Measurements and Fasteners Course

1. Basic Measurements Module

Introduction:

It is generally agreed that some form of measurement or inspection is critical to producing a quality product. However, not all measurement is inspection. According to the dictionary, the verb form of inspect is to look something over carefully and critically, especially for flaws. Nevertheless, to measure is to ascertain extent, dimension, quantity and capacity, especially by comparison with or to a standard, specification and/or detail drawing.

Inspection means someone created or used something and now wants to see whether it is good or bad. Inspection always answers a yes or no question: is it good or bad, pass or fail, go or no-go?

The value of measurement lies in the types of decisions it allows managers to make. Measurement provides data (information as opposed to yes/no) and information supports decisions.

Getting real numbers is important. The value of a measurement lies in the value of the decisions that can be made with the measurement data.

The measurement module provides the student with the knowledge to select the proper measurement
tools for each measurement task and the skill to properly use those tools. The class is heavily oriented to hands-on exercises and attainment of proficiency in the use of measurement tools.

Prerequisite:

Basic ability to read and write English and basic math skills are necessary to student succeed in this module.

Module Outline:

Instructional Topics	Primary Instructional Points
Basic Principles	Measurement units Accuracy Discrimination Reference Point vs Measured Point Direct vs Indirect Measurement Repetition Test Cleanliness Parallax errors Manual errors Equipment care
Basic Tools	Micrometers Rulers Calipers Dial calipers Ball gages Depth gages Surface gages
Outside Measurement	Tools- Micrometers, Calipers Direct vs. indirect measurement Measurements perpendicular across the piece Measure round shapes
Length	Tools- Rulers, calipers, micrometers Reference blocks and bars
Inside Measurement	Tools- Inside micrometers, calipers Techniques for finding the largest diameter
Hole Diameters And Concentricity	Tools- micrometers, calipers, ball gages Measuring at more than one depth
Depth	Tools- Dial depth micrometers, rulers/scales calipers Measuring round shapes Measuring across cavities
Gap	Feeler gauges
Flats and Surfaces	Tools- knife edge gages, straight edges
Metal Hardness	Surface cleanliness Assuring uniform indentation
Rubber and Plastic Hardness	Tools- Durometer Rubber hardness Durometer reading and typical rubber hardness

2. NDE Module

Student Performance Objectives:

Upon completion, the student will have an appreciation of NDT and understand that the various techniques are complementary. Items one through four below are types of NDT that will be presented and demonstrated according to ASNT (American Society for Nondestructive Testing) recommended practices. References to PT, MT, UT and RT are acronyms that ASNT have assigned to these NDT disciplines. Other acronyms that may be used by other organizations or corporations, are also indicated. Item 5, Hardness tests will be discussed in classroom and demonstrated using shear pin brinell and Leeb method.

Introduction:

Nondestructive Testing (NDT) is an extensive field covering all aspects of defect detection and is an important step in assuring that pressure containing and/or load bearing structural components and systems perform their function in a reliable and cost effective fashion. NDT technicians and engineers define and implement tests that locate and characterize material conditions and flaws that might otherwise cause equipment to fail prematurely. These tests are performed in a manner that does not affect the future usefulness of the object or material. In other words, NDT allows parts and materials to be inspected and measured without damaging them. Because it allows inspection without interfering with a product's final use, NDT provides an excellent balance between quality control and cost-effectiveness.

Prerequisites:

Knowledge of basic math and measurement techniques. Ability to read and write English.

Module Outline:

Instructional Topics	Primary Instructional Points
Introduction	General introduction to NDE and the techniques Overview of techniques
Visual Inspection	Advantages and disadvantages Techniques for visual inspection Tools that support visual evaluation Visual weld inspection and evaluation Weld types Weld defects to look for
Visual Inspection Lab	Students will examine several samples for defects and show proficiency in visual evaluation techniques

Liquid Penetrant Inspection	Advantages and disadvantages overview Materials used in PT Considerations for PT Detailed discussion of PT steps
Liquid Penetrant Inspection Lab	Students will perform PT on Laboratory samples with known defects and show proficiency in all phases of the process.
Magnetic Particle Inspection	Advantages and disadvantages Materials compatible with MT Magnetic fields and their effects Procedure for MT Interpretation of indications
Magnetic Particle Inspection Lab	Students will perform MT on laboratory samples with known defects and show proficiency in all phases of the process.
Ultrasonic Inspection	NOTE: This is an abbreviated coverage of the subject that focuses on thickness evaluation and does not do more that introduce crack detection and measurement. Advantages and disadvantages Principles of UT Equipment used for UT Applications of UT Thickness evaluation Calibration
Ultrasonic Inspection Lab	Students will perform UT on laboratory samples with known thickness and shoe proficiency in thickness evaluation. The instructor will demonstrate crack detection and measurement but students will not be required to perform that activity.
Radiography Inspection	NOTE: This is an abbreviated coverage of the subject that focuses on the concept and types of RT and on film image interpretation. Advantages and disadvantages Principles of UT Equipment used for UT Applications of UT Thickness evaluation Calibration
Radiographic Inspection Lab	The lab for this topic consists of students reading sample film images and discussing the indications they see.

3. Fasteners Module

Synopsis and Introduction

While simple in concept; proper fastener selection and torquing techniques are critical to the success of any operation. The fastener module will familiarize students with the types of bolted fasteners that are available and used for various material joining and connecting applications. Students will be shown the various visual and tool-assisted methods of identifying fastener material strengths, thread types, and other properties. The necessity of applying the proper bolt pre-load will be discussed and demonstrated using various types of torque wrenches. The methods of repairing threaded fasteners will be discussed and demonstrated. The proper techniques for torquing bolts in a bolted pattern will be discussed and demonstrated.

Prerequisites

Students should have a general understanding of fasteners including a basic understanding of torque techniques.

Overview

The topics to be discussed will be presented in sections. Each section will be covered in detail during classroom instruction. Students will then conduct laboratory exercises associated with the classroom section just discussed, so that the practical importance of the subject matter can be evaluated and understood through hands-on exercises. The following sections will be taught:

a.Definitions and Terminology – The definitions of bolts, studs, screws, and other types of fasteners will be reviewed.

b.Threads and Thread Measurement – The various types of threads, both English and Metric, will be evaluated.

c.Thread Repair – Various techniques for thread repair will be described.

d.Torque – The concept of torque and the calculations associated with torque will be introduced.

e.Torque Wrenches – The various types of torque wrenches will be evaluated.

f.Bolt Failures – The various failure modes and fracture surface “signatures” will be described.

g.Torquing Bolt Patterns – The proper technique for torquing bolts in a bolted pattern such as a flange joint will be described. The use of a hydraulic torque wrench to torque large, high strength, bolts in a pattern will be evaluated in detail.