Probing into fumes

The gas industry has agreed ‘best practice’ for the use of portable electronic combustion gas analysers (ECGAs). This article reviews the recommended procedures, the typical features of the instrumentation, and presents a scenario that illustrates the way an operative can use such an instrument to best effect in dwellings when responding to a report of fumes.

The recent publication of BS 7967: 2005 *Carbon monoxide in dwellings and combustion performance of gas-fired appliances*. Parts 1, 2 and 3, and the CORGI Gas Installer manual *Using Portable Electronic Combustion Gas Analysers for investigating Reports of Fumes* should help gas operatives carry out the appropriate tests and procedures when investigating reports of fumes.

Part 1 of the BS gives details of how to investigate and deal with reports of fumes, smells, spillage and leakage of combustion products and carbon monoxide detector activation.

Part 2 gives details of how to use the analyser and the threshold limits for the test undertaken.

And Part 3 gives guidance on how to interpret and respond to the measurements obtained.

Note: A fourth Part has joined the suite of BS 7967 standards and looks at servicing and maintenance of gas-fired appliances.

Before undertaking any form of investigation of reports of fumes, operatives need to have received adequate training and have sufficient skills/knowledge to undertake the investigation safely and correctly. The consequences of not being competent to undertake this work could lead to an inadequate investigation or misinterpretation of the readings obtained. This could lead to unsafe appliances being left in operation, with gas users lives being put at risk.

Of course it has always been possible to check the safe operation of individual appliances using tried and tested servicing/maintenance procedures. However, with the development of the ECGA it has now become possible to make sure:

- the appliance combustion is satisfactory
- there is no build-up of products of combustion in the room atmosphere
- the products are not coming into the dwelling from outside or from an adjacent property.

Although there are investigation courses available, currently there is no ACS assessment for investigating reports of fumes (see Note) and therefore it is recommended that the gas operative is aware of the contents of the BS and/or the CORGI manual.

Note: A new ACS assessment for using ECGAs as part of a commissioning process or as part of an appliance service and maintenance visit is now available to operatives called CPA1. Operatives currently using ECGA’s should make arrangement to undertake this assessment as soon as reasonably practicable.

Instrumentation

Combustion gas analysis has been used as a diagnostic tool for a number of years although this has predominantly been in the non-domestic sector using fixed instrumentation dedicated to larger gas-fired equipment.

The advent of ECGA instrumentation in the 1980s led to British Gas developing procedures based upon exhaustive field measurements and resulted in both efficient and effective servicing of appliances for their domestic customers. It was not until recently, however, that the industry as a whole agreed best practice for using such instrumentation even though instrument performance standardisation BS 7927 and its European harmonised successor BS EN 50379-1 has existed for some time.

The fundamental functions of analysers that are common to each model enable the measurement of combustion performance via the flue gases (CO/CO_2 ratio). This generally means carbon monoxide (CO) in ambient air can be measured although carbon dioxide (CO_2), whilst measurable in the flue gases via an oxygen sensor, produces an inaccurate reading in ambient air.

Instruments often have supplementary features such as the means to record maximum values, print data as a record, measure differential pressures, surface temperatures and other parameters useful to the domestic gas operative. When choosing equipment, it is important to look for specific compliance with BS EN 50379-1.

A further consideration when using instrumentation is the design of sample probes to be used in different situations. Typically, an open ended probe (see Figure 1), often made from rigid stainless steel, comes supplied with the ECGA. The flexible silicone tubing through which the sample passes between the probe and the measuring instrument allows for probes to be interchanged. Instances where the design of probe is important to obtain good representative measurements are:

- Where a draught diverter prevents access using a rigid open-ended probe. Here, it is recommended that a probe is fabricated using 6mm OD malleable tubing, approximately 50cm long.
- Where a free-standing kitchen grill has to be sampled, combustion products flow out across an area approximately 20cm by 5cm. Here, representative sampling can be achieved using a multi-hole probe that can be placed on top of the outlet (see Figure 2 on following page)
- Where sampling of combustion products flowing through an outlet, for example from a flueless sink water heater, a multi-hole probe can provide representative concentration measurements (see Figure 3 on following page).

Scenario

Engineer Mandy Dixon has been called to a house where the owner has reported that the carbon monoxide (CO) alarm has activated. After introducing herself to the elderly customer and showing her CORGI ID card, she asks if anybody in the property is feeling unwell. The customer tells her she is feeling fine.

Before entering the house she switches her analyser on and allows it to calibrate and zero in fresh air. She knows it is within its calibration period as it has just been returned after service. Mandy enters the

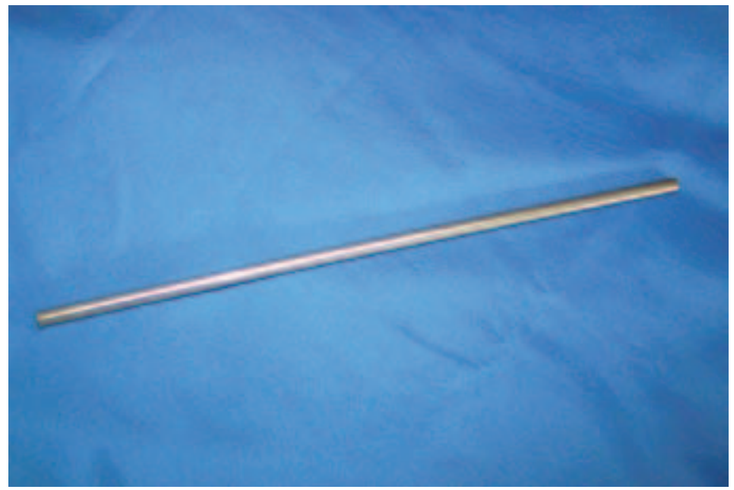

Figure 1. Typical openended sampling probe

Continued on next page >

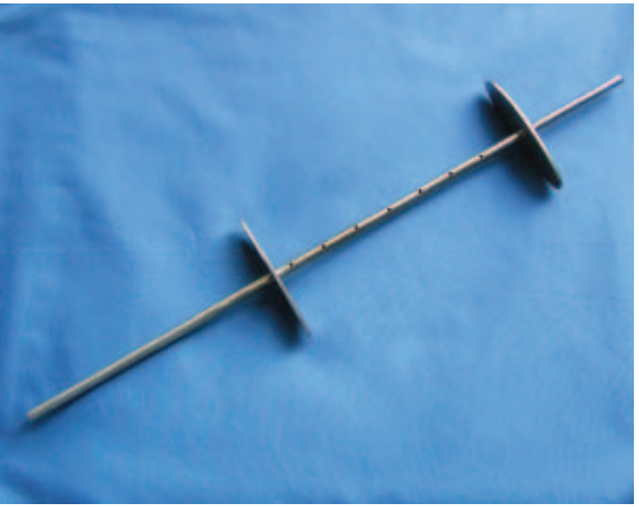

Figure 2. Typical cooker sampling probe

Figure 3. Typical angled multi hole sampling probe

house sampling the atmosphere at high level and records 50ppm CO. She immediately takes the customer outside to the relative safety and warmth of her van and asks her what appliances are on and the location of the gas meter. The customer advises that the boiler is on and the fire is operating at the low setting. The cooker is not in use. Mandy then goes back into the house, monitoring the atmosphere, turns off the gas supply at the ECV and ventilates the property by opening the front and back doors.

She checks the atmosphere periodically, taking great care to ensure her own safety by carrying out atmosphere tests from near the outside door. The CO level quickly drops to 2ppm, so she checks the atmosphere throughout the house to confirm all is safe and there is no localised build-up of CO within. In all cases where a CO level is initially detected the loft and other accessible voids should also be checked.

Once the atmosphere has been confirmed clear of CO, the customer is brought back into the property and the appliance/installation assessment can proceed. After carrying out a gas tightness test and checking the service regulator operating pressure is within tolerance, a visual survey of the appliances needs to be carried out.

Mandy identifies a wall-mounted gas boiler and cooker in the kitchen, and a gas fire in the lounge. She also notices that the CO alarm is positioned at low level on a bookcase shelf in the lounge, a location that does not comply with the alarm manufacturer's instructions.

Mandy uses appropriate documentation to record her findings, for example, CORGI's Fumes Investigation Reports - Parts 1 and 2. Mandy also refers to flow charts and combustion performance action levels contained in both BS 7967 and CORGIs manual to ensure she keeps her investigation on track.

The boiler has no visual signs of spillage or heat distress, the cooker looks relatively new and in good condition, but the fire is showing signs of spillage on the front panel above the radiant panels. Mandy begins her examinations by carrying out combustion checks on each appliance in turn starting with the fire as this is thought to be the most likely cause of the problem.

The gas fire is old and there are signs of spillage on the front panel above the radiant canopy. She puts the fire into full operation and an open-ended sample probe positioned 2m above the floor in the centre of the room is used to sample the room atmosphere. Additionally, Mandy replaces the open-ended probe for an angled multi-hole probe to sample in the convection air outlet. These tests confirm that no products of combustion are escaping into the room. A final check is to carry out a standard fire spillage test, making sure that all the doors and windows into the room are closed. She also checks for the presence of extract fan devices as these would need to be put into full operation during the test. The spillage test proves satisfactory.

Important: It should be noted that until the visual tests and atmosphere build-up tests have been completed, the appliance should not be moved or disturbed in any way.

Once Mandy is satisfied that no products of combustion were escaping from the fire she checks the operating pressure, gas rate, control operation and general condition and the catchment space and flue as far as possible. The fire is found to be in good condition for its age, other than the signs of spillage above the radiants.

Upon further discussion with the customer, it transpires that there had been problems with the gas fire last year and it was visited by a local CORGI registered business who carried out successful remedial work to the flue, serviced the fire and sold her the CO alarm.

Having examined the fire thoroughly and confirming all is satisfactory, Mandy then proceeds to the boiler, which appears in good condition with no signs of leakage of combustion products. However, there is a small discoloured patch of rusty water on the work top directly below the boiler. Mandy turns on the appliance and carries out a sweep around the case with the analyser using an open-ended probe. She measures 60ppm CO from around the top of the case and 45ppm in the kitchen atmosphere adjacent to the boiler.

Mandy immediately turns the boiler off and then removes the outer case, which on this model also provides the combustion chamber seal and room sealing integrity of the appliance. Although the seal is in good condition, pliable and complete, the rear panel around the pipe exit for the primary return pipe has corroded badly due to a water leak. The corrosion has created a hole in the top panel. She knows that this appliance is a positive pressure fan-flued room-sealed boiler and it is vital that the integrity of the case and seals is maintained.

No further tests are required at this stage until a decision has been made as to whether to repair or replace the boiler. Mandy advises the customer of the problem with the boiler who gives her permission for it to be disconnected from the gas supply. Mandy classifies the installation as Immediately Dangerous (ID) in accordance with the current Gas Industry Unsafe Situations Procedure (GIUSP). The customer asks for a quotation for a new high efficiency boiler to be installed.

Note: It needs to be remembered that the cooker should be checked. Just because a fault was found with the boiler and the cooker had not been in operation does not necessarily mean that everything is in order with the cooker.

The operating pressure and ventilation are checked and confirmed to be satisfactory. The ignition and flame pictures on all burners are checked together with the safety devices. The heat sensing phial on the oven FSD has become dislodged and is slightly out of position causing the device to not operate. Mandy repositions it and confirms it operates correctly.

A combustion test is carried out on the grill using the special grill probe (figure 2) and confirms there are no problems. The oven combustion is checked using the multi-hole probe and a visual inspection of the hotplate burners confirms there are no concerns with the cooker operation.

Mandy notes that there is no stability device fitted to the cooker. As she has progressed though the tests, she has been recording her findings on appropriate documentation and is therefore sure that she has a proper record of her investigation and has drawn the correct conclusions.

The fire and cooker are left connected, but Mandy advises the customer (preferably in writing) that the cooker is classified as Not to Current Standards (NCS) due to no cooker stability device being fitted. Mandy then completes her documentation, leaving a copy with the customer.

Mandy feels confident that as she has carried out the task in accordance with the procedures outlined in BS 7967 and completed the necessary documentation in a methodical manner without jumping to the wrong conclusions.

It is important to note from this scenario that the 'obvious' appliance proved not to be the culprit. It should also be noted that if the CO alarm had been correctly positioned at higher level, it would have sounded sooner and reduced the risk of the customer being exposed to an excessive level of CO

to sum up

- If you are intending to carry out this type of work it is important to ensure you are competent as leaving a malfunctioning appliance in operation can have fatal consequences
- When necessary use the British Standard or CORGI manual for reference
- It is important to ensure all appliances are checked to ensure satisfactory operation and where necessary consideration should be given to CO entering the property from another source
- Don't forget your own safety when carrying out these tests, ensure you monitor the CO level where necessary
- Ensure that your ECGA is within the calibration period and working correctly
- Record the findings of the investigation and leave any malfunctioning appliances in accordance with the GIUSP

This article was written by Downstream Gas, who is involved with the British Standard Committee responsible for drafting BS 7967 and who wrote the CORGI manual. Downstream Gas has developed a course covering fumes investigation, and is in the process of introducing this to a number of training organisations around the country. For further information about Downstream Gas and the services they offer visit www.downstreamgas.co.uk