## Loading Chart for neon-transformers

It is important to choose the correct transformer for each set of tubes.
A set can be one tube or also several tubes, depending on the application.

Usually the designer and electrical engineer cooperate to define how many tubes will be connected in series and as a consequence which transformer is needed to supply power to that particular set of tubes.

There are two things that we need to know when selecting a transformer : mA and Volts.
**mA** is the intensity of the secondary current and as a consequence the brightness of the tube will depend on the mA. We standardize on the following mA : 30 mA / 60 mA / 90 mA / 120 mA
Please note that these values are respectively 1,2 times higher than the current they are designed to run at, so:
a '30 mA' transformer should run at 25 mA,
a '60 mA' transformer should run at 50 mA
a '90 mA' transformer should run at 75 mA
a '120 mA' transformer should run at 100 mA
(Inside Europe we have a different tradition, we call the transformers 25 / 50 / 75 / 100 mA, the same value as they are meant to run at.)
*Usually 25 and 50 mA is for tubes with diameter 15 mm, 75 and 100 mA is for tubes with diameter of 20 mm.*

**Volts** is the level of output of the transformer. This voltage needs to match the tubes that are connected to that particular transformer. Each tube needs a certain voltage to start, that is the **ignition voltage**. As long as the voltage that is applied between the two electrodes of that tube stays below the ignition voltage, the tube will not start. Once the tube is started in combination with the transformer the voltage across it's terminals will drop to about half that value, it is the **running voltage** and that is actually the only voltage you can measure. The ignition voltage is fixed for every tube in the way it has been manufactured. So it is the glassshop that manufactured the tubes that defined what ignition voltage each tube has.

If the glasshop works by the book then the ignition voltage will match the value that one can estimate during the design stage, that is before manufacturing. There are only three variables that are linked to the ignition voltage of a neontube: length, diameter and type of gasfilling. So, a well experienced designer can almost predict what type of transformer he will need for a set of tubes when he defines what the length and diameter of the tube will be and what type of gas will have to be put inside.

Let's analyse this.
Length : It is clear that for every meter we need a certain voltage, hence the longer the tube the higher the voltage. So from now on we will calculate per meter of tube. (For easy under-standing, we can compare the situation with a garden watering hose. A long hose needs higher water pressure for the water to come out.)

The diameter : a small diameter tube needs more voltage per meter than a large diameter tube. (A very thin hose needs much more water pressure than a thick one.)

The gasfilling : there are two main types of gases that are used with neontubes: Neon and Argonmix. Neon requires a higer voltage per meter (for a certain diameter) than Argonmix (for the same diameter). When we say Argonmix we already indicate that Argon usually is mixed with other gas, and most of the times it is Neongas. Depending on the area where the tubes will be used the gasmixture will be 25%Neon/75%Argon or 50%Ne/50%Ar or 75%Ne/25%Ar. In warmer areas we can use less Ne, in colder areas (like northern China) we use more Ne. In Indonesia, the Philippines and Singapore we can use 15%Ne/85%Ar because they do not have cold days.

**Volt / m table**

| Tube diameter (mm) | 8 | 10/11 | 12 | 13/14 | 15 | 18/20 | 22/25 |
|---|---|---|---|---|---|---|---|
| Neon only | 1360 | 1220 | 1190 | 1050 | 925 | 755 | 656 |
| 75% Ne+25% Ar | 1100 | 1005 | 965 | 850 | 738 | 595 | 530 |
| 50% Ne+50% Ar | 985 | 900 | 860 | 750 | 646 | 515 | 457 |
| 25% Ne+75% Ar | 860 | 798 | 756 | 650 | 554 | 437 | 383 |
| Argon only | 738 | 675 | 650 | 550 | 460 | 340 | 310 |

***Courtesy of Siet transformers, Italy***

For quick reading we have a table that shows the ignition voltage for each type of tube, per meter tube length. This is the 'Loading Chart'. Select the diameter of the tube and the type of gas mixture and you can immediately cross read the required ignition voltage.

For 20 mm diameter and 25%Ner/75%Ar : appr.437 Volt/m.
When estimating the necessary voltage for a certain set of tubes we need to add 250 Volts per pair of electrodes. This is due to the electric power loss in the emission of the electrode.
That gives us for a set of 6 tubes, each tube 2.2 meter long, when filled with 25%Ne/75%Ar :
(6x(2.4x437))+(6x250) = 7,793 Volts. So we choose the next value or 8,000 Volts.
Because we use tubes of 20 mm diameter and we want the tube to be reasonably bright, we choose 60 mA, so the order will be a transformer of 8 kV 60 mA.

Our european neon transformers on the asian market automatically limit the secondary current to 20% more than the running current. That means, even if you short circuit an output terminal, the secondary current will never be more than 1.2 times the ‘ideal’ current. Because of this sometimes installers are a little bit careless in using the correct transformer for their application: the output would be limited anyway. So they use a 10 kV or, even worse, a 12 or 15 kV.
In doing so they forget that an oversized transformer wastes power and creates a potential risk for the life expectancy. Wasting power seems irrelevant to some people but if you are in Shanghai on a hot summer day when the power is cut for several hours then you start thinking differently. Your country’s power resources are not unlimited and should be treated with respect. Also, if your transformers are installed inside a building then the air-conditioner has to pump out the excess heat that you create, that costs money and electricity, again. So it is very important to use the correct transformer, not too much oversized.
Last, but not least, choosing the correct transformer can be substantially cheaper than just using a ‘standard’ oversized one. This is probably the best incentive to do it correctly.

Estimating transformers based on calculation is only a guideline. Calibration of the real combination of tubes and transformer in ‘on-site conditions’ is a necessity. Therefore we can check the secondary mA or check the primary current and verify these against the values printed on the label on the transformer.
Take care when measuring the secondary mA in a high voltage circuit, this can only be done by qualified technicians as it involves serious risks if not done properly.

A quick way, for well equipped installers, to know the correct transformer before installation is to use an oversized transformer, like a 10 kV (with the same mA rating as the one you are going to use later) and connect it to a similar set of tubes that you plan to use in the final installation. Next, with a high voltage probe measure the voltage between one terminal and earth and also between the other terminal and earth, next add up these two values and you have the running voltage for this set of tubes. Multiply the obtained value in kiloVolts by 1.9 and you have the correct ignition voltage, or the transformer ‘no load output’ voltage. Again this method is for very skilled installers only and should be carried out with utmost care.

In the next issue we will explain something more about measuring secondary currents and high voltage. We will also check the running voltage of tubes with different gas mixtures.

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