



FILE NO.:	F43.130
DATE:	JULY 15, 1997
SUPERSEDES:	F43.130
DATE:	AUGUST 1993

APPLICATION DATA - FIRE PUMP

INTRODUCTION

Armstrong Darling Fire pumps meet all of the requirements for fire pump service with its standard production pumps. Armstrong Darling Fire Pumps are constructed in accordance with the requirements of Underwriter's Laboratories of Canada (ULC), Underwriters' Laboratories Inc. (UL), Factory Mutual Research Corporation (FM) and comply with the standards of the National Fire Protection Association (NFPA) Pamphlet 20, testimonial to the high quality of Armstrong Darling pump products.

In addition, Armstrong Darling products are backed by over 100 years of design and manufacturing experience.

FIRE PUMP GENERAL INFORMATION

Fire Pumps are purchased for two main reasons:

- A) To protect Buildings and Property against fire loss through an overhead automatic sprinkler network or stand pipe system.
- B) To secure lower insurance premiums.

TYPES OF FIRE PUMPS

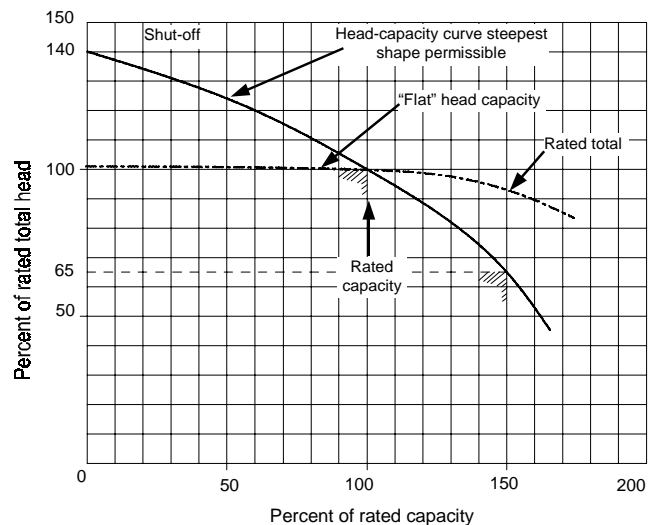
- Horizontal split case pumps
- Horizontal split case double suction pumps
- Vertical In-line centrifugal pumps
- End suction single stage pumps

RATED PUMP CAPACITIES

Fire Pumps have the following rated capacities in USGPM and l/min. or larger and are rated at net pressures of 40 PSI (2.7 Bars) or more.

GPM	l/m	GPM	l/m	GPM	l/m
25	95	400	1514	2000	7570
50	189	450	1703	2500	9462
100	379	500	1892	3000	11355
150	568	750	2839	3500	13247
200	757	1000	3785	4000	15140
250	946	1250	4731	4500	17032
300	1136	1500	5677	5000	18925

PERFORMANCE REQUIREMENTS



PUMP CHARACTERISTIC CURVES

1. The pump is required to demonstrate its ability to achieve 65% of rated pressure when flowing at 150% of rated capacity with a total lift of 15 ft (4.6M).
2. Shut-off head will range from a minimum of 101% to a maximum of 140% of head.
3. On production runs a witnessed hydrostatic pressure test is required to a minimum 1½ times the maximum design working pressure of the pump (the sum of the marked maximum net head developed and the marked maximum positive suction pressure), but in no case less than 250 PSI. Each pump casing must withstand the hydrostatic test pressure for a period of 5 minutes without evidence of rupture. For the sake on consistency Armstrong Darling uniform tests all Fire Pumps to not less than 250 PSIG.

FIRE PUMP - GENERAL INFORMATION

STANDARDS AND CODES

All codes have one thing in common; they are based on some kind of standards against which products are tested to see if the products satisfy the Code. Codes in America have the force of statutory law and nonconforming equipment can be removed, forcibly if necessary and the purchaser takes the loss. It is therefore general practice to write into the Codes specific references to one or other of the several nationally recognized testing laboratories such as UL, ULC and FM.

STANDARD FOR THE INSTALLATION OF CENTRIFUGAL FIRE PUMPS - Pamphlet 20

The National Fire Protection Association (NFPA) is a National Advisory Board dedicated to promoting research and development and improving methods to reduce loss by fire. This Association establishes Standards and Codes that all Members use as guides.

NFPA does no testing of its own, instead it relies on the testing laboratories of UL, ULC and FM, who are also NFPA Members. These laboratories are qualified and equipped to conduct the necessary tests, and their Label is in fact fulfillment and enforcement of the corresponding NFPA Standards.

TESTING LABORATORIES



UNDERWRITERS LABORATORIES OF CANADA (ULC) is a recognized testing laboratory which lists fire protection equipment as a guide. The ULC Label on the Fire Pump is the only evidence provided by Underwriters Laboratories of Canada to identify pumps which have been produced under the Labels Service Program.

These Fire Pumps are the subject of continued review and examination at the point of manufacture by the ULC inspector to determine that the details of construction and performance are the same as those established at the time of the initial investigation.

UNDERWRITERS LABORATORIES INC. (UL) is a nationally recognized testing laboratory which lists fire protection products which have been evaluated with respect to reasonably foreseeable hazards to life and property, and which pass its stringent tests and standards. Its key words are "Testing for Public Safety".

Like its Canadian namesake, the UL label on the Fire Pump is the only evidence provided by Underwriters Laboratories Inc. to identify pumps which have been produced under the UL re-examination service program. Inspections at the manufacturers' plant are carried out quarterly.

FACTORY MUTUAL RESEARCH CORPORATION (FM) is a Testing Laboratory that grants approval for fire protection equipment that passes its own rigid requirements and which is listed in Factory Mutual's Approval Guide. Its key words are "Protection from Fire, Explosions, and Breakdown". Approval is based on evaluation of the product (examination and tests) and of the manufacturer (facilities and quality control procedures). These examinations are repeated as part of Factory Mutual's approved product follow-up program.

FIRE PUMP GENERAL INFORMATION

FIRE PROTECTION INSURANCE AGENCIES

Fire Insurance can be purchased from a Stock Company or Mutual Company. Both types of companies have their own Agencies which set and maintain standards, perform engineering functions, establish rates, specify appropriate label, and supervise and inspect actual installations for Fire Pumps. The Stock Insurance Companies function through Underwriters Laboratories Inc. (UL), and Underwriters Laboratories of Canada (ULC). The Mutual Companies function through the associated Factory Mutual (FM) district offices. At times it is possible for the end user to obtain approval for a particular label by contacting the Insurance Company and requesting what is required, over and above the requirements of the offered particular label.

NOTE:

- NEW Fire Pumps shipped to site with incorrect pressures due to errors must be returned to the manufacturer for modifications and a new label.
- EXISTING Fire Pumps can be mechanically repaired in the field with no loss of label. Whenever the impeller in a listed fire pump is replaced with an identical impeller and/or rotating assembly, a field test must be performed by the manufacturer or his representative. The field re-test results shall equal the original pump performance.

TYPE OF INFORMATION	U.S. STOCK COMPANIES	CANADIAN STOCK COMPANIES	FACTORY MUTUAL COMPANIES (FM)
APPROVING AUTHORITY AND TESTING LABORATORIES	Underwrites Laboratories Inc. (UL)	Underwriters Laboratories Canada (ULC)	FM (Engineering Division)
PUBLISHED STANDARDS	NFPA 20	NFPA 20	Loss Prevention Data Sheet 3-7N
APPROVED EQUIPMENT LIST	Underwrites Laboratories Fire Equipment List	U.L.C. List of Equipment Materials Volume General	FM Approval Guide
HOME OFFICE ADDRESS	Underwrites Laboratories Inc. 333 Pfingsten Road Northbrook, Illinois 60062	Underwriters Laboratories Canada (ULC) 7 Crouse Road Scarborough, Ontario M1R 3A9	FACTORY MUTUAL 1151 Boston-Providence Turnpike P.O. Box 9102 Norwood, Mass. 02062
LOCAL INSPECTION GROUP	Insurance Services Office (I.S.O.)	Insurers Advisory Organization (I.A.O.)	FM District Office

MANUFACTURER'S REQUIREMENTS FOR APPROVAL

GENERAL

It is the responsibility of the manufacturer to establish and maintain an effective Quality Control Program to assure that all purchased parts, parts fabricated within the manufacturer's factory and finished pumps intended to bear the ULC/UL/FM Listing Marks comply with the construction requirements detailed in the individual sections of the Procedure Guides.

- Anticipated pump performance, including total head, power requirements and efficiency versus flow characteristics. If different impellers or a range of impeller diameters are used to obtain the rated head range for the pump being examined, complete details shall be provided concerning the range of performance specifications to be evaluated
- detail drawings of each part used in the pump assembly with material lists and physical property specifications
- Calculations used to determine shaft size, casing bolt size, and ball bearing life
- General assembly drawing(s) showing the pump and attachments
- Maintenance, operation and installation instructions
- Drawing of test stand showing piping hook-up for testing purposes

NOTE: Once approved the manufacturer cannot substitute any components without resubmitting for approval.

TEST EQUIPMENT

The manufacturer's test stand must include calibrated pressure gauges, flow measuring instruments, calibrated wattmeters, ammeters and voltmeters, (or dynamometer) piping, valves, calibrated motors and tachometer.

CALIBRATION OF TEST EQUIPMENT

It is the responsibility of the manufacturer to maintain properly calibrated test equipment. The gauges used to conduct the operation and hydrostatic strength tests shall be calibrated:

- A. at least once a year
- B. whenever the gauge has been subjected to physical abuse such as might result from its being dropped or struck with an object
- C. at any other time when the accuracy of the gauge appears questionable

The manufacturer shall keep the current certificates of calibration on file for review by ULC, UL or FM representatives.

TEST TO BE CONDUCTED

The manufacturer conducts an operation test and a hydrostatic pressure test on each Listed Fire Pump. The operation test is conducted to determine the pump speed, horsepower input, suction pressure and discharge pressure at zero flow (shutoff), rated capacity and 150% rated capacity.

The pump shall deliver not more than

- 140% of the rated pressure at shut off

The pump shall deliver not less than

- The rated pressure at the rated flow
- 65% of the rated pressure at 150% of the rated flow with a total suction lift of 15 ft. (4.6M)

The maximum power required will be determined. A total suction head adequate to produce the maximum power requirement for the pump shall be provided. Maximum power will occur when there is no increase in power with an increase in the total suction head.

Additional points may be determined in order to provide a check on the accuracy of the performance curve. Allowance is made for difference in velocity heads and gauge elevations with respect to the pump center line.

With regards to new product submittals at least one sample pump of each rated capacity will be tested. If one or more impellers having a range of impeller diameters is used to obtain the desired head range for the pump, the minimum and maximum impeller diameters of each type will be tested. Intermediate impeller diameters may be tested at the discretion of the authorities having jurisdiction.

HYDROSTATIC PRESSURE TEST

The hydrostatic pressure test is to be conducted on each pump for a period of not less than 5 minutes. The test pressure is to be not less than twice the maximum design working pressure on the pump, but in no case less than 250 PSI (1724 kPa), with casing showing no rupture, crack or signs of permanent deformation.

TEST RECORDS

The manufacturer shall keep records indicating the size, model number (or equivalent), and the serial number of the pump tested; the date the pump was tested; name and location of installation. These records shall be maintained for at least 12 months after the pump is shipped, and shall be available for review by UL-ULC-FM Representatives.

FIRE PUMP AND JOCKEY PUMP SELECTION PROCEDURE

Fire Pump selection is made in six (6) steps

STEP 1 Determine who is going to insure the property to be protected. There are four possibilities in North America

- a) **US Stock Companies** will require a “UL” label on the Fire Pump equipment which is to be built as per NFPA 20 Standards.
- b) **Canadian Stock Companies** similarly will require a “ULC” label as per NFPA 20 Standards.
- c) **Factory Mutual Companies** will require an “FM” label and will follow the “Loss Prevention Data Sheet 3-7N”.
- d) **Self-Insured** Government Agency will generally require a “UL” label as per NFPA 20 Standards.

Step 2 Determine the Fire Pump Capacity

This is done by taking into account the local code in consultation with the local inspection group of the authority having jurisdiction.

Approving Authority	UL	ULC	FM	Gov't Agency
Local Inspection Group	Insurance Services Office (I.S.O.)	Insurer Advisory Organization (I.A.O.)	FM District Office	Gov't District Office

These are: Generally, the Fire Pump capacity will be any of the following GPM:
 25, 50, 75, 100, 150, 250, 300, 400, 450, 500, 750, 1000, 1250, 1500, 2000, 2500, 3000, 4000, 5000.

Step 3 Determine the suction pressure and the boost pressure

The suction pressure is very important as it directly affects the boost pressure. Usually this is the city pressure from the municipal main. On request the city will run a test and will run a test an will issue a letter stating that at a specified time and date the city pressure at that point was ... PSI. Civil Servants will never commit themselves to guarantee any pressure. It is therefore up to the Consulting Engineer to decide on what suction pressure to base Fire Pump selection.

Usually, he will assume a minimum suction pressure based on the city test and district city pressure history, taking into account the additional pressure drop when the Fire Pump will be in operation at 150% volume capacity. Minimum acceptable suction pressure is usually 20 PSI.

The boost pressure is calculated as follows:
 (Net boost pressure must be 40 PSI or more)

ADD:

- Static head figured from pump elevation to highest sprinkler head or fire hose cabinet
- Required pressure at highest sprinkler head or fire hose cabinet. Generally, this is governed by the local construction code and it may vary up to 100 PSI depending on the hazard, the flow in the riser and the minimum duration
- Friction in supply lines and risers

DEDUCT:

- Suction pressure at pump elevation

Note:

A hydraulically designed system may be required where water supplies are borderline.

STEP 4 Determine if Fire Pump is to be electric motor driven or diesel engine driven

While this could be a straightforward question of reliable emergency power supply, it is often governed by the Code and in some cities and for certain types of buildings it is required that both types of fire pumps be installed. Alternately, generating sets are also being specified with one or two electric Fire Pumps.

STEP 5 Select the Fire Pump

a) Vertical In-Line Fire Pump

Enter the specific capacity rating table with the boost pressure required and note the pump selection and the motor HP for FM or ULC labeled pump.
 Example: for 500 GPM at 120 PSI select 6x4LA-F Fire Pump with 60 HP @ 3500 RPM motor

Note 1

In-Line Fire Pumps are available with FM label for 750 GPM capacity.

Note 2

Vertical In-Line Fire Pumps can be packaged as: Firepak Econo, Firepak Ultra and Firepak Ultra Plus.

FIRE PUMP AND JOCKEY PUMP SELECTION PROCEDURE

Booster Fire Pump selection is made in six (6) steps (cont'd)

STEP 5 Select the Fire Pump

b) Split Case Fire Pump - Electric driven

Series 4600F single stage and class B₂ two stage.

Fire Pumps are selected by entering the specific capacity rating table with the boost pressure required. Make sure that the required label is available for the pump selected and for the pressure required.

Example:

For 1000 GPM at 110 PSI select a 6x5x10F Fire Pump with a 100 HP @ 3560 RPM motor and UL or ULC or FM

Split case Fire Pump - Diesel driven

Proceed with Series 4600F or Class B₂ Pump selection in the same manner as above, checking if required label is available. For diesel engine selection note the maximum brake horsepower from fire pump rating table and select diesel engine of a listed and/or approved rating exceeding this maximum pump BHP. Derating for altitude and temperature must be taken into account.

STEP 6 Select the Jockey Pump

Capacity: 5 to 10 USGPM is generally acceptable. It should not exceed the water demand of one sprinkler, that is 20 USGPM.

Pressure Boost: Usually 5 PSI higher than that of the Fire Pump so that the Jockey Pump starts before the main Fire Pump.

Pump Selection: There are no approved pumps for this service. Any pump which meets the pressure maintenance requirement of the system may be used.

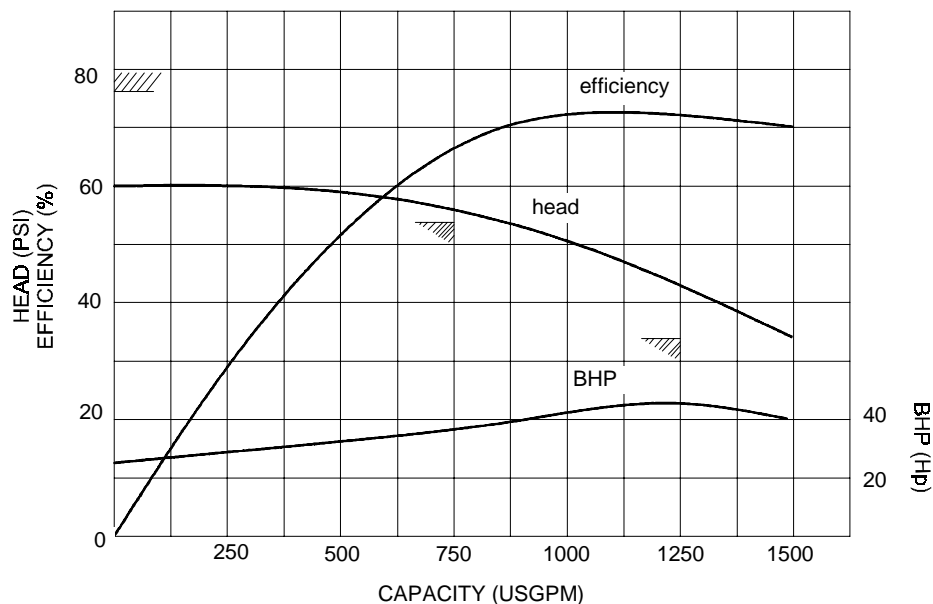
FIRE PUMP PRESSURE SETTINGS (per NFPA - pamphlet 20)

The fire pump system when started by pressure drop should be arranged as follows:

1. The **jockey pump stop point** and the **fire pump stop point** should equal the fire pump shut off pressure, plus the minimum static suction pressure.
2. The **jockey pump start point** should be 10 PSI less than the jockey pump stop point.
3. The **fire pump start point** should be 5 PSI less than the jockey pump start point. Use 10 PSI increments for each additional pump.
4. Where minimum run timers are provided, the pump will continue to operate after attaining these pressures. The final pressures should not exceed the pressure rating of the system.
5. When the operating differential of pressure switches does not permit these settings, the settings should be as close as the equipment will permit. The settings should be established by pressures observed on test gauges.
6. The **circulation relief valve** should be set in the field at the lowest suction pressure, plus the rated pressure of the unit raised to the next higher 5 lb. increment.

Example:	Rated capacity and head: 750 USGPM - 55 PSI Minimum Suction Pressure: 50 PSI Armstrong Darling 6x5 LY-F Fire Pump		
Stop Point: Fire pump & Jockey Pump:	Fire Pump Shut-off 60 PSI	+ Min. Suct. Pressure + 50 PSI	= cut-out = 110 PSI
Start Point: Jockey Pump:	Jockey Pump Stop Point 110 PSI	- 10 PSI - 10 PSI	= cut-in = 100 PSI
Start Point: Fire Pump:	Jockey Pump Start Point 100 PSI	- 5 PSI - 5 PSI	= cut-in = 95 PSI
Circulation Relief Valve:	Minimum suct. pressure 50 PSI	+ rated pressure + 55 PSI	+ 5 PSI + 5 PSI = 110 PSI
Resume:	Fire Pump: Cut-in 95 PSI - Cut-out 110 PSI Jockey Pump: Cut-in 100 PSI - Cut-out 110 PSI Circulation Relief Valve to open at 110 PSI		

6 x 5 LY-F, 1750 RPM - 750 GPM @ 55 PSI



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