

US Tobacco GAP Program

Flue-Cured Tobacco Barn Testing

Purpose

This procedure measures the carbon dioxide (CO₂) levels inside an empty flue-cured tobacco barn to assess if combustion products are leaking from the heat exchanger into the curing chamber. Carbon dioxide is not related to the formation of tobacco specific nitrosamines (TSNAs) but is used as an indicator of a heat exchanger leak.

Barn Testing Protocol

1. All tobacco curing barns used to supply tobacco to a company participating in the US Tobacco GAP Program and designated as being in service must have a properly functioning heat exchanger and be tested for leaks every three years. The cost and scheduling of barn testing is the responsibility of the grower.
2. All barns used by a contract grower must be tested collectively and receive a passing evaluation.
3. Barns found to have a failing heat exchanger must be repaired and retested as having a properly functioning (passing) heat exchanger or placed out-of-service by removing all utility connections as described in #5 below.
4. Barn testing records are to be kept by the contract grower and copies provided to participating contractor purchasers according to contract requirements.
5. Barns designated to be out-of-service (no utility connections) need not be tested.
6. Barns operating on a boiler system with a liquid to air heat exchanger (radiator) need not be tested unless a conventional fueled heat exchanger is installed and utilized as backup or supplemental heat.
7. Barn testing for the US Tobacco GAP Program must be performed by persons receiving training provided by an agency recognized by US Tobacco GAP. Such training is intended to ensure that barn testing is conducted in a correct and consistent manner.
8. Training for barn testing will be provided by University Extension tobacco programs and a list of individuals receiving training will be maintained and made available to growers and the industry.
9. Barn testing can be conducted by independent third-party companies or individual growers who have received training identified in item #7 above.

Barn Testing Procedure

1. The **Barn Testing Report** should be completed to include:

- Farmer or Farm name and address
- Location of barns
- Testing date
- Total number of barns to be tested
- Testing entity company name or individual name
- CO₂ probe serial number and calibration information
- Barn ID numbers

If barns are tested at multiple locations for an individual farm, then separate reports should be completed to record the location of the barns.

2. **Barn Settings:**

Prior to conducting the initial measurement, make sure:

- Barn is at ambient (outside) temperature and contains no tobacco.
- Fan is ON
- Heat is OFF
- Fresh **air dampers** are **CLOSED**.

3. **Conducting the barn test:**

- Leave the fan ON
- Record the initial (ambient) CO₂ level inside the barn
- Advance the thermostat 20° to 30°F above the ambient air temperature to ensure the burner will run continuously for 10 minutes.
 - Depending on the ambient temperature, the thermostat set point above ambient that will result in the burner operating continuously for 10 minutes may be less than 20°F.
- Continue to monitor the levels for approximately 10 minutes after the burner ignites and record the final (10 minute) CO₂ measurement.

4. **Determination of heat exchanger status:**

- Calculate the difference between the barn initial (ambient) CO₂ level and the final (10 minute) CO₂ measurement.
 - If the difference measured is LESS than 200 ppm, the heat exchanger status is PASS.
 - If the difference measured is GREATER than 200 ppm, the heat exchanger status is FAIL and must be retested after repairs are made.
- Barns with a FAIL status must both be repaired and retested or removed from service.

5. **Results of the barn testing** along with a copy of the CO₂ probe calibration are to be left with the grower.

Barn Testing Notes:

- Allow the CO₂ meter to warm up for approximately 5 minutes prior to conducting any measurement.
- Observe the maximum operating environment temperature specified by the CO₂ meter manufacturer. This typically ranges from 120°F to 140°F. The meter probe may be placed inside the barn through the front exhaust vent or, if available, access doors at the rear of the barn. The meter sensing probe needs to be inside the curing chamber.
- Typical ambient CO₂ levels range from 300 ppm to 500 ppm. Ambient readings outside this range may indicate a faulty CO₂ probe or instrument error.
- If the CO₂ level increase exceeds 200 ppm prior to the burner operating for 10 minutes continuously, the procedure may be halted and the barn status listed as FAIL.

CO₂ Probe Calibration:

The CO₂ probe should be recalibrated based on the manufacturer recommended calibration interval to ensure accuracy of the measurement. The probe calibration date should be recorded on the **Flue-Cured Barn Testing Report**. A copy of the calibration sheet should be provided to the grower and kept with the barn testing report.

CO₂ Meter Equipment Recommendations:

There are multiple commercially available low concentration CO₂ meters that could be utilized for this procedure: *Vaisala* CARBOCAP GM70 or *Vaisala* Indigo 201 Transmitter with the GMP252 probe, *Testo* 535 and *Extech* EA80. However, the EA80 does not include a remote sensing probe and as a result direct observation of the reading during the procedure is not possible.

Minimum Specifications

Resolution: 1 ppm CO₂
Accuracy: +/- 50 ppm CO₂
Measurement Range: 0 – 5000 ppm CO₂ (or less if available)
CO₂ sensor calibration certificate

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