

(f) Verify that all NDIR analyzers meet the water rejection ratio and the CO₂ rejection ratio as specified in §91.325.

(g) Verify that the dynamometer test stand and power output instrumentation meet the specifications in Table 2 in appendix A to this subpart.

§91.329 Catalyst thermal stress test.

(a) *Oven characteristics.* The oven used for thermally stressing the test catalyst must be capable of maintaining a temperature of 500 ±5 °C and 1000 ±10 °C.

(b) *Evaluation gas composition.* (1) A synthetic exhaust gas mixture is used for evaluating the effect of thermal stress on catalyst conversion efficiency.

(2) The synthetic exhaust gas mixture must have the following composition:

Constituent	Volume percent	Parts per million
Carbon Monoxide ¹	1	.....
Oxygen	1.3	.....
Carbon Dioxide	9	.....
Water Vapor	10	.....
Sulfur Dioxide	.....	20
Oxides of Nitrogen	.....	280
Hydrogen	.....	3500
Hydrocarbon ^{1,2}	.....	4000
Nitrogen=Balance	.....	.....

¹ Alternatively, the carbon monoxide and hydrocarbon proportions of the mixture may be changed to 1.2% and 4650 ppm, respectively (using on of these alternative concentrations requires that the other be used simultaneously).
² Propylene/propane ratio=2/1.

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APPENDIX A TO SUBPART D OF PART 91—TABLES

TABLE 1—SYMBOLS USED IN SUBPARTS D AND E

Symbol	Term	Unit
A _{YM}	Final weighted emission test results	g/kW-hr
C ₃ H ₈	Propane	
C _B	Concentration of emission in background sample	ppm
C _D	Concentration of emission in dilute sample	ppm
CO	Carbon monoxide	
CO ₂	Carbon dioxide	
conc	Concentration (ppm by volume)	ppm
D _X	Density of a specific emission (XX)	g/m ³
D _{XX}	Volume concentration of a specific emission (XX) on a dry basis.	percent
DF	Dilution factor of dilute exhaust.	
D1	Water vapor mixture concentration	percent
f	Engine specific parameter considering atmospheric conditions	
G _{AIRD}	Intake air mass flow rate on dry basis	kg/h
G _{FUEL}	Fuel mass flow rate	kg/h
GP	Analyzer standard operating pressure	Pa
G _s	Mass of carbon measured during a sampling period	g
H	Absolute humidity (water content related to dry air)	gr/kg
H ₂	Hydrogen	
i	Subscript denoting an individual mode	
IT	Indicated torque	N-m
K	Wet to dry conversion factor	
K _H	Humidity correction factor	
K _V	Calibration coefficient for critical flow venturi	
M _X	Molecular weight of a specific molecule(XX)	g/mole
mass	Pollutant mass flow	g/h
M _{FUEL}	Mass of fuel consumed during a sampling period	g
N	Pump revolutions during test period	revs
N ₂	Nitrogen	
NO	Nitric oxide	
NO ₂	Nitrogen dioxide	
NO _X	Oxides of nitrogen	
O ₂	Oxygen	
O ₂ I	Oxygen concentration of the burner air	percent
P	Absolute pressure	kPa
P _{AUX}	Declared total power absorbed by auxiliaries fitted for the test	kW
P _B	Total barometric pressure (average of the pre-test and post-test values).	kPa
P _{dew}	Test ambient saturation vapor pressure at the dew point	kPa
P _e	Absolute pump outlet pressure	kPa
P _{ED}	Pressure drop between the inlet and throat of metering venturi	kPa
P _i	P _i =P _{M,i} + P _{AUX,i}	

TABLE 1—SYMBOLS USED IN SUBPARTS D AND E—Continued

Symbol	Term	Unit
P _M	Maximum power measured at the test speed under test conditions.	kW
P _P	Absolute pump inlet pressure	kPa
P _{PI}	Inlet pressure depression of venturi or pump	kPa
P _{PO}	Pressure head at CVS pump outlet	kPa
P _S	Dry atmospheric pressure	kPa
P _V	Absolute venturi inlet pressure	kPa
P _{wb}	Saturated vapor pressure	Pa
Q _C	Volumetric flow rate of dilute exhaust through CVS at STP	m ³ /hr
Q _S	Gas flow rate	m ³ /min
R _{STP}	Ideal gas constant at STP	m ³ /mole
R ₂	Fuel carbon weight fraction	g/g
STP	Standard temperature and pressure	
t	Elapsed time for test period	sec.
T	Absolute temperature at air inlet	°C
T _a	Ambient temperature	°C
T _{EI}	Air temperature in to metering venturi or flowmeter	°C
T _K	Absolute temperature	K
T _P	Absolute pump inlet temperature	°C
T _{PI}	Air temperature at CVS pump inlet	°C
T _{PO}	Air temperature at CVS pump outlet	°C
T _V	Absolute venturi inlet temperature	°C
V _O	Pump flow	m ³ /rev
W	Average mass flow of emissions	g/hr
W _X	Mass rate of specific emission (XX)	g/hr
WXX	Volume concentration in exhaust of specific emission (XX) on wet basis.	ppm, ppmC, %
WF	Weighing factor	
Z1	Water concentration	percent
α	Fuel specific factor representing the hydrogen to carbon ratio.	

TABLE 2—MEASUREMENT ACCURACY CALIBRATION FREQUENCY

No.	Item	Permissible deviation from reading ¹		Calibration frequency
		non-idle	idle	
1	Engine speed	±2%	±2%	Monthly.
2	Torque	±5% .....	.....	Monthly.
3	Fuel consumption	±1%	±5%	Monthly.
4	Air consumption	±2%	±5%	As required.
5	Coolant temperature	±2 °C	Same	As required.
6	Lubricant temperature	±2 °C	Same	As required.
7	Exhaust back pressure	±5%	Same	As required.
8	Inlet depression	±5%	Same	As required.
9	Exhaust gas temperature	±15 °C	Same	As required.
10	Air inlet temperature (combustion air)	±2 °C	Same	As required.
11	Atmospheric pressure	±0.5%	Same	As required.
12	Humidity (combustion air) (relative)	±3.0%	Same	As required.
13	Fuel temperature	±2 °C	Same	As required.
14	Temperature with regard to dilution system.	±2 °C	Same	As required.
15	Dilution air humidity	±3% absolute	Same	As required.
16	HC analyzer	±2% ²	Same	Monthly.
17	CO analyzer	±2% ²	Same	Monthly.
18	NO _x analyzer	±2% ²	Same	Monthly.
19	NO _x converter check	90%	Same	Monthly.
20	CO ₂ analyzer	±2% ²	Same	Monthly.

¹ All accuracy requirements pertain to the final recorded value which is inclusive of the data acquisition system.

² If reading is under 100 ppm then the accuracy shall be ±2 ppm.

TABLE 3—TEST FUEL SPECIFICATIONS

Item	Property	Tolerance	Procedure (ASTM) ¹
Sulfur, ppm max	1000 .....	.....	D 2622
Benzene, max. percent	1.5 .....	.....	D 3606
RVP, psi	8.6	±0.6	D 323
Octane, R+M/2	89.9	±3.1	D 2699 D 2700

TABLE 3—TEST FUEL SPECIFICATIONS—Continued

Item	Property	Tolerance	Procedure (ASTM) ¹
IBP, °C	32.8	±11.0	D 86
10% point, °C	53.3	±5.5	D 86
50% point, °C	101.7	±8.3	D 86
90% point, °C	160.0	±11.1	D 86
End Point, max. °C	212.8	.....	D 86
Phosphorus, g/l, max	0.02	.....	D 3231
Lead, g/l, max	0.02	.....	.....
Manganese, g/l, max	0.004	.....	.....
Aromatics, max. percent	35	.....	D 1319
Olefins, max. percent	10	.....	D 1319
Saturates, percent	remain	.....	D 1319

¹ All ASTM Procedures in this table have been incorporated by reference. See §91.6.