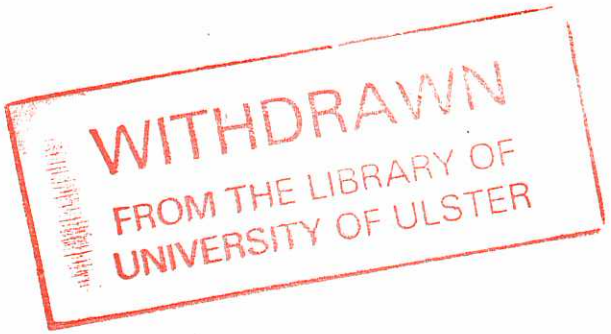
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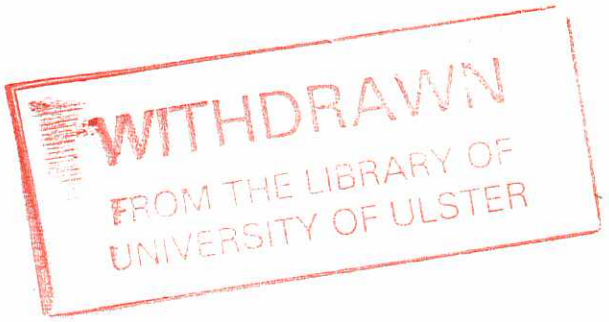
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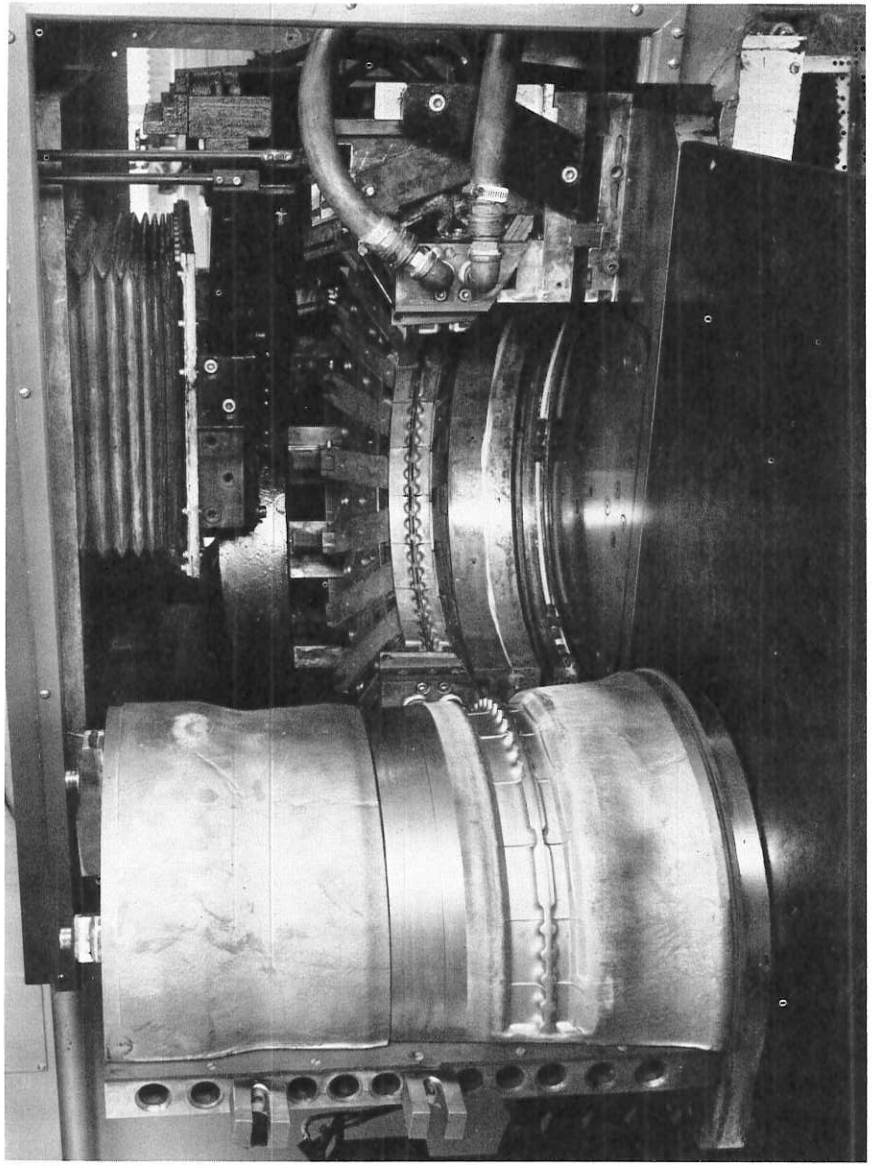
Practice and Theory of Electrochemical Machining

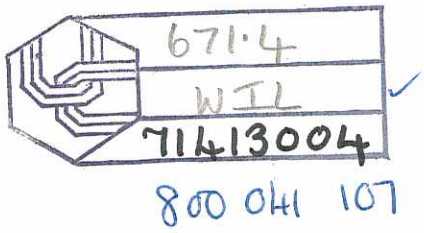


The one in. deep, 180° rib configuration on this titanium compressor casing was machined in 25 min using 10,000 A. In operation, the array of electrodes in the background close on the rib and move radially into the casing. Electrolyte is supplied from between the two opposing banks of electrodes. (Courtesy of the General Electric Company.)

Practice and Theory of Electrochemical Machining

JOHN F. WILSON

WILEY–INTERSCIENCE, a division of John Wiley & Sons, Inc.
New York · London · Sydney · Toronto



Library of Congress Catalog Card Number: 76-165952

ISBN 0-471-94970-1

Printed in the United States of America.

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Foreword

Twelve years have elapsed since electrochemical machining was first introduced as a serious and usable metalworking process. During that time, several hundred ECM installations have been put into service, particularly (but not exclusively) in the jet engine field. A number of excellent technical papers and at least five doctoral theses dealing with the process have been prepared as a result of research.

This is, however, the first book that brings together both practical and analytical considerations and looks at each in light of the other. Accordingly, it ought to serve as a useful bridge of reciprocal communication between the laboratory and the shop or, more broadly, the universities and industry. I stress the reciprocity of the communication because this is a field in which there is not only the usual time lag between what is learned by scientists in the laboratory and its application by the practical men who use the process, but also a lack of understanding by at least some scientific investigators of phenomena that appear in practice and could illuminate and bring insight to further scientific investigation.

This is important because there is room for significant advances by the accretion of new knowledge about the process; Faraday's statement of elementary principles is more useful for saying what cannot be done with the process than it is as a guide to achieving precision, designing tools, or obtaining a fine finish.

John Wilson brings to the book a unique combination of practical experience and a facility for understanding and explaining the analytical material, and it is therefore fortunate that it is he who has written this book about electrochemical machining.

Much in this field has been in the realm of opinion; thus despite the book's technical subject matter, it will provoke controversy for the same kind of reason that there was controversy about the surface of the moon until men landed there. I do not agree with some things written here;

there will be others who will disagree with me or with other parts of the book.

As more is learned, other books will appear, but in writing this one the hard job of breaking new ground has been done. It will be useful to those who work in the field as a practical guide. It will be a stimulant to scientific investigators to press for a better understanding of the phenomena that underlie the many very valuable and useful characteristics of this new process.

Lynn A. Williams
President
Anocut Engineering Company

August 1971

Preface

The components of sophisticated design and the tough, heat-resistant, metal alloys, that are produced in the space and aeroengine industries have provided the need and impetus for the development of new manufacturing techniques. As these new technologies reach maturity, all industries can look to them as means of improving their manufacturing efficiency. Electrochemical machining is one of these techniques; it offers a fundamentally different, effective, and economic alternative to mechanical methods of machining metals. As with any newly presented idea, at first electrochemical machining appears difficult and complex, but with use its simplicity becomes apparent. It has reached maturity, and the complex analysis, wealth of research, and practical experience can now be resolved into simple ideas and concepts. These are the basis for successful application of electrochemical machining.

In writing this book I have tried to present these simple electrochemical machining ideas and concepts in a practical form. The book is not a treatise but rather an instruction, containing the essential theories and technology for using the process effectively to machine components and indicating needed areas of research.

The first chapters will, I hope, help the reader to understand how the process functions and where it may be applied in our manufacturing industries, along with its economics and the equipment required in its operation. In the technology of tooling design and operation, however, I think the diverse capability and potential of electrochemical machining can be fully appreciated. Therefore Chapters 7 to 12, liberally illustrated with sketches and photographs, have been devoted to a step-by-step guidance in applying the process, starting from the initial review of a component drawing to the actual operation of production tooling. In following these detailed but interesting aspects of the process, the reader should experience the same enthusiasm and confidence that I have in

electrochemical machining and its future in our industries. Those who will be working closely with this process should find the counsel offered helpful in avoiding the costly failures, delays, and limitations of inexperience.

I hope the book will help people in industry, such as managers, engineers, technicians and draftsmen, to obtain full benefit from electrochemical machining's special capabilities. It should also help particularly student engineers, to become conversant with yet another facet of modern technology. Electrochemists and researchers will find Chapter 13, a discussion of electrochemistry, of particular interest, since many areas of research, that promise significant advances in process technology are suggested.

It should be noted that the material and conclusions set forth here are not those of any company but are presented by me in my individual capacity.

I thank my wife for her patience, my colleagues for their counsel, and the companies that contributed photographic illustrations to the book.

JOHN F. WILSON

Bristol, England
February 1971

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