EET | Manufacturing of Calibration Gas Mixtures
1

Steps | Manufacturing Process
Manufacturing Steps

- Cylinder Preparation Process
- Cylinder Filling Process
- Mixture Homogenization Process
- Mixture Analysis
- Mixture Stability
- Traceability & Uncertainty
Step 2 | Cylinder Preparation
Cylinder Preparation Process Steps

- Inspection of the inner surface
- Mounting the valve
- Heating
- Evacuation
- Purging
- Chemical Treatment / Passivation
- Cylinder ready to fill
3 Step Mixture Filling
Cylinder Filling Process
Multiple Cylinder Filling Process

- **Raw Materials**
  - O$_2$
  - CO$_2$
  - SO$_2$
  - NO
  - HC
  - CO

- **Balance gas**
  - N$_2$

- **Analyzer**

- **Blending chamber**

- **Raw Materials**
  - Balance gas

- **Analyzer**

**Diagram Details**

- Multiple Cylinder Filling Process
- O$_2$, CO$_2$, SO$_2$, NO, HC, CO
- Balance gas: N$_2$
- Analyzer

**Images**

- Multiple cylinder filling process diagram
- Analyzer

**Texts**

- "INDUSTRIAL MERCHANT"
Step | Homogenization
Mixture Homogenization Step
5
Step  | Analysis
Mixture Analysis Step
Analytical Uncertainty & Traceability

<table>
<thead>
<tr>
<th>Concentration (ppm)</th>
<th>Calibration Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.024</td>
</tr>
<tr>
<td>10</td>
<td>0.512</td>
</tr>
<tr>
<td>20</td>
<td>1.040</td>
</tr>
<tr>
<td>30</td>
<td>1.568</td>
</tr>
<tr>
<td>40</td>
<td>2.063</td>
</tr>
<tr>
<td>50</td>
<td>2.544</td>
</tr>
<tr>
<td>60</td>
<td>3.057</td>
</tr>
<tr>
<td>70</td>
<td>3.516</td>
</tr>
<tr>
<td>80</td>
<td>4.021</td>
</tr>
<tr>
<td>90</td>
<td>4.488</td>
</tr>
<tr>
<td>100</td>
<td>4.968</td>
</tr>
</tbody>
</table>

“True Value”

Reference Standards

Analytical Instrument

Calibration Curve

Instrument Response Data

Product

THIS DOCUMENT IS INTERNAL

06-09-2018

March 2016

WETERINGS, Werner

Industri Gases

WLTP Workshop (Paris)
Primary Reference Materials (PRM)
Step | Mixture Stability
Mixture Stability Verification

![Graph showing mixture stability over time](image)

- Concentration (ppb) vs. Elapsed Time (days)
- Initial concentration decreases sharply, then stabilizes around 100 ppb for the remaining time period.
Step 7 | Traceability & Uncertainty
Traceability & Uncertainty

\[
U_{(NMI)} \quad U_{(BIPM)} \quad U_{(Supplier)}
\]
Uncertainty in the Chain of Comparisons

(U (Supplier))

(U (NMI))

(U (Car Manufacturer))
Impact Cal Gas Uncertainty on Total Uncertainty

PN-PEMS uncertainty framework (HDV)

Framework for the assessment of the measurement uncertainty
Based on light duty NOx assessment

\[
\text{Uncertainty} = \sqrt{\text{analyzer}^2 + \text{flow}^2 + \text{work}^2 + \text{other} - \text{CVS}}
\]

Giechaskiel et al. 2018, JRC report EUR 29138 EN
IM|BL | Thank you for your attention
# Information classification

**Owner:**
Ir W.P.J.M. Weterings

## Prepared by
Werner Weterings
IMBL Base - WIM HQSE Manager & DA Specialty Gases

## Reviewed by
Werner Weterings
IMBL Base - WIM HQSE Manager & DA Specialty Gases

## Approved by
Werner Weterings
IMBL Base - WIM HQSE Manager & DA Specialty Gases

---

## Handling Rules

<table>
<thead>
<tr>
<th>Classification:</th>
<th>Source: MA-WBL Sensitive Information Procedure v2a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>INTERNAL (default level)</td>
</tr>
<tr>
<td>Definition</td>
<td>Information intended for wide-spread diffusion within Air Liquide. Protected by internal standard common rules of Air Liquide. Unauthorized disclosure would have a &quot;Low&quot; impact on the company.</td>
</tr>
<tr>
<td>IM examples</td>
<td>• WKOM content • Operating Model Handbooks • Internets</td>
</tr>
</tbody>
</table>

### Handling Rules

<table>
<thead>
<tr>
<th>Distribution List</th>
<th>Any Air Liquide personnel on need-to-know basis.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access by third parties</td>
<td>No restrictions.</td>
</tr>
<tr>
<td>Labelling</td>
<td>&quot;INTERNAL&quot; should be labelled on all electronic and physical documents. The document header should include the name of the business owner.</td>
</tr>
<tr>
<td>Information Access Control</td>
<td>User identification (based on password authentication) with, if required, access rights restrictions (based on user groups)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Devices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Devices</td>
<td>No restrictions.</td>
</tr>
<tr>
<td>Employee personal devices</td>
<td>No restrictions.</td>
</tr>
<tr>
<td>Portable media storage (USB Keys, USB drive, etc...)</td>
<td>No restrictions.</td>
</tr>
<tr>
<td>Electronic Storage Location</td>
<td>All except external public storage (such as public file-sharing or web servers).</td>
</tr>
<tr>
<td>Electronic Storage Protection</td>
<td>Password authentication.</td>
</tr>
<tr>
<td>Physical Storage Protection</td>
<td>Apply clean desk policy.</td>
</tr>
<tr>
<td>Electronic Transmission</td>
<td>Use of corporate network and email.</td>
</tr>
<tr>
<td>Deletion</td>
<td>No restrictions.</td>
</tr>
<tr>
<td>Printing</td>
<td>No restrictions.</td>
</tr>
<tr>
<td>Faxing</td>
<td>Take reasonable precautions to restrict access and confirm delivery to recipient.</td>
</tr>
<tr>
<td>Mailing</td>
<td>No restrictions.</td>
</tr>
<tr>
<td>Destruction Method</td>
<td>No restrictions.</td>
</tr>
</tbody>
</table>

---