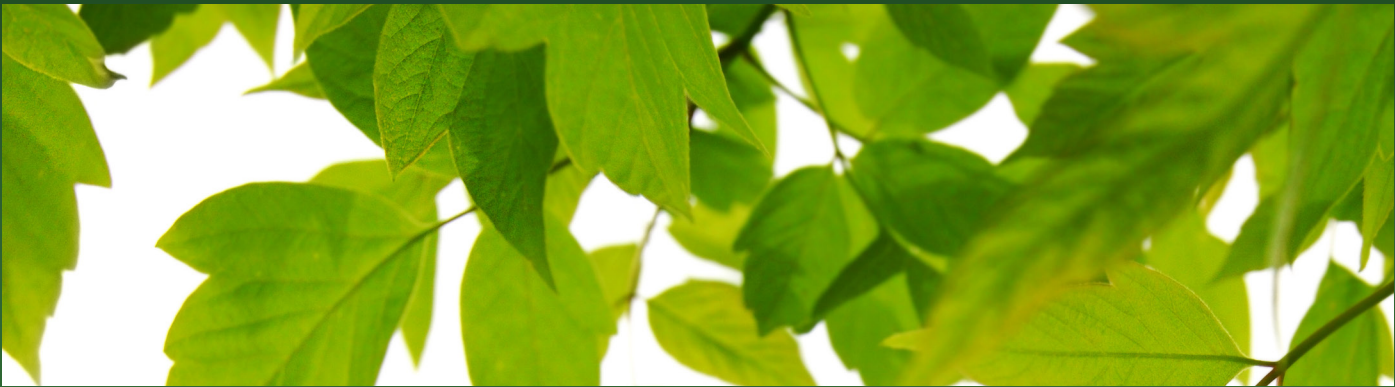




PENN BARRY™

LEED™ & Green Buildings Application Guide

Moving Your Way



LEED™ & Green Building Application Guide:

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General

This document provides application highlights covering the use of PennBarry products in green buildings.

Introduction

Buildings in the United States are responsible for 39% of CO₂ emissions, 40% of energy consumption, and 13% of potable water consumption. The HVAC systems and specifically the fans are a big percentage of the energy use in a building. Making buildings green is a significant economic and environmental opportunity. Greater building efficiency can meet 85% of future U.S. demand for energy. The green revolution is increasing the demand for sustainable, green, and energy efficient design.

Leadership in Energy & Environment

The United States Green Building Council (USGBC) developed the Leadership in Energy & Environmental Design (LEED™) Green Building Rating System™. The LEED council is a voluntary, consensus-based national standard board for developing high-performance, sustainable buildings. USGBC members represent all segments of the building industry and update the program continuously.

Purpose

The LEED rating system was created for the following reasons:

- Define “green building” by establishing a common measurement standard.
- Promote integrated, whole building design practices.
- Recognize environmental leadership in the building industry.
- Stimulate green competition.
- Raise consumer awareness of green building benefits.
- Transform the building market.

More information about the USGBC and LEED can be found on the USGBC website (www.usgbc.org).

Current Standards

The current LEED standards are as follows:

- LEED for New Construction
- LEED Core & Shell
- LEED for Schools
- LEED for Commercial Interiors
- LEED for Existing Buildings

Several other LEED systems are under development or in pilot as well.

LEED Rating System

Using the LEED rating system, a project can become LEED certified by obtaining points for “green” building processes, systems, and materials. The four levels of LEED certification are as follows.

- General certification requires 40-49 points.
- Silver certification is 50-59 points.
- Gold certification is 60-79 points.
- Platinum certification is 80+ points.

The Project Checklist consists of several sections, each with various topics, called Credits. The following list provides the section categories.

- Sustainable Sites (SS)
- Water Efficiency (WE)
- Energy & Atmosphere (EA)
- Materials & Resources (MR)
- Indoor Environmental Quality (EQ)
- Innovation & Design Process (ID)

Prerequisites and Credits exist within each section. To achieve LEED certification, prerequisites for all sections of LEED must be met regardless of which Credits are submitted for certification. LEED certified projects must also provide annual energy consumption data to maintain their LEED status.

LEED is a system based on synergies. A specific model fan cannot automatically achieve a LEED point. However, fans provide the supply and exhaust air that contributes to many LEED credits. Proper fan application will help you meet ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy and ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality. These ASHRAE standards are required to achieve the following LEED Indoor Environmental Quality credits.

- IEQ Prerequisite 1, Minimum Indoor Air Quality Performance
- IEQ Credit 2, Increased Ventilation
- IEQ Credit 7.1, Thermal Comfort, Design
- IEQ Credit 7.2, Thermal Comfort, Verification

In addition to those credits, exhaust fans can help you achieve IEQ Credit 5, Indoor Chemical and Pollutant Source Control. The real green potential associated with fans however is in the energy consumption of a building.

Fans and Building Energy

Fans are a major contributor to the energy use in a building and fan selection is key to reducing energy usage. Fan selection should consider all aspects for the system including efficiency, airflow, pressure, noise, and system effects. Proper fan selection will help you achieve Energy & Atmosphere Prerequisite 2, Minimum Energy Performance, and Energy & Atmosphere Credit 1, Optimize Energy Performance.

The Energy & Atmosphere Prerequisite 2, Minimum Energy Performance, requires that all new construction exceed ASHRAE Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings, design requirements by 10%. Under Energy and Atmosphere Credit 1, Optimize Energy Performance, exceeding ASHRAE 90.1-2007 by more than 10% will qualify for LEED points. A building can achieve up to 19 points for every additional 2% points saved in energy above the 10% energy savings requirement up to 48%. A building can also achieve an additional exemplary performance point, for a total of 20 points, for exceeding ASHRAE 90.1-2007 by 50%.

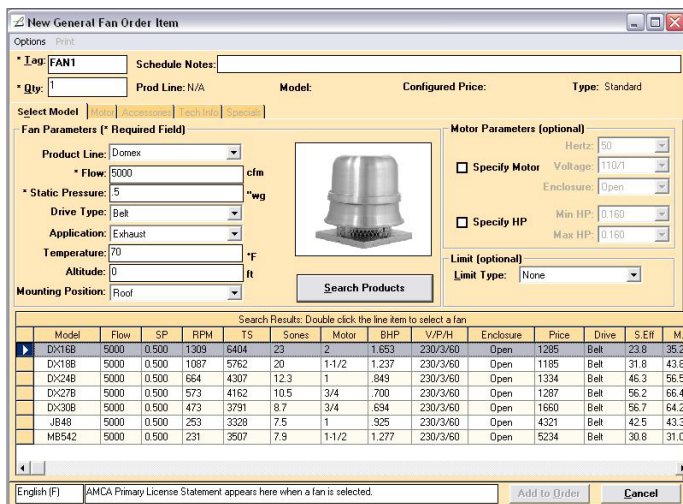
Since the HVAC system can be 40% of the total energy use of a building and the fans contribute to nearly 40% of that, proper selection of the HVAC system and the fans are critical to achieving multiple points for the Optimize Energy Performance credit.

Selecting Fans for Maximum Efficiency

Ideally, fan selection should be made at the best efficiency point. At this point the fan operates most cost effectively in terms of energy efficiency and maintenance. Operating at peak efficiency reduces wear and allows for longer intervals between maintenance. As the operating point moves away from peak efficiency, bearing loads and noise increases. For the best efficiency, the fan should be selected to deliver the required airflow at the expected static pressure with the lowest horsepower motor possible.

Fan selection should consider all aspects for the system and should be based on “normal” operation. Peak demand typically happens for short periods of time. Running a fan at maximum efficiency during normal operation for long periods of time saves more energy than operating at maximum efficiency at peak demand and at lower efficiency at normal demand. The optimal fan selection would range from to the right of maximum efficiency at peak demand, at or near maximum efficiency at normal demand, and to the left of peak efficiency during times of low demand.

Often several fans will meet the airflow and pressure requirements of an application. The Domex selection below shows that 7 units will achieve 5000 cfm and 0.5” wg.



Model	Flow	SP	RPM	TS	Sones	Motor	BHP	V/P/H	Enclosure	Price	Drive	S.E.#	M
DX16B	5000	0.500	1309	6404	23	2	1.653	230/3/60	Open	1295	Belt	23.8	35.2
DX18B	5000	0.500	1087	5762	20	1-1/2	1.237	230/3/60	Open	1185	Belt	31.8	43.8
DX24B	5000	0.500	664	4307	12.3	1	.849	230/3/60	Open	1334	Belt	46.3	56.5
DX27B	5000	0.500	573	4162	10.5	3/4	.700	230/3/60	Open	1287	Belt	56.2	66.4
DX30B	5000	0.500	473	3791	8.7	3/4	.694	230/3/60	Open	1660	Belt	56.7	64.2
JB4B	5000	0.500	253	3328	7.5	1	.925	230/3/60	Open	4321	Belt	42.5	43.3
MB542	5000	0.500	231	3507	7.9	1-1/2	1.277	230/3/60	Open	5234	Belt	30.8	31.0

Figure 1. Domex Selection

The selection criteria used to narrow down to a specific size can make a large difference in first costs and operating costs. Assuming a \$0.10 per kWh electricity rate, 2500 operating hours a year, and a motor efficiency of 0.88, the least expensive size, DX18B, will cost about \$262 to operate per year. Using the same assumptions, the unit with the highest total efficiency, DX27B, would cost \$148 to operate per year, over 40% less. The difference in first cost between these two sizes is \$102, but the \$114 savings in energy use per year makes up for that in under one year. An additional benefit to the DX27B is that it is also quieter than the DX18B.

ASHRAE 90.1 Mandatory Provisions and Prescriptive Path

ASHRAE 90.1 also addresses many mandatory and prescriptive provisions relative to fans, hoods, ventilators (gravity and powered), and energy recovery ventilators that must be followed to achieve LEED certification.

Shut-off Control

ASHRAE 90.1 requires that all outdoor air supply and exhaust hoods, vents, and ventilators must have motorized dampers that will automatically close when the spaces are not in use. Gravity dampers are only acceptable in buildings less than three stories tall (unless the building is in climate zones 1, 2, and 3 based on the US Department of Energy climate zone map shown below). ASHRAE 90.1 also requires that fans with motors greater than 0.75 hp have automatic controls that are capable with shutting off fans when they are not required.

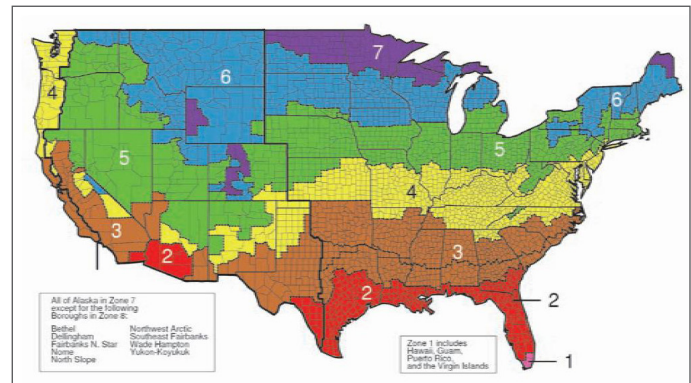


Figure 2. US Department of Energy Climate Zone Map

Maximum Horsepower Requirements

Under the prescriptive path, which is required by LEED to meet the Minimum Energy Performance prerequisite as well as the Optimize Energy Performance credit, ASHRAE 90.1 sets a fan power limitation for both motor nameplate and fan brake horsepower. In a VAV system, the maximum allowable motor nameplate hp must not exceed 0.0015 times the design cfm. The brake horsepower cannot exceed 0.0013 times the design cfm plus a pressure drop adjustment correction factor A. The exception to this is in applications involving hospital and lab systems, fans exhausting air from fume hoods, and fans with motors 1 hp or less. In addition, the fan motor selected must not be larger than the first available motor size larger than the brake horsepower.

Energy Recovery Ventilators

The prescriptive path under ASHRAE 90.1 also calls for the use of energy recovery ventilators with an effectiveness of 50% or greater for systems that have a supply air capacity of 5000 cfm or greater and a minimum outdoor air supply of 70% of design supply. Several exceptions apply such as laboratory systems, systems exhausting toxic, flammable, or corrosive fumes, projects that provide more than 60% of the outdoor air heating through site-recovered or site-solar energy, and when the largest exhaust source is less than 75% of the design outdoor airflow. Several more exceptions apply.

In addition to the ASHRAE 90.1 requirements, LEED Indoor Environmental Quality Prerequisite 1, Minimum Indoor Air Quality Performance, requires that the building must meet the minimum requirements of Sections 4 through 7 of ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality and Indoor Environmental Quality Credit 2, Increased Ventilation, requires you provide an additional 30% of outdoor air. Using an ERV can help you bring in the required outside air for ASHRAE 62.1 while meeting the energy reduction requirements of ASHRAE 90.1.

LEED Material & Resources

Total Material Value and MEP Products

Many of the Credits in the Material & Resources section of LEED require the project to calculate the total material value of the project. Mechanical, electrical, and plumbing (MEP) products as well as labor, overhead, and fees are not to be included. If exact material cost, without labor, overhead, and fees, cannot be determined, LEED will allow the use of 45% of the total project cost for the total material cost calculations.

The reason for excluding MEP products is that typically, MEP products are not recycled or reused, which is the focus of the Material & Resources section of LEED. Including MEP products would increase the total material value of a project while not adding value to the total recycled or reused material content, and, therefore, make it more difficult to achieve the 10% and 20% necessary to achieve some of the Material & Resource Credits. For this reason, fans cannot be included in the calculations for any of the Material & Resources credits with the exception of MR Credit 2, Construction Waste Management.

Green Building Codes and Programs

With energy considerations growing, there is an increased interest in “green” buildings, sustainable design, and energy savings. Although the U.S. Green Building Council is not a government agency, many local governing bodies are requesting, and in some cases requiring, green design features into their new construction requirements. Some states and cities offer tax incentives for buildings that meet green building codes or become LEED certified and others will most likely offer incentives in the future.

Energy Policy Act of 2005

The Energy Policy Act of 2005 (EPAct 2005), which went into effect December 31, 2005 provides tax incentives for energy efficiency measures. For commercial buildings, the EPAct 2005 offers business taxpayers a deduction of \$1.80 per square foot for commercial buildings that achieve a 50% reduction in annual energy cost to the user, compared to a base building defined by the industry standard ASHRAE/IESNA 90.1-2001. Energy costs refer only to heating, cooling, lighting and water heating, since only these uses are within the scope of the ASHRAE standard and within the control of the building designer.

Energy Independence and Security Act of 2007

The Energy Independence and Security Act of 2007 signed into law on December 19, 2007 created standards for energy use in Federal buildings and requires a 30% reduction in energy use by 2015.

The Act also required the Secretary of Energy to appoint a Director of Commercial High-Performance Green Buildings to establish and manage the Office of Commercial High-Performance Green Buildings and establish the Zero-Net-Energy Commercial Buildings Initiative to reduce the quantity of energy consumed by commercial buildings and achieve zero net energy commercial buildings in the US.

American Recovery and Reinvestment Act of 2009

The American Recovery and Reinvestment Act (ARRA) of 2009 economic stimulus package enacted in February 2009 provides funding for energy efficiency and energy codes. States will receive millions of dollars from DOE through the State Energy Program if they agree to requirements for investments in existing energy efficiency programs, and adoption and implementation of energy codes. State implementation of energy codes must reach a compliance level of 90% within eight years.

American Clean Energy and Security Act

The Waxman-Markey climate and energy bill, also known as the American Clean Energy and Security Act (ACES), which is awaiting a Senate vote at this time, would set new energy-efficiency standards for buildings and would require 30% energy-efficiency improvement by 2010 and 50% improvement by 2016.

All of these bills have changed or will change the way we build buildings. These acts, along with public interest in building more efficient and sustainable buildings are being backed up by federal, state, and local green building legislation.

Federal, State and Local Green Requirements

The General Services Administration (GSA) was one of the first to require LEED in their building projects in 2000. Currently LEED initiatives including legislation, executive orders, resolutions, ordinances, policies, and incentives are found in 44 states, 132 cities, 33 counties, 33 towns, 33 state governments, 12 federal agencies, 16 public school jurisdictions and 39 institutions of higher education in the US alone.

The list of federal, state, and local governments and agencies is too long to list here, but can be found on the USGBC's LEED Initiatives in Governments and Schools webpage (<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1852>).

Summary

Green buildings are here to stay. Owners are interested in saving money on energy costs while providing a comfortable working environment. State and local governments are implementing tax credits for energy efficient and environmentally friendly buildings.

More information about green buildings can be found on the Green Building section of the PennBarry website (www.pennbarry.com) and on individual state websites and green building organizations' websites, such as the U.S. Green Building Council (www.usgbc.org), WorldBuild (www.worldbuild.com), the American Council for an Energy-Efficient Economy (www.aceee.org), and many others. The EPA also has information on green buildings on its website (<http://www.epa.gov/greenbuilding/>).

Abbreviations

The following table lists abbreviations used within this document.

Abbreviation	Term
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
EA	Energy & Atmosphere
EPA	Environmental Protection Agency
EQ	Indoor Environmental Quality
GSA	General Services Administration
hp	Horsepower
HVAC	Heating Ventilation and Air Conditioning
HVAC&R	Heating Ventilation and Air Conditioning and Refrigeration
LEED	Leadership in Energy and Environmental Design
MEP	Mechanical, Electrical, and Plumbing
MR	Materials & Resources
rpm	Revolutions Per Minute
SS	Sustainable Site
USGBC	United States Green Building Council
VAV	Variable Air Volume
WE	Water Efficiency

LEED 2009 for New Construction & Major Renovations Project Checklist

Sustainable Sites

<input type="checkbox"/> Prerequisite 1	Construction Activity Pollution Prevention	
<input type="checkbox"/> Credit 1	Site Selection	
<input type="checkbox"/> Credit 2	Development Density and Community Connectivity	
<input type="checkbox"/> Credit 3	Brownfield Redevelopment	
<input type="checkbox"/> Credit 4.1	Alternative Transportation—Public Transportation Access	
<input type="checkbox"/> Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	
<input type="checkbox"/> Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	
<input type="checkbox"/> Credit 4.4	Alternative Transportation—Parking Capacity	
<input type="checkbox"/> Credit 5.1	Site Development—Protect or Restore Habitat	
<input type="checkbox"/> Credit 5.2	Site Development—Maximize Open Space	
<input type="checkbox"/> Credit 6.1	Stormwater Design—Quantity Control	
<input type="checkbox"/> Credit 6.2	Stormwater Design—Quality Control	
<input type="checkbox"/> Credit 7.1	Heat Island Effect—Nonroof	
<input type="checkbox"/> Credit 7.2	Heat Island Effect—Roof	
<input type="checkbox"/> Credit 8	Light Pollution Reduction	

26 Possible Points

Required

1
5
1
6
1
3
2
1
1
1
1
1
1

Water Efficiency

<input type="checkbox"/> Prerequisite 1	Water Use Reduction Required	
<input type="checkbox"/> Credit 1	Water Efficient Landscaping	
<input type="checkbox"/> Credit 2	Innovative Wastewater Technologies	
<input type="checkbox"/> Credit 3	Water Use Reduction	

10 Possible Points

2 - 4
2
2 - 4

Energy and Atmosphere

<input type="checkbox"/> Prerequisite 1	Fundamental Commissioning of Building Energy Systems	
<input type="checkbox"/> Prerequisite 2	Minimum Energy Performance	
<input type="checkbox"/> Prerequisite 3	Fundamental Refrigerant Management	
<input type="checkbox"/> Credit 1	Optimize Energy Performance	
<input type="checkbox"/> Credit 2	On-site Renewable Energy	
<input type="checkbox"/> Credit 3	Enhanced Commissioning	
<input type="checkbox"/> Credit 4	Enhanced Refrigerant Management	
<input type="checkbox"/> Credit 5	Measurement and Verification	
<input type="checkbox"/> Credit 6	Green Power	

35 Possible Points

Required
Required
Required
1 - 19
1 - 7
2
2
3
2

Materials and Resources

<input type="checkbox"/> Prerequisite 1	Storage and Collection of Recyclables	
<input type="checkbox"/> Credit 1.1	Building Reuse—Maintain Existing Walls, Floors and Roof	
<input type="checkbox"/> Credit 1.2	Building Reuse—Maintain Existing Interior Nonstructural Elements	
<input type="checkbox"/> Credit 2	Construction Waste Management	
<input type="checkbox"/> Credit 3	Materials Reuse	
<input type="checkbox"/> Credit 4	Recycled Content	
<input type="checkbox"/> Credit 5	Regional Materials	
<input type="checkbox"/> Credit 6	Rapidly Renewable Materials	
<input type="checkbox"/> Credit 7	Certified Wood	

14 Possible Points

Required
1 - 3
1
1 - 2
1 - 2
1 - 2
1
1

Indoor Environmental Quality

<input type="checkbox"/> Prerequisite 1	Minimum Indoor Air Quality Performance	
<input type="checkbox"/> Prerequisite 2	Environmental Tobacco Smoke (ETS) Control	
<input type="checkbox"/> Credit 1	Outdoor Air Delivery Monitoring	
<input type="checkbox"/> Credit 2	Increased Ventilation	
<input type="checkbox"/> Credit 3.1	Construction Indoor Air Quality Management Plan—During Construction	
<input type="checkbox"/> Credit 3.2	Construction Indoor Air Quality Management Plan—Before Occupancy	
<input type="checkbox"/> Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	
<input type="checkbox"/> Credit 4.2	Low-Emitting Materials—Paints and Coatings	
<input type="checkbox"/> Credit 4.3	Low-Emitting Materials—Flooring Systems	
<input type="checkbox"/> Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	
<input type="checkbox"/> Credit 5	Indoor Chemical and Pollutant Source Control	
<input type="checkbox"/> Credit 6.1	Controllability of Systems—Lighting	
<input type="checkbox"/> Credit 6.2	Controllability of Systems—Thermal Comfort	
<input type="checkbox"/> Credit 7.1	Thermal Comfort—Design	
<input type="checkbox"/> Credit 7.2	Thermal Comfort—Verification	
<input type="checkbox"/> Credit 8.1	Daylight and Views—Daylight	
<input type="checkbox"/> Credit 8.2	Daylight and Views—Views	

15 Possible Points

Required
Required
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1

Innovation in Design

<input type="checkbox"/> Credit 1	Innovation in Design	
<input type="checkbox"/> Credit 2	LEED Accredited Professional	

6 Possible Points

1 - 5
1

Regional Priority

<input type="checkbox"/> Credit 1	Regional Priority	
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4 Possible Points

1 - 4

☐ Areas where PennBarry products can help you earn LEED points.

100 Base Points
+ 6 (Innovation in Design)
+ 4 (Regional Priority)

PennBarry Product Solutions:



PennBarry is proud to be your preferred manufacturer of commercial and industrial fans and blowers. To learn more about how PennBarry products can assist you in your next application, simply contact your nearest PennBarry representative or visit us on the web at www.pennbarry.com.

General Products

Roof and Wall Exhaust Centrifugal Fans
Ceiling, Wall, and Inline Centrifugal Fans
Roof Supply Centrifugal Fans
Square and Round Centrifugal Fans
Wall Mounted Axial Fans
Hooded Roof Axial Fans
Upblast Roof Axial Fans
Gravity Ventilators
Roof Curbs

Industrial Products

Utility Vent Sets
Freestanding Centrifugal Fans
Industrial & Material Handling Fans
Tubular Centrifugal Inline Fans
Mixed Flow Centrifugal Fans
Plug & Plenum Fans
Wall Mounted Propeller Fans
Tubaxial Fans
Vaneaxial Fans
Bifurcator Fans
Fume Exhaust Fans

Energy Recovery Products

Outdoor Units
Indoor Units



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Moving Your Way

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