Rewarding Learning

A2 LEVEL Section C

FACT FILES

Technology & Design

For first teaching from September 2011

For first award in Summer 2013

Quality and Assurance

technology and design

FACT FILE

3.18 Quality and Assurance

Learning Outcomes

Students should be able to:

- Develop an understanding of the various processes and strategies employed in quality control and assurance systems e.g the use of measuring devices, jigs, templates and fixtures;
- Devise appropriate tests for products to meet specific requirements;
- Describe the use of ICT in Quality Control and Assurance.

Course Content

What is Quality Control?

Quality control is a range of checks, tests and processes employed by manufacturers to ensure that their product meets a standard that is acceptable to them before it's goods leave the factory. This ensures that the customer receives a product which will perform as the manufacturer intended.

Quality control can begin with the inspection of the raw materials required for the manufacturing processes and end with the packaging and delivery of the product to the customer. It involves inspection at all stages of manufacturing and focuses on the physical processes and the actual product itself. The inspections would be carried out by trained staff using specialised equipment.

The testing will normally involve actual examination of the product or parts and any not meeting the required standard may be rejected or remanufactured.

Inspections

Inspecting the materials and parts can be done by looking at surface finish, dimensions and physical fit during the different stages of manufacturing. Size and fit of parts and components is a common inspection, and this can be done easily using gauges of a set size to check quickly rather than using a rule to meassure. Often gauging can be done electronically and data can be analysed to aid the production process.

Whilst measuring samples on a production line is essential to ensure the product has been accurately manufactured, it can also be a time consuming process. Manufacturers make use of gauges - often in the form of electronic or pneumatic test rigs - to determine if a part or product has been manufactured to it's required dimensions, this is often referred to as tolerance. When parts are manufactured it is very difficult to ensure they are all exactly the same size and it is often too expensive to produce every part to that standard, so often a manufacturer will state that the part or component is +(greater than) or –(smaller than) the stated dimension.

For example if a diameter of a LED is 8mm with a tolerance of 0.25 that means when the LED is made it, it's diameter will be between 7.75mm and 8.25mm. If this tolerance was being checked as part of quality control testing the LED could be checked against it's upper limit (8.25mm) and it's lower limit (7.75mm) by passing the it through two gauges, if the LED passed through the lower limit of 7.75mm then it would be discarded for being too small and if it didn't fit into the upper limit of 8.25mm then it would also be discarded being outside the manufacturers tolerance.

Whilst manufacturers could make products like an LED to very precise dimensions it would be very expensive to do this for such a small product. By carrying out quality control tests a manufacturer can at least assure their products do fit within a small tolerance, a tolerance which will not affect the use or performance by the end user.

Jigs, Templates and Fixtures.

In small scale manufacturing, where products are manufactured in small batches with a small relatively skilled labour force, products are largely made by hand with machinery used to assist. This could lead to varying sizes and finish of a product as the processes at this level a largely reliant on the skill of the machinist. To avoid differences in a line of products templates are used to aid the manufacturing process. Furniture, musical instrument and clothing manufacturers make use of templates as they require accurate cutting and shaping of resistant material to ensure quality.

These templates below are for an electric guitar, these templates would be placed onto the timber and drawn around before being cut using large table saws and routers. Templates can be manufactured using CNC to ensure an accurate starting point, this improves accuracy whilst still enabling a product to be 'hand-made'.

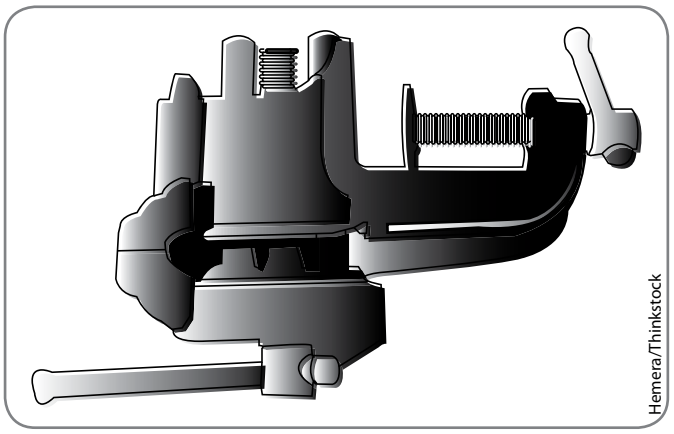
JIGS

Where holes have to be accurately drilled in the same position repeatedly a jig can be used to aid accuracy. Whilst the process of drilling is not very difficult, positioning a drill in the same place over several different pieces can be difficult and time consuming. However if a jig is used the drill operator just has to ensure the material is fitted correctly in the jig to ensure accurate holes.

Below is a jig for drilling holes accurately in a kitchen door, by using jigs the kitchen manufacturer knows that doors can be drilled accurately assuring quality to the customer and preventing wastage through inaccurate drilling. It's disadvantages are the jigs need to be correctly fitted to perform properly and they can wear after prolonged use reducing their accuracy. Often if different thickness of materials are to be used, resetting or adjusting can often be time consuming and rely on the skill and accuracy of the user.

Fixtures

Fixtures allow a manufacturer to repeatedly test a manufactured piece or sample material under similar conditions. By using a specific fixture to hold the material or sample product more accurate test results can be achieved during quality control testing. Fixtures can be mechanical clamps (like the one right), pneumatic or hydraulic and they allow the manufacturer to test (often to destruction)a part or product.



Devising Appropriate Tests

One way a manufacturer can assure quality in it's product is by physically testing the product. These tests can highlight strength and weaknesses in the design which the manufacturer can correct before the product leaves the factory. Whilst testing can be done during the development of the product it is often used as part of quality control to ensure that there are no issues with the production processes.

In order to devise an appropriate test it would be important to identify what physical property or specific requirement was being checked. Common tests may include testing it's mechanical properties – tensile, compressive, shear, torsional and bending strength. These forces will be a common occurrence in the day to use of most products, and tests can be easily measured for performance and comparing against similar products.

It may be important to test a specific aspect of the product, for example how long a mobile phone battery will last under certain conditions, or how far a wireless baby monitor will carry it's signal. These tests are just examples and using a product's specification and a list of mechanical properties it can be quite straightforward design a test for a specific requirement.

Materials used to manufacture a product may have properties which can cause a product to fail and it may be necessary to test these. For instance plastic can deform at high temperatures, so if a product like a hairdryer or toaster is made from plastic it will need to be tested for stability at high temperatures.

Using ICT in Quality Control and Assurance.

Whilst it may be impossible for a manufacturer to ensure 100% quality across all aspects of manufacture, there are ways of reducing the extent and quantity of any defects that may occur during production.

Before manufacturing begins, the amount of errors can be mathematically calculated to take into account any variations there may in the production process. As manufacturing begins samples are taken out of the production line and tested for defects. These samples and tests are recorded and the feedback is added to the system. The system would employ computers using sensors to physically test the dimension, fit, hole positions, surface finish etc. This is a continual process and allows the manufacturer to improve quality by identifying where in the production line there are the most errors and compensating with better machines or different materials. By reducing wastage the manufacturer can save money and speed up manufacturing

Revision questions

1. Briefly describe **two** methods a guitar manufacturer might use to ensure an instrument is accurately cut to shape? [2]

2. Briefly explain how a manufacturer might ICT to improve quality control processes. [2]

3. What is the purpose of using a fixture during the testing of material or product. [1]

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