

DIN ISO 21940-11:2023-04 (E)

Mechanical vibration - Rotor balancing - Part 11: Procedures and tolerances for rotors with rigid behaviour (ISO 21940-11:2016 + Amd 1:2022)

Contents		Page
National foreword		4
National Annex NA (informative) Bibliography		6
Foreword		7
Introduction.....		8
1	Scope	9
2	Normative references	9
3	Terms and definitions.....	9
4	Pertinent aspects of balancing.....	9
4.1	General	9
4.2	Representation of the unbalance.....	9
4.3	Unbalance effects.....	10
4.4	Reference planes for unbalance tolerances.....	10
4.5	Correction planes	12
4.5.1	General	12
4.5.2	Rotors which need one correction plane only	12
4.5.3	Rotors which need two correction planes.....	12
4.5.4	Rotors with more than two correction planes.....	12
4.6	Permissible residual unbalance.....	13
5	Similarity considerations	13
5.1	General	13
5.2	Permissible residual unbalance and rotor mass	13
5.3	Permissible residual specific unbalance and service speed.....	14
6	Specification of unbalance tolerances	14
6.1	General	14
6.2	Derivation of the unbalance tolerances	14
6.3	Balance quality grade G.....	15
6.3.1	Classification	15
6.3.2	Special designs.....	15
6.3.3	Permissible residual unbalance.....	18
6.4	Experimental evaluation.....	18
6.5	Unbalance tolerances based on bearing forces or vibrations.....	18
6.5.1	Bearing forces	18
6.5.2	Vibrations	19
6.6	Methods based on established experience.....	19
7	Allocation of permissible residual unbalance to tolerance planes	19
7.1	Single plane.....	19
7.2	Two planes	19
7.2.1	General	19
7.2.2	Limitations for inboard rotors.....	20
7.2.3	Limitations for outboard rotors.....	20
8	Allocation of unbalance tolerances to correction planes	21
8.1	General	21
8.2	Single plane.....	22
8.3	Two planes	22

9	Assembled rotors	22
9.1	General	22
9.2	Balanced as a unit.....	22
9.3	Balanced on component level	22
10	Accounting for errors in the verification of permissible residual unbalances.....	23
10.1	General	23
10.2	Unbalance tolerance.....	23
10.3	Combined error of unbalance measurements.....	23
10.4	Verification of the permissible residual unbalance.....	23
10.4.1	General	23
10.4.2	Unbalance readings within tolerance	24
10.4.3	Unbalance readings out of tolerance.....	24
10.4.4	Region of uncertainty.....	24
A1	11 Notification of necessary balancing information at the design stage A1.....	24
	Annex A (informative) Example of the specification of permissible residual unbalance based on balance quality grade G and allocation to the tolerance planes	25
A.1	Rotor data.....	25
A.2	Specification of U_{per} based on Formula (6).....	26
A.3	Specification of U_{per} based on Figure 2	26
A.4	Allocation to tolerance planes (bearing planes).....	28
A.5	Check on limitations in accordance with 7.2.2 for inboard rotors.....	28
A.6	Result.....	28
	Annex B (informative) Specification of unbalance tolerances based on bearing force limits	29
B.1	General	29
B.2	Example.....	29
B.2.1	Assumption.....	29
B.2.2	Calculation	29
	Annex C (informative) Specification of unbalance tolerances based on established experience	31
C.1	General	31
C.2	Similar rotors.....	31
C.2.1	General	31
C.2.2	Extrapolation from known rotors	31
C.2.3	Calculation	31
C.3	Dissimilar rotors.....	32
	Annex D (informative) Rules for allocating unbalance tolerances from tolerance planes to correction planes.....	33
D.1	General	33
D.2	Correction planes in-between tolerance planes	33
D.3	Correction planes outside tolerance planes.....	34
D.4	More complex geometry	35
A1	Annex E (informative) Notification of unbalance tolerances on technical drawings	36
E.1	General	36
E.2	Example A1	36
	Bibliography.....	38