

3rd Chemical Process Safety Sharing (CPSS)



Chemical
Process Safety Sharing

Topic : Fire Pump Design Practice
Present Name : Kasana Lajarojana
Position : Senior Engineer
Company: IRPC



GTC



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ES



SCG
CHEMICALS

IRPC

Fire Pump Design Practice



**Kasana Lajarojana, IRPC
January, 2019**

Presentation Outlines

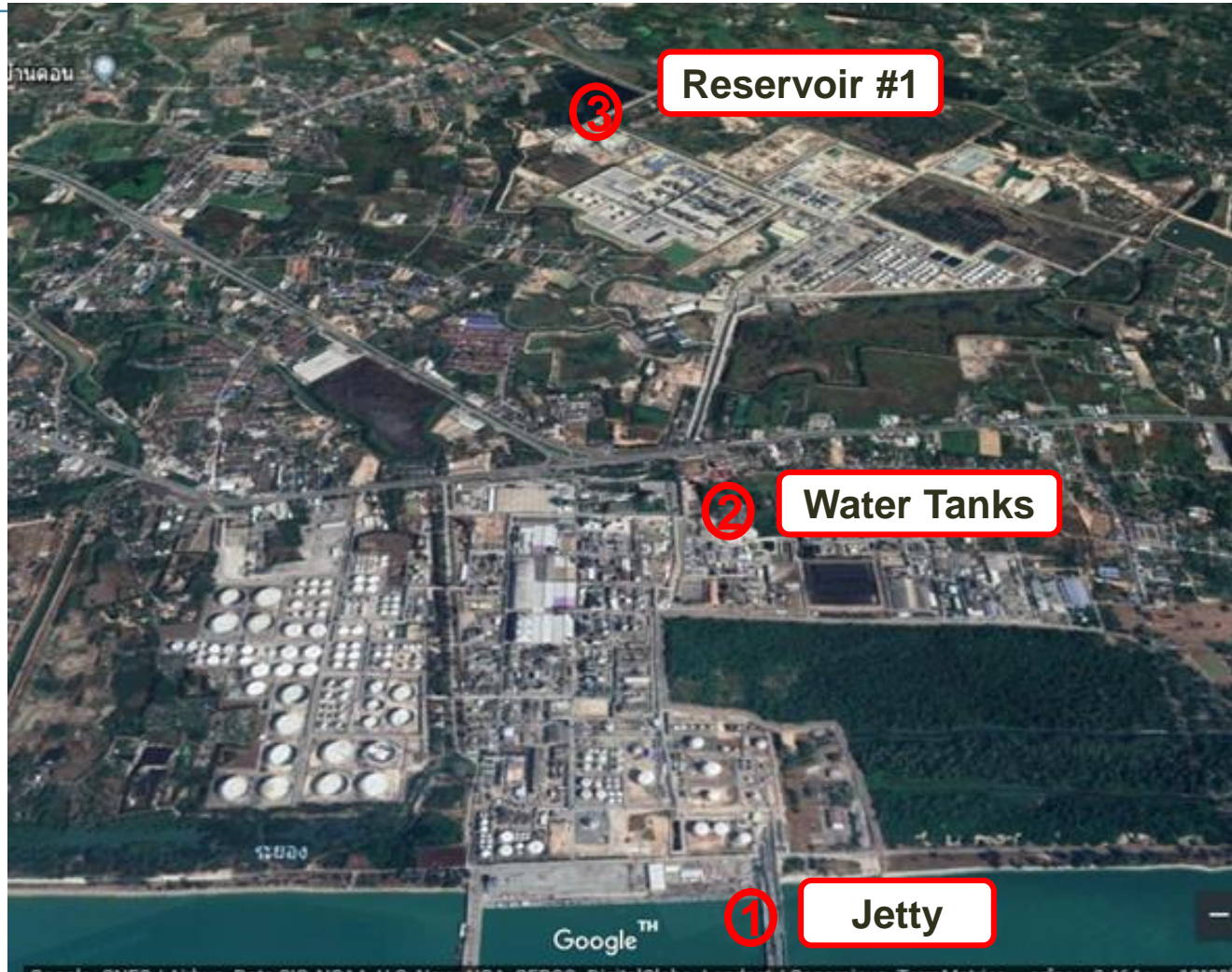


Introduction and Standard Approval for Fire Pump

Design Practice for Fire Pump



IRPC Fire Pump Stations

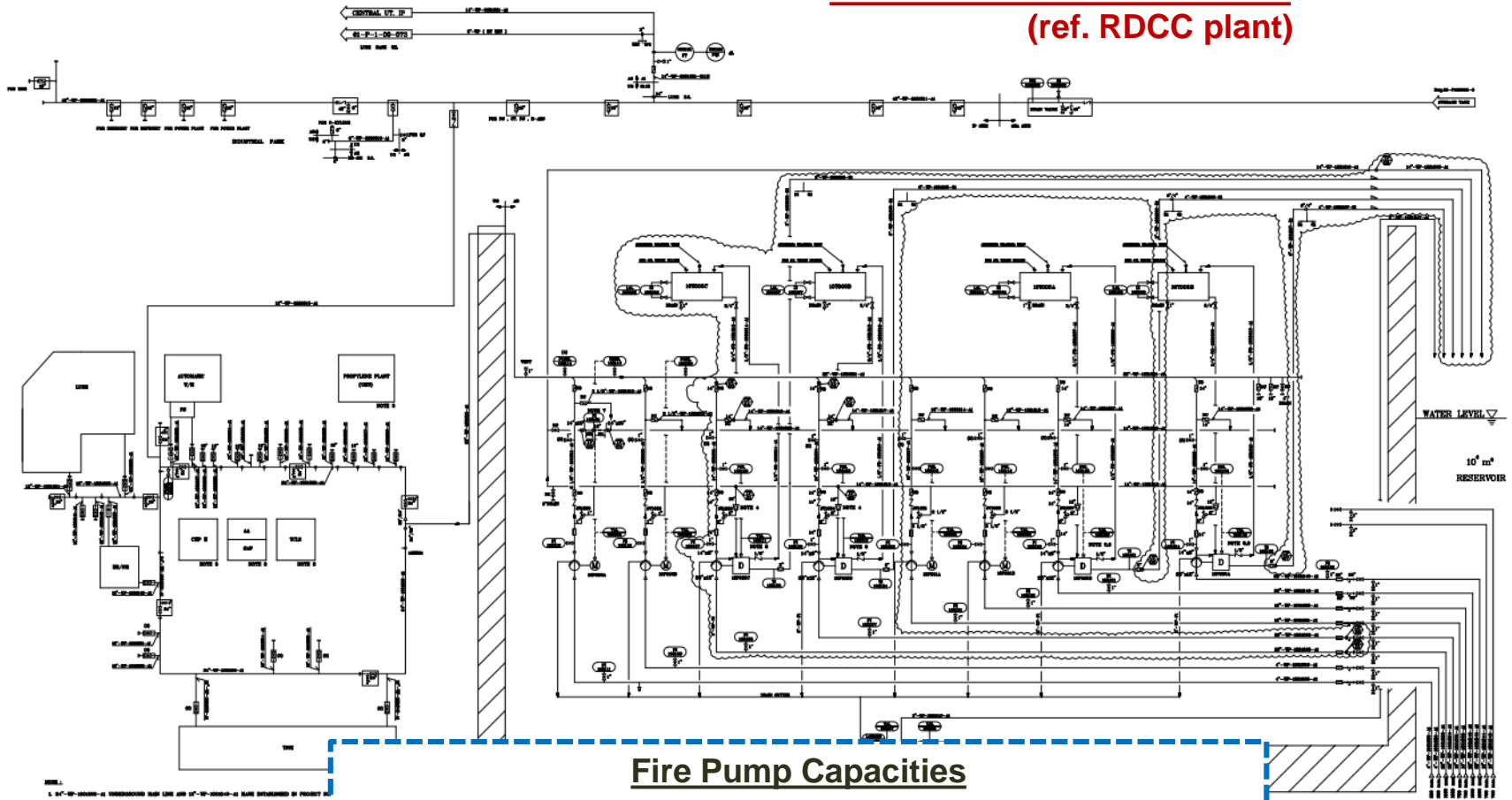


Installation Fire Pump in IRPC IP Site Project



Fire pump system in IP site

**Maximum Fire water demand : 3500 m³/hr.
(ref. RDCC plant)**



Fire Pump Capacities

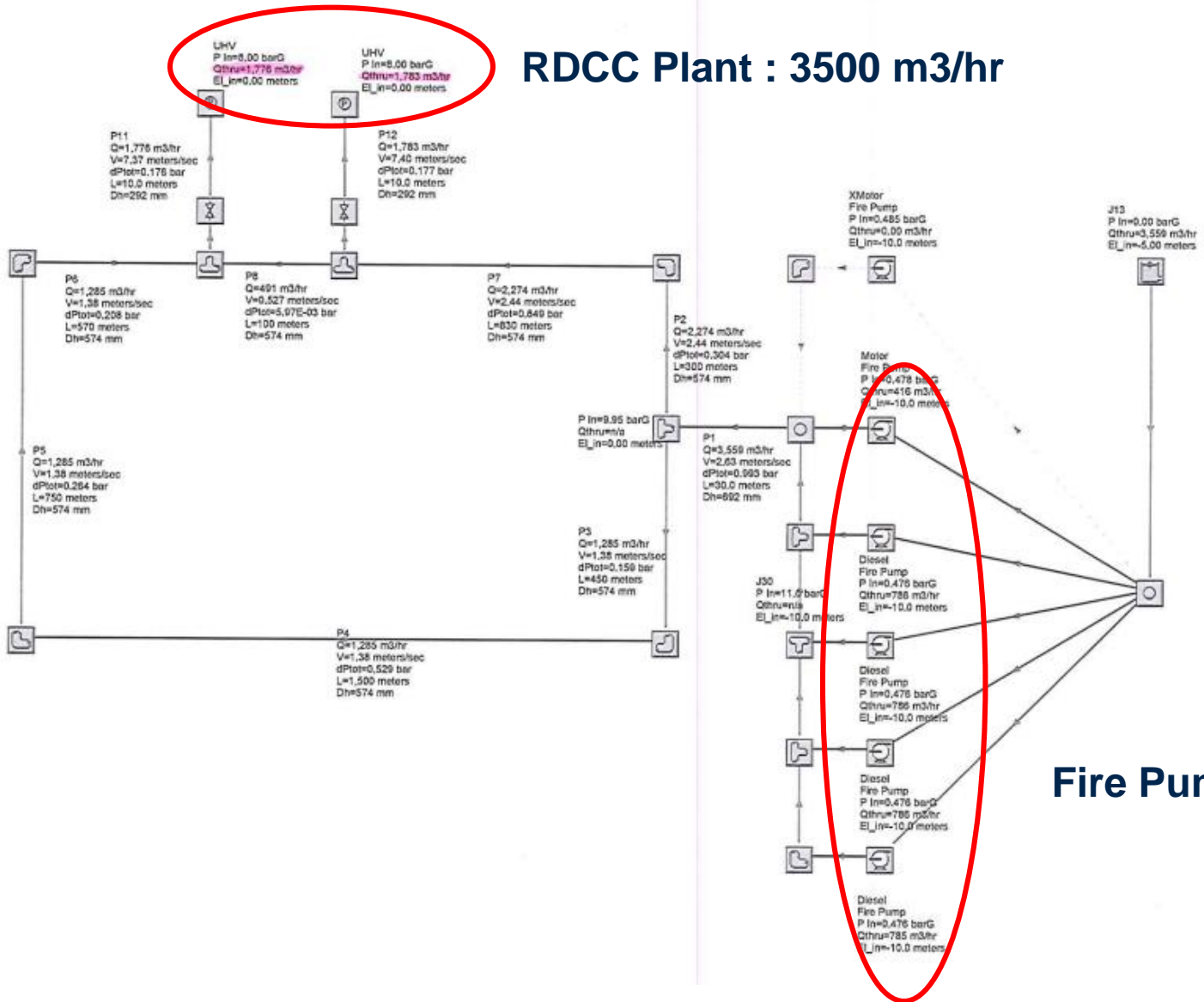
- Diesel Engine driver : 4 X 3500 @ 10.5 barg GPM
- Electric Motor driver : 2 X 2000 @ 10.5 barg GPM

Total Capacities 18000 GPM (4,000 m³/hr.)

NOTE:
1. ALL 10" DIAMETER OR LARGER PIPES SHALL BE 10" OR 12" DIAMETER AS SHOWN IN PROJECT AND SHALL BE WELDED.
2. ALL 8" DIAMETER PIPES SHALL BE 8" DIAMETER AS SHOWN IN PROJECT AND SHALL BE WELDED.
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WF piping network calculation

AFT Fathom Model
 C:\AFT Products\AFT Fathom 7.0\works\fire fighting water for UHV (Hazen factor 115).fth
 Base Scenario



RDCC Plant : 3500 m3/hr

Fire Pumps

NFPA 20



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NFPA® 20

Standard for the Installation of Stationary Pumps for Fire Protection

2016 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

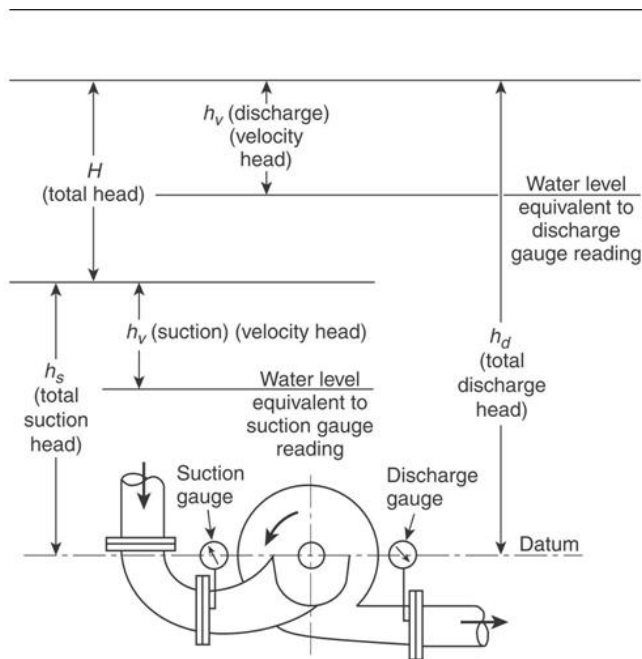
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3rd Chemical Process Safety Sharing (CPSS)
31st January, 2019, Thailand

Centrifugal Fire Pump Type

Horizontal Shaft Type

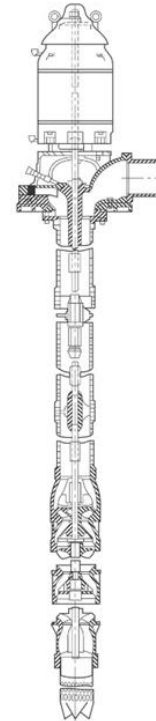


Note: Installation with suction head above atmospheric pressure shown.

FIGURE A.3.3.25.3.1 Total Head of All Types of Stationary (Not Vertical Turbine-Type) Fire Pumps.

Vertical Shaft Type

Water-lubricated, open lineshaft pump, surface discharge, threaded column and bowls



Oil-lubricated, enclosed lineshaft pump, underground discharge, flanged column and bowls

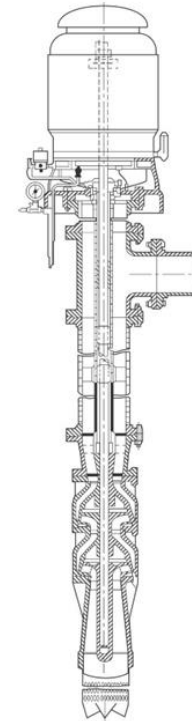


FIGURE A.7.1.1 Water-Lubricated and Oil-Lubricated Shaft Pumps.

Fire Pump Driver



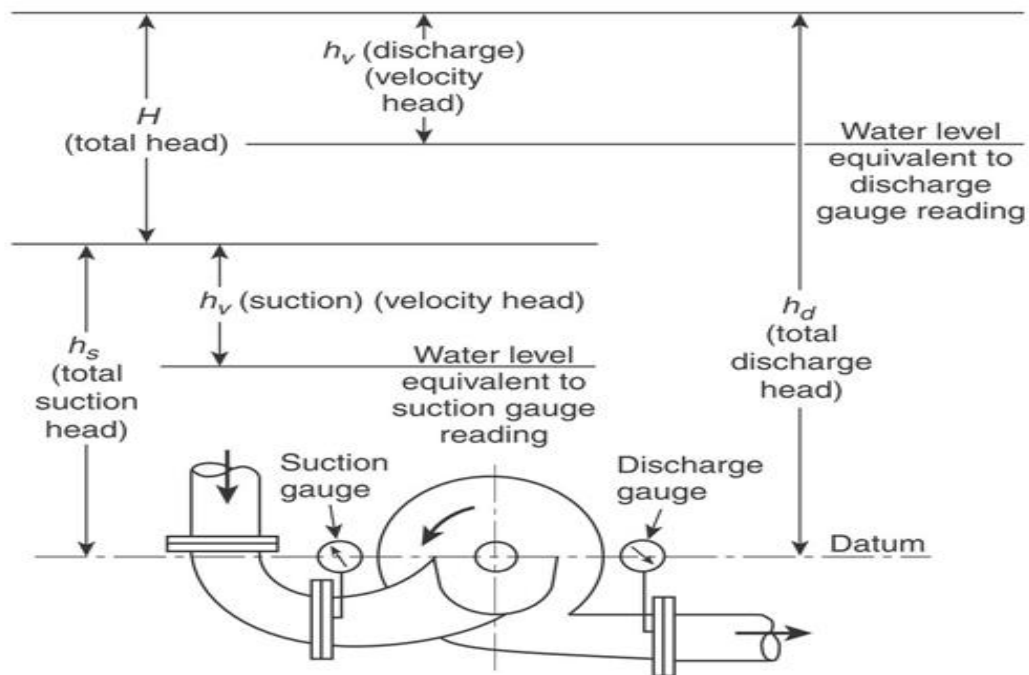
ELECTRIC MOTOR



DIESEL ENGINE

Acceptable drivers for pumps at a single installation shall be electric motors, diesel engines, steam turbines, or a combination thereof.

Standard regulation for Centrifugal Fire Pump



Note: Installation with suction head above atmospheric pressure shown.

FIGURE A.3.3.25.3.1 Total Head of All Types of Stationary (Not Vertical Turbine-Type) Fire Pumps.

“ Centrifugal pumps shall not be used where a static suction lift is required ”

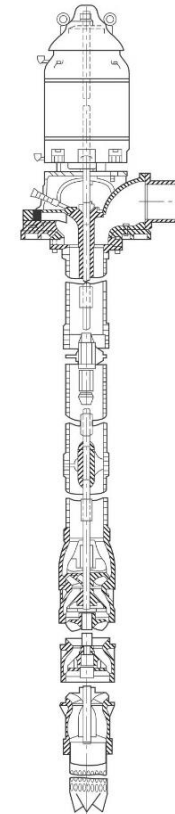
Standard regulation for Centrifugal Fire Pump



Vertical Shaft Turbine

- Application: Where the water supply is located below the discharge flange centerline and the water supply pressure is insufficient to deliver the water to the fire pump, a vertical shaft turbine-type pump shall be used.

Water-lubricated,
open lineshaft pump,
surface discharge,
threaded column and bowls



Oil-lubricated,
enclosed lineshaft pump,
underground discharge,
flanged column and bowls

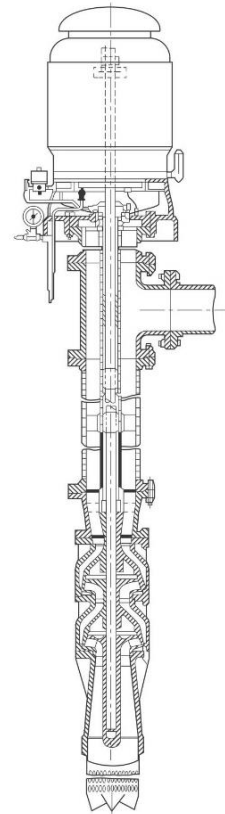


FIGURE A.7.1.1 Water-Lubricated and Oil-Lubricated Shaft Pumps.

Standard regulation for Centrifugal Fire Pump

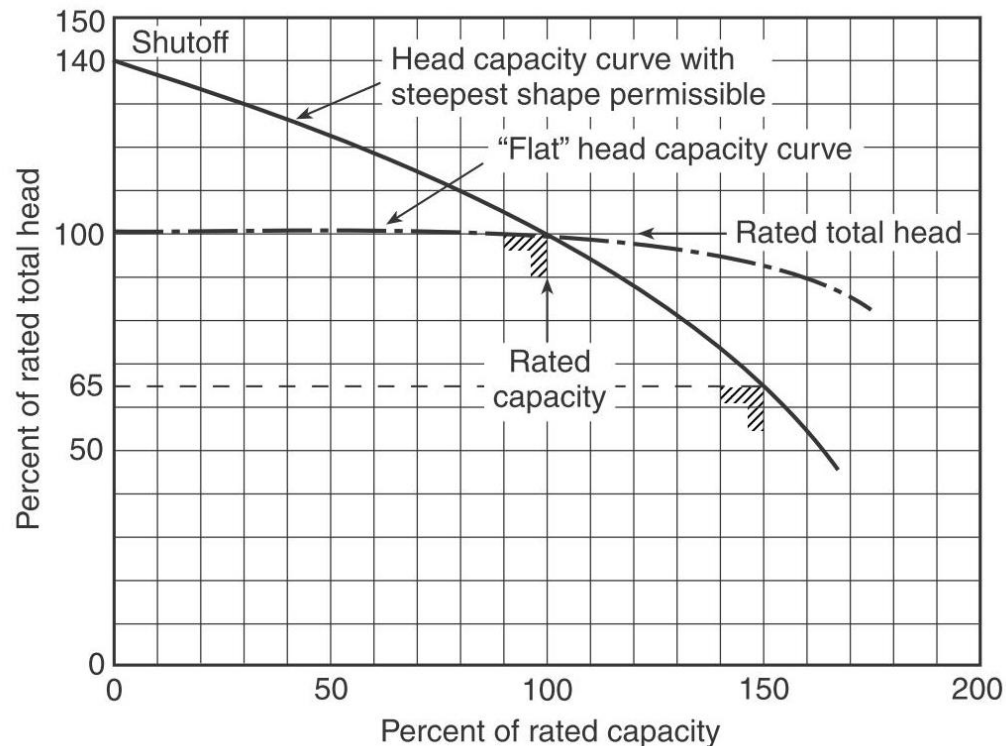
- The net pump shutoff (churn) pressure plus the maximum static suction pressure, adjusted for elevation, shall not exceed the pressure for which the system components are rated.
- **Pressure relief valves and pressure regulating devices in the fire pump installation shall not be used as a means to meet the requirements.**
- Certifies shop test curves showing head capacity and brake horsepower of the pump shall be furnished by the manufacturer to the purchaser.
- Acceptable drivers for pumps at a single installation shall be electric motors, diesel engines, steam turbines, or a combination thereof.

Table 4.9.2 Centrifugal Fire Pump Capacities

gpm	L/min	gpm	L/min
25	95	1,000	3,785
50	189	1,250	4,731
100	379	1,500	5,677
150	568	2,000	7,570
200	757	2,500	9,462
250	946	3,000	11,355
300	1,136	3,500	13,247
400	1,514	4,000	15,140
450	1,703	4,500	17,032
500	1,892	5,000	18,925
750	2,839		

Standard regulation for Centrifugal Fire Pump

- Pumps shall furnish not less than 150 percent of rated capacity at not less than 65 percent of total rated head.
- Each discharge outlet in a multistage multiport pump shall furnish not less than 150 percent of rated capacity at not less than 65 percent of total rated head.



Summary of Centrifugal Fire Pump Data (U.S. Customary)

Pump Rating (gpm)	Minimum Pipe Sizes (Nominal) (in.)						
	Suction ^{a,b,c}	Discharge ^a	Relief Valve	Relief Valve Discharge	Meter Device	Number and Size of Hose Valves	Hose Header Supply
25	1	1	3/4	1	1/4	1 — 1 1/2	1
50	1 1/2	1 1/4	1 1/4	1 1/2	2	1 — 1 1/2	1 1/2
100	2	2	1 1/2	2	2 1/2	1 — 2 1/2	2 1/2
150	2 1/2	2 1/2	2	2 1/2	3	1 — 2 1/2	2 1/2
200	3	3	2	2 1/2	3	1 — 2 1/2	2 1/2
250	3 1/2	3	2	2 1/2	3 1/2	1 — 2 1/2	3
300	4	4	2 1/2	3 1/2	3 1/2	1 — 2 1/2	3
400	4	4	3	5	4	2 — 2 1/2	4
450	5	5	3	5	4	2 — 2 1/2	4
500	5	5	3	5	5	2 — 2 1/2	4
750	6	6	4	6	5	3 — 2 1/2	6
1000	8	6	4	8	6	4 — 2 1/2	6
1250	8	8	6	8	6	6 — 2 1/2	8
1500	8	8	6	8	8	6 — 2 1/2	8
2000	10	10	6	10	8	6 — 2 1/2	8
2500	10	10	6	10	8	8 — 2 1/2	10
3000	12	12	8	12	8	12 — 2 1/2	10
3500	12	12	8	12	10	12 — 2 1/2	12
4000	14	12	8	14	10	16 — 2 1/2	12
4500	16	14	8	14	10	16 — 2 1/2	12
5000	16	14	8	14	10	20 — 2 1/2	12

Notes:

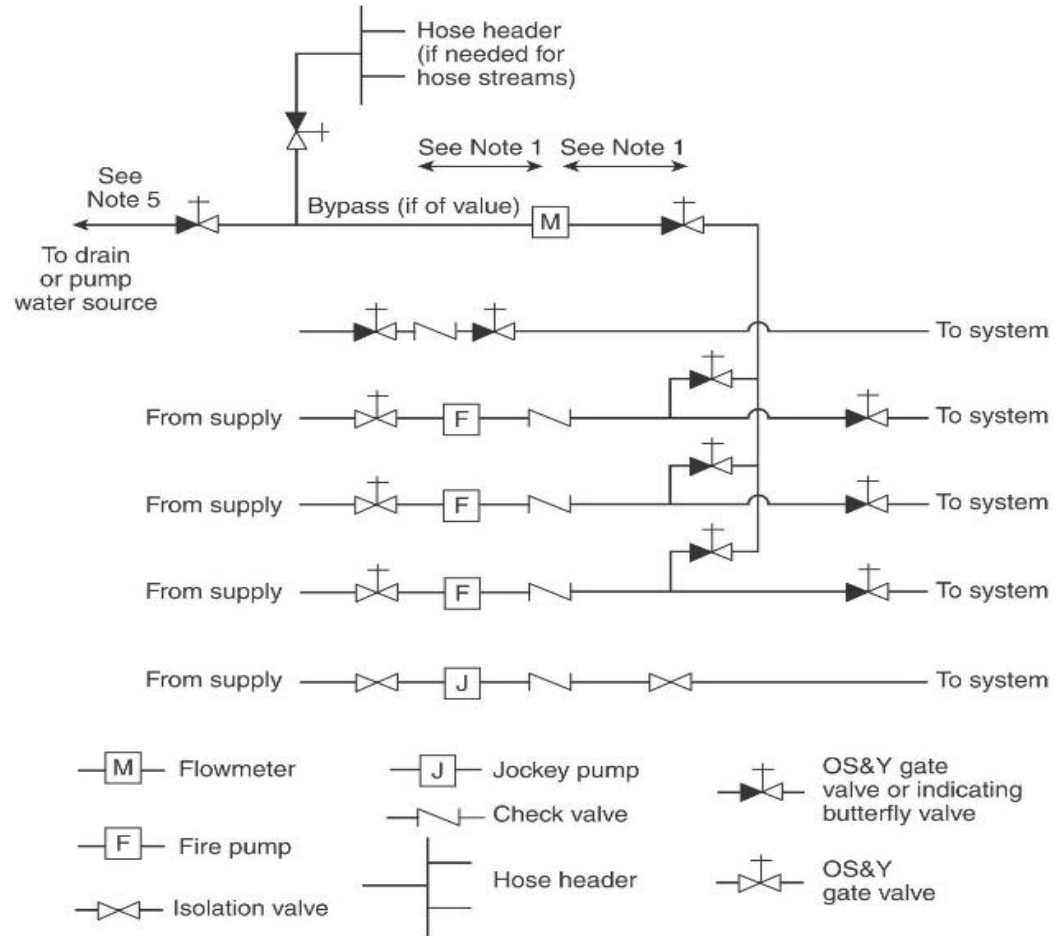
- (1) The pressure relief valve is permitted to be sized in accordance with 4.19.2.1.
- (2) The pressure relief valve discharge is permitted to be sized in accordance with 4.19.6.2.
- (3) The flowmeter device is permitted to be sized in accordance with 4.21.2.3.
- (4) The hose header supply is permitted to be sized in accordance with 4.21.3.4.

^aActual diameter of pump flange is permitted to be different from pipe diameter.

^bApplies only to that portion of suction pipe specified in 4.15.3.3.

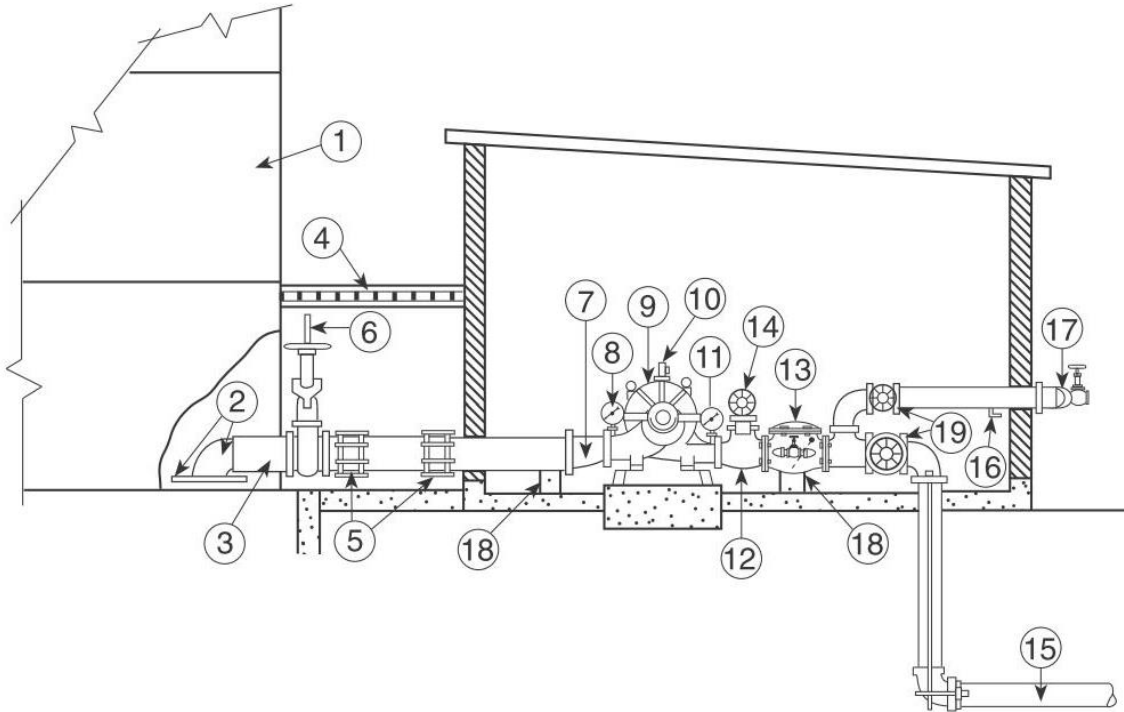
^cSuction pipe sizes in Table 4.27(a) are based on a maximum velocity at 150 percent rated capacity to 15 ft/sec (4.6 m/sec) in most cases.

Typical Arrangement of Fire Pump



- Preferred arrangement for measuring fire pump water flow with meter for multiple pumps and water supplies. Water is permitted to discharge to a drain or to the fire pump water source.

Horizontal Split-Case Fire Pump Installation with Water Supply Under a Positive Head



- 1 Aboveground suction tank
- 2 Entrance elbow and square steel vortex plate with dimensions at least twice the diameter of the suction pipe. Distance above the bottom of tank is one-half the diameter of the suction pipe with minimum of 6 in. (152 mm).
- 3 Suction pipe
- 4 Frostproof casing
- 5 Flexible couplings for strain relief
- 6 OS&Y gate valve (see 4.14.5 and A.4.14.5)
- 7 Eccentric reducer
- 8 Suction gauge
- 9 Horizontal split-case fire pump
- 10 Automatic air release
- 11 Discharge gauge
- 12 Reducing discharge tee
- 13 Discharge check valve
- 14 Relief valve (if required)
- 15 Supply pipe for fire protection system
- 16 Drain valve or ball drip
- 17 Hose valve manifold with hose valves
- 18 Pipe supports
- 19 Indicating gate or indicating butterfly valve

Fire Pump Characteristic curve conform to NFPA 20

Patterson Pump Company

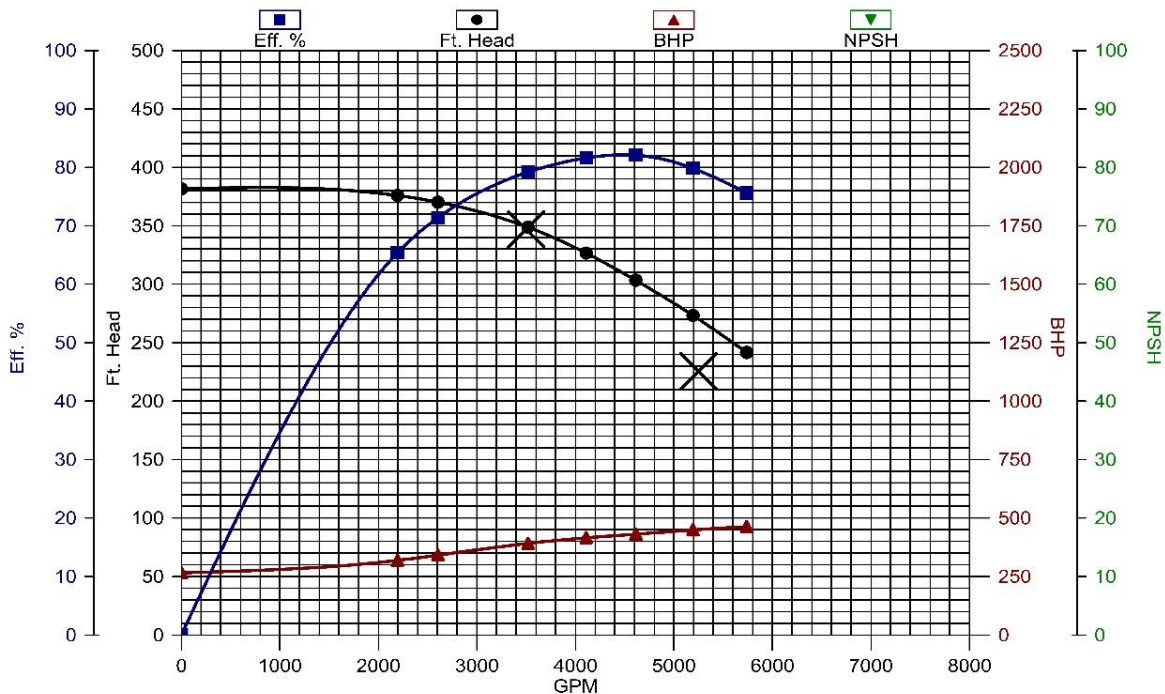
Serial No: FP-C0132833-01
 Pump Type: 12X8 MAAH
 Imp Pattern: C-3946-A
 Imp Dia: 18.5
 Vane Tips: FULL
 No. Stages: 1
 Certified By: JBB

Sold To: B. GRIMM TRADING
 Test Driver: GE
 IIP: 600
 Eff%: 1
 Test RPM: 1775
 Test Type: Performance Test
 Approved By: *JL AMEGALA*



Job: 295442-1
 GPM: 3500
 Ft. Head: 347
 Rated RPM: 1750
 Test Num: 1
 Date: Nov-11-2014

Witnessed By: *JL AMEGALA*



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MODEL NO. 12X8MAAH SERIAL NO. 295442-1	U/L/FM NAME PLATE (SPLIT-CASE) PURCELL	SCALE 1:1 CHECKED ALB APPROVED AP	PART NUMBER 28001014 DATE MAY 28, 1978
APPROVED: JUN 10, 2010			



HYDROSTATIC PRESSURE TEST REPORT

Serial Number: FP-C0132833-01 Job # 295442
 Pump Model: 12x8 MAAH
 Test Pressure (PSI): 450 ps.
 Test Duration (MIN): 10 min
 Test Liquid: Water, Temperature ranging from 50 to 70 degrees F
 Test Facility: Small Pump Assy Gauge S/N: 11132013
 Large Pump Assy Gauge S/N: _____
 Other Gauge S/N: _____
 Test Results: PASS FAIL

Tested By: *[Signature]* Date: 11/20/14
 Witnessed By: *[Signature]* N/A



Design Practice for

“Fire Pump Installation Project”





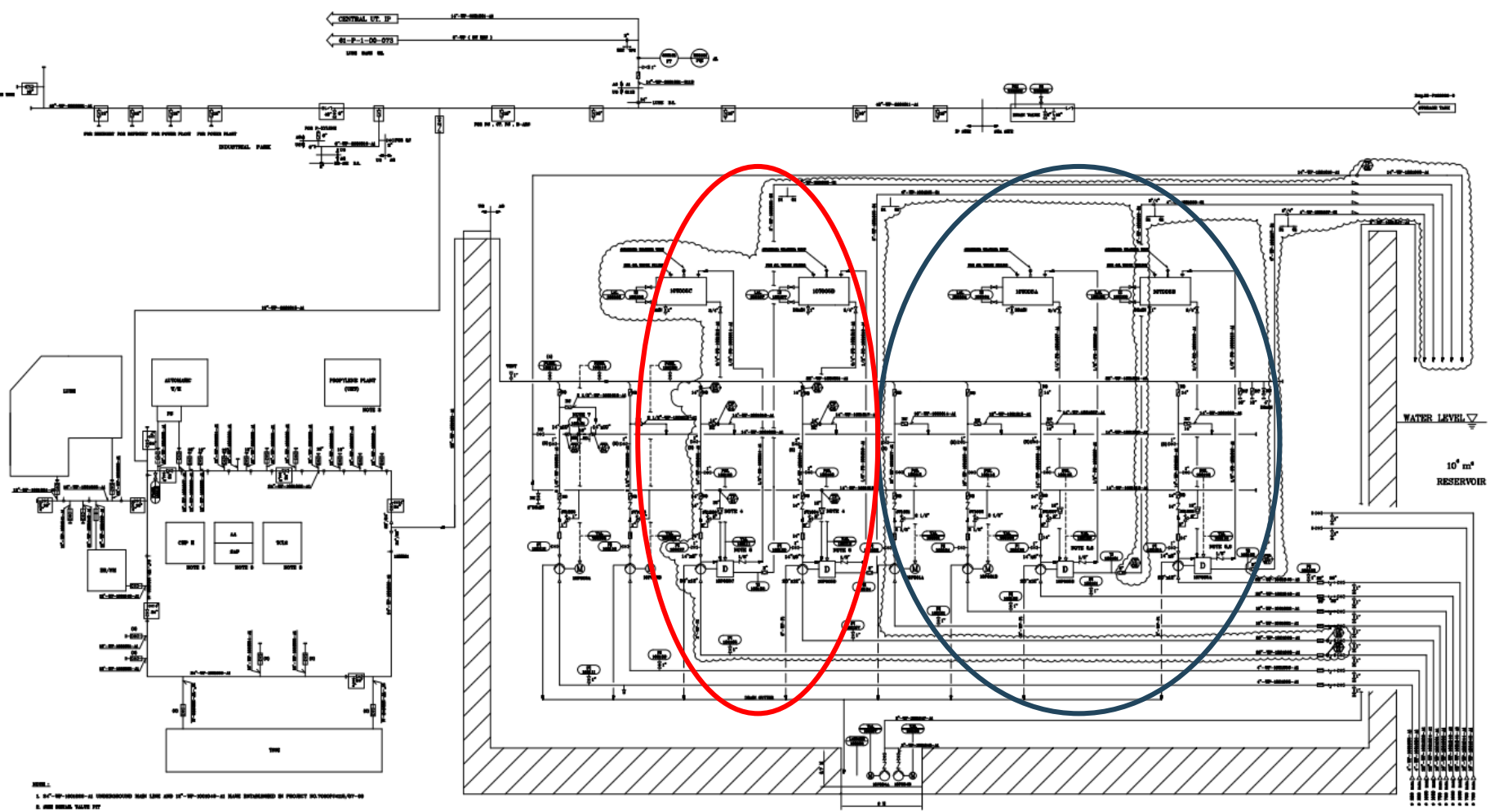
Diesel Engine Driver Installation

- Exhaust System
- Cooling System & Raw Water outlet Drain

Pressure Relieve Valve for Fire Pump

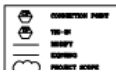
Jockey pump capacity





NOTE:
 1. UT-10-00000-02 UNDERGROUND TANK LINE AND UT-10-00000-03 HAVE IDENTIFIERS OF PROJECT POLYETHYLENE-01-02
 2. NEW DESIGN TANK 07

- TABLE 07
- 1. THE FRUITS TANKS SHOULD LINK THE TOP 2. ALTERNATE AND PROGRADE PLANT
 - 3. (100) SHALL BE CONNECTED TO 20" PIPING TANKS ACCORDING TO THE DRAWING OF SIDE PLANT
 - 4. BUMP TANK SHALL BE CONNECTED TO COOL. TANK SIDE PLANT.





Exhaust System



The exhaust back pressure shall not exceed the engine manufacturer's recommendations.

Exhaust System

Page 1 of 1

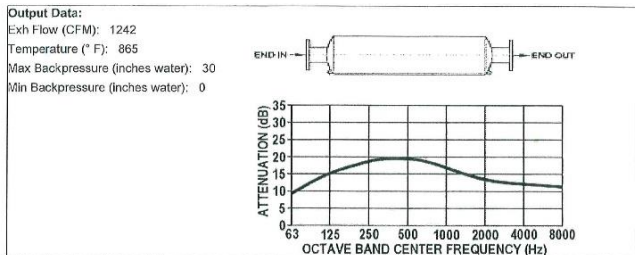
CLARKE

Fire Protection Products, Inc.

Exhaust Backpressure Calculator - Results
Calculations made 7/17/2014

Data input by:

Input Data:		
Customer:	Job Name:	Job Number:
ENGINE DATA:	Piping Data:	Silencer Data:
Manufacturer: Clarke	Pipe Size: 5"	Manufacturer: Clarke USA
Engine Model: DR8H-UFAA68	#90° elbow or Y: 2	Pipe Size: 5"
Engine RPM: 1760	Number 45° elbows:	Model: C06545
Engine HP: 495	Number Tees:	Application: Industrial
	Straight Pipe (Feet): 65.6	Connection: 150# Flange



Exhaust Pipe Recommendation:

BACKPRESSURE CALCULATIONS (inches water)	+ 10.9	Pipe
	+ 6.3	Silencer (see notes 1 and 4)
	17.2	Total
	30.0	Maximum Allowable Backpressure

Result: Total Backpressure is within limits

- 1) CAUTION: Silencer Backpressure is based upon a Clarke USA provided Silencer. Actual Silencer Backpressure will vary depending upon the actual Silencer used (manufacturer, size, type and model). If the total Backpressure from the pipe, Silencer and orifice plate (if required) is close to the engine Maximum Allowed Backpressure, it is highly recommended you obtain the actual Backpressure (for the engine exhaust flow given above) on the Silencer being used and then confirm that the total Backpressure is still under the Maximum Allowed Backpressure.
- 2) Schedule 40 pipe used in calculations
- 3) All pipe sizes and lengths are in inches and feet.
- 4) NOTE: This engine has a dual exhaust system and requires two silencers. The backpressure calculation is based on two silencers. For a single silencer, contact Clarke.

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Print



Heat Exchanger Waste Outlet

- An outlet shall be provided for the wastewater line from the heat exchanger, and the discharge line shall not be less than one size larger than the inlet line.
- The outlet line shall be as short as practical, shall provide discharge into a visible open waste cone, and shall have no valves in it.
- The outlet shall be permitted to discharge to a suction reservoir, provided a visual flow indicator and temperature indicator are installed.
- When the waste outlet piping is longer than 15 ft (4.6 m) or its outlet discharges are more than 4 ft (1.2 m) higher than the heat exchanger, or both, the pipe size shall be increased by at least one size.



Cooling System

Heat Exchanger Waste Outlet.

- An outlet shall be provided for the wastewater line from the heat exchanger, and the discharge line shall not be less than one size larger than the inlet line.
- The outlet line shall be as short as practical, shall provide discharge into a visible open waste cone, and shall have no valves in it.
- **Exception:** It shall be permitted to discharge to a suction reservoir provided a visual flow indicator and temperature indicator are installed.



Pressure Relief Valve

Relief Valves for Centrifugal Pumps

- **Pressure relief valves and pressure regulating devices in the fire pump installation shall not be used.**
- Pressure relief valves shall be used only where specifically permitted by this standard.
- Where a diesel engine fire pump is installed and where a total of 121 percent of the net rated shutoff (churn) pressure plus the maximum static suction pressure, adjusted for elevation, exceeds the pressure for which the system components are rated, a pressure relief valve shall be installed.



Jockey Pump

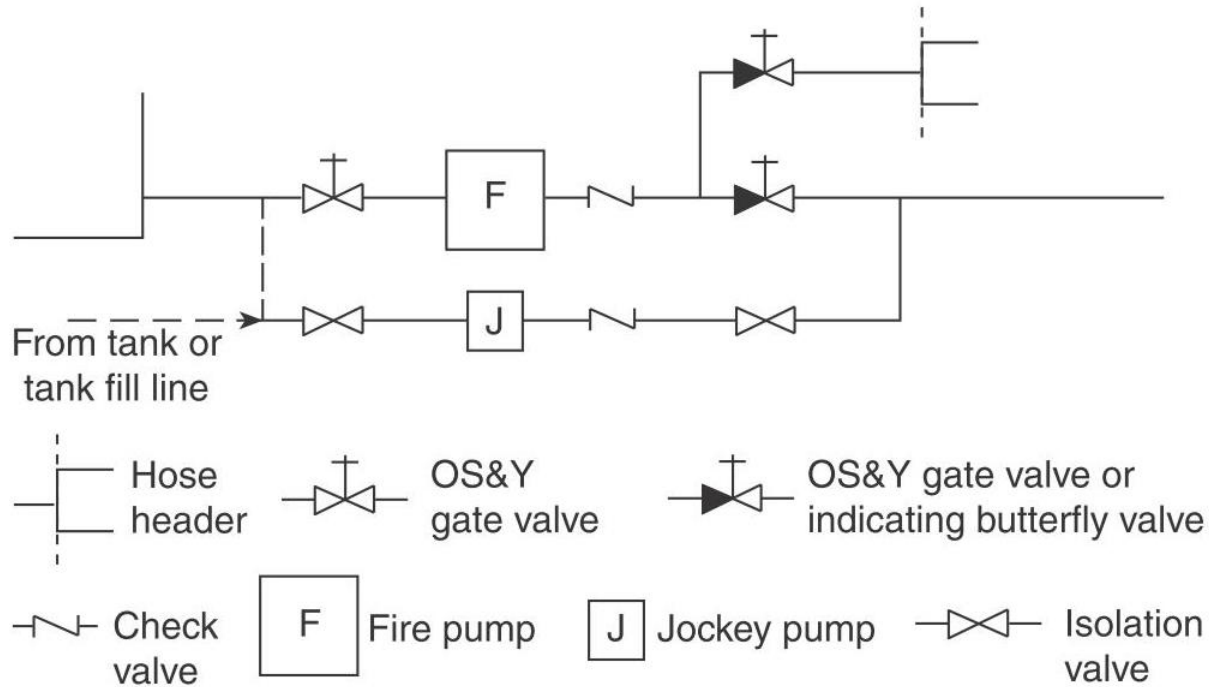


FIGURE A.4.26.6.5 Jockey Pump Installation with Fire Pump.

Jockey Pump Capacity

Pressure Maintenance (Jockey or Make-Up) Pumps

- The pressure maintenance pump shall be sized to replenish the fire protection system pressure due to allowable leakage and normal drops in pressure.
- **Pressure maintenance pumps shall have rated capacities not less than any normal leakage rate.**
- Underground mains are permitted by NFPA 24 to have some leakage
- **One guideline that has been successfully used to size pressure maintenance pumps is to select a pump that will make up the allowable leakage rate in 10 minutes or 1 gpm (3.8 L/min), whichever is larger.**

Jockey Pump Capacity

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NFPA® 24

Standard for
the Installation of Private
Fire Service Mains and
Their Appurtenances

2016 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

**Table 10.10.2.2.6 Hydrostatic Testing Allowance at 200
(13.8 bar) psi (gph/100 ft of Pipe) (lph/100 m of Pipe)**

Nominal Pipe Diameter (in.) (mm)	Testing Allowance
2 (50)	0.019 (0.236)
4 (100)	0.03 (0.472)
6 (150)	0.057 (0.708)
8 (200)	0.076 (0.944)
10 (250)	0.096 (1.19)
12 (300)	0.115 (1.43)
14 (350)	0.134 (1.66)
16 (400)	0.153 (1.90)
18 (450)	0.172 (2.14)
20 (500)	0.191 (2.37)
24 (600)	0.229 (2.84)

Notes:

- (1) For other length, diameters, and pressures, utilize Equation 10.10.2.2.6a or 10.10.2.2.6b to determine the appropriate testing allowance.
- (2) For test sections that contain various sizes and sections of pipe, the testing allowance is the sum of the testing allowances for each size and section.



Jockey Pump





Thank you for your attention

