HANDBOOK OF PRECISION ENGINEERING

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- Volume 1 Fundamentals**
- Volume 2 Materials**
- Volume 3 Fabrication of Non-metals**
- Volume 4 Physical and Chemical Fabrication Techniques**
- Volume 5 Joining Techniques**
- Volume 6 Mechanical Design Applications**
- Volume 7 Electrical Design Applications**
- Volume 8 Surface Treatment**
- Volume 9 Machining Processes**
- Volume 10 Forming Processes**
- Volume 11 Production Engineering**
- Volume 12 Precision Measurement**

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HANDBOOK OF PRECISION ENGINEERING

Edited by A. Davidson

Volume 11 Production Engineering

Macmillan Education

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Foreword

During the last twenty or thirty years, precision engineering, although not strictly a separate branch of engineering, like shipbuilding and the aircraft industry, has emerged as a specialized technology, involving methods and ideas foreign to conventional mechanical engineering.

Precision-engineered parts (or fine mechanisms, as they are often termed) are very often of limited size, and vary in quantity from one-off to very long runs. But they don't have to be small, of course. For example, the driving mechanism of an observatory telescope, which is fairly large, has to be designed and constructed with extreme precision, whilst an ordinary watch, which is quite small by comparison, is relatively crude as far as tolerances are concerned.

Examples of fine mechanisms are to be found in telecommunications equipment; optical apparatus such as microscopes and comparators, as well as cameras and projectors; office machines like typewriters, accounting and calculating machines; various toys of a technical nature, mentioned because of their often ingenious design and the consummate tool-making that goes into them; electric shavers; and various electronic equipment used in the home.

There is a need, in industry and in training schools, for a handbook such as this, covering, in a convenient form, the different subjects that are related to the design of fine mechanisms. Much of the material dealt with is not new in itself, of course, but, because it is presented specifically in the context of precision engineering, it should be invaluable to designers, manufacturers and users of precision-engineered parts.

The authors, each of whom is a specialist in his own field, do not claim to have covered the individual subjects fully in the chapters assigned to them. They have presented the main features as clearly as possible, and provided international references from which the reader can obtain more details as required.

The handbook is divided into eleven parts, of which Volume 1 deals with the general principles to be observed when designing a product, and Volume 2 with the materials available. Theoretical and practical data useful to designers and draughtsmen is given.

Volumes 3–5 and 8–10 discuss production techniques, and production staff will find them to contain comprehensive information on production methods and plant. Volumes 6, 7, 11 and 12 deal with the practical design of precision-engineered products, and the equipment and components required for this purpose. Designers, manufacturers and users can all profit from them.

The editor would like to take this opportunity of thanking the authors and all who have helped to produce the handbook.

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Introduction

A. Davidson

The production of precision equipment, in single items as well as in mass production, has many facets. This volume extensively reviews not only the technical aspects but also points of organisation.

The book is intended for those directly engaged in production as well as for designers in order that they may become acquainted with the possibilities and the difficulties encountered in manufacture and can use this knowledge during the development stage of the products. This is of importance since for a smooth running production it is essential that the right conditions are incorporated in the design.

The first chapter deals with the organisation and planning of workshops where the term 'workshop' is taken in the broadest sense. Planning, production management, stock control and product documentation are becoming of increasing interest and must be considered as important subjects, particularly in view of the growing competition in delivery time.

In the manufacture of precision engineering products more and more people are directly or indirectly concerned with assembly techniques. It is surprising therefore that in the literature, apart from the odd paper or description of a special technique, one can find little that concerns itself with the essentials of the assembly techniques. In the chapter dealing with this subject the important issues are brought to the fore whilst also the subject 'service' is treated extensively since it plays a part in deciding the necessary assembly technique. Various examples illustrate the matter discussed. Assembly technique is followed by mechanisation. It is obviously impossible to deal with all technical possibilities since these would themselves easily fill several volumes. The author has restricted himself to mentioning the fundamental backgrounds including the indication of advantages and drawbacks of designing or buying-in of machine parts or complete production machines. In addition the importance is stressed of designing the product with possible future mechanisation in mind.

Electronics plays an ever increasing part in production equipment, thus giving rise to the establishment of close contacts between the mechanical and electronics engineer. In the chapter on this subject the possibilities and limitations of electronics are highlighted whilst it also deals with the fundamentals. The examples are selected to illustrate the characteristic properties of electronic aids without claim to being complete.

In modern literature the science dealing with all matters connected with friction is called 'tribology'. The chapter on this subject covers only a small part of the field. Apart from a brief theoretical treatment of the concepts friction, wear and lubrication, only those aspects of the bearing and lubri-

cation technique that are of interest for production are discussed. The ever growing demand for quality and long life necessitates increased attention to bearings and lubrication. This chapter also deals with after-care and preventive maintenance, two subjects that are often neglected.

Of particular importance in the manufacture is the quality aspect. This determines the external image and the continued existence of the company concerned. In order to guarantee good quality it is essential to know all conditions of use in actual practice so that they can be imitated as accurately as possible during the quality investigations. The drawing up of a correct specification and the quality requirements that go with it is of the utmost importance. This is indicated in the chapter dealing with this matter where also suggestions for classification in order of importance are made. The requirements arising from this are of great significance for the design. Equipment used in quality control investigations is also discussed.

Finally attention is given to all aspects connected with packaging and transport. The products and articles to be dispatched are becoming more complex and fragile every day, necessitating higher demands on packing materials and packing methods. This chapter also deals with the quality side of packaging.

The units and symbols used are those of the International System of Units (S.I.) as explained in Volume 1, Chapter 1.