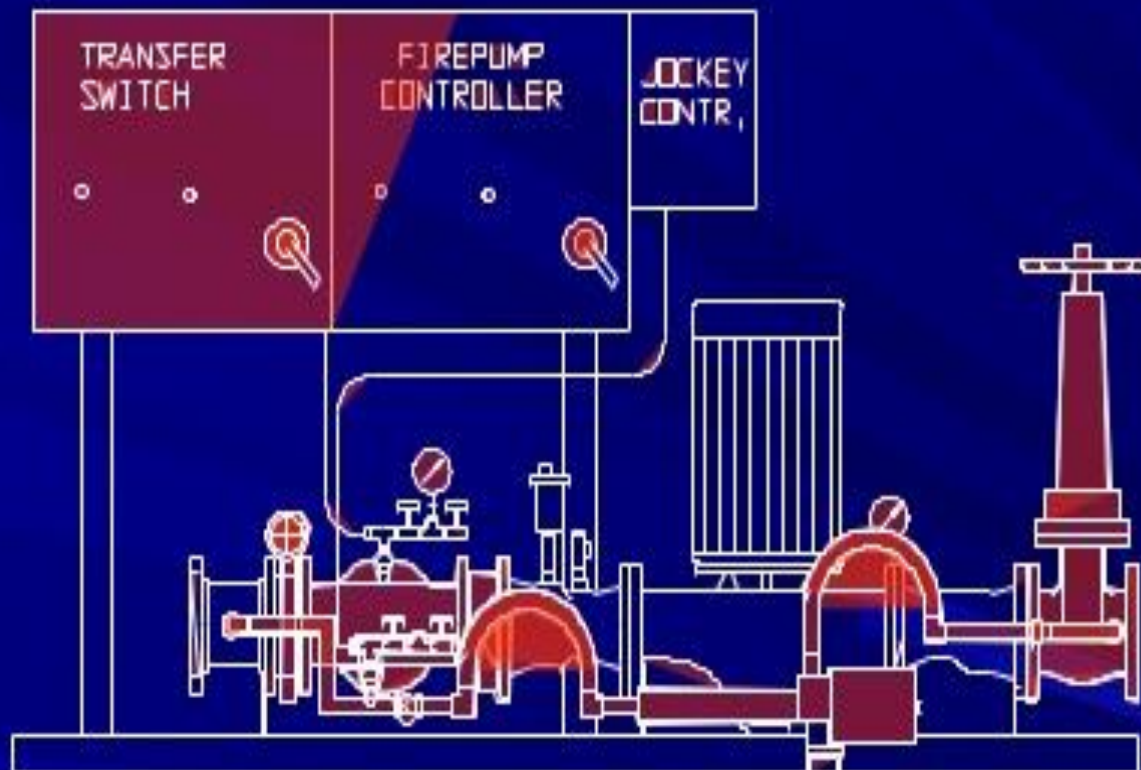


NFPA20

Standard for the Installation of Stationary Pumps for Fire Protection



Purpose of a Fire Pump

HSE

- To protect lives and properties against fire by supplying an adequate water supply to automatic sprinklers or standpipe systems
- To meet building codes and insurance requirements

Purpose of Fire Pump

HSE

- The purpose of this standard is to provide a reasonable degree of protection for life and property from fire through installation requirements for stationary pumps for fire protection based upon sound engineering principles, test data, and field experience.

Codes and Standards

HSE

- National Fire Protection Association - NFPA
 - Establishes the norms that governs all fire installation
 - Continuously revises the codes (Last issue 2003)

Listing Authorities

HSE

- Underwriters Laboratories (UL)
- Underwriters Laboratories of Canada (ULC)
- Factory Mutual Research Corporation (FM)

Centrifugal Fire Pump Capacities.

- **4.8.1** A centrifugal fire pump for fire protection shall be selected so that the greatest single demand for any fire protection system connected to the pump is less than or equal to 150 percent of the rated capacity (flow) of the pump.

Codes and Standards

HSE

■ NFPA Philosophy

- A fire pump system should operate irrespective of any damage it may cause to itself
- No element of the system under emergency conditions should:
 - Prevent a fire pump from turning on
 - Cause a fire pump to turn off
- Changes to the code must be substantiated by data or experience (actual scenarios)

Water Supply Tanks for Very Tall Buildings.

- **5.6.1.1** Where the primary supply source is a tank, two or more water tanks shall be provided.
- **5.6.1.1.1** A water tank shall be permitted to be divided into compartments such that the compartments function as individual tanks.
- **5.6.1.1.2** The total volume of all tanks or compartments shall be sufficient for the full fire protection demand.
- **5.6.1.1.3** Each individual tank or compartment shall be sized so that at least 50 percent of the fire protection demand is stored with any one compartment or tank out of service.
- **5.6.1.2** An automatic refill valve shall be provided for each tank or tank compartment.
- **5.6.1.3** A manual refill valve shall be provided for each tank or tank compartment.
- **5.6.1.4** Each refill valve shall be sized and arranged to independently supply the system fire protection demand.
- **5.6.1.5** The automatic and manual fill valve combination for each tank or tank compartment shall have its own connection to one of the following:

Fire Pump Test Arrangement.

- **5.4** Where the water supply to a fire pump is a tank, a listed flow meter or a test header discharging back into the tank with a calibrated nozzle(s) arranged for the attachment of a pressure gauge to determine pitot pressure shall be required.

Codes and Standards

HSE

■ NFPA20 Structure:

- Definitions (3 pages)
- Centrifugal Fire Pumps (5 pages)
- Positive Displacement Pumps (2 pages)
- Electric Motors (1 page)
- Diesel Engines (4 pages)
- Controllers (12 pages)
- Pump Installation and Related Components (10 pages)
- Acceptance Tests and Maintenance (2 pages)

Water Supply

- Where fire pumps are installed on a city main, a fire flow test should be performed to determine minimum and maximum supply pressures as well as suitability of supply for the fire protection system
- Where adequate city supply water is unavailable, a suction tank or pit should be installed
- Tank sizing must consider 150% of the fire pump rated flow
- Total water requirements are defined in NFPA13 (Sprinkler Systems), NFPA14 (Standpipe Systems), NFPA15 (Spray or Mist Systems), Mains)

Pump Requirements

- “Centrifugal fire pumps shall be listed for fire protection service.”
- “Pumps shall furnish not less than *150%* of rated capacity at not less than *65%* of total rated head. The shutoff head shall not exceed *140%* of rated head for any type pump.”

Water Flow Test Devices.

- **4.20.1.1*** A fire pump installation shall be arranged to allow the test of the pump at its rated conditions as well as the suction supply at the maximum flow available from the fire pump.

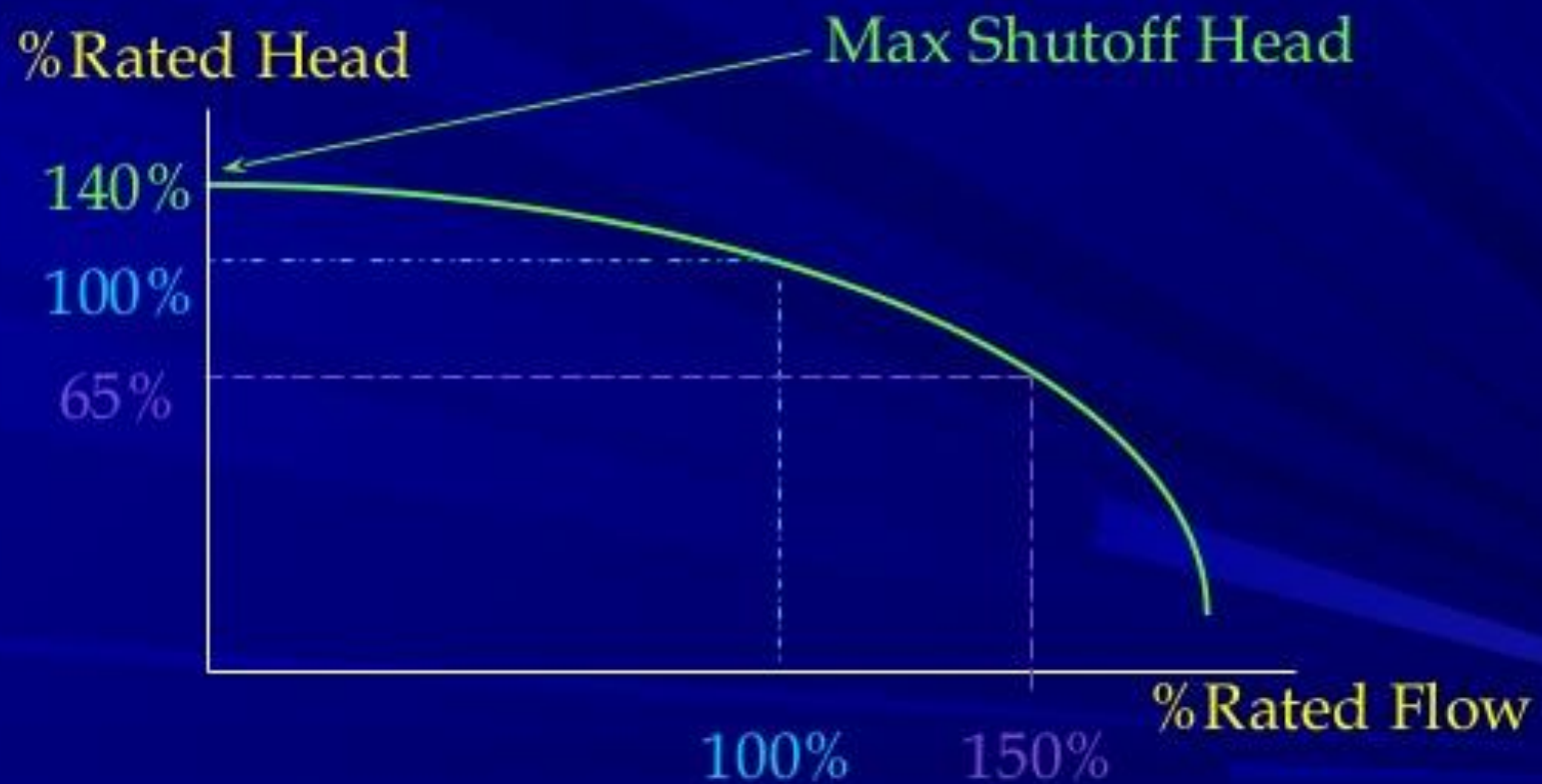
Equipment Protection.

- **4.12.1*** General Requirements. The fire pump, driver, controller, water supply, and power supply shall be protected against possible interruption of service through damage caused by explosion, fire, flood, earthquake, rodents, insects, windstorm, freezing, vandalism, and other adverse conditions.

Outdoor Fire Pump Units.

- **4.12.1.2.1** Fire pump units that are outdoors shall be located at least 50 ft (15.3 m) away from any buildings and other fire exposures exposing the building.
- **4.12.1.2.2** Outdoor installations shall be required to be provided with protection against possible interruption, in accordance with 4.12.1.
- **4.12.1.3** Fire Pump Buildings or Rooms with Diesel Engines. Fire pump buildings or rooms enclosing diesel engine pump drivers and day tanks shall be protected with an automatic sprinkler system installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

Pump Requirements



VIL Fire Pumps

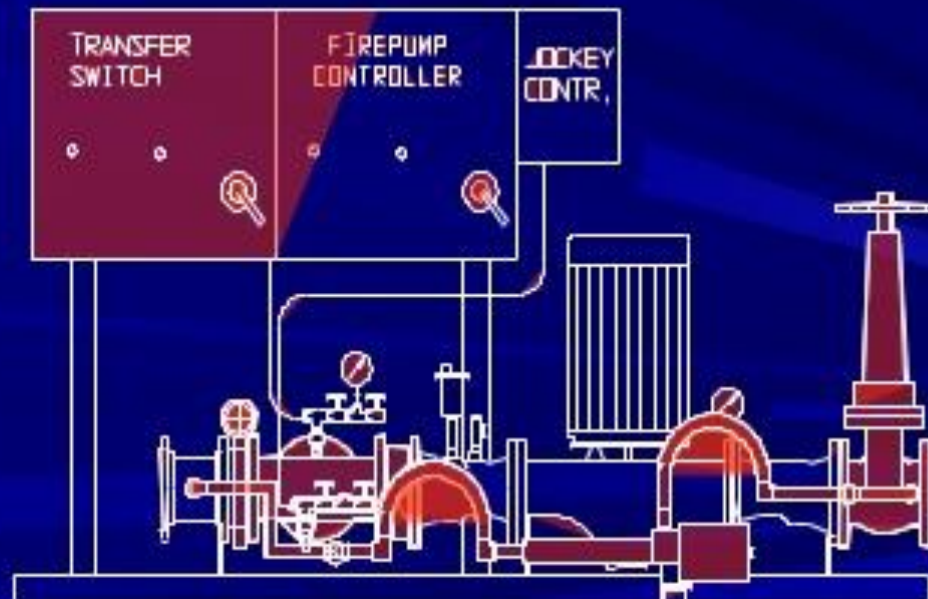
HSE

■ BENEFITS

- Compact
- Serviceable
- Reliable
- Cost Effective

■ DRAWBACKS

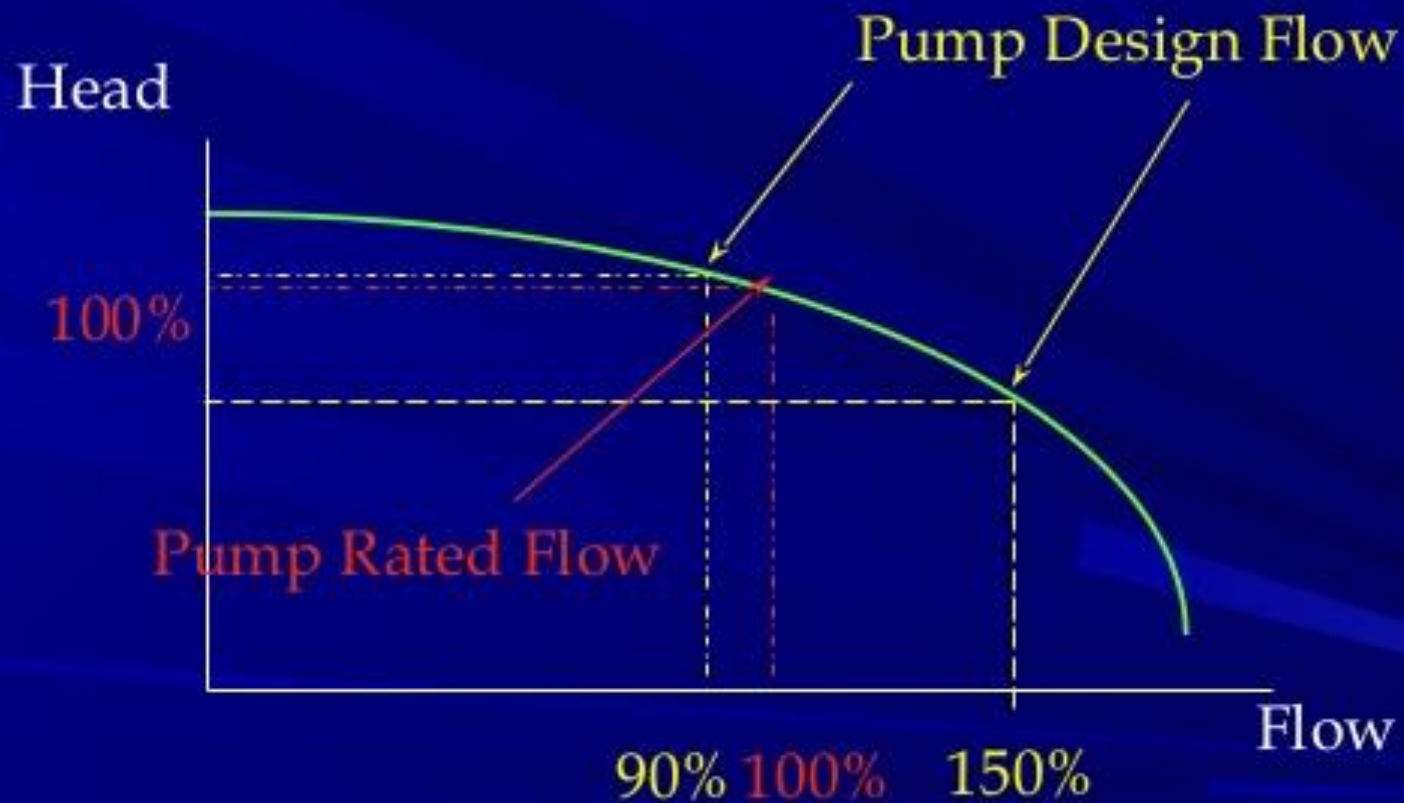
- Only available up to 1500GPM
- Electric Drive Only
- Requires suction strainer



Pump Sizing

“A stationary pump for fire protection should be selected in the range of operation from 90 percent to 150 percent of its rated capacity. The performance of the pump when applied at capacities over 140 percent of rated capacity can be adversely affected by the suction conditions. Application of the pump at capacities less than 90 percent of the rated capacity is not recommended. The selection and application of the fire pump should not be confused with pump operating conditions. With proper suction conditions, the pump can operate at any point on its characteristic curve from shutoff to 150 percent of its rated capacity.”

Pump Sizing



Misinterpreted Code Requirement

HSE

- Sizing the fire pump - a listed pump should be applied for flows from 90% to 150% of its rated point
- Most fire pumps are sized to exceed the duty requirement of the fire protection system
- The rated flow is a convention used to regulate the listing of pumps

Pump Requirements

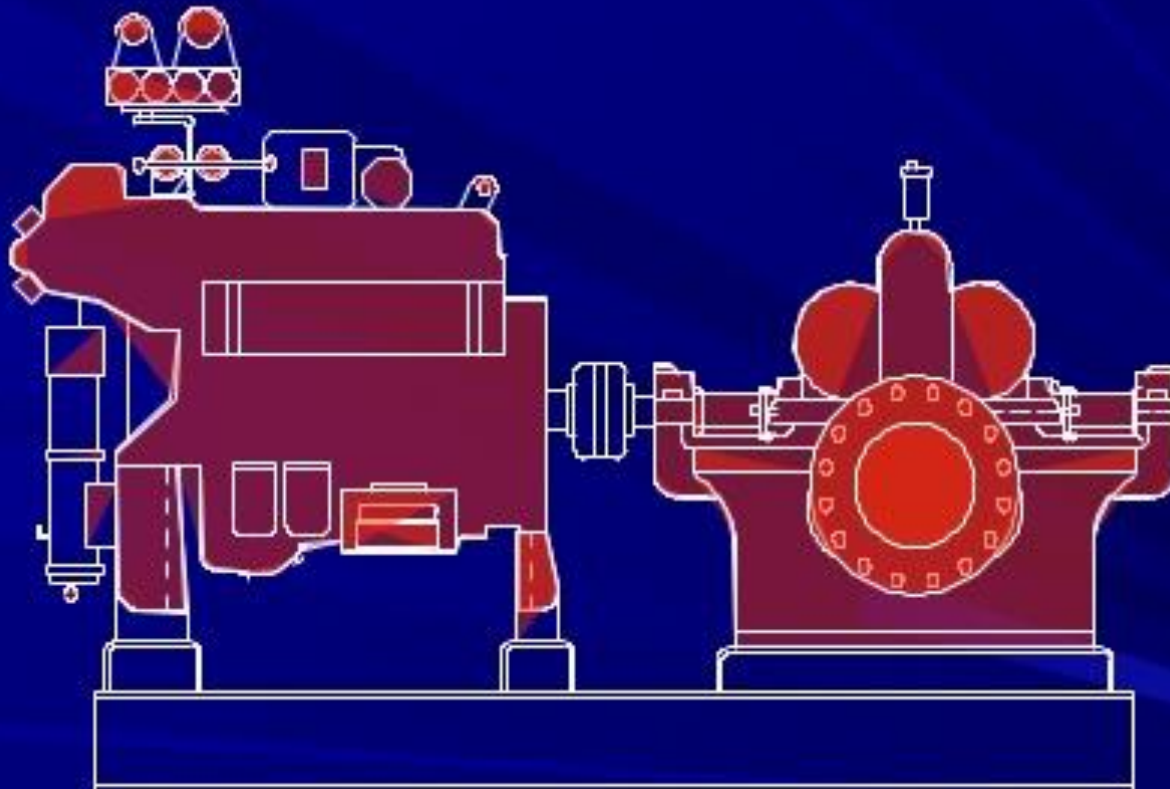
- FM & UL require that fire pumps have packing seals
- ULC allows mechanical seals
- Packing requires periodic adjustment and replacement as it hardens over time
- The packing gland should be tightened until the seal leaks 30 drips per minute
- If the gland is tightened to much, the seal receives no lubrication and will burn

Allowable Pump Types

HSE

- Horizontal Split Case
- Vertical In-Line
- End Suction
- Vertical Turbine

Horizontal Split Case Fire Pumps



HSC Fire Pumps

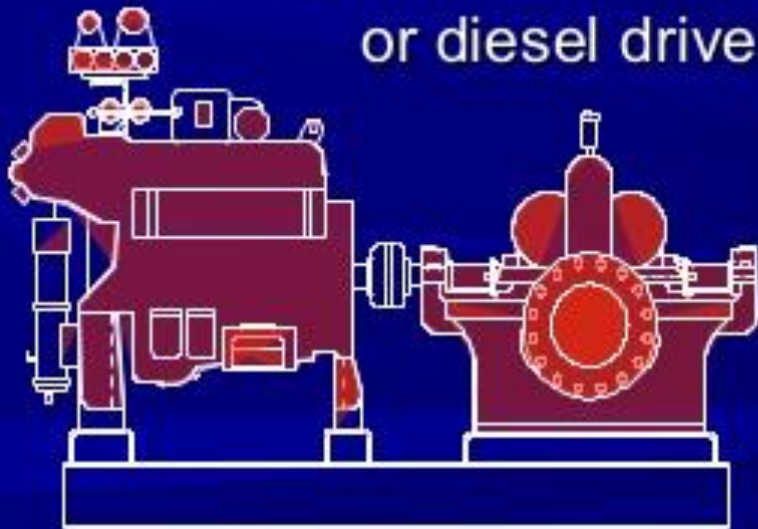
HSE

■ BENEFITS

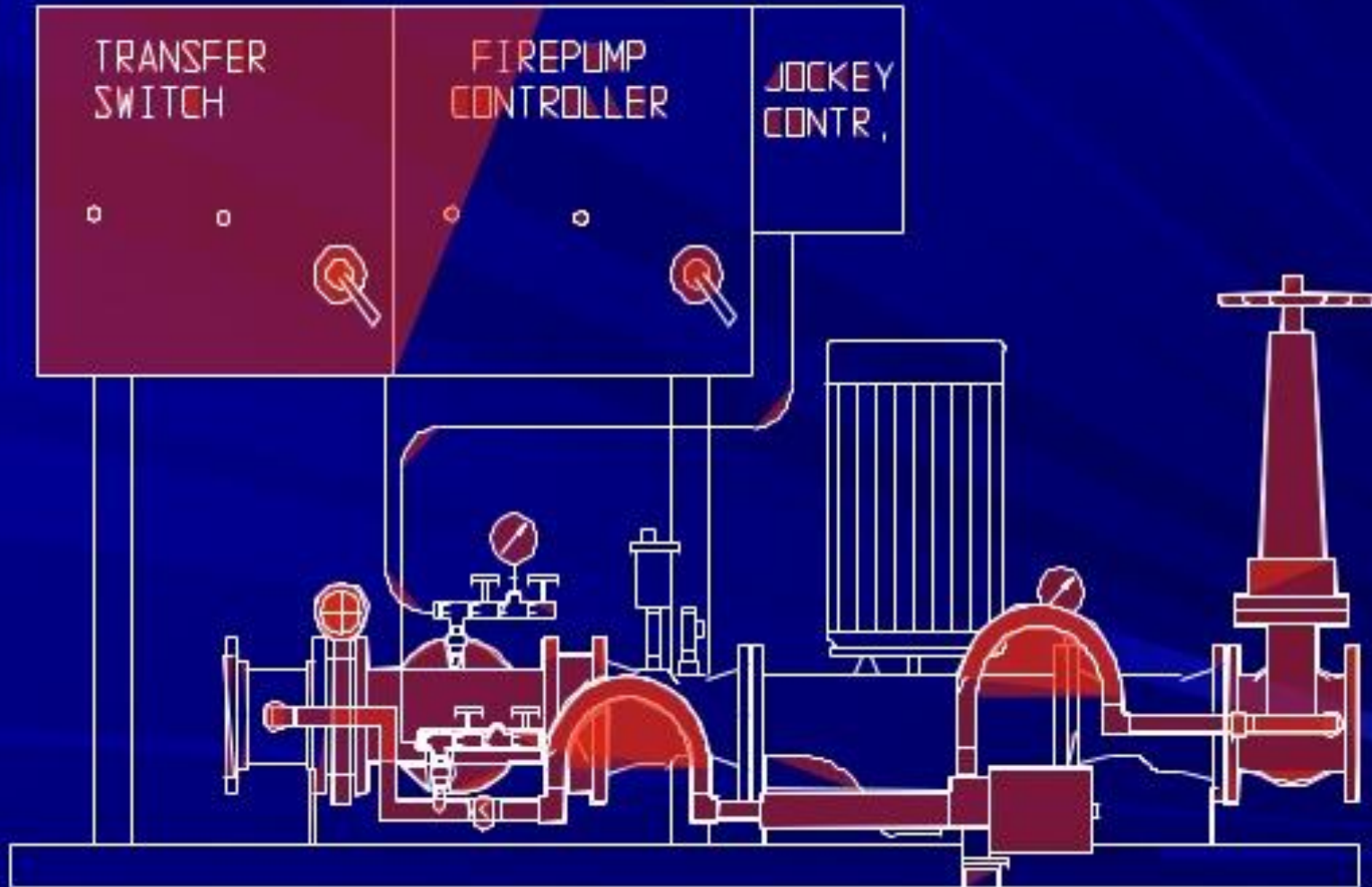
- Available in a wide flow and head range
- Serviceable without disturbing piping or driver
- Available in electric or diesel drive

■ DRAWBACKS

- Large floor space requirement
- Restricts mechanical room layout due to direction of rotation
- More costly
- More difficult to service

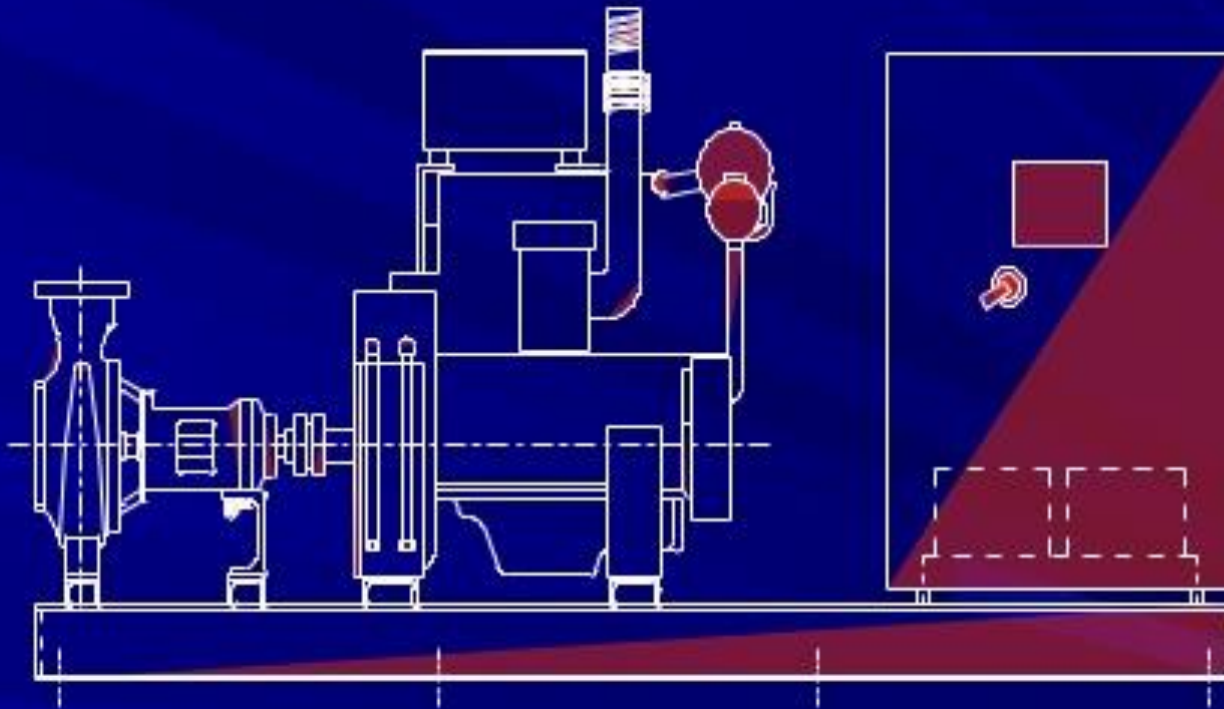


Vertical In-Line Fire Pumps



HSE

End Suction Fire Pumps



End Suction Fire Pumps

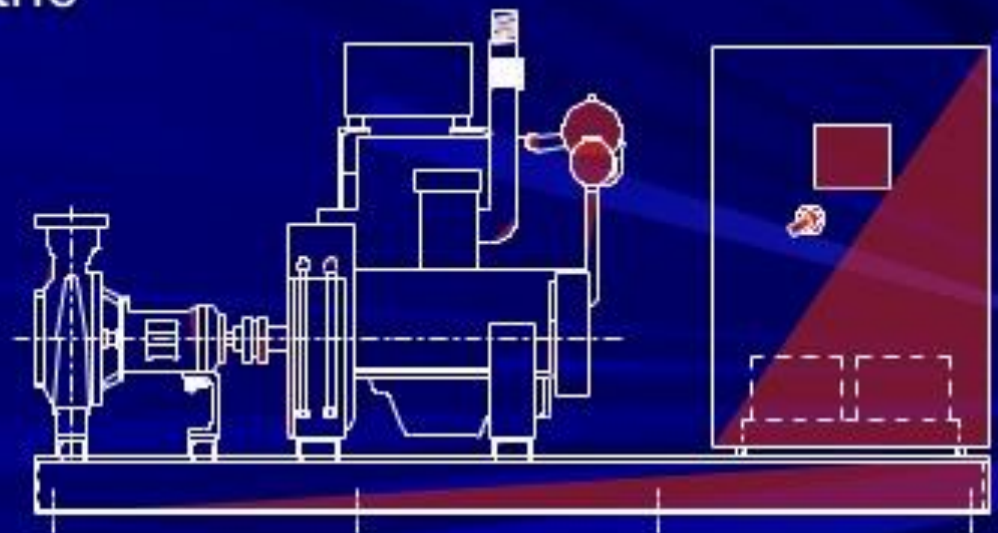
HSE

■ BENEFITS

- Moderate floor space requirement
- Flexibility in mechanical room layout
- Available in electric or diesel drive
- Serviceable

■ DRAWBACKS

- Only available up to 1500gpm
- Single suction design limits hydraulic efficiency



Vertical Turbine Fire Pumps

- Used where a flooded suction cannot be maintained
- Underground water sources or below ground tanks with above ground pump room



Vertical Turbine Fire Pumps

HSE

■ BENEFITS

- Will operate under suction lift
- Available in electric or diesel drive
- Available over wide flow and head range

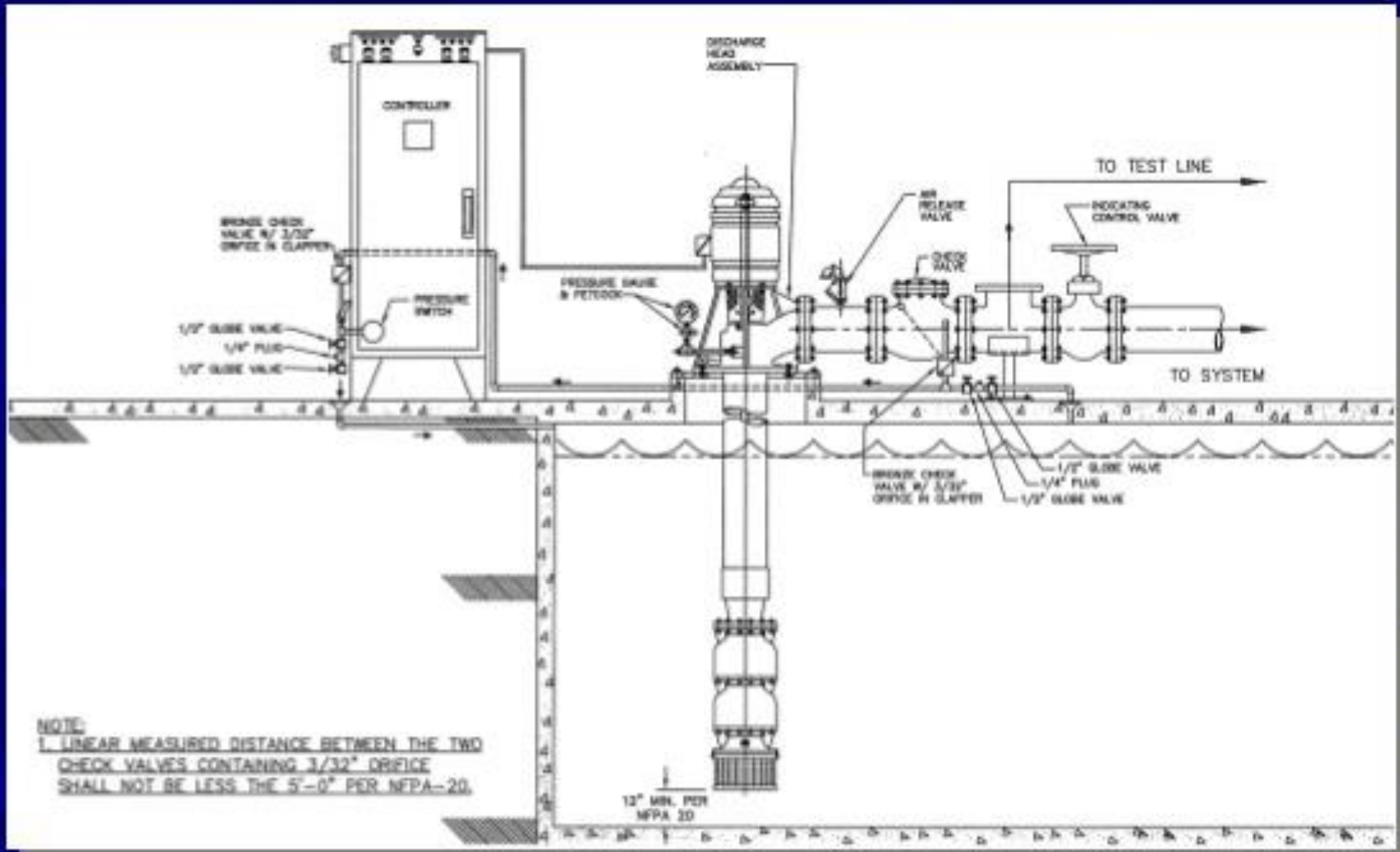
■ DRAWBACKS

- More costly
- More difficult to service and install



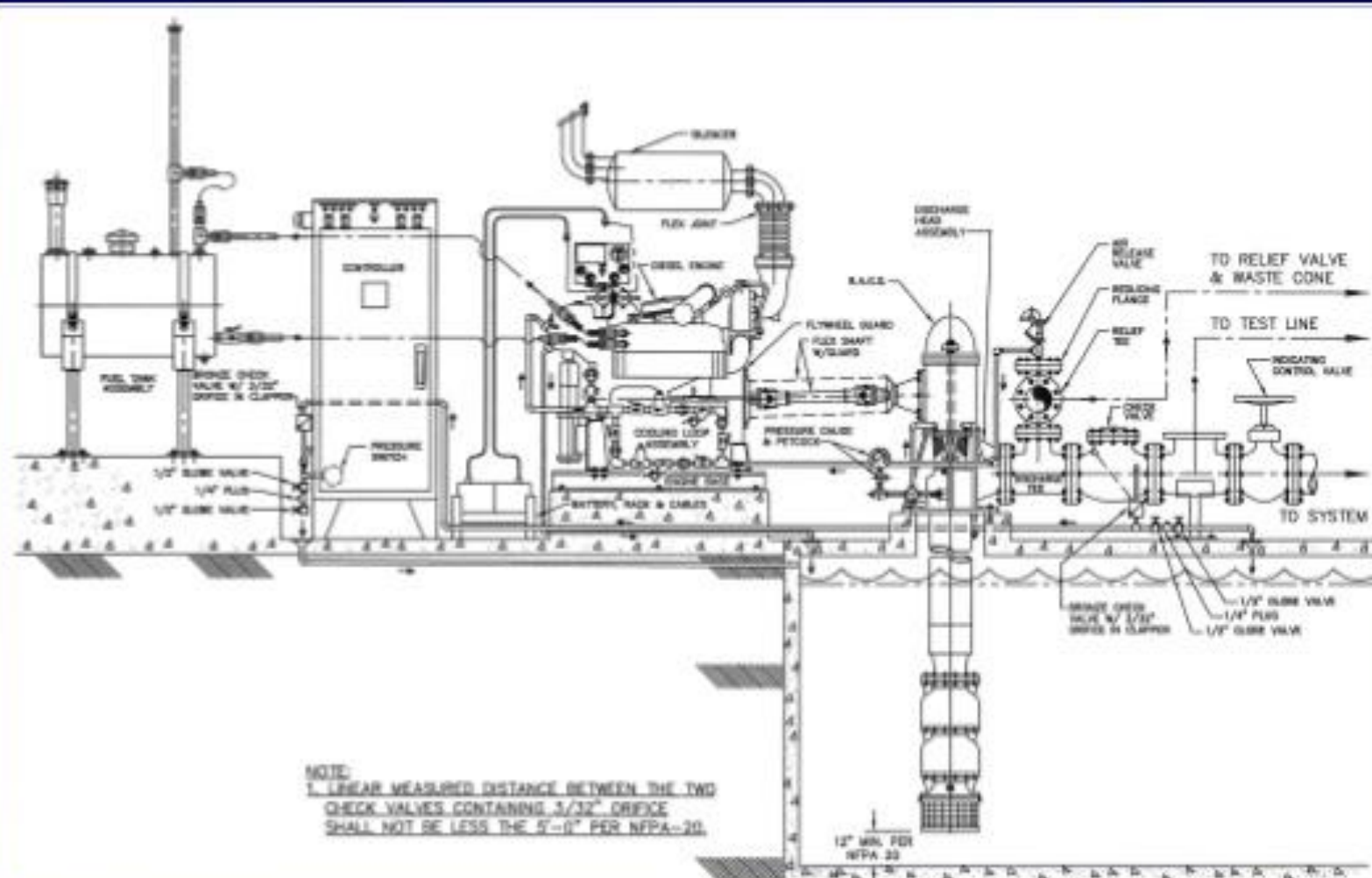
Typical Application Wet Pit - Electric Motor Driver

HSE



Typical Application

Wet Pit - Diesel Engine Driver



NFPA Required Pump Accessories

HSE



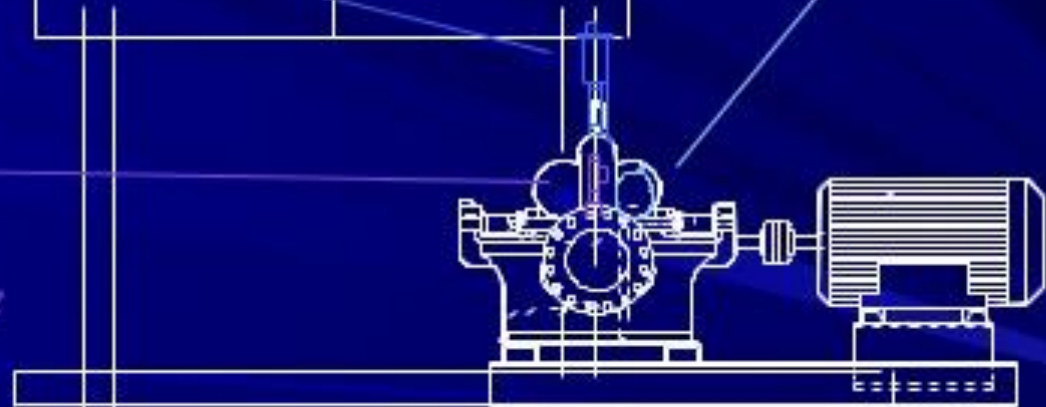
*Air Release
Valve*



Pressure Relief Valve
• *three pressure
ranges*
• *adjustable on site*



*Suction &
Discharge
Gauges*

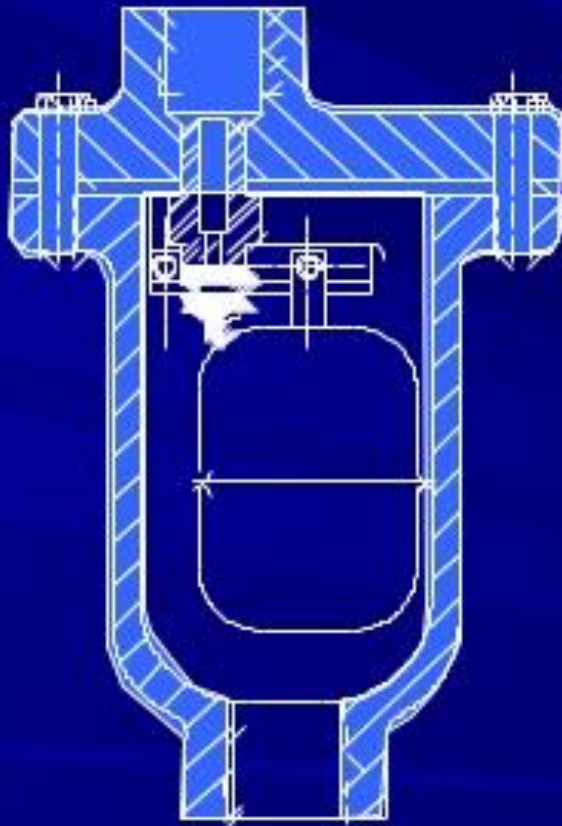


NFPA Required Pump Accessories

- Suction gauge must be of the compound type (capable of reading negative pressure or vacuum)
- Discharge gauge must read two times the working pressure of the pump and not less than 200psi

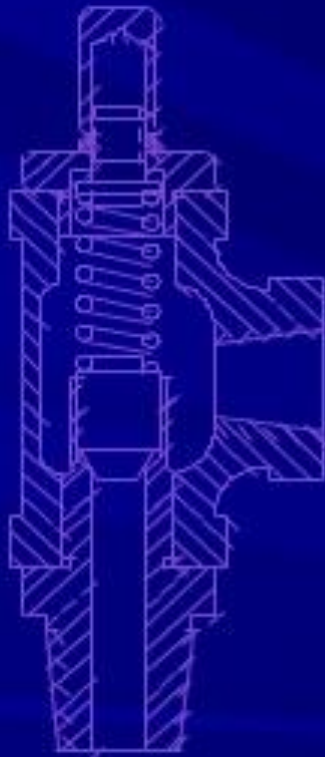


Air Release Valve



- 1/2" Air Release Valve is required
- Exception: top centre-line discharge end suction and vertical fire pumps

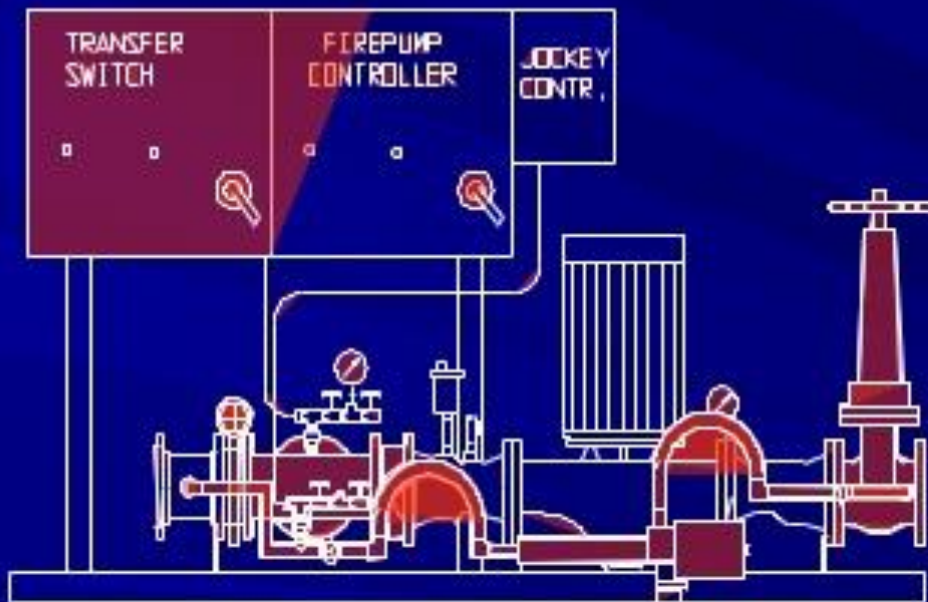
Casing Relief Valve



- 3/4" up to 2500usgpm
- 1" over 3000usgpm
- Should be set between the maximum suction pressure and minimum suction pressure plus the closed valve pressure of the pump
- Piped before the fire pump discharge check valve

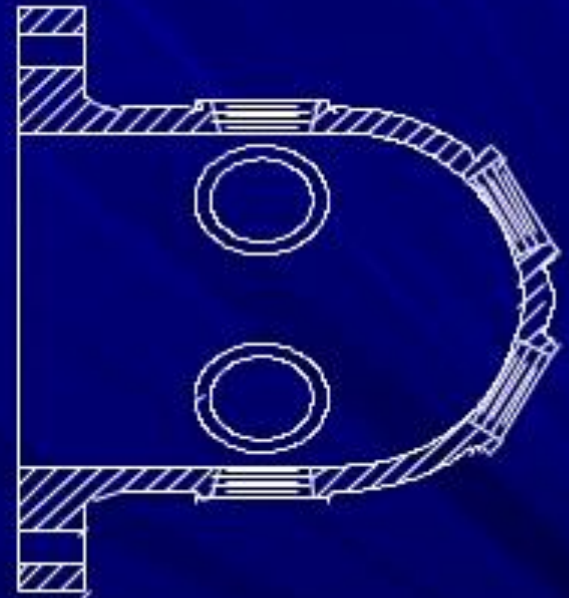
Isolation Valves

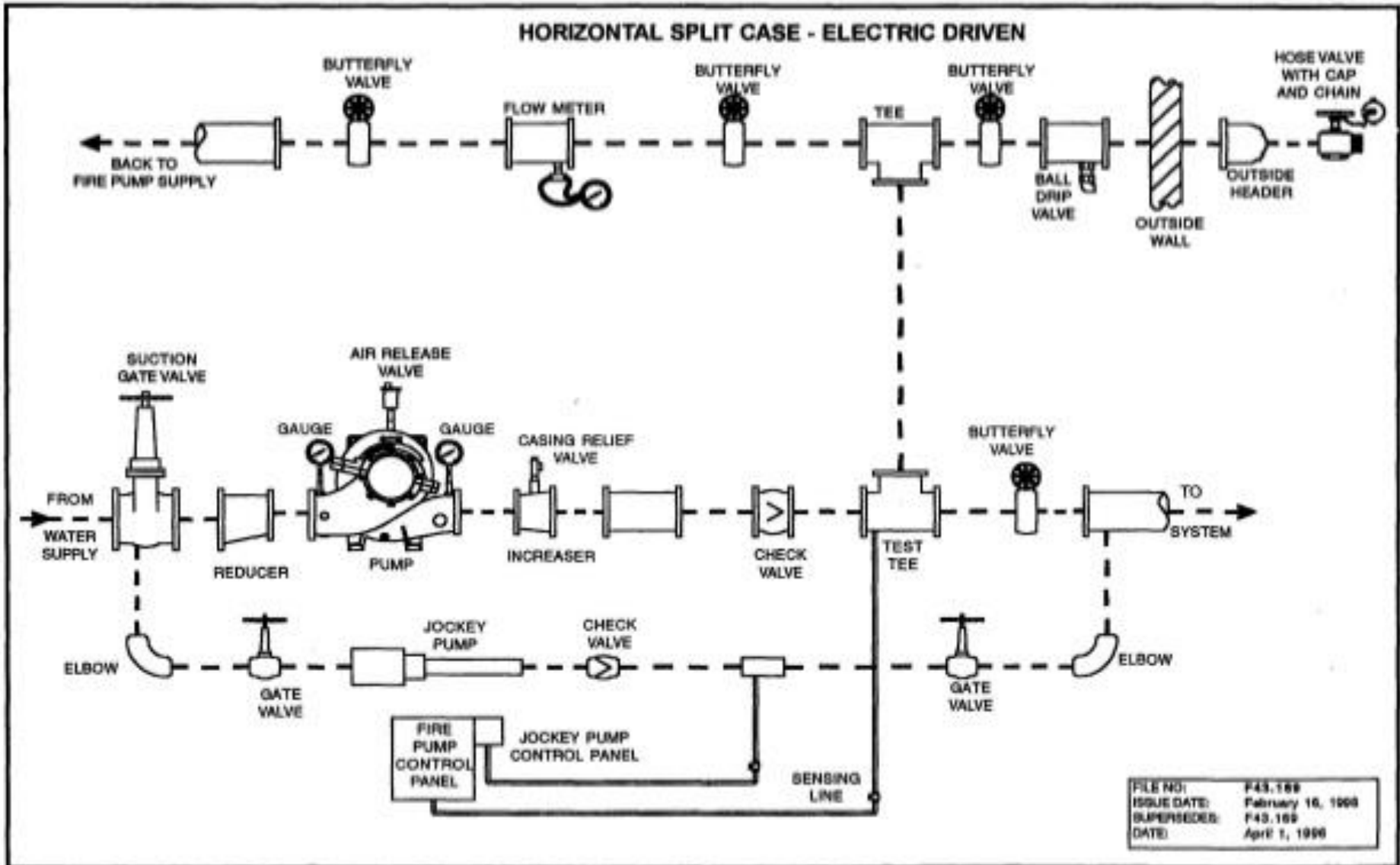
- Suction OS&Y Gate Valve
- Discharge Butterfly Valve
- Both must be supervised
- Discharge Butterfly Valve Installed after "Test Tee" and pressure sensing line



Hose Valve Systems

- Provides testing means
- Sized by pump rated capacity
- There are hundreds of different thread types depending on jurisdiction
 - type should be specified on projects



ARMSTRONG**TYPICAL FIRE PUMP & CONTROLLER ARRANGEMENT**

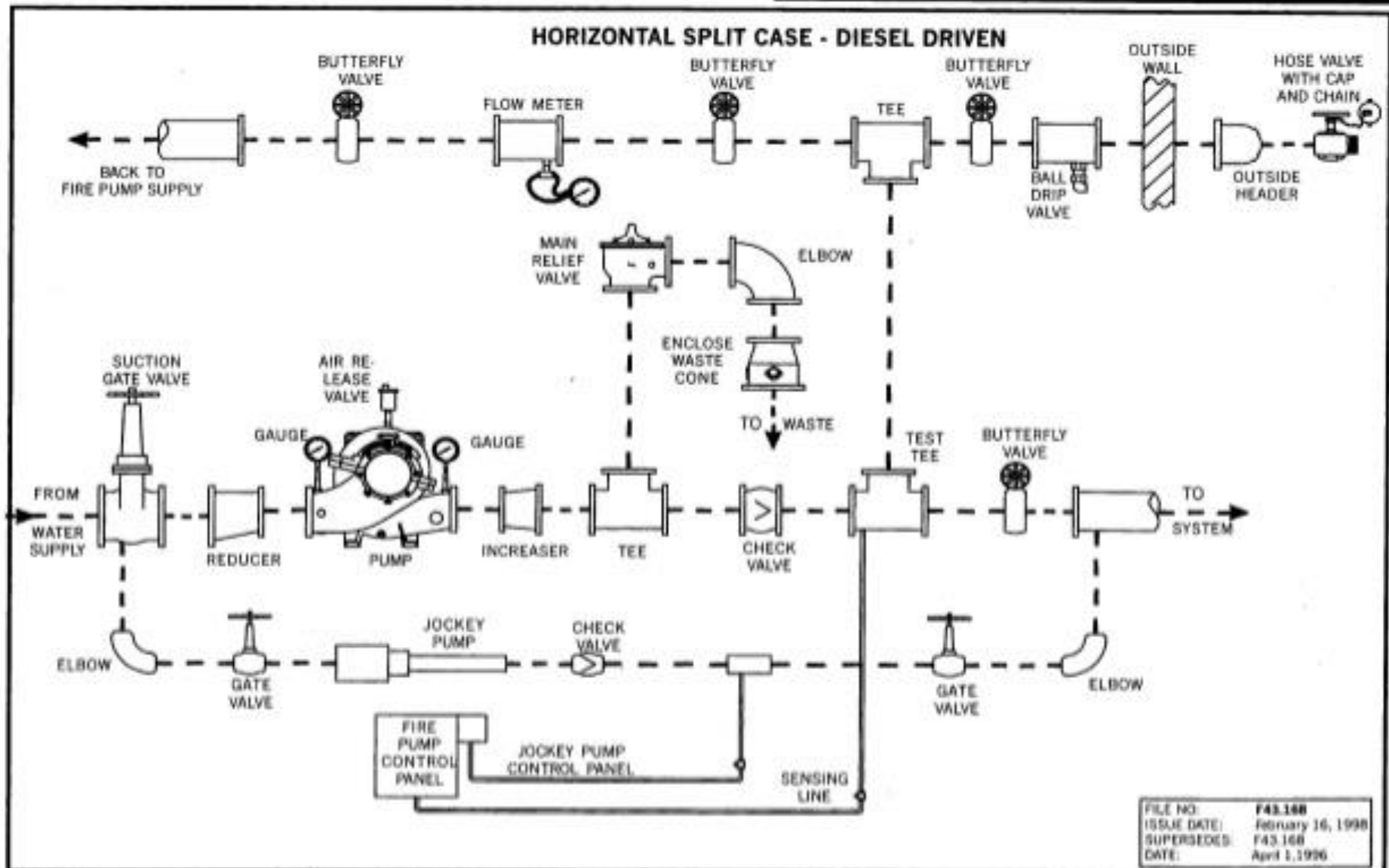
Flow Meters

HSE

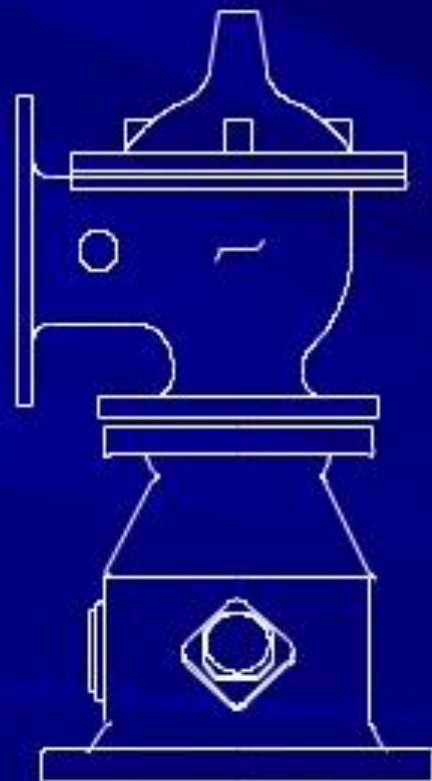
- Does not replace a hose valve system
- Flow meters must be listed for fire protection service
- Gauge reading is a minimum of 175% the pump rated flow
- Provides a testing means without wasting water
- Flow meter is installed in bypass back to suction
- Must be installed with isolation valves per manufacturer's specifications
- RULE OF THUMB:
 - Annular Type - 10Ø upstream - 5Ø downstream
 - Venturi Type - 7Ø upstream - 5Ø downstream

ARMSTRONG

TYPICAL FIRE PUMP & CONTROLLER ARRANGEMENT



Main Relief Valves and Waste Cones

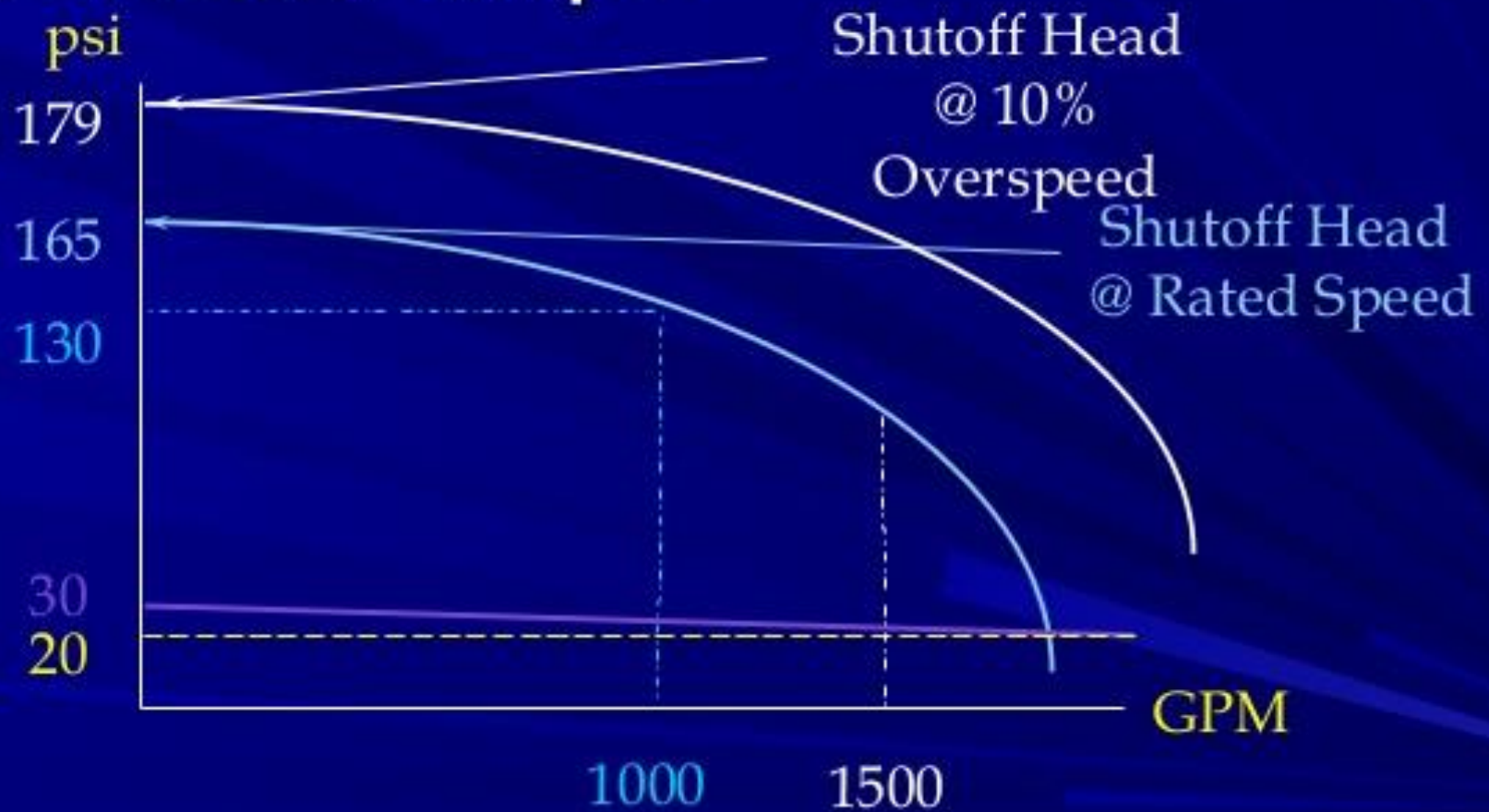


- Sized by pump rated capacity
- Spring or pilot operated
- Waste cone provides visibility of flow through the valve
- When it is used:

Diesel driven systems) 1
???Electric systems) 2

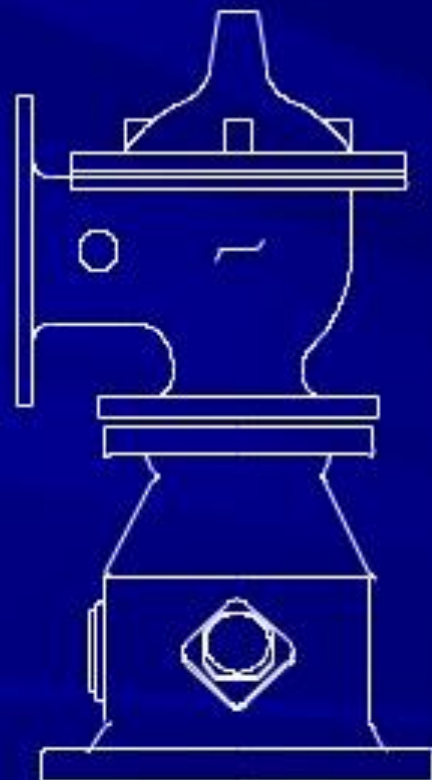
Main Relief Valve - Diesel Pumps

HSE



Main Relief Valves and Waste Cones

HSE



- Recommended on all diesel driven systems
- Not required on diesel if maximum supply pressure plus $1.21 \times$ closed valve pressure does not exceed system pressure rating
- NFPA allows piping back to suction - NOT recommended
- Relief valve should be set below maximum pressure rating of the system

Main Relief Valve - Electric Pump

HSE



Misinterpreted Code Requirement

HSE

- Devices in the discharge piping - main relief or pressure reducing valves should only be installed where absolutely necessary
- Valves introduce a failure mode and should only be used when required

NFPA Fitting Sizing

Piping, Relief Valves, Metering Devices, and
Hose Valves should be sized according to
.Table 2-20 on Page 20-13

NFPA Required Pump Accessories

HSE

Fire Pump Rating GPM (L/s)	Suction Size (in.)	Discharge Size (in.)	Relief Valve Size (in.)	Relief Valve Discharge (in.)	Flow Meter Size (in.)	Number & Size of Hose Valves	Hose Valve Manifold Size (in.)
25 (95)	1	1	3/4	1	1 1/4	1 - 1 1/2 "	1
50 (189)	1 1/2	1 1/4	1 1/4	1 1/2	2	1 - 1 1/2 "	1 1/2
100 (379)	2	2	1 1/2	2	2 1/2	1 - 2 1/2 "	2 1/2
150 (568)	2 1/2	2 1/2	2	2 1/2	3	1 - 2 1/2 "	2 1/2
200 (757)	3	3	2	2 1/2	3	1 - 2 1/2 "	2 1/2
250 (946)	3 1/2	3	2	2 1/2	3 1/2	1 - 2 1/2 "	3
300 (1136)	4	4	2 1/2	3 1/2	3 1/2	2 - 2 1/2 "	3
400 (1514)	4	4	3	5	4	2 - 2 1/2 "	4
450 (1703)	5	5	3	5	4	2 - 2 1/2 "	4
500 (1892)	5	5	3	5	5	2 - 2 1/2 "	4
750 (2839)	6	6	4	6	5	3 - 2 1/2 "	6
1000 (3785)	8	6	4	8	6	4 - 2 1/2 "	6
1250 (4731)	8	8	6	8	6	6 - 2 1/2 "	8
1500 (5677)	8	8	6	8	8	6 - 2 1/2 "	8
2000 (7570)	10	10	6	10	8	6 - 2 1/2 "	8
2500 (9462)	10	10	6	10	8	8 - 2 1/2 "	10
3000 (11,355)	12	12	8	12	8	12 - 2 1/2 "	10

Pressure Maintenance Pump (Jockey

- Every system has a normal leakage rate that will result in a pressure drop
- Jockey Pump will maintain the pressure in the system
- This will prevent the main fire pump from starting for minor leaks

Jockey Pump Sizing

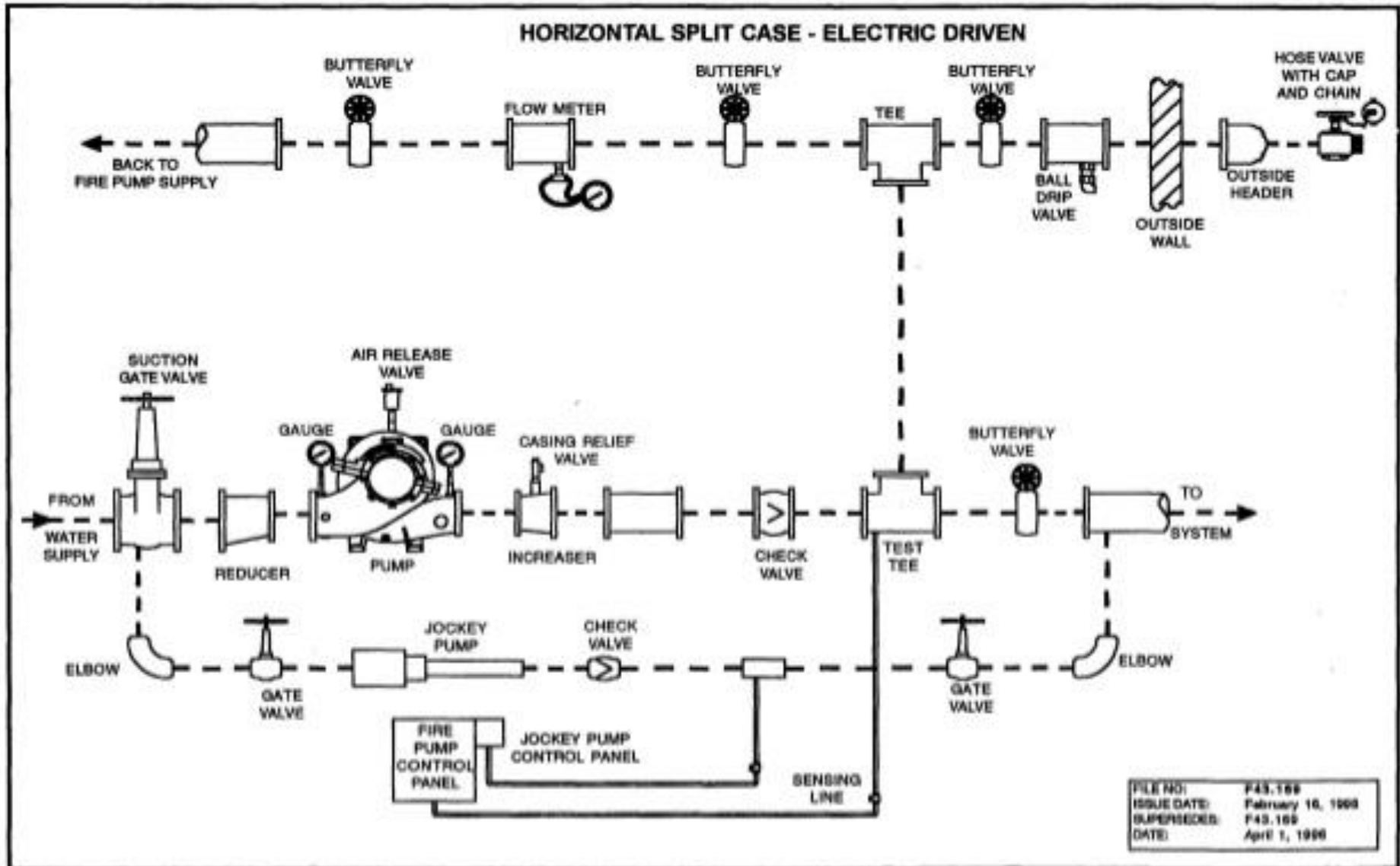
- Jockey pumps should be sized for 1% of the flow of the main fire pump
- Jockey pumps should be sized to provide 10psi more pressure than the main fire pump
- Jockey pump should be sized so that it cannot meet the demand of the lowest flow fire protection fitting in the system

Fire Pump Operation

- Fire pumps are designed to start on a pressure switch setting
- Some fire pumps can be started automatically based on a deluge valve opening, or a remote signal
- The pressure sensing line is the lifeline for the fire protection system

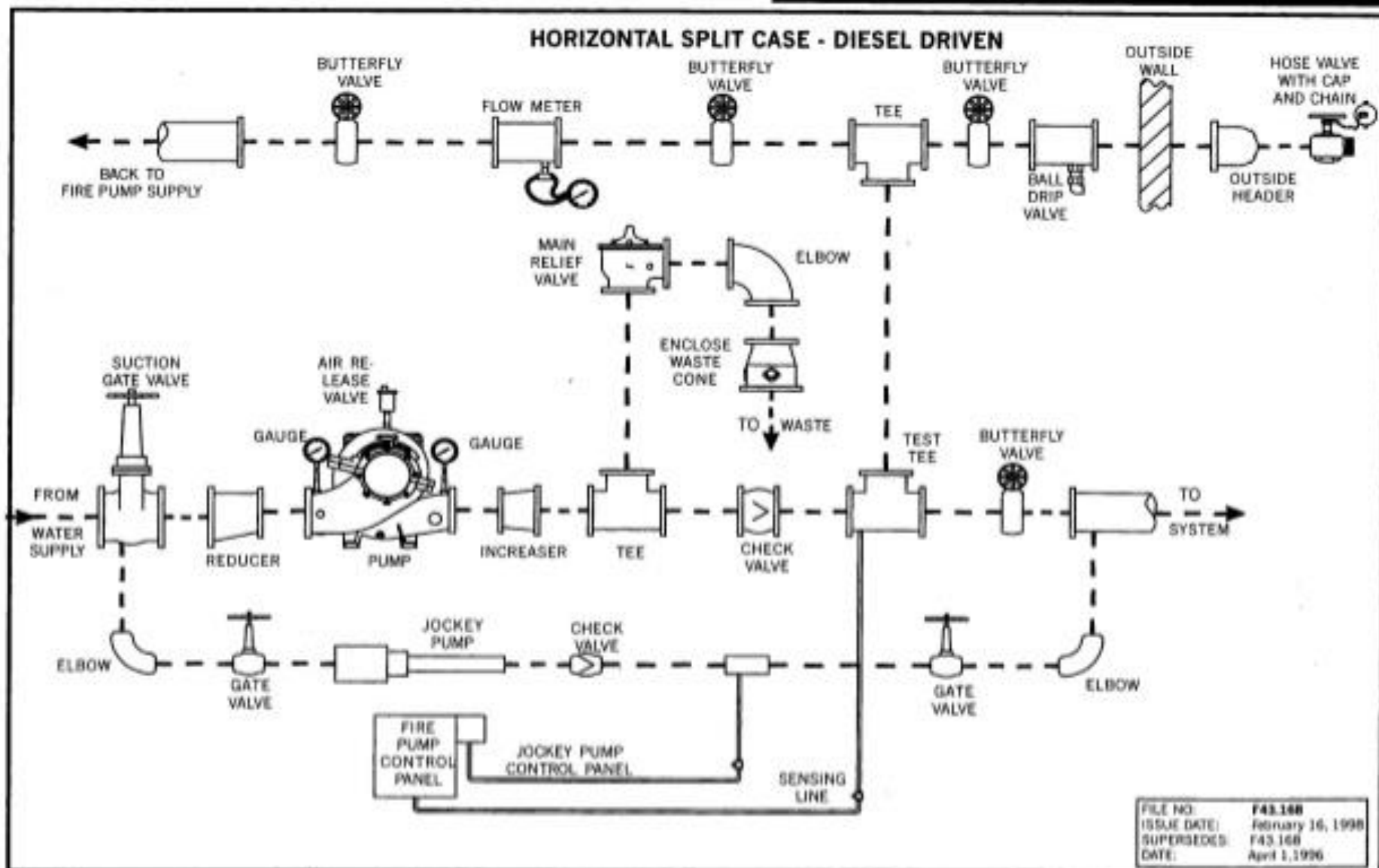
Fire Pump Operation

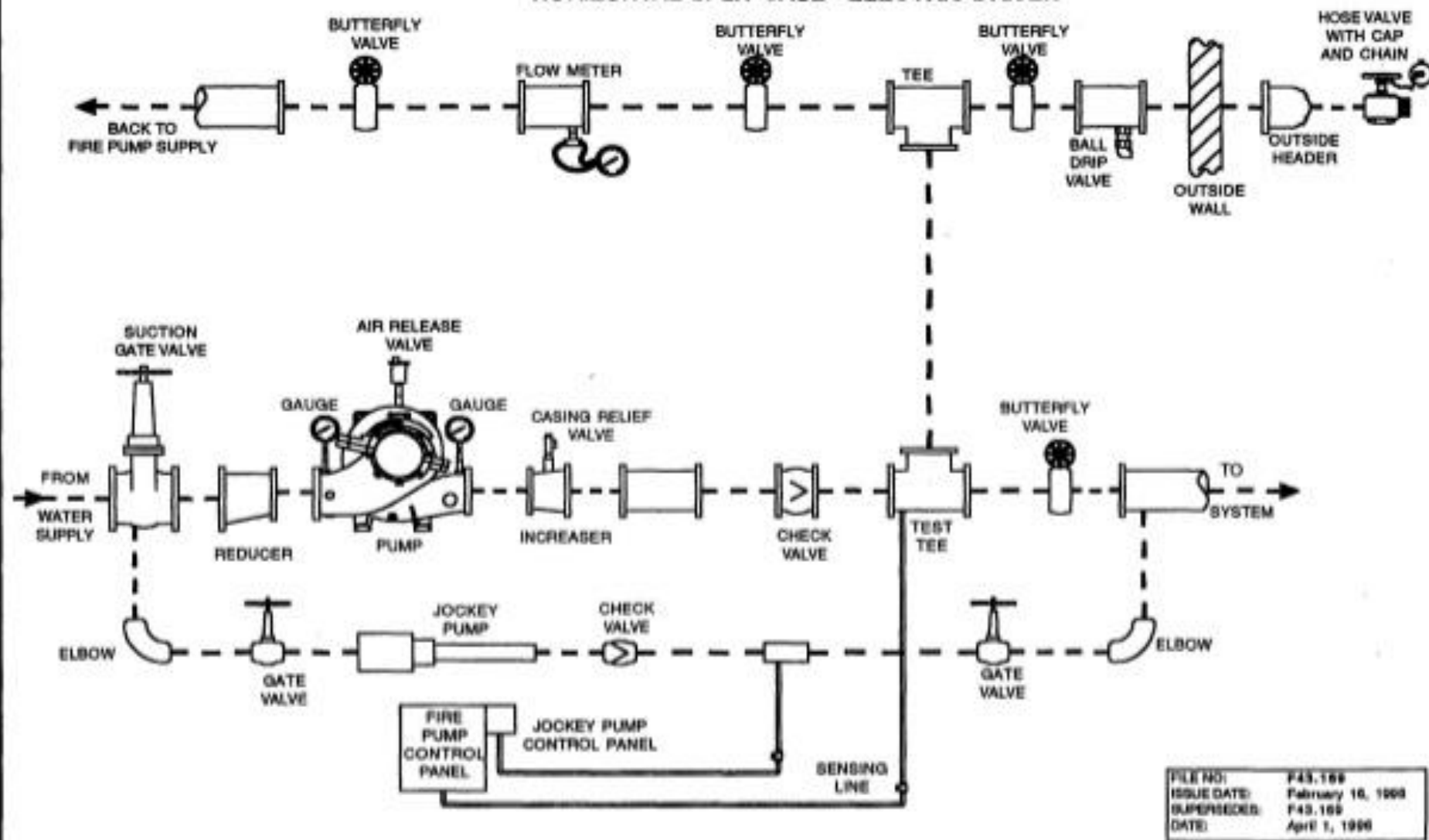
- Pressure switches should be rated for maximum pressure conditions
- Sensing lines must be 1/2" non-ferrous (copper) with two check valves with a 3/32" hole drilled in the flapper
- Check valves are for damping of pressure when the pump starts to protect the pressure switch
- Check valves are installed 5 feet apart and must open on a pressure drop in the sensing line
- Check valves close when the pump starts
- Jockey pump and fire pump sensing lines must be separate

ARMSTRONG**TYPICAL FIRE PUMP & CONTROLLER ARRANGEMENT**

ARMSTRONG

TYPICAL FIRE PUMP & CONTROLLER ARRANGEMENT

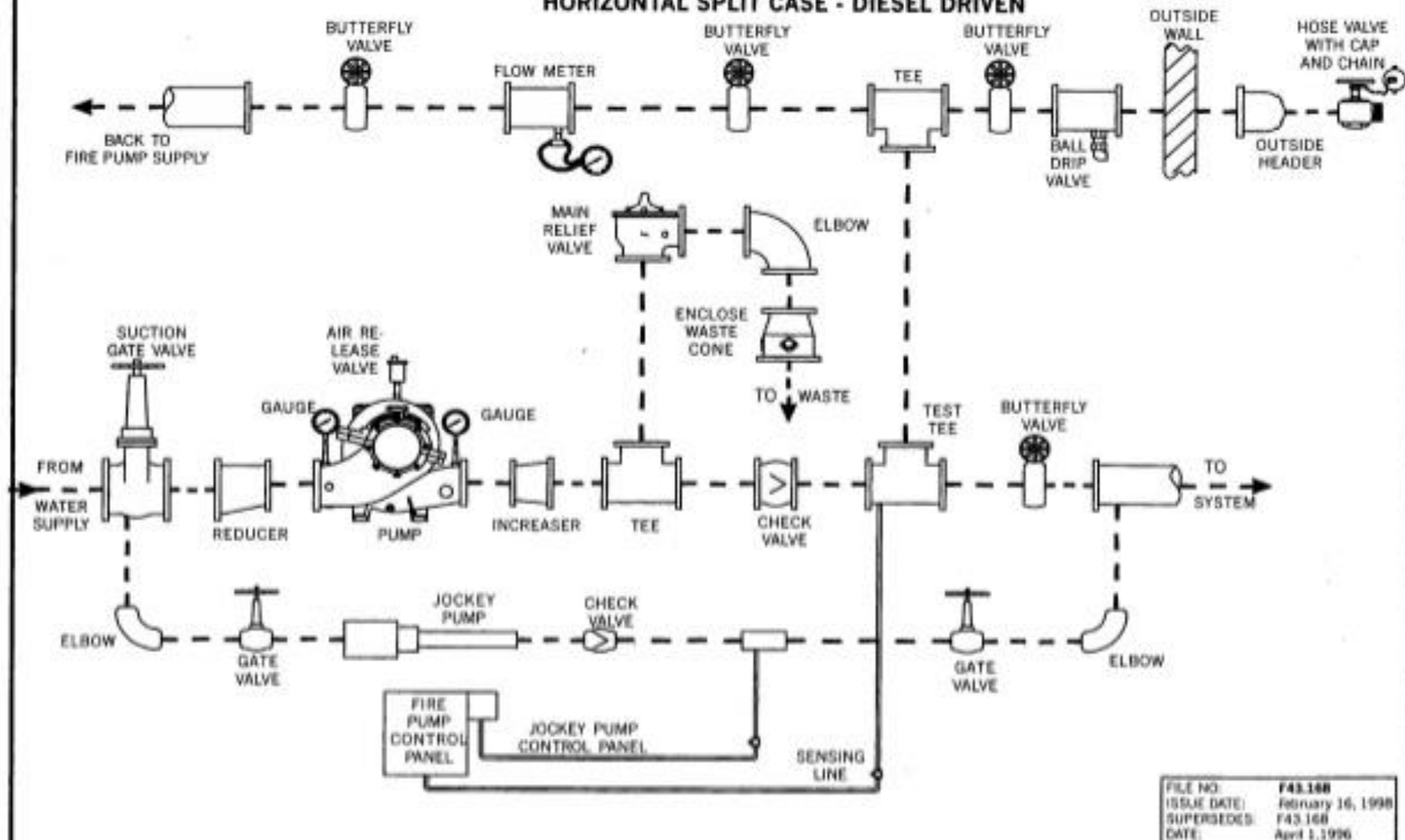


ARMSTRONG**TYPICAL FIRE PUMP & CONTROLLER ARRANGEMENT****HORIZONTAL SPLIT CASE - ELECTRIC DRIVEN**

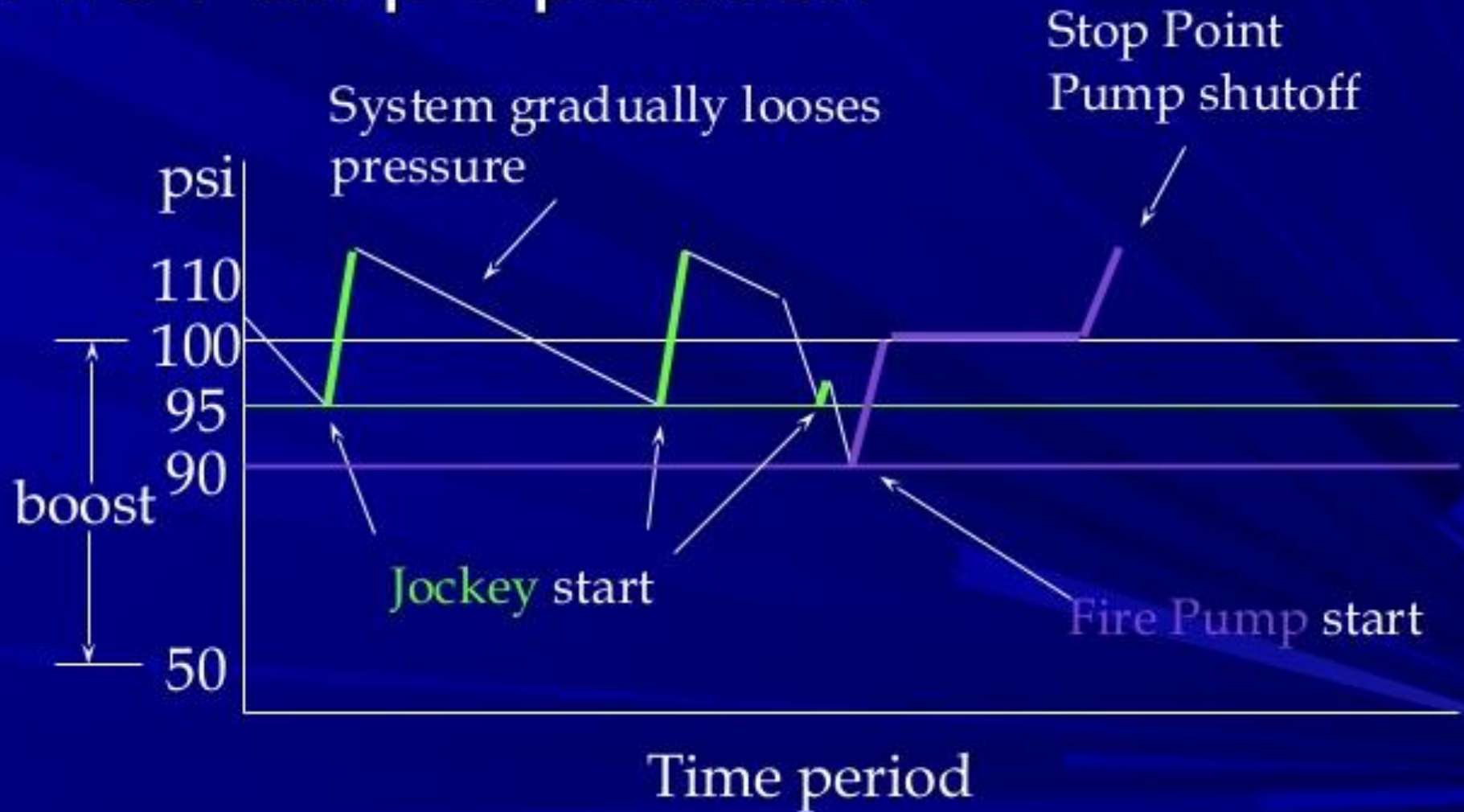
ARMSTRONG

TYPICAL FIRE PUMP & CONTROLLER ARRANGEMENT

HORIZONTAL SPLIT CASE - DIESEL DRIVEN



Fire Pump Operation



Critical New Code Requirements (2003)

HSE

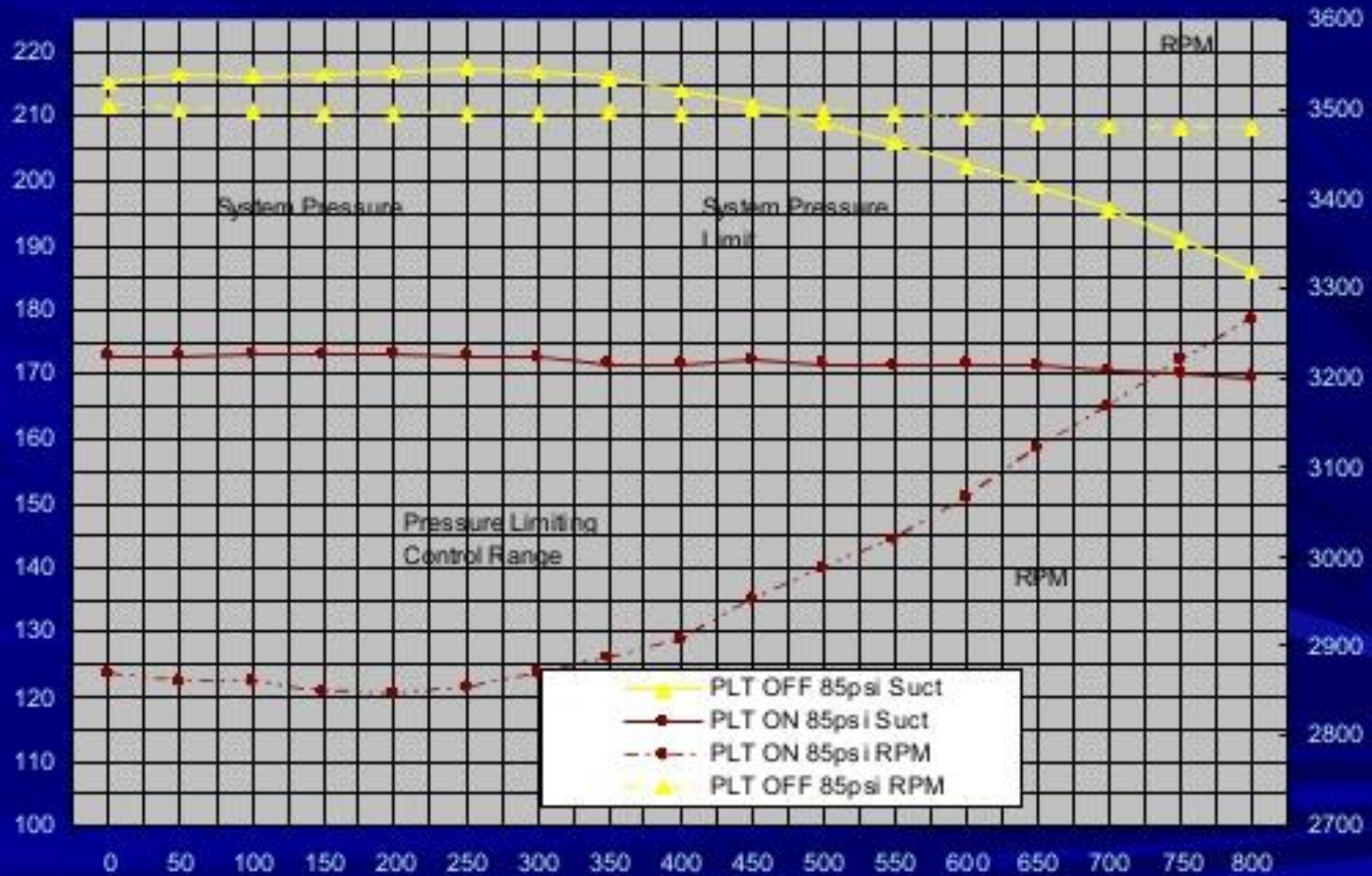
- Extensive changes to NFPA20 including chapter numbers
- Fire pump sizing will move from the Appendix to the main text of the code
- Greater clarity on devices in the discharge piping
- Provisions for the acceptance of electronic speed governors on diesel engines
- Reference to NEMA ICS 14-2001 as Appendix B (Application Guide for Electric Fire Pump Controllers)

Critical New Code Requirements (2003)

HSE

- Diesel tank supervision and markings
- Alternate valve arrangement for diesel cooling lines
- Provision for reading amperage and voltage on limited service controllers
- Variable speed drivers as pressure limiting devices
- Copper lines and fittings not allowed for diesel piping

Typical System Performance - 500gpm, 160psi
including 85psi Suction Pressure



FIRE PUMP CONTROLLERS

HSE

- Diesel or Electric
- Full Service or Limited Service
- HP of the motor
- Voltage of the installation
- Withstand rating
- Starting method

CONTROLLER STARTING METHOD



■ Across the Line

- Limited Service - Under 30hp
- Full Service



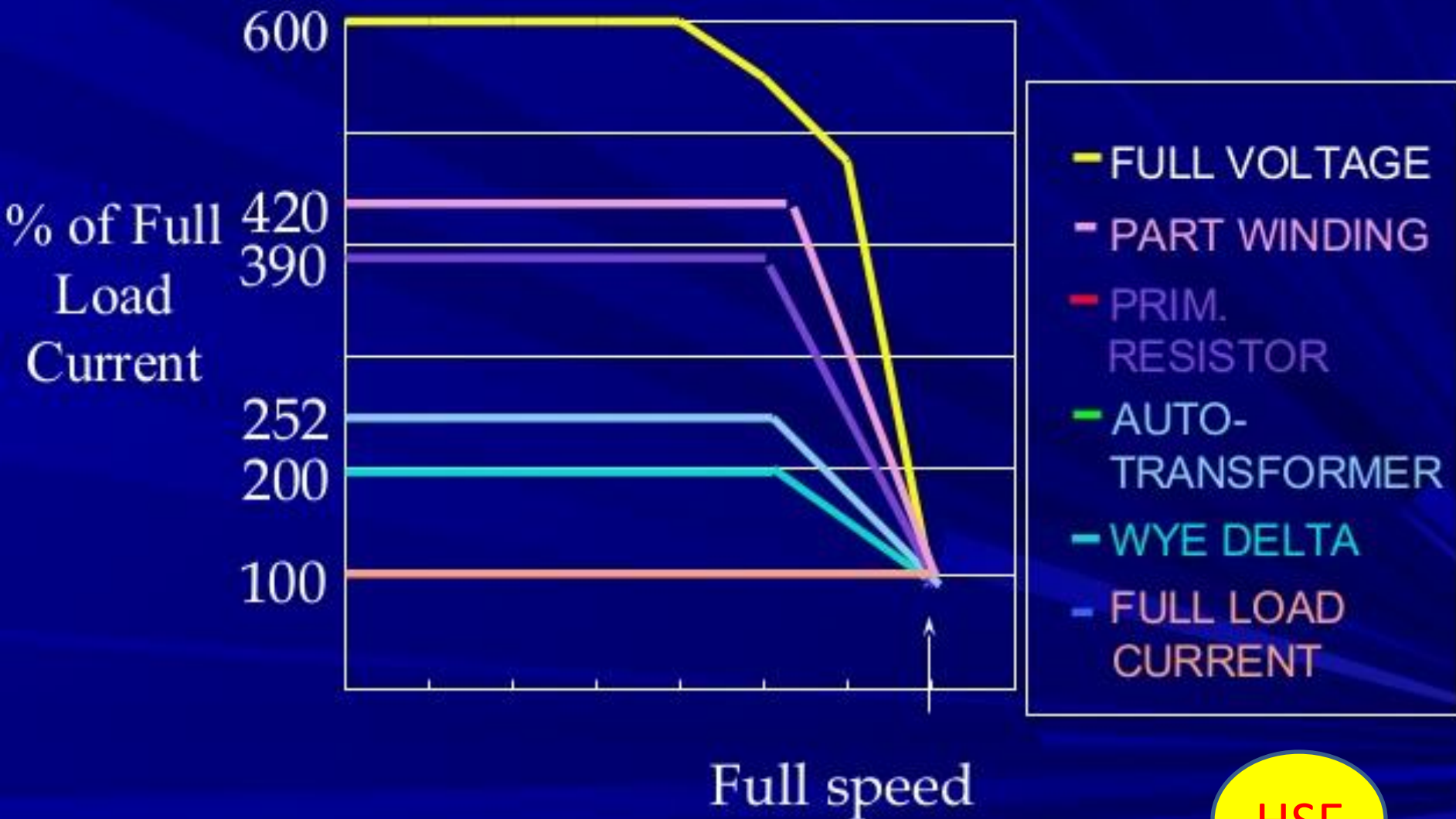
■ Reduced Voltage

- Auto Transformer
- Wye Delta - Special Motor Required
- Part Winding - Special Motor Required
- Primary Resistor



HSE

CONTROLLER STARTING METHOD



HSE

AUTOMATIC TRANSFER SWITCHES

HSE

- What is it?
 - An additional controller used in case of a power failure
- Why use it?
 - To transfer the power to another source (generator or diesel)
- When to use it?
 - If Authorities Require One
 - If Power Source not Reliable



DIESEL CONTROLLERS

HSE

■ Serve Three Basic Functions:

- Start the Diesel Engine in an emergency
- Monitor the Operation and Condition of the Diesel Engine
- Keep the batteries charged

DIESEL CONTROLLERS

HSE

- Diesel Can be Started by Three Methods:
 - Pressure Switch (In the Automatic Mode)
 - Pressure Switch (In the Test Mode)
 - Manual Cranking (In the Automatic or Manual Mode)
- Starting sequence:
 - Alternating cranking sequence
 - Six cranks every 30 seconds until diesel starts
 - If diesel fails to start, an alarm is activated

DIESEL CONTROLLERS

HSE

■ Diesel Can be Stopped by Two Methods:

- Manually by Pushing the Stop Button
- Automatically after 30 minutes during weekly test

■ Overspeed shutdown:

- A diesel fire pump will shut down in an emergency condition if the diesel operates more than 20% faster than the rated speed

DIESEL CONTROLLERS

HSE

■ Diesel Controller Alarms

- Battery and Charger Failures
- Diesel operating condition (High Coolant Temperature, Low Oil Pressure, Overspeed, Failure to Start)
- Contacts for remote indication of alarm conditions
- Optional Pump Room Alarms (Low suction pressure, flow meter on, Main Relief Valve open, Low/High Pump Room temperature, Low fuel level, Others)

DIESEL CONTROLLERS

HSE

■ Battery Charging Systems:

- One charger for each set of batteries
- Chargers are capable of fully charging the batteries in 24 hours
- Batteries remain in an overcharged condition

Pump Maintenance

HSE

- Pump acceptance tests are defined in NFPA20 Chapter 11
- Inspection and maintenance are defined in NFPA25 Chapter 5
- Seals and bearings are the highest maintenance item for a pump
- The packing should be checked and adjusted each time the pump is tested
- As fire pumps do not run often, bearings should be checked for cleanliness and to ensure that adequate oil or grease has been applied (depending on the type of bearing)
- Motor bearings should also be checked

SAFETY SHOULD NOT BE COMPROMISED

!Thank you

A green five-pointed star logo is located in the bottom right corner of the slide. The letters 'HSE' are written in white inside the star.

HSE