21世纪高等职业教育
模具设计与制造技术规划教材

模具专业英语

王浩钢 主编
李海平 副主编

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内 容 提 要

模具技术涉及高分子材料、模具金属材料、模具结构、成型加工设备等诸多领域，相关技术设备的引进和国际合作交流很多。该专业所涉及的科技英语词汇、语句等虽常见于各专业文献中，但无法全面、系统地反映材料、设备、工艺的内在联系。本书主要内容包括模具设备、塑料模具设计、冲压模具设计、工程材料、加工制造及现代模具设计 CAD/CAM 等方面的英语阅读文章和词汇。本书词汇部分的选词和释义均围绕工程实际应用，均是设备、结构以及数值模拟中常用的概念和专业词汇。

本书可作为高职高专模具设计、制造等相关专业的教材，也可供相关工程技术人员参考使用。

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21 世纪高等职业教育模具设计与制造技术规划教材

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编者的话

近年来我国模具行业快速发展，汽车、玩具、电子行业、电器和仪器仪表、建材等行业都对模具有大量的需求。目前，中国约有模具生产企业2万余家，从业人员有100多万人，随着模具行业的不断发展壮大，与国外企业和行业的交流越来越多，相关技术设备的引进和国际合作交流增多。模具专业英语也越来越受到人们的关注。

模具技术涉及高分子材料、模具金属材料、模具结构、成型加工设备等诸多领域，相关的专业英语资源非常丰富，但是模具专业方面的词汇、语句等散见于各专业的文献中，却无法全面、系统地反映材料、设备、工艺的内在联系，所以市场迫切需要这类教材。

本书参考了数本美国和英国的现行教材，摘选部分优秀篇章，并作了部分修改，课后还对部分疑难语句进行翻译，主要内容包括模具设备、塑料模具设计、冲压模具设计、工程材料、加工制造及现代模具设计CAD/CAM等方面的英语阅读文章和词汇。本书词汇部分的选词和释义均围绕工程实际应用，将设备、结构以及数值模拟中常用的概念和词汇结合起来，便于理解。

本书由河南工业大学王浩钢、李海平，安阳工学院赵成刚、刘素华，中原工学院穆运超等老师编写。同时在本书的编写过程中，也得到了郑州参数技术有限公司的张磊刚工程师、郑州工大模具培训学校的张红林老师的大力支持，在此表示深切的感谢。

编者

2006.1.1

前　言

在当今世界上，高度发达的制造业和先进的制造技术已经成为衡量一个国家综合经济实力和科技水平的最重要标志之一，成为一个国家在竞争激烈的国际市场上获胜的关键因素。目前，中国制造业已跻身世界第四位，中国已成为制造业大国，但尚不是制造业强国。中共十六大明确提出："用高新技术和先进适用技术改造传统产业，大力振兴装备制造业。"当前，要从制造大国走向制造强国，必须优先发展先进制造业。这就要求，必须大力发展以数控技术为主的先进制造技术，提高模具设计制造水平,提升计算机辅助设计与制造（CAD/CAM）的技术水平。

自改革开放以来，到目前为止制造业在中国国民经济中的比重已占到45%，制造业部门成为GDP增长的主要支撑力量。无论从制造业占国民生产总值和财政收入的比重来讲，还是从扩大就业、保持社会稳定来讲，可以说，至少在21世纪前50年制造业仍然是我国国民经济增长的主要源泉。

制造业要发展，人才是关键。尽快拥有一批高技能人才和高素质劳动者，是先进制造业实现技术创新和技术升级的迫切要求，高等职业教育担负着培养高技能人才的根本任务。中国打造"世界工厂"，为中国高等职业教育的发展提供了难得的机遇和艰巨的挑战。

为顺应中国制造业的深层次发展和现代设计方法、数控技术的广泛应用，人民邮电出版社组织全国知名专家，经过与现代数控、模具生产制造企业技术人员的反复研讨，编写了适合当前技术改革、紧跟技术发展的相关高等职业学校教材，包括数控技术规划教材、模具设计与制造技术规划教材、机械专业基础规划教材、计算机辅助设计与制造技术规划教材四个系列，系列之间紧密联系、相辅相成。

四个系列教材均以高等职业教学中的实际技能要求为主旨，内容简明扼要，突出重点。编写方法上注重发挥实例教学的优势，引入众多生产应用实例和操作实训题，便于读者对全书内容的融会贯通，加深理解。其特色主要如下。

1. 教材的重点实例全部编入图册，形成全套教材的整体配合。图册既可以作为全套教材的总结，又可以作为工程实例中的模板；既可以使学生们在三年的学习之后，通过图册加以回顾，又可以在工作中，通过对已学实例加以修改完成工程项目要求。

2. 教材的例图尽量使用当前常用的新图，尽量贴近工程。

3. 辅助设计的教材全部采用"案例教学"的教学方法，并且设计了软件学会之后与工程实践相结合的实践教程（实践教程配有视频教学光盘）。

4. 采用螺旋结构、分四层逐级深入的教学方法，形成各系列教材的整体配合。

5. 课程的整体设计上，特别强调与工程实践的联系。各系列中最后的几门课程，尽量联系到当代工程的实例，使学生们在学习了一定的知识、掌握了相关的技能后，能够应用于工程中。

四个系列的教材分别适合于高职高专院校机械类专业的数控、模具、基础和辅助设计的

课程教学，也可选作数控、模具技能培训教材或从事数控加工和模具设计的广大工程技术人员的参考书。

我们衷心希望，全国关心高等职业教育的广大读者能够对教材的不当之处给予批评指正，来信请发至 yangkun@ptpress.com.cn。

21 世纪高等职业教育模具设计与制造技术规划教材编写委员会

目　录

Lesson 1　The Injection Molding and Machine

The injection molding

Injection molding is principally used for the production of the thermoplastic parts, although some progress has been made in developing a method for injection molding some thermosetting materials. The problem of injecting a melted plastic into a mold cavity from a reservoir of melted material has been extremely difficult to solve for thermosetting plastics which cure and harden under such conditions within a few minutes①. The principle of injection molding is quite similar to that of die-casting. The process consists of feeding a plastic compound in powdered or granular form from a hopper through metering and melting stages and then injecting it into a mold②. After a brief cooling period, the mold is opened and the solidified part ejected. Injection-molding machines can be arranged for manual operation, automatic single-cycle operation, and full automatic operation. The advantage of injection molding are:

(i) a high molding speed adapted for mass production is possible;

(ii) there is a wide choice of thermoplastic materials providing a variety of useful properties;

(iii) it is possible to mold threads, undercuts, side holes, and large thin sections.

The injection-molding machine

Several methods are used to force or inject the melted plastic into the mold. The most commonly used system in the larger machines is the in-line reciprocating screw, as shown in Figure 1-1. The screw acts as a combination injection and plasticizing unit. As the plastic is fed to the rotating screw, it passes through three zones as shown: feed, compression, and metering. After the feed zone, the screw-flight depth is gradually reduced, forcing the plastic to compress. The work is converted to heat by shearing the plastic, making it a semifluid mass. In the metering zone, additional heat is applied by conduction from the barrel surface. As the chamber in front of the screw becomes filled, it forces the screw back, tripping a limit switch that activates a hydraulic cylinder that forces the screw forward and injects the fluid plastic into the closed mold③. An antiflowback valve prevents plastic under pressure from escaping back into the screw flights.

The clamping force that a machine is capable of exerting is part of the size designation and is measured in tous. A rule-of-thumb can be used to determine the tonnage required for a particular job. It is based on two tons of clamp force per square inch of projected area. If the flow pattern is difficult and the parts are thin, this may have to go to three or four tons.

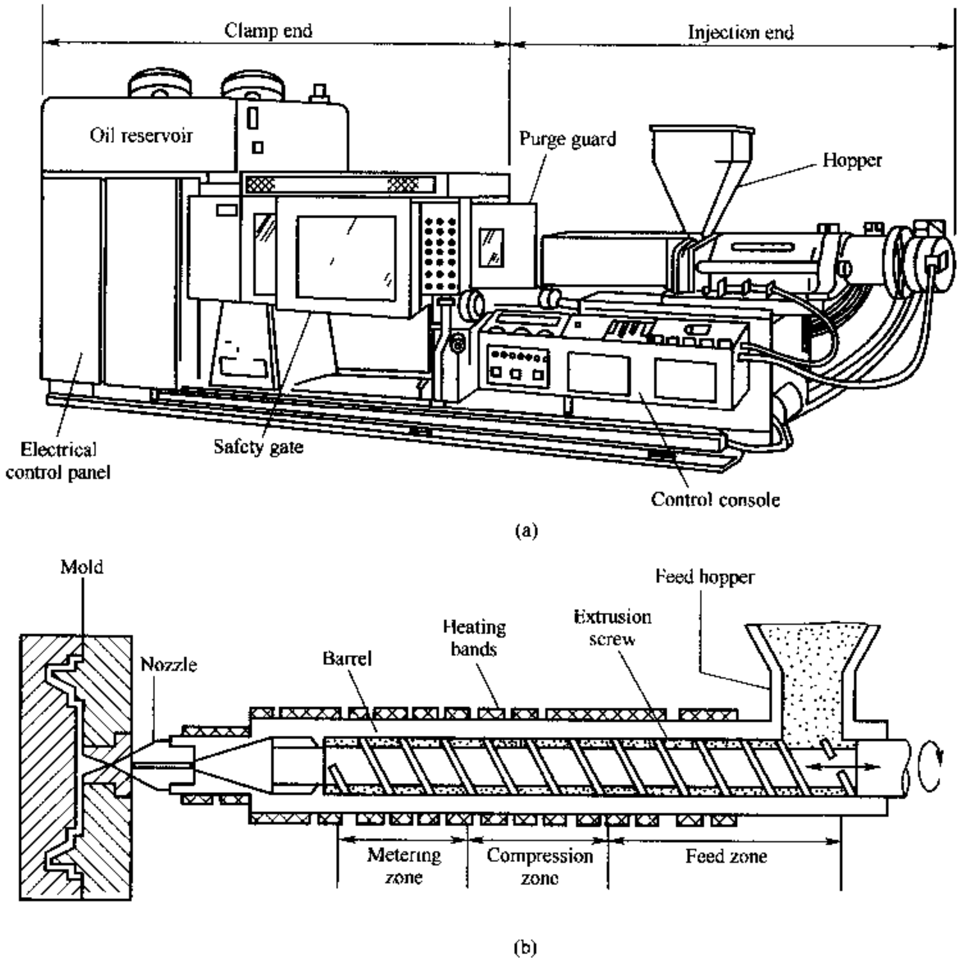

Figure 1-1 (a) The injection-molding machine (b) The reciprocating-screw injection system

Many reciprocating-screw machines are capable of handing thermosetting plastic materials. Previously these materials were handled by compression or transfer molding. Thermosetting materials cure or polymerize in the mold and are ejected hot in the range of 375℃～410℃. Thermoplastic parts must be allowed to cool in the mold in order to remove tbem without distortion. Thus thermosetting cycles can be faster. Of course the mold must be heated rather than chilled, as with thermoplastics.

New Words and Expressions

injection molding 注射模
principally ['prinsipli] *adj.* 主要地
thermoplastic [ˌθəːmə'plæstik] *n.* 热塑性，热塑性塑料
thermosetting [ˌθəːməu'setiŋ] *n.* 热固性
plastic ['plæstik, plɑːstik] *n.* 塑胶，塑料

melted *vt.* (使)熔化，使软化
cavity ['kæviti] *n.* 型腔
reservoir ['rezəvwɑ:] *n.* 容器，储存器
extremely [iks'tri:mli] *adj.* 极端地，非常地
principle ['prinsəpl] *n.* 法则，原则，原理
die-casting 压力铸造
compound ['kɔmpaund] *n.* 混合物，复合的，混合
powdered ['paudəd] *vt.* 弄成粉的，粉状的
granular ['grænjulə] *adj.* 由小粒而成的，粒状的
hopper ['hɔpə] *n.* 加料漏斗
metering['mi:təriŋ] *vt.* 测量(法)，计[配]量，测定
eject [i'dʒekt] *vt.* 逐出，喷射
solidify [sə'lidifai] *vt.* (使)凝固，(使)团结
manual ['mænjuəl] *adj.* 手的，手动的，手工的
automatic [ˌɔ:tə'mætik] *adv.* 自动的，机械的
property ['prɔpəti] *n.* 性质，特性
thread [θred] *n.* 螺纹
undercut ['ʌndəkʌt] *n.* 侧向分型，底切
reciprocating screw 往复螺杆
plasticize ['plæstisaiz] *vt.* 使成可塑体
compression [kəm'preʃ(ə)n] *vt.* 浓缩，压缩
screw-flight 螺杆的螺纹
convert [kən'və:t] *vt.* 使转变，转换
shear [ʃiə] *vt.* 剪，剪切
semifluid [ˌsemi'flu:id, ˌsemai-] *adj.* 半流质，半流质的
barrel ['bærəl] *n.* 桶
chamber ['tʃeimbə] *n.* 室，房间
trip [trip] *vt.* 松开棘爪而开动；使跳闸；切断
switch [switʃ] *n.* 开关，转换，转变
hydraulic [hai'drɔ:lik] *adj.* 水力的，水压的
cylinder valve 气缸阀
clamping force 锁紧力
exert [ig'zə:t] *vt.* 尽(力)，施加(压力)
rule-of-thumb 单凭经验的方法
transfer molding 传递模塑法，转送成形
polymerize ['pɔliməraiz] *vt.* (使)聚合
distortion [dis'tɔ:ʃən] *vt.* 扭曲，变形
plunger ['plʌndʒə] *n.* 柱塞
spurt [spə:t] *vt.* (液体等) 喷射，喷出

sprue [spru:] *n.* 浇口，溶渣
optimum ['ɔptiməm] *adj.* 最适宜的
foam [fəum] *vt.* 起泡沫

Notes

① The problem of injecting a melted plastic into a mold cavity from a reservoir of melted material has been extremely difficult to solve for thermosetting plastics which cure and harden under such conditions within a few minutes.

热固性塑料熔体在很短的时间内就会固化和硬化，在从料斗向模具型腔注入热固性塑料熔体的过程中，也会出现这种情况，这个问题一直非常难解决。

句中的 of injecting a melted plastic into a mold cavity from a reservoir of melted material 介词短语作后置定语修饰 the problem，which cure and harden under such conditions within a few minutes 定语从句作后置定语修饰 thermosetting plastics。

② The process consists of feeding a plastic compound in powdered or granular form from a hopper through metering and melting stages and then injecting it into a mold.

注塑成型的工艺过程包括：首先把料斗中的粉状或粒状的塑料混合物依次输送到定量区和熔化区，然后再注射到模具型腔中。

句中 consist of 意为：由……组成，由 and 连接的三个动名词短语作 of 的宾语。

③ As the chamber in front of the screw becomes filled, it forces the screw back, tripping a limit switch that activates a hydraulic cylinder that forces the screw forward and injects the fluid plastic into the closed mold.

当熔体充满螺杆前部区域时，螺杆在熔体压力的作用下后退，触动限位开关使液压缸工作，在液压力的作用下推动螺杆向前运动，将熔融塑料注射到闭合的模具型腔中。

句中 as 引导的时间状语从句，that activates a hydraulic cylinder that forces the screw forward and injects the fluid plastic into the closed mold 为限制性定语从句修饰 a limit switch，that forces the screw forward and injects the fluid plastic into the closed mold 修饰 a hydraulic cylinder。

【正文译文】

第 1 课　注塑模和注塑机

注塑模

尽管成型某些热固性材料的方法取得了一定进步，但注塑模主要（还是）用来生产热塑性塑件。（这主要是因为）热固性塑料熔体在很短的时间内就会固化和硬化，在从料斗向模具型腔注入热固性塑料熔体的过程中，也会出现这种情况，这个问题一直非常难解决。注塑成型原理和铸造十分相似。注塑成型的工艺过程包括：首先把料斗中的粉状或粒状的塑料混合

物依次输送到定量区和熔化区，然后再注射到模具型腔中，经过短时冷却后，开模，推出成型塑件。注塑机分为手动、半自动及全自动操作。注塑模具有以下优点：

（i）较高的成型速度使大批量生产成为可能；

（ii）为成型具有不同使用性能的热塑性材料提供了较宽的选择；

（iii）可以成型带有螺纹的塑件、侧向凹陷的塑件、带有侧孔的塑件以及较大的薄壁件。

注塑机

熔融塑料注入模具中通常有几种方式。在大型注塑机上常采用往复螺杆式的注入方式，如图 1-1 所示。螺杆同时具有注射和塑化的功能。树脂原料进入旋转的螺杆时，要经过图示的三个区域：喂入区、压实区和塑化区。经过喂入区后，为压实树脂原料，螺杆螺旋部分的深度逐渐降低，同时传递树脂原料间因剪切作用而产生的热量，使原料呈半流动状态。在计量区，螺缸表面的加热装置对熔体进一步加热。当熔体充满螺杆前部区域时，螺杆在熔体压力的作用下后退，触动限位开关使液压缸工作，在液压力的作用下推动螺杆向前运动，将熔融塑料注射到闭合的模具型腔中。防倒流阀能够阻止受压熔体倒流进螺杆的螺旋区。

注塑机的锁模系统所提供的锁模力由（塑件在分型面的投影）尺寸决定，锁模力以吨为单位。通常靠经验来决定塑件所需要的锁模力总吨数，一般在塑件投影面积上每平方英寸需要作用两吨锁模力。如果熔体流动困难或塑件较薄，锁模力应提高到三到四吨。

许多螺杆式注塑机能生产热固性塑料。以前，热固性塑料由挤出模具或传递模具生产。热固性塑料熔体在模具内固化或发生聚合反应，并在温度为 375℃～410℃范围内推出。热塑性塑料熔体必须在模具内冷却成型，以保证推出时不发生变形。这种热硬化性循环速度很快。当然，生产热塑性塑件时，模具必须被加热，而不是冷却。

Reading Material

A competent mould designer must have a thorough knowledge of the principles of mould making as the design of the various parts of the mould depends on the technique adopted for its manufacture.

This chapter is included primarily for the beginner who does mot have a background knowledge of the various machining and other mould making techniques. To cover the topic of mould making thoroughly would require a companion work equal in size to this monograph and therefore this inroduction to the subject must, of necessity, be superficial. However, we hope that very fact that it is included in a monograph on design, will emphasize the importance of mould making as a subject and will also encourage the beginner to a further and more complete study in this field.

The majority of moulds are manufactured by the use of conventional machine tools found in most modern toolroons. From the manufacturing viewpoint we classify the mould into two parts: (i) the cavity and core, and (ii) the remainder of the mould. The latter parts is commonly referred to as bolster work.

The work on the cavity and core is by far the most important as it is from these members that the plastics moulding takes its form.

The work on the cavity and core can further be classified depending upon whether the form is of a simple or a complex nature. For example, the cavity and core for a circular or rectangular box-tupe moulding is far simpler to make than a cavity and core to produce, say a telephone handset moulding. The mould parts for the simple form are produced on such machine tools as the lathe ang the milling machine, whereas the more complex form requires the use of some kind of copying machine .

The bolster work is mot as critical as the manufacture of the cavity and core forms but, nevertheless, accuracy in the manufacture of the various parts is necessary to ensure that the mold can be assembled by the fitter without an undue amount of bench-work.

Now, while the bolster work is always produced on conventional machime tool , the cavity and core, particularly the former , can be produced by one of a number of other techniques. These include investment casting, electro-deposition, cold hobbing, pressure casting and spark machining.

Machine tools

The purpose of any machine tool is to remove metal .Each machine tool removes metal in a different way. For example, in one type (the lathe) another type (the milling machene) a cutter is rotated and metal is removed as the work is peogressed geneath it .

Which machine tool is to be used for a particular job depends to a large extent upon the type of machining required. There is, however, a certain amount of overlapping and some machine tools can be utilized for several different operations. In the illustrations which follow, typical machining operations are illusurated but it must mot be assumed that the particular machinetool is restricted to the operation shown.

The machine tools which will be found in the modern toolroom are as follows:

(i) Lathes for turning, boting and screwcutting, etc.

(ii) Cylindrical grinding machines for the production of precision cylindrical surfaces.

(iii) Shaping and planning machines for the reduction of steel blocks and plates to the required thickness and for 'squauing up' these plates.

(iv) Surface grinding machines for the production of precision flat surfaces .

(v) Milling machines for the rapid removal of metal, for machining slots , recesses , boring holes machining splines , etc.

(vi) Tracer-controlled milling machines for the accurate reproduction of complex cavuty and core forms .

In addition to the above list of major machine tools there is, of course , ancillary equipment without which no toolroom would be complete .This includes power saws , drilling machines , toolpost grinders , hardening and polishing facilities , etc.

Castings

The manufacture of cavities and cores in steel by the conventional casting method uding sand moulds is mot satisfactory owing to the poor finish obtained and to the porosity which occurs on , or just below , the surface of the casting . The expenditure involved in plugging, machining and finishing these concentional castings makes this method of mould making uneconomic .

The shaw investment casting pricess does mot , however , share the disadvantages associated with sand casting and is therefore applicavle to the manufacture of cavities and cores . The process is carried out by specialists and the mouldmaker supplies the company with a pattern of the required mould part. As the final casting will be an accurate reproduction of the pattern supplied , this must be manufactured to close tolerances and have a good surface finish . To allow for the contraction of the steel on cooling the pattern is made approximately 0.020 mm/mm(in/in) oversize .

Electro-deposition

Electro-deposition is an electrochemical process used to reproduce accurately a cavity or core form fron a given pattern. The pattern can be made in an easily worked material and is the reverse form to that required. That is a male pattern is required for a cavity and a female pattern for a core. Normally it is much easier to machine a male pattern than the reverse cavity form and it is for this reason that most applications for this technique are for intricate cavity work.

Cold hobbing

Cold hobbing is a process in which a hardened sreel master hob is forced into a soft steel blank under condiderable pressure.

Hobbing is used for the production of cavities which by virtue of their shape would be difficult to die-sink on conventional machine tools.

Pressure casting

Beryllium-copper is a material which is increasingly being used in mould construction because it possesses several desirable characteristics. In particular it has a high thermal conductivity combined with a reasonable hardness (Brinell Hardness Number of about 250)which makes it suitable for certain types of cavity and core , and for other mould parts , such as hot-runner unit secondary muzzles .

Its high thermal conductivity means that when beryllum-copper is used for a cavity or a core the heat fron the melt will be transferred away from the impression faster than if a corresponding steel cavity and core are used, and this often results in a shorter moulding cycle.

Beryllium-copper can be machined , in which case the conventional machine tools are used , and it can be cold-hobbed , hot-hobbed or pressure-cast . The last technique offers certain advantages over the bobbing methods , in that cold or hot hobbing of beryllium-copper tends to work harden the material which results in the development of stress concentrations .

Pressure casting (or liquid hobbing) is used naubky for the productiob of cavities but it can be used , where applicable , for the priduction of the cores as well . As the terms suggest , it is basically a process which combines the casting and hobbing techniques .

Spark machining

This is one of more recent additions to moukd making methods and , strictly speaking , it should come under the machine tool section . However , as the principle of operation is different fron that of all other basic machine tools it is prefersble to discuss this techmique separately .

Spaek machining is a process in whichsteel , or other metals , can be machined by the application of an electrical discharge spark . The apark is localized and metal is progressively removed in small quantities over a period of time .

Bench fitting

Irrespective of the machine tool or technique used to manufacture the various parts of the mould, the final responsibility for the finishing of the individual parts and assembly ptocedure adopted by the bench fitter varies from tool room to toolroom and quite often between individual tool makers working in the same toolroom ; it is tberefore impossible to set down a standard paooern for the work . In consequence , we intend only to indicate the general approach to this problem without going into details . We will do this by considering the various stages in the bench fitting involved in the manufacture of a simple mould .

【阅读材料译文】

称职的模具设计师必须具有丰富的模具制造方面的知识，因为模具各部件的设计依赖于生产这些部件时所采用的制造方法。

本章主要针对没有任何机加工知识和其他模具制造技术的初学者，介绍模具制造的基本知识。全面且浅显地介绍这部分知识与本文具有同等重要的意义。然而，我们希望论述设计方面的著作，能够强调模具制造的重要性，把他作为一门学科来论述，并且激励初学者更加深入更加全面地研究这一领域。

大多数模具是利用经过现代技术改装的传统机床加工制造的。从制造角度，模具分为两部分：（i）型腔和型芯；（ii）模具其他部分。后者通常作为模具的支撑部件。

加工型腔和型芯是（模具制造中）最重要的工作，因为这两部分决定塑件的形状及表面质量。

加工型腔和型芯的工作依据他们的形状进一步划分为简单和复杂两种形式，例如，制造圆（环）形或直角的型腔和型芯要比制造电话机手柄的型腔和型芯的难度大得多。形状简单的模具零件常在车床和磨床（传统）机床上加工，而复杂部件则需要使用仿形机加工。

制造支撑部件并不像制造型腔和型芯那么重要，但是，为使模具在不需要许多钳工工作的基础上顺利装配，确保各部件的制造精度也是非常重要的。

虽然目前支撑件一般在传统机床上制造。但是型腔和型芯，特别是型腔可以由其他技术制造，例如熔模铸造、电解法精炼、冷挤压制模法、压力铸造及电火花加工。

机床

所有机床的用途都是去除金属，（但是）每种机床去除金属的形式各不相同。例如，有的机床（如车床），有的机床（如铣床）则是以刀具回转，工件进给的方式去除金属。

选择哪种机床加工工件，很大程度上取决于（工件的）加工要求。但是由于机床具有多种加工方式，选择机床时可能存在多种选择。但是不能认为这些机床的加工方式仅限于所列出的方式。

现代加工中应用的机床有如下几种：

（i）车床，用于车削、钻削和螺纹加工等。