Cross-Brand Gas Sensor Replacement Guide

This application provides engineers and purchasing personnel with a practical guide addressing key issues when substituting electrochemical gas sensors of different brands in gas detection instruments. Due to variations in sensor dimensions, electrical characteristics and sensitivity across manufacturers, direct replacement may result in inaccurate readings or equipment failure. Consequently, this document focuses on core properties of sensors, essential evaluation parameters and systematic validation procedures to ensure reliable performance and compliance with safety standards following sensor substitution.

Understanding the Core Characteristics of Electrochemical Gas Sensors

To ensure successful substitution, it is essential to first understand the key characteristics that determine compatibility throughout the substitution process.

Characteristics	Description	Influence On Substitution
Operating Principle & Target Gas	The sensor is engineered for a specific target gas and operates based on an electrochemical reaction that produces an electrical current directly proportional to the gas concentration.	**【Primary Matching Criterion】** It is essential to ensure that the replacement sensor detects exactly the same target gas as the original one. Particular attention should be given to variations in cross-interference gas characteristics.
Mechanical Dimensions & Pin Configuration	Including sensor's physical dimensions, number of pins, and arrangement (working electrode, counter electrode, reference electrode and auxiliary electrode, if applicable).	**【Physical Compatibility】** The replacement sensor must be physically mountable onto the existing sensor housing or PCB socket, with pin definitions and positions (working electrode, counter electrode, reference

		electrode and auxiliary electrode, if applicable) fully consistent.
Sensitivity (Output Signal)	Referring to the magnitude of the electrical current generated by the sensor when exposed to a specific gas concentration, typically expressed in nA/ppm or μA/ppm.	**【Key Parameter】** Differences in sensitivity are a primary cause of reading inaccuracies. The instrument must be recalibrated following sensor replacement.
Gain Resistor (R gain)	Used to convert the current signal into voltage signal. The resistance value affects sensor's linearity and response.	Different sensors feature respective optimal gain resistor values. When replacing a sensor, the resistance can be adjusted with reference to the recommended Rgain values listed in SemeaTech's product list.
Bias Voltage	The voltage applied between sensor's reference electrode and working electrode, which is used to maintain the stability of the internal electrochemical reaction.	**【Key Parameter】** Most electrochemical sensors require zero bias voltage. However, certain sensors (such as O_2, HBr, C_2H_4, ETO, C_2H_3Cl, THT, as well as biased HCl and NO sensors —note that HCl and NO also have unbiased versions, denoted by the suffix "U") require a specific applied bias. Proper matching must be confirmed.
Response Time (T90)	The time required for sensors to reach 90% of final reading after exposure to target gas.	The response time of replacement sensors should not be significantly slower than that of original sensors to ensure timely alarm activation.

Baseline & Baseline Shift	In clean air, the sensor's output signal (baseline) should be stable and close to zero. Baseline shift refers to the phenomenon where the sensor's output spontaneously deviates from the initial value when not exposed to target gas.	The baseline and baseline shift of newly replaced sensors should remain within acceptable limits; otherwise, detection accuracy and stability may be compromised.
Resolution	The minimum incremental change in target gas concentration that sensor can reliably detect. Higher resolution signifies enhanced sensitivity to variations in the target gas concentration.	**【Key Parameter】** The resolution of the newly replaced sensors must remain within an acceptable range; Otherwise, the detection limit and measurement stability may be compromised. This is especially important for electrochemical sensors used in air quality monitoring.

Replacement Assessment Procedure (Step-by-Step Guide)

We recommend following the systematic procedure outlined below for sensor evaluation and replacement:

Step 1 ： Information Collection and Cross-referencing

1. **Obtain original sensor datasheet：** Collect the complete datasheet for the original equipment manufacturer's sensors, documenting all core parameters listed in the first section above
2. **Identify potential replacement models:** Screen potential replacement sensor models based on target gas, mechanical dimensions and pin definition
3. **Detailed Comparison of Datasheets**: Conduct an item-by-item comparison between the data sheets of

candidate replacement sensors and the original sensor, focusing particularly on differences in sensitivity, resolution and bias voltage.

Step 2：Circuit Compatibility Check

1. **Gain Resistor (R_{gain}) adjustment：** If the recommended Rgain value for the replacement sensor differs from original design, the corresponding resistor on the PCB must be replaced.
2. **Confirmation of the bias voltage circuit：** Verify whether the bias voltage supplied by instrument circuit meets the requirements of the new sensor. In the vast majority of cases, zero bias voltage is sufficient and no modification is required.
3. **Signal Conditioning Circuit Evaluation：** Due to potential variations in sensitivity, the subsequent operational amplifier gain circuit may require recalculation and adjustment to ensure the output signal range matches the input range of the ADC (analogue-to-digital converter).

Step 3：Laboratory validation testing

Warning: All gas testing must be conducted by qualified personnel in a well-ventilated environment, in compliance with safety regulations.

1. **Baseline Test：** Place the instrument equipped with the new sensor in a clean air environment. After powering on and allowing it to stabilize, observe whether the baseline signal remains stable.
2. **Calibration：** Calibrate the new sensor using standard concentration calibration gas and then record the calibration coefficient.
3. **Accuracy and Linearity Testing：** Testing was conducted using multiple calibration gases of varying concentrations to verify the instrument's reading accuracy across entire measurement range.
4. **Response Time (T90) Test：** Compare the response time of the new and old sensors under identical test conditions.
5. **Cross-sensitivity Test：** Expose the sensor to common interfering gases (such as hydrogen interference for CO sensors) to assess whether selectivity meets the application requirements.

6. **Long-term stability test：** Conduct observations over a period of several days or weeks, documenting baseline drift and evaluating long-term performance.

Key Recommendations for Successful Substitution

- **Cooperate closely with distributors or suppliers：** Communicate with technical support team of alternative sensor distributors or suppliers during the initial evaluation phase and they can provide selection advice and application expertise.
- **Do not neglect the software：** After successful replacement, ensure that the sensor model, serial number and calibration parameters are updated within the device software. Consider pre-configuring distinct calibration parameter profiles for different sensor models.
- **Consider certification requirements：** The end product requires safety certifications such as UL, ATEX, or IECEx and ensure that the selected replacement sensors also possess the corresponding certifications. Failure to do so may necessitate re-certification of the entire unit.
- **Small-batch trial production：** Before proceeding with the full-scale transition to the new supplier, conduct pilot production and small batch testing to verify supply chain stability and ensure product consistency.

Appendix

- **SemeaTech Product List:** *https://www.semeatech.com/uploads/Tech_Docs/Product-List.pdf*
- **Product Introduction:** *https://www.semeatech.cn/plus/list.php?tid=135*
- **Electrochemical Sensor Common Q&A (FAQ)** :https://www.semeatech.cn/plus/list.php?tid=135

Contact Us

If you are looking for reliable sensor alternatives for your equipment, our application engineering team is readily available to provide technical support.

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