



Flexible Finishing Machine M-CM5AL Aimed at Automobile Engine Cylinder Block

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In manufacturing facilities for automotive parts, it has been a challenge to realize high-variety flexible-volume manufacturing in the finishing process. The flexible finishing machining center M-CM5AL is a product that solves such a technical challenge and is used in many mass production lines. The following describes the features of the M-CM5AL and the advantages for manufacturing lines using this product.

1. Product specifications

Table 1 shows the major specifications of the M-CM5AL. In addition to five machining axes (X, Y, Z, A, and B) and a magazine for standard tools, the machine has a special magazine on its side face. The special magazine can store three tools in total, including crank-bore finishing line bars and machining accuracy measuring heads.

2. Product features

- (1) Automatically changeable crank-bore finishing line bars
The M-CM5AL can automatically change line bars with a tool length of 870 mm and a weight of 30 kg, as

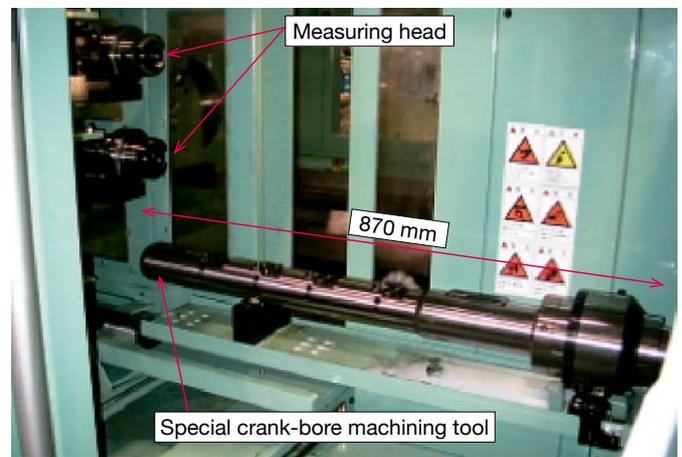


Fig. 1 Special magazine

Table 1 Major machine specifications

Spindle	Size	HSK-100A
	Max. spindle speed	6 000 min ⁻¹
	Max. motor power	30 kW
Axis travel	X-axis	700 mm
	Y-axis	610 mm
	Z-axis	1 200 mm
Rapid feed rate	X-, Y-, and Z-axes	50 m/min
Table	Standard	B-axis
	Optional	A-axis or AB-axes
Tool magazine (Standard)	Max. tool diameter	φ250 mm
	Max. tool weight	15 kg
	Max. tool length	360 mm
	Tool storage capacity	20 tools
	Tool change time (T-T)	2.5 sec
Tool magazine (Special) for (1) crank-bore finishing and (2) measuring of cylinder and crank bore	Max. tool diameter	φ145 mm
	Max. tool weight	30 kg
	Max. tool length	870 mm
	Tool change time (T-T)	8 sec

shown in **Fig. 1**. In addition, it uses a drawer-style line bar storage design for easy maintenance, including the cutting tool adjustment.

- (2) Line boring with both ends supported

The M-CM5AL enables the line boring with the

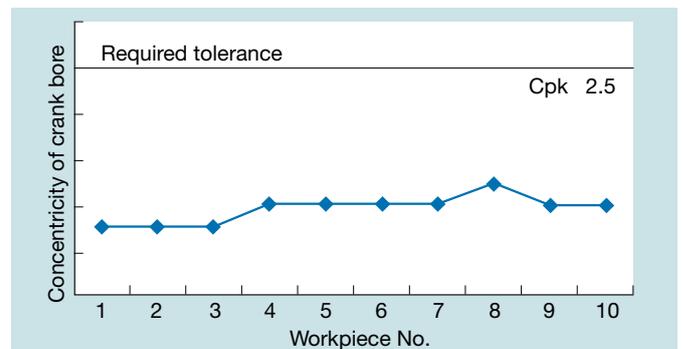


Fig. 2 Measured concentricity of crank bores (continuous machining of 10 workpieces)

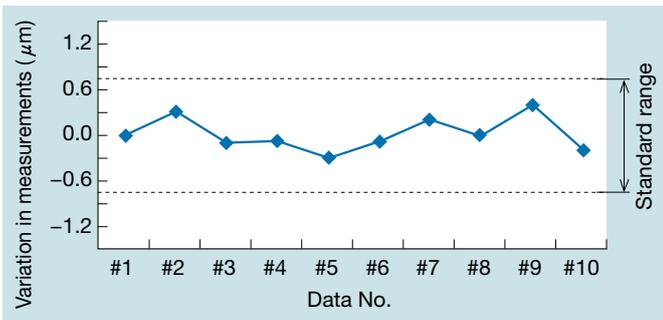


Fig. 3 Variation in measurements with every tool change

workpiece supported by the line bar the both ends of which are on the supports, which is a well-established machining technique in mass-production lines. As shown in **Fig. 2**, the machine offers a process capability of Cpk 2.5 in terms of concentricity of the crank bore in continuous machining of 10 workpieces.

(3) Automatically changeable measuring heads

The M-CM5AL can automatically change the measuring heads used for measuring machining accuracy of cylinder and crank bores. As shown in **Fig. 3**, it guarantees a repeatability of 1.5 μm or less in the measurement data from 10 workpieces.

3. Advantages for manufacturing lines using this product

(1) Stepped investment and adjustable production volume

Figure 4 compares a manufacturing line consisting of conventional special-purpose machines with that consisting of the M-CM5AL. The use of the M-CM5AL allows all finishing tasks to be completed on a single machine, although conventionally a line of special-purpose machines with several machining units must be constructed for the finishing process. In addition, varying production volume needs can be addressed by the use of multiple M-CM5AL, by increasing or decreasing the number of M-CM5AL in the manufacturing line.

(2) High-variety manufacturing

In a line consisting of conventional special-purpose machines, it has been difficult to machine a mixture of products, V6 and V8 cylinder blocks for example, due

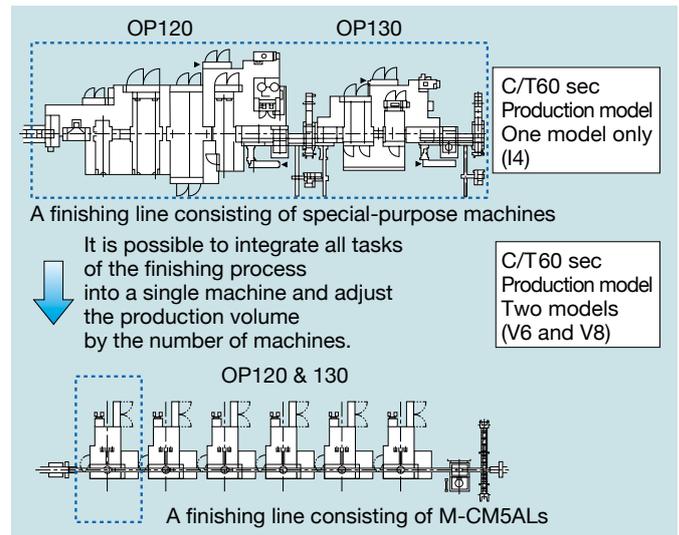


Fig. 4 Comparison with a conventional special-purpose line

to a large difference in the bank angle of the cylinder bore as well as the cylinder bore number. However, the M-CM5AL, equipped with an automatic tool changer and the A- and B-axes controlled table, offers the capability of mixed production through the use of ID tags or other means.

(3) Improved cost efficiency

The graphs in **Fig. 5** show results of the comparison between a line consisting of conventional special-purpose machines and a line using the M-CM5AL, in terms of the relationship between production capacity and capital investment (Fig. 5 (a)) and between production volume and cost per workpiece (Fig. 5 (b)), respectively. In lines consisting of conventional special-purpose machines, the capital cost at the start-up and reduction of production is extremely large because investment is made taking into account the maximum production volume. In contrast, in lines using the M-CM5AL, the cost per workpiece can be maintained at a low level because capital investment can be made based on the production volume and the production facilities can be easily standardized among different lines for potential convertibility. Thus, the M-CM5AL can improve the cost efficiency per capital investment.

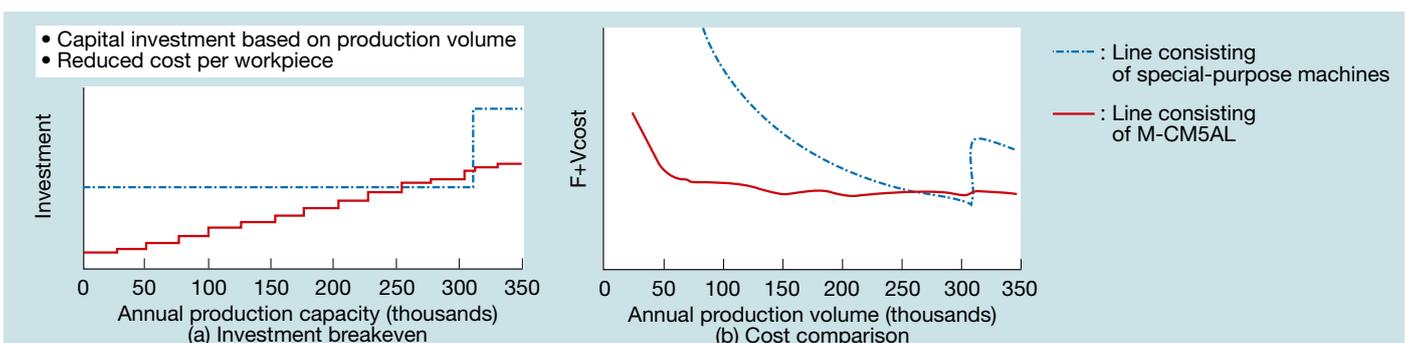


Fig. 5 Comparison of cost efficiency