TECHNICAL TRAINING - SWAPPING DOWNTIME FOR PRODUCTIVITY!

Mechanical Systems & Tools – Syllabus [Detailed]

1 Staying Safe in the Mechanical World!

Your automation.ie *Fact Sheets*!

Understand Mechanical Energy Types!

- Potential Energy
- Kinetic Energy

Know the Hazards in the Mechanical World

Be aware of Personal Protective Equipment (PPE)

Appreciate the Importance of Good Housekeeping

2 Engineering Pocket Books.

Familiarization of the *Zeus Pocket-Book*

Familiarization the *Engineers Reference Pocket-Book*

Familiarisation of the *Engineers Reference Handbook*

3 The ISO Metric System.

Understanding the ISO System

Understand the concept of *Base* & *Derived* Units

Use Software to Perform Quantity Conversions

Practice Metric & Imperial Conversion Exercises

4 Tools & Their Correct Use.

Understand Drive Systems for Screws & Bolts:

- Screwdrivers - Information, Types & Sizes:
  - Flat
  - Philips
  - Pozidriv
- Hex Type Drives:
  - Allen Keys
  - Standard TORX
  - Security TORX

The Importance of The Right Tool for the Right Job!

Use an Impact Screwdriver

Know your Spanners:

- Metric / Imperial types
- Understand A / F and A / C Terminology
- Spanner Types:
  - Open Spanners
  - Ring Spanners
  - Combination Spanners
  - Crows Foot Spanners
  - Adjustable Spanners
  - Ratcheting Ring Spanners
  - Hook Spanners
  - Pin Spanners

Circlip Types:

- Twin eye External
- e-clip External
- Twin eye Internal
- Wire type Internal

Circlip Pliers:

- Internal
- External

Dismantle and Rebuild Circlip assemblies.

Sockets:

- 4,6,8,& 12-point Sockets
- Metric / Imperial
- AF / AC Terminology
- Accessories:
  - Swivel Sockets
  - Universal jointed Sockets
  - Universal joint extensions
  - Fluted Sockets
  - Specialised Sockets
  - Drives and drive sizes
  - Ratchet Handles
  - Speeder Handles

Torque Wrenches:

- Types:
  - Beam
  - Click
  - Electronic
- Understanding Torque Calibration Units:

- Newton Meters
- Kilogram Meters
- Kilogram Centimetres
- Foot Pounds

- Understand Range & Span
- Torque the Nut or Torque the Bolt?
- Care & Calibration
- Practical Session using a Torque Wrench

Examine the contents of a Typical factory Toolbox!

5 Mechanical Measurement.

Use a Vernier Callipers - Metric & Imperial

Use a Micrometer - Metric & Imperial

Using Measuring Gauges:

- Thread Pitch Gauges
- Slip Gauges
- Feeler Gauges

6 Engineering Materials.

Know the Properties of Engineering Materials

Understanding Specific Engineering Materials

- Metals
- Polymers
- Ceramics
- Composites

Understanding Basic Metallurgy:

- Ferrous Metals:
  - Pig, Wrought & Cast Irons
  - Carbon Steel & Alloy Steel
  - Heat Treatment of Steel
- Non-Ferrous Metals:
  - Bronze
  - Aluminium
  - Copper
  - Lead
  - Nickel
  - Tin
  - Titanium
  - Zinc
- Alloys
  - Brass
  - Bronze

- Solder

Understand Hardness & Rockwell numbers

7 Methodical Dismantling & Re-assembly Practices.

Cleanliness & Organisation

Methodical Dismantling

Good Storage Practices

Methodical Reassembly Practices

Functionality Testing & Returning to Production

8 Lubrication, Friction & Wear (Tribology).

Understand the purpose of Lubrication

Know about Viscosity & Viscosity Index

Understand what Full-Film Lubrication is

Understand what Boundary Lubrication is

Lubrication example as applied to a Journal Bearing

What are & why use Automatic Lubricating Systems

9 Mechanical Seals.

Gaskets:

- Application of Gaskets
- Gasket Materials
- Gasket Inspection
- Making a new Gasket

O-Rings:

- Application of O-Rings
- Inspecting of O-Rings
- Replacing O-Rings

Lip Seals:

- Application of Lip Seals
- Inspecting of Lip Seals
- Replacing Lip Seals

Stuffing Boxes & Gland Packings:

- Applications of Stuffing Boxes
- Cutting & Packing Methods
- Adjusting a Packing Set
- Lubrication of Packings

10 Limits & Fits.

Understand the Principal of Limits & Fits

Understanding the ISO Referencing System

Consulting the *Engineers Reference Handbook*:

- Clearance Fits
- Transition Fits
- Interference Fits

11 Drills, Drill Bits & Reamers.

Safety First!

Drill Bits:

- Metric / Imperial
- Drill Bit Design Characteristics
- Checking for Wear / Sharpening Options

Feeds & Speeds

Drilling Techniques

Reamers:

- Establishing Fits: Consult Limit & Fits Chart
- Feeds & Speeds

12 Screw Thread Technology.

Nomenclature for Threads

Examination of differing Thread Types:

- Metric
  - Metric Coarse
  - Metric Fine
- Unified Thread Standard (UTS)
  - UNC
  - UNF
  - UNEF

Referring to Engineering Pocket Books - Threads

Thread Lead, Thread Pitch, Thread Starts

Thread Handedness

Using Thread Gauges - Metric & UTS

Tapping an Internal screw thread

Cutting an External screw thread

13 Screws, Bolts, Nuts & Washers.

Screws:

- Types & Function:
  - Wood Screw
  - Machine Screw
  - Thread Cutting Machine Screw
  - Sheet Metal Screw
  - Self-Drilling Sheet Metal Screw
  - Socket Screw
  - Grub-Screw
  - Coach Screw
  - Threaded Bar

Bolts:

- Types & Function:
  - Hex Bolt
  - Cup Square Bolt
  - Eye Bolt
  - Eye Lag Bolt
  - J- Bolt
  - U- Bolt
  - Shoulder Bolt
  - Elevator Bolt
  - Hanger Bolt
  - Sex Bolt
  - Mating Bolt
  - Wing Bolt
  - Socket Bolt
- Bolt Head Markings

Common Head Types for Bolts & Screws

Nuts:

- Types & Function:
  - Hex Nut
  - Heavy Hex Nut
  - Nylon Insert Lock Nut
  - Half / Jam Nut
  - Nylon Insert Half Nut / Jam Nut
  - Wing Nut
  - Dome Nut
  - Acorn Nut
  - Flange Nut
  - Tee Nut
  - Square Nut
  - Prevailing Torque Lock Nut
  - K-Lock Nut / Keps Nut
  - Coupling Nut
  - Slotted Nut

- Castle Nut

Washers:

- Types & Function:
  - Flat Washer
  - Mudguard Washer
  - Finishing Washer
  - Split lock Washer
  - Serrated Lock Washer - External Tooth
  - Serrated Lock Washer - Internal Tooth
  - Square Washer
  - Dock Washer
  - Ogee Washer
  - Sealing Washer
  - Schnorr Washer
  - Nordlock Washer

14 Dealing with Broken / Sheared Studs & Damaged Threads.

Broken Stud Removal using Easi-Out's

Thread Repair using Helicoils

15 Bearings & their Applications.

Introduction to Bearings:

- Purpose of Bearings
- Defining Radial & Axial Loading

Bearing Types & Applications:

- Plain Bearings
- Ball Bearings
- Roller Bearings:
  - Standard Roller
  - Spherical Roller Bearings
  - Tapered Roller Bearings
  - Thrust Roller Bearings
- Needle Bearings:
  - Radial Needle Bearings
  - Thrust Needle Bearings
- Linear Ball Bearings

Maximising Bearing Service Life

Bearing Mounting & Dismounting

16 Power Transmission Systems.

Mechanical Drive Couplings

Electro-Magnetic Clutches & Brakes

Belts & Pulleys, Types & Tensioning:

- Flat Belts
- Vee Belts
- Poly-Vee Belts
- Timing Belts

Chains & Sprockets:

- Terminology
- Types
- Anatomy of Roller Chains
- Tensioning
- Breaking & Making Chain Links:
  - Quick Release Link
  - Split Link
  - Cotter Link
  - Rivet Link

17 Reading Mechanical Prints.

Engineering Drawing Equipment

Understand 1st & 3rd Angle Projection

Basic Engineering Drawing Principals

Introduction to Geometric Dimensioning & Tolerancing (GD&T)

18 Machining Processes.

Grinding:

- Cylindrical Grinding
- Surface Grinding

Centre Lathe

Milling Machine

CNC Machining

Spark Erosion

19 Welding Processes.

Gas

Electric Arc

MIG

TIG

20 Open Floor Discussion!

Open Floor Discussion