GARY S. COYNE

THE LABORATORY HANDBOOK

of Materials, Equipment, & Technique

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OF MATERIALS, EQUIPMENT, AND TECHNIQUE

Garv S. Covne

Prentice Hall
Englewood Cliffs, New Jersey 07632

Library of Congress Cataloging-in-Publication Data

Coyne, Gary S.
The laboratory handbook of materials, equipment & technique / by Gary S. Coyne.
p. cm.
Includes bibliographical references (p.) and index.
ISBN 0-13-126228-9
1. Chemical apparatus--Handbooks, manuals, etc. 2. Chemical laboratories--Handbooks, manuals, etc. I. Title.
QD53.C69 1992
542--dc20 91-27821
CIP

Editorial/production supervision: *Harriet Tellem*
Cover design: *Lundgren Graphics*
Prepress buyer: *Mary E. McCartney*
Manufacturing buyer: *Susan Brunke*
Acquisitions editor: *Betty Sun*
Editorial assistant: *Maureen Diana*

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Published by Prentice-Hall, Inc.
A Simon & Schuster Company
Englewood Cliffs, New Jersey 07632

The publisher offers discounts on this book when ordered in bulk quantities. For more information, write: Special Sales/Professional Marketing, Prentice-Hall, Inc., Professional & Technical Reference Division, Englewood Cliffs, New Jersey 07632.

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Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

ISBN 0-13-126228-9

Prentice-Hall International (UK) Limited, *London*
Prentice-Hall of Australia Pty. Limited, *Sydney*
Prentice-Hall Canada Inc., *Toronto*
Prentice-Hall Hispanoamericana, S.A., *Mexico*
Prentice-Hall of India Private Limited, *New Delhi*
Prentice-Hall of Japan, Inc., *Tokyo*
Simon & Schuster Asia Pte. Ltd., *Singapore*
Editora Prentice-Hall do Brasil, Ltda., *Rio de Janeiro*

I dedicate this book to my wife, Mara.

If you want to find out if your spouse loves you, write a book. I am a lucky person: my wife loves me, and I have this book and our still-successful marriage to prove it. If she didn't love me, I still might have this book, but the marriage would have been gone long ago.

Foreword

A science department that has the good fortune to have, as a member of its staff, an experienced and inventive equipment designer and glassblower is thrice blessed. First, because the students and faculty, instead of having to rely on standard commercial designs for equipment, can themselves be inventive, and have their designs custom-made. Second, because there can be rapid availability of a wide range of apparatus. And third, because the members of the department can draw upon that staff member's experience and ingenuity to avoid costly and possibly hazardous mistakes in the design and application of equipment.

The Department of Chemistry and Biochemistry at California State University, Los Angeles, is fortunate indeed to have Gary Coyne on its staff, and he helps the department in all the ways I have indicated above—and more. If your department is not so fortunate, or even if it is, but wants to learn more about the applications of materials commonly used in constructing scientific equipment, buy this book. It is an unusual exposition of the properties of a wide range of materials, including glass, that make an important contribution to the fabrication of scientific equipment. In it you will find the fundamentals of equipment design, detailed discussions of measurement basics, and the techniques of manipulating materials. Additionally, it has a full presentation of the principles and parts of practical laboratory vacuum systems.

This book tells you not only how things are done, but why they are done. I recommend it to any creative scientist, and I thank Gary Coyne for having had the idea and the perseverance to write it.

Harold Goldwhite
Professor of Chemistry
California State University, Los Angeles

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Preface

I am a scientific glassblower. Although that may not turn many heads, my profession indirectly forms the basis of how and why this book began. As a scientific glassblower at a university, I have two primary functions: the first is to make research apparatus, and the second is to repair broken research apparatus. In addition to my formal glassblowing duties, I am often a middle person in the academic hierarchy, since students often find staff less intimidating than professors. As such, students are likely to come to me with their "dumb questions" on how to use a piece of laboratory equipment.

When students don't bother (or know) to ask "dumb questions" before proceeding with their laboratory work, they inevitably come to me with pieces of apparatus for repair. After repairing the damage caused by the students' ignorance, I talk to the students (and, occasionally, the professors) to see what went wrong (although I usually know from the nature of the damage), and guide them toward safer laboratory procedures. From these experiences, I've gained knowledge of the problems that inexperienced people have in laboratories.

This book actually started when I got into a discussion with a professor who had the mistaken belief that the number designation for an O-ring joint referred to the outside diameter of the connecting tube. I took a caliper and showed him that the number actually referred to the inside, not outside, diameter of the hole at the O-ring fixture. This incident inspired me to write a simple monograph on the identification of standard taper joints, ball-and-socket joints, and O-ring joints.

I wrote several more monographs, on various subjects, until another faculty member suggested I assemble them for publication in a journal. After some consideration, I wrongly assumed I had enough information for a book. At the time, I really didn't know enough to fill a book, but because I was ignorant of that fact, I proceeded, expecting to finish the book in short order. Some five years later (after much research and learning) I have a book, a bit more wisdom, and hopefully more knowledge.

The purpose of this book is to provide some basics on the materials, equipment, and techniques required in a laboratory. In addition to the information on how various procedures are done, I've also added historical and other background information to better explain how and why these procedures, equipment, and theory evolved. Some readers may not find all the answers they need, whereas other readers may wonder why *obvious* information is included. Unfortunately, no manual of this type can be all-inclusive, and what may be obvious for one may be new for another. I apologize for omissions of information which you hoped to find, and I encourage those of you who found little new to please share your knowledge.

I am indebted to many of the Chemistry department faculty at California State University, Los Angeles, not only for their willingness to answer many of my "dumb questions," but for their support throughout this whole process. I would be in error if I did not single out one special faculty member, Dr. Cathy Cobb, who proofread and served as a sounding board on various

aspects of this book, with whom I co-wrote a paper, and who has been a special friend. I am also indebted to many strangers, all experts in their fields, who answered their phones and my "dumb questions."

Please note:

Proper operation of all equipment should be taught to all potential users. Such knowledge should *never* be assumed. The most dangerous person in a laboratory, to both equipment and other personnel, is the person who through pride, ego, or ignorance, claims knowledge that he or she does not have. It is up to the professor, group leader, or research director to monitor the quality of technical support and provide additional training as required.

A simple laboratory procedure to provide information to those who need it can be provided by photocopying all equipment manuals, no matter how seemingly trivial. These photocopies should be placed in binders and stored in a specific location in the lab where equipment is used. The originals should be placed in the research director's office and not removed unless new copies are made as needed.

I would be honored if a copy of this book were placed next to those binders, available to all.

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