

ISO/TR 10064-5:2005-04 (E)

Cylindrical gears - Code of inspection practice - Part 5: Recommendations relative to evaluation of gear measuring instruments

Contents	Page
Foreword	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Instrument environment	2
4.1 Environment	2
4.1.1 Important parameters	2
4.1.2 Practical guidelines	3
4.1.3 Workshop environment	3
4.2 Effect of temperature on gears and artifacts	4
4.2.1 Profile temperature effect calculation	4
4.2.2 Helix temperature effect calculation	5
4.2.3 Tooth thickness temperature effect calculation	5
5 Measurement system condition	5
5.1 Evaluation procedure for generative instruments	6
5.1.1 Verification of mounting centres	6
5.1.2 Axial measuring slide verification	10
5.2 Evaluation procedures for CMM type measuring instruments	14
5.2.1 Performance test according to ISO 10360	14
5.2.2 Ball plate test	15
5.2.3 Rotary tables	16
5.3 Probe system	16
5.3.1 Stylus	16
5.3.2 Data recording system	17
5.4 Filtering	21
5.4.1 Mechanical filtering	21
5.4.2 Electrical filtering	21
5.4.3 Mathematical filtering	22
5.5 Uncertainty estimation	22
6 Artifacts	22
6.1 Mounting reference features	22
6.2 Suggested master artifacts	22
6.2.1 Integral base circle involute master	23
6.2.2 Helix artifact	23
6.2.3 Pitch variation, total cumulative pitch variation and runout artifact	24
6.2.4 Tooth thickness artifacts	25
6.2.5 Workpiece-like artifacts	25
6.3 Modified base circle involute artifact testing	27
6.4 Non-involute -- Pin (cylindrical), plane (flank) and ball (spherical) artifacts	27
6.4.1 Types of non-involute artifacts	27
6.4.2 Non-involute artifact function	29
6.4.3 Plane artifact calibration	30
6.4.4 Pin or ball artifact calibration	30
6.4.5 Probe-tip effects when calculating reference curve	30
6.4.6 Measurement location	31

6.4.7	Non-involute master interpretation	31
6.5	Helix artifact testing	31
6.5.1	Modified-lead helix artifact testing	31
6.5.2	Non-involute helix masters	32
6.6	Modified eccentricity pitch artifact testing	32
7	Uncertainty estimation guidelines	32
7.1	Uncertainty estimation methods	32
7.1.1	General methods	32
7.1.2	Comparator methods	33
7.2	Calculation of U95 measurement uncertainty	33
7.3	Measurement parameters	34
7.3.1	Line-fit parameters	34
7.3.2	Band-fit parameters	35
7.3.3	Pitch parameters	35
8	Measurement procedures	35
8.1	Traceability	35
8.2	Operating conditions	35
8.2.1	Conditions for bias determination	35
8.2.2	Conditions for standard uncertainty estimation	35
8.2.3	Conditions for combined determinations	36
8.3	Measurements	36
8.4	Calibration procedure	36
8.4.1	Initial set-up and adjustments	36
8.4.2	Initial calibration procedure	36
8.4.3	Ongoing calibration procedure	37
8.4.4	Tooling and gauges	37
9	Comparator measurement uncertainty estimation guidelines	37
9.1	Direct comparator example A	37
9.2	Comparator approach, expanded for workpiece characteristic influence	39
9.2.1	Comparator example B	39
9.2.2	Comparator example C	41
9.3	Comparator approach, expanded for workpiece characteristic and geometry similarity influences	43
10	Statistical process control	43
10.1	Definitions	43
10.2	Constructing the X and MR chart	43
10.3	Criteria for evidence of lack of control	44
10.4	When control chart data fails one or more criteria according to 10.3	46
11	Instrument fitness for use	46
11.1	Limiting measurement uncertainty	46
11.1.1	GPS Tolerance reduction method	46
11.1.2	Tolerance ratio method	48
11.1.3	Instrument uncertainty guidelines	48
11.2	Measurement uncertainty sources	49
11.3	Reducing measurement uncertainty	50
11.3.1	Following a different calibration procedure	50
11.3.2	Reducing uncertainty of the reference master certification	50
11.3.3	Improving the measuring process	50
12	Measurement process (instrument) correlation	51
12.1	Basis for comparison	51
12.2	Correlation of measurement	51
	Annex A (informative) Effect of temperature on gears and artifacts	52
	Annex B (informative) Modified involute, helix, pitch artifact testing	58
	Annex C (informative) Non-involute pin, ball, or plane (flank) artifact interpretation	69
	Bibliography	89