General Information
- Glossary of Terms -

ANSI
American National Standards Institute. It establishes the performance standards for ballasts, lamps and testing methods which are accepted by the lighting industry.

- **ANSI Standard C82.1** provides parameters for electromagnetic ballasts.
- **ANSI Standard C82.11** provides parameters for electronic ballasts.

A specific standard for the method of measurement of the fluorescent lamp ballast including a means of determining the relative light output of the ballast. This is a bench top test conducted at room temperature 77°F (25°C) with the ballast and lamps exposed to open air. The lamp bulb wall temperature will be approximately 100°F (37.8°C). Under these conditions, the spot brightness of the lamp(s) is measured on both the ballast under test and a reference ballast made to specific industry standards. The light reading with the test ballast is expressed as a percentage of the reading with the reference ballast and is termed relative light output.

Ballast
A power regulating device used with an electric discharge lamp to obtain the necessary circuit conditions (voltage, current and wave form) for starting and operating.

Electromagnetic Ballast
A ballast that uses a “Core & Coil” assembly to transform electrical current for starting and operating fluorescent lamps.

Electronic Ballast
(a.k.a.: High Frequency or Solid State Ballast) Operates lamps at frequencies above 20 kHz. Typically, more energy efficient and quieter than electromagnetic ballasts.

Hybrid Ballast
A ballast that incorporates an electronic circuit to eliminate power to the lamp filaments after is started, but operates the lamps at 60 Hz.

Magnetic Ballast
See Electromagnetic Ballast above.

Ballast Factor (BF)
The ratio of the light output from a reference lamp run by the ballast under test to the light output from the same reference lamp run by an ANSI specified reactor.

Ballast Losses
Power supplied to the ballast but not transformed into energy used by the lamp. This lost energy is converted to heat.

Ballast Efficacy Factor (BEF)
A measure of relative light output per watt consumed by a given lighting system (ballast factor divided by input wattage).

CBM
Certified Ballast Manufacturers Association. A group of ballast manufacturers who accept the ANSI specifications and design their ballasts to meet these standards. Certification programm indicating a ballast has been tested by ETL to meet ANSI specifications (logo appears on applicable models).

CBM Certified by ETL
A ballast meeting the ANSI standards as certified by ETL may bear the CBM/ETL label. ETL conducts an unannounced follow-up field testing program to assure the continuing conformance of the ballast manufacturers.

ETL
Electrical Testing Laboratories. A nationally recognized independent laboratory that tests ballasts for CBM and certifies that the ballasts meet ANSI standards.

EMI
(Electromagnetic Interference)
Electrical disruption (“noise”) created by certain types of equipment and may be conducted onto power lines or radiated through the air.

FCC
(Federal Communications Commissions)
Regulatory agency charged with developing and policing standards regarding all modes of telecommunication.

FCC Regulations
Legally enforceable U.S. government standards for EMI and RFI that must be met by high frequency electronic devices used in this country for Class A (industrial) or Class B (residential) applications.

Fluorescent Lamp
A phosphor-lined glass tube in which electric discharge of ultraviolet enegy excites the phosphor and transforms that energy into visible light.

Frequency
The rate of change in an alternating current, measured by cycles (positive and negative) per second or hertz (Hz).

Harmonic Distortion
Multiples of the fundamental frequency (60 Hz) that distort the line AC wave from excessive odd triplet harmonics (3fd, 9th...) causing large currents on the neutral line in a three phase system.

Third Harmonic
The component of a periodic wave having a frequency of three times the fundamental. In a 60 Hz wave, the third harmonic is 180 Hz, (3 x 60 Hz).

Total Harmonic Distortion (T.H.D.)
Magnitude of the total input current harmonics as compared with the amplitude of the fundamental line current, measuring in percent.

Hertz (Hz)
Unit used to measure frequency of alternation of current or voltage; 60 cycles per second = 60 Hz.

High Frequency Operation
Refers to the operation of lamps by electronic ballasts at frequencies above 20 kHz.

High Power Factor
A power factor of 90 percent or higher. Electric power companies may have a penalty charge if overall building factors fall below 90 percent.

Input Watts
The total power input to the ballast which includes lamp watts and ballast losses. The total power input to the fixture is the input watts to the ballast or ballasts and is the value to be used when calculating cost of energy and air conditioning loads.

Instant Start
Lamp are started by high voltage without preheating of the filaments.

Lamp Current Crest Factor (CF)
The peak lamp current divided by the RMS (average) lamp current. Lamp manufacturers require < 1.7 for best lamp life with most applications.

Lamp Diameters
The numbers refer to 1/8 inch (3.18mm) increments. T = Tubular, T5 = 5/8 inch (15.9mm) diameter, T8 = 8/8 inch or 1 inch (25.4mm) diameter, T12 = 12/8 inch or 1.5 inch (38.1mm) diameter.

Lamp Flicker
Rapid strobe-like effect occurring in many fluorescent lamps. It is virtually unrecognizable in lamps operated by an electronic ballast, because of the high frequency operation.

Parallel Lamp Connections
Multiple-output current paths from a single ballast to allow lamps to operate independent of one another. With parallel connections, lamps remain fully lit if any of the companion lamps fail.

Potting
Material used the completely surround and encapsulate componets of ballasts, providing thermal and structural integrity and protecting ballast against adverse environmental conditions.

Power Factor (PF)
The ratio of the real power (watts) to apparent power (volts x amps). 1.0 is an ideal power factor.

High Power Factor Ballast - A ballast that requires less line current than a low power factor ballast. A ballast in which the power factor is greater than .90.

Rapid Start
Lamps are started with a ballast that provides low-voltage for preheating the filaments then applies starting voltage and continues to apply filament voltage during operation.

RFI
(Radio Frequency Interference)
Electrical noise that is generated by various types of equipment and may be radiated through the air.

Series Lamp Connection
Only one current path passes through the lamps. If one lamp fails, the path is broken and all the lamps extinguish (at least partially). Design typical of electromagnetic and many electronic ballasts.

Watt
Unit of measurement for electrical power.

Energy Saving Ballasts

Energy saving ballasts use less power than standard ballasts. The full light output WATT REDUCER ballasts save energy due to their highly efficient design which drastically reduces internal losses so energy is not wasted in heating the ballast. This also results in cooler ballast operation providing at least double the average life of a standard ballast. There are also energy saving ballasts which operate lamps at reduced light output level resulting in an almost proportional savings in energy.

It can be difficult for the end-user to calculate the amount of energy saved because of the confusion of terms, trade names and different savings published by various ballast manufacturers. Although the ANSI method is an excellent test for comparing one ballast to another, it is not practical for determining ballast performance in actual fixtures under heat stabilized or normal operating conditions nor useful in calculating energy savings in installations. The most accurate method of ascertaining this information is to run comparison tests with the actual fixture to be used, under the installation's operating conditions with all of the combinations of ballasts and lamps being considered. Since many users are unable to conduct such tests themselves, they must rely on published test data supplied by the ballast and lamp manufacturers. Variation of test conditions can greatly affect the results. All test conditions must be the same in order to compare lamp/ballast/fixture systems.

Energy Saving Lamps

Energy saving lamps are designed to operate at reduced wattage. The original energy saving lamps had a proportionate reduction in light output. However, the second generation, known as "lite white" energy saving lamps, provide virtually the same light output as standard lamps while operating at its reduced wattage. These energy saving lamps consume only 34 watts when used in place of 40 watt standard Rapid Start lamps, 60 watts for 75 watt 96" (2438.4mm) standard Slimline lamps, 95 watts for the 112 watt 96" (2438.4mm) standard High Output Rapid Start lamps, or 185/195 watts for the 218 watt 96" (2438.4mm) standard Extra High Output Rapid Start lamp.

These lamps may be used only with those ballasts where the ballast label indicates UL listing for use with reduced wattage lamps.

Energy saving lamps should not be used below an ambient temperature of +60°F (15.6°C) nor can they be used in conjunction with reduced light output, dimming or low power factor ballasts.

Energy Saving Systems

The combination of the full light output energy saving WATT REDUCER ballast with any brand of energy saving lamp described above forms a system which provides a greater reduction in energy cost than either the ballast or lamp separately.

Specially designed, high efficiency ballasts are available to operate reduced wattage, high lumen T8 Rapid Start lamps. This ballast/lamp combination will result in a significant savings of lighting energy costs compared to their standard counterparts.

Internal Ballast Protection
- CLASS P -

Underwriters' Laboratories, Inc. promulgated standards in compliance with the National Electrical Code establishing a Class P ballast classification for fluorescent fixtures installed indoors.

A Class P ballast must employ internal thermal protection limiting its operating temperature so that the case temperature, except for certain specified short-term excursions, does not exceed 110°C in the event of a short-circuit in the windings or the power capacitor. The only exception to this ruling is a fixture employing a simple reactance type ballast.

The Class P Ballast is equipped with an automatic resetting thermal protector built-in adjacent to the transformer coils. The resetting thermal protector functions as a thermostat which will open and temporarily deactivate the ballast when it exceeds the permissible temperature. It will reset when the ballast cools to a safe operating temperature. The ballast will continue to recycle until the cause of overheating is eliminated. If the ballast is defective, it must be replaced. If the cause is external, the Class P ballast will resume normal operation after abnormal conditions are eliminated.

Although Class P ballasts are protected against excessive operating temperature, they are still subject to the normal parameters for ballast life. In proper application and for normal ballast life, the maximum coil temperature of the ballast should not exceed 105°C. A temperature increase of 10°C results in a 50% reduction of ballast life. This elevated temperature could occur without tripping the thermal protector.

The Class P ballasts are identified by the suffix "-TC-P" after the regular catalog number. Example: Cat. No. 202-B-TC-P (depends of manufacturer).

NOTE:

The National Electrical Code requires that where fluorescent fixtures are installed indoors, the ballast shall have thermal protection integral within the ballast except for simple reactance ballasts. This ruling applies to replacement ballasts as well as those contained within new luminaires. Underwriters' Laboratories, Inc. approved Class P ballasts comply with this requirement.

All high power factor ballasts are equipped with capacitors. Oil filled capacitors contain non-resetting internal protection and are manufactured without PCB's.

Low Leakage to Ground Ballasts

Special one and two lamp, 30 and 40 watt, high power factor Rapid Start ballasts and two and three lamp, 20 watt, Trigger Start ballasts are available to meet requirements for "low leakage current to ground". Please request for catalog numbers and availability.

Type 1 and Type 2 Ballasts

TYPE 1 - Non-weatherproof ballasts can be used in outdoor fixtures or in fixtures for wet and damp locations according to Underwriters' Laboratories, Inc. requirements. The ballast must be used within a metal enclosure. These ballasts are designed to meet Underwriters' Laboratories, Inc. requirements for outdoor Type 1 use. Type 1 ballasts are so indicated on the ballast label.

TYPE 2 - Non-weatherproof ballasts which are similar to Type 1 except that they may be used in a non-metallic enclosure. Type 2 ballasts are so indicated on the ballast label.

Operation and Care

Compliance with National Electrical Code and Underwriters' Laboratories, Inc. Requirements

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 protection.

Ballast Replacement

Ballast replacement presents 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.

Heat

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 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

ABNORMAL CONDITIONS
- shorted starter
- dead or burned out lamp
- rectifying lamp (nearing end of lamp life, blackened ends)
- excessive ambient heat

FIXTURE DESIGN
- improper design resulting in inadequate dissipation of heat from ballast and lamp

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.

The manufacturers 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 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 the specific ballasts to be used, should be heat tested under simulated installation conditions to assure that the ballasts will not cycle when the fixtures are installed.

Low Ambient Temperature (cold)

Most fluorescent ballasts and lamps are designed for optimum performance (starting dependability and light output) at an ambient temperature of 77°F (25°C).

STARTING DEPENDABILITY
All ballasts have a limitation as to their ability to start lamps at a low ambient temperature. We can offer a number of ballasts which will provide reliable starting down to -20°F (-28.9°C). Please request for catalog no's and availability.

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.

LIGHT OUTPUT
Although a ballast may start a lamp reliably in low temperatures, light output will be reduced until the lamp wall temperature reaches 100°F (37.8°C) to 120°F (48.9°C). This temperature will be reached when bare lamps are exposed to still air of 70°F (21.1°C) to 80°F (26.7°C). Drafts and moving cold air may cause the lamp to flicker. To avoid this problem, the use of enclosed fixtures is recommended. By so doing, heat generated by the lamp is confined within the enclosure raising the lamp temperature to a level which will maintain proper light output. Bear in mind that excessive lamp shielding may cause lamp and ballast overheating in the summertime.

BALLASTS SHOULD BE PROTECTED FROM WEATHER, MOISTURE OR OTHER ABNORMAL ATMOSPHERIC CONDITIONS AND SPECIAL APPLICATIONS SUCH AS FREEZER INSTALLATIONS BY FIXTURES DESIGNED TO MEET SPECIAL ADVERSE CONDITIONS.

Sound

Care must be taken to select a ballast with the proper 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 temperature

Careful analyses of all influences bearing on sound within an area to be illuminated will enable you to select the proper ballast to eliminate objectionable ballast noise. Just as the ballasts are produced to meet various electrical requirements, so are they made to fit particular sound needs. In situations where required light output necessitates using a ballast with a sound rating not normally acceptable, the ballast should be remotely located.

Polarity

Polarity refers to the proper connection of ballast lead wires to line wires. To aid you in making a correct installation, the Ballast leads are color-coded for easy identification. For example, the white ballast lead is to be connected to the neutral (grounded) and the black lead always to the phase (“hot”) line wire. For line 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.

Grounding

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 combination may also result in failure of certain lamps to start.

Operating 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:

NOMIINAL VOLTAGE	VOLTAGE RANGE MINIMUM	MAXIMUM
120	110	125
127	115	133
208	194	218
220	205	232
236	220	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 the 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.

Special Check Points for Rapid Start Ballasts

The following list of checks is intended to aid you in obtaining full rated performance from a Rapid Start installation:

- Be sure Rapid Start lamps are being used.
- Make certain the lamps are seated properly.
- Check socket spacing against length of lamp to assure proper contact.
- Check polarity,*
- Be sure the luminaire is grounded.*
- Lamps of forty watt (40 W) rating or less, except 265 mA, must be mounted within one-half inch (12.7mm) of a grounded metal reflector, cover of the ballast channel or grounded metal strip at least one inch (25.4mm) wide over the full length of the lamp. Spacing of three quarter inch (19.1mm) applies to 265 mA T8 lamps. Spacing of one inch (25.4mm) applies to 800 mA and 1500 mA lamps.
- Voltage on each lampholder measured across the two contact springs should be between 3.5 and 4.5 volts. This can be checked with a special filament circuit tester, available upon request.

*Check these points by using a voltmeter. It must indicate nearly full line voltage between the black ballast lead and metal fixture.

The above check list may also be used for Trigger Start ballasts with the exception that general lamps are used instead of Rapid Start Lamps.

Additional Suggestions for Proper Performance of Ballasts in Plastic Signs

- Sign ballasts should be mounted in the lower or cooler area of a sign or in any other location where the ballast would be least subject to heat from the lamps.
- To facilitate the dissipation of heat from a ballast by conduction, the mounting surface of a ballast should be in good contact with the coolest portion of a sign. At no time should the temperature on any point of the ballast casement exceed 90°C. A rise above this temperature will result in reduced ballast life.
- The ballast must be located away from any possible area of water accumulation within the sign.
- Where a ballast is mounted vertically, the lead wires exiting from the top of the ballast case should be looped to direct water that may run down the leads away from the ballast; thus avoiding the possibility of water entering the ballast through the lead openings.
- Don’t leave faulty lamps in a sign. This can cause the ballast to overheat and burn out prematurely.
- Be sure the white lead wire of the ballast is connected to the grounded (neutral) wire of the power line.
- As a lamp starting aid, all 800 mA and 1500 mA lamps must be mounted within one inch (25.4mm) of a grounded metal reflector, cover of the ballast channel or grounded metal strip at least one inch (25.4mm) wide over the full length of the lamp.