

# Energy Blueprint Worksheet

PG. \_\_\_\_\_ OF \_\_\_\_\_

## ENERGY-EFFICIENT ENVELOPE

NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

LOCATION: \_\_\_\_\_

PROJECT ID: \_\_\_\_\_

TABLE 5.5-5 BUILDING ENVELOPE REQUIREMENTS (HDD65: 5401-7200, CDD50: 1801-3600)		
OPAQUE ELEMENTS	NONRESIDENTIAL	
	ASSEMBLY MAXIMUM	MINIMUM INSULATION R-VALUE
<i>Roofs</i>		
Insulation entirely above deck	U-0.063	R-15.0 ci
Metal Building	U-0.065	R-19.0
Attic and other	U-0.034	R-30.0
<i>Walls, Above Grade</i>		
Mass	U-0.123	R-7.6 ci
Metal Building	U-0.113	R-13.0
Steel Framed	U-0.084	R-13.0 + R-3.8 ci
Wood Framed and other	U-0.089	R-13.0
<i>Walls, Below Grade</i>		
Below Grade Wall	C-1.140	NR
<i>Floors</i>		
Mass	U-0.087	R-8.3 ci
Steel Joist	U-0.052	R-19.0
Wood Framed and other	U-0.033	R-30.0
<i>Slab-On-Grade Floors</i>		
Unheated	F-0.730	NR
Heated	F-0.840	R-10 for 36 inches
<i>Opaque Doors</i>		
Swinging	U-0.700	
Non-swinging	U-1.450	

ASHRAE/IESNA Standards 90.1-2001 (as of 9/1/04)

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**WORKSHEET INSTRUCTIONS:** Please circle the appropriate values for all of the building envelopes components, and submit the results from the latest program versions of COMcheck or ASHRAE's EnvStd.

**FOR BUILDING A FOUNDATION FOR ENERGY EFFICIENCY**

<b>TABLE 5.5-5 BUILDING ENVELOPE REQUIREMENTS (HDD65: 5401-7200, CDD50: 1801-3600)</b>		
	<b>NONRESIDENTIAL ASSEMBLY MAXIMUM U-VALUE (FIXED/OPERABLE)</b>	<b>ASSEMBLY SHGC (ALL ORIENTATIONS/ NORTH-ORIENTED)</b>
<b>FENESTRATION</b>		
<i>Vertical Glazing, % of Wall</i>		
0-10.0%	$U_{fixed}$ -0.57 $U_{oper}$ -0.67	$SHGC_{all}$ -0.49 $SHGC_{north}$ -0.49
10.1 – 20.0%	$U_{fixed}$ -0.57 $U_{oper}$ -0.67	$SHGC_{all}$ -0.39 $SHGC_{north}$ -0.49
20.1 – 30.0%	$U_{fixed}$ -0.57 $U_{oper}$ -0.67	$SHGC_{all}$ -0.39 $SHGC_{north}$ -0.49
30.1 – 40.0%	$U_{fixed}$ -0.57 $U_{oper}$ -0.67	$SHGC_{all}$ -0.39 $SHGC_{north}$ -0.49
40.1 – 50.0%	$U_{fixed}$ -0.46 $U_{oper}$ -0.47	$SHGC_{all}$ -0.26 $SHGC_{north}$ -0.36
<i>Skylight with Curb, Glass, % of Roof</i>		
0-2.0%	$U_{all}$ -1.17	$SHGC_{all}$ -0.49
2.1 – 5.0%	$U_{all}$ -1.17	$SHGC_{all}$ -0.39
<i>Skylight with Curb, Plastic, % of Roof</i>		
0 – 2.0%	$U_{all}$ -1.10	$SHGC_{all}$ -0.77
2.1 – 5.0%	$U_{all}$ -1.10	$SHGC_{all}$ -0.62
<i>Skylight with Curb, All, % of Roof</i>		
0 – 2.0%	$U_{all}$ -0.69	$SHGC_{all}$ -0.49
2.1 – 5.0%	$U_{all}$ -0.69	$SHGC_{all}$ -0.39

ASHRAE/IESNA Standards 90.1-2001 (as of 9/1/04)  
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## ENERGY-EFFICIENT LIGHTING

TABLE 9.5.1 LIGHTING POWER DENSITIES USING THE BUILDING AREA METHOD		
BUILDING TYPE	LIGHTING POWER DENSITY (W/FT <sup>2</sup> )	MAXIMUM W/FT <sup>2</sup> ELIGIBLE FOR INCENTIVE
Automotive Facility	0.9	.85
Convention Center	1.2	1.15
Court House	1.2	1.15
Dining: Bar Lounge/Leisure	1.3	1.25
Dining: Cafeteria/Fast Food	1.4	1.35
Dining: Family	1.6	1.55
Dormitory	1.0	.95
Exercise Center	1.0	.95
Gymnasium	1.1	1.05
Healthcare-Clinic	1.0	.95
Hospital	1.2	1.15
Hotel	1.0	.95
Library	1.3	1.25
Manufacturing Facility	1.3	1.25
Motel	1.0	.95
Motion Picture Theater	1.2	1.15
Multi-Family	0.7	.65
Museum	1.1	1.05
Office	1.0	.95
Parking Garage	0.3	.25
Penitentiary	1.0	.95
Performing Arts Center	1.6	1.55
Police/Fire Station	1.0	.95
Post Office	1.1	1.05
Religious Building	1.3	1.25
Retail	1.5	1.45
School/University	1.2	1.15
Sports/Arena	1.1	1.05
Town Hall	1.1	1.05
Transportation	1.0	.95
Warehouse	0.8	.75
Workshop	1.4	1.35

ASHRAE/IESNA STANDARD 90.1-2001 (as of 9/1/04)  
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**TABLE 9.6.1  
LIGHTING POWER DENSITIES USING THE SPACE-BY-SPACE METHOD**

<b>COMMON SPACE TYPES<sup>a</sup></b>	<b>LPD (W/FT<sup>2</sup>)</b>	<b>BUILDING SPECIFIC SPACE TYPES</b>	<b>LPD(WFT<sup>2</sup>)</b>
Office – Enclosed	1.1	Gymnasium/Exercise Center	
Office – Open Plan	1.1	Playing Area	1.4
Conference/Meeting/Multipurpose	1.3	Exercise Area	0.9
Classroom/Lecture/Training	1.4	Courthouse/Police Station/Penitentiary	
For Penitentiary	1.3	Courtroom	1.9
Lobby	1.3	Confinement Cells	0.9
For Hotel	1.1	Judges Chambers	1.3
For Performing Arts Theater	3.3	Fire Stations	
For Motion Picture Theater	1.1	Fire Station Engine Room	0.8
Audience/Seating Area	0.9	Sleeping Quarters	0.3
For Gymnasium	0.4	Post Office -- Sorting Area	1.2
For Exercise Center	0.3	Convention Center -- Exhibit Space	1.3
For Convention Center	0.7	Library	
For Penitentiary	0.7	Card File and Cataloging	1.1
For Religious Buildings	1.7	Stacks	1.7
For Sports Arena	0.4	Reading Area	1.2
For Performing Arts Theater	2.6	Hospital	
For Motion Picture Theater	1.2	Emergency	2.7
For Transportation	0.5	Recovery	0.8
Atrium – First Three Floors	0.6	Nurse Station	1.0
Atrium – Each Additional Floor	0.2	Exam/Treatment	1.5
Lounge/Recreation	1.2	Pharmacy	1.2
For Hospital	0.8	Patient Room	0.7
Dining Area	0.9	Operating Room	2.2
For Penitentiary	1.3	Nursery	0.6
For Hotel	1.3	Medical Supply	1.4
For Motel	1.2	Physical Therapy	0.9
For Bar Lounge/Leisure Dining	1.4	Radiology	0.4
For Family Dining	2.1	Laundry – Washing	0.6
Food Preparation	1.2	Automotive – Service/Repair	0.7
Laboratory	1.4	Manufacturing	
Restrooms	0.9	Low Bay (<25 ft Floor to Ceiling Height)	1.2
Dressing/Locker/Fitting Room	0.6	High Bay (≥25 ft Floor to Ceiling Height)	1.7
Corridor/Transition	0.5	Detailed Manufacturing	2.1
For Hospital	1.0	Equipment Room	1.2
For Manufacturing Facility	0.5	Control Room	0.5

**TABLE 9.6.1 (Cont'd)  
LIGHTING POWER DENSITIES USING THE SPACE-BY-SPACE METHOD**

<b>COMMON SPACE TYPES<sup>a</sup></b>	<b>LPD (W/FT<sup>2</sup>)</b>	<b>BUILDING SPECIFIC SPACE TYPES</b>	<b>LPD(WFT<sup>2</sup>)</b>
Stairs – Active	0.6	Hotel/Motel Guest Rooms	1.1
Active Storage	0.8	Dormitory – Living Quarters	1.1
For Hospital	0.9	Museum	
Inactive Storage	0.3	General Exhibition	1.0
For Museum	0.8	Restoration	1.7
Electrical/Mechanical	1.5	Bank/Office – Banking Activity Area	1.5
Workshop	1.9	Religious Buildings	
		Worship Pulpit, Choir	2.4
		Fellowship Hall	0.9
		Retail [For accent lighting, see 9.3.1.2.1 (c)]	
		Sales Area	1.7
		Mall Concourse	1.7
		Sports Arena	
		Ring Sports Area	2.7
		Court Sports Area	2.3
		Indoor Playing Field Area	1.4
		Warehouse	
		Fine Material Storage	1.4
		Medium/Bulky Material Storage	0.9
		Parking Garage – Garage Area	0.2
		Transportation	
		Airport – Concourse	0.6
		Air/Train/Bus – Baggage Area	1.0
		Terminal – Ticket Counter	1.5

**NOTES:**

**a** In cases where both a common space type and a building specific type are listed, the building specific type shall apply.

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## CHILLER PROJECT DATA

**CUSTOMER:** \_\_\_\_\_ **EQUIPMENT SUPPLIER:** \_\_\_\_\_  
**ADDRESS:** \_\_\_\_\_ **ADDRESS:** \_\_\_\_\_  
**UI CONTACT:** \_\_\_\_\_ **CONTACT:** \_\_\_\_\_  
**PHONE:** \_\_\_\_\_ **PHONE:** \_\_\_\_\_

### SECTION I Operating Schedule Information

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Occupied on-peak hours per week (<=80)												
Occupied off-peak hours per week (<=88)												
Chiller operation allowed this month (Y/N)												

**NOTE:** On-peak hours are Monday-Friday 7 a.m. to 11 p.m. Off peak: 11 p.m. to 7 a.m. plus all weekend hours.

### SECTION II Cooling Load Information

	OCCUPIED HOURS	UNOCCUPIED HOURS
Cooling tons at 100°F OAT (1) (see back)		
Economizer set point temperature (°F)		
Cooling tons just above economizer set point temperature (2)		
Cooling tons just below economizer set point temperature (3)		
Cooling tons at 0°F OAT (4), or process load		

### SECTION III Chiller Information (ARI 550/590 – 98)

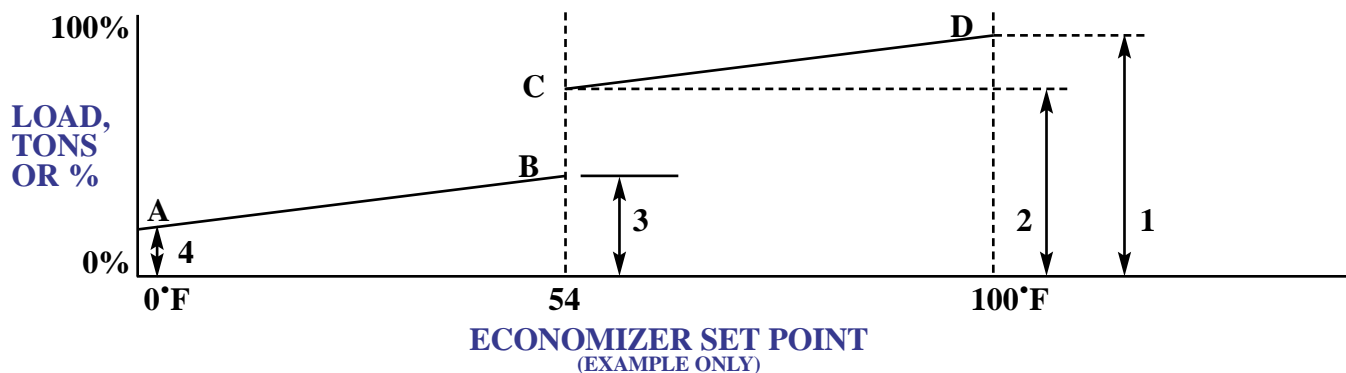
ATTACH CHILLER SELECTION SHEET	CHILLER 1	CHILLER 2	CHILLER 3	CHILLER 4
ARI Rated Capacity (tons)				
Efficiency Rating, IPLV				
VFD Used (Y/N)				
If Yes, IPLV without VFD				
Compressor Type (See Below)				
ARI Chiller Efficiency at 100% Load				
ARI Chiller Efficiency at 75% Load				
ARI Chiller Efficiency at 50% Load				
ARI Chiller Efficiency at 25% Load				

### SECTION IV Auxiliaries Information

Secondary chilled water pump BHP				
Secondary CWP – Single speed or VFD				
Primary chilled water pump BHP				
Condenser water pump BHP				
Tower fan BHP				
Tower fan – 1 speed / 2 speed / VFD				
Other (kW)				

Compressor Types: 1. Water-cooled centrifugal, R-123, larger than 250 tons  
 2. Water-cooled centrifugal, R-134a, larger than 250 tons  
 3. Air cooled up to 450 tons  
 4. Water-cooled screw up to 700 tons

## COOLING LOAD INFORMATION



**COOLING LOAD:** Expressed as five data inputs. For existing projects, the facility HVAC manager should determine these numbers. For new ones, the HVAC design engineer should determine them.

**1. COOLING TONS AT 100°F OAT (OUTSIDE AIR TEMPERATURE):** Input the maximum comfort load in tons that the chiller must meet during occupied/unoccupied hours. This occurs when it is 100 degrees outdoors and very humid.

**ECONOMIZER SET POINT:** Most facilities have “airside economizer cycles”, which, when outside air temperature is sufficiently cold, enable the air handlers to bring in sufficient amounts of cool outside air to cool the building without the need to run a chiller. Some facilities have “waterside economizers” which accomplish much the same “free” cooling. The temperature at which the outside air is sufficiently cold is termed the economizer set point temperature. For most airside economizer installations, the number is about 54 degrees. For most waterside economizer installations, it is more like 40 degrees.

**2. COOLING TONS JUST ABOVE ECONOMIZER SET POINT:** Input the comfort load in tons that the chiller must meet during **OCCUPIED/UNOCCUPIED HOURS**, when outside air temperature is almost cold enough to do much of the building’s cooling load by introducing “free” outside air cooling. The cooling load that the chiller must meet “at Economizer OAT+” is not always “0” tons. It is close to zero for residential projects which are very weather dependent. It is much higher for industrial plants (say 20 to 60% of the maximum load “At 100 deg OAT”), where lighting and process heat sources predominate.

For outside air temperatures between the economizer OAT and 100 degrees, it is assumed that the “Occupied/unoccupied Cooling Load” varies linearly between the two tonnage figures input at each of those temperatures.

**3. COOLING TONS BELOW ECONOMIZER SET POINT:** Recognizes chiller loads below the economizer OAT. For example, some buildings have fancoil units serving the perimeter zones with no capability of introducing outside air. They must offset solar heat gains through windows, even when outside air is below the economizer cutoff. Other buildings have computer room air conditioning units or process cooling loads requiring chilled water at all outside air temperatures.

**4. COOLING TONS AT 0°F OAT:** The process load, if any, plus comfort load during occupied hours, when outside air temperature is at zero degrees. This number is “0” for most jobs. For the example of computer room air conditioners, the same tonnage number as for **AT ECONOMIZER CUTOFF** applies, because the load does not change with outside air.

For outside air temperatures between the economizer OAT and 0 degrees, it is assumed that the “occupied cooling load” varies linearly between the two tonnage figures. For most jobs, the input for **AT 0°F OAT** is zero, because cooling is not needed.

## FOR BUILDING A FOUNDATION FOR ENERGY EFFICIENCY

CHILLER RATINGS			
TABLE 3. - ENTERING CONDENSER FLUID TEMPERATURES AT PART LOAD I-P SYSTEM			
% LOAD	2003 STANDARD		
	WC °F ECWT	AC °F EDB	EC °F EWB
100%	85	95	75
75%	75	80	68.75
50%	65	65	62.5
25%	65	55	56.25

WC = water-cooled                      ECWT = entering condenser water temperature  
 AC = air-cooled                        EDB = entering air dry bulb temperature  
 EC = evaporative cooled              EWB = entering air wet bulb temperature

Table 6. ARI Standard 550/590-03 is reprinted below to show the ARI Standard Rating Condition. This chart is reprinted with permission from ARI:

CHILLER RATINGS			
TABLE 6. STANDARD RATING CONDITIONS			
	Water-Cooled	Evaporatively-Cooled	Air-Cooled
<b>CONDENSER WATER</b>			
Entering	85°F		
Flow Rate	3.0 gpm/ton		
<b>CONDENSER FOULING FACTOR ALLOWANCE</b>			
Water Side	0.00025 h ft <sup>2</sup> °F/Btu		
Air-Side		0 h ft <sup>2</sup> °F/Btu	0 h ft <sup>2</sup> °F/Btu
<b>ENTERING AIR</b>			
Dry Bulb			95°F
Wet Bulb		75°F	
<b>EVAPORATOR WATER</b>			
Leaving	44°F		
Flow Rate	2.4 gpm/ton		
<b>EVAPORATOR FOULING FACTOR ALLOWANCE</b>			
Water-Side	0.0001 h ft <sup>2</sup> °F/Btu		
Refrigerant-Side	0 h ft <sup>2</sup> °F/Btu		
<b>CONDENSERLESS</b>			
	Water or Evaporatively Cooled	Air-Cooled	
Saturated Discharge	105°F	125°F	
Liquid Refrigerant	98°F	105°F	
Barometric Pressure - 29.92 in. of Hg			

NOTE: All ARI Standards and Guidelines can be ordered through the ARI Website at: <http://www.ari.org>



