



# NFPA 1911 Pump Testing

May 31<sup>st</sup>, 2023

# UL's Colorado Staff

Chris Baker – Lead Field Engineer (September 2008)

- Northglenn, CO
- 303-815-2043
- christopher.baker@ul.com

Jeff Weldon – Field Engineer (August 2018)

- Elizabeth, CO
- 720-569-8179
- jeff.weldon@ul.com

# Agenda

1. Classroom Presentation
2. Hands On Presentation



# NFPA 1911 Pump Testing

Standard For The Inspection,  
Maintenance, Testing, and Retirement  
Of In-Service Emergency Vehicles  
(Chapter 21)

2017 Edition

# SAFETY MOMENT

UL **IS** Supposed To Be A Safety Company

- Hearing Protection
- Foot Protection
- Eye Protection
- Heat/Cold Protection
- Water/Electricity



# Why Pump Test?

**SIMPLE!**

**To ensure the pump can do  
what it says it can do.**

# Which Pumps To Test?

- “Regular” pumps
- Wildland pumps
- Ultra-High-Pressure (UHP) pumps
- Industrial pumps

# When to Test & Methods of Testing

Per Section 21.2, pumps should be tested:

1. Annually
2. After repairs
  - Removal of pump transmission
  - Removal of pump
  - Removal of chassis transmission, pump PTO or pump hydraulic drive
  - Engine overhaul or removal
  - Engine injector or injection pump replacement/repair
  - Engine or transmission ECM replacement/reprogramming
  - Engine turbo charger replacement
  - Radiator removal

Per Section 21.3, the test methods are:

1. Draft
2. Hydrant



# Environmental Conditions

1. Air Temperature  
0°F - 110°F
2. Water Temperature  
35°F - 90°F
3. Barometric Pressure  
29 in Hg minimum

# Suction Hose, Discharge Hose & Flow Measuring Equipment

## Suction Hose

When testing from draft at elevations up to 2,000 ft, the suction hose shall be as specified in NFPA 1901 or NFPA 1906.

## Discharge Hose

Shall allow discharge of the rated capacity of the pump to the nozzles or other flow measuring equipment.

Shall meet requirements of NFPA 1961 & NFPA 1962.

3 inch hose = 500 GPM

## Flow Measuring Equipment

Pitot tips or flowmeters

Shall be able to measure flow within +/- 5%

Pitot tips shall be smoothbore

# Suction Hose (Continued)

The following is the typical size/number of suction hoses needed (up to 2,000 feet in elevation):

Pump Capacity (GPM)	Intakes
Less than 500	One suction up to 4 inch
750	One suction up to 4.5 inch
1,000 to 1,250	One suction up to 6 inch
1,500 to 2,000	Up to two 6 inch
2,250 to 2,500	Up to three 6 inch

When more than one suction hose is used, they do NOT have to be the same size.

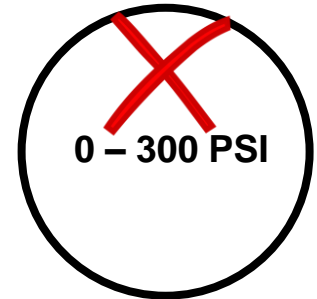
Example: 1500 GPM with (1) 6 inch & (1) 2.5 inch

At elevations over 2,000 feet, you can do pretty much whatever is needed to achieve desired capacity.

# Pressure Measuring Equipment (Section 21.5.4)

1. All gauges shall meet requirements for Grade A as specified in ASME (American Society of Mechanical Engineers) B40.100.
2. Pump intake (vacuum) gauges shall be at least 3.5" and shall have a range of 0 to 30 in Hg.
3. Pitot gauges shall be at least 2.5" and have a range of at least 0 to 160 PSI.
4. Which discharge pressure gauge is correct?

Discharge gauges shall be at least 3.5" and have a range of 0 to **400 PSI**.



# Test Gauge Calibration & Engine Speed Measuring Equipment

## Gauge Calibration

All test gauges shall be calibrated **annually**.

\*Previous edition of 1911 required that gauges be tested with 60 days of test.

## Speed Measuring

Shall consist of a nonadjustable tachometer from the engine or transmission electronics, a revolution counter on a checking shaft outlet and a stopwatch or other measuring equipment that is accurate to within +/- 50 RPM of actual speed.

# Engine Driven Accessories

If the chassis engine drives the pump, the total continuous electrical loads (excluding: Aerial pump, Foam pump, Hydraulic equipment, Winch, Windshield wipers, Hazard flashers & CAFS compressor) shall be applied for the entire pumping portion of the test.

Basically, all 12-volt systems must be on.

All emergency lights, headlights, air conditioner, compartment lights, etc.

IF the apparatus was built to the 1996 or newer of NFPA 1901 and has a generator that is driven by the same engine that drives the pump, that generator **shall** be ran at a minimum of 50% of its rated capacity throughout the pumping portion of the test.

Example: A 6 Kw generator must be loaded down to at least 3 Kw.

We (UL) accomplish this by using a resistive load bank, but you can use any method as long as the 50% load is achieved.

# Resistive Load Bank



# Resistive Load Bank

**The L-63 LOAD BANK** is designed to provide a temporary load for field servicing and testing 120/240 volt single or 120/208 three phase, 60HZ generators and inverters. The L-63 load bank is air cooled and completely self contained. The load is 30KW at 208VAC three phase and 20KW at 240VAC single phase.

## MODEL L-63 DIMENSIONS

Length.....22"  
Width.....8"  
Height.....11"  
Weight.....35 lbs.





# Tests To Be Conducted

1. Vacuum Test (Both of them)
2. Interlocks
3. Engine Speed
4. Pump Shift Indicator
5. Tank To Pump Test
6. Priming Test
7. Performance Tests
8. Pressure Governor/Discharge Relief Valve Tests
9. Gauge Accuracy Tests
10. Flowmeter Test
11. Intake Relief Valve Test

# Vacuum Tests

The nominal amount of vacuum required is 22 in Hg but for every 1,000 feet above 2,000 feet in elevation, the minimum vacuum required is allowed to be dropped by 1 in Hg.

Example: 5,080 feet of elevation requires a minimum of 18.9 in Hg.

Test #1:

All discharges uncapped and valves closed, all gated intakes uncapped/unplugged and valves closed.

Test #2:

All discharges uncapped and valves closed, all gated intakes capped/plugged and valves open.

Once required vacuum has been achieved, it cannot drop more than 10 in Hg in 5 minutes.

# Interlock, Engine Speed & Pump Shift Indicator Tests

## Interlocks

If the apparatus has electronic pump throttle controls, a test must be done to ensure the engine speed cannot be advanced while in various configurations. Sections 21.7.4.1, 21.7.4.2 & 21.7.4.3 list all the different configurations.

## Engine Speed

Also known as the “no-load governed speed test”. Hold throttle down all the way and the RPM’s shall be within +/- 50 RPM of what is stated on the pump performance placard. If there isn’t a stated engine speed, still do the test but the pass/fail needs to be “N/A”.

## Pump Shift Indicator

The pump shift indicators in the cab and at the pump panel shall indicate correct pump status when the pump is engaged.

# Tank To Pump & Priming Tests

If the apparatus has an on-board water tank, a test shall be conducted to verify the tank to pump flow rate.

Water tanks equal to 499 gallons or less = 250 GPM minimum

Water tanks equal to 500 gallons or more = 500 GPM minimum

Priming Test = How long it takes to get water into the pump.

Pumps rated 1,250 GPM or less = 30 seconds max

Pumps rated 1,500 GPM or more = 45 seconds max

An additional 15 seconds shall be permitted to prime the pump if the pump includes an auxiliary intake that is 4 inches or larger.

# Net Pump Pressure (NPP)

## From Draft

1/2 vacuum reading added to discharge pressure = Net Pump Pressure

Example: 145 psi discharge pressure & 10 in Hg vacuum = 150 psi (npp)

## From Positive Pressure (Hydrant)

Intake pressure + discharge pressure = Net Pump Pressure

Example: You want the NPP to be 200 psi and you have 30 psi intake pressure. You would set the discharge pressure at 230 psi.

# Performance Tests

## “Regular” Pumps

100% capacity @ 150 psi  
(npp) for 20 minutes

100% capacity @ 165 psi  
(npp) for 5 minutes

Only on pumps 750 - 2,999  
gpm

70% capacity @ 200 psi (npp)  
for 10 minutes

50% capacity @ 250 psi (npp)  
for 10 minutes

## Wildland & UHP Pumps

30 minutes at rated capacity &  
NPP

Readings taken every 15  
minutes.

## Industrial Pumps

3,000 gpm or larger

100% capacity @ 100 psi  
(npp) for 20 minutes

70% capacity @ 150 psi (npp)  
for 10 minutes

50% capacity @ 200 psi (npp)  
for 10 minutes

NO Overload Test

# Two Stage Pumps

100%, Overload & 70% in parallel/volume

50% in series/pressure

# Pressure Governor/Discharge Relief Valve Tests

## “Regular” Pumps

1. Establish 100% flow @ 150 psi (npp)
2. Set relief to 150 psi
3. Close discharges
4. Pressure rise shall not exceed 30 psi

Also test @ 90 psi & 250 psi

## Wildland Pumps

1. Establish rated flow/pressure
2. Set relief to rated pressure +/- 5%
3. Close discharges
4. Pressure rise shall not exceed 60 psi

## UHP Pumps

1. Establish rated flow/pressure
2. Set relief valve to rated pressure
3. Close discharges
4. Pressure rise shall not exceed 40% of rated pump pressure
5. Pump operated with discharges closed for 3 minutes, pump temperature shall not exceed 140°F

## Industrial Pumps

1. Establish 100% flow at 100 psi (npp)
2. Set relief to 100 psi
3. Close discharges
4. Pressure rise shall not exceed 30 psi

Also test @ 90 psi & 200 psi



# Gauge Accuracy & Flowmeter Tests

## Gauge Accuracy Test

Each discharge gauge shall be tested at 150, 200 & 250 psi

Any gauge off by more than +/- 10 psi shall be recalibrated, repaired or replaced

## Flowmeter Test

Each flowmeter shall be test for accuracy at a flow determined by the discharge size

Any flowmeter off by more than +/- 10% shall be recalibrated, repaired or replaced

Discharge Size (Inch)	Flow (GPM)
1.5	128
2	180
2.5	300
3	700
4	1,000

# Test Results

The pumping system (engine, pump, transmission) shall not overheat, lose power or exhibit other defects during the entire test.

The flow rate, discharge pressure, intake pressure & engine speed recordings for each test shall be averaged.

## Section 21.8.4

If the engine speed required to meet any of the test points during the pumping tests exceeds 110% of the engine speed shown on the pump performance placard, the pump shall be repaired or replaced.

Example: Placard shows 100% capacity @ 1,500 RPM.

Max RPM's allowed to achieve 100% is 1,650 RPM.

# Test Results (Continued)

## Section 21.7.7.5:

If the flow rate or pressure readings vary by more than 5% during a particular test, the reason for the fluctuation shall be determined, the cause corrected, and the test continued or repeated.

We (UL) interpret this to say the pressure/flow can have a +/- 5% tolerance and still be acceptable.

Example: 1,000 GPM @ 150 PSI @ 1,500 RPM

You can lower the GPM by no more than 5%, lower the pressure by no more than 5% & raise the RPM's by more more than 110%.

950 GPM @ 142.5 PSI (NPP) @ 1,650 RPM



# Test Results (Continued)

Pump Performance Placard:					
100%	1,260	GPM @	150 PSI @	1,520	RPM
Overload	Unknown	GPM @	165 PSI @	Unknown	RPM
70%	889	GPM @	200 PSI @	1,680	RPM
50%	630	GPM @	250 PSI @	1,820	RPM

## As Tested Performance:

Test Condition	Pump Control Position	Flow (GPM)	Discharge Pressure (PSI)	Vacuum (inHg.)	Net Pump Pressure (PSI)	Counter Speed (RPM)	Engine Speed (RPM)	Pump Speed (RPM)	Test Results
100% Capacity For 20 Minutes	Single Stage	1,197	130	13.0	137	1,187	1,650		Test Failed
Overload For 5 Minutes	Single Stage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Conducted
70% Capacity For 10 Minutes	Single Stage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Conducted
50% Capacity For 10 Minutes	Single Stage	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Conducted

NFPA 1911, Chapter 21 allows the following to achieve any given test setting: Increase the RPM's by no more than 110% of what is shown on the pump specification label, lowering the flow by no more than 5% of the desired flow and lowering the NPP (Net Pump Pressure) by no more than 5% of the desired pressure. With all 3 of those taken into consideration, the modified setting for achieving the 100% capacity test on this truck is: 1,197 GPM @ 142 NPP @ 1,672 RPM. The pump could not achieve these new, modified test settings. Testing stopped.

# How Long To Test?

To do all required tests & to do them properly, it takes approximately 2 hours per test.  
That's 3 to 4 pumps a day (5 **IF** everything runs smoothly).

# Discussion





# Thank you

[UL.com/Solutions](https://UL.com/Solutions)