

Sealing Materials for Retrofill

SC A3 - PS2 – Q8, Report [10103](#) states retro-fill can be realized with C4-FN/CO2 without exchange of sealing material. This seems to be in contrast with the findings of authors of [10656](#) who recommend replacement of the EPDM (SF6) gaskets with buthyl type for CO2 carrier gas and the use of N2 carrier in retro-fill? Can specialist share experiences on the optimum gas mixture and material compatibility?

Michael Gatzsche, Moritz Böhm, Switzerland

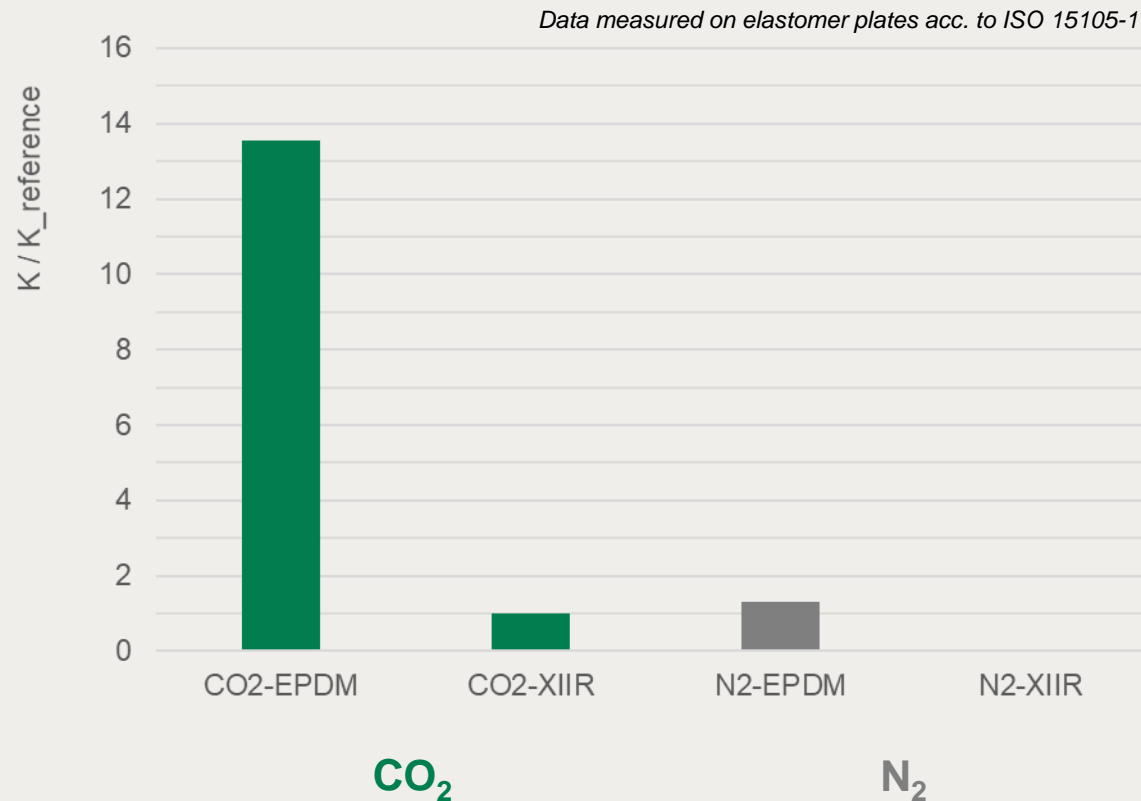
HITACHI
Inspire the Next

C4-FN based gas mixtures with CO₂ and N₂ carrier gas for different applications – 2022 Cigré session papers:

- C4-FN/CO₂ and C4-FN/CO₂/O₂
 - new SF₆ alternative high-voltage equipment: **11118** (1000 kV GIL), **10659** (145 kV LPIT), **10126** (various switchgear and GIL), **10136** (17.5...38 kV load break switches), **10656** (420 kV GIS + various switchgear), **10658** (145 kV GIS CB), **10799** (170 kV GIS), **10966** (170 kV GIS), **10317** (245 kV CB), **10848** (245 kV/420 kV GIS CB), **10102** (420 kV GIS)
 - Retrofill of existing SF₆ equipment in the installed base: **10103** (420 kV GIL)
- C4-FN/N₂/O₂
 - Retrofill of existing SF₆ equipment in the installed base: **10656** (420 kV GIL)
- CO₂ and N₂ are the **carrier gases with >80 mol%** concentration in total gas and thus play a major role in **selection of sealing material**
- **CO₂ is the dominant carrier gas for new SF₆ alternative equipment**, a wide variety of HV equipment, and necessary for HV gas circuit breakers
- **N₂ can be an interesting carrier gas for Retrofill application**, due to **permeation properties**

Group Discussion Meeting

Sealing material selection based on permeation data



1. Permeation rate is strongly depending on temperature, gas and sealing material
2. Permeation rate of **CO₂ / XIIR** is comparable to **N₂ / EPDM**
3. For CO₂-based gas mixtures, a change from e.g. EPDM to XIIR is required, otherwise a significant increase in gas permeation is expected (~factor 7-10)
4. Retrofill, as presented in 10656, uses N₂ as carrier gas, and therefore a change of sealing material is not required.

Retrofill Gas Mixture and Implication on Sealing Material Choice and On-site Work Scope

- Generally, retrofill of existing SF₆ equipment with an SF₆ alternative requires type testing, as well as qualification of the existing materials for the SF₆ alternative → see 10656 and our contribution in B3 PS2 Q2.
- Specifically, the choice of gas mixture determines the sealing material
- C4-FN/CO₂ and C4-FN/CO₂/O₂
 - Change sealing material to XIIR, in case EPDM is installed → significant on-site work for exchanging the flange sealings
- C4-FN/N₂/O₂
 - No change of sealing material necessary, i.e. EPDM can remain → less on-site work, shorter outage time

