purified nitrogen. For field testing, *zero gas* may include ambient air.

[70 FR 40516, July 13, 2005, as amended at 73 FR 37346, June 30, 2008; 73 FR 59342, Oct. 8, 2008; 74 FR 8428, Feb. 24, 2009; 74 FR 56518, Oct. 30, 2009; 75 FR 23058, Apr. 30, 2010; 76 FR 57467, Sept. 15, 2011]

### § 1065.1005 Symbols, abbreviations, acronyms, and units of measure.

The procedures in this part generally follow the International System of Units (SI), as detailed in NIST Special Publication 811, which we incorporate by reference in § 1065.1010. See § 1065.20 for specific provisions related to these conventions. This section summarizes the way we use symbols, units of measure, and other abbreviations.

(a) *Symbols for quantities.* This part uses the following symbols and units of measure for various quantities:

| Symbol | Quantity | Unit | Unit symbol | Units in terms of SI base units |
|---|---|---|---|---|
| $\alpha$ | atomic hydrogen to carbon ratio. | mole per mole | mol/mol | 1 |
| *A* | area | square meter | $m^2$ | $m^2$ |
| $A_0$ | intercept of least squares regression. | | | |
| $A_1$ | slope of least squares regression. | | | |
| $\beta$ | ratio of diameters | meter per meter | m/m | 1 |
| $\beta$ | atomic oxygen to carbon ratio | mole per mole | mol/mol | 1 |
| $C^\#$ | number of carbon atoms in a molecule. | | | |
| *d* | Diameter | meter | m | m |
| *DR* | dilution ratio | mole per mol | mol/mol | 1 |
| $\varepsilon$ | error between a quantity and its reference. | | | |
| *e* | brake-specific emission or fuel consumption. | gram per kilowatt hour | g/(kW·hr) | $g \cdot 3.6^{-1} \cdot 10^6 \cdot m^{-2} \cdot kg \cdot s^2$ |
| *F* | F-test statistic | | | |
| *f* | frequency | hertz | Hz | $s^{-1}$ |
| $f_n$ | angular speed (shaft) | revolutions per minute | r/min | $2 \cdot \pi \cdot 60^{-1} \cdot m \cdot m^{-1}$ |
| $\gamma$ | ratio of specific heats | (joule per kilogram kelvin) per (joule per kilogram kelvin). | (J/(kg·K))/(J/(kg·K)) | 1 |
| *K* | correction factor | | | 1 |
| *l* | length | meter | m | m |
| $\mu$ | viscosity, dynamic | pascal second | Pa·s | $m^{-1} \cdot kg \cdot s$ |
| *M* | molar mass[1] | gram per mole | g/mol | $10^{-3} \cdot kg \cdot mol^{-1}$ |
| *m* | mass | kilogram | kg | kg |
| $\dot{m}$ | mass rate | kilogram per second | kg/s | $kg \cdot s^{-1}$ |
| $\nu$ | viscosity, kinematic | meter squared per second | $m^{-2}/s$ | $m^{-2} \cdot s^{-1}$ |
| *N* | total number in series | | | |
| *n* | amount of substance | mole | mol | mol |
| $\dot{n}$ | amount of substance rate | mole per second | mol/s | $mol \cdot s^{-1}$ |
| *P* | power | kilowatt | kW | $10^3 \cdot m^2 \cdot kg \cdot s^{-3}$ |
| *PF* | penetration fraction | | | |
| *p* | pressure | pascal | Pa | $m^{-1} \cdot kg \cdot s^{-2}$ |
| $\rho$ | mass density | kilogram per cubic meter | $kg/m^3$ | $kg \cdot m^{-3}$ |
| *r* | ratio of pressures | pascal per pascal | Pa/Pa | 1 |
| $R^2$ | coefficient of determination | | | |
| *Ra* | average surface roughness | micrometer | $\mu m$ | $10\text{-}^{-6}$ m |
| *Re*# | Reynolds number | | | |
| *RF* | response factor | | | |
| *RH* | *relative humidity* | | | |
| $\sigma$ | non−biased standard deviation. | | | |
| *S* | *Sutherland constant* | *kelvin* | *K* | *K* |
| *SEE* | standard estimate of error | | | |
| *T* | absolute temperature | kelvin | K | K |
| *T* | Celsius temperature | degree Celsius | °C | K − 273.15 |
| *T* | torque (moment of force) | newton meter | N·m | $m^{-2} \cdot kg \cdot s^{-2}$ |

| Symbol | Quantity | Unit | Unit symbol | Units in terms of SI base units |
|---|---|---|---|---|
| $t$ | time | second | s | s |
| $\Delta t$ | time interval, period, 1/frequency. | second | s | s |
| $V$ | volume | cubic meter | $m^3$ | $m^3$ |
| $\dot{V}$ | volume rate | cubic meter per second | $m^3/s$ | $m^3 \cdot s^{-1}$ |
| $W$ | work | kilowatt hour | kW·hr | $3.6 \cdot 10^{-6} \cdot m^2 \cdot kg \cdot s^{-2}$ |
| $w_c$ | *carbon mass fraction* | *gram per gram* | *g/g* | *1* |
| $x$ | amount of substance mole fraction [2]. | mole per mole | mol/mol | 1 |
| $\bar{x}$ | flow-weighted mean concentration. | mole per mole | mol/mol | 1 |
| $y$ | generic variable | | | |

[1] See paragraph (f)(2) of this section for the values to use for molar masses. Note that in the cases of $NO_X$ and HC, the regulations specify effective molar masses based on assumed speciation rather than actual speciation.

[2] Note that mole fractions for THC, THCE, NMHC, NMHCE, and NOTHC are expressed on a $C_1$ equivalent basis.

(b) *Symbols for chemical species.* This part uses the following symbols for chemical species and exhaust constituents:

| Symbol | Species |
|---|---|
| Ar | argon. |
| C | carbon. |
| $CH_4$ | methane. |
| $C_2H_6$ | ethane. |
| $C_3H_8$ | propane. |
| $C_4H_{10}$ | butane. |
| $C_5H_{12}$ | pentane. |
| CO | carbon monoxide. |
| $CO_2$ | carbon dioxide. |
| H | atomic hydrogen. |
| $H_2$ | molecular hydrogen. |
| $H_2O$ | water. |
| He | helium. |
| $^{85}Kr$ | krypton 85. |
| $N_2$ | molecular nitrogen. |
| NMHC | nonmethane hydrocarbon. |
| NMHCE | nonmethane hydrocarbon equivalent. |
| NO | nitric oxide. |
| $NO_2$ | nitrogen dioxide. |
| $NO_X$ | oxides of nitrogen. |
| $N_2O$ | nitrous oxide. |
| NOTHC | nonoxygenated hydrocarbon. |
| $O_2$ | molecular oxygen. |
| OHC | oxygenated hydrocarbon. |
| $^{210}Po$ | polonium 210. |
| PM | particulate mass. |
| S | sulfur. |
| $SO_2$ | sulfur dioxide. |
| THC | total hydrocarbon. |
| $ZrO_2$ | zirconium dioxide. |

(c) *Prefixes.* This part uses the following prefixes to define a quantity:

| Symbol | Quantity | Value |
|---|---|---|
| μ | micro | $10^{-6}$ |
| m | milli | $10^{-3}$ |
| c | centi | $10^{-2}$ |
| k | kilo | $10^3$ |
| M | mega | $10^6$ |

(d) *Superscripts.* This part uses the following superscripts to define a quantity:

| Superscript | Quantity |
|---|---|
| overbar (such as $\bar{y}$) | arithmetic mean. |
| overdot (such as $\dot{y}$) | quantity per unit time. |

(e) *Subscripts.* This part uses the following subscripts to define a quantity:

| Subscript | Quantity |
|---|---|
| abs | absolute quantity. |
| act | actual condition. |
| air | air, dry. |
| atmos | atmospheric. |
| cal | calibration quantity. |
| CFV | critical flow venturi. |
| cor | corrected quantity. |
| dil | dilution air. |
| dexh | diluted exhaust. |
| exh | raw exhaust. |
| exp | expected quantity. |
| hi,idle | condition at high – idle. |
| i | an individual of a series. |
| idle | condition at idle. |
| in | quantity in. |
| init | initial quantity, typically before an emission test. |
| j | an individual of a series. |
| max | the maximum (*i.e.,* peak) value expected at the standard over a test interval; not the maximum of an instrument range. |
| meas | measured quantity. |
| out | quantity out. |
| part | partial quantity. |
| PDP | positive – displacement pump. |
| ref | reference quantity. |
| rev | revolution. |
| sat | saturated condition. |
| slip | PDP slip. |

| Subscript | Quantity |
|---|---|
| span | span quantity. |
| SSV | subsonic venturi. |
| std | standard condition. |
| test | test quantity. |
| test,alt | alternate test quantity. |
| uncor | uncorrected quantity. |
| zero | zero quantity. |

(f) *Constants.* (1) This part uses the following constants for the composition of dry air:

| Symbol | Quantity | mol/mol |
|---|---|---|
| $x_{Arair}$ | amount of argon in dry air | 0.00934 |
| $x_{CO2air}$ | amount of carbon dioxide in dry air. | 0.000375 |
| $x_{N2air}$ | amount of nitrogen in dry air | 0.78084 |
| $x_{O2air}$ | amount of oxygen in dry air | 0.209445 |

(2) This part uses the following molar masses or effective molar masses of chemical species:

| Symbol | Quantity | g/mol ($10^{-3}$ kg·mol$^{-1}$) |
|---|---|---|
| $M_{air}$ | molar mass of dry air[1] | 28.96559 |
| $M_{Ar}$ | molar mass of argon | 39.948 |
| $M_{C}$ | molar mass of carbon | 12.0107 |
| $M_{C3H8}$ | molar mass of propane | 44.09562 |
| $M_{CH4}$ | molar mass of methane | 16.043 |
| $M_{CO}$ | molar mass of carbon monoxide | 28.0101 |
| $M_{CO2}$ | molar mass of carbon dioxide | 44.0095 |
| $M_{H}$ | molar mass of atomic hydrogen | 1.00794 |
| $M_{H2}$ | molar mass of molecular hydrogen | 2.01588 |
| $M_{H2O}$ | molar mass of water | 18.01528 |
| $M_{He}$ | molar mass of helium | 4.002602 |
| $M_{N}$ | molar mass of atomic nitrogen | 14.0067 |
| $M_{N2}$ | molar mass of molecular nitrogen | 28.0134 |
| $M_{NMHC}$ | effective molar mass of nonmethane hydrocarbon[2] | 13.875389 |
| $M_{NMHCE}$ | effective molar mass of nonmethane equivalent hydrocarbon[2] | 13.875389 |
| $M_{NOx}$ | effective molar mass of oxides of nitrogen[3] | 46.0055 |
| $M_{N2O}$ | molar mass of nitrous oxide | 44.0128 |
| $M_{O}$ | molar mass of atomic oxygen | 15.9994 |
| $M_{O2}$ | molar mass of molecular oxygen | 31.9988 |
| $M_{S}$ | molar mass of sulfur | 32.065 |
| $M_{THC}$ | effective molar mass of total hydrocarbon[2] | 13.875389 |
| $M_{THCE}$ | effective molar mass of total hydrocarbon equivalent[2] | 13.875389 |

[1] See paragraph (f)(1) of this section for the composition of dry air.
[2] The effective molar masses of THC, THCE, NMHC, and NMHCE are defined by an atomic hydrogen-to-carbon ratio, α, of 1.85.
[3] The effective molar mass of $NO_X$ is defined by the molar mass of nitrogen dioxide, $NO_2$.

(3) This part uses the following molar gas constant for ideal gases:

| Symbol | Quantity | J/(mol) · K) ($m^2 \cdot kg \cdot s^{-2}$ $mol^{-1} \cdot K^{-1}$) |
|---|---|---|
| $R$ | molar gas constant | 8.314472 |

(4) This part uses the following ratios of specific heats for dilution air and diluted exhaust:

| Symbol | Quantity | [J/(kg·K)]/ [J/(kg·K)] |
|---|---|---|
| $\gamma_{air}$ | ratio of specific heats for intake air or dilution air. | 1.399 |
| $\gamma_{dil}$ | ratio of specific heats for diluted exhaust. | 1.399 |
| $\gamma_{exh}$ | ratio of specific heats for raw exhaust. | 1.385 |

(g) *Other acronyms and abbreviations.* This part uses the following additional abbreviations and acronyms:

ASTM American Society for Testing and Materials
BMD bag mini-diluter
BSFC brake-specific fuel consumption
CARB California Air Resources Board
CFR Code of Federal Regulations
CFV critical-flow venturi
CI compression-ignition
CITT Curb Idle Transmission Torque
CLD chemiluminescent detector
CVS constant-volume sampler
DF deterioration factor
ECM electronic control module
EFC electronic flow control
EGR exhaust gas recirculation
EPA Environmental Protection Agency
FEL Family Emission Limit
FID flame-ionization detector
GC gas chromatograph
GC–ECD gas chromatograph with an electron-capture detector

GC–FID gas chromatograph with a flame ionization detector
IBP initial boiling point
ISO International Organization for Standardization
LPG liquefied petroleum gas
NDIR nondispersive infrared
NDUV nondispersive ultraviolet
NIST National Institute for Standards and Technology
NMC nonmethane cutter
PDP positive-displacement pump
PEMS portable emission measurement system
PFD partial-flow dilution
PMP Polymethylpentene
pt. a single point at the mean value expected at the standard.
PTFE polytetrafluoroethylene (commonly known as Teflon™)
RE rounding error
RESS rechargeable energy storage system
RMC ramped-modal cycle
RMS root-mean square
RTD resistive temperature detector
SSV subsonic venturi
SI spark-ignition
UCL upper confidence limit
UFM ultrasonic flow meter
U.S.C. United States Code

[70 FR 40516, July 13, 2005, as amended at 73 FR 37346, June 30, 2008; 73 FR 59342, Oct. 8, 2008; 74 FR 56518, Oct. 30, 2009; 76 FR 57468, Sept. 15, 2011]

### § 1065.1010 Reference materials.

The materials listed in this section are incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, a document must be published in the FEDERAL REGISTER and the material must be available to the public. All approved materials are available for inspection at the Air and Radiation Docket and Information Center (Air Docket) in the EPA Docket Center (EPA/DC) at Rm. 3334, EPA West Bldg., 1301 Constitution Ave. NW., Washington, DC. The EPA/DC Public Reading Room hours of operation are 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number of the EPA/DC Public Reading Room is (202) 566–1744, and the telephone number for the Air Docket is (202) 566–1742. These approved materials are also available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call (202) 741–6030 or go to *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html*. In addition, these materials are available from the sources listed below.

(a) *ASTM materials.* Copies of these materials may be obtained from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428–2959, or by calling (877) 909–ASTM, or at *http://www.astm.org*.

(1) ASTM D86–07a, Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure, IBR approved for §§ 1065.703, 1065.710.

(2) ASTM D93–09 (Approved December 15, 2009), Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester, IBR approved for § 1065.703.

(3) ASTM D445–09 (Approved July 1, 2009), Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity), IBR approved for § 1065.703.

(4) ASTM D613–05, Standard Test Method for Cetane Number of Diesel Fuel Oil, IBR approved for § 1065.703.

(5) ASTM D910–07, Standard Specification for Aviation Gasolines, IBR approved for § 1065.701.

(6) ASTM D975–07b, Standard Specification for Diesel Fuel Oils, IBR approved for § 1065.701.

(7) ASTM D1267–02 (Reapproved 2007), Standard Test Method for Gage Vapor Pressure of Liquefied Petroleum (LP) Gases (LP-Gas Method), IBR approved for § 1065.720.

(8) ASTM D1319–03, Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption, IBR approved for § 1065.710.

(9) ASTM D1655–07e01, Standard Specification for Aviation Turbine Fuels, IBR approved for § 1065.701.

(10) ASTM D1837–02a (Reapproved 2007), Standard Test Method for Volatility of Liquefied Petroleum (LP) Gases, IBR approved for § 1065.720.