

TROUBLESHOOTING FLUORESCENT LAMP BALLASTS



ELECTRICAL TEST EQUIPMENT

Note: Voltage and current measurements present the possibility of exposure to hazardous voltages and should be performed only by qualified personnel.

The following equipment is recommended for testing fluorescent fixtures:

True RMS Voltmeter

Ranges: 0-300-1000 Volts AC

Ammeter (clamp-on type acceptable)

Ranges: 0-10 Amperes AC

Multi-meter (with voltage and current ratings as shown above)

Frequency: 60Hz for electromagnetic, above 20kHz for electronic

TROUBLESHOOTING FLUORESCENT APPLICATIONS

SAFETY FIRST: Troubleshooting procedures must take place within these guidelines:

- *Those working on the fixtures (and hence, in situations where they may be exposed to hazardous voltages) must be properly qualified to perform such work.*
- *Ballasts, starters, capacitors and fixtures must be grounded in accordance with the National Electrical Code® (NEC). In the case of fluorescent ballasts, the case must be grounded either to the fluorescent fixture or, if remote mounted, by other means such as a wire from ballast case to ground. Without proper fixture and ballast grounding, a shock hazard may exist due to the fluorescent fixture becoming energized by an internal ballast failure. In addition, all ballasts have normal leakage. When the ballast is properly grounded, the leakage current does not constitute a hazard.*

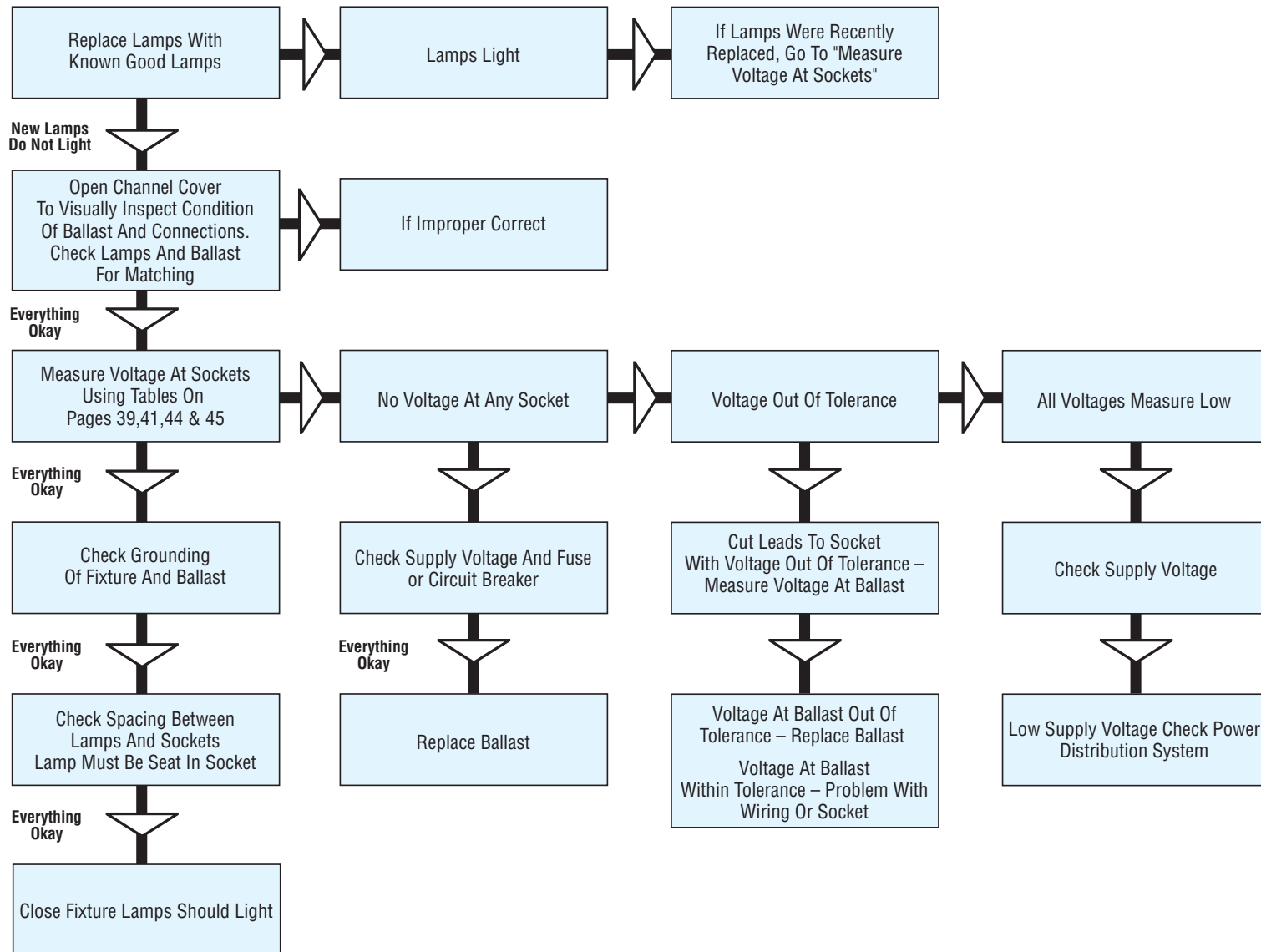
- *Any work performed on the lighting system, including inspection, troubleshooting and maintenance, should be done with the fixture properly de-energized and the circuit locked and tagged according to Occupational Safety and Health Act (OSHA) requirements.*

INOPERATIVE FIXTURE

Often when a fixture becomes inoperative, the cause is not attributable to the ballast. It is therefore important to examine all components of the fixture before removing the ballast for replacement. The following procedure is recommended:

1. *Change or check all lamps to ensure satisfactory operation.*
2. *As lamps are removed, examine all sockets to ensure proper and positive contact with lamp pins.*
3. *If starters are used, each starter should be checked and replaced wherever necessary.*
4. *Examine all connections within the fixture to ensure their conformance with the wiring instructions appearing on the ballast.*
5. *Examine and test ballast.*

LAMPS NOT STARTING



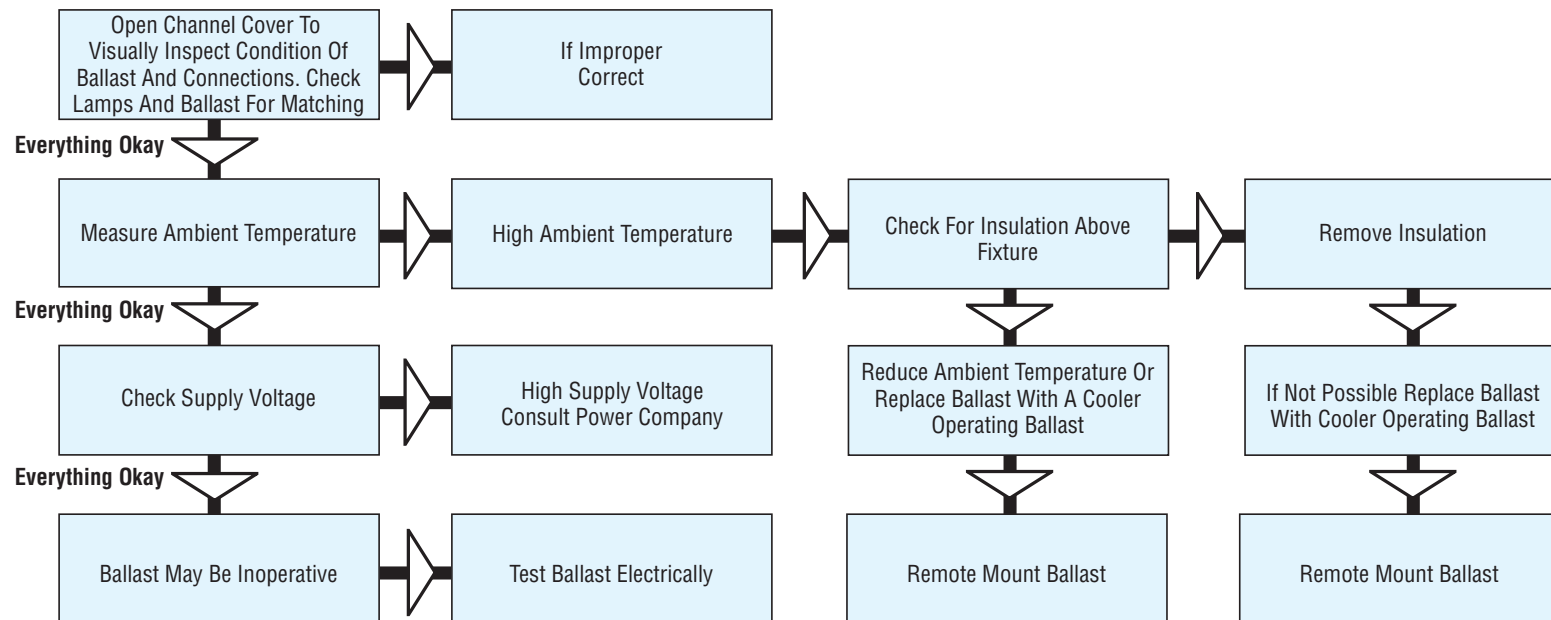
CYCLING

The National Electrical Code® stipulates that most ballasts installed indoors must contain a cut-out device that protects the ballast from overheating.

If abnormal ambient conditions cause the ballast to overheat, the thermal protection device's switch disconnects the ballast from the line. Once cooled, the ballast is reconnected and restarts the lamps.

If the conditions persist, the ballast will switch off again repeatedly in a process called "cycling."

LAMP CYCLING



LAMP “SWIRLING”

Another problem that may occur is a process known as swirling or spiraling, where light does indeed appear to swirl or spiral inside the tube. This is normal for some lamps when first lighted, and in these cases the problem will correct itself after a few hours of operation.

- *This problem may also be caused by cold temperatures. In this case, the lamps may need to be jacketed or otherwise shielded from the cold drafts. Also, check that the lamps are rated for the actual temperature measured.*
- *This problem may also be caused by low input voltage; check and correct.*
- *Next, check for ballast and lamp compatibility and replace the wrong component.*
- *Replace lamp with known good lamp. If condition still exists, change ballast.*

PREHEAT

To measure starting current and operating current, the ammeter must be connected between the colored high voltage secondary lead of the ballast and the lamp.

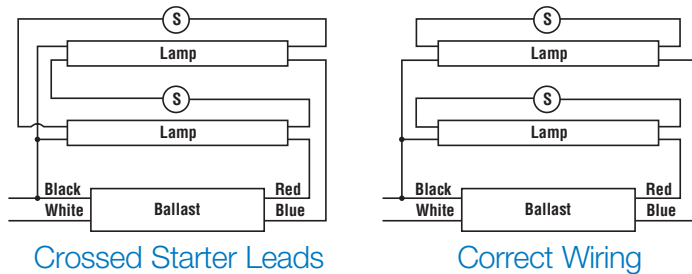
To determine starting voltage, remove lamp and connect voltmeter between respective primary and secondary leads of each lamp according to ballast wiring diagram.

Lamp Type	Operating Current (Ampere)	Starting Current (Ampere)	Starting Voltage (Minimum) (Open Circuit)
F4T5	.17	.16-.25	108
F6T5	.16	.16 -.25	108
F8T5	.145	.16 -.25	108
F13T5	.165	.18 -.27	180
F14T8	.365	.44 -.65	108
F14T12	.38	.44 -.65	108
F15T8	.305	.44 -.65	108
F15T12	.325	.44 -.65	108
F18T8	.385	.35 -.80	108
F19T8	.355	.35 -.80	108
F20T12	.38	.44 -.65	108
F25T12	.46	.41-.95	108
F30T8	.355	.40-.65	176
F40T12	.43	.55 -.75	176
F90T17	1.50	1.45 - 2.2	132

TROUBLESHOOTING PREHEAT INSTALLATIONS

One of the major causes of trouble with a Preheat circuit is the miswiring of the fluorescent ballast. This condition can be noted by short lamp or starter life, non-starting of lamp, or premature failure of the ballast. For example, with a two lamp ballast, the starter leads from the two pairs of lamp holders may be crossed. If both starters open at the same time, the lamps will start. However, if one lamp starts before the other, the nonstarting lamp may blink on and off for a long time before starting if it will start at all.

To determine if wired correctly, short the terminals of a fluorescent starter with a fine bare wire. Remove all starters from the fixture but leave the lamps in. Insert the shorted starter in one starter slot. If the fixture is wired properly both ends of the same lamp will glow. If crosswired, one end of each lamp will glow.



There have been many installations of Preheat fluorescent lighting in which two lamp ballasts are operating with one lamp on and one lamp out, or with shorted starters. These conditions will cause premature ballast failures due to the ballast coils being operated above their coil temperature limitation. Thus it is advisable that all inoperative lamps and starters be immediately replaced.

Other causes of difficulty could be (1) low or high circuit voltage, (2) improper lamp holder contact, (3) pinched wires or (4) improper lamps.

SLIMLINE & INSTANT START

To determine starting voltage, the lamp must be removed and voltmeter connected between the respective primary and secondary leads of each lamp as designated on ballast label. For series-sequence ballasts, the red lead must be in position while measuring the starting voltage of the remaining lamp.

Lamp Type	* Starting Voltage (Minimum)
F24T12	270
F36T12	315
F40T12/IS	385
F40T17/IS	385
F42T6	405
F48T12	385
F64T6	540
F72T8	540
F72T12	475
F96T8 (200mA)	675
F96T8 (265mA)	675
F96T12	565

- * **For Single Lamp**, measure voltage between Red & White leads.
- For Two Lamp (SERIES SEQUENCE)**, measure voltage between Red & White. Insert lamp in Red & White position, then read voltage between Blue & Black.
- For Two Lamp (Lead Lag)**, measure voltage between Red & White and Blue & White leads.
- For Electronic (parallel)**, measure voltage between Red & Blue leads.

TROUBLESHOOTING SLIMLINE & INSTANT START INSTALLATIONS

There are two common electromagnetic ballast circuits for the two lamp operation of Slimline lamps: The Lead Lag circuit and the Series Sequence circuit. Electronic ballasts operate the lamps in parallel.

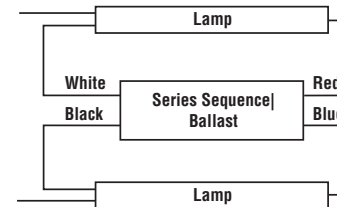
The Lead Lag Slimline Ballast operates one lamp independently of the other. Thus, if one lamp becomes inoperative, the other lamp will still light. There are two legs in the Lead Lag circuit: one leg of the circuit is called the lead section and contains an inductive coil and a capacitor in series with the lamp. The other leg just contains an inductive coil and is called the lag section. This is how the name "Lead Lag" was derived. It is permissible to use Lead Lag Slimline Ballasts for starting of Slimline lamps down to temperatures of 0°F and above.

The Series Sequence Slimline Ballast was introduced in order to reduce the size, weight, and cost of the Slimline Ballast. In this circuit two lamps are operated in series, with the lamps starting in sequence. If one lamp becomes inoperative the other will not fully light or light at all.

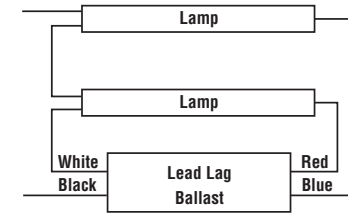
Short lamp life or premature end blackening can be due to (1) low supply voltage, (2) improper lamp-socket contact or (3) miswiring of the ballast.

The open circuit voltage of a Slimline Ballast, in many cases, is great enough to start a lamp with one lamp filament de-activated. This lamp will become extremely black at one end and will flicker. If the lamp is not replaced, the ballast will overheat and eventually fail.

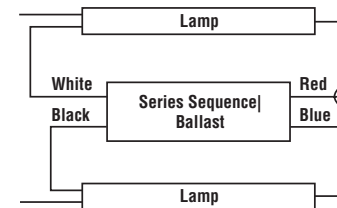
If an Electromagnetic Slimline Ballast is operated with one lamp on and one lamp off, the ballast will experience higher coil temperatures which could result in premature ballast failures. In cases of short ballast life, check this factor. Electronic Slimline ballasts generally are not effected by lamp failure.



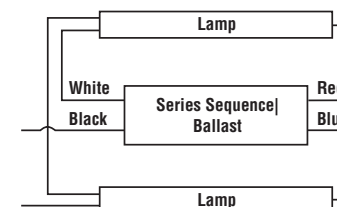
CORRECT



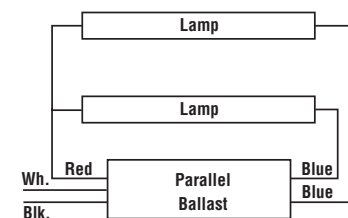
CORRECT



INCORRECT



INCORRECT



CORRECT

RAPID START

To measure starting voltage, connect voltmeter between the highest reading Red lead and Blue lead with lamp removed.

To measure filament voltage on a single lamp unit, read voltage between Red-Red and Blue-Blue leads. For two lamp units, read voltage between Red-Red, Blue-Blue and Yellow-Yellow leads.

Rapid Start – 430 MA. Lamp Type	Starting Voltage (Minimum @ 50 F)		Filament Voltage
	Single Lamp	Two Lamp	
F14T12	108	157	7.5 - 9.0
F15T8	108	157	7.5 - 9.0
F15T12	108	157	7.5 - 9.0
F20T12	108	157	7.5 - 9.0
F17T8	140	210	3.4 - 4.5
F25T8	170	260	3.4 - 4.5
F25T12	200	256	3.4 - 4.5
F30T12	150	215	3.4 - 4.5
F32T8	200	300	3.4 - 4.5
F40T8	250	385	3.4 - 4.5
F40T10	200	256	3.4 - 4.5
F40T12	200	256	3.4 - 4.5
FC6T9	150	225	3.4 - 4.5
FC8T9	180	—	3.4 - 4.5
FC12T9	200	—	3.4 - 4.5
FC16T9	205	—	3.4 - 4.5
FC8T9 & FC12T9	—	230	3.4 - 4.5
FC12T9 & FC16T9	—	230	3.4 - 4.5

Rapid Start – 800 & 1500 MA. Lamp Type	Starting Voltage (Minimum)						Filament Voltage
	Single Lamp			Two Lamp			
	50 F	0 F	-20 F	50 F	0 F	-20 F	
F24T12/HO	85	110	140	145	195	225	3.4 - 4.5
F36T12/HO	115	155	190	195	235	260	3.4 - 4.5
F48T12/HO	155	203	240	256	290	310	3.4 - 4.5
F60T12/HO	210	240	290	325	350	365	3.4 - 4.5
F72T12/HO	260	283	340	395	410	420	3.4 - 4.5
F84T12/HO	280	330	360	430	445	455	3.4 - 4.5
F96T8/HO	450	—	—	775	—	—	3.6 - 4.8
F96T12/HO	295	330	360	465	480	490	3.4 - 4.5
F48PG17/VHO	160	205	240	250	265	300	3.4 - 4.5
F48T12/VHO	160	205	240	250	265	300	3.4 - 4.5
F72PG17/VHO	225	270	310	350	360	400	3.4 - 4.5
F72T12/VHO	225	270	310	350	360	400	3.4 - 4.5
F96PG17/VHO	300	355	400	470	470	500	3.4 - 4.5
F96T12/VHO	300	355	400	470	470	500	3.4 - 4.5

NOTE: Electronic ballasts generally provide starting voltages higher than those listed in the above tables. These open circuit voltages are listed on the ballast's label. Filament voltages for electronic and electromagnetic ballasts are the same.

TROUBLESHOOTING RAPID START INSTALLATIONS

The Rapid Start circuit (described on page 7) eliminates the annoying flicker associated with starting Preheat systems. Rapid Start circuits also simplify maintenance since no starter is used.

The Rapid Start lamp operates on the principle of utilizing a starting voltage which is insufficient to start the lamps while the cathodes are cold but is sufficient to start the lamps when the cathodes are heated to maintain emission temperature. This voltage range between starting cold and starting hot is a very narrow band of voltage which must be closely controlled in order to prevent either failure of the lamps to start or instant starting of the lamps with cold cathodes which is detrimental to the lamps.

In order to stay within this range of voltage, it is necessary to excite the gas within the lamps by means of an external voltage which is applied to the gas within the lamps to create ionization. This external excitation is created by means of the capacity that is present between the lamp and the reflector or channel. In order to act effectively, the fixture must be connected to ground and the white lead of the ballast connected to ground lead of power supply. Thus it is stated on the label of Rapid Start ballasts "MOUNT LAMPS WITHIN 1/2 INCH (3/4 INCH or 1 INCH) OF GROUNDED METAL REFLECTOR."

The majority of new fluorescent installations today use ballasts of the Rapid Start design. The HIGH OUTPUT (800 MA), and VERY HIGH OUTPUT (1500 MA) lamps are of the Rapid Start design.

Refer to the figure on page 48. BLUE-BLUE, YELLOW-YELLOW, RED-RED LEADS are the built-in filament windings which supply a voltage of 3.4 to 4.5 volts to the lamp cathodes. If the cathodes are not properly heated, premature lamp end blackening will result. The lack of heating could be due to:

1. *Improper seating of the lamp within the socket.*
2. *Broken sockets.*
3. *Broken lamp pins.*
4. *Too great of socket spacing.*
5. *Damaged lamp cathode(s).*
6. *Ballast lead wire not properly connected to socket.*
7. *Low supply voltage.*
8. *Inadequate ballast filament voltage.*
9. *Improper wiring.*

To determine if there is adequate voltage at the lamp cathodes, measure the voltage at the socket terminals. The voltage at the sockets should read between 3.4 and 4.5 volts. If there is adequate voltage, the lamp end blackening can be due to conditions 1, 2, 3, 4, or 5. If the voltage is not adequate it can be due to one or more of conditions 6, 7, 8, or 9.

If random starting of Rapid Start lamps is experienced, be sure the fixture is properly grounded. As previously stated, for completely reliable starting in Rapid Start circuits it is necessary to have a starting aid.

The starting aid should be an electrically grounded metal strip at least 1 inch wide and extending the full length of the lamp. The lamp should be within 1/2 inch of the grounded strip for 40 watt lamps and smaller, (3/4 inch for T8 lamps) and 1 inch for higher output lamps.

If, under high humidity conditions, Rapid Start lamps start slowly or do not start at all although the cathodes are properly heated, this may be due to dirt on the lamps which is offsetting the silicon coating on the lamps, or it may be due entirely to a poor silicon coating. If it is a new installation (in operation only a few months) which experiences random starting under high humidity conditions, in most cases it will be due to low supply voltage or poor silicon coating on the lamps.

When random starting is experienced under high humidity conditions in an installation in operation for a longer period of time this is usually due to dirt on the lamps. The lamps should be washed in water to remove the dirt.

Sometimes with a two lamp Rapid Start series ballast only one lamp will light to full brilliance and the other will not light. Refer to the figure below. If the lamp between the Red leads and Yellow leads is lit and the other lamp is out, look for a pinched Yellow lead. If the lamp between the Red and Yellow leads does not light and the other does, it is probably due to a short within the ballast.

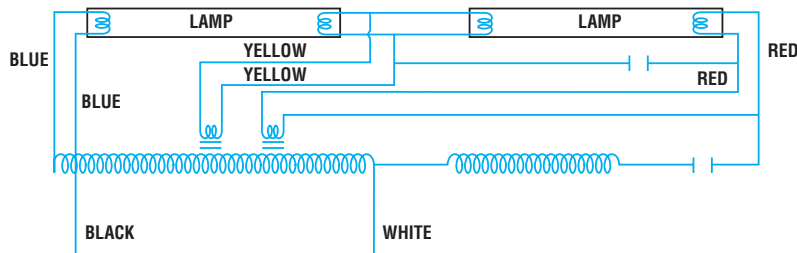


FIG .1

MODIFIED RAPID START

This type of ballast starts and operates the lamps similar to Rapid Start Ballasts, so troubleshooting on pages 44-48 would also apply. The only difference is that filament heating is reduced or eliminated after the lamps ignite so the 3.4-4.5 volts specified cannot be measured during normal operation. Also, some two lamp ballasts require that only one lamp be removed when measuring starting and filament voltages. If both lamps are removed, these voltages cannot be accurately measured.

INSTANT START OF RAPID START LAMPS

This type of ballast does not provide filament heating to the lamps. Only the starting voltage which is listed on the ballast label can be measured when the lamp is removed. The wiring of this ballast requires that the lamp filaments be shorted together and then connected to the ballast to obtain rated lamp life. If the filaments are not shorted, the lamps will ignite properly but fail prematurely. Rated lamp life when using this Instant Start Ballast may be reduced vs. a Rapid Start Ballast depending on how frequently the lamps are started.



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