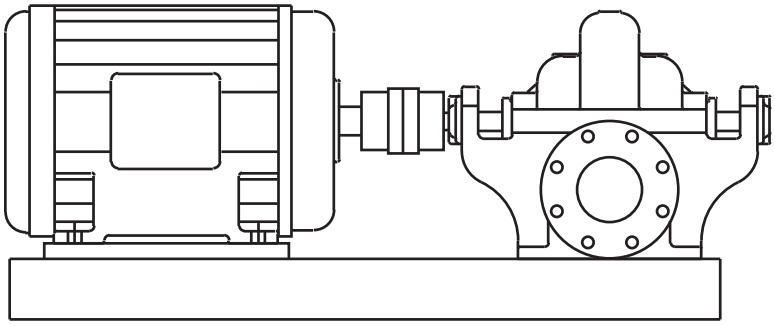

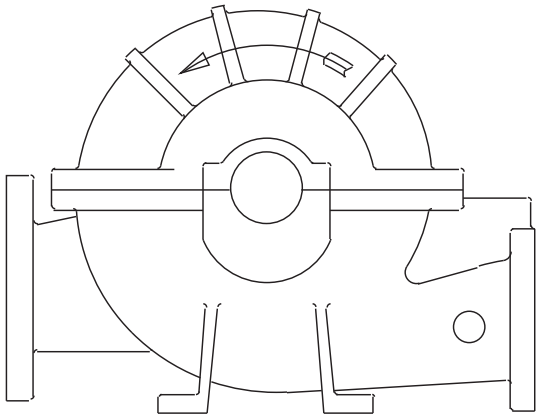

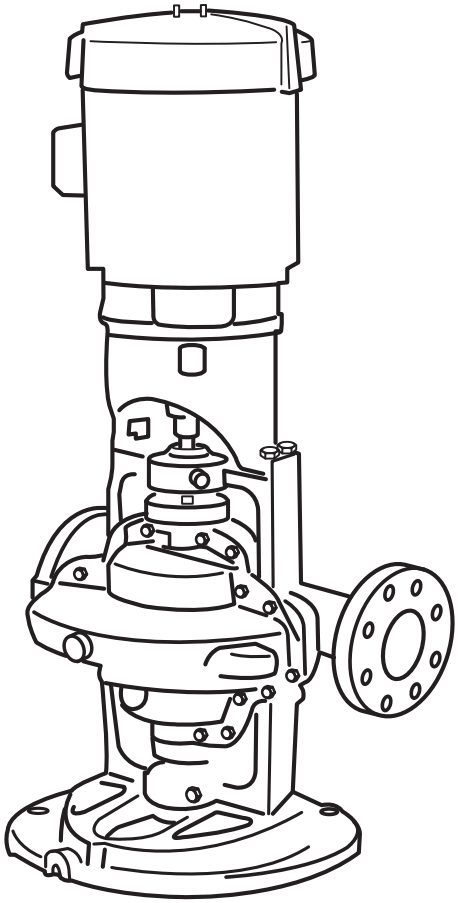

Furnish and install where shown on plans_____ Aurora Fire Pump System(s) complete with pump, driver, controller and accessories. The pumping unit shall be listed by Underwriters' Laboratories, Inc. and/or shall be fully approved by the Associated Factory Mutual Fire Insurance Companies, where applicable. The pumping unit shall meet all requirements of the National Fire Protection Association Pamphlet No.20. The Fire Pump shall be designed to deliver_____G.P.M. when operating at_____PSIG. The pump shall also deliver not less than 150% of rated capacity at a pressure not less than 65% of rated pressure. The shut off pressure shall not exceed 140% of rated pressure. Suction pressure is_____PSIG. The pump shall operate at a maximum synchronous speed of_____ R.P.M.

The Fire Pump shall be (one of the following):

(A) AURORA MODEL 481 HORIZONTAL BASE MOUNTED size _____-481-_____ horizontal split case, bronze fitted, SINGLE STAGE, double suction centrifugal pump.

(B) AURORA MODEL 485 HORIZONTAL BASE MOUNTED size _____-485-_____ horizontal split case, bronze fitted, TWO STAGE, single suction, centrifugal pump.

The driver shall be a horizontal, foot mounted, open drip-proof (or T.E.F.C.), ball bearing type, AC, induction, squirrel cage motor: wound for _____ volts, 3 phase, 60 (50) Hertz. The motor shall be of such capacity that 115% of the full-load ampere rating shall not be exceeded at any condition of pump load. Locked rotor current shall not exceed the values specified in NFPA Pamphlet No.20.

AURORA MODELS 481-483-485

ENGINEERING SPECIFICATIONS
CENTRIFUGAL FIRE PUMPS

Pump and motor shall be mounted on a common baseplate of steel (or optional with drip rim). Pump and motor shall be checked for alignment after the pump base has been installed and grouted in place.

C. AURORA MODEL 483 VERTICAL BASE MOUNTED size _____-483-_____ vertical splitcase, vertical mounted, bronze fitted, SINGLE STAGE double suction, centrifugal pump.

The driver shall be a vertical, open drip-proof (or T.E.F.C.), ball bearing type, AC, induction, squirrel cage "P" face motor: wound for _____ volts, 3 phase, 60 (50) Hertz. The motor shall be of such capacity that 115% of the full-load ampere rating shall not be exceeded at any condition of pump load.
Locked rotor current shall not exceed the values specified in NFPA Pamphlet No.20.

The mounting feet of the pump shall be machined perpendicular to the shaft. The pump shall be bolted to an extra heavy cast iron drip rim ring base. The top of the pump shall be machined to receive the motor mounting bracket. The mounting bracket shall be machined with registered fits to align pump and motor.

Casings shall be of cast iron having a minimum tensile strength of 35,000 P.S.I. Bearing housing supports, and suction and discharge flanges shall be integrally cast with the lower half of the casing. Removal of the upper half of the casing must allow the rotating element to be removed without disconnecting the suction and discharge flanges.

Impellers shall be of the enclosed type and shall be of vacuum cast bronze. Impellers shall be dynamically balanced, keyed to the shaft, and held in place with threaded shaft sleeves.

The pump shaft shall be made of SAE 1045 Steel or equal, accurately machined to give a true running rotating element. Shaft shall be protected by bronze sleeves which are key locked and threaded so that the sleeves tighten with the rotation of the shaft. An o-ring shall seal between the impeller hub and the shaft sleeve to protect the pump shaft.

Pump shall be equipped with renewable bronze casing rings so designed that hydraulic pressure will seat them against a shoulder in the pump case around the full periphery of the wearing ring. The wearing rings will be locked by dowelling to prevent rotation. The rotating element uses heavy duty grease lubricated ball bearings and shall be equipped with water slingers. Bearing housings shall be so designed to flush lubricant through the bearing.

All pumps where the suction pressure is expected to average 40 P .S.I. or below, shall be provided with a lantern ring connected to the pressure side of the pump by a cored passage in the parting flange of the pump. Stuffing boxes shall be equipped with split bronze packing glands designed for easy removal for packing inspection and maintenance.

The fire pump unit shall include the following accessories, as required by NFPA standards (depending on the conditions under which the pumps are to be installed).

1.	Flow metering device	_____
2.	Eccentric tapered suction reducer	_____
3.	Concentric tapered discharge increaser	_____
4.	Discharge tee	_____
5.	Base elbow	_____
6.	Hose valves	_____
7.	Caps and chains	_____
8.	Hose valve header	_____
9.	Blind flange	_____
10.	Pressure gauges	**X**
11.	Main relief valve (mandatory for engine drives)	_____
12.	Circulation relief valve	**X**
13.	Relief cone - enclosed (mandatory for engine drives)	_____
14.	Automatic air release valve	**X**
15.	Splash shield (electric drive only)	_____
16.	Balldrip valve	_____
17.	Coupling guard	**X**

The Fire Pump motor control shall be U .L. Listed and/ or F.M. Approved, where applicable. It shall be completely assembled, wired and tested by the control manufacturer before shipment from the factory, and shall be labeled "Fire Pump Controller." The controller shall be located as close as practical and within sight of the motor. The controller shall be so located or protected that it will not be injured by water escaping from the pump or connections. The controller shall be of the combined manual and automatic, (across-the-line) (primary resistor) (partwind) (limited service) (wye delta) type, and shall be complete with:

1. Disconnect switch - externally operable, quick-break type.

2. Circuit breaker - time delay type with trips in all phases set for 300% of the motor full-load current. The interrupting capacity of circuit breaker shall be_____asymmetrical amperes.

3. Motor starter - across-the-line type capable of being energized automatically through the pressure switch or manually by means of an externally operable handle.

4. Pressure switch set to cut in at_____p.s.i.g. and out at_____p.s.i.g.

5. Running period timer - set to keep motor in operation, when started automatically, for a minimum period of one minute for each 10 HP motor rating, but not to exceed 7 minutes.

6. Pilot lamp - to indicate circuit breaker closed and power available.

7. Ammeter test link and voltmeter test studs.

8. Alarm relay - to energize an audible or visible alarm through an independent source of power to indicate circuit breaker open or power failure.

9. Manual selection station - a two position station shall be provided on the enclosure marked " Automatic" and "Non-automatic."

10. Means shall be provided on the Controller to operate an alarm signal continuously while the pump is running.

Control equipment shall meet all requirements of NFPA No.20.

ENGINE DRIVE

The Fire Pump shall be driven by a U .L. Listed and F.M. Approved diesel engine. The engine shall conform to the requirements of NFPA Pamphlet No.20 and be approved for Fire Pump use. The rated speed shall not exceed _____RPM and shall develop _____ H.P. to drive the pump. Reserve H.P. shall be as stipulated in Pamphlet No.20 when the unit is operating at_____ft. above sea level in an ambient temperature not greater than_____degrees F.

The engine shall be of the self-contained open type mounted on a suitable base with the following minimum accessories, plus any others that may be necessary by local requirements.

1. Dual battery set sized to NFPA Pamphlet No.20 requirements with electrolyte shipped in separate containers, rack and cables **X**

2. Dual battery charger of proper type for batteries used (included in U.L. Listed/F.M. Approved controller) **X**

3. Electric starter with suitable generator and voltage regulator **X**

4. Engine water pump **X**

5. Heat exchanger cooling system **X**

6. Water cooled or ceramic blanketed exhaust manifold **X**

7. Lubricating oil pump and filter **X**

8. Speed governor **X**

9. Fuel injection system **X**

10. Air cleaner **X**

11. Stubshaft **X**

12. Fuel Pump **X**

13. Engine Jacket Pre-heater **X**

14. Oil Emersion Heater **X**

15. Proper instrument panel complete with engine run warning light, water temperature gauge, oil pressure gauge, ammeter, totalizing type tachometer and hour meter **X**

16. Commercial Grade Muffler **X**

17. Cooling water line for the engine heat exchanger assembly **X**

18. Flexible exhaust connectors **X**

All engine wiring for automatic operation shall terminate in a proper junction box to permit field connection to a separate control panel.

AURORA MODELS 481-483-485

ENGINEERING SPECIFICATIONS
CENTRIFUGAL FIRE PUMPS

FUEL SYSTEM

A suitable fuel system for the diesel engine shall be furnished. It must be in accordance with NFPA Pamphlet No.20, and shall include a____gallon above surface storage tank. Flexible fuel connectors, combination vent-flash arrestor and fill cap shall be included.

AUTOMATIC ENGINE CONTROL PANEL

The automatic engine control panel shall be approved for fire pump service and shall meet the requirements of NFPA Pamphlet No. 20. The panel shall be of the floor-mounted type, and enclosed in a moisture and dust tight housing. A combination manual and automatic type controller with "Manual-Off-Automatic" selector switch shall be provided also, a 115 volt single phase power failure relay or a pressure switch, which will (when the system drops to ____psig) activate all electrical circuits to automatically start the engine.

Should the engine fail to start after the required cranking cycles, the controller shall disconnect the starting circuit and activate an alarm system using lights and buzzer or bell. "Low oil pressure" and "high jacket-water temperature" shall also be indicated by a suitable alarm system. The engine shall not shut down if either of these conditions occurs during an operating cycle.

The engine shall be started automatically by the controller at least once a week and operate a minimum of 30 minutes. An appropriate timing arrangement shall determine the day and hour of this test.

Starting the engine by a fire alarm relay, deluge valve relay, or remote push-button station shall be included in the controller circuit.

In the event the pump, engine and control are in an unattended area, a remote alarm panel shall be furnished as per NFPA Pamphlet No.20.

TESTS

The pump and electric motor (or engine) shall be thoroughly shop-tested by the respective manufacturers as required by NFPA Pamphlet No.20. The control panel shall also be tested as a unit. All such tests shall be conducted prior to shipment.

The pump, driver, controller and all accessories shall be purchased under a unit contract. The pump shall be given a complete performance test with POSITIVE SUCTION PRESSURE. A certified performance curve shall be prepared and submitted. Pumps shall also be hydrostatically tested to twice the shut off pressure, but in no case less than 250 lbs. per sq. inch.

In the case of diesel drives, the pump manufacturer shall perform a second pump operational test as a unit with the job engine. Test data shall be furnished.

The pump manufacturer shall assume unit responsibility and shall provide the services a factory trained representative to supervise and/or be available to conduct final field acceptance tests.

AURORA FIRE PUMPS

MAXIMUM ALLOWABLE WORKING PRESSURE

RATED CAPACITY G.P.M.	AP MODEL DESIGNATIONS	RATED HEAD PRESSURE RANGE P.S.I.	APPROXIMATE SPEED R.P.M.	MAXIMUM ALLOWABLE WORKING PRESSIRE P.S.I.
250	2.5-481-10B	51-115	2950/3000	250
250	2.5-483-10B	51-115	2950	250
250	2.5-481-10B	52-167	3550/3560	250
250	2.5-483-10B	52-167	3560	250
250	3-481-10	40-120	2950/3000	210
250	3-481-10/DI	40-120	2950/3000	450
250	3-483-10	40-120	2950	210
250	3-481-10	40-100	3550/3560	210
250	3-481-10/DI	40-100	3550/3560	450
250	3-483-10	40-100	3560	210
500	3-481-10	50-150	3550/3560	210
500	3-483-10	50-150	3560	210
500	3-481-10/DI	50-150	3550/3560	450
500	3-491-9A	46 - 101	3000	588
500	3-491-9A	55 - 125	3300	588
500	3-491-9C	95 - 140	3550/3560	588
500	3-492-10A	125 - 165	3550/3560	254
500	4-481-11A	40-55	1750/1770	270
500	4-483-11A	40-55	1770	270
500	4-481-11C	55-134	2950/3000	275
500	4-483-11C	55-134	2950	275
500	4-481-11C/DI	55-134	2950/3000	500
500	4-481-11C	75-180	3300	275
500	4-481-11C/DI	75-180	3300	500
500	4-481-11D	61-138	2950/3000	275
500	4-483-11D	61-138	2950/3000	275
500	4-481-15	60-80	1750/1770	200
500	4-483-15	60-80	1770	200
500	4-485-15	150-210	1750/1770	270
500	4-492-10	110 - 170	3550/3560	436
500	4-492-14	45 - 75	1750/1770	175
500	4-492-18	76 - 125	1750/1770	175
500	5-485-12	182-319	2950	625
500	5-485-12	188-330	3000	625
500	5-485-12	228-476	3560	625
500	5-485-15	68-144	1460/1480	270
500	6-491-12A	97 - 140	2600	425
500	6-491-12A	149 - 164	2800	425
500	6-491-12A	157 - 190	2950/3000	425
500	6-491-12A	163 - 233	3300	425
500	6-491-12A	191 - 278	3550/3560	425
750	4-481-11A	40-50	1750/1770	270
750	4-483-11A	40-50	1770	270
750	4-481-11C/DI	66-164	3300	500
750	4-481-11C	66-164	3300	275
750	4-481-11C	65-192	3550/3560	275
750	4-483-11C	65-192	3560	275
750	4-481-11C/DI	65-192	3550/3560	500

1. The data shown above is listed in the current Fire Protection Equipment Directory of U.L. and is consistent with the requirements of F.M.
2. Maximum Working Pressure (PSI) is defined by U.L. as the maximum pressure that can be developed at the discharge flange under any operating condition. Applications where working pressures exceed these limits must be referred to the factory. Maximum pressure at the discharge flange = maximum suction pressure plus maximum total developed head.
3. In determining "Maximum Allowable Working Pressure", both agencies require initial hydrostatic testing approval at twice the values shown above.

DI = Ductile Iron construction

AURORA FIRE PUMPS

MAXIMUM ALLOWABLE WORKING PRESSURE

RATED CAPACITY G.P.M.	AP MODEL DESIGNATIONS	RATED HEAD PRESSURE RANGE P.S.I.	APPROXIMATE SPEED R.P.M.	MAXIMUM ALLOWABLE WORKING PRESSIRE P.S.I.
750	4-481-15	71-95	1750/1770	200
750	4-481-11D	81-190	3550/3560	275
750	4-483-11D	81-190	3550/3560	275
750	4-483-15	71-95	1770	200
750	4-491-11A	225	3550/3560	363
750	4-491-11A	100 - 143	3550/3560	363
750	4-491-11A	100 - 150	2950/3000	363
750	4-491-11A	100 - 185	3300	363
750	4-491-11A	144 - 221	3550/3560	363
750	4-491-11C	140 - 175	3300	363
750	4-491-11C	145 - 200	3550/3560	363
750	4-491-14C	55 - 90	1750/1770	396
750	4-491-14C	60 - 130	2100	396
750	4-491-14C	75 - 160	2300	396
750	4-491-8A	67 - 78	2950/3000	225
750	4-492-18	100 - 125	1750/1770	175
750	5-481-11C	105-154	2950/3000	325
750	5-483-11C	105-154	2950	325
750	5-481-11C/DI	105-154	2950/3000	450
750	5-481-15	50-70	1750/1770	210
750	5-483-15	50-70	1770	210
750	5-491-18A	115 - 240	2300	345
750	5-491-18A	90 - 140	1750/1770	345
750	5-491-18A	95 - 200	2100	345
750	6-485-12	197-340	2950	625
750	6-485-12	205-352	3000	625
750	6-485-12	310-506	3560	625
750	6-485-17A	80-175	1460/1480	330
750	6-485-17A/DI	80-175	1460/1480	400
750	6-485-17A	140-245	1750/1770	330
750	6-485-17A/DI	140-245	1750/1770	400
750	6-491-12A	132 - 148	2800	425
750	6-491-12A	142 - 175	2950/3000	425
750	6-491-12A	147 - 218	3300	425
750	6-491-12A	180 - 266	3550/3560	425
1000	4-491-14C	95	2100	396
1000	4-491-14C	100 - 120	2100	396
1000	4-491-14C	95 - 150	2300	396
1000	5-481-11B	145-165	3300	325
1000	5-481-11B/DI	145-165	3300	450
1000	5-481-11B	165-200	3550/3560	325
1000	5-483-11B	165-200	3560	325
1000	5-481-11B/DI	165-200	3550/3560	450
1000	5-481-11C	90-135	3300	325
1000	5-481-11C/DI	90-135	3300	450
1000	5-481-11C	97-146	2950/3000	325
1000	5-483-11C	97-146	2950	325
1000	5-481-11C/DI	97-146	2950/3000	450
1000	5-481-11C	90-160	3550/3560	325
1000	5-483-11C	90-160	3560	325
1000	5-481-11C/DI	90-160	3550/3560	450
1000	5-481-15	50-90	1750/1770	210
1000	5-483-15	50-90	1770	210
1000	5-481-17	90-125	1750/1770	210

1. The data shown above is listed in the current Fire Protection Equipment Directory of U.L. and is consistent with the requirements of F.M.
2. Maximum Working Pressure (PSI) is defined by U.L. as the maximum pressure that can be developed at the discharge flange under any operating condition. Applications where working pressures exceed these limits must be referred to the factory. Maximum pressure at the discharge flange = maximum suction pressure plus maximum total developed head.
3. In determining "Maximum Allowable Working Pressure", both agencies require initial hydrostatic testing approval at twice the values shown above.

DI = Ductile Iron construction

AURORA®
Pentair Water

AURORA FIRE PUMPS

MAXIMUM ALLOWABLE WORKING PRESSURE

RATED CAPACITY G.P.M.	AP MODEL DESIGNATIONS	RATED HEAD PRESSURE RANGE P.S.I.	APPROXIMATE SPEED R.P.M.	MAXIMUM ALLOWABLE WORKING PRESSIRE P.S.I.
1000	5-483-17	90-125	1770	210
1000	5-491-14A	75 - 125	2100	396
1000	5-491-18A	110 - 240	2300	345
1000	5-491-18A	85 - 135	1750	345
1000	5-491-18A	90 - 200	2100	345
1000	5-492-10	85 - 120	2950/3000	436
1000	6-481-11	40-50	1750/1770	200
1000	6-481-11HH	69-115	2600	500
1000	6-481-11HH	93-155	2950/3000	500
1000	6-481-11HH	74-186	3300	500
1000	6-481-11HH	188-219	3550/3560	500
1000	6-481-14HH	77-133	2100	500
1000	6-481-14HH	96-160	2300	500
1000	6-481-14HH	75-203	2600	500
1000	6-481-14HH	102-287	2950/3000	500
1000	6-481-14HH	130-248	3300	500
1000	6-481-14HH	154-287	3550/3560	500
1000	6-481-18C	81-108	1460/1480	325
1000	6-481-18C/DI	81-108	1460/1480	450
1000	6-483-11	40-50	1770	200
1000	6-483-18C	81-108	1480	325
1000	6-485-17A	130-240	1750/1770	330
1000	6-485-17A/DI	130-240	1770	400
1250	4-491-14C	116 - 147	2300	396
1250	4-491-14C	155 - 230	2500	396
1250	4-491-14C	64 - 84	1750/1770	396
1250	4-491-14C	94 - 121	2100	396
1250	5-491-18A	119 - 134	1750/1770	345
1250	5-491-18A	119 - 193	2100	345
1250	6-481-11HH	96-110	2600	500
1250	6-481-11HH	98-151	2950/3000	500
1250	6-481-11HH	111-182	3300	500
1250	6-481-11HH	132-216	3550/3560	500
1250	6-481-14HH	94-130	2100	500
1250	6-481-14HH	87-156	2300	500
1250	6-481-14HH	122-301	2600	500
1250	6-481-14HH	110-287	2950/3000	500
1250	6-481-14HH	122-247	3300	500
1250	6-481-14HH	145-287	3550/3560	500
1250	6-481-15	55-96	1750/1770	230
1250	6-483-15	55-96	1770	230
1250	6-481-18B	100-140	1750/1770	225
1250	6-483-18B	100-140	1770	225
1250	6-481-18B/DI	100-140	1750/1770	450
1250	6-481-18C	78-105	1750/1770	325
1250	6-483-18C	78-105	1770	325
1250	6-481-18C/DI	78-105	1750/1770	450
1250	6-481-18C	81-108	1460/1480	325
1250	6-483-18C	81-108	1480	325
1250	6-481-18C/DI	81-108	1460/1480	450
1250	6-481-20	84-168	1750/1770	230
1250	6-483-20	84-168	1770	230
1250	6-481-20/DI	84-168	1750/1770	450
1250	8-481-12	43-52	1750/1770	200
1250	8-483-12	43-52	1770	200
1250	8-481-21	90-142	1750/1770	325
1250	8-481-21	136-200	1750/1770	325

1. The data shown above is listed in the current Fire Protection Equipment Directory of U.L. and is consistent with the requirements of F.M.
2. Maximum Working Pressure (PSI) is defined by U.L. as the maximum pressure that can be developed at the discharge flange under any operating condition. Applications where working pressures exceed these limits must be referred to the factory. Maximum pressure at the discharge flange = maximum suction pressure plus maximum total developed head.
3. In determining "Maximum Allowable Working Pressure", both agencies require initial hydrostatic testing approval at twice the values shown above.

DI = Ductile Iron construction

AURORA FIRE PUMPS

MAXIMUM ALLOWABLE WORKING PRESSURE

Supersedes Section 910 Page 74
Dated February 1, 2005

RATED CAPACITY G.P.M.	AP MODEL DESIGNATIONS	RATED HEAD PRESSURE RANGE P.S.I.	APPROXIMATE SPEED R.P.M.	MAXIMUM ALLOWABLE WORKING PRESSIRE P.S.I.
1500	5-481-11D	90-120	3300	250
1500	6-481-11HH	121-144	2950/3000	500
1500	6-481-11HH	142-209	3550/3560	500
1500	6-481-14HH	142-196	2600	500
1500	6-481-14HH	153-285	2950/3000	500
1500	6-481-14HH	137-240	3300	500
1500	6-481-14HH	158-283	3550/3560	500
1500	6-481-15	50-90	1750/1770	230
1500	6-483-15	50-90	1770	230
1500	6-481-18B	95-134	1750/1770	225
1500	6-483-18B	95-134	1770	225
1500	6-481-18B/DI	95-134	1750/1770	450
1500	6-481-18C	75-102	1460/1480	325
1500	6-483-18C	75-102	1480	325
1500	6-481-18C/DI	75-102	1460/1480	450
1500	6-481-20	80-165	1750/1770	230
1500	6-483-20	80-165	1770	230
1500	6-481-20/DI	80-165	1750/1770	450
1500	6-492-10	95-135	3300	440
1500	6-492-10	100 - 175	3550/3560	440
1500	6-492-10U	82 - 115	2950/3000	440
1500	6-491-14C	88-151	2300	482
1500	6-491-14C	85-125	2100	482
1500	6-491-14C	90-100	1900	482
1500	6-491-14C	76-86	1750/1770	482
1500	6-491-14A	99-164	2300	478
1500	6-491-14A	95-135	2100	478
1500	6-492-15	70-90	1750/1770	191
1500	6-492-18	90 - 145	1750/1770	200
1500	8-481-12	40-50	1750/1770	200
1500	8-481-21	88-141	1460/1480	325
1500	8-481-21	135-200	1750/1770	325
1500	8-483-12	40-50	1770	200
2000	6-481-15B	80-100	1750/1770	200
2000	6-481-20/DI	123-150	1750/1770	450
2000	6-481-15B	100-125	2100	200
2000	6-481-18C	100-140	1750/1770	225
2000	6-483-15B	80-100	1770	200
2000	6-481-18C/DI	100-140	1750/1770	450
2000	6-481-20	123-150	1750/1770	230
2000	6-483-18C	100-140	1770	225
2000	6-483-20	123-150	1770	230
2000	6-491-14A	90 - 125	2100	482
2000	6-491-14A	90 - 150	2300	482
2000	6-491-18C	105 - 170	2100	362
2000	6-491-19A	210	2200	332
2000	6-491-19A	115 - 155	1750/1770	332
2000	6-491-19A	135 - 200	2100	332
2000	8-481-17B	52-94	1460/1480	208
2000	8-483-17B	52-94	1480	208
2000	8-481-17B	53-127	1750/1770	208
2000	8-483-17B	53-127	1770	208
2000	8-481-21	82-135	1460/1480	325
2000	8-481-21	130-195	1750/1770	325
2000	8-492-15	63 - 87	1750/1770	194

1. The data shown above is listed in the current Fire Protection Equipment Directory of U.L. and is consistent with the requirements of F.M.
2. Maximum Working Pressure (PSI) is defined by U.L. as the maximum pressure that can be developed at the discharge flange under any operating condition. Applications where working pressures exceed these limits must be referred to the factory. Maximum pressure at the discharge flange = maximum suction pressure plus maximum total developed head.
3. In determining "Maximum Allowable Working Pressure", both agencies require initial hydrostatic testing approval at twice the values shown above.

DI = Ductile Iron construction

AURORA FIRE PUMPS

MAXIMUM ALLOWABLE WORKING PRESSURE

RATED CAPACITY G.P.M.	AP MODEL DESIGNATIONS	RATED HEAD PRESSURE RANGE P.S.I.	APPROXIMATE SPEED R.P.M.	MAXIMUM ALLOWABLE WORKING PRESSIRE P.S.I.
2500	8-481-17B	75-130	1750/1770	208
2500	8-483-17B	75-130	1770	208
2500	8-481-17B	115-144	2100	208
2500	8-481-21A	100-125	1460/1480	325
2500	8-481-21A	123-190	1750/1770	325
2500	8-491-14A	50	1750/1770	321
2500	8-491-14A	125 - 135	2300	321
2500	8-491-14A	55 - 75	1750/1770	321
2500	8-491-14A	75 - 85	2100	321
2500	8-491-14A	90 - 115	2100	321
2500	8-491-14A	90 - 120	2300	321
2500	8-491-18A	135	1750/1770	330
2500	8-492-19	90 - 125	1750/1770	184
2500	10-481-18	65-100	1460/1480	200
2500	10-481-18D	63-96	1460/1480	237
3000	8-491-14A	60 - 80	1750/1770	321
3000	8-491-14A	95 - 115	2100	321
3000	8-491-18A	130	1750/1770	330
3000	8-491-18A	104 - 115	1750/1770	330
3000	8-491-18A	120 - 125	1750/1770	330
3000	8-491-18A	130 - 165	2100	330
3000	10-481-15C	100-110	2300	200
3000	10-481-18	61-99	1460/1480	200
3000	10-481-18	99-145	1460/1480	200
3000	10-481-18D	61-95	1460/1480	237
3000	10-481-18D	90-138	1750/1770	237
3000	10-492-18	94 - 151	1750/1770	185
3500	10-481-18	60-97	1460/1480	200
3500	10-481-18	98-140	1750/1770	200
3500	10-481-18D	59-94	1460/1480	237
3500	10-481-18D	88-135	1750/1770	237
3500	10-492-18	100 - 153	1750/1770	185
4000	10-481-18	95-100	1750/1770	200
4000	10-481-18D	64-92	1460/1480	237
4000	10-481-18D	85-134	1750/1770	237
4000	10-491-20	94 - 98	1750/1770	335
4000	10-491-20	110 - 225	1900	335
4000	12-481-18A	67-102	1460/1480	200
4500	10-481-18D	81-132	1750/1770	237
4500	10-491-20	90 - 195	1750/1770	335
4500	10-491-20	106 - 223	1900	335
5000	10-481-18D	91-130	1750/1770	237
5000	10-491-20	88 - 109	1750/1770	335
5000	10-491-20	110 - 195	1750/1770	335
5000	10-491-20	110 - 221	1900	335
5000	10-491-20	102 - 109	1900	335

1. The data shown above is listed in the current Fire Protection Equipment Directory of U.L. and is consistent with the requirements of F.M.
2. Maximum Working Pressure (PSI) is defined by U.L. as the maximum pressure that can be developed at the discharge flange under any operating condition. Applications where working pressures exceed these limits must be referred to the factory. Maximum pressure at the discharge flange = maximum suction pressure plus maximum total developed head.
3. In determining "Maximum Allowable Working Pressure", both agencies require initial hydrostatic testing approval at twice the values shown above.

DI = Ductile Iron construction

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FIRE PUMPS

Fire pumps for industrial plants and similar locations have a range of capacities from 500 to 4,500 gallons per minute. Their principal use is to make available large amounts of water for fire protection. They may take suction from a public main simply to increase the pressure available from such a source, but they are more often provided with their own reservoirs, suction tanks or wells, making the plant independent of piped water from public systems.

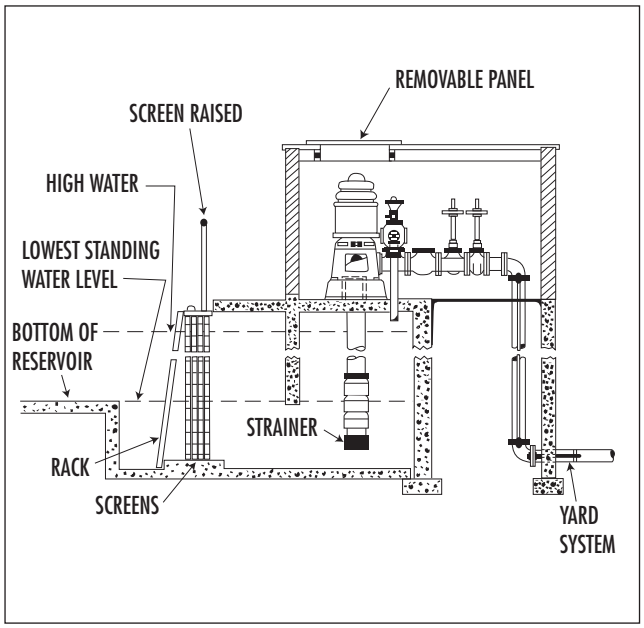
Pumps, which are used to make up pressure deficiencies in water supplies (which otherwise are of adequate volume), are referred to as "booster" pumps. These are often installed in a by-pass so that the city or other supply may be used directly when desired. Such booster pumps have commonly been of 500 to 1,000 gallons per minute capacity.

Small pumps known as "special fire service" pumps are sometimes used in situations where a limited amount of water is available (as from a city main) and it is necessary to avoid drafting too heavily from it. At zero lift, their maximum capacity should not exceed 130 percent of rated capacity .The capacities of such pumps are ordinarily 150, 200, 300 or 450 gallons per minute. Such special fire service pumps may also be used as booster pumps where local conditions make such small pumps acceptable.

Currently, most fire pumps installed are centrifugal types because these lend themselves readily to electric; steam turbine or internal combustion engine drive, and may be readily arranged for automatic operation.

PUMP CHARACTERISTICS

Permanently installed fire pumps may be designed to deliver their rated capacity against a specified head. This is usually 231 feet or l00 pounds per square inch, but in any case may be set according to the expected service demands. Fire pumps are required to deliver 150 percent of rated capacity at not less than 65 percent of the rated pressure. This produces a "flat" characteristic curve for these pumps. This is in contrast to the performance characteristics used for automobile pumpers and industrial pumps.



VERTICAL SHAFT TURBINE-TYPE FIRE PUMP INSTALLATION IN WET PIT

This is favored arrangement when the fire pump must take suction under a lift. Trash rack has 1/2-inch flat or 3/4-inch round steel bars spaced 2 to 3 inches apart. Double screens, one shown raised, one in position.

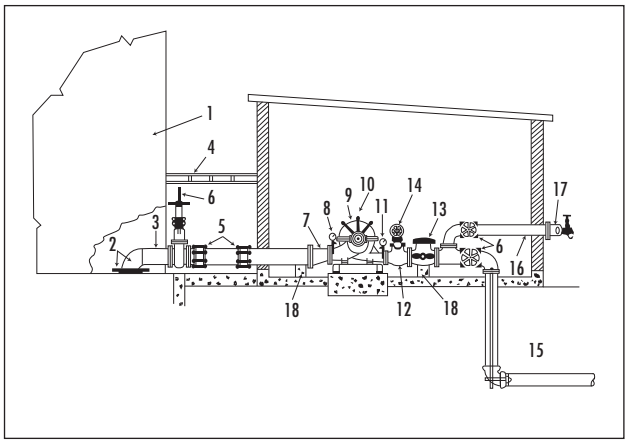
PUMP SUCTION (HORIZONTAL PUMP WITH WATER SUPPLY UNDER A POSITIVE HEAD)

Including allowance for velocity and friction loss through all suction pipe and fittings, the size of the suction pipe shall be such that the total equivalent operating suction lift will not exceed 15 feet. The suction pipe must be tight and not be excessively long. The inspector will find that many pump troubles are traceable to improper suctions. Workmen do not always make suction pipes tight. An uneven grade may leave high spots where an air pocket may break the suction. A long suction pipe introduces excessive friction loss. Each pump should have a separate suction pipe.

(1) UL Listed Only

PRIMING

The suction pipe and pump casing must be full of water for the pump to work. The pump casing must be provided with an automatic air release valve or umbrella cock to allow evacuation of air.



ARRANGEMENT OF CENTRIFUGAL FIRE PUMP WITH WATER ALWAYS UNDER A HEAD

1. Aboveground suction tank. 2. Entrance elbow and square vortex plate, 4 by 4 feet, 4 inches above bottom of tank. 3. Suction pipe. 4. Frostproof casing. 5. Flexible couplings. 6. Valves, indicating type. 7. Eccentric reducer. 8. Suction gage. 9. Horizontal fire pump. 10. Umbrella cock or automatic air release. 11. Discharge gage. 12. Reducing tee. 13. Discharge check valve. 14. Relief valve, if required. 15. Discharge pipe. 16. Drain valve or ball drip. 17. Hose valve manifold with hose valves. 18. Pipe supports.

INSPECTION OF FIRE PUMPS

A. Trace water from its source to the pump. Water meters on supplies from mains should not be type with excessive friction loss. Meters, or any fish traps with them, should not be obstructed. Wells on vertical pumps should be straight and of adequate diameter. Suction pipe from a large uncovered reservoir, or from a pond or river supply, should get only water free from sediment and foreign material. Examine screens at intakes and inquire what arrangements are for their periodic cleaning.

B. Inspect the pump house or pump room. Note combustible construction or any storage of combustible materials in the pump room. Consider the location of pump house or pump room noting if it might be made inaccessible or the power supplies made unreliable by a fire or by flood waters. Determine adequacy of pump room ventilation to help prevent dampness.

C. Note size and type of pump and arrangement of control devices. Note size of suction and discharge connections and pipes. Give length of suction pipe and the head in feet under which water is received by the pump, or the lift in feet.

D. Ask for any records kept of weekly running tests made both to check operation of the pump and the operation of manual and automatic starting, stopping and general control equipment provided as part of the installation. See the results of the last annual full capacity test.

E. Fire pumps are designed for relatively infrequent use, but must be able to perform satisfactorily even after standing idle for some time. Note whether the conditions generally make this possible. The pump should not be used for any other pumping service. It should be possible for an excited and perhaps unskilled person to start the pump. Note the extent to which employees show familiarity with the operation of the pump.

CENTRIFUGAL FIRE PUMPS

Following are some of the important features to cover in an inspection.

There are many other details and for these consult CENTRIFUGAL FIRE PUMPS, NFPA No.20, which covers the common method of driving; electric motors, steam turbines, gasoline (installations prior to adoption of 1974 edition of NFPA No.20) and diesel engines.

In general, pump and driver should be provided as a unit together with all needed control equipment. There should be acceptable evidence available for the inspector that the entire assembly is properly designed, such as listing of the assembly by Underwriters' Laboratories, Inc.. Underwriters' Laboratories of Canada or Factory Mutual Research Corporation.

CENTRIFUGAL FIRE PUMP INSTALLATIONS

PUMP SIZE, GPM	500	750	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500
SIZE OF DISCHARGE PUMP, INCH (MIN)	5	6	6	8	10	10	12	12	12	14
SIZE OF SUCTION PUMP, INCH (MIN)	5	6	8	8	10	10	12	12	14	16
SIZE OF RELIEF VALVE, INCH	3	4	4	6	6	6	8	8	8	8
NUMBER OF HOSE VALVES	2	3	4	6	6	8	12	12	16	16

A. Check manufacturer's head-delivery, efficiency and brake horsepower curves against the conditions of service to determine general suitability of the pump.

B. Note nameplate data on electric motors to determine suitability.

C. Investigate reliability of the electric power supply. There should be at least one reliable source from stations not subject to fire damage and preferably two independent circuits to the pump house. Underground circuits are best, but in any case arrangements should be such that possible interruptions by fire, wind or high water are minimized.

D. Look for suitable disconnecting means for electric circuits and proper overcurrent protection. Inspect the transformer installation.

E. Examine starting and stopping and general control arrangements. Note whether manual, or combined automatic and manual. Where a motor driven centrifugal pump is the sole sprinkler supply, record any central station supervisory service providing positive indications at the central station that the pump has operated normally.

F. Location of control equipment should be within sight of the pump. Electrical apparatus should be protected against leakage from the pump and other moisture. Control equipment should be in cabinets. Backs of cabinets should be easily accessible.

G. Investigate the steam supply to turbines driving pumps.

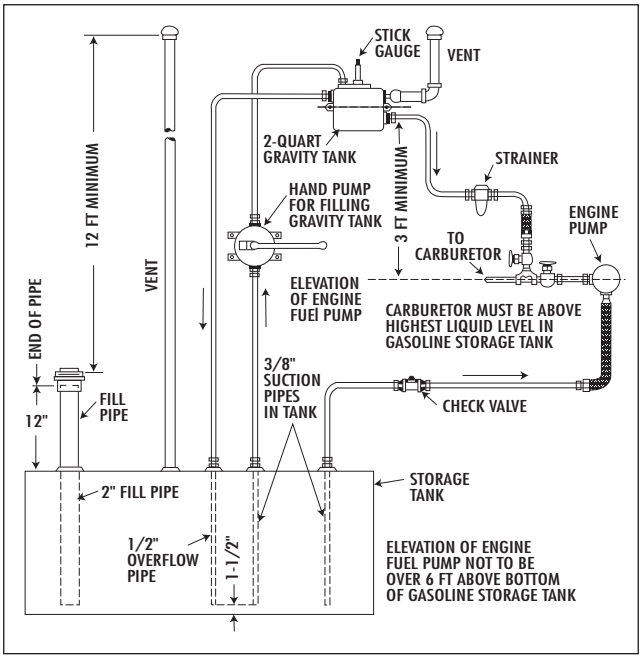
H. If internal combustion engine drive is provided, investigate ventilation of the pump room. Gasoline engines should not be installed in depressed pump rooms where gasoline vapors, which are heavier than air, may accumulate. Inspect the storage of main supply of gasoline or oil fuel. Ask if gasoline supply is fresh -not more than a year old. Note if exhaust pipe is run to a safe place outside. Flexible connection in exhaust pipe at engine should allow for pipe expansion. Storage batteries should be properly maintained and necessary spare parts kept on hand.

STEAM SUPPLIES FOR PUMPS

A. Note location of boiler house or boiler room. It should be cut off from remainder of property and from probable interference by fire. The location should be above high flood water .

B. Note number and horsepower of boilers. There should be a minimum of two boilers providing steam for fire pumps. Horsepower of boilers on which steam is regularly maintained should be sufficient to operate all fire pumps to capacity.

For reciprocating steam pumps the boiler should be able to keep 50 pounds up at all times. Turbines may require pressures 40 to 70 pounds. Very high pressures are not desirable and superheated steam should not be used on reciprocating type pumps. In general, reducing valves should be avoided, but see NATIONAL STANDARD STEAM FIRE PUMPS, NFPA No.21, for description of an arrangement which may be used for the fire pump supply when steam with high superheat is the supply normally available.



GASOLINE ENGINE FUEL SYSTEM
Schematic diagram of suitable pump feed for fuel. The valve in the line from the 2-quart tank to the carburetor is normally kept closed.

C. Investigate reliability of supply of water for boiler feed, which should be separate from the main water supply when possible.

D. Investigate dependability of fuel supplies to boilers, noting total amount stored on the premises. Minimum storage should be about 48 hours supply.

E. Steam piping in the boiler house should be so arranged that anyone or all boilers may be reserved for steam pump supply only.

F. Steam line to the pumps should be an independent line from header on the boiler. The main should run to the pump as directly as possible. If there are two fire pump lines, each should have a valve at the boiler and pump. Throttle valve should be of globe pattern.

G. Investigate possibility of steam main or mains being broken by falling walls or burning buildings. Mains should be installed to take care of expansion and contraction and be provided with proper traps.

H. Valves in steam lines should be open and steam should be up to the throttle valves on the pumps.

2. TESTS OF FIRE PUMPS

In even a brief or routine inspection the inspector should request that pumps be operated a few minutes at rated speed with water discharging through some convenient opening. Steam reciprocating pumps may run until water is discharging freely through the relief valve. The management of a property with a fire pump should make similar running tests weekly. It should have employees to make tests for the inspector. The inspector should not operate equipment.

On acceptance and at annual intervals, the pump should be given a complete test. The annual tests are set up to provide a complete check on the performance of the whole assembly: suction connections, pump, prime mover, steam and electric supplies. In making such tests, several lines of 2-1/2" hose, 50 to 200 feet long, are laid out from hydrants or from the pump manifold. Water is pumped and discharged through the hose lines, the amount being calculated from pitot tube gage reading at the nozzles. Inspectors should insist that nozzles be lashed at some convenient location to make the work of testing easier and avoid injuries to men holding nozzles.

CENTRIFUGAL PUMPS

A. Determine that pump is primed and casing is full of water. Interior wearing rings may be damaged by operation without water.

B. Have the pump started" observing proper method of starting for various types of drive.

C. Observe bearings for signs of overheating.

D. Observe alignment of pump and driver. Note tightness of foundation bolts.

E. Observe stuffing boxes of pump. With water seal supplied with water" a small leak at stuffing box glands is necessary.

F. Watch pressure gages. Signs of suction leaks may be indicated by flickering of gages or knocking in pump. Gage readings also may suggest that there are obstructions in the suction line" such as ice" or that screens are clogged, that well supply is inadequate" or that intakes are insufficiently immersed.

G. Have all outlets closed, including relief valve, and note that pump shuts off at the proper pressure (for horizontal shaft pumps usually not over 120 percent of rated pressure; for vertical shaft pumps 140 percent)

H. If pump is arranged for automatic as well as manual starting, have the pump started by opening a test connection.

ELECTRICALLY DRIVEN CENTRIFUGAL PUMPS

Electric pump controllers may have detailed instructions given on the controller and these should be followed. Manual starting should be repeated a number of times at each set.

STEAM TURBINE DRIVEN PUMP

A. To start pump, have steam admitted slowly at first to permit warming up of turbine casing before allowing full head of steam on turbine.

B. If pop safety valve on casing blows, have steam shut off and examine exhaust piping for closed valve or obstructed portion of piping.

C. Observe that governors maintaln proper speed. Have the emergency governor valve tested by tripping it.

D. To vary speeds below rated speeds, have main throttle valve used.

INTERNAL COMBUSTION ENGINE DRIVEN PUMP.

To start pump, follow manufacturer's instructions as to starters.

FIRE PUMP START-UP AND FIELD ACCEPTANCE TEST

The following is a general outline for starting and field testing Fire Pump Systems. It is understood that requirements and methods vary depending on the location (city). Anyone becoming involved In fire pump sales, must fully understand all local requirements, within his designated territory, the NFPA-20 Pamphlet and the Factory Mutual Fire Protection Manual. A general method to follow is outlined below.

I. Be specific and complete when ordering Fire Pumps and accessories so that the necessary and correct items can be supplied.

2. Trouble can not be tolerated on the day of the field acceptance test, therefore

A. Visit the jobsite after the equipment has been delivered and check for completeness and correctness and answer any questions the contractor may have.

B. Visit the jobsite after installation and check for correctness of installation.

3. After the installation is complete and the Fire Pump System is pressurized and checked by the contractor" an initial test should be conducted. This is to check the controller and motor. The test should be conducted (with contractor present if possible on engine drive systems, engine representative will be present for start-up) as follows:

A. Close all valves on discharge outlets. Check pump and motor alignment.

B. Open suction valve.

C. Check motor controller service manual and perform any necessary steps outlined, in the manual, prior to putting controller into operation. Also, read manual to understand how to operate the controller. Set controller to manual position.

D. With controller in manual position, the pump can be started. Check relief valves, be sure they are not completely closed. Start pump.

E. Adjust packing (if necessary), note if pump bearings are heating excessively; check pump RPM.

F. Completely close all relief valves. Check shut-off pressure of pump and see if the total dynamic head agrees with factory certified head/capacity curve.

G. Stop pump.

H. The jockey pump should be on line and proper system pressure maintained.

I. Set the motor controller to the automatic position.

J. Drop system pressure to below normal with test valve. The fire pump should start automatically.

4. After all is checked and equipment is operating properly arrangements can be made to perform the field acceptance test. People required to be present and forms necessary for recording the test can be obtained from the local insurance authorities.

5. Equipment necessary for field testing varies considerably in different localities. The maximum that you, as a supplier of the fire pump, should supply is:

A. Calibrated ammeter.

B. Volt meter.

C. Tachometer.

D. Pitot tube and gauge.

E. *Calibrated suction and discharge gauges with a range accuracy of 1/4%. (First three items are in your APCO-MATIC kit)

*The gauges furnished with the pump are 3% accurate and could lead to problems if used for the field acceptance test. Equipment which is necessary for the test and should be supplied by the local authorities:

1) 50 ft. of 2-1/2' hose for each hose connection on the outside hose header.

2) Play pipe with 1-3/4" nozzle for each hose.

6. Field acceptance tests will vary in all locations. The following steps are general and for electric drives. You will have to add any other requirements which might be particular to your territory:

A. Hose and play pipe should be connected to each opening of outside hose header.

B. Close discharge valve leading to building fire system.

C. Open discharge valve leading to outside hose header.

D. Suction valve should be open.

E. Close all relief valves.

F. Open one (1) outside hose valve.

G. Using pitot tube and gauge with 1-3/4" nozzle, valve should be adjusted until gauge on pitot tube reads 30 PSI, this is equal to 500 GPM.

By opening additional valves and measuring the flow to equal 500 GPM, the proper flow (500, 1000, 1500, 2000, 2500, 3000, 3500, 4000 or 4500) can be obtained. Chart 1 lists nozzle pressures and flows for various nozzle sizes.

H. Open the necessary hose valves to obtain the rated flow. Check all nozzles making sure the correct flow is maintained. Changing one valve usually changes the flow in the other hoses. When the proper flow is assured, check and record the following data:

1) Suction gauge pressure.

2) Discharge gauge pressure.

3) Check RPM with tachometer.

4) Voltage.

5) Amps (on all legs).

The panels are equipped with jacks for connecting the volt meter and ammeter.

I. Return to the nozzles and check flow to make sure it did not change. If any change is noted, re-establish the proper flow, recheck and record data. Repeat this until you are sure all necessary data is correct and recorded.

J. Adjust hose valves until a flow of 150% of rated flow is obtained. Proceed as before and record necessary data. Again, accuracy is very, very important and necessary.

K. This step applies only if required by the local authorities. It is not required by U.L. but is required by F .M. Open all hose valves full or just short of extreme cavitation by the pump. Record all data.

L. Close all hose valves completely. Make sure all relief valves are closed. Check and record all data at this shutoff (0 GPM) condition.

M. Set relief valves to proper setting.

I) System relief valve should be set slightly over maximum system pressure.

2) Casing relief valve should be set slightly under shutoff pressure of the pump.

Q. Data obtained should match the certified performance test from the factory (at 0 GPM, rate GPM, and 150% rated GPM). Average value of the highest amps recorded should not exceed the nameplate amps of motor by more than 115% (due to normal variations of test equipment, 120% may be considered acceptable).

R. If data does not agree with test, recheck your data and if necessary, retest pump. Be sure you figure total dynamic head correctly.

NOZZLE	GPM AT VARIOUS NOZZLE SIZES					
PRESS.	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-3/4
10	l00	130	160	195	235	285
20	160	203	245	290	348	410
30	206	254	308	366	430	498
35	222	275	332	395	464	538
40	238	294	355	423	496	575
45	252	311	377	448	525	610
50	266	328	397	473	555	643
55	279	344	417	496	582	675
60	291	360	435	518	608	705
62	296	366	442	526	618	716
64	301	371	449	535	628	728
66	305	377	456	543	637	739
68	310	383	463	551	647	750
70	315	388	470	559	656	761
72	319	394	477	567	666	772
74	323	399	483	575	675	783
76	328	405	490	583	684	793
78	332	410	496	590	693	803
80	336	415	502	598	702	814
85	347	428	518	616	723	839
90	357	440	533	634	744	863
95	366	452	547	651	765	887
100	376	464	562	668	784	910
105	385	476	575	685	804	932
110	394	487	589	701	823	954
115	403	498	602	717	841	976
120	412	509	615	732	859	997

(1) UL Listed Only