

CETA PERFORMANCE STANDARD ***CPC100***



The Pressure Washer
Industry Standard

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PURPOSE: CETA’s objective in publishing this standard is to provide a uniform method for testing and rating pressure washers. The movement toward performance standards has become a world-wide effort. The use of such standards offers significant advantages. A performance-based standard focuses on desired characteristics of the final product, service or activity, rather than the processes to produce it. (Note: Performance-based standards are also known as *objective-based* standards).

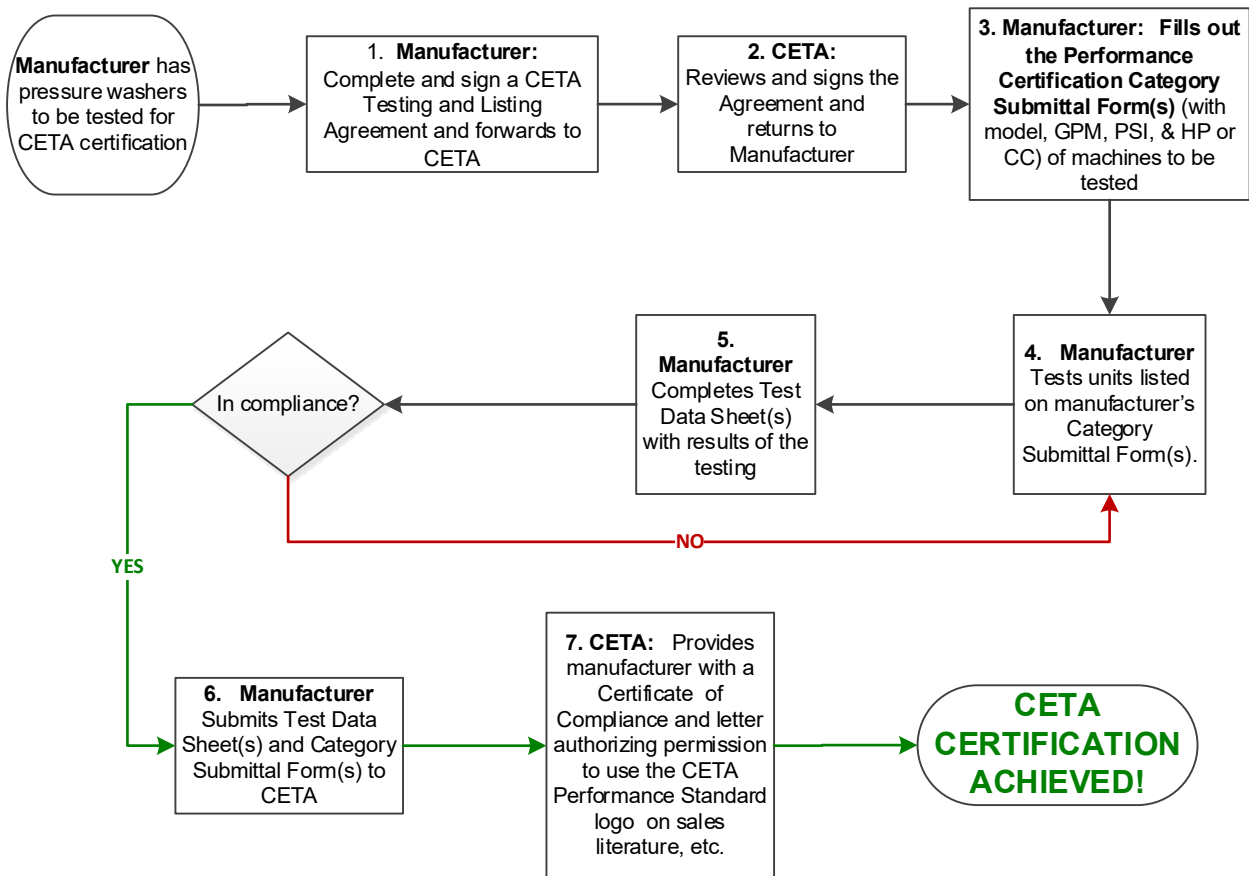
The goal is to have a standard to evaluate pressure washer specifications used in advertising. CETA certification will not only improve the image of our members, but will provide leverage in an industry with increasing competitive pressure.

SCOPE: These guidelines cover portable, stationary and fixed pressure washers, in which the discharge line is hand supported and manipulated and built for household/retail or commercial/industrial application as defined in UL 1776, Section 1.1, 1995 (or latest edition).

NOTE: *This standard does not pertain to propane powered engines!*



**PERFORMANCE STANDARD
PROCESS FLOW**



1.0 DEFINITIONS

- 1.1. **Bypass mode:** Condition under which trigger gun is closed and the machine is recirculating water internally.
- 1.2. **Chemical Injector:** Device used to introduce chemicals into the water stream.
- 1.3. **Engine:** An internal combustion device that converts chemical energy from a fuel into mechanical energy.
- 1.4. **Engine working speed:** Engine speed under pump load (flow mode) defined by pressure washer manufacturer in which the equipment is to operate on a regular basis. This speed must not exceed engine manufacturer limits. The recommendable working speed range is usually between 3150 and 3450 RPM.
- 1.5. **Flow mode:** Condition under which trigger gun is open spraying water through high pressure nozzle.
- 1.6. **GPM:** Gallons per minute.
- 1.7. **M.W.F., (Maximum working flow):** Actual pressurized fluid flow through machine while pressure washer is operated at engine/motor working speed and using the high pressure nozzle, wand, gun and hose as intended by the manufacturer. [could be calculated into gallons per minute (GPM)].
- 1.8. **M.W.P., (Maximum Working Pressure):** Pressure generated at the pump cylinder head, upstream of any regulating or chemical injection device(s), while the unit is operated at M.W.F. condition.
- 1.9. **Motor:** Electric device that converts electric energy into mechanical energy.
- 1.10. **Motor working speed:** Motor design speed, (RPM's on motor plate).
- 1.11. **Nozzle:** A device with an orifice of known size, typically located at the end of the gun/wand assembly that generates flow restriction and builds up pressure in the system.
- 1.12. **Pressure Washer:** A powered device designed and intended to clean with pressurized water.
- 1.13. **PSIG:** Pounds per square inch gauge.
- 1.14. **RPM:** Revolutions per minute.
- 1.15. **Trapped pressure:** pressure generated between the unloader discharge and the gun trigger valve while pressure washer is in bypass mode. This concept is applicable to pressure washers equipped with unloader valves working under trapped pressure principle only.
- 1.16. **Unloader valve:** A device responsible for initiating the bypass mode when the trigger is not depressed, preventing buildup of pressure.
- 1.17. **WOT:** Wide Open Throttle

2.0 CALIBRATION OF EQUIPMENT

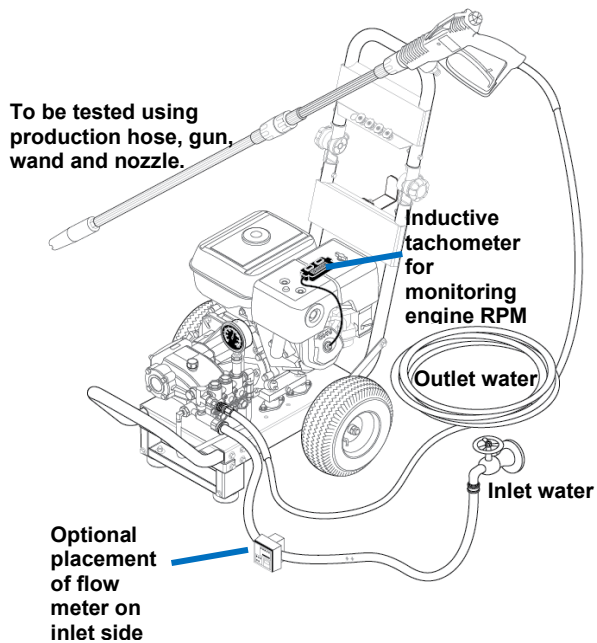
2.1. Calibration

- Measuring devices should be calibrated according to the device—manufacturer's specification and calibration standards shall be traceable to National Institute of Standards and Technology (NIST).
- The date of calibration shall be clearly marked on each measuring device.
- Measuring devices shall have been calibrated not more than 12 months prior to test date.

3.0 TEST PREPARATION

3.1. Prepare units for test.

Figure 1:



3.2. Units shall be tested with production hose, gun, wand, nozzle and all accessories as intended for sale.

- Cold or hot pressure washers will be tested in the *cold water mode*.
- Inlet water temperature at 50°- 80°F.
- Inlet water pressure not to exceed 80 psi.
- The test shall be conducted at an ambient temperature of 77° ± 10°F.
- Nozzle orifice size must be recorded in the test results.

4.0 CALCULATION SECTION

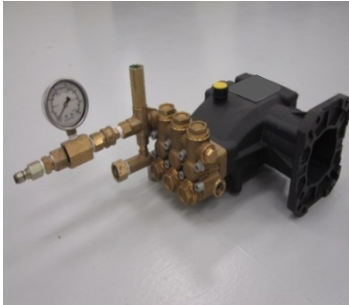
4.1. **The maximum working pressure (MWP)** has to be measured at the pump cylinder head, upstream of any regulator or chemical injection device. It is recommended that a pressure gauge or an electronic transducer is installed on one of discharge check valves caps on top of the pump head. A special fitting may be required for this. (See Image 1 for reference)

Image 1:



- While in continuous operation of the pressure washer, record six pressure values from gauge, one every five minutes, the maximum working pressure will be the average of these values. For advertising purposes, the maximum pressure a machine can be rated is 10% more than the calculated average.

Image 2:



- Locating the pressure gauge in the unloader valve discharge as shown in image 2, (or at any point between the unloader valve and the gun). Test at factory settings or maximum setting that can be attained.
- *NOTE: If a chemical injector is built inside the head of the pump, and the pressure gauge is mounted at the discharge port of the manifold, the injector will restrict water flow and pressure to approx. 5% of measured pressure, which can be added to the calculated average.*

4.2. **The maximum working flow (MWF)** will be determined by the average of six values taken one at a time, every five minutes, while in continuous operation of the machine at working engine or motor speed. Measurements shall be taken using a calibrated flow meter installed on the suction line as shown in Figure 1. For advertising purposes, the maximum flow a machine can be rated is 10% more than the calculated average.

Another method to determine MWF:

Using a stop watch, operate machine with selected high pressure nozzle and fill a container for a minimum of one minute. Place container on calibrated scale and weigh it with the water, then weigh it without the water.

Use the following formula to convert mass flow to volume if using the scale and stop watch method to measure mass flow:

$$MWF = \frac{(W_{wo} - W_o) \times 0.1198}{\text{Test Time in Minutes}}$$

W_o = Weight of container in pounds (lb)

W_{wo} = Total weight including container in pounds (lb)

Maximum working flow could also be calculated based on the maximum working pressure (4.3.) and nozzle specified by manufacturer, using the following formula:

$$MWF = (Nozzle\ Size) \sqrt{\frac{MWP}{4000}}$$

Where:

- MWP is expressed in PSI
- MWF will result in GPM
- Nozzle Size is expressed in a 1-10 size scale (e.g. 3.5 nozzle size orifice)

Electrically driven machine test criteria:

- Power supply voltage to be within ± 10% of motor name plate rated voltage.
- Motor amperage during the test shall not exceed the motor name plate rating, including service factor.

Engine driven machine test criteria:

- The engine used for the test purpose shall be representative of the engine supplied for sale with all mufflers, deflectors, guards, filters, etc., installed.
- The engine speed shall be adjusted to the working speed determined by pressure washer manufacturer.

5.0 ENGINE LOAD TESTING

5.1. **Estimating the engine load:** The engine working speed is measured while recording the maximum working flow and pressure.

5.2. While spraying, manually force the throttle lever on the carburetor (overriding the governor) and record the speed. *Note - do not exceed the safe operating speed of the product or 4000 rpm, whichever is lower!*

A minimum speed increase of 175 rpm indicates acceptable engine loading. *Note: Pressure washer engine loading can be approximated through the affinity laws. The applicable principle states there is a power relationship between various speeds. This can be stated as a **percent load**.*

$$\text{Percent load} = [(\text{Loaded speed})/(\text{Wide open throttle speed})]^3 * 100$$

Acceptable loading on the engine is defined as using no more than 85% of maximum available engine power. By solving for the difference in "loaded" and "wide open throttle" speeds, using a typical loaded speed of 3200 rpm and 85% load, about 175 rpm difference is determined.

$$\begin{aligned} \text{Percent load} &= [(\text{Loaded speed})/(\text{Wide open throttle speed})]^3 * 100 \\ 85 &= [(3200)/(\text{Wide open throttle speed})]^3 * 100 \\ \text{WOT speed} &= 3378 \text{ rpm} \end{aligned}$$

Please note that the other pressure washer parameters also follow the affinity laws:

$$\text{Volume}_2 = \text{Volume}_1 \times \text{RPM}_2/\text{RPM}_1$$

$$\text{Pressure}_2 = \text{Pressure}_1 \times (\text{RPM}_2/\text{RPM}_1)^2$$

Note: Power output is substantially influenced by atmospheric conditions including barometric pressure, ambient temperature, and relative humidity. In addition, altitude reduces power at a rate of 3.5% for every 1000 feet above sea level.

6.0 CERTIFICATION

Compliance to this standard is determined by load limits as rated on electric motor name plate rating. Engine size is determined by (section 5.0 above) engine load test. If product tested has electric motor and engine capacity to drive the rated pressure and flow as rated by the manufacturer, compliance is achieved.

- *Perform testing on some of the pressure washers ready for certification to determine their specifications.*
- *Prepare a specifications list of the models to be tested.*
 - *Testing will be based on a machine's descriptive classification:*
 - *Cold Water Gasoline/Diesel Powered;*
 - *Cold Water Electric Powered*
 - *Hot Water Electric Powered, Diesel/Oil Heated*
 - *Hot Water Electric Powered, NG or LP Heated*
 - *Hot Water Electric Powered, Electric Heated*
 - *Hot Water Gasoline/Diesel Powered, Diesel/Oil Heated*
- *Perform a representative test on your equipment to determine compliance to the Performance Standard.*
- **FLOW and PRESSURE** are measured to determine engine and/or motor performance being certified. Heat output, electrical ratings, and other items on a typical rating plate are not included in the performance certification.
- When the test results are completed, forward the affirmative report to CETA, who will provide an official letter of compliance and information pertaining to the use of the CETA Performance Standard logo.*

***NOTE: The CETA Performance logo is protected as a trademark of the CETA Performance Standard CPC100. Any use or publication of the CETA logo without express written consent from the Cleaning Equipment Trade Association (CETA) is a violation of 15 U.S.C. §1114!**

7.0 DOCUMENTATION

Retain the following records as confirmation of performance testing:

- 8.1. Manufacturer's copy of CETA Testing and Listing Agreement
- 8.2. Proof of calibration of measuring devices. (see page 3)
- 8.3. Completed Performance Certification Category Submittal forms;
- 8.4. Test Data Sheet(s), notes, calculations and photographs taken during the testing process.
- 8.5. Official letter and Certificate of Compliance awarded by the CETA administration.

NOTE: Manufacturers should maintain Technical Construction Files for each current certified model.

8.0 REFERENCES

This formula is for reference only and will not be used for testing certification. It can be used by manufacturers to calculate engine or motor size.

Hp – Calculated horsepower required to generate rated flow and rated pressure combined.
MWF– Rated flow in gallons per minute
MWP – Rated pressure in PSI.
LF – Loss Factor as a decimal. (see figures below)



E_{pump}
 Pump efficiency expressed as a decimal, use default value of **0.87**
(-or- the pump manufacturer's stated efficiency may be used if substantiated by data.)



E_{trans}
 Transmission device efficiency expressed as a decimal.

Direct drive – 1.0
Gearbelt/toothbelt – 0.98
V belt – 0.97
Gear box w/helical gears – 0.96




LOSS FACTOR (LF):
 Diesel engines – **0.9**
 Electric motors – **1.0**
 Gas engines – **0.82**

FORMULA:

Hp = [(MWF)(MWP)] / [1714 (E_{pump})(E_{trans})(LF)]

APPENDIX A
Test Data Sheet
 Electronic copies are available

			Test Data Sheet CPC100, CETA Pressure Washer Performance Standard					
Test Machine:			Ratings:					
Brand:			Pressure:	psi	Inlet Temp.:	°F		
Model:			Flow Rate:	gpm	Inlet Press.:	psi (est)		
PN:			Nozzle Size:		Amb. Temp.:	°F		
PN-SN:			Nozzle Angle:	°	Drive HP:	hp		
Results Summary:			Press. Location					
Average			% Deviation		Requirement			
Pressure:	#DIV/0!	psi	#DIV/0!	%	±10	%		
Flow Rate:	#DIV/0!	gpm	#DIV/0!	%	±10	%		
			Difference					
Spike Pressure:	#DIV/0!	psi	#DIV/0!	psi	psi	P1 - Manifold		
						P2 - Unloader		
						P3 - Chem Inj.		
Engine Loading:	#DIV/0!	% of Load			85% Max.	%		
						P4 - Gun		
HP - Calculated:	#DIV/0!	hp	(reference only - adjust for drive configuration)					
						Calculated Field		
Test Data: (6 measurements at 5 min. intervals)			Flow Rate			8.3472	lb/gal	
No.	Time (hhmm)	Pressure (psi)	Spike (psi)	by gauge (gpm)	by psi (gpm)	by wt. (gpm)	Wt of Water (lbs)	Test Time (sec)
Start PW								
1					0.00	#DIV/0!		
2					0.00	#DIV/0!		
3					0.00	#DIV/0!		
4					0.00	#DIV/0!		
5					0.00	#DIV/0!		
6					0.00	#DIV/0!		
Averages		#DIV/0!	#DIV/0!		0.00	#DIV/0!	#DIV/0!	
Measuring Device:				Nozzle				
SN:				Calibr ?				
Last Calibration Date:				no				
(w/i last 12 mo.)								
Gas Engine Tests Only								
Loaded		Wide Open Throttle						
Pump RPM:		rpm		rpm				
(use the low er of max safe operating rpm or 4000)								
Reference for HP Calculations:								
Pump Efficiency:		Transmission Efficiency		Loss Factor				
Default:	0.87	Direct Drive:	1.00	Electric Motor:	1.00			
		Gear Belt Drive:	0.98	Diesel Engine:	0.90			
		V-belt Drive:	0.97	Gas Engine:	0.82			
		Gearbox:	0.96					
Notes:						Pass/Fail:		
						Test Date:		
						Test Cell:		
						Tested By:		



**Submit Applications to:
CETA PERFORMANCE CERTIFICATION**

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Cross Roads, TX 76227
(800) 441-0111**