Computer Models
For
Fire and Smoke

Model Name:	FAST/CFAST
Version:	3.1.6
Classification:	Zone Model
Very Short Description:	A zone model to predict the environment in a compartmented structure.
Modeler(s), Organization(s):	Walter W. Jones, National Institute of Standards and Technology
User's Guide:	A User's Guide for FAST: Engineering Tools for Estimating Fire Growth and Smoke Transport, NIST Special Publication 921, 2000 Edition
Technical References:	A Technical Reference for CFAST: An Engineering Tools for Estimating Fire Growth and Smoke Transport, NIST Technical Note 1431.
Validation References:	(all of the following papers cite experimental comparisons with the model):
	A Comparison of CFAST Predictions to USCG Real-Scale Fire Tests, Journal of Fire Protection Engineering (in press).
	A Technical Reference for CFAST: An Engineering Tools for Estimating Fire Growth and Smoke Transport, NIST Technical Note 1431 (2000).
	Quantifying fire model evaluation using functional analysis, Fire Safety Journal 33 (1999), 167-184.
	Development of an Algorithm to Predict Vertical Heat Transfer Through Ceiling/Floor Conduction, Fire Technology 34, 139 (1998).

Fire Hazard Assessment Methodology, NISTIR 5836 (1996).

Progress Report on Fire Modeling and Validation, NISTIR 5835 (1996).

Comparison of CFAST Predictions to Real Scale Fire Tests, Institut de Securite, Fire Safety Conference on Performance Based Concepts (1996).

Calculating Flame Spread on Horizontal and Vertical Surfaces, NISTIR 5392 (1994).

Modeling Smoke Movement Through Compartmented Structures, Journal of Fire Sciences, *11*, 172 (1993).

Improvement in Predicting Smoke Movement in Compartmented Structures, Fire Safety Journal, 21, 269 (1993).

Verification of a Model of Fire and Smoke Transport, Fire Safety Journal 21, 89 (1993).

Availability: Available from http://fast.nist.gov/ or the National Fire Protection Association (http://www.nfpa.org).

Price: There is no cost from NIST for the download or having the CD; NFPA distributes the CD together with printed documentation for $25.

Necessary Hardware: Intel architecture, running DOS 6.0 or later. Runs under Windows **3.1, 95, 98 and 2000**, but *not* NT. Versions are available for the Silicon Graphics systems.

Computer Language: FORTRAN/C

Size: Approximately 10MB of disk space, and 4MB of RAM required.

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Detailed Description:

CFAST is the Consolidated Model of Fire Growth and Smoke Transport. It is the kernel of the zone fire models that are supported by BFRL. FAST and FASTLite are data editors and reporting tools which are "front" and "back" ends for the model CFAST. For additional details on the naming convention, please visit the web site http://fast.nist.gov/versionhistory.htm. There are a several data editors which have been developed elsewhere: FireCAD from the RJA Group and FireWalk through the University of California, Berkeley.

CFAST is a zone model and is used to calculate the evolving distribution of smoke, fire gases and heat throughout a constructed facility during a fire. In CFAST, each compartment is divided into two layers, and many zones for detailed interactions. The modeling equations used in CFAST take the mathematical form of an initial value problem for a system of ordinary differential equations (ODE). These equations are derived using the conservation of mass, the conservation of energy, the ideal gas law and relations for density and internal energy. These equations predict as functions of time quantities such as pressure, layer heights and temperatures given the accumulation of mass and enthalpy in the two layers. The CFAST model then solves of a set of ODEs to compute the environment in each compartment and a collection of algorithms to compute the mass and enthalpy source terms. The model incorporates the evolution of the species, such as carbon monoxide, which are important to the safety of individuals subjected to a fire environment.

Version 3.1.6 models up to 30 compartments, a fan and duct system for each compartment, 31 individual fires, up to one flame-spread object, multiple plumes and fires, multiple sprinklers and detectors, and the ten species considered most important in toxicity of fires including the effective fatal dose. The geometry includes variable area/height relations, ignition of multiple objects such as furniture, thermophysical and pyrolysis databases, multilayered walls, ignition through barriers and vents, wind, the stack effect, building leakage, and flow through holes in floor/ceiling connections. The distribution includes graphic and text report generators, a plotting package and a system for comparing many runs done for parameters estimation.