

# Troubleshooting & Maintenance for Linear Fluorescent Lighting

## Suggestions for Fluorescent Fixture Maintenance

Preventing a problem from occurring is always more desirable and economical than fixing it later. A scheduled program of preventive maintenance can save money while maintaining productivity and safety.

By using the following maintenance suggestions, the ballast will have a longer, more trouble-free life. There are many lighting maintenance contractors and electrical contractors who will economically perform a scheduled maintenance program.

To obtain normal ballast life and maximum efficiency from a fluorescent lighting installation, fixtures should be periodically inspected for:

- Lamps cycling on and off
- Heavy lamp discoloration
- Dim lamps
- Slow-starting lamps
- Inoperative lamps
- Dust and dirt

The significance and correction of these conditions can vary with the type of lamp and ballast used, and are covered in greater detail later in this guide. The following general maintenance procedures apply to all lamp and ballast types and will help ensure maximum performance and long component life:

- Lamps should be replaced when they reach 70%-80% of their rated life. Your lamp supplier has additional information available regarding lamp maintenance procedures.
- Lamps, reflectors, and lenses should be cleaned periodically as an accumulation of dirt, combined with high humidity conditions, can impede starting.
- Lamps should be checked to be sure the proper lamp type is being used, according to the information on the label of the installed ballast. Many lamp types currently offered are interchangeable physically, but not electrically, such as T8 and T12 rapid start lamps.
- Line voltage should be checked at the fixture and compared with the ballast rating to be sure it is within the prescribed limits.
- Lamps cycling on and off may be a warning that the ballast is operating too high a temperature, causing the automatic resetting thermal protector to deactivate the ballast when the temperature limit is exceeded. Detailed information and corrective action can be found elsewhere in this guide.
- Make sure that lamp socket spacing and mounting distance from grounded fixture or metal strip are correct and lamps are properly seated. **(See Appendix C)**
- Make certain polarity is correct. **(See Appendix D)**
- Be sure the fixture and ballast(s) are properly grounded. **(See Appendix E)**

## Safety First

Ballast replacement and lighting maintenance present the possibility of exposure to potentially hazardous voltages and should be performed only by qualified personnel. All installation, inspection, and maintenance should be performed only with the entire circuit power to fixture or equipment turned off.

All ballasts and fixtures must be installed and operated in compliance with the National Electrical code, requirements of Underwriters Laboratories, Inc., and all applicable codes and regulations. This includes, but is not limited to, proper grounding of ballasts and fixtures as well as prescribed branch and total circuit protections.

## Troubleshooting

This concise guide provides a logical sequence and procedures for troubleshooting and correcting the most commonly encountered problems in a typical fluorescent lighting system. There are many specialized ballasts, lamps, fixtures and lighting controls which are not specifically addressed. The troubleshooter should always check for special conditions which might exist in an installation, creating an exception to the rules or a potential safety hazard.

Proper maintenance of any lighting system is essential to maintain levels of illumination necessary for productivity, merchandising, visual comfort, safety and security. If an individual component fails and is allowed to remain in the lighting system, costly damage to other components can result. Major repairs can often be avoided by simple maintenance procedures and timely attention to small problems, such as replacing burned-out lamps.

## CAUTION!

Any electrical system presents potential hazards. Troubleshooting or maintenance procedures should only be performed by qualified personnel. Ballasts and other components, as well as the fixture, must be grounded. All components must be installed and operated in compliance with the National electrical code and all local electrical ordinances.

## Protect the Ballast

A ballast, like any electrical device, generates heat. To ensure maximum ballast life, it is imperative that operating temperatures be kept as low as possible. Burned-out or failing lamps, or high temperatures in or around the fixture, can cause the ballast to overheat, resulting in premature failure. For additional information regarding heat and recommendations for maximizing ballast life and performance, consult Universal Lighting Technologies' catalogs.

Most fluorescent ballasts incorporate internal automatic-resetting thermal protection, which deactivates the ballast should it overheat. Normal operation resumes once the ballast has cooled sufficiently. Cycling will continue until the cause of overheating is corrected.

Ballasts manufactured before 1984 may contain non-resetting thermal protection, which permanently deactivates the ballast, or no thermal protection at all.

## For Additional Assistance

If additional troubleshooting assistance is required, or you have any questions regarding your lighting system, we're ready to help! **Call Universal Lighting Technologies' Technical Engineering Service™ Department at 1-800-225-5278.**

## CHART 1

### All Lamps in Fixture Are Inoperative

Is there power to the fixture?	<b>NO</b>	Correct external cause and check for normal operation.
<b>YES</b>		
Are in-line fuses or other devices such as starters, sensors, or photocells at fault?	<b>YES</b>	Replace faulty components and check for normal operation.
<b>NO</b>		
Is the ballast(s) operating properly? (See Appendix A)	<b>NO</b>	Replace faulty ballast(s). Normal operation should resume.
<b>YES</b>		
Are ambient conditions impeding performance? (See Appendix B)	<b>YES</b>	Install properly rated ballasts or lamps, or correct abnormal operating conditions.
<b>NO</b>		
Are lamps or sockets at fault? (see Appendix C)	<b>YES</b>	Replace faulty components and check for normal operation.
<b>NO</b>		
<b>OTHER POSSIBLE CAUSES:</b>		
Line voltage? (Appendix D)		
Improper grounding? (Appendix E)		
Incompatible components?		

## CHART 2

### Some Lamps in Fixture Are Inoperative

Have lamps failed under normal conditions?	<b>YES</b>	Replace failed lamps and check for normal operation.
<b>NO</b>		
Are abnormal lamp or socket conditions at fault? (See Appendix C)	<b>YES</b>	Correct abnormal conditions or components and check for normal operation.
<b>NO</b>		
Is the ballast(s) operating properly? (See Appendix A)	<b>NO</b>	Replace faulty ballast(s). Normal operation should resume.

## CHART 3

### Lamps Start Slowly, Flicker Excessively, or Fail Prematurely

Are lamps or sockets at fault? (See Appendix C)	<b>YES</b>	Replace faulty components or make necessary repairs and check for normal operation.
<b>NO</b>		
Are ambient conditions impeding performance? (See Appendix B)	<b>YES</b>	Install properly rated ballasts or lamps, or correct abnormal operating conditions.
<b>NO</b>		
Are line voltage and polarity correct? (See Appendix D)	<b>NO</b>	Correct supply voltage to within specified tolerance or correct polarity.
<b>YES</b>		
Are fixture and components properly grounded? (See appendix E)	<b>NO</b>	Correct grounding problem. If necessary, add grounded metal strip starting aid.
<b>YES</b>		
<b>OTHER POSSIBLE CAUSES:</b>		
Faulty ballast? (See Appendix A)		
Incompatible components?		

## CHART 4

### Lamps Are Cycling (turning on and off at intervals)

Is the air Temperature in and around the fixture too warm? (See Appendix B)	<b>YES</b>	Correct abnormal operating conditions and check for normal operation.
<b>NO</b>		
Is ballast overheating due to another external cause? (See Appendix F)	<b>YES</b>	Correct abnormal conditions or components and check for normal operation.
<b>NO</b>		
Is the ballast(s) at end-of-life? (See Appendix A)	<b>YES</b>	Replace faulty ballast(s). Normal operation should resume.
<b>NO</b>		
<b>IF PROBLEM PERSISTS, REVIEW MAINTENANCE SECTION FOR OTHER SUGGESTIONS.</b>		

## CHART 5

### Excessive Noise

Is the ballast securely mounted? Are any fixture components loose?	<b>YES</b>	Tighten loose components. Make sure all ballast mounting holes are used.
<b>NO</b>		
Are the ballasts properly sound rated? (Appendix G)	<b>YES</b>	Install ballasts of the proper sound rating or remotely mount the ballasts.
<b>YES</b>		
Is the ballast(s) operating properly? (See Appendix A)	<b>NO</b>	Replace faulty ballast(s). Normal operation should resume.

## CHART 6 Interference (See Appendix H)

Is a radio or antenna too close to the lamp?	<b>YES</b>	Radio and antenna must be 4 to 10 feet from lamps depending on lamp type.
<b>NO</b>		
Is interference due to power line feedback from lamps to the radio or equipment?	<b>YES</b>	Correct condition by use of radio interference filters.
<b>NO</b>		
<b>IF PROBLEM PERSISTS, CONSULT EQUIPMENT MANUFACTURER FOR ADDITIONAL RECOMMENDATION.</b>		

## Rapid Start Ballasts

Rapid start ballasts supply a controlled low voltage (filament voltage) which heats the lamp cathodes sufficiently for the starting voltage to initiate an arc. If the filament voltage is low, the lamps may not start.

The filament voltages for the most typically encountered rapid start ballasts are:

- F30T12/RS – 3.5 to 4 volts
- 800ma – 3.5 to 4.3 volts
- F40T12/RS – 3.5 to 4 volts
- 1500ma – 3.5 to 4.3 volts

## Cathode Cut-Out (Hybrid) Rapid Start Ballasts

To perform the tests outlined above on (2) lamp hybrid ballasts, one lamp must be in place while the other sockets are tested. Remove only one lamp at a time.

## Electronic Ballasts for Rapid Start Lamps

Because of the special operating characteristics of many electronic ballasts, such as high-frequency operation, parallel circuitry and instant starting, field testing can be difficult and procedures varied. Eliminate other possible causes and replace the ballast if necessary.

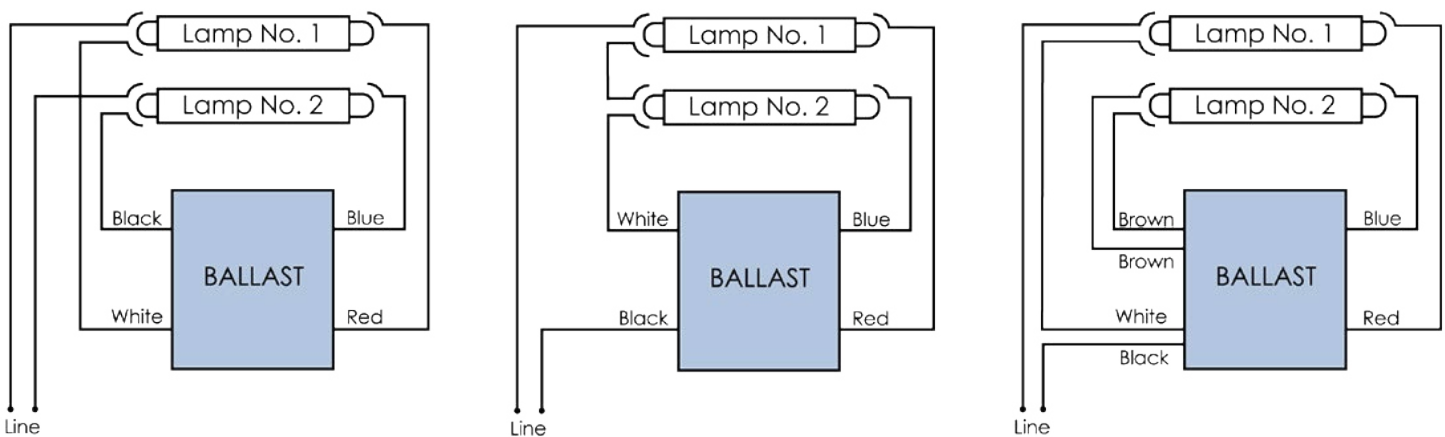
A circuit tester can be used to determine whether the ballast is functional.

## Instant Start (Slimline) Ballast

Because of wiring variations between ballast manufacturers, and the availability of Series and Lead-Lag ballast circuits, miswiring is the most frequently encountered cause of Slimline system problems. Check the manufacturer's catalog or the ballast label for the correct wiring diagram.

Typical variations in Slimline wiring.

Check the ballast label!



## DANGER!

*CHECKING THE STARTING VOLTAGE OF A SLIMLINE BALLAST SHOULD ONLY BE PERFORMED BY A LICENSED ELECTRICIAN.*

The starting voltage is measured across the primary and secondary leads to the sockets, using a high resistance voltmeter with a range of zero to 1000 volts.

## Minimum Starting Voltage

- F72T12 – 475 volts
- F96T12 – 565 volts

For other applications and additional information, consult Universal Lighting Technologies' Technical Engineering Service Department.

The open circuit voltage of a Slimline ballast is often sufficient to strike an arc even if only one lamp cathode is operational. This will overheat the ballast and adversely affect its service life. End-of-life or burned-out lamps left in the fixture will also place abnormal stress on the Slimline ballast. Universal ballasts incorporate internal protection which minimizes the adverse effects of lamp problems on the ballast. visual comfort, safety and security. If an individual component fails and is allowed to remain in the lighting system, costly damage to other components can result. Major repairs can often be avoided by simple maintenance procedures and timely attention to small problems, such as replacing burned-out lamps.

## End of Service Life

A ballast will perform its designed function for many thousands of hours until insulation on the coil windings break down, or an internal component, such as the capacitor, fails. Following the troubleshooting charts will determine the root cause of a problem and help avoid unnecessary and costly ballast replacement.

OTHER SIGNS OF END-OF-LIFE BALLASTS INCLUDE:

- Excessive noise
- Leaking of potting compound
- Nuisance trip-outs (See Chart 4 – “Cycling”)



# Appendix B: Ambient Temperature and Atmospheric Conditions

### Temperature

Most fluorescent ballasts are designed for optimum performance (starting dependability and light output) at an ambient temperature of 70° F to 80° F, which in still air will provide a lamp wall temperature of 100° F to 120° F. Any variation will affect performance as noted in the following sections.

#### Low Ambient Temperature

All ballasts have a limitation as to their ability to start lamps at low temperature. Always check the ballast and lamp manufacturers' recommended "minimum starting temperature" if low ambient temperature is a suspected problem.

Low ambient temperature is not the sole factor in determining poor starting conditions. Voltage, humidity, drafts, polarity, dirt and spacing between lamps and starting aid may also influence starting dependability.

Universal Lighting Technologies produces a number of ballasts which provide reliable starting down to -20° F.

Drafts and moving cold air may cause the lamp to flicker. To correct problems caused by cold and drafts, the use of enclosed fixtures is recommended. This allows heat generated by the lamps and ballasts to be retained within the fixture, raising the bulb wall temperature to a level which will maintain proper light output. Bear in mind that excessive lamp shielding may also cause lamp and ballast overheating in the summertime.

#### Moisture

Many fluorescent lamp ballasts are designed for use only in dry environments, protected from moisture and weather. If ballasts are to be used under circumstances exposing them directly to weather, moisture or other atmospheric conditions, special fixtures or ballasts designed for such environments must be used.

All Universal Lighting Technologies encased fluorescent lamp ballasts meet UL TYPE 1 requirements and can be used in outdoor fixtures or in fixtures for wet or damp locations.

Moisture or humidity, combined with dirty lamps, can cause hard starting. Keeping the fixture and lamps clean will alleviate most moisture-related problems.

#### High Ambient Temperature

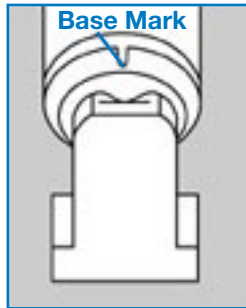
To meet the requirements of Underwriters Laboratories, Inc., and assure maximum service life, the fixture and application must be designed to prevent any part of the ballast case from exceeding 90° C. Operation above this limit will shorten ballast life, can possibly damage adjacent materials or thermally protected ballasts, and cause cycling (on and off) of the lamps.

For additional information regarding heat, its effect on ballasts and possible solutions to high temperature related problems, refer to **Appendix F**.

# Appendix C: Possible Lamp and Socket Problems

## Lamp Seating in Socket

- Check for proper rotation and fit of the lamps in the sockets. The lamps must be properly seated in the sockets, with spacing between the socket and lamp small enough to assure proper contact but free enough to prevent binding.
- Check for loose or broken sockets and dirty socket contacts.
- Make any mechanical adjustments or corrections required, as noted during inspection.



This lamp is seated properly in the socket, with the mark on the base aligned with the center of the socket.



This lamp is hanging on one pin, obviously not seated properly.



This lamp is not rotated properly in the socket, which is indicated by the base mark being off-center from the socket.

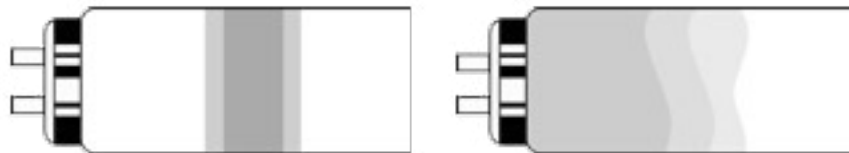
## Visual Inspection of Rapid Start Lamps

Rapid Start lamps have filaments or cathodes which must be continuously heated by the ballast. Although lamps may start if the filaments are not properly heated, excessive end-blackening of the lamp and shorter lamp life will result.

To help pinpoint the trouble in malfunctioning Rapid Start fixtures, we suggest the following procedure using Universal Lighting Technologies Circuit Testers.

## Rapid Start Lamps

- Check for blackened ends on lamp. This may be caused by improper lamp filament heating which, if not corrected, will continue to destroy lamps.



## Bi-pin for 30- or 40-watt Lamps

- End banding may occur gradually during normal lamp life.
- Excessive end-blackening could be caused by insufficient cathode heating, which will result in shortened lamp life.



### Recessed Bi-pin for 800ma or 1500ma Lamps

- 1500ma lamps may discolor at end of lamps during operation. This is normal for this type of lamp.
- Caution: 1500ma T12 and 800ma lamps are the same size. Be sure to use the correct lamp/ballast combination.

### Visual Inspection of Slimline Lamps

For fixtures using Slimline lamps, this additional procedure should be followed:

- Heavy lamp-end discoloration indicates approaching end of life, necessitating immediate lamp replacement.
- Inoperative lamps should be replaced by known good lamps.
- If the good lamp does not operate, check sockets, wiring, line voltage, polarity and grounding.
- When the previous items appear to be correct and the lamp still does not operate properly, it may be assumed that the ballast is inoperative and should be replaced.
- Inoperative Slimline lamps should not be left in a fixture, as the ballast will overheat and burn out prematurely.

### Slimline Lamps

- End-banding develops gradually during normal lamp life.



- End-banding develops gradually during normal lamp life.



### Lamp Circuits

When troubleshooting, remember that ALL lamps in a series circuit will extinguish if one lamp should fail. Universal Lighting Technologies' TRIAD electronic ballasts are available in parallel versions, which allow companion lamps to remain fully lighted if one lamp should fail. Consult electronic linear fluorescent literature for additional information.

If one lamp of a series circuit fails and the others remain lighted, it could indicate an internal short in the ballast. Consult Appendix A for ballast tests.

### Component Substitution

Never use a ballast or lamp for other than its recommended application. Although many lamp types and ballast designs are physically interchangeable, their electrical characteristics and requirements are totally different. Always check the ballast label or manufacturers' specifications to assure component compatibility.

## Line Voltage Limits

To receive the full benefits of rated lamp output and to prolong ballast life, it is essential that voltage supplied to an installation be maintained within limits prescribed for each circuit. These limits are listed below.

Nominal Voltage	Voltage Range	
	Minimum	Maximum
120	110	125
220	205	232
240	225	250
277	255	290
347	315	364
480	450	505
600	570	630

Subjecting a ballast to excessive voltage for an extended period of time results in deterioration of the insulation. This insulation breakdown will cause early ballast failure.

Low voltage has no damaging effect on the ballast. However, lamps may not start with desired reliability and early lamp failure could result.

## Polarity

Polarity refers to the proper connection of ballast lead wires to line wires. To aid you in making a correct installation, Universal Lighting Technologies ballast leads are color-coded for easy identification. The white ballast lead is to be connected to the neutral (grounded) and the black lead always to the phase (“hot”) line wire. For systems with neither of the line wires at ground potential, specially designed ballasts are required. A change in polarity may result in the voltage from lead to ground exceeding limits specified by Underwriters Laboratories, Inc. In some types of ballasts, a change in polarity may decrease voltage from lead to ground, thereby impeding the starting dependability of the ballast.

## Power Factor

Power factor expresses how efficiently the lighting system utilizes electric current. It is the ratio of input watts to the input volt amperes. High power factor ballasts are those with a minimum power factor of 90% or greater. Low power factor ballasts generally draw twice the current of a high power factor ballast designed for the same application. Many utility companies charge a penalty should the power factor of an installation fall below a prescribed level.

$$\% \text{ Power Factor} = \frac{\text{Input Watts}}{\text{Line Current} \times \text{Line Voltage}} \times 100$$

Ballast cases and fixtures must always be grounded. The ballast case may be grounded to the fixture or otherwise connected to ground. It would be hazardous to make contact with an ungrounded fixture or ballast when in operation. Neglecting to properly ground the ballast and fixture may result in the failure of certain lamps to start.

If improper grounding is suspected, check for poor contact due to excessive paint on the fixture, loose mounting of the ballast or surface rust, which may be impeding electrical contact.

### Visual Inspection of Slimline Lamps

For fixtures using Slimline lamps, this additional procedure should be followed:

- T12 Rapid Star: 1/2 ”
- T12 Slimline, 800ma or 1500ma Rapid Start: 1”
- T8 Rapid Start: 3/4 ”
- T8 Slimline: 1-1/4 ”

A fluorescent lamp ballast, like any other electrical device, generates heat during its normal operation. With proper planning for the maximum dissipation of this heat in both fixture design and installation layout, a problem need not arise.

It is imperative that operating temperatures be kept as low as possible. Although excessive temperature may not cause the ballast to burn out immediately, it will definitely shorten ballast life.

According to the Underwriters Laboratories, Inc. requirements, the ballast case temperature should not exceed 90° C and the coil temperature should not exceed 105° C. However, the correlation between coil temperature and ballast case temperature will vary with ballast type and design. It is desirable to minimize the differential between case and coil temperatures to considerably less than 15° C – the lower the coil temperature, the longer the ballast life.

The causes of ballast overheating are many and varied:

### Misapplication

- Incorrect lamp size or type
- Incorrect number of lamps
- Incorrect primary voltage or frequency
- Incorrect fixture

### Fixture Design

- Improper design, resulting in inadequate dissipation of heat from ballast and lamp

### Abnormal Conditions

- Incorrect lamp size or type
- Incorrect number of lamps
- Incorrect primary voltage or frequency
- Incorrect fixture

### Other

- Incorrect wiring
- Excessive line voltage fluctuation
- Fixture surrounded by heavy insulation
- Ceiling of low heat conductivity

To prevent damage to the ballast and fixture from overheating and to maintain proper light output, simple precautionary measures can be taken to assure long, trouble-free ballast life.

### Universal Lighting Technologies' Engineering Staff Recommends:

- Selection of a proper ballast to match the requirements of the lamp, fixture, voltage and installation.
- Mounting of a ballast within the fixture with as much surface contact as possible between the ballast and metal portions of the fixture.
- The use of heat-conducting dissipators, if necessary, which increase surface contact or otherwise increase heat conductivity between the ballast case and metal portions of the fixture which are cooler than the ballast.
- Designing the fixture to attain maximum dissipation of heat by conduction, convection or radiation and, where necessary, allowing space between the fixture and a low-density ceiling.
- If necessary, remote location of the ballast in a cooler area outside the fixture.
- Planned lamp maintenance – the organized replacement of dead or burned-out lamps when used with preheat or Slimline ballasts.
- Use of special LOW HEAT rise, VERY LOW HEAT rise and SUPER LOW HEAT rise ballasts where available and necessary.

Lamps, too, are affected by overheating. A rise in bulb wall temperature beyond its rated operating point generally will result in reduced light output and shortened lamp life.

With the required use of Class P ballasts, it is imperative that all fixtures equipped with that specific ballast be heat-tested under simulated installation conditions.

### Sound

Care must be taken to select a ballast with the sound rating for a particular lighting installation. All electrical equipment produces some noise. This is also true of fluorescent lamp ballasts. It is the degree of noise or hum which determines the existence of a problem. Ballast sound will be noticeable only when it exceeds the ambient sound level. It is obvious that a ballast made primarily for use in a factory location would not be suitable in a library.

- The presence of objectionable ballast hum depends upon various factors:
- The ambient sound level of the area to be lighted
- The selection of properly sound-rated ballasts
- Fixture design and construction
- Method of mounting ballast to fixture
- Type and purpose of room
- Acoustics of room
- Number of ballasts in a given area
- Excessive ballast operating temperatures

Careful analysis of all influences bearing on sound within an area to be lighted will enable you to select the proper ballast to eliminate objectionable ballast noise. Just as Universal Lighting Technologies ballasts are produced to meet various electrical requirements, so are they made to fit particular sound needs (see "Sound Rating" chart below).

In situations where required light output necessitates using a ballast with a sound rating not normally acceptable, the ballast should be remotely located.

### Sound Rating

A- For installations such as private offices, recording studios, study halls, libraries, etc. (where the ambient sound level is 20 to 24 decibels)

B- For offices, residential use, etc. (where the ambient sound level is 25 to 30 decibels)

C- For large office areas, commercial use, stores, etc. (where the ambient sound level is 31 to 36 decibels)

D- For manufacturing facilities, large stores, offices with much equipment in use (where the ambient sound level is 37 to 42 decibels)

### Radio Interference

A fluorescent lamp, an arc discharge device, creates radio waves which may interfere with radio reception by direct radiation or by feedback through the power line if the radio and lamps are on the same circuit.

Since the radiated signal is extremely weak, this problem can be remedied by simply moving the radio a short distance (10 feet) from the light source.

If the interference is caused by feedback in the power line, a noise suppression filter will generally eliminate the problem. If the problem persists, separate branch circuits may be required for the radio equipment and lighting fixtures.

To meet FCC regulations, the radio interference filter is now built into the ballast.



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