

TABLE OF CONTENTS

1. INTRODUCTION	9
2. MACHINING TECHNOLOGIES USED IN THE MACHINING INDUSTRY, INCLUDING THE AUTOMOTIVE AND AVIATION INDUSTRY	20
2.1. Classification of basic manufacturing technologies	20
2.2. Characteristics of basic manufacturing technologies	22
2.2.1. Metal cutting technology..	22
2.2.2. Abrasive machining	30
2.2.3. Erosive machining	34
2.2.3.1. Electro-chemical machining	35
2.2.3.2. Electro-erosive machining	36
2.2.4. Casting	37
2.2.5. Polymer processing	41
2.2.6. Metal forming	42
2.2.7. Bonding	44
2.2.8. Assembly	47
2.3. Technological process design rules	52
2.4. Example of technological process design	56
3. GEOMETRICAL PRECISION OF MACHINE PARTS	65
3.1. Tolerances and fittings	65
3.1.1. Basic concepts	65
3.1.2. Selection of tolerance field location	67
3.1.3. Basic formulas	67
3.1.4. Calculation examples	68
3.2. Shape tolerance	70
3.3. Orientation tolerance	70
3.4. Location tolerance	71
3.5. Run-out tolerance	72
3.6. Roughness of machined surfaces	73
3.6.1. Basic concepts	73
3.6.2. Surface roughness measurement methods	75
4. QUALITY ENGINEERING IN MANUFACTURING TECHNOLOGIES – INTRODUCTION	79
5. PRODUCT AND PROCESS QUALITY ASSURANCE AND IMPROVEMENT SYSTEMS	83
5.1. Economic aspects of quality	83
5.2. Quality management rules	89

5.3. Quality assurance system certification ...	93
5.4. Total quality management (TQM)	101
6. STATISTICAL TECHNOLOGICAL PROCESS CONTROL (SPC).....	103
6.1. Function and place of SPC in quality engineering	103
6.2. Process stability analysis with control charts	104
6.2.1. Control charts structure basics and types	104
6.2.2. Classic control charts for continuous data	109
6.2.3. Control charts for unconventional technological processes	113
6.2.3.1. Control charts with variable samples size	113
6.2.3.2. Control charts with variable sampling intervals	113
6.2.3.3. Control charts with variable control limits	123
6.3. Process capability analysis using quality capability indices	125
6.4. Examples of process quality analysis for basic manufacturing technologies	131
6.4.1. Metal cutting technology	131
6.4.2. Metal forming	137
6.4.2.1. Sheet folding process control with a vision system [103, 104, 109]	137
6.4.2.2. Quality analysis in the cutting process [105]	138
6.4.3. Casting [67, 106, 107, 108]	139
6.4.4. Polymer processing	142
6.4.5. Welding	144
7. STATISTICAL ACCEPTANCE INSPECTION	157
7.1. Introduction	157
7.2. Batch creation and sampling criteria	158
7.3. Alternative assessment inspection	159
7.3.1. One-stage alternative sampling plan	159
7.3.2. Two-stage alternative sampling plan	160
7.3.3. Multi-stage alternative sampling plan	162
7.3.4. Sequential alternative sampling plan	162
7.4. Test plan specifications	163
7.4.1. Operating-characteristic function (OC curve)	163
7.4.2. Reception inspection with the alternative method	164
7.4.3. Recipient inspection with the numeric method	167
7.5. Example of use of the Statistical Reception Inspection procedure [63]	169
7.5.1. Batch diagnosis with the alternative method	170
7.5.2. Batch diagnosis in statistical reception inspection (SRI) using a method with numerical assessment	172
8. MEASUREMENT SYSTEM ANALYSIS (MSA)	175
8.1. Measurement systems and data collection	176
8.1.1. Measurement uncertainty	178
8.1.2. Measurement accuracy	180
8.1.3. Measurement error	181
8.2. Methodology of stability and measurement system capability analysis	182
9. METHODS AND TECHNIQUES USED IN QUALITY ENGINEERING	188
9.1. FMEA method	189
9.2. QFD method	197
9.3. Ishikawa diagram	202
9.4. Pareto-Lorenz diagram	204

9.5. 5S method	207
9.6. Six Sigma methodology	211
10. INFORMATION AND IT SYSTEM IN QUALITY ENGINEERING	214
11. HUMAN FACTOR IN QUALITY ENGINEERING	218
REFERENCES	221