



Laboratory Modeling Guideline using ASHRAE 90.1-2007 Appendix G

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Introduction

The following is a guideline for energy modeling of laboratory spaces in a building in accordance with ASHRAE Standard 90.1-2007 Energy Standard for Buildings Except Low-Rise Residential Buildings, Appendix G. The provisions of this guideline are limited to systems serving laboratory spaces¹.

The intent of this guideline is to clarify and modify the requirements of ASHRAE 90.1, in order to improve its applicability to laboratories. The 2007 version of the standard addresses almost all of the laboratory-related issues identified in earlier versions. Consequently this guideline recommends only two modifications to the standard, as shown in the table below:

Guideline Area	ASHRAE 90.1-2007 section being modified
Modeling load diversity and reheat energy impacts	Table G3.1 No.4 Schedules [Left Column - Proposed Building Performance]
Supply-air-to-room air temperature difference for laboratory spaces	G3.1.2.8 Design Airflow Rates

All other sections of the standard should be followed as defined in the standard. For energy efficiency measures that are not explicitly addressed by the standard, modelers should follow Section G.2.5, Exceptional Calculation Methods. This guideline does not cover the details of such calculation methods.

The modifications to the sections of the standard are indicated through additions (underscore) and ~~deletions~~ (strikethrough).

¹ As per OSHA 1910-1450, "Laboratory means a facility where the 'laboratory use of hazardous chemicals' occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis. Laboratory scale means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. 'Laboratory scale' excludes those workplaces whose function is to produce commercial quantities of materials."

Table G.3.1 No.4. Schedules [Left Column - Proposed Building Performance]

Accurately model the equipment load in each laboratory space instead of using an average across all spaces. Appendix A of this guideline includes sample schedules that may be used for equipment, lighting, occupancy, and fumehoods. Alternatively, schedules based on observed load patterns could be used.

Rationale: It is important to consider the variation of internal equipment loads from one space to the next. This variation can have a substantial impact on energy use, especially reheat energy. To capture this effect, and reward designs that reduce reheat, equipment load variation should be modeled. Note that the variation should be modeled identically in the baseline and proposed designs.

G3.1.2.8 Design Airflow Rates

System design supply airflow rates for the baseline building design shall be based on a supply-air-to-room-air temperature difference of 20°F or the required ventilation air or makeup air, whichever is greater. For systems serving laboratory spaces, use a supply-air-to-room-air temperature difference of 17 deg F. If return or relief fans are specified in the proposed design, the baseline building design shall also be modeled with fans serving the same functions and sized for the baseline system supply fan air quantity less the minimum outdoor air, or 90% of the supply fan air quantity, whichever is larger.

Rationale: The usual supply-air-to-room-air temperature difference in commercial applications is 20 deg F. However, the minimum airflow rates in typical commercial buildings are much lower than those required in laboratory occupancies. The higher minimum airflow rates warrant a smaller temperature difference, to avoid excessive reheat.

APPENDIX A

The schedules are based on ASHRAE 90.1-1989 for office occupancy except as noted (laboratories classified as office in ASHRAE 90.1). The schedules assume heavier loads during more typical working hours, 8am-5pm. Fans are assumed to be on 24 hours throughout the day. If the laboratory operates on a seasonal schedule, such as a school schedule, and has lower usage during one season adjust the schedules as needed.

Lab Occupancy Schedule

<u>Weekday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 - 7	5 (see note)
7 - 8	10
8 - 9	20
9 - 11	90
11 - 13	45
13 - 18	90
18 - 19	30
19 - 22	10
22 - 24	5 (see note)

<u>Weekend, Holiday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 - 7	5 (see note)
7- 9	10
9 -13	30
13 - 18	10
18 - 24	5 (see note)

Note: Minimal occupancy added to reflect laboratory operation.

Lab Lighting Schedule

<u>Weekday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 - 6	20(see note)
6 - 7	30(see note)
7 - 8	50(see note)
8 - 12	90
12 - 13	80
13 - 17	90
17 - 18	90
18 - 20	50
20 - 22	30(see note)
22 - 24	20 (see note)

<u>Weekend, Holiday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 - 6	10 (see note)
6 - 8	10 (see note)
8 -12	40 (see note)
12 - 17	20 (see note)
17 - 24	10 (see note)

Note: Lighting loads added to reflect 24-hour laboratory operation.

Lab Equipment Schedule

The schedules for internal equipment loads have been modified from the ASHRAE 90.1-1989 equipment schedules that are identical to the lighting schedules.

Lab Equipment Load Schedule – Typical

<u>Weekday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 - 7	20
7 - 8	30
8 - 9	40
9 - 12	50
12 - 13	40
13 - 17	50
17 - 18	40
18 - 20	30
20 - 24	20

<u>Weekend, Holiday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 - 6	20
6 - 8	30
8 -12	40
12 – 17	30
17 – 24	20

Lab Equipment Load Schedule – High use

<u>Weekday, Weekend, Holiday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 - 24	100

Fume Hood Diversity Schedule – Use only for laboratories that are fume hood driven. For internally load driven laboratories, no fume hood diversity schedules are necessary.

<u>Weekday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 - 7	53
7 - 8	55
8 - 9	60
9 - 12	98
12 - 13	73
13 - 17	98
17 - 18	65
18 - 20	55
20 - 24	53

Note: Schedule based on premise that fume hood use is directly related to occupancy of the laboratories. Using the laboratory occupancy schedule above and 100% hood airflow when in use and 50% airflow when not in use (assumes 18” operating sash height and minimum flow of 25 cfm/SF of hood work surface per NFPA 45).

<u>Weekend, Holiday</u>	
<i>Period: Start – End (Hour)</i>	<i>% Diversity</i>
0 – 7	53
7 – 9	55
9 – 13	65
13 – 18	55
18 – 24	53

Note: Schedule based on premise that fume hood use is directly related to occupancy of the laboratories. Using the laboratory occupancy schedule above and 100% hood airflow when in use and 50% airflow when not in use (assumes 18” operating sash height and minimum flow of 25 cfm/SF of hood work surface per NFPA 45 – see fume hood design criteria standard).