Pearson BTEC Level 4 Higher Nationals in Engineering (RQF)

Unit 17: Quality and Process Improvement

Unit Workbook 2

in a series of 2 for this unit

Learning Outcomes 3 and 4

Industry Standards and Total Quality Management

Contents

INTRODUCTION

Determine the role of standards in improving efficiency, meeting customer requirements and opening up new opportunities for trade

- The history of standards.
- The role of standards and their importance in enabling and supporting trade and industry.
- Standards for measurement.
- International Standards for management (ISO 9000, 14000, 18000).
- European Foundation for Quality Management (EFQM) as an aid to developing strategic competitive advantage.

Analyse the importance of Total Quality Management and continuous improvement in manufacturing environments

- The importance of quality to industry: how it underpins the ability to improve efficiency, meet customer requirements and improve competitiveness.
- Principles, tools and techniques of Total Quality Management (TQM).
- Understanding and implementation of Six Sigma.

GUIDANCE

This document is prepared to break the unit material down into bite size chunks. You will see the learning outcomes above treated in their own sections. Therein you will encounter the following structures;

Purpose

Explains *why* you need to study the current section of material. Quite often learners are put off by material which does not initially seem to be relevant to a topic or profession. Once you understand the importance of new learning or theory you will embrace the concepts more readily.

Theory

Conveys new material to you in a straightforward fashion. To support the treatments in this section you are strongly advised to follow the given hyperlinks, which may be useful documents or applications on the web.

Example

The examples/worked examples are presented in a knowledge-building order. Make sure you follow them all through. If you are feeling confident then you might like to treat an example as a question, in which case cover it up and have a go yourself. Many of the examples given resemble assignment questions which will come your way, so follow them through diligently.

Question

Questions should not be avoided if you are determined to learn. Please do take the time to tackle each of the given questions, in the order in which they are presented. The order is important, as further knowledge and confidence is built upon previous knowledge and confidence. As an Online Learner it is important that the answers to questions are immediately available to you. Contact your Unit Tutor if you need help.

Challenge

You can really cement your new knowledge by undertaking the challenges. A challenge could be to download software and perform an exercise. An alternative challenge might involve a practical activity or other form of research.

Video

Videos on the web can be very useful supplements to your distance learning efforts. Wherever an online video(s) will help you then it will be hyperlinked at the appropriate point.

3.2 Standards for Measurement

3.2.1 Defining Measurement Systems

The two main systems for measurement are imperial and metric, the metric system is the standard adopted by almost the entire globe, the exceptions still using Imperial are Liberia, Myanmar and the United States. The difference in the metric and imperial system can be shown in Table 3.1 below.

Table 3.1: Metric and imperial units of measuring length

Metric	Imperial
12 inches to 1 foot	10mm to 1cm
3 feet to 1 yard	100cm to 1m
1760 yards to 1 mile	1000m to 1km

The use of metrics can make calculations much simpler, hence why it is almost globally adopted. With this in mind, but it's also important to define the units of measurement in technical drawings, technical drawings have four different unit lists:

- Inch, pound, second (IPS)
- Millimetre, gram, second (MMGS)
- Centimetre, gram, second (CGS)
- Meter, kilogram, second (MKS)

If these units aren't defined, a manufacturer could make the wrong assumption, and end up with a completely incorrect sized part, which will stall production and be incredibly costly.

3.2.2 Fittings

When considering fittings in an assembly, it is important to think about what kind of fit is required, as this will give different operations. ISO defines three different types of fits, which can then be sub-categorised:

- Clearance fit
- Transition (location) fit
- Interference

Clearance fit is a case where the hole is larger than the shaft, meaning that the two parts will be able to free to slide and rotate. Table 3.2 shows the possible subcategories for clearance fits.

Table 3.2: Clearance fits

Type	Description	Example
Loose running	Large clearance, accuracy is not essential	Pivots, latches,
Free running	Large clearance, high running speeds	Journal Bearings
Easy running	Moderate clearances for high running speeds	Long shafts, pump or fan bearings
Close running	Small clearances for moderate running speeds	Shafts, spindles, sliding rods
Sliding	Minimal clearance for high accuracy	Guiding shafts, sliding gears
Location	Close clearances for precision accuracy	Precision guiding

Transition fit is a case where the hole is fractionally smaller than the shaft, and a mild force will be required to assemble or disassemble the system. Table 3.3 shows different classifications of transition fits.

Table 3.3: Transition fits

Type	Description	Example
Tight	Assembled or disassembled by hand	Hubs, gears
Similar	Assembled or disassembled by rubber mallet	Pulleys, bearings
Fixed	Assembled or disassembled with a light pressing force	Plugs

Interference fit will have a smaller hole than the shaft and will need a high force or heat to assemble or disassemble the system, Table 3.4 shows the different types of interference fits.

Table 3.4: Interference fits

Type	Description	Example
Press	Light interference using cold pressing	Retainers
Driving	Medium interference with hot pressing or high force cold pressing	Permanent mounting onto a shaft
Forced	High interference shrink fit with large temperature difference	

These fits are normally given a label for shorthand in technical drawings (in the case for a loose-running shaft, H11 for the hole, e11 for the shaft). Table 3.5 shows the tolerances in the fitting for a three types of clearance fits. (**These tolerances may vary as the shaft increases in size**).

Table 3.5: Clearance fit tolerances

	Loose-Running			Free-Running			Sliding		
	Hole H11	Shaft e11	Fit	Hole H9	Shaft d9	Fit	Hole H8	Shaft f7	Fit
Max	$+0.060$	-0.060	$+0.180$	$+0.025$	-0.020	$+0.070$	$+0.010$	-0.002	$+0.018$
Min	$+0.000$	-0.120	-0.060	$+0.000$	-0.045	-0.020	$+0.000$	-0.008	-0.002

3.2.3 Threads

The thread is the turn that is seen on a screw or bolt, that helps anchor it into the assembly. The thread of a nut and bolt are always designed to match, if it doesn't match it can create a lot of stresses in the system, or just jam it. When choosing the appropriate thread size, there a few things that need to be considered, such as the pitch, clearance hole and tapping diameter.

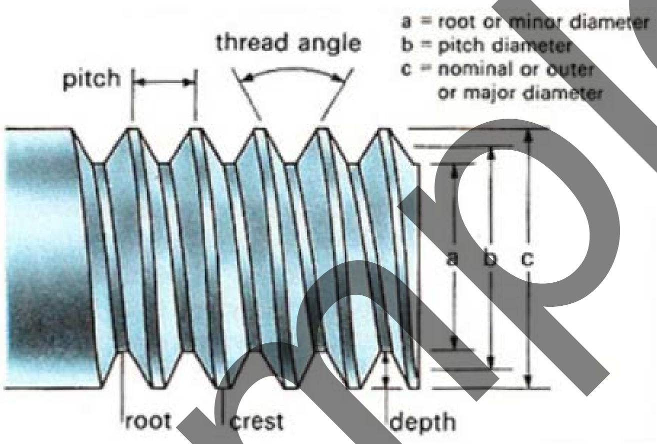

Fig.3.1: A diagram of a screw or bolt thread

Pitch: Width of a thread shown in Fig.3.1

Tapping Diameter: This is the diameter of the hole required to mate with the thread of the screw or bolt.

Clearance Hole: This is the diameter of the hole required to allow the threads to pass through, but not the head of the screw or bolt.

ISO standards split the threading as "coarse" (standard) or "fine", a table of ISO standard threads are shown in Table 3.2.