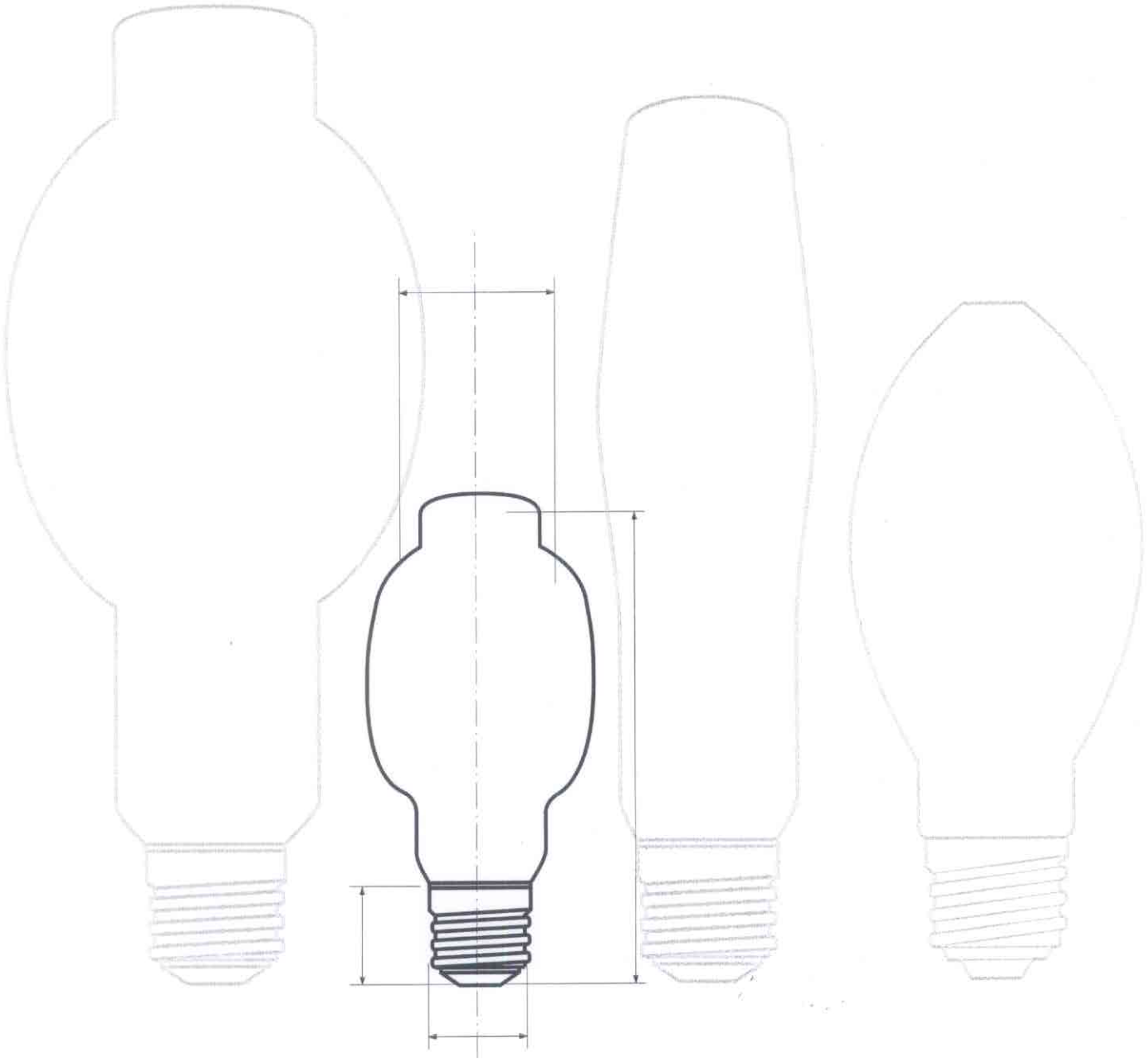
Engineering Bulletin

Troubleshooting High Intensity Discharge Lighting Systems

Metal Halide, Mercury, and High Pressure Sodium



OSRAM SYLVANIA

HID-011-0198

Introduction

This troubleshooting guide is intended to provide the engineer, plant engineer, and lighting maintenance personnel with an overview of common HID lighting system problems. The guide lists common modes of system failure or symptoms and points out most of the possible causes with respective verification/corrective action.

For additional information regarding product ratings or performance specifications, please consult other OSRAM SYLVANIA publications or contact Customer Service. Phone and fax numbers are listed on the back page.

HID Troubleshooting Glossary

Term	Definition
Arc Tube	Inner piece of quartz or ceramic material containing the electrodes, rare gas, and chemicals which emits the light.
Ballast	A magnetic or electronic circuit designed to operate High Intensity Discharge (HID) lamps correctly. Characteristics of ballasts are controlled by ANSI Standards.
Envelope	Outer glass bulb designed to maintain a controlled atmosphere surrounding the arc tube and contain any UV radiation emitted from the arc tube.
HID	High Intensity Discharge usually encompassing Metal Halide, Mercury, and High Pressure Sodium.
Maintenance	Normal reduction in light output over time.
Mortality Curve / Rated Life	OSRAM SYLVANIA INC. has published average rated life values in the catalog. For example, an average rated life of 20,000 hours means that after 20,000 hours of burning, up to half of the lamps could be expected to have failed. OSRAM SYLVANIA INC. publishes a mortality curve for most lamps which indicates the percentage of lamps in a population which could fail at any time over the rated life.
Restrike Time	Most HID lamps require a time period after the lamp has been shut off before it will relight. During this time, the lamp cools down.

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HID Troubleshooting Checklist

The following items should be checked before any replacement of lamps is made in an installation. Although many of the items may appear obvious or too simple, the list should be thoroughly checked to avoid unnecessary changeouts and expense.

1. Is the power distribution system functioning properly? Is the power switch on?
2. Do the circuit breakers remain closed when power is applied?
3. Is electric eye or photocell functioning properly?
4. Is proper line voltage available at the ballast primary? Is it within specification?
5. On multi-phase circuits, are all phases operating with all phase circuit breakers and grounds functioning properly?
6. Does the voltage rating on the ballast nameplate agree with the line voltage and frequency available?
7. Is the fixture properly wired?
8. Is ballast properly grounded in the fixture or to pole and mounting hardware?
9. Is the socket in good condition? Contacts, shells and leads in good condition?
10. Is the lamp compatible with the ballast? Mercury on Mercury or Metalarc,® Metalarc® on Metalarc,®
    Lumalux on proper ANSI ballast, Unalux on Mercury lag-type ballast.
    Check fixture nameplate, ballast nameplate, and lamp description for agreement.
11. Is the lamp igniter operating? They are required for most High Pressure Sodium and some Metalarc lamps.
12. Does lamp operating position agree with specified position of lamp?
13. Are you testing with a known good lamp?
14. If color complaint, do lamps have at least 100 hours on them?
15. If color complaint, when you switch lamps and wait 10 minutes, did color follow lamp or stay with fixture?
16. Has the installation experienced unusual power conditions? Brown outs, black outs, loss of phase...?
17. Is the installation new (some possible "bugs" not worked out yet) or is it a relamp?
18. Does the system include a dimmer, bi-level system, etc? If so, is it functioning properly?
19. Does the system experience frequent hot re-strikes?

Metal Halide/Mercury

PROBLEM	POSSIBLE CAUSE	VERIFICATION/CORRECTIVE ACTION
Lamp Will Not Start	Normal End of Life	Normal end of life occurs when the electrodes have aged enough to make it difficult or impossible to produce ionization and strike the arc or to prevent warming to full output. Increase in arc tube starting voltage due to out-gassing of contaminants also causes normal end of life. Calculate failure percentage and refer to published life expectancy curve to determine if lamp mortality is occurring at a normal rate. At rated life, up to half the lamps in population could be expected to have failed. Be aware: reduced burning cycles (generally below 10 hours per start) may significantly reduce lamp life. See catalog or published literature for details. The simplest procedure is to test the lamp in an adjacent fixture which is known to be operating properly and then replace as necessary. (It should be kept in mind that series ballasts will occasionally extinguish the adjacent lamp if one is removed.)
	Lamp Loose in Socket	Apply a reasonable amount of torque on the lamp to tighten. Lamp should be installed until resistance in the socket is firm. As lamp turns, it may start. Inspect lamp base for indications of arcing at the center contact button. If the base is distorted and prevents proper insertion, replace lamp. If center contact of the socket is depressed too far to make contact with the lamp, replace the socket.
	Photocell Inoperative	Cover electric eye for one minute with power applied to the fixture. Replace electric eye if inoperative.
	Improper Wiring	Compare actual wiring to wire diagram on the ballast label. Check continuity from source to ballast and ballast to socket. Check for loose connection and insufficient wire size. Repair if necessary.
	Low Voltage at Fixture	Measure voltage at input. For CWA and magnetic-regulated ballasts, measured line voltage should be within 10% of nameplate rating. For reactor and high-power factor reactor ballasts, measured line voltage should be within 5% of nameplate rating. Increased loading or demand usually reduces the line voltage. Therefore, check voltage under full load. If tapped ballast, ensure input lead is connected to proper tap. Increase supply voltage if feasible.
	Improper Ballasting	Proper ballasting is *essential* for HID lamp operation. Any HID lamp will perform erratically or fail to start on an improper ballast. Ensure the ballast nameplate agrees with the line voltage and lamp used. Improper ballasting can cause premature lamp failure. Note: Mercury lamps will operate satisfactorily on ballasts designed for Metal Halide lamps of the same wattage. Unalux lamps operate on *lag* type Mercury ballasts only. If an electronic ballast is being used, ensure the lamp is compatible. Consult the manufacturer if necessary.
	Defective Shorted Ballasts	A shorted ballast will generally cause the seals at the end of the arc tube to rupture with an indicative blackening in the seal area. Shorted condition may be due to shorted capacitors, shorted leads or windings. Most often it is due to series capacitors in lead circuits.

Metal Halide/Mercury

PROBLEM	POSSIBLE CAUSE	VERIFICATION/CORRECTIVE ACTION
Lamp Will Not Start	Improper Lamp Operating Position	Metal Halide lamps must be operated within 15 degrees of the burning position indicated on the lamp description. A lamp operated beyond the specified position may not start, may perform poorly, or may fail early.
	Lamp Had Been Operating. Insufficient Cool-Down Time.	Metal Halide / Mercury lamps require a period of off-time to cool prior to re-starting. Mercury and Metal Halide lamps require from 4 to 20 minutes to cool down. In fixtures, the restart time varies with the amount of ventilation and ambient conditions. Maximum restrike time is specified by ANSI.
	High Restrike Voltage	For Metal Halide only, if the power to the lamp is interrupted during the warm-up period, the voltage required to restart the lamp may be higher than that required for a lamp which has been allowed to stabilize. Allow lamp to cool down to room temperature and then reapply power.
	Improper Ballast for Conditions	Lamps are designed to start within two minutes when operated on the proper ballast. At low temperatures, the ballast may not supply enough voltage to start the lamp. At -20° F, for example, ANSI specifications state that 90% of the lamps shall ignite when proper voltages are impressed. A reactor 240-volt primary ballast might not satisfactorily start a Mercury lamp at -20° F. The same problem may exist at a very high temperature. "Indoor" ballasts that are installed indoors but are connected to lamps that are installed outdoors may not start the lamps. There is not sufficient secondary voltage. Check lamp environment against published performance characteristics. (See Engineering Bulletin on HID lamps and indoor/outdoor ballast catalogs.)
	End of Ballast Life	The ballast appearance may indicate age or failure. Excessive heat could lead to charring or swollen capacitors. Check electrical characteristics with meter. Frequently, the failure mode of a ballast is capacitor failure, with consequent low-power factor operation and high current. This leads to overheating of the core and coil and eventual failure.
	Ballast Overheating	Some ballasts are equipped with thermal cut-out circuits. For Powertronics ballast, the thermal switch is internal to the ballast. Either allowing cool-down time or cycling the input may re-energize the ballast. Overheating may be due to lamp, ballast, fixture, or ambient conditions.
	Defective Safety Micro Switch	Some fixtures are equipped with a micro switch which prevents lamp operation unless the lens is closed. Switch failure could prevent the input from being applied to the ballast even with the lens closed.
	Defective Igniter	Some Metal Halide lamps depend on an external or internal igniter to provide high voltage pulses to start the lamp. If the pulse is not generated or is below specification, lamps will fail to start. A below-specification igniter may start a lamp initially but fail to start it at a later time, as the lamp's required starting voltage can increase for a short period while the lamp seasons. An improper or failing igniter may provide enough voltage to start lamps initially, but fail to start it at a later time, as the lamp's required starting voltage can increase. Install a known operating lamp to determine whether ballast or lamp needs replacing. Measure spikes with oscilloscope and compare to ANSI.

Metal Halide/Mercury

PROBLEM	POSSIBLE CAUSE	VERIFICATION/CORRECTIVE ACTION
Lamp Will Not Start	Mismatched Igniter	Many designs require that the ballast and igniter be carefully matched to provide a proper pulse value. A low pulse will not start the lamp and a high pulse can damage the components of the ballast. The igniter should be mounted within the specified distance from the lamp. Caution: Starting pulses can damage meters. Measure with oscilloscope and compare to ANSI. Consult labels and manufacturers' catalogs to ensure compatibility among lamp, ballast, and igniter.
	Wrong Socket	Some sockets are designed for use with protected lamps only. These sockets are usually installed in open fixtures. A standard Metal Halide lamp will not fit in these special sockets. Use the correct lamp.
Short Lamp Life	Lamp Defects	Replace lamp. If arc tube leaker suspected, confirm with Tesla coil or Sylvania HID lamp tester.
	Lamp Physically Damaged	Possibly from transportation or handling. Lamp may burn a short period of time even if outer jacket is cracked. A crack in the glass-to-base region could indicate that the lamp was inserted too tightly into socket. Look for broken arc tube or loose parts. Replace lamp.
	Poor Electrical Contact	Poor electrical contact between the lamp base and lampholder contact can occur in single-ended or double-ended lamps. For single-ended lamps, the cause can be lamps which are not inserted sufficiently or deformed/mispositioned center contacts. Replace socket if necessary. For double-ended lamps, poor seating in the lampholders can cause poor contact. Inspect for indications of arcing or oxide growth. Reposition lamp. Measure socket spacing. Replace socket and lamp if necessary.
Lamps Cycle	Wrong Input Voltage	Ensure ballast nameplate agrees with line voltage.
	Low Line	Ensure input voltage within 10% of rating.
	Super Metal Halide Lamp in Incorrect Socket	Horizontal Super Metal Halide lamps have a special position-oriented mogul base (POM) which must be matched to a position-oriented mogul socket (POM) to assure proper arc tube orientation. If lamp is mis-oriented, light output will be low and life will be short. Arc tube rupture may increase in frequency.
	Wrong Ballast	Ensure ballast nameplate matches lamp type.
	Low Open-Circuit Ballast Voltage	Measure the open-circuit voltage and compare to ANSI Standard.
	Variable Voltage	Heavy motor loads or welding appliances on line can cause flickering and interruptions. Remove lighting circuits from the circuits servicing these devices. Provide voltage regulators. Check for loose connections. Use of CWA ballasts may help the situation.
	Hi-Re-ignition Voltage	Chemistry of a defective lamp sometimes affects the lamp voltage detrimentally. A high-spike on the lamp voltage waveform will cause the lamp to cycle out, cool down, and then repeat the cycle. This could also indicate normal end of life.
	High-Spike Ballasts	Ballasts may produce secondary re-ignition spikes which cause lamps to cycle. Measure with oscilloscope. Replace ballast as required.
Lamps Flicker	Variable Voltage	Heavy motor loads or welding appliances on line can cause flickering of lamps. Install line conditioner or isolate lighting circuits from circuits servicing these devices.

Metal Halide/Mercury

PROBLEM	POSSIBLE CAUSE	VERIFICATION/CORRECTIVE ACTION
Lamp Starts Slowly	Hard Starter	Lamp may not strike for several minutes or may hang up in a glow state for long periods of time causing lamp damage. Replace with good lamp.
	Ambient Temperature Is Too Cold	Check ballast nameplate and lamp rating to ensure that the ambient temperature is above the minimum rating.
	Wrong Ballast / Low Open Circuit Voltage	Check ballast nameplate and lamp etch to ensure that the correct ballast is being used. Ensure that input voltage is not low and that ballast is tapped correctly.
Fuses Blow or Circuit Breakers Operate on Lamp Start-Up	Overloaded Circuit	Rewire to allow starting current of lamp/ballast combination.
	High Transient Current	High momentary currents can be caused by reactor or autotransformer ballasts. Use circuit-protective devices incorporating time-delay elements.
Low Light Output	Normal Light Output Reduction over Life	Refer to maintenance characteristics of lamp in technical publications comparing light output vs. burning time. Metal Halide and Mercury lamps normally experience light-output depreciation over life.
	Incorrect Ballast	Compare ballast nameplate and lamp etch to ensure proper ballast is used. Be aware of installations where lamp wattages are intermixed throughout the facility in similar or identical fixtures. An example would be downlighting with Metal Halide Par38 lamps in malls where 70W and 100W are intermixed. Ensure that Metal Halide PAR38 lamps are not installed in incandescent fixtures.
	Incorrect Voltage	Measure line voltage. Ensure ballast is tapped correctly.
	Incorrect Ballast Output	Ensure ballast is wired correctly. Measure open-circuit voltage and operating characteristics of known good lamp to compare against published values.
	Dirt Accumulation	Clean lamp and luminaire. Establish maintenance program.
	Incorrect Lamp	Ensure wattage / voltage of lamp matches ballast nameplate.
Arc Tube is Bulged Early in Lamp Life	Over/Under wattage operation. Improper Ballasting.	Compare ballast nameplate and lamp type to ensure proper ballast is being used.
	Excessive Current or Voltage	Check voltage at ballast. Check for current or voltage surges related to electrical distribution system. Check for shorted capacitors and replace defective equipment if required.
	Fixture/Reflector Problem	Reflector design may redirect energy directly onto the arc tube or other parts of lamp causing overheating. Compare rise in lamp voltage to ANSI published standards. Check for missing reflector.
	Glow State Operation	Due to many possible causes, lamp will go into glow state and not fully start. Arc tube will darken and life will be shorted. Replace lamp, check ballast. At end of life, some lamps go into glow state.
	Lamp Burned in Wrong Position	Improper burning position (burning a Base Up lamp in the Base Down position) will cause bulging of the arc tube, arc tube ruptures, internal arc outs, etc. Check the etch carefully and compare to actual fixture orientation. Some fixtures can be improperly mounted upside down.

Metal Halide/Mercury

PROBLEM	POSSIBLE CAUSE	VERIFICATION/CORRECTIVE ACTION
Lamp Breakage Occurs	Scratched Glass Bulb	Investigate careless handling. Check pole type bulb changer, if used. Ensure socket does not contact neck of bulb causing scratches.
	Improper Insertion	Check remaining lamps in installation for unusually high amount of torque to remove from socket. Lamps should be inserted until firm contact/resistance is met.
	Excessive Vibration	Some fixtures/poles may inherently be more susceptible to vibration. Fixtures may be in a high wind or high vibration area.
	Vandalism	Check for damage to fixture as well as lamp.
Color Variation	Normal Metal Halide Product	Metal Arc product has color variation from lamp to lamp. Color variation will vary between one group of lamps and another. A minimum time of 100 to 300 hours is required on Metalarc® lamps prior to making any type of qualitative or quantitative judgment on color.
	Normal Maintenance	A gradual color shift will occur with Metal Arc product over time. The group of lamps will tend to shift in color as a group, so it will not be overly noticeable. Light output will decrease as well which may cause a perceived color shift. To minimize the difference of lifelong burning: burn all lamps the same number of hours per day, burn all lamps the same schedule (on at 8:00 a.m., off at 5:00 p.m.) Avoid spot replacement if possible (new lamps will look different than older ones). A group relamp will minimize this effect.
	Wrong Lamp Color	Check lamp etch and catalogue rating. Be aware of 3K and 4K product. Replace with correct lamp.
	Clear vs. Coated	Check lamp etch and check for presence of phosphor coating on outer bulb. Ensure all lamps are either coated or clear.
	Range of Manufacturing Tolerance	Color differences are inherent in Metal Halide products. Most Metal Halide products are manufactured to an industry-recognized 10-step oval. (Lamps are measured using an ANSI-specified reference circuit in controlled ambient conditions.) This means that lamps at opposite ends of the 10-step color oval would exhibit 20 perceptible color differences between them.
	Variations in Luminaires	Variations in the surface or finish of the reflectors and/or lenses can introduce color differences.
	Varying Lamp Positions	Especially in PAR applications or if mixing BU and HOR fixtures, intermixed burning positions will affect color.
	Variations in Environment	Wall washing (reflecting the light off walls) will exaggerate the color differences of Metal Halide lighting.
	Super Metal Halide in Incorrect Socket	Horizontal Super Metal Halide lamps must have a special POM socket (Position-oriented Mogul). If the lamp-base pin is not inserted in the socket notch correctly, the arc tube will be mispositioned. This will result in varied color and low lumens. Lamps could be more prone to A/T ruptures upon failure also.
	Arc Tube Tip Mis-positioned	The position of the inner arc tube tip may affect the color of some double-ended Metal Halide lamps. Consult the manufacturer for specifics regarding the product of concern. Generally it is best to avoid positioning the inner arc tube tip in the down position.

High Pressure Sodium

PROBLEM	POSSIBLE CAUSE	VERIFICATION/CORRECTIVE ACTION
Lamp Will Not Start	Normal End of Life	Normal end of life occurs when the electrodes have aged enough to make it difficult or impossible to produce ionization and strike the arc or to prevent warming to full light output. Rise in arc tube voltage due to Sodium depletion also causes normal end of life (cycling). Calculate failure percentage and refer to published life expectancy curve to determine if lamp mortality is occurring at a normal rate. At rated life, either 50% or 35% of the lamps in population could be expected to have failed, depending upon type. Cycling does not occur at end of life in Lumalux Plus lamps. The lamps will extinguish and remain off. Be aware: reduced burning cycles (generally below 10 hours per start) may significantly reduce lamp life. See catalog or published literature for details. The simplest procedure is to test the lamp in an adjacent fixture which is known to be operating properly and then replace as necessary. (It should be kept in mind that series ballasts will occasionally extinguish the adjacent lamp if one is removed.)
	Lamp Loose in Socket	Apply a reasonable amount of torque on the lamp to tighten. Lamp should be installed until resistance in the socket is firm. As lamp turns, it may start.
	Base of Socket Defect	Inspect lamp base for indications of arcking at the center contact button. If the base is distorted and prevents proper insertion, replace lamp. If center contact of the socket is depressed too far to make contact with the lamp, replace the socket.
	Photocell Inoperative	Cover photocell for one minute with power applied to the fixture. Replace if inoperative. Look for adjacent light sources which could be shining on the photocell and causing the lamp to remain off at night.
	Improper Wiring	Compare actual wiring to wire diagram on the ballast label. Check continuity from source to ballast and ballast to socket. Check for loose connection and insufficient wire size. Repair if necessary.
	Low Voltage at Fixture	Measure voltage at input. For CWA and magnetic regulated ballasts, measured line voltage should be within 10% of ballasts, measured line voltage should be within 5% of nameplate rating. Increased loading or demand usually reduces the line voltage. Therefore, check voltage under full load. If tapped ballast, ensure input lead is connected to proper tap. Increase supply voltage if feasible.
	Improper Ballasting	Proper ballasting is essential for HID lamp operation. Any HID lamp will perform erratically or fail to start on an improper ballast. Ensure the ballast nameplate agrees with the line voltage and lamp used. Improper ballasting can cause premature lamp failure. Note: Unalux lamps operate on lag type Mercury ballasts.
	Defective Shorted Ballasts	A shorted ballast will generally cause lamp failure. Shorted condition may be due to shorted capacitors, shorted leads or windings.
	Lamp Had Been Operating. Insufficient Cool-down Time.	High Pressure Sodium lamps (with the exception of Stand-By lamps) require several minutes of cool-down time prior to restarting.

High Pressure Sodium

PROBLEM	POSSIBLE CAUSE	VERIFICATION/CORRECTIVE ACTION
Lamp Will Not Start	End of Ballast Life	The ballast appearance may indicate age or failure. Excessive heat could lead to charring or swollen capacitors. Check electrical characteristics with meter. Frequently, the failure mode of a ballast is capacitor failure, with consequent low power factor operation and high current. This leads to overheating of the core and coil and eventual failure.
	Ballasts Overheating	Some ballasts are equipped with thermal cut-out circuits. Either allowing cool-down time or cycling the input may re-energize the ballast. Overheating may be due to lamp, ballast, fixture or ambient conditions.
	Defective Igniter	High Pressure Sodium lamps (with the exception of Unalux lamps which operate on a Mercury ballast) depend on an external igniter to provide high-voltage pulses to start the lamp. An improper or failing igniter may provide enough voltage to start lamps initially, but fail to start it at a later time, as the lamp's required starting voltage can increase. Install a known operating lamp to determine whether ballast or lamp needs replacing. Measure spikes with oscilloscope and compare to ANSI.
	Mismatched Igniter	Many designs require that the ballast and igniter be carefully matched to provide a proper pulse value. A low pulse will not start the lamp and a high pulse can damage the components of the ballast. The igniter should be mounted within the specified distance from the lamp. Caution: Starting pulses can damage meters. Measure with oscilloscope and compare to ANSI. Consult labels and manufacturer's catalogs to ensure compatibility among lamp, ballasts, and igniter.
Short Lamp Life	Lamp Defects	Replace lamp. Identify defect if possible.
	Lamp Physically Damaged	Possibly from transportation or handling. Lamp may burn short period of time even if outer jacket is cracked. A crack in the glass-to-base region could indicate that the lamp was inserted too tightly into socket. Look for broken arc tube or loose parts. Replace lamp.
Lamps Cycle	Wrong Input Voltage	Ensure that ballast nameplate agrees with line voltage and the lamp used.
	Low Line	Ensure input voltage within 10% of rating.
	Low Open-circuit Ballast Voltage	Measure the open-circuit voltage and compare to ANSI Standard.
	Variable Voltage	Heavy motor loads or welding appliances on line can cause flickering and interruptions. Remove lighting circuits from the circuits servicing these devices. Provide voltage regulates. Check for loose connections. Use of CWA ballasts may help the situation.
	High-Spike Ballasts	Ballasts may produce secondary re-ignition spikes which cause lamps to cycle. Measure with oscilloscope. Replace ballast as required.
	End of Life	High Pressure Sodium lamps typically cycle at the end of life (either due to Sodium depletion or voltage rise due to severe arc tube blackening). Note: Lumalux Plus lamps are designed not to cycle at end of life but to remain off. Check mortality curve to determine if failure rate is within expectations.

High Pressure Sodium

PROBLEM	POSSIBLE CAUSE	VERIFICATION/CORRECTIVE ACTION
Lamps Cycle	Fixture Effect	Lamp voltage rises when lamps are operated in a fixture. The rise of lamp voltage is dependent upon fixture design, and the maximum allowed value is specified by ANSI. Excessive voltage rise caused by some fixtures will cause cycling and short life.
Lamp Starts Slowly	Hard Starter	As a lamp ages, voltage required to start lamps may increase. Replace with known good lamp.
	Ambient Temperatures Too Cold	Check ballast nameplate and lamp rating to ensure that the ambient temperature is above the minimum rating. Lamps should start at temperatures down to -40° F.
	Wrong Ballast/Low Open Circuit Voltage	Check ballast nameplate and lamp etch to ensure that the correct ballast is being used. Ensure that input voltage is not low and that ballast is tapped correctly.
Fuses Blow or Circuit Breakers Operate on Lamp Start-Up	Overloaded Circuit	Rewire to allow starting current of lamp/ballast combination.
	High Transient Current	High momentary currents can be caused by reactor or autotransformer ballasts. Use circuit-protective devices incorporating time-delay elements.
Low Light Output	Normal Light-Output Reduction Over Life	Refer to maintenance characteristics of lamp in technical publications comparing light output vs. burning time. High Pressure Sodium lamps normally experience light-output depreciation over life.
	Incorrect Ballast	Compare ballast nameplate and lamp etch to ensure proper ballast is used. Be aware of installations where lamp wattages are intermixed throughout the facility in similar or identical fixtures. LU150/55 and LU150/100.
	Incorrect Voltage	Measure line voltage. Ensure ballast is tapped correctly.
	Incorrect Ballast Output	Ensure ballast is wired correctly. Measure open-circuit voltage and operating characteristics of known good lamp to compare against published values.
	Dirt Accumulation	Clean lamp and luminaire. Establish maintenance program.
	Incorrect Lamp	Ensure wattage/voltage of lamp matches ballast nameplate, i.e., LU150/55 and LU150/100 require different ballasts.
Lamp Breakage Occurs	Scratched Glass Bulb	Investigate careless handling. Check pole type bulb changer, if used. Ensure socket does not contact neck of bulb, causing scratches.
	Improper Insertion	Check remaining lamps in installation for unusually high amount of torque to remove from socket. Lamps should be inserted until firm contact/resistance is met.
	Excessive Vibration	Some fixtures/poles may inherently be more susceptible to vibration. Fixtures may be in a high wind or high vibration area.
	Vandalism	Check for damage to fixture as well as lamp.
Color Variation	Clear vs. Coated	Check lamp etch and check for presence of phosphor coating on outer bulb. Ensure all lamps are either coated or clear.

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