EUROPEAN COMMISSION
5th EURATOM FRAMEWORK PROGRAMME 1998-2002
KEY ACTION : NUCLEAR FISSION

HTR-M

European Project for the development of HTR Technology - Materials for the HTR

CONTRACT N°
FIKI-CT-2000-00032

SCHEME FOR HTR-M MATERIALS DATA COLLECTION

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Dissemination level : CO
Document Number: HTR-M-01/11-D-0.0.22

SCHEME FOR HTR-M MATERIALS DATA COLLECTION

by

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C6463/TR/007
MTC/01/095
Issue 02
Date: June 2004

DOCUMENT ISSUE RECORD
(engineering documents)

Adding value through knowledge

Document Title :	Scheme for HTR-M materials data collection

Purpose of Issue : Final Issue

Security Class : Commercial-in-Confidence

Issue	Description of Amendment	Originator/ Author	Checker	Approver	Date
01		A A Braithwaite	D.E. Buckthorpe	T. Lennox	Nov 2001
02	Final Issue Including Comments from HTR-M Partners	A A Braithwaite	D.E. Buckthorpe	T. Lennox	June 2004

Total number of pages:	Intro:	(i)-(iv)	Text	1-3	Tables	T1-T4	Figures	-	Appendices	-

Previous issues of this document shall be destroyed or marked **SUPERSEDED**

Title Scheme for HTR-M Materials Data Collection

Summary: This report forms part of the contribution towards the development of a materials database within the EC Fifth framework Project HTR-M on materials for the HTR. The report describes a simple system based on Microsoft Excel spreadsheets which can be used for the collection and analysis of data. The system is based on that used in a number of previous collaborative EU projects.

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Summary sheet only

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1 Introduction

This report forms part of the contribution towards the development of a materials database within the EC Fifth framework Project HTR-M on materials for the HTR. An aim of the HTR-M project is to provide design and material test data for potential HTR materials. Where data are not available for selected materials, it is necessary to assemble materials property information so that it can be reviewed and evaluated to provide design data and support decisions made concerning HTR developments. This note describes a simple system based on Microsoft Excel spreadsheets which can be used for the collection and analysis of data. The system is based on that used in a number of previous collaborative EU projects (eg. Refs. 1 and 2).

2 Structure of the database system

The system consists essentially of a series of linked Excel worksheets. For a series of test results on a particular material, information on the test material is first entered into material detail sheets and the material is identified by a unique number. Results from tests on this material are then entered into an associated worksheet. Each set of data is accompanied by the material unique number, so that necessary material information can be retrieved when necessary.

(In previous collaborations a block of numbers has been allocated to each contributor, so that accidental duplication of numbers is avoided).

3 Content of the worksheets

3.1 Material details

The contents of the material sheets are shown in Table 1a. It will be seen that Sheet 1.1 contains information relating to the material production, while Sheet 1.2 contains compositional information. In previous work it was found convenient to record the composition information separately to limit the size of the worksheets on the desk top.

If the test material involves a weldment, then two additional sheets (1.3 and 1.4) are used, these allow details of the weld consumable and of the weldment itself to be entered. Compositional details of the weld or the consumable can be entered on Sheet 1.2.

Examples of material details recorded using the system are shown in Table 1b. These were taken from the data supplied for Ref. 2 and illustrate the link between, for example, weld parent and consumables.

3.2 Test details

The extent and the precise format of the test worksheets are governed by the requirements of the data. Examples of sheets used for some of the properties which will be required are given in Table 2a.

For tensile test results all the information is collected on a single worksheet (see 2.1 on Table 2a) but for more complex tests more than one sheet is needed. Generally

three linked sheets are used: one for materials test details, one for the basic property measurements (allowing a re-analysis of the data if desired), and one for the derived properties which are normally used in design or assessment. The link between information on the three sheets is maintained by means of a unique number allocated to each test.

Sheets 2.2.1 to 2.2.3 in Table 2a show column headings which may be used in linked worksheets for fracture toughness and creep properties. For fracture toughness properties, the test information (specimen details, testing standard etc.) is recorded in Sheet 2.2.1, original J and δa values are recorded in 2.2.2, and 2.2.3 contains values of $J_{initiation}$, J_{IC} etc obtained in the original work.

Sheets 2.3.1 to 2.3.4 in Table 2a include information arranged similarly for creep properties, except that in this case an additional sheet is included to record creep rupture data.

Similar work sheets (Ref. 1) have been used for the collection of impact and fatigue crack growth properties, and it is envisaged that the same general structure would be used for the recording of other property information, for example fatigue endurance data.

Examples of data entries for tensile and fracture toughness properties are shown in Table 2b. These examples were taken from Ref. 1, and illustrate the way in which the material and test unique numbers maintain the link between information on different worksheets.

3.3 Design data

For each particular property, it is intended that a separate sheet would be designated for the recording of design (or assessment) data, from codes or standards. This would allow comparisons to be made between experimental data recorded on the database and the equivalent design data.

The additional sheets are indicated on Table 2a as 2.1.2 for tensile date, 2.2.4 for fracture toughness, 2.3.5 for creep rupture and 2.3.6 for creep strain. The precise form of the toughness and creep data sheet will depend upon the data available, so no column headings are shown for these sheets on Table 2a.

It is envisaged that design data would be stored on the sheets as a set of XY pairs. In cases where the design data are represented only by an equation, the XY data would be generated mathematically. Similarly, if design information is only available as a published graph (without data points) the information would again be represented by a set of XY pairs; obtained for example by scanning the graph into a TIF file and using a programme such as a Biosoft Ungraph to digitise the data.

4 References

1. Final report on CEC study contract RAI-0227-UK, A A Braithwaite (NNC), C Escaravage (Novatome), H Huthmann (Siemens), D Lehmann, A A Tavassoli (CEA). NNC Report C9261/TR/001 1996.

2. Final report on CEC study contract, RAI-0214-UK, A A Braithwaite (NNC), H Breitling (Siemens), I Curbishley (AEA-T), C Escaravage (Novatome), D Lehmann, A A Tavassoli (CEA). NNC Report C8642/TR/001 1996.

Table 1a Worksheet headings for materials information

1.1 Product detail

Material Unique No	Specification	Producer	Product form	Cast No	Heat No	Section Size, mm	Heat Treatment		Cold work	Reference	Other Information
							As rec	Additional			

1.2 Chemical analysis

Material Unique No	Element wt%	C	Mn	etc	Other information

1.3 Weld Consumable details

Consumable unique no	Steel making practice	Manufacturer	Product Name	Batch No	Wire/rod diameter	Reference	Other Information

1.4 Weldment details

Weldment Unique No	Consumable unique no	Welding process	Weld geometry	Heat input	Preheat Temperature	Interpass Temperature	PWHT Temp	PWHT Time	Reference	Other information

Table 1b Examples of materials information

1.1 Product detail

Material Unique No	Specification	Producer	Product form	Cast No	Heat No	Section Size, mm	Heat Treatment		Cold work	Reference	Other Information
							As rec	Additional			
M5000	(grade 91)	Creusot Loire	Plate	85 829		40	N&T			2	

1.2 Chemical analysis

Material unique no	C wt %	Mn	Si	S	P	Ni	Cr	Mo	(etc)	Reference	Other Information
M5000	0.105	0.38	0.43	0.003	0.009	0.13	8.26	0.85		2	Ladle analysis
M5000	0.105	0.38	0.40	0.002	0.009	0.13	8.30	0.97		2	Product analysis
C5000	0.107	0.75	0.32	0.007	0.010	0.07	8.25	0.92		2	Product analysis

1.3 Weld Consumable details

Consumable unique no	Manufacturer	Product Name	Batch no	Wire/rod diameter	Reference	Other information
C5000	Oerlikon	Cromocord 9M	029.578	5 mm	2	

1.4 Weldment details

Weldment unique no	Material unique no	Consumable unique no	Welding process	Weld Geometry	Heat input	Preheat temp	Interpass temp	PWHT temp	PWHT time	Reference	Other Information
W5003	M5000	C5000	MMA	double V, 12/45°				760°C	16 h	2	

Table 2a Worksheet headings for data collection

2.1 Tensile Properties									
2.1.1 Tensile test results									
Material Unique No	Specimen orientation	Specimen location	Test temp °C	YS MPa	UTS MPa	Elongation %	R of A %	Reference	Other information
2.1.2 Tensile design datas									
Temp °C	YS MPa	UTS MPa	Elongation %	R of A %	Reference	Other Information			
2.2 Fracture toughness properties									
2.2.1 Fracture toughness test detail									
Material unique no	Test unique no	Test temp, °C	Specimen type	Specimen size, mm	Specimen orientation	Specimen location	Side grooves	Testing standard	Crack monitoring	Blunting Line	Reference	Other information
2.2.2 Fracture toughness J-δa values									
Test unique no	J, $kJ.m^2$	δa, mm	Other information						
2.2.3 Fracture toughness test results									
Test unique no	J initiation definition	J initiation kJ/m^2	J_{lmm} kJ/m^2	J_{IC} kJ/m^2	dJ/da kN/m^2	Equation J=f(δa)	Other information		
2.2.4 Fracture toughness design data									
2.3 Creep properties									
2.3.1 Creep test details									
Material unique no	Test Unique No	Specimen orientation	Specimen location	Test Temp, °C	Stress MPa	Reference	Other Information		
2.3.2 Creep rupture test results									
Test unique no	Time to fail, h	Elongation %	R of A %	Other Information					
2.3.3 Creep strain test data									
Test Unique No	Time, h	Strain %	Other information						
2.3.4 Creep Strain Results									
Test Unique No	Primary creep rate	Secondary creep rate	Other information						
2.3.5 Creep rupture design data									
2.3.6 Creep strain design data									

Table 2b Example of data entry (extracted from data supplied for Ref 1)

2.1 Tensile Properties

Material unique no	Specimen orientation	Specimen location	Test temp, °C	YS MPa	UTS MPa	Elongation %	R of A %	Reference	Other information
M2001	S		100	320	490	20	68	1	

2.2 Fracture Toughness Properties

2.2.1 Fracture Toughness Test Details

Material unique no	Test Unique no	Test temp, °C.	Specimen type	Specimen size, mm	Specimen orientation	Specimen location	Side grooves	Testing standard	Crack Monitoring	Blunting line	Reference	Other information
M2001	T201	100	CTJ	25	ST		yes	NF A 03-183	compliance	4	1	

2.2.2 Fracture toughness J – a values

Test unique no	J, kJ/m^2	a, mm	Other information
T2101	7.5 19.9 56.1 77 98.2 119.5 (etc)	0 0.25 0.16 0.2 0.23 0.32	

2.2.3 Fracture Toughness Test Results

Test unique no	$J_{initiation}$ definition	$J_{initiation}$ kJ/m^2	$J_{1\ mm}$ kJ/m^2	J_{IC} kJ/m^2	J_{max} kJ/m^2	dJ/ kN/m^2	Equation J = f(a)	A	C	Other information
T2101	0.2BL	349	549	299	597	215	J = A +C (a)	259	216	