



Designation: D 2506 – 80 (Reapproved 1989)

An American National Standard

## Standard Terminology Relating to Solid Rocket Propulsion<sup>1</sup>

This standard is issued under the fixed designation D 2506; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 These symbols and definitions provide nomenclature for those parameters of common usage associated with solid rocket propulsion. In the interest of common understanding and standardization, consistent word usage is encouraged to help eliminate the major barrier to effective technical communication, particularly in the case of words having economic importance.

### 2. Significance and Use

2.1 Significant terms are grouped into major categories which have generally accepted meanings. Within each major category, significant terms are given definite meanings, symbols, and definitions. The following criteria determine acceptability of a term for inclusion:

- 2.1.1 The term is of interest to solid propulsion workers.
- 2.1.2 The term has a specific application or has been subject to misunderstanding or misuse.
- 2.1.3 The term is not adequately defined for general use in any standard dictionary.
- 2.1.4 Terms are used in current systems.

### DEFINITION OR DESCRIPTION OF TERMS

3. **Geometry**—Linear dimensions shall be expressed in feet or inches, including any decimal parts, and abbreviated as ft or in. Angular dimensions shall be expressed in degrees and decimal parts of a degree, for example, 15.23 deg.

- 3.1 *Area of Propellant Burning Surface* ( $A_b$ ).
- 3.2 *Flow Area at Nozzle Exit Plane* ( $A_e$ ).
- 3.3 *Flow Area at Grain Port* ( $A_p$ ).
- 3.4 *Flow Area at Nozzle Throat* ( $A_t$ ).
- 3.5 *Web Thickness of Propellant* ( $w$ ).
- 3.6 *Nozzle Divergence Half-Angle* ( $\alpha$ ).
- 3.7 *Nozzle Convergence Half-Angle* ( $\beta$ ).

4. **Impulse** ( $I$ )—Impulse shall be expressed as pounds-force-seconds (lbf·s). A numeral in the subscript to  $I$  indicates the time elapsed from zero time. The numeral may be changed to suit the application.

4.1 *Action Time Impulse* ( $I_a$ )—The area under the “thrust action time” portion of the thrust-time record.

4.2 *Burning Time Impulse* ( $I_b$ )—The area under the “thrust burning time” portion of the thrust-time record.

4.3 *Propellant Specific Impulse* ( $I_{sp}$ )—This symbol is used only in general reference to propellant specific impulse or in reporting nonstandard corrected values of  $I_{sp}$  (Notes 1 and

2). All numerical values must be accompanied by specification of the following assumptions:

- 4.3.1 Chamber pressure ( $P_c$ ),
- 4.3.2 Ambient pressure ( $P_{amb}$ ),
- 4.3.3 Nozzle area expansion ratio ( $E$ ) and whether or not this is optimum, and
- 4.3.4 Nozzle divergence half-angle ( $\alpha$ ).

NOTE 1—Use the same time interval and propellant mass assumptions as for  $I_{sp}$ ; therefore, do not report a numerical value of  $I_{sp}$  without also reporting the corresponding value of  $I_{sp}$ .

NOTE 2—With the only exception of  $I_{sp}^*$ , all reported values of propellant specific impulse must be accompanied by a statement of the assumptions made in calculating a theoretical value, or a statement of the existing motor conditions and assumptions in obtaining a measured or corrected value. A degree sign ( $^\circ$ ) indicates a theoretical value, not a value that has been obtained from or derived from the results of a motor firing. In stating the assumptions or motor conditions, or both, a shorthand notation may be used if no confusion will result. For example, a measured propellant specific impulse of 241.6 lbf·s/lbm over the 25 psia action time from a motor operating at 1230 psia, exhausting to 11.6 psia with an expansion ratio of 9.8, a nozzle divergence angle of 17.5 deg, and an expended mass of 3563 lbm may be abbreviated as follows:

$$I_{sp}(1230/11.6, 9.8, 17.5^\circ, a_{0.25p}, m_m - m_{bo} = 3563) = 241.6 \text{ lbf}\cdot\text{s}/\text{lbm}$$

4.4 *Theoretical Propellant Specific Impulse* ( $I_{sp}^*$ ), calculated from propellant thermodynamic properties. All numerical values must be accompanied by specification of the following assumptions:

- 4.4.1 Chamber pressure ( $P_c$ ),
- 4.4.2 Ambient pressure ( $P_{amb}$ ),
- 4.4.3 Nozzle area expansion ratio ( $E$ ) and whether or not this is optimum,
- 4.4.4 Nozzle divergence half-angle ( $\alpha$ ),
- 4.4.5 Assumption of frozen or equilibrium exit composition, and
- 4.4.6 Physical state of exhaust condensables.

4.5 *Measured (Delivered) Propellant Specific Impulse* ( $I_{sp}$ ), calculated from data from an actual motor firing. All numerical values must be accompanied by specification of the following motor conditions:

- 4.5.1 Chamber pressure ( $P_c$ ),
- 4.5.2 Ambient pressure ( $P_{amb}$ ),
- 4.5.3 Nozzle area expansion ratio ( $E$ ),
- 4.5.4 Nozzle divergence half-angle ( $\alpha$ ),
- 4.5.5 Time interval used for impulse determination, and
- 4.5.6 Propellant mass assumption.

4.6 *Theoretical Delivered Propellant Specific Impulse* ( $I_{sp}^*$ ), calculated from propellant thermodynamic properties assuming the same motor conditions reported for  $I_{sp}$  with the added specifications of either frozen or equilibrium exit composition and physical state of exhaust condensables. One

<sup>1</sup> These definitions are under the jurisdiction of ASTM Committee F-7 on Aerospace Industry Methods and are the direct responsibility of Subcommittee F07.02 on Propellant Technology.

Current edition approved Oct. 31, 1980. Published March 1981. Originally published as D 2506 – 66 T. Last previous edition D 2506 – 70 (1980).