

APPENDIX A
DATA INPUT FOR FDS SIMULATOR

A 1. INTRODUCTION

Appendix A aims to present some examples of data input needed to perform fire simulations by using FDS.

A 1.1 Materials' Definitions

Parameters describing specific material and fuels are contained in a separate database. The user is free to modify the database file.

This section presents an example of data set needed to define the materials' characteristics in the database.

For combustible materials there are two different sets of data describing the material's behaviour in case of fire: by means of the heat of vaporisation or giving the ramp of the heat release rate per unit of area.

First Example: Heat of Vaporisation

```
&SURF ID = 'UPHOLSTERY' / Combustible material
FYI = 'Fleischmann and Chen, 100% acrylic, combustible'
C_DELTA_RHO = 1.29 / Specific heat x density x thickness (KJ/°K m²)
TMPIGN = 280. / Ignition temperature (°C)
DENSITY = 40.0 / Density of the fuel (Kg/ m³)
BURNING_RATE_MAX = 0.03
HEAT_OF_VAPORIZATION = 1500.
HEAT_OF_COMBUSTION = 30000. /
```

Second Example: Heat Release Rate per Unit Area

```
&SURF ID = 'GYPSUM BOARD' / Combustible material
FYI = 'Quintiere, Fire Behavior'
HRRPUA = 100. / Peak of heat release rate per unit of area (KW/ m²)
RAMP_Q = 'GB' /
KS = 0.48 / Thermal Conductivity (W/m °K)
ALPHA = 4.1E-7 / Thermal Diffusivity (m²/s)
DELTA = 0.1 / Thickness in (m²)
TMPIGN = 400. / Ignition temperature (°C)
```

In this case, the definition of the fire behaviour of the material is needed.

The fire behaviour of the material is given by the Heat Release Rate profile where F indicates the fraction of the peak value of heat release rate:

```
&RAMP ID='GB',T= 0.0,F=0.0 /
&RAMP ID='GB',T= 1.0,F=0.5 /
&RAMP ID='GB',T= 2.0,F=1.0 /
&RAMP ID='GB',T=10.0,F=1.0 /
&RAMP ID='GB',T=20.0,F=0.0 /
&RAMP ID='GB',T=30.0,F=0.0 /
```

For non-combustible materials, only the thermal properties related to the heat fluxes are reported in the database:

```
&SURF ID = 'MARINITE'  
ALPHA=1.14E-7 / Thermal Diffusivity (m2/s)  
KS=0.12 / Thermal Conductivity (W/m °K)  
DELTA=0.0254 / Thickness in (m2)
```

```
&SURF ID = 'SHEET METAL'  
FYI = '18 guage sheet metal'  
C_DELTA_RHO = 4.7 / Specific heat x density x thickness (KJ/°K m2)  
DELTA = 0.0013 / Thickness in (m2)
```

A 1.2 Sprinklers' Definitions

The file describing sprinklers' performance as used in FDS simulations is reported in the following. The designer can modify the database adding the parameters' values case by case.

```
MANUFACTURER  
Nobody (to be completed by designer)  
MODEL  
K-5  
OPERATING_PRESSURE/ Sprinkler operating pressure in units of bars  
0.483  
K-FACTOR/ K-factor of sprinkler in unit of L/min/bar1/2  
79.  
RTI/ Response Time Index of sprinkler in units of (m*sec)1/2  
  
110.  
C-FACTOR/ C-factor of sprinkler in unit of (m/s)1/2  
0.  
ACTIVATION_TEMPERATURE/ Link activation temperature (°C)  
70.  
OFFSET_DISTANCE/ Distance in m from sprinkler orifice where the droplets are initialised  
0.1  
SIZE_DISTRIBUTION/ Information about the droplet size distribution  
1  
800 2.43 0.6  
VELOCITY/ Description of the initial droplet velocity distribution  
1  
55. 75. 8.0
```

A 1.3 Example of Input File – PS

This section contains an example of the input file to be prepared in order to perform a FDS simulation. The data are referred to simulation C-M-15 (please refer to section 4.3).

```
&HEAD CHID='C-M-15',TITLE='NATURAL VENTILATION' /SIMULATION ID  
&TIME TWFIN=500. /SIMULATION TIME
```

&MISC SURF_DEFAULT='MARINITE', REACTION='POLYURETHANE',
DATABASE='C:\nist\fds\database3\database3_1.data\MISCELLANEOUS DATA (DEFAULT SURFACE; TYPE OF
REACTION; MATERIALS'DATABASE DIRECTORY

Meshes

&GRID IBAR=128,JBAR=80,KBAR=32 /NUMBER OF GRID CELLS
&PDIM XBAR0=1.466488, XBAR=17.11649, YBAR0=-2.409751, YBAR=7.590205, ZBAR0=0, ZBAR=3.7/ DOMAIN

Domain Boundaries

&VENT XB=12.56649,15.36649, 1.840227, 3.340227, 0.0,0.0, SURF_ID='OPEN', /STAIRWAY OPENING
&VENT XB=1.466488,17.11649, -2.409751, 1.840227, 0.0,0.0, SURF_ID='CARPET', /FLOOR COVERAGE
&VENT XB=1.466488,12.56649, 1.840227, 3.340227, 0.0,0.0, SURF_ID='CARPET', /FLOOR COVERAGE
&VENT XB=1.466488,17.11649, 3.340227, 7.590205, 0.0,0.0, SURF_ID='CARPET', /FLOOR COVERAGE
&VENT XB=15.36649,17.11649, 1.840227, 3.340227, 0.0,0.0, SURF_ID='CARPET', /FLOOR COVERAGE
&VENT XB=17.11649,17.11649, -0.284751, 0.215249, 2.8,3.1, SURF_ID='BLOWER' /FORCED VENTILATION OPENING
&VENT XB=17.11649,17.11649, 2.340249, 2.840249, 2.8,3.1, SURF_ID='BLOWER' /FORCED VENTILATION OPENING
&VENT XB=17.11649,17.11649, 4.965249, 5.465249, 2.8,3.1, SURF_ID='BLOWER' /FORCED VENTILATION OPENING
&VENT XB=11.07,12.27, -2.409751,-2.409751, 0.0,2.0, SURF_ID='OPEN', /EMERGENCY EXIT
&VENT XB=11.07,12.27, 7.590205, 7.590205, 0.0,2.0, SURF_ID='OPEN', /EMERGENCY EXIT
&VENT XB=16.11649,16.61649, -2.409751,-2.409751, 2.8,3.1, SURF_ID='OPEN', /NATURAL VENTILATION OPENING
&VENT XB=16.11649,16.61649, 7.590205, 7.590205, 2.8,3.1, SURF_ID='OPEN', /NATURAL VENTILATION OPENING

Fire Definition

&SURF ID='fuoco' HRRPUA=1700 RAMP_Q='RAMP_FIRE',RGB=1,0,0, /

&RAMP ID='RAMP_FIRE',T= 0.0, F=0.0 /
&RAMP ID='RAMP_FIRE',T= 200.0,F=0.34 /
&RAMP ID='RAMP_FIRE',T= 300.0,F=0.54 /
&RAMP ID='RAMP_FIRE',T= 380.0,F=1.0 /
&RAMP ID='RAMP_FIRE',T= 550.0,F=0.16 /
&RAMP ID='RAMP_FIRE',T=1000.0,F=0.0 /

Obstruction Surface Types

&SURF ID='BLOWER', VEL=-1.2, TMPWAL=15. /FORCED VENTILATION PARAMETERS

Sprinklers'Number 15

&SPRK XYZ= 3.706488, 0.430249, 2.2, MAKE='K-5-prova'/Sprinkler1
&SPRK XYZ= 3.706488, 3.270249, 2.2, MAKE='K-5-prova'/Sprinkler2
&SPRK XYZ= 3.706488, 6.110249, 2.2, MAKE='K-5-prova'/Sprinkler3
&SPRK XYZ= 5.946488, 1.850249, 2.2, MAKE='K-5-prova'/Sprinkler4
&SPRK XYZ= 5.946488, 4.690249, 2.2, MAKE='K-5-prova'/Sprinkler5
&SPRK XYZ= 8.186488, 0.430249, 2.2, MAKE='K-5-prova'/Sprinkler6
&SPRK XYZ= 8.186488, 3.270249, 2.2, MAKE='K-5-prova'/Sprinkler7
&SPRK XYZ= 8.186488, 6.110249, 2.2, MAKE='K-5-prova'/Sprinkler8
&SPRK XYZ=10.426488, 1.850249, 2.2, MAKE='K-5-prova'/Sprinkler9
&SPRK XYZ=10.426488, 4.690249, 2.2, MAKE='K-5-prova'/Sprinkler10
&SPRK XYZ=12.666488, 0.430249, 2.2, MAKE='K-5-prova'/Sprinkler11
&SPRK XYZ=12.666488, 3.270249, 2.2, MAKE='K-5-prova'/Sprinkler12
&SPRK XYZ=12.666488, 6.110249, 2.2, MAKE='K-5-prova'/Sprinkler13
&SPRK XYZ=14.906488, 0.250249, 3.699, MAKE='K-5-prova'/Sprinkler14
&SPRK XYZ=14.906488, 4.690249, 3.699, MAKE='K-5-prova'/Sprinkler15

Obstructions

&OBST XB=0,3.991491,-1.08,-0.9848122,0,2,2 SURF_ID='VINYL SIDING' / Secondary Panels
&OBST XB=3.89,3.991491,-2.409751,-0.9848122,0,2,2 SURF_ID='VINYL SIDING' / Secondary Panels
&OBST XB=0,3.991491,6.165266,6.26,0,2,2 SURF_ID='VINYL SIDING' / Secondary Panels
&OBST XB=3.89,3.991491,6.165266,7.590205,0,2,2 SURF_ID='VINYL SIDING' / Secondary Panels

&OBST XB=1.466488,13.26649,-2.409751,7.590205,2,2,3 SURF_ID='COMBUSTIBLE CEILING TILE' / CEILING PANELS
&OBST XB=13.16,13.26649,-2.409751,7.590205,2,2,3.7 SURF_ID='COMBUSTIBLE CEILING TILE' / CEILING PANELS

&OBST XB=15.36649,15.46649,-2.409751,7.590205,0,1,4 SURF_ID='VINYL SIDING' / Secondary Panels
&OBST XB=15.36649,17.11649,-2.409751,7.590205,1,3,1.4 SURF_ID='VINYL SIDING' / Secondary Panels

&OBST XB=13.04932,13.24933,-0.4550921,1.294909,0,1,5 ,RGB=0,1,0, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=12.55433,13.04933,-0.4550926,1.294908,0,0,5 ,RGB=0,1,0, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=13.40433,13.89933,-0.4550926,1.294908,0,0,5 ,RGB=0,1,0, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
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&OBST XB=14.25433,14.74933,-0.4550926,1.294908,0,0,5 ,RGB=0,1,0, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
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&OBST XB=4.260499,4.755499,-2.034773,-0.8947732,0,0,5 ,RGB=1,0,1, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
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&OBST XB=9.160499,9.360498,6.075227,7.215227,0,1,5 ,RGB=1,0,1, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
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&OBST XB=3.209989,3.410504,3.045183,5.405227,0,1,5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
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&OBST XB=4.060504,4.260504,3.142732,5.502775,0,1,5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
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&OBST XB=4.909989,5.110504,3.142731,5.502775,0,1.5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY'/UPHOLSTERED SEAT
&OBST XB=5.960499,6.455499,3.142775,5.502775,0,0.5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY'/UPHOLSTERED SEAT
&OBST XB=5.760504,5.960504,3.142732,5.502775,0,1.5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY'/UPHOLSTERED SEAT
&OBST XB=5.759989,5.960504,3.142731,5.502775,0,1.5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY'/UPHOLSTERED SEAT

&OBST XB=6.810499,7.305499,3.142775,3.642775,0,0.5 ,SURF_IDS='fuoco','UPHOLSTERY','UPHOLSTERY'/ UPHOLSTERED SEAT BURNING

&OBST XB=6.810499,7.305499,3.642775,5.502775,0,0.5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY'/UPHOLSTERED SEAT
&OBST XB=6.610504,6.810504,3.142732,5.502775,0,1.5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY'/UPHOLSTERED SEAT
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&OBST XB=7.460504,7.660504,3.142732,5.502775,0,1.5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY'/UPHOLSTERED SEAT
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&OBST XB=8.309989,8.510504,3.142731,5.502775,0,1.5 RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
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&OBST XB=10.00999,10.2105,3.142731,5.502775,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=8.510499,9.005499,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=8.309989,8.510504,-0.3223214,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=8.310504,8.510504,-0.3223218,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=7.459989,7.660504,-0.3223214,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=7.460504,7.660504,-0.3223218,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=7.660499,8.155499,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=7.660499,8.155499,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=6.610504,6.810504,-0.3223218,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=6.810499,7.305499,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=5.759989,5.960504,-0.3223214,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=5.760504,5.960504,-0.3223218,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=5.960499,6.455499,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=4.909989,5.110504,-0.3223214,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=4.910504,5.110504,-0.3223218,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=5.110499,5.605499,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=4.059989,4.260504,-0.3223214,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=4.060504,4.260504,-0.3223218,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=4.260499,4.755499,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=3.410499,3.905499,-0.2247732,2.135227,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=3.210504,3.410504,-0.2247736,2.13527,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=3.209989,3.410504,-0.2247732,2.13527,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=10.00999,10.2105,-0.3223214,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=10.0105,10.2105,-0.3223218,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=10.2105,10.7055,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=9.159989,9.360504,-0.3223214,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=9.160503,9.360504,-0.3223218,2.037722,0,1.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT
&OBST XB=9.360498,9.855499,-0.3223213,2.037679,0,0.5 ,RGB=0.5,0.5,0.5, SURF_ID='UPHOLSTERY' / UPHOLSTERED SEAT

&OBST XB=14.11115,14.3649, -1.8,-0.97, 0,0.2333333 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS
&OBST XB=14.3649,14.61865, -1.8,-0.97, 0,0.4666667 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS
&OBST XB=14.61865,14.8724, -1.8,-0.97, 0,0.7 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS
&OBST XB=14.8724,15.12615, -1.8,-0.97, 0,0.9333333 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS
&OBST XB=15.12615,15.3799, -1.8,-0.97, 0,1.166667 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS

&OBST XB=14.11115,14.3649, 6.15,6.98, 0,0.2333333 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS
&OBST XB=14.3649,14.61865, 6.15,6.98, 0,0.4666667 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS
&OBST XB=14.61865,14.8724, 6.15,6.98, 0,0.7 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS
&OBST XB=14.8724,15.12615, 6.15,6.98, 0,0.9333333 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS
&OBST XB=15.12615,15.3799, 6.15,6.98, 0,1.166667 ,RGB=0,1,1, SURF_ID='STEEL' / STEEL STAIRS

Output

```
&SLCF PBX=3.2 ,QUANTITY='TEMPERATURE'/  
&SLCF PBX=11.67 ,QUANTITY='TEMPERATURE'/  
&SLCF PBY=2.5 ,QUANTITY='TEMPERATURE'/  
&SLCF PBY=-0.65 ,QUANTITY='TEMPERATURE'/  
&SLCF PBY=5.75 ,QUANTITY='TEMPERATURE'/
```

```
&THCP XYZ=11.67, -0.4, 1.8, QUANTITY='TEMPERATURE'/
```

```
&THCP XYZ=11.67, 5.5, 1.8, QUANTITY='TEMPERATURE'/
```

Plot3d

```
&PL3D DTSAM=30, QUANTITIES='TEMPERATURE','U-VELOCITY','V-VELOCITY','W-VELOCITY','soot density'/  
&PL3D DTSAM=30, QUANTITIES='TEMPERATURE','U-VELOCITY','V-VELOCITY','W-VELOCITY','soot density'/  
&PL3D DTSAM=30, QUANTITIES='visibility'/
```

```
&BNDF DTSAM=60,QUANTITY='BURNING_RATE' /  
&BNDF DTSAM=60,QUANTITY='WALL_TEMPERATURE'/
```