

***Analysis of Fuels, Tyre Surfaces and Tyre Inflation Gases  
at the racetrack with a Mobile Gas Chromatograph System "mobilab"***  
by Karl-Heinz Stegner and Eugen Klaus

## **1. Mobile Laboratory**

At the request of the DMSB e.V, Stegner & Klaus Engineering have developed and produced a mobile laboratory for analysis and examination of fuels, particularly racing fuels, tyre inflation gases as well as rubber samples from tyre surfaces of racing tyres.

This mobile laboratory consists of the following equipment:

- Gas chromatograph (GC for the examination of the rubber and the fuel)
- Electronic injector (permits a direct examination of rubber in the GC)
- Automatic sampler (for an automatic injection of fuel into the GC)
- Hydrogen generator (for the production of the H<sub>2</sub> to run the equipment )
- Hydrogen sensor (for the supervision of hydrogen leakages of the stove in the GC)
- Zero air generator (for production of pure air to run the equipment )
- Air compressor (for operation of the GC system)
- Printer (for documentation)
- Mobile computer (for the evaluation of the analysis)

With this laboratory, an analysis and examination of fuels, racing tyre surfaces as well as of tyre inflation gases is possible while still at the circuit. The laboratory is designed for transportation with motor vehicles or by airfreight (under consideration of compliance with the dangerous goods regulations). The complete equipment is installed in four Flight-Cases (55 cm, 60 cm, 65 cm, B, H, T, weight approx. 230 kg), which unpack into two columns to form the laboratory.

With this equipment, the analyses described above can be performed in almost any location. (See picture).



Picture 1: Mobile laboratory arranged into two columns

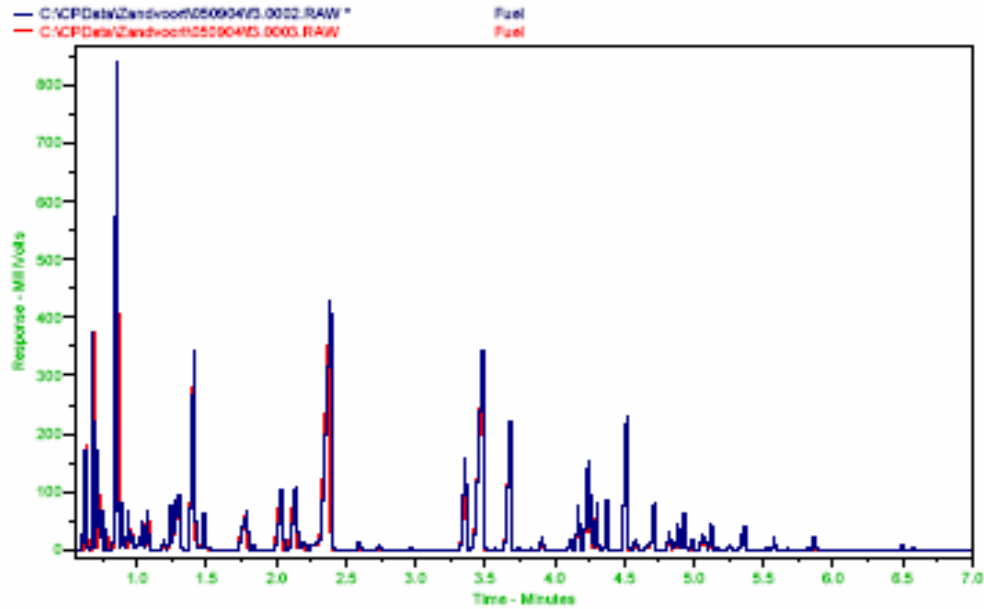
## **2. Fuel Analysis**

### **2.1 Fuel Sampling**

A reference sample is taken from the specified fuel. At a suitable place the fuel from the racing vehicle is taken directly from the fuel system by a tube into a fuel-tight locking container. Three (3) samples are taken. One sample is examined on the spot, a second one is given to the organizer and the third sample stays with the racing team.

### **2.2 Test Method**

The reference sample and the samples out of the racing vehicle are examined in the gas chromatograph. In the GC the fuel mixture is separated into its individual components and each component is shown in a chromatogram. The evaluation is made by comparing the reference sample to the samples from the racing vehicle as a finger print. Changes or contaminations of the fuel are shown in the different chromatograms.



Picture 2: comparing the reference sample to the actual fuel sample

### 3. Analysis of Tyre Compound

#### 3.1 Method of Taking Tyre Samples

S & K Engineering have developed a method of testing the rubber of racing tyres, which permits a gentle sampling out of the racing tyre or the tyre surface without damaging either the tyre or the tyre surface. The sample is taken with a special instrument.

The instrument enables you to draw strips out of the tyre surface which are approx. 1-2 mm wide, 0.3 mm thin and approx. 25-30 mm long. In sequence each single stripe is examined and presented in a gas chromatogram to discover any eventual chemical treatment, i.e. whether softeners have been used.

To exclude possible faults, the samples should be taken at three different parts of the tyre surface. From each of these locations, three strips have to be taken and distributed to the team, the organizer and the laboratory. These samples are kept in sealed metal boxes (e.g. the same type of containers as for the fuel).

### **3.2 Methods to Analyse Tyres**

S & K Engineering, i.e. Dipl.Ing.(University) Karl-Heinz Stegner and Dipl.Ing.(FH) Eugen Klaus in cooperation with diploma chemist Dr. Harald Wetzel have developed and improved two methods, which permit the analysis of solid rubber samples from tyre surfaces in a summary proceeding (direct analysis in an injector in the GC) and in a further procedure, lasting a little more time (extraction). Both methods are carried out with the help of the available GC-Systems equipment.

The **direct analysis** of the tyre sample in the GC shows the result within 10 min after the beginning of the test. The rubber sample (or a part of the sample) is put into a glass liner in front of the corresponding separating column within the GC. It is then subjected to a temperature program where the sample is

























The analysis and result of one single sample is available within approx. 15 min after receipt in the laboratory. Pollutions like oil, gasoline (fuel) or cooling water do not influence the analysis in any way, i.e. arguments of teams are not effective, that the vehicle concerned had driven over oil, fuel or other contaminants,. The method permits both, an analysis of brand new as well as used (driven) tyres.