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International Standard ISO 2953

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Balancing machines — Description and evaluation

Machines à équilibrer — Description, caractéristiques et possibilités

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 2953 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock.*

ISO 2953 was first published in 1975. This second edition cancels and replaces the first edition, of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Annexes

Balancing machines — Description and evaluation

1 Scope

This International Standard sets out standards for the evaluation of performance and characteristics of machines for balancing rotating components where correction is required in one or more planes perpendicular to the shaft axis. It stresses the importance attached to the form in which the balancing machine characteristics should be specified by the manufacturer and also outlines methods of evaluating balancing machines. Adoption of the format suggested in 4.1 and 4.2 makes it easier for the user to compare one manufacturer's product with another's. Guidance as to the manner in which users should state their requirements is given in annex A.

It should be noted that the terminology used throughout this International Standard is in accordance with ISO 1925 and this terminology should be employed by manufacturers and users when applying this International Standard.

2 Field of application

This International Standard is applicable to balancing machines that support and rotate rigid workpieces (that is, workpieces that are rigid at balancing speeds) and that indicate the amounts and angular locations of unbalance corrections required.

It covers both those machines that measure out-of-balance effects on soft bearings and those that measure out-of-balance effects on hard bearings. It also relates to resonance-type machines, provided that mechanical compensators are incorporated.

Technical requirements for such balancing machines are also dealt with; however, special features, such as those associated with automatic correction, are excluded.

Details of proving rotors, test masses and performance tests to be employed to ensure compliance with specified unbalance indicating capability are given. Tests for other machine capacities and performance parameters are not contained in this International Standard.

Annex A gives an indication of the information a user might supply to a manufacturer and a suggested method of tabulating it. Annex B gives some of the definitions relevant to the provisions of this International Standard.

This International Standard does not specify balancing criteria; these will be found in ISO 1940.

3 References

ISO 1925, *Balancing — Vocabulary.*

ISO 1940, *Balancing quality of rotating rigid bodies.*

4 Capacity and performance data of the machine

The manufacturer shall specify the data listed in 4.1 or 4.2 for horizontal or vertical machines respectively, as applicable and in a similar format.

4.1 Capacity and performance data of horizontal machines (See page 4 for notes)

Manufacturer : .... Model : ....

4.1.1 Rotor mass and unbalance limitations

4.1.1.1	Balancing speeds or speed ranges (see also 4.1.3.1)		Min.	n_2	n_3	n_4	n_5
4.1.1.2[1)]	Rotor mass kg (lb)	maximum					
		minimum					
	Occasional overload force per support : N (kgf, lbf)						
	Maximum negative force per support : N (kgf, lbf)						
4.1.1.3[2)]	Maximum rotor moment of inertia with respect to the shaft axis kg·m^2 (lb·ft^2)						
	Cycle rate						
4.1.1.4[3)]	Maximum unbalance g·mm/kg or g·mm (lb·in/lb or oz·in)	measurable					
		permissible					
4.1.1.5[4)] For inboard rotors	Minimum achievable residual specific unbalance, e_{mar} (see clause 6) g·mm/kg (lb·in/lb)	maximum mass					
		0,2 × maximum mass					
		minimum mass					
	Corresponding deflection of analogue amount-of-unbalance indicator : mm (in), respectively number of digital units	maximum mass					
		0,2 × maximum mass					
		minimum mass					
4.1.1.5.1[4)] For outboard rotors	Minimum achievable residual specific unbalance, e_{mar} (see clause 6) g·mm/kg (lb·in/lb)	maximum mass					
		0,2 × maximum mass					
		minimum mass					
	Corresponding deflection of analogue amount-of-unbalance indicator : mm (in), respectively number of digital units	maximum mass					
		0,2 × maximum mass					
		minimum mass					

4.1.1.6 Production efficiency (see clause 7)

4.1.1.6.1 Time per measuring run

a) Time for mechanical adjustment: .... s

b) Time for setting indicating system: .... s

c) Time for preparation of rotor: .... s

d) Average acceleration time: .... s

e) Reading time: .... s

f) Average deceleration time: .... s

g) Relating readings to rotor: .... s

h) Other necessary time: .... s

j) Total time per measuring run [a) to h) above]: .... s

4.1.1.6.2 Unbalance reduction ratio for inboard rotors: .... %

4.1.1.6.3 Unbalance reduction ratio for outboard rotors: .... %

4.1.2 Rotor dimensions

4.1.2.1[5] Rotor envelope limitations (see figure 1)

4.1.2.2 Rotor diameter

Maximum diameter over bed : .... mm (in)

Maximum diameter over which belt can drive : .... mm (in)

Minimum diameter over which belt can drive : .... mm (in)

4.1.2.3 Distance between journal centrelines

Maximum : .... mm (in)

Minimum : .... mm (in)

Maximum distance from coupling flange to centreline of farthest bearing : .... mm (in)

Minimum distance from coupling flange to centreline of nearest bearing : .... mm (in)

4.1.2.4 Journal diameter

Maximum : .... mm (in)

Minimum : .... mm (in)

4.1.2.4.1[6] Maximum permissible peripheral journal speed .... m/s (ft/s)

4.1.2.5 Correction plane limitations (consistent with the statements in 5.4)

4.1.2.6 Correction plane interference ratios (consistent with the statements in 5.4 and based on the proving rotor)

4.1.3 Drive

4.1.3.1[7]

	Balancing speed rev/min	Rated torque on workpiece N·m (lbf·ft)
n_1	....	....
n_2	....	....
n_3	....	....
n_4	....	....
n_5	....	....
n_6	....	....
n_7	....	....
n_8	....	....
	or	or
	steplessly variable from	steplessly variable from
	....	....
	to	to
	....	....

4.1.3.2[8] Zero-speed torque : .... % of rated torque on workpiece

Run-up torque adjustable from .... to .... % of rated torque on workpiece

Peak torque .... % of rated torque on workpiece

4.1.3.3 [9] Type of drive to workpiece : ....

4.1.3.4 Prime mover (type of motor) : ....

4.1.3.4.1 Rated power : .... kW (hp)

Motor speed : .... rev/min

Power supply, voltage/frequency/phase : .... / .... / ....

4.1.3.5 Brake

4.1.3.5.1 Type of brake : ....

Braking torque adjustable from .... to .... % of rated torque

Can brake be used as a holding device? Yes/No

4.1.3.6 Motor and controls in accordance with the following standard(s) : ....

4.1.3.7 Speed regulation provided :

Accurate or constant within .... % of .... rev/min, or .... rev/min

4.1.4 [10] **Couple unbalance interference ratio** [g.mm/g.mm^2 (oz.in/oz.in^2)] .... %

4.1.5 Air pressure requirements : .... Pa (psi); .... m^3/s (ft^3/s)

NOTES TO 4.1

) The maximum mass of rotor which can be balanced shall be stated over the range of balancing speeds.

he occasional overload force need only be stated for the lowest balancing speed. It is the maximum force per support that can be accommodated by the machine without immediate damage.

he negative force is the static upward force resulting from a workpiece having its centre of gravity outside the bearing support.

) The maximum moment of inertia [mass × (radius of gyration)^2] of rotor with respect to the shaft axis which the machine can accelerate n a stated acceleration time shall be given for the range of balancing speeds (n_1, n_2, ...) together with the corresponding cycle rate. Cycle rate for a given balancing speed is the number of starts and stops which the machine can perform per hour without damage to the machine when balancing a rotor of the maximum moment of inertia.

) In general, for rigid rotors with two correction planes, one-half of the stated value pertains to each plane; for disc-shaped rotors, the full stated value holds for one plane.

) Limits for soft-bearing machines shall generally be stated in gram millimetres per kilogram (specific unbalance), since this value represents a measure of rotor displacement and, therefore, motion of the balancing machine bearings. For hard-bearing machines, the limits shall generally be stated in gram millimetres, since these machines are usually factory-calibrated to indicate unbalance in such units. (See clause 6.) For two-plane machines, this is the result obtained when the minimum achievable residual unbalance is distributed between the two planes.

) Adequate envelope drawings of the pedestals and of other obstructions, such as belt-drive mechanism, shroud mounting pads, thrust arms and tie bars, shall be supplied to enable the user to determine the maximum rotor envelope that can be accommodated and the tooling and/or adaptors required.

6) A combination of large journal diameter and high balancing speed may result in an excessive journal peripheral speed. The maximum journal peripheral speed shall be stated.

7) When belt drive is supplied, balancing speeds shall be tested for both the maximum and minimum diameters over which the belt can drive, or other convenient diameter.

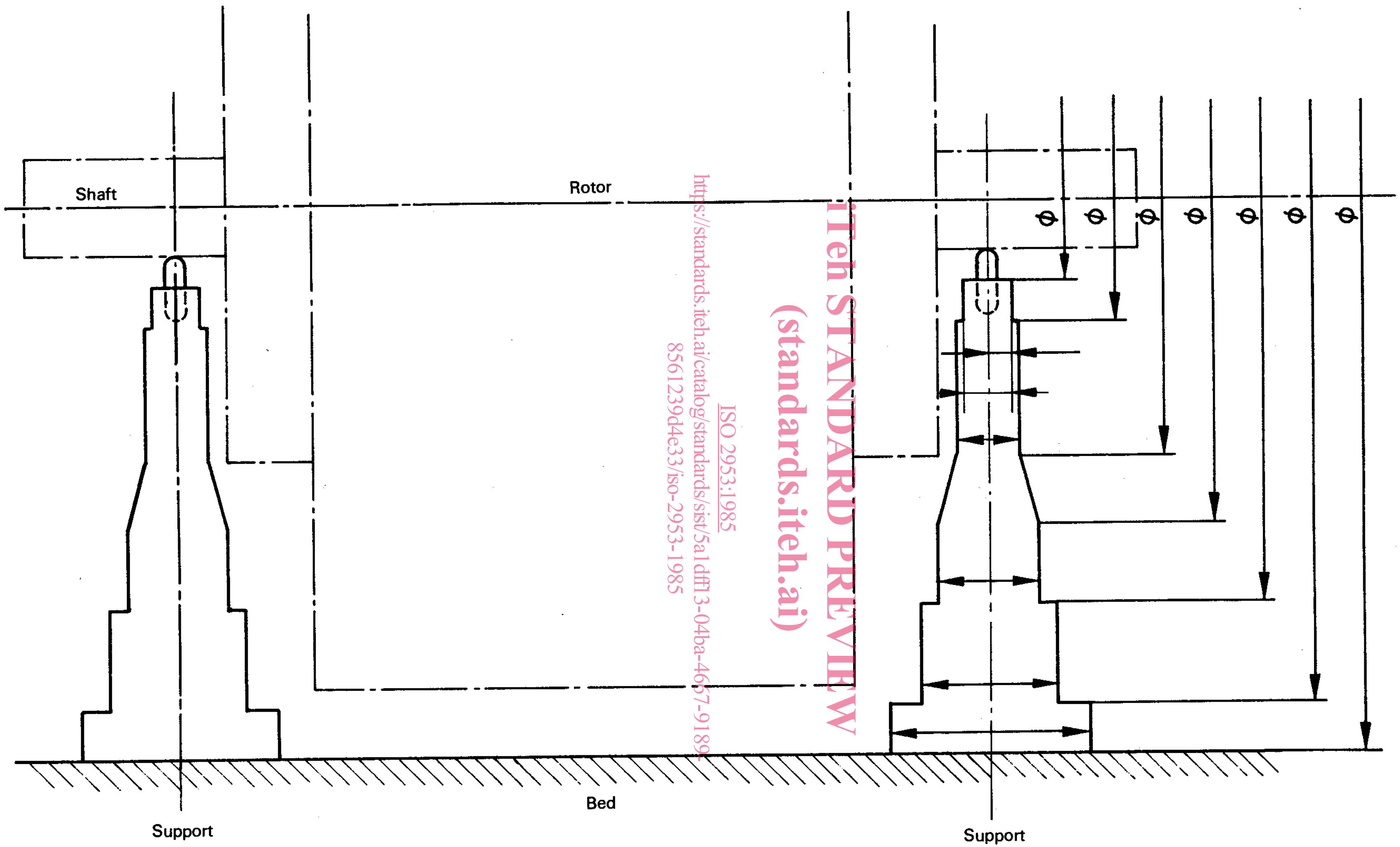
8) In most cases, maximum torque is required for accelerating a workpiece. However, in the case of workpieces with high windage and/or friction loss, maximum torque may be required at balancing speed. When there is axial thrust, it is necessary that provisions be made to take this into account.

9) Examples of the type of drive to the workpiece are :

- end drive by universal joint driver,
- end drive by band,
- belt drive,
- magnetic field,
- driven bearing rollers,
- air jet, etc.

The manufacturer shall state if the axial position of the drive can be adjusted.

10) This value is only applicable for single-plane balancing machines. It describes the influence of couple unbalance in the rotor on the indication of static unbalance.



NOTES

1 If the left-hand support is not a mirror image of the right-hand support, separate dimensions shall be shown.

2 The profile of the belt-drive equipment shall be shown, if applicable.

Figure 1 — Example of machine support drawing illustrating rotor envelope limitations

.2 Capacity and performance data of vertical machines (See page 8 for notes)

Manufacturer : .... Model : ....

.2.1 Rotor mass and unbalance limitations

			Min.	n_2	n_3	n_4	n_5
4.2.1.1	Balancing speeds or speed ranges (see also 4.2.3.1)						
4.2.1.2[1)]	Rotor mass (kg/lb)	maximum					
		minimum					
	Occasional overload force up to : N (kgf, lbf)						
4.2.1.3[2)]	Maximum rotor moment of inertia with respect to the shaft axis kg·m^2 (lb·ft^2)						
	Cycle rate						
4.2.1.4[3)]	Maximum unbalance g·mm/kg or g·mm (lb·in/lb or oz·in)	measurable					
		permissible					
4.2.1.5[4)]	Minimum achievable residual specific unbalance, e_{mar} (see clause 6) g·mm/kg (lb·in/lb)						
	Corresponding deflection of analogue amount-of-unbalance indicator : mm (in), respectively number of digital units						

.2.1.6 Production efficiency (see clause 7)

.2.1.6.1 Time per measuring run: .... s

a) Time for mechanical adjustment: .... s

b) Time for setting indicating system: .... s

c) Time for preparation of rotor: .... s

d) Average acceleration time: .... s

e) Reading time: .... s

f) Average deceleration time: .... s

g) Relating readings to rotor: .... s

h) Other necessary time: .... s

j) Total time per measuring run [a) to h) above]: .... s

4.2.1.6.2 Unbalance reduction ratio: .... %

4.2.2 Rotor dimensions

4.2.2.1 Maximum diameter: .... mm (in)

4.2.2.2 Rotor height :

a) Maximum overall height : .... mm (in)

b)[5] Maximum height of centre of gravity : .... mm (in)

at 100 % of maximum mass : .... mm (in)

at 50 % of maximum mass : .... mm (in)

at 25 % of maximum mass : .... mm (in)

4.2.2.3[6] Rotor envelope limitations, including machine spindle or mounting plate interface (see figure 2)

4.2.2.4 Correction plane limitations (consistent with the statements in 5.4)

4.2.3 Drive

4.2.3.1

	Balancing speed rev/min	Rated torque on workpiece N·m (lbf·ft)
n_1	....	....
n_2	....	....
n_3	....	....
n_4	....	....
n_5	....	....
n_6	....	....
n_7	....	....
n_8	....	....

4.2.3.2[7] Zero-speed torque : .... % of rated torque on workpiece

Run-up torque adjustable from .... to .... % of rated torque on workpiece

Peak torque .... % of rated torque on workpiece

4.2.3.3 Prime mover (type of motor) : ....

4.2.3.3.1 Rated power : .... kW (hp)

Motor speed : .... rev/min

Power supply, voltage/frequency/phase : .... / .... / ....

4.2.3.4 Brake

4.2.3.4.1 Type of brake : ....

Braking torque adjustable from .... to .... % of rated torque

Can brake be used as a holding device? Yes/No

4.2.3.5 Motor and controls in accordance with the following standard(s) : ....

4.2.3.6 Speed regulation provided :

Accurate or constant within .... % of .... rev/min, or .... rev/min

4.2.4[8] **Couple unbalance interference ratio** [g·mm/g·mm² (oz·in/oz·in²)] : .... %

4.2.5 Air pressure requirements : .... Pa (psi) ; .... m³/s (ft³/s)

NOTES TO 4.2

1) The maximum mass of rotor which can be balanced shall be stated over the range of balancing speeds.

The occasional overload force need only be stated for the lowest balancing speed. It is the maximum force that can be accommodated by the machine without immediate damage.

2) The maximum moment of inertia [mass × (radius of gyration)²] of a rotor with respect to the shaft axis which the machine can accelerate in a stated acceleration time shall be given for the range of balancing speeds (n_1, n_2, ...) together with the corresponding cycle rate. Cycle rate for a given balancing speed is the number of starts and stops which the machine can perform per hour without damage to the machine when balancing a rotor of the maximum moment of inertia.

3) In general, for rigid rotors with two correction planes, one-half of the stated value pertains to each plane; for disc-shaped rotors, the full stated value holds for one plane.

4) Limits for soft-bearing machines shall generally be stated in gram millimetres per kilogram (specific unbalance), since this value represents a measure of rotor displacement and, therefore, motion of the balancing machine bearings. For hard-bearing machines, the limits shall generally be stated in gram millimetres, since these machines are usually factory-calibrated to indicate unbalance in such units. (See also clause 6.) For two-plane machines, this is the result obtained when the minimum achievable residual unbalance is distributed between the two planes.

5) If the machine is equipped with two or more speeds, this information shall be stated for each speed. If the machine is equipped with steplessly variable balancing speeds, then the information shall be given in the form of a table, formula or graph.

6) Adequate drawings of the support surface of the spindle or mounting plate, and of obstructions, such as drill heads, electrical control cabinets, etc. above the mounting plates, shall be supplied to enable the user to determine the maximum rotor envelope that can be accommodated and the tooling and/or adaptors required.

7) In most cases, maximum torque is required for accelerating a workpiece. However, in the case of workpieces with high windage and/or friction loss, maximum torque may be required at balancing speed.

8) This value is only applicable for single-plane balancing machines. It describes the influence of couple unbalance in the rotor on the indication of static unbalance.