NEMA BIM 100-2021 White Paper

BIM Content for Electrical Products: Current Status and Industry Needs

Contents

Executive Summary

This white paper summarizes the current status of electrical product information available in BIM libraries and their adoption by industry. A market survey and interviews with MEP consultants were conducted to identify the most common workflows and BIM data needs to support their workflow. Most BIM objects available for electrical products include 3-D geometry data, product catalog information, and limited performance data.

Use of these BIM objects may help BIM modelers quickly add product geometry and catalog information in the MEP design workflow, but they are largely avoided by BIM modelers because of incompatibility with model workflows, including schedules. Therefore, there is a huge potential for electrical product technical data based upon a common industry data model, allowing BIM modelers to use manufacturer-provided BIM objects directly in models. The advantage to the manufacturer is the built-in presence of the manufacturer's name and model number in construction document schedules, indicating basis of design.

Data requirements to support these workflows for most common electrical products are identified by reviewing the IFC, COBie, and Revit data models. A NEMA guideline document is proposed as a resource for electrical product manufacturers to develop BIM content to support design workflows beyond 3-D geometry.

Three levels of BIM data are proposed such that manufacturers will have options to create data content incrementally and address specific workflow needs. In addition, a Revit shared parameter file with Level 2 product data is developed to assist NEMA Members distributing BIM libraries to include standardized property names and data as an initial step toward standardization. This shared parameter data set will also be submitted to the Autodesk Revit development team for their consideration and potential adoption, along with ASHRAE BIM.MTG for inclusion in data.ashrae.org initiatives.

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1. Background and Scope

The NEMA Strategic Initiatives program identified "Digitalization of Construction Projects with Building Information Modeling (BIM)" as one of the key initiatives for the electroindustry. The primary goal of this BIM initiative is to develop industry guidance to promote the use of BIM data of electrical products that will minimize coordination issues and increase the efficient use of this data throughout the lifecycle of a building project.

Building information modeling (BIM) has become the primary design development and documentation tool for all building construction industry processes. Several commercially available BIM authoring tools provide a varied list of properties for electrical products. Industry Foundation Classes (IFC), COBie, and Revit families are three of the most common BIM data models that support electrical distribution and terminal equipment, pumps, motors, switchgear, lighting fixtures and controls, and other related electrical products.

Even though BIM authoring tools offer the database capabilities for electrical products, BIM modelers and component library developers often do not have Standard guidelines for specifying all the required data to coordinate trades and processes to consume this BIM data efficiently. Often BIM modelers, while incorporating electrical products, are unable to use the manufacturer-provided data because of either missing information or inconsistency in interoperability of the data. This lack of standardization prevents manufacturer BIM content from being used within a BIM model without significant editing by the modeler to enable compatibility and achieve interoperability. Thus, modelers tend to avoid manufacturer content in favor of either self-developed content or third-party content solutions.

This white paper summarizes a survey of users and content developers to identify current industry practices, BIM adoption barriers, and needs for enriching BIM models with electrical product data. Several NEMA Members were contacted and a market survey was conducted.

2. BIM Electrical Data Workflows

The building electrical systems design process and BIM data requirements can be grouped into the following three phases of design (CERL, 2013):

    a. Criteria Phase (Programming and Concept Design)
    b. Schematic Design (Design Development)
    c. Coordinated Design (Construction Documents)

BIM data for electrical systems design during these phases is primarily focused on modeling electrical devices and equipment such as lighting fixtures, receptacles, appliances, transformers, generators, and panel boxes. Typical questions asked during this process are:

    a. What is the number and what are the types of circuits?
    b. Is there adequate power and lighting for the space's intended use?
    c. Does it meet the energy code requirements for lighting power density and electrical transformers?

As design progresses through these various phases, the BIM model with the required electrical properties data will help designers size the equipment, ensure compatibility of electrical connections in the design, and prevent overloads and mismatched voltages. In addition, having the required electrical product data in the BIM model will facilitate coordination with other MEP design activities, including energy analysis, HVAC equipment sizing, and lighting analysis. The National BIM Standard Version 3 (NBIMS, 2015) identified electrical product information exchanges in a comprehensive model named SPARKie (East, 2013). These information exchange requirements are very elaborate and include the following workflows that are used as the basis for identifying electrical product data requirements in the current work (NBIMS, 2015):

a. **Develop Electrical Basis of Design:** *Document process model, constraints, formulas, and tables used for making decisions on electrical design, including: lighting calculations showing required and designed foot-candles; estimated panelboard loading (including 25% extra as a projection of future building loads); a projection/summation of the panelboard loads to justify the sizing of the building transformers; an economic analysis to justify the selection of either 120Y/208V or 277Y/480V on the secondary side of the building transformers; an analysis, for the 277Y/480 V choice, as to whether the step down transformer(s) shall be large central units or smaller units placed throughout the building; a short-circuit analysis to determine the AIC rating of the system components; a coordination study to determine the circuit breaker settings and system coordination.*

b. **Propose Electrical Equipment Requirements:** *Generate One Line Diagram (http://en.wikipedia.org/wiki/One-line_diagram). Determine process for acquiring electrical equipment (e.g., design assist) and verify that the process is acceptable to all participating parties. Determine connected load and demand load for each space. Determine diversity coefficients. Determine circuits. Determine loads at distribution points. Select equipment (or candidates) at each occurrence.*

c. **Size Electrical System:** *Review and verify hourly ratings and code requirements for separations between electrical equipment rooms and adjoining spaces (could potentially impact room areas). Size distribution boards, cables, transformers.*

d. **Estimate Energy Usage:** *Calculate connected loads and demand loads at each circuit, and for overall electrical system. Submit Load Letter (format provided by utility), with values specified per project.*

e. **Determine Electrical Supply Requirements:** *Electrical Engineer uses the Product Type Template and updated plans and other-discipline information to determine total electrical supply requirements. Select from compatible product types for each product occurrence [or if required, select 3 compatible product types that are suitable]. Obtain owner's approval.*

f. **Calculate System Loads:** *Add connected loads and demand loads at each circuit, multiply by coefficients.*

g. **Select Architectural Light Fixtures:** *Select suitable type(s) from vendor catalogs.*

h. **Develop Product Type Specifications/Candidates:** *Resize to meet capacity, selecting alternate product types that fit requirements.*

This project team contacted and interviewed several MEP design practitioners who mentioned that current BIM models for electrical design are focused primarily on construction documentation of cable trays, wiring, panel, switchboard, and equipment schedules. One common workflow uses nominal voltage, real power, and power factor of all connected loads to calculate apparent load as shown in Figure 1.
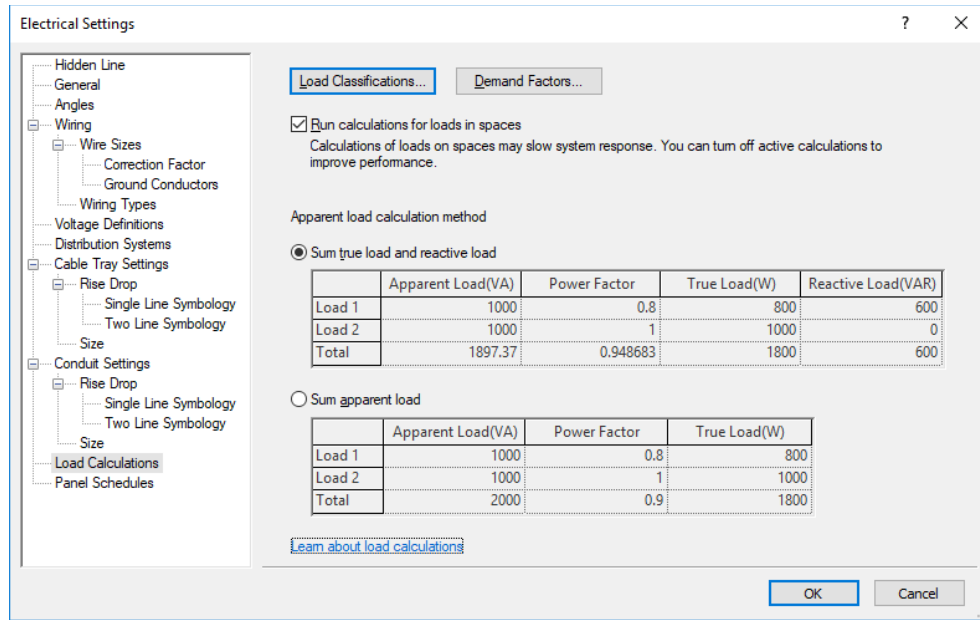
Figure 1: Electrical Load Calculation Methods in Revit

Though there is great potential for process improvement and integrated design possible with BIM models containing electrical product data, many of the above workflows are currently not adopted by practitioners because of the need for creating a BIM model containing the components, lack of Standard data models, and non-availability of product data to incorporate them in the BIM models.

To assist MEP designers, there are proprietary solutions and third-party vendor tools with Revit object families and shared parameters available for electrical systems design. One such solution available from CTC Software Solutions named MEP Productivity Pack (CTC, 2019) was reviewed.

Figure 2 shows an example of data typically required for an overhead door, including the apparent load, full load amps (FLA), and overcurrent protection requirements. When all equipment, fixtures, and devices are provided with this input, then the total electrical loads (apparent load, power factor, and real power) as shown in Figure 1 can be calculated.

If a user wanted to place a duplex receptacle for a 1/3 HP overhead door opener, then parameters could be used to indicate:

Identity Mark: OHD-1 (or however it is tagged)

Description: Overhear Door Opener

Voltage Nominal: 120 V

Number of Poles: 1

Phase: 1

Load Classification: MTR

Motor Power Input: 1/3

Note: **Full Load Amps** is 7.2 A per NEC Table 430.248.

In the **E_Motorlist – Multiple Circuit Load Calculations – Multi-Category** the results will be:

ID: OHD-1

DESCRIPTION: OVERHEAD DOOR

LOCATION: (Room number is populated from placement in model)

- Or select **Use Space Identity Override** and **Space Name Override** and/or **Space Number Override**

MOTOR POWER:

- 1/3 HP (This comes from "Horsepower Input")

VOLT: 120

PHASE: 1

Figure 2: MEPPP Example Data Input and Load Calculation Results (CTC, 2019)

3. Current Status of Electrical Product Data in BIM Libraries

An informal survey of NEMA Members and an internet search of available online BIM libraries was done to develop an understanding of the current status of electrical product data included by manufacturers distributing BIM libraries. Eighteen NEMA Member companies were identified and contacted. The following three manufacturers responded with their respective BIM libraries:

a. ABB
b. Eaton Lighting
c. Schneider

In addition to the above three libraries, a large collection of BIM products available from https://www.bimobject.com were reviewed. There are over 100,000 electrical product BIM objects available at this online catalog for designers. A random sample was taken of electrical products from 10

manufacturers, including GE, Lutron, Panasonic, Sony, Mitsubishi, and Bose. This review resulted in grouping the available BIM product data into the following four categories:

Class 1 - **CAD Libraries:** Several manufacturers provide a catalog of 2-D geometry and symbols that electrical designers can include in specifying products and for documentation of electrical systems.

Class 2 - **Geometry Model Libraries:** Geometry model libraries contain 3-D geometry models of products that can be included in creating architectural BIM models. The primary objective here is to include location information within the model along with product identification data for visualization and documentation. A large majority of currently available BIM libraries belong to this category. With such libraries, no electrical design or electrical product performance can be evaluated.

Class 3 - **Proprietary BIM Model Libraries:** Several manufacturers have extensive 3-D geometry models of products with the proprietary data specific to the product category such as electrical fixtures, panels, motors, appliances, etc., that can be used to generate equipment schedules and fixture schedules. Some of these BIM product libraries include operation and maintenance information, catalog model number, product classification details as per CSI, MasterFormat, or other industry Standard formats. Proprietary property sets are also included by some manufacturers with product performance data such as color temperatures and luminous intensities for lighting fixtures along with tools for lighting design. Although a BIM model can be configured to use these proprietary property sets, these property sets are incompatible with other BIM objects and are therefore considered to be unusable by many BIM modelers.

Class 4 - **Industry Standard BIM Model Libraries:** A few manufacturers have developed BIM object libraries with 3-D object models consistent with property sets and data for electrical products using one of the four data models discussed in this report. Most libraries in this category are based on Revit "Type Properties" for lighting and electrical products. However, most available libraries have either incomplete or no data for such properties.

Figure 3 shows sample data currently available in BIM models that can be classified mostly in Classes 2 and 3 discussed above. In many cases, phase, voltage, apparent load, and power factor are the most commonly found electrical properties data. This is consistent with the workflow discussed in the previous section for electrical systems design for electrical load calculations in Revit.

1	Electrical Product		General Infomation		Electrical Engineering					Other Data
2	**Brand**	**Product**	**Constraints**	**Dimensions**	**Pole Numbers**	**Phase**	**Voltage**	**Apparent Load**	**Power Factor**	
3	Bosch	Camera Security	Elevation	Depth&Height&Width	-	-	-	-	-	-
4	Lutron	Ceiling Occupancy Sensor	-	-	-	-	-	-	-	-
5	Panasonic	LCD Display		-	1	-	110V	125W	-	-
6	Panasonic	Dish Washer	-	-	1	1	230V	-	1	-
7	Sony	Visual Projector	-	-	1	-	120V	-	-	Group
8	Eemax	Tankless Water Heater	-	-	1	1	480V	-	1	Inlet&Outlet
9	Lutron	Light Fixture	-	-	1	-	120V	14W	1	-
10	Bose	Loud Speaker	Elevation	Depth&Height&Width	1	1	-	-	-	-
11	Mitsubishi	Heat Pump	-	-	3	-	400V	-	1	-

Figure 3: Sample Data in BIM Models of Electrical Products (https://www.bimobject.com)

During the review of NEMA Member–provided product libraries, a wide variation of type properties is observed in the BIM libraries depending on the type of product. For example, lighting product data from Schneider Digital Lumens and Cooper Lighting are shown in Figures 4 and 5. It can be observed that the type parameters provided by manufacturers for each of the electrical and photometric properties are significantly different and, in many cases, include product-specific data. The variations in naming of type parameters, units, level of details, and lack of data make it difficult for designers to rely on the BIM data

for design workflow beyond the automatic calculation of dependent parameters within the instance of the object in the BIM model.

Figure 4: Example Lighting Fixture Data from Schneider Digital Lumens

Figure 5: Example Lighting Fixture Data from Cooper Lighting

4. Review of BIM Data Models and Electrical Product Data

BIM authoring tools often use an internal proprietary data model to represent geometric data and design information. Standardization and interoperability efforts have evolved into the following four most widely used Standards, which are reviewed for identifying the electrical product data that will support the workflow discussed in Section 2:

    a. Industry Foundation Classes IFC 4.0
    b. COBie
    c. Revit Parameters
    d. CIBSE Product Data Template

4.1   Industry Foundation Classes (IFC 4.0)

IFC is a vendor-neutral data schema used for documenting the digital description of buildings and their components in a Standard format. The development of IFCs originally began in 1997 and is currently managed and maintained by buildingSMART International. IFCs have been widely implemented and adopted worldwide. It is currently available as an international Standard, ISO 16738-1:2018. The schema specification includes domain-specific data elements for all aspects covering the building lifecycle. The "IfcElectricalDomain" is reviewed to identify the properties relevant for the following electrical products:

      a. Electrical appliance
      b. Distribution panels
      c. Junction box
      d. Light fixture
      e. Lamp
      f. Outlet
      g. Transformer

All electrical products have property sets, "Pset_ElectricalDeviceCommon," that identify attributes common to all products, as shown in Table 1. The IFC definition of all these attributes includes data type and range checking limits that implementers can use to define the properties.

Table 1: Property Set Attributes Common to All Electrical Domain Objects

PropertyName
PowerFactor
NumberOfPoles
HasProtectiveEarth
IP_Code
RatedCurrent
RatedVoltage
NominalFrequencyRange
ConductorFunction
InsulationStandardClass

IFC property sets for the electrical domain include product-specific data attributes for all the product types identified above. Product-specific attributes are discussed in Section 5 of this report. In addition, manufacturer information, service life, and warranty details can also be represented when using the IFC data model.

4.2   COBie

COBie, the Construction-Operations Building Information Exchange, is an international Standard for representing BIM data relating to building asset management. This includes project data for equipment lists, product performance, warranties, maintenance schedules and spare parts lists, etc., required for the operation and maintenance of buildings. COBie data is mandated as part of submittals for meeting owner requirements of U.S. Federal projects. It is also widely used in the UK and Europe. COBie requirements for electrical properties cover the following assets:

      a. Light fixtures
      b. Outlets
      c. Switches
      d. Distribution panels
      e. Switchgear
      f. Generators

For the purposes of the NEMA guideline development, all above assets were reviewed except generators. A consolidated list of COBie attributes covering the electrical assets is presented in Table 2. All products must have the following three properties: **Current, Voltage, and Frequency**. In addition, attributes specific to the asset are identified as minimum requirements that need to be provided by product manufacturers. Data elements in COBie are consistent with IFC schema, and software tools are available to extract COBie data from IFC-based BIM models.

Table 2: COBie Electrical Product Attributes (COBie, 2012)

Transformers	Switches	Light Fixtures
Wattage	Switch Voltage	Load Classification
Voltage Rating	Switch Number of Poles	Ballast Voltage
Voltage	Load Classification	Ballast Number of Poles
Temperature Rise		Lamp Wattage Comments
Secondary Voltage		
Primary Voltage		*Photometrics Data*
Number of Phases		Light Loss Factor
kVA Rating		Initial Intensity
K-Factor		Initial Color
Impedance		Color Filter
Frequency		
Current Rating		

4.3 Revit Parameters

As a BIM authoring tool, Revit is most widely used in North America, and product manufacturers often develop BIM libraries of Revit families to support their customers. Parameters are often defined by the modelers to take advantage of design calculations and generate schedules. The MEP domain model in Revit has significant electrical properties information, which is relevant for electrical product manufacturers. There are several categories of electrical products that can be used in creating a Revit BIM model:

    a. **Electrical Equipment:** Distribution equipment, including panelboards, switchboards, and transformers
    b. **Electrical Fixtures:** Receptacles, safety switches, and junction boxes
    c. **Lighting Fixtures:** Luminaires
    d. **Lighting Devices:** Switches, controllers, and contactors
    e. **Conduits and Conduit Fittings**
    f. **Cable Trays and Cable Tray Fittings**
    g. **Communication, Data, Fire Alarm, Nurse Call, Security, and Telephone Devices**

BIM product data for all the above categories may be grouped into several parameter groups, including Electrical, Dimensions, and Identity Data. Each parameter must be assigned a specific data type, such as Length, Electrical Potential, or Electrical Power. For the purposes of developing NEMA BIM guidelines, several electrical and lighting default product families provided with Revit 2019 were reviewed. Table 3 shows a sample list of electrical properties currently available. Unit specifications for these parameters can be defined using unit type as needed.

Table 3: Revit Parameters from Standard Default Revit Families (Revit MEP, 2019)

Transformers	Switches	Light Fixtures
Wattage Voltage Rating Voltage Temperature Rise Secondary Voltage Primary Voltage Number of Phases kVA Rating K-Factor Impedance Frequency Current Rating	Switch Voltage Switch Number of Poles Load Classification	Load Classification Ballast Voltage Ballast Number of Poles Lamp Wattage Comments *Photometrics Data* Light Loss Factor Initial Intensity Initial Color Color Filter

Revit family parameters may be defined as shared in order to extend the usefulness of the BIM information. Within Revit, a shared parameter is one that has been assigned a Globally Unique Identifier (GUID) in order to distinguish it from any other parameter, even parameters that have the same name and data type. Shared parameters are typically stored in and accessed from a specifically formatted file known as a shared parameters file. Parameters must be shared in order to be used within schedules and for certain other Revit functions and workflows.

4.4 CIBSE Product Data Template

The UK government regulations requiring use of building information modeling since 2016 triggered the development of Product Data Templates (PDT) to help manufacturers provide product data in a Standard format. PDTs can be viewed as electronic product sell sheets with all the performance data that can be included in BIM model development.

Currently, 34 PDTs have been developed and published covering mostly HVAC and electrical products. In the electrical product category, only luminaire PDTs are of interest in this NEMA guideline development effort, while the other PDTs are related to cabling, wiring, cable trays, and electrical distribution products. The luminaire PDT has 10 data groups—manufacturer data, application data, lamp data, dimensional data, construction and finish data, accessories data, photometric performance data, electrical data, sustainability data, and operations and maintenance data. In total, there are more than 150 data elements present in this PDT.

Table 4 shows all the attributes and units from this PDT for application, lamp, electrical, and photometric data groups.

Table 4: Attributes from CIBSE Luminaire Product Data Template

Application Data	
Luminaire Type	Text
Intended Market	Text
Application Environment	Text
Maximum Operating Temperature	°C
Minimum Operating Temperature	°C
Emergency	Y/N
Air Handling	Y/N
Fire Rated	Y/N
Fire Rated Temperature	°C
Fire Rating Duration	Hours
IP Rating	Text
IK Rating	Text
Hazardous Area Category	Text
Hazardous Area Protection Type	Text
Light Fixture Mounting Type	Text
Standards	Text

Electrical Data	
Control Gear Required	Y/N
Control Gear Type	Text
Control Gear Location	Text
Integral Fuse or Circuit Protection	Y/N
Suitable for Dimming	Y/N
Suitable Dimmer Type	Text
Motion Detector Control	Y/N
Suitable for Photocell Control	Y/N
Int. Emerg. Lighting Battery Type	Enum.
Testing Method	Enum.
Emergency Light Output Percentage	%
Dur. of Integral Emergency Lighting	Hours
Number of Poles	Number
Earth Point	Y/N
Voltage	Volt
Supply Phase	Number
Frequency	Hertz
Current	Amp
Total Power	Watt
Power Factor	Number
External Control Line Voltage	Volt
Control Gear Standby Power	Watt
Emergency Charging Power	Watt

Lamp Data	
Primary Lamp Type	Text
LED Initial Color Variation	Number
LED Maintained Color Variation	Number
LED Lifetime	Hours
Basis of Lifetime Lumen Depreciation	Lxx
Basis of Lifetime Luminaire Failures	Fxx
Drive Current	mA
Ambient Temperature	°C
Wattage	Watts
International Type Code	Text
Lamp Cap	Text
Lamp Included	Y/N
Initial Lumens	lm
Efficacy	lm/W
Color Temperature	K
Color Rendering Index	Number
Rated Lamp Life	Hours
Voltage	Volt
Number of Primary Lamps	Number
Secondary Lamp	Y/N
Secondary Lamp Int'l Type Code	Text
Secondary Lamp Cap	Text
Secondary Lamp Included	Y/N
Secondary Lamp Initial Lumens	lm
Secondary Lamp Efficacy	lm/W
Secondary Lamp Color Temp.	K
Secondary Lamp Color Rendering Index	Number
Secondary Rated Lamp Life	Hours
Secondary Lamp Voltage	Volt
Number of Secondary Lamps	Number

Photometric Performance Data	
Light Output Pattern	Text
Total Light Output	Lumen
Overall Light Output Ratio	%
Downward Component	%
Upward Component	%
Beam Angle Transverse Axis	Degree
Beam Angle Longitudinal Axis	Degree
IES Files	URL
Luminance at 65° Angle	cd/m^2
Unified Glare Rating	Text

5. Levels of Product Data

For the purposes of the proposed guideline Standard development, BIM product libraries are assumed to have basic data such as product name, type, model number, and dimensions representing the product information. Electrical product data representation in the commonly used BIM data models varies widely and is primarily used for documentation and proprietary design workflow.

This research proposes and defines three levels of BIM electrical product data to guide manufacturers in providing consistent data that can be incorporated in BIM models for design workflow beyond documentation:

Level 1: General Product Data: Basic product information such as name, ID, model, and dimensional data

Level 2: Basic Electrical Properties Data: Electrical properties data such as voltage, current, and performance data

Level 3: Extended Product Performance Data: Additional properties required to support electrical systems design, lighting design, and code compliance

In each level, a common set of data elements from all the industry Standard data models is developed. This set provides a comprehensive list of BIM data that will support model documentation for design and construction.

6. Proposed Guideline for Electrical Product Data

This section identifies the electrical product data requirements for Levels 1 and 2. The table lists parameters in formats appropriate for Revit but may be adapted for other BIM authoring tools.

The list presented is intended to be preliminary and is still being developed and vetted for inclusion in a NEMA guideline Standard. It is hoped that all manufacturers will be able to consistently provide this data using the element name, unit, and data type using shared parameters with a unique GUID.

The successful use of this data by BIM authoring tools and application software developers will lead to wider adoption and use of this data while improving the quality and consistency of BIM models. This may be of particular advantage to product manufacturers, as adopting common Revit shared parameters will allow manufacturer name and/or model number to automatically populate in construction document schedules.

Level 1: General Product Data

Parameter Group	Parameter Name	Unit (Typical)	Data Type	Notes
Identity Data	Manufacturer	-	Common Text	Required
	Product Description	-	Common Text	Required
	Model Number	-	Common Text	Required
	Serial Number	-	Common Text	If Applicable
	Product Data URL	-	Common Text	Required
	Identity Mark	-	Common Text	If Applicable
	Family Version	-	Common Text	Required
	Certification Approvals	-	Common Text	Required
Dimensional Data	Equipment Length	Inches	Common Length	Required
	Equipment Width	Inches	Common Length	Required
	Equipment Diameter	Inches	Common Length	If Applicable
	Equipment Height	Inches	Common Length	Required
	Equipment Depth	Inches	Common Length	Required
	Equipment Weight	Pound-Force	Structural Weight	Required
	Clearance Depth on Top	Inches	Common Length	If Applicable
	Clearance Depth on Bottom	Inches	Common Length	If Applicable
	Clearance Depth on Right	Inches	Common Length	If Applicable
	Clearance Depth on Left	Inches	Common Length	If Applicable
	Clearance Depth on Back	Inches	Common Length	If Applicable
	Clearance Depth on Front	Inches	Common Length	If Applicable

Level 2: Basic Electrical Properties Data

Parameters	Data Element Name	Unit (Typical)	Data Type	Notes
Light Fixtures				
Lamps Luminaires	Rated Voltage	Volts	Electrical Potential	
	Rated Current	Amperes	Electrical Current	
	Apparent Power	Volt-Amperes	Electrical Apparent Power	
	Wattage	Watts	Electrical Wattage	
	Frequency	Hertz	Electrical Frequency	
	Phase	-	Common Integer	
	Number of Poles	-	Electrical Number of Poles	
	Power Factor	-	Common Number	
Electrical Devices				
Switches Receptacles	Rated Voltage	Volts	Electrical Potential	
	Rated Current	Amperes	Electrical Current	
	Number of Poles		Electrical Number of Poles	
Electrical Appliances				
Refrigerators Microwaves Washers Dryers Ranges Vent Fans	Rated Voltage	Volts	Electrical Potential	
	Rated Current	Amperes	Electrical Current	
	Wattage	Watts	Electrical Wattage	
	Frequency	Hertz	Electrical Frequency	
	Phase	-	Common Integer	
	Number of Poles	-	Electrical Number of Poles	
	Power Factor	-	Common Number	

Electrical Equipment				
Panels Transformers	Rated Voltage	Volts	Electrical Potential	
	Rated Current	Amperes	Electrical Current	
	Phase		Common Integer	
	kVA Rating	Kilovolt Amperes	Electrical Apparent Power	
	Impedance	-	Common Number	
	Frequency	Hertz	Electrical Frequency	
	K-Factor	-	Number	
	Secondary Voltage	Volts	Electrical Potential	(As Needed)
	AIC Rating	Kiloamperes	Electrical Current	

Level 3: Extended Product Performance Data

Parameters	Data Element Name	Unit (Typical)	Data Type	Notes
Light Fixtures				
Lamps Luminaires	Lamp Type	-	Common Text	
	Wattage	Watts	Electrical Wattage	
	Color Rendering Index	-	Common Integer	
	Color Temperature	Kelvin	Electrical Color Temperature	
	Luminous Flux	Lumens	Electrical Luminous Flux	
	Efficacy	Lumens/Watt	Electrical Efficacy	
	Light Loss Factor	-	Common Number	
Electrical Devices				
Switches Receptacles	Load Classification	-	Electrical Load Classification	
	Number of Outlets	-	Number	
Electrical Appliances				
Refrigerators Microwaves Washers Dryers Ranges Vent Fans	Equipment Type	-	Common Text	
	Efficiency Rating	-	Common Number	If Applicable
	Operating Temperature	Degrees Celsius	Electrical Temperature	
	Annual Energy Use	Btu or kWh	Energy	

Electrical Equipment					
Panels Transformers	Full Load Amps	Amperes	Electrical Current	
	Ampacity Rating	Amperes	Electrical Current	
	Primary/Secondary Current	Amperes	Electrical Current	
	Primary/Secondary/Maximum Apparent Power	Watts	Electrical Wattage	
	Real/Imaginary Impedance Ratio	-	Common Number	
	Load Classification	-	Electrical Load Classification	

7. Conclusions and Recommendations

Current BIM authoring tools and BIM object libraries provided by electrical product manufacturers have wide variation in the support of electrical systems design workflows. The primary barriers for adoption are the complexity, lack of common data definitions, and inconsistency in the availability of data in BIM object libraries.

The IFC data model, Revit Parameters, and CIBSE Product Data Templates contain an extensive list of data elements and properties for BIM interoperability of electrical product data, but much of this is currently not used by any applications and not commonly available to support interoperability. Hence a subset of the properties is identified and extracted as appropriate for the NEMA guidelines.

Three levels of implementation are proposed to support the primary workflows of documentation, electrical systems design, and lighting energy code compliance calculations. The proposed data groups and data elements are selected to be generic, be simple to use, and incorporate in the BIM object libraries. A guideline Standard defining the data groups and data elements is being developed as a basis for manufacturers to enhance their BIM product libraries. It will advance the industry use of electrical product data for design workflows and encourage BIM modelers to use product manufacturer content as a basis of design.

This white paper has identified the electrical product properties information required in BIM model libraries. However, the interoperability of this BIM data is dependent on the BIM authoring tool's ability to share this data across all electrical design and procurement activities. Revit, the most-used BIM authoring tool, assigns a GUID for each parameter. Even if manufacturers provide the product properties identified in this white paper in their BIM libraries, the use of such information will be limited unless all these parameters have an industry Standard GUID across all manufacturers' products to enable interoperability.

A companion NEMA guideline is being proposed to accomplish this objective. If every electrical product manufacturer provides data using such a shared parameter list, it will greatly improve the usability of the BIM libraries beyond geometry.

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