Failure Analysis of Heat Treated Steel Components

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This book is dedicated to our families, without whose continued support the completion of this work would not have been possible:

My husband, Antonio Carlos Canale,  
and my children, Amanda, Sara, and Bruno  

*L.C.F.C.*

To my lovely wife, Carla Mesquita, and my dear son, Rafael  

*R.A.M.*

My wife, Alice  

*G.E.T.*
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Material failures can lead to many potentially disastrous consequences, including poor product quality, necessary repair or component or equipment replacement, production downtime losses, environmental impact, and even loss of life. Furthermore, failures may arise from not one but various causes, including design, material composition, and, in the case of metals such as steel, improper thermal processing. Therefore, when failures do occur, it is critically necessary to not only identify these failures but also to determine and correct their root cause. This is a primary objective of this work.

There are many books, journals, and other references that focus on various aspects of failure analysis. However, there are relatively few that focus on steel failures arising during thermal processing, such as forging, casting, heat treatment, welding, and others. A second objective of this book is to provide a reasonably thorough reference detailing potential failures that may occur during thermal processing and the identification of their root cause, even if it is not specifically the thermal process being considered.

An important feature of *Failure Analysis of Heat Treated Steel Components* is that it not only discusses various causes of a failure and its identification but also integrates this discussion with the metallurgy of the process, thus providing one comprehensive resource. This book was developed as a reference source for use by designers, practicing metallurgists, mechanical and materials engineers, quality-control technicians, and heat treaters. This book also will serve as an important textbook for various advanced undergraduate and graduate courses on either failure analysis or thermal processing of steel.

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