ORGANIZATION OF TABULATED ALBDF DATA

This document describes the organization of the tabulated data for the absorption-line blackbody distribution function, ALBDF, generated by John Pearson [1].

The ALBDF data are organized first by total pressure. This is done because most frequently a system is at a single value of total pressure, while temperature and concentration almost generally vary within a system. For each of the species considered (H2O, CO2, and CO), the ALBDF data are given in 10 separate files, corresponding to the ten total pressures considered. The total pressures used are 0.1, 0.25, 0.5, 1, 2, 4, 8, 15, 30, and 50 atm.

For H2O, the mole fraction of H2O (remainder air), , has a significant impact on the ALBDF. Therefore, ALBDF data are given at nine values of H2O mole fraction: 0, 0.05, 0.1, 0.2, 0.3, 0.4, 0.6, 0.8, and 1.0. In the H2O database files, ALBDF data at all temperature and absorption cross-section combinations are given at the first mole fraction, at the second mole fraction, and so on.

For each mole fraction of H2O, and for each of the ALBDF data files for CO2 and CO, the data are next organized according to the gas temperature, *Tg*. Values of gas temperature vary from 300 K to 3000 K, with 28 values evenly spaced at 100 K intervals.

The ALBDF data are next organized according to blackbody source temperature, *Tb*. Again, the same 28 evenly-spaced values ranging from 300 K to 3000 K are used.

The final variable in the hierarchy is the absorption cross-section, *C*. The values for absorption cross-section vary from 0.0001 m2/mol to 1000 m2/mol, with 10 intervals per decade that are logarithmically evenly spaced according to:

|  |  |
| --- | --- |
|  | *j* = 0 … 70 |

If the data are to be read for calculations, the following example demonstrates the structure of the files for H2O:

open("h2o\_p1.txt")

for (NY = 1:9)

for (NTg = 1:28)

for (NTb = 1:28)

for (NC = 1:71)

read (F1[NY,NTg,NTb,NC])

If the species of interest is CO2 or CO, the outer loop over mole fraction may be eliminated.

The data can be read in this manner, at which point an interpolation scheme of the user's choice is employed to calculate the ALBDF as a function of arbitrary independent variables, *F*(*C*,*Tg*,*Tb*,*Y,p*). At the current resolution of the database, simple linear interpolation has been shown sufficient to achieve near-line-by-line accuracy. Further, a user may reduce the resolution of the database or output the data with a different structure if desired.

A sample C++ code utilizing the database to calculate the ALBDF at sample conditions is found on the website. Also, to download the data files, right click the link to the files and select "Save Link As..."

References

1. Pearson, J.T., 2013, *The Development of Updated and Improved SLW Model Parameters and Its Application to Comprehensive Combustion Predictions*, Ph.D. Dissertation, Brigham Young University, Provo, UT.