

Please follow step by step and tick off as you go!

Initial Status

- Nickel window in place
- IV4 closed
- silicon power supplies off
- pre-amps off
- cables to gauges CG5, CG5A, B and C and PNG5 are connected
- coolant unit off
- camera 12Volt supply is disconnected
- VV5 closed
- VV5A closed
- GV5 closed
- turbo off, BV5 closed
- RV5 closed
- H2 hand valve above chamber closed
- RV4 closed
- manual valve on roughing line closed
- VV5 attached to nitrogen bottle
- TUDA in "Gas mode"
- The section of flammable gas line from TUDA to blue panel is filled with nitrogen
- TUDA is at 1atm of air

1) Pump down chamber and re-entrant flange

- Open H2 fill hand valve on top of TUDA
- Open RV5
- Open RV4
- Open roughing line manual valve slowly (~1Torr/s)
- Pump until CG5 reads <250mTorr
- Close RV5 and quickly open BV5
- Turn on turbo pump
- Close hand valve on roughing line
- When CG5<150mTorr, open GV5
- When CG5<10mTorr, turn on PNG5
- Pump with turbo and cryo until PNG5<7E-5Torr

2) Flush with nitrogen

Fill:

- Close GV5
- Close BV5
- Turn off turbo
- Wait for ~10min for turbo to spin-down
- Open VV5
- Open N2 bottle and flow valve (a little)
- Slowly open hand valve on vent line (~1Torr/s)
- Fill to ~700Torr nitrogen (do not over pressure chamber) and close hand valve
- Close nitrogen bottle and flow valve
- Close VV5

Pump:

- Open RV5
- Slowly open roughing line hand valve (~1Torr/s)

- Once below 1Torr, fully open hand valve. (Note that hand valve must now be left open to allow remote pumping in an emergency).

3) Make TUDA safe for introduction of hydrogen

- Close RV5 and check leak rate less than 83mTorr in 5 minutes
- Disconnect cables to CG5, CG5A, B and C and PNG5 (all under chamber, for PNG5 disconnect at black screw connector ~30cm along cable)
- Open RV5 (and RV4 if it has tripped shut)
- Check camera 12V supply is disconnected (on top of TUDA)
- Put up exclusion zone tape, and warning signs
- Put up aluminium shielding on end of TUDA
- Remove bolts from TUDA down stream flange
- Put on personal protective equipment

4) Fill with hydrogen

- Close hydrogen fill valve on top of TUDA
- Inform Ops you are about to fill TUDA with hydrogen:
 - When $CG4 < 50\text{mTorr}$, ask Ops to close RV4 and 5 and quickly open IV4
 - IV4 may trip shut again, if not ask Ops to close it
- Open H2 fill valve on blue panel
- slowly open H2 fill valve on top of TUDA chamber ($\sim 1\text{Torr/s}$) – **H2 is now flowing into TUDA!**
- Fill with H2 until CM5 reads 250Torr
(if $CG4 > 40\text{mTorr}$ before fill is complete)
 - close H2 valve on TUDA
 - close H2 supply valve
 - close supply valve on blue panel
 - ask Ops to open and close IV4
 - resume filling with H2
 - repeat this process if necessary)
- close H2 valve on TUDA
- close H2 supply valve
- close supply valve on blue panel
- Change trip point on Baratron control box to 280Torr
- Check pressure in TUDA is stable ($< 1\text{Torr}$ increase 5 minutes)
- Switch on cooler, set point to 10°C
- Switch on pre-amps
- Turn on detector biases

Chamber is ready to take beam.