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NEMA STANDARDS PUBLICATION

NEMA LE 5

PROCEDURE FOR DETERMINING LUMINAIRE EFFICACY RATINGS FOR FLUORESCENT LUMINAIRES

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

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PROCEDURE FOR DETERMINING LUMINAIRE EFFICACY RATINGS FOR FLUORESCENT LUMINAIRES

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Foreword

This Standards Publication was developed to assist the federal government, state governments, electrical utility companies, and manufacturers of lighting fixtures in performing a standardized test method for determining the luminaire efficacy rating of fluorescent lighting fixtures incorporating various shielding media and various types of applicable lamps and ballasts.

This Standards Publication was prompted by the need of the lighting fixture manufacturing industry to have a uniform method of determining energy efficiency of their products using various components.

It is not the intent of this Standards Publication to inhibit luminaire design or to impose arbitrary tolerances on any luminaire manufacturer.

Even though the recommendations for regulations in Appendix A take into consideration, in part, lighting quality through incorporation of visual comfort probability, the International Association of Lighting Designers and the Illuminating Engineering Society of North America desire to include in the future an additional numerical value for lighting quality to accompany the luminaire efficacy rating value. This numerical expression for lighting quality has not yet been fully developed.

The preparation of this standards publication was accomplished by the Indoor Lighting Section in close cooperation with the Lamp, Ballast, and Outdoor Lighting Sections of the NEMA Lighting Equipment Division. Input from users and other interested parties has been sought and evaluated. Inquiries, comments and proposed or recommended revisions should be submitted to the Indoor Lighting Section of NEMA by contacting:

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Purpose

The purpose of this standards publication is to:

a. Provide governmental agencies with a practical and uniform method for calculating a metric for regulating the "energy efficiency" of fluorescent luminaires.

b. Provide electrical utility companies with a method to establish minimum luminaire efficacy ratings for use with energy savings rebate programs.

c. Provide a luminaire efficacy rating methodology for fluorescent luminaires which is applicable to all lamp/ballast systems, thus providing a tool for promoting energy efficient luminaires to the lighting engineering and design community.

d. Create a workable and realistic number of fluorescent luminaire types for regulating "energy efficiency."

e. Organize the types of luminaires into categories which will reasonably represent the design function, physical and dimensional attributes, and the photometric characteristics of the various types of high volume luminaires.

f. Preserve for the lighting fixture manufacturers and the lighting industry the right to use laboratory facilities, testing methods, and completed test data that currently exist and are in accordance with approved industry standards.

g. Establish a luminaire efficacy rating (LER) based on rated lumens per watt, in lieu of a standard based solely on either coefficients of utilization or luminaire efficiency. The word "rated" is used so as not to require the use of absolute photometry and to be able to use published rated lumen values. LER is calculated using actual test values of both ballast factor and total input watts to establish the rated efficacy of the luminaire (LER is given in rated lumens per watt).

Scope

This standards publication provides a procedure for the determination of the luminaire efficacy rating of fluorescent luminaires under laboratory test conditions.

This standard describes five types of fluorescent, high-volume luminaires. Each luminaire type is classified into subcategories which, in combination, represent better than 80% of the fluorescent luminaire market in the United States.

This standard does not apply to low volume or specialty luminaires, i.e. security luminaires.

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Section 1
REFERENCED PUBLICATIONS AND DEFINITIONS

1.1 REFERENCED PUBLICATIONS

The following publications are adopted in whole or in part as indicated by reference in this standards publication.

American National Standards Institute (ANSI)
11 West 42nd Street, 13th Floor
New York, NY 10036

ANSI C82.2-1984 (R 1989)	*Methods of Measurement of Fluorescent Lamp Ballasts*
ANSI C82.3-1983 (R 1989)	*Specifications for Fluorescent Lamp Reference Ballasts*
ANSI C78.1-1991	*Dimensional and Electrical Characteristics of Rapid Start Type Fluorescent Lamps*
ANSI C78.3-1991	*Fluorescent Lamps — Instant-start and Cold Cathode Types — Dimensional and Electrical Characteristics*
ANSI C78.375-1991	*Fluorescent Lamps — Guide for Electrical Measurements*
ANSI/IEEE 100-1992	*IEEE Standard Dictionary of Electrical and Electronics Terms*

Illuminating Engineering Society of North America (IESNA)
120 Wall Street, FL. 17
New York, NY 10005-4001

IESNA	Lighting Handbook - 8th Edition
IESNA LM-9-1988	*Approved Method for the Electrical and Photometric Measurements of Fluorescent Lamps*
IESNA LM-41-1985	*Approved Method for Photometric Testing of Indoor Fluorescent Luminaires*

1.2 DEFINITIONS

Ballast—An auxiliary device used with an electrical discharge lamp(s) to obtain the necessary circuit conditions (voltage, current, and wave form) for the proper starting and operation of a particular fluorescent lamp(s) from a particular line voltage and frequency.

Ballast factor (BF)—A term used to describe the percentage of light output produced when a fluorescent lamp(s) is energized from a commercially available ballast as compared to the light output produced when energized from a reference ballast. Ballast factor tests are run in accordance with ANSI C82.2.

Fixture—The structural parts of a luminaire, including parts designed to distribute the light, and to position and/or protect the lamp(s), to mount and support the ballast(s) and to provide a wire way or means of connecting the lamp(s) and ballast(s) to the

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power supply. A fixture includes the ballast(s), but does not include lamp(s).

Floating door—A door frame which appears visually separated from the fixture housing by a regressed area on all four sides/ends. The regressed area is normally painted black. Thus, the door frame appears to float.

Fluorescent lamp—A low pressure mercury electric-discharge lamp in which a fluorescing coating (phosphor) transforms a portion of the ultraviolet energy generated by the arc discharge into visible light.

Luminaire—A complete lighting unit consisting of a lamp or lamps and ballast(s) together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps through the ballast(s) to the power supply.

Luminaire efficacy rating (LER)—A term used to describe a mathematical method of determining the rated efficacy of a luminaire.

Reference ballast—A ballast especially constructed to have certain prescribed electrical characteristics for use in testing electrical discharge lamps and other ballasts in accordance with ANSI C82.3.

Shielding angle (of a luminaire)—The angle between a horizontal line through the light center and the line of sight at which the bare source first becomes visible.

Spacing criterion—luminaire (SC)—A classification parameter for indoor luminaires relating to the distribution of the direct illuminance component produced on the work plane. The SC of a luminaire is an estimated maximum ratio of spacing to mounting height above the work plane for a regular array of that luminaire such that the work plane illuminance will be acceptably uniform.

Square cell louver—A louver having a cell size approximately equal both lengthwise and crosswise.

Typical fluorescent rated lamp lumens—The rated average lumen output for a typical lamp, taken from the manufacturer's catalog. These values are substantiated by tests performed in laboratories accredited by the National Voluntary Laboratory Accreditation Program.

Visual comfort probability (VCP) — The rating of a lighting system expressed as a percent of people who, when viewing from a specified location and in a specified direction, will be expected to find it acceptable in terms of discomfort glare.

NOTE: For use in this procedure, the room size for VCP is to be 60' × 60' × 8.5' viewed both parallel and perpendicular to lamps.

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Section 2
SELECTION OF COMPONENTS

2.1 TEST SPECIMEN — LIGHTING FIXTURE

The fixture selected for test shall be clean and representative of the manufacturer's current and regular production.

2.2 TEST SPECIMEN(S) — FLUORESCENT BALLAST(S)

Ballast(s) chosen for the test shall be typical of current production and shall be tested and certified as having a ballast factor that is within ±0.025 of established ballast factors, or the manufacturer's established ballast factor, for the particular ballast/lamp when tested in accordance with ANSI C82.2.

2.3 TEST SPECIMEN(S) — FLUORESCENT LAMPS

Lamps of stable output should be used. They should be constant in light output for constant line voltage and repeated operation.

Lamps selected for tests should be typical of current production and should be selected for uniform luminance and color from end-to-end and around the axis.

Lamps shall conform to the requirements for reference lamps in accordance with ANSI C78.1 and C78.3. Where American National Standards do not exist for a given lamp type, values published by the lamp manufacturers shall apply. Lamps shall be burned for at least 100 hours in order to ensure stable electrical characteristics.

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Section 3
TESTING FACILITIES AND EQUIPMENT

3.1 FACILITIES

Because of the importance of obtaining accurate and repeatable measurements, a National Voluntary Laboratory Accreditation Program accredited, photometric laboratory is recommended for testing.

The photometric laboratory shall have facilities for performing tests in accordance with all applicable sections of the IESNA LM-41.

3.2 GENERAL CRITERIA

Due to the sensitivity of fluorescent lamp light output to air flows, all testing should be conducted in a simulated "draft free" environment. Since air movement is necessary to avoid thermal stratification, care should be taken to minimize any draft or air flow within the immediate vicinity of the test lamps or luminaire, or both.

Temperature should be controlled to 25°C (77°F) within a tolerance of ±1°C (1.8° F).

Lamp circuit pin connections should remain the same throughout the tests both for the calibration and for the luminaire test.

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Section 4
PROCEDURE

4.1 LUMINAIRE EFFICACY RATING — FLUORESCENT LUMINAIRES

Luminaire efficacy rating shall be specified as a minimum value as shown in 4.4 for each luminaire type and classification shown in 4.2.

4.2 LUMINAIRE TYPE AND CLASSIFICATIONS

a. 2' × 4' Recessed
   2 Lamp, 3 Lamp, 4 Lamp
   Lensed
   Spacing Criterion > 1.1
   VCP < 70, ≥ 70

b. 2' × 4' Recessed
   2 Lamp, 3 Lamp, 4 Lamp
   Louvered
   Spacing Criterion > 1.1
   VCP ≥80
   Shielding Angle < 22°, 22° – 29°, ≥ 30°

c. Plastic Wraparound
   2 Lamp, 4 Lamp
   Width < 9", 9" – 12", > 12"

d. Strip Lights
   1 Lamp, 2 Lamp

e. Industrial
   2 Lamp

4.3 EXCEPTIONS

Exceptions to minimum luminaire efficacy rating:

a. Air handling luminaires with "floating door" construction may have LER values 6% lower than (multiply values by 0.94) shown in appropriate minimum LER table.

b. Luminaires with average luminance in the lengthwise, crosswise, and 45° plane that do not exceed 250 footlamberts at 55° from the vertical may have an LER value of 4% less than shown in appropriate minimum LER table. This exception is in addition to that shown in Exception a.

c. If the spacing criterion is ≤ 1.1, add 6% to each number (multiply each number by 1.06) in the appropriate minimum LER table.

4.4 LUMINAIRE EFFICACY RATING FOR FLUORESCENT LUMINAIRES — REGULATORY REQUIREMENTS

Luminaire efficacy rating shall be specified as a minimum value, a value which cannot be lowered by changing the type of applicable lamp after original installation.

The minimum base system is defined as follows:

Nominal 4-foot T12 Lamp Luminaire:
Lamp = F40 T12 34 Watt
Halophosphor
Ballast = Premium Magnetic (E)
T12

All other currently available lamp/ballast systems (excluding specialty products) are more efficient and have a higher LER value (including nominal 8-foot luminaires using 8-foot T8 or T12 lamps).

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Section 5
CALCULATIONS

5.1 LUMINAIRE EFFICACY RATING — FLUORESCENT LUMINAIRES

Luminaire efficacy rating (LER) shall be calculated for a given luminaire by the following formula:

$$LER = (EFF \times TLL \times BF) / \text{Watts Input}$$

Where:

LER = Luminaire efficacy rating, expressed in rated lumens per watt. This value shall be shown as a whole number, rounding up (≥0.5) or down (<0.5) as required.

EFF* = Luminaire efficiency, expressed as a two-place decimal rounding up (≥0.005) or down (<0.005) as required. (Three place decimals may be used if desired.)

TLL = Total lamp lumens. Total number of lamps in the test luminaire multiplied by the typical rated fluorescent lamp lumens of the test lamps in accordance with Table 6-1.

BF = Ballast factor of test ballast or the average ballast factor of test ballasts used in the photometric test.* This value is to be shown as a two-place decimal, rounding up (≥0.005) or down (< 0.005) as required.

Watts Input = Total wattage of the luminaire as measured during the photometric test.* This value is to be shown as a whole number, rounding up (≥ 0.5) or down (< 0.5) as required.

*The photometric test for luminaire efficiency shall be in accordance with IESNA LM 41.

5.2 CALCULATION OF BALLAST FACTOR

Ballast factor (BF) should be calculated in the following comparative method:

$$BF_T = BF_B \times (CF_T / CF_B)$$

Where:

BF_T = Ballast factor of the ballast being tested (unknown ballast factor)

BF_B = Ballast factor of base test ballast for lamp type being tested (known ballast factor)

CF_T = Calibration flux with ballast being tested

CF_B = Calibration flux using same lamps as being used in test for which ballast factor is being calculated (same as used for CF_T) and operated on base ballast(s) used for BF_B.

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Table 5-1
TYPICAL RATED FLUORESCENT LAMP LUMENS*

Description	Watts	Phosphor	CRI	Avg. Rated Lumens
F40T12	34	Halophosphor (Cool White)	62	2650
F40T12 (Plus)	32	Halophosphor (Cool White)	62	2520
F40T12	40	Rare Earth (741)	70–79	3200
F40T10	42	Rare Earth	80–89	3700
F32T8	32	Rare Earth (741)	70–79	2850
F96T12	75	Rare Earth (741)	70–79	6420
F96T12	60	Halophosphor (Cool White)	62	5400
F96T12HO	110	Rare Earth (741)	70–79	9200
F96T12HO	95	Halophosphor (Cool White)	62	8000

* Typical rated average lamp lumens at 100 hours as established by the NEMA Lamp Section. Tested in accordance with IES LM-9 and ANSI C78.375 in laboratories recommended as being accredited by the National Voluntary Laboratory Accreditation Program.

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Section 6
LIGHTING ENERGY COST

6.1 COMPARATIVE YEARLY ENERGY COST OF LIGHT

The yearly lighting energy cost for comparative purposes in this procedure is to be based on 1000 lumens and the following:

a. 3000 average burning hours per year

b. $0.08/kwh average electrical energy rate

Thus the constant (K) for the comparative yearly lighting energy cost per watt = $0.24.

6.2 CALCULATION

Comparative yearly lighting energy cost = $(K / LER) \times 1000$

Where:

K = $0.24 (3000 average burning hours per year × $0.08/kWh average electrical energy cost)

LER = The LER value for the given luminaire under consideration

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Section 7
RECOMMENDED REPORTING CATEGORIES AND FORMAT

7.1 CATEGORY DESCRIPTION

7.1.1 LER values and comparative yearly lighting energy cost values should be shown in promotional literature and catalogs in conjunction with other pertinent information as shown below.

a. Catalog number (showing number of lamps)

b. Luminaire category

c. Lamp type and rated lumen value

d. Ballast type

e. Luminaire lumen output (EFF × TLL × BF), or the values for efficiency, total lamp lumens, and ballast factor may be shown individually

f. Luminaire watts input

g. LER

h. Comparative yearly lighting energy cost per 1000 lumens (The cost of light—see Section 6.)

i. Luminaire efficiency

7.1.2 A two-letter designation for the luminaire category should be included with the luminaire efficacy rating value whenever it is given. The first letter of the designation should be "F" for fluorescent luminaires. The second letter should be one of the following letters, representing categories as set forth in the tables in Appendix A:

a. L — lensed (Table A-1)

b. P — parabolic louvered (Table A-2)

c. W — wraparound (Table A-3)

d. S — strip (Table A-4)

e. I — industrial (Table A-5)

7.2 RECOMMENDED REPORTING FORMAT

An example of the recommended format for reporting is shown in Table 7-1.

Table 7-1
REPORTING FORMAT

1	2	3	4	5	6	7	8	9
Luminaire Catalog #	Luminaire Category	Lamp Type	Ballast Type	Luminaire Lumen Output*	Luminaire Watts Input	LER	Energy Costs**	Luminaire Efficiency
NEMA G440A12	FL	F40T12 34 W 2650 Lu.	Premium Magnetic (E)	6654	138	48	$5.00	89%

* Calculated as (EFF × TLL × BF). See Section 5.1.

** Comparative yearly lighting energy cost per 1000 lumens.

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7.3 RECOMMENDED LAMP/BALLAST SYSTEM TESTS

It is suggested that photometric tests be run on the following lamp/ballast systems for Nominal 4-foot lamp luminaires.

a. Lamp = F40 T12 34 Watt Halophosphor
Ballast = Premium magnetic (E) T12

b. Lamp = F32 T8 32 Watt Rare Earth Phosphor
Ballast = Electronic T8

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Appendix A
RATIONALE AND RECOMMENDED REGULATIONS FOR FLUORESCENT LUMINAIRES

A.1 LUMINAIRE CHARACTERISTICS

In reviewing fluorescent luminaires, judging a luminaire by efficiency alone is a poor measure of merit. The most efficient luminaire is basically a "bare lamp." Likewise, judging a luminaire by its coefficient of utilization (CU) is inappropriate. A luminaire's coefficient of utilization is not only a function of its efficiency, but its application as well. The CU is dependent in part on the geometry of the room in which it is installed and the reflectivity of the room surfaces.

Luminaires must be classified into various categories and rated within these categories. The following are some examples:

Type	Physical Dimensions
Recessed	Width
Surface mounted	Depth
Suspended	Length
Strip lights	
Plastic wraparounds	
Industrials	

Physical dimensions are important, because a luminaire that is recessed mounted within a ceiling must mate with the ceiling construction for width and length, and its depth must correlate with the available plenum depth.

The inexpensive wraparound unit may be shallow and narrow, so as to be inconspicuous in the space and to minimize cost. (Even the least efficient wraparound is much more efficient than the incandescent unit it replaces.)

Photometric Characteristics*
Spacing criterion — spacing to mounting height
Visual comfort probability
Shielding angle
Maximum average luminance
Side luminance
Coefficient of utilization
Efficiency

*For definitions, refer to the IESNA Lighting Handbook — 8th Edition.

Electrical Characteristics
Number of lamps
Type and wattage of lamps
Number and type of ballast
Power factor
Watts input — total for luminaire

A.2 FLUORESCENT MARKET— PERCENTAGE BY TYPES SHIPPED

The U.S. Department of Commerce reports four major types of fluorescent fixtures which constitute 90% of the fluorescent commercial, institutional, and industrial markets*.

*Current Industrial Report: Electric Lighting Fixtures: 1990, U.S. Department of Commerce, Bureau of Census, Washington, D.C., October, 1990.

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Type	Description	Percent
1	Recessed (Air and Non-air handling)	41
2	Strip lights	25
3	Plastic wraparounds	13
4	Industrial	11
5	All others	10
	TOTAL	100

The type 1 recessed lighting fixture is comprised of many sizes from 1' × 1' to 4' × 4', but the predominate size is 2' × 4', which represents better than 75% of the market:

Size	Percent
2′ × 4′	75
2′ × 2′	12
1′ × 4′	10
Other	3
TOTAL	100

The approximate breakdown by lamp quantity for the 2' × 4' recessed fixture is:

Lamps	Percent
4	53
2	28
1	18
Other	1
TOTAL	100

The type 2 (strip light) consists primarily of 4-foot and 8-foot lengths, using the 4-foot, rapid start 40 watt lamp or the 8-foot slim line or high output, rapid start fluorescent lamp. Approximately 20% are one lamp, and 78% are two lamp units.

The type 3 (plastic wraparound) fixture is primarily a 4-foot long fixture employing the 4-foot, rapid start lamp. The approximate lamp and fixture width breakdown is as follows:

No. of Lamps	Percentage	Fixture Width
1	5	3–8 inches
2	67	8–18 inches
3	1	13–18 inches
4	27	13–18 inches
TOTAL	100	

The type 4 (industrial) fixture is primarily 4 feet and 8 feet in length, using the 4-foot, rapid start 40 watt lamp or the 8-foot, slim line or high output, rapid start lamp. The two lamp version comprises approximately 87% of the product.

A.3 LUMINAIRE TYPES AND CLASSIFICATIONS

In analyzing the fluorescent lighting market, the Indoor Lighting Section has determined that the following types of luminaires, subdivided into the appropriate classifications, would be representative of the market:

a. 2' × 4' Recessed
   Lensed
   Spacing Criterion > 1.1
   2 Lamp, 3 Lamp, and 4 Lamp
   VCP < 70, ≥ 70

b. 2' × 4' Recessed
   Louvered
   Spacing Criteria > 1.1
   2 Lamp, 3 Lamp, and 4 Lamp
   VCP ≥ 80
   Shielding angle < 22°, 22°–29°, ≥ 30°

c. Plastic Wraparound
   2 Lamp and 4 Lamp
   Width < 9", 9"–12", >12"

d. Strip Lights
   1 Lamp and 2 Lamp

e. Industrial
   2 Lamp Only

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A.4 HEAT TRANSFER LUMINAIRES

The F40 T12 34 watt or F40 T12 32 watt fluorescent lamp is not recommended for use in heat transfer luminaires. Test data should be secured for heat transfer luminaires for each lamp/ballast system selected.

A.5 RECOMMENDED REGULATIONS— FLUORESCENT LUMINAIRES ONLY

The minimum required luminaire efficacy rating (LER) for fluorescent luminaires (nominal 4-foot T12 luminaries) shall be in accordance with Tables A-1 through A-5.

A.6 PHOTOMETRIC TESTS*

Photometric tests on fluorescent luminaires which were run with the F40 T12 40 watt lamp and were completed prior to 1993 may be utilized for the calculation of LER values, through the year 2000, by substituting appropriate F40 T12 34 watt lamp lumen values from Table 5-1 and appropriate ballast factors and watt input values as required from Tables A-6 through A-11.

*The photometric test for luminaire efficiency shall be in accordance with IESNA LM-41.

Table A-1
MINIMUM LER
(Nominal 4-Foot T12 Lamp Luminaire)
2' × 4' LENSED RECESSED FLUORESCENT LUMINAIRES WITH SPACING CRITERION >1.1

VCP	< 70	≥ 70
4 Lamp	43	41
3 Lamp	43	42
2 Lamp	47	46

NOTE: Exceptions are the following:

a. Air handling luminaires with "floating door" construction may have LER values 6% lower than (multiply values by 0.94) shown in Tables A-1 and A-2.

b. Luminaires with average luminance in the lengthwise, crosswise, and 45° plane that do not exceed 250 footlamberts at 55° from the vertical may have an LER value of 4% less than (multiply values by 0.96) shown in Tables A-1 and A-2. This exception is in addition to that shown in Note a.

c. If the spacing criterion is ≤1.1, add 6% to each number (multiply each number by 1.06) in the table.

Table A-2
MINIMUM LER (Nominal 4-Foot T12 Lamp Luminaire)
2' × 4' LOUVERED RECESSED FLUORESCENT LUMINAIRES WITH VCP ≥ 80 AND SPACING CRITERION >1.1

Shielding Angle	< 22°	22–29°	≥ 30°	Square Cell Louver ≥ 30°
4 Lamp	46	41	37	37
3 Lamp	47	46	41	38
2 Lamp	53	50	47	39

NOTE: Exceptions are the following:

a. Air handling luminaires with "floating door" construction may have LER values 6% less than (multiply values by 0.94) shown in Tables A-1 and A-2.

b. Luminaires with average luminance in the lengthwise, crosswise, and 45° plane that do not exceed 250 footlamberts at 55° from the vertical may have an LER value of 4% less than (multiply values by 0.96) shown in Tables A-1 and A-2. This exception is in addition to that shown in Note a.

c. If the spacing criterion is ≤ 1.1, add 6% to each number (multiply each number by 1.06) in the table.

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Table A-3
MINIMUM LER (Nominal 4-Foot T12 Lamp Luminaire)
PLASTIC WRAPAROUND LUMINAIRES

Width	< 9"	9-12"	>12"
4 Lamp	—	—	46
2 Lamp	46	47	48

Table A-4
MINIMUM LER (Nominal 4-Foot T12 Lamp Luminaire) BARE LAMP STRIP LUMINAIRES

Number of Lamps	LER
2	56
1	50

Table A-5
MINIMUM LER (Nominal 4-Foot T12 Lamp Luminaire) BARE LAMP INDUSTRIAL LUMINAIRES

Number of Lamps	LER
2	53

NOTE: All other commercial fluorescent luminaires are considered low volume and are excluded.

Table A-6
(Nominal 4-Foot Fluorescent)
TYPICAL RATED AVERAGE BALLAST FACTORS*

	Lamp Type			
Ballast Type Description	F40 T12	F40 T12 ES	F40 T10	F32 T8
1 Lamp Premium Magnetic (E)	.94	.87	.95	.94
1 Lamp Premium Magnetic T8	N/A	N/A	N/A	.94
1 Lamp Heater Cutout	.83	.81	.85	.86
1 Lamp Electronic	.88	.88	.85	.88
2 Lamp Premium Magnetic (E)	.94	.87	.95	.94
2 Lamp Premium Magnetic T8	N/A	N/A	N/A	.94
2 Lamp Heater Cutout	.83	.81	.85	.86
2 Lamp Electronic	.88	.88	.85	.88
3 Lamp Magnetic	N/A	.87	N/A	N/A
3 Lamp Magnetic T8	N/A	N/A	N/A	N/A
3 Lamp Heater Cutout	N/A	N/A	N/A	.86
3 Lamp Electronic	.88	.88	.85	.88
4 Lamp Electronic	.88	.88	.85	.88

N/A = Not Applicable

NOTE: Variations in electronic ballast design may result in variances from values shown above. Ballast factors should be calculated in accordance with Section 5.2.

* Industry standard typical rated average ballast factors as established by the NEMA Ballast Section. Tested in accordance to ANSI C82.2.

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Table A-7
FLUORESCENT 2' x 4' RECESSED — LENSED
TYPICAL RATED INPUT WATTS

Lamps			Ballast	Input
Quantity	Description	Lamp Watts	Description	Watts
4	F40 T12	40	Premium Magnetic (E)	162
4	F40 T12	40	Heater Cutout	137
4	F40 T12ES	34	Premium Magnetic (E)	138
4	F40 T12ES	34	Heater Cutout	112
4	F32 T8	32	Premium Magnetic T8	133
4	Lamp	N/A	Electronic	*
3	F40 T12	40	Premium Magnetic (E)	128
3	F40 T12	40	Heater Cutout	113
3	F40 T12ES	34	Premium Magnetic (E)	113
3	F40 T12ES	34	Heater Cutout	93
3	F32 T8	32	Premium Magnetic T8	103
3	Lamp	N/A	Electronic	*
2	F40 T12	40	Premium Magnetic (E)	84
2	F40 T12	40	Heater Cutout	70
2	F40 T12ES	34	Premium Magnetic (E)	70
2	F40 T12ES	34	Heater Cutout	56
2	F32 T8	32	Premium Magnetic T8	70
2	Lamp	N/A	Electronic	*

N/A = Not Applicable

*Due to the many variable designs of electronic ballasts, no typical rated watts input can be given. Photometric tests may be run on each luminaire employing electronic ballasts to determine efficiency, ballast factor, and watts input.

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Table A-8
2' x 4' FLUORESCENT RECESSED — LOUVERED
TYPICAL RATED INPUT WATTS

Lamps			Ballasts	
Quantity	Description	Lamp Watts	Description	Input Watts
4	F40 T12	40	Premium Magnetic (E)	165
4	F40 T12	30	Heater Cutout	140
4	F40 T12ES	34	Premium Magnetic (E)	140
4	F40 T12ES	34	Heater Cutout	112
4	F32 T8	32	Premium Magnetic T8	140
4	Lamp	N/A	Electronic	*
3	F40 T12	40	Premium Magnetic (E)	132
3	F40 T12	40	Heater Cutout	115
3	F40 T12ES	34	Premium Magnetic (E)	113
3	F40 T12ES	34	Heater Cutout	93
3	F32 T8	32	Premium Magnetic T8	105
3	Lamp	N/A	Electronic	*
2	T40 T12	40	Premium Magnetic (E)	85
2	F40 T12	40	Heater Cutout	70
2	F40 T12ES	34	Premium Magnetic (E)	70
2	F40 T12ES	34	Heater Cutout	56
2	F32 T8	32	Premium Magnetic T8	70
2	Lamp	N/A	Electronic	*

N/A = Not Applicable

*Due to the many variable designs of electronic ballasts, no typical rated watts input can be given. Photometric tests may be run on each luminaire employing electronic ballasts to determine efficiency, ballast factor, and watts input.

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Table A-9
FLUORESCENT PLASTIC WRAPAROUND
TYPICAL RATED INPUT WATTS

Lamps			Ballast	
Quantity	Description	Lamp Watts	Description	Input Watts
2	F40 T12	40	Premium Magnetic (E)	81
2	F40 T12	40	Heater Cutout	69
2	F40 T12ES	34	Premium Magnetic (E)	72
2	F40 T12ES	34	Heater Cutout	54
2	F32 T8	32	Premium Magnetic T8	70
2	Lamp	N/A	Electronic	*
4	F40 T12	40	Premium Magnetic (E)	164
4	F40 T12	40	Heater Cutout	140
4	F40 T12ES	34	Premium Magnetic (E)	144
4	F40 T12ES	34	Heater Cutout	116
4	F32 T8	32	Premium Magnetic T8	142
4	Lamp	N/A	Electronic	*

N/A = Not Applicable

*Due to the many variable designs of electronic ballasts, no typical rated watts input can be given. Photometric tests may be run on each luminaire employing electronic ballasts to determine efficiency, ballast factor, and watts input.

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Table A-10
FLUORESCENT STRIP LIGHTS
TYPICAL RATED INPUT WATTS

Lamps			Ballast	
Quantity	Description	Lamp Watts	Description	Input Watts
1	F40 T12	40	Premium Magnetic (E)	49
1	F40 T12	40	Heater Cutout	44
1	F40 T12ES	34	Premium Magnetic (E)	42
1	F40 T12ES	34	Heater Cutout	36
1	F32 T8	32	Premium Magnetic T8	36
1	Lamp	N/A	Electronic	*
2	F40 T12	40	Premium Magnetic (E)	87
2	F40 T12	40	Heater Cutout	71
2	F40 T12ES	34	Premium Magnetic (E)	71
2	F40 T12ES	34	Heater Cutout	57
2	F32 T8	32	Premium Magnetic T8	71
2	Lamp	N/A	Electronic	*
1	F96 T12	75	Magnetic	99
1	F96 T12HO	110	Magnetic	134
2	F96 T12	75	Premium Magnetic	156
2	F96 T12HO	110	Premium Magnetic	235
1 or 2	Lamp	N/A	Electronic	*

N/A = Not Applicable

*Due to the many variable designs of electronic ballasts, no typical rated watts input can be given. Photometric tests may be run on each luminaire employing electronic ballasts to determine efficiency, ballast factor, and watts input.

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Table A-11
FLUORESCENT INDUSTRIALS
TYPICAL RATED INPUT WATTS

Lamps			Ballast	
Quantity	Description	Lamp Watts	Description	Input Watts
2	F40 T12	40	Premium Magnetic (E)	87
2	F40 T12	40	Heater Cutout	71
2	F40 T12ES	34	Premium Magnetic (E)	71
2	F40 T12ES	34	Heater Cutout	57
2	F32 T8	32	Premium Magnetic T8	71
2	Lamp	N/A	Electronic	*
2	F96 T12	75	Premium Magnetic	156
2	F96 T12 HO	110	Premium Magnetic	235
2	Lamp	N/A	Electronic	*

N/A = Not Applicable

*Due to the many variable designs of electronic ballasts, no typical rated watts input can be given. Photometric tests may be run on each luminaire employing electronic ballasts to determine efficiency, ballast factor, and watts input.

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