Neon versus cold cathode – a terminology issue

What is the difference between cold cathode and neon? In a word – none. The difference in description of what is essentially the same product can be attributed to a marketing function. The signage industry rarely uses glass in excess of 15 mm, and makes reference to neon. The architectural lighting industry sometimes uses neon in excess of 20 mm and refers to the lighting system as cold cathode lighting. Higher amperages are often applied to boost the light output. This is primarily to eliminate confusion with standard fluorescent lighting, which is hot cathode lighting. The term cold cathode refers to the type of electrode being used. It refers to the physics of the operation of the electrode, when compared to a hot cathode electrode such as is used in fluorescent lighting.

Hot cathode electrodes (fluorescent lighting) generate electrons by thermionic emission (heat). The point of generation is small and operates above 1000 °C. Cold cathode electrodes (neon) generate electrons via the high voltages applied and operate below 200 °C.

There is no difference in the manufacture of neon and cold cathode - nor is there a difference in the glass used or the gases used for different colours, or the electrodes used (dependent on amperage). They are the same product - just used in different industries.

Why even use neon?

Colour
All colours are available, and the colours do not shift when dimmed.

Bends
All shapes are possible.

Control
Cold cathode can handle continual flashing on and off, and dimming.

Why use glass?
Glass is the only material that is economical to produce and that is physically able to contain gas inside a tube throughout its lifespan.

Neon and fire
The ionization process is basically the gaining and losing of charged electrons.
In this process a small amount of energy is released giving off the light as seen with both neon and argon gas. In the case of Argon (blue) filled neon tubes there is a small amount of mercury added. This is the catalyst in the process causing the phosphor coating to illuminate. Argon gas in the neon tube is merely the carrier of current. The illumination aspect of argon gas is very slight. When mercury is in vapour form (mercury has a low boiling temp) and an electrical current is passed through it, mercury gives off ultraviolet light.

This ultra violet light causes the phosphor to illuminate. Without mercury, the tube is very dull. This is usually seen on cold winter mornings or days when the ambient temperature is very low, causing the mercury to condense into liquid. As the day warms up, the tubes become brighter. To avoid this problem we use “winter gas” (75% neon and 25% argon). In very cold countries they add a little krypton gas. Neon gas has higher resistance than argon, thus the lamp has a higher operating temperature, keeping the mercury in vapour form in cold weather.

In order to ionise the gas between the electrodes, a high voltage is required over the two electrodes. This allows electrons to flow from one electrode to the other, thus exciting the internal gases. In the case of neon alone, this produces a red colour, provided there is no phosphor coating on the glass. In other cases the “excited” internal gases collide with the phosphor coating on the glass and so produce visible light. Sometimes up to 15 kV is required, and this means that arcing to ground is a common occurrence – especially in older installations. Although the voltages are high, the current drawn is low – normally 30 mA.

**Pointers for a safe installation**

**Flammable materials**

Neon should never be used in conjunction with flammable material such as fibreglass unless a stringent maintenance programme is enforced to ascertain the integrity of the insulation materials. This is still not fail-safe. The day that the MV cable decides to fail, allowing flashover to the nearest grounded conductor, is the day that a fire starts – and this could be as little as three hours after the last inspection.

**Basic electrical installation codes**

Very often installations are undertaken by contractors, with very little electrical training.

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**Guidelines on neon installations**

Are listed in SANS 10142/1 - 2003, as amended.

Typically these call for:

- An isolator before the transformer to disconnect both the live and the neutral supplies.
- A device on the transformer housing that disconnects the power supply when the cover is opened.
- A fireman’s switch in all premises where there are permanent neon installations.
- Neon within reach of the public or below 2,4 m from ground level must not be accessible.

**Devices for additional protection**

Most European neon transformer manufacturers offer electronic devices in conjunction with an e-terminal type transformer that protect against ground fault or open circuit situations. These electronic devices are very sensitive and are usually calibrated to just below the rated current of the transformer.
These devices work well except when:

- Dimming is required - as soon as the current to the unit is lowered the safety device switches off
- When the voltage of the transformer is manipulated the current will also change (Ohm’s law), so the sensitive device will normally disconnect
- When the neon is constantly “flashing” or “chasing”. Protective devices are normally designed to reset themselves whenever the supply voltage reconnects. With flashing or chasing, the protective device is continually resetting itself
- In the event of a broken piece of neon (open circuit fault)

For example, assume a flash rate of two per second or 7200 flashes per hour – at this rate of resetting itself, it’s no surprise that the protective device will fail.

**Light output of (cold cathode) neon in its various colours**

Attached is a table indicating the different outputs of neon in relation to colour. These levels are indications only - each neon glass manufacturer’s product will differ slightly.

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**A brief history on neon**

(reference H J Wulf – a history of lighting)

1854 – Development of Pluckler-Geissler tubes, which were filled with dilute gases. 1894 – Moore McFarlan made the first discharge lamps using various gases for different colours: nitrogen for yellow, carbon dioxide for white.

1909 – Ramsey first used neon gas in tubes – however George Claude (Fr.) at the same time realised that the tube’s red light would be good for advertising. He also discovered that adding other gases could vary the light’s colour.

Length of glass as well as quality of transformer will also affect output. Yellows and greens are much brighter to the eye than dark blue, for example. This is a function of the eye’s sensitivity and not actually a result of less energy being emitted by the darker colours.

Contact Otto Horlacher, Giantlight, Tel (082) 451-5506, fols@global.co.za

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