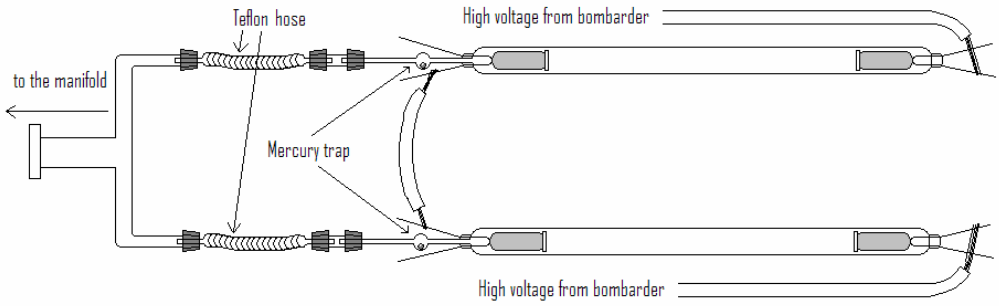
How to properly bombard the cold cathode lamps and TecnoLux Triplux electrodes

Before filling the lamps with rare gases and mercury, the inner wall of the glass tube with his fluorescent coating must be purified from the materials adsorbed into them. Without this operation they would latterly be emitted putting the lamps out of order. The bombarding process will vaporize (out gas) and pump out those materials. The electrodes also must be purified and out gassed. But, in addition, their internal coating (activation) must be chemically converted into emissive oxides. This means that the electric discharge created for the bombardment have to provide the energy needed to burn the emission coating. If this happens in the right way and conditions, the remains of this process will be the emissive material coating the inner walls of the purified metal of the shells.

Let see how to do this in the best way:

1. With the manifold under vacuum or low rare gas pressure (coming from previously filled lamps), close the separation valve (provided by the TecnoLux vacuum systems), in order to avoid exposing to atmospheric pressure the high vacuum section with the vacuum gauges.

2. Open the air inlet valve and connect the lamps to the manifold and the high voltage terminals to the electrodes, following the scheme of the drawing below:



3. Open the fore vacuum valve and wait some seconds until the sound of the pump is greatly reduced. This reduced sound will indicate that the pressure in the lamps is

reduced to some mbar. In this situation the moisture, adsorbed by the glass, fluorescent coating and electrodes will be delivered, filling the tube's atmosphere.

4. Open the separation valve in order to be able to monitor the pressure into the tubes.

5. The bombarding discharge must start in dry air. Provide dry air into the tubes: Close the fore vacuum valve and open both the diffusion pump's valves (inlet and outlet) to accelerate the vaporisation. - After the pressure is reduce to 50µ (0,050 mbar, indicated by the electronic vacuometer), close both the diffusion pumps valves.

6. Open the air inlet valve to introduce 1 or 2 mbar of air (which contains only the humidity of the surrounding atmosphere), regulating the pressure with the fore vacuum valve. With the hand or finger keep closed the inlet mouth of the valve to avoid that too much air will be introduced.

7. Switch on the lamps, regulating the bombarding current at 100 mA in case of small diameter and small electrodes (from diameter 6 till 12 mm) and at 200 mA in case of bigger lamps.

8. In the first phase the out gassed vapours will increase the pressure. During bombarding the pressure should be maintained initially between 2 to 6 mbar, operating on the fore vacuum valve. In between this pressure values, the higher pressures will accelerate the heating of the glass tubes, while lower pressures will accelerate the heating of the electrodes. For better quality lamps, after 1 or 2 minutes of bombarding, switch off the current and repeat the operation described in point 5 and 6. This would remove the developed impurities and replace them wit dry air. Than switch on the current again.

9. Gradually increase the current until 200 mA in case of small diameter and small electrodes (from diameter 6 till 12 mm) and until 400 mA in case of bigger lamps.

10. When the temperature of the glass tube reaches 170 °C (when a foil of paper start to get brown), operating on the fore vacuum valve, reduce the pressure until 1 mbar (not lower than this! Otherwise the emission coating would be partially evaporated and

damaged). Note when the discharge will switch from the outside surface into the electrode's shells trough the ceramic collar. This is when the chemical conversion of the emission coating happens and the shell start to become incandescent. The shell will become red starting from the area near the ceramic collar. The heat will be gradually transferred to the bottom. It is important that the entire surface gets the red colour. If it is difficult to reach this condition, it is because the current is too high. In this case avoid insisting with high current. It will be better to reduce the current or stop the current for a while (15 to 30 seconds). When starting the current again, the heating will be more uniform and will move toward the back side of the shells.

11. After the all surface became red, and the glass temperature will have reached a temperature of 220 °C (the foil of paper got dark brown), increase the current to the maximum level (250 mA for electrodes type 10/25 and 12/25; 400 mA for electrodes type 12/40 and 15/40; 500 mA for electrodes type 15/60, 18/75, 18/90; 800 mA for electrodes type 18/120 and 18/150). At the end of this phase the electrode's shell are orange (to be cautious, please do not leave the electrodes at this high temperature for more than 30 seconds), the discharge at the mouth of the electrodes must be stable, and while the fore vacuum valve is closed the pressure rises only slowly, since the chemical conversion of the emission coating and the out gassing of the glass is complete. The glass temperature can reach 260°C (the paper smokes, - Higher temperature can damage certain phosphors – like i.e. the standard green). Remember that during the all bombarding process the pressure should never be lower than 1 mbar! After reaching the above conditions stop bombarding switching of the current, close the fore vacuum valve and open both the diffusion pump valves. If, in this last stage of the bombarding, before the electrodes are orange and the discharge stable, the temperature of the tubes gets too high, just close the fore vacuum valve and stop the current until the glass temperature will be reduced slightly below 200 °C, than switch on again and continue.

12. In case of large tubes (diameter 25 mm and long length) or very narrow tubes (6 mm diameter) the tube could cool down before that enough vacuum is produce inside the lamps, or near the farer electrodes. The pressure that you can read on the gauges, in fact, does not correspond immediately to the actual vacuum into the lamps because the narrow tabulation connecting the lamps to the manifold, or the narrow glass tube

of the lamps itself, slows down the vacuum, independently on the performances of the pumps installed. In this case it will be useful to help pumping out the impurities rinsing them with Helium. If you intend to do this, after both the diffusion pump valves have been open for 30 seconds, close them again, let introduce about 10 mbar of Helium, switch on the bombarder at the current of about 150 mA for about 20 seconds, than switch off and open both the diffusion pump valves.

13. Let the tubes cool down until 30 to 50 °C (in any case higher than the ambience temperature), than close the diffusion pump valves, fill with rare gas at the pressure indicated in the table for each diameter (10 % higher if the temperature is 50%; For lamps shorter of 1 m increase the pressure by 10% of the value for each 10 cm of reduced length) and tip off the lamps.

14. When the electrode's shell have reached the ambience temperature, send the drop of mercury into the tubes (only for mercury lamps), tip of the remaining tubulation and share the drops at both the electrodes. Let age the lamps connected to a magnetic transformer supplying the nominal current of the lamps or slightly higher for about 1 hour. If, like in the TecnoLux vacuum system, the connection to the manifold is made through a flexible Teflon pipe, or a Mercury dispenser is installed, it is possible to introduce the mercury during the stage 13. In this case the hot shell will make the mercury vaporise and it can be more difficult to send drops to the far electrode, but, if the electrode is purified as it should be, the quality of the lamp will not be affected.