

3

SHAPING MATERIALS

UNIT 1 • MATERIAL RETENTION PROCESSES



1

A student named Peter Parker is interviewing Mr O' Connor, a mechanical engineer, for a school project on metalworking processes. Read their conversation and fill in the blanks with the words in the box. Then role-play the dialogue in pairs.

accuracy • around • better • cavity • chapter • characteristics • definitely • desired don't • empty • information • made • material • means • melting • mind • moulds • pleased • porosity • process • processes • project • provide

PETER PARKER

Good Morning Mr O'Connor.
My name's Peter Parker and
I'm working on a school
(1) on
metalworking (2)
Do you (3) if I
ask you some questions?

Well, I'd like to start my
project with a (7)
dealing with casting.

How are moulds
(14) in sand
casting? How are they usually
classified?

What are the main
(19) and
applications of products made
with sand casting?

MR O'CONNOR

Hello, (4) to meet you. No, I (5)
.....! I'd be happy to help you with your school
project! What (6) do you need?

Right. Casting (8) pouring a molten metal
into an (9) mould so that it takes the form
of the (10), after hardening. Moulding, (11)
..... and casting are the basic steps of any casting
(12); sand casting is (13) the
oldest and best known casting technique.

A pattern made of wood, plastic or metal is used to
make (15) Sand is packed (16)...this
pattern, which is then removed, leaving an empty cavity
with the (17) shape: that's the mould.
Moulds are classified as temporary or permanent,
depending on the (18) they are made of.

They are not particularly expensive but show high
(20) with limited dimensional (21)
..... Other processes, such as die, permanent
or centrifugal casting (22) higher accuracy
and (23) surface finish. They are widely
employed in mass production.

UNIT 2 • MATERIAL REMOVAL PROCESSES



1

Below is an incomplete list of the components of most lathes. Match the parts of the lathe with the missing definitions.

- **Bed:**
 - **Ways:** inner and outer guide rails that are precision machined parallel to assure accuracy of movement.
 - **Headstock:**
 - **Spindle:**
 - **Chuck:** 3-jaw (self centering) or 4-jaw (independent) device used to clamp part being machined.
 - **Tailstock:**
 - **Carriage:**
 - **Cross Slide:** mounted on the traverse slide of the carriage, and uses a handwheel to feed tools into the workpiece.
 - **Toolholder:** to mount tool holders in which the cutting bits are clamped.
 - **Compound:** mounted to the cross slide, it pivots around the tool post.
 - **Apron:**
 - **Lead Screw:** for cutting threads.
 - **Split Nut:** when closed around the lead screw, the carriage is driven along by direct drive without using a clutch.
1. moves on the outer ways. It is used for mounting and moving most of the cutting tools.
 2. fits on the inner ways of the bed and can slide towards any position on the headstock to fit the length of the workpiece.
 3. attached to the front of the carriage, it has the mechanism and controls for moving the carriage and cross slide.
 4. usually made of cast iron. Provides a heavy rigid frame on which all the main components are mounted.
 5. mounted in a fixed position on the inner ways, usually at the left end. Using a chuck, it rotates the work.
 6. hole through the headstock to which bar stock can be fed.



2

Now listen to the recording and check your answers.



3

The following conversation takes place at a machine tool exhibition. Mr. Wallace needs machinery for his new plant and needs to collect information on vertical milling machines. Mr. Cooper works for a company making machine tools and provides information on a new model of vertical milling centre. Read the text and put the sentences in the right order. You can use the brochure below as a guide.

- a. ☐ **Wallace.** Uhm...Well, that's certainly a possibility. Could I have some detailed information on its structural features and operations?
- b. ☐ **Wallace.** What are the worktable's dimensions and the spindle speed?
- c. ☐ **Cooper.** Sure, here it is. And remember that optical rules and internal spindle cooling equipment can be provided on request!
- d. ☐ **Wallace.** Good morning. My name's Paul Wallace and I'm in charge of the purchase office of WALLACE & GRIBALDI S.P.A. I'm collecting information on new types of vertical milling machines for a plant we are setting up in the outskirts of Turin.
- e. ☐ **Wallace.** I see.... Do you think you could give me a brochure to show to my partners?
- f. ☐ **Cooper.** The worktable is mm1200x500 and the spindle speed is RPM 60:6000.
- g. ☐ **Cooper.** As you can see, it is really solid and rigid but also fast and precise with limited noise and vibrations. The workpiece is supported tightly and the axis movement is very smooth. It is particularly suitable for moulds and model makers and, in general, for long production runs and high speed works. However, it is very versatile and can be used for drilling and smaller milling operations as well.
- h. ☐ **Cooper.** Pleased to meet you Mr Wallace. I'm George Cooper and I'm the sales manager of LIVERPOOL IND. CO. LTD, specializing in the manufacturing of machine tools. Well, Personally, I would advise you to consider the CZ4537 model over there. It's a new one.

CZ 4537 VERTICAL MILLING CENTRE

FEATURES:

- Solid and rigid: suitable for any mechanical engineering use, above all for moulds and model makers.
- Fast and precise: perfect solution for long production runs and high speed works.
- Versatile and suitable for drilling and smaller milling operations or as back-up equipment for lathe shops.
- Total support for the workpiece ensured by large base dimensions and perfect slide position.
- Limited noise and vibrations.
- Smooth axis movement ensured by large rectangular slides in ground and tempered steel.
- Internal spindle cooling provided on request.



TECHNICAL INFORMATION:

- | | |
|----------------------------|-----------------|
| • Worktable | mm 1200x500 |
| • X-axis stroke | mm 800 |
| • Y- axis stroke | mm 500 |
| • Z- axis stroke | mm 600 |
| • Tool store | standard |
| • Spindle motor power | kW 7,5 standard |
| • Spindle speed range | RPM 60:6000 |
| • Axis working feed speed | standard |
| • Optical rules | optional |
| • Internal Spindle cooling | optional |

UNIT 3 • UNCONVENTIONAL MACHINING PROCESSES



1

Read the text on pages 124-125 of New Mechways and answer the following questions.

- a. What is USM used for?
- b. How is material removal carried out in USM?
- c. How does AJM differ from USM?
- d. What are the advantages of WJM over USM and AJM?
- e. What materials is WJM usually applied to?



2

Read the text which follows and complete the chart on the next page.

■ UNCONVENTIONAL MACHINE TOOLS

Unconventional machine tools were developed primarily to shape the ultrahard alloys used in heavy industry and aerospace applications and to shape and etch¹ the ultrathin materials used in such electronic devices as microprocessors.

Plasma-arc machining (PAM) employs a high-velocity jet of high-temperature gas to melt material. PAM is generally used for materials that are difficult to cut by any other means, such as stainless steels and aluminum alloys.

Laser-beam machining (LBM) uses a beam of light to vaporize unwanted material. LBM is particularly suitable for making accurate holes in refractory metals and ceramics and very thin materials.

Electrodischarge machining (EDM), also known as spark erosion, employs electrical energy to remove metal from the workpiece without touching it, so that delicate operations can be performed. A pulsating high-frequency electric current is applied between the tool point and the workpiece, causing sparks to vaporize small areas of the workpiece. EDM can produce shapes unobtainable by any conventional machining process.

Electrochemical machining (ECM) uses electrical energy to remove material: current is used to dissolve the metal and remove it from the workpiece, which must be electrically conductive. A wide variety of operations can be performed by ECM, including etching, marking, hole making, and milling.

Ultrasonic machining (USM) employs high-frequency, low-amplitude vibrations to create holes and other cavities. A relatively soft tool is shaped as desired and vibrated against the workpiece while a mixture of fine abrasive and water flows between them. The friction of the abrasive particles gradually cuts the workpiece. Materials such as hardened steel, carbides, rubies, quartz, diamonds, and glass can easily be machined by USM.

In **electron-beam machining** (EBM), electrons in a vacuum chamber are accelerated and directed against a precisely limited area of the workpiece; on impact, the kinetic energy of the electrons is converted into thermal energy that melts and vaporizes the material to be removed, forming holes or cuts. EBM equipment is commonly used by the electronics industry to aid in the etching of circuits in microprocessors.

(Adapted from *Encarta*)



MACHINE TOOL	TECHNIQUE	MATERIAL / SECTOR
Plasma-arc machining (PAM)	<i>high-velocity jet of high-temperature gas to melt material</i>	
Laser-beam machining (LBM)		<i>refractory metals, ceramics and very thin materials</i>
Electrodischarge machining (EDM)		
Electrochemical machining (ECM)		
Ultrasonic machining (USM)		
Electron-beam machining (EBM)		



3

Decide if the following statements are true (T) or false (F) and correct the false ones.

- | | T | F | Correction |
|--|--------------------------|--------------------------|------------|
| a. A milling cutter is a multiple-point tool. | <input type="checkbox"/> | <input type="checkbox"/> | |
| b. Low melting point and low shrinkage on cooling are important properties in casting. | <input type="checkbox"/> | <input type="checkbox"/> | |
| c. Grinding machines never employ abrasive tools. | <input type="checkbox"/> | <input type="checkbox"/> | |
| d. Cores are used to make holes and cavities in casting. | <input type="checkbox"/> | <input type="checkbox"/> | |
| e. Moulding, melting and casting are the basic steps involved in the foundry process. | <input type="checkbox"/> | <input type="checkbox"/> | |

