

An Approach to Best Welding Practice : Part – XIV

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“AN APPROACH TO BEST WELDING PRACTICE, Part – XIV” is the Fourteenth Detail Part of **“AN APPROACH TO BEST WELDING PRACTICE”** which was written as a General and Overall approach to the subject matter.

AN APPROACH TO BEST WELDING PRACTICE, Part – XIV is particularly focused on the Safety Aspects especially on the issues of Ergonomical hazards for Fusion Welding Processes to obtain the best possible Accident Free shop floor operation.

This is a Working Guideline for Supervisors and Operators working in an Engineering Fabrication Plant using welding as the main manufacturing process to initiate awareness for observing Safety Rules and regulations.

As the Guidelines are lengthy to cover in a single issue, it is divided into two Sections. Section – I is published in this issue and the Section – II is expected to be published in the next issue.

SAFETY

Safety has been defined in many ways and in different formats.

- Safety means protection and freedom from Hazards.
- Safety means keeping away from danger
- Safety means systematically tackling dangerous and hazardous situations.

In general, dangers and hazards are caused by :

- ◆ Tools and Tackles
- ◆ Manufacturing Process
- ◆ Machineries and Plants
- ◆ Human errors.

Every manufacturing factory using machineries and equipment impose Hazards which are to be mitigated by all concerned. In order to make the working environment as much safe as possible we must understand, evaluate and mitigate dangers

and hazards arising out of the process and associated tools, plant and equipment. At the same time we must formulate the safety rules to follow.

HAZARDS OF WELDING

- ◆ Fire and Explosion hazards.
- ◆ Electric shock.
- ◆ Radiation from Arc.
- ◆ Gases and Fumes
- ◆ Work-Related Musculoskeletal Disorders

INTRODUCTION

WELDING ERGONOMICS

The word Ergonomics has several meanings. The first is literal. Derived from two Greek words: Ergo = work; and Nomos = laws. Therefore ergonomics literally means the laws of work.

But the practical meaning of Ergonomics is fitting the task and work environment to the Human limitations. Ergonomists try to design tasks and workplaces to suit the capability of the human. In most of our workplace layout design and selection of production processes there are many tasks, work environments, and even products, which do not take human capabilities into consideration.

Ergonomics is the science of designing and arranging plant, machinery, equipment and positioning of job for efficient and effective workout by operators. It is also named as Human Factors Engineering. It is the science and relationship interaction between worker and workplace environment. Ergonomics attempt to make the workplace comfortable to the operators to work with minimum fatigue of body and limbs. Ergonomics focus on designing Process and Method to suit worker capabilities and not changing worker. It does not try to

make workers adjust to the workplace. When a workplace is designed properly, the worker feels comfortable. Quality and production increase. Everyone benefits.

PROBLEMS FROM POOR ERGONOMICS.

- Musculoskeletal Disorders (MSD)
- Repetitive Motion Injury.
- Worker Dissatisfaction.
- Increased Absenteeism.
- Increased Turnover rates.

SYMPTOMS OF MSDS.

- Less Gripping strength.
- Less Range of Motion.
- Loss of Muscle function.
- Painful Joints.
- Pain, Numbness in body Limbs.
- Shooting or Stabbing Pains.
- Swelling or Inflammation.
- Stiffness or Burning sensation.

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OBJECTIVES OF ERGONOMICS

- Reduce injuries and disorders.
- Ensure worker Safety.
- Ensure worker Health.
- Reduce Absenteeism.
- Ensure worker Productivity.

SYMPTOMS OF MSDS.

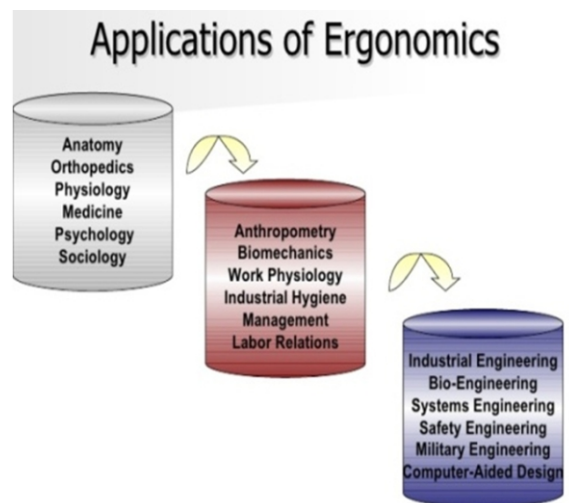
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CAUSES OF THE PROBLEMS

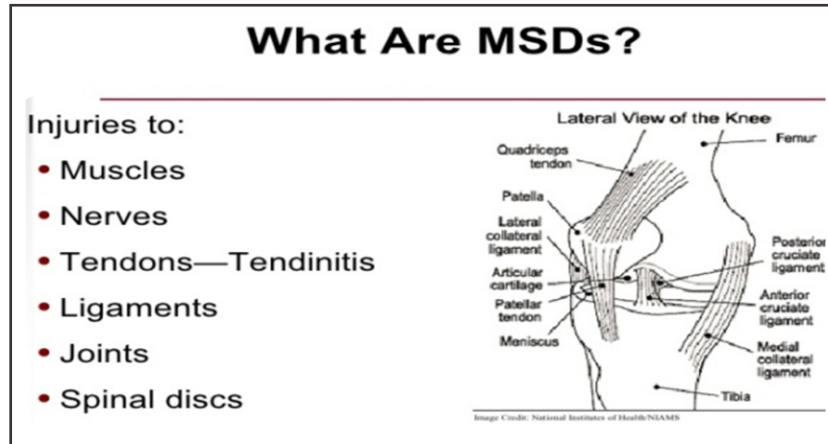
- Reaching.
- Bending.
- Heavy Lifting.
- Using continuous Force.
- Working with Vibrating Equipment.
- Repetitive Motions.
- Awkward Postures.
- Temperature.

Ergonomics includes many different scientific disciplines such as : physiology, biomechanics, psychology, anthropometry, industrial hygiene and kinesiology.



Benefits of Ergonomics





MUSCULOSKELETAL DISORDERS

Exposure to occupational hazards adversely affect the functioning of human body and in turn reduce worker productivity and product/work quality and increase musculo-skeletal problems. MSDs, or musculoskeletal disorders, are injuries and disorders of the soft tissues (muscles, tendons, ligaments, joints, and cartilage) including the nerves and tendon sheaths, and most frequently involve the arms and back. Occupational safety and health professionals have called these disorders in variety of names :

- Cumulative trauma disorders,
- Repeated trauma,
- Repetitive stress injuries,
- Occupational overexertion syndrome.

These are painful and often disabling injuries generally developing gradually over a period of weeks, months and years. MSDs usually result from exposure to multiple risk factors that can cause or accelerate the disorders MSDs can cause a number of conditions, including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis .

The Nature of Welding

In any metal fabrication industry, welding plays a vital role; it is a versatile manufacturing process and its application covers almost all the Engineering products including Nano-Technology. Welding is said to contribute to 50% of the nation's gross national product. Welding at awkward body positions with prolonged time are key factors in causing injuries. Welders have a high prevalence of musculoskeletal complaints, including back injuries, shoulder pain, tendonitis,

and reduced muscle strength. In this background, there is lot of scope for improvement in the operating (welding) postures which in turn helps in increased productivity, worker safety and quality of work in welding-industry. Problems are mismatches between man and machine, improper layout design, unhealthy work environment and mainly illiteracy among workers. Small scale industries face serious occupational health and safety challenges. Workers working in a shop floor throughout the day will experience a certain level of discomfort in their body parts; this in turn affects quality, and productivity.

Welding is a precise task that requires the welder to maintain static postures for relatively long periods of time. In almost all cases welding in the field requires the welder to adapt to the workplace, rather than adapting the workplace to the welder. This is because metal is heavy and it is easier to have the welder assume an awkward posture, than move a ship. Welding also is hot work and generates metal fumes that can contain many relatively harmful metals.

The use of proven ergonomic principles can improve the way a particular task is performed, thereby reducing welder exposure to risk factors. This generally translates to a healthier workforce, improved morale, greater productivity and increased product quality.

Most of the tasks welders perform are dictated by the design of the item being worked. In many cases, the materials are big, heavy, and might be covered with dirt, rust, and/or grime.

Work Related Musculoskeletal Disorders in Welding

Many injuries can develop when there is a mismatch between the capabilities of the workforce and the demands of the task. These injuries are generally called Work Related Musculoskeletal Disorders or WMSDs. These have also been

called Cumulative Trauma Disorders (CTDs) or Repetitive Stress Injuries (RSIs)

In general, these conditions develop because of micro-traumas that occur to the body over time. Consider lower back vertebral disk degeneration. The vertebral disk is made of flexible cartilage and contains a semi-liquid gel. The cartilage is in the form of rings. When a person performs lifts beyond their capability, these rings can degrade. If the person continues performing such lifts the disk can rupture. When it ruptures it bulges out and can place pressure on a spinal nerve causing severe pain.

Work situations and conditions that are likely to cause MSD problems include the following:

- Exerting excessive force more than normal ;
- Continuous and excessive repetition of movements that can irritate tendons and increase pressure on nerves;
- Forced awkward postures, or unsupported positions that stretch physical limits, can compress nerves and irritate tendons;
- Static postures, or positions that a worker must hold for long periods of time, can restrict blood flow and damage muscles;
- Abrupt motion, such as increased speed or acceleration when bending and twisting, can increase the amount of force exerted on the body;
- Compressive forces from grasping sharp edges like tool handles, can concentrate force on small areas of the body, reduce blood flow and nerve transmission, and damage tendons and tendon sheaths;
- Inadequate recovery time for tissue repair due to overtime, lack of breaks, and failure to vary tasks.
- Continuous and excessive vibration, usually from vibrating tools, can decrease blood flow, damage nerves, and contribute to muscle fatigue.
- Vibration of the whole-body such as from driving trucks or operating subways, or continuous chipping can affect skeletal muscles and cause low-back pain; and
- Working in extreme hot or cold temperatures can adversely affect a worker's coordination and manual dexterity and cause a worker to use more force than necessary to perform a task.

These risk factors, either alone or in combination, can subject the muscles, tendons, cartilages of the workers' shoulders, arms, hands, wrists, backs, and legs to thousands of repetitive twisting, forceful, or flexing motions during a typical workday. MSDs, however will result from these risk factors when present for a sufficient duration, frequency, or magnitude.

The many possible causes of injury are not limited to one industry or to specific occupations, but result from a pattern of usage. Physical Work Place Risk Factors with common causes of injury are:

- Repetitive gripping / twisting
- Repetitive reaching
- Repetitive moving
- Static postures
- Lack of rest to overcome fatigue

These causes fall into six major physical workplace risk factors:

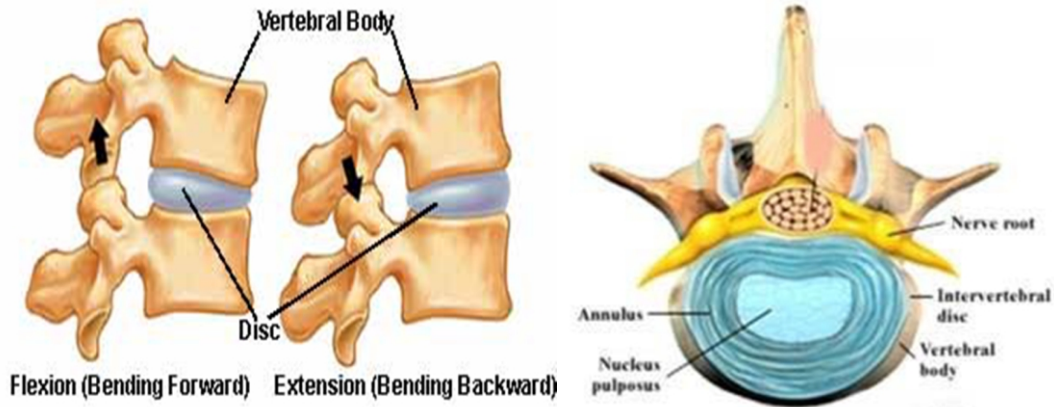
- Force to perform the task
- Highly repetitive tasks
- Poor, awkward or static postures
- Pressure points or compression
- Vibration
- Duration

When present with sufficient frequency, magnitude, or in combination, these risk factors may cause Work-related Musculoskeletal Disorders (WMSDs) – injuries and illnesses that affect muscles, nerves, tendons, ligaments, joints, spinal discs, skin, subcutaneous tissues, blood vessels, and bones.

Additionally, environmental conditions such as working in extreme temperatures may contribute to the quick development of WMSDs. Personal risk factors, such as physical conditioning, preexisting health problems, gender, age, work technique, hobbies and organizational factors (e.g., job autonomy, quotas, deadlines) may also contribute to, but do not cause, development of WMSDs.

Common WMSDs for welders include:

- Back Injuries – From strains and sprains to degradation of the vertebral disks
- Bursitis – Inflammation of a saclike bodily cavity, containing a viscous lubricating fluid located between a tendon and a bone or at points of friction between moving structures (i.e. inflammation of a bursa)



Spinal disc and vertebra

- Carpal Tunnel Syndrome – A complex disorder that starts with the inflammation of the tendon sheaths in the wrist and progresses into the degradation of median nerve
- Tendonitis – Inflammation of the tendons
- Tenosynovitis – Inflammation of tendon sheath
- Thoracic Outlet Syndrome – A disorder in which blood vessels and nerves in the upper shoulder region are compressed and cause pain. This condition is sometimes caused by chronic postures associated with overhead work.
- Trigger Finger – Tendons in the fingers “lock down” due to injury to the tendons

Musculoskeletal Disorders. The awkward positions are :

- Compression: Leaning on a hard surface Awkward & Static Posture: Holding the arms away from the body for long durations.
- Awkward & Static Posture: Extension of the neck, static loading in the arms and shoulders
- Awkward & Static Posture: Hot work in a static posture caused by the constrained space Compression: Leaning on a hard surface
- Awkward & Static Posture: Working with the back bent forward and wrist in extension Compression: Leaning on a hard, sharp surface
- Awkward & Static Posture: Working with the back bent.

The awkward welding positions shown below causes extensive

Ergonomics Stressors Compression : Leaning on a hard surface Awkward & Static Posture: Holding the arms away from the body for long durations



Welding with the hands in front of the body

Ergonomics Stressors: Awkward & Static Posture: Extension of the neck, static loading in the arms and shoulders



Welding above shoulder height

Ergonomics Stressors: Awkward & Static Posture: Extension of the neck, static loading in the arms and shoulders



Welding at ground level

**Ergonomics Stressors: Awkward & Static Posture :
Extension of the neck, static loading in the arms and shoulders**



Welding above shoulder height

**Ergonomics Stressors: Awkward & Static Posture: Hot work in a static posture caused
by the constrained space Compression: Leaning on a hard surface**



Welding in constrained spaces

**Ergonomics Stressors: Awkward & Static Posture: Working with the back bent forward
and wrist in extension Compression: Leaning on a hard, sharp surface**



Welding with back bent forward

**Ergonomics Stressors: Awkward & Static Posture: Working with the back bent
Forward Compression: Kneeling on a hard surface**



Working with the back bent forward

Ergonomics Stressors: Awkward & Static Posture: Statically Holding a stooped



Working in a stooped posture

**Ergonomics Stressors: Awkward & Static Posture: Working with the back bent forward
and holding the arms away from the body Compression: Resting the arms on a hard surfaces**



Working with the back bent forward

Ergonomics Stressors: Awkward & Static Posture

A few of the following photographs show various awkward and strained body postures during welding which invariably cause ergonomic stresses.

