specially designed lifting aid is available, using the principle of a lever arm to create a powerful lifting force. Automated computerized feeding devices are available and can feed a number of cows at the same time, including customized or individual mixed ration for every cow. Motorized feed carts are also available. Some have a seat and others are driven with the worker standing by the cart and operating button controls to move it. Divide heavy bags into two lighter bags or put less material in the cart to decrease the push force. Put less material on the shovel. Request feed to be delivered in 50 lb. bags.

Frequent positions

- Sit/drive, walk, stand
- Use of hands/repetitive
- Twist

Occasional positions

- Sit/drive, walk, stand, squat, climb, work overhead, work shoulder level

Giving injections *(light to very heavy work)*

**This task can be heavy work if the animal makes sudden movements.*

Injections are given near the hip of the animal or in the neck area. This usually is a brief activity but can be lengthy when injecting IV drugs. Some force is needed to insert the needle through the skin. When giving an IV, a leader is placed into the nose of the animal. A rope is attached to the leader. This rope is wrapped around a post in order to secure the animal's head and neck and force may be required to hold the animal in place. A quick stabbing force is used to place the needle. It can take up to ten minutes for the medication to empty into the animal. The bottle may need to be held up at shoulder level or above unless there is a holder available.

Potential risks/concerns

- Sudden movements of the animal
- Force needed to hang on to the rope that is attached to the cow

Ergonomic suggestions

Develop a pole-type holder so you don't need to hang onto the bottle of medicine. Stand with a wide stance to be better able to withstand sudden movements of the animal. Use a treatment chute to stabilize the animal. Have someone available to assist you.

Frequent positions

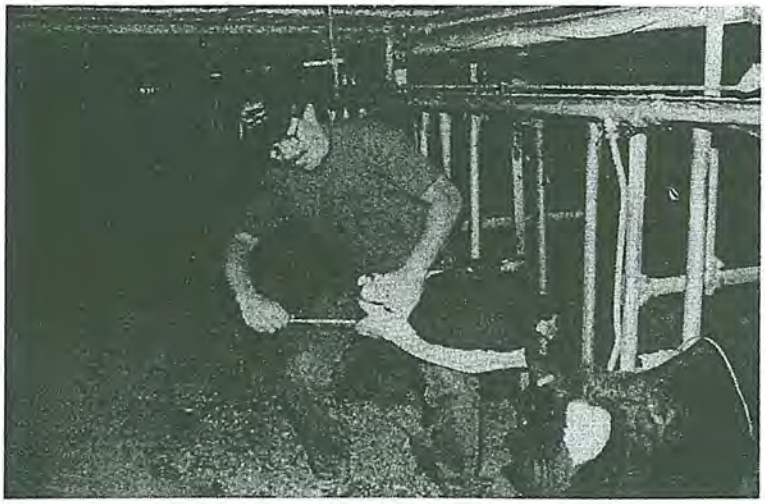
- Walk, stand, twist

Occasional positions

- Work overhead, work shoulder level

Giving oral medications *(light to very heavy work)*

**This task can be very heavy work if the animal makes sudden movements.*



The method used most frequently is holding the animal's head with one hand while administering the medication with the other hand. The medication can be in a special device (called a "balling gun") used to push the pill or "bolus" down the animal's throat. The worker has to hold back on the animal's head with one hand, try to get the balling gun down the esophagus instead of the windpipe, then quickly push the plunger-like device down. At times, as with injections, a leader is placed into the nose with a rope attached (and secured to a post) to hold the animal.

Potential risks/concerns

- Sudden movements of the animal

Ergonomic suggestions

Always have two people available. One person can control the animal by using a halter rope or other device. The other person can place the medication. Maintain a wide stance to better withstand sudden movements of the animal.

Frequent positions

- Walk, stand, twist

Occasional positions

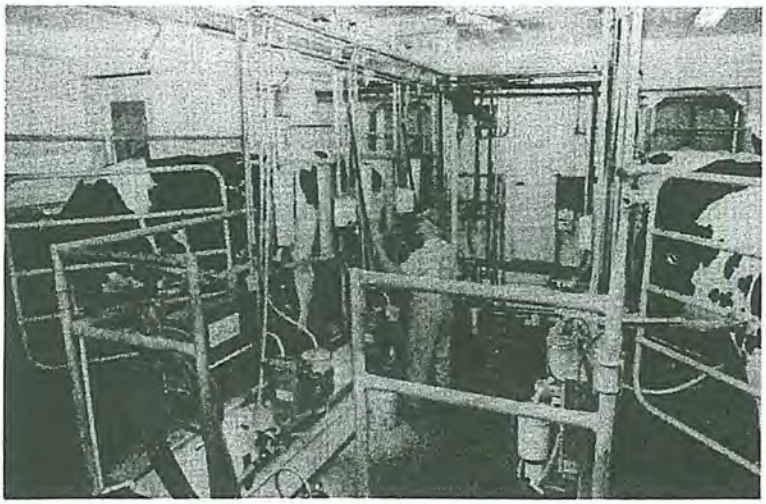
- Bend, squat, work overhead, work shoulder level

Milking of dairy cows

General description

Cows are milked 2-3 times per day. Generally with a parlor system, the herd size is greater, and it may take longer than pipeline or bucket systems. However, there are fewer tasks associated with parlor milking systems. Working in a parlor system eliminates the frequent bending and/or squatting associated with pipeline or bucket system. All milking systems require the worker to strip the udder (the teat is grasped and milk is pushed out to stimulate milk let-down). The worker also checks for teat problems by stripping the udder on a regular basis.

Parlor milking *(light work)*



Cows are brought into a raised area for milking. The worker stands in an area between two rows of cows and is at a level lower than the cows to eliminate the need to bend or squat to reach the udder. Tasks involved include washing or spraying the teats (many have sprayers suspended from the ceiling), pre-dipping and/or stripping (removing milk from the udder prior to or following milking), then attaching the milking unit. The weight of an average unit is 6 lbs. Parlor milking requires the least amount of individual tasks. The time spent milking varies on the size of the herd. It could take as much as 4 hours for a herd of 200 cows.

Frequent positions

- Walk, stand
- Use of hands/repetitive

Occasional positions

- Bend, climb, twist, work shoulder level

Pipeline milking *(light to very heavy work)*

This type of milking involves transporting the milking units (the claw which attaches to the udders and the unit itself) from the milk house (a room connected to the barn) to the animals. The cows teats are prepared by washing, stripping and/or pre-dipping. The towels, water buckets, and/or dip are placed in various areas, including on the floor, on a cart, or carried on the farmer using a belt or hook. Hoses are attached to both a pipeline (which carries milk to the bulk tank in the milk house) and the pulsator line. This involves reaching as high as 72 inches (from the floor). This line provides power to operate the claw attached to the teats. The unit weighs approximately 6 lbs. If an automatic take-off is used, the unit retracts from the teats when the it senses a decrease in milk output. The worker will then put the unit on the next cow. The entire unit (claw and hoses) average about 8-10 lbs. Pipeline milking involves an average of 20 individual tasks. It usually takes 1-2 hours to milk the herd, but depends on the size of the herd.

Frequent positions

- Walk, stand
- Use of hands/repetitive
- Twist, bend, squat

Occasional positions

- Squat, work overhead, work shoulder level

Bucket milking *(medium to very heavy work)*

The bucket milking system begins with the worker carrying four to six stainless steel milking buckets (each weighing approximately 20 lbs.) with milking units attached. They are carried from the milk-house to the barn. A belt is placed around the cow in order to attach the bucket. Next, the worker attaches a hose to the vacuum suction pipeline, attaches the bucket to the belt, and then turns a valve on the unit so that it powers the four inflations which attach to the teats. The unit remains attached to the teats for approximately five minutes. The unit is detached from the cow by turning off the valve located on the claw, and detaching the hose from the vacuum suction. The full bucket of milk is lifted, (weighing approximately 40-50 lbs.), and carried to the step-saver and poured into the step-saver which is about hip level. The step-saver (a stainless steel container that holds the milk and pumps it through a hose to the bulk tank) is located in the aisle in the middle of the barn. This pipes the milk into the bulk tank for cooling and refrigeration. Bucket milking requires the most amount of tasks in comparison to pipeline and parlor milking. This method of milking typically averages over 30 separate sub-tasks. It usually takes 1-2 hours to milk the herd, depending on the size of the herd.

Potential risks/concerns

- Repetitive bending and squatting (bucket and pipeline milking)
- Sudden movement of animal
- Frequent forward and overhead reaching
- Frequent heavy lifting and carrying (bucket milking)

Ergonomic suggestions

Parlor milking has the least amount of tasks. If you are not parlor milking, use a cart to transport buckets and udder preparation supplies. Place teat dip and other supplies within easy reach, such as on a cart, on a holder attached to your pants, or on a holder attached to a wall or beam. If a step-saver is used, move it along with you as far as possible to minimize the carry distance. Alternate methods of bending and squatting. A milking stool (which attaches to you) can be used to decrease the strain on your back or knees.

Frequent positions

- Walk, stand, twist, bend, twist
- Use of hands/repetitive, squat

Occasional positions

- Work overhead, work shoulder level

Moving animals *(light to medium work)*

Moving animals can entail carrying newborn calves (which can weigh up to 100 lbs.) and using force to move larger animals. The worker may need to hold gates in place while the animal is pushing against it. Some gates require up to 40 lbs. of force to open them especially if they are slid across a surface. They may also need to push against the cow while milking in order to attach the milking equipment. Sometimes an ATV-type vehicle is used to herd the cattle. The terrain may be uneven and there usually is exposure to vibration. Some climbing and crawling over and under fences may also be necessary.

Potential risks/concerns

- Sudden movements of animal
- Balance is needed for uneven terrain
- Heavy lifting

Ergonomic suggestions

Do not carry calves any distance. If possible, use a vehicle or trailer to transport calves. Be aware of hazardous situations and plan ahead, and have someone assist you. Be aware of terrain changes if walking with a heavy load.

Frequent positions

- Walk, stand

Occasional positions

- Sit, drive, use of hands/repetitive, bend, squat, climb, twist

Trimming hooves *(medium work)*

** This task can be very heavy work if done without any special mechanical devices.*

Hooves are trimmed using a large pair of trimmers. A hoof can be positioned by a) putting a rope around the hoof which is then anchored over a beam above the animal. A worker is holding this rope with a strong force and grasp; b) a special stanchion used in which the animal's hoof is placed on a device which is maneuvered using a crank to lift the hoof; c) the animal being tipped on its' side utilizing a special device. The hooves are then trimmed while the animal is in this position. The latter is a typical system used by professional hoof trimmers. Movements need to be done quickly as there is a risk of getting kicked. The average time it takes to trim a hoof is five minutes. This task is not done a daily basis. Standing and bending in a static position is required. Some farms hire a professional trimmer or utilize the veterinarian for this task.

Potential risks/concerns

- Sustained forward bend or squat
- Sudden movements of the animal

Ergonomic suggestions

Be sure to have proper equipment for this task. There are professional hoof trimmers that will assist you with this task. Ask your local implement dealer for suggestions.

Frequent positions

- Walk, stand, bend, twist

Occasional positions

- Squat, twist

Cleaning buckets (bulk tank, milk house)

(medium work)

Pipeline and bucket milking only

After each milking, buckets are washed along with the bulk tank and general milk house area. There is a sink in the milk house to wash buckets and typically some prolonged bending is used to reach into the sink. The typical milking unit weighs 6 lbs. If bucket milking, the empty bucket weighs 20 lbs. Some workers use a cart to transport their buckets. Once washed, the claws and hoses are placed on holders on the wall requiring some forward and overhead reaching. In addition to washing buckets, general equipment is usually wiped, sprayed or brushed down. Many farms have cleaning solutions and teat dip delivered in large drums that have a handle on the top of them, similar to a suitcase handle. The drums weigh 150-200 lbs. It takes approximately 20-30 minutes to wash all of the milking equipment. On average, there are 4-6 units to be washed.

Potential risks/concerns

- Sustained forward bending
- Repetitive lifting
- Sustained reach
- Some heavy lifting

Ergonomic suggestions

Use a cart or other holding device to eliminate placing buckets on the floor. Place a small step ladder in the milk house to decrease overhead reach distance.

Frequent positions

- Walk, stand, bend, twist
- Use of hands/repetitive

Occasional positions

- Squat, work overhead, work shoulder

Cleaning grates and stalls *(light to medium work)*

A shovel, or other sharp-edged tool is used to clean manure from stalls. This is done once or twice daily. It can require forward reach with the shovel being pulled or pushed across the surface towards the gutter (an area behind the cow). Grates are cleaned usually by brushing across them back and forth with a broom or gliding a shovel across the top. The force required is variable, depending on the amount of manure or the surface. Twisting is frequent. Many times the worker is facing forward and reaches/twists to the left or right to clean the grate or stall.

Potential risks/concerns

- Sudden movement of animal
- Frequent twisting
- Frequent bending
- Sustained forward reach

Ergonomic suggestions

Keep shovel or broom as close as possible to the body. Step forward when reaching forward with shovel or broom. Avoid twisting when making side to side motions. Use the entire body instead.

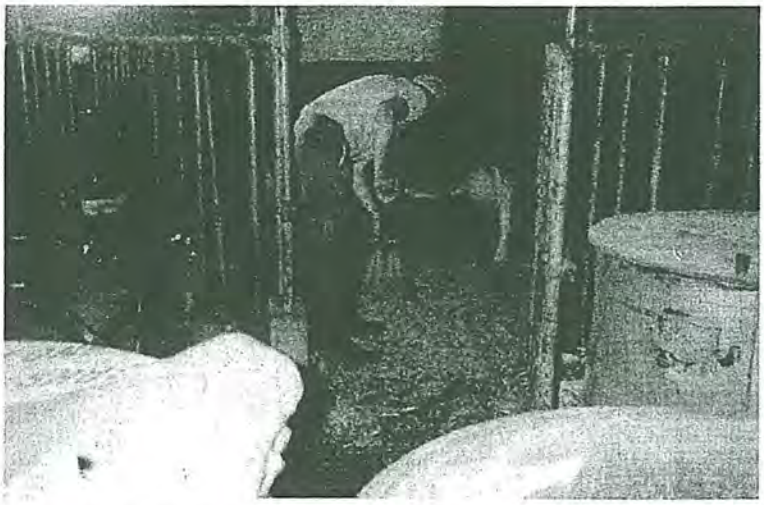
Frequent positions

- Walk, stand, bend, twist
- Use of hands/repetitive

Occasional positions

- Squat

Cleaning pens *(medium to heavy work)*



Pens are cleaned on a daily to weekly basis. Tools used are scrapers, forks and/or shovels. Tractors with buckets can be used and may be driven over rough uneven surfaces. The weight in a fork or shovel varies and can be up to 30 lbs. A full wheelbarrow can require a force of 60 lbs. to lift. The manure is transferred from the floor into a wheelbarrow, manure spreader or into the gutter. At times the worker may toss material over the top of the pen which requires overhead work.

Potential risks/concerns

- Falling
- Prolonged twisting and bending
- Large horizontal distance (moment arm*)
- Injuries incurred due to loose animals
- Asymmetric lift

*distance from front of body

Ergonomic suggestions

Place less manure on the fork, shovel or in the wheelbarrow. Pivot rather than twist and keep the weight close to the body. Bend your knees and lift with your legs when picking up the wheelbarrow. Use automated devices such as a skid steer loader, if possible.

Frequent positions

- Walk, stand, bend, twist
- Use of hands/grasp

Occasional positions

- Sit, drive, squat, work overhead, work shoulder level

Scraping floors *(light to medium work)*

When cows leave the barn after each milking, the floor is scraped. Build-up on the floor can cause uneven surfaces and sudden jolts when pushing carts or scrapers. Usually, this build-up is removed by using a sharp-edged scraper requiring much force. It takes approximately 10-15 minutes to complete this task, but depends upon the size of the barn. Twisting can occur depending on where the scraper is held. Push force varies and depends upon the amount of manure.

Potential risks/concerns

- Falls
- Sudden movements

Ergonomic suggestions

Hold onto the scraper handle with one hand over top of the handle, and one hand along the handle instead of both hands along the handle (which requires more bending). A device is available that allows you to stand erect while scraping. It is constructed with a wheel assembly and a wide cleaning blade set at an angle to the handle to ensure the least amount of back stress.

Frequent positions

- Walk, stand, bend, twist
- Use of hands/grasp

Occasional positions

- Squat

Spreading lime in barn *(medium to heavy work)*

For cleanliness and to increase traction in the barn, lime is placed on the aisle after scraping is done. Lime bags weigh 66 2/3 lbs. and are lifted from a stack and emptied into a lime spreader or bucket. If using the bucket, the worker needs to carry it in one hand and use the other hand to scoop the lime out and throw it on the floor. Bending occurs occasionally when reaching into a bucket or bag or when lifting a bag of lime. The number of bags is usually minimal. Occasionally lime is thrown over the top of a pen. Twisting occurs occasionally to frequently when throwing/spreading the lime by hand. A lime spreader is pushed with minimal force the length of the barn.

Potential risks/concerns

- Heavy lifting
- Slippery surface
- Asymmetrical lifting

Ergonomic suggestions

Use a lime spreader or cart. Keep the item you are lifting close to your body.

Frequent positions

- Walk, stand
- Use of hands/grasp

Occasional positions

- Bend, squat, work shoulder level, twist

Sweeping mangers *(medium work)*

After each feeding, the remaining feed is swept with a push broom requiring sustained bending. The feed is usually swept into a pile and is picked up with a shovel and placed into a cart. This requires repetitive bending. It is typically unloaded into a bunk or into a pile. Forward reaching frequently occurs when sweeping due to the length of the handle and reaching out when pushing the feed forward. It is also required when dumping the shovelful of feed into the cart. Twisting frequently occurs due to the position of the body when sweeping. Twisting occurs frequently when dumping the feed from the shovel into the cart. The force required to lift a shovelful of feed can be up to 30 lbs. The carry distance is usually minimal. A moderate to strong push force is required on the broom. The force varies with the amount and weight of the feed.

Potential risks/concerns:

- Prolonged forward bending
- Asymmetric lifting
- Frequent twisting motion
- Large horizontal distance (moment arm)

Ergonomic suggestions

Hold onto the handle with one hand over top of the handle, and one hand along the handle instead of both hands along the handle (which requires more bending).

Frequent positions

- Walk, stand, bend, twist
- Use of hands/grasp

Occasional positions

- Squat

Fencing/fencing repair *(medium to heavy work)*

** Work capacity depends on weight of equipment and resistance of soil and rocks.*

This task involves using a post hole digger. A non-automated post hole digger weighs approximately 40 lbs. A manual post-hole driver weighs approximately 15-20 lbs. A tractor-powered (power take-off) post-hole digger weighs in excess of 500 lbs. The post is manually or automatically placed in the ground. A pounding device is used for metal fence posts. It involves bending to unroll the barbed wire, bending to pick up equipment, and walking in the field on uneven surfaces. Metal fence posts can also be lifted and each can weigh 5 lbs. or more. These metal posts are usually bundled in groups of 5. They are usually lifted and carried in bundles. Wooden posts are bulky and can weigh 20 lbs. When putting the wire onto the post, the wires need to be tightened either manually or with a tightening device.

Potential risks/concerns

- Downward force with jolting motion
- Frequent bending and pulling/tightening
- Walking on uneven surfaces
- Asymmetric lifting of posts
- Hitting rocks while digging (hand-held diggers)
- Sudden movements when using hand-held powered post hole digger

Ergonomic suggestions

If possible, use an automated post hole digger. Place all necessary items on a tractor bucket or wagon to decrease the need to carry items or pick them up from the ground.

Frequent positions

- Walk, stand, bend, squat
- Use of hands, work overhead, work shoulder level

Occasional positions

- Sit/drive, twist

Welding *(light to heavy work)*

Many farm workers do their own welding to assist with machinery repair. Welding consists of holding the welding rod against the item to be repaired and could involve some prolonged positioning such as bending. A welding rod is of minimal weight but the item being welded may be heavy. Items to be welded can occasionally be pushed or pulled in order to position for welding and the weight can vary.

Potential risks/concerns

- Forward reaching
- Prolonged bending or squatting
- Lifting heavy objects

Ergonomic suggestions

Place items on a cart or table to decrease bending and the amount of stress on the back, neck, and shoulders. A portable table with a step on it and a body support are available to provide a place to hold tools and also provide extra support to reach high places.

Frequent positions

- Walk, stand, use of hands
- Bend, squat, work overhead
- Work shoulder level, twist

Occasional positions

- Use of feet, crawl
- Climb

Handling seed/planting *(medium to heavy work)*

Seed is usually delivered to the farm. When planting time arrives, the seed is usually placed on a trailer and driven out to the field. The planters (which are pulled by a tractor) need to be loaded with seed. The bags weigh 50-100 lbs. The seed is poured into holders on the planter. Occasional climbing occurs when the worker steps up onto the planter to pour the seed. The step up is approximately 15 inches off the ground. Occasionally the worker must stack the seed bags for storage. This requires overhead work and forward reach. Lifting can be repetitive, as the planter is usually loaded every 60 minutes. With a 4-row planter, 4 bags of seed are handled with each loading, or 35-40 buckets or over 80-100 shovels-full of seed are handled at each loading. Bags of fertilizer and chemicals are also lifted and these can be the same weights and repetitions as the seed.

Potential risks/concerns

- Frequent lifting
- Frequent bending
- Frequent forward reaching

Ergonomic suggestions

Keep the seed bag close to your body while lifting. Have seed delivered in bulk and place the seed in the planter using automation. Purchase 50 lb. bags instead of 100 lb. bags. Have the seed delivered or picked up and stored onto the wagon that will be taken to the field. This will minimize material handling. Augers are available that can be attached to wagons, trucks, and gravity boxes to transfer your bulk items to planters or another area. An auger is available to unload grain from the side of a truck. This assists the driver who needs to remain in the cab and is unable to see the end gate.

Frequent positions

- Sit/drive, use of hands
- Use of feet, bend, twist
- Work overhead, work shoulder level

Occasional positions

- Walk, stand, squat, climb

Handling hay *(medium to heavy work)*

The baler (machinery that picks up hay from the field and puts it into square or round bales secured by twine) is driven out to the field. The baler either has a kicker that throws the bale of hay back to the wagon, or a worker rides on the wagon and has to reach down and grab the bale from the baler. Another method is using a round or square baler that drops the bales onto the field. A tractor or forklift then moves them to storage. If the stack baler method is used, the worker on the wagon stacks the bales from floor to overhead level (up to 7 bales high). This is being done while the wagon is moving over sometimes rough terrain. Frequent bending, twisting, climbing, forward reach, and work overhead is required when working with bales of hay. The worker driving the tractor can be sitting for long periods of time. (Some farm operations minimize hay bale handling by utilizing a round baler, which eliminates any manual handling.) When the wagon is full, it is brought to the barn. Workers (lifting one or two bales at a time) unload the bales onto an elevator. The elevator assists in moving the bales into the hay mow. In the hay mow the bales drop from the elevator and usually there are workers stacking the hay in the mow. A hay track near the ceiling can be used. The hay bales go from the elevator to the hay track, which is another conveyor for the bales. The hay track is set up so bales can be dropped in various areas of the barn which reduces carrying distance.

A bale of hay weighs between 30 and 60 lbs, and can weigh more if it has high moisture content or is very large. For a worker unloading the wagon, a bale is handled every 5-10 seconds and there are usually 100-150 bales on a load. For a worker in the mow, a bale can be handled every 15-30 seconds. Not all workers have someone stacking hay in the mow. Some use round bales, eliminating the need for any lifting of bales.

The carry distance varies. For one unloading the wagon, it can be up to the length of the wagon, which is typically 16-20 feet long. In the mow, the carry distance varies with length of the mow and location of elevator. The distance can be over 40 feet.

At times, the hay bales are pushed or pulled before lifting them. This could be while still on the wagon or when removing them from the elevator. A large amount of force could be required to pull a bale that is caught between others on the wagon.

Frequent positions

- Walk, stand, use of hands
- Use of feet, bend, work overhead
- Work shoulder level, twist

Occasional positions

- Sit/drive, squat, climb

Potential risks/concerns

- Sitting for extended periods of time
- Frequent neck rotation
- Repetitive lifting and bending
- Walking on uneven surfaces
- Danger of hay bales falling from overhead level
- Standing and walking on a moving wagon (over uneven surfaces)
- Contact stress on hands (palmar surface)
- Prolonged exposure to heat
- Frequent twisting

Ergonomic suggestions

Rotate tasks and use a round baler, if possible. Consider using a bale accumulator which will automatically collect 10 bales and place them in a package behind the baler. Another bale fork picks the packages up and loads trailers or trucks in the field. The bales can be moved or stacked anywhere the tractor will go.

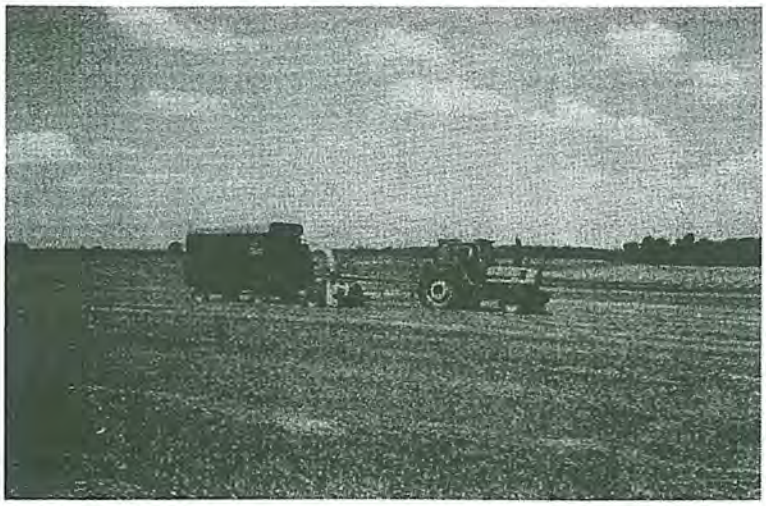
A semi-automatic bale box is available that has a chute which attaches to the front of the bale box and turns the bales as they come down the conveyor. It is necessary to walk only a few steps to unload each bale.

Automatic bale wagons are also available. These wagons pick up, load, haul and stack.

If using a large round or square baler, various lifts and forks are available that can be attached to implements in order to move them.

Harvesting field crops *(sedentary to medium work)*

**Work capacity can vary depending on tasks being done.*



One worker operates the tractor which pulls the harvester. As much as 16 hours of tractor driving in one day is not uncommon during harvest season. This requires sitting and twisting (spine rotation) to look behind to the harvester. There is usually a device that can be operated from the tractor that unhitches the wagons. Usually another worker drives empty wagons to the field and takes a full wagon-load back to the silo where it is unloaded. A blower is used to move the harvested crop into the silo. The blower is powered by a high revolution power take-off attached to and powered by a tractor. It achieves enough power to "blow" the forage up as high as 100 feet through a silo pipe through the top of the silo. The worker must manually operate tractor controls to initiate the power take-off. To initiate the automatic unloading mechanism, another power take-off is hitched from the wagon to a tractor pulling it. This requires some pulling and lifting of the power take-off from the wagon. It also entails horizontal reach. The power take-off generates power to move conveyors on the wagon to move the forage forward and into the blower in an automated fashion. The speed of the power take-off (and the unloading speed) is controlled by the tractor's acceleration power. A worker usually stands on the tractor to regulate the speed of unloading, and when problems arise, this person needs to move quickly to stop the motors and unloading process. Some shoveling of feed that falls on the ground can be done after each unloading. This shoveling can require up to 30 lbs. of force to lift. Occasional bending, squatting, climbing, and working overhead are necessary for this task.

Potential risks/concerns

- Prolonged sitting
- Vibration

Ergonomic suggestions

When looking behind, try to turn your whole body instead of just twisting the back. Automatic aiming devices are available on choppers. Use self-unloading gravity boxes and a rope-controlled wagon disconnect.

Frequent positions

- Sit/drive, twist
- Use of hands, use of feet

Occasional positions

- Walk, stand, bend, squat, climb

Hitching and coupling of equipment

(light to medium work)

Wagons and harvesting machinery are attached to the tractor by hitching. Some hitches rest on the ground and some are suspended off the ground. The worker bends forward to pick up the hitch. The upward force required to lift a hitch can be up to 40 lbs. and hitching can take place with great frequency (about every 20 minutes). Occasionally, a push/pull force is used to move the wagon ahead or behind in order to get it hitched to the tractor. This can entail over 100 lbs. of force, while bending, twisting, and using a horizontal reach. Some hitches are made with telescoping ends which eliminates the need for the farmer to pull the wagon forward to be hitched. To unhitch the wagon, it is usually done manually or there is a cable pulled (from the tractor cab) which opens the hitch. This is typical for harvesting equipment. A moderate grasp is needed to lift the hitch. Fine manipulation is required to place the pin quickly and accurately in the hitch.

Potential risks/concerns

- Lift and bend
- Light to medium lifting
- Pulling

Ergonomic suggestions

Use telescoping or suspended hitches, if possible. Avoid pulling the wagon hitch to the tractor. Instead, back the tractor to the hitch. Automatic remote hitching systems are available which allow the implement hitching from the tractor seat.

Frequent positions

- Walk, stand, use of hands
- Bend

Occasional positions

- Squat, twist

Rock picking *(Light to heavy work)*

Some farms have many field rocks that need to be manually picked before or after planting in order for the seed to grow and to keep the rocks out of equipment. Usually a tractor and a wagon are driven onto the field and then up and down the rows. The workers walk along picking up rocks and tossing them onto the trailer. Most rocks weigh 5 lbs. or less, but can weigh 40 lbs. or more. One worker is assigned to drive tractor continually, or the driver periodically gets off the tractor to pick the rocks. Standing and walking is frequent (if one is not driving the tractor). Frequent repetitive bending is required. A worker can bend and lift up to 70 times per 15 minutes. A small number of rocks are picked up and carried or tossed onto a wagon, in a bucket or on a bucket attached to a tractor. The time between each bend can be a second or two, or up to 60 seconds. Workers can regulate the pace at which they work, but tend to work quite steadily in order to get this task done. Forward reach occurs frequently to constantly when reaching for the rocks on the ground as well as when tossing them. Twisting occurs occasionally to frequently when lifting and throwing. Depending on the type of soil, rocks are usually picked 3 to 4 hours per day and 2-3 days per season.

Potential risks/concerns

- Frequent bending
- Heavy lifting
- Some twisting

Ergonomic suggestions

Use rock picker or forks with narrow tines to decrease bending. Information on automated rock picking equipment can be obtained from your local implement dealer.

Frequent positions

- Walk, stand, use of hands
- Bend, squat, twist

Occasional positions

- Sit/drive, climb, work overhead, work shoulder level

Tractor driving *(light work)*

This is a frequent activity from spring through fall. The type of tractor seat and the type of terrain varies. Most tractors require some shifting using varied force. Some tractors require no operation of hand controls to shift. The length of time on a tractor varies but can be many hours including into the night. If the crop is ready and needs to be harvested, workers can put in as many as 16 hours per day on the tractor. The tractor operator has one foot stretched out pushing the clutch repeatedly. Vibration exposure can be a problem with prolonged tractor work. Some tractor operators sit in a forward flexed posture or need to flex forward to operate some of the hand or foot controls. The farmer needs to climb on and off the tractor. The first step up into the tractor is approximately 20 inches off the ground. Some tractors have an added step which brings the first step down to 15-18 inches off the ground. To get into the tractor, the operator typically grasps a handle at head level or above to help balance or pull up into the tractor. This can be a 74 inch reach overhead on some large tractors. A forward reach is required to grasp the steering wheel and operate the hand controls. Rotation and twisting occurs frequently. The tractor operator repeatedly looks behind to monitor equipment or the field. The twisting occurs at both the neck and back. Usually, the tractor operator looks over the right shoulder. Some tractors are equipped with swivel seats. Minimal to moderate force is required to operate the hand controls and push in the clutch. The push force on a clutch can be 50-75 lbs. The pull force on a hand control can be 20 lbs. Some tractors require minimal force for both hands and feet. A minimal to moderate grasp is required on the steering wheel, especially when turning. Many tractors have power steering.

Frequent positions

- Sit/drive, use of hands
- Use of feet

Occasional positions

- Walk, stand, bend, climb, twist

Potential risk/concerns:

- Falls from tractor
- Roll-overs
- Prolonged vibration
- Prolonged and repeated clutching with only one foot
- Sustained positioning
- Frequent twisting motions

Ergonomic suggestions

When purchasing tractors, look for the swivel air ride seats and easy shifting mechanisms. Place a lumbar cushion in the tractor seat to provide continual back support.