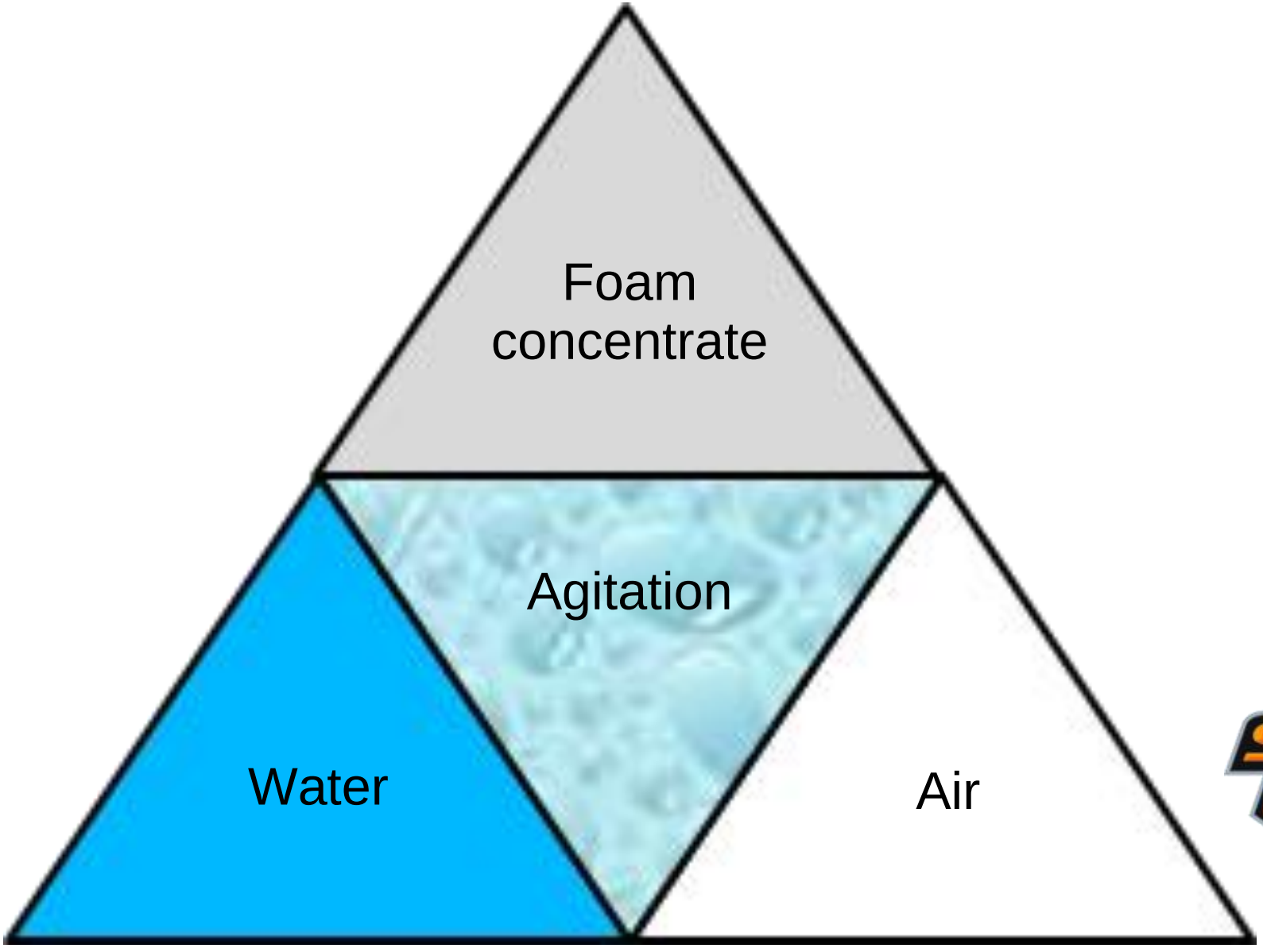
Water Based Agents

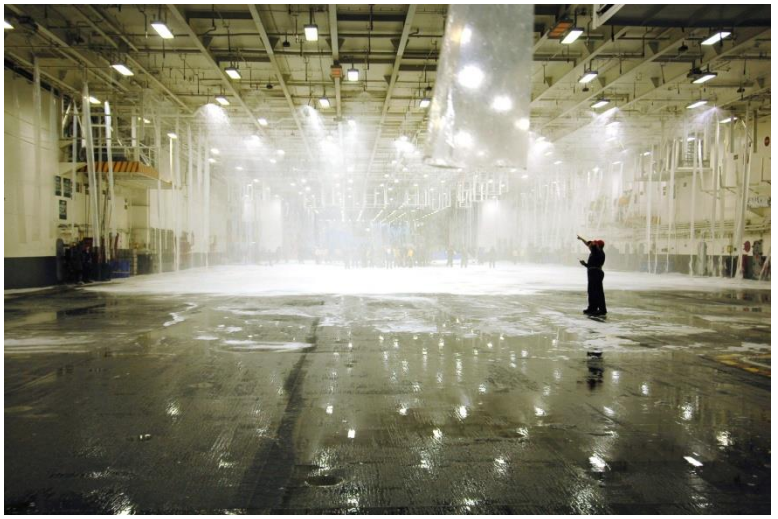
- Determine when water based suppression agents are appropriate
- Describe how water based agents suppress fires
- Explain the impact of corrosion

Foam Tetrahedron



Systems

- Fixed
  - Surface application
  - Seal protection for floating roof tanks
  - Containment protection
  - Subsurface injection
- Semifixed Type A
  - Piping in place but not attached to foam source
- Semifixed Type B
  - Foam solution in fixed piping to connections for hand application
    - Similar to standpipe concept
- High Expansion
  - Local application or total flooding



Standards

- NFPA 11 *Standard for Low-Medium and High-Expansion Foam Systems*
- NFPA 16 *Standard for the Installation of Foam-water Sprinkler and Foam-Water Spray Systems*
- NFPA 409 *Standard on Aircraft Hangars*
- NFPA 30 *Flammable and Combustible Liquids Code*

Uses And Limitations

where to use.

- Foams halt the generation of flammable vapors
- Great importance in Aircraft operations
  - Large fuel spills need rapid foam application and this is accomplished by properly designed foam systems
- Warehouses and large storage facilities have a similar need
- Breaks down and vaporizes

Application Criteria

- Burning liquid must be below its boiling point at ambient conditions
- If applied at higher than 212 ºF, may produce dangerous frothing and slop over
- Liquid must not be unduly destructive to the foam used
- The liquid must not be water reactive
- The fire must be a horizontal surface fire for low expansion foam

Types Of Foam

- Aqueous Film Forming Foam agents - AFFF
  - Provides a film over the solution to prevent the release of vapors
- Protein foaming agents – P
  - Produce dense, viscous foams of high stability, high temperature resistance, and good resistance to burn back but they are less resistance to break down than AFFF and FP foams
- Fluoroprotein Foaming Agents - FP
  - Similar to protein foam but contain fluorinated service agents for “fuel shedding” properties where the foam becomes coated with fuel
- Film Forming Floral Protein agents – FFFP
  - Generate a self healing continuous floating film on hydrocarbon fuel services
- Alcohol type foaming agents - AR
  - Involve fuels that our water soluble (e.g. methyl ethel keytone, acetone). Produce a floating gel-like mass for foam build up on water-soluable fuels

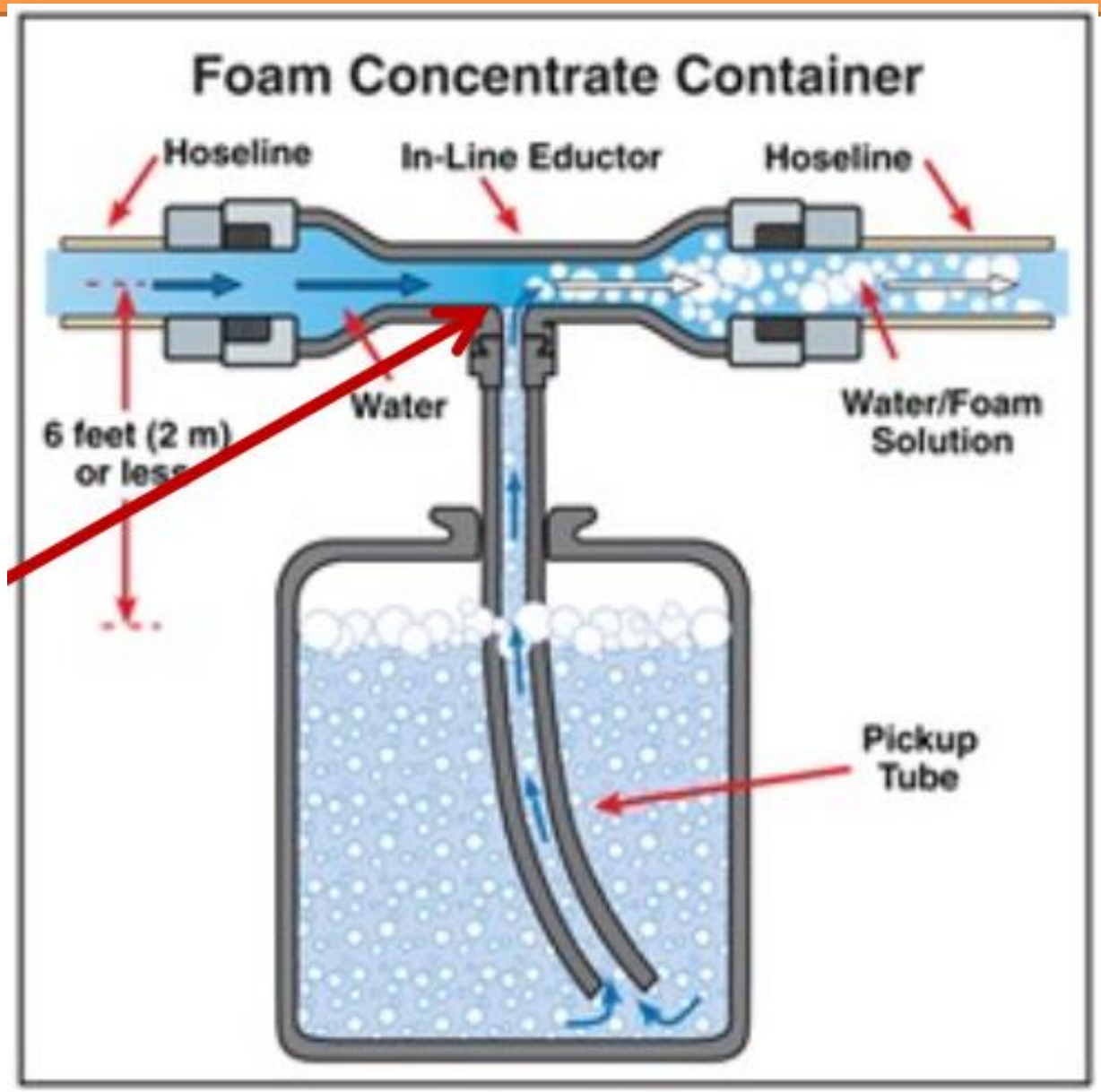
Types Of Foam

- Medium and high expansion foaming agents
  - Flooding agents for use in a confined spaces
  - Effects on fire
    - Prevent the air necessary for continued combustion from reaching the fire
    - Water in the foam is converted to steam which reduces oxygen concentration and absorbs heat
    - Solution not converted to steam will penetrate class A materials
    - High expansion foam provides an insulating barrier for protection of exposed materials or structures

Guidelines For Foam Fire Protection

- The more gently the foam is applied the more rapid extinguishment
- All foams have a recommended application rates and pressure ranges
- Air foams more stable when generated with water at ambient temperature
- Apply foam to the sides of the fire

Foam Eductors



https://www.youtube.com/watch?v=wYAOHYKBYas

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Applying Agent

- Multiple nozzle designs allow for
  - Local application
  - Total compartment application
  - Zoned application

Maintenance

- Maintenance considerations
  - Frequently monitor water levels in storage tanks
  - Monitor the water quality for algae growth
  - Valves could be of non-indicating type
    - Key valves are supervised open
  - Valves on systems are electrically activated
    - A manual means of operating the valve must be provided
  - Develop a means of checking the functionality of pneumatic valves
  - Conduct annual trip test
  - Ensure minimum nozzle pressure is sustained

Water Mist Fire Suppression Systems

- Industrial maritime regulatory organizations mandated installation of sprinkler systems on passenger ships
- 1990 - The International Maritime Organization required all ships capable of caring more than 36 passengers to be equipped with automatic sprinkler systems by 1997
  - Needed to find a system that could be considered equivalent to sprinklers but would:
    - Discharge less water
    - Use smaller diameter piping having a lower overall weight
- NFPA 750 *Standard On Water Mist Fire Protection Systems*
  - System design performance-based

Water Mist Fire Suppression Systems

- Additional need to find a replacement for ozone depleting halons
  - Water behavior
  - Gas Behavior
- Nozzles ceiling height for flashover suppression
  - Cooling
  - Radiation shielding
  - Carried by plume
  - Shielded fires
- Mist Generation
  - Impingement
  - Pressure jet
  - Twin fluid

Applications

- Machinery spaces
  - Contain diesel fuel and lubricating oil spills
  - Overheated bearings
  - Electrical arcing
  - Large vessels equipped with CO_2 or halon systems

Applications

- Turbine enclosures
  - The turbine itself and it's fuel lines
  - Standard equipment in offshore drilling platform
  - Halon 1301 and the CO_2 total flooding systems have been the preferred method
  - Studies have confirmed the ability of a water mist fire suppression system to extinguish fires in a turbine enclosure

Applications

- Marine accommodation, public spaces and service areas
- Hotels and galleries
  - Used in remote with minimal water supply
  - Limit water damage
- Electrical equipment rooms, computer rooms
  - Testing has shown that electrical charge does not transmit through atomized spray
  - Consensus on a general design and system performance approach has not been reached
- Tunnels

Applications

- Aircraft passenger compartment
  - High cost
  - Not required

Water Hybrid

- Combined nitrogen and water mist
- Self-contained unit
- Displaces oxygen and removes heat
- Minimal water usage

Water Spray Systems

- Typically provided to protect a specific piece of equipment from exposure fires through covering the surface with water
- The discharge from the nozzles differs from the discharge of fix sprinklers
  - The water pattern maybe elliptical or circular to help overcome wind
  - Water spray systems are typically deluge
  - Independent water supply
  - NFPA 15 *Standard For Water Spray Fixed Systems For Fire Protection*

Applications

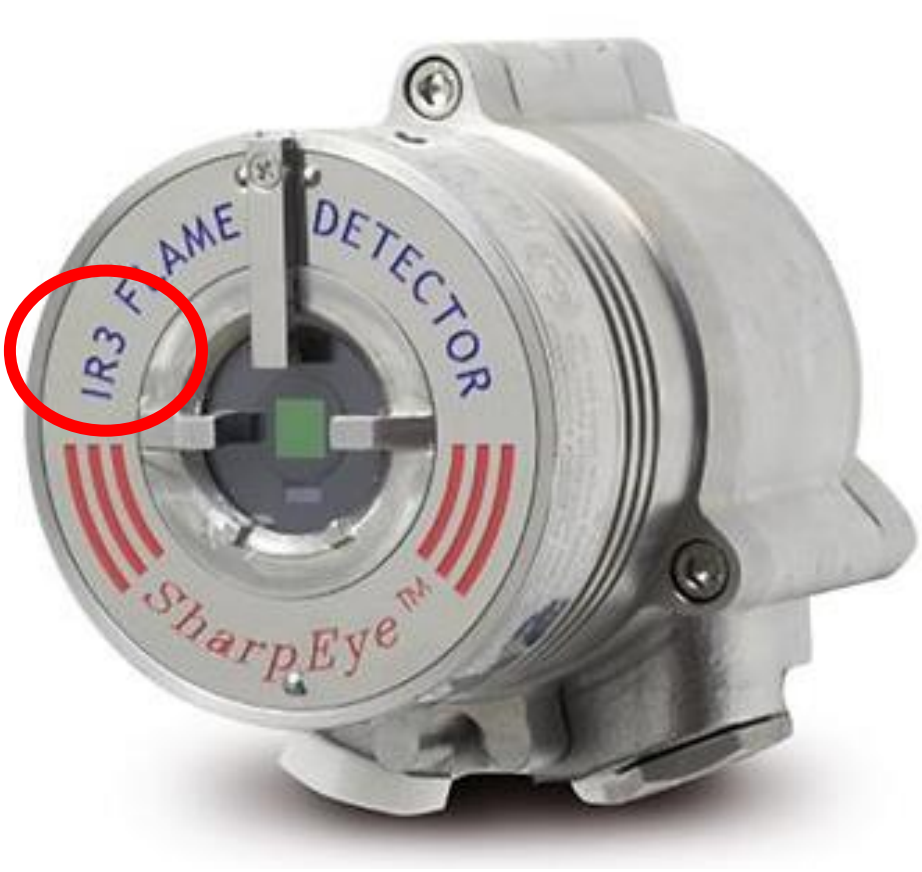
- Flammable liquid and gas tanks, associated piping and equipment
- Electrical transformers
- Cable trays and support structures
- Open conveyor systems
- Openings in firewalls

Ultra-High-Speed Water Spray Systems

- Initiation of water discharge within 100 milliseconds
  - Within 36 in
- NFPA 15 *Standard For Water Spray Fixed Systems For Fire Protection*
- Application
  - Rocket fuel manufacturing
  - Solid propellant manufacturing
  - Ammunition manufacturing
  - Pyrotechnics manufacturing

General Detection

- Optical flame detection for open areas to detect ultraviolet or infrared light
  - Detector must be capable of reacting to the wavelengths expected


IR3 FLAME DETECTOR
SharpEye™


UV/IR FLAME DETECTOR
SharpEye™

General Detection

- Points to consider
  - Survey the hazard area to determine sources of false signals and shield detection device
  - Determine elements that could interfere with detector operation (e.g. dust or ice)
  - Use test data to determine the speed with which detector is required to respond

Corrosion

- Regular corrosion far more common than MIC
  - Oxygen and iron
- Not bad water or bad pipes
  - Galvanized
  - Thin walls

Corrosion

- Accelerated
  - More O_2 = More Corrosion
  - Dry pipe fail faster than wet pipe
  - Galvanized fail much faster than black
  - Level of activity (drain/fill, remodels)
  - System design trapped air/water
  - Quality of the system installation
  - Higher temperatures increase corrosion
    - (every 10 °C increase = 2X corrosion rate)

Mitigation In Affected Systems

- Pipe cleaning is typically an option when corrosion is not excessive (i.e. pitting)
- Severely affected portions should be replaced or cleaned to remove obstructions

Prevention In New Systems

- Specify thicker piping
- Frequency of water flow testing
  - Repeated drainage and refilling can increase biological corrosion
- Chemical injection
  - Points to consider
    - Sprinklers typically located directly over people
    - Systems typically drain into foliage or biologically sensitive drains
    - Must complete a complete toxicity review of the additive