

Ford 6.7L VTW Test

**Form 1**

**Version**

**Conducted For**

	V = Valid; The Reference Oil/Non-Reference Oil was evaluated in accordance with the test procedure.
	I = Invalid; The Reference Oil/Non-Reference Oil was not evaluated in accordance with the test procedure.
	N = Results Cannot be Interpreted As Representative of Oil Performance (Non-Reference Oil) and shall not be used in determining an average test result using multiple test criteria

	NR = Non-Reference Oil Test
	RO = Reference Oil Test

Test Number			
Stand:		Stand Run Number:	
Engine:		Engine Hours:	
End of Test Date:		End of Test Time:	
CPD Kit Number:			
Oil Code <sup>A</sup> :			
Formulation Stand Code <sup>B</sup> :			
Alternate Codes:			

In my opinion the test \_\_\_\_\_ been conducted in a valid manner in accordance with Test Method DXXX and the appropriate amendments through the information letter system. The remarks included in this report describe the anomalies associated with this test.

<sup>A</sup> Reference Testkey or Non-Reference Oil Code <sup>B</sup> ACC-Registered Tests Only

Submitted By:

\_\_\_\_\_

Testing Laboratory

\_\_\_\_\_

Signature

\_\_\_\_\_

Typed Name

\_\_\_\_\_

Title

**Form 2**  
**Table of Contents**

1.	Title / Validation Declaration Page	Form 1
2.	Table of Contents	Form 2
3.	Summary of Test Method	Form 3
4.	Test Results Summary	Form 4
5.	Operational Summary Controlled	Form 5
6.	Operational Summary Uncontrolled	Form 6
7.	Rocker Arm Wear	Form 7
8.	Rocker Arm Wear Summary	Form 7A
9.	Pushrod Wear	Form 8
10.	Pushrod Wear Summary	Form 8A
11.	Rocker Arm Fulcrum Ball Wear	Form 9
12.	Rocker Arm Fulcrum Ball Wear Summary	Form 9A
13.	Roller Follower Wear	Form 10
14.	Oil Analysis Summary	Form 11
15.	Oil Consumption Calculation	Form 12
16.	Downtime & Maintenance Summary	Form 13
17.	Test Comments	Form 14
18.	Test Fuel Analysis (Last Batch)	Form 15

## Ford 6.7L VTW Test

### Form 3 Summary of Test Method

This test method was developed to evaluate the performance of engine oils in controlling engine valvetrain wear in turbocharged and intercooled four-cycle diesel engines with roller-style cam followers, and a ball and socket style rocker arms and running on ultra-low sulfur diesel fuel. The test is 200 hours and is run at peak power to induce wear.

The engine is a MY 2019 Ford Power Stroke diesel engine with a displacement of 6.7L. It is an electronically controlled, turbocharged, charge air-cooled, eight-cylinder, direct-injection, compression ignition engine with an in-block camshaft, dual push tube per cam-follower, and a four valve per cylinder arrangement. The engine is re-used for multiple tests with new valvetrain parts installed prior to each test.

#### Schedule of Conditions for the Test Procedure

	Set Point for Wear Phase
Time, h	200
Engine Speed, r/min	2800
Fuel Flow Rate, kg/hr	70.5
Air Temperature at CAC Outlet, °C	50
Air Temperature in Engine Intake, °C	25
Engine Coolant-Outlet Temperature, °C	90.5
Fuel Temperature at Engine Inlet, °C	35
Oil Temperature in Engine Gallery, °C	109
Air Pressure in CAC Coolant System, kPag	>25
Air Pressure in Engine Coolant System, kPag	>120
Air Pressure in Engine Intake, kPaA	95
Exhaust Pressure in Tailpipe, kPaA	194
Air Pressure at CAC Outlet, kPag	>160
Engine Torque, Nm	Record
Air Dewpoint Temperature at Engine Inlet, °C	Record
Air Temperature at Turbo-Compressor Outlet, °C	Record
Air Temperature of Ambient Test Cell, °C	Record
CAC Coolant-Inlet Temperature, °C	Record
CAC Coolant-Outlet Temperature, °C	Record
Engine Coolant-Inlet Temperature, °C	Record
Exhaust Temperature in Left Exhaust Manifold, °C	Record
Exhaust Temperature in Right Exhaust Manifold, °C	Record
Exhaust Temperature in Tailpipe, °C	Record
Fuel Temperature at Engine Outlet, °C	Record
Oil Temperature in Oil Pan, °C	Record
Air Pressure at Dewpoint Measurement Location, kPaA	Record
Air Pressure at Turbo-Compressor Outlet, kPag	Record
Air Pressure in Engine Crankcase, kPag	Record
Barometric Pressure, kPaA	Record
Exhaust Pressure in Left Exhaust Manifold, kPag	Record
Exhaust Pressure in Right Exhaust Manifold, kPag	Record
Fuel Pressure at Engine Inlet, kPag	Record
Oil Pressure in Engine Gallery, kPag	Record
Oil Pressure Pre-Filter, kPag	Record
Oil Pressure Filter Delta, kPa	Record
Engine Coolant Flow Rate, L/min	Record
Air Moisture Content at Engine Inlet, g/kg	Record
Voltage from Engine Coolant Temperature Sensor, V	Record
Fuel Injection Timing, degBTDC	Record

Ford 6.7L VTW Test

**Form 4  
Test Results Summary**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Lab Oil Code	TMC Oil Code <sup>A</sup>
SAE Viscosity	Number of Tests Since Last Calibration <sup>C</sup>
Soot @ 100 hours:	Soot @ 200 hours:

Start Dates and Time	
Engine Start Date	Engine Start Time
Test Clock Start Date	Test Clock Start Time

	Rocker Arm Wear (mg)	Push Rod Wear (mg)	Roller Follower Wear (µm)
Original Result			
Transformed Result			
Correction Factor			
Corrected Transformed Result			
Severity Adjustment <sup>B</sup>			
Final Transformed Result			
Final Original Unit Result			

Last Stand Reference Results <sup>B</sup>			
Test Number:			
Oil Code:			
Test Length:		TMC Oil Code:	
EOT Date:		EOT Time:	
Stand Calibration Expiration Date:			
Soot @ 100 hours:		Soot @ 200 hours:	
	Rocker Arm Wear (mg)	Push Rod Wear (mg)	Roller Follower Wear (µm)
Final Original Unit Results			

A - Reference Tests Only

B - Non-Reference Tests Only

C - Operationally Valid Tests Only, including current test

Ford 6.7L VTW Test

**Form 5  
Controlled Quantities**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Controlled Quantities	Quantity	Units	QI Threshold	EOT QI <sup>4</sup>	Target	Avg	Std Dev	Max	Min	No of Samples	BQD
	Engine Speed	r/min	0.000		2800						
	Fuel Flow Rate	kg/h	0.000		70.5						
	Air Temperature at CAC Outlet	°C	0.000		50						
	Engine Coolant-Outlet Temperature	°C	0.000		90.5						
	Air Temperature in Engine Intake	°C	0.000		25						
	Fuel Temperature at Engine Inlet	°C	0.000		35						
	Oil Temperature in Engine Gallery	°C	0.000		109						
	Air Pressure in Engine Intake	kPaA	0.000		95						
	Exhaust Pressure in Tailpipe	kPaA	0.000		194						
	CAC Coolant System Pressure	kPag			>25						
	Engine Coolant System Pressure	kPag			>120						
Air Pressure at CAC Outlet	kPag			>160							

*A - QI values above the threshold are acceptable by the surveillance panel. QI values below the threshold may be considered acceptable based on engineer review.*

Operational Power Check Summary						
Quantity	Units	Target	Avg	Std Dev	Max	Min
Engine Speed	r/min	2800				
Torque	Nm	>1050				

Ford 6.7L VTW Test

**Form 6**  
**Uncontrolled Quantities**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Uncontrolled Quantities	Quantities	Units	Target	Avg	Std Dev	Max	Min
	Torque	Nm	tbd				
	Turbo-Compressor Outlet Temperature	°C	tbd				
	Test Cell Ambient Temperature	°C	tbd				
	CAC Coolant-Inlet Temperature	°C	tbd				
	CAC Coolant-Outlet Temperature	°C	tbd				
	Engine Coolant-Inlet Temperature	°C	tbd				
	Left Exhaust Manifold Exhaust Temperature	°C	tbd				
	Right Exhaust Manifold Exhaust Temperature	°C	tbd				
	Exhaust Tailpipe Temperature	°C	tbd				
	Engine Outlet Fuel Temperature	°C	tbd				
	Oil Sump Temperature	°C	tbd				
	Turbo-Compressor Outlet Pressure	kPag	tbd				
	Engine Crankcase Pressure	kPag	tbd				
	Barometric Pressure	kPaA	tbd				
	Left Exhaust Manifold Exhaust Pressure	kPag	tbd				
	Right Exhaust Manifold Exhaust Pressure	kPag	tbd				
	Engine Inlet Fuel Pressure	kPag	tbd				
	Oil Gallery Pressure	kPag	tbd				
	Oil Filter Inlet Pressure	kPag	tbd				
Oil Filter Delta Pressure	kPa	tbd					
Engine Coolant Flow Rate	l/min	tbd					
Engine Inlet Air Moisture Content	g/kg	tbd					
Voltage from Engine Coolant Temperature Sensor	V	tbd					
Fuel Injection Timing	degBTDC	tbd					

Ford 6.7L VTW Test

**Form 7**  
**Rocker Arm Wear**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Rocker Arm Wear				
Bank	Location	Pre-Test Mass, g	Post-Test Mass, g	Mass Loss, mg
Right	1I			
	2I			
	3E			
	4E			
	5I			
	6I			
	7E			
	8E			
	9I			
	10I			
	11E			
	12E			
	13I			
	14I			
	15E			
	16E			
Left	17I			
	18I			
	19E			
	20E			
	21I			
	22I			
	23E			
	24E			
	25I			
	26I			
	27E			
	28E			
	29I			
	30I			
	31E			
	32E			

Ford 6.7L VTW Test

**Form 7A**  
**Rocker Arm Wear Summary**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

<b>Intake Rocker Arm Mass Loss Summary, mg</b>	<b>Right</b>	<b>Left</b>	<b>Overall</b>
Average			
Minimum			
Maximum			
Standard Deviation			

<b>Exhaust Rocker Arm Mass Loss Summary, mg</b>	<b>Right</b>	<b>Left</b>	<b>Overall</b>
Average			
Minimum			
Maximum			
Standard Deviation			

<b>Overall Rocker Arm Mass Loss Summary, mg</b>	
Average	
Minimum	
Maximum	
Standard Deviation	

<b>Rocker Arm Batch</b>	
-------------------------	--



Ford 6.7L VTW Test

**Form 8  
Pushrod Wear**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Pushrod Wear				
Head	Location	Pre-Test Mass, g	Post-Test Mass, g	Mass Loss, mg
Right	1I			
	2I			
	3E			
	4E			
	5I			
	6I			
	7E			
	8E			
	9I			
	10I			
	11E			
	12E			
	13I			
	14I			
	15E			
	16E			
Left	17I			
	18I			
	19E			
	20E			
	21I			
	22I			
	23E			
	24E			
	25I			
	26I			
	27E			
	28E			
	29I			
	30I			
	31E			
	32E			

Ford 6.7L VTW Test  
**Form 8A**  
**Pushrod Wear Summary**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Intake Pushrod Mass Loss Summary, mg	Right	Left	Overall
Average			
Minimum			
Maximum			
Standard Deviation			

Exhaust Pushrod Mass Loss Summary, mg	Right	Left	Overall
Average			
Minimum			
Maximum			
Standard Deviation			

Overall Pushrod Mass Loss Summary, mg	
Average	
Minimum	
Maximum	
Standard Deviation	

Pushrod Batch	
---------------	--

Ford 6.7L VTW Test  
**Form 9**  
**Rocker Arm Fulcrum Ball Wear**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

<b>Fulcrum Ball Wear</b>				
<b>Head</b>	<b>Location</b>	<b>Pre-Test Mass, g</b>	<b>Post-Test Mass, g</b>	<b>Mass Loss, mg</b>
<b>Right</b>	<b>1I</b>			
	<b>2I</b>			
	<b>3E</b>			
	<b>4E</b>			
	<b>5I</b>			
	<b>6I</b>			
	<b>7E</b>			
	<b>8E</b>			
	<b>9I</b>			
	<b>10I</b>			
	<b>11E</b>			
	<b>12E</b>			
	<b>13I</b>			
	<b>14I</b>			
	<b>15E</b>			
	<b>16E</b>			
<b>Left</b>	<b>17I</b>			
	<b>18I</b>			
	<b>19E</b>			
	<b>20E</b>			
	<b>21I</b>			
	<b>22I</b>			
	<b>23E</b>			
	<b>24E</b>			
	<b>25I</b>			
	<b>26I</b>			
	<b>27E</b>			
	<b>28E</b>			
	<b>29I</b>			
	<b>30I</b>			
	<b>31E</b>			
	<b>32E</b>			

Ford 6.7L VTW Test

**Form 9A**

**Rocker Arm Fulcrum Ball Wear Summary**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

<b>Intake Fulcrum Ball Mass Loss Summary, mg</b>	<b>Right</b>	<b>Left</b>	<b>Overall</b>
Average			
Minimum			
Maximum			
Standard Deviation			

<b>Exhaust Fulcrum Ball Mass Loss Summary, mg</b>	<b>Right</b>	<b>Left</b>	<b>Overall</b>
Average			
Minimum			
Maximum			
Standard Deviation			

<b>Overall Fulcrum Ball Mass Loss Summary, mg</b>	
Average	
Minimum	
Maximum	
Standard Deviation	

Ford 6.7L VTW Test

**Form 10**  
**Roller Follower Wear**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Head	Location	Wear, $\mu\text{m}$
<b>Right</b>	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
<b>Left</b>	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	

<b>Roller Follower Wear Summary, <math>\mu\text{m}</math></b>	<b>Right</b>	<b>Left</b>	<b>Overall</b>
Average			
Minimum			
Maximum			
Standard Deviation			

Ford 6.7L VTW Test  
**Form 11**  
**Oil Analysis Summary**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Hours	Viscosity at 100°C, cSt	TGA, % Soot	TBN, mg KOH/g	TAN, mg KOH/g	IR Oxidation		Fuel Dilution, %	Metal Elements, mg/kg <sup>A</sup>							
					Peak Height, ABS/cm	Integrated Area, ABS/cm <sup>2</sup>		Al	Cr	Cu	Fe	Na	K	Si	Sn
0															
25															
50															
75															
100															
125															
150															
175															
200															

*A - The accepted SI units for concentration is mg/kg and it is a 1:1 conversion to ppm.*

	<b>175 Hrs</b>	<b>200 Hrs</b>
<b>MRV, cP</b>		
<b>MRV Yield Stress, Pa</b>		

Ford 6.7L VTW Test

**Form 12**

**Oil Consumption Calculation**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

<b>Hours</b>	<b>Average Oil Consumption, g/h</b>
0-25	
25-50	
50-75	
75-100	
100-125	
125-150	
150-175	
175-200	
Average	

Ford 6.7L VTW Test

**Form 13**  
**Downtime & Maintenance Summary**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		

Number of Downtime Occurrences			
Test Hours	Date	Downtime	Reasons
			<b>Total Downtime, hours</b>





Ford 6.7L VTW Test

**Form 15**

**Test Fuel Analysis (Last Batch)**

Laboratory:	EOT Date:	EOT Time:
Test Number:	Test Length:	
Oil Code:		
Formulation Stand Code:		
Fuel Supplier:	Fuel Batch ID:	

Measurement	Specs.	Analysis		Test Method
		New	EOT	
Total Sulfur <sup>A</sup> , ppm	7 - 15			D5453 or equivalent
Gravity <sup>A</sup> , °API	34 - 37			D4052

A - Measurements are stand samples.