



### INTRODUCTION

The maritime work environment is very complex. Mariners work on a variety of vessels including tankers, cargo carriers, fishing vessels, military ships, barges, and offshore installations. In addition, maritime crew perform different types of work such as maintenance, production, repair, food services, manual materials handling, and drilling while working shift work. In addition, these tasks are performed in a moving environment, possibly in tight spaces, while potentially exposed to adverse environmental conditions, and living on the vessel.

Early indications of musculoskeletal disorders (MSDs) include numbness, tingling, pain, restriction of joint movement, or soft tissue swelling. Maritime employees suffer from strains and sprains of the low back muscles, and associated low back disorders, persistent or recurring general shoulder pain (related to e.g., rotator cuff tendonitis), lower extremity MSDs, and a variety of symptoms associated with vibration.

Some MSDs develop gradually over time as a result of intensive work. When the work environment requires employees to assume awkward or static body postures for a prolonged period of time, the employees may be at risk of developing MSDs. Activities outside the workplace that involve substantial physical demands may also cause or contribute to MSDs. In addition, the development of MSDs may be related to genetic causes, gender, age, and other factors. Finally, there is evidence that reports of MSDs may be linked to certain psychosocial factors such as job dissatisfaction, monotony, and limited job control. This Ergonomic Design and Safety Toolkit Module only address physical risk factors in the workplace. The ergonomics-related risk factors that maritime employees are most often exposed to include:

- Force
- Repetition
- Awkward and prolonged static body posture
- Contact stress
- Ship/installation motion
- Vibration
- Cold temperatures combined with the risk factors above
- High temperatures combined with the risk factors above

The combination of these risk factors in a job may result in a greater risk of injury. However, the presence of risk factors on a job does not necessarily mean that the employees will develop MSDs.

Providing a safer and more comfortable work environment may also result in additional benefits including reduced absenteeism, increased efficiency and productivity, decreased fatigue, and improved employee morale.

### TERMS/DEFINITIONS

*Ergonomics*: is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Practitioners of ergonomics, ergonomists, contribute to the planning, design and evaluation of tasks, jobs, products, organizations, environments and systems in order to make them compatible with the needs, abilities and limitations of people. (IEA, 2000).



*Musculoskeletal disorder (MSDs)*: can affect the body's muscles, joints, tendons, ligaments and nerves. Many work-related MSDs develop over time and can be related to the employee themselves, the work itself, or by the employees' working



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environment both the physical and psychosocial environment). They can also result from fractures sustained in an accident. Typically, MSDs affect the back, neck, shoulders and upper limbs; less often they affect the lower limbs.

### DISCUSSION

#### Protecting Employees

For many operations, the number and severity of injuries resulting from physical overexertion, as well as associated costs, may be substantially reduced. It is recommended that employers develop a process for systematically addressing ergonomic issues in their work environments and incorporate this process into their existing safety and health programs. To be most effective, the process should be tailored to an individual vessel/installation's operations.

Shipboard and shore side management personnel should consider the general steps discussed below when establishing and implementing an ergonomics program. It should be noted, however, that each vessel/installation may have different needs and limitations that should be considered when identifying and correcting workplace problems. Vessel/installations may implement different types of programs and activities and may assign staff from a variety of departments to accomplish the goals of the ergonomics program.

*Providing Management Support.* Strong support by management is critical for the overall success of an ergonomics process. Vessels/installations should develop clear goals and objectives for the ergonomics process, discuss them with the employees, and assign responsibilities to the designated staff members to achieve those goals, and provide feedback to employees. Implementation of an effective ergonomics process includes a sustained effort, the coordination of activities, and the resources necessary to ensure that the objectives of the ergonomics process will be accomplished.

Many ship/vessel operators have successfully integrated more than an ergonomics process into their business; for example, the "just-in-time", "six-sigma", "lean manufacturing", and "five S" strategies focus on providing the right material to the right place at the right time in a proper manner. These strategies attempt to eliminate non-value activities and reduce variability in business processes. Ergonomics is a good fit with these strategies - ergonomic principles help to identify and control activities that detract from employee performance and may lead to MSDs.

*Involving Employees.* Employees are a vital source of information about hazards in their workplaces. They have a unique insight into the problems of their jobs and can assist in identifying work-related risk factors. Employees' opinions and suggestions for change are valuable, particularly in such a difficult and complex work environment as a vessel/installation. Employees can provide early reports of MSD symptoms, submit their concerns and suggestions for reducing exposure to risk factors, and evaluate the changes made as a result of an ergonomic assessment. They can also participate in other activities such as ergonomic task groups and respond to management surveys and questionnaires.

Employee involvement in the ergonomics process may also enhance employee morale and job satisfaction. Employee involvement leads to greater acceptance when changes are made and to better understanding of ergonomics both on and off the job.

*Providing Training.* Training is also an important element of the ergonomics process. Training ensures that employees are informed about ergonomic concerns in the workplace and ways to minimize the risk of injury. Training is best provided by individuals who have experience with ergonomic issues in the maritime industry. Training should be provided in a manner and language that all employees can understand.

Training prepares employees for active participation in the ergonomics process, including identifying potential problems, implementing solutions, and evaluating the process. Effective training includes:



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- Proper use of equipment, tools, and machine controls
- Best work practices, including proper lifting techniques
- Awareness of work tasks that may lead to pain or injury
- Recognition of MSDs and their early indications
- Addressing early indications of MSDs before serious injury develops
- Appropriate procedures for reporting job-related injuries and illnesses

Employees will benefit from orientation and hands-on training received prior to starting tasks with potential ergonomic risk factors. Employees should also be notified of workplace changes, instructed on using new equipment, and notified of new work procedures.

*Identifying Problems.* It is important to periodically review the job/task work areas and the activities of employees to identify possible ergonomic issues. Information about existing problems can be obtained from a variety of sources including analysis of injury/illness/near miss records.

In addition, observations of workplace conditions and work processes, job analyses, workplace surveys, and employee interviews are important in identifying ergonomics-related risk factors. The ergonomics-related risk factors that may lead to the development of MSDs include:

- Force - the amount of physical effort required to perform a task (such as heavy lifting, pushing, pulling) or to maintain control of the equipment or tools.
- Repetition - performing the same motion or series of motions frequently for an extended period of time.
- Awkward and prolonged static postures - assuming positions that place stress on the body, such as repeated or prolonged reaching above the shoulder height, bending forward or to the side, twisting, kneeling, or squatting.
- Contact stress - pressing the body or part of the body (such as the hand) against hard or sharp edges, or using the hand as a hammer.
- Vibration - using vibrating tools such as sanders, chippers, drills, grinders, or reciprocating saws may result in fatigue, pain, numbness, increased sensitivity to cold, and decreased sensitivity to touch in fingers, hands, and arms. Exposure to whole body vibration may damage the joints of the skeletal system.

Cold temperatures combined with the risk factors above may increase the risk of musculoskeletal disorders.

When there are several risk factors in a job, as is often found on board ships and offshore installations, there can be a greater risk of injury. Whether certain work activities put an employee at risk of injury can depend on the duration (how long), frequency (how often), and magnitude (how intense) of the employee's exposure to the risk factors in the activity, as well as other factors (including employee factors). These characteristics are particularly important when considering work activities and conditions. For example:



- Grinding in a small compartment can involve a combination of vibration, force, and awkward postures.
- Pulling cable through an overhead channel can involve awkward postures and repetition.
- Using vibratory tools outdoors can involve awkward postures and vibration in a cold environment.

Additionally, the following types of employee behavior may indicate the presence of ergonomics related problems:

- Employees shaking arms and hands or rolling shoulders due to discomfort
- Employees voluntarily modifying workstations and equipment to increase comfort
- Employees bringing in medically related products to the worksite (such as wrist braces).



## Implementing Solutions

Examples of potential solutions for various ergonomic concerns are located in the Implementing Solutions section of this Module.

*Addressing Reports of Injuries.* Addressing reports of injuries is essential to the success of the ergonomics process. The goal of this effort is to ensure evaluation, diagnosis, and treatment of musculoskeletal disorders. Addressing reports of injuries focuses vessel/installations' efforts on preventing MSDs in those specific jobs where injuries occur most often and are most severe. It also provides needed input into the management of the ergonomics process. Integrating health care providers into vessel/installation ergonomic efforts promotes returning to work more quickly and successfully. As a part of the ergonomics process, addressing reports of injuries:

- Reinforces employee training on the recognition of the indications of MSDs and the necessary procedures for reporting potential injuries
- Encourages employees to report MSDs and potential MSDs early. Early reporting, diagnosis, and interventions can limit injury severity, improve effectiveness of treatment, minimize the likelihood of permanent damage, and reduce the number of claims.
- Provides prompt medical evaluation, medical care, and follow-up care (including rehabilitation services when available)
- Provides guidance on job modifications, restrictions, or alternative jobs for injured employees.

Work accommodations and alternative duty tasks will help employees recover faster, so that they can return to their usual job without restrictions and risk of re-injury. Health care providers of maritime companies, who remain knowledgeable about operations and work practices by conducting periodic, systematic workplace walkthroughs to observe workplace conditions and processes, can effectively identify potential alternative duty jobs and maintain close contact with the employees.

*Evaluating Progress.* Procedures and mechanisms to assess the effectiveness of the ergonomics process are also important. Evaluation and follow-up are essential to continuous improvement and long-term success. Ergonomics processes should be regularly evaluated to determine whether ergonomic objectives are met, including after new solutions are implemented. Such evaluations should include input from vessel/installation managers, health care providers, and employees to review goals, suggest changes in the process, and evaluate the effectiveness of ergonomic improvements.

The success of an ergonomics process can be evaluated based on interaction with employees and observations of the work environment, which are likely to be sufficient for small shipyards. Evaluation of more formal processes in larger organizations can also include activity and outcome measures used as indicators of process performance. Process evaluations may include the following:

- Direct communication with employees during training sessions, interviews during workplace observations, and follow-up medical evaluations
- Evaluation of each element of the ergonomics process, as determined by activity measures such as:
  - Average time between employee report of injury, risk factors or other ergonomics-related problem and implementation of appropriate solutions
  - Number of jobs analyzed and number of hazards identified
  - Number of employees trained
  - Number of risk factors reduced or eliminated
- Evaluation of the success in eliminating or reducing exposure to the ergonomic risks factors as determined by outcome measures that may include:



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- o Number of recordable MSDs
- o MSD incidence rate,
- o Number of workers' compensation claims,
- o Severity rate of MSDs,
- o Annual medical cost for MSDs
- o Average workers' compensation costs per MSD
- o Number of job transfer requests per trade

The results of process evaluations can be used to change the goals of the process over time. As some goals are achieved, it may be appropriate to focus efforts on other goals that remain.

### Implementing Solutions

The section on ergonomic solutions for vessels/installations describes changes to equipment, work practices, and procedures that can address ergonomics-related risk factors, help control costs, and reduce employee turnover. These changes may also increase employee productivity and efficiency because they eliminate unnecessary movements and reduce heavy manual work. Employers should use engineering controls, where feasible, as the preferred method of dealing with ergonomic issues on board vessels/installations. Engineering solutions should then be followed up with administrative controls, then lastly personal protective equipment. When dealing with ergonomic solutions, the use of personal protective equipment alone is not considered an acceptable form of ergonomic control.

### SUMMARY

Proactive ergonomic initiatives taken by the maritime industry may result in a reduction in injuries and illnesses. Many maritime tasks are performed in awkward body postures, at nonadjustable workstations, on scaffolds, and in enclosed or confined spaces.

More remains to be learned about the relationship between workplace activities and the development of MSDs. This Module provide recommendations for vessels/installations to help reduce the number and severity of work-related musculoskeletal disorders, increase employer and employee awareness of ergonomic risk factors, eliminate unsafe work practices, alleviate muscle fatigue, and increase productivity.

The general information in this Module is intended to provide maritime employers and employees with general solutions and a useful reference when determining the need for ergonomic assistance for specific jobs on board.

### REFERENCES

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