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## License Agreement

for the CFD Test Case

### HF-7: LOX/H<sub>2</sub>-Combustion with self-sustained acoustic excitation

The test data of this test case was generated by Dr.-Ing. Stefan Gröning during his doctorate project (2010 – 2016) under the scientific supervision of Univ.-Prof. Dr. rer.nat. M. Oschwald in the Combustion Dynamics Group of Dr. Justin Hardi at the DLR Institute of Space Propulsion in Lampoldshausen, Germany.

The research project was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) in the frame of the DFG-Special Research Field Transregio 40 to some extent, which is gratefully acknowledged.

The test case "HF-7" is open to everyone, who wants to use the data base for CFD validation. The provision of this test case is intended to be a contribution to the field of research on thermo-acoustic instabilities, especially to high frequency combustion instabilities in rocket engines in order to advance progress in these fields. The provider of the test case highly appreciates to share results, experience and other useful information among the group of users and encourages all users to participate in that sense. Joint publications are welcome.

The test case consists of two documents:

- (1) the Test Case Description
- (2) the Test Case Data Set.

By signing this license agreement the user accepts:

- to not give access to anybody else to the contents of the test case description and test case data set
- to not distribute the contents of the test case and test case data set to third parties
- that he does not gain any rights on the obtained data or any other information on the test case.
- to cite in every publication (or in any other form of communication) the source and origin of his information, i.e. naming the authors and the institute. If the test case is used in any form of

publication, the relevant publications below must be cited. Furthermore, the origin of the data base must be mentioned as follows: "The measurements on the test case "HF-9" were carried out at the Institute of Space Propulsion at the German Aerospace Center in Lampoldshausen, Germany. Part of the investigations was funded by the Deutsche Forschungsgemeinschaft SFB TRR 40 "

- to give feedback to the Institute of Space Propulsion at the German Aerospace Center in Lampoldshausen about what he did with the provided information. Participation in the potential workshops and inclusion of these results in the data base are solicited and welcome.

After the signed License Agreement has been received by the contact at DLR listed below the detailed Test Case Description and the Test Case Data Set will be made available to the licensee.

### **Relevant publications of the test case:**

- [1] Gröning S., Hardi J., Suslov D., Oswald M., Influence of hydrogen temperature on the stability of a rocket engine combustor operated with hydrogen and oxygen, CEAS Space Journal, Vol. 9, pp. 59-76, 2017
- [2] Gröning S., Hardi J.S., Suslov D., Oswald M., Injector-Driven Combustion Instabilities in a Hydrogen/Oxygen Rocket Combustor, Journal of Propulsion and Power, Vol. 32, pp. 560-573
- [3] Gröning S., Hardi J.S., Suslov D., Oswald, M., Analysis of phase shift between oscillations of pressure and flame radiation intensity of self-excited combustion instabilities, 6th EUCASS, Krakow, Poland, 2015
- [4] Gröning S., Suslov D., Hardi J., Oswald M., Influence of hydrogen temperature on the acoustics of a rocket engine combustion chamber operated with LOX/H<sub>2</sub> at representative conditions, Space Propulsion Conference, Cologne, Germany, 2014
- [5] Gröning S., Untersuchung selbsterregter Verbrennungsinstabilitäten in einer Raketenbrennkammer, Dissertation, RWTH Aachen University, Germany, 2017

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CFD Test Case

**HF-7: LOX/H2-Combustion with self-sustained acoustic excitation**

**License Agreement**

**User Details:**

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With my signature I fully accept the license agreement on the CFD test case HF-9 of DLR  
Institute of Space Propulsion :

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