

Content

1	Introduction	11
1.1	Object of metallographic examination of casting alloys	11
1.2	Sampling in general	14
1.3	Preparation of metallographic samples	16
1.4	Etchant composition	19
1.5	Interpretation	21
1.6	Documentation	23
1.7	Scanning electron microscopy and electronic (beam) microscopy	23
1.7.1	Electron microscopy in materials research	23
1.7.2	Fundamentals of scanning electron microscopy and micro-analysis	24
1.7.2.1	Structure of a scanning electron microscope	24
1.7.3	Vacuum system of a scanning electron microscope	27
1.7.4	Interaction between electrons and material	28
1.7.5	Electron beam microanalysis (EDXS/WDXS)	33
1.7.6	Microstructure analysis using OIM	38
1.7.6.1	Orientation Imaging (OIM) and EBSD (Electron Backscatter Diffraction)	38
1.7.7	Sample preparation	38
1.7.8	Light microscope (LiMi) - Infinite Focus Microscope (IFM)	40
1.7.9	3D reconstruction of surfaces using SEM	41
1.7.10	ZEISS DSM 982 Gemini	42
1.7.11	ZEISS Ultra 55	43
1.7.12	FEI Quanta 200 ESEM and FEI Quanta 600 FEG-ESEM	44
1.7.13	FEI Nova Nanolab 200 Dual Beam FIB/FEGSEM	49
1.7.14	Atomic Force Microscope (AFM)	50
1.7.15	References	51
1.7.16	Literature	52
2	Cast Iron	55
3	Ductile Iron	63
3.1	Standardisation	63
3.2	Production	64
3.2.1	Selection of the charge materials	64
3.2.2	Procedure Steps	65
3.3	Structure characteristics	68
3.3.1	Graphite	70
3.3.2	Metallic Matrix	78
3.3.3	Solidification structure	82
3.4	Inoculation	86
3.4.1	Influence on the graphite formation	88
3.4.2	Influence on the matrix	90
3.5	Unalloyed ductile iron	92
3.5.1	Ferrite	92

3.5.2	Pearlite	93
3.5.3	Carbides	101
3.6	Low-alloyed ductile iron	104
3.6.1	Graphite	108
3.6.2	Ferrite	109
3.6.3	Pearlite	112
3.6.4	Carbides	117
3.6.5	Special Alloyed Ductile Iron	118
4	ADI - Austempered ductile iron or bainitic ductile iron	123
4.1	Standardisation	123
4.2	Production	125
4.3	Structure in general	126
4.4	Austenite	128
4.5	Ferrite, Pearlite, Martensite, Carbides	
5	Austenitic ductile iron	137
5.1	Standardisation	137
5.2	Production	137
5.3	Structure Characteristics	140
5.4	Graphite	141
5.5	Austenite	141
5.6	Carbides	147
5.7	Structural stability	150
6	Structural anomalies	153
6.1	Marginal degeneration of graphite	153
6.2	Graphite flotation	156
6.3	Chunky graphite	157
6.4	Degeneration of graphite	160
6.5	Marginal decarburisation	160
6.6	Dross	164
6.7	Segregations	166
6.8	Phosphide eutectic	171
6.9	Inverse solidification of cast iron resulting in white structure (inverse chill)	174
7	Compacted/vermicular graphite cast iron	177
7.1	Standardisation	177
7.2	Production	179
7.3	Structure in general	181
7.4	Graphite	185
7.5	Basic structure	192
8	Appendix	197
	Number of Nodulus, magnification 100 :1	199
	Elemental Mapping	201
	Example EDXS-Elemental-Mappings	202
9	Index	209