

Location of Respiratory Headbox Chamber:

Faculty of Agriculture, National University of Laos, Vientiane capital, Lao PDR.

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Description of facility: NUOL's Respiratory headbox facility comprise two parts as: <ul style="list-style-type: none">• Feed bunk adequate to feed and record intake of 18 cattle individually.• Four (4) headboxes with the fix air flow, gas sampling system and associated metabolic crates for collection of faeces and manure.
Principle of operation: <i>Summary:</i> The four headboxes all operate independently. Air is continuously drawn from the top of each headbox into an exhaust pipe then through an in-line recording air flow meter and into a side-channel blower that draws the air then voids it into the atmosphere. As air is drawn out the exhaust pipe from the headbox, fresh ambient air is drawn into the headbox around the loose-fitting shroud. A continuous subsampling of exhaust and ambient gas into Tedlar bags is made using miniature peristaltic pumps. Each bag of subsampled gas (1 per headbox plus one ambient air bag) is subsequently analysed by a multi-gas analyser. System details are as below: <i>Headbox details:</i> 90 L x 80 W x 110 H cm box, raised 30 cm off the ground. Box is made of welded steel screened with 6mm thick polycarbonate. Door is secured by 3 'butchers latches' and has a foam strip between door and box to ensure an airtight seal. The shroud dimensions are as shown in Photo 1. <i>Air flow:</i> Air is drawn through each headbox by a side channel of ring blowers (Ventex 2RB010-7AA11), at a rate of 500L/minute. This is the maximum flow possible with this pump. Flow rate is varied by a 'T-piece' fitted into the pipe between the flow meter and the ring blower, with a gate valve on the stem of the 'T' that is open to the atmosphere. By opening this gate vale, ambient air is allowed into the blower, reducing the amount of air being drawn from the headbox & through the flow meter. The flow meter (ATZTA TBX - Aichi Tokei) has a self-contained battery with 7-year life. The display on the in-line meter is recorded at the start and end of the 23h measurement period and divided by time elapsed to calculate flow rate. <i>Air Temperature and Pressure:</i> Measuring the temperature and pressure of air before going through the flow meter is done by inserting a hand-held temperature and pressure gauge (Barometric Pressure Gauge PCE-THB 38-ICA incl.) into a sampling port in front of the flow meter. Temperature and pressure are read 3 times per day and the values written down in the experiment log sheets. Typically, pressure is only 3-6kPa less than the atmospheric pressure (approx. 100kPa depending on altitude). <i>Air Sampling:</i> A continuous sample of air over 23h from when the chamber doors are closed is collected into a pre-evacuated 5L Tedlar bag. The sample bag is left sealed and connected via tygon tubing to a miniature peristaltic pump (LONGER Peristaltic Pump Miniature BQ50-1J) which is adjusted to pump at 2-3 mL air/minute. The bag is opened and the pump turned on when the headbox door is closed. The bag is pulled closed to seal 23h later and taken for immediate analysis. <i>Gas analysis:</i> The gas is analysed using an Aquagas GA40T+ multigas analyser, that reports O ₂ , CO ₂ , and CH ₄ gas levels directly on-screen. It is not linked to a computer. The analyser draws approximately 1.5L gas sample/minute and is used as below: <ul style="list-style-type: none">• Analysis is done in a well-ventilated room well away from cattle or other sources of methane (this is so the background CH₄ level is truly 0 ppm).• The analyser is allowed to warm up for at least one hour before use.

- The 'Zero Standard' (Pure N₂) and the calibration/span gas (CH₄ in N₂) are run through the analyser. They are transferred into evacuated Tedlar gas bags directly from the cylinder and then the gas analyser draws sample (1.5L/m,in) from the Tedlar bag into the gas analyser. The expected O₂, CO₂ and CH₄ concentrations are written down, along with the observed concentrations.
- Look at the calibration bag results ~ was it within 10% of the value shown in the cylinder itself? If it is <10% different then we can correct all the gas bag readings by whatever the % difference is. So if the calibration gas was meant to be 1,000 ppm but we read it as 950ppm, the value is 5% low, so we would multiply up all the other CH₄ ppm values by 5% before we use them. If the reading is more than 10% different than the stated concentration on the cylinder certificate, then you should recalibrate the GA40T+ analyser (or any other analyser). This is a complicated procedure for the GA40T+.
- Each of the 5 Tedlar bags (background or ambient bag + 4 headbox bags) are then sequentially sampled for 15-30 seconds – the reading should have stabilised on the analyser display by then. Write down or print the results for all 3 gases.
- Then repeat the measurement of each bag, recording the concentrations shown 40s after connecting each bag.
- The Zero Standard and the calibration gas bags are then repeated.

Gas recovery procedure:

A short-term 3min recovery of tracer gas (CO₂) delivered up the exhaust outlet is used to calculate gas recovery. CO₂ is released from a small cylinder at a fixed rate of 10-15g/min using a regulator with a rotameter. The cylinder is placed on an electric scale reporting to 1g and every 30s the cylinder weight and the CO₂ in the exhaust air is recorded. Weight loss from the (small) cylinder is multiplied by the flow rate to work out the expected (100% recovery) increase in CO₂ level expected and this is compared with the ppm of CO₂ observed.

Photo of NUOL's Respiratory headbox facility comprise two parts as below:

FAG-NUOL's Respiratory headbox facility comprise two part as:



Photo of respiratory headbox chambers metabolic crates system in National University of Laos:
Front of respiratory headbox chambers metabolic crates

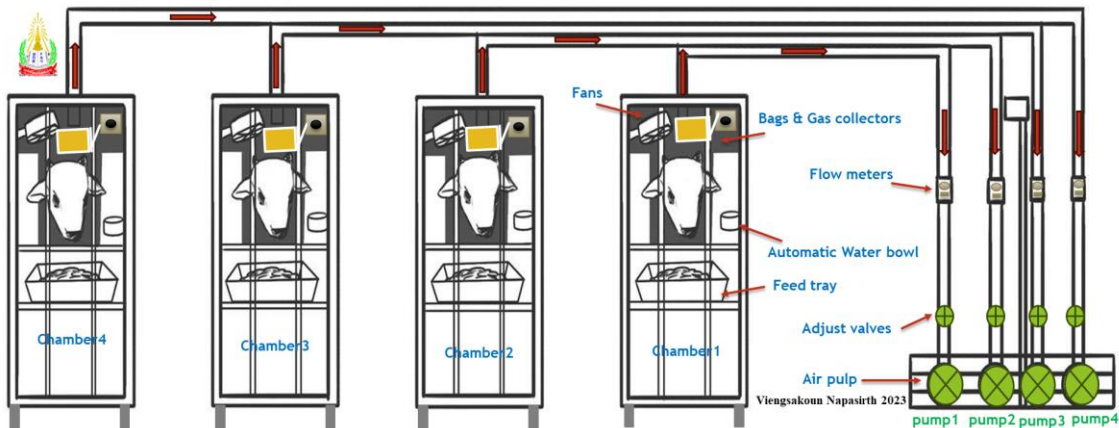


Back of respiratory headbox chambers metabolic crates, showing adjustable back rails and the wooden loading ramp in place (below).



Sketch with measurements of headbox – so somebody can copy design

Respiratory Headbox chamber metabolic crates in FAG-NUOL Lao PDR.



Manufacturer's template for neck shroud construction



Front headbox chamber

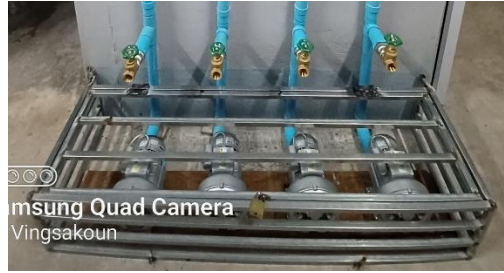


Back of headbox chamber



Photo of airflow components

- Blower fan and any air bleed-in valves



- Flow meters



Photo of gas collection, analyser & and filter/dryer components

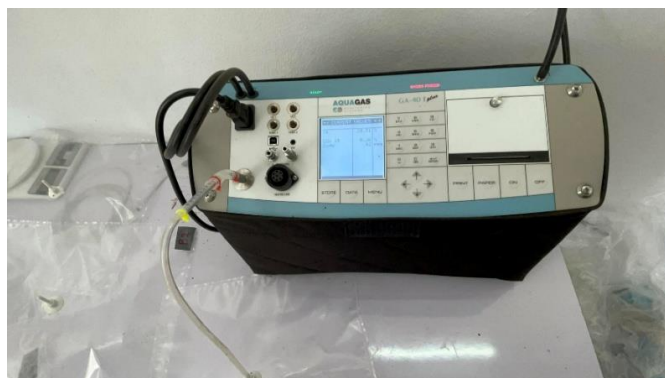


Photo of gas recovery in action

