1. Safety instructions

- Do not subject the tube to mechanical stresses.
- Do not subject the connection leads to any tension.
- The tube may only be used with tube holder D (1008507).

If voltage or current is too high or the cathode is at the wrong temperature, it can lead to the tube becoming destroyed.
- Do not exceed the stated operating parameters.
- Only change circuits with power supply equipment switched off.
- Only exchange tubes with power supply equipment switched off.

When the tube is in operation, the stock of the tube may get hot.

- Allow the tube to cool before dismantling.

The compliance with the EC directive on electromagnetic compatibility is only guaranteed when using the recommended power supplies.

2. Description

The luminescence tube serves to demonstrate the luminescence of a phosphorous anode when excited by electrons (cathodoluminescence) or ultraviolet light (photoluminescence).

The luminescence tube is a highly evacuated tube with an electron gun consisting of a pure tungsten heater filament inside an apertured “cathode can” and a cylindrical anode contained in a clear glass bulb. A luminescence screen with three mica flags with different phosphors is mounted on a metal support.
3. Technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament voltage</td>
<td>6.3 V AC/DC (8.0 V max.)</td>
</tr>
<tr>
<td>Filament current</td>
<td>1.8 A typical at $U_F = 6.3$ V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>2000 - 5000 V DC</td>
</tr>
<tr>
<td>Anode current</td>
<td>180 µA typical at $U_A = 4000$ V</td>
</tr>
<tr>
<td>Screen current</td>
<td>100 µA typical at $U_S = 4000$ V</td>
</tr>
<tr>
<td>Glass bulb</td>
<td>130 mm diam. approx.</td>
</tr>
<tr>
<td>Total length</td>
<td>260 mm approx.</td>
</tr>
</tbody>
</table>

Luminescence screen:
- 5.1: fluorescent blue, approx. 450 nm, medium decay time
- 5.2: fluorescent red, approx. 625 nm, medium short decay time
- 5.3: fluorescent green, approx. 510 nm fluorescent, approx. 515 nm phosphorescent, long decay time

4. Operation

To perform experiments using the luminescence tube, the following equipment is also required:

1. Tube holder D 1008507
2. High voltage power supply 5 kV (115 V, 50/60 Hz) 1003309
   or 1 High voltage power supply 5 kV (230 V, 50/60 Hz) 1003310
3. Analogue multimeter Escola 100 1013527
4. High-pressure mercury vapour lamp 1000852
5. Spectrum tube power supply (115 V, 50/60 Hz) 1003195
   or Spectrum tube power supply (230 V, 50/60 Hz) 1003196
6. Infra-red light source

Additionally recommended:
- Protective Adapter, 2-Pole 1009961

4.1 Setting up the tube in the tube holder
- The tube should not be mounted or removed unless all power supplies are disconnected.
- Push the jaw clamp sliders on the stanchion of the tube holder right back so that the jaws open.
- Push the bosses of the tube into the jaws.
- Push the jaw clamps forward on the stanchions to secure the tube within the jaws.
- If necessary plug the protective adapter onto the connector sockets for the tube.

4.2 Removing the tube from the tube holder
- To remove the tube, push the jaw clamps right back again and take the tube out of the jaws.

5. Example experiments

5.1 Excitation by cathode ray bombardment
- To better observe the afterglow effects (phosphorescence), carry out the last step of the experiment in a darkened room.
- Set up the luminescence tube as shown in fig.1.
- Connect both the screens and the anode to earth for maximum safety.
- Switch on the power supply but do not to a high voltage. Monitor the screen in the white light of tube heating.

There is no luminescent phenomenon observable.
- Set the voltage $U_A$ to about 3500 V.
- Observe the luminescence.

The three phosphors fluorescent at different wavelengths (colours).
- Vary the voltage between 2500 V and 4500 V.
- Observe the change of the luminescent phenomenon.

While the intensity of the fluorescence varies with the voltage, wavelength does not.
- With $U_A$ at 4500 V use a hand held spectroscope to view the emissions from each phosphor.

Note that the emission from the red phosphor comprises a number of discrete emission lines.
- With the power supply and observe the afterglow (phosphorescence).

The removal of the source of thermionic bombardment causes luminescence to cease. The decay of emission from the phosphors is particularly apparent on the green phosphor.

5.2 Excitation by ultra-violet light
- Set up the luminescence tube as shown in fig.2.
- Do not switch on the power supply.

Note that there is no visible photoluminescence due to the ambient light levels.
• Proceed with the experiment when the room is darkened.
• Illuminate the gun side of the screen with ultra-violet light and note the initial time dependency of emission intensity. Do not gaze into the light of the UV lamp.

The three phosphors fluoresce at the same wavelength as when excited by cathode ray bombardment.
• Remove the ultraviolet light and observe the afterglow (phosphorescence).

The decay characteristic of the green phosphor appears longer than was observed after removal of cathode ray bombardment. The reason for this is that the phosphorescence of this material is quenched by infra-red radiation. When the filament supply is switched off there remains sufficient infra-red emission from the cooling filament to partially quench phosphorescence.
• Set the voltage to about 4500 V and note the current flowing (typically 0.02 μA due to leakage on or through the glass bulb).
• Illuminate the phosphors with ultra-violet light and note that there is no change in current.

Since there is no change in current, it is clear that the emission from the phosphorous materials is due to excitation processes and not to ionisation.

5.3 Phosphorescence and quenching
• Remove all connecting leads from the tube (refer to fig. 3).
• Set up a ultra-violet light source so that the gun side of the screen can be illuminated.
• Set up a infra-red light source so that the backside of the screen can be illuminated.
• Illuminate the phosphors with ultra-violet light until the green phosphor has built up to full intensity.
• Switch off the ultra-violet light source and immediately switch on the infra-red light source.

The phosphorescence of the unprotected half of the green phosphor is quenched while the other half remains unaffected.

Fig. 1 Excitation by cathode ray bombardment
Fig. 2 Excitation by ultraviolet light

Fig. 3 Phosphorescence and quenching