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