Pearson BTEC Level _ Higher Nationals in Engineering (RQF)

Unit 50: Advanced Manufacturing Technology

Unit Workbook 1

in a series of 2 for this unit

Learning Outcome 1 & 2

Advanced Manufacturing Processes & Technologies

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INTRODUCTION

Recognise a range of advanced manufacturing processes to cite examples of where they are most effective.

- *Manufacturing Processes:*
  - Pressing and forming, casting and moulding, joining and soldering, mixing, final assembly, packaging, material handling, quality control/inspection.
- *Advanced Manufacturing Processes:*
  - Additive manufacturing technology (e.g. replacing forming, moulding, pressing), 3D printing, impact on rapid prototyping, availability of spares/obsolete parts, medical components available and customised.
  - Mass customisation through 3D printing, opening up a self-serve market.
  - Robotics/human interface and automation, high-precision technology and productivity e.g. aerospace, automotive, electronics assembly.
- *Types of Application or Industry:*
  - Industry examples: aerospace, automotive, healthcare, electronics, food and beverage, chemical and pharmaceutical, minerals, oil and gas, retail, fashion.
  - Application examples: assembly, joining, moulding, soldering.

Analyse advanced manufacturing technologies to determine their appropriateness for an application or process.

- *Manufacturing Technologies:*
  - High precision robotics and automation: healthcare (components and processes), aerospace, automotive, process control and visualisation through automation technology.
  - Improvement in productivity through greater automation.
  - Quality of manufacturing processes improved through integration of robotics.
  - Examples of using 3D printing and other forms of additive manufacturing to produce medical equipment, spare parts for items that may have become obsolete, mass customisation; what the customer wants, when they want it.

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.

1.1 Manufacturing Processes

In order to consider advanced manufacturing, one must consider manufacturing that is not considered as advanced, that is to say, the common, traditional methods of manufacturing which are still being utilised today. It is necessary to do this so that one can distinguish the differences between traditional and advanced manufacturing, as well as to recognise the development of manufacturing throughout time and how advanced technologies are impacting and building upon on these traditional processes.

1.1.1 Pressing and Forming

Pressing and forming are a group of processes which are commonly used to create parts from sheet or bulk metal or plastic, through means of mechanical deformation.

In the case of bulk material, there are several common forming processes, each resulting in severe deformation, there are extremely high forces involved in each and this bulk forming is usually undertaken under hot working conditions, this is usually always the case with plastics.

Where sheet material is concerned, there is a set of several different processes which can be deployed, depending on the desired final form and shape of the product.

Some of the basic bulk and sheet forming processes are depicted below:

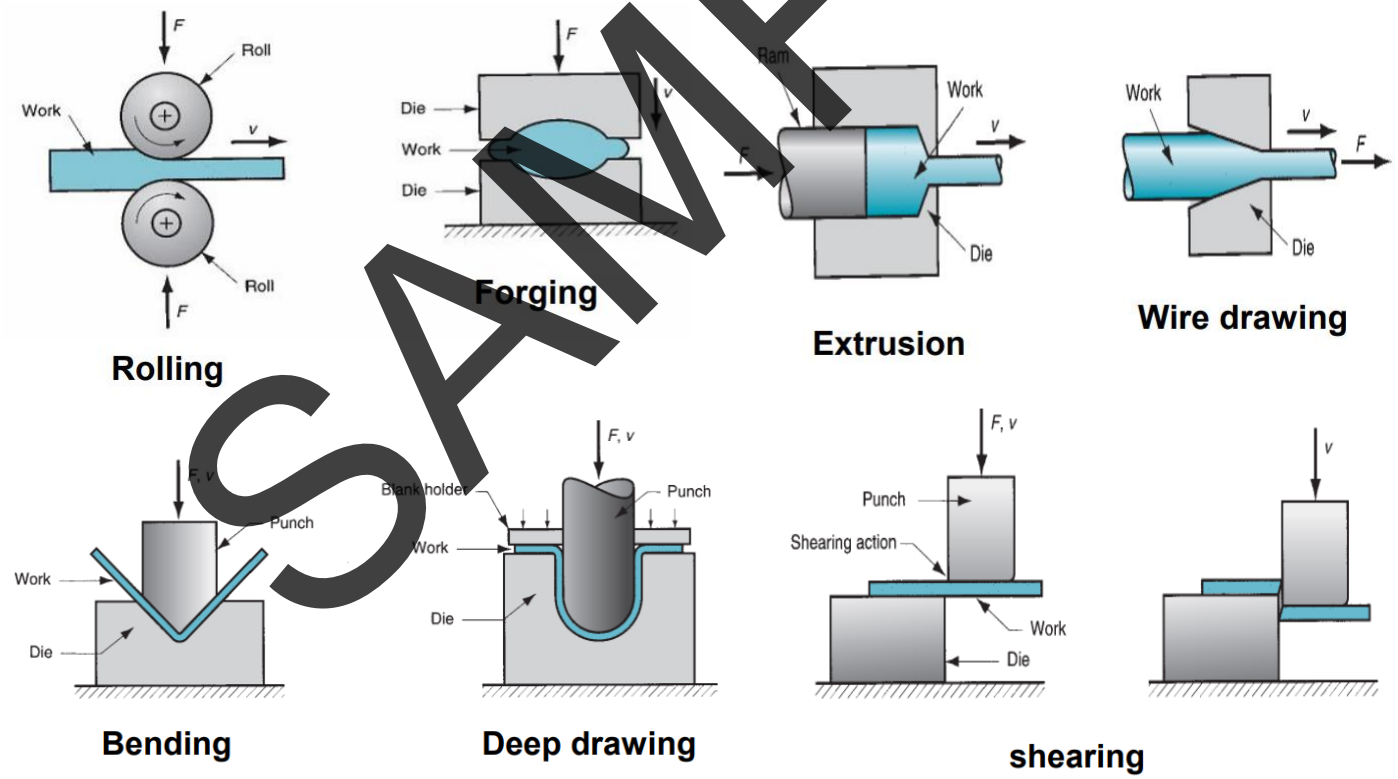

Figure 1.1: *Bulk & Sheet Forming Processes*

There are also numerous types of metal casting commonly in use, as detailed below:

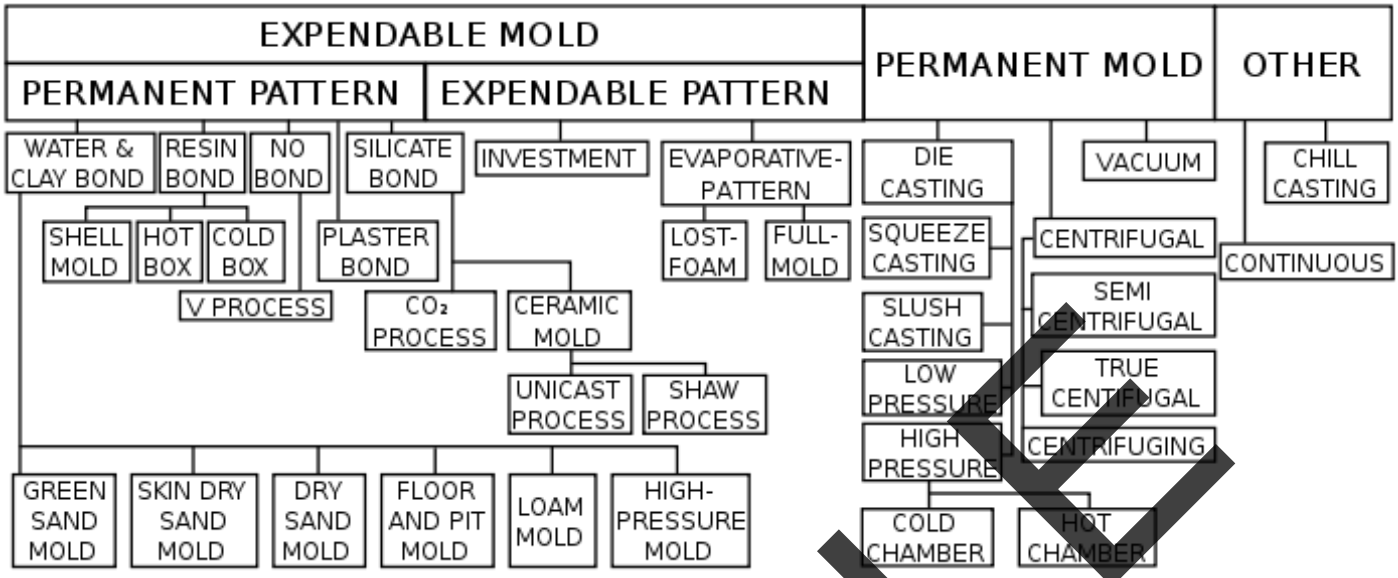

Figure 1.3: *Metal Casting Processes*

1.1.3 Joining and Soldering

In manufacturing, the joining of materials is an integral part of the process overall: parts and components are produced which require joining together and, depending on the situation and application, different joining methods may be used.

Broadly speaking, there are three categories of joining, they are: mechanical joining, welding and adhesive. There are several advantages and disadvantages to each method and often, they are actually combined to bring together the best assets of each method.

The mechanical joining process includes fastening and/or clamping via nuts, bolts, screws, interlocks and rivets. It can be used across all material groups, between similar or dissimilar materials and produces good versatility, usability and dismantlability, which is particularly useful where periodic maintenance is required. However, mechanical processes do have disadvantages because, by their nature, they have to create holes in order to join.

Soldering is a term applied to a process of joining two, usually metal, components together via the use of a filler material and it is very commonly used in the electronics industry. It is similar to the process of welding, however, differs in one major way: in welding, the two workpieces to be joined are heated and the edges are actually melted, whereas in soldering, the workpieces are not heated.

There are many different types of welding, commonly in use today, see the welding processes chart below:

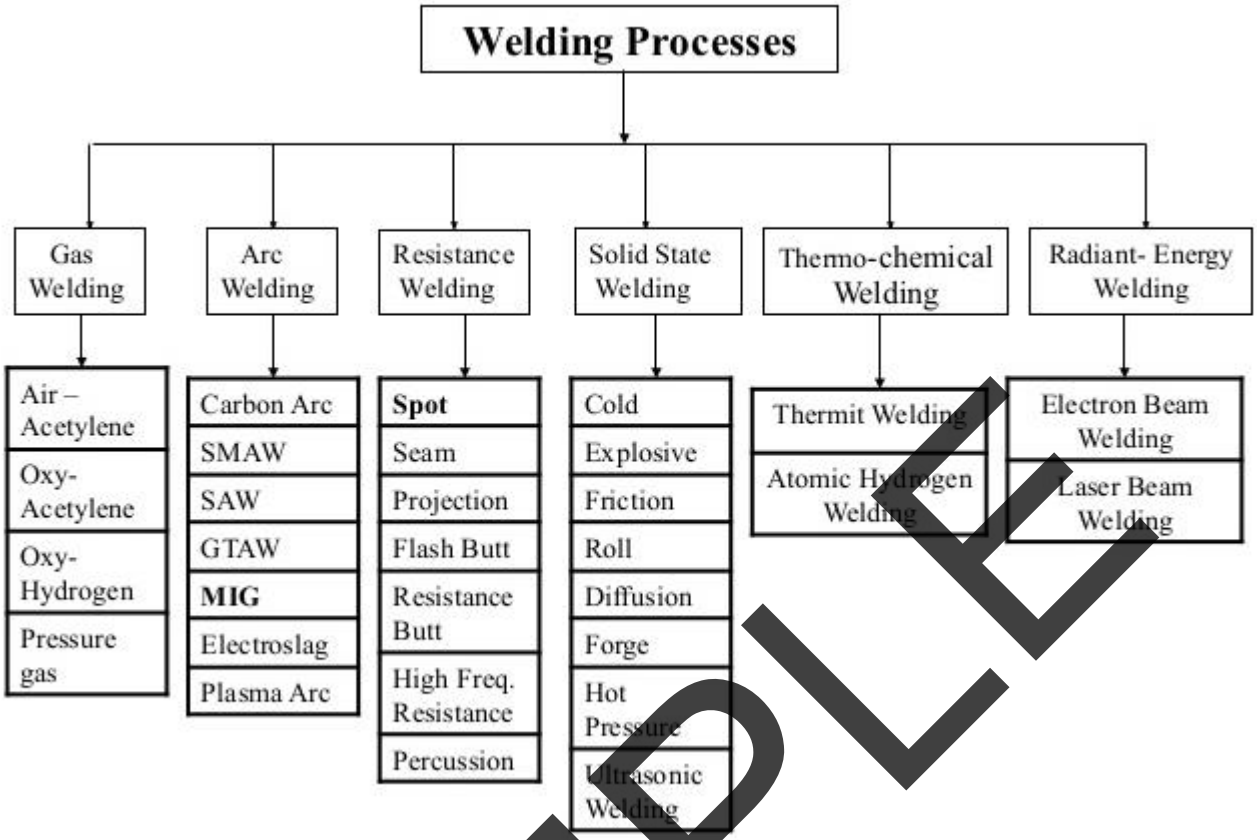

Figure 1.3: *Welding Processes*

Adhesives may also be used to bond materials together; this method of joining can be used to bond dissimilar metals together however it does have a weakness in regard to the joints peeling apart.

1.1.4 Mixing

The process of mixing in engineering refers to action of creating a uniform substance, usually in terms of its composition. A common example can be seen in a swimming pool, whereby the pumps serve the purpose of mixing the water to maintain a consistent temperature across its entire volume. In industry, mixing is frequently utilised in order to mix two liquids, two solids, a liquid and a solid, a liquid and a gas or a solid and a gas.

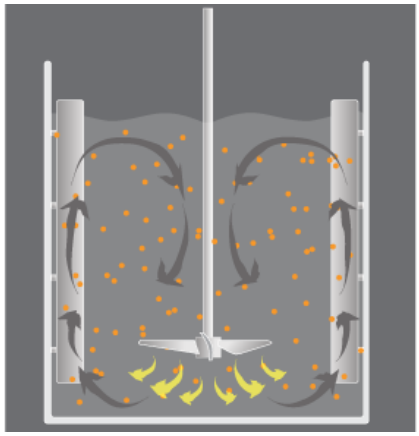

Figure 1.4: *Industrial Mixing Representation*