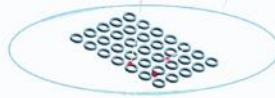


# GOLDEN RULES OF AGING PREVENTION



- Ultra-Pure gases
- Non-Organic Quenchers (CO<sub>2</sub>)
- Choice of non-Outgassing Building Materials
- Non-Polymerizing Additives: Methylal, Propylic Alcohol
- Improved Cleaning Protocols
- Avoid Silicone-Containing Materials: Tubing, Sealings, ....
- Zapping: Burning Deposits with High Current on Anodes
- Addition of Compounds with Etching Properties (O<sub>2</sub>, CF<sub>4</sub>)
- The creation of reactive species is enhanced at high values of the electric field

But sometime tiny details escape, and an ageing effect appears



ageing test validation  
for each component



Detector Stability and Ageing phenomena in gaseous detector  
<https://indico.cern.ch/event/1237829/contributions/5637193/>

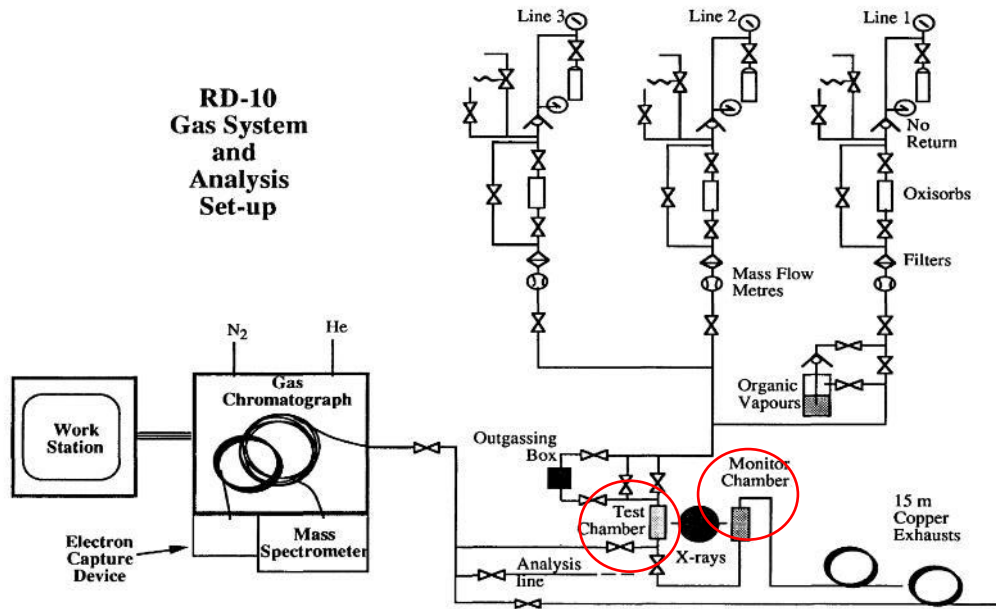
EP Detector Seminar  
<https://indico.cern.ch/event/1368663/>

# Selection of detector (and services) components

## Materials and components: Outgassing and Effects on Detectors

<https://detector-gas-systems.web.cern.ch/Material%20and%20Standards/pipematerials.htm>

<https://detector-gas-systems.web.cern.ch/Material%20and%20Standards/elastomer.htm>



M. Capeáns: Nucl. Instr. Meth. A515(2003)73.

Table 3  
List of investigated epoxy compounds curing at temperatures above 50°C

Source	Epoxy	Curing T (°C)	Outgas	Effect in detector	Global result
CERN/GDD	EPOTECNY E505 SIT	50	YES	NO	OK
HERA-B/ITR	EPOTEK H72	65	YES*	NO	OK*
CERN/GDD	AMICON 125	85	NO	—	OK
CERN/GDD	POLYIMIDE DUPONT 2545	65	NO	—	OK
ATLAS/TRT	RUTAPOX L20	60	NO	—	OK
CERN/GDD	ARALDITE AW 106	70	YES	—	BAD
CERN/GDD	LOCTITE 330	—	YES	YES	BAD
CERN/GDD	EPOTECNY 503	65	YES (Silicone)	—	BAD
CERN/GDD	NORLAND UVS 91	50	YES	—	BAD

Table 6  
Outgassing tests carried out for some sealants used for fixing small gas leaks in chambers and gas systems

Source	Material	Type	Outgas	Effect in detector	Global result
CERN/GDD	VARIAN Torr-Seal	Solvent-free epoxy resin	NO	NO	OK
CERN/GDD	RHODORSIL CAF4	Caoutchouc Silicone RTV	NO	NO	OK ?
CERN/GDD	DOW CORNING R4-3117 RTV	Silicone based	YES	NO	OK ?
HERA-B/OTR	LOCTITE 5220	Polyurethane-based	YES	—	BAD

Table 9  
Outgassing properties of some plastic pipes

Material	Type	Outgas	Effect in detector	Global result
PP	Polypropylene	NO	NO	OK
RILSAN NYLON	Polyamide	Water	NO	OK*
PEEK Crystalline	Polyetherether ketone	NO	NO	OK
PEEK Amorphous	Polyetherether ketone	YES	—	BAD
PEE	—	YES	—	BAD
PUR	Polyurethane	YES	—	BAD