# SPECIFIED ENGLISH
FOR NUMERICAL CONTROL

# 数控技术应用
## 专业英语

武秋霞　编著

山西人民出版社

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# 前　言

随着我国社会主义市场经济的进一步发展，越来越多的企业对技术人员的专业外语水平提出了较高的要求。尤其对数控技术应用专业的学生来说，由于数控技术综合应用计算机、自动控制、自动检测及精密机械等高新技术，专业英语已成为他们今后工作中所必需的工具之一。为适应这一需要，特编写了这本数控技术专业英语。本书参照了《两年制高等职业教育数控技术应用专业领域技能型紧缺人才培养指导方案》，并突出以下指导思想：以培养学生专业英语学习策略意识为导向，以促进并训练学生获得较好的专业英语应用技能为目标。之所以这样做，首先是因为：无论对于哪一门课，学生学习策略意识的获得都是至关重要的。然而，由于各种原因，学生在英语学习方面的学习策略意识相对薄弱，很多学生英语基础较差，学习效率较低，这一点严重地影响到专业英语的学习。为改善这一状况，在专业英语学习中强调学习策略意识的培养就显得非常有必要。其次，专业英语本身有很多自身的特点，把握这些特点并培养起相应的学习策略可以非常有效地提高学生的学习效率，使学生获得较好的专业英语应用技能。

本书主要内容有：第一部分为“强化阅读”(intensive reading)，共编有 15 个单元。每单元由课文、参考译文、练习及导学部分组成。15 篇课文是难度较为适中的有关数控技术及应用的文章，供课堂详解。练习部分主要是术语和语段的英译汉、填空题及讨论题，这些练习项目有助于学生专业英语技能的获得。导学部分分 15 个专题对学生专业英语学习进行指导。第二部分为“拓展阅读”(extensive reading)，选有 8 篇与数控技术及其应用有关的文章，这些文章再加上“补充阅读”(supplementary reading)的内容，涉及面比较广泛，目的是使学生接触更多的专业词汇和表达，提高英语阅读能力和翻译技能。

本书编写及出版过程中参阅了很多相关资料，得到了山西综合职业技术学院教务处刘会杰处长及数控分院景海平院长的帮助和支持。太原大学外语学院崔波副教授审阅了书稿。在此谨表感谢。

编著者

2006 年 6 月

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# PART 1

# Intensive Reading

# UNIT 1 The Need for Numerical Control

Numerical control (NC) has become popular in shops and factories. Perhaps your first question concerning numerical control is: Why we need it?

As we know, making parts and putting them together is manufacturing. Nowadays manufacturing is very important to us all. Look around you right now and you will find that nearly everything—blue jeans, chairs, books, pencils, eyeglasses—is manufactured.

Manufacturing needs different types of machine tools and all machine tools requie some type of control system for their operations and feed movements. The most versatile control system has been man, but he is readily influenced by his environment. His speed is slow and erratic, and his ability to repeat dimensions is extremely limited.

Different kinds of control systems have been developed to overcome the many shortcomings of man as a control system. Instructions to the machine concerning feed movements, positioning, cycling, and sequencing have been built into the machine in the form of cams, stops, timers, and other mechanical and electrical devices. This type of control is restricted to parts of similar configuration and machine tools employing it are often referred to as fixed-program machine tools. The use of a battery of fixed-program machine tools connected by transfer mechanisms has resulted in a system capable of producing a large number of parts. However, the expense of developing and constructing such a system prohibits its use for small-lot production. For example, it is excellent for the automotive industry, where thousands of identical parts are produced, but it is not suitable for the aircraft industry, where in comparison to the auto industry, relatively few parts are produced in short-run and individualized production.

In addition, in the early 1940s, the need to produce military products, such as airplanes, accelerated technical research. As a result, the products being produced at the end of the war were too complex in shape or too closely toleranced for practical manufacturing.

It became necessary to develop variable-program machine tools and it was the need for variable-program machine tools that led to the development of numerical control.

In 1947, John Parsons of the Parsons Corporation began experimenting with the idea of using three-axis curvature data to control machine tool motion for the production of aircraft components. In 1949, Parsons was awarded a U. S. Air Force contract to build what was to become

the first numerical control machine. In 1951, the project was assumed by the Massachusetts Institute of Technology. In 1952, numerical control arrived when MIT demonstrated that simultaneous three-axis movements were possible using a laboratory-built controller and a Cincinnati vertical spindle. By 1955, after further refinements, numerical control became available to industry.

A numerically controlled (NC) machine tool is controlled by numbers. Instructions for the NC machine are written in numerical form. These numerical instructions are written (programmed) in advance and stored on a suitable medium which is usually 1-in.-wide punched tape, although magnetic tape and punched cards have been used. The numerical instructions are fed into a main control unit, where they are stored, interpreted, and changed into signals that are understood by the machine tool. The main control unit consists of a system of electronic interpreting devices, and in general is the director of all machine operations. The coded instructions can control the machine slide positions, spindle speeds, directions of spindle rotation, amount of feed, direction of feed movements, flow of coolant, and sequence of machining operations and can select the cutting tool for each operation. On some sophisticated machines, coded instructions may be coordinated to control the machine axis movements to machine complicated three-dimensional surfaces. The instructions to the machine can easily be changed by replacing the roll of the tape on the main control unit with another, similar to the way a movie-projector operator changes a roll of movie film.

NC systems offer some of the following advantages over manual methods of production.

1. Better control of tool motions under optimum cutting conditions.
2. Improved part quality and repeatability.
3. Reduced tooling costs, tool wear, and job setup time.
4. Reduced time to manufacture parts.
5. Reduced scrap.
6. Better production planning and placement of machining operations in the hands of engineering.

## WORDS AND EXPRESSIONS TO WATCH

numerical /nju:'merikəl/ *adj*. 数字的
control /kən'trəul/ *n*. & v. 控制
versatile /'və:sətail/ *adj*. 多面手的,万能的
erratic /i'rætik/ *adj*. 不稳定的
dimension /di'menʃən/ *n*. 尺寸,尺度
sequence /'si:kwəns/ *n*. 顺序,次序;*v*. 把……按顺序排好
prohibit /prə'hibit/ *vt*. 禁止,阻止
individualize /ˌindi'vidjuəlaiz/ *v*. 赋予个性,个别地加以考虑

punch /pʌntʃ/ *n*. 冲压机,冲床,打孔机;*vt*. 冲孔,打孔
interpret /in'tə:prit/ *v*. 解释说明
sophisticated /sə'fistikeitid/ *adj*. 复杂的,老练的
coordinate /kəu'ɔ:dinit/ *v*. 调整,整理,使……协调
repeatability /ri,pi:tə'biliti/ *n*. 可重复性
scrap /skræp/ *n*. 废料,碎片
feature /'fi:tʃə/ *n*. 特色
in comparison to 与……比较
in advance 提前
numerical control (NC) 数字控制
electronic interpreting device 电子译码装置
fixed-program machine tool 固定程序机床
variable-program machine tool 可变程序机床
small-lot production 小批量生产
automotive industry 汽车工业
aircraft industry 航空工业
punched tape 穿孔纸带
three-dimensional surface 三维曲面

## NOTES

1. Instructions to the machine concerning feed movements, positioning, cycling, and sequencing have been built into the machine in the form of cams, stops, timers, and other mechanical and electrical devices that are manually established by the operator before each particular job. 通过在机床上配置凸轮、挡块、定时器以及其他的机械和电气装置,与进给运动、位置控制、循环控制、顺序控制有关的操作程序已经由操作者在每次进行不同工件的加工前手工设定好。

这是一个比较长的主从复合句。理解这种长句的关键是搞清其主体结构。这句的主体部分是:Instructions have been built, 其结构是"主语 + 谓语",句中有一个定语从句 that are manually established by the operator before each particular job。

machine 一般情况下作名词用,译作"机器",有时根据上下文,译作"机床"。如:That machine is a shaper. 那台机床是牛头刨床。与某些词搭配,译作"……机床"。如:

boring machine 镗床
milling machine 铣床
drilling machine 钻床
grinding machine 磨床
general purpose machine 通用机床
special machine 专用机床

machine 还可以做动词用，表示“机加工”，如：The cutting speed and feed are very important in machining processes. 切削速度和进给量在机械加工中非常重要。

in the form of：以……的形式。这个表达在科技英语中经常用到。

2. Machine tools employing this type of control are often referred to as fixed-program machine tools. 采用这种控制类型的机床通常称为固定程序机床。

这是一个定义句：be referred to as...的意思是：称为……。在数控专业英语文章中，定义句非常常见，要学会定义句的常见表达。refer to 有下列常用意义：

(1)“参考，查阅”

如：Refer to the assembly drawing about the position of parts. 关于零件的位置，可查阅装配图。

(2)“指…… ”

如：On most NC vertical milling machines, the Y axis refers to the cross movement of the table. 大部分数控立式铣床上，Y 轴指的是工作台的横向运动。

(3)be referred to as . . . ，“叫作……，称作……”

如：Cutting at right angles to the axis of the work is referred to as facing. 与工件轴线成直角的切削叫做端面切削。

3. For example, it is excellent for the automotive industry, where thousands of identical parts are produced, but it is not suitable for the aircraft industry, where in comparison to the auto industry, relatively few parts are produced in short-run and individualized production. 例如，他应用在进行成千上万相同零件生产的汽车工业上非常合适，而用在与汽车工业相比只有少数几个加工零件相同的航空工业上就不合适。

这是一个比较长的复杂句，由两个分句并列而成，两个并列分句又分别带有非限制性定语从句。两个并列分句的主体结构都是“主语＋谓语＋表语”。注意这句的翻译，虽然是非限制性定语从句，但还是翻译为前置定语。

4. NC systems offer some of the following advantages over manual methods of production. 相对手工制造而言，NC 系统具有下列优势。

over 的基本词义是：在……之上、超过……。over 在 advantage 后表示：比起……来具有某种优势，是很有用的一个表达。如：Abrasive machining has some advantages over other machining processes. 强力磨削比起其他加工方法来具有某些优点。

5. Better production planning and placement of machining operations in the hands of engineering. 有利于做出更好的制造规划，并使加工操作更易于安排。

in the hand of：在……掌握之中，被……控制

# 参考译文

## 对数控的需求

数控已广泛地应用于车间与工厂。也许你的第一个关于数控的问题是:为什么我们需要数控?

正如我们所知,生产零部件并把他们组装起来就是制造。当今,制造对我们所有的人都很重要。现在请环顾一下周围,你会发现几乎每一样东西——蓝色牛仔裤、椅子、书、铅笔、眼镜——都是制造出来的东西。

制造需要不同类型的机床,而所有的机床都要求有某种类型的控制系统来控制操作和进给运动。最常见的控制系统是人。但人很容易被其周围的环境所影响,人操作的速度慢而且容易出错,重复获得加工尺寸的能力也相当有限。

不同种类的控制系统已被研制出来以克服人作为控制系统的许多缺点。在机床上与进给运动、位置控制、循环控制、顺序控制有关的操作程序已经通过在机床上配置凸轮、挡块、定时器以及其他的机械和电气装置,由操作者在每次进行不同工件的加工前手工设定好。这种控制方式局限在相似零件的加工上。采用这种控制类型的机床通常称为固定程序机床。使用一组固定程序机床并通过传输机械装置连接在一起的系统已经形成了生产大批零件的能力。然而,开发和建立这样一种系统的费用限制了他在小批量生产中的使用。例如,他应用在进行成千上万相同零件生产的汽车工业上非常合适,而用在与汽车工业相比只有少数几个加工零件相同的航空工业上就不合适。

另外,20 世纪 40 年代初,生产诸如飞机之类军用品的需求加快了技术研究的步伐。结果,对于实际加工而言,战争末期要求制造的产品在形状方面过于复杂,或者对公差的要求过于精密了。

这样,就有必要研制可变程序机床,而正是对可变程序机床的需要导致了数控的发展。

1947 年,Parsons 公司的 John Parsons 着手进行一项试验,他想用空间数据控制机床加工飞机零件。1949 年,Parsons 公司与美国空军签订了制造第一台数控机床的合同。1951 年,美国麻省理工学院承担了这一项目。1952 年,麻省理工学院(MIT)使用实验室制造的数控器和辛辛那提立式主轴展示三轴联动获得成功,这标志着数控时代的到来。到了 1955 年,几经改进之后,数控技术开始应用于工业生产。

数控(NC)机床是一种通过数字控制的机床。用在数控机床上的指令以数字方式写下来。这些数字指令事先编好并储存在合适的介质上。尽管磁带和穿孔卡已有使用,但通常还是用一英寸宽的纸带。数控指令输入主控制单元,在主控制单元中,数控指令被储存、译码成为机床所能识别的信号。主控制单元由电子译码装置组成的系统构成,通常他也是机床所有运动的指挥者。编码指令能控制机床工作台位置、主轴转速、主轴转动方向、进给量、进给运动的方向、冷却

液的流动、加工顺序和为每一道加工选择刀具。在一些复杂的机床上，编码指令可以用来协调控制机床的多轴运动，从而加工复杂的三维曲面。机床上的控制指令很容易通过更换在主控制单元上的纸带而改变，就像电影放映员更换一卷电影胶片一样。

相对手工制造而言，NC 系统具有下列优势：

1. 有利于在最佳切割条件下控制刀具运动。
2. 提高了产品质量及一致性。
3. 降低了加工成本，减少了刀具磨损和作业准备时间。
4. 减少了生产零件的时间。
5. 减少了废品。
6. 有利于做出更好的制造规划，并使加工操作更易于安排。

## EXERCISES

1. **Translate the following phrases into Chinese and recite them.**

machine tool
control system
feed movements
mechanical and electrical device
fixed-program machine tool
variable-program machine tool
small-lot production
automotive industry
aircraft industry
individualized production
numerical instructions
punched tape
magnetic tape
punched cards
main control unit
electronic interpreting device
coded instructions
complicated three-dimensional surface

2. **Fill in the blanks with proper words or phrases according to the text. Do not refer to the passage until you finish the exercise.**

(1) Numerical control (NC) has become _____ in shops and factories.

(2) Perhaps your first question _____ numerical control is: Why we need it?

(3) Manufacturing needs different _____ of machine tools and all machine tools _____

some type of control system for their operations and feed movements.

(4) The most _____control system has been man, but he is readily influenced by his environment. His speed is slow and erratic, and his ability to repeat dimensions is extremely limited.

(5) Control systems have been developed to _____ the many shortcomings of man as a control system.

(6) Instructions to the machine concerning _____, _____, _____, and _____ have been built into the machine in the form of cams, stops, timers, and other mechanical and electrical devices.

(7) For example, it is _____ for the automotive industry, where thousands of identical parts are produced, but it is not _____ for the aircraft industry, where in comparison to the auto industry, relatively few parts are produced in short-run and individualized production.

(8)_____, in the early 1940s, the need to produce military products, such as airplanes, accelerated technical research.

(9)_____, the products being produced at the end of the war were too complex in shape or too closely toleranced for practical manufacturing.

(10) The numerical instructions are _____ into a main control unit, where they are stored, interpreted, and changed into signals that are understood by the machine tool.

3. **Translate the following into Chinese.**

Numerical control has been used in industry for over 40 years. Simply put, numerical control is a method of automatically operating a manufacturing machine based on a code of letters, numbers, and special characters. A complete set of coded instructions for executing an operation is called a program. The program is translated into corresponding electrical signals for input to motors which run the machine. Numerical control machines can be programmed manually. If a computer is used to create a program, the process is known as computer aided programming.

4. **Subjects for discussion.**

What does numerical control mean?

What is the need for numerical control?

What are the shortcomings of man as a control system?

What's the difference between the fixed-program machine tool and the variable-program machine tool?

# 导学

## 专业英语学习要有策略意识

同学们经过了多年的基础英语学习，现在进入专业英语学习阶段。专业英语的英文原文是English for special purposes，简称 ESP。ESP 是人们从事专业活动时所使用的英语语言，如数控专业英语(English for numerical control)，机械工程专业英语(English for mechanical engineering)等。20 世纪 80 年代以来，专业英语受到英语教学的重视，成为非英语国家对学生进行英语和专业教学的一个重要组成部分。

专业英语学习是基础英语学习的延伸，主要特点是语言学习密切结合专业知识。高职高专专业英语学习的主要任务是：通过本课程的学习使学生能够掌握本专业常用英语词汇及术语，具有阅读专业英语文献、产品使用说明书，获取信息，了解国内外本专业发展动态，以及与国外同行用英语进行专业知识与技能交流的能力，以适应 21 世纪高职人才培养的需要。

为了顺利完成课程任务，在专业英语学习中，同学们要注意培养自己的学习策略意识。当然，任何一门课程的学习都应当有策略意识，但在专业英语学习中尤其要注意这一点。我们可以从以下几个方面认识这一问题。

——首先要理解和认识学习策略。学习策略不等于学习方法和学习技巧。学习方法和学习技巧是学习者为了解决某个学习问题或为了使学习过程更有效而采取的某些具体的做法或手段。学习策略除完全包括学习方法和学习技巧以外，还包括其他很多方面，比如学习者对学习内容和学习过程本身的认识；学习者对学习目标和学习过程的宏观调控和计划等。学习策略比学习方法和学习技巧涵盖的内容要广得多。在学习中有意识地培养学习策略，可以有效地提高学习者的学习效果和效率。

——由于各种原因，不少学生进入专业英语学习阶段时英语基础仍然比较差，在这种情况下，如果不去努力学会学习，不注意培养并使用有效的学习策略，仍然还是被动地、不加思索地读一读单词，念一念课文，很难有效完成学习任务。

——专业英语课一般涵盖很多与专业有关的方面，涉及面广，内容多。而且，专业英语课一般开设在高年级，由于学生专业课学习以及实训的加强，往往课时数不多。因此，课堂教学没有比较充分的时间帮助学生一方面将英语基础补上来，另一方面进行足够的专业阅读。这就要求学生在有限的课程学习时间内学会学习，在较短的时间内，有意识地培养学习策略意识，在基础英语的提高以及专业英语的学习中取得比较好的效果，同时为进一步拓展学习内容，获取信息打下基础。

就数控专业英语来说，由于数控技术涉及机械、电子、机电一体化、计算机、自动化以及数学等很多方面的知识和内容，即使选材广泛也不能完全满足今后工作的需要，要学会学习，为今后工作中的继续学习奠定基础。

——专业英语属于专门用途英语，在词汇、句式、语篇各层次上都有很多自身的特点。比如：用词高度术语化，常出现大量专业术语、缩略词和符号语等；常使用抽象名词和介词等名词化结构，使语言呈现明显的静态倾向；语篇结构上，常用表达各种逻辑关系的句法手段，因而多长句、复合句等。如果对这些特点不加归纳和总结，学习中往往会感到有困难，容易对学习失去信心。因此，同学们在专业英语学习中应当努力感知、理解、归纳、掌握所学内容的特点，有意识地培养自己的学习策略意识，学会学习。

——同学们开始学习专业英语时，已进入比较高的年级，有了更多的自主意识，有了一定的自学能力和自觉性，认知能力发展迅速，认知方式也更丰富。同时，经过中学及大学基础阶段的学习之后，学生对英语学习有一定程度的宏观把握能力。这些都是培养并使用有效学习策略的有利条件。

——在学习策略的培养上可以从以下几方面入手：要有在语言知识和语言技能的学习中培养自己学习策略的意识；阅读有关英语学习以及专业英语学习策略的书籍；多加注意和配合教师在学习策略培养方面的指导。

需要指出的是，专业英语教学中学习策略意识的培养不仅只是使本课程学习得到改善，实现学习目标，还有利于学生基础英语水平的提高。而且，学习策略的培养，并不只是为了提高学生们在校学习期间的学习效果，更好地实现学习目标，更重要的是有利于学生探索适合自己的学习途径，使其获得独立、自主学习的能力，为进一步学习，甚至终身学习创造条件。

# UNIT 2 Fundamentals of Numerical Control

Simply put, controlling a machine tool by means of a prepared program is known as numerical control, or NC. NC equipment has been defined by the Electronic Industries Association (EIA) as "A system in which actions are controlled by the direct insertion of numerical data at some points. The system must automatically interpret at least some portion of this data".

In a typical NC system the numerical data which is required for producing a part is maintained on a punched tape and is called the part program. The part program is arranged in the form of blocks of information, where each block contains the numerical data required to produce one segment of the work-piece. The punched tape is moved forward by one block each time the cutting of a segment is completed. The block contains, in coded form, all the information needed for processing a segment of the work-piece: the segment length, its cutting speed, feed, etc. Dimensional information (length, width, and radii of circles) and the contour form (linear, circular, or other) are taken from an engineering drawing. Dimensions are given separately for each axis of motion (x, y, etc.). Cutting speed, feed-rate, and auxiliary function (coolant on and off, spindle direction, clamp, gear changes, etc.) are programmed according to surface finish and tolerance requirements.

Preparing the part program for an NC machine tool requires a part programmer. The part programmer must possess knowledge and experiences in mechanical engineering. He must be familiar with the function of NC machine tools and machining process and have to decide on the optimal sequence of operations.

In NC machine tools, each axis of motion is equipped with a separate driving device which replaces the hand-wheel of the conventional machine. The driving device may be a DC motor, a hydraulic actuator, or a stepping motor. The type selected is determined mainly by the power requirements of the machine.

The NC machine tool system contains the machine control unit (MCU) and the machine tool itself. The MCU has to read and decode the part program, to provide the decoded instructions to the control loops of the machine axes of motion, and to control the machine tool operation.

The MCU consists of two main units: the data processing unit (DPU) and the control loops unit (CLU). The function of the DPU is to decode the information received from the tape, pro-