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1. General details

Client: Inntaler Omnibus Betriebs-GmbH
Endach 30, 6330 Kufstein

Operator: Inntaler Omnibus Betriebs-GmbH

Address: Endach 30, 6330 Kufstein

Contractor: UWS Environmental Services Walter Stolz

Measurement analyst: Dr Walter Stolz

System examined: Ku 313 VO bus

Test conducted on: 31.05.2012

Reason for measurement: Test measurement with and without hydrogen addition

Measurement bases:

1. Continuous measurements

1.1 Oxygen (O₂), carbon monoxide (CO), nitrogen oxides (NO_x) reported as nitrogen dioxide (NO₂)

Basis:

RWTÜV Anlagentechnik GmbH

Report on the suitability testing of the testo 360-3 multicomponent measurement unit

Report No.: 5.0.2/0067/98 – 200 23 660

Measurement system: testo 360-3 multicomponent measurement unit, made by TestoTherm

1.2 Uncombusted gaseous organic substances, reported as carbon (org. C/HC)

VDI 3481 Sheet 4: Gaseous emission measurement - Measurement of the concentrations of total organic carbon and methane carbon using the flame ionisation detector (FID); 2007-02 edition

Measuring instrument: flame ionization detector, made by JUM

Heated measurement gas line, made by Winkler

Registration of the measurements:

Data logger and Comsoft software, made by Testotherm

2. Discontinuous measurements

Dust

Test method: VDI 2066 Sheet 1: Particulate matter measurement, dust measurement in flowing gases, gravimetric determination of dust load; 2006-11

Dust measurement probe with glass filter and stainless steel filter sleeves, made by Ströhlein

Analytical balance, made by Mettler

Dry gas meter, made by Elster

Precision barometer, made by Lufft

Measurement sites: exhaust pipe downstream of silencer

2. Objective

In the exhaust gas streams from the combined heat and power plant, the concentrations of the following substances were to be determined:

- dust
- carbon monoxide (CO)
- nitrogen oxides (NO_x), reported as nitrogen dioxide (NO₂)
- uncombusted gaseous organic substances, reported as carbon (org. C/HC)

The measurements were supposed to show that the injection of hydrogen (H₂) into the intake air brings about a measurable diesel saving and a lowering of the emission concentrations.

The electrical energy needed for the analytical instruments was provided by a mobile diesel generator.

3. Description of the bus and mode of operation during the measurements

3.1 Technical description

Manufacturer:	Setra
Model:	S 315 NF
Engine:	Horizontal 6-cylinder straight engine Direct injector with exhaust gas turbocharger (pump-nozzle)
Year of manufacture:	2005
Power [kW]:	185 kW
License plate:	Ku 313 VO
Area of use:	town bus

3.2 Mode of operation during the measurements

The same route was driven on country roads and main roads in the immediate area of Kufstein without (run 1) and with hydrogen addition (run 2).

The route was:

Endach (depot) – Zell – Langkampfenerstrasse – Schaftenau – Langkampfen – Kirchbichl – Bad Häring – Schwoich – Eibergbundesstrasse – as far as Loferer Bundesstrasse – U-turn – Eibergbundesstrasse – Endach (depot). One journey was 40.3 km. The journey featured a number of steep sections.

4. Measurement results

All the measurement results are based on exhaust gas at 0°C and 1013 hPa after removal of the moisture content of water, and a residual oxygen content of 5% by volume. They are reported in the unit mg/m³_N and are average values over the measurement period.

4.1 Dust

Measurement No.	Measurement time	Concentration [mg/m ³ _N]	Run
1	09:48 – 10:46	18	1 (- H ₂)
2	13:17 – 14:15	14	2 (+ H ₂)

4.2 Oxygen, carbon monoxide (CO), nitrogen oxides (NO_x as NO₂), org. C/HC

Measurement No.	Measurement time	[mg CO/m ³ _N]	[mg NO ₂ /m ³ _N]	[mg C/m ³ _N]	% O ₂
1	09:48 – 10:46	303	2712	99	16.6
2	13:17 – 14:15	248	2398	60	14.9

5. Summary and assessment

On 31.05.12, emission measurements were conducted on the bus Ku 313 VO. The results (averaged over the total measurement period, based on dry exhaust gas at 0°C, 1013 hPa and a residual oxygen content of 5% by volume) were:

Substance or parameter	Unit	Measurement result for run 1 (without hydrogen)	Measurement result for run 2 (with hydrogen)
Oxygen	% by vol.	16.6	14.9
Dust	[mg/m ³ _N]	18	14
Carbon monoxide (CO)	[mg/m ³ _N]	303	248
Nitrogen oxides as NO ₂	[mg/m ³ _N]	2710 ¹⁾	2400 ¹⁾
Org. C/HC	[mg/m ³ _N]	99	60

¹⁾ rounded to 10 mg/m³

According to the measurements by the operator's representatives, 1.71 l of diesel were saved.

We hope that you found this measurement report useful and thank you for your order.



Kufstein, 31.05.12

Dr Walter Stolz