



Good afternoon my name is Bob Talley, PE; Level 3 Elec Inspect and PM

Welcome to the session entitled “Can I blame the electrician?” Welcome to the session entitled “Can I blame the electrician?” Apparently blame is a big issue in our society. A friend of mine offered me the following quote: “its not whether you win or lose ... its how you place the blame.”

Just so you know, I don't have anything against electricians. A few years ago I started reminding designers that the electrical engineer and electrical contractor really hold the success of the final inspection in their hands. The building must pass the SCO life safety inspection or the owner typically cannot obtain a Beneficial Occupancy of the facility. The life safety inspection involves the proper operation of the Fire alarm system, emergency lighting, illuminated exit signs and a functioning sprinkler system that correctly interfaces with the fire alarm system. If the building has electro-magnetic locks we will check to see that they were wired and installed in accordance with the building code. If the electrical engineer has prechecked the operation of all those systems we have a high chance the building will be accepted. Thus the title of this session

Can I blame the ... Electrician?

New technologies, elevators, VFDs,
UPS units, LED lighting, power
conversion equipment, Third Party,
fire, sprinkler and security systems ...



Our session will actually cover many construction issues that can surround the work of the electrical trade including: elevator controllers, UPS units and LED lighting which are all forms of power conversion equipment. That will lead us look at “Harmonics and Wave form distortion.” And we will talk about Third Party Approvals, Security Systems and Life Safety Inspections.



Today's session is a continuation of last year's presentation in the sense that we are still looking at construction problems, but this time want us to look deeper into the nature of the problems.

So lets start with the big picture.

New products are constantly coming to the market. Our owners, designers, suppliers and contractors are all being pushed by market forces to deploy these new products. For that reason today's session will cover some basic electrical concepts. I just want to remind all of us ... that electrical characteristics of new products can impact the entire building. Since all most all of the design disciplines, A,C,P,M,E,F and sprinkler are deploying electrical products, we all need to remember that these products can interact.

Electrical Products

- Architects - elevator systems, elec. locks, kitchen equipment and security systems
- Mechanical – motors, variable frequency drives, electronic control systems
- Plumbing – electronic valves and pumps
- Sprinkler – fire alarm interface layouts and components
- Civil – pumps, hot boxes, lift stations



Architects are writing specifications that often include electromagnetic door locks and door holds, elevator controllers, specialty lighting, security systems and kitchen equipment.


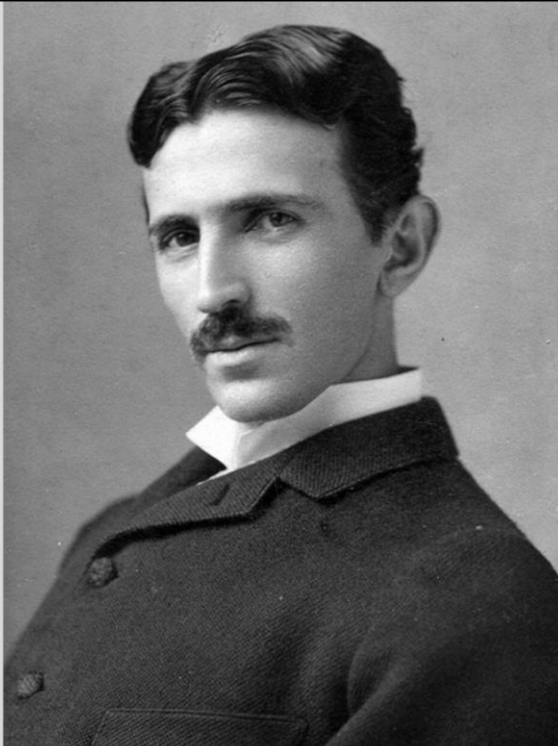
Mechanical engineers write specifications for motors, starters, variable frequency drives, automation system and electronic control systems.

Plumbing engineers write specifications for pumps, electronic valves, automatic valves and 24 volt transformers .

Sprinkler designers are now tasked with interfacing with the fire alarm systems and layouts. Even the new fire pump controllers can have VFDs if the owner has the need and the budget.

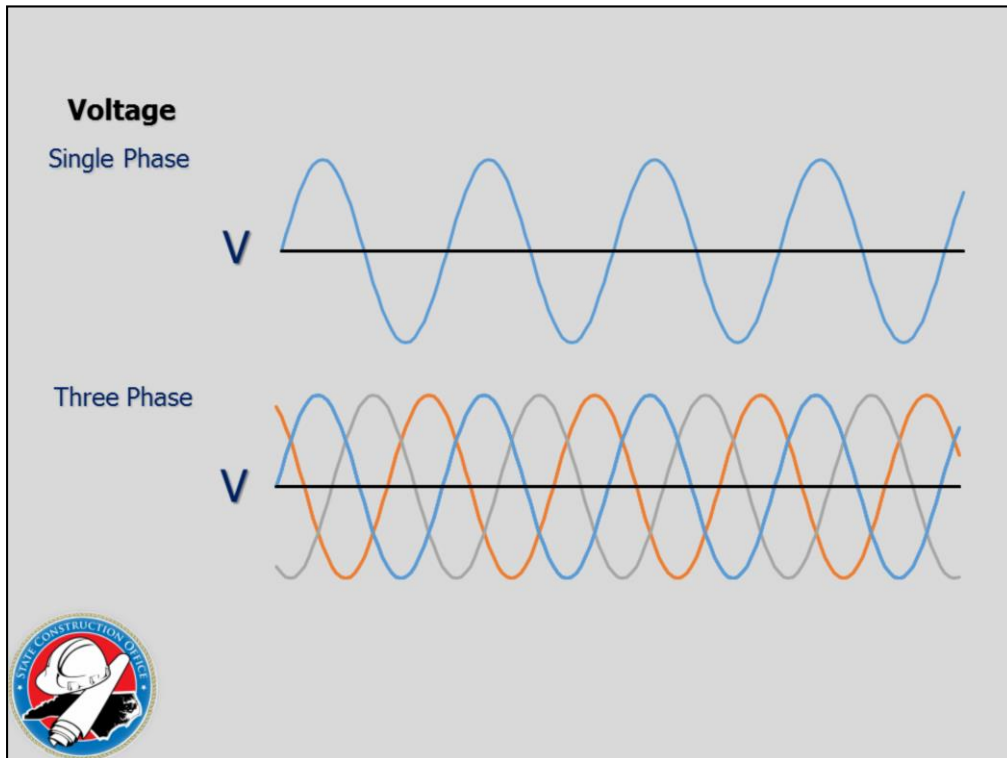
Civil engineers are specifying lift stations, hot boxes, pumps and control systems.

The proliferation of electronic products has been a blessing; but, we are starting to see some problems that have been long predicted as electronic components interact.

<p>Nikola Tesla Electrical Engineer Mechanical Engineer Futurist</p> <p>Inventor of alternating current (AC) machinery</p> <p>Rotating electric field Rotating magnetic field</p> <p>Harness the power to change the world</p> 	
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Now for a little background ... Our electric system is based on the work of Nikola Tesla and the financing of George Westinghouse.

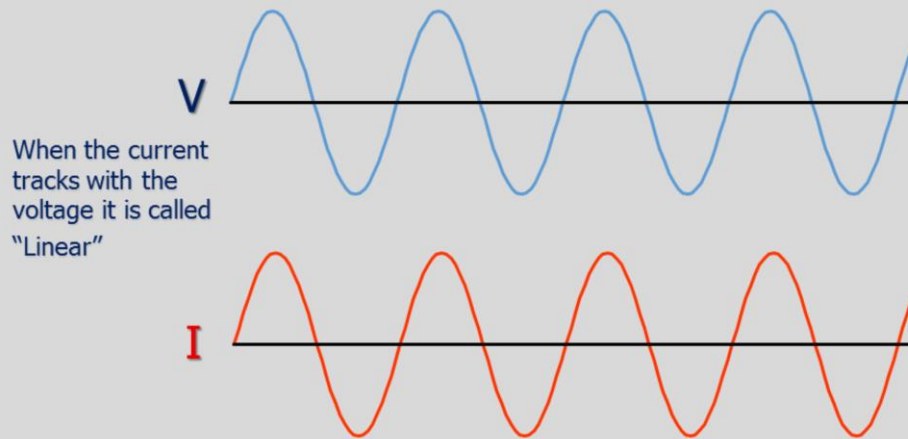
Tesla was a mathematician, electrical engineer, mechanical engineer, futurist and the inventor of alternating current machinery. In this system the voltage alternates back and forth across the zero mark. Tesla realized there was usable power in the relationship between rotating electric fields and rotating magnetic fields. Created by generators, the sinusoidal wave form is very elegant and literally provided the horsepower to change our world. They deployed a three phase alternating power system and it changed the world



Lets talk about Voltage

Single Phase ... Three Phase

Voltage and Current



Voltage and Current - when current track with the voltage it is called a linear relationship, as this graph demonstrates

1960s

New technologies, transistors,
computers, micro devices



Then came the 1960s - Until the 1960s the electrical utility system primarily supplied linear loads. That means the current wave form tracked with the voltage wave form. Incandescent bulbs, well pumps, ceiling fans, air conditioning units, electric stoves and ovens all used alternating current to make life more pleasant for Americans. But the 60's brought significant change to our world. The advent of the transistor and proliferation of small electronic devices that followed led to changes in the way electric power was used.

IEEE 519

1981

1992

2014



IEEE 519 was written to offer a Standard on Harmonic limits or how to be a good neighbor - By the 1970s the writing was on the wall that change was coming. IEEE 519 was first issued in 1981 placing the responsibility for clean power on the utility. They were not happy and IEEE 519 was revised and reissued in 1992 with an emphasis on shared responsibility for clean power. Now the document has been revised again and a 2014 version is available.

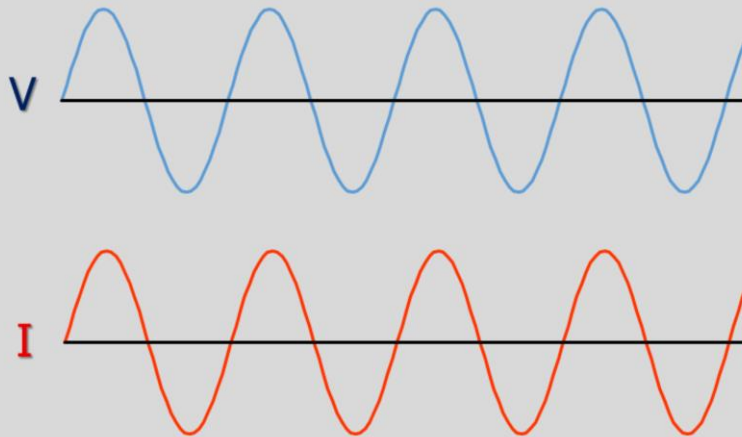
2015

New technologies now include:
elevators, VFDs, UPS units, LED
lighting, power conversion
equipment security systems...



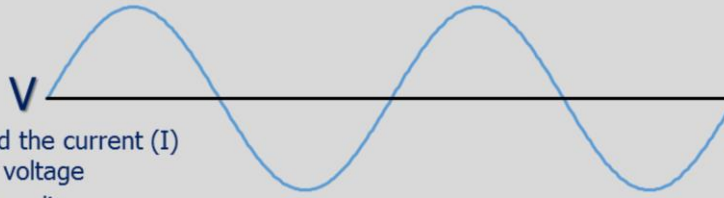
Now in 2015 ... the new technologies now include elevator controllers, variable frequency drives (VFDs), UPS units, LED lighting, Power conversion equipment, and security systems.

Voltage and Current Linear Loads



In the past the loads were primarily linear. But now the majority of the electronics in my house (except for the stove, oven and AC unit) all have small transformers attached to the cord. The laptop, the phone charger, the flat screen TV, the LED Christmas lights and the clocks all need small power.

Voltage and Current Switch Mode Power Supply (SMPS)



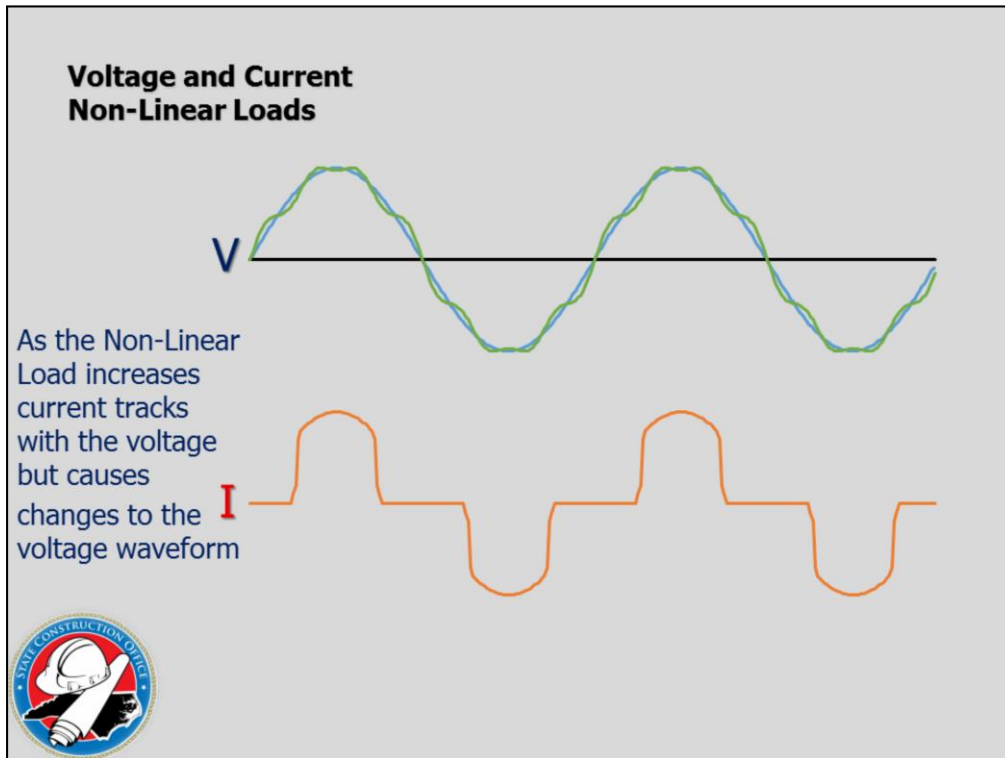
For a SMPS load the current (I) tracks with the voltage but it will not be a linear relationship.



When the non-linear load is large, it will impact the voltage waveform

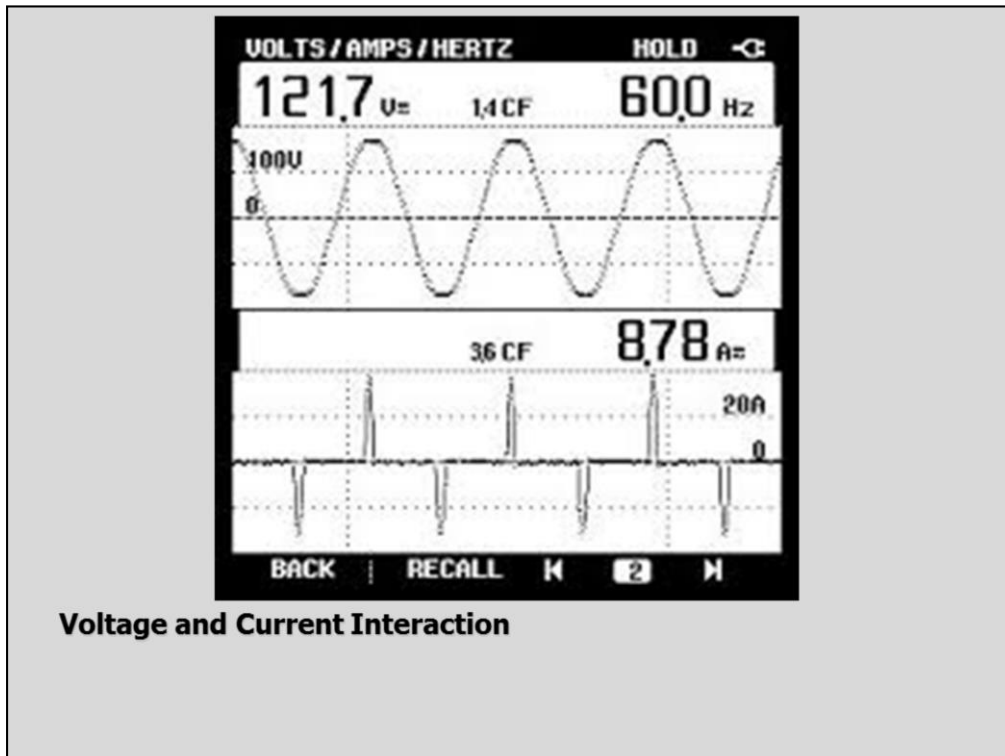


The cheapest way to convert AC power to a suitable source for electronic equipment is to use a Switch Mode Power Supply (SMPS).



Voltage and current interact. The higher the current the higher the voltage drop, for a given conductor size. To reduce the impact we increase the conductor size. That is a well known relationship.

Now most of the new electronic equipment comes with some type of power conversion system to convert from the 120 volt supply to the 3, 12 or 24 volts it needs to operate the equipment. The same is true in principal for the big equipment like UPS units and Variable Frequency drives. The basic power conversion form uses a concept that charges a capacitor once the wave form is two thirds of max height and stop charging once the wave form drops below that value. This leads to a pulsing current draw. (See the example). This is called a Switch Mode Power Supply. I am over simplifying here but you can get the concept. That sudden pulse can cause nonlinear voltage drops on the system. The non-linear voltage change ... distorts the voltage wave form.



SMPS


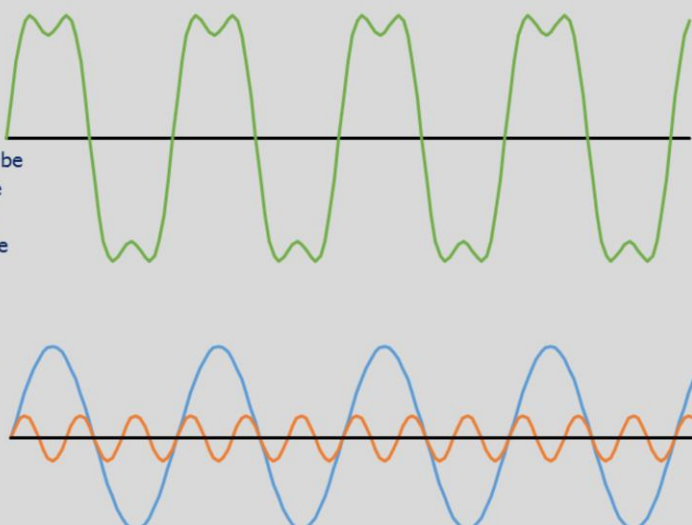
The non-linear load (ie the current) is only a problem once it gets large enough to start interacting with the voltage waveform. When voltage and current interact we call the interaction either Harmonic distortion or Wave form distortion. Harmonic distortion can be evaluated and broken into component parts. Repeating distortion is harmonic. Non-repeating distortion is the single event type.

If the advantage of SMPS is that it is cheap what is the draw back? Well the SMPS can create problems for the power system. As long as the current draw is small compared to the system the pulse will have limited impact on the system.

Remember it is not just your computer that uses current in that window. Ever device attached to that phase of the panel board uses power at the same time. The total result can be rather large.

Distortion and Harmonics

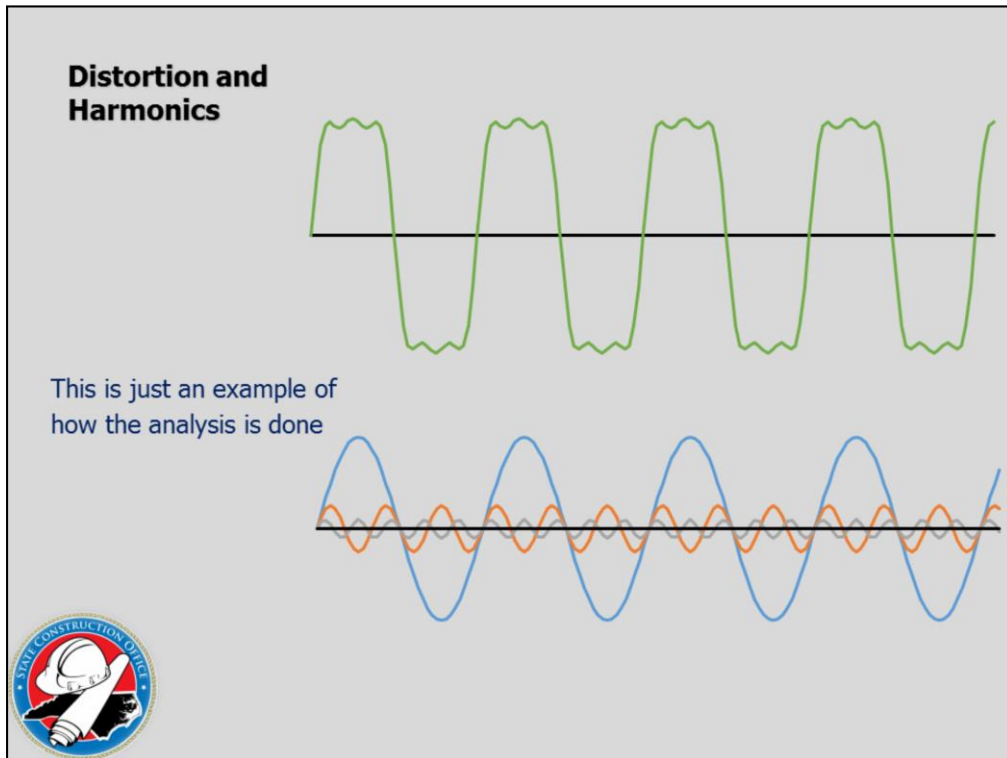
- Distortion evaluation
- Voltage Distortion can be evaluated by assuming we have multiple frequencies that add together to create the condition.
- If the distortion is repeatable then it can be evaluated as a harmonic of the fundamental frequency.



Distortion evaluation

Voltage Distortion can be evaluated by assuming we have multiple frequencies that add together to create the condition.

If the distortion is repeatable then it can be evaluated as a harmonic of the fundamental frequency.



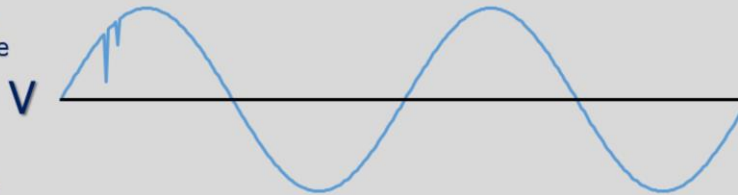
This is another example showing the fundamental and two harmonics. You see how they add together.

Why is this important? Because if we can understand what is happening we can find a way to mitigate the associated problems. We might add filters, traps, transformers, etc.



Distortion and Harmonics

Single event distortions are not considered "Harmonic" they are not repeatable



Cause?
- On or Off state change



Single events are not considered "harmonic distortion". Combine a single event with a distorted voltage wave and very odd things can happen.

Distortion and Harmonics

OPTIONS:

Look at the "big project picture"
Specify appropriate equipment
Evaluate conversion equipment
Determine line reactor needs
Evaluate cost impact

Make sure you are informed.

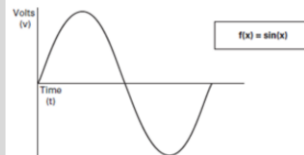
Not a problem until it's a problem



What Are Harmonics?

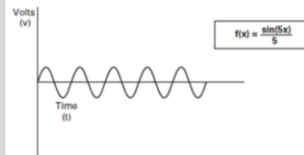
Take a perfect wave with a fundamental frequency of 60 Hz, which is close to what is supplied by the power company.

Perfect Wave



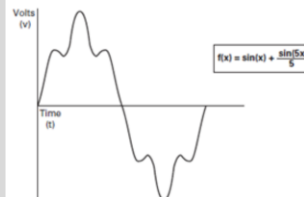
Add a second wave that is five times the fundamental frequency—300 Hz (typical of frequency added to the line by a fluorescent light).

Second Wave



Combine the two waves. The result is a 60 Hz supply rich in fifth harmonics.

Resulting Supply



There are a number of resources available on the web and in the library for helping you better understand Harmonic Distortion. This picture is just one sample of what is available. Each manufacturer will provide a slightly different understanding and do their best to explain why their product is best.


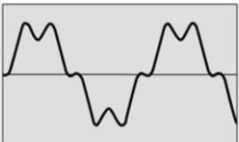




OPTIONS:


Look at the "big project picture"...Specify appropriate equipment...Evaluate conversion equipment

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Distortion and Harmonics



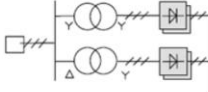
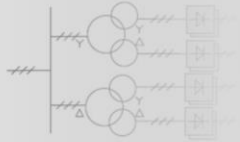
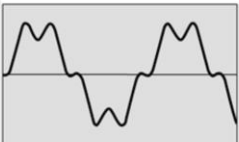
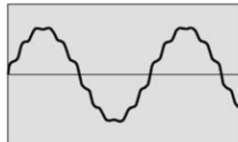
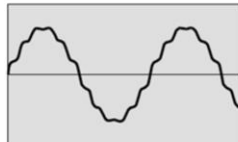
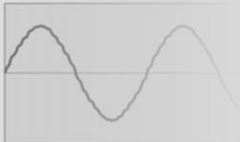
<p>6-pulse rectifier</p>  <p>Current Waveform</p> 	<p>12-pulse rectifier</p>  <p>Current Waveform</p> 	<p>24-pulse rectifier</p>  <p>Current Waveform</p> 
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This is one manufacturer's explanation of available product.

6 pulse, shown, is the simplest version, These devices use two pulses per wave, since there are 3 waves that yields a 6 pulse device.

Distortion and Harmonics

6-pulse rectifier	12-pulse rectifier	12-pulse rectifier	24-pulse rectifier
			
Current Waveform 	Current Waveform 	Current Waveform 	Current Waveform 

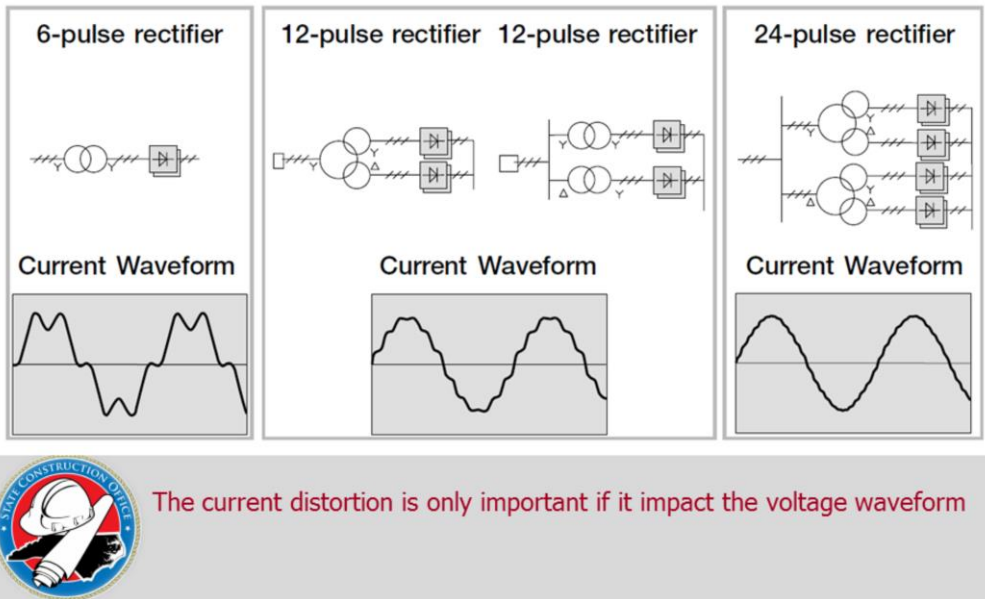


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Distortion and Harmonics



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(next) the 12 is made of 2 – six pulse units

The 24 can be made from two 12 pulse units

Distortion and Harmonics

■ Take Away

- Electrical Distortion
 - Harmonic – Repeatable
 - Distortion – single event
- Can be mitigated
 - Line reactors
 - 12 pulse, 18 pulse, etc.
 - Phase shift transformers
 - More robust supply
 - Add linear loads
- Designer - cannot put the responsibility on the manufacturer



Take Away, Electrical Distortion

Harmonic – Repeatable

Distortion – single event

Distortion be mitigated

Line reactors

12 pulse, 18 pulse, etc.

Phase shift transformers

More robust supply

Add linear loads

Designer - **cannot put the responsibility on the manufacturer**

So the Phone Rings ...

- Help my new LED lights are flashing
 - Project to remove 4500 kva of 40 year old unit substations. We don't support 4160 volt
 - Replaced all the 4160 volt system and let utility serve all the 480 volt panels.
 - New Utility transformer is 500 kva
 - The new LED lights were replaced with a better light by the manufacturer



So the phone rings

With that background let's look at some of the phone calls we have received the last couple of years. Removed 5,000 kva of unit sub stations on a job site. Yes it was over designed – we had Progress Energy install a 500 kva utility transformer to serve the building. Suddenly all of the new LED lighting in the facility was flashing. Answer - replaced the lights



4160 volt equipment

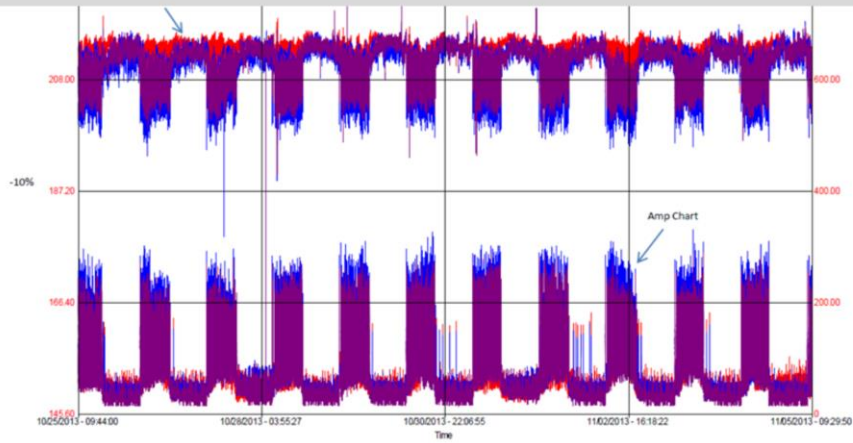
Changing equipment may create new opportunities for solving problems.

Picture of the 4160 volt gear – new opportunities to succeed

So the Phone Rings ...

- Elevator keeps “trapping” people:
 - 20 story tall elevator
 - Recently modernized - new VFD controller
 - No posted VFD settings or Elev settings
 - Elevator is 80% of the power used at site
 - Emergency lighting turns on every time the elevator starts
 - Replace the feeders and decrease length

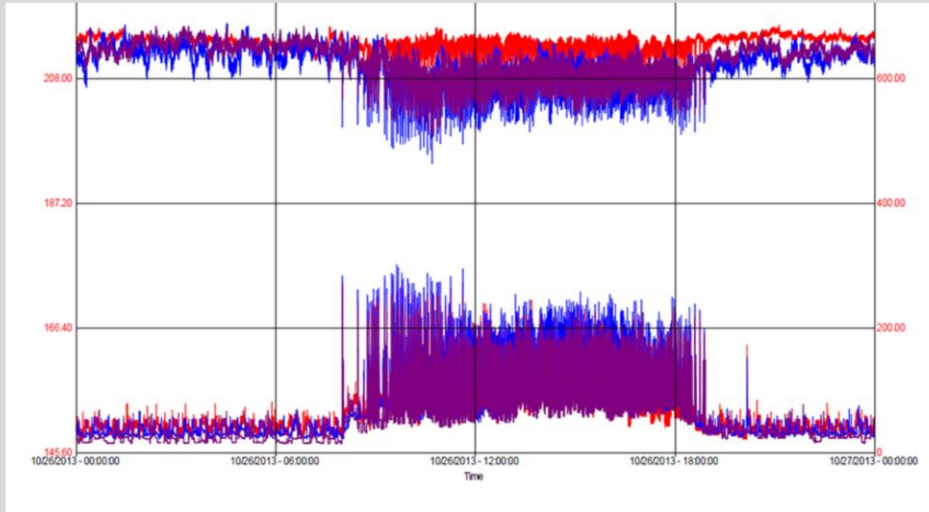




Three Phase Voltage and Current
 Cycle-by-Cycle Readings
 Max, Min, & Average Over Consecutive 10 Second Intervals

Voltage and Current Interaction

This is a 10 day chart. Current goes up and voltage goes down.



Voltage and Current Interaction

Enlarged view over a 24 hour period

So the Phone Rings ...

- Elevators are turning off trapping people
 - 4 story building with 4 new elevators
 - VFD type controllers, each with a separate isolation transformer
 - No posted variables or settings for the drives
 - Ran all the elevators until one would stop.
 - Proved equipment was interacting
 - Manufacturer replaced the controllers



Elevators are turning off trapping people

4 story building with 4 new elevators

VFD type controllers, each with a separate isolation transformer

No posted variables or settings for the drives

Ran all the elevators until one would stop.

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So the Phone Rings ...

- New building with roof top AHU keeps turning off and requires tech to reset
 - 60 HP Supply and 20 HP Return
 - Feeders are sized per NEC
 - Drives are 6 pulse type with 3% Line Reactors
 - No posted variables or settings for the drives
 - Fault code indicates trip on OC during start
 - Changed VFD parameters



New building with roof top AHU keeps turning off and requires tech to reset
60 HP Supply and 20 HP Return
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So the Phone Rings ...

- Owner complains that generator is broken
 - New building with ducted hood exhaust manifold and 60 hp fan periodically shuts off
 - 3% line reactors are installed
 - No posted variables or settings for the drives
 - Owner wants to know why generator is not running to keep the fan operational
 - Changed parameters - Still under review



Owner complains that generator is broken

New building with ducted hood exhaust manifold and 60 hp fan periodically shuts off

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Owner wants to know why generator is not running to keep the fan operational

Changed parameters - Still under review

So the Phone Rings ...

- Boiler plant manager complains of random activation of Emergency Stop System
 - Building has four 60 hp fans
 - New VFDs were specified with line reactors
 - No posted variables or settings for the drives
 - Opened the VFD and saw a large empty spot
 - Add line reactors and problems ceased



Boiler plant manager complains of random activation of Emergency Stop System

Building has four 60 hp fans

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**Listed
Equipment**

GS 66-23

What is the big deal about
Third Party Inspection?

Suitability is required by
the NC General Statutes

Article 4.

Electrical Materials, Devices, Appliances and
Equipment.

§ 66-23. Sale of electrical goods regulated.

Every person, firm or corporation before selling, offering for sale, assigning, or disposing of by gift as premiums or in any similar manner any electrical material, devices, appliances or equipment shall first determine if such electrical materials, devices, appliances and equipment comply with the provision of this Article. (1933, c. 555, s. 1; 1989, c. 681, s. 1.)



GS 6623 sale of goods - regulated

Listed Equipment

GS 66-24

What is the big deal about
Third Party Inspection?

Suitability is required by
the NC General Statutes

§ 66-24. Identification marks required.

All electrical materials, devices, appliances and equipment shall have the maker's name, trademark, or other identification symbol placed thereon, together with such other markings giving voltage, current, wattage, or other appropriate ratings as may be necessary to determine the character of the material, device, appliance or equipment and the use for which it is intended; and it shall be unlawful for any person, firm or corporation to remove, alter, change or deface the maker's name, trademark or other identification symbol. (1933, c. 555, s. 2; 1989, c. 681, s. 1.)



GS66 24 manufacturer marks are required - I recently turned a project down because the manufacturer could not figure out what they wanted to provide. Their system drawings did not match the equipment they shipped. The labels on their equipment did not match the equipment provided.

Listed Equipment

GS 66-25

What is the big deal about Third Party Inspection?

Suitability is required by the NC General Statutes



§ 66-25. Acceptable listings as to safety of goods.

All electrical materials, devices, appliances, and equipment shall be evaluated for safety and suitability for intended use. This evaluation shall be conducted in accordance with nationally recognized standards and shall be conducted by a qualified testing laboratory. The Commissioner of Insurance, through the Engineering Division of the Department of Insurance, shall implement the procedures necessary to approve suitable national standards and to approve suitable qualified testing laboratories. The Commissioner may assign his authority to implement the procedures for specific materials, devices, appliances, or equipment to other agencies or bodies when they would be uniquely qualified to implement those procedures.

In the event that the Commissioner determines that electrical materials, devices, appliances, or equipment in question cannot be adequately evaluated through the use of approved national standards or by approved qualified testing laboratories, the Engineering Division of the Department of Insurance shall specify any alternative evaluations which safety requires.

The Engineering Division of the Department of Insurance shall keep in file, where practical, copies of all approved national standards and resumes of approved qualified testing laboratories. (1933, c. 555, s. 3; 1989, c. 681, s. 1.)

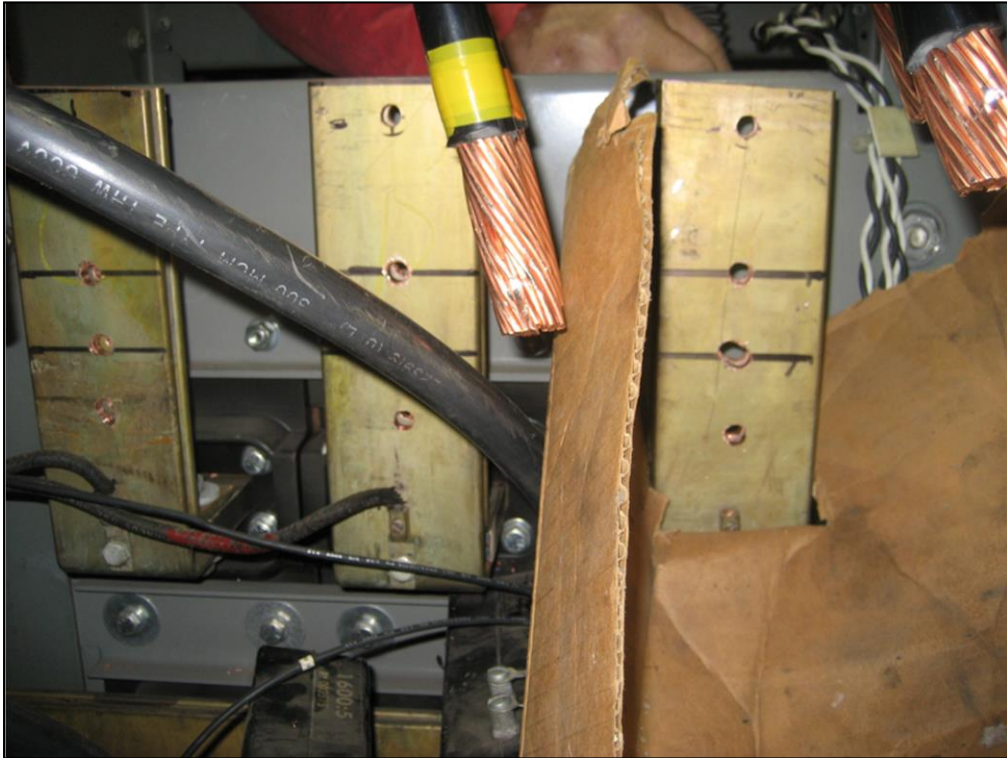
GS6625 Listing is about suitability -

Most contractors believe an inspector should tell you what to fix. That is true when I have a NEC code reference. But when the issue is with the electrical construction of the equipment it is not so clear. – When we see real problems the best thing to do is to tell the manufacturer or the contractor who purchased the equipment to get it third party approved. It is amazing what they can find.



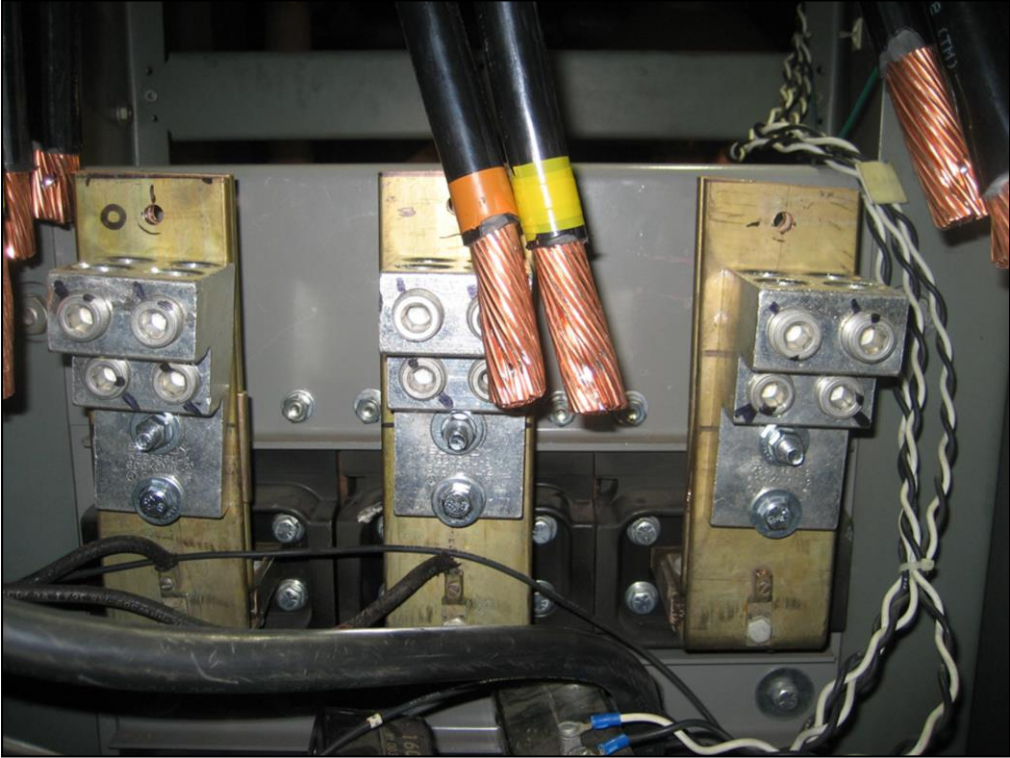
50 year old equipment served by bus duct from the utility vault. The engineers drawing say to remove the bus duct and refeed the gear from a new 1500 amp switch.

The contractor did not order an interior bus termination kit. That kit which would have been factory built, third party listed and come with instructions would have prevented the mess we had.



The electrical contractor took a sawzall and cut the bus bars off – evidenced by this photo. He then drilled nonsymmetrical holes in the bus and attempted to attach lugs. It did not look right to me. I don't build switchboards for a living. I told the contractor they had created a problem and modified the SWBD outside if it listing. It took months for him to find the right company who could tell him how to bring the board into compliance with the UL standard for switchboards.

I also learned a new term. "Angel dust" that is what is created by copper shavings in an electrical switchboard. Because if there is a problem the next thing you see is angels



Another view

Listed Equipment

What is the big deal about
Third Party Inspection

Cause?

- Equipment was field modified
Note the mains are not supported
and the bus is not supported.



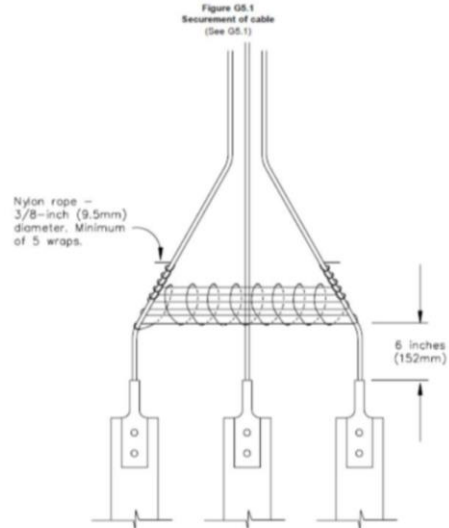
It took months to get the right third party inspection department on site. This is photo is from the third party report detailing what was needed to fix the switchboard. Someone knowledgeable in the area of switchboard construction and willing to work with the contractor to fix the situation.

Listed Equipment

The UL Standard for Switchboard construction details the requirements for the support of the incoming mains.



Due to the inability to test the switchboard per 9.2.4.2.4.1 of UL 891, the switchboard must be marked in accordance with 6.3.3.1 and G5.1 for Securement of Line Cable. The Line Cables entering the switchboard and connecting to the terminal blocks added to the Line Bus shall be secured as identified in Figure G5.1.



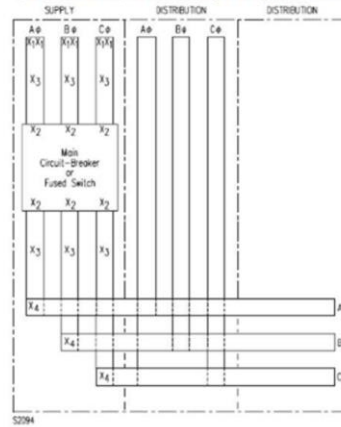
These are sample pages of the report.

Listed Equipment

The UL Standard for Switchboards provides the details for bracing the bus bars.



Figure G3.6
Location of supports for right-angle connection of edge-to-edge bus bar with cables not connected directly to main
(See Clauses G3.1.7, G3.2.3, G3.3.4, Figure G3.1, and Table G3.1)



In which:

X_1, X_2 - Two supports required at line terminal and except only one support may be used for a single bus bar 2 - 3 in (50.8 - 76.2 mm) wide with a short-circuit current rating of 50 000 A or less.

X_2 - For the purposes of determining distances from Table G3.1, this point is considered a support.

X_3 - One support required at intervals as specified in Table G3.1.

X_4 - One support required at connection of vertical to horizontal bus or as shown in Figure G3.4.

How to brace the bars

**Listed
Equipment
with Label**

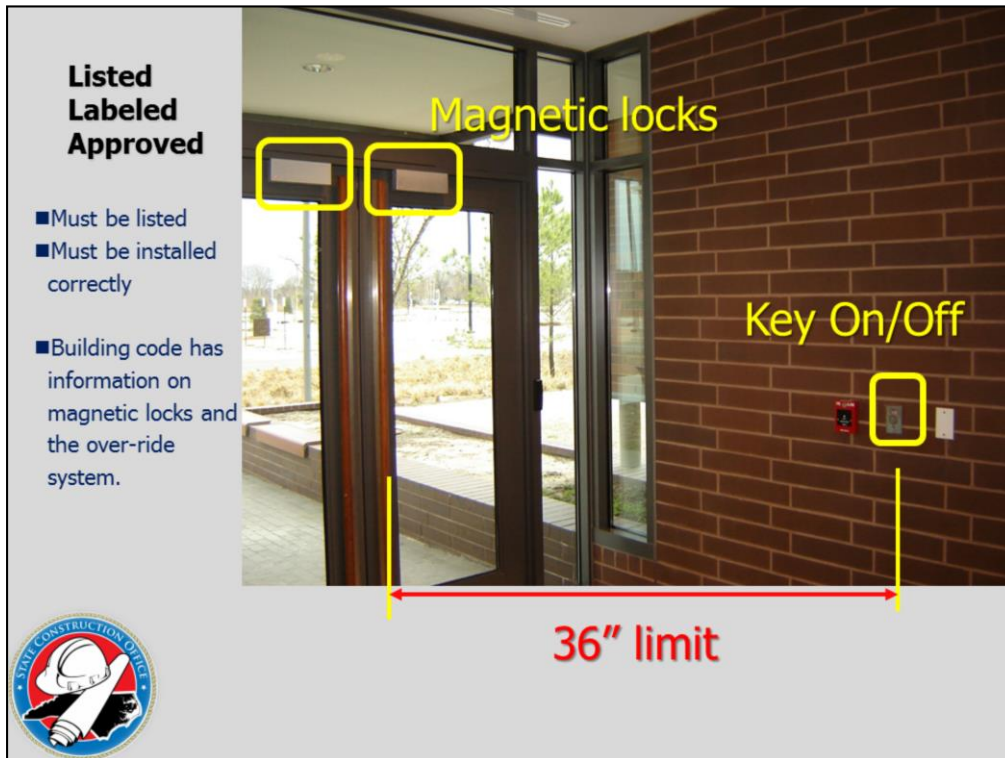
This is the view after the nylon ties were installed and the bus bars supported.

Our inspectors are not prepared to tell a contractor how to modify a switchboard.

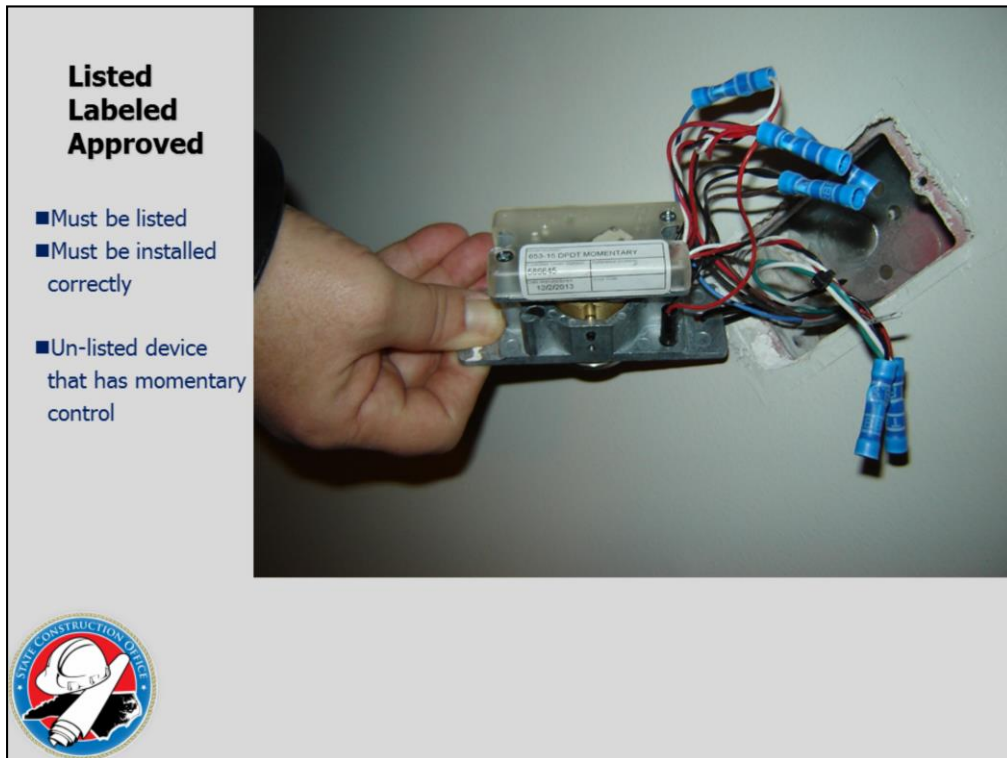
Now it gets a Third Party Label and is approved by inspector



Then we were provided a final report by the third party agency and their label went on the equipment.



Seems like every one wants to use magnetic locks these days. The building code is very specific about the use of a magnetic lock. The rules change with the occupancy and the tenant. Please don't expect your hardware specifier to get the code right on these devisees. Because of the use of power to the locks and the access control system your site electrician will be involved. If his boxes are not installed in the code required location you could spend significant time making repairs; because this system does impact LIFE SAFETY.

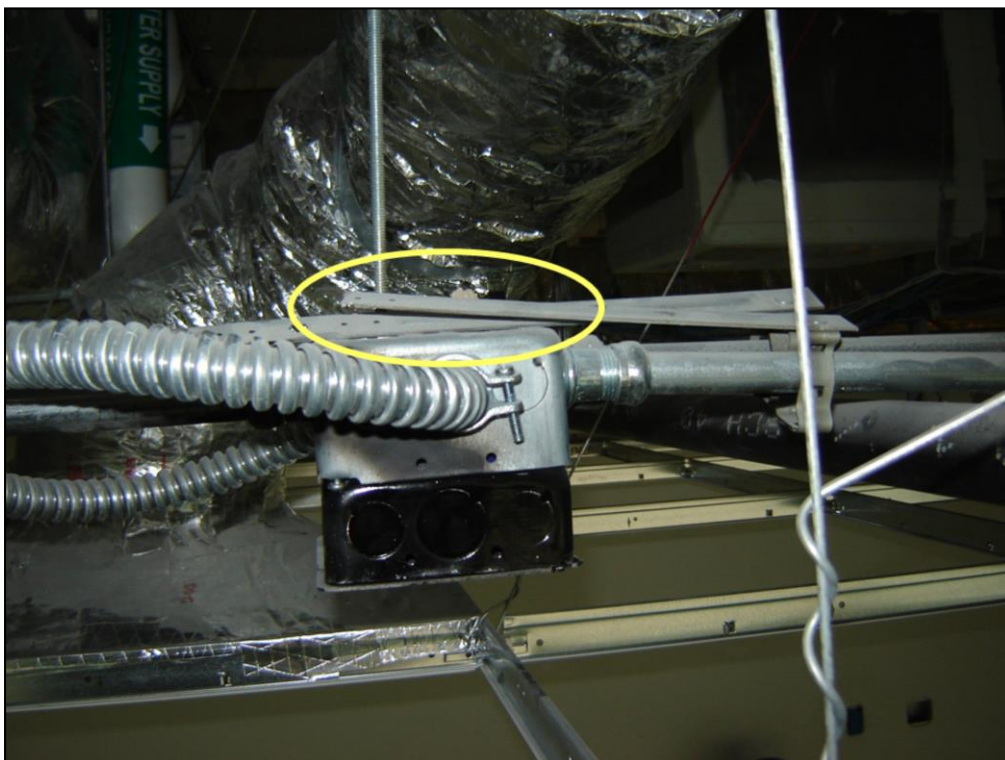


This is a look at the locks back side – also used in the previous picture. It has a momentary trigger. I think that keeps it from being the ON/OFF type of lock required by the NC building code.

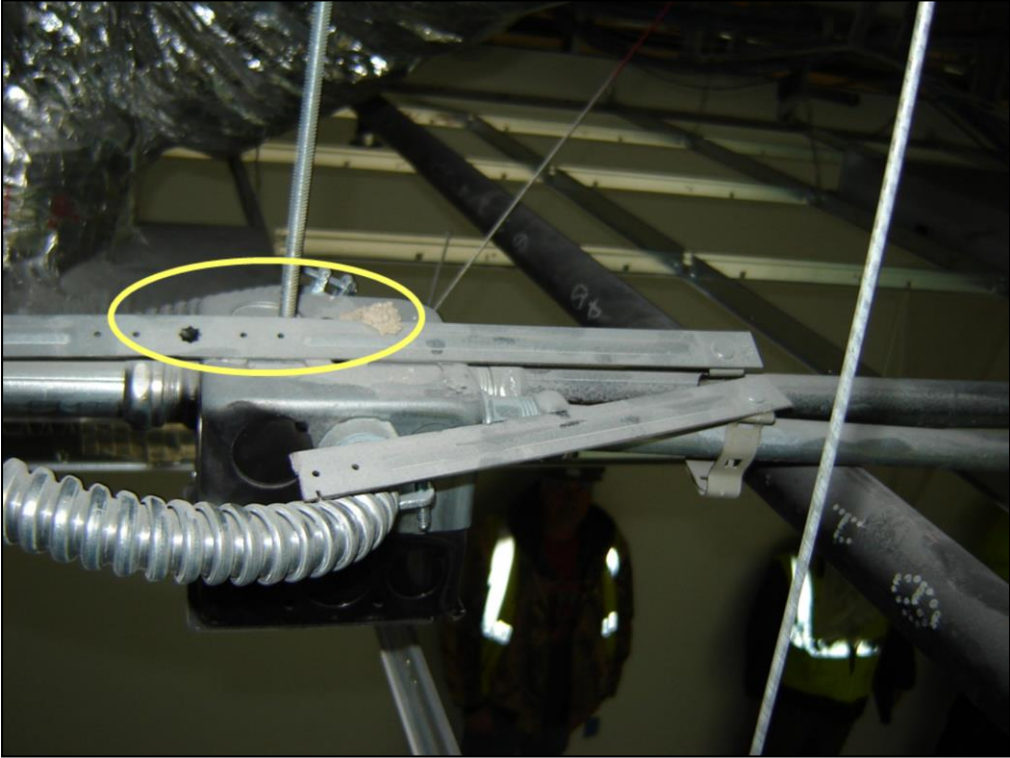
Additionally this lock is not Third Party Listed, we talked to the factory. Based on the way it operates I suspect it can not be listed to meet the UL standard for Special Locking Arrangements.

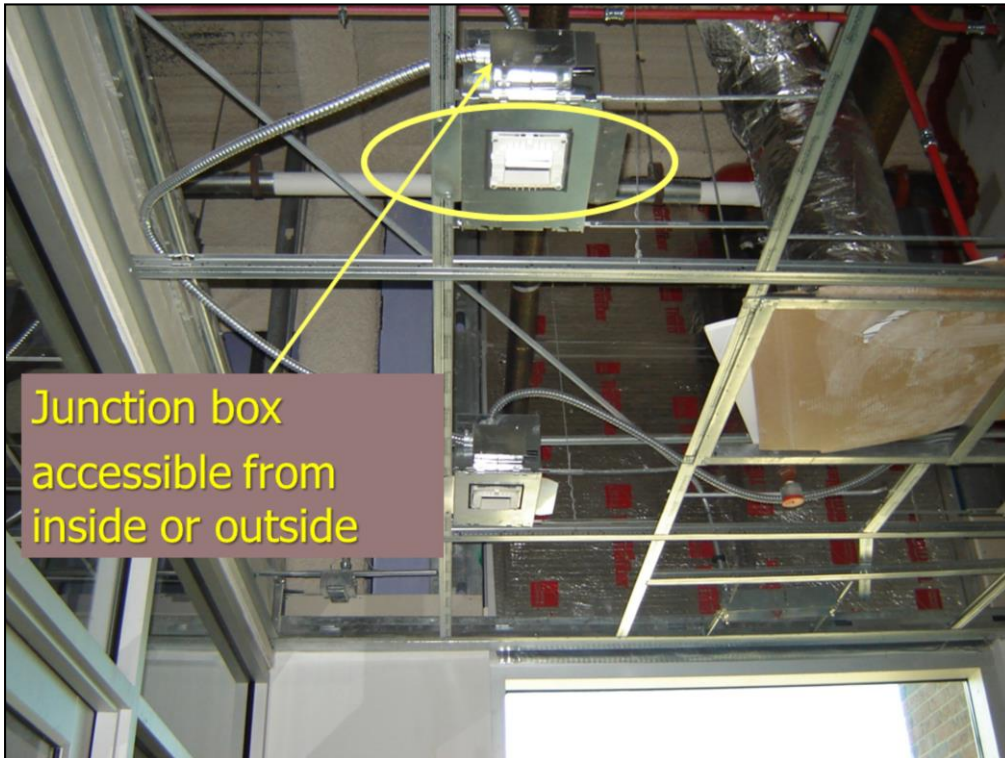


Conduit support device called a "Helicopter" – I am learning to hate these things. Primarily because they are so often misused. They are not supposed to be bent or broken and are supposed to use two screws. Read the instructions.



I can almost understand the logic on the last picture but this one is an attempt to deceive the inspector. From the floor it looked pretty good.



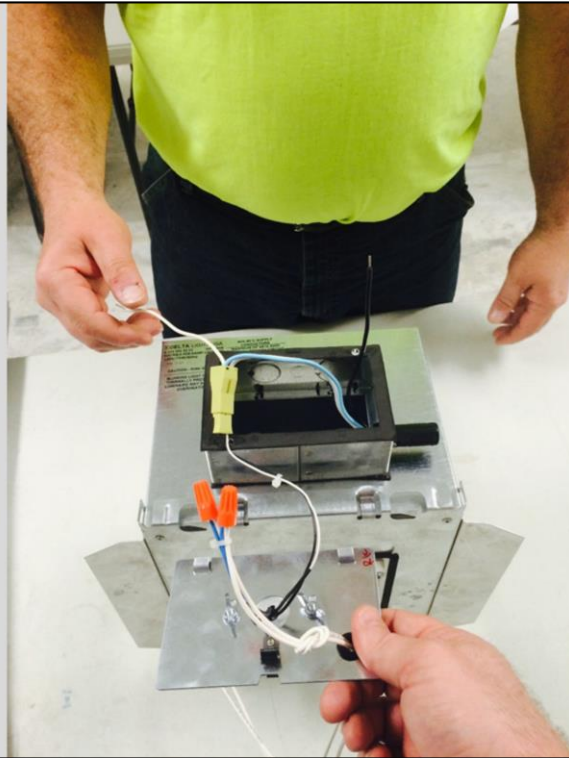


Lets look at another new fixture type. It has a third party label but this is going to be a problem if you buy it.

I found this on a recent project. The manufacturer never thought about how to meet the NEC.

**Listed
Labeled
Approved**

- Must be listed
- Must be installed correctly
- Example
 - Sealed ceiling
 - Where is the access?



Better view of the fixture



This is a 4 inch opening. I cannot put my hands on the wiring to install wire nuts. The contractor did not leave enough wire to meet the NEC requirements.

Listed Labeled and Approved

Just because it has a label
does not mean it will be
approved for the site.



300.14 Length of Free Conductors at Outlets, Junctions, and Switch Points. At least 150 mm (6 in.) of free conductor, measured from the point in the box where it emerges from its raceway or cable sheath, shall be left at each outlet, junction, and switch point for splices or the connection of luminaires or devices. Where the opening to an outlet, junction, or switch point is less than 200 mm (8 in.) in any dimension, each conductor shall be long enough to extend at least 75 mm (3 in.) outside the opening.

Exception: Conductors that are not spliced or terminated at the outlet, junction, or switch point shall not be required to comply with 300.14.

300.15 Boxes, Conduit Bodies, or Fittings — Where Required. A box shall be installed at each outlet and switch point for concealed knob-and-tube wiring.

Fittings and connectors shall be used only with the specific wiring methods for which they are designed and listed.

Where the wiring method is conduit, tubing, Type AC cable, Type MC cable, Type MI cable, nonmetallic-sheathed cable, or other cables, a box or conduit body shall be installed at each conductor splice point, outlet point, switch point, junction point, termination point, or pull point, unless otherwise permitted in 300.15(A) through (L).

(A) **Wiring Methods with Interior Access.** A box or conduit body shall not be required for each splice, junction, switch, pull, termination, or outlet points in wiring methods with removable covers, such as wireways, multioutlet assemblies, auxiliary gutters, and surface raceways. The covers shall be accessible after installation.

(B) **Equipment.** An integral junction box or wiring compartment as part of approved equipment shall be permitted in lieu of a box.

(C) **Protection.** A box or conduit body shall not be required where cables enter or exit from conduit or tubing that is used to provide cable support or protection against physical damage. A fitting shall be provided on the end(s) of the conduit or tubing to protect the cable from abrasion

not spliced or terminated and shall be accessible after installation.

(G) **Direct-Buried.** A box or conduit body shall be installed at each tap in direct-buried wiring.

(H) **Insulated Discontinuity.** A box or conduit body shall be installed at each splice or connection supplied by nonmetallic-sheathed cable.

(I) **Enclosures.** A box or conduit body shall be installed at each splice, switch, or pull point in an enclosure, cutout box, in an enclosure, or in a raceway.

(J) **Luminaires.** A box or conduit body shall be installed at each luminaire.

(K) **Embedded.** A box or conduit body shall be installed at each splice where the conductor is embedded in a wall or ceiling.

(L) **Manholes and Handholes.** A box or conduit body shall not be required for handhole enclosures or handhole enclosures for electrical equipment. The provisions of Part V shall apply for handhole enclosures.

300.16 Raceway

(A) **Box, Conduit, or Fitting.** A box or conduit body shall be installed at each splice, junction, switch, pull, termination, or outlet points in wiring methods with removable covers, such as wireways, multioutlet assemblies, auxiliary gutters, and surface raceways. The covers shall be accessible after installation.

It can be listed and labeled but it still has to meet the NEC requirements.

So the Phone Rings ...

- The fire dampers on a new building won't reset after a fire alarm system test
 - Building was specified with 120 volt dampers
 - Apparently 24 volt dampers were installed at the end of project
 - Someone added 2 KVA, 24 volt transformers
 - Capable of 80 amps on the secondary
 - But the 20 amp, 120 volt wire was provided by electrician
 - Fuses were added to the wiring compartment – then disabled
 - A problem was found with dampers at the Final Inspection but GC had it "fixed"



The fire dampers on a new building won't reset after a fire alarm system test

**Listed
Labeled
Approved**

This 2 kva transformer is
Listed and Labeled

It was never inspected

Someone added fuses in the
compartment (wrong size)

All fuses were bypassed

The 12 AWG wire was heat
damaged



This 2 kva transformer is Listed and Labeled

It was never inspected

Someone added fuses in the compartment (wrong size)

All fuses were bypassed

The 12 AWG wire was heat damaged



The fix ... the contractor is removing the 2 kva transformers and installing 75 VA transformers at each damper ... working nights and weekends.

So the Phone Rings ...

■ The security camera system keeps locking up

- Owners have a three year old camera system they hate
- It has specialty software that is difficult to trouble shoot
- They believe the “installers” had the same problem
- A different security system provider explained that there was a failure to calculate the bandwidth of the equipment specified.
- Owner needed to add components and rewire the system
- Now it works



Security – Like elevators, access control, lighting, data and kitchen equipment there are now “Specialist” who want to design security camera systems. Just because someone is good at figuring out some part of a system it does not make them the best at specifying the actual equipment. For the camera equipment currently being sold you need to cross check the design with a “data” guy.

Security Equipment

A performance specification for security equipment yielded this installation.

There are a number of problems with the system that was deployed.



A performance specification for security equipment yielded this installation.

If the final product looks like this photo for security installation, beware.

One problem on this project - the security designer did not see IP cameras as a data issue or require the installation to be built in accordance within typical data specifications.

The system problem as described to me: “what you have is like trying to shove an elephant down a fire hose ... what comes out don’t look much like elephant”

Chapter 9

[F] **906.5 Conspicuous location.** Portable fire extinguishers shall be located in conspicuous locations where they will be readily accessible and immediately available for use. These locations shall be along normal paths of travel, unless the fire code official determines that the hazard posed indicates the need for placement away from normal paths of travel.

[F] **906.6 Unobstructed and unobscured.** Portable fire extinguishers shall not be obstructed or obscured from view. In rooms or areas in which visual obstruction cannot be completely avoided, means shall be provided to indicate the locations of extinguishers.

[F] **906.7 Hangers and brackets.** Hand-held portable fire extinguishers, not housed in cabinets, shall be installed on the hangers or brackets supplied. Hangers or brackets shall be securely anchored to the mounting surface in accordance with the manufacturer's installation instructions.

[F] **906.8 Cabinets.** Cabinets used to house portable fire extinguishers shall not be locked.

Exceptions:

1. Where portable fire extinguishers subject to malicious use or damage are provided with a means of ready access.

this code, the *International Fire Code*, and relevant laws, ordinances, rules and regulations, as determined by the fire code official.

[F] **907.1.2 Fire alarm shop drawings.** Shop drawings for fire alarm systems shall be submitted for review and approval prior to system installation, and shall include, but not be limited to, all of the following:

1. A floor plan that indicates the use of all rooms.
2. Locations of alarm-initiating devices.
3. Locations of alarm notification appliances, including candela ratings for visible alarm notification appliances.
4. Location of fire alarm control unit, transponders and notification power supplies.
5. Annunciators.
6. Power connection.
7. Battery calculations.
8. Conductor type and sizes.
9. Voltage drop calculations.

The following is from 907.1.2 and details the requirements of the shop drawings. It is not a small list. And it might require significant work for both the designer and the contractor. let me enlarge it for you.

Remember designers – SCO does not review the fire alarm shop drawings – we have contracted with you to review the drawings prior to installation. We then back check at the final inspection.

Chapter 9

FIRE PROTECTION SYSTEMS

10. Manufacturers' data sheets indicating model numbers and listing information for equipment, devices and materials.
11. Details of ceiling height and construction.
12. The interface of fire safety control functions.
13. Classification of the supervising station.

[F] 907.1.3 Equipment. Systems and components shall be listed and approved for the purpose for which they are installed.

[F] 907.2 Where required—new buildings and structures. An approved fire alarm system installed in accordance with the provisions of this code and NFPA 72 shall be provided in new buildings and structures in accordance with Sections 907.2.1 through 907.2.23 and provide occupant notification in accordance with Section 907.5, unless other requirements are provided by another section of this code.

A minimum of one manual fire alarm box shall be provided in an approved location to initiate a fire alarm signal for fire alarm systems employing automatic fire detectors or waterflow detection devices. Where other sections of this code allow elimination of fire alarm boxes due to sprinklers, a single fire alarm box shall be installed.

sole purpose of allowing a live voice announcement from an approved, constantly attended location.

[F] 907.2.2 Group B. A manual fire alarm system shall be installed in Group B occupancies where one of the following conditions exists:

1. The combined Group B *occupant load* of all floors is 500 or more.
2. The Group B *occupant load* is more than 100 persons above or below the lowest level of exit discharge.
3. The Group B *fire area* contains a Group B ambulatory health care facility.

Exception: Manual fire alarm boxes are not required where the building is equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1 and the occupant notification appliances will activate throughout the notification zones upon sprinkler waterflow.

[F] 907.2.2.1 Group B ambulatory health care facilities. Fire areas containing Group B ambulatory health care facilities shall be provided with an electronically supervised automatic smoke detection system installed within the ambulatory health care facility and in public

The list also include items 10-13 as listed.

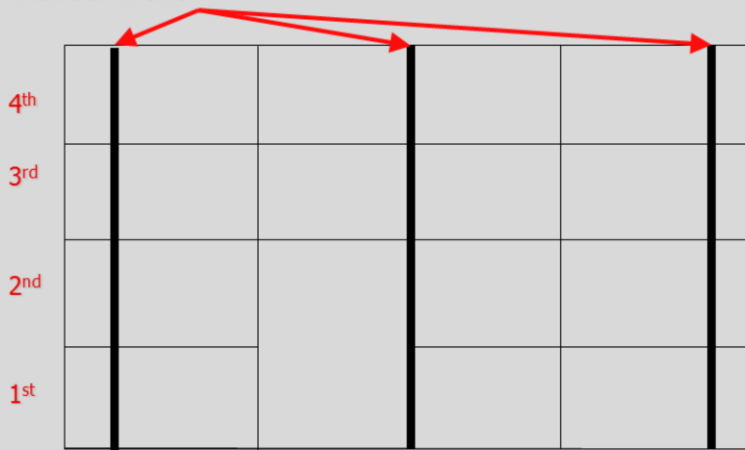
Note that all systems and components must be listed and approved for the purpose installed.

Now assuming you know to use Chapter 9, NFPA 72,

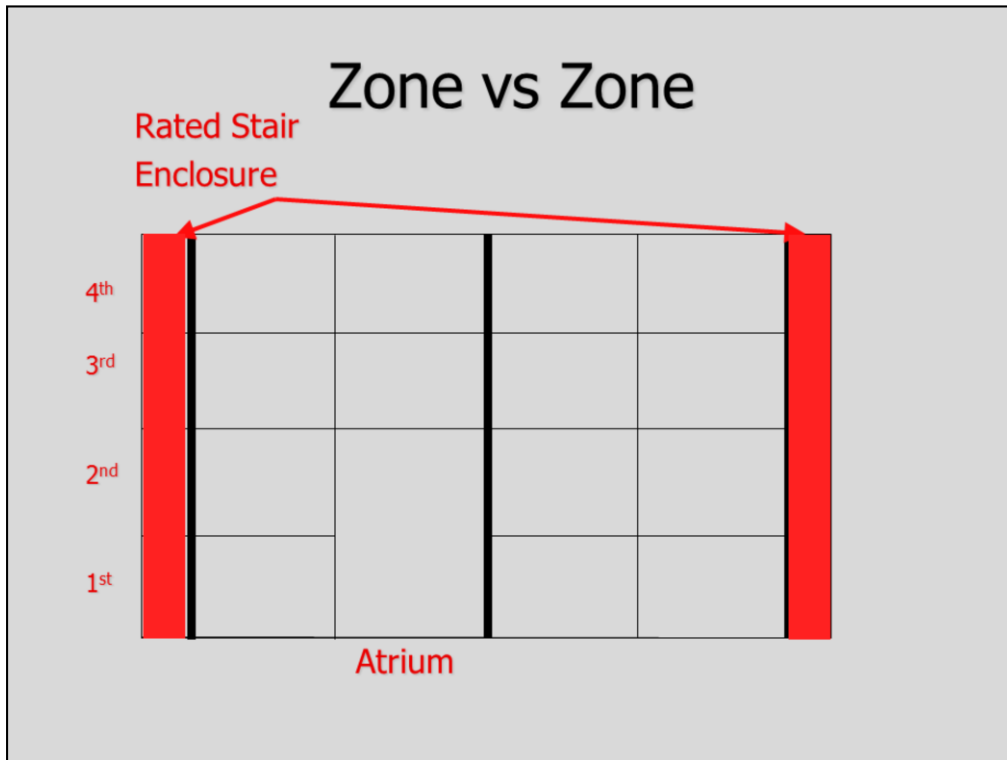
For Accessibility use Chapter 11 and ANSI 117.1 (2009) then you have a good start at understanding the minimum requirements. It does not mean you system will work that is just the minimum.

Zone vs Zone

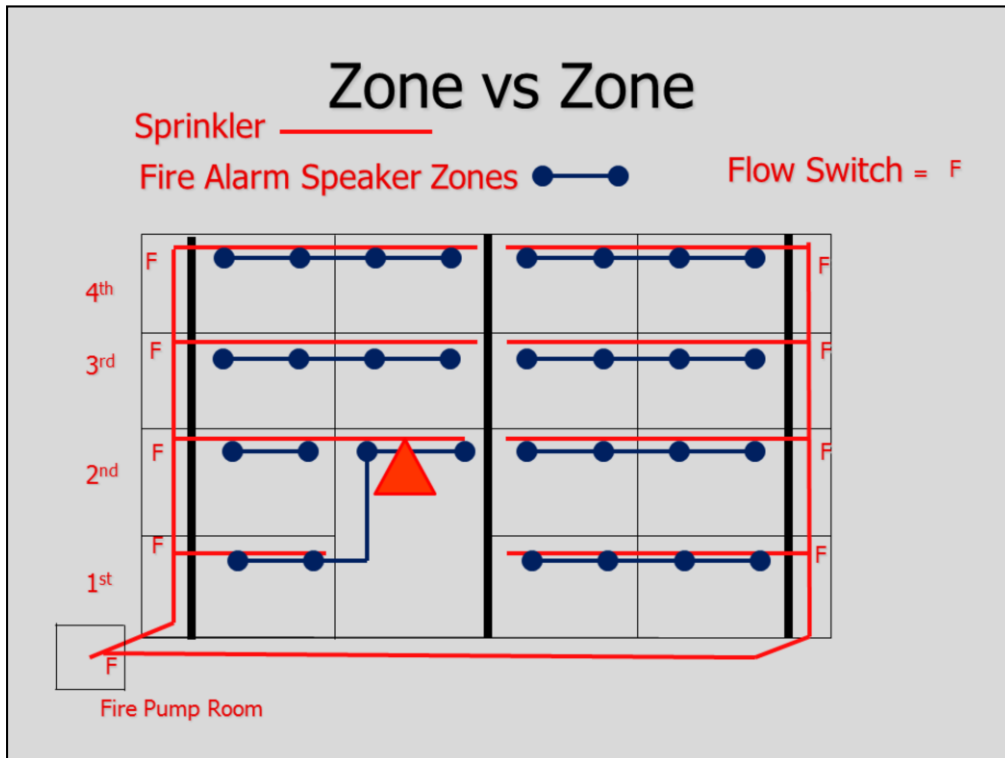
Rated Walls



Lets build a model 4 story building with a center fire wall and rated stair wells.



Rated stairs and an atrium type area



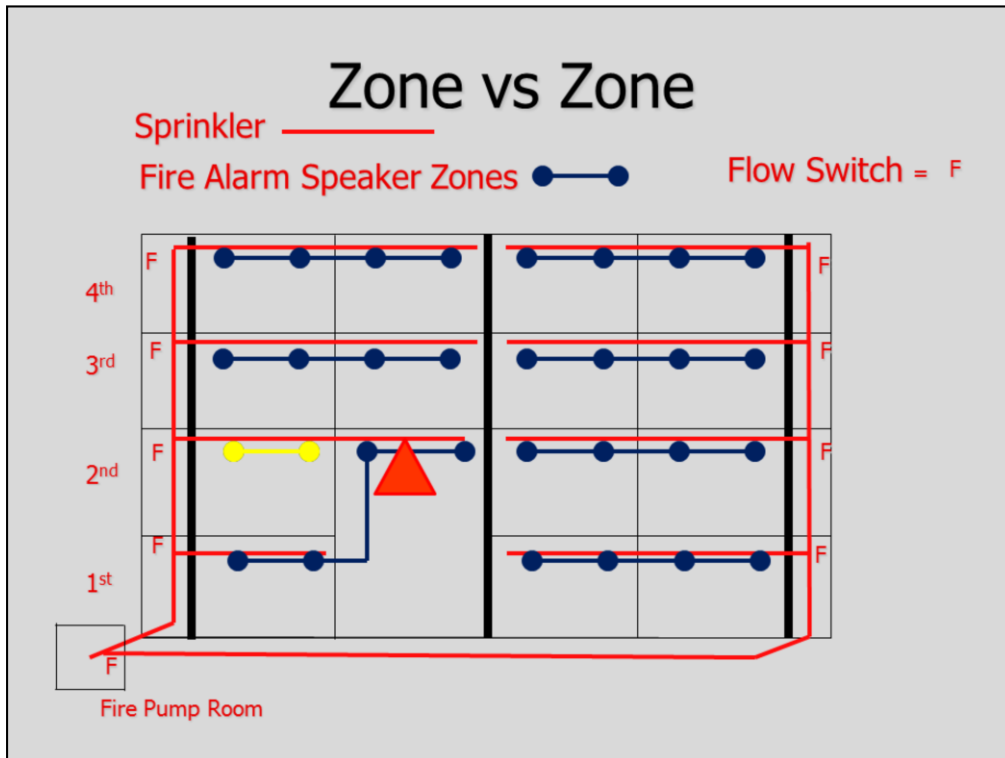
Add sprinkler and

Lets put speaker zones in the facility .

For simplicity lets assume we will only move the people in the actual fire zone.

YES I am oversimplifying to help make a point regarding the coordination of fire alarm zones with sprinkler zones.

Lets add flow switches to find the fire.



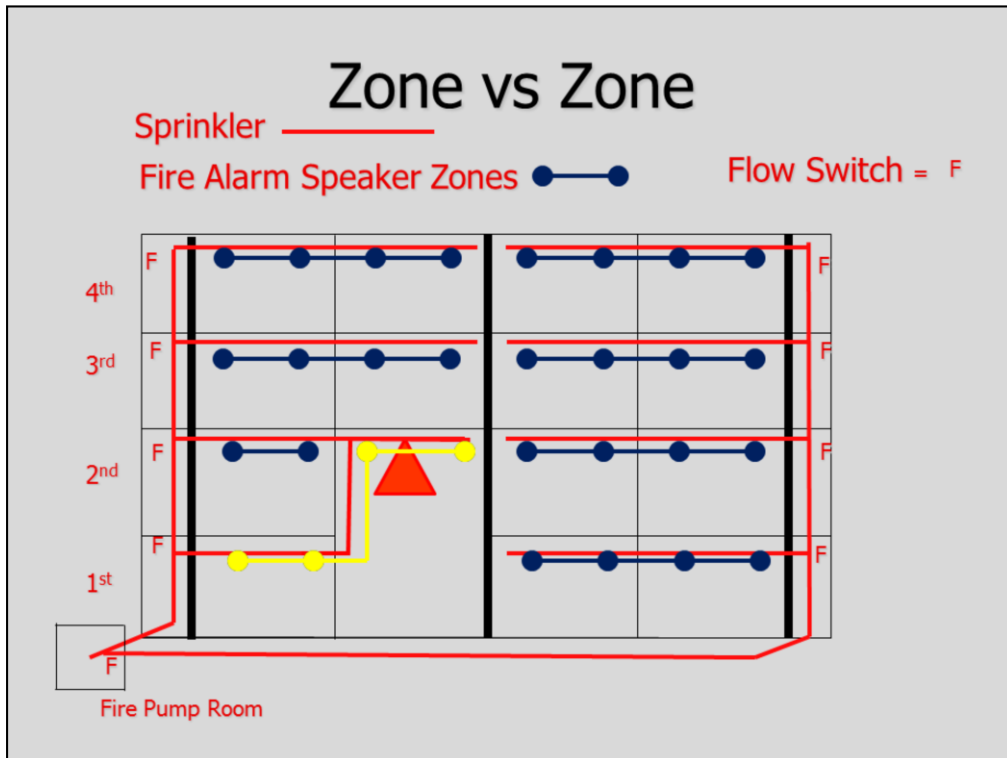
Activate the sprinkler

Flow

See the zone in alarm

That is a problem the atrium is in a different section.

This coordination problem is real, though greatly over simplified.



This is the fix.

Who is to blame?

Generator requires service from both sides



Generator requires service from both sides – hate to be checking this on a snowy night. We are ordering an access platform.

Frozen Coils

HVAC renovation:

Received new control system

Freeze stat tripped but was not hard wired to the dampers.

The control system was programmed incorrectly and opened the dampers to 100%.

Coils froze and flooded the building.



Who's fault is it?



Frozen - HVAC renovation:

Received new control system

Freeze stat tripped but was not hard wired to the dampers.

The control system was programmed incorrectly and opened the dampers to 100%.

Coils froze and flooded the building.



You can do something for an item to lose the approval for use.

In this case you cannot blame the electrician. When he left the site there was a building. The electrician did not remove the building.

SUMMARY

- Harmonic distortion must be considered
- Large non—linear loads can interact
- Specify Listed and Labeled Equipment
- Equipment must be suitable for the conditions
- Delegate Design at your own risk
 - “Specialist” may not understand the NC codes
 - Still need to coordinate electrical characteristics
- Designer must review the installation



Summary

Expect to see more “new technologies”

Harmonic distortion must be considered

Large non—linear loads can and typically do interact

Specify Listed and Labeled Equipment

Equipment must be suitable for the conditions

Delegate Design at your own risk

“**Specialist**” may not understand the NC codes

Still need to coordinated electrical characteristics

Designer must review the installation

...QUESTIONS

Questions?



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Are there any question on the material or on some issue we should have covered?