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Clarification for Test Cases Calculations

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Test Cases

- Two test cases have been selected for the Working Group numerical activities:

  - One for graphite ablation in air atmosphere under laminar conditions (Maah's experiments).

  - The second is the ablation of carbon phenolic Narmco 4028 (Sutton's experiments) also in air atmosphere.

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Heat-Flux Assumptions

- No heat-flux profile was provided in the Test Case Definition.

⇨ This data was not explicitly available from the experiments.

As explained on the following slides, it is therefore proposed for the purpose of the test cases 1 and 2 to consider the nominal heat flux values to be constant over the test duration.

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Sutton Experiments (Test Case 1)

There is no profile of the heating rate.

The heating rate has been calculated using stagnation parameters and Fay & Ridell correlation for cold wall heat-flux.

There was no measurement of heat flux during the experiments.

For the numerical rebuilding, Sutton assumed the nominal heat flux value of each test to be constant over the duration of the tests.

It is proposed to use the same approach for Test Case 1.

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Heat-Flux and Time duration for Test Case 1

	Experimental conditions and results			
Stagnation pressure (atm)	Heating rate (W/cm^2)	Duration (s)	Nominal total enthalpy (MJ/kg)	Surface temperature
0,035	760	60	34.9	2485
0,6	2073	45	23	3376
2,2	761	60	4.63	2076
5,6	570	30	2.36	2085
15	1011	20	2.55	2579

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Maah's Experiments (Test Case 2)

There were some measurements of the heat-flux: three by test, but without time history. So, this data has little usefulness.

Also here, the proposition is therefore to use the nominal values of the heat-flux, considering them constant during the test.

Anyway, in these tests there is little difference between the measured and nominal values of the heat-flux (the difference reaches 10% only for one point, around 2-3% for the others).

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Heat-Flux and time duration for Test Case 2

Stagnation pressure (atm)	Duration (s)	Nominal total enthalpy (MJ/kg)	Heat-flux (MW/m^2)	Surface temperature (K)	Mass fraction of oxygen
0.31	30	25.05	14.19	3370	0.23
2.4	29.3	5.43	7.95	2480	0.23
8.62	15.2	2.55	6.13	2320	0.08
10.91	15.7	1.91	4.84	2135	0.09

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Outputs for Test Case 1 (from TN4)

- Total recession as function of stagnation pressure with and/or without imposing the value of the surface temperature (Excel datasheet)
- If surface temperature is not an input: surface temperature as function of stagnation pressure (Excel datasheet).
- Surface species, reactions, mole fraction profiles from the surface if available (CFD calculations) or at the surface.
- All used inputs.

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Outputs for Test Case 2 (from TN4)

- Recession as function of stagnation pressure with and without imposing the value of the surface temperature (Excel datasheet).
- For the first and last cases of the matrix (see Table Slide 7): Recession and surface temperature (if not imposed) as function of time.
- For the two other cases (see Table Slide 7): Recession and surface temperature (if not imposed at the end of the running time.
- Surface species, reactions, mole fraction profiles from the surface if available (CFD calculations) or at the surface.
- All used inputs.