Gas for World wide RPCs

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Contents

- The problem

Gas Bottle

Is simple

Chamber

- Sourcing the gases
  - Storing
  - Mixing
  - Exhaust
  - Safety

Gas Sources

- R134a
    - Industrial gas for refrigeration systems, But purity is 99.9% with a max of 100ppm
- Iso-butane quality 35, Flammable, Commercial name, R600a, Camping Gas cylinders
- SF6 quality ? non toxic

Source the Gases in your country

- PanGas
- Linde
- Air Liquid
- CarbaGas
- Camping Gas

Bottles and regulation

- IsoButane
  - Use camping gas cylinders. Usually a mixture of propane and Butane. Small volume is a smaller safety hazard. See switching installation made for CV-300 Plus bottles.

See other photos here

- http://project-cms-rpc-endcap.web.cern.ch/project-cms-rpc-endcap/rpc/Services/Gas/GasMixingInstitutes/GasBottles/IsoButane/CampingGas/DistributionCV300Plus/

- Freon and SF6 bottle regulators

Mixing

- 3 approaches
  - 1 simple analogic gas panel
  - 2 MFC with simple rack
    Sophisticated with isobutene control (LEL control), humidity
  - 3 CERN Rack 20kchf (See appendix for details)
  - 4 re-cycle, closed loop

  - Mixing rate calculator

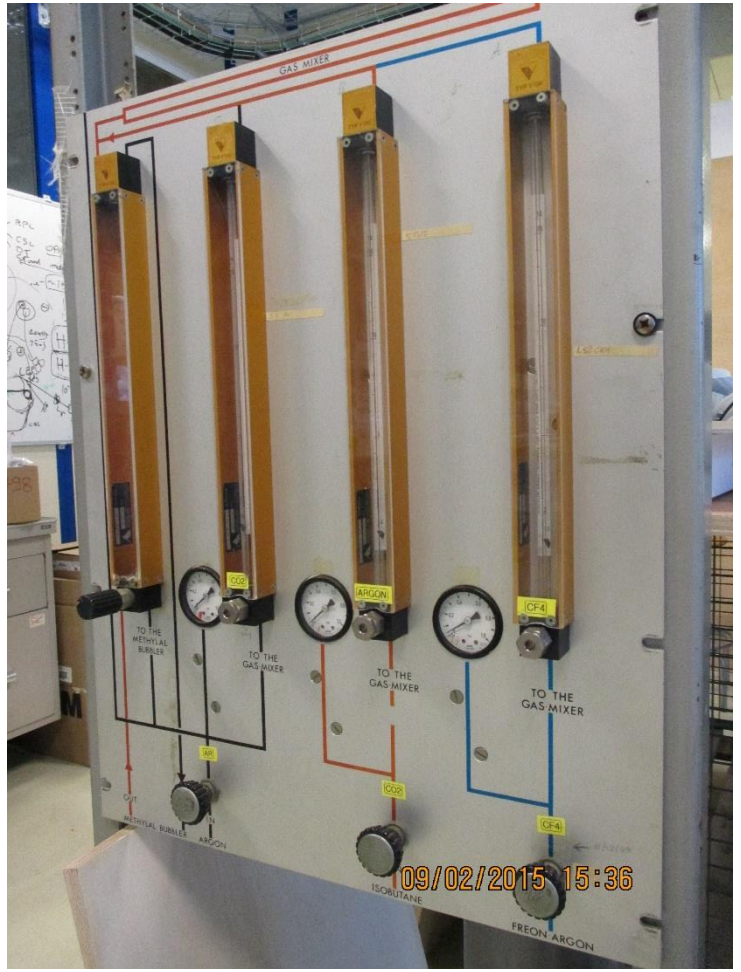
http://project-cms-rpc-endcap.web.cern.ch/project-cms-rpc-endcap/rpc/Services/Gas/GasMixingInstitutes/MixingRackCERN/MixingFlowRates.xlsx

Analogue some times called Rotameter

- Available cheaply (perhaps at CERN)
- Vogtlin (Swiss)
- Difficult to calibrate

  (We have the calibration curves……..)
- A first approach, that was used 20 years ago,

  to get set-up.



Mass Flow Controllers

Generally expensive equipment

Flow Measurement & Control
Mass Flow Equipment

376

Flow Measurement & Control

Model 8112 Series
Self-Contained Mass Flowmeter

Shown with optional 1/4" tube connections

Description
The Model 8112 Series Mass Flowmeters are offered as a more accurate alternative to Matheson's Standard Tube Cube® flowmeters. This series bridges the gap between standard flowmeters and higher priced mass flowmeters.

Design Features
- Self-contained direct reading of the flow rate
- Optional 9-pin connector for output data transmission
- Adjustable zero

Specifications

Maximum Operating Pressure:	150 psig (1035 kPa)
Optimum Operating Pressure:	20 psig (138 kPa)
Temperature Range:	0° to 50°C (32° to 122°F)
Temperature Coefficient:	0.15% full Scale/1°C
Standard Calibration Temperature:	0°C (32°F)
Response Time:	2 seconds to 98% of final flow (25-100% full scale)
Accuracy:	+/-1.5% full scale
Repeatability:	+/-0.5% full scale
Flow Capacity	20 sccm-20 slpm: 1 sccm to 20 slpm Nitrogen
Voltage Input:	12 VDC (12-15 VDC nominal); 100 mA max
Voltage Output:	0-5 VDC; 4-20 mA (optional)
End Connections:	1/4" NPT Female
Shipping Weight:	2 lbs

Each unit is shipped calibrated for Nitrogen at 0°C. Each unit is also supplied with the power pack to supply voltage to the unit

Very simple rack

Front panel with Analogue meters

Rear area with MFCs, mixer and piping

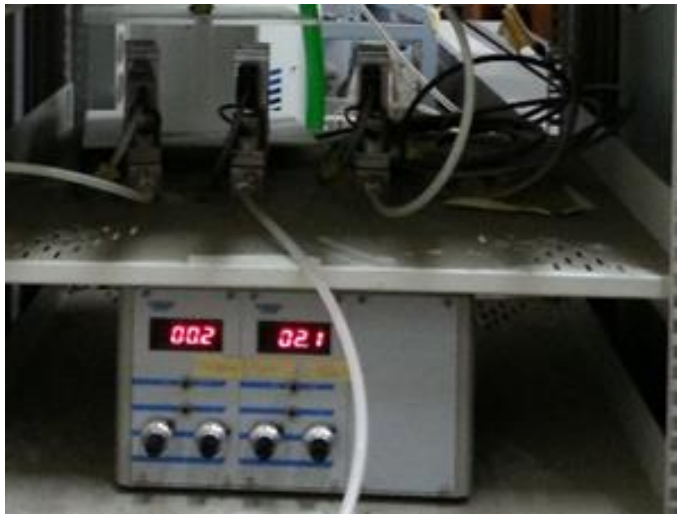
Many types of mass flow meters available; Mathesongas, Aalborg, Sierra, Bronkhorst, Alicat, Brooks Instruments etc

An example of the two CERN gas racks in Korea since 15years

Bubbler panel

6 channel panel Distribution

3x MFCs with plastic piping



4x Channel controller

Rear View showing humidifier and mixing volume

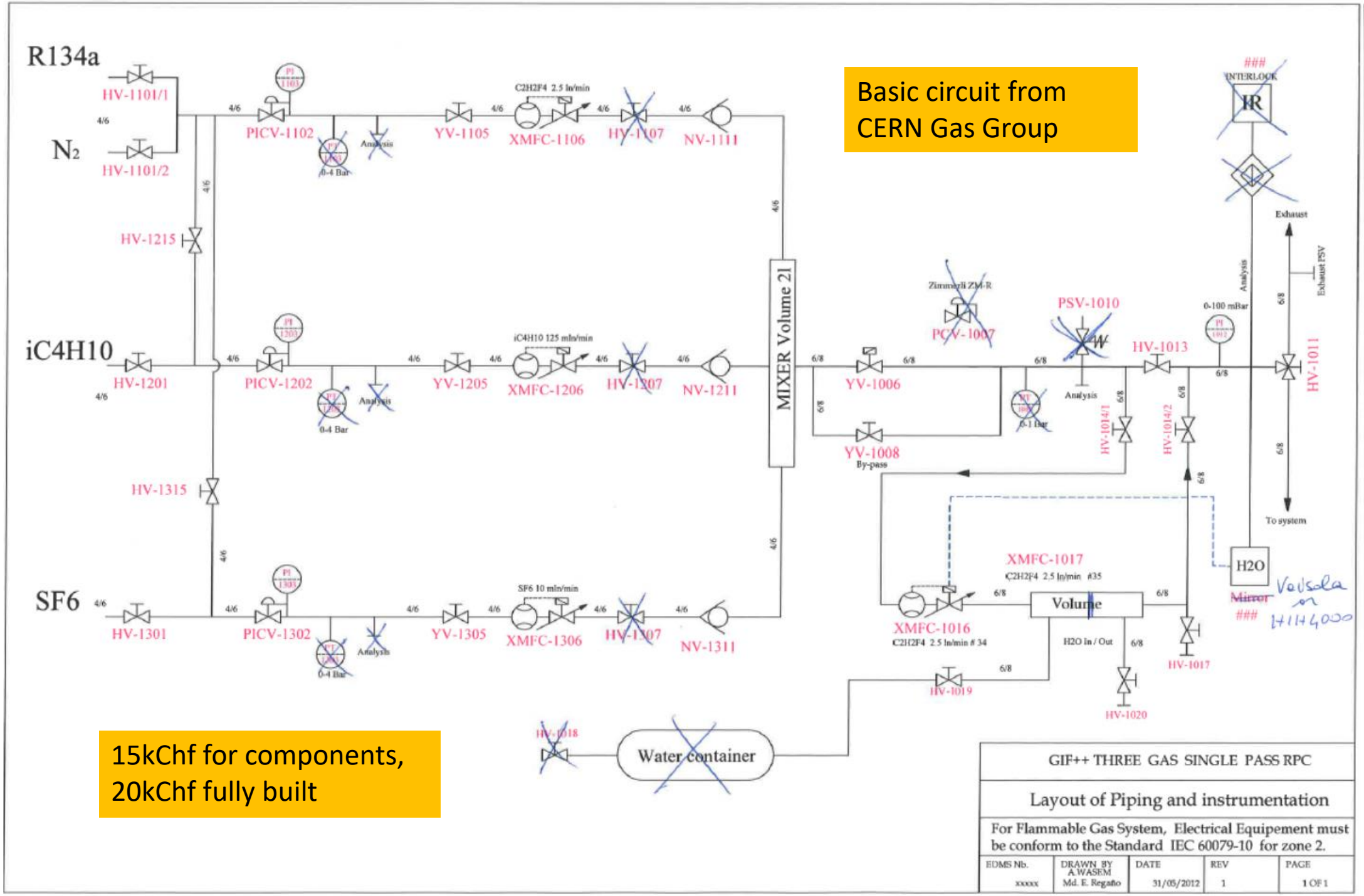
See Appendix for component list

Humidifier the gas to stop HPL drying

- There are 2 approaches

  - 1 separate the gas flows, one for dry proportion and the 2nd for the wet proportion that is bubbled thru water. This can be done with 2 “rotameters”.

  - 2 pass the entire mixture thru water at the temperature that gives the RH you require, eg a fridge set at 10degC for approx. 50% RH. CERN still has old elements of this type available.
  - 3 Pass the gas through a long plastic pipe(150m of Rilsan dia8 x 6mm) submerged in a water tank. The humidity is a function of the flow rate but it works for Lyon.



Basic circuit from CERN Gas Group

15kChf for components, 20kChf fully built

GIF++ THREE GAS SINGLE PASS RPC

Layout of Piping and instrumentation

For Flammable Gas System, Electrical Equipement must be conform to the Standard IEC 60079-10 for zone 2.

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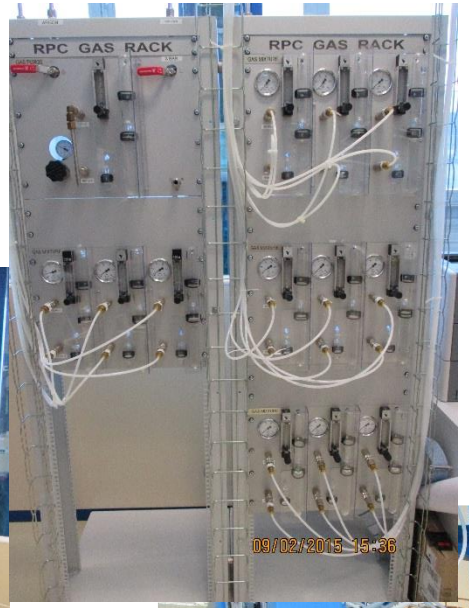
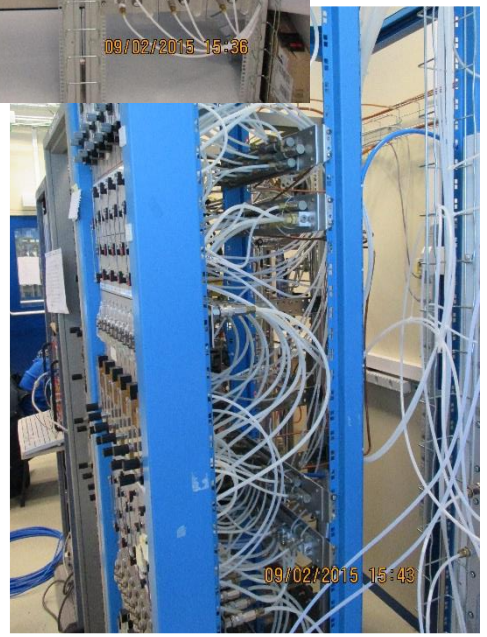
Industrial type approach(possibly with recirculation)





Exhaust

- The exhaust should be safe away from the area of use, outside.
- The gases are heavier than air and so should not exit far above the chambers to avoid hydrostatic back pressure.
- Limit the retro-diffusion of oxygen by very

  long lines or bubblers

Safety

- Normally all the system should have an ATEX classification
- Hand held devices at moderate prices available such as Oldham or Draeger
- Hand held gas detector

- https://www.youtube.com/watch?v=DgWAenS9kzc
- https://www.youtube.com/watch?v=Ocw6TZ5XVAo
- https://www.youtube.com/watch?v=0QV1zR9kIM0

Appendix

- http://project-cms-rpc-endcap.web.cern.ch/project-cms-rpc-endcap/rpc/Services/Gas/GasMixingInstitutes/MixingRackCERN/PriceQuotationMixerRPCv2.docx
- http://project-cms-rpc-endcap.web.cern.ch/project-cms-rpc-endcap/rpc/Services/Gas/GasMixingInstitutes/MixingRackCERN/RecirculationRack_ShoppingList_v2_june2014.xlsx
- http://www.draeger.com/sites/assets/PublishingImages/Products/gds_regard_3900_3910/Attachments/explosion_protection_br_9046262_en.pdf

Component list for Korean Gas Rack

- Rack
- 3 MFCs & controller
- Distribution panel
- Mixing Volume
- Bubbler
- Humidifier
- 3x Pressure regulators for gas bottles
- Piping and some unions