

# SAMPLING DEVICE FOR HIGH-PRESSURE HYDROGEN



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## Introduction

Hydrogen supplied to hydrogen refuelling stations must meet the strict requirements set out in the ČSN ISO 14687 standard. Collecting hydrogen samples for analysis requires specialised sampling equipment and uniform methodology detailing the sampling procedure. The purpose of the project Sampling device for high-pressure hydrogen is to summarize the key aspects of the sampling strategies applied in other countries to date and propose a proprietary procedure for a uniform method of sampling hydrogen from hydrogen refuelling stations in the Czech Republic. The procedure will be implemented on an equipment prototype for hydrogen fuel sampling to perform subsequent laboratory analysis of potentially contained gaseous contaminants. The procedure will be verified on real field samples.

The results summarized in this poster were obtained as part of sub-project DP007 „Sampling device for high-pressure hydrogen“ of the National Hydrogen Mobility Center(TN02000007) with co-financing from the Technology Agency of the Czech Republic.

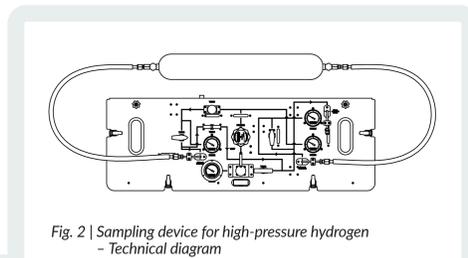


Fig. 2 | Sampling device for high-pressure hydrogen - Technical diagram

## Methods

Hydrogen vehicles powered by proton-exchange membrane fuel cells are very susceptible to damage caused by certain impurities in hydrogen fuel. For this reason, it is crucial to establish a system for hydrogen fuel quality testing at hydrogen refuelling stations (HRS). In order to facilitate the testing, hydrogen fuel must be transported from the HRS to an accredited laboratory safely and without contamination by using a sampling device. The device must be capable of intaking hydrogen at a pressure of 700 bar –the standard refuelling pressure for hydrogen personal vehicles. The project aims to develop a fully functional sampling device compatible with hydrogen refuelling stations throughout Europe and intended for deployment across the entire European market.

The device will serve to facilitate hydrogen fuel quality testing according to ČSN ISO 14687, which identifies maximum allowed concentrations of certain critical impurities in hydrogen fuel. Due to high sensitivity of fuel cells to the presence of impurities in hydrogen fuel and abundance of many of the impurities in atmosphere the sampling device must be inert to prevent false positives.

The hydrogen sampling device developed in this project is designed to sample the fuel by simply connecting the device to the nozzle of the HRS without the need to interrupt the station's normal operation. As opposed to some previous sampling devices the device developed in this project does not require a hydrogen vehicle to be filled during the sampling process which simplifies its operation.

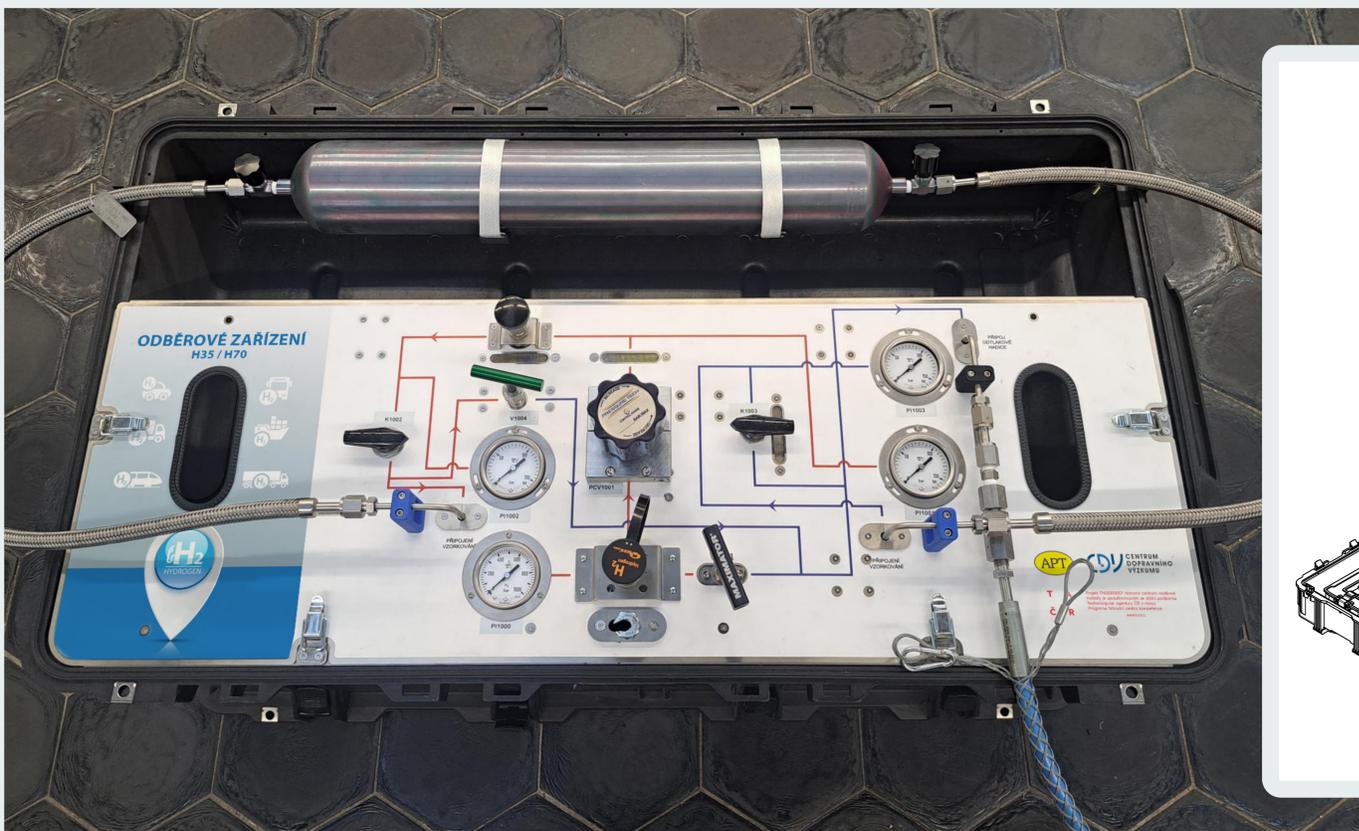


Fig. 1 | Sampling device for high-pressure hydrogen

## Results

The main results of the project are utility model and working sample of the sampling device and a working sample of a device for preparing sample containers for hydrogen fuel sampling.

### 1 | Sampling device for high-pressure hydrogen (Figure 1)

The main body of the sampling device is placed in a mobile case that can be fitted into a transport vehicle as can be seen on Figure 2. The device consists of the measuring equipment and a detachable pressure cylinder. The pressure bottle can intake hydrogen at pressure of 100 bar and can be replaced to facilitate collection of multiple hydrogen fuel samples.

When in operation the sampling device is connected to an external exhaust vent. This allows the device to collect samples without a hydrogen vehicle present.

The device is compatible with both 350 bar and 700 bar refuelling stations.

The device is constructed in a way that minimizes the number of dead-end zones for gas in order to maximize the amount of hydrogen taken from the refuelling station is used for analysis. In places where dead-end zones are unavoidable separating manometric diaphragms are used to ensure no contamination of the hydrogen sample by the manometers.

This allows the operator to purge the whole sampling device of leftover gas from previous measurements which minimizes risk of cross contamination.

### 2 | Device for preparing sampling containers for hydrogen fuel sampling (Figure 3)

The device is a stationary rack located in a laboratory for hydrogen analysis. It is equipped with two connection ports into which detachable pressure cylinders used for storing fuel samples can be inserted. The primary function of the device is to completely "reset" the history of each sampling container prior to reuse. This is achieved through multiple fully automated cycles of flushing with high-purity hydrogen (7.0) and evacuation under ultra-high vacuum, ensuring the complete removal of any residual gases or contaminants from previous sampling operations. To further enhance the desorption of impurities from the inner walls of the containers, the pressure receptacles may be heated up to 50 °C during the cleaning process. This procedure guarantees 100% purity of the sampling containers and eliminates any influence of previous samples on subsequent hydrogen analyses.

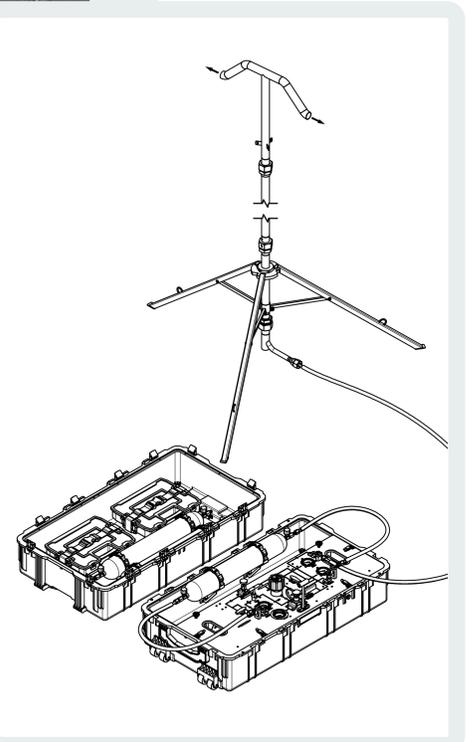


Fig. 2 | Sampling device for high-pressure hydrogen - Technical diagram

Fig. 3 | Device for preparing sample containers for hydrogen fuel sampling



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## Acknowledgements

„This project is co-financed from the state budget by the Technology Agency of the Czech Republic under the Národní centra kompetence Programme.

This work utilized outputs from Odběrové zařízení vysokotlakého vodíku (TN02000007-007) project.“

The results of the project Odběrové zařízení vysokotlakého vodíku (Sampling device for high-pressure hydrogen) are available online in Czech at [www.cistadoprava.cz/nahyc-m/dp007](http://www.cistadoprava.cz/nahyc-m/dp007)

