TECHNICAL MANUAL

Oregon OSHA

Section VII

(previously Section VI of Oregon OSHA's Technical Manual)

ERGONOMICS

CHAPTER 1: BACK DISORDERS AND INJURIES

*All information within this section and chapter has been reproduced from the Oregon OSHA Technical Manual (circa 1996) unless otherwise stated within the "**Chapter Revision Information**", located at the beginning of each chapter.*

SECTION VII: CHAPTER 1

BACK DISORDERS AND INJURIES

Oregon OSHA TECHNICAL MANUAL

<u>Chapter Revision Information:</u>

- *This chapter was previously identified as Section VI, Chapter 1 in Oregon OSHA's circa 1996* ***Technical Manual****. The section number was modified from Section VI to Section VII in March 2014 to provide uniformity with federal OSHA's Technical Manual (OTM).*

- *In March 2014, the chapter's multilevel listing format was modified from an alphanumeric system to a roman numeral system.*

- *In March 2014, all "OSHA 200 Log" occurrences were updated to "OSHA 300 Log."*

- *In March 2014, Appendix VII:1-2. was revised to provide uniformity with federal OSHA's Technical Manual's version of Appendix VII:1-2.*

- *In March 2014, Appendix VII:1-3. was revised to provide uniformity with federal OSHA's Technical Manual's version of Appendix VII:1-3 while maintaining state specific procedures for Oregon OSHA.*

- *In March 2014, Appendix VII:1-4. was incorporated to provide uniformity with federal OSHA's Technical Manual. Oregon OSHA's circa 1996* ***Technical Manual*** *did not contain an Appendix VII:1-4.*

- *In March 2014, Appendix VII:1-5. was incorporated to provide uniformity with federal OSHA's Technical Manual. Oregon OSHA's circa 1996* ***Technical Manual*** *did not contain an Appendix VII:1-5.*

SECTION VII: CHAPTER 1

BACK DISORDERS AND INJURIES

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I. Introduction

A. General

Chronic back disorders can develop gradually as a result of repetitive activity over time. Because of the slow onset and insidious character of this internal injury, the condition is often ignored until the symptoms become chronic. Acute back injuries are usually the immediate result of improper lifting techniques or too heavy loading rather than from external agents. Injuries can arise in muscle, tendon, bursa, and ligaments, either singly or in combination.

B. Incidence

Although musculoskeletal disorders including back injuries account for few work-related deaths, they do account for a significant amount of human suffering, loss of productivity, and economic burden on compensation systems.

Musculoskeletal disorders are the leading cause of disability of people in their working years and afflict over 19 million. Half of the nation's work force is affected at some time during their working lives.

An increase in musculoskeletal disorders is already evident. The frequency and economic impact of musculoskeletal conditions including back injuries and disorders on the work force are expected to increase over the next several decades as the average age of the work force increases and medical costs go up.

II. Back Injuries

A. Contributing Factors

- Fatigue.
- Congenital defects of the spine.
- Increase in service and high-tech hand-intensive jobs.
- An aging work force.
- A reduction in worker turnover for economic reasons.
- Widespread use of vibrating and air-powered tools.
- Proliferation of assembly line techniques, increasing line speed, and piece rates.
- Increased awareness of workplace hazards.

B. Manual Materials Handling

Manual materials handling is the principal source of compensable injuries in the American work force, and four out of five of these injuries will affect the lower back.

III. Back Disorders

A. Factors Associated with Back Disorders

Back disorders result from the cumulative effect of several contributors:

- Poor posture-how one sits or stands.
- Stressful living and working activities-staying in one position for too long or not learning to relax.
- Loss of body flexibility with age, etc.-becoming stiff.
- Faulty body mechanics-how one lifts, pushes, pulls, or moves objects.
- Poor physical condition-losing the strength and endurance to perform physical tasks without strain, as in aging.
- Poor design of job or work station.
- Repetitive lifting of awkward items, equipment, or (in health-care facilities) patients.
- Excessive reaching or twisting.
- Bending while lifting.
- Static bent postures.
- Heavy lifting.
- Lifting with forceful movement.
- Sitting and vibration, as experienced by truck drivers, etc.

B. Signs and Symptoms

Signs and symptoms include pain when attempting to assume normal posture, shoulder droop, decreased mobility, and need for assistance to stand or rise from a seated position.

IV. Investigation Guidelines

A. Records Review: OSHA 300 LOG

Note when back or other musculoskeletal disorders appear excessive from incidence rate calculations.

To determine if trends exist, at least several years of the OSHA 300 log will be needed for review. Review the past three years.

Record or copy information, including occupational titles, departments, dates of injury or illness, from the OSHA 300 log. This information can be used to calculate the incidence rate (see Appendix VII:1-1).

If you determine that there is a need for a more in-depth analysis of the extent and magnitude of the back disorders, see Appendix VII:1-1.

B. Employer, Employee Interviews

1. Walkaround

Videotaping can be considered for later viewing at the office.

Observe worker postures and lifting.

Determine weight of objects lifted.

2. Evaluation

Videotapes can be later reviewed for evidence of potential musculoskeletal hazards (see Appendix VII:1-3).

Manual lifting:

- Repetitive material handling increases employee's vulnerability to disorders.
- Three variables in evaluating manual lifting tasks to determine how heavy a load can be lifted are: the horizontal distance from the load to the employee, the vertical distance through which the load is handled, and the frequency with which the load is handled.
- Additional variables include floor and shoe traction, space constraints, twisting, two-handed lifts, size of load, stability, gripability, etc.
- NIOSH Lifting Formula, computerized version (see Appendix VII:1-2), is available in area offices.

V. Prevention and Control

A. Engineering Controls

1. General

Alter the task in some way that will eliminate the hazardous motion and/or change the position of the arms, wrists, or body such as adjusting the height of a pallet or shelf.

2. Manual Handling Tasks

Material handling tasks should be designed to minimize the weight, range of motion, and frequency of the activity. Work methods and stations should be designed to minimize the distance between the person and the object being handled.

Platforms and conveyors should be built above the knee and below shoulder height to minimize awkward postures. Conveyors and rollers should be used for horizontal motion whenever possible. Reduce the size or weight of the object(s) lifted.

High-strength push-pull requirements are undesirable, but pushing is better than pulling. Material handling equipment should be easy to move, with handles that can be easily grasped in an upright posture. Load should be of size that can be handled by most employees.

Bending the upper body and spine to reach into a bin or container is highly undesirable. The bins should be tilted or equipped with collapsible sides.

Repetitive or sustained twisting, stretching, or leaning to one side are undesirable. Corrections could include repositioning bins and moving parts and conveyors closer to the employee.

Workbench or workstation configurations can force people to bend over and tilt the head. Corrections should emphasize adjustments necessary for employee to remain in a relaxed upright stance or fully supported, seated posture.

Store heavy objects at waist level.

Provide lift-assist devices, tables, and hoists.

B. Administrative Controls and Work Practices

Administrative controls should not be viewed as primary methods of control.

Techniques can be used to identify high-risk jobs and quantify the required job demands.

Worker training and education:

- Training programs range from fundamental instruction on the proper use of tools and materials to instructions on emergency procedures and use of protective devices.

- Training should be job-specific and include exercise programs, stretching, etc.
- Strength and fitness training reduces compensation costs for most fit individuals.
- Back school educates workers in back care.

Rotating of employees, providing a short break every hour, or adding employees may be helpful.

Light work.

C. Other

Standing for extended periods places excessive stress on the back and legs. Solutions include a footrest or rail, resilient floor mats, height-adjustable chairs or stools, and opportunities for the employee to change position.

Sitting is preferable to standing, but the chairs or stools must be properly chosen.

Proper adjustable lumbar support may be provided.

Static seated postures with bending or reaching may have to be evaluated.

VI. Bibliography

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Singleton, W.T. ed. 1982. *The Body at Work: Biological Ergonomics.* 1st. ed. New York: Cambridge University Press.

APPENDIX VII:1-1. In-depth Analysis

The usefulness of the information gained from the review of the OSHA 300 log is limited by internal practices of recording injuries and illnesses. Some plants record everything and some record only those cases that are sent to see a physician. With back disorders, these cases are not always recognized as being work-related and therefore are not recorded. Thus, the Compliance Officer must determine the internal procedure for recording on the OSHA 300, i.e., who records, what cases are recorded, and when cases are recorded (see Field Inspection Reference Manual).

The following is a systematic approach to identifying the extent and magnitude of a disease or injury and is based on epidemiological principles. The approach consists of records review, worker surveys, and job analysis respectively. This information may be used to determine which jobs pose a risk to workers.

Workers' Compensation Records

Advantages:

- Identify additional cases, departments, and job titles.

Limitations:

- Does not include cases where treatment is paid for directly by the employee or comprehensive health insurance.

- Describes only most severe and advanced problems. May fail to identity problems in early stage of development.

Plant Medical Records

In larger plants that employ health care providers, individual employee medical folders, or records, will be maintained and every visit to the health office may be recorded in the record. Such records can be accessed through a medical access order.

There may also be a first-aid log or health office sign-in log.

Entries in these records often include:

- Date of visit,
- Department or location where employee works,
- Description of injury or illness,
- Treatment given, including medications, and
- Work restrictions recommended.

Monthly summaries of employee visits to the health office are often compiled by health office personnel.

If there are too many records, review a random sample of records to identify cases of back disorders.

Safety and Accident Reports

Internal reports that may be available in the health, safety or personnel office.

These cases may not be noted on the OSHA 300 Log or in worker compensation records. Employee may just want to report the injury or disorder and not seek treatment.

Payroll Records (If available)

Used to obtain information on number of hours worked.

Serves as crude measure of exposure potential and can be used to compare jobs in terms of incidence rates of all forms of back disorders.

Useful in identifying job titles or departments with high absentee or turnover rates.

Available Information from Records Review

- Total number of back injuries and disorders reported to the company.
- Date each case reported.
- Department or specific job of those who are injured or ill.
- Number of workers on the same job or in the same department.

What You Can Do With the Information

The incidence rate can be calculated for the entire establishment and for each department. This procedure allows comparison between and within the same departments from year to year.

Incidence rate = (Number of cases) / Total population at risk in a given time period.

- Numerator: Number of workers (cases) in specified group or department that experience a disorder in a specified time period.
- Denominator: Total number of workers in a specified group or department within the same time period.

Note: If counting system recognized only lost-time or Workers Compensation cases, relatively low incidence rates may be computed.

Survey the Workers

Purpose

Assist in identifying new or early cases of back injury and disorders in the work force. Also useful in smaller facilities where data gathered from records review may be limited. The major reason for this is to collect data on the number of workers that may be experiencing some form of back injury or disorder. This is also a good method for identifying departments or jobs where potential back problems exist.

Factors to be Considered in Designing a Questionnaire or Survey

Reading level and primary language of workers if the questionnaire or survey is self - administrated. Wording is very important and must be geared to particular respondents.

Length of the questionnaire (usually should not exceed 20 minutes).

Instructions: Are they clear?

Important questions should be asked first.

Sensitive or personal questions should be asked later in the survey.

Multiple-choice questions are easier to evaluate but limit the potential responses of the person being questioned.

Mass Medical Screening

Mass medical screening could be useful.

Job Analysis and Observation

Each job in which workers have a greater incidence of back disorders might be subject to a job analysis after an appropriate records review and worker survey.

Work Methods Analysis

Observe employees at work:

- Notice what employees are doing to make themselves more comfortable in the workplace. For example, look for improvised foot rests, padding, or homemade tools and devices.
- Watch for repeated motions and the position of the arms, wrist and trunk. (e.g., overstretching or unusual posture).

Record the movements, possibly with a videotape camera for later slow-motion analysis.

Describe the positions seen.

An ergonomic check-list can be helpful on inspections.

Work station and tool evaluation may be necessary.

APPENDIX VII:1-2. Evaluation of Lifting Tasks

NIOSH Work Practice Guide for Manual Lifting

In 1981, NIOSH developed an equation to assess lifting conditions. In 1991, NIOSH issued a revised equation for the design and evaluation of manual lifting tasks. The 1991 equation uses six factors that have been determined to influence lifting difficulty the most, combining the factors into one equation. Two of the factors which are new to the revised equation include twisting (asymmetry) and the quality of the worker's grip on the load (coupling). Using the equation involves calculating values for the six factors in the equation for a particular lifting and lowering task, thereby generating a Recommended Weight Limit (RWL) for the task. The RWL is the load that nearly all healthy employees (90% of the adult population, 99% of the male and 75% of the female workforce) can lift over a substantial period of time (i.e., up to 8 hours) without placing an excessive load on the back.

The revised equation also incorporated a term called the Lifting Index, which is defined as a relative estimate of the level of physical stress associated with a particular manual lifting task. The estimate of the level of physical stress is defined by the relationship of the weight of the load lifted divided by the recommended weight limit. A level greater than one indicates that the lifted weight exceeded the RWL and should be addressed using either administrative or engineering controls. A level greater than three indicates that the lifted weight exceeds the capacity to safely lift for most of the population, is likely to cause injury, and should be modified by implementation of engineering controls.

The 1991 equation still maintains the 1981 biomechanical criteria for establishing the maximum lower back compression force of 770 lbs. For the revised equation, the load constant was reduced from 90 pounds to 51 pounds. This reduction was driven by the need to increase the minimum horizontal distance from 6 inches to 10 inches (which is believed to be the minimum attainable horizontal distance as measured from the spine during lifting) in the 1991 equation. Aside from this reduction the 1991 revised equation represents only a two-pound reduction from the 1981 version when adjusted for revised horizontal distance.

Application of the NIOSH lifting tasks assumes the following:

- Lifting task is two-handed, smooth, in front of the body, hands are at the same height or level, moderate-width loads (i.e., they do not substantially exceed the body width of the lifter), and the load is evenly distributed between both hands.
- Manual handling activities other than lifting are minimal and do not require significant energy expenditure, especially when repetitive lifting tasks are performed (i.e., holding, pushing, pulling, carrying, walking or climbing).
- Temperatures (66-79°F) or humidity (35-50%) outside of the ranges may increase the risk of injury.

- One-handed lifts, lifting while seated or kneeling, lifting in a constrained or restricted work space, lifting unstable loads, wheelbarrows and shovels are not tasks designed to be covered by the lifting equation.
- The shoe sole to floor surface coupling should provide for firm footing.
- Lifting and lowering assumes the same level of risk for low back injuries.
- Using the Guidelines in situations that do not conform to these ideal assumptions will typically underestimate the hazard of the lifting task under investigation.

The computed values of the Recommended Weight Limit are used by the CSHO as a guide to estimate risk. **The numbers by themselves** do not identify a hazardous activity. The employer's incidence of injuries and lack of programs for training, work practice controls, and engineering controls related to lifting are elements used to determine the seriousness of the hazard.

Calculations

The revised lifting equation for calculating the Recommended Weight Limit (RWL) is based on a multiplicative model that provides a weighting for each of six variables:

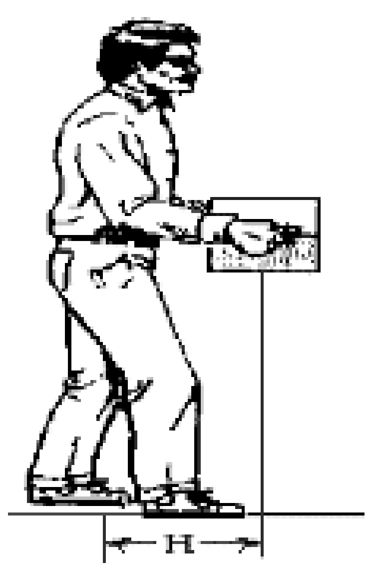
$RWL = LC \times HM \times VM \times DM \times AM \times FM \times CM$

where:

LC = Load Constant *(51 pounds)*

HM = Horizontal Multiplier *(10/H)*

Figure VII:1-1. **Horizontal Measurement**



Horizontal location of the hands (H): The horizontal location of the hands at both the start (origin) and end (destination) of the lift must be measured. The horizontal location is measured as the distance from the mid-point between the employee's ankles to a point projected on the floor directly below the mid-point of the hands grasping the object (the middle knuckle can be used to define the mid-point). The horizontal distance should be measured when the object is lifted (when the object leaves the surface).

VM = Vertical Multiplier $(1 - (0.0075|V\text{-}30|))$

Vertical location of the hands (V): The vertical location is measured from the floor to the vertical mid-point between the two hands (the middle knuckle can be used to define the mid-point).

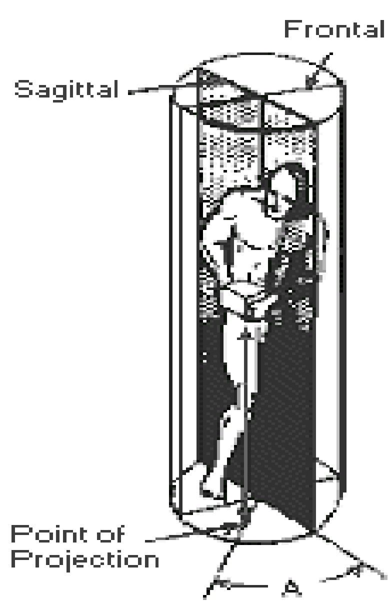
DM = Distance Multiplier $(0.82 + (1.8 / D)$

Travel Distance of the load (D): The total vertical travel distance of the load during the lift is determined by subtracting the vertical location of the hands (V) at the start of the lift from the vertical location of the hands (V) at the end of the lift. For lowering, the total vertical travel distance of the load is determined by subtracting the vertical location of the hands (V) at the end of the lower from the vertical location of the hands (V) at the start of the lower.

AM = Asymmetric Multiplier $(1 - (0.0032A))$

Asymmetry Angle(A): The angular measure of the perpendicular line that intersects the horizontal line connecting the mid-point of the shoulders and the perpendicular line that intersects the horizontal line connecting the outer mid-point of the hips.

Figure VII:1-2. **Measurement of Asymmetry Angle (A)**



FM = Frequency Multiplier (See Frequency Table Below (Table VII:1-1))

Lifting Frequency (F): The average lifting frequency rate, expressed in terms of lifts per minute, must be determined. The frequency rate can be determined by observing a typical 15 minute work period, and documenting the number of lifts performed during this time frame. The number of lifts observed is divided by 15 to determine the average lifts per minute. Duration is measured using the following categories: **Short** (Less than one hour); **Moderate** (1 to 2 hours); **Long** (2 to 8 hours).

Table VII:1-1. **Frequency Multiplier Table (FM)**

Frequency Lifts/min (F) ‡	**Work Duration**					
	< 1 Hour		**>1 but < 2 Hours**		**> 2 but < 8 Hours**	
	V < 30 †	V > 30	V < 30	V > 30	V < 30	V > 30
< 0.2	1.00	1.00	.95	.95	.85	.85
0.5	.97	.97	.92	.92	.81	.81
1	.94	.94	.88	.88	.75	.75
2	.91	.91	.84	.84	.65	.65
3	.88	.88	.79	.79	.55	.55
4	.84	.84	.72	.72	.45	.45
5	.80	.80	.60	.60	.35	.35
6	.75	.75	.50	.50	.27	.27
7	.70	.70	.42	.42	.22	.22
8	.60	.60	.35	.35	.18	.18
9	.52	.52	.30	.30	.00	.15
10	.45	.45	.26	.26	.00	.13
11	.41	.41	.00	.23	.00	.00
12	.37	.37	.00	.21	.00	.00
13	.00	.34	.00	.00	.00	.00
14	.00	.31	.00	.00	.00	.00
15	.00	.28	.00	.00	.00	.00
> 15	.00	.00	.00	.00	.00	.00

† Values of V are in inches.

‡ For lifting less frequently than once per 5 minutes, set F = 2 lifts/minute.

CM = Coupling Multiplier **(See Coupling Table Below (Table VII:1-2))**

Object coupling (C): The classification of the quality of the hand-to-object coupling (rated as **Good, Fair**, or **Poor**).

Table VII:1-1. **Frequency Multiplier Table (FM)**

GOOD	FAIR	POOR
CM = 1.00	**V < 30" then CM = 0.95**	**CM = 0.90**
	V > or = to 30" then CM = 1.00	
1. For containers of optimal design, such as some boxes, crates, etc., a "Good" hand-to-object coupling would be defined as handles or hand-hold cut-outs of optimal design.	1. For containers of optimal design, a "Fair" hand-to-object coupling would be defined as handles or hand-hold cut-outs of less than optimal design.	1. Containers of less than optimal design or loose parts or irregular objects that are bulky or hard to handle.
2. For loose parts or irregular objects, which are not usually containerized, such as castings, stock, supply materials, etc., a "Good" hand-to-object coupling would be defined as a comfortable grip in which the hand can be easily wrapped around the object.	2. For containers of optimal design with no handles or hand-hold cut-outs or for loose parts or irregular objects, a "Fair" hand-to-object coupling is defined as a grip in which the hand can be flexed about 90 degrees.	2. Lifting non-rigid bags (i.e., bags that sag in the middle).

Help using the lifting formula is available through the Directorate of Technical Support and Emergency Management.

Lifting Analysis Worksheet Table

The actual worksheet can be found in Appendix VII:1-5. The lifting analysis should be performed using both the average and maximum weights.

APPENDIX VII:1-3. Video Guidelines for Ergonomic Evaluations

Video Guidelines for Ergonomic Evaluations

Obtaining good video documentation for ergonomic evaluations can be difficult -- as the tasks are often performed in inaccessible areas with poor lighting conditions and a lot of extraneous movement taking place. This guide presents suggestions for capturing effective video documentation of potential ergonomic hazards.

Preparation

Use the OSHA Form 300 logs and 801's, complaint information, and interviews to help **prioritize** areas for taping. It is desirable to have at least a **two-person team** when performing an evaluation. One person can operate the video camera while the other can record task and employee information.

The equipment needed for an ergonomic inspection will generally include:

- Video Camera with **extra tapes** and **charged batteries**
- Tape measure
- Small Notebook
- Fanny pack
- Small scale (Chattillon or fish scale that can measure pull forces)
- Bungee cord or small piece of rope
- Questionnaires for employee interviews concerning ergonomic factors.

Other useful items may include:

- Stop watch
- Lens cleaning paper
- Extra batteries for internal clock
- Skylight UV filter. This is a must in a dirty environment if you do not have a protective case.

The following are general suggestions on camera usage which, if reviewed prior to going on-site, will provide the best video documentation for the analyst and ensure that all pertinent information is obtained and documented.

- Become **familiar** with the camera and read the operators manual. Shoot some test footage so you are familiar with all the functions of the camera.

- **Always activate the date and time** mechanism on the camera so that this information is displayed on the video during the entire taping series. This will provide additional reference points with which to correlate written information with the videotape footage. Be aware of the position of the date and time printout on the video footage to make sure that it is not superimposed over the top of important features of the video documentation.

- For operations with extraneous movement it may be necessary to use the manual focus to avoid the camera refocusing on irrelevant moving objects. Determine where the focus point is for the camera you are using. It may not be in the center of the viewfinder. To make this determination place the camera on auto focus and try to focus on a small item such as a hanging pendant that has nothing else in the same plane. Hang the item from a doorway and try to focus by moving the item back and forth in the field of the viewfinder. You have found the focus point when the camera focuses on the item.

- If the camera has a high speed shutter, turn it off and use the auto shutter. high speed requires too much light for most industrial tasks. If you are taping a worker with dark clothes against a light background (such as a window, or a white wall), activate the "back lit" capability on the camera.

- Practice visual **slating** of information. This should be done by filming a piece of paper with information clearly written on it just prior to or directly after videotaping the task. Use a marker or dark pen that can be clearly seen. The macro-zoom on your camera will permit use of a small notebook or journal to be used as a slate. A small notebook is easy to carry and any pertinent notes can be recorded on the slate sheet for easy correlation and future reference. Macro-zoom is also helpful for documentation of small informational areas such as labels.

- If visual slating is absolutely not possible, cover the lens with your hand and record the information verbally before the actual job taping begins. Be aware that you will need to speak directly into the camera microphone to be clearly understood. Use of an external microphone can be helpful in audio slating.

- Hold the camera as still as possible or use a tripod if available. Don't walk with the camera unless absolutely necessary to record the task. When you change location, move slowly and minimize camera movement. Use the zoom instead of walking whenever possible. Use the manual focus whenever there is extraneous movement in the frame of action to ensure the focus will be on the items of interest.

Videotapping Tasks

The following items outline the procedures used for obtaining useful video documentation.

- If possible tape the operation in the **order** of production. Do the beginning of the production process first and proceed through all tasks of interest.

- Visually **SLATE** at least the name of the task just prior to or directly after videotaping the task.

- Tape 5-10 minutes for all jobs including approximately 10 cycles. A cycle is considered to be a set of repeated motions during which one part or assembly is processed. Jobs that have relatively long cycle times in excess of 30-60 seconds may require fewer than 10 cycles if all aspects of the job are recorded at least 3-4 times.

- Begin each task with a whole-body view of the worker from the side including the chair and/or the floor. Hold this view for 2-3 cycles and then zoom the camera in for a closer view of the area of principal interest. Tape from a variety of angles to allow a determination of wrist deviation, arm postures, back angles, etc. Tape from both sides and the front if possible. The total footage may be distributed between these different angles.

- Videotape the operation from a distance to give perspective to the analyst about workstation layout.

- Find an entity of known dimension in the frame of the picture and measure it for reference purposes. The employee's forearm from the wrist to the elbow is a convenient landmark since it is in most frames and is measurable on the television screen. If possible place a piece of contrasting tape on the reference points to provide a more distinct and identifiable location point. Record the reference dimensions either by visually slating the information or verbally recording the data. If using a ruler or tape measure as your reference point, ensure that the increments are clearly visible.

- Obtain video footage of tools or machinery that are used on the job. Videotape labels from hand tools, machinery, weight from boxes, etc.

Analysis of Videotapes

Allow plenty of time for analysis.

There is information that cannot be readily obtained by visual inspection of the video documentation. The following information should be recorded on the videotape slate at the **beginning of the taping sequence**:

- Name, SIC code, and location of the facility being inspected.
- Date of inspection.
- Name of Compliance Officer(s), and OSHA office performing the inspection.

Additionally, the following information should be visually slated at the **beginning of each individual task** or recorded in a written Supplemental Factors Checklist. Written information should be referenced to the video documentation and must accompany the videotape when submitted for analysis.

- The name of the task and employee.

- Anthropometry (height) of the employee.

- Ambient conditions when working in extreme areas (freezers, furnaces, etc.).

- Clothing and PPE (materials, etc.).

- The period of time in which the task is performed including work-rest schedules.

- The nature of injuries as determined from the OSHA 300 Log's or interviews.
- Weight and dimension of loads lifted.
- Dimensions of the work items seen in the shot (i.e., pallets, tables, shelving units, etc.).
- Vertical distance between origin and destination of lift. Horizontal distance the load is held from the body at the beginning and end of the lift. These distances can be estimated directly from the video documentation if measuring will significantly interfere with the operation. To do this there must be a clear view of the entire body and the work space, preferably in profile. Provide dimensional information on as many work items seen in the footage as possible.
- Distance loads must be carried.
- Production data to aid in determining if the video segment is representative of normal activity.
- Conditions that might affect grip or traction (ie., sand on the floor, ice on boxes being lifted, etc.).

APPENDIX VII:1-4. Supplemental Factors for Ergonomic Tape Evaluations

Worker Information:

Worker's Name:

Worker's Height:

Distance from wrist to elbow or between contrast markers:

Past medical or CTD problems (prior to this task):

Current medical or CTD problems:

Non-occupational activities:

Job Information:

Job Name:

Location:

Time of videotape sequence:

Job Description (task frequency, cycle time, time on job; is the job always performed in this manner?):

Number of employees on job (now and normally):

Line speed; Self or machine-paced; (pieces/min):

Break schedule (micro-rest breaks possible):

Rotation schedule:

Jobs in rotation:

Job and Ergonomic Training

Given by Whom:

Hands-on or theoretical:

Time spent in training:

Updates:

How often:

Last update:

Update given by whom:

Workstation Information	* Make a sketch of the workstation layout on separate sheet of paper or reference to area of tape that shows the entire work layout.

Is the workstation adjustable, can it be tilted or rotated (mechanism and range of motion, heights, dimensions):

Table:

Chair:

What is the worker standing on (concrete, wood):

Is it slippery:

Can work positions be changed (sit/stand):

Reach distances:

Horizontal:

Vertical:

Tool Information	* Answer these questions and make a sketch or identify the tool on the video segment for each tool used. Use other sheets of paper if needed.

Name of tool:

Type of tool and Power Source:

Torque:

Reciprocating or vibrating:

Other:

Weight of tool:

Handle:

Span and Length:

Material:

If air-powered, is the exhaust away from the hand:

Miscellaneous Information:

What objects or materials are handled and their weight (for patients estimate the amount of help they can provide):

Name & Weight:

Temperature of work environment:

Personal protective equipment:

Are gloves worn, What material:

Estimate of task exertion level:

Estimate of hand and finger exertion level:

(1 = Low; hold coffee cup; to **5 = high**; open large "Bulldog" paper clip)

Does the employee have an opinion concerning the nature of the problem, management commitment, and possible corrective measures?

Employee Signature (optional, but desirable)______________________________________

APPENDIX VII:1-5. Lifting Analysis Worksheet

LIFTING ANALYSIS WORKSHEET

DEPARTMENT ____________________

JOB TITLE ____________________

ANALYST'S NAME ____________________

DATE

JOB DESCRIPTION

____

____

STEP 1. Measure and record task variables

Object Weight (lbs)		Hand Location				Vertical Distance	Asymmetric Angle (deg.)		Frequency Rate	Duration	Object Coupling
		Origin		Dest			Origin	Destination	lifts/min	Hrs	
L(AVG)	L(MAX)	H	V	H	V	D	A	A	F		C

STEP 2. Determine the multipliers and compute the RWLs

RWL = LC x HM x VM x DM x AM x FM x CM

ORIGIN	RWL =	51	x		x		x		x		x		x		–	
DEST.	RWL =	51	x		x		x		x		x		x		–	

STEP 3. Compute the LIFTING INDEX

ORIGIN LIFT INDEX $\frac{\text{OBJECT WEIGHT}}{\text{RWL}}$ = ____________________ = ____________________

DESTINATION LIFT INDEX $\frac{\text{OBJECT WEIGHT}}{\text{RWL}}$ = ____________________ = ____________________

Table 2 Vertical Multiplier			
V	**VM**	**V**	**VM**
in		cm	
0	.78	0	.78
5	.81	10	.81
10	.85	20	.84
15	.89	30	.87
20	.93	40	.90
25	.96	50	.93
30	1.00	60	.96
35	.96	70	.99
40	.93	80	.99
45	.89	90	.96
50	.85	100	.93
55	.81	110	.90
60	.78	120	.87
65	.74	130	.84
70	.70	140	.81
>70	.00	150	.78
		160	.75
		170	.72
		175	.70
		>175	.00

Table 3 Distance Multiplier			
D	**DM**	**D**	**DM**
in		cm	
≤10	1.00	≤25	1.00
15	.94	40	.93
20	.91	55	.90
25	.89	70	.88
30	.88	85	.87
35	.87	100	.87
40	.87	115	.86
45	.86	130	.86
50	.86	145	.85
55	.85	160	.85
60	.85	175	.85
70	.85	>175	.00
>70	.00		

Table 4 Asymmetric Multiplier	
A	**AM**
deg	
0	1.00
15	.95
30	.90
45	.86
60	.81
75	.76
90	.71
105	.66
120	.62
135	.57
>135	.00

Table 5 Asymmetric Multiplier						
Frequency Lifts/min (F) ‡	**Work Duration**					
	≤ 1 Hour		**> 1 but ≤ 2 Hours**		**>2 but ≤ 8 Hours**	
	V < 30 †	V ≥ 30	V < 30	V ≥ 30	V < 30	V ≥ 30
≤ 0.2	1.00	1.00	.95	.95	.85	.85
0.5	.97	.97	.92	.92	.81	.81
1	.94	.94	.88	.88	.75	.75
2	.91	.91	.84	.84	.65	.65
3	.88	.88	.79	.79	.55	.55
4	.84	.84	.72	.72	.45	.45
5	.80	.80	.60	.60	.35	.35
6	.75	.75	.50	.50	.27	.27
7	.70	.70	.42	.42	.22	.22
8	.60	.60	.35	.35	.18	.18
9	.52	.52	.30	.30	.00	.15
10	.45	.45	.26	.26	.00	.13
11	.41	.41	.00	.23	.00	.00
12	.37	.37	.00	.21	.00	.00
13	.00	.34	.00	.00	.00	.00
14	.00	.31	.00	.00	.00	.00
15	.00	.28	.00	.00	.00	.00
>15	.00	.00	.00	.00	.00	.00

† Values of V are in inches.

‡ For lifting less frequently than once per 5 minutes, set F = 2 lifts/minute