Strand Lighting

FACT sheet

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GUIDE TO INSTALLATION AND DIMMING OF LOW VOLTAGE LIGHTING

Introduction

During the last decade there has been a substantial growth in the use of low voltage halogen lamps, particularly those with integral "dichroic" reflectors, for accent and effect lighting. They were initially used to update conventional spotlighting reflector lamp installations to give greater visual impact in merchandising display, but are now widely used in a variety of applications, in particular, spotlight or downlight formats.

Many installations use remote transformers feeding multiple lamps, either in separate luminaires or via ELV track. The remainder use luminaires which embody a transformer, thus connecting directly to mains, following normal installation practices. These notes deal with the application of separate transformers and are relevant to Strand Lighting Minispots, and Spotlight and Downlight Series.

Electrical installers have sometimes not realized that special attention to cable sizes and circuitry is needed to cope with the unusually high currents taken by these low volt lamps. As a result, the use of inadequately specified transformers and/or over-long cable runs have introduced excessive lamp voltage deviations, thus adversely effecting the lighting performance.

The object of these guidelines is to assist the installer to avoid these pitfalls. SELV (Safe Extra Low Voltage) is not inherently complex or unsafe; on the contrary the low user voltage makes a luminaire safer than its 240v counterpart. However overloaded cabling can present a fire risk.

Effects of Voltage Deviation on Lamp Performance

Low voltage halogen lamps behave like ordinary filament lamps. Typically at 5% over-volts, (e.g. 12.6V instead of 12V), lamp life expectancy is halved. At 5% under-volts, (e.g. 11.4V), life expectancy is doubled - but light output drops by 17%.

It is important to avoid reducing lamp life by over-volt conditions. However some users may wish to deliberately under-run lamps ie, at 95% to extend lamp life. This can be achieved by dimming means. The Strand Lighting Finesse automatically has this control as a feature.

If lamp voltage is lower than 11.4V the light loss increases, but life expectancy may not increase further, so this value must be regarded as the practical minimum unless dimming further for aesthetic lighting purposes.

Objective lamp voltage should be within + 2½% (11.7V to 12.3V), giving 140% and 70% lamp life respectively.

Factors Influencing the Voltage Measured at the Lamps

1. The declared tolerance of + 6% on the mains supply is already greater than objective. However, it is mostly held to within 2 or 3 per cent. Nevertheless, this means that further voltage deviations introduced by transformers and wiring must be reduced to a practical minimum as they may be ***additive*** to these mains variations.

2. Transformer regulation, (i.e. the difference between full load and no load secondary voltages) must be very good when two or more lamps are being jointly supplied. This is to prevent over-volting of lamps remaining after others have failed.

   Note: It is bad practice to use transformers which have poor regulation but are designed to deliver, say, 11.8V on full load (and e.g. 12.5V on half load). Full load transformer voltage should be 12V, at the specified input voltage, otherwise cable sizes may have to be increased to prevent further volt-drops.

3. Cable volt-drop, caused by the unusually high lamp currents, is inevitable and must be minimised by selecting appropriate cable sizes to suit lamp currents and lengths of runs. Cable volt-drop should not exceed 0.3 Volts to any lamp.

   (See Table 1 below).

These measures are calculated to provide between 11.7V and 12.0V ***at the lamps*** on full transformer load, and 12.0V and 12.3V on half load - when the mains is at its nominal value (220, 230 or 240V).

Keeping transformer and cable voltage variations under control retains lamp performance within acceptable limits.

It should be noted that one 50W 12V lamp draws a current of over 4A

Minimizing Cable Volt-Drops

In the UK the IEE Wiring Regulations contain tables showing current-handling characteristics of cables in various installation modes and Table 1 shown below is based on information given in Table 2 9 D2 of the Regulations, for flat PVC cables laid separately.

Table 1

Cable

ble

Maximum cable runs: 0.3 volt drop on 12 volt supply

	1.0mm²	1.5mm²	2.5mm²	4.0mm²	6.0mm²	10.0mm²
	4.3m	6.4m	10.5m			
	2.4m	3.7m	5.1m	9.4m		
	1.7m	2.6m	4.2m	6.5m	10.2m	
	1.1m	1.7m	2.8m	4.4m	6.9m	11.4m
	0.9m	1.3m	2.1m	3.3m	5.1m	8.6m
	-	0.6m	1.1m	1.6m	2.5m	4.3m
	-	-	0.7m	1.1m	1.7m	2.8m
	-	-	-	-	1.3m	2.1m

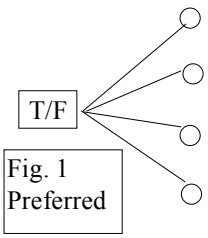

Fig. 1
Preferred

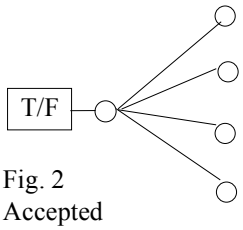

Fig. 2
Accepted

* *Cable length must be halved for LV track transformer connection.*

Note: If the full load transformer voltage is less than 12.0V the maximum cable run per size should be reduced accordingly to ensure that 11.7 volts are present at the lamp.

Example: Transformer output is 11.8V:
Reduce max. cable length to 1/3rd.

Table 1 should be used as a guide. Actual volt-drops measured in practice are influenced by conductor temperatures.

Wiring Technique

Table 1 confirms that transformers must be located as near as possible to the luminaires, particularly for higher wattages.

The most appropriate wiring configuration for multiple luminaires from a central transformer is a radial layout, with individual cables brought back to the transformer. (Fig. 1).

A short length of heavier cable may be used between the transformer and a junction box used to provide more terminals if necessary. (Fig.2).

Wiring configurations in Fig. 3 and Fig. 4 are not recommended as volts rise when lamps fail, causing shorter life expectancy for the remainder.

Earthing and Protection for Safety

1. As the transformer is specified as a Safety Isolating type the low voltage circuit must not be earthed.

2. Keep LV cables separated from mains cables, unless insulated to the same degree.

See IEE WIRING REGULATIONS

Low Voltage Track

Most LV tracks have 4mm² conductors and therefore introduce a volt-drop along their length causing the lamp furthest from the connection end to run at about 0.3V less than the terminal voltage.

For this reason two 25A tracks should not be joined in series unless the total proposed lamp load is 200 Watts or less (e.g. 10 x 20W lamps), otherwise the furthest lamps will be seriously under-volted.

In view of this additional volt-drop along the track, the permissible cable volt-drop must be reduced, which means reducing the Table 1 distance between track and transformer.

> ***NOTE 1:*** Sometimes track supply transformers have tappings to provide an over-voltage output to compensate for the volt-drop of longer cables, thus producing 12.0V on the track terminals on full lamp load.
>
> This transformer over-voltage should be limited to 12.6V otherwise there is a risk of over-volting lamps remaining burning after others have been removed or have failed.
>
> ***NOTE 2:*** If site restrictions prevent the transformer from being mounted within typically one or two metres from the track terminals it is prudent to specify mains voltage track equipped with LV luminaires having their own integral transformers.

Consider cable volt-drop and maximum current capacity, wire each lamp individually, locate track transformer adjacent to the track.

Transformer Specifications

For optimum lamp operation transformers must deliver the correct voltage, be safe to use, and be installed to comply with the IEE Wiring Regulations.

1. When supplying two or more lamps, regulation should be better than 5%.

2. Full load secondary voltage should be at full rating (12.0V) with manufacturing tolerance of ± 1%.

3. Should comply with BS3535 EN60 742 and be a Safety Isolating type.

4. The transformer primary should be protected with an appropriate fuse and additional output fusing is recommended for larger transformers.

5. Thermal fuses are recommended for larger (track) transformers, to protect against overheating/overloading. This is particularly important if the loads are to be dimmed.

6. Output terminals should be generously rated to accommodate larger cables, and several parallel terms provided when a number of separate lamps are to be connected, to avoid loose contacts and subsequent arcing.

7. Mains voltage connections must be enclosed, and this is usually achieved by mounting the transformer, terminals etc. within a housing.

Electronic Transformers

These convert the mains voltage to 12V by use of a high frequency circuit enabling a very small transformer to be accommodated. Their light weight makes them attractive for building into individual luminaires.

If used it is most important that the installer ascertains from the manufacturer the degree of isolation of the low voltage output. The IEE Wiring Regulations require that it is not less than that of a safety isolating transformer, i.e. is suitable to safely use with un-earthed low voltage wiring and class III luminaires. Any precautions necessary to prevent radio frequency interference should also be established. Special precautions need to be taken for dimming; see section 10.

It is a false economy to use low priced, under-specified transformers.

Using Transformers

1. The transformer should be installed in a well ventilated space and be well supported and mounted on a non-combustible surface.

2. Access to fuses and for wiring should not be restricted.

3. Any switchgear used to control the circuit should be able to withstand the 'switch-on surge' of 4 or 5 times the running current. It may be necessary to switch larger transformers separately to avoid nuisance tripping of circuit breakers or fuses.

4. If the transformer has tappings to compensate for cable volt-drop, check that the voltage on the luminaire or track terminals is correct on full load.

5. Low voltage cable connections must be tight, otherwise arc damage will ensue.

6. Site each transformer to minimize LV cable lengths.

Position transformers for minimum cable, but accessibly with consideration for high currents.

Dimming

LV Halogen lamps can be dimmed, although they should not be flashed repetitively, but the dimmer must be suitable for the inductive transformer load. Transformers may produce more noise when used on dimmers.

Inductive loads such as Low Voltage lighting or Cold-Cathode may be dimmed using Multidim, Unidim, Microdimmer or Finesse, providing the following guidelines are observed:

1. **De-Rating**

   Dimmers must be de-rated to allow for surge currents which occur with an inductive load. A wide range of transformer types are on the market, and each type will have a different inrush current characteristic. This makes it impossible to define an exact de-rating factor. Nevertheless as a general 'rule of thumb' it is suggested that the following guideline is applied.

   De-rate the dimmer by 40% if the load is transformer-fed.

   If this guideline is ignored, 'nuisance' tripping of the MCB (or fuse blowing) may occur at switch on, or when fading the dimmer to full.

2. **Types of Transformer** (see also section for general specifications)

   Conventional "frame" type transformers are recommended. The dimmer must be connected to control the supply to the transformer's primary side, and so the transformer should be of a quality suitable to withstand the increased heating effect of dimming. If in any doubt in this respect, please verify with the transformer manufacturer that it is of a type suitable to be dimmed. Strand Lighting Ltd supply a range of boxed transformers which are approved for use with Strand Lighting dimmers.

   If Toroidal (circular) transformers are used, very high surge currents can occur, and extra de-rating is therefore required (more than the amount suggested above).

   Only certain makes of electronic transformers are suitable for dimming. Please consult Strand Lighting for further information on the approved types.

3. **Protection**

   If the load circuit also includes MCBs, they should also be rated to allow for the surge currents. The primary side of each transformer should be individually fused (most commercial transformers incorporate this).

   Many transformers also include thermal trips on the primary side of the transformer which can be either auto-resetting or manual resetting. Auto re-setting is preferable as access to transformers may be difficult once an installation has been completed.

   Important: Dimmers must never be switched on driving only into a transformer without any secondary load connected. If there is any likelihood of this occurring, then to avoid damaging the transformer a suitable load resistor should be fitted in parallel with the transformer primary or across the dimmer output. There must always be some "resistive" component in the dimmer's load. Never operate the dimmer with Transformers but no lamps.

Lamps

Avoid touching quartz bulbs and dichroic reflectors with bare fingers. Where they are to be used in a particularly vulnerable or dusty position the versions having a built-in front glass are recommended.

Always use lamps of the wattage specified for the luminaire. Exceeding the max wattage will lead to dangerous overheating, reducing below it can lead to over-volting and shortened lamp life. Refer to manufacturer's recommendations on handling low voltage lamps.

Summary

LV Halogen lamps have introduced a new aspect to lighting installation. By following this guide the benefits, performance and great potential of the new technology will be gained in full.