Table 9-0 Variables Used in This Chapter

Symbol	Variable	ips units	SI units	See
A	area	in^2	m^2	Case 7A
a	acceleration	in/sec^2	m/sec^2	Case 8A
c	damping constant	lb-sec/in	N-sec/m	Case 8A, 9A
C_f	coefficient of fluctuation	none	none	Case 9A
d	diameter	in	m	Case 7A
E	energy	in-lb	joules	Case 9A
F	force or load	lb	N	all
g	gravitational acceleration	in/sec^2	m/sec^2	Case 8A
k	gas-law exponent	none	none	Case 7A
k	spring rate or spring constant	lb/in	N/m	Case 8A, 9A
l	length	in	m	Case 7A
m	mass	$lb\text{-}sec^2/in$	kg	all
P	power	hp	watts	Case 8A
p	pressure	psi	Pa	Case 7A
r	radius	in	m	Case 7A
T	torque	lb-in	N-m	all
v	volume	in^3	m^3	Case 7A
v	linear velocity	in/sec	m/sec	Case 8A
W	weight	lb	N	Case 8A
y	displacement	in	m	all
ω	rotational or angular velocity	rad/sec	rad/sec	all
ω_n	natural frequency	rad/sec	rad/sec	Case 9A
ζ	damping ratio	none	none	Case 9A

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you have to redesign each part several times. A CAD solid modeling program will also be a valuable design tool. Lacking a computer-based model, you will be faced with redoing your calculations from scratch for each iteration, which is not a pleasant prospect. We will make extensive use of computer-aided design tools in these case studies.

9.1 CASE STUDY 8—A PORTABLE AIR COMPRESSOR*

A building contractor needs a small, gasoline-engine powered air compressor to use for driving air hammers on remote job sites. A preliminary design concept is shown in Figure 9-1. A single-cylinder, two-stroke engine with flywheel is coupled through a clutch (that can be disengaged to start the engine) to a gearset to reduce the engine speed and boost its torque appropriately. The ratio for this gearset is to be determined. The 2.5-hp gasoline engine is governed at 3800 rpm. The gearset's output shaft drives the crankshaft of a single-cylinder Schramm (poppet valve) piston compressor through a keyed coupling. Some preliminary thermodynamic calculations (see files CASE8-A) have indi-

* The student may not have yet been exposed to all aspects of these broad-scale problems in his or her studies to date, but should nevertheless not be dismayed if some details of these case studies seem obscure. One will undoubtedly encounter more detailed explanation of these topics in other courses, in later experience, or in self-study. One of the more interesting aspects of design engineering is its breadth. One must continually learn new things in order to be able to solve real engineering problems. An engineering education only begins in college and is far from complete at graduation. One should welcome the challenge of exploring new topics throughout one's career.