INTERNATIONAL STANDARD 229

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Machine tools — Speeds and feeds

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 39 has reviewed ISO Recommendation R 229 and found it suitable for transformation. International Standard ISO 229 therefore replaces ISO Recommendation R 229-1961.

ISO Recommendation R 229 was approved by the Member Bodies of the following countries :

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

The Member Bodies of the following countries expressed disapproval of the Recommendation on technical grounds :

Netherlands
U.S.A.*

The Member Body of the following country disapproved the transformation of ISO/R 229 into an International Standard :

United Kingdom

* Subsequently, this Member Body approved the Recommendation.

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Machine tools — Speeds and feeds

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the speeds (number of revolutions or strokes per minute) and the feeds (in millimetres or in inches, per minute, per revolution, or per stroke) of machine tools working by removal of metal and driven directly by an electrical motor.

It is not applicable, for obvious technical reasons, to machines with continuous speed variations, feeds for thread forming, etc.

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 (see ISO 3).

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 $\sqrt[20]{10}$.

The limits of tolerance, compared with these theoretical values, are given in table 1.

TABLE 1 — **Limits of tolerances**

Tolerance % for speeds	**Tolerance % for 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 + 6	− 2 + 6	− 3 + 5	− 2 + 3	− 3 + 2

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.)

3 SPEEDS

3.1 Definitions

For the purposes of this International Standard, the following definitions apply :

3.1.1 speeds : The spindle speeds per minute *under load* of the spindle of the machine.

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

3.1.3 actual value : The value, which must lie within the limits of the prescribed tolerances, conventionally given by the formula :

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

where

N_c is the speed of the motor, under load, inscribed on the plate;

N_v is the 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 shall include only values taken from the R 20 series of preferred numbers, as shown in column 1 of table 2, 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, shall 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

$$^{-2}_{+6}\ \%$$ of the value.

It is the sum of

an electrical tolerance of $^{0}_{+3}\ \%$ and

a mechanical tolerance of approximately $^{-2}_{+3}\ \%$.

Table 2 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 2 – **Speeds : number of revolutions or strokes per minute**

Basic value R 20	**Limits corresponding to the total tolerance : electrical + mechanical** $^{-2}_{+6}$ % approximately		**Limits for calculating the mechanical tolerance**[1] $^{-2}_{+3}$ % approximately	
	min.	max.	min.	max.
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

1) For the calculation of the transmission ratio of the driving equipment, the speed at the input is taken as lower by 6 % 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.)

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

4 FEEDS

4.1 Definitions

For the purposes of this International Standard, the following definitions apply :

4.1.1 feeds : 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 basic value : The value shown on the plate of the machine and used for calculating cutting times.

4.1.3 actual value : The value which must lie within the limits of the prescribed tolerances.

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

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

where

N_c is the speed of the motor under load, indicated on the plate;

N_v is the speed of the motor, measured with the machine running without load.

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

4.2 Basic values

The complete range of basic values for the feeds of a machine tool shall include only values taken from the R 20 series of preferred numbers, as shown in column 1 of table 3, 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, shall 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 :

$^{-2}_{+6}$ % for feeds in millimetres per minute,

$^{-3}_{+5}$ % for feeds in inches per minute.

It is the sum of

an electrical tolerance of about $^{0}_{+3}$ %, and of

a mechanical tolerance equal about to :

$^{-2}_{+3}$ % for feeds in millimetres per minute,

$^{-3}_{+2}$ % for feeds in inches per minute.

Table 3 gives, in millimetres, and table 4 in inches,

— 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 (coinciding with the limits of the actual values corresponding to the tolerance specified below for the feed per revolution (or per stroke)).

4.4 Tolerances on the feed per revolution (or per stroke)

The actual value on the feed per revolution (or per stroke) shall lie within the minimum and maximum limits shown in columns 4 and 5 of table 3, for millimetres, and of table 4, for inches, which correspond only to the mechanical tolerance of the gearbox, since the feed per revolution (or per stroke) is independent of the motor.

NOTE — The resulting feed per minute, which is the product of the feed per revolution (or per stroke) and the speed per minute, may vary, by the combined action of the tolerances on these last two factors,

between − 4 % and + 9 %, if the feed is expressed in millimetres, and

between − 5 % and + 8 %, if it is expressed in inches.

TABLE 3 — Feeds in millimetres

Basic value R 20	Feeds per minute[1]		Feeds per revolution (or per stroke)[2]	
	Limits of the tolerance $^{-2}_{+6}$ % approximately		Limits of the tolerance $^{-2}_{+3}$ % approximately	
	min.	max.	min.	max.
1	2	3	4	5
1	0,98	1,06	0,98	1,03
1,12	1,10	1,19	1,10	1,16
1,25	1,23	1,33	1,23	1,30
1,4	1,38	1,50	1,38	1,45
1,6	1,55	1,68	1,55	1,63
1,8	1,74	1,88	1,74	1,83
2	1,96	2,12	1,96	2,06
2,24	2,19	2,37	2,19	2,31
2,5	2,46	2,66	2,46	2,59
2,8	2,76	2,99	2,76	2,90
3,15	3,10	3,35	3,10	3,26
3,55	3,48	3,76	3,48	3,65
4	3,90	4,22	3,90	4,10
4,5	4,38	4,73	4,38	4,60
5	4,91	5,31	4,91	5,16
5,6	5,51	5,96	5,51	5,79
6,3	6,18	6,69	6,18	6,50
7,1	6,94	7,50	6,94	7,29
8	7,78	8,42	7,78	8,18
9	8,73	9,45	8,73	9,18
10	9,80	10,6	9,80	10,3

TABLE 4 — Feeds in inches

Basic value R 20	Feeds per minute[1]		Feeds per revolution (or per stroke)[2]	
	Limits of the tolerance $^{-3}_{+5}$ % approximately		Limits of the tolerance $^{-3}_{+2}$ % approximately	
	min.	max.	min.	max.
1	2	3	4	5
0.040	0.038 6	0.041 7	0.038 6	0.040 6
0.045	0.043 3	0.046 9	0.043 3	0.045 7
0.050	0.048 4	0.052 4	0.048 4	0.051 2
0.056	0.054 3	0.059 1	0.054 3	0.057 1
0.063	0.061 0	0.066 1	0.061 0	0.064 2
0.071	0.068 5	0.074 0	0.068 5	0.072 1
0.080	0.077 2	0.083 5	0.077 2	0.081 1
0.090	0.086 2	0.093 3	0.086 2	0.090 9
0.100	0.097	0.105	0.097	0.102
0.112	0.109	0.118	0.109	0.115
0.125	0.122	0.132	0.122	0.128
0.140	0.137	0.148	0.137	0.144
0.160	0.154	0.166	0.154	0.162
0.180	0.172	0.186	0.172	0.181
0.200	0.193	0.209	0.193	0.203
0.224	0.217	0.235	0.217	0.228
0.250	0.243	0.263	0.243	0.256
0.280	0.273	0.295	0.273	0.287
0.315	0.306	0.331	0.306	0.322
0.355	0.344	0.372	0.344	0.362
0.400	0.388	0.417	0.386	0.406

1) The limits given for the actual values of feeds per minute in columns 2 and 3 correspond to the sum of the electrical and mechanical tolerances. The mechanical tolerance is calculated as for feeds per revolution (or per stroke) from values in columns 4 and 5, but, for the calculation of the transmission ratio of the driving equipment, the speed at the input is taken as lower by 6 % 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.)

2) The actual limits of feed per revolution (or per stroke) in columns 4 and 5 correspond to a mechanical tolerance only.

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

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