

Fire Sprinklers Save Lives and Money...

The Economics of Retrofit

by Kenneth E. Isman, P.E.

Director of Engineering Standards

National Fire Sprinkler Association, Inc.

Fire sprinkler systems have been required for years by local codes and ordinances because they provide relatively simple, extremely reliable, affordable fire protection. But because they have been mandated by law, many building owners, architects and specifying engineers see them as an "extra" in construction. They sometimes go to great lengths to avoid sprinkler protection.

In reality, sprinklers not only provide excellent fire protection, they also represent an excellent investment opportunity for building owners. This paper will look at sprinklers from a purely monetary perspective.

The examples in this paper are intended to be existing buildings which are retrofitted with fire sprinklers. The same type of analysis also applies to new construction. This paper will not attempt to deal with new construction options. Those are addressed in the NFSA publication, *The Fire Sprinkler Guide*.

There are at least six ways in which fire sprinklers help put money back in the pocket of a building owner: Insurance Savings, Income Tax Deductions, Life Safety Code Compliance, Federal Legislation, Liability Avoidance, and No Business Interruption.

Insurance...

It is critical that we understand that the rates developed by ISO are used as the benchmark for that "specific" building by all member insurance companies. The rates established are considered manual rates. The next step in the process is most interesting when analyzing the COST elements involved with automatic sprinkler systems, from a building owner's outlook particularly. To illustrate this, we will study five different types of commercial buildings. The examples are listed below with the parameters used to develop SAMPLE rates for the building and contents.

1. **Condominium** - Five stories, 100,000 square feet, 10 years old, personal dwellings, joisted masonry construction
2. **Hotel** - Twenty stories, 257,000 square feet, 10 years old, dwelling, masonry construction - noncombustible
3. **Office Building** - Ten stories, 109,251 square feet, 10 years old, office utilization, masonry construction
4. **Food Processing Center** - One story, 20,000 square feet, food processing, noncombustible construction
5. **Warehouse** - One story, 40,000 square feet, storage facility, noncombustible storage

Note - The examples illustrated are "average" buildings with normal occupancy and contents. There is not any high hazard material listed other than those normally associated with the inherent usage described.

Assume now that we have requested the ISO Commercial Risk Services to establish base fire rates and contents rates for each building. Two requests were made for each property;

1. **Without** an automatic fire sprinkler system and,
2. **With** an automatic fire sprinkler system.

It must be noted that these illustrations are "estimated rates" (loss cost), promulgated on "average" fictional properties with usual contents and occupancy. A recap of the range of rates for each example is shown in Table 2-1. For illustration purposes, the low side of the "range" is used.

**Table 2-1
ISO Sample Rates**

Sample Building	Building Rates*			Contents Rates		
	Nonsprinklered	Sprinklered	% Reduction	Nonsprinklered	Sprinklered	% Reduction
Condominium	.273	.103	63	.461	.200	57
Hotel	.257	.088	66	.512	.303	41
Office Building	.110	.059	47	.161	.092	43
Food Processing Plant	.553	.062	89	.949	.146	85
Warehouse	.369	.048	87	.599	.106	83

* Building Rates for new and existing properties are identical.

The rate reduction for sprinklered buildings and contents are significant. All rates promulgated by ISO Commercial Risk Services, Inc. are multiples to values of \$100. For example, if the condominium was valued at \$4 million, we would multiply this value by the base rates (see Table 2-2).

**Table 2-2
Building Premium Development**

\$4,000,000 Building Value	X	.273/\$100 Value Nonsprinklered Base Rate	=	\$10,920
		.103/\$100 Value Sprinklered Base Rate		Insurance Company Manual Premium <u>4,120</u>
				Premium Reduction \$6,800

The same criteria applies in determining the manual premium for Contents (Table 2-3).

**Table 2-3
Contents Premium Development**

\$1,500,000 Contents Value	X	.461/\$100 Value Nonsprinklered Base Rate	=	\$6,915
		.200/\$100 Value Sprinklered Base Rate		Insurance Company Manual Premium <u>3,000</u>
				Premium Reduction \$3,915

The accumulated difference in "manual" premiums resulting from having an automatic fire sprinkler system installed, in this instance, would be \$10,715 per year.

HPR (Highly Protected Risk) properties enjoy even greater discounts and must be fully sprinklered. This paper will not use HPR rates, but the building owner should be made aware that sprinklers, in addition to other items, can achieve even greater savings.

Income Tax...

Three types of income tax deductions are allowed for businesses which install fire sprinkler systems:

1. A depreciation allowance for the value of the system
2. The interest on a loan
3. Qualified Rehabilitation Tax Credit

The depreciation schedule varies depending on the type of building. For residential occupancies (apartments and condominiums) the schedule is 27.5 years, while it is 31.5 years for commercial occupancies.

The Qualified Rehabilitation Tax Credit applies to buildings which were built before 1936 (nonresidential only) or buildings which are designated as historic structures (residential or nonresidential). When buildings in either of these two categories undergo a major renovation which is greater than or equal to the value of the building immediately prior to the renovation, the building owner receives a dollar for dollar tax credit in the first tax year which the building is placed back in service. The amount of the tax credit is 20 percent of the rehabilitation expense for historic structures and 10 percent of the rehabilitation expense for buildings built before 1936.

Although retrofit of a sprinkler system alone is not normally enough to qualify for this credit, when other rehabilitation work is being done, fire sprinklers should be added as part of that rehabilitation. The remainder of the rehabilitation expenses should be depreciated using the 27.5 or 31.5 year schedule, whichever is appropriate.

Life Safety Code...

The 1991 and 1994 editions of NFPA 101, *The Life Safety Code*, require all high-rise apartments, hotels, and office buildings to be fully sprinklered or have an engineered life safety system. An engineered life safety system is composed of some combination of standpipes, detectors, smoke control, exits, compartmentation, and partial sprinkler protection. While this may appear to be less expensive than sprinklers initially, often in the long run sprinklers will pay for themselves while an engineered life safety system will not. Insurance companies rarely give discounts for these engineered life safety systems.

Federal Legislation...

On September 25, 1990, President Bush signed into law the *Hotel and Motel Fire Safety Act of 1990*. This bill requires that by 1996, 90 percent of all travel reimbursed by the Federal government for overnight stays be in fire safe hotels. The bill also requires that, beginning in 1994, all conferences sponsored with Federal money be in fire safe hotels. The bill states that in order to be fire safe, any hotel or motel more than three stories in height must be sprinklered.

If a hotel, motel, or conference center owner wished to get a share of the more than \$1.3 billion currently being spent by the Federal government in travel and conference expenses, it is clear that sprinklers will need to be installed. For a complete list of requirements of the *Hotel and Motel Fire Safety Act*, see the article on page 14 of the Summer 1991 issue of *Sprinkler Quarterly*.

Another piece of Federal legislation which will have a profound effect on the sprinkler industry is the *Americans with Disabilities Act* (ADA). Among its many complex requirements is the provision for an "area of refuge" for disabled people to go during a fire. There must be such an area on every floor of every building (new and existing) large enough to hold two wheelchairs and separated from the rest of the floor by a two-hour fire separation assembly. This area would also have to be in, or adjacent to, an exit or exit stairwell. However, the area of refuge does not have to be installed in fully sprinklered buildings. When sprinklered, the whole building effectively becomes an area of refuge. Additional Federal legislation has also been passed which requires sprinkler protection in most Federal buildings.

Liability Avoidance . . .

It is now becoming increasingly important for building owners to provide fire sprinklers in many occupancies even if codes do not require them. Recent court decisions involving large life loss fires have stated that even though codes did not require fire sprinkler systems when the building was built, widespread use of these systems along with requirements for new buildings to have them has led to the public expecting sprinklers as a "reasonable level of care." These court decisions have required building owners to pay out more than \$1 million per life lost in a fire; millions of dollars which would never have been paid out had a sprinkler system been installed.

Business Interruption . . .

Nobody ever plans on losing parts or all of a building. But a fire in an unsprinklered building will shut down major portions, if not the whole building. Loss in revenue to the owner takes many forms depending on the occupancy type. Owners no longer get rent, manufacturers lose space and products, hotels lose conference bookings and guests until the hotel can reopen.

The vast majority of companies which suffer major fires never again open their doors. Take the office building at One Meridian Plaza in Philadelphia, Pennsylvania, as an example. A fire on February 23, 1991, completely burned out the unsprinklered 22nd through 29th floors. Only the sprinkler system on the 30th floor saved the building. Unfortunately today, several years after the fire, the building is still closed. No one can enter, even on the lower floors, which were relatively undamaged by the fire. Could your business or community afford such a loss?

Fire sprinklers limit the fire and fire damage to a small area. After a fire, rooms can quickly be reoccupied minimizing losses in revenue.

Example #1

The property is a hotel, 20 stories high, with a total of 257,000 square feet. It is estimated that to retrofit a sprinkler system in this building would cost \$449,750 ($257,000 \times \1.75). According to Table 2-1, and assuming a value for the building and its contents, the insurance for the building in its current state, and if it were sprinklered, is shown in the following table:

<i>Annual Insurance Summary</i>		
Insurance	Unsprinklered	Sprinklered
Building	45,303	15,760
Contents	<u>19,737</u>	<u>11,680</u>
<i>Total</i>	65,040	27,440
Savings		37,600

As we can see, this owner will save \$37,600 a year in building and contents insurance by installing sprinklers. Even more will be saved in liability insurance, but since that is difficult to quantify, we will not include it in this analysis.

In addition to insurance, the owner also gets a depreciation allowance. Since this is a commercial building, the schedule is 31.5 years. The depreciation allowance is then $449,750/31.5 = 14,278$. In order to find how much the hotel owners saves, we multiply the allowance times the business tax rate. Most businesses have a tax rate of 34 percent. Therefore, the amount of money actually saved is $14,278 \times 0.34 = \$4,854$.

If the building owner actually had \$449,750 in cash that he wanted to invest, the sprinkler system would be an excellent investment. With the insurance and the tax savings, the sprinkler system yields \$42,454 ($37,600 + 4,854$) each year. Compare that to another investment which yields 10 percent. The hotel would get \$44,975 in interest, but would have to pay \$15,291 in income tax on the interest. This investment would only yield \$29,684 for the hotel owner each year.

<i>Investment Comparison</i>	
Sprinkler System	
	$37,600 + 4,854 = 42,454$
Other Investment (10 percent)	
	$44,975 - 15,291 = 29,684$

Example #2

Since most hotel owners don't have \$449,750 in cash for a sprinkler system, they must consider financing. In addition to the insurance and depreciation savings, the interest on a sprinkler system loan is also tax deductible.

If we take the same hotel and borrow the \$449,750 over 15 years at 7 percent interest, our annual payments would be \$48,516. The amount of these annual payments which is interest would vary from year to year, but would average \$18,533 ($[(48,516 \times 15) - 449,750]/15$).

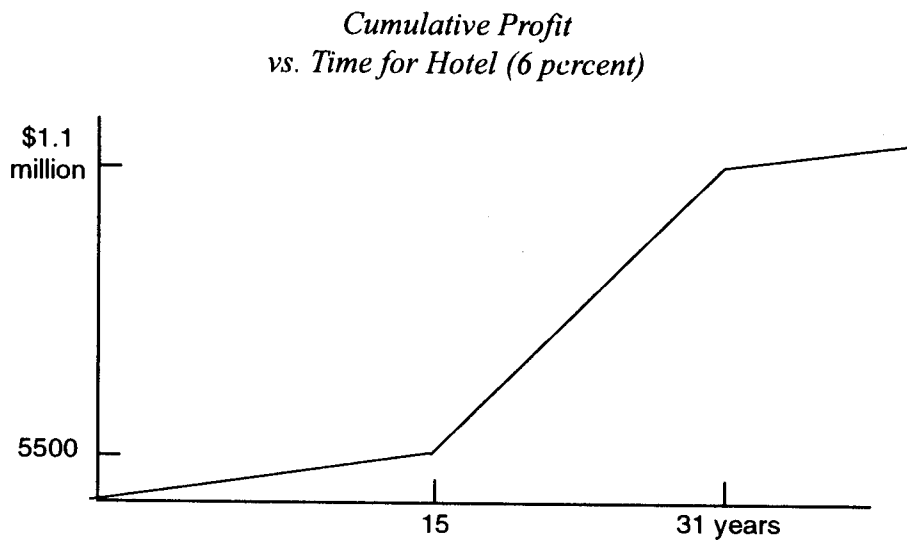
Again, the average interest amount would have to be multiplied by the tax rate to compute the money actually returned to the business. In this case, the owner averages \$6,301 ($18,533 \times 0.34$) each year.

If we compare the cost of installing a sprinkler system each year to the benefits, we see that sprinklers easily pay for themselves.

Annual Cost/Benefit Comparison

Cost		Benefits	
Loan	48,516	Insurance	37,600
		Tax (interest)	6,301
		Tax (depreciation)	<u>4,854</u>
		Total	48,755

As we can see, this business will make \$239 each year by installing sprinkler systems. This may not sound like much, but after 15 years, the loan would be paid off and the business would still be making \$42,454 from insurance and depreciation. If this money were invested at 6 percent over the next 16 years, it would accumulate to more than one million dollars! Not a bad investment considering someone else's money was used.



Example #3

For our third example, let's consider a ten-story office building with a total area of 109,251 square feet. We will estimate the cost of retrofit of a sprinkler system at \$191,189 (109,251 x \$1.75).

The insurance savings would be as follows, assuming an amount for the building and contents:

Annual Insurance Survey

Insurance	Unsprinklered	Sprinklered
Building	8,696	4,664
Contents	<u>7,035</u>	<u>4,020</u>
Total	15,731	8,684
Savings		7,047

The depreciation allowance and income tax deduction can also be calculated as follows:

$$191,189/31.5 \times 0.34 = 2,064$$

If this system were also financed at 7 percent over 15 years, the annual payments would be \$20,605. The average annual interest and tax deduction would be:

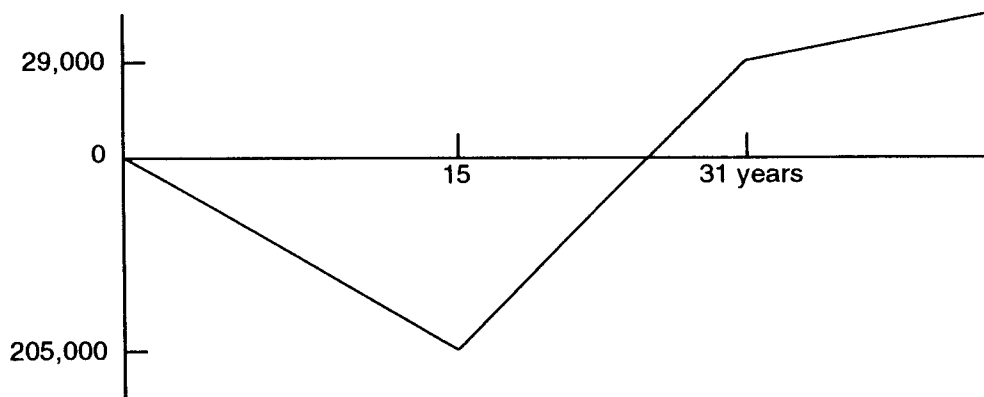
$$[(20,605 \times 15) - 191,189]/15 \times 0.34 = 2,672$$

A comparison of the cost and the benefits of installing a fire sprinkler system in this building is as follows:

Cost		Benefits	
Loan	20,605	Insurance	7,047
		Tax (interest)	2,672
		Tax (depreciation)	<u>2,064</u>
		Total	<u>11,783</u>

Most office building owners only go this far in their analysis. They need to be taken a few steps further. After the loan is paid off, the insurance and depreciation benefits still apply for the next 16 years. The sprinklers will still pay for themselves.

*Cumulative Profit
vs. Time for Office (6 percent)*



As we stated before, new editions of the *Life Safety Code* and Federal legislation are going to force building owners to make changes to their buildings. Caution should be exercised by building owners. The solution, which looks cheaper in the beginning, may cost the owner much more in the long run.

Let's look at the cost of an engineered life safety system for our office building. According to the *Life Safety Code*, an engineered life safety system consists of some combination of standpipes, smoke or heat detectors, smoke control, exits, compartmentation, and partial sprinkler protection.

Assuming that the standpipe and exit systems are adequate, this office building would still need a smoke detection system, some smoke control, a two-hour fire separation on each floor, and sprinklers in hazardous areas. It is estimated that this engineered life safety system would cost \$113,000. Since it is approximately half the cost of a sprinkler system, this might look appealing to a building owner, but in the long run, it would be a mistake.

Engineered Life Safety System

Standpipe	Adequate
Smoke Detection	42,300
Smoke Control	35,000
Exits	Adequate
Compartments (two-hour separation)	27,700
Sprinklers (Hazardous areas)	<u>7,500</u>
<i>Total</i>	<u>113,000</u>

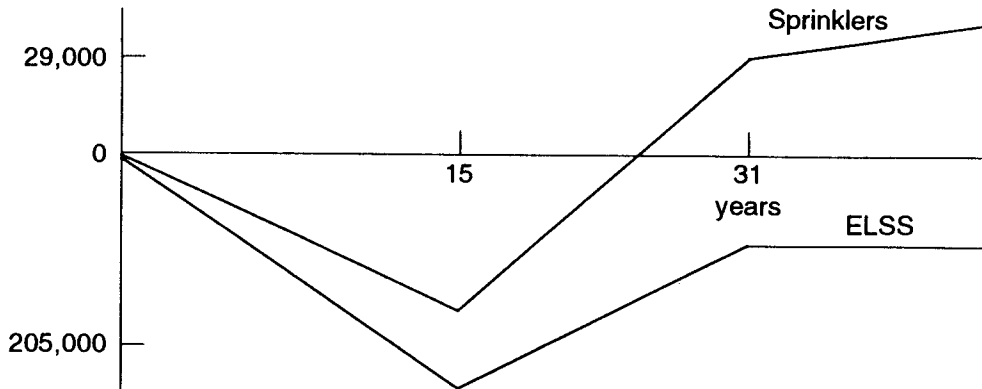
If the engineered life safety system was financed at 7 percent over the same term as the sprinkler system (15 years), the annual payments could be \$12,190. Tax deductions on interest (1,583) and depreciation (1,219) would total \$2,802. A comparison of the different types of upgrades to building safety is shown below.

Comparison of Upgrades to Building Safety

	Sprinklers	Engineered Life Safety System
Initial Annual Cost	20,605	12,190
<i>Tax Savings</i>		
Interest	-2,672	-1,583
Depreciation	-2,064	-1,219
Insurance Savings	<u>-7,047</u>	<u>0</u>
<i>Real Annual Cost</i>	<u>8,822</u>	<u>9,388</u>

As we can see, the sprinkler system is actually cheaper than the engineered life safety system. In addition, the sprinkler system will pay for itself while the engineered life safety system never will. Also, the sprinklers will help bring in Federal government business and help avoid liability claims and losses to business interruption.

*Cumulative Profit vs. Time for Office
Sprinklers and Engineered
Life Safety System (6 percent)*



Example #4

For this example, let's consider a five-story condominium which is 100,000 square feet in area. The sprinkler system is estimated to cost \$175,000 (100,000 x 1.75). Assuming a value for the building and contents, the insurance on the building (which is paid by the condo association) is as follows:

<i>Annual Insurance Summary</i>		
Insurance	Unsprinklered	Sprinklered
Building	16,473	6,215
Contents	4,610	2,000
<i>Total</i>	<u>21,083</u>	<u>8,215</u>
Savings		12,868

The depreciation on the system would apply to the condo association and would be:

$$175,000/27.5 \times 0.34 = 2,164$$

This would make the total savings to the condo association \$15,032 (12,868 + 2,164). These savings would be passed on to the individual owners in lower condominium common charges. If there were 50 owners in the building and they were all asked to come up with the money for a sprinkler system evenly, each owner would have to come up with \$3,500. If each owner took out a second mortgage against the equity in their condo, the interest would be tax deductible at their personal tax rate (28 percent for most people). Assuming that they borrowed the money at 8 percent and that they expect to pay it back in five years, their annual payments would be \$877. The average tax benefit would be:

$$[(877 \times 5) - 3,500]/5 \times 0.28 = \$50$$

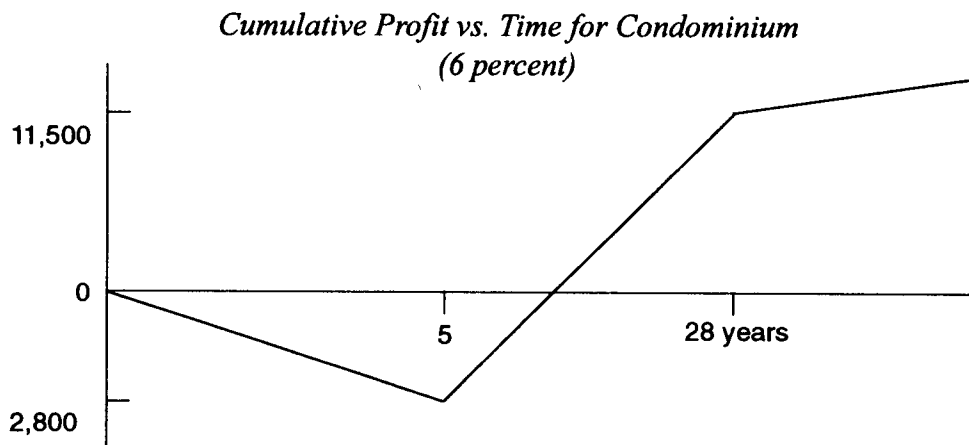
The individual condo owners would also save on their personal condominium owner's insurance. Although ISO currently recommends a 15 percent reduction on the total policy for sprinklers, most insurance companies are only giving 5 to 10 percent. For this exercise, we will choose an insurance company giving a 10 percent discount (if your company doesn't offer this discount, maybe you ought to change companies). This will save our owners another \$30 annually.

Let's put the cost and benefit together:

Comparison of Annual Cost and Benefit to Individual Condominium Owners

Cost		Benefits	
Loan	877	Lower common charges due to	
		insurance and depreciation savings	301
		Income Tax Deduction (Personal	50
		Condo Owner's Personal Insurance	30
		<i>Total</i>	<u>381</u>

So each individual condominium owner will be paying \$496 a year for complete sprinkler protection. A small price to pay. After the loan is paid back, the condominium owners continue to profit from lower insurance costs and from the depreciation allowance.



Example #5

For this example we will do a food processing plant which is one story high and 20,000 square feet. The sprinkler system is estimated to cost \$35,000 (20,000 x 1.75). Assuming a value for the building and contents, the insurance would be as follows:

Annual Insurance Summary

Insurance	Unsprinklered	Sprinklered
Building	3,277	367
Contents	<u>18,980</u>	<u>2,920</u>
<i>Total</i>	<u>22,257</u>	<u>3,287</u>
Savings		18,970

The depreciation allowance and tax deduction would be computed as follows:

$$35,000/31.5 \times 0.34 = 378$$

If the sprinkler system were financed at 8 percent over 10 years, the annual payments would be \$5,216. The tax deductions on the interest would be computed as follows:

$$[(5,216 \times 10) - 35,000]/10 \times 0.34 = 583$$

Summary of Cost vs. Benefit for Food Plant

Cost		Benefits	
Loan	5,216	Insurance	18,970
		Tax (interest)	378
		Tax (depreciation)	<u>583</u>
		Total	19,931

How could this building owner afford *not* to put in a fire sprinkler system!

Example #6

For this example, we will do a one-story 40,000 square foot warehouse. The sprinkler system is estimated to cost \$70,000 (40,000 x 1.75).

Annual Insurance Summary

Insurance	Unsprinklered	Sprinklered
Building	4,006	521
Contents	<u>23,960</u>	<u>4,240</u>
Total	27,966	4,761
Savings		23,205

The depreciation tax deduction can be calculated as follows:

$$70,000/31.5 \times 0.34 = 755$$

If the system is financed at 8 percent over 10 years, the annual payments would be \$10,432. The average tax deduction on the interest would be:

$$[(10,432 \times 10) - 70,000]/10 \times 0.34 = 1167$$

Comparison of Cost and Benefit for Warehouse

Cost		Benefits	
Loan	10,432	Insurance	23,205
		Tax (interest)	1,167
		Tax (depreciation)	<u>755</u>
		Total	25,127

Again, this person can't afford *not* to install a sprinkler system.

Conclusion . . .

Retrofitting fire sprinklers into existing buildings, especially high-rise buildings, can be a cost effective proposition, and, as our examples have shown, fire sprinklers can also be a wise investment for all types of occupancies.

(Rewrite - January 1995)