



michigan municipal league

# Liability & Property Pool Workers' Compensation Fund

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## RISK CONTROL SOLUTIONS

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A Service of the Michigan Municipal League Liability and Property Pool and  
the Michigan Municipal League Workers' Compensation Fund

### LIGHTNING PROTECTION FOR YOUR MUNICIPALITY



Lightning protection technology and lightning safety awareness are important components of every municipality's public safety program. Lightning protection systems are designed to protect not only life, but also critical emergency communications including police, fire and 911. Municipalities commonly protect high-risk facilities such as hospitals, schools, public utilities, public landmarks, as well as hazardous waste and materials storage facilities and industrial sites.

In addition to protecting public buildings, facilities such as stadiums, pools, golf courses, etc. incorporate lightning protection systems into the design of on-site structures.

#### LIGHTNING FACTS

Clouds store both positive and negative electrical charges. Updrafts in the clouds separate the charges. Positive charges accumulate at the top of the cloud. Negative charges accumulate in the lower portion of the cloud and interact with charges in the ground. When sufficient charges accumulate so that release is imminent, the condition creates a lightning bolt. A lightning bolt is a spark that carries the charges stored in the clouds. The separation of charges in the ground acts as an amplifier. It allows a release of charges and a lightning strike to the ground.

Many people believe a lightning strike is a single bolt; however, it is actually a string of several bolts. On average, up to 25 strokes may occur in a strike. Typical lightning strikes carry the equivalent of 2.9 billion kilowatts of power. This amount is six times the total generating electric capacity of the United States.

The Lightning Protection Institute conducted a study that demonstrates that:

- 32% of lightning strikes hit roofs and projections such as satellite dishes or chimneys;
- 29 % of lightning strikes hit overhead power lines and phone lines;
- 29% of lightning strikes hit television antennas; and
- 10% of lightning-strikes hit trees near structures.

On average, lightning strikes cause 30% of the church fires and at least 18% of lumberyard fires in the United States annually. They also cause significant losses to more than 18,000 houses and 12,000 other buildings.

In addition, according to the Lightning Protection Institute, lightning...

- Packs between 35,000 to 40,000 amperes of current.
- Can generate temperatures as high as 50,000 degrees Celsius.
- Falls somewhere on earth every second.
- Travels as far as 40 miles.
- Kills nearly 100 people each year in the United States and injures hundreds of others.
- Can and does strike the same place twice.
- Causes billions of dollars in property damage each year and many times results in fire and total property loss.

In addition to direct losses such as property damage to buildings, a lightning strike may result in the indirect losses that often accompany the destruction or damage of buildings and their contents. For example, municipalities rely upon the integrity of their structures as they provide services to their communities. A stroke of lightning to an unprotected building that houses the police or fire station may result in an interruption of vital services to the community. The consequences of such an interruption can range from the public's loss of confidence to a citizen's death when a department is unable to respond to an emergency call.

### **NFPA 780**

Since lightning frequently causes property damage, municipalities should evaluate the need for lightning protection. They should consult the National Fire Protection Association Code 780 (NFPA 780) to determine the need for lightning protection for each municipal structure. NFPA 780 includes a Risk Assessment Guide (Appendix H) to assist in this determination. Municipalities should provide lightning protection for those structures having a risk index of four or greater according to the NFPA 780 Risk Assessment.

Municipalities located in geographic areas that are subject to frequent or to severe thunderstorms need lightning protection. Being in an area with few but extremely severe thunderstorms may be more significant than being in an area with more frequent, but milder storms. Other factors you should consider are:

- Topography – the type of land on which a building is located -- flat, hillside or hilltop, mountaintop.
- Relative location – the structure's position in relation to taller buildings or short buildings in the area as well as to adjacent structures or terrain.
- Type of structure -- single family dwelling, municipal services building, library, etc.
- Building height, construction, and design.
- Occupancy -- the building's use and how many people typically are in it.
- Contents -- residential furnishings, flammable liquids or gases, historical contents, etc.
- The presence of highly sensitive solid state electronics such as monitors, computers, and fax machines.
- Special Risks such as the use, handling or storage of hazardous or flammable materials.

### **LIGHTNING PROTECTION**

Lightning protection focuses on providing a means by which a lightning discharge may enter or leave the earth without damaging the property protected. The three major components of a lightning protection system are:

- 1) Air terminals,
- 2) Conductors, and
- 3) Grounding.

The installation of lightning-protection systems can take place on the exterior of a building, or can be partially or fully concealed within the structure. A qualified contractor should design and install the system.

### **ELECTRICAL PROTECTION SYSTEMS**

A lightning protection system installed to protect a structure from direct strokes does not protect against possible voltage surges on electric service conductors and TV or radio antenna systems. Municipalities should consider surge arrestors or electrical protection systems to protect the electrical services to the buildings. Article 280 of NFPA 70, National Electrical Code, covers the installation of surge arrestors on power and communication lines.

### **MAINTENANCE AND INSPECTION**

Proper maintenance of lightning-protection systems is essential. Municipalities should give attention to ground connections, as rods may break or become corroded at or just below the ground level where the damage is not apparent. Damage may occur to the components of the system due to additions or repairs to the building. Roofers and other general contractors have been known to disable the protection unit during construction activities. Deterioration or mechanical damage to the components of the lightning protection system that go undetected and do not get repaired result in an unprotected structure.

NFPA 780 recommends periodic inspections of lightning protection systems to assure their integrity. At a minimum, municipalities should conduct inspections:

- After installation.
- Annually - Visual Inspection, including points and grounding connections.
- Every five years -- Thorough inspection.
- Whenever the municipality alters the structure.
- After a known lightning discharge to the system.

The frequency of such inspections may vary and depends upon such factors as:

- The classification of structure or area protected.
- The level of protection the systems provide.
- The immediate environment (corrosive atmospheres).
- The materials from which the components of the protection system are made.
- The type of surface to which system components are attached.

In addition, NFPA 780 recommends that inspections and testing take place at differing times of year to assure the effectiveness of the system during various seasons.

Suggested Municipal Structures to Evaluate:

Service buildings such as fire, police, water & sewer	Power generating stations
Playgrounds, picnic areas, ball parks & other open areas	Hangars
Libraries, museums, & historical structures	Water towers & cooling towers
Golf & other recreational shelters	Places of assembly such as schools & recreational facilities

**DO:**

1. Install UL-listed, properly rated transient surge protection at all levels (not just the service entrance) of the electrical power and exterior lighting systems (especially those that originate or terminate outside the facility), and monitor/test regularly for degradation or failures.
2. Install transient surge protection for all data, control, and communications circuits coming into or going out of the facility, whether overhead or underground. Also monitor/test regularly for degradation or failures.
3. Use multiple, properly installed and bonded, grounding electrodes per the NEC (more is better, if properly bonded together) to obtain no more than 5 - 10 ohms impedance to earth ground (even less for sensitive electronic systems). Ensure building steel and all metal underground metal piping entering the building, including gas pipelines, are bonded to the electrode system.
4. Bond all electrodes, metal enclosures, metal raceways, ground busses, and cable shields together at a single point, and then to the grounding electrodes, using low-impedance bonding jumpers of appropriate materials and types for the frequencies of the different systems (reference UL-96A).
5. Bond together the grounding systems of all the out structures of multi-structure facilities, to create an equi-potential ground plane, especially if the structures share hard-wired power, control, data, or communications links.
6. Record weather data whenever an apparent lightning strike occurs, or whenever suspected transient damage to equipment is discovered. Try to obtain written documentation from a local weather station for the day or period when the event occurred.
7. Whenever apparent transient surge damage is suspected, contact the serving electric utilities (telephone, CATV, and power) and obtain documentation on whether an anomaly might have occurred, including a lightning strike, on any of the utility's service lines.
8. Keep ALL parts that appear to have been damaged by a transient event, for review by the insurance appraiser. Take photographs of all damage and damaged parts before starting any repairs or replacing parts.
9. Test grounding and bonding systems regularly for damage, deterioration, increased impedances, open circuits, and multiple grounds that are not bonded.
10. If equipment is damaged or ceases to operate, due to an apparent or possible transient event, test it and all other related circuits and equipment for hidden damage before attempting to re-energize or operate the affected equipment.
11. For lightning protection systems, use appropriately sized and types of copper conductors as down leads in lieu of the building's or tower's (relatively) high-impedance structural steel.
12. Have your facility evaluated per NFPA 780 or LPI-175 to determine if a lightning protection system is recommended for the type, size, and use of your facility.
13. Consider using properly designed and installed dedicated circuits, with dedicated neutrals and isolated ground conductors, for sensitive electronics equipment, especially if recommended by the manufacturer. Consider shielded isolation transformers if appropriate.

**DON'T:**

1. Install multiple and separate isolated grounding systems, regardless of what system vendors recommend.
2. Install ground rods so the spacing between them is less than their length – this reduces their effectiveness.
3. Use non-listed and ineffectual mechanical clamps, lugs, etc., for bonding grounding wires to metal structures, piping, and metallic enclosures.

4. Rely on building or tower structural frames as grounding “conductors”, in lieu of copper down leads, for lightning protection.
5. Mix transient surge device leads in the same raceways with, or adjacent to, data, communications or critical power circuits.
6. Operate or attempt to operate/restart equipment after it has experienced possible transient damage to itself or to its controls without first testing ALL related circuits and equipment for obvious and hidden damage – this could lead to increased or collateral damage, which may not be covered by insurance.
7. Rely on the normal transient surge protection, installed by some utilities (e.g., telephone, CATV, etc.) on their incoming services, to protect your equipment.
8. Buy transient voltage surge suppressors that guarantee energy savings.
9. Install transient surge protective device leads that exceed the manufacturer’s recommended lengths (shorter is better), or with kinks or sharp bends.
10. Double-lug TVSS leads with power wiring – use dedicated and approved connectors/circuit breakers.



Important Phone Numbers:

**MML Risk Management Services (800) 653-2483**  
**The League’s Loss Control Services (800) 482-0626**

Note:

This document is not intended to be legal advice. It does not identify all the issues surrounding the particular topic. Public entities are encouraged to review their procedures with an expert who is knowledgeable about the topic.