

Cast irons - Part 1: Materials and properties for design

Contents

| | Page |
|--|------|
| Foreword | v |
| Introduction | vi |
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Terms and definitions | 1 |
| 4 Why use cast irons as an engineering material? | 5 |
| 4.1 General | 5 |
| 4.2 Why use grey cast iron? | 5 |
| 4.3 Why use spheroidal graphite cast iron? | 5 |
| 4.4 Why use ausferritic spheroidal graphite cast iron (austempered ductile iron, ADI)? | 6 |
| 4.5 Why use malleable cast iron? | 6 |
| 4.6 Why use compacted (vermicular) graphite cast iron? | 6 |
| 4.7 Why use austenitic cast iron? | 6 |
| 4.8 Why use abrasion-resistant cast iron? | 7 |
| 5 Overview | 7 |
| 5.1 General | 7 |
| 5.2 Recent changes in standardization | 7 |
| 5.3 General microstructure of cast iron | 9 |
| 5.4 Section sensitivity and the effects of relevant wall thickness on material properties | 11 |
| 5.5 Understanding hardness | 11 |
| 5.6 Heat treatment | 12 |
| 5.7 Welding | 13 |
| 6 ISO 185, Grey cast irons | 13 |
| 6.1 Overview | 13 |
| 6.2 Effect of structure on properties | 16 |
| 6.3 Metal composition and carbon equivalent | 16 |
| 6.4 Graphite form, distribution and size | 16 |
| 6.5 Section sensitivity | 19 |
| 6.6 Effect of alloying elements | 19 |
| 6.7 Heat treatment | 20 |
| 6.8 Choosing the grade | 20 |
| 7 ISO 1083, Spheroidal graphite cast irons | 21 |
| 7.1 Overview | 21 |
| 7.2 Effect of structure on properties | 22 |
| 7.3 Metal composition and carbon equivalent | 22 |
| 7.4 Graphite form and size | 22 |
| 7.5 Relevant wall thickness in spheroidal graphite iron | 24 |
| 7.6 Effect of alloying elements | 24 |
| 7.7 Matrix structure and resultant properties | 24 |
| 7.8 Influence from strain rate and temperature on properties for ferritic, ferritic-pearlitic and pearlitic grades | 26 |
| 7.8.1 General | 26 |
| 7.8.2 Influence from pearlite content at constant silicon level | 26 |
| 7.8.3 Influence from silicon content in fully ferritic matrix | 27 |
| 7.9 Special case of impact-resistant grades | 29 |
| 7.10 Heat treatment | 30 |
| 7.11 Choosing the grade | 31 |

| | | |
|---------------------------|---|-----------|
| 8 | ISO 17804, Ausferritic spheroidal graphite cast irons (ADI)..... | 31 |
| 8.1 | Overview..... | 31 |
| 8.2 | Heat treatment process | 34 |
| 8.3 | Effects of alloying elements | 35 |
| 8.4 | Graphite form and size | 35 |
| 8.5 | Matrix structure and the resultant properties | 36 |
| 8.6 | Influence from relevant wall thickness on mechanical properties | 36 |
| 8.7 | V-notch impact energy grade | 36 |
| 8.8 | Abrasion-resistant grades | 36 |
| 8.9 | Machinability | 37 |
| 8.10 | Choosing the grade | 37 |
| 9 | ISO 5922, Malleable cast irons | 38 |
| 9.1 | Overview | 38 |
| 9.2 | Metal composition and carbon equivalent | 40 |
| 9.3 | Heat treatment | 41 |
| 9.3.1 | General | 41 |
| 9.3.2 | Blackheart malleable irons | 41 |
| 9.3.3 | Whiteheart malleable irons | 42 |
| 9.4 | Graphite form and size | 42 |
| 9.5 | Mechanical property requirements and the influence of structure | 42 |
| 9.6 | Impact properties | 43 |
| 9.7 | Section sensitivity | 43 |
| 9.8 | Choosing the grade | 43 |
| 10 | ISO 16112, Compacted (vermicular) graphite cast irons | 44 |
| 10.1 | Overview | 44 |
| 10.2 | Compacted graphite iron — intermediate properties | 45 |
| 10.3 | Effect of structure on properties | 46 |
| 10.4 | Metal composition and carbon equivalent | 46 |
| 10.5 | Graphite form and size | 46 |
| 10.6 | Section sensitivity in compacted graphite iron | 47 |
| 10.7 | Matrix structure and the resultant properties | 47 |
| 10.8 | Heat treatment | 47 |
| 10.9 | Choosing the grade | 48 |
| 11 | ISO 2892, Austenitic cast irons | 48 |
| 11.1 | Overview | 48 |
| 11.2 | Effect of structure on properties | 49 |
| 11.3 | Chemical composition and its effect | 50 |
| 11.4 | Effect of composition on carbon equivalent | 51 |
| 11.5 | Graphite form and size | 51 |
| 11.6 | Heat treatment | 51 |
| 11.7 | Choosing the grade | 52 |
| 12 | ISO 21988, Abrasion-resistant cast irons | 53 |
| 12.1 | Overview | 53 |
| 12.2 | Effects of structure on properties | 55 |
| 12.3 | Chemical composition | 56 |
| 12.4 | Unalloyed and low alloyed cast irons | 56 |
| 12.5 | Nickel-chromium cast iron | 56 |
| 12.6 | High chromium cast iron | 56 |
| 12.7 | Influence of chemical composition on properties and performance | 57 |
| 12.8 | Section sensitivity | 58 |
| 12.9 | Heat treatment | 58 |
| 12.10 | Choosing the grade | 59 |
| Bibliography | 61 | |