CHAPTER 1 SOLUTIONS TO END-OF-CHAPTER EXERCISES

1.1. Some standards are frequently cited because these standards cover (1) areas in which industries are having difficulty complying, or (2) areas in which enforcement agencies are giving a great deal of attention, or both.

1.2. Many aspects about the standards might be useful. The text emphasizes the importance of the "why" behind the standards that do exist.

1.3. No. It is an unattainable goal. Such a strategy fails to recognize the need for discrimination among hazards to be corrected.

1.4. (1) Hazards that are physically infeasible to correct.
(2) Hazards that are physically feasible, but are economically infeasible, to correct.
(3) Hazards that are physically feasible and economically feasible to correct.

1.5. (1) Causes other more serious hazards to be overlooked while reacting to less serious ones.
(2) Deteriorates credibility with top management.

1.6. A safety hazard is acute, causes or threatens to cause injuries, and is usually more obvious than a health hazard.
A health hazard is chronic, causes or threatens to cause illness in the long run, and is usually more subtle than a safety hazard.

1.7. Some example safety hazards:
unguarded belts, pulleys, gears, saws, and punch presses; fires; explosions; open platforms; defective ladders; welding near open flammable or combustible materials; overloaded or defective cranes, hoists, or slings; ungrounded electrical equipment; exposed live electrical conductors.
Some example health hazards:
coal dust, cotton dust, chronic loud noise, welding fumes, asbestos, vinyl chloride, lead fumes, mercury, manganese, cadmium.

1.8. Some valid examples are spray paint, coal dust, benzene, and carbon disulfide.

1.9. Some valid examples are noise, welding, and radiation.

1.10. Health hazards are usually more subtle than safety hazards; the industrial hygienist must look for "unseen" hazards.

1.11. Safety hazards may appear more grave, but there are probably many

health hazard-related illnesses and deaths which are not documented.

1.12. Work training, statistics, job placement, industrial relations.

1.13. A comprehensive safety and health program involves engineering, and placement of the function within the personnel department may restrict authority too much.

1.14. This places the Safety and Health Manager in an adversarial position with enforcement officials.

1.15. CPSC concentrates on the responsibility of the manufacturers of the machines and equipment, whereas OSHA concentrates on the responsibility of the employer who places the equipment into use in the workplace.

1.16. (NSC) National Safety Council

1.17. ANSI (American National Standards Institute)
Prepares voluntary standards for occupational safety and health among other types of standards. OSHA adopted many ANSI standards early on, invoking its temporary right to promulgate "national consensus standards."

1.18. OSHA is concerned with hazardous exposures to <u>workers</u>, i.e. worker safety and health.
EPA is concerned with hazardous exposures to the public, particularly as these hazards affect the earth, water, and atmosphere.
Many safety and health hazards inside the plant and outside are the same, or are caused by the same chemical agents or physical factors. Thus a firm's compliance with both EPA and OSHA regulations are often the responsibility of the same individual.

1.19. 1-800-35-NIOSH; the agency that responds is, obviously, NIOSH, the National Institute for Occupational Safety and Health.

1.20. Passage of The Occupational Safety and Health Act of 1970, which created the Occupational Safety and Health Administration (OSHA).

1.21. Prior to passage of the OSHA law occupational health seemed remote and not of a great deal of concern. Plant nurses were concerned with first aid and physical examinations. After OSHA, occupational disease prevention rose in importance.

1.22 The Bhopal, India disaster in which the release of methyl isocyanate gas killed 2500 civilians. This incident showed that dangerous working conditions do not just impact the workers, but everyone around a facility.

1.23 Reductions in energy consumption, for example, can lower a firm's bottom line energy cost while decreasing its impact on the environment.

1.24 The four environmental issues addresses were global warming, green engineering, petroleum conservation, and tobacco smoke.

1.25 Green engineering is focused on the reduction of carbon fuels, which in turn directly impact global warming.

1.26 Systems Safety is considered essential in airlines, aerospace, and hospitals. These are industries in which the failure of a system can be catastrophic.

1.27 Systems Safety recognizes the benefit of such life-cycle planning and design, and the System Safety Society is one of the

CHAPTER 2 SOLUTIONS TO END-OF-CHAPTER EXERCISES

2.1. The achievement of worker safety lies principally in the hands of the workers themselves and their direct supervisors; thus it is principally a line function. Safety and health managers, however, are staff positions.

2.2. Acting as a facilitator in assisting, motivating, and advising the line function in achieving worker safety and health.

2.3. They too often are such emotional crusaders for the cause that they lose their credibility and with it their eligibility to be considered a "manager."

2.4. That safety must be achieved by line personnel facilitated by the staff function.

2.5. Go to top management to re-determine its level of commitment to safety and health.

2.6. The workers compensation system is a state, not federal system. The system is nearly 100 years old; the first workers compensation laws were introduced into state legislatures in 1909.

2.7. The ostensible purpose is to protect the worker by providing statutory compensation levels to be paid by the employer for various injuries that may be incurred by the worker.
An ulterior feature is immunity from additional liability for the employer, except where "gross negligence" can be proven.

2.8. Management contends that some risk is inescapable in any line of work. Therefore, their answer to the question is no. The worker bears some of the risk in return for his/her pay for the job.

2.9. The employer or the employer's insurance carrier.

2.10. An industrial safety consultant employed by an insurance company. The consultant's objective is to keep claims low among clients of his insurance company.

2.11. A standardized recordkeeping system for industrial safety established by the National Safety Council and later superseded by OSHA's system of recordkeeping.

2.12. Differences in recordkeeping requirements for OSHA and its predecessor Z16.1 system. Also other variations in conditions, such as employment levels and recession cycles.

2.13. The "lost workdays" method would not reveal some very serious accidents, especially fatalities, that do not cause a loss of a workday.

2.14. One that is work related and requires medical treatment.

2.15. $\frac{25 \times 200{,}000}{300 \times 40 \times 50} = \frac{25}{3} = 8.33$

2.16. The injury/illness incidence rate computation prescribed by OSHA relates to 200,000 work-hours (roughly one year for a 100-employee firm), whereas the traditional frequency rate relates to 1,000,000 work-hours (roughly one year for a 500 employee firm). Also the OSHA injury/illness incidence rate applies to all work-related injuries/illnesses which require medical treatment, whereas the traditional frequency rate related only to "lost-time" cases.

2.17. Frequency measures the numbers of cases per standard quantity of work-hours.
Severity measures the total impact of cases in terms of total "lost workdays" per standard quantity of workhours.
Seriousness is the ratio of severity to frequency and measures the average seriousness of all cases.
All three are obsolete terms now.

2.18. OSHA Form 300a, the annual "Summary of Work-Related Injuries and Illnesses" must be posted on February 1 each year and remain posted until April 30.

2.19. For general records: 5 years (Chapter 5 will reveal longer retention requirements for certain records.)

2.20. Yes; they can help to discover hazards, but they can also dilute responsibility for workplace safety and health and can degenerate into spy parties. Without adequate orientation, safety and health committees can often become unreasonable.

2.21. Direct costs are the "tip of the iceberg" compared to indirect costs.

2.22.
(1) Costs of wages paid for time lost by workers who were not injured.
(2) Cost of damage to material or equipment.
(3) Cost of wages paid for time lost by the injured worker.
(4) Extra cost of overtime work necessitated by the accident.
(5) Cost of wages paid supervisors for time required for activities necessitated by the accident.
(6) Wage cost caused by decreased output of injured worker after return to work.
(7) Cost of learning period of new worker.
(8) Uninsured medical cost borne by the company.
(9) Cost of time spent by higher supervision and clerical workers.
(10) Miscellaneous costs such as public liability claims, rental equipment, and lost sales.

2.23. Noninjury accidents are usually caused by the same types of conditions and practices that result in injury accidents.

2.24. First-line supervisors

2.25. A six-month work period = 1000 hours.

(a) General injury/illness rate = $\frac{18 \times 200{,}000}{50 \times 1000} = 72$

(b) Traditional frequency rate = $\frac{4 \times 1{,}000{,}000}{50 \times 1000} = 80$

(c) Comparing with general statistics for the Year 2000 in Figure 2.2, this appears to be a very dangerous industry. For the Year 2000, the total incidence rate (lost workday cases + cases without lost workdays) was 6.1, compared to this firm's general rate of 72. This firm is approximately six times as dangerous as the "average firm" in the private sector. Even compared to the most dangerous industries in Figure 2.2 ("transportation by air" and "transportation equipment") this firm is more than four times as dangerous. The "traditional frequency rate" of 80 is not comparable to Table 2.2 because it is based on a

factor of 1,000,000, not 200,000. Had the "lost workday cases" rate been calculated using the 200,000 factor, the result would have been 16. This would compare with a general "private sector" rate of 3.0 for the Year 2000. So, by the "lost workday cases" criterion also, this is a very dangerous firm.

2.26.

$$\text{Total injury incidence rate} = \frac{(2 + 1) \times 200{,}000}{25 \times 2000}$$

$$= 300/25 = \underline{12}$$

$$\text{LWDI} = \frac{1 \times 200{,}000}{25 \times 2000} = \underline{4}$$

2.27. (a) Total incidence rate

$$= \frac{(3+1+1+1+1) \times 200{,}000}{62 \times 2000}$$

$$= \underline{11.29}$$

(b) (According to current OSHA recordkeeping policy, count calendar days, not just workweek days, i.e. 7 days/wk, not 5 days/wk)

Number-of-lost-workdays rate

$$= \frac{(7+7+42) \times 200{,}000}{62 \times 2000}$$

$$= \underline{90.3}$$

(c)

$$\text{LWDI} = \frac{1 \times 200{,}000}{62 \times 2000} = \underline{1.6}$$

(excludes illnesses and all fatalities)

2.28. The 12 first-aid cases are non-recordable. The two illnesses do not enter into the calculation of the LWDI, but the lost-time injuries would. Therefore, the LWDI would be calculated as:

$$\text{LWDI} = \frac{3 \times 200{,}000}{135 \times (4/12) \times 2000} = 6.67 \text{ for the 4-month period}$$

Since 6.67 > 3.6, this would indicate that improvement is needed to meet the objective. However, if no more lost time injuries occurred for the year (an unlikely outcome):

$$LWDI = \frac{3 \times 200{,}000}{135 \times 2000} = \frac{300}{135} = 2.22$$

and the objective LWDI of 3.6 would easily be met.

2.29. The classification of the 12 accident files in this case study is subject to some variation due to individual judgment. This analysis will assume the following classification:

		Columns on the OSHA 300 Log										
File		**G**	**H**	**I**	**J**	**K**	**L**	**M1**	**M2**	**M3**	**M4**	**M5**
1	not recordable											
2			X				14					X
3	not recordable											
4			X			28	7		X			
5					X			X				
6					X			X				
7	not recordable											
8					X				X			
9			X				14				X	
10	not recordable											
11		X						X				
12			X			42	3	X				
	Column Totals:	1	4	0	3	70	38	4	2	0	1	1

(a) $LWDI = \frac{1 \times 200{,}000}{900 \times 2000} = \frac{1}{9} = .11$

(The LWDI excludes fatalities, excludes illnesses, and includes all "lost-time" injuries, including those injuries in which the worker has "restricted work activity days," i.e. is temporarily transferred to another job, even if there are no days away from work.)

Total Injury rate (excluding fatalities) $= \frac{(4 - 1) \times 200{,}000}{900 \times 2000} = \frac{3}{9} = .33$

Total Illness rate $= \frac{(2+0+1+1) \times 200{,}000}{900 \times 2000} = \frac{4}{9} = .44$

Fatality rate $= \frac{1 \times 200{,}000}{900 \times 2000} = \frac{1}{9} = .11$

Number-of-lost-workdays rate $= \frac{(70 + 38) \times 200{,}000}{900 \times 2000}$

$= 108/9 = 12$

Specific hazard incidence rate (fractures) $= \frac{(1 + 1) \times 200{,}000}{900 \times 2000}$

$= 2/9 = .22$

(b) Comparing National Safety Council Statistics for 2000 (see Figure 2.2 of the text):

Total incidence (including fatalities)
.89 << 6.1 therefore, much safer than the all industry average

2.30. To complete the table, add up the columns to get the following totals:

File	G	H	I	J	K	L	M1	M2	M3	M4	M5
Column totals:	1	2	3	3	67	16	4	2	2	0	1

(a) Injury incidence (excludes the fatality) $= \frac{(4 - 1) \times 200{,}000}{50 \times 2000} = 6$

(b) Illness incidence $= \frac{5 \times 200{,}000}{50 \times 2000} = 10$

(c) Number-of-lost-workdays rate $= \frac{(67 + 16) \times 200{,}000}{50 \times 2000}$

(counts restricted work activity days)

$= \frac{83 \times 200{,}000}{100{,}000} = 166$

(d) LWDI $= \frac{1 \times 200{,}000}{50 \times 2000} = 2$ (Don't count injuries in which there were

no lost workdays; also exclude fatalities)

2.31.

1998 premium	$120,000
1998 modifier	1.05
unadjusted premium:	$120,000/1.05 = $114,286
2001 modifier	.80
2001 premium:	$114,286 x .80 = $91,429
Actual savings:	$120,000 - $91,429 = $28,571
% savings	= ($28,571/120,000) x 100% = 23.8%

2.32.

a. Lost Workday Cases:
OSHA 300 cols H + I
b. Cases Involving Days Away From Work & Deaths:
OSHA 300 cols G + H
c. Nonfatal Cases Without Lost Workdays:
OSHA 300 col J
d. Total Cases:
OSHA 300 cols G + H + I + J
(or the total of all of the M columns)
e. Lost Workdays
OSHA 300 cols K + L
f. Days Away From Work
OSHA 300 col L

2.33. To complete the table, add up the columns to get the following totals:

File	G	H	I	J	K	L	M1	M2	M3	M4	M5
Column totals:	1	2	3	3	67	16	4	2	2	0	1

The following calculations are compared to National Safety Council (NSC) estimates reported in Injury Facts, 2002 edition:

Cases Involving Days Away From Work & Deaths (cols G + H) $= \frac{(1+2) \times 200{,}000}{165 \times 2000} = 1.82$ versus 1.8 (NSC)

Total recordable cases (cols G + H + I + J) $= \frac{(1+2+3+3) \times 200{,}000}{165 \times 2000} = 5.45$ vs 6.1 (NSC)

Days Away From Work (cols L) $= \frac{16 \times 200{,}000}{165 \times 2000} = 9.70$

(Injury Facts, 2002 edition, reports 85,000,000 days away from work for injuries incurred in the previous year (2001). The total worker force was estimated at approximately 136,500,000. Applying the formula to the national data:

$$\text{Days Away From Work} = \frac{85{,}000{,}000 \times 200{,}000}{136{,}500{,}000 \times 2000} = 62.27$$

This figure is considerably higher than the 9.70 figure calculated for the data in this problem.

2.34. For a military "rated" officer the fatality dollar valuation used by the U.S. Air Force is $1,100,000 and for a civilian fatality the corresponding number is $460,000. The difference is believed to be due to the government investment in expensive flight training for the rated officer.

2.35. The text shows the current National Safety Council cost estimates as follows:

fatality: $790,000
work injury: $28,000

Each year the NSC publishes updates for these estimates in Injury Facts. Students might want to check the library for the latest update. The 2002 edition shows the following estimates:

fatality: $1,020,000
work injury: $29,000

2.36. $120

2.37. Action on Smoking and Health lobbies for OSHA to promulgate a standard on Indoor Air Quality. OSHA has proposed a standard, but as of early 2003 it had not been promulgated as a Final Standard.

2.38. Workplace violence

2.39. The company did preemployment drug screening tests for all applicants in a three month hiring period (750 applicants). Surprisingly, half of the 750 applicants failed the test. The test was a urinalysis designed to indicate whether drugs had been used in the preceding two or three days and was conducted by a hospital laboratory service. The test results indicated that the use of marijuana was the most prevalent. ALCOA hired 130 applicants who passed the test and reported that as a group those hired were better workers than those hired prior to the drug screening program.

2.40. The firm may face discrimination charges unless it is fair and even-

handed in its policies for hiring and employee termination in cases of alcohol or drug abuse. The same rules that are applied to new employees should be applied to existing employees.

2.41. No; workplace homicide is often associated with despair over downsizing or a termination notice for some other reason. There is evidence that homicide in the workplace is committed in a methodical and selective way.

2.42. Although preemployment testing has been shown to be effective in recruiting dependable and safer employees, the program can run afoul of Title VII of the Civil Rights Act of 1964 if the testing program is discriminatory against females or racial minorities. The EEOC has published guidelines for such programs. Of particular interest is the comparative failure rates of the tests when the scores of white males is compared to those of females or racial minorities. Another consideration is the Americans with Disabilities Act that protects disabled workers in much the same way as the Civil Rights Act protects females and racial minorities.

2.43.

a. control of sharps
b. effective system of housekeeping
c. effective laundry
d. effective disposal of waste
e. washing, cleaning, and disinfecting exposed surfaces
f. provision for storage and consumption of food in areas protected from exposure
g. prohibition of application of cosmetics, lip balm, or contact lenses in exposed areas of the plant
h. provision of personal protective equipment.

2.44. the eyes

2.45 The table is considered independent of inflation, as the unit of measure is “weeks” of compensation, not dollars.

2.46 To show an interest in the well-being of the employee and uncover fraudulent claims.

2.47 The number-of-lost-workdays rate counts all lost workdays (by definition one or more days for each case, whereas the LWDI is a count of incidents with one or more lost workdays. Since each lost-workday incident must have one or more days, it will always be as high or higher than the LWDI.