

**U.S. DEPARTMENT
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NISTIR 6088

Data Structures for the Fire Data Management System, FDMS 2.0

Rebecca W. Portier
Richard D. Peacock
Paul A. Reneke

The NIST logo is rendered in a large, bold, black, sans-serif font. The letters are thick and have a slight shadow effect, giving them a three-dimensional appearance. The 'N' and 'S' are particularly prominent due to their size and the way they connect to the other letters.

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November 1997

Sponsored in part by

Standard Reference Data Program
National Institute of Standards and Technology
Gaithersburg, MD 20899

U.S. Department of Commerce

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Bibliographic Information

Abstract

Fire Data Management System, FDMS, is a design for a computer database to store and retrieve fire test results obtained from bench-scale and real-scale tests as well as fire simulation programs. By storing available fire test values in a common format, this data is readily available and easily exchanged. This guide provides detailed descriptions of the physical data structures for the next generation of the database, FDMS 2.0

Key words

Computers; databases; cone calorimeters; data sets; experiments; fire tests; furniture calorimeters; information storage; information retrieval

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Data Structures for the Fire Data Management System, FDMS 2.0

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1 Database Design

1.1 Introduction

A unified method of accessing data is valuable to both experimental and modeling efforts in the development of the science of fire. For experimentalists, easy to use data organization and retrieval tools facilitate analysis of the data. For modelers, access to experimental data is important for both model input and evaluation of the predictive capability of the models. FDMS, the Fire Data Management System [1], is a design for a computer database for organizing and presenting fire data obtained from bench-scale and real-scale tests as well as fire simulation programs. By storing available fire test values in a common format, this data is readily useable and easily exchanged.

The goal for FDMS is to provide access to a database of test values generated from a variety of sources within the fire community. The FDMS provides an open file design that will easily accommodate future test apparatus formats. The FDMS concept is not limited by computer platforms, computer languages, or data inflexibilities.

An initial attempt at providing a FDMS database was begun under the direction of the Fire Research Station according to the design proposed by Babrauskas, Janssens, Peacock, and Batho [2],[3]. The resulting software, FDMS 1.0 [4], provides for storage and retrieval of Cone Calorimeter and Furniture Calorimeter test data. After completion of the analysis of FDMS 1.0, it was determined that a redesign of the physical file formats was necessary to accommodate additional test methods. Technical documentation [5] providing details for proposed database file formats was generated as the first step in this second stage of development. This report contains details of the technical data structure design including modifications necessary for implementation of an Internet database implementation of the FDMS.

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1.2 Logical Views of the Database Design

In order to accurately design a computer database, it is essential that all potential views of the data be evaluated first. A database of fire data could be accessed for a variety of queries other than the results of known fire tests. For example, a list of professional fire organizations might be desired, or within a laboratory, a technician might require the calibration history for a particular instrument. It is necessary to determine all potential views, and the data relevant for each, prior to the design of the physical file structures. At this design level, no consideration for the number of physical files, the size of each file, the type of each field, or the size of individual fields is necessary. Because these physical constraints are ignored, the database views being evaluated are referred to as logical views. Once all logical views of the database have been considered and the inclusion of all required data has been verified, these views are then merged into one comprehensive view. In database terminology, this comprehensive view is referred to as the conceptual view. From the FDMS conceptual view, the actual physical structure is derived.

In designing the structures for FDMS 2.0 databases, the following logical views have been considered:

- Fire Professionals and Affiliated Organizations
- Fire Test Products
- Fire Test Measurements
- Fire Test Methods
- Fire Test Results
- Instrumentation Types
- Laboratory Instrumentation

A complete description of the purpose of each view can be found in the appropriate subsections below.

1.3 Entity-Relationship Diagrams and Entity-Attribute Diagrams

Each logical view of a database can be graphically represented using a variety of software engineering diagrams. The most common of these are the Entity-Relationship Diagram (ERD) and the Entity-Attribute Diagram (EAD). A combination of these diagrams is frequently used in the early stages of the software design process to represent the items of interest, relationships between items, and those attributes of individual items which have been identified as critical to meeting the user's requirements. Pictorial representations of these components simplify the description making it possible for a user to determine if critical components are missing or improperly represented.

Figure 1 below provides an overview of symbols used in the creation of all ERD and EAD diagrams throughout this report. These symbols have been categorized as basic constructs, advanced constructs, indicators of cardinality, and key representations.

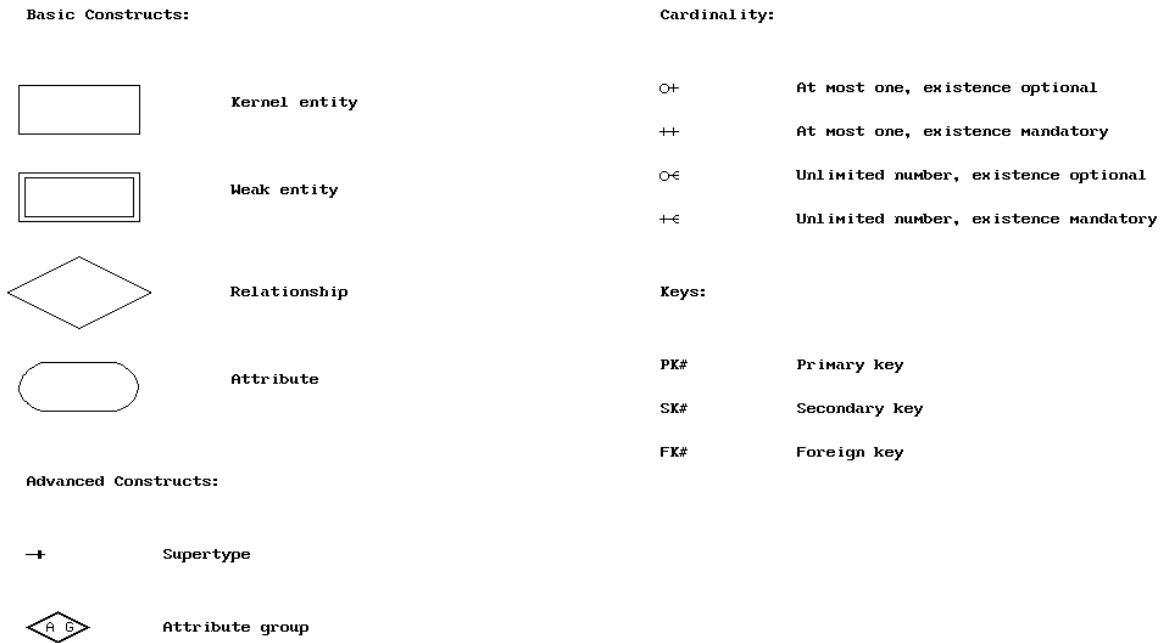


Figure 1. Fundamental Entity-Relationship Diagram Constructs.

The basic constructs of an ERD or EAD diagram are the entities, relationships, and attributes. Entities are the principal items for which information is stored. A group of similar items is referred to as an entity type while an occurrence within the group is referred to as an entity instance. For example, professional fire organizations is an entity type while the Building and Fire Research Laboratory is an entity instance. Typically, the use of the term entity without the modifier "instance" refers to the entity type. Entities can be further classified as one of two types: kernel and weak. Kernel entities exist independently of all other entities while weak entities require the existence of at least one other entity. For a laboratory technician tracking instrument calibrations, each instrument is a kernel entity. However, the calibrations are weak entities since they require the existence of an instrument before they can be recorded. The relationships in ERD diagrams represent any association between individual entities. The attributes are the actual characteristics of an entity or relationship. Attributes apply to

relationships as well as entities since some characteristics become relevant only in the relationship between two entities.

Advanced EAD constructs utilized in this report include attribute groups and supertype attributes. Attribute groups provide the ability to replace a grouping of several attributes with a single attribute referred to as the supertype attribute. Attribute group notation can also be used to indicate the derivation of an attribute, the supertype attribute, from one or more additional attributes. This is commonly done to indicate those attributes which define a primary key for an entity instance.

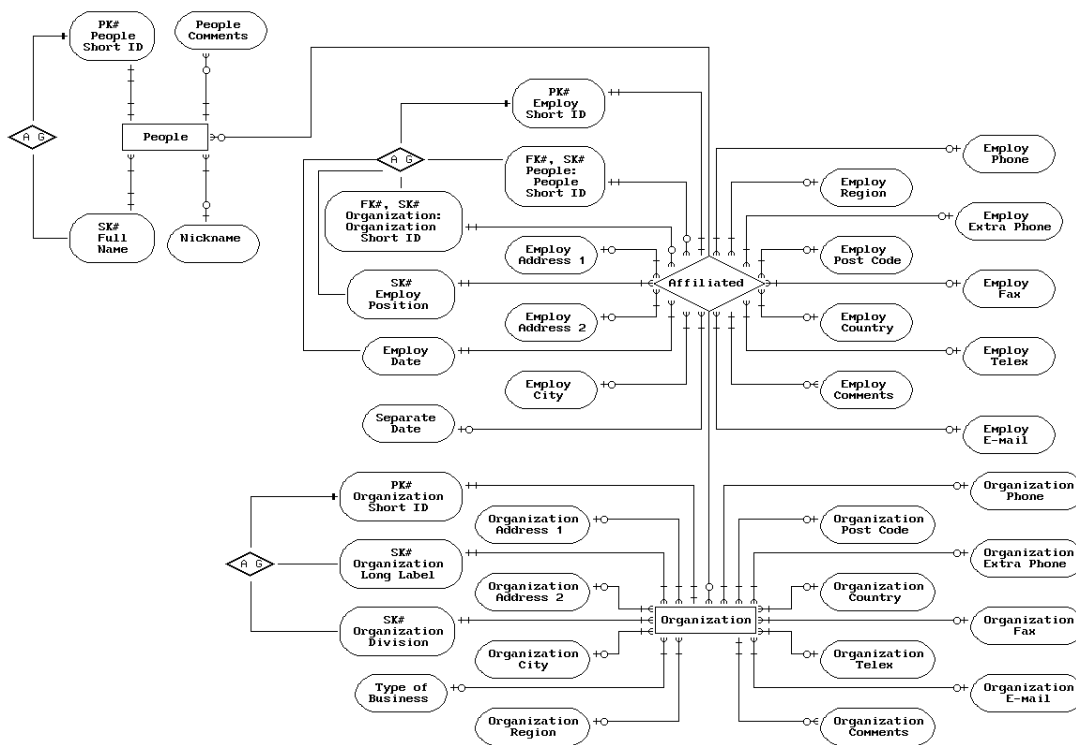
Cardinality in ERD diagrams indicates the minimum and maximum number of entity occurrences permitted in a relationship for any one occurrence of an entity. An example of cardinality in an ERD diagram is the relationship between a fire test and a standardized test method such as the Cone Calorimeter. For any fire test there is a cardinality of one and only one to the type of test method, in this case, the Cone Calorimeter. For the Cone Calorimeter test method, there may be zero or many fire test occurrences in the database. In EAD diagrams, cardinality indicates the minimum and maximum number of values each attribute may acquire for an entity or relationship instance. In an EAD diagram representing the calibration of laboratory instrumentation, a calibration history entry will have one and only one date, an operator might not be entered but at most one is possible, and there may be zero or many notes describing the calibration. Four types of cardinality are possible in this report: zero or one, one and only one, one or many, and zero or many. These cardinalities can be understood by considering any one occurrence of an entity or relationship. For a single occurrence, a cardinality of zero or one for a related entity or attribute implies that that entity or attribute does not have to exist, but if it does, there can be no more than one occurrence. A cardinality of one and only one implies that the object must exist and cannot have more than one possible value. The remaining cardinalities allow for multiple occurrences and differ only in the requirement for existence of an occurrence of the object.

The final symbolic representation in the EAD diagrams below is the key indicator. Keys are used to quickly access particular entity instances in a database. Three types of keys have been used. Primary keys are used to uniquely identify an occurrence of the entity. A primary key attribute must have one value occurrence for each entity in the database and cannot have more than one. Secondary keys are used to access entities which share a common attribute occurrence. The existence of a secondary key attribute value is not mandatory, and the number of entity occurrences with this attribute value is unlimited. Finally, the foreign key attribute indicates that the value for the attribute is actually obtained from the attribute of another entity or relationship occurrence.

1.4 Fire Professionals and Affiliated Organizations

The Fire Professionals and Affiliated Organizations logical view of the FDMS supports inquiries such as the following:

- What fire testing organizations are located in the United States?
- With which organization(s) is a known fire professional affiliated and in what capacities?
- What is the mailing address for the Building and Fire Research Laboratory?
- I need to speak with a fire modeler at the Building and Fire Research Laboratory. Who should I call and what is the number?



View 1. Fire Professionals and Affiliated Organizations

The following requirements were considered in the derivation of the logical view:

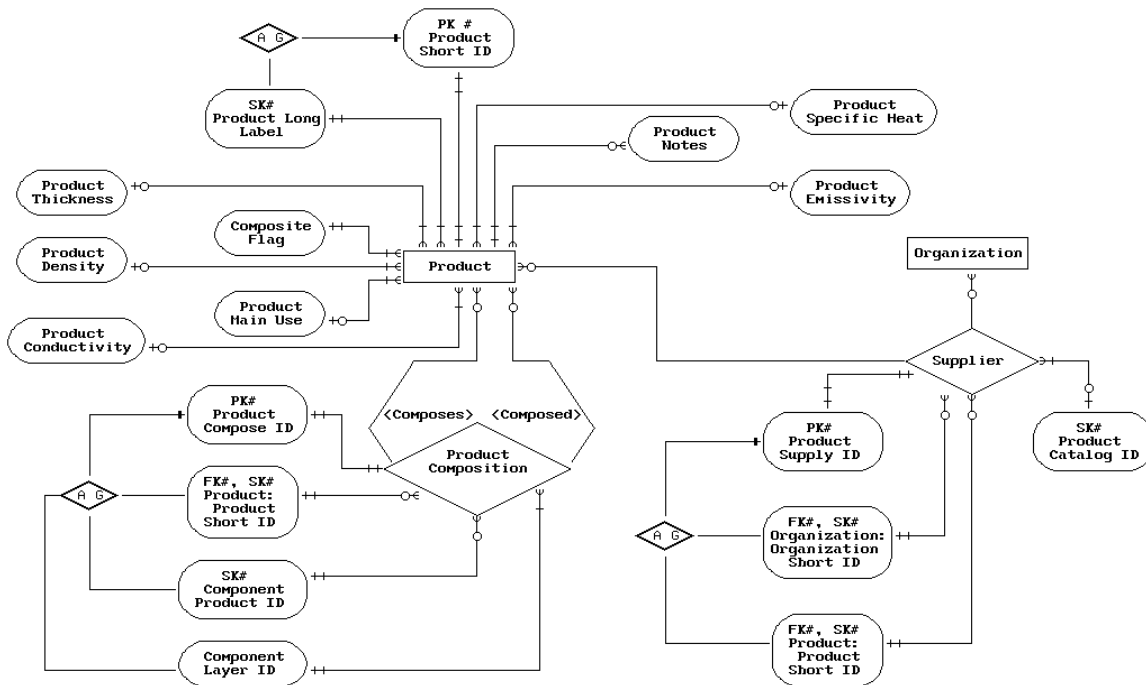
- People can share a common full name. There must be an additional way to determine uniqueness other than full name.
- An individual may be known by both a formal name and a less formal nickname. Inquiries should be possible for either.

- An individual can be affiliated with more than one organization at the same time whether as employee, member, committee officer, etc.
- An organization can have more than one individual affiliated at any time.
- An individual can be affiliated with the same organization in different capacities at the same time. Similarly, an individual's affiliation with an organization may vary over time assuming several distinct capacities.
- An organization may have several divisions each with different addresses.
- An individual can change employers, divisions within an employer organization, and professional organization memberships.
- An individual may return to a previous employer or organization at a future date.
- Entries for individuals may need to be made even though the affiliated organizations are not known.
- Entries for an organization may need to be made even though the affiliated individuals are not known.
- The ability to add general comments about an individual or an organization must be supported. The format of these comments should allow the user to include any information considered pertinent for that individual or organization. The number and length of comments needed is uncertain.
- The ability to add comments specifically about an individual's affiliation with an organization must be supported. The format of these comments should allow the user to include any information considered pertinent. The number and length of comments needed is uncertain.
- A variety of communication methods are available today. Do not limit the communications information exclusively to address and phone number.
- Inquiries on job titles must be supported.
- Inquiries on the type of business must be supported.

1.5 Fire Test Products

The terminology "test products" refers to materials of interest in fire tests. These products can be composites of additional materials. The terminology "product" will refer to both singular materials and composites. The Fire Test Products logical view of the FDMS supports inquiries such as the following:

- What products are commonly used in fire tests?
- A known product is a composite of other products. What are the other products? What are the thermophysical properties of these products, individually? What are the thermophysical properties of the composite?
- In what materials is a known product used as a component?
- A fire test is to be run using a known product. Who supplies this product?



View 2. Fire Test Products

The following requirements were considered in the derivation of the logical view:

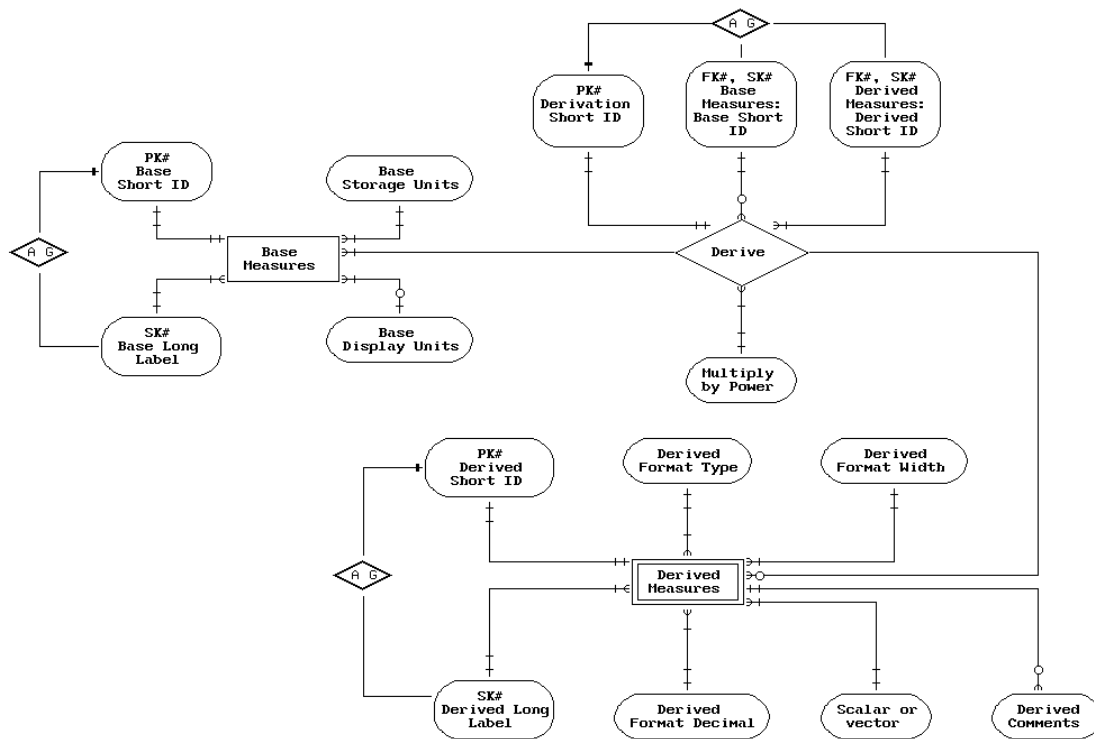
- Products could share a common description. There must be an additional way to determine uniqueness other than product description.
- Product thermophysical properties must be available for individual products as well as composite products. These thermophysical properties include density, thickness, conductivity, specific heat, and emissivity.
- A product may be a composition of several additional products. This is not required.
- A composite product may be composed of additional composite products.
- The number of products used to create a composite cannot be assumed.
- A product may be supplied by more than one supplier.
- A supplier may supply more than one product.
- Entries for products may need to be made even though the supplier is not known.
- Entries for a supplier cannot be made without knowing the product supplied.
- The product catalog number may vary depending on the supplier of the product.

- The ability to add general comments about a product must be supported. The format of these comments should allow the user to include any information considered pertinent. The number and length of comments needed is uncertain.
- Inquiries on the common use of a product must be supported.

1.6 Fire Test Measurements

The Fire Test Measurements logical view of the FDMS supports inquiries such as the following:

- What measurements are evaluated in fire tests?
- From what base measure is a known measurement derived?
- In what units is a derived measurement stored?
- In what units is a derived measurement displayed?



View 3. Fire Test Measurements

The following requirements were considered in the derivation of the logical view:

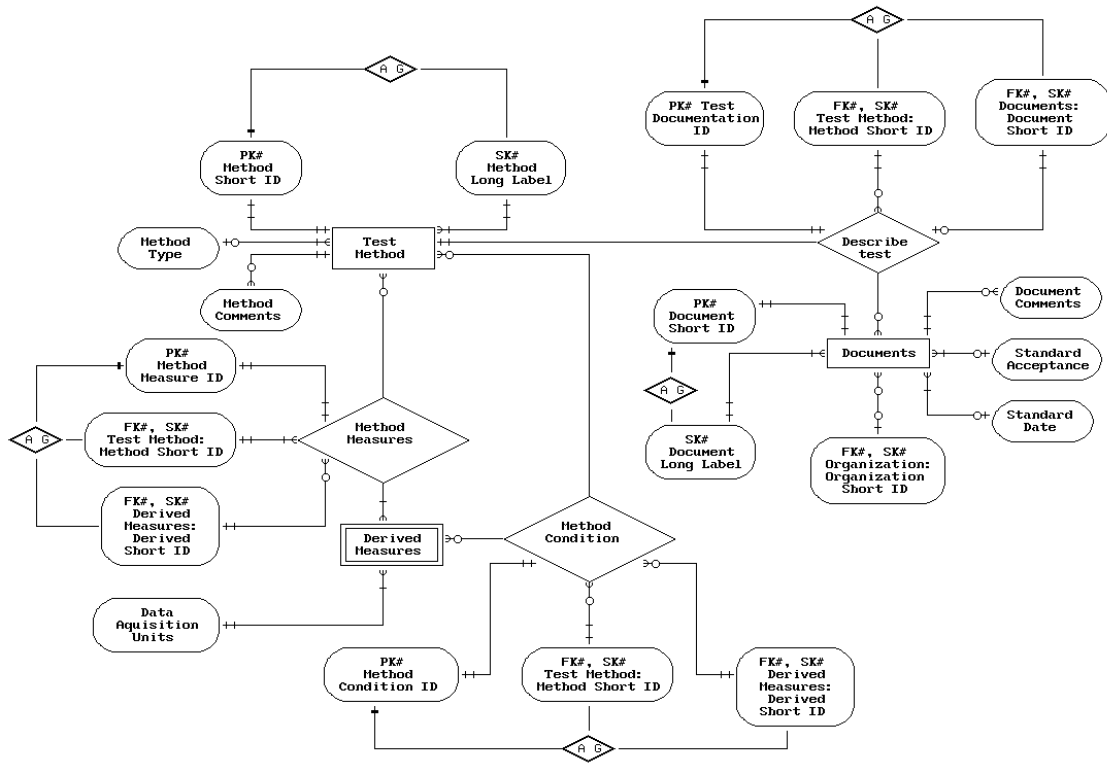
- Fire test measurements can be grouped into two types: base measures and measurements derived by some combination of the base measures.
- Base measurements are a finite set which should not be expanded or modified by the user.
- Users must be able to derive a new measurement from this set of base measures to use in the definition of new test methods or in experimental test runs.
- The units of storage for derived measurements are determined by the units of storage for the base measurements.
- The units of display for derived measurements are determined by the units of display for the base measurements. These display units should not vary between test methods so that value comparisons for a derived measurement can be made independent of the test method by which they were obtained.
- The units of storage for base measurements cannot be modified by the user.
- The units of display for base measurements should be customizable by the user.
- The units of data acquisition for a derived measurement can vary by the test method as well as by the laboratory for the same test method. For this reason, data acquisition units should be customizable by the user within each defined test method.
- The format type and size for a derived measurement should remain the same regardless of the type of fire test for which it was evaluated.
- Measurements could share a common description. There must be an additional way to determine uniqueness other than measurement description.
- The ability to add general comments about a derived measurement must be supported. The format of these comments should allow the user to include any information considered pertinent. The number and length of comments needed is uncertain.

See subsection 2.5.5 for a further discussion of base measurements and derived measurements in addition to a detailed list of the set of measurements provided in an initial installation.

1.7 Fire Test Methods

The Fire Test Methods logical view of the FDMS supports inquiries such as the following:

- What test methods are commonly used for fire tests? What measurements are obtained for each?
- What fire models are currently available? What type of evaluations does each provide?
- For a known test method, what documentation describes the method? What organization is responsible for this documentation and what is the document number?
- What test methods or fire models evaluate a known derived measurement?
- For a known test method, what setup conditions are required?



View 4. Fire Test Methods

For each fire test method, various derived measurements from the test measurement logical view are selected. The role for each measure is either as a setup condition prior to running the test or an evaluation of the effects of the test. Setup "conditions" will be used to refer to those measures needed for test setup while "measures" will refer to the results actually measured.

The following requirements were considered in the derivation of the logical view:

- Fire test methods and models are constantly evolving. The user must be able to define a new method in the database without requiring additional programming effort.
- A test method may evaluate derived measurements which are evaluated in other methods as well.
- A test method should be defined once. Multiple test runs for this method should be tracked separately from this definition.
- A document describes only one test method.
- Two or more documents can define identical test methods. This is due to the endorsement of a test method by separate organizations.

- For any one document number, one organization is responsible. Other organizations assign a distinct document number even if the text of the document does not change.
- Not all test methods tracked by users will be accepted as standards.
- Methods could share a common description. There must be an additional way to determine uniqueness other than method description.
- The ability to add general comments about a test method or document must be supported. The format of these comments should allow the user to include any information considered pertinent. The number and length of comments needed is uncertain.

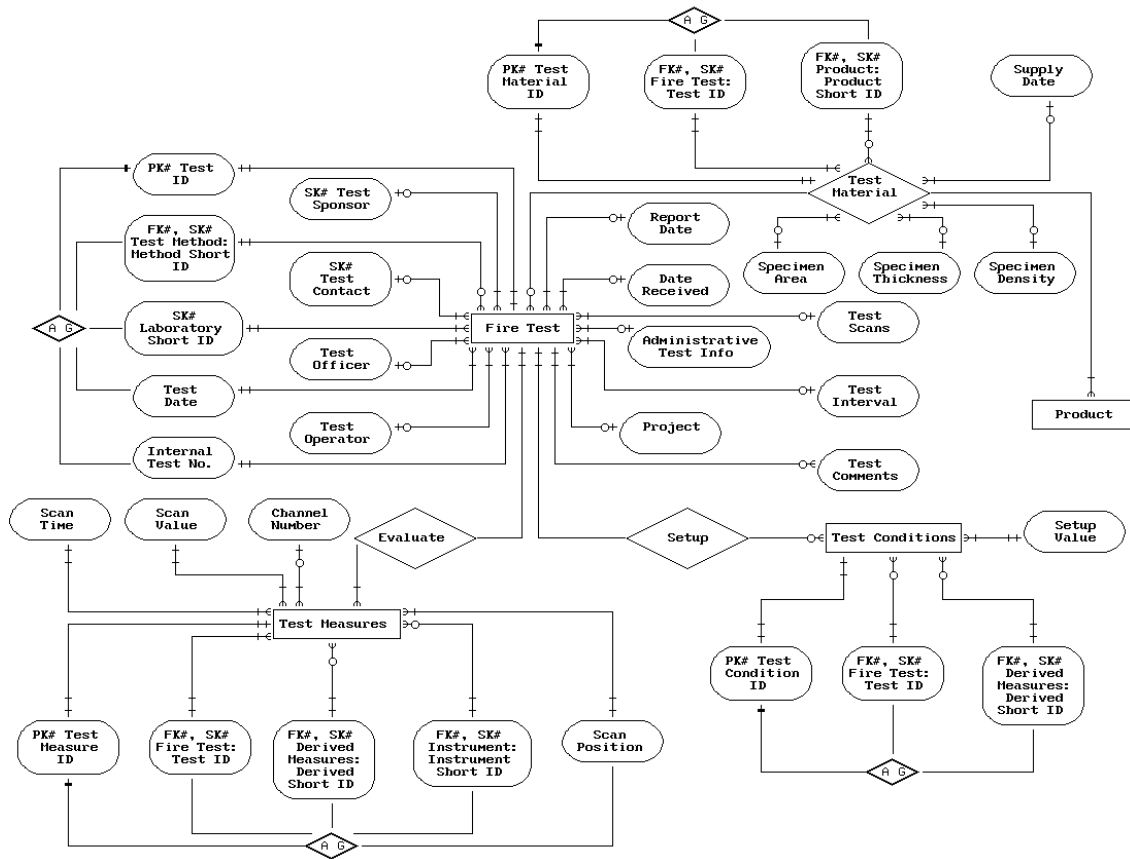
1.8 Fire Test Results

The Fire Test Results logical view of the FDMS supports inquiries such as the following:

- For a known product and derived measurement, what test results are available?
- For a known laboratory, test method, and date, what tests were run?
- For a known test run, what were the results of all measurements?
- For a known test run, what were the setup conditions?
- For a known test run, what were the temperature readings from selected locations?
- For a known test run, what products were tested?
- For a known test run, what measurement was obtained through a specified channel?

The following requirements were considered in the derivation of the logical view:

- Fire test methods and models are constantly evolving. The user must be able to define new results in the database without requiring additional programming effort.
- Fire test uniqueness is fully determined by the test method, the testing laboratory, the date of the test, and the run number within the laboratory.
- Multiple products may be tested at one time that are not part of a composite product.
- If a composite product is tested, the components must be easily determined.
- For any derived measurement, some real-scale tests report more than one set of time scans for that measurement. Additional scans are uniquely determined by the position of the instrumentation.
- For any test run, not all derived measurements defined for the method will be recorded.
- Inquiries for values of a particular derived measurement and a particular product without specifying a test will be more common than inquiries for the full set of test values of one test run.
- The ability to add general comments about a test run must be supported. The format of these comments should allow the user to include any information considered pertinent. The number and length of comments needed is uncertain.

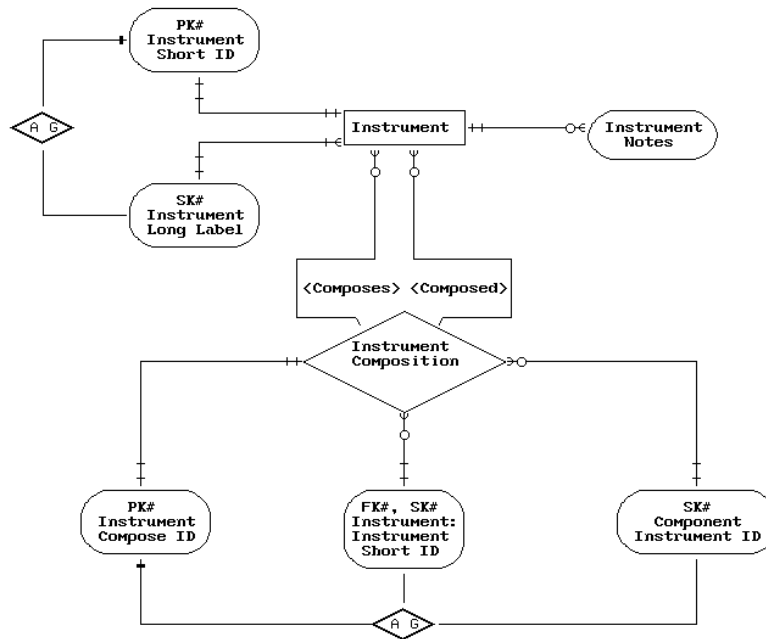


View 5. Fire Test Results

1.9 Instrumentation Types

The Instrumentation Type logical view supports inquiries such as the following:

- For a known instrument type, what other instrument types are components?
- What instrument types are commonly used in fire tests?



View 6. Instrumentation Types

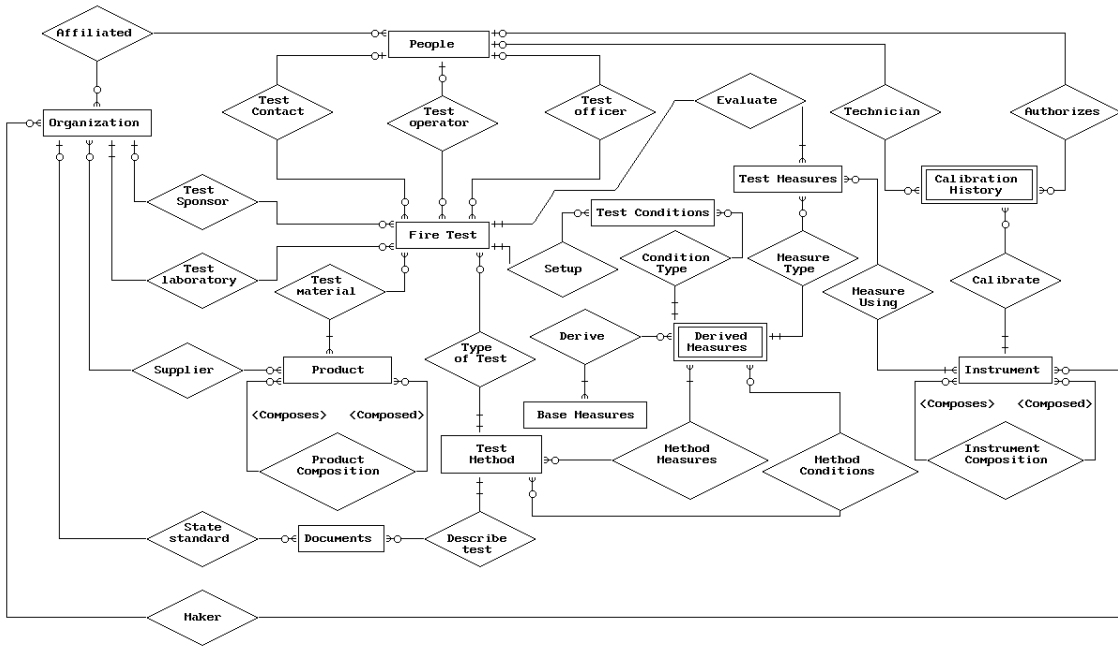
The following requirements were considered in the derivation of the logical view:

- Instrument types could share a common description. There must be an additional way to determine uniqueness other than instrument description.
- Instruments can be a composite of other types of instruments. Knowledge of this composition is important.
- Since instrument composition is not determined by particular instances of an instrumentation type, time variance is not important.
- The ability to add general comments about an instrument must be supported. The format of these comments should allow the user to include any information considered pertinent. The number and length of comments needed is uncertain.

- When multiple instruments are available, identification numbers have frequently been assigned within the laboratory. Unique identification is possible through this number.
- Instruments can be a composite of other instruments. Knowledge of this composition is important.
- Instrument composition varies over time and is not necessarily dependent on particular test runs.
- The ability to add general comments about an instrument must be supported. The format of these comments should allow the user to include any information considered pertinent. The number and length of comments needed is uncertain.
- The ability to add general comments about a calibration must be supported. The format of these comments should allow the user to include any information considered pertinent. The number and length of comments needed is uncertain.

1.11 FDMS Conceptual View

With all logical views completed and verified, the logical views are merged into a comprehensive view of the entire database. The FDMS conceptual view differs from the individual views only in the introduction of the relations: "test sponsor," "test laboratory," "test contact," "test operator," "test officer," and "state standard." These are shown as relations instead of the attributes indicated in the individual views since those attribute values are obtained from the related entities in the conceptual view. This relationship was seen in the individual views as foreign keys and is critical to avoid introducing redundancy into the database.



View 8. FDMS Conceptual View

2 Physical Structure of a FDMS Database

2.1 Derivation of Physical Files

This technical documentation updates the documentation provided in reference [5] to provide comprehensive documentation of the file structures and interconnections of the physical database implementation. Updated sections have been included for the database available codes and physical file structures. Comprehensive tables detailing the purpose of each physical database file and field descriptions by file are included. Some experience with computer databases and database concepts is assumed throughout the remainder of this reference guide.

Wherever possible, file names and field names from FDMS 1.0 format have been retained for consistency. The purpose of each file is summarized in a table in section 3. A description for each field is included in the table in section 4.

2.2 Physical Database File Formats

The internal structure of each file is presented in this section by comparing the existing format to the original design specifications with variations highlighted. The original specifications can be found in the FDMS technical documentation [5]. Each format specification details file offsets to provide developers details regarding access to stored values. The width and decimal columns reflect storage requirements for string field types only. All other entries in these columns indicate display formats. Physical storage requirements are determined by the field type. Variations in screen format or display format are included so that developers generating import and export files can support the same numeric precision. Highlighted field name changes indicate the need for corresponding adjustments in files generated in the FDMS exchange format. The field name as it exists in the Internet implementation is highlighted in the field name column with the previous design name displayed to the right. New fields are indicated with a ***** NEW ***** to the right of the specification line. If an entry exists under the related/choice file columns, this implies that any entry in the corresponding database field is required to use an existing entry from the specified related/choice file and field.

Field types and widths for each attribute are assigned using formats from the existing FDMS 1.0 format whenever possible. Field types supported include: string (fixed-length strings), vstring (variable-length strings), character, integer (4 byte integer) ushort (unsigned 2 byte integer), ulong (unsigned 4 byte integer), float (single precision floating point), date, logical, and choice. Logical field types allow "Yes" or "No," "On" or "Off" type entries. Choice fields support selection of one value from an enumerated set of choices in the CHOICE data file. The format of the CHOICE data file is detailed in subsection 2.9.6. Possible entries for any choice field are enumerated for that field name in section 4.

Variable length fields, vlength, store a 4 byte integer count indicating the number of remaining elements in the field. The interpretation of the 4 byte leading integer in these variable length fields is dependent on the contents of other fields within the physical database record. If other fields indicate that the information following the count is a text string, each element is decoded as a 1 byte character. If other fields indicate that the information following the count is an array, each element is decoded as a 4 byte floating point number. All other records are interpreted as containing scalar data in the vlength fields and only one 4 byte value after the counter is decoded. Implementation of this new field type has made it possible to consolidate the TSTCONDI, TSTCONDR, and TSTCONDS files into one TESTCOND file. Similarly, the TSTMEASI, TSTMEASR, and TSTMEASS files have been combined into one TESTMEAS file. For each record in the TESTCOND and TESTMEAS file, the corresponding derived measurement is accessed in the DRVDMEAS file using the DRVID field relation. The contents of the DRVFORM field for the derived measurement are then used to interpret the type of data stored in the VALUE field of the original TESTCOND or TESTMEAS record. If no entry exists for the measurement in the DRVDMEAS file, the measurement is assumed to be vector floating point.

There are two common techniques for storing date fields in database applications. The first technique requires the establishing of a base year for all stored dates. An unsigned short integer field is then used to store a year offset of 0-119 packed into bits 9-15. The month is stored in bits 5-8 and the day in bits 0-4. For a date MM/DD/YYYY and a base year 1980, the stored short integer value would be $(YYYY-1980)*512 + MM*32 + DD$. The other storage approach requires an unsigned long integer and can store any date MM/DD/YYYY as $YYYY*10000 + MM*100 + DD$. This approach does not require a base year and can accommodate a large range of dates. Because storage in a FDMS database is likely to become an issue in the future, the first storage technique has been selected with a base year of 1970. This provides storage for any date from 1970 - 2089. This range can be easily adjusted by changing the base year. However, if this date range is inadequate, the base year should be adjusted prior to storing any dates in the database in order to avoid extensive modifications to existing data in the future. It is also possible to convert this date format to the longer format in the future if the upper date limit becomes a problem.

Two bookkeeping fields are added to the PEOPLE, ORGANISE, AFFILIAT, PRODUCT, INSTRUM, DRVDMEAS, DOCUMENT, METHOD, and TEST files. Since these fields pertain only to the internal handling of the physical files, they are not indicated as attributes in the logical views. The PRIVATE field is used to determine a level of update/view access for each record in the file. The LAST_UPD field stores the latest date for which the record information is considered current. This prevents outdated information imported from other FDMS applications from overwriting a more current version of the data.

The remainder of this physical file section details file formats under subsection headings that correspond to the logical view subsections. For each subsection, the width and decimal columns reflect storage requirements for string field types only. All other entries in these columns indicate display formats. Physical storage requirements are determined by the field type. If an

entry exists under the related/choice file columns, this implies that any entry in the corresponding database field is required to use an existing entry from the specified related/choice file and field.

2.3 Fire Professionals and Affiliated Organizations

2.3.1 ORGANISE

In addition to the field name change below, a new index has been created to assist in searching the file using the contents of the ORGTYPE field. This field supports grouping of organizations based on the type of business.

<u>Field Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>Related/Choice File</u>	<u>Choice Field</u>
ORGID	String	10			
ORGTYPE	Choice				
LAST_UPD	Date				
PRIVATE	Choice				
ORGANISE	VString				
DIVISION	VString				
ADDRESS1	VString				
ADDRESS2	VString				
CITY	VString				
REGION	VString				
POSTCODE	VString				
COUNTRY	VString				
PHONE	VString				
MORPHONE	VString				
FAX	VString				
TELEX	VString				
E_MAIL	VString				E-MAIL

2.3.2 ORGNOTES

<u>Field Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>Related/Choice File</u>	<u>Choice Field</u>
ORGID	String	10		ORGANISE	ORGID
SEQNO	UShort				
NOTE	VString				

2.3.3 PEOPLE

The LASTNAME, FRSTNAME, and MIDNAME fields have replaced the FULLNAME field in the previous design. This provides for easier sorting based on individual's names with the disadvantage that the three fields must now be concatenated in order to display the full name. The new TITLE field provides storage for professional titles such as *Professor* or *Dr.* Position titles should be stored in the POSITION field of the AFFILIAT file.

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
PERSONID	String	10			
LAST_UPD	Date				
PRIVATE	Choice				
LASTNAME	VString				*** NEW ***
FRSTNAME	VString				*** NEW ***
MIDNAME	VString				*** NEW ***
NICKNAME	VString				
TITLE	VString				*** NEW ***

2.3.4 PERNOTES

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
PERSONID	String	10			
SEQNO	UShort				
NOTE	VString				

2.3.5 AFFILIAT

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
PERSONID	String	10		PEOPLE	PERSONID
ORGID	String	10		ORGANISE	ORGID
DATE_BEG	Date				
DATE_END	Date				
LAST_UPD	Date				
PRIVATE	Choice				
POSITION	VString				
ADDRESS1	VString				
ADDRESS2	VString				
CITY	VString				
REGION	VString				
POSTCODE	VString				
COUNTRY	VString				
PHONE	VString				
MORPHONE	VString				
FAX	VString				
TELEX	VString				
E-MAIL	VString				

2.3.6 AFFNOTES

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
PERSONID	String	10		PEOPLE	PERSONID
ORGID	String	10		ORGANISE	ORGID
SEQNO	UShort				
NOTE	VString				

2.4 Fire Test Products

2.4.1 PRODUCT

The previous field names PRODENS, PROCOND, PROSHEAT, PROEMISS, and PROTHICK have been replaced with generic field names that can be used in other files to indicate the same type of information. For these fields, values specific to the product design are stored in this file. Variations from these values specific to a specimen tested are stored in corresponding fields in the TESTPROD file. New fields have been added to store the length, height, and mass dimensions for a designed product. These fields also have corresponding fields in the TESTPROD file to accommodate differences in actual specimen tests.

Field Name	Type	Width	Decimal	Related/Choice File	Choice Field
PRODID	String	10			
MAINUSE	Choice				
COMPOS	Logical				
DENSITY	Float			PRODENSI	
LENGTH	Float			*** NEW ***	
HEIGHT	Float			*** NEW ***	
THICK	Float			PROTHICK	
MASS	Float			*** NEW ***	
COND	Float			PROCOND	
SPHEAT	Float			PROSHEAT	
EMISS	Float			PROEMISS	
LAST_UPD	Date				
PRIVATE	Choice				
PRODNAME	VString				

2.4.2 PRODNOTE

Field Name	Type	Width	Decimal	Related/Choice File	Choice Field
PRODID	String	10		PRODUCT	PRODID
SEQNO	UShort				
NOTE	VString				

2.4.3 PRODBASE

Field Name	Type	Width	Decimal	Related/Choice File	Choice Field
PRODMAIN	String	10		PRODUCT	PRODID
PRODSUB	String	10		PRODUCT	PRODID
LAYERID	VString				

2.4.4 PRODSUPP

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
PRODID	String	10		PRODUCT	PRODID
MANUFID	String	10		ORGANISE	ORGID
CATNO	Vstring				

2.5 Fire Test Measurements

Typically, temperature, pressure, length, energy, mass, and time are considered a comprehensive set of base measures in the scientific and engineering communities. The FDMS base measure implementation is an expanded set of this traditional set of base measures in an attempt to accommodate display unit variations in the same fire test method. For example, it is not uncommon for one test to record some derived temperature measurements using °C and other measures using K. In order to accommodate this exception, two temperature base measures are provided in FDMS: temperature and absolute temperature. The energy release rate and energy absorption rate base measures have been included as a convenience to the user since these measures commonly display as watts instead of kilojoules/second. Four base measures have been added to accommodate dimensionless measures. A ratio base measure handles numerical ratios of two measured or calculated values. For example, an average value for any measured variable would be represented as a ratio. Similarly, a percent base measure exists for those measures expressed as percentages of other measures. Dimensionless numerical measures which are not numerical ratios or percentages are handled by the dimensionless base measure. The text base measure deals with derived measures having display values such as "Yes" or "No," "Horizontal" or "Vertical," or text descriptions of observed behavior.

2.5.1 BASEMEAS

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
BASEID	String	10			
BASESTOR	Choice				
BASEDISP	Choice				
BASENAME	VString				

2.5.2 DRVDBASE

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
DRVID	String	10		DRVMEAS	DRVID
BASEID	String	10		BASEMEAS	BASEID
BASEPWR	Float				

2.5.3 DRVDMEAS

The field DRVVECSC from the original design has been deleted. This field is no longer needed since the DRVFORM field provides sufficient information to determine if the measurement is vector or scalar. The fields DRVWIDTH and DRVDCML have been changed from type integer to type ushort since a 2 byte integer is sufficient to store the width and number of decimal place positions and will require less storage space.

<u>Field Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>Related/Choice</u>	
				<u>File</u>	<u>Field</u>
DRVID	String	10			
DRVFORM	Choice				
DRVWIDTH	UShort				
DRVDCML	UShort				
LAST_UPD	Date				
PRIVATE	Choice				
DRVNAME	Vstring				

2.5.4 DRVDNOTE

<u>Field Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>Related/Choice</u>	
				<u>File</u>	<u>Field</u>
DRVID	String	10		DRVDMEAS	DRVID
SEQNO	UShort				
NOTE	Vstring				

2.5.5 Initial Installation Data

Base measures cannot be defined by the user. Storage units for base measures are the SI units and cannot be modified. Display units for the base measures are user selectable. Base measures available with an installed FDMS system, the corresponding storage units, and available display units are shown in the table below.

Table 1. FDMS Base Measurements

Base Measure	Display Units	Storage Units
Temperature	celsius, fahrenheit	kelvin
Absolute Temperature	kelvin, rankine	kelvin
Pressure	pascal, atmosphere, bar, mercury (mm of mercury), water (inches of water)	pascal
Length	meter, centimeter, millimeter, foot, inch	meter
Energy	joule, kilojoule, megajoule, btu	joule
Energy Release Rate	watt, kilowatt, megawatt, btu/s, btu/hour	watt
Energy Absorption Rate	watt, kilowatt, megawatt, btu/sec, btu/hour	watt
Mass	gram, kilogram, pound	kilogram
Time	second, hour, minute	second
Ratio		
Percent		
Dimensionless		
Text		

Derived measures are created through combinations of the individual base measures. The set of derived measures covers those vector and scalar measurements evaluated by the Cone Calorimeter, Furniture Calorimeter, LIFT, and the Room/Corner test in FDMS 1.0. Derived measures are also provided for any setup conditions required by these same test methods. Additional derived measures can be created as needed by the user for other test methods. One of the strengths of this physical file implementation is the ability to easily generate new derived measures, and consequently, new fire test methods, without creating a new physical file structure.

Storage units for derived measures are determined by the storage units for the base measures. Display units are determined by the user selected base measure display units. Data acquisition units are determined by the individual test methods and are discussed in subsection 2.6. Derived measures provided in FDMS, the component base measures, and the current usage as scalar or vector are indicated in table 2. Note that the use of scalar and/or vector values for a measure reflects an initial definition. Some measures (for example, thermal conductivity) could be either scalar or vector in a specific application of FDMS.

Table 2. FDMS Derived Measurements

Derived Measures			
Short Label	Long Label	Base Measure	<u>Scalar/Vector</u>
AREA	Specimen area.	Length ²	S
ASCARITE	Indicates if CO ₂ was removed from the sample before O ₂ was measured using Ascarite or equivalent means.	Text	S
AVGCO	Test average of the CO yield.	Ratio	S
AVGCO2	Test average of the CO ₂ yield.	Ratio	S
AVGH2O	Test average of the H ₂ O yield.	Ratio	S
AVGHC	Test average of the effective heat of combustion.	Energy · mass ⁻¹	S
AVGMDOT	Test average of the mass loss rate.	Mass · time ⁻¹ · length ⁻²	S
AVGQDOT	Test average of the rate of heat release.	Energy release rate · length ⁻²	S
AVGSIGMA	Test average of the specific smoke extinction area.	Length ² · mass ⁻¹	S
B-LIFT	LIFT Ignition parameter.	Time ^{-0.5}	S
BURNER	Burner heat release rate.	Energy release rate	V
BURNSPEC	Heat output values specified for the burner program.	Energy release rate	S
C-CONE	Orifice constant as determined from the CH ₄ burner calibration.	Length ^{0.5} · mass ^{0.5} · temperature ^{0.5}	S
C-LIFT	Slope of correlated flame spread data.	Time ^{0.5} · length ^{1.5} · energy release rate ⁻¹	S
CO60	Average CO yield over 60 seconds subsequent to ignition.	Ratio	S
CO180	Average CO yield over 180 seconds subsequent to ignition.	Ratio	S

Derived Measures			
Short Label	Long Label	Base Measure	Scalar/Vector
CO300	Average CO yield over 300 seconds subsequent to ignition.	Ratio	S
CONDUCT	Conductivity.	Energy absorption rate · length ⁻¹ · temperature ⁻¹	S
COPROD	Production rate of Carbon monoxide.	Mass · time ⁻¹	V
COSTACK	Carbon monoxide concentration in exhaust stack.	Percent	V
COYIELD	Carbon monoxide yield.	Ratio	V
CO260	Average CO ₂ yield over 60 seconds subsequent to ignition.	Ratio	S
CO2180	Average CO ₂ yield over 180 seconds subsequent to ignition.	Ratio	S
CO2300	Average CO ₂ yield over 300 seconds subsequent to ignition.	Ratio	S
CO2PROD	Production rate of Carbon dioxide.	Mass · time ⁻¹	V
CO2STACK	Carbon dioxide concentration in exhaust stack.	Percent	V
CO2YIELD	Carbon dioxide yield.	Ratio	V
DENSITY	Density.	Mass · length ⁻³	S
E	Oxygen consumption constant.	Energy · mass ⁻¹	S
EXTCOEFF	Smoke extinction coefficient in exhaust stack.	Length ⁻¹	V
FLAMEOUT	Time to flameout.	Time	S
FLASH	Time when flashover is observed in the room.	Time	S

Derived Measures			
Short Label	Long Label	Base Measure	Scalar/Vector
FLOW	Flow rate of a gas burner.	Mass · time ⁻¹	S
FLOWDUCT	Duct flow rate.	Mass · time ⁻¹	V
FLOWGAS	Flow rate of gas to ignition burner.	Mass · time ⁻¹	V
FLOWVEL	Volumetric flow rate.	Length ³ · time ⁻¹	V
FLUX	Flux.	Energy release rate · length ⁻²	S
FLUXCEIL	Heat flux measurement at compartment ceiling.	Energy release rate · length ⁻²	V
FLUXFLOR	Heat flux measurement at compartment floor.	Energy release rate · length ⁻²	V
FRAME	Denotes if the edge frame was used.	Text	S
GRID	Denotes if the wire grid was used.	Text	S
H2O60	Average H ₂ O yield over 60 seconds subsequent to ignition.	Ratio	S
H2O180	Average H ₂ O yield over 180 seconds subsequent to ignition.	Ratio	S
H2O300	Average H ₂ O yield over 300 seconds subsequent to ignition.	Ratio	S
H2OPROD	Production rate of water vapor.	Mass · time ⁻¹	V
H2OSTACK	Water vapor concentration in exhaust stack.	Percent	V
H2OYIELD	Water vapor yield.	Ratio	V
HBR	HBr yield.	Ratio	S
HC	Effective heat of combustion.	Energy · mass ⁻¹	V

Derived Measures			
Short Label	Long Label	Base Measure	Scalar/Vector
HC60	Average heat of combustion over 60 seconds subsequent to ignition.	Energy · mass ⁻¹	S
HC180	Average heat of combustion over 180 seconds subsequent to ignition.	Energy · mass ⁻¹	S
HC300	Average heat of combustion over 300 seconds subsequent to ignition.	Energy · mass ⁻¹	S
HCL	HCl yield.	Ratio	S
HCLPROD	Production rate of HCl.	Mass · time ⁻¹	V
HCLSTACK	Hydrogen chloride concentration in exhaust stack.	Percent	V
HCLYIELD	Hydrogen chloride yield.	Ratio	V
HCN	HCN yield.	Ratio	S
HRR	Heat release rate.	Energy release rate	V
HRR/A	Heat release rate per unit area.	Energy release rate · length ⁻²	V
HRRTOT	Total heat released.	Energy	V
IGNITOR	Ignitor used.	Text	S
IGNTYPE	Ignition type.	Text	S
INERTIA	Thermal inertia.	Energy release rate ² · time · length ⁻⁴ · absolute temperature ⁻²	S
IRRAD	Heat flux calibration meter.	Energy release rate · length ⁻²	V
LOCATION	Location of the specimen.	Text	S
MASS	Specimen mass.	Mass	V
MASS/A	Specimen mass per unit area.	Mass · length ⁻²	V

Derived Measures			
Short Label	Long Label	Base Measure	Scalar/Vector
MASSF	Specimen mass at the end of the test.	Mass	S
MASSFLOW	Mass flow rate.	Mass · time ⁻¹	V
MASSI	Specimen mass before the start of the test.	Mass	S
MASSLOSS	Specimen mass loss during the test.	Mass	S
MAXEXT	Maximum value of the smoke extinction area flow rate.	Length ² · time ⁻¹	S
MAXMDOT	Peak mass loss rate.	Mass · time ⁻¹ · length ⁻²	S
MAXQDOT	Peak rate of heat release.	Energy release rate · length ⁻²	S
MAXSIGMA	Peak specific smoke extinction area.	Length ² · mass ⁻¹	S
MAXTIME	Time to the peak rate of heat release.	Time	S
MDOT60	Average mass loss rate over 60 seconds subsequent to ignition.	Mass · time ⁻¹ · length ⁻²	S
MDOT180	Average mass loss rate over 180 seconds subsequent to ignition.	Mass · time ⁻¹ · length ⁻²	S
MDOT300	Average mass loss rate over 300 seconds subsequent to ignition.	Mass · time ⁻¹ · length ⁻²	S
MLR	Mass loss rate of the sample.	Mass · time ⁻¹	V
MLR/A	Mass loss rate of the sample per unit area.	Mass · time ⁻¹ · length ⁻²	V
MOUNT	Specifies the means of mounting.	Text	S
O2SUPPLY	Oxygen concentration in supply air.	Percent	V
O2STACK	Oxygen concentration in exhaust stack.	Percent	V

Derived Measures			
Short Label	Long Label	Base Measure	Scalar/Vector
ORIENT	Specimen orientation, horizontal or vertical.	Text	S
OXYGEN	Nominal value of the oxygen concentration in the enclosure around the heater and sample.	Percent	S
PHI	Flame heating parameter.	Energy release rate ² · length ⁻³	S
PILOT	Indicates if ignition was piloted.	Text	S
PRESORI	Pressure drop across exhaust orifice plate.	Pressure	V
PRESPROB	Pressure drop across bi-directional flow probe.	Pressure	V
PRESTUBE	Pressure difference at pitot-static tube.	Pressure	V
PYRLYSIS	Pyrolysis rate.	Mass · time ⁻¹	V
QDOT60	Average rate of heat release over 60 seconds subsequent to ignition.	Energy release rate · length ⁻²	S
QDOT180	Average rate of heat release over 180 seconds subsequent to ignition.	Energy release rate · length ⁻²	S
QDOT300	Average rate of heat release over 300 seconds subsequent to ignition.	Energy release rate · length ⁻²	S
QIG	Minimum flux for ignition.	Energy release rate · length ⁻²	S
QSMIN	Minimum flux for spread.	Energy release rate · length ⁻²	S
RHCOND	Relative humidity for specimen conditioning.	Percentage	S
RHTEST	Relative humidity of the supply air for conducting the test.	Percentage	S

Derived Measures			
Short Label	Long Label	Base Measure	Scalar/Vector
SEA	Smoke specific extinction area in exhaust stack.	$\text{Length}^2 \cdot \text{mass}^{-1}$	V
SEARATE	Smoke extinction area flow rate.	$\text{Length}^2 \cdot \text{time}^{-1}$	V
SIGMA60	Average specific smoke extinction area over 60 seconds subsequent to ignition.	$\text{Length}^2 \cdot \text{mass}^{-1}$	S
SIGMA180	Average specific smoke extinction area over 180 seconds subsequent to ignition.	$\text{Length}^2 \cdot \text{mass}^{-1}$	S
SIGMA300	Average specific smoke extinction area over 300 seconds subsequent to ignition.	$\text{Length}^2 \cdot \text{mass}^{-1}$	S
SOOT	Ratio of mass of soot deposited on the soot filter to mass of specimen loss during the test.	Ratio	S
SOOTMASS	Soot mass sampler flow rate.	$\text{Mass} \cdot \text{time}^{-1}$	V
SPHEAT	Specific heat.	$\text{Energy} \cdot \text{mass}^{-1} \cdot \text{temperature}^{-1}$	S
SUMEXT	Total smoke extinction area released during the test.	Length^2	S
SURFDENS	When thin textiles, papers, etc. are covering some standard substrate, it is most appropriate to describe them by their surface density.	$\text{Mass} \cdot \text{length}^{-3}$	S
TEMP1	Temperature at specimen location 1.	Temperature	V
TEMP2	Temperature at specimen location 2.	Temperature	V
TEMP3	Temperature at specimen location 3.	Temperature	V

Derived Measures			
Short Label	Long Label	Base Measure	Scalar/Vector
TEMPCOND	Temperature for specimen conditioning.	Temperature	S
TEMPFLOW	Temperature at the flow measuring station.	Temperature	V
TEMPGAS	Temperature of the gas at specified depth in compartment.	Temperature	V
TEMPLAS	Temperature at laser extinction beam.	Temperature	V
TEMPORI	Temperature at the orifice plate.	Temperature	V
TEMPSMK	Temperature at the smoke meter.	Temperature	V
TEMPSTCK	Temperature of gas in exhaust stack.	Temperature	V
TEMPSURF	Surface temperature of the ceiling or wall at specified location.	Temperature	V
TEMPTEST	Temperature of the supply air for conducting the test.	Temperature	S
THICK	Specimen thickness.	Length	S
TIG	Minimum temperature for ignition.	Temperature	S
TIGN	Time to ignition.	Time	S
TIME	Time from start of ignition source.	Time	V
TOTLHEAT	Total heat released during the test	Energy	S
TOTLHEAT/ A	Total heat released during the test per unit area.	Energy · length ⁻²	S
TSMIN	Minimum temperature for spread.	Temperature	S

Derived Measures			
Short Label	Long Label	Base Measure	Scalar/Vector
TSTAR	Characteristic equilibrium or thermal steady state time.	Time	S
TUH	Total unburned fuel yield.	Ratio	S
TUHSTACK	Total unburned hydrocarbon concentration in exhaust stack.	Percent	V
TUHYIELD	Total hydrocarbons yield.	Ratio	V
VELOCITY	Velocity.	Length · time ⁻¹	V
VOLLAS	Volumetric flow at laser extinction beam.	Length ³ · time ⁻¹	V
VOLSTACK	Volumetric flow in exhaust stack.	Length ³ · time ⁻¹	V
VOLUME	Volume.	Length ³	S

2.6 Fire Test Methods

The logical view for fire test methods can be implemented in several ways. The traditional approach creates one physical file for each test method with a field position assigned to each setup condition and test measurement. In this implementation, the test method description is the file format description for the storage of the actual test results. Methods measuring a common derived measurement might assign these fields at different positions within the different method files and could potentially use different field formats for each. The consequence is that inquiries for the fire test results of a particular derived measurement regardless of test method can be difficult to obtain. All files with this measurement field would need to be searched individually. The search is complicated by the varying position and field format of the measurement field for each test method format. Additionally, the creation and modification of physical file formats for individual test methods involves programming effort.

The alternative approach implemented in FDMS creates a record for each test method in a combined file of methods, **METHOD**. For each test method entry in this file, additional records specifying setup conditions and test measurements are stored in the METHMEAS file, one for each derived measurement. One physical file is used to store setup conditions and test measurement definitions with differentiation handled by a logical field, MEASCOND, for each record. The differentiation between setup conditions and test measurements becomes important in the storage implementation of the test results since additional information is required for the

test measurements. This physical implementation for fire test methods allows new measurements to be added to existing methods, old measurements to be deleted, and new methods to be defined without generating new file structures or programming routines. Queries for the values of a selected derived measurement can be handled without requiring knowledge of the particular file, field, or format specifiers. Storage for the actual test results is handled by the files discussed in subsection 2.7.

For each setup condition and test measurement within the method, data acquisition units can be specified. These are the units the laboratory used in evaluating the measurement and are needed to determine how to convert imported values to the appropriate stored SI units for that derived measurement in a FDMS database. If no units are specified for the measurement, the default assumed will be the SI storage units for that derived measurement. Most derived measurements are generated from 2 to 3 base measurements. However, this is not a number which can be assumed since derived measurements now or in the future could be composed of 4, 5, or more base measurements each. For each base measurement composing the derived measurement, a different data acquisition unit must be specified. In order to accommodate the varying number of components, the traditional database implementation generates individual records in a separate file, one for each component base measurement, indicating the data acquisition units for that base measurement. An alternative approach could store the base measurement units as a comma-delimited variable length string in the METHMEAS file for the derived measurement. The problem with this approach is in determining the order with which to match the units to the component base measurements. Since the composition of a derived measurement could potentially be altered at a later time by a user, this further complicates interpretation of this string when implementing data conversion. For this reason, the traditional approach is implemented in FDMS 2.0 with one modification. For each measurement in METHMEAS, a flag field is used to indicate when the default SI storage units should override the user specified units. This prevents the need to delete the individual records when switching back to the default only to create new records at a later time. For further details on the use of the data acquisition units when importing data, refer to section 4.

2.6.1 METHOD

A new index has been created to assist in searching the file using the contents of the METHTYPE field. This field supports grouping of test methodologies based on the scale of the type: bench-scale, intermediate-scale, and full-scale.

Field		Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u> <u>Field</u>
METHID	String	10		
METHTYPE	Choice			
LAST_UPD	Date			
PRIVATE	Choice			
METHNAME	VString			

2.6.2 METHMEAS

The field MEASCOND has been deleted. A new file METHCOND has been created to store method conditions separate from method measurements. This is consistent with the original design storing test conditions and test measurements in separate physical files.

Field				Related/Choice	
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
METHID	String	10		METHOD	METHID
DRVID	String	10		DRVDMEAS	DRVID
DATAACQU	Logical				

2.6.3 METHACQU

Field				Related/Choice	
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
METHID	String	10		METHOD	METHID
DRVID	String	10		DRVDMEAS	DRVID
BASEID	String	10		BASEEMEAS	BASEID
BASEACQU	Choice				

2.6.4 METHDOC

Field				Related/Choice	
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
METHID	String	10		METHOD	METHID
DOCID	String	10		DOCUMENT	DOCID

2.6.5 METHNOTE

Field				Related/Choice	
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
METHID	String	10		METHOD	METHID
SEQNO	UShort				
NOTE	VString				

2.6.6 METHCOND

This new file can be used to store method conditions separate from method measurements. This is consistent with the original design storing test conditions and test measurements in separate physical files.

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
METHID	String	10		METHOD	METHID
DRVID	String	10		DRVDMEAS	DRVID
DATAACQU	Logical				

2.6.7 DOCUMENT

The new field ADMIN provides storage for a document ID internal to the originating organization. For example, reports generated at NIST typically are noted as NISTIRxxxx or NISTTNxxxx. This field accommodates these administrative, internal codes. The field DOCID could store a NIST reference number for any document if that number is available. Otherwise, an internal identifier is generated for that document. The fields DOCORG and DOCDATE were the field STDORG and STDDATE in earlier versions of the FDMS format. Identifying the fields as documents allows inclusion of documents other than standards.

The new field DOCVIDEO indicates if the document is stored as a video. This allows for future development efforts which could allow users of a FDMS database the ability to play movies stored as documents.

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
DOCID	String	10			
DOCSTD	Logical				
DOCORG	String	10		ORGANISE	ORGID
DOCDATE	Date				
AUTHID	String	10		PERSON	PERSONID *** NEW ***
ADMIN	String	20			*** NEW ***
DOCVIDEO	Logical				*** NEW ***
LAST_UPD	Date				
PRIVATE	Choice				
DOCTITLE	VString				

2.6.8 DOCNOTE

Field Name	Type	Width	Decimal	Related/Choice	
				File	Field
DOCID	String	10		DOCUMENT	
SEQNO	UShort				
NOTE	VString				

2.6.9 Initial Installation Data

Test methods initially defined within for use by NIST include the Cone Calorimeter, the Furniture Calorimeter, the Lateral Ignition and Flame spread Test apparatus, and the room/corner test. Entries provided for each include:

Table 3. FDMS Test Methodology Codes

Test Methodologies		
Code	Description	Currently in Database
1ROOM	1 room tests at NBS, 1985.	6
3ROOMCORR	3 room with corridor tests at NBS, 1988.	28
4ROOMCORR	4 room with corridor tests at Factory Mutual for NBS, 1986.	56
CONE	Cone Calorimeter tests for EUREFIC community, 1990.	87
CONE	Cone Calorimeter tests for furniture project at NIST, 1992-1994.	59
FREEBURN	Freeburn tests at NBS, 1985.	6
MULTSTORY	Plaza Hotel tests by NBS, 1990.	11
ROOM	Room/Corner tests for EUREFIC community, 1990.	18
ROOM	Room/Corner tests at NBS, 1984.	4

Table 4. FDMS Derived Measurements and Data Acquisition Units by Test Method

Derived Measurement	Method Measurements		
	Method Short Label	Measure/Condition	Data Acquisition Units
ASCARITE	CONE, FURN, ROOM	C	
AVGCO	CONE, FURN, ROOM	M	kg/kg

Method Measurements			
Derived Measurement	Method Short Label	Measure/Condition	Data Acquisition Units
AVGCO2	CONE, FURN, ROOM	M	kg/kg
AVGH2O	CONE, FURN, ROOM	M	kg/kg
AVGHC	CONE, FURN, ROOM	M	MJ/kg
AVGMDOT	CONE, FURN, ROOM	M	g/(s·m ²)
AVGQDOT	CONE, FURN, ROOM	M	kW/m ²
AVGSIGMA	CONE, FURN, ROOM	M	m ² /kg
B-LIFT	LIFT	M	s ^{-0.5}
BURNER	ROOM	C	kW
BURNSPEC	ROOM	M	
C-CONE	CONE, FURN	C	
C-LIFT	LIFT	M	s ^{0.5} · m ^{0.5} · W ⁻¹
CO60	CONE, FURN, ROOM	M	kg/kg
CO180	CONE, FURN, ROOM	M	kg/kg
CO300	CONE, FURN, ROOM	M	kg/kg
COPROD	ROOM	M	g/s
COSTACK	CONE, FURN, ROOM	M	
COYIELD	CONE, FURN, ROOM	M	kg/kg
CO260	CONE, FURN, ROOM	M	kg/kg
CO2180	CONE, FURN, ROOM	M	kg/kg
CO2300	CONE, FURN, ROOM	M	kg/kg
CO2PROD	ROOM	M	g/s
CO2STACK	CONE, FURN, ROOM	M	
CO2YIELD	CONE, FURN, ROOM	M	kg/kg
E	CONE, FURN, ROOM	C	kJ/g
EXTCOEFF	CONE, FURN, ROOM	M	m ⁻¹
FLAMEOUT	CONE, FURN, LIFT, ROOM	M	s
FLASH	ROOM	M	s
FLOW	CONE, FURN, ROOM	C	kg/s
FLOWDUCT	CONE, FURN, ROOM	M	kg/s

Method Measurements			
Derived Measurement	Method Short Label	Measure/Condition	Data Acquisition Units
FLOWGAS	FURN, ROOM	M	kg/s
FLUX	CONE, FURN, ROOM	C	kW/m ²
FLUXCEIL	ROOM	M	kW/m ²
FLUXFLOR	ROOM	M	kW/m ²
FRAME	CONE	C	
GRID	CONE	C	
H2O60	CONE, FURN, ROOM	M	kg/kg
H2O180	CONE, FURN, ROOM	M	kg/kg
H2O300	CONE, FURN, ROOM	M	kg/kg
H2OPROD	ROOM	M	g/s
H2OSTACK	CONE, FURN, ROOM	M	
H20YIELD	CONE, FURN, ROOM	M	kg/kg
HBR	CONE, FURN, ROOM	M	kg/kg
HC	CONE, FURN, ROOM	M	MJ/kg
HC60	CONE, FURN, ROOM	M	MJ/kg
HC180	CONE, FURN, ROOM	M	MJ/kg
HC300	CONE, FURN, ROOM	M	MJ/kg
HCL	CONE, FURN, ROOM	M	kg/kg
HCLPROD	ROOM	M	g/s
HCLSTACK	CONE, FURN, ROOM	M	
HCLYIELD	CONE, FURN, ROOM	M	kg/kg
HCN	CONE, FURN, ROOM	M	kg/kg
HRR	ROOM	M	kW
HRR/A	CONE, FURN	M	kW/m ²
HRRTOT	ROOM	M	kJ
IGNITOR	ROOM	C	
IGNTYPE	FURN	C	
INERTIA	LIFT	M	kW ² · s · m ⁻⁴ · K ⁻²
IRRAD	CONE, FURN, ROOM	M	kW/m ²

Method Measurements			
Derived Measurement	Method Short Label	Measure/Condition	Data Acquisition Units
LOCATION	ROOM	C	
MASS	CONE, FURN, ROOM	M	kg
MASS/A	CONE, FURN, ROOM	M	kg/m ²
MASSI	CONE, FURN, LIFT, ROOM	M	kg
MASSF	CONE, FURN, LIFT, ROOM	M	kg
MASSFLOW	ROOM	M	kg/s
MASSLOSS	CONE, FURN, LIFT, ROOM	M	kg
MAXEXT	ROOM	M	m ² /s
MAXMDOT	CONE, FURN, ROOM	M	g/(s·m ²)
MAXQDOT	CONE, FURN, ROOM	M	kW/m ²
MAXSIGMA	CONE, FURN, ROOM	M	m ² /kg
MAXTIME	CONE, FURN, ROOM	M	s
MDOT60	CONE, FURN, ROOM	M	g/(s·m ²)
MDOT180	CONE, FURN, ROOM	M	g/(s·m ²)
MDOT300	CONE, FURN, ROOM	M	g/(s·m ²)
MLR	CONE, FURN, ROOM	M	g/s
MLR/A	CONE, FURN, ROOM	M	g/(s·m ²)
MOUNT	ROOM	C	
O2STACK	CONE, FURN, ROOM	M	
O2SUPPLY	CONE, FURN, ROOM	M	
ORIENT	CONE	C	
OXYGEN	CONE, FURN, ROOM	C	
PHI	LIFT	M	kW ² /m ³
PILOT	CONE	C	
PRESORI	CONE, FURN, ROOM	M	Pa
PRESPROB	FURN, ROOM	M	Pa
PRESTUBE	FURN, ROOM	M	Pa
QDOT60	CONE, FURN, ROOM	M	kW/m ²
QDOT180	CONE, FURN, ROOM	M	kW/m ²

Method Measurements			
Derived Measurement	Method Short Label	Measure/Condition	Data Acquisition Units
QDOT300	CONE, FURN, ROOM	M	kW/m ²
QIG	LIFT	M	kW/m ²
QSMIN	LIFT	M	kW/m ²
RHCOND	CONE, FURN, LIFT, ROOM	C	
RHTEST	CONE, FURN, LIFT, ROOM	C	
SEA	CONE, FURN, ROOM	M	m ² /kg
SEARATE	CONE, FURN, ROOM	M	m ² /s
SIGMA60	CONE, FURN, ROOM	M	m ² /kg
SIGMA180	CONE, FURN, ROOM	M	m ² /kg
SIGMA300	CONE, FURN, ROOM	M	m ² /kg
SOOT	CONE, FURN, ROOM	M	kg/kg
SOOTMASS	CONE, FURN, ROOM	M	kg/s
SUMEXT	ROOM	M	m ²
SURFDENS	ROOM	C	kg/m ³
TEMP1	CONE, FURN, ROOM	M	°C
TEMP2	CONE, FURN, ROOM	M	°C
TEMP3	CONE, FURN, ROOM	M	°C
TEMPCOND	CONE, FURN, LIFT, ROOM	C	°C
TEMPFLOW	FURN, ROOM	M	°C
TEMPGAS	ROOM	M	°C
TEMPLAS	CONE	M	°C
TEMPORI	CONE	M	°C
TEMPSMK	CONE, FURN, ROOM	M	°C
TEMPSURF	ROOM	M	°C
TEMPSTCK	ROOM	M	°C
TEMPTEST	CONE, FURN, LIFT, ROOM	C	°C
TIG	LIFT	M	°C
TIGN	CONE, FURN, LIFT, ROOM	M	s
TOTLHEAT	CONE, FURN, ROOM	M	MJ

Method Measurements			
Derived Measurement	Method Short Label	Measure/Condition	Data Acquisition Units
TOTLHEAT/A	CONE, FURN, ROOM	M	MJ/m ²
TSMIN	LIFT	M	°C
TSTAR	LIFT	M	s
TUH	CONE, FURN, ROOM	M	kg/kg
TUHSTACK	CONE, FURN, ROOM	M	
TUHYIELD	CONE, FURN, ROOM	M	kg/kg
VOLLAS	CONE	M	m ³ /s
VOLSTACK	CONE, FURN, ROOM	M	m ³ /s

2.7 Fire Test Results

The physical file implementation for the fire setup condition values requires several files. The need for this type of implementation can be seen when the formats of the values are considered. Because the set of derived measurements specified as setup conditions has a variety of value formats, for example, integer, floating point, or string, implementation in one combined file requires that the value field be stored as a variable length string. The physical file TESTCOND replaces the three files TSTCONDI, TSTCONDR, and TSTCONDS in earlier designs.

The physical file implementation for the fire test measurements is similar to the setup condition values. Similar to the TESTCOND file, the TSTMEASI, TSTMEASR, and TSTMEASS files have been combined into one TESTMEAS file.

Vector value test measurements require a third type of file implementation. Several alternatives were considered for the implementation of the vector values. One alternative stores all vector measurements for a test in a common external file with a file identifier stored as a field for that test in FDMS. This is the approach used in FDMS 1.0. With this implementation approach, queries for the results of a particular measurement involve reading all entries in the file and selecting the appropriate time and value entries. This is a time-consuming interface for fire models since multiple disk accesses are involved making this approach unacceptable. A more traditional database approach stores one record for each derived measurement scan using a particular instrument and position. For example, suppose stored vector values for the carbon dioxide concentration in the exhaust stack are queried for the value at time 20 seconds. Seven CO2STACK records are stored:

```
CO2STACK 0 .141575
CO2STACK 5 0.1511
```

```

CO2STACK 10 0.181125
CO2STACK 15 0.238425
CO2STACK 20 0.2998
CO2STACK 25 0.35435
CO2STACK 30 0.408925

```

To determine the value at time 20 seconds, one disk access is required. However, the time values must be repeated for each distinct derived measurement scan. For an FDMS application using floating point time values, storage requirements for the time and value pair are 8 bytes for each record entry. Also, since the time is part of the primary index with this approach, an entry is also required in the index file. Entries in the index file are stored as string equivalents rather than the 4 byte floating point representation. Consequently, for each time and value pair in the database, a minimum of 12 bytes is required for storage. The approach implemented in FDMS combines the two previous approaches and creates one database record for each derived measurement. Vector values are stored as a comma-delimited string. This approach provides quick access to a particular measurement but requires accessing a separate TIME record to determine individual time points. For the previous example, two vector records are stored as follows:

```

TIME      0,5,10,15,20,25,30
CO2STACK 0.141575,0.1511,0.181125,0.238425,0.2998,0.35435,0.408925

```

To determine the value at time 20 seconds, the TIME record is accessed first. The number of values until time 20 is counted, in this case, 5. The CO2STACK record is now accessed and the string parsed until the fifth value is read. The answer to the query is 0.2998. Aside from two disk accesses, this parsing takes place in memory and should be fast. Storage requirements are determined by the length of each observation value represented as a string. However, since time is not repeated and is not stored as part of the index, storage of the floating point values as string values should require less storage space than the traditional database approach.

The primary key identifier for a particular test run stored in FDMS is a combination of the test method, the laboratory, the testdate, and a laboratory assigned internal test number. Since this primary key must be repeated for each record in the setup condition and test measurement physical files for that test, a large amount of storage space is required. For this reason, a unique unsigned 4 byte integer identifier is assigned by FDMS to each unique combination of test method, laboratory, testdate, and test number. This assigned test identifier, TESTID, is then stored for all related test records. The TESTID field is specific to local installations. If the combination of test method, laboratory, testdate, and test number do not already exist in the central database, a new TESTID value is generated.

Similarly, the primary key identifier for a set of vector test measurement scans is the derived measurement, the instrument used, and the x,y, and z positions of that instrument. This combination is assigned a unique unsigned 2 byte integer identifier, TESTIID, by FDMS to reduce the storage requirements for each scan of that measure in the vector value file. If TIME scan values are different for different derived measurements within a test method, an additional

TSTINSTR entry can be created for the TESTID which then generates a new TESTIID field to distinguish the two types of time scans.

2.7.1 TEST

The new field PEERSTAT provides an indicator of the status of the peer review process for individual tests stored in the Internet database.

Field Name	Type	Width	Decimal	Related/Choice	
				File	Field
METHID	String	10		METHOD	METHID
LABID	String	10		ORGANISE	ORGID
TESTDATE	Date				
TESTNO	UShort				
TESTID	ULong				
SPONID	String	10		ORGANISE	ORGID
SPCONTID	String	10		PEOPLE	PERSONID
OFFID	String	10		PEOPLE	PERSONID
OPERID	String	10		PEOPLE	PERSONID
REPDATE	Date				
RECEIVED	Date				
LAST_UPD	Date				
PRIVATE	Choice				
PEERSTAT	Logical				
SUMFLAG	Logical				
ADMIN	VString				
PROJECT	VString				

*** NEW ***

2.7.2 TSTINSTR

The new field DRVID addresses an oversight of the original design. The previous design indicated that the TESTIID field was generated to represent a unique combination of TESTID, DRVID, INSTRID, CVOL, and position within in the related TESTMEAS file. However, the DRVID field was inadvertently left out of the specified format. The field type for TESTIID has been changed from ushort to ulong as a requirement for allowing the database engine to automatically sequence this field. The XPOS, YPOS, and ZPOS fields have been combined with the CVOL field into a variable length string field. These values were not always available for stored instrumentations, and the level of detail implied was not required when exporting data to ASCII files. When exact positions are reported, the information is stored in combination with the instrumentation description as a text string. The field type for INTERVAL has been changed from ushort to float to accommodate values reported in contributed data files.

Field Name	Type	Width	Decimal	Related/Choice		
				File	Field	
TESTID	ULong			TEST	TESTID	
DRVID	String	10		DRVDMEAS	DRVID	*** NEW ***
TESTIID	ULong					
INSTRID	String	10		INSTR	INSTRID	
CHANNEL	UShort					
SCANS	UShort					
INTERVAL	Float					
CVOL	VString					

2.7.3 TESTPROD

The new field SPORG addresses an oversight of the original design. The file PRODSUPP provided for tracking all organizations which supplied a type of material, but no provision was made for indicating which organization was responsible for supplying the material for a particular test. The CVOL, XPOS, YPOS, and ZPOS fields provide for tracking of the compartment or control volume details of the location of each product tested in full-scale tests. Finally, the field MASS has been added to allow for specimen deviations from the design mass of a product tested. The design mass is stored in a corresponding field in the PRODUCT file. The order of the fields TESTID and PRODID has been reversed from the original design specification to correctly generate indices.

Field Name	Type	Width	Decimal	Related/Choice		
				File	Field	
TESTID	ULong			TEST	TESTID	
PRODID	String	10		PRODUCT	PRODID	
SPORG	String	10		ORGANISE	ORGID	*** NEW ***
SPDATE	Date					
CVOL	String	10		TESTCVOL	CVOL	*** NEW ***
XPOS	Float					*** NEW ***
YPOS	Float					*** NEW ***
ZPOS	Float					*** NEW ***
DENSITY	Float					
AREA	Float					
THICK	Float					
MASS	Float					*** NEW ***

2.7.4 TESTCOND

The physical file TESTCOND replaces the three files TSTCONDI, TSTCONDR, and TSTCONDSD in earlier designs. The field type for VALUE has been changed to the new vlength field type.

Field Name	Type	Width	Decimal	Related/Choice		
				File	Field	
TESTID	ULong			TEST	TESTID	
DRVID	String	10		DRVDMEAS	DRVID	
VALUE	VLength					

2.7.5 TESTMEAS

The physical file TESTMEAS replaces the three files TSTMEASI, TSTMEASR, and TSTMEASS in earlier designs. The order of the fields DRVID and TESTIID has been reversed from the original design specification to correctly generate indices. The new field TIMEID was needed to identify measurements for alternate time lines. The field type for TESTIID has been changed from ushort to ulong to correspond with the change in the TSTINSTR file. The field type for VALUE has been changed to the new vlength field type.

Field				Related/Choice	
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
TESTID	ULong			TEST	TESTID
DRVID	String	10		DRVDMEAS	DRVID
TESTIID	ULong			TESTINSTR	TESTIID
TIMEID	UShort				
VALUE	VLength				

*** NEW ***

2.7.6 TSTMEASV

Field				Related/Choice	
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
TESTID	ULong			TEST	TESTID
TESTIID	UShort			TESTINSTR	TESTIID
DRVID	String	10		DRVDMEAS	DRVID
VALUE	VString				

2.7.7 TESTNOTE

Field				Related/Choice	
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
TESTID	ULong			TEST	TESTID
SEQNO	UShort				
NOTE	VString				

2.7.8 TESTDOC

This file is used to store documents relating specifically to tests performed. The previous design provided for a tie between documents and descriptions of the test methodology, but made no provision for tying documents to reports or journal articles describing the results of the test.

Field				Related/Choice	
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
TESTID	ULong			TEST	TESTID
DOCID	String	10		DOCUMENT	DOCID

2.7.9 TESTCVOL

This file is used to store descriptions of various compartments, control volumes, or observation areas for full-scale tests including dimensions of each control volume, the type of burner used, and the location of the burner within the control volume.

Field		Related/Choice			
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
TESTID	ULong			TEST	TESTID
CVOL	String	10			
WIDTH	Float				
DEPTH	Float				
HEIGHT	Float				
BURNSTD	String	10			
BXPOS	Float				
BYPOS	Float				
BZPOS	Float				

2.7.10 SUMMARY

Once real-scale tests are imported into the FDMS format, the storage requirements of the data could quickly overload most storage platforms. For this reason, an additional physical file is provided to store the definitions of polynomial curves over a variety of time intervals for any of the derived measures recorded in the test. These curves can be used to reproduce statistically acceptable values for the original measures, but cannot be expected to produce exact values. Consider a test with scans every 5 seconds for 4 hours producing results for 50 measures throughout a room. This test will require space for (12 scans/minute) * (60 minutes/ hour) * (4 hours/measure) * (50 measures) = 144,000 results in the TSTMEASV file. If instead these values can be represented with 5 curves for each measure, and each curve is a polynomial of degree 3, the required space becomes (4 coefficients/curve) * (5 curves/ measure) * (50 measures) = 1000 results. The savings in space for large quantities of data can be easily seen.

Such summary files are envisioned for non-standardized, real-scale tests only. Results for these types of types can be distributed from a central database as either full vector values or the summary curves. All other data would be distributed as full vector values.

Field		Related/Choice			
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
TESTID	ULong			TEST	TESTID
TESTIID	UShort			TESTINSTR	TESTIID
DRVID	String	10		DRVDMEAS	DRVID
ISTART	Float				
PDEGREE	UShort				
COEF0	Float				
COEF1	Float				
COEF2	Float				

COEF3	Float
COEF4	Float
COEF5	Float

2.8 Instrumentation Types

2.8.1 INSTRUM

Field		Related/Choice			
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
INSTRID	String	10			
LAST_UPD	Date				
PRIVATE	Choice				
SERIAL	VString				

2.8.2 INSTRBAS

Field		Related/Choice			
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
INSTRMAN	String	10		INSTR	INSTRID
INSTRSUB	String	10		INSTR	INSTRID

2.8.3 INSTRNOT

Field		Related/Choice			
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
INSTRID	String	10		INSTR	INSTRID
SEQNO	UShort				
NOTE	VString				

2.8.4 Initial Installation Data

Instrumentation types will be stored in a file which can be expanded by the user. Instrument types which have been identified and will be provided with an installed FDMS system are listed below. Additional common instrumentation not included in this list should be noted so that they can be included with each initial installation of FDMS rather than requiring each user to create their own.

Table 5. FDMS Instrumentation Types

Instrument Type
Carbon Dioxide Analyzer
Carbon Monoxide Analyzer
Heat Flux Meter
Load Cell
Oxygen Analyzer
Pressure Transducer
Smoke Extinction Laser System
Type K thermocouple
Water Vapor Analyzer

2.9 Laboratory Instrumentation

2.9.1 INSTRUM

Field Name	Type	Width	Decimal	Related/Choice File	Choice Field
INSTRID	String	10			
MAKERID	String	10		ORGANISE	ORGID
INSTRTYP	String	10		INSTRUM	INSTRID
COMMDATE	Date				
CALINTER	UShort				
CALDATE	Date				
LAST_UPD	Date				
PRIVATE	Choice				
SERIAL	VString				

2.9.2 INSTRBAS

Field Name	Type	Width	Decimal	Related/Choice File	Choice Field
INSTRMAN	String	10		INSTR	INSTRID
INSTRSUB	String	10		INSTR	INSTRID
COMPDATE	Date				
COMPTIME	UShort				

2.9.3 INSTRNOT

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
INSTRID	String	10		INSTR	INSTRID
SEQNO	UShort				
NOTE	VString				

2.9.4 CALIB

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
INSTRID	String	10		INSTR	INSTRID
CALDATE	Date				
OPERID	String	10		PEOPLE	PERSONID
OFFID	String	10		PEOPLE	PERSONID
CONV	Choice				
PDEGREE	UShort				
COEF0	Float				
COEF1	Float				
COEF2	Float				
COEF3	Float				
COEF4	Float				
COEF5	Float				
CALFILE	VString				

2.9.5 CALIBNOT

Field			Related/Choice		
<u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>File</u>	<u>Field</u>
INSTRID	String	10		INSTR	INSTRID
CALDATE	Date				
SEQNO	UShort				
NOTE	VString				

2.9.6 CHOICE

Entries for choice field types in any FDMS file must link to a CHOICE data file using a primary key derived from the file name, the choice field name, and one of the possible choices for that field. All available choices for a field can be enumerated using the file name and choice field name to match entries in the CHOICE data file. The one exception is the key for available display units for base measures in BASEMEAS. In this case, selection is achieved using the file name and the BASEID entry for the base measure, *e.g.*, temperature or pressure. Enumerated choices for each field can be found in the description of that field in section 4. The code for each enumerated choice are the underlined letters of the choice value. Storage space required for a choice field in a linked data file are the character codes required to uniquely select a choice from

the list. The use of several letters to represent the choice was done to simplify selection of codes for similar phrases and to accommodate current SI representation for measurement units.

The field FILE has been deleted. Choice selection is now keyed off the FIELD entry, and allows a finite list of choices to be shared between files provided each file uses the same field name.

<u>Field</u> <u>Name</u>	<u>Type</u>	<u>Width</u>	<u>Decimal</u>	<u>Related/Choice</u>	
				<u>File</u>	<u>Field</u>
FIELD	String	8			
CODE	String	4			
VALUE	VString				

3 FDMS File Definitions

Table 6. FDMS File Definitions

File Definitions	
File	Purpose
AFFILIAT	Indicates affiliations between an individual and an organization
AFFNOTES	Notes pertaining to an entry in AFFILIAT.
BASEMEAS	A set of FDMS provided base measures. Used for creating all derived measurements in FDMS.
CALIB	Calibration entries for laboratory instrumentation.
CALIBNOT	Notes pertaining to an entry in CALIB.
DOCNOTE	Notes pertaining to an entry in DOCUMENT.
DOCUMENT	A set of documents specifying fire test methods.
DRVDBASE	Indicates combination of base measures from BASEMEAS required to generate an entry in DRVDMEAS.
DRVDMEAS	A set of derived measures from the base measures in BASEMEAS.
DRVDNOTE	Notes pertaining to an entry in DRVDMEAS.
INSTRBAS	Indicates components of laboratory instrumentation in INSTRUM.
INSTRNOT	Notes pertaining to an entry in INSTRUM.
INSTRUM	A set of laboratory specific instrumentation at local FDMS sites or instrumentation types at the central FDMS database site.
METHACQU	The data acquisition units for each component base measure of a derived measurement. Used in data conversion when importing data to the database.
METHCOND	Setup conditions for a particular fire test method.
METHDOC	Documents describing a particular fire test method.
METHMEAS	Measurements for a particular fire test method.
METHNOTE	Notes pertaining to an entry in METHOD.
METHOD	A set of fire test methods available in FDMS.
ORGANISE	A set of organizations involved with the collection or evaluation of fire test results.
ORGNOTES	Notes pertaining to an entry in ORGANISE.
PEOPLE	A set of fire professionals.
PERNOTES	Notes pertaining to an entry in PEOPLE.
PRODBASE	Indicates components of a product in PRODUCT.
PRODNOTE	Notes pertaining to an entry in PRODUCT.
PRODSUPP	Indicates suppliers of a product entry in PRODUCT.
PRODUCT	A set of products for which fire tests are typically conducted.

Table 6. FDMS File Definitions

File Definitions	
File	Purpose
TEST	Descriptions of all fire tests stored in FDMS.
TESTCVOL	Descriptions of various compartments, control volumes, or observation areas for a test.
TESTDOC	Documents describing a particular test performed.
TESTNOTE	Notes pertaining to an entry in TEST.
TESTPROD	Products from PRODUCT which were tested for an entry in TEST.
TESTCOND	Condition values for an entry in TEST.
TSTINSTR	Instruments from INSTRUM which were used to measure results for an entry in TEST.
TESTMEAS	Test results for an entry in TEST.

4 FDMS Field Definitions

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
ADDRESS1	ORGANISE, AFFILIAT	Street address.
ADDRESS2	ORGANISE, AFFILIAT	Additional mailing information.
ADMIN	DOCUMENT, TEST	Laboratory specific code used to store internal administrative information such as Cost Center code or invoice number for test or assigned organization code for document.
AREA	TESTPROD	Specimen area. For the Cone Calorimeter, the area under the specimen holder edge or the edge frame is <i>not</i> included.
BASEACQU	METHACQU	Data acquisition units for a base measure component of a derived measurement within a test method. Used in data conversion when importing data to the database.

Table 7. FDMS Field Definitions

Field Definitions														
Field	File	Description												
BASEDISP	BASEMEAS	Display units for the base measure. User selectable. Choices are:												
		<table> <tr> <td>Temperature</td> <td><u>C</u>elsius, <u>F</u>ahrenheit</td> </tr> <tr> <td>Absolute Temperature</td> <td><u>K</u>elvin, <u>R</u>ankine</td> </tr> <tr> <td>Pressure</td> <td><u>P</u>ascal, <u>A</u>tmosphere, <u>B</u>ar, <u>M</u>ercury, <u>W</u>ater</td> </tr> <tr> <td>Length</td> <td><u>M</u>eter, <u>C</u>entimeter, <u>M</u>illimeter, <u>F</u>oot, <u>I</u>nch</td> </tr> <tr> <td>Energy</td> <td><u>J</u>oule, <u>K</u>ilojoule, <u>M</u>egajoule, <u>B</u>TU</td> </tr> <tr> <td>Energy Release Rate</td> <td><u>W</u>att, <u>K</u>ilowatt, <u>M</u>egawatt, <u>B</u>TU/second, <u>B</u>TU/hour</td> </tr> <tr> <td>Energy Absorption Rate</td> <td><u>W</u>att, <u>K</u>ilowatt, <u>M</u>egawatt, <u>B</u>TU/second, <u>B</u>TU/hour</td> </tr> </table>	Temperature	<u>C</u> elsius, <u>F</u> ahrenheit	Absolute Temperature	<u>K</u> elvin, <u>R</u> ankine	Pressure	<u>P</u> ascal, <u>A</u> tmosphere, <u>B</u> ar, <u>M</u> ercury, <u>W</u> ater	Length	<u>M</u> eter, <u>C</u> entimeter, <u>M</u> illimeter, <u>F</u> oot, <u>I</u> nch	Energy	<u>J</u> oule, <u>K</u> ilojoule, <u>M</u> egajoule, <u>B</u> TU	Energy Release Rate	<u>W</u> att, <u>K</u> ilowatt, <u>M</u> egawatt, <u>B</u> TU/second, <u>B</u> TU/hour
Temperature	<u>C</u> elsius, <u>F</u> ahrenheit													
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Length	<u>M</u> eter, <u>C</u> entimeter, <u>M</u> illimeter, <u>F</u> oot, <u>I</u> nch													
Energy	<u>J</u> oule, <u>K</u> ilojoule, <u>M</u> egajoule, <u>B</u> TU													
Energy Release Rate	<u>W</u> att, <u>K</u> ilowatt, <u>M</u> egawatt, <u>B</u> TU/second, <u>B</u> TU/hour													
Energy Absorption Rate	<u>W</u> att, <u>K</u> ilowatt, <u>M</u> egawatt, <u>B</u> TU/second, <u>B</u> TU/hour													
BASEDISP	BASEMEAS	Mass												
		Time												
		<table> <tr> <td></td> <td><u>G</u>ram, <u>K</u>ilogram, <u>P</u>ound</td> </tr> <tr> <td></td> <td><u>S</u>econd, <u>H</u>our, <u>M</u>inute</td> </tr> </table>		<u>G</u> ram, <u>K</u> ilogram, <u>P</u> ound		<u>S</u> econd, <u>H</u> our, <u>M</u> inute								
	<u>G</u> ram, <u>K</u> ilogram, <u>P</u> ound													
	<u>S</u> econd, <u>H</u> our, <u>M</u> inute													
BASEID	BASEMEAS, DRVDBASE, METHACQU	Short label ID for a base measure. User selectable or computer generated.												
BASENAME	BASEMEAS	Long label for a base measure. Used to generate a short label ID.												
BASEPWR	DRVDBASE	Power to which a base measure is raised in deriving a derived measure.												

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
BASESTOR	BASEMEAS	Storage units for the base measure. SI units. Units are: Temperature <u>K</u> elvin Absolute Temperature <u>K</u> elvin Pressure <u>P</u> ascal Length <u>M</u> eter Energy <u>J</u> oule Energy Release Rate <u>W</u> att Mass <u>K</u> ilogram Time <u>S</u> econd Conductivity Time <u>S</u> econd
BURNSTD	TESTCVOL	Type of burner used to ignite fire. Choices are: <u>A40</u> : ASTM40 <u>A150</u> : ASTM150 <u>A160</u> : ASTM160 <u>BSI1</u> : BSI Source #1, butane burner <u>BSI2</u> : BSI Source #2, butane burner <u>BSI3</u> : BSI Source #3, butane burner <u>BSI4</u> : BSI Source #4, 8.5 g crib (1.0 kW) <u>BSI5</u> : BSI Source #5, 17 g crib (1.9 kW) <u>BSI6</u> : BSI Source #6, 60 g crib (3.5 kW) <u>BSI7</u> : BSI Source #7, 126 g crib (7.0 kW) <u>I100</u> : ISO100 <u>I300</u> : ISO300 <u>NBSW</u> : NBS wastebasket burner, 50 kW methane <u>NCRB</u> : NORDTEST crib, 126 g <u>OTHR</u> : Other <u>SBA</u> : Alternative sand burner (305 mm x 305 mm) <u>SBS</u> : Standard sand burner (170 mm x 170 mm) <u>TFRS</u> : FRS T-head burner, 25 kW propane
BXPOS	TESTCVOL	X position of the burner within the control volume.
BYPOS	TESTCVOL	Y position of the burner within the control volume.
BZPOS	TESTCVOL	Z position of the burner within the control volume.
CALDATE	INSTR, CALIB, CALIBNOT	Date of the last calibration.
CALFILE	CALIB	Reference field indicating where the original or official calibration report may be found, <i>e.g.</i> , a report number or a notebook page. Most laboratories will have a different system for doing this.
CALINTER	INSTRUM	Recommended calibration interval in months.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
CATNO	PRODSUPP	Optional catalog number since it may not exist for all products. May include alphabetical characters as well as numbers.
CHANNEL	TSTINSTR	Channel number used for laboratory instrument during test.
CITY	ORGANISE, AFFILIAT	City name.
CODE	CHOICE	Choices for entry into a database structure field when that field allows limited number of possible entries, <i>e.g.</i> , MAINUSE to select type of usage for a product in the PRODUCT file.
COEF0	CALIB, SUMMARY	Coefficient required for the polynomial conversion of instrument data to physical units, or summary data to fire test vector values. Refer to the conversion equations in the CONV field description for exact details involving polynomial conversion.
COEF1	CALIB, SUMMARY	Optional coefficient required for the polynomial conversion of instrument data to physical units, or summary data to fire test vector values. Refer to the conversion equations in the CONV field description for exact details involving polynomial conversion.
COEF2	CALIB, SUMMARY	Optional coefficient required for the polynomial conversion of instrument data to physical units, or summary data to fire test vector values. Refer to the conversion equations in the CONV field description for exact details involving polynomial conversion.
COEF3	CALIB, SUMMARY	Optional coefficient required for the polynomial conversion of instrument data to physical units, or summary data to fire test vector values. Refer to the conversion equations in the CONV field description for exact details involving polynomial conversion.
COEF4	CALIB, SUMMARY	Optional coefficient required for the polynomial conversion of instrument data to physical units, or summary data to fire test vector values. Refer to the conversion equations in the CONV field description for exact details involving polynomial conversion.
COEF5	CALIB, SUMMARY	Optional coefficient required for the polynomial conversion of instrument data to physical units, or summary data to fire test vector values. Refer to the conversion equations in the CONV field description for exact details involving polynomial conversion.
COMMDATE	INSTRUM	Date the instrument was first commissioned.
COMPDATE	INSTRBAS	Date the laboratory instrument composition was modified.
COMPOS	PRODUCT	Indicates if the product is a composite.
COMPTIME	INSTRBAS	Time the laboratory instrument composition was modified.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
COND	PRODUCT	Conductivity of the product.
CONV	CALIB	<p>Type of conversion of instrument data to physical units. Three types of conversion are possible: polynomial, logarithmic, and Type K thermocouples.</p> <p>For polynomial conversion, CONV contains a capital <u>P</u> with the degree of the polynomial specified in PDEGREE. Required constants are entered in the CONST fields. The polynomial conversion equation is:</p> $\begin{aligned} (\text{physical units}) = & \text{COEF0} \\ & + \text{COEF1} * (\text{analog units}) \\ & + \text{COEF2} * (\text{analog units})^2 \\ & + \text{COEF3} * (\text{analog units})^3 \\ & + \text{COEF4} * (\text{analog units})^4 \\ & + \text{COEF5} * (\text{analog units})^5. \end{aligned}$ <p>For logarithmic conversion, CONV contains <u>L</u>OG. The logarithmic conversion equation is:</p> $\begin{aligned} (\text{physical units}) = & \text{COEF0} \\ & * \ln(1 - \text{CONST1} * (\text{analog units})) \end{aligned}$ <p>If CONV contains <u>T</u>YPEK, the software will perform an automatic conversion to the physical temperature units using built in conversion algorithms.</p>
COUNTRY	ORGANISE, AFFILIAT	Country name, common name instead of full name (<i>e.g.</i> , USA, not United States of America)
CVOL	TESTCVOL, TESTPROD, TSTINSTR	Control volume describing a compartment or control area where a product, or instrument was placed, <i>e.g.</i> , stack, ceiling, floor, etc..
DATAACQU	METHMEAS	Indicates when user specified data acquisition units should be used for data conversion or the default SI storage units. Used in data conversion when importing data to the database.
DATE_BEG	AFFILIAT	Date affiliation between individual and organization began.
DATE_END	AFFILIAT	Date affiliation between individual and organization ended.
DELETED	ALL	Used by the database system to indicate a deleted record.
DENSITY	PRODUCT, TESTPROD	Density of the composite product specimen or the component layer.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
DEPTH	TESTCVOL	Depth of the control volume entry.
DIVISION	ORGANISE	Division/department/branch (<i>e.g.</i> , Building and Fire Research Laboratory).
DOCDATE	DOCUMENT	Date document was accepted as standard.
DOCID	DOCUMENT, DOCNOTE, METHDOC	Number of a document proposing a fire test method or describing a test conducted.
DOCORG	DOCUMENT	ORGID number from the ORGANISE table for the document standards organization.
DOCSTD	DOCUMENT	Indicates if document has been accepted as a standard.
DOCTITLE	DOCUMENT	Title of a document proposing a fire test method or describing a test conducted.
DOCVIDEO	DOCUMENT	Indicates if the document stored is a video. This allows for future development efforts which could allow users of an FDMS database the ability to play movies stored as documents.
DRVDCML	DRVDMEAS	Number of decimal positions of derived measure value.
DRVFORM	DRVDMEAS	Format of derived measure value. Choices are: Integer Floating Point Vector Floating Point Variable String
DRVID	DRVDMEAS, DRVDNOTE, DRVDBASE, METHACQU, METHMEAS, TESTCOND, TESTMEAS, TSTINSTR, SUMMARY	Short label ID for a derived measurement. User selectable or computer generated.
DRVNAME	DRVDMEAS	Long label for a derived measure. Used to generate a short label ID.
DRVWIDTH	DRVDMEAS	Number of positions for derived measure value.
E_MAIL	ORGANISE, AFFILIAT	E-mail address.
EMISS	PRODUCT	Product emissivity.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
FAX	ORGANISE, AFFILIAT	Facsimile number, including country code.
FIELD	CHOICE	A database structure field name required to obtain list of possible choices for entry into the database, <i>e.g.</i> , MAINUSE to select type of usage for a product in the PRODUCT file.
FRSTNAME	PEOPLE	First name of the individual.
HEIGHT	PRODUCT	Designed height of the product specimen or component layer.
HEIGHT	TESTCVOL	Height of the control volume entry.
INSTRID	INSTRUM, INSTRBAS, INSTRNOT, CALIB, CALIBNOT, TSTINSTR	Short Label ID for the instrument type at the central database or the specific laboratory instrument for local site installations. User selectable or computer generated.
INSTRMAN	INSTRBAS	INSTRID from INSTRUM table for a composite instrument.
INSTRSUB	INSTRBAS	INSTRID from INSTRUM table for a component instrument.
INSTRTYP	INSTRUM	INSTRID for a general instrument type description entry.
INTERVAL	TSTINSTR	Time interval between two consecutive scans.
ISTART	SUMMARY	Initial time point for a parameterized curve.
LABID	TEST	ORGID number from the ORGANISE table for the laboratory where the test was conducted.
LASTNAME	PEOPLE	Last name of the individual.
LAST_UPD	ORGANISE, PEOPLE, AFFILIAT, PRODUCT, DRVDMEAS, METHOD, DOCUMENT, TEST, INSTRUM	When several sources of information are available, it may not be clear which information is the most current. This field is updated only when it is known that the information in the record is current and correct. If any information being entered is uncertain, this field should be left blank. Such a version of the record is preferentially discarded when a verified record becomes available.
LAYERID	PRODBASE	Indicator of the layer of a component in a composite product.
LENGTH	PRODUCT	Designed length of the product specimen or component layer.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
MAINUSE	PRODUCT	Main area in which the product is used. Choices are: <u>AS</u> : Adhesives/Sealants <u>BS</u> : Building Structure <u>BF</u> : Building Fabric <u>CI</u> : Cable Insulation <u>CT</u> : Clothing/Textiles <u>DO</u> : Decor/Ornament <u>FA</u> : Fabric (Furnishings) <u>FB</u> : Barrier (Furnishings) <u>FC</u> : Film/Coating <u>FF</u> : Furnishings <u>FO</u> : Foam (Furnishings) <u>MA</u> : Marine <u>MD</u> : Medical/Dental <u>MI</u> : Military <u>PC</u> : Packaging/Containers <u>SL</u> : Sports/Leisure <u>SU</u> : Service/Utilities <u>TI</u> : Thermal Insulation <u>TR</u> : Transport
MAKERID	INSTRUM	ORGID number from the ORGANISE table for the company manufacturing this instrument.
MANUFID	PRODSUPP	ORGID number from the ORGANISE table for the company manufacturing this product.
MASS	PRODUCT, TESTPROD	Designed mass for an entry in the PRODUCT file. Deviations from the designed mass for a product specimen tested in TESTPROD.
METHID	METHOD, METHACQU, METHMEAS, METHDOC, METHNOTE, TEST	Short label ID for a test method. User selectable or computer generated.
METHNAME	METHOD	Long label for a test method. Used to generate a short label ID.
METHTYPE	METHOD	Type of the test method described. Choices are: <u>B</u> ench-scale <u>I</u> ntermediate-scale <u>R</u> eal-scale <u>M</u> odel
MIDNAME	PEOPLE	Middle name of the individual.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
MORPHONE	ORGANISE, AFFILIAT	Telephone extension or an alternative telephone number for an individual.
NICKNAME	PEOPLE	Additional first name person is known by.
NOTE	ORGNOTES, PERNOTES, AFFNOTES, PRODNOTE, DRVDNOTE, METHNOTE, DOCNOTE, TESTNOTE, INSTRNOT, CALIBNOT	Comments or notes for the associated main files.
OFFID	TEST, CALIB	PERSONID number from the PEOPLE table for the laboratory officer responsible for a test. For CALIB, the individual who has signature authority to issue a calibration report.
OPERID	TEST, CALIB	PERSONID number from the PEOPLE table for the individual who performed the test. For CALIB, the individual who actually performed the calibration.
ORGANISE	ORGANISE	Name of the organization (<i>e.g.</i> , National Institute of Standards and Technology).
ORGID	ORGANISE, ORGNOTES, AFFILIAT, AFFNOTES	Assigned to uniquely identify the organization. User selectable or computer generated.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
ORGTTYPE	ORGANISE	Type of organization. Choices are: <u>AR</u> : Architect <u>CN</u> : Consulting <u>CS</u> : Codes and Standards <u>ED</u> : Education <u>EG</u> : Engineering <u>FO</u> : Forensics <u>FR</u> : Fire Research <u>FS</u> : Fire Service <u>GO</u> : Government <u>HC</u> : Health Care <u>IN</u> : Insurance <u>MA</u> : Manufacturing <u>RM</u> : Risk Management <u>TA</u> : Trade Association <u>TS</u> : Testing <u>UT</u> : Utility
PDEGREE	SUMMARY, CALIB	Degree of the polynomial for parameterized curve.
PEERSTAT	TEST	Indicator of the status of the peer review process for individual tests stored in the Internet database.
PERSONID	PEOPLE, PERNOTES, AFFILIAT, AFFNOTES	Assigned to uniquely identify an individual. This is necessary to distinguish two people with the same name. User selectable or computer generated.
PHONE	ORGANISE, AFFILIAT	Telephone, including country code.
POSITION	AFFILIAT	Position in which the individual is affiliated with an organization.
POSTCODE	ORGANISE, AFFILIAT	Postal code (Zip code for USA).
PRIVATE	ORGANISE, PEOPLE, AFFILIAT, PRODUCT, DRVDMEAS, METHOD, DOCUMENT, TEST, INSTRUM	Allows a laboratory to define the level of access by other organizations to test results in the database. Choices are: <ul style="list-style-type: none"> • Allow the data to be <u>ex</u>ported without allowing modifications. • <u>P</u>urge any test information which might identify the manufacturer before allowing export. • Do <u>not</u> allow export under any circumstances.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
PRODID	PRODUCT, PRODNOTE, PRODSUPP, TESTPROD	Assigned to uniquely identify the test product. This is necessary since many products have similar names which are difficult to distinguish.
PRODMAIN	PRODBASE	PRODID value from PRODUCT table for the main product composing the sample.
PRODNAME	PRODUCT	Commercial name of the test product.
PRODSUB	PRODBASE	PRODID value from PRODUCT table for the secondary product composing the sample.
PROJECT	TEST	Reserved for a laboratory-specific identification of the test series to which the test belongs. This is typically a way to refer to the sponsorship of a test. In addition to FILE, some laboratories call this "Test Code," "Job Number," or "Test Reference."
RECEIVED	TEST	Date test results were received.
REGION	ORGANISE, AFFILIAT	State for USA, county for UK, etc.
REPDATE	TEST	Date the test was reported.
SCANS	TSTINSTR	Total number of scans for the test. For Cone Calorimeter, value is entered by CONERUN.
SEQNO	ORGNOTES, PERNOTES, AFFNOTES, PRODNOTE, DRVDNOTE, METHNOTE, DOCNOTE, TESTNOTE, INSTRNOT, CALIBNOT	Sequence for the comment or note.
SERIAL	INSTRUM	Identical to the header line "SERIAL NAME" imported as part of the raw data.
SPCONTID	TEST	PERSONID number from the PEOPLE table for the contact person at the sponsoring organization.
SPDATE	TESTPROD	Supply date for test product.
SPHEAT	PRODUCT	Product specific heat.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
SPONID	TEST	ORGID number from the ORGANISE table for the sponsoring organization.
SPORG	TESTPROD	ORGID number from the ORGANISE table for the organization supplying the product.
SUMFLAG	TEST	Logical indicator for vector values stored as observed values in TESTMEAS or parameterized curve in SUMMARY.
TELEX	ORGANISE, AFFILIAT	Telex number.
TESTDATE	TEST	Date the original test was run.
TESTID	TEST, TSTINSTR, TESTPROD, TESTMEAS, TESTCOND, TESTNOTE, SUMMARY	An internal integer assignment to reduce storage requirements for a unique test identifier. A unique identifier is determined by LABID, TESTDATE, INSTRNO, and TESTNO. This assignment requires less storage space.
TESTIID	TSTINSTR, TESTMEAS, SUMMARY	A similar assignment to TESTID except that assignment is based on instrument and position so that the same instrument can be used to measure a value at several positions within the test environment.
TESTNO	TEST	Serial test number assigned. It is specific to the laboratory and to an instrument. For the Cone Calorimeter, it is assigned by the CONERUN software.
THICK	PRODUCT, TESTPROD	Designed thickness of the composite product or product component layer. Deviations from designed thickness for test specimens.
TIMEID	TESTMEAS	Identify alternate time lines.
TITLE	PEOPLE	Professional titles such as <i>Professor</i> or <i>Dr.</i> Position titles should be stored in the POSITION field of the AFFILIAT file.
VALUE	TESTMEAS, TESTCOND, CHOICE	Value of the test measure or condition or a description string for a code entry in the CHOICE file.
WIDTH	TESTCVOL	Width of the control volume entry.
XPOS	TESTPROD, TSTINSTR	X position of a fire test instrument or product within a specified control volume.
YPOS	TESTPROD, TSTINSTR	Y position of a fire test instrument or product within a specified control volume.

Table 7. FDMS Field Definitions

Field Definitions		
Field	File	Description
ZPOS	TESTPROD, TSTINSTR	Z position of a fire test instrument or product within a specified control volume.

5 FDMS Export Format

The FDMS exchange format includes all information needed to completely describe a test stored in a FDMS 2.0 format database. This includes supplemental information such as details of the organization laboratory where the test was conducted, details of the product tested including component materials and supplier, and details of the test methodology such as Cone Calorimeter or some type of full-scale test. The FDMS exchange format enables laboratories to describe in detail tests conducted at their installation and to contribute the results of those tests for inclusion in the Internet database. For laboratory data to be included in the Internet database, each test must be stored in the FDMS exchange format following guidelines specified in section 6. For users of the Internet software, the FDMS exchange format allows selected tests to be transferred to individual FDMS 1.0 database programs.

The exchange format is subdivided into several sections individually prefaced by the TABLE key word. Each TABLE key word corresponds to a physical database file as detailed in section 3 of the FDMS 2.0 Technical Documentation [5] (and updated in section 5 of this report). Within a TABLE section, the physical file is indicated by entry of the file name on the line immediately following the key word. For a current example of the FDMS exchange format, it is recommended that the user use the Internet database to generate a FDMS exchange file for any of the tests currently available.

5.1 Test General Description

Specification of a test in the FDMS exchange format requires that the file begin with a TABLE key word followed immediately on the next line with a description of the test type. For example, to indicate a Cone Calorimeter test, the file would begin with:

```
TABLE  
CONE
```

For each type of information available for a test, specification continues by using the corresponding field name from the physical file structure on one line followed by the detailed information on a separate line. Field names used in describing tests can be found in subsection 3.6.1 of the FDMS 2.0 Technical Documentation [5]. For example, if the laboratory responsible for conducting the test was the National Institute of Standards and Technology (NIST), an entry similar to the following should be made:

```
LABID  
NIST
```

To indicate the date the test was conducted, the following entry would be required:

TESTDATE
06/06/95

Specification of the test continues in this manner until all available details have been entered. There is no required order for the TEST physical file fields within the exchange format except for the requirement that the TABLE key word followed by test type be the first two lines of the exchange format file. If details for any of the TEST physical file fields are unavailable, the field key word and detail line can be excluded from the exchange file, or the key word can be entered followed by a blank line. For example, if the operator for the test is not known, the OPERID key word does not need to be entered. If it is entered, leave a blank line before continuing with other fields.

To uniquely identify a test, the following key words must be included (Note that lines following each key word below are examples only; entries are dependent on details for each contributed test):

TABLE
CONE
LABID
NIST
TESTDATE
12/14/87
TESTNO
1

5.2 Test Conditions

Test conditions describe important setup aspects for each test. Examples of test conditions include ambient temperature, relative humidity, and orientation of panels. Test conditions are specified by a key word indicating the type of condition followed by the value for that condition on the following line. Test conditions can be single integer or floating point values, multiple numeric values representing points on a curve, or text strings. Some examples of test conditions for a Cone Calorimeter test include:

FLUX
50
ORIENT
H
PILOT
Y

For a Room/Corner test, specification of the burner heat release rate would be:

BURNER
0 40 600 300

For each test condition, select a measure key word from Table 3 in section 5.3 of this report. If an appropriate measure key word does not exist in the table, assign a new code and enter as the key word line with (C) following the key word to indicate this represents a new test condition. For example, a new condition RHAMB would be entered as:

RHAMB (C)

This is a string describing ambient relative humidity prior to running the test.

Test condition key words can be entered in the FDMS exchange file in any order and can be intermixed with test detail fields. Test condition key words must be entered between the TABLE key word entry indicating the test type and any other supplemental TABLE key word entries.

5.3 Test Products

The test product section of the exchange file specifies the product database code and characteristic dimensions of the material(s) or object(s) on which the test was run. For each unique product code listed in the test product section of the exchange file, there should be a corresponding detail entry. Refer to subsection 5.5 for product detail specifications.

A PRODIDn entry should be made for each product tested where n varies from 1 to 9. On the line following the PRODIDn entry, enter a database code for the corresponding product. Follow each PRODIDn entry with AREA, THICK, and DENSITY entries with corresponding value lines for each of the three key words. For example, if the product tested was a fire-resistant polystyrene with area of .01m² and thickness of 1mm, the following would be included in the FDMS exchange file for the test:

PRODID1
FRPOLYSTYRN
AREA
0.01
THICK
.001

It is important to note that numeric values for test products in the exchange file are not converted during the import. It is recommended that all measures with similar base measure origins use consistent SI units. In the above example, area and thickness both use length as the base measure with SI units of (m).

Test product key words can be intermixed in the FDMS exchange file with test detail fields. However, the AREA, THICK, and DENSITY key words should be kept with the corresponding PRODIDn key word. Test product entries must be entered between the TABLE key word entry indicating the test type and any other supplemental TABLE key word entries.

5.4 Test Notes

Comments and observations about the fire test are stored in the test notes section of the exchange file. Each comment line is prefaced on the preceding line by a key word of the form COMMENTn where n varies from 1 through 5. Test note key words can be intermixed in the FDMS exchange file with test detail fields. Test note entries must be entered between the TABLE key word entry indicating the test type and any other supplemental TABLE key word entries. An example of notes for a test:

```
COMMENT1
Flaming out time 4 minutes and 49 seconds
COMMENT2
Spark ignited used--tuh is down--no soot collected
```

5.5 Supplementary File Information

For each entry from the test description section of the exchange file that specifies a database code, a supplementary file information section should be included. For example, if the test laboratory specified was NIST, a supplementary ORGANISE file section should be included:

```
TABLE
RECORD
ORGANISE
ORGID
NIST
ORGANISE
National Institute of Standards and Technology
DIVISION
Building and Fire Research Laboratory
CITY
Gaithersburg
REGION
MD
POSTCODE
20899
COUNTRY
```

USA
PHONE
(301) 975-6879

Each supplementary file section is prefaced by a TABLE key word corresponding to a physical database file in Chapter 3 of the FDMS 2.0 Technical Documentation [5] or the addendum section 5 of this report. Within a TABLE section, the physical file is indicated by entry of the file name on the line immediately following the key word. For each type of information available for a file structure, specification continues by using the corresponding field name from the physical file structure on one line followed by the detailed information on a separate line.

Supplementary file sections should typically be included to detail the organization conducting the test, the organization sponsoring the test, the officer conducting the test, a contact person concerning questions about the test, and product details for each material(s), object(s), and component(s) tested.

5.6 Scalar Test Measures

Scalar test measures are single integer or floating point numeric observations for the test. Examples of scalar test measures would be time to ignition, average heat of combustion, or maximum heat of combustion. Scalar test measures are specified by a key word indicating the type of measurement followed by the value for that measure on the following line. Some example scalar test measure key words include:

```
TIGN
20
AVGHC
2.66689e+6
```

For each scalar test measurement, select a measure key word from Table 3 in section 5.3 of this report. If an appropriate measure key word does not exist in the table, assign a new code. For example, a new scalar measure AVGTEMP would be entered as:

```
AVGTEMP
300
```

It is important to note that numeric values for test measures in the exchange file are not converted during the import. It is recommended that all measures with similar base measure origins use consistent SI units. For a complete list of the base measures supported by FDMS, see Table 1 in subsection 3.4.5 of the FDMS 2.0 Technical Documentation [5]. In the above examples, time to ignition uses SI units of seconds, average heat of combustion uses SI units of J/kg, and average temperature uses SI units of degrees K.

Scalar test measure key words can be entered in the FDMS exchange file in any order and can be intermixed with test detail fields. Scalar test measure key words must be entered between the TABLE key word entry indicating the test type and any other supplemental TABLE key word entries.

5.7 Vector Test Measures

Vector test measures are multiple integer or floating point numeric observations representing a curve, typically dependent on time, for the test. The vector data section of the exchange file is always entered after all test details and supplementary file information. The vector data section is indicated by the key word VECTOR DATA. Specification for each vector data variable involves 5 heading lines followed by separate lines for each observation on the curve. The 5 heading lines include:

VARIABLE
Instrumentation
Short Label Description
Long Label Description
Units for the Measure

For each vector test measurement, select a measure key word from Table 3 in section 5.3 of this report. If an appropriate measure key word does not exist in the table, assign a new code.

It is important to note that numeric values for test measures in the exchange file are not converted during the import. It is recommended that all measures with similar base measure origins use consistent SI units. For a complete list of the base measures supported by FDMS, see Table 1 in subsection 3.4.5 of the FDMS 2.0 Technical Documentation [5]. Although the original FDMS 2.0 Technical Documentation provides for conversion of measures and specification of acquisition units, this has proven difficult to implement due to inconsistent abbreviations for SI measures as well as inconsistent representation of combined measures between and within laboratories. For example, mass flow rates may be specified as kg/s, kg/sec, kg*s⁻¹, kg*sec⁻¹, g/s, g/sec, g*s⁻¹, and g*sec⁻¹. Until a reliable method for identifying components of complex measurements has been developed, the SI assumption will be made and no conversion of values will be done.

An example of a vector data section of a FDMS exchange file is:

VECTOR DATA
VARIABLE
Time
TIME
Time from sample insertion

S
0
5
10
15
20
25
30
35
VARIABLE
DERIVED
HRR/A
Heat release rate
W/m²
0
0
0
0
2.38666e5
2.96634e5
2.97947e5
2.53458e5
VARIABLE
DERIVED
MLR/A
Rate of Mass Loss
kg/s*m²
0
0
0
0
1.42541e-2
1.42541e-2
1.42541e-2
1.42541e-2
VARIABLE
DERIVED
HC
Effective Heat of Combustion
J/kg
0
0
0

```

0
1.67969e7
1.67969e7
1.67969e7
1.67969e7
VARIABLE
DERIVED
SEA
Smoke specific extinction area in exhaust stack
m2/kg
0
0
0
0
39.80252
66.90142
96.34313
120.6028

```

Note that each entry has the exact same number of curve entries as every other measure in the vector measure section. In the above example, each curve has 8 points specified. Also note that every measure specifies consistent SI units for each of the base measure components. For example, mass loss rate per unit area is specified as $\text{kg/s}\cdot\text{m}^2$, effective heat of combustion is specified as J/kg , and the smoke specific extinction area is specified as m^2/kg . Incorrectly reported values would result if mass loss rate per unit area was specified as $\text{g/s}\cdot\text{m}^2$ while effective heat of combustion and smoke specific extinction area were reported mass using kg .

Vector test measure entries can be entered in the FDMS exchange file in any order. Vector test measure key words must be the last section of the exchange file. There should be no TABLE key word entries after the VECTOR DATA key word specification.

5.8 Example FDMS Exchange Files

An example of a properly formatted FDMS Exchange files is included as Appendix A for a Cone Calorimeter test. These examples are complete except for long lists of repeated number in the vector data. These omissions are indicated in the examples with a series of vertical dots in the example listings:

```

.
.
.
.

```

In a complete file, these would simply be a complete list of the values for the associated vector data.

5.9 Preparing Data in FDMS Exchange Format

At present, files for import into FDMS databases must be prepared in the FDMS exchange file format. This sections provides an overview of the minimum requirements for a FDMS exchange format file to facilitate file preparation.

Each file must begin with a TABLE key word followed by the test type:

```
TABLE  
CONE
```

Uniquely identify each test by providing the laboratory, test date, and laboratory assigned test number.

```
LABID  
NIST  
TESTDATE  
10/17/94  
TEST  
1
```

Include at least one product.

```
PRODID1  
DGLSFIR
```

Floating point numbers in database are single-precision; do not include values with more than six digits of precision.

```
AVGHC  
19.61524
```

For a file type (TEST, ORGANISE, PRODUCT, etc.), keep all field-related data together; order is not significant.

```
TABLE  
RECORD  
ORGANISE
```

ORGID
NIST
ORGANISE
National Institute of Standards and Technology
. . .

Vector data must follow the VECTOR DATA key word.

VECTOR DATA
VARIABLE
Time
TIME
Time from sample insertion
Sec
0.0
5.0
. . .

Unrecognized key words in the import file are treated as new measurements and are imported into the test measurement file. Scalar versus vector import file parsing is determined by the measurement position in relation to the VECTOR DATA key word.

Do not use the same measurement name to describe both a scalar and a vector measurement. Whenever possible, use the measurement key words specified in table 4.

Do not include extraneous blank lines in the file.

Individual inputs are limited to a single line. Long titles or descriptions must be on a single line and cannot extend to a second line. The line length for a single line is not limited however; lines longer than 80 characters are acceptable.

The FDMS exchange file format is primarily intended for transferring already existing FDMS data from one database set to another. As such, the format for the file is tightly controlled and relatively inflexible.

6 Review Criteria for FDMS Data

Clearly, the integrity of data in any database is of paramount importance to the utility of the database. For the database to become useful to a wider audience, information on the quality of the data in the database must be included as part of the database. The FDMS format is intended to be used in individual laboratories to store, edit, and retrieve their own test results, as well as a central repository for contributed data. Any criteria included in the database to indicate the quality of the data should allow for multiple levels of review and certification to support such a diverse audience.

In general, the information in this section is adapted from the ASTM guide for database quality indicators [6]. This guide provides nine indicators to assess the utility of data for the intended purpose. One of the indicators in the ASTM guide pertains only to the database in its entirety (a “database supported” field used to indicate the level of active support available to keep the database current). This indicator is not included for individual tests in a FDMS database. Recognizing that the original intent of the ASTM document was to apply to scalar values of chemical property data, the field for “Statistical basis of data” has been simplified to include few qualifiers more representative of the current state-of-the-art in fire testing. Statistical methods to compare fire test measurements is an active research area [7]. As appropriate techniques are better understood, this field can be expanded to include more explicit statistical methods.

Table 7 shows the indicators which are to be used within the NIST implementations of the FDMS format to qualify each data set included in the database:

1. *Source of data* – Identifies the type of publication which documents the test. Further information on the associated documents is included with entries the TESTDOC file by entries associated to the test by its unique TESTID.
2. *Statistical basis of data* – indicates to the user a measure of the degree to which data can be directly compared to other data, if the data can be used for design, or if their principal value is for rough comparison. For example, single-point test values are of the lowest reliability for most purposes, but may be of interest for developmental materials or if replicate or other data are not available.
3. *Material development or production status* – Is the material currently available, in the research or development stage, or an obsolete material?
4. *Evaluation status* – Were the test data generated according to a standard test procedure and was the data validated by a recognized and competent method? Were the test data evaluated by an expert body or individual to determine reasonableness, fit with theory, or expectations?

5. *Certification status* – Were the test data certified by an expert body or individual to determine their applicability or appropriateness for a specific application?
6. *Completeness of materials description* – The usefulness of any particular data set is critically related to the ability of the user of the data to precisely identify the material which was tested. In addition to identification of the product, manufacturer, or supplier of the material(s) which were tested, information on the form or condition of the material(s), processing history, or precise history of the material(s) may be appropriate. These descriptors indicate to the potential user the nature of the listed properties and their applicability to a particular purpose.
7. *Completeness of test procedure description* – This descriptor does not indicate the actual test procedure used, but will indicate whether or not a standard test procedure was used to generate the data. Further information on a test procedure is included with entries in the METHDOC file associated to the test by its unique TESTID.
8. *Completeness of material(s) information* – at least partial information on material
9. *Completeness of test procedure description* – any category is acceptable

Table 7. Quality indicators for data included in FDMS

Indicator	Description	Available Values
1	Source of data set	J – Journal publication H – Handbook publication G – Government report P – Producer brochure U – Unpublished report X – Source unknown
2	Statistical basis of data set	S – Statistical representation of multiple data sets R – Replicate tests associated with this test are included in the database I – Individual test X – Unknown
3	Material development or production status	P – Production material R – Experimental material O – Obsolete, no longer in production
4	Evaluation status	E – Evaluated independently S – Evaluated at testing organization X – Not evaluated
5	Certification status	C – Certified independently S – Certified by testing organization X – Not certified
6	Completeness of material(s) information	F – Full information on material form, condition, and processing history P – Partial information on material form, condition, and processing history X – No information on material form, condition, or processing history
7	Completeness of test procedure description	S – Standard tests; documented N – Non-standard tests; documented X – Test procedure(s) not documented

7 References

- [1] Babrauskas, V., Peacock, R.D., Janssens, M., and Batho, N.E., Standardizing the Exchange of Fire Data - The FDMS, *Fire and Materials* 15, 85-92 (1991).
- [2] Babrauskas, V., Janssens, M., Peacock, R.D., and Batho, N.E., Technical Documentation and User's Guide for FDMS, A Fire Data Management System, unpublished (1990).
- [3] Dark Star Research Ltd., Penley, Clwyd, England.
- [4] FDMS 1.0 version software distributed by Fire Research Station, Borehamwood, Herts, WD6 2BL, England, attn: S.A. Ames.
- [5] Portier, R. W., Fire Data Management System, FDMS 2.0, Technical Documentation, Natl. Inst. Stand. Technol., Technical Note 1407 (1995). Also available through the anonymous ftp site [candela.cfr.nist.gov](ftp://candela.cfr.nist.gov/pub/reports) in /pub/reports.
- [6] Standard Guide for Formatting and Use of Material and Chemical Property Data and Database Quality Indicators, Annual Book of ASTM Standards, Vol 14.01, American Society for Testing and Materials, Philadelphia (1992).
- [7] Peacock, R. D., Jones, W. W., and Bukowski, R. W., Verification of a Model of Fire and Smoke Transport, *Fire Safety J.* 21 (2), 89-129 (1993).

Appendix A Sample Cone Calorimeter FDMS Exchange File

TABLE
CONE
QUALITY
0000000
LABID
NIST
TESTDATE
11/4/1992
OPERID
LEEJ
OFFID
OHLEMILIT
SPONID
NIST
SPCONTID
OHLEMILIT
REPDATE
11/5/1992
RECEIVED
11/5/1992
ADMIN

TEST
T5643
PROJECT

ASCARITE (C)
Y
C_CONE (C)
0.0433699
E (C)
12.98
FLOW (C)
24
FLUX (C)
35000
FRAME (C)
N
GRID (C)
N
ORIENT (C)
H
OXYGEN (C)
20.95

PILOT (C)
Y
RHCOND (C)
50
RHTEST (C)
50
TEMPCOND (C)
296
PRODID1
MO75NY25FA
PRODORG1

PRODID2
CAL117POL
PRODORG2

AREA
0.01
DENSITY
0
THICKNESS
0.00508
AVGCO
0.0569845
AVGCO2
0.765017
AVGHC
1.33502E+07
AVGMDOT
0.00705412
AVGQDOT
91203.7
CO180
0.051432
CO2180
0.372119
CO2300
0.910439
CO260
0.335426
CO300
0.0672572
CO60
0.0927525
FLAMEOUT
414
HC180
4.78615E+06
HC300
1.44801E+07
HC60

7.05034E+06
MASSF
0.00804759
MASSI
0.0321
MASSLOSS
2.405240
MAXMDOT
0.0132412
MAXQDOT
306240
MAXTIME
255
MDOT180
0.00508008
MDOT300
0.0069843
MDOT60
0.00648544
QDOT180
28212.3
QDOT300
104236
QDOT60
56302.3
TIGN
21
TOTLHEAT
3.5084E+07
USER\$2
-3.492366E-03
USERNUM1
409415
USERNUM2
15.5613
COMMENT1
Flaming out time at 6 minutes and 54 seconds. Sample first
COMMENT2
flaming out at 52 seconds and reflamed again at 3 minutes
COMMENT3
and 20 seconds. Sample flaming at edges of sample at 5
COMMENT4
minutes and 13 seconds. Spark ignited used and turned off
COMMENT5
after ignition of sample. No soot collected-TUH is down
PRIVATE
N
LAST_UPD
0/0/1980
TABLE
RECORD

METHOD
METHID
CONE
METHNAME
Cone Calorimeter
TYPE
BNCH
PRIVATE
N
LAST_UPD
7/29/1994
TABLE
RECORD
ORGANISE
ORGID
NIST
ORGAN
National Institute of Standards and Technology
DIVISION

ADDRESS1

ADDRESS2

CITY

REGION

POSTCODE

COUNTRY

PHONE

MPHONE

FAX

TELEX

EMAIL

TYPE

PRIVATE

LAST_UPD
0/0/1980
TABLE
RECORD
PEOPLE

PERSONID
LEEJ
LASTNAME
Lee
FRSTNAME
Jack
MIDNAME

NICKNAME

PRIVATE
N
LAST_UPD
11/9/1994
TABLE
RECORD
PRODUCT
PRODID
MO75NY25FA
PRODNAME
Modacrylic 75%, Nylon 25% Fabric
MAINUSE

COMPOS
YES
PRODENSI
0
PROLENGTH
0
PROHEIGHT
0
PROTHICK
0
PROCOND
0
PROSHEAT
0
PROEMISS
0
PRIVATE
NO
LAST_UPD
05/15/1997
TABLE
RECORD
PRODUCT
PRODID
CAL117POL
PRODNAME
Cal 117 Polyurethane
MAINUSE

COMPOS
 YES
 PRODENSI
 0
 PROLENGTH
 0
 PROHEIGHT
 0
 PROTHICK
 0
 PROCOND
 0
 PROSHEAT
 0
 PROEMISS
 0
 PRIVATE
 NO
 LAST_UPD
 05/15/1997
 VECTOR DATA
 VARIABLE
 DERIVED
 CO2YIELD
 Carbon dioxide yield;\ * Carbon Dioxide Yield
 kg/kg
 0
 0
 0
 0
 0
 1.09876
 1.03172
 0.800747
 0.425673
 0.242668
 0.146201
 0.141136
 0.244935
 0.162767
 0.159089
 0.134046
 0.276287
 0.259836
 0.23614
 0.190668
 0.203335
 0.143167
 0.0350495
 0.148871

0.158523
0.118113
0.0721001
0.222264
0.208616
0.199369
0.120573
0.0978741
0.0837487
0.0479196
0
0.155169
0.130958
0.18944
1.18224
1.54814
1.89884
1.98006
2.14921
2.11394
2.15889
2.08052
1.98085
1.95331
1.85909
1.92501
1.80108
1.86625
1.68095
1.69572
1.64487
1.61026
1.65617
1.58949
1.60955
1.52798
1.47203
1.35536
1.31746
1.37074
1.52247
1.28886
1.35737
1.37042
1.21844
0
0
0
0
0
0

0
0
0
0
0
0
0
0
0
VARIABLE
DERIVED
COYIELD
Carbon monoxide yield;Carbon Monoxide Yield
kg/kg
0
0
0
0
0
0.0264949
0.0694565
0.0685621
0.0990001
0.107421
0.124962
0.150593
0.123521
0.127617
0.0786565
0.0777479
0.0422005
0.0432928
0.0316833
0.0325268
0.0266779
0.0268174
0.0268777
0.0269292
0.0263171
0.0263761
0.0265512
0.026137
0.026968
0.0276506
0.0280212
0.0293574
0.0294565
0.0296082
0.0306819
0.0304662
0.0402105
0.0422607

0
0
0
0
1.07752E+07
1.07752E+07
1.07752E+07
1.07752E+07
9.47452E+06
7.80924E+06
5.99671E+06
4.30594E+06
3.00279E+06
2.14634E+06
1.68113E+06
1.48928E+06
1.4444E+06
1.45238E+06
1.47478E+06
1.49732E+06
1.51047E+06
1.5133E+06
1.5103E+06
1.50044E+06
1.49307E+06
1.49152E+06
1.4944E+06
1.5147E+06
1.54653E+06
1.59044E+06
1.65113E+06
1.71766E+06
1.80073E+06
1.95242E+06
2.26475E+06
2.91422E+06
4.10563E+06
5.90224E+06
8.30254E+06
1.10643E+07
1.37989E+07
1.62519E+07
1.81245E+07
1.93709E+07
2.01322E+07
2.05191E+07
2.07609E+07
2.0997E+07
2.12454E+07
2.15289E+07
2.18022E+07

2.20154E+07
2.21972E+07
2.23519E+07
2.25169E+07
2.27215E+07
2.29477E+07
2.31963E+07
2.3435E+07
2.36642E+07
2.38869E+07
2.40845E+07
2.4267E+07
2.44308E+07
2.45507E+07
2.30993E+07
2.00765E+07
1.54587E+07
9.286E+06
4.64645E+06
1.54422E+06

0
0
0
0
0
0
0
0
0
0
0
0
0

VARIABLE

DERIVED

HRR/A

Heat release rate per unit area;Heat release rate
W/m²

0
0
0
0
0

157585
148432
131820
114797
92118.6
46341.4
15581
8306.76
7988.35
6957.76

6831.02
7109.41
7206.15
6692.42
7377.22
6671.82
6960.26
6879.2
6648.52
6903.91
6859.49
7089.37
6319.08
6933.91
6597.8
6431.17
6926.92
6865.88
7503.8
6880.01
7513.55
8319.26
8610
8926.72
11568.3
49675.4
79261.1
105892
136443
168154
199228
226078
252695
264127
279654
285372
306240
296270
291105
278300
265807
253634
244290
236449
226057
208994
187694
170080
139480
117423
104690

94564.4
79253.9
67989
62234.9
56655.3
52706.6
48851.2
42353.1
39520.4
35793.3
32434.2
29597
24727.7
21715.1
20242
16650.1
11751.5
VARIABLE
DERIVED
MLR/A
Mass loss rate of the sample per unit area;\TB / Rate of Mass Loss
kg/m²*s
0
0
0
0
0
0.00877919
0.00877919
0.00877919
0.00877919
0.00813354
0.00698669
0.00593314
0.00533274
0.00513927
0.00495081
0.00498453
0.00506032
0.00496671
0.00486599
0.00472503
0.00454875
0.00449663
0.00452643
0.00448985
0.00457629
0.0045986
0.00453319
0.00462527
0.00445375

0.00436967
0.00432632
0.00411546
0.00409253
0.00405995
0.00393728
0.00392576
0.00382225
0.00364043
0.00391332
0.00417381
0.00468016
0.00556089
0.00619306
0.00718254
0.00836336
0.00947151
0.0107448
0.0118025
0.0124877
0.0130158
0.0132412
0.0132293
0.0131731
0.01284
0.0124153
0.0118953
0.0112692
0.0106919
0.0100344
0.0094072
0.00864626
0.0077683
0.00687405
0.00592967
0.00509016
0.00440852
0.00381811
0.00329098
0.00292486
0.00249146
0.00226353
0.00203761
0.00175018
0.0016864
0.00132604
0.00114023
0.00110626
0.000780616
0.000820079
0.000820079

0.000820079
0.000820079
0
VARIABLE
RAW
O2STACK
Oxygen concentration in exhaust stack;Oxygen level in exhaust duct
%
20.95
20.9427
20.9445
20.8819
20.6463
20.6
20.6229
20.6559
20.6967
20.748
20.8485
20.9167
20.9324
20.933
20.9353
20.9355
20.9349
20.9348
20.9358
20.9343
20.9359
20.9352
20.9355
20.9359
20.9353
20.9355
20.9349
20.9366
20.9352
20.936
20.9364
20.9353
20.9354
20.934
20.9354
20.9339
20.9323
20.9317
20.931
20.9253
20.8442
20.7779
20.7168

20.6486
20.5744
20.5002
20.4316
20.3701
20.3352
20.2966
20.2729
20.2299
20.2412
20.2564
20.2864
20.3175
20.3418
20.3745
20.3927
20.4211
20.4614
20.5143
20.5592
20.6311
20.6837
20.7134
20.7363
20.7738
20.7994
20.8127
20.8239
20.8343
20.8437
20.8574
20.8635
20.8719
20.8795
20.8856
20.8967
20.9032
20.9066
20.914
20.9248
VARIABLE
DERIVED
OD
Smoke optical density / meter in exhaust stack

0
0
0.0467776
0.568177
1.37648
2.53129

2.29254
1.99483
0.913924
0.585767
0.334884
1.25701
0.903895
0.917539
0.837287
1.19536
1.2282
1.46615
1.86716
1.6293
1.31528
1.24577
1.69216
1.48527
1.98344
1.71571
2.18115
1.97282
1.97518
1.96294
1.89911
2.08286
1.881
1.81952
1.9277
1.53232
1.65157
1.76612
1.65024
1.58903
1.25994
0.31281
0.47525
0.798677
1.05908
1.43085
1.56533
1.67045
1.70856
1.69576
1.72683
1.60028
1.49524
1.40863
1.34344
1.19743
1.26896

1.20203
1.22253
1.12404
0.976459
1.05991
0.871224
0.751936
0.597436
0.469257
0.565449
0.350678
0.228144
0.21623
0.202066
0.189053
0.131445
0.10457
0.0958581
0.0676479
0.0635076
0.0520552
0.0610437
0.0494503
0.0361019
0.0256376
0.0119871

VARIABLE

DERIVED

SEA

Smoke specific extinction area in exhaust stack;Smoke specific extinction area
in exhaust stack

m²/kg

0

0

0

0

0

836.564

964.87

933.178

822.658

700.379

686.64

787.043

899.316

1012.47

1129.12

1276.91

1451.04

1617.14

1735.6

1777.66
1779.73
1813.65
1888.43
2001.99
2152.96
2259.1
2357.16
2406.01
2449.17
2494.98
2513.95
2563.2
2543.92
2508.96
2488.38
2427.08
2404.22
2335
2104.74
1779.29
1363.74
954.052
723.624
634.858
648.891
715.92
744.476
745.082
729.057
702.343
675.796
647.62
619.249
598.473
585.994
585.395
598.615
612.745
633.726
652.002
666.188
681.573
678.717
680.858
673.6
651.021
601.777
494.546
356.914
205.64

90.9487
26.9897
0
0
0
0
0
0
0
0
0
0
0
0

VARIABLE
DERIVED
SMOKERATE
\ B / Rate of Smoke Production

0
0
0
0
2091.41
6595
11340.1
15729.7
19537.3
23004.8
26689.1
30904.9
35684.4
41038.4
47053.5
53873.3
61543.8
69925.6
78708.7
87602.2
96585.7
105841
115567
125954
136984
148525
160433
172571
184931
197454
210146
222914

DERIVED
SMOKEVOL
Smoke volume flowing in exhaust stack

0
0
0.00112377
0.0136457
0.0321494
0.0586004
0.0537941
0.0464856
0.0215828
0.013906
0.00794425
0.030333
0.0218628
0.0220302
0.0201893
0.0286851
0.0293618
0.035294
0.0446852
0.0388728
0.0316027
0.0297466
0.0406425
0.0355625
0.0471651
0.0412167
0.0519961
0.047241
0.046985
0.0469736
0.0456033
0.0498476
0.0449205
0.0433258
0.0461306
0.0363081
0.0394214
0.0422013
0.0393766
0.0377979
0.0300912
0.00736002
0.0111053
0.0186931
0.0246954
0.0332533
0.0361867

0.0388591
0.0394426
0.0393718
0.0397284
0.037395
0.0345324
0.0327497
0.0312817
0.0279237
0.0294351
0.0283642
0.0287424
0.0266079
0.0230492
0.025101
0.0207679
0.0179386
0.0142675
0.0112065
0.0134598
0.00845414
0.00548539
0.00520334
0.00480452
0.00454327
0.00318615
0.00251452
0.00229539
0.00162473
0.00152626
0.00124963
0.00147458
0.00119448
0.000873938
0.000615327
0.00028917

VARIABLE

TIME

TIME

Time from start of ignition source;Time from sample insertion

s

0

5

10

15

20

25

30

35

40

45

50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185
190
195
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300

305
310
315
320
325
330
335
340
345
350
355
360
365
370
375
380
385
390
395
400
405
410

VARIABLE

DERIVED

VOLSTACK

Volumetric flow in exhaust stack;Volume flow in exhaust duct

0.0239523
0.0238743
0.0240162
0.0240091
0.023349
0.0231433
0.0234577
0.0232961
0.0236084
0.0237326
0.0237153
0.0241238
0.0241799
0.0240028
0.0241054
0.0239896
0.0238989
0.0240651
0.0239248
0.0238512
0.02402
0.0238708
0.0240107
0.0239361

0.0237722
0.0240158
0.0238316
0.0239386
0.0237804
0.0239228
0.0240056
0.023925
0.0238738
0.0238043
0.023923
0.0236875
0.0238617
0.0238876
0.0238538
0.0237794
0.0238757
0.0235215
0.0233601
0.023398
0.0233108
0.0232333
0.0231107
0.0232558
0.0230785
0.0232111
0.0229999
0.023361
0.0230882
0.0232427
0.0232781
0.0233131
0.0231897
0.0235902
0.0235038
0.023665
0.0235982
0.0236754
0.0238308
0.0238497
0.0238743
0.0238744
0.0237969
0.0241009
0.0240365
0.0240567
0.0237699
0.0240246
0.0242322
0.0240391
0.0239385

0.0240102
0.0240256
0.0239986
0.0241489
0.0241479
0.0242003
0.0239938
0.0241162