Lutra*dyn*

14th Workshop on Pyrotechnic Combustion Mechanisms

Combustion & Detonation of Energetic Materials Round Robin Test Program

Participants

EKVI-Code
EXPLO-5 Code, M. Sućeska, University of Zagreb, Croatia
FACT-Sage , K. Hack, GTT Technologies, Germany
ICT Code, S. Kelzenberg, Fraunhofer ICT, Pfinztal, Germany
IVTAN THERMO Code, G. Belov, Russia
NASA-CEA, E.-C. Koch, Lutradyn, Germany
REAL, G. Belov, Russia
THOR Code, A. Campos, University of Coimbra, Portugal

Dear Colleagues,

Thank you again for your kind willingness to present at the

14th Workshop on Pyrotechnic Combustion Mechanisms

on June 25, 2018.

The Workshop will start with a get together the day before (Sunday June 24) around 18:00 with a "warm up" for the presenters to meet and talk.

The workshop starts on Monday 25, at 8:30 with sessions presenting the various codes by their developers or advanced users.

After a (lunch) break the Workshop looks into the results of the Round Robin which is followed by a final discussion.

For the Round Robin we kindly ask you to conduct the following calculations and submit the results in the required form (ascii text files) no later than June 17, 2018, to: e-c.koch@lutradyn.com and sebastian.knapp@ict.fraunhofer.de

We look forward to seeing you in Kaiserslautern!

Best regards

Ernst-Christian Koch – Sebastian Knapp
Lutra*dyn* Fraunhofer ICT
Kaiserslautern/Germany Pfinztal/Germany
Workshop Co-Chairs

Thermodynamic and compositional data

Name	**Formula**	**Density** ($g\ cm^{-3}$)	**$\Delta_f H$** ($kJ\ mol^{-1}$)
Aluminum	Al	2.699	0
Boron carbide	B_4C	2.52	-62.68
Copper oxide	CuO	6.3	-156.1
Hexafluoropropene-Vinylidenefluoride-copolymer, *Viton®A*	$(C_3\ F_6)_n(C_2H_2F_2)_m$ (with n/m = 1/3.5) = $C_{10}H_7F_{13}$	1.775	-2784
Octogen (HMX)	$C_4H_8N_8O_8$	1.906	84.01
Phosphorus, red (P_R)	P	2.2	0
Polytetrafluorethylene (PTFE)	$(C_2F_4)_n$	2.25	-809
Potassium perchlorate	$KClO_4$	2.52	-432.79
Potassium nitrate	KNO_3	2.109	-494.63
Silicon	Si	2.329	0
Silver iodate	$AgIO_3$	5.890	-95.80

Test case 1, TC-1

High Explosive, PBXN-5

95 wt-% Octogen
05 wt-% Viton®A

Detonation at TMD[1]:

- P_{CJ}[2] [GPa]
- V_D[3] [m s^{-1}]
- T_{CJ}[4] [K]
- V/V_0 [5] [kJ cm^{-3}]
- Gas volume [dm^3 kg^{-1}]
- Composition of detonation products at 298 K (25 °C) (no reaction with ambient air) [wt-%]

Deflagration at P = 0.1 MPa, 1 MPa

- Composition of deflagration products at 298 K (25 °C) (no reaction with ambient air) [wt-%]
- Adiabatic deflagration temperature, T_{ad} (no reaction with ambient air) [K]

[1] Theoretical Maximum Density
[2] Detonation Velocity
[3] Detonation-Pressure
[4] Detonation Temperature
[5] Cylinder Expansion Energy

Test case 2, TC-2

Aluminized High Explosive, PBX-Alf

60 wt-% Octogen
10 wt-% Aluminum
20 wt-% PTFE
10 wt-% Viton®A

Detonation at TMD:

- P_{CJ}[GPa]
- V_D[m s^{-1}]
- T_{CJ}[K]
- V/V_0 [kJ cm^{-3}]
- Gasvolume [dm^3 kg^{-1}]
- Composition of detonation products at 298 K (25 °C) (no reaction with ambient air) [wt-%]

Deflagration at P = 0.1 MPa, 1 MPa

- Composition of deflagration products at 298 K (25 °C) (no reaction with ambient air) [wt-%]
- Adiabatic deflagration temperature, T_{ad} (no reaction with ambient air) [K]

Test case 3, TC-3

High Blast Explosive, PBX-PF

68 wt-% Octogen
20 wt-% P_R
12 wt-% Viton®A

Detonation at TMD:

- P_{CJ} [GPa]
- V_D [m s^{-1}]
- T_{CJ} [K]
- V/V_0 [kJ cm^{-3}]
- Gasvolume [dm^3 kg^{-1}]
- Composition of detonation products at 298 °C (no reaction with ambient air) [wt-%]

Deflagration at P= 0.1 MPa, 1 MPa

- Composition of deflagration products at 298 K (25 °C) (no reaction with ambient air) [wt-%]
- Adiabatic deflagration temperature, T_{ad} (no reaction with ambient air) [K]

Test case 4, TC-4

ADW-Pyrolant

65 wt-% $AgIO_3$
15 wt-% Viton®A
20 wt-% Si

Deflagration at P = 0.1 MPa, 1 MPa

- Composition of the equilibrium composition at T_{ad}. (no reaction with ambient air)
- Composition of deflagration products at 298 K (25 °C) (no reaction with ambient air) [wt-%]
- Adiabatic deflagration temperature, T_{ad} (no reaction with ambient air) [K]

Test case 5, TC-5

Screening Smoke

60 wt-% P_R
05 wt-% Viton®A
15 wt-% Si
20 wt-% KNO_3

Deflagration at P = 0.1 MPa, 1 MPa

- Composition of the equilibrium composition at T_{ad}. (no reaction with ambient air)
- Composition of deflagration products at 298 K (25 °C) (no reaction with ambient air) [wt-%]
- Adiabatic deflagration temperature, T_{ad} (no reaction with ambient air) [K]

Test case 6, TC-6

Green Flare

57 wt-% KClO4
38 wt-% B_4C
05 wt-% Viton®A

Deflagration at P = 0.01MPa, 0.1 MPa, 1 MPa

- Composition of the equilibrium composition at T_{ad}. (no reaction with ambient air)
- Composition of deflagration products at 298 K (25 °C) (no reaction with ambient air) [wt-%]
- Adiabatic deflagration temperature, T_{ad} (no reaction with ambient air) [K]

Test case 7, TC-7

Thermite

Fuel: Al
Oxidant: CuO

Deflagration at P = 0.01MPa, 0.1 MPa, 1 MPa

- Determine the range of stoichiometries for which a solution can be obtained
- Composition of the equilibrium composition at T_{ad}. (no reaction with ambient air) versus stoichiometry
- Composition of deflagration products at 298 K (25 °C) (no reaction with ambient air) [wt-%] versus stoichiometry
- Adiabatic deflagration temperature, T_{ad} (no reaction with ambient air) [K] versus stoichiometry