NFPA 20 – 2016 and Beyond

Gayle Pennel, P.E. - Aon Fire Protection Engineering
NFPA 20 -2016 Major Changes

- Automatic Supervision of Pressure Transducers
- Connectivity Annex – Standardized Data Reporting Format
- Introduction of Multistage Multiport Pumps
- Additional Requirements for Vertical Staging of Fire Pumps
- New NFPA Sample Fire Pump Acceptance Test Form
- Break Tanks and Refilling Requirements Moved from NFPA 20 to NFPA 22
Automatic Supervision of Pressure Transducers

- **10.5.2.1.3** Where an electronic pressure sensor is used to automatically control fire pump operation, the fire pump controller shall monitor the transducer during automatic testing.
- **10.5.2.1.3.1** Where the transducer pressure reading exceeds 10 psi (0.68 bar) during any automatic pump start that was initiated by the solenoid drain valve, as required by 10.5.2.1.8.3, the controller shall activate a visual and audible alarm, that can be silenced.
Automatic Supervision of Pressure Transducers (continued)

- **10.5.2.1.3.2** Where an electronic pressure sensor is used to control fire pump operation, the fire pump controller shall monitor for and provide a signal for the following electronic pressure sensor conditions:
  
  - (1) Any time the transducer output is less than 10 percent of rated span or below its rated zero pressure output
  
  - (2) Any time the pressure transducer reading is more than 10 percent above its rated full-scale output
Introduction of Multistage Multiport Pumps

- Single driver with multiple stages and multiple outlets
- Similar to fire pumps in series except a single driver, with multiple impellers in a shared case and no shut off of check valves between outlets.
- Currently being used in Europe
Introduction of Multistage Multiport Pumps
Vertical Staged Fire Pumps

- **4.20.2.1** Except as permitted by 4.20.2.2, all the pumps that are a part of a series fire pump unit shall be located within the same fire pump room.

- **4.20.2.2** Pumps that are a part of a series fire pump unit shall be permitted to be located in separate pump rooms where all the following conditions are met:
  1. Each pump shall be arranged so that all pumps operating in series can be manually stopped or started from all pump rooms housing the series fire pumps.
  2. The suction and discharge pressures from all pumps operating in series shall be displayed in all pump rooms housing the series fire pumps.
Vertical Staged Fire Pumps (continued)

- (3) The alarms and signals shall be annunciated in the other pump rooms for all pumps that are a part of the series fire pump unit in accordance with 4.20.2.8 and 4.20.2.9.

- (4) The interconnect control wiring between the controllers in different pump rooms shall comply with 4.20.2.7 and 4.20.2.8.

- (5) A pump room communication system that shall comply with 4.20.2.9 and 4.20.2.10.

  4.20.2.10.1 A two-way, in-building emergency services communications system in accordance with NFPA 72 shall be provided in each pump room where pumps in series are not located in the same room.

  4.20.2.10.1.1 The communication system shall meet the survivability requirements of NFPA 72
Break Tanks and Refilling Requirements Moved from Chapter 4 of NFPA 20 to NFPA 22

- Requirements remain the same
- Refilling requirements for High Rise retained in NFPA 20
5.5 Auxiliary Power. Where electric motor–driven fire pump(s) are used, a reliable emergency source of power in accordance with Section 9.6 or a back-up fire pump in accordance with Section 9.3 shall be provided for the fire pump installation.
3.3.38* No Flow (Churn, Shutoff). The condition of zero flow when the fire pump is running but the only water passing through the pump is a small flow that is discharged through the pump circulation relief valve or supplies the cooling for a diesel engine driver.

3.3.47 Rated Flow. The capacity of the pump at rated speed and rated pressure as marked on the manufacturer's nameplate.

3.3.42.3 Rated Pressure. The net pressure (differential pressure) at rated flow and rated speed as marked on the manufacturer’s nameplate.

3.3.41* Peak Load. As it pertains to acceptance testing in this standard, the maximum power required to drive the pump at any flow rate up to 150 percent of rated capacity (flow).
3.3.42.1 *Discharge Pressure.* The total pressure available at the fire pump discharge flange.

3.3.42.2* **Net Pressure (Differential Pressure).** For vertical turbine fire pumps, the total pressure at the fire pump discharge flange plus the total suction lift. For other fire pumps, the total pressure at the fire pump discharge flange minus the total pressure at the fire pump suction flange.

3.3.42.4 **Suction Pressure.** The total pressure available at the fire pump suction flange

3.3.67.2 **Suction Pressure Regulating Valve.** A pilot-operated valve installed in discharge piping that maintains positive pressure in the suction piping, while monitoring pressure in the suction piping through a sensing line.
NFPA Sample Fire Pump Acceptance Test Form

Sample Centrifugal Fire Pump Acceptance Test Form

Information on this form covers the minimum requirements of NFPA 20 for performing acceptance tests on centrifugal fire pumps with electric motor or diesel engine drives. A separate form is required for each pump operating simultaneously. This form does not cover periodic inspection, testing, and maintenance required by NFPA 20.

Owner:
Owner’s address:

Pump location:
Property address:

Date of test:
Minimum demands of fire protection systems:

System demand information supplied by:

Pump type: Horizontal Q Vertical Q Inline Q Other (specify)
Manufacturer:
Model or type:
Shop/Serial number:

Pump rated for:

gpm at

psi at

psi at 100%

psi at closure

Inlet discharge size:
Inlet suction size:

If suction from tank, tank diameter:
B, height:
E, net capacity:
gpm:

Driver:
Electric motor:
Diesel engine:

Manufacturer:
Shop/Serial number:
Model or type:

Rated horsepower:
Electric motor, rated voltage:
Operating voltage:

Rated range:
Phase cycles:
Service factor:

Controller manufacturer:

Shop/Serial number:
Model or type:

Control panel rated:

Vac:
HP:

Automatic switch:
Yes:
No:

Manual switch:
Yes:
No:

Do controller control HP & VAC switch modes?
Yes:
No:

Pressure maintenance ( giorni: pump capacity )
Yes:
No:

Automatic switch:
Yes:
No:

Manufacturer:
Shop/Serial number:
Model or type:

Sprinkler valve provided on jockey pump discharge:
Yes:
No:

Jockey pump rated for:

gpm at

in.

Jockey pump controller manufacturer:

Shop/Serial number:
Model or type:

Jockey pump controller rated:

Vac:
HP:

Note: All spaces to be filled in. All questions are to be answered Yes, No, or Not Applicable. All ‘No’ answers are to be explained in the comments portion of this form.

I. Flush Test (Table 24.1.1.1) — Conduct before hydraulic test

A. Supply off main fire protection pump or reservoir

B. Supply piping was flushed at

gpm (See Table 14.1.1.1)

C. Was pipe from tank discharge to pump checked visually inspected:

D. Copy of Contractor’s Material and Test Certification for Underground Piping attached: (See Figures A.14.1.5.1(h) and A.14.1.5.1(d))

II. Hydrostatic Test (14.1.2.1)

A. Minimum pump discharge pressure at rated speed and maximum allowable conditions:

B. Piping tested at

psi for 2 hours:

C. Copy of Contractor’s Material and Test Certification for

D. Piping System attached: (See Figures A.14.1.5.1(h) and A.14.1.5.1(d))

III. People Present (14.2.1)

Were the following present to witness the test:

A. Pump manufacturer/representative?

Yes:
No:

B. Engine manufacturer/representative?

Yes:
No:

C. Controller manufacturer/representative?

Yes:
No:

D. Transfer switch manufacturer/representative?

Yes:
No:

E. Authority having jurisdiction/representative?

Yes:
No:

F. Owner or owner’s representative?

Yes:
No:

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Fire Pump Acceptance Test Form (continued)
**Fire Pump Acceptance Test Form (continued)**

**ANNEX A**

<table>
<thead>
<tr>
<th>Test</th>
<th>Pump speed (rpm)</th>
<th>Needle size (in.)</th>
<th>Needle used</th>
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</tbody>
</table>

C. Did the fire pump performance exceed the manufacturer’s factory curves within the accuracy limits of the test equipment during the multiple tests? Yes No N/A

**VII. Main Pressure Relief Valve**

A. Is a noise pressure relief valve installed on the fire pump discharge? Yes No
B. During variable speed performance testing, was the flow rate through the main pressure relief valve at least? Yes No
C. During constant speed performance testing, was the flow rate through the main pressure relief valve at least? Yes No
D. During variable speed performance testing, was the flow rate through the main pressure relief valve at least? Yes No
E. During constant speed performance testing, was the flow rate through the main pressure relief valve at least? Yes No
F. During variable speed performance testing, was the flow rate through the main pressure relief valve at least? Yes No
G. During constant speed performance testing, was the flow rate through the main pressure relief valve at least? Yes No
H. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
I. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
J. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
K. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
L. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
M. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
N. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
O. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
P. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
Q. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
R. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
S. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
T. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
U. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
V. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
W. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
X. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
Y. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No
Z. Did the pump start at least 2 minutes after the main pressure relief valve was opened? Yes No

**VIII. Controller Test**

A. Did the pump start at least 6 times from automatic sources? Yes No N/A
B. Was each automatic starting fixture tested at least once? Yes No
C. Did the pump start at least 6 times manually? Yes No
D. Was the pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
E. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
F. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
G. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
H. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
I. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
J. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
K. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
L. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
M. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
N. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
O. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
P. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
Q. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
R. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
S. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
T. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
U. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
V. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
W. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
X. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
Y. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
Z. Was the engine driven fire pump run for at least 5 minutes during each of the operations in Parts A, B, and C above? Yes No
### Fire Pump Acceptance Test Form (continued)

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. Were both RFCs tested if supported?</td>
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<tr>
<td>Q. Was the engine tested and run on both RFCs at rated flow and full load?</td>
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<tr>
<td>R. Were all alarm functions including RFC alarms for fire detection failure, low flow, and any primary sensor failure confirmed?</td>
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<tr>
<td>S. Were all equipment protective devices including the control centre breaker selected, sized, and set in accordance with NFPA 20?</td>
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<tr>
<td>T. Was the fire pump started at least once from each power source and run for at least 5 minutes?</td>
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<tr>
<td>U. Upon variation of a power failure, while the pump is operating at peak load, did the transfer switch transfer from the current to the emergency source without opening equipment protective devices on either line?</td>
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<tr>
<td>V. When normal power was restored, did retransfer from emergency to normal power occur without opening equipment protective devices operating on either line?</td>
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<tr>
<td>W. Were at least half of the automatic and manual start-up required by Port A and C performed with the pump connected to the alternate source?</td>
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<tr>
<td>X. Were all signal conditions associated with the satisfactory operation of the equipment confirmed?</td>
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<tr>
<td>Y. Did the pump run for at least 1 hour during the tests?</td>
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</tbody>
</table>

**NOTE:** Fire tests include all tests the design requires—i.e., no flow and flow conditions.

### Water Storage Tank
- A. Tank capacity (gallons): ____________ B. Diameter (ft): ____________
- C. Elevated tank (Yes) ____________ (No) ____________ Required tank size: ____________
- D. Fill rate (acre-feet per minute): ____________
- E. Water level of tank at ____________ in and an operating level of ____________ in. (Field verified by measuring the water level from the tank wall.)
- F. ____________ in and ____________ minutes, ____________ in. (Field verified by other means, typically.)
- G. ____________ in and ____________ minutes, ____________ in. (Field verified by other means, typically.)

### Test Evaluation
- A. Did the pump performance match the manufacturer’s certified data test under all load conditions? ____________
- B. Did the pump discharge pressure exceed the acceptance criteria from the manufacturer’s certification? ____________
- C. Did the pump flow rate and performance meet the requirements of NFPA 20? ____________

### Test Information
- **Tester:** ____________
- **Company:** ____________
- **Address:** ____________

I certify that the information on this form is correct and that all equipment tested was tested in operation condition upon completion of this test except as noted in the comments section below.

**Signature of tester:** ____________
**Date:** ____________
**License or certification number (if applicable):** ____________

### Comments
(Any “No” answers, test failures, or other problems must be explained—see additional sheet if necessary.)

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**Figure A.14.2.6.5(a) Continued**
FIGURE A.14.2.6.5(b) 1000 gpm at 100 psi Fire Pump Acceptance Test – Constant Speed Operation.

FIGURE A.14.2.6.5(c) Variable Speed Fire Pump Acceptance Test – Variable Speed Operation 1000 gpm at 100 psi Fire Pump.
Fire Pump Acceptance Test Form (continued)

**FIGURE A.14.2.6.5(b)** 1000 gpm at 100 psi Fire Pump Acceptance Test – Constant Speed Operation.

**FIGURE A.14.2.6.5(c)** Variable Speed Fire Pump Acceptance Test – Variable Speed Operation 1000 gpm at 100 psi Fire Pump.
Fire Pump Acceptance Test Form (continued)

FIGURE A14.2.6.5(d)  Horsepower and Amperage Sample Curve – Underperforming 1500 gpm at 105 psi Fire Pump.
Test Equipment.

- **14.2.6.1.1** Calibrated test equipment shall be provided to determine net pump pressures, rate of flow through the pump, volts and amperes, and speed.

- **14.2.6.1.2** Calibrated test gauges, transducers, and other devices used for measurements required in 14.2.6.1.1 during the test shall be used and shall bear a label with the latest date of calibration.

- **14.2.6.1.2.1** Gauges, transducers, and other devices used for measurements required in 14.2.6.1.1 during the test shall be calibrated annually at minimum.

- **14.2.6.1.2.2** Calibration of gauges, transducers, and other devices used for measurements required in 14.2.6.1.1 during the test shall be maintained at an accuracy level of \( \leq 1 \) percent.
14.2.6.1.2.3 Fire pump controller voltage and current readings on controllers that are factory calibrated and adjusted to 3 percent shall be permitted to be used in lieu of calibrated volt/amp meters for the acceptance test.

14.2.6.1.2.4 Fixed outlet flow devices shall be inspected for damage, but they shall not require calibration.

14.2.6.1.3 Discharge and sensing orifices that can be visually observed without disassembling equipment, piping, or valves shall be visually inspected and shall be free of damage and obstructions that could affect the accuracy of the measurement.

14.2.6.1.4 Discharge orifices shall be listed or constructed to a recognized standard with a known discharge coefficient.
14.2.6.1.5 Requirements for personal protective equipment and procedures in accordance with NFPA 70E shall be followed when working near energized electrical or rotating equipment.
Test Equipment (continued)

- **14.2.6.1.5** Requirements for personal protective equipment and procedures in accordance with *NFPA 70E* shall be followed when working near energized electrical or rotating equipment.
Packaged Fire Pump Assemblies.

4.30.1 A packaged fire pump assembly, with or without an enclosure, shall meet all of the following requirements:

- ...

- (3) The assembly shall be listed for fire pump service.

- (4) The total assembly shall be engineered and designed by a system designer as referenced in 4.3.2.

- ...

...
Minimum Pump Suction Pressure from Tank

- **4.15.3.2** The requirements of 4.15.3.1 shall not apply where the supply is a suction tank with its base at or above the same elevation as the pump, and the gauge pressure at the pump suction flange shall be permitted to drop to -3 psi (-0.2 bar) with the lowest water level after the maximum system demand and duration have been supplied.
Automatic Shutdown After Automatic Start

10.5.4.2. Automatic shutdown shall not be permitted if starting and running causes are present.

10.5.4.2.1 Automatic shutdown shall be permitted only in the following circumstances:

1. During automatic testing in accordance with 10.5.2.7
2. Where approved by the authority having jurisdiction

10.5.4.2.2 Where automatic shutdown after automatic start is permitted, a minimum run timer set for at least 10 minutes shall be used.
Limited Service Controllers.

- **10.7**

  **10.7.1 Limitations.** Limited service controllers consisting of automatic controllers for across-the-line starting of squirrel-cage motors of 30 hp or less, 600 V or less, shall be permitted to be installed where such use is acceptable to the authority having jurisdiction.

- **10.7.2.3** The manually operated isolating switch specified in 10.4.2 shall not be required.
Automatic Fuel Maintenance Systems

- **11.6.4.4** An active fuel maintenance system listed for fire pump service shall be permitted to be installed for the maintenance of the fuel in the supply tank.

- **11.6.4.4.1** Where provided, the active fuel maintenance system shall be equipped with a visible indicator to indicate when the system is in need of maintenance.

- **11.6.4.4.2** Where provided, the active fuel maintenance system shall be equipped with a contact closure for signaling to the controller when the system is in need of maintenance.
11.6.4.4.3 Where provided, the active fuel maintenance systems shall be permanently connected to the fuel tank as follows:

1. All connections shall be made directly to the tank.

2. The supply from the tank to the active fuel maintenance system shall include a manual shutoff valve and a connection to the drain located between the bottom of the tank and the drain valve of the fuel storage tank.

3. The return from the active fuel maintenance system to the fuel storage tank shall be connected to the dedicated connection on the top of the tank with a drop tube down to the 50 percent level, and shall include a manual shutoff valve for servicing the system.
Emergency-Run Mechanical Control at Controller

10.5.3.2*. 10.5.3.2.1 The controller shall be equipped with an emergency-run handle or lever that operates to mechanically close the motor-circuit switching mechanism.

10.5.3.2.1.1 This handle or lever shall provide for nonautomatic continuous running operation of the motor(s), independent of any electric control circuits, magnets, or equivalent devices and independent of the pressure-activated control switch.
Automatic Testing

- **12.7.2.7.1** The controller equipment shall be arranged to automatically start, run, and shut down the engine at the minimum no-flow test frequency and duration required by NFPA 25.

- **12.7.2.7.2** Performance of this weekly program timer shall be recorded as a pressure drop indication on the pressure recorder. (See 12.4.4.)

- **12.7.2.7.3** A solenoid valve drain on the pressure control line shall be the initiating means.

- **12.7.2.7.4** The engine shall shut down automatically on high engine temperature, low oil pressure, or high cooling water temperature if no other starting or running cause exists.
Connectivity Scope

- **C.1.1** This annex covers considerations relating to the access of fire pump controllers, including access methods, security considerations, accessible information, potential use of accessible information, long-term improvement in reliability, and standardization that allows the full potential of connectivity to be met.
Connectivity – Access Levels

- **C.8 Recommended Requirements.**
- **C.8.1** Separate access protocols should be used for the following access levels:
  - (1) Read-only access to performance information — Level 1
  - (2) Access for statistical analysis by independent body — Level 2a
  - (3) Access for manufacturer analysis — fire pump — Level 2b
  - (4) Access for manufacturer analysis — controller — Level 2c
  - (5) Access for remote testing — Level 2d with alarm to be triggered if the pump is not restored to automatic mode within 8 hours
Connectivity – Remote Operation of Fire Pumps

- **C.7 Remote Control.** Remote starting and/or stopping is prohibited.
Table D.8.2.2 Recommended Equipment Data

<table>
<thead>
<tr>
<th>Data</th>
<th>Information Source</th>
<th>Supervision Monitoring</th>
<th>Performance Monitoring</th>
<th>Fire Pump Manufacturer</th>
<th>Controller Manufacturer</th>
<th>Independent 3rd party statistical analysis</th>
<th>Diesel Engine Manufacturer</th>
<th>Remote Operations</th>
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<td>A – Controller should access and record data automatically</td>
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<td>M – Requires Manual Input at time of installation or test</td>
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<td>M/A – Probably Requires Manual Input at time of installation or test but may be able to Record Automatically</td>
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## Connectivity – Continuously Monitored Data

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</tr>
<tr>
<td>Suction Pressure</td>
<td>A</td>
<td>X</td>
</tr>
</tbody>
</table>

...  

- **A** – Controller should access and record data automatically  
- **M** – Requires Manual Input at time of installation or test  
- **M/A** – Probably Requires Manual Input at time of installation or test but may be able to Record Automatically
## Connectivity – Test Performance Data

### Table D.8.2.4 Recommended Test Performance Data

<table>
<thead>
<tr>
<th>Time Stamped Data Multiple Data Sets&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Information Source&lt;sup&gt;*&lt;/sup&gt;</th>
<th>Supervision Monitoring</th>
<th>Performance Monitoring</th>
<th>Fire Pump Manufacturer</th>
<th>Controller Manufacturer</th>
<th>Independent 3&lt;sup&gt;rd&lt;/sup&gt; party statistical analysis</th>
<th>Diesel Engine Manufacturer</th>
<th>Remote Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Date</td>
<td>A</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Test Reference Identifier</td>
<td>A</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Data Set Reference Identifier</td>
<td>A</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Suction Pressure</td>
<td>A</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>System Pressure</td>
<td>A</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

<sup>*</sup>A – Controller should access and record data automatically  
<sup>*M – Requires Manual Input at time of installation or test</sup>  
<sup>*M/A – Probably Requires Manual Input at time of installation or test but may be able to Record Automatically</sup>  

1“A “Record Data Now Button” or input from a tablet or computer is needed to record each set and / or subset of performance data along with the Test and Data Set Identifier, recommend providing for a minimum of 5 data sets for constant speed pumps and 7 data sets for variable speed pumps
## Connectivity – Performance Data

### Table D.8.2.5 Recommended Performance Data

<table>
<thead>
<tr>
<th>Time Stamped Data</th>
<th>Data Accessible To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Data Sets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supervision</td>
</tr>
<tr>
<td>Flow through pump</td>
<td>M/A</td>
</tr>
<tr>
<td>RPM adjusted Net Pressure</td>
<td>A</td>
</tr>
<tr>
<td>RPM adjusted Flow</td>
<td>A</td>
</tr>
<tr>
<td>% of Factory Certified Curve</td>
<td>A</td>
</tr>
<tr>
<td>Hours on diesel engine or electric motor</td>
<td>A</td>
</tr>
<tr>
<td>Maximum System flow Demand (at pump discharge Flange)</td>
<td>M</td>
</tr>
<tr>
<td>Maximum System pressure Demand (at pump discharge Flange)</td>
<td>M</td>
</tr>
<tr>
<td>Pump passed initial test</td>
<td>M</td>
</tr>
<tr>
<td>Pump could supply maximum system demand</td>
<td>M</td>
</tr>
</tbody>
</table>

- **A** – Controller should access and record data automatically
- **M** – Requires Manual Input at time of installation or test
- **M/A** – Probably Requires Manual Input at time of installation or test but may be able to Record Automatically

1“A “Record Data Now Button” or input from a tablet or computer is needed to record each set and / or subset of performance data along with the Test and Data Set Identifier, recommend providing for a minimum of 5 data sets for constant speed pumps and 7 data sets for variable speed pumps
## Maintenance Data

<table>
<thead>
<tr>
<th><strong>Data</strong></th>
<th><strong>Information Source</strong></th>
<th><strong>Data Accessible To</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Supervision Monitoring</strong></td>
<td><strong>Performance Monitoring</strong></td>
</tr>
<tr>
<td>Date of Maintenance / Repair</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Maintenance / Repair Identifier</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Pump could supply maximum system demand before maintenance / repair</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Pump was significantly impaired</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Pump was partially impaired</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Failure Mode</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Explanation of Failure</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Part replaced (1)</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Part replaced (2)</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Part replaced (3)</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>Part replaced (4)</td>
<td>M</td>
<td>X</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **A** – Controller should access and record data automatically
- **M** – Requires Manual Input at time of installation or test
- **M/A** – Probably Requires Manual Input at time of installation or test but may be able to Record Automatically
- **1** For Failure Modes and Parts Replacement that involve the fire pump or motor
- **2** For Failure Modes and Parts Replacement that involve the fire pump controller
- **3** For Failure Modes and Parts Replacement that involve the Diesel Engine Driver

4A “Record Data Now Button” or input from a tablet or computer is needed to record each set and/or subset of performance data
## Connectivity – Failure Mode

<table>
<thead>
<tr>
<th>Table D.8.2.7</th>
<th>FAILURE MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water supply inadequate</td>
</tr>
<tr>
<td></td>
<td>Electric power supply failure</td>
</tr>
<tr>
<td></td>
<td>Pipe, fitting, and/or valve failure:</td>
</tr>
<tr>
<td></td>
<td>Controller failure:</td>
</tr>
<tr>
<td></td>
<td>Pump running condition failure:</td>
</tr>
<tr>
<td></td>
<td>Pump running operation failure:</td>
</tr>
<tr>
<td></td>
<td>Relief valve failure:</td>
</tr>
<tr>
<td></td>
<td>Diesel engine failure:</td>
</tr>
<tr>
<td></td>
<td>Diesel engine system failure:</td>
</tr>
<tr>
<td></td>
<td>Component Failure (Identify Component)</td>
</tr>
<tr>
<td></td>
<td>Other (provide comment)</td>
</tr>
</tbody>
</table>
## Connectivity – Components List

<table>
<thead>
<tr>
<th>Table D.8.2.8 Components List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impeller</td>
</tr>
<tr>
<td>Shaft</td>
</tr>
<tr>
<td>Bearings</td>
</tr>
<tr>
<td>Electric Motor</td>
</tr>
<tr>
<td>Diesel Engine</td>
</tr>
<tr>
<td>Batteries</td>
</tr>
<tr>
<td>Controller</td>
</tr>
<tr>
<td>Circuit Board</td>
</tr>
<tr>
<td>Relief valve</td>
</tr>
<tr>
<td>Check Valve</td>
</tr>
<tr>
<td>Control Valve</td>
</tr>
</tbody>
</table>
## Connectivity – ModBus Registers

<table>
<thead>
<tr>
<th>ModBus Register</th>
<th>Register Use</th>
<th>Analog or Digital</th>
<th>Format</th>
<th>Permanence / Static / Dynamic</th>
</tr>
</thead>
<tbody>
<tr>
<td>40001</td>
<td>AC Volts lines 1-2</td>
<td>A xxxxx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40002</td>
<td>AC Volts lines 2-3</td>
<td>A xxxxx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40003</td>
<td>AC Volts lines 3-1</td>
<td>A xxxxx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40004</td>
<td>AC Amps line 1</td>
<td>A xxxxx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40005</td>
<td>AC Amps line 2</td>
<td>A xxxxx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40006</td>
<td>AC Amps line 3</td>
<td>A xxxxx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40007</td>
<td>System Pressure (psi or bars)</td>
<td>A xxxx.x or xxx.xx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40008</td>
<td>Suction Pressure (psi or bars)</td>
<td>A xxxx.x or xxx.xx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40009</td>
<td>VFD Speed (HZ)</td>
<td>A XXXXX</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40010</td>
<td>Aux Input #1, 0-100%</td>
<td>A xxxxx</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>40011</td>
<td>Aux Input #2, 0-100%</td>
<td>A xxxxx</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

**MODBUS REGISTER DESCRIPTION ALARM ON STATE**

<table>
<thead>
<tr>
<th>ModBus Register</th>
<th>Description</th>
<th>Format</th>
<th>Permanence / Static / Dynamic</th>
</tr>
</thead>
<tbody>
<tr>
<td>40012</td>
<td>Alarm Register #1</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>40013</td>
<td>Minimum Run Delay Timing High</td>
<td>D bit-0</td>
<td>D</td>
</tr>
<tr>
<td>40014</td>
<td>Accelerate Delay Timing High</td>
<td>D bit-1</td>
<td>D</td>
</tr>
<tr>
<td>40015</td>
<td>High Zone Delay Timing High</td>
<td>D bit-2</td>
<td>D</td>
</tr>
<tr>
<td>40016</td>
<td>Sequence Delay Timing High</td>
<td>D bit-3</td>
<td>D</td>
</tr>
<tr>
<td>40017</td>
<td>Load Shed Active High</td>
<td>D bit-4</td>
<td>D</td>
</tr>
<tr>
<td>40018</td>
<td>Low Discharge Pressure Alarm High</td>
<td>D bit-5</td>
<td>D</td>
</tr>
<tr>
<td>40019</td>
<td>Low Suction Alarm High</td>
<td>D bit-6</td>
<td>D</td>
</tr>
<tr>
<td>40020</td>
<td>Low Suction Shutdown Active High</td>
<td>D bit-7</td>
<td>D</td>
</tr>
<tr>
<td>40021</td>
<td>System Over Pressure Alarm High</td>
<td>D bit-8</td>
<td>D</td>
</tr>
<tr>
<td>40022</td>
<td>Restart Delay Timing High</td>
<td>D bit-9</td>
<td>D</td>
</tr>
<tr>
<td>40023</td>
<td>Weekly Test Demand Active High</td>
<td>D bit-10</td>
<td>D</td>
</tr>
<tr>
<td>40024</td>
<td>Failure to Start Alarm High</td>
<td>D bit-11</td>
<td>D</td>
</tr>
<tr>
<td>40025</td>
<td>Lockout Active High</td>
<td>D bit-12</td>
<td>D</td>
</tr>
<tr>
<td>40026</td>
<td>VFD Ready High</td>
<td>D bit-13</td>
<td>D</td>
</tr>
<tr>
<td>40027</td>
<td>VFD Forward Command Active High</td>
<td>D bit-14</td>
<td>D</td>
</tr>
<tr>
<td>40028</td>
<td>VFD Reverse Command Active High</td>
<td>D bit-15</td>
<td>D</td>
</tr>
</tbody>
</table>

NA: Not applicable. P: Permanent. S: Static. D: Dynamic

*One decimal place assumed if psi and two decimal places assumed if bar.*
NFPA 2019 Proposals

- Move All or part of Connectivity Annex to Body of Standard
3.3.39 Power

3.3.39.1 Alternate Power. An power source that is available independently of the primary power supply.

3.3.39.2 On-Site Power Production Facility. An on-site The normal supply of electric power for the site that is expected to be constantly producing power.

3.3.40.39.3* On-Site Standby Generator. A facility producing electric power on site as the alternate supply of electrical power. It differs from an on-site power production facility, in that it is not constantly producing power. [70:695.2]

3.3.39.4 Standby Power: An alternate power source this is normally inactive but becomes active whenever the primary power is lost.
NFPA 2019 Proposals (continued) - Power

- **4.26.9** The pressure maintenance pump shall not be required to have alternate secondary or standby power.

- **5.5 Alternate Auxiliary Power.** Where electric motor-driven fire pump(s) are used, a reliable alternate emergency source of power in accordance with Section 9.6 or a back-up fire pump in accordance with Section 9.3 shall be provided for the fire pump installation.
4.3 Pump Operation.

4.3.1 Except as permitted in 4.3.2, in the event of fire pump operation, qualified personnel shall respond to the fire pump location to determine that the fire pump is operating in a satisfactory manner whenever the fire pump is operating.

4.3.2 Where remote monitoring that meets NFPA 72 and all of the following requirements, qualified personnel shall be permitted to monitor the no-flow test remotely.

   1) Visual observation adequate to verify the appropriate water discharge thought the packing.
Remote Supervision of Non-Flow Fire Pump Test

- 2) Visual observation of both sides of the pump adequate to identify smoke emitted from the pump, pump driver or controller.
- 3) Smoke detection
- 4) Suction pressure
- 5) Discharge pressure
- 6) Unusual noise
- 7) Diesel engine temperature and oil pressure
- 8) Room temperature
- 9) Pump Speed
- 10) Pump or motor vibration
- 11) Flow through the circulation relief valve
Remote Supervision of Non-Flow Fire Pump Test

- 12) Discharge through the main pressure relief valve (when provided)
- 13) Temperature of pump impeller casing
- 14) Temperature of pump packing
- 15) Visual and audible alarm for abnormal
  - a) Suction pressure
  - b) Discharge pressure
  - c) Diesel engine temperature
  - d) Room temperature
  - e) Pump Speed (in excess of \( \pm 5\% \) of rated speed)
  - f) Pump or motor vibration
  - g) Flow through the circulation relief valve
- h) Discharge through the main pressure relief valve (when provided)
Remote Supervision of Non-Flow Fire Pump Test

- h) Discharge through the main pressure relief valve (when provided)
- i) Temperature of pump impeller casing
- j) Temperature of pump packing

16) Qualified shall respond to the pump house on an abnormal alarm within 5 minutes

17) The value of each point monitored shall be recorded a minimum frequency of every 2 minutes for a 10 minute test and every 5 minutes for a 30 minute test.
Questions