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Kitchen Fire Suppression Systems Post-Event Analysis

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October 22, 2014



Presentation Outline

1. Overview of System Components
2. Regulations
3. UL300 and Wet Chemical Systems
4. Commercial Kitchen Statistics
5. System Components
6. Inspection, Testing, and Maintenance
7. Inspections—Post Event
8. System Failure Examples



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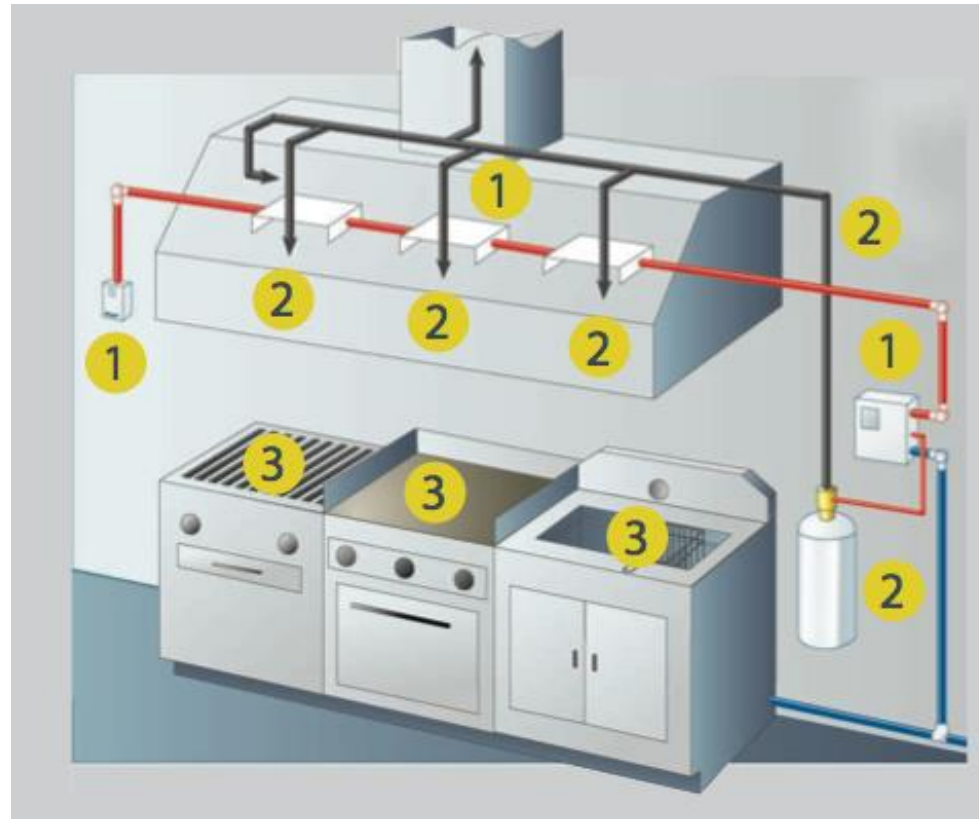
Kitchen Suppression Systems

OVERVIEW OF SYSTEM COMPONENTS

A Kitchen Suppression System

Component Overview

1. Heat detectors or manual pull
2. Agent cylinder and piping
3. Cooking appliances in coverage area



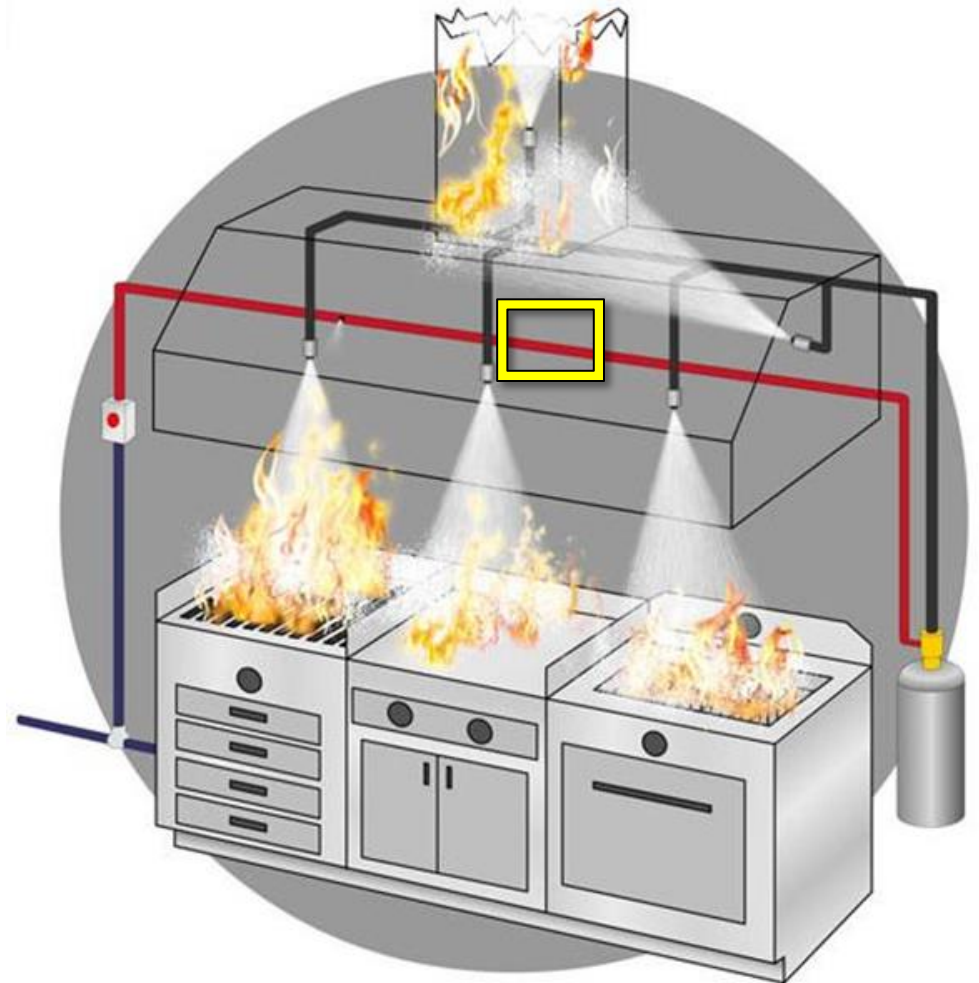


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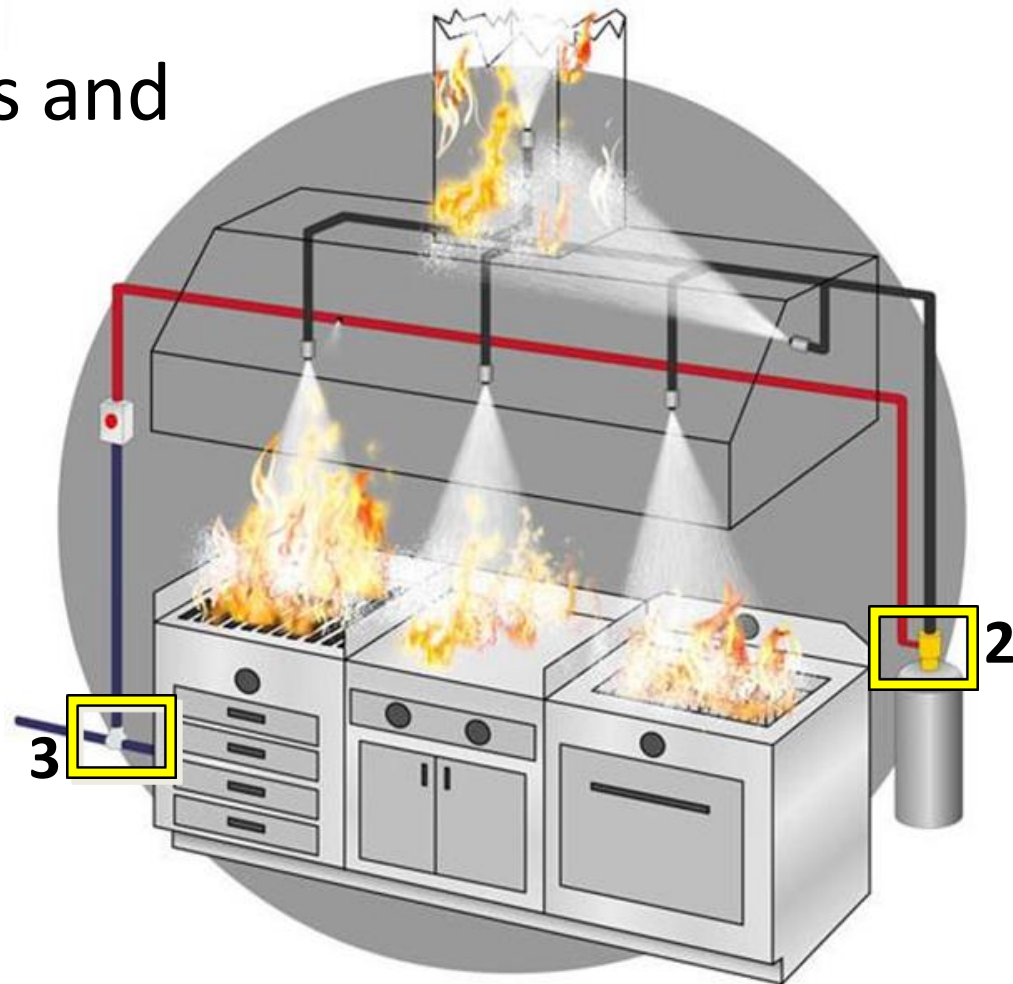
Actuation Sequence

1. Detector fuses



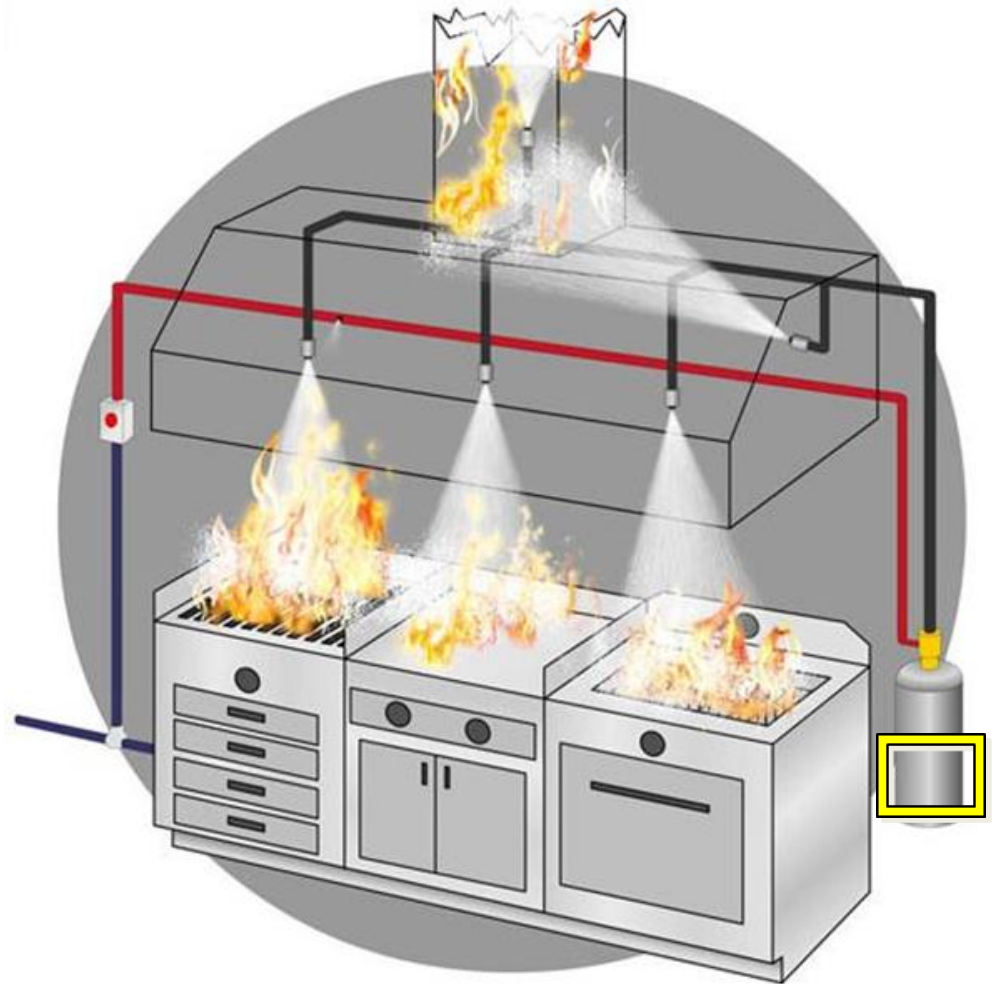
Actuation Sequence *(continued)*

2. Control valve opens and
3. Energy Source shut off



Actuation Sequence *(continued)*

4. Agent released





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Summary

- Agent
- Detection
- Releasing mechanism
- Fuel supply cutoff
- Nozzles

Kitchen Suppression Systems

REGULATIONS



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Kitchen Suppression System—Regulations

- Most states adopt IFC
- IFC adopts NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations (WWW.NFPA.ORG)*
- NFPA 96 requires the installation of a fire suppression system in all commercial cooking hoods and most commercial cooking appliances
- Two main types of systems:
 - Dry chemical systems (pre-1994)
 - Wet chemical systems (post-1994)

Kitchen Suppression System— Regulations *(continued)*

- NFPA 96 adopts NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, and NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*
- NFPA 96 requires compliance with ANSI/UL 300, *Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment*, for new/modified systems



NFPA 17—Dry Chemical Systems

- Minimum installation requirements for dry chemical fire-extinguishing systems.
- Dry chemical systems are not UL 300 listed, but operate in the same way.

Grandfathered Dry Chemical Systems

- Dry chemical systems are obsolete for commercial cooking applications.
- Many are still in service and can remain in service (grandfathered) in most jurisdictions until:
 - Changes in the cooking media
 - Repositioning or replacement of cooking equipment
 - They can no longer be maintained



NFPA 17A— Wet Chemical Systems

- Standard covers minimum installation requirements for:
 - Hoods
 - Plenums
 - Ductwork
 - Associated cooking appliances
- Also dictates the:
 - Design
 - Installation
 - Operation
 - Testing
 - Maintenance of wet chemical extinguishing systems



NFPA 17A— Wet Chemical Systems

(continued)

- Many Systems are “Pre-engineered” systems:
 - Designed and tested at the factory
 - The hazards protected are specifically limited as to type and size by a testing laboratory, based on actual fire tests
 - Strict configuration. No modifications.



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Kitchen Suppression Systems

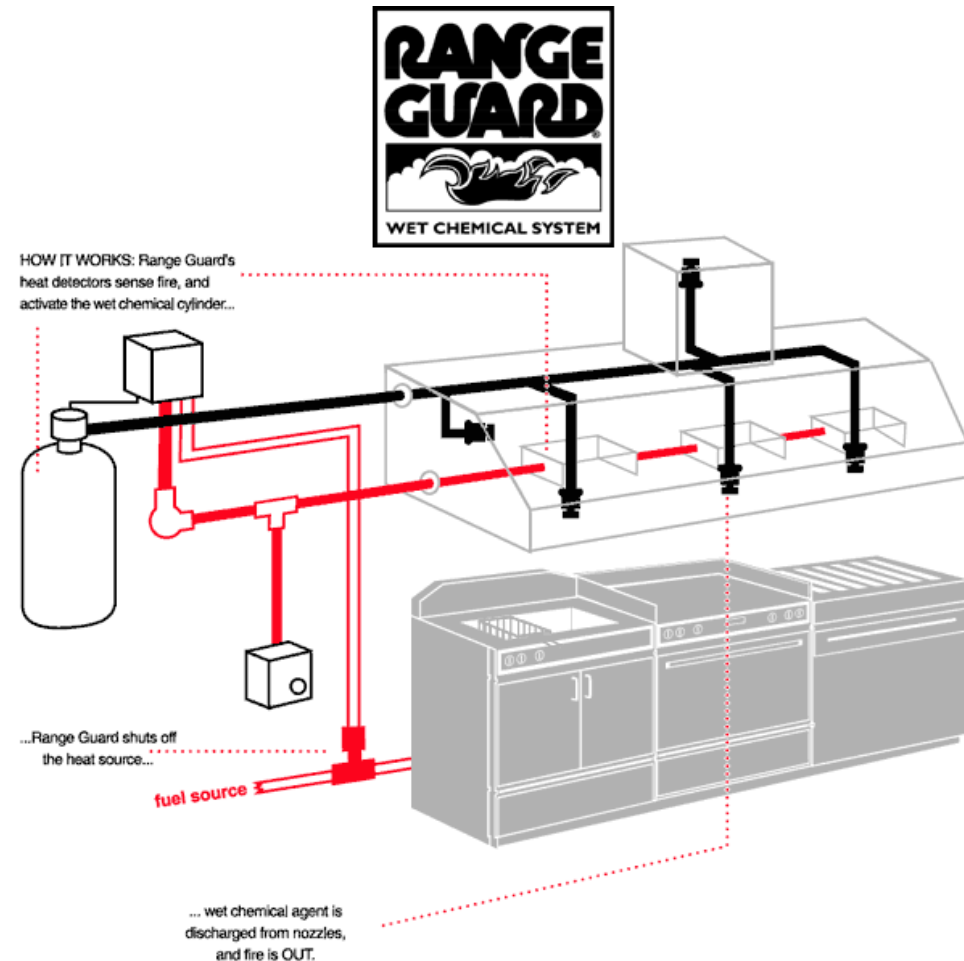
UL 300 AND WET CHEMICAL SYSTEMS

Wet Chem Systems— How The Agent Works



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- Wet chemical agent extinguishes fire by:
 - Saponifying the surface grease (converting it into combustion-resistant soap)
 - The cooling effects of water vaporization
 - Interrupting the chemical chain reaction of combustion





What is UL 300?

- Title: *“Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas”*
- Pre-UL 300 systems were based on tests from the 1960s
 - Auto-ignition temperature of animal fat is 550–600°F
 - Currently, 70–75% of commercial kitchens use vegetable oils in high-efficiency fryers
 - Auto-ignition temperature of vegetable oil is 685°F
- High-efficiency fryers heat faster and cool slower
- Fires are hot, stubborn, and difficult to extinguish



UL 300 *(continued)*

- Requirements for full-scale testing
- Requires strict performance of the system to extinguish fire in duct, hood, plenum, and cooking appliances

UL 300 Adoption



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STATE BY STATE UL 300 COMPLIANCE

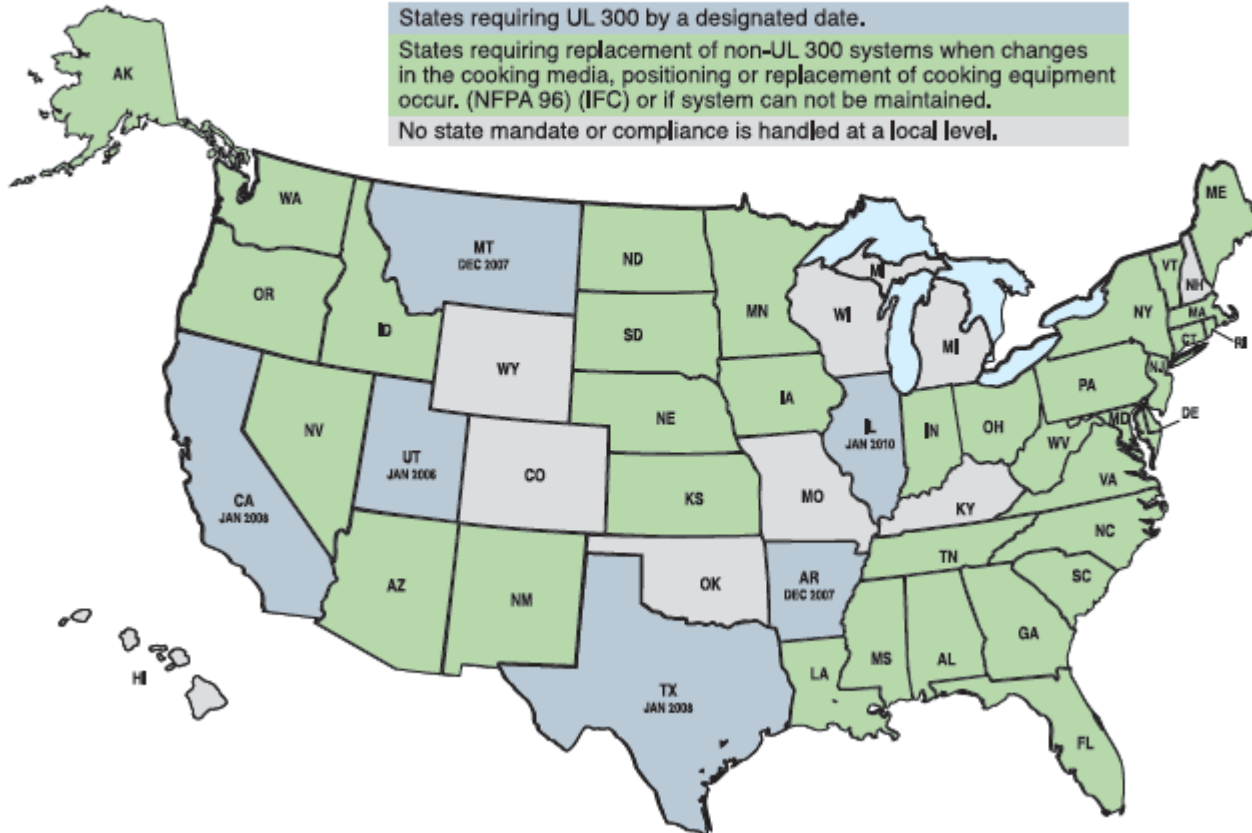
Information is based on the latest obtained as of January 2009.

It is a state by state look at UL300 requirements, local codes could vary. Always contact your local authority to verify requirements.

States requiring UL 300 by a designated date.

States requiring replacement of non-UL 300 systems when changes in the cooking media, positioning or replacement of cooking equipment occur. (NFPA 96) (IFC) or if system can not be maintained.

No state mandate or compliance is handled at a local level.





RESTAURANT FIRE PROTECTION CHANGES



UL 300 *(continued)*

- Test conditions:
 - Duct and hood are coated with grease
 - Appliances are located directly below the duct entrance to simulate a burning run back, worst case situation
 - Grease is ignited with a large burner
 - Tests are performed with a specified airflow through the hood and duct systems and with no airflow to evaluate performance under each condition
 - The system must successfully extinguish the fire in all areas without splashing or re-ignition of cooking grease



UL300 Test Success

- 5.1.2 When tested with a cooking appliance, an extinguishing system unit shall:
 - a) Result in the flame in the appliance to be completely extinguished upon complete discharge of the extinguishing agent;
 - b) For deep fat fryers, woks and ranges, not permit re-ignition of the grease for 20 minutes or;
 - until the temperature of the grease decreases at least 60F below its observed autoignition temperature, whichever is longer; and
 - c) For all appliances other than deep fat fryers, woks and ranges, not permit re-ignition of grease for 5 minutes



UL300

Test Conditions

- Minimum qty of extinguishing agent
- Minimum discharge rate
 - Max # of pipes and fittings is to be used
- Agent cylinder filled to rated capacity
- 50 F minimum ambient temperature
- Multiple runs:
 - Max and min nozzle heights
- Splash Tests using minimum nozzle heights



UL300 – Specific Appliances

- Deep Fat Fryers:
 - Commercial model, minimum 9” deep.
 - Average cooling rate of not more than 5 F/min.
 - Grease heated at maximum burner input rate to 600 F and then shut off
 - Liquid grease autoignition temperature > 685 F
 - Grease temperature measured 1” below surface
 - Grease level to the top of the drip board



UL300 – Specific Appliances

- Griddle:
 - Constructed of sheet metal, not less than 0.079” thick and 1” deep.
 - Filled with liquid grease to a depth of ¼”
 - One minute minimum freeburn



UL300 – Specific Appliances

- Range Top:
 - Commercial range top with variable configurations
 - Two vessels:
 - Cast iron skillet 13 – 14” diameter filled with 1” liquid grease
 - Stainless steel pot 10” diameter filled with 4” of liquid grease
 - Separate tests for each vessel
 - Worst-case extinguishment scenario used



UL300 – Specific Appliances

- Char broiler (70% lean steaks used some of these tests)
 - Mesquite wood
 - Lava, pumice or synthetic rock
 - Gas radiant
 - Electric
 - Upright
- Chain Broiler
- Wok

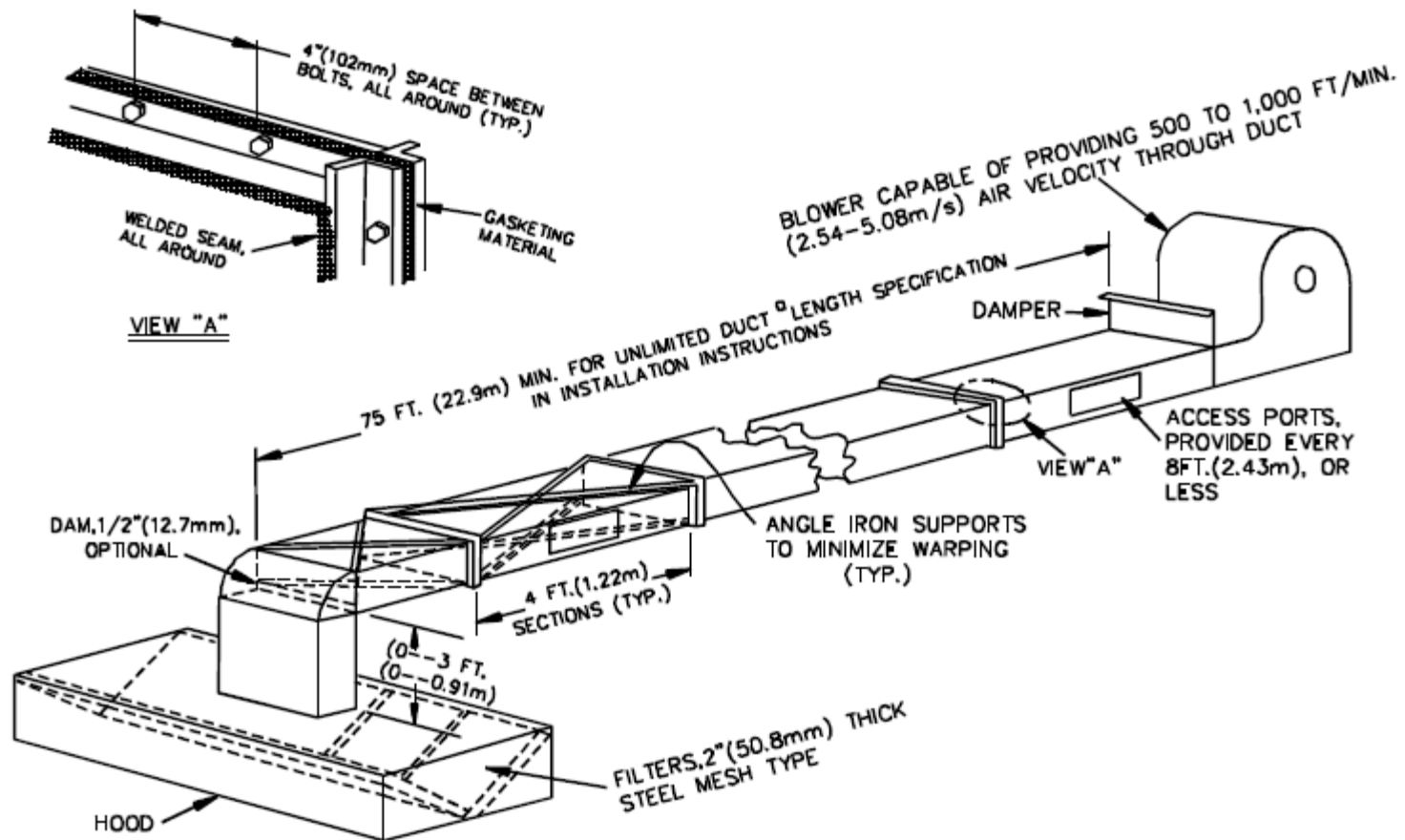
UL 300 – Other tested elements



- Hood
- Duct
- Filter and frame

Figure 6.1

Typical test apparatus for hood and duct (full scale) testing



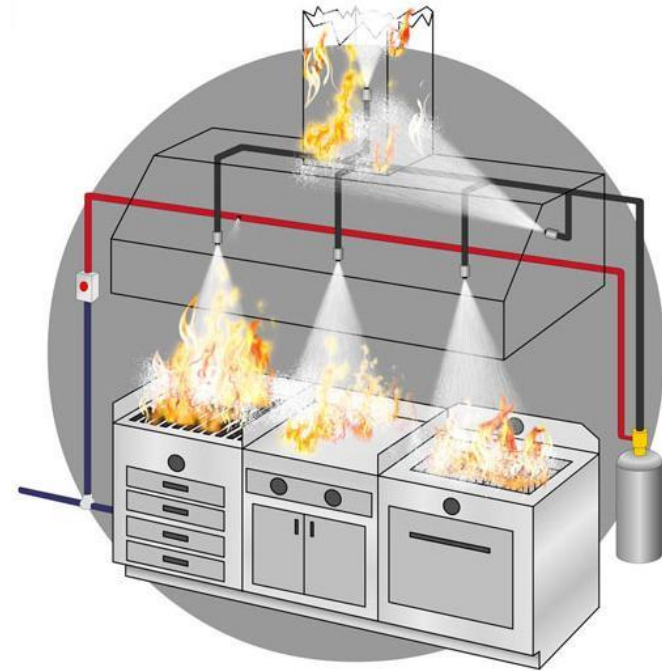
^aDuct may be located in the middle or end of the hood.



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Kitchen Suppression Systems

SYSTEM COMPONENTS



Commercial Kitchen Statistics

Source: NFPA

- ~8,500 fires a year
- 38% are confined
- 26% do not involve appliances
- Common appliance fire origins:
 - Fryers (3%)
 - Chimney/flue (3%)
 - Broilers (2%)
 - Ranges/stovetops (2%)
 - Grills (1%)
 - Ovens (1%)
 - Grease hood and exhaust fans (1%)



System Components—Kidde Cylinders

- 5 different sized cylinders
- Each cylinder is pressurized with nitrogen or air to 175 psig



System Components—Ansul Cylinders

- DOT specification
- Manufacturer
- Date
- Serial number
- Weight

AGENT TANK ASSEMBLY

The agent tank shipping assembly (3-Gallon, Part No. 429862, and 1.5 Gallon, Part No. 429864) consists of a stainless steel tank and an adaptor/tube assembly. The adaptor/tube assembly contains a burst disc. The burst disc prevents agent leakage due to significant temperature fluctuations in the area where the tank is located. Under normal conditions, the tank requires hydrostatic testing every twelve years. The date of manufacture is stamped on the tank nameplate.

The tank is shipped uncharged and must be filled with only ANSULEX Low pH Liquid Fire Suppressant during installation.

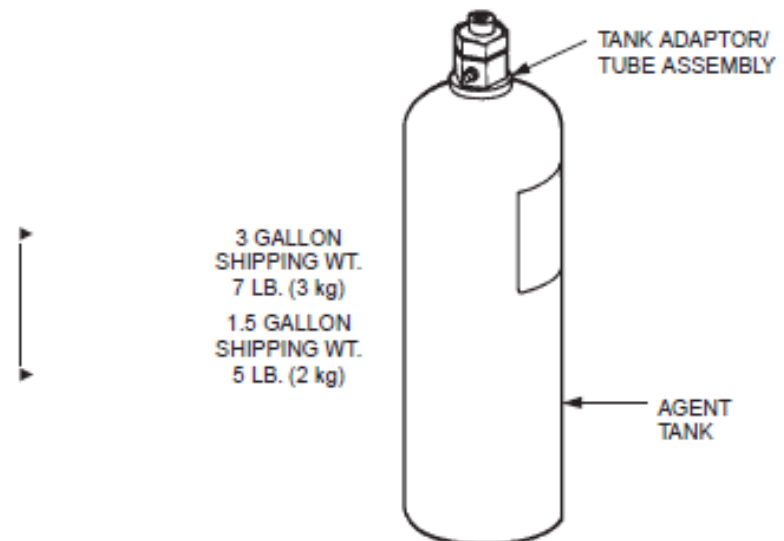
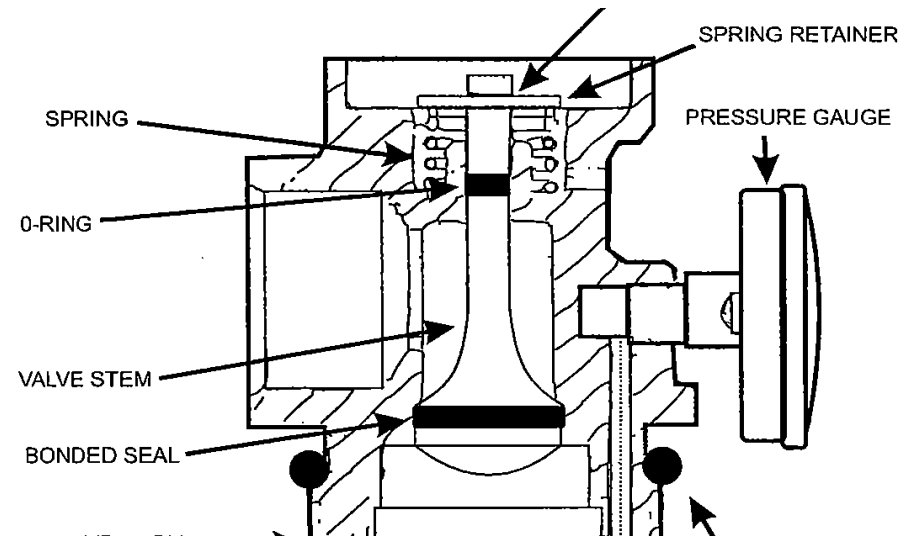
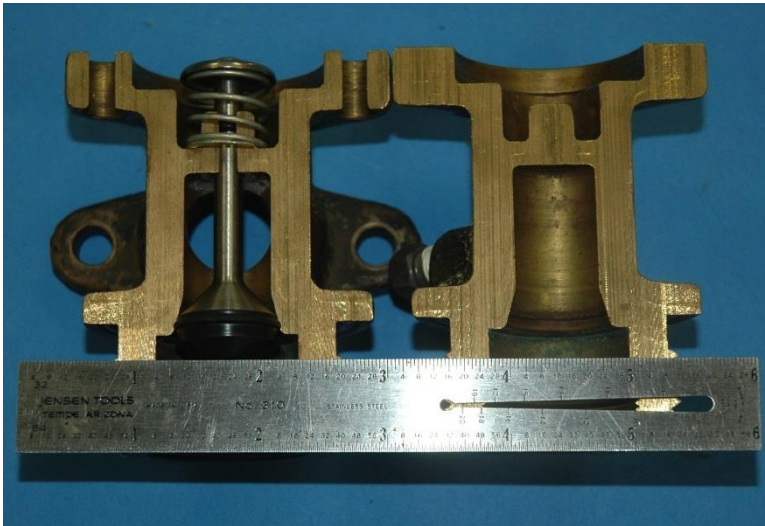


FIGURE 7
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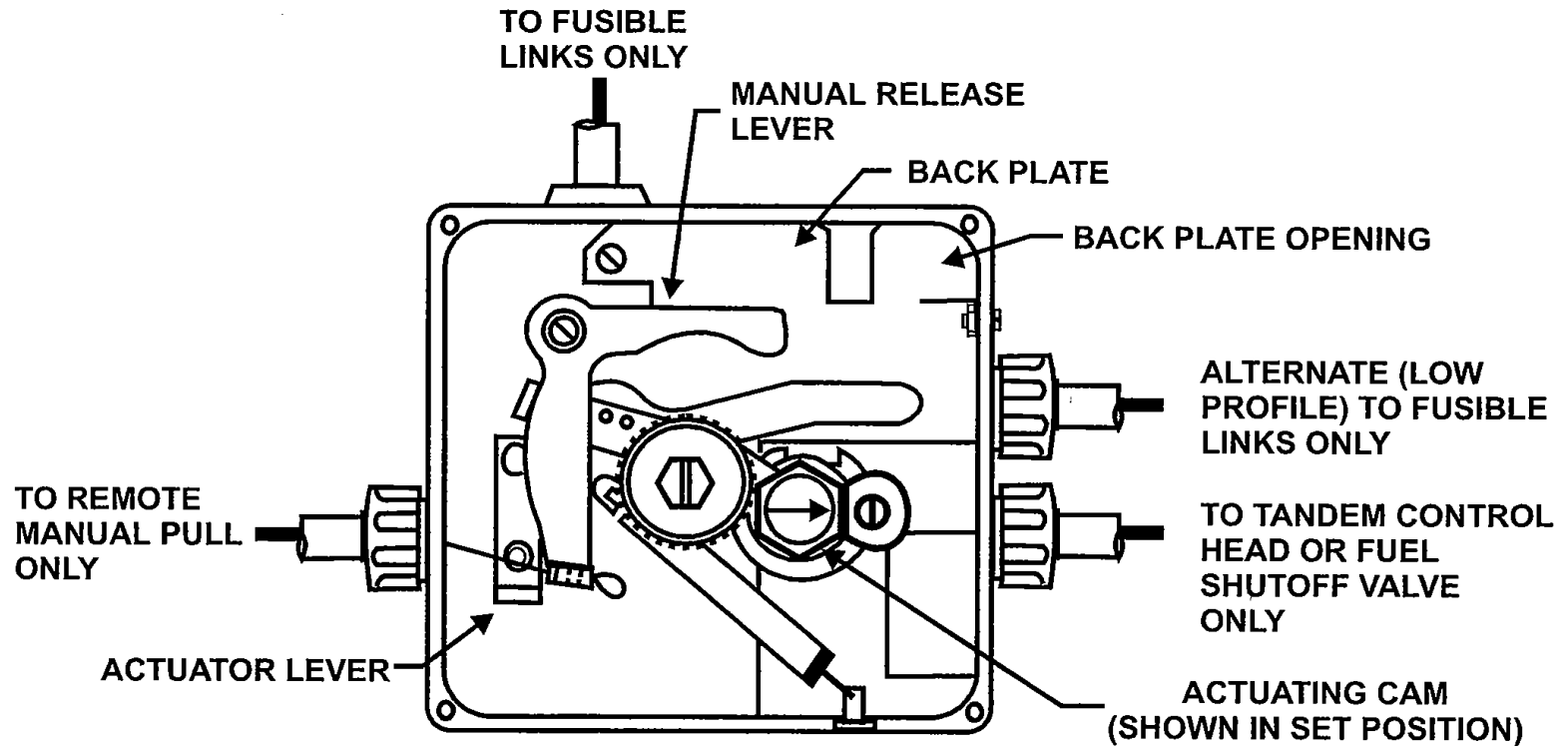


System Components— Kidde Cylinder Valve





System Components— Mechanical Control Head





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System Components— Pneumatic Control Head



System Components— Electric Control Head



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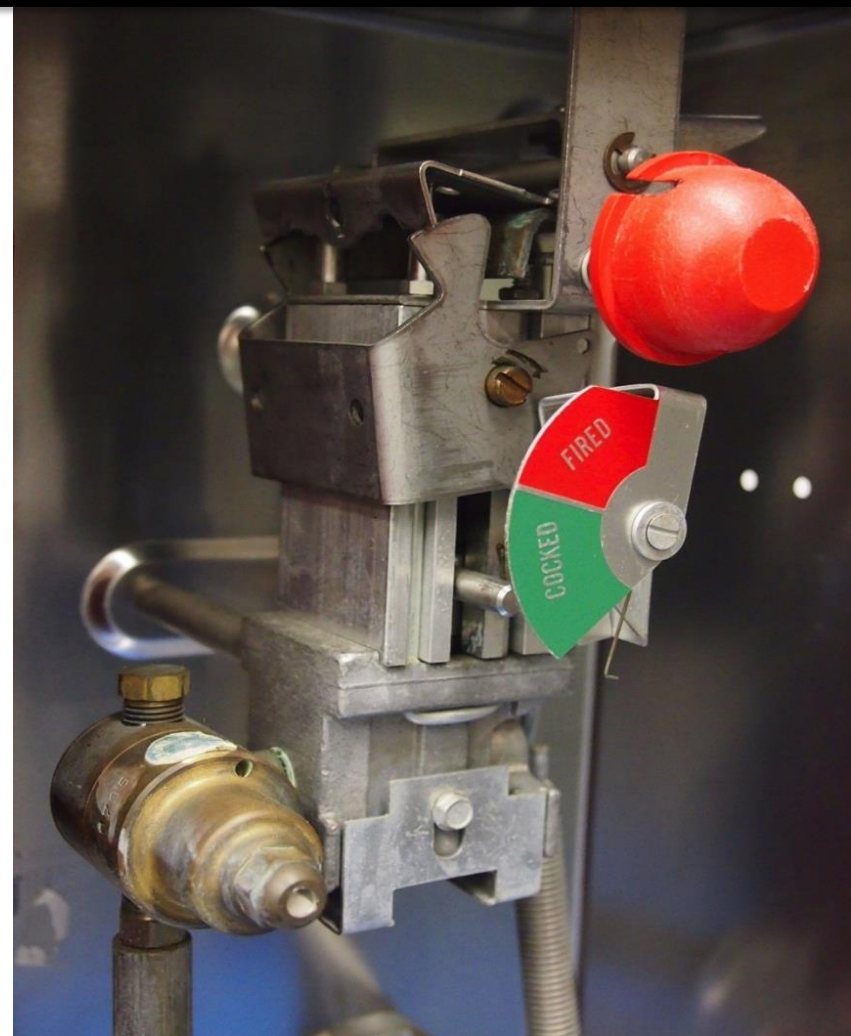
- Used on systems equipped with thermostats
- Requires power
- Detectors close power circuit to control head
- A solenoid releases a spring-loaded plunger which depresses the valve stem in the cylinder valve, discharging the contents of the cylinder



System Components— Ansul Releasing Mechanism

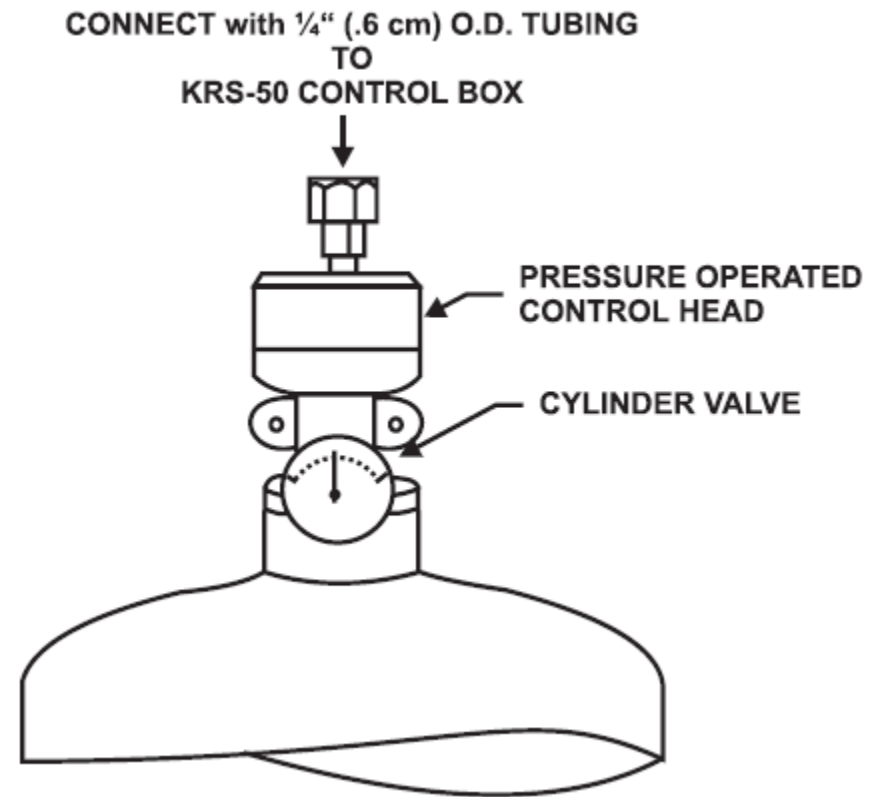


Pressure-operated actuator



System Components— Kidde Pressure Operated Actuator

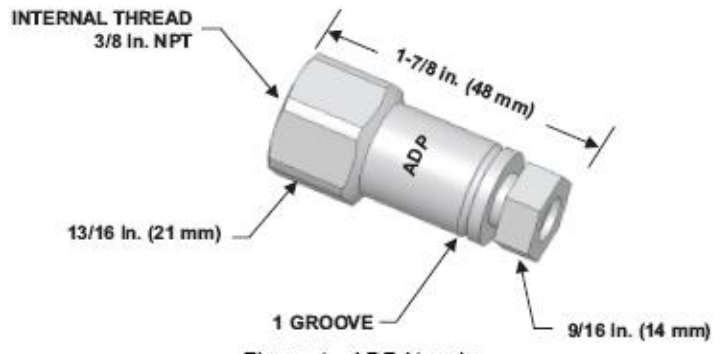
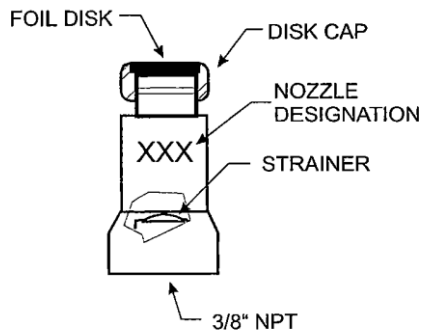
- Used with the KRS-50/A+ control
- Contains a piston that is driven down by CO₂ pressure
- The piston will remain in the “discharged” position as long as CO₂ pressure is maintained



System Components— Kidde Nozzles



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- **Seven types:**

- Appliance/duct/plenum nozzle (ADP)—1 groove
- Fryer nozzle (F)—2 grooves
- Mesquite nozzle (DM)—0 grooves
- Range nozzle (R)—4 grooves
- Gas radiant/wok nozzle (GRW)—3 grooves
- Low proximity fryer (LPF)—2 grooves in 1 and 4 position
- Low proximity range (LPR)—0 grooves (blunt shape)

System Components— Ansul Nozzles

NOZZLES

► There are twelve types of discharge nozzles each designed to distribute the liquid agent in a uniform pattern throughout the hazard area:

- | | |
|-----------------|-----------------|
| ► 1. 1W Nozzle | 7. 245 Nozzle |
| 2. 1N Nozzle | 8. 260 Nozzle |
| 3. 1/2N Nozzle | 9. 290 Nozzle |
| 4. 3N Nozzle | 10. 2120 Nozzle |
| 5. 2W Nozzle | 11. 1F Nozzle |
| ► 6. 230 Nozzle | 12. 1100 Nozzle |

Although these nozzles are similar in appearance and have certain common parts, the tip of each nozzle is designed for a specific application and must only be used in those areas. See Nozzle Application Chart in Section IV – System Design, for individual nozzle usage.

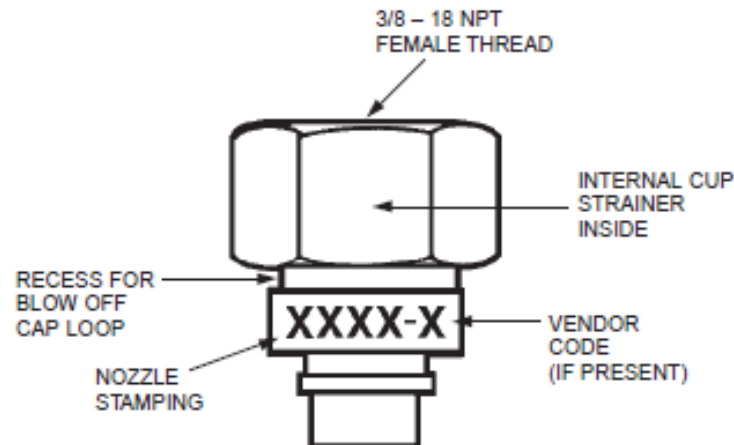


FIGURE 13

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System Components—Ansul Nozzles

(continued)

RUBBER BLOW-OFF CAPS

The Rubber Blow-Off Cap, Part No. 77676, help keep the orifice of the nozzle free of grease or other substances that could interfere with agent distribution. A retaining strap attaches the blow-off cap to the nozzle. Rubber Blow-Off Caps must be ordered as a Shipping Assembly, Part No. 77695, which contains 50 blow-off caps, or Part No. 77411, which contains 12 blow-off caps.

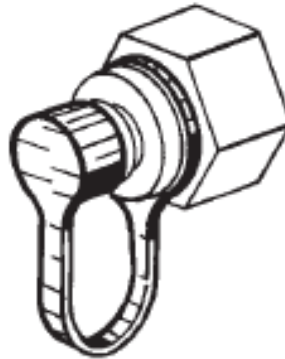


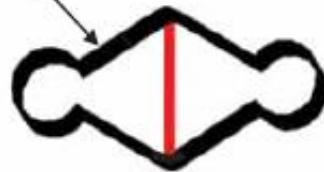
FIGURE 15
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System Components— Detectors



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RAPID RESPONSE
THERMO-BULB LINK



STANDARD RESPONSE
THERMO-BULB LINK



Figure 1. Thermo Bulb, P/N 87-12009X-XXX



Figure 2. KML Heat Detector Links, P/N WK-282661-XXX



Figure 3. KFA Heat Detector Link, P/N 87-120060-001

System Components— Detector Ratings



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Table 1. Thermo Bulb Detector Link Ratings

Standard Response Part Number	Rapid Response Part Number	Detector Temperature Rating	Color	Maximum Exposure Temperature
87-120090-165	87-120095-165	165°F (74°C)	Red	100°F (38°C)
87-120090-212	87-120095-212	212°F (100°C)	Green	150°F (65°C)
87-120090-286	87-120095-286	286°F (141°C)	Blue	225°F (107°C)
87-120090-360	87-120095-360	360°F (182°C)	Mauve	300°F (149°C)
87-120090-450	87-120095-450	450°F (232°C)	Black	375°F (191°C)
87-120090-500	87-120095-500	500°F (260°C)	Black	435°F (224°C)

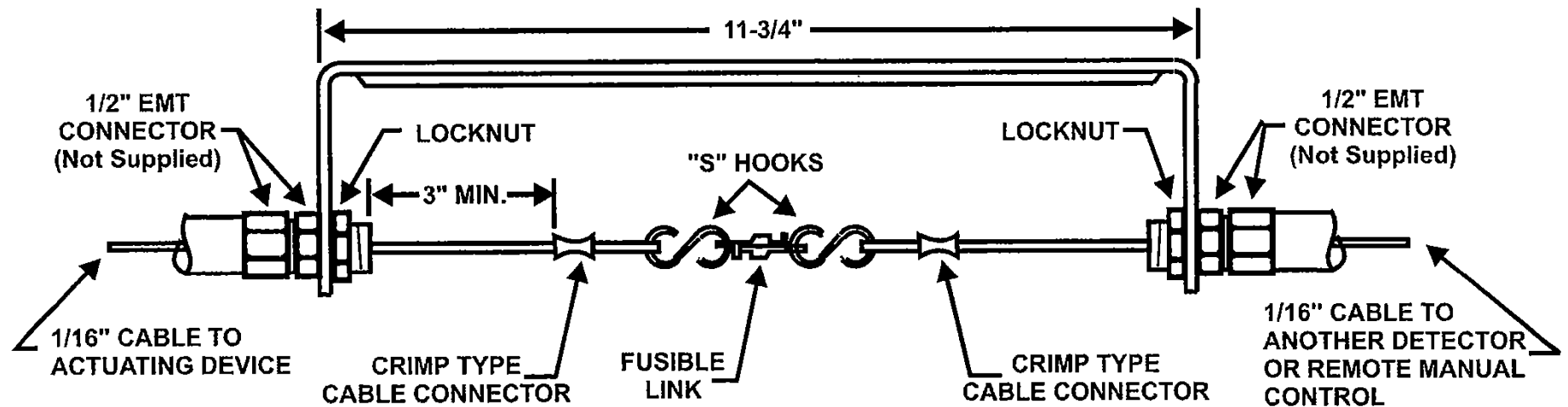
Table 2. KML and KFA Detector Link Ratings

Fusible Metal Detector Link Part Number	Detector Temperature Rating	Color	Maximum Exposure Temperature
Model KML			
WK-282661-000	165°F (74°C)	Yellow	100°F (38°C)
WK-282662-000	212°F (100°C)	White	150°F (65°C)
WK-282664-000	360°F (182°C)	Unpainted	300°F (149°C)
WK-282666-000	500°F (260°C)	Orange	440°F (226°C)
Model KFA			
87-120060-001	360°F (182°C)	Unpainted	300°F (149°C)

System Components— Detector



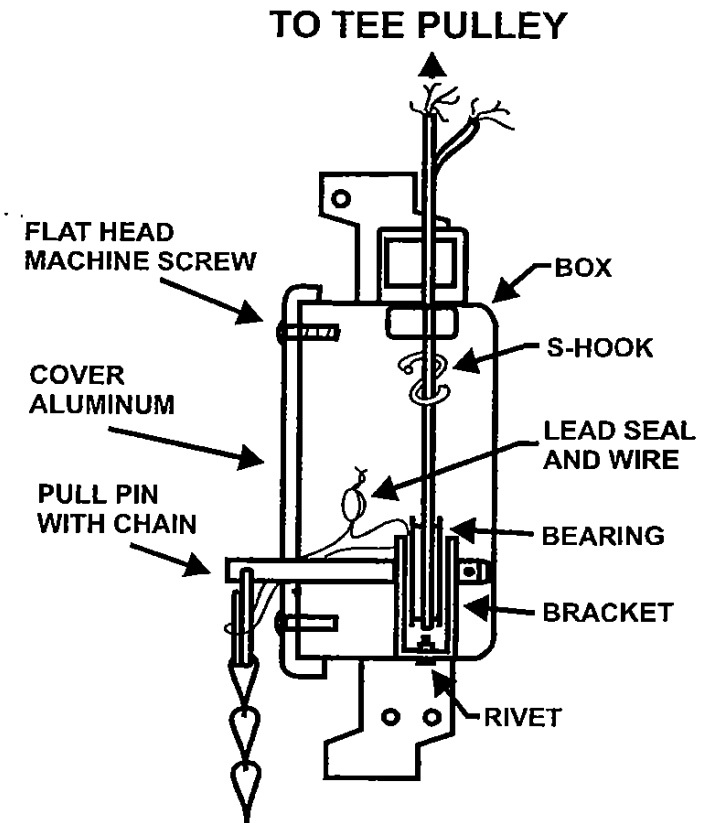
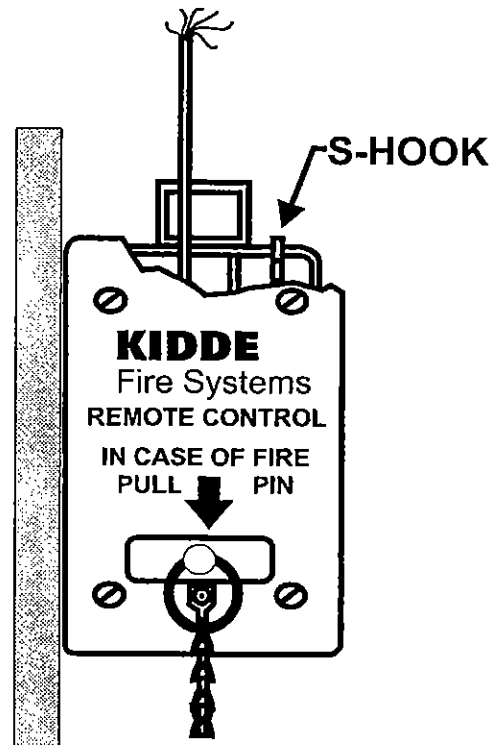
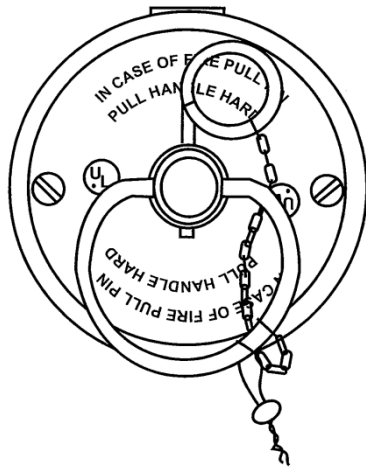
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System Components— Manual Pull



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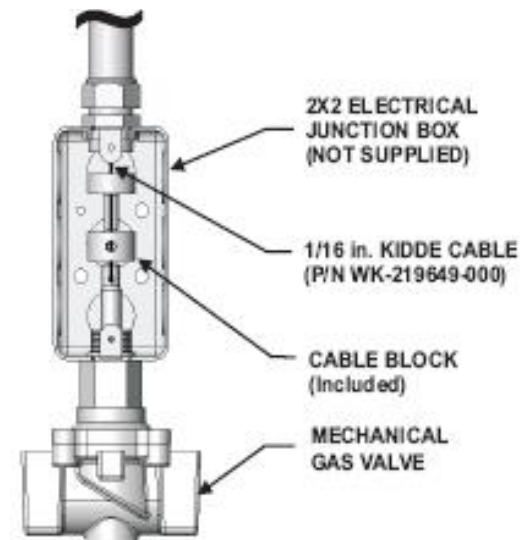
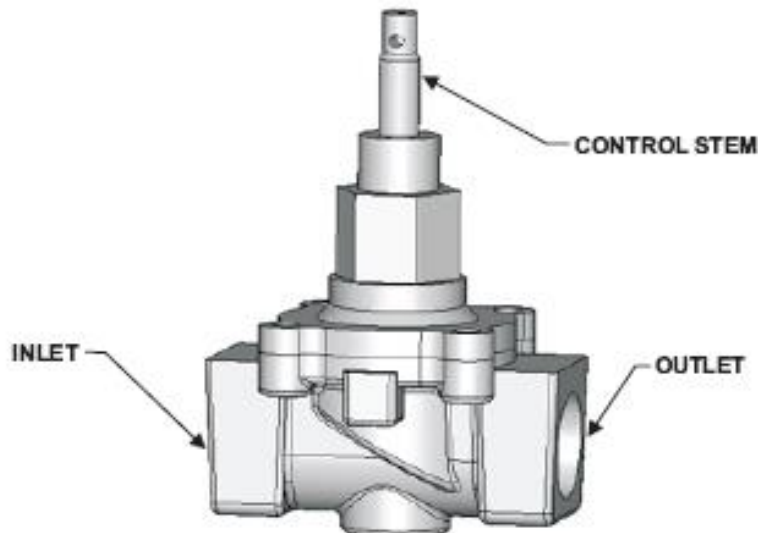


System Components— Gas Valve



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- Mechanical or electrical
- Required on systems used to protect gas-fueled appliances





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Kitchen Suppression Systems

INSPECTION, TESTING AND MAINTENANCE

- **NFPA 17 – NFPA 17A**
 - **Monthly inspection**
 - **Semiannual inspection**
 - **12-year inspection**

Monthly Inspection/Maintenance

- The owner is to perform the following "quick check" inspection to verify the following:
 1. Proper location (system and cylinder)
 2. Manual pull stations are unobstructed and in clear view
 3. Tamper seals are intact and system is in the ready condition
 4. No obvious physical damage exists that might prevent operation
 5. The pressure gage on the cylinder is in the green operable range
 6. The nozzle caps and their seals are intact, undamaged, and tight
 7. The inspection tag or certificate is in place and current
 8. Deficiencies require corrective action
 9. Keep a record
 10. Schedule semiannual inspection



Semiannual Inspection/Maintenance

- Semiannually, the following inspection and testing shall be performed by a certified installer:
 1. Check for any changes to appliances and positioning
 2. Check that all seals are intact, there are no signs of tampering, and inspect cylinder and system components for damage
 3. Disconnect mechanical control head(s) or remove the CO₂ cartridge
 4. Replace or hydrostatically test corroded components or if the cylinder is over 12 years old
 5. Check nozzle seals, remove and clean nozzle, and replace the seal annually
 6. A. Operate the last detector; check control head and gas valve operation
B. Operate remote pull; check control head and gas valve operation
 7. Operate any pneumatic releases or electrical shut-offs and check system gas valve for grease build-up

Semiannual Inspection/Maintenance

(continued)

8. Replace fusible links with fusible links that have the required temperature rating
9. Clean grease out of conduit openings at detector bracket
10. Remove covers and check corner pulleys for grease accumulation; make sure that the cable is on the pulleys
11. Check that the fan warning sign is legible and conspicuous (if not, replace)
12. Reset the detection system and adjust cable if necessary
13. Replace the removed CO₂ cartridge (Step 3) with a new, manufacturer approved, CO₂ cartridge
14. Reconnect mechanical control head(s)
15. Remove keeper pin
16. Date and sign the inspection tag or certificate
17. Review system operation again with owner

12-Year Inspection/Maintenance

1. Hydrostatic testing is to be performed on the cylinder in compliance with the appropriate DOT requirements
2. The wet chemical is to be discarded when performing the hydrostatic test. DO NOT REUSE THE OLD AGENT as per NFPA-17A.
3. The cylinder is to be either hydrostatically tested or volumetric-expansion tested to two times its standard rating. The cylinder's standard rating is stamped on the crown or footing of the cylinder.
4. To protect the restaurant during this testing period, a substitute cylinder is to be used, one of equal or greater size. You may use an alternate protection method as long as it is acceptable to the authority having jurisdiction.
5. Return the system to service



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Kitchen Suppression Systems

INSPECTIONS— POST-FIRE FIELD ANALYSIS



Site Inspection

Document:

1. Agent control valve status
 - Open/closed - visual
2. System layout/arrangement with dimensions
 - Sketch, note pipe lengths and diameters
 - Note fusible link locations
 - Fuel shutoff location
 - Protected appliance location and type/size
3. Pipe and nozzle blockages analyzed
 - Visual check for 'stuff' in nozzles, piping

Site Inspection *(continued)*



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4. Kitchen cleaning/housekeeping
5. Hood cleanliness – There should not be 6” of char in the hood and filters
6. Condition of protective caps – On, off, or present or not?
7. Check for installation errors:
 - a. Missing or off-position nozzles
 - b. Missing or off-position fusible links
 - c. Presence of activation cartridges in control box
 - d. Control head cable(s) mis-installed

Site Inspection *(continued)*



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8. Electrical/Gas shutoff valve status
 - Visual check of plunger. May need followup in lab for pressure test.
9. Type, location, and condition of all appliances
10. Presence, type, and condition of plenum filters
11. Exhaust duct condition, proximity to combustibles
12. Exhaust fan condition
13. Origin and cause tasks
14. Burn pattern analysis
15. Evidence collection

Interview Questions



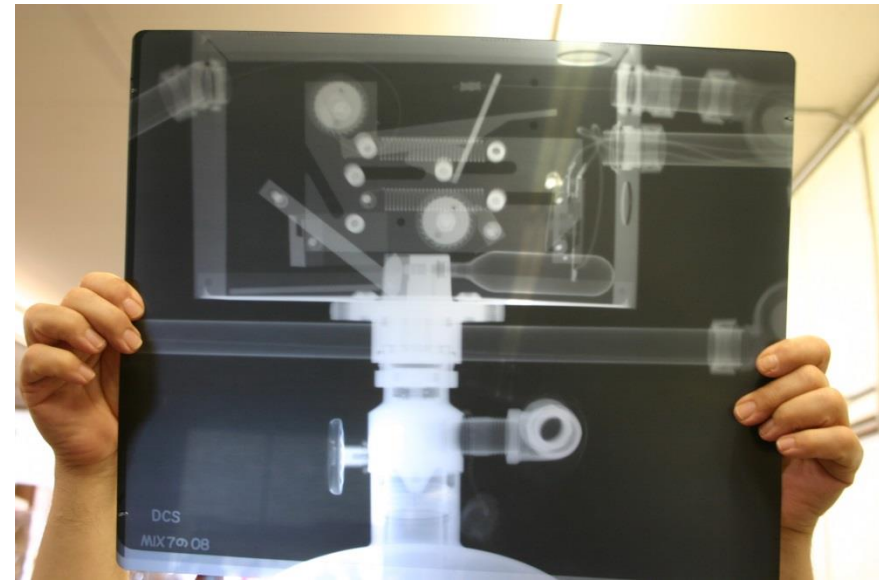
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- Going beyond the O&C scope:
 - Who services the extinguishing system?
 - When was it last serviced? (Tag should show date)
 - Did they need to change out any parts?
 - Have there been any problems with the system?
 - Do you have an invoice? (Get copy or photo)
 - Have there been any changes to the cook line?
 - Has any of the cooking equipment been serviced recently?
 - What type of oil do you use? (Good to get a sample)
 - Who cleans the ductwork? When was it last cleaned?



Lab Inspection

- Evidence inspections typically are more detailed and focused
- Evidence inspection activities include:
 1. Detailed component documentation – disassembly and possible destructive testing
 2. Functionality testing
 3. Chemical analysis of materials and agent
 4. Metallurgy



Note Nozzle Position—Use Dowels and Clips





Weigh Cylinders

- Helps to determine if any agent remains in the system
- Compare weight to mfg. spec for full cylinder.
- Complete discharge or other issues?
 - Nozzles
 - Piping
 - Leak in discharge gas seal



Inspect Detectors— Type, Location, and T Rating Compare with NFPA 17A and MFG data

5.6.1.5 At least one fusible link or heat detector shall be installed within each exhaust duct opening in accordance with the manufacturer's listing.

5.6.1.6 A fusible link or heat detector shall be provided above each protected cooking appliance and in accordance with the extinguishing system manufacturer's listing.



Inspect Nozzle Caps and Condition





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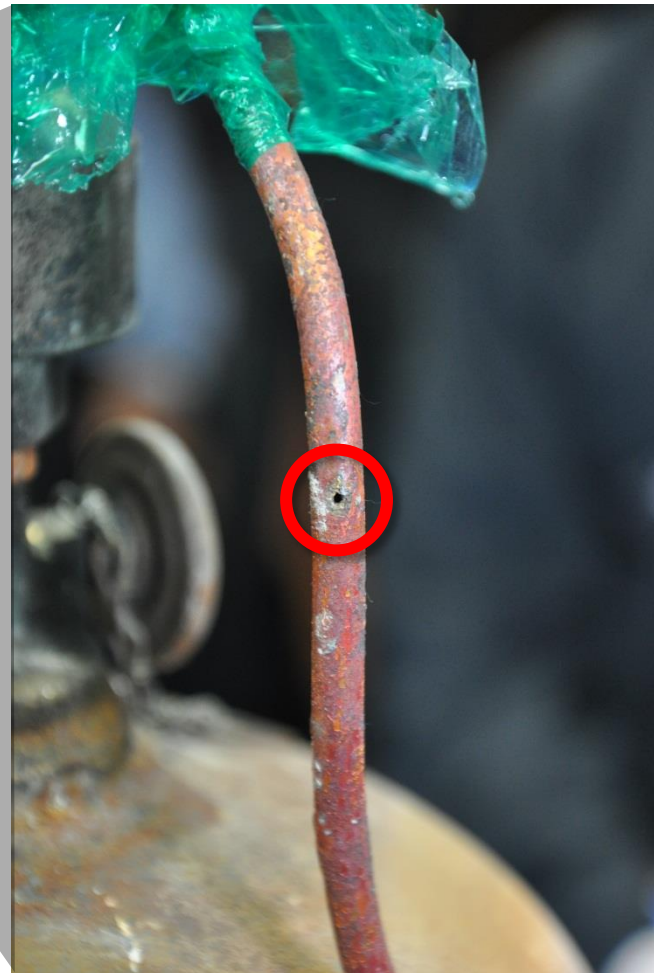
Kitchen Suppression Systems

SYSTEM FAILURE EXAMPLES

System Failures—Installation/Service

- Incorrectly connected control box
- Inspection tools (disarming pins) left in control box
- Solution not flushed out of system piping
 - Turns to thick sludge, impairing operation
- Actuator installed backwards
- Dirty nozzles/screens
- Discharged test gas cylinder left in control box

Holes in Pressure Actuating Line



Blockages



Blockages *(continued)*



Ansul R-102 system
Likely grease blockage

Blockages



Dip tube from Ansul R-102 system.

Servicing



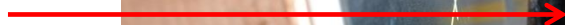
That Griddle...



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Flue



Missing CO₂ Cartridge



Actuator plunger



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We covered:

1. System Components
2. Regulations
3. UL300 and Wet Chemical Systems
4. Statistics
5. Specific Components
6. IT&M
7. Scene and Lab Inspections—Post Event
8. Failure Examples



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