# Aircraft Materials and Processes

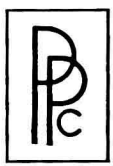
# AIRCRAFT MATERIALS *and* PROCESSES

*by*

GEORGE F. TITTERTON

*Assistant Chief Engineer, Grumman Aircraft Engineering Corporation*
*Formerly Faculty Lecturer, Graduate Division, College of Engineering, New York University*

*Fifth Edition*



PITMAN PUBLISHING CORPORATION
NEW YORK TORONTO LONDON

5.1

*Associated Companies*
SIR ISAAC PITMAN & SONS, LTD.
London Melbourne Johannesburg
SIR ISAAC PITMAN & SONS (CANADA), LTD.
Toronto

PRINTED IN THE UNITED STATES OF AMERICA

PITMAN AERONAUTICAL PUBLICATIONS

*Aeronautical Engineering Series*

*Teichmann:* Airplane Design Manual

*Titterton:* Aircraft Materials and Processes

*Katz:* Principles of Aircraft Propulsion Machinery

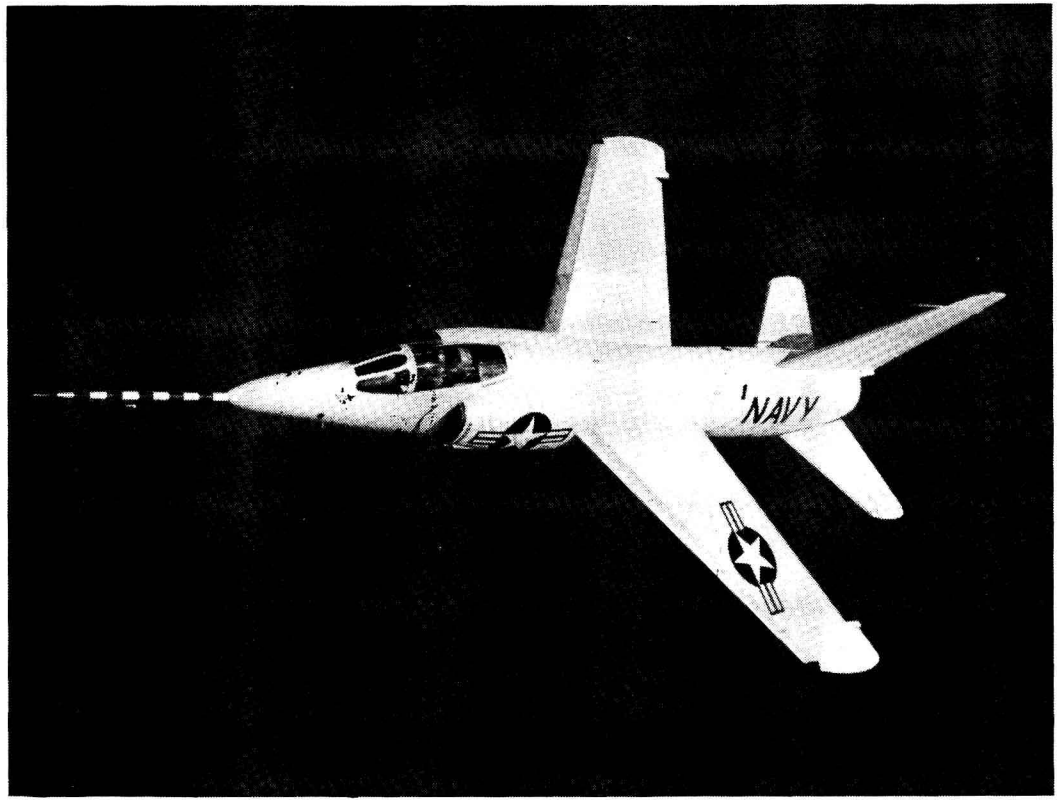
*Pope:* Aerodynamics of Supersonic Flight

*Dommasch, Sherby, and Connolly:* Airplane Aerodynamics

*Steinbacher and Gerard:* Aircraft Structural Mechanics

*Dommasch:* Principles of Aerodynamics

*Dommasch:* Elements of Propeller and Helicopter Aerodynamics




Grumman Tiger—Navy Supersonic Fighter

# PREFACE TO FIFTH EDITION

During the past few years, rapid advancements have been made in aircraft performance, structural materials, and processes. Advances in the quality of new materials such as titanium, high-temperature materials, plastics, and super-strength steels indicate that these new materials should find wide use in the aircraft industries in the near future. Emphasis has been placed on the effects of heat from aerodynamic heating and jet engine heating on aircraft materials in order to help the engineer select the most efficient materials. The author has included all of the latest processes, materials, and specifications.

## *PREFACE TO THE FOURTH EDITION*

The great expansion of the aircraft industry that is currently under way has made it desirable to bring this text right up to date. This will make the latest information on materials and processes readily available to the newcomers as well as the experienced designers, engineers, and mechanics.

## *PREFACE TO THE THIRD EDITION*

During the war years many new materials and processes have been developed. Many of these have been specifically designed for aircraft applications. The author has made an effort to include all the latest materials and processes in the revised text. Many of those described are so new that they have not yet acquired an extensive manufacturing and service background. The basic data on materials that show promise have been included in the revised text to keep this revision up-to-date for as long a time as possible.

## *PREFACE TO THE SECOND EDITION*

The reception this book received during the last four years has indicated its value to students, engineers, designers and shop men. At this time of national emergency, the book has been carefully revised to include the latest materials and processes. It is the author's hope that the revised edition will prove useful in training the new personnel now entering the rapidly expanding aircraft industry.

## *PREFACE TO THE FIRST EDITION*

The author's purpose in writing this book was to present in one coordinated volume the essential information on materials and processes used in the construction of aircraft. Unimportant details have been purposely omitted in the interest of brevity and readability. Within the airacraft field this volume is rather general in scope and should meet the needs of students, engineers, and designers, as well as practical shop men.

This book is based largely upon a series of lectures given by the author at New York University. Similar lectures were also given to a miscellaneous group composed of engineers, shop men, and purchasing department employees of a large aircraft manufacturing corporation. Both in these lectures and the book itself, the author has drawn freely on a fund of information obtained while employed as an engineer in the Naval Inspection Service. As a result, the latest materials and processes used in aircraft construction have been described from a utilitarian point of view. Numerous suggestions have been included on the choice of material for a particular job and on the best way of working, heat treating, and finishing materials for specific applications.

The technical data for a book of this type must, of necessity, be collected from many sources. Government publications have been used to a large extent. These include Army, Navy, and Federal specifications as well as reports of the Forest Products Laboratory. The Handbook of the Society of Automotive Engineers has also been invaluable for reference purposes. The author is also indebted to many persons and companies for their coöperation in supplying data, and for proofreading portions of the text. The following named deserve special mention for their efforts along these lines:

Mr. Frederick C. Pyne of the Aluminum Company of America
Mr. Frank G. Flocke of the International Nickel Company
Mr. Harry A. Goslar of the Naval Inspection Service
The Dow Chemical Company

The author also wishes to thank those who so generously provided illustrations for the text. In so far as possible these contributions have been acknowledged in the title of the illustration.

It is, of course, improbable that a book such as this is wholly free of errors. The author will appreciate having errors brought to his attention to insure their correction in future revisions of this volume.

GEORGE F. TITTERTON.

# CONTENTS

PAGE

PAGE

# ILLUSTRATIONS