

# T-5 Fluorescent Lamps

# Electronic Ballasts: CONSUMER FRIENDLY



**C**onsumer VOICE tested ten brands of 28 watts slim line tube light (T-5), for the first time in India as per international standards and brings you its test findings.

The T5 Tubular Fluorescent Lamps (TFLs) are relatively thinner than most tube-lights and considered to be more energy efficient and offer a higher intensity of light output than even its previous version T8 lamps. The T5 tubes are fluorescent lamps that are 5/8" (16mm) of an inch in diameter. The diameter of T5 tube is only 16mm. As the T5 tube is a miniature and slimmer tube, it needs the main raw materials, that is; glass and phosphor, only 43.8% of a T8 tube. With less raw materials consumption and small size, T-5 tube can save cost and space in storage and transportation. Equipped by the electronic ballast, a T5 fluorescent lamp can be started at low temperature and low voltage. Normally, a T5 fluorescent lamp can be lighted up at 15° C and above and at 20% of lesser Voltage than that of type T8. The average life of T5 lamp is above 10,000 hours however it could not gain market due to its higher price, which is very high as compared to T8 lamps. It has also discouraged a number of manufacturers which has led to lesser competition to push & popularize T5.

## BALLASTS

Ballast, also called or popularly known as choke is the heart of a discharge lamp, providing sufficient voltage for lamp ignition. With the advancement and improvement in solid state devices and availability of sophisticated integrated circuit functions, there are commercially available Electronic Ballasts that provide 50Hz A.C. input to the ballast and operate the lamps at 20–50kHz, with resulting improvements in ballast efficiency and lamp efficacy. Better designs have circuits which keep the line-current harmonic distortion below 20% and provides power factor in excess of 90%.

Electronic ballast for T-5 fluorescent lighting systems have fast become popular due to its advantages like Greater Efficiency, generating less internal heat, thereby reducing power losses, lighter in weight, instant starting of lamp quieter operation etc.

BRAND	RANK
Osram	1
Philips	2
Surya	3
Bajaj	4
Compact	5
Crompton Greaves	6
Cema	7
Wipro	8
Havells	9
Oreva	10

## INITIAL LUMINOUS FLUX

The initial reading of the luminous flux of a lamp shall be not less than 92% of the rated value.

The results of initial lumen of all brands are within the specified limit 92% of rated value. All brands have higher initial lumen than rated value

### Key Findings: T-5

**This is the first time that T5 TFLs Tube lights and their ballasts have been tested in India independently.**

**T-5 TFLs are considered to be higher in energy efficiency performance: Found to be consuming up to 28 watts (lumen efficacy 85-96) only thus further saving w.r.t. T-12 Lamp with magnetic ballasts which means they consume only up to 32 watts against 60 watts. T-5 TFLs have a much longer life. Test finding reveals that not a single lamp from 150 lamps tested failed till 2000 hrs which is continuing to be tested further for 4000 hours. In lumen output (light intensity) after 2000 hrs, all the brands had over 92 % of lumen output except one but that still had over 90%.**

# Comparative Test

except the brands CG and Compact. Initial lumen of brands Osram Philips and Surya was higher as compared to other brands and have been rated accordingly.

## COLOR TEMPERATURE

The initial reading of the chromaticity coordinates x and y of a lamp shall be within 5 SDCM from the rated value. The colour coordinates of fluorescent lamps are expected to be within the chromatic graph chart which reflects the color consistency. Tube lights emits cool day light (6500 K). This is marked on the packaging & lamp. The results of all the brands are within the specified limits. Least deviation was observed in case of Osram and highest for Wipro.

## HOW MUCH HOW FAR

The luminous efficacy of a lamp decreases with regular usage and time and for a discharge lamp it may fall by as much as 50 per cent before the lamp fails. After 2000 hrs of running the lamp lumen output was measured and Lumen maintenance in percentage reported in the following table.

Brand	Rated Lumen,	Initial Lumen* (Actual)	Lumen Flux* after 2000 hrs running	Lumen maintenance* (Light Output) %
Philips	2480	2610	2498	95.61
Surya	2480	2563.6	2427	95.06
Osram	2400	2624.13	2470.7	94.14
Oreva	NM	2497.5	2352	93.98
Crompton Greaves	2760	2635.53	2468.5	93.64
BAJAJ	2470	2492.4	2324.4	93.59
Compact	2600	2449	2285.6	93.32
Cema	2350	2449	2267.2	92.55
Wipro	2480	2547.73	2352.7	92.52
Havells	2200	2470	2221	90.07

\* Mean Values

For TFLs T5 the requirement have been specified as 92% of rated LM value **however rated LM is not**

## VALUE FOR MONEY

Considering performance and cost factor brands Osram and Philips are value for money and recommended for buying.

declared by any manufacturer.

All the brands performed well i.e. above 90% of initial lumen value. The highest LM was found in case of brand Philips (95.61%) followed by brands Surya (95.06%) and Osram (94.14%). Brands Havells LM was 90% which is slightly lower than the other brands but met the specified requirements of the parameters set by the **INTERNATIONAL STANDARD IEC 60081 -2005**

## CONCLUSION

Keeping in view the above stated test parameters performed on all 10 brands of T 5 fluorescent lamps, it has been found that **all** the brands fulfil the quality, life and safety performance tests and give value for money to the consumers. In terms of luminous &

life test, all brands have fared well. As far as life test is concerned, none of the brands failed till the completion of 2000 hours. After 2000 hours lumen

## Key Findings: BALLASTS

**Electronic Ballasts consumed between 2.67 – 6.35 Watts which is significantly low as compared to magnetic ballast.**

**Most of ballasts have high power factor > .9 thus no loss to the utility.**

**Harmonic distortion was higher in 7 brands. Only 3 brands i.e, Osram, Compact and Philips complied with the requirement.**

maintenance was between 90-96 % of initial lumen which is very good. The test is continuing at lab for 4000 hours and results are awaited.

There was problem in ballasts as low power factor has been observed in 5 brands.

## PACKAGING AND MARKING

Packing of brand Osram was better among the brands tested where as Cema and Compact were lower. Surprisingly there was no packaging for the brand Oreva as it was marketed in insufficient packaging condition, attracting high risk for handling for avoiding damage.

Marking on the lamp should carry manufacturer's name, rated Watts marked "W", color Temperature, Starting Conditions, Rated Lumen and Country of Manufacturer etc.

Brand Oreva did not declared lumen. Seven out of ten brands did not declare power factor.

## STARTING PERFORMANCE

Lamp shall start fully within 0.1 sec or 100 mili-seconds and remain alight.

All the lamps of all the brands lighted in few mili-seconds getting full weightage.

## Advantages and disadvantages of T5 systems versus T8 systems in lighting design

- The smaller size of T5 lamps allows for smaller luminaries.
- The smaller lamp diameter of T5 lamps makes it easier to design optical systems that distribute light in the intended directions.
- The higher light output of T5 high output lamps may reduce the number of luminaries per area of lighting.

## Altogether these factors contribute to higher life and high light output

A **DISADVANTAGE** of T5 lamps, if they are inappropriately used, is the resulting glare. Glare can be prevented, though, by choosing luminaries that shield (translucent cover) the light sources from view. Another measure to avoid glare is to decrease the visual size or solid angle of these light sources. But that means added cost and hassels for consumers.

## Circuit power factor at rated voltage 240V

Power factor is the ratio of true power or watts to apparent power or volt

amps. They are identical only when current and voltage are in phase than the power factor is 1.0. The power factor is expressed in decimal or percentage.

The measured circuit power factor shall not differ from the marked value by more than 0.05 when the ballast is operated with one or more reference lamp(s) and the whole combination is supplied at its rated Voltage and frequency.

**Watt Loss:** The watt loss was observed from 2.67 to 6.35 Watts. Watt loss of Brand Bajaj was lowest followed by Havells and Cema. Brand Osram had highest (6.35 W) watt loss.

## Are T5 lamps good for the environment: LESS MERCURY!

Although the efficacy of T5 lamps is equivalent to that of T8 lamps, the compact size of T5 lamps reduces the amount of materials used in their manufacture, as also the potential for toxic substance contamination, and packaging materials needed for shipment and sale. T5 lamps can, therefore, have less impact on the global environment than T8 lamps.

In addition to their smaller dimensions,

T5 lamps have an improved phosphor coating that prevents mercury from being absorbed into the phosphor and the bulb glass. This technology allows for reduced mercury content in the lamp, as well as higher **lumen maintenance**.

Compared to the larger T8 or T12 lamps, T5 lamps save material. The reduced surface area allows manufacturers to use nearly 60% less glass and phosphor material when manufacturing T5 lamps as compared to T12 lamps.

## Do T5 lamps need special ballasts?

T5 lamps need special ballasts to operate. The T5 ballasts will not work with T12 or T8 lamps, although at least one manufacturer offers electronic ballasts that can operate either T5 or T8 lamps with appropriate wiring. T5 lamps operate at frequencies greater than 20 kilohertz. **Instant start, rapid start, and programmed start** electronic ballasts are available for T5 lamp operation.

T5 is superior to T8 in that it creates more usable light. However, it is not a "game changing" technology in that its superiority renders T8 obsolete (as is the case with T12). Finally, the real game changer will be LED and organic LED technologies. These technologies will render both T5 and T8 obsolete in the future. For the mean time, T8 and T5 will continue to be the reliable, energy efficient choice for a multitude of general applications.

**Color:** The color coordinates of fluorescent lamps are expected to be within the chromaticity graph chart. This is a requirement of the national standards and refers to color consistency. TFL emits cool day light (6500K). This is expressed in Kelvins (K) and is marked on the packaging. The least deviation was observed in case of Osram and highest for Wipro. However

## COMPARISON OF T-5 & T-8 FLUORESCENT LAMPS:

Criteria	T-8 + Ballast (mag.) (36 watts)	T-5 + E.Ballast (28 watts)	Key difference for T-5 *
Average purchase (with tube) cost, Rs.	150	500	By 350 additional
Initial Lumen, (Approx)	2400	2500	100 (higher)
Lumen Efficacy/Watt	62-68.5	85.7- 94	25 (higher)
Life/Hours	5000	10000	5000 (higher)
Average power consumption in watts	52	32	20 (lower)
Operating Cost, Per year @8 hrs per day use	147.7KWh/year or Rs. 674/year	92 KWh/year or Rs. 414/year	57.7 KWh. Lower or Rs. 260 lower

\*Pay back period for additional cost of T-5 in 1 year is Rs. 300/- (Rs. 260/- Savings + Rs. 40/- Cost of Additional T-8 Lamp saved) Rate @ Rs. 4.5 per unit.

# Comparative Test

results of all the brands are within the specified limits thus passing the test.

## CAUTION: WHAT CAUSES LIGHTS TO DIM!

If your lights dim when an appliance (fridge, air conditioner, etc.) comes on, check to see if the lights are on the same circuit with the appliance. Most fixed appliances (fridge, air cond, etc.) should be on a dedicated circuit back to the main panel. These devices draw quite a bit of current in the first second or so when they first start up. If all the lights in your house are dim all the time or periodically, the problem could be at the local utilities substation, transformer or their service feed coming into your house. This is one of the first things you might want to have checked.

## GLOSSARY

**BALLAST:** A device required by electric-discharge light sources such as fluorescent or HID lamps to regulate voltage and current supplied to the lamp during start and throughout operation.

**POWER FACTOR:** The ratio of active power (in watts) to apparent power (in rms volt-amperes), power factor is a measure of how effectively an electric load converts power into useful work. Power factor (PF) is calculated using the equation  $PF = \frac{\text{active power}}{[(\text{rms voltage}) \times (\text{rms current})]}$ . Phase displacement and current distortion both reduce power factor. A power factor of 0.9 or greater indicates a high power factor ballast.

## COLOR TEMPERATURE:

Color temperature is a characteristic of visible light that has important applications in lighting, photography, videography, publishing, manufacturing, astrophysics, and other fields. The color temperature of a light source is the temperature of an ideal black-body radiator that radiates light



Life Test in progress at Testing Laboratory

of comparable due to that of the light source. Color temperature is conventionally stated in the unit of absolute temperature, the Kelvin, having the unit symbol K.

Color temperatures over 5,000K are called *cool colors* (bluish white), while lower color temperatures (2,700–3,000 K) are called *warm colors* (yellowish white through red).

## LUMINOUS FLUX

Luminous flux is a quantitative expression of the brilliance of a source of visible light, which is electromagnetic energy within the wavelength range of approximately 390 nanometers (nm) to 770 nm. This quantity is measured in terms of the power emitted per unit solid angle from an isotropic radiator, a theoretical point source that radiates equally in all directions in three-dimensional space, the standard unit

of luminous flux is the lumen (lm).

**Source:** [www.lrc.rpi.edu](http://www.lrc.rpi.edu)

## HOW WE TESTED

In absence of specific Indian standard, test program has been adopted from IEC: 60081 – 2005 for T5 Tubular Fluorescent Lamps for General Lighting Service). Test method was followed as per IEC 60081 -2005 along with general guidelines from IS: 2418 Pt. II for Tubular Fluorescent Lamps and IEC 60929 for Electronic Ballasts.

## MANUFACTURER RESPONSE

As per our policy, before publishing, test results were shared with their manufacturers and invited their comments. Crompton Greaves has confirmed that they had discontinued the low power factor ballast to HPF >0.90 and Harmonic Distortion is within the specified limits.

## COMPARATIVE PERFORMANCE SCORE OF FLUORESCENT LAMPS - T 5 & BALLASTS (28 WATTS)

Parameters ↓	Brand →	% weightage	Osram	Philips	Surya	BAJAJ	Compact	Crompton Greaves	Cema	Wipro	Havells	Oreva
<b>T 5 Lamp -28 W</b>												
Retail Price/MRP, Rs.			80/105	85/110	80/95	80/120	80/105	80/120	80/100	80/120	80/95	75/75
1. Starting Characteristics		4	4	4	4	4	4	4	4	4	4	4
2. Electrical characteristics		10	9.63	9.50	9.70	9.83	9.99	9.05	9.81	9.39	9.60	9.65
3. Initial Luminous Flux		20	19.44	19.12	18.07	16.49	12.59	17.62	15.5	17.72	15.97	13.09
4. Chromaticity coordinates (color)		6	5.75	3.90	4.85	5.00	4.25	4.05	5.4	3.15	4.10	4.65
5. Lumen Maintenance		25	22.59	23.51	23.16	22.24	22.08	22.28	21.59	21.58	20.04	22.49
6. Packing, marking & dimensions		5	4.50	4.30	4.30	4.30	4.10	4.30	4.10	4.30	4.30	3.30
<b>Total Score for Lamp</b>		<b>70</b>	<b>65.9</b>	<b>64.3</b>	<b>64.1</b>	<b>61.7</b>	<b>57.0</b>	<b>61.3</b>	<b>60.4</b>	<b>60.1</b>	<b>58.0</b>	<b>57.2</b>
<b>Ballast -28W</b>												
Retail Price/MRP Rs.			450/580	400/400	391/400	400/540	350/430	400/600	430/500	450/700	600/620	352/415
1. Operating conditions		4	3.13	3.51	3.03	3.28	3.13	3.66	3.71	3.38	3.74	3.04
2. Circuit power factor		4	3.92	3.92	3.36	3.84	3.80	2.20	2.22	2.14	2.69	2.20
3. Harmonic current		8	7.51	7.04	4.97	5.72	7.15	2.88	2.91	2.81	3.08	2.76
4. Operational tests for abnormal conditions		2	2	2	2	1.2	2	2	2	2	2	2
5. Watt Loss		5	3.18	4.19	4.39	5.0	4.51	4.73	4.76	4.08	4.82	3.62
6. General and regular tests #		7	5.98	5.37	5.68	6.33	5.29	5.61	4.75	5.71	4.95	5.48
<b>Total Score for Ballast</b>		<b>30</b>	<b>25.7</b>	<b>26.0</b>	<b>23.4</b>	<b>25.4</b>	<b>25.9</b>	<b>21.1</b>	<b>20.4</b>	<b>20.1</b>	<b>21.3</b>	<b>19.1</b>
<b>OVERALL SCORE (Lamp+Ballast)</b>		<b>100</b>	<b>91.6</b>	<b>90.4</b>	<b>87.5</b>	<b>87.2</b>	<b>82.9</b>	<b>82.4</b>	<b>80.8</b>	<b>80.3</b>	<b>79.3</b>	<b>76.3</b>

# General and regular tests includes packing, marking, maximum current, supply current and operating current waveforms.

Rating: >90 – Very good, 71-90- Good , 51-70- Average, 31-50- Poor, below 30 – Very Poor

# MERCURY DECODED



**I**n Mercury-Lamps (FLUORESCENT, COMPACT FLUORESCENT, MERCURY VAPOR, SODIUM VAPOR AND METAL MULTI-VAPORS AND MIXED) mercury is used as vital component. Mercury percentage in these lamps varies depending on the manufacturer, the type of lamp and the manufacturing year. At the time when these lamps start to decline, they generate a hazardous release of mercury, which should be disposed properly. There has been considerable increase in the popularity of these lamps because they are energy saving and using less electricity than their traditional counterparts, but the disposability has become a question of concern.

The Indian authority into environment has constituted a task force to bring in a policy on waste management of mercury and other hazardous elements in the consumer items. Although there are some guidelines presently being supposedly followed.

### AN INTRO TO MERCURY...

Also called Quicksilver for its shining white appearance like silver, Mercury is the only metal which takes liquid form at an ambient temperature. Generally found as bright red crystalline solid cinnabar (HgS), Mercury is an odorless liquid metal that sinks in water and is counted as a heavy metal. It takes a solid shape at 39 degree Celsius and can be cut with the help of knife; mercury is mobile and ductile at different temperatures. The atom of mercury is capable of disabling enzymes and live elements in human body and hence mercury can cause potential damage to the bio-chemical balance of the human physical system.

If compared to its traditional counterpart the incandescent bulb a fluorescent light tube of 40 watts emits 2,150 lumens where an incandescent bulb with same watts emits only 455 lumens. Added to that, fluorescent tubes last longer and are far behind at creating heat as compared to incandescent bulb or lamp. The latest version in fluorescent tube include T8 and T5 with tri-band phosphor and are extremely good at saving the power consumption.

### ROLE OF MERCURY IN FLUORESCENT LAMPS

A Fluorescent lighting system consists of two or three main components: The fluorescent lamp, The Ballast, and the Starter system. The basic concept

behind a fluorescent lamp is that a flow of electrical current occurs between two metal conductors placed in a glass tube, a process also known as arcing.

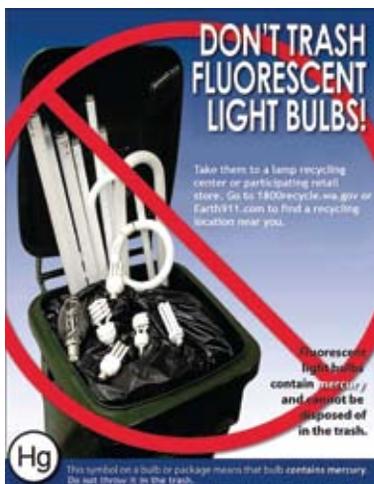


### CONSUMERS

At consumer level, the discarded lamps are collected by the kabari and collectively handed over to the glass recyclers for the recovery of glass material, in a highly unorganized sector. The used lamps are also often thrown in the garbage bins or garbage dumpsites, contaminating air, water and soil, because a portion of the mercury, in vapor form, is released into the air from the lamps broken during transportation. The rest of the mercury is released onto the soil with further possibility of getting into the surface and/or ground water bodies through the soil.

### INTERNATIONAL STANDARDS OF TREATMENT AND DISPOSAL OF FLUORESCENT LAMPS...

Collection, handling, transportation, treatment and disposal of mercury lamps in most of the western world follow the guidelines of WEEE (WASTE ELECTRICAL & ELECTRONICS EQUIPMENTS) based on the directives of the concept of Extended Producers' responsibility. There is a market oriented system and the consumer has to pay for the collection, treatment, and disposal with the



help of the concerned authorities. Most of the civilized countries have developed a legal system to handle the whole issue of the disposal of the mercury lamps, such as WEEE Directive in the EU and Universal Waste Rules in the USA.

## MERCURY ON HUMAN BODY...

Highly toxic and related with the hazardous effects on human body MERCURY includes irreversible damage to human nervous system. The following factors of mercury exposure are important:

### Inhalation:

Mercury vapor is highly toxic when inhaled and can cause severe respiratory problems, symptoms of toxicity may occur as sore throat, coughing, pain, uneasiness in chest, difficulty in breathing, headache, muscle weakness, anorexia, gastrointestinal disturbance, fever, and bronchitis etc.

### Ingestion:

Ingestion (through mouth) of mercury may cause burning of the mouth and pharynx, vomiting, abdominal pain, corrosive ulceration, bloody diarrhea. Ingestion may be followed by a rapid and weak pulse, shallow breathing, paleness, exhaustion, tremors and giddiness.

### Skin Contact:

Contact of Mercury with skin causes irritation and a burning sensation to skin. Symptoms include redness and pain. It may cause skin allergy and sensitization. Mercury can be absorbed through the skin with symptoms parallel to ingestion.

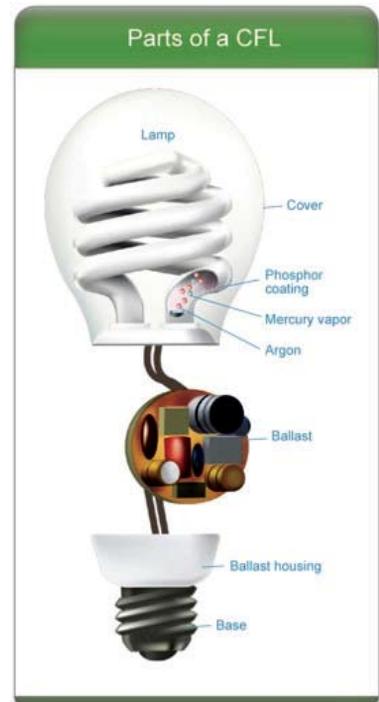
### Eye Contact:

Contact of Mercury with eye causes irritation and burns. Symptoms include redness, pain, and blurred vision with rest of the symptoms discussed earlier in the article. Serious and permanent eye damage, also can take place depending upon amount of exposure.

## HANDLING AND DISPOSAL

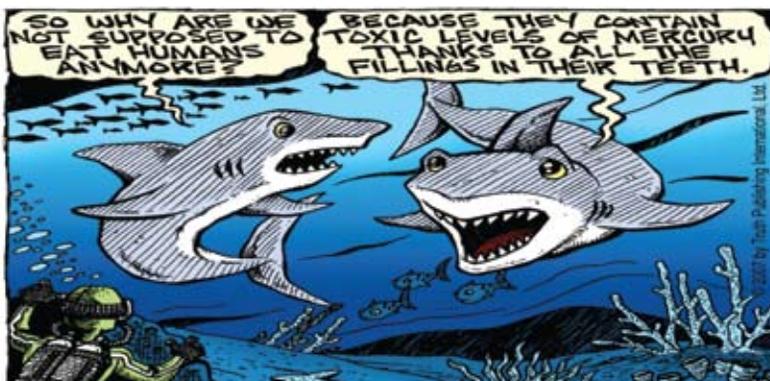
Handling of Used/Broken Fluorescent Lamps (FLs) is a subject of concern and few points are being given here for consumers to handle and dispose the used lamps as described below:

1. The user must not throw used lamp in general the dust bin, instead give to the junk collector (kabari) making a proper packet of the lamp or to a recycling agency meant for disposal of used FLs.
2. A care full handling by repacking the used lamps in the same boxes the lamps were bought and brought in.
3. In case of broken lamps too it should be handed over to a



recycling agency safely so that it can be disposed and recycled by the experts.

4. In case of a break open windows and leave the room for at least fifteen minutes and please don't allow anybody to enter the room. If there is an exhaust fan use it.
5. Clean the area without using vacuum cleaner and use rubber gloves instead of using your bare hands.
6. Using sticky tape or duct tape could be a good idea to pick up small pieces and powder of mercury.
7. Place the clean-up material in a plastic bag and without fail seal it's mouth and place it in yet another plastic bag and dispose it according to the above said measures, wash your hands after the whole operation.



Footnote: FLUORESCENT LAMPS (FLS), INCLUDING FLUORESCENT TUBE LIGHT (FTL) AND COMPACT FLUORESCENT LAMP (CFL)

**CENTRAL POLLUTION CONTROL BOARD**

(MINISTRY OF ENVIRONMENT & FORESTS)