

SECTION 26 51 00

LIGHTING

PART 1 GENERAL

1.01 SUMMARY

A. This section provides general requirements for a complete and fully operational lighting system including:

1. Interior lighting fixtures
2. Exterior lighting fixtures
3. Lamps
4. Ballasts
5. Accessories
6. Light fixture support
7. Lighting level values

B. Related Sections:

1. Division 26 - Grounding and Bonding for Electrical Systems.
2. Division 26 - Raceway and Boxes for Electrical Systems.
3. Division 26 - Lighting Control Devices

1.02 REFERENCES

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and Sections under Division 1 General Requirements.

B. Conform to Reference Standards by date of issue current on date of Contract Documents, except where a specific date is established by code.

1. ANSI/NFPA 70 National Electrical Code
2. NFPA 101 Life Safety Code
3. UL 57 Electrical Luminaires
4. UL 496 Edison Base Lampholders
5. UL 542 Lampholders, Starter Holders for Fluorescent Lamps
6. UL 924 Emergency Lighting and Power Equipment
7. UL 935 Fluorescent Lamp Ballasts
8. UL 1029 HID Lamp Ballasts
9. UL 1570 Fluorescent Luminaires
10. UL 1571 Incandescent Luminaires
11. UL 1572 High Intensity Discharge Luminaires
12. UL 773 Plug-In Photo controls for Use with Area Lighting
13. UBC Standard Section 47.1813 Luminaires
14. ANSI/IESNA RP-29-06
15. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
16. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

1.03 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70 and the LA City Electrical Code.
- E. Luminaires, ballasts, lamps and other components and controls shall equal or exceed the requirements of all applicable state and/or LA City energy codes.
- F. Designated manufacturers are listed to define the requirements for quality and function of the specified product. Equivalent or better products of other, unnamed manufacturers may be proposed for consideration by adhering to procedures set forth in this section and in Division 1 – Product Requirements.
- G. Mockups: Light Fixture Details for fixture type(s) requiring mockups. Provide lighting fixtures for room or module mockups.
 - 1. Obtain Architect of Record and County's Representative approval of fixtures for mockups prior to starting installation.
 - 2. Install fixtures for mockups with power and control connections.
 - 3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 4. Remove mockups when directed. Fixtures may be reinstalled in the Work with approval of County.
 - 5. Mockups evaluated on the project site may become part of the complete Work with the approval of the County's Representative if the mockup is undisturbed at the time of substantial completion.

1.04 SUBMITTALS

- A. Comply with requirements of specification section describing Submittal Procedures
- B. The authorized manufacturer's representative for the project area shall prepare submittals for each lighting fixture type. In addition to the fixture submittals, a list shall be provided identifying the manufacturer representative for each fixture type. Provide manufacturers' names, addresses, and telephone numbers. Requests for prior approval shall also include this information. Submittals or requests for prior approval without this information will be rejected.
- C. Product Data shall indicate that light fixture, lamps, and ballasts fully comply with contract documents. Data shall be submitted for each type of light fixture indicated, arranged in order of fixture designation. For standard catalog fixtures provide product catalog sheets indicating data on features, accessories, finishes, and the following:
 - 1. Materials and dimensions of luminaires.
 - 2. Photometric data, in IESNA format, based on certified results of laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in the Project.
 - a. Photometric data shall be certified by a qualified independent testing agency.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
 - 3. Low voltage transformers.
 - 4. Fluorescent and high intensity discharge ballasts.
 - 5. LED power supplies.
 - 6. Types of lamps, including manufacturer, wattage, and Color Rendering Index (CRI) and color temperature in degrees Kelvin (K).

7. Air and Thermal Performance Data: For air-handling light fixtures, furnish data required in "Submittals" Article in Division 23 Diffusers, Registers, and Grilles.
- D. Shop Drawings shall:
1. Show details of nonstandard or custom fixtures.
 2. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
 3. For custom fixtures, modified fixtures, or linear fluorescent fixtures mounted in continuous rows, submit scaled drawings prepared by the manufacturer showing all details of construction, lengths of runs, pendant and power feed locations, accessories, finishes, and lists of materials.
 4. Developer Design/Builder to provide the manufacturer with accurate field dimensions where required.
 5. Wiring diagrams, power and control wiring.
- E. Wiring Diagrams shall detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- F. Coordination Drawings shall include reflected ceiling plans, sections, and other details drawn to scale and coordinating the following items:
1. Light fixtures
 2. Suspended ceiling components
 3. Structural members to which suspension systems for light fixtures will be attached
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets
 - b. Speakers
 - c. Sprinklers
 - d. Smoke and fire detectors
 - e. Occupancy sensors
 - f. Access panels
- G. Product Certificates shall be signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- H. Maintenance Data shall be provided for lighting fixtures and equipment to include in emergency, operation, and maintenance manuals specified in specifications section describing Operations and Maintenance Data.
- I. Special Warranties specified in this Section.
- J. Review of luminaire submittals which indicate voltage, mounting condition, or quantities shall not be considered to be approval of said voltage, mounting condition, or quantities. Developer Design/Builder shall field verify voltage and actual mounting condition and method.
- K. Product samples complete with housing, trim, specified lamp, and 8' cord with plug shall be submitted if requested.

1.05 SUBSTITUTIONS

- A. Comply with requirements of specification section describing Product Requirements.
- B. Lighting fixtures are based on the fixture types and manufacturers specified. If substitution of fixtures other than those specified is desired, product information must be submitted to the Lighting Designer 21-days prior to the close of the bid period. No requests for substitution will be accepted after this date.

- C. Substitution requests shall include all information required under in paragraph 1.6 - SUBMITTALS. Requests for approval shall be accompanied by a working fixture sample (including lamps, cord and plug). Provide the name of at least one installation where each proposed substitute has been installed for at least six months. Provide the name and telephone number of the County's Representative, and Architect of Record.
- D. Equipment delivery lead time shall not be held as a valid reason for requesting luminaire substitution unless luminaire lead time from specified manufacturer is in excess of 14 weeks. It shall be the sole responsibility of the Developer Design/Builder to determine necessary equipment lead times, deliver submittals for review in a timely fashion, and place orders accordingly to ensure timely delivery.
- E. When requesting a substitution, Developer Design/Builder shall provide unit and extended pricing for specified luminaire, unit and extended pricing for proposed alternate, and unit and extended savings to County to be realized by accepting proposed alternate. If requested, Developer Design/Builder shall provide unit pricing for each luminaire type specified to provide a baseline comparison for substitution request.
- F. The proposed substitutions must be installed at the bidder's expense in a location selected by the County's Representative.
- G. If the substitution request is accepted, approval will be in the form of an addendum to the specifications issued to all registered plan holders.
- H. A maximum of two substitution requests shall be reviewed for any single fixture type. If a substitution has not been approved following this process, the Developer Design/Builder shall provide the specified fixture.

1.06 CUSTOM LIGHT FIXTURES

- A. All custom light fixtures require a prototype to be submitted prior to commencement of fabrication. The purpose of the prototype will be to review construction, lamp placement within the fixture, lamp type, optical assembly, finishes, etc. Modifications may be required as a result of the prototype review. These modifications and others that do not materially affect the cost of the fixture shall be incorporated at no additional cost to the County.

1.07 COORDINATION

- A. Coordinate layout and installation of light fixtures with ceiling system and other construction that penetrates ceilings or is supported by them including mechanical system, fire suppression, AV, and partition assemblies.
- B. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed fixtures shall have frames that are compatible with the ceiling systems.
- C. Coordination Meetings: Hold first meeting before submittal of shop drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area. Coordinate depth and location of all light fixtures and ductwork in all areas.

1.08 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive County of other rights County may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Developer Design/Builder under requirements of the Contract Documents.
- B. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Special Warranty Period for Electronic Ballasts: Five years from date of manufacture, but not less than four years from date of Substantial Completion.

2. Special Warranty Period for Electromagnetic Ballasts: Manufacturers' standard warranty, but not less than three years from date of manufacture.
- C. Special Warranty for Fluorescent Lamps: Manufacturer's standard form, made out to County and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Catalog series numbers specified on the plans represent the type and style of fixture. The fixture size shall correspond with the wattage indicated or the actual length of the fixture as indicated.
- B. Numbers are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, type of lamp, type of ballast, finish trim, ceiling type, mounting hardware or special requirements as specified as required by the particular installations. Acceptable manufacturers and series numbers are listed. The manufacturer listed shall provide complete fixtures equaling or exceeding the written specifications. Verify these requirements and order fixtures as required for a complete and fully operational installation per the contract documents and per code.

2.02 GENERAL MATERIAL REQUIREMENTS

- A. Fixtures shall be free of light leaks while providing sufficient ventilation of lamps to provide the required photometric performance. Ballasts and transformers shall be adequately vented.
- B. Lampholders shall hold lamps securely against normal vibration and maintenance handling.
- C. Light fixtures containing lamps which require protective shielding shall be furnished with a tempered glass lens or approved unbreakable lens UL listed for the application.
- D. Metal Parts shall be free from burrs, sharp corners, and edges. Metal work shall be free from tool marks and dents and shall have accurate angles bent as sharply as compatible with the gauges of the required metal. Intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. All miters shall be in accurate alignment with abutting intersection members.
- E. Sheet Metal Components shall be steel, unless otherwise indicated. Components shall be formed and supported to prevent warping and sagging. Luminaires to be painted after fabrication. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.
- F. Fixture hardware to comply with the following material standards: For steel and aluminum fixtures, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. For bronze fixtures, all hardware shall be stainless steel or bronze.
- G. Doors, Frames, and other internal access to the lighting fixture shall be smooth operating, free from light leaks under normal operating conditions, and designed to permit relamping without use of tools.
- H. Provide supplemental safety device or arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Safety devices shall be detachable if necessary and shall not interfere with fixture performance, maintenance, or the seating of any fixture element. Safety device shall not be visible during normal fixture operation and from normal viewing angles.

- I. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 %.
 2. Specular Surfaces: 90 %.
 3. Diffusing Specular Surfaces: 75 %.
 4. Laminated Silver Metalized Film: 90 %.
- J. Minimum footcandle levels shall be per IES recommendations and for areas listed below are as follows:
1. General office - 50 fc
 2. Private office - 50 fc
 3. Corridors and hallways - 20 fc
 4. Electrical rooms and maintenance areas - 30 fc
 5. Parking structure
 - a. Arrive aisles and parking areas - 5 fc
 - b. Parking structure entrance and exists - 50 fc
 6. Elevator lobbies - 10 fc
- K. Reflector cones shall adhere to the following criteria:
1. Cones designed for vertically mounted lamps shall provide a minimum of 45 degree cutoff of lamp and lamp image. Cones designed for horizontally mounted lamps shall provide a minimum of 55 degree cutoff of lamp and lamp image. There shall be no visible lamp flashing in the cone.
 2. Plastic material shall not be used for reflector cones, unless otherwise specified.
 3. Cones shall not be permanently fastened to the housing or ceiling and shall be removable without tools. Retention devices shall not deform the cone or be visible from normal viewing angles.
 4. Trim shall be flush to the finished ceiling without gaps or light leaks. Where the flange trim is separate from the cone, it shall have the same finish as the reflector cone.
 5. Reflector cones shall be of uniform gauge, not less than 0.032" thick, high purity aluminum Alcoa 3002 alloy. Cones shall be free of spin marks or other defects.
 6. Manufacture cone using the Alzak process. Refer to the fixture schedule for cone color and finish (i.e. Specular or diffuse) requirements. For compact fluorescent fixtures, finish shall eliminate iridescence.
- L. Lenses, Diffusers, Covers, and Globes shall be 100 % virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
1. Plastic, polycarbonate and acrylic shall be UV stabilized and shall have high resistance to yellowing and other changes due to aging, exposure to heat and ultraviolet radiation.
 2. Lens thickness shall be 0.125" (3 mm) unless other thickness is indicated.
 3. Lenses shall have uniform brightness throughout the entire visible area.
- M. Adjustable light fixtures shall have positive locking devices to fix the aiming angle. Fixtures shall be capable of being re-lamped without adjusting the aiming angle.
- N. Each lighting fixture that has a lamp with an oval shape beam pattern or a spread lens that defines beam orientation shall contain lamp or lens locking devices to insure that lamp or lens orientation is not disturbed during future lamp replacement or cleaning.
- O. All fixtures and ballasts must operate within the temperature limits of their design and as specified by Underwriters' Laboratories, Inc. in the applications and mounting conditions herein specified.
- P. Fixtures recessed in suspended ceilings where the space above the ceiling is either an air supply or return plenum shall conform to NEC Article 300-22.

- Q. Provide plaster frame for recessed light fixtures mounted in other than T-bar ceilings. Verify mounting with architectural reflected ceiling plan before ordering light fixtures.
- R. Provide wire guards on all fluorescent open strip type fixtures.
- S. For weatherproof or vapor tight installations, painted finishes of fixtures and accessories shall be weather resistant enamel using proper primers or galvanized and bonderized epoxy, so that the entire assembly is completely corrosion resistant for the service intended. Exterior finishes shall have an outdoor life expectancy of not less than 20 years without any visible rust or corrosion. Where aluminum parts come into contact with bronze or steel parts, apply a coating material to both surfaces to prevent corrosion.
- T. Fixtures for use outdoors or in areas designated as damp locations shall be suitably gasketed to prevent the entrance of moisture. Provide approved wire mesh screens for ventilation openings. Dissimilar metals shall be separated by non-conductive material to prevent galvanic action.

2.03 LUMINAIRES

- A. Furnish products as specified herein and per provisions in Division 1.
- B. Manufacturers: Lithonia, Lightolier, Prudential, Widelight and Morelight. Substitutions: Under provisions of Division 1.
- C. Install ballasts, lamps, and specified accessories at factory.
- D. Office areas and meeting rooms:
 - 1. Type A Lighting Fixture: 2X2 recessed direct/indirect high performance energy saving 2 lamp louvered light fixture with perforated metal diffuser (Lithonia #2AV-G-224T5HO-MPR-Mvolt-GEB10PS).
 - 2. Type A1 Lighting Fixture: 2X2 recessed direct/indirect high performance energy saving 2 lamp louvered light fixture with perforated metal diffuser, on emergency generator circuit (Lithonia #2AV-G-224T5HO-MPR-MVOLT-GEB10PS).
 - 3. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- E. Served, Basement Programmed Spaces, Utility Corridors, Staff Areas, Coffee/Copy and Un-assigned Spaces:
 - 1. Type B Lighting Fixtures: 2X2 recessed direct/indirect high performance energy saving 2 lamp louvered light fixture with prismatic diffuser (Lithonia #2SP-217-MVOLT-A12-GEB101S).
 - 2. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- F. Toilets, Corridors, Conference Rooms and Offices:
 - 1. Type C Lighting Fixtures: 6 inch round recessed open compact fluorescent downlight with gold alzaic reflector and white trim (Kurt Versen P926 Series).
 - 2. Type C1 Lighting Fixtures (Offices Only): 6 inch round recessed open compact fluorescent wall washer with gold alzaic reflector and white trim (Kurt Versen P905 Series).
 - 3. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- G. Mechanical, Plumbing and Electrical Rooms, Janitor Closets, Exit Stairs:
 - 1. Type D Lighting Fixtures: 4'-0" long surface fluorescent with high impact wraparound prismatic diffuser with 2 circuit input for connection to emergency power (Prudential #P5160 Series)
 - 2. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.

- H. Conference Rooms:
1. Type E Lighting Fixtures: 5'-0" long decorative pendant indirect fluorescent fixture with double parabolic reflector (Louis Poulsen #RED-2/35W/T5/no mini-bi-pin 277 natural painted aluminum).
 2. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- I. Dining Rooms:
1. Type F Lighting Fixtures: 4'-0" and 8'-0" long decorative fluorescent pendant fixture (Focal Point Twelve Series).
 2. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- J. Cove Lighting:
1. Type G Lighting Fixtures: Low profile fluorescent staggered strip light 2 lamp row (Lithonia EM35-254T5HO-MVOLT-PLF2)
 2. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- K. Exit Signs:
1. Type H Lighting Fixtures: LED exit sign with red letters on clear acrylic background (Lithonia #RP Series)
 2. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- L. Parking Structure:
1. Type J Lighting Fixtures: 16 inch round LED surface fixture with polycarbonate lens (Phillips Exceline #PROLYTER PGQ Series).
 2. 16 inch round LED surface fixture with polycarbonate lens, on emergency generator circuit (Phillips Exceline #PROLYTER PGQ Series).
 3. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- M. Parking Structure Roof Deck:
1. Type K Lighting Fixtures: 20'-0" LED area standard with Type V distribution (Phillips Widelight #OP2L Series)
 2. Type K1 Lighting Fixtures: 20'-0" LED area standard with Type V distribution, on emergency generator circuit (Phillips Widelight #OP2L Series)
 3. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- N. Parking Structure Stairwells and Elevator Lobby:
1. Type N Lighting Fixtures: 4'-0" surface fluorescent with high impact vandal resistant acrylic diffuser and tamperproof screws; on emergency generator circuit.
 2. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.
- O. Generator Yard:
1. Type P Lighting Fixtures: Surface mounted HID wall pack with high impact acrylic diffuser UL listed for wet locations and 90 minute emergency battery pack (Lithonia #INDX12125-N50243).

2. Control: Low voltage wall switches, occupancy sensors, room control unit, photocell for daylight harvesting and time clock for programmed areas.

P. Developer/Design Builder shall ensure the following efficiency values:

Lamp Type	Recommended
Four-Foot Lamps	
T8, 32 watts	2800 lumens or more
T12, 34 watts	2800 lumens or more
Eight-Foot Lamps	
T8,59 watts	5700 lumens or more
T12,60 watts	5600 lumens or more
U-Tube Lamps	
T8/U,31-32 watts	2600 lumens or more
T12/U,34 watts	2700 lumens or more

Q. Fluorescent Ballast:

Lamp Type	# of Lamps	Recommended BEF
Four-Foot and U-Tube Lamps		
T8,32 Watts	1	2.54 or higher
	2	1.44 or higher
	3	0.93 or higher
	4	0.73 or higher
T12,34 Watts	1	2.64 or higher
	2	1.41 or higher
	3	0.93 or higher
Eight-Foot Lamps		
T8,59 Watts	2	0.80 or higher
T12,60 Watts	2	0.80 or higher

R. HID Luminaires:

Upward Efficiency	Lamp Wattage	Closed Fixture (HC) LER	Open Fixture (HO) LER
		Recommended	Recommended
Metal Halide Lamps			
0%	150-399	41 or higher	insuff. data
	400-999	53 or higher	59 or higher
	≥1000	77 or higher	insuff. data
1%-10%	150-399	56 or higher	insuff. data
	400-999	62 or higher	64 or higher
	≥1000	insuff. data	88 or higher
>20%	150-399	62 or higher	77 or higher
	400-999	65 or higher	insuff. data
	≥1000	insuff. data	insuff. data

High Pressure Sodium Lamps			
0%	150-399	58 or higher	68 or higher
	400-999	63 or higher	84 or higher
	≥1000	insuff. data	insuff. data
1%-10%	150-399	64 or higher	63 or higher
	400-999	82 or higher	89 or higher
	≥1000	insuff. data	109 or higher
11%-20%	150-399	insuff. data	78 or higher
	400-999	insuff. data	94 or higher
	≥1000	insuff. data	insuff. data
>20%	150-399	75 or higher	77 or higher
	400-999	insuff. data	insuff. data
	≥1000	insuff. data	insuff. data

S. Downlight Luminaires:

Luminaire Type (NEMA designation)	Recommended LER
Compact Fluorescent Lamps (CFLs)	
Open Optics	29 or higher
Baffled Optics	21 or higher
Lensed Optics	24 or higher
Metal Halide Lamps	
Open Optics	35 or higher
Lensed Optics	30 or higher

T. Fluorescent Luminaires:

Luminaire Type (NEMA Designation)	Number of Lamps	Recommended LER
2' x 4' Recessed		
Lensed (FL)	2	62 or higher
	3	61 or higher
	4	61 or higher
VDT-Preferred Louvered (FP)	2	50 or higher
	3	51 or higher
	4	54 or higher
Plastic Wraparound		
Four-Foot (FW)	2	63 or higher
	4	62 or higher
Strip Lights		
Four-Foot (FS)	1	70 or higher
	2	70 or higher
Industrial		
Four-Foot (FI)	2	67 or higher
Eight-Foot (FI)	2	68 or higher

2' x 2' Recessed, for U-Tube Lamps		
VDT-Preferred	2	41 or higher
Lensed	2	49 or higher

U. Compact Fluorescent Lamps:

To Replace Incandescent Bulb Rated at	Necessary Light Output (Lumens)	Typical CFL Replacement Wattage	Recommended CFL Lumens per Watt (lpW)
Bare Bulbs			
40 watts	495 or more	11 - 14 watts	45 lpW or more
60 watts	900 or more	15 - 19 watts	60 lpW or more
75 watts	1200 or more	20 - 25 watts	60 lpW or more
100 watts	1750 or more	≥29 watts	60 lpW or more
Reflector Type Bulbs			
50 watts	550 or more	17 - 19 watts	33 lpW or more
60 watts	675 or more	20 - 21 watts	40 lpW or more
75 watts	875 or more	≥22 watts	40 lpW or more

2.04 INCANDESCENT/TUNGSTEN HALOGEN FIXTURES

- A. Tungsten halogen is a type of incandescent light source and will be held to the same requirements as incandescent fixtures. Tungsten halogen lamp seal temperature shall not exceed 350 degrees Celsius with an ambient temperature of 25 degrees Celsius when tested per UL Bulletin 57, Paragraph 328-334. Submit certified heat test by independent testing laboratory.

2.05 FLUORESCENT FIXTURES

- A. Housing shall be minimum code gauge steel or rigid aluminum construction painted after fabrication with high reflectance white paint unless otherwise coordinated with the County's Representative.
- B. Shielding shall adhere to the following criteria:
1. Egg crate louvers shall be aluminum, continuously bound in a perimeter channel frame. Frame, louver, and support shall be painted to a finish as selected by County's Representative.
 2. Parabolic louvers shall be Alzak aluminum with a low iridescent finish, specular, semi-specular, or American Matte as indicated.
 3. Flat translucent diffuser shall be 100% virgin acrylic and shall have matte finish on exterior side. Diffuser shall be of sufficient density to completely obscure lamp image.
 4. Flat clear lenses shall be injection molded 100% virgin acrylic or clear tempered glass, thickness as required per program.
 5. Clear patterned lenses shall be injection molded 100% virgin acrylic. For lenses with convex pattern of prisms or cones, specified minimum thickness refers to distance from the flat surface to the base of the pyramids or cones, or to the thickness of undisturbed material. For lenses with concave pattern, specified minimum thickness refers to overall thickness of the material. Lenses shall fully eliminate lamp image when viewed from all directions between 45-90 degrees from vertical. From 0-45 degrees the ratio of maximum brightness to minimum brightness shall not exceed 3:1. Minimum thickness shall not be less than 0.125" with a minimum weight of 8 ounces per square foot.
 6. Parawedge louvers shall be injection molded plastic with specular silver anti-static finish.
- C. Doorframes shall be supplied with concealed hinges and latching. Provide mitered corners with no gaps or light leaks.

- D. Lamp mounting shall adhere to the following criteria:
1. Lamps used in rapid start circuits 430 ma and below shall be mounted within ½" of grounded metal of equal length to the lamp. For lamps operating at 800 ma and 1500 ma, mount within 1" of grounded metal of equal length to the lamp.
 2. Provide one grounding lamp holder per lamp for rapid start circuits using single lamp ballasts.

2.06 FLUORESCENT LAMP BALLASTS

- A. General Requirements: Provide lamp-ballast systems approved by the manufacturer to maximize lamp performance and to qualify for manufacturer's extended lamp and ballast warranties. Unless otherwise indicated, provide products manufactured by one of the following; Osram/Sylvania, Magnetek, or Advance, with features that include the following:
1. Ballasts shall be Instant Start, Rapid Start or Programmed Start technology, depending on location and application.
 2. Life: Ballasts shall provide normal rated lamp life as stated by lamp manufacturers.
 3. Electronic integrated circuit, solid-state, full-light-output, energy efficient type, compatible with lamps and lamp quantities specified.
 4. Certifications: Underwriters Laboratories (UL) listed Class P, Certified Ballast Manufacturer (CBM), and Electrical Testing Laboratory (ETL).
 5. Comply with ANSI C82.11
 6. Operating voltage: shall match voltage of circuit. Ballasts shall operate lamps correctly within 10% voltage variation without damaging ballasts.
 7. Operating Frequency: 60 Hz.
 8. Lamp Operating Frequency: 20 kHz or higher.
 9. Flicker: Ballasts shall operate lamps with no visible flicker.
 10. Power Factor: 0.95 or higher.
 11. Total Harmonic Distortion Rating: Less than 10%.
 12. Ballast Factor: 0.85 or higher, or, as otherwise required per program.
 13. Lamp Current Crest Factor: 1.7 or less.
 14. Sound Ratings:
 - a. A for 430 ma and 265 ma
 - b. B for 800 ma
 - c. C for 1500 ma
 15. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
 16. Transient Protection: Comply with IEEE C62.41, Category A or better.
 17. Interference: Comply with 47 CFR, Chapter 1, Part 18, and Subpart C for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 18. Operating Temperatures: Ballasts shall operate in ambient temperatures up to 105 degrees Fahrenheit (40 degrees Celsius) and shall have thermal protection.
 19. Compact fluorescent lamp end of life detection and shutdown circuit.
 20. Automatic lamp starting after lamp replacement.
 21. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation condition without modification or rewiring in the field.
 22. Utility Funding: Ballasts shall meet utility requirements for projects which are applying for utility rebates or funding.
- B. Dimming Ballasts: Comply with general and fixture-related requirements above for electronic ballasts. Unless otherwise indicated, provide products manufactured by one of the following; Osram/Sylvania, Lutron, or Advance, with features that include the following:
1. Provide ballasts with dimming capability (1%, 5%, 10%) as indicated, (Provide 5% dimming capability if not specified).

2. Compatibility: Certified by manufacturer for use with specific dimming system indicated for use with each dimming ballast.
3. Ballast shall maintain constant light output for a line voltage variation of +/- 10%.
4. Ballast shall provide continuous, flicker-free dimming over the entire dimming range.
5. Ballast shall not require lamps to come to full brightness before striking lamps at any dimmed light level.

C. Low Temperature Ballasts shall be as follows:

1. Temperatures 0 Degrees Fahrenheit (Minus 17 degrees Celsius) and Higher: Electronic or electromagnetic type rated for 0 degrees Fahrenheit (minus 17 degrees Celsius) starting and operating temperature with indicated lamp types.
2. Temperatures: Minus 20 degrees Fahrenheit and Higher: Electromagnetic type designed for use with indicated lamp types.

2.07 HIGH INTENSITY DISCHARGE (HID) FIXTURES

- A. Housing shall be minimum code gauge steel or rigid aluminum construction painted after fabrication with high reflectance white paint. Steel housing shall be bonderized or otherwise rust protected.
- B. Lamp holder housing shall be cast aluminum with integral heat radiating fins to insure cool lamp base operation, unless otherwise noted.
- C. Fixtures which will not accommodate open fixture rated lamps shall have clear tempered glass lenses, unless otherwise noted.

2.08 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. General Requirements: Unless otherwise indicated, provide products manufactured by one of the following: Advance, Holophane, or Aromat. Provide electronic metal halide ballasts for all metal halide fixtures utilizing ceramic metal halide lamps of 150W or less.
- B. Metal Halide Electronic Ballasts shall include the following features:
 1. Lamp end of life detection and shutdown circuit.
 2. Sound Rating: A
 3. Total Harmonic Distortion Rating: Less than 15%.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp current Crest Factor: 1.5 or less.
 6. Power Factor: 0.90 or higher.
 7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 8. Protection: Class P thermal cutout.
 9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
 10. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
 - a. High-Level Operation: 100% of rated lamp lumens.
 - b. Low-Level Operation: 35%/50% of rated lamp lumens.
 - c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
 11. Continuous Dimming Ballast: Dimming range shall be from 100% to 35% of rated lamp lumens without flicker. Lamp color shift shall be consistent from fixture to fixture.
 - a. Ballast input watts: Reduced to a maximum of 50% of normal at lowest dimming setting.

- b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
- C. Metal Halide Electromagnetic Ballasts shall include the following features:
 - 1. Operating voltage: Match voltage of circuit. Confirm voltage requirements with electrical requirements.
 - 2. Comply with ANSI 82.4.
 - 3. Type: Constant wattage autotransformer or regulating high-power-factor type, except for metal halide lamps below 175 watts without igniters where high resistance auto transformer type is acceptable.
 - 4. Minimum Starting Temperature: Minus 22 degrees Fahrenheit (minus 30 degrees Celsius) for single lamp ballasts.
 - 5. Normal Ambient Operating Temperature: 104 degrees Fahrenheit (40 degrees Celsius).
 - 6. High Power Factor: 90% minimum.
 - 7. Open circuit operation that will not reduce average life.
 - 8. Each ballast shall be individually protected by an in-line fuse in a Bussman fuseholder type HLR for 120V and 277V, type HEX for 208V, 240V, and 480V.
 - 9. Encapsulation: Manufacturer's standard epoxy-encapsulated model designed to minimize audible fixture noise. Ballast shall be rated "low noise" or "extra quiet".
- D. High Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 194 degrees Fahrenheit (90 degrees Celsius).
 - 1. Instant Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballast, and mogul sockets up to 150W.
 - a. Restrike Range: 105 to 130V ac.
 - b. Maximum Voltage: 250V peak or 150V ac RMS
 - 2. Minimum Starting Temperature: Minus 40 degrees Fahrenheit.
 - 3. Open-circuit operation shall not reduce average lamp life.
- E. Auxiliary, Instant-on, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when HID lamp reaches approximately 60% light output.

2.09 LAMPS

- A. Provide products manufactured by one of the following: Osram/Sylvania, General Electric, Philips, Ushio, Venture, or approved equal.
- B. Provide lamp-ballast systems approved by the manufacturer to maximize lamp performance and to qualify for manufacturer's extended lamp and ballast warranties. All lamps of the same type are to be provided by the same manufacturer.
- C. Lamp each fixture with the proper quantity of lamps of the type specified.
- D. Incandescent, including Tungsten Halogen Lamps:
 - 1. Lamps with diodes are not acceptable.
 - 2. General Service lamps: Inside frosted, 120V, filament lamps with a minimum 1000 hours rated life.

3. Low Voltage (MR-11, and MR-16) Tungsten Halogen lamps operating at 12 volts shall consist of a precision faceted dichroic glass reflector allowing heat to be transmitted backwards while reflecting light forwards in a controlled beam. Coating on back of lamp shall be sufficiently dense and even to prevent light from escaping through the back of the reflector. Lamp shall use Constant Color (GE), Color Consistent (Philips) or similar technology. Lamps shall have the following minimum lamp life characteristics:
 - a. MR-11 (20 and 35 watt) 3000 hours
 - b. MR-11 (50 watt) 2000 hours
 - c. MR-16 (35, 50, and 75 watt) 4000 hours

E. Fluorescent Lamps:

1. All fluorescent lamps shall be tri-phosphor technology.
2. Correlated Color Temperature: 3500 K
3. Minimum Color-Rendering Index: 85 CRI.
4. Fluorescent Lamps provided are required to have passed the latest Federal TCLP testing.
5. Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

F. High Intensity Discharge (HID) Lamps

1. Metal halide lamps used in interior applications shall be ceramic metal halide for wattages that do not have ceramic metal halide technology, provide phosphor coated, color corrected lamps with a minimum CRI of 80.
2. Metal halide lamps used in exterior applications shall be clear lamps, unless otherwise noted.
3. Seasoning: HID lamps shall be seasoned after installation by operating the lamps for 100 hours without turning off.
4. Mercury vapor lamps are not acceptable.

G. LED Lamps:

1. Furnished with lighting fixture.

2.10 SOCKETS

- A. Incandescent sockets shall be porcelain for medium or mogul screw base. For other lamp types, as required by base type.
- B. Fluorescent sockets shall be suitable for lamp and ballast type specified.
- C. HID sockets shall be porcelain for mogul or medium base lamps, pulse rated as required. Sockets shall be keyed for all position oriented lamps. For other lamp types as required by base type.

2.10 WIRING

- A. All wiring shall be as required by code for fixture wiring.
- B. All flexible cord wiring between fixture components or to electrical receptacles and not in wireways shall have a minimum temperature rating of 105 degrees Celsius.
- C. Cords shall be fitted with proper strain reliefs and watertight entries where required by application.
- D. No internal wiring shall be visible at normal viewing angles.

- E. For Master/Slave fixtures: Supply ballasts in adjacent fixtures to operate one or more lamps in the adjacent fixtures as indicated. For single lamp fixtures, provide a two-lamp ballast for two adjacent fixtures. For three-lamp fixtures, provide one two-lamp ballast for the outboard lamps in each fixture and an additional two-lamp ballast for the center lamp in each of two adjacent fixtures.
- F. For Tandem Wired fixtures in continuous rows, and as otherwise required per program, supply ballasts and wiring to control all inboard lamps together and all outboard lamps together.

2.11 FIXTURE SUPPORT COMPONENTS

- A. Comply with Section pertaining to General Electrical Provisions, paragraph entitled Equipment anchorage, Support, Seismic Restraint, and Bracing for fixture support and bracing.
- B. Where the ceiling is of insufficient strength to support the weight of the lighting fixtures, provide additional framing from building structure to support luminaires as required.
- C. Single-Stem Hangers shall be 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish shall be the same as the luminaire.
- D. Twin-Stem Hangers shall be two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish shall be the same as the luminaire.
- E. Rod Hangers shall be 3/16-inch minimum diameter, cadmium-plated threaded steel rod.
- F. Wires shall be ASTM A 641/A 641M, Class 3, soft temper, zinc coated steel, 12 gauge.
- G. Wires for humid spaces shall be ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gauge.
- H. Hook Hangers shall be integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- I. Aircraft Cable Support shall use cable, anchorages, and intermediate supports recommended by fixture manufacturer.
- J. Hangers for Pendant Industrial Fixtures shall be heavy duty No. 8 jack chain with hangers, "S" hooks, mounting. Straps, and all required accessories for complete installation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure.
- D. Install recessed luminaires to permit removal from below.
- E. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- F. Install clips to secure recessed grid-supported luminaires in place.

- G. Install wall-mounted luminaires at height as required per program.
- H. Install accessories furnished with each luminaire.
- I. Connect luminaires to branch circuit outlets provided under Division 26.
- J. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- K. Install specified lamps in each luminaire.
- L. Interface with air handling accessories furnished and installed under Division 23.
- M. Ground and bond interior luminaires in accordance with Division 26.
- N. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- O. Mounting height as indicated is from finished floor to bottom of pendant light fixture or to the center of the outlet box for wall mounted light fixtures unless otherwise noted. Submit mounting height locations to County's Representative for review and approval.
- P. Mounting height may also be determined as the length of the pendant below finished ceiling.
- Q. Provide all necessary hanging or mounting devices and accessories for all fixtures. Verify the types needed for various ceiling conditions. Plaster rings shall be provided where required, unless otherwise determined.
- R. Verify weight and mounting method of all fixtures prior to ordering and provide suitable support. Coordinate with other trades the installation of fixtures that require additional blocking or support. Fixture mounting assemblies shall comply with all local seismic codes and regulations.
- S. In accessible suspended ceilings, fixture wiring connection, including equipment grounding conductor, is to be through use of 72-inch maximum flexible conduit from a rigidly supported junction box.
- T. Wire per requirements of branch circuit installation. Properly ground each fixture.
- U. Light fixtures located in recessed ceilings with a fire resistive rating of 1 hour or more shall be enclosed in an approved fire resistive rated box equal to that of the ceiling.
- V. Install fixtures with vent holes free of air blocking obstacles.
- W. Developer Design/Builder shall be responsible for adjusting aperture flanges or rings on all recessed fixtures to be flush with the finished ceiling. Fixture trim shall completely conceal ceiling opening.
- X. Adjust variable position lampholders for proper lamp position prior to fixture installation.

3.02 FIXTURE SUPPORT

- A. Comply with specifications section describing General Electrical Provisions, paragraph entitled Equipment Anchorage, Support, Seismic Restraint, and Bracing for fixture support and bracing.
- B. Provide all necessary hanging or mounting devices for all fixtures, verify the type needed for various ceiling conditions. Plaster rings shall be provided where required.
- C. Provide two slack No. 12 safety wire hangers or threaded rods for each recessed mounted fluorescent fixture. Secure from opposite corners of each fixture and fasten to structure above, independent of ceiling system. Locate supports not more than 6 inches from fixture corners.

- D. Developer Design/Builder's electrical contractor is to provide and install locking clips for all fixtures installed in suspended ceilings. The locking clip is to be attached to the fixture with a sheet metal screw or similar device and secured to the main or supporting T-bar runner to guarantee a secure installation. Clips shall be located at or near fixture corners.
- E. Fixtures which are of a size smaller than the ceiling grid shall be located as indicated on the reflected ceiling plans. Fixtures shall be supported with at least two 3/4 inch metal channels spanning and secured to the ceiling tees.
- F. Metal decking shall not be pierced for luminaire support.
- G. Where pendants or rods are longer than 48 inches, brace to limit luminaire swinging.
- H. Brace suspended luminaires installed near ducts or other mechanical elements so that they do not swing into obstructions.
- I. Wall mounted light fixtures shall be supported from four-square outlet box plaster ring and from wall at non-feed end with two 1/4-inch bolt for gypsum board walls or 1/4-inch Hilti-Quick bolts for existing concrete wall.

3.03 INCANDESCENT FIXTURES

- A. Surface or Pendant Type: Attach to heavy formed steel straps attached to the outlet box by means of threaded stems with locknuts, or directly to the outlet box where the fixture is specifically so designed.
- B. Recessed Type in Accessible Ceilings: Mount in frames suitable for the ceiling with the recessed portion of the fixture securely supported from the ceiling opening by use of a metal trim ring.
- C. Recessed Type in Non-accessible Ceilings: As specified for mounting in accessible ceilings, except provide access to wiring through the ceiling opening for the fixture.

3.04 COMPACT FLUORESCENT FIXTURES

- A. Install as for incandescent fixture, except where special provisions are required for ballast arrangement; provide access to ballasts in all cases.

3.05 FLUORESCENT FIXTURES

- A. Recessed Type: Provide four integral tabs (one at each corner) which rotate into position and lock on ceiling tees after fixture is lifted into the ceiling cavity or provide four clips similar to Caddy #535. Provide mounting frames suitable for the ceiling type. In addition, provide slack earthquake safety wire hangers secured diagonally from opposite fixture corners to structural members above suspended ceiling. Comply with Authority Having Jurisdiction.
- B. Wall Mounted Type: Support from four-square outlet box plaster ring and from wall at non-feed end with two 1/4 inch bolt for gypsum board walls or 1/4 inch bolts to pre-set inserts for concrete wall.
- C. Fluorescent lighting fixtures shall be switched as indicated. Four-lamp fixtures shown with 2-level switching shall be wired with lamps, 1, 4 and 2, 3 each on separate switch-legs for 2-level switching. Three-lamp fixtures shown with 2-level switching shall be wired with lamps, 1, 3 and 2 each on separate switch-legs for 2-level switching.
- D. If clearance above T-bar system is too restricted to "tip-in" fixture, coordinate with acoustic ceiling installer by leaving one cross T-bar off until the cross T-bar shall be secured into its proper place. Fluorescent fixtures installed in hidden spline type ceilings shall have supporting channels installed by Developer Design/Builder's ceiling contractor to adequately support the fixture without providing additional hangers from the structural ceiling above the suspended ceiling.
- E. Install air handling light fixtures with dampers closed and ready for adjustment.

- F. Surface Mounted Type:
 - 1. Where mounted on accessible ceilings, support from structural members above ceiling by means of hanger rods through ceiling or as approved.
 - 2. Continuous Runs of Fixtures:
- G. Pendant Mounted Type:
 - 1. Provide strong back channel entire fixture length unless light fixture is designed specifically to be self-supporting.
 - 2. Where suspended below accessible ceiling, provide structural support at suspended ceiling level from structural members above ceiling. Do not run hanger rods through ceiling.

3.06 HIGH INTENSITY DISCHARGE FIXTURES

- A. Install as for incandescent fixture, except where special provisions are required for ballast arrangement; provide access to ballasts in all cases.
- B. Provide an earthquake chain as noted above for each fixture when fixture is supported by the ceiling suspension system. Provide two chains for units larger than 250 watts or 12" x 24" in dimension.
- C. For fixtures with remote ballasts, isolate ballast from the structure.

3.07 LIGHTING CONTROL

- A. Provide branch circuiting in coordination with lighting control requirements of specification section 26 09 23 Lighting Control Devices and as otherwise required per program.

3.08 CLEANING AND ADJUSTING

- A. Remove protective plastic covers from light fixtures and fixture diffusers only after construction work, painting and clean-up are completed. Remove, clean, and reinstall all dirty lamps, reflectors and diffusers.
- B. Make final adjustment of aimable light fixtures and adjustable light settings for review and approval of the County's Representative during a scheduled period of time prior to the completion of the project, after normal business hours if required. Include all equipment and personnel expenses including overtime required for focusing.
- C. Fixtures, reflectors, and accessories which are damaged, blemished, or impregnated with fingerprints shall be replaced at the Developer Design/Builder's expense. All finishes shall be unmarred upon project completion.

3.09 FIELD QUALITY CONTROL

- A. Coordinate all testing procedures and schedule with the specification section describing Commissioning Agent – Demonstration and Training. All testing is to be documented with test procedures, results and initials of witnessing personnel and submitted to Commissioning Agent.
- B. Coordinate inspection and testing of Lighting Fixtures with specification section describing – Lighting Control Equipment.
- C. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- D. Replace all burned out lamps or inoperative lamps at the end of construction prior to County occupancy.
- E. Advance Notice: Give dates and times for field tests.

- F. Provide instruments to make and record test results. Verify that instruments are within the required accuracy range for the tests performed.
- G. Test as follows: Verify proper operation, switching and phasing of each fixture after installation.
- H. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

END OF SECTION