

## 数控成形砂轮磨齿机

CNC

GEAR FORM

GRINDING MACHINE



# YK 73125



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FORM GEAR

GRINDING MACHINE

YK73125成形砂轮磨齿机是一种适用于冶金、矿山、机车、船舶、化工、发电设备、军工、航空航天等重型机械传动中高精度齿轮加工的精密金属切削机床。其加工原理为成形法磨削，即将砂轮轴截面截形修整为与齿轮齿槽相适应的截面，进行成形磨削加工。该机床动作及操作简单，可采用深切缓进给的磨削方法进行加工，具有加工精度高、效率高、可靠性及稳定性高、自动化操作程度高、全数控、适用性强、加工对象种类多、齿轮修形灵活等特点，与传统的展成法相比有着明显的不可替代的优势。

**数控成形砂轮磨齿机具有磨削功率大、几何精度、运动精度、控制精度及精度保持性、机床可靠性、工作稳定性要求较高的特点。**

**为了保证机床运动和支承的高精度、高刚性的要求，各负载轴（立柱径向运动轴X轴、砂轮齿向运动轴Z轴、圆工作台旋转轴C轴）均采用静压导轨，减少了滚动直线导轨在较大负载的情况下容易出现爬行和滞后的情况，机床定位精度尤其是动态运动精度大大提高，保证了工件的加工精度。**

**本机床静压系统采用恒流式静压系统。该方式的原理是：在机床设计允许范围内不论负载如何变化，静压泵站对每个静压油腔均供应恒流量的静压油。恒流式静压系统的优点是调整方便，对静压油清洁度要求相对较低，对静压油油温的变化不敏感，提高了机床的稳定性；为保证机床静压系统的稳定工作，本机床各导轨静压油采用两级过滤以保证静压油的清洁；液压泵采用多头齿轮泵，该泵流量准确稳定且对油的清洁度要求相对较低，工作稳定可靠；静压油箱采用既有制冷又有加热的恒温控制系统，也提高了机床静压系统的稳定性。**

**本机床的其余运动导轨采用了高精度滚针式直线导轨，保证了很高的运动刚度和运动精度。**

**本机床所有数控轴测量反馈均采用全闭环，使用高精度光栅作为检测元件；数控系统采用NUM1050数字伺服系统，该系统比普通模拟量伺服系统精度更高，运算速度更快，尤其是抗干扰能力获得极大提高。**

**修整器丝杆在运动过程中采用液压消除以保证丝杆受单向负载，在运动过程中处于稳态并对负荷的变化不敏感，提高砂轮修整的稳定性和精度。丝杆采用2毫米小螺距丝杆，以提高电机转速，解决电机低速特性较差的缺点，使电机运转更平稳；使用小螺距丝杆还可以增大减速比，使伺服电机运动误差得到**

更大的衰减，减小了电气系统误差对机械运动精度的影响，提高了修整精度。

**机**床圆工作台消隙结构采用单涡轮+液压马达消隙，消隙力可调，结构简单可靠，提高了稳定性。

**另**外，为了工件测量方便，该机床配备了随机测量系统。

**在**软件方面，自主开发了包括磨削计算、参数化界面、齿轮常用数据库、随机测量等系列功能的程序包。程序界面友好、操作简单，使用户使用更加得心应手。

YK73125 CNC gear form grinding machine is a precision metal-cutting machine tool. It is used for grinding high precision gears adopted in heavy-duty machinery transmission. It is suitable for industries such as metallurgy, mineral, locomotive, ship-making, chemical industry, generating equipment, military, aircraft and spacecraft and so on. Its machining principle is method of form grinding, i.e. section shape of grinding wheel shaft is modified to engage with gullet of gear well, so form grinding can be carried out. Movements and operations of the machine are simple, it employs deep-cutting slow-feeding mode to grinding. It is characterized by high machining accuracy, high efficiency, excellent reliability, good stability, high automation, fully CNC, strong suitability, various machining objects, and agile modifying of gear, etc. It has unsubstitutional advantages compared to traditional form grinding method.

## Structure features

The machine features high grinding power, high geometrical accuracy, high moving accuracy, high control accuracy, excellent accuracy retaining performance, working reliability and working stability.

**■** To guarantee movement of the machine and high accuracy and rigidity requirements, each load axis (column radial movement axis X, grinding wheel longitudinal movement axis Z, circle worktable rotation axis C) employs hydrostatic guideway, which reduces easy generated machine creep and lag phenomena when linear rolling guideway bears larger loads. Machine positioning accuracy especially dynamic moving accuracy greatly improve, thus guarantee machining accuracy of workpiece.

**■** Machine employs constant flow hydrostatic system. Its principle is: No matter how load vary within machine design allowed, hydrostatic pump station supply constant flow hydrostatic oil to each hydrostatic oil cavity. Constant flow hydrostatic system features advantages of convenient adjustment, relatively lower requirements to hydrostatic oil cleanliness, and non-sensitive to hydrostatic oil temperature changes, thus improves machine stability. To ensure stable working of machine hydrostatic system, hydrostatic oil of each guideway employs two-stage filtering to guarantee oil clean. Hydraulic pump adopts multi-start gear pump. The pump feature correct and stable flow, relatively lower requirements to oil cleanliness, and stable and reliable works. Hydrostatic oil tank employs constant temperature control system that can refrigerate and heat, which also improves stability of hydrostatic system.

**■** Other moving guideways employ high accuracy needle type linear guideway and ensure high moving rigidity and accuracy.

**■** All CNC axes measuring feedback employs fully closed-loop, high accuracy grating is used as detecting elements. CNC system employs NUM 1050 digital servo system, its accuracy and calculation speed are larger



## Structure features

and faster than those of common servo-simulation system respectively, anti-interference capability has greatly improved especially.

■ During moving, dresser leadscrew employs hydraulic backlash elimination to guarantee leadscrew bear single direction load, and is under stable condition and non-sensitive to load changes during moving, which improves stability and accuracy of grinding wheel dressing. 2mm small screw-pitch leadscrew is employed to improve motor speed, solve problem that low speed characteristics of motor are too bad and make motor run more stable. Using small screw-pitch leadscrew can also increase deceleration ratio to make servo motor moving error get larger attenuation, and reduce effect of electric system error on mechanical moving accuracy and improve dressing accuracy.

■ Backlash elimination of circle worktable employs single turbine & hydraulic motor, backlash eliminating force can be adjusted. Its structure is simple and reliable and it can improve stability.

■ In addition, measuring system is supplied with the machine for the convenience of measuring workpiece.

■ In software, we developed program package that features functions of grinding calculation, parameterized interface, common database of gears, measuring supplied with the machine, etc. Program interface is user-friendly and its operation is simple, which makes user more serviceable.

### 数控轴数

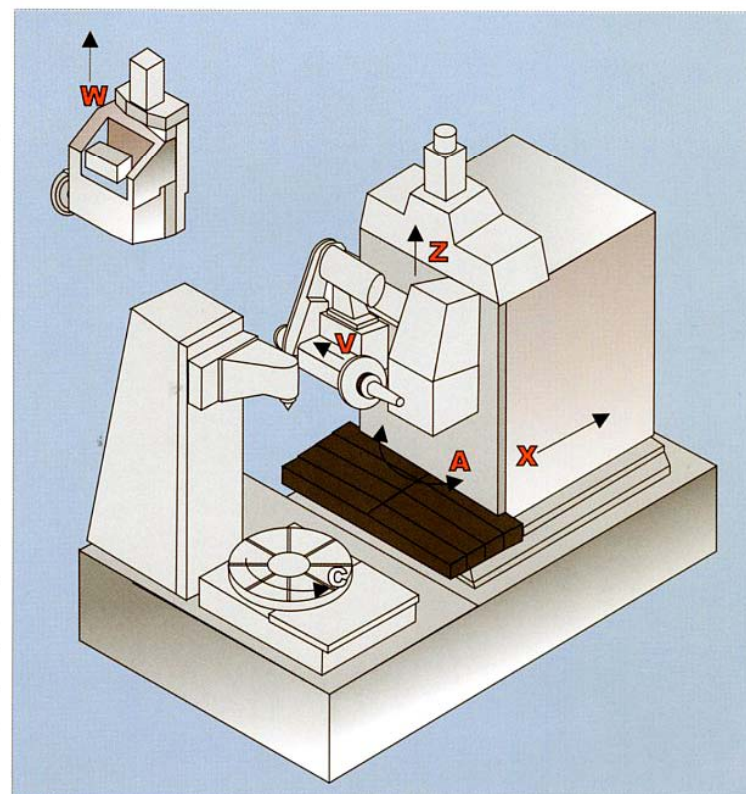
### CNC axes

机床为7轴数控，全部采用闭环控制

立柱径向运动轴	X轴
砂轮齿向运动轴	Z轴
滑座螺旋角旋转轴	A轴
转动工作台旋角轴	C轴
砂轮轴向进给轴	Y轴
修整砂轮轴	W轴

The machine have 6 CNC axes, which are all closed-loop control, they are described as follows

Column radial movement axis	(X axis)
Grinding wheel longitudinal movement axis	(Z axis)
Helix angle rotation axis	(A axis)
Rotation axis of rotating worktable	(C axis)
Grinding wheel axial feeding axis	(Y axis)
Grinding wheel dressing axis	(W axis)





# 数控成形砂轮磨齿机

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## 性能特点

### Performance features

1

#### 磨削效率高

① 机床工作时除分度及修整砂轮时间外，均属有效磨削时间，提高了效率。

② 成形法加工齿轮，其砂轮截形与齿轮磨削接触面积大，单位时间磨削量增加，提高了效率。

③ 成形砂轮磨齿机可采用深切缓进给磨削和强力冷却技术，减少了粗磨次数，即分度次数和时间，提高了效率。

2

#### 加工精度高

该机床采用数字式数控系统和伺服系统，配备全闭环位置检测元件和控制系统，而且机床工作时本身动作相对简单且运动平稳，无冲击，从而实现了很高的机床运动精度，加上软件系统的精度校正，提高了成形砂轮磨齿机的加工精度，并可轻松实现各种特殊齿形的磨削。

3

#### 工件检测方便

Yk73125数控成形砂轮磨齿机所有数控轴均采用全闭环控制，在不受磨削力的情况下，光栅和数控系统检测精度远高于工件加工精度，精度已达到测量精度要求，可做测量轴使用，并可直接打印测量数据，省去了齿轮拆卸、运送、检测、再重新调整机床磨削的麻烦及重复定位误差，提高了工作效率。

#### 1.High grinding efficiency.

① Except for indexing and dressing grinding wheel, the machine working time are all efficient grinding time, so efficiency is enhanced.

② Form grinding is used to machining gears, contact area between grinding wheel section shape and gear is large during grinding, grinding capacity per unit time is increased, efficiency is enhanced.

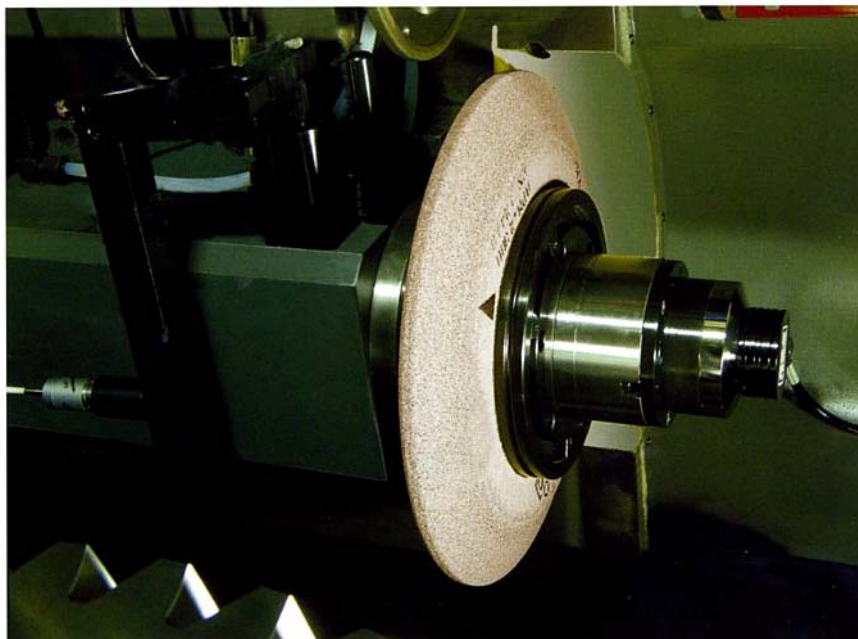
③ CNC Form grinding machine adopts deep-cutting slow-feeding grinding and forced cooling technology, rough grinding times, i.e. indexing times and time are reduced, efficiency is enhanced.

#### 2. High machining accuracy

The machine employs digital CNC system and servo system, equips with fully closed-loop position detecting elements and control system, and its own movement is relatively simple when the machine working, it runs stably and no impact, thus high moving accuracy is realized, in addition, software system accuracy is enhanced, thus working accuracy of CNC gear form grinding machine is improved, grinding all kinds of special tooth profile can be realized easily.

#### 3.Convenient workpiece detecting

All CNC axes of the machine adopt fully closed-loop control, when each axis doesn't stress grinding force, detecting accuracy of grating and treating accuracy of CNC system is higher than workpiece machining accuracy greatly, machine accuracy has reached detecting accuracy requirement, axes of the machine can be used as measuring axes and print measuring data directly, save dismantling, transportation and detecting of gears, and leave out troubles of adjusting machine grinding again and repeatability positioning error, working efficiency is enhanced.





## 机床规格

## Specification

加工范围		Working range
最大齿顶直径	Max. tip dia.	φ 800mm
最小齿根直径	Min. root dia.	φ 100mm
模数	Module	2-20 (25) mm
齿数	No. of teeth	无限制 Unlimited
最大直齿宽度	Max. facewidth (spur gear)	600mm
螺旋角	Helix angle	±45°
工作台最大载荷	Max. load of worktable	2000kg

主要机械参数		Main mechanical parameters
磨具功率	Grinding apparatus power	20KW (MAX)
砂轮直径	Grinding wheel dia.	φ 400~ φ 300mm
砂轮最大厚度	Max. grinding wheel thickness	63 (80) mm
工作台直径	Worktable dia.	φ 650mm
尾架距台面高度	Height between tailstock and worktable	700~1200mm
工作台高度	Worktable height	980mm



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独立开发的

数控成形砂轮磨齿机软件

Self-developed Software for  
CNC Gear Form Grinding Machine

YK73125数控成形砂轮磨齿机软件系统主要包含以下功能模块

## 1 各种适磨齿轮的几何参数计算模块

包括标准的、变位的、修形的直、斜齿圆柱齿轮的几何参数计算以及常用工艺参数、测量参数计算，同时向数据库中录入基本的工件数据。

## 2 砂轮截形计算模块

根据工件的基本参数及用户对所加工齿轮的特殊要求，如：齿形修形参数、齿向修形参数、齿顶及齿根过渡曲线参数等，自动计算出的砂轮截形数据，满足用户对齿轮的各种特殊磨削要求。

## 3 磨削工艺参数及磨削加工程序自动生成模块

根据用户输入的齿轮参数，自动生成齿轮的磨削加工程序的NC代码。用户可以直接使用此代码进行磨削，也可以进行人工干预，以对加工NC代码进行详细的调整。

## 4 随机测量程序模块

在机床装有随机测量系统的前提下，可根据测量数据绘制齿形、齿向、周节、累积等齿轮测量图，可打印输出或保存，供用户对当前磨削效果进行分析；程序也可对测量结果进行自动分析和判断。如果磨削为达到预期精度，程序可在第二次齿轮修正磨削时对机床参数和砂轮截形数据进行自动修正。

## 5 工件参数及加工程序管理模块

实现所有磨削工件的几何参数、工艺参数及加工程序的数据库管理，达到安全、稳定、易用、直观的目的。随着机床使用时间的推移，用户的操作经验将被记录在此数据库中逐渐形成一些成熟、典型的磨削工艺，便于用户随时调用、查询、参考。

Software system of YK73125 CNC gear form grinding machine mainly consists of the following function modules.

### 1. Geometrical parameters calculation module of all kinds gears suitable for grinding

It consists of geometrical parameters calculation, common technological parameters and measuring parameters calculation of standard gears, gears with addendum modification, modified spur and helical cylindrical gears, at the same time, records basic workpiece data in database.

### 2. Section shape calculation module of grinding wheel

According to basic workpiece data and special requirements of customer to machined gears, such as: profile modification parameters, longitudinal modification parameters, tip and root transition curve parameters, etc. section shape data of grinding wheel can be automatically calculated to meet all kinds of special grinding requirements of customer to machined gears.

### 3. Automatic created module of grinding technological parameters and grinding machining program

According to gear parameters input by customer, NC code of grinding machining program of gears will be automatically created. Customer can directly use the code to grind, also can carry out manpower intervene to adjust NC code in detail.

### 4. Measuring program module supplied with the machine

In prerequisite for measuring system supplied with the machine, gear measuring diagram such as profile, longitudinal, pitch, cumulative pitch, etc. can be drawn according to measuring data, it can be printed and saved and used to analyze current grinding effect for customer; The program can automatically analyze and judge measuring results. If gears can't reach expected accuracy, during second modified grinding, the program can automatically correct machine parameters and section shape data of grinding wheel.

### 5. Management module of workpiece parameters and machining program

Database management of geometrical parameters, technological parameters and machining program of all ground workpieces can be realized, which attains safe, stable, easy use and visual purposes. As time goes on, operating experience of customer will be recorded in database and form mature and typical grinding technology gradually, which is convenient for customer to routine call, consult and refer.



