PART 1: GENERAL

1.01  Luminaires

A. This standard is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design for new construction and renovations. The responsibility of the engineer is to apply the principles of this section such that the University may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be justified through life cycle cost (LCC) analysis and submitted to the University for approval.

B. Lighting design shall meet the requirements of the ASHRAE 90.1-2010 as currently adopted by the State of Texas Energy Code and meet the recommended illumination levels of the current edition of the Illuminating Engineering Society of North America (IESNA) Lighting Handbook.

C. In addition the lighting design shall target lighting power densities a minimum of 25% below the values allowed in the ASHRAE 90.1-2010 Standard. For fluorescent lighting systems in new construction (or renovations with fixture replacements) and with typical ceiling heights of approximately 9 feet, this can be accomplished by using light colored wall finishes and 2-lamp high efficiency fixtures with the components specified below.

D. For renovations where fixture replacements are not desirable, high efficiency retrofit kits are available from fixture manufacturers and third party sources that provide efficiencies equal to new high efficiency fixtures.

E. Fluorescent luminaires that utilize double-ended lamps and contain ballast(s) that can be serviced in place shall have a disconnecting means either internal or external to each luminaire.

F. Do not use low pressure sodium, mercury vapor or standard incandescent lamps.

PART 2: PRODUCTS

INTERIOR LUMINAIRES

2.01  Fluorescent Lighting

A. Linear & Compact Lamps
   1. All linear fluorescent lamps installed within conditioned spaces shall be 4-foot straight tube, F28T8, 28-watt, high lumen output or 2-foot linear tube, F17T8 high lumen output type.
   2. All fluorescent lamps installed in unconditioned or refrigerated spaces shall be 4-foot straight tube, F32T8, 32-watt, high lumen output type.
3. All linear 17, 28 and 32 watt fluorescent lamps shall have a minimum rated life of 24,000 hours at 3 hours/start (instant start ballast), 95% or higher lumen maintenance
4. CCT of 4,100K and CRI ≥80
5. No eight-foot lamps allowed. Use combination of 4-foot lengths in 8 foot fixtures.
6. All screw and plug-in compact type fluorescent lamps installed within conditioned spaces shall operate by an electronic ballast with a power factor ≥60% for screw-in, ≥95% for plug-in, have a minimum rated lamp life of 10,000 hours at 3 hours/start, CCT of 4100K and CRI ≥80. CFLs installed in unconditioned spaces will have the additional requirement of being operated by an electronic ballast designed for unconditioned spaces.

B. Ballasts for Linear Lamps.

1. Fluorescent ballasts shall be high frequency (see item 12 below), U.L. approved, CBM certified to operate as specified one, two or three T8 lamps
2. Shall be integrated circuit type electronic constant wattage, constant light output
3. Shall have a power factor ≥95%
4. Shall have Class A sound rating
5. Shall be Class P thermally protected with automatic reset
6. Shall have a current crest factor less than 1.5
7. Shall have a total harmonic distortion (THD) <10%.
8. Where not separately switched three or four lamp fixtures may contain 3 and 4 lamp ballasts.
9. Ballast factor shall be 0.77 or 0.78 for Low Powered ballasts, between 0.85 and 0.90 for Normal Powered ballasts, and greater than 1.12 for high output ballasts.
10. Shall be instant start and classified as NEMA premium efficiency
11. Shall be designed to accommodate multiple voltage input, have built in anti-striation technology and utilize parallel lamp operation circuitry
12. Ballasts shall further be designed such that the output frequency to the lamps is high enough (typically 40 kHz or greater) so as to not interfere with common infrared devices

C. Prismatic acrylic diffusers for fluorescent fixtures shall be A12 pattern and at least 1/8” thick. Do not use styrene lenses.

D. Troffers with air handling capability are not allowed unless prior approval is given by the University.

2.02  HID Lighting

A. Mercury vapor and high & low pressure sodium lamps/luminaires are not allowed, only metal halide.

B. “Open type” fixtures should not be used indoors due to safety concerns.
C. PULSE Start Lamps  
1. Minimum rated lamp life shall be 20,000 hours for lamps >150 watt and 15,000 hours for lamps ≤150 watt  
2. CCT of 4000K and CRI ≥80

D. PULSE Start Ballasts  
1. HID ballast shall be multi-tap encased and potted thermally protected with a power factor ≥90%, constant wattage regulating and autotransformer type.  
2. Ballast ambient operating temperature range shall be 20 to +130°F. Ballasts shall be compatible to the lamps chosen for specific burning position, and compensate for the loss in efficiency.  
3. Provide isolation mounting and insulation of HID ballasts to reduce sound transmission or radiation.  
4. Each HID ballast shall have a fast acting primary inline fuse built into the fixture assembly by the manufacturer

2.03 LED Lighting

A. Screw-in retrofit lamps  
1. Shall meet DOE’s Energy Star or Design Light Consortium performance criteria for qualified screw-in or pin-based LED lamps.  
2. Shall have Lamp CCTs conforming to ANSI C78.377A color binning and utilize a 4 step MacAdam Ellipse Algorithm binning process (Philips Optibin or equal) within each retrofit lamp for greater CCT consistency.  
3. The CCT shall be 4000K unless otherwise approved by the University. The CRI shall be ≥80.  
4. Each lamp shall have a power factor ≥90%.  
5. Each lamp shall have total harmonic distortion (THD) <10%  
6. Shall be tested in accordance with LM-79-08 electrical and photometric measurements. Provide to the University, test results of each unique lamp.  
7. Shall be tested in accordance with LM-80 lumen depreciation test. Provide to the University, test results of each unique lamp. The L70 rated life result shall be a minimum of 25,000 hours for MR11, 16 and candelabra lamps; 40,000 hours for PAR 20, 30, 38 and BR30 lamps.  
8. Shall carry a 3 year minimum product warranty covering failure of ALL electrical components.

B. Luminaires  
1. The luminaire manufacturer shall be registered as a DOE Quality Advocate.  
2. Shall meet DOE’s Energy Star or Design Light Consortium performance criteria  
3. The luminaire manufacturer shall provide the manufacturer’s name of the LED being used in the luminaire.  
4. Shall be UL, or ETL, listed and be furnished complete with LEDs and power supplies.
5. LED light source packages, arrays or modules used in the luminaire shall be tested in accordance with LM-80 lumen depreciation test. Provide to the University, test results of each unique package, array or module. The L70 rated life result shall be a minimum of 50,000 hours.

6. Shall be tested in accordance with LM-79-08 electrical and photometric measurements. Provide to the University, test results of each unique luminaire.

7. The CCT shall be 4000K unless otherwise approved by the University. The CRI shall be ≥80.

8. Each luminaire shall have a power factor ≥90%.

9. In instances where the LED sources are to be mounted directly into the architecture, such as installing a strip LED by using an adhesive tape, the LED manufacturer shall provide a recommended heat sink volume adequate to achieve rated life at L70.

10. Each luminaire shall carry a 3 year minimum product warranty covering failure of ALL electrical components.

C. Power Supplies
   1. LED power supplies shall operate LEDs within the current limit specification of the manufacturer.
   2. Shall operate from 60Hz input source and have input power factor >90% and a minimum efficiency of 70% at full rated load of the driver.
   3. Shall have short circuit and overload protection.
   4. Shall have a minimum starting temperature of 0°F and a maximum case temperature rating of at least 70°C.
   5. Power supply output shall be regulated to +/-5% across published load range.
   6. Shall have a Class A sound rating.
   7. Shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47CFR part 15, non-consumer (Class A) for EMI/RFI.
   8. Shall contain no PCBs.
   9. Shall carry a 3 year minimum warranty from date of manufacturer against defects in material or workmanship, including a replacement, for operation at or below the maximum case temperature specification. (For LED lamps and internal power regulation components for defects resulting in a fixture lumen depreciation >30%.)
   10. Dimmable power supplies shall allow the light output to be maintained at the lowest control setting (prior to off) without dropping out.

D. Exit Signs
   1. Fixtures shall be LEC or LED, hard wired, perimeter or edge lit and preferably green on clear background type.
   2. If a back-up circuit is not available, then exit sign must be a battery back-up type with self-diagnostics that shall perform both 30-day and annual 90-minute tests with LED indication.
3. Where it is not possible to run conduit, photo luminescent type may be used but will require prior University approval.

4. Tritium gas exit signs are not allowed.

2.04 Induction Lighting

A. Lamps
   1. Minimum rated life of 100,000 hours
   2. CCT of 4100K and CRI ≥80

B. Ballasts
   1. Shall have Class A sound rating
   2. Shall have a UL Listed Class P, Type 1 outdoor
   3. CSA certified
   4. Shall have a 70 °C maximum case temperature
   5. Shall have ANSI C62.41 Category A transient protection
   6. Shall be designed to accommodate multi-voltage input
   7. System efficacy ≥70 LPW
   8. Total harmonic distortion <15%
   9. Power factor >90%

2.05 Exterior Luminaries

A. The performance criteria is the same as interior luminaires plus the additional or “in lieu of” criteria below:
   1. Lamp CRI shall be ≥70 for metal halide and LED light sources.
   2. Shall be durable, corrosion resistant fixtures that are readily maintainable and have minimal luminaire O&M costs
   3. Shall have light cut-off capability in order to minimize light pollution

B. The following luminaire descriptions are to establish design intent and to set a standard of quality. All luminaires shall be UL listed for wet or damp locations depending on the application.

   3. Area and Parking Lot Luminaires: Die-cast aluminum with nominal 1/8” wall thickness minimum cutoff luminaire equipped with a pulse-start metal halide lamp. The finish shall be corrosion-resistant polyester powder coating. If LED type is proposed, each will be evaluated on a case by case basis. See Design Standards Matrix for further information.
4. Pedestrian Walk, Plaza Light Standard (NO EXCEPTIONS to the following criteria:)
   a) **WAU15DMHMDA8TDC4** Fixture, Washington Series, Utility Grade, 150 Watt Metal Halide, Medium Base Socket, Multivolt (120/208/240/277) Factory wired at 277 Volt Only, (Q015543) Fixture Painted To Match Tiger Drylac Number RAL 7039, Symmetric Type V Optics, (Q015543) Trip Painted to Match Tiger Drylac Number RAL 7039, Spike Finial.
   b) Listed below are the components of the above mentioned pole and luminaire:
      - **LAMP**-Pulse Start, 150 watt metal halide, medium base socket, multivolt (120/208/240/277), 4000K CCT and CRI >= 70.
      - **#NY13C17CACSH** Pole, North Yorkshire, Fluted Cast, Cast Aluminum Post, 12’ 7” height, Custom Painted to Match Tiger Drylac RAL #7039.
      - **#WASH8-REPL** Optics, Type V, Symmetric, Lunar Optics Bottom Glass Assembly.
      - **#(AOL-18189)3370-AR7039-CTN** Optics, Top Relamping Glass with Trim Painted to match Tiger Drylac RAL #7039, Spike Finial.

**PART 3: EXECUTION**

3.01 **Interior Lighting**

A. Professional Service Provider (PSP) shall provide a room by room, computer generated photometric lighting design for approval. All calculations and data shall be presented in the design development and construction documents. Also provide tabulated results of lighting power density calculations in W/sf showing the actual, the ASHRAE 90.1-2010 allowable, and the 25% savings target per 1.01, C. Increased energy consumption of 10% or more must be reported in accordance with State Energy Code reporting procedures. REFER: http://www.seco.cpa.state.tx.us/tbec/statefunded.php.

B. Applications other than standard general purpose lighting (T8 lamps), require presentation to the University. Use of specialty or incandescent lamps requires prior University approval. Minimize the number of different lamp types used.

C. Emergency light fixtures shall have the LED emergency light indicator mounted such that it is visible from the ground.

D. Lay-in type fluorescent fixtures must have supports to structure at two opposing corners minimum. These supports are to be attached to the fixture housing. Ceiling supports are in addition to these supports.

E. Outlet boxes for lighting shall be 4” square or 4” octagon boxes mounted to the structure. These boxes may feed up to 4 light fixtures individually so that each fixture can be taken out of service without affecting the remainder of a circuit. Do not daisy chain light fixtures.
F. Stairwell light fixtures shall be located such that they may be reached safely with no more than an 8-foot ladder.

G. Require in-line fuses in fixtures which are not locally switched or where lighting circuit should not be turned off for safety reasons. (i.e. stairwells)

H. Egress lighting is required to illuminate an average of 1 foot candle in all paths of egress. Egress lighting shall be powered by emergency power automatic transfer switch (ATS) dedicated to Life Safety Loads. In buildings where emergency power circuits do not exist, install self-diagnostic emergency fluorescent ballasts and/or emergency lighting units. Ballasts shall provide a minimum of 90 minutes of code required emergency lighting at compliant illumination levels. Self-diagnostics shall perform both 30-day and annual 90-minute tests with LED indicator.

Battery packs for emergency ballasts shall be rated for high temperature operation and have a five year warranty. Battery audible alarms shall be disabled.

I. Lighting Designer shall verify installation meets design intent and operates properly unless a commissioning agent assumes this responsibility.

3.02 Exterior Lighting

A. All walkways, sidewalks, and parking lots shall be illuminated to levels recommended by the IESNA or as required to meet the University’s security needs, whichever is higher.

B. Upon request from Utilities & Energy Management Electrical Distribution Division, all engineering calculations of illumination levels and lighting power density shall be presented in construction documents.

C. Exterior lighting should be accomplished using lighting standards and wall packs. Lighting bollards, step and handrail lighting, tree lighting, and in-grade fixtures are not allowed.

D. Exterior and site lighting shall be shown on site plan. List distances between poles, fixtures and other site lighting devices.

E. Provide pole mounting height and pole base installation detail.

F. Lighting Designer shall verify installation meets design intent and operates properly unless a commissioning agent assumes this responsibility.
### Design Standards Lighting Matrix

<table>
<thead>
<tr>
<th>Use of Area</th>
<th>Type of Fixture</th>
<th>Lamps</th>
<th>Fixture Efficiency</th>
<th>Recommended average light levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom, library, office</td>
<td>Lensed or louvered fluorescent/LED</td>
<td>2 – T8, 28 or 17 watt, 4100K LED, 4000K</td>
<td>Fluorescent ≥80% LED ≥90 LPW</td>
<td>45 to 55 foot candles at work surface</td>
</tr>
<tr>
<td>Kitchen, machine shop, laboratory</td>
<td>Lensed or wrap around fluorescent/LED</td>
<td>2 to 3 – T8, 28 or 17 watt, 4100K LED 4000K</td>
<td>Fluorescent ≥80% LED ≥90 LPW</td>
<td>50 to 65 foot candles at work surface</td>
</tr>
<tr>
<td>Conference room</td>
<td>Lensed or louvered fluorescent/LED</td>
<td>2 – T8, 28 or 17 watt, 4100K LED, 4000K</td>
<td>Fluorescent ≥80% LED ≥90 LPW</td>
<td>35 to 45 foot candles at work surface</td>
</tr>
<tr>
<td>Lobby, lounge, reception, copy room, exhibit hall, dining, food court, locker, study and common area</td>
<td>Optional recessed can fluorescent/LED wall washers</td>
<td>CFL 4100K LED 4000K</td>
<td>Fluorescent ≥60% LED ≥40 LPW</td>
<td>NA</td>
</tr>
<tr>
<td>Restroom</td>
<td>Lensed fluorescent/LED</td>
<td>2 – T8, 28 or 17 watt, 4100K LED, 4000K</td>
<td>Fluorescent ≥80% LED ≥90 LPW</td>
<td>20 to 35 foot candles at 30”AFF</td>
</tr>
<tr>
<td>Corridor with exhibit space</td>
<td>Lensed or louvered fluorescent/LED</td>
<td>2 – T8, 28 or 17 watt, 4100K LED, 4000K</td>
<td>Fluorescent ≥80% LED ≥90 LPW</td>
<td>30 to 40 foot candles at floor level</td>
</tr>
<tr>
<td>Corridor with exhibit space</td>
<td>Optional recessed can fluorescent/LED wall washers</td>
<td>CFL 4100K LED 4000K</td>
<td>Fluorescent ≥60% LED ≥40 LPW</td>
<td>NA</td>
</tr>
<tr>
<td>Stairway, corridor</td>
<td>Commensurate with architectural finish of space/LED</td>
<td>2 – T8, 28 watt, 4100K LED 4000K</td>
<td>Fluorescent ≥80% LED ≥90 LPW</td>
<td>15 to 25 foot candles at floor level</td>
</tr>
<tr>
<td>Storage, Mach/Elect room</td>
<td>Industrial fluorescent</td>
<td>2 – T8, 28 watt, 4100K</td>
<td>Fluorescent ≥80%</td>
<td>20 to 30 foot candles at 30” AFF</td>
</tr>
</tbody>
</table>
### 5.26.50 – INTERIOR & EXTERIOR LIGHTING
DESIGN AND CONSTRUCTION STANDARD

<table>
<thead>
<tr>
<th>Location</th>
<th>Type/Description</th>
<th>Lumen Output</th>
<th>Color Temperature</th>
<th>Luminaire Type</th>
<th>Distance/Candles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer room</td>
<td>18 cell 3” parabolic i.e. Lithonia 2PM3N series</td>
<td>2 – T8, 28 watt, 4100K</td>
<td>Fluorescent ≥65%</td>
<td>35 to 45 foot candles at work surface</td>
<td></td>
</tr>
<tr>
<td>Exhibit</td>
<td>LED or fluorescent wall wash or track</td>
<td>Varies</td>
<td>Varies based on application</td>
<td>Varies based on application</td>
<td></td>
</tr>
<tr>
<td>Pedestrian walk</td>
<td>Pole-mount with cut off (see item B. 4 in Section 2.02 Exterior Luminaires for specifics)</td>
<td>Pulse start 150 watt MH, 4000K</td>
<td>NA</td>
<td>1 to 2 foot candles at ground level</td>
<td></td>
</tr>
<tr>
<td>UT shuttle stops</td>
<td>Varies</td>
<td>Pulse start MH or LED</td>
<td>Varies</td>
<td>10 to 20 foot candles at ground level</td>
<td></td>
</tr>
<tr>
<td>High bay areas</td>
<td>High bay fluorescent</td>
<td>Varies-T8, 28 watt, 4100k</td>
<td>Fluorescent ≥80%</td>
<td>Varies based on function of space</td>
<td></td>
</tr>
<tr>
<td>Building exterior wall packs</td>
<td>Cut-off wall pack with fluorescent or LED light source</td>
<td>CFL 42 watt, 4100K, LED 4000K</td>
<td>Fluorescent ≥80% LED ≥75 LPW</td>
<td>1 to 2 foot candles at ground level</td>
<td></td>
</tr>
<tr>
<td>Surface mounted canopy luminaires</td>
<td>Vapor tight</td>
<td>2 – T8, 32 watt, 4100K, LED 4000K, metal halide 4000K</td>
<td>Fluorescent or metal halide ≥80% LED ≥75 LPW</td>
<td>10 foot candles or IES recommended level</td>
<td></td>
</tr>
<tr>
<td>Areas requiring scaffolding to access</td>
<td>LED or induction</td>
<td>LED 4000K Induction 4100K</td>
<td>Varies based on application</td>
<td>Varies based on application</td>
<td></td>
</tr>
<tr>
<td>Parking garage, interior</td>
<td>LED or metal halide,</td>
<td>LED 4000K, metal halide 4000K</td>
<td>Varies based on application</td>
<td>Varies, see light control standards for further details</td>
<td></td>
</tr>
<tr>
<td>Area &amp; parking lot lighting</td>
<td>Pole-mount with cut off</td>
<td>Pulse start MH or LED</td>
<td>LED ≥75 LPW for typical shoebox type (deduct 10-15 LPW for house side shield optics)</td>
<td>8 to 10 foot candles at ground level</td>
<td></td>
</tr>
</tbody>
</table>

END OF STANDARD