

The Michigan Energy Code: A Guide for Improving the Energy Efficiency of Your Existing Facility

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Acknowledgements

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A.R. Brouwer Company

Disclaimer

This brief presentation does not provide a comprehensive review of the Michigan Energy Code (MEC). It does provide a cursory overview of some of the changes to the MEC that may be implemented as strategies with high returns on investment to improve facility performance.

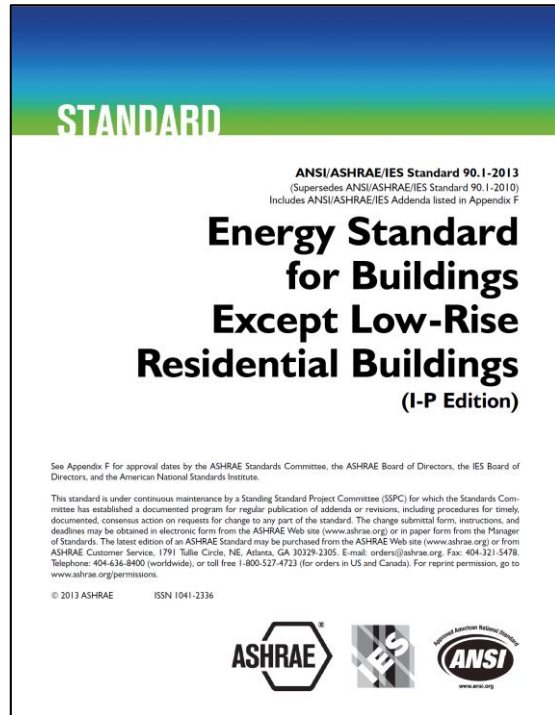
Learning Objectives

Participants will be able to:



- List 10 key changes to the Michigan Energy Code relative to mechanical systems, power and lighting
- Understand the energy and economic impacts of key changes to the MI Energy Code
- Use the Michigan Energy Code as a source of strategies to improve the energy performance of their existing facilities

Commercial Code Advancement



Recent Commercial Code Advancement

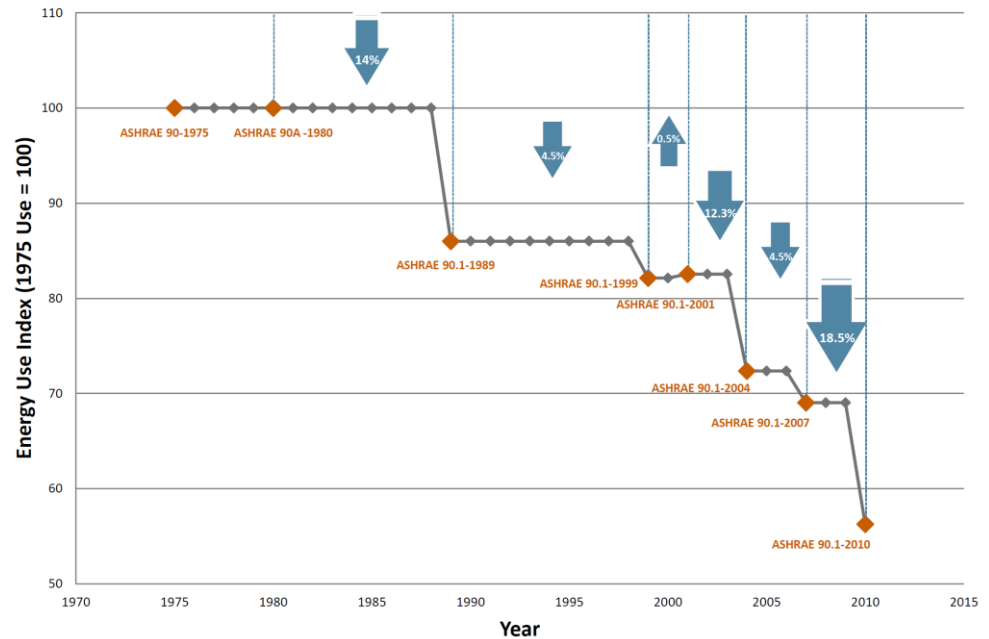
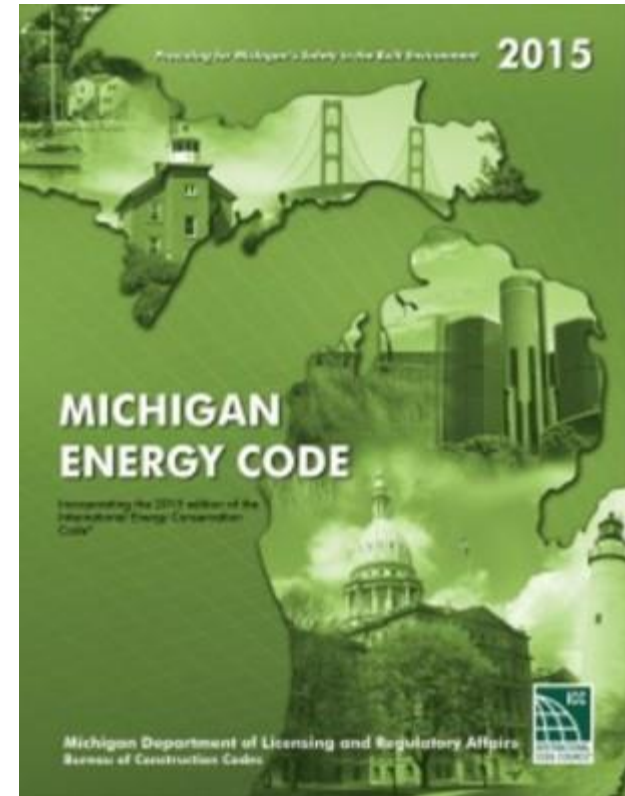
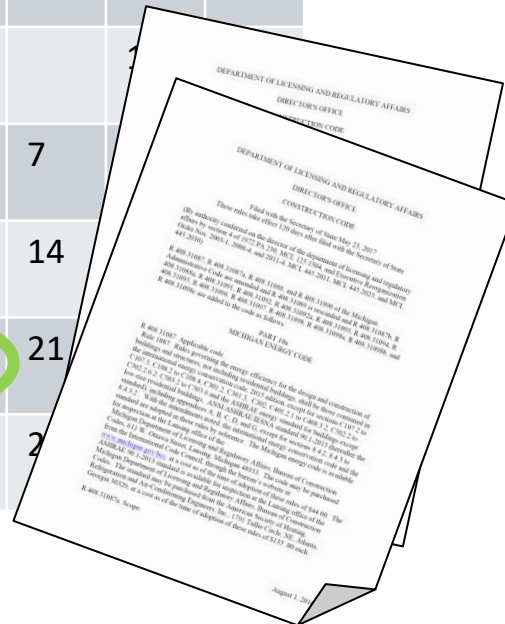


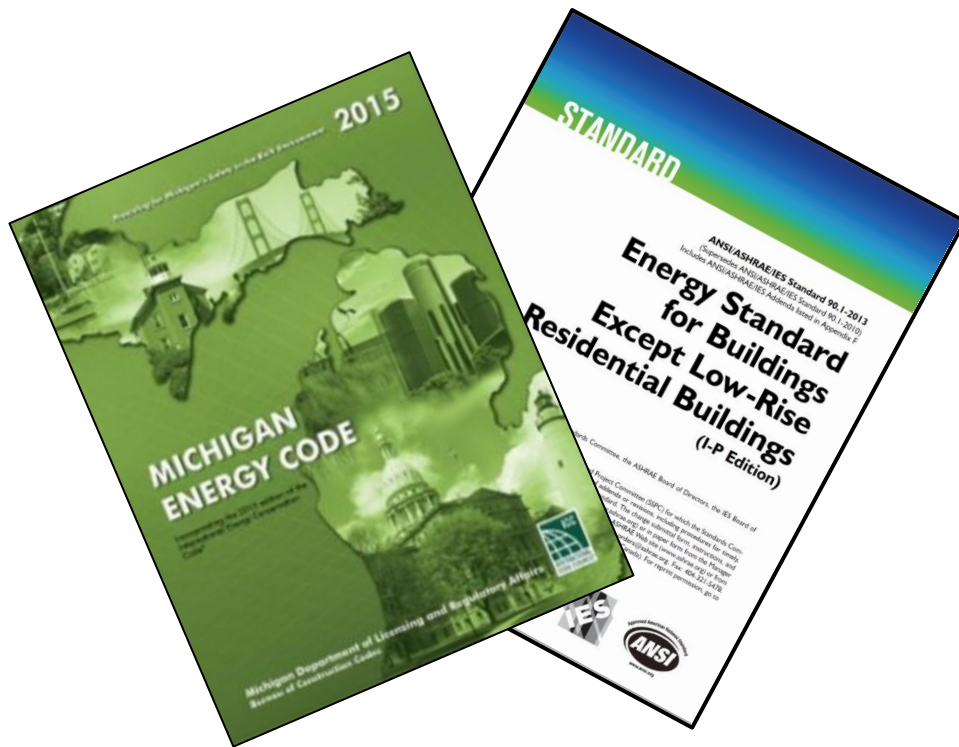
Image Credit: U.S. DOE

ASHRAE 90.1-2013 for Michigan

SEPTEMBER 2017						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
3	4	5	6	7		
10	11	12	13	14		
17	18	19	20	21		
24	25	26	27	28		



MI Energy Code / ASHRAE 90.1-2013



Section 1- Purpose

Section 2- Scope

Section 3- Definitions

Section 4- Administration and Enforcement

Section 5- Building Envelope

Section 6- Heating Ventilation and Air Conditioning

Section 7- Service Water Heating

Section 8- Power

Section 9- Lighting

Section 10- Other Equipment

Section 11- Energy Cost Budget Method

Section 12- Normative References

The Michigan Energy Code & ASHRAE 90.1-2013: Top 15 Ideas for Improving the Energy Efficiency of Your Existing Facility

PURPOSE

Purpose

To establish the minimum energy efficiency requirements of buildings, other than low-rise residential buildings, for:

- Design
- Construction
- Operational Plan
- Maintenance Plan
- Utilization of on-site renewables

#1 Revisit the Facility Operation Plan

Mission & Vision

Goals & Objectives

Services & Space Functions

Operating Hours & Schedules

Setpoints, Ranges & Limitations for:

- Interior & Exterior Lighting
- Temperature & Humidity
- Domestic Hot Water
- Outdoor Air Quantity
- Indoor Air Quality

Controls

Energy Use Targets

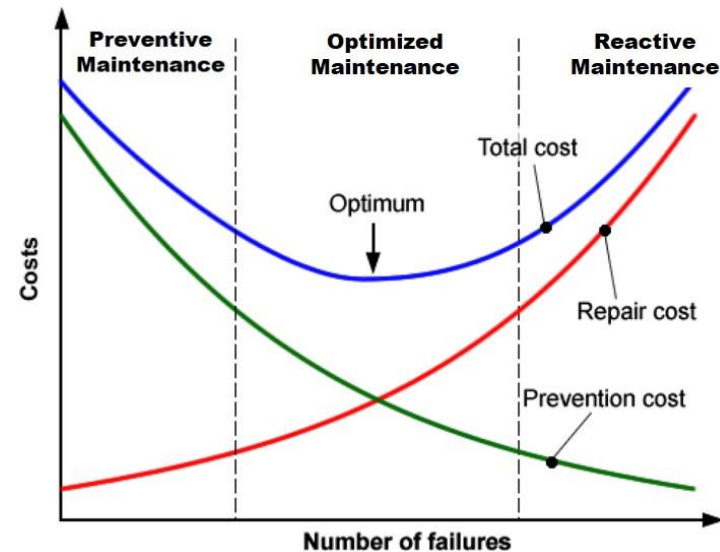
Key Performance Indicators

Authorities, Responsibilities &
Organization Structure

Management Policies



#2 Invest in the Maintenance Program



#2 Invest in the Maintenance Program

Avoid degradation in equipment and system performance and in IEQ



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SCOPE

MI Energy Code / ASHRAE 90.1-2013 Scope

New Construction



Additions



Photo Credit: AR Brouwer Company

Alterations



New Systems and Equipment
for Certain Industrial or
Manufacturing Processes

and

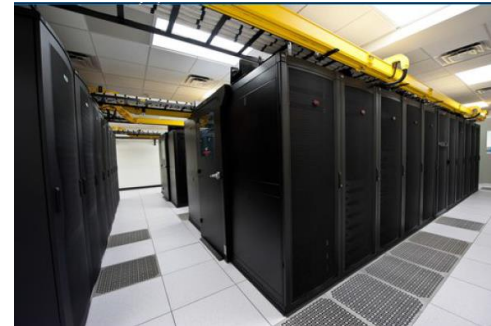


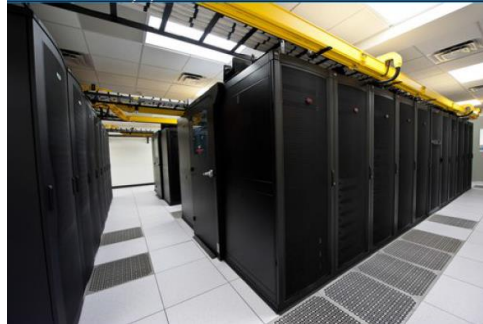
Photo Credit: NREL

#3 Expand the Energy Efficiency Scope

Refrigeration
Equipment



IT Rooms &
Data Centers



Escalators &
Elevators



Strategies to Expand the Energy Efficiency Scope



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BUILDING ENVELOPE

#4 Control Vestibules

Automatic controls to shut off heating when $OAT \geq 45^{\circ}F$

Controlled by a thermostat

Maximum space setpoint of $60^{\circ}F$



Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

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HEATING, VENTILATING and AIR-CONDITIONING

#5 Off-Hour Thermal Setpoints



Heating Setback: -10°F

Cooling Setup: $+5^{\circ}\text{F}$

Optimum Start based on:

- Space Temperature
- Occupied Setpoint
- Outside Temperature
- Time-to-Scheduled Occupancy

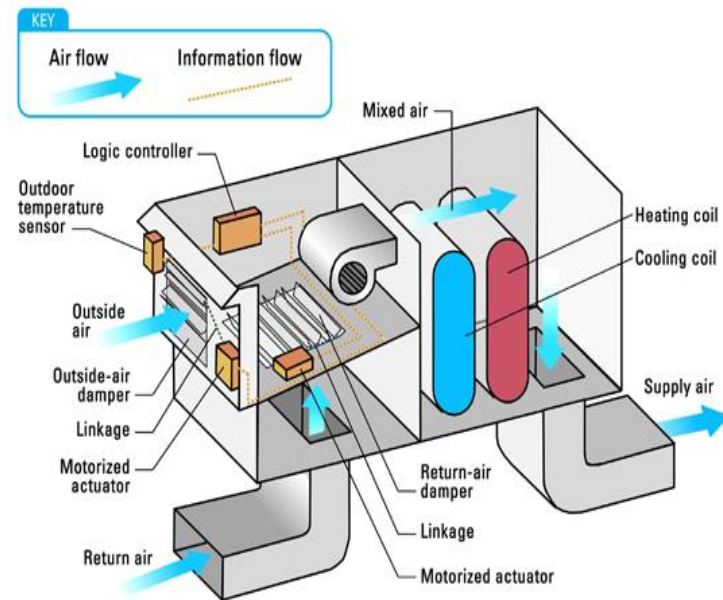
Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

#6 Economizers

Minimum Equipment Capacity for which an Economizer is Required

Application	Minimum Capacity
Comfort	≥ 4.50 tons
Computer Rm	≥ 11.25 tons

Adapted from ASHRAE 90.1-2013



Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

#7 Calibrate Sensors

AIR SENSOR MINIMUM ALLOWABLE ACCURACIES		
Sensor	Calibrated Accuracy	Range
Dry Bulb	$\pm 2^{\circ}\text{F}$	40°F to 80°F
Wet Bulb	$\pm 2^{\circ}\text{F}$	40°F to 80°F
Enthalpy	$\pm 3 \text{ Btu/lb}$	20 Btu/lb to 36 Btu/lb
Differential Enthalpy	$\pm 3 \text{ Btu/lb}$	20 Btu/lb to 36 Btu/lb
Relative Humidity	$\pm 5\%$	20% RH to 80% RH

Adapted from ASHRAE 90.1-2013



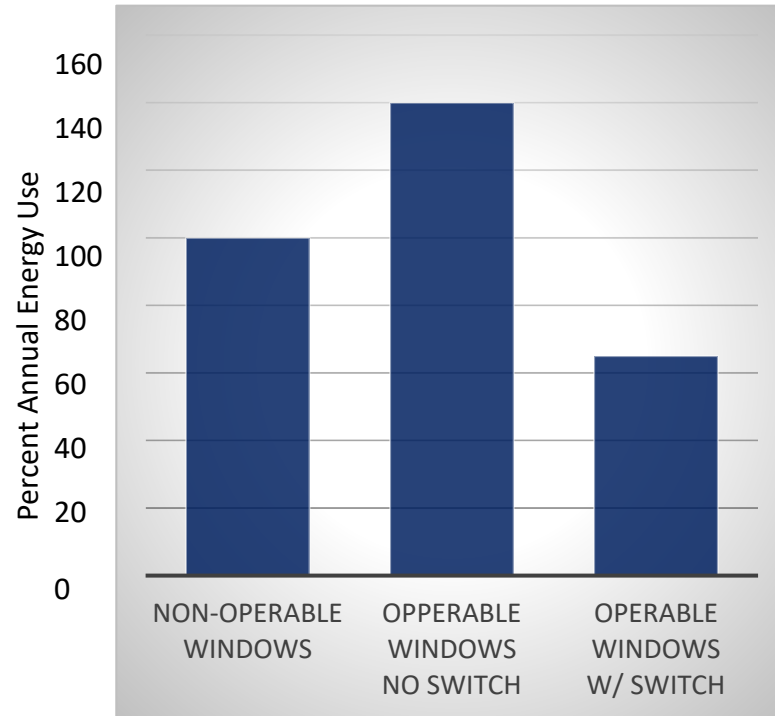
#8 Building-to-HVAC System Interlocks

Within 5 minutes of door opening do one of:

- Disable mechanical heating
- Reset heating setpoint $\leq 55^{\circ}\text{F}$

Within 5 minutes of door opening do one of:

- Disable mechanical cooling
- Reset cooling setpoint to $\geq 90^{\circ}\text{F}$
- Cooling can remain enabled if $\text{OAT} < \text{RAT}$



Results of Taylor Engineering study at UC Mercer Campus. "Operable Windows and HVAC Systems." Allan Daly. HPAC Engineering, Dec 2002.

Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

#9 Seal Ductwork & Air-Handlers

TABLE 6.4.4.2A Minimum Duct Seal Level^a

Duct Location	Duct Type			
	Supply ≤2 in. w.c. ^a	Supply in. w.c. ^b	Exhaust	Return
Outdoor	A	A	C	A
Unconditioned spaces	B	A	C	B
Conditioned spaces ^c	C	B	B	C

Adapted from ASHRAE 90.1-2007

All ductwork with pressure class ratings constructed to
Seal Class A

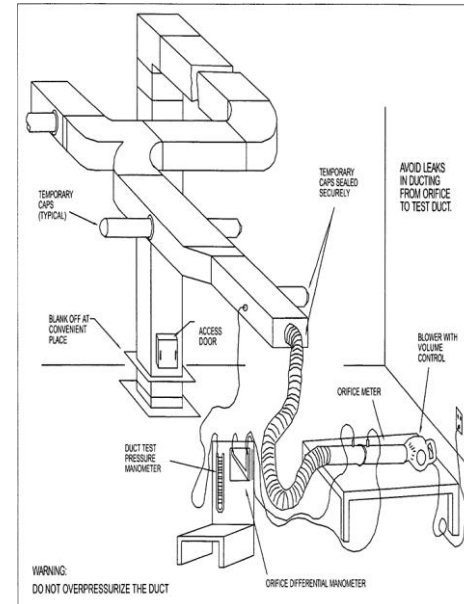


Image Source: SMACNA HVAC Air Duct Leakage Test Manual

Test all ductwork with design operating pressure > 3in. wc

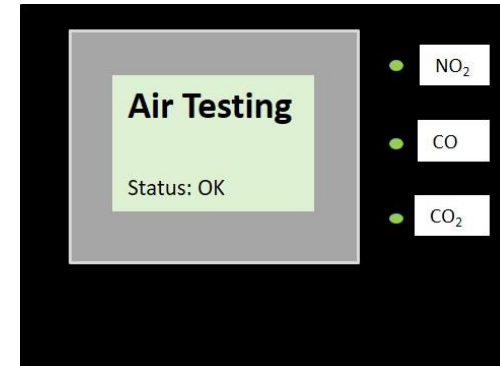
$$L_{MAX} = C_L P^{0.65}$$

C_L = Duct leakage class, cfm/100ft²
4 cfm/100ft²

P = Test pressure
 = Design pressure class

#10 Demand Controlled Ventilation for Enclosed Parking Garages

- System shall automatically detect contaminant levels and stage fans to a minimum airflow rate of $\leq 50\%$ of design capacity



Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

#11 Equipment Efficiency Improvements

Improvement in minimum efficiencies

Additional listed equipment

- Commercial Refrigeration
- Commercial Refrigerators
- Commercial Freezers
- Computer Room Air-Conditioners & Condensing Units
- Heat Exchangers
- Heat Rejection Equipment
- VRF Equipment

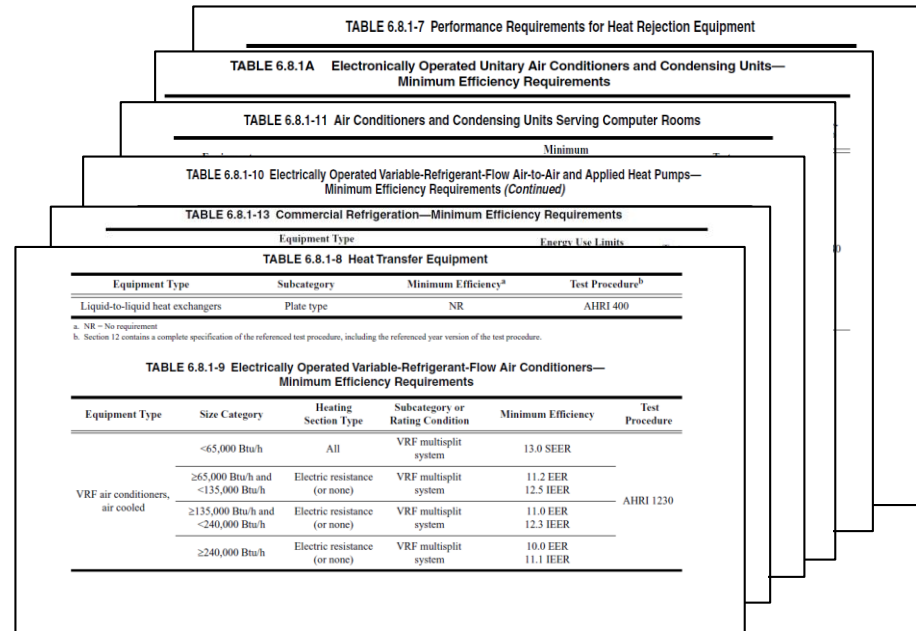


TABLE 6.8.1-7 Performance Requirements for Heat Rejection Equipment

TABLE 6.8.1A Electronically Operated Unitary Air Conditioners and Condensing Units—Minimum Efficiency Requirements

TABLE 6.8.1-11 Air Conditioners and Condensing Units Serving Computer Rooms

Minimum

TABLE 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow Air-to-Air and Applied Heat Pumps—Minimum Efficiency Requirements (Continued)

TABLE 6.8.1-13 Commercial Refrigeration—Minimum Efficiency Requirements

Energy Use Limits

TABLE 6.8.1-8 Heat Transfer Equipment

Equipment Type	Subcategory	Minimum Efficiency ^a	Test Procedure ^b
Liquid-to-liquid heat exchangers	Plate type	NR	AHRI 400

^a NR = No requirement
^b Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

TABLE 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
VRF air conditioners, air cooled	<65,000 Btu/h	All	VRF multisplit system	13.0 SEER	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	Electric resistance (or none)	VRF multisplit system	11.2 EER 12.5 IEER	
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	11.0 EER 12.3 IEER	
	≥240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	10.0 EER 11.1 IEER	

Excerpted from ASHRAE 90.1-2013

#12 Direct Digital Controls

- Monitor zone and system demand for:
 - Fan Pressure
 - Pump Pressure
 - Heating
 - Cooling

- Transfer data between zones, air distribution system controllers and HVAC plant controllers

- Automatically detect zones & systems excessively driving reset logic and notify system operator

- Readily allow operator to remove zones from the algorithm

- Trend and graphically display input and output data



Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

#13 Computer Room Cooling

- $PUE_1 \leq$ Table 6.6.1 value
- PUE_1 is the hourly simulated Computer Room PUE_1 , per 90.1 Appendix G
- PUE_{0-1} Table 6.6.1 value
- PUE_{0-2} Table 6.6.1 value
- PUE_{0-1} highest value determined at outdoor cooling design temperature for 100% IT equipment energy
- PUE_{0-2} highest value determined at outdoor cooling design temperature for 50% IT equipment energy

MAXIMUM COMPUTER ROOM PUE	
Climate Zone	PUE
5a	1.36
6a	1.34
7	1.32

Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

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LIGHTING

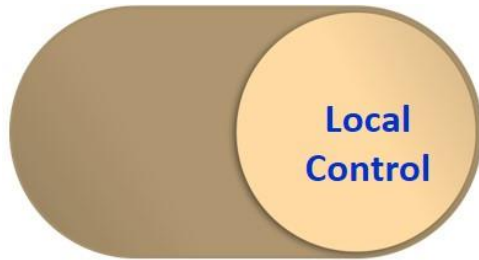
#14 Reduced Lighting Power Densities

Building Area Method	LPD W/ft ²
Convention Center	1.01
Hospital	1.05
Manufacturing Facility	1.17
Office Building	0.82
School/University	0.87
Warehouse	0.66

Adapted from ASHRAE 90.1-2013

Space-by-Space Method	LPD W/ft ²
Manufacturing	
In a detailed manufacturing area	1.29
Equipment room	0.74
High Bay Area	1.23
Extra High Bay Area	1.05
Low Bay Area	1.19

#15 Interior Lighting Control Strategies



Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

Applying Interior Lighting Controls

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method (Continued)

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:

- (1) All REQs shall be implemented.
- (2) At least one ADD1 (when present) shall be implemented.
- (3) At least one ADD2 (when present) shall be implemented.

Informative Note: This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.

Common Space Types ¹	LPD, W/ft ²	RCR Threshold	Local Control (See Section 9.4.1.1[a])	Restricted to Manual ON (See Section 9.4.1.1[b])	Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	Bilevel Lighting Control (See Section 9.4.1.1[d])	Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e] ⁶)	Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f] ⁶)	Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	Automatic Full OFF (See Section 9.4.1.1[h])	Scheduled Shutoff (See Section 9.4.1.1[i])
			a	b	c	d	e	f	g	h	i
Conference/Meeting/Multipurpose Room	1.23	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
Confinement Cells	0.81	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Copy/Print Room Corridor ²	0.72	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—

Adapted from ASHRAE 90.1-2013

Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

#16 Exterior Lighting Control



Automatically turned OFF when sufficient daylight is available

EXTERIOR LIGHTING CONTROL		
BUILDING ELEMENT	OFF	ON
Façade and Landscaping	At the later of: <ul style="list-style-type: none"> • 12 midnight • Closing • Time established by AHJ 	At the earlier of: <ul style="list-style-type: none"> • 6 am • Opening • Time established by AHJ
BUILDING ELEMENT	REDUCED BY AT LEAST 30%	ON
Unspecified and Signage	At the later of: <ul style="list-style-type: none"> • 12 midnight • Within 1 hr of closing 	At the earlier of: <ul style="list-style-type: none"> • 6 am • Opening

Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

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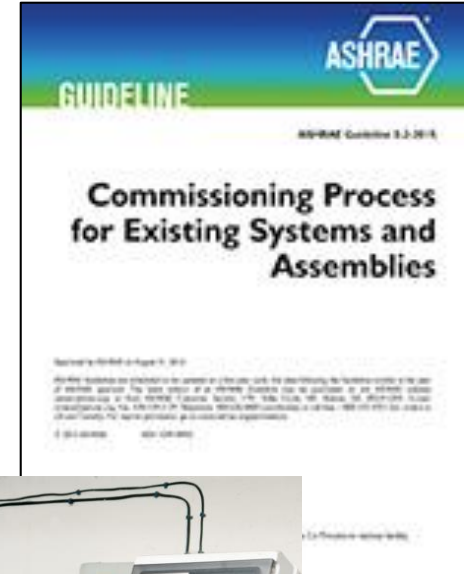
COMPLIANCE DOCUMENTATION

#17 HVAC Commissioning

HVAC air and water distribution systems balanced and balance reports provided to the building owner for systems serving zones greater than 5,000 ft².

HVAC control systems tested to ensure all control elements are:

- Properly calibrated
- Properly located
- Properly adjusted
- Properly programmed
- Working in accordance with construction documents and manufacturers' instructions



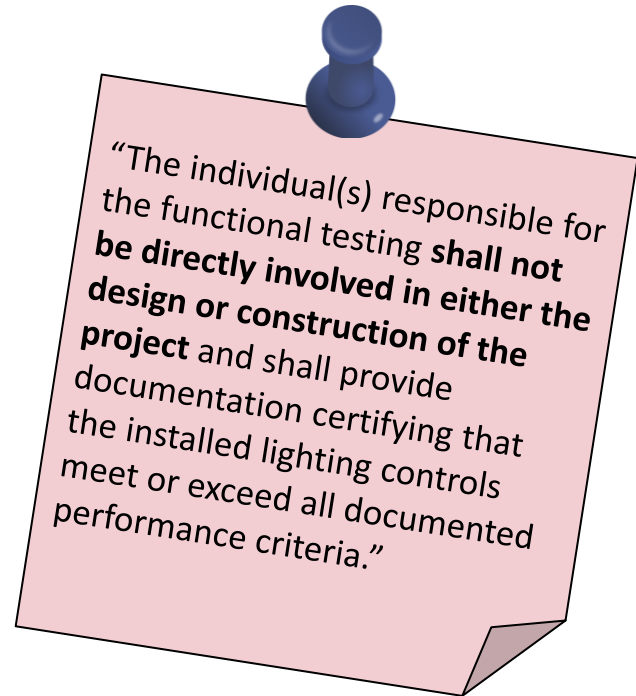
HVAC system commissioning for projects that are larger than 10,000ft².

Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

#18 Lighting Control Function Testing

Lighting control devices and system is function tested to ensure all hardware and software is:

- Properly calibrated
- Properly located
- Properly adjusted
- Properly programmed
- Working in accordance with construction documents and manufacturers' instructions



#19 Compliance Documentation

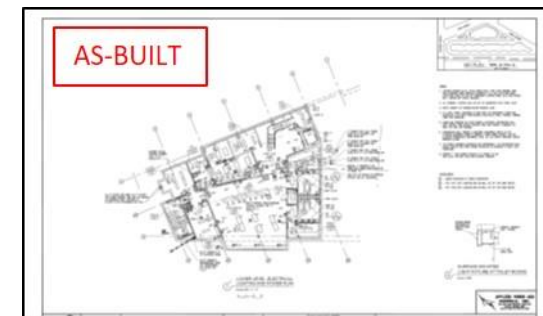
Construction documents require within 90 days of acceptance the following to be supplied to owner:

- ▶ Record Drawings
- ▶ Balance Reports for Air and Water Distribution Systems
- ▶ Commissioning Reports
- ▶ Equipment capacity, setpoints and installed options
- ▶ Daylighting Areas and Inventories
- ▶ Operation Manual with setpoints and performance criteria
- ▶ Maintenance Manual with routine maintenance identified
- ▶ Narrative sequence of operation
- ▶ Names of qualified service providers



**OWNER'S
OPERATION &
MAINTENANCE
MANUAL**

Your Building
12345 Street
Jan 1, 2018



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POWER & OTHER

#20 Energy Monitoring

- Measurement devices are required for each new building to meter the following utilities if they are supplied by a energy provider or plant not within the building:

- Natural Gas
- Fuel Oil
- Propane
- Steam
- Chilled Water
- Hot Water



- Energy use sampling rate \leq 60 minutes
- Hourly, Daily, Monthly, and Annual Reporting of consumption and demand
- Data maintained for \geq 36 months

Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.



Submetering

Measure and record independent energy use for:

- Whole Building
- HVAC
- Interior Lighting
- Exterior Lighting
- Receptacles

Maintain records for at least 3 years

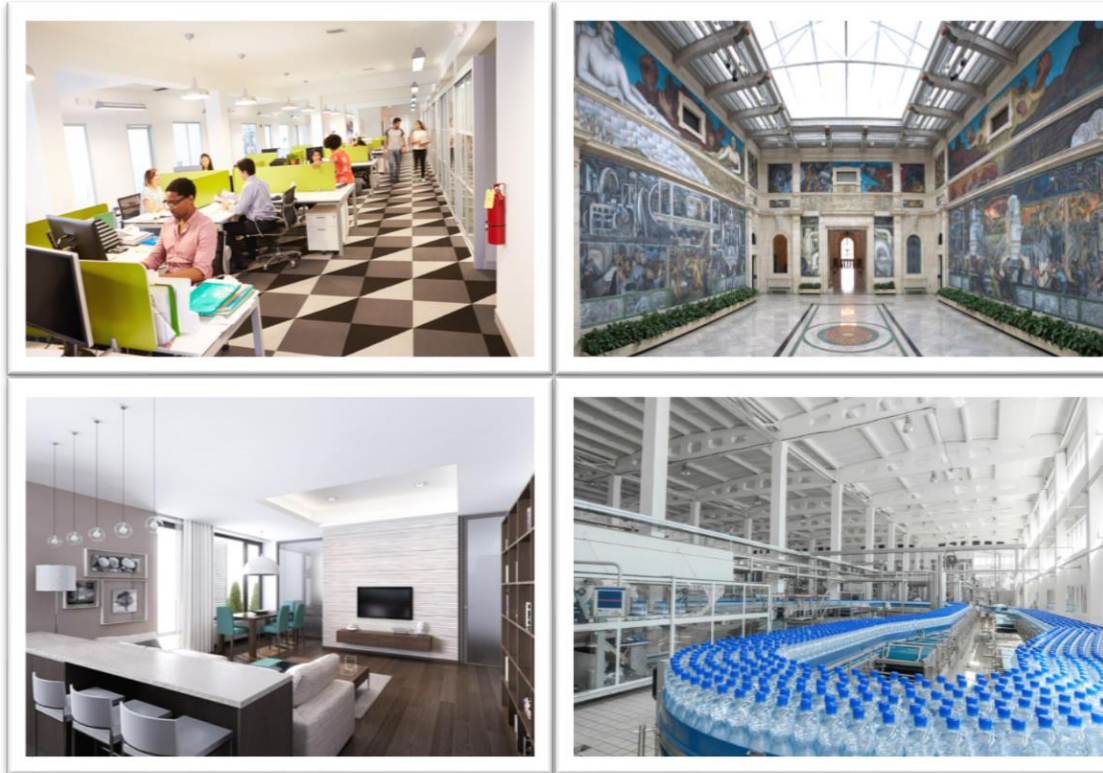
Sample Rate of at least 15 minutes

Reported at hourly, daily, monthly and annually



Exceptions apply. See MI Energy Code 2015 and/or ASHRAE 90.1-2013 for complete details.

Because an Energy Efficient Facility...




...creates and maintains an indoor environment in which people are happy to work, live or play; and extends the productive life of the building asset.

Questions



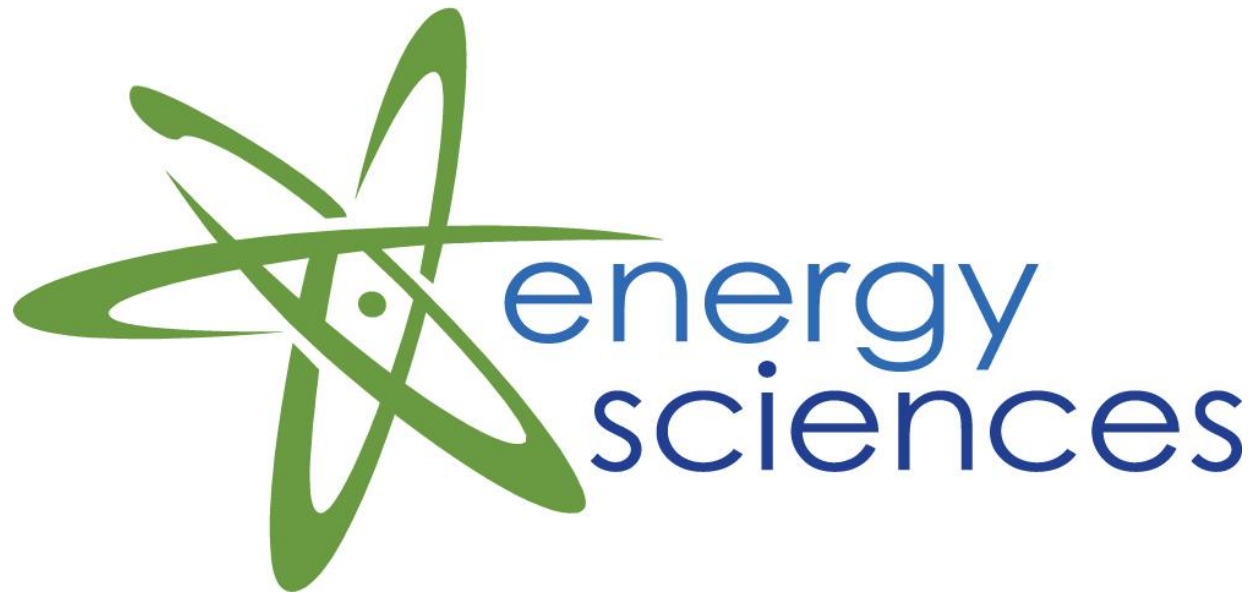
For Additional Information

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THANK YOU