Computer Models
For
Fire and Smoke

Model Name:	ASET (Available Safe Egress Time)
Version:	-----
Classification:	Zone model
Very Short Description:	A simple, user-friendly, one-room smoke-filling model computer colde which simulates the smoke layer thickness, temperature, and concentrations of products of combustion due to a fire of time-dependent, user-specified, energy and product release-rate.
Modeler(s), Organization(s):	L.Y. Cooper and D.W. Stroup, Center for Fire Research, National Institute of Standards and Technology.
User's Guide:	Cooper, L.Y. and Stroup, D.W., Calculating Available Safe Egress Time (ASET) – A Computer Program and User's Guide, NBSIR 82-2578, National Institute of Standards and Technology (NIST) (formerly Natinal Bureau of Standards), Gaithersburg, MD, 1982.
Technical References:	Cooper, L.Y., "A Concept for Estimating Safe Available Egress Time in Fires", *Fire Safety Journal*, Vol. 5, pp. 135-144, 1983. Cooper, L.Y., "A Mathematical Model for Estimating Available Safe Egress Time in Fires", *Fire and Materials*, Vol. 6, pp. 135-144, 1982. Cooper, L.Y. and Stroup, D.W., "ASET – A Computer Program for Calculating Available Safe Egress Time," *Fire Safety Journal*, Vol. 9, pp. 29-45, 1985. Cooper, L.Y., The Compartment Fire-Generated Environment and Smoke Filling, Section 2/Chapter 7 of the *SFPE Handbook of Fire Protection Engineering*, Society of

Fire Protection Engineering, Boston, MA, pp. 2-116 – 2-138, 1988.

Validation References: -----

Availability: www.fire.nist.gov

Price: Free

Necessary Hardware: The executable program will run on an IBM PC or compatible computer. The source code will compile on a computer that supports ANSI FORTRAN 77.

Computer Language: Fortran

Size: 105K free memory for MS-DOS version.

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Detailed Description:

ASET is a simple, user-friendly, one-room fire model computer code which simulates the smoke layer thickness, temperature, and concentrations of products of combustion due to a fire of time-dependent, user-specified, energy and product release-rate. The code is supported by the user's guide of reference 3 (abbreviated form included in reference 4). Input data describing the fire's elevation and energy and product of combustion release rates are used together with enclosure size (height and area) and user-specified detection and hazard criteria to determine the time of fire detection, t_{DET}, time of onset of hazardous conditions, t_{HAZ}, and the Available Safe Egress Time (ASET).

For detection criteria the user can specify a detectable upper-smoke-layer temperature, rate-of-temperature rise, or concentration of a detectable product-of-combustion.

When the predicted smoke-layer interface is above some characteristic, user-specified face elevation, hazardous conditions are assumed to occur if and when a hazardous radiation exposure from the upper layer is attained. Such an exposure is defined by a critical, user-specified, upper-layer temperature.

If the interface is below face elevation, then hazard is assumed to occur if and when a critical, user-specified concentration of some hazardous product-of-combustion is attained. However, the latter critical temperature would be lower than the former one, and hazardous conditions are now initiated as a result of direct burns or inhalation of hot gases. When the interface has dropped below face elevation, hazard is also assumed to occur if and when a critical, user-specified concentration of some hazardous product-of-combustion is attained.

ASET models the energy release rate of the fire (the fire growth) by either one of two methods. The first method uses continuous, user-specified, exponential-growth curve segments. The other method uses pairs of user-specified data points (energy release rate, time) with linear interpolation between them. Either of these methods would be used to describe the time-varying energy relase rate of the free-burning combustibles whose hazard is being evaluated. Ther would be different types of data inputs depending on which fire-growth model is chosen.

ASET models a product-of-combustion release rate of the fire by one of two methods. The first method is defined by an unchanging, user-specified constant of proportionality between the product-of-combustion release rate and the previously-specified energy release rate. The other method uses pairs of user-specified data points (product release rate, time) with linear interpolation between them. The product release rate is specified in units of u_c per unit time, where u_c is a dimensional unit appropriate for the particular product. For example, u_c could have the dimension of mass, number of particles, etc.

The program has a capability of modeling up to two different product of combustion species, and of simulating their respective upper layer concentrations. The first of these is a product whose upper layer concentration would be the basis of a detection criterion, and the second is a product which can lead to hazard.

ASET solves the model equations outlined in references 2 and 4 and simulates the changing environment (layer thickness, temperature, and product concentration) in the fire room. At every time step into the simulation, the prevailing conditions in the room are checked against the detection and hazard criteria being invoked. In this way, the times t_{DET} and t_{HAZ} corresponding to every room geometry and to each pair of detection and hazard criteria are eventually identified. The ASET's are computed and displayed in the computer output along with other potentially useful results of the computations. Each simulation continues in time until the onset of hazard or until a maximum, user-specified time is attained.