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MACHINE TOOL SPEEDS AND FEEDS

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BRIEF HISTORY

The ISO Recommendation R 229, *Machine Tool Speeds and Feeds*, was drawn up by Technical Committee ISO/TC 39, *Machine Tools*, the Secretariat of which is held by the Association Française de Normalisation (AFNOR).

Work on this question by the Technical Committee began in 1950, taking into account the studies which had been made by the former International Federation of the National Standardizing Associations (ISA), and led, in 1958, to the adoption of a Draft ISO Recommendation.

In January 1959, this Draft ISO Recommendation (No. 271) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to editorial amendments, by the following Member Bodies:

Belgium	Germany	Romania
Burma	Hungary	Sweden
Czechoslovakia	Italy	Switzerland
Denmark	Pakistan	United Kingdom
Finland	Poland	U.S.S.R.
France	Republic of South Africa	

Two Member Bodies opposed the approval of the Draft:

Netherlands U.S.A.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in December 1961, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 229 December 1961

MACHINE TOOL SPEEDS AND FEEDS

1. SCOPE

This ISO Recommendation, dealing with machine tool speeds and feeds, applies to machine tools working by removal of metal and driven directly by an electrical motor, except in those cases where its application is obviously impracticable on technical grounds (e.g. machines with continuous speed variations, feeds for thread forming, etc.).

This ISO Recommendation is composed of two distinct parts, of which one concerns the speeds (number of revolutions or strokes per minute), and the other the feeds (in millimetres or in inches, per minute or per revolution, or per stroke).

2. GENERALITIES

2.1 The *basic values* of the speeds, as well as those of the feeds, are taken from the R 20 series of preferred numbers.*

2.2 The permissible limits for the *actual values* have been determined not from the basic values, but from the corresponding theoretical values of the geometric series with ratio $\sqrt[20]{10}$.**

Compared with these theoretical values, the limits of tolerance are:

Percentage limits of tolerances

Speeds	Feeds			
number of revolutions or strokes per minute	millimetres per minute	inches per minute	millimetres per revolution or per stroke	inches per revolution or per stroke
− 2 per cent + 6 per cent	− 2 per cent + 6 per cent	− 3 per cent + 5 per cent	− 2 per cent + 3 per cent	− 3 per cent + 2 per cent

2.3 The adoption of percentage limits, slightly different according as the feed is expressed either in millimetres or in inches, is justified by the necessity to make the prescribed limits coincide, whatever the unit of measurement used. (So as to achieve this condition in a more precise way, the limits in inches have been directly converted from the limits in millimetres.)

* See column (3) in Table 1 of ISO Recommendation R 3 — *Preferred Numbers. Series of Preferred Numbers.*

** See column (7) in Table 1 of ISO Recommendation R 3.

3. SPEEDS

3.1 Definitions

3.1.1 The speeds covered by this ISO Recommendation are the spindle speeds per minute *under load* of the spindle of the machine.

3.1.2 The *basic value* is that shown on the plate of the machine and used for calculating cutting times.

3.1.3 The *actual value*, which should lie within the limits of the prescribed tolerances, is conventionally given by the following formula:

$$\text{Spindle speed under load} = \text{spindle speed without load} \times \frac{N_c}{N_v}$$

where N_c = speed of the motor, under load, inscribed on the plate, and
N_v = speed of the motor measured with the machine running without load.

3.2 Basic values

The complete range of basic values for the speeds of a machine tool should include only values taken from the R 20 series of preferred numbers, as shown in column 1 of Table 1, or from their decimal multiples or submultiples.

Provided that this condition is satisfied, the scaling is left free and the values may be chosen so as to meet the requirements of the machine tool.

3.3 Tolerances

The actual values of the speeds checked as indicated above, should lie within the limits of the total tolerance.

Compared with the theoretical numbers in the geometric series with ratio $\sqrt[20]{10}$, this total tolerance is approximately equal to:

$$\begin{matrix} - \text{ 2 per cent} \\ + \text{ 6 per cent} \end{matrix} \quad \text{of the value.}$$

It is the sum of

an electrical tolerance of $\begin{matrix} 0 \text{ per cent,} \\ + \text{ 3 per cent,} \end{matrix}$ and

a mechanical tolerance of approximately $\begin{matrix} - \text{ 2 per cent.} \\ + \text{ 3 per cent.} \end{matrix}$

Table 1 gives:

in columns 2 and 3, the limits of the actual values, corresponding to the prescribed tolerance (total tolerance): electrical + mechanical;

in columns 4 and 5, the limits for calculating the mechanical tolerance.

TABLE 1. — **Speeds: number of revolutions or strokes per minute**

Basic value R 20	Limits corresponding to the total tolerance: electrical + mechanical — 2 per cent + 6 per cent approximately		Limits for calculating the mechanical tolerance * — 2 per cent + 3 per cent approximately	
	minimum	maximum	minimum	maximum
1	2	3	4	5
100	98	106	98	103
112	110	119	110	116
125	123	133	123	130
140	138	150	138	145
160	155	168	155	163
180	174	188	174	183
200	196	212	196	206
224	219	237	219	231
250	246	266	246	259
280	276	299	276	290
315	310	335	310	326
355	348	376	348	365
400	390	422	390	410
450	438	473	438	460
500	491	531	491	516
560	551	596	551	579
630	618	669	618	650
710	694	750	694	729
800	778	842	778	818
900	873	945	873	918
1 000	980	1 060	980	1 030

To extend the table upwards or downwards, divide or multiply the given values by 10 or a power of 10.

* For the calculation of the transmission ratio of the driving equipment, the speed at the input is taken as lower by 6 per cent than the synchronous speed of the motor. (The quotient of the speed at the input by each of the two tabulated limits gives the extreme values of the transmission ratio.)

4. FEEDS

4.1 Definitions

4.1.1 *The feeds* covered by the present ISO Recommendation may be:

either the feed per minute *under load* if the feed mechanism is directly driven by the motor,

or the feed per revolution (or per stroke), if it is driven by the spindle.

4.1.2 *The basic value* of the feed is that shown on the plate of the machine and used for calculating cutting times.

4.1.3 *The actual value* which should lie within the limits of the prescribed tolerances,

(a) *In the case of feed by minute*, is given, by convention, by the following formula:

$$\text{Feed under load} = \text{feed without load} \times \frac{N_c}{N_v}$$

where N_c = speed of the motor under load, indicated on the plate, and
N_v = speed of the motor measured with the machine running without load.

(b) *In the case of feed per revolution (or per stroke)*, is not related to the motor.

4.2 Basic values

The complete range of basic values for the feeds of a machine tool should include only values taken from the R 20 series of preferred numbers, as shown in column 1 of Table 2, or their decimal multiples or submultiples.

Provided that this condition is satisfied, the scaling is left free and the values may be chosen so as to meet the requirements of the machine tool.

4.3 Tolerances on the feed per minute (driven independently of the spindle)

The actual value of the feed per minute, checked as indicated above, should lie within the limits of the total tolerance.

Compared with the theoretical numbers in the geometric series with ratio $\sqrt[20]{10}$, this total tolerance is approximately equal to:

$\begin{matrix} - \text{ 2 per cent} \\ + \text{ 6 per cent} \end{matrix}$ for feeds in millimetres per minute,

$\begin{matrix} - \text{ 3 per cent} \\ + \text{ 5 per cent} \end{matrix}$ for feeds in inches per minute.

It is the sum of

an electrical tolerance of about $\begin{matrix} 0 \text{ per cent} \\ + \text{ 3 per cent} \end{matrix}$, and of

a mechanical tolerance equal about to:

$\begin{matrix} - \text{ 2 per cent} \\ + \text{ 3 per cent} \end{matrix}$ for feeds in millimetres per minute,

$\begin{matrix} - \text{ 3 per cent} \\ + \text{ 2 per cent} \end{matrix}$ for feeds in inches per minute.

Table 2 gives, in millimetres, on page 7 and Table 3, in inches, on page 8:

in columns 2 and 3, the limits of the actual values, corresponding to the tolerance specified (total tolerance: electrical + mechanical),

in columns 4 and 5, the limits for calculating the mechanical tolerance of the feed per minute (those limits coincide with the limits of the actual values corresponding to the tolerance specified below for the feed per revolution (or per stroke)).