COMPRESSOR HANDBOOK

Paul C. Hanlon Editor

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PREFACE

Compressors fall into that category of machinery that is "all around us" but of which we are little aware. We find them in our homes and workplaces, and in almost any form of transportation we might use. Compressors serve in refrigeration, engines, chemical processes, gas transmission, manufacturing, and in just about every place where there is a need to move or compress gas.

The many engineering disciplines (e.g. fluid dynamics, thermodynamics, tribology, and stress analysis) involved in designing and manufacturing compressors make it impossible to do much more than just "hit the high spots," at least in this first edition.

This is such a truly broad field, encompassing so many types and sizes of units, that it is difficult to cover it all in one small volume, representing the work of relatively few authors. Possibly, more than anything else, it will open the door to what must follow—a larger second edition.

In compressors, the areas of greatest concern are those parts with a finite life, such as bearings, seals and valves, or parts that are highly stressed. Treatment of these components takes up a large portion of the handbook, but at the same time space has been given to theory, applications and to some of the different types of compressors.

Much in this handbook is based on empirical principals, so this should serve as a practical guide for designers and manufacturers. There are also test and analysis procedures that all readers will find helpful. There should be something here for anyone who has an interest in compressors.

Paul C. Hanlon

ABOUT THE EDITOR

Paul C. Hanlon is manager of product design with C. Lee Cook in Louisville, Kentucky. A mechanical engineering graduate of the University of Cincinnati, he has worked for over 40 years in the design, application, and troubleshooting of seals for engines, compressors, and other major equipment used throughout the chemical, oil, and gas-processing industries. Mr. Hanlon is also the author of numerous articles for leading technical journals.

Contents

CHAPTER 1
COMPRESSOR THEORY

Derek Woollatt
Manager, Valve and Regulator Engineering
Dresser-Rand Company

1.1 NOMENCLATURE

		Units (*See note below*)
a	Speed of Sound in Gas	ft/sec
a, b	Constants in Equation of State (Pressure Form)	
A, B	Constants in Equation of State (Compressibility Form)	
B	Bore	Inch
CL	Fixed Clearance as a Fraction of Swept Volume	
c_P	Specific Heat at Constant Pressure	$ft.lb_f/lb_m.R$
c_V	Specific Heat at Constant Volume	$ft.lb_f/lb_m.R$
e	Specific Internal Energy (i.e. Internal Energy per unit mass)	$ft.lb_f/lb_m$
E	Internal Energy	$ft.lb_f$
F	Flow Area	$Inch^2$
h	Specific Enthalpy (i.e. Enthalpy per unit mass)	$ft.lb_f/lb_m$
H	Enthalpy	$ft.lb_f$
HP	Horsepower	
J	Joule's Equivalent	$ft.lb_f/BTU$
k	Ratio of Specific Heats ($= c_P/c_V$)	
m	Mass Flow Rate	lb_m/sec
M	Mass	lb_m
n_T	Isentropic Temperature Exponent	
n_V	Isentropic Volume Exponent	
N	Compressor Speed	rpm
P	Pressure	lb_f/in^2 Abs
PW	Power	$ft.lb_f/min$